EXHIBIT 1
APPLICATION FORM AND FEES

Benton County
COMMUNITY DEVELOPMENT DEPARTMENT

Office: Kalapuya Building
4500 SW Research Way
Corvallis, OR 97333
(541) 766-6819
www.co.benton.or.us/cd

LAND USE APPLICATION

CONDITIONAL USE PERMIT

File # LU-_____
(OFFICE USE ONLY)

Fee: $10,000 deposit.
(SEE CURRENT FEE SCHEDULE)

ALL SECTIONS MUST BE COMPLETED BY OWNER, OWNER'S AGENT or APPLICANT. ATTACH ADDITIONAL SHEETS AS NECESSARY. COUNTY REVIEW WILL BEGIN WHEN THE APPLICATION IS DETERMINED TO BE COMPLETE.

I. Property Owner Information

Name(s): Valley Landfills, Inc., Ryan Lawler, Vice President Phone #1: 1-425-646-2142

Mailing Address 28972 Coffin Butte Road Phone #2: _____

City: Corvallis State: OR Zip: 97330 Email: c/o jeff.condit@millernash.com

II. Applicant Information (skip this section if Property Owner is Applicant)

Name(s): Valley Landfills, Inc., Ryan Lawler, Vice President Phone #1: 1-425-646-2142

Mailing Address: 28972 Coffin Butte Road Phone #2: _____

City: Corvallis State: OR Zip: 97330 Email: c/o jeff.condit@millernash.com

Other individuals to be notified of this application: Name, Address, City & Zip, or Email

_____

_____

III. Property Information

Site Address: 28972 to 29175 Coffin Butte Road, Corvallis, Oregon 97330

Assessor's Map & Tax Lot Number: T 10 S, R 41 W, Section(s) 80, Tax Lot(s) 801, 1101, 1107, 1107, 1108,

Acreage: 70.66 Zoning: LS and FC Fire District: Adair Rural

Water Supplied By: wells Sewage Disposal Type: subsurface

Existing Structures: See Burden of Proof Attached

Current use(s) of the property: See Burden of Proof Attached

IV. Request Summary (Example: **"**Conditional Use approval to operate a commercial kennel in the RR Zone.")

Conditional use approval to expand the area in which landfill activities maybe conducted to the south side of Coffin Butte Road.

Attached Documentation: With all land use applications, the "burden of proof" is on the applicant to demonstrate how the proposal complies with the Benton County development code and other law. It is important that you provide **ALL** the information listed on the following pages at the time you submit your application. The processing of your application will not begin until the application is determined to be complete.

Conditional Use Criteria *Please answer each question in detail on a separate sheet of paper.* ***BOP Attached.***

1. Describe how the proposed use will not seriously interfere with uses on adjacent property, with the character of the area, or with the purpose of the zone.

2. Describe how the proposed use will not impose an undue burden on any public improvements, facilities, utilities, or services available to the area.

3. If the property is zoned Exclusive Farm Use (EFU) or Forest Conservation (FC), describe how the proposed use will not force a significant change in accepted farm or forest practices on surrounding lands devoted to farm or forest use.

4. If the property is zoned EFU or FC, describe how the proposed use will not significantly increase the cost of accepted farm or forest practices on surrounding lands devoted to farm or forest use.

5. Will the proposed use involve the use of water (plumbing facilities, bathroom, water for processing, etc.)? _____ If yes:
   a. Is there an existing well or spring on the proposed parcel(s)? _____ Please attach a copy of a well log or pump test, if available, which identifies the rated yield of this water source.
   b. Is there an existing septic system on the proposed parcel(s)? _____ An evaluation by Environmental Health may be required of an existing system unless the system was recently installed or repaired. Please attach a copy of any septic system records you may have available.

6. Is the only access or proposed access to the property via a road that crosses a railroad? _____
   If yes, please draw the location on your map and explain here: _____

Mitigating Measures *Please answer in detail on a separate sheet of paper.*

1. Describe any special measures you propose to undertake in order to minimize impacts on adjacent properties and public services, and to ensure compliance with the purpose of the zone. Consideration may be given to such features as: location of the use on the parcel; road capacities in the area; driveway location; parking area; on-site traffic circulation; landscape or fencing separations; size of structures; signs; exterior lighting; noise; air emissions; drainage and more. **BOP Attached.**

Attachments

1. A copy of deed(s) covering the subject property. **BOP, Exhibit 25.**

2. A copy of all easements or other instruments granting access to any proposed parcel that does not have frontage on a public road. **N/A.**

3. An accurate scale drawing of the property, showing the locations of existing and proposed structures, roads, water supply, subsurface sewage system, easements, and driveways. Label all tax lots. **See BOP.**

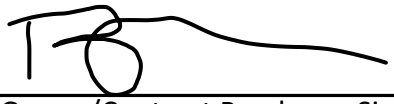
Signature(s)

Assessed Property Value Notice

This action or any future related action(s), if approved, may result in a change to my property valuation, and therefore the tax amount I pay annually. I will contact the Assessor's Office at 541-766-6855 to discuss and understand potential property tax impacts.

■ **I understand**

I hereby certify that I am the legal owner or contract purchaser of the above noted property; that the information contained herein is accurate to the best of my knowledge; and that the requested conditional use permit would not violate any deed restrictions attached to the property.



07/16/2024

Owner/Contract Purchaser Signature — Date

Owner/Contract Purchaser Signature — Date

For Office Use Only

Date Application Received:_____ Receipt Number:_____ By:_____

File Number Assigned:_____ Planner Assigned:_____

Date Application Deemed Complete:_____

EXHIBIT 3

VESTING DEEDS TO THE TAX LOTS CONTAINED IN THE DEVELOPMENT SITE

BENTON COUNTY, OREGON **2011-483725**
DE-SP
Stn=9 PAIGE **10/13/2011 12:26:34 PM**
$20.00 $11.00 $10.00 $17.00 $20.00 **$78.00**

I, James V. Morales, County Clerk for Benton County, Oregon, certify that the instrument identified herein was recorded in the Clerk records.
James V. Morales - County Clerk

AFTER RECORDING RETURN TO:
Williams Mullen
200 South 10th Street, 16th Floor
Richmond, Virginia 23219
Attn: David A. Reed, Esq.

SPECIAL WARRANTY DEED

October 12, 2011

STATE OF OREGON §
§
COUNTY OF BENTON §

That VALLEY LANDFILLS, INC., an Oregon corporation ("Grantor"), for and in consideration of the sum of TEN AND NO/100 DOLLARS ($10.00) and other valuable consideration, the receipt of which is hereby acknowledged, has GRANTED, BARGAINED, SOLD, and CONVEYED, and by these presents does GRANT, BARGAIN, SELL and CONVEY unto VALLEY LANDFILLS, INC., an Oregon corporation ("Grantee") all of that certain lot, tract or parcel of land located in Benton County, Oregon and being more fully described on Exhibit "A" attached hereto and incorporated herein by reference.

TOGETHER WITH all improvements thereon, all personal property located at, on, upon, under or associated therewith, riparian and other water rights, oil, gas and mineral rights, and all privileges and easements appurtenant to the certain lot, tract or parcel of land described in Exhibit "A" (collectively, the "Property").

For the same consideration recited above, Grantor hereby BARGAINS, SELLS and TRANSFERS all interest, if any, of Grantor in (i) strips or gores lying adjacent to the Property and abutting or immediately adjacent properties, and (ii) any land underlying and adjacent streets or roads.

This conveyance is made subject to all covenants, easements, conditions, restrictions and other matters of record or which would be disclosed by a survey or physical inspection of the Property), but only to the extent they affect or relate to the property.

TO HAVE AND TO HOLD the Property, unto Grantee and Grantee's successors and assigns forever; and Grantor does hereby bind itself and its successors and assigns to WARRANT AND FOREVER DEFEND all and singular the Property unto Grantee, its

successors and assigns, against every person whomsoever lawfully claiming or to claim the same or any part thereof, by, through or under Grantor, but not otherwise.

WHEREFORE, the Special Warranty Deed is executed to be effective as of the date set forth above.

GRANTOR:

VALLEY LANDFILLS, INC.,
an Oregon corporation

By: _____
Printed Name: Tim M. Benter
Title: Vice President

STATE OF Arizona §
§
COUNTY OF Maricopa §

This instrument was acknowledged before me on this 12th day of October, 2011, by Tim M. Benter, as Vice President, of Valley Landfills, Inc., an Oregon corporation, for and on behalf of said corporation.

Notary Public in and for the State of Arizona

Jessica Beatty
Printed Name of Notary Public
My Commission Expires: 5/25/2014

Notary Public State of Arizona
Maricopa County
Jessica Ann Beatty
My Commission Expires 05/25/2014

EXHIBIT "A"
The Property

RESULTANT VALLEY LANDFILLS TRACT (TL 801+ portion TL 1106)

All of that land referred to as Parcel 1 as conveyed to Valley Landfills, Inc. by deed recorded as M-236945-97, Deed Records of Benton County, Oregon;

TOGETHER WITH the following-described tract:

A tract of land in Section 18, Township 10 South, Range 4 West, Willamette Meridian, Benton County, Oregon, said tract being that "parcel of land" conveyed to Valley Landfills, Inc. by deed recorded as M-102556-88, Deed Records of Benton County, and being more specifically described as follows:

Beginning at the Northwest corner of the Monroe Hodges DLC No. 46 in said Township and Range;
THENCE along the north line of Parcel I of that land conveyed to Valley Landfills, Inc. by deed recorded as M-236945-97, Deed Records of Benton County, S 63°12'20"W 688.06 feet to a 5/8" iron rod on the west one-sixteenth line of said Section 18;
THENCE along said one-sixteenth line, N 00°02'20"E 1479.53 feet to a 5/8" iron rod;
THENCE S 27°40'17"E 800.38 feet to a 5/8" iron rod;
THENCE N 71°09'04"E 600.00 feet to a 5/8" iron rod;
THENCE N 30°15'15"E 598.74 feet to a 5/8" iron rod;
THENCE S 87°52'19"E 532.63 feet to a 5/8" iron rod on a line parallel with and 100 feet westerly of, when measure perpendicular to, the centerline of the relocated Pacific Highway West as described and conveyed to the State of Oregon by deed recorded in Book 119 at Page 836, Deed Records of Benton County;
THENCE along said parallel line, S 07°30'41"E 921.39 feet to a 5/8" iron rod at the Northeast corner of that tract conveyed to Consumers Power, Inc. by deed recorded in Book 185 at Page 214, Deed Records of Benton County;

THENCE S 89°59'11"W 209.79 feet to a 5/8" iron rod at the Northwest corner of said Consumers Power tract;
THENCE S 07°30'41"E 209.79 feet to a 5/8" iron rod at the Southwest corner thereof, being on a line parallel with and 30 feet Northerly of, when measure perpendicular to, the north line of the Monroe Hodges DLC No. 46 in said Township and Range;
THENCE along said line parallel to the Hodges DLC line, S 89°59'11"W 1132.30 feet to the Northwest corner of that 30 foot-wide strip of land described as part of Parcel l as conveyed to Valley Landfills, Inc. by deed recorded as M-236945-97, Deed Records of Benton County;
THENCE S 00°00'49"E 30 feet to a point on the westerly projection of said north line of the Hodges DLC, said point being S 89°59'11"W 30 feet from the Northwest corner of said Hodges DLC;
THENCE N89°59'11"E 30 feet to the point of beginning at said Northwest DLC corner.

The Basis of Bearings and data for this description is Benton County survey CS 8020.
16022245_1.DOC

M-142396-91

WARRANTY DEED

(Statutory Form)

GRANTOR: DONALD E. RATLIFF and MAURINE C. RATLIFF, Trustees under Declaration of Trust dated May 7, 1986

CONVEYS AND WARRANTS TO

GRANTEE: VALLEY LANDFILLS, INC., an Oregon Corporation

the following described real property free of encumbrances except as specifically set forth herein:

SEE ATTACHED EXHIBIT "A"

10-111189

10-4-18 1101

THIS INSTRUMENT WILL NOT ALLOW USE OF THE PROPERTY DESCRIBED IN THIS INSTRUMENT IN VIOLATION OF APPLICABLE LAND USE LAWS AND REGULATIONS. BEFORE SIGNING OR ACCEPTING THIS INSTRUMENT, THE PERSON ACQUIRING FEE TITLE TO THE PROPERTY SHOULD CHECK WITH THE APPROPRIATE CITY OR COUNTY PLANNING DEPARTMENT TO VERIFY APPROVED USES.

The true and actual consideration for this transfer stated in terms of dollars is $ 115,000.00 . However, if the actual consideration consists of or includes other property or other value given or promised, such other property or value was part of the / the whole of the (indicate which) consideration.

If grantor is a corporation, this has been signed by authority of the Board of Directors.

DATED: December 12, 1991

GRANTOR: Donald E. Ratliff
Donald E. Ratliff, Trustee
Maurine C. Ratliff
Maurine C. Ratliff, Trustee

Until a change is requested, all tax statements shall be sent to the following address:

PO BOX 807, CORVALLIS OR 97339

STATE OF OREGON, County of Benton ss.
Date: DECEMBER 12, 1991
Personally appeared the above named Donald E. Ratliff and Maurine C. Ratliff and acknowledged the foregoing instrument to be their voluntary act and deed. Before me:

Notary Public for Oregon
My commission expires: 10/28/95

STATE OF OREGON, County of ss.
Date:
Personally appeared. who being sworn, stated that he/she is the of grantor corporation and that this instrument was voluntarily signed on behalf of the corporation. Before me:

Notary Public for Oregon
My commission expires:

WARRANTY DEED

RATLIFF TO VALLEY LANDFILL INC.

AFTER RECORDING RETURN TO
VALLEY LANDFILLS INC.
PO Box 807
Corvallis OR 97339

(DON'T USE THIS SPACE: RESERVED FOR RECORDING LABEL IN COUNTIES WHERE USED.)

STATE OF OREGON, County of ss.
I certify that the within instrument was received for record on the day of , 19 , at o'clock M., and recorded in book on page
Witness my hand and seal of County affixed.

County Clerk

By Deputy

NUMBER:

EXHIBIT "A"

Beginning at a point which is 142.00 feet South 89°52' East and 614.31 feet North from the Southeast corner of the J. T. Hugharts Donation Land Claim No. 41 in Township 10 South, Range 4 West and No. 61 in Township 10 South, Range 5 West of the Willamette Meridian, Benton County, Oregon; running thence North 389.03 feet to an iron rod in the center line of the County Road; thence along the center of said County Road as follows: South 73°35'06" West 477.79 feet, along a spiral curve to the left (the long chord of which bears South 68°15'06" West 199.38 feet) a distance of 200.00 feet, along a 16° curve to the left (the long chord of which bears South 43°30' West 175.00 feet) a distance of 176.09 feet, and along a spiral curve to the left a distance of 56.18 feet, more or less, to a point due West of the point of beginning; thence East, leaving said County Road, 782.04 feet, more or less, to the point of beginning.

Subject to:

1. The rights of the public in and to that portion of the premises herein described lying within the limits of roads, streets and highways.

2. An easement created by instrument, including the terms and provisions thereof, Dated March 6, 1940 Recorded August 4, 1941, in Book 98, Page 446, Deed Records of Benton County, Oregon in favor of Benton-Lincoln Electric Cooperative, Inc. for Electric and telephone transmission and distribution lines; affects No specific location given.

3. Conditions, restrictions and reservations as contained in that certain deed from the United States of America to Bernard W. Hanson, et ux, recorded February February 25, 1949, in Book 125, Page 647, Deed Records of Benton County, Oregon.

4. An easement created by instrument, including the terms and provisions thereof, Dated June 4, 1971 Recorded September 27, 1971, as M-27769, Microfilm Records of Benton County, Oregon in favor of Consumers Power, Inc. for Electric and telephone transmission and distribution lines; affects Westerly boundary along Co. Rd. No. 05450.

5. An easement created by instrument, including the terms and provisions thereof, Dated August 17, 1972 Recorded November 1, 1972, as M-36153, Microfilm Records of Benton County, Oregon in favor of Consumers Power, Inc. for Electric and telephone transmission and distribution lines; affects Northerly boundary along Coffin Butte Road and Easterly boundary.

Account No.: 10-4-18 1101 Data: 005839

STATE OF OREGON } ss. 131643
County of Benton }

I hereby certify that the within instrument was received for record

'91 DEC 13 PM 2 44

and assigned № 142396 1991

in the Microfilm records of said county

Witness My Hand and Seal of County Affixed

DANIEL G. BURK
DIRECTOR OF RECORDS & ELECTIONS

By Marilyn Hamilton
DEPUTY

55

M 278438-99

AFTER RECORDING, RETURN TO:

Valley Landfills Inc.
P.O. Box 807
Corvallis, Oregon 97339

Until a change is requested,
all tax statements shall be sent to:

Valley Landfills Inc.
P.O. Box 807
Corvallis, Oregon 97339

TICOR TITLE INSURANCE CO. 80-617

STATUTORY WARRANTY DEED

Valley Landfills Inc., an Oregon Corporation ***, who took title as Valley Land Fills Inc., an Oregon Corporation ("Grantor"), conveys and warrants to Valley Landfills Inc., an Oregon Corporation ("Grantee") the real property described on the attached Exhibit A, free of encumbrances except easements, covenants, conditions, restrictions and encumbrances of record.***

The true consideration for this conveyance is the correction of vesting.

THIS INSTRUMENT WILL NOT ALLOW USE OF THE PROPERTY DESCRIBED IN THIS INSTRUMENT IN VIOLATION OF APPLICABLE LAND USE LAWS AND REGULATIONS. BEFORE SIGNING OR ACCEPTING THIS INSTRUMENT, THE PERSON ACQUIRING FEE TITLE TO THE PROPERTY SHOULD CHECK WITH THE APPROPRIATE CITY OR COUNTY PLANNING DEPARTMENT TO VERIFY APPROVED USES AND TO DETERMINE ANY LIMITS ON LAWSUITS AGAINST FARMING OR FOREST PRACTICES AS DEFINED IN ORS 30.930.

DATED ***this 16th day of August , 1999.***

Valley Land Fills Inc.
By: Duane Sorensen
Name/Title: Duane Sorensen, President

10-4-18 (28)

STATE OF OREGON

County of Benton

ss

The foregoing instrument was acknowledged before me this 16th ***day of*** August ***, 1999, by*** Duane Sorensen ***, as*** President ***of*** Valley Land Fills ***, on its behalf.***

George Abele
Notary Public for Oregon

OFFICIAL SEAL
GEORGE ABELE
NOTARY PUBLIC - OREGON
COMMISSION NO.051901
MY COMMISSION EXPIRES MAR. 07, 2000

EXHIBIT A

Legal Description

Beginning at the point of intersection of the centerline of Benton County Road No. 642 and the West line of the Monroe Hodges Donation Land Claim No. 46 in Section 18, Township 10 South, Range 4 West, Willamette Meridian, Benton County, Oregon; running thence South 3°33' East along the West line of said Donation Land Claim No. 46, 1,778.33 feet, more or less, to an iron pipe; thence North 89°52' West 1,897.40 feet to a point which is South 89°52' East, 142.00 feet from the Southeast corner of the Joseph T. Hughart Donation Land Claim No. 61; thence due North 1,003.34 feet to the centerline of said County Road No. 642; thence Northeasterly along the centerline of said County Road No. 642, 1,966.00 feet, more or less, to the point of beginning, in the County of Benton and State of Oregon.

27799

STATE OF OREGON } SS.
County of Benton

I hereby certify that the within instrument was received for record

'99DEC30 PM 1:22

1999

AND ASSIGNED **M278438**

In the microfilm records of said county

Witness My Hand and Seal of County Affixed
JOHN K. ANDERSON
County Administrative Officer

By _____ Deputy

60-2

M278439-99

AFTER RECORDING, RETURN TO:

Valley Landfills Inc.
P.O. Box 807
Corvallis, Oregon 97339

Until a change is requested,
all tax statements shall be sent to:

Valley Landfills Inc.
P.O. Box 807
Corvallis, Oregon 97339

TICOR TITLE INSURANCE CO. 80-617

STATUTORY WARRANTY DEED

Valley Landfills Inc., an Oregon Corporation, who took title as Valley Landfill Inc., an Oregon Corporation ("Grantor"), conveys and warrants to Valley Landfills Inc., an Oregon Corporation ("Grantee") the real property described on the attached Exhibit A, free of encumbrances except easements, covenants, conditions, restrictions and encumbrances of record.

The true consideration for this conveyance is the correction of vesting.

THIS INSTRUMENT WILL NOT ALLOW USE OF THE PROPERTY DESCRIBED IN THIS INSTRUMENT IN VIOLATION OF APPLICABLE LAND USE LAWS AND REGULATIONS. BEFORE SIGNING OR ACCEPTING THIS INSTRUMENT, THE PERSON ACQUIRING FEE TITLE TO THE PROPERTY SHOULD CHECK WITH THE APPROPRIATE CITY OR COUNTY PLANNING DEPARTMENT TO VERIFY APPROVED USES AND TO DETERMINE ANY LIMITS ON LAWSUITS AGAINST FARMING OR FOREST PRACTICES AS DEFINED IN ORS 30.930.

DATED this 16th day of August, 1999.

Valley Landfills, Inc.
By: Duane Sorensen
Name/Title: Duane Sorensen, President

STATE OF OREGON
County of Benton *ss*

The foregoing instrument was acknowledged before me this 16th *day of* August, *1999, by* Duane Sorensen, *as* President *of* Valley Landfills, Inc., *on its behalf.*

OFFICIAL SEAL
GEORGE ABELE
NOTARY PUBLIC - OREGON
COMMISSION NO.051901
MY COMMISSION EXPIRES MAR. 07, 2000

George Abele
Notary Public for Oregon

(20) (21)
10-4-18
10-4-19 (2)

EXHIBIT A

Legal Description

TRACT A:

All that part of the following described tract of land lying and being West of U.S. Highway 99W as the same is now located:

Beginning at a point on the West boundary line of the former right of way of the Southern Pacific Co., formerly the Oregon and California Railroad Company, as said right of way was located on July 3, 1962, which point is North 27.50 chains and West 10.71 chains from the Southeast corner of Monroe Hodges Donation Land Claim No. 46, Township 10 South, Range 4 West of the Willamette Meridian, Benton County, Oregon; and running thence West 66.01 chains to the West boundary line of said claim; thence North 3°21' West on said West boundary line, 32.20 chains; thence East 48.79 chains; thence South 2°30' West 12.43 chains; thence East 20.11 chains to a point on the West boundary line of the said railroad right of way; thence South 2°30' West, along the West boundary line of the said right of way, 19.58 chains to the point of beginning.

EXCEPTING THEREFROM the following described tract, to-wit:

Beginning at a point on the South line of the tract described in deed recorded in Book 125, Page 431, Benton County Deed Records, 27.50 chains North 3°13' West, along the claim line, and 18.36 chains North 89°55' East along the South line of said tract, from the Southwest corner of the Monroe Hodges Donation Land Claim No. 46, Township 10 South, Range 4 West, of the Willamette Meridian, Benton County, Oregon; thence North 89°55' East, along the South line of said tract, 5.620 chains to the West line of the Corvallis-Monmouth State Highway; thence North 5°29' West, along the West line of said highway, 4.291 chains; thence South 89°55' West, parallel to the South line of said tract, 6.060 chains; thence South 11°12'30'' East 4.353 chains to the point of beginning.

TRACT B:

That portion of the following described property lying South of Coffin Butte Road, Benton County, Oregon.

All that part of the following described tract lying West of the Pacific Highway West (U.S. 99 West) and South of County Road No. 45-12:

Beginning at the Northwest corner of the Monroe Hodges Donation Land Claim No. 46, Township 10 South, Range 4 West of the Willamette Meridian, Benton County, Oregon; thence East 50.865 chains along the North line of said claim; thence South 2°10' West 23.02 chains; thence West 49.01 chains to the West line of said claim; thence North 3°21' West 23.05 chains to the point of beginning.

EXHIBIT A

Legal Description

EXCEPTING THEREFROM the following described tract:

Beginning at a point on the West line of Highway 99 West at a point 300 feet North along the West line of said highway from the intersection with the South line of Tract 3 of deed recorded February 4, 1957 in Book 158, Page 313, Deed Records of Benton County, Oregon, in the Monroe Hodges Donation Land Claim No. 46, Township 10 South, Range 4 West of the Willamette Meridian, Benton County, Oregon; thence West parallel to the South line of said Tract 3, a distance of 435.6 feet; thence Northerly parallel to the West line of said highway, 300 feet; thence East to a point on the West line of said highway at a point 300 feet North of the point of beginning; thence South along said highway line 300 feet to the point of beginning.

ALSO EXCEPTING from the above described property that portion thereof conveyed to the State of Oregon for highway purposes by deed from the United States of America, acting by and through the Federal Farm Mortgage Corporation, dated May 16, 1947 and recorded October 25, 1947, in Book 119, Page 836, Deed Records of Benton County, Oregon.

ALSO EXCEPTING from the above described property that portion thereof conveyed to Benton County, Oregon, for road purposes by deed from the United States of America, dated May 9, 1947, recorded August 7, 1947 in Book 118, Page 568, Deed Records of Benton County, Oregon.

273800

STATE OF OREGON } ss.
County of Benton

I hereby certify that the within instrument was received for record

'99DEC30 PM 1:22

AND ASSIGNED M278439

In the microfilm records of said county

Witness My Hand and Seal of County Affixed
JOHN K. ANDERSON
County Administrative Officer

By _____ Deputy

60-2

M278439-99

AFTER RECORDING, RETURN TO:

Valley Landfills Inc.
P.O. Box 807
Corvallis, Oregon 97339

Until a change is requested,
all tax statements shall be sent to:

Valley Landfills Inc.
P.O. Box 807
Corvallis, Oregon 97339

TICOR TITLE INSURANCE CO. 80-617

STATUTORY WARRANTY DEED

Valley Landfills Inc., an Oregon Corporation, who took title as Valley Landfill Inc., an Oregon Corporation ("Grantor"), conveys and warrants to Valley Landfills Inc., an Oregon Corporation ("Grantee") the real property described on the attached Exhibit A, free of encumbrances except easements, covenants, conditions, restrictions and encumbrances of record.

The true consideration for this conveyance is the correction of vesting.

THIS INSTRUMENT WILL NOT ALLOW USE OF THE PROPERTY DESCRIBED IN THIS INSTRUMENT IN VIOLATION OF APPLICABLE LAND USE LAWS AND REGULATIONS. BEFORE SIGNING OR ACCEPTING THIS INSTRUMENT, THE PERSON ACQUIRING FEE TITLE TO THE PROPERTY SHOULD CHECK WITH THE APPROPRIATE CITY OR COUNTY PLANNING DEPARTMENT TO VERIFY APPROVED USES AND TO DETERMINE ANY LIMITS ON LAWSUITS AGAINST FARMING OR FOREST PRACTICES AS DEFINED IN ORS 30.930.

DATED this 16th day of August, 1999.

Valley Landfills, Inc.
By: Duane Sorensen
Name/Title: Duane Sorensen, President

STATE OF OREGON
County of Benton *ss*

The foregoing instrument was acknowledged before me this 16th *day of* August, *1999, by* Duane Sorensen, *as* President *of* Valley Landfills, Inc., *on its behalf.*

OFFICIAL SEAL
GEORGE ABELE
NOTARY PUBLIC - OREGON
COMMISSION NO.051901
MY COMMISSION EXPIRES MAR. 07, 2000

George Abele
Notary Public for Oregon

(20) (21)
10-4-18
10-4-19 (2)

EXHIBIT A

Legal Description

TRACT A:

All that part of the following described tract of land lying and being West of U.S. Highway 99W as the same is now located:

Beginning at a point on the West boundary line of the former right of way of the Southern Pacific Co., formerly the Oregon and California Railroad Company, as said right of way was located on July 3, 1962, which point is North 27.50 chains and West 10.71 chains from the Southeast corner of Monroe Hodges Donation Land Claim No. 46, Township 10 South, Range 4 West of the Willamette Meridian, Benton County, Oregon; and running thence West 66.01 chains to the West boundary line of said claim; thence North 3°21' West on said West boundary line, 32.20 chains; thence East 48.79 chains; thence South 2°30' West 12.43 chains; thence East 20.11 chains to a point on the West boundary line of the said railroad right of way; thence South 2°30' West, along the West boundary line of the said right of way, 19.58 chains to the point of beginning.

EXCEPTING THEREFROM the following described tract, to-wit:

Beginning at a point on the South line of the tract described in deed recorded in Book 125, Page 431, Benton County Deed Records, 27.50 chains North 3°13' West, along the claim line, and 18.36 chains North 89°55' East along the South line of said tract, from the Southwest corner of the Monroe Hodges Donation Land Claim No. 46, Township 10 South, Range 4 West, of the Willamette Meridian, Benton County, Oregon; thence North 89°55' East, along the South line of said tract, 5.620 chains to the West line of the Corvallis-Monmouth State Highway; thence North 5°29' West, along the West line of said highway, 4.291 chains; thence South 89°55' West, parallel to the South line of said tract, 6.060 chains; thence South 11°12'30'' East 4.353 chains to the point of beginning.

TRACT B:

That portion of the following described property lying South of Coffin Butte Road, Benton County, Oregon.

All that part of the following described tract lying West of the Pacific Highway West (U.S. 99 West) and South of County Road No. 45-12:

Beginning at the Northwest corner of the Monroe Hodges Donation Land Claim No. 46, Township 10 South, Range 4 West of the Willamette Meridian, Benton County, Oregon; thence East 50.865 chains along the North line of said claim; thence South 2°10' West 23.02 chains; thence West 49.01 chains to the West line of said claim; thence North 3°21' West 23.05 chains to the point of beginning.

EXHIBIT A

Legal Description

EXCEPTING THEREFROM the following described tract:

Beginning at a point on the West line of Highway 99 West at a point 300 feet North along the West line of said highway from the intersection with the South line of Tract 3 of deed recorded February 4, 1957 in Book 158, Page 313, Deed Records of Benton County, Oregon, in the Monroe Hodges Donation Land Claim No. 46, Township 10 South, Range 4 West of the Willamette Meridian, Benton County, Oregon; thence West parallel to the South line of said Tract 3, a distance of 435.6 feet; thence Northerly parallel to the West line of said highway, 300 feet; thence East to a point on the West line of said highway at a point 300 feet North of the point of beginning; thence South along said highway line 300 feet to the point of beginning.

ALSO EXCEPTING from the above described property that portion thereof conveyed to the State of Oregon for highway purposes by deed from the United States of America, acting by and through the Federal Farm Mortgage Corporation, dated May 16, 1947 and recorded October 25, 1947, in Book 119, Page 836, Deed Records of Benton County, Oregon.

ALSO EXCEPTING from the above described property that portion thereof conveyed to Benton County, Oregon, for road purposes by deed from the United States of America, dated May 9, 1947, recorded August 7, 1947 in Book 118, Page 568, Deed Records of Benton County, Oregon.

273800

STATE OF OREGON } ss.
County of Benton

I hereby certify that the within instrument was received for record

'99DEC30 PM 1:22

AND ASSIGNED M278439

In the microfilm records of said county

Witness My Hand and Seal of County Affixed
JOHN K. ANDERSON
County Administrative Officer

By _____ Deputy

EXHIBIT 4

WILDLIFE HABITAT ASSESSMENT AND SURVEYS AND ADDENDUM TO THE FINAL 2024 REPORT



Photo credit: S. James

Submitted to:

Jeff Shepherd, P.E.
Civil & Environmental
Consultants, Inc.

Submitted by:
Turnstone Environmental
Consultants, Inc.
PO Box 83362
Portland, OR 97283

Submitted:

July 12, 2024

Final 2024 Report:

Wildlife Habitat Assessment and Surveys

for the Coffin Butte Landfill Expansion Project

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INTRODUCTION

Civil & Environmental Consultants, Inc. ("CEC") contracted Turnstone Environmental Consultants, Inc. ("Turnstone") to perform a wildlife study for the Coffin Butte Landfill Expansion Project Area ("Project Area"). This study seeks to understand the following:

- Avian Monitoring
  - Likelihood of usage of the Project Area by protected grassland bird species
  - Occupancy status of the great blue heron nesting in the two known rookery sites
  - Behavior of bald eagles at the Coffin Butte Landfill Expansion Project Area
- Deer and Elk Study
  - Distribution and relative importance of deer and elk habitat surrounding and within the Coffin Butte Landfill Expansion Project Area

This report describes the findings of the habitat assessment and surveys as of July 12, 2024.

AVIAN MONITORING

Turnstone developed an Avian Monitoring Plan for the Coffin Butte Landfill Expansion Project (Appendix A). Wildlife biologists Jennifer Ringo and Gregory Reed from the Oregon Department of Fish and Wildlife (ODFW) and Jennifer Weikel from the Oregon Department of Forestry (ODF) reviewed the draft plan, suggested various edits, and ultimately approved the final monitoring plan. Communications with ODFW and ODF wildlife biologists are included in Appendix B. A copy of the draft report with imbedded ODFW and ODF wildlife biologist comments are available upon request.

The methods for the surveys are described in the Avian Monitoring Plan (Appendix A). The following topics are covered during training of all avian survey personnel:

Protocol and Data Procedures:

- General safety and survey techniques
- Scheduling
- General discussion of site maps
- Proper completion of forms
- Data management schedule

Great Blue Heron and Bald Eagle Life History:

- Ethology
- Suitable habitat
- Nesting chronology

Survey Procedures

- Basic flight patterns and vocalizations of the great blue heron and bald eagle
- Protocol and non-protocol weather conditions

Orienteering:

- GPS, UTM coordinates, map, and compass use
- Orthophoto interpretation

Grassland Bird Habitat

The project area contains closed landfill cells with open areas dominated by graminoids. These closed landfill cells are potential habitat for grassland birds, including the streaked horned lark (*Eremophila alpestris strigata*), a species protected by the Endangered Species Act of 1973.

In January of 2022, Turnstone ecologist Stephanie James visited the potential grassland bird habitat with ODFW grassland bird specialist Anne Mary Myers and ODFW wildlife biologist Gregory Reed to assess the likelihood of protected bird species using the Project Area as foraging and/or nesting habitat. Weather conditions were agreeable to observing the nest sites, with no rain or fog to impede visibility.

ODFW biologists determined the potential grassland habitat and rock quarry areas north of Coffin Butte Road are not likely used as nesting habitat by protected grassland birds, specifically the streaked horned lark (*Eremophila alpestris strigata*) and Oregon vesper sparrow (*Pooecetes gramineus* ssp. *affinis*); therefore, species-specific surveys for grassland birds are not needed.

Great Blue Heron Rookery Monitoring

Turnstone biologists are monitoring two great blue heron rookeries located within the Coffin Butte Landfill Expansion Project Area (Figure 1). In 2022 and 2023, Turnstone biologists conducted six reproductive productivity surveys each year for nesting great blue herons in the two known rookery locations. In 2024, at the time this report was finalized (July 12, 2024), Turnstone biologists have completed five out of six planned reproductive surveys. The survey forms for all years of monitoring are in Appendix C.



Figure 1. Great Blue Heron Rookeries in the Project Area and Observation Points

Year 1 Surveys (2022)

Turnstone biologists conducted six daytime surveys at each rookery site from February 17 through August 15, 2022 (Table 1 and Table 2). Turnstone biologists did not observe or detect any great blue herons nesting during any of the six visits at the western rookery (#2683). All surveys were conducted during mild weather conditions. One red-tailed hawk was observed several times during the survey and may be nesting in one of the potentially abandoned heron stick nests.

The great blue herons at the eastern site (#2716) occupied 14 stick nests during the first three surveys, from February through the end of April. The herons were generally standing and building on the nests, indicating a nest building period and possibly the initiation of an incubation period. In June, bald eagle juveniles invaded the colony and were observed moving between 10 of the 14 nests. All surveys were conducted during mild weather conditions.

Table 1. 2022 Great Blue Heron Survey Results for the Western Rookery (#2683)

Observation Period	Survey Date	Surveyor	Results of Reproductive Monitoring	
			Great Blue Heron	Other Birds Observed in Nests [1]
2/15 to 3/15	2/17	Stephanie James	10 inactive nests	RTHA
3/15 to 4/15	3/22	Stephanie James	10 inactive nests	RTHA
4/15 to 5/15	4/28	Stephanie James	10 inactive nests	RTHA
5/15 to 6/15	6/01	Stephanie James	10 inactive nests	RTHA
6/15 to 7/15	7/12	Stephanie James	10 inactive nests	RTHA
7/15 to 8/15	8/15	Stephanie James	10 inactive nests	RTHA, BAEA

Table 2. 2022 Great Blue Heron Survey Results for the Eastern Rookery (#2716)

Observation Period	Survey Date	Surveyor	Results of Reproductive Monitoring	
			Great Blue Heron	Other Birds Observed in Nests
2/15 to 3/15	2/17	Stephanie James	1 active nest	None
3/15 to 4/15	3/22	Stephanie James	11 active nests	None

[1] RTHA = red-tailed hawk, BAEA = bald eagle, CORA = common raven

Observation Period	Survey Date	Surveyor	Results of Reproductive Monitoring	
			Great Blue Heron	Other Birds Observed in Nests
4/15 to 5/15	4/28	Stephanie James	14 active nests	None
5/15 to 6/15	6/01	Stephanie James	14 inactive nests	BAEA
6/15 to 7/15	7/12	Stephanie James	14 inactive nests	None
7/15 to 8/15	8/15	Stephanie James	14 inactive nests	None

Year 2 Surveys (2023)

Biologists conducted six daytime surveys at each rookery site from March 1 through July 21, 2023 (Table 3 and Table 4). Turnstone biologists did not observe or detect any great blue herons nesting during any of the six visits at the two observation points. All surveys were conducted during mild weather conditions.

Table 3. 2023 Great Blue Heron Survey Results for the Western Rookery (#2683)

Observation Period	Survey Date	Surveyor	Results of Reproductive Monitoring	
			Great Blue Heron	Other Birds Observed in Nests
2/15 to 3/15	3/01	Stephanie James, Sarah McCord	10 inactive nests	CORA, RTHA, BAEA
3/15 to 4/15	3/31	Sarah McCord	10 inactive nests	RTHA, BAEA
4/15 to 5/15	5/05	Sarah McCord	10 inactive nests	RTHA
5/15 to 6/15	5/19	Sarah McCord	10 inactive nests	RTHA
6/15 to 7/15	6/16	Sarah McCord	10 inactive nests	RTHA
7/15 to 8/15	7/21	Sarah McCord	10 inactive nests	RTHA

Table 4. 2023 Great Blue Heron Survey Results for the Eastern Rookery (#2716)

Observation Period	Survey Date	Surveyor	Results of Reproductive Monitoring	
			Great Blue Heron	Other Birds Observed in Nests
2/15 to 3/15	3/01	Stephanie James, Sarah McCord	13 inactive nests	RTHA
3/15 to 4/15	3/31	Sarah McCord	13 inactive nests	RTHA
4/15 to 5/15	5/05	Sarah McCord	13 inactive nests	None
5/15 to 6/15	5/19	Sarah McCord	13 inactive nests	BAEA
6/15 to 7/15	6/16	Sarah McCord	13 inactive nests	None
7/15 to 8/15	7/21	Sarah McCord	13 inactive nests	None

Year 3 Surveys (2024)

At the time of the finalization of this report (July 12, 2024), Turnstone biologists had conducted five of the six required daytime surveys at each rookery site from February 22 through June 28, 2024 (Table 3). Turnstone biologists did not observe any great blue herons using the stick nests for nesting during any of the six visits at the two observation points. All surveys were conducted during mild weather conditions.

Table 5. 2024 Great Blue Heron Survey Results for the Western Rookery (#2683)

Observation Period	Survey Date	Surveyor	Results of Reproductive Monitoring	
			Great Blue Heron	Other Birds Observed in Nests
2/15 to 3/15	2/22	Sarah McCord	10 inactive nests	None
3/15 to 4/15	4/4	Sarah McCord	10 inactive nests	None
4/15 to 5/15	4/19	Sarah McCord	10 inactive nests	None
5/15 to 6/15	5/30	Sarah McCord	10 inactive nests	None
6/15 to 7/15	6/28	Sarah McCord	10 inactive nests	None
7/15 to 8/15	TBD	TBD	TBD	TBD

Table 6. 2024 Great Blue Heron Survey Results for the Eastern Rookery (#2716)

Observation Period	Survey Date	Surveyor	Results	
			Great Blue Heron	Other Birds Observed in Nests
2/15 to 3/15	2/22	Sarah McCord	13 inactive nests	None
3/15 to 4/15	4/4	Sarah McCord	13 inactive nests	None
4/15 to 5/15	4/19	Sarah McCord	13 inactive nests	None
5/15 to 6/15	5/30	Sarah McCord	13 inactive nests	None
6/15 to 7/15	6/28	Sarah McCord	13 inactive nests	None
7/15 to 8/15	TBD	TBD	TBD	TBD

Conclusion

Western Rookery (#2683)

During two years of protocol surveys (2022-2023), Turnstone biologists observed no active nesting by great blue herons within the western rookery (#2683). Three bird species were recorded visiting the stick nests during that time, including the common raven (*Corvus corax*), red-tailed hawk (*Buteo jamaicensis*), and bald eagle. A pair of red-tailed hawks were present during each survey, acting defensively, and are likely nesting in the in an abandoned stick nest the rookery in 2023.

Turnstone is continuing surveys in Year 3 (2024) to confirm the abandoned status, which requires three consecutive years of inactive status. At the time this report was finalized (July 12, 2024), Turnstone biologists completed five of the six required surveys. No nesting herons were observed as yet in 2024.

The western rookery is likely abandoned by great blue herons; however, the official status of the heron nests cannot be determined until the conclusion of the final sixth survey in 2024. Once the final visit is complete, Turnstone will submit an addendum to this report with the results.

Eastern Rookery (#2716)

During Year 1 (2022) surveys, Turnstone biologists observed active nesting by great blue herons within the eastern rookery (#2716) during the first three survey periods; however, in early June the colony had failed, and juvenile bald eagles were observed visiting the majority of the nests.

A red-tailed hawk pair was observed nesting in an abandoned stick nest in the rookery in Year 2 (2023). No great blue herons were observed in the eastern rookery (#2716) during any of the six 2023 reproductive productivity surveys; therefore, the rookery is considered inactive for 2023.

As with the western rookery, the eastern rookery is likely also abandoned by great blue herons. The official status of the heron nests cannot be determined until the conclusion of the final sixth survey in 2024. Once the final visit is complete, Turnstone will submit an addendum to this report with the results.

Mitigation and Protection Strategy for Great Blue Heron

As of the date of this final report, biologists have not observed any great blue heron nesting activity in the western rookery (#2683), which would be removed by the Landfill Expansion Project. If it is determined that there might be nesting activity during the final sixth survey of 2024, then mitigation measures would be implemented with the guidance of the state biologists with ODFW and ODF for compliance with state laws governing protections of resource sites.

If herons are found to be using the eastern rookery (#2716) during the final survey of 2024, then a Protection Strategy would be implemented during the Landfill Expansion Project activities, using a two-tiered approach with protection within the rookery itself (resource site) and within a buffer zone. This strategy provides effective protection within the rookery while allowing compatible activities at greater distances.

The relatively flat forested structure of the eastern rookery (#2716), existing tall hardwood trees in the contiguous forest extending away from Coffin Butte Road, and high human activity surrounding the rookery affect the shape of the buffer zones. The strategy for protecting the eastern rookery (#2716) includes providing protections within the resource site and a buffer zone extending 300 feet, measured from the perimeter of the rookery (Figure 2).

Great Blue Heron Rookery (within resource site)

The extent of the great blue heron rookery resource site was mapped on the ground to include active nest trees. Within the resource site, the land managers would retain all trees. There would be no habitat modification, such as overstory tree removal, vegetation clearing, construction of new roads, trails, buildings. Only actions allowed within the resource site would be deemed necessary by ODFW and the State Forester for improving the nesting habitat.

Vegetated Buffer Zone (within 300-ft buffer)

The Vegetated Buffer Zone would occur within the contiguous hardwood forest area which includes key components, perching and fledging trees, and replacement trees. No habitat modification, such as timber cutting, vegetation clearing, and development of new roads, trails, or buildings would occur within this zone.

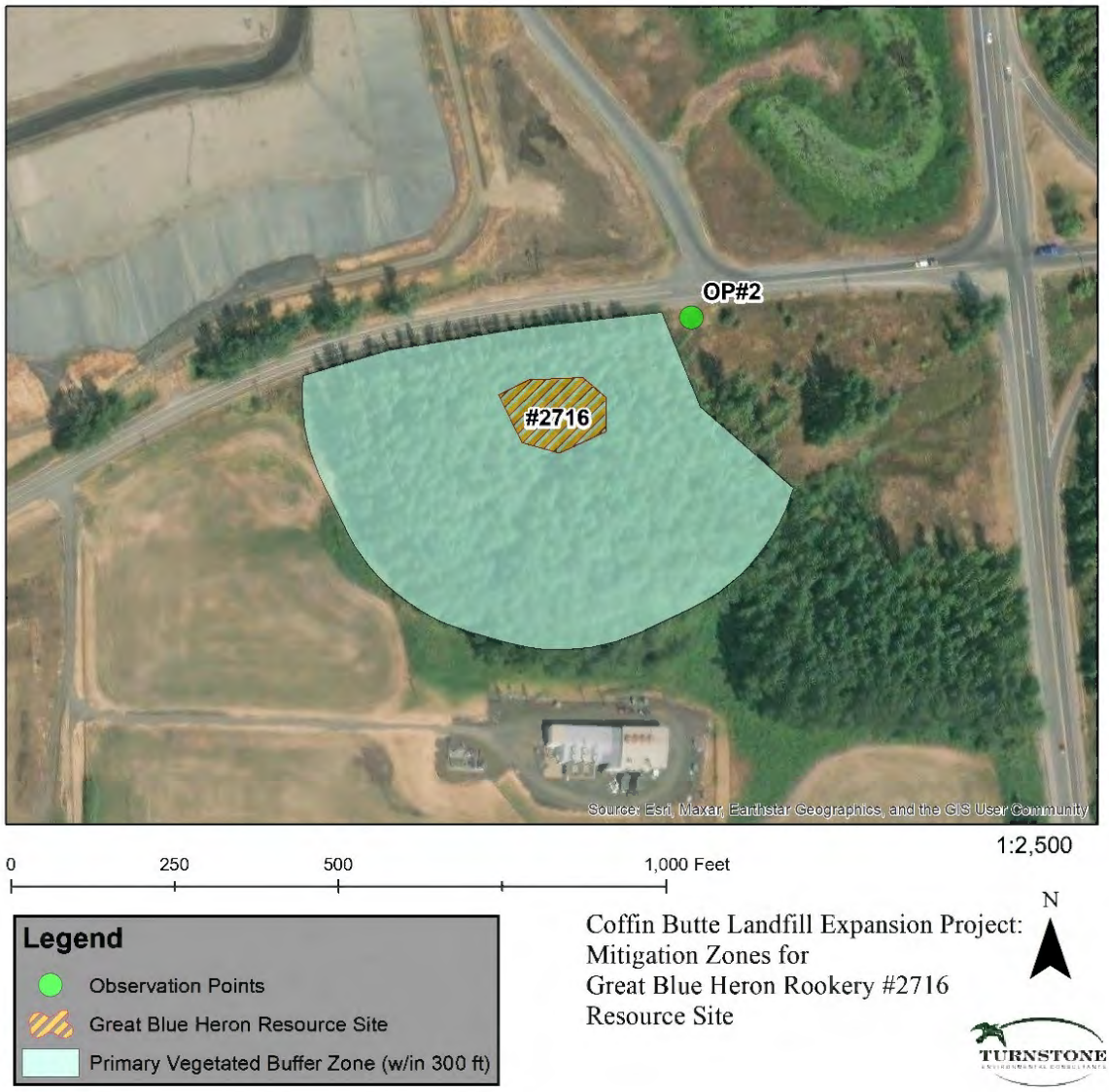


Figure 2. Great Blue Heron Protection Zone Surrounding the Eastern Rookery #2716

Due to the proximity of a high-use road, the great blue herons using the eastern rookery are likely habituated to the traffic noise; therefore, vehicular use of Coffin Butte Road within 300 feet of the rookery would be allowed during the great blue heron nesting period (February 15th to July 31st). The highest priority for protections within the Primary Vegetated Buffer Zone is the forest cover located between the resource site and Coffin Butte Road which acts as a visual screen. Forest management activities would only occur within the Primary Vegetated Buffer Zone with the approval of ODFW and the State Forester and for the enhancement of great blue heron nesting habitat. These enhancements may include tree topping to reduce windthrow potential and would only occur outside of the great blue heron nesting period (February 15th to July 31st).

Bald Eagle Activity

Turnstone conducted monthly monitoring of the behavior of bald eagles within Coffin Butte Landfill Expansion Project Area. The methods for the surveys are described in the Avian Monitoring Plan (Appendix A).

Year 1 (2022)

Turnstone biologists completed five surveys in 2022 for bald eagles during mild weather conditions which allowed for good visibility of the entire Coffin Butte Landfill Expansion Project Area. Biologists observed foraging and soaring behaviors in groups of eagles with as many as eleven juvenile bald eagles and six adult bald eagles. Biologists did not observe any bald eagles using nest sites within the study area.

Table 7. 2022 Bald Eagle Survey Results

Observation Period	Survey Date	Surveyor	Highest Number of Bald Eagles Observed at One Time	
			Juveniles	Adults
2/15 to 3/15	2/17	Stephanie James	4	6
3/15 to 4/15	3/22	Stephanie James	4	6
4/15 to 5/15	4/28	Stephanie James	4	6
5/15 to 6/15	6/01	Stephanie James	4	6
6/15 to 7/15	7/12	Stephanie James	4	6

Year 2 (2023)

Turnstone biologists completed five surveys in 2023 for bald eagles during mild weather conditions which allowed for good visibility of the entire Coffin Butte Landfill Expansion Project Area. Biologists observed foraging and soaring behaviors in groups of eagles with as many as four juvenile bald eagles and six adult bald eagles. Biologists did not observe any bald eagles using nest sites within the study area.

Table 8. 2023 Bald Eagle Survey Results

Observation Period	Survey Date	Surveyor	Highest Number of Bald Eagles Observed at One Time	
			Juveniles	Adults
2/15 to 3/15	2/17	Stephanie James, Sarah McCord	5	6
3/15 to 4/15	3/22	Sarah McCord	11	3

Observation Period	Survey Date	Surveyor	Highest Number of Bald Eagles Observed at One Time	
			Juveniles	Adults
4/15 to 5/15	4/28	Sarah McCord	3	2
5/15 to 6/15	6/01	Sarah McCord	5	3
6/15 to 7/15	7/12	Sarah McCord	0	0

Year 3 (2024)

Turnstone biologist Sarah McCord has completed all five surveys in 2024 for bald eagles during mild weather conditions which allowed for good visibility of the entire Coffin Butte Landfill Expansion Project Area. McCord observed roosting, foraging, and soaring behaviors in groups of eagles with as many as seven (7) juvenile bald eagles and (10) adult bald eagles.

McCord observed a golden eagle flying over the landfill with a blond nape and white based primaries during the first visit on February 22, 2024. Biologists did not observe any bald or golden eagles using nest sites within the study area in 2024.

Table 9. 2024 Bald Eagle Survey Results

Observation Period	Survey Date	Surveyor	Highest Number of Bald Eagles Observed at One Time	
			Juveniles	Adults
2/15 to 3/15	2/17	Sarah McCord	3	1
3/15 to 4/15	3/22	Sarah McCord	2	1
4/15 to 5/15	4/28	Sarah McCord	7	10
5/15 to 6/15	6/01	Sarah McCord	4	4
6/15 to 7/15	7/12	Sarah McCord	2	2

Conclusion

During three years (2022, 2023, and 2024) of monitoring bald eagle activity within the Coffin Butte Landfill Expansion Project Area, Turnstone biologists observed bald eagle juveniles and adults foraging, soaring, gliding, calling, and perching in adjacent trees. No bald eagles were observed nesting during any of the five surveys in each year; therefore, bald eagles are not likely nesting in the Coffin Butte Landfill Expansion Project.

DEER AND ELK STUDY

Turnstone is tasked with gathering existing information, performing field reconnaissance, and conducting a review of the use of the Coffin Butte Landfill Expansion Project Area by resident and/or migratory Columbian black-tailed deer (*Odocoileus hemionus columbianus*) and Roosevelt elk (*Cervus canadensis roosevelti*). The elk study uses a two-phase approach to gather information on deer and elk near the Project Area, integrating remote sensing, regional habitat analysis, and field reconnaissance by wildlife biologists.

The first phase of the deer and elk study includes a review of existing information, which is ongoing. The second phase of the deer and elk study included gathering additional baseline habitat data through field reconnaissance which aids in establishing locations for an array of trail cameras to document seasonal timing of deer and elk movement.

Habitat Assessment

The findings of this interim report are based on the information gathered during field investigation, recent aerial photographs, and the desktop evaluation of spatial data, including anecdotal observations within the 804-acre deer and elk Study Area, which includes all Coffin Butte Landfill Properties. The Deer and Elk Assessment Area includes the areas within a 5-mile radius of the Coffin Butte Study Area. The surrounding 5-mile Assessment Area includes 67,577 acres (Figure 3).

Turnstone wildlife biologists and geographic information system (GIS) analysts reviewed deer and elk habitat mapping created by ODFW in 2017.

The ODFW habitat categorization includes five habitat types with the following characteristics:

- **Summer Concentration Areas (Category 2):** provide essential and limited functions and values for concentrated migratory deer or elk typically from May through October
- **Winter Concentration Areas (Category 2):** provide essential and limited functions and values for concentrated migratory deer or elk typically from November through April
- **Year-round Major Habitat (Category 3):** provide essential functions and values for non-migratory deer or elk; not limited on a physiographic basis
- **Year-round Peripheral Habitat (Category 4):** provide important, but not essential functions and values for deer or elk
- **Impacted habitat (Category 4):** areas where the presence of deer and elk are considered in conflict with primary land uses

Deer and Elk Habitat Assessment Results

The study area contained no summer or winter concentration areas, which are essential for deer and elk that exhibit predominantly migratory behavior. These summer and winter concentration areas provide essential functions, such as thermal cover, protection from predation, and calving and fawning areas that are generally limited on the landscape. Over half of the surrounding 5-mile Assessment Area is considered Impacted Habitat, which are generally developed areas.

Year-round Major Habitat, which provides essential but not limited habitat for non-migratory deer and elk, occurs within about 27-percent of the surrounding 5-mile Assessment Area but

does not occur within the Coffin Butte study area. One hundred percent of the Coffin Butte study area is considered Year-round Peripheral Habitat, which provides important but not essential or limited functions, such as cover and forage. Table 10 summarizes the extent of elk habitat types within the Coffin Butte Study Area and surrounding 5-mile Assessment Area.

Turnstone biologists agree with the 2017 ODFW habitat mapping that found the deer and elk habitat within the Coffin Butte Study Area is likely important but not essential habitat for resident and migratory deer and elk populations.

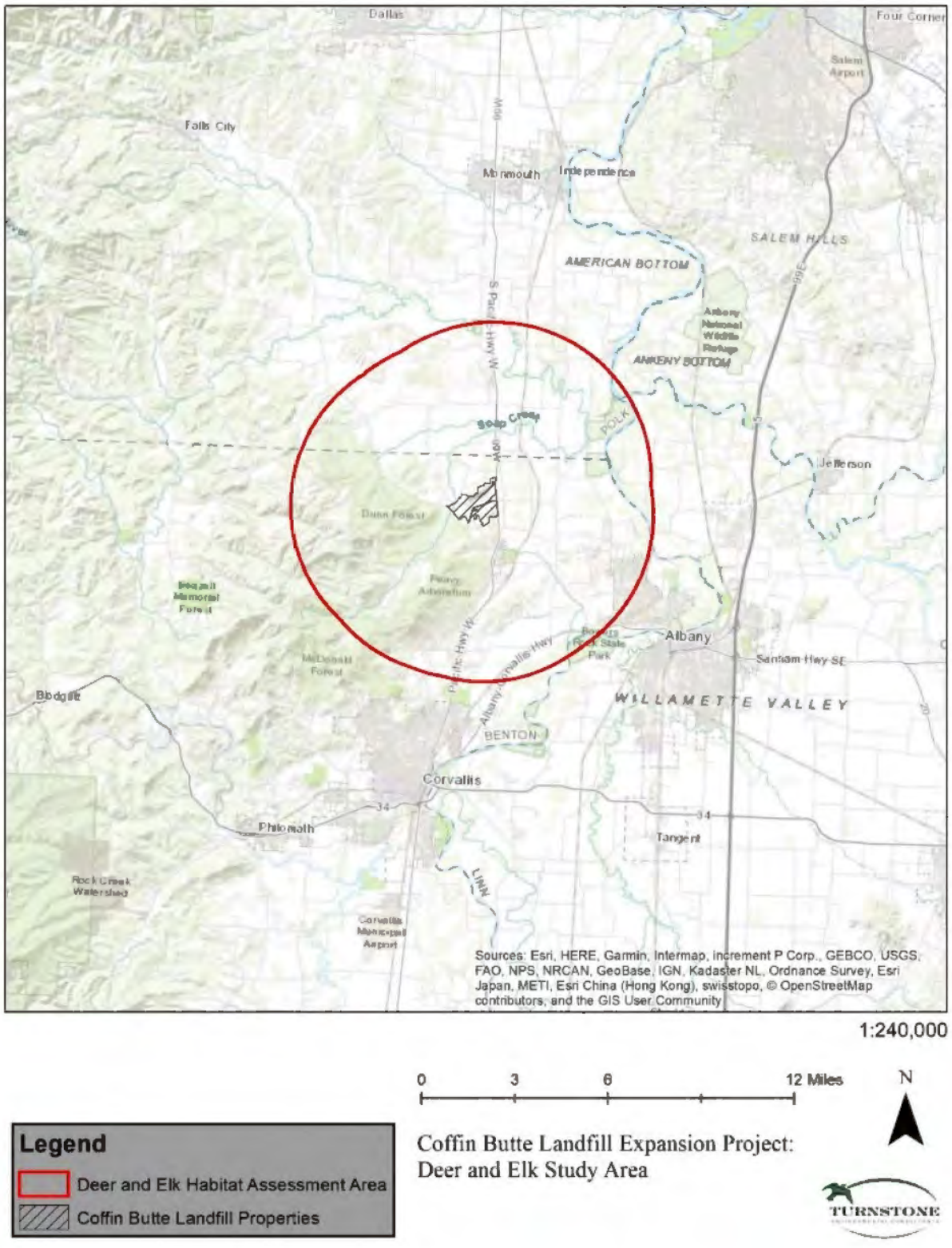


Figure 3. Study Area for the Elk Habitat Assessment

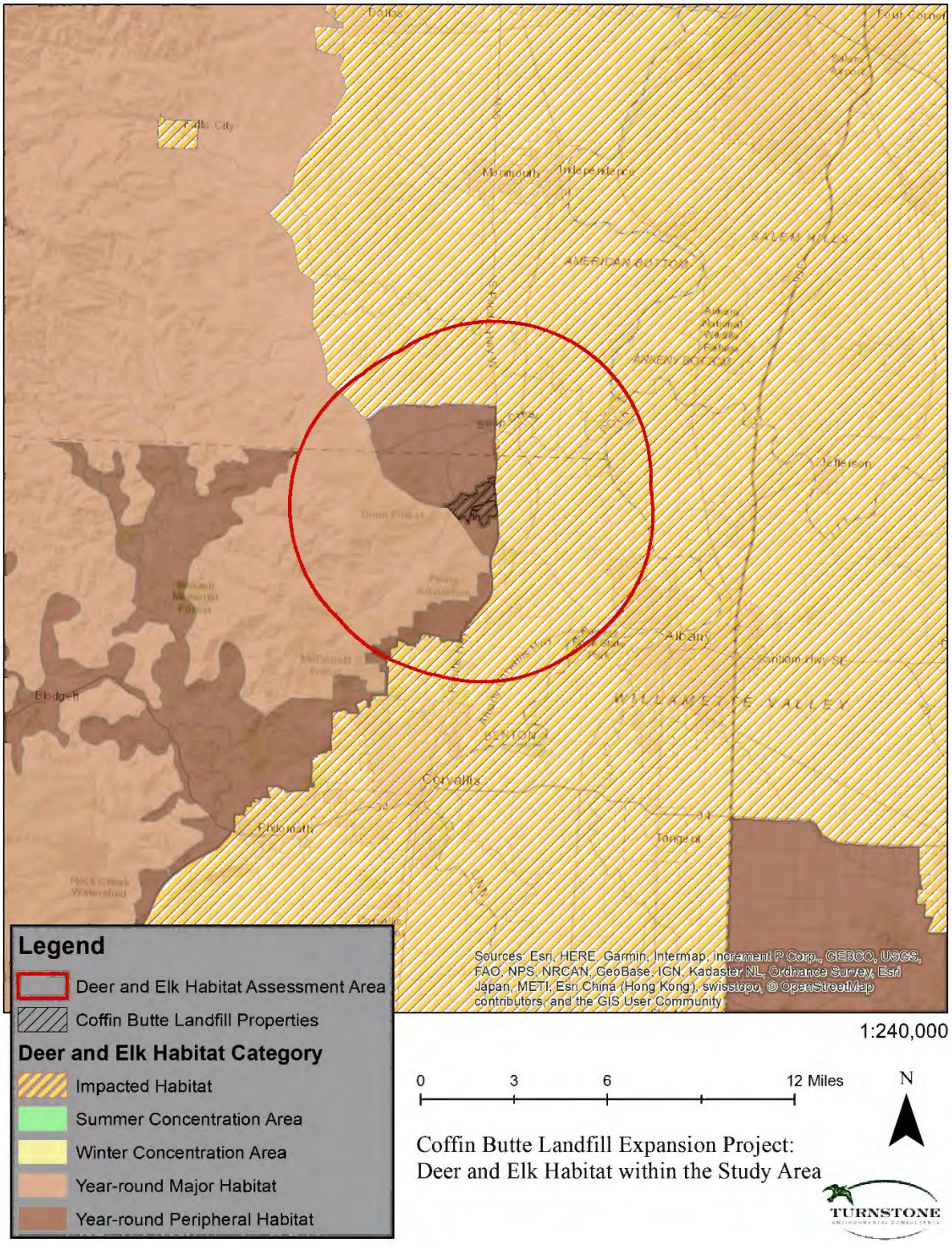


Figure 4. Deer and Elk Habitat in the Coffin Butte Landfill Expansion Project Study Area

Table 10. Elk Habitat within the Coffin Butte Landfill Expansion Project Study Area

Habitat Type	Habitat Category	Project Area (acres)	Percent of Project Area	Study Area (acres)	Percent of Study Area
Summer Concentration Area	2	0	0	0	0.0%
Winter Concentration Area	2	0	0	0	0.0%
Year-round Major Habitat	3	0	0	18,121	26.8%
Year-round Peripheral Habitat	4	804	100%	10,765	15.9%
Impacted Habitat	4	0	0	38,691	57.3%
Totals	**--**	**804**	**100%**	**67,577**	**100%**

Trail Camera Study

Turnstone wildlife biologists installed five trail cameras affixed to trees in five sampling areas with one camera in each sampling area in late May 2022. Two of the five cameras (A-4 and A-5) are located within the construction limits of the proposed landfill expansion site and three are outside the project site (A-1, A-3, and A-6). Turnstone biologists placed trail cameras along abandoned roads, game trails, and in forested areas with an open understory.

Large mammal species that occasionally use the Coffin Butte Landfill Expansion Project Area include the bobcat (*Lynx rufus*), cougar (*Puma concolor*), coyote (*Canis latrans*), Roosevelt elk (*Cervus canadensis roosevelti*), raccoon (*Procyon lotor*), and striped skunk (*Mephitis mephitis*).

Black-tailed deer use the project area throughout the year with the highest usage in the edge habit near Camera A-1, with an average of less than one (0.76) detection per day. All other trail cameras detected black-tailed deer an average of about once or twice per week (Table 11).

Table 11. Black-tailed Deer Detections per Day on Trail Cameras

Common Name	A-1	A-3	A-4	A-5	A-6
Black-tailed deer	276	76	160	143	134
Detections per day	0.76	0.21	0.13	0.39	0.37

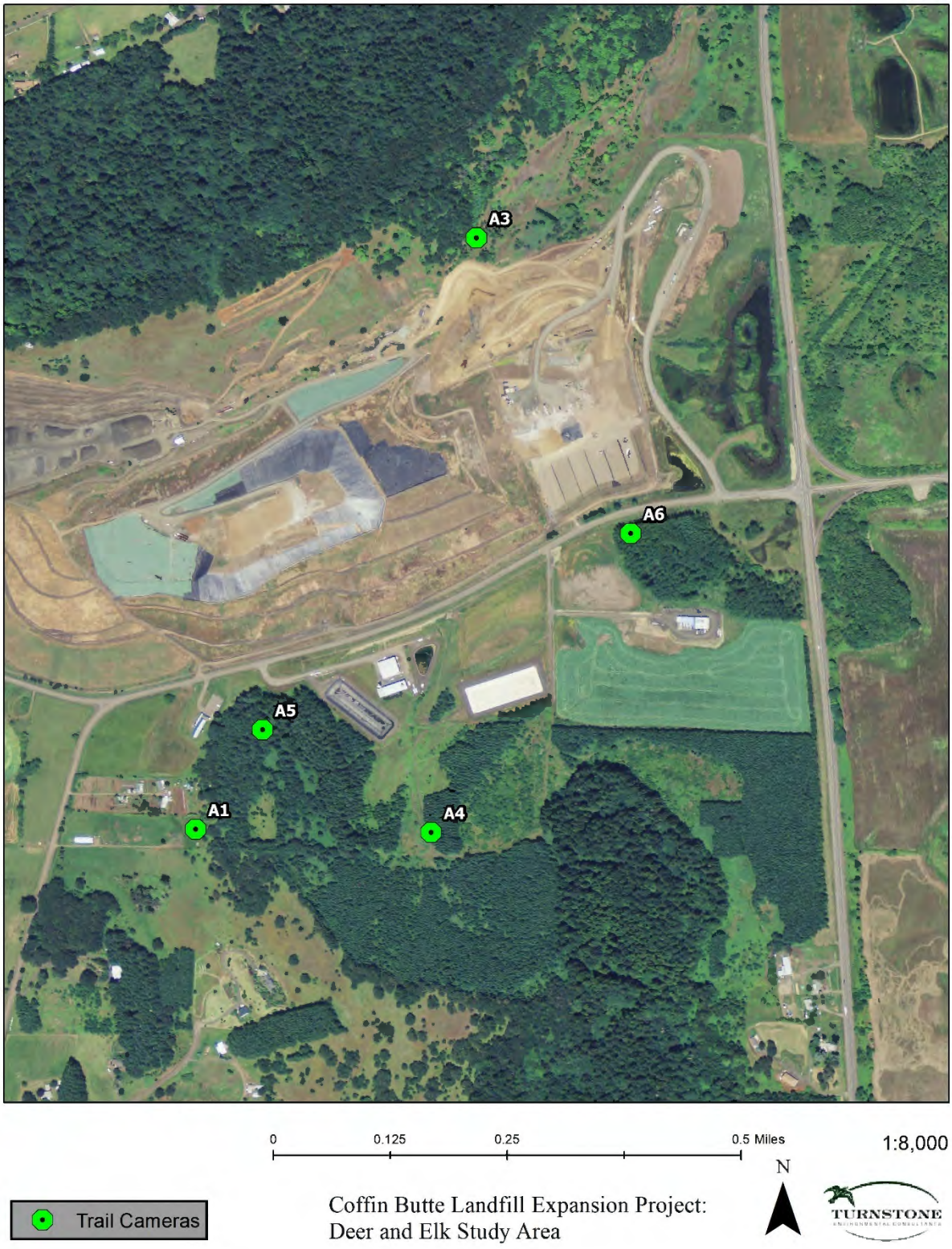


Figure 5. Trail Camera Locations in the Coffin Butte Landfill Expansion Project Study Area

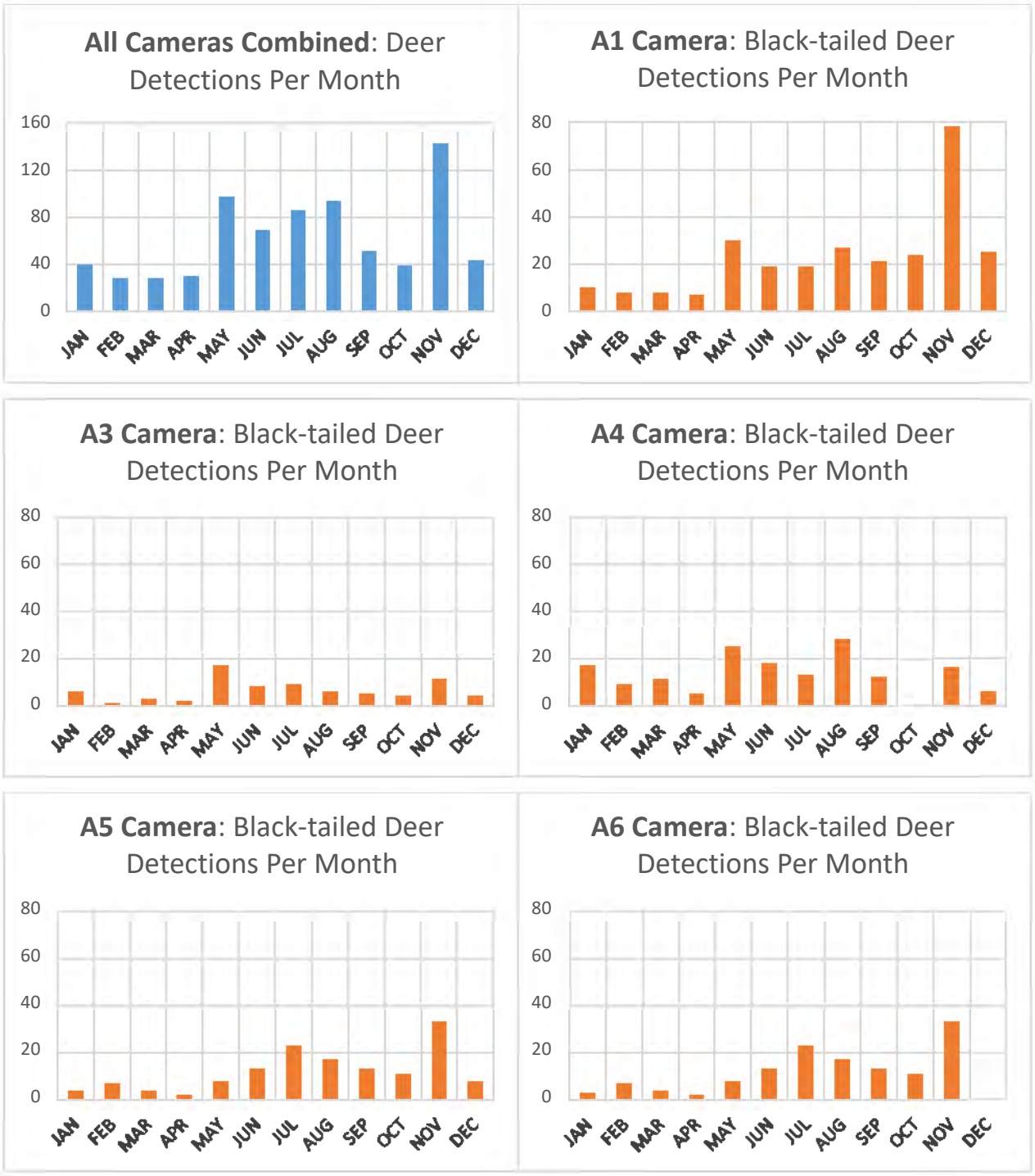


Figure 6. Black-tailed Deer Detections Per Month at Each Trail Camera

Table 12. Detections for Each Mammal Species Observed in the Camera Study Area

Common Name	A-1	A-3	A-4	A-5	A-6	Totals
Black-tailed deer	276	76	160	143	134	789
Bobcat	1	-	-	-	1	2
Cougar	1	-	1	-	-	2
Coyote	5	3	3	7	6	24
Elk	-	-	12	-	2	14
Raccoon	1	-	-	2	1	4
Skunk	-	-	-	-	3	3
All mammal species	283	80	176	152	148	838

A single cow and calf elk twosome were detected in late August and early September on Camera A-1 and A-4. A herd of elk were detected in mid-November during an 11-day period, numbering approximately 10 adults and 6 young of the year. A large herd of elk, numbering around 46 individuals visited the young coniferous forest stand in which Camera A-4 is placed for a 2-day period in early January.

The trail camera monitoring confirms the Coffin Butte study area is considered year-round habitat for black-tailed deer and peripheral habitat for elk and other large mammal species. This deer and elk habitat within the Coffin Butte Study Area provides cover and forage, that is likely important but not essential for resident and migratory deer and elk populations.



Figure 7. Large Mammals (excluding deer) Observed on Trail Cameras

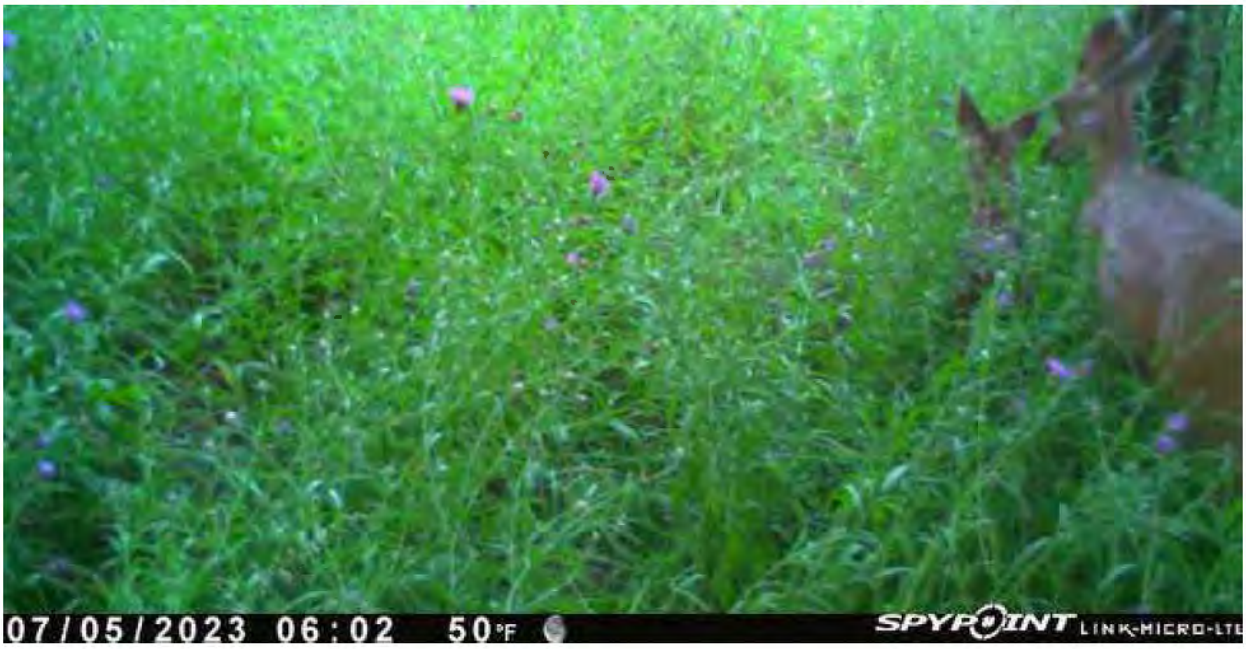


Figure 8. Adult Female Black-tailed Deer with Young of the Year in July on Camera A-1



Figure 9. A herd of elk in the Young Coniferous Forest in Mid-November on Camera A-4



Figure 10. Adult Male black-tailed Deer on Camera A-5 on an August Morning

APPENDIX A: AVIAN MONITORING PLAN



Photo credit: S. James

Final:

Avian Monitoring Plan

for Coffin Butte Landfill Expansion Project Area

Submitted to:

Civil & Environmental Consultants, Inc.
4045 NW 64th Street, Suite 415
OK City, OK 73116

Submitted by:

Turnstone Environmental Consultants, I
PO Box 83362
Portland, OR 97283

Date:

April 14, 2022

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INTRODUCTION

Turnstone Environmental Consultants, Inc. (Turnstone) proposes to conduct surveys for protected avian species within the Coffin Butte Landfill Expansion Project Area (Project Area) located in Benton County. Turnstone conducted a habitat assessment for the presence of protected bird species' habitat within the Project Area and found nesting habitat for the great blue heron (*Ardea herodias*) and foraging habitat for the bald eagle (*Haliaeetus leucocephalus*). Bald eagles are protected under the federal 1940 Bald Eagle Protection Act (16 USC 668–668d) and Heron rookeries are protected under the Oregon Forest Practices Act ("FPA"; OAR 629-665-0120). This monitoring plan details the species-specific survey methods for great blue herons and bald eagles which are known or suspected to occur within the Project Area.

HABITAT ASSESSMENT

Turnstone ecologist Stephanie James visited the western great blue heron rookery (#2683) and potential grassland bird habitat covering the closed landfill cells with wildlife biologists Anne Mary Myers and Gregory Reed from the Oregon Department of Fish and Wildlife (ODFW) in January 2022 to assess the likelihood of protected bird species using the Project Area as habitat. Weather conditions were agreeable to observing the nest sites, with no rain or fog to impede visibility.

ODFW biologists determined the potential grassland habitat and rock quarry areas north of Coffin Butte Road are not likely to be used as nesting habitat by protected grassland birds, specifically the streaked horned lark (*Eremophila alpestris strigata*) and Oregon vesper sparrow (*Pooecetes gramineus ssp. affinis*); therefore, surveys for grassland birds will not be needed.

Bald eagles were observed soaring and foraging in the Project Area. The bald eagle uses the Project Area as foraging habitat; however, it is unlikely bald eagles use the Project Area as nesting habitat.

Great blue herons likely use the western rookery (#2683) as nesting habitat. James and the ODFW wildlife biologists accessed the western rookery on foot and observed 24 stick nests in 17 nest trees. James documented the likely use of the eastern rookery (#2716) in October 2021 noting the signs of recent use such as the presence of stick nests with whitewash below. In January 2022, James observed 11 stick nests in 9 trees at the eastern rookery.

Monitoring Great blue heron nests could be accomplished from an observation point outside the forest stand and at least 150 feet from the closest nest, where there is low risk of disturbing or disrupting nesting (Figure 1).

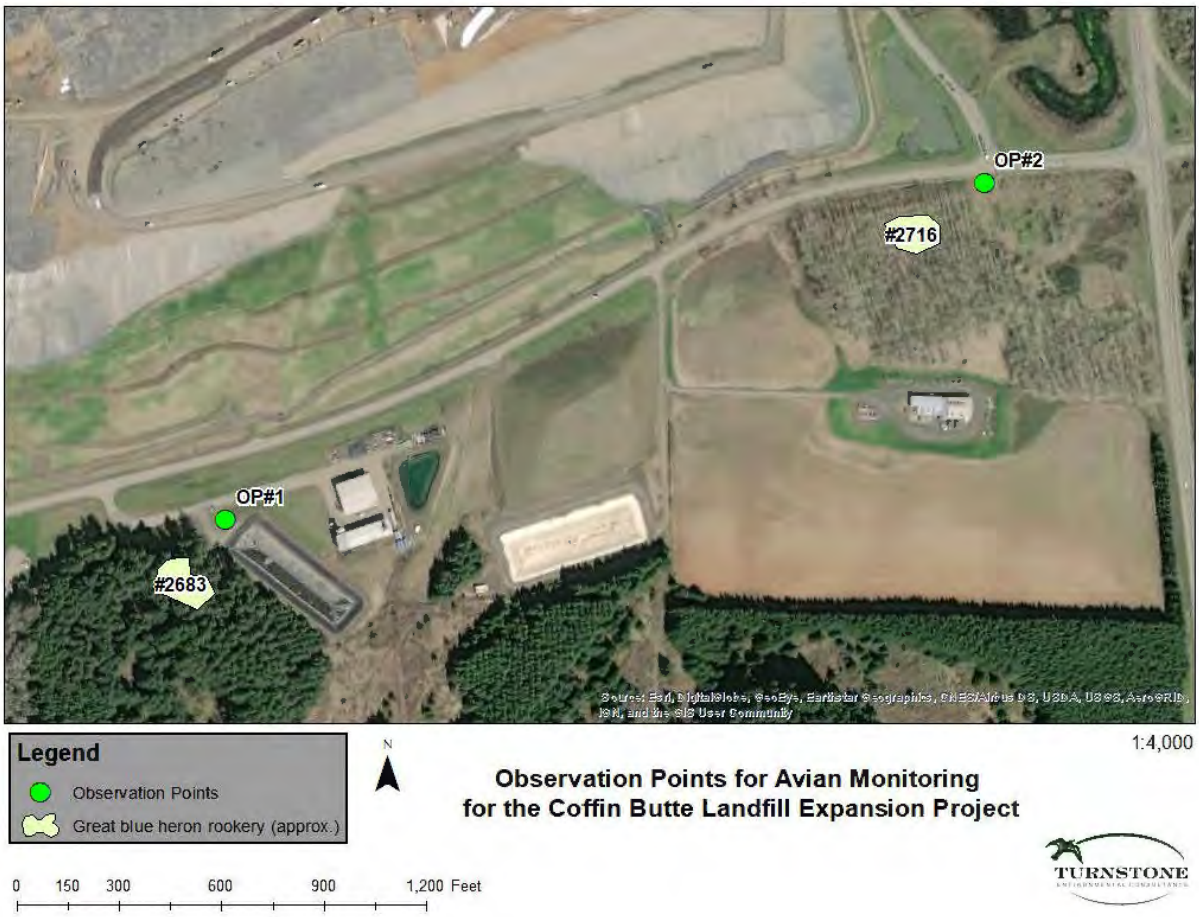


Figure 1. Observation Points for Avian Monitoring

SPECIES-SPECIFIC STUDIES

Great Blue Heron

Turnstone biologists will assess the extent of each rookery and conduct surveys during the breeding season. Mapping the extent of key components of each rookery will include the drip line of trees with stick nests and perching, fledgling, and replacement trees plus a forested buffer area as described in Forest Practice Rules.

Survey Schedule

In 2022, Turnstone will install one observation point for each of the two great blue heron rookeries. Turnstone will survey the two known sites for heron nesting, when heron court and initiate their breeding season and into the egg laying/incubation breeding stage. Turnstone biologists will assess the current nesting status of the known sites by conducting at surveys once per month during the breeding season. Turnstone recommends surveying the two known sites for occupancy and breeding status by conducting five survey visits during the breeding season (February 15 to Aug 15).

Survey Methodology

Surveys for the great blue heron will include estimating the number of occupied nests and breeding success, if possible, at the two known rookery sites located within the Project Area.

Biologists will survey each of the two rookeries to assess the current occupancy status. At the western rookery (#2683), biologists will monitor as many of the 24 great blue heron nests as possible from a single observation point (OP#1). Biologists will also determine breeding status for as many as possible of the 24 nests and any newly constructed nests. At the eastern rookery (#2716), biologists will monitor as many of the 11 great blue heron nests as possible from a single observation point (OP#2). Biologists will also determine breeding status for as many as possible of the 11 known nests and any newly constructed nests.

Table 1. Survey Visit Timing and Great Blue Heron Nesting Stages

Visit #	Date	Nesting Stage	Information Collected
1	February 15 to March 15	Nest building	Mapping and photographing each nest visible from the observation point at each rookery, noting if it is active or inactive, and noting any human disturbances and heron response during the observation period
2	March 15 to April 15	Egg laying/ Incubation	Mapping any new nests, recording active/inactive status for each visible nest, and noting any human disturbances and heron response during the observation period
3	April 15 to May 15	Incubation/Nestling	Recording active/inactive status and juvenile presence for each visible nest, and noting any human disturbances and heron response during the observation period
4	May 15 to June 15	Nestling/Fledgling	Recording active/inactive status and juvenile presence for each visible nest, and noting any human disturbances and heron response during the observation period
5	June 15 to July 15	Fledgling	Recording active/inactive status and juvenile presence for each visible nest, and noting any human disturbances and heron response during the observation period

Visit #	Date	Nesting Stage	Information Collected
6	July 15 to August 15	Fledgling	Recording active/inactive status and juvenile presence for each visible nest, and noting any human disturbances and heron response during the observation period

During each visit, surveyors would observe each heron nesting site for a 2-hour observation period during daylight hours when weather conditions are mild. Biologists will note any key components associated with a nest site, such as perching trees, fledging trees, and replacement nest trees, by observing herons use during visits.

A heron nest would be considered active if it has known or inferred presence of a mated pair as indicated by observance of at least one of the following activity patterns:

- Two adult herons are present on or near a nest, which has recently been repaired with fresh sticks (clean breaks) or fresh boughs on top, and/or having droppings and/or molted feathers on its rim or the ground underneath
- One adult heron is sitting low in the nest, presumably incubating
- Adult observed feeding young
- Eggs are present
- Young in nest or fledglings are present, by audio or visual detection

A heron nest would be considered unoccupied for the year if no presence activity (as described above) is observed during all five visits. If activity is observed initially but then no activity is observed for three consecutive visits the rookery would be considered active, but the nest failed.

Bald Eagle Surveys

Bald eagles are known to forage at the Coffin Butte landfill site; however, there are no known nest sites in or adjacent to the Project Area. Turnstone recommends surveying from a prominent point for a 2-hour observation period during daylight hours during the following survey windows. Additionally, the landfill site will be surveyed for bald eagle usage to determine if they are nesting, roosting, and/or foraging in the vicinity during nesting season which starts in February.

Table 2. Survey Timing for Bald Eagle Monitoring

Visit #	Date	Information Collected
1	February 15 to March 15	Record bald eagle activity within project area
2	March 15 to April 15	Record bald eagle activity within project area
3	April 15 to May 15	Record bald eagle activity within project area

Visit #	Date	Information Collected
4	May 15 to June 15	Record bald eagle activity within project area
5	June 15 to July 15	Record bald eagle activity within project area

Survey Methods

Turnstone biologists will assess the use of the Project Area as foraging habitat for bald eagles by observing their behavior from one of the two observation points (Figure 1) for a 2-hour observation period during daylight hours, concurrent with great blue heron observation period. During each visit, surveyors will record the greatest number of bald eagle adults and the greatest number of bald eagle juveniles seen at one time during the observation period.

If a new bald eagle nest is observed in or adjacent to the Project Area, then Turnstone biologists will assess the current nesting status of the bald eagle sites. This would be accomplished by conducting four-hour visits one per month between March 1 and July 15, coinciding with the primary nest initiation and young rearing periods, and from a vantage point using scope and binoculars that do not disturb eagles during suitable observation conditions.

Reporting

Within 4 weeks of the survey completion, Turnstone will submit a field survey technical memorandum that includes the survey methods, results, and mapping that depicts complete survey area and results. Turnstone will submit detection location information in GIS format within 2 weeks of completion and in a technical memo, which also documents the survey approach, protocols, and mapped results within 4 weeks of completion.

APPENDIX B: COMMUNICATIONS WITH ODFW AND ODF WILDLIFE BIOLOGISTS

From:	WEIKEL Jennifer * ODF
To:	Stephanie James; REED Gregory C * ODFW
Cc:	AnneMary Myers
Subject:	RE: Coffin Butte site visit
Date:	Wednesday, March 16, 2022 12:00:04 PM
Attachments:	CB_monitoring_plan_2022-03-02 - ODF edits.docx

Looks good Stephanie. I only have one comment in the document.

Your plan would exceed what we'd need for any Forest Practices-related issues. If you find that one of the rookeries is not active in 2022, I would recommend at least two additional years of surveys. If we have three consecutive years surveys with no nesting, we can change the status of that rookery to abandoned under the FPA.

Jennifer Weikel
Wildlife Biologist, Forest Resources Division
Oregon Department of Forestry
jennifer.weikel@odf.oregon.gov

From: Stephanie James <stephanie@turnstoneenvironmental.com>
Sent: Wednesday, March 02, 2022 2:59 PM
To: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>
Cc: AnneMary Myers <AnneMary.Myers@state.or.us>; WEIKEL Jennifer * ODF <Jennifer.WEIKEL@odf.oregon.gov>
Subject: RE: Coffin Butte site visit

Greetings,

Greg and Jennifer R – Thank you for reviewing and providing input. This draft monitoring plan includes responses to your comments/edits. Turnstone is currently under contract to survey for 2022 only. However, the plan at this point is to conduct surveys each year indefinitely.

Jennifer W – Please review the attached monitoring plan for the Coffin Butte Landfill Expansion project.

Thanks,
Stephanie

Stephanie A. James - Environmental Scientist
Turnstone Environmental Consultants, Inc.
(503) 283-5338 x103

From: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>

Sent: Wednesday, February 23, 2022 5:12 PM
To: Stephanie James <stephanie@turnstoneenvironmental.com>
Cc: AnneMary Myers <AnneMary.Myers@state.or.us>
Subject: RE: Coffin Butte site visit

Hi Stephanie,

Thanks for sending the survey plan. Overall, I think the plan looks good. We made a few edits and asked a few questions with track changes. Our manager, Jennifer Ringo, also added some suggestions throughout. We were also curious how many years the surveys are planned?

If you haven't done so already, I would also recommend coordinating with ODF's private lands wildlife biologist, Jennifer Weikel (jennifer.weikel@odf.oregon.gov) or the Stewardship Forester for this area. They would probably have some guidance on what would be deemed an inactive or unoccupied rookery based on the FPA rules. Let us know if there are any follow up questions or clarifications needed.

Best,

Greg Reed
District Wildlife Biologist
Oregon Department of Fish and Wildlife
7118 NE Vandenberg Ave
Corvallis, OR 97330
Office: 541-757-5226
Cell: 541-961-6381

My email address has changed to: gregory.c.reed@odfw.oregon.gov

From: Stephanie James <stephanie@turnstoneenvironmental.com>
Sent: Wednesday, February 16, 2022 6:53 AM
To: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>
Cc: AnneMary Myers <AnneMary.Myers@state.or.us>
Subject: RE: Coffin Butte site visit

Hi Greg and Anne Mary,

Please find attached a survey plan for the Coffin Butte Expansion Project. Let us know if there are any modifications needed. We plan to conduct the first surveys in early March.

Thanks,
Stephanie

Stephanie A. James - Environmental Scientist
Turnstone Environmental Consultants, Inc.
(503) 283-5338 x103

From: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>
Sent: Wednesday, January 19, 2022 11:44 AM
To: Stephanie James <stephanie@turnstoneenvironmental.com>
Subject: RE: Coffin Butte site visit

Sounds good. I assume we will just meet at the main office building for the Coffin Butte?

From: Stephanie James <stephanie@turnstoneenvironmental.com>
Sent: Wednesday, January 19, 2022 11:35 AM
To: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>
Subject: RE: Coffin Butte site visit

That would be great to have Anne Mary join. Wednesday at 1pm works for me. I'll make sure that we have a decent path for accessing the western rookery. Please be ready to encounter lots of poison oak!

Stephanie A. James - Environmental Scientist
Turnstone Environmental Consultants, Inc.
(503) 283-5338 x103

From: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>
Sent: Wednesday, January 19, 2022 11:31 AM
To: Stephanie James <stephanie@turnstoneenvironmental.com>
Subject: RE: Coffin Butte site visit

Does 1 pm on Wed work for you? I would also like the Assistant District Wildlife Biologist, Anne Mary Myers, to come along, if that is alright? Previously, she was ODFW's Grasslands Biologist, so she is a great asset if we are going to look at grassland bird habitat.

-Greg

From: Stephanie James <stephanie@turnstoneenvironmental.com>
Sent: Wednesday, January 19, 2022 11:14 AM
To: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>
Subject: RE: Coffin Butte site visit

Hi Greg –

Wednesday or Thursday next week would work for me. I would like to access the western GBHE rookery in the conifers on Poison Oak Hill, and then also look at potential grassland bird habitat (SHLA and VESP) on some of the closed landfill cells north of Coffin Butte road. It shouldn't take more than 2 hours.

Also, please let me know if ODFW can release the location(s) of any other GBHE rookeries in the area.

Thanks,
Stephanie

Stephanie A. James - Environmental Scientist
Turnstone Environmental Consultants, Inc.
(503) 283-5338 x103

From: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>
Sent: Wednesday, January 19, 2022 11:02 AM
To: Stephanie James <stephanie@turnstoneenvironmental.com>
Subject: RE: Coffin Butte site visit

Hi Stephanie,

Sorry for not getting back to you. I would be happy to meet with you next week. What are you wanting to look at on the site visit? I am available Tues afternoon, and most of Wed-Fri next week. There is a very small chance we will start our elk helicopter surveys next week, which would limit my availability.

Thanks,

Greg Reed
District Wildlife Biologist
Oregon Department of Fish and Wildlife
7118 NE Vandenberg Ave
Corvallis, OR 97330
Office: 541-757-5226
Cell: 541-961-6381

My email address has changed to: gregory.c.reed@odfw.oregon.gov

From: Stephanie James <stephanie@turnstoneenvironmental.com>

Sent: Wednesday, January 19, 2022 10:48 AM
To: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>
Subject: RE: Coffin Butte site visit

Hi Greg – Please let me know if you're available for a site visit next week.

Thanks,
Stephanie

Stephanie A. James - Environmental Scientist
Turnstone Environmental Consultants, Inc.
(503) 283-5338 x103

From: Stephanie James
Sent: Monday, January 17, 2022 10:35 AM
To: Gregory.C.Reed@odfw.oregon.gov
Subject: Coffin Butte site visit

Hi Greg,

Are you available the week of January 24 to visit the GBH rookeries at the Coffin Butte site?

Stephanie A. James - Environmental Scientist
Turnstone Environmental Consultants, Inc.
(503) 283-5338 x103

APPENDIX C: FIELD FORMS

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 02/22/2024 **Visit No:** 1 **Previous Visit Date: N/A**

Arrival Time: 07:45 **Departure Time:** 09:45

Observers: Sarah McCord

Weather: Partly cloudy, dry, calm

Comments: No GBHE observed in the rookery during survey. One RTHA seen in and around the nests, calling and perched, likely using stand for nesting.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 04/04/2024 **Visit No:** 2 **Previous Visit Date:** 02/22/2024

Arrival Time: 07:47 **Departure Time:** 09:47

Observers: Sarah McCord

Weather: Overcast, dry, calm

Comments: RTHA in the stand. No heron activity.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 04/19/2024 **Visit No:** 3 **Previous Visit Date:** 04/04/2024

Arrival Time: 12:46 **Departure Time:** 14:46

Observers: Sarah McCord

Weather: Breezy, dry, clear

Comments: No GBHE observed in the rookery during survey.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 05/30/2024 **Visit No:** 4 **Previous Visit Date:** 04/19/2024

Arrival Time: 07:56 **Departure Time:** 09:56

Observers: Sarah McCord

Weather: Breezy, scattered clouds, dry

Comments: Two adult BAEA, three sub-adult BAEA, and two adult RTHA in the stand. No heron activity.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 05/30/2024 **Visit No:** 5 **Previous Visit Date:** 04/19/2024

Arrival Time: 06:52 **Departure Time:** 08:52

Observers: Sarah McCord

Weather: Breezy, scattered clouds, dry

Comments: Two juvenile BAEA in stand upon arrival. Two STJA juveniles begging and being fed by adult. No herons.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 7/11/2024 **No. of Visits:** 5

Observers: S. McCord

Weather: Surveys conditions were calm and dry or with light precipitation

GPS Coordinates: 44.6988, -123.2235

Comments: No GBHE observed in the rookery. 6th survey is planned to occur between July 15 and August 15, 2024, and will be included in an addendum report.

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				1st Visit Date: 02/22/2024			2nd Visit Date: 04/04/2024			3rd Visit Date: 04/19/2024					Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young			
OB1	A	1	70%												INACTIVE
OB1	A	2	55%												INACTIVE
OB1	B	3	65%												INACTIVE
OB1	C	4	80%												INACTIVE
OB1	C	5	55%												INACTIVE
OB1	D	6	70%												INACTIVE
OB1	E	7	60%												INACTIVE
OB1	F	8	55%												INACTIVE
OB1	G	9	45%												INACTIVE
OB1	H	10	85%												INACTIVE

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - West **Colony Code:** #2683
Date: 7/11/2024 **No. of Visits:** 5
Observers: S. McCord
Weather: Surveys conditions were calm and dry or with light precipitation
GPS Coordinates: 44.6988, -123.2235
Comments:

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				4th Visit Date: 05/30/2024			5th Visit Date: 6/28/24			6th Visit Date:			Nest Success Summary		Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Y/N	No. Fledged	
OB1	A	1	70%												INACTIVE
OB1	A	2	55%												INACTIVE
OB1	B	3	65%												INACTIVE
OB1	C	4	80%												INACTIVE
OB1	C	5	55%												INACTIVE
OB1	D	6	70%												INACTIVE
OB1	E	7	60%												INACTIVE
OB1	F	8	55%												INACTIVE
OB1	G	9	45%												INACTIVE
OB1	H	10	85%												INACTIVE

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 02/22/2024 **Visit No:** 1 **Previous Visit Date:** N/A

Arrival Time: 09:48 **Departure Time:** 11:48

Observers: Sarah McCord

Weather: Partly cloudy, dry, calm

Comments: 13 stick nests observed with no GBHE.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N						
OB2	B	2	45%	N						
OB2	C	3	70%	N						
OB2	D	4	65%	N						
OB2	B	5	60%	N						
OB2	E	6	60%	N						
OB2	F	7	60%	N						
OB2	F	8	0%	N						Nest missing from tree
OB2	G	9	55%	N						
OB2	G	10	50%	N						
OB2	H	11	60%	N						
OB2	I	12	55%	N						
OB2	J	13	45%	N						
OB2	K	14	60%	N						

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 04/04/2024 **Visit No:** 2 **Previous Visit Date:** 02/22/2024

Arrival Time: 09:50 **Departure Time:** 11:50

Observers: Sarah McCord

Weather: overcast, dry, calm

Comments: Songbirds observed. No heron activity.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N						
OB2	B	2	45%	N						
OB2	C	3	70%	N						
OB2	D	4	65%	N						
OB2	B	5	60%	N						
OB2	E	6	60%	N						
OB2	F	7	60%	N						
OB2	F	8	0%	N						Nest missing from tree
OB2	G	9	55%	N						
OB2	G	10	50%	N						
OB2	H	11	60%	N						
OB2	I	12	55%	N						
OB2	J	13	45%	N						
OB2	K	14	60%	N						

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 04/19/2024 **Visit No:** 3 **Previous Visit Date:** 04/04/2024

Arrival Time: 10:44 **Departure Time:** 12:44

Observers: Sarah McCord

Weather: Clear, dry, breezy

Comments: No herons, only songbirds observed.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N						
OB2	B	2	45%	N						
OB2	C	3	70%	N						
OB2	D	4	65%	N						
OB2	B	5	60%	N						
OB2	E	6	60%	N						
OB2	F	7	60%	N						
OB2	F	8	0%	N						Nest missing from tree
OB2	G	9	55%	N						
OB2	G	10	50%	N						
OB2	H	11	60%	N						
OB2	I	12	55%	N						
OB2	J	13	45%	N						
OB2	K	14	60%	N						

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 05/30/2024 **Visit No:** 4 **Previous Visit Date:** 04/19/2024

Arrival Time: 10:00 **Departure Time:** 12:00

Observers: Sarah McCord

Weather: Scattered clouds, dry, breezy

Comments: No herons observed.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N						
OB2	B	2	45%	N						
OB2	C	3	70%	N						
OB2	D	4	65%	N						
OB2	B	5	60%	N						
OB2	E	6	60%	N						
OB2	F	7	60%	N						
OB2	F	8	0%	N						Nest missing from tree
OB2	G	9	55%	N						
OB2	G	10	50%	N						
OB2	H	11	60%	N						
OB2	I	12	55%	N						
OB2	J	13	45%	N						
OB2	K	14	60%	N						

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 06/28/2024 **Visit No:** 5 **Previous Visit Date:** 05/30/2024

Arrival Time: 09:00 **Departure Time:** 11:00

Observers: Sarah McCord

Weather: Scattered clouds, dry, breezy

Comments: No herons observed, only songbirds

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N						
OB2	B	2	45%	N						
OB2	C	3	70%	N						
OB2	D	4	65%	N						
OB2	B	5	60%	N						
OB2	E	6	60%	N						
OB2	F	7	60%	N						
OB2	F	8	0%	N						Nest missing from tree
OB2	G	9	55%	N						
OB2	G	10	50%	N						
OB2	H	11	60%	N						
OB2	I	12	55%	N						
OB2	J	13	45%	N						
OB2	K	14	60%	N						

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 7/11/2024 **No. of Visits:** 5

Observers: S. McCord

Weather: Surveys conditions were dry and calm or breezy

GPS Coordinates: 44.6959, -123.2316

Comments: No GBHE observed in the stand.. STJA, RTHA and BAEA were observed in the stand. The final 6th survey will occur between July 15 and August 15, 2024.

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				1st Visit Date: 02/22/2024			2nd Visit Date: 03/31/2023			3rd Visit Date: 04/19/2024					Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young			
OB2	A	1	50%												INACTIVE
OB2	B	2	45%												INACTIVE
OB2	C	3	70%												INACTIVE
OB2	D	4	65%												INACTIVE
OB2	B	5	60%												INACTIVE
OB2	E	6	60%												INACTIVE
OB2	F	7	60%												INACTIVE
OB2	F	8	0%												Nest missing
OB2	G	9	55%												INACTIVE
OB2	G	10	50%												INACTIVE
OB2	H	11	60%												INACTIVE
OB2	I	12	55%												INACTIVE
OB2	J	13	45%												INACTIVE
OB2	E	14	60%												INACTIVE.

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - East **Colony Code:** #2716
Date: 7/11/2024 **No. of Visits:** 5
Observers: S. McCord
Weather: Surveys conditions were dry and calm or breezy
GPS Coordinates: 44.6959, -123.2316
Comments:

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				4th Visit Date: 05/30/2024			5th Visit Date: 6/28/24			6th Visit Date:			Nest Success Summary		Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Y/N	No. Fledged	
OB2	A	1	50%												INACTIVE
OB2	B	2	45%												INACTIVE
OB2	C	3	70%												INACTIVE
OB2	D	4	65%												INACTIVE
OB2	B	5	60%												INACTIVE
OB2	E	6	60%												INACTIVE
OB2	F	7	60%												Nest missing
OB2	F	8	0%												INACTIVE
OB2	G	9	55%												INACTIVE
OB2	G	10	50%												INACTIVE
OB2	H	11	60%												INACTIVE
OB2	I	12	55%												INACTIVE
OB2	J	13	45%												INACTIVE
OB2	E	14	60%												INACTIVE

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 03/01/2023 **Visit No:** 1 **Previous Visit Date:**

Arrival Time: 10:25 **Departure Time:** 12:25

Observers: Stephanie James, Sarah McCord

Weather: Partly cloudy, dry, calm

Comments: No GBHE observed in the rookery during survey. On separate occasions, 1 COHA, 2 RTHA adults, 1 BAEA juv, and 2 BAEA adults visited the rookery.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 03/31/2023 **Visit No:** 2 **Previous Visit Date:** 03/01/2023

Arrival Time: 10:37 **Departure Time:** 12:37

Observers: Sarah McCord

Weather: Overcast, drizzling rain, calm

Comments: No GBHE observed in the rookery during survey. On separate occasions, 2 RTHA adults, 2 BAEA juv, and 1 BAEA adult visited the rookery.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 05/05/2023 **Visit No:** 3 **Previous Visit Date:** 03/31/2023

Arrival Time: 11:05 **Departure Time:** 13:05

Observers: Sarah McCord

Weather: Breezy, scattered clouds, dry until last 45 mins then misty rain

Comments: Ravens. RTHA pair begging and chatting, keeping close watch on me and escorting ravens away from stand. Coopers hawk fly-over.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 05/19/2023 **Visit No:** 4 **Previous Visit Date:** 05/05/2023

Arrival Time: 08:13 **Departure Time:** 10:13

Observers: Sarah McCord

Weather: Breezy, scattered clouds, dry

Comments: No GBHE observed in the rookery during survey. RTHA pair in stand, calling, chasing off other birds and scolding me for my presence.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 06/16/2023 **Visit No:** 5 **Previous Visit Date:** 05/19/2023

Arrival Time: 08:47 **Departure Time:** 10:47

Observers: Sarah McCord

Weather: Breezy, scattered clouds, dry

Comments: No GBHE observed in the rookery during survey. RTHA screaming soft raspy but not a juv, pair responses, may be on nest.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 07/21/2023 **Visit No:** 6 **Previous Visit Date:** 06/16/2023

Arrival Time: 08:35 **Departure Time:** 10:35

Observers: Sarah McCord

Weather: calm, clear, dry

Comments: No GBHE observed in the rookery during survey. RTHA present and calling in stand, vultures and small birds.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 3/24/2023 **No. of Visits:** 6

Observers: S. James, S. McCord

Weather: Surveys conditions were calm and dry or with light precipitation

GPS Coordinates: 44.6988, -123.2235

Comments: No GBHE observed in the rookery site. RTHA are likely nesting in an abandoned stick nest within the rookery site.

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				1st Visit Date: 03/01/2023			2nd Visit Date: 03/31/2023			3rd Visit Date: 05/05/2023					Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young			
OB1	A	1	70%												INACTIVE
OB1	A	2	55%												INACTIVE
OB1	B	3	65%												INACTIVE
OB1	C	4	80%												INACTIVE
OB1	C	5	55%												INACTIVE
OB1	D	6	70%												INACTIVE
OB1	E	7	60%												INACTIVE
OB1	F	8	55%												INACTIVE
OB1	G	9	45%												INACTIVE
OB1	H	10	85%												INACTIVE

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 3/24/2023 **No. of Visits:** 6

Observers: S. James, S. McCord

Weather: Surveys conditions were calm and dry or with light precipitation

GPS Coordinates: 44.6988, -123.2235

Comments:

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				4th Visit Date: 05/19/2023			5th Visit Date: 6/16/23			6th Visit Date: 07/21/2023			Nest Success Summary		Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Y/N	No. Fledged	
OB1	A	1	70%												INACTIVE
OB1	A	2	55%												INACTIVE
OB1	B	3	65%												INACTIVE
OB1	C	4	80%												INACTIVE
OB1	C	5	55%												INACTIVE
OB1	D	6	70%												INACTIVE
OB1	E	7	60%												INACTIVE
OB1	F	8	55%												INACTIVE
OB1	G	9	45%												INACTIVE
OB1	H	10	85%												INACTIVE

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 03/01/2023 **Visit No:** 1 **Previous Visit Date:**

Arrival Time: 08:15 **Departure Time:** 10:15

Observers: Stephanie James, Sarah McCord

Weather: Partly cloudy, dry, calm

Comments: 14 stick nests observed with no GBHE. One nest is likely occupied by a breeding pair of RTHA, one of which was stilling low in Nest #6.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N						
OB2	B	2	45%	N						
OB2	C	3	70%	N						
OB2	D	4	65%	N						
OB2	B	5	60%	N						
OB2	E	6	60%	Y		2	0		1AS, EX, ASN	RTHA nesting, defending
OB2	F	7	60%	N						
OB2	F	8	0%	N						Nest missing from tree
OB2	G	9	55%	N						
OB2	G	10	50%	N						
OB2	H	11	60%	N						
OB2	I	12	0%	N						
OB2	J	13	0%	N						
OB2	K	14	0%	N						

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 03/31/2023 **Visit No:** 2 **Previous Visit Date:** 03/01/2023

Arrival Time: 08:32 **Departure Time:** 10:32

Observers: Sarah McCord

Weather: Overcast, drizzling rain, calm

Comments: 14 stick nests observed with no GBHE. One nest is likely occupied by a breeding pair of RTHA

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N						
OB2	B	2	45%	N						
OB2	C	3	70%	N						
OB2	D	4	65%	N						
OB2	B	5	60%	N						
OB2	E	6	60%	Y		2	0		ASN	RTHA nesting, defending
OB2	F	7	60%	N						
OB2	F	8	0%	N						Nest missing from tree
OB2	G	9	55%	N						
OB2	G	10	50%	N						
OB2	H	11	60%	N						
OB2	I	12	0%	N						
OB2	J	13	0%	N						
OB2	K	14	0%	N						

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 05/05/2023 **Visit No:** 3 **Previous Visit Date:** 03/31/2023

Arrival Time: 08:20 **Departure Time:** 10:28

Observers: Sarah McCord

Weather: Breezy, scattered clouds, dry

Comments: No GBHE observed in the rookery during survey. Turkey vulture and ravens soaring above stand.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 05/19/2023 **Visit No:** 4 **Previous Visit Date:** 05/05/2023

Arrival Time: 10:20 **Departure Time:** 12:20

Observers: Sarah McCord

Weather: Breezy, scattered clouds, dry

Comments: No GBHE observed in the rookery during survey. 1 adult BAEA chased out of stand by blackbird. 1 J BAEA perched in stand before flying back to landfill. 1 GBHE fly-over.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 06/16/2023 **Visit No:** 5 **Previous Visit Date:** 05/19/2023

Arrival Time: 10:49 **Departure Time:** 12:49

Observers: Sarah McCord

Weather: Breezy, clear, dry

Comments: No GBHE observed in the rookery during survey. Vultures and small birds, one GBHE fly-by headed to field to the west.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 07/21/2023 **Visit No:** 6 **Previous Visit Date:** 06/16/2023

Arrival Time: 10:40 **Departure Time:** 12:40

Observers: Sarah McCord

Weather: Breezy, clear, dry

Comments: No GBHE observed in the rookery during survey. Vultures and small birds, large group of ravens circling landfill.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - East **Colony Code:** #2716
Date: 3/24/2023 **No. of Visits:** 6
Observers: S. James, S. McCord
Weather: Surveys conditions were calm and dry or with light precipitation
GPS Coordinates: 44.6959, -123.2316
Comments: No GBHE adults observed, RTHA defending and sitting low in Nest #6

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				1st Visit Date: 03/01/2023			2nd Visit Date: 03/31/2023			3rd Visit Date: 05/05/2023					Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young			
OB2	A	1	50%												INACTIVE
OB2	B	2	45%												INACTIVE
OB2	C	3	70%												INACTIVE
OB2	D	4	65%												INACTIVE
OB2	B	5	60%												INACTIVE
OB2	E	6	60%	STD	0										RTHA nesting
OB2	F	7	60%												INACTIVE
OB2	F	8	0%												Nest missing
OB2	G	9	55%												INACTIVE
OB2	G	10	50%												INACTIVE
OB2	H	11	60%												INACTIVE
OB2	I	12	55%												INACTIVE
OB2	J	13	45%												INACTIVE
OB2	E	14	60%												INACTIVE.

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - East **Colony Code:** #2716
Date: 3/24/2023 **No. of Visits:** 6
Observers: S. James, S. McCord
Weather: Surveys conditions were calm and dry or with light precipitation
GPS Coordinates: 44.6959, -123.2316
Comments:

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				4th Visit Date: 05/19/2023			5th Visit Date: 6/16/23			6th Visit Date: 07/21/2023			Nest Success Summary		Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Y/N	No. Fledged	
OB2	A	1	50%												INACTIVE
OB2	B	2	45%												INACTIVE
OB2	C	3	70%												INACTIVE
OB2	D	4	65%												INACTIVE
OB2	B	5	60%												INACTIVE
OB2	E	6	60%												INACTIVE
OB2	F	7	60%												Nest missing
OB2	F	8	0%												INACTIVE
OB2	G	9	55%												INACTIVE
OB2	G	10	50%												INACTIVE
OB2	H	11	60%												INACTIVE
OB2	I	12	55%												INACTIVE
OB2	J	13	45%												INACTIVE
OB2	E	14	60%												INACTIVE

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 02/17/2022 **Visit No:** 1 **Previous Visit Date:**

Arrival Time: 12:51 **Departure Time:** 14:51

Observers: Stephanie James

Weather: Partly cloudy, misty, calm

Comments: No GBHE observed during survey. A RTHA adult was aggravated calling, seen flying to/from the forest stand

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 03/22/2022 **Visit No:** 2 **Previous Visit Date:** 02/17/2022

Arrival Time: 09:33 **Departure Time:** 11:33

Observers: Stephanie James

Weather: Cloudy, dry, light breeze

Comments: No GBHE observed during survey. Two RTHA adults calling from the forest stand.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 04/28/2022 **Visit No:** 3 **Previous Visit Date:** 03/22/2022

Arrival Time: 12:40 **Departure Time:** 14:40

Observers: Stephanie James

Weather: Cloudy, dry, light breeze

Comments: No GBHE observed during survey. Two RTHA adults seen and heard, likely occupying a stick nest in the rookery.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 06/01/2022 **Visit No:** 4 **Previous Visit Date:** 04/28/2022

Arrival Time: 12:27 **Departure Time:** 14:27

Observers: Stephanie James

Weather: Clear, calm, dry

Comments: No GBHE observed during survey. Two RTHA adults seen and heard, likely occupying a stick nest in the rookery.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 07/12/2022 **Visit No:** 5 **Previous Visit Date:** 06/01/2022

Arrival Time: 11:20 **Departure Time:** 13:20

Observers: Stephanie James

Weather: Clear, calm, dry

Comments: No GBHE observed during survey. Two RTHA adults seen and heard, likely occupying a stick nest in the rookery.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 08/15/2022 **Visit No:** 6 **Previous Visit Date:** 07/12/2022

Arrival Time: 18:20 **Departure Time:** 20:20

Observers: Stephanie James

Weather: Clear, calm, dry

Comments: No GBHE observed. Two juv BAEA inspected some of the stick nests. Two RTHA adults seen and heard, likely occupying a stick nest in the rookery.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 8/20/2022 **No. of Visits:** 6

Observers: S. James

Weather: Surveys conditions were calm and dry or with light pricipitation

GPS Coordinates: 44.6988, -123.2235

Comments: No GBHE observed in the rookery site. RTHA are likely nesting in an abandoned stick nest within the rookery site.

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				1st Visit Date: 02/17/2022			2nd Visit Date: 03/22/2022			3rd Visit Date: 04/28/2022					Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young			
OB1	A	1	70%												INACTIVE
OB1	A	2	55%												INACTIVE
OB1	B	3	65%												INACTIVE
OB1	C	4	80%												INACTIVE
OB1	C	5	55%												INACTIVE
OB1	D	6	70%												INACTIVE
OB1	E	7	60%												INACTIVE
OB1	F	8	55%												INACTIVE
OB1	G	9	45%												INACTIVE
OB1	H	10	85%												INACTIVE

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: **Colony Code:**

Date: 8/20/2022 **No. of Visits:** 6

Observers: S. James

Weather: Surveys conditions were calm and dry or with light pricipitation

GPS Coordinates: 44.6988, -123.2235

Comments:

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				4th Visit Date: 06/01/2022			5th Visit Date: 7/12/22			6th Visit Date: 08/15/2022			Nest Success Summary		Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Y/N	No. Fledged	
OB1	A	1	70%										N	0	INACTIVE
OB1	A	2	55%										N	0	INACTIVE
OB1	B	3	65%										N	0	INACTIVE
OB1	C	4	80%										N	0	INACTIVE
OB1	C	5	55%										N	0	INACTIVE
OB1	D	6	70%										N	0	INACTIVE
OB1	E	7	60%										N	0	INACTIVE
OB1	F	8	55%										N	0	INACTIVE
OB1	G	9	45%										N	0	INACTIVE
OB1	H	10	85%										N	0	INACTIVE

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 02/17/2022 **Visit No:** 1 **Previous Visit Date:**

Arrival Time: 10:42 **Departure Time:**12:42

Observers: Stephanie James

Weather: Partly cloudy, misty, calm

Comments: Eleven stick nests observed, one active.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	Y	STD	1	0		1AS, STICK	
OB2	B	2	45%	N						
OB2	C	3	70%	N						
OB2	D	4	65%	N						
OB2	B	5	60%	N						
OB2	E	6	60%	N						
OB2	F	7	60%	N						
OB2	F	8	50%	N						
OB2	G	9	55%	N						
OB2	G	10	50%	N						
OB2	H	11	60%	N						

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 03/22/2022 **Visit No:** 2 **Previous Visit Date:** 02/17/2022

Arrival Time: 11:39 **Departure Time:** 13:48

Observers: Stephanie James

Weather: Partly cloudy, misty, calm

Comments: Eleven stick nests observed, eleven active.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	Y	STD	1	0		1AS, STICK	
OB2	B	2	45%	Y	STD	2	0		2AS	
OB2	C	3	70%	Y	STD	1	0		1AS	
OB2	D	4	65%	Y	STD	1	0		1AS	
OB2	B	5	60%	Y	STD	3	0		2AS, ASN	
OB2	E	6	60%	Y	STD	1	0		1AS, STICK	
OB2	F	7	60%	Y	STD	2	0		1AS, ASN	
OB2	F	8	50%	Y	STD	1	0		ASN	
OB2	G	9	55%	Y	STD	2	0		1AS, ASN	
OB2	G	10	50%	Y	STD	2	0		1AS, ASN, STICK	
OB2	H	11	60%	Y	STD	1	0		1AS, STICK	

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 04/28/2022 **Visit No:** 3 **Previous Visit Date:** 03/22/2022

Arrival Time: 10:02 **Departure Time:** 12:36

Observers: Stephanie James

Weather: Partly cloudy, misty, calm

Comments: Fouteen stick nests observed, all active.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	Y	STD	1	0		1AS	
OB2	B	2	45%	Y	STD	2	0		2AS	
OB2	C	3	70%	Y	STD	1	0		1AS	
OB2	D	4	65%	Y	STD	1	0		1AS	
OB2	B	5	60%	Y	STD	3	0		2AS	
OB2	E	6	60%	Y	INC	1	0		1AS	Possibly turning eggs in nest
OB2	F	7	60%	Y	STD	2	0		1AS, ASN	
OB2	F	8	50%	Y	STD	1	0		ASN	
OB2	G	9	55%	Y	STD	2	0		1AS, ASN	
OB2	G	10	50%	Y	STD	2	0		1AS, ASN	
OB2	H	11	60%	Y	STD	1	0		1AS, STICK	
OB2	I	12	55%	Y	STD	1	0		1AS, STICK	
OB2	J	13	45%	Y	STD	1	0		1AS	
OB2	K	14	60%	Y	STD	1	0		1AS	

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 06/01/2022 **Visit No:** 4 **Previous Visit Date:** 04/28/2022

Arrival Time: 14:33 **Departure Time:** 16:38

Observers: Stephanie James

Weather: Clear, dry, calm

Comments: Four BAEA juveniles visited most of the nests, in groups of two or four. No GBHE observed during survey.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N	FN	0	0			4 Juv BAEAs visited nest
OB2	B	2	45%	N	FN	0	0			2 Juv BAEAs visited nest
OB2	C	3	70%	N	FN	0	0			2 Juv BAEAs visited nest
OB2	D	4	65%	N	FN	0	0			4 Juv BAEAs visited nest
OB2	B	5	60%	N	FN	0	0			
OB2	E	6	60%	N	FN	0	0			4 Juv BAEAs visited nest
OB2	F	7	60%	N	FN	0	0			2 Juv BAEAs visited nest
OB2	F	8	50%	N	FN	0	0			
OB2	G	9	55%	N	FN	0	0			2 Juv BAEAs visited nest
OB2	G	10	50%	N	FN	0	0			2 Juv BAEAs visited nest
OB2	H	11	60%	N	FN	0	0			
OB2	I	12	55%	N	FN	0	0			2 Juv BAEAs visited nest
OB2	J	13	45%	N	FN	0	0			2 Juv BAEAs visited nest
OB2	K	14	60%	N	FN	0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 07/12/2022 **Visit No:** 5 **Previous Visit Date:** 06/01/2022

Arrival Time: 09:08 **Departure Time:** 11:08

Observers: Stephanie James

Weather: Clear, dry, calm

Comments: No GBHE observed during survey.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N	FN	0	0			
OB2	B	2	45%	N	FN	0	0			
OB2	C	3	70%	N	FN	0	0			
OB2	D	4	65%	N	FN	0	0			
OB2	B	5	60%	N	FN	0	0			
OB2	E	6	60%	N	FN	0	0			
OB2	F	7	60%	N	FN	0	0			
OB2	F	8	50%	N	FN	0	0			
OB2	G	9	55%	N	FN	0	0			
OB2	G	10	50%	N	FN	0	0			
OB2	H	11	60%	N	FN	0	0			
OB2	I	12	55%	N	FN	0	0			
OB2	J	13	45%	N	FN	0	0			
OB2	K	14	60%	N	FN	0	0			

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 08/15/2022 **Visit No:** 6 **Previous Visit Date:** 07/12/2022

Arrival Time: 16:15 **Departure Time:** 18:15

Observers: Stephanie James

Weather: Clear, dry, calm

Comments: No GBHE observed during survey.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N	FN	0	0			
OB2	B	2	45%	N	FN	0	0			
OB2	C	3	70%	N	FN	0	0			
OB2	D	4	65%	N	FN	0	0			
OB2	B	5	60%	N	FN	0	0			
OB2	E	6	60%	N	FN	0	0			
OB2	F	7	60%	N	FN	0	0			
OB2	F	8	50%	N	FN	0	0			
OB2	G	9	55%	N	FN	0	0			
OB2	G	10	50%	N	FN	0	0			
OB2	H	11	60%	N	FN	0	0			
OB2	I	12	55%	N	FN	0	0			
OB2	J	13	45%	N	FN	0	0			
OB2	K	14	60%	N	FN	0	0			

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 8/20/2022 **No. of Visits:** 6

Observers: S. James

Weather: Surveys conditions were calm and dry or with light pricipitation

GPS Coordinates: 44.6959, -123.2316

Comments: GBHE adults were observed nest building, potentially, incubating eggs during March, April. After June 1, no GBHE observed, 2-4 juvenile BAEA visited/raided most nests.

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				1st Visit Date: 02/17/2022			2nd Visit Date: 03/22/2022			3rd Visit Date: 04/28/2022					Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young			
OB2	A	1	50%	STD	0		STD	0		STD	0				
OB2	B	2	45%				STD	0		STD	0				
OB2	C	3	70%				STD	0		STD	0				
OB2	D	4	65%				STD	0		STD	0				
OB2	B	5	60%				STD	0		STD	0				
OB2	E	6	60%				STD	0		INC	0				
OB2	F	7	60%				STD	0		STD	0				
OB2	F	8	50%				STD	0		STD	0				
OB2	G	9	55%				STD	0		STD	0				
OB2	G	10	50%				STD	0		STD	0				
OB2	H	11	60%				STD	0		STD	0				
OB2	I	12	55%							STD	0				New nest in Apr.
OB2	J	13	45%							STD	0				New nest in Apr.
OB2	E	14	60%							NV	0				New nest in Apr.

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 8/20/2022 **No. of Visits:** 6

Observers: S. James

Weather: Surveys conditions were calm and dry or with light pricipitation

GPS Coordinates: 44.6959, -123.2316

Comments:

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				4th Visit Date: 06/01/2022			5th Visit Date: 7/12/22			6th Visit Date: 08/15/2022			Nest Success Summary		Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Y/N	No. Fledged	
OB2	A	1	50%	FN	0		FN	0		FN	0		N		Juv. BAEA
OB2	B	2	45%	FN	0		FN	0		FN	0		N		Juv. BAEA
OB2	C	3	70%	FN	0		FN	0		FN	0		N		Juv. BAEA
OB2	D	4	65%	FN	0		FN	0		FN	0		N		Juv. BAEA
OB2	B	5	60%	FN	0		FN	0		FN	0		N		
OB2	E	6	60%	FN	0		FN	0		FN	0		N		Juv. BAEA
OB2	F	7	60%	FN	0		FN	0		FN	0		N		Juv. BAEA
OB2	F	8	50%	FN	0		FN	0		FN	0		N		
OB2	G	9	55%	FN	0		FN	0		FN	0		N		Juv. BAEA
OB2	G	10	50%	FN	0		FN	0		FN	0		N		Juv. BAEA
OB2	H	11	60%	FN	0		FN	0		FN	0		N		
OB2	I	12	55%	FN	0		FN	0		FN	0		N		Juv. BAEA
OB2	J	13	45%	FN	0		FN	0		FN	0		N		Juv. BAEA
OB2	E	14	60%	FN	0		FN	0		FN	0		N		

Bald Eagle Observation Data Sheet - Coffin Butte Landfill

Date:	02/22/2024	**Visit No:**	1	**Most BAEA adults observed at one time:**	1
Observer(s):	S. McCord	**Arrival Time:**	07:45	**Most BAEA juveniles observed at one time:**	3
Weather:	Some fog, scattered clouds, calm,dry	**Departure Time:**	11:48	**Most GOEA adults observed at one time:**	1
Comments:	GOEA seen soaring over landfill. BAEA adult and 3 immature seen soaring over landfill.			**Most GOEA juveniles observed at one time:**	0

Date:	04/04/2024	**Visit No:**	2	**Most BAEA adults observed at one time:**	1
Observer(s):	S. McCord	**Arrival Time:**	07:47	**Most BAEA juveniles observed at one time:**	2
Weather:	Dry, calm, overcast	**Departure Time:**	11:50	**Most GOEA adults observed at one time:**	0
Comments:	1 adult BAEA, 2 juvenile BAEA observed over the landfill			**Most GOEA juveniles observed at one time:**	0

Date:	04/19/2024	**Visit No:**	3	**Most BAEA adults observed at one time:**	10
Observer(s):	S. McCord	**Arrival Time:**	10:44	**Most BAEA juveniles observed at one time:**	7
Weather:	Breezy, clear, dry	**Departure Time:**	14:46	**Most GOEA adults observed at one time:**	0
Comments:	10 adults and 7 juveniles (17 soaring a thermal together!) BAEA			**Most GOEA juveniles observed at one time:**	0

Date:	05/30/2024	**Visit No:**	4	**Most BAEA adults observed at one time:**	4
Observer(s):	S. McCord	**Arrival Time:**	07:56	**Most BAEA juveniles observed at one time:**	4
Weather:	Breezy, scattered clouds, dry	**Departure Time:**	12:00	**Most GOEA adults observed at one time:**	0
Comments:	4 adults and 4 juvenile BAEA observed over the landfill			**Most GOEA juveniles observed at one time:**	0

Date:	06/28/2024	**Visit No:**	5	**Most BAEA adults observed at one time:**	2
Observer(s):	S. McCord	**Arrival Time:**	06:52	**Most BAEA juveniles observed at one time:**	2
Weather:	Breezy, scattered clouds, dry	**Departure Time:**	11:00	**Most GOEA adults observed at one time:**	0
Comments:	2 adults and 2 juvenile BAEA observed over the landfill			**Most GOEA juveniles observed at one time:**	0

Date:		**Visit No:**		**Most BAEA adults observed at one time:**	
Observer(s):		**Arrival Time:**		**Most BAEA juveniles observed at one time:**	
Weather:		**Departure Time:**		**Most GOEA adults observed at one time:**	
Comments:				**Most GOEA juveniles observed at one time:**	

Bald Eagle Observation Data Sheet - Coffin Butte Landfill

Date:	03/01/2023	**Visit No:**	1	**Most BAEA adults observed at one time:**	6
Observer(s):	S. James	**Arrival Time:**	08:25	**Most BAEA juveniles observed at one time:**	5
Weather:	Partly cloudy, dry, calm	**Departure Time:**	12:30	**Most GOEA adults observed at one time:**	0
Comments:	BAEA adults and juveniles were seen soaring, perching, foraging, and commingling above and near the landfill.			**Most GOEA juveniles observed at one time:**	0

Date:	03/31/2023	**Visit No:**	2	**Most BAEA adults observed at one time:**	3
Observer(s):	S. McCord	**Arrival Time:**	08:32	**Most BAEA juveniles observed at one time:**	11
Weather:	Overcast,drizzlingrain,calm	**Departure Time:**	12:37	**Most GOEA adults observed at one time:**	0
Comments:	AEA adults and juveniles were seen soaring, perching, foraging, and commingling above and near the landfill.			**Most GOEA juveniles observed at one time:**	0

Date:	05/05/2023	**Visit No:**	3	**Most BAEA adults observed at one time:**	2
Observer(s):	S. McCord	**Arrival Time:**	08:20	**Most BAEA juveniles observed at one time:**	3
Weather:	Breezy, scattered clouds, dry	**Departure Time:**	13:05	**Most GOEA adults observed at one time:**	0
Comments:	Surprisingly few raptors visible this morning. Eagles soaring among some turkey vultures. May have been more on other side of landfill.			**Most GOEA juveniles observed at one time:**	0

Date:	05/19/2023	**Visit No:**	4	**Most BAEA adults observed at one time:**	3
Observer(s):	S. McCord	**Arrival Time:**	08:13	**Most BAEA juveniles observed at one time:**	5
Weather:	Breezy, scattered clouds, dry	**Departure Time:**	12:20	**Most GOEA adults observed at one time:**	0
Comments:	One adult BAEA perched in cottonwood rookery stand before flying back to dump. Eagles soaring and foraging above and near landfill.			**Most GOEA juveniles observed at one time:**	0

Date:	06/16/2023	**Visit No:**	5	**Most BAEA adults observed at one time:**	0
Observer(s):	S. McCord	**Arrival Time:**	08:47	**Most BAEA juveniles observed at one time:**	0
Weather:	Breezy, clear, dry	**Departure Time:**	12:49	**Most GOEA adults observed at one time:**	0
Comments:	No bald eagles observed. Vultures and corvids seen around landfill.			**Most GOEA juveniles observed at one time:**	0

Date:	07/21/2023	**Visit No:**	6	**Most BAEA adults observed at one time:**	2
Observer(s):	S. McCord	**Arrival Time:**	08:35	**Most BAEA juveniles observed at one time:**	0
Weather:	Clear, calm, dry	**Departure Time:**	12:40	**Most GOEA adults observed at one time:**	0
Comments:	2 adult bald eagles seen near landfill. No juveniles oberved. Vultures and corvids present.			**Most GOEA juveniles observed at one time:**	0

Bald Eagle Observation Data Sheet - Coffin Butte Landfill

Date:	02/22/2024	**Visit No:**	1	**Most BAEA adults observed at one time:**	1
Observer(s):	S. McCord	**Arrival Time:**	07:45	**Most BAEA juveniles observed at one time:**	3
Weather:	Some fog, scattered clouds, calm,dry	**Departure Time:**	11:48	**Most GOEA adults observed at one time:**	1
Comments:	GOEA seen soaring over landfill. BAEA adult and 3 immature seen soaring over landfill.			**Most GOEA juveniles observed at one time:**	0

Date:	04/04/2024	**Visit No:**	2	**Most BAEA adults observed at one time:**	1
Observer(s):	S. McCord	**Arrival Time:**	07:47	**Most BAEA juveniles observed at one time:**	2
Weather:	Dry, calm, overcast	**Departure Time:**	11:50	**Most GOEA adults observed at one time:**	0
Comments:	1 adult BAEA, 2 juvenile BAEA observed over the landfill			**Most GOEA juveniles observed at one time:**	0

Date:	04/19/2024	**Visit No:**	3	**Most BAEA adults observed at one time:**	10
Observer(s):	S. McCord	**Arrival Time:**	10:44	**Most BAEA juveniles observed at one time:**	7
Weather:	Breezy, clear, dry	**Departure Time:**	14:46	**Most GOEA adults observed at one time:**	0
Comments:	10 adults and 7 juveniles (17 soaring a thermal together!) BAEA			**Most GOEA juveniles observed at one time:**	0

Date:	05/30/2024	**Visit No:**	4	**Most BAEA adults observed at one time:**	4
Observer(s):	S. McCord	**Arrival Time:**	07:56	**Most BAEA juveniles observed at one time:**	4
Weather:	Breezy, scattered clouds, dry	**Departure Time:**	12:00	**Most GOEA adults observed at one time:**	0
Comments:	4 adults and 4 juvenile BAEA observed over the landfill			**Most GOEA juveniles observed at one time:**	0

Date:	06/28/2024	**Visit No:**	5	**Most BAEA adults observed at one time:**	2
Observer(s):	S. McCord	**Arrival Time:**	06:52	**Most BAEA juveniles observed at one time:**	2
Weather:	Breezy, scattered clouds, dry	**Departure Time:**	11:00	**Most GOEA adults observed at one time:**	0
Comments:	2 adults and 2 juvenile BAEA observed over the landfill			**Most GOEA juveniles observed at one time:**	0

Date:		**Visit No:**		**Most BAEA adults observed at one time:**	
Observer(s):		**Arrival Time:**		**Most BAEA juveniles observed at one time:**	
Weather:		**Departure Time:**		**Most GOEA adults observed at one time:**	
Comments:				**Most GOEA juveniles observed at one time:**	



Photo credit: S. James

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Addendum to the
Final 2024 Report:

Wildlife Habitat Assessment and Surveys

for the Coffin Butte Landfill Expansion Project

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INTRODUCTION

Civil & Environmental Consultants, Inc. ("CEC") contracted Turnstone Environmental Consultants, Inc. ("Turnstone") to perform a wildlife study for the Coffin Butte Landfill Expansion Project Area ("Project Area"). This document is an addendum to the *Final 2024 Report: Wildlife Habitat Assessment and Surveys for the Coffin Butte Landfill Expansion Project* (Turnstone, 2024).

Great Blue Heron Rookery Monitoring

Turnstone biologists are monitoring two great blue heron rookeries located within the Coffin Butte Landfill Expansion Project Area (Figure 1). In 2022 and 2023, Turnstone biologists conducted six reproductive productivity surveys each year for nesting great blue herons in the two known rookery locations. In 2024, at the time the Final 2024 Report was finalized (July 12, 2024), Turnstone biologists had completed five out of six planned reproductive surveys for the great blue heron reproductive monitoring. The survey forms for the final sixth visit of 2024 great blue heron rookery monitoring are in Appendix A.

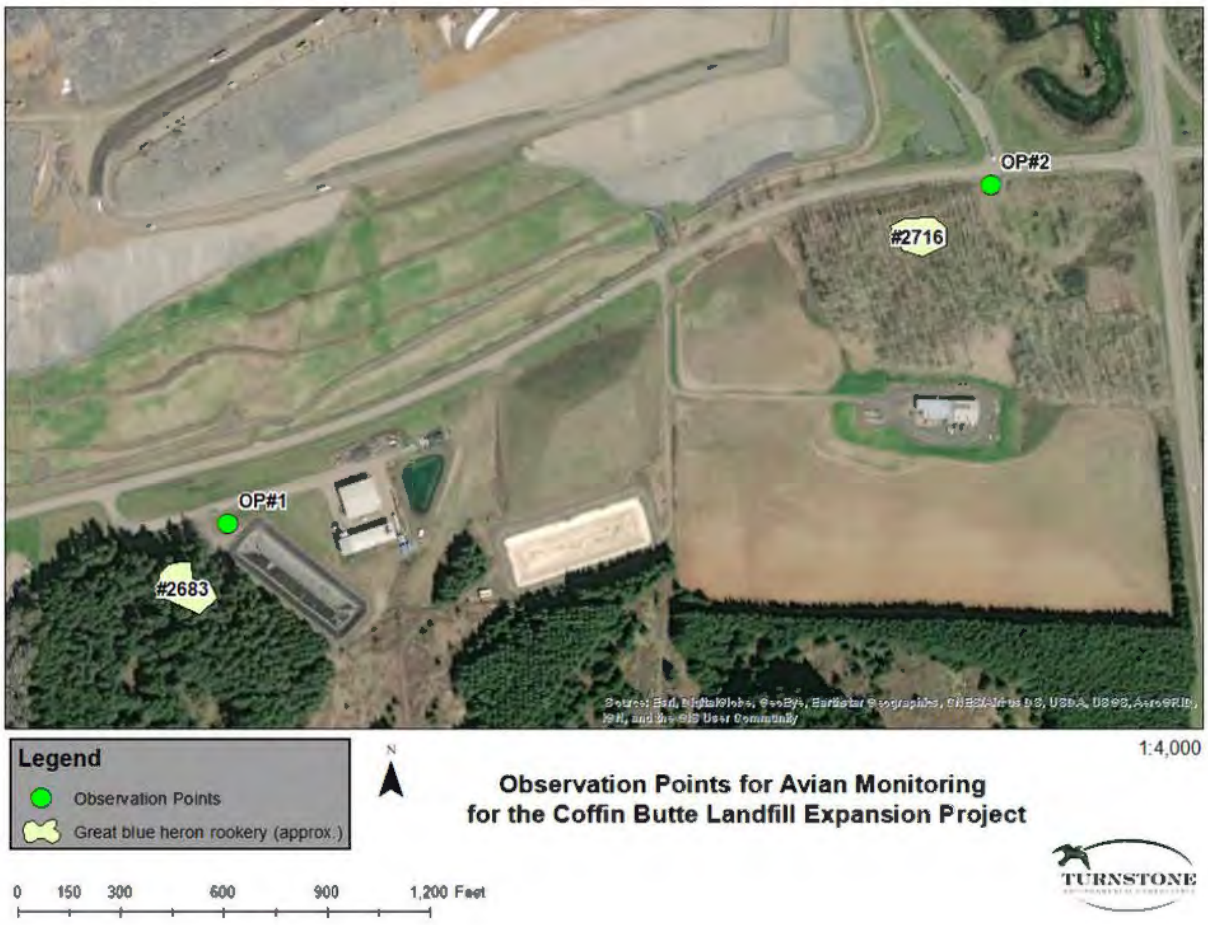


Figure 1. Great Blue Heron Rookeries in the Project Area and Observation Points

Year 3 Surveys (2024)

At the time of the finalization of this report (July 12, 2024), Turnstone biologists had conducted five of the six required daytime surveys at each rookery site from February 22 through June 28, 2024 (Turnstone, 2024). The final visit was conducted on July 18, 2024, and Turnstone biologists did not observe any great blue herons using the stick nests for nesting during any of the six visits at the two observation points. All surveys were conducted during mild weather conditions.

Table 1. 2024 Great Blue Heron Survey Results for the Western Rookery (#2683)

Observation Period	Survey Date	Surveyor	Results of Reproductive Monitoring	
			Great Blue Heron	Other Birds Observed in Nests
2/15 to 3/15	2/22	Sarah McCord	10 inactive nests	None
3/15 to 4/15	4/4	Sarah McCord	10 inactive nests	None
4/15 to 5/15	4/19	Sarah McCord	10 inactive nests	None
5/15 to 6/15	5/30	Sarah McCord	10 inactive nests	None
6/15 to 7/15	6/28	Sarah McCord	10 inactive nests	None
7/15 to 8/15	7/18	Sarah McCord	10 inactive nests	None

Table 2. 2024 Great Blue Heron Survey Results for the Eastern Rookery (#2716)

Observation Period	Survey Date	Surveyor	Results	
			Great Blue Heron	Other Birds Observed in Nests
2/15 to 3/15	2/22	Sarah McCord	13 inactive nests	None
3/15 to 4/15	4/4	Sarah McCord	13 inactive nests	None
4/15 to 5/15	4/19	Sarah McCord	13 inactive nests	None
5/15 to 6/15	5/30	Sarah McCord	13 inactive nests	None
6/15 to 7/15	6/28	Sarah McCord	13 inactive nests	None
7/15 to 8/15	7/18	Sarah McCord	13 inactive nests	None

Conclusion

Western Rookery (#2683)

During consecutive three years of protocol surveys (2022-2024), Turnstone biologists observed no active nesting by great blue herons within the western rookery (#2683). Three bird species were recorded visiting the stick nests during that time, including the common raven (*Corvus corax*), red-tailed hawk (*Buteo jamaicensis*), and bald eagle. A pair of red-tailed hawks were present during each survey, acting defensively, and are likely nesting in the in an abandoned stick nest the rookery in 2023. The western rookery is likely abandoned by great blue herons; therefore, the western rookery (#2683) is an abandoned Great Blue Heron Resource Site.

Eastern Rookery (#2716)

During Year 1 (2022) surveys, Turnstone biologists observed active nesting by great blue herons within the eastern rookery (#2716) during the first three survey periods; however, in early June the colony had failed, and juvenile bald eagles were observed visiting the majority of the nests.

A red-tailed hawk pair was observed nesting in an abandoned stick nest in the rookery in Year 2 (2023). No great blue herons were observed in the eastern rookery (#2716) during any of the six 2023 reproductive productivity surveys; therefore, the rookery is considered inactive for 2023.

As with the western rookery, the eastern rookery is likely also abandoned by great blue herons. The eastern rookery (#2716) is considered inactive for 2024. Turnstone recommends continuing surveys in 2025 to determine if the eastern rookery is inactive for a third consecutive year, which would deem this Great Blue Heron Resource Site officially abandoned.

APPENDIX A: FIELD FORMS

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 07/18/2024 **Visit No:** 5 **Previous Visit Date:** 05/30/2024

Arrival Time: 07:22 **Departure Time:** 09:22

Observers: Sarah McCord

Weather: Breezy, scattered clouds, dry

Comments: No herons observed.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB1	A	1	70%	N		0	0			
OB1	A	2	55%	N		0	0			
OB1	B	3	65%	N		0	0			
OB1	C	4	80%	N		0	0			
OB1	C	5	55%	N		0	0			
OB1	D	6	70%	N		0	0			
OB1	E	7	60%	N		0	0			
OB1	F	8	55%	N		0	0			
OB1	G	9	45%	N		0	0			
OB1	H	10	85%	N		0	0			

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - West **Colony Code:** #2683

Date: 8/6/2024 **No. of Visits:** 6

Observers: S. McCord

Weather: Surveys conditions were calm and dry or with light precipitation

GPS Coordinates: 44.6988, -123.2235

Comments: No GBHE observed in the rookery.

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				1st Visit Date: 02/22/2024			2nd Visit Date: 04/04/2024			3rd Visit Date: 04/19/2024					Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young			
OB1	A	1	70%												INACTIVE
OB1	A	2	55%												INACTIVE
OB1	B	3	65%												INACTIVE
OB1	C	4	80%												INACTIVE
OB1	C	5	55%												INACTIVE
OB1	D	6	70%												INACTIVE
OB1	E	7	60%												INACTIVE
OB1	F	8	55%												INACTIVE
OB1	G	9	45%												INACTIVE
OB1	H	10	85%												INACTIVE

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - West **Colony Code:** #2683
Date: 8/6/2024 **No. of Visits:** 6
Observers: S. McCord
Weather: Surveys conditions were calm and dry or with light precipitation
GPS Coordinates: 44.6988, -123.2235
Comments:

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				4th Visit Date: 05/30/2024			5th Visit Date: 6/28/24			6th Visit Date: 07/18/2024			Nest Success Summary		Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Y/N	No. Fledged	
OB1	A	1	70%										N	0	INACTIVE
OB1	A	2	55%										N	0	INACTIVE
OB1	B	3	65%										N	0	INACTIVE
OB1	C	4	80%										N	0	INACTIVE
OB1	C	5	55%										N	0	INACTIVE
OB1	D	6	70%										N	0	INACTIVE
OB1	E	7	60%										N	0	INACTIVE
OB1	F	8	55%										N	0	INACTIVE
OB1	G	9	45%										N	0	INACTIVE
OB1	H	10	85%										N	0	INACTIVE

Great Blue Heron Data Sheet - Colony Reproductive Productivity

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 07/18/2024 **Visit No:** 5 **Previous Visit Date:** 06/28/2024

Arrival Time: 09:29 **Departure Time:** 11:29

Observers: Sarah McCord

Weather: Scattered clouds, dry, breezy

Comments: No herons observed.

Nest Status Codes	Nest Activity Code eg's
STD - adult standing	**1AS/2AS -** 1 or 2 adult stand
INC - incubation	**ASN -** adult stand near
YNG - young in nest	**EX -** adult exchange
NV - birds not visible	**COP -** copulatory behaviour
FN - failed nest	**STICK** - stick brought to nest

Young Age Codes	
1 - 1 to 2 wks old	**3 -** 4 to 6 wks old
2 - 2 to 4 wks old	**4 -** 6 to 8 wks old

Observer Location	Tree No.	Nest No.	Nest Location	Nest Active? (Y/N)	Nest Status	No. Adults	No. Young	Age of Young	Nest Activities	Comments
OB2	A	1	50%	N						
OB2	B	2	45%	N						
OB2	C	3	70%	N						
OB2	D	4	65%	N						
OB2	B	5	60%	N						
OB2	E	6	60%	N						
OB2	F	7	60%	N						
OB2	F	8	0%	N						Nest missing from tree
OB2	G	9	55%	N						
OB2	G	10	50%	N						
OB2	H	11	60%	N						
OB2	I	12	55%	N						
OB2	J	13	45%	N						
OB2	K	14	60%	N						

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - East **Colony Code:** #2716

Date: 8/6/2024 **No. of Visits:** 6

Observers: S. McCord

Weather: Surveys conditions were dry and calm or breezy

GPS Coordinates: 44.6959, -123.2316

Comments: No GBHE observed in the stand.. STJA, RTHA and BAEA were observed in the stand.

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				1st Visit Date: 02/22/2024			2nd Visit Date: 03/31/2023			3rd Visit Date: 04/19/2024					Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young			
OB2	A	1	50%												INACTIVE
OB2	B	2	45%												INACTIVE
OB2	C	3	70%												INACTIVE
OB2	D	4	65%												INACTIVE
OB2	B	5	60%												INACTIVE
OB2	E	6	60%												INACTIVE
OB2	F	7	60%												INACTIVE
OB2	F	8	0%												Nest missing
OB2	G	9	55%												INACTIVE
OB2	G	10	50%												INACTIVE
OB2	H	11	60%												INACTIVE
OB2	I	12	55%												INACTIVE
OB2	J	13	45%												INACTIVE
OB2	E	14	60%												INACTIVE.

Great Blue Heron - Coffin Butte Landfill Annual Colony Visits Summary

Colony Name: Coffin Butte - East **Colony Code:** #2716
Date: 8/6/2024 **No. of Visits:** 6
Observers: S. McCord
Weather: Surveys conditions were dry and calm or breezy
GPS Coordinates: 44.6959, -123.2316
Comments:

No. Data Sheets Used in Season:	
	Summary
	Tree Mapping
	Disturbance
X	Reproductive Productivity
	Arrival/Departure
	Colony Floor Search
	Climbing

Individual Nest Information				4th Visit Date: 05/30/2024			5th Visit Date: 6/28/24			6th Visit Date: 07/18/2024			Nest Success Summary		Comments
From Where	Tree No.	Nest No.	Nest Location	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Nest Status	No. Young	Age of Young	Y/N	No. Fledged	
OB2	A	1	50%										N	0	INACTIVE
OB2	B	2	45%										N	0	INACTIVE
OB2	C	3	70%										N	0	INACTIVE
OB2	D	4	65%										N	0	INACTIVE
OB2	B	5	60%										N	0	INACTIVE
OB2	E	6	60%										N	0	INACTIVE
OB2	F	7	60%										N	0	Nest missing
OB2	F	8	0%										N	0	INACTIVE
OB2	G	9	55%										N	0	INACTIVE
OB2	G	10	50%										N	0	INACTIVE
OB2	H	11	60%										N	0	INACTIVE
OB2	I	12	55%										N	0	INACTIVE
OB2	J	13	45%										N	0	INACTIVE
OB2	E	14	60%										N	0	INACTIVE

WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

APPENDIX A

APPENDIX A
FIELD EXPLORATION SUMMARY

GENERAL

Subsurface conditions for the proposed Coffin Butte Landfill South Expansion Area, located in Corvallis, Oregon, were explored by advancing nineteen (19) borings (designated BH-01 through BH-19), fifteen (15) test pits (designated TP-01 through TP-05, TP-08 through TP-13, and TP-15 through TP-18), and nine (9) cone penetration tests with geoprobe sampling (designated GP/CPT-01 through GP/CPT-09) at the approximate locations shown on **Figures 2a and 2b**, *Exploration Location Map*. TP-06, TP-07, and TP-14 were not excavated due to conflicts with utilities, access restrictions, and a mechanical breakdown. Boring, test pit, CPT, and geoprobe logs are included in this appendix. The procedures used to advance the borings and test pits, collect soil samples, and other field techniques are described in detail in this appendix. Unless otherwise noted, all soil sampling and classification procedures followed local engineering practices which are in general conformance with relevant ASTM procedures and the Unified Soil Classification System (USCS). "General conformance" means that certain local and common excavation and descriptive practices and methodologies have been followed.

TEST PITS

Fifteen (15) test pits were advanced with a CAT 310 trackhoe, operated by RL Reimers Excavation of Albany, Oregon between August 16 and September 23, 2021. The test pits were observed by a Wallace Group geotechnical professional who maintained a detailed log of subsurface conditions and materials encountered, collected soil samples, and documented backfilling. The test pits were advanced to depths ranging from 7- to 12-feet below ground surface (bgs). Grab samples were retrieved for laboratory testing. Test pits were backfilled using spoils from the excavations.

Dynamic Cone Penetration (DCP) testing was conducted to evaluate the relative density of the soil. DCP procedures are generally described in ASTM Special Technical Publication 399, which have been modified by Wallace Group to provide better representation of soil relative density or stiffness. During the DCP test, a 1.5-inch diameter steel cone is driven up to 18 inches into the soil using a 15-pound hammer dropped from a height of 18 inches. The number of blows is recorded and can be roughly correlated to the Standard Penetration Test. The number of blows required to drive the cone 12 inches into the soil provides a measure of the relative density of granular soils such as sand and gravel, and the strength of fine-grained soils such as silt and clay.

BORINGS

Nineteen (19) borings, advanced with a combination of hollow-stem augers (HSA), mud rotary, and HQ rock coring techniques. Borings BH-01 through BH-14 were drilled by using a track-mounted CME drilling rig, operated by Western States Drilling of Hubbard, Oregon on September 7 through 28, 2021. Borings BH-15 through BH-19 were drilled using a track-mounted CME drilling rig, operated by HazTech Drilling of Nampa, Idaho on November 8 through 16, 2022. The borings were observed by a Wallace Group geotechnical professional who maintained a detailed log of subsurface conditions and materials encountered, collected soil samples, and documented backfilling. The borings were advanced to depths ranging from 25.1- to 165-feet below ground surface (bgs). Disturbed (SPT), relatively undisturbed (Shelby tube), and rock core (HQ wireline) samples were retrieved for laboratory testing. Borings were abandoned using bentonite backfill.

BH-16 and BH-17 were converted into temporary piezometers (designated MW-16 and MW-17, respectively) by Oregon Geotechnical Explorations on November 21 and 22, 2022. Piezometers were installed to depths of 20-feet bgs in MW-16 and 100-feet bgs in MW-17.

CONE PENETRATION TESTING

Nine (9) CPTs were advanced by Oregon Geotechnical Explorations of Salem, Oregon between September 21 through November 8, 2022. The CPTs were performed by hydraulically-pushing a 1.4-inch-diameter, cone-tipped probe, with a projected area of 10 square centimeters, into the ground. The cone tip measures tip resistance, and a friction sleeve behind the cone tip measures frictional resistance. Electrical strain gauges or load cells within the cone continuously measured cone tip resistance and frictional resistance during the entire depth of each probing. Accumulated data was processed to provide engineering information, such as the types and approximate strength characteristics of the soil encountered. CPT's were advanced to depths between 10- to 65-feet bgs. Pore pressure dissipation testing was performed at all CPT locations to evaluate the depth to groundwater. Shear wave velocity measurements were collected in CPT-08.

Nine geoprobes (GP) were advanced adjacent to CPT locations to collect soil samples for laboratory testing. Geoprobes were advanced adjacent to CPT-01 through CPT-09 and were designated GP-01 through GP-09, as shown on Figure 2. Geoprobes were advanced by vibrating a 1.25-inch-diameter casing to depths ranging between 10- and 30-feet bgs. CPT and GP holes were abandoned with bentonite.

MATERIAL DESCRIPTIONS

Soil samples were visually classified in the field as they were collected. Consistency, color, and other distinguishing characteristics of the samples were noted. Afterwards, the soil samples were re-examined in the laboratory and the field descriptions were modified where necessary. The terminology used in the rock descriptions are defined in the following sections.

SAMPLING AND LABORATORY TESTING

Disturbed and relatively undisturbed soil samples were retrieved from the borings. The samples were classified and capped, sealed in plastic bags, or placed into core boxes for further examination and physical testing in our laboratory for gradation, moisture content, rock specimen point load testing, Atterberg limits, triaxial, and permeability.

BORING, TEST PIT, AND GP/CPT LOGS

Figure A is a Legend explaining the information and symbols presented on the test pit and boring logs. The logs are presented on Figures A-1 through A-15 (Test Pits), A-16 through A-36 (Borings and Piezometers), A-37 through A-45 (Geoprobes), and A-46 through A-54 (CPTs). The logs describe the materials encountered and the depths where materials and/or characteristics of these materials changed, although the changes may be gradual. Where material types and descriptions changed between samples, the contacts were interpreted. On each boring log, the types of samples collected (including their identification number) are reported, including laboratory test results and blow counts. Corrected N-values, as presented on the boring logs, represent sampler blow counts that have been corrected for sampler type and hammer energy.

GROUNDWATER

Groundwater was encountered during subsurface exploration for this project and groundwater elevations during drilling are presented on the logs in Appendix A.

TERMINOLOGY USED TO DESCRIBE SOIL AND ROCK

Soils exist in mixtures with varying proportions of components. The predominant soil, i.e., greater than 50 percent based upon total dry weight, is the primary soil type and is capitalized in our log descriptions, e.g., SAND, GRAVEL, SILT or CLAY. "General Accordance" means that certain local and common descriptive practices have been followed. In accordance with ASTM D2488, group symbols (such as GP or CH) are applied on that portion of the soil passing the 3-inch (75mm) sieve based upon visual examination. The following describes the use of soil names and modifying terms used to describe fine- and coarse-grained soils.

Fine - Grained SOILS (More than 50% fines passing 0.074 mm, #200 sieve)

The primary soil type i.e. SILT or CLAY is designated through visual – manual procedures to evaluate soil toughness, dilatancy, dry strength, and plasticity. The following describes the terminology used to describe fine - grained soils and varies from ASTM 2488 terminology in the use of some common terms.

Primary Soil Name and Symbols		
SILT (ML & MH)	CLAY (CL & CH)	ORGANIC SILT & CLAY (OL & OH)

Descriptions of plasticity are described based on the plasticity index results of Atterberg limits testing, as follows:

Plasticity Description	**Plasticity Index (PI)**
Non-Plastic	0 - 3
Low Plasticity	4 - 10
Medium Plasticity	>10 – 20
High Plasticity	>20 – 40
Very High Plasticity	>40

Modifying terms describing secondary constituents, estimated to 5 percent increments, are applied as follows:

Description	% Composition
Trace sand, trace gravel	5% - 10%
With sand; with gravel	15% - 25%
Sandy, or gravelly	30% - 45%

Borderline Symbols, for example CH/MH, are used where soils are not distinctly in one category or where variable soil units contain more than one soil type. Dual Symbols, for example CL-ML, are used where two symbols are required in accordance with ASTM D2488.

Soil Consistency. Consistency terms are applied to fine-grained soils (fines content > 50 percent). Descriptive terms are based on direct measure or correlation to the Standard Penetration Test N-value as determined by ASTM D1586-84, as follows.

Consistency Term	SPT N-value	Unconfined Compressive Strength	
		Tons/sq.ft.	kPa
Very soft	Less than 2	Less than 0.25	Less than 24
Soft	2 - 4	0.25 - 0.5	24 - 48
Medium stiff	5 - 8	0.5 - 1.0	48 – 96
Stiff	9 - 15	1.0 - 2.0	96 – 192
Very stiff	16 - 30	2.0 - 4.0	192 – 383
Hard	Over 30	Over 4.0	Over 383

Coarse-Grained Soils (less than 50% fines)

Coarse-grained soil descriptions, i.e., SAND or GRAVEL, are based on that portion of materials passing a 3-inch (75mm) sieve. Coarse-grained soil group symbols are applied in accordance with ASTM D2488 based upon the degree of grading, or distribution of grain sizes of the soil. For example, well graded sand containing a wide range of grain sizes is designated SW; poorly graded gravel, GP, contains high percentages of only certain grain sizes. Terms applied to grain sizes follow.

	Particle Diameter	
	Inches	**Millimeters**
Sand	0.003 - 0.19	0.075 - 4.8
Gravel	0.19 - 3.0	4.8 - 75
	Additional Constituents	
Cobble	3.0 - 12	75 - 300
Boulder	12 - 120	300 - 3050
Rock Block	>120	>3050

The amount of 'fines' in the soil are described as indicated by the following examples. Other soil mixtures will provide similar descriptive names.

Example: Coarse-Grained Soil Descriptions with Fines

Less than 5% fines	5 to 12% fines (Dual Symbols)	Greater than 12% to Less than 50% fines
GRAVEL: GW or GP	GRAVEL WITH SILT, GW-GM	SILTY GRAVEL: GM
SAND: SW or SP	SAND WITH CLAY, SP-SC	SILTY SAND: SM

Cohesionless Soil Structure terms are applied to granular, non-plastic soils based on direct measure or correlation to the Standard Penetration Test N-value as determined by ASTM D1586.

Cohesionless Soil Structure Term	***SPT N-value***
Very loose	0 - 4
Loose	4 - 10
Medium dense	10 - 30
Dense	30 - 50
Very dense	> 50

Terminology Used to Describe Rock

The descriptions of rock strength, joint space or bedding, vesicularity, and quality are as follows:

Scale of Rock Strength

Description	Designation	Unconfined Compressive Strength, psi	Unconfined Compressive Strength, MP	Field Identification
Very low strength	R1	100 – 1000	0.7 – 7	Crumbles under firm blows with point of geology pick; can be peeled by a pocketknife.
Low strength	R2	1,000 – 4,000	7 – 28	Can be peeled by a pocketknife with difficulty; shallow indentation made by firm blows of geology pick.
Moderate strength	R3	4,000 – 8,000	28 – 55	Cannot by scraped or peeled with a pocketknife; specimen can be fractured with a single firm blow of geology hammer.
Medium high strength	R4	8,000 – 16,000	55 – 110	Specimen requires more than one blow with a geology hammer to fracture it.
High strength	R5	16,000 – 32,000	110 – 120	Specimen requires many blows of geology hammer to fracture it.
Very high strength	R6	> 32,000	> 220	Specimen can only be chipped with geology pick.

Descriptive Terminology for Joint Spacing or Bedding

Descriptive Term	*Spacing of Joints*	
Very close	Less than 2 inches	< 50 mm
Close	2 inches - 1 foot	50 mm – 300 mm
Moderately close	1 foot - 3 feet	300 mm – 1 m
Wide	3 feet -10 feet	1 m – 3 m
Very wide	Greater than 10 feet	> 3 m

Descriptive Terminology for Vesicularity

Descriptive Term	*Percent voids by volume*
Dense	< 1%
Slightly vesicular	1 – 10%
Moderately vesicular	10 – 30%
Highly vesicular	30 – 50%
Scoriaceous	> 50%

Correlation of RQD and Rock Quality

Rock Quality Descriptor	RQD Value
Very poor	0 – 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90

Scale of Rock Weathering

Stage	*Description*	*Quality Distinction*
Fresh	Rock is fresh, crystals are bright, a few joints may show slight staining because of ground water.	Discoloration
Very Slight	Rock is generally fresh, joints are stained, some joints may have thin clay coatings, crystals in broken faces show bright.	Discoloration only on major discontinuity surfaces [i]
Slight	Rock is generally fresh, joints are stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some feldspar crystals are dull and discolored. Rocks ring under hammer if crystalline.	Discoloration on all discontinuity surfaces and on rock
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some are clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.	Decomposition and/or disintegration < 50% of rock [ii]
Moderately Severe	All rock, except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick. Rock goes "clunk" when struck.	Decomposition and/or disintegration > 50%, but not complete
Severe	All rock, except quartz, discolored or stained. Rock "fabric" is clear and evident but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of harder rock usually left, such as corestones in basalt.	Decomposition and/or disintegration > 75%, nearly complete
Very Severe	All rock, except quartz, discolored or stained. Rock "fabric" is discernible, but mass effectively reduced to "soil" with only fragments of harder rock remaining.	Decomposition and/or disintegration 100% with structure/fabric intact
Complete	Rock is reduced to "soil". Rock "fabric" is not discernible, or only in small scattered locations. Quartz may be present as dikes or stringers.	Decomposition and/or disintegration 100% with structure/fabric destroyed

NOTES: [i] Discontinuities consist of any natural break (joint, fracture or fault) or plane of weakness (shear or gouge zone, bedding plane) in a rock mass

[ii] Decomposition refers to chemical alteration of mineral grains; disintegration refers to mechanical breakdown

[iii] Stage and description from ASCE Manual No. 56 (1976), quality distinction from Murray (1981)

KEY TO SYMBOLS

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)


BASALT: Basalt


CH: USCS High Plasticity Clay


CL: USCS Low Plasticity Clay


CL-ML: USCS Low Plasticity Silty Clay


FILL: Fill (artificial fill)


GC: USCS Clayey Gravel


GM: USCS Silty Gravel


MH: USCS Elastic Silt


ML: USCS Silt


SANDSTONE: Sandstone


SC: USCS Clayey Sand


SC-SM: USCS Clayey Sand


SHALE: Shale


SM: USCS Silty Sand

SAMPLER SYMBOLS


Grab Sample


Rock Core (RC)


Standard Penetration Test


Shelby Tube

WELL CONSTRUCTION SYMBOLS


Bentonite Seal


Filter Pack


Slotted Pipe


Top Cap: 1 pipe group, 1st pipe

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
MC - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
FINES - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)
OC - ORGANIC CONTENT (%)

TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UCCS - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION


Water Level at Time of Drilling, or as Shown


Water Level at End of Drilling, or as Shown

Water Level After 24 Hours, or as Shown

KEY TO SYMBOLS - WALLACE GROUP DATA TEMPLATE.GDT - 10/10/23 09:21 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A

TEST PIT NUMBER TP-01

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/17/21 **COMPLETED** 8/17/21
GROUND ELEVATION 323.7 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0				SANDY LEAN CLAY WITH GRAVEL, moist, reddish brown, fine to coarse grained, angular to subangular, organics to 1', more gravel with depth	
2.5	GB S-1	CL			
5.0					
7.0					316.7

Refusal at 7.0 feet on basalt.
Bottom of test pit at 7.0 feet.

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 1

TEST PIT NUMBER TP-02

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/17/21 **COMPLETED** 8/17/21
GROUND ELEVATION 302 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	DCP BLOW COUNTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0		19 18 35	CL		SANDY LEAN CLAY WITH GRAVEL, stiff, moist, dark brown, fine to coarse grained, subangular, organic soil	
					2.0	300.0
2.5			CL		LEAN CLAY WITH SAND, stiff, moist, reddish brown, fine grained, subangular	
5.0					5.0	297.0
7.5	GB S-1		GC		CLAYEY GRAVEL WITH SAND, stiff, moist, red with gray, fine to coarse grained, angular, friable	
10.0					10.0	292.0

Refusal at 10.0 feet on basalt.
Bottom of test pit at 10.0 feet.

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 2

TEST PIT NUMBER TP-03

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/16/21 **COMPLETED** 8/16/21
GROUND ELEVATION 308.3 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0					
		CL		SANDY LEAN CLAY, stiff, moist, dark brown to black, fine grained, organic	
2.5				2.5	305.8
	GB S-1	GC		CLAYEY GRAVEL WITH SAND, moist, tan with reddish brown, fine to coarse grained, subangular, with cobbles and weathered in-place pillow basalt	
5.0					
				7.0	301.3

Refusal at 7.0 feet on basalt.
Bottom of test pit at 7.0 feet.

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

TEST PIT NUMBER TP-04

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/16/21 **COMPLETED** 8/16/21
GROUND ELEVATION 334.2 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	DCP BLOW COUNTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0					SANDY LEAN CLAY, stiff, moist, reddish brown, fine grained	
2.5	GB S-1	54 68 75	CL			
5.0						
6.0						328.2
					SANDY LEAN CLAY WITH GRAVEL, stiff, moist, dark reddish brown	
7.5			CL			
10.0						324.2
10.0					Refusal at 10.0 feet on basalt. Bottom of test pit at 10.0 feet.	

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 4

TEST PIT NUMBER TP-05

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/16/21 **COMPLETED** 8/16/21
GROUND ELEVATION 297.8 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	DCP BLOW COUNTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0		45 67 78			SANDY LEAN CLAY, stiff, moist, reddish brown, fine grained	
	GB S-1					
2.5			CL			
5.0					5.0	292.8
	GB S-2				SANDY LEAN CLAY WITH GRAVEL, stiff, moist, dark reddish brown	
7.5			CL			
					9.0	288.8
			GM		SILTY GRAVEL WITH SAND, moist, dark gray, fine to coarse grained, angular, weathered in-place basalt	
10.0					10.0	287.8

Refusal at 10.0 feet on basalt.
Bottom of test pit at 10.0 feet.

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

TEST PIT NUMBER TP-08

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/28/21 **COMPLETED** 9/28/21
GROUND ELEVATION 247.7 ft
EXCAVATION CONTRACTOR Sure Flow INC
GROUND WATER LEVELS:
EXCAVATION METHOD Hydro Excavation
AT TIME OF EXCAVATION 7.50 ft / Elev 240.20 ft
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0				SANDY LEAN CLAY, moist, dark brown, fine grained	
2.5	GB S-1	CL			
5.0					
7.5					
8.0				Refusal at 8.0 feet on basalt. Bottom of test pit at 8.0 feet.	239.7

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 6

TEST PIT NUMBER TP-09

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/16/21 **COMPLETED** 8/16/21
GROUND ELEVATION 253.2 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	DCP BLOW COUNTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0		29 35 41			SILT WITH SAND, stiff, moist, gray to reddish brown, fine grained	
2.5	GB S-1					
5.0			ML			
7.5						
10.0	GB S-2					
12.0					Refusal at 12.0 feet on limit of excavator. Bottom of test pit at 12.0 feet.	241.2

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 7

TEST PIT NUMBER TP-10

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/16/21 **COMPLETED** 8/16/21
GROUND ELEVATION 256.3 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0		CL		LEAN CLAY WITH SAND, stiff, moist, gray, fine grained	
4.0					252.3
	GB S-1	CL		SANDY LEAN CLAY, stiff, moist, red with gray	
11.0					245.3

Refusal at 11.0 feet on limit of excavator.
Bottom of test pit at 11.0 feet.

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 8

TEST PIT NUMBER TP-11

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/17/21 **COMPLETED** 8/17/21
GROUND ELEVATION 310 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	DCP BLOW COUNTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0					SANDY LEAN CLAY, stiff, moist, dark brown, fine grained, with organics	
			CL			
2.5						
					3.0	307.0
		61			CLAYEY SAND, moist, yellowish brown, fine grained, trace cobbles	
	GB S-1	68				
		74				
5.0			SC			
					7.0	303.0
7.5					CLAYEY GRAVEL WITH SAND, moist, dark red, fine to coarse grained, angular to subangular, weathered basalt	
			GC			
10.0					10.0	300.0

Refusal at 10.0 feet on basalt.
Bottom of test pit at 10.0 feet.

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 9

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

TEST PIT NUMBER TP-12

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/17/21 **COMPLETED** 8/17/21
GROUND ELEVATION 360 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	DCP BLOW COUNTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0		35 19 24	CL		SANDY LEAN CLAY WITH GRAVEL, stiff, moist, reddish brown, fine to coarse grained, organic to 1'	
4.0						356.0
5.0	GB S-1		GC		CLAYEY GRAVEL, moist, dark reddish brown, fine to coarse grained, angular, gravel increases with depth	
9.0						351.0

Refusal at 9.0 feet on basalt.
Bottom of test pit at 9.0 feet.

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 10

TEST PIT NUMBER TP-13

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/17/21 **COMPLETED** 8/17/21
GROUND ELEVATION 445 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0		ML		SANDY SILT, stiff, moist, dark brown, fine grained, low plasticity, roots and organics	443.0
2.0		GC		CLAYEY GRAVEL WITH SAND, stiff, moist, dark reddish tan, fine to coarse grained, angular to subangular, increasing gravel with depth	438.0
2.5	GB S-1				
5.0					
7.0				Refusal at 7.0 feet on basalt. Bottom of test pit at 7.0 feet.	

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

TEST PIT NUMBER TP-15

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/16/21 **COMPLETED** 8/16/21
GROUND ELEVATION 288 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0				SANDY LEAN CLAY, stiff, moist, red with gray, fine grained, medium plasticity	
2.5					
5.0	GB S-1	CL			
7.5					
10.0					
11.0				Refusal at 11.0 feet on limit of excavator. Bottom of test pit at 11.0 feet.	277.0

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 12

TEST PIT NUMBER TP-16

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/16/21 **COMPLETED** 8/16/21
GROUND ELEVATION 309 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0				SANDY LEAN CLAY, stiff, moist, red with gray, fine grained	
2.5	GB S-1				
5.0		CL			
7.5					
10.0	GB S-2				
12.0					297.0

Refusal at 12.0 feet on limit of excavator.
Bottom of test pit at 12.0 feet.

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 13

TEST PIT NUMBER TP-17

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/16/21 **COMPLETED** 8/16/21
GROUND ELEVATION
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0				SANDY LEAN CLAY, stiff, moist, red with gray, fine grained
2.5	GB S-1			
5.0		CL		
7.5				
10.0				
11.0				Refusal at 11.0 feet on limit of excavator. Bottom of test pit at 11.0 feet.

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

TEST PIT NUMBER TP-18

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 8/16/21 **COMPLETED** 8/16/21
GROUND ELEVATION 390 ft
EXCAVATION CONTRACTOR RL Reimers
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 310 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER EXCAVATION ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	DCP BLOW COUNTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0.0					SANDY LEAN CLAY, stiff, moist, red with gray, fine grained	
2.5		50 64 78				
5.0			CL			
7.5						
	GB S-1					
10.0					10.0	380.0

Refusal at 10.0 feet on limit of excavator.
Bottom of test pit at 10.0 feet.

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:48 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 15

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-01

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/9/21 **COMPLETED** 9/24/21
GROUND ELEVATION 291.7 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING 7.50 ft / Elev 284.20 ft
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SILTY SAND WITH GRAVEL, medium dense, moist, brown with grayish white, fine to coarse grained, subangular to subrounded, medium plasticity	
	SPT S-1	93	8 8 8	19	-				
5									
	SPT S-2	87	10 11 13	29	-				
	SPT S-3	93	9 10 8	22	LL: 52 PI: 19 Fines: 33.3% MC: 33.7%				
10						SM			
	SPT S-4	93	10 20 25	54	very dense wet				
15									
	SPT S-5	87	13 17 21	46	dense				
20								20.0	271.7
	SPT S-6	100	11 23 43	55				SILTY SAND, clayey sand, very dense, wet, tan with black, fine to coarse grained, subangular to subrounded, low plasticity	
25									
	SPT S-7	100	29 47 50	116		SC-SM			
30									
	SPT S-8	100	16 23 30	64	MC: 39.1% Fines: 36.0%				
35								35.0	256.7

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 16.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-01

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35	SPT S-9	100	50/4"	60/4"		SM		SILTY SAND WITH GRAVEL, very dense, wet, dark gray, fine to coarse grained, angular to subangular, weathered basalt	
40	SPT S-10	100	42 50/3"	50/5"					
45	SPT S-11	100	50/5"	60/5"				45.4 Bottom of borehole at 45.4 feet.	246.3

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 16.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-02

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/28/21 **COMPLETED** 9/28/21
GROUND ELEVATION 244 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING 4.90 ft / Elev 239.10 ft
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SANDY LEAN CLAY, moist, dark brown, fine grained, medium plasticity	
5						CL			
10								10.0	234.0
	SPT S-1	100	1 2 2	5	-	CL		LEAN CLAY, medium stiff, wet, olive brown, fine grained, subrounded to rounded, medium plasticity	
15	ST ST-1	100			MC: 36.1% DD: 83 / 85 / 86 pcf c: 1000 psf phi: 8.8 degrees			15.0	229.0
	SPT S-2	100	3 3 5	10		CL		SANDY LEAN CLAY, stiff, wet, dark greenish gray, fine grained, subrounded to rounded, high plasticity	
20	SPT S-3	100	2 2 3	6	medium stiff				
25								25.0	219.0
	SPT S-4	100	4 6 7	16		ML		SANDY SILT, very stiff, wet, tan with gray, fine to coarse grained, angular to subangular, weathered in-place basalt, trace gravel	
30	SPT S-5	100	6 19 22	49	hard				
35									

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Figure: A - 17.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-02

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35	SPT S-6	100	17 25 24	59		ML		SANDY SILT, very stiff, wet, tan with gray, fine to coarse grained, angular to subangular, weathered in-place basalt, trace gravel *(continued)*	
40	SPT S-7	100	7 10 18	34					
45	SPT S-8	100	8 12 14	31					
50	SPT S-9	100	50	60/6"				50.5 Bottom of borehole at 50.5 feet.	193.5

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 17.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-03

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/10/21 **COMPLETED** 9/16/21
GROUND ELEVATION 510 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SANDY SILT WITH GRAVEL, hard, moist, reddish brown with gray, fine to coarse grained, angular to subangular, medium plasticity, with cobbles	
	SPT S-1	87	10 13 14	32	-	ML			
5	SPT S-2	86	14 33 50/5"	106/11"					
								8.0	502.0
10								SILTY GRAVEL WITH SAND, very dense, moist, grayish red with brown, fine to coarse grained, angular to subangular, low plasticity, with cobbles, weathered basalt	
	SPT S-3	67	43 50/1"	60/1"	MC: 20.0% Fines: 13.2%	GM			
15								15.0	495.0
	SPT S-4	100	50/1"	60/1"				BASALT, unweathered to highly weathered, greenish gray, low strength to medium high strength, R1 - R3/R4, fractures are filled with siltstone, chlorite alteration in places, basalt is brecciated	
	RC C-1	58 (0)							
20	RC C-2	97 (68)							
25	RC C-3	85 (52)			21.5': UCS: 624 psi				
30	RC C-4	67 (45)			28.5': UCS: 5377 psi				
35	RC C-5	97 (75)			32.5': UCS: 2297 psi				

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 18.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-03

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35								BASALT, unweathered to highly weathered, greenish gray, low strength to medium high strength, R1 - R3/R4, fractures are filled with siltstone, chlorite alteration in places, basalt is brecciated *(continued)*	
40	RC C-6	100 (70)			36.5': UCS: 264 psi				
45	RC C-7	100 (58)							
50	RC C-8	80 (48)			47.5': UCS: 439 psi				
55	RC C-9	97 (57)							
60	RC C-10	78 (43)			60': UCS: 248 psi				
65	RC C-11	73 (18)							
70	RC C-12	100 (62)			67': UCS: 2460 psi				
75	RC C-13	90 (33)			73': UCS: 473 psi				

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 18.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-03

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
75								BASALT, unweathered to highly weathered, greenish gray, low strength to medium high strength, R1 - R3/R4, fractures are filled with siltstone, chlorite alteration in places, basalt is brecciated *(continued)*	
80	RC C-14	93 (68)			79': UCS: 473 psi				
85	RC C-15	100 (53)			85': UCS: 677 psi				
90	RC C-16	100 (27)			87': UCS: 979 psi				
95	RC C-17	85 (40)							
100	RC C-18	48 (0)							
105	RC C-19	100 (65)			103': UCS: 223 psi 105': UCS: 3242 psi				
110	RC C-20	65 (18)			108': UCS: 640 psi				
								111.0	399.0

Bottom of borehole at 111.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 18.3

BORING NUMBER BH-04

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/27/21 **COMPLETED** 9/27/21
GROUND ELEVATION 343.9 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SILTY SAND, clayey sand, stiff, moist, brownish gray, fine to coarse grained, angular to subangular, medium plasticity	
	SPT S-1	100	3 6 10	19	MC: 36.9% Fines: 41.2%	SC-SM			
5	SPT S-2	100	10 50/5"	60/5"	medium dense				
7.5									336.4
	SPT S-3	100	50/3"	60/3"				SILTY GRAVEL WITH SAND, very dense, moist, gray, fine to coarse grained, angular to subangular, low plasticity, highly weathered and fractured in-place basalt	
10	SPT S-4	100	50/3"	60/3"					
15	SPT S-5	100	50/2"	60/2"		GM			
20	SPT S-6	100	50/2"	60/2"					
25									
25.0									318.9
	SPT S-7	100	50/2"	60/2"				BASALT, slightly weathered, slightly fractured, greenish gray, low strength to medium high strength, brecciated, palagonite/chlorite infilling, R3/R1	
	RC C-1	97 (60)							
30									
30.0									313.9

Bottom of borehole at 30.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 19

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-05

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/17/21 **COMPLETED** 9/20/21
GROUND ELEVATION 443.4 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SILTY SAND WITH GRAVEL, dense, moist, reddish brown with gray, fine to coarse grained, angular to subangular, medium plasticity, with cobbles	
	SPT S-1	20	12 17 21	46	LL: 67 PI: 30 MC: 37.2% Fines: 22.7%	SM			
5	SPT S-2	60	10 14 18	38					
								7.0	436.4
	SPT S-3	96	47 50/4"	60/4"		GM		SILTY GRAVEL WITH SAND, very dense, moist, gray with reddish brown, fine to coarse grained, angular to subangular, low plasticity, with cobbles	
10								10.0	433.4
	SPT S-4	0	50/3"	60/3"				BASALT, slightly weathered to moderately weathered, moderately fractured, greenish gray, very low strength to high strength, R0 - R3/R4, fractures are filled with siltstone, chlorite alteration in places, basalt is brecciated	
	RC C-1	89 (0)							
	RC C-2	40 (0)			11': UCS: 929 psi				
15									
	RC C-3	65 (10)							
20									
	RC C-4	40 (0)							
25								25.0	418.4
								BASALT, highly weathered to weathered, intensely fractured, greenish gray, very low strength to medium high strength, R0 - R3, basalt is brecciated with a siltstone matrix	
	RC C-5	80 (15)			30': UCS: 1022 psi				
30									
	RC C-6	40 (7)							
35									

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 20.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-05

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35								BASALT, highly weathered to weathered, intensely fractured, greenish gray, very low strength to medium high strength, R0 - R3, basalt is brecciated with a siltstone matrix *(continued)*	
40	RC C-7	38 (0)							
45	RC C-8	50 (0)							
50	RC C-9	40 (0)			47': UCS: 5332 psi				
55	RC C-10	43 (0)							
60	RC C-11	33 (0)							
65	RC C-12	55 (0)			61': UCS: 324 psi				
70	RC C-13	32 (0)							
75	RC C-14	33 (0)							

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 20.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-05

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
75								BASALT, highly weathered to weathered, intensely fractured, greenish gray, very low strength to medium high strength, R0 - R3, basalt is brecciated with a siltstone matrix *(continued)*	
80	RC C-15	47 (0)							
85	RC C-16	60 (0)							
90	RC C-17	33 (0)			90': UCS: 18061 psi				
95	RC C-18	37 (0)							
100	RC C-19	40 (0)							
105	RC C-20	93 (45)			105': UCS: 374 psi				
110	RC C-21	40 (0)							
115	RC C-22	60 (25)							

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 20.3

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-05

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
115								BASALT, highly weathered to weathered, intensely fractured, greenish gray, very low strength to medium high strength, R0 - R3, basalt is brecciated with a siltstone matrix *(continued)*	
120	RC C-23	72 (45)			119.5': UCS: 1059 psi				
125	RC C-24	67 (0)			125': UCS: 1529 psi				
130	RC C-25	80 (50)			127': UCS: 1204 psi				
								131.0	312.4

Bottom of borehole at 131.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 20.4

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-06

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/27/21 **COMPLETED** 9/27/21
GROUND ELEVATION 291.2 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0						CL		SANDY LEAN CLAY, medium stiff to very stiff, moist, brown with gray, fine grained, high plasticity	
	SPT S-1	67	4 5 5	12	-				
5	SPT S-2	100	0 2 5	8	200 - 250 psi				
	ST ST-1	100							
	SPT S-3	100	2 2 3	6	medium stiff				
10	SPT S-4	100	3 3 6	11	stiff				
15	SPT S-5	100	6 7 12	23	very stiff				
20	SPT S-6	93	3 5 5	12	stiff				
25	SPT S-7	100	5 4 6	12					
								26.5	264.7

Bottom of borehole at 26.5 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 21

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-07

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/28/21 **COMPLETED** 9/28/21
GROUND ELEVATION 338.9 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SANDY LEAN CLAY, stiff, moist, reddish brown with black, fine to coarse grained, angular to subangular, high plasticity, weathered and decomposed basalt	
	SPT S-1	100	5 4 5	11	-				
5	SPT S-2	100	2 3 5	10					
	SPT S-3	100	1 3 4	8					
10	SPT S-4 ST ST-1	100 100	1 1 3	5	medium stiff MC: 65.0% DD: 54 pcf c: 350 psf phi: 37 degrees consol test - see App B				
15	SPT S-5	100	2 3 4	8	stiff	CL			
20	SPT S-6	100	2 3 5	10					
25	SPT S-7	100	1 1 4	6	medium stiff				
30	SPT S-8	100	2 3 6	11	stiff			31.5	307.4

Bottom of borehole at 31.5 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

BORING NUMBER BH-08

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/24/21 **COMPLETED** 9/24/21
GROUND ELEVATION 309.3 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0						CL		SANDY LEAN CLAY, very stiff, moist, orangeish brown with gray, fine to coarse grained, medium plasticity, weathered in-place basalt	
	SPT S-1	93	6 7 6	16	-				
5	SPT S-2	80	14 17 17	41	hard				
	SPT S-3	93	12 19 14	40					
10	SPT S-4	100	10 10 13	28	very stiff				
15								15.0	294.3
	SPT S-5	100	18 22 37	71		SC		CLAYEY SAND WITH GRAVEL, very dense, moist, orangeish brown with gray, fine to coarse grained, angular to subangular, medium plasticity, basalt texture, weathered basalt	
20	SPT S-6	100	30 23 46	83	MC: 23.2% Fines: 21.3%				
25	SPT S-7	100	17 39 50/4"	107/10"				26.3	283.0

Bottom of borehole at 26.3 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 23

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-09

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/22/21 **COMPLETED** 9/23/21
GROUND ELEVATION 359.1 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SANDY SILT WITH GRAVEL, stiff, moist, reddish brown with gray, fine to coarse grained, angular to subangular, medium plasticity	
	SPT S-1	93	4 5 6	13	-				
5	SPT S-2	87	3 7 10	20	very stiff				
	SPT S-3	80	9 13 23	43	hard	ML			
10	SPT S-4	93	29 37 21	70					
15								15.0	344.1
	SPT S-5	100	50/2"	60/2"				SILTY GRAVEL WITH SAND, very dense, moist, gray with reddish brown, fine to coarse grained, angular to subangular, weathered in-place basalt, with cobbles	
20	SPT S-6	25	50/4"	60/4"		GM			
25								25.0	334.1
	SPT S-7	100	50/2"	60/2"				BASALT, highly weathered to weathered, intensely fractured, greenish gray, very low strength to medium high strength, R0 - R3, fractures are filled with siltstone, chlorite/palagonite alteration in places, basalt is brecciated	
	RC C-1	0 (0)							
	RC C-2	33 (10)			26': UCS: 350 psi				
30									
	RC C-3	87 (15)			35': UCS: 481 psi				
35									

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 24.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-09

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35								BASALT, highly weathered to weathered, intensely fractured, greenish gray, very low strength to medium high strength, R0 - R3, fractures are filled with siltstone, chlorite/palagonite alteration in places, basalt is brecciated *(continued)*	
40	RC C-4	40 (0)							
45	RC C-5	97 (60)			43.5': UCS: 631 psi 45.5': UCS: 1410 psi				
50	RC C-6	48 (0)							
55	RC C-7	55 (0)							
60	RC C-8	68 (17)			57': UCS: 14194 psi 57': UCS: 7636 psi				
65	RC C-9	32 (0)							
70	RC C-10	85 (54)			69': UCS: 1059 psi				
								70.0 Bottom of borehole at 70.0 feet.	289.1

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 24.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-10

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/28/21 **COMPLETED** 9/28/21
GROUND ELEVATION 263.1 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0	SPT S-1	100	5 4 4	10	-	CL		SANDY LEAN CLAY, stiff, moist, dark brown, fine to coarse grained, subangular to subrounded, medium plasticity, [FILL]	259.1
								4.0	
5	SPT S-2	100	3 6 9	18	LL: 60 PI: 35 MC: 32.0% Fines: 74.6%	CH		SANDY FAT CLAY WITH GRAVEL, very stiff, moist, reddish brown, fine to coarse grained, angular to subangular, high plasticity	255.1
								8.0	
	SPT S-3	100	18 33 34	80		GM		SILTY GRAVEL WITH SAND, very dense, moist, gray, fine to coarse grained, angular to subangular, low plasticity	
10	SPT S-4	100	50	60/6"					
15	SPT S-5	67	50/3"	60/3"					
20	SPT S-6	100	50/2"	60/2"	MC: 20.5% Fines: 27.0%				
25	SPT S-7	100	50/2"	60/2"				25.2	237.9
								Bottom of borehole at 25.2 feet.	

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Figure: A - 25

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-11

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/8/21 **COMPLETED** 9/9/21
GROUND ELEVATION 274.8 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SILTY SAND, medium dense, moist, dark reddish brown with gray, fine grained, high plasticity	
5	SPT S-1	87	3 4 5	11	-	SM			
	SPT S-2	93	3 4 5	11	MC: 49.7% Fines: 33.5%				
								7.0	267.8
10	SPT S-3	100	1 2 3	6				SANDY SILT, medium stiff, moist, dark reddish brown with gray, fine grained, high plasticity	
	SPT S-4	100	1 2 3	6					
15	ST ST-1	100			MC: 69.8% DD: 52 / 57pcf Su: 1039 psf k: 0.00000411 cm/s consol test - see App B				
	SPT S-5	93	1 2 2	5	LL: 85 PI: 41 MC: 80.7% Fines: 65.9%				
20	SPT S-6	93	2 3 5	10	stiff	MH			
25	SPT S-7	100	1 2 3	6	medium stiff				
30	SPT S-8	100	1 2 3	6	MC: 72.2% Fines: 54.9%				
35									

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 26.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-11

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35								SANDY SILT, medium stiff, moist, dark reddish brown with gray, fine grained, high plasticity *(continued)*	
40	SPT S-9	100	4 8 10	22	very stiff	MH			
45								45.0	229.8
								SILTY SAND, very dense, moist, greenish gray, fine grained, angular to subangular, low plasticity, weathered basalt	
50	SPT S-10	100	14 21 30	61		SM		51.5	223.3

Bottom of borehole at 51.5 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 26.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-12

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/7/21 **COMPLETED** 9/7/21
GROUND ELEVATION 270.7 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SANDY ELASTIC SILT, stiff, moist, orangeish brown, fine grained, high plasticity, saprolitic basalt	
	SPT S-1	93	2 6 6	14	-				
5	SPT S-2	100	2 2 4	7	medium stiff				
	SPT S-3	100	1 1 3	5	LL: 78 PI: 36 MC: 61.1% Fines: 50.7%				
10	SPT S-4 ST ST-2	93 100	0 1 1	2	MC: 63.9% DD: 58 pcf Su: 1159 psf consol test - see App B				
	SPT S-5	100	1 1 1	2	soft	MH			
15	SPT S-6	100	0 2 1	4	medium stiff				
20	SPT S-7 ST ST-3	100 100	1 2 4	7	MC: 64.9% c: 200 psf phi: 41 degrees consol test - see App B				
25	SPT S-8	100	1 2 5	8					
								28.0	242.7
30	SPT S-9	100	1 1 2	4	LL: 67 PI: 21 MC: 66.3% Fines: 48.2%	SM		SILTY SAND, loose, moist, orangeish brown, fine grained, angular to subangular, saprolitic basalt, weathered basalt	
35									

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 27.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-12

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35	SPT S-10	100	2 2 3	6		SM		SILTY SAND, loose, moist, orangeish brown, fine grained, angular to subangular, saprolitic basalt, weathered basalt *(continued)*	
40	ST ST-1	80							
45	SPT S-11	100	5 10 18	34	MC: 44.2% Fines: 38.0% dense			46.5 Bottom of borehole at 46.5 feet.	224.2

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Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-13

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/9/21 **COMPLETED** 9/9/21
GROUND ELEVATION 390.2 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0						ML		SANDY SILT, very stiff, moist, dark red with gray, fine grained, medium plasticity, weathered saprolitic basalt	
	SPT S-1	67	5 10 12	26	-				
5	SPT S-2	73	5 7 6	16					
	SPT S-3	80	2 3 5	6	medium stiff				
10	SPT S-4	73	2 4 4	10	stiff				
15	SPT S-5	80	1 1 2	4	medium stiff				
20								20.0	370.2
	SPT S-6	93	5 11 21	38		SM		SILTY SAND WITH GRAVEL, dense, moist, dark red with gray, fine to coarse grained, angular to subangular, weathered basalt	
25	SPT S-7	93	3 6 10	19	MC: 47.7% Fines: 27.1% medium dense				
30								30.0	360.2
	SPT S-8	87	18 13 34	56	MC: 25.2% Fines: 18.8%	SM		SILTY SAND WITH GRAVEL, very dense, moist, greenish gray, fine to coarse grained, angular to subangular, weathered basalt	
35									

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 28.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-13

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35	SPT S-9	100	50/3"	60/3"		SM		SILTY SAND WITH GRAVEL, very dense, moist, greenish gray, fine to coarse grained, angular to subangular, weathered basalt *(continued)*	
40	SPT S-10	0	50/1"	60/1"					
45	SPT S-11	100	50/1"	60/1"				45.0	345.2
	RC C-1	52 (26)						BASALT, highly weathered to slightly weathered, moderately fractured, greenish gray, low strength to medium high strength, R1 - R3	
50								50.0	340.2

Bottom of borehole at 50.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 28.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-14

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/7/21 **COMPLETED** 9/7/21
GROUND ELEVATION 239 ft
DRILLING CONTRACTOR Western States Soil Conservation Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS	Corrected N-Value	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SANDY FAT CLAY, stiff, moist, brown to gray, high plasticity	
	SPT S-1	80	3 3 7	12	-				
5									
	SPT S-2	100	2 3 3	7	LL: 56 PI: 31 MC: 32.6% Fines: 77.8% medium stiff	CH			
	SPT S-3	100	1 3 3	5					
10									
	ST ST-1	0							
	ST ST-2	0							
15								12.0	227.0
	SPT S-4	100	2 3 6	11	LL: 62 PI: 39 MC: 32.4% Fines: 62.2%	CH		SANDY FAT CLAY WITH GRAVEL, stiff, moist, greenish gray, fine grained, rounded, high plasticity	
	SPT S-5	100	17 37 42	95					
20									
	SPT S-6	100	10 27 50/5"	92/11"	MC: 15.0% Fines: 21.0%	SM			
25								17.0	222.0
	SPT S-7	100	50/1"	60/1"	MC: 4.1% Fines: 18.1%			SILTY SAND WITH GRAVEL, very dense, moist, greenish gray with brown, fine to coarse grained, angular to subangular, medium plasticity, weathered-in-place basalt	
								25.1	213.9
								Bottom of borehole at 25.1 feet.	

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-15

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 11/8/22 **COMPLETED** 11/12/22
GROUND ELEVATION 408 ft
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING 6.00 ft / Elev 402.00 ft
LOGGED BY KAK **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								CLAYEY SAND, very dense, moist, red and gray, fine to coarse grained	
5	SPT S-1		17 20 25	54		SC			
10	SPT S-2		37 50/5"	60/5"				10.0	398.0
15						GM		SILTY GRAVEL WITH SAND, wet, gray, fine to coarse grained, angular, weathered basalt at 10.5'	
20	RC C-1	87 (0)						15.0	393.0
25	RC C-2	67 (0)						BASALT, slightly weathered, highly fractured, interbedded, gray to greenish gray, very low strength to moderate strength, clay infilling, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R2	
30	RC C-3	75 (0)							
35	RC C-4	77 (10)							

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Figure: A - 30.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-15

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35	RC C-5	50 (17)						BASALT, slightly weathered, highly fractured, interbedded, gray to greenish gray, very low strength to moderate strength, clay infilling, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R2 *(continued)*	
40	RC C-6	100 (0)							
45	RC C-7	83 (19)							
50	RC C-8	92 (60)							
55	RC C-9	73 (20)							
	RC C-10	97 (13)							
	RC C-11	75 (0)							
60	RC C-12	92 (28)							
65	RC C-13	100 (65)							
	RC C-14	73 (0)							
70	RC C-15	60 (0)			69' - 70' clayey soft highly weathered				
75	RC C-16	83 (17)							

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 30.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-15

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
75	RC C-17	120 (37)			75' - 77.5' clayey soft			BASALT, slightly weathered, highly fractured, interbedded, gray to greenish gray, very low strength to moderate strength, clay infilling, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R2 *(continued)*	
80	RC C-18	97 (88)							
85	RC C-19	97 (77)							
90	RC C-20	95 (14)							
95	RC C-21	70 (0)							
	RC C-22	86 (0)							
100	RC C-23	90 (20)							
	RC C-24	100 (0)							
	RC C-25	100 (58)							
105	RC C-26	20 (7)			106' - 110' highly weathered topsoil no returns washed out				
110	RC C-27	100 (57)							
115									

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 30.3

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-15

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
115	RC C-28	100 (73)						BASALT, slightly weathered, highly fractured, interbedded, gray to greenish gray, very low strength to moderate strength, clay infilling, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R2 *(continued)*	
120	RC C-29	100 (80)							
125	RC C-30	100 (60)							
130	RC C-31	100 (35)							
135	RC C-32	100 (50)			132' - 133' fast advance softer				
140	RC C-33	100 (87)							
145	RC C-34	100 (40)							
150	RC C-35	100 (32)							
155	RC C-36	63 (0)							

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 30.4

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-15

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
155	RC C-37	100 (0)						BASALT, slightly weathered, highly fractured, interbedded, gray to greenish gray, very low strength to moderate strength, clay infilling, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R2 *(continued)*	
	RC C-38	100 (64)							
160	RC C-39	43 (0)							
	RC C-40	100 (37)							
165								165.0	243.0

Bottom of borehole at 165.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-16

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 11/16/22 **COMPLETED** 11/16/22
GROUND ELEVATION 310 ft
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING 19.40 ft / Elev 290.60 ft
LOGGED BY KAK **CHECKED BY** LMS
24HRS AFTER DRILLING 4.60 ft / Elev 305.40 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								FAT CLAY, hard, moist, brown to light brown, fine grained	
5	SPT S-1		3 10 18	34	wet	CH			
10	SPT S-2		18 25 35	72					
15	SPT S-3		22 29 29	70					
								17.5	292.5
20	SPT S-4	0 (0)	50/5"	60/5"				SHALE, slightly weathered, blueish green, fine, very low strength to low strength, basaltic rip-up clasts at contact, R0 - R1	
	RC C-1	100 (0)							
	RC C-2	75 (13)							
25	RC C-3								
	RC C-4	100 (63)							
30	RC C-5	100 (67)							
	RC C-6	100 (63)							
35								23.0	287.0
								BASALT, unweathered to slightly weathered, slightly fractured, interbedded, gray to greenish gray, moderate strength, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R2	

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Figure: A - 31.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-16

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35									
40	RC C-7	100 (63)						BASALT, unweathered to slightly weathered, slightly fractured, interbedded, gray to greenish gray, moderate strength, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R2 *(continued)*	270.0
							40.0	Bottom of borehole at 40.0 feet.	

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-17

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 11/13/22 **COMPLETED** 11/14/22
GROUND ELEVATION 400 ft
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING 20.50 ft / Elev 379.50 ft
LOGGED BY KAK **CHECKED BY** LMS
24HRS AFTER DRILLING 19.50 ft / Elev 380.50 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SANDY LEAN CLAY, stiff, moist, yellowish red to blackish gray, fine to medium grained, subangular to subrounded, medium plasticity, gravelly weak cementation, iron oxide staining	
5	SPT S-1		3 4 5	11					
10	SPT S-2		7 10 14	29	very stiff				
15	SPT S-3		2 5 7	14	organic/peat lenses at 15-16.5' stiff 17' - 19' weakly cemented sand organic stringers	CL			
20	SPT S-4		14 50/5"	60/5"	20' - 25' weathered top of rock augered to core point at 25'				
25	RC C-1	86 (29)			26.5' - 27.5' soil-filled fracture (clay)			25.0 BASALT, unweathered to slightly weathered, moderately fractured, interbedded, blackish gray to greenish gray, very low strength to high strength, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R4	375.0
30	RC C-2	80 (0)							
	RC C-3	100 (6)							
35	RC	100							

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 32.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-17

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35	C-4	(33)						BASALT, unweathered to slightly weathered, moderately fractured, interbedded, blackish gray to greenish gray, very low strength to high strength, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R4 *(continued)*	
40	RC C-5	100 (23)			38' - 38.5 soil-filled fracture (clay/organics)				
45	RC C-6	100 (78)							
50	RC C-7	100 (63)							
55	RC C-8	100 (23)							
	RC C-9	100 (30)							
	RC C-10	67 (0)							
60	RC C-11	100 (23)							
	RC C-12	100 (27)							
65	RC C-13	100 (88)							
70	RC C-14	80 (50)							
75	RC C-15	100 (67)							
	RC C-16	100 (60)							

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 32.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-17

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
75	RC C-17	100 (24)						BASALT, unweathered to slightly weathered, moderately fractured, interbedded, blackish gray to greenish gray, very low strength to high strength, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R4 *(continued)*	
80	RC C-18	100 (50)							
	RC C-19	100 (60)							
85	RC C-20	100 (63)							
90	RC C-21	100 (27)							
	RC C-22	100 (73)							
95	RC C-23	100 (54)							
100	RC C-24	100 (62)							
	RC C-25	100 (50)							
105	RC C-26	100 (23)							
	RC C-27	100 (0)							
110	RC C-28	100 (17)							
	RC C-29	100 (17)							
115									

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 32.3

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-17

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
115	RC C-30	100 (90)						BASALT, unweathered to slightly weathered, moderately fractured, interbedded, blackish gray to greenish gray, very low strength to high strength, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R4 *(continued)*	
120	RC C-31	100 (73)						120.0	280.0

Bottom of borehole at 120.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-18

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 11/12/22 **COMPLETED** 11/13/22
GROUND ELEVATION 370 ft
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING 25.20 ft / Elev 344.80 ft Conclusion of HSA , cor
LOGGED BY KAK **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0								SANDY LEAN CLAY, very stiff, moist, reddish brown with blackish gray, fine grained, subangular to subrounded, medium plasticity, laminated, weak cementation, iron oxide staining	
5	SPT S-1		5 7 8	18		CL			
10	SPT S-2		24 14 13	32	10' - 10.5' weakly cemented sand stringer hard				
15	SPT S-3		50/5"	60/5"					
20	SPT S-4		8 4 5	11	stiff				
25	SPT S-5		3 12 48	72	25' - 26' wet elastic/plastic tan clay interbed atop rock weathered rock 27' - 30' weathered top of bedrock augered to core point at 30'			27.0	343.0
30	RC C-1	100 (53)						BASALT, slightly weathered to unweathered, moderately fractured, interbedded, greenish gray to blackish gray, very low strength to medium high strength, clastic infilling, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R3	
35	RC C-2	100 (62)							

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 33.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-18

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35								BASALT, slightly weathered to unweathered, moderately fractured, interbedded, greenish gray to blackish gray, very low strength to medium high strength, clastic infilling, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R3 *(continued)*	
40	RC C-3	100 (63)							
45	RC C-4	100 (67)							
50	RC C-5	100 (55)							
55	RC C-6	100 (58)			57' - 58.5' greenish gray drilling fluids changed to brown then back to gray				
60	RC C-7	100 (65)							
65	RC C-8	100 (77)							
70	RC C-9	100 (80)							
75	RC C-10	100 (67)							

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 33.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-18

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
75								BASALT, slightly weathered to unweathered, moderately fractured, interbedded, greenish gray to blackish gray, very low strength to medium high strength, clastic infilling, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R3 *(continued)*	
80	RC C-11	100 (55)			80' - 81.5' volcaniclastic poorly-graded sand interbed (S-6)				
	GB S-6								
	RC C-12	100 (62)							
85	RC C-13	100 (67)			C-13 and C-14 contained sloughing sand atop core from wash out at 80'				
	RC C-14	100 (67)							
90	RC C-15	100 (50)							
	RC C-16	100 (71)							
95	RC C-17	100 (90)							
	RC C-18	100 (50)							
100	RC C-19	88 (29)							
	RC C-20	100 (71)							
105									
	RC C-21	100 (33)							
110									
	RC C-22	100 (58)							
115									

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 33.3

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-18

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
115									
	RC C-23	100 (30)						BASALT, slightly weathered to unweathered, moderately fractured, interbedded, greenish gray to blackish gray, very low strength to medium high strength, clastic infilling, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R3 *(continued)*	
120	RC C-24	100 (30)							250.0
							120.0	Bottom of borehole at 120.0 feet.	

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-19

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 11/15/22 **COMPLETED** 11/16/22
GROUND ELEVATION 438 ft
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME Track Rig
AT TIME OF DRILLING 17.83 ft / Elev 420.17 ft
LOGGED BY KAK **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0						GM		0.5 SILTY GRAVEL WITH SAND, slightly moist, blackish gray, fine to coarse grained, angular to subangular, road base, [FILL]	437.5
								FAT CLAY, stiff, moist, yellowish red to orangeish black, fine grained	
5	SPT S-1		3 4 4	10					
10	SPT S-2		0 0 0	0	very soft	CH			
15	SPT S-3		1 1 3	5	medium stiff				
20	SPT S-4		8 7 7	17	very stiff wet				
25	RC C-1	100 (28)			22.5' - 25' top of rock augered to core point at 25'			22.5 BASALT, slightly weathered to unweathered, moderately fractured, interbedded, greenish gray to blackish gray, very low strength to medium high strength, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R3	415.5
30	RC C-2	100 (58)							
35	RC C-3	100 (73)							

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 34.1

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-19

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
35								BASALT, slightly weathered to unweathered, moderately fractured, interbedded, greenish gray to blackish gray, very low strength to medium high strength, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R3 *(continued)*	
	RC C-4	100 (33)							
40	RC C-5	100 (0)							
	RC C-6	100 (86)							
45	RC C-7	100 (20)							
	RC C-8	67 (0)							
50	RC C-9	100 (70)							
	RC C-10	100 (33)							
55	RC C-11	100 (0)							
	RC C-12	61 (19)							
60	RC C-13	80 (0)							
	RC C-14	100 (8)			63.5' - 64' highly weathered rock with clay infilling				
65	RC C-15	76 (12)							
	RC C-16	100 (33)							
70	RC C-17	100 (13)							
	RC C-18	100 (47)							
75									

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 34.2

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-19

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
75								BASALT, slightly weathered to unweathered, moderately fractured, interbedded, greenish gray to blackish gray, very low strength to medium high strength, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R3 *(continued)*	
	RC C-19	100 (13)							
80	RC C-20	100 (33)							
	RC C-21	100 (35)							
85					86' - 87' greenish gray drilling fluids changed to brown gray again at 87'				
	RC C-22	100 (8)							
90	RC C-23	80 (30)							
	RC C-24	87 (13)							
95	RC C-25	100 (0)							
	RC C-26	100 (50)							
100	RC C-27	100 (20)			100' - 100.5' bit jammed trip out of hole to inspect				
	RC C-28	100 (0)							
105	RC C-29	100 (50)							
	RC C-30	100 (50)							
110									
115	RC C-31	100 (63)							

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 34.3

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER BH-19

CLIENT CEC, Inc. **PROJECT NAME** Coffin Butte Landfill

PROJECT NUMBER 21129-1 **PROJECT LOCATION** Corvallis, OR

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS	Corrected N-Value	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
115									
120	RC C-32	100 (33)						BASALT, slightly weathered to unweathered, moderately fractured, interbedded, greenish gray to blackish gray, very low strength to medium high strength, clay infilling, moderately weathered zones, highly fractured zones, discontinuites are high angle (55 - 90 degrees) with chloritic siltstone, pyrite, and calcite infilling, joints and discontinuities are wavey to smooth with schistose/phyllitic faces, R0 - R3 *(continued)*	
								120.0	318.0

Bottom of borehole at 120.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 15:02 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER GP-01

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/21/22 **COMPLETED** 9/22/22
GROUND ELEVATION 238.82 ft
DRILLING CONTRACTOR Oregon Geotechnical Explorations
GROUND WATER LEVELS:
DRILLING METHOD geoprobe 6622
AT TIME OF DRILLING 1.97 ft / Elev 236.85 ft
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0					SANDY FAT CLAY, stiff to very stiff, wet, brown to gray	
5	GB S-1	MC: 29.9% Fines: 98.1% LL: 58 PI: 32	CH			
	ST ST-1					
10	GB S-2	MC: 35.6% Fines: 97.4% LL: 54 PI: 31				
	ST ST-2					
15					15.0	223.8
	ST ST-3		CH		SANDY FAT CLAY WITH GRAVEL, stiff to very stiff, wet, greenish gray	
20					20.0	218.8
			CL		SANDY LEAN CLAY WITH GRAVEL, stiff to very stiff, wet, greenish gray with brown, weathered in-place basalt	
					22.5	216.3

Bottom of borehole at 22.5 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER GP-02

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/22/22 **COMPLETED** 9/22/22
GROUND ELEVATION 237.06 ft
DRILLING CONTRACTOR Oregon Geotechnical Explorations
GROUND WATER LEVELS:
DRILLING METHOD geoprobe 6622
AT TIME OF DRILLING 2.02 ft / Elev 235.04 ft
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0				SANDY LEAN CLAY, stiff to very stiff, wet, brown to gray	
5	GB S-1	CL			
	GB S-2				
10	ST ST-1			12.0	225.1
	GB S-3	CL		SANDY LEAN CLAY WITH GRAVEL, stiff to very stiff, wet, reddish brown to reddish black, weathered in-place basalt	
15	ST ST-2			17.0	220.1

Bottom of borehole at 17.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

BORING NUMBER GP-03

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/22/22 **COMPLETED** 9/22/22
GROUND ELEVATION 258.82 ft
DRILLING CONTRACTOR Oregon Geotechnical Explorations
GROUND WATER LEVELS:
DRILLING METHOD geoprobe 6622
AT TIME OF DRILLING 12.00 ft / Elev 246.82 ft
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING 19.00 ft / Elev 239.82 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0					SANDY LEAN CLAY, stiff, moist, brown to gray	
	GB S-1		CL			
5						
	GB S-2					
	ST ST-1		ML			
10						
	GB S-3	wet				
					14.0	244.8
15					SILTY SAND WITH GRAVEL, dense to very dense, wet, greenish gray with red, fine to coarse grained, angular to subangular, weathered in-place basalt	
	GB S-4		SM			
					19.0	239.8
					Bottom of borehole at 19.0 feet.	

SANDY SILT, stiff, moist, red with gray, fine grained, weathered in-place basalt

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

BORING NUMBER GP-04

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/22/22 **COMPLETED** 9/22/22
GROUND ELEVATION 263.42 ft
DRILLING CONTRACTOR Oregon Geotechnical Explorations
GROUND WATER LEVELS:
DRILLING METHOD geoprobe 6622
AT TIME OF DRILLING 20.82 ft / Elev 242.60 ft
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0					SANDY FAT CLAY, very stiff to hard, moist, red with gray, fine grained, weathered in-place basalt	
5	GB S-1	MC: 22.6% LL: 63 PI: 38	CH			
10	GB S-2	MC: 37.3%				
	ST ST-1					
15	GB S-3	MC: 40.1% LL: 75 PI: 38				
					17.0	246.4
20	ST ST-2	MC: 70.0% C': 0 psf phi: 33.3°	MH		ELASTIC SILT WITH SAND, medium stiff to very stiff, wet, red with gray, weathered in-place basalt	
					22.0	241.4
25	GB S-4	MC: 75.6%	MH		ELASTIC SILT WITH SAND, medium stiff to very stiff, wet, red with gray, weathered in-place basalt	
	GB S-5	MC: 69.7% LL: 78 PI: 30				
	GB S-6	MC: 70.3%				
30	ST ST-3	MC: 65.4 / 62.9 / 69.6% DD: 61 / 63 / 59 pcf C': 0 psf phi: 35.5°				
					30.5	232.9
					Bottom of borehole at 30.5 feet.	

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 40

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER GP-05

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/22/22 **COMPLETED** 9/22/22
GROUND ELEVATION 302.68 ft
DRILLING CONTRACTOR Oregon Geotechnical Explorations
GROUND WATER LEVELS:
DRILLING METHOD geoprobe 6622
AT TIME OF DRILLING 15.70 ft / Elev 286.98 ft
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0					ELASTIC SILT, stiff to very stiff, moist, dark brown, fine grained, weathered in-place basalt, with sand	
5	GB S-1	-	MH			
	GB S-2	MC: 42.6% LL: 73 PI: 34				
					9.0	293.7
10	ST ST-1	MC: 41.2 / 48.2 / 41.2% DD: 79 / 71 / 79 pcf C': 150 psf phi: 39°	SC		CLAYEY SAND, medium dense, moist, red with gray, weathered in-place basalt	
					14.0	288.7
15	GB S-3	MC: 45.1% Fines: 28.9%	SC-SM		SILTY SAND, clayey sand, wet, dark gray brown, fine to coarse grained, angular to subangular, weathered in-place basalt	
					17.5	285.2

Bottom of borehole at 17.5 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER GP-06

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/22/22 **COMPLETED** 9/22/22
GROUND ELEVATION 290.84 ft
DRILLING CONTRACTOR Oregon Geotechnical Explorations
GROUND WATER LEVELS:
DRILLING METHOD geoprobe 6622
AT TIME OF DRILLING 31.90 ft / Elev 258.94 ft
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0					ELASTIC SILT, stiff to hard, moist, red with gray, fine grained, weathered in-place volcanics	
5	GB S-1	-	MH			
10	GB S-2	MC: 39.0% LL: 80 PI: 36				
	ST ST-1					
14.0						276.8
15	GB S-3		ML		SILT, stiff, moist, dark brown and yellow, with fine grained sand	
20	GB S-4	MC: 71.9%				
20.0						270.8
	ST ST-2		MH		ELASTIC SILT, stiff, moist, light tan with reddish gray	
25	GB S-5	MC: 75.0% LL: 84 PI: 30				
26.0						264.8
	GB S-6	MC: 80.6%	ML		SILT, stiff to very stiff, brownish yellow and yellowish brown	
30	ST ST-3					
31.0						259.8
					Bottom of borehole at 31.0 feet.	

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 42

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER GP-07

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/23/22 **COMPLETED** 9/23/22
GROUND ELEVATION 287.77 ft
DRILLING CONTRACTOR Oregon Geotechnical Explorations
GROUND WATER LEVELS:
DRILLING METHOD geoprobe 6622
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING 4.50 ft / Elev 283.27 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0					SANDY LEAN CLAY, moist, brown to gray, fine to coarse grained, angular to subangular, [FILL]	
	GB S-1	MC: 26.9% Fines: 53.1%	CL			
4.0						283.8
5			CL		SANDY LEAN CLAY, medium stiff, wet, dark gray to greenish gray, fine grained, organics	
	ST ST-1					
7.0						280.8
	ST ST-2		ML		SILT, medium dense, wet, brown and very light brown, fine to coarse grained, angular, trace sand and weathered in-place basalt	
10						
	GB S-2	MC: 38.3%				
15						
15.0						272.8
	GB S-3	MC: 25.5% Fines: 45.9%	SC		CLAYEY SAND, medium dense to dense, tannish brown, fine to coarse grained, angular, weathered in-place basalt	
20						
	GB S-4					
25						
25.0						262.8

Bottom of borehole at 25.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER GP-08

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 11/8/22 **COMPLETED** 11/8/22
GROUND ELEVATION 360.17 ft
DRILLING CONTRACTOR Oregon Geotechnical Explorations
GROUND WATER LEVELS:
DRILLING METHOD geoprobe 6622
AT TIME OF DRILLING ---
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0				SANDY LEAN CLAY WITH GRAVEL, stiff to hard, moist, reddish brown with dark gray, fine to coarse grained, subangular to subrounded, with cobbles, weathered in-place basalt	
	GB S-1				
5					
	GB S-2				
10		CL			
	GB S-3				
15					
	GB S-4				
				19.0	341.2
20				BASALT, dark gray	
				21.0	339.2

Bottom of borehole at 21.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Wallace Group Inc.
62915 NE 18th Street, Suite 1
Bend, OR 97701

BORING NUMBER GP-09

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED 9/23/22 **COMPLETED** 9/23/22
GROUND ELEVATION 288.85 ft
DRILLING CONTRACTOR Oregon Geotechnical Explorations
GROUND WATER LEVELS:
DRILLING METHOD geoprobe 6622
AT TIME OF DRILLING 7.28 ft / Elev 281.57 ft
LOGGED BY SMW **CHECKED BY** LMS
24HRS AFTER DRILLING ---
NOTES

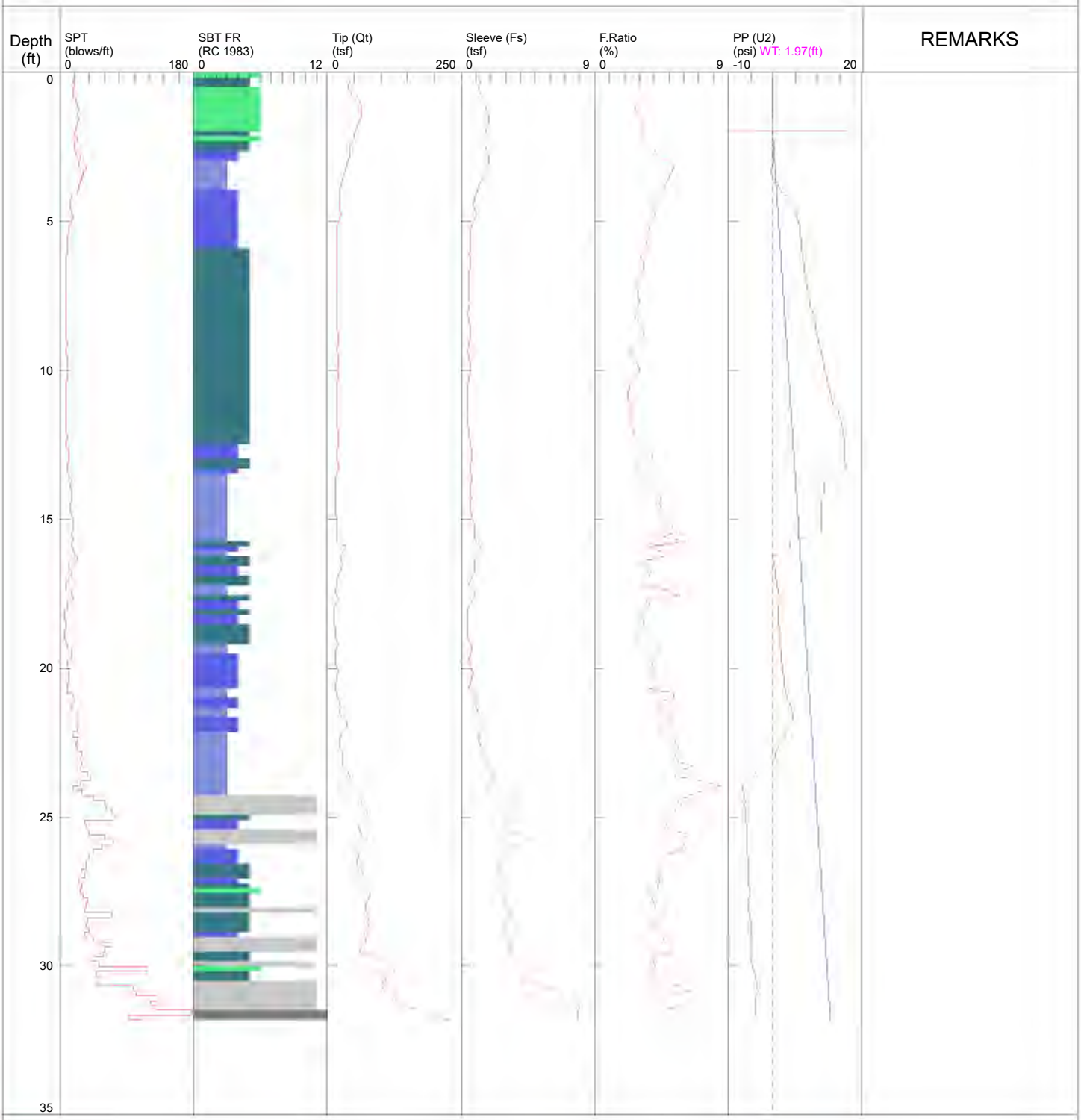
DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Approximate Elevation
0					FAT CLAY, stiff to very stiff, moist, dark gray, fine grained, roots and organics	
	GB S-1	MC: 28.3% Fines: 92.9% LL: 73 PI: 53	CH			
5	ST ST-1					
					6.5	282.4
	GB S-2		SM		SILTY SAND WITH GRAVEL, very dense, wet, tan with blackish brown, fine to coarse grained, angular to subangular, weathered basalt	
10					10.0	278.9

Bottom of borehole at 10.0 feet.

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 12/15/23 12:47 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

The Wallace Group / CPT-1 / 29160 Coffin Butte Rd

OPERATOR: OGE DMM
CONE ID: DDG1532
TEST DATE: 9/21/2022 4:21:43 PM
TOTAL DEPTH: 31.824 ft

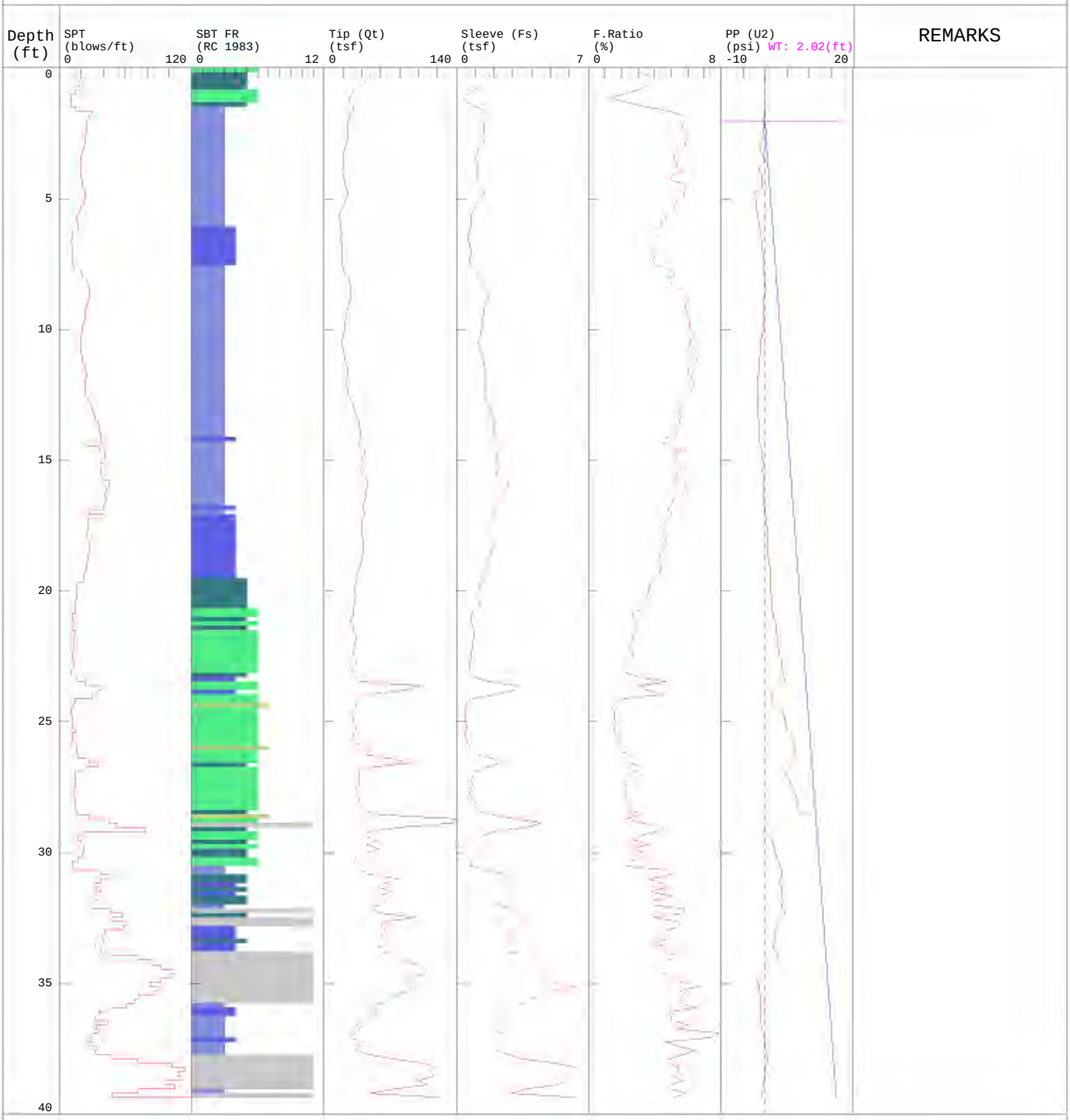


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

The Wallace Group / CPT-2 / 29160 Coffin Butte Rd

OPERATOR: OGE DMM
CONE ID: DDG1532
TEST DATE: 9/21/2022 3:15:49 PM
TOTAL DEPTH: 39.370 ft

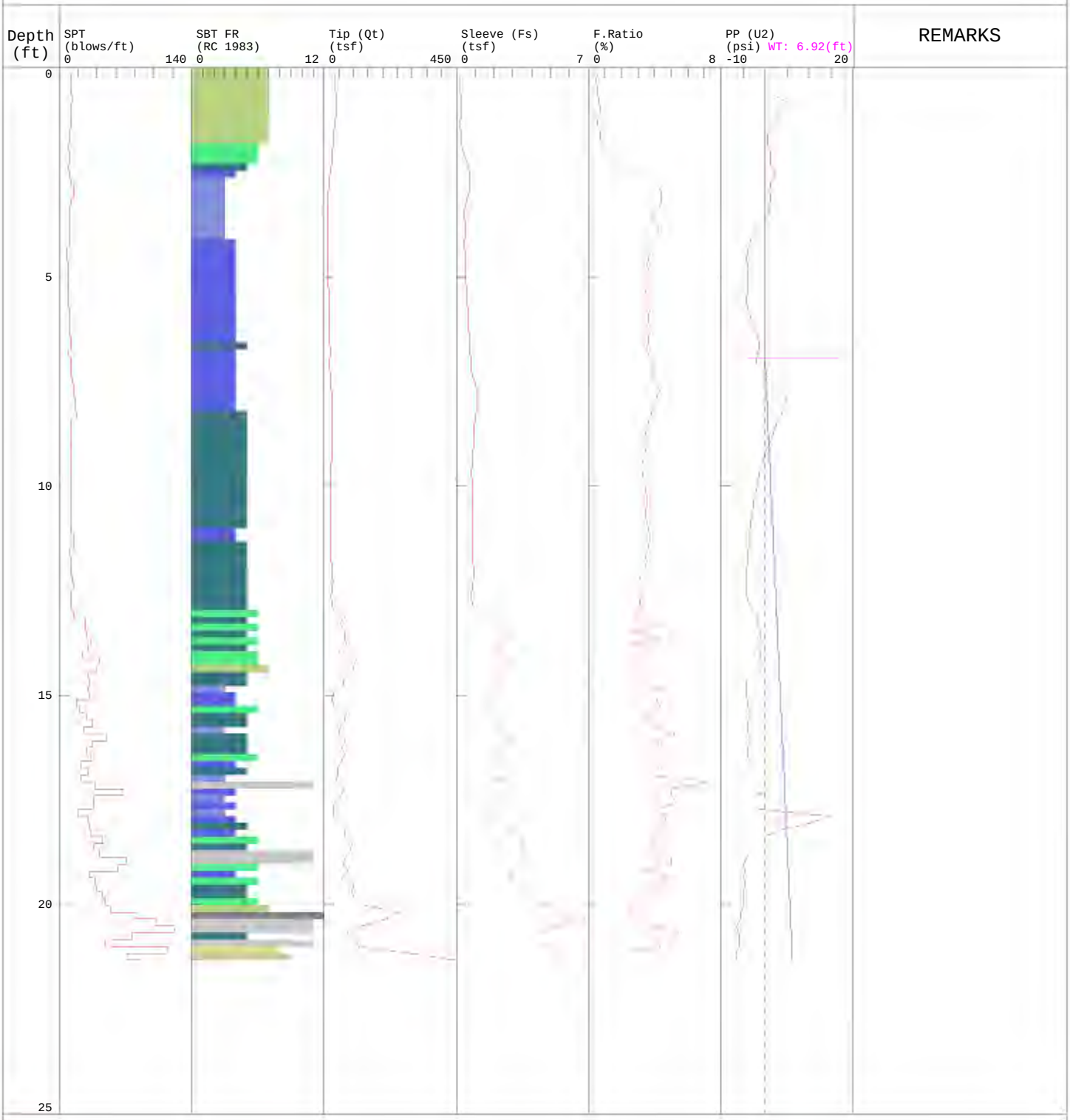


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

The Wallace Group / CPT-3 / 29160 Coffin Butte Rd

OPERATOR: OGE DMM
CONE ID: DDG1532
TEST DATE: 9/21/2022 10:38:43 AM
TOTAL DEPTH: 21.325 ft

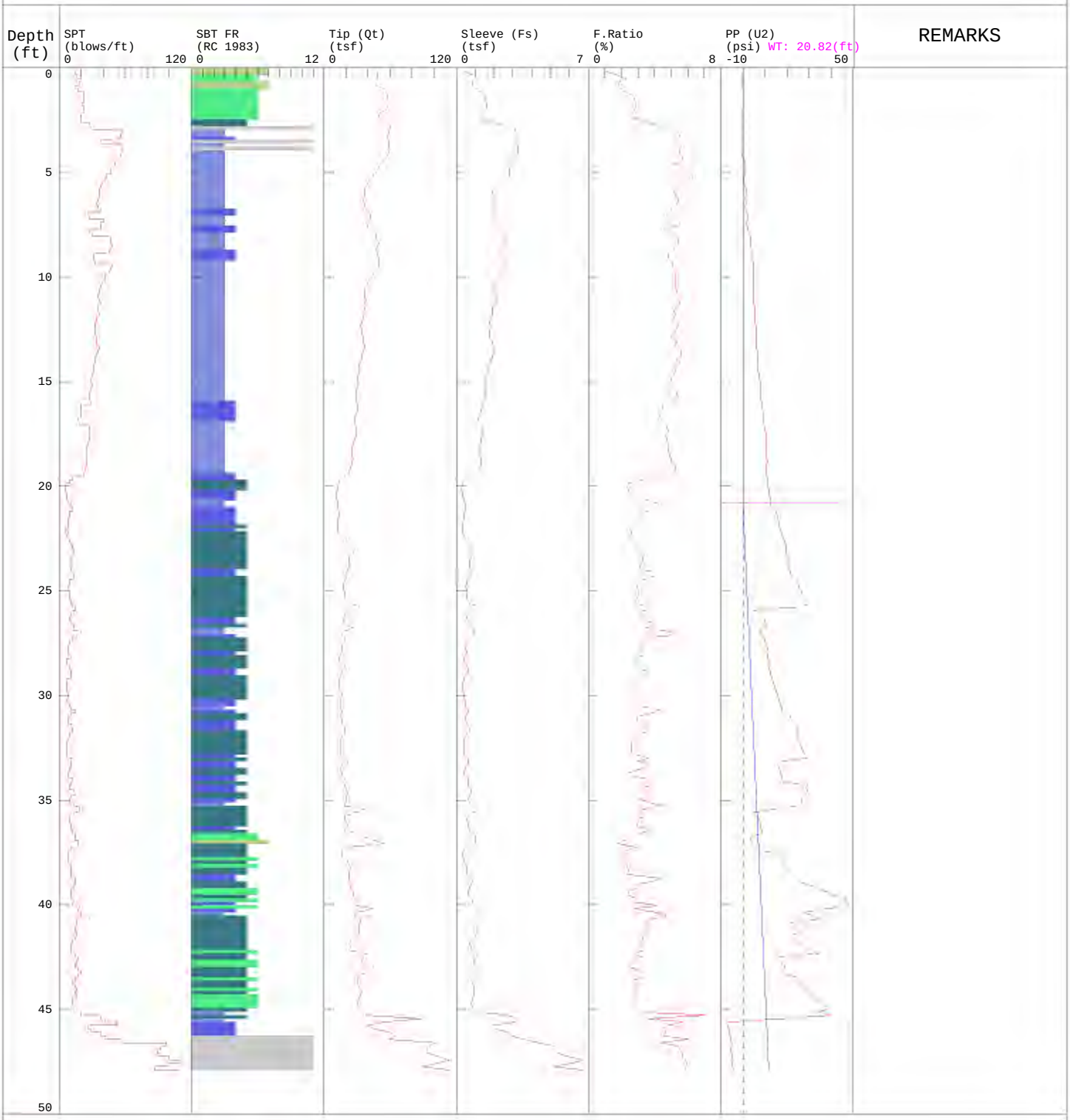


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

The Wallace Group / CPT-4 / 29160 Coffin Butte Rd

OPERATOR: OGE DMM
CONE ID: DDG1532
TEST DATE: 9/21/2022 2:02:24 PM
TOTAL DEPTH: 47.900 ft

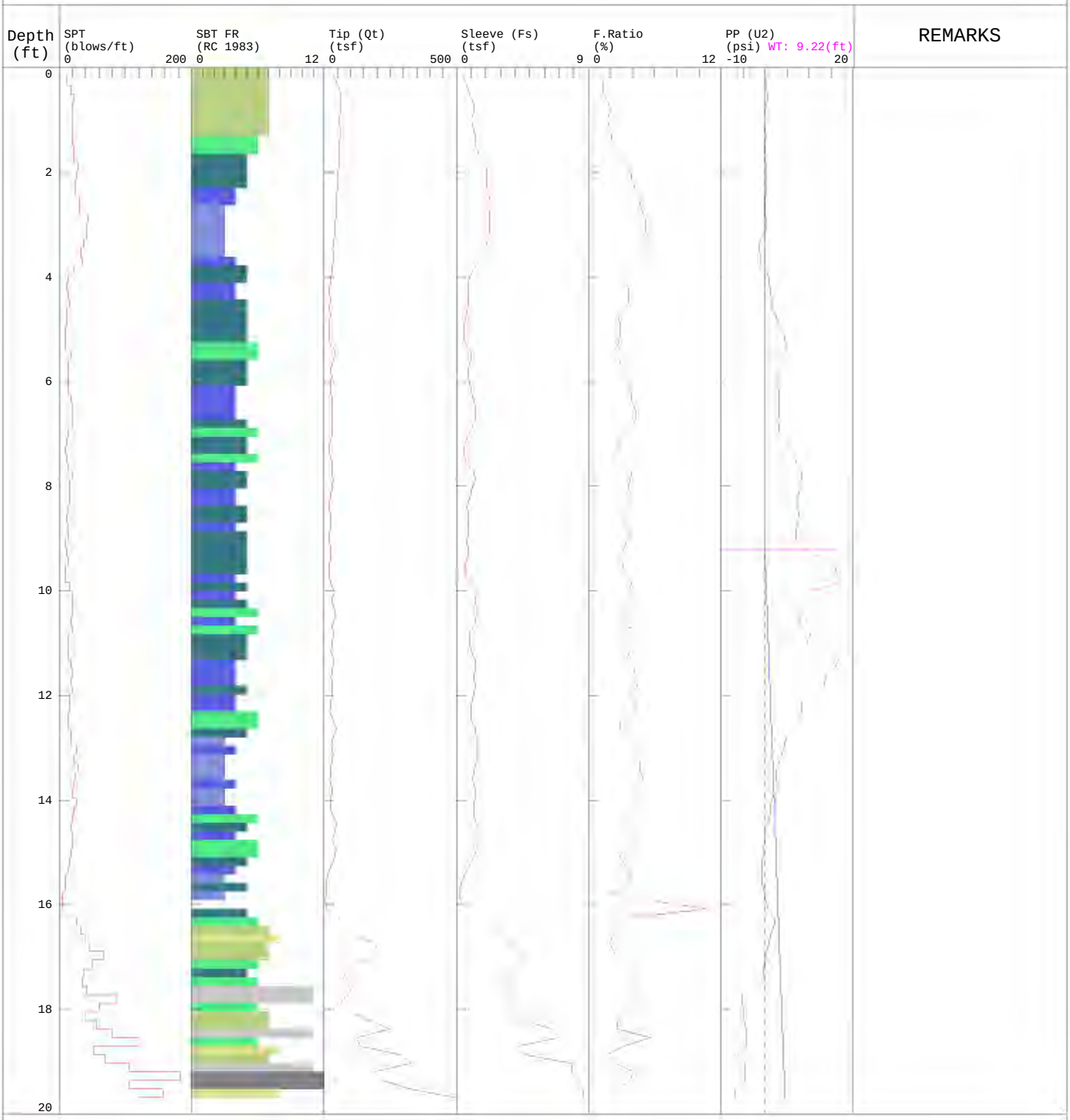


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

The Wallace Group / CPT-5 / 29160 Coffin Butte Rd

OPERATOR: OGE DMM
CONE ID: DDG1532
TEST DATE: 9/21/2022 11:37:33 AM
TOTAL DEPTH: 19.685 ft

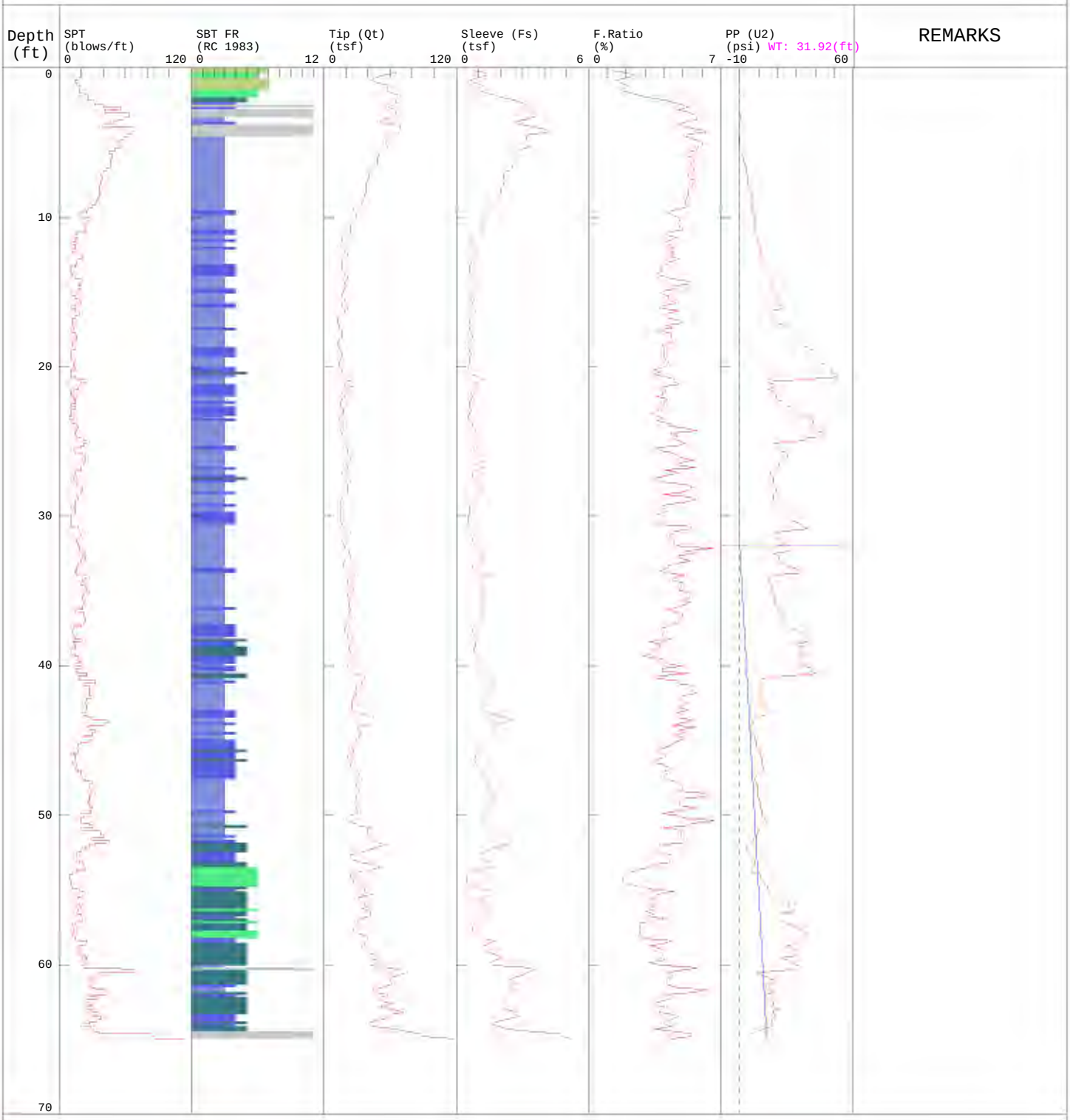


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

The Wallace Group / CPT-6 / 29160 Coffin Butte Rd

OPERATOR: OGE DMM
CONE ID: DDG1532
TEST DATE: 9/21/2022 12:36:51 PM
TOTAL DEPTH: 64.961 ft

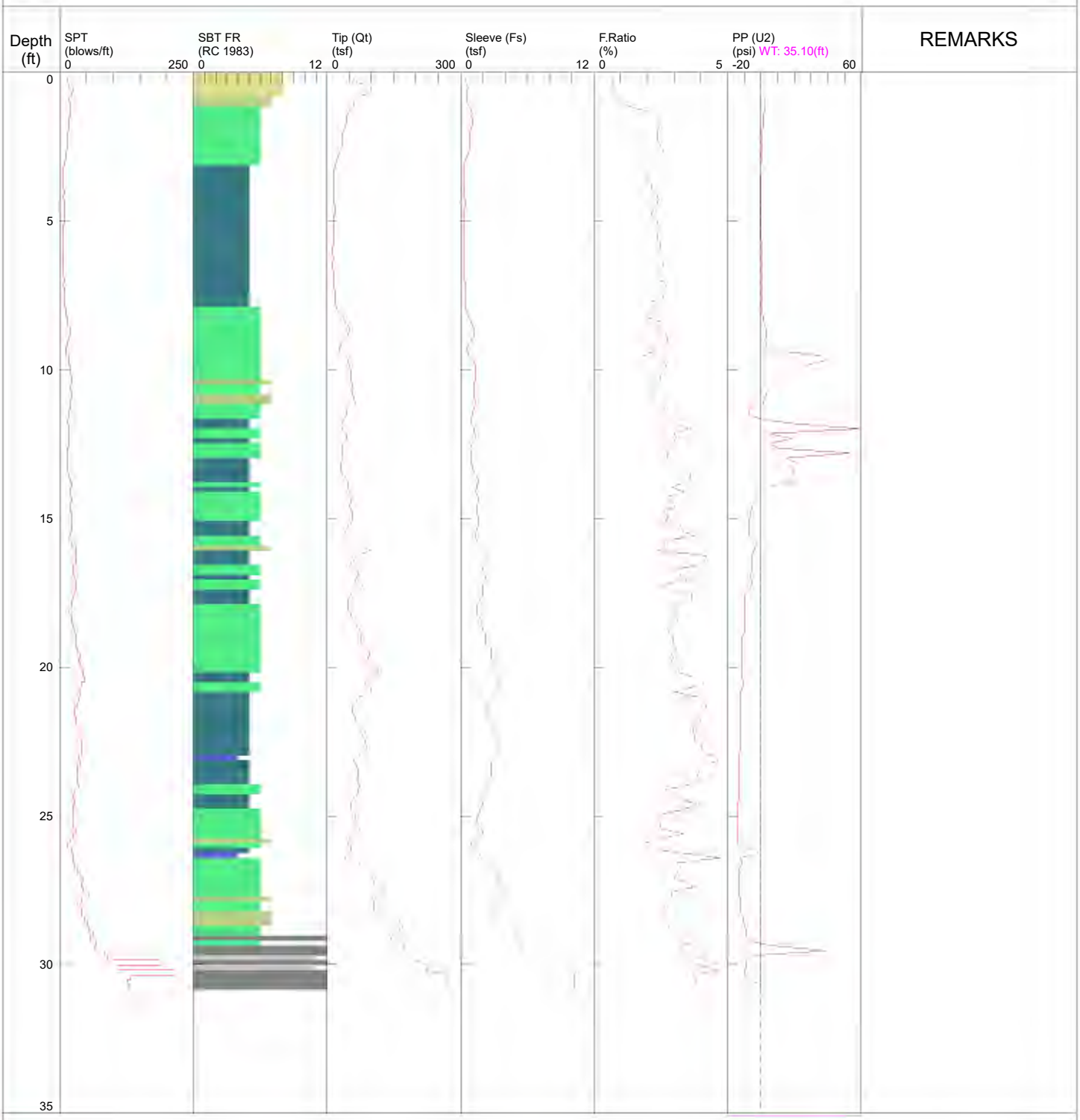


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

The Wallace Group / CPT-7 / 29160 Coffin Butte Rd

OPERATOR: OGE DMM
CONE ID: DDG1532
TEST DATE: 9/23/2022 8:28:45 AM
TOTAL DEPTH: 30.840 ft

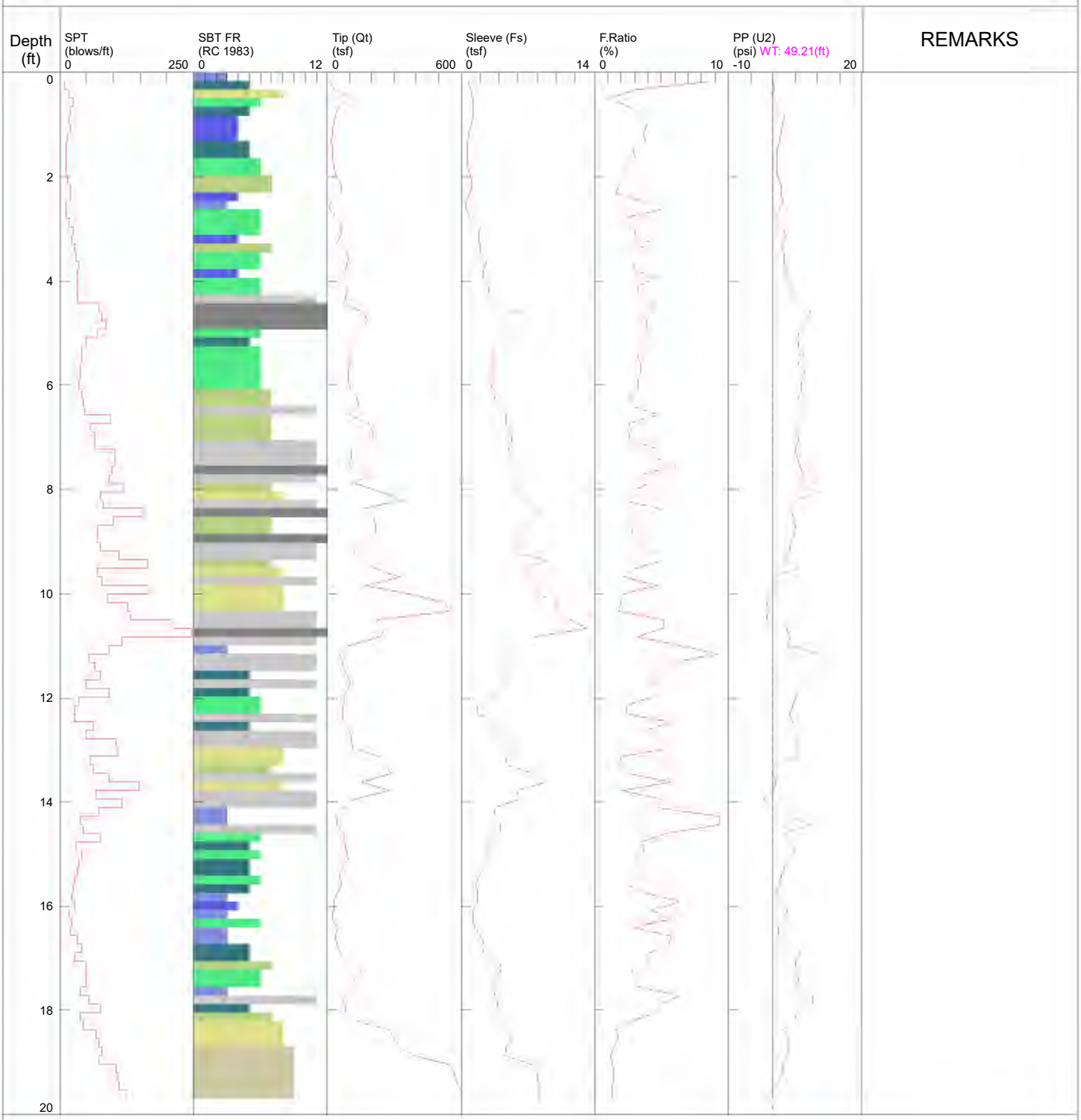


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

The Wallace Group / CPT-8 / 29160 Coffin Butte Rd Corvallis

OPERATOR: OGE BAK
CONE ID: DDG1296
TEST DATE: 11/8/2022 12:20:14 PM
TOTAL DEPTH: 19.685 ft

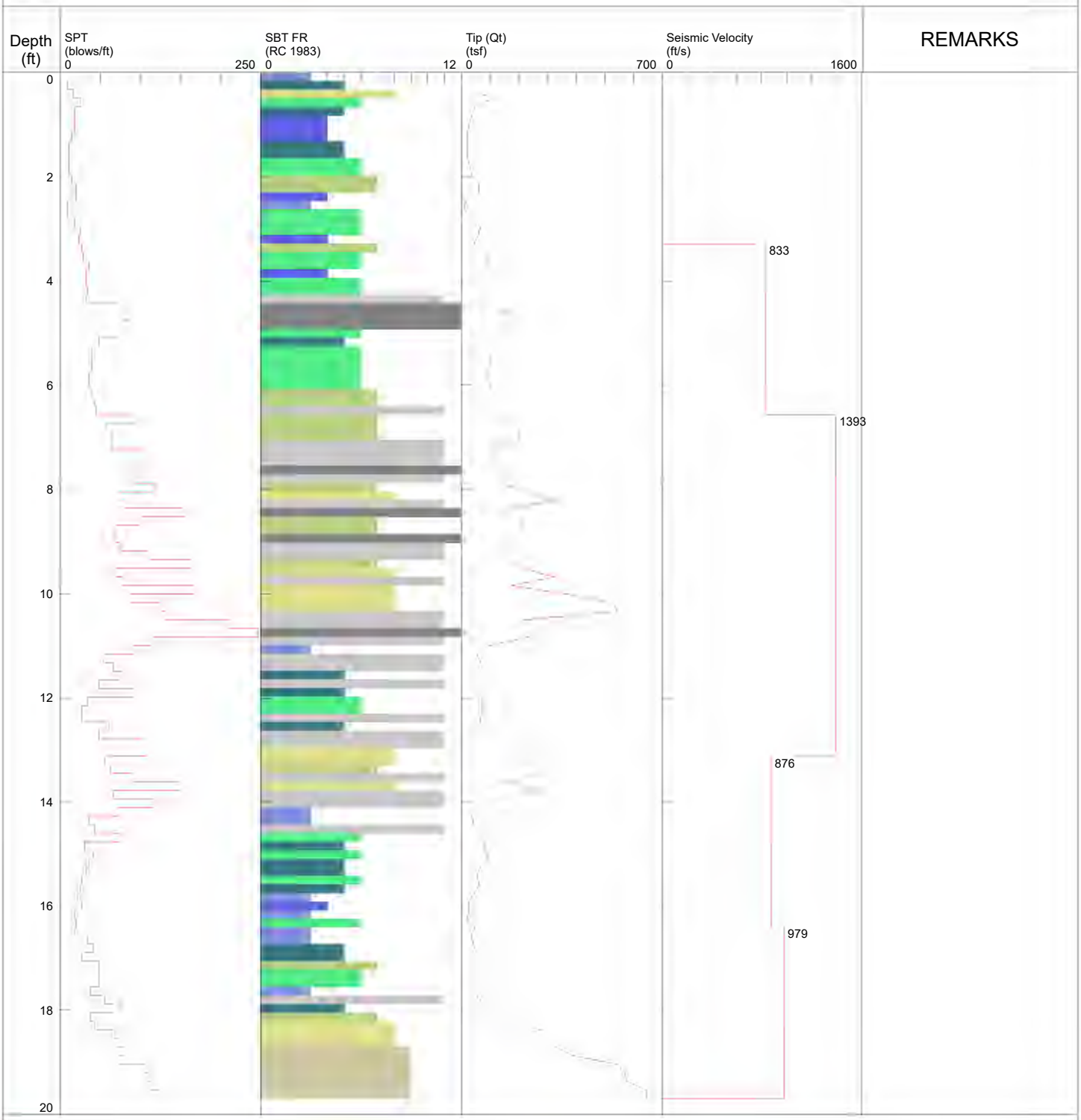


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

The Wallace Group / CPT-8 / 29160 Coffin Butte Rd Corvallis

OPERATOR: OGE BAK
CONE ID: DDG1296
TEST DATE: 11/8/2022 12:20:14 PM
TOTAL DEPTH: 19.685 ft

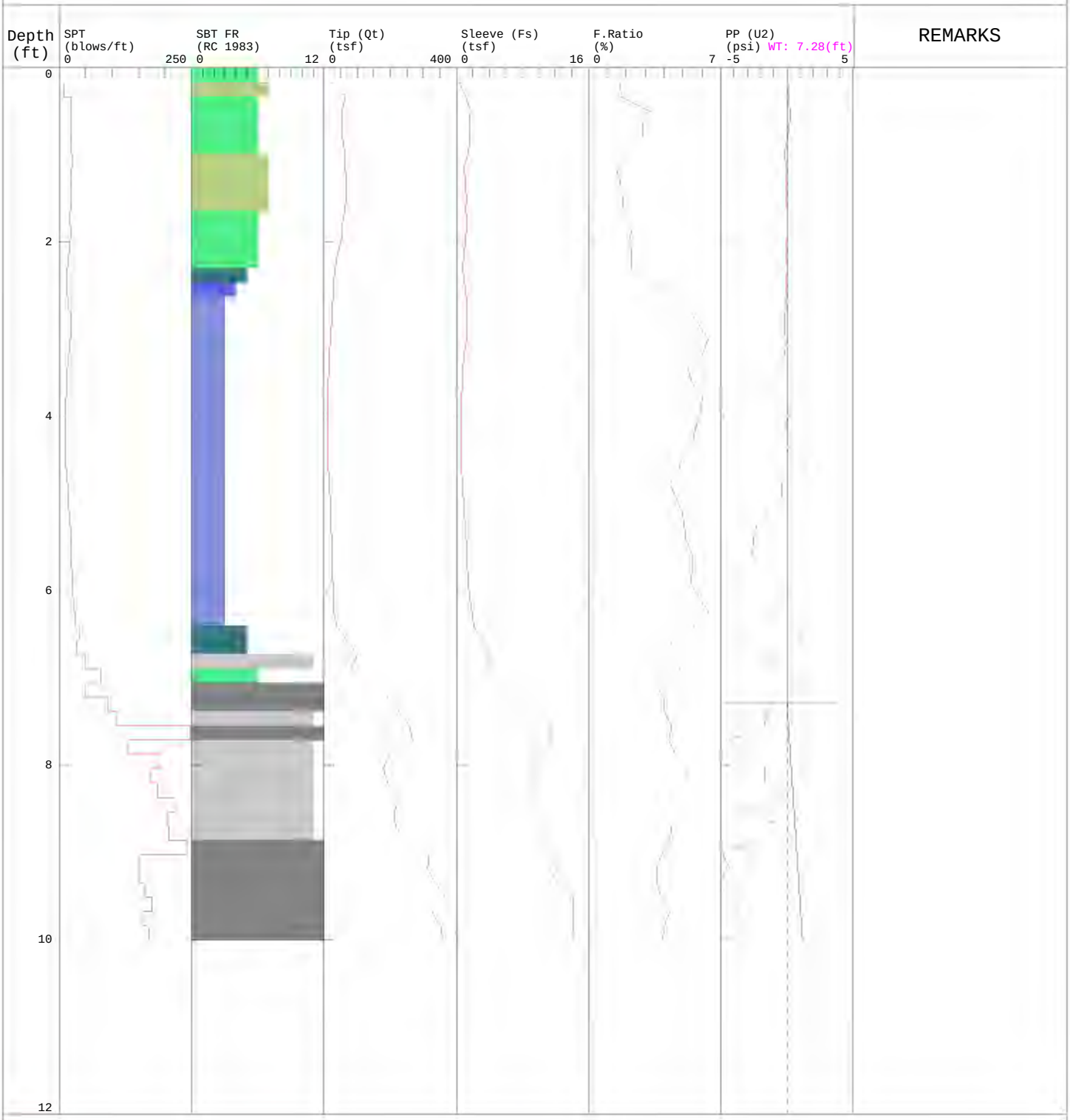


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

The Wallace Group / CPT-9 / 29160 Coffin Butte Rd

OPERATOR: OGE DMM
CONE ID: DDG1532
TEST DATE: 9/23/2022 11:14:11 AM
TOTAL DEPTH: 10.007 ft



1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

APPENDIX B

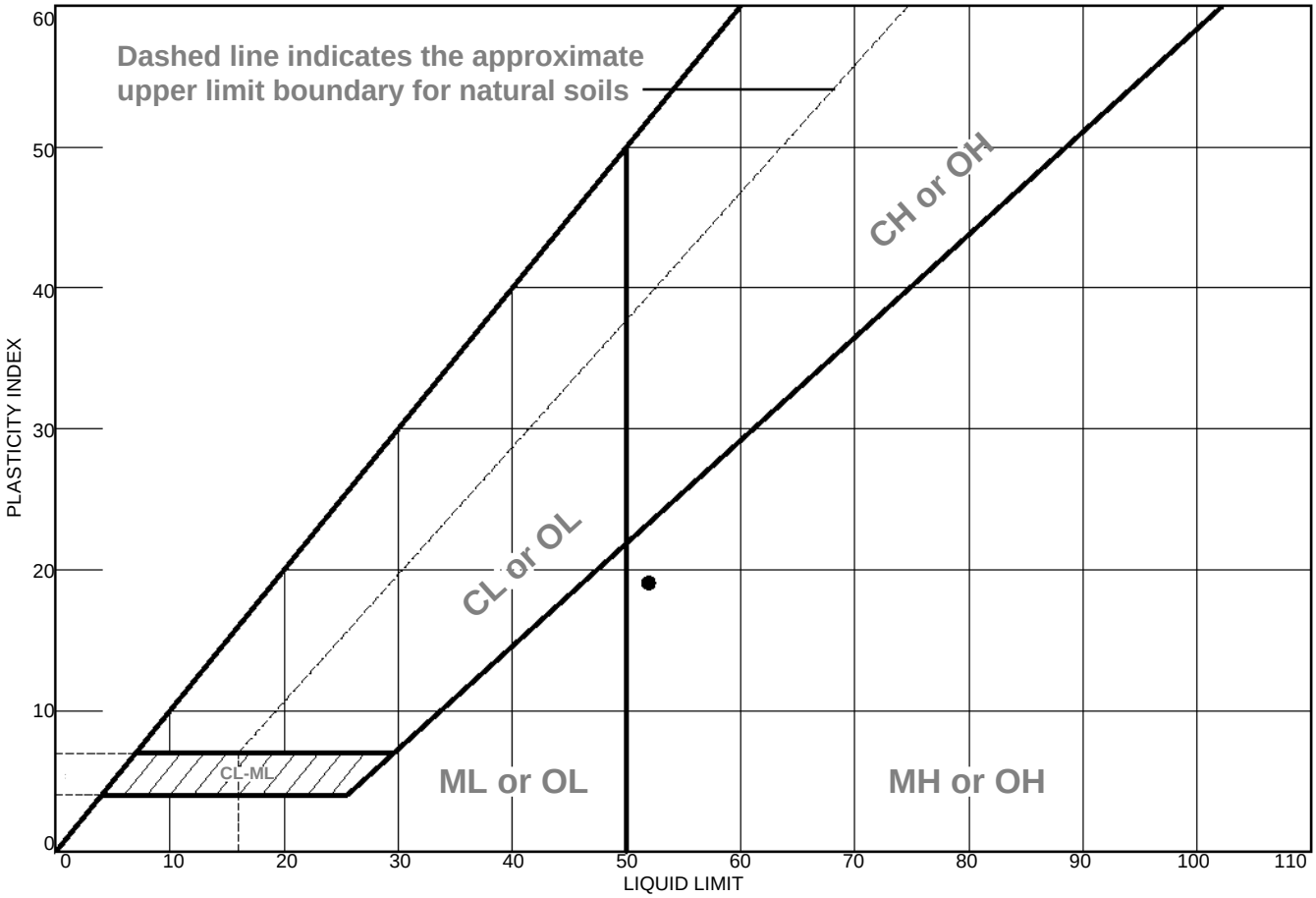
TABLE B - LABORATORY TESTING SUMMARY
Coffin Butte Landfill Expansion

Boring Number	Sample Type	Top Depth (feet, bgs)	Corrected SPT N-Value (blows per foot)	Material Description	Moisture Content, ASTM D2216 (percent)	Point Load Testing, ASTM D5731 UCS (PSI)	Atterberg Limits, ASTM D4318 Liquid Limit	Plastic Limit	Plasticity Index	Grain Size, ASTM D422 Percent <#40	Percent <200	Consolidation, ASTM D2435 C_{EC}	C_{ER}	OCR	UU Triaxial, ASTM D2850 Cell Pressure (psf)	Deviator Stress (psf)	CU Triaxial, ASTM D4767 Total c (psf)	Total phi (degrees)	CD Triaxial, ASTM D7181 Effective c (psf)	Effective phi (degrees)	CD Direct Shear, ASTM D3080 Effective c (psf)	Effective phi (degrees)	Flexible Wall Permeability, ASTM D5084 Saturation (percent)	Average k (cm/sec)
BH-01	SPT	7.5	22	SILTY SAND WITH GRAVEL (SM)	33.7	-	52	33	19	-	33.3	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-01	SPT	30.0	64	CLAYEY AND SILTY SAND (SC-SM)	39.1	-	-	-	-	-	36.0	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-02	Shelby	13	-	SANDY SILT (ML)	36.1	-	-	-	-	-	-	-	-	-	-	-	1000	8.8	-	-	-	-	-	-
BH-03	SPT	10	60/1"	SILTY GRAVEL WITH SAND (GM)	20.0	-	-	-	-	-	13.2	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	21.5	-	BRECCIATED BASALT WITH SILTSTONE	-	624	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	28.5	-	BRECCIATED BASALT WITH SILTSTONE	-	5377	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	32.5	-	BRECCIATED BASALT WITH SILTSTONE	-	2297	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	36.5	-	BRECCIATED BASALT WITH SILTSTONE	-	264	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	47.5	-	BRECCIATED BASALT WITH SILTSTONE	-	439	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	60	-	BRECCIATED BASALT WITH SILTSTONE	-	248	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	67	-	BRECCIATED BASALT WITH SILTSTONE	-	2460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	73	-	BRECCIATED BASALT WITH SILTSTONE	-	473	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	79	-	BRECCIATED BASALT WITH SILTSTONE	-	473	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	85	-	BRECCIATED BASALT WITH SILTSTONE	-	677	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	87	-	BRECCIATED BASALT WITH SILTSTONE	-	979	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	103	-	BRECCIATED BASALT WITH SILTSTONE	-	223	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	105	-	BRECCIATED BASALT WITH SILTSTONE	-	3242	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-03	HQ Core	108	-	BRECCIATED BASALT WITH SILTSTONE	-	640	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-04	SPT	2.5	19	CLAYEY AND SILTY SAND (SC-SM)	36.9	-	-	-	-	-	41.2	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-05	SPT	3.0	46	SILTY SAND WITH GRAVEL (SM)	37.2	-	67	37	30	-	22.7	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-05	HQ Core	11	-	BRECCIATED BASALT WITH SILTSTONE	-	929	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-05	HQ Core	30	-	BRECCIATED BASALT WITH SILTSTONE	-	1022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-05	HQ Core	47	-	BRECCIATED BASALT WITH SILTSTONE	-	5332	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-05	HQ Core	61	-	BRECCIATED BASALT WITH SILTSTONE	-	324	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-05	HQ Core	90	-	BRECCIATED BASALT WITH SILTSTONE	-	18061	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-05	HQ Core	105	-	BRECCIATED BASALT WITH SILTSTONE	-	374	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-05	HQ Core	120	-	BRECCIATED BASALT WITH SILTSTONE	-	1059	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-05	HQ Core	125	-	BRECCIATED BASALT WITH SILTSTONE	-	1529	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-05	HQ Core	127	-	BRECCIATED BASALT WITH SILTSTONE	-	1204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-06	Shelby	5.0	-	SANDY LEAN CLAY (CL)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-07	Shelby	10	-	SANDY LEAN CLAY WITH GRAVEL (CL)	65.0	-	-	-	-	-	-	0.32	0.025	4.8	-	-	-	-	-	-	350	37	-	-
BH-08	SPT	20	83	CLAYEY SAND WITH GRAVEL (SC)	23.2	-	-	-	-	-	21.3	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-09	HQ Core	26	-	BRECCIATED BASALT WITH SILTSTONE	-	350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-09	HQ Core	35	-	BRECCIATED BASALT WITH SILTSTONE	-	481	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-09	HQ Core	44	-	BRECCIATED BASALT WITH SILTSTONE	-	631	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-09	HQ Core	46	-	BRECCIATED BASALT WITH SILTSTONE	-	1410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-09	HQ Core	57	-	BRECCIATED BASALT WITH SILTSTONE	-	14194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-09	HQ Core	57	-	BRECCIATED BASALT WITH SILTSTONE	-	7636	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-09	HQ Core	69	-	BRECCIATED BASALT WITH SILTSTONE	-	1059	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-10	SPT	5.0	18	SANDY FAT CLAY WITH GRAVEL (CH)	32.0	-	60	25	35	-	74.6	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-10	SPT	20	60/2"	SILTY GRAVEL WITH SAND (GM)	20.5	-	-	-	-	-	27.0	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-11	SPT	5.0	11	SILTY SAND (SM)	49.7	-	-	-	-	-	33.5	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-11	Shelby	12	-	SANDY SILT (ML)	80.7	-	-	-	-	-	-	0.31	0.04	4.7	880	1039	-	-	-	-	-	-	-	-
					69.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97	$4.11x10^{-6}$
BH-11	SPT	15	5	SANDY ELASTIC SILT (MH)	65.9	-	85	44	41	-	65.9	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-11	SPT	30	6	SANDY SILT (ML)	72.2	-	-	-	-	-	54.9	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-12	SPT	7.5	5	SANDY ELASTIC SILT (MH)	61.1	-	78	42	36	-	50.7	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-12	Shelby	10	2	SANDY ELASTIC SILT (MH)	63.9	-	-	-	-	-	-	0.33	0.03	8.4	770	1154	-	-	-	-	-	-	-	-
BH-12	Shelby	20	7	SANDY ELASTIC SILT (MH)	64.9	-	-	-	-	-	-	0.17	0.025	2.3	-	-	-	-	-	-	200	41	-	-
BH-12	SPT	30	4	SILTY SAND (SM)	66.3	-	67	46	21	-	48.2	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-12	SPT	45	34	SILTY SAND (SM)	44.2	-	-	-	-	-	38.0	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-13	SPT	25	19	SILTY SAND WITH GRAVEL (SM)	47.7	-	-	-	-	-	27.1	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE B - LABORATORY TESTING SUMMARY
Coffin Butte Landfill Expansion

Boring Number	Sample Type	Top Depth (feet, bgs)	Corrected SPT N-Value (blows per foot)	Material Description	Moisture Content, ASTM D2216 (percent)	Point Load Testing, ASTM D5731 UCS (PSI)	Atterberg Limits, ASTM D4318 Liquid Limit	Atterberg Limits, ASTM D4318 Plastic Limit	Atterberg Limits, ASTM D4318 Plasticity Index	Grain Size, ASTM D422 Percent <#40	Grain Size, ASTM D422 Percent <200	Consolidation, ASTM D2435 C_{EC}	Consolidation, ASTM D2435 C_{ER}	Consolidation, ASTM D2435 OCR	UU Triaxial, ASTM D2850 Cell Pressure (psf)	UU Triaxial, ASTM D2850 Deviator Stress (psf)	CU Triaxial, ASTM D4767 Total c (psf)	CU Triaxial, ASTM D4767 Total phi (degrees)	CD Triaxial, ASTM D7181 Effective c (psf)	CD Triaxial, ASTM D7181 Effective phi (degrees)	CD Direct Shear, ASTM D3080 Effective c (psf)	CD Direct Shear, ASTM D3080 Effective phi (degrees)	Flexible Wall Permeability, ASTM D5084 Saturation (percent)	Flexible Wall Permeability, ASTM D5084 Average k (cm/sec)
BH-13	SPT	30	56	SILTY SAND WITH GRAVEL (SM)	25.2						18.8	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-14	SPT	5.0	7	SANDY FAT CLAY (CH)	32.6	-	56	25	31	-	77.8	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-14	SPT	15	11	SANDY FAT CLAY WITH GRAVEL (CH)	32.4	-	62	23	39	-	62.2	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-14	SPT	20	92/11"	SILTY SAND WITH GRAVEL (SM)	15.0	-	-	-	-	-	21.0	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-14	SPT	25	60/1"	SILTY SAND WITH GRAVEL (SM)	4.1	-	-	-	-	-	18.1	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-01	Grab	3.0	-	SANDY CLAY (CH)	29.9	-	58	26	32	99.2	98.1	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-01	Grab	8.5	-	SANDY CLAY (CH)	35.6	-	54	23	31	99.0	97.4	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-04	Grab	3.0	-	SANDY CLAY (CH)	22.6	-	63	25	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-04	Grab	7.0	-	SANDY CLAY (CL)	37.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-04	Grab	13.5	-	SANDY CLAY (CL)	40.1	-	75	37	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-04	Shelby	18.5	-	SANDY CLAY (CL)	69.8	-	-	-	-	-	-	-	-	-	-	-	-	-	0	33.3	-	-	-	-
GP/CPT-04	Grab	22.0	-	SANDY SILT (ML)	75.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-04	Grab	25.0	-	ELASTIC SILT WITH SAND (MH)	69.7	-	78	48	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-04	Grab	27.0	-	SANDY SILT (ML)	70.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-04	Shelby	28.0	-	SANDY SILT (ML)	65.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	35.5	-	-
GP/CPT-05	Grab	6.5	-	ELASTIC SILT WITH SAND (MH)	42.6	-	73	39	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-05	Shelby	10.0	-	SANDY CLAY (CL)	41.2, 48.2, 41.2	-	-	-	-	-	-	-	-	-	-	-	-	-	150	39	-	-	-	-
GP/CPT-05	Grab	14.0	-	SILTY SAND WITH GRAVEL (SM)	45.1, 28.9	-	-	-	-	72	36.4	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-06	Grab	7.0	-	ELASTIC SILT (MH)	39.0	-	80	44	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-06	Grab	18.0	-	SANDY SILT (ML)	71.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-06	Grab	24.0	-	ELASTIC SILT (MH)	75.0	-	84	54	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-06	Grab	27.0	-	SANDY SILT (ML)	80.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-07	Grab	2.0	-	SANDY CLAY (CL)	26.9	-	-	-	-	81	53.1	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-07	Grab	12.0	-	CLAYEY SAND WITH GRAVEL (SC)	38.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-07	Grab	16.0	-	CLAYEY SAND (SC)	25.5	-	-	-	-	82	45.9	-	-	-	-	-	-	-	-	-	-	-	-	-
GP/CPT-09	Grab	2.0	-	CLAY (CH)	28.3	-	73	20	53	97.3	92.9	-	-	-	-	-	-	-	-	-	-	-	-	-

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty Sand with Gravel	52	33	19	Not Tested	33.3	SM

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** BH-01 **Depth:** 7.5-9' **Sample Number:** S-1

Remarks:

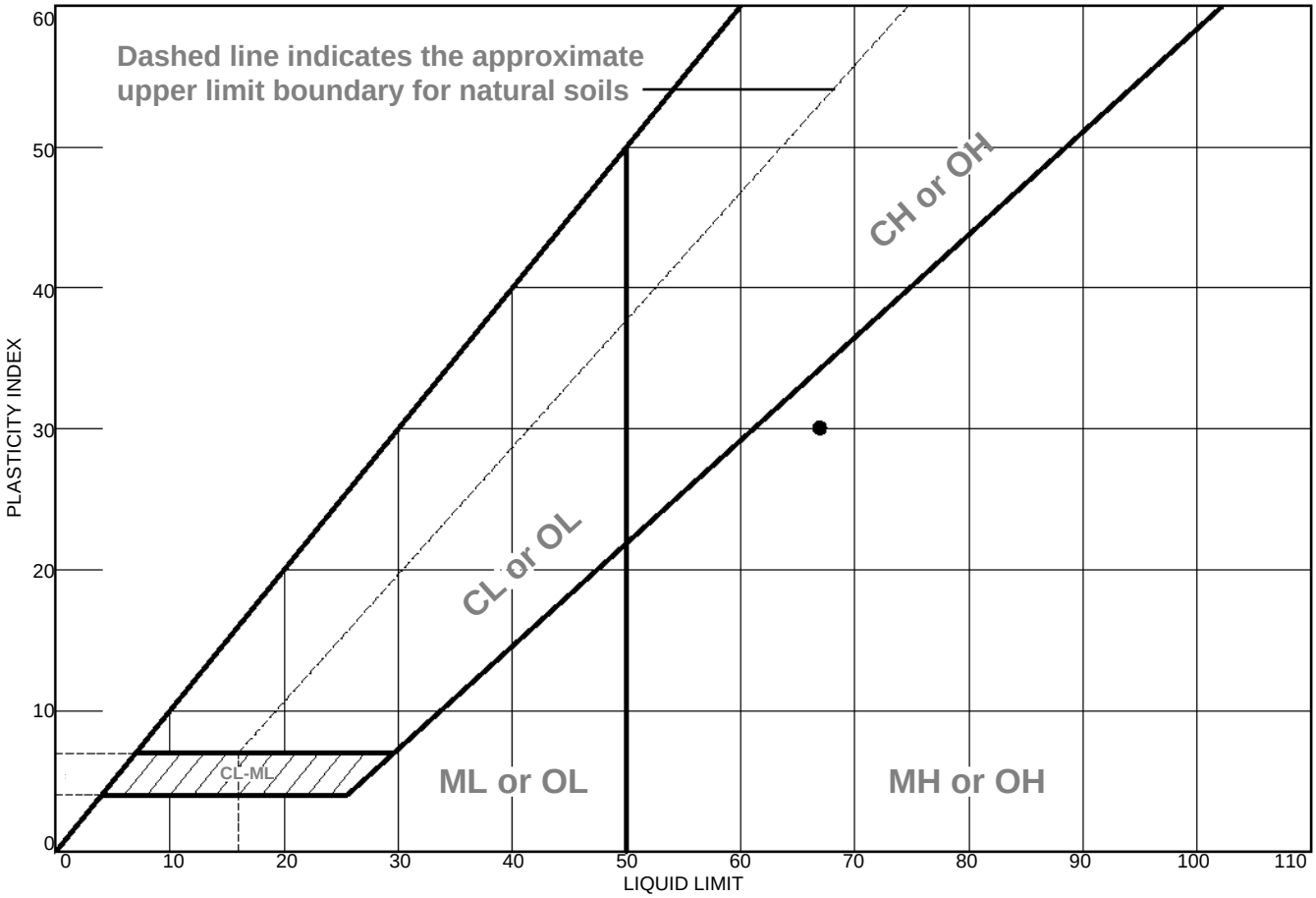
●Sampled By: SMW
Sample Date: Week of 08-16-21
ASTM D4318 - Multipoint Method
Wet Prepped, Liquid Limit Device, Hand Rolled

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Figure B-1

Tested By: PJH **Checked By:** LMS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty Sand with Gravel	67	37	30	Not Tested	22.7	SM

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** BH-05 **Depth:** 3' **Sample Number:** S-2

Remarks:

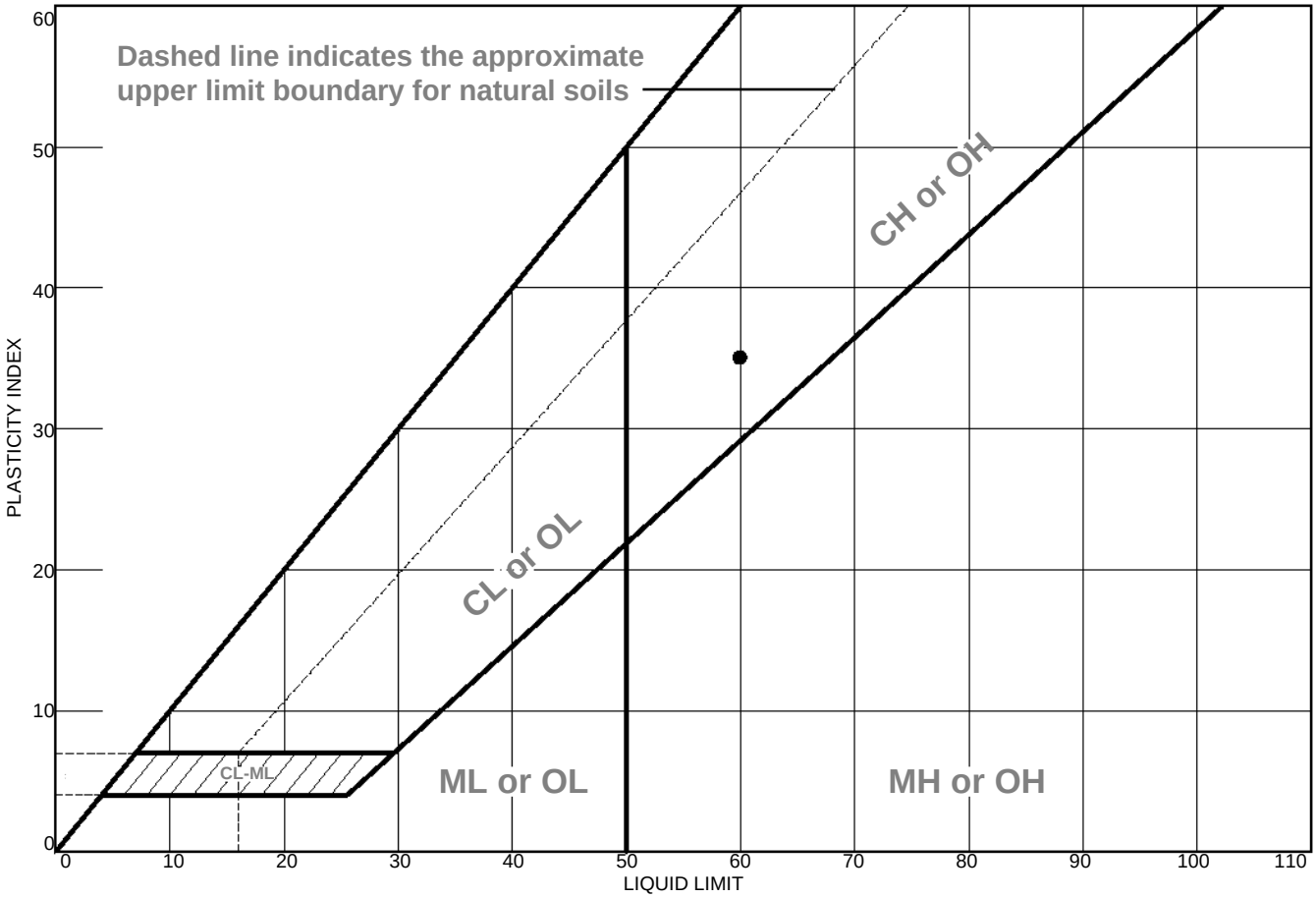
●Sampled By: SMW
Sample Date: Week of 08-16-21
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Figure B-2

Tested By: PJH **Checked By:** LMS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy Fat Clay with Gravel	60	25	35	Not Tested	74.6	CH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** BH-10 **Depth:** 5-6.5' **Sample Number:** S-2

Remarks:

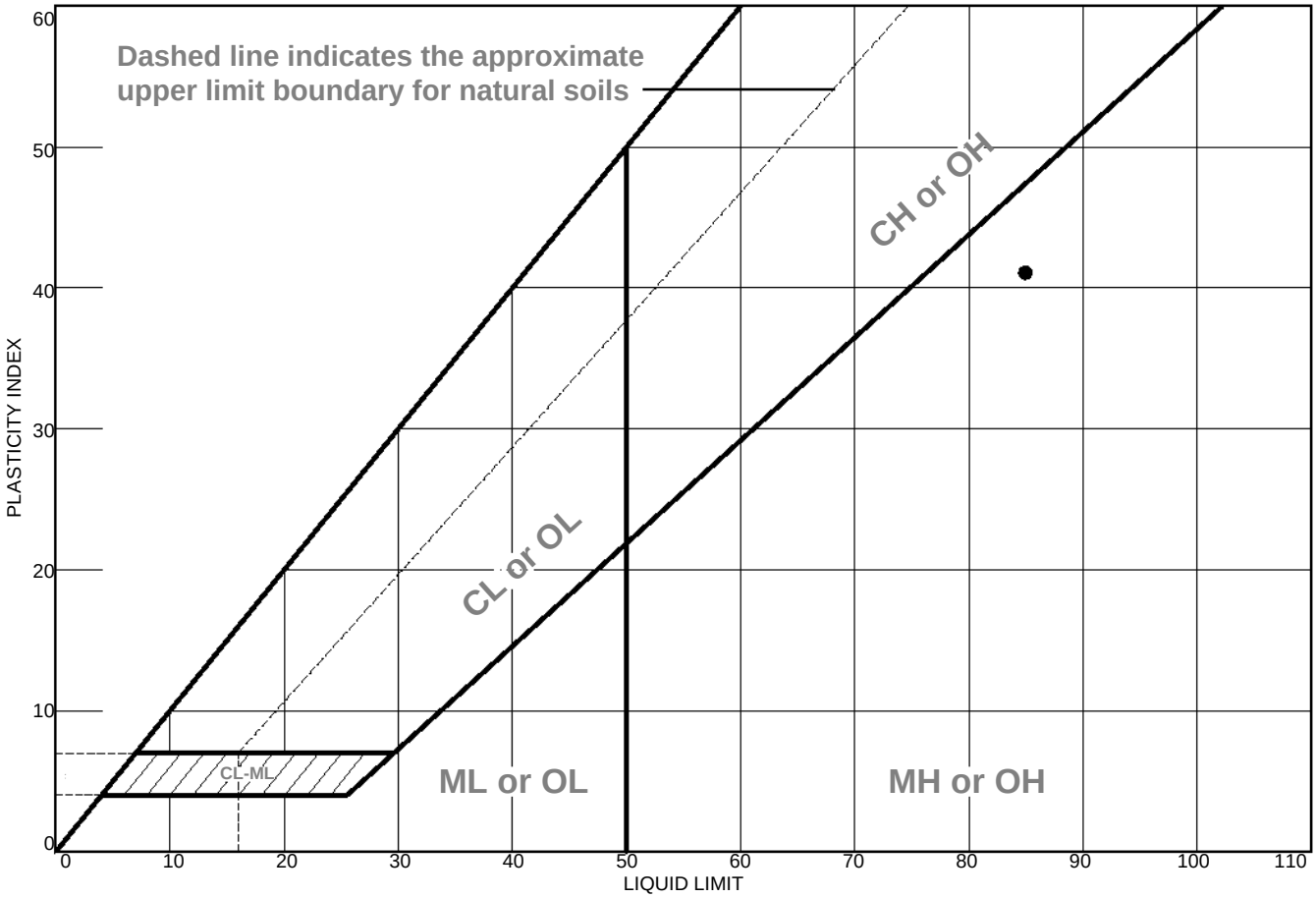
●Sampled By: SMW
Sample Date: Week of 08-16-21
ASTM D4318 - Multipoint Method
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Figure B-3

Tested By: PJH **Checked By:** LMS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy Silt	85	44	41	Not Tested	65.9	MH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** BH-11 **Depth:** 15-16.5' **Sample Number:** S-7

Remarks:

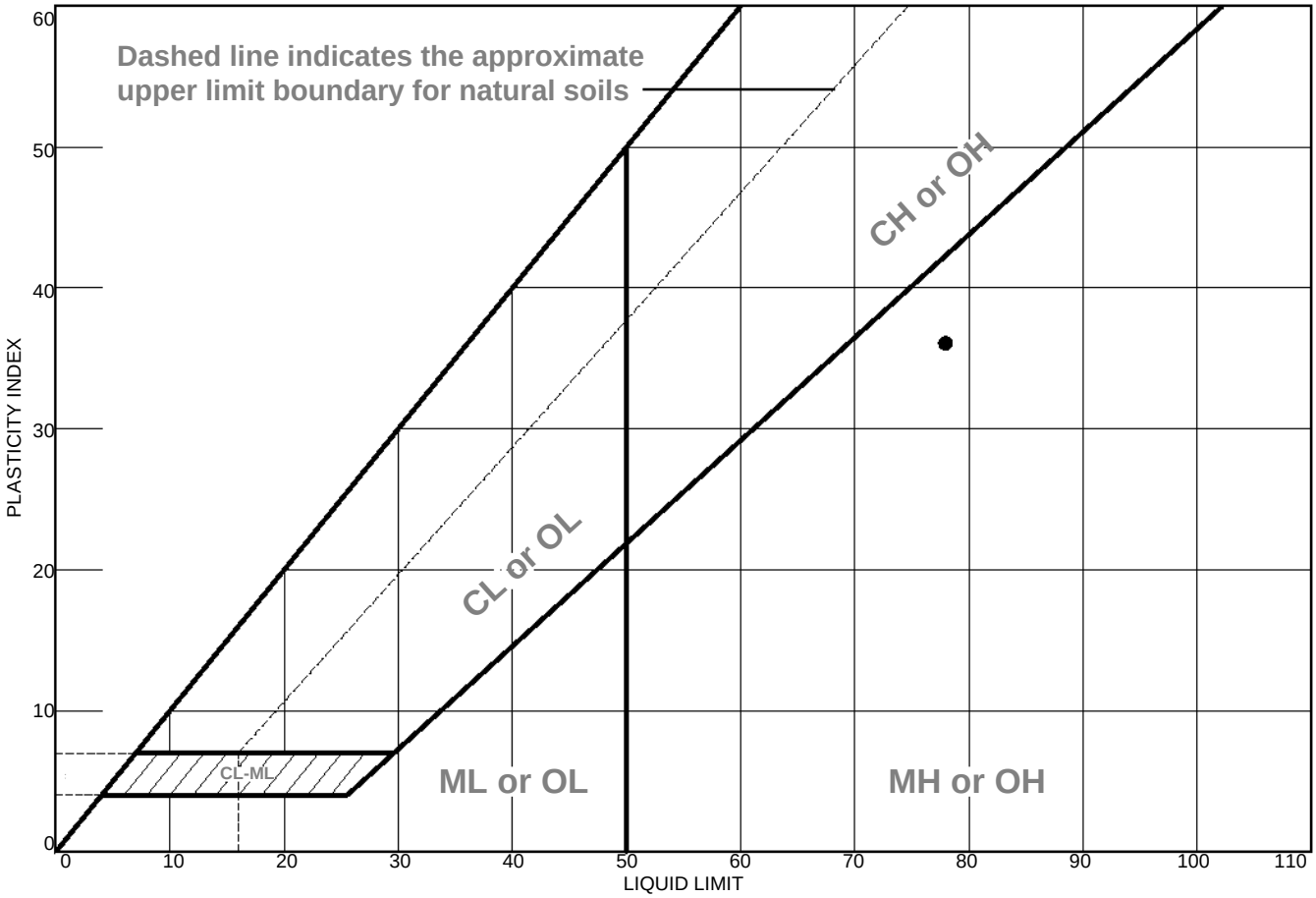
●Sampled By: SMW
Sample Date: Week of 08-16-21
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Figure B-4

Tested By: PJH **Checked By:** LMS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy Elastic Silt	78	42	36	Not Tested	50.7	MH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** BH-12 **Depth:** 7.5-9' **Sample Number:** S-3

Remarks:

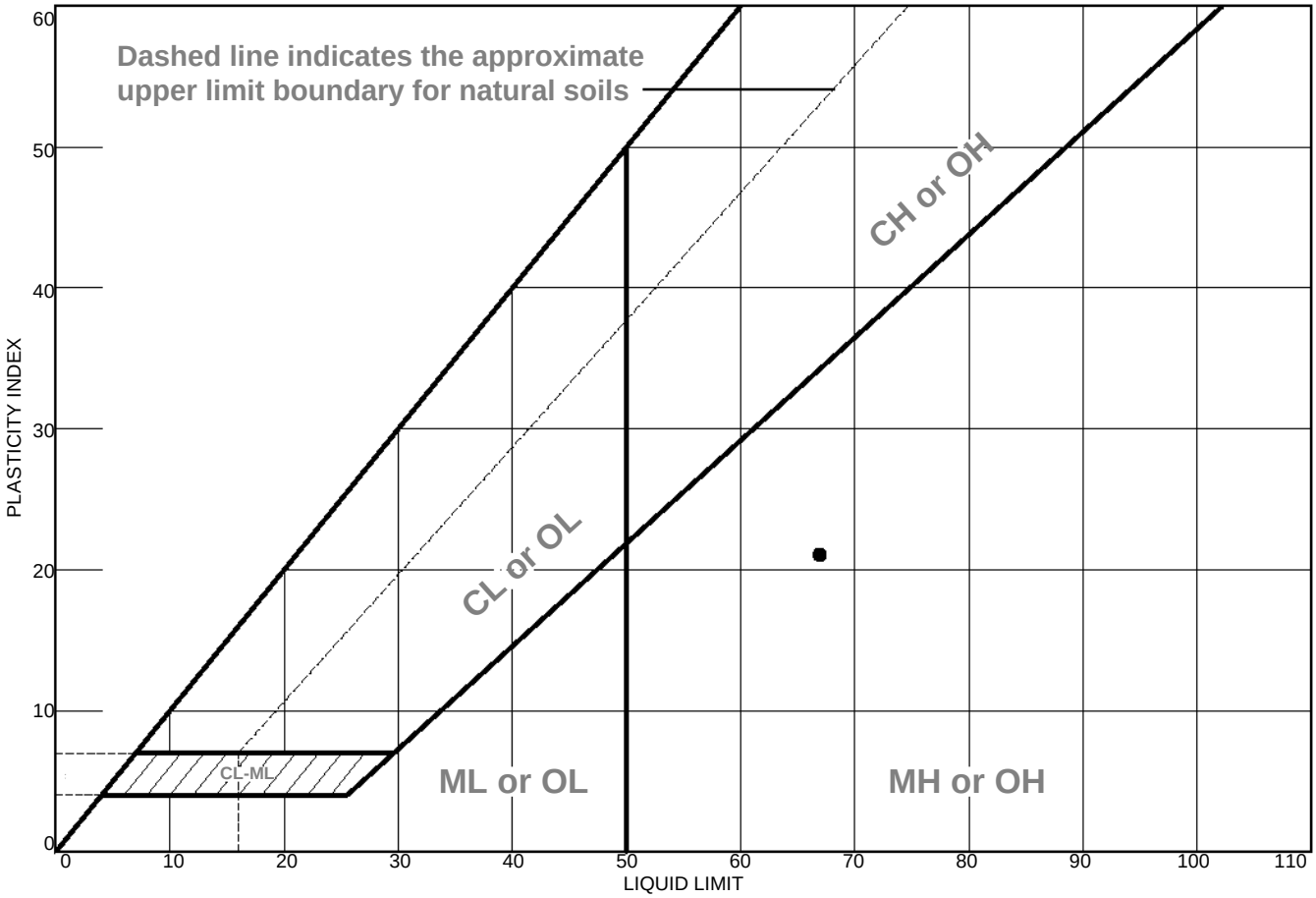
●Sampled By: SMW
Sample Date: Week of 08-16-21
ASTM D4318 - Multipoint Method
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Figure B-5

Tested By: PJH **Checked By:** LMS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty Sand	67	46	21	Not Tested	48.2	SM

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** BH-12 **Depth:** 30-31.5' **Sample Number:** S-9

Remarks:

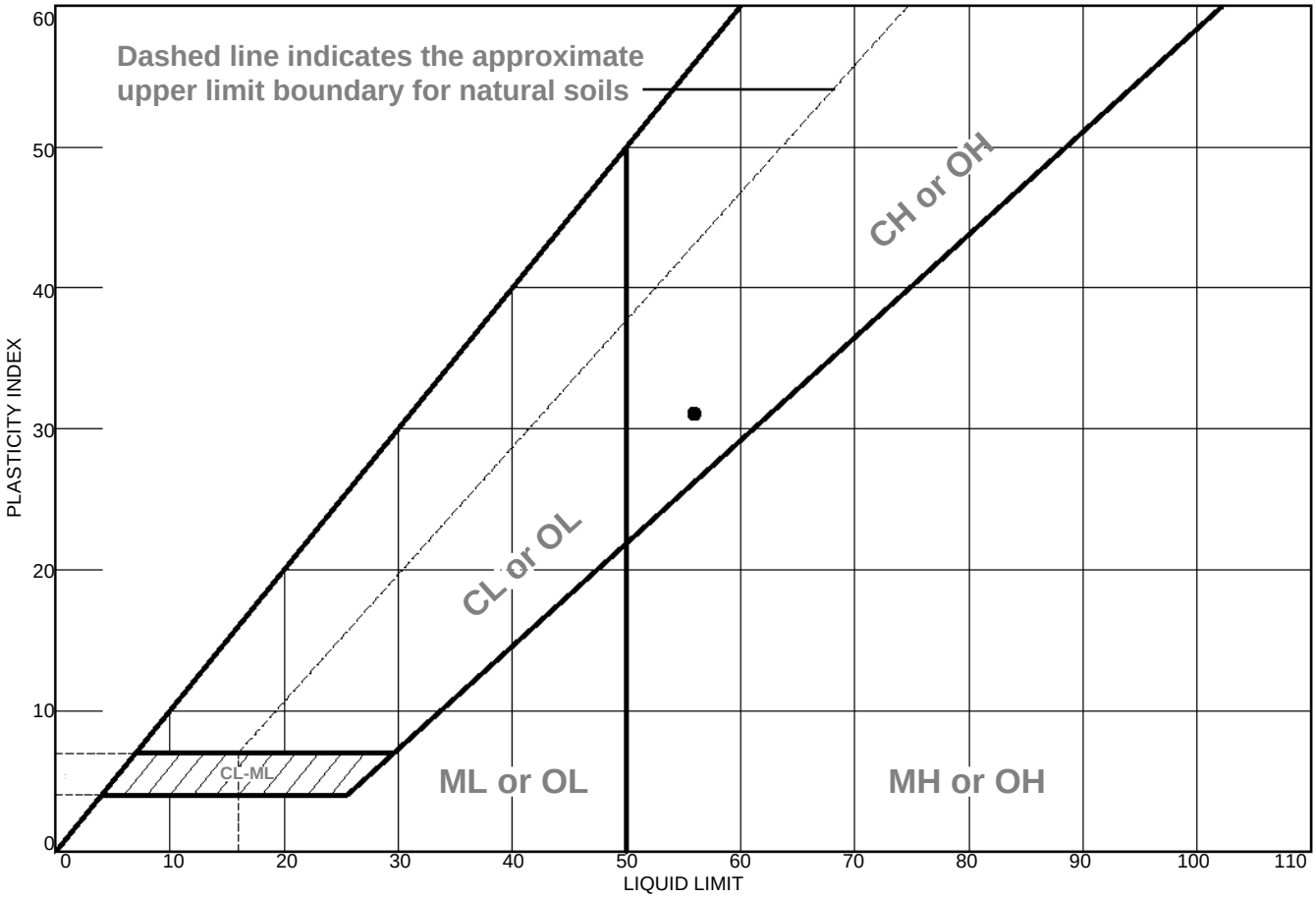
●Sampled By: SMW
Sample Date: Week of 08-16-21
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Figure B-6

Tested By: PJH **Checked By:** LMS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy Fat Clay	56	25	31	Not Tested	77.8	CH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** BH-14 **Depth:** 5-6.5' **Sample Number:** S-2

Remarks:

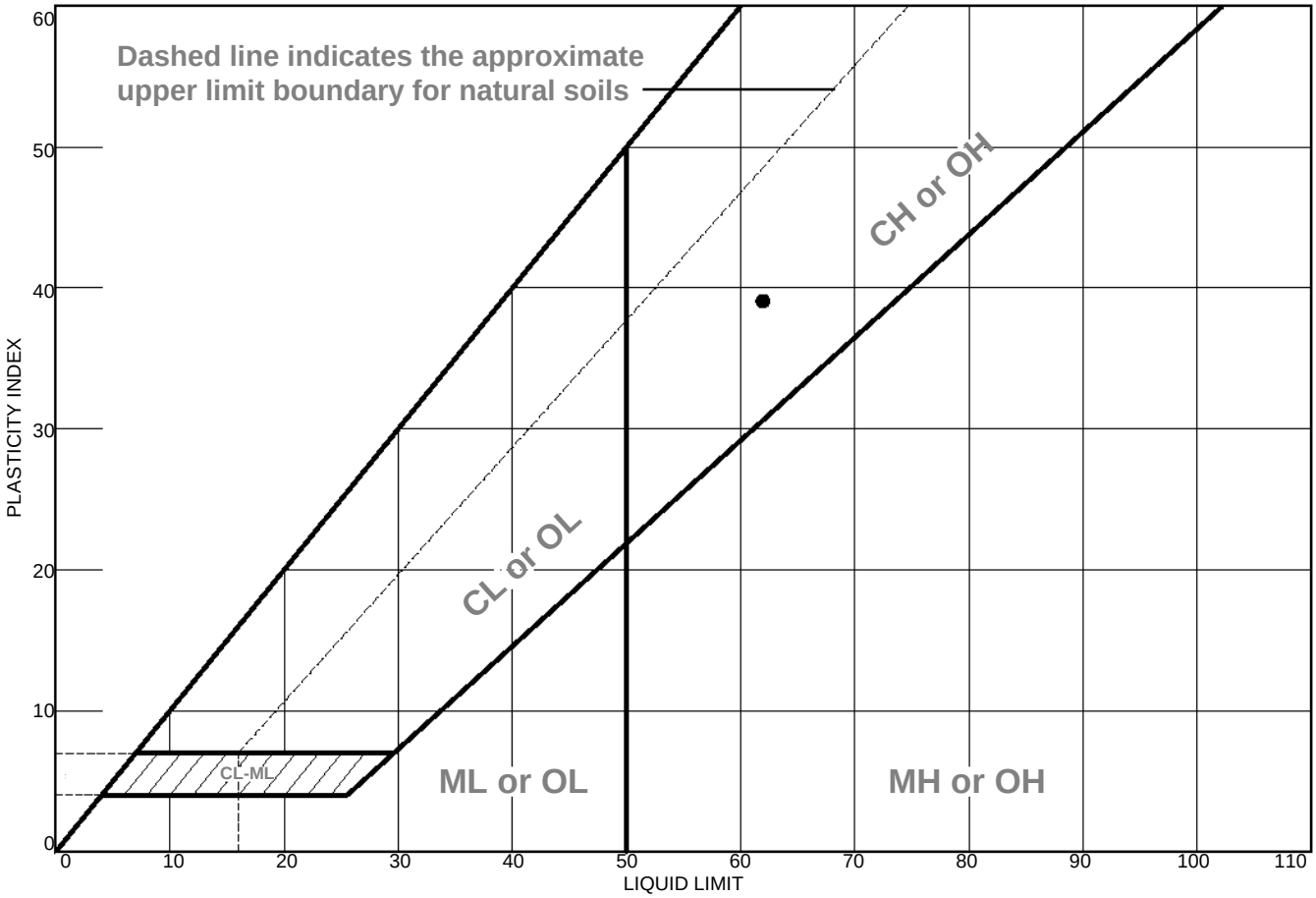
●Sampled By: SMW
Sample Date: Week of 08-16-21
ASTM D4318 - Multipoint Method
Wet Prepped, Liquid Limit Device, Hand Rolled

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Figure B-7

Tested By: PJH **Checked By:** LMS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy Fat Clay	62	23	39	Not Tested	62.2	CH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** BH-14 **Depth:** 15-16.5' **Sample Number:** S-4

Remarks:

●Sampled By: SMW
Sample Date: Week of 08-16-21
ASTM D4318 - Multipoint Method
Wet Prepped, Liquid Limit Device, Hand Rolled

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Figure B-8

Tested By: PJH **Checked By:** LMS

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No. 200 Sieve Wash

(Material Finer than No. 200 Sieve)

ASTM C117 / D-1140

Client: Civil & Env. Consultants, Inc.
Project Coffin Butte Landfill
Location: Corvallis, OR
Sample Location: Borings
Date Sampled: 8/17/2021

Project Number: 21129 - 1
Lab Number: WGG0233
Technician: PJH
Date Received: 9/17/2021
Date Analyzed: 11/29/2021

Location	BH-01	BH-03	BH-11
Depth	7.5'	10'	15'
Wet Weight	340.6	510	360.1
Dry Weight	254.8	425	199.3
Moisture %	33.7%	20.0%	80.7%
Weight After Wash	170.0	369.1	67.9
Weight Passing #200	84.8	55.9	131.4
% Passing #200	33.3%	13.2%	65.9%

Location	BH-11	BH-12	BH-12
Depth	30'	7.5'	30'
Wet Weight	455.4	417.2	400.1
Dry Weight	264.4	259	240.6
Moisture %	72.2%	61.1%	66.3%
Weight After Wash	119.3	127.6	124.7
Weight Passing #200	145.1	131.4	115.9
% Passing #200	54.9%	50.7%	48.2%

REVIEWED BY: L. Splitter
DATE: 1/24/2022

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No. 200 Sieve Wash

(Material Finer than No. 200 Sieve)

ASTM C117 / D-1140

Client: Civil & Env. Consultants, Inc.
Project Coffin Butte Landfill
Location: Corvallis, OR
Sample Location: Borings
Date Sampled: 8/17/2021

Project Number: 21129 - 1
Lab Number: WGG0233
Technician: PJH
Date Received: 9/17/2021
Date Analyzed: 11/29/2021

Location	BH-12	BH-13	BH-13
Depth	45'	25'	30'
Wet Weight	284.7	464.7	443.2
Dry Weight	197.4	314.6	353.9
Moisture %	44.2%	47.7%	25.2%
Weight After Wash	122.4	230.5	287.3
Weight Passing #200	75	85.1	66.6
% Passing #200	38.0%	27.1%	18.8%

Location	BH-14	BH-14	BH-14
Depth	5'	20'	15'
Wet Weight	452.7	664.6	443.5
Dry Weight	341.5	577.8	335
Moisture %	32.6%	15.0%	32.4%
Weight After Wash	75.8	456.3	126.5
Weight Passing #200	265.7	121.5	208.5
% Passing #200	77.8%	21.0%	62.2%

REVIEWED BY: L. Splitter
DATE: 1/24/2022

Note: Data and results shown above include ASTM Test Methods C117 and D1140. This report pertains only to the material tested and/or inspected and is not to be reproduced without prior authorization of Wallace Group. If part of a larger document, this report is not to be removed or reproduced separately. This report is the property of the Client and shall not be distributed to other parties without Client's permission.

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ASTM C117 / D-1140

Client: Civil & Env. Consultants, Inc.
Project Coffin Butte Landfill
Location: Corvallis, OR
Sample Location: Borings
Date Sampled: 8/17/2021

Project Number: 21129 - 1
Lab Number: WGG0233
Technician: PJH
Date Received: 9/17/2021
Date Analyzed: 11/30/2021

Location	BH-01	BH-04	BH-05
Depth	30'	2.5'	3'
Wet Weight	499.8	491.6	291.2
Dry Weight	359.3	359.1	212.2
Moisture %	39.1%	36.9%	37.2%
Weight After Wash	229.9	211.1	164.0
Weight Passing #200	129.4	148.0	48.2
% Passing #200	36.0%	41.2%	22.7%

Location	BH-08	BH-10	BH-10
Depth	20'	5'	20'
Wet Weight	510.6	389.5	104.6
Dry Weight	414.5	295	86.8
Moisture %	23.2%	32.0%	20.5%
Weight After Wash	326.4	74.8	63.4
Weight Passing #200	88.1	220.2	23.4
% Passing #200	21.3%	74.6%	27.0%

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WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

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Project Number: 21129 - 1
Lab Number: WGG0233
Technician: PJH
Date Received: 9/17/2021
Date Analyzed: 11/30/2021

Location	BH-11	BH-14
Depth	5'	25'
Wet Weight	371.2	48.4
Dry Weight	247.9	46.5
Moisture %	49.7%	4.1%
Weight After Wash	164.9	38.1
Weight Passing #200	83	8.4
% Passing #200	33.5%	18.1%

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A Division of Northwest Geotech, Inc.
9120 SW Pioneer Court, Suite B, Wilsonville, Oregon 97070 | ph: 503.682.1880 fax: 503.682.2753 | www.nwgeotech.com

TECHNICAL REPORT

Report To: Lisa Splitter, P.E., G.E.
Wallace Group, Inc.
62915 NE 18th St, Ste. 1
Bend, Oregon 97701

Date: 12/16/2021

Lab No.: 21-430

Project: Coffin Butte (Project #21129-1)

Project No.: 3691.1.1

Report of: One-dimensional consolidation, direct shear, unconsolidated undrained triaxial compression and flexible wall permeability testing.

Sample Identification

As requested, NTI completed one-dimensional consolidation testing, direct shear testing, unconsolidated undrained triaxial compression testing and flexible wall permeability testing on samples delivered to our laboratory on 9/15/21 and 10/22/21. Testing was performed in accordance with the standards indicated. Our laboratory test results are summarized on the following table and page.

Laboratory Testing

Sample ID: BH-7 ST-1 @ 10.0-12.0 Ft.

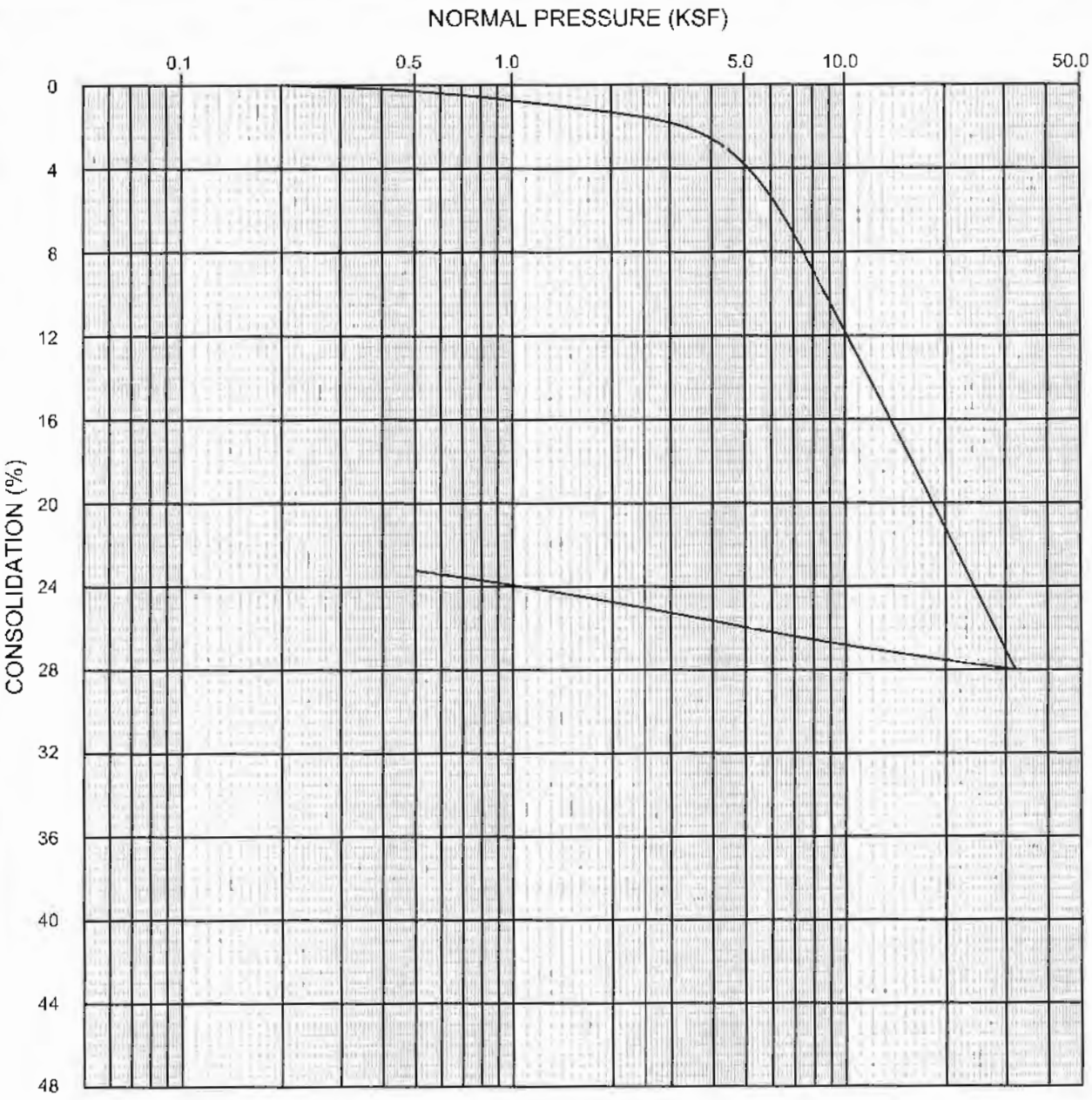
One Dimensional Consolidation of Soil (ASTM D2435)			
Test	**Initial Conditions**		**Final Conditions**
Moisture Content, (%)	65.0		56.9
Dry Unit Weight, (pcf)	54.4		70.3
Height of Specimen, (inches)	0.75		0.57
Load (ksf)	**Dial Reading (inches)**	**Load (ksf)**	**Dial Reading (inches)**
Initial	0.0006	16.0	0.1365
0.5	0.0032	32.0	0.2099
1.0	0.0056	8.0	0.1993
2.0	0.0095	2.0	0.1857
4.0	0.0192	0.5	0.1751
8.0	0.0662		

Attachments: Laboratory Test Results
Consolidation Test Results

Copies: (1) Addressee

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SYMBOL	SAMPLE LOCATION	NORMAL PRESSURE AT SATURATION (KSF)
———	BH-7 ST-1 @ 10.0 - 12.0 FT.	0.50

CONSOLIDATION TEST RESULTS - ASTM D2435

PROJECT NO. 3691.1.1	WALLACE GROUP, INC. COFFIN BUTTE	LAB NO. 21-430

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Lab No.: 21-430

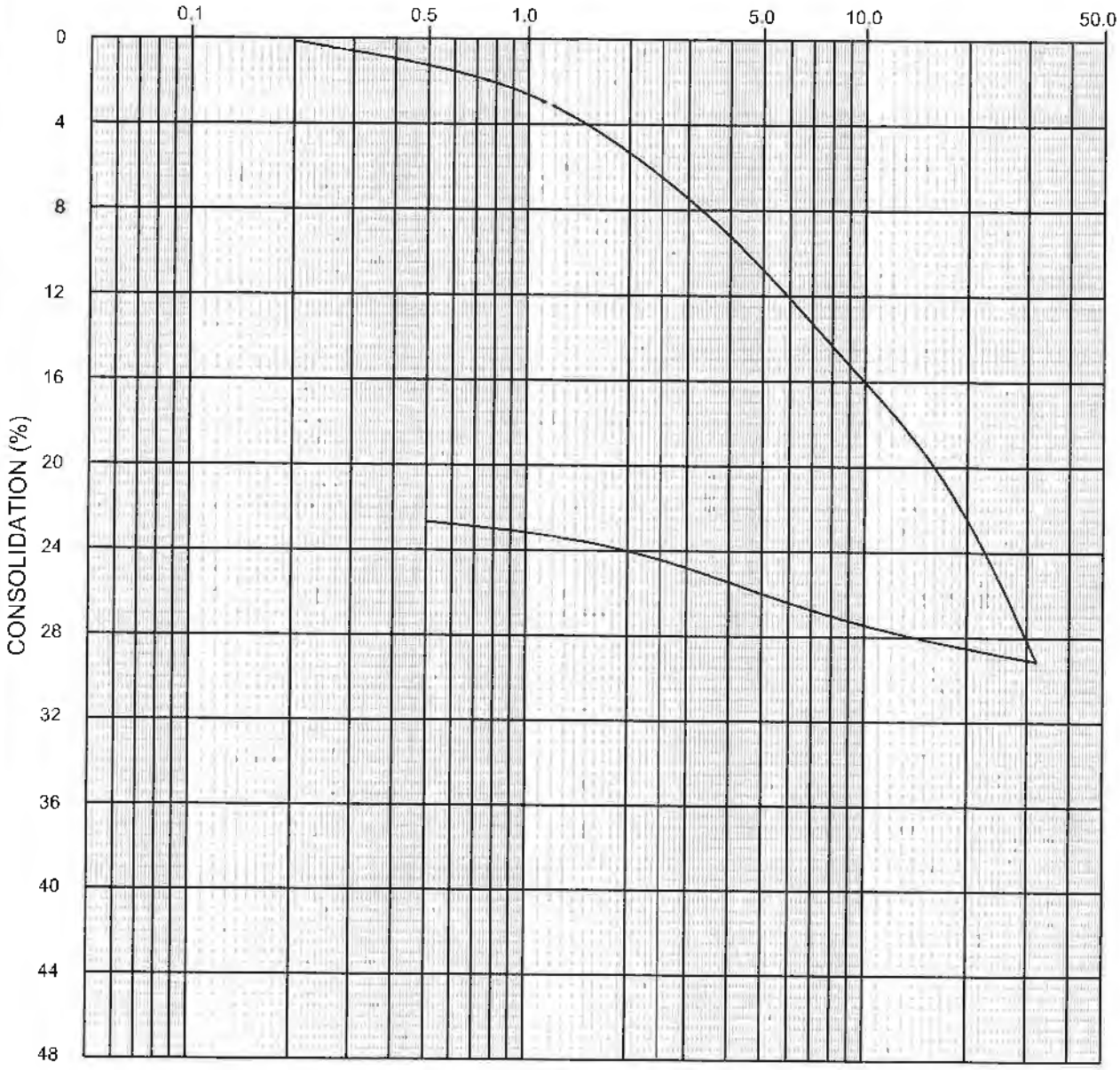
Project: Coffin Butte (Project #21129-1)

Project No.: 3691.1.1

Sample ID: BH-11 ST1-S6 @ 12.0-14.0 Ft.

One Dimensional Consolidation of Soil (ASTM D2435)			
Test	**Initial Conditions**		**Final Conditions**
Moisture Content, (%)	75.6		60.1
Dry Unit Weight, (pcf)	52.3		65.7
Height of Specimen, (inches)	0.75		0.58
Load (ksf)	**Dial Reading (inches)**	**Load (ksf)**	**Dial Reading (inches)**
Initial	0.0008	16.0	0.1571
0.5	0.0094	32.0	0.2177
1.0	0.0199	8.0	0.2026
2.0	0.0401	2.0	0.1829
4.0	0.0694	0.5	0.1700
8.0	0.1076		

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SYMBOL	SAMPLE LOCATION	NORMAL PRESSURE AT SATURATION (KSF)
———	BH-11 ST-1 S-6 @ 12.0 - 14.0 FT.	0.50

CONSOLIDATION TEST RESULTS - ASTM D2435

PROJECT NO. 3691.1.1	WALLACE GROUP, INC. COFFIN BUTTE	LAB NO. 21-430

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Lab No.: 21-430

Project: Coffin Butte (Project #21129-1)

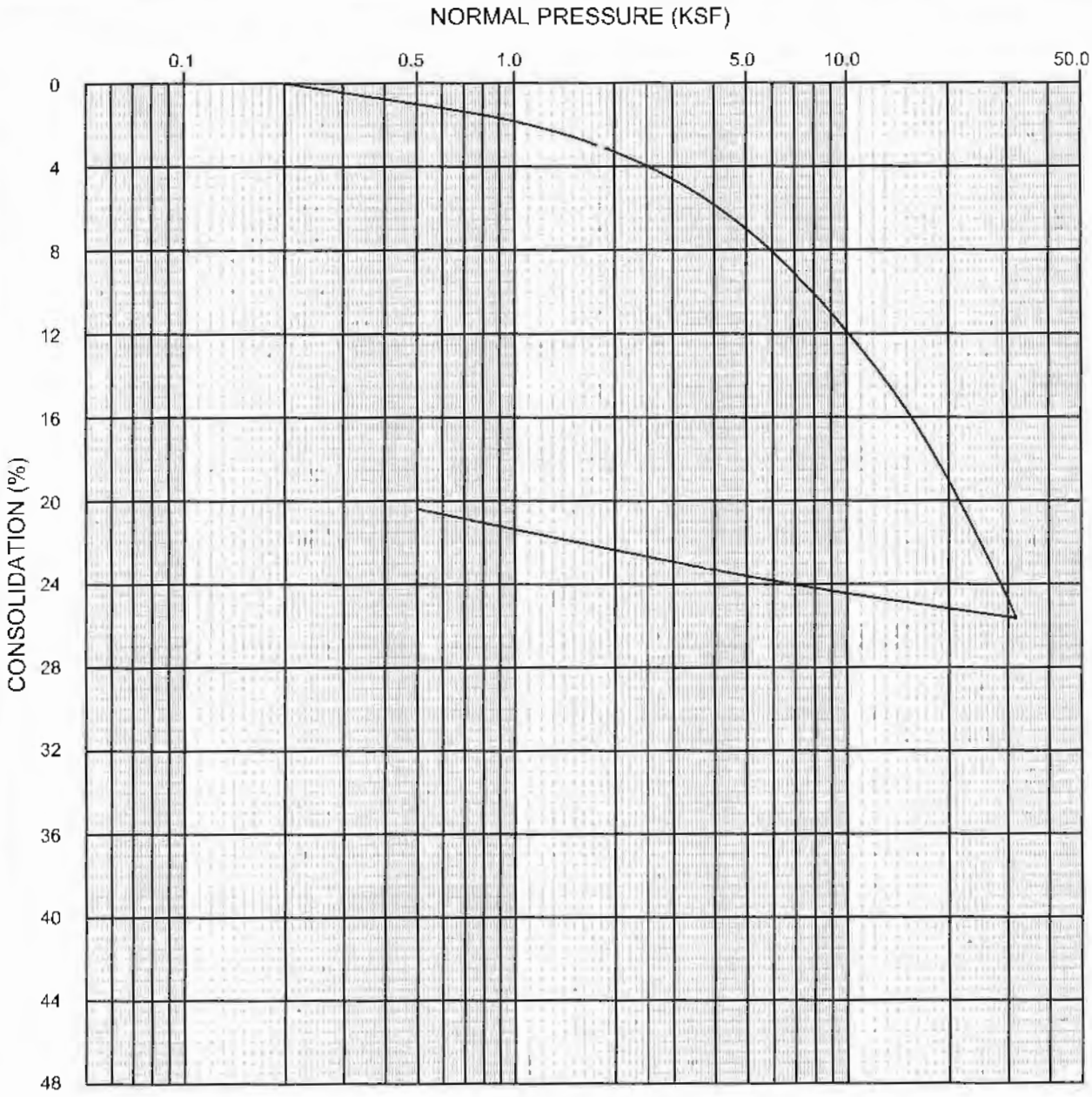
Project No.: 3691.1.1

Sample ID: BH-12A ST-2 @ 10.0-12.0 Ft.

One Dimensional Consolidation of Soil (ASTM D2435)			
Test	**Initial Conditions**		**Final Conditions**
Moisture Content, (%)	63.9		56.9
Dry Unit Weight, (pcf)	58.1		69.4
Height of Specimen, (inches)	0.75		0.60
Load (ksf)	**Dial Reading (inches)**	**Load (ksf)**	**Dial Reading (inches)**
Initial	0.0000	16.0	0.1235
0.5	0.0075	32.0	0.1920
1.0	0.0140	8.0	0.1815
2.0	0.0245	2.0	0.1680
4.0	0.0435	0.5	0.1535
8.0	0.0760		

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REVIEWED BY: Michael A. Ginsbach



SYMBOL	SAMPLE LOCATION	NORMAL PRESSURE AT SATURATION (KSF)
———	BH-12A ST-2 @ 10.0 - 12.0 FT.	0.50

CONSOLIDATION TEST RESULTS - ASTM D2435

PROJECT NO. 3691.1.1	WALLACE GROUP, INC. COFFIN BUTTE	LAB NO. 21-430

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Date: 12/16/2021

Lab No.: 21-430

Project: Coffin Butte (Project #21129-1)

Project No.: 3691.1.1

Sample ID: BH-12A ST-3 @ 20.0-22.0 Ft.

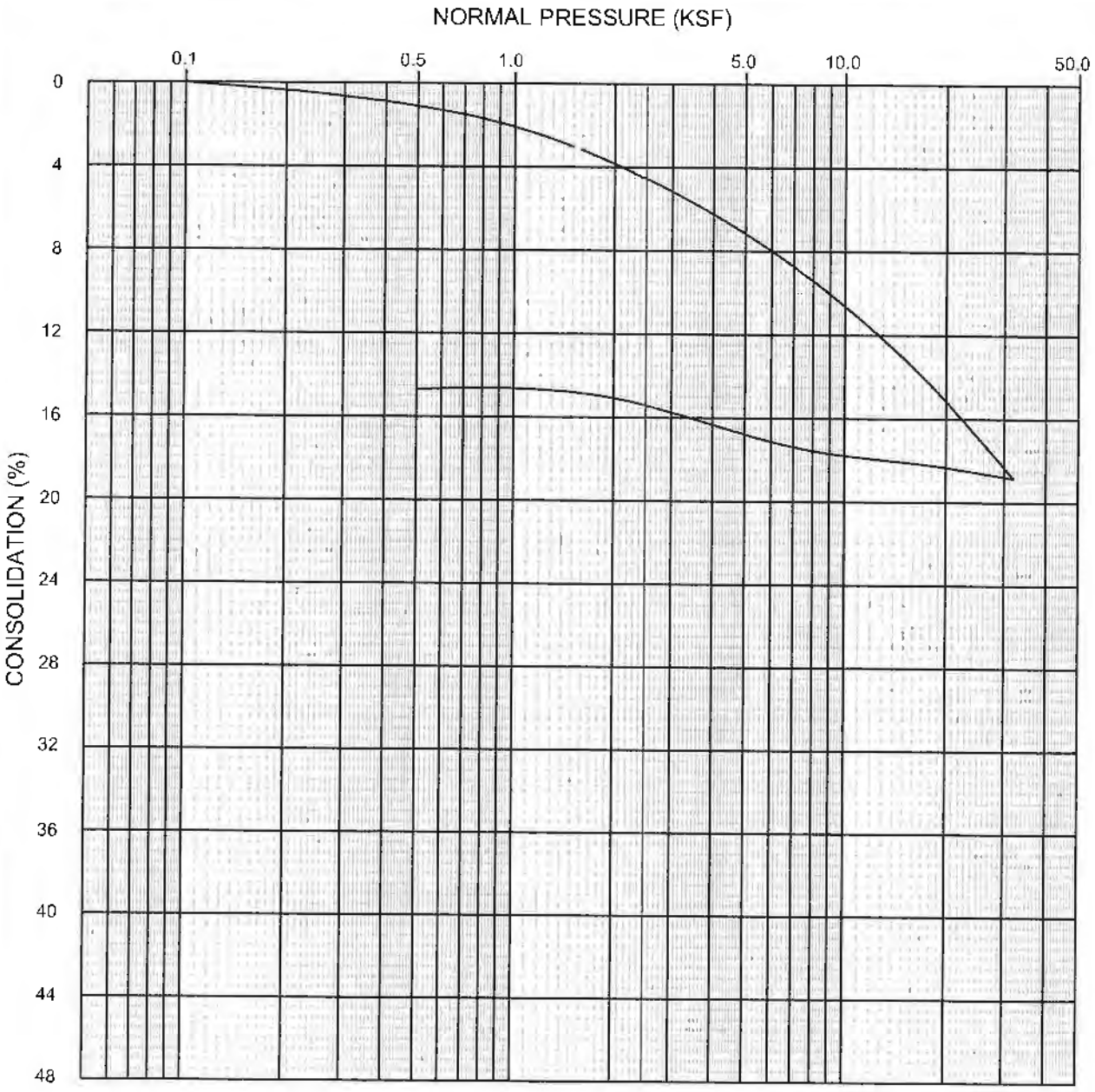
One Dimensional Consolidation of Soil (ASTM D2435)

Test	Initial Conditions	Final Conditions
Moisture Content, (%)	64.9	47.7
Dry Unit Weight, (pcf)	62.5	74.9
Height of Specimen, (inches)	1.0	0.85

Load (ksf)	Dial Reading (inches)	Load (ksf)	Dial Reading (inches)
Initial	-0.0010	16.0	0.1354
0.5	0.0107	32.0	0.1880
1.0	0.0207	8.0	0.1753
2.0	0.0380	2.0	0.1509
4.0	0.0623	0.5	0.1464
8.0	0.0944		

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SYMBOL	SAMPLE LOCATION	NORMAL PRESSURE AT SATURATION (KSF)
———	BH-12A ST-3 @ 20.0 - 22.0 FT.	0.50

CONSOLIDATION TEST RESULTS - ASTM D2435

PROJECT NO. 3691.1.1	WALLACE GROUP, INC. COFFIN BUTTE	LAB NO. 21-430

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Date: 12/16/2021

Lab No.: 21-430

Project: Coffin Butte (Project #21129-1)

Project No.: 3691.1.1

Sample ID: BH-11 ST1-S6 @ 12.0-14.0 Ft.

Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils – Sample Data (ASTM D2850)				
Mass (grams)	**Length (inches)**	**Diameter (inches)**	**Moisture Content (percent)**	**Dry Density (pcf)**
993.4	6.103	2.846	69.8	57.4



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Date: 12/18/2021

Lab No.: 21-430

Project: Coffin Butte (Project #21129-1)

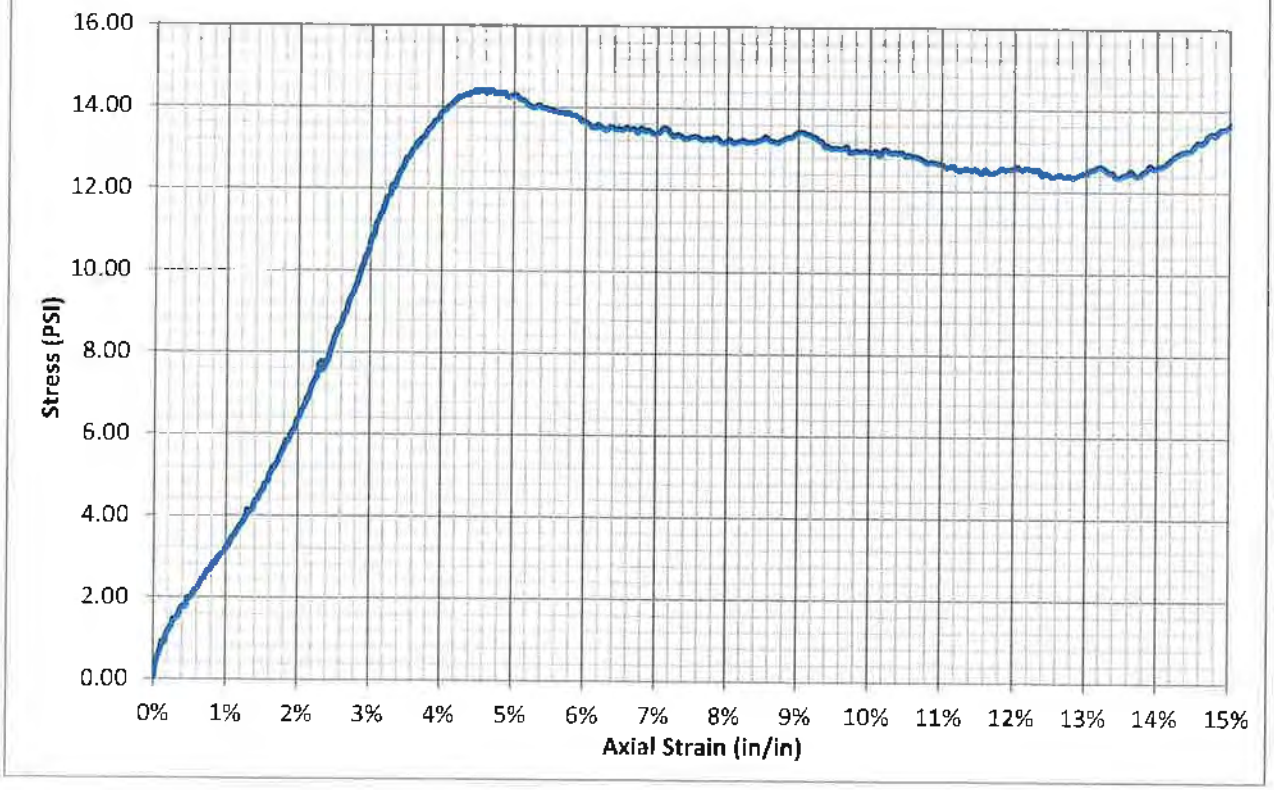
Project No.: 3691.1.1

Sample ID: BH-11 ST-1-S6 @ 13.5-14.0 Ft.

Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils – Test Data (ASTM D2850)

Strain Rate (%/min)	Peak Strength (psi)	Confining Pressure (psf)	Notes
0.01831	14.435	880	Shear at base, blocky.

Stress Strain Figure



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Date: 12/16/2021

Lab No.: 21-430

Project: Coffin Butte (Project #21129-1)

Project No.: 3691.1.1

Sample ID: BH-12A ST-2 @ 10.0-12.0 Ft.

Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils – Sample Data (ASTM D2850)				
Mass (grams)	**Length (inches)**	**Diameter (inches)**	**Moisture Content (percent)**	**Dry Density (pcf)**
1031.1	6.110	2.853	56.8	64.2





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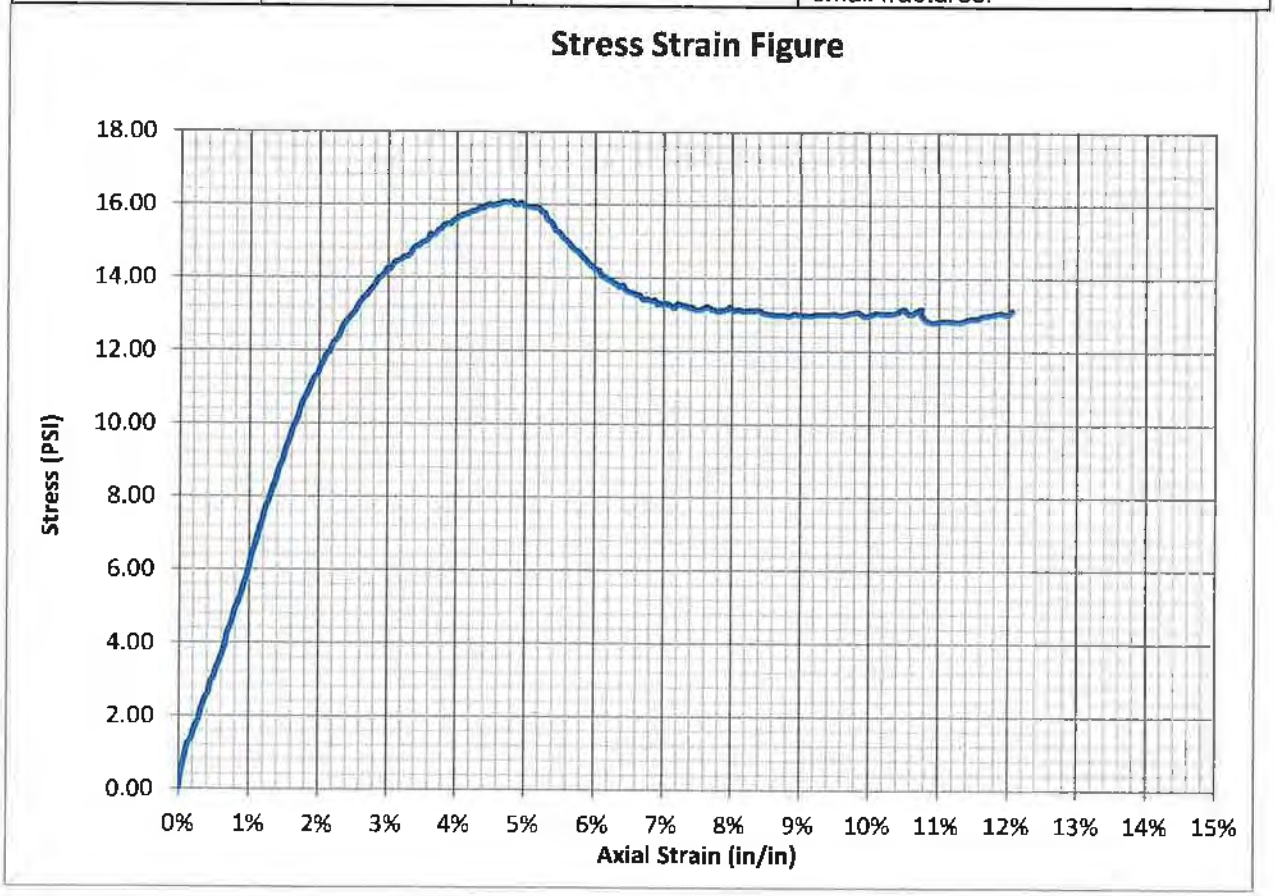
Lab No.: 21-430

Project: Coffin Butte (Project #21129-1)

Project No.: 3691.1.1

Sample ID: BH-12A ST-2 @ 10.0-12.0 Ft.

Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils – Test Data (ASTM D2850)			
Strain Rate (%/min)	**Peak Strength (psi)**	**Confining Pressure (psf)**	**Notes**
0.03055	16.093	770	Decomposed rock. Contains many small fractures.



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Date: 12/16/2021

Lab No.: 21-430

Project: Coffin Butte (Project #21129-1)

Project No.: 3691.1.1

Sample ID: BH-11 ST-S6@12.0-14.0 Ft.

Flexible Wall Permeability – Sample Data (ASTM D5084 – Method C)					
Mass (grams)	**Length (inches)**	**Diameter (inches)**	**Area (sq. inches)**	**Moisture Content (percent)**	**Dry Density (pcf)**
351.6	2.172	2.861	6.427	69.8	56.5

Flexible Wall Permeability – Test Data (ASTM D5084 – Method C)			
Sample Condition	**Saturation at Time of Testing (percent)**	**Head (psi)**	**Hydraulic Gradient (in/in)**
undisturbed	97	0.5	6.80

Flexible Wall Permeability – Test Results (ASTM D5084 – Method C)				
Test 1 k (cm/sec)	**Test 2 k (cm/sec)**	**Test 3 k (cm/sec)**	**Test 4 k (cm/sec)**	**Average k (cm/sec)**
4.17×10^{-6}	4.01×10^{-6}	4.11×10^{-6}	4.15×10^{-6}	4.11×10^{-6}

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Date: 12/16/2021

Lab No.: 21-430

Project: Coffin Butte (Project #21129-1)

Project No.: 3691.1.1

Sample ID: BH-7 ST-1 @ 10.0-12.0 Ft.

Direct Shear Test of Soils Under Consolidated Drained Conditions – Sample Data (ASTM D3080)			
Test	**500psf Normal Load Initial Conditions**	**1500psf Normal Load Initial Conditions**	**2500psf Normal Load Initial Conditions**
Moisture Content, (%)	53.8	57.3	61.8
Dry Unit Weight, (pcf)	62.1	58.7	55.9
Peak Shear Strength, (psf)	701	1497	2196

Note: Displacement rate used during testing, 0.00017 inches/minute

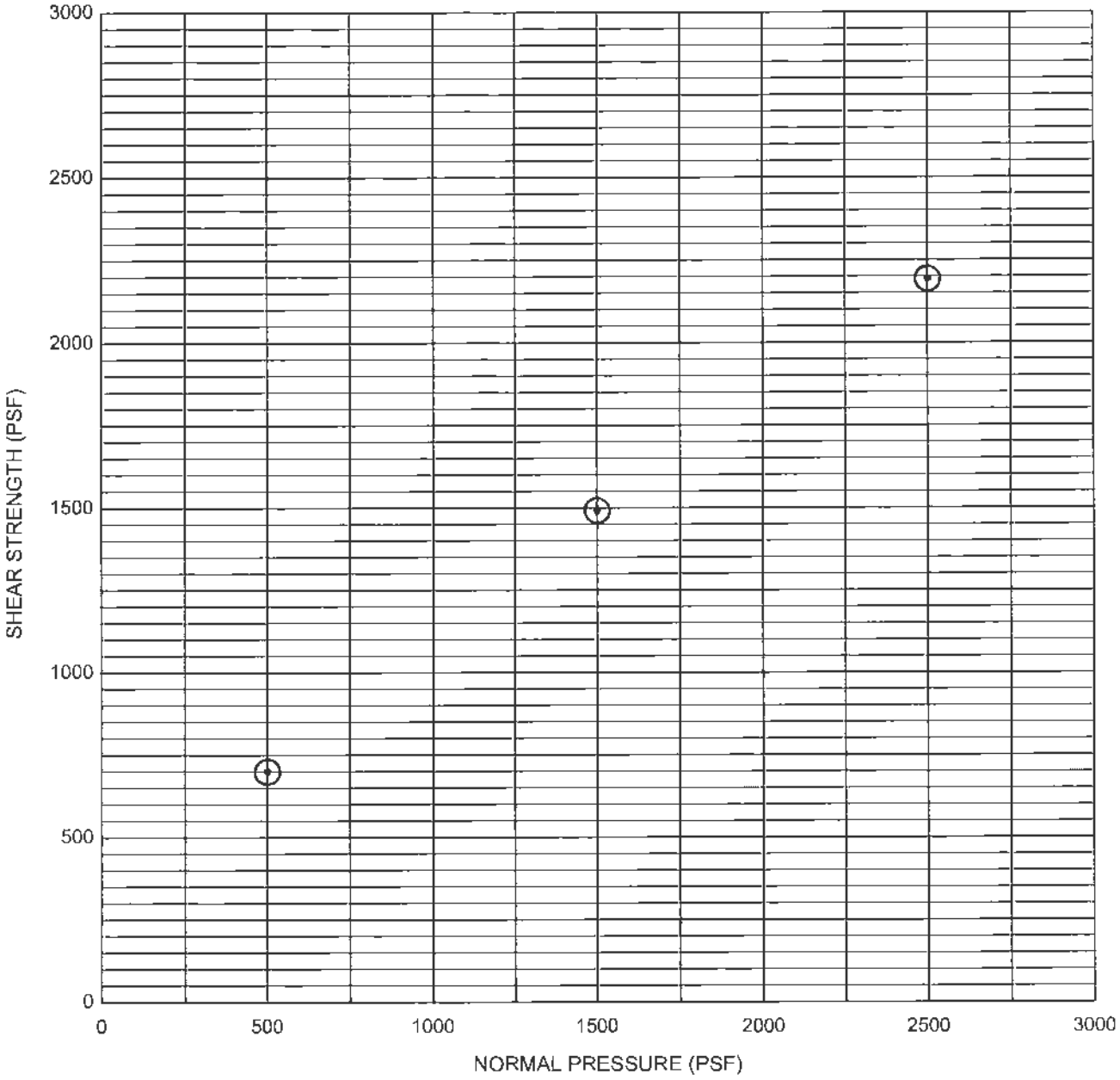
Sample ID: BH-12A ST-3 @ 20.0-22.0 Ft.

Direct Shear Test of Soils Under Consolidated Drained Conditions – Sample Data (ASTM D3080)			
Test	**500psf Normal Load Initial Conditions**	**1500psf Normal Load Initial Conditions**	**2500psf Normal Load Initial Conditions**
Moisture Content, (%)	55.9	57.7	63.1
Dry Unit Weight, (pcf)	62.2	59.9	59.6
Peak Shear Strength, (psf)	567	1340	2164

Note: Displacement rate used during testing, 0.00013 inches/minute

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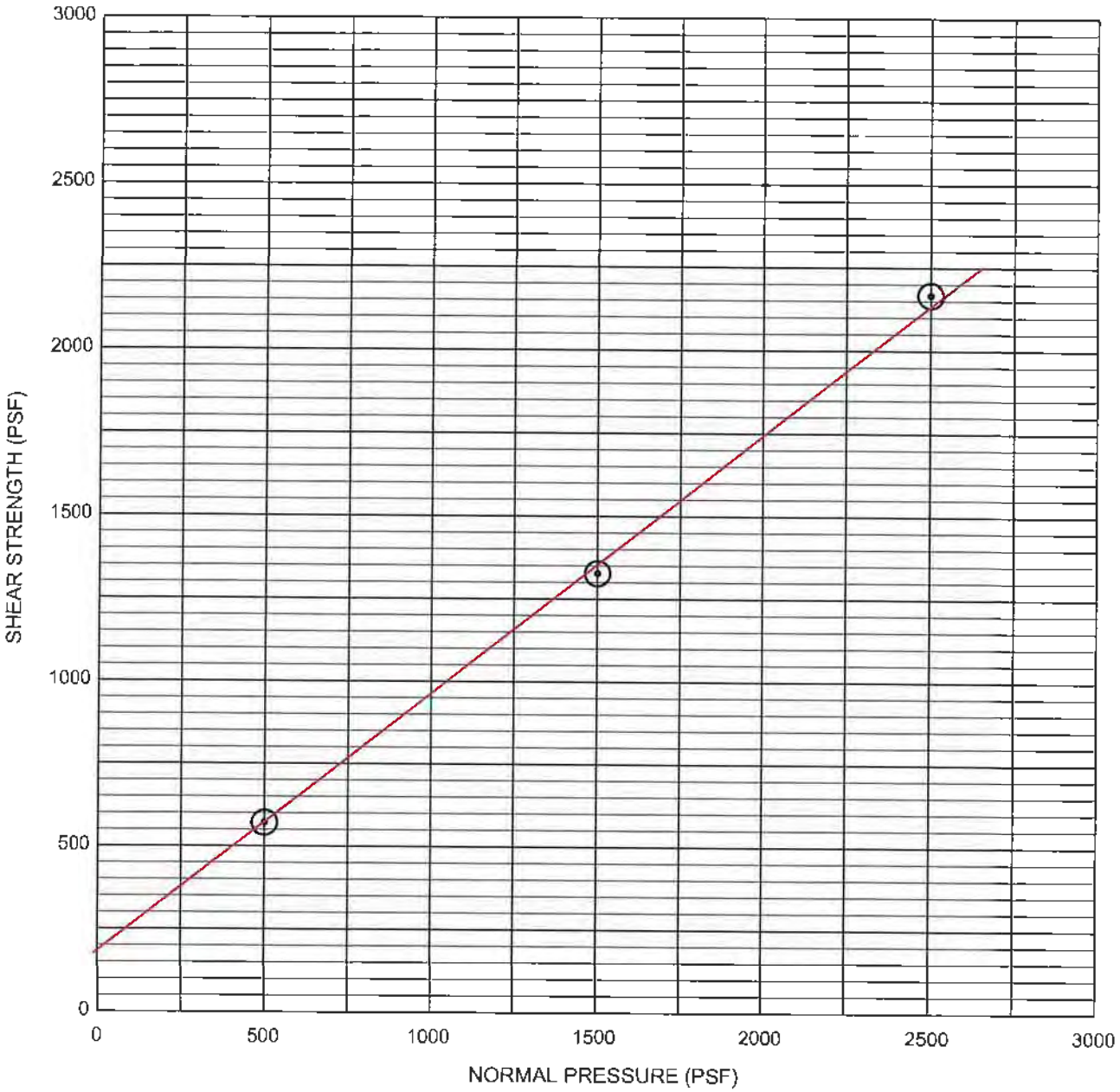


SYMBOL	SAMPLE LOCATION	COHESION (psf)	FRICTION ANGLE	REMARKS
⊙	BH-7, ST-1 @ 10.0 - 12.0 FT.	--		SATURATED; UNDISTURBED

DIRECT SHEAR TEST RESULTS - ASTM D3080

PROJECT NO. 3691.1.1	WALLACE GROUP, INC. COFFIN BUTTE	LAB NO. 21-430

Northwest Testing, Inc.



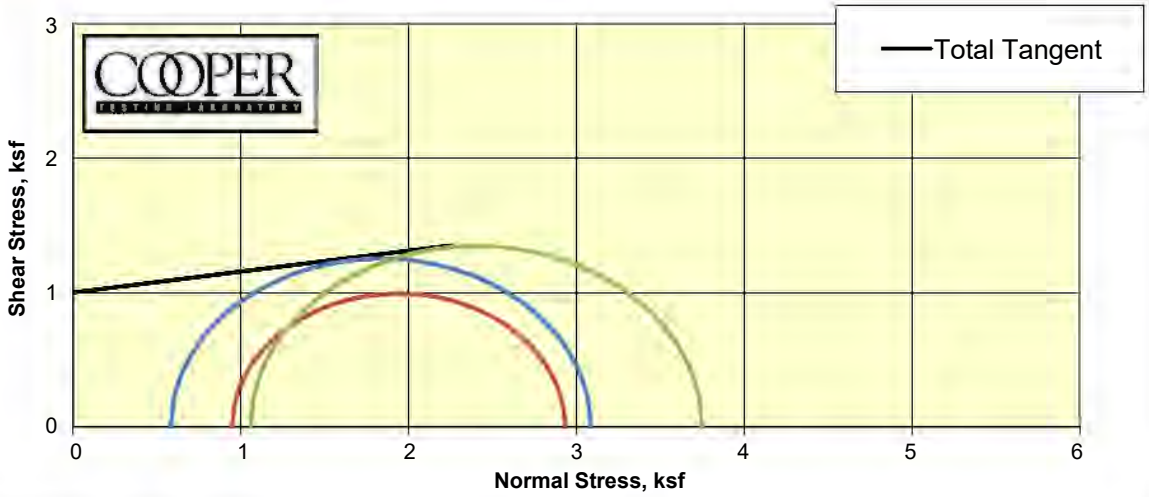
SYMBOL	SAMPLE LOCATION	COHESION (psf)	FRICTION ANGLE	REMARKS
⊙	BH-12A, ST-3 @ 20.0 - 22.0 FT.			SATURATED; UNDISTURBED

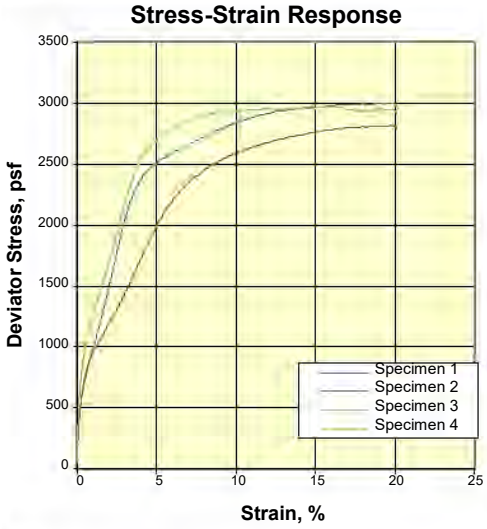
DIRECT SHEAR TEST RESULTS - ASTM D3080

PROJECT NO. 3691.1.1	WALLACE GROUP, INC. COFFIN BUTTE	LAB NO. 21-430

Northwest Testing, Inc.

Consolidated Undrained Triaxial Compression
ASTM D4767m





CTL Number:	1152-001
Client Name:	The Wallace Group
Project Name:	Coffin Butte Landfill
Project Number:	21129-1
Date:	12/23/2021 By: MD/DC
Total C	1.000 ksf
Total phi	8.8 degrees
Eff. C	N/A ksf
Eff. Phi	N/A degrees ©

Remarks: Engineering judgement is required to determine phi and cohesion, no phi or cohesion is reported. To add phi and cohesion to the report go to the "Report" tab and in cells M18 through P19 enter end points for a line through the Mohr's circles. The points plotted can be changed on the "Shear Values" tab using cells B3, F3, and J3.

Specimen	1	2	3	4
Boring	BH-2	BH-2	BH-2	
Sample	ST-1	ST-1	ST-1	
Depth	13(Tip-13.5")	13(Tip-6.5")	13(Tip-1/2")	
Visual Description	Olive Brown CLAY	Olive Brown CLAY	Olive Brown CLAY	
MC (%)	36.1	35.7	36.3	
Dry Density (pcf)	85.6	83.4	85.3	
Saturation (%)	98.7	92.6	98.6	
Void Ratio	1.007	1.059	1.012	
Diameter (in)	2.87	2.87	2.87	
Height (in)	5.99	5.75	5.98	
	Final			
MC (%)	36.2	36.0	36.3	
Dry Density (pcf)	86.0	86.3	85.9	
Saturation (%)	100.0	100.0	100.0	
Void Ratio	0.996	0.990	0.998	
Diameter (in)	2.87	2.83	2.87	
Height (in)	5.97	5.73	5.94	
Cell Pressure (psi)	63.6	66.4	67.6	
Back Pressure (psi)	59.6	59.8	60.3	
	Total Stresses At:			
Strain (%)	5.0	5.0	5.0	
Deviator (ksf)	2.501	1.983	2.689	
Excess PP (psi)				
Sigma 1 (ksf)	3.084	2.931	3.747	
Sigma 3 (ksf)	0.583	0.948	1.058	
P (ksf)	1.834	1.940	2.402	
Q (ksf)	1.251	0.991	1.345	
Stress Ratio	5.292	3.091	3.542	
Rate (in/min)	0.0300	0.0287	0.0299	

BENCHMARK GEOTECHNICAL LABS

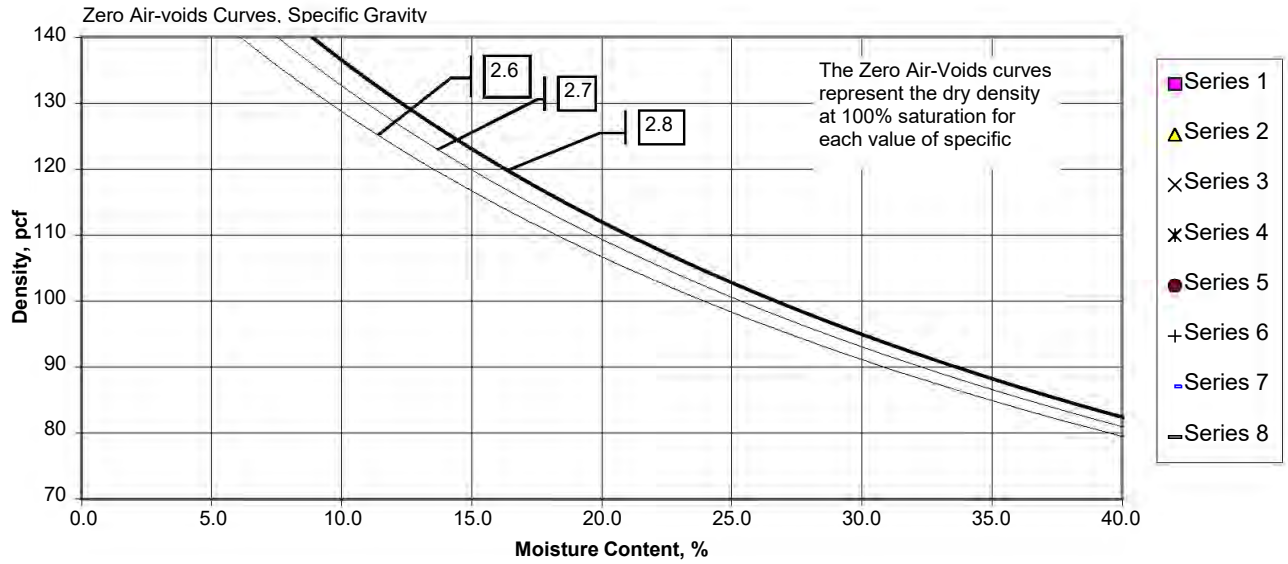
Moisture-Density-Porosity Report
(ASTM D7263b)

BGL Job No:	026-029	**Project No.**	21129	**By:**	PJ
Client:	The Wallace Group	**Date:**	10/13/22		
Project Name:	Coffin Butte Landfill	**Remarks:**			

Boring:	GP-04	GP-04	GP-04	GP-04	GP-04	GP-04	GP-05	GP-05
Sample:	S-1	S-2	S-3	S-4	S-5	S-6	S-2	S-3
Depth, ft:	3	7	13.5	22	25	27	6.5-8	14-17
Visual Description:	Reddish Brown CLAY	Red CLAY	Red CLAY	Yellow & Brown SILT	Yellow & Brown SILT	Yellow & Brown SILT	Brown & Dark Brown SILT	Mottled Dark Grayish Brown Sandy SILT
Actual G_s								
Assumed G_s								
Moisture, %	22.6	37.3	40.1	75.6	69.7	70.3	42.6	45.1
Wet Unit wt, pcf								
Dry Unit wt, pcf								
Dry Bulk Dens.ρb, (g/cc)								
Saturation, %								
Total Porosity, %								
Volumetric Water Cont,Θw,%								
Volumetric Air Cont., Θa,%								
Void Ratio								
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered to be approximate.

Moisture-Density



BENCHMARK GEOTECHNICAL LABS

Moisture-Density-Porosity Report
(ASTM D7263b)

BGL Job No:	026-029	**Project No.**	21129	**By:**	PJ
Client:	The Wallace Group	**Date:**	10/13/22		
Project Name:	Coffin Butte Landfill	**Remarks:**			

Boring:	GP-06	GP-06	GP-07					
Sample:	S-4	S-6	-					
Depth, ft:	18	27	12-14					
Visual Description:	Mottled Dark Brown & Yellow SILT	Brownish Yellow & Yellowish Brown SILT	Brown & Very Pale Brown SILT, trace Sand					
Actual G_s								
Assumed G_s								
Moisture, %	71.9	80.6	38.3					
Wet Unit wt, pcf								
Dry Unit wt, pcf								
Dry Bulk Dens.ρb, (g/cc)								
Saturation, %								
Total Porosity, %								
Volumetric Water Cont,Θw,%								
Volumetric Air Cont., Θa,%								
Void Ratio								
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered to be approximate.

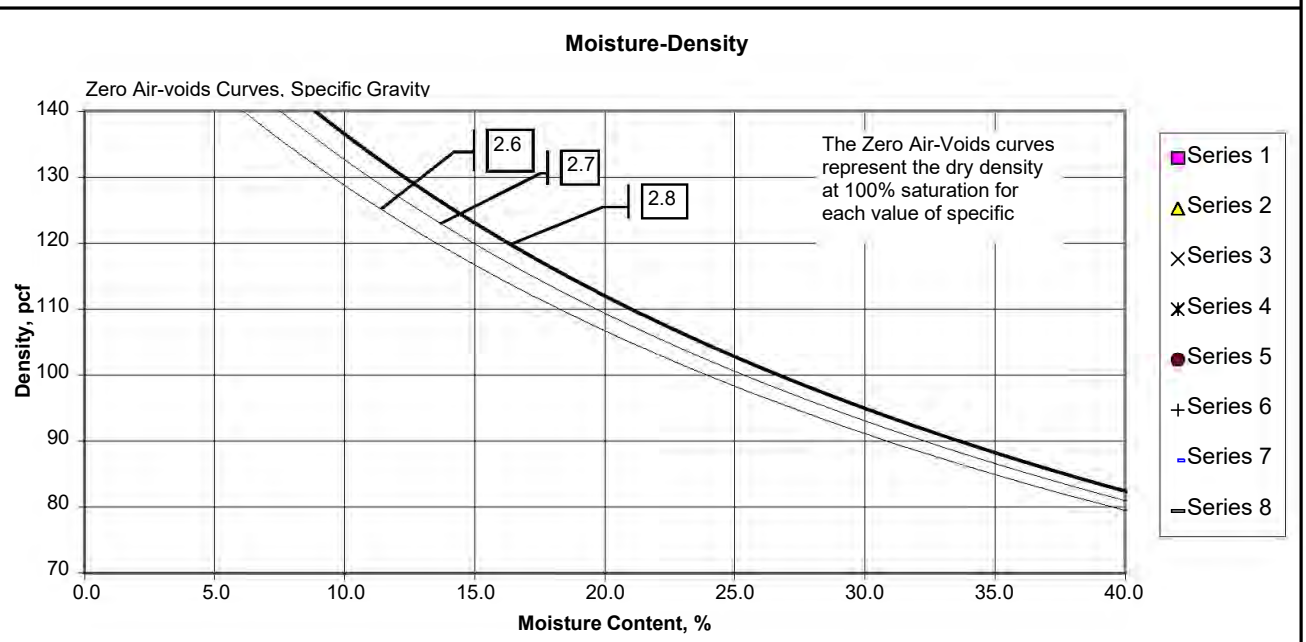


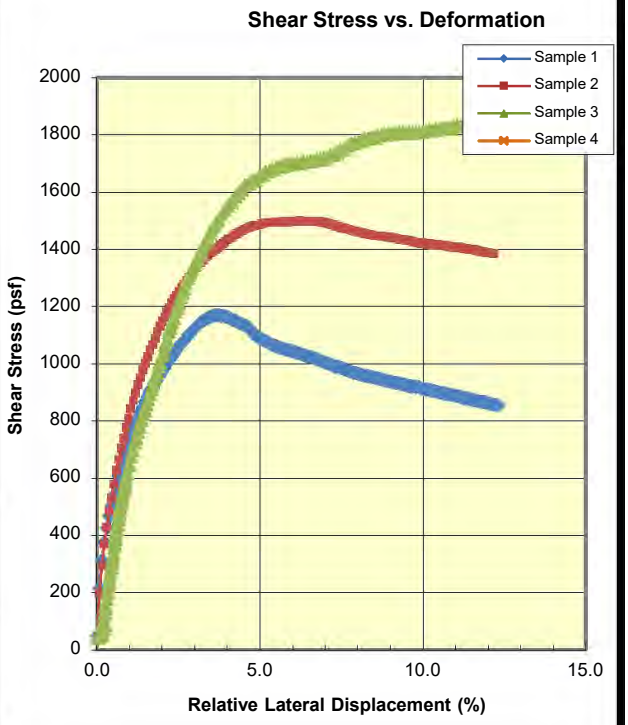
Fig B-31

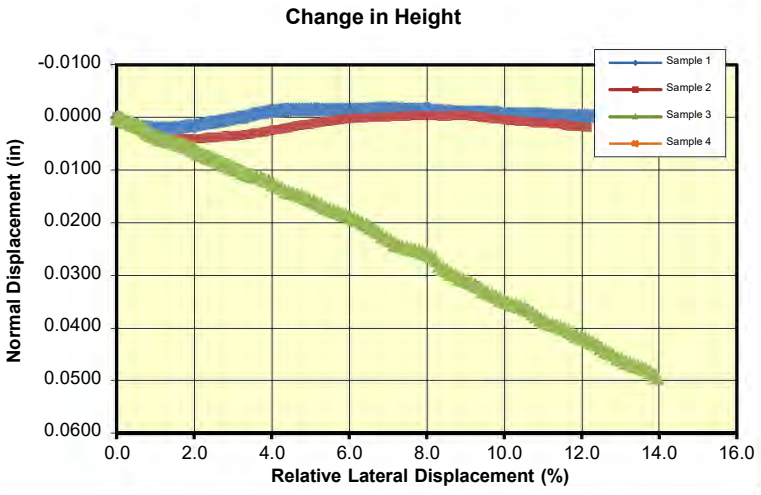
Consolidated Drained Direct Shear (ASTM D3080)

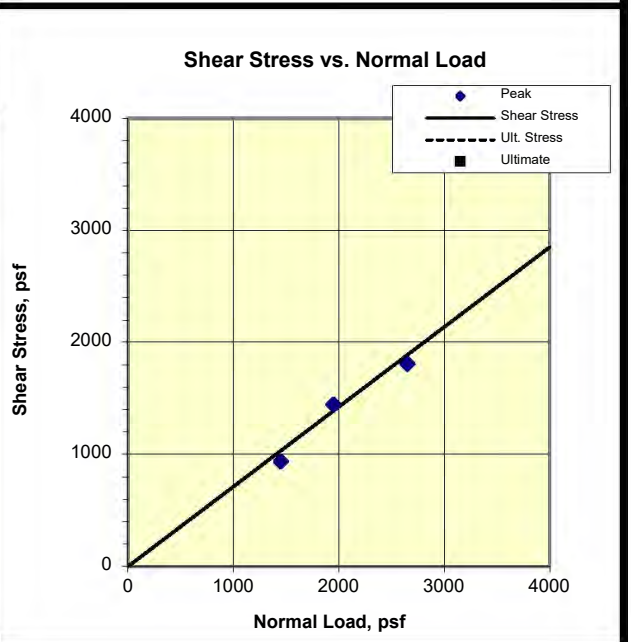
CTL Job #:	1152-002	Project #:	21129-4	By:	MD
Client:	Wallace Group	Date:	1/3/2023	Checked:	PJ
Project Name:	Coffin Butte Landfill Expansion	Remolding Info:			

Specimen Data				
	1	2	3	4
Boring:	GP-4	GP-4	GP-4	
Sample:	ST-3	ST-3	ST-3	
Depth (ft):	28-30.5	28-30.5	28-30.5	
Visual Description:	Yellowish Brown CLAY w/ Sand	Yellowish Brown CLAY w/ Sand	Yellowish Brown CLAY w/ Sand	
Normal Load (psf)	1450	1950	2650	
Dry Mass of Specimen (g)	102.0	103.4	101.2	
Initial Height (in)	0.98	0.99	1.01	
Initial Diameter (in)	2.87	2.85	2.87	
Initial Void Ratio	1.851	1.788	1.962	
Initial Moisture (%)	65.4	62.9	69.6	
Initial Wet Density (pcf)	101.4	102.1	100.1	
Initial Dry Density (pcf)	61.3	62.7	59.0	
Initial Saturation (%)	99.0	98.5	99.3	
ΔHeight Consol (in)	0.0209	0.0340	0.0580	
At Test Void Ratio	1.790	1.692	1.792	
At Test Moisture (%)	63.5	59.9	63.7	
At Test Wet Density (pcf)	102.4	103.9	102.5	
At Test Dry Density (pcf)	62.6	64.9	62.6	
At Test Saturation (%)	99.3	99.2	99.6	
Strain Rate (%/min)	0.01	0.01	0.01	
Strengths Picked at	9%	9%	9%	
Shear Stress (psf)	938	1442	1808	
ΔHeight (in) at 9%	-0.0010	0.0023	0.0308	
Ultimate Stress (psf)				

Phi (deg)	35.5	Ult. Phi (deg)	
Cohesion (psf)	0	Ult. Cohesion (psf)	





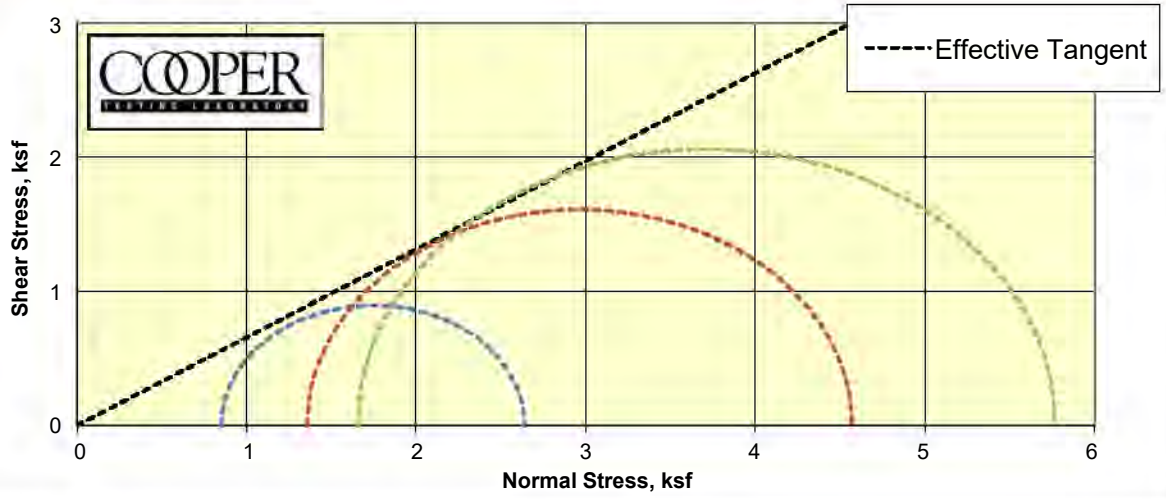


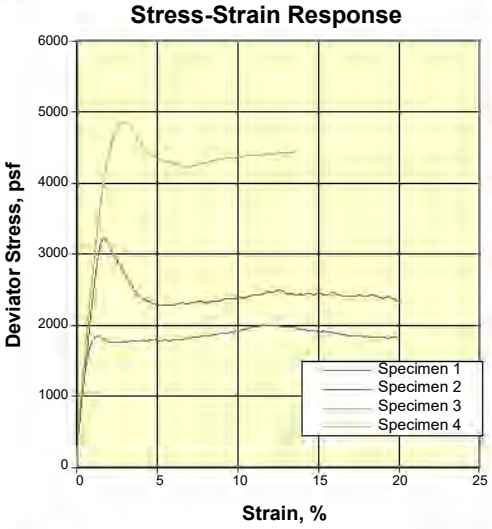
Remarks:

©

Fig B-32

Consolidated Drained Triaxial Compression
ASTM D7181



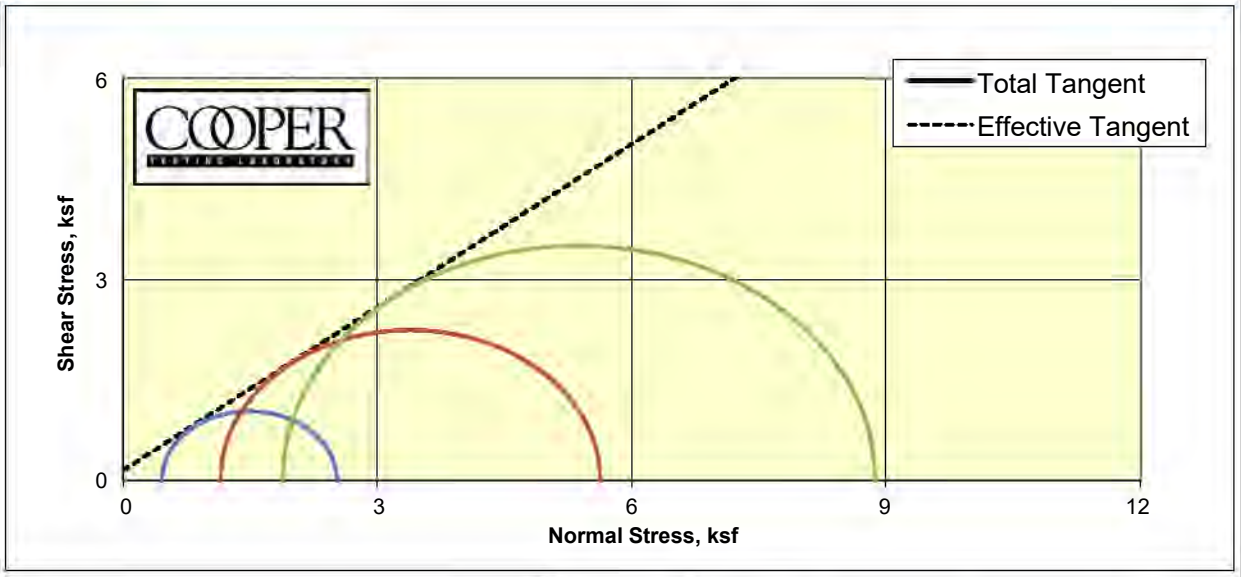


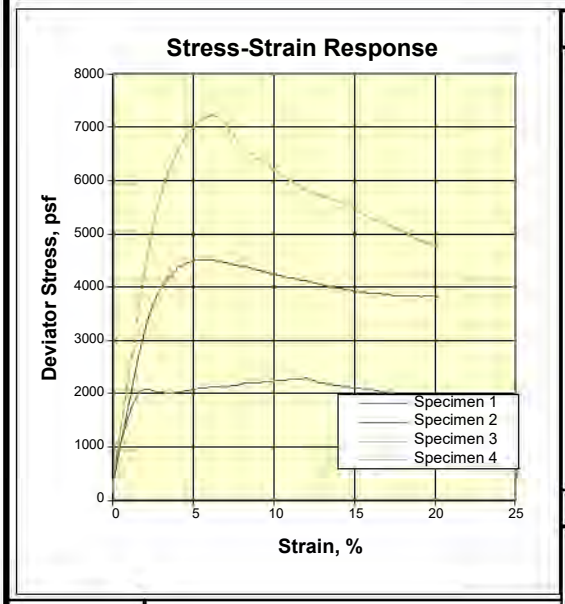
CTL Number:	1152-002
Client Name:	The Wallace Group
Project Name:	Coffin Butte Landfill Expansion
Project Number:	21129-4
Date:	12/13/2022 By: MD/DC
Total C	N/A ksf
Total phi	N/A degrees
Eff. C	0.000 ksf
Eff. Phi	33.3 degrees ©

Specimen	1	2	3	4
Boring	GP-4	GP-4	GP-4	
Sample	ST-2	ST-2	ST-2	
Depth	17.5(Tip-15")	18.5(Tip-7.5")	18.5(-1")	
Visual Description	Reddish Yellow CLAY w/ Sand (Silty)/ SILT w/ Sand (slightly plastic)	Reddish Yellow CLAY w/ Sand (Silty)/ SILT w/ Sand (slightly plastic)	Reddish Yellow CLAY w/ Sand (Silty)/ SILT w/ Sand (slightly plastic)	
MC (%)	65.7	69.8	69.0	
Dry Density (pcf)	62.6	58.9	59.8	
Saturation (%)	97.8	95.0	96.1	
Void Ratio	2.063	2.257	2.204	
Diameter (in)	2.87	2.87	2.87	
Height (in)	5.98	5.98	6.01	
	Final			
MC (%)	69.8	70.8	66.1	
Dry Density (pcf)	62.3	59.7	61.3	
Saturation (%)	100.0	100.0	100.0	
Void Ratio	2.075	2.210	2.130	
Diameter (in)	2.88	2.86	2.85	
Height (in)	5.96	5.94	5.97	
Cell Pressure (psi)	105.5	110.0	112.3	
Back Pressure (psi)	99.7	100.6	100.8	
	Effective Stresses At:			
Strain (%)	1.7	1.7	1.7	
Deviator (ksf)	1.788	3.215	4.115	
Excess PP (psi)	-0.1	-0.1	-0.1	
Sigma 1 (ksf)	2.640	4.571	5.770	
Sigma 3 (ksf)	0.851	1.356	1.655	
P (ksf)	1.745	2.963	3.712	
Q (ksf)	0.894	1.608	2.058	
Stress Ratio	3.101	3.372	3.487	
Rate (in/min)	0.0004	0.0004	0.0004	

Fig B-33

Consolidated Drained Triaxial Compression
ASTM D7181





CTL Number:	1152-002
Client Name:	The Wallace Group
Project Name:	Coffin Butte Landfill Expansion
Project Number:	21129-4
Date:	12/20/2022 By: MD/DC
Total C	N/A ksf
Total phi	N/A degrees
Eff. C	0.150 ksf
Eff. Phi	39.0 degrees ©

Specimen	1	2	3	4
Boring	GP-5	GP-5	GP-5	
Sample	ST-1	ST-1	ST-1	
Depth	10(Tip-15")	10(Tip-7.5")	10(Tip-.5")	
Visual Description	Reddish Yellow Clayey SAND w/ Gravel	Dark Brown Mottled Yellow Silty SAND grading to Reddish Yellow Clayey SAND w/ Gravel	Dark Brown Mottled Yellow Silty SAND	
MC (%)	41.2	48.2	41.2	
Dry Density (pcf)	78.5	71.4	78.8	
Saturation (%)	95.5	94.4	96.1	
Void Ratio	1.186	1.405	1.179	
Diameter (in)	2.87	2.87	2.87	
Height (in)	5.98	5.98	5.99	
	Final			
MC (%)	49.3	50.8	40.0	
Dry Density (pcf)	78.6	72.1	78.8	
Saturation (%)	100.0	100.0	100.0	
Void Ratio	1.185	1.382	1.177	
Diameter (in)	2.88	2.87	2.89	
Height (in)	5.94	5.92	5.92	
Cell Pressure (psi)	102.7	108.2	114.0	
Back Pressure (psi)	99.7	100.2	100.9	
	Effective Stresses At:			
Strain (%)	5.0	5.0	5.0	
Deviator (ksf)	2.065	4.484	6.993	
Excess PP (psi)	-0.2	0.0	0.0	
Sigma 1 (ksf)	2.523	5.630	8.873	
Sigma 3 (ksf)	0.457	1.147	1.880	
P (ksf)	1.490	3.389	5.376	
Q (ksf)	1.033	2.242	3.497	
Stress Ratio	5.517	4.910	4.721	
Rate (in/min)	0.0004	0.0004	0.0004	

Fig B-34

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OVEN DRY MOISTURE CONTENT
ASTM D-2216

Client:	CEC, Inc.	**Date Sampled:**	9/22/2022
Project Name:	Coffin Butte Landfill	**Project No. :**	21129 - 1
Technician:	PJH	**Lab No.:**	WGG0281
Reviewed By:	LMS	**Date Analyzed:**	10/14/2022

Location	GP-06		GP-06
Depth	7'		24'
Wt. Dish & Wet Soil	639.3		463.3
Wt Dish & Dry Soil	528.1		300.3
Wt of Dish	242.9		83.0
Wt of Water	111.2		163.0
Wt of Dry Soil	285.2		217.3
Percent Moisture	39.0		75.0

Note: Data and results shown above include ASTM Test Method D2216. This report pertains only to the material tested and/or inspected and is not to be reproduced without prior authorization of Wallace Group. If part of a larger document, this report is not to be removed or reproduced separately. This report is the property of the Client and shall not be distributed to other parties without Client's permission.

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No. 200 Sieve Wash

(Material Finer than No. 200 Sieve)

ASTM C117 / D-1140

Client: Civil & Environmental Consultants
Project Coffin Butte Landfill
Location: Corvallis, OR
Sample Location: GP-09 & GP-01
Date Sampled: 9/22/2022

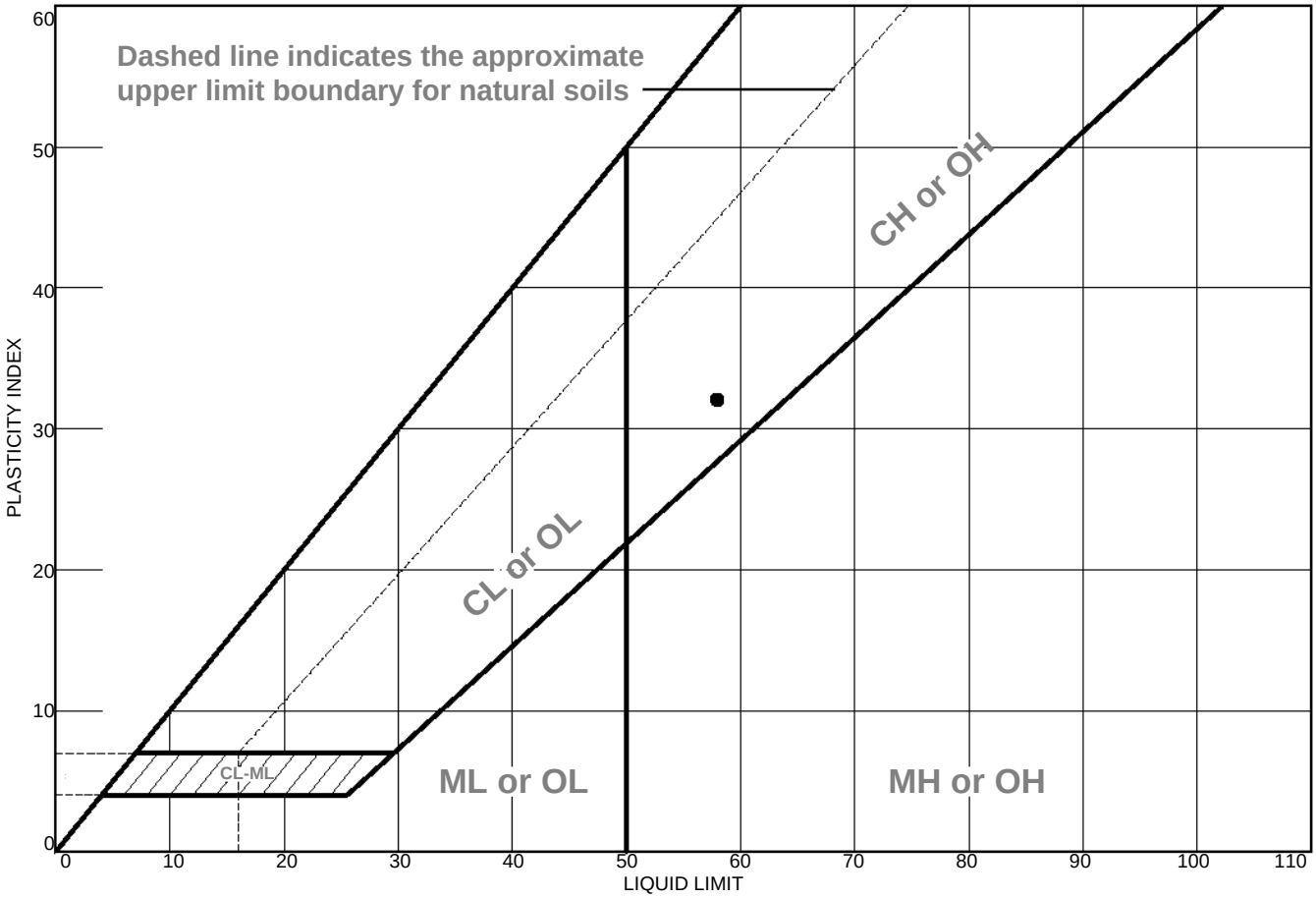
Project Number: 21129 - 1
Lab Number: WGG0281
Technician: PJH
Date Received: 9/25/2022
Date Analyzed: 10/17/2022

Location	GP-09	GP-01	GP-01
Depth	2 - 4'	3'	8.5'
Wet Weight	464.8	493.4	383.9
Dry Weight	362.3	379.7	283.1
Moisture %	28.3%	29.9%	35.6%
Weight After Wash	25.8	7.1	7.4
Weight Passing #200	336.5	372.6	275.7
% Passing #200	92.9%	98.1%	97.4%

REVIEWED BY: L. Splitter
DATE: 6/30/2023

Note: Data and results shown above include ASTM Test Methods C117 and C1140. This report pertains only to the material tested and/or inspected and is not to be reproduced without prior authorization of Wallace Group. If part of a larger document, this report is not to be removed or reproduced separately. This report is the property of the Client and shall not be distributed to other parties without Client's permission.

Plasticity Index of Soil (D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clay	58	26	32	99.2%	98.1%	CH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** GP-01 **Depth:** 3' **Sample Number:** S-1

Remarks:

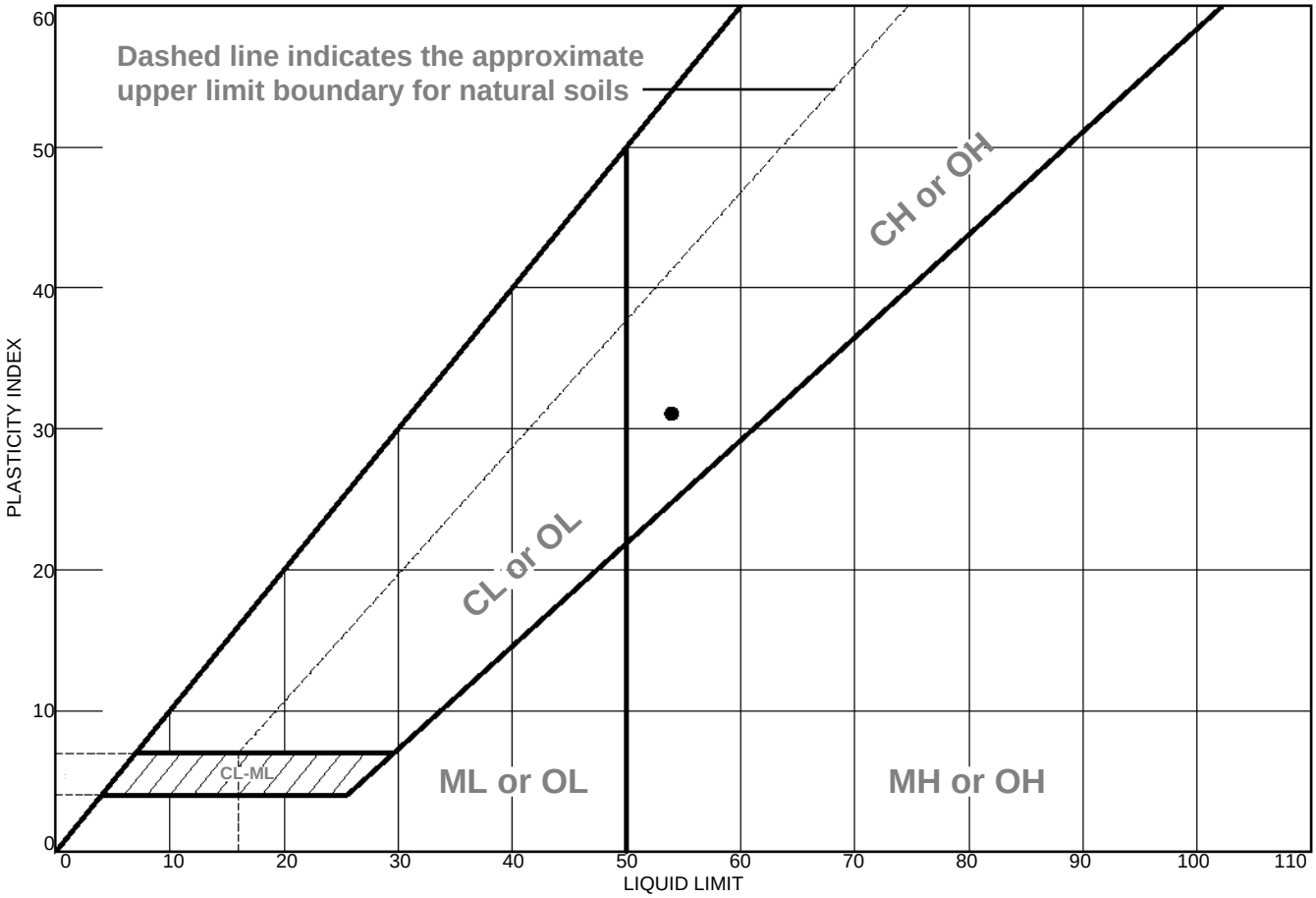
●Lab No.: WGG0281
Sampled By: SMW on 09-22-22
ASTM D4318 | Multipoint Method A
Wet Prepped, Manual Liquid Limit Device & Hand Rolled

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Figure B-37

Tested By: PJH **Checked By:** LMS

Plasticity Index of Soil (D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clay	54	23	31	99.0%	97.4%	CH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** GP-01 **Depth:** 8.5' **Sample Number:** S-2

Remarks:

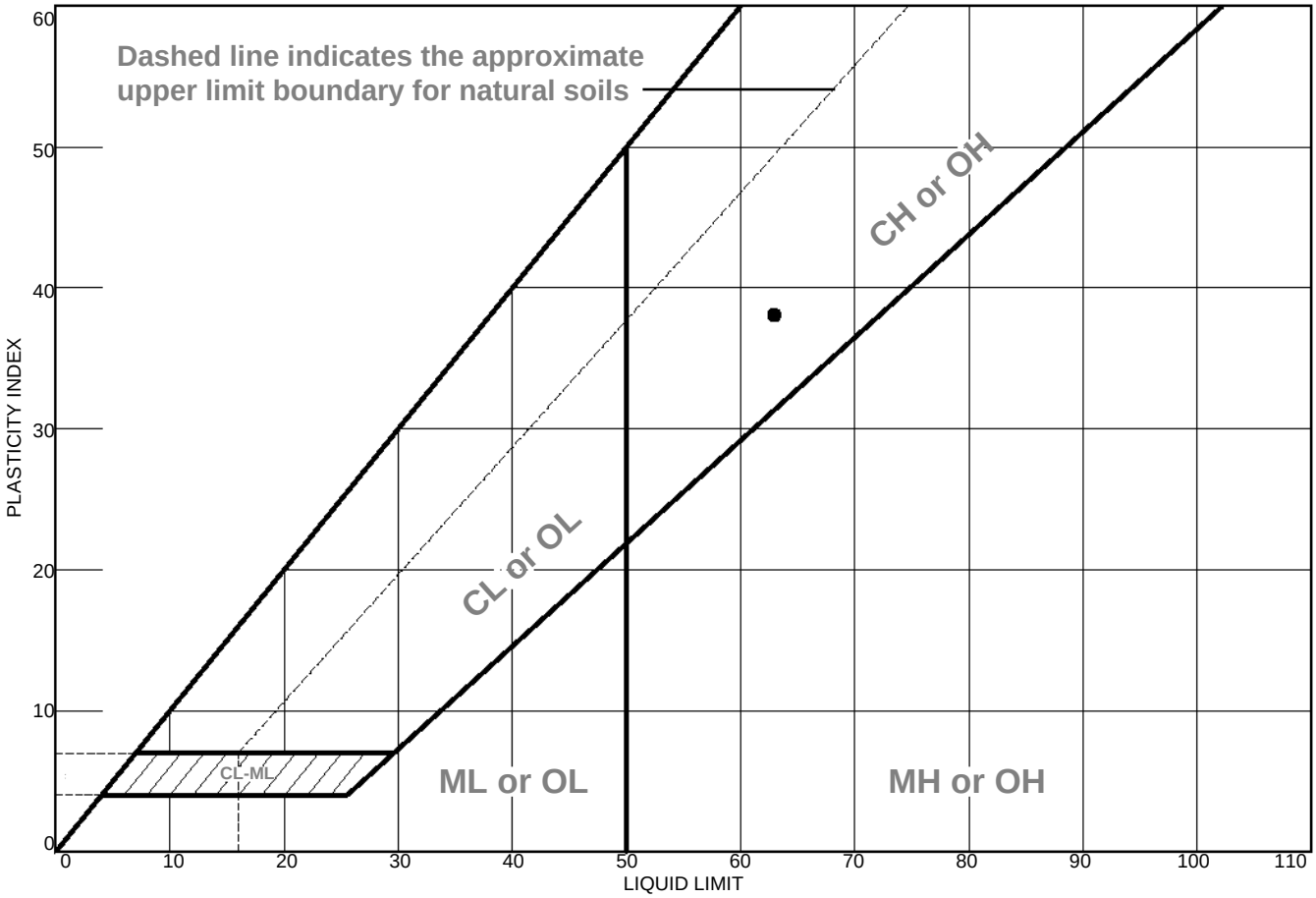
●Lab No.: WGG0281
Sampled By: SMW on 09-22-22
ASTM D4318 | Multipoint Method A
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Figure B-38

Tested By: PJH **Checked By:** LMS

Plasticity Index of Soil (D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clay	63	25	38	Not Tested	Not Tested	MH-CH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** GP-04 **Depth:** 3' **Sample Number:** S-1

Remarks:

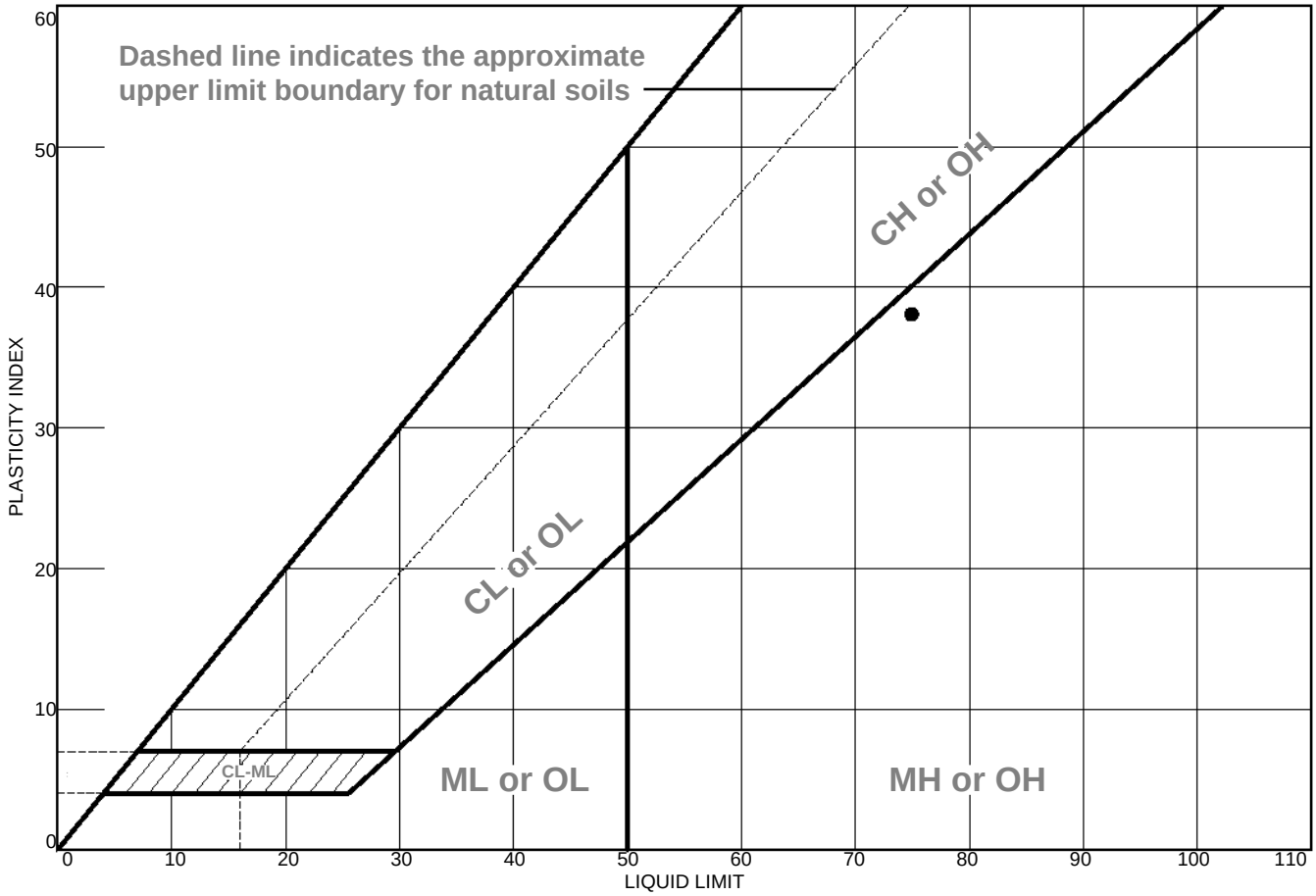
●Lab No.: WGG0281
Sampled By: SMW on 09-22-22
ASTM D4318 | Multipoint Method A
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Figure B-39

Tested By: PJH **Checked By:** LMS

Plasticity Index of Soil (D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Elastic Silt with Sand	75	37	38	Not Tested	Not Tested	MH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** GP-04 **Depth:** 17' **Sample Number:** S-3

Remarks:

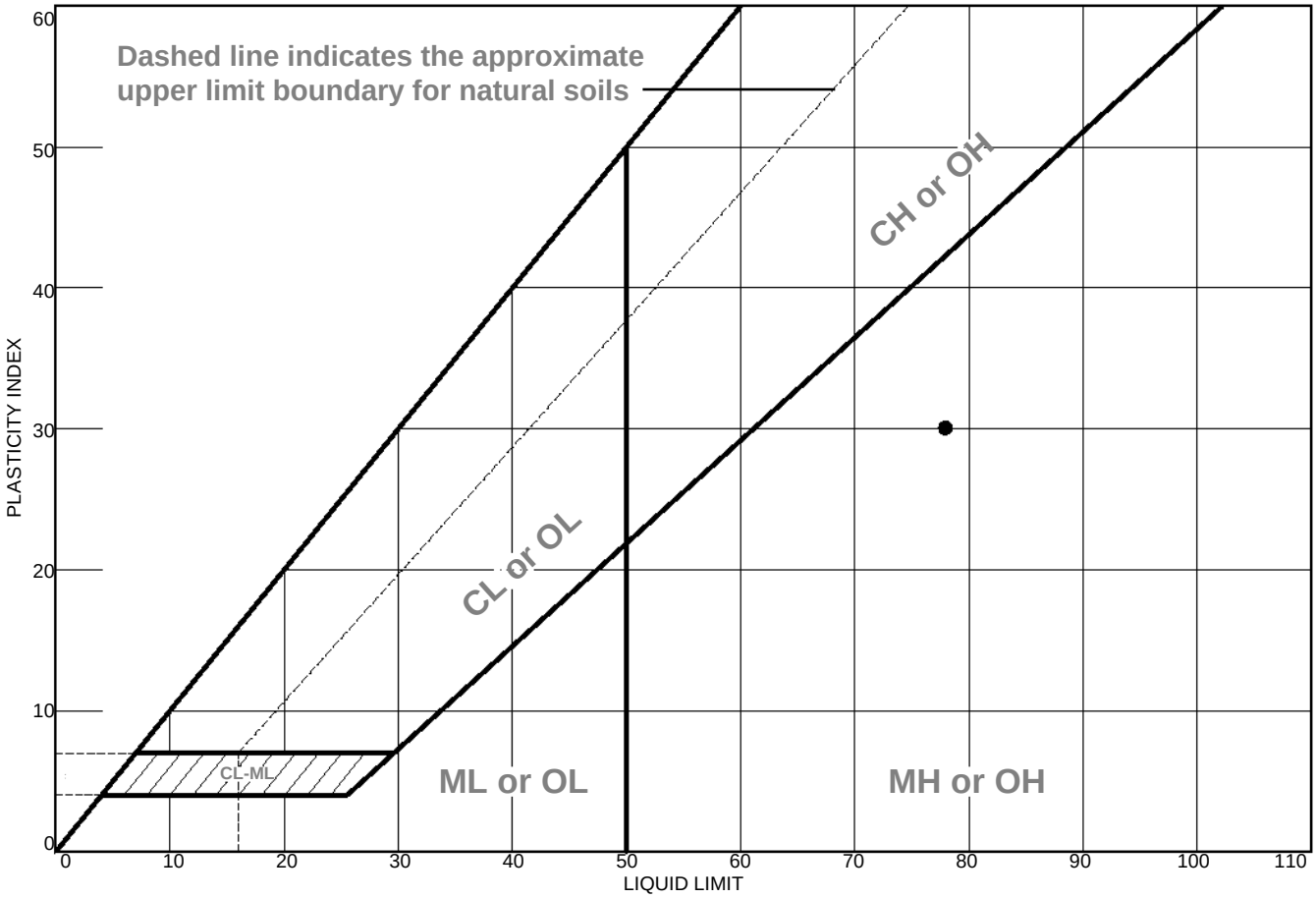
●Lab No.: WGG0281
Sampled By: SMW on 09-22-22
ASTM D4318 | Multipoint Method A
Wet Prepped, Manual Liquid Limit Device & Hand Rolled

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Figure B-40

Tested By: PJH **Checked By:** LMS

Plasticity Index of Soil (D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Elastic Silt with Sand	78	48	30	Not Tested	Not Tested	MH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** GP-04 **Depth:** 25' **Sample Number:** S-5

Remarks:

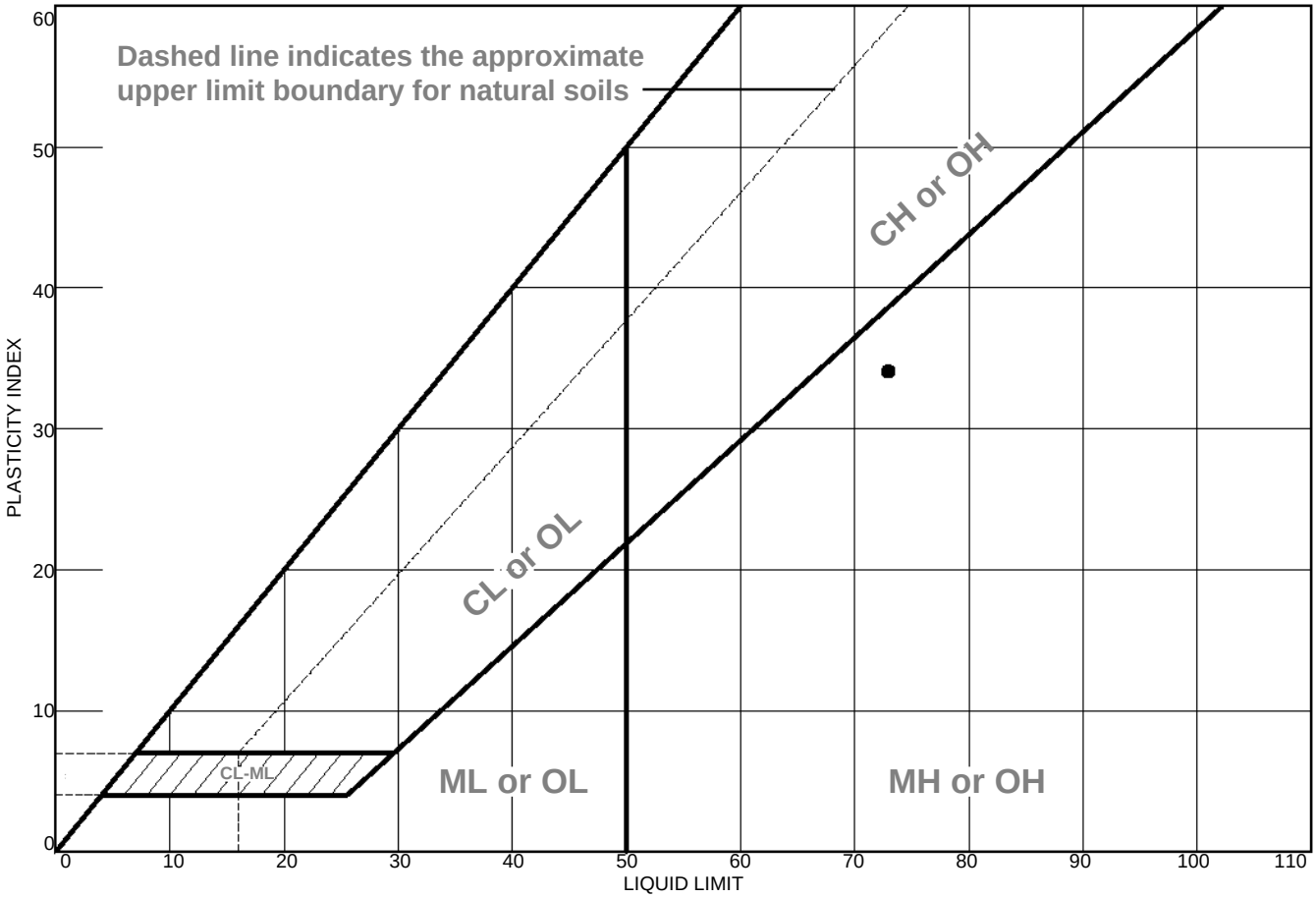
●Lab No.: WGG0281
Sampled By: SMW on 09-22-22
ASTM D4318 | Multipoint Method A
Wet Prepped, Manual Liquid Limit Device & Hand Rolled

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Figure B-41

Tested By: PJH **Checked By:** LMS

Plasticity Index of Soil (D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Elastic Silt with Sand	73	39	34	Not Tested	Not Tested	MH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** GP-05 **Depth:** 6.5 - 8' **Sample Number:** S-2

Remarks:

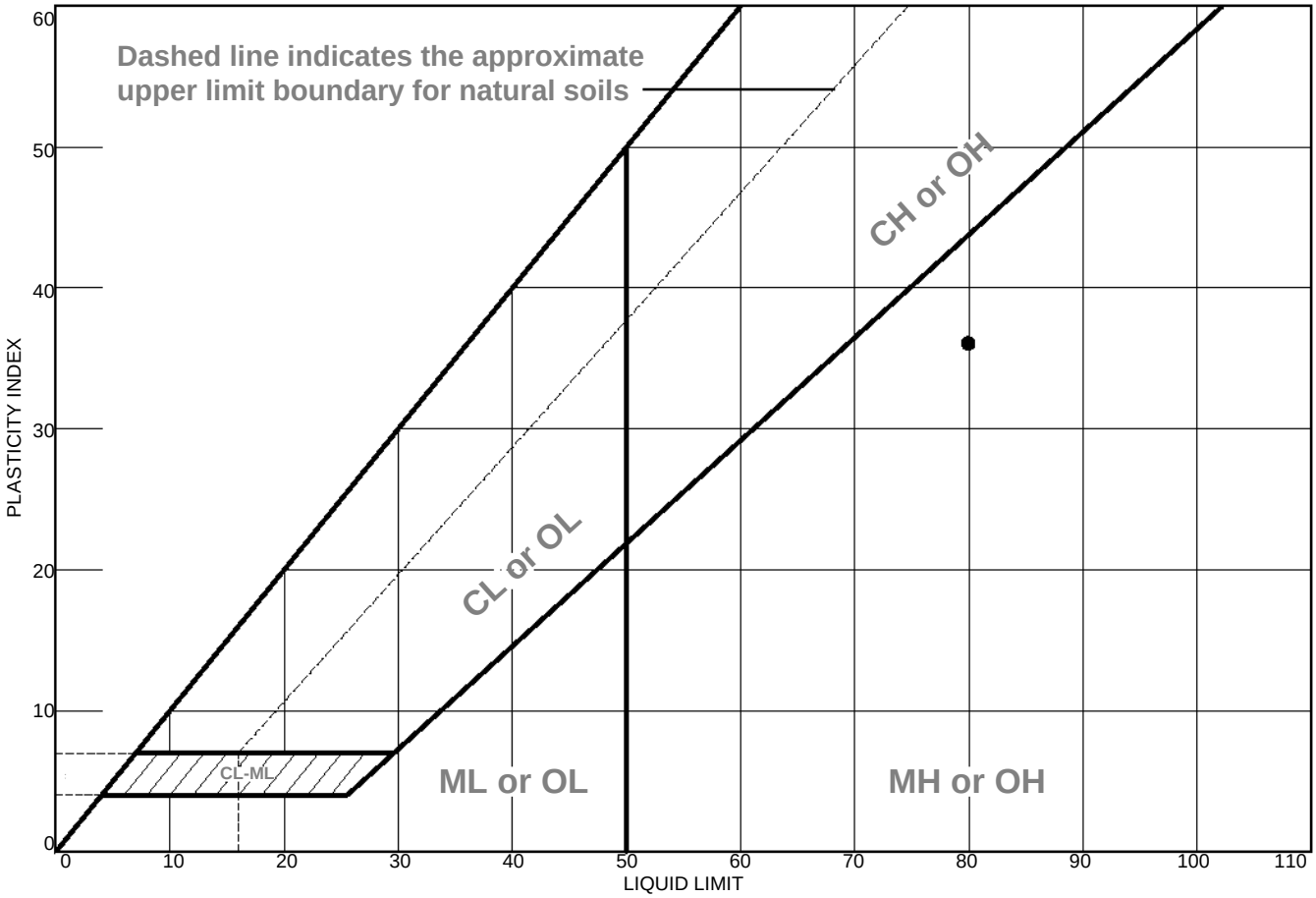
●Lab No.: WGG0281
Sampled By: SMW on 09-22-22
ASTM D4318 | Multipoint Method A
Wet Prepped, Manual Liquid Limit Device & Hand Rolled

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Figure B-42

Tested By: PJH **Checked By:** LMS

Plasticity Index of Soil (D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Elastic Silt	80	44	36	Not Tested	Not Tested	MH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** GP-06 **Depth:** 7' **Sample Number:** S-2

Remarks:

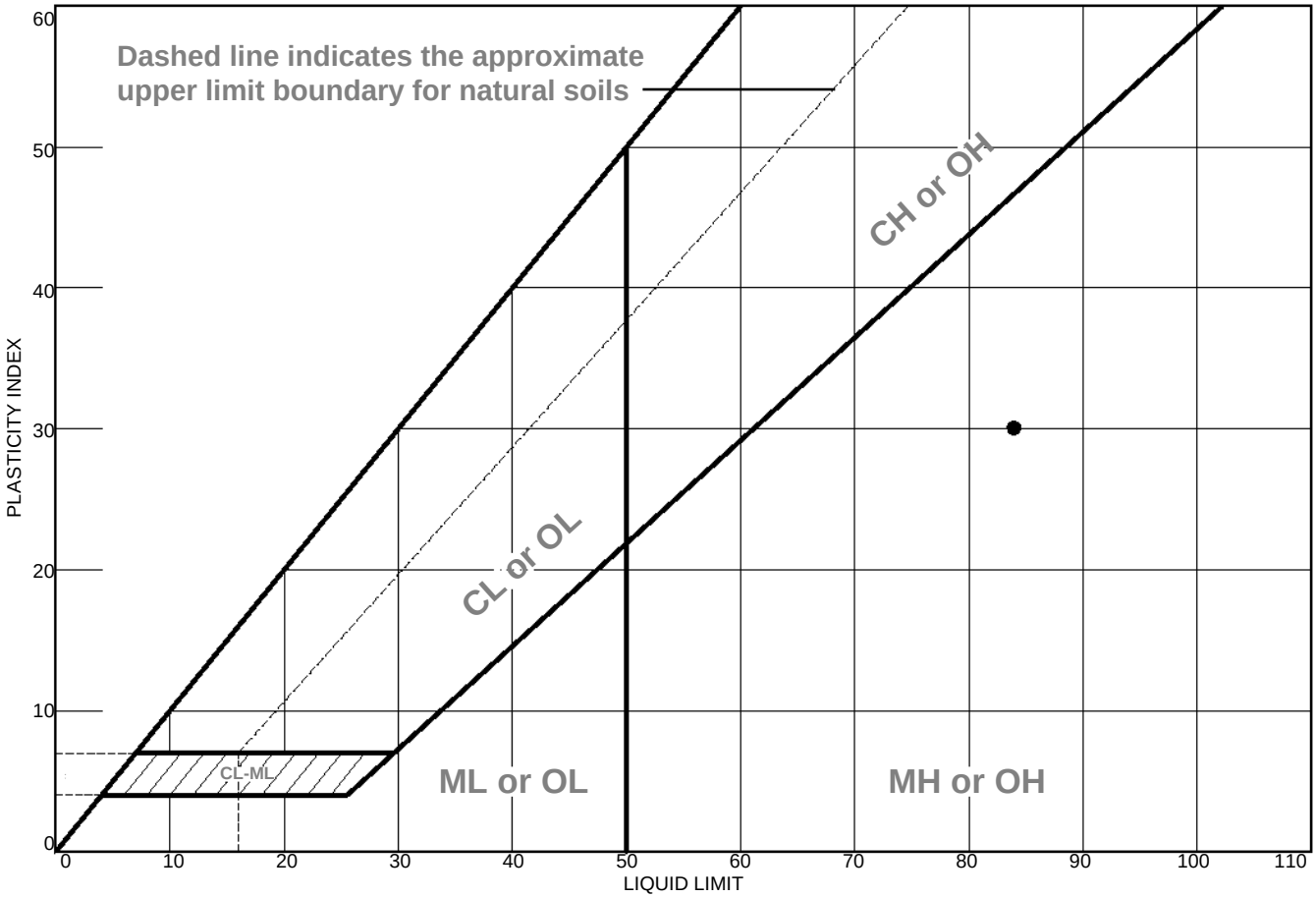
●Lab No.: WGG0281
Sampled By: SMW on 09-22-22
ASTM D4318 | Multipoint Method A
Wet Prepped, Manual Liquid Limit Device & Hand Rolled

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62935 NE 18th Street, St. B
Bend, Oregon 97701

Figure B-43

Tested By: PJH **Checked By:** LMS

Plasticity Index of Soil (D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Elastic Silt	84	54	30	Not Tested	Not Tested	MH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** GP-06 **Depth:** 24' **Sample Number:** S-5

Remarks:

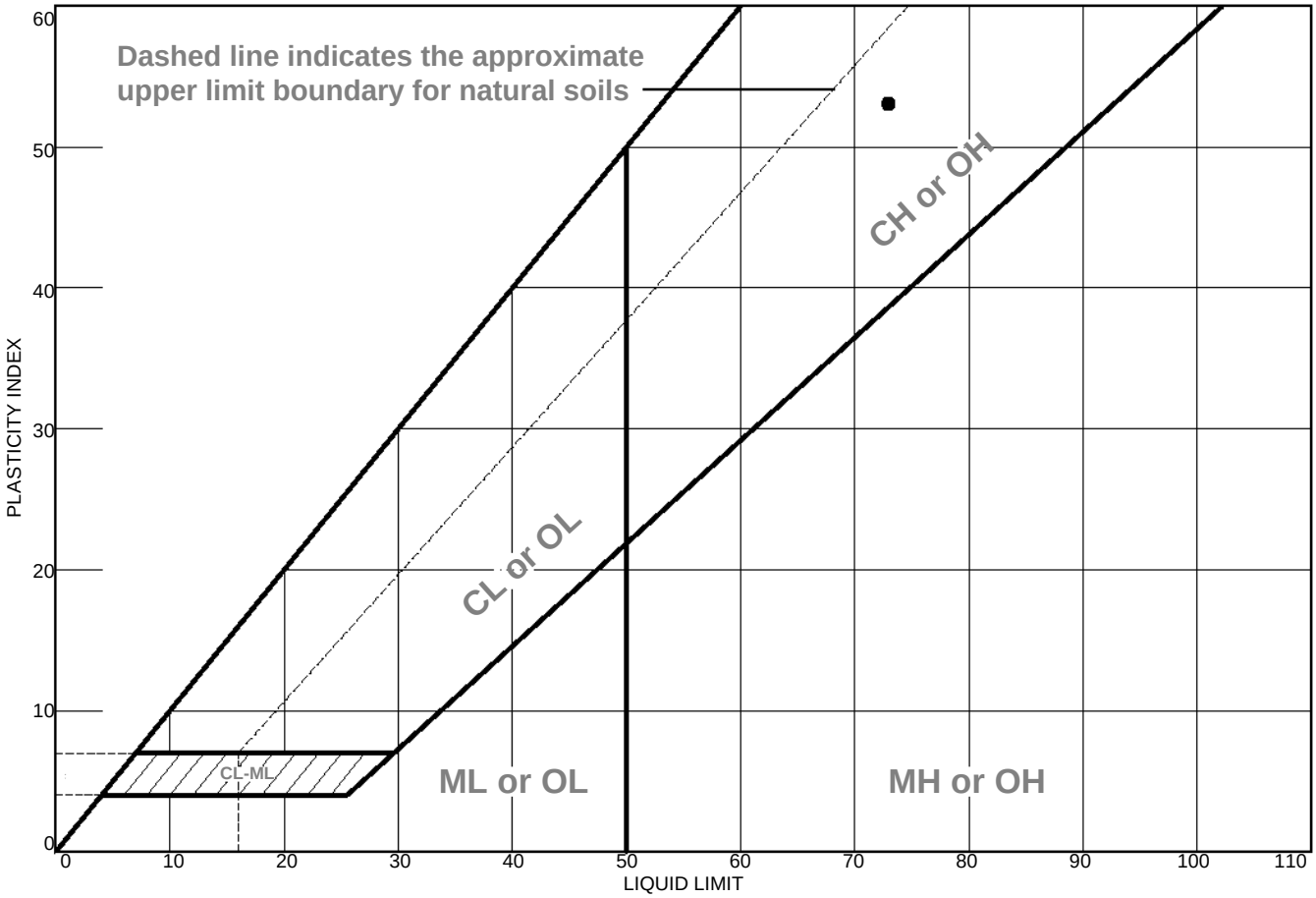
●Lab No.: WGG0281
Sampled By: SMW on 09-22-22
ASTM D4318 | Multipoint Method A
Wet Prepped, Manual Liquid Limit Device & Hand Rolled

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Bend, Oregon 97701

Figure B-44

Tested By: PJH **Checked By:** LMS

Plasticity Index of Soil (D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Fat Clay with Organics	73	20	53	97.3%	92.9%	CH

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

● **Source of Sample:** GP-09 **Depth:** 2 - 4' **Sample Number:** S-1

Remarks:

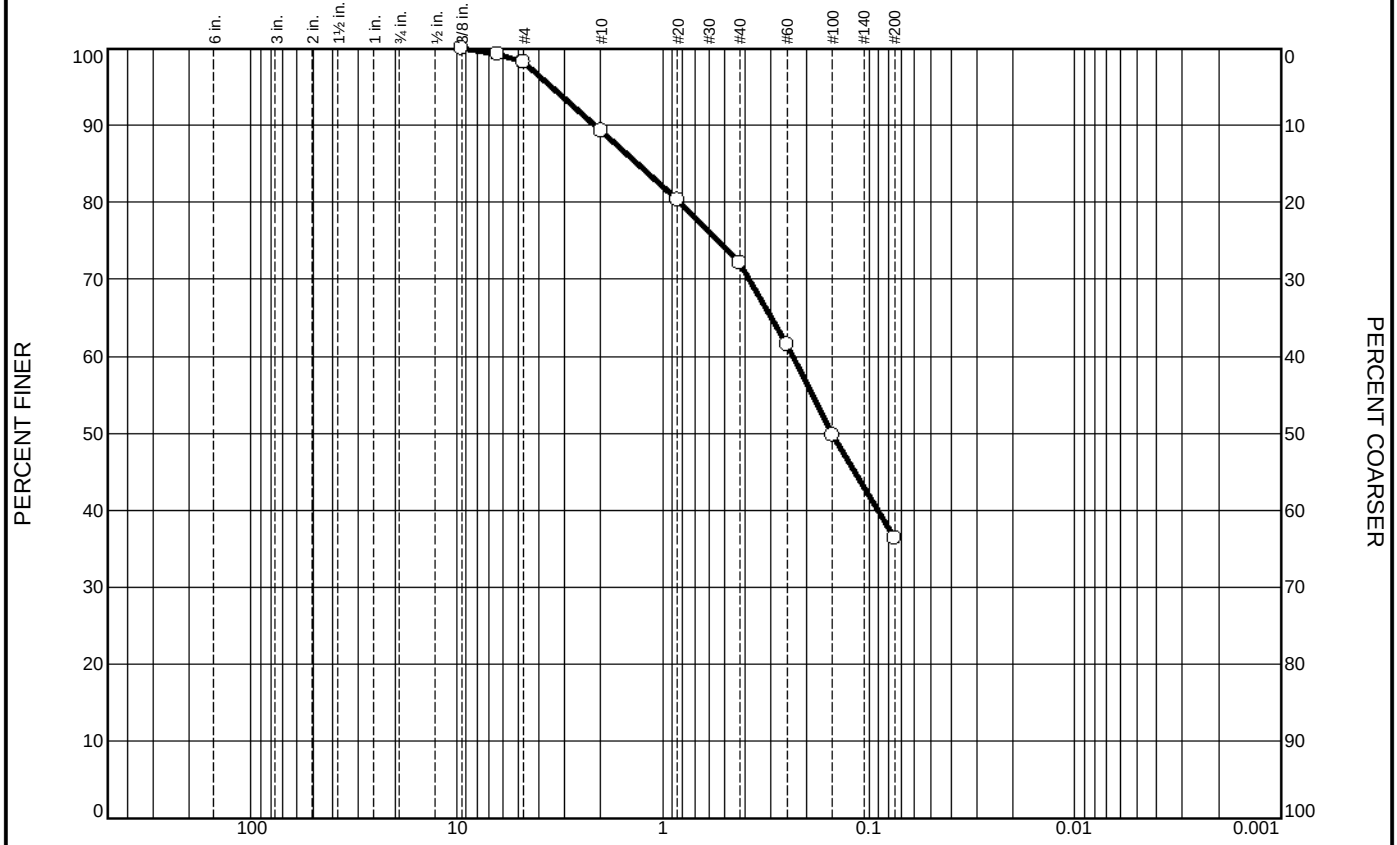
●Lab No.: WGG0281
Sampled By: SMW on 09-22-22
ASTM D4318 | Multipoint Method A
Wet Prepped, Manual Liquid Limit Device & Hand Rolled

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Figure B-45

Tested By: PJH **Checked By:** LMS

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.8	8.9	17.1	35.8	36.4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	Not Tested	Not Tested	1.3264	0.2338	0.1516					

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Silty, Clayey Sand	10-17-22	SC-SM	28.9%

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

○ **Source of Sample:** GP-05 **Depth:** 14' **Sample Number:** S-3

Remarks:

○Lab No.: WGG0281

Sampled By: SMW

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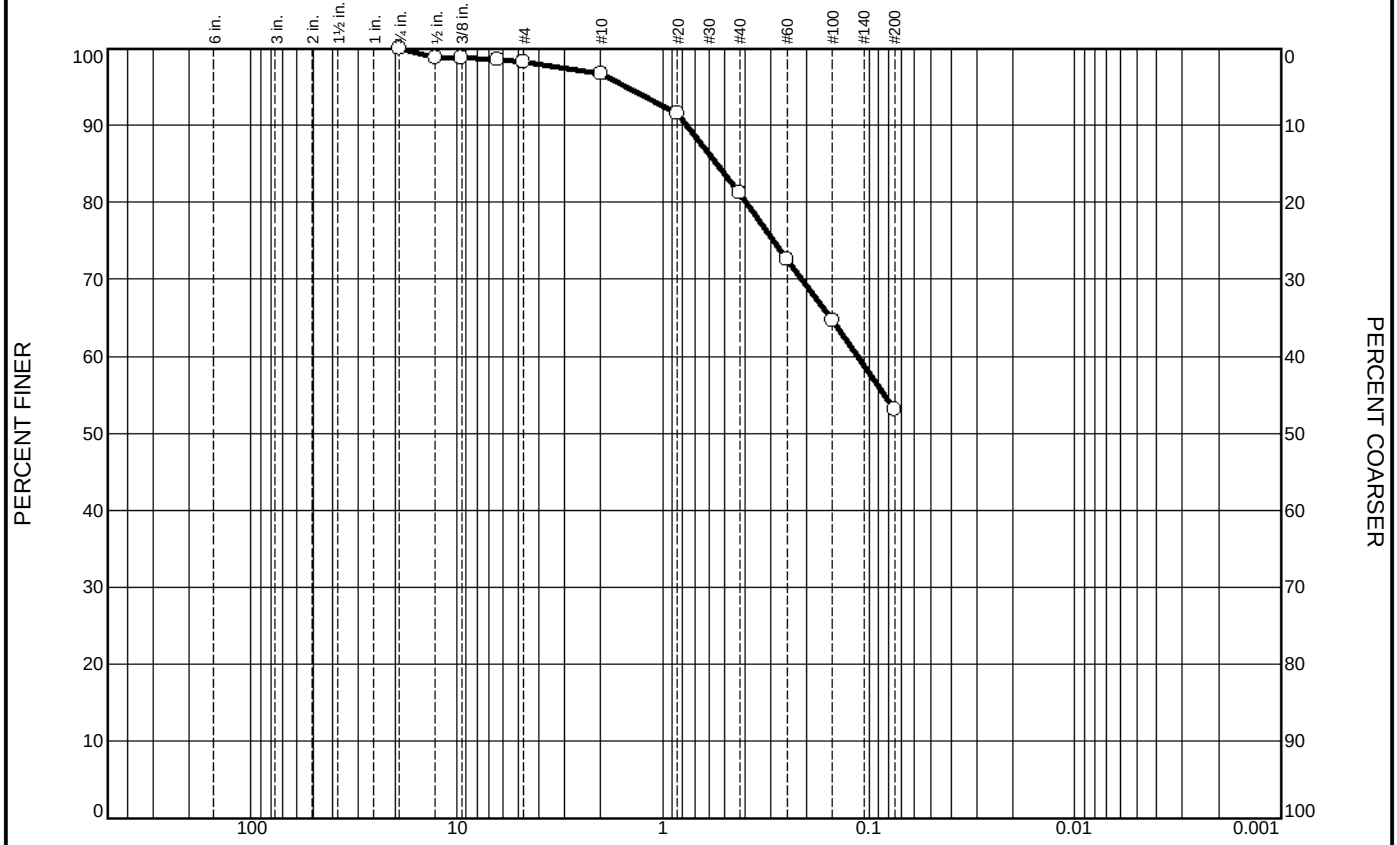
wallacegroup-inc.com

62915 NE 18th Street, St. 1
Bend, Oregon 97701

Figure B-46

Tested By: PJH **Checked By:** LMS

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.8	1.5	15.5	28.1	53.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	Not Tested	Not Tested	0.5479	0.1135						

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Sandy Clay	10-17-22	--	26.9%

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

○ **Source of Sample:** GP-07 **Depth:** 2 - 4' **Sample Number:** S-1

Remarks:

○Lab No.: WGG0281

Sampled By: SMW on 09-22-22

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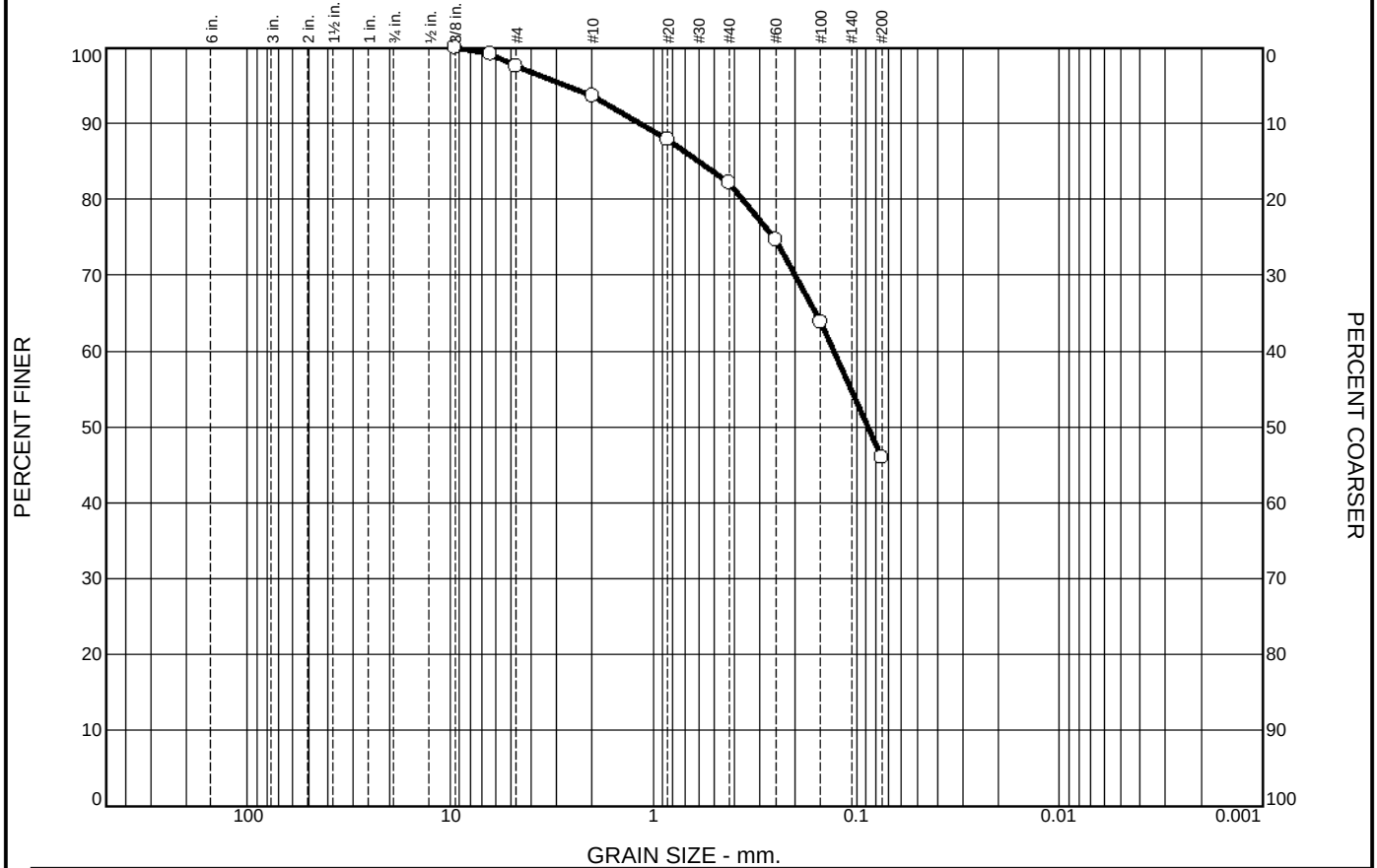
wallacegroup-inc.com

62915 NE 18th Street, St. 1
Bend, Oregon 97701

Figure B-47

Tested By: PJH **Checked By:** LMS

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	2.4	4.0	11.4	36.3	45.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	Not Tested	Not Tested	0.5986	0.1293	0.0878					

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Clayey Sand	10-17-22	SC-SM	25.5%

Project No. 21129 **Client:** Civil & Environmental Consultants, Inc.

Project: Coffin Butte Landfill

○ **Source of Sample:** GP-07 **Depth:** 16 - 18' **Sample Number:** S-3

Remarks:

○Lab No.: WGG0281

Sampled By: SMW on 09-22-22

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62915 NE 18th Street, St. 1
Bend, Oregon 97701

Figure B-48

Tested By: PJH **Checked By:** LMS

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APPENDIX C

ASCE Hazards Report

Address:
28972 Coffin Butte Rd
Corvallis, Oregon
97330

Standard:	ASCE/SEI 7-22	**Latitude:**	44.695572
Risk Category:	II	**Longitude:**	-123.233928
Soil Class:	D - Stiff Soil	**Elevation:**	297.144000732361 ft (NAVD 88)





Seismic

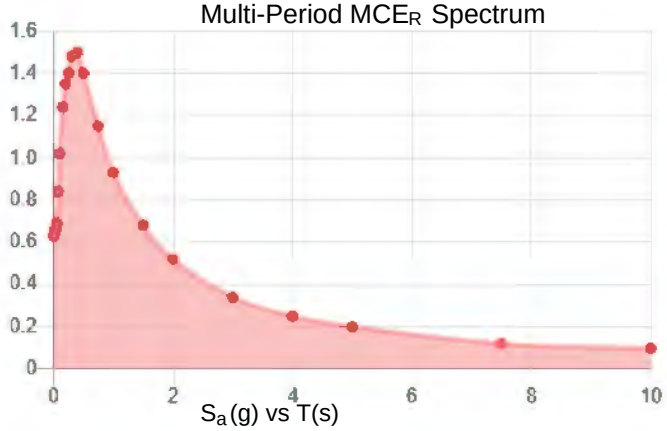
Site Soil Class: D - Stiff Soil

Results:

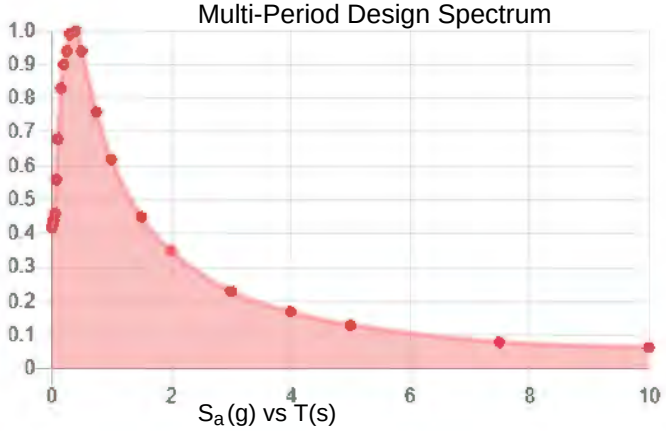
PGA_M :	0.61	T_L :	16
S_{MS} :	1.35	S_S :	1.05
S_{M1} :	0.94	S_1 :	0.44
S_{DS} :	0.9	V_{S30} :	260
S_{D1} :	0.63		

Seismic Design Category: D

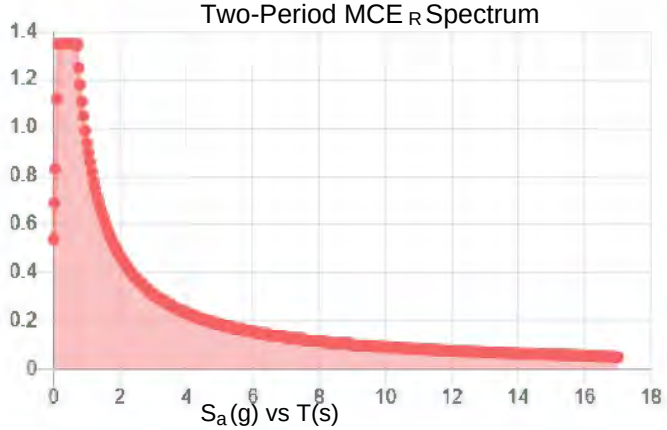
Multi-Period MCE_R Spectrum



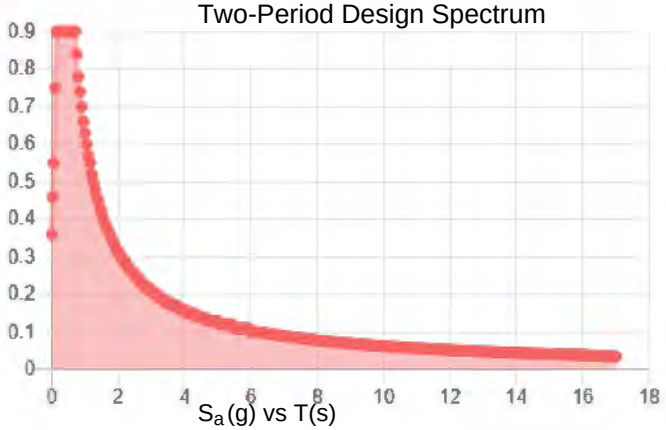
Multi-Period Design Spectrum



Two-Period MCE_R Spectrum



Two-Period Design Spectrum



MCE_R Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: Sun Jul 14 2024

Date Source:
USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

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APPENDIX D



Existing conditions at BH-05 during the geotechnical exploration.



Drilling performed with track-mounted CME rig, operated by Western States Drilling, on February 16 through 18, 2021 and HazTech Drilling on November 8 through 16, 2022. Note the skid steer and cleared road required for site access.



Drilling was performed using hollow-stem auger, mud-rotary, and HQ wireline coring techniques.



Boring location B-13, which is typical of the dense onsite vegetation and restricted access.



Borings were backfilled using bentonite.



Areas near known landfill utilities were advanced using a vacuum truck.



Typical rock core, consisting of brecciated and altered basaltic rocks of the Siletz River Volcanics.



Initial exploration was performed using a CAT excavator.



Test pits were advanced to the limit of the machine's reach, or excavator refusal on competent bedrock.



Typical test pit profile, consisting of weathered in-place volcanic soils transitioning into bedrock.



Test pits were located to provide access to the proposed boring locations, and the excavator was used to clear and grade access to the borings.



The higher elevations of the site are characterized by dense vegetation, with shallower depth to rock.

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APPENDIX E

Final Draft Memorandum			
To:	Lisa Splitter, PE, GE, The Wallace Group	Project:	Coffin Butte Slope Stability Analysis
From:	Jamie Schick, CEG, Delve Underground	cc:	
Prepared by:	Jamie Schick, CEG, Luke Ferguson, PE, Ethan Guzek, PG(WA), Delve Underground	Job No.:	6309.0
Date:	November 6, 2023		
Subject:	Coffin Butte Landfill Slope Stability Analysis		

1.0 Introduction and Background Information

1.1 General

This Technical Memorandum has been developed by Delve Underground (Delve) for the Coffin Butte Landfill Expansion (Project). Delve is performing this work for the Wallace Group, LLC in support of their geotechnical engineering efforts associated with the design of this facility. The Wallace Group is a subconsultant to Civil and Environmental Consultants, Inc., who is completing the landfill design for Republic Services, Inc. Figure 1 presents the site location. The project includes the relocation of Coffin Butte Road, which will require excavating two cuts in existing slopes south of the current roadway to make room for the landfill expansion. Sections of these cuts will be in excess of 100 feet in height. Delve is under contract to complete the geotechnical engineering associated with these cuts and provide cut slope recommendations.



Figure 1. Vicinity map of project area.

1.2 Project Description

The Coffin Butte landfill is located in Oregon in the mid-Willamette Valley approximately 10 miles north of Corvallis, OR. Proposed upgrades to the landfill site include the construction of new landfill cells immediately south of the existing Coffin Butte Landfill. As part of the upgrade, the existing Coffin Butte Road is planned to be relocated to the south of the proposed landfill expansion area. From the intersection of Coffin Butte Road and NW Soap Creek Road, Coffin Butte Road is proposed to extend southeast, then east along the southern border of the expansion area before continuing northeast and north along the boundary of the expansion area to realign with the existing Coffin Butte Road. Construction of this reroute will include deep cuts into two separate bedrock knobs that will result in cut slopes in excess of 100-foot-high above the new road alignment. Locations of the proposed expansion area, preliminary grading plan, subsurface explorations, cross sections and Coffin Butte Road relocation provided by the Wallace Group are included in **Appendix A**.

The current cut slope geometry includes a 2 Horizontal to 1 Vertical (2H:1V) slope cut below the roadway and a 1.5H:1V cut slope above the proposed Coffin Butte Road. This memorandum summarizes our analysis, design, and recommendations regarding these proposed cuts as well as an evaluation of alternative cut angles to facilitate construction efforts and improve slope performance.

2.0 Geologic Setting

The site is located northwest of Albany, Oregon in the central portion of the Willamette Valley, an alluvial-filled structural basin located between the Oregon Coast Range and Cascade Range (Orr and Orr, 2012). Bedrock beneath the site consists of the Siletz River Volcanics, which are part of a chain of volcanic seamounts accreted to western North America during the Paleocene to early Eocene (approximately 60 million years ago) (Bela, 1979). The bedrock consists of a complex assemblage of pillow basalts with minor interbeds of tuffaceous claystone, siltstone and sandstone. The formation also includes flow breccias and coarse pyroclastic deposits. Both the east and west hillslopes at the site are underlain by this bedrock. A more complete discussion of the geologic setting and site history is contained in the project geotechnical engineering report completed by the Wallace Group (Wallace Group, 2023).

3.0 Site Exploration

3.1 Site Reconnaissance

A site reconnaissance was completed on September 29, 2021, by a senior engineering geologist from Delve Underground to inspect the project area and condition of exposed bedrock in the area. This included a reconnaissance of the existing rock quarry immediately west of the current Coffin Butte Landfill. Discontinuity mapping completed in the rock quarry was used to support the kinematic analysis for the proposed cut slope geometries.

In general, the discontinuities mapped were very persistent (greater than 30 feet in trace length) and typically filled with clay, sand, and gravel sized particles. The infilling was up to two inches in thickness. See Photographs 1 and 2 for typical exposures of mapped discontinuities. Conchoidal fractures associated with the basalt exposed in the rock quarry were not mapped.



Photograph 1. Typical steeply dipping joints in the existing Coffin Butte quarry.



Photograph 2. Steeply dipping joint trending subparallel to an existing cut face.

During the site reconnaissance, exposures of the existing soils on the eastern knob excavated for drill rig access were observed. These cuts generally consisted of silty to clayey gravels that were interpreted as shallow colluvium with decomposed bedrock near the base. Cuts were typically less than 5 foot high.

3.2 Field Exploration

A subsurface exploration program was completed in two phases due to changes in the landfill configuration during design. Wallace Group performed the subsurface exploration program for support of the project during the summer/fall of 2021 and 2022. The exploration program for the western hillslope included four borings (B-3, B-5, B-9 and B-15) which were advanced to depths of 111 feet, 131 feet, 70 feet and 165 feet and four test pits (TP-1, TP-12, TP-13 and TP-14). Four borings (B-7, BH-17, BH-18 and BH-19) and one CPT (GP/CPT-08) were drilled in the eastern hillslope. Borehole locations are shown on site plan in Appendix A.

Borings were advanced with mud rotary drilling techniques within soil material and HQ wireline, triple-tube rock coring techniques in rock materials in accordance with ASTM D 2113. Disturbed soil samples were collected in conjunction with Standard Penetration Testing (SPT) at selected intervals using a standard 2-inch diameter split-barrel sampler and automatic safety hammer system. In each test, the sampler was advanced 18 inches by dropping a 140-pound hammer, 30-inches for each strike in accordance with ASTM D1586. Details of the exploration

program are presented in the Wallace Group geotechnical report (Wallace Group, 2023). Downhole imaging in explorations was not performed.

3.3 Lab Testing

Point load testing (PLT) was conducted on select samples from borings conducted during the 2021 investigation. Test results were used to estimate the approximate intact rock strength of the bedrock. PLT results are provided in **Appendix B**. The results of point load testing are discussed in greater detail below.

4.0 Site Conditions

4.1 Surface Conditions

The eastern and western hillslopes consist of two bedrock knobs located at the north end of a ridgeline in the Willamette Valley. The knobs extend over two hundred feet above the valley floor and are generally east, north and west facing. Slopes on these hillslopes vary between approximately 15 and 25 degrees with locally shallower sections. Indications of existing slope instabilities (scarps, pistol butt, or jack strawed trees) were not observed during the site reconnaissance. Signs of springs or seeps were not observed, however it was summer at the time of the site reconnaissance.

4.2 Subsurface Conditions

The materials encountered in the project explorations were grouped into three general stratigraphic units based on their geologic origin and stratigraphic position. General units include colluvial soil, weathered rock, and rock. Engineering properties of soil and rock appear to vary between the east and west half of the site based on relative density and composition (for soils) and rock type, weathering, and intact strength (for rock). Variations in subsurface conditions are likely to exist between borings. The following paragraphs describe the geotechnical unit characteristics in greater detail in context of cut slope considerations.

- **Colluvial Soil**: Colluvial soils mantle weathered rock and rock across the project area to depths of 5 to 25 feet with soils being thinner across the west slopes and thicker across the east slopes. Colluvial materials encountered included silty sands, clayey sands, and sandy silts. In the western hillslope, colluvial soils are present in the upper 5 to 10 feet of the subsurface and typically consist of reddish-brown, medium dense to very dense silty sands, clayey sands, and sandy silts. In the eastern hillslope, colluvial soils are present in the upper 20 to 25 feet of the subsurface and typically consist of very loose to medium dense clayey sand.

- **Weathered Rock**: Decomposed to highly weathered bedrock was encountered beneath the colluvial soils. This material was typically drilled and sampled with SPTs and often

described as very dense gravels on logs. However, based on the observation that SPT tests generally encountered refusal, this material was interpreted as weathered bedrock. Typical unit thickness ranged between 3 and 7 feet.

Rock: Bedrock was encountered below the overlying soils and weathered bedrock in all borings. This unit consists primarily of fresh to highly weathered greenish gray basalt. The fresh basalt strength ranged from weak to strong. Highly weathered zones encountered were typically limited to isolated intervals only a few feet in extent. The basalt in the western hillslope was generally intensely brecciated with infilling of siltstone. The brecciation is interpreted as genetic, associated with the deposition of the basalt on seamount slopes where it often disaggregated into fragments surrounded by a silty matrix. For the purpose of this memorandum, this is referred to as a volcanic breccia. The basalt encountered in borings completed in the eastern hillslope was generally intact, with only isolated intervals of brecciation, and in general was composed predominantly of basalt with minor siltstone matrix. For the purpose of this memorandum, this is referred to as a basalt.

Point load tests (PLTs) on the basalt indicate an unconfined compressive strength (UCS) of generally 2,000 to 5,000 psi. PLT results from the siltstone matrix indicate UCS values ranging from approximately 200 to 1,000 psi.

Recovery and Rock Quality Designation (RQD) for borings BH-3, BH-5, BH-17, BH-18 and BH-19 are summarized in Table 1. RQD values indicate the rock quality is very poor to poor on the western hillslope and poor to fair on the eastern hillslope.

Table 1. Summary of Rock Core Recovery and RQD

Borehole	Recovery			RQD		
	Min	Max	Average	Min	Max	Average
Western Hillslope						
BH-3	48	100	87	0	75	47
BH-5	48	93	51	0	50	8
Eastern Hillslope						
BH-17	80	100	97	6	100	51
BH-18	95	100	100	30	80	60
BH-19	61	100	95	4	73	34

4.3 Groundwater

The project subsurface explorations did not encounter groundwater in the western hillslope except for BH-15 where groundwater was encountered at 5 feet below ground surface. In addition, information provided by Civil & Environmental Consultants (CEC) indicates groundwater in the vicinity of this area is relatively shallow, at least seasonally. Groundwater

was encountered in eastern hillslope borings BH-17, BH-18 and BH-19 at depths of approximately 16, 25, and 18 feet below ground surface (bgs), respectively.

5.0 Kinematic Analysis

When the face of a rock mass is exposed in a rock cut confining pressure is relieved and the potential exists for blocks created by natural discontinuities in the rock mass to fall out of the slope. These block failures result in safety hazards and maintenance issues. A kinematic analysis compares mapped discontinuities in the rock mass with proposed cut slope orientations to determine the potential of blocks to fail out of the proposed slope.

Project specific discontinuity orientation data was used to perform a kinematic assessment of how potential blocks formed by joints and fractures in the rock will behave when the rock mass is disturbed by a slope cut, and whether the proposed cut slope will be stable or will result in blocks created by discontinuities sliding or falling out of the slope. In the majority of designed cut slopes, blocks predominantly fail by planar sliding or wedge sliding.

5.1 Joint Sets

The mapped rock discontinuity data (consisting of 45 joint orientations) were plotted on a stereonet in the RocScience software program Dips in order to visualize the rock mass discontinuities in two dimensions. Analysis of clustering of discontinuity data suggests two prominent joint set orientations with the following orientations (dip/dip direction):

- Joint Set 1: 76/226
- Joint Set 2: 65/336

The resulting stereonet is provided in **Appendix B**.

5.2 Markland Analysis

Delve utilized the Markland Analysis technique with mapped joint orientations and an estimated rock mass peak friction angle to study the kinematic stability of the overall rock mass with respect to the proposed cut slope orientation. Where the stability of a rock slope is controlled by the structure of the rock mass, Markland Analysis is a well-documented and widely accepted design tool used to evaluate the rock slope stability relative to a proposed cut inclination (Hoek and Bray, 1981 and FHWA, 1998). The RocScience computer program Dips was used for this analysis to analyze the potential for planar and wedge sliding failures. It should be noted that Markland Analysis is a tool for evaluating the potential for specific modes of failure but does not directly calculate factors of safety.

For analysis, peak friction angle of the basalt rock mass was assumed to be 33° based observations of joint conditions and previous experience in similar basalt material. Kinematic

stability was analyzed at four different cut slope orientations, as shown in Table 1.

Table 1. Analyzed cut slope orientations.

Slope Orientation	Cut Slope Angle	Slope Cut Direction	Notes
#1	63°	010°	Approx. 1/2H:1V NNE facing slope
#2	63°	355°	Approx. 1/2H:1V NNW facing slope
#3	53°	010°	Approx. 3/4H:1V NNE facing slope
#4	53°	355°	Approx. 3/4H:1V NNW facing slope

5.2.1 Results

Stereonet outputs resulting from the Markland Analysis are provided in **Appendix C** and a summary of results is provided in this section.

Analysis suggests that the kinematic potential for planar sliding and wedge sliding is moderate at Slope Orientations #1 and #2 (cut slope angles of 63°) and low at Slope Orientations #3 and #4 (cut slope angles of 53°). Based on these results, we recommend that the slope is not cut steeper than 53° (approx. 0.75H:1V).

If the slope is cut at a steeper angle than 53° there exists the potential for planes and wedges formed by discontinuities in the rock mass to become unstable and slide out of the cut slope, resulting in potential failure during construction or ongoing rockfall which could impact operations below the cut slope. If cut at an inclination greater than 53 degrees, potentially unstable wedges and planes would likely need to be reinforced using rock anchors, increasing project cost. By cutting the slope at 53-degrees, the number of kinematically viable blocks created will be significantly reduced. Limited rock reinforcement, scaling, and rockfall mitigation (ditch or mesh) may be still required for a 53-degree cut slope and are discussed further in Section 7.0.

6.0 Limit Equilibrium Analysis

Kinematic analysis considers failure of blocks or masses of rock that have potential to fail along discontinuities in the rock mass but does not consider the global stability of the cut. To address the potential for larger scale shear failure through the rock mass, or failure through colluvial material at the brow of the slope, 2D limit equilibrium analysis was performed using the RocScience computer program SLIDE2. A limit equilibrium analysis considers all the forces driving a slope failure (mainly gravity) and the forces resisting a slope failure (mainly shear strength of the slope material) to assess the factor of safety of the slope. In addition to dry conditions, slope stability was analyzed under wet and seismic conditions where reduction of effective shear strength or external horizontal loading could potentially affect site conditions.

For limit equilibrium analysis, a factor of safety of 1.0 indicates that the forces driving a failure and the forces resisting a failure are equal, and the slope is near a state of failure. A factor of safety greater than 1.0 suggests the slope is stable, and a factor of safety less than 1.0 suggests the slope is prone to displacement or theoretically should have already failed. Generally, a factor of safety greater than 1.3 is considered allowable for permanent slopes affecting the general public (Oregon GDM, 2023). Transient groundwater and seismic loads were also considered and minimum factors of safety of 1.1 and 1.0, respectively, were considered acceptable. Assumptions and methods of limit equilibrium analysis are provided in the following sections.

6.1 Slope Geometry

Construction of 2D limit equilibrium model geometry was based on topographic and cross-section information provided by the Wallace Group (**Appendix C**). To evaluate the tallest cut sections among the provided data for cut slope analysis, Section B-B' and D-D' were chosen to represent the west and east slopes, respectively.

Configuration of ground surfaces for modelled sections B-B' and D'-D' (constructed to represent recommended cut slope inclinations) assumed the following:

- Slope of 2H:1V below the roadway.
- Slope of 0.75H:1V in rock and weathered rock above the roadway.
- Slope of 1.5H:1V to 2H:1V Slope inclinations at the brow of the slope where colluvium soil is encountered. Inclination varies between the east and west cuts depending on soil conditions anticipated based on results of exploration.

Representation of ground conditions at depth, particularly geologic unit boundaries, were constructed based upon lateral projection of adjacent borehole information for each cross section. Section B-B' was influenced most by explorations BH-03, BH-05, and BH-15. Section D-D' was influenced most by explorations BH-17 and BH-19. Geologic sections were constructed such that depths of unit transitions were consistent with observations in nearby explorations. Between and outside available borehole locations (along the profile) geologic interpretations were made assuming simple linear relationships across the project area, continuity of unit thicknesses or trends in thickness, and general tendency for the soil-weathered rock-rock profile to roughly parallel the existing surface topography. Model construction of the geologic profile at depth influenced the surface construction as material type and assumed unit-boundary locations influenced cut inclination transitions. In particular the interpreted boundary between soil and weathered rock dictated where the cut-slope transitions from 0.75H:1V to (1.5 - 2.0) H:1V inclination. Because of the assumptions made and variation in subsurface conditions, representation of subsurface geometry along the height of the cut should be considered approximate.

6.2 Material Strengths

Strength of soils was represented using Mohr-Coulomb criterion which includes modelling of soil strength using a frictional and cohesive component. Values selected for friction and cohesion for each unit were based on relative density of material encountered during exploration and lab tests regarding material composition. Strength of weathered rock and rock was represented using the Generalized Hoek-Brown criterion based on estimated values for unconfined compressive strength (UCS), geologic strength index (GSI) and assumed equation constants (such as the Hoek-Brown constant M_i) based on published values corresponding to rock type. For rock material strength estimates, UCS values were based on point-load testing performed on samples collected during exploration activities.

Material properties assumed for limit equilibrium analysis of Section B-B' (West Slopes) and D-D' (East Slopes) are summarized in Tables 2 and 3.

Table 2. Assumed material properties for geologic materials for Section B-B' (West Slopes).

Geologic Unit	Unit Weight	Strength Model	Friction Angle	Cohesion	UCS	GSI
Soil (Colluvium)	125 pcf	Mohr-Coulomb	34°	100 psf	-	-
Weathered Rock	165 pcf	Generalized Hoek-Brown	-	-	30,000 psf	30
Volcanic Breccia	170 pcf	Generalized Hoek-Brown	-	-	200,000 psf	45

Table 3. Assumed material properties for geologic materials for Section D-D' (East Slopes).

Geologic Unit	Unit Weight	Strength Model	Friction Angle	Cohesion	UCS	GSI
Soil (Colluvium)	125 pcf	Mohr-Coulomb	30°	150 psf	-	-
Weathered Rock	165 pcf	Generalized Hoek-Brown	-	-	30,000 psf	30
Basalt	175 pcf	Generalized Hoek-Brown	-	-	480,000 psf	55

6.3 Groundwater Conditions

Groundwater was assumed present in the bedrock based on the results of the subsurface investigation and information provided by CEC. In addition, a perched groundwater condition was evaluated to account for potential transient groundwater surcharge in colluvium and weathered rock related to high rainfall events. This was modeled as a perched groundwater condition atop the bedrock such that the weathered rock was fully saturated and the overlying colluvium was approximately 30-50% saturated in relation to unit thickness. Groundwater conditions within the bedrock were modeled by assuming saturated conditions in the bedrock and the perched groundwater condition. Dry conditions were also modeled.

6.4 Seismic Loading Parameters

Seismic loading criteria for the project were developed by the Wallace Group and include a peak ground acceleration of 0.55g at locations where rock cuts are anticipated. This was incorporated into the slope stability modeling as an external pseudo-static horizontal load condition equivalent to approximately half the PGA. This method of representing seismic forces imparted on a slope is industry standard for limit equilibrium stability modelling (Wyllie, 2018). The pseudo static horizontal load was modelled at 0.25g.

6.5 Results

Results of the limit equilibrium analysis suggest stable conditions at the following cut inclinations or shallower:

- Volcanic Breccia and Basalt: 0.75H:1V
- Weathered Rock: 0.75H:1V
- Colluvium soils (West): 1.5H:1V
- Colluvium Soils (East): 2H:1V

Calculated factors of safety for dry conditions, wet conditions, and seismic conditions are presented in Table 4. Printouts of the produced models can be found in **Appendix D**. The eastern hillslope colluvial soils were also modeled assuming a steeper 1.5H:1V slope however the resultant factors of safety did not meet the design criteria.

Table 4. Summary of Limit Equilibrium Modelling Results

Section	Dry Condition	Wet Condition	Seismic Scenario
B-B’	1.8 G	1.7 C	1.2 C
D-D’	1.8 C	1.6 C	1.1 C
*G (Global) indicates minimum factor of safety surface extended from the bottom to top of slope **C (Colluvium) indicates minimum factor of safety surface was limited to soil and weathered rock. Factor of safety for failure through bedrock was higher. ***Wet condition was not included in the seismic scenario			

As stated at the end of Section 5.0 and beginning of 6.0, this analysis considers global stability. Individual blocks of rock or raveling of colluvial material from the brow of the slope may still be a limited hazard at the proposed cut inclinations. Section 7.0 below discusses potential measures that can be taken to manage potential rockfall risks.

7.0 Rockfall Mitigation

As the cut slope is constructed, the fractured nature of the rock mass will lead to relatively small blocks being created in the exposed cut slope. Over the design life of the cut, these blocks will represent a continued source of potential rockfall from the cut face. This rockfall hazard can be mitigated through a combination of scaling, rock reinforcement, construction of a catchment ditch at the toe of the slope and installing a draped mesh over the slope.

7.1 Scaling

Scaling involves mechanically removing unstable blocks from the cut slope face either by hand or with equipment. Removing the blocks in a controlled construction environment reduces the amount of loose material on the slope and thereby reduces the rockfall hazard. This is usually the first step in rockfall mitigation and also serves to improve site safety. However, depending on the erosion and weathering rate of on-slope material, it is not typically effective as a long-term solution as a sole means and method for addressing rockfall.

7.2 Catchment Ditch

A catchment ditch constructed at the base of the cut slope serves as an area for any small falling rocks to collect in a safe area without impacting the roadway. A catchment ditch for rockfall purposes typically consists of a mono-sloped ditch, dipping away from the roadway towards the slope, constructed at a 6H:1V or 4H:1V inclination. Typical ditch construction is usually intended to capture approximately 90% of rockfall.

For an 80-foot-tall slope cut at a 0.75H:1V slope inclination, the ditch width required to catch 90% of rockfall (assume ditch inclination of 4H:1V) would be approximately 26 feet. For a 6H:1V ditch configuration the ditch would need to be approximately 31 feet wide (Pierson et al., 2001). Because slope heights across the east and west slopes are planned in excess of 90-100 feet at some locations, ditch widths greater than approximately 30 feet would likely be required to catch 90% of rockfall if using ditch catchment as the sole means of rockfall management. However, ditch widths on the order of 10 feet can be used if a drape mesh is applied to the slope to guide rockfall into the catchment ditch. Drape mesh application is discussed in the following section.

It should also be noted that depending on rockfall severity, the catchment ditch will require periodic maintenance visits to clear the ditch of fallen rocks and maintain its effectiveness. The frequency of required catchment ditch cleaning typically varies from annually at high volume rockfall slopes to every 5 or 10 years at low volume rockfall slopes.

7.3 Drape Mesh

Drape mesh installed over rock slopes guides ongoing rockfall from source areas on the slope into a catchment ditch, effectively reducing the impact of rockfall on roadway operations and

reducing the required ditch width. Drape mesh is constructed by installing ground anchors across the brow of the slope and hanging the mesh on a top cable that spans the horizontal length of the brow of the slope. Typically mesh coverage extends 5-10 feet back from the brow and extends down to 5-10 feet above the bottom of ditch. In the case of cut slopes for this project, it would be recommended that mesh be hung 10 feet back from the brow to cover colluvium material near the edge of the 0.75H:1V slope and extend to approximately 10 feet above bottom of ditch to allow for easy ditch cleanout.

7.4 Rock Reinforcement

Depending on the type of material used, drape mesh can contain blocks measuring 2-5 feet in diameter. If there are blocks on the slope larger than what the mesh can contain and that cannot be scaled, rock reinforcement may be used to pin the blocks in place. This involves drilling 3–4-inch diameter holes through the blocks and into the stable backslope, inserting a steel bar, and grouting the bar in place to effectively hold the unstable block in place. Considering that the planned cut slopes of 0.75H:1V effectively cut away the potential for sliding on the steeper persistent joints noted in the rock mass, the quantity of rock reinforcement elements would likely be limited and the length of elements would likely be limited to 10-20 feet.

It is difficult to quantify how much slope reinforcement may be needed until blasting, excavation, and scaling have been completed. However, because reinforcement of individual blocks would be primarily for rockfall management, rather than global stability, reinforcement efforts would likely be limited and sporadic assuming limited overbreak or ground disturbance from controlled blasting operations.

8.0 Construction Considerations

8.1 Blasting

Blasting associated with rock excavation will require a detailed specification to support the project. Blasting considerations that should be evaluated include minimizing fly rock, blast vibrations, and air blast. Specifications should consider the requirement of a blasting consultant on the contractor team.

8.2 Inspection

Based on our kinematic analysis, the potential for failure of the rock slope due to planar or wedge failure is considered low. However, it is possible that localized, random unmapped joints and fractures in the rock mass can create unstable blocks. Therefore, we recommend that a qualified geotechnical engineer or engineering geologist be on site during bench excavation construction to observe the slope for persistent joints inclined at 0.75H:1V inclinations or less that have the potential to daylight the slope and lead to block failures during excavation. If

instabilities are observed, mitigation options consisting of rock reinforcement or additional excavation can be explored to maintain a safe site.

8.3 Rockfall Management

It is recommended that scaling of the rockslope be performed periodically during construction to remove loose blocks from the slope. If cutting the slopes at a 0.75H:1V inclination, it is recommended that drape mesh be installed over the slope and a 10-foot-width ditch be constructed at the base of the slope. It is also recommended to maintain funds for limited amounts of steel bar rock reinforcement installation.

9.0 Closure

This report was prepared for the exclusive use of the Wallace Group, Inc. in conjunction with the Coffin Butte Landfill Upgrades Project. Our conclusions and recommendations are based on our interpretation of the information from the geotechnical exploration and analyses, as well as our professional experience and judgment.

In the performance of geotechnical work, specific information is obtained at specific locations at specific times, and geologic conditions can change over time. It should be acknowledged that variations in rock and soil conditions may exist between exploration and exposed locations and this report does not necessarily reflect variations between different explorations. The nature and extent of variation may not become evident until construction.

This report was completed within the limitations of the approved scope of work, schedule, and budget. The services rendered have been performed in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same area. Delve Underground is not responsible for the use of this report in connection with anything other than the project at the location described above.

DELVE UNDERGROUND

Jamie Schick, CEG, LEG, LHG
Senior Associate

Luke Ferguson, PE
Project Engineer

10.0 References

Bela, James, (1979). *Geologic Hazards of Eastern Benton County, Oregon, Oregon Department of Geology and Mineral Industries*, Bulletin 98.

FHWA (1998). *Rock Slopes Reference Manual*. Federal Highway Administration. Report #FWHA-HI-99-007. Wyllie, D., and Mah, C.W.

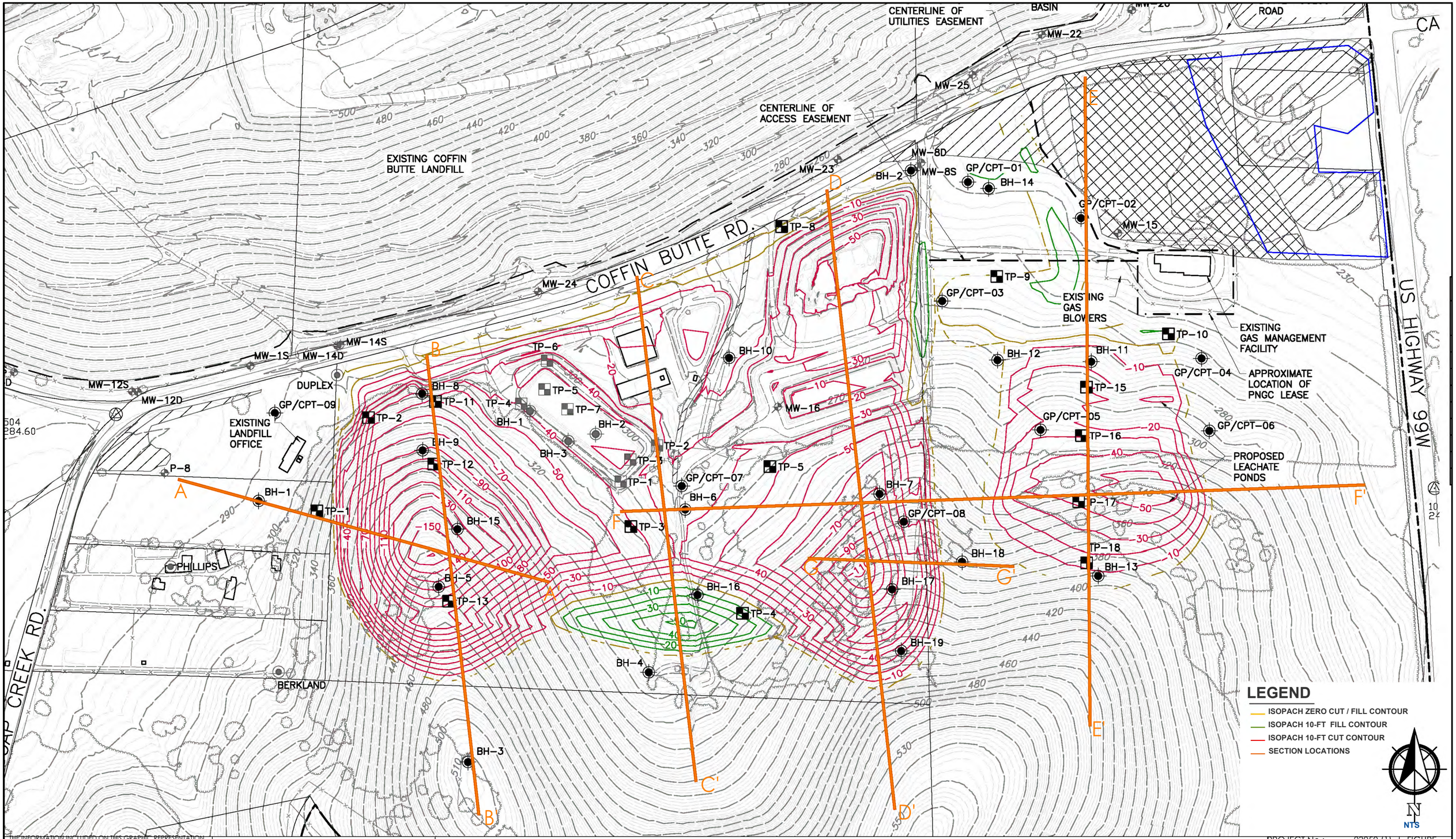
Hoek, E., and Bray, J.W., (1981). *Rockslope Engineering*. Institution of Mining and Metallurgy, 357 p.

Orr, E.L. and Orr, W.N., 2012. *Oregon Geology, 6th Edition*. Corvallis: Oregon State University Press

Pierson, L., Gullixson, C., and Chassie, R., (2001). *Rockfall Catchment Area Design Guide*, ODOT and FHWA, Report No. FHWA-OR-RD-02-04m.

Wyllie, D.C., 2018. Rock Slope Engineering, Section 11.6.2, 306-307pp. CRC Press.

Appendix A: Site Grading Plan and Cross Sections Provided by the Wallace Group



LEGEND

- ISOPACH ZERO CUT / FILL CONTOUR
- ISOPACH 10-FT FILL CONTOUR
- ISOPACH 10-FT CUT CONTOUR
- SECTION LOCATIONS

N

NTS

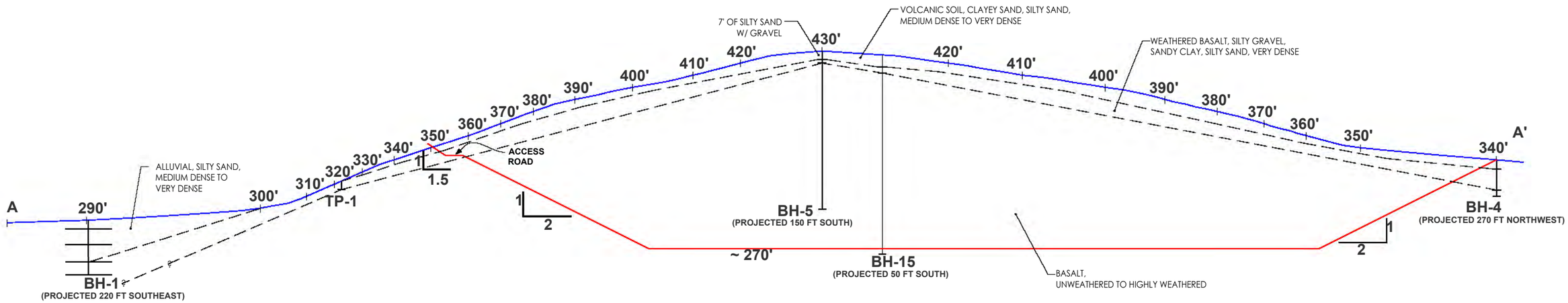
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WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

SECTION LOCATION MAP
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	July 31, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_8.DWG

FIGURE 8



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE

GRAPHIC SCALE
0 21.25 42.5 85 170
(IN FEET)
1 inch = 85 ft.

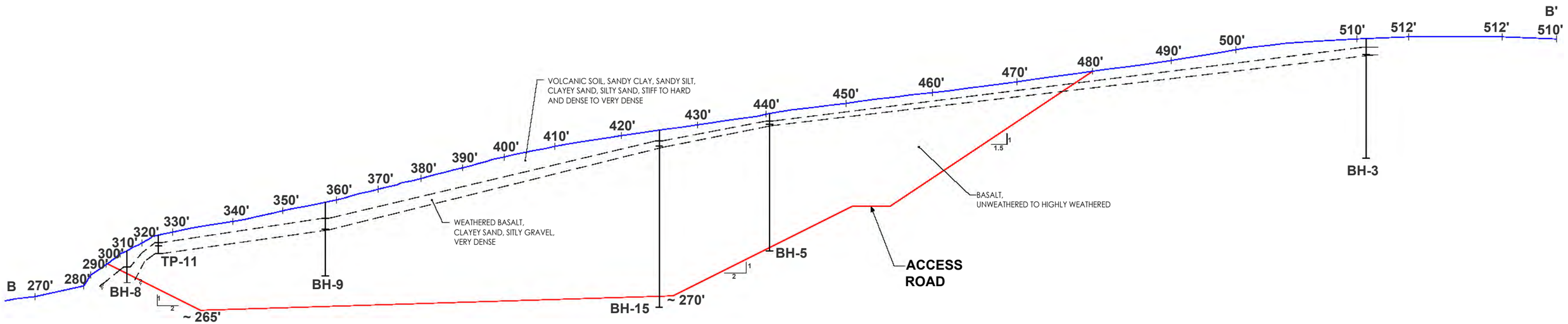
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CROSS-SECTION A-A'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	April 1, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_1.DWG

FIGURE 1



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE

GRAPHIC SCALE

0 22.5 45 90 180

(IN FEET)

1 inch = 90 ft.

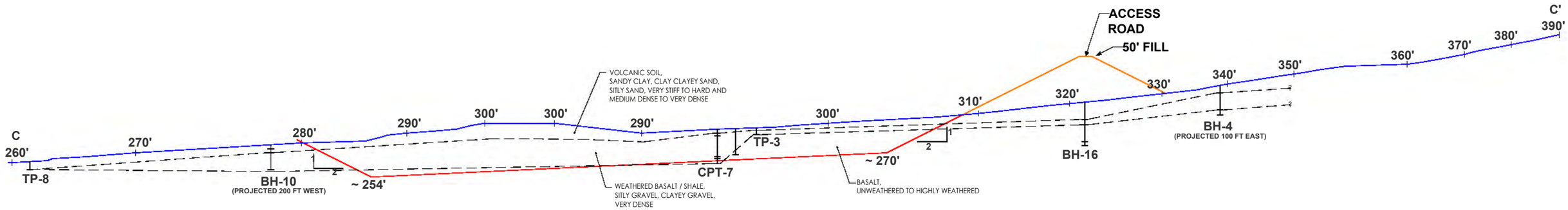
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CROSS-SECTION B-B'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	April 1, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_2.DWG

FIGURE 2



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE
- ISOPACH ZERO CUT/ FILL LINE

GRAPHIC SCALE

0 25 50 100 200

(IN FEET)

1 inch = 100 ft.

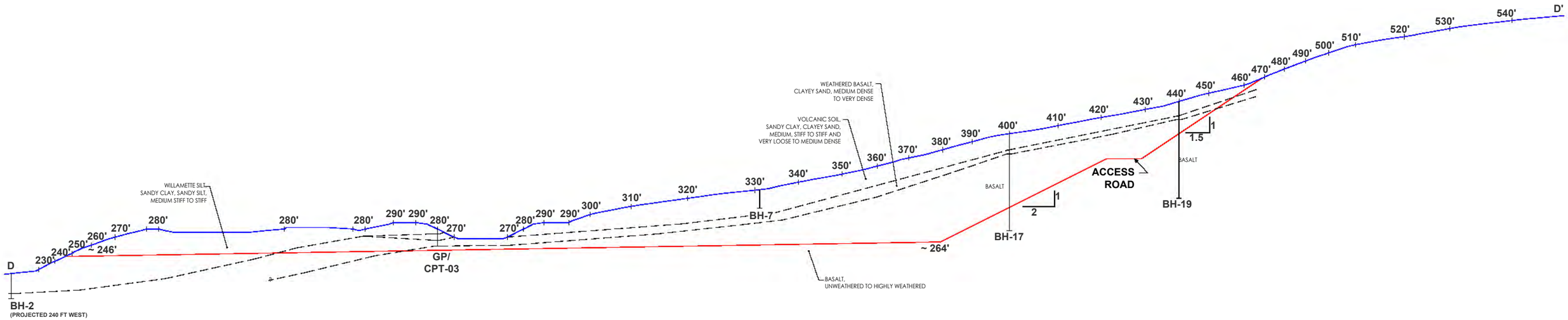
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CROSS-SECTION C-C'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	April 1, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_3.DWG

FIGURE 3



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE

GRAPHIC SCALE

0 30 60 120 240

(IN FEET)

1 inch = 120 ft.

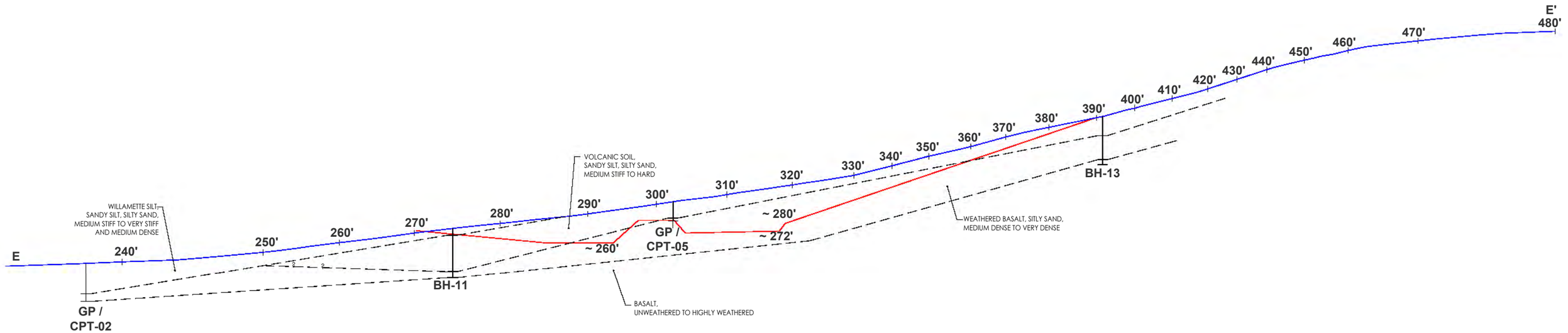
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CROSS-SECTION D-D'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	June 5, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_4.DWG

FIGURE 4



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE

GRAPHIC SCALE

0 25 50 100 200

(IN FEET)

1 inch = 100 ft.

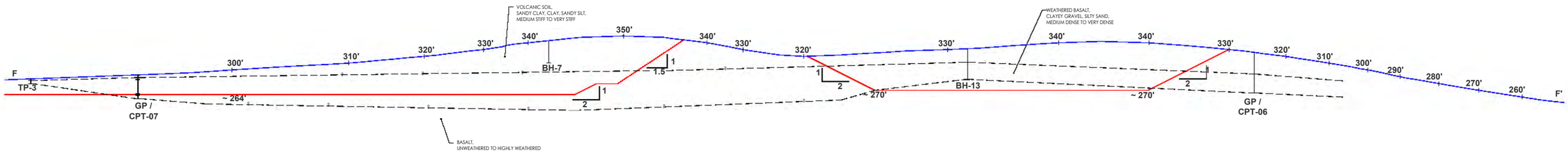
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CROSS-SECTION E-E'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	June 5, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_5.DWG

FIGURE 5



LEGEND

EXISTING 10-FT CONTOUR

ISOPACH 10-FT CUT LINE

GRAPHIC SCALE

0 36.25 72.5 145 290

(IN FEET)

1 inch = 145 ft.

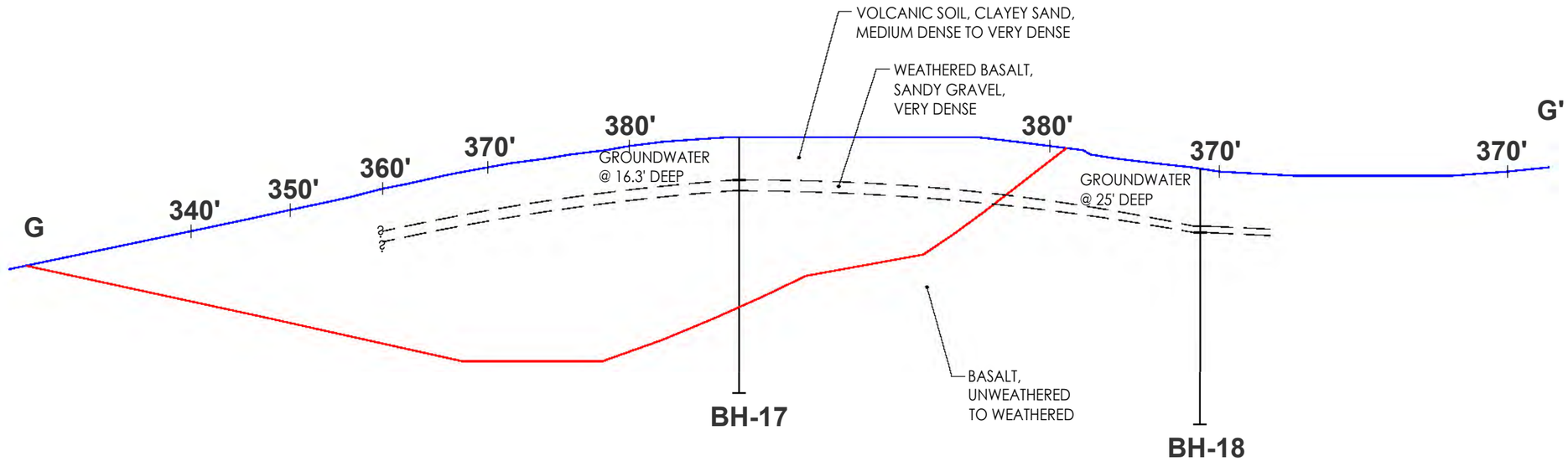
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CROSS-SECTION F-F'
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COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	April 1, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_6.DWG

FIGURE 6



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE

GRAPHIC SCALE

0 15 30 60 120

(IN FEET)

1 inch = 60 ft.

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CROSS-SECTION G-G'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	July 10, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_7.DWG

FIGURE 7

Appendix B: Point Load Testing Results

SUMMARY OF POINT LOAD TEST

PROJECT: Coffin Butte
PROJECT NO.: 6309.0
PROJECT LOCATION: Corvallis, Oregon
SAMPLED BY:
DATE SAMPLED:

LAB SAMPLE NO.: NA
SAMPLE NO.: NA
SAMPLE DESCRIP.: NA
DATE PLT TESTED: 11/15/2021
PLT TESTED BY: J. Siemens, J. Schick

TEST NOTES: All tests were diametral unless noted.
All samples were not moisture controlled.

Borehole ID	Depth (ft)	Test Number	Rock Type**	Depth or Diameter, D (mm)	D' (mm)	ΔD/D, penetration ratio (%)	Failure Load, P (kN)	Failure Load, P (N)	De^2 (mm^2)	Equivalent Diameter, De (mm)	Uncorrected Point Load Strength Index, I_s (Mpa)	Uncorrected Point Load Strength Index, I_s (PSI)	Size Correction Factor, F	Corrected Point Load Strength Index, $I_{s(50)}$ (Mpa)	Corrected Point Load Strength Index, $I_{s(50)}$ (PSI)	Estimated Uniaxial Compressive Strength, UCS (Mpa)*	Estimated Uniaxial Compressive Strength, UCS (PSI)*	Test Validation (Valid/Invalid)	Comments
9	57.0	1	Basalt	59.5	57.5	3	13.00	13000	3421	58.5	4	551	1.07	4.1	591	97.9	14194	Invalid	Followed Fractures on core axis
9	69.0	2	Breccia	59.5	56.0	6	0.95	950	3332	57.7	0	41	1.07	0.3	44	7.3	1059	Invalid	Fracture through matrix
9	43.5	3	Breccia	59.0	57.0	3	0.57	570	3363	58.0	0	25	1.07	0.2	26	4.3	631	Invalid	Fracture through matrix
9	45.5	4	Breccia	59.5	58.0	3	1.30	1300	3451	58.7	0	55	1.08	0.4	59	9.7	1410	Invalid	Fracture through matrix
9	35.0	5	Siltstone	58.5	55.0	6	0.42	420	3218	56.7	0	19	1.06	0.1	20	3.3	481	Valid	
9	26.0	6	Breccia	60.5	56.5	7	0.32	320	3418	58.5	0	14	1.07	0.1	15	2.4	350	Invalid	Followed Fractures on core axis
5	11.0	7	Breccia	59.0	57.0	3	0.84	840	3363	58.0	0	36	1.07	0.3	39	6.4	929	Invalid	Fracture through matrix
5	30.0	8	Breccia	59.5	57.0	4	0.93	930	3392	58.2	0	40	1.07	0.3	43	7.0	1022	Invalid	Fracture through matrix
5	47.0	9	Basalt	45.0	39.5	12	2.94	2940	1778	42.2	2	240	0.93	1.5	222	36.8	5332	Invalid	Clast, non-diametral
5	61.0	10	Breccia	59.5	57.0	4	0.30	295	3392	58.2	0	13	1.07	0.1	14	2.2	324	Invalid	Fracture through matrix
5	90.0	11	Basalt	59.5	57.5	3	16.50	16500	3421	58.5	5	699	1.07	5.2	751	124.2	18016	Valid	
5	105.0	12	Breccia	59.5	57.0	4	0.34	340	3392	58.2	0	15	1.07	0.1	16	2.6	374	Invalid	Fracture through matrix
5	119.5	13	Siltstone	59.5	57.5	3	0.97	970	3421	58.5	0	41	1.07	0.3	44	7.3	1059	Valid	
5	125.0	14	Breccia	59.5	58.0	3	1.41	1410	3451	58.7	0	59	1.08	0.4	64	10.5	1529	Valid	
5	127.0	15	Breccia	59.5	58.0	3	1.11	1110	3451	58.7	0	47	1.08	0.3	50	8.3	1204	Valid	
9	57.0	16	Basalt	38.0	35.5	7	3.40	3400	1349	36.7	3	366	0.87	2.2	318	52.6	7636	Invalid	Clast, non-diametral
3	21.5	17	Siltstone	59.0	56.5	4	0.56	560	3334	57.7	0	24	1.07	0.2	26	4.3	624	Valid	
3	28.5	18	Breccia	59.0	57.0	3	4.86	4860	3363	58.0	1	210	1.07	1.5	224	37.1	5377	Valid	Fracture through clast
3	32.5	19	Breccia	59.5	57.0	4	2.09	2090	3392	58.2	1	89	1.07	0.7	96	15.8	2297	Valid	Fracture through clast
3	36.5	20	Siltstone	59.5	55.5	7	0.24	235	3302	57.5	0	10	1.06	0.1	11	1.8	264	Invalid	
3	47.5	21	Siltstone	59.5	58.0	3	0.41	405	3451	58.7	0	17	1.08	0.1	18	3.0	439	Invalid	
3	60.0	22	Basalt	59.5	58.5	2	0.23	230	3481	59.0	0	10	1.08	0.1	10	1.7	248	Invalid	Followed Fractures on core axis
3	67.0	23	Breccia	59.5	52.5	12	2.10	2100	3124	55.9	1	98	1.05	0.7	103	17.0	2460	Invalid	Fracture through clast
3	73.0	24	Siltstone	59.0	57.5	3	0.43	430	3393	58.2	0	18	1.07	0.1	20	3.3	473	Valid	
3	85.0	25	Breccia	59.5	57.5	3	0.62	620	3421	58.5	0	26	1.07	0.2	28	4.7	677	Invalid	
3	79.0	26	Siltstone	59.0	57.5	3	0.43	430	3393	58.2	0	18	1.07	0.1	20	3.3	473	Valid	
3	87.0	27	Siltstone	59.0	52.5	11	0.83	830	3098	55.7	0	39	1.05	0.3	41	6.7	979	Valid	
3	105.0	28	Breccia	59.0	54.5	8	2.83	2830	3216	56.7	1	128	1.06	0.9	135	22.4	3242	Invalid	No fracture, penetration
3	105.0	29	Breccia	59.5	56.5	5	2.95	2950	3362	58.0	1	127	1.07	0.9	136	22.5	3265	Valid	
3	103.0	30	Siltstone	59.0	56.5	4	0.20	200	3334	57.7	0	9	1.07	0.1	9	1.5	223	Valid	
3	108.0	31	Breccia	59.5	58.0	3	0.59	590	3451	58.7	0	25	1.08	0.2	27	4.4	640	Valid	
																Assumed C*	24.0		

Notes: * Estmated UCS was calculated using an estimated correlation factor (C) of 24

Number of total breaks:	31
Number of basalt breaks	5
Number of breccia breaks	17
Number of siltstone breaks	9

McMILLEN JACOBS ASSOCIATES

CALCULATIONS (ASTM D5731)

Uncorrected Point Load Strength *

$I_s = P / De^2$

I_s = Point load strength index, Mpa
P = failure load, N
$De^2 = D^2$, for diametral core tests without platen penetration, mm^2
$De^2 = 4A/\pi$ for axial, block, and lump tests, mm^2
*For D = 50mm, if D is not equal to 50 mm, use size corrected point load index below.

D' = final separation of the loading points with significant platen penetration, mm
De = equivalent core diameter, mm
$De^2 = 4/\pi$ W x D' for block, and lump shapes with platen penetration, mm^2
De^2 = D x D' for cores with platen penetration, mm^2

Where:
A = WD = minimum cross-sectional area of a plane through the platen contact points

Size Corrected Point Load Index

$I_{s(50)} = k_{PLT} \times I_s$

$k_{PLT} = (De / 50)^{0.45}$

$I_{s(50)}$ = size-corrected point load strength index
k_{PLT} = size correction factor

C Value

$\sigma_c = C \times I_{s(50)}$

σ_c = uniaxial compressive strength (UCS)
C = C-value, correlation value

The uniaxial compressive strength, σ_c, is related to the point load index, $_{s(50)}$, by what is commonly referred to as the C-Value, which is a site specific value
The C-Value relating to a site is found by plotting the LAB Unconfined Compressive strengths (UCS) vs. the corrected Point Load ($I_{s(50)}$) data.
If no correlation, a generalized C-value can be used, C = 24.
This procedure is only used to correct FIELD point load test data. Laboratory data will already provide UCS values. However, the lab UCS and PLT data is used to find the C-Value.

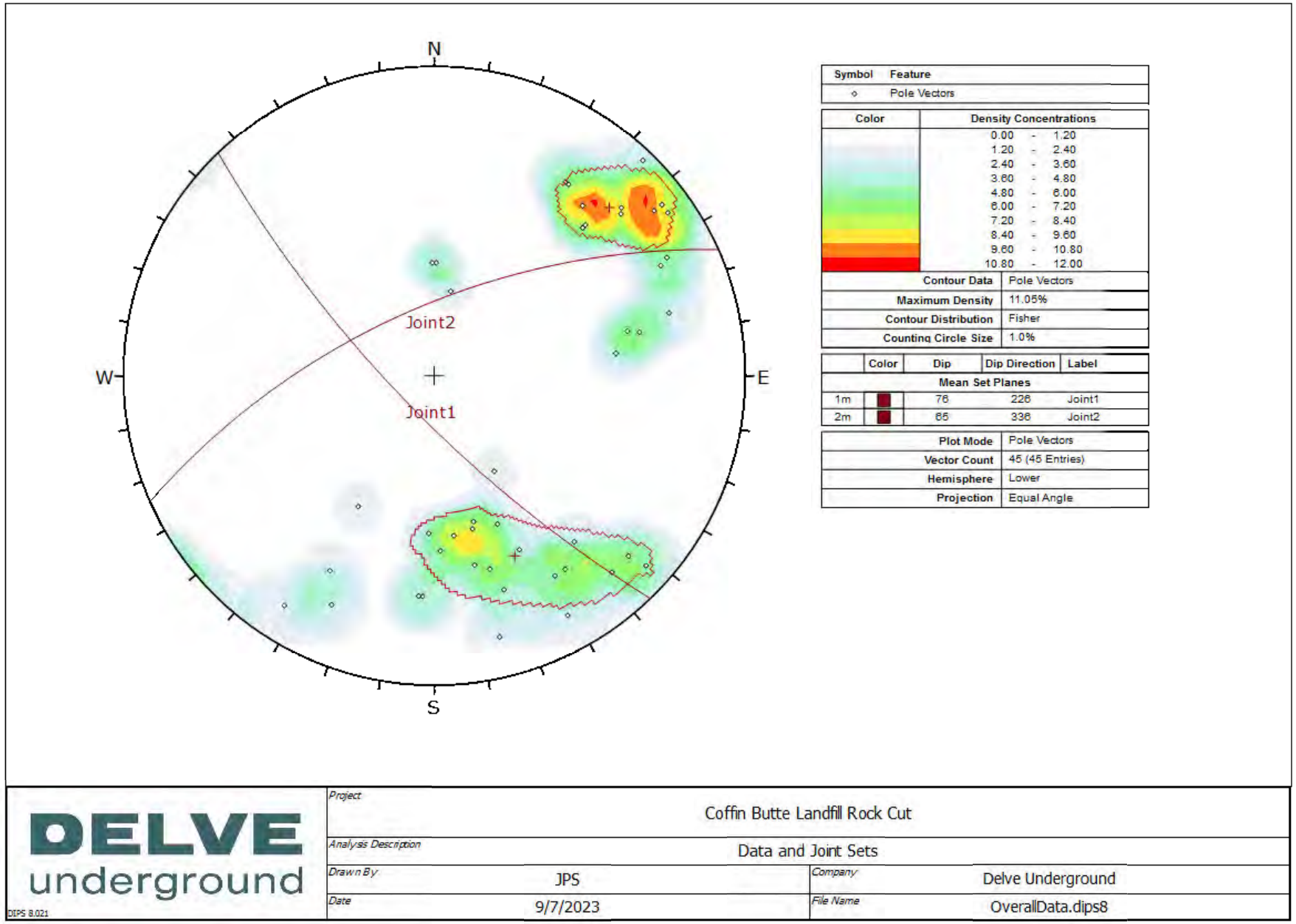
Reducing data

Find the minimum and maximum values and delete. ASTM calls for 2 lowest and 2 highest values to be deleted (data set choice).
Average the rest of the values for the set to get Is(50) and UCS.

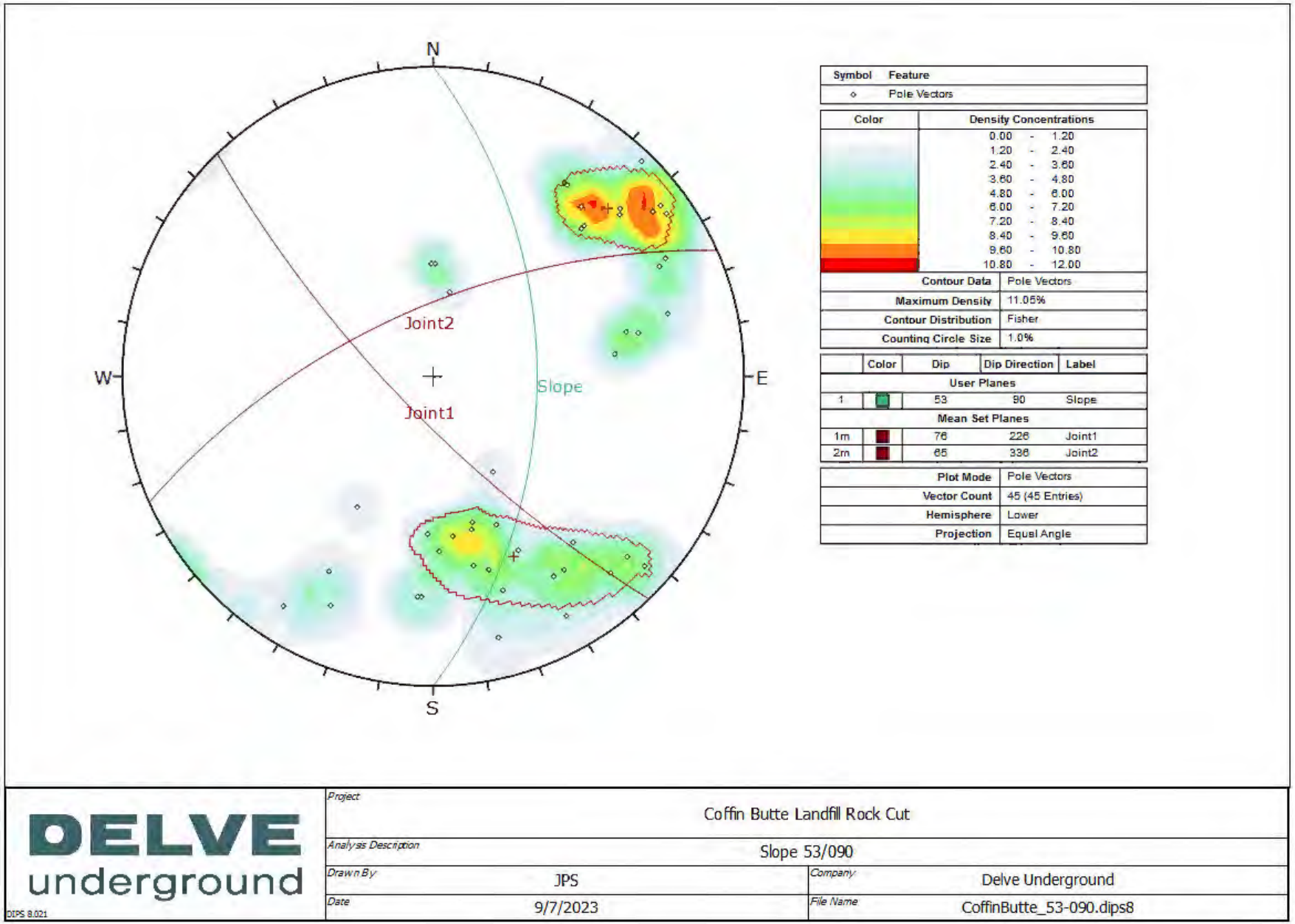
Calculations further explained in FHWA-IF-02-034 and ISRM RTH 325-89.

Appendix C: Stereonet and Kinematic Results

Overall Stereonet



Slope: 53/090 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	90	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

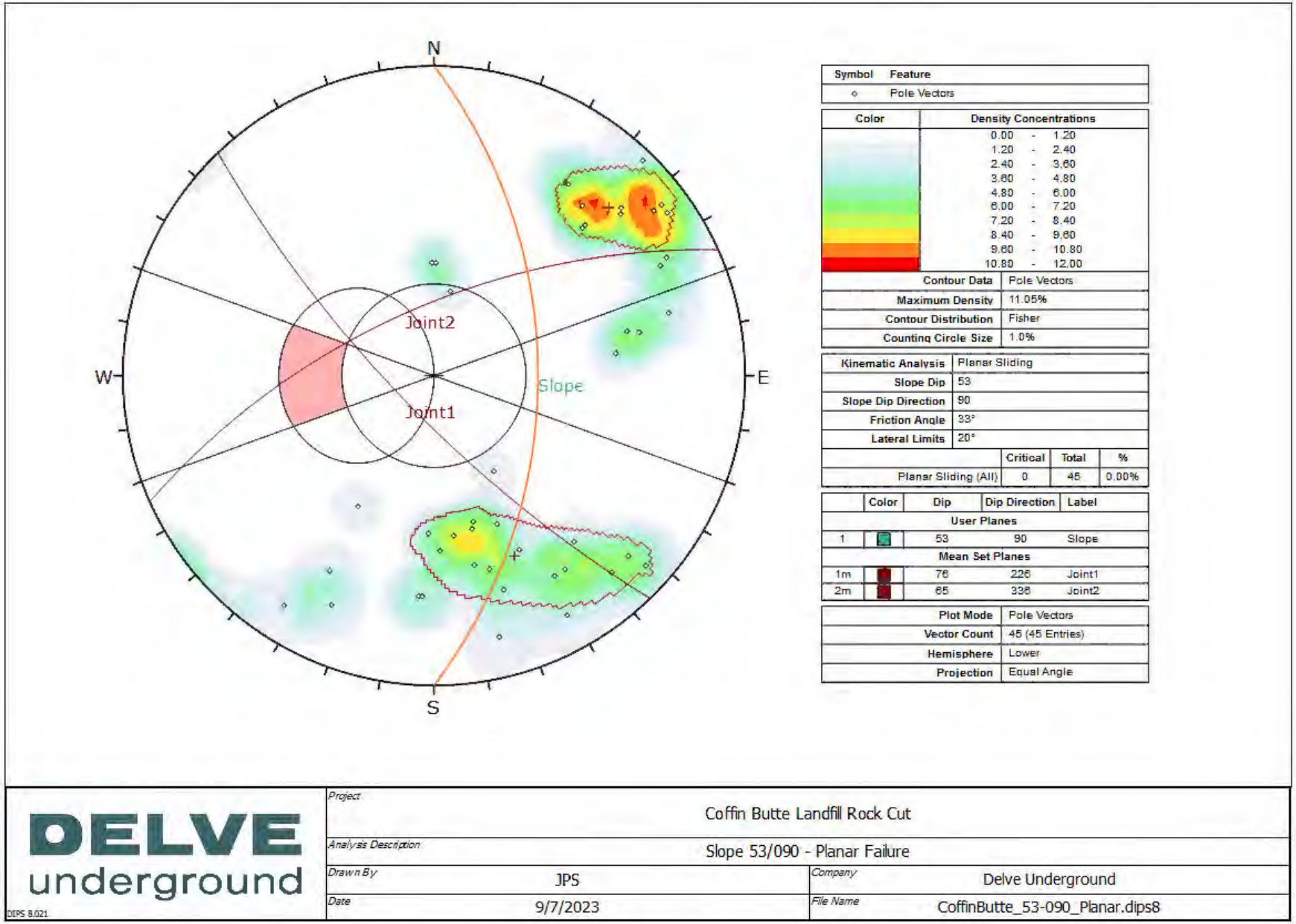
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/090		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-090.dips8

Slope: 53/090 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	53
Slope Dip Direction	90
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	90	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

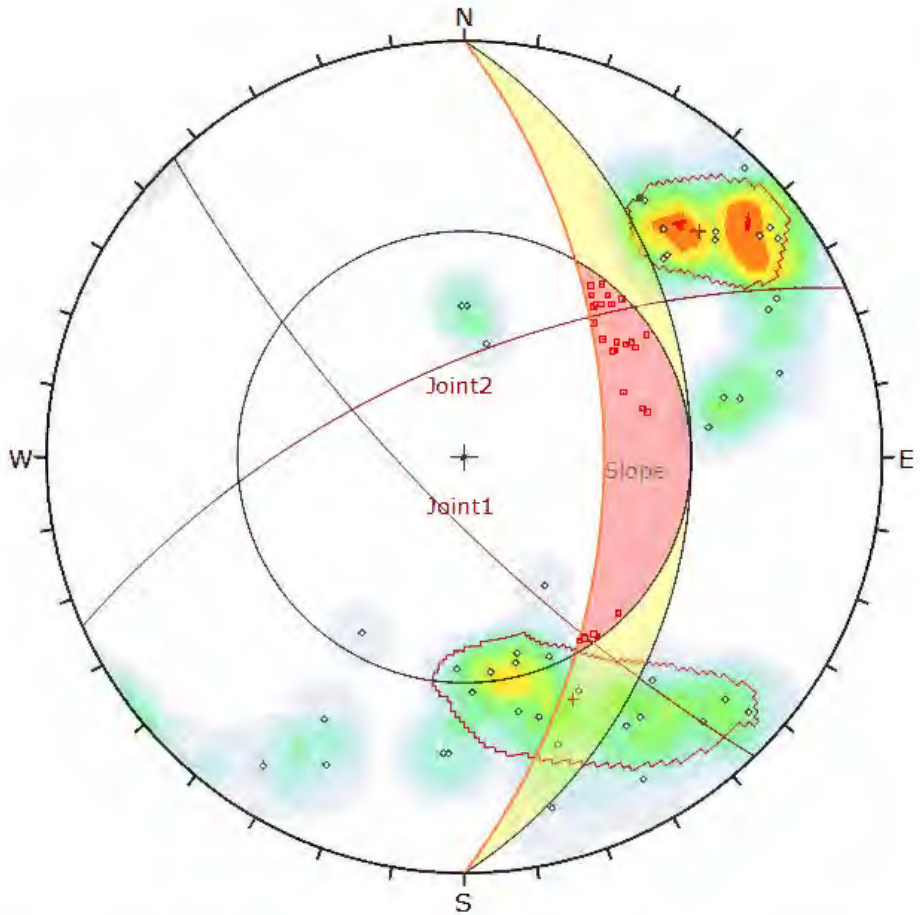
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/090 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-090_Planar.dips8

Slope: 53/090 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	53		
Slope Dip Direction	90		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	31	990	3.13%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	90	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		85	336	Joint2

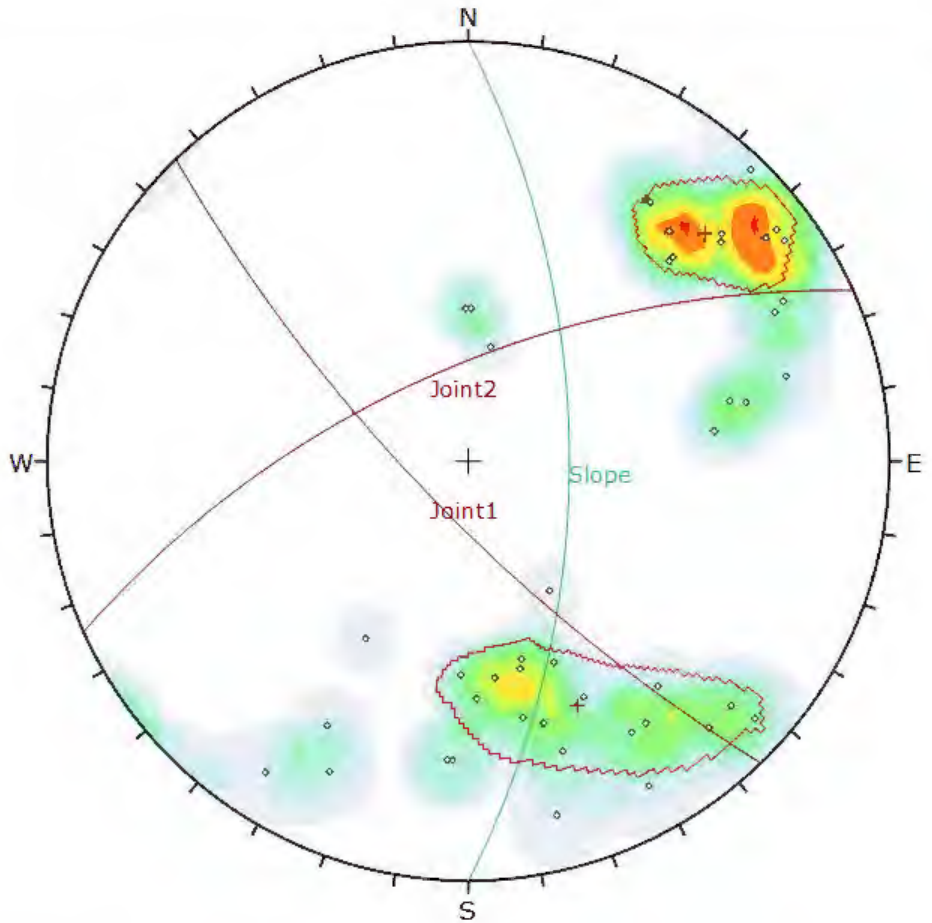
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/090 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-090_Wedge.dips8

Slope: 63/090 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	90	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

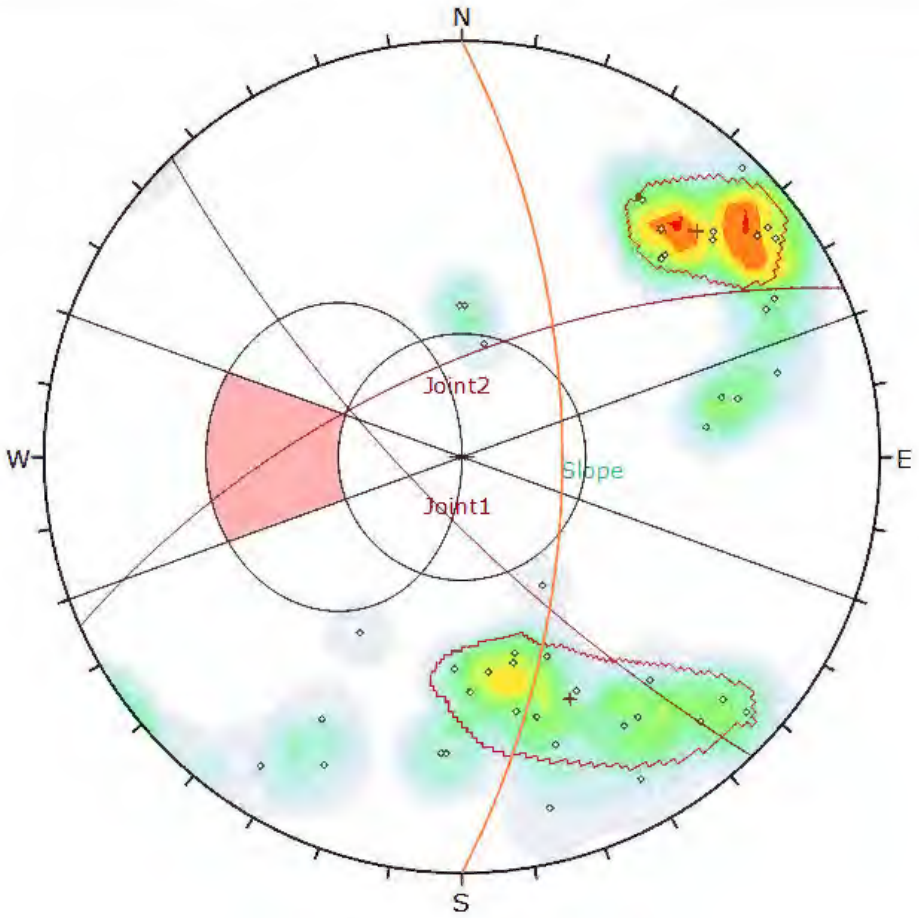
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/090		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-090.dips8

Slope: 63/090 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	63
Slope Dip Direction	90
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	90	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

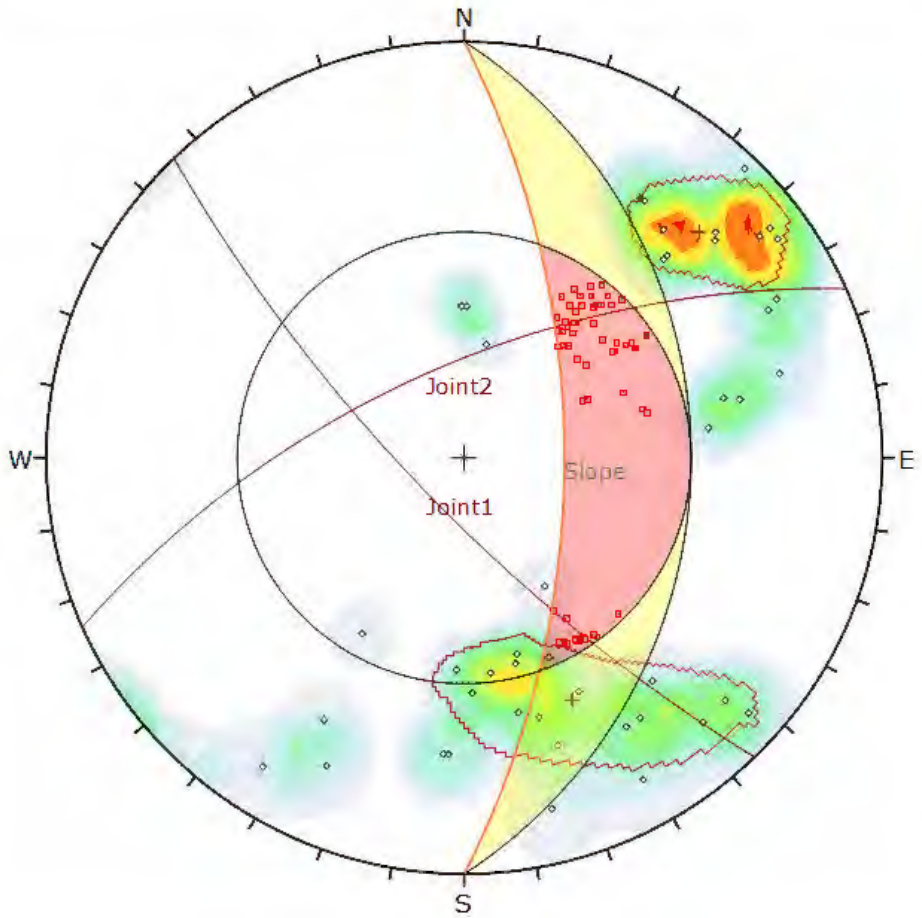
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/090 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-090_Planar.dips8

Slope: 63/090 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	63		
Slope Dip Direction	90		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	66	990	6.67%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	90	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

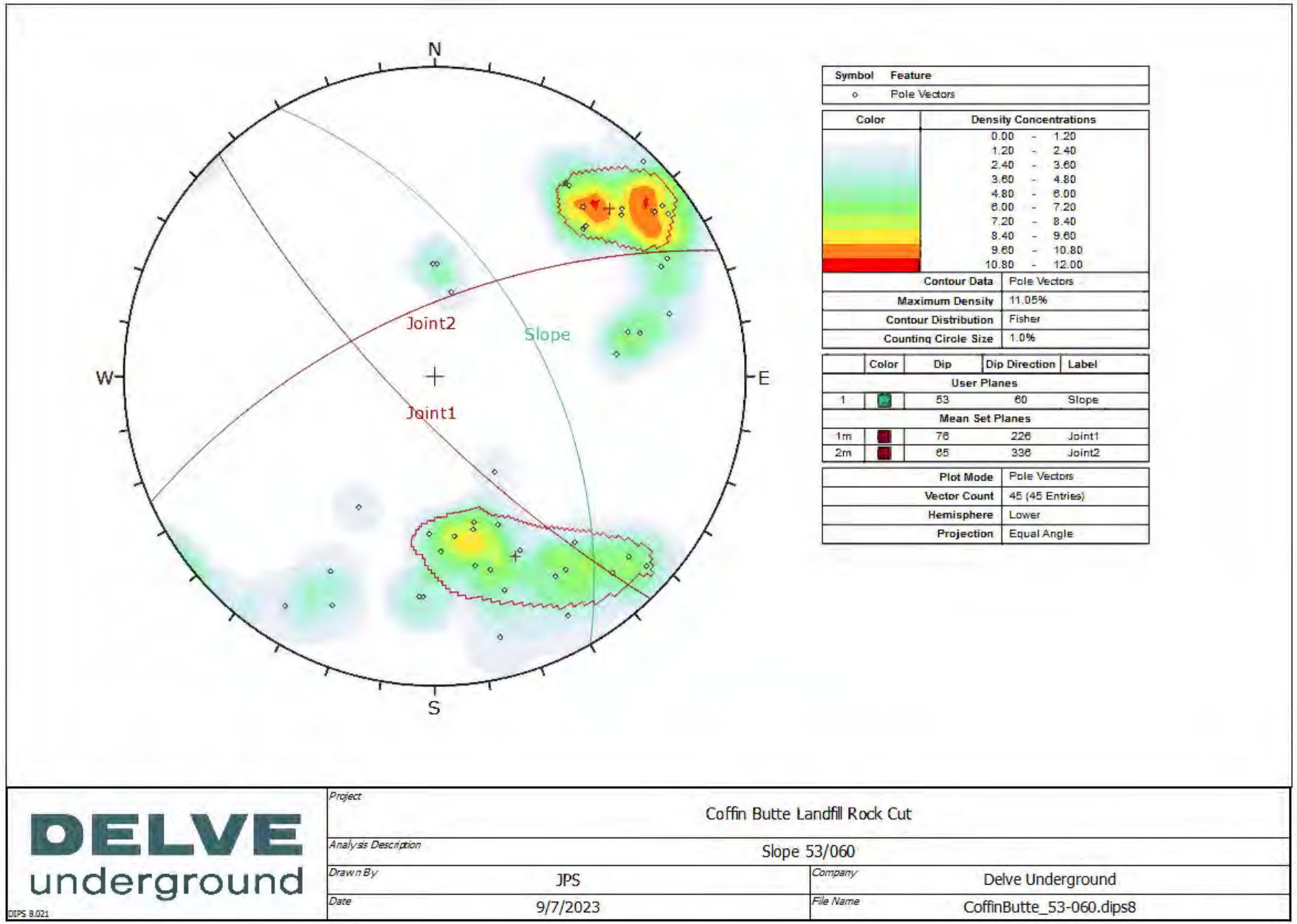
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/090 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-090_Wedge.dips8

Slope: 53/060 – Stereonet



Symbol	Feature
○	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	60	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

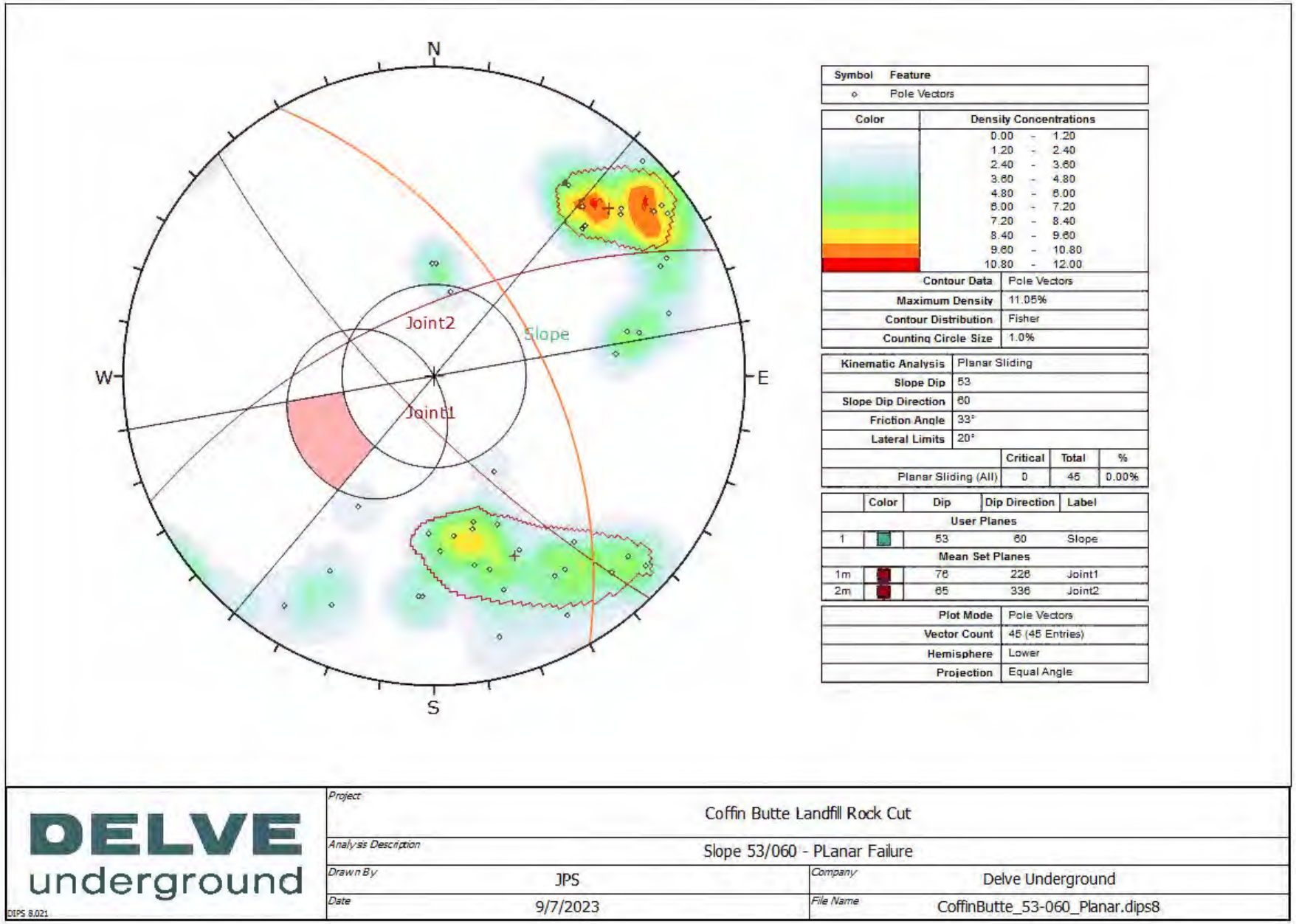
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/060		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-060.dips8

Slope: 53/060 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding		
Slope Dip	53		
Slope Dip Direction	60		
Friction Angle	33°		
Lateral Limits	20°		
	Critical	Total	%
Planar Sliding (All)	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	60	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

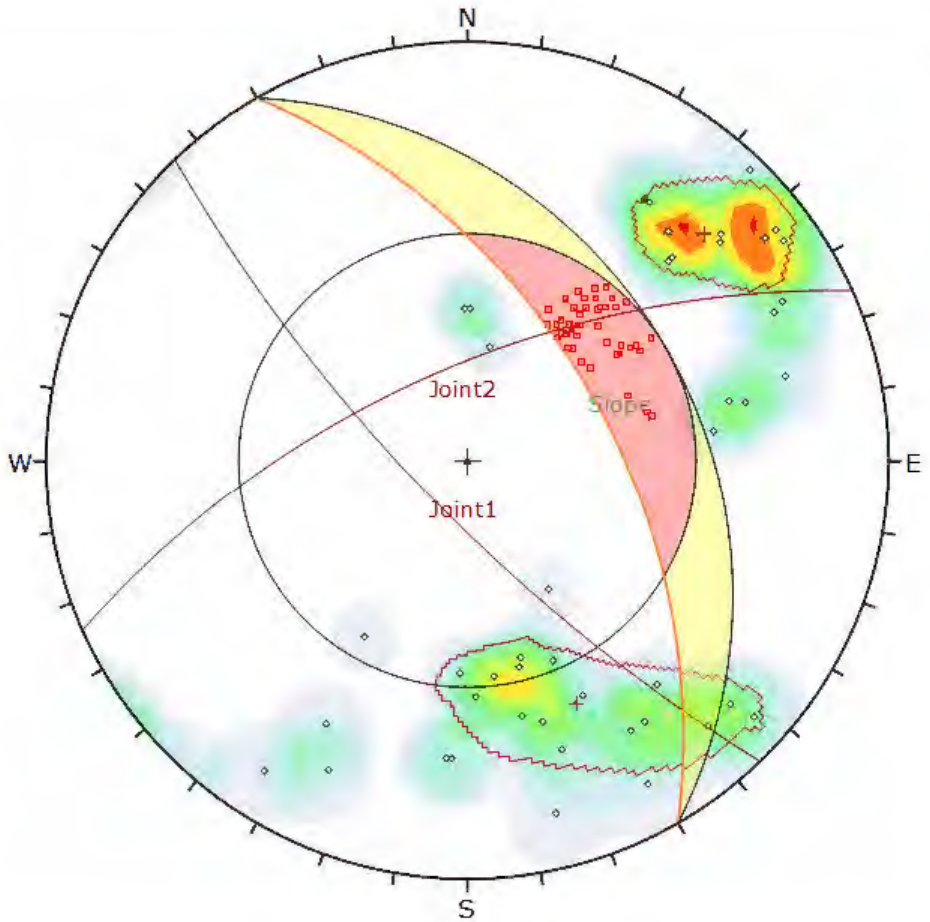
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/060 - PLanar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-060_Planar.dips8

Slope: 53/060 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	53
Slope Dip Direction	60
Friction Angle	33°

	Critical	Total	%
Wedge Sliding	45	990	4.55%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	60	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

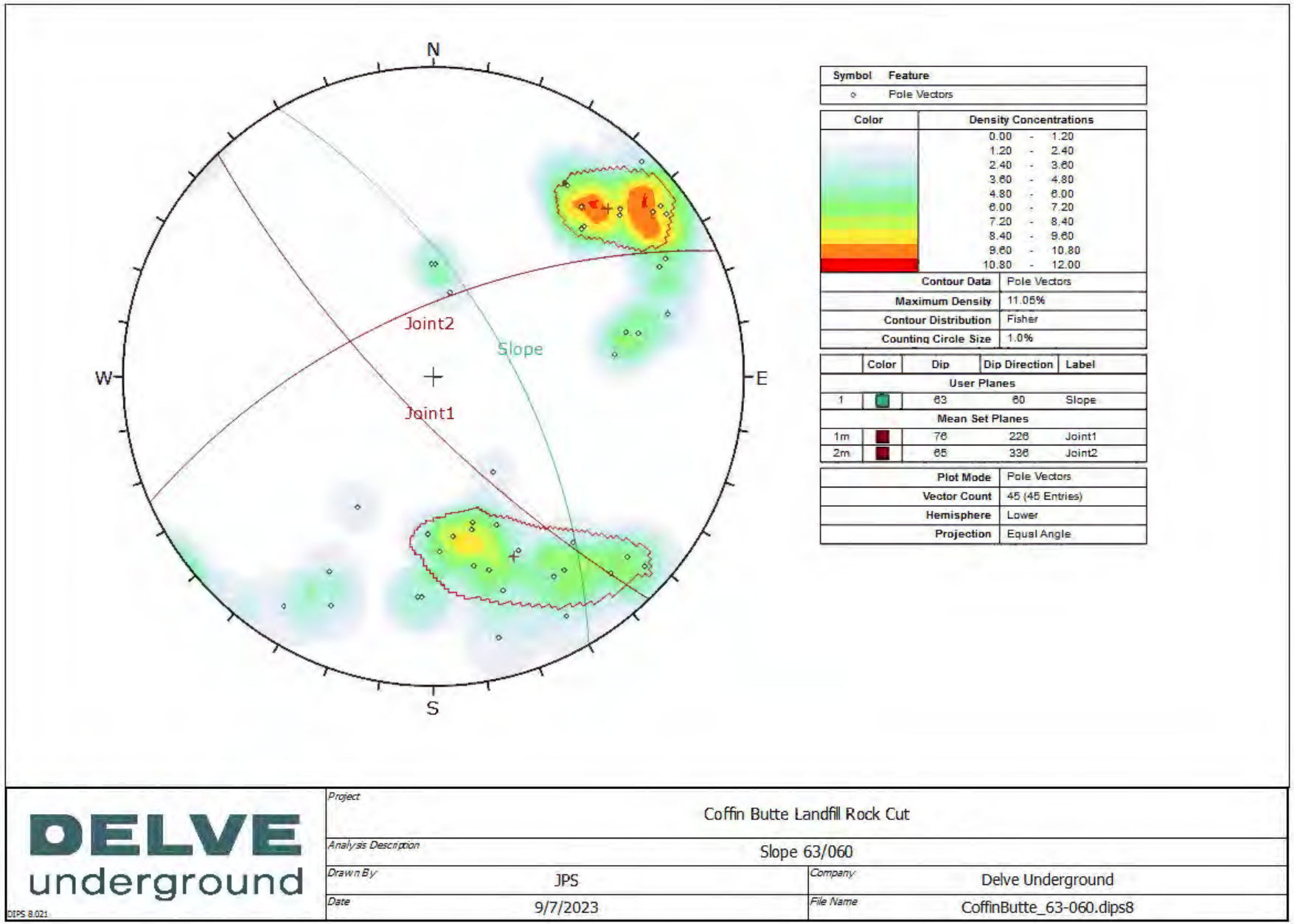
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/060 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-060_Wedge.dips8

Slope: 63/060 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	60	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

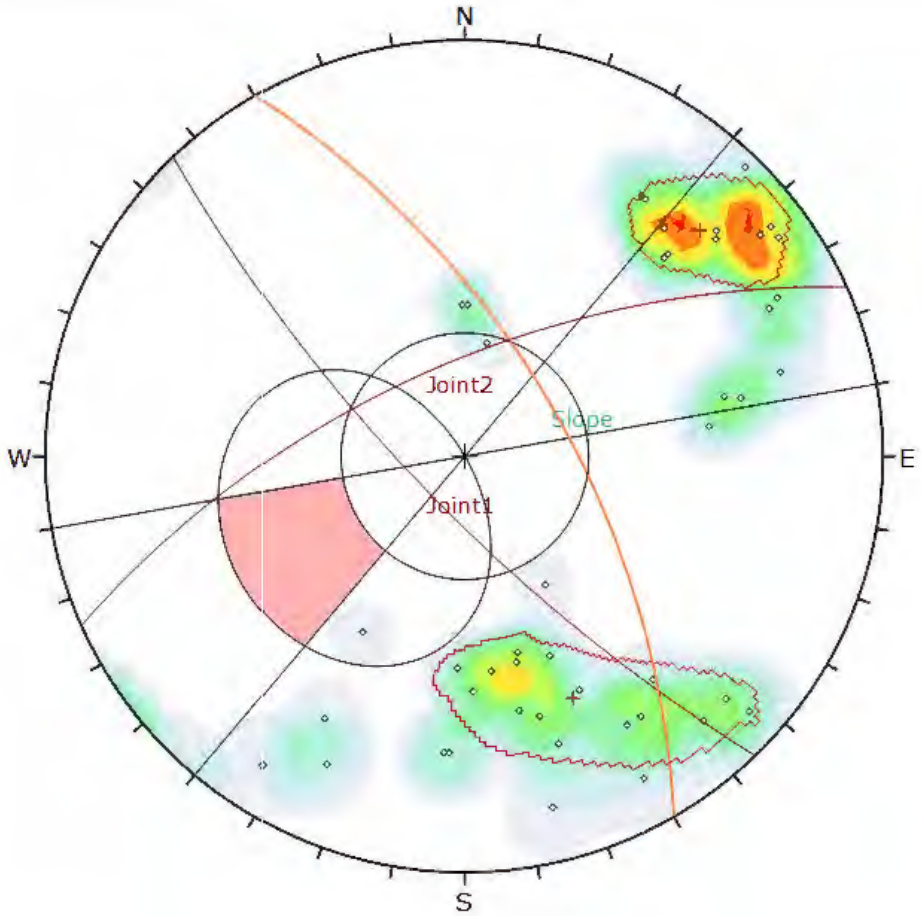
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/060		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-060.dips8

Slope: 63/060 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	63
Slope Dip Direction	60
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	60	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

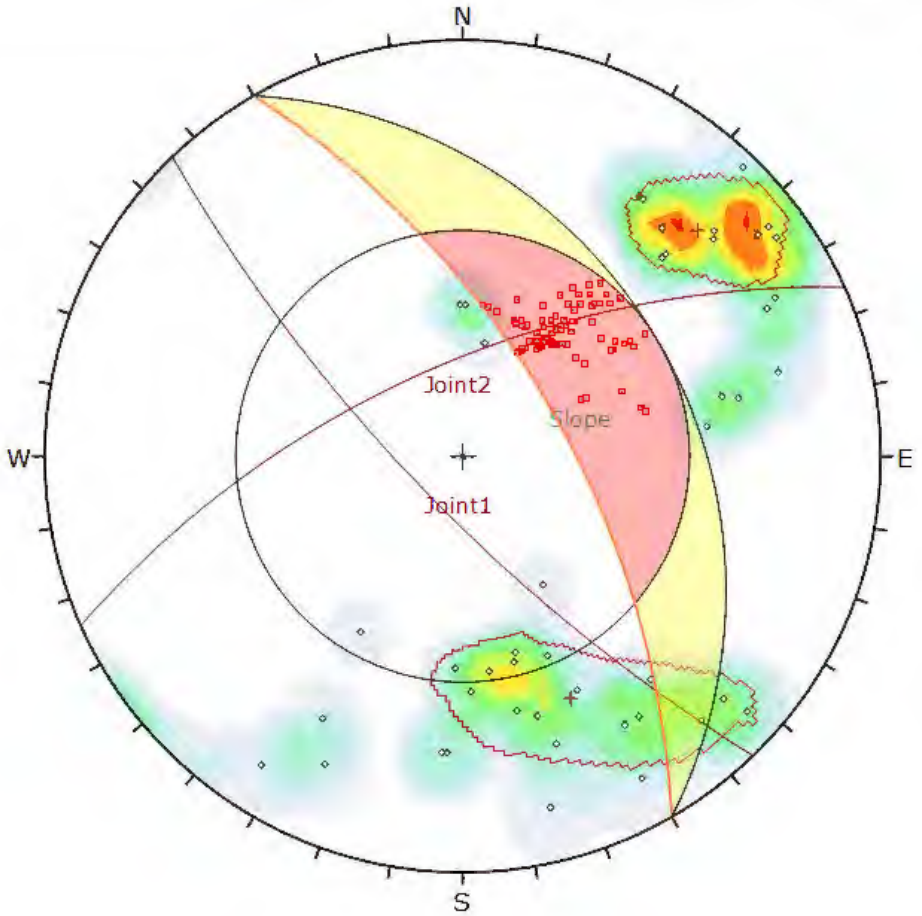
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/060 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-060-Planar.dips8

Slope: 63/060 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	63
Slope Dip Direction	60
Friction Angle	33°

	Critical	Total	%
Wedge Sliding	87	990	8.79%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	60	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

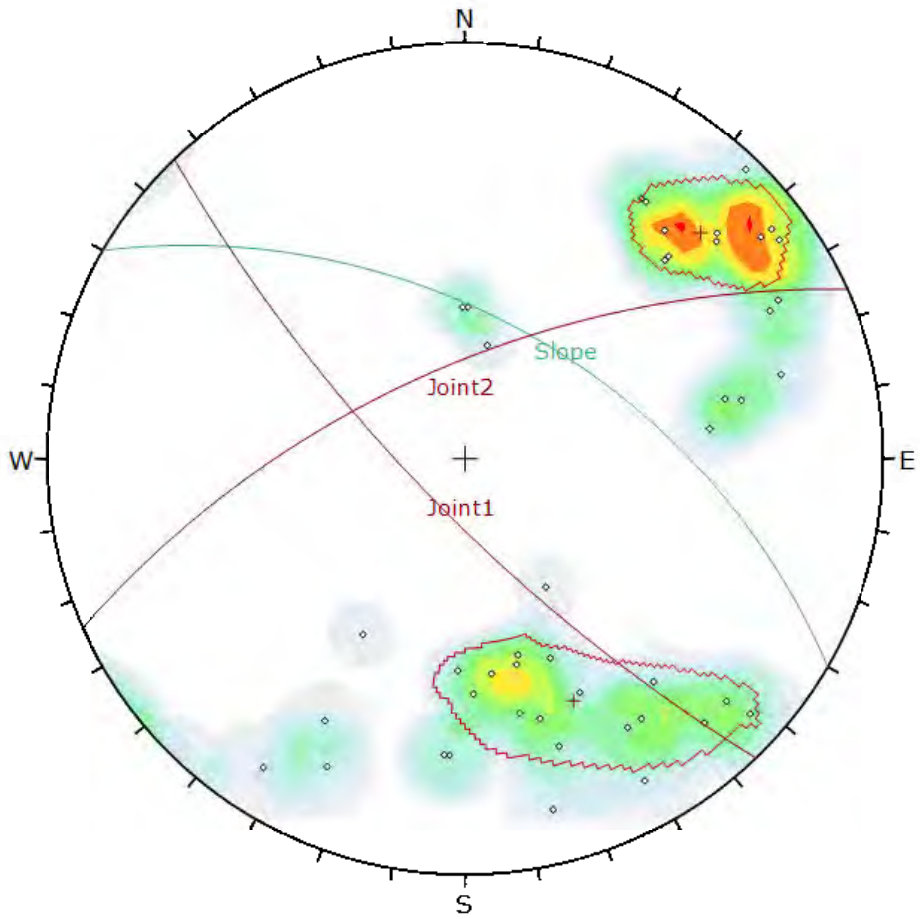
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/060 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-060-Wedge.dips8

Slope: 53/030 – Stereonet



Symbol	Feature
○	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	30	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

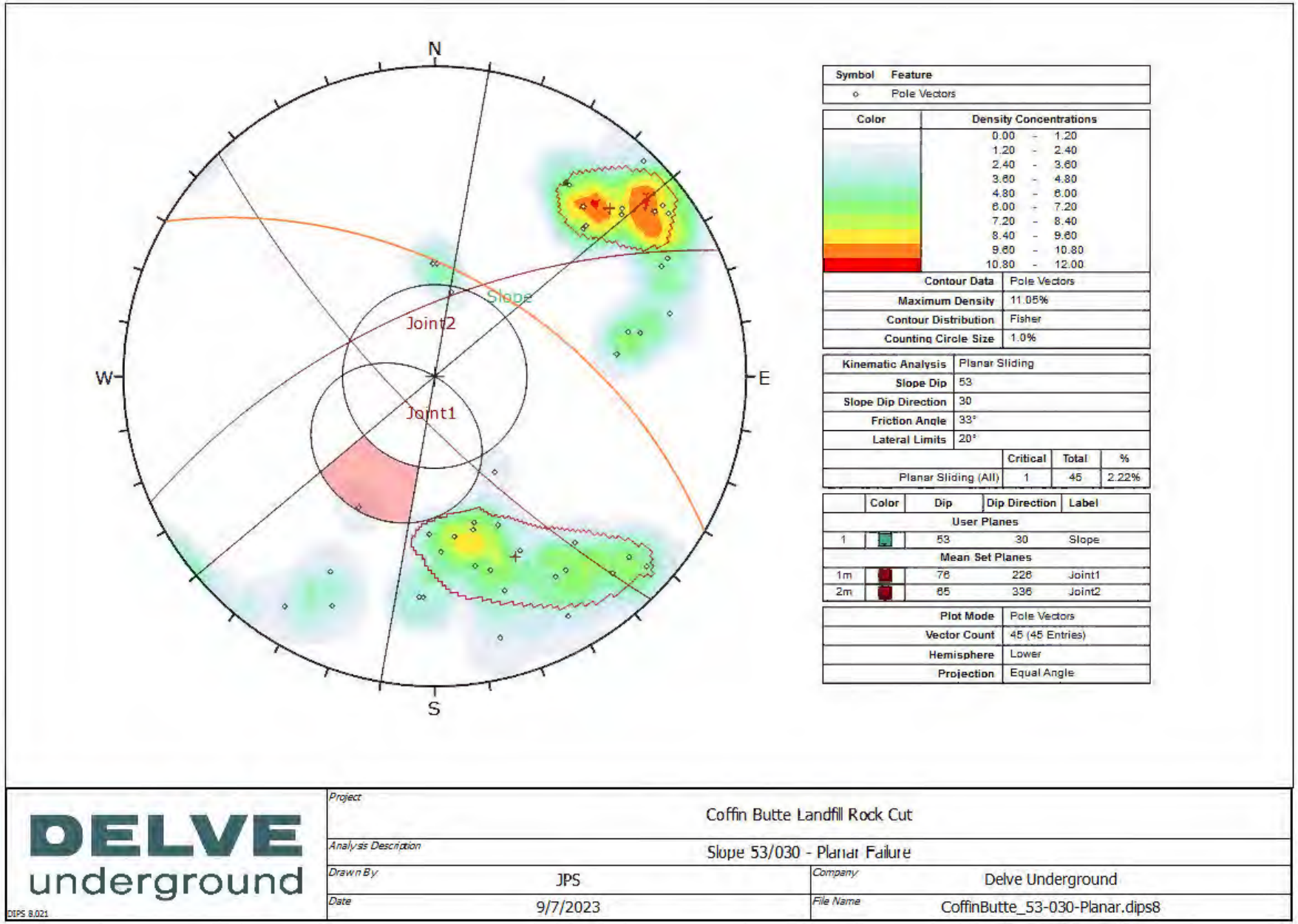
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/030		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-030.dips8

Slope: 53/030 – Planar Failure



Symbol	Feature
○	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding		
Slope Dip	53		
Slope Dip Direction	30		
Friction Angle	33°		
Lateral Limits	20°		
	Critical	Total	%
Planar Sliding (All)	1	45	2.22%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	30	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		85	336	Joint2

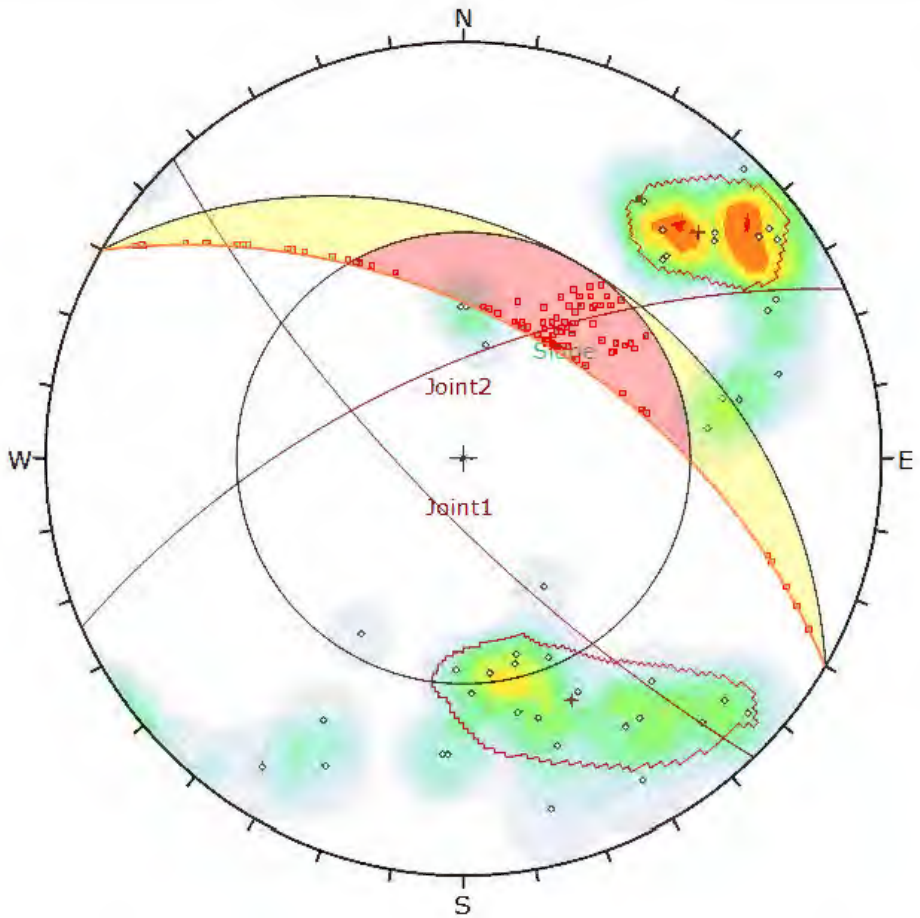
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/030 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-030-Planar.dips8

Slope: 53/030 – Wedge Failure



Symbol	Feature
◦	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	53		
Slope Dip Direction	30		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	92	990	9.29%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	30	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		85	336	Joint2

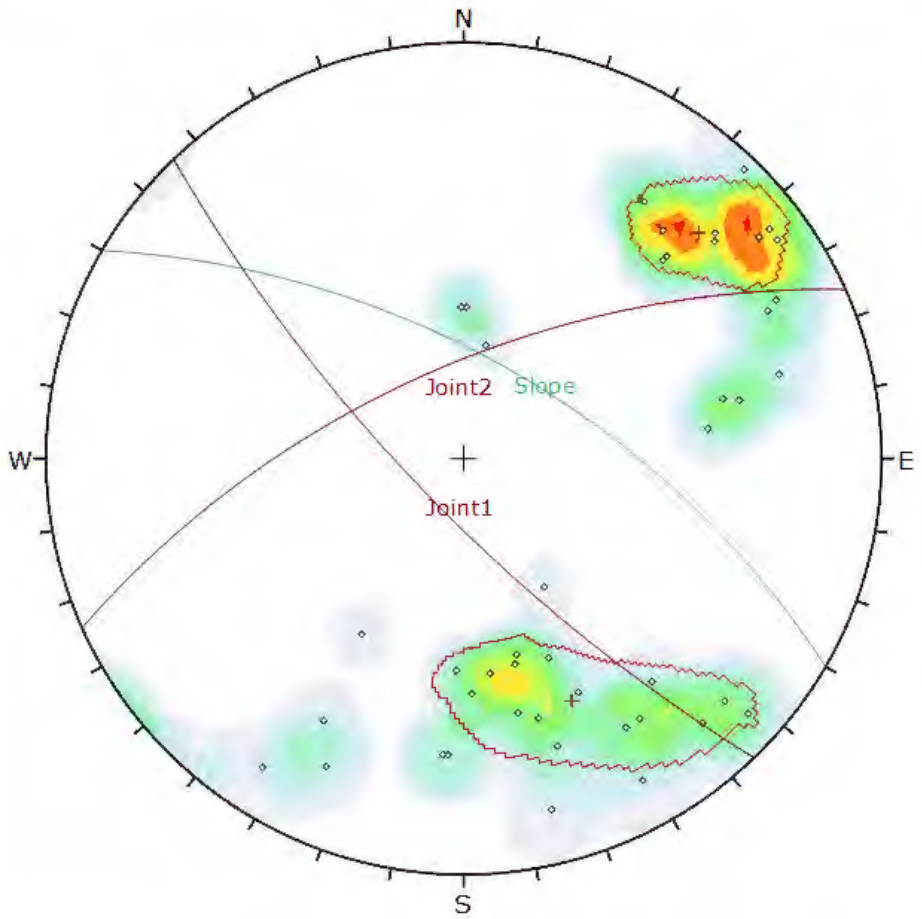
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/030 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-030-Wedge.dips8

Slope: 63/030 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	30	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

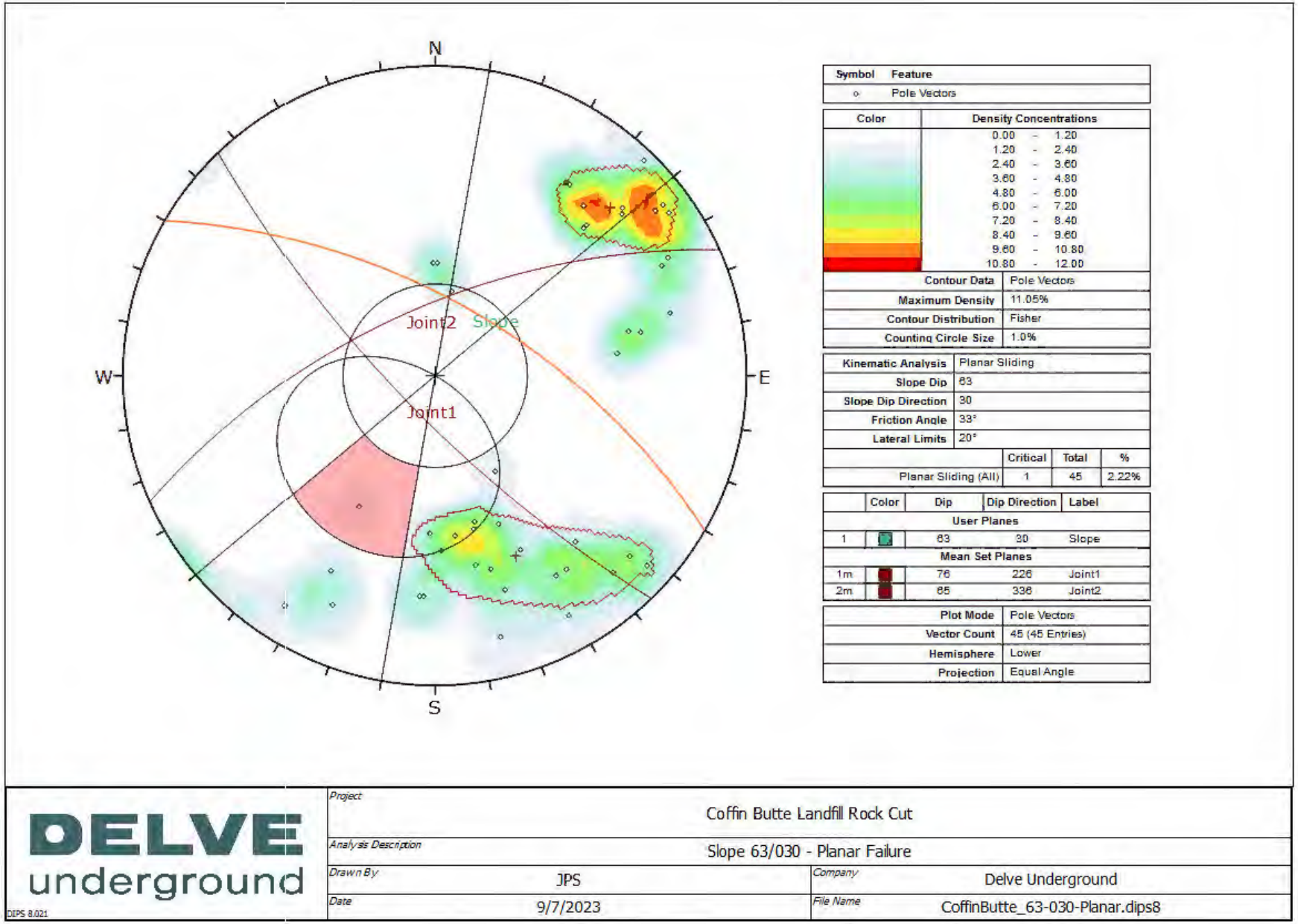
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/030		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-030.dips8

Slope: 63/030 – Planar Failure



Symbol	Feature
○	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	63
Slope Dip Direction	30
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	45	2.22%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	30	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

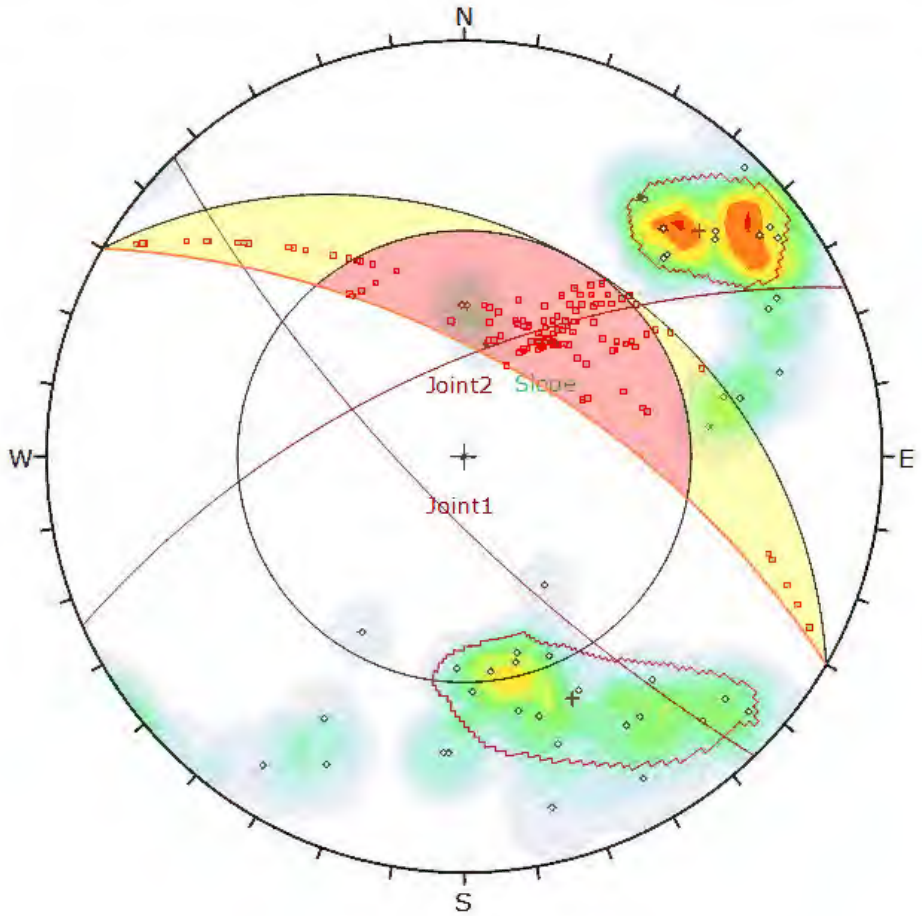
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/030 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-030-Planar.dips8

Slope: 63/030 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	63
Slope Dip Direction	30
Friction Angle	33°

	Critical	Total	%
Wedge Sliding	128	990	12.93%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	30	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

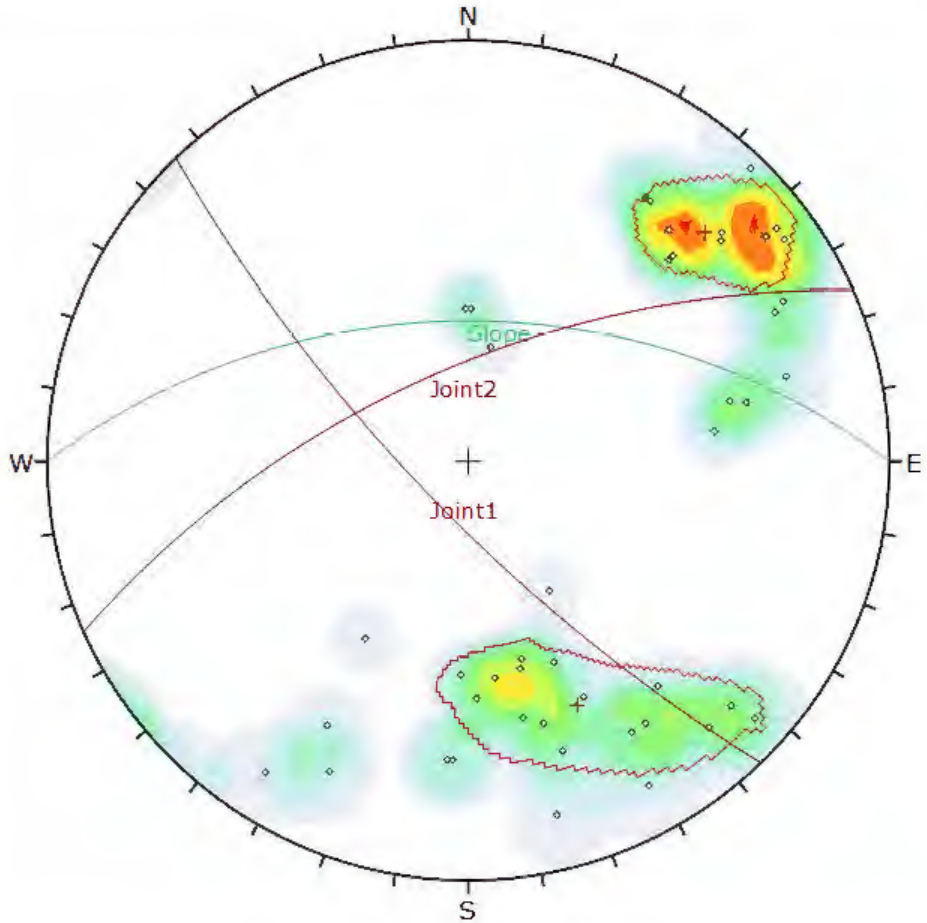
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/030 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-030-Wedge.dips8

Slope: 53/000 – Stereonet



Symbol	Feature
○	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	360	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

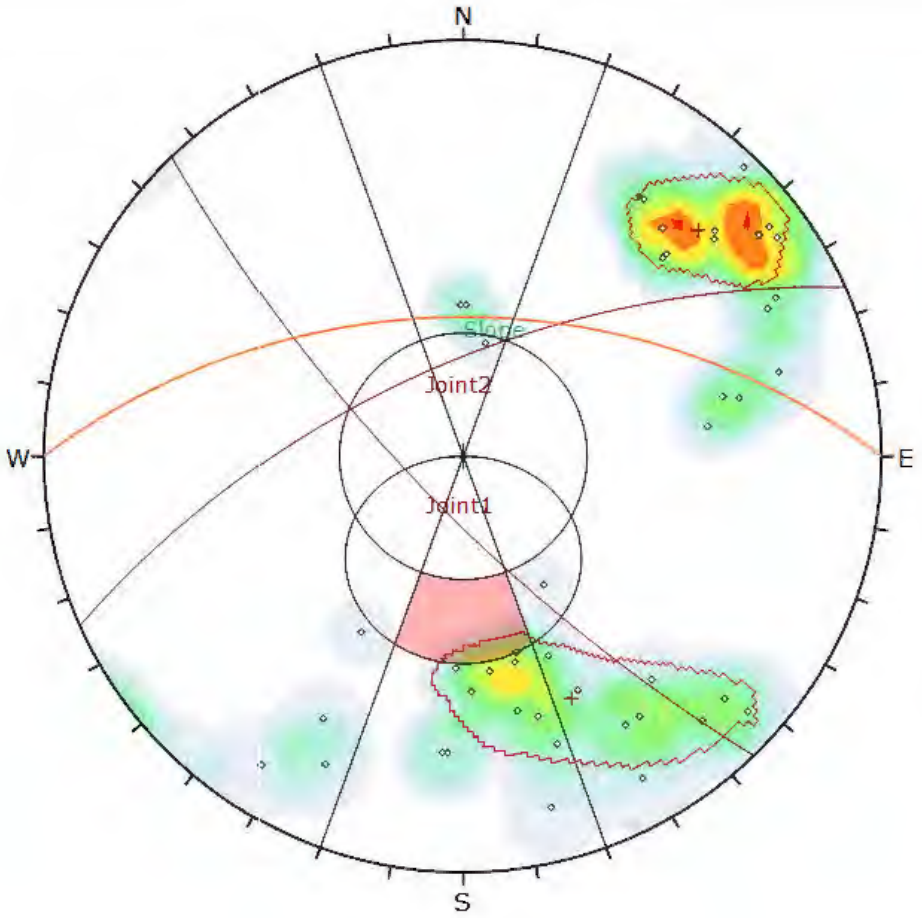
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/000		
Drawn By	JPS	*Company*	Delve Underground
Date	9/7/2023	*File Name*	CoffinButte_53-000.dips8

Slope: 53/000 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	53
Slope Dip Direction	0
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	45	2.22%
Planar Sliding (Set 2: Joint2)	1	16	6.25%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	360	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		85	338	Joint2

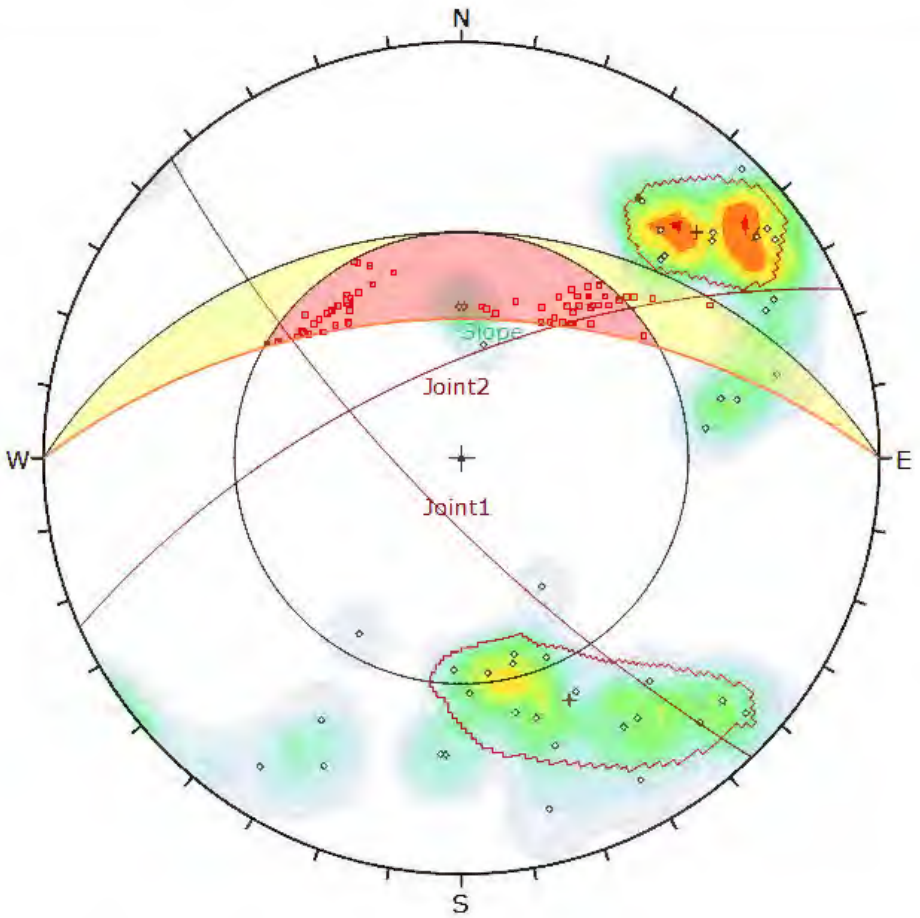
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/000 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-000-Planar.dips8

Slope: 53/000 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	53		
Slope Dip Direction	0		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	67	990	6.77%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	360	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

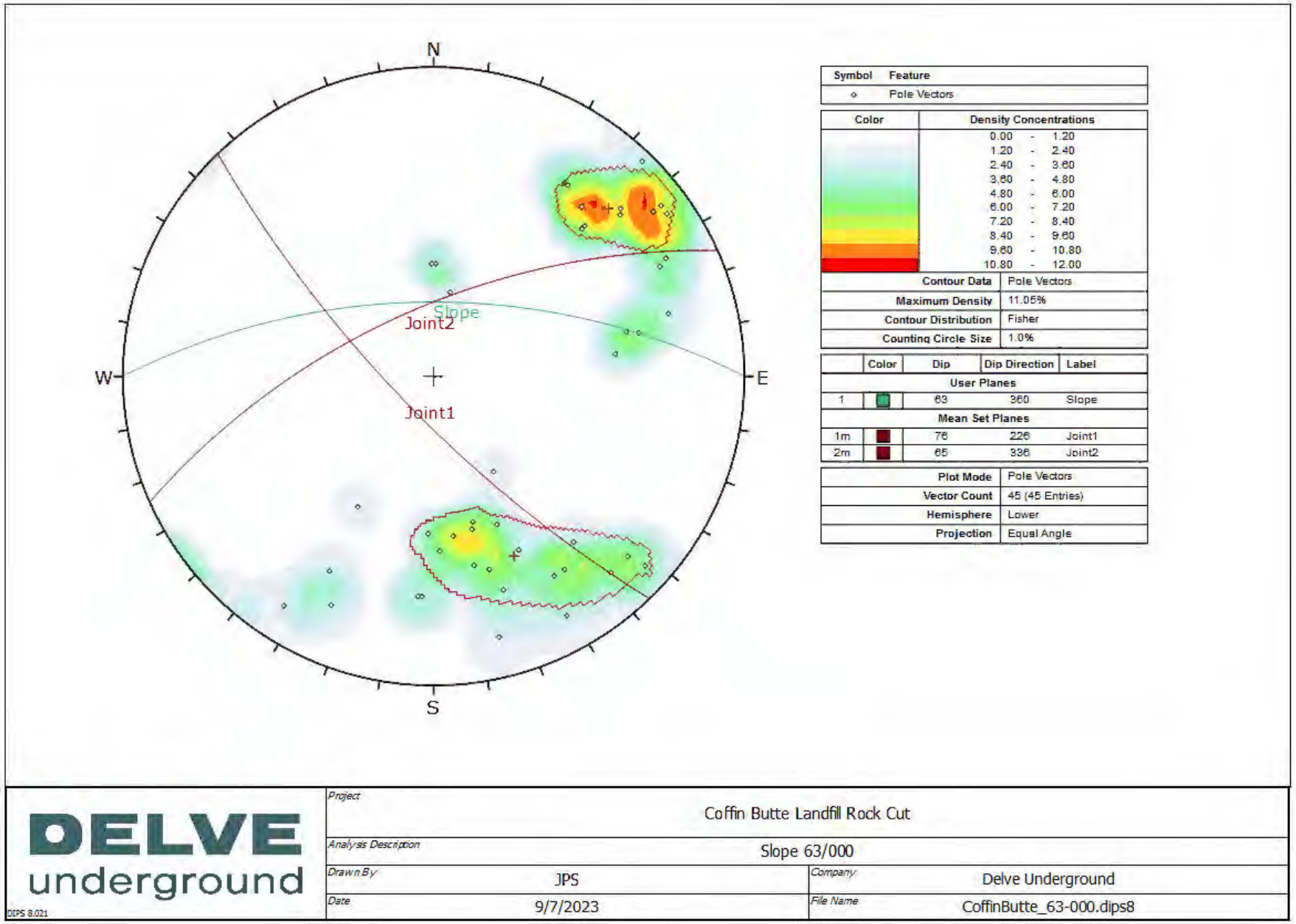
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/000 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-000-Wedge.dips8

Slope: 63/000 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	360	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

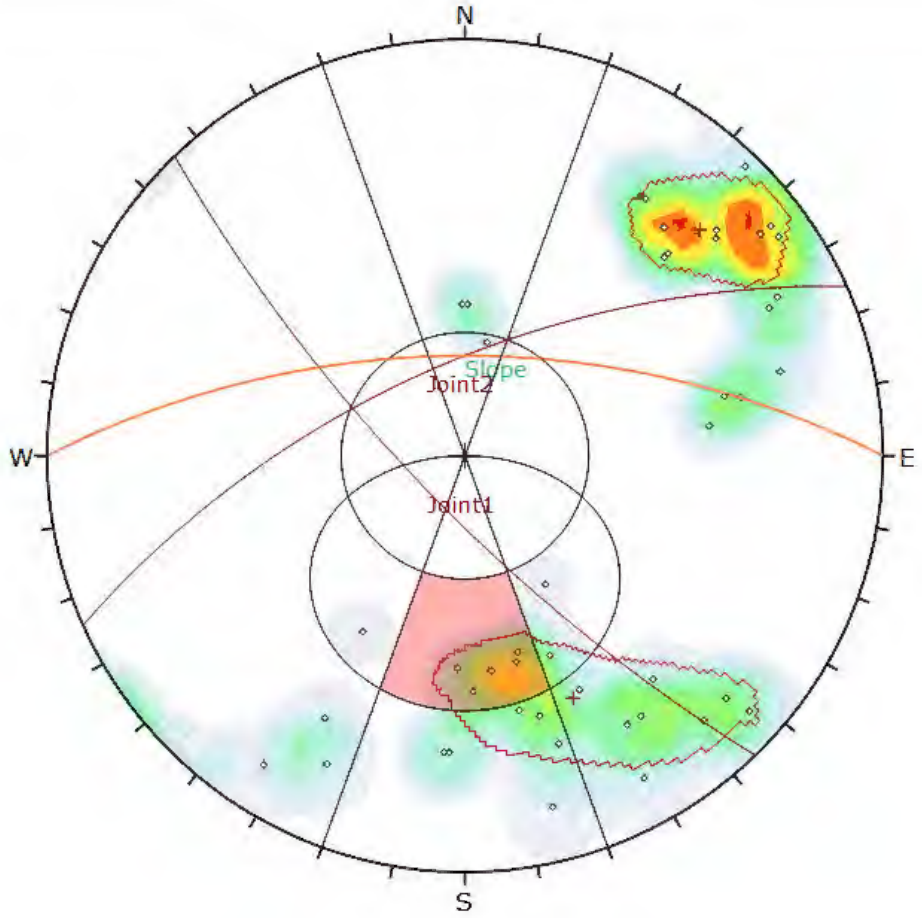
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/000		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-000.dips8

Slope: 63/000 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	63
Slope Dip Direction	0
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	5	45	11.11%
Planar Sliding (Set 2: Joint2)	5	16	31.25%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	360	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

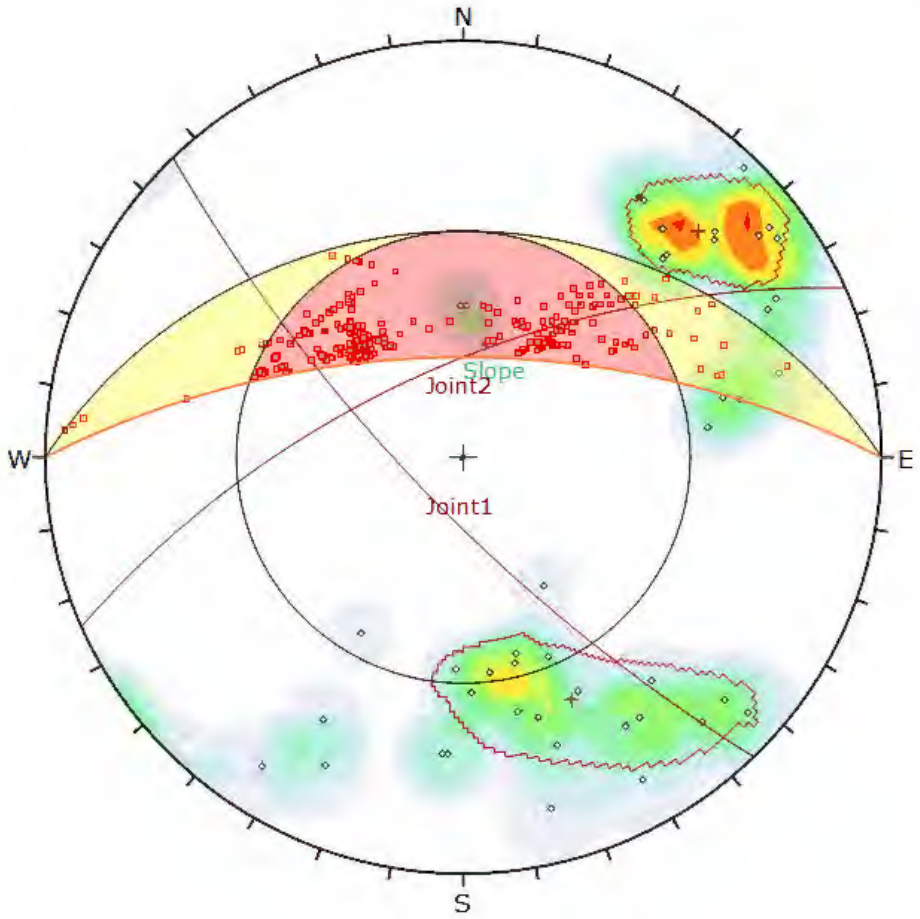
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/000 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-000-Planar.dips8

Slope: 63/000 – Wedge Failure



Symbol	Feature
	Pole Vectors
	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	63		
Slope Dip Direction	0		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	286	990	28.89%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	360	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

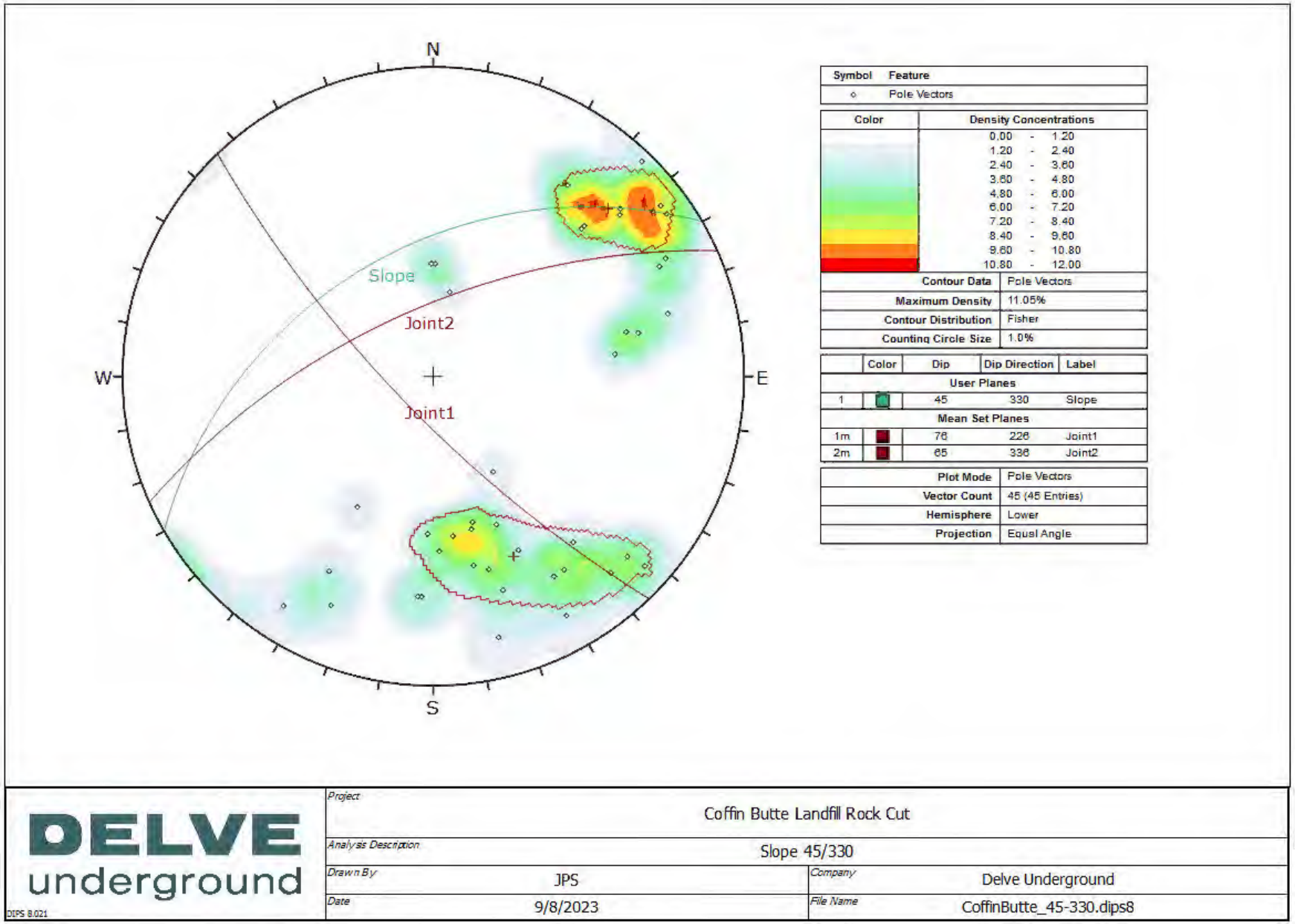
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/000 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-000-Wedge.dips8

Slope: 45/330 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	330	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

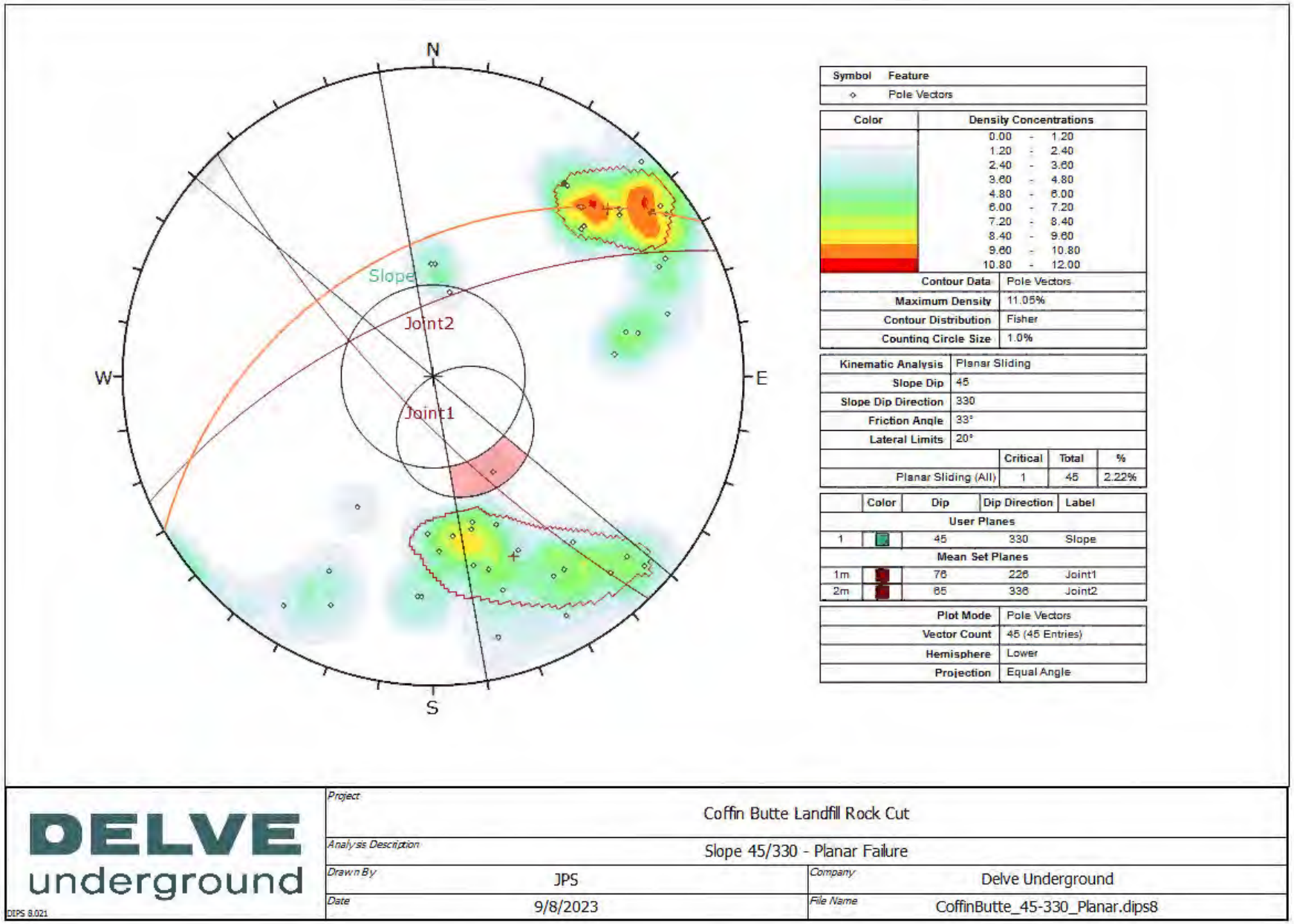
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 45/330		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_45-330.dips8

Slope: 45/330 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	330
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	45	2.22%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	330	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		85	336	Joint2

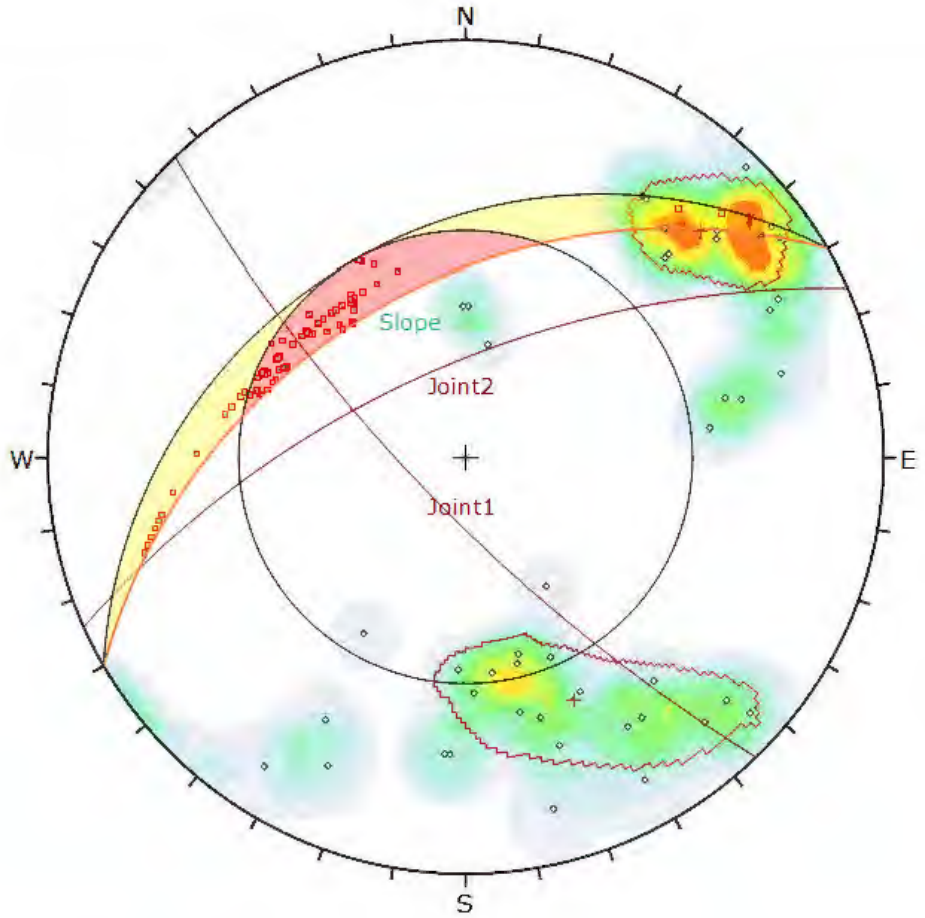
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 45/330 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_45-330_Planar.dips8

Slope: 45/330 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	330
Friction Angle	33°

	Critical	Total	%
Wedge Sliding	77	990	7.78%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	330	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		85	336	Joint2

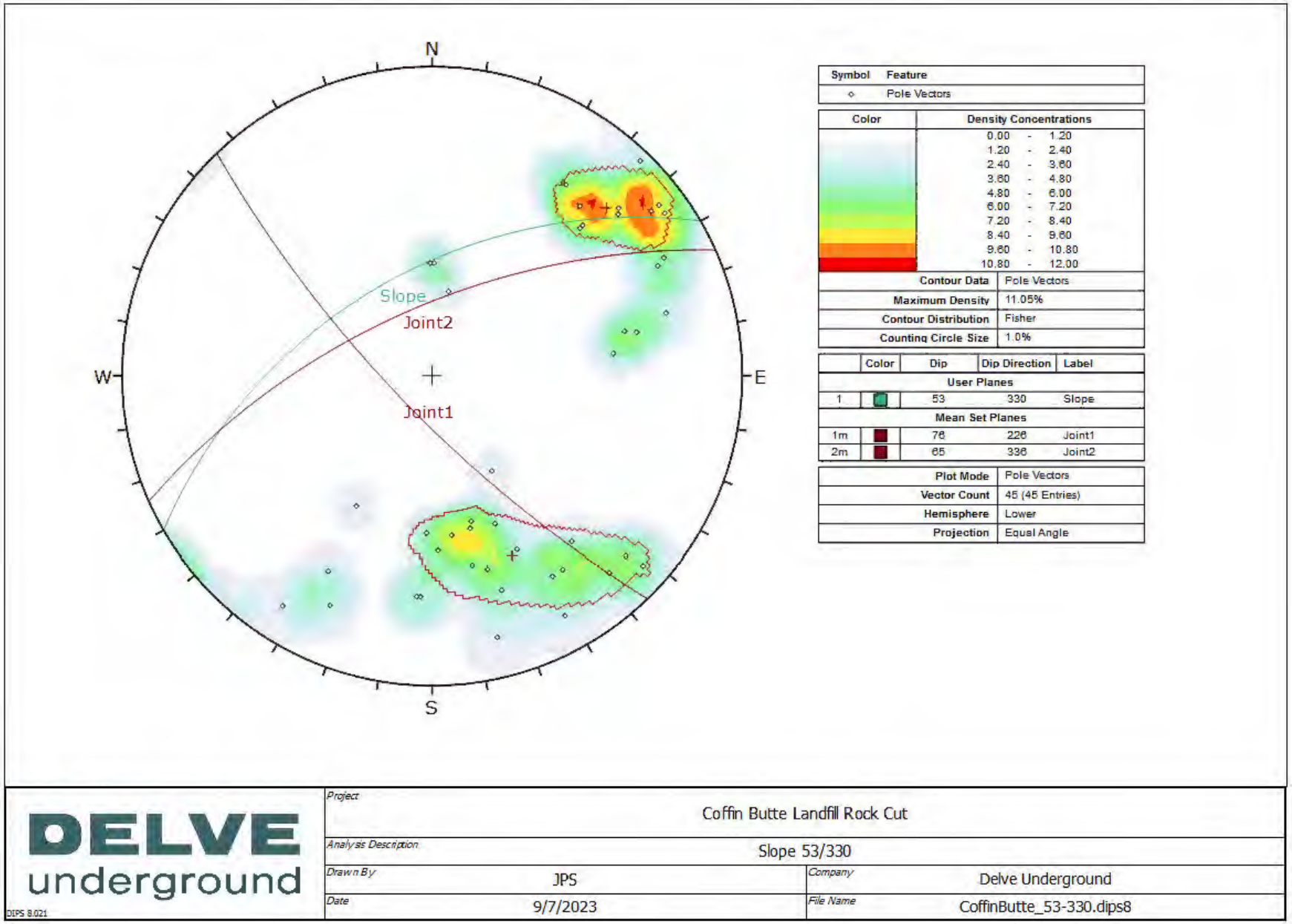
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 45/330 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_45-330_Wedge.dips8

Slope: 53/330 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	330	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

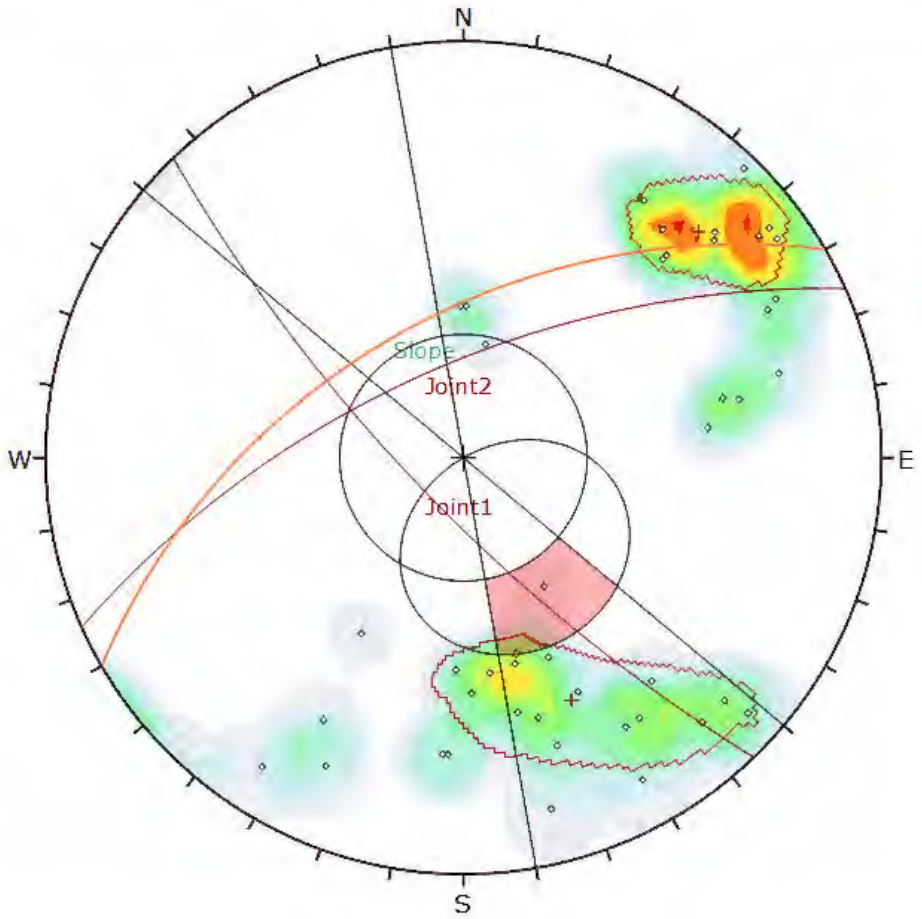
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/330		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-330.dips8

Slope: 53/330 – Planar Failure



Symbol	Feature
◦	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	53
Slope Dip Direction	330
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	2	45	4.44%
Planar Sliding (Set 2: Joint2)	1	16	6.25%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	330	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

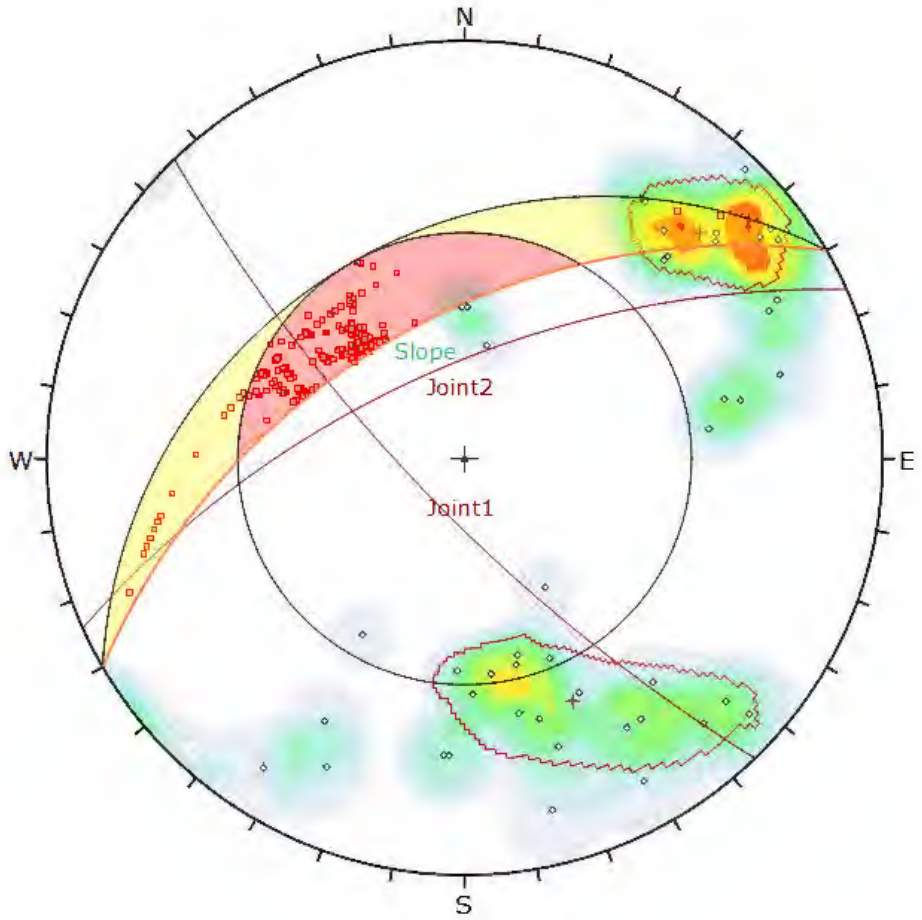
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/330 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-330_Planar.dips8

Slope: 53/330 – Wedge Failure



Symbol	Feature
	Pole Vectors
	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	53		
Slope Dip Direction	330		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	199	990	20.10%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	330	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

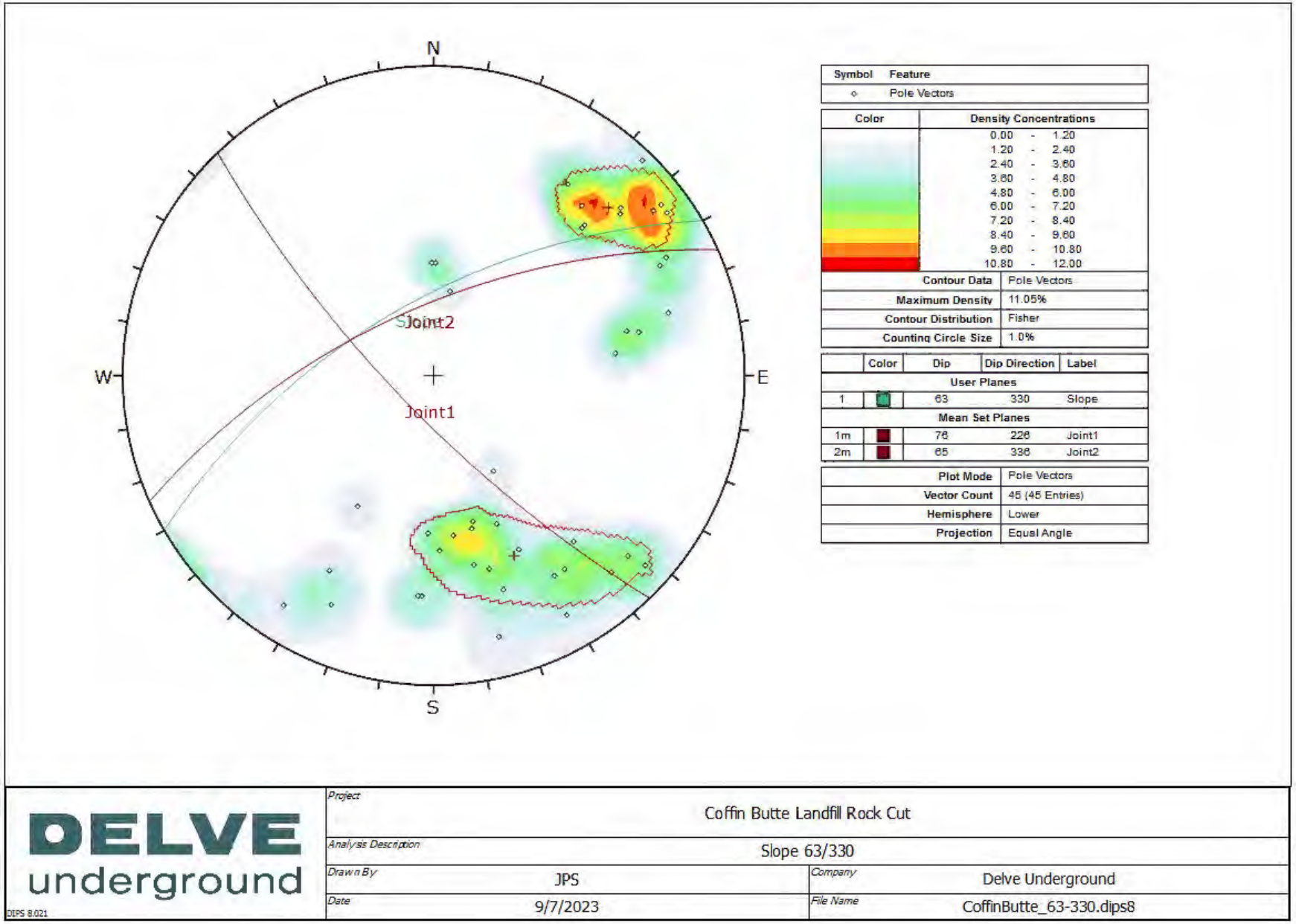
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/330 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-330_Wedge.dips8

Slope: 63/330 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	330	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

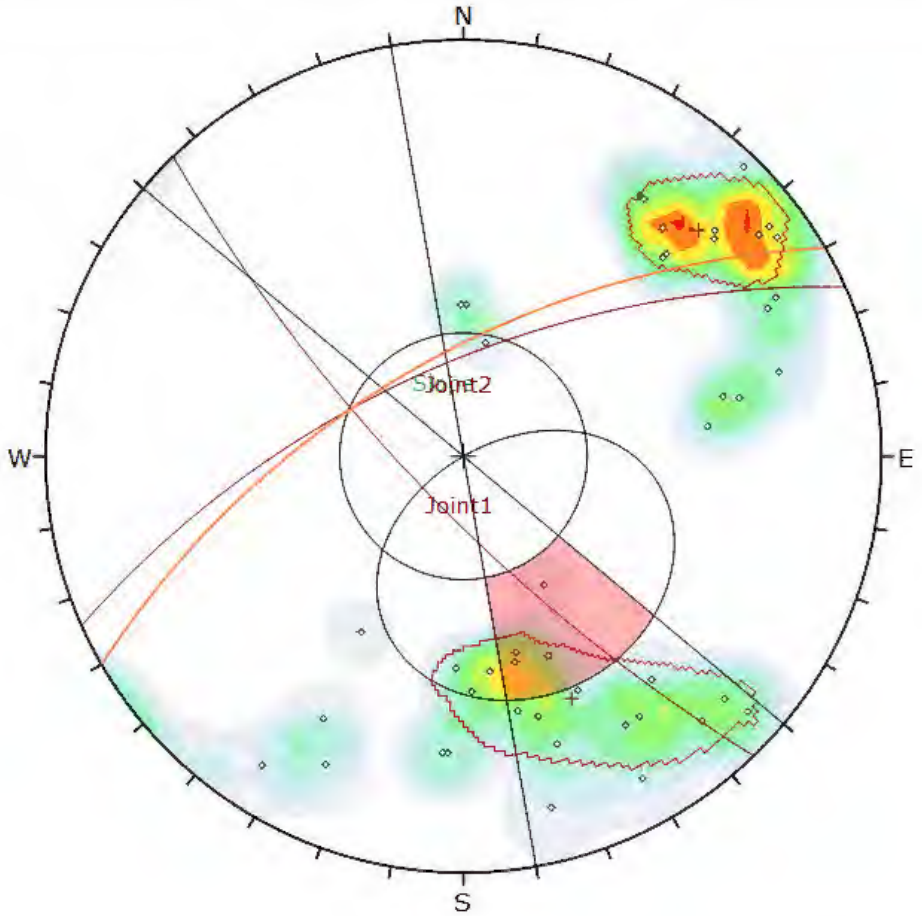
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/330		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-330.dips8

Slope: 63/330 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	63
Slope Dip Direction	330
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	4	45	8.89%
Planar Sliding (Set 2: Joint2)	3	16	18.75%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	330	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

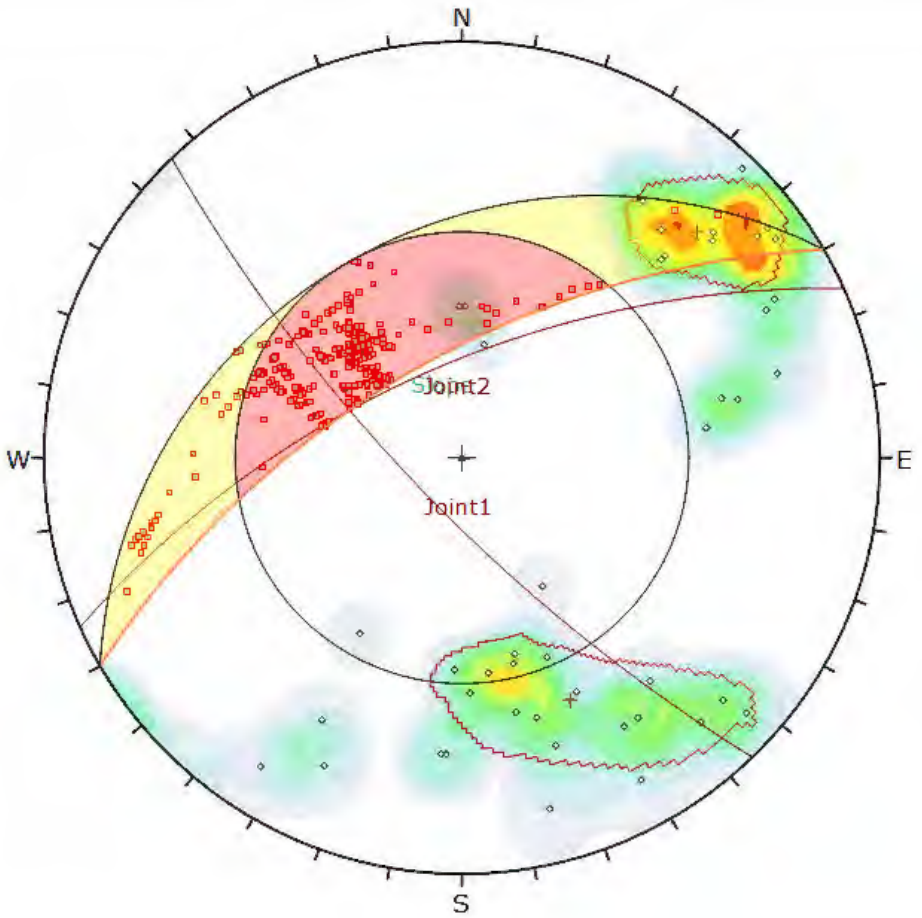
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/330 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-330_Planar.dips8

Slope: 63/330 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	63		
Slope Dip Direction	330		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	333	990	33.64%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	330	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	338	Joint2

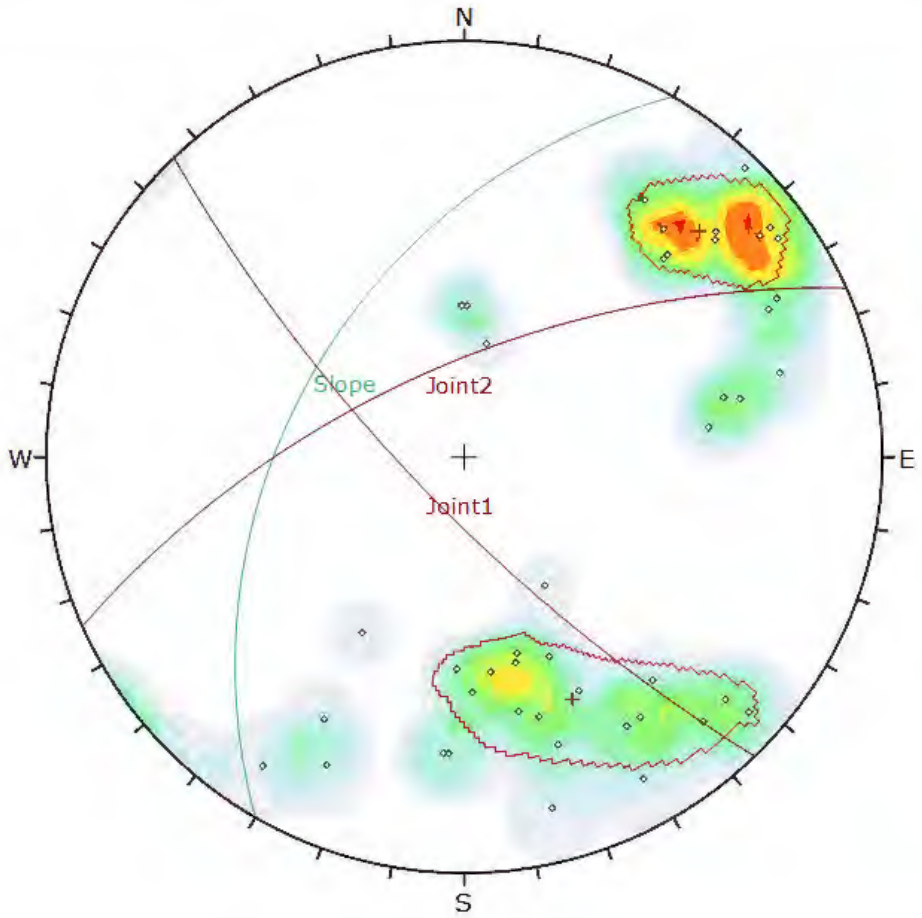
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/330 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-330_Wedge.dips8

Slope: 45/300 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	300	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

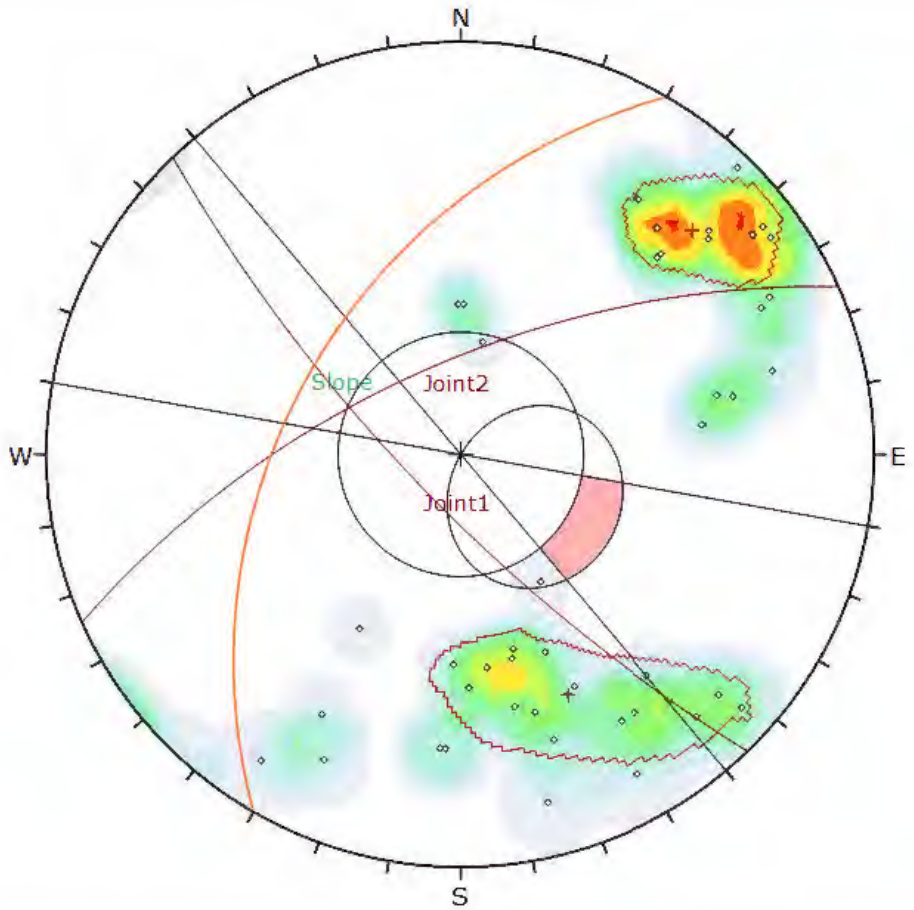
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 45/300		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_45-300.dips8

Slope: 45/300 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	300
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	300	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

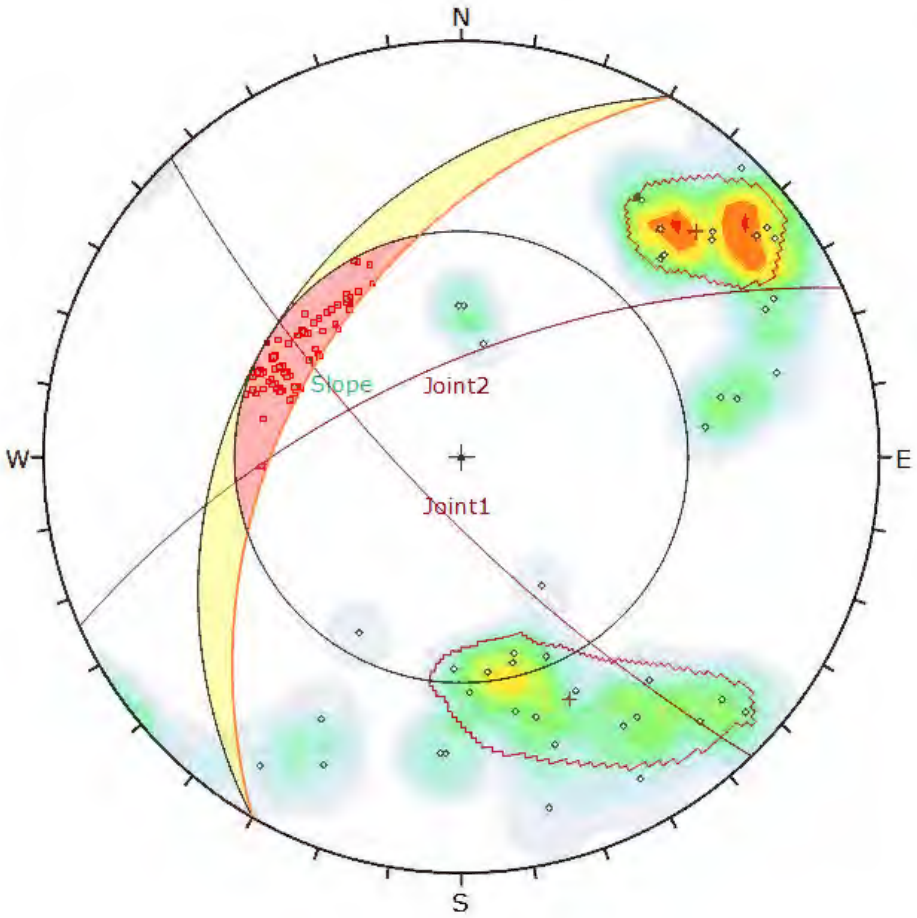
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 45/300 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_45-300_Planar.dips8

Slope: 45/300 – Wedge Failure



Symbol	Feature
○	Pole Vectors
□	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	300
Friction Angle	33°

	Critical	Total	%
Wedge Sliding	90	990	9.09%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	300	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

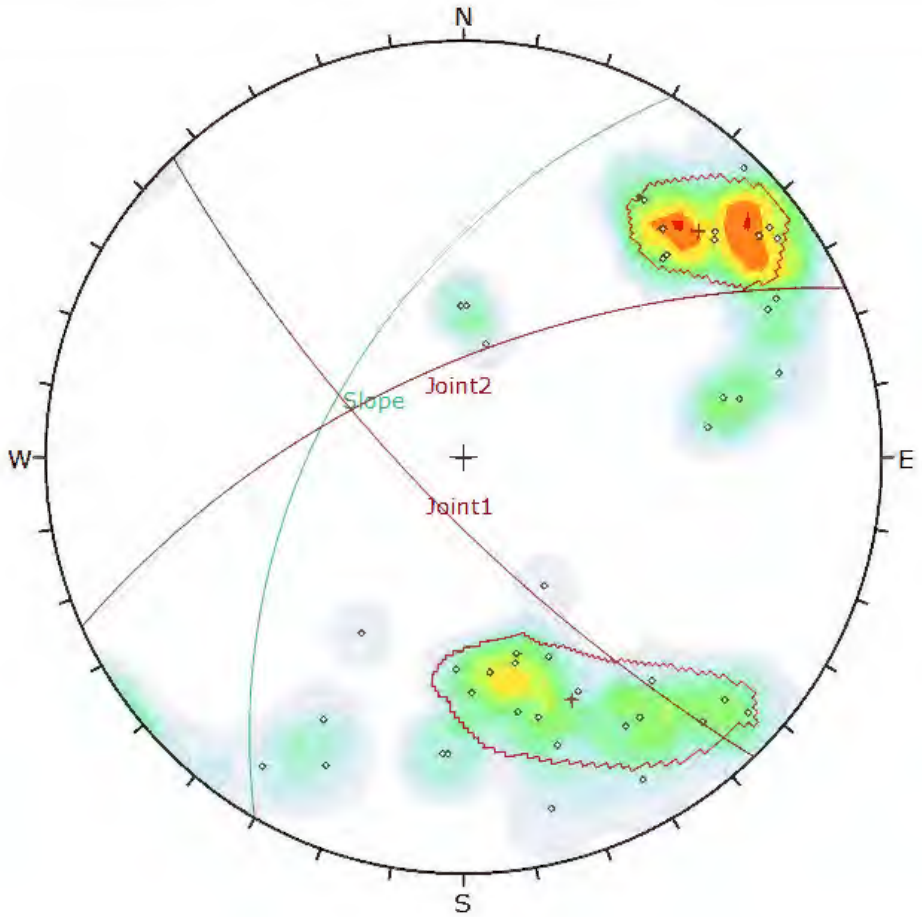
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 45/300 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_45-300_Wedge.dips8

Slope: 53/300 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	300	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

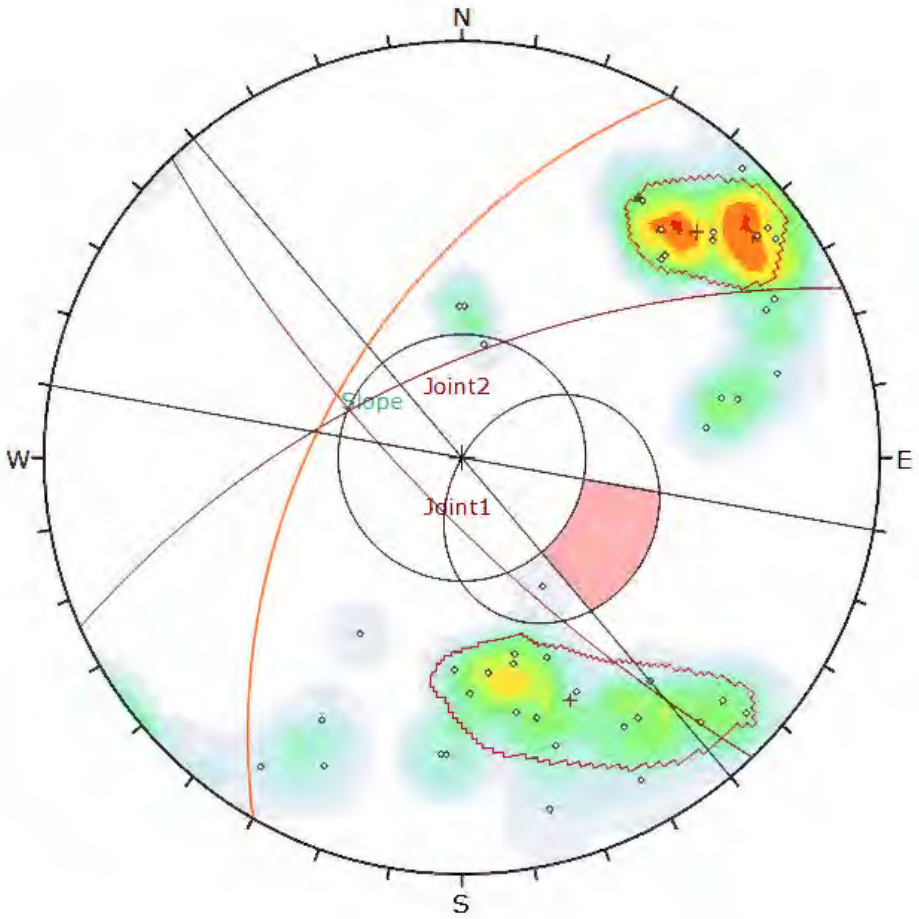
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/300		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-300.dips8

Slope: 53/300 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	53
Slope Dip Direction	300
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	300	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		85	336	Joint2

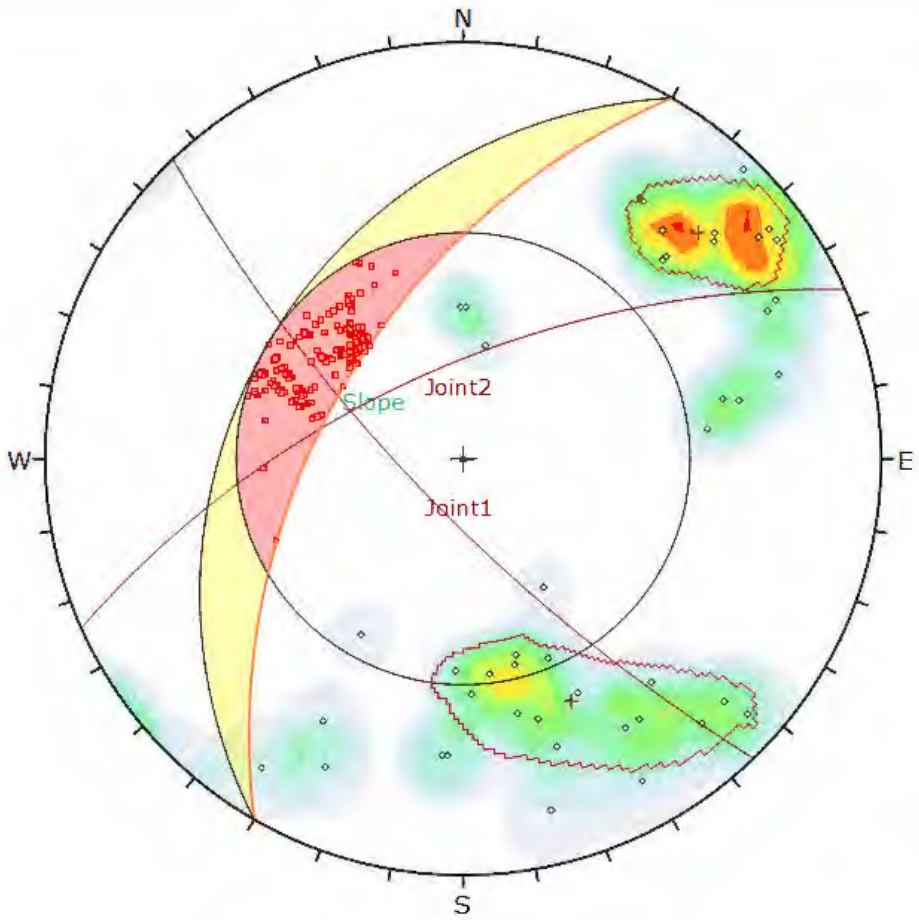
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/300 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-300_Planar.dips8

Slope: 53/300 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	53		
Slope Dip Direction	300		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	197	990	19.90%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	300	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

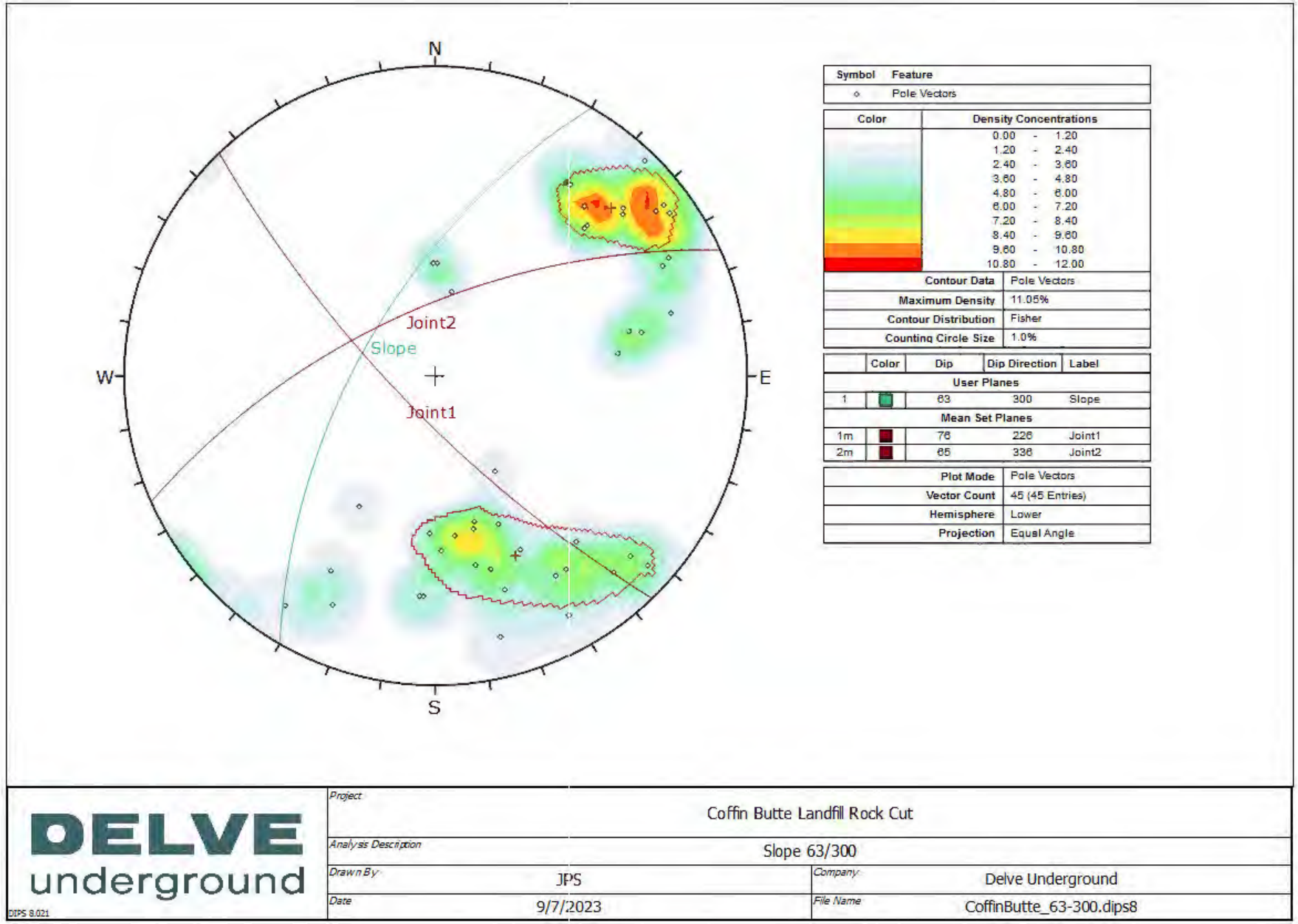
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/300 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_53-300_Wedge.dips8

Slope: 63/300 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	300	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

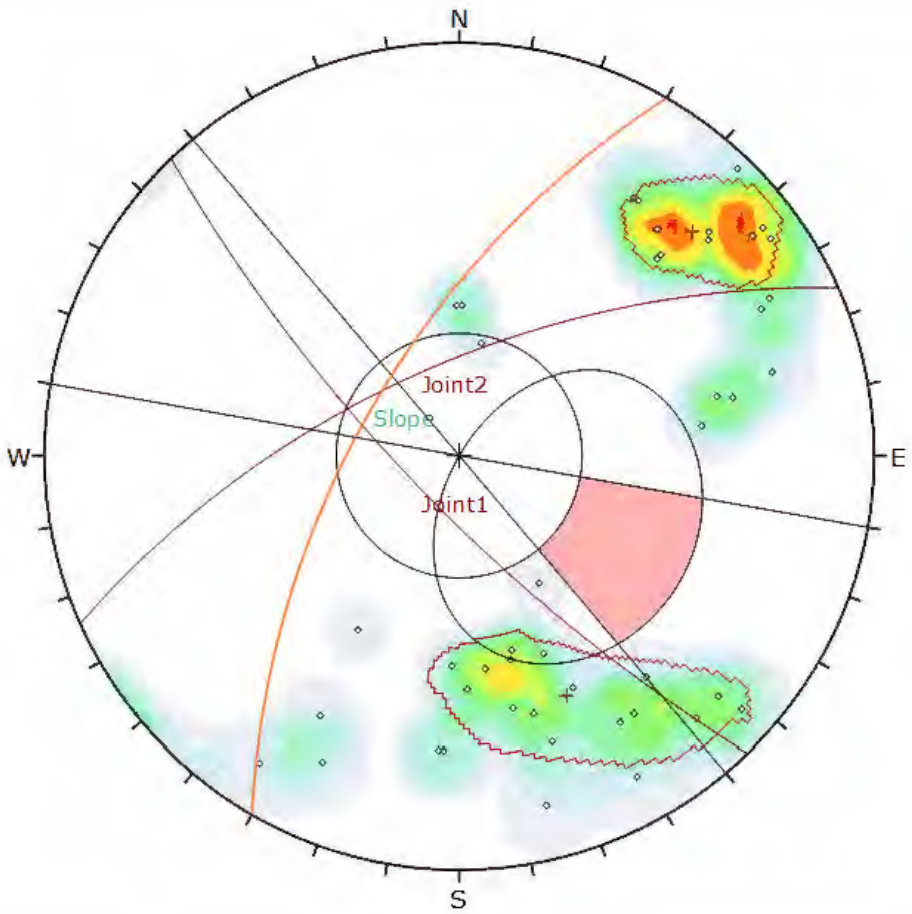
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/300		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-300.dips8

Slope: 63/300 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	63
Slope Dip Direction	300
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	300	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

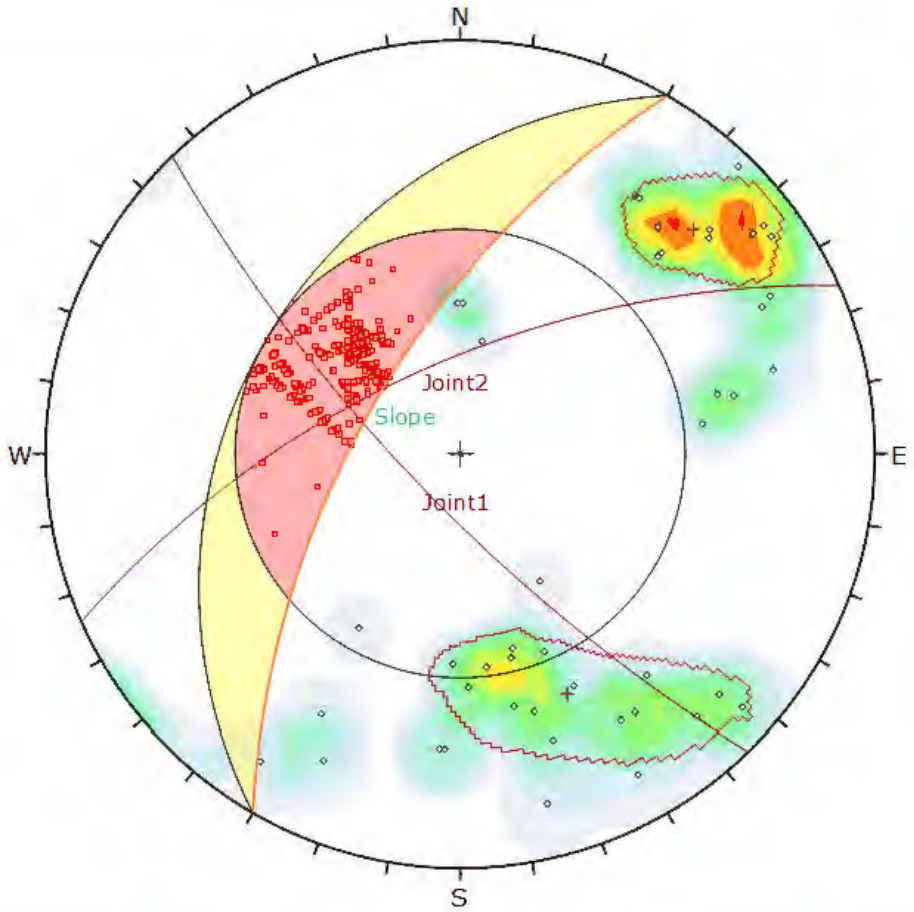
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/300 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-300_Planar.dips8

Slope: 63/300 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	63
Slope Dip Direction	300
Friction Angle	33°

	Critical	Total	%
Wedge Sliding	317	990	32.02%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	300	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

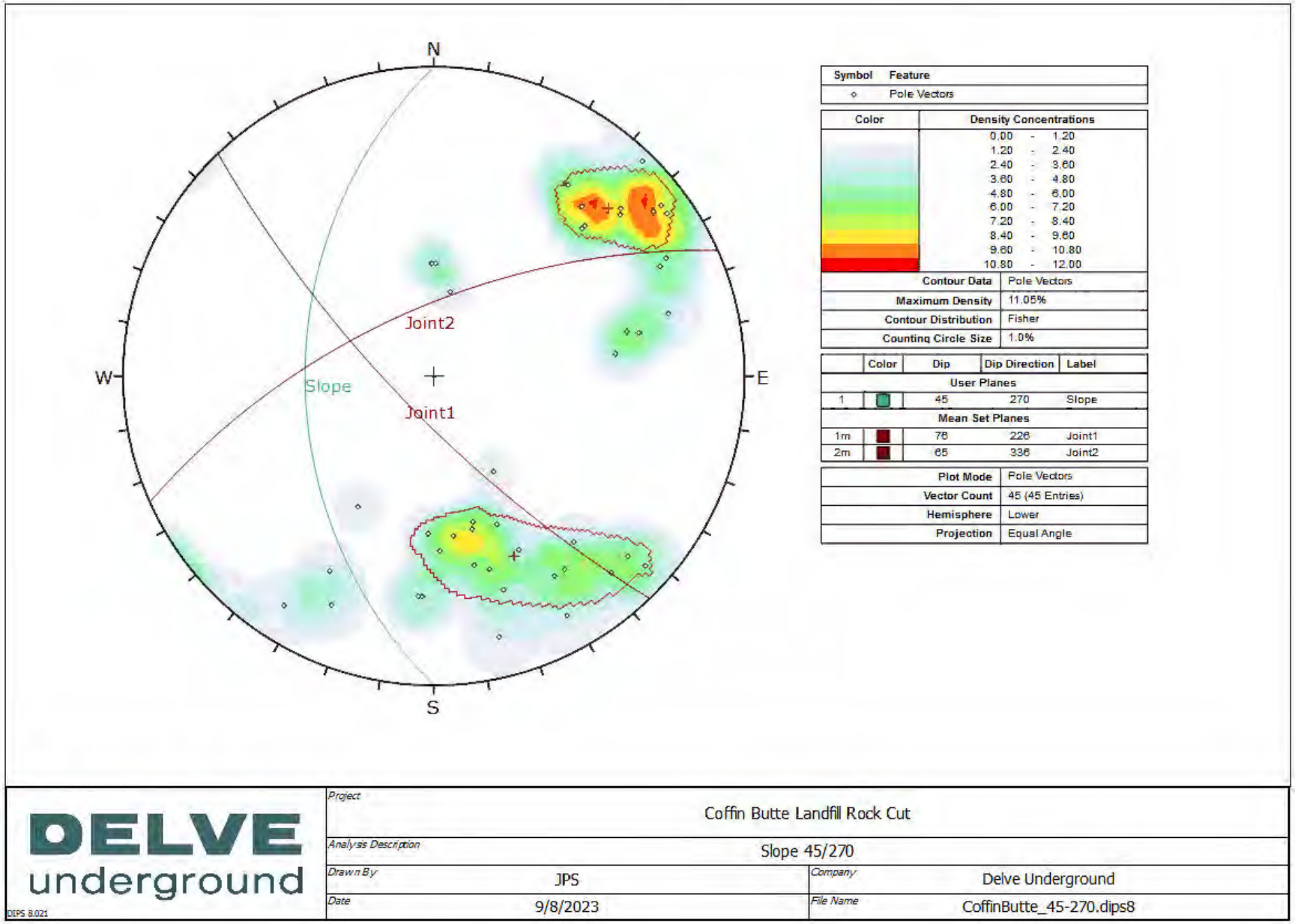
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/300 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/7/2023	File Name	CoffinButte_63-300_Wedge.dips8

Slope: 45/270 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	270	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

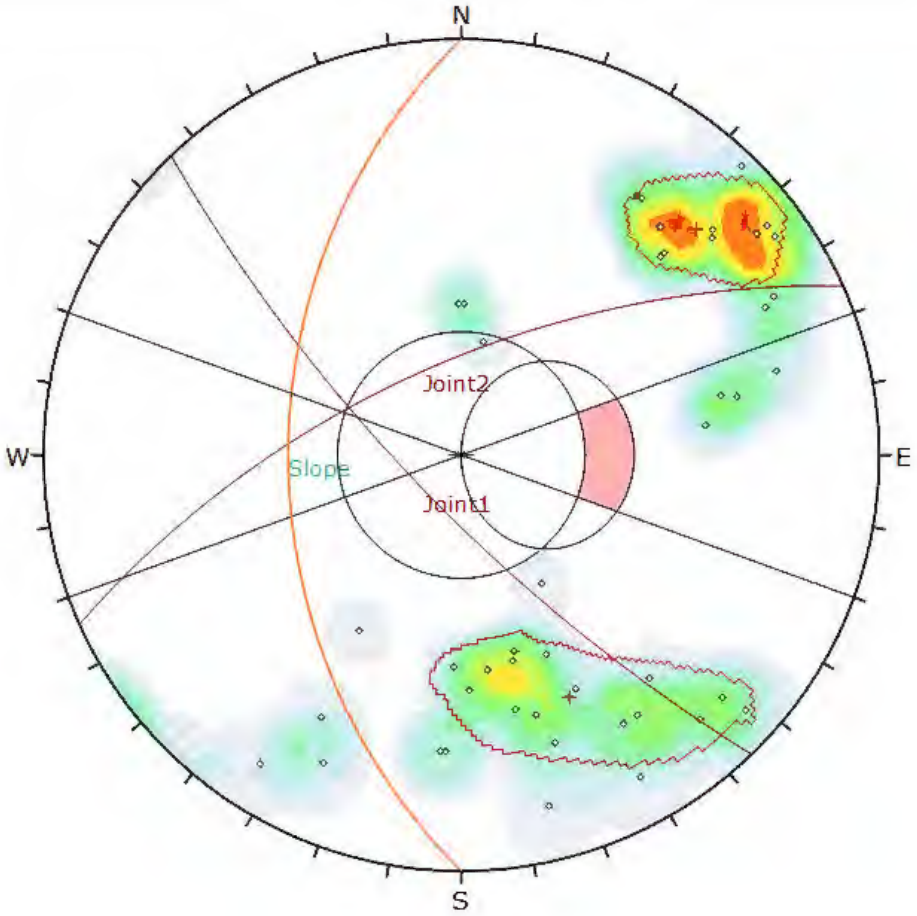
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 45/270		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_45-270.dips8

Slope: 45/270 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	270
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	270	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

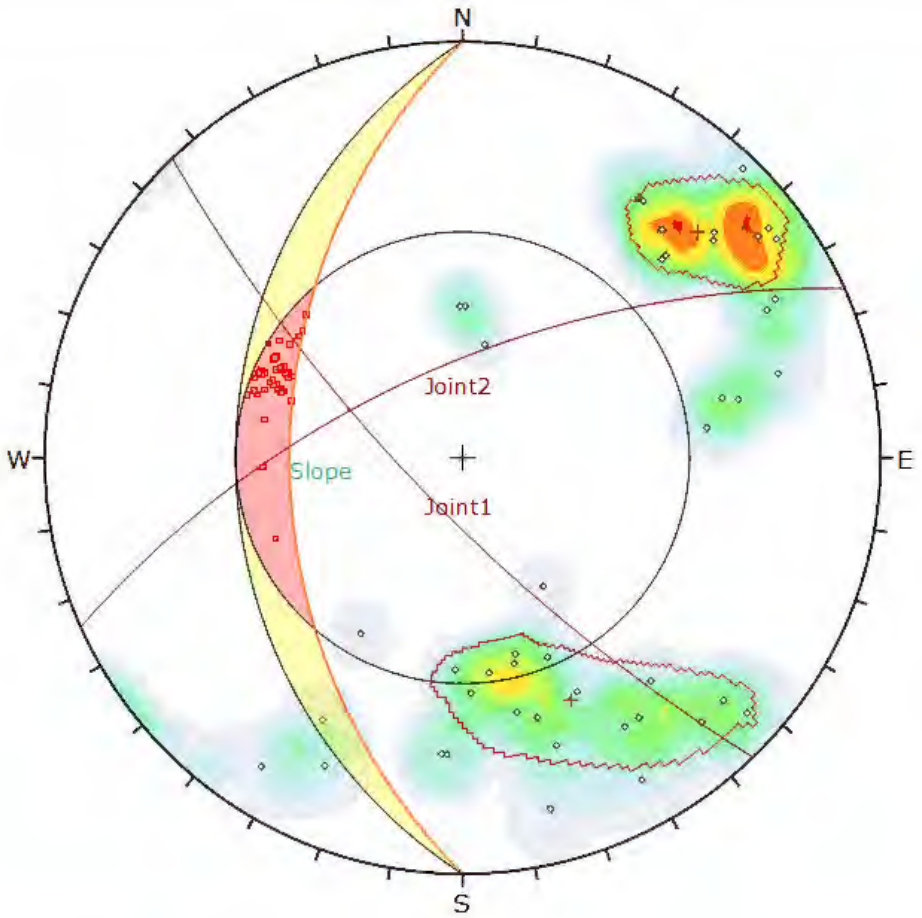
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 45/270 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_45-270_Planar.dips8

Slope: 45/270 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	45		
Slope Dip Direction	270		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	47	990	4.75%

	Color	Dip	Dip Direction	Label
User Planes				
1		45	270	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		85	336	Joint2

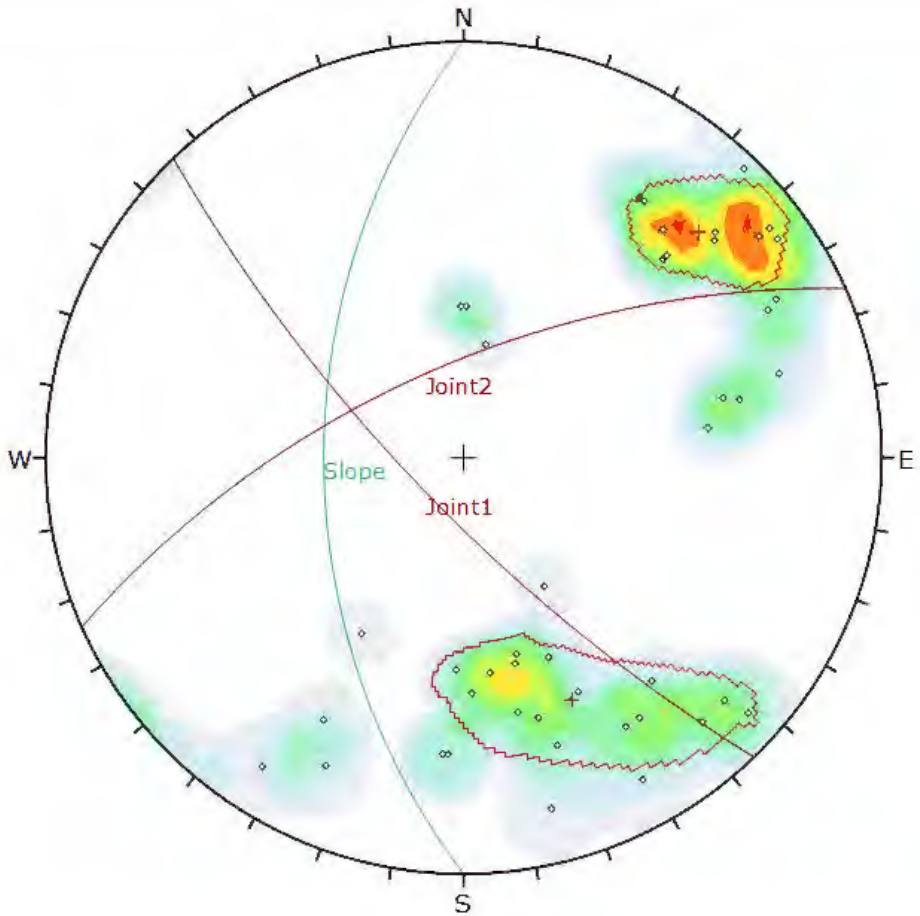
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 45/270 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_45-270_Wedge.dips8

Slope: 53/270 – Stereonet



Symbol	Feature
○	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	270	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

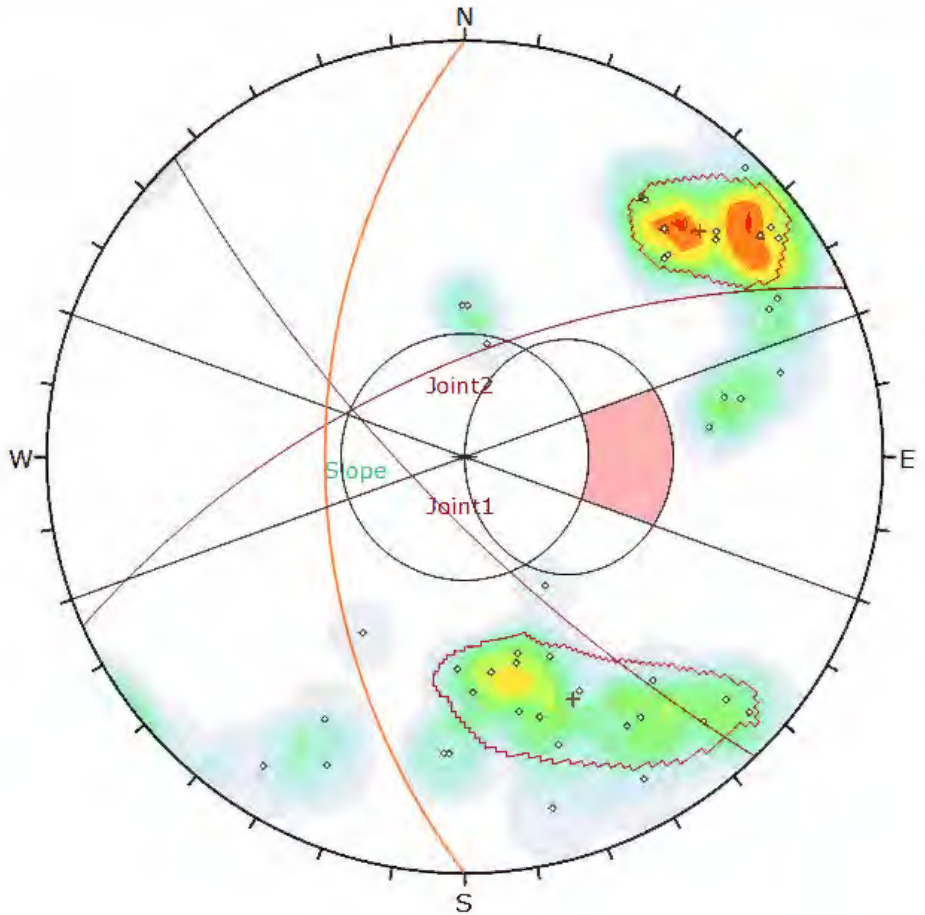
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/270		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_53-270.dips8

Slope: 53/270 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	53
Slope Dip Direction	270
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	270	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

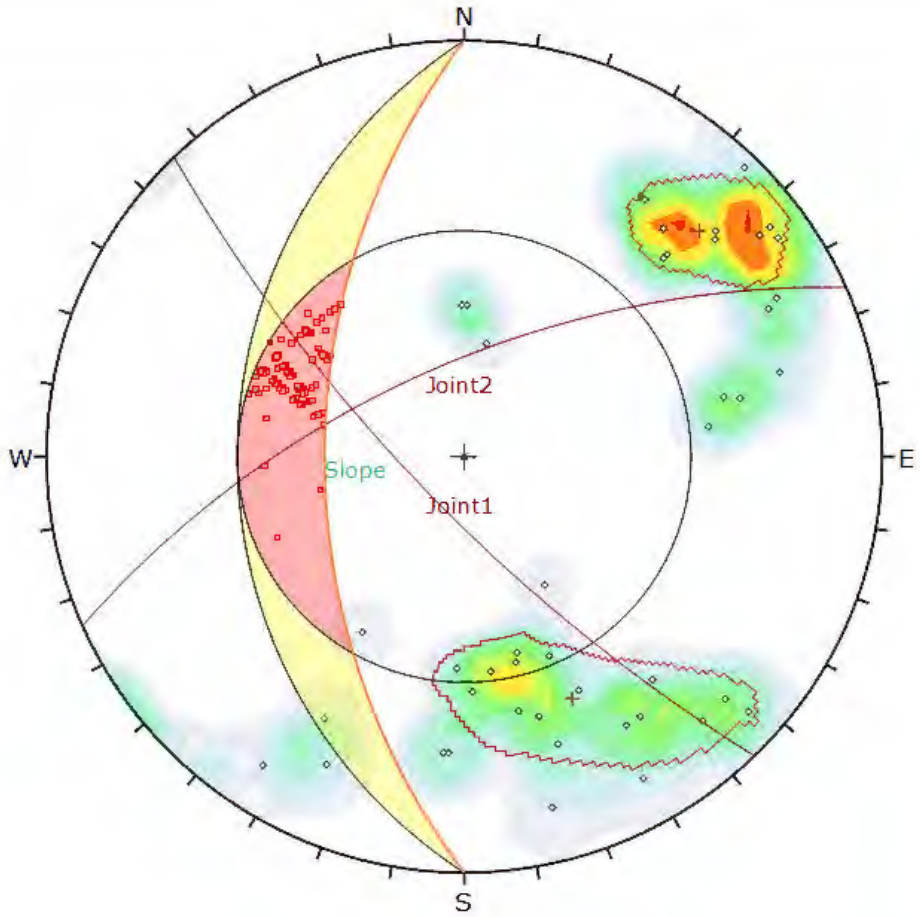
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/270 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_53-270_Planar.dips8

Slope: 53/270 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	53		
Slope Dip Direction	270		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	100	990	10.10%

	Color	Dip	Dip Direction	Label
User Planes				
1		53	270	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

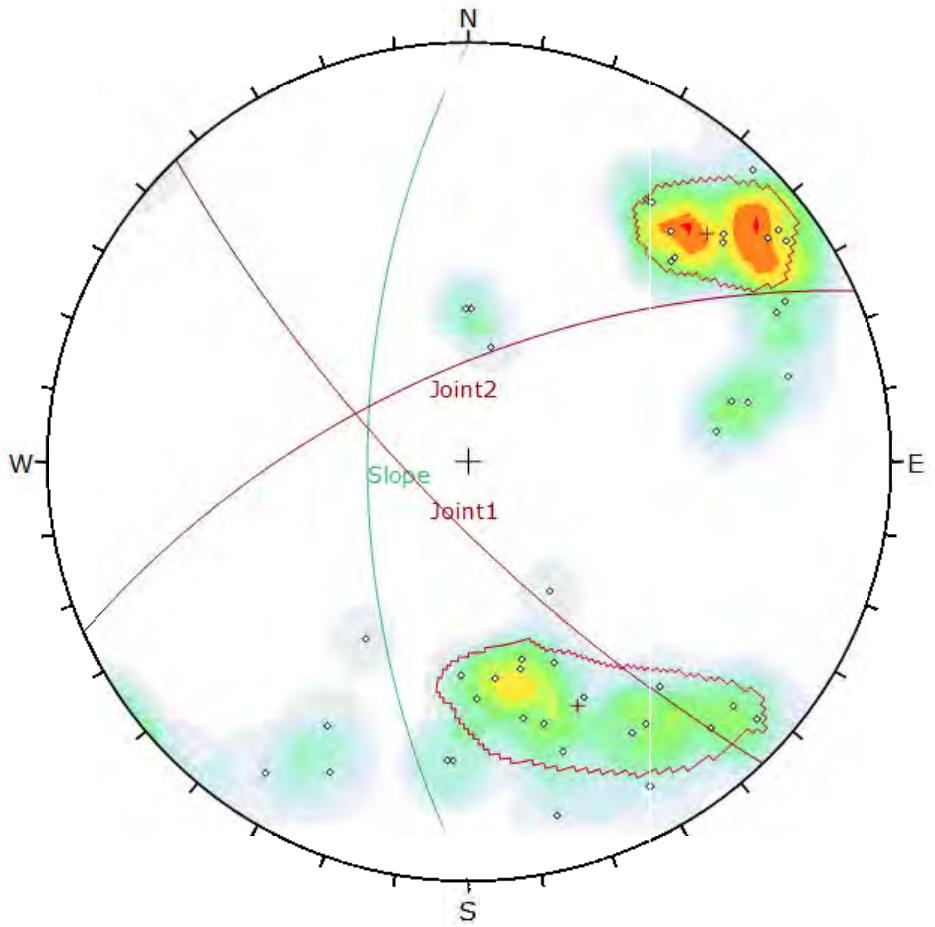
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 53/270 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_53-270_Wedge.dips8

Slope: 63/270 – Stereonet



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	270	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

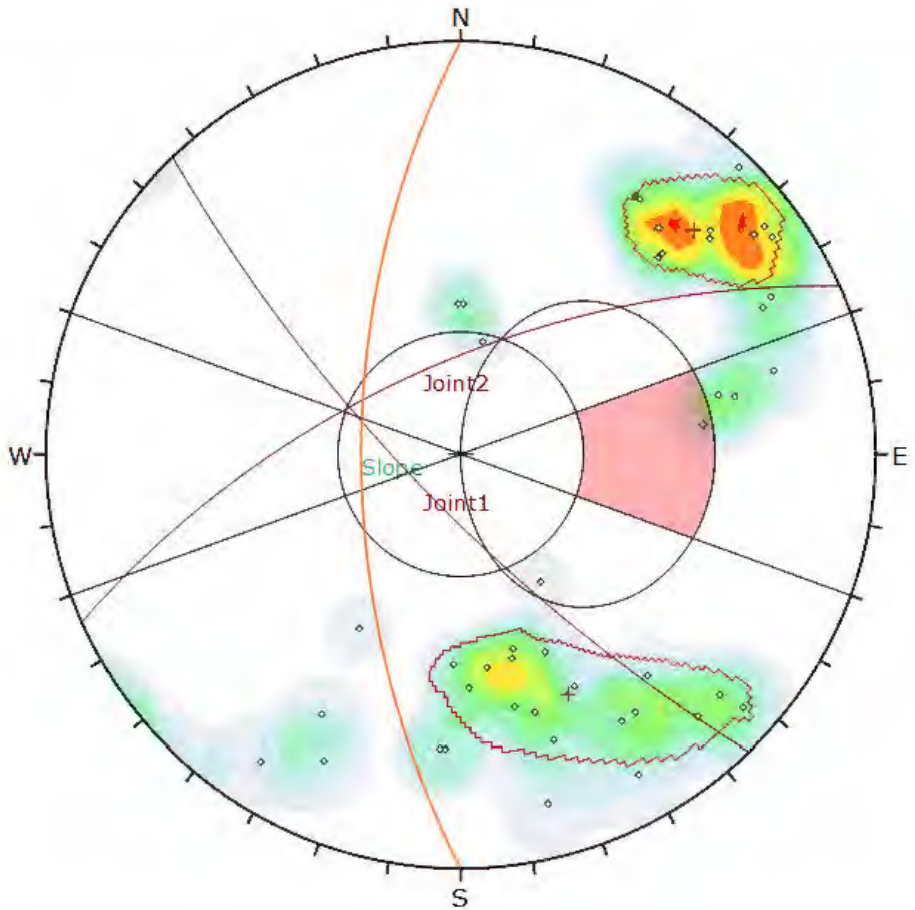
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/270		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_63-270.dips8

Slope: 63/270 – Planar Failure



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding		
Slope Dip	63		
Slope Dip Direction	270		
Friction Angle	33°		
Lateral Limits	20°		
	Critical	Total	%
Planar Sliding (All)	1	45	2.22%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	270	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

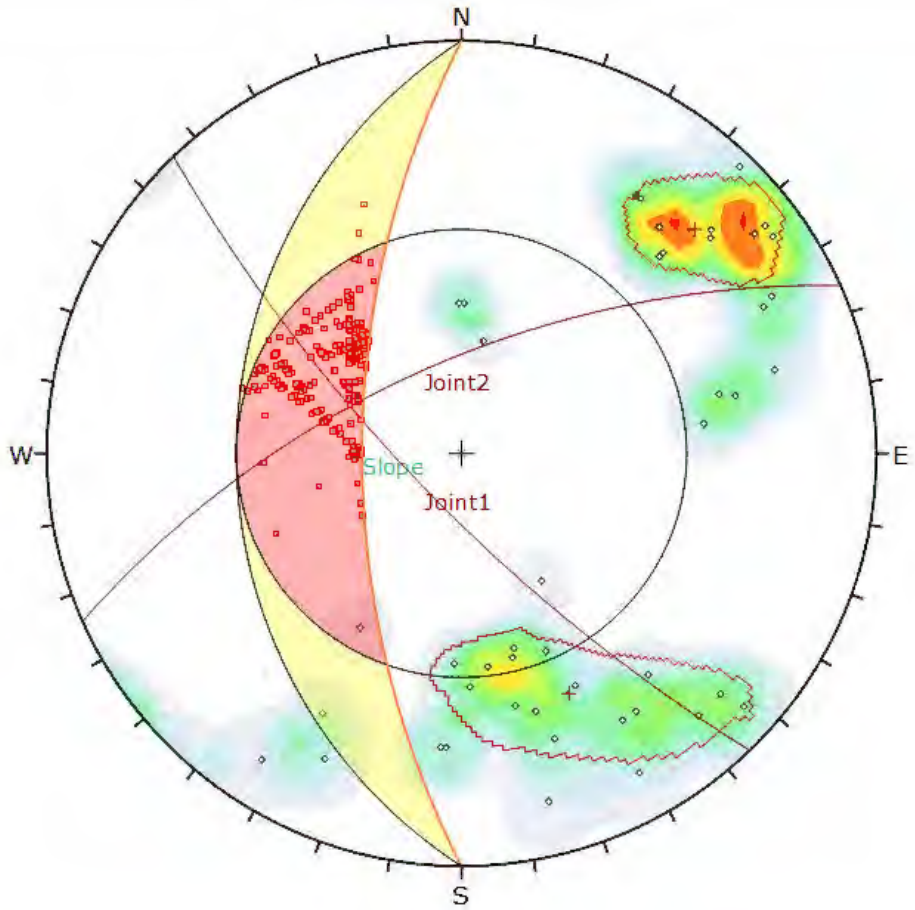
Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Angle

DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/270 - Planar Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_63-270_Planar.dips8

Slope: 63/270 – Wedge Failure



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding		
Slope Dip	63		
Slope Dip Direction	270		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	284	990	28.69%

	Color	Dip	Dip Direction	Label
User Planes				
1		63	270	Slope
Mean Set Planes				
1m		76	226	Joint1
2m		65	336	Joint2

Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	990
Hemisphere	Lower
Projection	Equal Angle

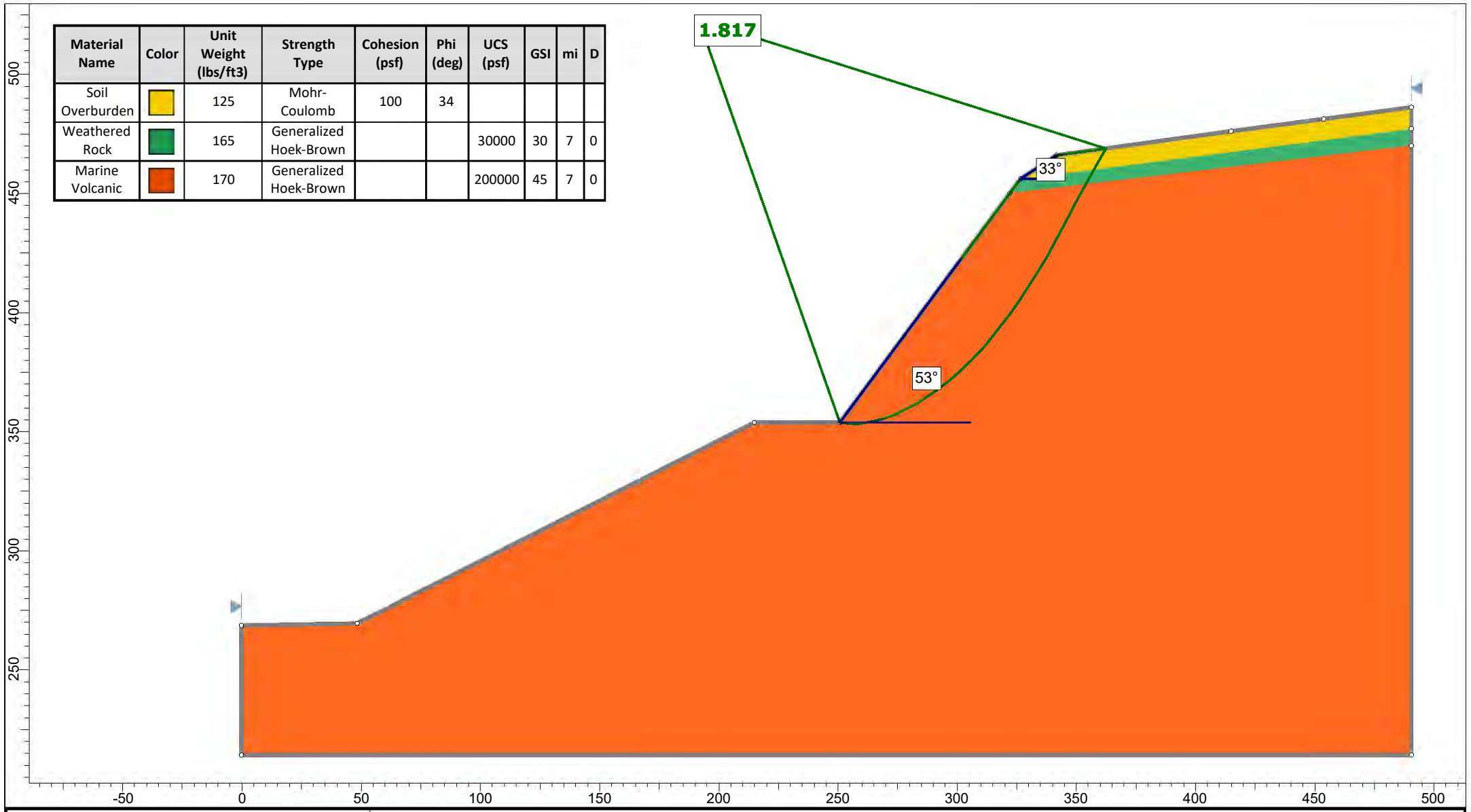
DELVE underground

DIPS 8.021

Project	Coffin Butte Landfill Rock Cut		
Analysis Description	Slope 63/270 - Wedge Failure		
Drawn By	JPS	Company	Delve Underground
Date	9/8/2023	File Name	CoffinButte_63-270_Wedge.dips8

Appendix D: Limit Equilibrium Stability Results

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
Soil Overburden		125	Mohr-Coulomb	100	34				
Weathered Rock		165	Generalized Hoek-Brown			30000	30	7	0
Marine Volcanic		170	Generalized Hoek-Brown			200000	45	7	0

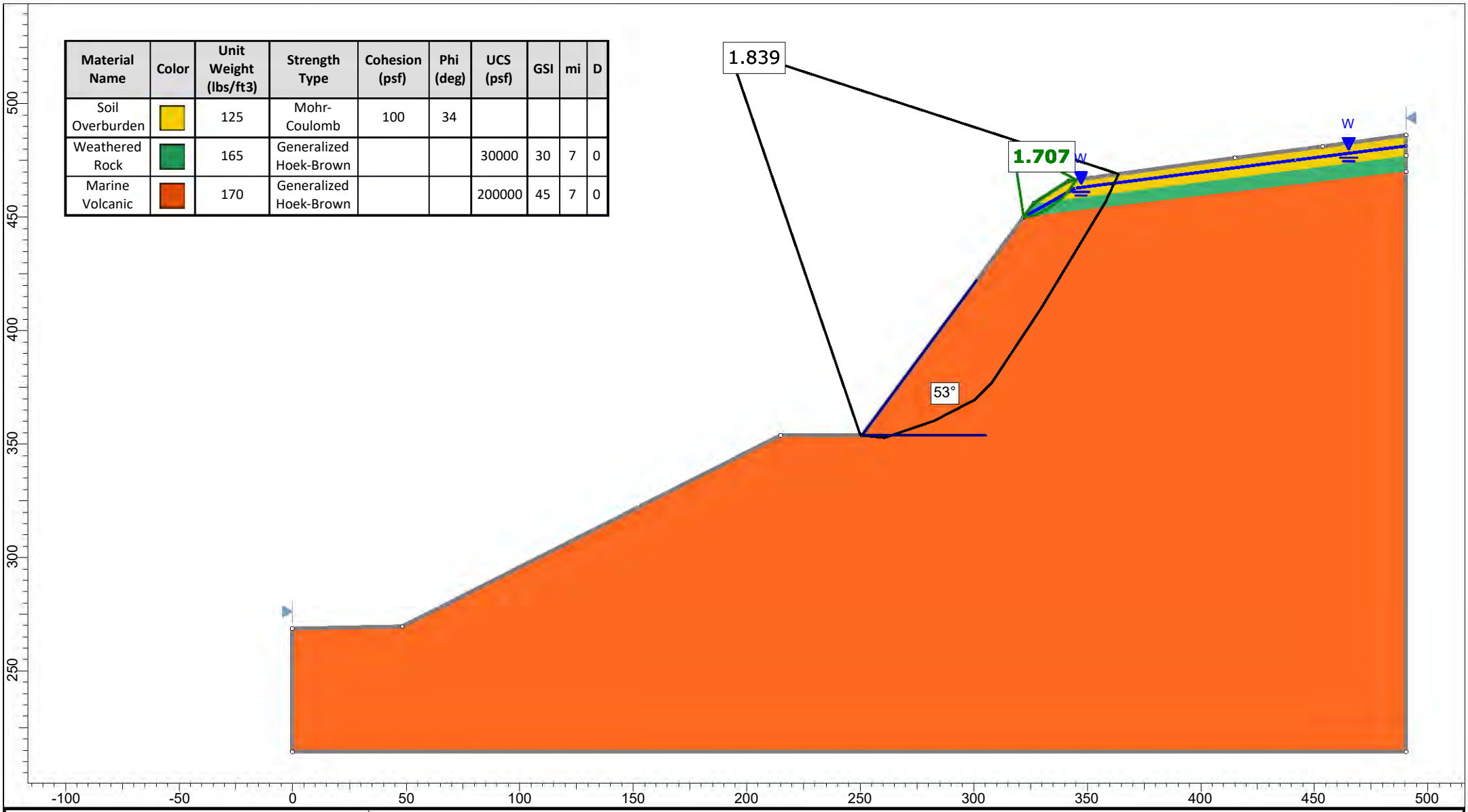


DELVE underground

SLIDEINTERPRET 9.027

Project	Coffin Butte Landfill		
Group	Section B - Dry - 0.75:1, 1.5:1	*Scenario*	Cuckoo
Drawn By	Guzek	*Company*	Delve Underground
Date	9/27/2023, 8:59:34 AM	*File Name*	09-2023_Section-B.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
Soil Overburden		125	Mohr-Coulomb	100	34				
Weathered Rock		165	Generalized Hoek-Brown			30000	30	7	0
Marine Volcanic		170	Generalized Hoek-Brown			200000	45	7	0

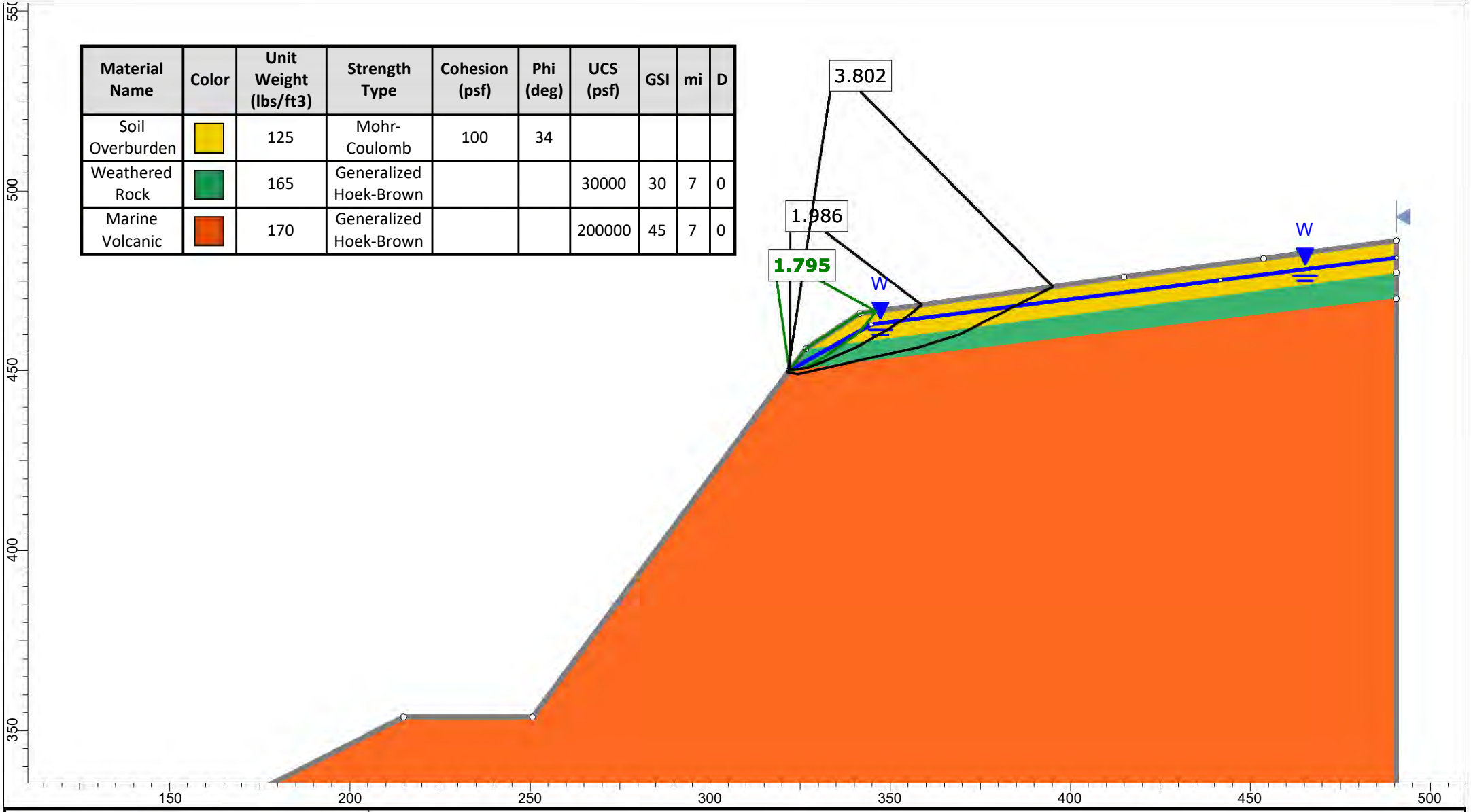


DELVE underground

SLIDEINTERPRET 9.027

Project	Coffin Butte Landfill		
Group	Section B - Wet - 0.75:1, 1.5:1	*Scenario*	Cuckoo
Drawn By	Guzek	*Company*	Delve Underground
Date	9/27/2023, 8:59:34 AM	*File Name*	09-2023_Section-B.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
Soil Overburden		125	Mohr-Coulomb	100	34				
Weathered Rock		165	Generalized Hoek-Brown			30000	30	7	0
Marine Volcanic		170	Generalized Hoek-Brown			200000	45	7	0

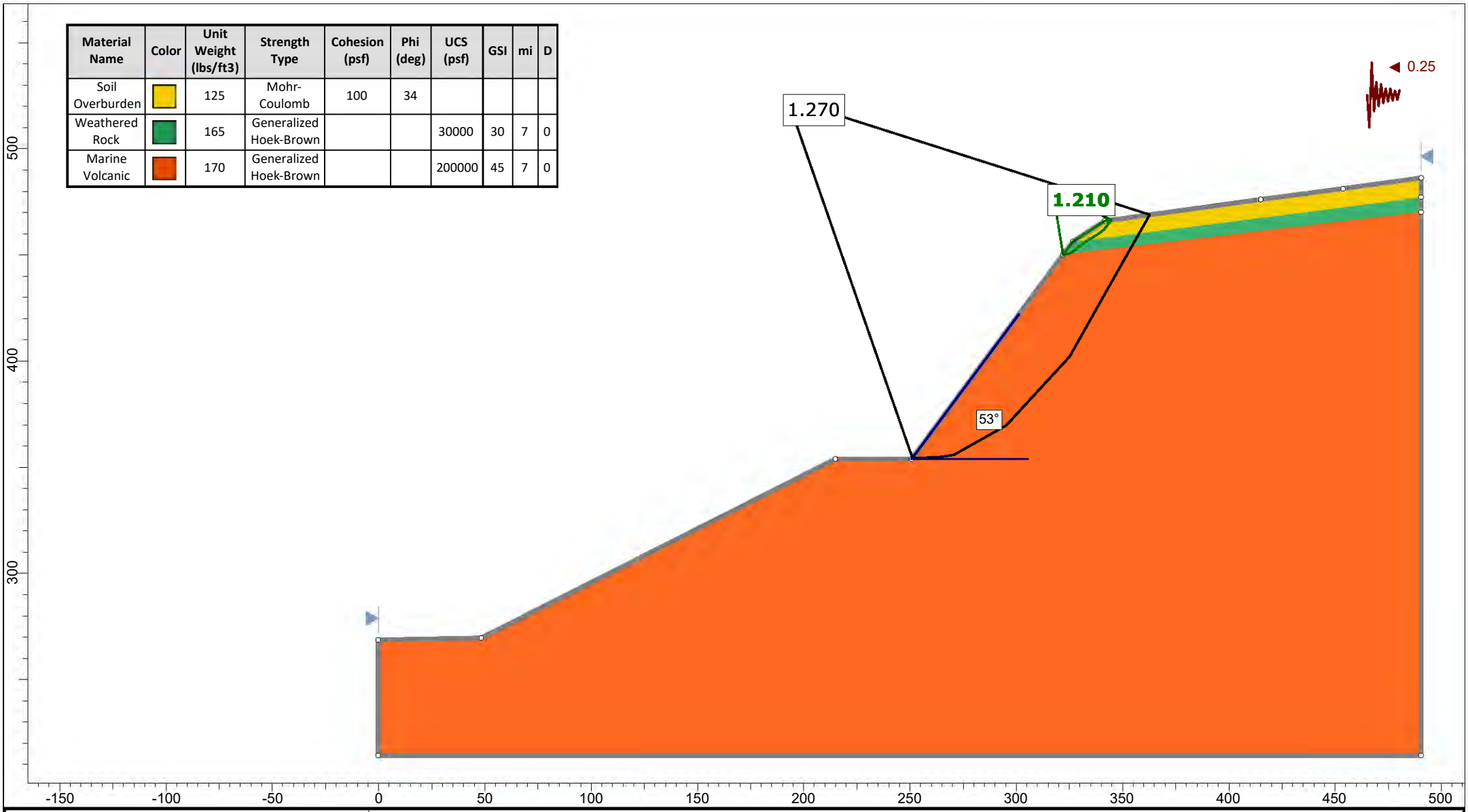


DELVE underground

SLIDEINTERPRET 9.027

Project	Coffin Butte Landfill		
Group	Section B - Fully Saturated - 0.75:1, 1.5:1	*Scenario*	Cuckoo
Drawn By	Guzek	*Company*	Delve Underground
Date	9/27/2023, 8:59:34 AM	*File Name*	09-2023_Section-B.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
Soil Overburden		125	Mohr-Coulomb	100	34				
Weathered Rock		165	Generalized Hoek-Brown			30000	30	7	0
Marine Volcanic		170	Generalized Hoek-Brown			200000	45	7	0

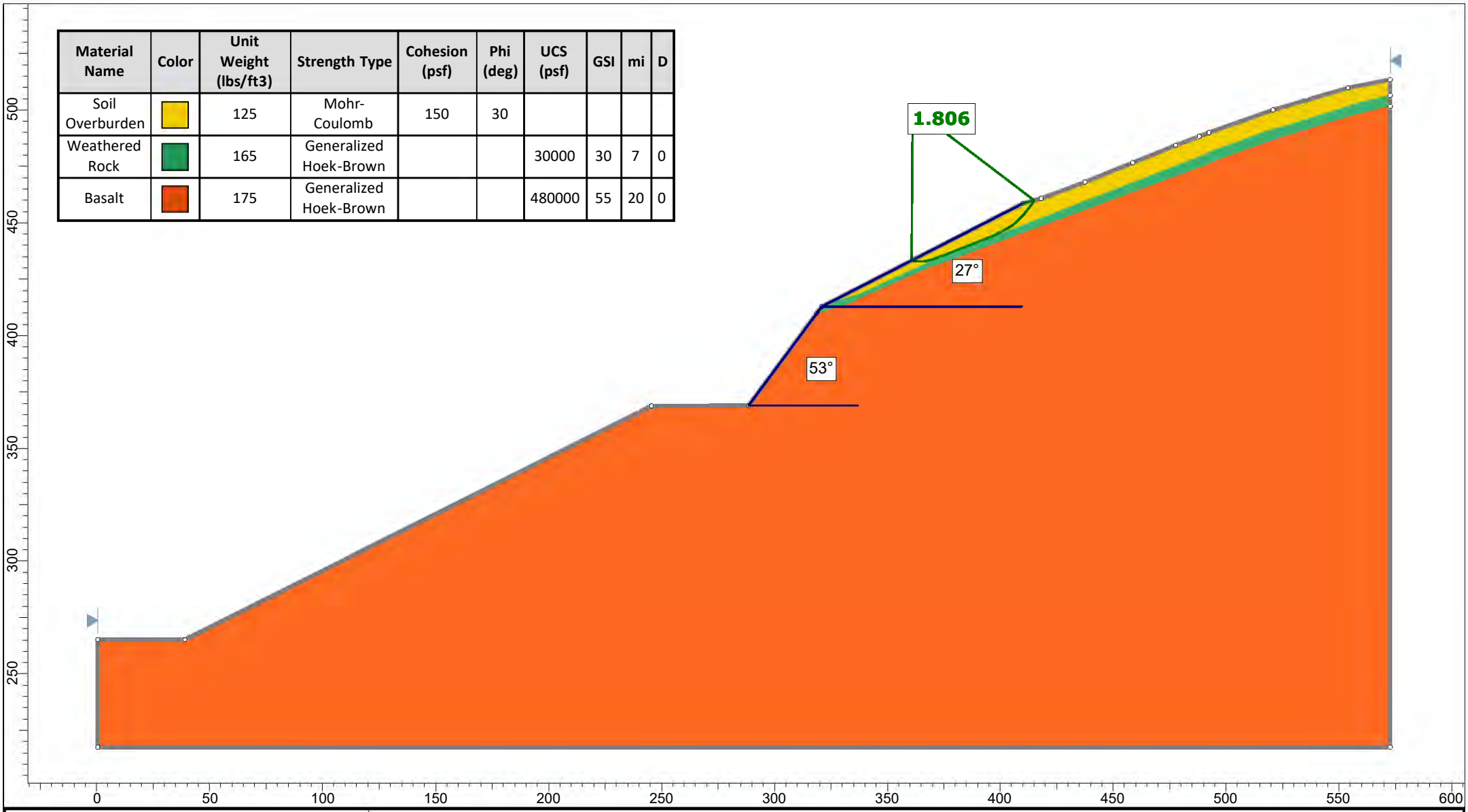


DELVE underground

SLIDEINTERPRET 9.027

Project	Coffin Butte Landfill		
Group	Section B - Seismic - 0.75:1, 1.5:1	*Scenario*	Cuckoo
Drawn By	Guzek	*Company*	Delve Underground
Date	9/27/2023, 8:59:34 AM	*File Name*	09-2023_Section-B.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
Soil Overburden		125	Mohr-Coulomb	150	30				
Weathered Rock		165	Generalized Hoek-Brown			30000	30	7	0
Basalt		175	Generalized Hoek-Brown			480000	55	20	0

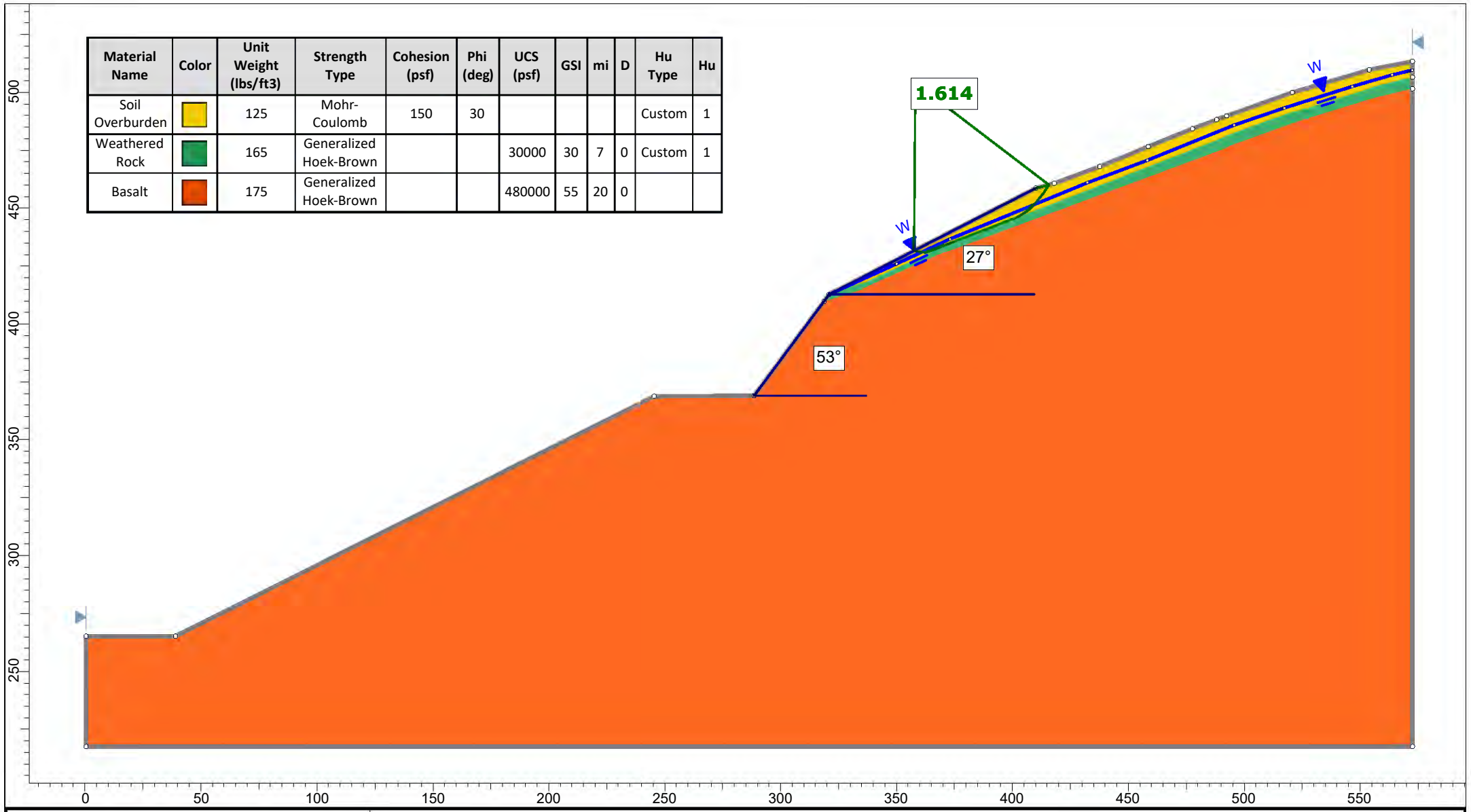


DELVE underground

SLIDEINTERPRET 9.027

Project	Coffin Butte Landfill		
Group	Section D - Dry - 0.75:1, 2:1	*Scenario*	Cuckoo
Drawn By	Guzek	*Company*	Delve Underground
Date	9/27/2023, 8:59:34 AM	*File Name*	09-2023_Section-D.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D	Hu Type	Hu
Soil Overburden		125	Mohr-Coulomb	150	30					Custom	1
Weathered Rock		165	Generalized Hoek-Brown			30000	30	7	0	Custom	1
Basalt		175	Generalized Hoek-Brown			480000	55	20	0		

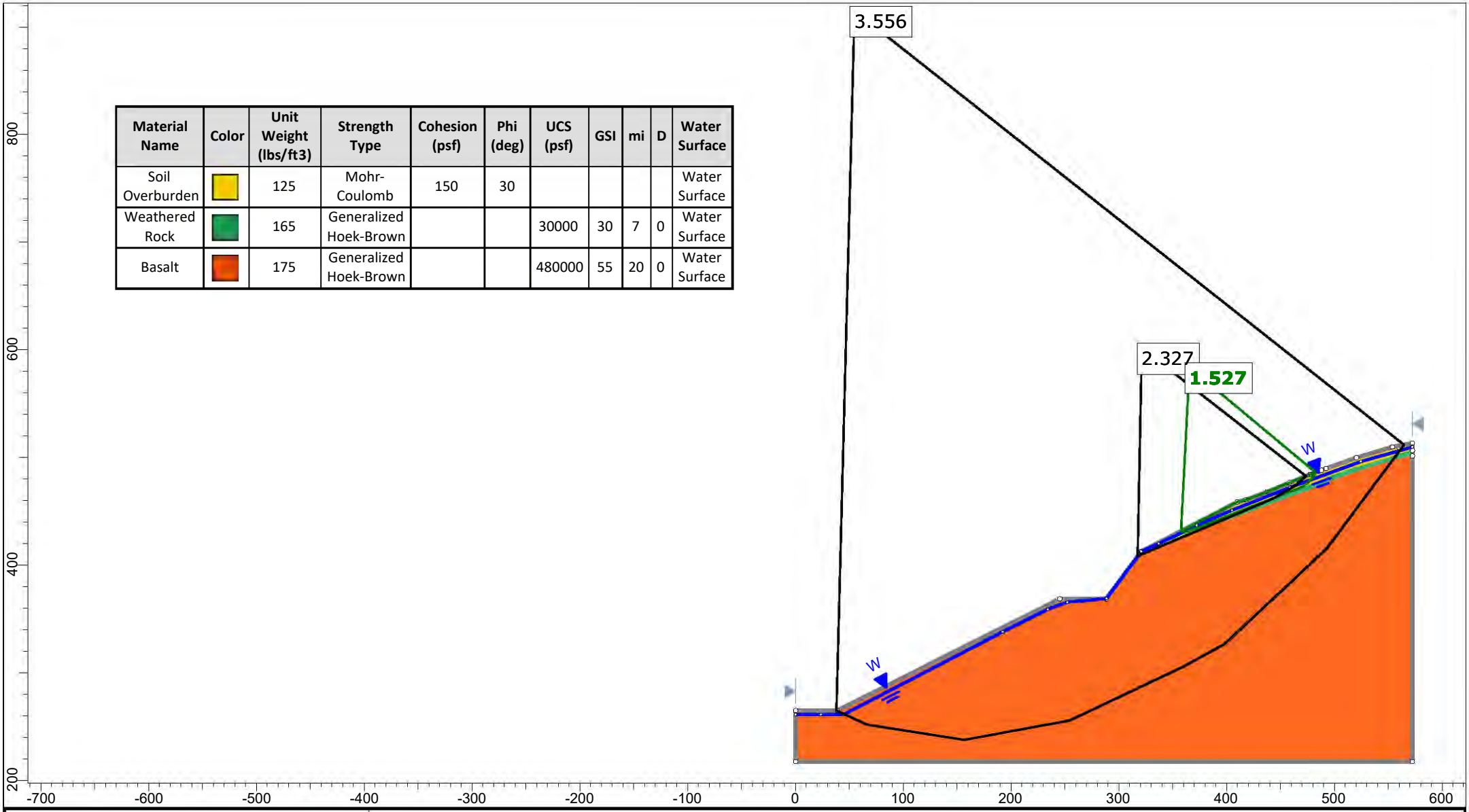


DELVE underground

SLIDEINTERPRET 9.027

Project	Coffin Butte Landfill		
Group	Section D - Wet - 0.75:1, 2:1	Scenario	Cuckoo
Drawn By	Guzek	Company	Delve Underground
Date	9/27/2023, 8:59:34 AM	File Name	09-2023_Section-D.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D	Water Surface
Soil Overburden		125	Mohr-Coulomb	150	30					Water Surface
Weathered Rock		165	Generalized Hoek-Brown			30000	30	7	0	Water Surface
Basalt		175	Generalized Hoek-Brown			480000	55	20	0	Water Surface

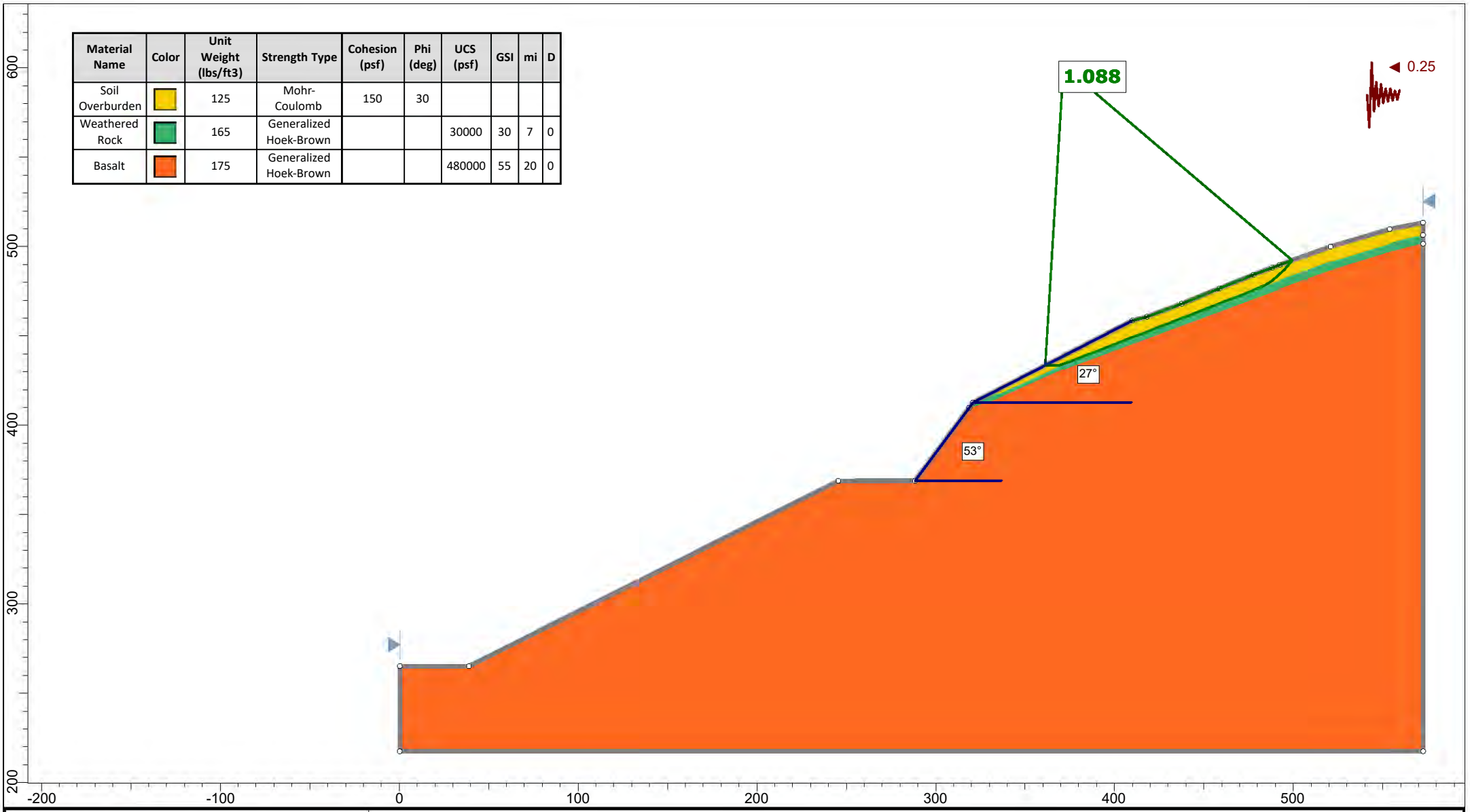


DELVE underground

SLIDEINTERPRET 9.027

Project	Coffin Butte Landfill		
Group	Section D - Fully Saturated - 0.75:1, 2:1	Scenario	Cuckoo
Drawn By	Guzek	Company	Delve Underground
Date	9/27/2023, 8:59:34 AM	File Name	09-2023_Section-D.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	UCS (psf)	GSI	mi	D
Soil Overburden		125	Mohr-Coulomb	150	30				
Weathered Rock		165	Generalized Hoek-Brown			30000	30	7	0
Basalt		175	Generalized Hoek-Brown			480000	55	20	0



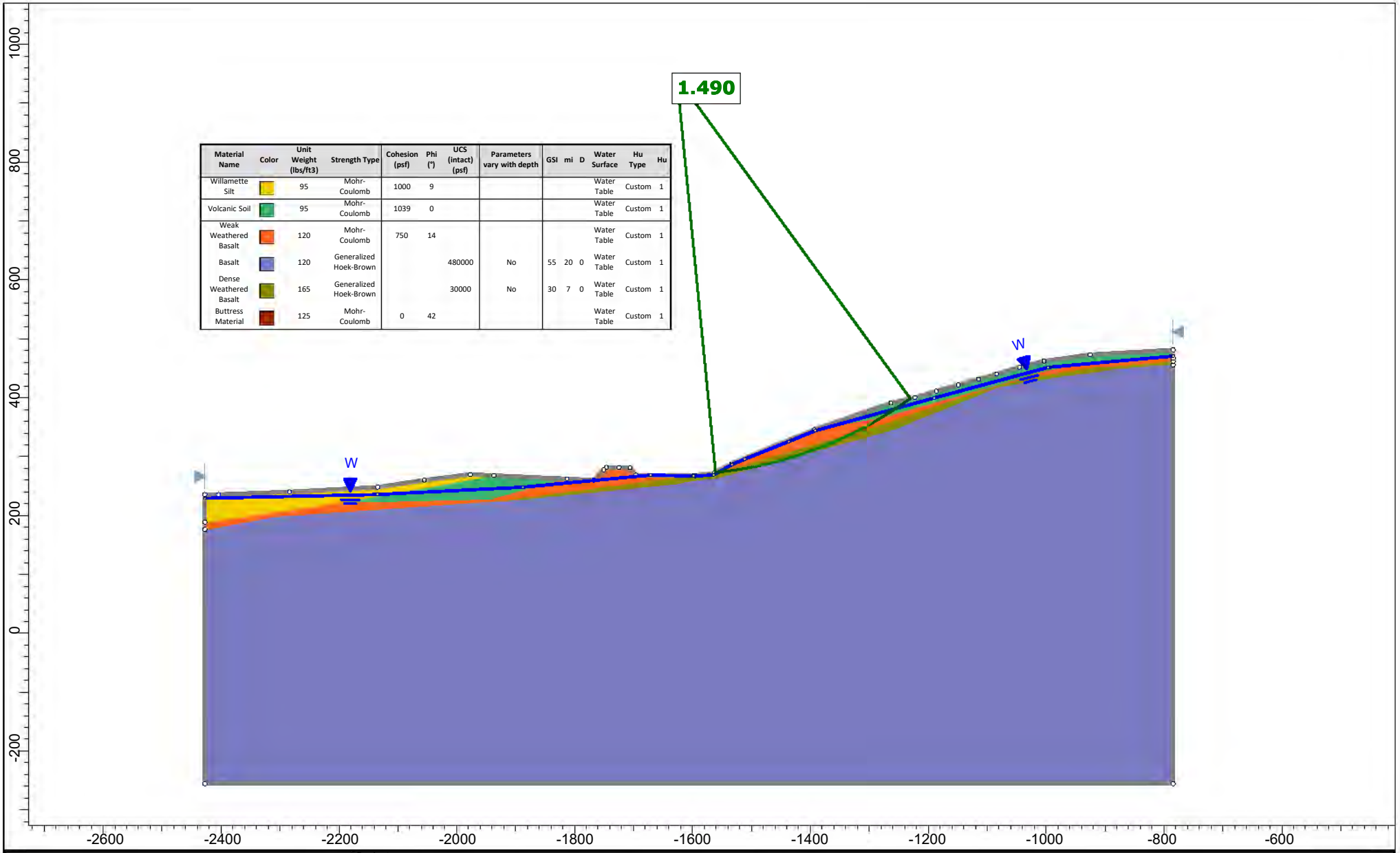
DELVE underground

SLIDEINTERPRET 9.027

Project	Coffin Butte Landfill		
Group	Section D - Seismic - 0.75:1, 2:1	*Scenario*	Cuckoo
Drawn By	Guzek	*Company*	Delve Underground
Date	9/27/2023, 8:59:34 AM	*File Name*	09-2023_Section-D.slmd

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APPENDIX F

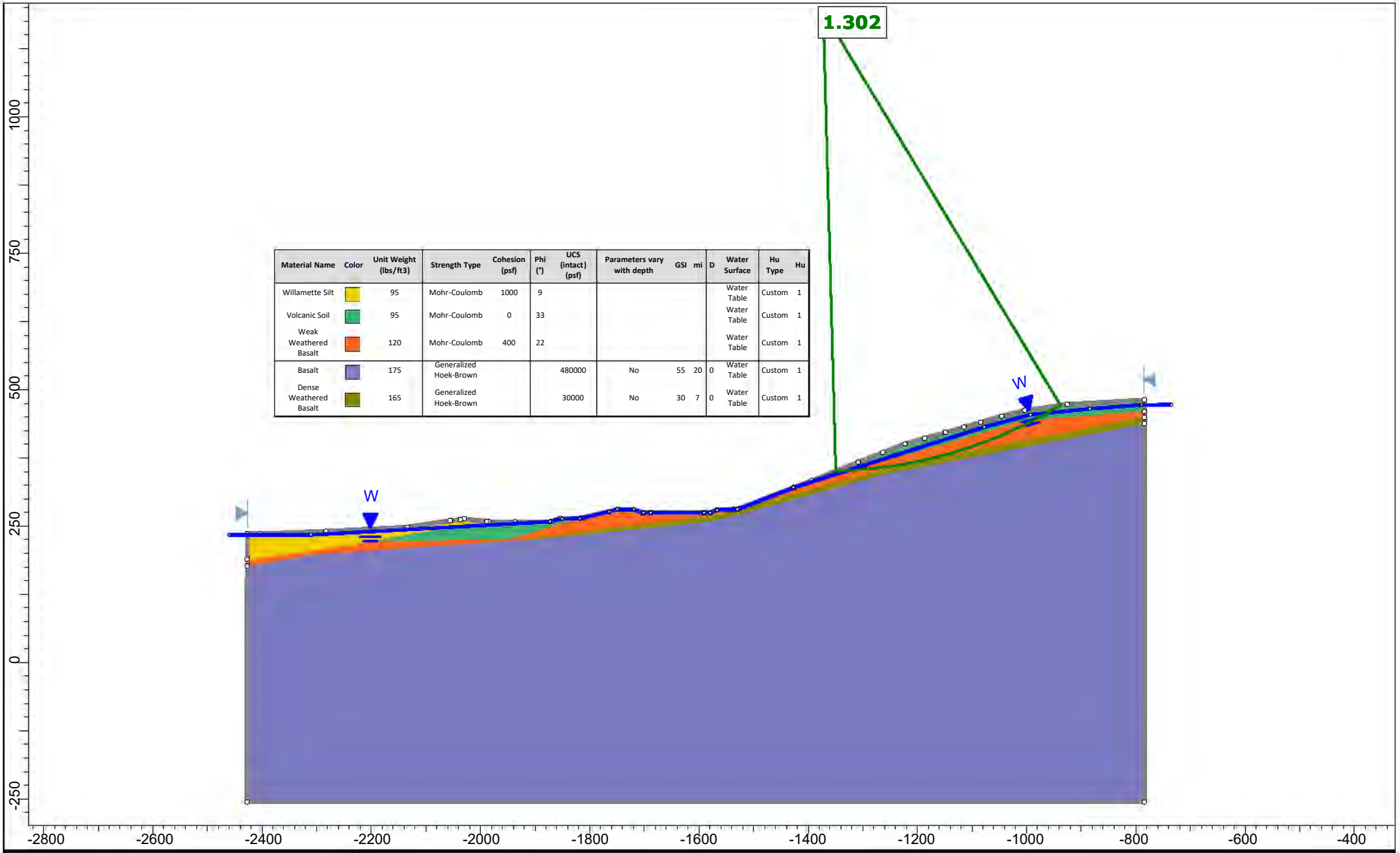


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	UCS (intact) (psf)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu
Willamette Silt		95	Mohr-Coulomb	1000	9						Water Table	Custom	1
Volcanic Soil		95	Mohr-Coulomb	1039	0						Water Table	Custom	1
Weak Weathered Basalt		120	Mohr-Coulomb	750	14						Water Table	Custom	1
Basalt		120	Generalized Hoek-Brown			480000	No	55	20	0	Water Table	Custom	1
Dense Weathered Basalt		165	Generalized Hoek-Brown			30000	No	30	7	0	Water Table	Custom	1
Buttress Material		125	Mohr-Coulomb	0	42						Water Table	Custom	1

rocscience

SLIDEINTERPRET 9.028

Project	Coffin Butte Landfill Southern Expansion		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	L. Splitter	*Company*	Wallace Group
Date	10/25/2023, 3:34:10 PM	*File Name*	Section E_ Short Term Condition for buttress construction.slmd

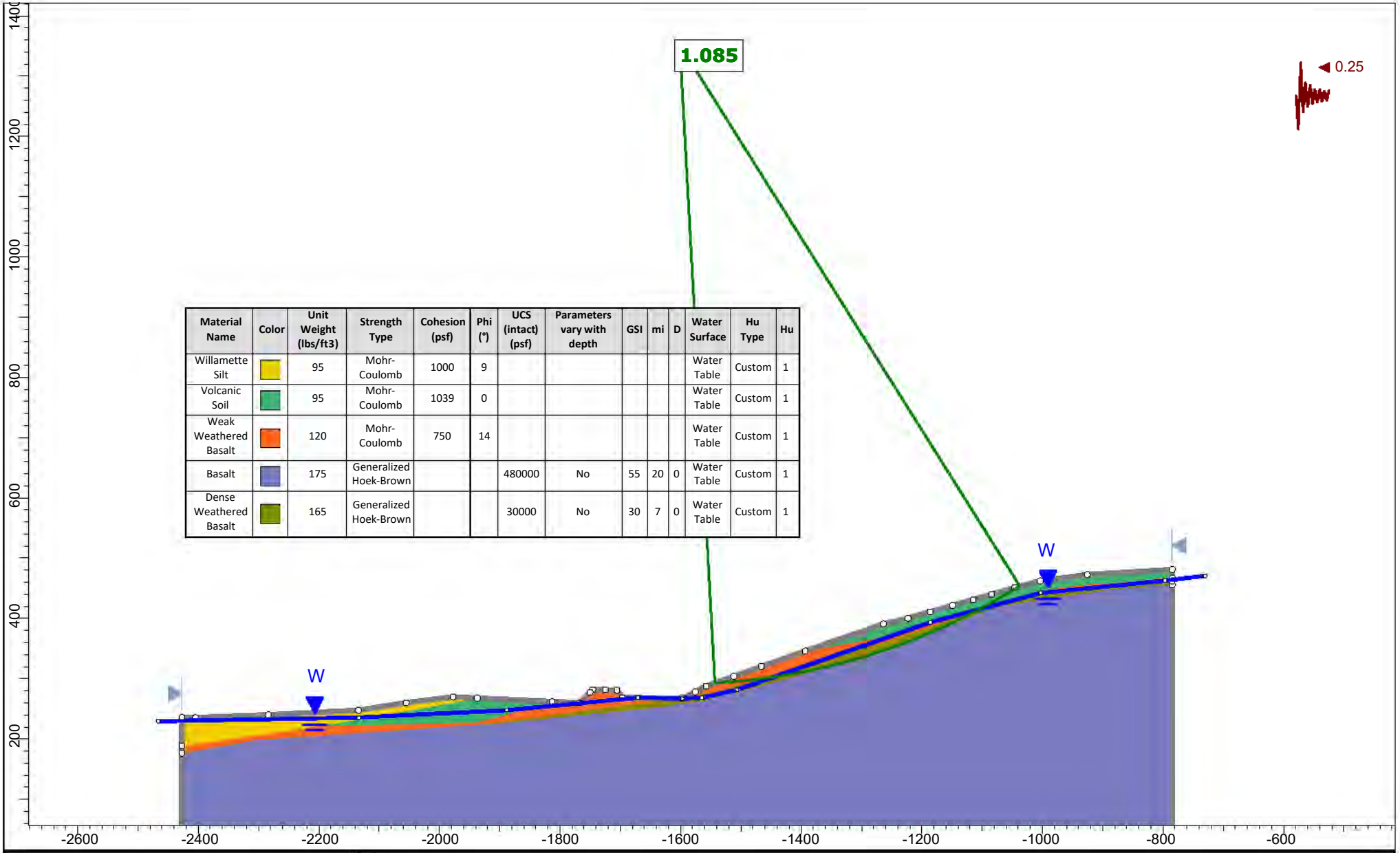


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	UCS (intact) (psf)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu
Willamette Silt		95	Mohr-Coulomb	1000	9						Water Table	Custom	1
Volcanic Soil		95	Mohr-Coulomb	0	33						Water Table	Custom	1
Weak Weathered Basalt		120	Mohr-Coulomb	400	22						Water Table	Custom	1
Basalt		175	Generalized Hoek-Brown			480000	No	55	20	0	Water Table	Custom	1
Dense Weathered Basalt		165	Generalized Hoek-Brown			30000	No	30	7	0	Water Table	Custom	1

rocscience

SLIDEINTERPRET 9.028

Project	Coffin Butte Landfill Southern Expansion		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	L. Splitter	*Company*	Wallace Group
Date	10/25/2023, 3:34:10 PM	*File Name*	Section E_ LongTerm Condition Static.slmd

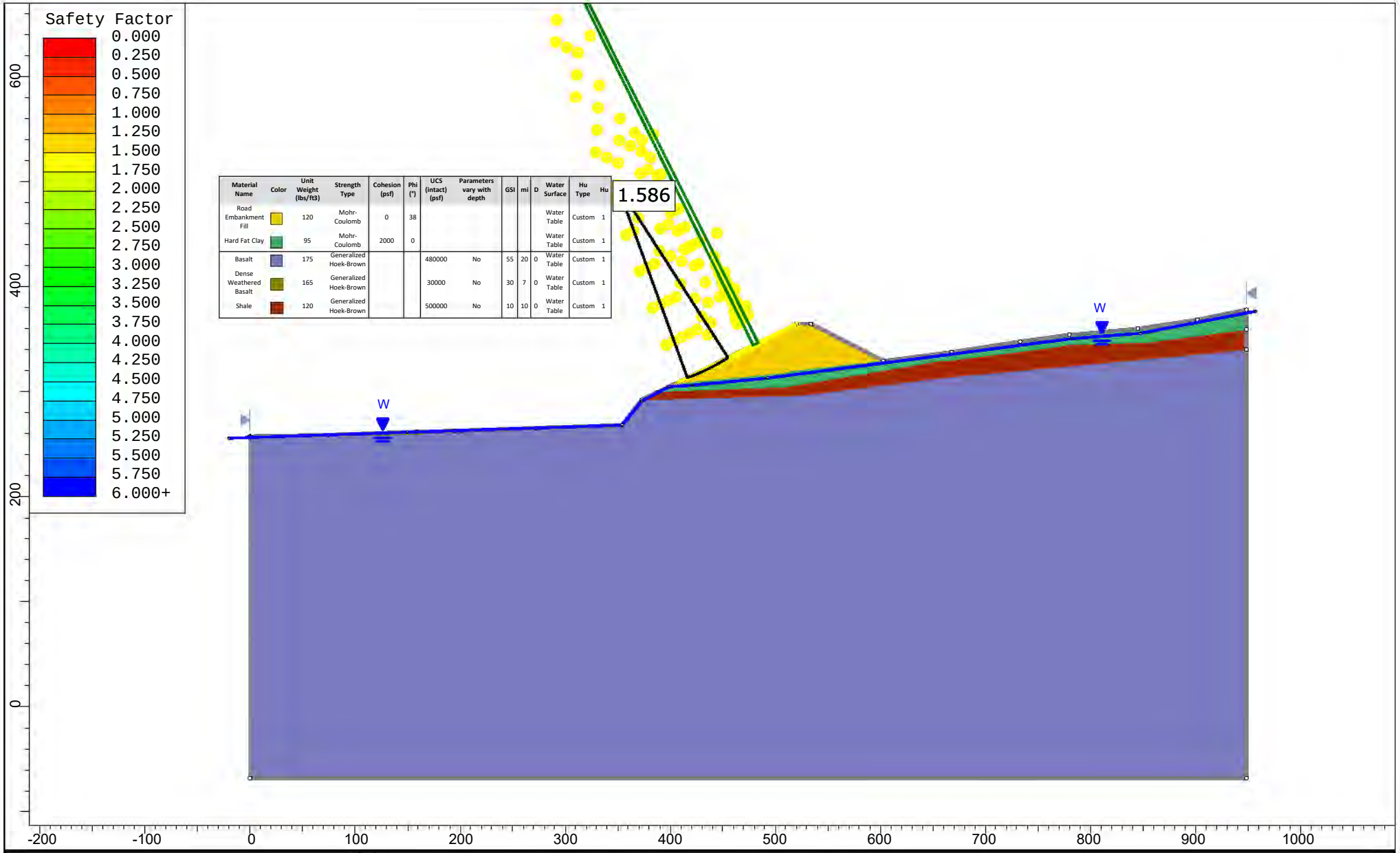


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	UCS (intact) (psf)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu
Willamette Silt		95	Mohr-Coulomb	1000	9						Water Table	Custom	1
Volcanic Soil		95	Mohr-Coulomb	1039	0						Water Table	Custom	1
Weak Weathered Basalt		120	Mohr-Coulomb	750	14						Water Table	Custom	1
Basalt		175	Generalized Hoek-Brown			480000	No	55	20	0	Water Table	Custom	1
Dense Weathered Basalt		165	Generalized Hoek-Brown			30000	No	30	7	0	Water Table	Custom	1

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SLIDEINTERPRET 9.028

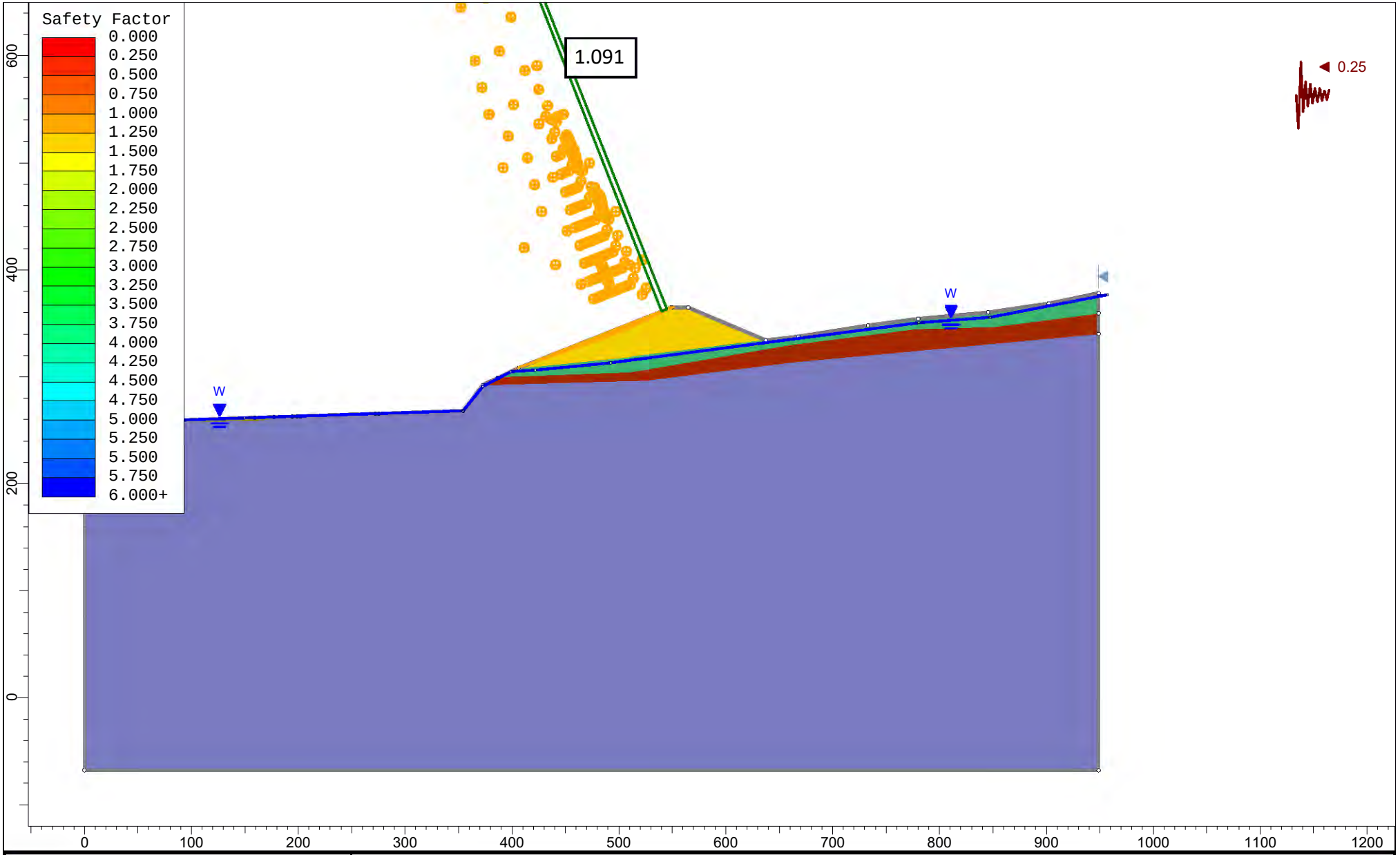
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Group	Group 1	Scenario	Master Scenario
Drawn By	L Splitter	Company	Wallace Group
Date	10/25/2023, 3:34:10 PM	File Name	Section E_ Short Term Condition Seismic no buttress.slmd



rocscience

SLIDEINTERPRET 9.028

Project	Coffin Butte		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	L Splitter	*Company*	Wallace Group
Date	12/20/2023, 2:39:01 PM	*File Name*	Section C_long term.slmd



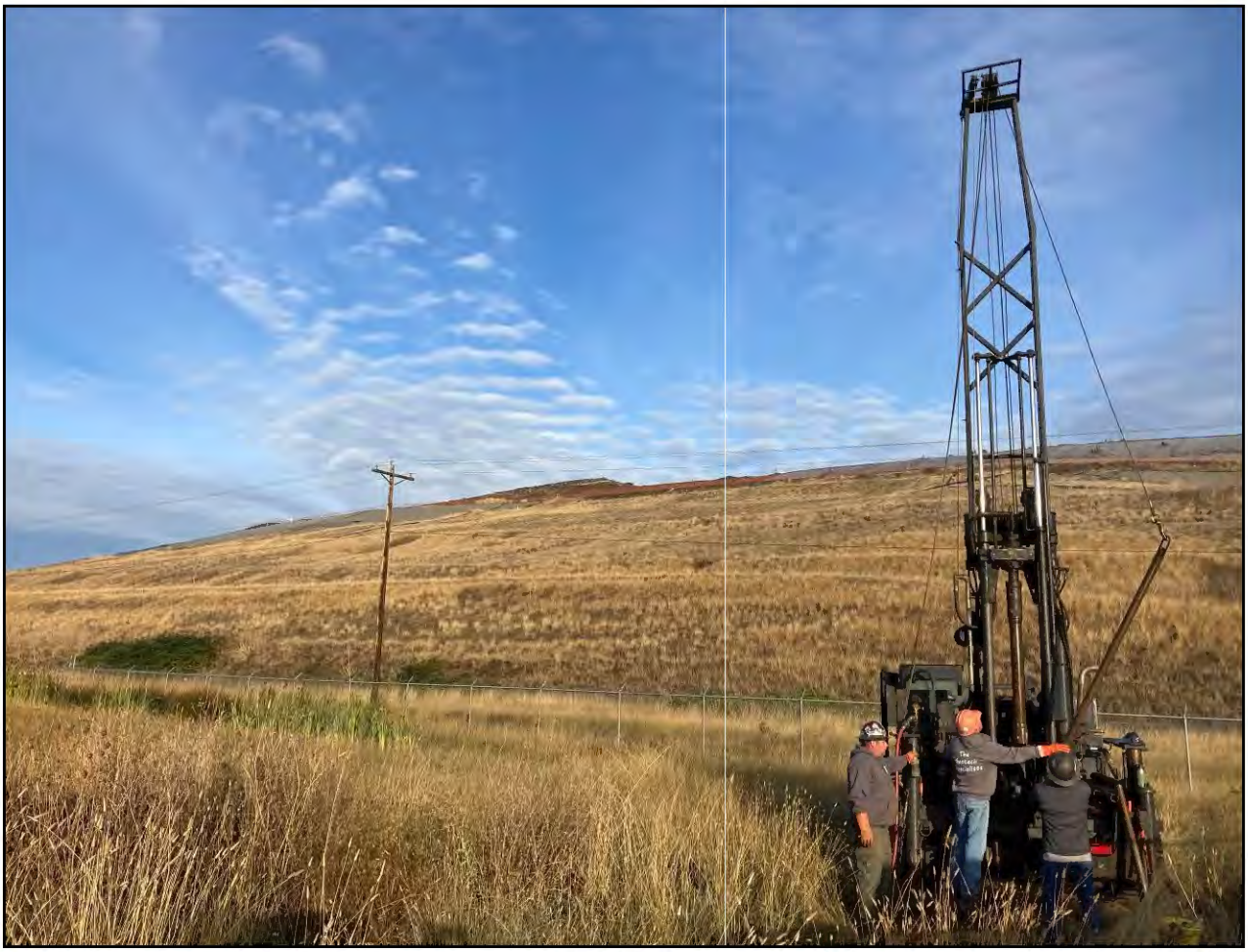
rocscience	Project	Coffin Butte	
	Group	Group 1	Scenario: Master Scenario
	Drawn By	L Splitter	Company: Wallace Group
	Date	12/20/2023, 2:39:01 PM	File Name: Section C_seismic 2.5 to 1.slmd

SLIDEINTERPRET 9.034

EXHIBIT 5
PHASE II GEOTECHNICAL EXPLORATION REPORT

WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

PHASE II GEOTECHNICAL EXPLORATION REPORT
COFFIN BUTTE LANDFILL SOUTH EXPANSION AREA
28972 COFFIN BUTTE ROAD
CORVALLIS, OREGON



July 15, 2024

Wallace Group Project No. 21129 (1)

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A Report Prepared For:

Civil and Environmental Consultants, Inc.
c/o Mr. Jeff Shepherd, P.E.
4045 NW 64th Street
Oklahoma City, Oklahoma 73116

PHASE II GEOTECHNICAL EXPLORATION REPORT
COFFIN BUTTE LANDFILL SOUTH EXPANSION AREA
28972 COFFIN BUTTE ROAD
CORVALLIS, OREGON

Wallace Group Project Number 21129 (1)

Prepared By:



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Senior Geotechnical Engineer



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EXECUTIVE SUMMARY

The Wallace Group, Inc., (Wallace Group) completed geotechnical-engineering explorations for the proposed Coffin Butte Landfill South Expansion Area, located in Corvallis, Oregon (**Figure 1**, *Vicinity Map*). A figure with exploration locations is shown on **Figure 2**, *Exploration Location Map*. Wallace Group performed the geotechnical explorations in two phases, beginning in September 2021. Before a Phase I geotechnical exploration report was published, Wallace Group performed additional subsurface explorations, beginning in November 2022. Thus, this exploration report is considered the Phase II geotechnical exploration report.

Coffin Butte Landfill (CBLF) is an operating municipal solid waste disposal facility owned and operated by Valley Landfills, Inc. Draft development plans were provided by Civil and Environmental Consultants, Inc. (CEC), dated April 2022. Based on the draft development plans, a new landfill cell is planned south of the existing CBLF cells and Coffin Butte Road. Construction for the expansion area will include cuts of up to 155 feet into the northern flank of Tampico Ridge. To construct the planned access roads, up to 50 feet of structural fill will be placed within the valley in the south-central portion of the site and up to 10 feet of structural fill will be placed northeast of the new cell. Two new leachate ponds will be constructed east of the new cell and cuts for pond construction will be up to 50 feet deep. Additional improvements will include the construction of a new landfill administration office, asphalt-paved parking lot, and access roads.

Subsurface explorations generally encountered 6- to 25-feet of fine-grained alluvium (Willamette Silt) underlain by weathered basalt and basalt in the lower elevations. Competent basalt was encountered in the lower elevations at depths ranging between 22- and 65-feet below ground surface (bgs). The higher elevations of the site are underlain by fine-grained to coarse-grained colluvium and volcanic saprolites, which are generally coarser with increasing elevation. These soils are underlain by brecciated and altered basalt bedrock, with the depth to rock generally decreasing with increased elevation. On the western hillside of Tampico Ridge, basalt was encountered at depths ranging between 10- and 25-feet bgs. On the eastern hillslope, surface soil was generally weaker than the western hillslope and basalt was encountered at depths ranging between 19- and 45-feet bgs. In the valley formed between the two hillsides, the depth to basalt ranged from 21- to 23-feet bgs.

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Based on this exploration, the sites appear suitable for the expected development from a geotechnical perspective, provided the recommendations contained in this report are incorporated into design and construction.

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1.0 INTRODUCTION

1.1 GENERAL

The Wallace Group performed geotechnical explorations in two phases, beginning in September 2021. Before a Phase I geotechnical exploration report was published, Wallace Group performed additional subsurface explorations, beginning in November 2022. Thus, this exploration report is considered the Phase II geotechnical exploration report.

The Wallace Group, Inc., (Wallace Group) completed a geotechnical-engineering exploration for the proposed Coffin Butte Landfill (CBLF) South Expansion Area, located at 28972 Coffin Butte Road, Corvallis, Oregon (**Figure 1**, *Vicinity Map*). CBLF is located approximately 11 miles north of downtown Corvallis. Figures with exploration locations are shown on **Figures 2a and 2b**, *Exploration Location Map*.

1.2 PROJECT DESCRIPTION

CBLF is an operating municipal solid waste disposal facility owned and operated by Valley Landfills, Inc. Development areas for the south expansion area include the following tax lots:

- Tax Lot 104180001101: 3.89-acres
- Tax Lot 104180001104: 3.80-acres
- Tax Lot 104180001107: 59.2-acres
- Tax Lot 104180001200: 82.7-acres

Draft development plans were provided by Civil and Environmental Consultants, Inc. (CEC), dated April 2022. Based on the draft development plans, a new landfill cell is proposed south of the existing CBLF cells and Coffin Butte Road. Construction for the expansion area will include cuts of up to 160-feet into the northern flank of Tampico Ridge. To facilitate the construction of new access roads, up to 50 feet of structural fill will be placed and compacted within the valley in the south-central portion of the site and up to 10 feet of structural fill will be placed northeast of the new cell. Two new leachate ponds will be constructed east of the proposed cell and cuts for pond construction will be up to 50-feet deep. Additional improvements will include the construction of a new landfill administration office, asphalt-paved parking lot, and access roads.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this exploration was to evaluate general subsurface conditions within the potential development areas and provide geotechnical design recommendations which will be

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incorporated into project documents for Oregon DEQ-approval prior to the start of construction. The geotechnical exploration and site characterization work performed by Wallace Group was conducted in general accordance with applicable sections of Oregon DEQ's Solid Waste Landfill Guidance and included the following tasks:

- Reviewed and evaluated available geologic, hydrogeologic, and geotechnical data for the Coffin Butte Landfill site and surrounding Benton County area.
- Notified the One-Call Utility Notification Service to identify any public or private utilities near the proposed exploration locations.
- Drilled nineteen (19) borings within the proposed landfill expansion and proposed leachate pond areas using a track-mounted drilling rig equipped with mud-rotary drilling/rock coring equipment.
- Excavated fifteen (15) backhoe test pits within the proposed landfill expansion and leachate pond areas.
- Performed nine (9) cone penetration tests (CPTs) and advanced geoprobes adjacent to the CPT locations within the proposed landfill expansion and leachate pond areas.
- Converted two borings into temporary piezometers to measure depth to groundwater.
- Supervised, sampled, and logged test pits and borings. Soil samples were retrieved, sealed, and transported to the Wallace Group's A2LA-accredited geotechnical laboratory for further evaluation and testing or distribution to other geotechnical laboratories for specialized geotechnical testing.
- Performed geotechnical laboratory testing to measure and confirm the engineering and index properties of the soil and rock materials encountered.
- Performed geotechnical engineering analyses and provided recommendations and design criteria for excavating into soil and rock, maintaining cell and pond slope stability, designing foundations for the planned office building, and performing the planned earthwork, including recommendations for fill placement and compaction, and site drainage.
- Prepared this geotechnical exploration report summarizing our findings, conclusions, and recommendations.

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2.0 FIELD EXPLORATION

2.1 SUBSURFACE EXPLORATION

Subsurface conditions were explored by advancing nineteen (19) borings (designated BH-01 through BH-19), fifteen (15) test pits (designated TP-01 through TP-05, TP-08 through TP-13, and TP-15 through TP-18), and nine (9) cone penetration tests (CPTs) with geoprobe sampling (designated GP/CPT-01 through GP/CPT-09). TP-06, TP-07, and TP-14 were not excavated due to conflicts with utilities and access or equipment failure.

Borings BH-01 through BH-14 were drilled between September 7 and 28, 2021 by Western States Soil Conservation Inc. of Hubbard, Oregon, and BH-15 through BH-19 were drilled between November 8 through 23, 2022 by HazTech Drilling of Nampa, Idaho. Test pits were excavated between August 16 and September 28, 2021, using a CAT 310 excavator operated by RL Reimers Excavation of Albany, Oregon. CPTs and geoprobes were advanced by Oregon Geotechnical Explorations of Salem, Oregon between September 21 through November 8, 2022. A Wallace Group geotechnical professional logged the test pits and borings, supervised the CPTs and geoprobe work, performed dynamic-cone penetrometer (DCP) testing at selected test pit locations, and visually classified the soil and rock materials encountered at the exploration locations. The exploration logs, located in **Appendix A**, describe the materials encountered at each location explored. The soil and bedrock types between explorations are anticipated to be similar; however, variation should be expected. The stratigraphic contacts presented on the exploration logs represent the approximate boundaries between various soil and bedrock types. The approximate locations of the exploration locations are shown in **Figures 2a and 2b**.

A more complete description of the sampling techniques and soil-classification terminology is presented in **Appendix A**.

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3.0 LABORATORY TESTING

Soil samples were transported to the Wallace Group geotechnical laboratory in Bend, Oregon, where they were visually classified, and either prepared for in-house laboratory testing or transported to Northwest Testing, Inc. of Wilsonville, Oregon, or Cooper Testing Laboratory of Mountain View, California for specialized geotechnical laboratory testing. Laboratory tests were conducted in general accordance with standard procedures and included the following tests:

- Moisture Content, ASTM D2216;
- Gradation Analyses, ASTM C117 / C136 and D422;
- Classification of Soil for Engineering Purposes, ASTM D2487;
- Atterberg Limits, ASTM D4318;
- Consolidation, ASTM D2435;
- UU Triaxial, ASTM D2850;
- CD Triaxial, ASTM D4767;
- CD Direct Shear, ASTM D3080;
- Flexible Wall Permeability, ASTM D5084 Method C; and
- Unconfined Point Load Testing, ASTM D5731.

Laboratory test results are included in **Appendix B**.

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4.0 EXISTING SITE CONDITIONS

4.1 SURFACE CONDITIONS

The subject property includes the development of an approximate 42-acre area located south of the active CBLF. The CBLF south expansion area includes the northern flank of Tampico Ridge to the south extending to Coffin Butte Road on the north. Tampico Ridge includes hilltop peaks with elevations of 510 feet mean sea level (msl) on the west and 570 feet on the east. A valley is present between the two hilltop peaks in the south-central portion of the proposed landfill cell. The development area slopes down towards the south near Coffin Butte Road where elevations range from 260 feet msl on the east to 290 feet msl on the west. Groundcover consists of dense thickets of blackberry, poison oak, and coniferous trees in the steep upland areas. The lower topography areas of the site, near existing landfill infrastructure, are generally cleared and planted with agricultural vegetation and/or grasses.

4.2 SUBSURFACE CONDITIONS

Subsurface explorations generally encountered soil over weathered bedrock which becomes competent bedrock at deeper depths. More specifically, there are differences in the types of soil and depths to bedrock at upper and lower regions of the project area.

Subsurface conditions at lower elevations generally consist of fine-grained alluvium (Willamette Silt) and is primarily underlain by weathered basalt (bedrock) which becomes more competent at deeper depths. At higher elevations of the project area, the surficial soils primarily consist of fine-grained to coarse-grained colluvium and volcanic saprolites, which are generally coarser at higher elevations. These soils are primarily underlain by weathered basalt and more competent brecciated and altered basalt bedrock at deeper depths. The colluvium/saprolite soil cover generally becomes thinner at higher elevations. On the western hillside of Tampico Ridge, competent basalt was encountered at depths ranging between 10 and 25 feet bgs. On the eastern hillslope, surface soils were generally weaker and thicker than the western hillslope and competent basalt was encountered at depths ranging between 19 and 45 feet bgs. At lower elevations in the valley, the depth to competent basalt ranged from 22 and 65 feet bgs.

4.2.1 Willamette Silt

Willamette Silt was encountered in the northeast portion of the project area at BH-2, BH-14, GP/CPT-01, and GP/CPT-02 and extended from the surface to depths ranging between 17 to 25 feet below ground surface (bgs). Gradation and index tests indicate the native soil generally classifies as sandy -silt (ML) and sandy-fat-clay (CH), according to the Unified Soil Classification

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System (USCS). The sandy silt and sandy clay were slightly moist to wet and brown, dark brown, tan, dark greenish gray, and gray with rounded to subrounded granular particles. Based on standard penetration testing, the Willamette Silt was generally medium stiff to stiff.

Where tested, the Willamette Silt samples contained 62 to 98 percent clay- and silt-sized particles and had moisture contents ranging between 30 to 36 percent. Atterberg limits testing indicates the soil is highly expansive with plasticity indices ranging from 31 to 39. Consolidated undrained (CU) triaxial testing indicates a total cohesion value of 1,000 pounds per square foot (psf) and total friction angle (phi) of 8.8 degrees at confining pressures ranging between about 2.9 and 3.7 kips per square foot (ksf). In the areas explored, the Willamette Silt was found to be underlain by weathered-in-place basalt.

4.2.2 Low Elevation Alluvium

Alluvial soil was encountered in GP/CPT-09 at the northwest portion of the development area, near the proposed new office building site. The alluvial soil layer extended from the surface to a depth of 6.5 feet bgs. Gradation and index tests indicate the native soil generally classifies as clay (CH), according to the USCS. The clay was moist and brown and dark gray in color. Based on CPT testing, the alluvial soil was generally stiff to very stiff.

Where tested, the clay contained 93 percent clay- and silt-sized particles and had a moisture content of 28 percent. Atterberg limits testing indicates the soil exhibited very high expansion potential and had plasticity index of 53. Consolidation testing on the alluvial fine-grained material indicates that it is slightly over-consolidated with over-consolidation ratios (OCRs) ranging between 2.3 and 8.4. In the areas explored, the alluvial soil was underlain by weathered-in-place basalt.

4.2.3 Volcanic Saprolite and Colluvium

Volcanic saprolite (in-place soil derived from the chemical weathering of rock) and colluvium (unconsolidated material derived from rain and gravity-driven soil movement) mantles the weathered basalt and competent basalt on the Tampico Ridge hillside. Volcanic saprolite and colluvium were encountered extending from the surface to depths ranging between 7 to 45 feet bgs. Colluvium was encountered in isolated areas and the soil mantle primarily consists of volcanic saprolite. Localized areas of thicker colluvial deposits may be encountered during construction.

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Gradation and index tests indicate the soil generally classifies as silty-sand-with-gravel (SM), silty-sand (SM), clayey-sand (SC), sandy-silt-with-gravel (ML), sandy-silt (MH), and sandy-clay (CL), according to the field classifications and USCS. The silty-sand was moist to wet, tan, black, brown, orange, red, and gray, fine to coarse grained with subangular to subrounded particles. Based on SPT testing, the volcanic soil was generally found to be medium dense to very dense and very soft to hard. In general, the volcanic soil and colluvium are weaker and less dense on the eastern knob and northeastern portion of the site than the western knob and northwestern portion of the site.

Where tested, the clay contained 22.7 to 65.9 percent clay- and silt-sized particles and had moisture contents of 33.5 to 75.6 percent. Atterberg limits testing indicates the soil exhibits very high expansion potential with plasticity indices ranging from 19 to 41. In the areas explored, the alluvial soil was underlain by weathered-in-place basalt.

4.2.4 Granular Weathered Basalt

Willamette Silt, alluvial soil, volcanic saprolite, and colluvial soil were underlain by granular weathered basalt bedrock at depths ranging between 7 to 45 feet bgs. Gradation and field classifications indicate the weathered basalt generally classifies as silty -sand-with-gravel (SM), silty-sand (SM), silty-gravel-with-sand (GM), sandy-silt (ML), and sandy-clay (CL). The granular weathered basalt was moist to wet, gray, red, orange, and brown, fine to coarse grained, angular to subangular, and contains cobbles in some areas. Based on SPT testing, the weathered basalt is generally loose to very dense or medium stiff to hard.

Where tested, the weathered basalt contains 13.2 to 48.2 percent clay- and silt-sized particles with moisture contents ranging from 4.1 to 66.3 percent. Atterberg limits testing indicates the weathered rock exhibited moderate expansion potential with a plasticity index of 21. Where exploration locations were advanced through the granular weathered rock, it was underlain by basalt bedrock.

4.2.5 Brecciated and Altered Basalt Bedrock

Competent basalt bedrock was encountered at depths ranging between 10 to 65 feet bgs. The competent basalt encountered in borings was typically unweathered to moderately weathered, slightly to moderately fractured, with varying levels of brecciation, interbedding, and schistose/phyllitic alteration. Alterations generally occurred near high angle (55° to 90°) fractures and joints that were accompanied by chloritic siltstone interbeds, pyrite, calcite, and clay infilling. The bedrock ranged from very low strength to high strength with field strength

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indices of R0 to R4. Basalt textures were waxy to smooth, and the bedrock varied from dark gray to greenish gray. Basalt bedrock was encountered in borings BH-03, BH-04, BH-05, BH-09, and BH-13. No bedrock was encountered within the depths explored in BH-01, BH-02, BH-06, BH-07, BH-08, BH-10, BH-11, BH-12, and BH-14. The test pits encountered refusal on basalt at the higher elevation areas of the site, such as at TP-01, TP-02, TP-03, TP-04, TP-05, TP-08, TP11, TP-12, and TP-13, which typically will require drilling and blasting, hydraulic hammers, or large equipment to remove competent bedrock.

4.3 GROUNDWATER

Groundwater was encountered during the exploration at depths ranging between 4.6 and 67 feet bgs with the groundwater level generally deeper towards the northeast. We expect groundwater will be present within fractures of the weathered and competent bedrock, perched above the interface between soil and bedrock, and within alluvial soils at the lower elevation areas. Fractures provide the primary transport mechanism of groundwater in the bedrock; therefore, the occurrence and amount of groundwater encountered during the excavation of the expansion cell and ponds will depend on the nature, distribution, and interconnection of the fractures.

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5.0 SEISMIC CONSIDERATIONS

5.1 REGIONAL AND SITE GEOLOGY

The Coffin Butte Landfill site is located approximately 11 miles north of downtown Corvallis, on the border of the Willamette Valley and Coast Range physiographic provinces. The Willamette Valley is a flat, riverine valley, formed by the cyclic damming and flooding of the Willamette River during the last ice age. This resulted in a broad flat valley with deep deposits of silt, clay, and organic soil, and a generally shallow water table (Orr, 1992).

The Coast Range is a volcanic complex and forearc basin which was accreted on the western edge of the North American plate between 66 and 30 million years ago (mya) (Snavely, et al, 1965). The Coast Range is locally composed of the Siletz River Volcanics, which are a Paleocene to middle Eocene aged sequence of pillow basalt flows, basalt breccias and conglomerates, and basaltic sedimentary interbeds (Walker and MacLeod, 1991). These rocks are generally altered and/or zeolitized and veined with calcite (Keith and Staples, 1985).

The site is generally divided into two zones: rocky upland areas underlain by the Siletz River Volcanics, and lowland areas composed of soft and or elastic fine-grained soils either derived from the Willamette Silt or volcanic saprolites. The Siletz River Volcanic uplands are generally composed of a thin mantle of granular soils overlying hard and competent basalt. These units have groundwater present in discontinuous layers and fracture zones of the basalt.

The lowland areas, present in the northeast and eastern portions of the site, are composed of fine-grained soils. These areas generally have shallow groundwater, and either consist of Willamette Silt, or highly weathered Siltez River volcanics that have been weathered in-place due to the influence of groundwater.

5.2 REGIONAL SEISMICITY

There are two primary earthquake source types that have been identified in the Pacific Northwest region: Cascadia Subduction Zone sources and shallow crustal sources. These sources result in three earthquake source classifications: (1) shallow crustal earthquakes, (2) deep earthquakes with a moment magnitude greater than 7.0 on the seismogenic part of the subducting plate of the Cascadia Subduction Zone, and (3) an earthquake with a possible moment magnitude of 9.0 (+/- 0.2) on the seismogenic part of the interface between the Juan de Fuca Plate and the North American Plate on the Cascadia Subduction Zone. Historic seismic

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activity in the Corvallis area has been primarily from shallow crustal sources associated with the locally mapped Corvallis Fault Zone (Personius-USGS, 2002).

For evaluating the earthquake ground motions at this site, we relied on the work of Geomatrix (1995) for the Oregon Department of Transportation (ODOT Report) and information more recently published by the United States Geological Survey (USGS). The geotechnical seismic design recommendations contained herein are provided in accordance with the Oregon Structural Special Code (OSSC), based on ASCE 7-22. The approach used for evaluating seismic conditions is based on the following:

- Earthquake sources in Oregon are identified primarily from published geologic records rather than recorded seismic data. Of the three source mechanisms considered in OSSC Section 1803.3.2, recorded seismic data are available only for shallow crustal events. The potential for periodic, large-magnitude subduction zone events along the Oregon Coast is based primarily on geologic evidence, as large, subduction zone events are believed to occur at intervals of 300 to 500 years. The most recent significant subduction zone earthquake occurred in the year 1700, based on a tsunami recorded in Japan. As a result, there are significant uncertainties associated with evaluating many of the key parameters required to assess earthquake hazards.
- To prepare the ODOT Report, Geomatrix assessed the seismic hazard in Oregon using probabilistic seismic hazard analysis techniques. The analyses performed included quantitatively addressing the uncertainties associated with the required input parameters for each of the identified potential earthquake sources. Based on the results of the analyses conducted, earthquake ground motion maps were generated for the State of Oregon for 500-year, 1,000-year and 2,500-year return periods for peak ground acceleration and 5-percent-damped spectral accelerations at spectral periods of 0.3 and 1.0 seconds. Generalized elastic response spectra were also developed for various regions of Oregon based on the relative influence of subduction zone seismic sources and shallow crustal sources to the overall seismic hazard.
- We also reviewed the 2023 USGS fault maps for the State of Oregon. Information provided by the USGS is consistent with the Geomatrix report, for seismic events with return intervals of 2,500 years (approximately equivalent to the two percent probability of exceedance in 50 years), specified in the OSSC.

The following sections include more detailed descriptions of the potential seismic sources, the methods used to evaluate peak ground accelerations, the methods used to develop the site-specific response spectra, and a discussion of the specific seismic concerns.

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5.2.1 Subduction Zone Sources

An active subduction zone is located where the Juan de Fuca Plate is subducting beneath the North American Plate approximately 50 miles off the Oregon Coast. Earthquake types associated with the subduction zone include interface events at the boundary where two plates intersect and intra-slab events within the subducting Juan de Fuca Plate. Potential ground shaking and accelerations at the project site are expected to be significant. The northeastern portion of the site will be at risk of ground shaking amplification where soft, river plain sediments are present.

5.2.2 Crustal Sources

In the analyses associated with the Geomatrix ODOT Report, crustal sources incorporated into the analyses modeled both regional source zones and specific identified geologic faults.

Regional Zone: In this model, earthquakes are assumed to occur randomly within a general region. The advantage of this approach is that it allows provision for the possibility of unidentified or unknown fault sources. Maximum earthquake magnitudes are estimated for each source zone based on historic seismicity, maximum seismogenic depth and threshold of surface faulting. The project site is located in the southern Willamette Valley. Maximum earthquake magnitudes associated with crustal sources in the southern Willamette Valley and return interval of 2,500 years is Moment Magnitude (M_w) 5.75.

Specific Faults: The following discrete faults or fault zones are classified in the ODOT Report as "probable Quaternary Age" or later faults and are located within about 25 miles of the site. The ODOT Report and United States Geological Survey (USGS) identified two, isolated, northeast trending faults that displace late Quaternary deposits or geomorphic surfaces (less than 780,000 years old) in the southern Willamette Valley. These faults are located on the western and eastern borders of Corvallis. The Corvallis fault (west) and Owl Creek fault (east) are generally characterized as "inactive" and are up to approximately 40 km long.

The Corvallis fault, which forms the western boundary of the Willamette Valley near Corvallis, is mapped as close as four miles to the south of the site. The Corvallis fault is interpreted as northeast-trending, southwest-dipping Tertiary thrust fault, that thrusts the Eocene aged Siletz River Volcanics over the Eocene Tyee formation (Personius-USGS, 2002). The fault may also have been reactivated as a steeply dipping left lateral strike slip fault. Although there is no evidence that the fault is active due to late Pleistocene or Holocene displacement, USGS data suggests that the fault may be active with a long recurrence interval. Two alternative maximum

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rupture lengths are possible; 23 km length with a probability of 0.4 or 35 km length with a probability of 0.4. The calculated movement of the fault is approximately 0.2 mm/year, and it is classified as Class B.

The Owl Creek fault, in southern Willamette Valley, is located six miles to the southeast of the site. The steeply east-dipping Owl Creek fault is a reverse fault associated with an anticline in the Eocene Spencer Formation mapped in the subsurface east of Corvallis on the floor of the southern Willamette Valley. The fault, which has no geomorphic expression, apparently offsets the middle to late Pleistocene Rowland Formation, but does not offset the latest Pleistocene Willamette Formation. The most recent movement on the Owl Creek fault is defined as middle and late Quaternary, less than 750,000 years old. The Owl Creek fault is interpreted as northeast striking and approximately 12 km long (USGS, 2022). The calculated movement of the fault is approximately 0.2 mm/year.

5.3 EARTHQUAKE GROUND MOTIONS

5.3.1 Ground Response Spectra

Local geologic deposits can significantly amplify the ground response and the response of structures (represented by a response spectrum) as earthquake motions are propagated from bedrock to the soil surface.

Based on the conditions encountered during our field exploration program and shear wave velocity measurements collected in CPT-08, 2022 ASCE 7 Site Class D (Stiff Soil) is recommended for use in design. Based on the site's latitude, longitude, and subsurface conditions, site-specific response spectra were developed. The spectra shown in Appendix C includes the criteria for Site Class D (Stiff Soil) from the 2022 OSSC, with a return interval of 2,500 years (approximately equivalent to a two percent probability of exceedance in 50 years). For Site Class D, the resulting short period spectral response acceleration (0.2 second) for the site (S_s) is 1.05g, and the 1.0 second (S_1) spectral response acceleration is 0.44g. The five percent damped design spectral response acceleration at short periods (S_{DS}) is 0.9g. The seismic curve is presented in **Appendix C**.

5.3.2 Peak Ground Acceleration

The peak ground accelerations developed in the ODOT report were estimated by combining the earthquake sources discussed above with published attenuation relationships (Sadigh et. al, 1993; Idriss, 1991; Boore et. al., 1993). Peak ground accelerations and spectral accelerations

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incorporated into the 2022 OSSC have been periodically modified based on more recent USGS studies.

Based on the USGS Seismic Design Maps using the 2022 ASCE 7, the risk-based peak ground acceleration recommended for this site is 0.61g for Site Class D (Stiff Soil). Based on our understanding of previous geotechnical studies performed for landfill cells constructed on the north side of Coffin Butte Road, the site-specific PGA was 0.33g. Subsurface conditions in the southern expansion area include deeper soil over brecciated and altered basalt bedrock than encountered in the landfill cells to the north. We anticipate that a risk-based PGA of 0.61g is appropriate for the southern expansion area and will be more conservative than using a site-specific PGA.

5.4 SEISMIC HAZARDS SUMMARY

The OSSC specifically requires that certain geologic hazards be addressed in a site-specific seismic study. These are summarized in this section.

Ground Motion: Discussed in Section 5.3, Earthquake Ground Motions.

Liquefaction/Settlement: The potential for seismically induced liquefaction to develop within the profile was evaluated using the procedure outlined by Youd et. al. (2001). The procedure uses standard penetration test (SPT) blow counts and other soil data to estimate the cyclic resistance ratio (CRR) profile with depth (ratio of the cyclic shear stress required to cause liquefaction to the initial vertical effective stress). The cyclic stress ratio (CSR) profile with depth (ratio of cyclic shear stress to initial vertical effective stress) resulting from the design level earthquake is estimated from the total and effective stresses, the peak ground surface acceleration value, the magnitude of the design level earthquake, and a depth dependent stress reduction factor.

Based on the results of our geotechnical exploration, and lack of loose, saturated soils with a plasticity index of less than 12, the liquefaction potential at the site is low.

Landslide/Lateral Spreading: There is a risk from earthquake-induced landslides and the landslide potential analyses are presented in Section 6. The risk for lateral spreading is low due to the lack of significant potentially liquefiable zones.

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Fault Rupture: The trace of the nearest mapped fault is associated with the Corvallis fault. This northeast trending fault is approximately four miles south of the project site (USGS, 2023). Based on our geologic research and local experience, the fault is reasonably mapped, and while in relatively close proximity to the project, it does not appear likely for fault rupture to occur at the proposed landfill site.

Tsunami or Seiche: There is no risk, based on the inland location of the site and lack of significant bodies of water in the immediate vicinity of the project.

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6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of field exploration, laboratory testing, engineering analyses, and our local experience, it is our opinion that the site is suitable for the anticipated development from a geotechnical perspective. The primary geotechnical concerns are the highly expansive silts and clays in the lowland areas, potential settlement of new fills, and static and seismic slope stability of the new landfill cell and leachate pond excavations.

6.1 ROADWAY EMBANKMENT FILLS

Embankment fills for access roads will be constructed in the northeast portion of the site and in the south-central portion of the site. Fill placed for embankment roads in the northeast and south-central will be approximately 10 and 50 feet thick, respectively. Subsurface conditions vary from soft alluvial deposits in the northeast to dense volcanic soil in the south-central area. Based on the subsurface explorations, we expect that the 10-foot-tall roadway embankment constructed in the northeast will be underlain by approximately 13 to 28 feet of alluvial deposits, consisting of soft to very stiff silt and clay, underlain by very loose to very dense weathered basalt. The 50-foot-tall south-central embankment will be underlain by 10 to 25 feet of medium dense to very dense sand and gravel and hard clay, over basalt bedrock. In general, the upper five feet of soil in the south-central area is medium dense and the density increases with depth.

6.1.1 Roadway Embankment Site Preparation

We recommend that all development areas are stripped of organic soil to expose native soil. The development areas should be considered to extend five feet beyond the perimeter of the embankment fill areas. We anticipate deeper stripping depth will be required where mature trees are removed or were previously removed. All roots larger than 0.5-inch diameter should be removed. Once the organic soil and roots are removed, the subgrade should be scarified to a depth of at least eight (8) inches, moisture-conditioned at least three (3) percent above the optimum moisture content and compacted to at least 95 percent of the maximum Standard Proctor dry density as determined by ASTM D698 using suitable compaction equipment. The exposed soil subgrade should be kept moist until covered by new structural fill and/or pavement.

In the lowland area, soil exposed after stripping may be weak, saturated, and/or incapable of supporting the weight of construction equipment or achieving proper compaction; therefore, subgrade stabilization may be required prior to adding new fill. We first recommend that a

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Wallace Group representative evaluate the exposed subgrade and determine the most appropriate procedure for subgrade stabilization. Acceptable subgrade stabilization approaches include: 1) over-excavating and removing weak material to expose firm subgrade, and subsequently backfilling the excavation with compacted select fill, as described in a subsequent section of this report, and 2) over-excavating and removing weak material to a depth of at least two feet, and subsequently placing geogrid across the base of the excavation, placing a poorly graded, ¾-inch drain rock or crushed rock material over the geogrid in horizontal uncompacted lift of 12 inches or less, and compacting the granular material to the satisfaction of the Wallace Group representative; the process should be repeated until the over-excavated area has been fully backfilled.

In the south-central embankment area, the upper five (5) feet of medium dense sand should be removed to expose very dense sand and gravel or hard clay. The exposed subgrade should be scarified to a depth of at least eight (8) inches, moisture conditioned to above the optimum moisture content, and compacted to at least 95 percent of the maximum Standard Proctor dry density, as determined by ASTM D698 using suitable equipment. The exposed soil subgrade should be kept moist until covered by new structural fill and/or pavement. Embankment slopes should be no steeper than 2.5 to 1 (H to V).

6.1.2 Roadway Embankment Structural Fill and Placement

Where structural fill is needed to construct roadway embankments, we recommend it consist of appropriately graded sand and gravel having 100 percent passing a two-inch sieve, less than 30 percent retained on the ¾-inch sieve, and less than 20 percent passing a No. 200 sieve. On-site, non-organic, native soil, will not likely be suitable for reuse as structural fill due to the high content of silt and clay-sized particles and highly expansive properties. We recommend the structural fill have a maximum dry density (ASTM D698) of at least 90 pounds per cubic foot (pcf).

In addition, we recommend:

- Structural fill be placed in horizontal lifts not exceeding 8 inches in uncompacted thickness, moisture-conditioned to within a range of +/- 2 percent of optimum moisture content, and compacted as recommended in **Table 6.1.2**, *Engineered Fill Specifications Summary.*
- Structural fill should be placed in level lifts and benched into slopes. During the benching process, a Wallace Group representative should determine if subsurface

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drainage should be installed to collect water that seeps from the existing hillslope and redirect the water to a suitable outlet.

- Structural fill should not be placed during freezing weather or on frozen subgrade to avoid potential thaw settlement.
- Compaction of fill should be performed to achieve the minimum relative compaction shown in **Table 6.1.2**. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D698 laboratory compaction procedure.
- A Wallace Group representative should periodically observe the fill placement and test the fill for grain-size, fines content, plasticity, and compaction.

The southern slope of the roadway embankment fill placed in the Tampico Ridge valley, in the south-central portion of the site, should be constructed with drainage elements to prevent potential erosion and piping of the embankment fill. Wallace Group recommends that the embankment is constructed with concrete lined v-ditches near the southern base of the embankment to direct surface water away from the embankment. The embankment should be graded such that the crest directs water away and reduces the potential for surface water flow over the crest. The potential for erosion should be reduced by constructing benches into the southern slope every 15 vertical feet. The benches should be wide enough to allow maintenance and should be sloped towards the embankment and constructed with concrete lined v-ditches which direct water away from the slope. In addition, the soil slope face should be hydroseeded to reduce surface erosion. Concrete lined v-ditches should be monitored and maintained.

As an alternative to the construction of benches and intermediate concrete lined v-ditches includes covering the soil slope surface with an erosion mat which is hydroseeded. The erosion control mat should be constructed with an anchor trench at the top of slope in accordance with the manufacturer's recommendations and be secured using high load anchors. The concrete lined v-ditch at the base of the southern slope should also be included to direct surface water away from the embankment.

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Table 6.1.2, below, summarizes the placement and compaction specifications for anticipated uses of structural fill for this project.

Table 6.1.2
Engineered Fill Specifications Summary
Coffin Butte Landfill Southern Expansion Area
28972 Coffin Butte Road
Corvallis, Oregon

Material Type & Specifications	Placement Location	Placement Specifications
Base Course – Crushed Aggregate, ¾-inch minus, <8% passing #200 sieve.	Base Course Beneath Slabs on Grade, Pavement, and Footings	Maximum 6" lifts; compacted to minimum 95% of Standard Proctor density (ASTM D698) for floor slabs, footings, 92% for pavement, exterior slabs and sidewalks.
Structural Fill - Granular, Inorganic soil, 2-inch minus, <30% retained on ¾-inch sieve, <20% passing #200 sieve. Non-plastic. Maximum dry density of at least 90 pcf.	Beneath Slabs on Grade, Exterior Slabs, Pavement, Sidewalks, Utility Trench Backfill, and Footings	Maximum 8" lifts; compacted to minimum 95% of Standard Proctor density (ASTM D698) for floor slabs, footings, all fill exceeding 5 feet vertical, 92% for pavement, exterior slabs and sidewalks.
Granular Landscape Fill – Inorganic soil, 3-inch minus.	Landscaped Areas	Fill depth less than 4 feet, compaction not required. Fill depths greater than 4 feet, compact to a minimum of 90% of Standard Proctor (ASTM D698).

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6.2 LANDFILL CELL SITE PREPARATION

We recommend that all development areas are stripped of organic soil to expose native soil. Based on the depths of proposed excavation, softer volcanic soil, alluvial deposits, and Willamette Silt will be removed. However, there is potential for some softer soil to remain along the northern and eastern perimeter and in the valley between the east and west knob. If subgrade stabilization measures are needed, the process described in Section 6.1.1 should be utilized.

6.3 EXCAVATIONS

To construct the CBLF southern expansion area, cuts will be up to 155-feet at the western knob of Tampico Ridge, up to 110-feet at the eastern knob, and up to 50-feet for the construction of the leachate ponds (**Figure 2b**, *Exploration Location Map*). Cuts to remove the native silt, clay, and gravel soil can generally be excavated with conventional earth-moving equipment such as excavators and small dozers.

Competent basalt bedrock will likely require rock hammers or drilling and blasting to excavate. The western hillside may be excavatable mechanically; however, it will result in a ragged final slope which may be problematic over time. The eastern hillside is more competent and mechanical excavation methods will not be appropriate. We recommend that drilling and blasting is used during rock excavation. The rock excavation method should be performed in a manner that limits as much as practical blasting disturbance beyond the rock cut. We recommend the project documents incorporate the latest Oregon Department of Transportation (ODOT) Standard Specifications, Section 00335, for blasting and that a qualified blasting consultant is used. Groundwater will be encountered during the expected earthwork operations and dewatering operations are recommended during the construction of the leachate ponds.

The excavation areas have been divided into three areas based on the subsurface conditions: the western hillside slope, eastern hillside slope, and leachate ponds. In general, the western hillslope was underlain by volcanic soil consisting of medium dense to very dense sand and gravel and hard clay which was up to approximately 35-feet thick and underlain by weathered basalt and fresh basalt. The basalt in the western hillslope was intensely brecciated with infilling of siltstone.

The volcanic soil overlying bedrock in the eastern slope and within the valley was generally weaker than encountered in the west. The eastern slope was generally underlain by up to 27-

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feet of very soft to hard silt and clay underlain by weathered basalt and basalt. The bedrock encountered in the eastern hillslope was generally intact basalt with only isolated intervals of brecciation and was primarily composed of basalt with minor siltstone matrix. The subsurface conditions near the leachate ponds consisted of up to 28-feet of soft to very stiff fine-grained alluvial deposits underlain by weathered basalt and basalt bedrock.

Based on current plans, excavations in the landfill cell below the access road will be sloped at 2 to 1 horizontal to vertical (H to V) to accommodate the landfill liner. The access road loops around the cell to the south and the slope above the road is sloped at 1.5 to 1 (H to V). The two leachate ponds will be constructed with bottom of pond elevations of 257 feet and 272 feet msl on the north and south, respectively. The slope from the ponds will continue to the south at 2.5 to 1 (H to V) where it meets Tampico Ridge near elevation 400 feet msl.

6.4.1 Slope Stability Model Soil and Rock Design Values

The proposed excavations were evaluated using the SLIDE2 program, developed by Rocscience. Wallace Group teamed with Delve Underground to complete the excavation recommendations for the southern expansion. Subsurface conditions and engineering properties were selected based upon applicable Wallace Group borings, CPTs, and test pits and laboratory test results. Strength of the alluvial and volcanic soil was represented using the Mohr-Coulomb criteria for both short-term (after construction) and long-term conditions. Acceptable factors of safety were considered to be greater than or equal to 1.3 for short and long-term conditions and 1.0 for seismic analysis.

Strength of the volcanic breccia of the west slope and the basalt of the east slope were modeled using the Generalized Hoek-Brown relationships. The following tables summarize the soil and rock strengths used in the slope stability models.

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Table 6.4.1-1
Assumed Engineering Properties
West Slope

Geologic Unit	Unit Weight (pcf)	Strength Model	Friction Angle (degrees)	Cohesion (psf)	UCS (psf)	GSI
Soil (Colluvium)	125	Mohr-Coulomb	34	100	-	-
Weathered Rock	165	Generalized Hoek-Brown	-	-	30,000	30
Volcanic Breccia	170	Generalized Hoek-Brown	-	-	200,000	45

Table 6.4.1-2
Assumed Engineering Properties
East Slope

Geologic Unit	Unit Weight (pcf)	Strength Model	Friction Angle (degrees)	Cohesion (psf)	UCS (psf)	GSI
Soil (Colluvium)	125	Mohr-Coulomb	30	150	-	-
Weathered Rock	165	Generalized Hoek-Brown	-	-	30,000	30
Basalt	175	Generalized Hoek-Brown	-	-	480,000	55

Table 6.4.1-3
Assumed Engineering Properties
South Central Embankment

Geologic Unit	Unit Weight (pcf)	Strength Model	Friction Angle (degrees)	Cohesion (psf)	UCS (psf)	GSI
Embankment Fill	120	Mohr-Coulomb	38	0	-	-
Hard Clay	95	Mohr-Coulomb	0	2,000	-	-
Shale	120	Generalized Hoek-Brown	-	-	500,000	10
Basalt	175	Generalized Hoek-Brown	-	-	480,000	55

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Table 6.4.1-4
Assumed Short-Term Engineering Properties
Leachate Ponds

Geologic Unit	Unit Weight (pcf)	Strength Model	Friction Angle (degrees)	Cohesion (psf)	UCS (psf)	GSI
Willamette Silt	95	Mohr-Coulomb	9	1000	-	-
Soil (Volcanic/ Colluvium)	95	Mohr-Coulomb	0	1039	-	-
Weak Weathered Rock	120	Mohr-Coulomb	14	750	-	-
Dense Weathered Rock	165	Generalized Hoek-Brown	-	-	30,000	30
Basalt	175	Generalized Hoek-Brown	-	-	480,000	55

Table 6.4.1-5
Assumed Long-Term Engineering Properties
Leachate Ponds

Geologic Unit	Unit Weight (pcf)	Strength Model	Friction Angle (degrees)	Cohesion (psf)	UCS (psf)	GSI
Willamette Silt	95	Mohr-Coulomb	9	1000	-	-
Soil (Volcanic/ Colluvium)	95	Mohr-Coulomb	33	0	-	-
Weak Weathered Rock	120	Mohr-Coulomb	22	400	-	-
Dense Weathered Rock	165	Generalized Hoek-Brown	-	-	30,000	30
Basalt	175	Generalized Hoek-Brown	-	-	480,000	55

6.4.2 Eastern and Western Hillside Excavations

Delve utilized the Markland Analysis technique with mapped joint orientations and an estimated rock mass peak friction angle to study the kinematic stability of the overall rock mass with respect to the proposed cut slope orientation. Delve concluded that the rock slope should not be cut an at angle steeper than 53 degrees (approximately 0.75 to 1, H to V). Limited rock reinforcement, scaling, and rockfall mitigation (ditch or mesh) may still be required for a 53-degree cut slope). Rockfall mitigation techniques are discussed in detail in **Appendix E**.

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Global stability of the eastern and western hillside cut was evaluated using a 2D limit equilibrium analysis. The analysis was performed using the Rocscience SLIDE2 computer program and the material strength properties presented in **Section 6.3.1**. The selected subsurface conditions were based on cross-sections B-B' at the western slope and Section D-D' at the eastern slope. Configuration of the models assumed the following cut inclinations:

- Slope of 2H:1V below the access road
- Slope of 0.75H:1V in rock and weathered rock above the access road
- Slope of 1.5H:1V at the brow of the slope where colluvium is encountered on the west slope.
- Slope of 2.5H:1V at the brow of the slope where colluvium is encountered on the east slope.

As discussed in **Appendix E**, the limit equilibrium analysis suggests stable conditions provided the west and east slopes are cut at the following inclinations or shallower:

- Volcanic Breccia and Basalt: 0.75H:1V
- Weathered Rock: 0.75H:1V
- Colluvium soil: 1.5H:1V at the west slope
- Colluvium soil: 2H:1V at the east slope below the access road and 2.5H:1V above the access road

The interpreted boundary between soil and weathered rock will dictate where the cut-slope transitions from 0.75H:1V to 1.5H:1V or 2H:1V to 2.5H:1V. Because of the assumptions made and variation in subsurface conditions, representation of subsurface geometry along the height of the cut should be considered approximate. Transition in the cut slope angle from colluvium to rock should be confirmed and modified as necessary during construction. See **Appendix E** for further discussion on the rock cut analysis and conclusions. Acceptable excavation slopes are presented on **Figure 12**.

6.4.3 Leachate Pond Excavations

Wallace Group evaluated the global stability of the leachate pond cut using a 2D limit equilibrium analysis for short-term (during construction), long-term, and seismic conditions. The analysis was performed using the Rocscience SLIDE2 computer program and the material strength properties are presented in **Section 6.3.1**. The selected subsurface conditions were based on cross-section E-E.' Configuration of the model assumed the cut slope is 2.5H:1V from the base of the leachate pond cut to the intersection with the slope to the south at an approximate elevation of 400 feet msl. Based on the available groundwater data, the models

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were evaluated assuming that the groundwater is approximately 17-feet bgs at the south and 5-feet bgs at the north. Seismic loading conditions were assumed to be 40 percent of the PGA, a seismic load of approximately 0.25g.

Based on the results of the slope stability modeling, the following table summarizes the minimum factors of safety for the three conditions:

Table 6.4.3-1
Modeling Factor of Safety Summary
Leachate Ponds

Slope Stability Condition	Estimated Factor of Safety
Short-Term	1.3
Long-Term	1.3
Seismic	1.0

The global factors of safety for the planned 2.5H:1V cut slope will be acceptable for the short-term, long-term, and seismic conditions. Some localized slope failures of the leachate pond edges are possible; therefore, Wallace Group recommends that the leachate pond slopes are constructed using compacted structural fill which extends from the bottom of pond to a lateral distance of at least 25-feet. Structural fill should be placed in level lifts and bear on dense soil or hard weathered basalt. Cuts into native soil for the construction of the ponds should not be steeper than 2.5H:1V. We recommend the slope is cut, then benches are constructed during fill placement. Benches in the native soil should be approximately 5 feet deep and 5 feet high. A keyway should be constructed at the base of the fill that is at least 8-feet wide and 6-feet deep. If a long-term slope stability factor of 1.5 is preferred, horizontal drains should be constructed upslope of the leachate pond to lower the groundwater elevation to below the very dense weathered basalt. Output slope models are presented in **Appendix F**.

The safety of the workers and equipment in or near excavations is the responsibility of the contractor. During construction, Wallace Group should observe cut slopes to confirm the inclinations are appropriate for the conditions encountered. It is the responsibility of the contractor to maintain safe and stable slopes during construction. The slope stability analyses did not include surcharge loading from construction equipment or stockpiled material.

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6.5 SETTLEMENT ESTIMATES

The laboratory consolidation test results indicate that the Willamette Silt and volcanic/colluvial soil is overconsolidated with overconsolidation ratios (OCRs) ranging from 2.3 to 8.4. Dependent on the landfill cell thickness, new loads added to the base of the landfill could result in recompression and a new cycle of primary consolidation. Considering the variable thickness of new fill and the amount of Willamette Silt and volcanic/colluvial soil which will remain after excavation, the amount of settlement will differ across the site. Based on an assumed landfill material unit weight of 80 pounds per square foot, we estimate up to 24 inches of consolidation settlement will occur within 50-years. Settlement estimates were computed using the computer modeling program Settle3 by Rocscience and the settlement contours are illustrated on **Figure 13**.

Roadway embankment fill placed in the lowland area will be underlain by weak fine-grained silt and clay. Where new fill is placed, total settlement is expected to be up to 8- to 10-inches within 50 years. It should be expected that some repairs to the embankment fill will be needed over time.

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7.0 ADDITIONAL SERVICES

7.1 DESIGN AND CONSTRUCTION PERIOD ENGINEERING SERVICES

Wallace Group will review the geotechnical and civil aspects of the project design plans and specifications, when completed, to confirm that our recommendations are incorporated into the project documents, and to make appropriate modifications, if necessary. We currently anticipate performing design review of foundation, grading, and drainage plans to document that our recommendations are incorporated into design. This review will reduce misinterpretation of our recommendations and reduce the potential for costly design changes and construction delays.

7.2 CONSTRUCTION INSPECTION AND TESTING

To maintain our role as the geotechnical engineer of record, Wallace Group will also observe and monitor earthwork construction including site preparation, placement, and compaction of engineered fill in building pad areas, utility trench backfill, foundation, and slab preparation. The purpose of these services will be to help document that site grading and development-area-subgrade preparation complies with the recommendations of this geotechnical report and the approved project plans and specifications. If subsurface conditions are encountered during construction that differ from the conditions described herein, we will review our recommendations considering these different conditions and recommend changes in design or construction procedures.

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8.0 LIMITATIONS

Exploratory test pits, borings, CPTs, and geoprobes performed for this study were placed to obtain an understanding of underground conditions for evaluation and design purposes. The exploration was performed using a mutually-agreed-upon scope of services. Variations from these conditions, not indicated by the test pits, are possible. These variations are sometimes enough to necessitate design modifications. CEC (Client) must recognize that it is impossible to predict every physical condition that will be encountered. If unexpected conditions are observed during construction, or if the size, type, elevation, or location of the proposed structures should differ significantly from the preliminary plans, we should be notified to review the recommendations contained in this report. The professional judgments expressed in this report meet the standard of care of our profession; however, no warranty is expressed or implied.

This report may be used only by the Client and only for the intended site and for the purposes stated within a reasonable time from its issuance, but in no event, later than five (5) years from the date of the report. Land or facility use, on- and off-site conditions, regulations, or other factors may change over time, and additional work may be required with the passage of time. Any party other than the Client or their design team who wishes to use this report shall notify the Wallace Group of such intended use. Based on the intended use of the report, the Wallace Group may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release Wallace Group from any liability resulting from the use of this report by any unauthorized party.

The contractor selected for this project is responsible for supervision and direction of the actual work performed by his employees, subcontractors, and agents. Wallace Group will use accepted geotechnical engineering and testing procedures; however, our testing and observations will not relieve the contractor of his primary responsibility to produce a completed project conforming to the project plans and specifications.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for the safety of personnel other than our own on the site. The safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein unsafe.

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9.0 REFERENCES

Geomatrix Consultants, 1995, Seismic Design Mapping State of Oregon: Final Report, prepared for Oregon Department of Transportation under personal services contract 11688.

Keith, Terry E.C. and Staples, Lloyd W, The Clay Minerals Society, 1985, *Zeolites in Eocene Basaltic Pillow Lavas of the Siletz River Volcanics, Central Coast Range, Oregon.* Vol. 33, No. 2, 135-144.

Oregon Department of Transportation, Standard Specifications for Construction, 2021.

Oregon Structural Specialty Code 2022, Based on 2018 International Building Code, with Oregon amendments.

Personius, S.F., compiler, U.S. Geological Survey Website, 2002, *Fault number 869, Corvallis fault zone, in Quaternary fault and fold database of the United States*, https://earthquakes.usgs.gov/hazards/qfaults

Snavely, Park D. Jr., Wagner, Holly C, and Macleod, Norman S., June 1965, *Preliminary Data on Compositional Variations of Tertiary Volcanic Rocks in the Central Part of the Oregon Coast Range,* The Ore Bin, Volume 27, No. 6.

Orr, William N., and Elizabeth L. Orr, 1992, Oregon Geology.

United States Geological Survey, 2023, Seismic Hazards website data base.

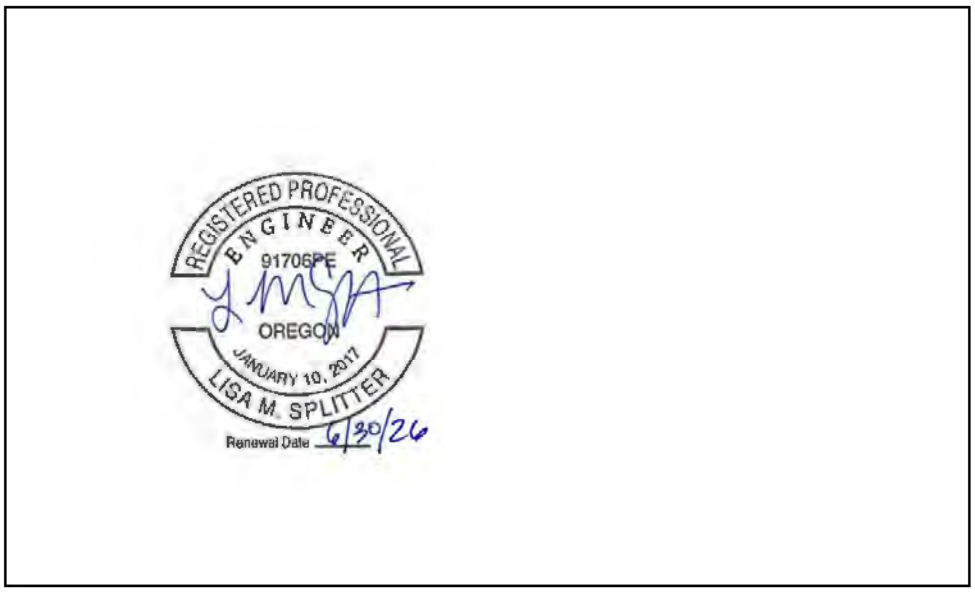
United States Geological Survey, 2020, *Lewisburg Quadrangle, Benton County, Oregon* (7.5-minute series-topographic).

Walker, G.W. and MacLeod, M.S., 1991, U.S. Geological Survey, *Geologic Map of Oregon.*

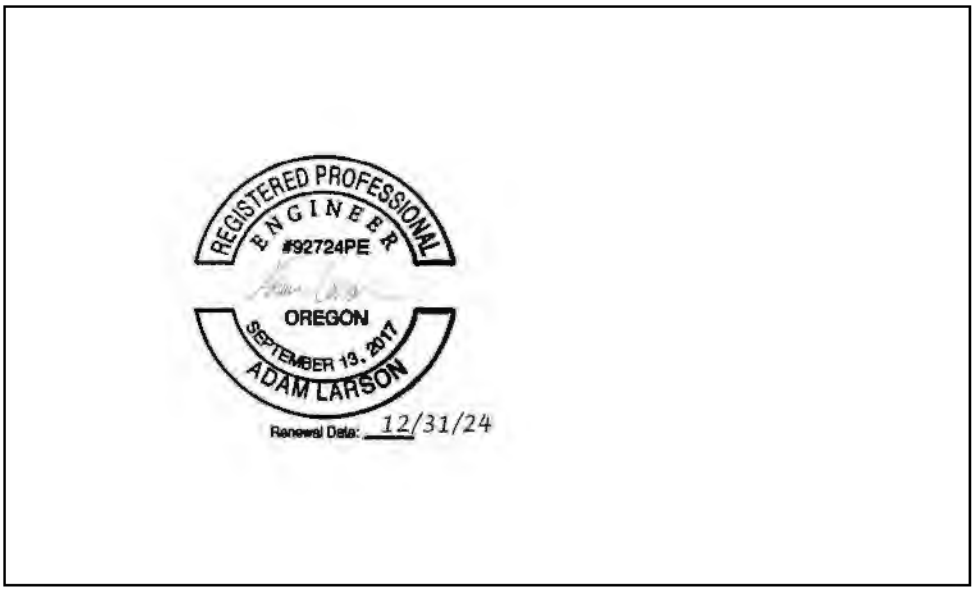
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10.0 PROFESSIONAL AUTHENTICITY

This report has been authored and reviewed by the undersigned, respectively. This report is void if the original seal(s) and signature(s) are not included.



Lisa M. Splitter, P.E., G.E.
Senior Geotechnical Engineer

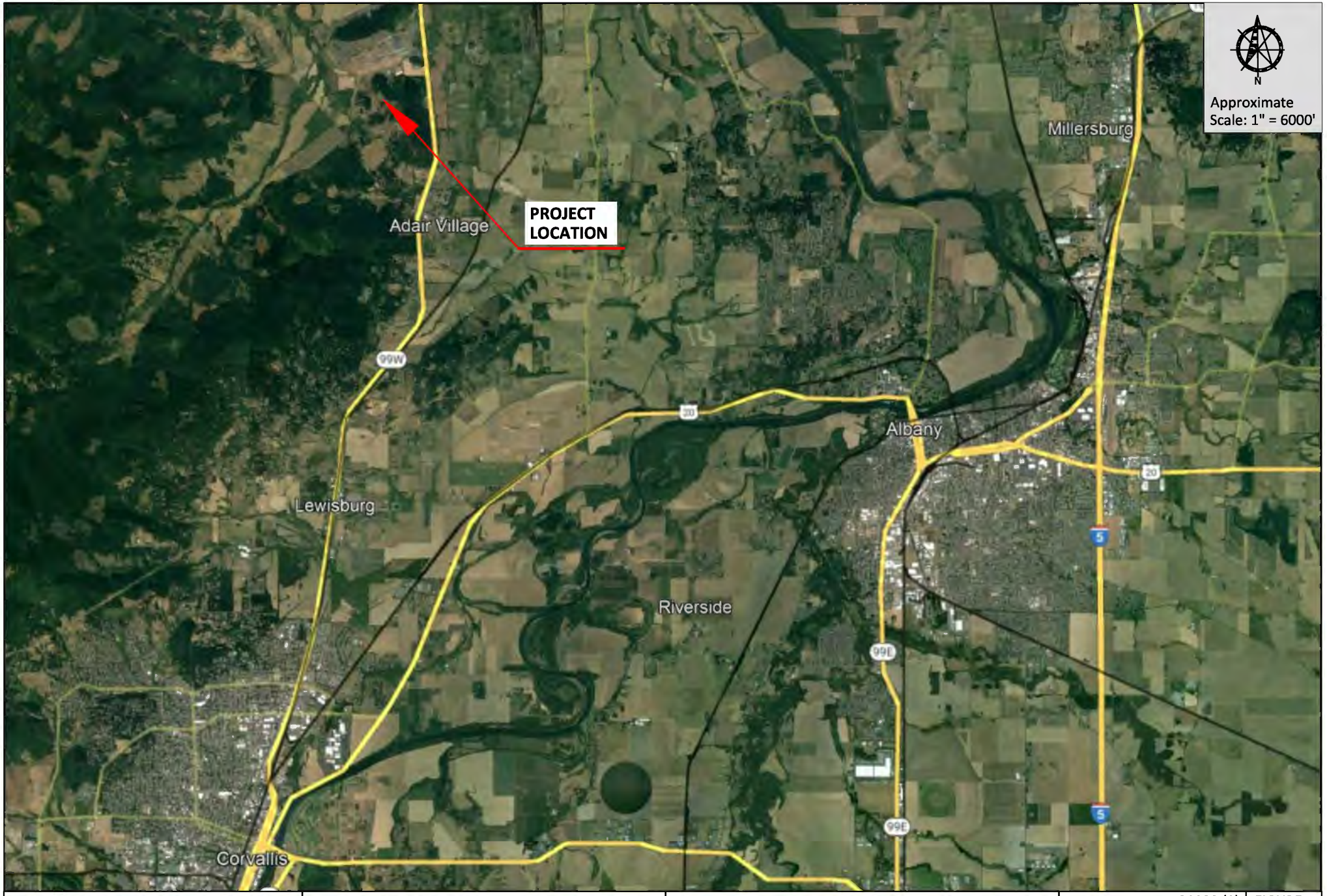


Adam Larson, P.E.
Project Geotechnical Engineer

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FIGURES



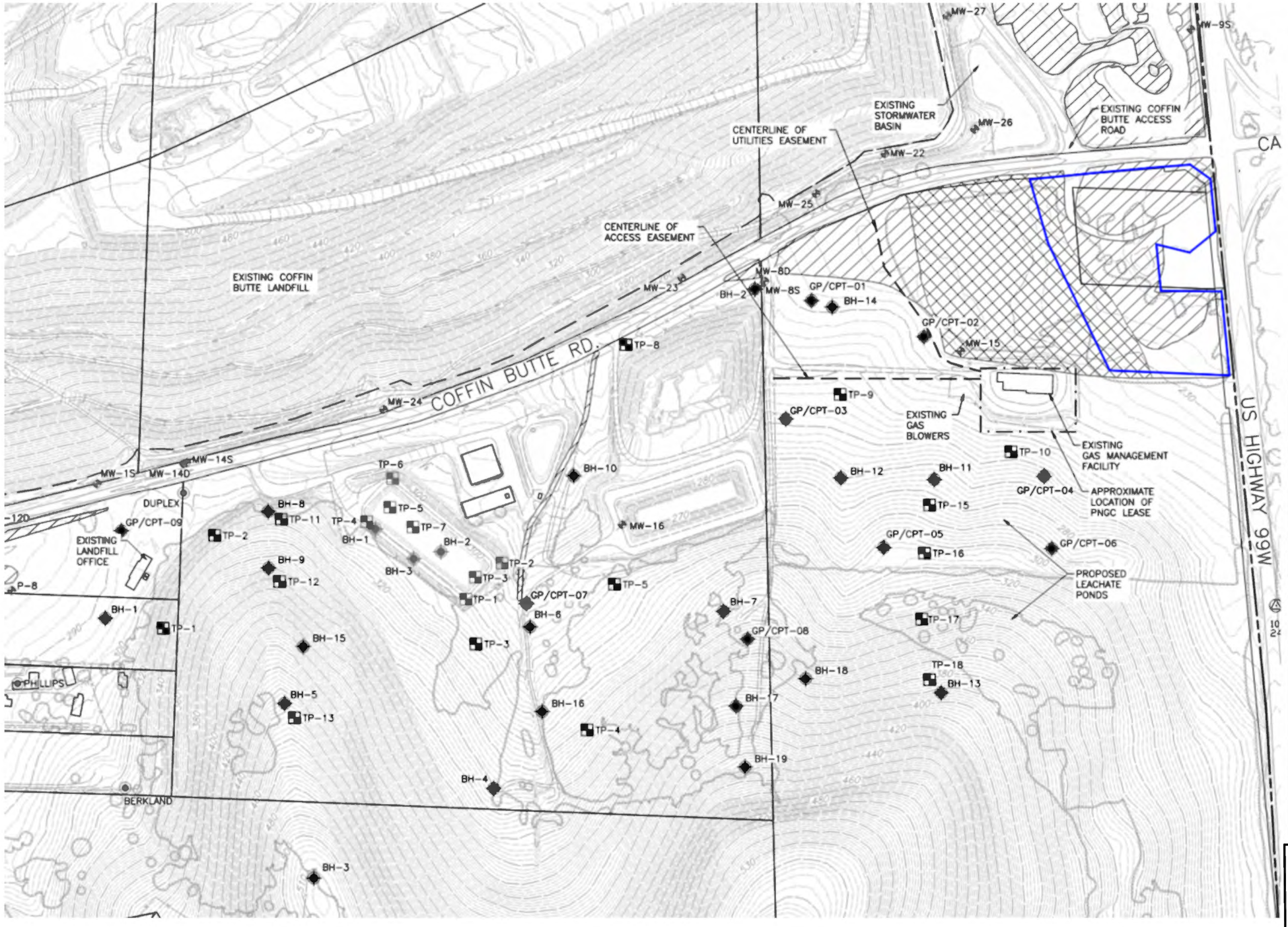
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VICINITY MAP
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No:	21129 (1)
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DRAWN BY:	KAK
CHECKED BY:	LMS
FILE NAME:	21129 (1) Figure 1

FIGURE
1



LEGEND

- PROPERTY BOUNDARY
- EXISTING LANDFILL BOUNDARY
- TAX LOT BOUNDARY
- EXISTING 10-FT CONTOUR
- EXISTING 2-FT CONTOUR
- EXISTING PALUSTRINE FORESTED WETLAND
- EXISTING PALUSTRINE EMERGENT WETLAND
- EXISTING GROUNDWATER MONITORING WELLS/PIEZOMETER
- DECOMMISSIONED MONITORING WELLS
- EXISTING WATER SUPPLY WELLS
- EXISTING BORE HOLE
- PROPOSED BORE HOLE
- EXISTING TEST PIT
- PROPOSED TEST PIT

PROPOSED BOREHOLE/TEST PIT TABLE

POINT #	DESCRIPTION	EXISTING GROUND ELEVATION	DESIGN GROUND ELEVATION	ELEVATION DIFFERENCE (FT)	NORTHING	EASTING
1	BH	291.73	314.31	+22.58	386993.30	7491228.00
2	BH	240.75	247.73	+6.98	388028.01	7493274.15
3	BH	510.00	500.01	-9.99	386177.39	7491884.63
4	BH	343.89	362.49	+18.60	386458.65	7492451.61
5	BH	443.43	313.86	-129.57	386726.13	7491792.60
6	BH	291.19	293.82	+2.63	386966.17	7492565.95
7	BH	338.92	321.62	-17.30	387015.13	7493175.46
8	BH	309.25	292.60	-16.65	387329.50	7491740.75
9	BH	359.05	295.02	-64.03	387151.79	7491742.28
10	BH	263.11	271.53	+8.42	387441.49	7492703.58
11	BH	274.77	265.00	-9.77	387429.86	7493839.53
12	BH	270.70	278.46	+7.76	387429.86	7493839.53
13	BH	390.17	376.93	-13.24	386760.08	7493861.25
14	BH	239.03	253.00	+13.97	387972.34	7493517.97
1	TP	323.66	331.61	+7.95	386961.84	7491410.53
2	TP	301.95	293.05	-8.90	387254.49	7491572.23
3	TP	308.29	297.30	-10.99	386912.70	7492395.46
4	TP	334.16	345.53	+11.37	386643.02	7492745.75
5	TP	297.77	286.17	-11.60	387100.73	7492831.97
8	TP	251.57	252.52	+0.95	387853.25	7492868.46
9	TP	253.18	265.38	+12.20	387697.22	7493543.05

N

APPROXIMATE SCALE
1" = 350'

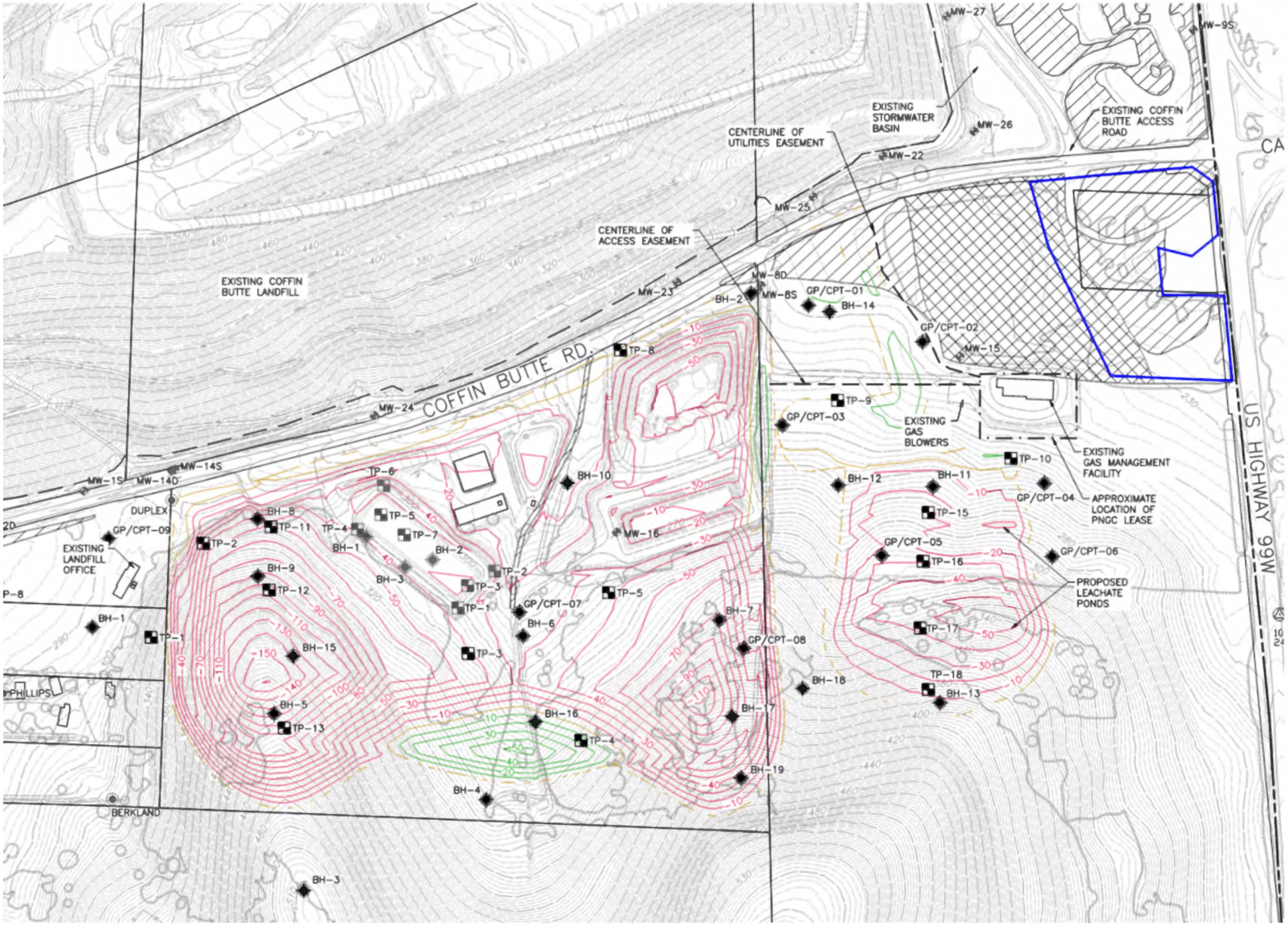
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EXPLORATION LOCATION MAP
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

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FIGURE: 2a



LEGEND

- PROPERTY BOUNDARY
- EXISTING LANDFILL BOUNDARY
- TAX LOT BOUNDARY
- 300 EXISTING 10-FT CONTOUR
- EXISTING 2-FT CONTOUR
- EXISTING PALUSTRINE FORESTED WETLAND
- EXISTING PALUSTRINE EMERGENT WETLAND
- EXISTING GROUNDWATER MONITORING WELLS/PIEZOMETER
- DECOMMISSIONED MONITORING WELLS
- EXISTING WATER SUPPLY WELLS
- EXISTING BORE HOLE
- PROPOSED BORE HOLE
- EXISTING TEST PIT
- PROPOSED TEST PIT

PROPOSED BOREHOLE/TEST PIT TABLE

POINT #	DESCRIPTION	EXISTING GROUND ELEVATION	DESIGN GROUND ELEVATION	ELEVATION DIFFERENCE (FT)	NORTHING	EASTI
1	GP/CPT	238.82	247.90	-9.08	387992.07	749345
2	GP/CPT	237.06	237.06	0.00	387878.79	749380
3	GP/CPT	258.82	263.12	-4.30	387619.91	749337
4	GP/CPT	263.42	263.42	0.00	387440.30	749418
5	GP/CPT	302.68	280.00	22.68	387216.21	749368
6	GP/CPT	290.84	290.84	0.00	387213.16	749420
7	GP/CPT	287.77	264.57	23.20	387040.06	749255
8	GP/CPT	360.17	315.26	44.91	386926.09	749325
9	GP/CPT	288.85	288.85	0.00	387269.13	749127

N

APPROXIMATE SCALE
1" = 350'

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EXPLORATION LOCATION MAP
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No:	21129 (1)
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FILE NAME:	21129 (1) Figure 2b

FIGURE: 2b



LEGEND

Qff2: Main Body of fine-grained Missoula Flood Deposits (Pleistocene)

Qtg: Weathered terrace deposits (Pleistocene and Pliocene?)

Tvc: Volcanic Rocks of the Coastal Range (Eocene)

Approximate Site Border

N

APPROXIMATE SCALE
1" = 5,000'

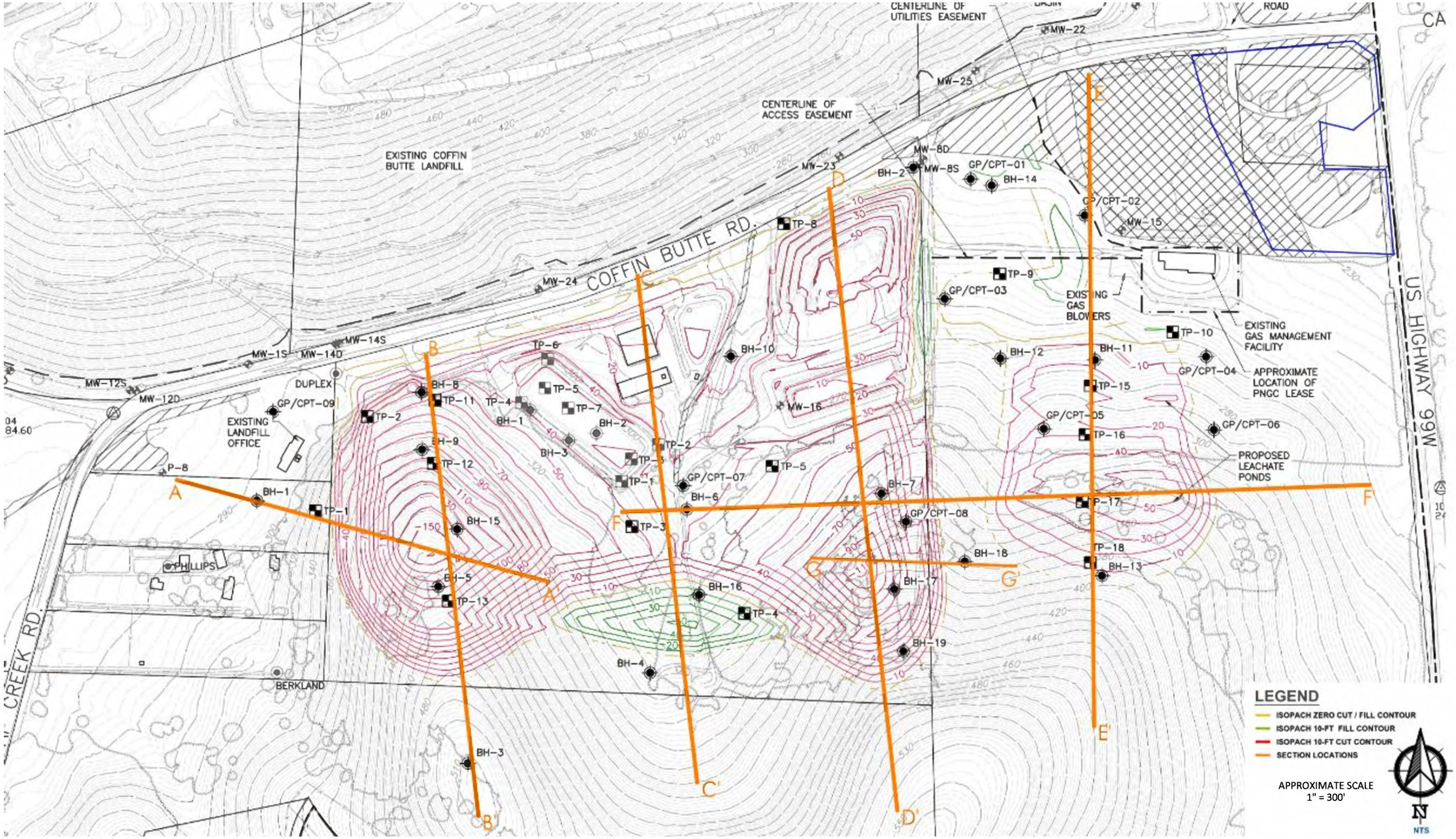
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SURFACE GEOLOGY MAP
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No:	21129 (1)
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FILE NAME:	21129 (1) Figure 3

FIGURE: 3



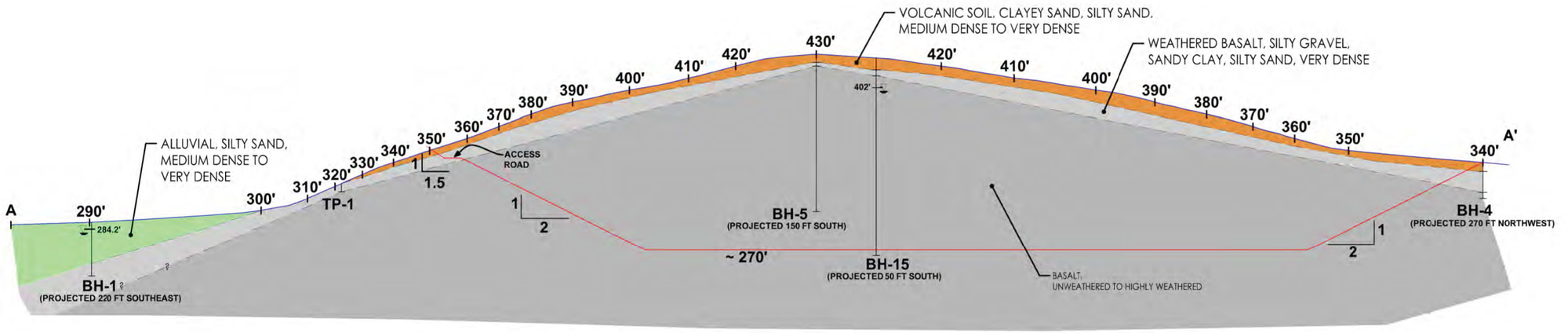
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CROSS SECTION LOCATION MAP
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

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DRAWN BY:	KAK
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FILE NAME:	21129 (1) Figure 4

FIGURE: 4



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE
- GROUNDWATER
- VOLCANIC SOIL
- WEATHERED BASALT
- BASALT
- ALLUVIAL

GRAPHIC SCALE

0 25 42.5 100 200

(IN FEET)

1 inch = 100 ft.

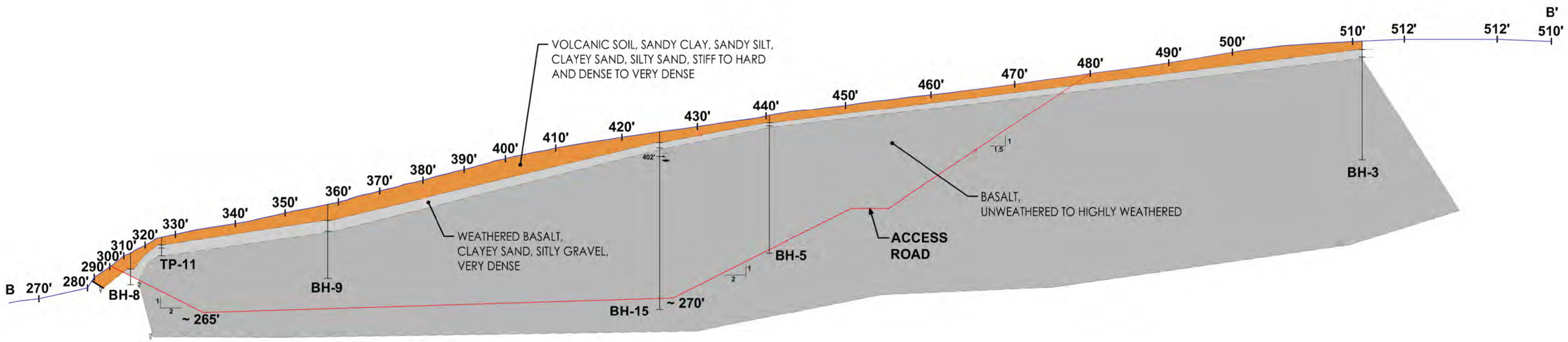
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CROSS-SECTION A-A'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	October 24, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_5.DWG

FIGURE 5



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE
- GROUNDWATER
- VOLCANIC SOIL
- WEATHERED BASALT
- BASALT

GRAPHIC SCALE

0 25 50 100 200

(IN FEET)

1 inch = 100 ft.

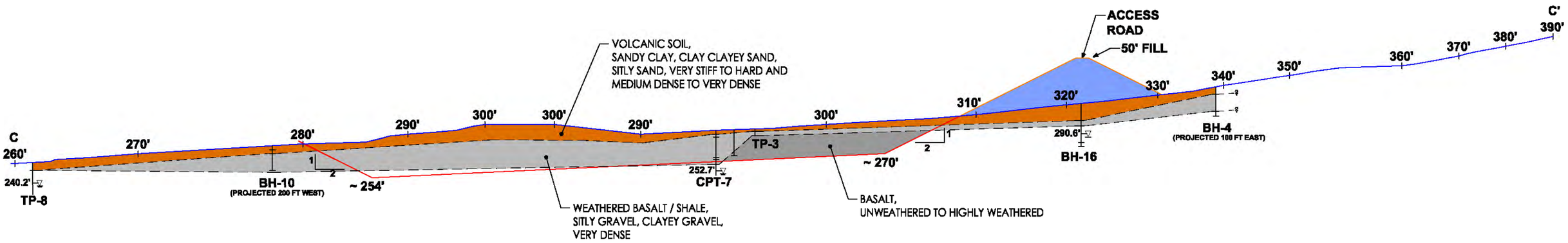
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NORTHWEST GEOSYSTEM EXPERTS

CROSS-SECTION B-B'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	October 24, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_6.DWG

FIGURE 6



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE
- ISOPACH ZERO CUT/ FILL LINE
- GROUNDWATER
- VOLCANIC SOIL
- WEATHERED BASALT
- BASALT
- FILL

GRAPHIC SCALE

0 25 50 100 200

(IN FEET)

1 inch = 100 ft.

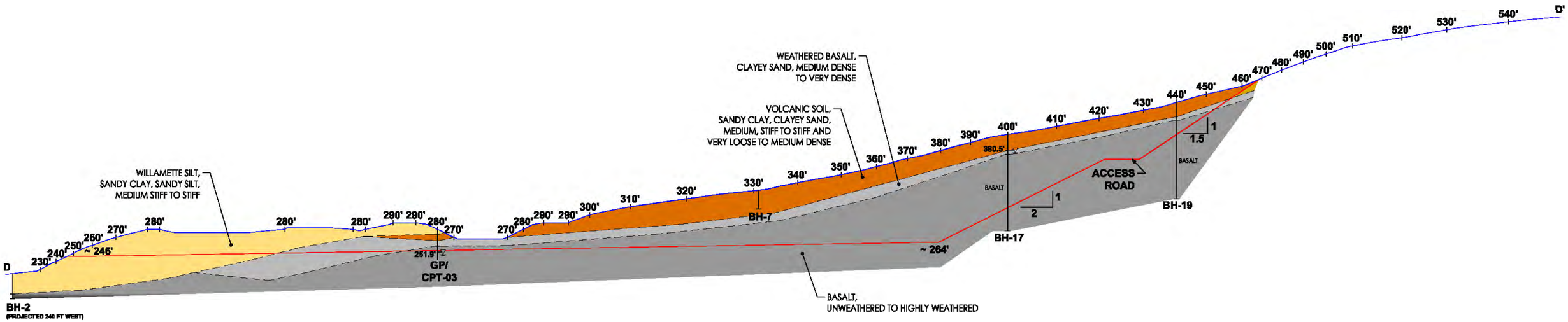
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WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

CROSS-SECTION C-C'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	October 24, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_7.DWG

FIGURE 7



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE
- GROUNDWATER
- WILLAMETTE SILT
- VOLCANIC SOIL
- WEATHERED BASALT
- BASALT

GRAPHIC SCALE

0 30 60 120 240

(IN FEET)

1 inch = 120 ft.

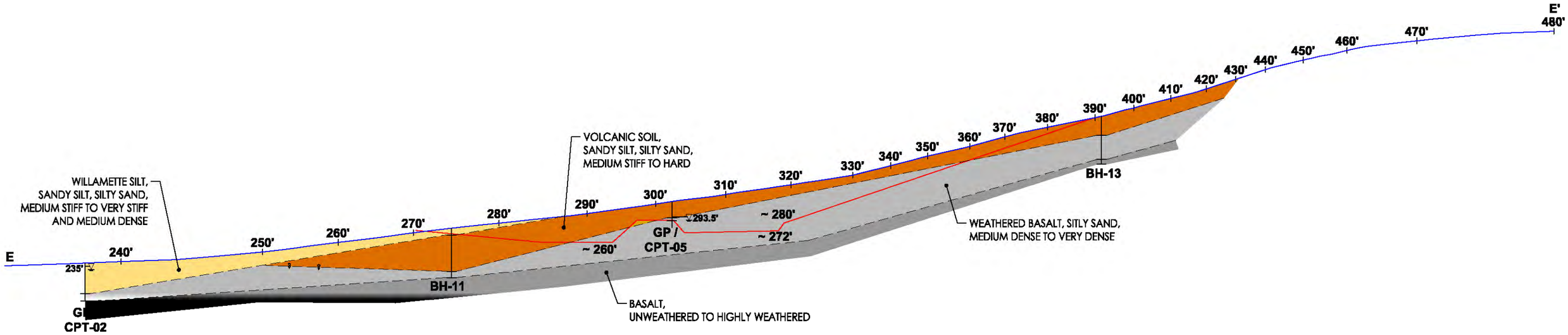
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WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

CROSS-SECTION D-D'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	October 24, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_8.DWG

FIGURE 8



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE
- GROUNDWATER
- WILLAMETTE SILT
- VOLCANIC SOIL
- WEATHERED BASALT
- BASALT

GRAPHIC SCALE

0 25 50 100 200

(IN FEET)

1 inch = 100 ft.

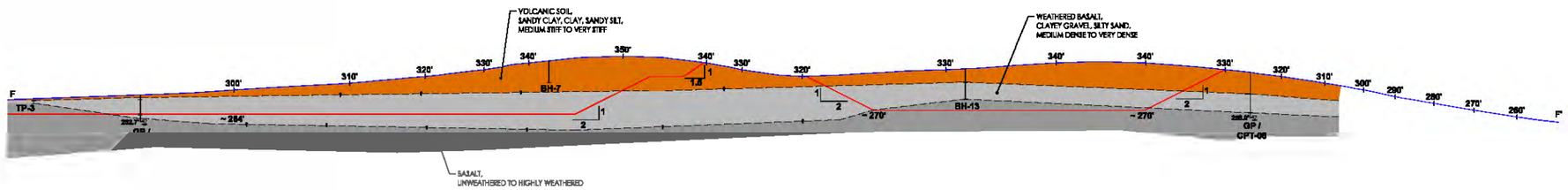
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WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

CROSS-SECTION E-E'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	October 24, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_9.DWG

FIGURE 9



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE
- GROUNDWATER
- VOLCANIC SOIL
- WEATHERED BASALT
- BASALT

GRAPHIC SCALE

0 50 100 200 400

(IN FEET)

1 inch = 200ft.

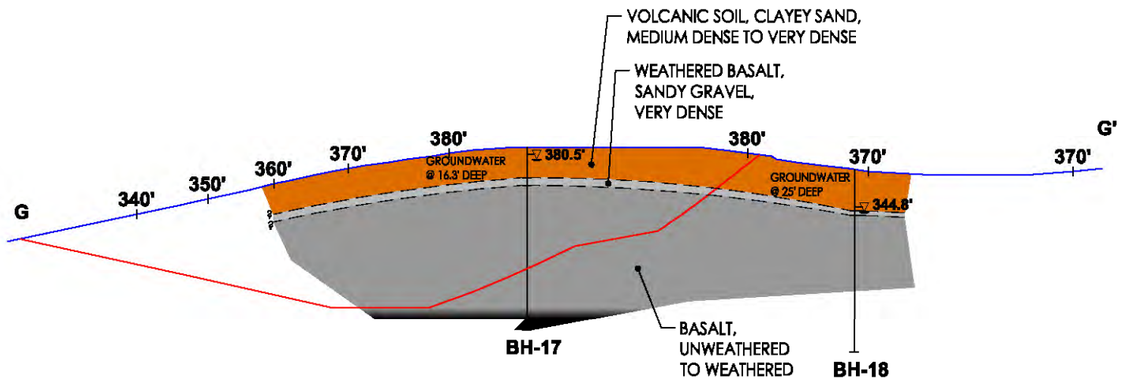
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WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

CROSS-SECTION F-F'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	October 24, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_10.DWG

FIGURE 10



LEGEND

- EXISTING 10-FT CONTOUR
- ISOPACH 10-FT CUT LINE
- GROUNDWATER
- VOLCANIC SOIL
- WEATHERED BASALT
- BASALT

GRAPHIC SCALE

0 25 50 100 200

(IN FEET)

1 inch = 100 ft.

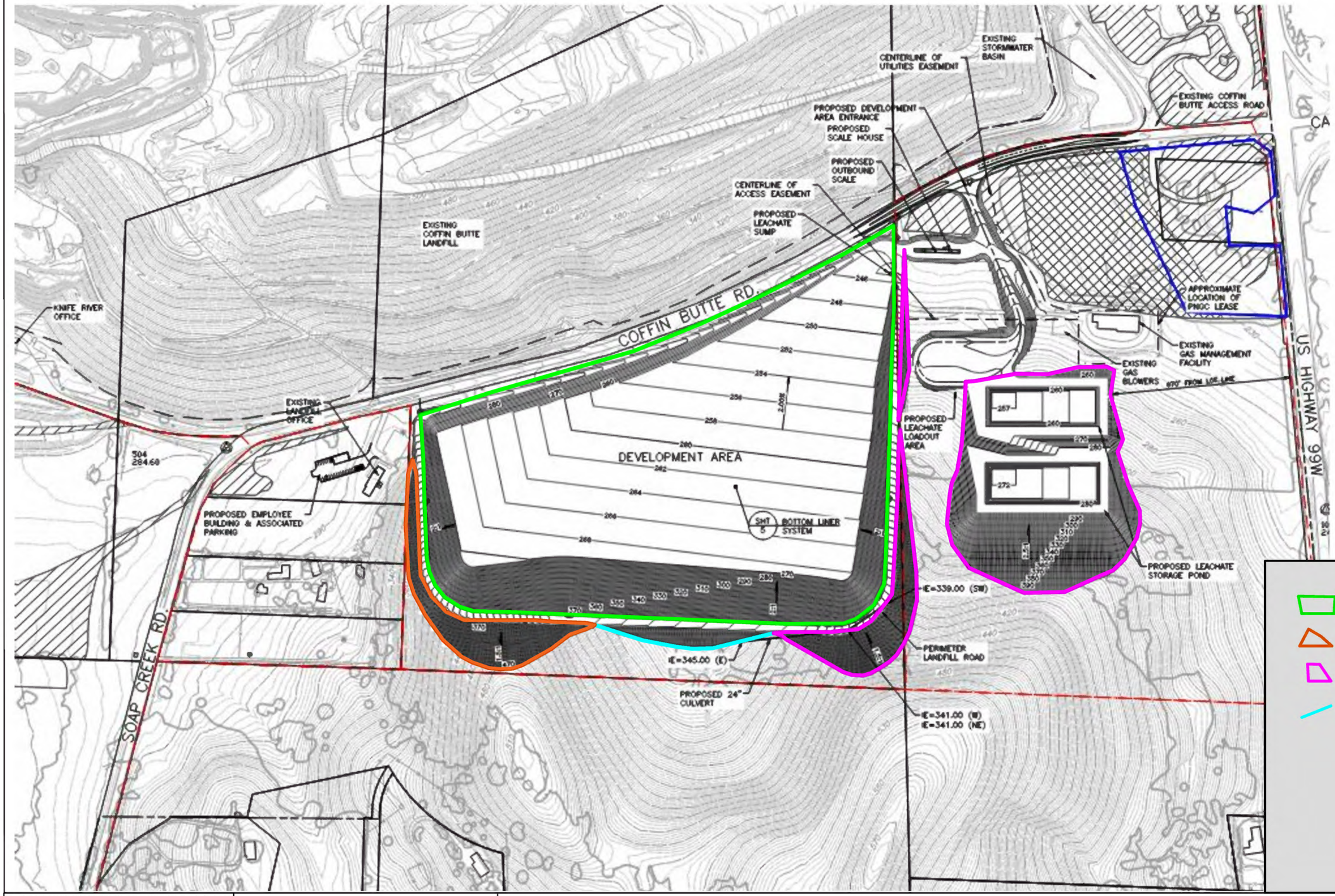
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WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

CROSS-SECTION G-G'
VALLEY LANDFILL INC.
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No.:	23050 (1)
DRAWN:	October 24, 2023
DRAWN BY:	DTJ
CHECKED BY:	LS
FILE NAME:	23050 (1)_FIGURE_11.DWG

FIGURE 11



LEGEND

- PROPERTY BOUNDARY
- EXISTING LANDFILL BOUNDARY
- TAX LOT BOUNDARY
- ZONING BOUNDARY
- WETLAND MITIGATION BOUNDARY
- 300 EXISTING 10-FT CONTOUR
- EXISTING 2-FT CONTOUR
- EXISTING PALUSTRINE FORESTED WETLAND
- EXISTING PALUSTRINE EMERGENT WETLAND
- 250 PROPOSED 10-FT CONTOUR
- 254 PROPOSD 2-FT CONTOUR

NOTES

1. TAX LOT BOUNDARIES FROM BENTON COUNTY ZONING MAP PANEL 41047C0975G, DATED 01/19/2000 (TAX LOT BOUNDARIES MAY DIFFER FROM ZONING DATED 2021).
2. PERIMETER LANDFILL ROAD WILL ONLY BE FOR PICKUP TRUCKS OR SMALLER VEHICLES.

LEGEND

- 0.75 to 1 (H to V) in rock
  2 to 1 (H to V) in soil
- 0.75 to 1 (H to V) in rock
  1.5 to 1 (H to V) in soil
- 2.5 to 1 (H to V)
- Concrete v - ditch

N

APPROXIMATE SCALE
1" = 5,000'

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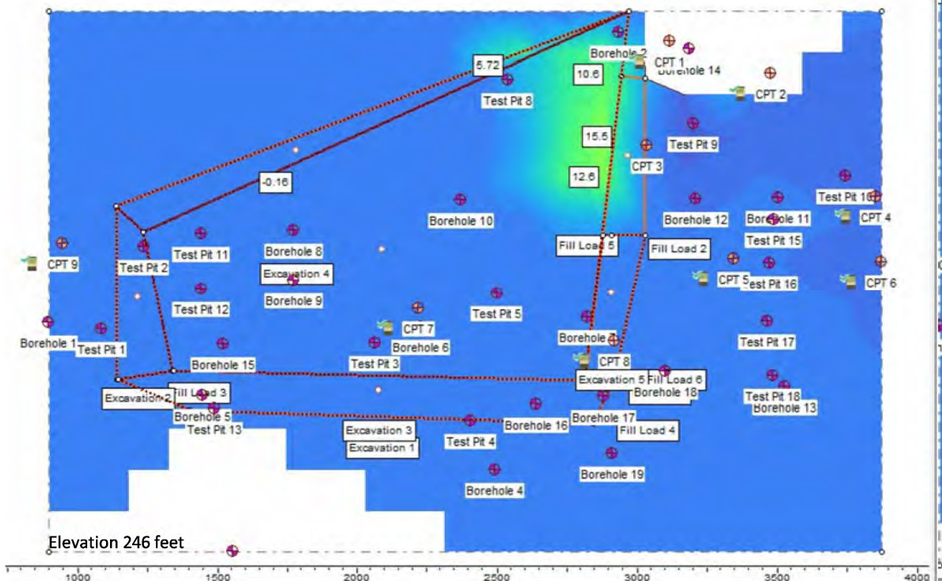
WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

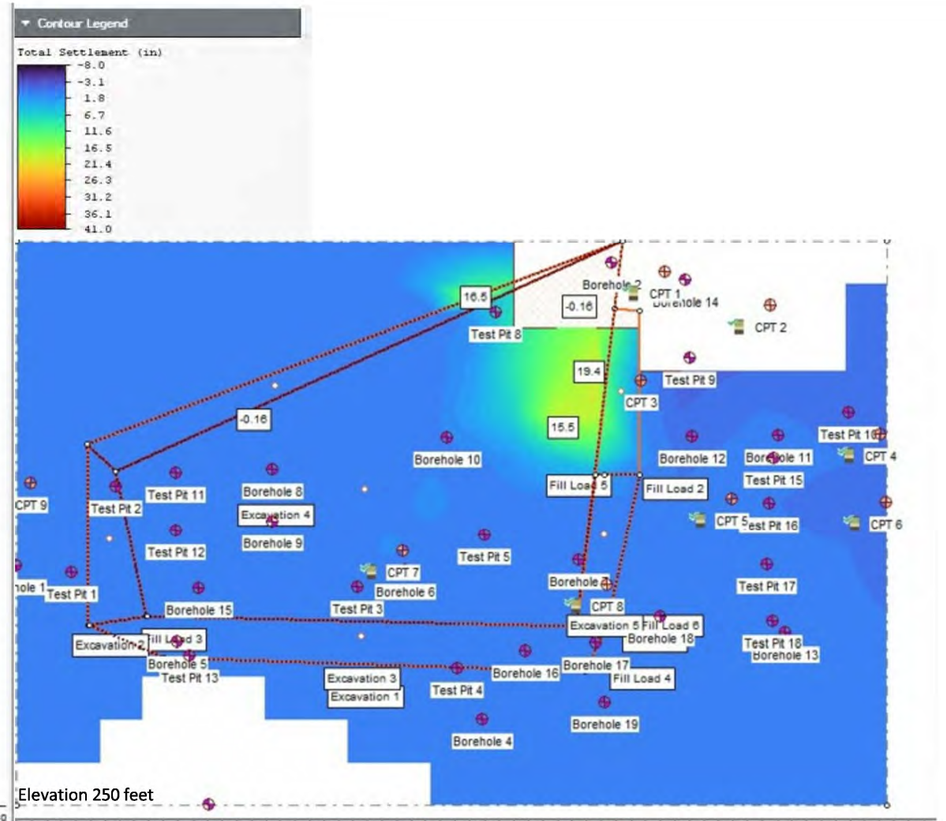
EXCAVATION PLAN
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

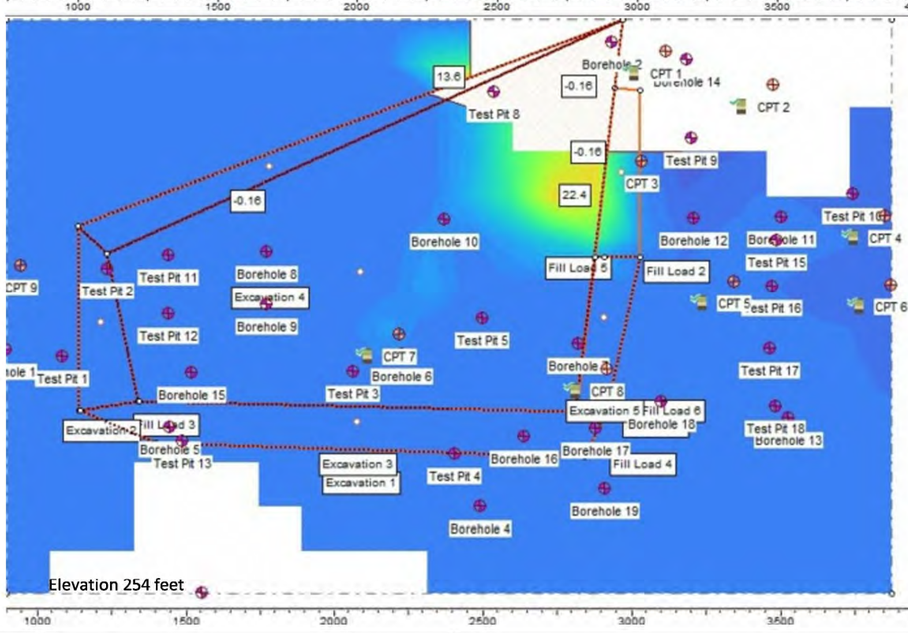
PROJECT No:	21129 (1)
DRAWN:	June 4, 2024
DRAWN BY:	KAK
CHECKED BY:	LMS
FILE NAME:	21129 (1) Figure 12

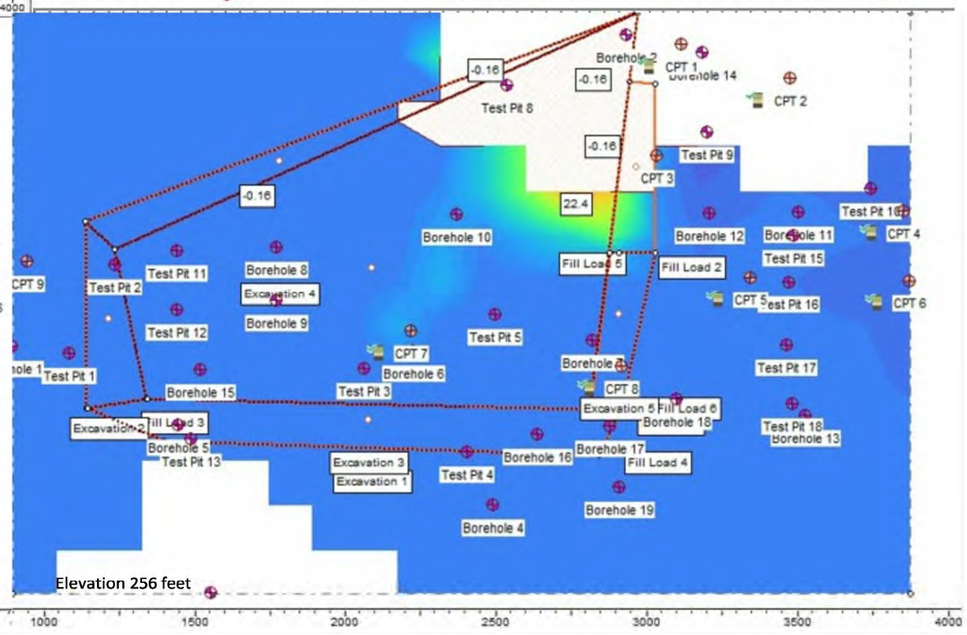
FIGURE: 12

Material Name	Color	Unit Weight (kips/ft3)	Sat. Unit Weight (kips/ft3)	Es (ksf)	Eur (ksf)	Poisson Ratio	Material Type	Cc/Cce	Cr/Cre	Pc (ksf)	Ca	Car	Secondary Consol. Method
Weak Volcanic Soil		0.089	0.095	220	220	0.3	Non-Linear	0.3	0.04	5.3	0.0165	0.0165	Standard
Dense Volcanic Soil		0.105	0.11	250	250	0.35	Non-Linear	0.17	0.02	15			
Basalt Rock		0.137	0.137			0.35							
Desiccated Weak Volcanic		0.09	0.09	220	220	0.2	Non-Linear	0.3	0.1	7.5	0.0165	0.0165	Standard









N

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WALLACE GROUP
NORTHWEST GEOSYSTEM EXPERTS

SETTLEMENT ESTIMATES VS. GROUND SURFACE ELEVATION
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

PROJECT No:	21129 (1)
DRAWN:	June 7, 2024
DRAWN BY:	KAK
CHECKED BY:	LMS
FILE NAME:	21129 (1) Figure 13

FIGURE: 13

EXHIBIT 6
WELL LOGS FOR PW-2 AND BERKLAND WELL

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

Bert 2144

WATER WELL REPORT

STATE OF OREGON
(Please type or print)
(Do not write above this line)

EMCON 176

RECEIVED
MAY 24 1978
WATER RESOURCES DEPT.
SALEM, OREGON

State Well No. 10S/5W-2
State Permit No.

(1) OWNER:
Name John Wilkenson
Address 27460 Fern Ridge Rd.
Sweet Home Ore.

(2) TYPE OF WORK (check):
New Well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary [X] Driven [ ]
Cable [ ] Jetted [ ]
Dug [ ] Bored [ ]

(4) PROPOSED USE (check):
Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

CASING INSTALLED:
Threaded [ ] Welded [X]
6" Diam. from 0 ft. to 20 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? [ ] Yes [X] No
Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? [ ] Yes [X] No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [X] No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " "
"Tested w/Air 15gpm" " "
Bailer test gal./min. with 89 ft. drawdown after 1 hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Cement
Well sealed from land surface to 18 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 12 sacks
How was cement grout placed? poured
Was a drive shoe used? [X] Yes [ ] No Plugs Size: location ft.
Did any strata contain unusable water? [ ] Yes [X] No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? [ ] Yes [X] No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Benton Driller's well number
¼ ¼ Section 24 T. 10S R. 5W W
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 196
Static level 31 ft. below land surface. Date 5/1
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6"
Depth drilled ft. Depth of completed well
Formation: Describe color, texture, grain size and structure of materi and show thickness and nature of each stratum and aquifer penetra with at least one entry for each change of formation. Report each chang position of Static Water Level and indicate principal water-bearing str

MATERIAL	From	To	SW
Topsoil	0	5	
Brown Broken Basalt	5	18	
Blue basalt	18	114	
Blue sandstone	114	138	
Blue basalt	138	158	
Blue sandstone	158	220	

Work started 4/27/78 19 Completed 5/1/78 19
Date well drilling machine moved off of well 5/1/78 19

Drilling Machine Operator's Certification:
This well was constructed under my direct supervisi Materials used and information reported above are true to best knowledge and belief.
[Signed] Claude Imbrie (Drilling Machine Operator) Date 5/8, 19
Drilling Machine Operator's License No. 1133

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report true to the best of my knowledge and belief.
Name Bert Jones (Person, firm or corporation) (Type or print)
Address 29400 Santiam Hwy Lebanon
[Signed] Bert Jones (Water Well Contractor)
Contractor's License No. 514 Date 5/8/78, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	PW-2
LOCATION	Benton County, Oregon	PAGE	1 OF 5
DRILLED BY	Staco Well Services	REFERENCE ELEV.	248.90'
DRILL METHOD	Air rotary	TOTAL DEPTH	199.00'
LOGGED BY	Craig D. Fanshier	DATE COMPLETED	7/30/92

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
				5				0-6 feet: SILTY CLAY (CL), brown, hard, dry. (ALLUVIUM)
				10				6-8 feet: GRAVELLY CLAY (CL), brown, 60-80% clay, soft, 20-40% gravel (medium grain gray basalt), dry.
								8-14 feet: SILTY CLAY (CL), light brown, low plasticity, damp.
				15				14-43 feet: GRAVELLY CLAY (CL), light brown to light yellowish brown clay, low plasticity, 20-30% gravels (1/8-1/2").
			▼ 17' 7/30/92	20				
				25				
				30				
				35				
			▽ 39' 7/29/92	40				
				45				43-89 feet: BASALT, brown to gray, 5% green, 5% purple tint, fine to medium grained, moderately weathered.
				50				

REMARKS

Boring drilled with air rotary using a 10-inch downhole hammer to 94 feet bgs and with a 6-inch downhole hammer from 94 to 199 feet bgs.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	PW-2
LOCATION	Benton County, Oregon	PAGE	2 OF 5
DRILLED BY	Staco Well Services	REFERENCE ELEV.	248.90'
DRILL METHOD	Air rotary	TOTAL DEPTH	199.00'
LOGGED BY	Craig D. Fanshier	DATE COMPLETED	7/30/92

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
				55				**43-89 feet: BASALT,** brown to gray, 5% green, 5% purple tint, fine to medium grained, moderately weathered.
								@ 52-57 feet: No green or purple tint.
				60				@ 57 feet: Easier drilling, trace quartz and plagioclase.
				65				@ 65 feet: Traces of quartz or plagioclase.
				70				@ 71-72 feet: Easier drilling.
				75				
				80				
				85				@ 85 feet: Harder drilling.
				90				**89-199 feet: BASALT,** 60% greenish gray, 40% purple tint, fine to medium grained. Fresh basalt.
				95				@ 95 feet: Borehole produces approximately 10 gpm water by air lifting through the drill pipe using the drilling air compressor.
				100				

REMARKS

Boring drilled with air rotary using a 10-inch downhole hammer to 94 feet bgs and with a 6-inch downhole hammer from 94 to 199 feet bgs.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	PW-2
LOCATION	Benton County, Oregon	PAGE	3 OF 5
DRILLED BY	Staco Well Services	REFERENCE ELEV.	248.90'
DRILL METHOD	Air rotary	TOTAL DEPTH	199.00'
LOGGED BY	Craig D. Fanshier	DATE COMPLETED	7/30/92

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
				105				89-199 feet: BASALT, 60% greenish gray, 40% purple tint, fine to medium grained. Fresh basalt.
				110				
				115				
				120				
				125				
				130				
				135				
				140				
				145				
				150				

REMARKS

Boring drilled with air rotary using a 10-inch downhole hammer to 94 feet bgs and with a 6-inch downhole hammer from 94 to 199 feet bgs.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	PW- 2
LOCATION	Benton County, Oregon	PAGE	4 OF 5
DRILLED BY	Staco Well Services	REFERENCE ELEV.	248.90'
DRILL METHOD	Air rotary	TOTAL DEPTH	199.00'
LOGGED BY	Craig D. Fanshier	DATE COMPLETED	7/30/92

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
				155				89-199 feet: BASALT, 60% greenish gray, 40% purple tint, fine to medium grained. Fresh basalt.
				160				
				165				
				170				
				175				
				180				
				185				
				190				
				195				
				200				

REMARKS

Boring drilled with air rotary using a 10-inch downhole hammer to 94 feet bgs and with a 6-inch downhole hammer from 94 to 199 feet bgs.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	PW- 2
LOCATION	Benton County, Oregon	PAGE	5 OF 5
DRILLED BY	Staco Well Services	REFERENCE ELEV.	248.90'
DRILL METHOD	Air rotary	TOTAL DEPTH	199.00'
LOGGED BY	Craig D. Fanshier	DATE COMPLETED	7/30/92

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
				205 210 215 220 225 230 235 240 245 250				Total depth drilled 199 feet below ground surface. Total depth sampled 199 feet below ground surface. **WELL COMPLETION DETAILS:** 0-94 feet: Bentonite grout slurry surface seal. +1.37-94 feet: 6-inch dia., 0.250-inch steel surface casing. 94-199 feet: Open borehole. 1.3-199 feet: 4.5-inch Class 160 PVC liner. 149-199 feet: 0.5-inch drilled perforation, 4 per foot (around circumference). End cap: PVC slip cap. **BOREHOLE DIMENSIONS:** 0-94 feet: 10-inch. 94-199 feet: 6-inch.

REMARKS

Boring drilled with air rotary using a 10-inch downhole hammer to 94 feet bgs and with a 6-inch downhole hammer from 94 to 199 feet bgs.

EXHIBIT 7
LETTER FROM JEFF SHEPHERD AND PAUL BURNS OF CEC REGARDING APPLICABLE OREGON DEQ PERMITS

February 26, 2024

Mr. Ian Macnab
Environmental Manager
Republic Services, Inc.
28972 Coffin Butte Rd
Corvallis, OR 97330

Subject: Oregon Department of Environmental Quality
Required Landfill Permits

Dear Mr. Macnab;

CEC has compiled the following information to provide an overview of the Oregon Department of Environmental Quality (ODEQ) permits required for the expansion of the Coffin Butte Landfill. The Coffin Butte Landfill holds permits for the existing facility and operation, but will need to obtain permit modifications from the ODEQ for approval to expand the landfill.

Modifications to the existing permits will be required for the ODEQ Solid Waste Facility Permit, the ODEQ 1200-Z stormwater Permit and the ODEQ title V (Air) Operating Permit. Following is a brief overview of each permit. The information in the overview is from the ODEQ Solid Waste Landfill Guidance Document, Department of State Lands website and ODEQ Air Quality and Water Quality websites.

As noted in the bulleted list below, a Land Use Compatibility Statement (LUCS) must accompany the application for the ODEQ permit modification application. Upon completion of the land use process by Benton County (Republic Services Conditional Use Permit Application), the County planning office completes Section 2 of the LUCS to indicate the use is compatible with the land use regulations and attaches written findings supporting the decision of compatibility. The LUCS will be included in the ODEQ Solid Waste Facility permit modification application.

ODEQ Solid Waste Permit:

The following documentation and information must be included with the permit application:

- A Land Use Compatibility Statement
- A recommendation from the local solid waste planning authority
- Demonstration of the need for a new, modified or expanded facility
- A Certificate of Business Registry
- Identifying any other known or anticipated permits
- Application fee and compliance fees (if required)
- Any other information DEQ deems necessary

Solid Waste facility Permit applications must include the following information:

Section 1: Location Restrictions

The location restrictions address the following:

- Airport safety
- Flood plains
- Wetlands
- Fault areas
- Seismic impact zones
- Unstable areas
- Critical habitat
- Sensitive hydrogeologic environments

Section 2: Phase I Site Characterization

- Phase I Site Characterization, the initial stage of data collection, establishes a preliminary framework for understanding the soils, geology and hydrogeology and plans the Phase II Site Characterization

Section 3: Phase II Site Characterization

- Phase II Site Characterization evaluates subsurface conditions in greater detail including the depth and extent of the uppermost (water bearing) geologic units and hydraulically interconnected units, the lithologic and hydraulic properties of these units, groundwater flow patterns, and other factors

Section 4: Geotechnical Investigations

- Phase I Geotechnical Investigation - Conduct a preliminary geotechnical investigation designed to accomplish the following objectives:
  - Characterize the variability, depth, aerial extent and engineering properties of on-site soils and other overburden deposits
  - Inventory soils and other overburden deposits suitable for use in construction, and identify the proposed use for these materials
  - Identify geotechnical considerations (such as settlement and slope stability) which must be addressed in the engineering design and/or further characterized by a Phase II Geotechnical assessment, and
  - Develop a work plan for conducting a Phase II Geotechnical investigation, as necessary, to adequately characterize on-site soils and other geotechnical considerations
- Phase II Geotechnical Investigation
  - Perform additional geotechnical investigations as required in the Phase II work plan and for design calculations and analyses.

Section 5: Conceptual Design of Landfill Facilities

- This section describes the elements of a Site Development Plan, including:
  - Facility operation
  - Conceptual design of landfill facilities
  - Leachate management
  - Surface water management
  - Landfill gas management
  - Environmental monitoring
  - Closure and end use
  - Supporting information

Section 6: Leachate Treatment and Disposal Feasibility Study

- Available leachate treatment alternatives should be evaluated. Methods that reflect site-specific conditions, and a full consideration of cross-media impacts should be selected for the facility

Section 7: Detailed Design

This section provides guidance on preparing detailed design plans and specifications for the following environmental control systems:

- Liner system
- Soil liner component
- Geomembrane component
- Primary leachate collection and removal system
- Secondary leachate collection and removal system
- Leachate treatment and storage impoundments
- Leachate holding tanks and conveyance pipelines
- Leachate treatment process
- Final cover system
- Surface water control system, and
- Landfill gas control system

Section 8: Facility Construction Program

The facility construction program should include the following elements:

- An organized, qualified construction project team
- Department-approved design drawings and specifications for each phase of landfill development
- A Construction Quality Control (CQC) program
- A Construction Quality Assurance (CQA) program, and
- Construction Certification Reports based on an evaluation of CQC and CQA documentation which certify that construction was completed in accordance with Department-approved plans and specifications

Section 9: Landfill Operations

- During the design phase of the project, prepare an operations plan that integrates the site development plan, the facility design elements, and the operational elements described in this subsection. Submit the plan to DEQ for review and approval.
- Once the landfill unit and related facilities are constructed and activated, prepare the O&M manual. Incorporate the operations plan elements, construction documents, and equipment manufacturers and suppliers data. Prepare separate O&M manuals for complex systems, such as leachate treatment systems, landfill gas control systems. Make the O&M manual available to operating personnel and place a copy of the manual(s) in the facility operating record.

Section 10: Environmental Monitoring

- Prepare and submit an Environmental Monitoring Plan (EMP) report to the Department for review and approval. Upon approval, all environmental monitoring must be conducted in accordance with the EMP, including any conditions of the approval. The plan should be stamped by an Oregon Registered Geologist with experience in environmental monitoring.
- The following regulations govern environmental monitoring:
  - 40 CFR Part 258, Solid Waste Disposal Facility Criteria
  - OAR 340 Division 94, Solid Waste Management
  - OAR 340 Division 40, Groundwater Quality Protection

Section 11: Closure and Post-Closure

- Minimum requirements for closure plans and post-closure plans for MSW landfills are specified in the Department's Financial Assurance Rule, OAR 340-94-100 through 145. The closure and post-closure requirements for Subtitle D landfills differ from those of non-Subtitle D MSW landfills (i.e., closing facilities).
- There are two separate categories of closure and post-closure plans:
  - Subtitle D ("worst case") Closure and Post-closure Plans are based on a hypothetical "worst case" scenario for closure and post-closure costs. This scenario establishes a conservative basis for estimating financial assurance funding requirements.

The Final Engineered Site Closure and Post-closure Plans are linked to the Closure Permit which must be obtained at least 5 years prior to anticipated final closure. The Final Engineered plans reflect the intended closure design. The Final Engineered plans contain all the elements of and replaces the Subtitle D plans.

Section 12: Financial Assurance

- Proper financial planning early in the development of landfill facilities is required to ensure that adequate funding will be available to cover the cost of closure(s), post-closure care, and any corrective action activities

- Maintain financial assurance to cover the costs of:
  - Closure of the landfill
  - Post-closure monitoring and maintenance of the landfill facilities, and
  - Any corrective action required by the Department

Two other Oregon Department of Environmental Quality Permits that are required for the landfill include:

Stormwater 1200-Z Industrial Stormwater General Permit –

- This permit regulates stormwater discharges from industrial facilities that may reach Oregon waterways, directly or through conveyance system such as ditches or storm drains.

The 1200-Z Permit modification is prepared and submitted to ODEQ concurrently with the ODEQ Solid Waste Facility permit modification process.

Oregon Title V (Air) Operating Permit -

- Air quality permits include enforceable conditions with which the owner or operator of a facility must comply. Some permit conditions are general to all types of emission units, and some permit conditions are specific to the source. The permit establishes limits on the types and amounts of air pollution allowed, operating requirements for pollution control devices or pollution prevention activities, and monitoring and reporting requirements

The Title V (Air) Operating Permit modification is prepared and submitted once the ODEQ Solid Waste Facility permit is issued.

A new permit which will be required for the project includes a Removal-Fill Permit for activity associated with fill required to construct an access road in a small area of wetland in the northeast corner of the development area (south side of Coffin Butte Road).

Oregon Department of State Lands Removal-Fill Permit

- Oregon's Removal-Fill Law (ORS 196.795-990) requires people who plan to remove or fill material in wetlands or waterways to obtain a permit from the Department of State Lands. This permit is broadly referred to as the "Removal-Fill Permit." The law applies to all landowners, whether private individuals or public agencies

Please let us know if you have any questions.

Sincerely;
Civil & Environmental Consultants, Inc.

Jeffery A. Shepherd, P.E.
Principal

Paul F. Burns
Principal

Attachment – ODEQ Solid Waste Landfill Guidance Document

ATTACHMENT

Section 1: Location Restrictions

1.1 Introduction

Regulatory reference

OAR 340-94-030 and 40 CFR Part 258 include location restrictions for new landfills or lateral expansions of existing landfills.

Location restrictions

The location restrictions address the following:

- airport safety
- flood plains
- wetlands
- fault areas
- seismic impact zones
- unstable areas
- critical habitat
- sensitive hydrogeologic environments

In this section

This section provides guidance on

- how to determine if the proposed new or lateral expansion of an existing municipal solid waste landfill is located in a restricted area, and
- how to make the associated location restriction demonstrations

How to respond

Complete the appropriate location restriction demonstrations and place the associated documentation in the facility operating record. Notify the Department when the demonstration has been placed in the operating record. Cite all sources used in making each of the analyses and demonstrations.

Inadequate demonstrations

If an existing landfill unit cannot successfully meet the location restrictions, then the unit must be closed in accordance with OAR 340-94-120 and post-closure activities must be conducted in accordance with OAR 340-94-130.

Related information

Site Characterization Reports, Site Geotechnical Investigations, and the facility conceptual design should provide relevant information for making location restriction demonstrations.

1.2 Airport Safety

Notification to FAA

Determine if the proposed new or lateral expansion of an existing municipal solid waste landfill is located within a five-mile (eight kilometer) radius of any airport runway end used by turbojet or piston-type aircraft. If so, notify the affected airport and the Federal Aviation Administration (FAA).

Need for demonstration

Determine if the proposed new or lateral expansion of an existing municipal solid waste landfill is within

- 10,000 feet (3,048 meters) of any airport runway end used by turbojet aircraft, or
- 5,000 feet (1,524 meters) of any airport runway end used by only piston-type aircraft

If so, demonstrate that the landfill is designed and operated so that the landfill does not pose a bird hazard to aircraft. Include a copy of the notifications, and any responses received from the FAA or affected airport.

The hazard of birds

Birds may be attracted to landfill units to satisfy a need for water, food, nesting, or roosting. Scavenger birds such as starlings, crows, blackbirds, and gulls are most commonly associated with active landfill units. Where bird/aircraft collisions occur, these types of birds are often involved due to their flocking, feeding, roosting, and flight behaviors.

Bird hazard demonstration

A demonstration that a landfill unit does not pose a bird hazard to aircraft within specified distances of an airport runway end should address at least the following elements:

- regulated distance
- public use
- collision risk
- landfill operation and design

Demonstration of regulated distance

The distance measurement can be made using existing maps showing the relationship of existing runways at the airport to the existing or proposed new unit or lateral expansion. The measurement can be made by drawing a circle of appropriate radius from the centerline of each runway end. The measurement only should be made between the end of the runway and the nearest landfill unit perimeter, not between any other boundaries.

Maps: Topographic maps (USGS 15-minute series) or State, regional, or local government agency maps providing similar or better accuracy would allow direct scaling, or measurement, of the closest distance from the end of a runway to the nearest landfill unit

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Demonstration of public use

The demonstration of whether the runway is part of a public use airport and whether all applicable public airports have been identified can be made by contacting the airport administration or the regional FAA office.

Note: The demonstration is not required for private airfields

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Demonstration of collision risk

The demonstration should address the likelihood that the landfill unit may increase bird/aircraft collisions. One approach is to determine whether birds are attracted to the landfill unit and whether this increased population may result in more in bird/aircraft collisions. The evaluation of bird attraction can be based on field observations at existing facilities that have similar geographic location, design features, and operational procedures.

Demonstration of landfill operation and design

The landfill unit design features and operational practices significantly effect the potential for bird/aircraft collisions. The demonstration should include a discussion of techniques to reduce collision risk. The following landfill design and operation techniques may be employed to reduce the bird hazard to aircraft:

- waste management
- bird control
- landfill design

Waste management techniques

Waste management techniques to reduce the supply of food to these birds include:

- frequent covering of wastes
- shredding, milling, or baling wastes, and
- diverting wastes that represent a food source for birds by source separation, composting, waste minimization, or other methods

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Frequent covering

Frequent covering of wastes effectively reduces the availability of the food supply. Depending on site operations, cover may need to be applied several times a day to minimize the working face.

Shredding, milling, or baling

Milling or shredding municipal solid waste breaks up food waste into smaller particle sizes and distributes the particles throughout non-food wastes, which dilutes food wastes and reduces the materials' attractiveness to birds.

Bird control techniques

The use of varying bird control techniques may prevent the birds from adjusting to a single method. The table below provides examples of various techniques. Many of these methods have limited long-term effects on controlling bird populations at landfills, as the birds adapt to the environment in which they find food.

Bird control technique	Example
visual deterrents	realistic models (still or animated) of the bird's natural predators (e.g., humans, owls, hawks, falcons)
sounds	cannons, distress calls of the scavenger birds, and sounds of its natural predators
physical barriers	fine wires strung across or near the working face
other more labor intensive methods	falconry and firearms

Landfill design

Proper design and operation can also reduce bird habitat. For example, good stormwater management can prevent surface water ponding, which limits a source of water for the birds.

Birds may also be attracted to a landfill unit as a nesting area. Closed landfill cells may provide a roosting habitat due to elevated ground temperatures and freedom from disturbance. Nesting can be minimized by examining the nesting patterns and requirements of undesirable birds and designing appropriate controls. For example, nesting by certain species can be controlled through the mowing and maintenance schedule at the landfill.

1.3 Floodplains

Need for demonstration

Determine if the proposed new or lateral expansion of an existing solid waste landfill is located in a 100-year floodplain. If so, demonstrate that the landfill will not:

- restrict the flow of the 100-year flood
- reduce the temporary water storage capacity of the floodplain, or
- result in washout of solid waste that poses a hazard to human health, the environment, wildlife, or land or water resources

Identification of floodplains

Identify floodplains using:

- flood insurance rate maps (FIRM) and flood boundary and floodway maps published by the Federal Emergency Management Agency (FEMA), or
- floodplain maps available through other agencies such as the U.S. Army Corps of Engineers; the U.S. Geologic Survey, the U.S. Soil Conservation Service, the Bureau of Land Management and state and local agencies

Maps not available: If floodplain maps are not available, and the facility is located within a floodplain, then a field study to delineate the 100-year floodplain may be required

Demonstration of temporary storage

To demonstrate that the facility does not significantly reduce the temporary storage capacity of the floodplain during the base flood, estimate the

- floodplain storage capacity that would likely exist in absence of the facility
- floodplain storage capacity available in the vicinity of the facility, and
- change in storage capacity and base flood elevation due to facility construction

Demonstration of washout

The location of facilities relative to the velocity distribution of floodwaters will greatly influence the susceptibility to washout. To demonstrate that the facility will not result in washout of solid wastes, provide a conservative estimate of the shear stress of the landfill components caused by the depth, velocity, and duration of impinging river waters during a 100-year storm event.

1.4 Wetlands

Need for demonstration

Determine and describe whether the proposed new or lateral expansion of an existing municipal solid waste landfill is located in wetlands. If so, demonstrate that the unit will not cause or contribute to significant degradation of the wetland.

Other required permits

If the municipal solid waste landfill unit is to be situated or significantly expanded in wetlands, then consult with and obtain a permit from the Corps of Engineers (COE). Include a copy of the permit or permit application in the demonstration, if applicable.

Reference: Section 404(b)(1) of the Clean Water Act

Involvement of other agencies

During the permitting process, the Department and the State Division of Lands will need to be contacted to schedule a site visit. In general, the COE will require notification and/or consultation on any proposed impact on any wetland regardless of the actual degree of the impact. Other agencies such as the Fish and Wildlife Service and the SCS may also need to be contacted.

Mitigation

Mitigation plans must be approved by the appropriate regulatory agencies and must achieve an agreed-upon measure of success. Examples of mitigation include restoration of degraded wetlands or creation of wetland acreage from existing uplands.

Wetlands identification

Wetlands are identified based on the presence of hydric soils, hydrophytic vegetation, and the wetland hydrology. These characteristics affect the functional value of a wetland in terms of its role in:

- supporting fish and wildlife habitats
- providing aesthetic, scenic, and recreational value
- accommodating flood storage
- sustaining aquatic diversity, and
- its relationships to surrounding natural areas through nutrient retention and productivity exportation (e.g., releasing nutrients to downstream areas, providing transportable food sources)

Examples of wetlands

The term "wetlands" includes swamps, marshes, bogs, and any areas that are inundated or saturated by ground water or surface water at a frequency and duration to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions.

Wetlands assessment

A wetland assessment will need to be conducted by a qualified and experienced multi-disciplinary team. The assessment should identify:

- the limits of the wetland boundary based on hydrology, soil types and plant types
- the type and relative abundance of vegetation, including trees, and
- rare, endangered, or otherwise protected species and their habitats (if any)

Delineation methods

The current methods used to delineate wetlands are presented in "COE Wetlands Delineation Manual," 1987, per a January 1993, EPA and COE agreement. The Federal manual for “Identifying and Delineating Jurisdictional Wetlands” (COE, 1989) contains an extensive reference list of available wetland literature. For example, lists of references for the identification of plant species characteristic of wetlands throughout the United States, hydric soils classifications, and related wetland topics are presented. USGS topographic maps, National Wetland Inventory (NWI) maps, Soil Conservation Service (SCS) soil maps, wetland inventory maps, and aerial photographs prepared locally also may provide useful information.

Evaluation of wetland value

Evaluation of ecological resource protection may include assessment of the value of the affected wetland.

Methods for evaluating wetland value

Available methods include:

- analysis of functional value
- the Wetland Evaluation Technique (WET), and
- the Habitat Evaluation Procedure (HEP)

The most appropriate technique for a specific site should be selected in conjunction with the Department and other applicable regulatory agencies.

Analysis of functional value

The functional value of a given wetland is dependent on its soil, plant, and hydrologic characteristics, particularly the diversity, prevalence, and extent of wetland plant species. The relationship between the wetland and surrounding areas (nutrient sinks and sources) and the ability of the wetland to support animal habitats, or rare or endangered species, contributes to the evaluation of functional value.

WET

Wetland Evaluation Technique (WET) allows comparison of the values and functions of wetlands before and after construction of a facility, thereby projecting the impact a facility may have on a wetland. WET was developed by the Federal Highway Administration and revised by the COE (Adamus *et al.*, 1987).

HEP

Habitat Evaluation Procedure (HEP) was developed by the Fish and Wildlife Service to determine the quality and quantity of available habitat for selected species. HEP and WET may be used in conjunction with each other to provide an integrated assessment.

Locating in a wetlands

Erosion potential and stability of wetland soils and any dredged or fill material used to support the landfill unit should be identified as part of the wetlands evaluation. Any adverse stability or erosion problems that could affect the landfill or contaminant effects that could be caused by the landfill unit should be resolved.

Minimizing impacts

All practicable steps are to be taken to minimize potential impacts of the landfill unit to wetlands. A number of measures that can aid in minimization of impacts are available. Appropriate measure are site-specific and should be incorporated into the design and operation of the landfill unit. For example, placement of ground water barriers may be required if soil and shallow ground water conditions would cause dewatering of the wetland due to the existence of underdrain pipe systems at the facility.

It is possible that the landfill unit/facility will not directly displace wetlands, but that adverse effects may be caused by leachate or run-off. Engineered containment systems for both leachate and run-off should mitigate the potential for discharge to wetlands.

Unavoidable impacts

All unavoidable impacts must be "offset" or compensated for to ensure that the facility has not caused, to the extent practicable, any net loss of wetland acreage. Wetland offset studies require review and development on a site-specific basis. This compensatory mitigation may take the form of

- upgrading existing marginal or lower-quality wetlands, or
- replacement of wetlands

Upgrading existing wetlands

To identify existing wetlands that may be proposed for upgrade, a cursory assessment of surrounding wetlands and uplands should be conducted. The assessment may include a study to define the functional characteristics and inter-relationships of these potential wetland mitigation areas. An upgrade of an existing wetland may consist of transplanting appropriate vegetation and importing low-permeability soil materials that would be conducive to forming saturated soil conditions. Excavation to form open water bodies or gradual restoration of salt water marshes by culvert expansions to promote sea water influx are other examples of compensatory mitigation.

Replacement of wetlands

The Division of State Lands (DSL) has established offset ratios to determine how much acreage of a given functional value is required to replace the wetlands that were lost or impacted. Preservation of lands, such as through perpetual conservation easements, may be considered as a viable offset option. DSL offset ratios require for wetlands of an equivalent functional value, that a larger acreage be created than was displaced.

Monitoring the mitigation

Due to the experimental nature of creating or enhancing wetlands, a monitoring program to evaluate the progress of the effort should be considered and may be required as a wetland permit condition. The purpose of the monitoring program is to verify that the created/upgraded wetland is successfully established and that the intended function of the wetland becomes self-sustaining over time.

1.5 Critical Habitat

Need for demonstration	Determine if the municipal solid waste landfill unit is located where landfill activities could cause or contribute to the reduction of the likelihood of survival and recovery of a threatened or endangered species. If so, demonstrate the measures that will be taken to protect the species. Reference: OAR 340-94-030(3)
Other permits required	If the municipal solid waste landfill unit is to be situated or significantly expanded in a critical habitat, obtain a permit from the Secretary of Interior.
Information on threatened and endangered species	The Oregon Department of Fish and Wildlife maintains an up to date database of information on threatened and endangered species. The database coordinator can be reached at (503) 229-5454.

1.6 Fault Areas

Need for demonstration

Determine if faults, having displacement in Holocene time, are likely or have been identified in the vicinity of the proposed new or lateral expansion of an existing municipal solid waste landfill unit. If so, demonstrate that the landfill:

- is more than 200 feet (60 meters) of a fault that has had displacement in Holocene time, or
- that an alternative setback distance of less than 200 feet (60 meters) will prevent damage to the structural integrity of the landfill unit and protect human health and the environment

Fault danger

Proximity to a fault can cause damage through:

- movement along the fault which can cause displacement of facility structures
- seismic activity associated with faulting which can cause damage to facility structures through vibratory action, and
- earth shaking which can cause ground failures such as slope failures

Locating fault areas

U.S. Geological Survey (USGS) mapping can be used to determine if a proposed landfill unit is located in a Holocene fault area. A series of maps known as the "Preliminary Young Fault Maps, Miscellaneous Field Investigation (MF) 916" was published by the USGS in 1978. For information, call the USGS at 1-800-USA-MAPS (USGS National Center in Reston, Virginia) or by calling (303) 236-7477 (USGS Map Sales Center in Denver, Colorado). The Oregon Division of Geology and Mineral Industries (DGAMI) is a good local source of data on Holocene faults. They can be reached at (503) 731-4444 (Nature of Oregon Information Center).

Locating a fault zone that has moved since the USGS maps and other sources were published may require a geologic reconnaissance of the site and surrounding areas to identify and map these features.

1.7 Seismic Impact Zones

Need for demonstration

Determine if the proposed new or lateral expansion of an existing municipal solid waste landfill is located in a seismic impact zone. If so, demonstrate that all containment structures are designed to resist the maximum horizontal acceleration in lithified earth material for the site. To make the demonstration:

- determine the expected peak ground acceleration from a maximum strength earthquake that could occur in the area
- determine the site-specific seismic hazards such as soil settlement, and
- design the facility to withstand the expected peak ground acceleration

Note: containment structures include liners, leachate collection and storage systems, and surface water control systems

Definition: seismic impact zone

A Seismic Impact Zone is an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth material expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 250 years.

Determining horizontal acceleration

The determination of the maximum horizontal acceleration of the lithified earth material for the site (see Figure 1-1) can be made by reviewing the seismic 250-year interval maps in U.S. Geological Survey Miscellaneous Field Study Map MF-2120, entitled "Probabilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico" (Altermissin *et al*., 1991). To view the original of the map that is shown in Figure 1-1 (reduced in size), contact the USGS office in your area. The original map (Horizontal Acceleration - Base modified from U.S.G.S. National Atlas, 1970, Miscellaneous Field Studies, Map MF 2120) shows county lines within each state. For areas not covered by the aforementioned map, USGS State seismic maps may be used to estimate the maximum horizontal acceleration. The National Earthquake Information Center, located at the Colorado School of Mines in Golden, Colorado, can provide seismic maps of all 50 states.

Other sources of information

The National Earthquake Information Center maintains a database of known earthquakes and fault zones. Information on the location of earthquake epicenters and intensities may be available through DGAMI or the Earthquake Information Center. For information concerning potential earthquakes in specific areas, the Geologic Risk Assessment Branch of USGS may be of assistance. Other organizations that study the effects of earthquakes on engineered structures include the National Information Service for Earthquake Engineering, the Building Seismic Safety Council, the National Institute of Science and Technology, and the American Institute of Architects.

Impact of seismic activity on landfills

Studies indicate that earthquakes produce superficial (shallow) slides and differential displacement, rather than massive slope failures (U.S. Navy 1983). Stresses created by superficial failures can affect the liner system, final cover systems, and leachate and gas collection and removal systems. Tensional stresses within the liner system can result in fracturing of the soil liner and/or tearing of the flexible membrane liner.

Design considerations

The design of the facility slopes, leachate collection system, and other structural components should have built-in conservative design factors. Additionally, redundant precautionary measures should be designed and built into the various landfill systems. Establish precautions using the table below.

If the maximum horizontal acceleration in the area is	and the facility is	then
greater than 0.1g	-----	complete an engineering evaluation of seismic effects when preparing the landfill design
less than 0.1g	situated in an area with low strength foundation soils or soils with potential for liquefaction	complete an engineering evaluation of seismic effects when preparing the landfill design
less than 0.1g	not situated in an area with low strength foundation soils or soils with potential for liquefaction	assess the facility for the effects of seismic activity, and design the landfill accordingly

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Engineering evaluation of seismic effects

The engineering evaluation should examine soil behavior with respect to earthquake intensity, including an evaluation of seismic effects on foundation soil stability and waste stability under seismic loading. When evaluating soil characteristics, it is necessary to know the soil strength as well as the magnitude or intensity of the earthquake in terms of peak acceleration. Other soil characteristics, including degree of compaction, sorting (organization of the soil particles), and degree of saturation, may need to be considered because of their potential influence on site conditions.

Example: deposits of loose granular soils may be compacted by the ground vibrations induced by an earthquake resulting in large uniform or differential settlements of the ground surface

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Design implications

Design modifications to accommodate an earthquake may include shallower waste sideslopes, more conservative design of dikes and run-off controls, and additional contingencies for leachate collection in case primary systems are disrupted. Strengths of the landfill component should be able to withstand these additional forces with an acceptable factor of safety. The design should be based on the evaluation of seismic effects.

Materials to use

Well-compacted cohesionless embankments or reasonably flat slopes in insensitive clay are less likely to fail under moderate seismic shocks (up to 0.15g and 0.20g acceleration). Embankments made of insensitive, cohesive soils founded on cohesive soils or rock may withstand even greater seismic shocks. For earthen embankments in seismic regions, designs with internal drainage and core material most resistant to fracturing should be considered.

Vulnerable landforms and materials

Slope materials vulnerable to earthquake shocks include:

- very steep slopes of weak, fractured and brittle rocks or unsaturated loess are vulnerable to transient shocks caused by tensional faulting
- loess and saturated sand may be liquefied by seismic shocks causing the sudden collapse of structures and flow slides
- similar effects are possible in sensitive cohesive soils when natural moisture exceeds the soil's liquid limit, and
- dry cohesionless material on a slope at an angle of repose will respond to seismic shock by shallow sloughing and slight flattening of the slope

In general, loess, deltaic soils, floodplain soils, and loose fills are highly susceptible to liquefaction under saturated conditions (USEPA, 1992).

Computer modeling

Geotechnical stability investigations frequently incorporate the use of computer models to reduce the computational time of well-established analytical methods. Several computer software packages are available that approximate the anticipated dynamic forces of the design earthquake by resolving the forces into a static analysis of loading on design cross sections. A conservative approach would incorporate both vertical and horizontal forces caused by bedrock acceleration if it can be shown that the types of material of interest are susceptible to the vertical force component. Typically, the horizontal force caused by bedrock acceleration is the major force to be considered in the seismic stability analysis.

Examples of computer models: PC-Slope by Geoslope Programming (1986), FLUSH by the University of California

Staffing

The use of professionals experienced in seismic analysis is strongly recommended for design of facilities located in areas of high seismic risk.

1.8 Unstable Areas

Need for demonstration

Determine if the site is located in an unstable area. If so, demonstrate that engineering measures have been incorporated into the appropriate landfill design to protect the structural integrity of the landfill.

Note: The results of the site stability investigation (see section 4) should be assessed in making this determination

Geotechnical factors

Consider the following factors when determining whether an area is unstable:

- on-site or local soil conditions that may result in significant differential settling
- on-site or local geologic or geomorphologic features, and
- on-site or local man-made features or events (both surface and subsurface)

Natural unstable areas

Natural unstable areas include those areas that have poor soils for foundations or are susceptible to mass movement. Examples are described below:

- Areas with compressible or expansive soils.
- Expansive soils usually are clay-rich soils that, because of their molecular structure, tend to swell and shrink by taking up and releasing water and thus are sensitive to a variable hydrologic regime. Bentontite is a commonly used example.
- Soils that are subject to rapid settlement (subsidence) include saturated silts, unconsolidated clays, and wetland soils in general.
- Sloped areas subject to mass movement such as avalanches, landslides, debris slides and flows, and rock slides. Such areas can be situated on steep or gradual slopes.

Human-induced unstable areas

Examples of human-induced unstable areas are described below:

- The presence of cut and/or fill slopes during landfill construction causing slippage of existing soil or rock.
- Excessive drawdown of ground water increases the effective overburden on the foundation soils underneath the unit causing excessive settlement or bearing capacity failure of the foundation soils.
- A closed landfill as the foundation for a new landfill ("piggy-backing") becoming unstable if the foundation wastes have not undergone complete settlement.

Unstable area demonstration contents

Assess the ability of the soils and/or rock to serve as a foundation and the ability of site embankments and slopes to maintain a stable condition. Develop a design that will address these types of concerns and prevent possible associated damage to structural components.

Stability assessment

In designing a new unit or lateral expansion or re-evaluating an existing unit, conduct a stability assessment to identify stability problems and preventive measures.

Source of information on natural features

- Nature of Oregon Information Center, Oregon Department of Geology and Mineral Industries at 731-4444
- Regional or local U.S. Soil Conservation Service soil maps
- Aerial photographs, and
- Site-specific investigations

Finding human-induced instability

To evaluate possible sources of human-induced ground instability, the site and surrounding area should be examined for activities related to extensive withdrawal of oil, gas, or water from subsurface geologic units. Evaluate construction or other operations that may result in ground motion (e.g., blasting).

Types of soil and rock failures

Principal modes of failure in soil or rock include:

- rotation (change of orientation) of an earthen mass on a curved slip surface approximated by a circular arc
- translation (change of position) of an earthen mass on a planar surface whose length is large compared to depth below ground
- displacement of a wedge-shaped mass along one or more plans of weakness;
- earth and mud flows in loose clayey and silty soils, and
- debris flows in coarse-grained soils

Common landfill failures

Two common types of failures can occur at a landfill unit:

- settlement
- loss of bearing strength

Settlement

Settlement beneath a landfill unit, both total and differential, should be assessed and compared to the elongation strength and flexure properties of the liner and leachate collection pipe system. Small amounts of settlement can damage leachate collection piping and sumps.

Allowable settlement is typically expressed as a function of total settlement because differential settlement is more difficult to predict. However, differential settlement is a more serious threat to the integrity of the structure than total settlement. Differential settlement generally occurs beneath a landfill in response to consolidation and dewatering of the foundation soils during and following waste loading.

Loss of bearing strength

Loss of bearing strength is a failure mode that can occur in areas that have expansive, compressible, or liquefaction-prone soils. Loss of bearing strength has occurred at sites where excavations for new landfill units near existing filled areas reduced the mass of the soil at the toe of the slope and the overall strength (resisting force) of the foundation soil.

1.9 Sensitive Hydrogeologic Environments

Need for demonstration

Determine if the landfill unit is located in a sensitive hydrogeologic environment.

Definition: sensitive hydrogeologic environments

Sensitive hydrogeologic environments are defined as:

- gravel pits excavated into or above a water table aquifer
- areas underlain by a sole source aquifer or other sensitive aquifer, and
- designated wellhead protection areas

Reference: OAR 340-90-030(4)

Definition: sensitive aquifer

A sensitive aquifer is defined as ". . . any unconfined or semi-confined aquifer which is hydraulically connected to a water table aquifer, and where flow could occur between the aquifers due to either natural gradients or induced gradients resulting from pumpage . . . ."

Location prohibition

OAR 340-94-030(4) does not allow landfill units to be located in sensitive hydrogeologic environments where the Department has determined that:

- groundwater must be protected from pollution because it has existing or potential beneficial uses, or
- existing natural protection is insufficient or inadequate to minimize the risk of polluting groundwater

1.10 Additional Resources

References

U.S. EPA's Solid Waste Disposal Facility Criteria, Technical Manual (EPA 530-R-93-017)

40 CFR Part 230 (Guidelines for Specification of Disposal Sites for Dredged or Fill Materials)

Section 2: Phase I Landfill Site Characterization

2.1 Introduction

Characterizing the site

Phase I Site Characterization, the initial stage of data collection, establishes a preliminary framework for understanding the soils, geology and hydrogeology and plans the Phase II Site Characterization.
Phase II Site Characterization (see Section 3) will evaluate site-specific subsurface conditions in greater detail including the depth and extent of the uppermost (water bearing) geologic units and hydraulically interconnected units, the lithologic and hydraulic properties of these units, groundwater flow patterns, and other factors.

Regulatory reference

OAR 340-93-130(4) requires a soils, geology and hydrogeology report and a feasibility study report for a new landfill or an expansion of an existing landfill. OAR 340-94-080, OAR 340-40 and 40 CFR Part 258 address groundwater hydrology, quality and groundwater monitoring.

Objectives of Phase I

The main objectives of the Phase I site characterization study are to

- describe existing site conditions
- determine if the site is suitable for landfill construction
- provide sufficient base-line information for developing the facility design, construction program, operations plan and environmental monitoring program.

How to respond

Prepare and submit to the Department a report describing the work performed in the Phase I Site Characterization. Geologic and hydrogeologic tasks should be performed by or under the direct supervision of an Oregon Registered Geologist with experience in conducting hydrogeologic investigations.

Report content

The Phase I Site Characterization report should address, at a minimum, completion of the tasks described in this subsection and the location restrictions defined in Section 1. Following the organizational format of this guidance will expedite Department review of the report. The report should be stamped by the Registered Geologist who performed or supervised the investigation.

In this section

This Section describes the recommended tasks that should be completed in preparation of Phase I Site Characterization study report. The following topics are addressed:

- existing conditions
- climate/meteorology
- hydrology
- water balance
- water use inventory
- geology and hydrogeology investigation, and
- phase II workplan

This guidance identifies the scope of investigations necessary to comply with the Solid Waste rules and provide the Department with sufficient data to evaluate the permit application or other submittals.

Related references

This Section focuses on technical guidance and format for the Phase I Site Characterization Report. Groundwater Monitoring requirements are addressed in more detail in Section 10 (Environmental Monitoring). Monitoring well construction standards are contained in a separate document ("Guidelines for Monitoring Well Drilling, Construction and Decommissioning," August 24, 1992).

2.2 Existing conditions

Site characterization task	Describe existing site conditions by providing the information in this subsection.
Site location	Describe the site location with respect to known or easily identifiable landmarks. Describe the site location in terms of the section, township, and range location for the site. Describe access to the site from the nearest U.S. or State Highway.
Legal description	Provide a legal description of the tract or tracts of land which have been or are proposed to be used for waste disposal activities.
Vicinity map	Prepare a map or series of maps showing the facility site and the area within at least a five-mile radius of the site boundary. The map(s) should clearly show the following: • the site location • the existing and proposed zoning and land uses • residential areas • public and private water supply wells • surface waters and surface water intakes • boundary of any municipal water supply service areas • access roads, bridges, railroads, and airports • historic sites • other existing and proposed man-made or natural features relating to the facility, and • the drawing date, a North arrow, and a bar scale Map format: The map should be on a U.S. Geological Survey (USGS) 7 1/2 minute quadrangle base or, if such a map is not available, a substitute base such as an enlargement of a USGS 15 minute quadrangle map, an Oregon Department of Transportation county map or city map at a similar scale.

Aerial photographs

Prepare a stereo pair of standard size (9 inches by 9 inches) recent vertical aerial photographs with a scale up to 1:40,000 which show the site and the area within at least a one-mile radius of the site boundary. Mark the site boundaries and actual fill areas on one of the photographs. Oblique aerial photographs or surface level photographs from various points around the site perimeter may also be submitted in support of the application. Photocopied reproductions of aerial photographs will not be accepted as fulfillment of this requirement.

Information concerning public agency sources for aerial photographs may be obtained by contacting:

Nature of Northwest
Oregon Dept. of Geology & Mineral Industries
800 NE Oregon Street #5, Suite 177
Portland, OR 97232
Phone: (503) 731-4444

Adjacent landowners

Show on a location map or on County Tax Lot map(s), the names and mailing addresses of all landowners within one quarter mile of the property and any other landowners identified as being affected by the proposed facility. Summarize this information on a separate list cross-referenced to the location map or the County Tax Lot map(s). Cite the source for obtaining the names and mailing addresses of persons identified as affected parties.

Site map

Prepare a detailed site map scaled at not more than one inch equals 200 feet (or other scale approved by the Department) that shows the following:

- the geographical location and boundaries of the disposal site
- the topography of the site and area within at least 1/4 mile of the site with contour intervals not to exceed five feet for slopes greater than five percent, or two feet if slopes are less than five percent
- natural features of the land including seeps, springs, streams, ponds and wetlands
- man-made features, including buildings, excavations, pipelines, utilities, recycling facilities, fences, roads, parking areas, drainage culverts, ditches, ponds, berms and dikes
- boundaries of all proposed, active, and closed waste disposal areas, and boundaries of all existing and proposed soil borrow areas
- locations of all existing and proposed borings, piezometers, monitoring wells, test pits, water supply wells, and any other facility monitoring or sampling points or devices
- benchmarks and permanent survey markers, and
- the drawing date, a north arrow, a bar scale, and an explanation of all map symbols

Use the National Geodetic Vertical Datum of 1929 as the vertical elevation datum, and the Oregon State Plane Coordinate System (ORS 93.330) as the horizontal control.

Map preparation: The map(s) should be prepared and stamped by a registered land surveyor or civil engineer. Surveyed well locations should:

- provide a horizontal accuracy of 0.2 feet (0.06 meters)
- provide the elevation of the land surface with a vertical accuracy of 0.1 feet (0.03 meters)
- provide the marked level at the top of the well casing with a vertical accuracy of 0.01 feet (0.003 meters)
- use National Geodetic Vertical Datum of 1929 as the vertical elevation control, and the Oregon State Plane Coordinate System (ORS 93.330) as the horizontal control
- describe the location in either latitude and longitude coordinates accurate to 0.1 seconds in latitude and longitude or UTM coordinates

2.3 Climate/Meteorology

Site characterization task	Provide current information based on or extrapolated from data collected at the closest reporting weather station or stations including: • average annual precipitation and monthly distribution of precipitation • average annual evaporation and monthly distribution of evaporation • average annual prevailing wind direction and monthly variation in wind direction • average and maximum wind velocities and monthly variations in wind velocity, and • average annual temperature and monthly variations in temperature
Obtaining information	This information can be obtained from the National Oceanic and Atmospheric Administration (NOAA), or other federal or state agencies reporting meteorological data.
On-site station	A site-specific station may need to be created if data from the nearest established meteorological station is not representative of site conditions.

2.4 Hydrology

Site characterization task

Evaluate and describe the surface water drainage of the site and of the surrounding area within at least a one-mile radius of the site. This information should include a map or maps at a scale of 1:24,000 showing major perennial, ephemeral and intermittent drainage channels, and their tributaries.

Map content

The maps should identify all existing wetlands and estuaries, and show the boundaries of the 100-year floodplain, based on data collected by the Federal Emergency Management Agency or other federal or state agencies reporting flood management data. Provide the minimum, maximum and average annual flow rates including monthly variations for all major streams. Values should be based on stream gauging data collected by the U.S. Geological Survey or other federal or state agencies reporting stream gauging data.

2.5 Water balance

Site characterization task

Analyze the average annual site water budget including precipitation, runoff, infiltration and evapotranspiration. Determine the monthly variations of each of these parameters for a one-year period.

Methods

Acceptable water balance methods include Thornthwaite-Mather (1957), the EPA Water Balance (1975), the EPA Help Model (1984), and/or other methods approved in advance by the Department.

2.6 Water Use Inventory

Site characterization task	Inventory and identify all water wells and water usage on-site and within a one-mile radius of the site boundary. Prepare a water well inventory report.
Well inventory	Identify all active and inactive water wells, irrigation wells, and surface water usage points within the targeted radius. Identify and field check all water usages within this radius which are listed in the drillers' log files or other records of the Oregon Water Resources Department (OWRD). Areas within the radius of investigation that are served by a municipal water supply should be included in the OWRD well records search.
Survey	Conduct a door-to-door field survey to identify wells not accounted for in OWRD files. For all wells identified in the OWRD files and the door-to-door survey, record the following information: • name and address of the well owner • name and address of the driller • date of drilling • well location • aquifer screened • approximate land surface elevation • depth of well • materials and construction (including casing, screen and annular seal depths and intervals) • reported yield • use of the water • reported or measured static and pumping water levels (or well drawdown) and dates of measurement, and • any available water quality data

Alternative to survey

In lieu of the door-to-door survey, provide the following information for areas served by a municipal supply:

- a map scaled at 1:24,000 or larger showing the boundary of the service area and the raw water intake location
- a record search for any other water usage within the radius of investigation
- a description of surface water supplies including the intake location, average daily and yearly withdrawal rates, and monthly distribution of withdrawals, and
- a description of groundwater supplies including their location, geologic logs and construction, average daily and yearly pumpage, monthly distribution of pumpage, and static and pumping water levels by well and aquifer

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Report content

The water well inventory report should include a map at a scale of 1:24,000 or larger showing the location and use of each well/surface water use point, and a table presenting the required information for each point. The report should include a copy of each available drillers' log, and cross-reference the logs to the well inventory maps and forms.

2.7 Geology and Hydrogeology Investigation

Site characterization task

Conduct a preliminary geology and hydrogeology investigation. Evaluate the regional geology and hydrogeology based on geological reconnaissance field mapping and existing published or unpublished reports and data from state and federal agencies, universities, consultants or other sources.

Investigation report

In the Phase I Site Characterization report:

- describe the regional geology including the age, areal and subsurface distribution, thickness, physical properties and genesis of major stratigraphic units; and the age, occurrence, orientation and physical description of major structural features
- describe the regional hydrogeology including the depth, thickness, physical characteristics and lateral persistence of major and minor aquifers and aquitards, rates and directions of groundwater flow, areas of recharge and discharge (including water wells), hydrologic boundaries, seasonal variations in groundwater levels and flow, and chemical quality of the groundwater
- describe the thickness, lateral extent, hydraulic conductivity and attenuative capacity of all in-situ geologic materials between the proposed base excavation for the landfill and the uppermost aquifer
- evaluate and explain the degree of protection afforded by the properties and extent of geologic materials described above
- prepare a hydrogeologic map of the site and the area within at least a one-mile radius of the site scaled at not more than one inch equals 2,000 feet that shows the surficial geology, the elevation of the water table or potentiometric surface and the regional groundwater flow direction (from published sources or field measurements), and the locations of known discharging wells
- prepare two cross-sections oriented at approximately right angles to each other, which illustrate the regional geology and hydrogeology of the site and vicinity, and
- list sources used to prepare descriptions

Geologic hazards

Geologic hazards may include seismic impacts, mass movement (e.g., landslides), unstable soils, flood inundation, shallow groundwater levels, tsunami, and volcanic eruptions. Location restrictions under OAR 340-94-030 address considerations such as Holocene fault zones, seismic impact areas and unstable areas.

Earthquake safety

Evaluate the earthquake safety of the site. The analysis should include

- a description of the seismo-tectonic setting and seismic history of the area, including size, frequency, and location of historic earthquakes
- potential for area to be affected by surface rupture, including sense and amount of displacement, and width of surface deformation zone
- probable response of site to likely earthquakes, including estimated ground motion, maximum ground acceleration, velocity and displacement
- potential for area to be affected by earthquake-induced landslides or soil liquefaction, and
- potential for area to be affected by regional tectonic deformation (subsidence or uplift)

To the extent possible, identify and evaluate all other known or suspected geologic hazards which may affect the design, construction, and operation of the facility.

2.8 Phase II Workplan

Propose workplan	Prepare a proposed work plan and schedule for conducting the Phase II Site Characterization Study and preparing a final report.
Workplan approval	This work plan should receive Department approval prior to the actual onset of site work. Section 3 of this guidance describes Phase II Site Characterizations.

2.9 Additional Resources

Reference	"Location Information Needed for the Groundwater Database," March 8, 1992 (DEQ)
Contacts	Oregon Maps and Aerial Photography, Oregon Department of Geology and Mineral Resources Driller's log files, Oregon Water Resources Department
Methods to determine water balance	Thornthwaite-Mather (1957) U.S. EPA Water Balance (1975) U.S. EPA "Hydrologic Evaluation of Landfill Performance (HELP) Model" (1984)

Section 3: Phase II Landfill Site Characterization

3.1 Introduction

Characterizing the site

Phase I Site Characterization (see Section 2), the initial stage of data collection, established a preliminary framework for understanding the soils, geology and hydrogeology and for planning the Phase II Site Characterization.
Phase II Site Characterization evaluates subsurface conditions in greater detail including the depth and extent of the uppermost (water bearing) geologic units and hydraulically interconnected units, the lithologic and hydraulic properties of these units, groundwater flow patterns, and other factors.

Basis for investigation

The scope of the investigations for Phase II site characterization should be based on the Phase I study results and the work plan developed as part of the Phase I study. If the proposed project involves a lateral expansion of an existing landfill unit, portions of the Phase II work may have previously been completed. If so, the appropriate documents should be referenced in the Phase II report.
Phase II Site Characterizations are frequently negotiated with the Department and may include direct Department involvement.

Objective of Phase II

The main objective of the Phase II site characterization study is to describe and evaluate the site geology and hydrogeology, including all stratigraphic units encountered, the uppermost aquifer or waterbearing zone, and all other potential zones of contaminant transport.

Definition: uppermost aquifer

U.S. EPA has defined the "uppermost aquifer" as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facilities boundary. U.S. EPA guidance refers to any saturated strata capable of producing representative groundwater samples as an aquifer.

How to respond

Prepare and submit to the Department a report describing the work performed in the Phase II site characterization. Geologic and hydrogeologic tasks must be performed by or under the direct supervision of a Registered Geologist with current Oregon registration and with experience in conducting hydrogeologic investigations, in accordance with OAR 340-93-130.

Report content

The Phase II Site Characterization report should address, at a minimum, completion of the tasks described in this subsection. Following the organizational format of this guidance will expedite Department review of the report. The report should bear the stamp of the Registered Geologist who performed or supervised the investigation.

Report illustrations

The report should contain illustrations, including the following:

- maps showing the as-built location of all borings, monitoring wells and other sampling locations
- boring logs
- as-built well construction details
- geologic maps and cross sections
- water table or potentiometric surface maps for all major aquifers or water-bearing zones, and
- geologic-structure contour maps depicting the soil-bedrock interface or other important subsurface features

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In this section

This Section describes the recommended tasks that should be completed in preparation of the Phase II Site Characterization Report. The following topics are addressed:

- surface investigation
- subsurface exploration
- environmental testing
- groundwater quality testing

Related references

This Section focuses on technical guidance and format for the Phase II Site Characterization Report. Groundwater Monitoring requirements are addressed in more detail in Section 10 (Environmental Monitoring). Monitoring well construction standards are contained in a separate document ("Guidelines for Monitoring Well Drilling, Construction and Decommissioning," August 24, 1992).

3.2 Surface Investigations

Site characterization task	Conduct appropriate surface mapping and surface geophysical logging to generate surface geology information, provide a basis for subsurface exploration, and delineate areas of previous waste disposal activities.
Surface geological mapping	Map the site in sufficient detail to determine the areal distribution of all surficial and bedrock units exposed across the entire site.
Standards	Practices and techniques used to obtain site-specific geologic and hydrogeologic data should be up-to-date, and consistent with industry-wide standards. All work should conform to applicable American Society for Testing and Materials (ASTM) standards, and/or appropriate U.S. Environmental Protection Agency (U.S. EPA) or Department guidelines.
Geophysical techniques	Geophysical techniques for performing surface investigations may include, but are not limited to, surface seismic, resistivity, gravity, radar, or magnetic surveys.

3.3 Subsurface Explorations

Site characterization task	Determine the geology and hydrogeology beneath the site through subsurface exploratory methods. Select the appropriate method(s) of subsurface exploration for the site that will allow collection of representative samples of subsurface media. A sufficient number of borings or other exploratory holes must be completed to adequately characterize the stratigraphy, and groundwater dynamics beneath the entire site.
Depth of investigation	The depth of investigation should be 100 feet below the landfill unit's proposed base excavation, or until the first encountered saturated zone is fully penetrated, whichever is deeper.
Methods	Borings, core drilling, test holes, test pits, cone penetration tests or other methods should be used.
Boring density	At least one boring should be continuously cored to obtain precise stratigraphic data and to obtain relatively undisturbed samples for laboratory testing and analysis. If a site is geologically complex or larger than five acres, additional continuously cored holes may be required to interpret stratigraphic and structural variations.
Standards	All borings should be constructed in accordance with applicable standards and guidelines, including: • "Guidelines for Groundwater Monitoring Well Drilling, Construction and Decommissioning," August 24, 1992 • standards developed by ASTM [such as D-5092-90] • OAR 690-240 Sampling methods should conform to ASTM D-1587, ASTM D-1586 or ASTM D-2113, as applicable.

Describe soil and overburden deposits

Classify soil and overburden deposits according to ASTM D-2488 and describe in detail according to their texture, color, mineralogy, moisture content, degree of weathering, geologic origin, and other relevant characteristics. The ASTM D-2488 visual method should be supplemented by appropriate ASTM D-2487 laboratory tests (i.e., mechanical and/or hydrometer grain size and Atterberg Limit tests) on representative samples from each stratigraphic unit.

Rock classification

Classify rock according to its lithology, mineralogy, color, grain size, degree of cementation, degree of weathering, density and orientation of fractures, other primary and secondary features, physical characteristics, and rock quality designation.

Documentation

Prepare a detailed geological log of each boring incorporating all information. Prepare a clear, labeled, photographic record of representative rock cores

Reference: Section 8.0 of the Department's August 24, 1992 guidance entitled "Groundwater Monitoring Well Drilling, Construction and Decommissioning"

Log content

The geological log should include, but is not limited to:

- the location of the hole
- the date drilled, driller's name and affiliation
- the site geologist's name and affiliation
- the elevation of the land surface surveyed to the nearest 0.01 foot
- the size (diameter) and total depth of the hole
- the type of drilling rig and method of drilling
- the type and volume of drilling fluids or additives used
- the penetration rate or standard penetration resistance
- the sampled intervals and the percent recovery
- the stratigraphic and lithologic information
- any aquifers, water-bearing zones and high permeability or fracture zones encountered
- any contamination observed
- any other drilling observations, including lost circulation zones or other difficulties encountered during drilling
- deposit classifications and descriptions
- the classification system used for deposit classification, and
- rock classifications

Geophysical	Perform appropriate downhole geophysical logging techniques to supplement data collected in the surface investigations.
Geophysical techniques	Geophysical techniques for subsurface explorations may include, but are not limited to, downhole caliper, SP, resistivity, induction, natural gamma, gamma-gamma, neutron density, sonic, dielectric, or other logging techniques.
Related activities	Subsurface exploration activities should be planned to maximize data transfer between geologic/hydrogeologic and geotechnical investigations.

3.4 Hydrogeologic Testing

Site characterization task

Conduct appropriate hydrogeologic testing to characterize the rate and directions of groundwater movement.

Unsaturated zone testing

Determine the saturated and unsaturated hydraulic conductivity and the vacuum pressure of unsaturated soils through field testing. Determine the porosity and moisture content of unsaturated soils through laboratory testing or geophysical techniques. Evaluate the spatial and temporal variability of these properties.

Saturated zone testing

Determine the hydraulic conductivity of all saturated water-bearing zones and aquifers identified in the subsurface investigation through field testing, as outlined in the Department's August 24, 1992 guidance, "Groundwater Monitoring Well Drilling, Construction and Decommissioning."

If the estimated hydraulic conductivity is...	Then...
greater than 10^{-3} cm/sec	an aquifer pumping test should be performed
less than 10^{-3} cm/sec	rising or falling head slug tests should be performed

Aquifer parameters

Determine the following:

- water table or potentiometric surface gradient
- rate and direction of groundwater flow for each aquifer or water-bearing zone
- vertical gradient between water bearing zones
- porosity for all aquifers and water-bearing zones identified during subsurface exploration, using laboratory or geophysical techniques, and
- hydraulic conductivity of all aquitards through laboratory and/or field testing

3.5 Environmental Testing

Site characterization task

Conduct appropriate environmental testing to assess background environmental quality prior to waste placement or to identify impacts from prior waste disposal practices.

Groundwater quality testing

Collect groundwater samples that are representative of formation water. Analyze these samples for the constituents and parameters listed in the table below.

Group	Parameters	Notes
Field indicators	Elevation of water level Specific Conductance pH Dissolved Oxygen Temperature Eh	These parameters must be measured in the field at the time samples are collected, either down-hole in situ, in a flow-through well, or immediately following sample recovery, with instruments calibrated to relevant standards
Laboratory indicators	Hardness (as $CaCO_3$) Total Dissolved Solids Total Alkalinity (as $CaCO_3$) Total Suspended Solids Specific Conductance (lab) Chemical Oxygen Demand pH (lab) Total Organic Carbon	Sample handling, preservation, and analysis are determined by requirements for each individual analyte: EPA or AWWA Standard Methods techniques must be followed.
Common anions and cations	Calcium (Ca) Manganese (Mn) Sulfate (SO_4) Magnesium (Mg) Ammonia (NH_4) Chloride (Cl) Sodium (Na) Carbonate (CO_3) Nitrate (NO_3) Potassium (K) Bicarbonate (HCO_3) Silica (SiO_2) Iron (Fe)	Dissolved concentrations must be measured. Samples must be field-filtered and field-preserved according to standard DEQ and/or EPA guidelines and analyzed by appropriate EPA or AWWA Standard Methods techniques. Results must be reported in mg/L and meq/L.

<table>
<tr><td>Trace metals</td><td>Antimony (Sb)
Chromium (Cr)
Selenium (Se)
Arsenic (As)
Cobalt (Co)
Silver (Ag)
Barium (Ba)
Copper (Cu)
Thalladium (Tl)
Beryllium (Be)
Lead (Pb)
Vanadium (V)
Cadmium (Cd)
Nickel (Ni)
Zinc (Zn)</td><td><table><tr><th>If the Total Suspended Solids concentration is...</th><th>then analyze for...</th></tr><tr><td>less than or equal to 100 mg/L in the sample</td><td>total concentrations (unfiltered)</td></tr><tr><td>greater than 100 mg/L in the sample</td><td>both total (unfiltered) and dissolved (field-filtered)</td></tr></table>
Samples must be field-preserved according to standard DEQ and/or EPA guidelines and analyzed by EPA Method 6010 or Department-approved equivalent. Results must be reported in mg/L.</td></tr>
<tr><td>Volatile organics</td><td>Analysis for all compounds detectable by EPA Method 8260 or EPA Method 524.2, including a library search to identify any unknown compounds present.</td><td>Method 8260 comprises the volatile organic constituents parameter group. Facilities that want to use Methods 8010 and 8020 as an alternative must obtain approval by the Department prior to use.</td></tr>
</table>

Surface water quality testing

Collect surface water samples as needed to characterize surface water quality up- and down-stream of the facility.

Other environmental testing

Conduct appropriate landfill gas testing, air quality test, or other environmental test as required to establish background environmental quality or to identify impacts from previous waste disposal practices.

Methods

Sample collection, handling, preservation, shipment, analysis and QA/QC should conform to procedures described in the approved work plan and in U.S. EPA SW-846, Test Methods for Evaluating Solid Waste, and Chapter 4 of the RCRA Technical Enforcement Guidance Document (TEGD), or other Department-approved methods.

3.6 Additional Resources

References

"Guidelines for Monitoring Well Drilling, Construction and Decommissioning," August 24, 1992 (DEQ)

Section 4: Geotechnical Investigations

4.1 Introduction

Investigation	As part of the Phase I Site Characterization, or other efforts to characterize the site, a Phase I Geotechnical Investigation may be performed.
How to respond	Prepare and submit a Geotechnical Report to support the Site Characterization Report. Geotechnical tasks must be performed by or under the direct supervision of a certified engineering geologist or professional civil engineer with current Oregon registration and experience in conducting engineering geology or geotechnical investigations.
Relation to engineering	Phase I and II Geotechnical Studies should produce sufficient site data to perform all relevant engineering analyses.
In this section	This section describes the tasks that should be performed as part of Phase I and Phase II Geotechnical Investigations.

4.2 Phase I Geotechnical Investigation

Objective of investigation

Conduct a preliminary geotechnical investigation designed to accomplish the following objectives:

- characterize the variability, depth, aerial extent and engineering properties of on-site soils and other overburden deposits
- inventory soils and other overburden deposits suitable for use in construction, and identify the proposed use for these materials
- identify geotechnical considerations (such as settlement and slope stability) which must be addressed in the engineering design and/or further characterized by a Phase II Geotechnical assessment, and
- develop a work plan for conducting a Phase II Geotechnical investigation, as necessary, to adequately characterize on-site soils and other geotechnical considerations

Tasks to be addressed

The Phase I Geotechnical Investigation should address, at a minimum, the tasks described in this subsection.

Describe surficial soils

Evaluate agricultural soil types and their distribution site-wide and within at least a one-mile radius of the site. At a minimum, prepare a soils map and describe the soils in the area. Basic data should be obtained from the U.S. Department of Agriculture Soil Conservation Service (SCS), and supplemented by additional site-specific reconnaissance or tests, as necessary, to confirm the accuracy and reliability of the SCS data.

Describe subsoils

Excavate backhoe test pits in a grid pattern across the site to characterize the depth, areal extent and uniformity of subsoils (overburden deposits). Collect representative soil samples for testing. Plot all test pits on a site map and log each test pit to include

- the location of the excavation
- a description of surface features before excavation
- the date excavated, excavator's name and affiliation
- the site geotechnical engineer's or engineering geologist's name and affiliation
- the elevation of the land surface surveyed to the nearest 0.01 foot
- depth of the excavation
- a detailed description of each stratigraphic unit, its depth, texture, color, mineralogy, grain properties, consistency or relative density, moisture content, degree of weathering, geologic origin, macroscopic features (e.g., root holes, slickensids), and other relevant or distinguishing characteristics
- each stratigraphic units Unified Soil Classification, using ASTM D-2488 visual method, and
- a clear, labeled, photographic record of all test pits

Supplemental tests

Supplement ASTM-D2488 with appropriate grain size and Atterberg limit tests on a representative number of samples of each stratigraphic unit.

Evaluate engineering properties of on-site materials

Analyze representative soil samples to evaluate their engineering properties as follows:

- determine the stability of on-site materials for foundation and sidewall construction
- determine the suitability of on-site materials facility construction, and
- inventory usable soils

Test soils

Perform the following tests:

- strength and compressibility (e.g., triaxial compression tests, consolidation tests) of foundation materials
- the following properites of low-permeability liner layer materials:
  - natural moisture content
  - in-situ density
  - compaction curves
  - Atterberg Limits
  - percent fines passing a #200 sieve
  - percent clay size content
  - percent coarse material retained on a #4 sieve, and
  - laboratory hydraulic conductivity
- grain size distribution and representative laboratory hydraulic conductivity of proposed drainage layer materials, correlate grain size distribution conductivity data

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Investigate site stability

Evaluate the site to identify and characterize any unstable conditions that could adversely impact facility structures, and to obtain sufficient data to plan more detailed Phase II studies. Stability analyses should be based on the investigator's professional judgment, published literature, field investigation, and data obtained from representative field and laboratory tests.

Stability factors

To determine if an area is stable, evaluate the following factors:

- weak and unstable foundation materials including soils, overburden, existing solid waste, peat deposits or other materials subject to excessive settlement
- active slope failure
- soils that may fail with a small increase in pore pressure or shear stress, or a small decrease in shear strength
- signs of pre-existing slope failure or slope failure in geologically similar material near the site
  - any other features that indicate the site is susceptible to instability

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Design considerations

Develop engineering measures to protect the integrity of the landfill structures.

Reference: OAR 340-94-030 and 40 CFR Part 258.15

Evaluation

Based on the results of the Phase I Geotechnical Investigation and Site Characterization, evaluate the following scenarios:

- Potentially unstable natural slopes and other on-site areas that could be destabilized by construction activities such as excavation, regrading or other site modifications;
- Stability of the landfill foundation considering site-specific topographic and geologic conditions, static and dynamic loads, pore-water pressures at the subgrade-liner interface, and any other relevant factors; and
- Compressibility of underlying geologic units and potential settlement of the landfill unit. Estimate total and differential settlement based on appropriate field and laboratory methods and design parameters.

Workplan

Prepare a workplan for the Phase II Geotechnical Investigation.

4.3 Phase II Geotechnical Investigations

Phase II study	Perform additional geotechnical investigations as required in the Phase II work plan and for design calculations and analyses.
Report	Document the results of the geotechnical investigations and present the findings in the Phase II Site Characterization report. Identify any geotechnical considerations that require additional investigation or analysis prior to detailed design and construction of landfill structures. As needed, confirm the engineering properties of on-site soil and rock materials that will be impacted by or used for landfill construction and operation activities.

4.4 Additional Resources

References

Sowers, G.F. (1979). "Soil Mechanics and Foundations: Geotechnical Engineering," The MacMillan Company, New York.

U.S. Navy (1986). "Design Manual - Soil Mechanics, Foundations, and Earth Structures," NAVFAC DM-7; Department of the Navy, Washington, D.C.

Winterhorn, H.F. and Fang, H.Y., (1975). "Foundation Engineering Handbook," Van Nostrard Reinhold, 1975.

U.S. EPA, (1993) "Solid Waste Disposal Facility Criteria Technical Manual" EPA 530-R-93-017.

Section 5: Conceptual Design of Landfill Facilities

5.1 Introduction

Conceptual design phase

The Site Development Plan provides the framework for establishing overall goals for facility design, construction, operation, and environmental monitoring. This section describes the methods and procedures for establishing appropriate design criteria and selecting technologies that will satisfy regulatory requirements and performance objectives.

How to respond

Prepare a comprehensive Site Development Plan that presents the conceptual design of landfill facilities and environmental control systems and documents the analysis used to select the proposed technologies. The plan should be prepared by or under the direct supervision of a professional engineer with current Oregon registration.

Plan content

The Site Development Plan should describe the elements in this subsection. The plan should be stamped by the professional engineer responsible for its preparation. Following the organizational format of this guidance will expedite Department review of the plan.

In this section

This section describes the elements of a Site Development Plan, including:

- facility operation
- conceptual design of landfill facilities
- leachate management
- surface water management
- landfill gas management
- environmental monitoring
- closure and end use
- supporting information

5.2 Facility Operation

Facility operation	Describe the existing and proposed facilities, anticipated waste stream characteristics, and operational procedures, including the items in this subsection.
Capacity and projected life	Specify the proposed capacity and projected life of the site.
Population to be served	Identify and list the communities expected to be served by the facility, and estimate their corresponding current populations. Describe how the listing was compiled. Cite all sources used to estimate population.
Industry to be served	Identify and list major industries to be served by the landfill, and describe how the listing was compiled.
Rate of waste disposal	Estimate the future flow of waste to the facility from communities and industries served and from any other projected sources. Include estimates for maximum daily, maximum monthly and average annual volume and weight of waste to be received. Cite all sources used to calculate volume and weight estimates.
Overall description of operation	Describe the operation including on-site equipment on site (i.e., compactors, dozers, grinders or chippers), anticipated hours of operation, and mode of delivery of solid waste to the site.
Site economic viability	Provide key assumptions used to calculate the economic viability of the proposed facility.
Site screening	Describe how the active landfill area(s) will be screened from public view. Reference: OAR 340-94-040(11)(f)

Planned future use

Describe the planned future use of the disposal site after closure.

Waste stream types

List and estimate the quantity of each type of waste stream projected to be disposed of at the facility.

Examples: domestic wastes, commercial and institutional wastes, industrial wastes, construction and demolition wastes, agricultural wastes, sewage sludge and grit, contaminated cleanup materials, other wastes requiring special handling [see OAR 340-94-040(11)(b)(J)]

Acceptance of industrial waste

If proposing to accept industrial wastes for disposal, report the major industrial waste stream(s). For each weight or volume calculation, treat as one waste stream all industrial waste generated from industries identified by the same first three digits in their Standard Industrial Classification (SIC) code.

Example: Spent casting sand from an aluminum foundry and spent casting sand from a nonferrous foundry should be treated as one waste stream since they are generated from industries having the same first three digits in their SIC code.

Definition: a "major" industrial waste stream comprises greater than one-quarter percent, by weight or volume, of the total estimated waste flow.

Regional facility

If the facility is a regional disposal site, discuss the following:

- plans from the local board of county commissioners for establishing a local citizens advisory committee
- how the information necessary for the Department to review and approve a Waste Reduction Program for any person who will send more than 75,000 tons of solid waste a year to the site will be submitted, and
- how the county, state and country of origin of the waste will be tracked

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5.3 Phased Development of Landfill Facilities

Phased development

Describe the phased development of the landfill. Establish a systematic blueprint of the construction, operation, and closure of each major phase of development.

Contents

Address the following elements in the design:

- design criteria used to determine the landfill's size, configuration, capacity, location, and environmental protection features
- design, construction, and operation considerations for initial cell development
- individual cell construction and the fill sequence
- slope stability in relation to construction, fill sequence, and side-slope liner design
- facility development drawings
- utility requirements including electrical power, water supply, and wastewater treatment and disposal
- earthwork materials for site construction and development, and
- environmental control technologies

Design criteria

Define the basis and any assumptions used to establish the landfill's footprint boundaries, overall configuration, capacity, and location considering at least the following factors:

- regulatory standards for location, design, and operation
- waste stream characteristics
- waste processing (e.g., incineration, composting, shredding)
- buffer zone requirements
- surface drainage patterns and physical characteristics of the site
- slope limitations on the landfill base and final cover profile
- land use and zoning restrictions
- location of utilities and support facilities
- transportation and access patterns
- environmentally sensitive areas
- geotechnical and hydrogeologic constraints, and
- end use alternatives

Facility development drawings

Prepare a series of scaled drawings showing the phased development of the site. Show each phase of landfill cell(s) development and site status when new cells are ready to be placed into service. The drawings should include at least one scaled plan-view and two perpendicular cross-sectional drawings of the excavation plan, fill sequence plan, and final grading plan.

Content of drawings

Identify the following information on the drawings:

- environmental monitoring components including groundwater monitoring wells, and gas monitoring probes, and surface water monitoring stations
- layout of landfill components including support facilities (e.g., public receiving and recycling areas)
- entrance and on-site roads, gates and fencing
- site drainage and surface water control structures (e.g., berms, dikes, ditches, culverts)
- surface impoundments
- soil stockpiles (i.e., the extent, available volume, and intended use of each soil, sub-soil, or rock unit identified as a borrow source)
- leachate collection, storage, treatment and disposal facilities
- special waste management areas (e.g., tires, bulky wastes, asbestos)
- planned total landfill footprint including buffer zones, landscaping, and site screening features
- planned excavations and base grades for each major phase of site development, relationship to hydrogeologic features (e.g., watertable profile, water bearing formations)
- configuration of the completed landfill and final grading plan
- the final landfill surface profile and its internal components, existing topography, and underlying geology/hydrogeology (in landfill cross-section views)
- existing landfill cells, including their operational status and configuration (e.g., exposed waste, intermediate cover, final cover, leachate drainage layer), and
- gas control system components

Earthwork materials for construction and development

Inventory on-site borrow materials and characterize their intended use as follows:

- analyze the results of the Phase I and Phase II geotechnical investigations and identify the intended uses of borrow materials
- quantify the available borrow materials
- describe the management and storage of soils and other construction materials

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5.4 Leachate Management

Leachate management

Describe the proposed leachate management strategies for the landfill's active operation, closure and post-closure stages.

Strategies

The leachate management strategy should be based on a systematic analysis of design, construction, and operation techniques, and the following objectives:

- accurately predict leachate quality and quantity
- select leachate control methods that are technically and economically sound
- maximize leachate containment and collection efficiencies (through liner system and collection and removal system design)
- maximize the reliability of leachate containment systems
- monitor the effectiveness of leachate control systems
- treat and dispose of leachate in an environmentally sound manner, and
- minimize leachate generation

Leachate management analysis

Perform a conceptual design analysis to evaluate background data, establish a rational basis for design, and to evaluate the performance and cost effectiveness of alternative technologies. This analysis should complete the following tasks:

- Evaluate leachate quantity and quality using methods described in Section 6
- Identify key assumptions and design criteria
- Evaluate alternative leachate control technologies
- Prepare conceptual design drawings of major components

Liner system: leachate containment

Prepare conceptual design drawings showing typical cross-sections of the proposed liner system including layer types and thicknesses, minimum slopes, and hydraulic conductivities of each soil layer. Describe the liner system components, including the soil and geosynthetic materials, potential sources of these materials, and the overall design basis.

Standard liner design

The standard composite-liner design incorporates the following components:

- a two-foot thick soil layer with a maximum permeability of 1×10^{-7} cm/sec
- a geomembrane layer with a minimum thickness of 60 mil for HDPE or 30 mil for other materials

The Department may require an enhanced liner design if site specific conditions suggest a significant potential for adverse groundwater quality impacts (see OAR 340-94-060(6)).

Alternative liner design demonstration

If an alternative liner system design is proposed, a demonstration must be made to the Director of the Department that the proposed design will:

- meet the performance standard in 40 CFR 258.40(a)(1), "the design must ensure that the concentration values listed in Table 1 ... will not be exceeded in the uppermost aquifer at the relevant point of compliance", and
- comply with the policies and specific performance requirements of Oregon's Groundwater Quality Protection Rules (i.e., prevent a leachate release exceeding the statistical background concentrations at the relevant point of compliance)

Workplan for alternative design

To facilitate Department review and approval of such a demonstration, submit a workplan describing methods to predict potential water quality impacts. The workplan must specify how the permittee intends to:

- characterize leachate quality and estimate leachate quantity
- estimate liner leakage using a hydrologic model such as the latest version of EPA's HELP model, and
- evaluate groundwater quality impacts due to forecasted leakage, using an appropriate groundwater flow and solute transport model, which demonstrates that the alternative liner design would adequately protect groundwater and surface water quality

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Leachate collection and removal system

Describe the basis for the design, including key assumptions and design criteria on how the Leachate Collection and Removal System (LCRS) will maintain leachate depths of less than 30 cm. Prepare a conceptual design of the LCRS that includes drawings showing typical cross-sections and a plan-view of system layout, manholes, cleanouts, sumps.

LCRS design criteria

The Department's recommended design criteria are as follows:

- Drainage layer slopes should be at least 2% (after settlement)
- Collection pipes should:
  - have slopes of at least 1%
  - meet the recommendations of (not minimums) of OAR 340-52-030, and
  - have enough slope to maintain scouring velocity
- Manhole spacings should not exceed the capabilities of available cleanout equipment and should meet recommendations (not minimums) of OAR 340-52-030 for sewer pipelines. At a minimum, cleanouts should be provided at both ends of all leachate collection pipes with sweep ends used to allow smooth access to cleanout equipment
- Leachate pipe should have a minimum diameter of 6 inches and should be schedule 80 or equivalent strength pipe
- Granular drainage layers should consist of competent, non-angular rock or rounded gravel and have a minimum in-place hydraulic conductivity of at least 1 x 10^{-2} cm/sec

Secondary LCRS: Under certain circumstances (see OAR 340-94-060(6)), the Department may require a secondary leachate collection system. Suggested design criteria for the secondary LCRS and other pertinent design-related information are provided in Section 7 (Detailed Design).

Leachate storage

Prepare a conceptual design of the storage system including cross-section and plan-view drawings and describe the design basis. Leachate storage impoundments should be located, designed, constructed, and monitored to at least the same standards as landfills. Leachate storage impoundments should be equipped with a leak detection system beneath the entire liner system, creating a double liner system to protect against the high hydraulic head typically impinging on the liner system.

Leachate treatment and disposal

Perform a leachate treatment feasibility study as outlined in Section 6 of this guidance. The results of this study should be used to develop conceptual design drawings and preliminary equipment specifications for the proposed treatment and disposal methods. The Department recommends treatment methods that reduce leachate contaminants, not methods that transfer the environmental problem to another medium.

Leachate minimization

Describe the design, construction, and operation techniques that will be used to minimize leachate production during the landfill's active and post-closure periods. The leachate minimization program should include the following elements:

- phased development and closure to minimize the active area footprint
- temporary geosynthetic covers to minimize infiltration in active cells
- run-on and runoff control systems for active and closed areas
- subsurface drainage systems to control groundwater seepage
- low permeability final cover systems to minimize infiltration during post-closure, and
- cell construction techniques that promote surface runoff rather than infiltration

5.5 Surface Water Management

Surface water

Describe the proposed methods for managing surface water run-on and runoff during the landfill's active operation and post-closure stages.

Surface water control during active landfill operations

Describe the surface water control measures and facilities that will be implemented and maintained during active landfill operations and how the system will

- intercept and divert run-on away from active and closed landfill cells (subareas)
- promote runoff from landfill areas capped with interim or final cover
- minimize site erosion
- temporarily store excess peak runoff flow until it can be discharged at a lower controlled rate
- control sediment transport by removing suspended solids from surface water runoff as necessary to comply with the facility's NPDES stormwater discharge permit, and
- collect and contain leachate-contaminated stormwater that accumulates in active landfill areas

Surface water control after final facility closure

Describe the surface water control measures and facilities that will be implemented and maintained after final closure of the facility and how the system will

- protect the integrity and effectiveness of the landfill cover system, and
- minimize long-term maintenance requirements after closure

Conceptual design

Prepare conceptual design drawings showing the complete surface water control systems that will be in place during active landfill operations and after cell closure.

5.6 Landfill Gas Management

Landfill gas

Describe the methods and technologies that will be used to control landfill gas.

Content

Evaluate the following design and construction considerations:

- site characteristics including topography, soils, geology, hydrogeology, climate
- fluctuations in groundwater levels, soil moisture, barometric pressure, and other environmental parameters
- locations of on-site structures, utilities, etc.
- adjacent land use and development
- size and age of the landfill and quantity of in-place refuse
- regulatory standards including federal air emission standards for landfills
- the landfill's operational history
- landfill gas monitoring results
- permitting requirements for flare units and other air emission sources
- operational status of the landfill unit (closed/full, active/partially full, new/empty, etc.)
- site development sequence
- suitable space for mechanical equipment (motor blowers, flares, electrical panels, etc.)
- moisture conditions within the landfill (saturated zones can impede gas flow)
- landfill gas quality (chemistry) and potential effects on leachate and groundwater quality
- design of existing and future landfill cells and potential influences on landfill gas flow paths
- current and future landfill gas production rates
- depth of in-place refuse below grade (interface between refuse and subsurface strata)
- available options for containing and managing landfill gas condensate
- capital costs and operation and maintenance costs of alternative designs

Types of control systems

There are two general types of landfill gas control systems: active systems and passive systems. Active control systems are recommended by the Department for most applications because of their superior flexibility and performance. However, active systems are usually substantially more expensive to construct and operate.

Conceptual design plans

Prepare preliminary engineering drawings showing the following landfill gas control system features:

- extraction well and/or horizontal collection trench locations and spacings
- configuration of collection lateral and header piping
- condensate drains, storage and treatment methods, and
- mechanical equipment complex (motor-blower, flare, and associated equipment)

Design criteria

The Department's recommended design criteria for landfill gas control systems are as follows:

- The landfill gas control system should be operationally flexible to accommodate changing gas production rates, migration patterns, gas chemistry, and other variables.
- Active control systems should be designed to provide 100 percent blower standby (backup) capability.
- The landfill gas control system should be designed for phased construction and expansion potential.
- Flame arresters should be incorporated into flare systems to prevent accidental ignition in the discharge piping system.
- Flare units should be equipped with automatic ignition systems and alarms.
- Header piping systems should have minimum (post-settlement) slopes of 3 percent for condensate drainage and collection.

Methane limits

The concentration of methane gas must not exceed

- 25 percent of the lower explosive limit for methane in facility structures, excluding gas control or recovery system components, or
- the lower explosive limit (LEL) at the facility property boundary

Reference: OAR 340-94-060(4) and 40 CFR Part 258.23(a)

Monitoring

Facilities must conduct routine monitoring, with a minimum frequency of once per quarter, to verify compliance with the allowable concentration limits.

5.7 Environmental Monitoring

Establishing monitoring

In most instances, detailed environmental monitoring programs will not be established until Phase II site characterization and detailed facilities design are completed.

Conceptual monitoring plan

Describe the overall monitoring strategies and objectives for

- groundwater
- surface water
- leachate
- landfill gas
- air (if applicable)

Guidance

Guidance for preparing an environmental monitoring plan is provided in Section 10.

5.8 Closure and End Use

Closure and post-closure

Describe the general procedures for final facility closure and the end use plan for the facility property. Closure of modern landfills is accomplished in phases when discrete cells or subareas reach final capacity. Closed areas must be maintained and monitored while active operations continue in other cells. For financial assurance purposes, these activities should be considered as interim closures. The 30-year post-closure care period does not officially begin until final facility closure is complete.

Reference: OAR 340-130

Reference

Minimum regulatory requirements for final facility closure are prescribed in OAR 340-94-100 and 40 CFR Part 258.1. Detailed closure provisions should be incorporated into the closure plan (see Section 11 for further instructions).

5.9 Supporting Information

Local government endorsement

Submit written recommendations of the local government unit(s) having jurisdiction to establish a new disposal site or to substantially alter, expand, or improve a disposal site or to make a change in the method or type of disposal. Such recommendations should include, but are not limited to, a statement of compatibility with:

- the acknowledged local comprehensive land use plan and zoning requirements or the Land Conservation and Development Commission's Statewide Planning Goals (using the Department's Land Use Compatibility Statement form), and
- the adopted local solid waste management plan

Reference: OAR 340-93-070(3)(b) requires submittal of local government information to document that the proposed new landfill or expansion of an existing landfill has been reviewed and approved by the local host community

Compatibility with solid waste plans

Explain how the proposed facility or facility expansion is compatible with all elements of the local solid waste management plan, and the state integrated solid waste management plan.

Waste reduction

If any local government or other person will send more than 75,000 tons of solid waste per year to the disposal site, submit a copy of the person's plans for implementing a waste reduction program.

Other permits

Identify any local, state, or federal permits, in addition to the Solid Waste Disposal Site Permit, that will be required for the proposed facility or expansion. If the permit has been granted, include a copy of the permit. If the permit has been previously applied for but not yet granted, include a copy of the permit application.

Examples: Corps of Engineers Section 404 permit; NPDES permit

Statement of need

Submit a statement clearly demonstrating the need for the new or expanded facility. For the renewal of a permit for an existing facility, the statement should relate to the continuing need for the facility. The statement of need should address the following criteria:

- the availability and capacity of alternative disposal sites or resource recovery systems and facilities
- the relationship of the permit application to current or proposed state and local solid waste management plans for the affected area
- the existence of contracts for disposal of waste at the proposed site
- the potential costs of shifting to available alternative sites and the proximity of such sites, and
- the ability of the proposed site to comply with statutory and regulatory requirements

5.10 Additional Resources

References

U.S. EPA Solid Waste Disposal Facility Criteria Technical Manual. November 1993

Washington D.O.E. Solid Waste Landfill Design Manual. June 1987.

Section 6: Leachate Treatment and Disposal Feasibility Study

6.1 Introduction

Evaluate treatment alternatives	Available leachate treatment alternatives should be evaluated. Methods that reflect site-specific conditions, and a full consideration of cross-media impacts should be selected for the facility.
Preferred methods	Preferred treatment methods are those that reduce the leachate contaminants rather than simply transferring the environmental problem to another medium. New landfills, and municipal solid waste landfills with significant expansions built after October 9, 1993, may need to complete a supplemental information form to help identify and prevent the transfer of pollutants from one medium to another.
How to respond	Submit a Feasibility Study Report that documents the analysis of treatment and disposal alternatives, including any assumptions. The Report should be stamped by the Profession Engineer who conducted the study.

Analysis of treatment options

Evaluate leachate treatment and disposal alternatives as follows:

- estimate leachate generation rates based on the latest Help Model analyses and/or actual leachate volume measurements from existing landfill cells
- determine the chemical and physical characteristics of the leachate and predict variations in leachate characteristics over time. For lateral expansion of existing facilities, sample and analyze leachate from an adjacent cell. For new facilities, obtain data from the nearest existing facility with a comparable physio-climatic setting and incoming waste stream
- identify final disposal alternatives and evaluate their feasibility in terms of cost effectiveness, environmental impact, technological constraints, regulatory requirements, and compatibility with other elements of the landfill design and operation
- define leachate treatment (effluent) requirements for the disposal alternatives and overall design criteria
- select a treatment process or processes which will achieve desired treatment performance for each disposal alternative
- estimate the capital and operation and maintenance costs of each alternative treatment and disposal method
- select the best alternative treatment and disposal system with regard to cost, reliability, flexibility and any other appropriate considerations

The study should be conducted by a Professional Engineer with current Oregon registration.

Selection of method

Leachate characteristics and treatability may be affected by landfill expansion and by partial or final closure. Therefore, the proposed treatment methods should be highly adaptable to accommodate variable chemical and hydraulic loading. The proposed system should consist of one or a combination of treatment options.

Treatability studies

If possible, selection of a process to treat leachate should be based upon treatability studies (laboratory or pilot scale) using the actual leachate. This is recommended for several reasons:

- Published leachate treatment performance data are rare. In the absence of treatability studies, inferences must be drawn from laboratory experimental studies, and industrial and municipal water and wastewater treatment experience.
- Lacking previous experience or treatability data, there is no guarantee that high levels of treatment can be achieved.
- It is likely that a combination of several unit processes will be needed to deal with the leachate. Arriving at the optimum system is unlikely without treatability studies.
- The complex leachate may not behave like other wastewaters, thus affecting design and operating criteria (e.g., chemical dosage requirements), and invalidating extrapolations from other experiences. Leachate composition also varies with age of the landfill.
- Capital investment, and especially operation and maintenance costs, are likely to be greater per unit volume treated than for municipal or industrial wastewater. However, costs will be difficult to estimate without treatment experience. Investment in a costly, unproven system that may not meet the required treatment objectives is imprudent.

Alternative evaluation

In spite of these considerations, treatability studies may not be possible at all sites. Representative leachate samples may be unavailable at new landfill sites or arid area sites. In such cases, use a more theoretical approach that relies on published data or data from another similar facility.

In this section

This section describes alternative treatment methods for landfill leachate, including:

- discharge to privately or publicly-owned treatment works
- land application
- on-site treatment with discharge to surface water
- re-application or re-injection to lined cell
- evaporation or impoundment, and
- other alternatives

6.2 Discharge to Privately or Publicly-Owned Treatment Works

The option

This alternative is subject to any pretreatment and/or wastewater connection requirements of the authority operating the treatment works. Discharges to publicly-owned treatment works (POTW) are not directly regulated by the Department.

Reference: "Management Plan Requirements for Leachate Disposal to Publicly-Owned Treatment Works," March 19, 1993

Examples of use

This method is currently practiced by several landfill in the Northwest, including:

- St. Johns Landfill, Portland, Oregon. Contact: Metro Solid Waste
- Cedar Hills Landfill, King County, Washington. Contact: King County Solid Waste Department
- Cathcart Landfill, Snohomish County, Washington. Contact: Snohomish County Solid Waste Department
- Kent Highlands Landfill, Kent, Washington. Contact: City of Seattle

6.3 Land Application

The option

This alternative is subject to possible pretreatment requirements.

Reference: "Standards for Leachate Spray Irrigation Management," October 28, 1992

Examples of use

This method is currently practiced by several landfills in Oregon, including:

- Coffin Butte Landfill, Benton County. Contact: Valley Landfills, Corvallis, Oregon
- Riverbend Landfill, Yamhill County. Contact: Sanifill of Oregon

6.4 On-site Treatment with Discharge to Surface Water

The option

This alternative is subject to effluent limitations as defined in a National Pollutant Discharge Elimination System (NPDES) permit. Application for a permit should be completed and submitted to the Department's Water Quality Division. If Total Maximum Daily Loads have been established or proposed for the receiving waters, additional requirements may be mandated above and beyond the NPDES permit.

Treatment processes

Generally, there are eight unit treatment processes applicable to leachate treatment:

- biological treatment
  - aerobic
  - anaerobic
- chemical precipitation
- ion exchange
- reverse osmosis
- carbon absorption
- stripping
- chemical oxidation
- wet oxidation

The applicability of each of these processes depends largely on the age of the leachate and the location and design of the landfill.

Examples of use

This method is currently practiced by Roseburg Landfill in Douglas County.
Contact: Douglas County of Public Works

6.5 Re-application or Re-injection to Lined Cell

The option

This alternative is permissible under the conditions of U.S. EPA's Solid Waste Disposal Facility Criteria 40 CFR Part 258. Only those cells where the composite liner and leachate collection system are equivalent to the minimum standards as described in 40 CFR 258.40(a)(2) can this form of leachate treatment be employed.

Minimum standards

Re-application of leachate is prohibited unless the landfill cell has at least the equivalent of each of the following three elements:

- upper component: a composite liner with 30-mil FML [60-mil HDPE], installed in direct and uniform contact with the compacted soil component
- lower component: a two-foot or thicker layer of compacted soil with a hydraulic conductivity no greater than 10^{-7} cm/sec
- leachate collection: a collection system capable of maintaining less than a 12 inch [30-cm] depth of leachate head

Considerations

The following considerations should be addressed:

- hydrogeology of the landfill site and the surrounding area within a 1/4-mile radius of the site
- climatic/meteorological data
- design details of the recirculation system
- monitoring of leachate levels in the landfill
- detailed contingency plans for leachate control, in the event that the leachate head levels cannot be maintained at less than a 12 inch [30-cm] depth
- metals accumulation in cover soils (if leachate is surface applied), and
- surface runoff and erosion control (if leachate is surface applied)

Examples of use

This method is practiced in limited use at Finley Buttes Landfill in Morrow County, Oregon.

6.6 Evaporation/Impoundment

The option

This alternative is subject to the same requirements as an application for a Water Pollution Control Facility (WPCF) permit. A lagoon, impoundment structure, or evaporation pond with a discharge to surface water is subject to a NPDES permit.

Inclusion in other documents

The Site Development Plan and detailed design plans and specifications should include:

- the rationale for selecting the proposed evaporation/impoundment technique
- water balance calculations
- pilot and bench tests, as appropriate, and
- alternative methods for residuals handling

Examples of use

This method is currently practiced at Columbia Ridge Landfill and Recycling Center in Gilliam County, Oregon.

6.7 Other Alternatives

Options

The Department will consider other treatment options, such as incineration, moisture source for composting if supporting information demonstrates consistency with DEQ regulations and water quality criteria.

6.8 Additional Resources

References

"Management Plan Requirements for Leachate Disposal to Publicly-Owned Treatment Works," DEQ, March 19, 1993

"Standards for Leachate Spray Irrigation Management," DEQ, October 28, 1992

Section 7: Detailed Design

7.1 Introduction

Detailed design phase

Fundamental design assumptions and criteria established during conceptual design should be reevaluated and refined at the outset of the detailed design stage. At this point, additional site characterization data, materials testing results, input from the Department and other reviewing agencies, permit requirements, and other available information should be incorporated into the design.

Regulatory references

Mandatory design standards and performance criteria are specified in 40 CFR 258 and OAR 340 Division 94. The design approach should also reflect current technologies, and conventional engineering principals and practices. Requirements for detailed design plans and specifications are described in OAR 340-93-140.

How to respond

Submit the following design documents to the Department for approval prior to construction, consisting of:

- detailed plans and specifications, stamped by a qualified professional engineer with current registration in Oregon
- a design report that describe the technologies and engineering analyses associated with the proposed design

Design plans and specifications

Base design plans and specifications on the results of Phase I and Phase II site characterization, geotechnical studies, and conceptual design analyses and reporting.

Design report

Prepare a design report that includes the following information:

- executive summary, conclusions, recommendations
- design basis, main assumptions, design criteria, and site constraints
- descriptions of key landfill components and their design functions
- a written explanation of the detailed design drawings and specifications
- a demonstration that landfill components will function as designed
- results of design-related materials testing
- preliminary specifications for construction materials, and
- engineering analyses and calculations used to develop the design

Format

To facilitate the Department's review, design reports, design plans and specifications and other related documents should have the same organizational format used in this guidance document. Design documents should be sufficiently detailed to enable the Department to determine whether mandatory standards and performance criteria have been achieved. Specifications should follow the standard format adopted by the Construction Specifications Institute.

In this section

This section provides guidance on preparing detailed design plans and specifications for the following environmental control systems:

- liner system
  - soil liner component
  - geomembrane component
- primary leachate collection and removal system
- secondary leachate collection and removal system
- leachate treatment and storage impoundments
- leachate holding tanks and conveyance pipelines
- leachate treatment process
- final cover system
- surface water control system, and
- landfill gas control system

7.2 Liner System

Performance criteria

Landfill liners are designed to protect the environment by preventing the release of leachate and landfill gas. New municipal solid waste landfill units and lateral expansions of existing landfill units must be equipped with either a composite liner, or a site-specific alternative design that meets the environmental performance criteria. Unless the Department approves an alternative design, liner systems must include:

- a soil liner component and
- a geomembrane liner component

These components are discussed in the following sections.

Reference: Minimum design standards for liner systems are specified in 40 CFR 258.2, 40 CFR 258.40(b), and 258.40(a)(1). Associated performance criteria are contained in the Department's groundwater protection rules [OAR 340-40-020(1),(2),(3)].

Proposing an alternative design

An alternative design proposal should be discussed with Department staff, before the development of formal design details. At this point, the Department will consider, from a technical and environmental standpoint, whether the proposal is viable. The Department will not approve alternative liner designs unless a convincing demonstration is made that the alternative design meets both the environmental performance requirements and the no-groundwater-degradation policy. Alternative design proposals will be subject to the opportunity for public comment.

Reference: See the Alternative Design discussion in Section 5: Conceptual Design of Landfill Facilities

Design document content

The design documents should address technical considerations such as

- performance criteria
- construction details (anchoring, penetrations)
- material properties
- dimensions
- bottom and sidewall slopes
- site operations (particularly the cell filling sequence and configuration),
- interface friction properties of liner system components, and
- subgrade conditions such as groundwater levels and soil properties

7.3 Liner System -- Soil Liner Component

Soil characteristics

Soils have a wide range of physical characteristics that are relevant to liner construction. These characteristics, described below, effect the soil's potential to meet the specified permeability of 1×10^{-7}.

Characteristic	Description
Soil plasticity	The soil plasticity index (PI) should be greater than 10 percent. However, soils with very high PI (above 30 percent), are cohesive, sticky and difficult to work with in the field. When high PI soils are too dry, they may form clods that are difficult to break down during compaction. Perferential flow paths may form around the clods, increasing the liner's permeability. Large soil particles or rock fragments can also form perferential flow paths.
Soil density and moisture	A soil's maximum density corresponds to the optimum moisture content, the minimum permeability to a moisture content wet of optimum. Wet soils, however, have less shear strength and more potential for desiccation cracking. When specifying moisture content, consider shear strength and other engineering properties. Typically, the permeability criterion can be achieved at moisture values of 1 to 7 percent above optimum.

Liner construction

Soil liners should be constructed in a series of compacted lifts. To specify lift thickness consider soil characteristics, compaction equipment, foundation characteristics, compaction requirements and liner permeability. The compactor must reach the lower portions of the lift to establish good, homogeneous bonding between lifts.

Soil test methods

Use the following test methods to characterize prospective liner soils:

- grain size distribution (ASTM D-422)
- Atterberg limits (ASTM D-4318), and
- moisture/density relationships by standard or modified Proctors (ASTM D-698 or ASTM D-1557), whichever is appropriate for the compaction equipment the foundation characteristics

Design criteria: soil liner

Design the soil liner to meet the following criteria:

- maximum saturated hydraulic conductivity (permeability) -- 1 x 10^{-7} cm/sec
- minimum compacted thickness -- least two feet
- Atterberg limits -- plasticity index ^{3} 10%;
- percent fines -- ^{3} 50% passing a #200 sieve;
- percent coarse material -- 10% retained on a #4 sieve;
- maximum particle size including clods -- 1 - 2 inches.

Recommended design procedures

Design the soil liner component by following the procedures below.

Step	Action
1	Specify performance objectives and material properties
2	Specify Unified Soil Classification, percent clay content (by hydrometer analysis to the 2 micron particle size) and the additional soil properties in the design criteria
3	Establish liner dimensions including thickness and surface area
4	Prepare appropriate design details, including details of connections between existing and new sections of the liner
5	For bentonite amended soils, specify the bentonite application rate as a percentage of the original dry weight of the soil, and mixing techniques
6	Specify construction requirements for the soil test pad the full-scale liner and associated earthwork
7	Specify Construction Quality Control (CQC) and Construction Quality Assurance (CQA) requirements

Reference: Also refer to the construction requirements in Sections 8.3, 8.4, and 8.5.

7.4 Liner System -- Geomembrane Liner Component

Design criteria: geomembrane liner

Design the geomembrane component of the landfill liner to meet the following criteria:

- HDPE geomembranes of at least 60 mils thick (or at least 30 mil thick for other materials) should be installed in direct and uniform contact with the underlying soil liner
- the geomembrane should be chemically compatible with leachate, landfill gas, and other expected environmental conditions within the landfill
- the geomembrane should be physically compatible with the proposed subgrade and backfill properties
- the geomembrane should be capable of withstanding the anticipated short-term and long-term stresses due to facility construction and operation.
- the number of pipe penetrations through the geomembrane should be minimized to the extent possible
- the geomembrane's friction properties should be compatible with other components of the liner system to minimize mechanical stresses on any component

Design approach

A systematic approach to design will enhance the geomembrane's performance, reliability and compatibility with other landfill components.

Recommended design procedures

Design the geomembrane liner component by following the procedures below. Where listed, refer to the pages in Section 7.13 (Appendix of Engineering Analyses and Calculations) for additional details.

Step	Action	Ref. pg.
1	Specify performance criteria and material properties for geomembranes and associated geosynthetics	---
2	Perform a geomembrane design analysis to determine acceptable geomembrane properties	7-25
3	Analyze the liner system's stability in side-slope areas	7-26
4	Analyze geomembrane runout or anchor trench requirements and prepare design details	---
5	Prepare design details for sumps, pipe penetrations, mechanical attachments to structures, etc.	---

Step	Action	Ref. pg.
6	Specify Construction Quality Control (CQC) and Construction Quality Assurance (CQA) requirements	---

Geomembrane specifications

Identify the geomembrane's function and specify desired properties for:

- the geomembrane to perform its intended function
- construction survivability, and
- in-service durability (i.e., resistance to temperature variations, UV radiations, leachate, mechanical stress)

Testing and acceptance

Establish minimum requirements for testing and acceptance of geomembrane conformance, including:

- sampling frequency
- sample size
- sampling technique
- conformance testing procedures
- acceptance criteria, and
- rejection procedures

7.5 Primary Leachate Collection and Removal System

Performance criteria

The primary leachate collection and removal system (LCRS) must be designed to function automatically, continuously, and as efficiently as possible within practical limits. The LCRS should maintain a leachate depth of less than 30-cm above the liner.

Reference: 40 CFR 258.40(a)(2)

Design criteria

Design the primary leachate collection and removal system to meet the following criteria:

- granular drainage layer percent fines -- < 5% passing No. 200 sieve.
- granular drainage layer hydraulic conductivity -- 1 x 10^{-2} cm/sec.
- granular drainage material should consist of carbonate-free, rounded gravel or non-angular rock.
- leachate collection pipe -- minimum 6-inch diameter, schedule 80 or equivalent strength pipe.
- minimum slopes for collection pipes -- 1% after predicted settlement; comply with OAR 340-52-030 for sewer pipelines (enough slope to maintain scouring velocity).
- minimum slopes for leachate drainage layer -- 2% after foundation settlement.
- manhole/cleanout spacing -- Should be compatible with available cleanout equipment and meet recommendations (not minimums) of OAR 340-52-030 for sewer pipes. At a minimum, provide cleanouts at both ends of all leachate collection pipes and sweep bends to accommodate cleanout equipment.

Recommended design procedures

Design the leachate collection and removal system (LCRS) by following the procedure below. Where listed, refer to the pages in Section 7.13 (Appendix of Engineering Analyses and Calculations) for additional details.

Step	Action	Ref. pg.
1	Prepare scaled drawings of the leachate collection system layout and construction details	---
2	Specify properties, characteristics and performance criteria of granular drainage layers, including Unified Soil Classification, grain size distribution, maximum particle size, maximum percent passing No. 200 sieve, thickness, and hydraulic conductivity at anticipated field density	---

Step	Action	Ref. pg.
3	Specify properties, characteristics and performance criteria of geosynthetic drainage layers, including polymer type, transmissivity and evidence of chemical compatibility. Analyze requirements for geosynthetic drainage material to determine allowable properties	7-25, 7-26, 7-28
4	Specify properties and characteristics of any granular filter layers, including Unified Soil Classification, grain size distribution and thickness	---
5	Specify properties and characteristics of any geosynthetic layers used for filtration or for liner protection. By analysis, determine allowable properties for protection or filtration layers	7-26, 7-28
6	Describe leachate collection pipe configuration, dimensions and properties, and analyze pipe loading and structural strength	7-31
7	Identify minimum slope specifications for drainage layers and collection pipes	---
8	Prepare leachate collection sump capacity and design details	---
9	Prepare manhole/cleanout design details, describe cleanout equipment capability and procedures, and analyze manhole-foundation design requirements	7-31
10	Identify the location and minimum spacing of manhole/cleanouts	---
11	Conduct a filtration analysis to evaluate the primary LCRS's clogging potential	7-31
12	Conduct an analysis of primary LCRS performance	7-30

7.6 Secondary Leachate Collection and Removal System

Need for secondary system

Under certain circumstances (see OAR 340-94-060(6)), the Department may require a secondary leachate collection and removal system (LCRS) to provide for additional groundwater protection and/or enhanced monitoring.

Design criteria

Design the secondary LCRS to detect and collect leachate at locations of maximum leak probability (e.g., liner penetrations, leachate collection sumps and leachate drain lines). Consider the following criteria:

- locate the secondary LCRS
  - beneath areas of maximum leak probability;
  - directly below and parallel to the liner system; and
  - above or hydraulically isolated from the seasonal-high water table to prevent groundwater intrusion into the secondary LCRS and potentially erroneous monitoring results.
- granular drainage layer percent fines -- < 5% passing No. 200 sieve.
- granular drainage layer hydraulic conductivity -- 1 cm/sec (at field density).
- granular drainage layer physical properties -- non-angular rock or rounded gravel free of carbonate material
- geosynthetic drainage layer transmissivity -- 5×10^{-4} m^2/s.
- minimum slope specifications for drainage layer and collection pipes -- pipes should meet recommendations (not minimums) of OAR 340-52-030 for sewer pipelines. Drainage layer should slope at least 2% (after settlement)
- manhole/cleanout location and spacing should not exceed capabilities of available equipment

Recommended design procedures

Design the secondary leachate collection and removal system (LCRS) by following the procedure below. Where listed, refer to the pages in Section 7.13 (Appendix of Engineering Analyses and Calculations) for additional details.

Step	Action	Ref. pg.
1	Prepare scaled drawings of the secondary leachate collection and removal system layout and construction details	---
2	Describe the secondary LCRS lining system, including its physical properties and dimensions	---

Step	Action	Ref. pg.
3	Specify granular drainage layer properties and performance criteria, including Unified Soil Classification, grain size distribution, maximum particle size, maximum percent passing No. 200 sieve, thickness, and hydraulic conductivity at anticipated field density	---
4	Specify geosynthetic drainage layer properties, and performance criteria, including polymer type and transmissivity. Determine allowable properties for geosynthetic drainage material should be determined by analysis	7-25, 7-26
5	Specify granular filter layer properties and performance criteria, including Unified Soil Classification, grain size distribution and thickness. Granular filter material must be free of carbonate material	---
6	Specify geosynthetic protective or filter layer properties. Determine allowable properties for geosynthetic by analysis	7-25
7	Describe leachate collection pipe configuration, dimensions and properties. Determine allowable properties by a structural stability analysis	7-31
8	Identify minimum slope specifications for drainage layers and collection pipes	---
9	Prepare leachate collection sump capacity and design details	---
10	Prepare manhole/cleanout design and operation details, including cleanout equipment capabilities and operating procedures. Analyze foundation requirements for manholes.	7-31
11	Identify manhole/cleanout configuration and spacing	---
12	Analyze the clogging potential within secondary LCRS components	7-31
13	Analyze the collection efficiency of the secondary LCRS	7-30

7.7 Leachate Treatment and Storage Impoundments

Performance criteria

Environmental safeguards for leachate treatment and storage impoundments should be comparable to or more extensive than what is required for a Subtitle D landfill cell. For minimum standards on location, design, construction, and monitoring see OAR 340-94-060(3).

Design Criteria

Design leachate treatment and storage impoundments to meet the following criteria:

- impoundment liners equal or exceed the landfill liner design
- the leak detection system underlies the impoundment liner to account for the substantial liquid depths within such impoundments
- impoundments have sufficient freeboard to contain and prevent overflow due to the 24-hour, 25-year storm
- available storage capacity reflects adopted leachate management practices and seasonal operating restrictions

Recommended design procedures

Design the leachate treatment and storage system by following the procedures below. Where listed, refer to the pages in Section 7.13 (Appendix of Engineering Analyses and Calculations) for additional details.

Step	Action	Ref. pg.
1	Calculate required storage capacity, account for leachate flow projections and the impoundment's internal water budget	7-31
2	Incorporate landfill cell design procedures	---
3	Design the leak detection system, incorporate all applicable steps outlined in Subsection 7.6 for secondary leachate collection and removal systems	---
4	Design leachate impoundments using landfill-cell equivalent detail and engineering analysis	---
5	Use applicable information previously developed for landfill cell design analyses	---

7.8 Leachate Holding Tanks and Conveyance Pipelines

Design criteria: holding tanks

Design leachate holding tanks to be:

- watertight
- composed of landfill-leachate compatible materials
- located on a flat, stable foundation, and
- sized to support the LCRS and leachate management practices

Design criteria: conveyance pipelines

Design conveyance pipelines to be:

- composed of landfill-leachate compatible materials
- consistent with the Departments' guidelines for sewer pipelines
- watertight and
- capable of withstanding in-service conditions, physical loads, stresses

Recommended design procedures

Design leachate holding tanks to meet the same operational considerations as impoundments. Design conveyance pipelines according to the guidelines for sewer pipelines.

References: OAR 340-060(3); OAR 340-52-020, Appendix A

7.9 Leachate Treatment Process

Performance criteria

Design the leachate treatment and disposal system to achieve effluent quality (leachate strength) objectives as appropriate for direct discharge or for pretreatment followed by discharge to another treatment facility.

Designing the system

The design of a leachate treatment and disposal system should include the following main stages:

Stage	Description
A feasibility study	Evaluate treatment and disposal alternatives and identify preferred method
Conceptual design	Prepare Conceptual Design (Engineering) Report including conceptual design plans and specifications for the selected alternative
Detailed design	Prepare detailed design plans and specifications and the Design Report

Selecting a design

Leachate composition and flow rates are highly variable and subject to numerous, site-specific physical and environmental influences. Select treatment technologies which can be easily modified to accommodate substantial changes in hydraulic loading and leachate strength.

Treatability studies

If possible, conduct treatability studies on site-specific leachate before committing to a particular leachate treatment process or technology. Treatment process staging may be necessary to accommodate variations in leachate chemistry and flow rates. Staging involves adding or deleting treatment processes or changing capacity of existing processes as future conditions warrant.

Design criteria

Establish leachate treatment goals and design criteria (e.g., effluent quality, treatment efficiency) consistent with final disposal requirements and raw leachate characteristics.

Recommended design procedures

Design the leachate treatment process based on the results of the site characterization studies, a feasibility study, and the conceptual design report. Re-evaluate the following critical design parameters established during conceptual design:

Design parameter	Evaluation criteria
Leachate characteristics	additional testing may be needed to assess the leachate's variability and treatability
Site geotechnical conditions	additional, localized geotechnical testing may be required to augment site-wide investigations
Leachate flow projections (hydraulic loading)	accuracy
Storage capacity and detention times	accuracy
Treatment efficiency forecasts	accuracy
The adaptability of proposed leachate treatment technologies	ability to accommodate short-term and long-term variations in leachate characteristics and treatment requirements

7.10 Final Cover System

Performance criteria

The final cover system should minimize water infiltration and erosion. Other important design issues include landfill gas containment and control, settlement, erosion, long-term maintenance requirements, and slope stability. Landfills that undergo remedial action to alleviate groundwater contamination, may be required to meet more stringent design criteria for the final cover.

References: 40 CFR 258.60(a) and OAR 340-94-120

Alternative designs

EPA allows approved state permitting programs, like Oregon's, flexibility in interpreting Subtitle D cover design requirements. Accordingly, the Department may consider alternative designs provided that critical performance criteria (e.g., minimal infiltration) are met. In the State's arid regions, for example, a properly designed soil cover may perform as well as a geomembrane.

Design criteria

Design the final cover system to meet the following criteria:

- minimum slopes of 2% and maximum slopes of 30%
- accommodate anticipated settlements
- contain landfill gas and enhance gas collection and recovery efforts
- minimize erosion
- minimize surface water infiltration
- promote efficient surface water drainage and runoff
- maintain stability on side slopes, and
- enhance site aesthetics

Design procedures

Design the final cover system by following the procedure below. Where listed, refer to the pages in Section 7.13 (Appendix of Engineering Analyses and Calculations) for additional details.

Step	Action	Ref. pg.
1	Prepare typical cross-sections of the cover system design for top and side slope	----
2	Use the HELP Model to predict infiltration	7-25
3	Analyze slope stability	7-26, 7-27
4	Analyze potential settlement	7-28

5	Describe each layer of the cover system, including: • foundation layer • low permeability layer • drainage layer • protective layer • topsoil layer • vegetative layer	---

Foundation layer

The foundation layer will serve as a base for either a low-permeability soil layer, or a geomembrane layer. The foundation layer must support and protect the cover during and after the construction phase.

Specify appropriate material properties, thickness, and configuration.

Low Permeability Layer

Design the low permeability layer to minimize moisture infiltration, to enhance landfill gas containment and control, and to accommodate site specific physical and environmental conditions.

Reference: Section 6.2 of this guidance provides detailed information on designing geomembrane and low-permeability soil layers

Drainage layer

Design the drainage layer to minimize infiltration, leachate generation, slope stability problems, erosion, and to enhance access for maintenance equipment.

Design procedures: drainage layer

Design the drainage layer of the final cover system by following the procedures below. Where listed, refer to the pages in Section 7.13 (Appendix of Engineering Analyses and Calculations) for additional details.

Step	Action	Ref. pg.
1	Specify properties, and performance criteria of granular drainage layers, including Unified Soil Classification, grain size distribution, maximum particle size, maximum percent passing No. 200 sieve, thickness and hydraulic conductivity	---
2	Specify properties, and performance criteria of geosynthetic drainage layers, including polymer type and transmissivity	7-25
3	Identify properties of granular filter layers, including Unified Soil Classification, grain size distribution and thickness;	---

4	Specify properties of geosynthetics used for protective or filter layers. Determine allowable properties by analysis	7-28
5	Analyze filter layer performance	7-31
6	Specify configuration, dimensions and properties of the collection pipe system. Analyze structural parameters.	7-31
7	Develop exit drain design details	---
8	Analyze drainage layer performance	7-30

Protective layer

An additional soil layer may be used to protect low-permeability layers from physical or environmental damage.

Design of protective layer

Specify the protective layer's properties and dimensions, including Unified Soil Classification, grain size distribution, thickness, hydraulic conductivity and maximum particle size (if placed directly on a geomembrane layer). Design the protective layer to:

- provide adequate rooting depth and soil moisture storage for selected vegetation
- protect the low-permeability layer against root penetration, freezing, drying and desiccation, and
- protect geosynthetic layers from puncture and other physical damage

Topsoil layer

The primary function of the topsoil layer is to provide an optimal growing medium for desirable vegetation. Topsoil may be amended with woodwaste, sewage sludge, or compost if applied appropriately at agronomic rates. Soil amendments should not cause odors, air-born contaminants or surface water quality problems.

Design criteria: topsoil layer

Specify top soil characteristics based on a thorough analysis of vegetation alternatives and fertilizer requirements, such as:

- thickness
- U.S.D.A. textural classification
- Soil Taxonomy
- pH
- organic content
- salinity
- nutrient content, and
- carbon to nitrogen ratio

If the topsoil layer will function as the protective layer, follow procedures for the design of the protective layer

Note: For additional information on soil properties and enhancement techniques, contact the County Agent of the Oregon State University Extension Service

Vegetative layer

The vegetative layer's main functions are to:
- minimize erosion and long-term maintenance, and
- maximize evapotranspiration

Design criteria: vegetative layer

The vegetative layer should be compatible with other cover-system components and easy to maintain. Plant shallow-rooted, locally adapted perennial plants that:
- resist drought and temperature extremes
- thrive in low nutrient soil with minimum nutrient addition
- establish dense growth to minimize cover soil erosion (limit is no more than 2 tons/acre/year), and
- survive and function with little or no maintenance

Reference: Refer to the Page 7-33 in Section 7.13 (Appendix of Engineering Analyses and Calculations) for additional details.

Alternative to vegetative layer

A vegetative layer may be incompatible with site climatic conditions or end use plan. If an alternative layer is planned, assess soil erosion, long-term maintenance requirements, and compatibility with other cover system components. The specified material should:
- accommodate settlement without compromising function
- maintain positive slopes to promote surface drainage off the cover
- be stable and erosion resistant during extreme precipitation and/or wind, and
- limit soil erosion to no more than 2 tons/acre/year

Reference: Refer to the Page 7-33 in Section 7.13 (Appendix of Engineering Analyses and Calculations) for additional details.

Typical cover system design

A typical final cover system design meets the thickness, slope, and specifications listed in the table below.

Layer	Construction material	Thickness	Slope	Specifications

Layer	Construction material	Thickness	Slope	Specifications
Top layer	vegetation	---	---	persistent, drought resistant, adapted to local conditions, shallow-rooted
	on soil	$\geq$ 12 inches	$\geq$ 2%	erosion rate < 2 tons/acre/year
Drainage layer	Soil (sand and gravel mixes)	$\geq$ 12 inches	$\geq$ 2%	SP (USCS) soil, K > 10^{-2} cm/sec
	geosynthetic	variable	$\geq$ 2%	performance equivalent to soil, hydraulic transmissivity > $3x10^{-5}$ m^2/s
Low-permeability layer	geomembrane (HDPE)	$\geq$ 60 mils	$\geq$ 2%	other types of FMLs should be at least 20 mils in thickness
	on low-permeability soil	$\geq$ 24 inches	$\geq$ 2%	in place K < 10^{-6} cm/sec

7.11 Surface Water Control System

Precipitation data

Select appropriate precipitation data for design analyses.

Reference: Refer to the Page 7-32 in Section 7.13 (Appendix of Engineering Analyses and Calculations) for additional details.

Design criteria

Design the surface water control system to meet the following criteria:

- prevent run-on flow onto active or inactive portions of the landfill (assuming peak discharge from the 25-year storm)
- collect and control run-off from active and inactive portions of the landfill (assuming a 24-hour, 25-year storm)
- comply with the provisions of the storm water discharge (NPDES) permit and the Clean Water Act
- control sediment transport and remove suspended solids as necessary to comply with the NPDES permit conditions
- collect and contain leachate contaminated stormwater that accumulates in active fill areas
- temporarily store excess run-off from peak flows until it can be discharged at a lower, controlled rate
- minimize site erosion
- protect the integrity and effectiveness of the landfill cover system, and
- minimize post-closure maintenance requirements

Design Procedures

Design the surface water control system for both the active landfill operation and post-closure phases by following the procedure below.

Step	Action
1	Define drainage basin boundaries
2	Identify potentially sensitive features, such as wetlands, fish migratory streams
3	Develop site grading plans for active and closed landfill scenarios
4	Develop design storm hydrographs and calculate peak flow volumes and velocities
5	Select and size appropriate control-system components, including ditches, culverts, and detention basins to safely pass peak flows
6	Specify permanent and temporary erosion control measures

Step	Action
7	Specify permanent and temporary siltation control measures, and
8	Perform applicable analyses and calculations Reference: Refer to the Page 7-32 in Section 7.13 (Appendix of Engineering Analyses and Calculations) for additional details.

7.12 Landfill Gas Control System

Designing the system

Design the landfill gas control system to accommodate a wide range of operational and environmental variables, withstand harsh physical/ environmental conditions, and function as long as needed.

Appropriate landfill gas control system technologies are:

- flexible operationally
- easy to construct and modify
- durable (physically and chemically)
- easy to monitor, and
- easy to maintain and repair

Design criteria

Design the landfill gas control system to:

- handle the maximum gas flow rate predicted for the landfill
- accommodate variability in gas generation, composition, and other operational parameters
- expand as needed to collect gas from future cells, and
- meet the applicable criteria in the table below

If designing...	then meet the following criteria:
an active control system	• extraction well boreholes should be at least 24 inches in diameter • construct extraction well casings and collection laterals and headers of PVC, HDPE or stainless steel • provide 100% blower standby (backup) capability • equip flare systems with flame arresters to prevent accidental ignition in the discharge piping system • equip flare units with automatic ignition systems and alarms • at sites with a high risk of off-site gas migration, install alarm systems with auto-dial-phone capabilities to contact response personnel 24-hours-a-day, 7-days-a-week • design perimeter extraction wells should be designed to provide 100-percent overlap of influence between adjacent wells (i.e., radii of influence of adjacent wells should completely overlap)
a passive control system	use only in combination with geomembrane cover and liner systems

Recommended design procedures

Establish the overall design basis by re-evaluating conceptual design criteria, landfill gas test data, and site characterization data. Incorporate the latest available engineering data and gas test data and following the design procedure below.

Step	Action
1	Determine the landfill's gas generation potential. Various modeling techniques may be used to predict approximate peak and total landfill gas production
2	Define the main operating functions of the landfill gas control system (i.e., landfill gas migration control, odor or air-emissions control, energy recovery, or multi-use)
3	Establish performance criteria, construction materials properties, equipment layout, and equipment types and characteristics. Design construction details (e.g., well or collection-trench depths and spacings and perimeter setbacks, header pipe sizes and configuration) to accommodate site-specific conditions
4	Prepare a facilities plan that depicts the following system components: • extraction well and/or collection trench locations and spacings • locations of adjustment valves and sampling ports • configuration of collection header piping • condensate drain locations • layout of mechanical equipment complex (i.e., blowers, flares, electrical panels) • locations of gas monitoring probes
5	Prepare design details that describe proposed materials and equipment for the major control system components (i.e., well casings, collection piping, granular materials, valves, blowers, flares) and typical design details for the following: • extraction wells • valves and sampling ports • condensate drains, sumps, pumps, storage tanks and associated equipment • mechanical equipment complex (blowers, flares, condensers, electrical panels, alarms, etc.), and • well or piping penetrations through the cover or liner systems

7.13 Appendix of Engineering Analyses and Calculations

Design report supporting information

As applicable, describe the assumptions, technical rationale, references, and factors of safety used for each engineering analysis or calculation. Incorporate relevant analyses and calculations into the Design Report.

Soil balance calculations

Calculate quantities of specialized and general-purpose soils:

- to construct and operate each phase of landfill development
- for phased closure and final closure construction
- available at the identified borrow source, and
- to be imported over the life of the site

Water balance analysis (HELP model)

Use the latest version of U.S. EPA's Hydrologic Evaluation of Landfill Performance (HELP) Model to estimate:

- water percolation through each barrier layer
- lateral drainage from each drainage layer, and
- hydraulic head build-up in each drainage layer

Model input should consist of site-specific climatological data, if available, and site-specific geotechnical and design data. Assume landfill operational status ? development plan and engineering design plans. Provide all input assumptions and the complete model output in the Design Report.

Use of geosynthetics

Geosynthetics such as geomembranes, geotextiles, geonets, geogrids and geocomposites have many possible applications in landfill design and construction. Non-structural materials such as geomembranes and geonets should not be subjected to significant physical stresses. Other liner or cover components must be designed to protect non-structural materials from physical stresses.

Note: For methods to evaluate interface friction and shear stresses of layered geosynthetic components see Stability Analyses on page 7-26.

Selecting a geosynthetic

Select geosynthetics by matching intended functions with compatible physical properties. Manufacturers' specifications are usually derived from laboratory tests which do not account or field conditions. Adjust for differences between laboratory and in-situ conditions by either:

- customizing laboratory and field tests to model field conditions, or
- using partial factors of safety to account for differences between laboratory tests and field conditions

Perform a “design by function” analysis to select the appropriate geosynthetic material, or establish material properties by following the procedure below.

Step	Action
1	Evaluate the geosynthetic layer and the materials above and below
2	Specify a design factor of safety that reflects the potential consequences of the geosynthetic’s failure
3	Describe the geosynthetic's primary function(s) and other critical functions
4	Calculate the numerical value for each geosynthetic property in question (as appropriate for the geosynthetic's intended function)
5	Specify testing requirements for selecting a geosynthetic product
6	Determine the partial factors of safety needed to compensate for differences between laboratory testing and the field conditions
7	Specify the minimum allowable properties for a product in a particular application

Reference: The suggested "design by function" approach to designing with geosynthetics is summarized in pages 61-62 of R. M. Koerner's Designing With Geosynthetics, 2nd Edition, Prentice-Hall Publ. Co., Englewood Cliffs, NJ, 1990, 652 pgs

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Stability analyses: parameters

Analyze the stability of all waste containment structures. Consider facilities design, construction and operation, and site characteristics (e.g., naturally unstable or seismically affected areas). Seismic impact zones, as defined in 40 CFR 258.14, exist at most locations in Oregon. Use appropriate testing and analysis to determine the following parameters:

- strength of soils and solid waste materials
- effective angles of internal friction for soils and solid waste
- friction angles of adjoining layer interfaces
- density of soils and solid waste, and
- pore water pressure in soils

Stability analyses: scenarios

Analyze the following scenarios using appropriate factors of safety:

- Potential rotational failure of the soil mass beneath the liner system
- Potential rotational failure of any containment dike, or other engineered structures
- Potential sliding failure of the liner system along the plane of the side slope
- The general slope stability and liner system stability along the plane of the liner system (assume active landfill operations and worst-case site development conditions
- Potential sliding failure or the cover system side slopes, assuming maximum pore water pressure in the drainage layer or cover soils over a geomembrane

Factors of safety

Suggested factor of safety (FS) values are shown in the table below. Actual values reflect engineering analyses site geotechnical and environmental characteristics, construction materials, operational procedures and risk factors.

Consequences of Slope Failure	**Uncertainty of Strength Measurements**	
	Small[1]	Large[2]
No imminent danger to human life or major environmental impact if slope fails:	1.25 (1.2)*	1.5 (1.3)
Imminent danger to human life or major environmental impact if slope fails:	1.5 (1.3)	2.0 or greater (1.7 or greater)

[1] Strength measurements are most reliable when the soil conditions are uniform and high quality test data are available

[2] Strength measurements are most uncertain when the soil conditions are complex and test data are inconsistent and incomplete

* Numbers without parentheses apply for static conditions and those within parentheses apply to seismic conditions.

Modified from: U.S. EPA, (1993), "Technical Manual for Solid Waste Disposal Facility Criteria - 40 CFR Part 258," November 1993.

Settlement

Settlement may involve a landfill cell, geologic units beneath the cell, or both. The amount of settlement depends on the characteristics of the solid waste and the underlying geological units.

Settlement analysis

Calculate for each landfill cell:

- the total consolidation of underlying geological units
- the total waste settlement
- differential settlement beneath the flattest sections of the liner system and maximum differential settlement beneath the liner footprint
- maximum differential settlement of the cover system
- slope allowance required to compensate for differential settlement of leachate drainage layers and collection pipes, and
- final cover slope allowances required to compensate for estimated differential settlement

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Settlement tolerances

Post-settlement slopes for leachate collection systems and cover systems should meet original design criteria

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Geotextile filter analysis

A geotextile filter should provide adequate cross-plane permeability and soil retention. Therefore, the geotextile's void spaces need to be compatible with adjoining materials. Analyze geotextile filters following the table below.

Step	Action
1	Specify a design factor of safety and calculate: • the required flow rate through the geotextile filter, and • the apparent opening size of the geotextile from the soil gradation
2	Specify appropriate geotextile testing (e.g., apparent opening size, permittivity)
3	Determine allowable flow rate. Use partial factors of safety to account for soil clogging, creep reduction of void spaces, and biological clogging
4	Consider other critical properties including: • chemical compatibility with landfill contaminants • survivability (during packaging, transportation, handling, and installation), and • ultraviolet-light resistance

Step	Action
5	Specify a particular geotextile product, or specify the required properties (e.g., apparent opening size and permittivity)

Geomembrane liner system

The geomembrane must have appropriate physical properties to withstand physical and environmental stresses during construction and long-term use. Analyze the critical design parameters following the procedure below

Step	Action
1	Calculate and specify a design factor of safety for construction and operation related stresses (i.e., tensile, shear, impact, and puncture stresses). Stress sources include anchorage, geomembrane weight, waste-weight, foundation subsidence, waste settlement, construction equipment operation, and contact subgrade and backfill materials (e.g., drainage layers)
2	Specify geomembrane testing procedures for critical properties (e.g., tensile strength, seam strength, tear resistance, puncture resistance, impact resistance, geomembrane friction, etc.). Use partial factors of safety to account for discrepancies between laboratory tests and field conditions
3	Consider other critical properties including: • chemical compatibility with leachate and gas • survivability during packaging, transportation, handling, and installation • ultraviolet light resistance, and • coefficient of thermal expansion (required slack in the geomembrane and acceptable temperature ranges for installation)
4	Specify a particular geomembrane product, or the minimum allowable geomembrane properties

Primary LCRS performance evaluation

Design the primary leachate collection and removal system (LCRS) using redundant features and conservative factors of safety to enhance its reliability. Evaluate critical design parameters using the following assumptions and analysis:

- Precipitation impinging directly on the drainage layer; the drainage layer is saturated; precipitation equals the wettest month's average rainfall. Calculate the hydraulic head for these conditions. The hydraulic head should not exceed 12 inches [30-cm] or the thickness of the drainage layer at any point in the LCRS, and
- All leachate collection pipes fail with the final cover is in place; surface water infiltration enters the drainage layer at a rate equal to the HELP Model estimate; the drainage layer is saturated; precipitation equals the wettest monthly total. Calculate hydraulic head for these conditions. The hydraulic head should not exceed 12 inches [30-cm] or the thickness of the drainage layer at any point in the LCRS.

Secondary LCRS performance evaluation

Evaluate the performance of the proposed secondary LCRS design by calculating the following:

- Leakage detection sensitivity: ". . . the smallest primary liner leakage rate which can be detected."
- Leakage collection efficiency: the ratio of the leakage collected at the secondary LCRS sump divided by the leakage entering the secondary LCRS and
- Leak detection time: the time required for leachate to travel from the point of entering the secondary LCRS to a collection sump

References: Background Document: Bottom Liner Performance in Double-Lined Landfills and Surface Impoundments, EPA/530-SW-87-013, U.S.EPA, 1987, 301 pgs.
Background Document: Proposed Liner and Leak Detection Rule, EPA 530-SW-87-015, U.S.EPA, 1987, 526 pgs.

Cover system drainage layer performance

Evaluate drainage layer performance and reliability by using the HELP Model or other appropriate method(s) to calculate the maximum hydraulic head buildup within this layer.

LCRS filtration analysis

Demonstrate that the conveyance systems for the primary, and secondary LCRSs and the final cover drainage system are designed to prevent clogging. Use analysis and calculations to show that:

- geotextile filter layers will adequately retain solids and pass liquids (see page 7-28), and
- granular filter layers will adequately retain solids and pass liquids (use analytical methods on pages 19 - 20 of Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments, U.S. EPA, EPA/530-SW-89-047, July 1989, and page 7-68 of Lining of Waste Containment and Other Impoundment Facilities, U.S. EPA, EPA/600/2-88/052, September 1989, or other appropriate techniques.

Structural stability of leachate pipes

Generate structural calculations to show that leachate collection pipes will withstand:

- static and dynamic loading from construction equipment;
- maximum potential loading from vehicular traffic;
- maximum static loading from the completed landfill; and
- stresses from long-term differential consolidation of the landfill foundation.

Manhole foundation bearing capacity

Calculate the bearing capacity of manhole foundations. Demonstrate that the bearing capacity will support anticipated loads without damaging the liner system. Consider differential-settlement induced down-drag forces that may occur where compressible waste and rigid manholes meet.

Leachate storage capacity

Calculate the storage capacity of the leachate impoundment, accounting for all in puts and outputs. Demonstrate that leachate storage impoundments or holding tanks will provide:

- adequate storage capacity for the maximum leachate flows; assume the leachate collection system maintains less than 12 inches [30-cm] of leachate depth
- adequate storage capacity to manage leachate as planned and to satisfy any seasonal limitations, and
- sufficient freeboard to contain leachate and prevent overflows, assuming a 24-hour, 25-year storm

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Leachate treatment and disposal

Calculate the efficiency of the proposed treatment system considering the following factors:

- design criteria, including regulatory requirements;
- availability of representative leachate for testing;
- untreated (influent) leachate characteristics, (i.e., quantity and quality);
- temporal and spatial variability of leachate characteristics;
- method(s) of leachate disposal;
- periodic design modifications (certain treatment processes may be phased in to accommodate variable leachate quality and hydraulic loading);
- proposed unit treatment processes and associated technologies;
- potential temperature variations in leachate and ambient air;
- nutrient addition requirements (e.g., phosphorous and/or nitrogen addition may be required to enhance biological treatment.

Surface water control

Evaluate the effectiveness of the surface water control system for conditions throughout the landfill's development and operation. Use a 24-hour, 25-year or more severe storm if extreme impacts could result from control system failure.

Obtain storm recurrence information from the Weather Bureau's Technical Paper 40, Rainfall Frequency Atlas of the United States for Durations for 30 Minutes to 100 Years. Alternatively, analyze local meteorological data to estimate storm intensity. Use the Rational Method, the Soil Conservation Service (SCS) method (i.e., Urban Hydrology for Small Watersheds, SCS Technical Release #55, June 1986 (TR-55)) or other recognized methods to estimate design-storm-related peak flows.

Demonstrate by analysis, that:

- Diversion and conveyance structures (e.g., berms and channels) are designed to divert all stormwater run-on away from the landfill footprint (assume peak discharge from the 25-year storm). Use standard analytical methods recommended by the US Dept. of Transportation (Federal Highway Administration), the US Army Corps of Engineers, the US Dept. of Agriculture (Soil Conservation Services) or other appropriate engineering methods.
- Sedimentation and detention facilities will retain peak runoff flows from the 25-year storm , trap sediment effectively, and comply with the facility's NPDES permit. Use the SCS methods (TR-55) to develop inflow hydrographs for sedimentation/detention structures.
- Active landfill cells have adequate capacity to contain stormwater and leachate during a 24-hour, 25-year storm.

Post-closure surface water control

Analyze requirements for post-closure surface water runoff control. Assuming 24-hour, 25-year storm conditions, demonstrate that:

- culvert and drainage channel cross-sections and slopes will pass design-storm-generated flow volumes
- surface water control facilities will minimize runoff velocities and related energy, and erosion of the landfill cover and drainage channels
- all drainage channels will convey flow at or below the maximum permissible (mean) velocities. Select the proper channel section for the appropriate hydraulic condition, and
- site maintenance will be minimized.

Note: Use standard engineering methods and procedures such as described in the Engineering Field Manual for Conservation Practice, U.S. Soil Conservation Service, 1984; SCS Engineering Handbook #5; Open Channel Hydraulics, V. T. Chow, 1959; Handbook of Hydraulics, 3d. edition, King, 1939; or other published references and specifications.

Cover soil erosion

Use the U.S.D.A. Universal Soil Loss Equation to estimate the erosion loss from the proposed final cover system. U.S. EPA guidance recommends a maximum soil loss of < 2 tons/acre/day. Values for the Universal Soil Loss Equation parameters can be obtained from the U.S. Soil Conservation Service's (SCS) Technical Guidance Document available at local SCS offices.

Landfill gas control system

Calculate or estimate the following design parameters:

- landfill gas production (peak and total production over the life of the landfill)
- gas well spacings and depths
- individual extraction-well flow rates
- system-wide collection efficiency
- maximum allowable headloss criterion
- minimum allowable vacuum pressure at the remotest extraction well.
- headloss from wells to the blower
- total accumulative flow rate within the collection pipes and headers
- required sizes for collection pipes and vacuum-motor-blowers, and flare units (if applicable)
- requirements for blower backup capabilities, and phased expansion of the mechanical equipment complex (i.e., blowers, flares, etc.) disposal or recovery systems and the collection system.

7.14 Additional Resources

Landfill technologies, design, and construction practices	Draft Technical Manual for Solid Waste Disposal Facility Criteria - 40 CFR Part 258, U.S.EPA, April 1992. Seminars - Requirements for Hazardous Waste Landfill Design, Construction and Closure, CERI-88-33; U.S.EPA; Center for Environmental Research Information, Cincinnati, OH 45268, 1988. Lining of Waste Containment and Other Impoundment Facilities, EPA/600/2-88/052, U.S.EPA, Risk Reduction Engineering Laboratory, Cincinnati, OH 45268, September 1988. Design, Construction, and Evaluation of Clay Liners for Waste Management Facilities, EPA/530/SW-86/007F, U.S.EPA, Office of Solid Waste and Emergency Response, Washington, DC 20460, November 1988.
Designing with geosynthetics	Koerner, Robert M., Designing With Geosynthetics, 2nd Edition, Prentice-Hall Publ. Co., Englewood Cliffs, NJ, 1990, 652 pgs.
Landfill cover systems	Seminars-Design and Construction of RCRA/CERCLA Final Covers, CERI 90-50, U.S.EPA, Office of Research and Development, Washington, DC 20460, 1990. Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments, EPA/530-SW-89-047, U.S.EPA, Office of Solid Waste and Emergency Response, Washington, DC 20460, July 1989. Proceedings of the 4th GRI Seminar on the topic of Landfill Closures: Geosynthetics, Interface Friction and New Developments, Geosynthetic Research Institute, Philadelphia, PA 19104, December 1990, 260 pgs.

Leachate treatment

Thornton, Richard J., and Blanc, Fredrick C., Leachate Treatment by Coagulation and Precipitation, proceedings of the American Society of Civil Engineers, Vol. 99, No. EE4, August 1973.

Chian, E. S. K., and De Walle, F. B., 1976, Sanitary Landfill Leachates and their Treatment, ASCE Environmental Engineering Division, No. EE2.

Chian, E. S. K., and De Walle, F. B., 1977, Evaluation of Leachate Treatment, Vols. I and II, Washington, DC: U.S. EPA, EPA-600/2-77-186.

Boyle, W. C., and Ham, R. K., 1974, Treatability of Leachate from Sanitary Landfills, Journal of Water Poll. Control Federation, Vol. 46, No. 5.

De Walle, F. B., and Chian E. S. K., 1977, Leachate Treatment by Biological and Physical-Chemical Methods, Proceedings of the Third Annual Solid Waste Research Symposium, U.S. EPA, March 14-16, 1977.

Robinson, H. D., and Maris, P. J., 1985, The Treatment of Leachates from Domestic Waste in Landfill Sites, Journal of Water Poll. Control Federation, January 1985, pp. 30-38.

Nelson, P. O., and Storhaug, R., 1985, Treatment of Leachate in Aerated Lagoons, Lab-Scale Study, Oslo, Norway, Norwegian Institute for Water Research, Report No. 0-84022.

Landfill gas control

EMCON Associates, 1980, Methane Generation and Recovery from Landfills, Ann Arbor Science, Ann Arbor, Michigan, p. 139.

Ham, R. K., et al., 1979, Recovery, Processing, and Utilization of Gas from Sanitary Landfills, Cincinnati, OH: U.S. EPA 600/2-79-001.

Section 8: Facility Construction Program

8.1 Introduction

Objective

The objective of the construction program is to translate the Department-approved engineering design into a completed facility that meets or exceeds the design plan specifications and performance objectives.

Elements

The facility construction program should include the following elements:

- an organized, qualified construction project team
- Department-approved design drawings and specifications for each phase of landfill development
- a Construction Quality Control (CQC) program
- a Construction Quality Assurance (CQA) program, and
- Construction Certification Reports based on an evaluation of CQC and CQA documentation which certify that construction was completed in accordance with Department-approved plans and specifications

How to respond

Submit the information below to the Department for each phase of landfill development (i.e., construction of new cells, cell closure, or environmental control facilities).

Document	When to submit
CQA plan	prior to initiating construction
soil liner test pad evaluation report	prior to beginning construction of the soil liner
construction certification report	after completing each phase of construction

Reference: OAR 340-93-140 and OAR 340-93-150 provide information on construction documents

In this section

This section describes the major construction project elements, including:

- construction project team
- construction guidelines
  - soil test pad
  - soil liner
  - excavation and subgrade preparation
  - geosynthetic liners
  - leachate and gas collection systems
- quality control program
- quality assurance plan
- construction certification reports

Differences in materials

The physical properties of natural earth materials are generally more variable than the properties of manufactured materials (e.g., geomembranes) which are produced under factory controlled conditions. Accordingly, these guidelines concentrate more on methods for earth-materials construction.

8.2 Construction Project Team

Project team organization

Organize the project team in terms of "Owner", "Designer", and "Constructor" or other equivalent divisions of responsibility. Regardless of the contractual arrangement used, the Owner, Designer, and Constructor functions are discrete, independent responsibilities.

Establishing the team

Establish and document the construction project team organization, including:

- a list of key project team members and their roles and responsibilities
- the minimum required experience for each project team member
- key project team members, their qualifications, and phone numbers and addresses
- an organizational flow chart identifying members of the project team, lines of authority, and lines of communication between the various team members

Team roles

The table below shows a typical construction project team.

Team Member	Role
Project Manager	Individual who represents the owner and is responsible for the overall coordination and management of the project activities
Owner	Party who initiates the project and is responsible for establishing and directing the project to completion
Owner's Team	Persons who advise and assist the owner in specialized areas and, if applicable, person(s) to whom the owner delegates authority to act on the owner's behalf
Construction Quality Assurance (CQA) Consultant	Party(s), who is part of the Owner's Team, and independent from the Project Manager, Constructor and Manufacturer. The CQA Consultant is responsible for observing, conducting and documenting activities related to the quality assurance of materials and construction on behalf of the Owner
Designer	Party whose primary role is to conceive, plan and provide quality design solutions in response to the owner's stated requirements
Design Team	Experienced staff and subcontractors who are responsible for various aspects of the design

Team Member	Role
Constructor	May be a contractor. Party responsible for planning, managing, and accomplishing the construction activities
Construction Team	Construction staff, material and equipment suppliers, specialty sub-contractors assembled by the Constructor

Note: For smaller projects, multiple functions can be accomplished by a single individual

Basis for organization

"Successful construction projects are conceived, planned, designed, and built by a project team consisting of an owner, design professional, and constructor. Quality is achieved when each team member's obligations are fulfilled competently and in a timely fashion, in cooperation with the other members." (ASCE Manual No. 73.)

8.3 Construction Guidelines - Soil Test Pad

Purpose of soil test pad

The purpose of a test pad(s) is to model the construction of the full-scale liner to verify that proposed construction materials and methods will produce the desired compaction and in-situ hydraulic conductivity. The assessment will enable the Project Team to establish final requirements for soil processing, placement and compaction.

Requiring a test pad

The design specifications should require the Constructor to complete a successful test pad evaluation before constructing the full-scale soil liner. An additional test pad should be prepared and evaluated for each significant change in construction materials, equipment, or methodology.

Construction procedures

Construct soil test pads according to the table below.

Step	Action
1	Use the same soil material, CQC program, and construction equipment and methods that will be used for the full-scale liner
2	Classify representative soil samples according to the Unified Soil Classification System (ASTM D2487)
3	Evaluate soil samples to define an acceptable range of water content and dry unit weight. Use careful judgment in interpreting laboratory hydraulic conductivity values, (i.e., there may be up to 1 order-of-magnitude difference between laboratory and field values) Reference: Daniel, D. E., and Benson, C. H. (1990), "Water Content - Density Criteria for Compacted Soil Liners," *Journal of Geotechnical Engineering*, Vol. 116, No. 12, pp. 1811 -1830.
4	Construct the test pad at least four times the width of the widest piece of equipment to be used
5	Construct the test pad long enough to allow the compaction equipment to attain normal operating speed before reaching the test area
6	Construct at least four compacted lifts

Achieving low hydraulic conductivity

The most important factors in achieving hydraulic conductivity criteria are:

- using suitable soil materials
- using appropriate construction equipment
- placing the soil at the correct water content
- properly preparing the surface between lifts
- achieving density specifications by using appropriate compaction equipment and procedures, and
- protecting completed lifts from damage

Duties of CQA consultant

Suggested duties of the Construction Quality Assurance (CQA) consultant include:

- Observe, approve and document the suitability of the prepared subgrade
- Observe, approve and document soil material selected for construction
- Observe and record during soil placement and compaction:
  - weather conditions
  - the construction equipment and methods used (e.g., equipment type and specifications, lift thickness before and after compaction, number of compactor passes, compactor speed), and
  - the CQC program
- Test the physical properties that will be used to evaluate construction of the full-scale soil barrier, including at least four water content (ASTM D2216) and four density (ASTM D1556) tests per compacted lift
- Collect at least four undisturbed samples from each compacted lift immediately adjacent to where physical properties are tested, and from those samples obtain at least four undisturbed test specimens from varying depths in the compacted lift. Test the specimens in the laboratory for hydraulic conductivity (ASTM D5084) to determine any correlation between laboratory hydraulic conductivity, tested physical properties, and in-situ hydraulic conductivity
- Repair or observe the repair of all holes left by density testing and soil sample collection
- Conduct field tests to determine in-situ hydraulic conductivity. The Department recommends at least one sealed double ring infiltrometer test (ASTM D5093 or equivalent method)
- Dig at least four (4) test pits in the test area, inspect for evidence of voids, large pores between remnant clods, signs of poor bonding between lifts, and other visible problems, and
- Prepare a report documenting the test pad(s) evaluation

Test pad evaluation report

The CQA consultant should prepare and submit to the Department a soil liner test pad evaluation report that includes:

- a summary of test data
- data analysis
- conclusions and recommendations regarding test pad performance and full-scale soil barrier construction.
- a detailed description of the construction materials, equipment and methods to be employed for full-scale liner construction

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Report review procedures

The Project Manager and Designer should evaluate the CQA Consultant's report and the test pad's conformance to the design specifications.

If the test pad's performance	then
conforms to design specifications	construct the full-scale soil liner using the same construction methods, equipment, and materials
fails design specifications	require the Constructor to construct and evaluate another test barrier using modified construction material, equipment, and methods

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Alternative to test pad assessment

The project schedule may not allow time to complete the test pad evaluation before the soil liner is constructed. If this situation arises, demonstrate to the Department that a full evaluation of the test pad is not needed to verify that the liner will meet the specifications.

Demonstration content

The demonstration should:

- show, with laboratory testing, that the proposed soil-liner material easily meets the specified hydraulic conductivity
- permit Department representatives to observe construction of the test pad and excavation of test pits
- show that the lifts are adequately bonded together and that soil clods are adequately remolded (few inter-clod voids or macro-pores should be visible)
- use the same materials, methods, and equipment to construct the soil liner, and
- recognize that completed liner segments may need re-construction or modifications if the soil test pad fails to meet the design specifications

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8.4 Construction Guidelines -- Soil Liner

Test pad results

The Project Manager and Designer should use the test pad modeling results to establish final requirements for liner construction and performance (specified compaction and hydraulic conductivity criteria).

Factors in establishing final construction requirements

In establishing final construction requirements, the Project Manager and Designer should carefully consider the following construction variables:

- properties of the low-permeability soils to be used for liner construction
- method of excavating and processing the soil prior to placement
- pre-compaction thickness and conditioning methods (e.g., disking, pulverizing, moisture adjustment)
- compaction equipment type, weight and length of feet (for footed rollers)
- compactor operations (number of compactor passes and maximum compactor speed)
- protection of compacted lifts that may be exposed to the elements
- scarification and moisture control between lifts
- mixing of bentonite and other soil additives

Key construction elements

Establish a construction program that has the following elements:

- systematic construction quality control (CQC) such that the resulting liner meets or exceeds the test pad's performance
- a CQA Consultant to monitor the construction and ensure that completed soil liners meet or exceed specifications, and
- provisions to protect completed soil liners from the effects of weather and other construction activities

Modifications to construction specifications

As the Constructor and CQA Consultant gain construction experience and "get a feel" for the soils, it may become desirable to modify certain construction criteria. Such adjustments should be made as described in the table below.

If the modification is	then	Examples
“functionally inferior”	obtain Department authorization prior to implementation	modifications including less compactive effort, reduced quality control, and increased lift thicknesses that potentially result in diminished hydraulic and strength properties
“functionally superior”	continue with construction	modifications, such as increased compactive effort, increased quality control, thinner lift thicknesses, that potentially reduce the hydraulic conductivity and enhance strength properties

8.5 Construction Guidelines -- Excavation and Subgrade Preparation

Excavation, stockpiling, and processing

Perform earthwork activities in accordance with the table below.

Step	Action
1	Segregate excavated soils according to their properties
2	Process excavated soils as necessary to meet required material specifications (e.g., pulverizing the soil to break down clods or screening the soil to remove large particles)
3	Place excavated/processed soils into compatible stockpiles of uniform material
4	Provide erosion control measures for excavation and stockpiling activities
5	Adjust the moisture content as necessary before using excavated or stockpiled soils (i.e., water needs to penetrate clods so they can be remolded)

Subgrade preparation

Construction procedures for liner or cover system subgrades should address the following factors:

- control of differential settlement
- removal of soft spots
- quality control testing (density, moisture content, soil classification, soil gradation)

8.6 Construction Guidelines -- Geosynthetic Materials

Typical geosynthetic materials

Landfill construction typically involves many applications for geosynthetic materials, including:

- geomembranes in liners and covers
- geotextiles as filters, cushions, and soil separators
- geogrids for slope and foundation support, and
- drain-nets for drainage

Installation specifications

Install geosynthetic materials in conformance with the specifications for:

- function and desired properties
- minimum testing and acceptance
- testing and acceptance procedures
- damage prevention, and
- installation procedures

Testing and acceptance procedures

Establish conformance testing and acceptance requirements that include the following procedures:

- The Constructor or Manufacturer should provide the Project Manager the Manufacturer's quality control certification (i.e., verification that the geosynthetic material meets project specifications)
- The Constructor or Manufacturer of a geomembrane should provide quality control certificates issued by the resin supplier, quality control certificates for each roll produced and certification that the supplied geomembrane and extrudate have the same material properties, and
- The Constructor or CQA Consultant should conduct sampling and conformance testing in accordance with ASTM D4759 "Standard Practice for Determining the Specification Conformance of Geosynthetics" to verify the manufacturer's certification

Damage prevention

Prevent damage to the geosynthetic material by using appropriate techniques for delivery packaging, labeling, transportation, handling and storage.

Installation procedure

Install the geosynthetic material as the specifications prescribe for:

- site preparation prior to placement of geosynthetic
- geosynthetics handling, placing, anchoring, seam overlaps, and post-installation inspection
- geomembrane seam welding (including preparation of geomembrane sheets and seaming equipment), weather and temperature constraints for seaming
- geomembrane wrinkles, folds, and bridging
- seam quality control testing and inspection
- repairing inadequate seams and damaged geomembranes, and
- covering or otherwise protecting geomembranes after installation to prevent damage

8.7 Construction Guidelines -- Leachate and Gas Systems

Leachate system construction

Construct the primary and secondary leachate collection and removal system(s) (LCRSs) according to specified requirements for:

- the performance objectives for each system component (i.e., for granular drainage material the hydraulic conductivity to be achieved)
- desired material properties (e.g., hydraulic conductivity, grain size distribution, non-carbonate rock for granular drainage material or inside diameter for LCRS piping)
- the required thickness for granular drainage and filter layers, and
- constructor requirements for LCRS work execution including:
  - slopes allowances to compensate for projected differential settlement
  - protection of liners during placement of overlying granular drainage materials
  - pre-operational cleaning and maintenance of the LCRS, and
  - demonstrating LCRS pipe continuity (e.g., pull a ball or other uniform object through the pipes)

Gas system construction

Construct the landfill gas control system according to the specified requirements for:

- construction staging and coordination with landfill operation and development
- connection of system components to and penetrations through geomembrane covers and other geosynthetics
- safety precautions for the Constructor's field crews and others who may be exposed (directly or indirectly) to landfill gas
- gas production and control system performance, and
- operational objectives

8.8 Quality Control Program

CQC defined

Construction quality control (CQC) refers to those actions taken by Manufacturers, Fabricators, or the Constructor to confirm that products and work quality meet the requirements of the contract. CQC includes inspections and testing of all furnished, constructed, and installed components. These activities are independent of construction quality assurance (CQA) activities.

CQC program

Establish detailed construction quality control (CQC) requirements for materials and workmanship, to show the Constructor how to furnish products and execute work. CQC should include systematic inspections and measures to control the quality of construction and to ensure conformance with the project specifications and contract requirements.

8.9 Quality Assurance Plan

CQA plan

Prepare a detailed construction quality assurance (CQA) plan that verifies and documents proper construction of facility components. The CQA plan should describe the proposed measures for monitoring the quality of materials and work performance. CQA plan elements pertaining to foundations, subgrades, embankments, soil barriers, geosynthetics, LCRSs, and landfill gas control systems should be developed and administered by a Professional Engineer with current Oregon registration and experience in the technical area.

CQA defined

CQA is an overview and inspection program consisting of systematic observations and tests to ensure that the final product meets design specifications. CQA plans, design plans and specifications, observations, and tests are used to provide quantitative criteria for evaluating final product acceptability.

Plan contents

The CQA plan should include site-specific information on the following topics:

- staff roles, responsibility, authority and communication
- qualifications of CQA consultant
- qualifications of construction team
- inspection activities
- geosynthetic construction
- earthwork construction
- documentation

Roles and responsibilities

The CQA plan should describe the role, responsibility, and authority of each party involved in executing the CQA plan. The plan should include an organizational flow diagram outlining the management structure, lines of communication, chain-of-command, and implementation procedures.

Qualifications of CQA consultant

The CQA plan should describe the technical expertise of the CQA consultant. The CQA consultant should represent the Owner's interests as an independent, qualified party and is responsible for observing, evaluating, and documenting quality of materials and construction.

Qualifications of construction team

The CQA plan should establish minimum qualifications for earthwork contractors, geosynthetic installers and geosynthetic material manufacturers.

Inspection activities

The CQA plan should outline the observations and tests that will be used to evaluate conformance with all design criteria, plans, and specifications for each project component.

Geosynthetic construction

The CQA plan should describe the responsibilities of the CQA consultant. Suggested duties include:

- monitoring geosynthetic material delivery, unloading and on-site storage and transport
- selecting geosynthetic material (destructive samples) for conformance testing
- determining the acceptability of geosynthetics according to ASTM D4759 "Standard Practice for Determining the Specification Conformance of Geosynthetics"
- monitoring the deployment of geosynthetics
- monitoring geosynthetic seaming operations
- monitoring and documenting CQC testing procedures (i.e., non-destructive seam testing, field tensiometer testing)
- monitoring and documenting geomembrane CQA testing (i.e., destructive seam sampling and testing, repair operations, sample labeling)
- documenting any on-site activities that could result in damage to the geosynthetics
- maintaining appropriate lines of communication with other project team members as specified in the CQA plan

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Earthwork construction

The CQA plan should describe procedures associated with earthwork, including:

- grading
- foundations
- embankments
- soil liners and covers
- granular drainage and filter layers
- excavations and backfill
- top soil (vegetative) layers
- road building, and
- soil processing (e.g., mixing with bentonite)

CQA of earthwork

CQA activities should include:

- earthwork monitoring
- earthwork sampling and testing
- evaluating prospective liner materials, and
- evaluating constructed soil liners

Earthwork monitoring

The CQA consultant should oversee all key phases of earthwork to monitor and document that materials and procedures meet the design specifications. The CQA consultant's oversight should include:

- borrow soils properties and performance
- test pad construction and performance
- borrow soils stockpiling methods
- raw material processing
- foundation and sub-grade preparation
- soil layer thickness and protection of underlying layers
- repair of any holes (e.g., from grade stakes) or other construction-related damage
- soil-liner construction (soil density, moisture content, permeability, equivalency to test pad construction)
- identification and repair of penetrations of the soil liner (e.g., penetrations resulting from CQC/CQA testing)
- protection of completed soil liner sections
- all other earthwork components (i.e., granular drainage or gas venting layers, operations layer, protective layers and topsoil layer)
- identification and modification of activities that could damage liners or drainage layers

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Earthwork sampling and testing

The CQA plan should describe sampling parameters and procedures for each discrete earthwork activity including testing frequency, rationale for selecting test locations, and acceptance and rejection criteria.

The QA Consultant should observe all aspects of earthwork, and personally perform the soil sampling and testing to develop a "feel" for the material. This hands-on involvement may improve the QA Consultant's observational skills and judgment, ultimately translating into better quality assurance.

Evaluating prospective liner materials

The CQA plan should specify parameters and testing frequencies for evaluating soils intended for liner construction. Test samples obtained from the borrow area, processing area, stockpile area or final placement area, provided:

- the samples meet low-permeability specifications, and
- the soil is suitable for or can be conditioned for compaction

Liner soil testing

The table below lists recommended parameters and testing frequencies for evaluating prospective soil liner material.

Parameter being tested	Test method reference	Testing frequency	Recommended performance
Percent fines (passing a No. 200 sieve)	ASTM D1140	1 per 1000 cy and 1 test each day soil is excavated or placed	$\geq$ 50%
Percent gravel (dry-weight retained on the No. 4 sieve)	ASTM D422	1 per 1000 cy and 1 test each day soil is excavated or placed	$\leq$ 10%
Atterberg limits	ASTM D4318	1 per 1000 cy and 1 test each day soil is excavated or placed	Plasticity Index $\geq$ 10%
Water content	ASTM D3017 ASTM D4643 ASTM D2216 (at least every 5th sample)	1 per 1000 cy and 1 test each day soil is excavated or placed	-----
Moisture/Density/ Permeability relationships	ASTM D698 ASTM D1557 ASTM D5084	1 per material type	

Note: Other equivalent tests may be used

Reference: Use relationships to define an acceptable range of Water Content and Dry Density Unit Weight, in accordance with procedures described by Daniel, and Benson, C. H. (1990), "Water Content - Density Criteria for Compacted Soil Liners," Journal of Geotechnical Engineering, Vol. 116, No. 12, pp. 1811 - 1830.

Evaluating the constructed soil liner

The CQA plan should specify parameters and testing frequencies for evaluating compacted soil liners. The plan should allow testing frequencies to be increased at the discretion of the CQA consultant.

Recommended parameters and frequencies

The table below lists recommended parameters and testing frequencies for evaluating constructed soil liners.

Parameter being tested	Test method reference	Testing frequency	Recommended performance

Water content	ASTM D3017 ASTM D4643 ASTM D2216(at least every 5th sample)	5/acre/compacted lift	
Density	ASTM D2922 ASTM D1556(at least every tenth sample)	5/acre/compacted lift	Nuclear density test should measure soil density near the bottom of each compacted lift; calibrate nuclear gauges to a known density each day of use
Thickness	Elevation monitoring	50 feet center to center or minimum 6 points per grade at top of first compacted lift and top of completed soil liner	

Note: Other equivalent tests may be used

Documentation

The CQA plan should specify detailed reporting requirements for the CQA activities, including:

- daily record keeping (observation and test data sheets)
- problem reporting and corrective measures data sheets
- project Manager and Designer acceptance reports (for errors, inconsistencies, and other problems)
- final documentation including as-built drawings, and
- the signature or initials of the person maintaining the records and generating the reports

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8.10 Construction Certification Reports

Submittal

Construction Certification Reports must be submitted to the Department each time a landfill development phase is completed and/or before a newly constructed waste management unit (a landfill cell or leachate impoundment) is activated. The report should document and certify that all required components and structures have been constructed in compliance with the permit requirements and approved design specifications.

Reference: OAR 340-93-150

Report content

Construction certification reports should include the following elements:

- an executive summary describing how well the project went and major problems encountered
- a summary of all construction and CQA activities
- a summary of all CQA observations, daily inspection/photo/video logs, and test data sheets
- problem identification/corrective measures
- designer's acceptance reports for errors and inconsistencies
- deviations from design and material specifications, including justifying documentation, and copies of change orders and recorded field adjustments
- certificates of acceptance (e.g., acceptance of subgrade for geomembrane liner installation)
- as-built drawings and photographs, including record surveys of soil liner and granular drainage layer thicknesses
- a certification statement(s) and signatures legally representing the CQA Consultant, Designer and Owner, one of the which is that of a professional engineer registered in Oregon, and
- a copy of the notation on the deed to the facility property for all closed cells, as required by 40 CFR 258.60(i)

8.11 Additional Resources

Low-permeability soil liner	Daniel, D. E. (1987), "Earthen Liners For Land Disposal Facilities," Geotechnical Practice for Waste Disposal '87 Proceedings, ASCE, Geotechnical Special Publication No. 13., pp. 21-39; Daniel, D. E., and Benson, C. H. (1990), "Water Content - Density Criteria for Compacted Soil Liners," Journal of Geotechnical Engineering, Vol. 116, No. 12, pp. 1811 - 1830; U.S. EPA (1988), Design, Construction, and Evaluation of Clay Liners for Waste Management Facilities, EPA/530/SW-86/007F; U.S. EPA (1988), Lining of Waste Containment and Other Impoundment Facilities, EPA/600/2-88/052, Chapter 9; and U.S. EPA (1989), Seminar Publication: Requirements for Hazardous Waste Landfill Design, Construction, and Closure, EPA/625/4-89/022, Chapter 6.
Geosynthetics -- construction quality control	U.S. EPA (1988), Lining of Waste Containment and Other Impoundment Facilities, EPA/600/2-88/052, Chapter 9; and. U.S. EPA (1989), Seminar Publication: Requirements for Hazardous Waste Landfill Design, Construction, and Closure, EPA/625/4-89/022, Chapter 6. For guidance on seaming geomembranes: U.S. EPA (1991), Technical Guidance Document: Inspection Techniques for the Fabrication of Geomembrane Field Seams, EPA/530/SW-91/051.
Leachate Collection and Removal	U.S. EPA (1988), Lining of Waste Containment and Other Impoundment Facilities, EPA/600/2-88/052, Chapter 9.

Construction Quality Assurance

U.S. EPA (1988), Lining of Waste Containment and Other Impoundment Facilities, EPA/600/2-88/052, Chapter 10;

U.S. EPA (1985), Construction Quality Assurance for Hazardous Waste Land Disposal Facilities, Public Comment Draft, EPA/530-SW-85-021;

Daniel, D. E., "Summary Review of Construction Quality Control for Compacted Soil Liners," Waste Containment Systems: Construction, Regulation, and Performance, R. Bonaparte (ed.), ASCE, New York, pp. 175 - 189; and

Chemical Waste Management, Inc. (June 15, 1990), Quality Assurance Manual For The Installation Of Geosynthetic Lining Systems.

General reference

For further information on construction principles and procedures, and project organization see ASCE (1990), Quality in the Constructed Project, ASCE Manual No. 73.

Section 9: Landfill Operations

9.1 Introduction

Operations plan

Develop an operations plan that describes the facility's operation and maintenance and incorporates the facility's planned development and specific design elements.

Reference: OAR 340-94-040(11)(b)

Operations and maintenance manual

Once new landfill units or related facilities are constructed and activated, prepare a detailed operations and maintenance (O&M) manual. The O&M manual should incorporate pertinent information from the following sources:

- operations plan
- final design documents
- post-construction documents
- hands-on operating experience, and
- equipment manufacturers

How to respond

During the design phase of the project, prepare an operations plan that integrates the site development plan, the facility design elements, and the operational elements described in this subsection. Submit the plan to DEQ for review and approval.

Once the landfill unit and related facilities are constructed and activated, prepare the O&M manual. Incorporate the operations plan elements, construction documents, and equipment manufacturers and suppliers data. Prepare separate O&M manuals for complex systems, such as leachate treatment systems, landfill gas control systems. Make the O&M manual available to operating personnel and place a copy of the manual(s) in the facility operating record.

O&M manual content

The O&M manual should be a practical document intended for day-to-day use by on-site operations personnel that:

- reflects the scope and content of field operations
- provides clear and detailed direction to landfill operating personnel
- addresses all topics identified in the operations plan
- includes a detailed table of contents
- includes definitions of all technical terminology, and
- is assembled as a loose-leaf binder to facilitate periodic revisions

Updating operations documents

Update the operations plan and the O&M manual as necessary to reflect significant facility expansions or changes in site operations and equipment.

In this section

This section describes the operational elements that should be addressed in the operations plan, including:

- general operations
- disposal operations -- waste handling
- disposal operations -- management of working area
- special waste management
- ancillary operations
- inspection and maintenance
- operating record
- contingency
- incremental post-closure operations, and
- personnel

9.2 General Operations

Security

Establish security measures to prevent unauthorized entry, waste disposal, and unsafe scavenging practices.

Signs

For public-use landfills, post signs bearing the following information:

- facility name
- business address and telephone number of the facility owner/operator (person or municipality)
- an emergency telephone number
- hours of operation
- current permit number, and
- a list of general types of materials which will be accepted or not accepted

Access hours and controls

Establish operating hours and man-made or natural barriers to:

- discourage entry by unauthorized persons
- limit access to the site to times when an attendant is on duty
- prevent unauthorized vehicular traffic and illegal dumping of wastes, and
- protect human health and the environment.

Reference: OAR 340-94-040(9) and 340-94-040(11)(h)

Aesthetics

Screen the active landfill area from public view.

Access roads

Construct and maintain on-site access roads to minimize traffic hazards, dust and mud and to provide reasonable all-weather access. Specify the maximum sustained grade of an access road. Construct stream crossings using culverts or other structures that do not increase the potential for flooding or excessive soil erosion. Incorporate roadway design in the detailed engineering drawings and specifications (Section 7).

Open burning

Prevent uncontrolled and/or unauthorized open burning.

Endangered species	Establish operating procedures to prevent the harming, killing, capturing or collecting of any endangered or threatened species, or to the direct or indirect alteration of critical habitat for those species. Protect any such species.
Floodplain integrity	Determine if facilities are located in the 100-year floodplain. The facility must not restrict the flow of a 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste.
Sewage disposal	Manage on-site sewage in accordance with Department-approved plans.

9.3 Disposal Operations -- Waste Handling

Weighing	Install equipment for weighing incoming loads or establish procedures for estimating weight by volume of waste loads. Account for the amount of incoming waste.
Scavenging controls	Prevent uncontrolled and unauthorized removal of solid waste. Material recovery activities must not create adverse health or environmental impacts.
Waste acceptability procedures	Establish waste acceptance procedures that include the following elements: • A random inspection program at the facility for detecting and preventing the disposal of regulated hazardous wastes, polychlorinated biphenyl wastes or any other unacceptable wastes as specified in the permit or determined by the Department. • Waste screening to control prohibited waste and special wastes which require prior Department approval. • Procedures used wherever prohibited or special wastes could enter the facility, including the working face, transfer stations, direct haulers, and landfill scale houses. • Procedures for managing prohibited wastes detected in landfilled waste. • Measures to handle unusual peak waste loads which may exceed the facility's capacity. References: 40 CFR 258.20 describes the requirements for a random inspection program; OAR 340-93-040 defines prohibited wastes
Liquid wastes	Prevent the disposal of bulk or non-containerized liquid waste and meet the requirements of 40 CFR 258.28(b).
Out of state wastes	For imported wastes, establish procedures to follow prohibitions or restrictions.
Salvage	Recover salvage materials in a planned and controlled manner. Reference: OAR 340-94-040(11)(k)

Litter control

Control litter by establishing good waste compaction practices, a small working face, and physical controls (e.g., permanent and portable fences), and cleanup procedures to prevent on and off-site windblown litter accumulations.

Reference: OAR 340-94-040(11)(l)

Vector and bird control

Control or prevent on-site populations of flies, rodents, other disease vectors, and birds.

References: OAR 340-94-040(10); 40 CFR 258.10

Inclement weather operations

Develop procedures for inclement weather operation, including provisions for:

- all-weather roads, wet-weather, and alternate disposal areas
- operating in extreme dry weather conditions or when dust emissions are excessive
- operating during other severe climatic conditions such as severe winds or snow, and
- notifying customers when severe climatic conditions require closure of disposal facilities

Reference: OAR 340-94-040(11)(b)(D)

Leachate system

Establish operation and maintenance procedures for the leachate management system and if applicable, the alternative leachate disposal system, scheduling of key activities during landfill development. Prepare a separate, detailed O&M manual for complex leachate treatment systems. Address the topics in the table below, as applicable.

System component	Topics to be addressed
Leachate Collection	Leachate collection system operation and performance Leachate level measurement techniques, frequency, location, for normal and wet weather operations Measures to prevent clogging and physical damage of collection system components
Leachate Storage	Odor control Leachate level monitoring Prevention of leachate releases to the environment (such as overflows or leaks) Liner system maintenance

System component	Topics to be addressed
Leachate Treatment/ Disposal	Influent and effluent testing Treatment efficiencies Treatment process adjustments and monitoring

Landfill gas control

Manage landfill gas to prevent subsurface migration of methane.
Describe detailed operation and maintenance procedures for the landfill gas control system in the facility O&M manual. Prepare a separate O&M manual for complex gas control systems.

References: OAR 340-94-040(5) and 40 CFR 258.23

Surface water control

Establish measures to prevent stormwater run-on onto active portions of the landfill and to control runoff. Incorporate a copy of the storm water pollution control plan into the operations plan.

Reference: Clean Water Act Sections 208, 319, and 402 involving wetlands; NPDES requirements in 40 CFR 258.26 and 258.27

Groundwater control

Operate and maintain the groundwater control system and associated equipment. Groundwater control measures may include dewatering systems (e.g., under drains and wells) and barrier systems (e.g., slurry walls, geomembrane walls) accompanied by pumps, manholes, buried piping, catch basins, outlets, and other equipment requiring operation and maintenance.

9.4 Disposal Operations -- Management of Working Area

Compatibility

Landfill disposal operations should be compatible with engineered structures and environmental control and monitoring systems, and should be consistent with the Site Development Plan and other aspects of facility operations.

Waste unloading

Develop waste unloading procedures for incoming vehicles and inspection procedures to identify and isolate prohibited or unacceptable wastes. Establish the size of the refuse unloading area from the following:

- incoming waste quantities
- number, size, and type of delivery vehicles
- compacting equipment requirements, and
- litter control and other environmental considerations

First layer of fill

Establish precautions to protect the geomembrane liner when the first layer of waste is placed and compacted in lined disposal areas. The first operations layer should be "select waste". Consider the following factors in establishing appropriate safeguards:

- the thickness and physical characteristics of the initial waste layer
- the availability of desirable "select waste" materials
- the thickness and physical characteristics of the drainage and operations layers
- whether the landfill cell design incorporates special-purpose geosynthetic materials (e.g., geotextiles) for added protection of the liner, and
- the type of equipment used to place and compact the initial waste layer

Definition: “Select waste” includes household waste but not demolition or land-clearing debris or other materials that may damage the liner system

Leachate minimization

Minimize leachate generation with appropriate landfill development and operations techniques.

Active face

Specify the nominal size of the active working face, and establish compatible waste unloading and filling procedures. Consider the following in determining the size of the working face:

- The width of the working face should only be wide enough to accommodate waste unloading and compaction equipment operation
- The cell height and length should be selected based on the daily volume of refuse received, and
- Cell end slopes should be kept as steep as possible (20 to 30 degrees)

Compaction

Establish procedures for waste spreading and compaction including layer thickness, maximum lift height, daily cell configuration and slopes, compaction equipment and compactive effort (i.e., minimum number of compactor passes over each layer of waste), and the intended density of solid waste.

Recommendation: The Department recommends that waste be spread in thin (about 1-foot-thick) layers and compacted with 3 to 5 passes of the compactor on slopes of about 3 horizontal to 1 vertical. The most effective compaction occurs with the compactor operating on a level surface.

Benefits of compaction

Proper compaction of solid waste at landfills can provide several important benefits including:

- conserving landfill space
- minimizing and controlling litter
- reducing daily cover efforts and cost
- reducing total and differential settlement of the waste and associated closure and post-closure costs, and
- creating a more aesthetic operation

Daily cover

Place "daily cover" on all exposed solid waste at the end of each operating day, or more often if necessary to control problems such as fly propagation, blowing litter, vectors, and fires. Place at least six inches of earthen material on exposed solid waste at the end of each working day, unless alternative cover designs or procedures are approved by the Department.

Reference: 40 CFR 258.21 describes requirements for daily cover

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Alternative daily cover

Alternative cover materials must provide the same level of control as earthen material. Example alternative covers include the following materials:

- Geosynthetic tarps (e.g., geotextiles and geomembranes)
- Spray-on foams
- Slurry products
- Inert waste materials (e.g., shredded tires, foundry sands)

Specifications should be established for cover material type, minimum thickness and frequency of application. Cover material sources and stockpile requirements should be identified.

Reference: 40 CFR 258.21(b) or (c), and OAR 340-94-040(8) describe the requirements for obtaining approval of alternate daily cover

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Intermediate cover

Place "intermediate cover" on the top and side slopes of an advancing lift which will not receive additional waste for at least two months. Design the intermediate cover to control surface water infiltration, disease vectors, fires, odors, blowing litter and scavenging. Intermediate cover should consist of at least one foot of compacted low-permeability soil. A geomembrane cover may also be required in areas where average annual rainfall exceeds 25 inches.

Interim cover

Place “interim cover” on segments of the landfill that reach final elevations before final cover installation. During the rainy season, place interim cover immediately after a cell reaches final elevations. Design the interim cover to minimize surface water infiltration, and potentially to serve as part of the foundation for the final cover system. Develop specifications for the interim cover's configuration, material properties (e.g. permeability), thickness, installation schedule and techniques, and raw-material sources.

9.5 Special Waste Management

Special waste management plan

Develop a Special Waste Management Plan including procedures for special waste acceptance, characterization, handling, storage, recordkeeping and disposal.

Contents

The plan should include the following elements:

- an analysis of special waste management alternatives
- a rationale for the proposed disposal alternative
- the physical and chemical characteristics of each waste
- the proposed (EPA and DEQ-approved) procedures for waste sampling, testing, and analysis
- an evaluation of whether the waste is compatible with the landfill (or other impoundment) liner and leachate management systems
- procedures to document and record daily and annual waste quantities (weight or volume), and waste sources and generating processes

Potential hazards

The table below descries the potential hazards associated with some wastes that may require special handling for disposal.

Potential hazard	Example waste
personnel safety hazards	asbestos
odor and vector problems	large dead animals
excessive leachate generation	sewage sludge
excessive settlement in the landfill	yard debris
puncturing or tearing the landfill liner	construction and demolition debris
fire hazards	tire chips
increasing the toxicity of landfill leachate	cleanup materials contaminated with hazardous substances

Reference: OAR 340-94-040(11)(b)(J)

Examples: special wastes

Special wastes include but are not limited to, the following specific items:

- asbestos
- treated infectious waste
- large animal carcasses
- hazardous-substance contaminated cleanup materials
- septage
- sewage sludges and grit
- industrial waste sludges
- industrial solid wastes
- ash
- construction and demolition waste, and
- over 25 gallons of petroleum-bearing wastes such as used oil filters, oil-absorbent materials, tank bottoms or oil sludges

9.6 Ancillary Operations

Recycling

Provide a place and opportunity for collecting source separated recyclable material. Specify the procedures to be followed in accepting recyclable materials at the facility.

Reference: OAR 340-93-160

Truck washing

Design truck washing facilities to reuse or recycle the waste water, or to discharge it to a sanitary sewer or leachate treatment system. Describe the following:

- truck washing facilities and the circumstances for their use, and
- methods for managing wash water

Required permits: Discharges to the land or to waters of the state require a National Pollutant Discharge Elimination System (NPDES) or a Water Pollution Control Facilities (WPCF) permit. The type of permit will be determined on a site-specific basis by the Department's Water Quality staff.

Operations equipment

Acquire and maintain adequate operations equipment. Select equipment for its type, important physical and mechanical specifications (i.e., ground pressure, length of compactor wheel cleats),. identify any operating restrictions (e.g., preventing compacting equipment contact with the liner), quantity and purpose. Maintain standby equipment for use in the event of breakdown or maintenance of primary equipment.

Note: The equipment types should be consistent with facility design, construction, and operational criteria

Electrical distribution system

Maintain the electrical distribution system at the facility to ensure proper function of metering points, transformers, disconnects, breakers, connections, and other power-system appurtenances.

9.7 Inspection and Maintenance

Schedule

Develop detailed inspection and maintenance procedures and a schedule for all facility components and items which require periodic inspection. Describe the activities to be conducted on a regularly scheduled basis.

Inspection form

Develop a standard inspection form to guide implementation and reporting. Form use should help maintain procedural and informational consistency.

Preventive program

Establish a preventative inspection and maintenance program schedule for all equipment and facilities including those in the table below.

Equipment/facility	Examples
personnel safety equipment	fire extinguishers
operating equipment	scrapers, dozers, compactors, loaders
support facilities	scale house, scales, public receiving area, administrative buildings
environmental control systems	landfill gas collection system, leachate collection and treatment systems sedimentation basins, cover system, liner system
environmental monitoring systems	groundwater monitoring wells, landfill gas monitoring probes, leachate monitoring sumps
transportation system	access roads, directional signs

9.8 Operating Record

Regulatory reference

Establish and maintain an operating record. Develop procedures to describe how the operating record will be established and maintained.

Reference: 40 CFR 258.29

Location

Retain the operating record near the facility or in an alternative location approved by the Department. Specify the location in the operations plan.

Content

Include the following information in the Operating Record:

Content	Regulatory source
Any required location restriction demonstrations (airport safety, floodplains, seismic impact zones or unstable areas)	40 CFR Part 258 Subpart B
Inspection records, training procedures and notification procedures included in the facility's hazardous waste screening program	40 CFR Part 258.20
Gas monitoring results and any required gas remediation plans	40 CFR Part 258.23
Documentation that the landfill meets design criteria if leachate or gas condensate is placed in the facility	40 CFR Part 258.40(a)(2)
Any demonstration, certification, finding, monitoring, testing, or analytical data (groundwater monitoring including detection and assessment monitoring, selection of a remedy and implementation of a corrective action program)	40 CFR Part 258 Subpart E
Closure and post-closure care plans and any monitoring, testing or analytical data	40 CFR Part 258 Subpart F
Any cost estimates and financial assurance documentation	40 CFR Part 258 Subpart G; OAR 340-94-140
For a landfill claiming the small community exemption, any information required by that paragraph to demonstrate compliance with the small community exemption	40 CFR Part 258.1(f)(2)

9.9 Contingency

Contingency plan scenarios

Develop a contingency plan that includes procedures for responding to the following scenarios:

- on-site personal injuries
- leachate releases
- surface water or groundwater contamination
- landfill gas migration and associated fire and explosion hazards
- liquid spills
- fires (e.g., equipment fires, "hot load" fires, disposal site fires, building fires)
- explosions, accidents, and other emergencies
- detection of leachate in any secondary leachate collection and removal system
- leachate storage facility at or above capacity
- tank and surface impoundment spills or leakage, and
- storms and inclement weather

Notification list

Create an emergency notification list in the contingency plan (e.g., contact person, address, telephone number) and procedures for:

- emergency assessment
- communication
- identification of emergency response organization
- identification of community, civil authorities and regulatory personnel, and
- reporting.

Layout map

Prepare a site layout map showing:

- facilities
- fire hydrant locations
- individual building floor plans showing locations of fire extinguishers, first aid kits and stations, exits and communication equipment, and
- other relevant site features

Fire prevention and control

Establish comprehensive procedures for fire prevention and control of equipment and solid waste fires.

Equipment fire prevention

Equipment fires generally are started by an electrical failure or fluid leak and oil and grease that spreads on the machine and on nearby refuse. Preventative maintenance on the machines will reduce the potential for leakage of flammable fluids. Routine cleaning of equipment will further contribute to fire prevention. Furnish a fire extinguisher with each piece of equipment. Consider automatic fire control systems for dozers and compactors.

Solid waste fire prevention

Landfills fires can be started by "hot loads," spontaneous combustion, unknown combustible materials subjected to sparks, and by equipment fires. On-site personnel must always be on the lookout for "hot loads" and flammable materials. Subsurface fires resulting from spontaneous combustion can be difficult to locate and extinguish. Extinguish near-surface fires by covering the area with dirt. If the fire is deep, excavating the burning material may be necessary. Follow appropriate personnel safety precautions in all of these situations. Inaccessible fires require a different strategy. Extinguish these fires by cooling the burning mass in-place, or reduce available oxygen by closing cracks and fissures, or by adjusting the gas control system operations.

9.10 Incremental Post-Closure Operations

Continuous closure

Landfill development is a continuous construction and operations activity. As areas are prepared to receive future waste, active areas are being filled and completed areas are closed. At large landfills this cycle may be repeated many times prior to final facility closure.

Relation to other plans

The site development plan provides for phased construction, operations, and closure. Final facility closure and post-closure are addressed in the closure, post-closure, and financial assurance plans.

Beginning of post-closure

The 30-year post-closure care period starts after final facility closure, not after each incremental closure. Incremental closure may involve one or more landfill modules. Final facility closure and the "worst-case closure" scenario (Subtitle D closure) involve the cessation of landfill operations.

Reference: OAR 340-94-130; Section 11 of this guidance

Inspection and maintenance

Establish routine inspection and maintenance procedures for completed landfill modules and activities to protect the integrity of the final cover system and other closure-related facilities.

Inspection and repair components

Establish procedures and a schedule for inspection, repair, and closed modules. The following critical components should be addressed:

- final cover
- surface water drainage system
- erosion and sedimentation control system
- landfill gas monitoring and control system
- leachate collection and removal system
- access control (e.g., security fence, gates, locks), and
- access roads (for inspection and maintenance)

9.11 Personnel

Operations staff

Establish an adequate operations staff and systematic qualifications, responsibilities and duties, and lines of authority.

Training topics

Train operations personnel in landfill development, construction and operation, as applicable. Training should emphasize the following:

- how to inspect waste loads and identify hazardous waste or PCB waste containers and labels
- hazardous waste handling procedures
- safety precautions, employee protective clothing and equipment, health
- first aid, 40 hour OSHA, and emergency procedures
- landfill operational practices
- record keeping, and
- permit requirements and regulatory compliance

Documentation

Place training documentation in the operating record.

Reference: 40 CFR Part 258.29

9.12 Additional Resources

References

U.S. EPA “Solid Waste Disposal Facility Criteria - Technical Manual”, October 9, 1993

Section 10: Environmental Monitoring

10.1 Introduction

Purpose

Environmental monitoring is required to evaluate the performance of engineered environmental control systems (e.g., liners, leachate and gas control systems) and to assess potential environmental impacts and public health and safety risks from any contaminant releases.

How to respond

Prepare and submit an Environmental Monitoring Plan (EMP) report to the Department for review and approval. Upon approval, all environmental monitoring must be conducted in accordance with the EMP, including any conditions of the approval.

The plan should be stamped by an Oregon Registered Geologist with experience in environmental monitoring.

Regulatory framework

The following regulations govern environmental monitoring:

- 40 CFR Part 258, Solid Waste Disposal Facility Criteria
- OAR 340 Division 94, Solid Waste Management
- OAR 340 Division 40, Groundwater Quality Protection.

Monitoring overview

The progression of activities and submittals related to the environmental monitoring include the following:

Stage	Activity	Guidance section
1	Site characterization	2 and 3
2	Engineering design	7
3	Interim monitoring	10.1
4	Environmental monitoring plan monitoring	10
5	Establishing permit specific concentration limits	10.15
6	Long-term monitoring	10.15

Complete the site characterization and engineering design stages prior to development of the EMP. Use the information on facility hydrology, geology, and hydrogeology in preparing the plan.

Interim monitoring

Interim monitoring may be required by the permit. Interim monitoring is conducted after site characterization until an approved EMP is implemented. Any interim monitoring requirements will be specified in the permit.

Plan updates

The monitoring program extends through the post-closure period of the landfill. Updates to the monitoring plan may be required for:

- facility development
- landfill expansion
- the addition of a new cell
- changes in the groundwater flow
- major changes in operations
- additional sampled media, or
- anytime the Department requires changes or additions to the program, such as installation of new wells or changes in sampling parameters

In this section

This section describes the elements that should be addressed in the Environmental Monitoring Plan, including:

- Environmental Monitoring Network Design
  - Groundwater
  - Surface Water
  - Leachate
  - Vadose Zone
  - Landfill Gas
  - Air Quality
- Groundwater Monitoring Network Construction
- Sampling and Analysis
- Data Analysis and Evaluation
  - Setting Permit Specific Concentration Limits
- Reporting
- Action Requirements, Assessment and Corrective Action

10.2 Environmental Monitoring Network Design

Monitoring network

The environmental monitoring network consists of several components designed to detect and characterize facility impacts through groundwater, surface water, vadose zone, leachate, and gas monitoring. The network's individual monitoring components should be compatible with each other and with site characteristics, the landfill design, and other facility operations.

Design considerations

Site characterization, engineering design, and the environmental monitoring network are interdependent elements of landfill development. Conceptual models of site hydrology, geology, and groundwater should be developed to define the physical and environmental criteria needed for designing the monitoring system.

EMP contents

The network system design section of the EMP should:

- describe how the monitoring network will characterize facility impacts through the monitoring of:
  - groundwater
  - surface water
  - leachate
  - vadose zone
  - landfill gas
  - private wells, and
  - any other appropriate environmental monitoring
- Identify new and existing wells and piezometers intended for the monitoring network. Justify the number of wells and well location, depths, and horizontal and vertical spacing
- Identify all sampling locations on a location map that shows:
  - the unique identification number of all sample locations
  - surrounding features, including manmade, natural features, and contours
  - the location and boundary of the facility
  - all landowners within one-half mile radius of the solid waste boundary
  - a North arrow
  - any USGS benchmarks

Map size: The location map should be at a scale of not more than 1" = 200' and contour intervals not to exceed 5'.

Professional surveying

The map should be prepared and stamped by a registered land surveyor or civil engineer. Surveyed well locations should:

- provide a horizontal accuracy of 0.2 feet (0.06 meters)
- provide the elevation of the land surface with a vertical accuracy of 0.1 feet (0.03 meters)
- provide the marked level at the top of the well casing with a vertical accuracy of 0.01 feet (0.003 meters)
- use National Geodetic Vertical Datum of 1929 as the vertical elevation control, and the Oregon State Plane Coordinate System (ORS 93.330) as the horizontal control, and
- describe the location in latitude and longitude coordinates accurate to 0.1 seconds of latitude and longitude

10.3 Monitoring Network Design -- Groundwater

Objective of groundwater monitoring

Monitor groundwater to provide reliable and representative information on:

- aquifer characteristics
- groundwater flow directions, and
- chemical and physical characteristics of groundwater being monitored

Network design

Describe the groundwater monitoring network, including:

- the number, location, spacing, depth, and screen interval of monitoring wells for each potentially impacted aquifer
- methods to provide background data and/or to intercept potential contaminant flow paths
- site-specific geology/hydrogeology as defined by site characterization
- the lateral and vertical extent of any existing contaminant plumes and their expected transport
- landfill configuration and size
- purpose of each well (detection, background, characterization)
- aquifer(s) monitored
- relationship to facility operations and other monitoring components (i.e., potential for landfill gas migration)

Well network

The network should adequately characterize each monitored aquifer or water bearing zone. The groundwater monitoring network should include a sufficient number of the following types of wells:

- background wells
- detection wells
- compliance wells, and
- piezometers (as appropriate)

Types of wells The table below discusses the types of groundwater monitoring wells that may be part of the monitoring program.

Well type	Description
Characterization wells	Designed to collect information to characterize the geology, hydrogeology and groundwater chemistry used for designing the facility and a long term monitoring program. Usually installed during the site characterization phases of the project. If located in desirable locations, may later be proposed for the long term monitoring program.
Background wells	Designed to characterize background water quality at the facility. Typically located upgradient from the waste disposal facility, but other configurations (i.e., cross gradient) may be approved by the Department if geologic, hydrogeologic or other conditions do not allow for a satisfactory upgradient location. Should be screened in the same water bearing zone(s) as the downgradient detection and compliance wells.
Detection wells	Designed to intercept pathways of contaminant migration from the facility. Usually installed at the downgradient edge of the solid waste disposal boundary to immediate detect any releases of contamination. Always located inside the compliance boundary. May coincide with the point of compliance.
Compliance wells	Designed to monitor the quality of groundwater downgradient from the landfill passing through the facility's compliance boundary. The compliance boundary is the point where groundwater must be at or below the permit specific concentration limits established for that facility. The default compliance boundary is the waste management boundary unless otherwise approved by the Department.
Piezometers	Used to measure groundwater elevations for determining hydraulic gradients and/or flow directions across the facility. Should be screened in the appropriate intervals to determine the vertical and horizontal groundwater gradients in the monitored aquifers.

Note: At new facilities, characterization of background water quality may be required before waste is accepted at the facility or new unit of landfill cell. Groundwater collected at both background and downgradient prior to accepting waste may be used to establish pre-operation background groundwater quality.

10.4 Monitoring Network Design -- Surface Water

Objective of surface water monitoring

Monitor surface water potentially impacted by leachate releases, contaminated groundwater seepage, or surface water run-off.

Related requirements

Surface water monitoring may be required by the Department's Water Quality program through National Pollutant Discharge Elimination System (NPDES) or Water Pollution Control Facility (WPCF) permits and/or through the solid waste permit.

Network design

Describe the surface water monitoring network, including:

- proposed upstream, downstream, and potential point of discharge locations for surface water monitoring
- provisions for minimum monitoring and reporting requirements of any facility NPDES or WPCF permit
- justification for the number and location of sampling points
- provisions to provide a permanent marker at each sampling station (i.e., survey marker) to establish re-usable sampling locations
- a description of any flow measuring devices, recording equipment, or staff gauges that may be installed at the sampling site

Sample location considerations

The proposed sampling locations should consider:

- potential or existing contaminant migration pathways
- overland flow paths defined by topographic maps and visual observation
- site drainage patterns and surface water management controls
- potential groundwater discharge points to surface water, and
- streamflow, contaminant dilution, and chemical behavior

Potential discharge sources

Landfills may produce the following surface water discharges:

- leachate seeps or other drainage
- contaminated groundwater, including springs, seeps, or underflow to surface water
- overflow of lagoons
- malfunction of leachate conveyance system

10.5 Monitoring Network Design -- Leachate

Objective of leachate monitoring

Monitor the landfill leachate's existing characteristics and changes in quality during landfill development. Monitor the primary leachate collection system's effectiveness (e.g., head level). Monitor the secondary leachate collection system for primary liner failure and the presence of liquid.

Network design

The EMP should describe the leachate monitoring network, including:

- a proposal and justification for the number, location, depths, spacing, and type(s) of leachate monitoring points to monitoring leachate quality, quantity, and the presence of liquid in the secondary leachate collection system
- proposed construction details, materials, and methods of installation for any new monitoring devices
- documentation/description of the construction and design of existing monitoring points
- scaled construction diagram of each device or typical device, and
- sampling or testing methods proposed during construction

Sampling locations

Leachate sampling locations could include:

- sumps, manholes, or other access points to the leachate collection system, if the site is equipped with such a system
- sampling points within the waste at locations that will yield representative samples, and account for the heterogeneities of the waste material and leachate
- sampling from landfill gas wells that penetrate leachate saturated waste zones, or
- vertical or horizontal wells specifically installed within the waste for sampling leachate

Design precautions

Consider the following precautions in the design of the leachate monitoring network:

- Leachate lagoons and holding ponds are not good monitoring points for characterizing raw leachate quality. The leachate can be diluted by rainfall and/or undergo chemical/quality changes during removal, exposure to the atmosphere, storage, and intentional treatment processes.
- Groundwater and surface water may infiltrate into the leachate collection system and dilute the leachate. These influences usually occur seasonally.
- Variations in the waste and leachate. Leachate quality can vary temporally and spatially due to differences in the composition, age, and disposal method.

10.6 Monitoring Network Design -- Vadose Zone

Objective of vadose zone monitoring

Detect leachate releases by monitoring the moisture content and quality of the pore water beneath the facility.

Network design

Describe the vadose zone monitoring network, including:

- the type of device, function, and site monitoring application
- the proposed number, location, depths, spacing, and type(s) of vadose zone monitoring devices
- proposed construction details, materials, and methods of installation
- scaled construction diagram of each device or typical device, and
- sampling or testing methods proposed during construction

Basis for design

Design the vadose zone monitoring network to reflect the following:

- landfill cell and leachate collection and conveyance system design
- site-specific unsaturated zone characteristics (soils, lithology, hydrology) as determined during the site characterization phases
- soil types, layers (stratigraphy), and characteristics including permeability, saturated and unsaturated hydraulic conductivity, particle size and distribution, and other chemical and physical characteristics, and
- water flow in the vadose zone beneath the landfill liner

Location considerations

Install monitoring devices beneath those areas where the liner is most likely to leak, such as sumps, collection laterals, or major liner seams. Other sensitive areas include low spots where water accumulates and locations where low permeable materials were removed during construction.

Monitoring methods

Example vadose zone monitoring methods are discussed in the table below.

Method	Description
collection lysimeters	• Lined basin installed beneath the landfill liner similar to a localized leachate collection system • Direct method of collecting soil water for chemical analysis • Collection of quantity and quality data from a discrete area

suction lysimeters	• Perform poorly in arid regions • Limited to extract samples from soils at tensions no greater than 1 or 2 atmospheres
other examples	• vapor probes - monitor/extract the soil gas for chemical analysis • ion probes - measure the ion concentrations • conductivity probes - measure the conductivity • tensiometers - measure the moisture content in the unsaturated zone • TDRs These methods monitor the soil water quality indirectly, by measuring other mediums (soil gas) or parameters, such as moisture content or conductivity, that can be used to predict water chemistry.

Note: These may not be the only available methods. Other methods may be proposed to meet the site's monitoring needs.

10.7 Monitoring Network Design -- Landfill Gas

Objective of landfill gas monitoring

Monitor for landfill gas migration at the facility boundary and within on-site structures. Design the landfill gas monitoring network to meet the following objectives:

- evaluate the performance of landfill gas control measures
- provide accurate, representative field measurements of methane and oxygen concentrations and static pressure
- monitor the efficiency of landfill gas recovery and control systems, and
- monitor the effectiveness of gas migration control wells

Network design

Describe the landfill gas monitoring network, including:

- proposed perimeter landfill gas monitoring probes to at least the same depth as the landfill's base elevation
- at least one proposed shallow probe between the landfill and each on-site structure with a maximum depth of 20 feet (6.1 meters)
- site-plan drawings showing proposed landfill gas monitoring probe locations
- design drawings showing proposed landfill gas monitoring probe depths, screened intervals and construction details
- the rationale for proposed monitoring probe locations, depths, and designs
- procedures for integrating gas monitoring system installation and operation with landfill development, and
- proposed operation and maintenance procedures

Probe construction

Probes should have maximum screened intervals of 30 feet (9.15 meters). For monitoring intervals greater than 30 feet, multiple-completion probes or probe clusters are required. Separate monitoring capabilities should be provided for each successive 30-foot interval.

Design considerations

The number and location of landfill gas probes is dependent on:

- subsurface conditions at the site
- hazards to surrounding land use
- public safety risks
- location and design of facility structures
- other underground structures or conduits
- landfill gas generation rates and migration potential, and
- the size and configuration of the landfill

Landfill gas composition

Landfill gas is composed of:

- approximately 50-60 percent methane
- approximately 40-50 percent carbon dioxide, and
- trace amount of VOC and other organic and inorganic gases

Hazards of landfill gas

Methane is combustible and explosive at concentrations of 5 - 15 percent by volume in air. Some of the trace gases, including VOCs, are toxic. Other hazards associated with landfill gas include the:

- accumulation of explosive concentrations of methane in on-site or off-site structures
- exposure of workers on or near landfills to high concentrations of toxic gasses
- exposure of workers to atmospheres lacking sufficient oxygen due to its displacement by landfill gas
- potential source of air emissions and water pollution, and
- potential impacts to groundwater from gas-born VOCs that can dissolve into solution under wet soil conditions

10.8 Monitoring Network Design -- Air Quality

Objective of air quality monitoring	Monitor point sources and diffuse area-wide sources for potential air contaminants. Point sources may include gas combustion flares. Diffuse area-wide sources may include raw landfill gas or fugitive dust from construction.
Contaminants	Potential air contaminants may include methane, odorous compounds, particulates, and volatile organic compounds.
NSPS	New source performance standards (NSPS) for municipal solid waste landfills have been issued to control emissions of non-methane organic compounds from large landfills. Landfills with a design capacity of 2.5 Mg (2.75 million tons) and emissions of non-methane organic compounds in excess of 50 Mg (55 tons per year) are subject to NSPS and may be required to implement control technologies.
Requirements	Contact the Department's Air Quality Program for monitoring and permit requirements.

10.9 Groundwater Monitoring Network Construction

EMP contents

Describe how wells will be constructed and evaluated to continually meet construction requirements and ensure accurate, representative samples are obtained, including:

- evaluation of monitoring network
- evaluation of monitoring points
- procedures for installation of new monitoring points
- plans for routinely evaluating monitoring points

Construction standards

New and existing monitoring wells proposed for the monitoring program should:

- be constructed to meet the construction criteria defined in
  - OAR 690 Division 240, and
  - the Department's August 24, 1992, Groundwater Monitoring Well Drilling, Construction and Decommissioning Guidelines
- be compatible with site-specific hydrogeologic conditions including physical, chemical, and hydraulic properties of the monitored zones
- use construction techniques that are protective of groundwater resources by preventing:
  - the introduction of surface contaminants, and
  - the vertical migration of contaminants between water bearing zones
- be designed for maximum well efficiency and minimum turbidity when sampling
- designed to last throughout the landfill's active life and post-closure period

Note: Multiple well screens or depth completions in a single borehole are not acceptable, unless approved by the department. Wells may only be screened in a single aquifer and zone.

Evaluation of monitoring network

Describe and evaluate the current status and integrity of the monitoring network as a whole.

Evaluation of monitoring points

Describe the current status and integrity of each monitoring point within the network. Evaluate monitoring wells to determine whether each is capable of obtaining representative samples. An Oregon Registered Geologist must certify this evaluation. Wells not capable of obtaining representative samples must be recommended to be decommissioned, and, if required by the Department, replaced. Provide records of the installation of existing monitoring wells including construction details and lithologic logs.

Procedures for installing new monitoring points

Install new monitoring points in accordance with the construction standards. Describe installation procedures, including:

- drilling methods, type of drilling equipment, drilling fluids, and methods to isolate surface soils and/or shallow water zones during borehole drilling and construction
- handling and decontamination of well material and equipment
- methods for subsurface sampling, including sampling intervals and provisions for collecting samples and describing color, texture, composition, moisture content, evidence of contamination and other relevant characteristics
- storage, testing, and disposal of drilling fluids and drill cuttings
- size (diameter) and depth of the borehole
- construction methods and materials, including the size and type of casing and screen, screened interval, and type and placement of filter pack and annular seal
- well development methods and procedures
- borehole geophysical methods to log the monitoring well, and
- field testing methods for aquifer characteristics

Note: Prepare a scaled construction diagram of each monitoring well

Plans for evaluating monitoring points

Describe procedures for routinely evaluating each monitoring point within the network to ensure that each point is capable of providing representative samples throughout the active and post-closure periods of the landfill.

10.10 Sampling and Analysis

EMP contents

Propose a sampling and analysis plan for collecting valid and representative groundwater, surface water, vadose zone, leachate, and landfill gas samples that will produce reliable and credible analytical results. The EMP should include:

- training provisions
- identification of devices
- sample point inspection procedures
- sampling procedures, and
- monitoring parameters and schedule

Training provisions

Describe how sampling personnel will be trained to use the sampling and analysis procedures.

Identification of devices

Provide the location, depth, and construction details of all environmental monitoring devices. Provide all monitoring point locations on a scaled, accurate map by monitoring type and identification numbers.

Sample point inspection

Describe procedures for inspecting and reporting on each monitoring point and the immediate surrounding area during sampling. Inspect each environmental monitoring point for:

- structure
- security features such as locks, cap, protective casing
- unusual conditions
- identification, and
- anything that could influence the collection of representative data or signify changing conditions.

Sampling procedures

Describe site-specific field sampling procedures for each monitoring type:

- field recordkeeping procedures
- field meter operation and calibration
- sampling order
- water level measurements
- sample equipment and collection methods
- purging equipment and method (include well volume calculation, field parameter monitoring, pump intake placement, disposal of purge water);
- sample containers and labeling
- sample filtration and preservation
- sample preservation and holding times
- sample transport/shipment
- equipment decontamination
- chain of custody
- proposed field and reporting forms

Monitoring parameters and schedule

Prepare a summary of sample parameters, frequency, and schedule, including the following:

- monitoring parameters
- approved analytical methods
- detection limits (for parameters that have a federal or state standards, the detection limit should be no more than 10% of the standard, or the rationale for setting such a detection limit should be explained)
- container type and volume
- preservative
- holding time
- sampling frequency and schedule

Typical monitoring parameters and sampling schedule for each type of environmental monitoring is discussed below.

Parameters and frequency

The following table discusses typical parameters and frequency that could be required for each type of monitoring. This is intended for general guidance purposes only. Parameters and frequency will be determined on a site-specific basis.

Media	Discussion and considerations
Groundwater	• Appropriate monitoring parameters will be based on site-specific hydrogeologic characteristics, leachate and landfill gas characteristics, regulatory requirements, anticipated contaminant mobility and persistence and contaminant concentrations relative to ambient groundwater conditions. • Quarterly monitoring of groundwater will usually be required until nine valid data points have been collected for background determination, statistical analysis, and establishment of permit-specific concentration limits.
Surface water	• Minimum monitoring and reporting requirements are specified in the Stormwater Discharge (NPDES) permit issued by the Department's Water Quality Program. • Sampling parameters should be good indicators of potential leachate discharge • Monitoring of groundwater discharges to surface water (i.e., seeps, drainages, springs) will usually require routine quarterly sampling. The monitoring parameters and schedule will be based on site-specific hydrogeology, surface hydrology and other environmental factors.
Vadose	Vadose zone monitoring parameters and sampling frequencies will vary depending on the type of monitoring devices used, site specific environmental and hydrogeologic conditions
Leachate	Leachate monitoring and frequency will be similar to the groundwater monitoring program, described above. Leachate quantity (flow rates) should be measured on a daily basis when leachate generation is occurring.
Secondary LCS	The secondary leachate collection system should be monitored on a routine basis for the presence of any liquids. If liquids are present, samples should be taken immediately and analyzed for leachate constituents.
Landfill gas	The monitoring schedule should be based on the following site specific factors: • soil conditions • hydrogeologic conditions • facility design and development history • location of facility structures and property boundaries • surrounding land use and location of off-site structures • changing site conditions which may affect gas generation and migration (e.g., barometric pressure, temperature, soil moisture, snow cover etc.) Minimum sampling frequency is quarterly. If possible monitoring should be conducted during periods when strong barometric lows are anticipated.
Air	Contact the Department's Air Quality Division

Groups defined Monitoring group parameters are defined in the table below.

<table>
<tr><th>Group</th><th>Parameters</th><th>Notes</th></tr>
<tr><td>1a - Field indicators</td><td>Elevation of water level
Specific Conductance
pH
Dissolved Oxygen
Temperature
Eh</td><td>These parameters must be measured in the field at the time samples are collected, either down-hole in situ, in a flow-through well, or immediately following sample recovery, with instruments calibrated to relevant standards</td></tr>
<tr><td>1b - Leachate indicators</td><td>Hardness (as $CaCO_3$)
Total Dissolved Solids
Total Alkalinity (as $CaCO_3$)
Total Suspended Solids
Specific Conductance (lab)
Chemical Oxygen Demand
pH (lab)
Total Organic Carbon</td><td>Sample handling, preservation, and analysis are determined by requirements for each individual analyte: EPA or AWWA Standard Methods techniques must be followed.</td></tr>
<tr><td>2a - Common anions and cations</td><td>Calcium (Ca)
Manganese (Mn)
Sulfate (SO_4)
Magnesium (Mg)
Ammonia (NH_4)
Chloride (Cl)
Sodium (Na)
Carbonate (CO_3)
Nitrate (NO_3)
Potassium (K)
Bicarbonate (HCO_3)
Silica (SiO_2)
Iron (Fe)</td><td>Groundwater samples: Dissolved concentrations must be measured. Samples must be field-filtered and field-preserved according to standard DEQ and/or EPA guidelines and analyzed by appropriate EPA or AWWA Standard Methods techniques. Results must be reported in mg/L and meq/L.</td></tr>
<tr><td>2b - Trace metals</td><td>Antimony (Sb)
Chromium (Cr)
Selenium (Se)
Arsenic (As)
Cobalt (Co)
Silver (Ag)
Barium (Ba)
Copper (Cu)
Thallium (Tl)
Beryllium (Be)</td><td>Groundwater samples:
<table><tr><th>If the Total Suspended Solids concentration is...</th><th>then analyze for...</th></tr><tr><td>less than or equal to 100 mg/L in the sample</td><td>total concentrations (unfiltered)</td></tr><tr><td>greater than 100 mg/L in the sample</td><td>both total (unfiltered) and dissolved (field-filtered)</td></tr></table></td></tr>
</table>

Group	Parameters	Notes
	Lead (Pb) Vanadium (V) Cadmium (Cd) Nickel (Ni) Zinc (Zn)	Samples must be field-preserved according to standard DEQ and/or EPA guidelines and analyzed by EPA Method 6010 or Department-approved equivalent. Results must be reported in mg/L.
3 - Volatile organic compounds	Analysis for all compounds detectable by EPA Method 8260 or EPA Method 524.2, including a library search to identify any unknown compounds present.	Method 8260 comprises the volatile organic constituents parameter group. Facilities that want to use Methods 8010 and 8020 as an alternative must obtain approval by the Department prior to use.
4 - Assessment monitoring parameters	Analysis for all compounds detectable by the following EPA methods: Semi-volatile Organic Constituents, according to EPA Method 8270 Mercury, according to EPA Method 7470 Cyanide, according to EPA Method 9010 Nitrite	All Method 8270 analyses must include a library search to identify any unknown compounds present
5 - additional surface water and leachate parameters	Total Kjeldahl Nitrogen Total Coliform Bacteria Total Phosphorus Fecal Coliform Bacteria Orthophosphate E. Coli Biological Oxygen Demand Total Halogenated Organics	In addition to Group 5, surface water samples should also be collected for Groups 1a, 1b, 2a (total concentrations) and 2b (total concentrations). In addition to Group 5, leachate samples should also be collected for Groups 1a, 1b, 2a (total concentrations), 2b (total concentrations) 3 and semi-volatile organics (EPA 8270).

10.11 Field QA/QC

EMP contents

Describe Field QA/QC procedures, including provisions for:

- documentation
- sample blanks and duplicates
- field blanks
- trip blanks
- equipment blanks
- duplicates

Documentation

Describe procedures to document sample collection, storage, including:

- maintenance of adequate field records and chain of custody
- recording sample collection data on field data sheets
- documenting sampling activities (collection, equipment calibration, decontamination) on field data sheets
- documenting any unusual conditions that may effect samples or any deviations from the normal sampling protocol
- proper labeling, storage and shipment

Sample blanks and duplicates

Describe how sample blanks and duplicates will be used to detect contamination coming from sample containers, preservation, equipment, storage, transport, and site conditions.

Field blanks

Describe procedures for managing field blanks. Field blanks should be collected and handled in the same manner as the sample group for which it is collected. Field blanks should be collected once per sampling day or once for every ten samples, whichever is more frequent.

Trip blanks

Describe procedures to ensure tat trip blanks are completed if volatile organic compounds (VOCs) are to be analyzed. Trip blanks are prepared by the laboratory at the same time and location for the sampling event. Trip blanks accompany the sample containers to and from the sample event. One trip blank for VOCs should be prepared for each sample shipment container.

Equipment blanks

Describe how equipment blanks will be used for non-dedicated sampling equipment requiring decontamination. De-ionized water is passed through the sampling equipment to the appropriate sample container. Equipment blanks are required for every sample parameter, once per sampling day or once for every ten samples, whichever is more frequent.

Duplicates

Describe procedures to collect duplicates under the same conditions as the original sample and treated the same as the sample parameter group. A duplicate for all analytes should be collected once per sample day or once every ten samples, whichever is more frequent.

10.12 Lab QA/QC

EMP contents

Describe laboratory QA/QC procedures, including:

- a written laboratory QA/QC plan from the laboratory conducting the analysis; each time the laboratory is changed, or a new lab is contracted, a new QA/QC plan is required
- routine equipment calibration to standards of known concentration on a schedule appropriate for the analytes of concern and analytical methods used
- analysis of laboratory method blanks, laboratory duplicates and matrix spikes for all analytes at a frequency of once per sampling event or once per day of analysis, whichever is more frequent
- analysis and reporting of the percent recovery of surrogate spikes in each sample analyzed for organic analytes

Reference: Contact the Department's laboratory (503-229-5983) for additional or updated laboratory QA/QC requirements.

10.13 Data Evaluation

EMP contents

describe site specific procedures for

- comparing groundwater sampling results to applicable standards
- performing statistical analyses, and
- identifying and addressing any field of lab data that did not meet lab quality objectives

Review of results

Review the groundwater analytical results after each groundwater sampling event:

If data show results...	Then...
above permit-specific concentration limits (if established)	1. notify the Department within 10 days of receipt of laboratory results, and 2. perform resampling within 15 days and evaluate results as described below *Note: If this is a known release, previously confirmed to the Department in writing, resampling is not required*
indicating a significant change in water quality at any monitoring point Examples of significant changes: Detection of a VOC or other hazardous constituent not previously detected in background Exceedance of a Table 1 or 3 value listed in OAR 340-40, unless the background water quality is above these numerical limits Exceedance of a Safe Drinking Water Standard Exceedance of an Action Limit Detection of a compound in an order of magnitude higher than background	1. notify the Department within 10 days of receipt of laboratory results, and 2. perform resampling within 15 days and evaluate results as described below *Note: If this is a known release, previously confirmed to the Department in writing, resampling is not required*
neither of the above	continue groundwater monitoring with next scheduled sampling event

Resampling results

Upon receipt of data from resampling, the results should be reviewed according to the following table

If resampling data show results	Then
that confirm the exceedance of a permit-specific concentration limit	1. notify the Department within 10 days of receipt of laboratory data, or within 60 days of the sample date (whichever comes sooner) 2. begin assessment monitoring 3. submit a Remedial Investigation workplan for Department approval within 90 days of the date of resampling; the plan must specify how the objectives of OAR 340-40-040(3) will be met by the proposed investigation
that confirm the significant change in water quality results noted in the routine sampling event	1. notify the Department within 10 days of receipt of laboratory data, or within 60 days of the sample date (whichever comes sooner) 2. submit a plan within 30 days (unless another time period is authorized) for developing an assessment program with the Department; this may include the monitoring of Group 4 parameters, in addition to routine detection monitoring
that do not confirm the results noted in the routine sampling event	1. continue with routine monitoring 2. discuss the data from the routine sampling event and the resampling results in the next annual environmental monitoring report

10.14 Reporting

Objective

Present the environmental monitoring data to the Department in an organized and clear format. Evaluate and interpret data to

- determine regulatory and permit compliance
- determine if leachate impacts have occurred
- assess the effectiveness of any corrective actions
- monitor potential health and environmental effects, and
- prepare and submit an annual monitoring report

EMP content

Propose an the annual environmental report that will:

- discuss the results of all environmental monitoring performed during the year
- discuss the results of the previous year's Data Analysis and Evaluation
- itemize any activities resulting from the exceedance of a relevant standard or significant change in water quality, such as resampling, submittal of a Preliminary Assessment, or Assessment Monitoring
- discuss any preventative measures and the results of such actions, if applicable
- assess the current status of the environmental monitoring network
- provide updated information for each sampling event and monitored unit, depicting groundwater flow rates and directions, and piezometric water contours
- summarize Sampling and Analysis, Field QA/QC, and Lab QA/QC techniques implemented during the year
- provide copies of applicable information, including field data, laboratory analytical reports and chain-of-custody reports; all data must be cross-referenced and labeled with the designated field sampling location
- provide summary tables of the year's monitoring data by location and parameter
- provide updated time series and box plots for appropriate parameters
- provide results of a major anion-cation balance for each groundwater monitoring well sampled for major anions and cations
- provide an executive summary

Statement of compliance

A one-page cover letter must accompany the Annual Environmental Monitoring Report that:

- compares the analytical results with the relevant monitoring standards (see Section 10.13)
- states whether or not federal or state standards were exceeded for the relevant media
- states whether or not a significant change in water quality occurred

The cover letter must be signed and stamped by an Oregon Registered Geologist with experience in hydrogeological investigations.

Data presentation

Below are some suggested formats for presenting the environmental monitoring data. Specific requirements may be discussed in the solid waste permit:

Presentation Type	Description
Tables	Data tables work well for summarizing analytical data and statistical parameters. For analytical and water level data: • arrange table by monitoring point identification number, parameter, and/or sampling event • present each type of monitoring data separately (i.e.; leachate, groundwater, surface water) • group groundwater data according to well designation (upgradient, downgradient) For statistical data: • arrange in individual tables by parameter and location • arrange sampling points on one axis and sample date on the other axis. Report statistical results in table body.
Time series charts	Useful for illustrating seasonal variations and changes in data over time. Prepare as follows: • plot a separate chart for each parameter of interest • plot all monitoring points for comparison on one graph • plot concentration on vertical axis using a consistent scale and equal spacing • plot time on the horizontal axis using a consistent scale and equal spacing • represent PSCL value as a line on graph • identify parameter, sample location, and other pertinent features on the graph

Presentation Type	Description
Box plots	Evaluate spatial variability of a parameter. Useful for illustrating data dispersion or variability of a data set or between data sets about the median value. Prepare as follows: • construct individual plots for each well and each parameter • plot boxes from multiple wells for a single constituent on a single grid for comparison • plots should include median, interquartile range, and maximum and minimum values • represent PSCL value as a line on the grid • clearly identify parameter and sample location *See the statistical references and guidelines in Section 10.12 below for details on the preparation, use, and interpretation of box plots.*
Potentiometric contour maps	Useful for plotting and contouring water level data to illustrate elevations, flow directions and gradients. Maps should include: • measuring point • date and season • elevation • contour interval • scale Plot different aquifers of interest on different maps and maps for each season or sample event. Incorporate surface water elevations with shallow aquifer elevations, if appropriate, and include leachate elevation levels. Do not include measurements of shallow and deep portions of the an aquifer on the same potentiometric map unless complete hydraulic communication has previously been established and there is no discernible vertical gradient
Other graphical methods	Other useful graphical methods for presenting and interpreting data include: • hydrographs • scatter plots • cross sections • histograms • trilinear diagrams • ion-concentration diagrams, and • contour maps Consult the Department hydrogeologist for the appropriate methods to use for individual facilities.

Note: Electronic copy of data should be provided. Acceptable electronic formats include Excel, Lotus 123, and Quatro Pro.

Water quality reporting concentrations

Water quality concentrations should be reported in milligram per liter (mg/L) for most organic and inorganic parameters; both mg/L and milliequivalents per liter (meq/L) for common anions and cations; micro-ohms per centimeter (uohms/cm) for specific conductance; s.u. for pH; degrees centigrade for temperature; and nephelometric turbidity units (NTU) for turbidity.

Typical annual report

A typical annual report includes the following information:

Section	Content
Background Information and Data Reporting	• site background information • presentation of water/leachate level data and groundwater flow rates using contour maps, tables, and graphs • summary of all field data, laboratory analytical reports, chain of custody reports, all cross-referenced with the field sampling locations • data validation (i.e.; cation/anion balance, comparison of blanks and duplicates, identify data problems or discrepancies, review of detection limits and holding times) • time series graphs • summary tables of the year's monitoring data by location and parameter
Water Quality Statistical Analysis	Box plots for the purpose of: • establishing background water quality and proposing permit-specific concentration limits • comparing monitoring results to compliance concentrations to determine if a release has occurred • assessing whether any corrective/preventative actions have been effective in reducing contaminant concentrations or controlling leachate releases to the environment
Data Interpretation and Evaluation	• evaluation of data quality trends in each monitoring point for each parameter, and a determination if any significant changes have occurred • review of statistical methods for background water quality and identifying potential impacts • a comparison of water quality in the downgradient monitoring points to upgradient/background monitoring points • comparison of data quality to any PSCLs that have been established • comparison of groundwater quality data to existing federal and state groundwater standards • assessment of whether any corrective or preventive actions have been effective in reducing or controlling releases • assessment of the effectiveness of any closure measures undertaken • list of any activities resulting for an identified exceedance

Section	Content
Conclusions and Recommendations	• summary of the data collection, evaluation, and results of all environmental monitoring performed during the year • discussion of any impacts, trends in data, and violations of PSCLs, exceedences of a standard, or significant changes • any recommendations for the monitoring program • identify any impacts and action requirements • discussion of the current status of the environmental monitoring network • executive summary

10.15 Establishing Permit-Specific Concentration Limits (PSCLs)

Contents

This section of the guidance discusses PSCLs and how to establish them. The requirement for proposing PSCLs will be included in the permit. References and guidelines on how to go about determining PSCLs are provided below. A proposal to establish PSCLs does not need to be included in the EMP, only provisions that it will be done in accordance with the permit requirements.

Definition: PSCL

OAR 340-40-010(3) defines a concentration limit as the maximum acceptable concentration of a contaminant allowed in groundwater at a Department specified compliance point.

Objective

To establish regulatory compliance concentration limits for pollutants of concern at the facility's compliance boundary. An exceedence of these limits would trigger concern and require some type of regulatory, assessment, preventive and/or corrective actions.

Regulatory reference

OAR 340-40-030(3) requires that PSCLs be specified in the permit for new and existing facilities.

Data requirements

Data requirements for establishing PSCLs are:

- a minimum of nine acceptable and valid data points for each parameter from the approved background well or wells is required for setting PSCLs.
- PSCLs are required for selected parameters that will be included in the long-term monitoring program at the site. These parameters will either be specified in the permit or should be discussed with the Department's hydrogeologist.
- statistical methods and calculations for determining PSCLs and background are provided in the references discussed below.

Setting PSCLs

Different methods are allowed for setting PSCLs at new and existing facilities.

PSCLs for existing facilities

PSCLs may be established anywhere between background water quality (as calculated below) and the reference/guidance levels in Tables 1, 2, and 3 of OAR 340-40. For parameters not in Tables 1, 2, or 3, background must be used for the PSCL.

PSCLs at new facilities

PSCLs must be established at the background water quality.

PSCL calculations

Calculations must follow one of the five methods listed in 40 CFR Part 258.53.

PSCL references

Available references for statistical guidelines and setting PSCLs include:

- Dessellier, Bruce, January 12, 1993, Draft Memorandum to Solid Waste Permits and Compliance, Subject: Statistical Guidance Memo for all RCRA Sites, Oregon Department of Environmental Quality
- USEPA, June 1992, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance

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Reduction in monitoring or parameters

Quarterly groundwater monitoring is typically required until nine valid data points are collected for each parameter. Once PSCLs are established, the permittee may request a reduction in the sampling frequency or parameter list. This request must be made, in writing, to the Department.

Long-term monitoring

Once PSCLs are established, the permittee may be required to propose an updated monitoring program for the wells to be monitored, the list of indicator parameters, new sampling frequency, and schedule. This should be discussed with the Department's hydrogeologist. Other limits, such as Action Limits, may be established in the permit. If warranted, Action Limits may be established for Table 3 (OAR 340-40) or other non-table, non-hazardous parameters depending upon site specific background concentrations.

10.16 Action Requirements, Assessment, and Corrective Action

Objective

Follow and implement the necessary notification, reporting, assessment and corrective actions required by 40 CFR Part 258 and OAR 340-40 when a contaminant release is identified at a facility during routine monitoring.

Assessment monitoring

Assessment monitoring is required if routine groundwater monitoring indicates a statistically significant increase above background in one or more of the constituents in Appendix I of the 40 CFR 258, or from an approved alternate list (40 CFR 258.54 (a)(2)) as is the case in Oregon. Individual permits may specify assessment monitoring requirements. Assessment monitoring should be discussed with the Department's hydrogeologist.

Preliminary assessment plan

The Department's Groundwater Quality Protection Rules require submittal of a plan for developing a preliminary assessment within 30 days after a confirmed exceedance of a PSCL, an Action Limit, or a significant change in water quality (as defined above), unless the Department approves another time schedule. The assessment should evaluate the source, extent, and potential migration of the contaminants.

Corrective action

Corrective action is required if an assessment monitoring parameter is detected at a concentration in excess of the PSCL or if the preliminary assessment determines that remedial action is necessary to maintain groundwater quality. Corrective action could consist of the following steps:

- perform a remedial investigation to determine the need for remedial action including a characterization of the contamination, characterization of the facility, and an endangerment assessment
- conduct a feasibility study that includes but is not limited to the development and evaluation of remedial action options
- select and implement the most appropriate remedial action

The specifics of the remedial investigation/feasibility study should be discussed with and approved by the Department prior to implementation.

Gas monitoring limits

Review gas monitoring results after each monitoring event for exceedences of methane limits. If methane levels exceed the specified limits the owner or operator must:

- immediately take necessary steps to protect human health and safety and notify the Department
- within 7 days of detection (unless the Department approves an alternative schedule), enter the methane levels in the operating record and describe the steps taken to protect human health and safety

Within 60 days of detection (unless the Department approves an alternative schedule) implement a remediation plan for the methane releases, incorporate the plan into the operating record, and notify the department that the plan has been implemented. The plan should describe the nature and extent of the problem and the proposed remedy.

Air quality and surface water

Follow specific air quality, water quality, and solid waste permit requirements.

10.17 Additional Resources

References

Oregon Department of Environmental Quality, October 27, 1989. Oregon Administrative Rules, Chapter 340, Division 40, Groundwater Quality Protection.

Oregon Department of Environmental Quality, August 24, 1992. Groundwater Monitoring Well Drilling, Construction, and Decommissioning.

Oregon Water Resources Department, July 1995. Administrative Rules, Chapter 690, Division 240, Construction, Maintenance and Abandonment of Monitoring Wells, Geotechnical Holes, and Other Holes in Oregon.

U.S. EPA, October 9, 1991. 40 CFR Parts 257 and 258, Solid Waste Disposal Facility Criteria; Final Rule.

U.S. EPA, November 1993. Technical Manual for Solid Waste Facility Criteria - 40 CFR part 258.

Oregon DEQ, March 1994, Water Quality Division. Draft Groundwater Monitoring Plan - Part B: Guidelines.

Washington Department of Ecology, June 1987, Solid Waste Landfill Design Manual.

Dessellier, Bruce, August 3, 1992, Draft Memorandum to Solid Waste Permits and Compliance, Subject: Statistical Guidance Memo For all RCRA Sites, Part 1. Oregon Department of Environmental Quality.

U.S.EPA, 1992, Statistical Analysis to Groundwater Monitoring Data at RCRA Facilities - Addendum to Interim Guidance.

Section 11: Closure and Post-Closure

11.1 Introduction

Regulatory reference

Minimum requirements for closure plans and post-closure plans for MSW landfills are specified in the Department's Financial Assurance Rule, OAR 340-94-100 through 145. The closure and post-closure requirements for Subtitle D landfills differ from those of non-Subtitle D MSW landfills (i.e., closing facilities).

Types of plans

There are two separate categories of closure and post-closure plans:

Subtitle D ("worst case") Closure and Post-closure Plans are based on a hypothetical "worst case" scenario for closure and post-closure costs. This scenario establishes a conservative basis for estimating financial assurance funding requirements.

The Final Engineered Site Closure and Post-closure Plans are linked to the Closure Permit which must be obtained at least 5 years prior to anticipated final closure. The Final Engineered plans reflect the intended closure design. The Final Engineered plans contain all the elements of and replace the Subtitle D plans.

How to respond: Subtitle D facilities

Landfills subject to Subtitle D should:

- prepare a "Worst-case" (Subtitle D) Closure Plan and a “Worst-case" (Subtitle D) Post-closure Plan for determining appropriate costs for financial assurance planning. Place the plans in the facility operating record and notify the Director of that action
- prepare a Final Engineered Closure Plan and a Final Engineered Post-closure Plan and submit them to the Department five years before the anticipated final closure date
- revise financial assurance cost estimates based on the final engineered plans

How to respond: Closing facilities

Non-Subtitle D facilities (closing facilities) are within the five-year final closure window and therefore should:

- prepare a Final Engineered Closure Plan and a Final Engineered Post-closure Plan and submit the plans to the Department at the date specified in the permittee's closure permit
- determine closure and post-closure costs for financial assurance planning, based on the Final Engineered Closure and Post-closure Plans

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Approval

The Final Engineered Site Closure Plan and Final Engineered Site Post-Closure Plan must be submitted to the Department for review and written approval.

In this section

This section describes the contents of the closure and post-closure plans.

11.2 Closure Plans

Subtitle D "Worst-Case" Closure Plan

The Subtitle D "Worst-Case" Closure Plan should include all elements specified in 40 CFR 258.60:

- a description of the steps necessary to close all landfill cells at any point during their active life
- a description of the final cover system
- an estimate of the largest area of the landfill ever requiring a final cover
- an estimate of the maximum inventory of wastes ever on site over the active life of the landfill
- a schedule for completing all activities necessary to satisfy the closure criteria in 40 CFR 258.60

Final Engineered Site Closure Plan

The Final Engineered Site Closure Plan should supplement all the elements of the "Worst Case" Closure Plan by adding the following:

- detailed design plans and specifications for the closure improvements, including final cover system, gas control system, runoff/run-on control system, leachate treatment and disposal system
- an updated final grading (topographic) plan for the site
- an end use plan
- a landscaping plan
- an assessment of long-term settlement and its potential effects on the integrity of the closure
- a detailed description of the design, function, and operation of all environmental control systems
- a description (plan) of how and when the facility will be closed (i.e., the procedures that will be used to ensure that facility operations are compatible with closure objectives and requirements)
- a detailed description of the environmental monitoring system;
- a schedule for implementing the closure plan
- a detailed closure cost estimate, and
- other information requested in the closure permit or otherwise required to comply with all applicable DEQ and federal regulations

Previously submitted information

If some of the required information has been previously submitted, review and updated it to reflect current conditions and any proposed changes in the closure program.

11.3 Post-Closure Plans

"Subtitle D" Post-closure Plans

The "Subtitle D" Post-closure Plan should identify and describe the post-closure activities required to properly monitor and maintain the closed landfill site. This post-closure plan should address all elements specified in 40 CFR 258.61 and include procedures for the following:

- maintaining the integrity and effectiveness of the final cover system
- maintaining and operating the leachate collection, treatment, and disposal systems
- maintaining and operating the environmental monitoring systems
- conducting Environmental quality monitoring (groundwater, surface water, landfill gas, leachate, air, etc.)
- maintaining and operating the landfill gas control system
- maintaining and operating the surface water runoff/run-on control systems
- providing overall, site-wide monitoring and security, and
- establishing appropriate uses of the property during the post-closure care period

Final Engineered Post-closure Plan

Incorporate in the Final Engineered Post-closure plan all elements of the "Subtitle D" post-closure plan, along with detailed closure design information. Include the following:

- a detailed schedule for post-closure monitoring, inspection, and maintenance and repairs
- detailed operation and maintenance procedures for all environmental monitoring and control systems that will be in active use during the post-closure period, and
- any other information required to comply with DEQ and federal regulations

Previously submitted information

Review and update any previously submitted post-closure informaiton to reflect current conditions and any proposed changes in closure or post-closure activities.

11.4 Additional Resources

References

Technical Manual for Solid Waste Disposal Criteria - 40 CFR Part 258, Subpart F (Chapter 6). U.S. EPA, November 1993.

Section 12: Financial Assurance

12.1 Introduction

Purpose of financial assurance

Proper financial planning early in the development of landfill facilities is required to ensure that adequate funding will be available to cover the cost of closure(s), post-closure care, and any corrective action activities.

Coverage

Maintain financial assurance to cover the costs of:

- closure of the landfill
- post-closure monitoring and maintenance of the landfill facilities, and
- any corrective action required by the Department

Exemptions

Exempt landfills must satisfy the exemption criteria in OAR 340-94-140(2) and meet the waste acceptance and final cover deadlines below:

Landfill type	that stopped receiving waste by...	and completed installation of final cover by...
any landfill	October 9, 1993	October 9, 1994
“small landfill” [40 CFR 258.1(e)(2)]	April 9, 1994	October 9, 1994
“very small landfill serving certain small communities” [40 CFR Part 258.1(f)(1)]	October 9, 1997	October 9, 1998

How to respond

Respond to applicable financial assurance requirements, as determined by the table below.

If the facility is...	Then...
subject to Subtitle D	place a financial assurance plan in the facility operating record and submit to the Department a copy of the mechanism and certification that the plan meets requirements
seeking an exemption	demonstrate to the Department that the facility meets the exemption criteria

Updating financial assurance

Review and update the cost estimates and the financial assurance annually during the operating life and post-closure care period, or until the corrective action is completed, as applicable. Place annual adjustments to the financial assurance plan in the facility operating record. Submit a certification to the Department that the annual update has been completed.

Review date: The annual review should occur on the anniversary of the date when the financial assurance plan was placed in the facility operating record and the certification was submitted to the Department, or at the end of the corporation's fiscal year if the mechanism is the corporate guarantee.

Schedule

The appropriate schedule for providing financial assurance will depend on each facility's operating status, size, anticipated closure date, and need for corrective action. Refer to OAR 340-94-140(3) for detailed schedule requirements associated with "worst case " closure plans, "Subtitle D" post-closure plans, Final Engineered Site Closure and Post-closure Plans and corrective action.

Cost calculations

For permittees meeting the criteria in 40 CFR Part 258.75 (a) through (c), the current value of future costs should be calculated using a discount rate no greater than the Department's current reference rate. The Department will determine the reference rate annually during the month of June. It shall be in effect for the fiscal year beginning the first day of July immediately following the determination date and ending on June 30 of the following calendar year. Refer to OAR 340-94-140 (4)(a) for detailed information.

Permittees can use discounting to determine costs only if they:

- certify that the closure date is certain and there are no foreseeable circumstances that will change the estimate of site life
- comply with all applicable permit requirements
- submit a statement from a registered engineer certifying that cost estimates are complete and accurate.

Contact: Department of Environmental Quality (503) 229-5378

12.2 Financial Assurance Plan

Contents of financial assurance plan

The financial assurance plan should contain the following elements:

- cost estimates for third-party closure, post-closure, corrective action (if required) and any other requirements the Department may impose as a condition of issuing a closure permit, closing the site, implementing post-closure care activities, or implementing corrective action
- the source of the cost estimates
- a detailed description of the form of the financial assurance and a copy of the financial assurance mechanism
- a method and schedule for acquiring and managing the required financial assurance funds
- a proposal for disposing of any excess moneys received or interest earned on moneys received for financial assurance
- adequate accounting procedures to insure that funds are collected in the correct amounts and used only for authorized purposes
- certification to the Director of DEQ that the financial assurance mechanism meets all state and federal requirements (at the time a financial assurance mechanism is submitted to the Department and when a financial assurance plan is placed in the facility operating record)
- annual updates of the cost estimates and financial assurance

Cost estimate

The financial assurance plan should include written cost estimates for the Final Engineered Site Closure Plan and Final Engineered Post-closure Plan, or the "worst case" closure and Subtitle D post-closure scenarios, as applicable.

Basis for estimate

Estimate costs based on detailed engineering analyses or construction contractor bids and itemize costs for expenses such as the following:

- mobilization of equipment
- construction materials
- construction activities
- overhead
- engineering and other consulting services
- operation and maintenance of environmental monitoring and control systems
- environmental monitoring and associated laboratory analyses
- general site maintenance activities
- miscellaneous expenses, contingencies, etc.

Considerations: closure estimate

Estimate closure costs based on the Final Engineered Site Closure Plan with consideration of the following factors:

- amount and type of solid waste deposited in the site
- the effectiveness of any buffer zones designed to protect adjacent land and drinking water sources
- the cost of the site's engineered closure improvements (i.e., final cover system, run-on/runoff control systems, other environmental control and monitoring systems, etc.)
- planned future use of the disposal site property
- the extent of site area closed prior to final closure of the entire site
- any other closure conditions imposed by the Department

Considerations: post-closure estimate

Estimate post-closure costs based on the Final Engineered Post-closure Plan. Consider the following factors:

- a minimum post-closure care period of 30 years after the date of final facility closure
- annual costs associated with the operation and maintenance of any required environmental control and monitoring systems
- any other conditions imposed by the Department relating to post-closure care of the site

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Considerations: corrective action

Estimate costs based on site-specific corrective action activities outlined in a Corrective Action Report (see 40 CFR Part 258.73). Estimate in current dollars and account for the cost of hiring a third party to perform the corrective action. Account for the total costs of corrective action activities for the entire corrective action period.

Form of financial assurance

Describe in detail the form of the financial assurance, using one of the allowable mechanisms. Include a copy of the mechanism in the plan.

Mechanisms for closure and post closure

Use any of the following forms of financial assurance for closure and post-closure activities:

Form of financial assurance	Requirements specified in...
trust fund	OAR 340-94-145(5)(a)
surety bond	OAR 340-94-145(5)(b) or OAR 340-94-145(5)(c)

irrevocable letter of credit	OAR 340-94-145(5)(d)
closure or post-closure insurance policy	OAR 340-94-145(5)(e)
corporate guarantee from a private corporation	OAR 340-94-145(5)(f)
local government financial test	OAR 340-94-145(5)(g)
local government guarantee	OAR 340-94-145(5)(h)
alternative form	OAR 340-94-145(5)(i); third party certification and prior approval of the form by the Department is required

Mechanisms for corrective action

Use any of the following forms of financial assurance for corrective action:

Form of financial assurance	Requirements specified in...
trust fund	OAR 340-94-145(5)(a)
performance surety bond	OAR 340-94-145(5)(c)
irrevocable letter of credit	OAR 340-94-145(5)(d)
corporate guarantee from a private corporation	OAR 340-94-145(5)(f)
local government financial test	OAR 340-94-145(5)(g)
local government guarantee	OAR 340-94-145(5)(h)
alternative form	OAR 340-940145(5)(i); third party certification and prior approval of the form by the Department is required

Method of acquiring and managing funds

Describe in detail the method and schedule for providing for or accumulating the appropriate amount of funds to ensure proper closure and post-closure care or implementation of corrective action, as applicable. The financial assurance mechanisms for closure, post-closure care and corrective action must ensure the funds will be available in a timely fashion when needed.

Excess moneys

Include a proposal for disposing of any excess moneys received or interest earned on moneys received for financial assurance. [OAR 340-94-140(4)(e)]

Collection of funds

Establish adequate accounting procedures to ensure that the disposal site operator does not:

- collect funds in excess of the amount specified in the financial assurance plan, or
- use the funds for any purpose other than required by OAR 340-94-140(1)

12.3 Additional Resources

Reference	Federal Reserve Statistical Release H.15 (519) Selected Interest Rates. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business.
Contact	Department of Commerce Bulletin Board: (202) 482-1986.

EXHIBIT 8
MAP AND LIST OF ADJACENT AND NEARBY PROPERTIES

LEGEND

- PROPERTY WITH LANDFILL OPERATIONS
- PROPERTY ADJACENT TO LANDFILL OPERATIONS
- PROPERTY ADJACENT TO ADJACENT PROPERTY

NORTH

SCALE IN FEET
0 1,000 2,000

REFERENCE

AERIAL PHOTOGRAPH, TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY AND GRID BY COOPER AERIAL SURVEYS COMPANY; DATE OF PHOTOGRAPHY: OCTOBER 07, 2021.

REGISTERED PROFESSIONAL ENGINEER
92360PE
OREGON
JULY 13, 2011
JEFF A. SHEPHERD
EXPIRES: 06/30/2026

REVISION RECORD

NO	DATE	DESCRIPTION

Civil & Environmental Consultants, Inc.
11811 N. Tatum Blvd., Suite 3057 - Phoenix, AZ 85028
Ph: 602.760.2324 · 877.231.2324 · Fax: 602.760.2330
www.cecinc.com

VALLEY LANDFILLS, INC.
COFFIN BUTTE LANDFILL
CONDITIONAL USE PERMIT
APPLICATION
CORVALLIS, OR 97330

BENTON COUNTY TAX LOTS & ZONING

DATE:	JULY 2024
DWG SCALE:	AS SHOWN
DRAWN BY:	JAS
CHECKED BY:	JAS
PROJECT NO:	322-142
APPROVED BY:	JAS

DRAWING NO.:
2

P:\320-000\322-141\-CADD\Dwg\SW01\322142-SW01-2-Benton County Tax Lots Exhibit.dwg[2] LS(8/13/2024 - jshaw) - LP: 8/13/2024 8:31 AM

NO.	TAX LOT NO.	OWNER NAME	CURRENT ZONING
1	104070000100	OREGON STATE GAME COMMISSION	OS
2	104070000300	R B WEBBER DEVELOPMENT LLC	EFU
3	104070000400	WILFONG TRISHA M	RR-5
4	104070000500	BURDOCK GARLAND R	RR-5
5	104070000601	RINKER TRISTA M	RR-5
6	104070000700	CLEARY BRYCE LAWRENCE	RR-5
7	104070000800	SCOTT DARCI L	RR-5
8	104070000900	WHITE JASON BYRON & JULIE B	RR-5
10	104070001100	AMADOR MARIBEL	RR-5
11	104070001200	LEAVENWORTH EDYNE	RR-5
12	104080000100	OREGON STATE GAME COMMISSION	OS
13	104170000100	OREGON STATE GAME COMMISSION	OS
18	104180000100	OREGON STATE GAME COMMISSION	OS
19	104180000101	CONSUMERS POWER INC	OS
20	104180000102	BUREAU OF LAND MANAGEMENT	OS
21	104180000200	PELTIER REAL ESTATE CO	FC
22	104180000201	POWELL LYNN MAY & HEALD NATHAN LESLIE	FC
23	104180000202	GOETZINGER DALE L & MONA G	RR-5
24	104180000300	DUBIKIN ALEXANDRE & POLUSHKIN GLIKERIA	FC
25	104180000301	VALLEY LANDFILLS INC	FC
26	104180000400	DUBIKIN ALEXANDRE & POLUSHKIN GLIKERIA	RR-5
27	104180000500	YOUNG CAROLYN	RR-5
28	104180000600	YOUNG CAROLYN	RR-5
29	104180000700	HOCKEMA JOSEPH E & JASMINE L	RR-5
30	104180000701	HOCKEMA JOSEPH E & JASMINE L	RR-5
31	104180000800	OREGON STATE FISH & WILDLIFE	FC
32	104180000801	VALLEY LANDFILLS INC	FC
33	104180000900	VALLEY LANDFILLS INC	FC
34	104180001000	VALLEY LANDFILLS INC	FC
35	104180001101	VALLEY LANDFILLS INC	FC
36	104180001102	VALLEY LAND FILLS INC	FC
37	104180001103	PHILLIPS SAMUEL F & CHERYL G	FC
38	104180001104	VALLEY LANDFILLS INC	FC
39	104180001105	PELTIER REAL ESTATE CO	EFU
40	104180001106	VALLEY LANDFILLS INC	LS
41	104180001107	VALLEY LANDFILLS INC	LS
42	104180001108	VALLEY LANDFILLS INC	LS
43	104180001200	VALLEY LANDFILLS INC	FC
44	104190000100	OREGON STATE GAME COMMISSION	OS
45	104190000200	BRADLEY LOWELL THOMAS & MARY ERIN	RR-10
46	104190000301	HOLDORF CATHERINE E, TR	EFU
47	104190000400	TAMPICO RIDGE LLC	RR-10
48	104190000402	KIPPER ROBERT J & JULIE A, TR	RR-10
49	104190000500	GEIER JOEL E & REBECCA S SHERMAN	RR-10
50	104190000600	CRESS MERRILL	RR-10
51	104190000700	MORRELL JEFFREY J & PATRICIA D	RR-10
52	104190001700	CLAPP CYNTHIA R	EFU & RR-10
53	104190001800	KEN & SARAH EDWARDSSON RL TRUST	EFU
54	104190001801	SLABAUGH ROGER L & MICHELLE V	EFU
55	104190001900	HERNANDEZ VICTOR	EFU
56	10419B000300	PELTIER REAL ESTATE CO	RR-10

NO.	TAX LOT NO.	OWNER NAME	CURRENT ZONING
57	10419B000400	CARLIN KATHERYN L, TR	RR-10
58	10419B000500	FRAZIER STEVEN & DAVIS LUE ANN	RR-10
59	10419B000600	GIBBS LANCE A	RR-10
60	10419B001200	BARBARA FICK LIVING TRUST	RR-10
61	10419B001300	BARBARA FICK LIVING TRUST	RR-10
62	10419B001301	VALLEY LANDFILLS INC	RR-10
63	10419B001500	CATHERINE E HOLDORF LIVING TRUST	RR-10
64	10419B001600	VALLEY LANDFILLS INC	RR-10
65	10419D000100	POSTLEWAIT JACOB EDWARD & ELIZABETH REGA	RR-10
66	10419D000200	HOLMES RICHARD H & CHARLCY L	RR-10
109	10419DD03700	YANEZ ERIC & BETHANY J	RR-5
110	10419DD03800	LOPEZ OMAR GENARO	RR-5
111	10419DD03900	ANTONIO & ELIZABETH AMANDI REVOCABLE LIV	RR-5
112	10419DD04000	ANTONIO & ELIZABETH AMANDI REVOCABLE LIV	RR-5
119	104200000300	OREGON STATE GAME COMMISSION	OS
339	105130000100	R B WEBBER DEVELOPMENT LLC	EFU
340	105130000200	DAVID & DEBRA HACKLEMAN TRUST	FC
341	105130000201	DAVID & DEBRA HACKLEMAN TRUST	FC
342	105130000202	BERKLUND HARRISUE, TR	FC
343	105130000203	BERKLUND HARRISUE, TR	FC
344	105130000300	DENOMA JOHN T JR & SEARS DONNA J	FC
345	105130000301	SEARS ROLLIN & DONNA JEANNE	FC
346	105130000400	BRISKEY JOINT REVOCABLE LIVING TRUST	FC
347	105130000500	DAVID A PLANT TRUST	EFU
348	105130000501	MARCUM DONALD R JR	EFU
349	105130000502	LINDSEY RICHARD T & KAREN J	EFU
350	105130000600	WINN TERRILL JAMES & APRIL DOVE	EFU
351	105130000601	GOETZINGER DALE L & MONA G	EFU
352	105130000700	OSC	FC
353	105130000800	VALLEY LANDFILLS INC	EFU
354	105130000900	VALLEY LANDFILLS INC	EFU
355	105130000901	VALLEY LANDFILLS INC	EFU
356	105130000902	VALLEY LANDFILLS INC	EFU
357	105130001000	VALLEY LANDFILLS INC	LS
361	105140000105	HARLAN ANNE M	EFU
362	105140000107	EDWARD L PORTZ & JOANN PORTZ TRUST	EFU
365	105140000111	HARLAN ANNE M	EFU
385	105140001400	BUCKOVIC FAMILY TRUST	EFU
411	105230000100	OREGON STATE BOARD HIGHER ED	FC
412	105240000101	JOHNSON DEBORA LEE, TR	EFU
413	105240000102	JOHNSON DEBORA LEE, TR	EFU
414	105240000103	VALLEY LANDFILLS INC	EFU
415	105240000104	LABRASSEUR GEORGE F & YOLANDE	EFU
416	105240000105	MASON FAMILY LIVING TRUST	EFU
417	105240000106	HOLDORF CATHERINE E, TR	EFU
418	105240000190	STAHL DEE M & WAYNE A	EFU
419	105240000200	VALLEY LANDFILLS INC	EFU
420	105240000300	OREGON STATE BOARD HIGHER ED	FC
421	105240000400	FLAK TIMOTHY A & LIND GINA M	RR-10
437	104190000401	SEARLS JAMES CLUETT	RR-10

REFERENCE

AERIAL PHOTOGRAPH, TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY AND GRID BY COOPER AERIAL SURVEYS COMPANY; DATE OF PHOTOGRAPHY: OCTOBER 07, 2021.

REGISTERED PROFESSIONAL ENGINEER
92360PE
OREGON
JULY 13, 2011
JEFF A. SHEPHERD
EXPIRES: 06/30/2026

REVISION RECORD

NO	DATE	DESCRIPTION

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VALLEY LANDFILLS, INC.
COFFIN BUTTE LANDFILL
CONDITIONAL USE PERMIT
APPLICATION
CORVALLIS, OR 97330

BENTON COUNTY TAX LOTS & ZONING

DATE:	JULY 2024
DRAWN BY:	JS
CHECKED BY:	JAS
DWG SCALE:	AS SHOWN
PROJECT NO:	322-142
APPROVED BY:	JAS

DRAWING NO.:
2A

P:\320-000\322-142\-CAD\Dwg\SHT\322142-SHT1-2-Benton County Tax Lots Exhibit.dwg[2A] LS(8/13/2024 - jshah) - LD: 8/13/2024 8:37 AM

EXHIBIT 9
MAP DEFINING THE ANALYSIS AREA SHOWING ODOR COMPLAINTS

LEGEND

- ODOR COMPLAINTS FROM 2021
- ODOR COMPLAINTS FROM 2023
- ODOR COMPLAINTS FROM 2024

NO.	YEAR	MONTH
1	2021	OCTOBER
2		NOVEMBER
3	2023	NOVEMBER
4		DECEMBER
5		DECEMBER
6	2024	JANUARY
7		FEBRUARY
8		FEBRUARY
9		FEBRUARY
10		FEBRUARY
11		FEBRUARY
12		FEBRUARY
13		MARCH
14		MARCH
15		MARCH
16		MARCH
17		MARCH
18		APRIL
19		APRIL
20		APRIL
21		JULY
22		JULY
23		JULY
24		AUGUST
25		AUGUST

NORTH

SCALE IN FEET

0 3,000 6,000

REFERENCE

REGISTERED PROFESSIONAL ENGINEER
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JULY 13, 2011
JEFF A. SHEPHERD
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COFFIN BUTTE LANDFILL
CONDITIONAL USE PERMIT
APPLICATION
CORVALLIS, OR 97330

EXHIBIT 9 - MAP OF THE ANALYSIS AREA

DATE:	JULY 2024
DWG SCALE:	AS SHOWN
DRAWN BY:	JS
CHECKED BY:	JAS
PROJECT NO.:	322-142
APPROVED BY:	JAS

DRAWING NO.:

A

P:\322-142\CAD\Exp\SHT\EXHIBIT 9-Map of the Analysis Area.dwg (5/10/21/2024 - jshell) - LP: 10/21/2024 2:51 PM

EXHIBIT 10

AERIAL IMAGE OF TOPOGRAPHY AND ROADS SURROUNDING THE LANDFILL AREA

F:\322-000\322-142\-CADD\Dwg\SW01\322142-SW01-EXHIBIT 10-Aerial photo of Topography.dwg[A] LS(10/21/2024 - jshah) - LP: 10/21/2024 2:41 PM



LEGEND

300 EXISTING 50-FT CONTOUR

REFERENCE

NORTH

SCALE IN FEET
0
3,000
6,000

REGISTERED PROFESSIONAL ENGINEER
JEFFREY A. SHEPHERD
92569PE
OREGON
JULY 15, 2017
EXPIRES: 06/30/2026

A

EXHIBIT 10 - AERIAL IMAGE OF TOPOGRAPHY AND ROADS SURROUNDING THE COFFIN BUTTE LANDFILL

DATE:	JULY 2024	DRAWN BY:	JS
DWG SCALE:	AS SHOWN	CHECKED BY:	JAS
PROJECT NO:			322-142
APPROVED BY:			JAS

VALLEY LANDFILLS, INC.
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REVISION RECORD

NO	DATE	DESCRIPTION

EXHIBIT 11
NOISE STUDY



REPUBLIC SERVICES COFFIN BUTTE LANDFILL
NOISE STUDY

September 25, 2023

Prepared For:

Civil & Environmental Consultants, Inc.

Prepared By:

THE GREENBUSCH GROUP, INC.

1900 West Nickerson Street Suite 201
Seattle, Washington 98119

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1.0 EXECUTIVE SUMMARY

This Noise Study includes a summary of existing sound levels measured near the proposed expansion area, sound levels produced by equipment currently being used at the landfill, and discussion of applicable regulatory criteria. To assess sound emissions of fill operations in the new area, predictions were made for both beginning grade and maximum future grade conditions. Predicted sound levels included in this Noise Study comply with applicable regulatory criteria without the inclusion of noise mitigation. Although not required to comply with code limits, it is recommended that all backup alarms used on the site be replaced with ambient sensing broadband backup alarms, if permitted by safety regulations.

2.0 INTRODUCTION

This Noise Study evaluates sound levels associated with the proposed expansion of the Republic Services Coffin Butte Landfill (project) located at 28972 Coffin Butte Road in Corvallis, Oregon. The proposed expansion is located on the south side of Coffin Butte Road, directly south of the existing landfill area.

In addition to the landfill expansion, a new 2,160 square foot employee building, scale house access road on the north side of Coffin Butte Road, access road on the south side of the proposed expansion area, and relocation of leachate ponds to support the landfill are proposed.

Equipment operating in the expansion area is anticipated to be similar to existing landfill operations: dozers, excavators, and compactors to move debris, tipping machines used to unload haul vehicles, and truck traffic.

This Noise Study includes a summary of sound level measurements made of existing operations and equipment, measurements of existing sound levels near the expansion area, predicted sound levels from future operations in the expansion area, and an analysis of compliance with regulatory criteria.

3.0 NOMENCLATURE

The auditory response to sound is a complex process that occurs over a wide range of frequencies and intensities. The decibel level, or “dB,” is a form of shorthand that compresses this broad range of intensities into a convenient numerical scale. The decibel scale is logarithmic. For example, using the decibel scale, a doubling or halving of energy causes the sound level to change by 3 dB; it does not double or halve the perceived loudness as might be expected.

The minimum sound level variation perceptible to a human observer is generally around 3 dB. A 5 dB change is clearly perceptible, and an 8 to 10-dB change is associated with a perceived doubling or halving of loudness. Common sound pressure levels are reported in Table 3.1. Mathematical descriptors have been developed to provide better assessment of sounds that vary over time and the human response to them.

- Equivalent Sound Level, L_{eq}, is the level of a constant sound having the same energy content as the actual time-varying level during a specified interval. The L_{eq} is used to characterize complex, fluctuating sound levels with a single number. Typical intervals for L_{eq} are hourly, daily, and annually.
- Maximum Sound Level, L_{max}, is the maximum recorded root mean square (rms) sound level for a given time interval or event. L_{max} can be defined for two time weightings, "slow" and "fast." "Slow" uses 1-second time constant, and "fast" uses a 125-millisecond time constant. For transient events of very short duration, L_{max} "fast" will be greater than L_{max} "slow." L_{max} "fast" is used throughout this report.
- Percentage Sound Level, $L_{(n)} – L_{(n)}$, is the sound level that is exceeded n percent of the time; for example, L_{08} is the level exceeded 8% of the time. L_{25} is the sound level exceeded 25% of the time.
- Sound Power Level, PWL or L_wA (A-weighted PWL), is the amount of energy per second generated by a source, measured in watts. The sound power level (PWL) is a decibel representation with a reference value of 1 pico-watt (pW). Sound power is independent of distance, path, or influence from any nearby surfaces.
- Sound Pressure Level, SPL, correlates with what is heard by the human ear. SPL is defined as the squared ratio of the sound pressure with reference to 20 micropascal (µPa). Sound pressure is affected by distance, path, barriers, directivity, etc. All sound pressure levels referenced in this document utilize this reference pressure.

Table 3.1 A-Weighted Levels of Common Sounds, dBA

Sound	Sound Level	Approximate Relative Loudness[1]
Jet Plane at 100 feet	130	128
Rock Music with Amplifier	120	64
Thunder, Danger of Permanent Hearing Loss	110	32
Boiler Shop, Power Mower	100	16
Orchestral Crescendo at 25 feet	90	8
Busy Street	80	4
Interior of Department Store	70	2
Ordinary Conversation at 3 feet	60	1
Quiet Car at Low Speed	50	1/2
Average Office	40	1/4
City Residence, Interior	30	1/8
Quiet Country Residence, Interior	20	1/16
Rustle of Leaves	10	1/32
Threshold of Hearing	0	1/64

1. As compared to ordinary conversation at 3 feet

Source: US Department of Housing and Urban Development, Aircraft Noise Impact Planning Guidelines for Local Agencies, November 1972

4.0 REGULATORY CRITERIA

The project is located within unincorporated Benton County and noise emissions are subject to the Benton County Code (BCC). However, the BCC does not include sound limits applicable to the site. Therefore, sound level limits default to requirements of the Oregon Administrative Rules (OAR).

OAR 340-035-0035 regulates sound emissions from commercial and industrial sound sources and are based on whether the site was previously used as a commercial or industrial site. The site has been used as an industrial site for over 20 years to support existing landfill operations and currently has two leachate ponds, soil stockpiles, and trucks hauling leachate. Based on existing operations at the site it is our understanding that the expansion area will be considered a new industrial or commercial sound source located on a previously used site and will be subject to OAR 340-035-0035(1)(A).

Under OAR 340-035-0035(1)(A) sound levels from the proposed operations could not exceed the levels shown in OAR 340-35-035 Table 8 (see Table 4.1). Additionally, if there is reasonable cause to believe these requirements do not adequately protect the health, safety, or welfare of the pubic, sound levels generated by the proposed operations would be subject to the octave band sound limits specified in OAR 340-35-035 Table 10 (see Table 4.2).

Sounds level limits identified in OAR 340-35-035 Table 8 and OAR 340-35-035 Table 10 are only enforced at noise sensitive properties, which are defined in OAR 340-035-0015(38) as follows:

"'Noise Sensitive Property' means real property normally used for sleeping, or normally used as schools, churches, hospitals or public libraries. Property used in industrial or agricultural activities is not Noise Sensitive Property unless it meets the above criteria in more than an incidental manner."

Measurement locations used to enforce these sound limits are 25 feet towards the noise source from the point of the noise sensitive building nearest the noise source, or at the point on the noise sensitive property line nearest the noise source, whichever is further from the noise source.

Table 4.1 OAR Hourly Sound Limits, dBA

Noise Metric	7:00 AM to 10:00 PM	10:00 PM to 7:00 AM
L_{50}	55	50
L_{10}	60	55
L_{01}	75	60

Source: OAR 340-35-035 Table 8

Table 4.2 OAR Octave Band Sound Limits, dB

Time	Frequency, Hz								
	31.5	63	125	250	500	1,000	2,000	4,000	8,000
7:00 AM to 10:00 PM	68	65	61	55	52	49	46	43	40
10:00 PM to 7:00 AM	65	62	56	50	46	43	40	37	34

Source: OAR 340-35-035 Table 10

OAR 340-035-0035(5) provides the following exemptions from OAR 340-35-035 Table 8 and Table 10 sound limits:

- Emergency equipment not operated on a regular or scheduled basis (OAR 340-035-0035(5)(a))
- Warning devices not operating continuously for more than 5 minutes (OAR 340-035-0035(5)(b))
- Sounds created by the tires or motor used to propel any road vehicle complying with the noise standards for road vehicles (OAR 340-035-0035(5)(c))
- Sounds created by bells, chimes, or carillons (OAR 340-035-0035(5)(e))

In addition to the regulations for commercial and industrial noise sources defined in OAR 340-35-0035, OAR 340-035-0030 includes policies for motor vehicle sound emissions (including road and off-road vehicles) and sound limits at noise sensitive properties when motor vehicles operate on private property within 1,000 feet of noise sensitive properties.

OAR 340-035-0015 defines motor vehicles, road vehicles, and off-road recreational vehicles as follows:

"'Motor Vehicle' means any vehicle which is, or is designed to be self-propelled or is designed or used for transporting persons or property. This definition excludes airplanes, but includes watercraft."

"'Off-Road Recreational Vehicle' means any motor vehicle, including watercraft, used off public roads for recreational purposes. When a road vehicle is operated off-road the vehicle shall be considered an off-road recreational vehicle if it is being used for recreational purposes."

"'Road Vehicle' means any motor vehicle registered for use on public roads, including any attached trailing vehicles."

OAR 340-035-0030(1)(d)(B) provides the following exemptions from the sound limits shown in OAR 340-35-030 Table 5, which apply to noise sensitive properties within 1,000 feet of vehicle operations:

- Motor vehicles initially entering or leaving property which is more than 1,000 feet from the nearest noise sensitive property or quiet area (OAR 340-035-0030(1)(d)(B)(ii))
- Motor vehicles operating on public roads (OAR 340-035-0030(1)(d)(B)(iii))
- Motor vehicles operating off-road for non-recreational purposes (OAR 340-030-0030(1)(d)(B)(iv))

Warning devices used on motor vehicles are exempt from all noise regulations under OAR 340-035-0030(3)(b).

Although OAR exemptions could be interpreted as exempting haul truck activities throughout the site given haul trucks are considered "road vehicles" and are operating off-road for non-recreational purposes, the Noise Study includes an evaluation of potential effects from trucking operations at nearby noise sensitive properties.

Increases to existing sound levels are not governed under the OAR for new industrial or commercial noise sources on previously used sites. However, this analysis includes an

assessment of increases to existing sound levels to address concerns expressed by the community. Increases to existing sound levels are compared with OAR regulatory criteria for new industrial and commercial noise sources on previously unused sites, which prohibits increasing exiting L_{10} or L_{50} statistical noise levels by more than 10 dB.

Based on OAR regulatory criteria and measured ambient sound levels (see Section 5.1 for additional information) the resulting sound limits for the project are shown in Table 4.3. The operating hours of the landfill are 4:30 AM to 5:30 PM on weekdays and 7:30 AM to 5:30 PM on Saturdays. Therefore, both daytime and nighttime sound limits shown in Table 4.3 apply. This analysis assumes on-site operations do not vary between daytime and nighttime hours and assesses compliance using the more stringent nighttime sound limits in Table 4.3.

Table 4.3 Project Sound Limits, (L_{01} / L_{10} / L_{50}), dBA

Location	Time	OAR Table 8 Limits (X)	Existing Sound Levels[1]	Existing Sound Levels + 10 dB (Y)	Project Limit (lowest of X and Y)
Location 1	Daytime	75 / 60 / 55	-[2] / 39 / 32	- / 49 / 42	75 / 49 / 42
	Nighttime	60 / 55 / 50	- / 28 / 22	- / 38 / 32	**60 / 38 / 32**
Location 2	Daytime	75 / 60 / 55	- / 41 / 38	- / 51 / 48	75 / 51 / 48
	Nighttime	60 / 55 / 50	- / 33 / 29	- / 43 / 39	**60 / 43 / 39**
Location 3[3]	Daytime	75 / 60 / 55	- / 58 / 53	- / 68 / 63	75 / 60 / 55
	Nighttime	60 / 55 / 50	- / 50 / 36	- / 60 / 46	**60 / 55 / 46**
Location 4	Daytime	75 / 60 / 55	- / 46 / 39	- / 56 / 49	75 / 56 / 49
	Nighttime	60 / 55 / 50	- / 35 / 29	- / 45 / 39	**60 / 45 / 39**
Noise Sensitive Properties	Daytime	75 / 60 / 55	-	-	75 / 60 / 55
	Nighttime	60 / 55 / 50	-	-	**60 / 55 / 50**

1. OAR 340-035-0035(1)B only prohibits L_{10} and L_{50} ambient sound levels from being exceeded by 10 dB
2. Indicates a non-applicable value
3. Measured sound levels may be influenced by the existing power plant, which will remain in place during the expansion

5.0 SOUND LEVEL MEASUREMENTS

Sound levels were measured near noise sensitive properties in the vicinity of the proposed expansion area to document the existing acoustic environment. Measurements were also made of existing operations at the current site for use in the analysis. Equipment used during the measurements are identified in Table 5.1.

Table 5.1 Measurement Equipment

Make and Model	Description	Serial Number
Svantek SV307	Sound Level Analyzer	78647
Svantek ST30	Microphone	82351
Svantek SV307	Sound Level Analyzer	78633
Svantek ST30	Microphone	103657
Svantek SV307	Sound Level Analyzer	106247
Svantek ST30	Microphone	111967
Svantek SV307	Sound Level Analyzer	78646
Svantek ST30	Microphone	114514
Larson Davis CAL200	Acoustic Calibrator	18605
Svantek 971	Sound Level Analyzer	51818
Svantek SV18	Preamplifier	49561
Aco Pacific 7052E	Microphone	62522
Larson Davis CAL200	Acoustic Calibrator	9512

All equipment was calibrated at a certified laboratory within one year of the measurement date. Field calibrations were made before and immediately after the measurements were completed. Environmental windscreens were used on all microphones during the measurements.

5.1 Existing Sound Levels

Existing sound levels were measured at three locations near noise sensitive properties between Friday October 15 and Tuesday October 19, 2021, and at a fourth location between Thursday January 13 and Saturday January 22, 2022. Wind conditions during the October measurements ranged from calm to 10 miles per hour and were generally from the south. Temperatures ranged between 40- and 69-degrees Fahrenheit. Precipitation ranged from 0 to 0.15 inches per day. Wind conditions during the January measurements ranged from calm to 12 miles per hour and were typically from the south. Temperatures during the January measurements ranged between 33- and 57-degrees Fahrenheit and precipitation ranged from 0 to 0.26 inches per day.

The four Svantek SV307 sound level analyzers shown in Table 5.1 were used to measure the existing acoustic environment. At all measurement locations, equipment collected hourly and 1-second 1/3 octave L_{eq}, broadband L_{max} sound levels at both 1-second and hourly intervals, and 1-hour L_n data were also measured. To help identify local noise sources, audio recordings were made when sound levels exceeded 40 dBA at Locations 1 and 2, 50 dBA at Location 3, and 65 dBA at Location 4. The locations of the measurements are illustrated in Figure 5.1 and photos of the measurement equipment are shown in Figure 5.2 through Figure 5.5.

Figure 5.1 Measurement Locations



Figure 5.2 Location 1



Figure 5.3 Location 2



Figure 5.4 Location 3



Figure 5.5 Location 4



The range and median hourly L_{10} and L_{50} sound levels at each measurement location are shown in Table 5.2 and graphically in the Appendix. It should be noted that due to equipment connectivity issues, some hours of data were incomplete. Levels in this document only include data collected over complete hours. Times when data was not recorded over a complete hour are identified in the Appendix.

Table 5.2 Measured Hourly Sound Levels, Low-High (Median)

Measurement Location	Daytime, dBA		Nighttime, dBA	
	L_{10}	L_{50}	L_{10}	L_{50}
Location 1	28-54 (39)	21-51 (32)	22-52 (28)	15-50 (22)
Location 2	33-53 (41)	30-50 (38)	27-49 (33)	26-48 (29)
Location 3	53-60 (58)	45-56 (53)	38-59 (50)	27-53 (36)
Location 4	30-55 (46)	26-47 (39)	26-51 (35)	24-46 (29)

Measured median L_{10} and L_{50} sound levels were below OAR sound limits at all measurement locations. Dominant sound sources at the measurement locations included birds, other nature sounds, and vehicle traffic on Soap Creek Road, Coffin Butte Road, and Highway 99 West. Sound levels were generally louder at locations closer to Highway 99 West and traffic noise became more prevalent. The existing on-site power plant may have contributed to the measured sound levels at Location 3.

5.2 Equipment Sound Levels

Sound levels from existing equipment and operations at the landfill were measured the morning of October 15, 2021, using the Svantek 971 sound level analyzer. Measurements were made of individual pieces of equipment including, excavators, dozers, compactors, tippers, and haul trucks, at distances of 15 feet to 75 feet.

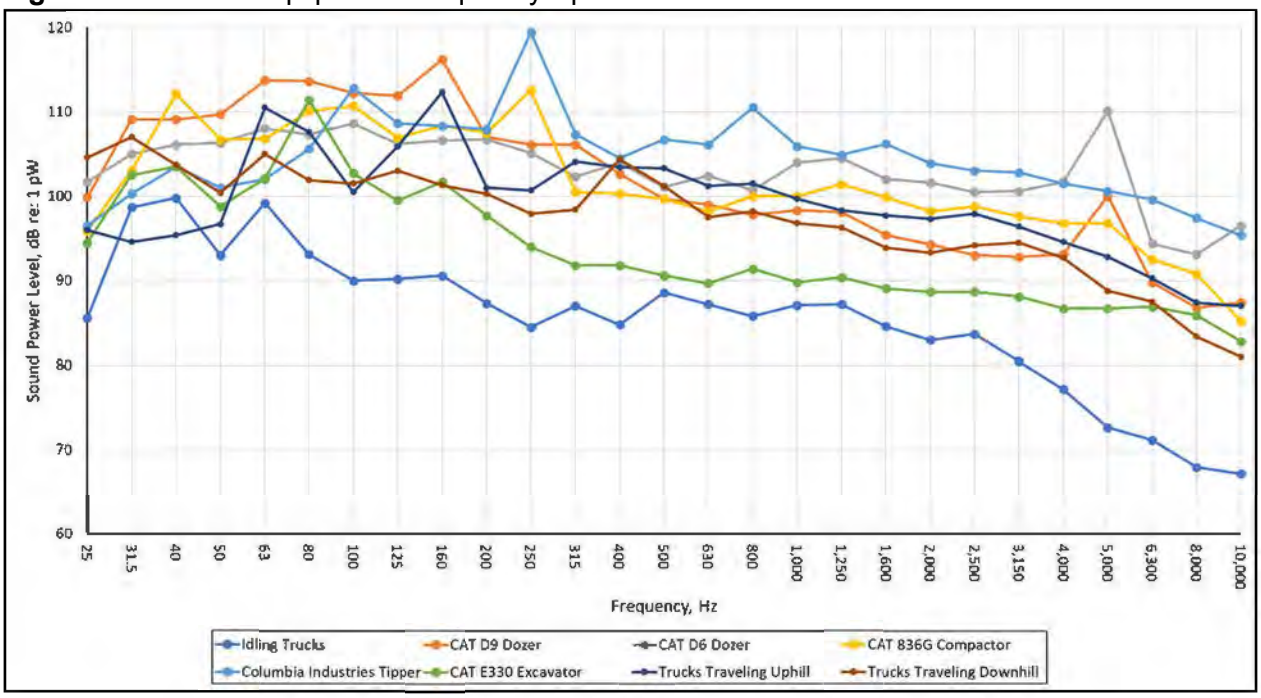
For mobile equipment and equipment not operating continuously, reported sound levels only include the loudest portions of the measurements. Because the data was collected at a variety of distances, measured sound pressure levels were used to compute equipment sound power levels, which are independent of distance. Measurement distances, sound pressure levels, and calculated sound power levels are shown in Table 5.3. A graph showing the frequency spectrum of the equipment is shown in Figure 5.6.

Table 5.3 Equipment Sound Levels, L_{eq}

Equipment	Measurement Distance, Feet	Sound Pressure Level, dBA	Sound Power Level, L_wA
CAT D9 Dozer	75	75	110
CAT D6 Dozer[1]	75	80	115
CAT 836G Compactor	45	81	111
Columbia Industries Tipper	30	90	117
CAT 330 Excavator	60	68	102
Idling Trucks	25	70	96
Trucks Traveling Uphill[2]	15	89	110
Trucks Traveling Downhill[3]	26	81	108

1. Reported sound levels are the logarithmic average of two measurements
2. Reported sound levels are the logarithmic average of eight measurements
3. Reported sound levels are the logarithmic average of five measurements

Figure 5.6 On-Site Equipment Frequency Spectrum



6.0 ANALYSIS

The primary tool used to predict sound levels at neighboring properties from proposed future operations was the 3-D computer noise modeling software environment, Cadna/A. Cadna/A utilizes the CADNA (Control of Accuracy and Debugging for Numerical Applications) computation engine developed by the Pierre et Marie Curie University of Paris. The models used for this project utilized the International Organization for Standardization 9613 Part II algorithms, implemented in the Cadna/A software, which accounted for the effects of distance, topography, and surface reflections.

The modeling process is typically accurate within 3 dB. Conservative assumptions were used in the model created for this project to ensure sufficient design margin within the predicted sound levels, allowing for direction comparison with project criteria.

Locations of equipment and future on-site topography were determined from drawings provided by Civil and Environmental Consultants, Inc. Offsite topographical information was based on LIDAR images of the area. Property line locations, zoning information, and locations of structures were determined from Benton County Geographical Information System (GIS) data.

To account for changes to the topography in the expansion area over time, both the beginning of landfill operations, when the site is nearly empty (Scenario 1), and when on-site operations are nearing completion and the site is nearly full (Scenario 2) were modeled. Near the beginning of operations, the middle of the expansion area will be approximately 260 feet above sea level and near the end of operations the expansion area will be approximately 450 feet above sea level.

Equipment measured on October 15, 2021, was modeled within the proposed expansion area. Operations within the expansion area are expected to be similar to existing operations and generate similar sound levels. In Scenario 1, equipment was placed near the southern portion of

the expansion area to produce conservative results at noise sensitive properties located south of the site. Equipment in Scenario 2 were distributed along at the highest point of the expansion area. Trucks using the landfill were modeled entering from Highway 99 West, using the scale house, proceeding to the expansion area, and returning to Highway 99 West. The hourly vehicle counts included in the noise models are shown in Table 6.1 and all vehicles were modeled traveling at 15 miles per hour.

OAR sound limits are based on hourly L_{01}, L_{10}, and L_{50} percentile sound levels. Percentile sound levels present modeling challenges due to variability in the duration of equipment operations, changes in sound levels produced by the equipment, and times when multiple pieces of equipment may operate simultaneously. This analysis predicts hourly L_{01} and L_{50} percentile sound levels as follows:

- L_{01} was modeled with all equipment operating simultaneously and each piece of equipment generating the loudest one-second sound level produced during the on-site equipment measurements. The L_{01} captures loud, transient events, such as banging truck gates and loud noises from unloading. Calculated pass-by levels were used to estimate the L_{01} sound level from trucks at individual properties. These predicted levels were then combined with predicted sound levels from other on-site equipment. While L_{01} sound levels themselves are not appropriately combined in this way, it represents a conservative prediction for L_{01} sound levels from the site.
- L_{50} is modeled with the assumption that L_{50} sound levels are similar to measured L_{eq} equipment sound levels. Equipment was modeled generating the loudest 1-second L_{eq} sound levels produced by each piece of equipment during the on-site measurements with a usage factor applied. The percentage of an hour that each piece of equipment produces the loudest sound levels (acoustical usage factors) were applied based on Federal Highway Administration (FHWA) Construction Noise Control Specification 721.560 and estimated operating times noted during the on-site equipment measurements.

Equipment types and quantities included in the noise models are shown in Table 6.1.

Table 6.1 Modeled Equipment

Equipment	Quantity	Usage Factor (%)[1]
CAT D9 Dozer	1	40
CAT D6 Dozer	1	40
CAT 836G Compactor	2	50
Columbia Industries Tipper	1	50
CAT 330 Excavator	1	40
Idling Trucks	4	100
Landfill Trucks[2]	47/hour	100

1. Based on information in the FHWA Construction Noise Control Specification 721.560 and operating times noted during on-site measurements.
2. Sound levels from trucks traveling uphill were used in the models.

Figure 6.1 Modeled Equipment Locations – Scenario 1

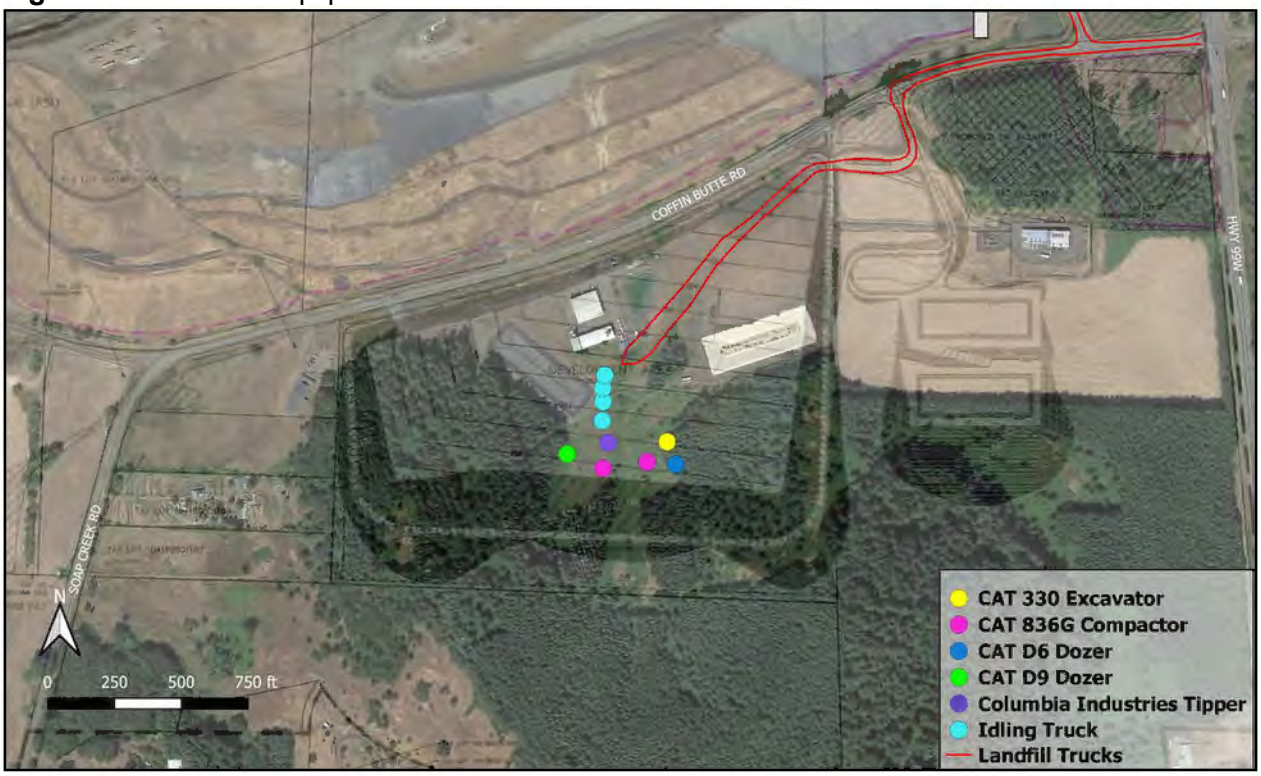
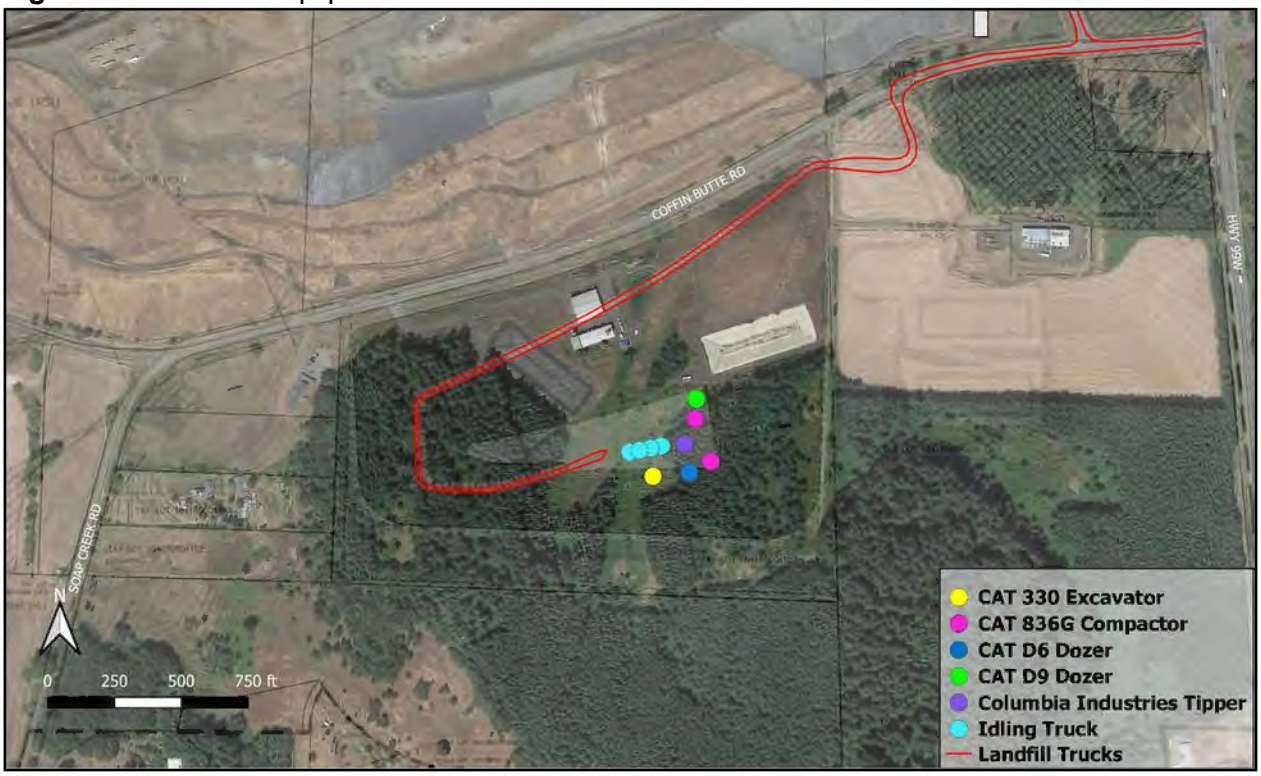


Figure 6.2 Modeled Equipment Locations – Scenario 2



7.0 MODELING RESULTS

Predicted sound levels included in this document represent the loudest sound levels anticipated at receiving noise sensitive properties and at the locations where existing sound levels were measured. The evaluation point locations are shown in Figure 7.1. These predicted sound levels represent on-site operations only and do not include contributions from off-site sound sources or safety devices such as backup alarms.

Figure 7.1 Evaluation Point Locations



Predicted unmitigated broadband sound levels from Scenario 1 are shown in Table 7.1 and predicted sound levels in each octave band are shown in Table 7.2.

Table 7.1 Predicted Unmitigated Broadband Sound Levels – Scenario 1, dBA

Location	Project Limits[1]		Predicted Sound Level		Satisfies OAR Limits?	
	L_{01}[3]	L_{50}	L_{01}	L_{50}	L_{01}	L_{50}
Location 1[2]	-	32	-	27	-	Yes
Location 2[2]	-	39	-	35		
Location 3[2]	-	46	-	39		
Location 4[2]	-	39	-	39		
North	60	50	44	42	Yes	Yes
South			36	35		
West			41	39		
East			42	40		
Southeast			38	36		

1. Based on nighttime OAR sound limits and 10 dB increase to existing sound levels
2. See Figure 5.1 for locations where existing sound levels were measured
3. OAR increases to existing sound levels only apply to L_{10} and L_{50} sound levels

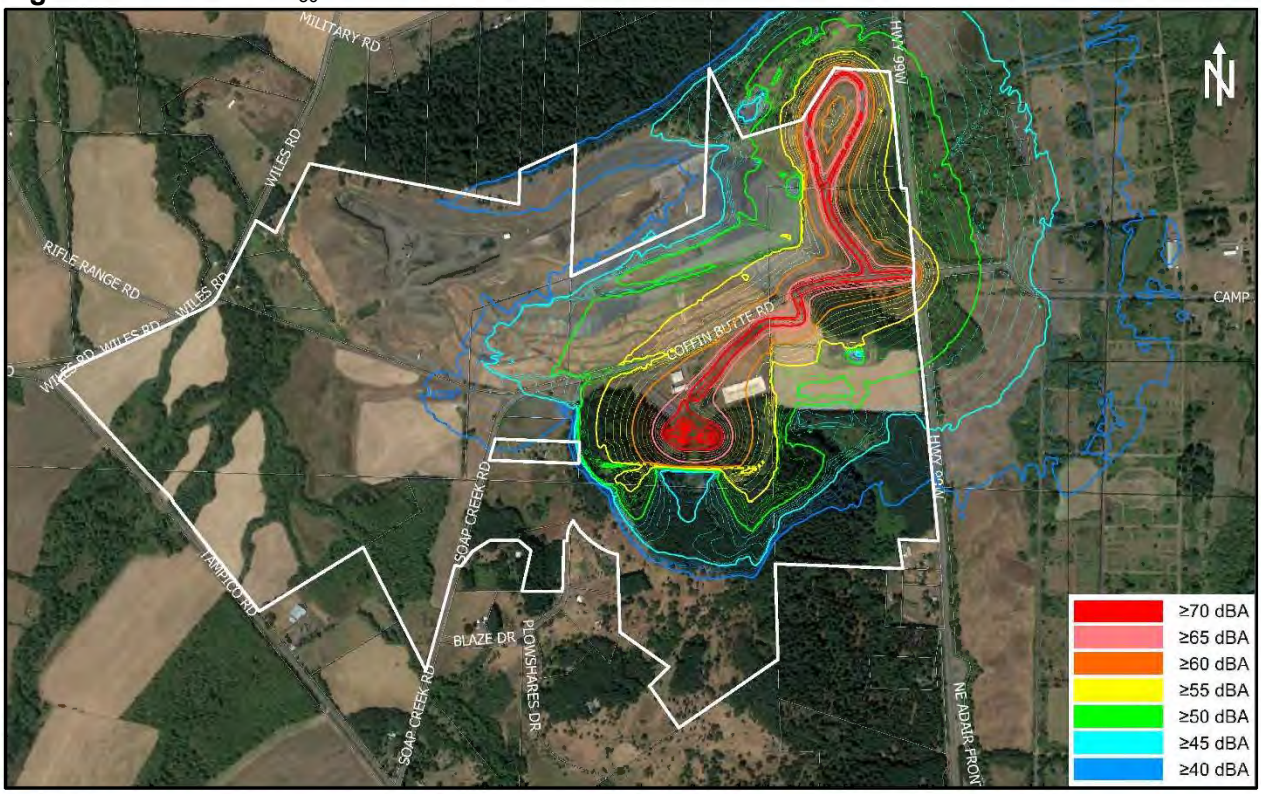
Table 7.2 Predicted Unmitigated L_{50} Octave Band Sound Levels – Scenario 1, dB

	Frequency, Hz								
	31.5	**63**	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**	**8,000**
OAR Sound Limits[1]	**65**	**62**	**56**	**50**	**46**	**43**	**40**	**37**	**34**
Location									
Location 1	36	38	36	30	23	21	14	1	-
Location 2	44	46	44	39	32	27	20	10	-
Location 3	38	46	45	37	38	33	26	6	-
Location 4	47	49	48	43	35	30	21	10	-
North	41	47	44	39	39	39	30	7	-
South	41	44	43	37	33	28	19	1	-
West	46	48	47	43	35	30	23	13	-
East	42	53	42	37	39	37	29	2	-
Southeast	36	44	42	35	35	31	24	1	-
Satisfies OAR Limits?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

1. Based on OAR 340-35-035 Table 10

As shown in Table 7.1 and Table 7.2 sound levels from Scenario 1 are anticipated to comply with OAR sound limits at all nearby noise sensitive properties and locations where existing sound levels were measured. Predicted sound levels are also below the median ambient sound levels measured during times when existing landfill operations were taking place. Predicted sound contours five feet above grade from Scenario 1 are shown in Figure 7.2.

Figure 7.2 Predicted L_{50} Sound Level Contours – Scenario 1



Predicted broadband sound levels from Scenario 2 are shown in Table 7.3 and predicted sound levels in each octave band are shown in Table 7.4. Sound levels at the locations where existing sound levels were measured are not included because existing sound level when the site is filled are not known.

Table 7.3 Predicted Unmitigated Broadband Sound Levels – Scenario 2, dBA

Location	Project Limits[1]		Predicted Sound Level		Satisfies OAR Limits?	
	L_{01}	L_{50}	L_{01}	L_{50}	L_{01}	L_{50}
North	60	50	45	43	Yes	Yes
South			47	43		
West			51	45		
East			43	41		
Southeast			40	37		

1. Based on nighttime OAR sound limits

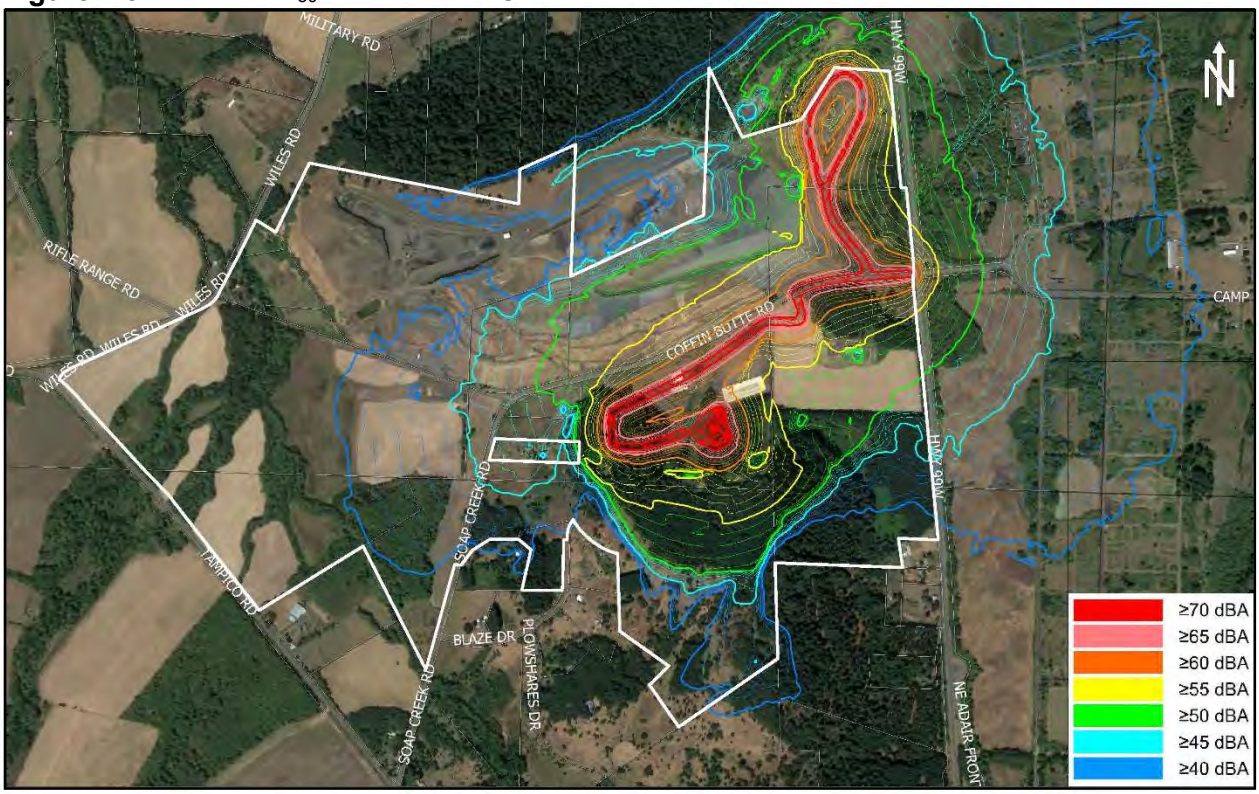
Table 7.4 Predicted Unmitigated L_{50} Octave Band Sound Levels – Scenario 2, dB

	Frequency, Hz								
	31.5	**63**	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**	**8,000**
OAR Sound Limits[1]	**65**	**62**	**56**	**50**	**46**	**43**	**40**	**37**	**34**
Location									
North	42	48	45	40	40	40	32	9	-
South	45	52	49	43	40	38	33	20	-
West	45	52	52	44	44	40	35	26	4
East	47	54	43	38	39	38	29	2	-
Southeast	42	46	44	38	36	31	24	2	-
Satisfies OAR Limits?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

1. Based on OAR 340-35-035 Table 10

Sound levels from the end of operations are anticipated to comply with OAR sound limits at all nearby noise sensitive properties. Predicted unmitigated sound contours five feet above grade from Scenario 2 are shown in Figure 7.3.

Figure 7.3 Predicted L_{50} Sound Level Contours – Scenario 2



Predicted sound levels from trucks using the landfill and on-site equipment comply with OAR sound limits at all nearby noise sensitive properties under both modeling scenarios. Anticipated sound levels from landfill operations under Scenario 2 are higher than those from Scenario 1 due to the increased elevation of the site as it becomes filled, which decreases the effectiveness of the screening provided by the hillside south of the site, and rerouting trucks to travel up the

north, west, and south slopes of the expansion area. Although not required to comply with codified sound limits, it is recommended that all backup alarms used on the site be replaced with ambient sensing broadband backup alarms, if permitted by safety regulations.

8.0 APPENDIX

8.1 Location 1 Ambient Sound Levels

Bolded and underlined values shown in Table 8.1 and Table 8.2 represent hours when the landfill was operating.

Table 8.1 Hourly L_{10} Sound Levels - Location 1, dBA

Start of Hour	L_{10}				
	Friday 10/15/2021	Saturday 10/16/2021	Sunday 10/17/2021	Monday 10/18/2021	Tuesday 10/19/2021
12:00 AM		27	24	48	25
1:00 AM		26	23	42	27
2:00 AM		23	23	36	25
3:00 AM		22	24	33	25
4:00 AM		24	23	**33**	**32**
5:00 AM		30	26	**39**	**41**
6:00 AM		30	27	**40**	**42**
7:00 AM		**34**	34	**46**	**44**
8:00 AM		**40**	37	**45**	**46**
9:00 AM		**39**	43	**46**	**47**
10:00 AM		**40**	42	**44**	**46**
11:00 AM		**44**	36	**42**	**45**
12:00 PM		**41**	37	**43**	
1:00 PM	**43**	**38**	36	**45**	
2:00 PM	-	**39**	38	**44**	
3:00 PM	**41**	**42**	35	**44**	
4:00 PM	**42**	**38**	35	**44**	
5:00 PM	**39**	**41**	39	**45**	
6:00 PM	38	36	35	39	
7:00 PM	35	38	32	33	
8:00 PM	31	31	54	28	
9:00 PM	30	31	54	29	
10:00 PM	28	29	52	31	
11:00 PM	26	28	49	27	

Note: "-" denotes hours when a complete hour of data was not collected

Table 8.2 Hourly L_{50} Sound Levels - Location 1, dBA

Start of Hour	L_{50}				
	Friday 10/15/2021	Saturday 10/16/2021	Sunday 10/17/2021	Monday 10/18/2021	Tuesday 10/19/2021
12:00 AM		22	20	45	18
1:00 AM		21	20	37	20
2:00 AM		18	20	30	19
3:00 AM		15	20	27	18
4:00 AM		19	19	**26**	**23**
5:00 AM		21	21	**30**	**36**
6:00 AM		23	23	**32**	**38**
7:00 AM		**27**	26	**39**	**40**
8:00 AM		**33**	31	**40**	**39**
9:00 AM		**33**	37	**40**	**41**
10:00 AM		**34**	33	**38**	**39**
11:00 AM		**32**	31	**35**	**39**
12:00 PM		**31**	32	**37**	
1:00 PM	**34**	**31**	30	**37**	
2:00 PM	-	**31**	30	**37**	
3:00 PM	**34**	**32**	28	**33**	
4:00 PM	**33**	**32**	30	**32**	
5:00 PM	**31**	**31**	29	**29**	
6:00 PM	31	30	27	24	
7:00 PM	31	32	29	23	
8:00 PM	27	29	32	21	
9:00 PM	24	27	51	22	
10:00 PM	23	24	50	22	
11:00 PM	22	23	46	20	

Note: "-" denotes hours when a complete hour of data was not collected

Figure 8.1 Hourly L_{10} Sound Levels over Measurement Period - Location 1

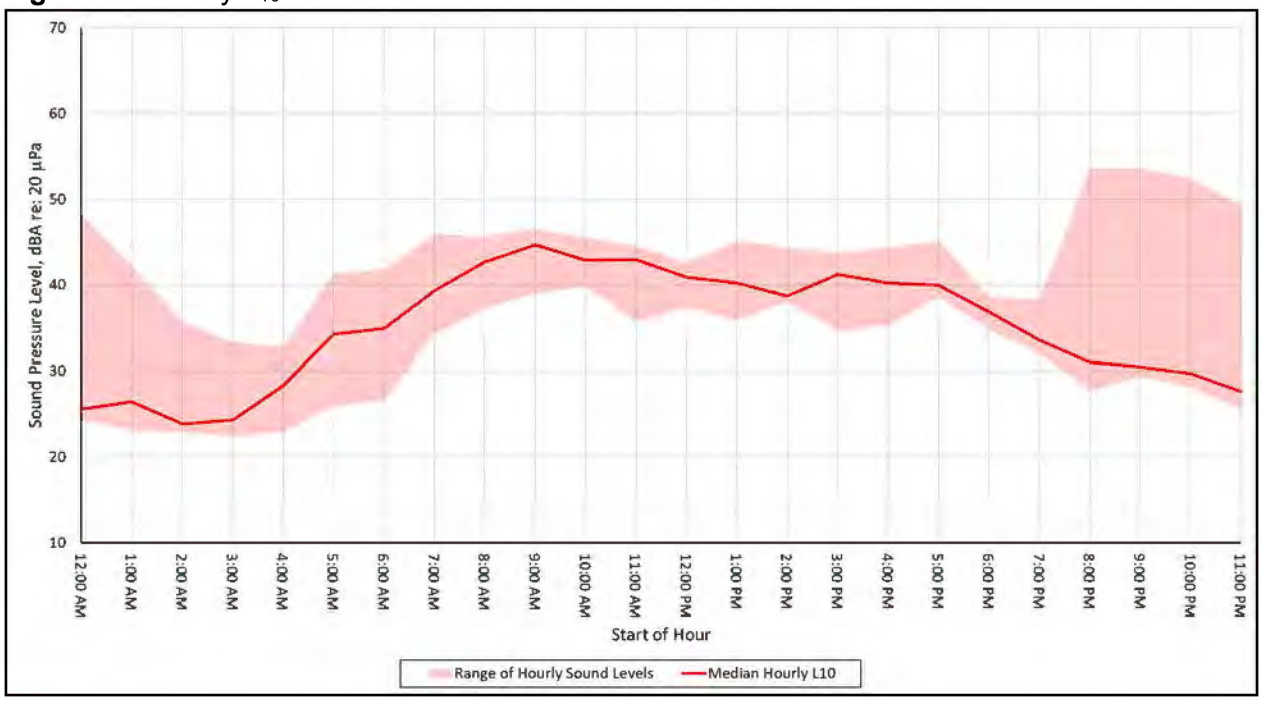
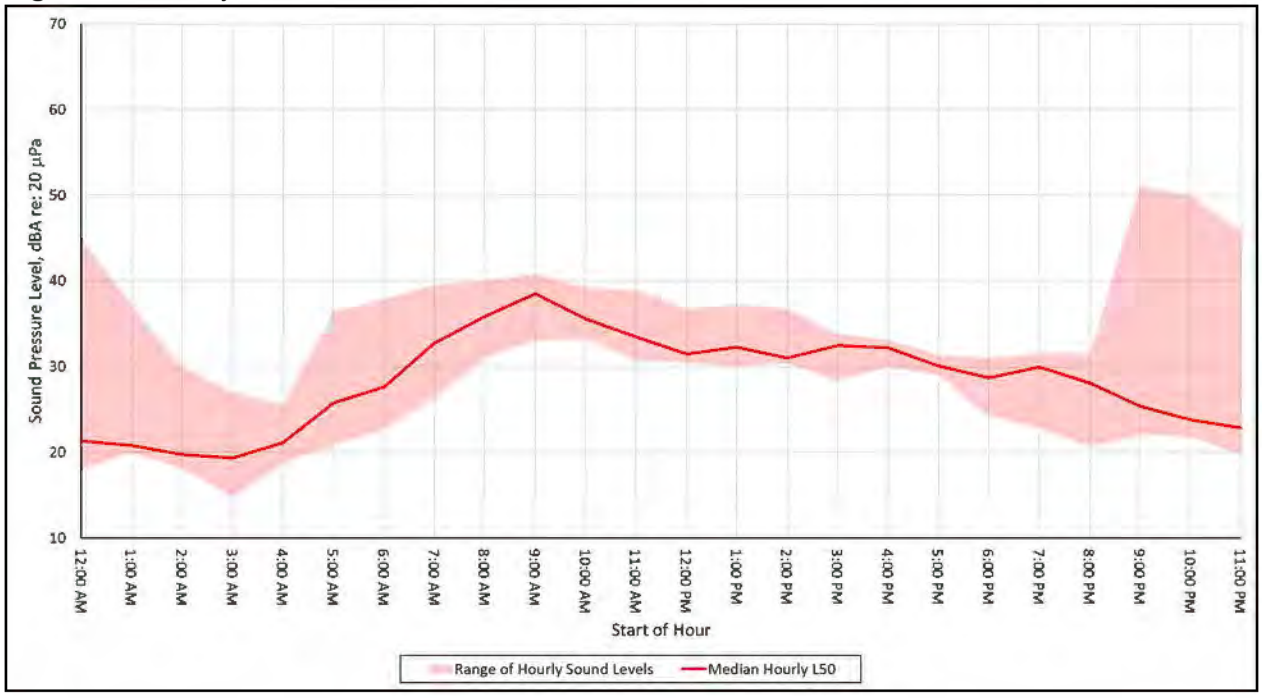


Figure 8.2 Hourly L_{50} Sound Levels over Measurement Period - Location 1



8.2 Location 2 Ambient Sound Levels

Bolded and underlined values shown in Table 8.3 and Table 8.4 represent hours when the landfill was operating.

Table 8.3 Hourly L_{10} Sound Levels - Location 2, dBA

Start of Hour	L_{10}				
	Friday 10/15/2021	Saturday 10/16/2021	Sunday 10/17/2021	Monday 10/18/2021	Tuesday 10/19/2021
12:00 AM		-	30	45	30
1:00 AM		34	30	37	33
2:00 AM		30	28	31	30
3:00 AM		27	30	29	29
4:00 AM		31	28	**31**	**33**
5:00 AM		37	33	**37**	**39**
6:00 AM		-	38	**40**	**41**
7:00 AM		**39**	41	**42**	**42**
8:00 AM		-	42	**42**	**42**
9:00 AM		-	41	**41**	**41**
10:00 AM		**41**	43	**41**	**43**
11:00 AM		-	46	**41**	**43**
12:00 PM		-	47	**41**	
1:00 PM	**44**	**43**	44	**41**	
2:00 PM	-	-	45	**41**	
3:00 PM	**39**	-	43	**43**	
4:00 PM	**40**	**42**	39	**45**	
5:00 PM	**39**	**43**	40	**44**	
6:00 PM	40	40	42	39	
7:00 PM	-	42	38	37	
8:00 PM	38	39	53	35	
9:00 PM	37	37	51	33	
10:00 PM	34	36	49	35	
11:00 PM	33	36	46	31	

Note: "-" denotes hours when a complete hour of data was not collected

Table 8.4 Hourly L_{50} Sound Levels - Location 2, dBA

Start of Hour	L_{50}				
	Friday 10/15/2021	Saturday 10/16/2021	Sunday 10/17/2021	Monday 10/18/2021	Tuesday 10/19/2021
12:00 AM		-	29	43	28
1:00 AM		28	29	35	30
2:00 AM		26	27	29	28
3:00 AM		26	29	27	28
4:00 AM		27	27	**28**	**30**
5:00 AM		29	29	**34**	**36**
6:00 AM		-	35	**38**	**39**
7:00 AM		**33**	38	**40**	**41**
8:00 AM		-	39	**40**	**40**
9:00 AM		-	38	**39**	**39**
10:00 AM		**37**	39	**38**	**41**
11:00 AM		-	43	**37**	**40**
12:00 PM		-	43	**38**	
1:00 PM	**37**	**38**	41	**38**	
2:00 PM	-	-	42	**39**	
3:00 PM	**34**	-	41	**39**	
4:00 PM	**35**	**36**	36	**40**	
5:00 PM	**34**	**35**	37	**40**	
6:00 PM	37	36	39	36	
7:00 PM	-	39	36	35	
8:00 PM	35	36	48	33	
9:00 PM	33	34	50	30	
10:00 PM	30	34	48	31	
11:00 PM	29	32	44	28	

Note: "-" denotes hours when a complete hour of data was not collected

Figure 8.3 Hourly L_{10} Sound Levels over Measurement Period - Location 2

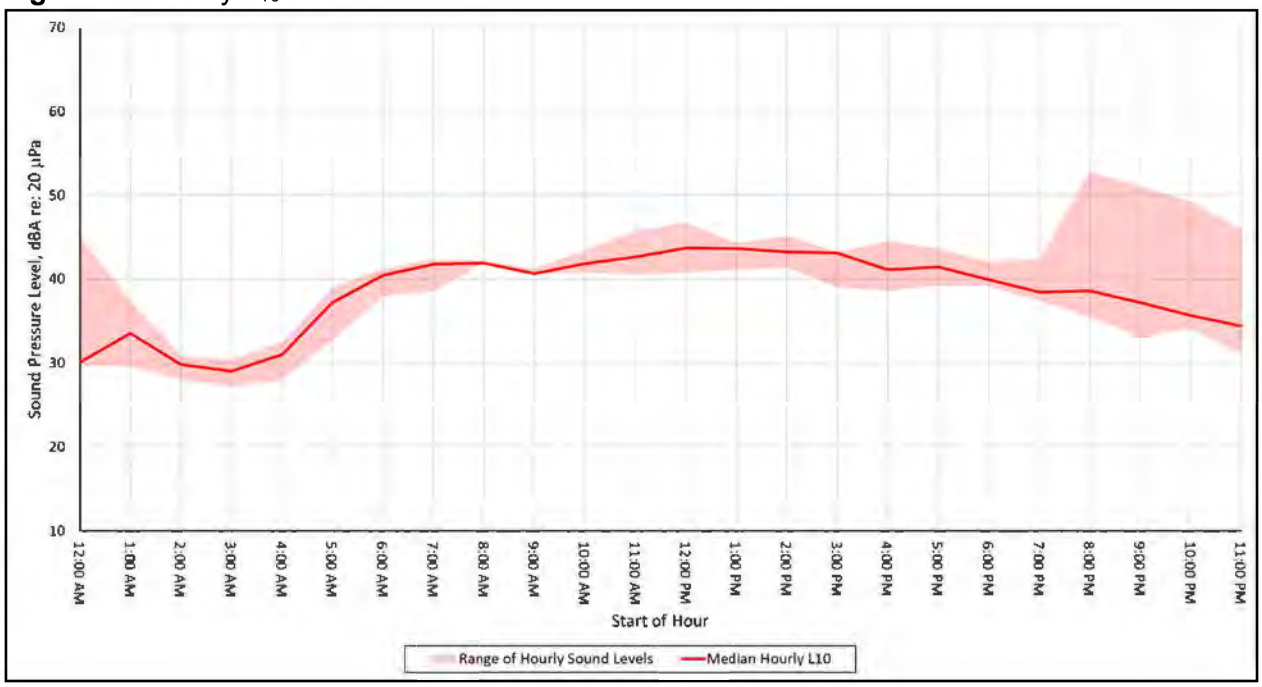
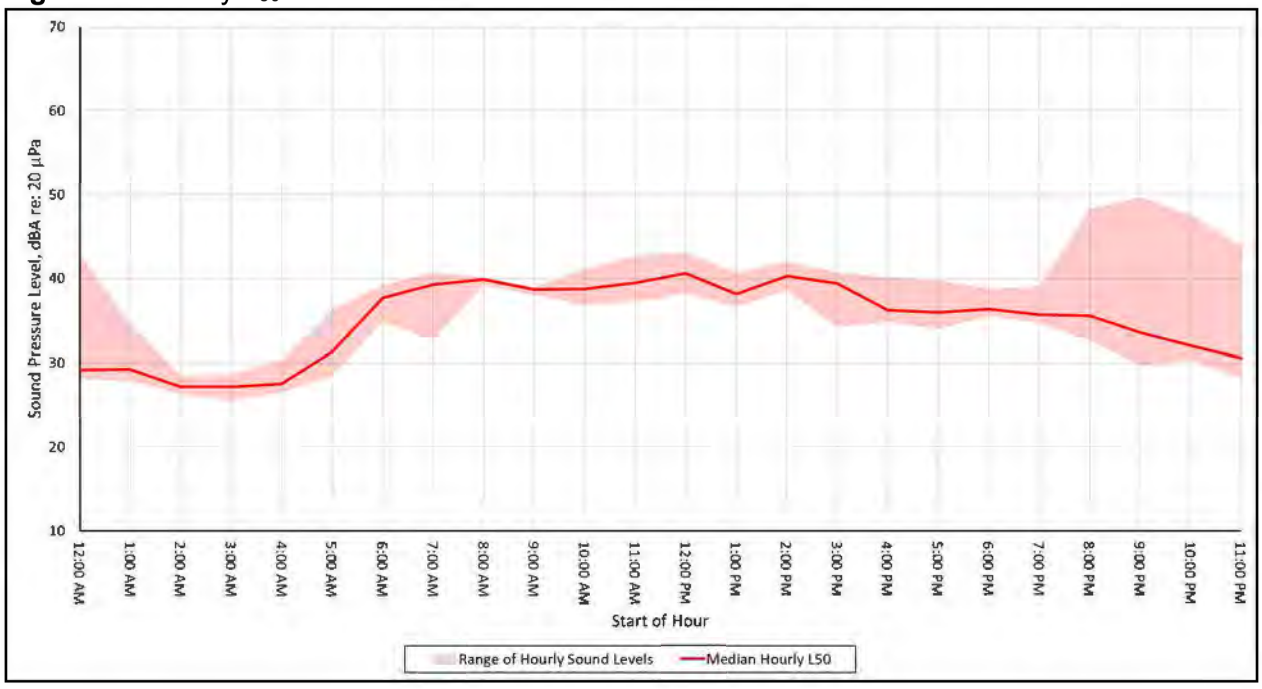


Figure 8.4 Hourly L_{50} Sound Levels over Measurement Period - Location 2



8.3 Location 3 Ambient Sound Levels

Bolded and underlined values shown in Table 8.5 and Table 8.6 represent hours when the landfill was operating.

Table 8.5 Hourly L_{10} Sound Levels - Location 3, dBA

Start of Hour	L_{10}				
	Friday 10/15/2021	Saturday 10/16/2021	Sunday 10/17/2021	Monday 10/18/2021	Tuesday 10/19/2021
12:00 AM		53	50	47	45
1:00 AM		51	48	43	48
2:00 AM		46	43	43	39
3:00 AM		42	38	48	46
4:00 AM		49	46	**53**	**51**
5:00 AM		51	50	**57**	**56**
6:00 AM		55	51	**59**	**58**
7:00 AM		**55**	54	**60**	**59**
8:00 AM		**57**	56	**59**	**58**
9:00 AM		-	56	**60**	**59**
10:00 AM		**59**	57	**60**	**58**
11:00 AM		**59**	58	**59**	
12:00 PM		**59**	58	**59**	
1:00 PM		**59**	58	**58**	
2:00 PM	**60**	**59**	58	**58**	
3:00 PM	**60**	**59**	58	**60**	
4:00 PM	-	**59**	58	**60**	
5:00 PM	**59**	**59**	57	**60**	
6:00 PM	-	57	57	58	
7:00 PM	56	56	56	56	
8:00 PM	-	55	54	55	
9:00 PM	56	53	53	54	
10:00 PM	55	52	51	52	
11:00 PM	52	51	50	49	

Note: "-" denotes hours when a complete hour of data was not collected

Table 8.6 Hourly L_{50} Sound Levels - Location 3, dBA

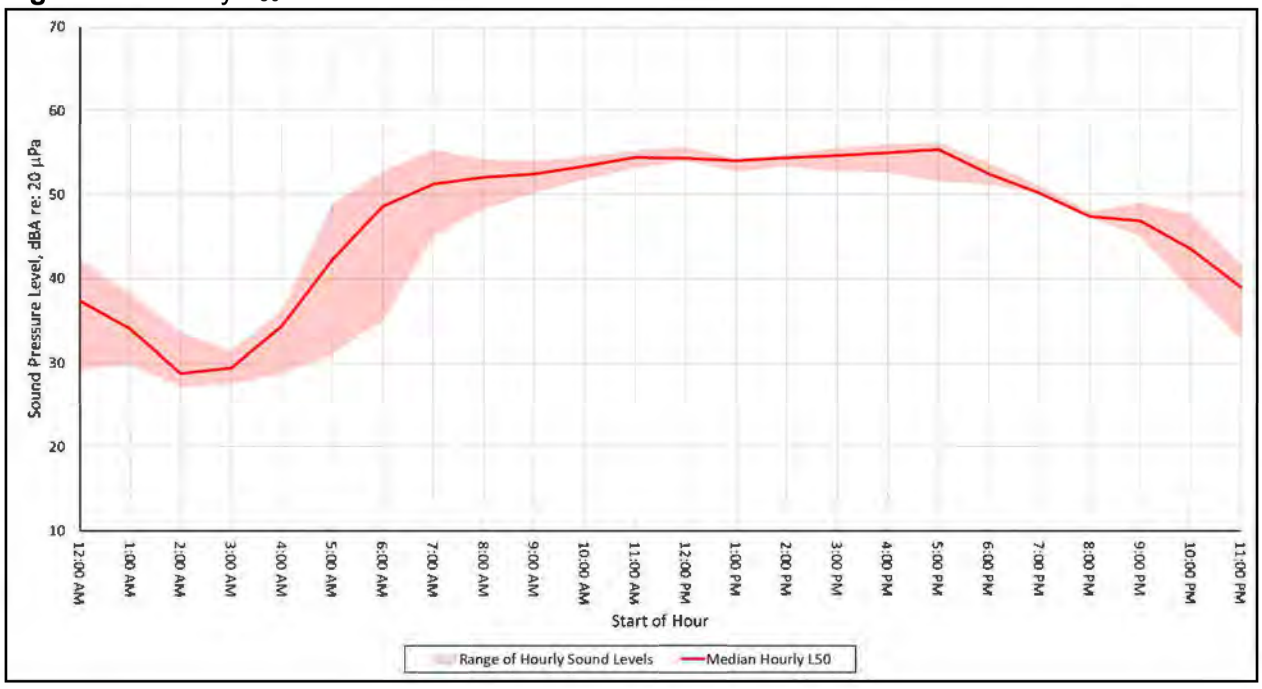
Start of Hour	L_{50}				
	Friday 10/15/2021	Saturday 10/16/2021	Sunday 10/17/2021	Monday 10/18/2021	Tuesday 10/19/2021
12:00 AM		42	34	41	29
1:00 AM		38	30	37	32
2:00 AM		28	27	34	29
3:00 AM		28	28	32	31
4:00 AM		34	29	**35**	**36**
5:00 AM		37	31	**49**	**47**
6:00 AM		46	35	**53**	**52**
7:00 AM		**47**	45	**55**	**55**
8:00 AM		**51**	48	**54**	**53**
9:00 AM		-	50	**54**	**52**
10:00 AM		**54**	52	**54**	**53**
11:00 AM		**55**	53	**54**	
12:00 PM		**56**	54	**54**	
1:00 PM		**54**	54	**53**	
2:00 PM	**55**	**55**	54	**53**	
3:00 PM	**56**	**55**	53	**54**	
4:00 PM	-	**55**	53	**56**	
5:00 PM	**56**	**55**	52	**56**	
6:00 PM	-	52	51	54	
7:00 PM	51	50	50	50	
8:00 PM	-	48	47	47	
9:00 PM	49	45	48	46	
10:00 PM	48	43	44	39	
11:00 PM	36	42	42	33	

Note: "-" denotes hours when a complete hour of data was not collected

Figure 8.5 Hourly L_{10} Sound Levels over Measurement Period - Location 3



Figure 8.6 Hourly L_{50} Sound Levels over Measurement Period - Location 3



8.4 Location 4 Ambient Sound Levels

Bolded and underlined values shown in Table 8.5 and Table 8.6 represent hours when the landfill was operating.

Table 8.7 Hourly L_{10} Sound Levels - Location 4, dBA

Start of Hour	L_{10}									
	Thursday 1/13/2022	Friday 1/14/2022	Saturday 1/15/2022	Sunday 1/16/2022	Monday 1/17/2022	Tuesday 1/18/2022	Wednesday 1/19/2022	Thursday 1/20/2022	Friday 1/21/2022	Saturday 1/22/2022
12:00 AM		44	34	31	27	33	31	45	46	33
1:00 AM		41	36	28	27	36	31	44	43	30
2:00 AM		38	31	30	26	31	27	37	41	32
3:00 AM		38	30	32	27	33	28	35	39	33
4:00 AM		**39**	27	31	**29**	**33**	**37**	**42**	**41**	31
5:00 AM		**45**	27	32	**42**	**44**	**47**	**48**	**47**	29
6:00 AM		**44**	27	31	**46**	**46**	**51**	**46**	**48**	29
7:00 AM		**52**	**33**	33	**50**	**49**	**49**	**52**	**53**	**38**
8:00 AM		**55**	**42**	37	**54**	**51**	**51**	**51**	**54**	**46**
9:00 AM		**55**	**41**	36	**52**	**50**	**53**	**53**		**45**
10:00 AM		**55**	**40**	38	**53**	**48**	**51**	**54**	**53**	**46**
11:00 AM		**52**	**41**	36	**50**	**49**	**52**	**52**	**54**	**45**
12:00 PM		**53**	**42**	40	**50**	**47**	**51**	**52**	**54**	**43**
1:00 PM	**53**	**49**	**39**	38	**50**	**47**	**51**	**53**	**54**	**45**
2:00 PM	**53**	**51**	**42**	38	**50**	**47**	**52**	**52**	**50**	**46**
3:00 PM	**50**	**50**	**40**	39	**49**	**48**	**49**	**53**	**50**	
4:00 PM	**48**	**48**	**41**	39	**45**	**45**	**48**	**50**	**47**	
5:00 PM	**43**	**46**	**39**	39	**43**	**44**	**45**	**47**	**44**	
6:00 PM	44	47	40	36	40	38	39	49	46	
7:00 PM	41	47	40	34	36	30	40	48	43	
8:00 PM	46	45	41	33	32	30	41	48	43	
9:00 PM	43	41	38	32	35	37	41	46	39	
10:00 PM	40	39	35	28	33	28	40	45	35	
11:00 PM	45	37	30	33	37	32	42	45	33	

Note: "-" denotes hours when a complete hour of data was not collected

Table 8.8 Hourly L_{50} Sound Levels - Location 4, dBA

Start of Hour	L_{50}									
	Thursday 1/13/2022	Friday 1/14/2022	Saturday 1/15/2022	Sunday 1/16/2022	Monday 1/17/2022	Tuesday 1/18/2022	Wednesday 1/19/2022	Thursday 1/20/2022	Friday 1/21/2022	Saturday 1/22/2022
12:00 AM		40	30	27	24	26	27	42	42	29
1:00 AM		39	29	25	25	25	26	40	40	27
2:00 AM		34	27	26	24	25	25	35	38	29
3:00 AM		34	25	28	24	25	24	34	35	29
4:00 AM		**34**	24	27	**25**	**27**	**30**	**34**	**37**	28
5:00 AM		**40**	24	27	**34**	**34**	**38**	**43**	**41**	26
6:00 AM		**39**	24	27	**37**	**39**	**46**	**42**	**42**	26
7:00 AM		**44**	**28**	26	**40**	**41**	**41**	**41**	**46**	**30**
8:00 AM		**45**	**33**	28	**42**	**43**	**43**	**42**	**46**	**39**
9:00 AM		**45**	**32**	29	**42**	**42**	**44**	**43**		**38**
10:00 AM		**45**	**31**	30	**44**	**40**	**43**	**44**	**45**	**39**
11:00 AM		**43**	**31**	28	**41**	**41**	**41**	**42**	**45**	**35**
12:00 PM		**43**	**32**	29	**41**	**40**	**42**	**42**	**45**	**34**
1:00 PM	**47**	**40**	**31**	28	**41**	**39**	**42**	**43**	**45**	**37**
2:00 PM	**46**	**43**	**33**	30	**40**	**39**	**42**	**43**	**41**	**35**
3:00 PM	**45**	**41**	**33**	29	**38**	**39**	**41**	**43**	**41**	
4:00 PM	**40**	**36**	**31**	31	**35**	**38**	**37**	**40**	**39**	
5:00 PM	**36**	**38**	**30**	31	**30**	**33**	**34**	**39**	**38**	
6:00 PM	39	43	37	32	31	29	35	46	43	
7:00 PM	37	43	38	30	30	27	37	46	40	
8:00 PM	40	41	38	28	27	27	38	46	40	
9:00 PM	37	37	35	28	26	28	38	44	34	
10:00 PM	37	36	32	25	26	25	37	42	32	
11:00 PM	41	33	27	28	26	27	39	41	29	

Note: "-" denotes hours when a complete hour of data was not collected

Figure 8.7 Hourly L_{10} Sound Levels over Measurement Period - Location 4

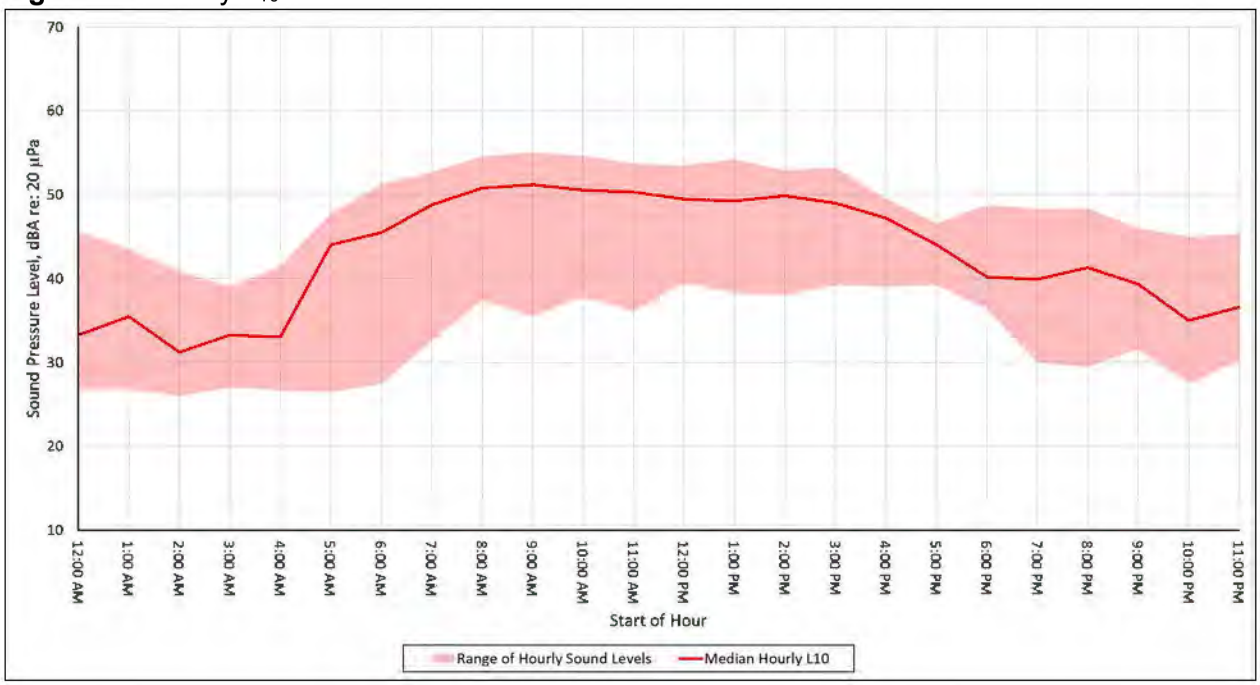


Figure 8.8 Hourly L_{50} Sound Levels over Measurement Period - Location 4

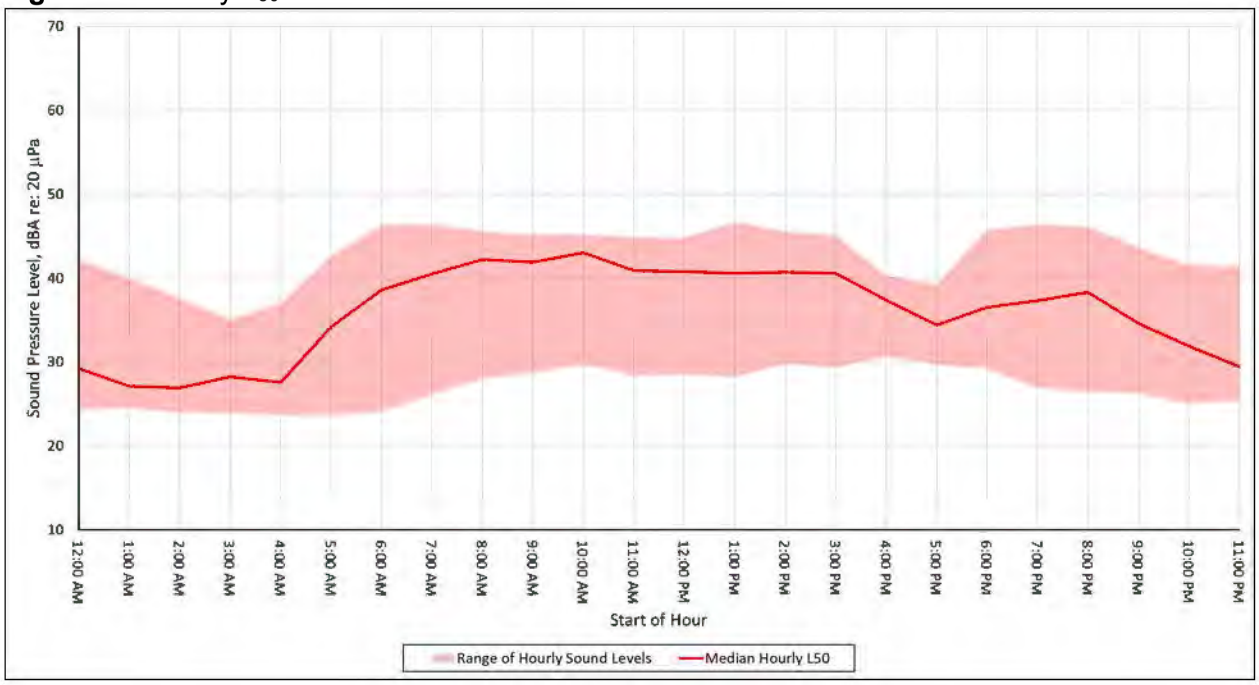


EXHIBIT 12
WEAVER CONSULTING GROUP FINDINGS ON ODOR

Weaver Consultants Group

7340 E. CALEY AVENUE, SUITE 110
CENTENNIAL, COLORADO 80111
PHONE: (720) 529-0132
FAX: (720) 529-0137

MEMORANDUM

To:	Ian Macnab Valley Landfills, Inc.	**Date:**	April 26, 2024
From:	Melissa Green Matt Stutz, P.E. Weaver Consultants Group	**Project No:**	0120-174-50-47-00
Re:	Findings on Odor Coffin Butte Landfill		

On December 7, 2021, the Planning Commission of the Benton County Community Development Department issued findings with respect to the proposed Coffin Butte Landfill (CBLF) Expansion. Valley Landfills, Inc. requested Weaver Consultants Group (WCG) to respond to the Planning Commission findings related to odor as it relates to air quality. WCG provides professional services to the solid waste industry across the nation, including the pacific northwest. WCG provides regulatory permitting and regulatory compliance services specific to air quality regulations at CBLF. CBLF is regulated under the US Environmental Protection Agency (USEPA) and the Oregon Department of Environmental Quality (ODEQ) and operates under an air quality permit issued by ODEQ. The purpose of this memorandum is to respond to the findings related to odor. WCG has provided the specific finding in ***italic bold*** font followed by WCG's response.

Planning Commission Findings:

Odor: Methane emission rules do not capture the impacts to the character and use of the area because many people testified that the smell inhibits them from going outside and enjoying the use of their property. Property owners within miles of the site stated they could smell the landfill. The current mitigation of an earthen cap over cells does not mitigate smell and smell reflects emissions of other gases such as Volatile Organic Compounds (VOCs) and hydrogen sulfide. The same mitigation is proposed for the expansion and if it currently does not mitigate the odor then it cannot be used as a mitigation for the future and be expected to minimize the concern.

Weaver Consultants Group offers the following to address landfill odors in general as well as providing site-specific data and information for CBLF, which documents metrics and submittals provided to the ODEQ.

Landfilling of solid waste is a generally accepted practice in the US. The practice is such that as waste is received at CBLF, it is immediately placed in the active area of the landfill. A landfill in total may have an area of 100 acres or more in overall size, but the area where the waste is placed

on a given day is much smaller. For CBLF, this day-to-day active area is less than ½-acre. Through the daily landfilling process, odors can be present in the active area and are similar to the odors of waste disposed of from residential households. To manage this, a 6-inch layer of soil or alternative daily cover (ADC) is spread at the end of each day over the top of the ½-acre active area. Typically, the active areas do not change in size with an expansion; rather, the active area will move depending on the operational need of the landfill. Therefore, the expansion should not increase the odor impacts of the active area as compared to the existing operation.

The reference to the use of "earthen cap over cells", also known as daily and intermediate soil cover, to mitigate odors has been proven in all climatic regions to be an effective means in mitigating odor. This 6-inch soil layer is found in the USEPA regulations, the ODEQ regulations, and is also referenced in the Solid Waste Association of North America (SWANA) Technical Policies Manual. SWANA is a non-profit organization who utilizes experts across North America to develop best practices for landfills. Additional information will be provided surrounding this soil cover layer later in this document.

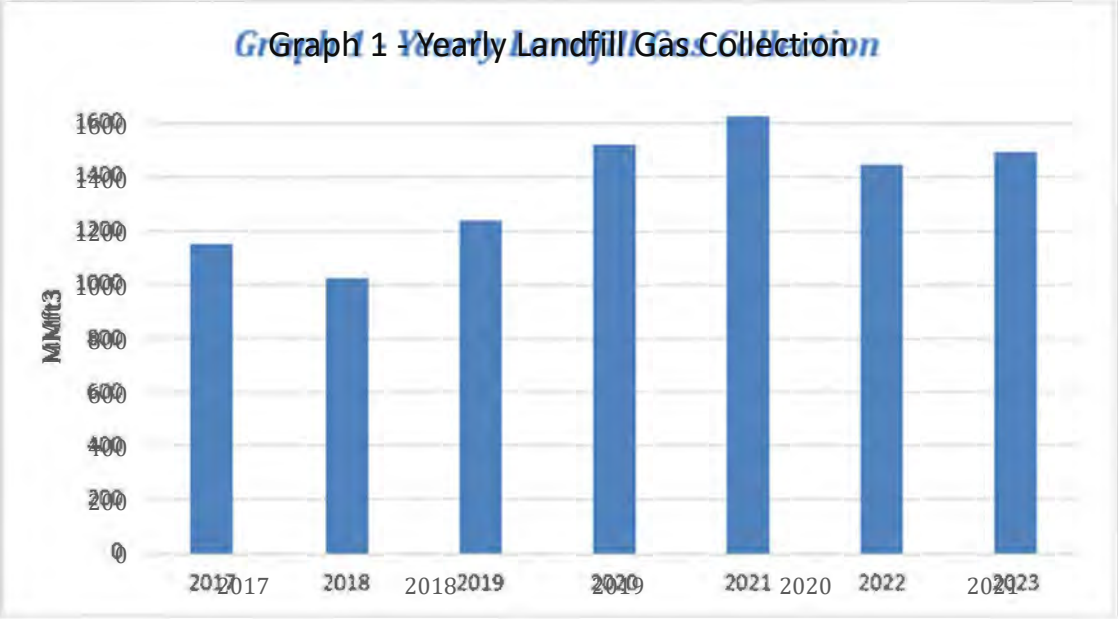
Landfill Gas Collection and Control

CBLF actively extracts landfill gas (LFG) out of the landfill in an effort to assist in controlling the mitigation of LFG. The following sections outline site-specific data related to this in addition to other odor control measures used at the landfill.

Over time, the waste placed in a landfill begins to decompose. One of the bi-products of this decomposition is a biogas referred to as LFG. LFG gas is generally considered to be 50% methane and 50% carbon dioxide. However, there are some trace compounds like hydrogen sulfide and VOCs generated within the landfill. To collect the LFG, the CBLF has a landfill gas collection and control system (GCCS). The GCCS is the main component and in conjunction with daily and intermediate soil cover is used for mitigating the potential odors. The installation of the GCCS is regulated by both the USEPA and the ODEQ. As outlined in the landfill expansion, the GCCS will continue to be used and expanded with the landfill.

Oregon currently has one of the most stringent landfill emissions standards in the United States. The current GCCS at the site includes over 350 collection points. Under the USEPA and ODEQ air regulations, landfills are required to install LFG extraction wells where waste is in place more than 5 years. However, CBLF installs LFG extraction wells every year typically in waste that is at most 1 year old to minimize off-site odors.

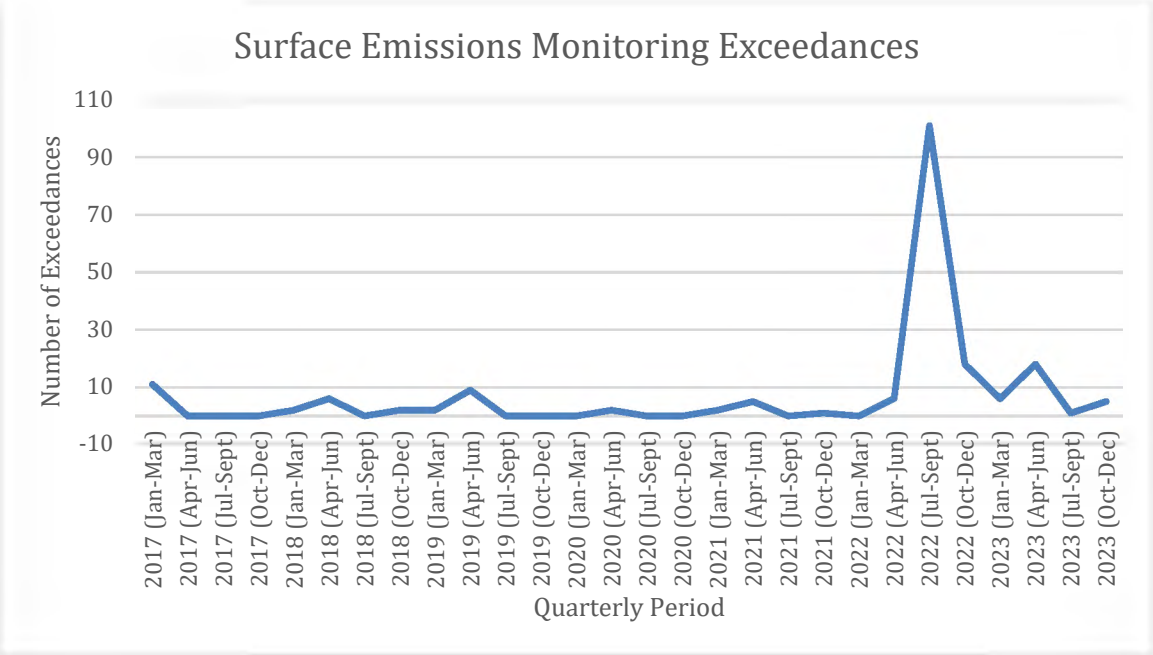
In an effort to understand the impact of the GCCS collection system on the landfill, WCG reviewed the LFG collection rates to look for trends. The following graph shows annual collected LFG.



As depicted in the graph, the gas collection has increased from 2018 to 2021. In 2022 the gas collection slightly decreased but then increased in 2023. These slight variances in gas collection are to be expected as gas generation and gas collection are dependent on several variables that include environmental and biological conditions.

Surface Emission Monitoring

To document the performance of the GCCS efficiency, CBLF has a comprehensive surface emissions monitoring (SEM) program. This SEM program consists of walking the surface of the landfill each quarter with a handheld meter which is held 2-4 inches from the landfill's surface. The meter continuously samples the air from the landfill surface to determine areas where LFG might be emitted. Should LFG be detected at 500 parts per million (ppm) methane above background, corrective action is taken, and the area is repaired and re-monitored. This method allows verification of how well CBLF is collecting and controlling LFG and reducing the potential of off-site odors. A review of the SEM data for CBLF shows that there have been very few instances where LFG was detected coming from the landfill's surface. The following graph provides data for each quarter since 2017 with the associated number of exceedances that occurred during the SEM. In the third quarter of 2022, the landfill commenced compiling with the new Oregon Administrative Rule Chapter 340 Division 239 for Landfill Gas Emissions that implemented new SEM requirements such as integrated monitoring. CBLF implemented corrective action on the exceedance locations and the quarterly exceedances have decreased in the SEM events since third quarter 2022.



Soil Cover

As mentioned previously, the landfill soil cover acts as a filter for LFG that are not collected by the GCCS. The portion of uncollected gas must first pass through the landfill's cover soils before being emitted. As it passes through these cover soils, the gases are reduced by oxidative and biological processes. Numerous studies have shown that a significant portion of the hydrogen sulfide (H_2S) in the uncollected gas is converted to sulfide minerals within the cover soils and therefore not released. [1]

USEPA has recognized the effects of methane oxidation in determining LFG emissions and has incorporated cover soil oxidation into calculations. These USEPA regulations recognize that up to 35% of methane in LFG that reaches the soil may be oxidized and therefore not emitted. A review of the soil cover logs for the facility indicate that soil covers or ADCs have been in continual use at the site.

[1] Cristine Plaza, Qiyong Xu, Timothy Townsend, Gabriel Bitton, Matthew Booth, *Evaluation of alternative landfill cover soils for attenuating hydrogen sulfide from construction and demolition (C&D) debris landfills*, Journal of Environmental Management, Volume 84, Issue 3(2007).

Y. Ding, Chaun Yu Cai, J. Xiong, A. Qian, J. Wei, B. Hu, W. Wu, Z. Han, H. Zhang, W. Ni, *Evaluation of Alternative Cover Materials for Reducing Hydrogen Sulfide Emission from Municipal Solid Waste (MSW) Landfills*, Transactions of the ASABE. 59. 949-957. 10.13031/trans.59.11711 (2016).

Ruo He , Fang-Fang Xia, Yun Bai, Jing Wang, Dong-Sheng Shen, *Mechanism of H2S removal during landfill stabilization in waste biocover soil, an alternative landfill cover*, Journal of Hazardous Materials, 217–218:67–75 (March 2012).

As an added measure, CBLF incorporates the use of a plastic liner over the top of various landfill areas which are not in use. The plastic liner provides an added measure of barrier against potential migrating odors.

CBLF has installed final cover in addition to the soil cover on nearly 40% of the landfill surface to assist in reducing off-site odors. Final cover is a multilayered system of various materials which are primarily used to reduce the amount of stormwater that will enter a landfill after closing and control the migrations of LFGs. Landfills are not required to install final cover until the landfill is no longer accepting waste. However, CBLF has installed final cover well before it is required regulatorily.

Site Odor Monitoring

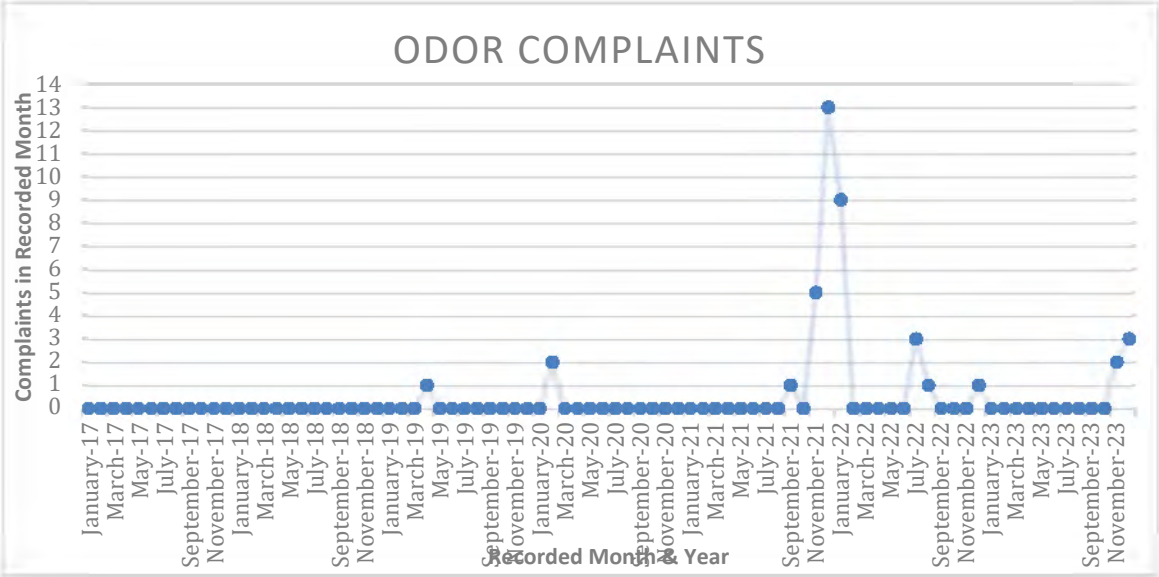
The site performs daily odor monitoring. This monitoring includes driving a loop starting at the office, travel west to Tampico, and then north of Coffin Butte Landfill, south on Highway 99, and then back to the site on Tampico. Landfill leaders complete an online Odor Management Training course and site employees complete annual training on odor monitoring. CBLF maintains a site-specific odor management plan that is updated annually or as needed. The plan includes, but is not limited to, information such as actions to take when odors are detected, identifying sources of odor, and methods for controlling odors at the site. A routine odor inspection is completed during every odor patrol. The inspections include, but are not limited to, information such as local weather data (temperature, wind direction, etc.), if any odors were detected, and odor details (such as location, type, distance from facility, possible sources, etc.). Complaints are documented and are investigated as soon as reasonably possible. Complaints and inspections are reviewed monthly by the Environmental Compliance Team.

In addition, the site also tracks and reports odor complaints it receives monthly. The following is a review of the odor complaints received at the site over time.

The following graph incorporates two sets of data:

1. Complaints received at the local level;
2. Complaints received at ODEQ.

One variable the graph does not show is the timing of the complaints.



Conclusion

Based on the review of the information above, CBLF's compliance with USEPA and ODEQ regulations, the implementation of industry best practices, and the data provided indicates that there has not been a significant impact to human health and environment related to LFGs or odors. An evaluation of key landfill control measures and data points do not indicate a widespread release of LFG or odors. The CBLF trends indicate the following:

- There was an increase in total gas collected from 2022 to 2023.
- Besides the spike that occurred in third quarter 2022 which appears to be related to the implementation of new SEM requirements, the surface emission exceedances are consistently low.
- The number of odor complaints from January 2017 until September 2021 was four, while there were 27 complaints from November 2021 until January 2022 which appear to be related to the public comment of the proposed landfill expansion From February 2022 through December 2023, the odor complaints once again ranged from 0 to 3 per month.
- The on-site data and the offsite data suggest that CBLF works to aggressively and actively implement measures to control potential off-site odors to the community.

EXHIBIT 13
NOVEMBER 19, 2021 MEMORANDUM FROM IAN MACNAB REGARDING ODOR, METHANE AND HYDROGEN SULFIDE

Date: November 19, 2021

To: Benton County Planning Department
From: Ian Macnab, Environmental Manager, Coffin Butte Landfill

Re: Coffin Butte Landfill Conditional Use Permit Application LU-21-047 – Odor, Methane and Hydrogen Sulfide

The purpose of this memorandum is to provide additional information on how odor, methane and hydrogen sulfide are controlled at Coffin Butte Landfill. These three items are highly interconnected and to a large degree act as one. They are all different constituents of landfill gas and are primarily regulated by the site's Title V air permit. See attachment A for a copy of the permit.

Beginning at Table 1, the permit lists the emissions units that are regulated at the landfill. Nuisance conditions, including odors or offsite dust, are regulated on page 5 of the permit.

Table 3 conditions 13.4 – 13.12 and 13.24 are all requirements to ensure landfill gas (methane) is collected and odors (hydrogen sulfide) reduced. It includes requirements for:

- Recordkeeping
- Installing a gas collection system sufficient for calculated gas flow rates
- Operation of the collection system
- Operation of the flare to destroy gas not utilized by the power plant

For each permit condition the table also references the appropriate federal regulations (40 CFR 60.75X) the landfill is subject to.

Beginning on the bottom of page 15 and continuing through page 19 the permit describes the Plant Site Emission Limits (PSELs). PSELs regulate how much can be emitted, how emissions are calculated and how emissions are monitored. Hydrogen sulfide is included with other sulfur compounds in the SO_2 category.

Finally, starting on page 20, the permit lists reporting requirements to DEQ and EPA. The expansion area would have all the same air permit requirements and limitations.

Additionally, regarding hydrogen sulfide, we have laboratory data from 2019 showing very low to non-detect levels of this compound in Coffin Butte's landfill gas. See attachment B for the laboratory report. The three samples taken directly from our gas collection system infrastructure measured:

- Sample 1 – 8.6 ppmv
- Sample 2 – non-detect
- Sample 3 – non-detect

As reference, EPA AP-42 Compilation of Air Pollutant Emission Factors, which is used for calculating landfill hydrogen sulfide emissions for Title V air permits uses an assumed value of 36 ppmv. Our emissions were well below this assumed value. Additionally, these samples were taken directly from the landfill gas pipeline. Actual emissions to the air from the surface of the landfill will be much lower as they would be highly diluted by ambient air.

As far as reduction in odors from the use of cover, that is addressed in our DEQ solid waste permit. See attachment C. The permit references that the permit is in accordance with ORS 459 and OAR Chapter 340.

Section 9.5 address daily cover and states:
"At the end of each working day the permittee must cover all solid waste with a six inch, or thicker, layer of compacted soil or DEQ-approved, alternative daily cover."

Section 9.6 addresses interim cover section and states:
"As specified in the DEQ-approved design and operation plans, the permittee must place and maintain interim cover over fill areas that will not receive additional waste for an extended period of time [i.e., greater than 120 days] and actively revegetate, in a DEQ-approved manner, any interim cover that will remain exposed for more than two years."

Coffin Butte is subject to regular DEQ inspections of the site and our compliance with permit conditions 9.5 and 9.6 are shown by our inspection

results. We have not been issued a violation for failure to properly cover with daily or intermediate cover.

Landfills are highly regulated by state and federal agencies. We submit reports on a monthly, quarterly, semi-annually, and annual basis depending on the permit requirements. Copies of these reports are provided to Benton County on a quarterly basis for their review.

Attachments:
A – Coffin Butte DEQ Title V Permit
B – 2019 Hydrogen Sulfide Test Report
C – Coffin Butte DEQ Solid Waste Permit

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
OREGON TITLE V OPERATING PERMIT

Western Region-Salem Office
750 Front Street NE, Suite 120
Salem, OR 97301-1039
Telephone (503) 378-8240

Issued in accordance with the provisions of ORS 468A.040
and based on the land use compatibility findings included in the permit record.

ISSUED TO:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

INFORMATION RELIED UPON:

Application Number: 23594
Received: 01/30/09

PLANT SITE LOCATION:

Coffin Butte Landfill
Highway 99 & Coffin Butte Road
Corvallis, OR 97330

LAND USE COMPATIBILITY STATEMENT:

Issued by: Benton County
Dated: 03/06/97

ISSUED BY THE DEPARTEMENT OF ENVIRONMENTAL QUALITY

Claudia Davis

Claudia Davis, Western Region Air Quality Manager

OCT 3 0 2009

Date

Nature of Business: Municipal Solid Waste Landfill

SIC: 4953

RESPONSIBLE OFFICIAL

Title: General Manager
Alternate: Vice President

FACILITY CONTACT PERSON

Name: Brian May
Title: General Manager
Phone: (541) 745-2018

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LIST OF ABBREVIATIONS THAT MAY BE USED IN THIS PERMIT

ACDP	Air Contaminant Discharge Permit	NA	Not applicable
Act	Federal Clean Air Act	NESHAP	National Emission Standard for Hazardous Air Pollutants
ASTM	American Society of Testing and Materials	NMOC	Nonmethane organic compounds
Btu	British thermal unit	NO_x	Nitrogen oxides
CFR	Code of Federal Regulations	NSPS	New Source Performance Standards
CO	Carbon monoxide		
CPMS	Continuous parameter monitoring system	O_2	Oxygen
		OAR	Oregon Administrative Rules
DEQ	Department of Environmental Quality	ODEQ	Oregon Department of Environmental Quality
dscf	Dry standard cubic feet	ORS	Oregon Revised Statutes
EF	Emission factor	O&M	Operation and maintenance
EPA	US Environmental Protection Agency	Pb	Lead
		PCD	Pollution control device
EU	Emissions unit	PM	Particulate matter
FCAA	Federal Clean Air Act	PM_{10}	Particulate matter less than 10 microns in size
FSA	Fuel sampling and analysis		
gr/dscf	Grain per dry standard cubic feet (1 pound = 7000 grains)	ppm	Parts per million
		PSEL	Plant Site Emission Limit
HAP	Hazardous Air Pollutant as defined by OAR 340-244-0040	SIP	State Implementation Plan
		SO_2	Sulfur dioxide
HCFC	Halogenated Chloro-Fluoro-Carbons	SSM	Startup, shutdown, malfunction
		ST	Source test
H_2S	Hydrogen sulfide	VE	Visible emissions
ID	Identification number or label	VMT	Vehicle miles traveled
I&M	Inspection and maintenance	VOC	Volatile organic compounds
LFG	Landfill gas		

Modified EPA Method 9: As used in this permit "Modified EPA Method 9" is defined as follows:

Opacity must be measured in accordance with EPA Method 9. For all standards, the minimum observation period must be six minutes, though longer periods may be required by a specific rule or permit condition. Aggregate times (e.g., 3 minutes in any one hour) consist of the total duration of all readings during the observation period that are equal to or greater than the opacity percentage in the standard, whether or not the readings are consecutive. Each EPA Method 9 reading represents 15 seconds of time. [See also the definition of "Opacity" in OAR 340-208-0010]

PERMITTED ACTIVITIES

1. Until such time as this permit expires or is modified or revoked, the permittee is allowed to discharge air contaminants from those processes and activities directly related to or associated with air contaminant source(s) in accordance with the requirements, limitations, and conditions of this permit. [OAR 340-218-0010 and 340-218-0120(2)]

2. All conditions in this permit are federally enforceable except as specified below:

   2.a. Conditions 6 through 12, G5, and G9 (OAR 340-248-0005 through 0180) are only enforceable by the state. [OAR 340-218-0060]

EMISSIONS UNIT (EU) AND POLLUTION CONTROL DEVICE (PCD) IDENTIFICATION

3. The emissions units regulated by this permit are the following [OAR 340-218-0040(3)]:

Table 1. EU and PCD IDENTIFICATION

Emission Unit Description	EU ID	Pollution Control Device Description	PCD ID
Landfill Gas Control System	Control	Open Flare	FL
Fugitive Landfill Gas, Cell 0	F-LFG1	None	NA
Fugitive Landfill Gas, Cells 1 to 4	F-LFG2	Landfill gas collection and extraction system	LFGCES-1
Vehicle traffic on paved roads	PIR	Water application	NA
Vehicle traffic on unpaved roads	UPR	Chemical suppressant and water application	NA
Tipper	TIP	None	NA
Petroleum contaminated soils	PCS	None	NA
Aggregate Insignificant activities:	AI		
Cell development, operation, and closing		None	NA
Wastewater treatment system operation		Baghouse	DC-1
Leachate collection and wastewater treatment		None	NA
Portable light plant		None	NA
Trash pumps		None	NA
Generator		None	NA

EMISSION LIMITS AND STANDARDS, TESTING, MONITORING, AND RECORDKEEPING REQUIREMENTS

The following tables and conditions contain the applicable requirements along with the testing, monitoring, and recordkeeping requirements for the emissions units to which those requirements apply.

Facility-wide Requirements

Table 2. Facility wide emission limits and standards

Applicable Requirement	Condition Number	Pollutant/ Parameter	Limit/Standard	Averaging Time	Testing Condition	Monitoring Condition
340-208-0210(2)	4	Fugitive emissions	Minimize	NA	NA	5
340-208-0300	6	Air contaminants	No nuisance	NA	NA	8
340-208-0450	7	PM >250μ	No fallout	NA	NA	8
340-248-0280(10)	9	Asbestos disposal	Handling procedures	Recordkeeping	NA	10
340-248-0280(11)	11	Asbestos cover	Maintain cover	Recordkeeping	NA	12

Fugitive Emissions

4. Applicable Requirement: The permittee must not allow or permit any materials to be handled, transported, or stored; or a building, its appurtenances, or a road to be used, constructed, altered, repaired, or demolished; or any equipment to be operated, without taking reasonable precautions to prevent particulate matter from becoming airborne. Such reasonable precautions must include, but not be limited to the following: [OAR 340-208-0210(2)]

   4.a. use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land;
   4.b. application of asphalt, oil, water, or other suitable chemicals on unpaved roads, materials stockpiles, and other surfaces which can create airborne dusts;
   4.c. full or partial enclosure of materials stockpiles in cases where application of oil, water, or chemicals are not sufficient to prevent particulate matter from becoming airborne;
   4.d. installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials;
   4.e. adequate containment during sandblasting or other similar operations; and,
   4.f. covering, at all times when in motion, open bodied trucks transporting materials likely to become airborne.

5. Monitoring Requirement: At least once each week for a minimum period of 30 minutes, the permittee must visually survey the plant for any sources of excess fugitive emissions using EPA Method 22. For the purpose of this survey, excess fugitive emissions are considered to be any visible emissions generated by fugitive sources that leave the plant site boundaries. The person conducting the observation does not have to be EPA Method 9 certified. However, the individual should be familiar with the procedures of EPA Method 9, including using the proper location to observe visible emissions. If sources of visible emissions are identified, the permittee must: [OAR 340-218-0050(3)(a)]

   5.a. immediately take corrective action to minimize the fugitive emissions, including but not limited to those actions identified in Condition 4; or,
   5.b. conduct a Modified EPA Method 9 test within 24 hours;
   5.c. Recordkeeping: The permittee must maintain records of the fugitive emissions surveys, corrective actions (if necessary), and/or the results of any modified EPA Method 9 tests.

Nuisance Conditions

6. Applicable Requirement: The permittee must not cause or allow air contaminants from any source to cause a nuisance. Nuisance conditions will be verified by Department personnel. [OAR 340-208-0300] This condition is enforceable only by the State.

7. Applicable Requirement: The permittee must not cause or permit the emission of any particulate matter larger than 250 microns in size at sufficient duration or quantity, as to create an observable deposition upon the real property of another person. The Department will verify that the deposition exists and will notify the permittee that the deposition must be controlled. [OAR 340-208-0450] This condition is enforceable only by the State.

8. Monitoring Requirement: The permittee must maintain a log of each air quality complaint received by the permittee during the operation of the facility and must provide the Western Region-Salem Office of the Department with written notification within 5 days of all nuisance complaints regarding fugitive dust, odors, or particulate deposition received. Documentation shall include date of contact, time of observed nuisance condition, description of nuisance condition, location of receptor, status of plant operation during the observed period, and time of response to complainant. A plant representative must immediately investigate the condition following the receipt of the nuisance complaint and a plant representative must provide a response to the complainant within 24 hours, if possible. This condition is only enforceable by the State. [OAR 340-218-0050(3)(a)]

Asbestos Disposal and Cover

9. Applicable Requirement: The permittee must meet the asbestos-containing material handling and disposal requirements and procedures specified in OAR 340-248-0280(10) for active waste disposal sites. This condition is only enforceable by the state.

10. Monitoring Requirement: The permittee must monitor the asbestos-containing material handling and disposal procedures, provide notifications, and record the information required as specified in OAR 340-248-0280(10) for active waste disposal sites. This condition is only enforceable by the State.

11. Applicable Requirement: The permittee must meet the asbestos-containing material disposal and cover standards specified in OAR 340-248-0280(11) for inactive waste disposal sites. This condition is only enforceable by the State.

12. Monitoring Requirement: The permittee must monitor the asbestos-containing disposal and cover requirements and provide notifications as specified in OAR 340-248-0280(11) for inactive waste disposal sites. This condition is only enforceable by the State.

Facility Wide Requirements

13. The following requirements apply facility wide, including, but not limited to, the solid municipal waste landfill, unless an alternate requirement is specifically stated for a particular emissions unit.

Table 3. Summary of NSPS and NESHAP requirements:

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.1	40 CFR 60.7(a)(4); 40 CFR 60.7(b); 40 CFR 60.7(f)	Notification and recordkeeping.	Maintain records of the occurrence and duration of any startup, shutdown, or malfunction in the operation of the affected facility. Maintain a file of all measurements and performance testing measurements and all other information required by this part recorded in a permanent form suitable for inspection.	Permittee shall furnish prior written or e-mail notification of any physical or operational change which may increase the emission rate of any air pollutant (such as taking operating gas collection wells off line) to which a standard applies to: ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 [40 CFR 60.4(a)]
13.2	40 CFR 60.11(d)	Maintain and operate any affected emission unit with good air pollution control practice for minimizing emissions.	None specified.	No additional monitoring required.
13.3	40 CFR 60.12	Circumvention.	None specified.	No additional monitoring required.
13.4	40 CFR 60.752(b)(2)(ii)(A); 40 CFR 60.753(a); 40 CFR 60.755(b) (Landfill NSPS Subpart WWW)	Install, within 60 days, and operate active collection system wells that collect gas from each area, cell, or group of cells in the landfill in which solid waste has been placed for: (1) 5 years or more if active, OR (2) 2 years or more if closed or at final grade.	None specified.	No additional monitoring required.

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.5	40 CFR 60.752(b)(2)(ii)(A) (Landfill NSPS Subpart WWW)	Install an active collection system that is designed to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control over the intended use period of the gas control or treatment system equipment.	To calculate maximum expected gas flow rate: $Q_m = \sum_{i=1}^{n} 2kL_oM_i\left(e^{-kt_i}\right)$ where, Q_m=maximum expected gas generation flow rate, m^3/yr k=methane generation rate constant, $year^{-1}$ L_o=methane generation potential, m^3/Mg solid waste M_i=mass of solid waste in the i^{th} section, Mg t_i=age of the i^{th} section, years [40 CFR 60.755(a)(1)(ii)]	Submit monthly report to: ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 Monthly report shall include the date of installation and the location of each well or collection system expansion added. [40 CFR 60.757(f)]
13.6	40 CFR 60.752(b); 40 CFR 60.754(a); 40 CFR 60.757(b); 40 CFR 60.4(a) (Landfill NSPS Subpart WWW)	Calculate the NMOC emission rate for the landfill. If the calculated NMOC emission rate is less than 50 Mg/yr, the permittee shall recalculate the NMOC emission rate and submit emission reports to the Department until such time as the calculated NMOC emission rate is ≥ 50 Mg/yr, or the landfill is closed.	Calculate the NMOC emission rate: $M_{NMOC} = \sum_{i=1}^{n} 2kL_oM_i(e^{-kti})(C_{NMOC})(3.6x10^{-9})$ where, M_{NMOC}=Total NMOC emission rate from the landfill (Mg/yr) k=methane generation rate constant=0.05 yr^{-1} or as determined using Tier 3 per 40 CFR 60.754 (a)(4) L_o=methane generation potential=170 m^3/Mg solid waste M_i=mass of solid waste in the i^{th} section (Mg) t_i=age of the i^{th} section (yr) C_{NMOC}=4000 ppm per 40 CFR 60.754(a)(3) $3.6x10^{-9}$=conversion factor The mass of the nondegradable solid waste may be subtracted from the total mass of solid waste in a particular section of the landfill when calculating the value for M_i if properly documented. [40 CFR 60.754(a)(1)(i)]	The permittee shall submit an NMOC emission rate report to: ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 (1) annually, OR (2) if the estimated NMOC emission rate as reported in the annual report is less than 50 Mg/yr in each of the next 5 consecutive years, the permittee may elect to submit an estimate of the NMOC emission rate for the next 5-year period in lieu of the annual report. If option (2) is chosen, this estimate shall be revised at least once every 5 years. If the actual waste acceptance rate exceeds the estimated waste acceptance rate in any year reported in the 5-year estimate, a revised 5-year estimate shall be submitted to ODEQ at the address given above. The revised estimate shall cover the 5-year period beginning with the year in which the actual waste acceptance rate exceeded the estimated waste acceptance rate. The NMOC emission rate report shall include the current amount of solid waste-in-place and the estimated waste acceptance rate for each year of the 5 years for which an NMOC emission rate is estimated. The NMOC emission rate report shall include all the data, calculations, sample reports and measurements used to estimate the annual or 5-year emissions. ODEQ may request such additional information as may be necessary to verify the reported NMOC emission rate. [40 CFR 60.4(a); 40 CFR 60.757(b)]
13.7	40 CFR 60.752(b)(2)(ii)(A); 40 CFR 60.759(a); 40 CFR 60.759(b) (Landfill NSPS Subpart WWW)	Install an activc collection system that is designed to collect gas at a sufficient extraction rate, sited at a sufficient density throughout all gas producing areas, and designed to minimize off-site migration of subsurface gas.	Nonc specified.	Keep for the life of the collection system an up-to-date, readily accessible plot map showing each existing and planned collector in the system and providing a unique identification location label for each collector. Keep up-to-date, readily accessible records of the installation date and location of all newly installed collectors. [40 CFR 60.758(d)]

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.8	40 CFR 60.753(b) (Landfill NSPS Subpart WWW)	Operate the LFG control system with negative pressure at each well-head except under the following conditions: (1) fire or increased well temperature; OR, (2) use of a geomembrane or synthetic cover; OR, (3) a decommissioned well. Passive gas collection wells do not have to meet this condition when approved in writing by the Department. Gas collection wells operating under an Alternative Operating and Monitoring Plan approved in writing by the Department do not have to meet this condition.	None specified.	Measure gauge pressure in the gas collection header at each individual well, monthly. If a positive pressure exists, action shall be initiated to correct the exceedance within 5 calendar days. If negative pressure cannot be achieved without excess air infiltration within 15 calendar days of the first measurement, the gas collection system shall be expanded to correct the exceedance within 120 days of the initial measurement of positive pressure. Any attempted corrective measure shall not cause exceedances of other operational or performance standards. [40 CFR 60.755(a)(3)] The annual report shall include record of instances when positive pressure occurred. [40 CFR 60.753(b)(1)]
13.9	40 CFR 60.753(c) (Landfill NSPS Subpart WWW)	Operate each interior wellhead in the LFG collection system with: (1) LFG temperature <55°C; AND, (2) either: (a) N_2 < 20%; OR, (b) O_2 < 5%. Passive gas collection wells do not have to meet this condition when approved in writing by the Department. Gas collection wells receiving a variance in writing from the Department concerning temperature do not have to meet this condition. Gas collection wells operating under an Alternative Operating and Monitoring Plan approved in writing by the Department do not have to meet this condition.	N_2 by RM 3C; O_2 by RM 3A, except that: (1) regulatory limit is between 20% and 50% of the span; AND, (2) data recorder not required; AND, (3) only 2 calibration gases are required; AND, (4) calibration error check not required; AND, (5) allowable sample bias, zero drift, and calibration draft are ±10%. Install a sampling port and a thermometer or other temperature measuring device at each wellhead. [40 CFR 60.756(a)]	Measure the N_2 or O_2 concentration in the LFG, and the temperature of the LFG at each individual well, on a monthly basis. If a well exceeds one of the operating parameters, action shall be initiated to correct the exceedance within 5 calendar days. If correction of the exceedance cannot be achieved within 15 calendar days of the first measurement, the gas collection system shall be expanded to correct the exceedance within 120 days of the initial exceedance. Any attempted corrective measure shall not cause exceedances of other operational or performance standards. [40 CFR 60.756(a); 40 CFR 60.755(a)(5)]

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.10	40 CFR 60.753(d) (Landfill NSPS Subpart WWW)	Operate LFG collection system so that the methane concentration is <500 ppm above background at the surface of the landfill.	Conduct surface testing around the perimeter of the collection area along a pattern that traverses the landfill at 30 meter intervals and where visual observations indicate elevated concentrations of LFG, such as distressed vegetation and cracks or seeps in the cover per the surface monitoring design plan and topographical map of the monitoring route. Instrument specifications and procedures for surface monitoring devices: (1) portable analyzer shall meet the instrument specifications provided in section 3 of RM 21, except that "methane" shall replace all references to VOC; AND, (2) calibration gas shall be methane, diluted to a nominal concentration of 500 ppm in air; AND, (3) instrument evaluation procedures of section 4.4 of RM 21 shall be used; AND, (4) calibration procedures provided in section 4.2 of RM 21 shall be followed immediately before commencing a surface monitoring survey. [40 CFR 60.755(d)] Conduct surface monitoring with a portable monitor meeting the specifications provided. The background concentration shall be determined by moving the probe inlet upwind and downwind outside the boundary of the landfill at a distance of at least 30 meters from the perimeter wells. Surface emission monitoring shall be performed in accordance with section 4.3.1 of RM 21, except that the probe inlet shall be placed within 5 to 10 cm of the ground. Monitoring shall be performed during typical meteorological conditions. [40 CFR 60.755(c)]	Monitor for cover integrity on a monthly basis. Implement cover repairs as necessary. [40 CFR 60.755(c)(5)] Conduct surface monitoring on a quarterly basis. Any reading of ≥500 ppm above background at any location shall be recorded as a monitored exceedance and actions below taken. As long as the specified actions are taken, the exceedance is not a violation of these operational requirements. The location of each monitored exceedance shall be marked and the location recorded. Cover maintenance or adjustments to the vacuum of the adjacent wells to increase the gas collection in the vicinity of each exceedance shall be made and the location shall be re-monitored within 10 calendar days of detecting the exceedance. Any location that initially showed an exceedance but has a methane concentration <500 ppm methane above background at the 10-day re-monitoring, shall be re-monitored 1 month from the initial exceedance. If the 1-month re-monitoring shows a concentration <500 ppm above background, no further monitoring of that location is required until the next quarterly monitoring period. If the re-monitoring of the location shows a second exceedance, additional corrective action shall be taken and the location shall be monitored again within 10 days of the second exceedance. If the re-monitoring shows a third exceedance for the same location, a new well or other collection device shall be installed within 120 calendar days of the initial exceedance, OR an alternative remedy to the exceedance, such as upgrading the blower, header pipes or control device, and a corresponding timeline for installation may be submitted to the Administrator for approval. No further monitoring of that location is required until remedy has been taken. [40 CFR 60.755(c)] Submit monthly report to: ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 Monthly report shall include the location of each exceedance of the 500 ppm methane concentration and the concentration recorded at each location for which an exceedance was recorded in the previous month. [40 CFR 60.757(f)]
13.11	40 CFR 60.753(e) (Landfill NSPS Subpart WWW)	Operate the collection system such that all collected gases are vented to the control system. In the event the LFG collection and control is inoperable, the gas mover system shall be shut down and all valves in the collection and control system contributing to venting of the gas to the atmosphere shall be closed within 1 hour.	None specified.	Records shall be kept of all periods when the LFG collection and control system is inoperable, the gas mover system is shut down, or the valves in the collection and control system are closed.

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.12	40 CFR 60.753(f) (Landfill NSPS Subpart WWW)	Operate the LFG control and treatment system at all times when the collected gas is routed to the system.	None specified.	No additional monitoring required.
13.13	40 CFR 60.755(e) (Landfill NSPS Subpart WWW)	The provisions of the NSPS apply at all times, except during periods of start-up, shutdown, or malfunction, provided that the duration of start-up, shutdown, or malfunction shall not exceed 5 days for collection systems.	None specified.	No additional monitoring required.
13.14	40 CFR 60.757(a)(3); 40 CFR 60.4(a) (Landfill NSPS Subpart WWW)	An amended design capacity report shall be submitted to the Department providing notification of any increase in the design capacity of the landfill.	None specified.	If triggered, the permittee shall submit an amended design capacity report to: ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 [40 CFR 60.4(a)]
13.15	40 CFR 60.758(a) (Landfill NSPS Subpart WWW)	Keep, for at least 5 years, up-to-date, readily accessible, on-site records of: (1) the maximum design capacity; AND, (2) the current amount of solid waste in-place; AND, (3) the year-by-year waste acceptance rate. Off-site records may be maintained if they are retrievable within 4 hours. Either paper copy or electronic formats are acceptable.	None specified.	No additional monitoring required.
13.16	40 CFR 60.758(b) (Landfill NSPS Subpart WWW)	Keep up-to-date, readily accessible records for the life of the control equipment of the following data, as measured during the initial performance test or compliance determination: (1) maximum expected gas generation flow rate as calculated in condition 15.5, AND, (2) the density of wells, horizontal collectors, surface collectors, or other gas extraction devices; And, (3) the average combustion temperature measured at least every 15 minutes and averaged over the same time period of the performance test; AND, (4) the percent reduction of NMOC determined as specified in conditions 16 and 17. Records of subsequent tests or monitoring shall be maintained for a minimum of 5 years. Records of the control device vendor specifications shall be maintained until removed.	None specified.	No additional monitoring required.
13.17	40 CFR 60.758(c) (Landfill NSPS Subpart WWW)	Keep for 5 years, up-to-date, readily accessible continuous records of the equipment operating parameters specified to be monitored in the NSPS as well as up-to-date, readily accessible records for periods of operation during which the parameter boundaries established during the most recent performance test are exceeded.	None specified.	No additional monitoring required.

<table>
<tr><th>Condition</th><th>Applicable Requirement</th><th>Description (for clarification purposes only, enforceable as listed under 'applicable requirement')</th><th>Monitoring and Analysis Procedure or Test Method</th><th>Monitoring, Recordkeeping, and Reporting Requirement</th></tr>
<tr><td>13.18</td><td>40 CFR 61.154(a), (c), (d)

(Asbestos NESHAP Subpart M)</td><td>In any active waste disposal site where asbestos-containing waste material has been deposited: (1) no visible emissions to the outside air; OR, (2) cover with ≥6 inches of compacted nonasbestos-containing material at the end of each operating day; OR, (3) cover with a chemical dust suppression agent (not to include any used, spent, or other waste oil) at the end of each operating day.</td><td>None specified.</td><td>No additional monitoring required.</td></tr>
<tr><td>13.19</td><td>40 CFR 61.154(b)

(Asbestos NESHAP Subpart M)</td><td>Areas of disposal of asbestos-containing waste material must: (1) have a natural barrier that adequately deters access by the general public; OR, (2) cover with ≥6 inches of compacted nonasbestos-containing material at the end of each operating day; OR, (3) install warning signs and fencing that meet the following: (a) display signs at all entrances and at intervals of ≤330 feet; AND, (b) signs posted such that legend is easily read; AND, (c) 20" x 14" upright format signs; AND, (d) sign legend, size, and style at least equal to (spacing between lines must be at least equal to the height of the upper text line):
<table>
<tr><th>Legend</th><th>Notation</th></tr>
<tr><td>Asbestos Waste Disposal Site.</td><td>1 inch Sans Serif, Gothic, or Block</td></tr>
<tr><td>Do Not Create Dust</td><td>¾ inch Sans Serif, Gothic, or Block</td></tr>
<tr><td>Breathing Asbestos is Hazardous to Your Health.</td><td>14 point Gothic</td></tr>
</table>
AND, (e) fenced in a manner adequate to deter access by the general public.</td><td>None specified.</td><td>No additional monitoring required.</td></tr>
</table>

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.20	40 CFR 61.154(e) (Asbestos NESHAP Subpart M)	Maintain waste shipment records for all asbestos-containing waste material received.	None specified.	Waste shipment records shall include: (1) name, address, and telephone number of the waste generator; AND, (2) name, address, and telephone number of the transporter(s); AND, (3) volume of waste; AND, (4) presence of improperly enclosed (leak-tight containers) or uncovered; AND, (5) date of waste receipt. Send a copy of the signed waste shipment record to the waste generator within 30 days of receipt of the waste. If significant amount of improperly enclosed or uncovered waste, report in writing (with copy of waste shipment record) to the Department for the waste generator (as indicated in the waste shipment record), ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 by the following working day. Submit reports (with copy of waste shipment record) of unreconciled waste quantity discrepancies within 15 days of waste receipt to ODEQ, at the address listed above. [40 CFR 61.154(e)(1), (2)]
13.21	40 CFR 61.154(f) (Asbestos NESHAP Subpart M)	Maintain, until closure, records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal area on a map or diagram of the disposal area.	None specified.	No additional monitoring required.
13.22	40 CFR 61.154(i) (Asbestos NESHAP Subpart M)	Furnish upon request, and make available during normal business hours for inspection by ODEQ, all records required by the Asbestos NESHAP.	None specified.	No additional monitoring required.
13.23	40 CFR 61.154(j) (Asbestos NESHAP Subpart M)	Notify ODEQ in writing at least 45 days prior to excavating or otherwise disturbing any asbestos-containing waste material that has been deposited at the site and is covered.	None specified.	Notification shall include: (1) scheduled starting and completion dates; AND, (2) reason for disturbing waste; AND, (3) emission control procedures to be implemented; AND, (4) location of any temporary storage site and the final disposal site. [40 CFR 61.154(j)]

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.24	40 CFR 60.752(b)(2)(iii)(A) and 40 CFR 60.18 (Landfill NSPS Subpart WWW)	1. Route excess landfill gas not utilized by IC engines to an open flare (Emissions Unit Control) designed and operated in accordance with 40 CFR 60.18. 2. The flare shall be designed for and operated with no visible emissions except for periods not to exceed a total of 5 minutes during any 2 consecutive hours. [40 CFR 60.18(c)(1)] 3. The flare shall be operated with a flame present at all times. [40 CFR 60.18(c)(2)] 4. The flare shall be designed for and operated with an exit velocity less than 60 ft/sec. [40 CFR 60.18(c)(4)(i)] 5. The flare shall be operated at all times when excess landfill gas not utilized by IC engines is being vented to it. [40 CFR 60.18(e)]	Install, calibrate, maintain, and operate according to the manufacturer's specifications the following equipment: (1) a heat sensing device, such as an ultraviolet beam sensor or thermocouple, at the pilot light or the flame itself to indicate the continuous presence of a flame; and (2) a device that records flow to or bypass of the flare. The owner or operator shall either: (i) install, calibrate, and maintain a gas flow measuring device that shall record the flow to the flare at least every 15 minutes; or (ii) secure the bypass line valve in the closed position with a car-seal or a lock-and-key type configuration. [40 CFR 60.756(c)] Reference Method 22 shall be used to determine the compliance with the visible emissions standard. The observation period is 2 hours. [40 CFR 60.18(f)(1)] The net heating value of the gas being combusted in the flare shall be calculated by the equation in 40 CFR 60.18 (f)(3). The actual exit velocity of the flare shall be determined by dividing the volumetric flowrate (in units of standard temperature and pressure) as determined by Reference Methods 2, 2A, 2C,or 2D as appropriate by the unobstructed (free) cross sectional area of the flare tip. [40 CFR 60.18(f)(4)]	Monitoring 1. Operate the heat sensing device or thermocouple. [40 CFR 60.756(c)(1)] 2. Record the gas flow to the flare at least every 15 minutes or visually inspect the seal or closure mechanism at least monthly. [40 CFR 60.756(c)(2)] Recordkeeping 1. Records of the flare vendor specifications until removal of the flare. [40 CFR 60.758(b)] 2. Up-to-date, readily accessible records for the life of the flare of: a. visible emissions readings b. heat content determinations c. flow rate or bypass flow rate measurements d. exit velocity determinations e. continuous records of the flare pilot flame or flare flame monitoring f. all periods of operations during which the pilot flame or the flare flame is absent [40 CFR 60.758(b((4) and (c)(4)]

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.25	40 CFR 63.6(e)(3) (Landfill NESHAP Subpart AAAA)	Develop and implement a written Startup, Shutdown, and Malfunction Plan (SSM Plan) by no later than January 16, 2004.	None specified.	Maintain written SSM Plan on site. If the SSM Plan fails to address, or inadequately addresses, a malfunction, revise the SSM Plan within 45 days after the event to include procedures for operating and maintaining the source during similar malfunctions, and a program of corrective actions for similar malfunctions. [40 CFR 63.6(e)((3)(viii)] Recordkeeping 1. Maintain records for each SSM Plan event which occurs. [40 CFR 63.10(b)(2)(i)] 2. Retain a copy of each previous (superceded) version of the SSM Plan for at least 5 years. [40 CFR 63.6(e)(3)(v)] Reporting 1. Report semiannually all SSM Plan actions that are consistent with the SSM Plan. [40 CFR 63.10(d)(5)(i)] 2. Notify DEQ within 2 days if an SSM event is not consistent with the SSM Plan and follow up with a letter within 7 days of the event. [40 CFR 63.6(e)(3)iv)]

EMISSIONS UNITS PIR AND UPR

Table 4. Summary of requirements for Emissions Units PIR and UPR:

Applicable Requirement	Condition Number	Pollutant/ Parameter	Limit/Standard	Averaging Time	Testing Condition	Monitoring Condition
340-208-0110(2)	14	Visible emissions	20% opacity	3 min. aggregate in 60 minutes	NA	15

14. Applicable Requirement: The permittee must not cause or allow the emissions of any air contaminant into the atmosphere for a period or periods aggregating more than three minutes in any one hour which is equal to or greater than 20% opacity, excluding uncombined water, from emissions units PIR and UPR. [OAR 340-208-0110(2) and 340-208-0110(3)(a)]

15. Monitoring Requirement: At least weekly, the permittee must visually survey the facility using EPA Method 22 for any sources of excess fugitive emissions. For the purpose of this survey, excess fugitive emissions are considered to be any visible emissions that leave the down wind plant site boundaries. The person conducting this survey does not have to be EPA Method 9 certified. However, the individual should be familiar with the procedures of EPA Method 9, including using the proper location to observe visible emissions. If sources of excess fugitive emissions are identified during the survey, the permittee shall perform one of the following:

15.a. immediately take corrective action to minimize the fugitive emissions; or,

15.b. conduct a modified EPA Method 9 test on the device(s) causing the opacity problem within 24 hours.

15.c. Recordkeeping: The permittee must maintain records of all inspections and any corrective action performed.

EMISSIONS UNIT TIP

Table 5. Summary of requirements for Emissions Unit TIP:

Applicable Requirement	Condition Number	Pollutant/ Parameter	Limit/Standard	Averaging Time	Testing Condition	Monitoring Condition
340-208-0110(2)	16	Visible emissions	20% opacity	3 min. aggregate in 60 minutes	NA	20
340-226-0210(1)(b)	17	PM/PM_{10}	0.1 gr/dscf	Avg. of 3 test runs	NA	20

16. Applicable Requirement: The permittee must not cause or allow the emissions of any air contaminant into the atmosphere for a period or periods aggregating more than three minutes in any one hour which is equal to or greater than 20% opacity, excluding uncombined water, from emissions unit TIP. [OAR 340-208-0110(2) and 340-208-0110(3)(a)]

17. Applicable Requirement: The permittee must not cause or allow the emission of particulate matter in excess of 0.1 grain per standard cubic foot from emissions unit TIP. [OAR 340-226-0210(1)(b)]

Insignificant Activities Requirements

18. The Department acknowledges that insignificant emissions units (IEUs) identified by rule as either categorically insignificant activities or aggregate insignificant emissions as defined in OAR 340-200-0020 exist at facilities required to obtain an Oregon Title V Operating Permit. IEUs must comply with all applicable requirements. In general, the requirements that could apply to IEUs are incorporated as follows:

18.a. OAR 340-208-0110 (20% opacity)
18.b. OAR 340-228-0210 (0.1 gr/dscf corrected to 12% CO_2 or 50% excess air for fuel burning equipment)
18.c. OAR 340-226-0210 (0.1 gr/dscf for non-fugitive, non-fuel burning equipment)
18.d. OAR 340-226-0310 (process weight limit for non-fugitive, non-fuel burning process equipment).

Unless otherwise specified in this permit or an applicable requirement, the Department is not requiring any testing, monitoring, recordkeeping, or reporting for the applicable emissions limits and standards that apply to IEUs. However, if testing were performed for compliance purposes, the permittee would be required to use the test methods identified in the definitions of "opacity" and "particulate matter" in OAR 340-208-0010 and perform the testing in accordance with the Department's Source Sampling Manual.

PLANT SITE EMISSION LIMITS

19. Applicable Requirement: The plant site emissions must not exceed the following limits for any 12 consecutive calendar month period: [OAR 340-222-0040 through OAR 340-222-0043]

Pollutant	Plant Site Emission Limit (Tons/yr)
PM	24
PM_{10}	14
CO	99
NO_x	39
SO_2	39
VOC	39
NMOC	49

19.a. The PSEL is based on the actual predicted emissions for the current operating conditions at the facility. A permit modification is required before the PSEL may be increased.

20. Monitoring Requirement: The permittee must determine compliance with the Plant Site Emission Limits established in Condition 19 of this permit by conducting monitoring in accordance with the following procedures, test methods, and frequencies: [OAR 340-218-0050(3)]

20.a. The permittee must monitor and maintain records of the following process parameters:

Table 6. PSEL Monitoring

Emissions Unit(s)	Process Parameter	Units	Measurement Frequency	Measurement Method
F-LFG1	Municipal solid waste in place in Cell 0	Mg or tons	Annually	Records
F-LFG2	Municipal solid waste in place in Cells 1, 2A/2B, 2C/2D, and 3	Mg or tons	Annually	Records
Landfill	Municipal solid waste accepted at landfill	Mg or tons	Annually	Records
F-LFG1 & F-LFG2	Landfill gas generated in each system	$MMft^3$/month, $MMft^3$/yr	Annually using EPA model calculation	Records
F-LFG2	Landfill gas collected and sent to IC engines and % methane	$MMft^3$/month, $MMft^3$/yr	Monthly/Annually	Records
PIR	Number of total vehicles on paved roads	Number	Monthly/Annually	Records
UPR 1	Number of total vehicles on unpaved road 1	Number	Monthly/Annually	Records
UPR 2	Number of commercial vehicles on unpaved road 2	Number	Monthly/Annually	Records
TIP	Number of hours operated	Hours	Monthly/Annually	Records
PCS	Petroleum contaminated soil received	Tons	Monthly/Annually	Records
Open Flare	Landfill gas collected and sent to open flare and % methane	$MMft^3$/month, $MMft^3$/yr	Monthly/Annually	Records

20.b. Emission factors for calculating pollutant emissions:

Table 7. Emission Factors

Emission Units(s)	Pollutant	Emission Factor	Emission Factor Units	Emission Factor Verification Testing	
				Yes/no	Test Method
F-LFG1	CO	10.3	lb/MMft^3 fugitive landfill gas	No	NA
	VOC	51.9	lb/MMft^3 fugitive landfill gas	No	NA
	NMOC	133.2	lb/MMft^3 fugitive landfill gas	No	NA
F-LFG2	CO	10.3	lb/MMft^3 fugitive landfill gas	No	NA
	VOC	51.9	lb/MMft^3 fugitive landfill gas	No	NA
	NMOC	133.2	lb/MMft^3 fugitive landfill gas	No	NA
PIR	PM	0.140	lb/vehicle	No	NA
	PM_{10}	0.027	lb/vehicle	No	NA
UPR 1	PM	0.010	lb/vehicle	No	NA
	PM_{10}	0.004	lb/vehicle	No	NA
UPR 2	PM	0.098	lb/vehicle	No	NA
	PM_{10}	0.021	lb/vehicle	No	NA
Open Flare	PM/PM_{10}	8.5	lb/MMft^3 combusted landfill gas	No	NA
	CO	110.0	lb/MMft^3 combusted landfill gas	No	NA
	NO_x	20.0	lb/MMft^3 combusted landfill gas	No	NA
	SO_2	8.4	lb/MMft^3 combusted landfill gas	No	NA
	VOC	1.16	lb/MMft^3 combusted landfill gas	No	NA
	NMOC	2.71	lb/MMft^3 combusted landfill gas	No	NA
TIP	PM/PM_{10}	0.253	lb/hr	No	NA
	CO	0.768	lb/hr	No	NA
	NO_x	3.57	lb/hr	No	NA
	SO_2	0.236	lb/hr	No	NA
	VOC/ NMOC	0.289	lb/hr	No	NA
PCS	VOC/ NMOC	0.033	lb/ton PCS	No	NA

20.c. For the emissions unit F-LFG1 listed in Table 8, the permittee must determine monthly and 12-month rolling emissions by multiplying the Process Parameter by the emission factor listed above for each pollutant. Calculations must be completed within 30 days of the end of each month.

E = (F-LFG1 generated) * EF *K

where:

E = Emissions, tons
EF = Emission factor, pounds/units
K = conversion constant: 1 ton/2000 lbs

20.d. For the emissions unit F-LFG2 listed in Table 8, the permittee must determine monthly and 12-month rolling emissions by multiplying the Process Parameter by the emission factor listed above for each pollutant. Calculations must be completed within 30 days of the end of each month.

E = (F-LFG2 generated – F-LFG2 collected to IC engines and flare) * EF * K

where:

E = Emissions, tons
EF = Emission factor, pounds/units
K = conversion constant: 1 ton/2000 lbs

20.e. For the emissions unit Open Flare listed in Table 7, the permittee must determine monthly and 12-month rolling emissions by multiplying the Process Parameter by the emission factor listed above for each pollutant. Calculations must be completed within 30 days of the end of each month.

E = (Open flare collected) * EF *K

where:

E = Emissions, tons
EF = Emission factor, pounds/units
K = conversion constant: 1 ton/2000 lbs

20.f. For the emissions units PIR, UPR 1, UPR 2, TIP, and PCS listed in Table 7, the permittee must calculate monthly and 12-month rolling emission by multiplying the Process Parameter by the emission factor listed above for each pollutant. Calculations must be completed within 30 days of the end of each month.

E = MP * EF * K

where:

E = Emissions, tons
MP = Monitored parameter, units/month or units/year
EF = Emission factor, pounds/units
K = conversion constant: 1 ton/2000 lbs

20.g. The emission factors listed in Condition 20.b. are not enforceable limits unless otherwise specified in this permit. Compliance with PSELs must only be determined by the calculations contained in Conditions 20.c. through 20.f of this permit using the measured process parameters recorded during the reporting period and the emission factors contained in Condition 20.b.

21. The permittee must determine compliance with Condition 19 (Plant Site Emission Limits) by summing the emissions calculated in Condition 20 for each emissions unit for each month and each 12-month rolling period, and adding the Aggregate Insignificant emissions of 1 ton per year by pollutant, and comparing the resulting emissions to the Plant Site Emission Limits in Condition 19.

GENERAL TESTING REQUIREMENTS

22. Unless otherwise specified in this permit, the permittee must conduct all testing in accordance with the Department's Source Sampling Manual. [OAR 340-212-0120 and 40 CFR 60.8]

22.a. Unless otherwise specified by a state or federal regulation, the permittee must submit a source test plan to the Department at least 30 days prior to the date of the test. The test plan must be prepared in accordance with the Source Sampling Manual and address any planned variations or alternatives to prescribed test methods. The permittee should be aware that if significant variations are requested, it may require more than 30 days for the Department to grant approval and may require EPA approval in addition to approval by the Department.

22.b. Only regular operating staff may adjust the processes or emission control device parameters during a compliance source test and within two (2) hours prior to the tests. Any operating adjustments made during a compliance source test, which are a result of consultation during the tests with source testing personnel, equipment vendors, or consultants, may render the source test invalid.

22.c. Unless otherwise specified by permit condition or Department approved source test plan, all compliance source tests must be performed as follows:

22.c.i. at least 90% of the design capacity for new or modified equipment;
22.c.ii at least 90% of the maximum operating rate for existing equipment; or
22.c.iii. at 90 to 110% of the normal maximum operating rate for existing equipment. For purposes of this permit, the normal maximum operating rate is defined as the 90th percentile of the average hourly operating rates during a 12 month period immediately preceding the source test. Data supporting the normal maximum operating rate must be included with the source test report.

22.d. Each source test must consist of at least three (3) test runs and the emissions results must be reported as the arithmetic average of all valid test runs. If for reasons beyond the control of the permittee a test run is invalid, the Department may accept two (2) test runs for demonstrating compliance with the emission limit or standard.

22.e. Source test reports prepared in accordance with the Department's Source Sampling Manual must be submitted to the Department within 45 days of completing any required source test, unless a different time period is approved in the source test plan submitted prior to the source test.

GENERAL MONITORING AND RECORDKEEPING REQUIREMENTS

General Monitoring Requirements:

23. The permittee must not knowingly render inaccurate any required monitoring device or method. [OAR 340-218-0050(3)(a)(E)]

24. Methods used to determine actual emissions for fee purposes must also be used for compliance determination and can be no less rigorous than the requirements of OAR 340-218-0080. [OAR 340-218-0050(3)(a)(F)]

25. Monitoring requirements must commence on the date of permit issuance unless otherwise specified in the permit or an applicable requirement. [OAR 340-218-0050(3)(a)(G)]

General Recordkeeping Requirements

26. The permittee must maintain the following general records of testing and monitoring required by this permit: [OAR 340-218-0050(3)(b)(A)]

26.a. the date, place as defined in the permit, and time of sampling or measurements;
26.b. the date(s) analyses were performed;
26.c. the company or entity that performed the analyses;
26.d. the analytical techniques or methods used;
26.e. the results of such analyses;
26.f. the operating conditions as existing at the time of sampling or measurement; and
26.g. the records of quality assurance for continuous monitoring systems (including but not limited to quality control activities, audits, calibration drift checks).

27. Unless otherwise specified by permit condition, the permittee must make every effort to maintain 100 percent of the records required by the permit. If information is not obtained or recorded for legitimate reasons (e.g., the monitor or data acquisition system malfunctions due to a power outage), the missing record(s) will not be considered a permit deviation provided the amount of data lost does not exceed 10% of the averaging periods in a reporting period or 10% of the total operating hours in a reporting period, if no averaging time is specified. Upon discovering that a required record is missing, the permittee must document the reason for the missing record. In addition, any missing record that can be recovered from other available information will not be considered a missing record. [OAR 340-214-0110, 340-212-0160, and 340-218-0050(3)(b)]

28. Recordkeeping requirements must commence on the date of permit issuance unless otherwise specified in the permit or an applicable requirement. [OAR 340-218-0050(3)(b)(C)]

29. Unless otherwise specified, the permittee must retain records of all required monitoring data and support information for a period of at least five (5) years from the date of the monitoring sample, measurement, report, or application. Support information includes all calibration and maintenance records and all original strip-chart recordings (or other original data) for continuous monitoring instrumentation, and copies of all reports required by the permit. All existing records required by the previous Oregon Title V Operating Permit must also be retained for five (5) years from the date of the monitoring sample, measurement, report, or application. [OAR 340-218-0050(b)(B)]

REPORTING REQUIREMENTS

General Reporting Requirements

30. Excess Emissions Reporting The permittee must report all excess emissions as follows: [OAR 340-214-0300 through 340-214-0360]

30.a. Immediately (within 1 hour of the event) notify the Department of an excess emission event by phone, e-mail, or facsimile; and

30.b. Within 15 days of the excess emissions event, submit a written report that contains the following information: [OAR 340-214-0340(1)]

30.b.i. The date and time of the beginning of the excess emissions event and the duration or best estimate of the time until return to normal operation;

30.b.ii. The date and time the owner or operator notified the Department of the event;

30.b.iii. The equipment involved;

30.b.iv. Whether the event occurred during planned startup, planned shutdown, scheduled maintenance, or as a result of a breakdown, malfunction, or emergency;

30.b.v. Steps taken to mitigate emissions and corrective action taken, including whether the approved procedures for a planned startup, shutdown, or maintenance activity were followed;

30.b.vi. The magnitude and duration of each occurrence of excess emissions during the course of an event and the increase over normal rates or concentrations as determined by continuous monitoring or best estimate (supported by operating data and calculations);

30.b.vii. The final resolution of the cause of the excess emissions; and

30.b.viii. Where applicable, evidence supporting any claim that emissions in excess of technology-based limits were due to any emergency pursuant to OAR 340-214-0360.

30.c. In the event of any excess emissions which are of a nature that could endanger public health and occur during non-business hours, weekends, or holidays, the permittee must immediately notify the Department by calling the Oregon Accident Response System (OARS). The current number is 1-800-452-0311.

30.d. If startups, shutdowns, or scheduled maintenance may result in excess emissions, the permittee must submit startup, shutdown, or scheduled maintenance procedures used to minimize excess

emissions to the Department for prior authorization, as required in OAR 340-214-0310 and 340-214-0320. New or modified procedures must be received by the Department in writing at least 72 hours prior to the first occurrence of the excess emission event. The permittee must abide by the approved procedures and have a copy available at all times.

30.e. The permittee must notify the Department of planned startup/shutdown or scheduled maintenance events.

30.f. The permittee must continue to maintain a log of all excess emissions in accordance with OAR 340-214-0340(3). However, the permittee is not required to submit the detailed log with the semi-annual and annual monitoring reports. The permittee is only required to submit a brief summary listing the date, time, and the affected emissions units for each excess emission that occurred during the reporting period. [OAR 340-218-0050(3)(c)]

31. Permit Deviations Reporting: The permittee must promptly report deviations from permit requirements that do not cause excess emissions, including those attributable to upset conditions, as defined in the permit, the probable cause of such deviations, and any corrective actions or preventive measures taken. "Prompt" means within 15 days of the deviation. Deviations that cause excess emissions, as specified in OAR 340-214-0300 through 340-214-0360 must be reported in accordance with Condition 23.

32. All required reports must be certified by a responsible official consistent with OAR 340-218-0040(5);[OAR 340-218-0050(3)(c)(D)]

33. Reporting requirements must commence on the date of permit issuance unless otherwise specified in the permit. [OAR 340-218-0050(3)(c)(E)]

Addresses of regulatory agencies are the following, unless otherwise instructed:

DEQ – Western Region
750 Front Street NE, Suite 120
Salem, OR 97310
(503) 378-8240

DEQ – Air Quality Division
811 SW Sixth Avenue
Portland, OR 97204
(503) 229-5359

Air Operating Permits
US Environmental Protection Agency
Mail Stop OAQ-108
1200 Sixth Avenue
Seattle, WA 98101

Semi-annual and Annual Reports

34. The permittee must submit three (3) copies of reports of any required mon ring at least every 6 months, completed on forms approved by the Department. Six month periods are uary 1 to June 30, and July 1 to December 31. One copy of the report must be submitted to the EPA a two copies to the DEQ regional office. All instances of deviations from permit requirements must be cl rly identified in such reports: [OAR 340-218-0050(3)(c)(A) and 340-218-0080(6)(d)]]

34.a. The first semi-annual report is be due on July 30 and must include the semi-annual compliance certification, OAR 340-218-0080.

34.b. The annual report is due on February 15 and must consist of the following:

34.b.i. the emission fee report; [OAR 340-220-0100]
34.b.ii. a summary of the excess emissions upset log; [OAR 340-214-0340]
34.b.iii. the second semi-annual compliance certification; [OAR 340-218-0080]
34.b.iv. the annual emission inventory report for the prior calendar year;
34.b.v. greenhouse gas emissions in accordance with Division 215 of OAR Chapter 340. [OAR 340-215-0040(3)(a)]

35. The semi-annual compliance certification must include the following (provided that the identification of applicable information may cross-reference the permit or previous reports, as applicable): [OAR 340-218-0080(6)(c)]

35.a. The identification of each term or condition of the permit that is the basis of the certification;

35.b. The identification of the method(s) or other means used by the owner or operator for determining the compliance status with each term and condition during the certification period, and whether such methods or other means provide continuous or intermittent data. Such methods and other means must include, at a minimum, the methods and means required under OAR 340-218-0050(3). *Note: Certification of compliance with the monitoring conditions in the permit is sufficient to meet this requirement, except when the permittee must certify compliance with new applicable requirements that are incorporated by reference into the permit. When certifying compliance with new applicable requirements that are not yet in the permit, the permittee must provide the information required by this condition.* If necessary, the owner or operator also must identify any other material information that must be included in the certification to comply with section 113(c)(2) of the FCAA, which prohibits knowingly making a false certification or omitting material information;

35.c. The status of compliance with terms and conditions of the permit for the period covered by the certification, including whether compliance during the period was continuous or intermittent. The certification must be based on the method or means designated in OAR 340-218-0040(6)(c)(B). The certification must identify each deviation and take it into account in the compliance certification. The certification must also identify as possible exceptions to compliance any periods during which compliance is required and in which an excursion or exceedance, as defined under OAR 340-200-0020, occurred; and

35.d. Such other facts as the Department may require to determine the compliance status of the source.

36. Notwithstanding any other provision contained in any applicable requirement, the owner or operator may use monitoring as required under OAR 340-218-0050(3) and incorporated into the permit, in addition to any specified compliance methods, for the purpose of submitting compliance certifications. [OAR 340-218-0080(6)(e)]

Monthly Reports

37. The permittee must report the following information for the preceding month within 30 days of the end of each calendar month to the Western Region-Salem office of the Department:

37.a. The cover integrity monitoring results and repairs, if necessary, as required by Condition 13.10;

37.b. The results of the quarterly surface methane monitoring, if conducted during the month, and corrective actions taken as required by Condition 13.10;

37.c. Any other information regarding upsets, maintenance required, or operational problems encountered during the month on the landfill gas collection or control systems;

37.d. Information concerning the installation date and location of any newly installed wells or expansion of the landfill gas collection system as required by Condition 13.7;

37.e. The amount of landfill gas collected and treated in both the IC engines and the flare;

37.f. The total operating hours of the IC engines and flare during the month; and,

37.g. Log of air quality complaints received during the month under Condition 8.

EMISSION FEES

38. Emission fees will be based on the Plant Site Emission Limits in Condition 19, unless the permittee elects to report actual emissions for one or more permitted processes/pollutants using the procedures in OAR 340 Division 220. If the permittee reports actual emissions for one or more permitted processes/pollutants, the permitted emissions for the remaining permitted processes/pollutants will be based on the following table: [OAR 340-220-0090]

Emission Source Description	Permitted Process Code (DEQ Codes)	PM_{10} (tons)	SO_2 (tons)	NO_x (tons)	VOC (tons
Roads	FS-1	3.1			
Open Flare	GS-1	2.2	2.2	5.2	0.3
Fugitive LFG	FS-2				11.0
Petroleum Cont. Soil	FS-2				0.8
Tipper	GS-1	0.3	0.2	3.6	0.3
AI	GS-1	1.0	1.0	1.0	1.0

NON-APPLICABLE REQUIREMENTS

39. State and Federal air quality requirements (e.g., rules and regulations) currently determined not applicable to the permittee are listed below along with the reason for the non-applicability: [OAR 340-218-0110]

Applicable Requirement	Reason Code
OAR Chapter 340:	
Division 202	
All rules	I
Division 204	
All rules	I
Division 206	
0050	C
0060 through 0070	I
Division 208	
0500 through 0610	D
Division 210	
0100 through 0120	B
Division 212	
0200 through 0280	J
Division 214	
0200 and 0220	C
0400 through 0430	B
Division 218	
0050(4)	B
0050(8)	H
0060	I
0070	I
0090	B
0100	B
0250	I
Division 222	
0042	C
0060	H
Division 224	
0050	C
0060	C
Division 225	
0045	C
Division 226	
0400	H
Division 228	
0100 through 0130	F
0300 through 0530	B
0600 through 0678	B
Division 230	
All rules	E
Division 232	
All rules	C
Division 234	
All rules	B
Division 236	
All rules	B
Division 240	
All rules	C
Division 242	
All rules	C
Division 248	
0210 through 0230	B
Division 250	
All rules	I
Division 252	
All rules	I
Division 254	
All rules	E
Division 256	
All rules	B
Division 257	
All rules	E
Division 258	
All rules	B
Division 260	
All rules	B
Division 262	
All rules	B
Division 264	
0100	D
0120 through 0170	D
0190	E
Division 266	
All rules	B
40 CFR	
Part 55	B
Part 57	B
Part 60, except subparts A, WWW, and appendixes	B
Part 61, except subparts A, M, and appendices	B
Part 63, except subparts A, AAAA, and appendices	B
Part 68	B
Part 72 through 76	B
Part 77	B
Part 78	B
Part 82, except subpart F	B
Part 85 through 89	B

Reason code definitions:

A this pollutant is not emitted by the facility
B the facility is not in this source category
C the facility is not in a special control/nonattainment area
D the facility is not in this county
E the facility does not have this emissions unit
F the facility does not use this fuel type

G the rule does not apply because no changes have been made at the facility that would trigger these procedural requirements
H this method/procedure is not used by the facility
I this rule applies only to DEQ and regional authorities
J there are no emissions units with add-on control devices or the pre-controlled potential emissions are less than 100 tons per year or the emissions units with add-on control devices and pre-controlled emissions greater than 100 tons per year are subject to emissions standards promulgated after November of 1990

GENERAL CONDITIONS

G1. General Provision

Terms not otherwise defined in this permit have the meaning assigned to such terms in the referenced regulation.

G2. Reference materials

Where referenced in this permit, the versions of the following materials are effective as of the dates noted unless otherwise specified in this permit:

a. Source Sampling Manual; January 23, 1992 - State Implementation Plan Volume 3, Appendix A4;
b. Continuous Monitoring Manual; January 23, 1992 - State Implementation Plan Volume 3, Appendix A6; and
c. All state and federal regulations as in effect on the date of issuance of this permit.

G3. Applicable Requirements [OAR 340-218-0010(3)(b)]

Oregon Title V Operating Permits do not replace requirements in Air Contaminant Discharge Permits (ACDP) issued to the source even if the ACDP(s) have expired. For a source operating under a Title V permit, requirements established in an earlier ACDP remain in effect notwithstanding expiration of the ACDP or Title V permit, unless a provision expires by its terms or unless a provision is modified or terminated following the procedures used to establish the requirement initially. Source specific requirements, including, but not limited to TACT, RACT, BACT, and LAER requirements, established in an ACDP must be incorporated into the Oregon Title V Operating Permit and any revisions to those requirements must follow the procedures used to establish the requirement initially.

G4. Compliance [OAR 340-218-0040(3)(n)(C), 340-218-0050(6), and 340-218-0080(4)]

a. The permittee must comply with all conditions of this permit. Any permit condition noncompliance constitutes a violation of the Federal Clean Air Act and/or state rules and is grounds for enforcement action; for permit termination, revocation and re-issuance, or modification; or for denial of a permit renewal application. Any noncompliance with a permit condition specifically designated as enforceable only by the state constitutes a violation of state rules only and is grounds for enforcement action; for permit termination, revocation and re-issuance, or modification; or for denial of a permit renewal application.
b. Any schedule of compliance for applicable requirements with which the source is not in compliance at the time of permit issuance is supplemental to, and does not sanction noncompliance with the applicable requirements on which it is based.
c. For applicable requirements that will become effective during the permit term, the source must meet such requirements on a timely basis unless a more detailed schedule is expressly required by the applicable requirement.

G5. Masking Emissions:

The permittee must not install or use any device or other means designed to mask the emission of an air contaminant that causes or is likely to cause detriment to health, safety, or welfare of any person or otherwise violate any other regulation or requirement. [OAR 340-208-0400] This condition is enforceable only by the State.

G6. Credible Evidence:

Notwithstanding any other provisions contained in any applicable requirement, any credible evidence may be used for the purpose of establishing whether a person has violated or is in violation of any such applicable requirements. [OAR 340-214-0120]

G7. Certification [OAR 340-214-0110, 340-218-0040(5), 340-218-0050(3)(c)(D), and 340-218-0080(2)]

Any document submitted to the Department or EPA pursuant to this permit must contain certification by a responsible official of truth, accuracy and completeness. All certifications must state that based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and, complete. The permittee must promptly, upon discovery, report to the Department a material error or omission in these records, reports, plans, or other documents.

G8. Open Burning [OAR Chapter 340, Division 264]

The permittee is prohibited from conducting open burning, except as may be allowed by OAR 340-264-0020 through 340-264-0200.

G9. Asbestos [40 CFR Part 61, Subpart M (federally enforceable), OAR Chapter 340-248-0005 through 340-248-0180 (state-only enforceable) and 340-248-0205 through 340-248-0280]

The permittee must comply with OAR Chapter 340, Division 248, and 40 CFR Part 61, Subpart M when conducting any renovation or demolition activities at the facility.

G10. Stratospheric Ozone and Climate Protection [40 CFR 82 Subpart F, OAR 340-260-0040]

The permittee must comply with the standards for recycling and emissions reduction pursuant to 40 CFR Part 82, Subpart F, Recycling and Emissions Reduction.

G11. Permit Shield [OAR 340-218-0110]

a. Compliance with the conditions of the permit is deemed compliance with any applicable requirements as of the date of permit issuance provided that:

   i. such applicable requirements are included and are specifically identified in the permit, or
   ii. the Department, in acting on the permit application or revision, determines in writing that other requirements specifically identified are not applicable to the source, and the permit includes the determination or a concise summary thereof.

b. Nothing in this rule or in any federal operating permit alters or affects the following:

   i. the provisions of ORS 468.115 (enforcement in cases of emergency) and ORS 468.035 (function of department);
   ii. the liability of an owner or operator of a source for any violation of applicable requirements prior to or at the time of permit issuance;

iii. the applicable requirements of the national acid rain program, consistent with section 408(a) of the FCAA; or
iv. the ability of the Department to obtain information from a source pursuant to ORS 468.095 (investigatory authority, entry on premises, status of records).

c. Sources are not shielded from applicable requirements that are enacted during the permit term, unless such applicable requirements are incorporated into the permit by administrative amendment, as provided in OAR 340-218-0150(1)(h), significant permit modification, or reopening for cause by the Department.

G12. Inspection and Entry [OAR 340-218-0080(3)]

Upon presentation of credentials and other documents as may be required by law, the permittee must allow the Department of Environmental Quality, or an authorized representative (including an authorized contractor acting as a representative of the EPA Administrator), to perform the following:

a. enter upon the permittee's premises where an Oregon Title V Operating Permit program source is located or emissions-related activity is conducted, or where records must be kept under the conditions of the permit;
b. have access to and copy, at reasonable times, any records that must be kept under conditions of the permit;
c. inspect, at reasonable times, any facilities, equipment (including monitoring and air pollution control equipment), practices, or operations regulated or required under the permit; and
d. as authorized by the FCAA or state rules, sample or monitor, at reasonable times, substances or parameters, for the purposes of assuring compliance with the permit or applicable requirements.

G13. Fee Payment [OAR 340-220-0010, and 340-220-0030 through 340-220-0190]

The permittee must pay an annual base fee and an annual emission fee for particulates, sulfur dioxide, nitrogen oxides, and volatile organic compounds. The permittee must submit payment to the Department of Environmental Quality, Business Office, 811 SW 6th Avenue, Portland, OR 97204, within 30 days of the date the Department mails the fee invoice or August 1 of the year following the calendar year for which emission fees are paid, whichever is later. Disputes must be submitted in writing to the Department of Environmental Quality. Payment must be made regardless of the dispute. User-based fees will be charged for specific activities (e.g., computer modeling review, ambient monitoring review, etc.) requested by the permittee.

G14. Off-Permit Changes to the Source [OAR 340-218-0140(2)]

a. The permittee must monitor for, and record, any off-permit change to the source that:

i. is not addressed or prohibited by the permit;
ii. is not a Title I modification;
iii. is not subject to any requirements under Title IV of the FCAA;
iv. meets all applicable requirements;
v. does not violate any existing permit term or condition; and
vi. may result in emissions of regulated air pollutants subject to an applicable requirement but not otherwise regulated under this permit or may result in insignificant changes as defined in OAR 340-200-0020.

b. A contemporaneous notification, if required under OAR 340-218-0140(2)(b), must be submitted to the Department and the EPA.

c. The permittee must keep a record describing off-permit changes made at the facility that result in emissions of a regulated air pollutant subject to an applicable requirement, but not otherwise regulated under the permit, and the emissions resulting from those off-permit changes.
d. The permit shield of Condition G9 does not extend to off-permit changes.

G15. Section 502(b)(10) Changes to the Source [OAR 340-218-0140(3)]

a. The permittee must monitor for, and record, any section 502(b)(10) change to the source, which is defined as a change that would contravene an express permit term but would not:

i. violate an applicable requirement;
ii. contravene a federally enforceable permit term or condition that is a monitoring, recordkeeping, reporting, or compliance certification requirement; or
iii. be a Title I modification.

b. A minimum 7-day advance notification must be submitted to the Department and the EPA in accordance with OAR 340-218-0140(3)(b).
c. The permit shield of Condition G9 does not extend to section 502(b)(10) changes.

G16. Administrative Amendment [OAR 340-218-0150]

Administrative amendments to this permit must be requested and granted in accordance with OAR 340-218-0150. The permittee must promptly submit an application for the following types of administrative amendments upon becoming aware of the need for one, but no later than 60 days of such event:

a. legal change of the registered name of the company with the Corporations Division of the State of Oregon, or
b. sale or exchange of the activity or facility.

G17. Minor Permit Modification [OAR 340-218-0170]

The permittee must submit an application for a minor permit modification in accordance with OAR 340-218-0170.

G18. Significant Permit Modification [OAR 340-218-0180]

The permittee must submit an application for a significant permit modification in accordance with OAR 340-218-0180

G19. Staying Permit Conditions [OAR 340-218-0050(6)(c)]

Notwithstanding conditions G16 and G17, the filing of a request by the permittee for a permit modification, revocation and re-issuance, or termination, or of a notification of planned changes or anticipated noncompliance does not stay any permit condition.

G20. Construction/Operation Modification [OAR 340-218-0190]

The permittee must obtain approval from the Department prior to construction or modification of any stationary source or air pollution control equipment in accordance with OAR 340-210-0200 through OAR 340-210-0250.

G21. New Source Review Modification [OAR 340-224-0010]

The permittee may not begin construction of a major source or a major modification of any stationary source without having received an air contaminant discharge permit (ACDP) from the Department and having satisfied the requirements of OAR 340, Division 224.

G22. Need to Halt or Reduce Activity Not a Defense [OAR 340-218-0050(6)(b)]

The need to halt or reduce activity will not be a defense. It will not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

G23. Duty to Provide Information [OAR 340-218-0050(6)(e) and OAR 340-214-0110]

The permittee must furnish to the Department, within a reasonable time, any information that the Department may request in writing to determine whether cause exists for modifying, revoking and reissuing, or terminating the permit, or to determine compliance with the permit. Upon request, the permittee must also furnish to the Department copies of records required to be retained by the permit or, for information claimed to be confidential, the permittee may furnish such records to the Department along with a claim of confidentiality.

G24. Reopening for Cause [OAR 340-218-0050(6)(c) and 340-218-0200]

a. The permit may be modified, revoked, reopened and reissued, or terminated for cause as determined by the Department.
b. A permit must be reopened and revised under any of the circumstances listed in OAR 340-218-0200(1)(a).
c. Proceedings to reopen and reissue a permit must follow the same procedures as apply to initial permit issuance and affect only those parts of the permit for which cause to reopen exists.

G25. Severability Clause [OAR 340-218-0050(5)]

Upon any administrative or judicial challenge, all the emission limits, specific and general conditions, monitoring, recordkeeping, and reporting requirements of this permit, except those being challenged, remain valid and must be complied with.

G26. Permit Renewal and Expiration [OAR 340-218-0040(1)(a)(D) and 340-218-0130]

a. This permit expires at the end of its term, unless a timely and complete renewal application is submitted as described below. Permit expiration terminates the permittee's right to operate.
b. Applications for renewal must be submitted at least 12 months before the expiration of this permit, unless the Department requests an earlier submittal. If more than 12 months is required to process a permit renewal application, the Department must provide no less than six (6) months for the owner or operator to prepare an application.
c. Provided the permittee submits a timely and complete renewal application, this permit will remain in effect until final action has been taken on the renewal application to issue or deny the permit.

G27. Permit Transference [OAR 340-218-0150(1)(d)]

The permit is not transferable to any person except as provided in OAR 340-218-0150(1)(d).

G28. Property Rights [OAR 340-200-0020 and 340-218-0050(6)(d)]

The permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations, except as provided in OAR 340-218-0110.

G29. Permit Availability [OAR 340-200-0020 and 340-218-0120(2)]

The permittee must have available at the facility at all times a copy of the Oregon Title V Operating Permit and must provide a copy of the permit to the Department or an authorized representative upon request.

ALL INQUIRIES SHOULD BE DIRECTED TO:

Department of Environmental Quality
Air Quality Division
Western Region-Salem Office
750 Front Street NE, Suite 120
Salem, OR 97301-1039
(503) 378-8240

Air TECHNOLOGY Laboratories, Inc.

September 18, 2019

LA Cert #04140
EPA Methods TO3, TO14A, TO15, 25C/3C, RSK-175

TX Cert T104704450-14-6
EPA Methods TO14A, TO15

UT Cert CA0133332015-3
EPA Methods TO3, TO14A, TO15, RSK-175

Weaver Consultants Group
ATTN: Melissa Green
7340 E. Caley Ave., Ste. 110
Centennial, CO 80111

LABORATORY TEST RESULTS

Project Reference: Total Sulfur Content Composition and Heat Value Testing
Project Number: 0120-174-50-20-02
Lab Number: K080707-01/04

Enclosed are **revised** results for sample(s) received 8/07/19 by Air Technology Laboratories. This revision replaces the report dated 8/26/19 in its entirety. Samples were received intact. Analyses were performed according to specifications on the chain of custody provided with the sample(s).

Report Narrative:

- Report revised to include a Level 4 raw data package, per client's request.
- Unless otherwise noted in the report, sample analyses were performed within method performance criteria and meet all requirements of the TNI Standards.
- The enclosed results relate only to the sample(s).

Preliminary results were e-mailed to Melissa Green on 8/22/19.

ATL appreciates the opportunity to provide testing services to your company. If you have any questions regarding these results, please call me at (626) 964-4032.

Sincerely,

Mark Johnson
Operations Manager
MJohnson@AirTechLabs.com

Note: The cover letter is an integral part of this analytical report.

K080707a

AirTECHNOLOGY Laboratories, Inc.

18501 E. Gale Ave., Suite 130
City of Industry, CA 91748
Ph: 626-964-4032
Fx: 626-964-5832

CHAIN OF CUSTODY RECORD

TURNAROUND TIME
Standard ☑ 48 hours ☐
Same Day ☐ 72 hours ☐
24 hours ☐ 96 hours ☐
Other:

DELIVERABLES
EDD ☐
EDF ☐
LEVEL 3 ☐
LEVEL 4 ☐

PAGE: OF

Condition upon receipt:
Sealed Yes ☐ No ☐
Intact Yes ☐ No ☐
Chilled _____ deg C

Project No.: 0120-174-50-20-02
Project Name: Total Sulfur content, composition and heat Value testing
Report To: Melissa Green
Company: Weaver Consultants Group
Street: 7340 E Caley Ave Suite 110
City/State/Zip: Centennial, CO 80111
Phone& Fax: 720-529-0132
e-mail: MGreen@WCGrp.com

BILLING
P.O. No.: Same
Bill to:

ANALYSIS REQUEST

LAB USE ONLY	SAMPLE IDENTIFICATION	SAMPLE DATE	SAMPLE TIME	MATRIX	CONTAINER TYPE	D5504 (extended list)	D1945				
K080707-01	1 canister 5948	8/6/19	12:35	G	C	x	x				
-02	2 " 5960	8/6/19	12:45	G	C	x	x				
-03	3 " 6010	8/6/19	1:02	G	C	x	x	90817MS			
-04	4 " 7131	8/6/19	1:15	G	C						

AUTHORIZATION TO PERFORM WORK: Corey Harkness	COMPANY: WCG	DATE/TIME: 8/6/19 11:00AM	
SAMPLED BY: Corey Harkness	COMPANY: WCG	DATE/TIME: 8/6/19 12:35pm	
RELINQUISHED BY: Corey Harkness	DATE/TIME: 8/6/19 2:30PM	RECEIVED BY: FedEx	DATE/TIME: 8/6/19 2:30PM
RELINQUISHED BY: FedEx	DATE/TIME: 8/7/19	RECEIVED BY: [signature]	DATE/TIME: 8/7/19 0912
RELINQUISHED BY:	DATE/TIME:	RECEIVED BY:	DATE/TIME:

COMMENTS
only test sample 4 as a back-up

METHOD OF TRANSPORT (circle one): Walk-In (FedEx) UPS Courier ATLI Other _____

DISTRIBUTION: White & Yellow - Lab Copies / Pink - Customer Copy

Preservation: **H**=HCL **N**=None / Container: **B**=Bag **C**=Can **V**=VOA **O**=Other

Rev. 03 - 5/7/09

Client:	Weaver Consultants Group
Attn:	Melissa Green
Project Name:	Total Sulfur Content Composition and Heat Value Testing
Project No.:	0120-174-50-20-02
Date Received:	08/07/19
Matrix:	Air
Reporting Units:	ppmv

ASTM D5504

Lab No.:	K080707-01		K080707-02		K080707-03			
Client Sample I.D.:	1		2		3			
Date/Time Sampled:	8/6/19 12:35		8/6/19 12:49		8/6/19 13:02			
Date/Time Analyzed:	8/8/19 14:54		8/8/19 15:12		8/8/19 15:29			
QC Batch No.:	190808GC3A1		190808GC3A1		190808GC3A1			
Analyst Initials:	CM/AS		CM/AS		CM/AS			
Dilution Factor:	4.2		4.6		4.6			
ANALYTE	Result ppmv	RL ppmv	Result ppmv	RL ppmv	Result ppmv	RL ppmv		
Hydrogen Sulfide	8.6	0.84	ND	0.92	ND	0.92		
Sulfur Dioxide	ND	0.84	ND	0.92	ND	0.92		
Carbonyl Sulfide	ND	0.84	ND	0.92	ND	0.92		
Methyl Mercaptan	2.3	0.84	ND	0.92	ND	0.92		
Ethyl Mercaptan	ND	0.84	ND	0.92	ND	0.92		
Dimethyl Sulfide	2.1	0.84	2.5	0.92	2.4	0.92		
Carbon Disulfide	ND	0.84	ND	0.92	ND	0.92		
Isopropyl Mercaptan	2.5	0.84	ND	0.92	ND	0.92		
t-Butylmercaptan	ND	0.84	ND	0.92	ND	0.92		
n-Propyl Mercaptan	ND	0.84	ND	0.92	ND	0.92		
Ethyl Methyl Sulfide	ND	0.84	ND	0.92	ND	0.92		
sec-Butyl Mercaptan	ND	0.84	ND	0.92	ND	0.92		
Thiophene	ND	0.84	ND	0.92	ND	0.92		
Isobutyl Mercaptan	ND	0.84	ND	0.92	ND	0.92		
Diethyl Sulfide	ND	0.84	ND	0.92	ND	0.92		
n-Butyl Mercaptan	ND	0.84	ND	0.92	ND	0.92		
Dimethyl Disulfide	ND	0.84	ND	0.92	ND	0.92		
2-Methylthiophene	ND	0.84	ND	0.92	ND	0.92		
3-Methylthiophene	ND	0.84	ND	0.92	ND	0.92		
Tetrahydrothiophene	ND	0.84	ND	0.92	ND	0.92		
2-Ethylthiophene	ND	0.84	ND	0.92	ND	0.92		
2,5-Dimethylthiophene	ND	0.84	ND	0.92	ND	0.92		
Diethyl Disulfide	ND	0.84	ND	0.92	ND	0.92		
Dimethyl Trisulfide	ND	0.84	2.5	0.92	ND	0.92		
Total Reduced Sulfur	15	0.84	5.0	0.92	2.4	0.92		

ND = Not Detected (below RL)
RL = Reporting Limit

Reviewed/Approved By: _____ Date 8/12/19

Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report

AirTECHNOLOGY Laboratories, Inc.
18501 E. Gale Avenue, Suite 130 ♦ City of Industry, CA 91748 ♦ Ph: (626) 964-4032 ♦ Fx: (626) 964-5832

Client:	Weaver Consultants Group
Attn:	Melissa Green
Project Name:	Total Sulfur Content Composition and Heat Value Testing
Project No.:	0120-174-50-20-02
Date Received:	08/07/19
Matrix:	Air
Reporting Units:	ppmv

ASTM D5504

Lab No.:	Method Blank							
Client Sample I.D.:	-							
Date/Time Sampled:	-							
Date/Time Analyzed:	8/8/19 10:57							
QC Batch No.:	190808GC3A1							
Analyst Initials:	CM/AS							
Dilution Factor:	1.0							
ANALYTE	**Result ppmv**	**RL ppmv**						
Hydrogen Sulfide	ND	0.20						
Sulfur Dioxide	ND	0.20						
Carbonyl Sulfide	ND	0.20						
Methyl Mercaptan	ND	0.20						
Ethyl Mercaptan	ND	0.20						
Dimethyl Sulfide	ND	0.20						
Carbon Disulfide	ND	0.20						
Isopropyl Mercaptan	ND	0.20						
t-Butylmercaptan	ND	0.20						
n-Propyl Mercaptan	ND	0.20						
Ethyl Methyl Sulfide	ND	0.20						
sec-Butyl Mercaptan	ND	0.20						
Thiophene	ND	0.20						
Isobutyl Mercaptan	ND	0.20						
Diethyl Sulfide	ND	0.20						
n-Butyl Mercaptan	ND	0.20						
Dimethyl Disulfide	ND	0.20						
2-Methylthiophene	ND	0.20						
3-Methylthiophene	ND	0.20						
Tetrahydrothiophene	ND	0.20						
2-Ethylthiophene	ND	0.20						
2,5-Dimethylthiophene	ND	0.20						
Diethyl Disulfide	ND	0.20						
Dimethyl Trisulfide	ND	0.20						
Total Reduced Sulfur	ND	0.20						

ND = Not Detected (below RL)
RL = Reporting Limit

Reviewed/Approved By: _____ Date 8/12/19
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report

AirTECHNOLOGY Laboratories, Inc.
18501 E. Gale Avenue, Suite 130 ♦ City of Industry, CA 91748 ♦ Ph: (626) 964-4032 ♦ Fx: (626) 964-5832

QC Batch No.: 190808GC3A1
Matrix: Air
Reporting Units: ppmv

ASTM D5504

Lab No.:	METHOD BLANK		LCS		LCSD			
Date/Time Analyzed:	8/8/19 10:57		8/8/19 10:22		8/8/19 10:40			
Analyst Initials:	CM/AS		CM/AS		CM/AS			
Date File:	08aug003		08aug001		08aug002			
Dilution Factor:	1.0		1.0		1.0			
ANALYTE	Result ppmv	RL ppmv	% Rec.	Criteria	% Rec.	Criteria	% RPD	Criteria
Hydrogen Sulfide	ND	0.20	73	70-130%	73	70-130%	0.2	<30
Carbonyl Sulfide	ND	0.20	102	70-130%	102	70-130%	0.1	<30
Methyl Mercaptan	ND	0.20	97	70-130%	99	70-130%	1.8	<30
Ethyl Mercaptan	ND	0.20	102	70-130%	103	70-130%	0.9	<30
Dimethyl Sulfide	ND	0.20	90	70-130%	90	70-130%	0.1	<30
Carbon Disulfide	ND	0.20	87	70-130%	86	70-130%	0.8	<30
Dimethyl Disulfide	ND	0.20	96	70-130%	94	70-130%	1.4	<30

ND = Not Detected (below RL)
RL = Reporting Limit

Reviewed/Approved By: _____ Date 8/22/19
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report

AirTECHNOLOGY Laboratories, Inc.
18501 E. Gale Avenue, Suite 130 ♦ City of Industry, CA 91748 ♦ Ph: (626) 964-4032 ♦ Fx: (626) 964-5832

Client: Weaver Consultants Group
Attn: Melissa Green

Client's Project: Total Sulfur Content Composition and Heat Value Testing
Project Number: 0120-174-50-20-02
Date Received: 8/7/2019
Matrix: Vapor
Units: % v/v

Natural Gas Analysis by ASTM-D1945/3588

Lab No.:		K080707-01		K080707-02		K080707-03					
Client Sample I.D.:		1		2		3					
Date/Time Sampled:		8/6/19 12:35		8/6/19 12:49		8/6/19 13:02					
Fixed Gas Date/Time Analyzed:		8/15/19 11:39		8/15/19 11:58		8/15/19 12:21					
Hydrocarbon Date/Time Analyzed:		8/8/19 10:01		8/8/19 10:23		8/8/19 11:08					
Analyst Initials:		CM/AS		CM/AS		CM/AS					
QC Batch #:		190808GC11A1		190808GC11A1		190808GC11A1					
Dilution Factor:		4.2		4.6		4.6					
ANALYTE	PQL	Results	RL	Results	RL	Results	RL				
Methane	0.0010	53	0.0042	53	0.0046	51	0.0046				
Ethylene	0.010	ND	0.042	ND	0.046	ND	0.046				
Ethane	0.010	ND	0.042	ND	0.046	ND	0.046				
Propane	0.010	ND	0.042	ND	0.046	ND	0.046				
Isobutane	0.010	ND	0.042	ND	0.046	ND	0.046				
n-Butane	0.010	ND	0.042	ND	0.046	ND	0.046				
Isopentane	0.010	ND	0.042	ND	0.046	ND	0.046				
n-Pentane	0.010	ND	0.042	ND	0.046	ND	0.046				
Hexanes	0.010	ND	0.042	ND	0.046	ND	0.046				
Heptanes	0.010	ND	0.042	ND	0.046	ND	0.046				
Oxygen/Argon	0.50	ND	2.1	ND	2.3	2.3	2.3				
Nitrogen	1.0	8.4	4.2	9.0	4.6	11	4.6				
Carbon Dioxide	0.010	37	0.042	37	0.046	35	0.046				
Gross Heat of combustion (BTU/FT3)	1.0	540	4.2	534	4.6	514	4.6				
Net Heat of combustion (BTU/FT3)	1.0	486	4.2	481	4.6	463	4.6				

PQL = Practical Quantitation Limit
ND = Not Detected (Below RL)
RL = PQL X Dilution Factor

Reviewed/Approved By: _____ Date: 8/20/19
Mark J. Johnson
Operations Manager

The cover letter is an integral part of this analytical report.

Client: Weaver Consultants Group
Attn: Melissa Green

Client's Project: Total Sulfur Content Composition and Heat Value Testing
Project Number: 0120-174-50-20-02
Date Received: 8/7/2019
Matrix: Vapor
Units: % v/v

Natural Gas Analysis by ASTM-D1945/3588

Lab No.:		K080707-01		K080707-02		K080707-03					
Client Sample I.D.:		1		2		3					
Date/Time Sampled:		8/6/19 12:35		8/6/19 12:49		8/6/19 13:02					
Fixed Gas Date/Time Analyzed:		8/15/19 11:39		8/15/19 11:58		8/15/19 12:21					
Hydrocarbon Date/Time Analyzed:		8/8/19 10:01		8/8/19 10:23		8/8/19 11:08					
Analyst Initials:		CM/AS		CM/AS		CM/AS					
QC Batch #:		190808GC11A1		190808GC11A1		190808GC11A1					
Dilution Factor:		4.2		4.6		4.6					
ANALYTE	PQL	Results	RL	Results	RL	Results	RL				
Methane	0.0010	53	0.0042	53	0.0046	51	0.0046				
Ethylene	0.010	ND	0.042	ND	0.046	ND	0.046				
Ethane	0.010	ND	0.042	ND	0.046	ND	0.046				
Propane	0.010	ND	0.042	ND	0.046	ND	0.046				
Isobutane	0.010	ND	0.042	ND	0.046	ND	0.046				
n-Butane	0.010	ND	0.042	ND	0.046	ND	0.046				
Isopentane	0.010	ND	0.042	ND	0.046	ND	0.046				
n-Pentane	0.010	ND	0.042	ND	0.046	ND	0.046				
Hexanes	0.010	ND	0.042	ND	0.046	ND	0.046				
Heptanes	0.010	ND	0.042	ND	0.046	ND	0.046				
Oxygen/Argon	0.50	ND	2.1	ND	2.3	2.3	2.3				
Nitrogen	1.0	8.4	4.2	9.0	4.6	11	4.6				
Carbon Dioxide	0.010	37	0.042	37	0.046	35	0.046				
Gross Heat of combustion (BTU/FT3)	1.0	540	4.2	535	4.6	514	4.6				
Net Heat of combustion (BTU/FT3)	1.0	486	4.2	481	4.6	463	4.6				

PQL = Practical Quantitation Limit
ND = Not Detected (Below RL)
RL = PQL X Dilution Factor

Reviewed/Approved By: _____ Date: 8/22/19
Mark J. Johnson
Operations Manager

The cover letter is an integral part of this analytical report

QC Batch # 190808GC11A1
Matrix: Air
Units: % v/v

QC for Natural Gas Analysis by ASTM-D1945

Lab No.:	Blank		LCS		LCSD			
Fixed Gas Date/Time Analyzed:	8/15/19 9:56		8/15/19 10:16/15:40		8/15/19 10:35/15:55			
Hydrocarbon Date/Time Analyzed:	8/8/19 9:39		8/8/19 8:54		8/8/19 9:16			
Analyst Initials:	CM/AS		CM/AS		CM/AS			
Dilution Factor:	1.0		1.0		1.0			
ANALYTE	Results	RL	%Rec	Criteria	%Rec	Criteria	RPD	Criteria
Methane	ND	0.0010	102	70-130	101	70-130	0.6	<20
Ethane	ND	0.010	102	70-130	102	70-130	0.7	<20
Propane	ND	0.010	109	70-130	104	70-130	4.5	<20
Isobutane	ND	0.010	111	70-130	104	70-130	6.1	<20
n-Butane	ND	0.010	111	70-130	103	70-130	7.3	<20
Neopentane	ND	0.010	110	70-130	104	70-130	5.5	<20
Isopentane	ND	0.010	111	70-130	100	70-130	10.8	<20
n-Pentane	ND	0.010	110	70-130	100	70-130	9.8	<20
n-Hexane	ND	0.010	103	70-130	96	70-130	7.6	<20
n-Heptane	ND	0.010	113	70-130	88	70-130	25.0	<20
Oxygen/Argon	ND	0.50	101	70-130	100	70-130	0.8	<20
Nitrogen	ND	1.0	101	70-130	100	70-130	0.6	<20
Carbon Dioxide	ND	0.010	95	70-130	95	70-130	0.2	<20

ND = Not Detected (Below RL)
RL = PQL X Dilution Factor

Reviewed/Approved By: _____ Date: 8/22/19
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report.

Attachment C

SOLID WASTE DISPOSAL SITE PERMIT:

Municipal Solid Waste Landfill

Oregon Department of Environmental Quality
165 E. Seventh Ave., Suite 100
Eugene, OR 97401-3049
541-687-7465

Issued as authorized by ORS 459.245 and in accordance with the provisions of Oregon Revised Statutes Chapter 459, 459A, Oregon Administrative Rules 340 Divisions 64, 90, 93, 95, 96 and 97 and subject to the Land Use Compatibility Statement referenced below.

ISSUED TO:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

541-745-5792

FACILITY NAME AND LOCATION:

Coffin Butte Landfill
28972 Coffin Butte Road
Corvallis, OR 97330

Section 13&18, T10S, R5&4W, Benton County

OWNER:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

541-745-5792

OPERATOR:

Coffin Butte Landfill
28972 Coffin Butte Road
Corvallis, OR 97330

541-230-5546

ISSUED IN RESPONSE TO:

- Solid waste permit renewal application received Dec 6, 2019
- Land Use Compatibility Statement from Benton County dated Dec. 20, 2000.

The determination to issue this permit is based on findings and technical information included in the permit record.

ISSUED BY THE OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

Brian Fuller
Material Management Manager
Western Region

July 28, 2020
Date

Permitted Activities

Until this permit expires or is modified or revoked, the permittee is authorized to establish, operate, and maintain a solid waste land disposal site in conformance with the requirements, limitations, and conditions set forth in this document, including all attachments.

TABLE OF CONTENTS

INTRODUCTION

This document is a solid waste permit issued by the Oregon Department of Environmental Quality in accordance with Oregon Revised Statutes (ORS) 459 and Oregon Administrative Rules (OAR), Chapter 340.

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PERMIT ADMINISTRATION

1.0 PERMIT ISSUANCE

1.1 Permittee

This permit is issued to Valley Landfills, Inc.

1.2 Permit number

This permit is DEQ Solid Waste Permit Number 306.

1.3 Permit term

The permit is issued on the date it is signed. The permit's expiration date is June 30, 2030.

1.4 Facility type

The facility is permitted as a municipal solid waste landfill.

1.5 Facility owner/ operator

The owner of this facility is:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

The operator of this facility is:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

1.6 Basis for permit issuance:

This permit is issued based upon the following documents submitted by the permittee:

- Solid waste permit application received Dec. 6, 2019
- Land Use Compatibility Statements from Benton County dated Dec. 20, 2000

1.7 Definitions

Unless otherwise specified, all terms are as defined in OAR 340-093-0030.

1.8 Legal control of property

The permittee shall at all times maintain legal control of the disposal site property; including maintaining a current permit, contract or agreement that allows the operation of the facility if the site is not owned by the permittee.

1.9 Submittal & notification address

Unless otherwise specified, all submittals and notifications to DEQ under this permit must be sent to:

Oregon Department of Environmental Quality
Manager, Materials Management Program
165 E Seventh Ave., Suite 100
Eugene, OR 97401-3049

Telephone: 541-687-7465

All submittals must include, at a minimum, one paper copy and one electronic copy in a format that is approved by the DEQ project manager. Note that some submittals may require more paper copies. Therefore, the permittee must confirm with the permit manager how many copies are necessary prior to submittal of a document.

Note: Whenever possible, the permittee should submit two-sided paper copies of all reports. DEQ may accept electronic submittals for portions of some reports, as approved in the Environmental Monitoring Plan or by DEQ.

2.0 DISCLAIMERS

2.1 Property rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights.

2.2 Department liability

DEQ, its officers, agents or employees do not sustain any liability on account of the issuance of this permit or on account of the construction, maintenance or operation of facilities pursuant to this permit.

3.0 AUTHORITY

3.1 Ten year permit

This permit is issued for a maximum of 10 years as authorized by Oregon Revised Statutes 459.245 (2).

3.2 Documents superseded

This document is the primary solid waste permit for the facility, superseding all of other solid waste permits issued for Coffin Butte Landfill by DEQ.

3.3 Permittee responsibility and liability

Conditions of this permit are binding upon the permittee. The permittee must conduct all facility activities in compliance with the provisions of the permit. The permittee is liable for all acts and omissions of the permittee's contractors and agents in carrying out the operations and other responsibilities pursuant to this permit.

3.4 Other compliance

This permit's issuance does not relieve the permittee from the responsibility to comply with all other applicable federal, state, or local laws or regulations, including the following solid waste requirements, and any future updates or additions to these requirements:

- Solid waste permit application received Dec. 6, 2019
- Oregon Revised Statutes, Chapters 459 and 459A
- Oregon Administrative Rules Chapter 340
- Any documents submitted by the permittee and approved by DEQ

3.5 DEQ access to disposal site

The permittee shall allow representatives of DEQ access to the disposal facility at all reasonable times for the purpose of making inspections, surveys, collecting samples, obtaining data and carrying out other necessary functions related to this permit.

Reference: OAR 340-093-0050(6).

3.6 Penalties

Violation of permit conditions will subject the permittee to civil penalties of up to $25,000 for each day of each violation.

Reference: ORS 459.995(1)(a)

4.0 PERMIT MODIFICATION

4.1 Five year review

In the permit's 4th to 6th year, DEQ will review the permit and amend it if necessary. DEQ will consider the following factors in making this determination:

- Compliance history of the facility
- Changes in volume, waste composition, or operations at the facility
- Changes in state or federal rules which should be incorporated into the permit

- A significant release of leachate or landfill gas to the environment from the facility
- Significant changes to a DEQ-approved site development plan, and/or conceptual design
- Other significant information or events

4.2 Permit modification

DEQ or the permittee may, at any time during the permit's term, propose to change the permit.

Once approved by DEQ, any permit-required plans become part of the permit by reference. DEQ may provide notice and opportunity for review of permit-required plans.

4.3 Modification and revocation by DEQ

DEQ may, at any time before the expiration date, modify, suspend or revoke this permit in whole or in part, in accordance with Oregon Revised Statutes 459.255, for reasons including but not limited to the following:

- Violation of any terms or conditions of this permit or any applicable statute, rule, standard or order of the Commission;
- Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts
- A significant change in the quantity or character of solid waste received or in the operation of the disposal site

4.4 Modification by permittee

The permittee must apply for a modification to this permit if there is a significant change in facility operations or a deviation from permitted activities.

4.5 Public participation

DEQ will issue a public notice to inform the public of any significant changes to the permit.

4.6 Changes in ownership or address

At least 10 days in advance, the permittee must report to DEQ any change in the facility's ownership or the permittee's or operator's name and/or address.

Reference: OAR 340-093-0070(6)(a)(A)

ALLOWABLE ACTIVITIES

5.0 AUTHORIZATIONS

5.1 Wastes authorized for receipt

This permit authorizes the facility to accept:

- Solid waste as defined in OAR 340-093-0030(91)
- The following waste, when special handling and management requirements for their disposal are included in a special waste management plan approved by DEQ:
    - Cleanup Materials Contaminated with Hazardous Substances as defined in OAR 340-093-0030(19), in accordance with OAR 340-093-0170
    - Waste requiring special management as defined in OAR 340-093-0190
    - Industrial solid wastes as defined in OAR 340-093-0030(53)

5.2 Authorization of other wastes

DEQ may authorize the permittee to accept other waste if:

- The permittee develops a Special Waste Management Plan and submits it to DEQ for review and approval;
- DEQ approves the Special Waste Management Plan
- The permittee can demonstrate that the materials are not hazardous waste, as defined by state and federal regulations or otherwise a threat to human health or waters of the state.

5.3 Tires for recycling

This permit authorizes the permittee to accept up to 100 whole tires at this facility for storage and removal.

This permit authorizes the permittee to accept up to 2,000 whole tires at this facility for storage and removal if the permittee maintains a continuous contract with a waste tire carrier to remove the tires from the site.

5.4 Salvaging and recycling

This permit authorizes the permittee to conduct salvaging and recycling in a controlled and orderly manner. The permittee must notify DEQ prior to changing salvaging and recycling operations. These operations must be described in the site Operations Plan.

6.0 PROHIBITIONS

6.1 Hazardous waste disposal

The permittee must not accept any regulated hazardous waste.

Reference: 40 CFR 258.20 (b).

In the event discovered waste is hazardous or suspected to be hazardous, the permittee must, within 24 hours, notify DEQ and initiate procedures to identify and remove the waste. Hazardous waste must be removed within 90 days, unless DEQ approves otherwise. The permittee's temporary storage and transportation practices must comply with DEQ rules.

6.2 Liquid waste disposal

The permittee must not accept liquid waste for disposal.

Definition: Liquid waste is waste that does not pass the paint filter test performed in accordance with EPA Method 9095B.

6.3 Vehicle disposal

The permittee must not accept discarded or abandoned motor vehicles, including trailers or mobile homes, for disposal.

6.4 Used oil disposal

The permittee must not accept used oil for disposal.

6.5 Battery disposal

The permittee must not accept lead-acid batteries for disposal.

6.6 Tire disposal

The permittee must not accept waste tires for disposal.

6.7 Recyclable material disposal

The permittee must not landfill or dispose of any source separated recyclable material brought to the disposal site.

Exception: If the source separated material is unusable or not recyclable it may be landfilled. DEQ must agree to such disposal and pre-approve the identified sources of unusable source separated material prior to its disposal.

6.8 Open burning

The permittee must not conduct any open burning at the site.

6.9 Electronic waste disposal

The permittee must not knowingly accept the following covered electronic devices for disposal:

- Computer monitors having a viewable area greater than four inches diagonally
- Televisions having a viewable area greater than four inches diagonally

- Desktop computers
- Portable computers

Reference: Oregon Revised Statutes 459.247 and 459A.300-365.

OPERATIONS AND DESIGN

7.0 OPERATIONS PLAN

7.1 Operations plan submittal

Within 270 days of the permit issue date, the permittee must review and submit any necessary updates to the site Operations Plan to DEQ for review and approval. The updated plan must be consistent with the conditions of this permit. A DEQ-approved plan becomes an integral part of the permit.

7.2 Plan content

The Operations Plan must describe facility operations, including the elements listed below, and demonstrate how the facility will comply with all regulatory and permit requirements:

General Topics	Describe plans or procedures for:
General operations	• Screening incoming waste to detect unauthorized or prohibited waste as required by 40 CFR 258.20(a) • Handling and removing unauthorized wastes discovered at the facility • Managing landfill gas • Managing landfill leachate in compliance with Subsection 9.15 • Recirculating landfill leachate & gas condensate in compliance with Subsections 5.5 and 9.15 • Monitoring landslide stability in compliance with Subsection 9.22 • Designing surface water and erosion control structures • Responding to non-compliance events or situations
Disposal operations	• Placing daily and interim cover • Detecting and preventing the disposal of regulated hazardous waste, and any other DEQ-prohibited waste • Disposing of putrescible waste • Disposal, handling and recordkeeping of cleanup materials contaminated with hazardous substances • Waste unloading and handling • Disposing of special waste • Using, stockpiling and tracking the receipt and use of waste approved for use as alternative daily cover • Reducing and controlling the risk of a landfill fire • Fill progression and phasing that is consistent with landslide stability recommendations, and takes into account other operational considerations
Special Waste Management Plan	• Identifying and characterizing special waste (i.e., waste which requires special management or waste streams not otherwise authorized by this permit) • Identifying the source of all special waste • Determining appropriate handling and disposal procedures • Documenting plan implementation, including waste characterization and location of waste disposition References: OAR 340-093-0190, OAR 340-094-0040[11][b][J]
Ancillary operations	• Waste unloading and handling • Solidifying liquid waste prior to disposal

General Topics	Describe plans or procedures for:
	• Handling and removal of waste tires • Placing and maintaining interim cover over inactive landfill areas • Managing transfer containers
Inspection and maintenance	• Washing equipment • Maintaining leachate and gas collection systems • Maintaining monitoring stations and devices • Periodically inspecting the continuity and integrity of primary leachate collection pipes • Maintaining surface water control structures
Operating record	• Establishing and maintaining the operating record
Contingency	• Backup methods for storing and/or disposing of leachate • Providing fire protection equipment, and arrangements made with local fire control agency • Notifying DEQ about emergencies and fires

7.3 Operations and maintenance manual

Within 60 days of the Operations Plan's approval the permittee must prepare and submit an updated Operations and Maintenance Manual which includes detailed inspection and maintenance procedures and an associated schedule for all facility components that require periodic inspection. The manual must include specific procedures for routine preventative maintenance and repairs and for response to emergency situations. The preventative inspection and maintenance program should address the following equipment and facilities: personnel safety equipment, operating equipment, support facilities, environmental control systems, environmental monitoring systems, and the transportation system. The permittee must keep a copy of the Operations and Maintenance Manual with the Operating Record, readily available for DEQ inspection and review.

7.4 Plan and manual updates

The permittee must update and revise both the Operations Plan and the Operations and Maintenance Manual as necessary to reflect current and future facility conditions and procedures.

The permittee must submit any associated revisions or updates to DEQ for review and approval.

7.5 Plan and manual compliance

The permittee must operate the facility in accordance with the approved Operations Plan and Operations and Maintenance Manual, and any amendments to these documents.

8.0 RECORDKEEPING AND REPORTING – OPERATIONS

8.1 Non-compliance reporting

The permittee must take immediate corrective action for any violations of permit conditions or DEQ rules and notify DEQ.

DEQ response: DEQ may investigate the nature and extent of the compliance problem and evaluate the adequacy of the permittee's corrective action plans.

8.2 Permit display

The permittee must display this permit where operating personnel can easily refer to it.

8.3 Access to records

DEQ must have access, when requested, to all records and reports related to the permitted facility.

8.4 Procedures

The permittee's recordkeeping and reporting procedures are as follows:

Step	Action
1	Keep the Operating Record at the facility or at another DEQ-approved location.
2	Place information required by 40 CFR 258.29 and this permit in the Operating Record.
3	During facility operations, record the daily amount of each waste type received and approved alternative daily cover - qualified waste used for daily cover. Record 0 if the waste is not received. *Identify the following waste types received and categorize them as either in- or out-of-state waste:* • Domestic solid waste and construction and demolition waste • Industrial solid waste • Asbestos • Contaminated cleanup materials (except materials counted as alternative daily cover qualified waste) • Approved alternative daily cover qualified waste received • Other (i.e., specify any waste type not included in the above list).
4	If applicable, every quarter, record the amount of each material recovered for recycling or other beneficial purpose.
5	Submit the information collected in Step 3 above on the Solid Waste Disposal Report/Fee Calculation form provided by DEQ. Pay solid waste fees as required by OAR 340-097. Date due: last day of the month following the end of the calendar quarter.
6	Submit the information collected in Steps 3 & 4 above to the Wasteshed Representative on DEQ provided or approved form. Date due: Jan. 25 of each year.
7	Retain copies of all records and reports for 10 years after their creation.
8	Update all records to reflect current conditions at the facility.

8.5 Submittal address

Send required submittals to:

Oregon Department of Environmental Quality
Materials Management Section
Environmental Solutions Division
700 NE Multnomah St., Suite 600
Portland OR 97232

503-229-5913

9.0 SPECIFIC OPERATING CONDITIONS

9.1 Discovery of prohibited waste

If the permittee discovers prohibited wastes, the permittee must notify DEQ within 24 hours and begin to isolate or remove the waste. In addition, the permittee must take digital photos of the prohibited waste to document its quantity, nature, identity and source.

Within 60 days following the discovery, the permittee must transport non-putrescible, non-hazardous prohibited waste to a disposal or recycling facility authorized to accept such waste, unless otherwise approved or restricted by DEQ. The permittee must obtain DEQ's written approval to store putrescible, non-hazardous, prohibited waste.

9.2 Spills notification

Oregon Revised Statue 466.635 and Oil and Hazardous Materials Emergency Response Requirements, Chapter 340, Division 142 require immediate notification to Oregon Emergency Response System (OERS) after taking any required emergency actions to protect human health and the environment when

oil or hazardous materials are spilled. The spill must be immediately reported to OERS at 1-800-452-0311 if the spill is of a reportable quantity. Reportable quantities include:

- *Any* amount of oil spilled to waters of the state
- Oil spills on land in excess of 42 gallons
- Two hundred pounds (25 gallons) or more of spilled pesticide residue
- Spills of hazardous materials that are equal to, or greater than, the quantity listed in the Code of Federal Regulations, 40 CFR Part 302 (List of Hazardous Substances and Reportable Quantities), and amendments adopted before July 1, 2002.

For a complete list of hazardous materials required to be reported, please refer to OAR 340-142-0050.

9.3 Access roads

The permittee must provide all-weather access roads from the landfill property line to the active operational area and the environmental monitoring stations, and maintain them in a manner that prevents traffic hazards, dust and mud.

The permittee must use appropriate means, including truck washing, as needed to prevent haul trucks from tracking mud on external roadways outside the landfill boundaries. Any truck washing activities must be conducted on a hard surface and any disposal of wastewater must be accomplished in a manner approved by DEQ.

9.4 Unloading area

The area(s) for unloading incoming waste must be clearly defined by signs, fences, barriers or other devices. The permittee must minimize width of the unloading area to the maximum extent practicable.

9.5 Daily cover

At the end of each working day the permittee must cover all solid waste with a six inch, or thicker, layer of compacted soil or with a DEQ-approved, alternative daily cover.

9.6 Interim cover

As specified in DEQ-approved design and operations plans, the permittee must place and maintain interim cover over fill areas that will not receive additional waste for an extended period of time [i.e., greater than 120 days] and actively revegetate, in a DEQ-approved manner, any interim cover that will remain exposed for more than two years.

9.7 Surface water structures

The permittee must maintain all stormwater drainage structures in good functional condition, report to DEQ any significant malfunctions or damage and complete repairs within 60 days of discovery the problem.

9.8 Stormwater pollution control plan

The permittee must update and implement the Storm Water Pollution Control Plan consistent with site conditions and the stormwater permit requirements. Refer to the National Pollutant Discharge Elimination System Stormwater Discharge Permit No. 1200-Z. In addition, the permittee must keep a current copy of the permit in the facility Operating Record.

9.9 Asbestos waste management

The permittee must offload and dispose of friable asbestos-containing solid waste as specified in DEQ-approved Operations Plan, Operations & Maintenance Manual, and in OAR 340-248.

9.10 Leachate management systems

The permittee must operate the disposal site in a manner that deters leachate production to the maximum extent practicable, and construct, operate and maintain in good functional condition all DEQ-approved leachate containment, collection, detection, removal, storage and treatment systems. The permittee must remove leachate continuously from all landfill leachate collection systems, to minimize fluid buildup on the bottom liner and prevent the hydraulic head (fluid depth) from exceeding one foot.

9.11 Leachate surface impoundments

The permittee must: 1) completely contain leachate stored within lined surface impoundments; 2) maintain a minimum dike freeboard of two (2) feet above the maximum leachate level in those impoundments unless otherwise approved by DEQ; 3) fence the impoundments to control public access; and 4) lock all gates when no attendant is on duty. In addition, the permittee must post clearly legible, visible signs that describe the surface impoundment's contents and display the words "no trespassing".

9.12 Litter control

The permittee must at all times minimize windblown litter and collect it quickly and effectively to prevent scattering, nuisance conditions and unsightliness.

9.13 Vector control

The permittee must minimize vectors in the active disposal area, including insects, rodents and birds.

9.14 Air emissions

The permittee must control air emissions, including dust, malodors, air toxics, etc. related to disposal site construction, operation and other activities, and comply with DEQ air quality standards.

9.15 Access control

The permittee must control public access to the landfill as necessary to prevent unauthorized entry and dumping.

9.16 Landfill entrance sign

A prominently displayed sign must indicate the following:

- The name of facility
- The emergency telephone number
- The days and hours of operation
- The authorized and prohibited waste
- The Solid Waste Permit number
- The operator's address
- The consequences to haulers if they attempt to dispose of prohibited materials
- Any other information critical to the safe and efficient operation of the facility.

9.17 Fire protection and reporting

The permittee must provide complete and sufficient protection equipment and facilities in accordance with DEQ-approved Operations Plan.

Arrangements must be made with the local fire control agency to immediately acquire their services when needed. The permittee must implement preventative measures to ensure adequate on-site fire control, as determined by the local fire control agency. Fires must be immediately and thoroughly extinguished.

Fires shall be reported to DEQ within 24 hours.

9.18 Water supply

The permittee must provide water in sufficient quantities for fire protection, dust suppression, establishment of vegetation, and other site operations requiring water.

9.19 Landfill gas management

The permittee must control landfill gas in accordance with the requirements of 40 CFR Parts 51, 52 and 60 and OAR 340-094-0060(4).

9.20 Landfill gas control system operation and maintenance

The permittee must operate and maintain the landfill gas control and monitoring systems in good working order as required to prevent nuisance odors, air emissions and landfill gas migration (see methane compliance limits in Section 18).

If critical landfill gas equipment is significantly damaged or compromised, the permittee must replace or repair that equipment, within 60 days of discovering the problem, and submit a written inspection report to DEQ.

10.0 SITE DEVELOPMENT AND DESIGN

10.1 Site development plan

Within 360 days of the permit issue date, the permittee must submit any necessary update to the long-term Site Development Plan to DEQ for review and approval. Once approved, the plan becomes an integral part of this permit.

Reference: The *Solid Waste Landfill Guidance, September 1996,* describes the basic elements of a Site Development Plan. Organizing the plan in accordance with the Guidance will expedite DEQ's review.

10.2 Baseline design criteria

New municipal landfill waste landfill disposal units must include the following engineering controls:

- A composite liner system, including a DEQ-approved geomembrane liner (at least 60 mils thick for high density polyethylene, and at least 30 mils thick for approved alternative geomembranes) and at least two feet of compacted soil with an in-place permeability of 1 X 10^{-7} cm/sec or less, or a DEQ-approved alternative liner pursuant to 40 CFR Part 258.40(a)(1);
- A primary leachate collection and removal system (LCRS) which fully covers the liner system and maintains a leachate depth of less than a one foot above the liner, per 40 CFR 258.40(a)(2). All leachate collection pipes must be serviceable by clean outs;
- A secondary leachate collection and removal system(s) designed to effectively monitor the overlying composite-liner system's performance and (1) detect and collect leachate at locations of maximum leak probability; and (2) prevent groundwater intrusion and related monitoring biases;
- A leachate collection sump(s) with a double composite liner system and a leak detection and removal system. Each composite liner must meet the minimum design criteria previously cited in this subsection;
- An operations layer that covers and protects the primary LCRS and liner system from physical damage; and
- A leachate surface impoundment (if applicable) with a double liner and leak detection and removal system. One liner must meet the minimum composite liner criteria described above.

10.3 Design plans

At least six months prior to the anticipated construction date for new disposal units, closure of existing units, or development of other ancillary facilities, the permittee must submit engineering design plans to DEQ for review and approval. The design plans must be prepared and stamped by a qualified Professional Engineer with current Oregon registration and specify and/or provide the following:

- All applicable performance criteria, construction material properties and characteristics, dimensions and slopes
- The design basis and all relevant engineering analyses and calculations

10.4 Construction requirements

The permittee must construct all improvements in accordance with:

- The approved plans and specifications
- Any DEQ imposed conditions of approval
- Any future DEQ approved amendments to the plans and specifications
- Construction work must begin within 18 months of plan approval

10.5 Construction documents

Prior to constructing any landfill engineering controls (e.g., final cover, new disposal unit, or other waste containment facilities or improvements), the permittee must submit complete construction documents and receive DEQ's written approval. The construction documents must:

- Define the construction project team
- Specify material and workmanship requirements to guide the constructor in executing work and furnishing products
- Include a Construction Quality Assurance Plan that describes how the project team will monitor the quality of materials and the constructor's work performance and assure compliance with project specifications and contract requirements.

Reference: Follow the current *Solid Waste Guidance* to expedite DEQ review of the construction documents.

10.6 Construction inspection

During construction of a new landfill disposal unit, final cover system, or any other landfill controls or engineered features, the permittee must provide DEQ with a summary and schedule of planned construction activities to facilitate DEQ's inspection and oversight.

10.7 Construction report submittal

Within 90 days of completing construction of a new landfill disposal unit, a final cover system, or other engineering controls, the permittee must submit to DEQ a Construction Certification Report prepared by a qualified independent party. The report must document and certify that the construction of all required components and structures complies with this permit and DEQ-approved design specifications.

10.8 Construction report content

The construction report must include:

- An executive summary describing the construction project and any major problems encountered
- A list of the governing construction documents
- A summary of all construction and construction quality assurance activities
- The manufacturer's written certifications that all geosynthetic materials conform with project specifications
- Test data documenting that soil materials conform with project specifications
- A summary of all construction quality assurance observations, including daily inspection records and test data sheets documenting that materials deployment and installation conform with project specifications
- A description of the problems encountered and the corrective measures implemented
- The designer's acceptance reports for errors and inconsistencies
- A list/description of any deviations from the design and material specifications, including justification for the deviations, copies of change orders and recorded field adjustments, and copies of DEQ's written approvals for deviations and change orders
- Signed certificates for subgrade acceptance prior to placement of soil liner and for acceptance of the soil liner prior to deployment of geomembrane liner
- Photographs and as-constructed drawings, including record surveys of the subgrade, soil liner, granular drainage layer and protective soil layer
- The certification statement(s) and signatures of the construction quality assurance consultant, designer, and facility owner. One of these representatives must be a professional engineer with current Oregon registration.

10.9 Approval to use new disposal units

The permittee must not dispose of solid waste in newly constructed disposal units until DEQ has accepted the Construction Certification. If DEQ does not respond to the Construction Certification Report within 30 days of its receipt, the permittee may place waste in the unit.

11.0 RECYCLING REQUIREMENTS

11.1 Materials

The permittee must provide a place for receiving the following recyclable materials:

☒	ferrous scrap metal	☒	mixed paper
☒	motor oil	☒	non-ferrous scrap metal (including aluminum)

☒	newspaper	☒	corrugated cardboard and kraft paper (brown paper bags)
☒	container glass	☒	tin cans

11.2 Receiving location

The place for receiving recyclable material must be located at the disposal site or at another location more convenient to the population served by the disposal site. The recycling center must be available to every person whose solid waste enters the disposal site.

11.3 Material use

All source separated recyclable materials must be reused or recycled.

11.4 Recycling information

The permittee must provide, to disposal site users, the following recycling information on printed handbills:

- The on-site or off-site location of the recycling center
- The recycling center's hours of operation
- A list of acceptable materials for recycling
- Instructions for preparing source separated recyclable material
- Reasons why people should recycle

11.5 Sign

A prominently displayed sign must indicate the following:

- The availability of recycling at the disposal site or another location

Note: The sign must indicate the recycling center location, if not at the disposal site

- The materials accepted at the recycling center
- The recycling center's hours of operation (if different than disposal site hours)

11.6 Storage

Unless DEQ approves otherwise, all recyclable materials, except car bodies, white goods and other bulky items must be stored in containers.

SITE CLOSURE

12.0 CLOSURE CONSTRUCTION AND MAINTENANCE

12.1 Worst-case closure plan development

Within 90 days of permit issuance, the permittee must develop a conceptual "worst-case" closure plan and a conceptual post-closure plan(s), obtain DEQ approval of the plan(s), and maintain up-to-date copies of these plan(s) in the facility file.

Reference: The plans must comply with 40 CFR, Part 258, Subpart F, and OAR 340-094-0110.

12.2 Notification

The permittee must notify DEQ and receive DEQ approval when the conceptual "worst-case" closure and conceptual post-closure care plans are updated and placed in the file.

12.3 Closure permit

In accordance with OAR 340-094-0100, the permittee must apply for a closure permit at least five years prior to the landfill's anticipated final closure.

12.4 Closure plan approval

At least six months prior to final closure of any portion of the landfill, the permittee must submit detailed engineering plans, specifications, and a closure schedule to DEQ for review and approval.

The design plans must be prepared and stamped by a qualified professional engineer with a current Oregon registration and specify and/or provide the following:

- All applicable performance criteria, construction material properties and characteristics, dimensions and slopes
- The design basis and all relevant engineering analyses and calculations

Reference: The *Solid Waste Landfill Guidance, September 1996,* describes Closure Plan preparation. Following that format will expedite DEQ review of the plan.

12.5 Closure schedule

The permittee must initiate and complete closure of each landfill disposal unit in accordance with 40 CFR 258.60(f)&(g), or an alternate schedule approved by DEQ.

12.6 Final cover

Unless DEQ approves otherwise, the final landfill cover must be:

- At least three feet thick {OAR 340-094-0120(2)(a)}
- Designed to minimize infiltration of precipitation as required by 40 CFR Part 258.60
- Graded to compensate for estimated differential settlement and maintain positive drainage. Final (post-settlement) slopes must range between two percent and 30 percent.

12.7 Vegetation

The permittee must establish and maintain a dense, healthy growth of native vegetation over the closed areas of the landfill consistent with the proposed final use.

12.8 Final cover maintenance.

The permittee must maintain the final surface contours of the landfill cover such that:

- Erosion is minimized and ponding of water is prevented
- The integrity of the cover system is preserved in accordance with the approved plans

The permittee must reconstruct the cover system with approved materials and grade and seed all areas that have settled or where water ponds, and all areas where the cover soil has been damaged or thinned by cracking or erosion. Areas where vegetation has not been fully established shall be fertilized, re-seeded and maintained. Any damage repair or other reconstruction of a geomembrane barrier component in the final cover system shall be conducted in accordance with a construction quality assurance plan approved by the DEQ.

12.9 Slope stability

The permittee must maintain the stability of the landfill slopes and the overall structural integrity of the landfill.

12.10 Deed record

Within 30 days after the disposal site's final closure, the permittee must record a notation on the deed to the facility property as required by 40 CFR 258.60(i) and OAR 340-094-0130(1)(a), and submit a copy of the notation on the deed to DEQ.

13.0 FINANCIAL ASSURANCE

13.1 Financial assurance plan

The permittee must submit an updated financial assurance plan to the DEQ for review and approval and provide financial assurance for the costs of site closure, post-closure care, and potential corrective action. In addition, the permittee must place the plan in the facility file.

Reference: The plan must be prepared in accordance with OAR 340-094-0140. Acceptable mechanisms are described in OAR 340-094-0145.

13.2 Financial assurance required.

The permittee must comply with applicable financial assurance criteria requirements prescribed by OAR 340-094-0140. The permittee must maintain an up-to-date Financial Assurance Plan in the facility Operating Record, and provide financial assurance for landfill closure, post-closure care and, if required, corrective action. The financial assurance provided must:

- Be in the amount required by OAR 340-094-0140(5)
- Be updated, annually, in accordance with OAR 340-094-0140(6)(e)
- Consist of a financial assurance mechanism complying with OAR 340-094-0145

13.3 Recertification of financial assurance.

The permittee must annually review and update their financial assurance in accordance with OAR 340-094-0140(6)(e).

By April 1 of each year, a notarized annual recertification of financial assurance must be submitted to DEQ demonstrating that this review has been completed. If a discount rate is used to estimate costs, the annual update must also include the certifications listed in OAR 340-094-0140(6)(d).

13.4 Use of financial assurance

The permittee must not use the financial assurance for any purpose other than to finance the permitted facility's approved closure, post-closure, and corrective action activities or to guarantee that those activities will be completed.

13.5 Continuous nature

The permittee must continuously maintain financial assurance for the facility until the permittee or other person owning or controlling the site is no longer required by DEQ to demonstrate financial responsibility for closure, post-closure care or corrective action.

ENVIRONMENTAL MONITORING

14.0 SITE CHARACTERIZATION

14.1 Workplan

At least 270 days prior to any new landfill construction or expansion beyond the currently characterized and approved footprint, the permittee must submit two (or more) copies of a detailed workplan to DEQ for review and approval. The workplan must summarize all site characterization completed to date, describe further site characterization that will be accomplished and include at least the following elements:

- A description of the landfill expansion
- A proposal for monitoring all relevant media within the expansion area
- An update to the Environmental Monitoring Plan that reflects all approved changes to the facility
- A detailed description of the planned investigation
- A detailed project schedule

14.2 Site characterization report

Within 180 days of DEQ's approval of the workplan, the permittee must submit at least two copies of the report to DEQ for review and approval. This report must be based on DEQ-approved workplan and any conditions of the approval. The report must be prepared and stamped an Oregon registered geologist or an Oregon registered engineering geologist. The permittee must submit the report and receive DEQ's approval before starting construction or operation of the new landfill area. Once approved, this report and any conditions of approval become an integral part of the permit.

Reference: The *Solid Waste Landfill Guidance, September 1996,* describes the applicable elements of a Site Characterization Report. Organizing the report in that manner will expedite DEQ's review of the plan.

15.0 ENVIRONMENTAL MONITORING PLAN

15.1 Environmental Monitoring Plan Submittal

Within 120 days when requested by DEQ, the permittee must submit an updated Environmental Monitoring Plan to DEQ for approval.

Major changes in updates to the original plan require that the entire plan be submitted as a stand-alone document; at a minimum, this must be done at least once every 10 years. The plan, or any updates to the plan, must be prepared and stamped by an Oregon registered geologist or an Oregon registered engineering geologist. Upon approval, this plan is incorporated into this permit by reference.

15.2 Environmental Monitoring Plan contents

The updated plan must include plans (other than monitoring that is already handled by an NPDES permit) implementing an environmental monitoring program that will characterize potential facility impacts, including leachate collection, containment, treatment and disposal. The updated plan may incorporate parts of the previous approved plan with any changes or additions since that time (i.e., approved permit-specific concentration limits, revised parameter lists, revised schedules and new wells).

The updated plan must include the following contents, as well as applicable elements from the reference document:

- Monitoring Network Design and Construction
- Sampling and Analysis Plan
- Field QA/QC Procedures
- Lab QA/QC Procedures
- Data Analysis and Evaluation
- Report Format and Executive Summary

Reference: The *Solid Waste Landfill Guidance, September 1996,* provides information on applicable elements of an Environmental Monitoring Plan. Following the organizational format provided in the Guidance will expedite DEQ review of the plan.

15.3 Environmental Monitoring Plan revisions and updates

The permittee must revise the current plan as necessary to reflect current and future environmental conditions, facility development and regulatory requirements. A geologist or certified engineering geologist, with current Oregon registration, must prepare and stamp the plan revisions and submit two copies (one printed and one electronic) to DEQ for review and approval.

15.4 Environmental Monitoring Plan public comment period

Plan changes may require a public comment period.

15.5 Long-term monitoring plan

After DEQ approves any Risk-Based Concentration Limits (RBCs), Permit-Specific Concentration Limits (PSCLs), Concentration Limit Variances (CLVs), Action Limits (ALs), or Site-Specific Limits (SSLs), the permittee must update the EMP to reflect the long-term monitoring program and submit the updated plan for DEQ review and approval.

Note: Also see this permit's requirements for establishing PSCLs, ALs, or SSLs and OAR 340-040-0030(4) for procedures to establish CLVs.

15.6 Leak Detection System

Any significant increase in flow rate in the leak detection system (or degradation of water quality) that have not been corrected (or significant progress made) within two years, also require an updated plan submittal. This plan update is required if a statistical analysis indicates that normal monitoring of detection and compliance sampling points have shown a degradation of water quality. The analysis should cover the period of time from before the changes to after the increased leakage (or degradation of water quality) occurred. The updated plan submittal must detail any proposed increases in frequency or parameter monitoring, as well as any additional monitoring points.

15.7 Additional monitoring points

The permittee must incorporate any new or replacement monitoring point or device into the Environmental Monitoring Plan and submit the updated plan to DEQ for review and approval.

15.8 Environmental Monitoring Plan Compliance

The permittee must conduct all environmental monitoring at the facility in accordance with the approved plan, including any conditions of approval, amendments and updates.

16.0 ENVIRONMENTAL SAMPLING REQUIREMENTS

16.1 Notification of sampling events

The permittee must notify DEQ, in writing, at least 10 working days prior to a scheduled sampling event.

16.2 Split sampling events

The permittee must split samples with DEQ at DEQ's request, and schedule split-sampling events with DEQ's laboratory at least 45 days ahead of time.

Oregon Department of Environmental Quality
Laboratory, Groundwater Monitoring Section
7202 NE Evergreen Parkway, Suite 150
Hillsboro, OR 97124
Phone: 503-693-5700 Fax: 503-693-4999

The permittee must conduct the following split sampling events with DEQ:

Fall or Spring 2024 (TBD)
Fall or Spring 2029 (TBD)
Other sampling events if requested by DEQ

16.3 Monitoring schedule

The permittee must refer to the approved EMP for environmental monitoring procedures. Quarterly monitoring benchmarks are defined below:

If sampling in the...	Schedule the sampling event	
	On, or after....	But on, or before...
Winter	Jan. 1	Feb. 28
Spring	April 1	May 31
Summer	July 1	Aug. 31
Fall	Oct. 1	Nov. 30

16.4 Monitoring after Environmental Monitoring Plan approval

The permittee must monitor the facility in accordance with: 1) the approved plan; 2) any conditions of DEQ's approval; and 3) any DEQ-approved amendments and updates.

16.5 Changes in sampling or split sampling

The permittee must submit a written request and obtain DEQ's written approval before changing the sampling program, including sampling frequency, parameters, or locations. Approved changes will become an integral part of the plan.

DEQ reserves the right to add to or delete from the list of scheduled sampling events, sampling locations, and sampling parameters, and to conduct unscheduled sampling or split sampling events.

If the split-sampling schedule changes, DEQ will try to notify the permittee at least 30 days prior to the next scheduled event.

17.0 ESTABLISHING PERMIT-SPECIFIC CONCENTRATION LIMITS (PSCLs), ACTION LIMITS (ALs), CONCENTRATION LIMIT VARIANCES (CLVs) AND SITE-SPECIFIC LIMITS (SSLs)

17.1 Gathering data

The permittee must monitor the designated background wells in accordance with the approved Environmental Monitoring Plan or propose an alternative intrawell approach. Site specific limits (SSLs) exist for several parameters at two wells and remedial action concentration limits exist for additional parameters at some other wells. Background monitoring shall continue until all necessary data sets have been collected, and may be used for creation of additional PSCLs, ALs and/or SSLs for parameters of concern. The permittee then must demonstrate to DEQ's satisfaction that the selected background-data set is valid and unaffected by facility releases.

17.2 Future disposal units or cells

Before using a new landfill unit or cell for waste disposal, the permittee must collect enough samples to determine background groundwater quality. Alternatively, the permittee may develop a program, to be approved by DEQ, for determining background groundwater quality with wells installed at the time of landfill cell construction.

17.3 Statistical analysis

To establish compliance concentration limits (PSCLs, ALs, and SSLs), the permittee must perform statistical evaluations of the monitoring results for each sampling event.

Use methods outlined in 40 CFR 258.53 or other DEQ accepted statistical methods.

References:

The permittee should use methods outlined in Environmental Protection Agency's "Statistical Analysis of Groundwater Monitoring at RCRA facilities" (March 2009) or other DEQ accepted statistical methods. DEQ's 2011 Guidance Document "Developing Concentration Limits at Permitted Solid Waste Facilities" provides some examples of acceptable methods.

17.4 Proposing PSCLs, ALs, and/or SSLs

The permittee must propose for DEQ's review and approval, a PSCL, AL or SSL pursuant to the guidelines specified in OAR 340-040. The proposal must address all required parameters. Once a statistically valid data set (at least nine acceptable data points) are established from the appropriate background well(s), the permittee may generate a PSCL, AL, or SSL for each designated, long-term monitoring parameter.

17.5 Changing PSCLs, ALs, and/or SSLs

If the permittee demonstrates to DEQ's satisfaction that background groundwater quality has significantly changed since the PSCL, AL or SSL was established, and if the change is unrelated to the permitted facility's influence, the permittee can propose to DEQ a revised level for the affected PSCL(s), AL(s) or SSL(s).

17.6 Establishing and changing CLVs

The permittee should refer to DEQ's Groundwater Quality Protection Rules [OAR 340-040-0030(4)] for guidance in establishing and changing Concentration Limit Variances (CLVs).

18.0 ENVIRONMENTAL MONITORING STANDARDS

18.1 Applicable regulatory standard

The permittee must not allow the release of any substance from the landfill into groundwater, surface water, or any other media which will result in a violation of any applicable federal or state air or water limit, drinking water rules, or regulations, beyond the solid waste boundary of the disposal site or an alternative boundary specified by DEQ. Refer to OAR 340-094-0080.

18.2 Compliance points

Compliance wells are defined in the most current site Environmental Monitoring Plan.

18.3 Review of results

The permittee must review the analytical results after each monitoring event according to the protocols established in the most currently approved site-specific Environmental Monitoring Plan.

18.4 Resampling results

Upon receipt of data from resampling, the permittee must review the analytical results according to the protocols established in the most currently approved site-specific Environmental Monitoring Plan.

18.5 Secondary leachate collection system (SLCS)

If the permittee observes liquids in the leak detection system, the permittee must respond in accordance with the approved plan procedures for sampling, analysis and reporting. If testing confirms landfill impacts

in the leak detection or secondary leachate collection system, and that system is compromised as a compliance point, DEQ may require the permittee to install additional detection or compliance wells and conduct further investigations.

The permittee must design each secondary leachate collection system-equipped landfill cell or sub-unit to allow for discrete sampling of the secondary leachate collection system without mixing, co-mingling or compositing of samples with other leachate sources.

18.6 Methane limits

The methane concentration must not exceed:

- Twenty-five percent of methane's Lower Explosive Limit in onsite structures (excluding gas control structures or gas recovery system components)
- Methane's Lower Explosive Limit at the facility property boundary

Note: Methane's Lower Explosive Limit is equal to a concentration of five percent by volume in air.

18.7 Methane exceedance

If methane levels exceed the specified limits, the permittee must:

1. Take immediate steps to protect human health and safety and notify DEQ within 24 hours
2. Within seven days of detection, confirm the measures taken to protect human health and safety (unless DEQ approves an alternative schedule), and describe the methane test results and response measures in the facility operating record
3. Within 60 days of the methane exceedance, develop and implement a remediation plan, incorporate the plan into the monitoring records, and submit a progress report to DEQ.

18.8 Certified environmental laboratory data

To assure the best possible data quality, DEQ requests that the permittee contract with environmental labs certified under the Oregon Environmental Laboratory Accredited Program (ORELAP) or the National Environmental Laboratory Accreditation Program (NELAP). The permittee should include a copy of the lab's certification with every data submittal. Use of an ORELAP or NELAP approved lab will facilitate DEQ's future review of Environmental Monitoring Plan updates, Annual Environmental Monitoring Reports, and RI/FS documents.

19.0 RECORDKEEPING AND REPORTING – ENVIRONMENTAL MONITORING

19.1 Annual Environmental Monitoring Report (AEMR)

Prior to March 31 of each year, the permittee must submit to DEQ two copies (one paper copy and one electronic copy) of an annual monitoring report for the previous calendar year's monitoring period. The report must conform to the format detailed in the approved plan and be prepared and stamped by a geologist or a certified engineering geologist, with current Oregon registration. Extensive ancillary information such as laboratory reports, and the historical analytical database, may be provided only in the electronic copy and not in the printed copy.

Note: The permittee should submit two-sided copies of all reports and may submit electronic submittals of reports.

19.2 Statement of compliance

The Annual Environmental Monitoring Report must include a brief (approximately one-page) cover letter that:

- Compares the analytical results with the relevant monitoring standards (RBCs, PSCLs, CLVs, ALs, or SSLs)
- Documents any exceedances of or federal or state standards for relevant media
- Documents any significant change in water quality, land quality, air quality or methane levels in monitored media

19.3 Annual Environmental Monitoring Report contents

The Annual Environmental Monitoring Report must reflect the facility's current conditions, present accurate data that correspond with the original field and lab data, and include the elements presented in the most recently approved plan.

19.4 Annual leachate treatment report

Prior to March 31 of each year, the permittee must submit an annual leachate monitoring report.

Reference: The report format should reflect DEQ's guidance: *Solid Waste Landfill Guidance*, September 1996, or the format presented in the most recently approved plan.

19.5 Annual leachate treatment report contents

This annual report must include the elements presented in the most recently approved plan.

Reference: The report format should reflect DEQ's guidance: *Solid Waste Landfill Guidance*, September 1996, or the format presented in the most recently approved plan.

19.6 Split sampling submittal

Within 90 days of any split sampling event, the permittee must submit the following information to DEQ's laboratory:

- A copy of all information pertinent to the sample collection handling, transport and storage, including field notes
- Copies of all laboratory analytical reports
- Copies of all laboratory Quality Assurance Quality Control reports
- A copy of the lab certification (ORLAP or NVLAP, see Certified Environmental Lab Data condition above)
- A hydrogeologic map of the site showing groundwater flow directions and water table contours
- Any other data or reports requested by DEQ

19.7 Lab address

Report all required split sampling information to:

Oregon Department of Environmental Quality
Laboratory, Groundwater Monitoring Section
7202 NE Evergreen Parkway, Suite 150
Hillsboro, OR 97124

Phone: 503-693-5700 Fax: 503-693-4999

19.8 DEQ response to split samples

If the permittee submits all required split sampling data and requests DEQ's results, DEQ's lab may provide, to the permittee, copies of the following information:

- DEQ's analysis of the split sample
- The QA/QC report
- The analytical report
- The field data sheets

20.0 ENVIRONMENTAL MONITORING NETWORK

20.1 Monitoring device installation

For future disposal units or cells, the permittee must install DEQ-approved background and detection and/or compliance wells at least 12 months before refuse disposal occurs in the new cells. A Site Characterization Report may also be required for any proposed new cell. DEQ may waive or modify this requirement if the permittee provides adequate justification for an alternative approach.

20.2 Monitoring stations and equipment

To assure that every sample is representative of the site's environmental conditions, the permittee must protect, operate, and maintain all environmental monitoring stations and equipment in accordance with DEQ's requirements.

20.3 Access to monitoring stations and equipment

To facilitate sample collection and/or inspection and maintenance activities, the permittee must maintain reasonable all-weather access to all monitoring stations and associated equipment.

20.4 Reporting equipment damage

Within 14 days of discovering any damaged monitoring equipment or station, the permittee must submit to DEQ a report describing the damage, the proposed repair or replacement measures, and the schedule to complete this work.

Example: a well's impaired function or altered position/location.

20.5 Monitoring well construction

The permittee must complete any monitoring well or gas monitoring probe abandonment (decommissioning), replacement, repair, or installation in a manner that complies with the Water Resources Rules, OAR 690-240, and with DEQ's *Guidelines for Groundwater Monitoring Well Drilling, Construction, and Decommissioning*, dated August 1992.

20.6 Reporting well construction and repairs

The permittee must document all monitoring well or gas probe repair and construction activities, including driller's logs, well location information, and construction information in a report prepared and stamped by a geologist or certified engineering geologist, with current Oregon registration. The permittee must submit the report to DEQ within 30 days of the action and include this documentation in the next Annual Environmental Monitoring Report.

20.7 Well decommissioning or replacement

The permittee must submit a written recommendation to DEQ prior to decommissioning or replacing any well or gas monitoring probe in the monitoring network. After receiving DEQ's approval, the permittee must decommission or replace any well or gas probe that meets the following criteria:

- The well or gas probe was installed in a borehole that hydraulically intersects two saturated stratas
- The permittee lacks supporting documentation demonstrating that the well or gas probe was properly installed and constructed
- The well or gas probe was damaged beyond repair or destroyed
- Other reasons as determined by either the permittee or DEQ

COMPLIANCE SCHEDULE

21.0 SUMMARY OF DUE DATES

21.1 Summary

The permittee must comply with the event-driven schedule shown below. This compliance schedule does not apply to many of the routine reporting requirements specified in other sections of the permit.

Due Date	Activity	See section...
120 days prior to new landfill construction or expansion	Submit updated Environmental Monitoring Plan	15.1 Environmental Monitoring Plan submittal
Within 90 days of permit issuance	Review and submit conceptual "worst-case" closure and post closure plan	12.1 Worst case closure plan development

April 1st of each year	Submit financial assurance plan and mechanism	13.3 Recertification of financial assurance
Within 360 days of permit issuance	Review and submit site development plan update	10.1 Site development plan
Within 270 days of permit issuance	Submit updated Operations Plan	7.1 Operations plan submittal
Within 60 days of Operations Plan approval	Submit updated Operations and Maintenance Manual	7.3 Operations and Maintenance Manual
By March 31 for each year	Submit an Annual Environmental Monitoring Report	19.1 Annual Environmental Monitoring Plan
By March 31 for each year	Submit an Annual Leachate Treatment Report	19.4 Annual leachate treatment report
SAMPLING:		
At least 10 working days prior to scheduled sampling event	Notify DEQ	16.1 Notification of sampling events
At least 45 days prior to split sampling event	Schedule split sampling event with DEQ laboratory	16.2 Split sampling events
Within 90 days of split sampling event	Submit required data/documents to DEQ laboratory	19.6 Split sampling submittal
EVENTS:		
Within 30 days of DEQ notification of need to install monitoring well or probe	Install groundwater monitoring well and/or probe	20.1 Monitoring device Installation
Within 30 days of any well construction	Submit well construction report	20.6 Reporting well construction and repairs
At least 6 months before any new disposal unit and/or closure construction	Submit engineering design plans and, if applicable, closure schedule	10.3 Design plans 12.4 Closure plan approval
At least 270 days prior to new construction or expansion	Submit a Site Characterization Report Workplan	14.1 Workplan
Within 180 days of DEQ approval of SCR workplan	Submit a Site Characterization Report	14.2 Site characterization report
Within 90 days after completion of any major construction	Submit Construction Certification Report	10.7 Construction report submittal
Within 18 months of plan approval	Begin construction	10.4 Construction requirements

ATTACHMENTS

22.0 ATTACHMENT

Attachments to the permit include:

Number	Description
1	Parameter Groups
2	Permit-specific concentration limits

22.1 Attachment 1: Parameter Groups

Overview

This attachment describes the environmental-monitoring parameter groups and associated requirements

Due to the duration of this permit, suggested analytical methods may change. If that is the case, use the most currently promulgated EPA method or DEQ-approved equivalent.

Note: Method means EPA SW 846 Method [suggested methods are in square brackets].

Group 1a: Field indicators

The field indicators parameter group includes the following parameters:

Elevation of water level
pH
Temperature
Specific Conductance
Dissolved Oxygen
Eh

With instruments calibrated to relevant standards, measure these parameters in the field when collecting samples. Acceptable methods include:

- Down-hole in situ
- In a flow-through well
- Immediately following sample recovery

Group 1b: Leachate indicators

The laboratory indicators parameter group includes the following parameters:

Total Dissolved Solids (TDS)
Total Suspended Solids (TSS)
Total Organic Carbon (TOC)
Chemical Oxygen Demand (COD)

Proper techniques for sample handling, preservation, and analysis are specific to each individual analyte: Follow appropriate EPA techniques or AWWA Standard Methods.

Group 2a: Common anions and cations

The common anions and cations parameter group includes the following parameters:

Calcium (Ca)
Sulfate (SO_4)
Total Ammonia (NH_3+NH_4)
Sodium (Na)
Nitrate (NO_3)
Silicon (Si)
Iron (Fe)
Manganese (Mn)
Magnesium (Mg)
Chloride (Cl)
Carbonate (CO_3)
Potassium (K)
Bicarbonate (HCO_3)

Dissolved concentrations must be measured. Field-filter and field-preserve samples according to standard DEQ and/or EPA guidelines and analyze by appropriate EPA or AWWA Standard Methods techniques. Report results in mg/L and meq/L.

Group 2b: Trace metals

The trace metals parameter group includes the following parameters:

Antimony (Sb)	Chromium (Cr)	Selenium (Se)
Arsenic (As)	Cobalt (Co)	Silver (Ag)
Barium (Ba)	Copper (Cu)	Thallium (Tl)
Beryllium (Be)	Lead (Pb)	Vanadium (V)
Cadmium (Cd)	Nickel (Ni)	Zinc (Zn)

If the Total Suspended Solids concentration is...	analyze for...
less than or equal to 100.0 mg/L in the sample	total concentrations (unfiltered)
Greater than 100.0 mg/L in the sample	both total (unfiltered) and dissolved (field-filtered)

Field-preserve samples according to standard DEQ and/or EPA guidelines and analyze by EPA Method 6010C or DEQ-approved equivalent.

Group 3: Volatile organic constituents

Analyze for all compounds detectable by EPA Method 8260B (C- other method 8/06) or EPA Method 524.2, include a library search to identify any unknown compounds present. The volatile-organic-compounds parameter group is equivalent to the EPA Method 8260B list.

DEQ must pre-approve alternative methods like EPA Method 8021B

Group 4: Assessment monitoring

The assessment monitoring parameter group includes the following parameters:

Semi-volatile Organic Constituents, including Phenols, EPA Method 8270D
Mercury, EPA Method 7470A
Cyanide, EPA Method 9010C (manual distillation) or 9012B (automated distillation)
Nitrite

All Method 8270D analyses must include a library search to identify any unknown compounds present.

Group 5: Surface water and leachate

The surface water parameter group includes the following parameters:

Total Kjeldahl Nitrogen (TKN)	Total Coliform Bacteria [EPA Method 9131]
Total Phosphorus (P)	Fecal Coliform Bacteria [EPA Method 9131]
Orthophosphate (PO_4)	E. Coli
Biological Oxygen Demand (BOD)	

22.2 Attachment 2: Remedial Action Concentration Limits and Permit Specific Concentration Limits

In accordance with OAR 340-040-0050(2) and as defined in the site Record of Decision (dated October 2004); Remedial Action Concentration Limits are established for the "west side" monitoring points specified in Section 18.2 of this permit as follows:

Compound	RACL	Basis	COPC
Volatile Organic Compounds (µg/L)			
1,4-Dichlorobenzene (1,4-DCB)	75	MCL/RL	Yes
Tetrachloroethene (PCE)	5	MCL	Yes
Trichloroethene (TCE)	5	MCL/RL	Yes
Vinyl chloride	2	MCL/RL	Yes
Trace Metals (µg/L)			
Antimony	6	MCL	No
Arsenic	10	MCL	Yes
Barium	1,000	RL	No
Beryllium	4	MCL	No
Cadmium	5	MCL	Yes
Chromium	50	RL	No
Lead	50	RL	No
Nickel	100	MCL	No
Selenium	10	RL	No
Silver	50	RL	No
Thallium	2	MCL	No
Dissolved Metals (µg/L)			
Iron	300	SMCL	Yes
Manganese	50	SMCL	Yes
Inorganic Compounds (mg/L)			
Chloride	250	SMCL	Yes
Total Dissolved Solids (TDS)	500	SMCL	Yes
RACL: Remedial Action Concentration Limit			
Basis: The lower of either Federal primary Maximum Contaminant Level (MCL) or State Reference Level (OAR 340-040-0020, Tables 1 through 3).			
SMCL: Secondary MCL			
COPC: Chemical of Potential Concern			

In accordance with Section 17 of this permit, Permit-Specific Concentration Limits are established for the "east side" monitoring points specified in Section 18.2 of this permit as follows:

Site Specific Limits for MW 26 and 27
Assumes 2 Compliance Wells, 7 or 8 COCs, Semiannual Sampling

Indicator Parameters (Date set: 2011-2018)	Statistical Distribution	Prediction Limits (mg/L)		Retesting
		MW-26	MW-27	
Bicarbonate	Normal	175[a]	495	1 of 2
Chloride	Normal	6.2	15.0	1 of 2
TDS	Normal	246[a]	499	1 of 2
Calcium	Normal	32.0[a]	100	1 of 2
Iron	NP/Normal	4.5	17.6	1 of 2
Magnesium	Normal	10.1	46.0	1 of 2
Manganese	Normal	0.74	8.9	1 of 2
Sodium	Normal	30.0	44.4	1 of 2

Note: [a] surrogate value calculated from MW-22.
Retesting scenario achieves annual site wide false positive rate of 10% per EPA Unified guidance.

EXHIBIT 14
COFFIN BUTTE LANDFILL EXPANSION ODOR DISPERSION MODELING STUDY

Coffin Butte Landfill Expansion
Odor Dispersion Modeling Study

Coffin Butte Landfill
28972 Coffin Butte Road
Corvallis, OR 97330

SCS ENGINEERS

Project No. 24224358.00 | October 22, 2024

5963 La Place Court, Suite 207
Carlsbad, CA 92008
760-744-9611

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1.0 INTRODUCTION

The Coffin Butte Landfill (CBLF) is proposing to expand the waste disposal area of the landfill by using an existing property just south of Coffin Butte Road. The goal of this study was to conduct an odor dispersion modeling analysis that compares the existing and proposed operating scenarios for potential nuisance odor impacts. Since odor is a subjective human response, odor dispersion modeling was used to provide an objective approach towards understanding how on-site emissions of odor potentially impact off-site locations.

Following this Introduction, Section 2 provides a description of the facility. Section 3 describes the methodology used in this study while Section 4 summarizes the results. Section 5 then presents the conclusions. Finally, the appendices provide supporting documentation.

2.0 FACILITY DESCRIPTION

2.1 LOCATION

The CBLF is located at 28972 Coffin Butte Road in Corvallis, Oregon (Benton County). The facility is located just west of Highway 99W, approximately nine miles north of downtown Corvallis. Coffin Butte Road runs through the facility. See Figure 1 for the CBLF property boundary [1].

Figure 1. Facility Location

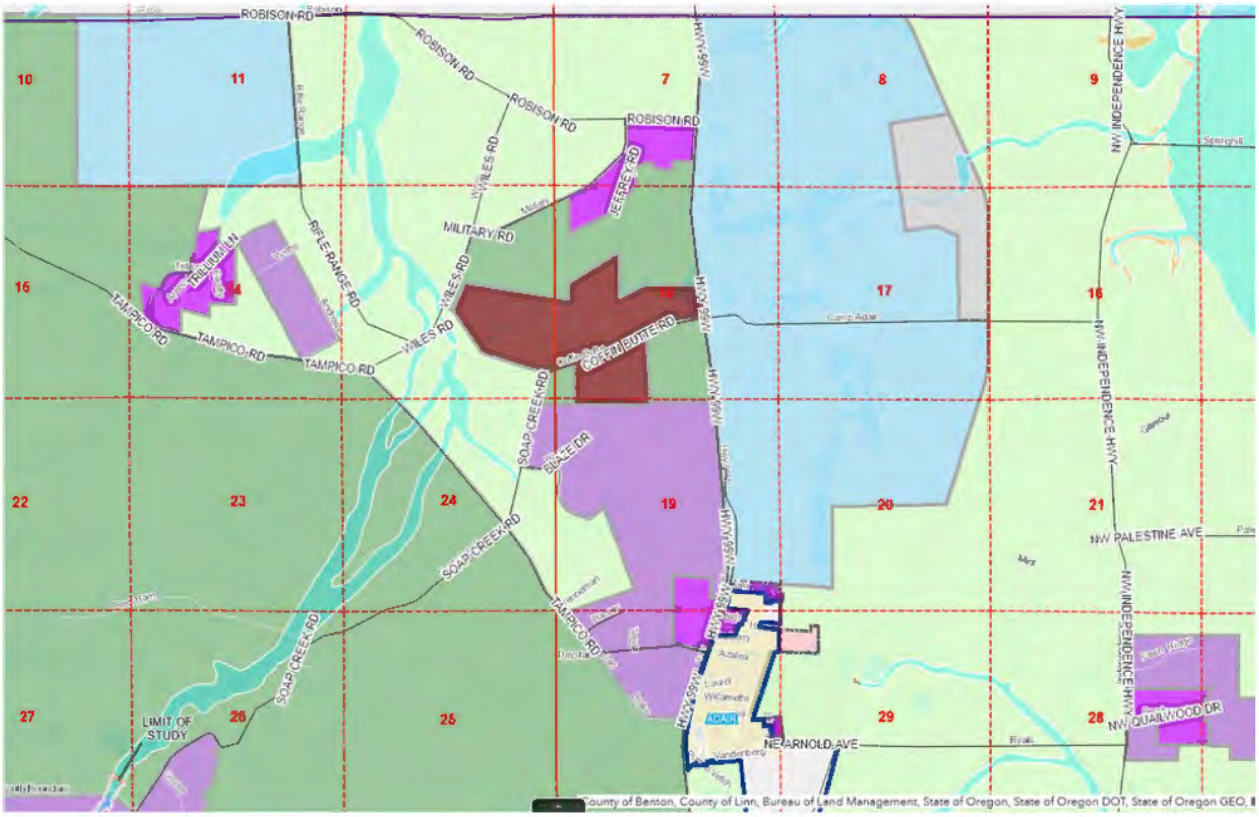


Note: Google Earth imagery from April 18, 2024.

2.2 LOCAL LAND USE / ZONING

Local land usage impacts air dispersion as surface characteristics differ for rural and urban conditions. Local land use near the CBLF is rural based upon the zoning map in Figure 2 [2].

Figure 2. Local Zoning Map



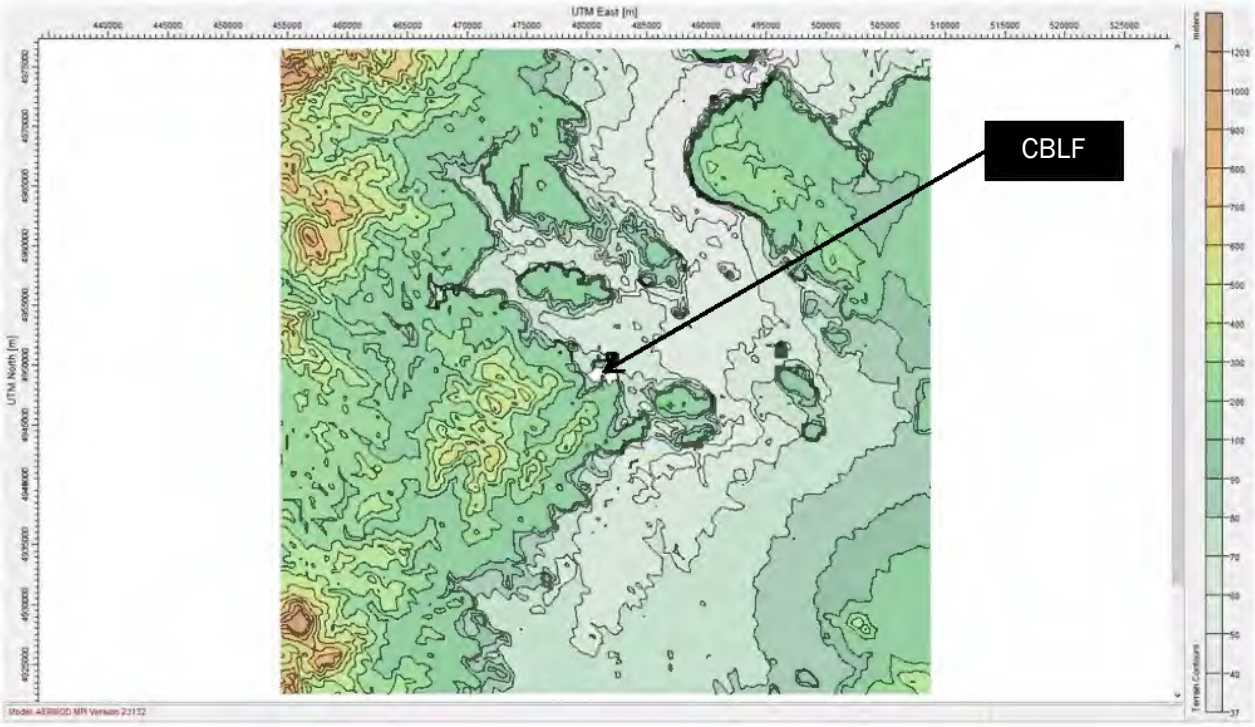
Zoning Color Code Legend:

- Exclusive farm use (light green);
- Forest conservation (green);
- Landfill (brown);
- Open space (light blue);
- Rural residential – 5 (magenta); and
- Rural residential – 10 (light magenta).

2.3 TERRAIN / TOPOGRAPHY

Local terrain also impacts air dispersion as winds can be channeled when flowing through canyons and valleys. In this case, the CBLF is located along the western edge of the Willamette Valley. See Figure 3 for the elevation contours surrounding the landfill [4].

Figure 3. Elevation Contour Map



2.4 CLIMATE AND METEOROLOGY

Local air quality is also impacted by the regional climate and meteorology as weather conditions control the transport and diffusion of emitted pollutants downwind from the release point into the surrounding area. Climate deals with long-term weather patterns while meteorology deals with short-term daily and hourly weather conditions. Nuisance odors are more likely to occur under poor meteorological conditions (e.g., low wind speed and stable wind conditions) that are common in the late night and early morning hours.

CBLF operates one weather station at the landfill. Nearby weather data is also collected by the National Oceanic and Atmospheric Administration (NOAA) / National Weather Service (NWS) at Corvallis Municipal Airport (KCVO) and Salem-McNary Field (KSLE). Table 1 provides information about these weather stations while Figure 4 displays their locations.

Table 1. Nearby Weather Monitoring Stations

Weather Data	On-site Weather Station	Corvallis Municipal Airport (KCVO)	Salem-McNary Field (KSLE)
Source	CBLF	NOAA	NOAA
USAF ID	---	726945	726940
WBAN ID	---	24202	24232
Frequency	30 minutes	1 hour	1 minute
Minimum wind speed (mph)	1	3.4	1
Wind direction resolution (deg)	1	10	1
Coordinates (Latitude, Longitude)	44.696, -123.234	44.5, -123.283	44.905, -123.001
Elevation (ft)	295	250	208
Distance from CBLF (miles)	0	13.9	18.5

A wind rose is used to display wind speed and wind direction (i.e., the direction from which the wind is blowing) data graphically for a designated historical time period (e.g., three years, seasonal, hour of the day). Figures 5 through 7 display wind roses for the CBLF, KCVO, and KSLE stations based upon the same three year time period (8/1/2021 to 8/1/2024). As shown in these figures, long term wind patterns vary depending upon the location measured. Therefore, wind conditions measured at the CBLF may not be representative of wind conditions at a reported odor complaint location due to valley terrain. See Appendix A for additional wind roses which compare the CBLF and KCVO wind roses based upon season and time of day.

Figure 4. Nearby Weather Monitoring Stations

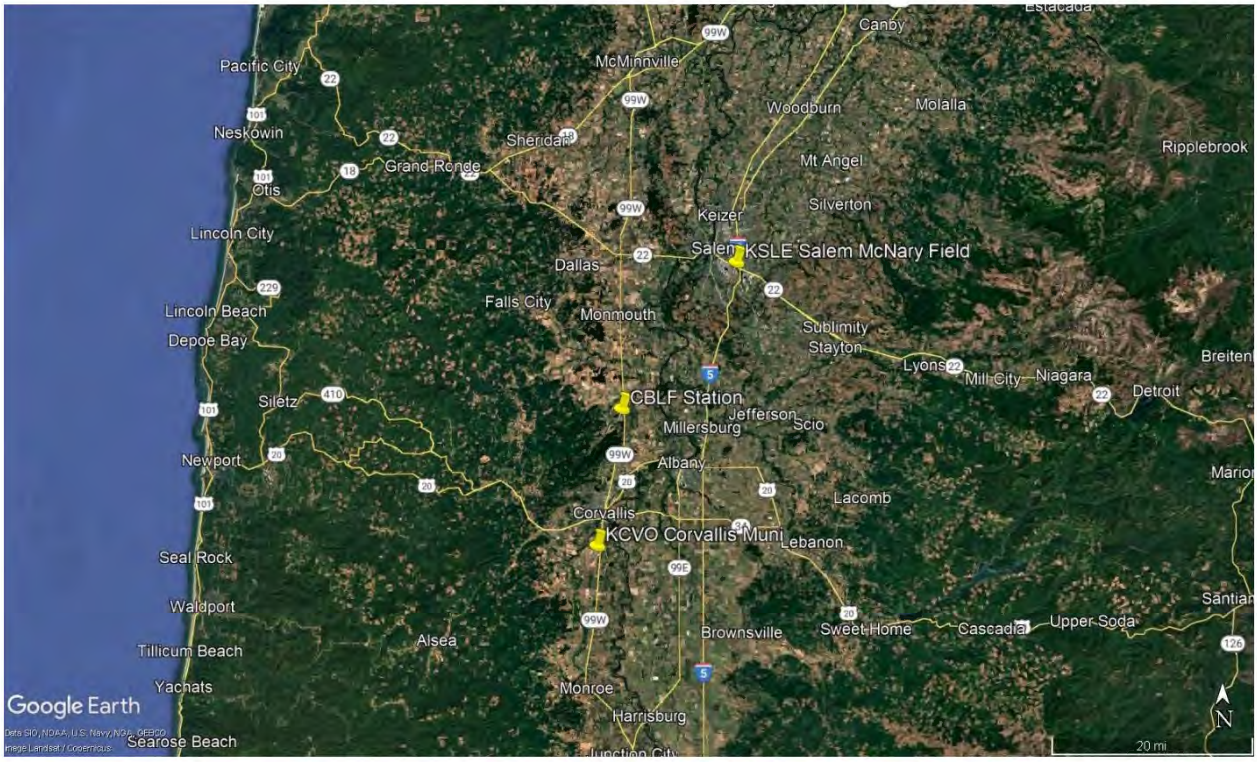


Figure 5. CBLF On-Site 3-Year Windrose

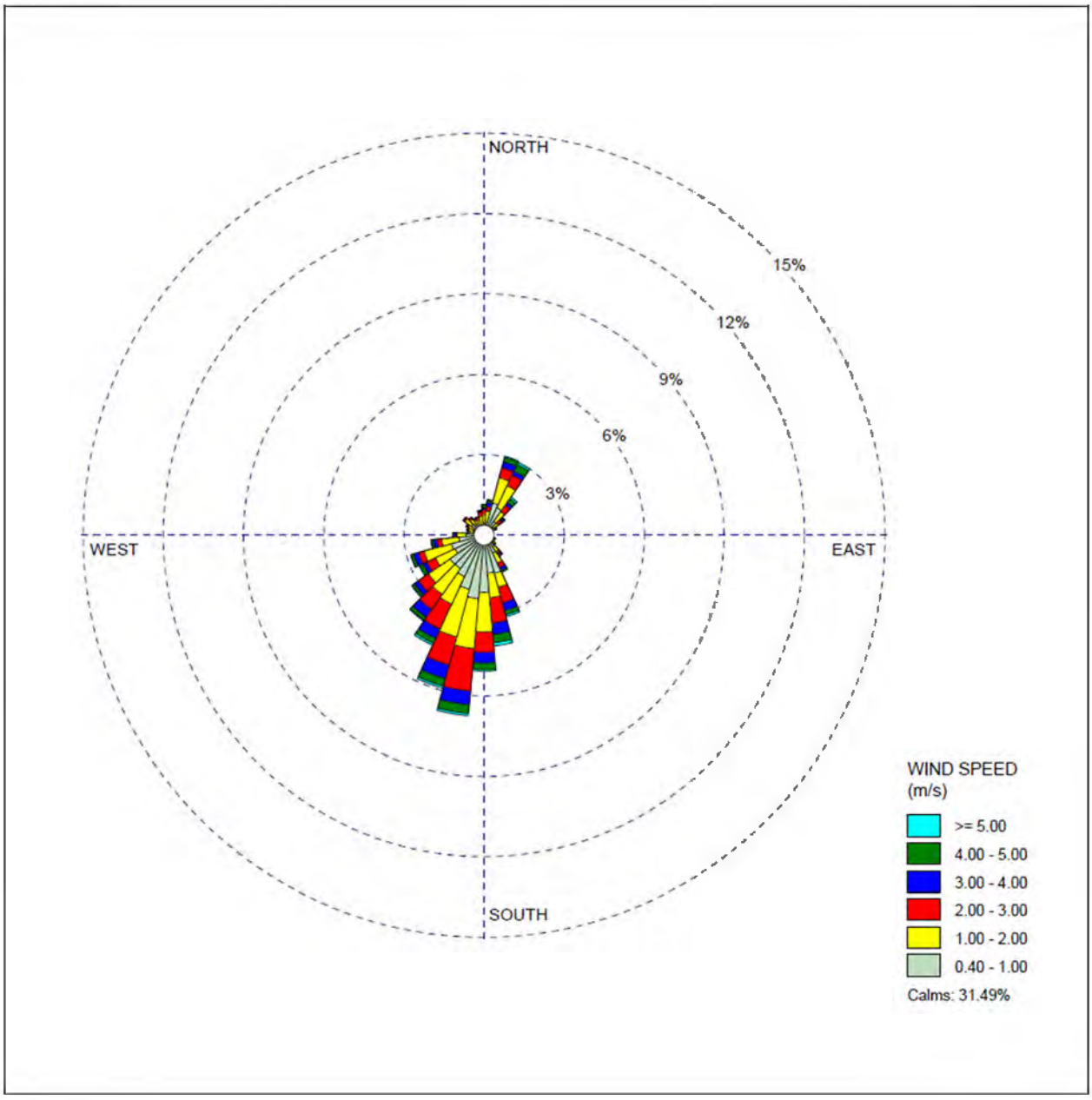


Figure 6. Corvallis Municipal Airport (KCVO) 3-Year Windrose

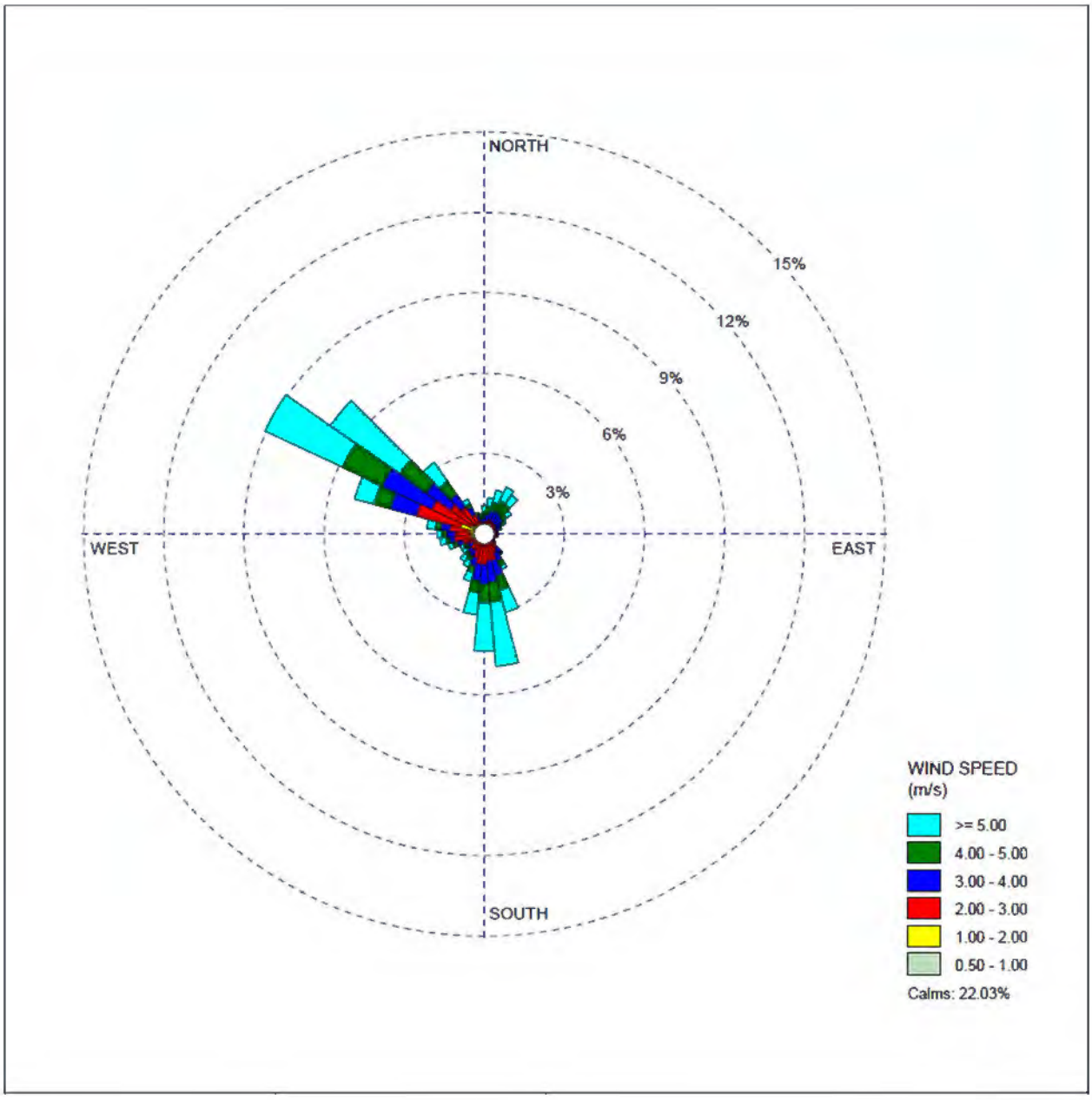
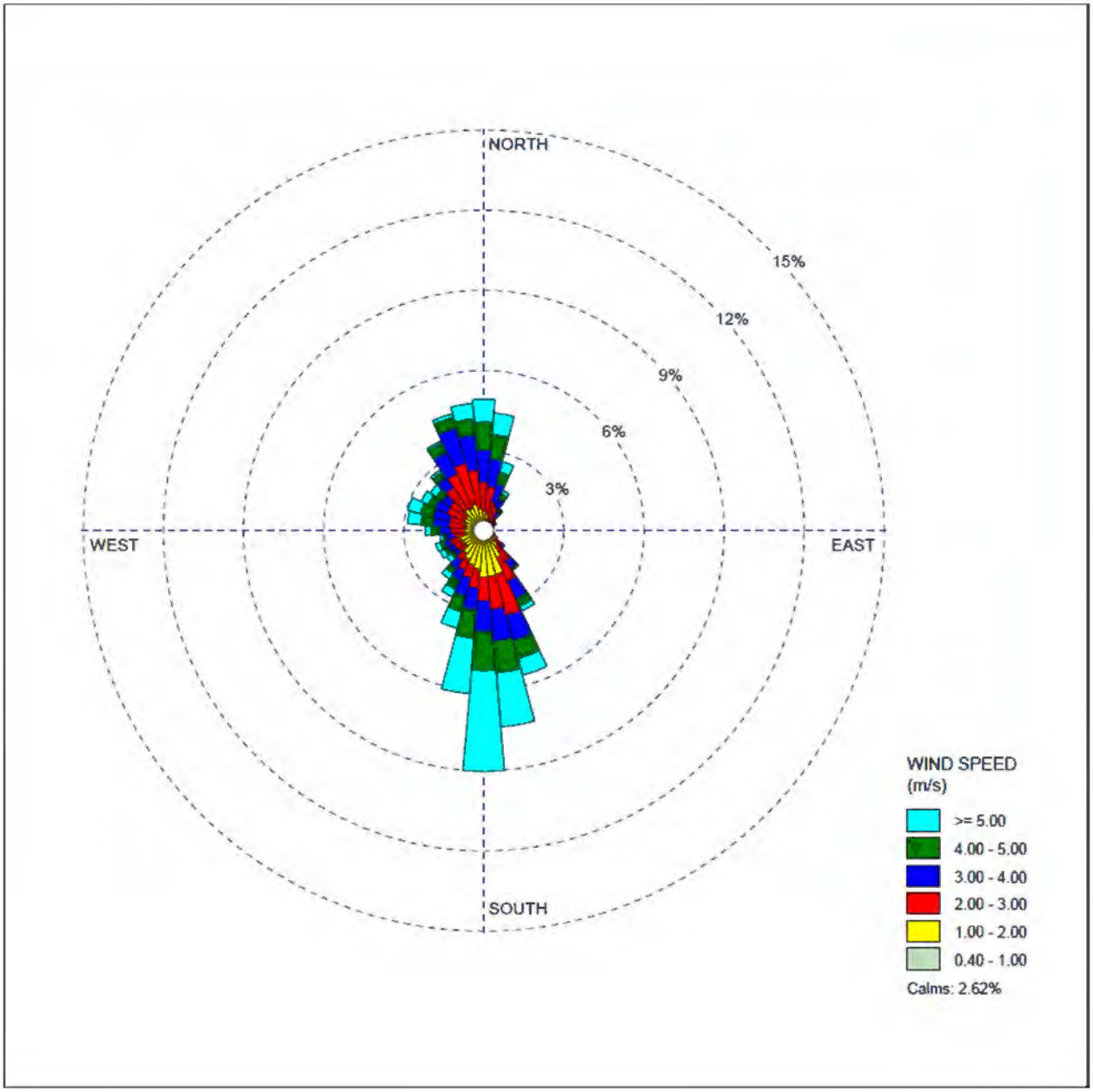


Figure 7. Salem-McNary Field (KSLE) 3-Year Windrose



2.5 POTENTIAL ODOR ACTIVITIES

CBLF accepts commercial and public solid waste. The waste is placed in layers at the working face, compacted by heavy equipment, and then covered daily. Once an area of the CBLF has reached capacity, it is eventually capped with final cover to minimize infiltration of precipitation and release of gases not captured by the landfill gas collection and control system (GCCS). Odor is potentially emitted from sources such as:

- working face;
- leachate (i.e., water that has passed through the landfill's layers);
- landfill gas (LFG) which is a natural byproduct of decomposing organic material; and
- flares which burn any excess LFG collected by the CBLF.

2.6 ODOR MONITORING AND CONTROL MEASURES

CBLF has developed and implemented a site-specific odor management plan that includes:

- application of daily cover;
- operating a LFG collection and control system;
- conducting surface emissions monitoring (SEM);
- monitoring local weather conditions (temperature, wind direction, etc.);
- conducting routine odor patrol inspections;
- responding to odor complaints received from the public and/or the Oregon Department of Environmental Quality (ODEQ);
- taking action when odors are detected/reported;
- observing the area of concern for smell and conditions;
- inspecting landfill operations for any unusual activities or conditions;
- identifying possible sources of odor; and
- confirming implementation of applicable odor minimization measures.

2.7 ODOR COMPLAINT HISTORY

SCS reviewed available data from recent odor complaints (January 2020 through August 8, 2024) to identify any specific patterns. Of the 70 odor complaints with exact dates reported, over half occurred during the winter season (see Table 2). Of the 50 complaints with the time of day reported, the peak complaint time was 8:00 am (see Figure 8). See Figure 9 and Figure 10 for odor complaint locations that provided an address or an intersection.

Table 2. Odor Complaints by Season

Season	Time Period	Complaints (%)
Winter	December 1 to February 29	55.7%
Spring	March 1 to May 31	21.4%
Summer	June 1 to August 31	14.3%
Fall	September 1 to November 30	8.6%

Figure 8. Odor Complaints by Time of Day

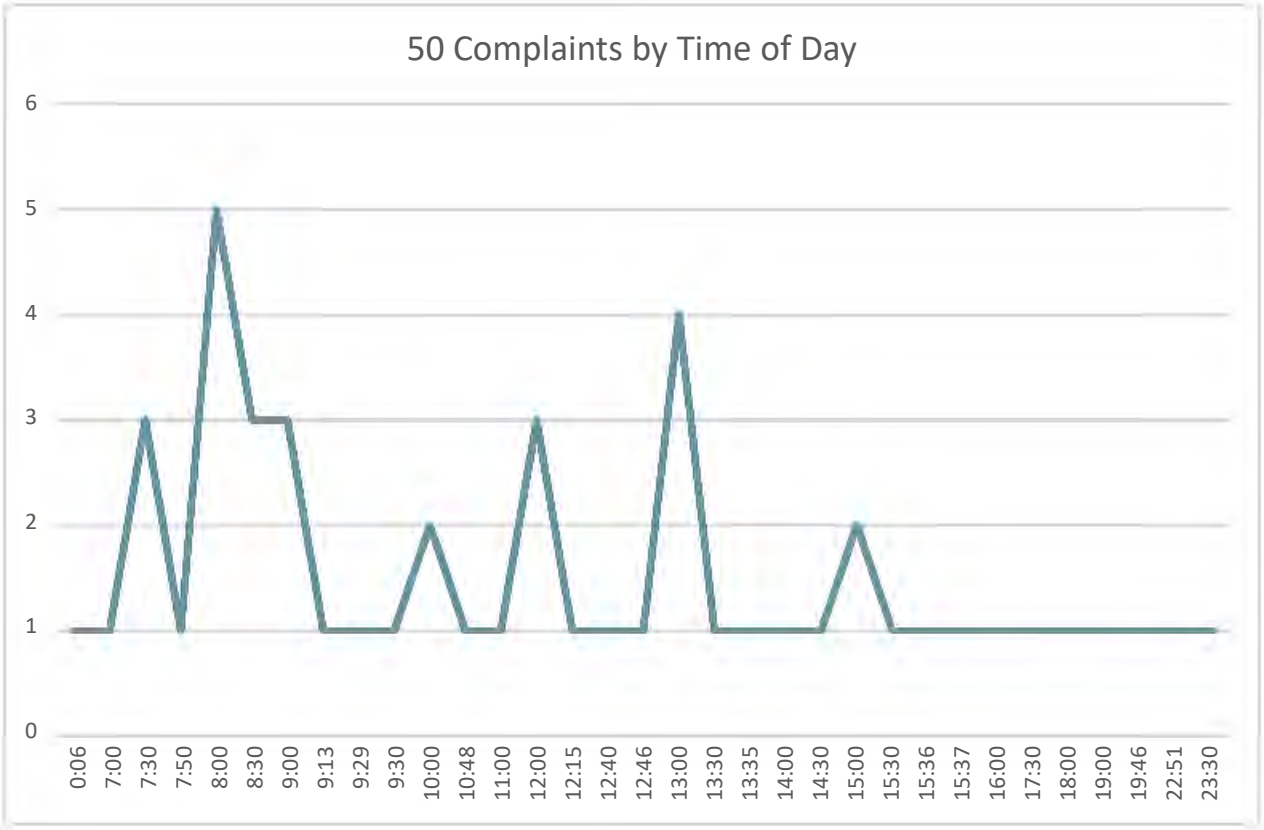


Figure 9. Odor Complaint Locations (View 1 of 2)

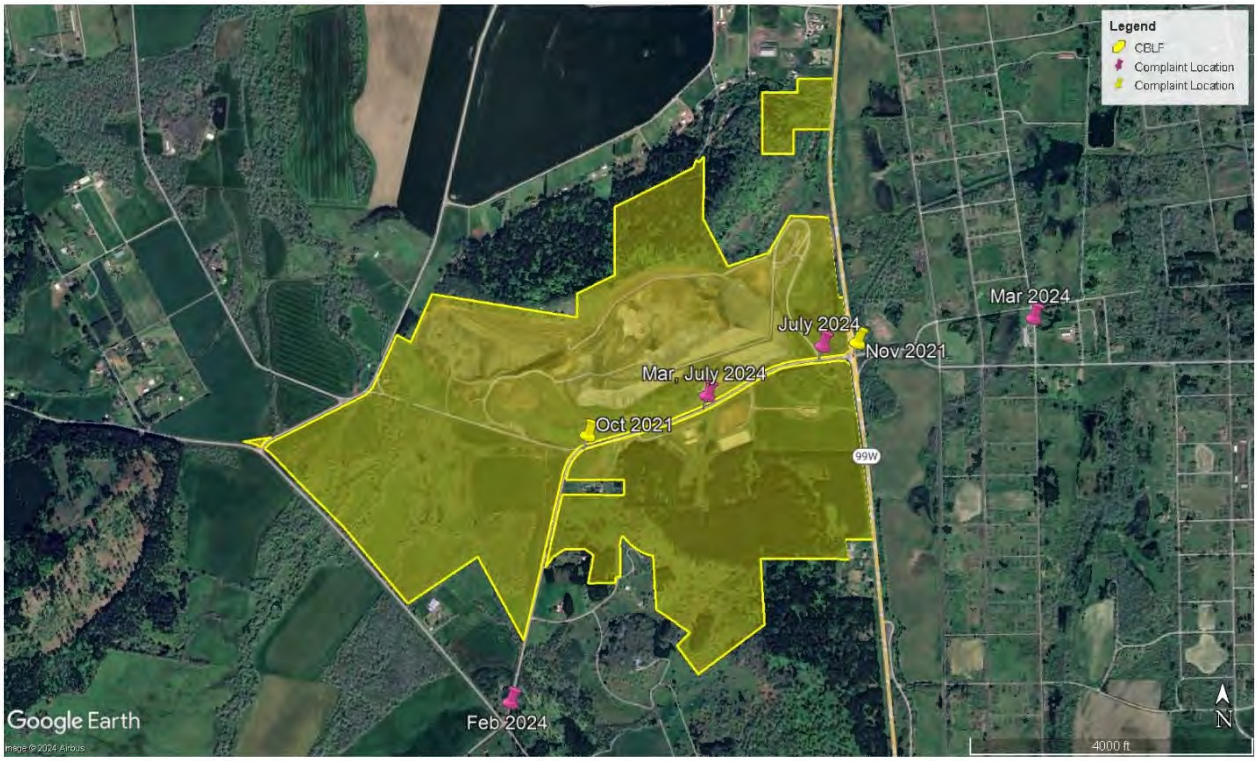
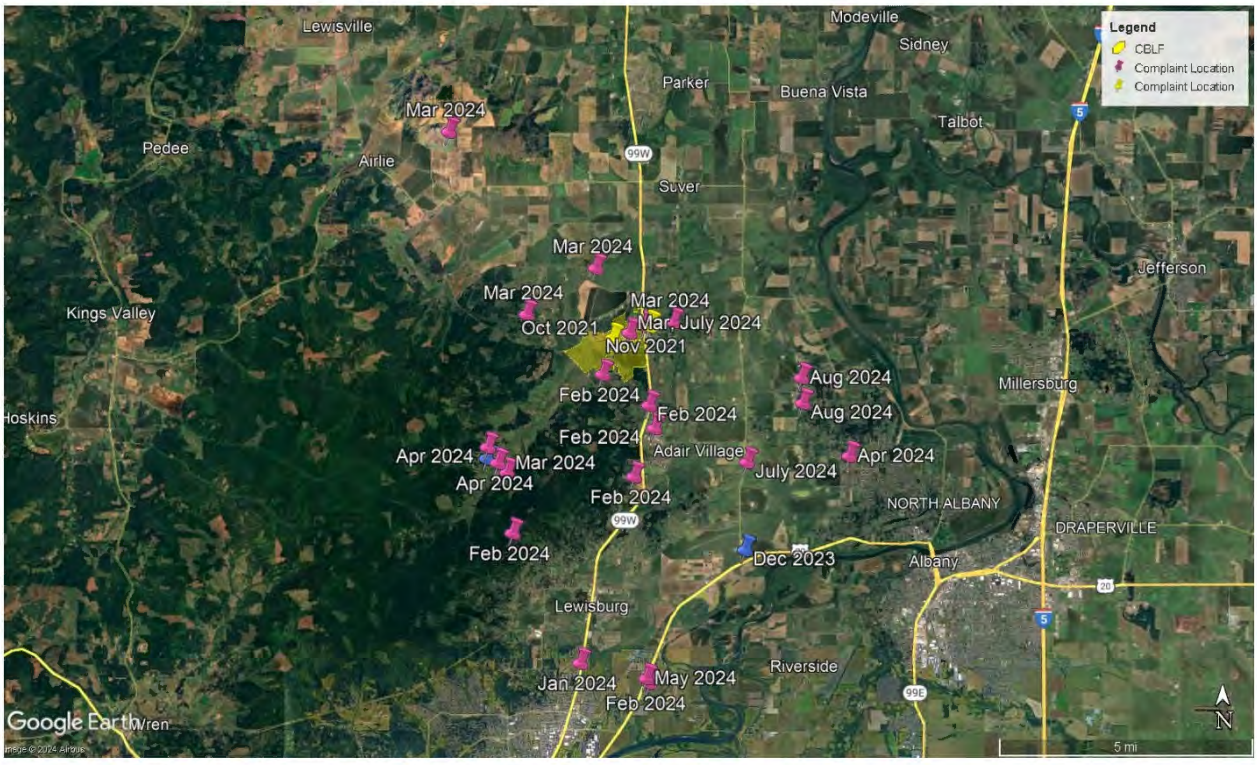


Figure 10. Odor Complaint Locations (View 2 of 2)



2.8 PROPOSED PROJECT

CBLF is requesting approval of a conditional use permit (CUP) application to expand the area on which landfill activities will be conducted to the south side of Coffin Butte Road (the "Development Site"). In addition to using the Development Site for the landfill, the proposed changes include an 1,800-square-foot employee building and parking on land to the west of the landfill, access road modifications on lands to the north, and the relocation of leachate ponds, leachate loadout, leachate sump, an outbound scale, portions of the perimeter landfill road, the shop/maintenance area, cut activities for landfill, and leachate ponds to support the landfill onto the property to the east (collectively, the "Project") [3]. Figure 11 displays the location of the expansion area in relation to existing operations.

Figure 11. Proposed Expansion Area (Taxlot 104180001107)



3.0 METHODOLOGY

Since odor is a subjective human response, odor dispersion modeling provides an objective approach towards understanding how on-site emissions of odor potentially impact off-site locations. The following summarizes the methodology used in this study.

3.1 MODEL SELECTION

The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) (EPA Version 23132 (May 12, 2023) incorporated into the Lakes Environmental AERMOD View 12.0 software suite) [5] was used to model representative emissions of odor from the landfill. AERMOD was selected for this study since:

- AERMOD is preferred/recommended by the EPA for near-field dispersion of emissions for distances less than 50 kilometers in both simple and complex terrain.
- AERMOD is acceptable to the ODEQ for dispersion modeling studies [6].
- AERMOD has undergone numerous validation studies.
- AERMOD is in the public domain and is readily available.
- AERMOD can model multiple sources and multiple receptors.
- AERMOD can use representative meteorological data to simulate atmospheric conditions that affect the transport and dispersion of air pollution from sources.
- AERMOD can use local terrain data to model receptors in complex terrain.
- AERMOD can be used to model impacts of odor causing pollutants.

Input data for AERMOD included the following which are described below:

- source parameters (locations, dimensions, emission rates, etc.);
- receptor locations;
- meteorological data;
- terrain data; and
- model options.

See below for details regarding the AERMOD model input.

3.2 SOURCE PARAMETERS

Source parameters were used to model the release of odor from two virtual sources (one representing existing operations and one representing proposed operations). Each source was modeled as a 100-meter by 100-meter area source with the same odor emission rate so that individual odor impacts could be compared. The odor emission rate for each source was estimated as odor concentration times odor volumetric flow rate using representative data since field measurements were not collected for this study.

Odor concentration is defined as the dilution of an odor sample with odor-free air, at which point only 50% of an odor panel (or population) will detect or recognize the odor (e.g., per ASTM 679-04 – Standard Practice for Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits). This point is expressed in units of “dilutions-to-threshold” or “D/T”. By definition, odor threshold is equal to 1 D/T (i.e., volume of odorous air after dilution divided by volume before dilution equals one). Typically, odors become a nuisance at or above 7 D/T [8,9]. For

this study, 500 D/T was used to represent odor concentrations from the working face, covered areas, and leachate based upon prior field studies conducted by SCS Engineers at other landfills.

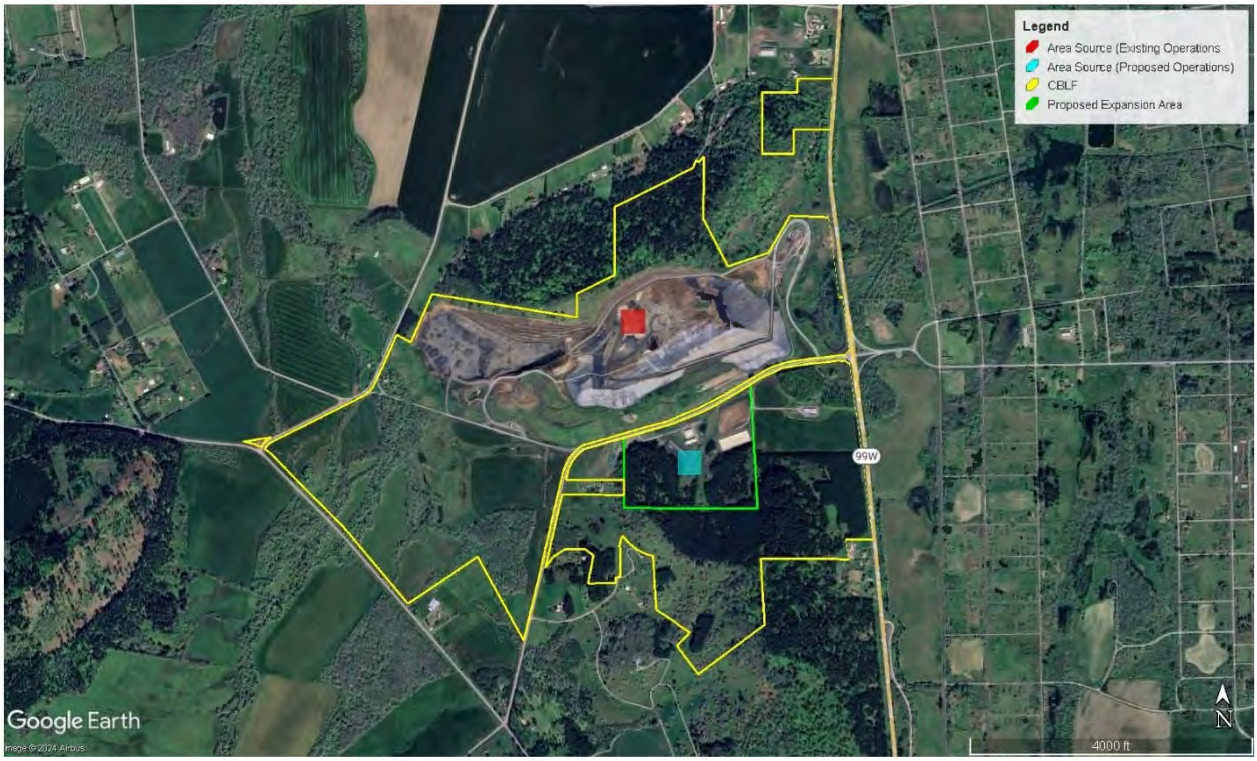
Odor volumetric flow rate (m^3/s) was estimated as vertical velocity (m/s) times the source's surface area (m^2). For this study, 1.0×10^{-4} m/s was used to represent the vertical velocity of odor emitted from the working face, covered areas, and leachate based upon prior field studies and odor studies conducted by SCS Engineers at other landfills.

Table 3 summarizes the source parameters modeled while Figure 12 displays the modeled source locations.

Table 3. Source Parameters Modeled

Parameter	Virtual Source #1 (Existing Operations)	Virtual Source #2 (Proposed Operations)
UTM X, Y Coordinates (m)	481500, 4949700	481745, 4949095
Elevation (m)	133.98	101.6 and 133.98
Release Height (m)	0	0
Length of X Side (m)	100	100
Length of Y Side (m)	100	100
Odor Concentration (D/T)	500	500
Vertical Velocity (m/s)	0.0001	0.0001
Odor Emission Rate per Area (D/T)*(m/s)	0.05	0.05
Odor Emission Rate (D/T)*(m^3/s)	500	500
Rotation Angle (deg)	0	0
Initial Vertical Dimension (m)	(none)	(none)

Figure 12. Modeled Area Source Locations



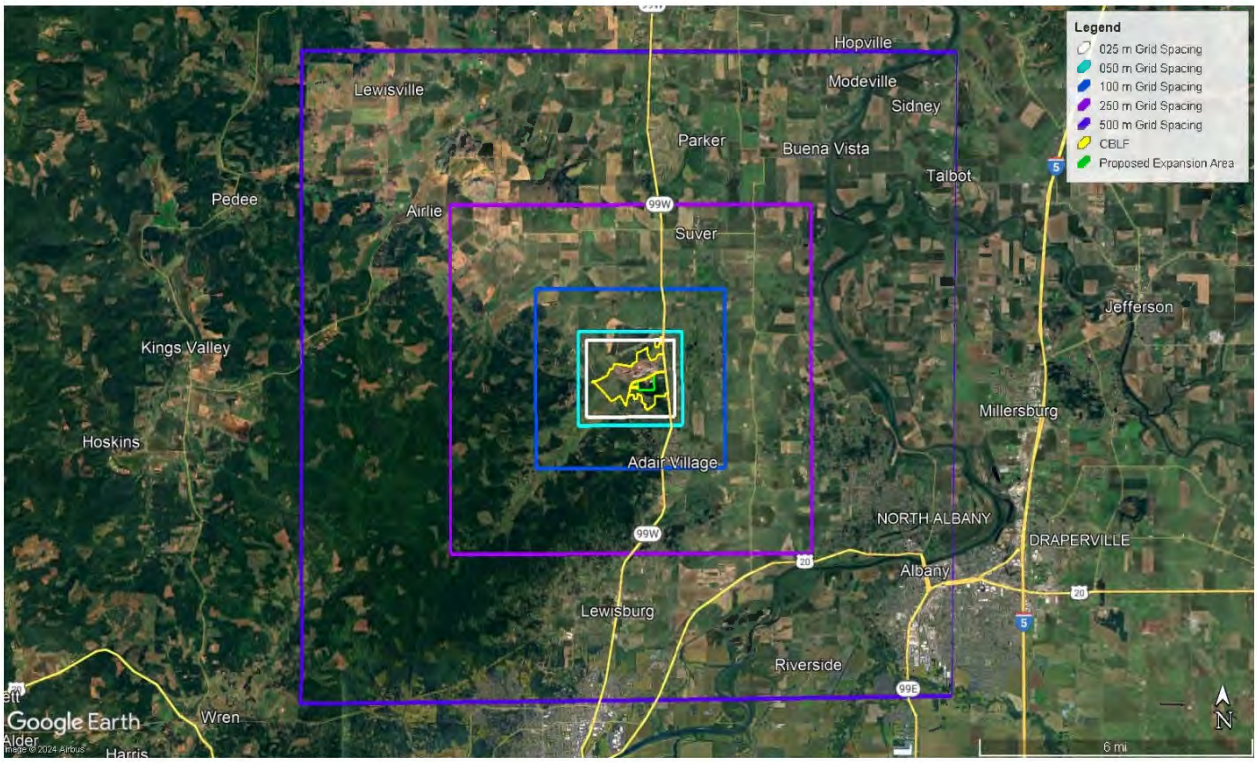
3.3 BUILDING DOWNWASH

Building downwash occurs when wind flowing over/around buildings impacts the dispersion of pollution from nearby stacks (point sources). Building downwash was not included since point sources were not modeled in the analysis.

3.4 RECEPTORS

AERMOD was used to generate nested 25-meter, 50-meter, 100-meter, 250-meter, and 500-meter spaced receptor grids over the landfill and surrounding area. Additional receptors were placed along the landfill's property boundary at 10-meter intervals. Receptor flag pole heights were set to zero meters (ground level). On-site receptors within the landfill's property boundary were removed from the analysis. See Figure 13 for the layout of the nested grids.

Figure 13. Nested Receptor Grid



3.5 METEOROLOGICAL DATA

Selection of an appropriate meteorological station for dispersion modeling purposes is based upon many factors such as the source's meteorological conditions (e.g., prevailing winds, mixing heights, etc.), terrain, surrounding land use and surface characteristics, and proximity. As seen in Section 2.4, wind conditions vary depending upon location within the valley. Therefore, three meteorological datasets were used in the analysis:

- KCVO surface data and Salem upper air data (2018 through 2023) processed by AERMET.
- KSLE surface data and Salem upper air data (2018 through 2023) processed by AERMET.
- Screening surface and upper air data generated for a range of weather conditions spanning all wind directions using AERMOD's Makemet utility.

3.6 TERRAIN DATA

Local terrain data was first downloaded from the United States Geological Survey (USGS) 1/3 arc-second National Elevation Dataset (NED). Elevations were then processed and imported into AERMOD for the sources and receptors modeled.

3.7 MODEL OPTIONS

AERMOD was used to predict maximum, off-site, 1-hour odor concentrations for each virtual source using the rural dispersion mode and elevated terrain. Table 4 summarizes the modeling scenarios analyzed. As indicated in Table 4, Source #2 (proposed operations) was modeled at two different elevations to represent future options (one at the current undeveloped elevation and one at the same elevation as the current working face).

Table 4. Modeling Scenarios

Scenario No.	Meteorological Data	Virtual Source #1 (Existing Operations) Modeled Elevation (m)	Virtual Source #2 (Proposed Operations) Modeled Elevation (m)
1	KCVO	133.98	101.6
2	KSLE	133.98	101.6
3	Makemet	133.98	101.6
4	KCVO	133.98	133.98
5	KSLE	133.98	133.98
6	Makemet	133.98	133.98

3.8 NUISANCE ODOR THRESHOLD

Oregon state laws prohibit businesses from emitting odors which cause a nuisance. These nuisance laws are implemented by the ODEQ which has developed a strategy for responding to odor complaints reported through an online tool. The strategy emphasizes early odor detection, voluntary cooperation and the rapid resolution of nuisance conditions related to odors [7]. Since the ODEQ's nuisance odor strategy does not include a D/T value for nuisance odor, this study used 7 D/T as the threshold for nuisance odor [8, 9].

4.0 RESULTS

Table 5 summarizes the peak, off-site, 1-hour odor concentrations for each modeling scenario. See Figure 14 for the peak, off-site impact locations. See Figure 15 through Figure 22 for the odor concentration contours from modeling scenario #3 which had the highest off-site impacts (note, reported odor complaint locations from Figure 10 are displayed in these figures for reference).

Table 5. Peak 1-Hour Off-site Odor Concentrations

Scenario No.	Meteorological Data	Virtual Source #1 (Existing Operations) Peak Off-Site Odor Concentration (D/T)	Virtual Source #2 (Proposed Operations) Peak Off-Site Odor Concentration (D/T)	Nuisance Odor Threshold (D/T)	Nuisance Odor Threshold Exceeded?
1	KCVO	0.42	0.64	7	No
2	KSLE	0.92	1.52	7	No
3	Makemet	1.21	2.04	7	No
4	KCVO	0.42	0.64	7	No
5	KSLE	0.92	1.52	7	No
6	Makemet	1.21	1.34	7	No

Figure 14. Peak 1-Hour Off-site Odor Impact Locations



Figure 15. Source #1 Odor Concentration D/T Contours (Scenario #3, View 1 of 4)



Figure 16. Source #1 Odor Concentration D/T Contours (Scenario #3, View 2 of 4)

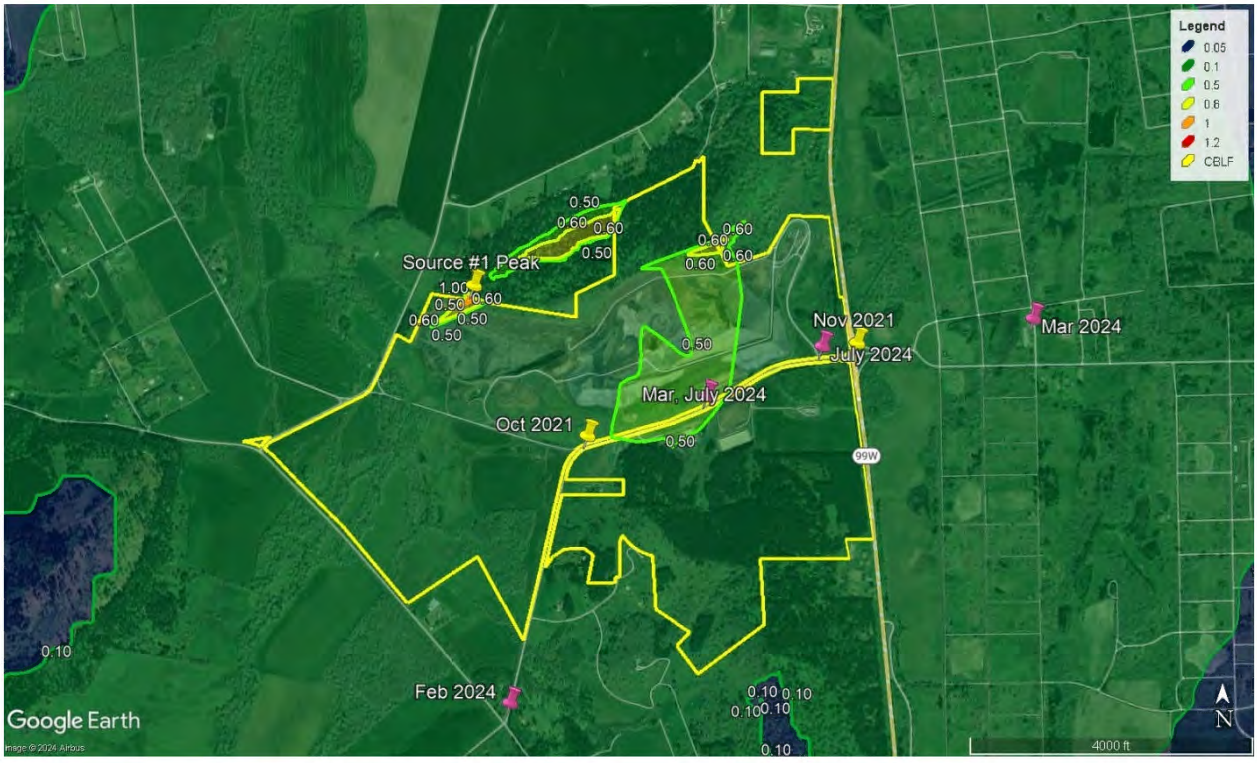


Figure 17. Source #1 Odor Concentration D/T Contours (Scenario #3, View 3 of 4)

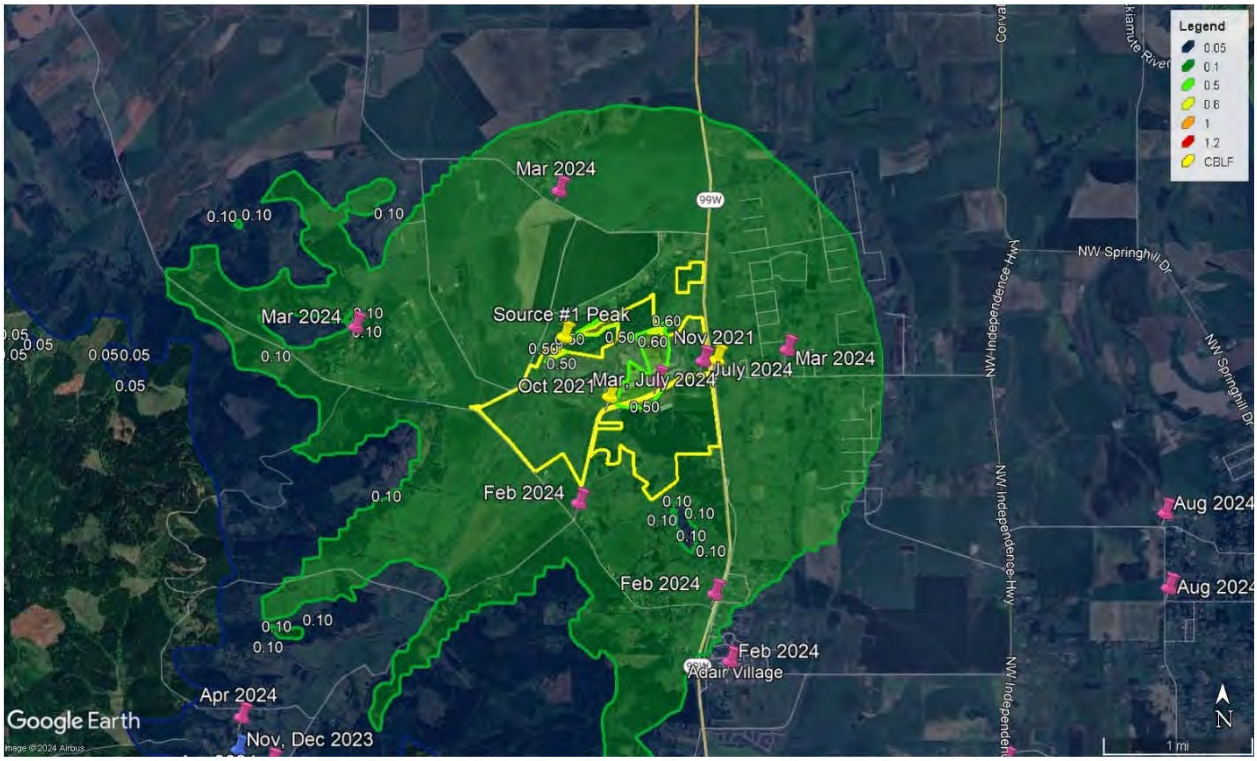


Figure 18. Source #1 Odor Concentration D/T Contours (Scenario #3, View 4 of 4)

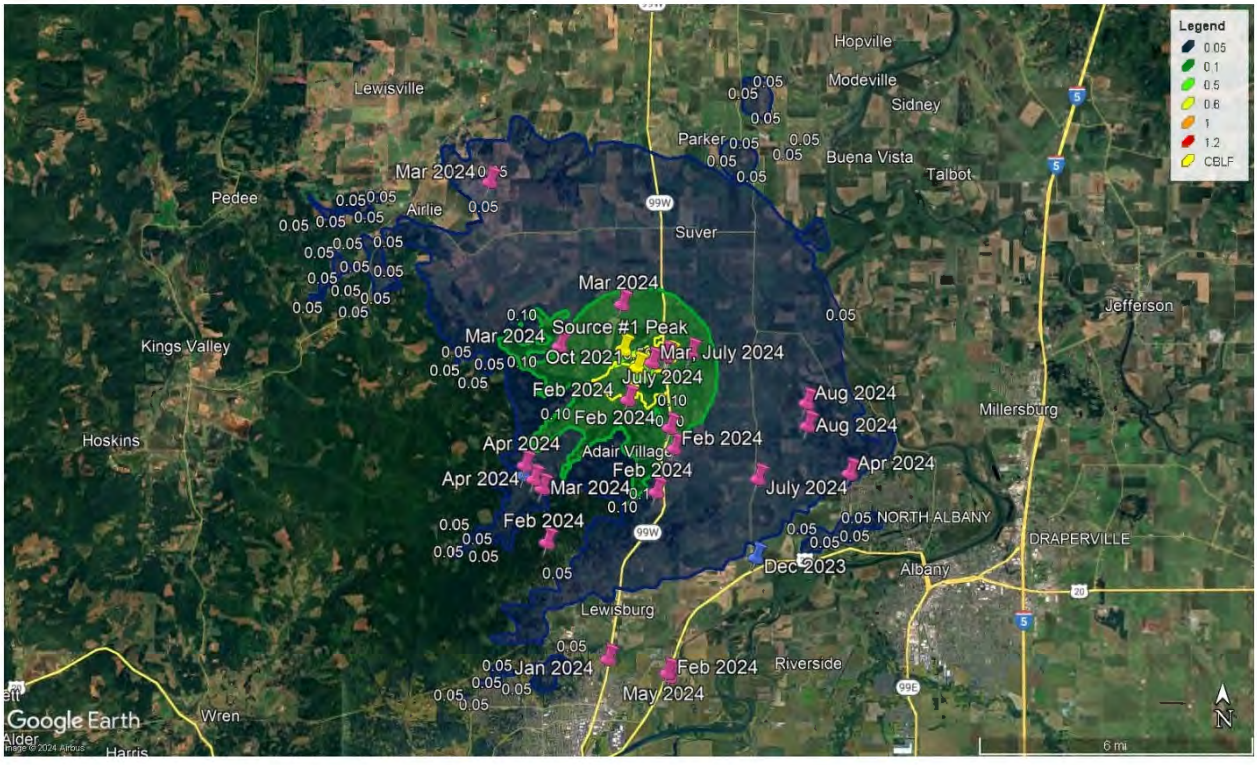


Figure 19. Source #2 Odor Concentration D/T Contours (Scenario #3, View 1 of 4)

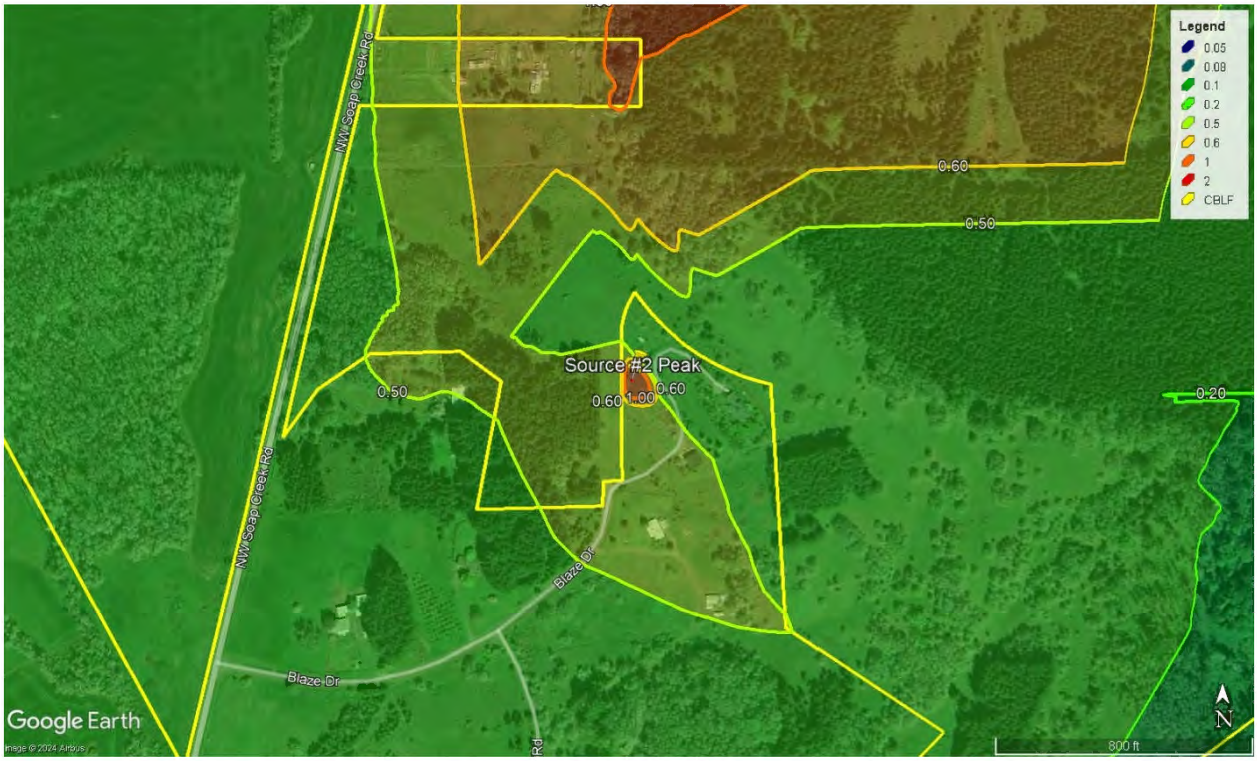


Figure 20. Source #2 Odor Concentration D/T Contours (Scenario #3, View 2 of 4)



Figure 21. Source #2 Odor Concentration D/T Contours (Scenario #3, View 3 of 4)

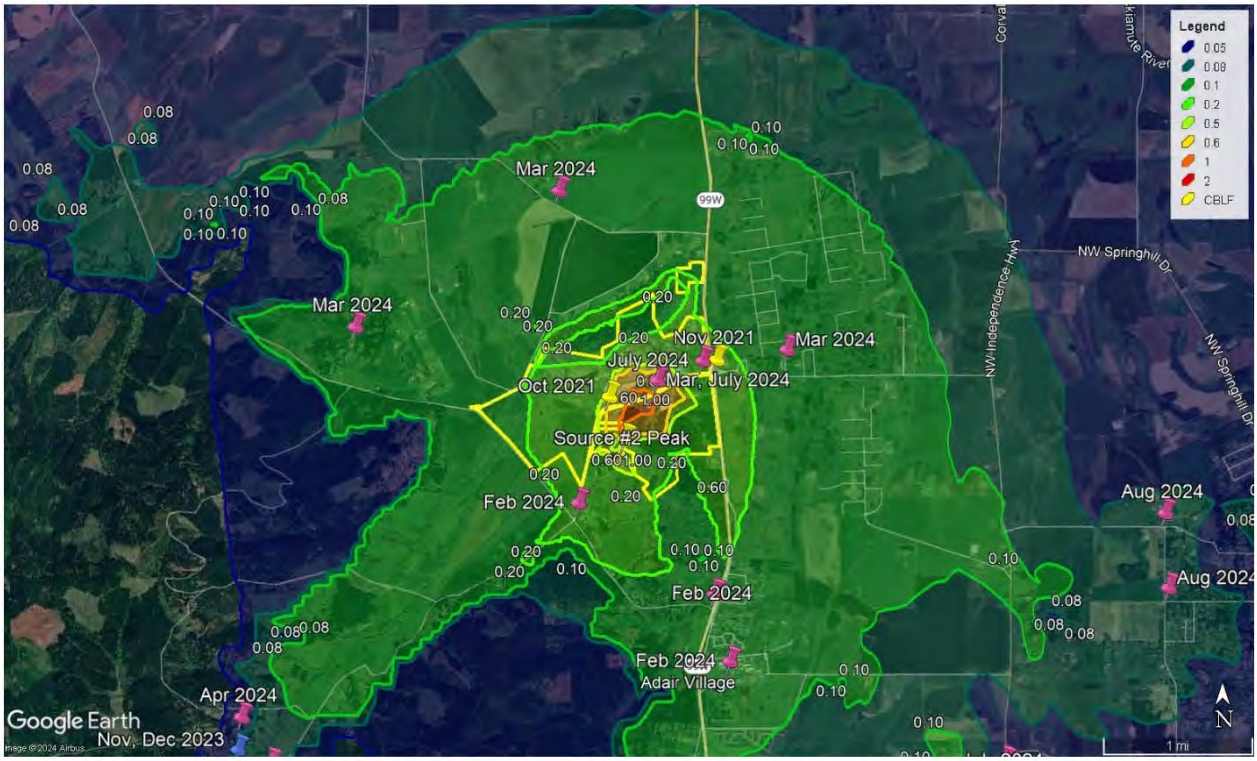
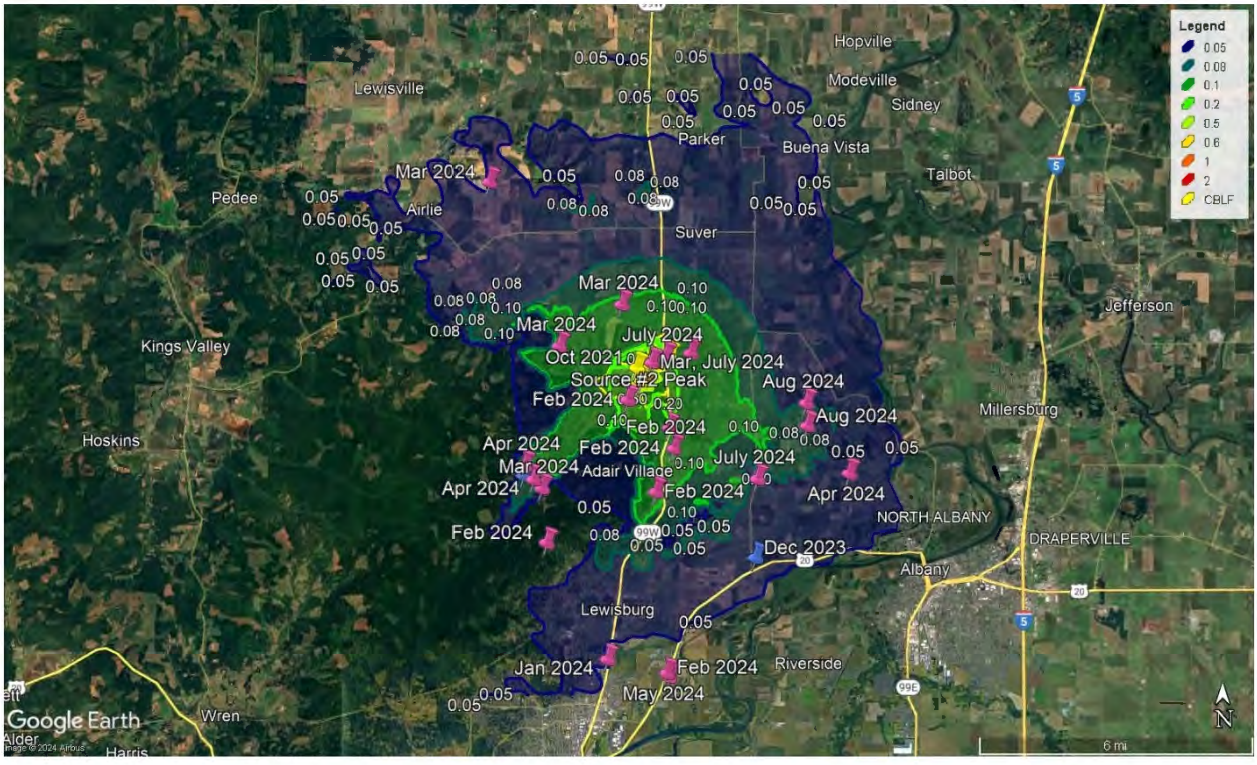


Figure 22. Source #2 Odor Concentration D/T Contours (Scenario #3, View 4 of 4)



5.0 CONCLUSIONS

The analysis modeled six different scenarios in order to predict the peak, off-site, 1-hour odor concentrations from existing and proposed operations for comparison to a numeric threshold of significance for nuisance odors (7 D/T). The following conclusions are presented based upon the results of this study:

- Peak, off-site, 1-hour odor concentrations were below 7 D/T (the numeric threshold of significance for nuisance odors) for all scenarios modeled.
- For existing operations (Source #1), the modeled peak, off-site, 1-hour odor concentration was north of the landfill (in two different locations depending upon the meteorological data used) and ranged from 0.42 to 1.21 D/T. Impacts above 1 D/T (the point at which only 50% of the population is expected to smell any odor) extended only a small distance off-site. None of the complaint locations from Figure 10 were within the 1 D/T contour.
- For proposed operations (Source #2), the modeled peak, off-site, 1-hour odor concentration was either along Coffin Butte Road or south of the landfill (in two different locations depending upon the meteorological data used) and ranged from 0.64 to 2.04 D/T. Impacts above 1 D/T (the point at which only 50% of the population is expected to smell any odor) were either along Coffin Butte Road or extended only a small distance off-site. Only one complaint location from Figure 10 was within the 1 D/T contour.
- Moving operations to the proposed expansion area will move the predicted peak, off-site 1-hour impact location, but impacts would remain well below the 7 D/T threshold.
- While off-site odors can occur as a result of the current and future landfill operations, these potential impacts are less than significant and expected to be short lived (i.e., only occur under weather conditions with poor atmospheric dispersion).

6.0 REFEFENCES

1. Benton County, “Taxlots”, https://gis.co.benton.or.us/gisdata/Assessment/.

2. Benton County, “Benton County Zoning Map Online”, https://cd.bentoncountyor.gov/maps/.

3. Valley Landfills, Inc., “Burden of Proof 2024 Conditional Use Application”, https://coffinbuttelandfill.com/2024-cup/.

4. United States Geological Survey, “National Elevation Dataset (NED)”, https://www.usgs.gov/publications/national-elevation-dataset.

5. Lakes Environmental, “AERMOD View 12.0”, AERMOD Version 23132, https://www.weblakes.com/, November 2023.

6. Oregon Department of Environmental Quality, “Recommended Procedures for Air Quality Dispersion Modeling”, https://www.oregon.gov/deq/aq/Pages/default.aspx, March 2022.

7. Oregon Department of Environmental Quality, “Nuisance Odor Strategy”, https://www.oregon.gov/deq/aq/pages/nuisance-odor.aspx.

8. San Diego State University and California Integrated Waste Management Board, “Contractor’s Report to the Board – Comprehensive Compost Odor Response Project”, March 2007, https://www2.calrecycle.ca.gov/Publications/Download/841.

9. McGinley, P.E., Charles M., “Enforceable Permit Odor Limits”, St. Croix Sensory, Inc., https://www.fivesenses.com/, 2000.

10. Hanson, J., Yesiller, N., et al, “Compaction Characteristics of Municipal Waste”, http://gwri.calpoly.edu/media/Research_Papers/Compaction_Characteristics_of_Municipal_Solid_Waste.pdf, 2010.

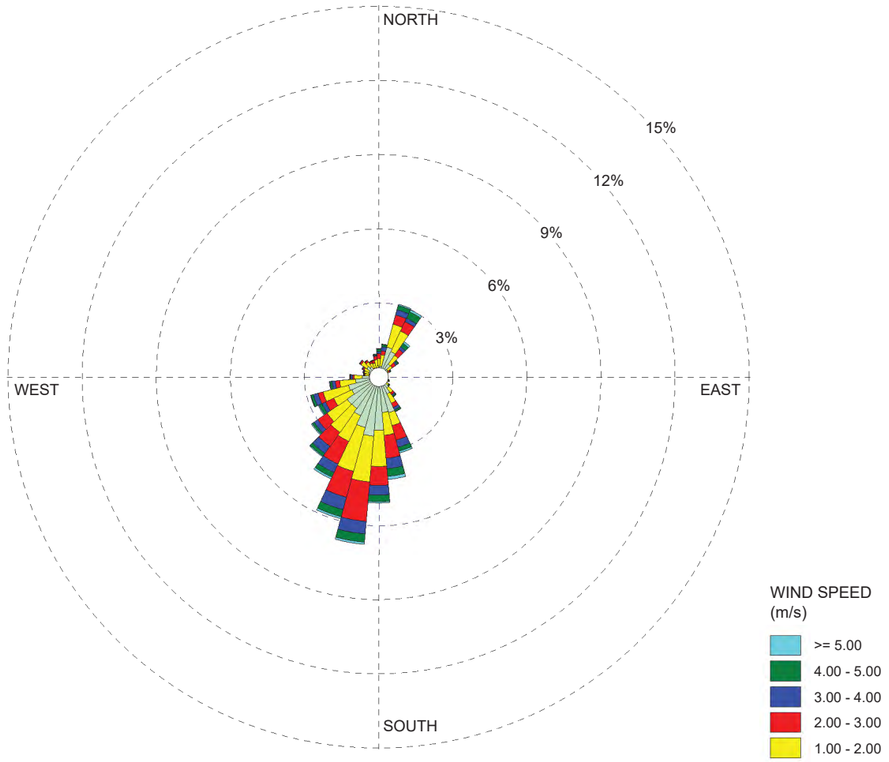
Appendix A

CBLF and KCVO Windrose Comparison

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR WINDROSE (8/1/2021 TO 8/1/2024)

DISPLAY:
Wind Speed
Direction (blowing from)



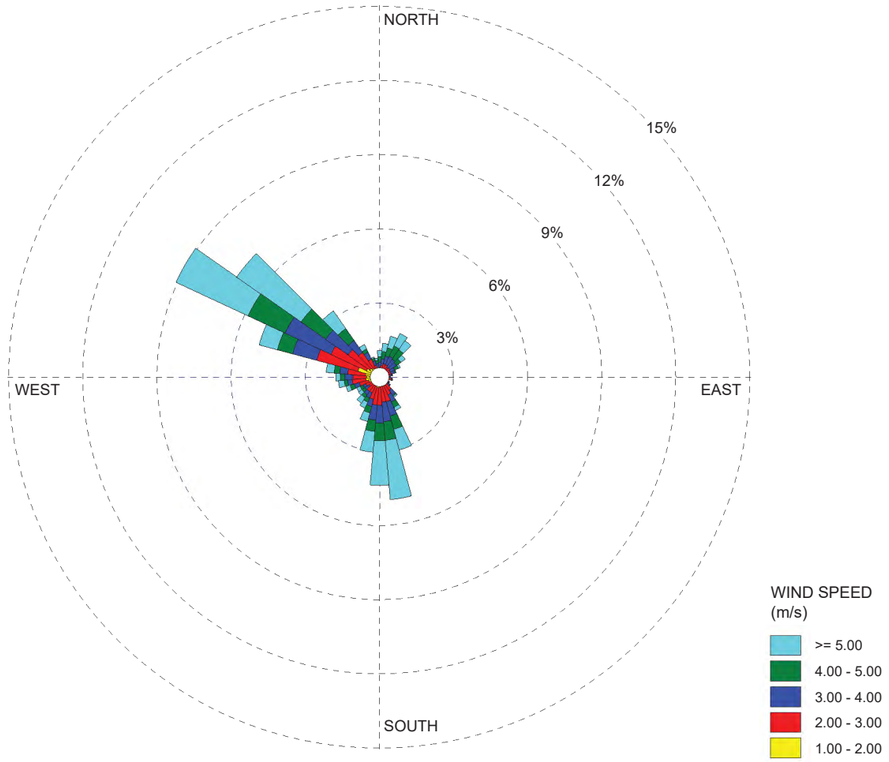
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **31.49%**	TOTAL COUNT: **52532**	
	AVG. WIND SPEED: **1.11 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR WINDROSE (8/1/2021 TO 8/1/2024)

DISPLAY:
Wind Speed
Direction (blowing from)



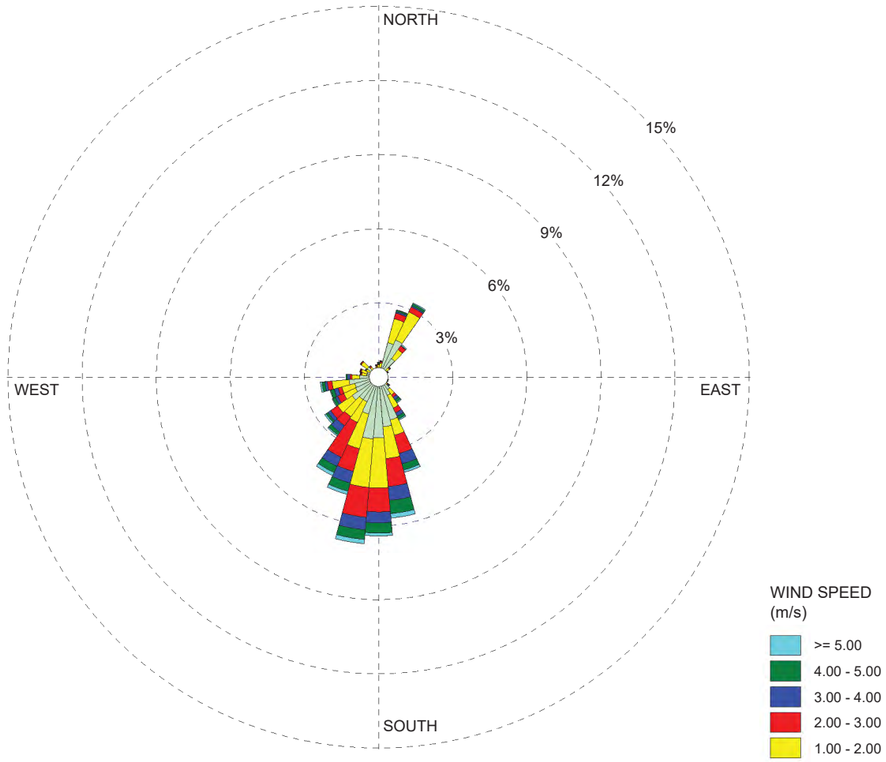
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 00:00** **End Date: 7/31/2024 - 23:59**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **22.03%**	TOTAL COUNT: **24841 hrs.**	
	AVG. WIND SPEED: **3.07 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR WINTER WINDROSE (8/1/2021 TO 8/1/2024, DEC-FEB)

DISPLAY:
Wind Speed
Direction (blowing from)



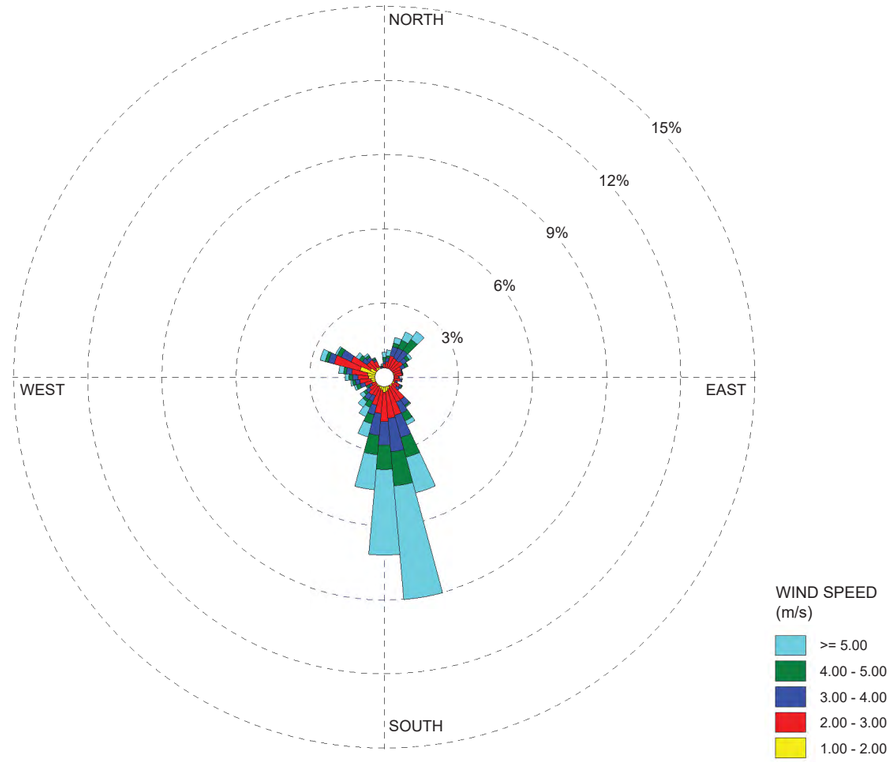
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **34.24%**	TOTAL COUNT: **13002**	
	AVG. WIND SPEED: **1.07 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR WINTER WINDROSE (8/1/2021 TO 8/1/2024, DEC-FEB)

DISPLAY:
Wind Speed
Direction (blowing from)



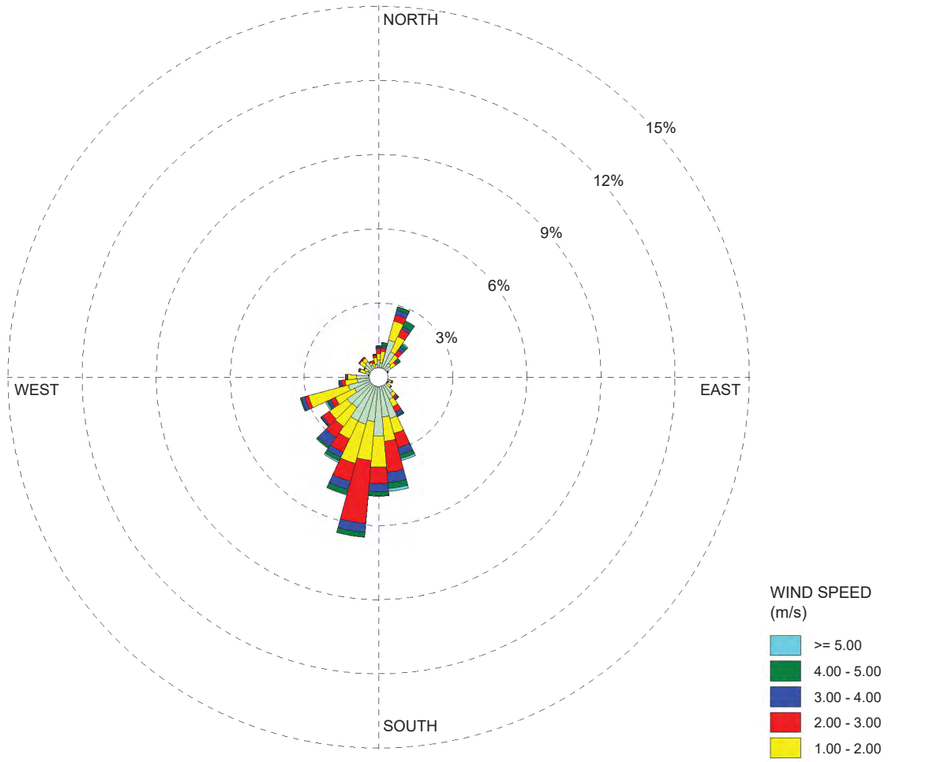
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 12/1/2021 - 00:00** **End Date: 2/29/2024 - 23:59**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **28.47%**	TOTAL COUNT: **6235 hrs.**	
	AVG. WIND SPEED: **2.66 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR FALL WINDROSE (8/1/2021 TO 8/1/2024, SEP-NOV)

DISPLAY:
Wind Speed
Direction (blowing from)



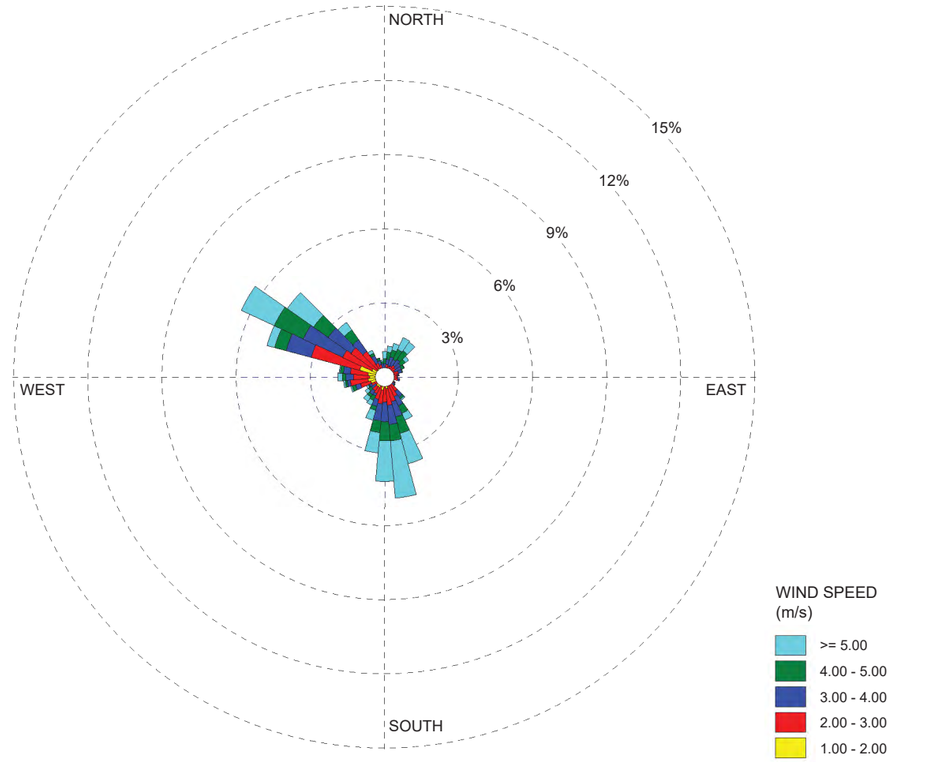
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **33.70%**	TOTAL COUNT: **13108**	
	AVG. WIND SPEED: **0.98 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR FALL WINDROSE (8/1/2021 TO 8/1/2024, SEP-NOV)

DISPLAY:
Wind Speed
Direction (blowing from)



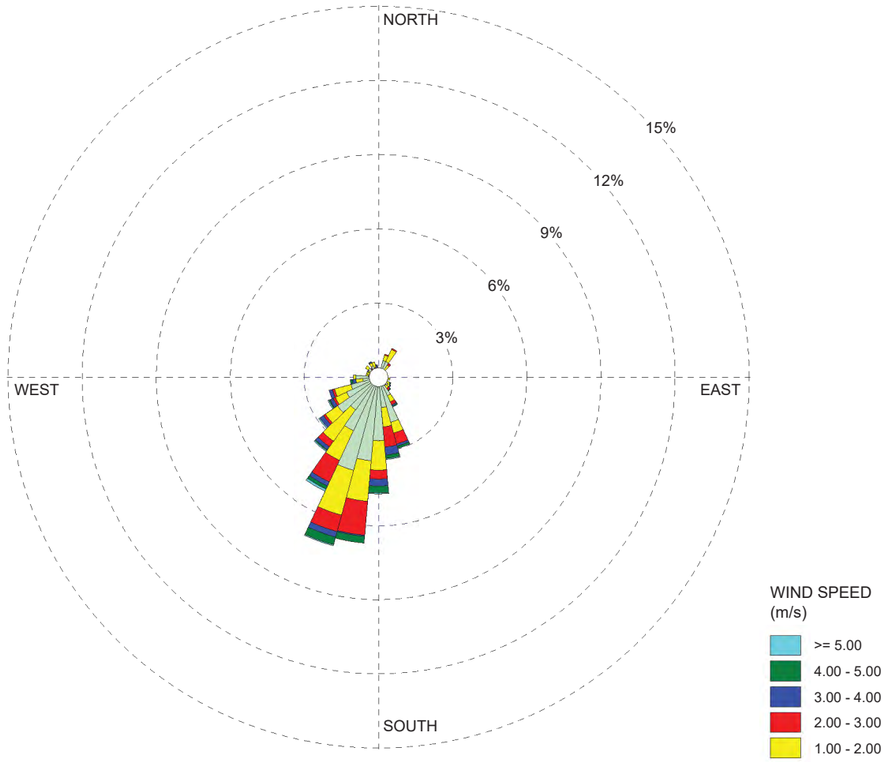
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 9/1/2021 - 00:00** **End Date: 11/30/2023 - 23:59**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **28.25%**	TOTAL COUNT: **6184 hrs.**	
	AVG. WIND SPEED: **2.59 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 01 WINDROSE (8/1/2021 TO 8/1/2024, 0000-0100)

DISPLAY:
Wind Speed
Direction (blowing from)



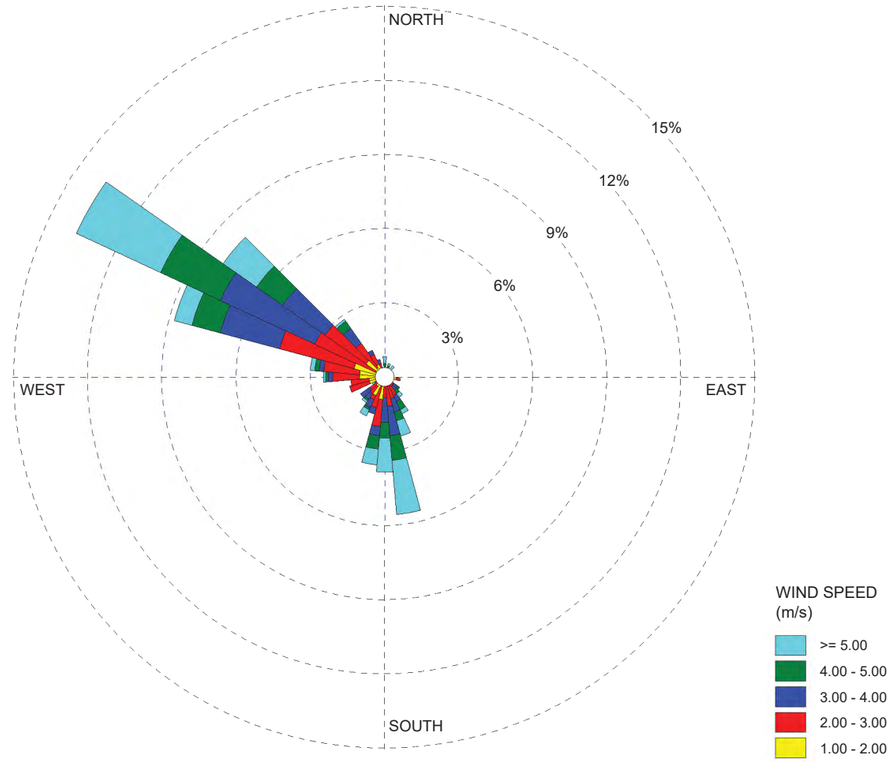
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **44.57%**	TOTAL COUNT: **2192**	
	AVG. WIND SPEED: **0.71 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 01 WINDROSE (8/1/2021 TO 8/1/2024, 0000-0100)

DISPLAY:
Wind Speed
Direction (blowing from)



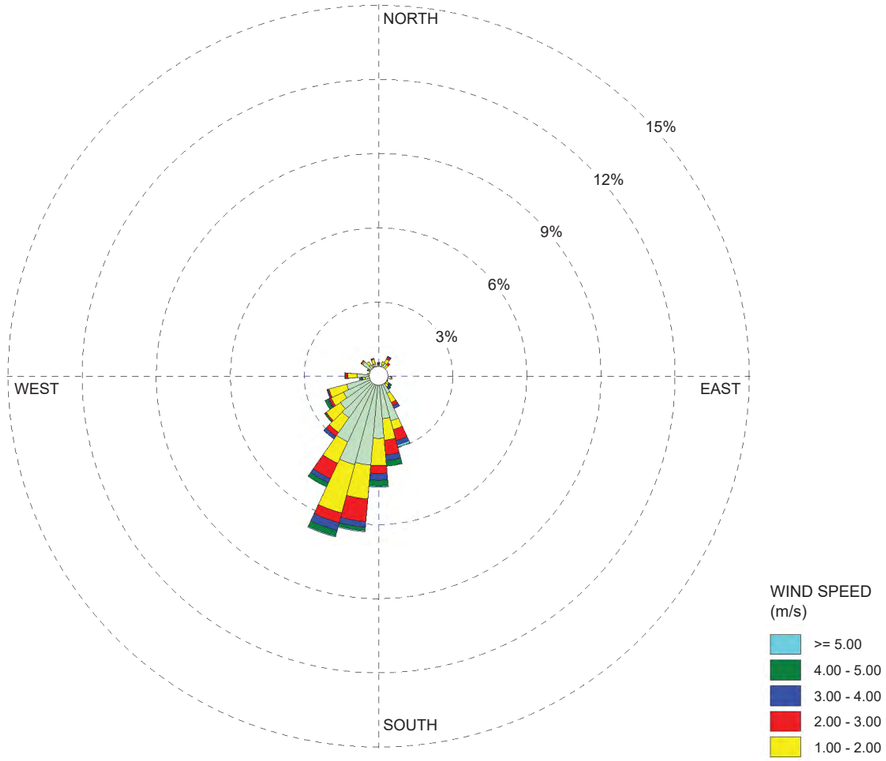
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 01:00** **End Date: 7/31/2024 - 01:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **24.27%**	TOTAL COUNT: **1069 hrs.**	
	AVG. WIND SPEED: **2.70 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 02 WINDROSE (8/1/2021 TO 8/1/2024, 0100-0200)

DISPLAY:
Wind Speed
Direction (blowing from)



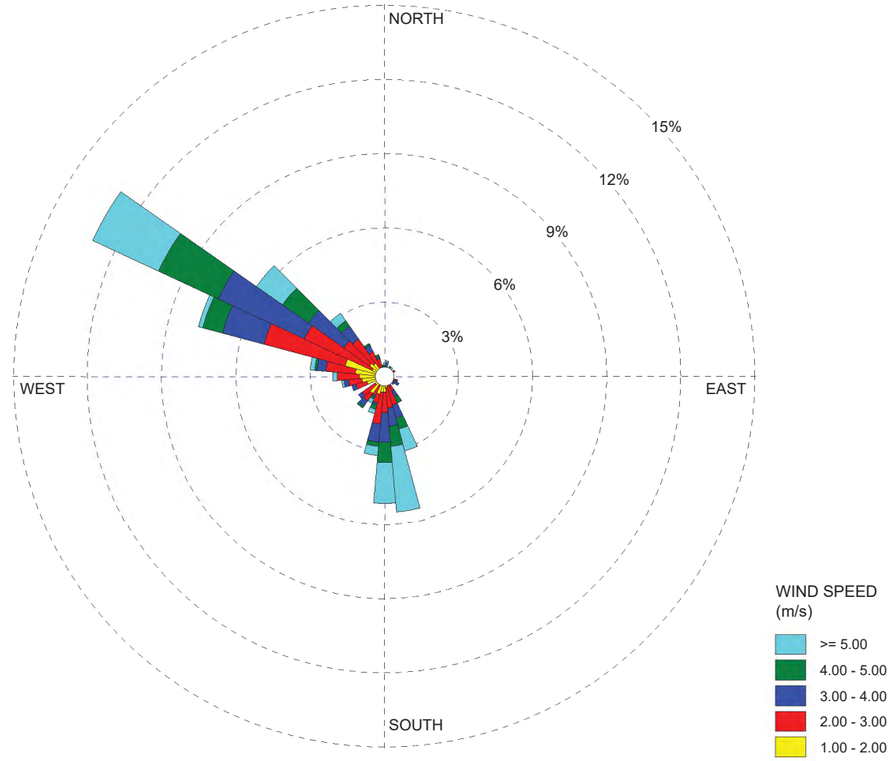
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **45.87%**	TOTAL COUNT: **2189**	
	AVG. WIND SPEED: **0.65 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 02 WINDROSE (8/1/2021 TO 8/1/2024, 0100-0200)

DISPLAY:
Wind Speed
Direction (blowing from)



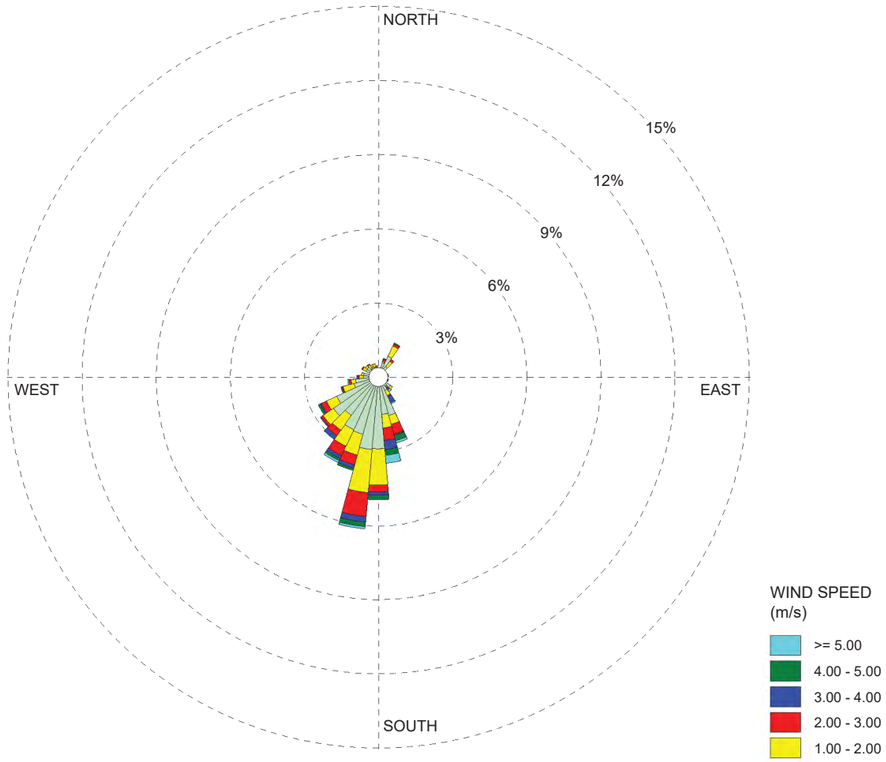
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 02:00** **End Date: 7/31/2024 - 02:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **27.10%**	TOTAL COUNT: **1074 hrs.**	
	AVG. WIND SPEED: **2.52 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 03 WINDROSE (8/1/2021 TO 8/1/2024, 0200-0300)

DISPLAY:
Wind Speed
Direction (blowing from)



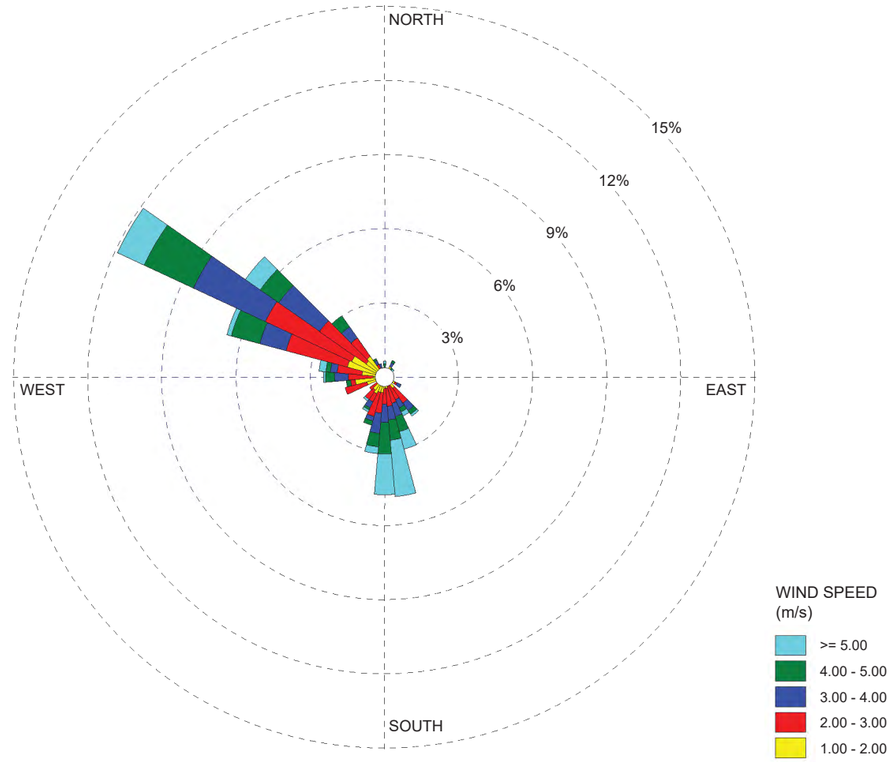
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **50.39%**	TOTAL COUNT: **2187**	
	AVG. WIND SPEED: **0.63 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 03 WINDROSE (8/1/2021 TO 8/1/2024, 0200-0300)

DISPLAY:
Wind Speed
Direction (blowing from)



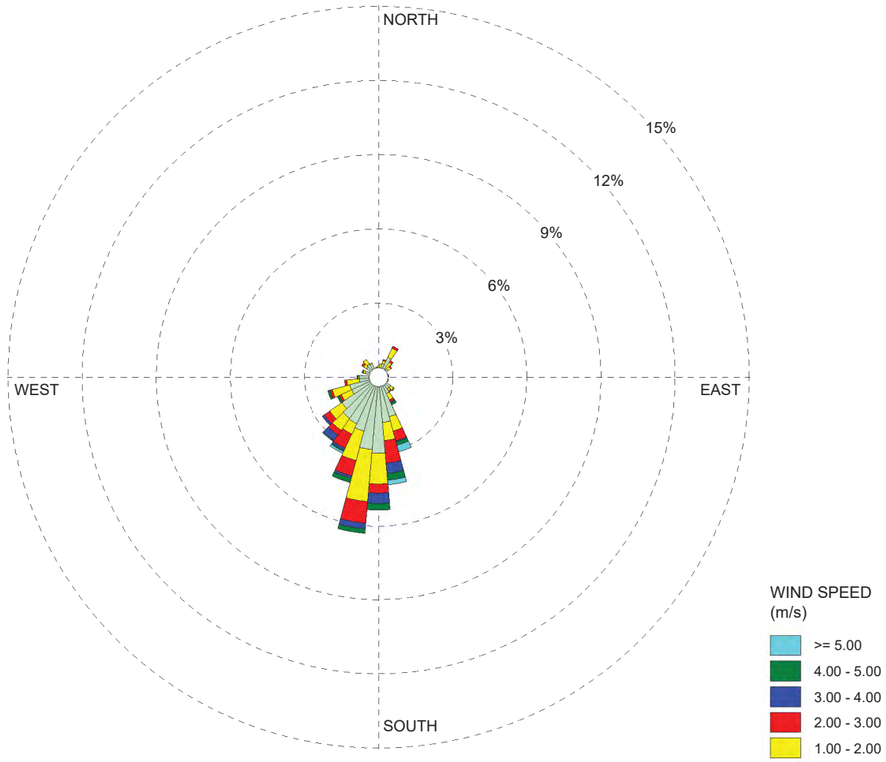
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 03:00** **End Date: 7/31/2024 - 03:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **29.29%**	TOTAL COUNT: **1075 hrs.**	
	AVG. WIND SPEED: **2.36 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 04 WINDROSE (8/1/2021 TO 8/1/2024, 0300-0400)

DISPLAY:
Wind Speed
Direction (blowing from)



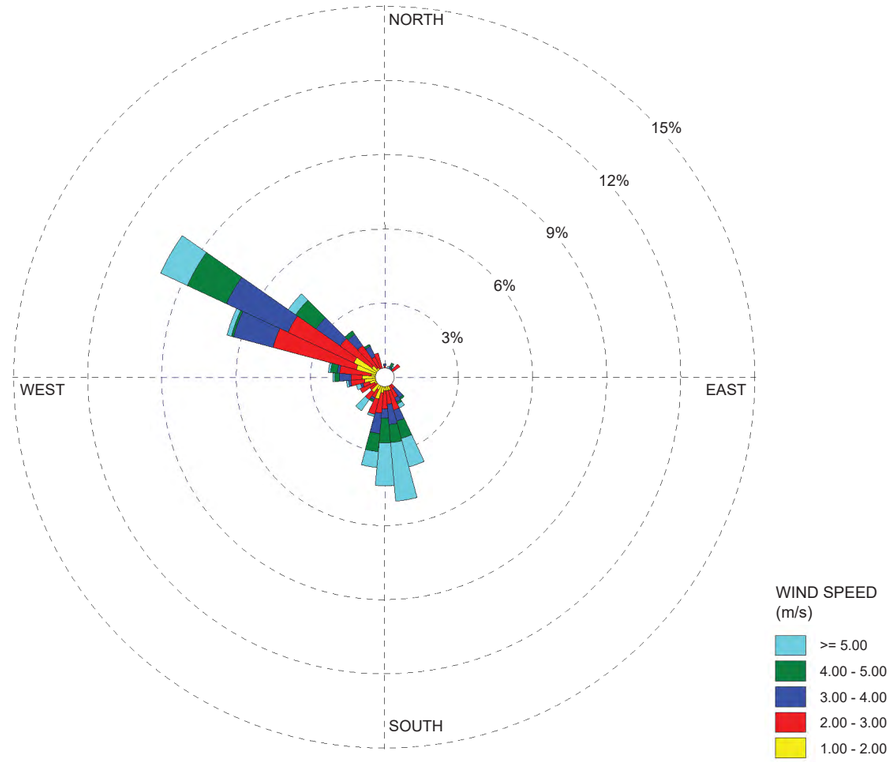
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **47.53%**	TOTAL COUNT: **2190**	
	AVG. WIND SPEED: **0.66 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 04 WINDROSE (8/1/2021 TO 8/1/2024, 0300-0400)

DISPLAY:
Wind Speed
Direction (blowing from)



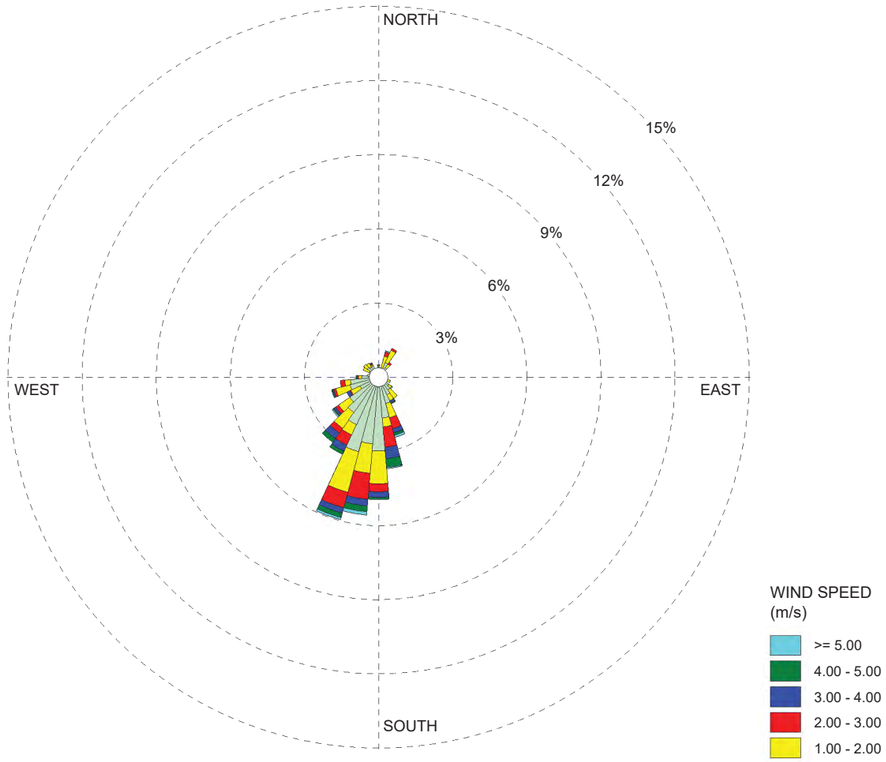
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 04:00** **End Date: 7/31/2024 - 04:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **33.94%**	TOTAL COUNT: **1069 hrs.**	
	AVG. WIND SPEED: **2.18 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 05 WINDROSE (8/1/2021 TO 8/1/2024, 0400-0500)

DISPLAY:
Wind Speed
Direction (blowing from)



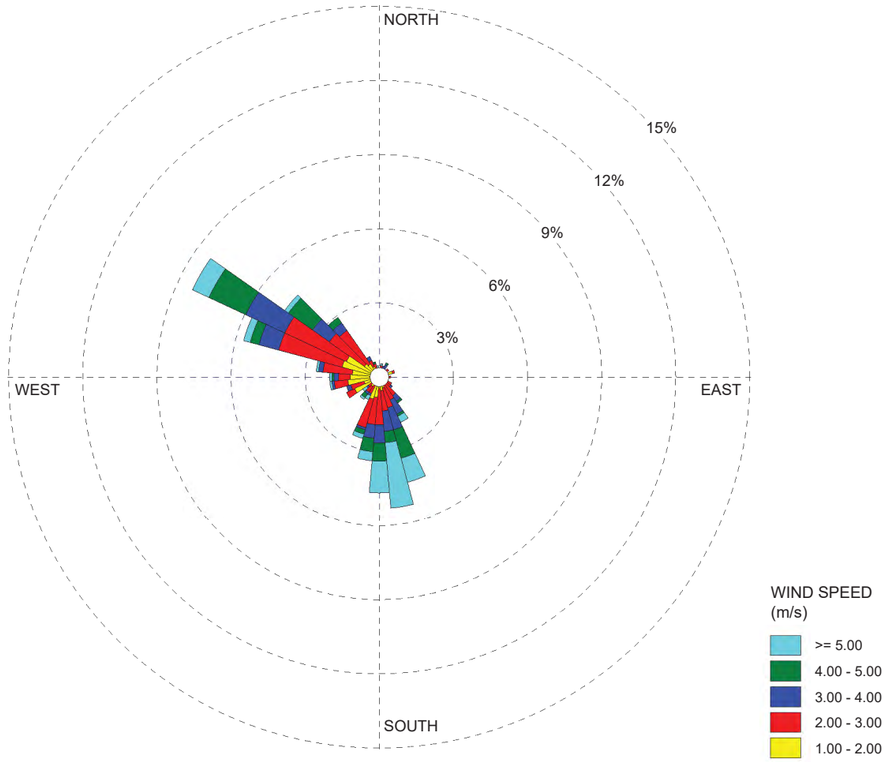
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **49.66%**	TOTAL COUNT: **2187**	
	AVG. WIND SPEED: **0.66 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 05 WINDROSE (8/1/2021 TO 8/1/2024, 0400-0500)

DISPLAY:
Wind Speed
Direction (blowing from)



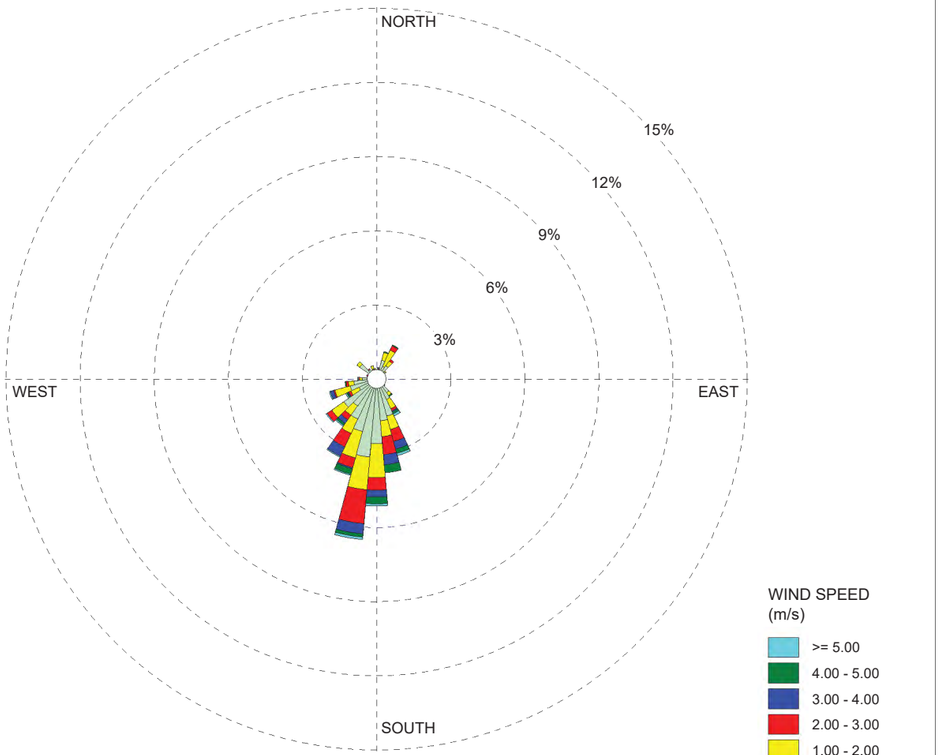
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 05:00** **End Date: 7/31/2024 - 05:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **32.85%**	TOTAL COUNT: **1074 hrs.**	
	AVG. WIND SPEED: **2.15 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 06 WINDROSE (8/1/2021 TO 8/1/2024, 0500-0600)

DISPLAY:
Wind Speed
Direction (blowing from)



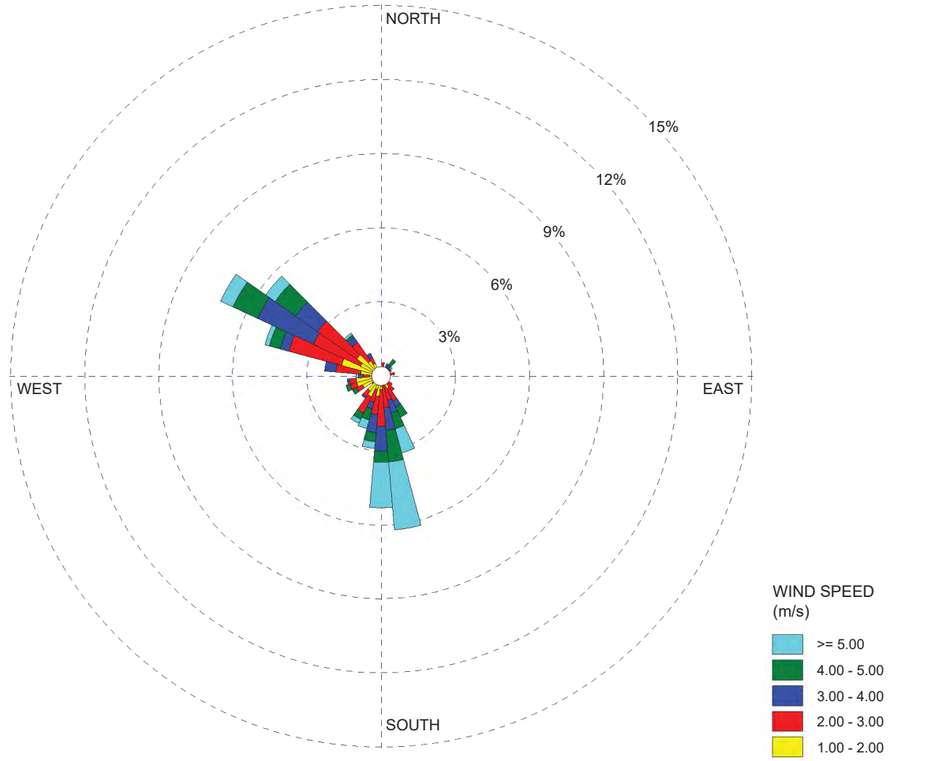
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **50.55%**	TOTAL COUNT: **2188**	
	AVG. WIND SPEED: **0.66 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 06 WINDROSE (8/1/2021 TO 8/1/2024, 0500-0600)

DISPLAY:
Wind Speed
Direction (blowing from)



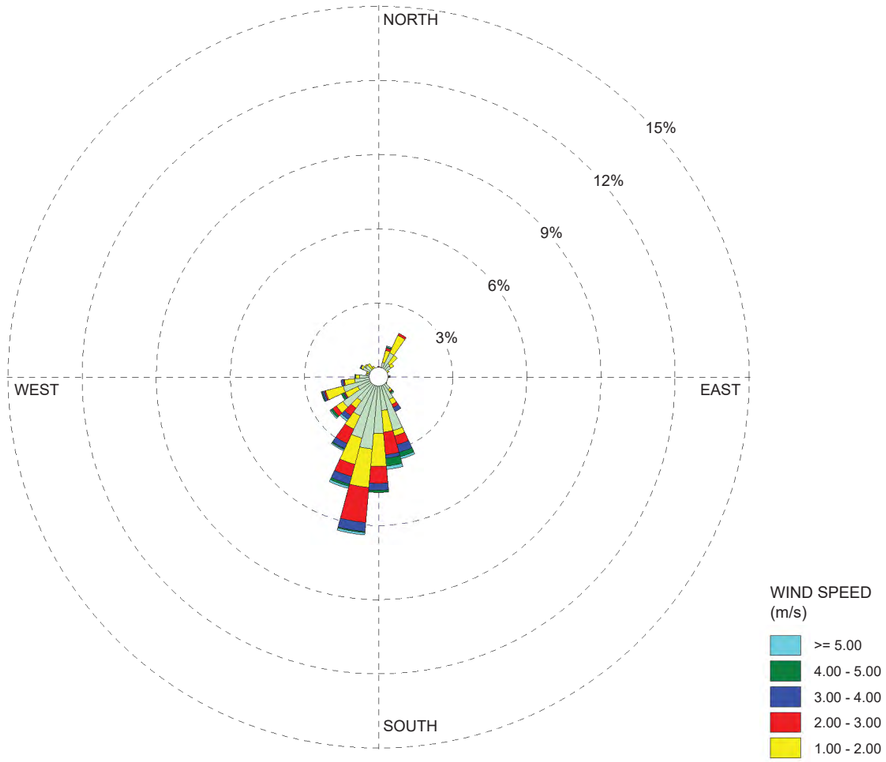
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 06:00** **End Date: 7/31/2024 - 06:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **37.41%**	TOTAL COUNT: **1073 hrs.**	
	AVG. WIND SPEED: **2.03 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 07 WINDROSE (8/1/2021 TO 8/1/2024, 0600-0700)

DISPLAY:
Wind Speed
Direction (blowing from)



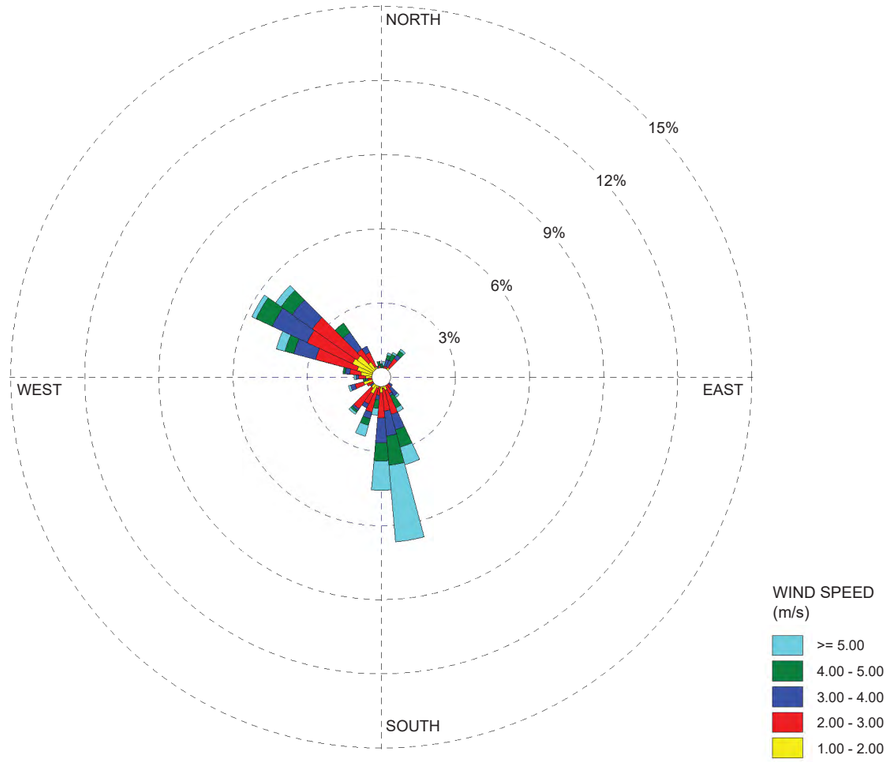
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **48.13%**	TOTAL COUNT: **2190**	
	AVG. WIND SPEED: **0.68 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 07 WINDROSE (8/1/2021 TO 8/1/2024, 0600-0700)

DISPLAY:
Wind Speed
Direction (blowing from)



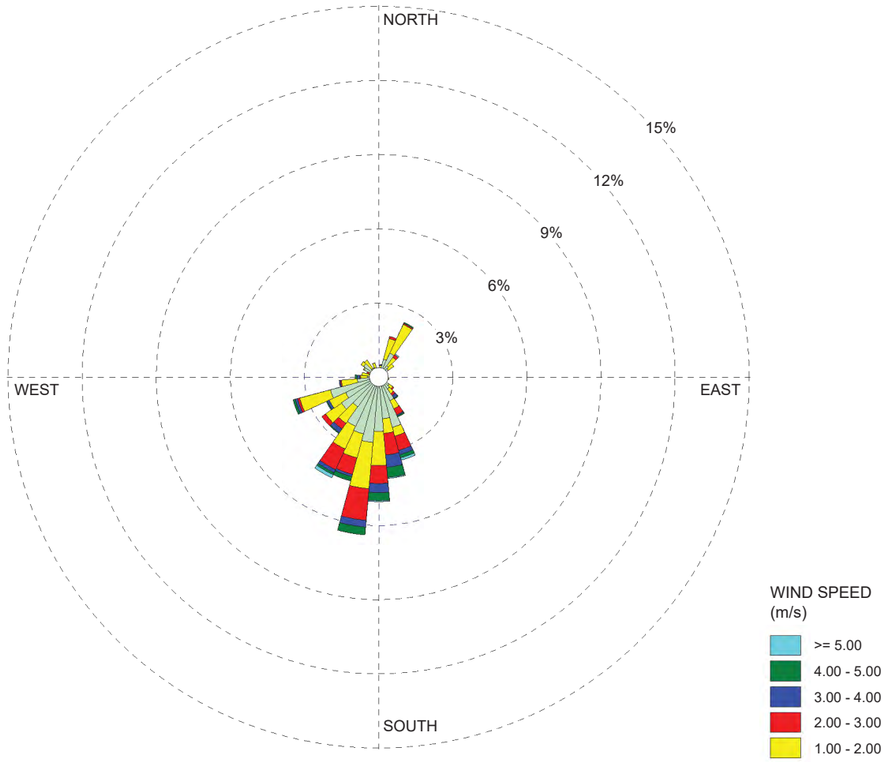
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 07:00** **End Date: 7/31/2024 - 07:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **39.69%**	TOTAL COUNT: **1069 hrs.**	
	AVG. WIND SPEED: **1.99 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 08 WINDROSE (8/1/2021 TO 8/1/2024, 0700-0800)

DISPLAY:
Wind Speed
Direction (blowing from)



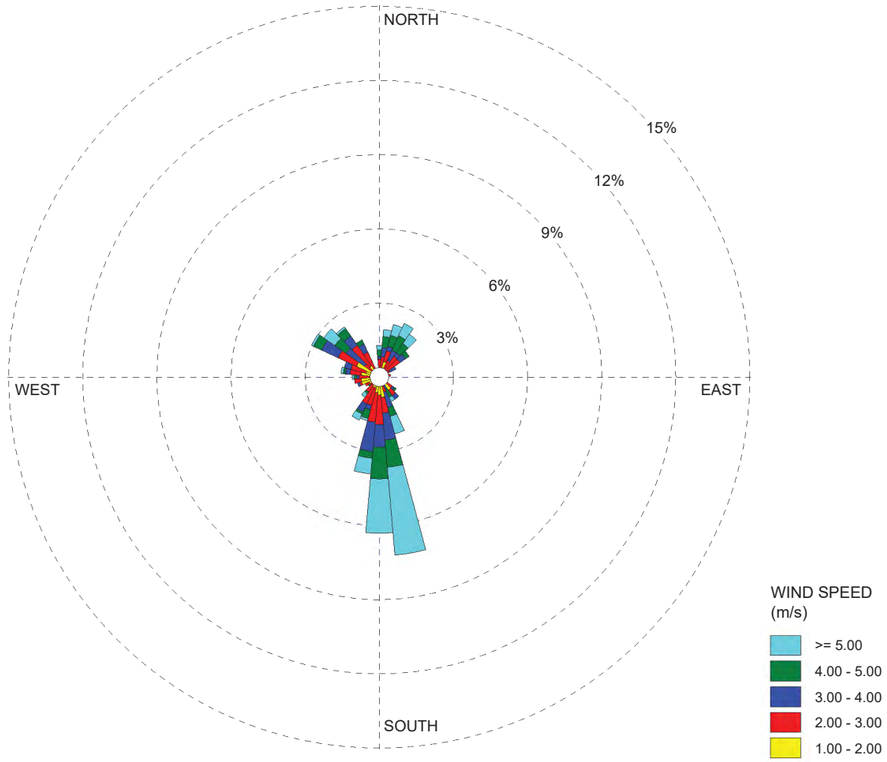
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **41.11%**	TOTAL COUNT: **2189**	
	AVG. WIND SPEED: **0.79 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 08 WINDROSE (8/1/2021 TO 8/1/2024, 0700-0800)

DISPLAY:
Wind Speed
Direction (blowing from)



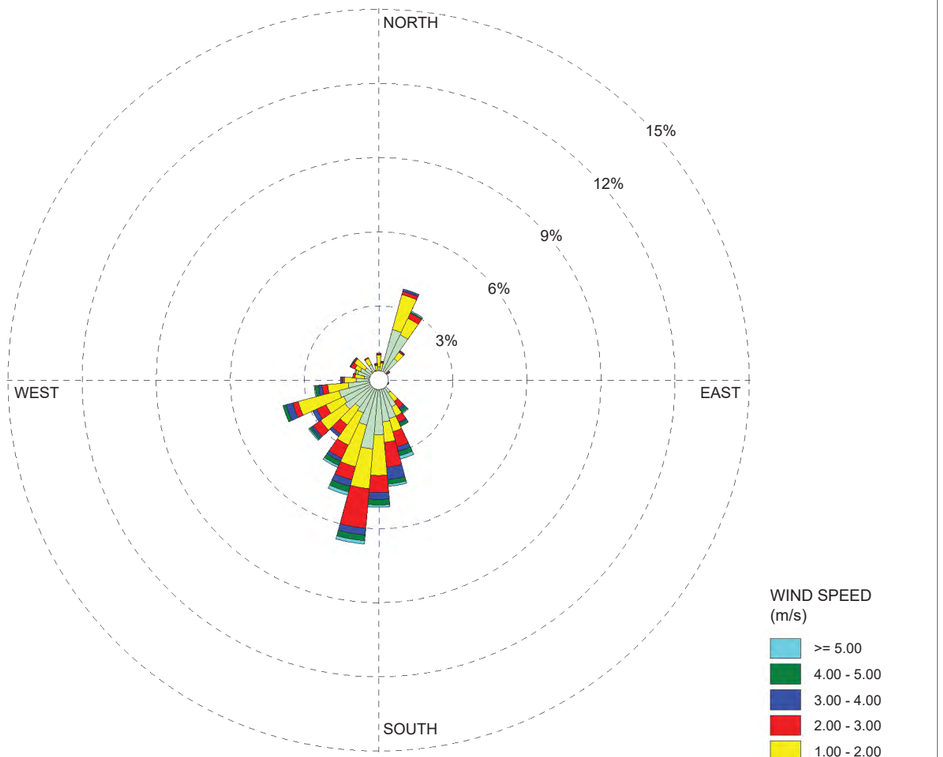
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 08:00** **End Date: 7/31/2024 - 08:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **35.58%**	TOTAL COUNT: **1034 hrs.**	
	AVG. WIND SPEED: **2.24 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 09 WINDROSE (8/1/2021 TO 8/1/2024, 0800-0900)

DISPLAY:
Wind Speed
Direction (blowing from)



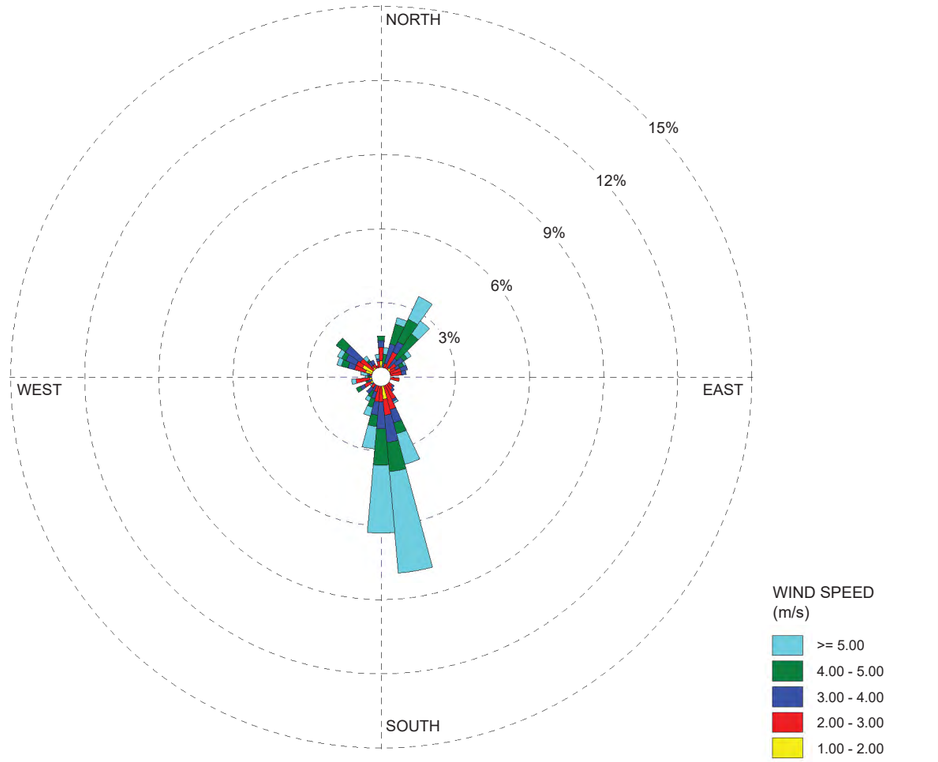
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **30.85%**	TOTAL COUNT: **2187**	
	AVG. WIND SPEED: **0.99 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 09 WINDROSE (8/1/2021 TO 8/1/2024, 0800-0900)

DISPLAY:
Wind Speed
Direction (blowing from)



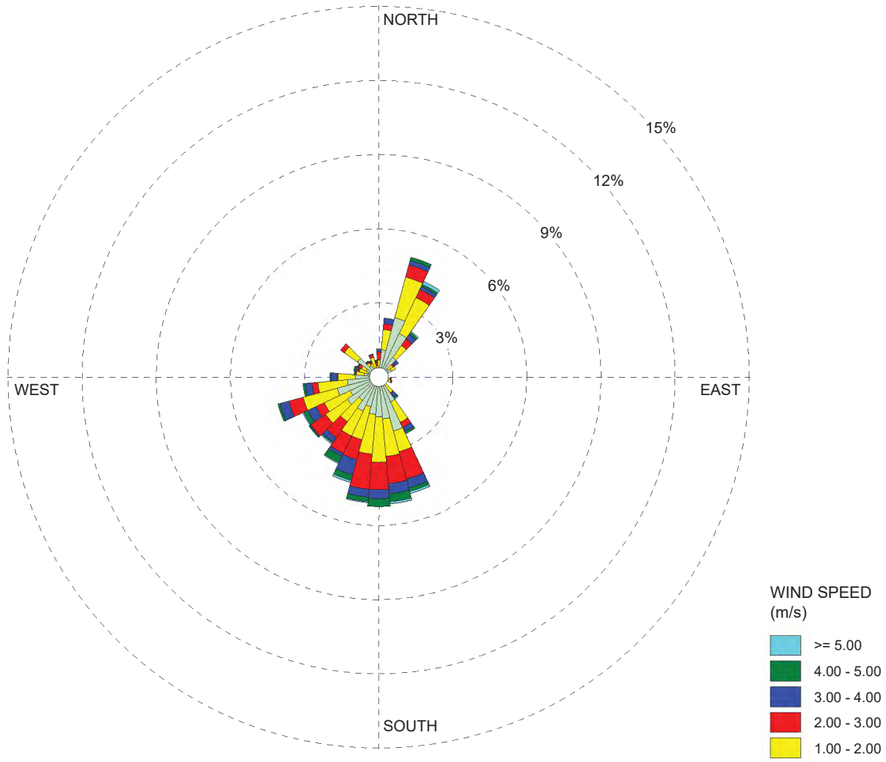
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 09:00** **End Date: 7/31/2024 - 09:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **30.84%**	TOTAL COUNT: **983 hrs.**	
	AVG. WIND SPEED: **2.55 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 10 WINDROSE (8/1/2021 TO 8/1/2024, 0900-1000)

DISPLAY:
Wind Speed
Direction (blowing from)



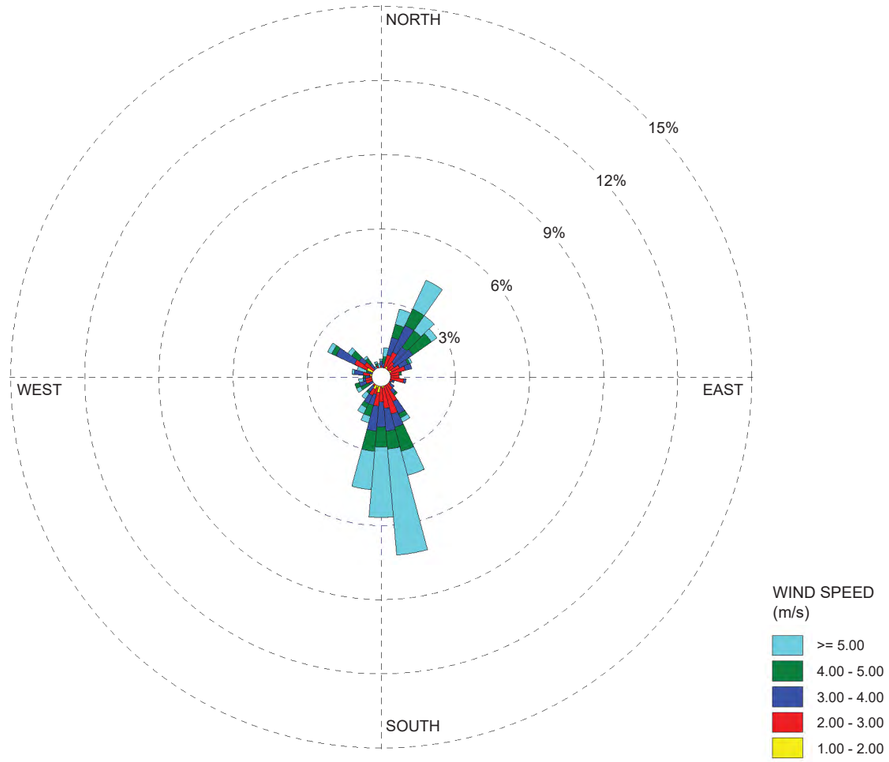
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **21.34%**	TOTAL COUNT: **2186**	
	AVG. WIND SPEED: **1.23 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 10 WINDROSE (8/1/2021 TO 8/1/2024, 0900-1000)

DISPLAY:
Wind Speed
Direction (blowing from)



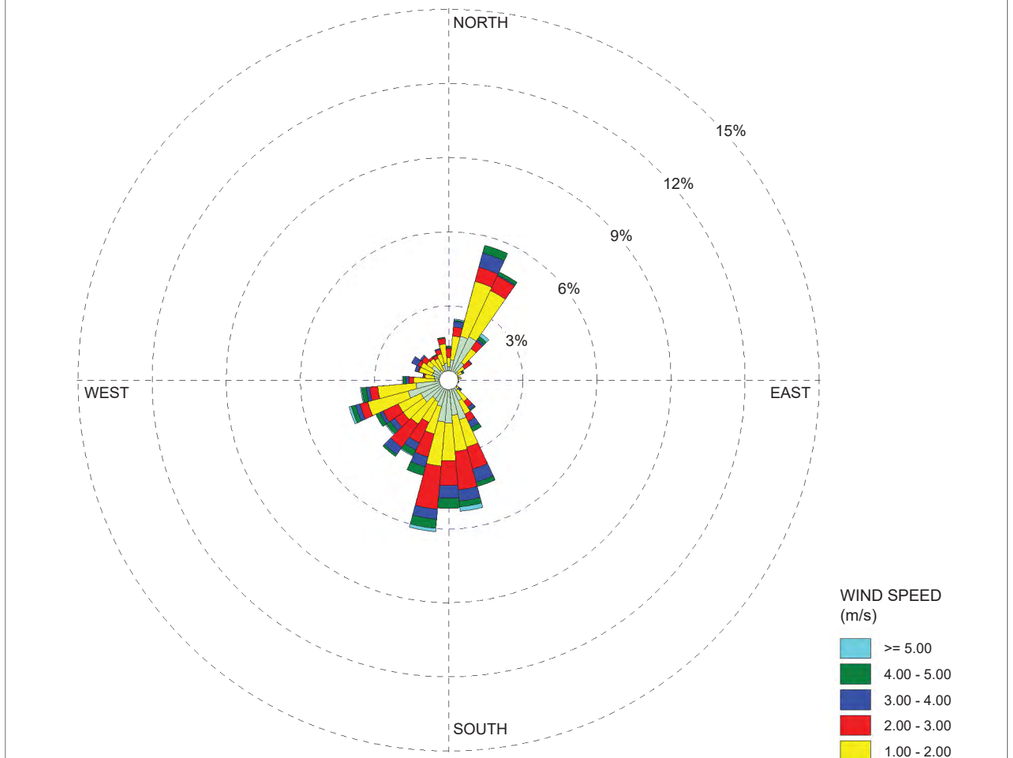
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 10:00** **End Date: 7/31/2024 - 10:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **23.91%**	TOTAL COUNT: **960 hrs.**	
	AVG. WIND SPEED: **2.88 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 11 WINDROSE (8/1/2021 TO 8/1/2024, 1000-1100)

DISPLAY:
Wind Speed
Direction (blowing from)



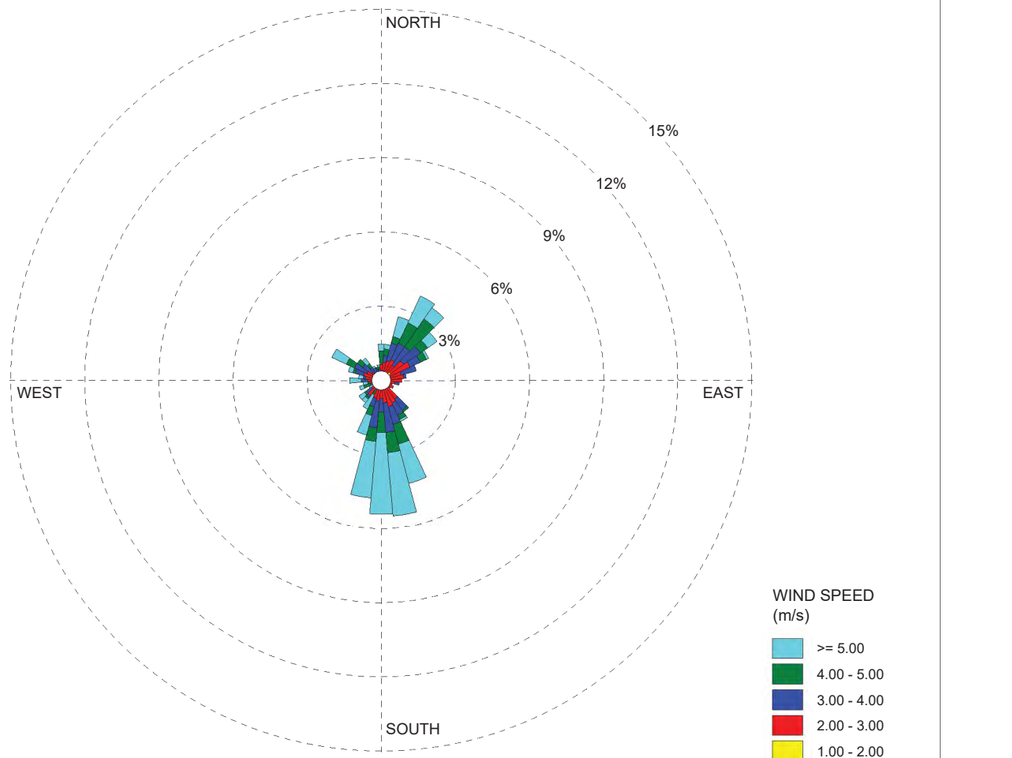
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **16.12%**	TOTAL COUNT: **2185**	
	AVG. WIND SPEED: **1.39 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 11 WINDROSE (8/1/2021 TO 8/1/2024, 1000-1100)

DISPLAY:
Wind Speed
Direction (blowing from)



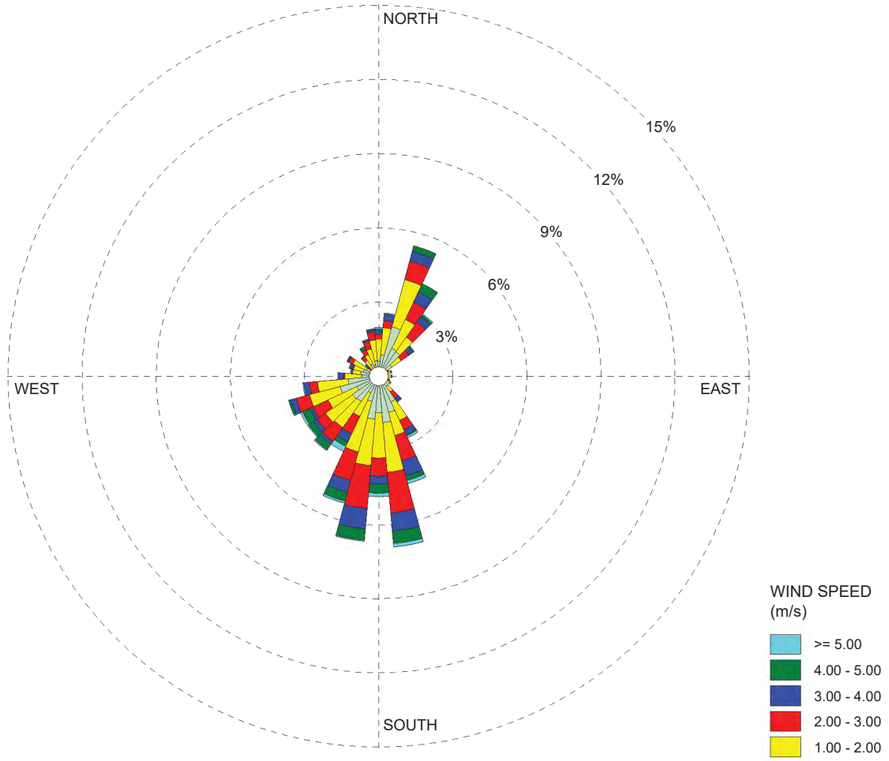
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 11:00** **End Date: 7/31/2024 - 11:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **21.62%**	TOTAL COUNT: **941 hrs.**	
	AVG. WIND SPEED: **3.08 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 12 WINDROSE (8/1/2021 TO 8/1/2024, 1100-1200)

DISPLAY:
Wind Speed
Direction (blowing from)



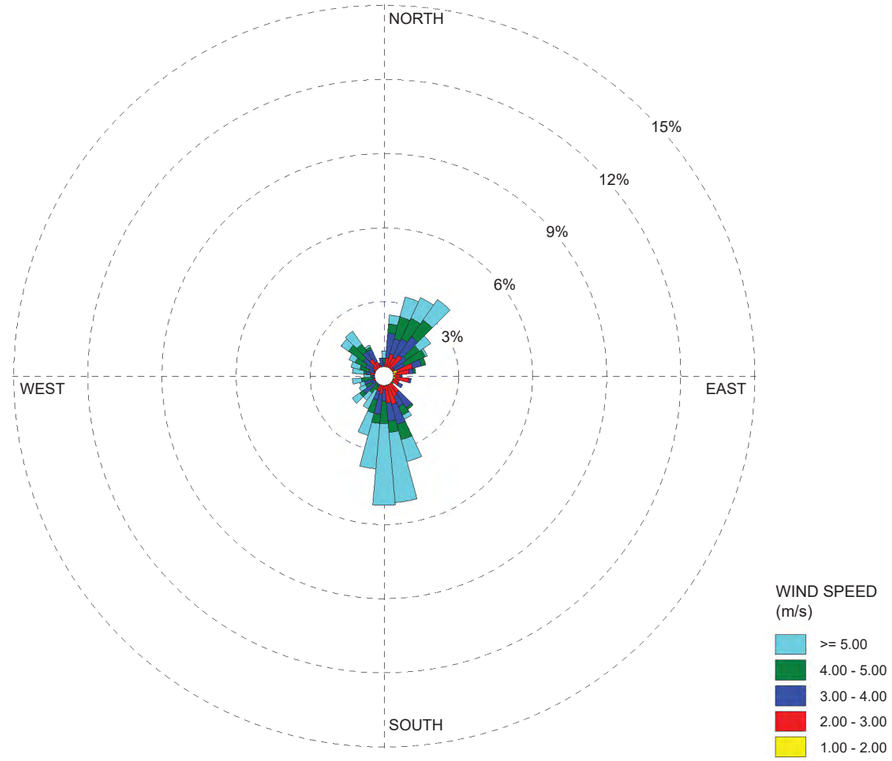
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **12.83%**	TOTAL COUNT: **2188**	
	AVG. WIND SPEED: **1.54 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 12 WINDROSE (8/1/2021 TO 8/1/2024, 1100-1200)

DISPLAY:
Wind Speed
Direction (blowing from)



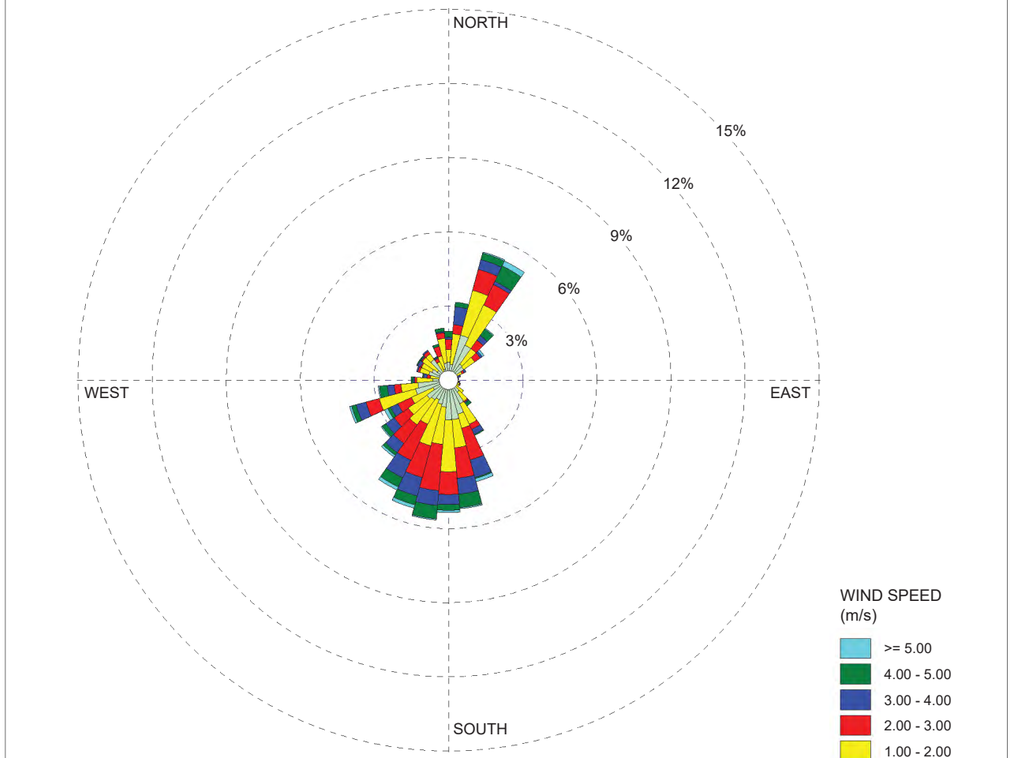
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 12:00** **End Date: 7/31/2024 - 12:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **16.97%**	TOTAL COUNT: **932 hrs.**	
	AVG. WIND SPEED: **3.37 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 13 WINDROSE (8/1/2021 TO 8/1/2024, 1200-1300)

DISPLAY:
Wind Speed
Direction (blowing from)



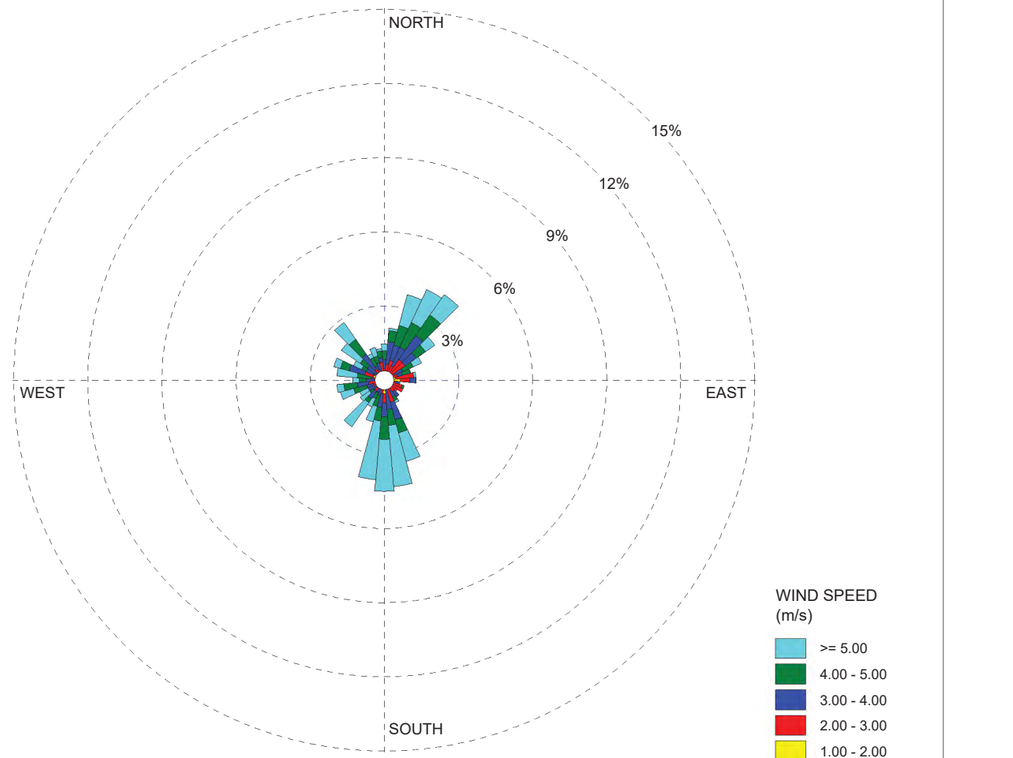
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **11.60%**	TOTAL COUNT: **2188**	
	AVG. WIND SPEED: **1.63 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 13 WINDROSE (8/1/2021 TO 8/1/2024, 1200-1300)

DISPLAY:
Wind Speed
Direction (blowing from)



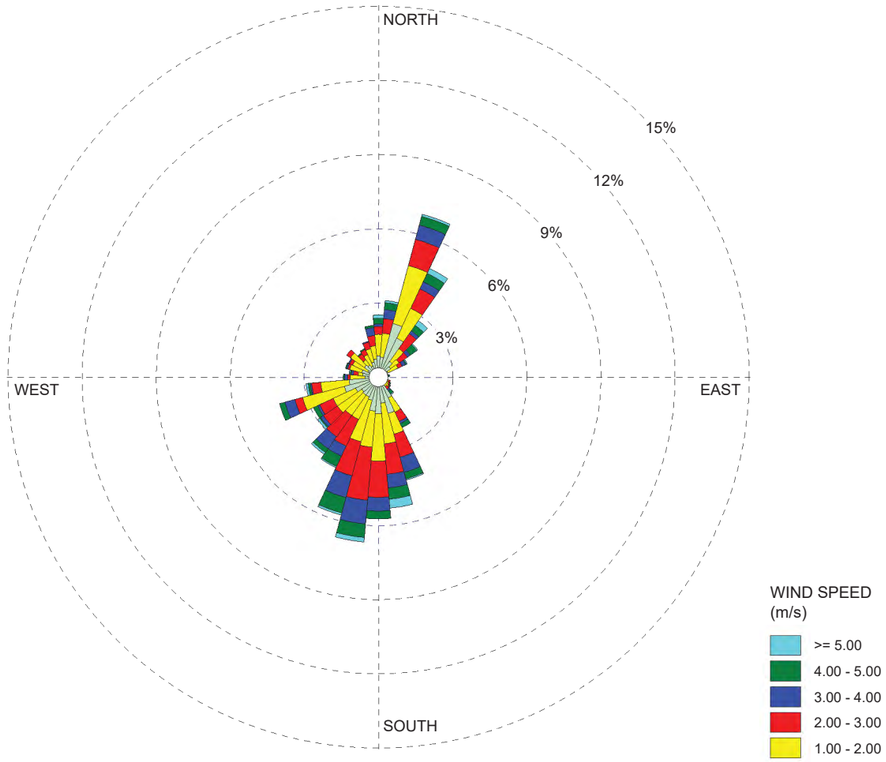
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 13:00** **End Date: 7/31/2024 - 13:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **15.05%**	TOTAL COUNT: **939 hrs.**	
	AVG. WIND SPEED: **3.54 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 14 WINDROSE (8/1/2021 TO 8/1/2024, 1300-1400)

DISPLAY:
Wind Speed
Direction (blowing from)



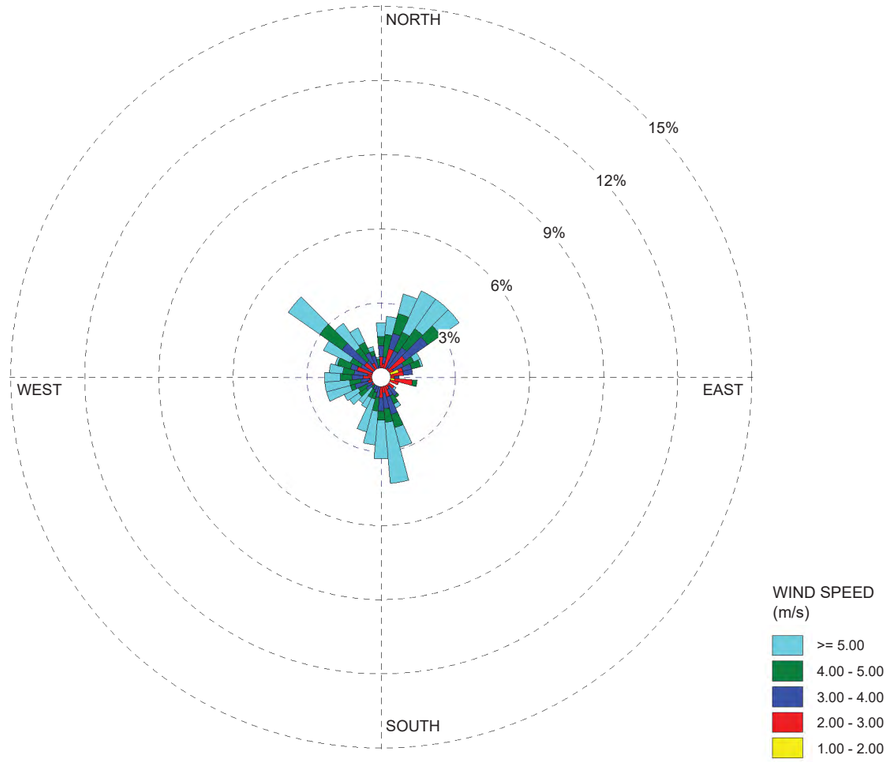
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **9.27%**	TOTAL COUNT: **2189**	
	AVG. WIND SPEED: **1.72 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 14 WINDROSE (8/1/2021 TO 8/1/2024, 1300-1400)

DISPLAY:
Wind Speed
Direction (blowing from)



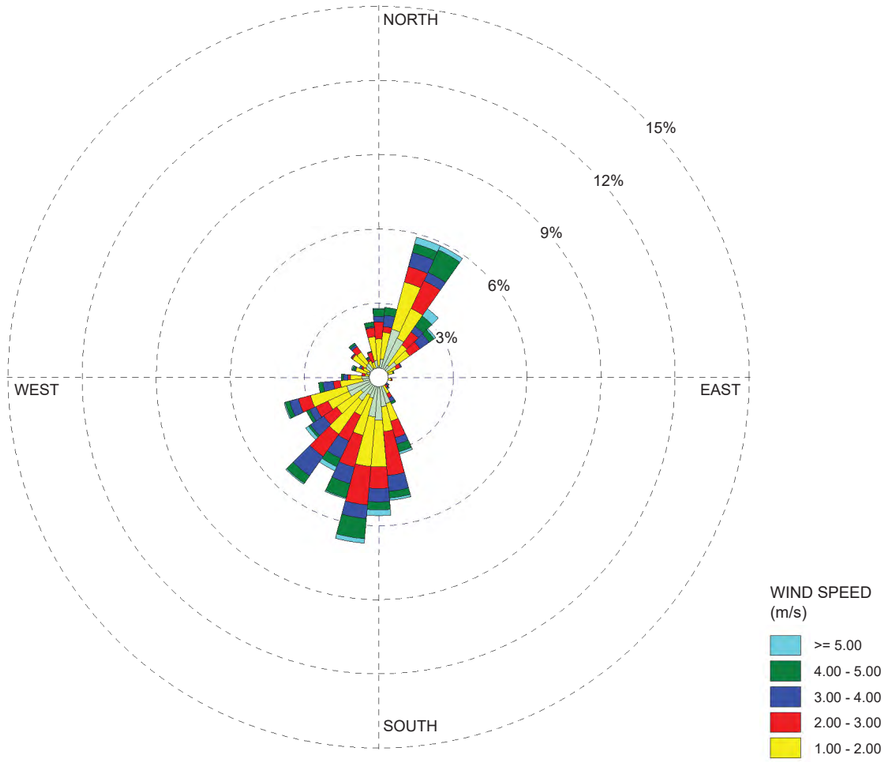
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 14:00** **End Date: 7/31/2024 - 14:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **11.95%**	TOTAL COUNT: **975 hrs.**	
	AVG. WIND SPEED: **3.80 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 15 WINDROSE (8/1/2021 TO 8/1/2024, 1400-1500)

DISPLAY:
Wind Speed
Direction (blowing from)



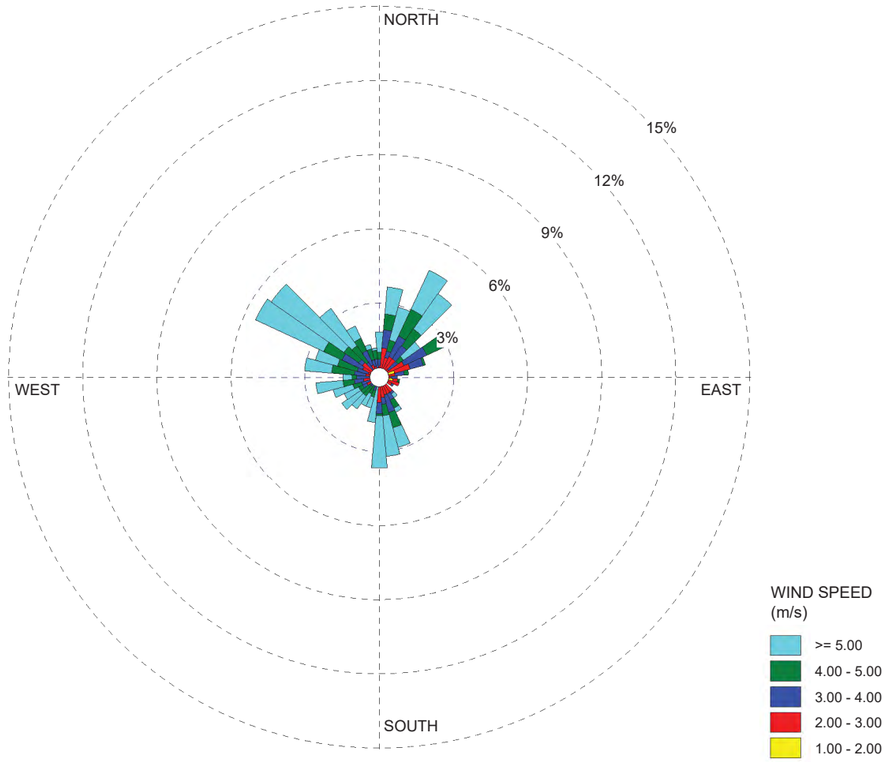
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **11.38%**	TOTAL COUNT: **2189**	
	AVG. WIND SPEED: **1.75 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 15 WINDROSE (8/1/2021 TO 8/1/2024, 1400-1500)

DISPLAY:
Wind Speed
Direction (blowing from)



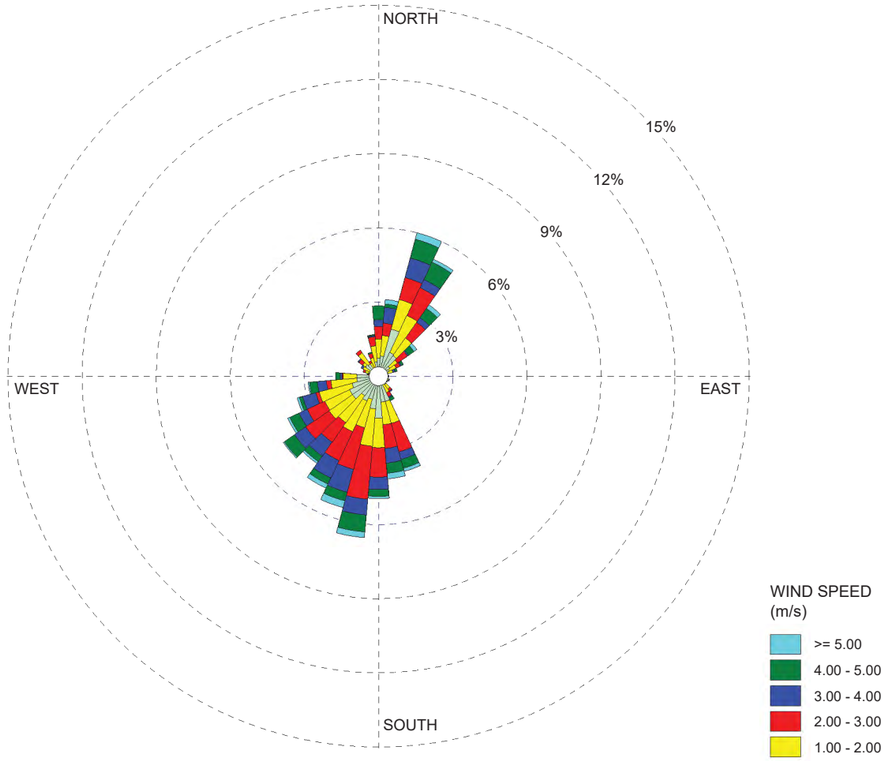
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 15:00** **End Date: 7/31/2024 - 15:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **10.49%**	TOTAL COUNT: **1001 hrs.**	
	AVG. WIND SPEED: **4.02 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 16 WINDROSE (8/1/2021 TO 8/1/2024, 1500-1600)

DISPLAY:
Wind Speed
Direction (blowing from)



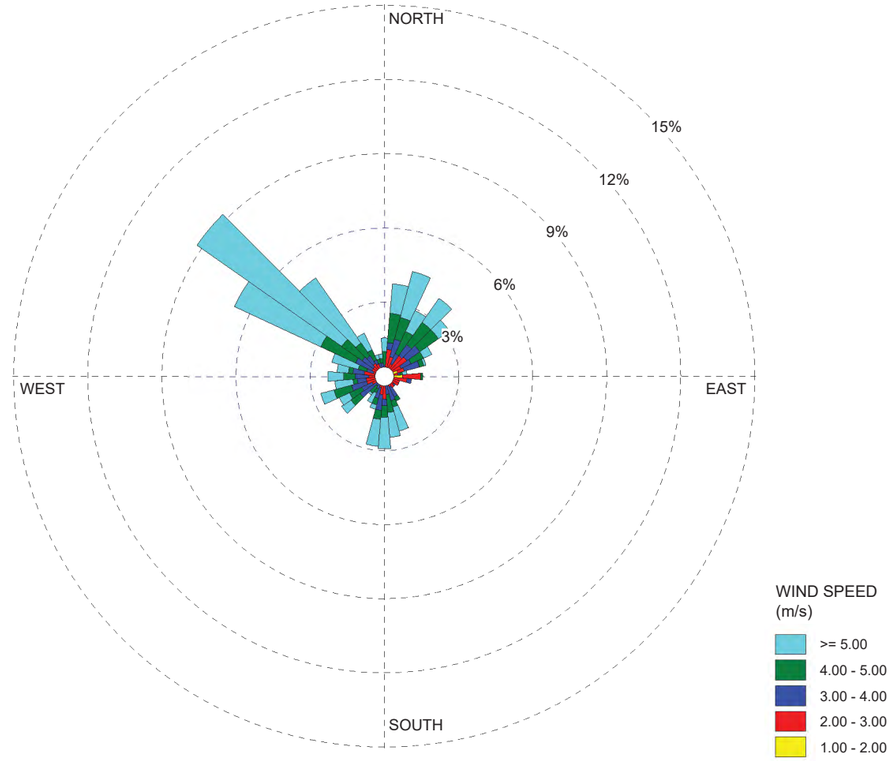
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **13.21%**	TOTAL COUNT: **2188**	
	AVG. WIND SPEED: **1.77 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 16 WINDROSE (8/1/2021 TO 8/1/2024, 1500-1600)

DISPLAY:
Wind Speed
Direction (blowing from)



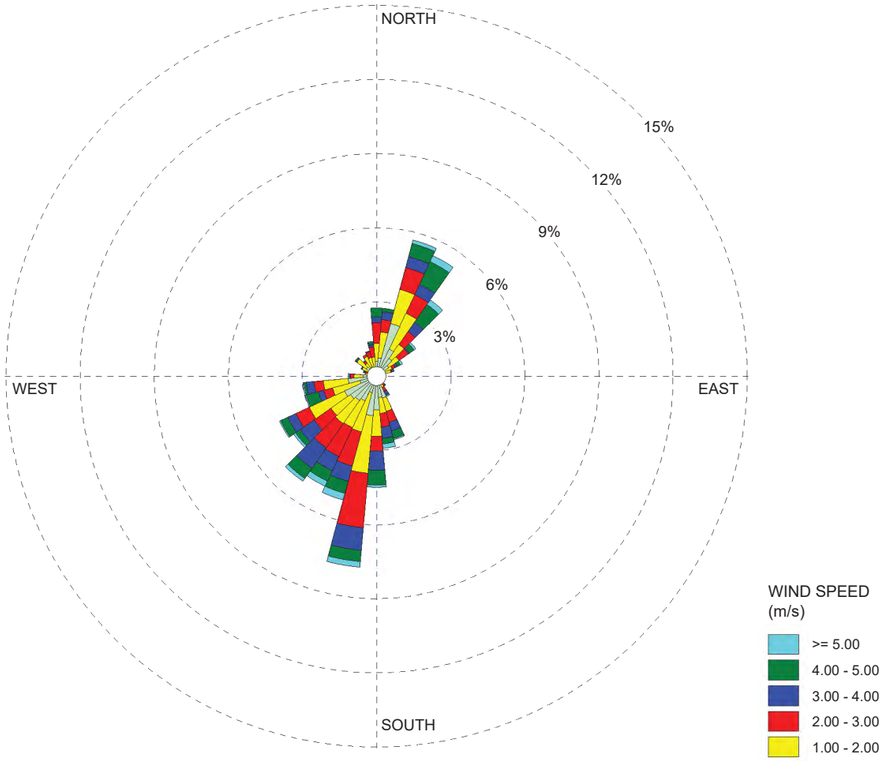
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 16:00** **End Date: 7/31/2024 - 16:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **10.31%**	TOTAL COUNT: **1034 hrs.**	
	AVG. WIND SPEED: **4.11 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 17 WINDROSE (8/1/2021 TO 8/1/2024, 1600-1700)

DISPLAY:
Wind Speed
Direction (blowing from)



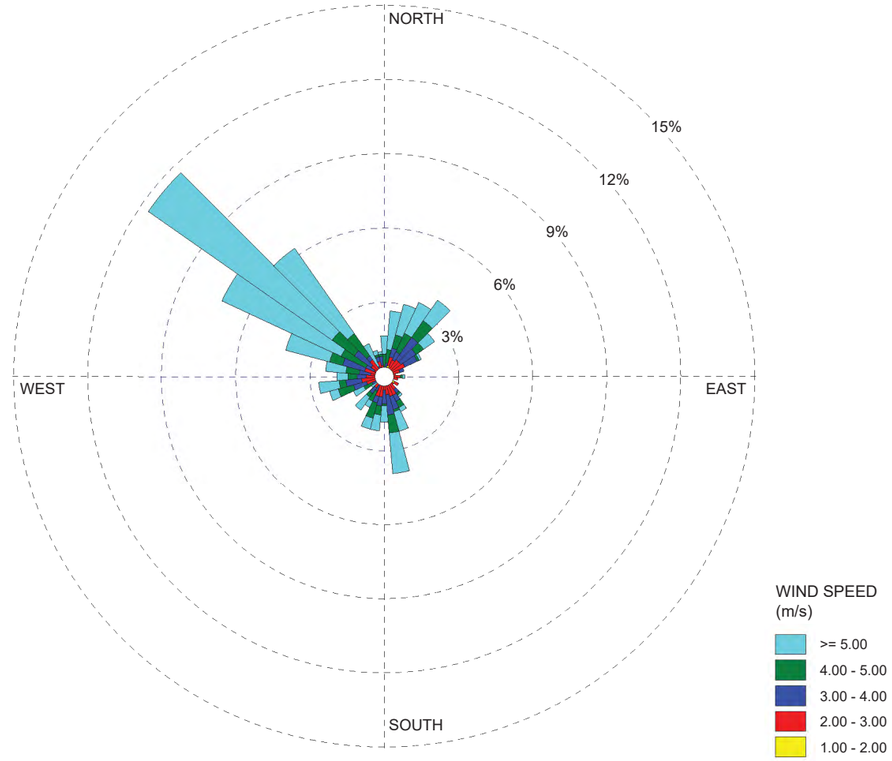
COMMENTS:		COMPANY NAME:	
Onsite (30 minute data)		**SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **17.49%**	TOTAL COUNT: **2190**	
	AVG. WIND SPEED: **1.68 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 17 WINDROSE (8/1/2021 TO 8/1/2024, 1600-1700)

DISPLAY:
Wind Speed
Direction (blowing from)



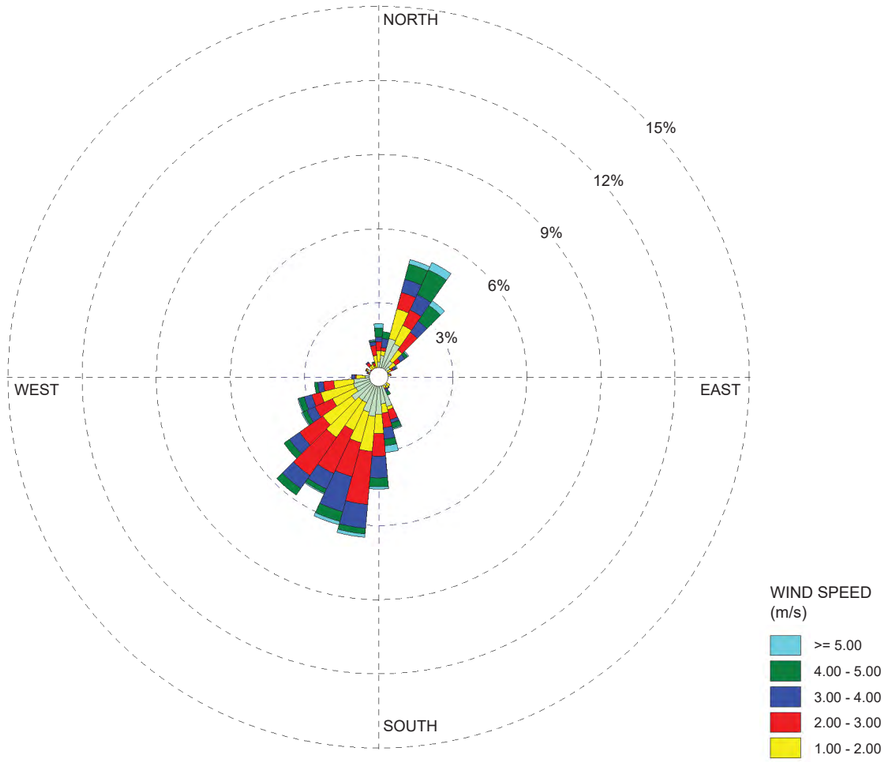
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
NOAA hourly data (10-degree wind directions)	**Start Date: 8/1/2021 - 17:00** **End Date: 7/31/2024 - 17:00**	**SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **11.95%**	TOTAL COUNT: **1056 hrs.**	
	AVG. WIND SPEED: **4.20 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 18 WINDROSE (8/1/2021 TO 8/1/2024, 1700-1800)

DISPLAY:
Wind Speed
Direction (blowing from)



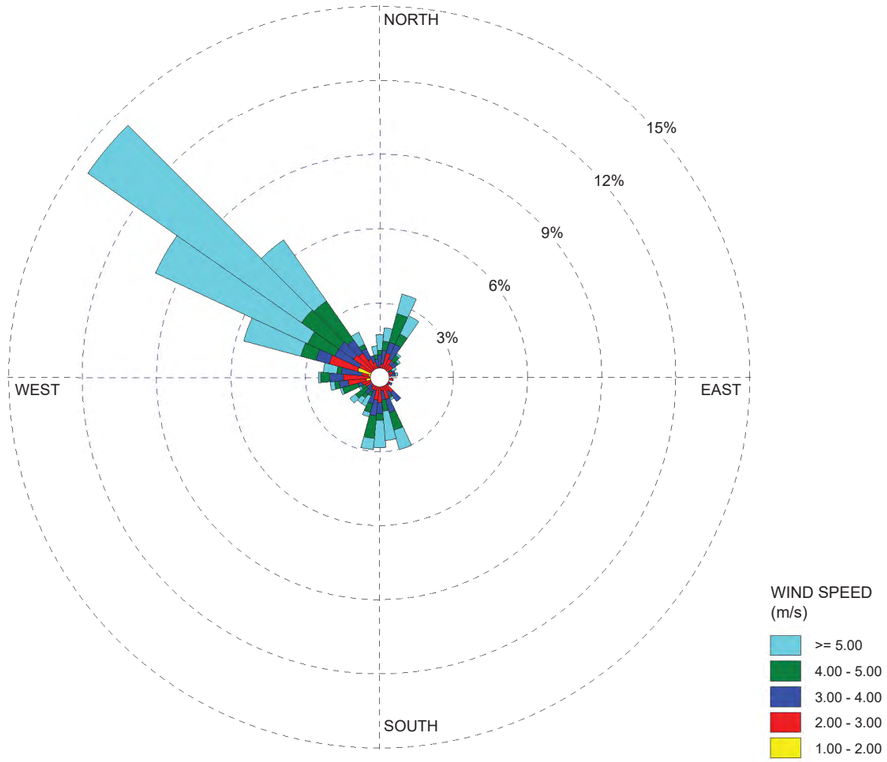
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **22.15%**	TOTAL COUNT: **2190**	
	AVG. WIND SPEED: **1.55 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 18 WINDROSE (8/1/2021 TO 8/1/2024, 1700-1800)

DISPLAY:
Wind Speed
Direction (blowing from)



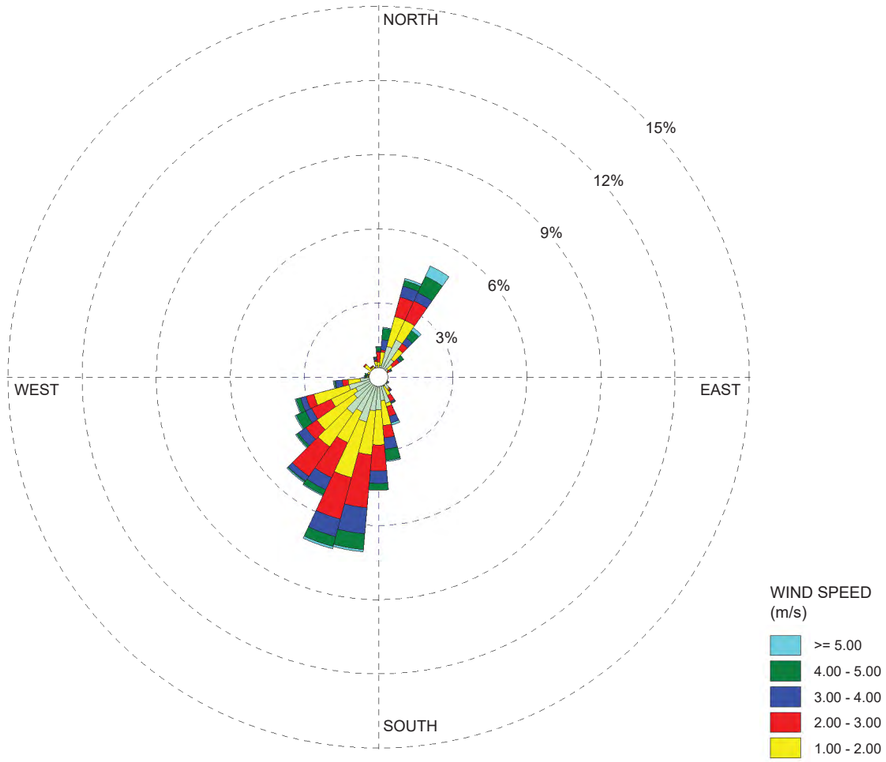
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 18:00** **End Date: 7/31/2024 - 18:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **12.23%**	TOTAL COUNT: **1075 hrs.**	
	AVG. WIND SPEED: **4.02 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 19 WINDROSE (8/1/2021 TO 8/1/2024, 1800-1900)

DISPLAY:
Wind Speed
Direction (blowing from)



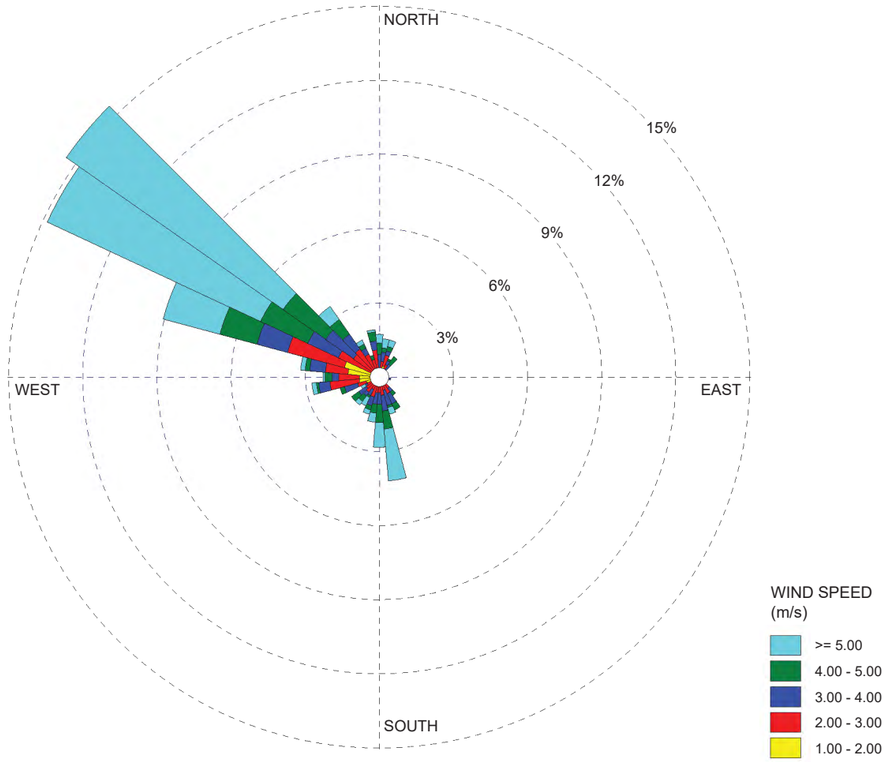
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **26.67%**	TOTAL COUNT: **2190**	
	AVG. WIND SPEED: **1.37 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 19 WINDROSE (8/1/2021 TO 8/1/2024, 1800-1900)

DISPLAY:
Wind Speed
Direction (blowing from)



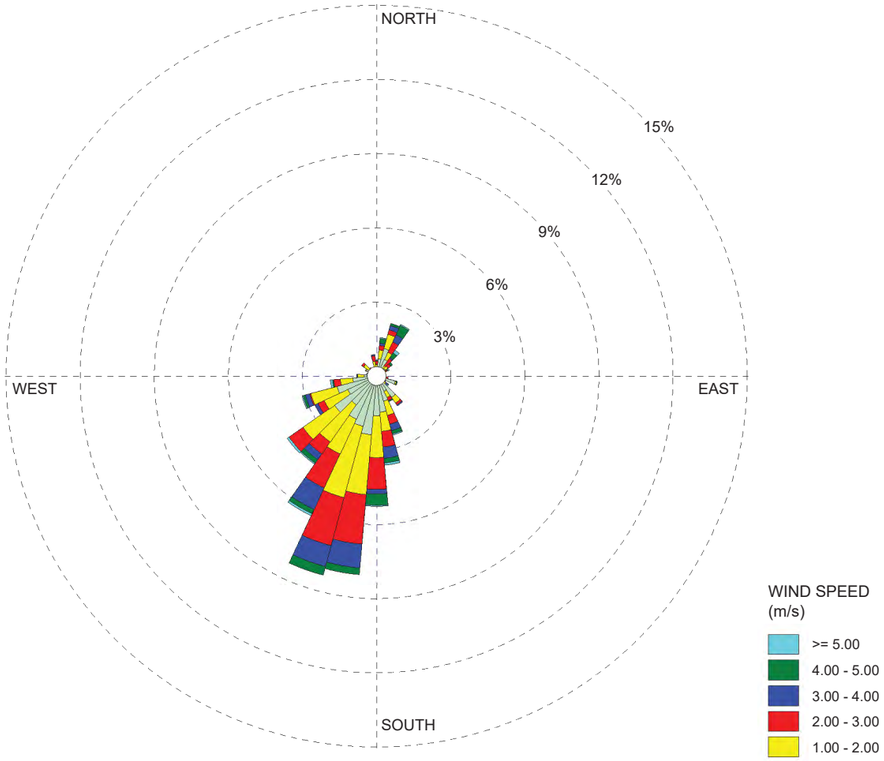
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 19:00** **End Date: 7/31/2024 - 19:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **12.50%**	TOTAL COUNT: **1070 hrs.**	
	AVG. WIND SPEED: **3.83 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 20 WINDROSE (8/1/2021 TO 8/1/2024, 1900-2000)

DISPLAY:
Wind Speed
Direction (blowing from)



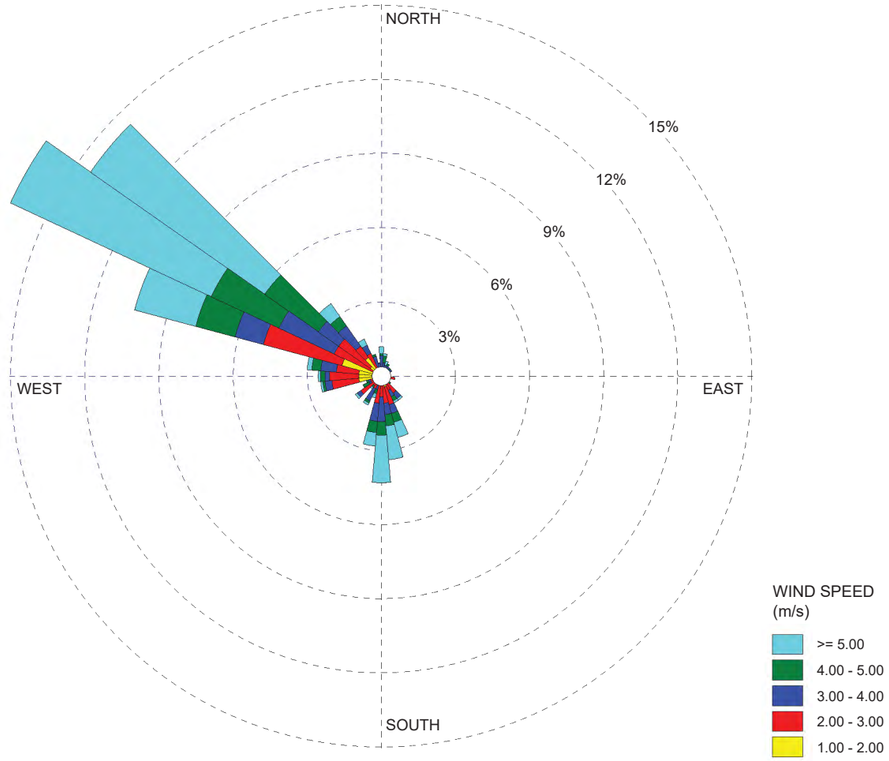
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **30.32%**	TOTAL COUNT: **2190**	
	AVG. WIND SPEED: **1.15 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 20 WINDROSE (8/1/2021 TO 8/1/2024, 1900-2000)

DISPLAY:
Wind Speed
Direction (blowing from)



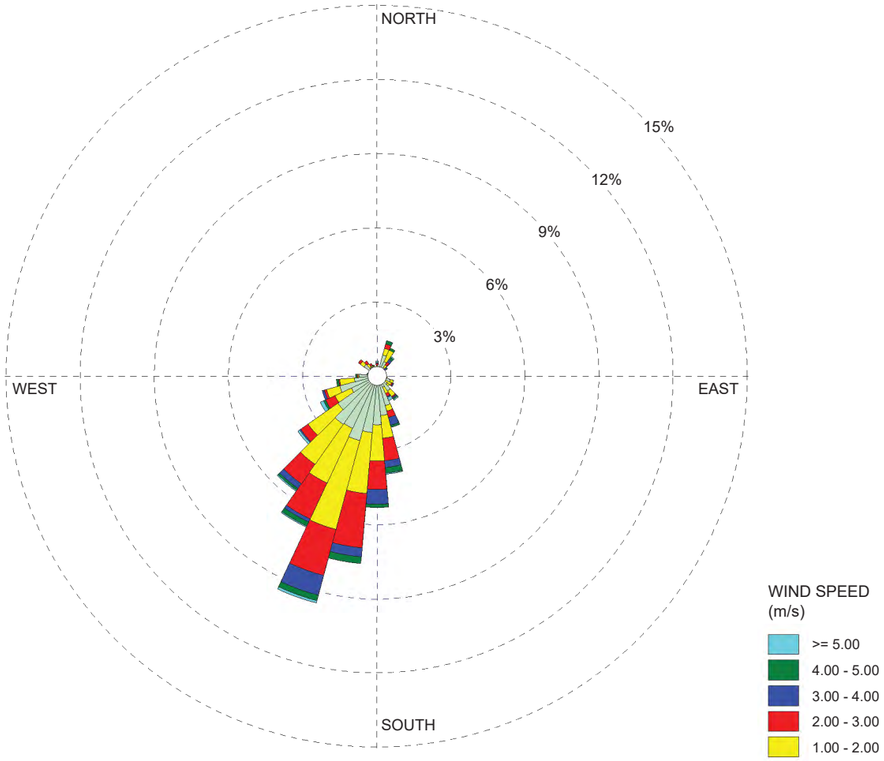
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 20:00** **End Date: 7/31/2024 - 20:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **14.23%**	TOTAL COUNT: **1067 hrs.**	
	AVG. WIND SPEED: **3.63 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 21 WINDROSE (8/1/2021 TO 8/1/2024, 2000-2100)

DISPLAY:
Wind Speed
Direction (blowing from)



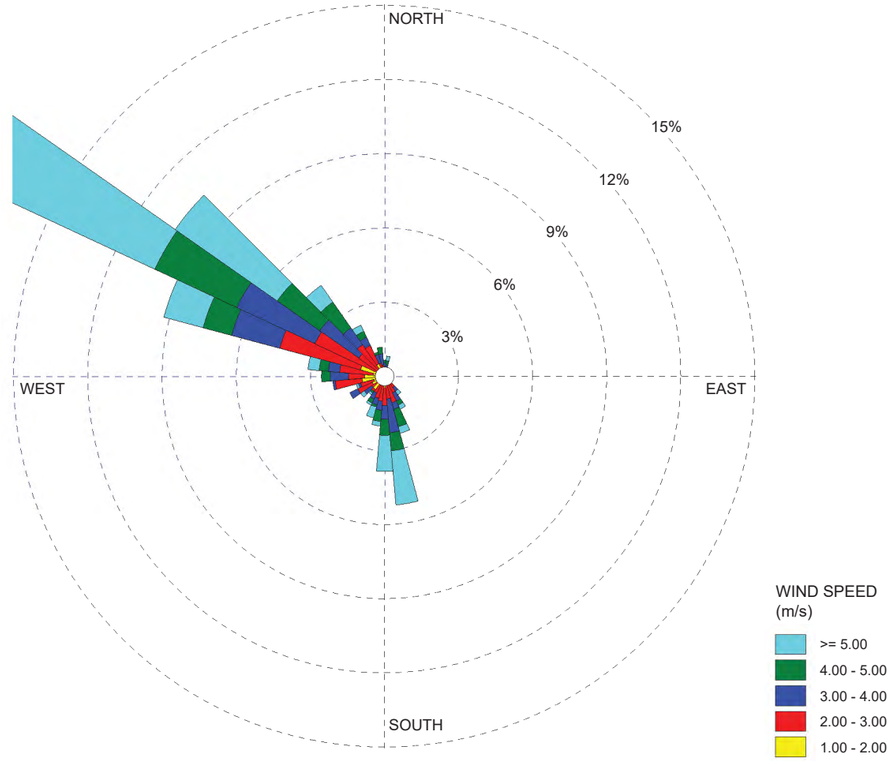
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **33.24%**	TOTAL COUNT: **2190**	
	AVG. WIND SPEED: **0.99 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 21 WINDROSE (8/1/2021 TO 8/1/2024, 2000-2100)

DISPLAY:
Wind Speed
Direction (blowing from)



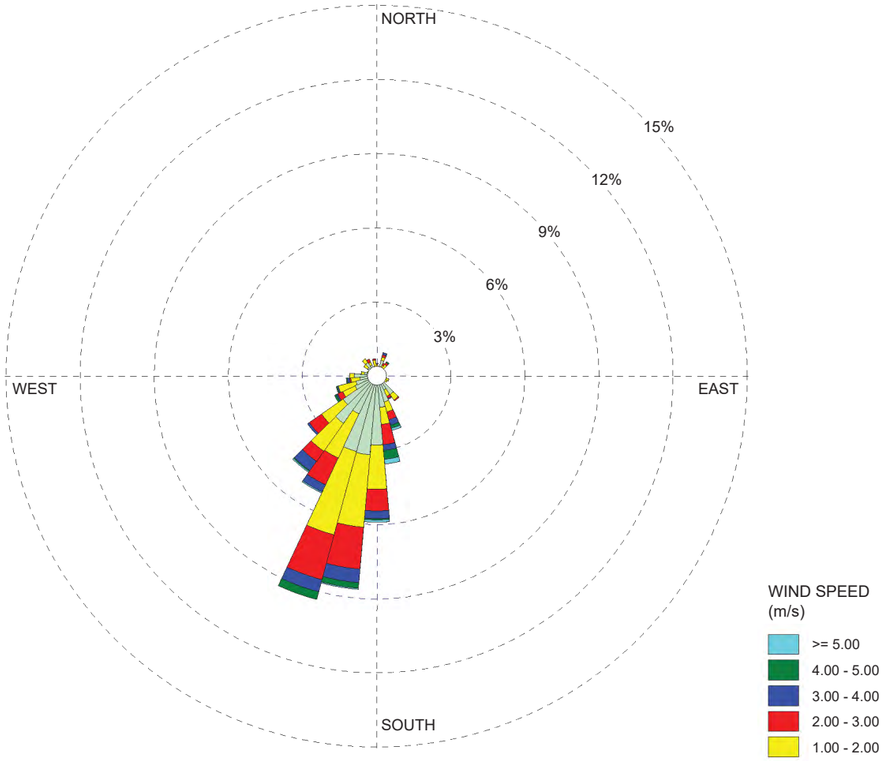
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 21:00** **End Date: 7/31/2024 - 21:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **14.60%**	TOTAL COUNT: **1074 hrs.**	
	AVG. WIND SPEED: **3.49 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 22 WINDROSE (8/1/2021 TO 8/1/2024, 2100-2200)

DISPLAY:
Wind Speed
Direction (blowing from)



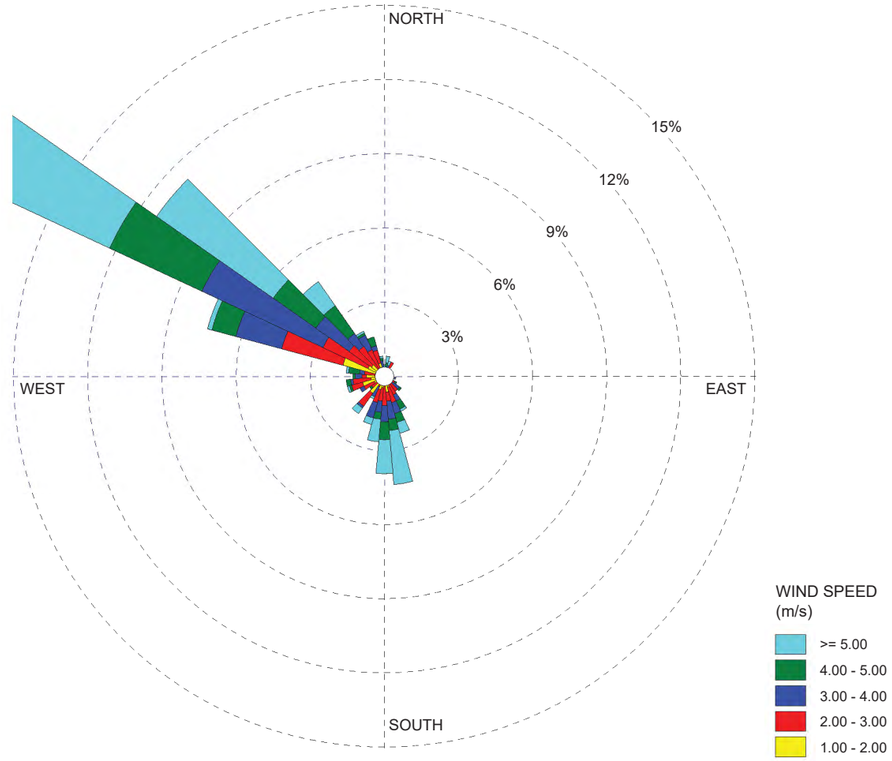
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **38.54%**	TOTAL COUNT: **2190**	
	AVG. WIND SPEED: **0.88 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 22 WINDROSE (8/1/2021 TO 8/1/2024, 2100-2200)

DISPLAY:
Wind Speed
Direction (blowing from)



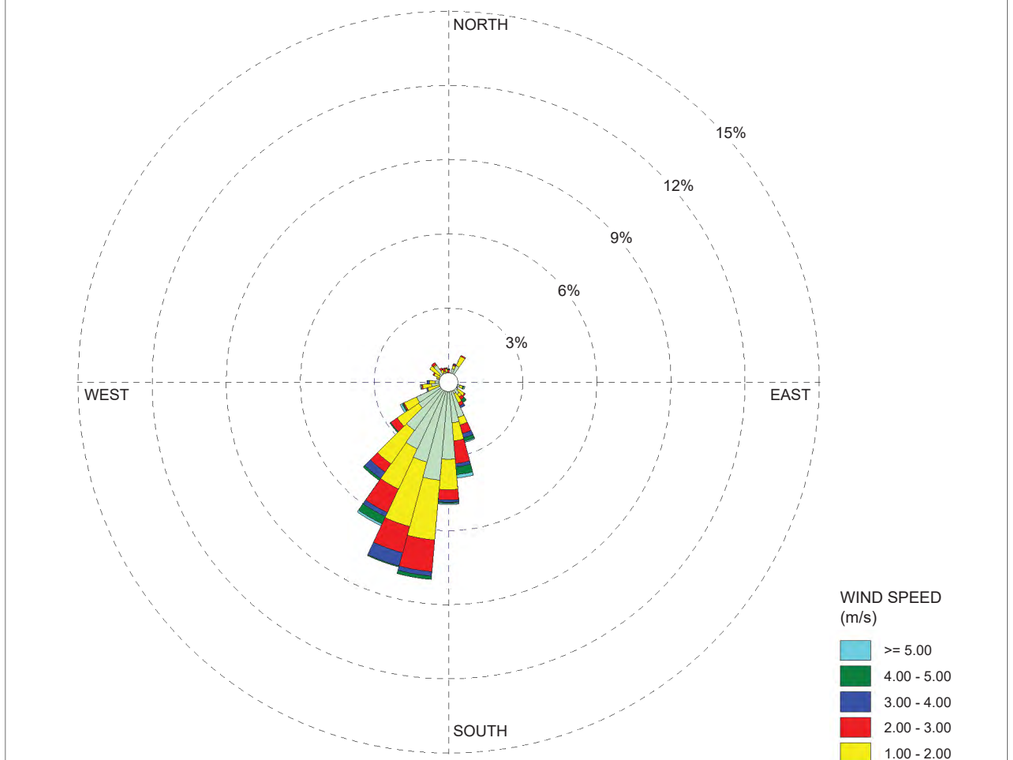
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 22:00** **End Date: 7/31/2024 - 22:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **17.15%**	TOTAL COUNT: **1071 hrs.**	
	AVG. WIND SPEED: **3.32 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 23 WINDROSE (8/1/2021 TO 8/1/2024, 2200-2300)

DISPLAY:
Wind Speed
Direction (blowing from)



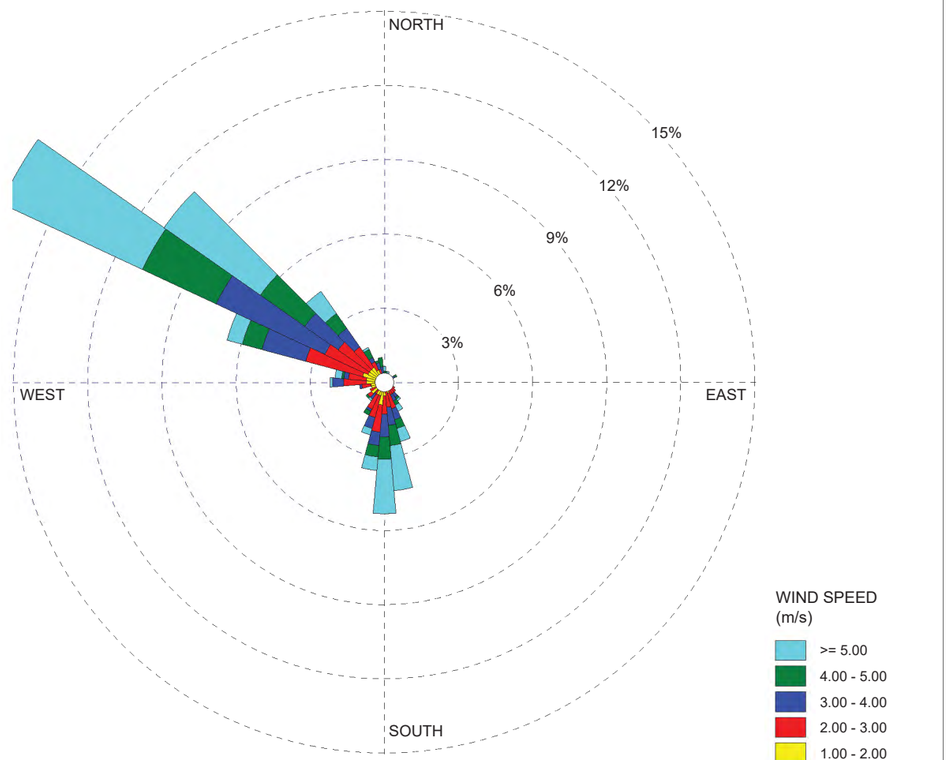
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **40.09%**	TOTAL COUNT: **2190**	
	AVG. WIND SPEED: **0.79 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 23 WINDROSE (8/1/2021 TO 8/1/2024, 2200-2300)

DISPLAY:
Wind Speed
Direction (blowing from)



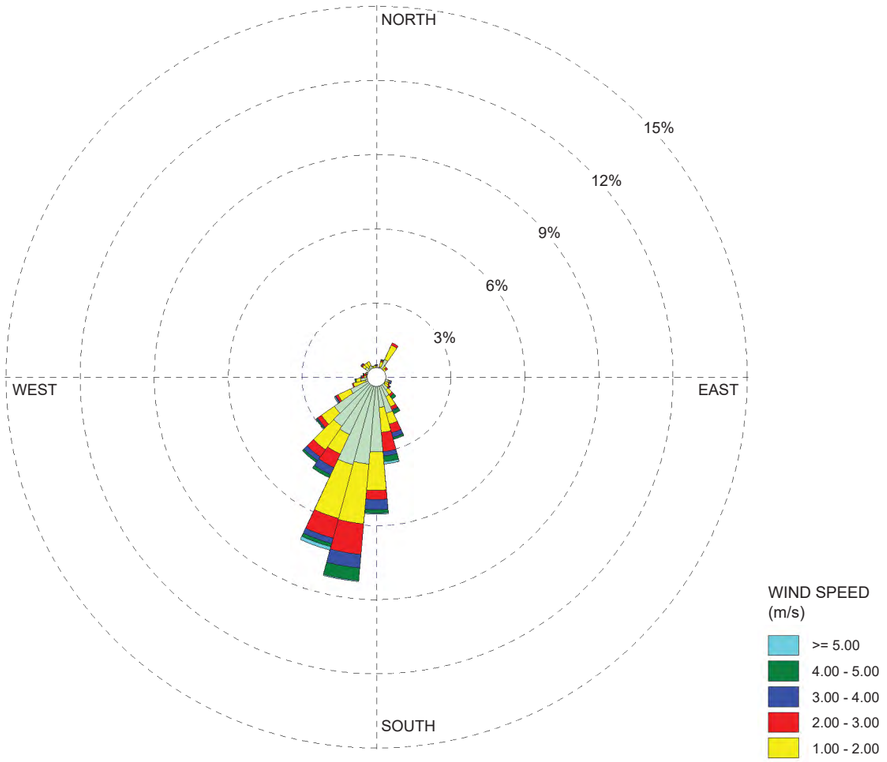
COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 23:00** **End Date: 7/31/2024 - 23:00**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **21.08%**	TOTAL COUNT: **1068 hrs.**	
	AVG. WIND SPEED: **3.06 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

COFFIN BUTTE LANDFILL
3-YEAR HOUR 24 WINDROSE (8/1/2021 TO 8/1/2024, 2300-2400)

DISPLAY:
Wind Speed
Direction (blowing from)



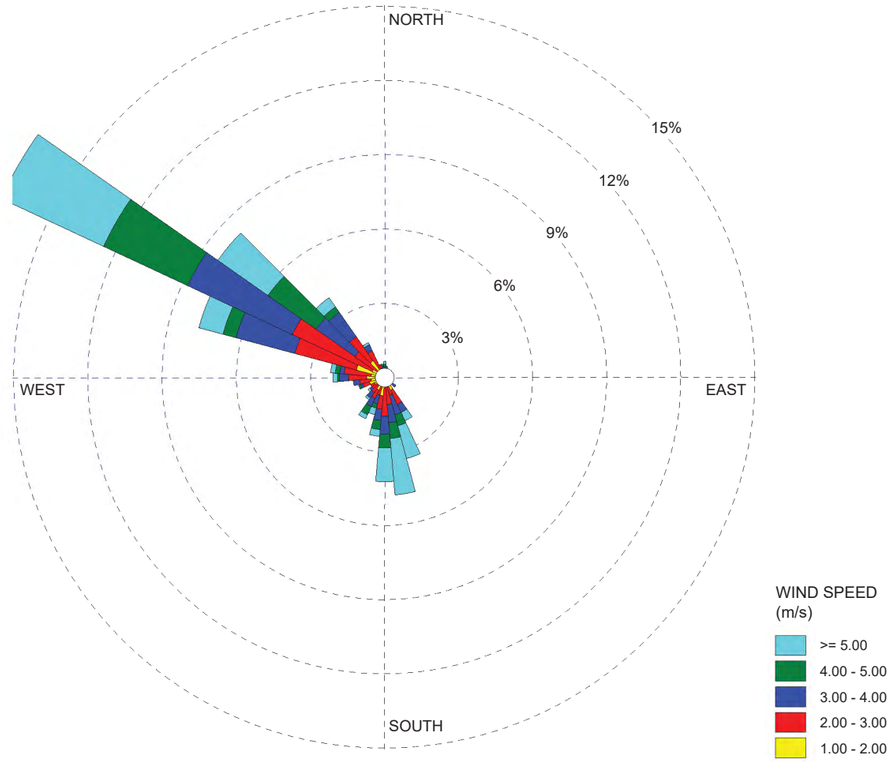
COMMENTS: Onsite (30 minute data)		COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **42.83%**	TOTAL COUNT: **2190**	
	AVG. WIND SPEED: **0.76 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

CORVALLIS MUNICIPAL AIRPORT (KCVO)
3-YEAR HOUR 24 WINDROSE (8/1/2021 TO 8/1/2024, 2300-2400)

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS: NOAA hourly data (10-degree wind directions)	DATA PERIOD: **Start Date: 8/1/2021 - 00:00** **End Date: 7/31/2024 - 23:59**	COMPANY NAME: **SCS ENGINEERS**	
		MODELER:	
	CALM WINDS: **23.72%**	TOTAL COUNT: **1058 hrs.**	
	AVG. WIND SPEED: **2.86 m/s**		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

EXHIBIT 15
TRAFFIC REPORT

TRANSIGHT CONSULTING, LLC
Transportation Engineering and Planning Services

Date:	February 26, 2024
To:	Inga Williams, Benton County
From:	Joe Bessman, PE
Project Reference No.:	1539
Project Name:	Coffin Butte Landfill Expansion



PURPOSE AND SUMMARY

The purpose of this memorandum is to provide a Transportation Impact Analysis for the Coffin Butte Landfill expansion in Benton County. The current landfill cell is projected to reach its capacity within the next four years, requiring that the planning and design of new landfill cells begin to continue to support landfill services for Linn, Benton, Lincoln, Polk, and Marion County areas.

In summary, the current Republic Services plan is to expand the landfill into lands designated by Benton County as "Landfill Site" (LS) that are located south of Coffin Butte Road. The landfill expansion area will include a new outbound scale, and widening of Coffin Butte Road is proposed to a three-lane Major Collector section between the existing landfill entrance and the expansion site to better support left-turns outside of the travel way.

The application proposes improvements to Coffin Butte Road. This plan will maintain area ingress and egress and continue to support the functional role of area transportation facilities. Key transportation findings of the current plan are as follows:

- There are no changes in area travel patterns with this revised configuration. Access to the landfill will continue to be provided from Coffin Butte Road, and Coffin Butte Road will remain open as a Benton County *Major Collector* and *Freight Route*.
- The widening of Coffin Butte Road to a three-lane section with improved shoulder/bicycle lanes will separate impacts to through travelers on Coffin Butte Road during the construction period and during the ensuing operation of the landfill.
- This plan creates no changes to emergency ingress and egress routes to the area.
- This plan creates no impacts to Tampico Road, thereby avoiding any need to improve this streetscape or otherwise modify the roadway character.
- This plan does not impact area cyclists. The widening of shoulders along the impacted portion of Coffin Butte Road to provide standard bicycle lanes is an improvement from the current condition and will bring the section into compliance with Benton County standards.
- This plan does not impact the adopted Transportation System Plan or require any changes to the functional classification or performance standards of surrounding streets.

The use of this new landfill area will provide time for Knife River to complete their ongoing processing of the rock resource within their current location, ultimately allowing the current quarry area to be used as a future landfill site.

PROJECT DESCRIPTION

The Coffin Butte Landfill is located west of Highway 99W near Adair Village, located between the cities of Corvallis and Independence. The current site is co-located with Knife River's quarrying operation. The overall site includes 740 acres, with over 500 acres dedicated to preservation and non-landfill uses. This landfill has been in operation for over 40 years at its current location, with this new phase necessary to continue to support the area population. The location of the site is provided in Figure 1 for context.



Figure 1. Site vicinity map. *Image source: maps.google.com.*

The expansion will encompass lands that are south of the current landfill location on the south side of Coffin Butte Road. Private passenger vehicles using the landfill will continue to use the scales and services on the north side of Coffin Butte Road, with these consolidated materials then hauled by commercial truck to the expansion site for disposal. Commercial account users will also be required to use the current scales

to weigh in, then will be directed to the expansion area to dispose of materials. These private and commercial vehicles will use a new outbound scale near the expansion site exit, will pay the appropriate fees, and will then exit onto Coffin Butte Road. Figure 2 illustrates the layout of the revised landfill for context.

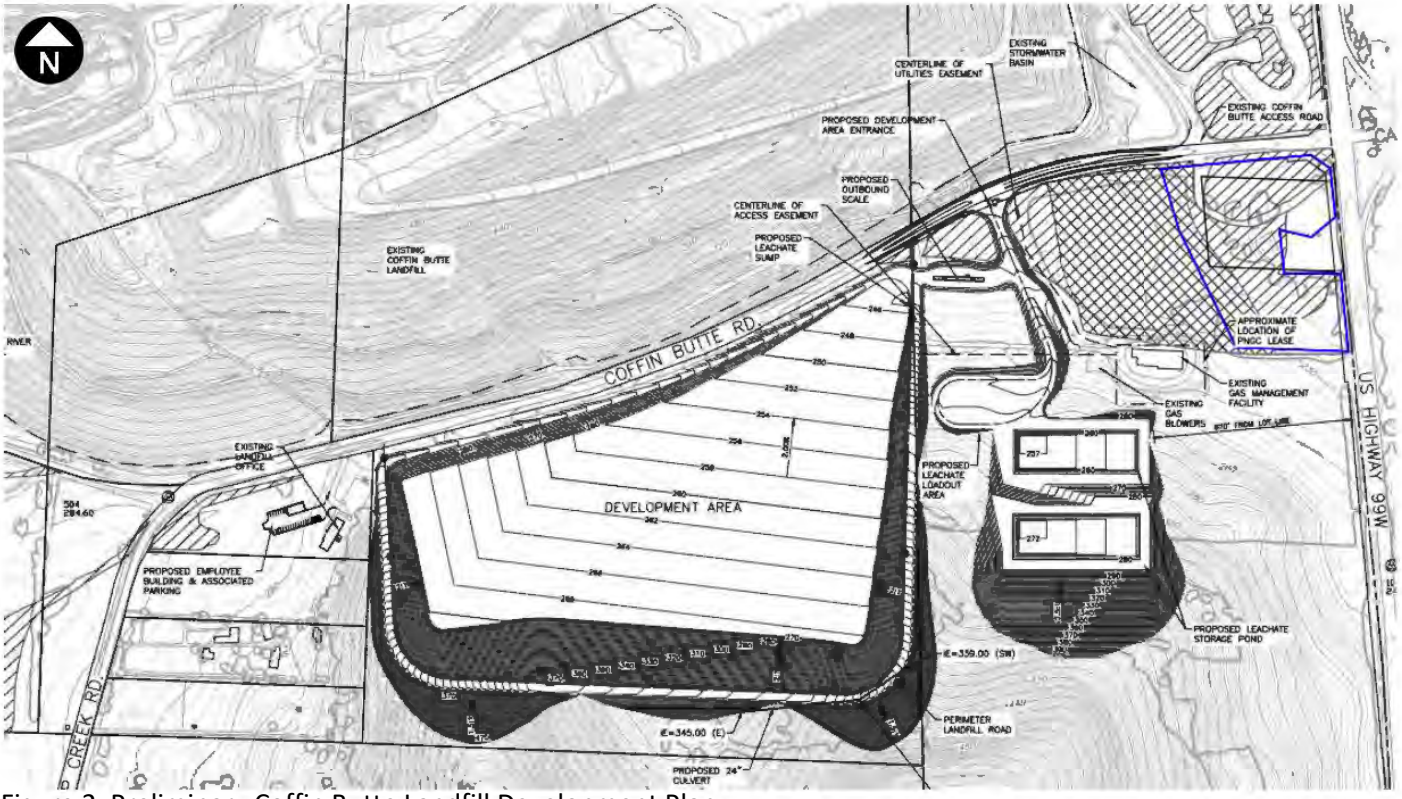


Figure 2. Preliminary Coffin Butte Landfill Development Plan.

This expansion area is intended to provide approximately six years of landfill capacity, allowing the established Coffin Butte site to function beyond the approximately 2026 lifespan of the current cells. When the new footprint is filled, landfill operations will then shift back to the north side of Coffin Butte Road within the current Knife River quarry location.

As a result of retaining the scales on the north side of Coffin Butte Road for the expansion there will be internal trips between the north and south sides of Coffin Butte Road. With the southern access serving commercial truck traffic a westbound left-turn lane has been proposed to avoid impacts to through travel on Coffin Butte Road. This preliminary turn lane design includes about 250 feet of queue storage, which can support up to four semitrucks at once (more than an 85th percentile queue). This extensive design provides a very high level of confidence that the storage will be adequate to avoid congestion along this low-volume section of Coffin Butte Road, though this design may be further refined as the civil plans progress.

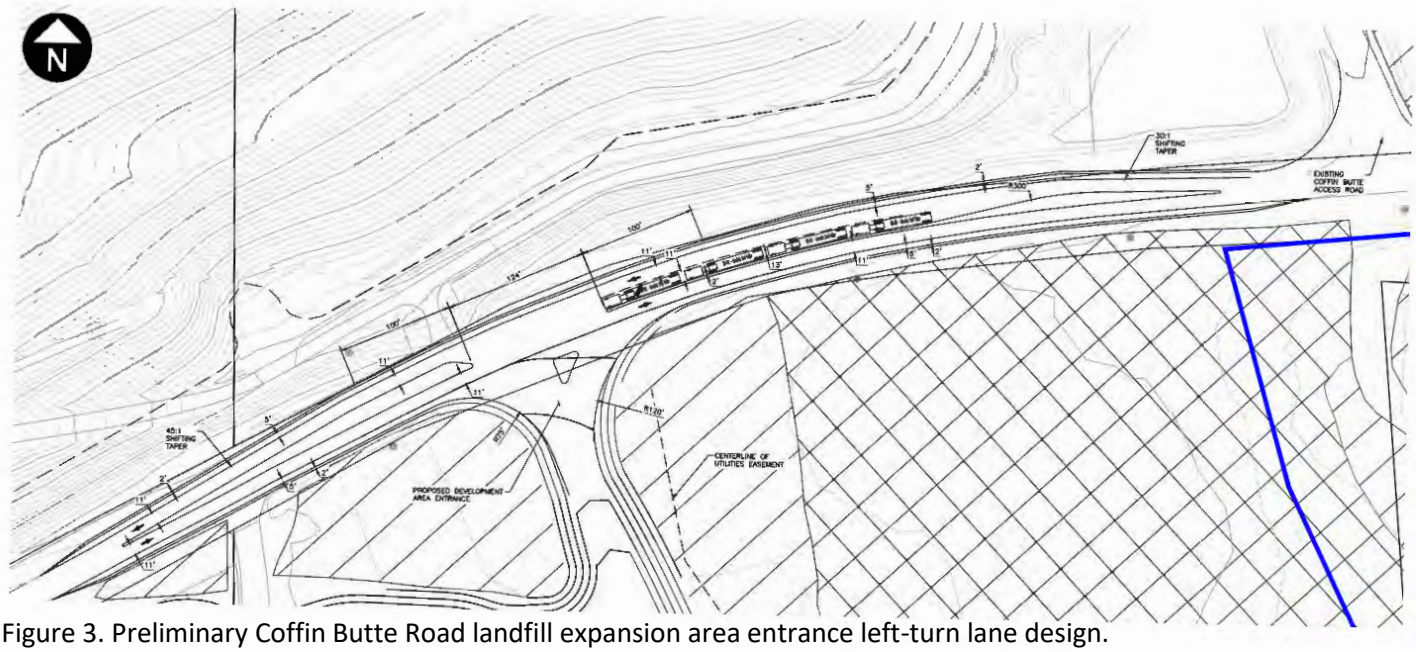


Figure 3. Preliminary Coffin Butte Road landfill expansion area entrance left-turn lane design.

SURROUNDING ROADWAY CHARACTERISTICS

Figure 4 illustrates the functional classification of the surrounding roadways as described within the Benton County Transportation System Plan. This plan shows that Tampico Road is classified as a *Major Collector,* Camp Adair Road east of Highway 99W is a *Minor Arterial,* and Highway 99W is classified as a *Principal Arterial*. Coffin Butte Road west of its intersection with Soap Creek Road and extending west to Wiles Road is a private road. Area roads are generally narrow two-lane roads with limited shoulders, with rural posted or statutory speeds between 45 and 55 miles per hour.

The new landfill entrance will be designed as a private road with wide turning radii capable of supporting large trucks, similar to the current entrance north of Coffin Butte Road. The entrance road will be paved, avoiding rock or debris from being pulled onto Coffin Butte Road.

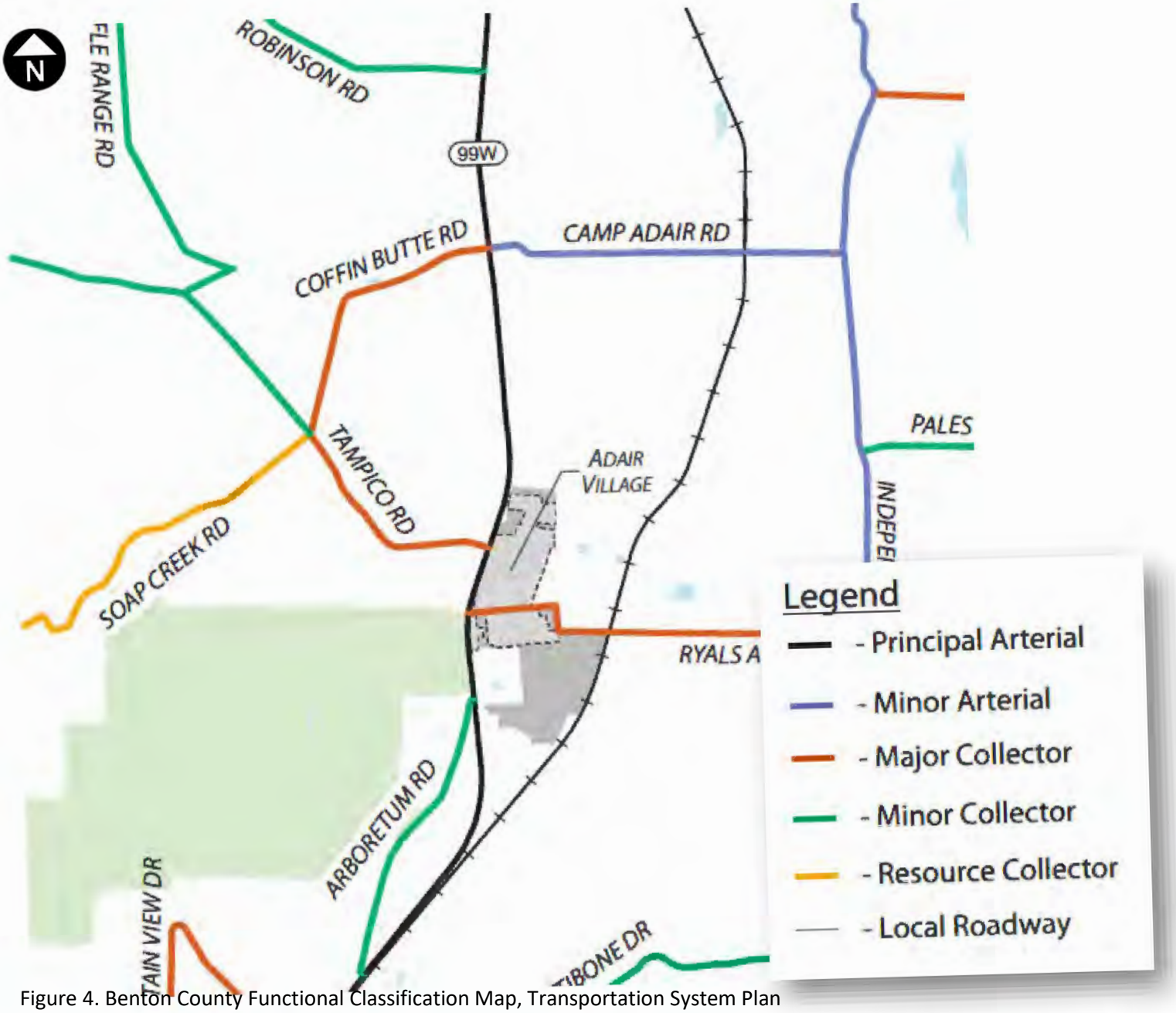


Figure 4. Benton County Functional Classification Map, Transportation System Plan

In January 2021 Benton County staff collected vehicular volume and classification data on Coffin Butte Road near its intersection with Soap Creek Road to assess the volume of trips and number of trucks per day near this section of Coffin Butte Road. The counts showed that traffic volumes were fairly consistent throughout the weekdays, with weekend volumes near the quarry about half of those reported on weekdays. The weekday volumes on Coffin Butte Road west of the landfill served about 243 average daily trips, with nearly 1/3 of these trips associated with trucks. This volume of trips equates to about one vehicle every two or three minutes during the peak hour of the day (see Figure 5).

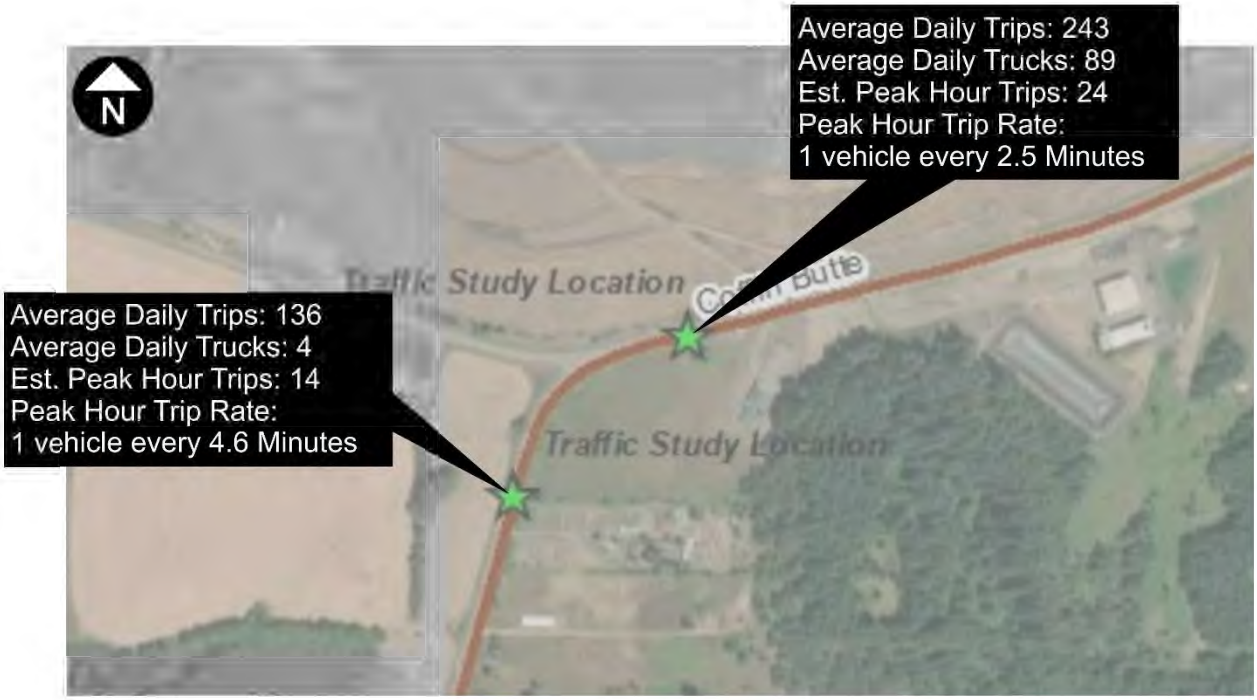


Figure 5. Summary of January 20, 2021 Traffic Study prepared by Benton County.

To confirm these County-provided traffic counts, a series of traffic counts were collected in mid-March 2021 throughout the study area. These traffic counts reflect peak commute period conditions during the 4:00 to 6:00 p.m. period, and are not intended to reflect the peak hour of the landfill or quarry operations but rather the most critical time period to access the Highway 99W system. This assessment is consistent with the time period assessed within Benton County's regional plans. Figure 6 illustrates the count locations and peak hour traffic volumes measured.

The counts show that during the peak evening commute hour the highway traffic is heavily biased in the northbound direction. The traffic counts show about 8 eastbound trips and 5 westbound trips within the section of Coffin Butte Road near the new access, which is a very low volume of conflicting traffic.

A third set of traffic counts was collected in January 2022 to again confirm travel patterns post-COVID pandemic and to assess a broader time period that is more reflective of peak quarry and landfill operations. This set of traffic counts again confirmed the very low traffic volumes throughout this area. During the peak hour on Coffin Butte Road (about 2:00 to 3:00 p.m.) this showed 16 westbound vehicles and 19 eastbound vehicles that would travel along Coffin Butte Road during this peak hour where the new access is located. Again, this is a very low volume of traffic that will not present any capacity-related needs, particularly with the separated westbound left-turn lane. These volumes, showing the individual peak hour throughout the system, are shown in Figure 7.

A fourth set of traffic counts was collected on September 19, 2023 at the NW Soap Creek Road/Coffin Butte Road and OR 99W/Coffin Butte Road intersections as well as at the existing landfill access on Coffin Butte Road and the Knife River Quarry access. These counts were conducted from 2:00 to 6:00 p.m. and showed similar traffic trends as the previous counts with volumes on the highway being predominantly in the northbound direction during the weekday p.m. peak hour. Coffin Butte Road continued to carry a relatively low volume of traffic outside of the vehicles heading to and from the existing landfill site. These volumes are shown in Figure 8. Comparison of the counts shows relatively stable conditions, with the 2023 traffic counts slightly higher based on the increased Knife River activity within the quarry site.

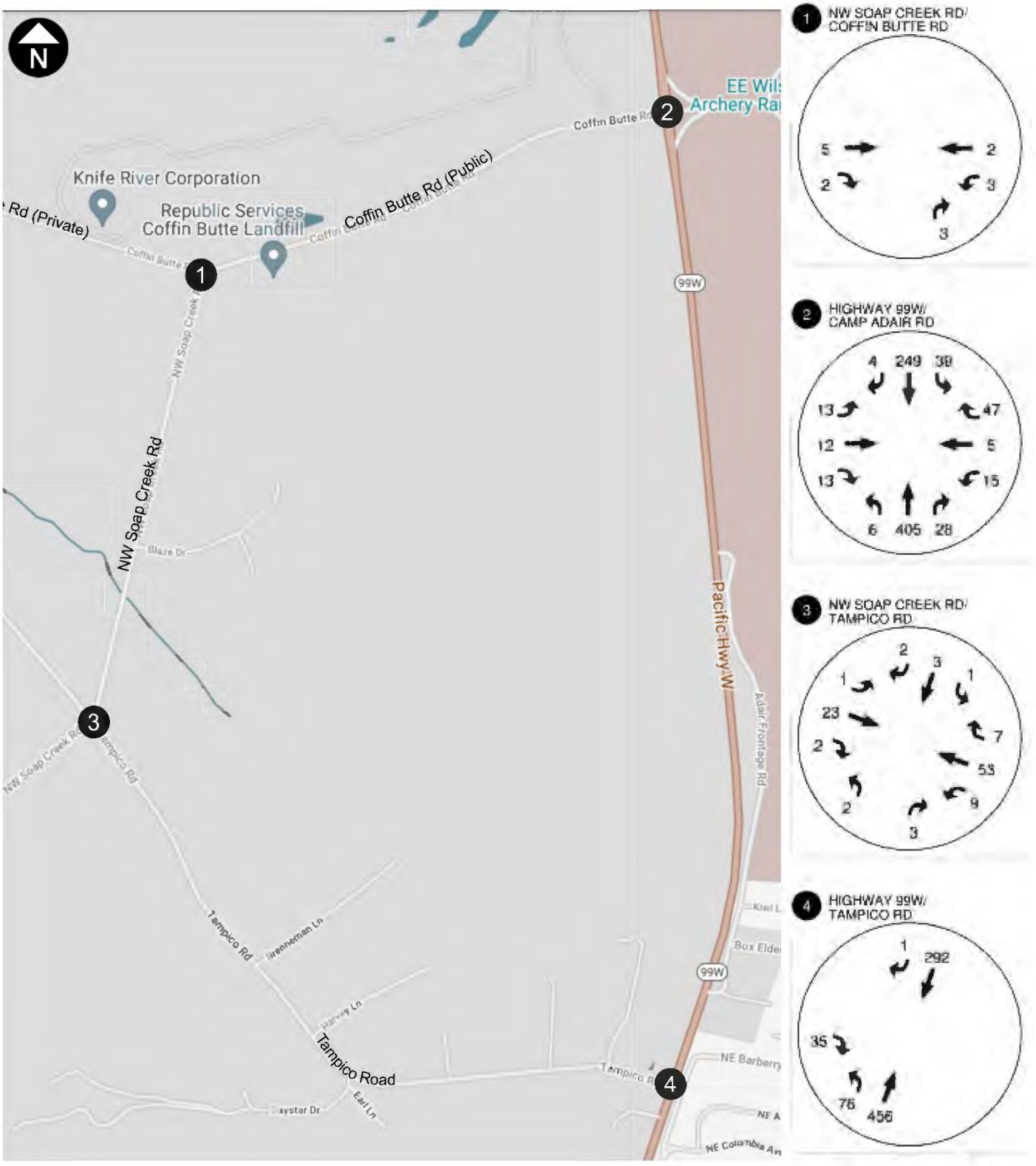
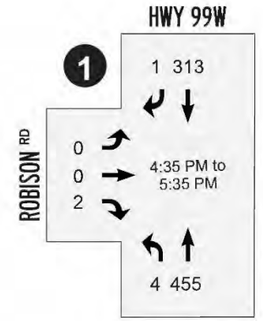
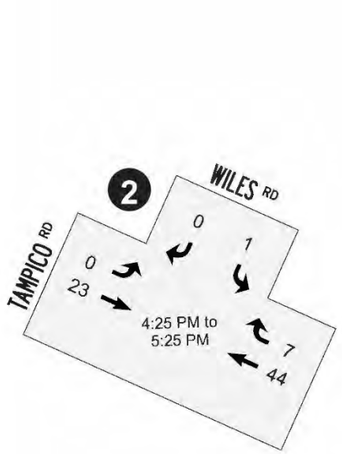
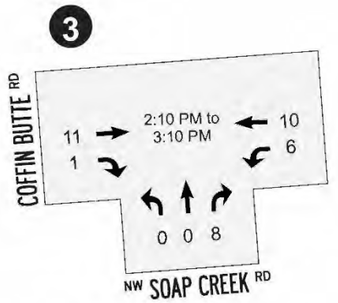


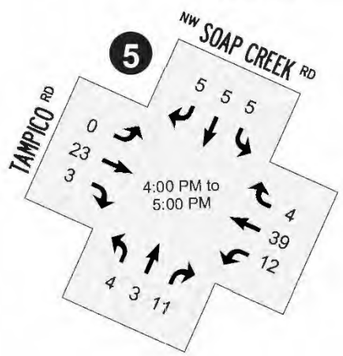
Figure 6. Peak evening commute hour traffic volumes. (Unadjusted mid-March 2021 traffic volumes)

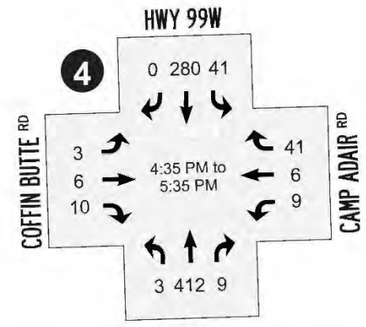












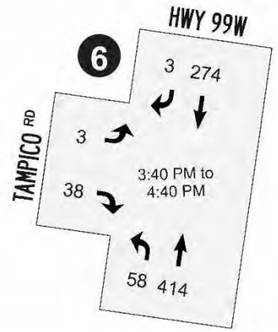


Figure 7. Individual Peak Hour Traffic Counts, counts collected in mid-January 2022.

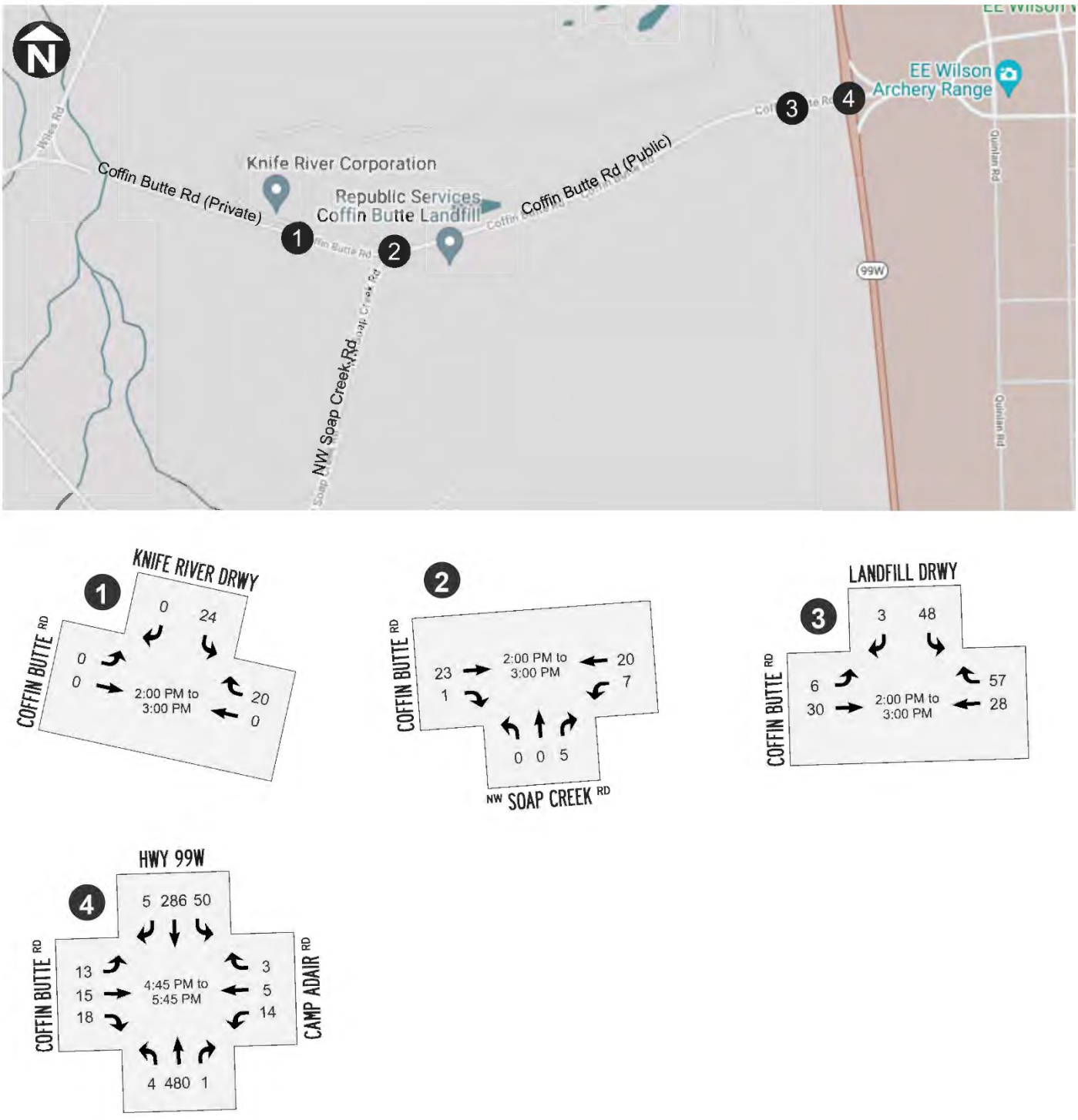


Figure 8. September 2023 Traffic Volumes (note that the peak highway volumes reflect a later peak hour than off-highway counts)

TRIP GENERATION ESTIMATES

Trip generation estimates are typically used to identify the impact of new development. Per County Code, the standard methodology for estimating trip generation is to consult the most current edition of the Institute of Transportation Engineers' (ITE) standard reference *Trip Generation, 11th Edition.* This manual offers a compilation of trip studies organized into specific categories based on use type. Unfortunately, the manual does not contain a category associated with landfill uses. The ITE manual typically correlates trip rates based upon a physical metric such as trips per square-foot, trips per number of students, or trips per employee. For a landfill, trip generation is not expected to correlate directly to the size of the facility itself, but rather to the population of the service area, tonnage of the facility, or potentially to the range of services provided. There are no changes proposed to the types of services provided, and so trip rates are expected to fluctuate only based on the population of the areas served.

Four other studies of transfer and recycling facilities were located online and reviewed to better understand the scale of these impacts. These facilities contain different characteristics than the Coffin Butte site and were located in larger urban areas, but provide useful information on facility characteristics and profiles that are expected to be similar to those of the Coffin Butte site. A summary of each of the studies reviewed is provided below:

- Cedar Hills Regional Landfill (HDR, 2010): This study provides limited information on the actual project as it did not include the overall report (only the transportation chapter), but provides useful time of day profiles for commercial (not self) haulers.
- Twin Creeks Landfill (HDR, 2016): This study assessed an increase from 750,000 tons per year to a maximum of 1,400,000 tons per year on the nearby system. This study showed a truck increase only, with +6 PM peak hour trucks given the dispersion of trucks throughout the day.
- Forward Landfill (Republic ITS, 2012): This study reflected post-recession traffic increases from the then-current level of 212 truckloads to its approved 620 truckloads per day (567-acre expansion to 751 acres). This study showed a +28 PM trip increase (3.3% of daily total).
- Factoria Recycling and Transfer Station (HDR, 2010). This study assessed a new facility that would support 600 tons per day by 2014. The study showed that it would generate a total of 57 trucks during the evening commute hour, generating a total of 114 p.m. inbound and outbound weekday p.m. peak hour trips).

Time of day distributions from actual log data of commercial- and self-haulers is provided in Figure 9. This shows that on weekdays the transfer center activity is elevated from around 10:00 a.m. until 4:00 p.m. This profile matches with the usage of the Coffin Butte site, which currently operates between 8:00 a.m. and 5:00 p.m. Monday through Saturday, with the facility closed on Sunday.

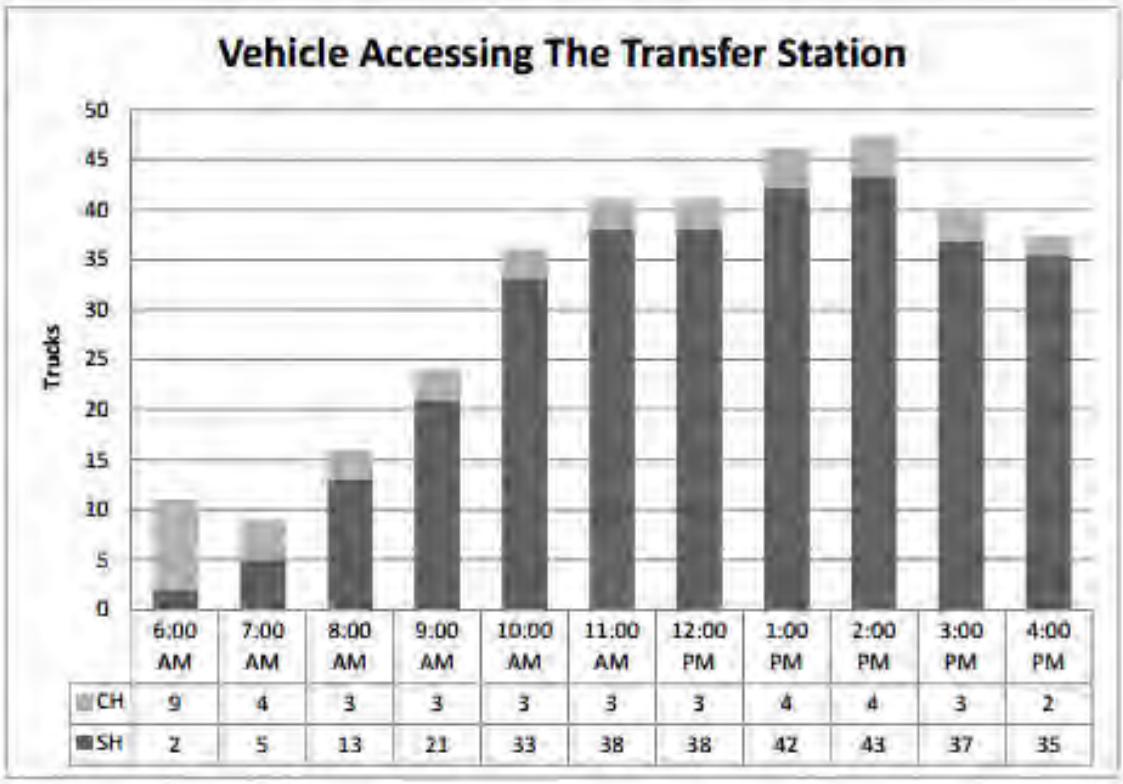


Figure 9. Factoria Trip Profiles (CH: Commercial Hauler, SH: Self-Hauler)
Source: HDR Factoria Recycling and Transfer Station TIA, 2010.

The general findings of this literature review indicated that trips were typically associated with tonnage, and it is expected that this will correlate to area population growth. As disposal services are considered a *utility,* these services are part of the trips generated by new developments throughout the region. While there is a point impact near the facility entrances, the regional impact of trash and recycling, and other similar services are accounted for within the individual development applications. These trip rates can fluctuate temporarily with building and development cycles, or with temporary events (such as past fire clean-up efforts).

The provision of the shift in active landfill area at Coffin Butte will allow the landfill to continue to support on-going growth in the region. Growth projections for the Linn-Benton area (see Figure 10) show population increases of approximately one percent annually, with a slightly declining rate of growth into the future. Linn County shows similar results, with one percent or lower rates into the 2040 horizon. The State of Oregon shows a total growth rate through 2040 that is only slightly higher at approximately 1.7%. These population trends are likely to dictate the rate of growth in landfill trips.

Population forecast by age in 2010 & 2040				
	Benton County		Oregon	
Age	2010	2040	2010	2040
0 to 4	3,778	4,527	237,556	317,024
5 to 9	4,109	4,443	237,214	317,456
10 to 14	4,466	4,839	242,553	324,469
15 to 19	8,789	8,224	254,860	321,532
20 to 24	13,763	12,502	253,048	328,685
25 to 29	5,926	6,211	265,033	339,951
30 to 34	4,488	5,693	259,111	346,862
35 to 39	4,227	5,239	251,163	341,211
40 to 44	4,368	5,493	248,362	345,342
45 to 49	5,013	6,325	262,879	361,003
50 to 54	5,725	6,203	276,196	349,254
55 to 59	5,924	5,959	273,423	337,313
60 to 64	4,723	5,340	236,143	297,787
65 to 69	3,196	4,644	169,847	268,516
70 to 74	2,188	3,736	120,194	235,769
75 to 79	1,823	3,420	91,601	208,589
80 to 84	1,462	2,993	74,019	171,351
85+	1,611	4,096	77,872	213,094
Total	85,579	99,886	3,831,074	5,425,408

Figure 10. Benton County Growth Projections.

The traffic counts that were collected on September 19, 2023 also help to quantify how the Coffin Butte landfill travel patterns operate today, highlighting the travel bias of Coffin Butte Landfill trips toward the Highway 99W corridor. Consistent with the landfill trip generation profile shown in Figure 9, traffic counts were collected throughout the study area over an extended time period to capture the 2:00 to 6:00 p.m. conditions at Coffin Butte.

The counts included the two existing accesses to the Coffin Butte landfill and Knife River Quarry to understand the existing trip characteristics of the site. The vehicles counted included both trucks and passenger cars for the landfill and quarry. As shown in Figure 11, the peak trip generation at these accesses during the count period was from 2:00 to 3:00 p.m. with 157 total vehicles. This number steadily declined to only 25 vehicles in the 5:00 to 6:00 p.m. hour. While there is a connection between the two sites, the vast majority of landfill trips are assumed to use the landfill access given the convenience to Coffin Butte Road and the location of the scales. During the peak hour, there were 114 trips recorded at the landfill access. This value matches the general scale of other landfill sites (note that in comparison to Figure 9, a vehicle generates an inbound and outbound trip).

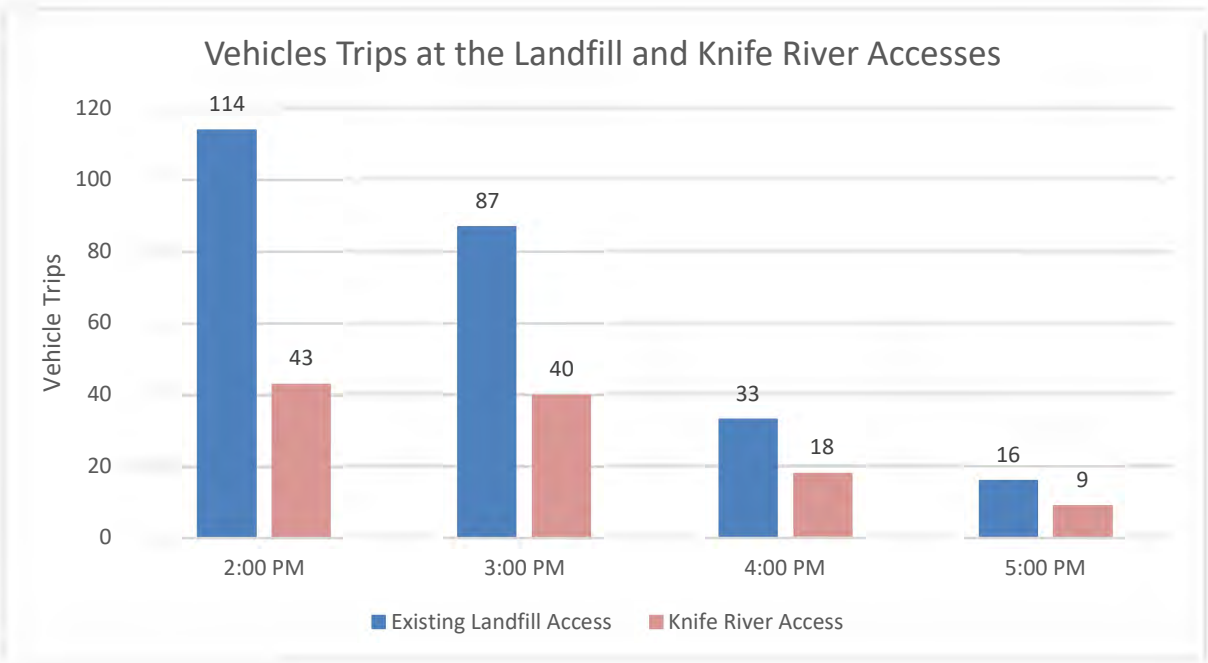
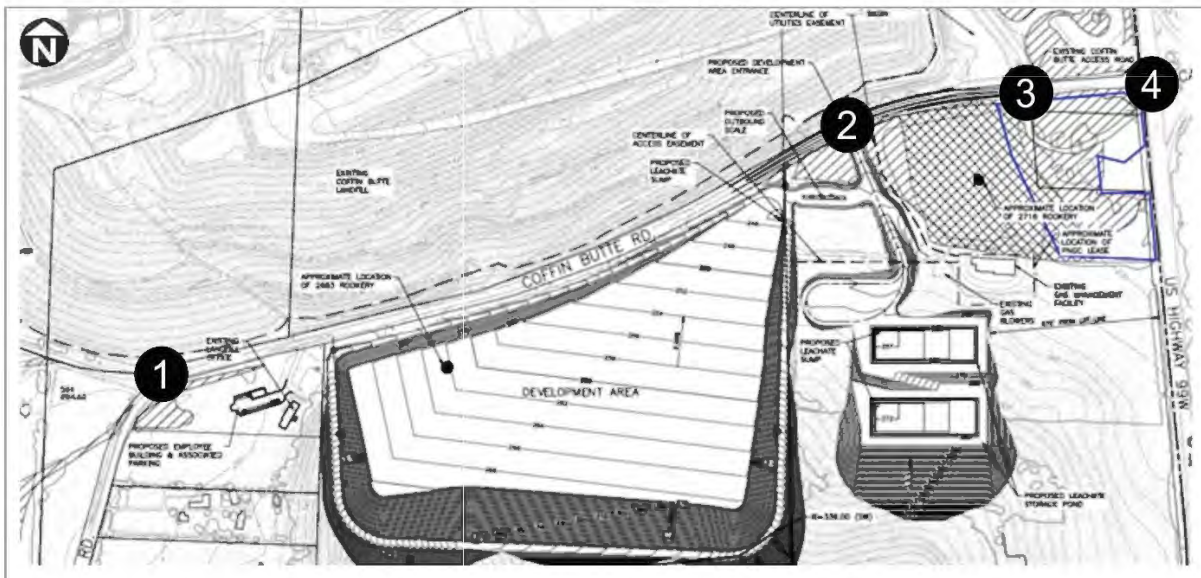


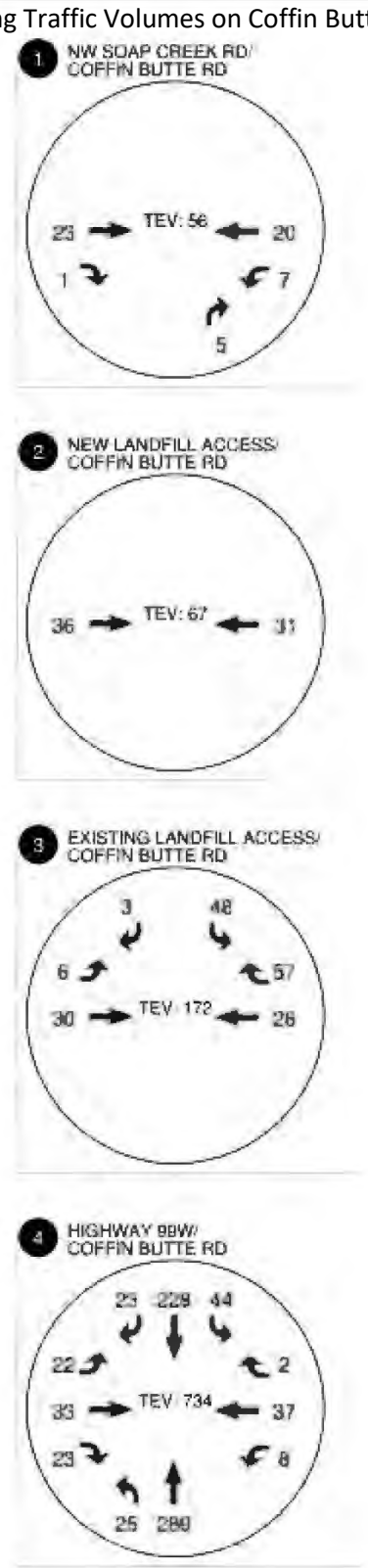
Figure 11. Existing Trip Profile, September 19, 2023.

In reviewing the travel patterns on Coffin Butte Road, during the peak 2:00 to 3:00 p.m. time period there were a total of 78 eastbound trips and 85 westbound trips to and from the highway. This is approximately 60-percent more than the January 2022 counts and can be attributed to the seasonal fluctuations of the landfill and quarry operations.

The traffic counts also separate truck trips from passenger vehicles, which provides an estimate of the number of commercial trucks within the traffic flow. This shows that 61% of the eastbound flow and 58% of the westbound flow on Coffin Butte Road is comprised of truck traffic. Based on this information, and in review of the layout of the proposed expansion site, Figure 12 illustrates the forecast traffic volumes on Coffin Butte Road during this 2:00 to 3:00 p.m. time period. This essentially shifts commercial truck trips to the new landfill site, retaining passenger vehicles in their current location. With trucks representing about 55% of the landfill trips during this hour it shows about 28 trucks entering the new expansion site (one truck every two minutes). Further, this shows no change in trips between the current landfill entrance and Highway 99W, or west of the new landfill entrance. The only segment of Coffin Butte Road that experiences a change in traffic volumes is the 740-foot segment of the roadway between the existing and proposed entrance.



Existing Traffic Volumes on Coffin Butte Road



Future Traffic Volumes with Expansion

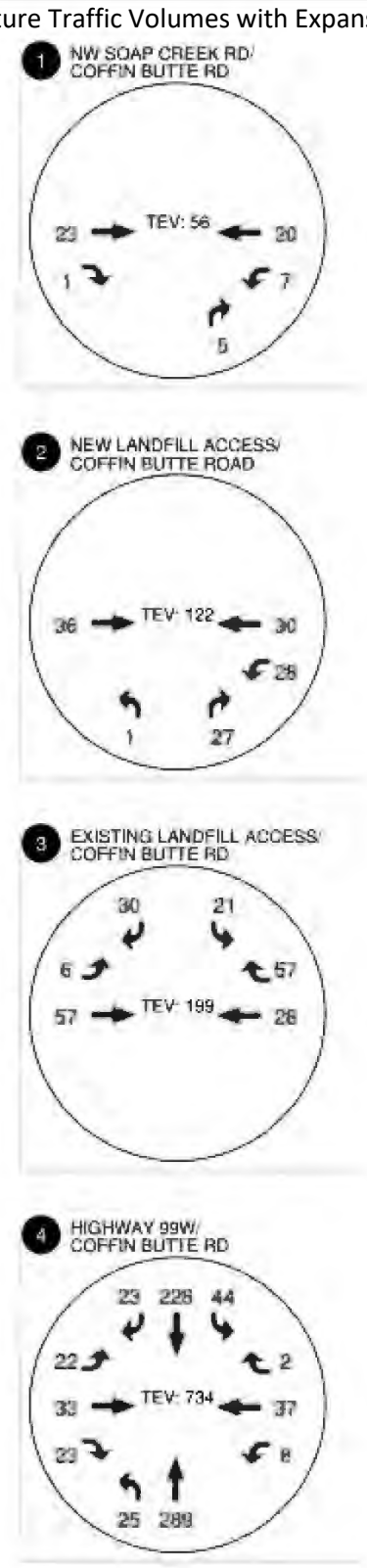


Figure 12. Year 2023 Existing and Rerouted Traffic Volumes, 2:00 to 3:00 p.m.

TRANSPORTATION OPERATIONS

The Benton County Transportation System Plan (TSP) was updated in 2019 and incorporated new mobility standards for its County roadways. The TSP identifies a two-tiered analysis standard for stop-sign controlled intersections:

- Intersection approaches with more than 20 vehicles during the weekday evening (4:00 to 6:00 p.m.) peak hour shall operate with a volume-to-capacity ratio of 0.90 or less during the spring or fall.
- No mobility targets apply to intersection approaches with less than 20 weekday p.m. peak hour trips.
- ODOT intersections are subject to the performance standards within Table 6 of the Oregon Highway Plan (OHP). For the stop-controlled Coffin Butte Road intersection with Highway 99W this requires a volume-to-capacity ratio of 0.75 or less.[1]

To show the adequacy of the transportation system to support these travel demands, an operational analysis was prepared to review the functionality of the access locations with the landfill expansion area. As summarized in Table 1, both of the landfill access intersections are shown to operate with very low delays (Level of Service "A") and well within County standards with current traffic volumes that are rerouted to reflect the modified configuration. As the landfill will serve the same population within the same location, it will continue to operate very similarly to its current conditions which are also well within acceptable County standards. Even with a 50% increase in the traffic volumes (reflective of population/tonnage growth far exceeding Benton County projections through 2040 as shown in Figure 10), the operations remain well within acceptable standards on this low volume road. Even with 50% growth both accesses will operate at Level of Service "B".

There is no change to external trips beyond what could occur today assuming continued use of the Coffin Butte landfill site, and therefore no additional transportation impact beyond the two accesses. Accordingly, further assessment of ODOT facilities or other County facilities is not provided.

Table 1. Summary of Operational Analysis (Existing Volumes with Expansion, 2:00 p.m. to 3:00 p.m.)

Intersection	Benton County Operational Standard	Level of Service	Intersection Delay	Volume to Capacity Ratio	95th Percentile Queue	Acceptable?
Existing Coffin Butte Landfill Entrance	v/c ratio < 0.90	SB: LOS A	SB: 9.8 s	SB: 0.08	SB: 1 veh (75 feet)	Yes
Proposed Expansion Area Entrance	v/c ratio < 0.90	NB: LOS A	NB: 9.7 s	NB: 0.04	NB: 1 veh (75 feet)	Yes

[1] Local Interest Road intersection with a Regional Highway outside an Urban Growth Boundary on Rural Lands.

The operations analysis shows that with the division of trips between the existing site for passenger vehicles and the expansion area for trucks all of the study intersections operate well within acceptable County standards. Forecast outbound 95th percentile queues are a single vehicle, which could include truck trips, so was estimated to be about 75 feet. The storage lengths proposed exceed this demand.

COFFIN BUTTE ROADWAY CROSS-SECTION

The proposed landfill expansion on the south side of Coffin Butte Road will add a new access connection. This access will be located approximately 740 feet west of the existing Coffin Butte landfill access. This complies with Benton County's access spacing standards identified within Table 8 of the TSP, which indicate that a 475-foot spacing for roads with a statutory speed of 50 miles per hour or higher. The Republic Services team recognizes that while Coffin Butte Road is a low-volume street, with the elevated amount of commercial trips associated with the landfill and quarry and area speeds, separation of left-turning vehicles on Coffin Butte Road is desired to maximize patron and public safety.

Typically, a traffic study will assess left-turn lane warrants based on ODOT's methodology to assess whether this widening is necessary. The left-turn lane warrants are essentially a cost-benefit analysis to assess whether this separation should occur, weighing the cost of the improvement with the benefit provided through crash reduction. For the Coffin Butte Landfill, the safety of Republic Services employees, patrons, and the traveling public is of paramount importance in this area, particularly with the types of vehicles that are present. While ODOT left-turn lane warrants are not met given the low volumes on Coffin Butte Road (see Figure 13), this treatment is proposed as shown within the preliminary drawings. The left-turn lane provides an extensive queue storage area capable of supporting several trucks simultaneously, and includes standard tapers for a 55 mph facility. Within the impacted area of the widening the road is also being improved to Benton County's *Major Collector* standard, with bicycle lanes and shoulders as shown in Figure 14.

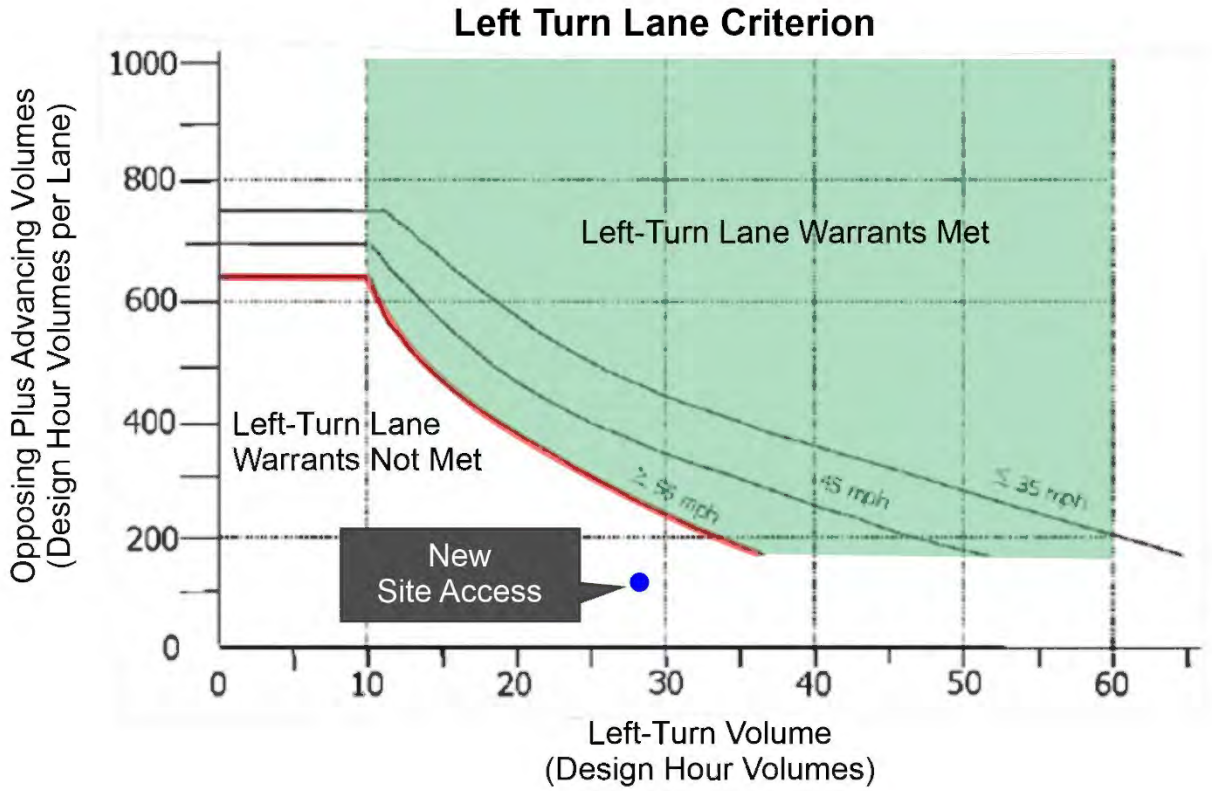


Figure 13. ODOT left-turn lane warrants showing the turn lane warrants are not met at the new access.

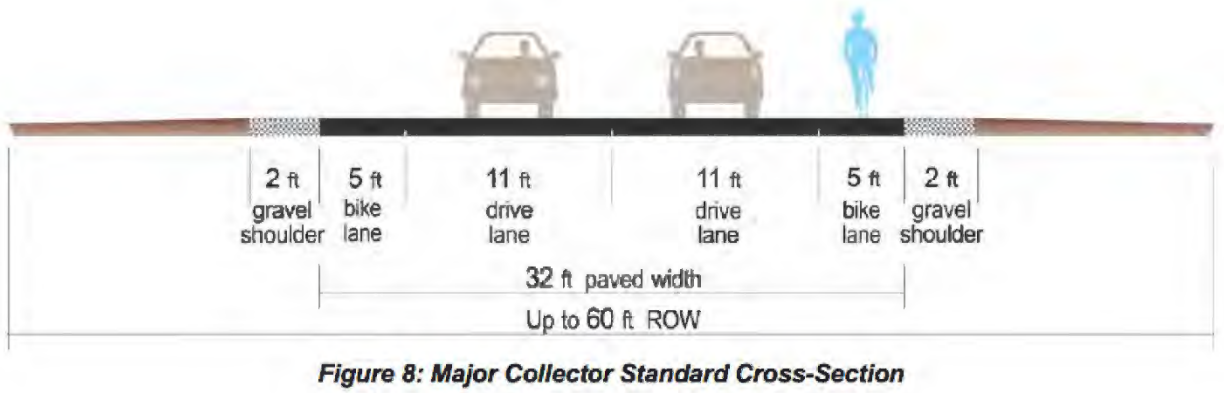


Figure 8: Major Collector Standard Cross-Section

Figure 14. Benton County Major Collector standard.

Since more than half the vehicles on Coffin Butte Road are commercial trucks, a wider roadway section is also being proposed. The preliminary design includes 12-foot travel lanes and a 14-foot center left-turn lane. This will improve separation for cyclists from the travel way, and help to accommodate these larger vehicles. Republic Services recognizes that this left-turn lane is not required per County standards, and the improvement is offered as a voluntary mitigation measure with the presumption that it is feasible as shown in the preliminary layout. Our team recognizes that there are adjacent roadside utilities and drainage areas, and while it is Republic Services intent to construct this improvement if approved by the County, if the design cannot be accommodated due to these (or other) constraints this voluntary improvement may be omitted.

ROADWAY SAFETY

Historical roadway safety was reviewed throughout the study area based on ODOT's most recent five years of available crash data. This review incorporates safety information for the most recent five-year period available, which spans from January 1, 2017 through December 31, 2021. Crash data was reviewed for the area bounded by Soap Creek Road, Coffin Butte Road, Tampico Road, and Highway 99W.

Crashes that are required for reporting to the DMV includes any collision that results in more than $1,500 (increased to $2,500 in 2018), collisions that result in any level of personal injury, and all collisions must involve one or more motor vehicle. ODOT crash records include collisions investigated by police and those that are self-reported, so the quality and completeness of data provided only reflects the inputs into the database and is not considered to be a fully complete or accurate indication of contributing factors.

- At 1:00 p.m. on August 4, 2017 a fatal collision was reported just south of Tampico Road on Highway 99W. The crash records indicate that tire failure led to a single-vehicle collision with the vehicle overturning. No other vehicles were involved and it did not appear from the available information that the vehicle struck any roadside objects causing the tire failure.
- There were no reported crashes along Coffin Butte Road or its continuation as Soap Creek Road during this review period.
- One collision was reported north of the Highway 99W/Tampico Road intersection. This included a motorist that swerved onto the shoulder prior to overturning. This collision did not result in any level of personal injury and the crash cause was cited as "other/improper driving."
- At 8:00 a.m. on January 7, 2019 a motorist on Tampico Road near Brenneman Lane drove onto the roadway ditch and overturned. No injuries were reported in this collision.
- At 2:00 p.m. on December 13, 2021 a fixed object collision happened at the Tampico Road/Harvey Lane intersection and was attributed to physical illness. It resulted in property damage only.
- Five collisions were reported at the Coffin Butte – Camp Adair intersection with Highway 99W during the five-year period:
    - An angle collision occurred on June 16, 2021 at 10:00 a.m. between a southbound through vehicle and an eastbound through vehicle. The crash was attributed to inattention and resulted in minor injuries (Injury B).
    - A crash with a deer or elk occurred just south of the intersection on August 21, 2021 at 10:00 p.m. No injuries were reported.
    - A turning collision was reported on June 25, 2020 around 9:00 a.m. The crash report cited inattention as the cause of the collision. The crash resulted in serious injuries.
    - An angle collision was reported on April 25, 2019 around 1:00 p.m. The crash resulted in minor injuries (Injury B). The crash report cited failure to yield the right-of-way and inattention as contributing factors.
    - An angle collision occurred on October 11, 2018 at 2:00 p.m. and resulted in property damage only. The crash reports cited failure to yield.

  Three of the five reported collisions at the Highway 99W intersection with Camp Adair Road resulted in some level of injuries.

There were no reported crashes at the Highway 99W/Tampico Road intersection during the review period, nor were there any crashes at the Tampico Road intersection with Soap Creek Road. Crashes within the study area were fairly low overall, and did not appear to identify any safety deficiencies. Intersection crash rates and comparison to ODOT's 90th percentile rates for similarly-configured rural intersections are provided in Table 2, and show that the crash rates remain below these thresholds.

Table 2. Intersection Crash Rates and ODOT Crash Rate Comparison

Intersection	Number of Reported Crashes (2017 to 2021)	Crashes per Million Entering Vehicles	>90th Percentile ODOT Crash Rate
Coffin Butte Road/ Soap Creek Road	0	0.00	No 3ST: 0.475
Coffin Butte Road/ Highway 99W	5	0.31	No 4ST: 1.080
Tampico Road/ Soap Creek Road	0	0.00	No 4ST: 1.080
Tampico Road/ Highway 99W	0	0.00	No 3ST: 0.475

Intersection Sight Distance

Intersection sight distance was field reviewed to ensure an adequate view of conflicting traffic was provided to drivers at the future public street/access locations, or to identify what sight line restrictions exist. The minimum recommended sight distance criteria based on the standard reference *A Policy on Geometric Design of Highways and Streets, 7th Edition* published by the American Association of State Highway and Transportation Officials (AASHTO) in 2018 (commonly referred to as the *Green Book*). This reference provides the recommended sight distances as measured from a height of 3.5 feet 14.5 feet from the edge of travel way at the access point serving the proposed development, based on the speed of the roadway. The AASHTO reference is based on conflicts between motorists traveling along the roadway and motorists completing movements at the intersection.

The topography of the area is generally flat with substantial sight lines in either direction of the proposed access location. There is an existing gated access nearly opposite the site that provides access to the perimeter road of the current landfill. Figure 15 illustrates the sight distance measurements and recommended minimum dimensions for this new access assuming installation of the left-turn lane and a statutory speed of 55 miles per hour.

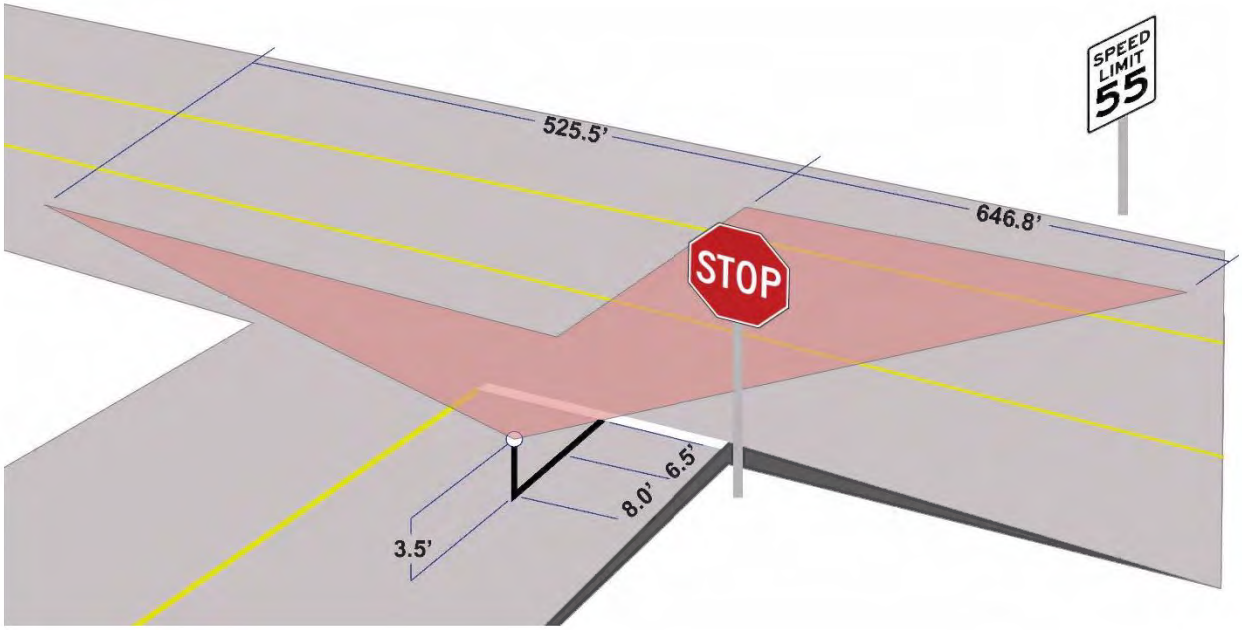


Figure 15. AASHTO minimum recommended intersection sight distance dimensions at the proposed landfill expansion access.

The site was visited and inventoried in May 2022 to verify the available sight lines at this entrance. Photos from the field review are provided in Figures 16 through 19, including passenger vehicle height (3.5 feet) and truck cab height (7.6 feet). This review shows that clear and unobstructed sight lines are available from this location, with sight lines of over 800 feet in either direction. Roadside vegetation toward the east (see Figures 18 and 19) should be removed to avoid partial occlusion of the views in this direction.



Figure 16. Proposed access location facing west along Coffin Butte Road (passenger vehicle height).



Figure 17. Proposed access location facing west along Coffin Butte Road (truck cab height).



Figure 18. Proposed access location facing east along Coffin Butte Road (passenger vehicle height).



Figure 19. Proposed access location facing east along Coffin Butte Road (truck cab height).

FINDINGS AND RECOMMENDATIONS

This report shows that the proposed landfill expansion provides minimal impacts to Benton County and ODOT transportation facilities. The proposed expansion site will not alter public trip routing, emergency ingress or egress, and it will retain the current landfill access routes. This layout maintains current functional designations identified in the County's Transportation System Plan and the design optimizes travel safety for patrons and employees.

As included within the preliminary civil plans, this application includes a voluntary proposal to widen Coffin Butte Road between the current entrance to the scales and the expansion area entrance and trim and/or remove existing vegetation within the sight lines. This widening will support separate left-turn lanes and will include shoulder widening per County standards and provide clear and unobstructed views of approaching motorists. Transportation patterns and landfill operations will effectively remain the same as they are today, and will function how they have already been approved to operate.

Thank you for the opportunity to provide these transportation materials for the Coffin Butte Landfill expansion. If you have any questions I can be reached at (503) 997-4473 or via email at joe@transightconsulting.com.

Attachments:

- Benton County Traffic Counts
- March 2021 Traffic Counts
- January 2022 Traffic Counts
- September 2023 Traffic Counts
- LOS Worksheets (Existing Weekday Afternoon Conditions)
- LOS Worksheets (Weekday Afternoon Conditions with 50% Growth)

Public Works Department
360 SW Avery Avenue
Corvallis, Oregon 97333
Phone: 541.766.6821

Memorandum

Date: January 20, 2021

To: Gordon Kurtz, Engineer Associate

Owen Millehrer, Civil Engineer

From: Thanh Huynh, Surveying and Engineering Intern

Subject: Coffin Butte Landfill Traffic Study

Coffin Butte RD #04451

Soap Creek RD #05450

Enclosed is a report of a traffic study conducted during two seven-day periods. The sites under investigation were along Coffin Butte Rd on either side of the entrance to the Coffin Butte Quarry, see attached map.

The purpose of this traffic study was to collect truck count and average daily traffic data. The equipment used to conduct this study was a Unicorn Vehicle Traffic Classifier. The vehicle traffic classifier records count, time, axle and speed. The data is compiled for each lane and for combined directions.

Table 1 indicates vehicle classification and average daily counts.

Table 1: Truck Counts and Average Daily Counts

Road	Total Truck Counts	Avg. Truck Counts	ADT
Coffin Butte	628	89	243
Soap Creek	31	4	136

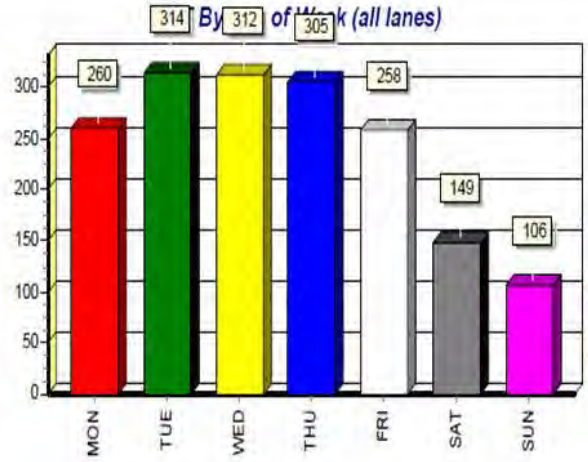
The traffic study report includes the following:

1. Map indicating traffic study sites.
2. Charts indicating Coffin Butte Rd and Soap Creek Rd average daily traffic.
3. Charts indicating Coffin Butte Rd and Soap Creek Rd axle class vs. volume.
4. Chart of vehicle classifications.

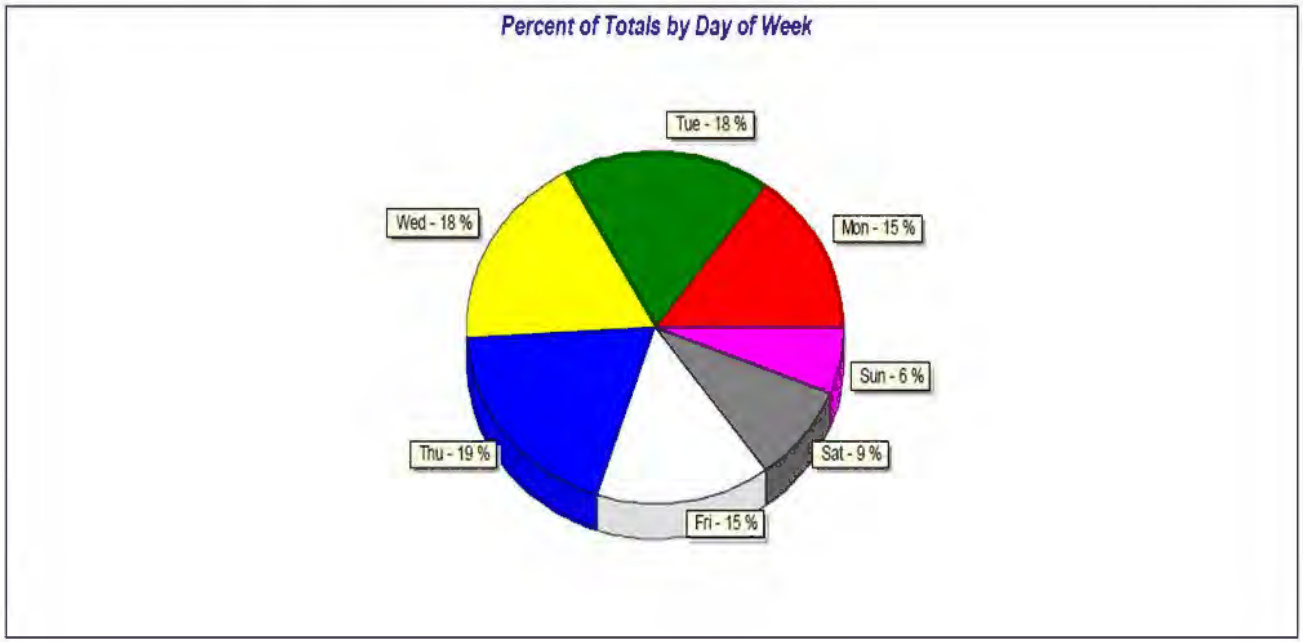
COFFIN BUTTE LANDFILL TRAFFIC STUDY SITES



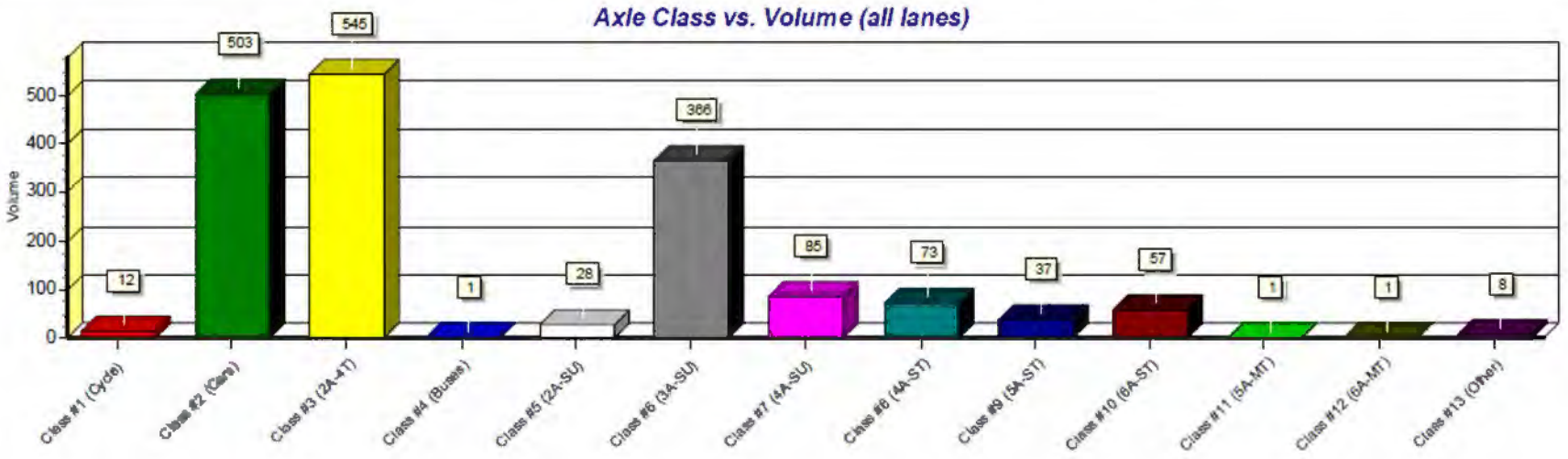
COFFIN BUTTE Charts For Data From: 13:00 - 12/10/2020 To: 14:59 - 12/17/2020



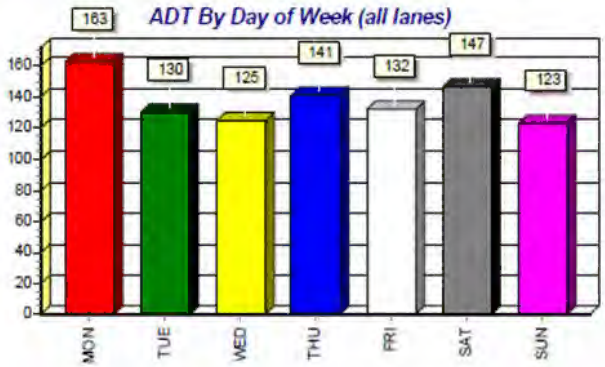
DAY	ADT	TOTAL	# DAYS
Mon	260	260	1.0
Tue	314	314	1.0
Wed	312	312	1.0
Thu	305	318	1.0
Fri	258	258	1.0
Sat	149	149	1.0
Sun	106	106	1.0



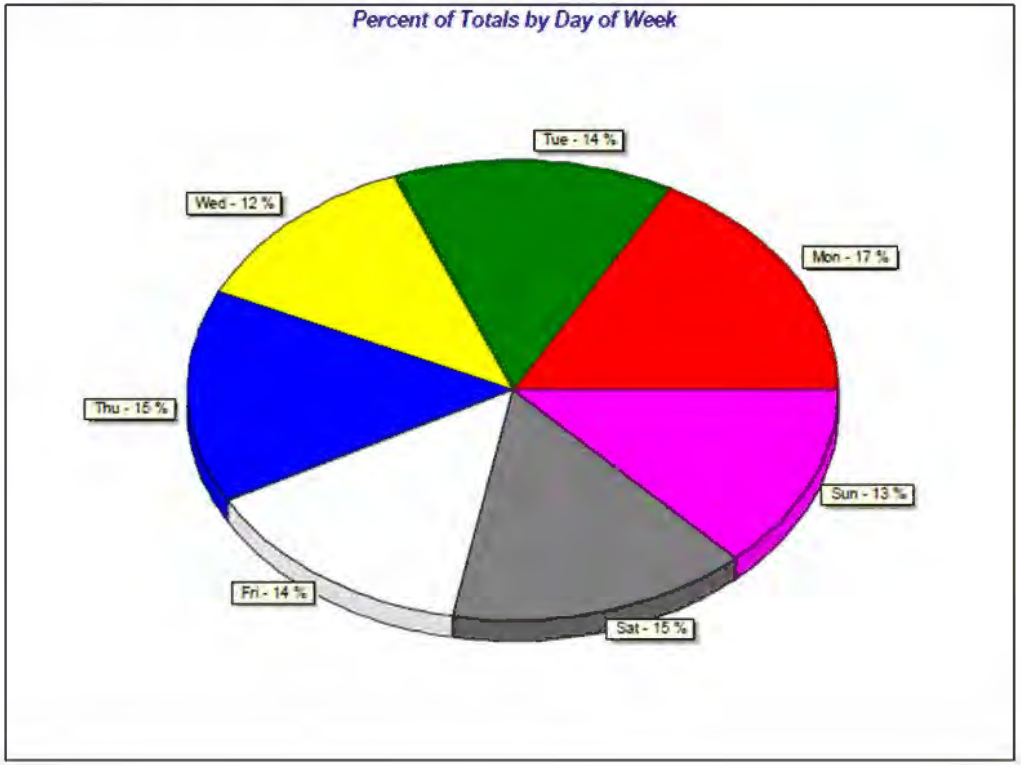
COFFIN BUTTE Axle Class Charts For Data From: 13:00 - 12/10/2020 To: 14:59 - 12/17/2020



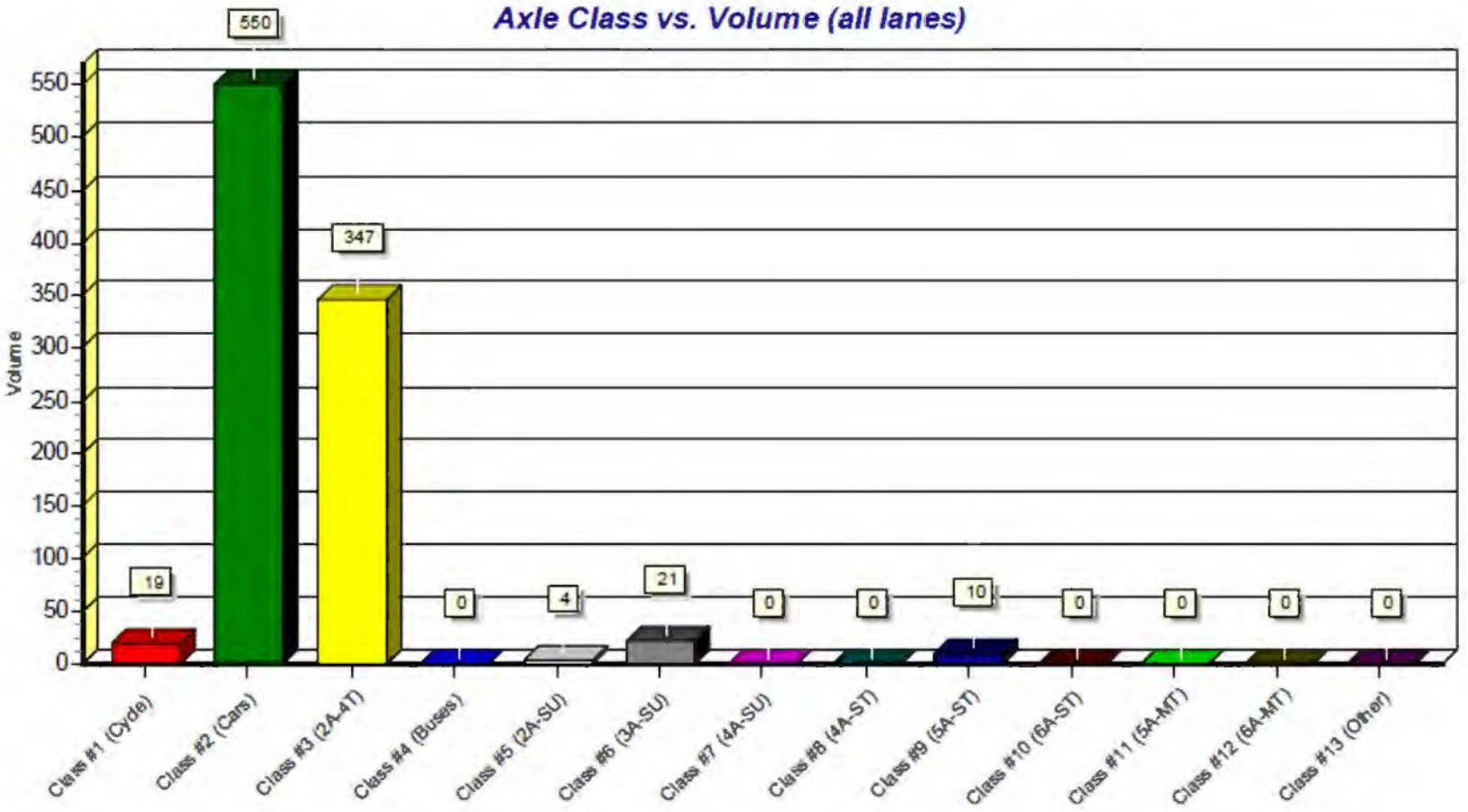
SOAP CREEK Charts For Data From: 16:00 - 01/13/2021 To: 14:59 - 01/20/2021



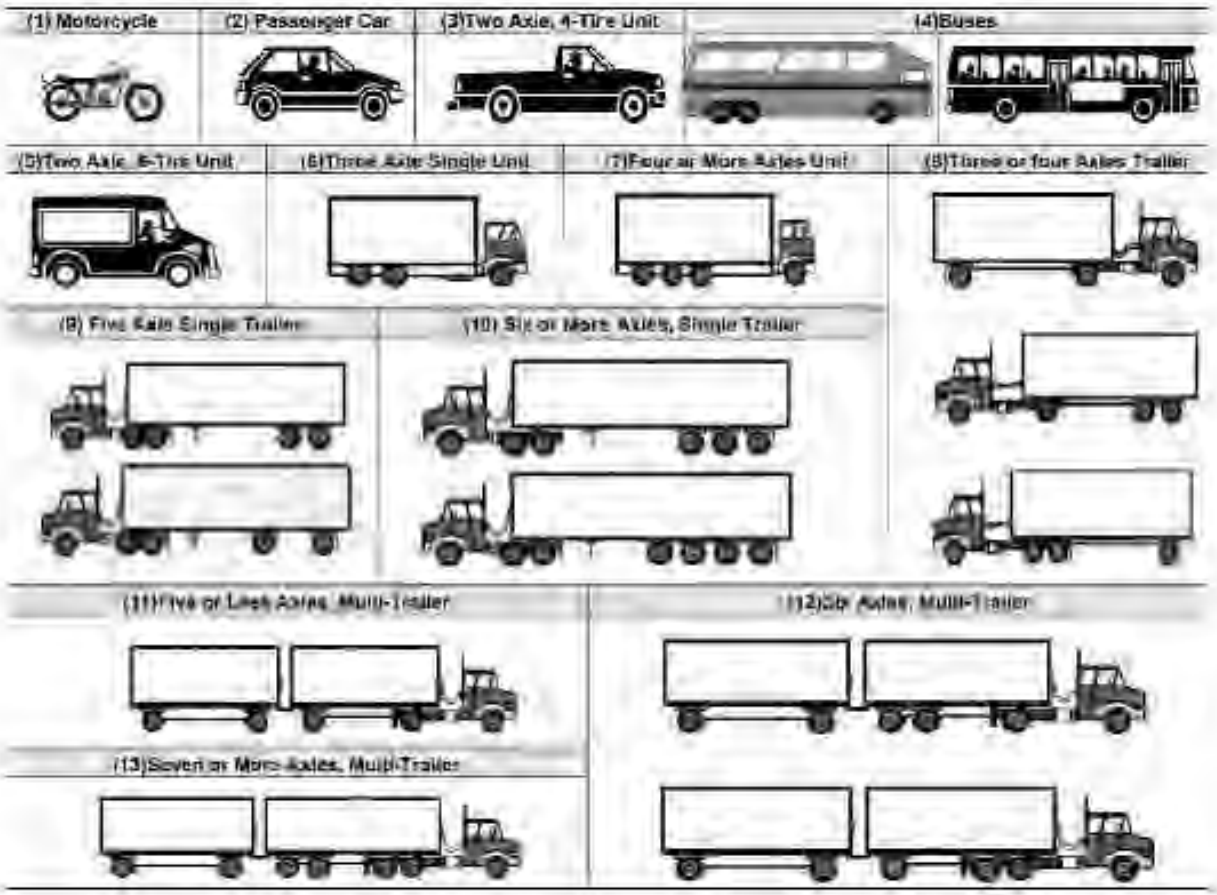
DAY	ADT	TOTAL	# DAYS
Mon	163	163	1.0
Tue	130	130	1.0
Wed	125	115	0.9
Thu	141	141	1.0
Fri	132	132	1.0
Sat	147	147	1.0
Sun	123	123	1.0



SOAP CREEK Axle Class Charts For Data From: 16:00 - 01/13/2021 To: 14:59 - 01/20/2021

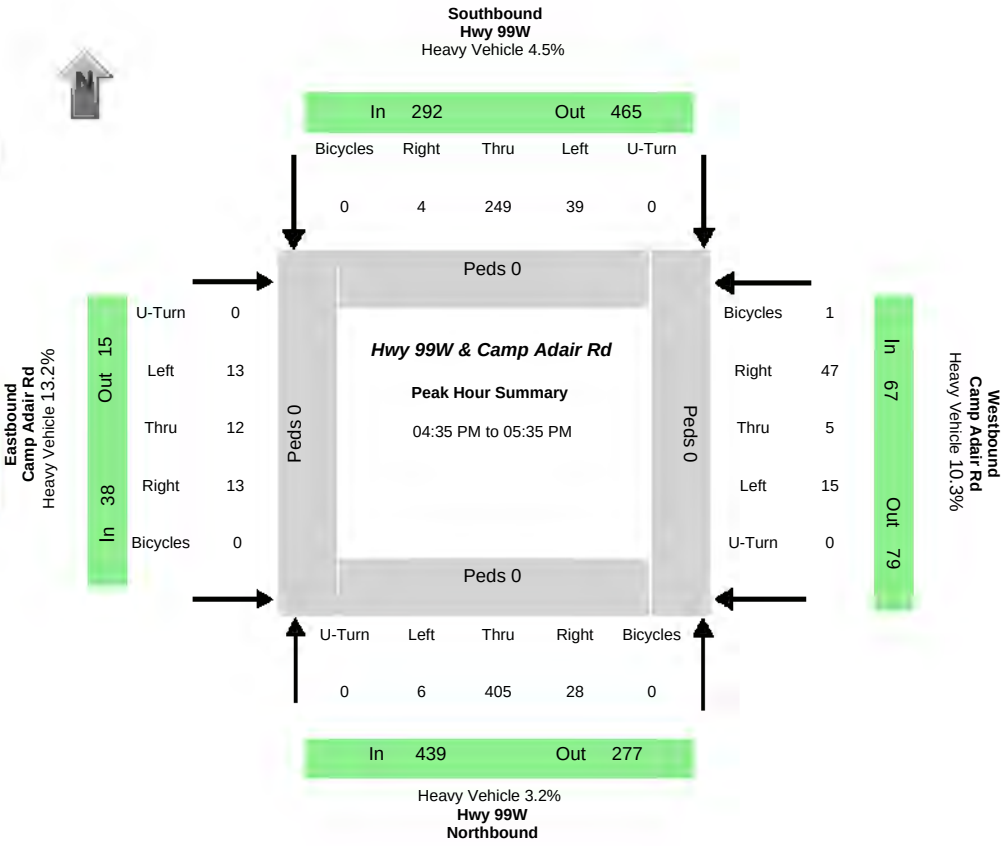


Vehicle Classification Chart



K-D-N
KEY DATA NETWORK

Data Provided by K-D-N.com 503-594-4224	
N/S street	*Hwy 99W*
E/W street	*Camp Adair Rd*
City, State	Monmouth OR
Site Notes	
Location	44.699580 - ?-123.220873
Start Date	Tuesday, March 16, 2021
Start Time	04:00:00 PM
Weather	
Study ID #	
Peak Hour Start	04:35:00 PM
Peak 15 Min Start	05:10:00 PM
PHF (15-Min Int)	0.90



Peak-Hour Volumes (PHV)

Northbound				Southbound				Eastbound				Westbound				Entering				Leaving			
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	NB	SB	EB	WB	NB	SB	EB	WB
6	405	28	0	39	249	4	0	13	12	13	0	15	5	47	0	439	292	38	67	277	465	15	79

Percent Heavy Vehicles

0.0%	3.5%	0.0%	0.0%	7.7%	4.0%	0.0%	0.0%	23.1%	8.3%	7.7%	0.0%	0.0%	20.0%	12.8%	0.0%	3.2%	4.5%	13.2%	10.4%	4.0%	4.9%	6.7%	5.1%

PHV- Bicycles

Northbound				Southbound				Eastbound				Westbound				
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	**Sum**
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1

PHV - Pedestrians

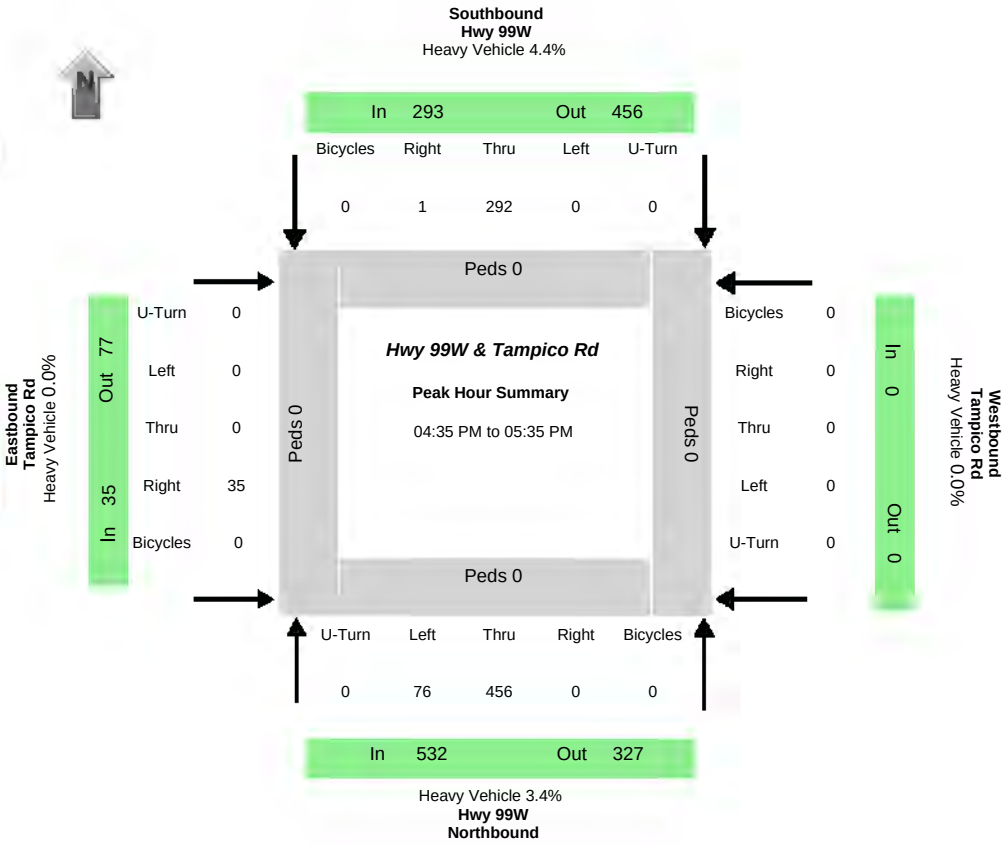
in Crosswalk				
NB	SB	EB	WB	**Sum**
0	0	0	0	0

All Vehicle Volumes

	Northbound Hwy 99W				Southbound Hwy 99W				Eastbound Camp Adair Rd				Westbound Camp Adair Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
04:00:00 PM	3	35	0	0	6	26	2	0	3	0	1	0	0	1	2	0		
04:05:00 PM	2	20	2	0	3	29	0	0	1	1	2	0	0	0	3	0		
04:10:00 PM	0	24	3	0	1	18	2	0	1	2	3	0	3	1	1	0	201	
04:15:00 PM	2	30	0	0	3	12	3	0	0	1	4	0	0	1	5	0	183	
04:20:00 PM	0	29	3	0	3	33	1	0	2	1	2	0	1	5	2	0	202	
04:25:00 PM	0	19	3	0	10	22	1	0	0	0	3	0	0	2	0	0	203	
04:30:00 PM	0	28	4	0	1	24	0	0	3	2	2	0	2	0	3	0	211	
04:35:00 PM	3	39	1	0	3	15	0	0	2	1	2	0	1	0	7	0	203	
04:40:00 PM	0	34	5	0	0	19	1	0	2	0	1	0	0	0	3	0	208	
04:45:00 PM	1	37	2	0	4	20	0	0	1	3	0	0	1	0	2	0	210	
04:50:00 PM	1	41	4	0	3	15	0	0	0	0	2	0	2	0	4	0	208	
04:55:00 PM	1	21	3	0	2	22	2	0	1	0	1	0	5	0	8	0	209	821
05:00:00 PM	0	22	1	0	3	25	1	0	0	0	1	0	3	2	5	0	201	805
05:05:00 PM	0	28	1	0	1	16	0	0	0	2	1	0	0	1	3	0	182	795
05:10:00 PM	0	41	3	0	4	11	0	0	1	1	2	0	0	0	3	0	182	802
05:15:00 PM	0	38	0	0	8	35	0	0	0	2	0	0	2	1	3	0	208	830
05:20:00 PM	0	44	3	0	3	24	0	0	0	0	0	0	1	0	3	0	233	826
05:25:00 PM	0	29	2	0	2	22	0	0	2	1	1	0	0	1	4	0	231	830
05:30:00 PM	0	31	3	0	6	25	0	0	4	2	2	0	0	0	2	0	217	836
05:35:00 PM	0	37	1	0	3	26	0	0	1	1	0	0	0	0	3	0	211	834
05:40:00 PM	0	32	0	0	0	21	0	0	2	0	0	0	0	0	2	0	204	826
05:45:00 PM	0	41	0	0	3	21	1	0	1	0	0	0	0	0	0	0	196	822
05:50:00 PM	0	30	2	0	1	26	1	0	0	0	0	0	1	1	2	0	188	814
05:55:00 PM	1	27	2	0	3	16	0	0	0	0	0	0	1	0	1	0	182	799

K-D-N
KEY DATA NETWORK

Data Provided by K-D-N.com 503-594-4224	
N/S street	*Hwy 99W*
E/W street	*Tampico Rd*
City, State	Monmouth OR
Site Notes	
Location	44.676819 - ?-123.220746
Start Date	Tuesday, March 16, 2021
Start Time	04:00:00 PM
Weather	
Study ID #	
Peak Hour Start	04:35:00 PM
Peak 15 Min Start	05:20:00 PM
PHF (15-Min Int)	0.89



Peak-Hour Volumes (PHV)

Northbound				Southbound				Eastbound				Westbound				Entering				Leaving			
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	NB	SB	EB	WB	NB	SB	EB	WB
76	456	0	0	0	292	1	0	0	0	35	0	0	0	0	0	532	293	35	0	327	456	77	0

Percent Heavy Vehicles

0.0%	3.9%	0.0%	0.0%	0.0%	4.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%	4.4%	0.0%	0.0%	4.0%	3.9%	0.0%	0.0%

PHV- Bicycles

Northbound				Southbound				Eastbound				Westbound				
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	**Sum**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PHV - Pedestrians

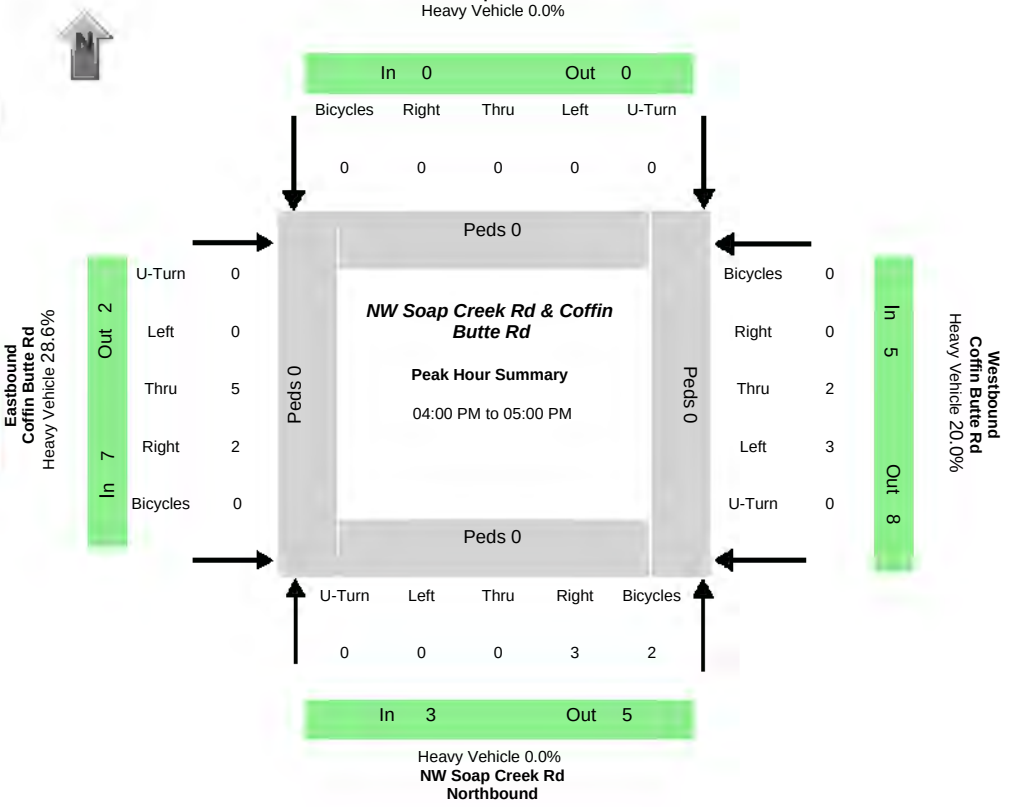
in Crosswalk				
NB	SB	EB	WB	**Sum**
0	0	0	0	0

All Vehicle Volumes

	Northbound Hwy 99W				Southbound Hwy 99W				Eastbound Tampico Rd				Westbound Tampico Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
04:00:00 PM	3	35	0	0	0	23	0	0	0	0	5	0	0	0	0	0		
04:05:00 PM	6	45	0	0	0	27	0	0	0	0	4	0	0	0	0	0		
04:10:00 PM	2	30	0	0	0	12	0	0	0	0	2	0	0	0	0	0	194	
04:15:00 PM	5	26	0	0	0	31	0	0	1	0	4	0	0	0	0	0	195	
04:20:00 PM	7	37	0	0	0	16	0	0	0	0	1	0	0	0	0	0	174	
04:25:00 PM	7	32	0	0	0	17	0	0	0	0	5	0	0	0	0	0	189	
04:30:00 PM	3	26	0	0	0	22	0	0	0	0	4	0	0	0	0	0	177	
04:35:00 PM	4	34	0	0	0	26	0	0	0	0	4	0	0	0	0	0	184	
04:40:00 PM	6	42	0	0	0	31	0	0	0	0	2	0	0	0	0	0	204	
04:45:00 PM	6	39	0	0	0	18	0	0	0	0	4	0	0	0	0	0	216	
04:50:00 PM	7	44	0	0	0	29	0	0	0	0	3	0	0	0	0	0	231	
04:55:00 PM	5	33	0	0	0	23	0	0	0	0	1	0	0	0	0	0	212	799
05:00:00 PM	10	24	0	0	0	23	0	0	0	0	3	0	0	0	0	0	205	793
05:05:00 PM	3	33	0	0	0	24	1	0	0	0	1	0	0	0	0	0	184	773
05:10:00 PM	3	43	0	0	0	18	0	0	0	0	3	0	0	0	0	0	189	794
05:15:00 PM	8	45	0	0	0	16	0	0	0	0	0	0	0	0	0	0	198	796
05:20:00 PM	6	44	0	0	0	34	0	0	0	0	6	0	0	0	0	0	226	825
05:25:00 PM	8	40	0	0	0	18	0	0	0	0	3	0	0	0	0	0	228	833
05:30:00 PM	10	35	0	0	0	32	0	0	0	0	5	0	0	0	0	0	241	860
05:35:00 PM	8	26	0	0	0	23	0	0	1	0	4	0	0	0	0	0	213	854
05:40:00 PM	5	42	0	0	0	20	0	0	0	0	2	0	0	0	0	0	213	842
05:45:00 PM	6	26	0	0	0	26	0	0	1	0	1	0	0	0	0	0	191	835
05:50:00 PM	8	40	0	0	0	23	1	0	0	0	0	0	0	0	0	0	201	824
05:55:00 PM	1	24	0	0	0	19	1	0	0	0	5	0	0	0	0	0	182	812

K-D-N
KEY DATA NETWORK

Data Provided by K-D-N.com 503-594-4224	
N/S street	*NW Soap Creek Rd*
E/W street	*Coffin Butte Rd*
City, State	Monmouth OR
Site Notes	
Location	44.695984 - -123.235559
Start Date	Tuesday, March 16, 2021
Start Time	04:00:00 PM
Weather	
Study ID #	
Peak Hour Start	04:00:00 PM
Peak 15 Min Start	04:30:00 PM
PHF (15-Min Int)	0.63



Peak-Hour Volumes (PHV)

Northbound				Southbound				Eastbound				Westbound				Entering				Leaving			
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	NB	SB	EB	WB	NB	SB	EB	WB
0	0	3	0	0	0	0	0	0	5	2	0	3	2	0	0	3	0	7	5	5	0	2	8

Percent Heavy Vehicles

0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	20.0%	50.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	28.6%	20.0%	20.0%	0.0%	50.0%	12.5%

PHV- Bicycles

Northbound				Southbound				Eastbound				Westbound				
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	**Sum**
0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2

PHV - Pedestrians

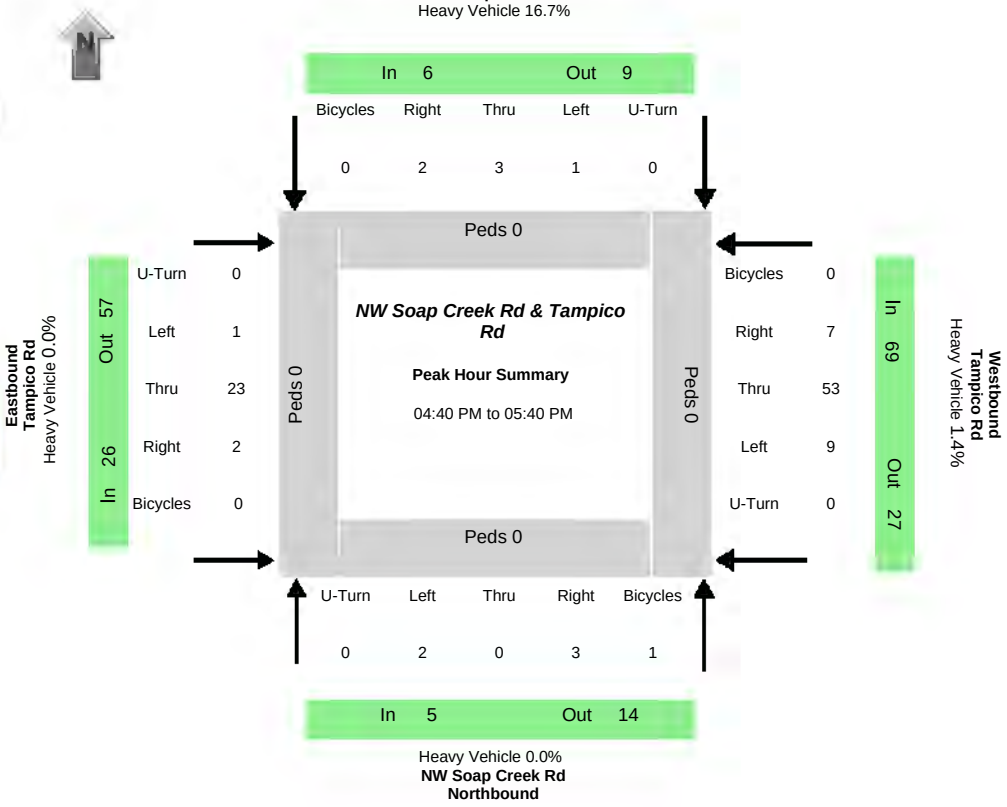
in Crosswalk				
NB	SB	EB	WB	**Sum**
0	0	0	0	0

All Vehicle Volumes

	Northbound NW Soap Creek Rd				Southbound NW Soap Creek Rd				Eastbound Coffin Butte Rd				Westbound Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
04:00:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0		
04:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0		
04:10:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	5	
04:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	
04:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
04:25:00 PM	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	
04:30:00 PM	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	4	
04:35:00 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
04:40:00 PM	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	6	
04:45:00 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
04:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5	
04:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15
05:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	14
05:05:00 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13
05:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	12
05:15:00 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	13
05:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4	15
05:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	13
05:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	12
05:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11
05:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8
05:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
05:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
05:55:00 PM	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	3	9

K-D-N
KEY DATA NETWORK

Data Provided by K-D-N.com 503-594-4224	
N/S street	*NW Soap Creek Rd*
E/W street	*Tampico Rd*
City, State	Monmouth OR
Site Notes	
Location	44.685389 - ?-123.239874
Start Date	Tuesday, March 16, 2021
Start Time	04:00:00 PM
Weather	
Study ID #	
Peak Hour Start	04:40:00 PM
Peak 15 Min Start	05:25:00 PM
PHF (15-Min Int)	0.72



Peak-Hour Volumes (PHV)

Northbound				Southbound				Eastbound				Westbound				Entering				Leaving			
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	NB	SB	EB	WB	NB	SB	EB	WB
2	0	3	0	1	3	2	0	1	23	2	0	9	53	7	0	5	6	26	69	14	8	57	27

Percent Heavy Vehicles

0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	14.3%	0.0%	0.0%	16.7%	0.0%	1.4%	0.0%	12.5%	0.0%	3.7%

PHV- Bicycles

Northbound				Southbound				Eastbound				Westbound				
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

PHV - Pedestrians

in Crosswalk				
NB	SB	EB	WB	Sum
0	0	0	0	0

All Vehicle Volumes

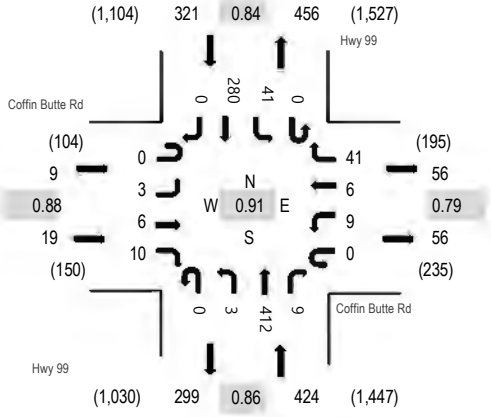
	Northbound				Southbound				Eastbound				Westbound					
	NW Soap Creek Rd				NW Soap Creek Rd				Tampico Rd				Tampico Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
04:00:00 PM	0	0	2	0	0	0	0	0	0	3	0	0	0	1	0	0		
04:05:00 PM	0	0	1	0	0	0	0	0	0	2	0	0	0	4	0	0		
04:10:00 PM	0	0	1	0	0	1	1	0	0	3	0	0	0	2	0	0	21	
04:15:00 PM	1	0	0	0	1	0	0	0	0	1	0	0	1	4	0	0	23	
04:20:00 PM	0	0	0	0	0	0	0	0	1	1	0	0	0	4	0	0	22	
04:25:00 PM	1	0	3	0	0	0	0	0	0	3	0	0	2	5	1	0	29	
04:30:00 PM	0	0	0	0	1	0	0	0	0	1	0	0	2	2	0	0	27	
04:35:00 PM	0	0	0	0	1	0	1	0	1	3	0	0	0	2	0	0	29	
04:40:00 PM	0	0	0	0	1	0	0	0	0	2	0	0	2	3	1	0	23	
04:45:00 PM	1	0	1	0	0	0	0	0	0	2	0	0	0	3	1	0	25	
04:50:00 PM	0	0	0	0	0	0	1	0	0	1	0	0	1	3	1	0	24	
04:55:00 PM	0	0	0	0	0	0	0	0	0	1	1	0	1	5	1	0	24	97
05:00:00 PM	0	0	0	0	0	0	0	0	0	3	0	0	0	3	1	0	23	98
05:05:00 PM	0	0	1	0	0	0	0	0	0	0	0	0	3	5	0	0	25	100
05:10:00 PM	0	0	0	0	0	0	0	0	0	2	0	0	1	2	0	0	21	97
05:15:00 PM	0	0	1	0	0	0	1	0	1	3	0	0	0	5	0	0	25	100
05:20:00 PM	0	0	0	0	0	1	0	0	0	1	0	0	0	2	0	0	20	98
05:25:00 PM	0	0	0	0	0	1	0	0	0	2	1	0	0	9	1	0	29	97
05:30:00 PM	0	0	0	0	0	0	0	0	0	4	0	0	1	4	0	0	27	100
05:35:00 PM	1	0	0	0	0	1	0	0	0	2	0	0	0	9	1	0	37	106
05:40:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	1	5	0	0	30	104
05:45:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	8	0	0	30	105
05:50:00 PM	0	0	2	0	0	0	0	0	0	1	0	0	0	4	0	0	23	105
05:55:00 PM	0	0	0	0	0	0	0	0	0	3	0	0	2	3	0	0	24	104

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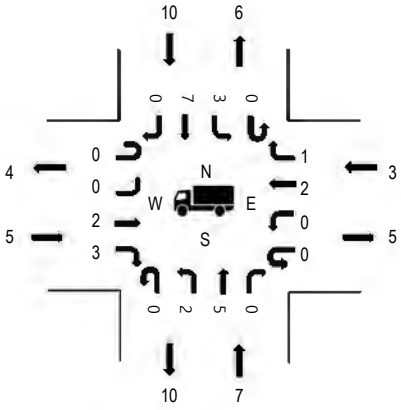
Location: 1 Hwy 99 & Coffin Butte Rd PM
Date: Wednesday, January 13, 2022
Peak Hour: 04:35 PM - 05:35 PM
Peak 15-Minutes: 05:20 PM - 05:35 PM

Peak Hour

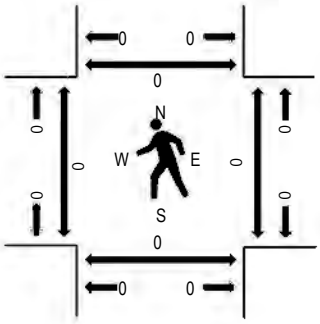
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	26.3%	0.88
WB	5.4%	0.79
NB	1.7%	0.86
SB	3.1%	0.84
All	3.0%	0.91

Traffic Counts - Motorized Vehicles

Interval Start Time	Coffin Butte Rd Eastbound				Coffin Butte Rd Westbound				Hwy 99 Northbound				Hwy 99 Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
2:00 PM	0	4	0	3	0	0	0	1	0	0	22	5	0	3	16	2	56	633
2:05 PM	0	0	0	0	0	1	0	3	0	2	13	1	0	3	9	3	35	629
2:10 PM	0	1	1	1	0	1	3	3	0	4	23	0	0	3	14	3	57	655
2:15 PM	0	1	0	3	0	1	0	0	0	0	29	1	0	1	17	1	54	650
2:20 PM	0	4	3	1	0	0	1	3	0	1	23	1	0	0	21	0	58	659
2:25 PM	0	2	2	0	0	0	0	2	0	1	24	1	0	2	5	2	41	656
2:30 PM	0	1	2	2	0	1	1	1	0	2	21	1	0	4	31	2	69	685
2:35 PM	0	4	1	3	0	0	1	2	0	0	12	0	0	2	14	1	40	677
2:40 PM	0	2	0	2	0	3	1	0	0	2	25	1	0	6	15	0	57	677
2:45 PM	0	1	2	0	0	3	1	1	0	4	14	2	0	3	11	1	43	688
2:50 PM	0	2	2	2	0	1	1	2	0	1	26	2	0	2	18	2	61	698
2:55 PM	0	1	0	1	0	1	1	3	0	3	22	0	0	0	30	0	62	700
3:00 PM	0	3	1	1	0	1	2	1	0	1	28	0	0	1	13	0	52	715
3:05 PM	0	0	1	4	0	2	1	2	0	0	28	0	0	4	19	0	61	721
3:10 PM	0	1	0	4	0	1	1	2	0	2	19	1	0	0	21	0	52	732
3:15 PM	0	1	3	4	0	1	1	3	0	0	29	3	0	0	17	1	63	735
3:20 PM	0	1	1	0	0	1	1	6	0	0	26	0	0	2	15	2	55	740
3:25 PM	0	2	0	1	0	1	1	3	0	3	31	3	0	5	20	0	70	752
3:30 PM	0	1	2	0	0	0	4	2	0	0	27	1	0	3	20	1	61	742
3:35 PM	0	0	2	1	0	1	0	1	0	2	21	2	0	1	9	0	40	734
3:40 PM	0	1	0	0	0	0	1	6	0	2	28	0	0	2	26	2	68	779
3:45 PM	0	1	0	1	0	1	1	0	0	3	25	2	0	6	13	0	53	777
3:50 PM	0	0	2	0	0	0	1	4	0	0	31	0	0	1	24	0	63	786
3:55 PM	0	2	3	1	0	0	0	3	0	3	37	1	0	6	21	0	77	790
4:00 PM	0	0	1	2	0	0	0	3	0	1	26	0	0	4	20	1	58	787
4:05 PM	0	2	2	1	0	1	1	4	0	0	34	3	0	4	20	0	72	791
4:10 PM	0	0	1	3	0	1	0	3	0	0	29	0	0	2	16	0	55	772
4:15 PM	0	0	0	1	0	0	1	2	0	1	40	2	0	1	20	0	68	785

Location: 1 Hwy 99 & Coffin Butte Rd PM

4:20 PM	0	1	3	0	0	0	3	2	0	2	25	2	0	2	27	0	67	774
4:25 PM	0	1	0	1	0	0	0	1	0	0	35	1	0	2	19	0	60	801
4:30 PM	0	2	3	0	0	0	0	5	0	0	22	1	0	5	14	1	53	806
4:35 PM	0	0	1	1	0	0	2	7	0	2	27	0	0	2	43	0	85	820
4:40 PM	0	0	2	0	0	0	1	3	0	0	28	1	0	5	26	0	66	802
4:45 PM	0	0	0	0	0	2	0	6	0	0	33	1	0	1	19	0	62	805
4:50 PM	0	0	1	0	0	0	0	3	0	1	28	1	0	2	31	0	67	813
4:55 PM	0	0	2	2	0	1	0	4	0	0	33	2	0	7	23	0	74	789
5:00 PM	0	0	0	0	0	1	0	3	0	0	33	0	0	5	20	0	62	761
5:05 PM	0	0	0	1	0	1	1	0	0	0	28	1	0	2	19	0	53	
5:10 PM	0	2	0	1	0	2	0	5	0	0	40	0	0	1	17	0	68	
5:15 PM	0	0	0	1	0	0	0	2	0	0	32	1	0	8	13	0	57	
5:20 PM	0	1	0	4	0	0	1	4	0	0	59	0	0	4	21	0	94	
5:25 PM	0	0	0	0	0	1	0	3	0	0	37	2	0	1	21	0	65	
5:30 PM	0	0	0	0	0	1	1	1	0	0	34	0	0	3	27	0	67	
5:35 PM	0	1	0	0	0	0	0	3	0	0	46	0	0	3	14	0	67	
5:40 PM	0	0	3	3	0	0	0	2	0	0	35	1	0	4	21	0	69	
5:45 PM	0	0	0	1	0	1	0	1	0	0	39	1	0	4	23	0	70	
5:50 PM	0	0	0	0	0	0	0	2	0	0	11	1	0	4	25	0	43	
5:55 PM	0	0	0	0	0	0	0	4	0	1	16	0	0	3	22	0	46	
Count Total	0	46	47	57	0	33	35	127	0	44	1,354	49	0	139	940	25	2,896	
Peak Hour	0	3	6	10	0	9	6	41	0	3	412	9	0	41	280	0	820	

Location: 1 Hwy 99 & Coffin Butte Rd PM

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
2:00 PM	5	1	1	0	7	2:00 PM	0	0	0	0	0	2:00 PM	0	0	0	0	0
2:05 PM	0	3	0	3	6	2:05 PM	0	0	0	0	0	2:05 PM	0	0	0	0	0
2:10 PM	2	1	2	0	5	2:10 PM	0	0	0	0	0	2:10 PM	0	0	0	0	0
2:15 PM	1	0	1	1	3	2:15 PM	0	0	0	0	0	2:15 PM	0	0	0	0	0
2:20 PM	6	1	1	0	8	2:20 PM	0	0	0	0	0	2:20 PM	0	0	0	0	0
2:25 PM	1	1	0	1	3	2:25 PM	0	0	0	0	0	2:25 PM	0	0	0	0	0
2:30 PM	3	5	1	7	16	2:30 PM	0	0	0	0	0	2:30 PM	0	0	0	0	0
2:35 PM	4	1	1	1	7	2:35 PM	0	0	0	0	0	2:35 PM	0	0	0	0	0
2:40 PM	1	3	1	1	6	2:40 PM	0	0	0	0	0	2:40 PM	0	0	0	0	0
2:45 PM	1	3	0	2	6	2:45 PM	0	0	0	2	2	2:45 PM	0	0	0	0	0
2:50 PM	5	1	3	4	13	2:50 PM	0	0	0	0	0	2:50 PM	0	0	0	0	0
2:55 PM	1	3	0	1	5	2:55 PM	0	0	0	0	0	2:55 PM	0	0	0	0	0
3:00 PM	1	1	3	0	5	3:00 PM	0	0	0	0	0	3:00 PM	0	0	0	0	0
3:05 PM	2	3	0	5	10	3:05 PM	0	0	0	0	0	3:05 PM	0	0	0	0	0
3:10 PM	1	2	2	1	6	3:10 PM	0	0	0	0	0	3:10 PM	0	0	0	0	0
3:15 PM	3	0	1	0	4	3:15 PM	0	0	0	0	0	3:15 PM	0	0	0	0	0
3:20 PM	1	2	1	2	6	3:20 PM	0	0	0	0	0	3:20 PM	0	0	0	0	0
3:25 PM	0	3	0	1	4	3:25 PM	0	0	0	0	0	3:25 PM	0	0	0	0	0
3:30 PM	1	2	1	2	6	3:30 PM	0	0	0	0	0	3:30 PM	0	0	0	0	0
3:35 PM	3	1	0	0	4	3:35 PM	0	0	0	0	0	3:35 PM	0	0	0	0	0
3:40 PM	0	1	0	2	3	3:40 PM	0	0	0	0	0	3:40 PM	0	0	0	0	0
3:45 PM	1	3	0	0	4	3:45 PM	0	0	0	0	0	3:45 PM	0	0	0	0	0
3:50 PM	0	0	1	0	1	3:50 PM	0	0	0	0	0	3:50 PM	0	0	0	0	0
3:55 PM	1	2	0	2	5	3:55 PM	0	0	0	0	0	3:55 PM	0	0	0	0	0
4:00 PM	1	2	0	0	3	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
4:05 PM	0	4	0	0	4	4:05 PM	0	0	0	0	0	4:05 PM	0	0	0	0	0
4:10 PM	1	1	0	1	3	4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0
4:15 PM	0	2	1	1	4	4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0
4:20 PM	0	0	2	0	2	4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0
4:25 PM	0	2	0	1	3	4:25 PM	0	0	0	0	0	4:25 PM	0	0	0	0	0
4:30 PM	2	4	0	1	7	4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0
4:35 PM	1	2	0	1	4	4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0
4:40 PM	1	0	1	0	2	4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0
4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0
4:50 PM	0	2	0	2	4	4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0
4:55 PM	1	1	0	3	5	4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0
5:00 PM	0	1	0	2	3	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	1	0	0	0	1	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
5:10 PM	1	1	0	1	3	5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0
5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
5:20 PM	0	0	2	0	2	5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0
5:25 PM	0	0	0	1	1	5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0
5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0
5:35 PM	0	1	1	0	2	5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0
5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	0	0	0	1	1	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	0	0	0	1	1	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	0	0	1	0	1	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	53	66	28	52	199	Count Total	0	0	0	2	2	Count Total	0	0	0	0	0
Peak Hour	5	7	3	10	25	Peak Hour	0	0	0	0	0	Peak Hour	0	0	0	0	0

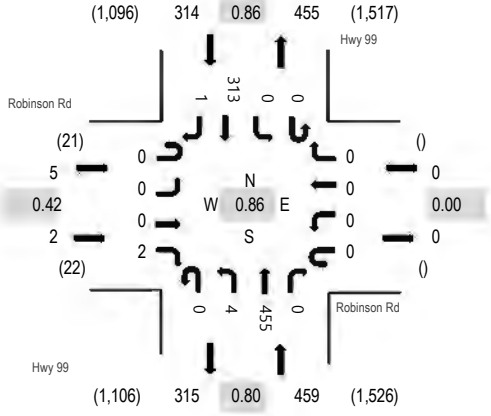
Location: 2 Hwy 99 & Robinson Rd PM

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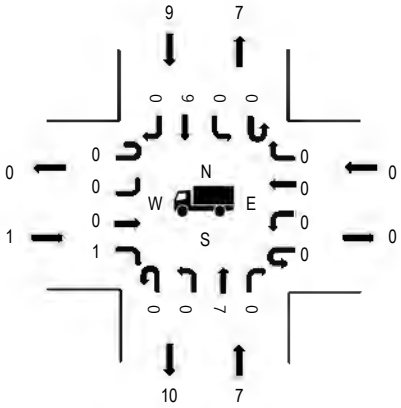
Location: 2 Hwy 99 & Robinson Rd PM
Date: Wednesday, January 13, 2022
Peak Hour: 04:35 PM - 05:35 PM
Peak 15-Minutes: 05:20 PM - 05:35 PM

Peak Hour

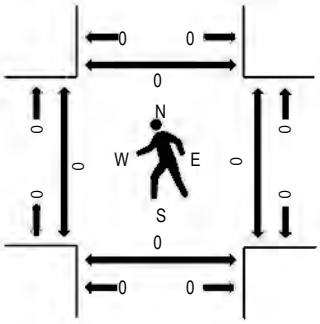
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	50.0%	0.42
WB	0.0%	0.00
NB	1.5%	0.80
SB	2.9%	0.86
All	2.2%	0.86

Traffic Counts - Motorized Vehicles

Interval Start Time	Robinson Rd Eastbound				Robinson Rd Westbound				Hwy 99 Northbound				Hwy 99 Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
2:00 PM	0	0	0	1	0	0	0	0	0	0	23	0	0	0	17	0	41	549
2:05 PM	0	0	0	0	0	0	0	0	0	0	22	0	0	0	18	0	40	549
2:10 PM	0	0	0	1	0	0	0	0	0	1	20	0	0	0	19	0	41	560
2:15 PM	0	0	0	0	0	0	0	0	0	0	32	0	0	0	17	0	49	568
2:20 PM	0	0	0	0	0	0	0	0	0	1	29	0	0	0	20	1	51	571
2:25 PM	0	0	0	1	0	0	0	0	0	1	21	0	0	0	22	0	45	565
2:30 PM	0	0	0	0	0	0	0	0	0	0	24	0	0	0	23	1	48	580
2:35 PM	0	0	0	0	0	0	0	0	0	0	26	0	0	0	23	0	49	591
2:40 PM	0	0	0	0	0	0	0	0	0	0	22	0	0	0	14	0	36	580
2:45 PM	0	0	0	0	0	0	0	0	0	0	18	0	0	0	20	0	38	594
2:50 PM	0	0	0	0	0	0	0	0	0	1	27	0	0	0	19	0	47	610
2:55 PM	0	1	0	4	0	0	0	0	0	0	31	0	0	0	28	0	64	629
3:00 PM	0	1	0	0	0	0	0	0	0	0	29	0	0	0	11	0	41	615
3:05 PM	0	0	0	0	0	0	0	0	0	0	28	0	0	0	23	0	51	642
3:10 PM	0	1	0	0	0	0	0	0	0	0	29	0	0	0	19	0	49	652
3:15 PM	0	1	0	0	0	0	0	0	0	2	29	0	0	0	20	0	52	658
3:20 PM	0	0	0	0	0	0	0	0	0	1	27	0	0	0	17	0	45	673
3:25 PM	0	0	0	1	0	0	0	0	0	0	34	0	0	0	25	0	60	686
3:30 PM	0	0	0	0	0	0	0	0	0	0	37	0	0	0	22	0	59	681
3:35 PM	0	0	0	0	0	0	0	0	0	0	24	0	0	0	14	0	38	676
3:40 PM	0	0	0	0	0	0	0	0	0	1	23	0	0	0	26	0	50	711
3:45 PM	0	0	0	1	0	0	0	0	0	0	29	0	0	0	24	0	54	728
3:50 PM	0	0	0	0	0	0	0	0	0	0	40	0	0	0	26	0	66	738
3:55 PM	0	0	0	0	0	0	0	0	0	0	26	0	0	0	24	0	50	732
4:00 PM	0	1	0	0	0	0	0	0	0	2	40	0	0	0	25	0	68	751
4:05 PM	0	0	0	2	0	0	0	0	0	0	39	0	0	0	20	0	61	741
4:10 PM	0	0	0	0	0	0	0	0	0	0	37	0	0	0	17	1	55	729

Location: 2 Hwy 99 & Robinson Rd PM

4:15 PM	0	0	0	1	0	0	0	0	0	0	35	0	0	0	31	0	67	728
4:20 PM	0	0	0	0	0	0	0	0	0	0	33	0	0	0	25	0	58	718
4:25 PM	0	1	0	0	0	0	0	0	0	1	34	0	0	0	19	0	55	746
4:30 PM	0	1	0	0	0	0	0	0	0	1	27	0	0	0	25	0	54	769
4:35 PM	0	0	0	1	0	0	0	0	0	0	33	0	0	0	39	0	73	775
4:40 PM	0	0	0	0	0	0	0	0	0	0	38	0	0	0	29	0	67	761
4:45 PM	0	0	0	0	0	0	0	0	0	1	37	0	0	0	26	0	64	772
4:50 PM	0	0	0	0	0	0	0	0	0	0	27	0	0	0	33	0	60	773
4:55 PM	0	0	0	0	0	0	0	0	0	0	35	0	0	0	34	0	69	750
5:00 PM	0	0	0	1	0	0	0	0	0	1	38	0	0	0	18	0	58	729
5:05 PM	0	0	0	0	0	0	0	0	0	0	26	0	0	0	23	0	49	
5:10 PM	0	0	0	0	0	0	0	0	0	0	39	0	0	0	15	0	54	
5:15 PM	0	0	0	0	0	0	0	0	0	0	36	0	0	0	20	1	57	
5:20 PM	0	0	0	0	0	0	0	0	0	1	61	0	0	0	24	0	86	
5:25 PM	0	0	0	0	0	0	0	0	0	1	46	0	0	0	31	0	78	
5:30 PM	0	0	0	0	0	0	0	0	0	0	39	0	0	0	21	0	60	
5:35 PM	0	0	0	0	0	0	0	0	0	1	37	0	0	0	21	0	59	
5:40 PM	0	0	0	0	0	0	0	0	0	0	49	0	0	0	29	0	78	
5:45 PM	0	1	0	0	0	0	0	0	0	0	37	0	0	0	27	0	65	
5:50 PM	0	0	0	0	0	0	0	0	0	0	17	0	0	0	20	0	37	
5:55 PM	0	0	0	0	0	0	0	0	0	0	19	0	0	0	29	0	48	
Count Total	0	8	0	14	0	0	0	0	0	17	1,509	0	0	0	1,092	4	2,644	
Peak Hour	0	0	0	2	0	0	0	0	0	4	455	0	0	0	313	1	775	

Location: 2 Hwy 99 & Robinson Rd PM

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
2:00 PM	0	3	0	2	5	2:00 PM	0	0	0	0	0	2:00 PM	0	0	0	0	0
2:05 PM	0	3	0	0	3	2:05 PM	0	0	0	0	0	2:05 PM	0	0	0	0	0
2:10 PM	0	2	0	0	2	2:10 PM	0	0	0	0	0	2:10 PM	0	0	0	0	0
2:15 PM	0	0	0	3	3	2:15 PM	0	0	0	0	0	2:15 PM	0	0	0	0	0
2:20 PM	0	3	0	0	3	2:20 PM	0	0	0	0	0	2:20 PM	0	0	0	0	0
2:25 PM	0	3	0	4	7	2:25 PM	0	0	0	0	0	2:25 PM	0	0	0	0	0
2:30 PM	0	0	0	3	3	2:30 PM	0	0	0	0	0	2:30 PM	0	0	0	0	0
2:35 PM	0	3	0	1	4	2:35 PM	0	0	0	0	0	2:35 PM	0	0	0	0	0
2:40 PM	0	2	0	1	3	2:40 PM	0	0	0	0	0	2:40 PM	0	0	0	0	0
2:45 PM	0	2	0	3	5	2:45 PM	0	0	0	0	0	2:45 PM	0	0	0	0	0
2:50 PM	0	2	0	3	5	2:50 PM	0	0	0	0	0	2:50 PM	0	0	0	0	0
2:55 PM	0	2	0	0	2	2:55 PM	0	0	0	0	0	2:55 PM	0	0	0	0	0
3:00 PM	0	3	0	1	4	3:00 PM	0	0	0	0	0	3:00 PM	0	0	0	0	0
3:05 PM	0	4	0	5	9	3:05 PM	0	0	0	0	0	3:05 PM	0	0	0	0	0
3:10 PM	0	4	0	0	4	3:10 PM	0	0	0	0	0	3:10 PM	0	0	0	0	0
3:15 PM	0	0	0	2	2	3:15 PM	0	0	0	0	0	3:15 PM	0	0	0	0	0
3:20 PM	0	2	0	0	2	3:20 PM	0	0	0	0	0	3:20 PM	0	0	0	0	0
3:25 PM	0	2	0	2	4	3:25 PM	0	0	0	0	0	3:25 PM	0	0	0	0	0
3:30 PM	0	2	0	2	4	3:30 PM	0	0	0	0	0	3:30 PM	0	0	0	0	0
3:35 PM	0	0	0	0	0	3:35 PM	0	0	0	0	0	3:35 PM	0	0	0	0	0
3:40 PM	0	1	0	1	2	3:40 PM	0	0	0	0	0	3:40 PM	0	0	0	0	0
3:45 PM	0	1	0	0	1	3:45 PM	0	0	0	0	0	3:45 PM	0	0	0	0	0
3:50 PM	0	1	0	0	1	3:50 PM	0	0	0	0	0	3:50 PM	0	0	0	0	0
3:55 PM	0	0	0	2	2	3:55 PM	0	0	0	0	0	3:55 PM	0	0	0	0	0
4:00 PM	0	1	0	0	1	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
4:05 PM	0	4	0	0	4	4:05 PM	0	0	0	0	0	4:05 PM	0	0	0	0	0
4:10 PM	0	0	0	1	1	4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0
4:15 PM	0	2	0	1	3	4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0
4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0
4:25 PM	0	1	0	0	1	4:25 PM	0	0	0	0	0	4:25 PM	0	0	0	0	0
4:30 PM	0	3	0	1	4	4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0
4:35 PM	1	1	0	0	2	4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0
4:40 PM	0	1	0	0	1	4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0
4:45 PM	0	1	0	0	1	4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0
4:50 PM	0	0	0	1	1	4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0
4:55 PM	0	1	0	4	5	4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0
5:00 PM	0	1	0	2	3	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
5:10 PM	0	1	0	1	2	5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0
5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
5:20 PM	0	1	0	0	1	5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0
5:25 PM	0	0	0	1	1	5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0
5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0
5:35 PM	0	1	0	0	1	5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0
5:40 PM	0	1	0	0	1	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	0	0	0	1	1	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	1	65	0	48	114	Count Total	0	0	0	0	0	Count Total	0	0	0	0	0
Peak Hour	1	7	0	9	17	Peak Hour	0	0	0	0	0	Peak Hour	0	0	0	0	0

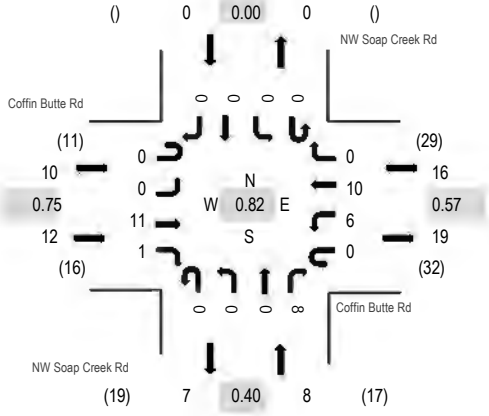
Location: 4 NW Soap Creek Rd & Coffin Butte Rd PM

ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

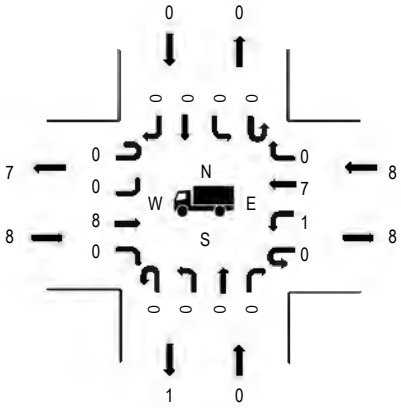
Location: 4 NW Soap Creek Rd & Coffin Butte Rd PM
Date: Wednesday, January 13, 2022
Peak Hour: 02:10 PM - 03:10 PM
Peak 15-Minutes: 02:10 PM - 02:25 PM

Peak Hour

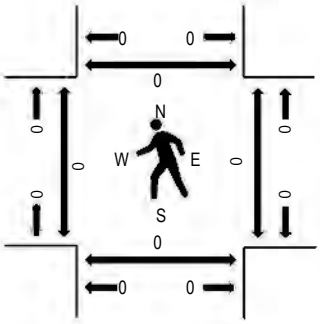
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	66.7%	0.75
WB	50.0%	0.57
NB	0.0%	0.40
SB	0.0%	0.00
All	44.4%	0.82

Traffic Counts - Motorized Vehicles

Interval Start Time	Coffin Butte Rd Eastbound				Coffin Butte Rd Westbound				NW Soap Creek Rd Northbound				NW Soap Creek Rd Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
2:00 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	31
2:05 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34
2:10 PM	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	4	36
2:15 PM	0	0	1	0	0	0	2	0	0	0	0	2	0	0	0	0	5	33
2:20 PM	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	29
2:25 PM	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	4	28
2:30 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	26
2:35 PM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	25
2:40 PM	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	24
2:45 PM	0	0	1	0	0	2	1	0	0	0	0	1	0	0	0	0	5	22
2:50 PM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	17
2:55 PM	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15
3:00 PM	0	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	4	13
3:05 PM	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	13
3:10 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	12
3:15 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	11
3:20 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	10
3:25 PM	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	2	11
3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
3:35 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	12
3:40 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	14
3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
3:50 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
3:55 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
4:00 PM	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	4	13
4:05 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	9
4:10 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8

Location: 4 NW Soap Creek Rd & Coffin Butte Rd PM

4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
4:20 PM	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	10
4:25 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
4:30 PM	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	3	9
4:35 PM	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	3	7
4:40 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
4:50 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
4:55 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
5:05 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:10 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	
5:20 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	
5:25 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:30 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	
5:35 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:40 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:50 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:55 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	
Count Total	0	0	15	1	0	18	11	0	0	0	0	17	0	0	0	0	62	
Peak Hour	0	0	11	1	0	6	10	0	0	0	0	8	0	0	0	0	36	

Location: 4 NW Soap Creek Rd & Coffin Butte Rd PM

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
2:00 PM	1	0	0	0	1	2:00 PM	0	0	0	0	0	2:00 PM	0	0	0	0	0
2:05 PM	0	0	0	0	0	2:05 PM	0	0	0	0	0	2:05 PM	0	0	0	0	0
2:10 PM	0	0	1	0	1	2:10 PM	0	0	0	0	0	2:10 PM	0	0	0	0	0
2:15 PM	1	0	2	0	3	2:15 PM	0	0	0	0	0	2:15 PM	0	0	0	0	0
2:20 PM	1	0	0	0	1	2:20 PM	0	0	0	0	0	2:20 PM	0	0	0	0	0
2:25 PM	2	0	0	0	2	2:25 PM	0	0	0	0	0	2:25 PM	0	0	0	0	0
2:30 PM	0	0	0	0	0	2:30 PM	0	0	0	0	0	2:30 PM	0	0	0	0	0
2:35 PM	0	0	1	0	1	2:35 PM	0	0	0	0	0	2:35 PM	0	0	0	0	0
2:40 PM	0	0	1	0	1	2:40 PM	0	0	0	0	0	2:40 PM	0	0	0	0	0
2:45 PM	1	0	1	0	2	2:45 PM	0	0	0	0	0	2:45 PM	0	0	0	0	0
2:50 PM	1	0	1	0	2	2:50 PM	0	0	0	0	0	2:50 PM	0	0	0	0	0
2:55 PM	1	0	0	0	1	2:55 PM	0	0	0	0	0	2:55 PM	0	0	0	0	0
3:00 PM	1	0	1	0	2	3:00 PM	0	0	0	0	0	3:00 PM	0	0	0	0	0
3:05 PM	0	0	0	0	0	3:05 PM	0	0	0	0	0	3:05 PM	0	0	0	0	0
3:10 PM	0	0	0	0	0	3:10 PM	0	0	0	0	0	3:10 PM	0	0	0	0	0
3:15 PM	0	0	0	0	0	3:15 PM	0	0	0	0	0	3:15 PM	0	0	0	0	0
3:20 PM	0	0	0	0	0	3:20 PM	0	0	0	0	0	3:20 PM	0	0	0	0	0
3:25 PM	0	0	0	0	0	3:25 PM	0	0	0	0	0	3:25 PM	0	0	0	0	0
3:30 PM	0	0	0	0	0	3:30 PM	0	0	0	0	0	3:30 PM	0	0	0	0	0
3:35 PM	0	0	0	0	0	3:35 PM	0	0	0	0	0	3:35 PM	0	0	0	0	0
3:40 PM	0	0	0	0	0	3:40 PM	0	0	0	0	0	3:40 PM	0	0	0	0	0
3:45 PM	0	0	0	0	0	3:45 PM	0	0	0	0	0	3:45 PM	0	0	0	0	0
3:50 PM	0	0	0	0	0	3:50 PM	0	0	0	0	0	3:50 PM	0	0	0	0	0
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4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
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4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0
4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0
4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0
4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0
4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0
4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0
5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
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5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
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5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	9	0	8	0	17	Count Total	0	0	0	0	0	Count Total	0	0	0	0	0
Peak Hour	8	0	8	0	16	Peak Hour	0	0	0	0	0	Peak Hour	0	0	0	0	0

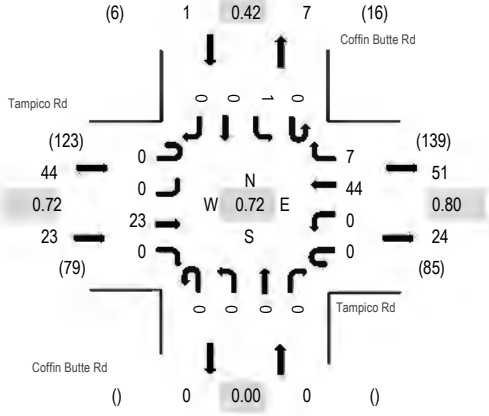
Location: 5 Coffin Butte Rd & Tampico Rd PM

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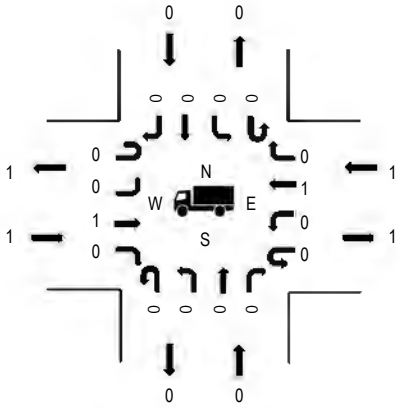
Location: 5 Coffin Butte Rd & Tampico Rd PM
Date: Wednesday, January 13, 2022
Peak Hour: 04:25 PM - 05:25 PM
Peak 15-Minutes: 04:45 PM - 05:00 PM

Peak Hour

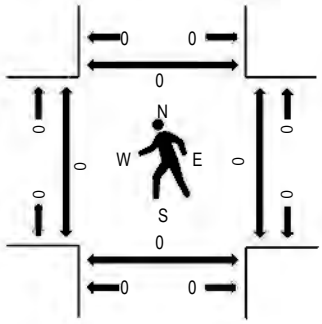
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	4.3%	0.72
WB	2.0%	0.80
NB	0.0%	0.00
SB	0.0%	0.42
All	2.7%	0.72

Traffic Counts - Motorized Vehicles

Interval Start Time	Tampico Rd Eastbound				Tampico Rd Westbound				Coffin Butte Rd Northbound				Coffin Butte Rd Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
2:00 PM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	46
2:05 PM	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	3	48
2:10 PM	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	3	51
2:15 PM	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	5	57
2:20 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	57
2:25 PM	0	0	3	0	0	0	0	1	0	0	0	0	0	2	0	0	6	58
2:30 PM	0	0	4	0	0	0	1	0	0	0	0	0	0	1	0	0	6	55
2:35 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	52
2:40 PM	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	3	55
2:45 PM	0	0	4	0	0	0	0	1	0	0	0	0	0	1	0	0	6	55
2:50 PM	0	0	3	0	0	0	2	0	0	0	0	0	0	0	0	0	5	57
2:55 PM	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	5	57
3:00 PM	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	4	56
3:05 PM	0	0	2	0	0	0	3	0	0	0	0	0	0	1	0	0	6	58
3:10 PM	0	0	3	0	0	0	6	0	0	0	0	0	0	0	0	0	9	58
3:15 PM	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	5	53
3:20 PM	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	50
3:25 PM	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	3	50
3:30 PM	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	55
3:35 PM	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	4	59
3:40 PM	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	3	61
3:45 PM	0	0	1	0	0	0	7	0	0	0	0	0	0	0	0	0	8	61
3:50 PM	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	5	66
3:55 PM	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	4	67
4:00 PM	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	6	70
4:05 PM	0	0	2	0	0	0	3	1	0	0	0	0	0	0	0	0	6	65
4:10 PM	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	4	60

Location: 5 Coffin Butte Rd & Tampico Rd PM

4:15 PM	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	66
4:20 PM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	71
4:25 PM	0	0	1	0	0	0	5	2	0	0	0	0	0	0	0	0	8	75
4:30 PM	0	0	2	0	0	0	4	1	0	0	0	0	0	0	0	0	7	70
4:35 PM	0	0	2	0	0	0	3	1	0	0	0	0	0	0	0	0	6	68
4:40 PM	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	3	63
4:45 PM	0	0	4	0	0	0	9	0	0	0	0	0	0	0	0	0	13	69
4:50 PM	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	6	58
4:55 PM	0	0	3	0	0	0	3	1	0	0	0	0	0	0	0	0	7	58
5:00 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	52
5:05 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	
5:10 PM	0	0	2	0	0	0	6	1	0	0	0	0	0	1	0	0	10	
5:15 PM	0	0	4	0	0	0	3	0	0	0	0	0	0	0	0	0	7	
5:20 PM	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	6	
5:25 PM	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	3	
5:30 PM	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	5	
5:35 PM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	
5:40 PM	0	0	2	0	0	0	6	1	0	0	0	0	0	0	0	0	9	
5:45 PM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	
5:50 PM	0	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	6	
5:55 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
Count Total	0	0	79	0	0	0	123	16	0	0	0	0	0	6	0	0	224	
Peak Hour	0	0	23	0	0	0	44	7	0	0	0	0	0	1	0	0	75	

Location: 5 Coffin Butte Rd & Tampico Rd PM

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
2:00 PM	0	0	1	0	1	2:00 PM	0	0	0	0	0	2:00 PM	0	0	0	0	0
2:05 PM	0	0	0	0	0	2:05 PM	0	0	0	0	0	2:05 PM	0	0	0	0	0
2:10 PM	0	0	0	0	0	2:10 PM	0	0	0	0	0	2:10 PM	0	0	0	0	0
2:15 PM	0	0	0	0	0	2:15 PM	0	0	0	0	0	2:15 PM	0	0	0	0	0
2:20 PM	0	0	0	0	0	2:20 PM	0	0	0	0	0	2:20 PM	0	0	0	0	0
2:25 PM	0	0	0	0	0	2:25 PM	0	0	0	0	0	2:25 PM	0	0	0	0	0
2:30 PM	0	0	0	0	0	2:30 PM	0	0	0	0	0	2:30 PM	0	0	0	0	0
2:35 PM	0	0	0	0	0	2:35 PM	0	0	0	0	0	2:35 PM	0	0	0	0	0
2:40 PM	0	0	0	0	0	2:40 PM	0	0	0	0	0	2:40 PM	0	0	0	0	0
2:45 PM	0	0	0	0	0	2:45 PM	0	0	0	0	0	2:45 PM	0	0	0	0	0
2:50 PM	0	0	0	0	0	2:50 PM	0	0	0	0	0	2:50 PM	0	0	0	0	0
2:55 PM	0	0	1	0	1	2:55 PM	0	0	0	0	0	2:55 PM	0	0	0	0	0
3:00 PM	1	0	0	0	1	3:00 PM	0	0	0	0	0	3:00 PM	0	0	0	0	0
3:05 PM	0	0	0	0	0	3:05 PM	0	0	0	0	0	3:05 PM	0	0	0	0	0
3:10 PM	0	0	0	0	0	3:10 PM	0	0	0	0	0	3:10 PM	0	0	0	0	0
3:15 PM	0	0	0	0	0	3:15 PM	0	0	0	0	0	3:15 PM	0	0	0	0	0
3:20 PM	0	0	0	0	0	3:20 PM	0	0	0	0	0	3:20 PM	0	0	0	0	0
3:25 PM	0	0	0	0	0	3:25 PM	0	0	0	0	0	3:25 PM	0	0	0	0	0
3:30 PM	0	0	0	0	0	3:30 PM	0	0	0	0	0	3:30 PM	0	0	0	0	0
3:35 PM	0	0	0	0	0	3:35 PM	0	0	0	0	0	3:35 PM	0	0	0	0	0
3:40 PM	0	0	0	0	0	3:40 PM	0	0	0	0	0	3:40 PM	0	0	0	0	0
3:45 PM	0	0	0	0	0	3:45 PM	0	0	0	0	0	3:45 PM	0	0	0	0	0
3:50 PM	0	0	0	0	0	3:50 PM	0	0	0	0	0	3:50 PM	0	0	0	0	0
3:55 PM	0	0	0	0	0	3:55 PM	0	0	0	0	0	3:55 PM	0	0	0	0	0
4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
4:05 PM	0	0	0	0	0	4:05 PM	0	0	0	0	0	4:05 PM	0	0	0	0	0
4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0
4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0
4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0
4:25 PM	1	0	1	0	2	4:25 PM	0	0	0	0	0	4:25 PM	0	0	0	0	0
4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0
4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0
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5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0
5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0
5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0
5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0
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5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	2	0	3	0	5	Count Total	0	0	0	0	0	Count Total	0	0	0	0	0
Peak Hour	1	0	1	0	2	Peak Hour	0	0	0	0	0	Peak Hour	0	0	0	0	0

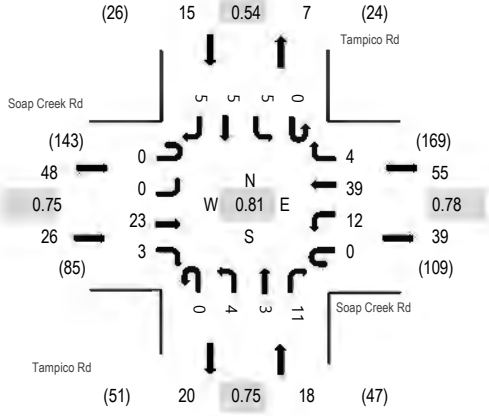
Location: 6 Tampico Rd & Soap Creek Rd PM

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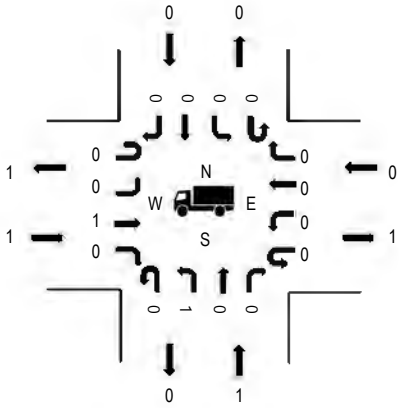
Location: 6 Tampico Rd & Soap Creek Rd PM
Date: Wednesday, January 13, 2022
Peak Hour: 04:00 PM - 05:00 PM
Peak 15-Minutes: 04:45 PM - 05:00 PM

Peak Hour

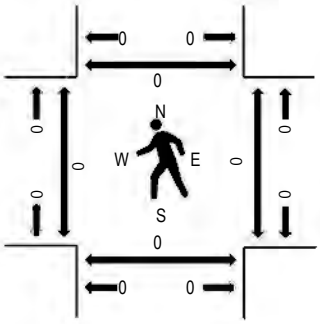
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	3.8%	0.75
WB	0.0%	0.78
NB	5.6%	0.75
SB	0.0%	0.54
All	1.8%	0.81

Traffic Counts - Motorized Vehicles

Interval Start Time	Soap Creek Rd Eastbound				Soap Creek Rd Westbound				Tampico Rd Northbound				Tampico Rd Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
2:00 PM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	60
2:05 PM	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	3	63
2:10 PM	0	0	2	0	0	1	3	0	0	0	0	0	0	0	0	0	6	70
2:15 PM	0	0	0	0	0	0	2	0	0	1	1	0	0	0	0	1	5	75
2:20 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	78
2:25 PM	0	2	3	0	0	0	1	0	0	0	0	1	0	0	0	0	7	80
2:30 PM	0	1	4	0	0	0	1	0	0	0	0	2	0	0	0	0	8	80
2:35 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	78
2:40 PM	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	3	83
2:45 PM	0	1	3	1	0	1	2	0	0	0	0	0	0	0	1	0	9	85
2:50 PM	0	0	3	0	0	2	2	0	0	0	0	0	0	0	1	0	8	84
2:55 PM	0	0	2	0	0	0	3	0	0	0	0	2	0	0	0	0	7	79
3:00 PM	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	1	5	78
3:05 PM	0	0	2	0	0	1	4	0	0	0	0	1	0	1	0	1	10	90
3:10 PM	0	0	4	0	0	1	5	0	0	0	0	0	0	1	0	0	11	87
3:15 PM	0	0	0	0	0	1	5	1	0	0	1	0	0	0	0	0	8	82
3:20 PM	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	3	76
3:25 PM	0	0	3	0	0	1	2	0	0	0	1	0	0	0	0	0	7	82
3:30 PM	0	0	0	0	0	1	4	0	0	0	0	0	0	1	0	0	6	85
3:35 PM	0	1	1	0	0	1	2	0	0	0	0	1	0	0	0	0	6	92
3:40 PM	0	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	5	97
3:45 PM	0	0	0	0	0	1	5	0	0	1	0	0	0	0	0	1	8	96
3:50 PM	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	3	104
3:55 PM	0	0	1	1	0	0	3	0	0	0	0	1	0	0	0	0	6	109
4:00 PM	0	0	3	1	0	2	3	0	0	1	1	1	0	1	3	1	17	114
4:05 PM	0	0	2	0	0	0	2	0	0	0	0	2	0	0	0	1	7	98
4:10 PM	0	0	0	0	0	1	4	0	0	0	0	0	0	1	0	0	6	94

Location: 6 Tampico Rd & Soap Creek Rd PM

4:15 PM	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	2	100
4:20 PM	0	0	1	0	0	1	2	1	0	1	1	1	0	0	1	0	9	106
4:25 PM	0	0	1	0	0	2	4	0	0	1	0	0	0	0	0	2	10	104
4:30 PM	0	0	3	0	0	2	3	1	0	0	1	1	0	2	0	0	13	100
4:35 PM	0	0	2	0	0	1	4	0	0	0	0	2	0	0	1	1	11	96
4:40 PM	0	0	0	0	0	0	3	0	0	0	0	1	0	0	0	0	4	88
4:45 PM	0	0	4	1	0	2	7	1	0	1	0	0	0	0	0	0	16	92
4:50 PM	0	0	3	0	0	1	2	0	0	0	0	1	0	1	0	0	8	83
4:55 PM	0	0	3	1	0	0	5	0	0	0	0	2	0	0	0	0	11	82
5:00 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	75
5:05 PM	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	3	
5:10 PM	0	0	3	0	0	0	6	0	0	1	1	1	0	0	0	0	12	
5:15 PM	0	0	4	0	0	1	3	0	0	0	0	0	0	0	0	0	8	
5:20 PM	0	0	0	0	0	0	4	0	0	1	1	1	0	0	0	0	7	
5:25 PM	0	0	0	1	0	3	2	0	0	0	0	0	0	0	0	0	6	
5:30 PM	0	0	1	0	0	3	4	0	0	0	0	0	0	1	0	0	9	
5:35 PM	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	3	
5:40 PM	0	0	0	0	0	0	6	1	0	0	0	1	0	0	0	0	8	
5:45 PM	0	0	2	0	0	1	3	0	0	0	0	1	0	0	0	0	7	
5:50 PM	0	0	2	0	0	1	3	1	0	0	0	0	0	0	0	0	7	
5:55 PM	0	1	0	0	0	0	1	0	0	0	0	2	0	0	0	0	4	
Count Total	0	6	72	7	0	36	125	8	0	9	10	28	0	9	8	9	327	
Peak Hour	0	0	23	3	0	12	39	4	0	4	3	11	0	5	5	5	114	

Location: 6 Tampico Rd & Soap Creek Rd PM

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

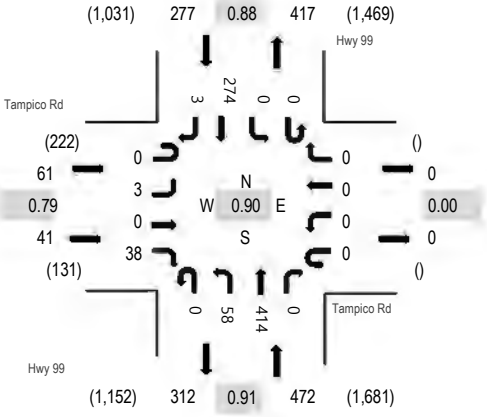
Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
2:00 PM	0	0	1	0	1	2:00 PM	0	0	0	0	0	2:00 PM	0	0	0	0	0
2:05 PM	0	0	0	0	0	2:05 PM	0	0	0	0	0	2:05 PM	0	0	0	0	0
2:10 PM	0	0	0	0	0	2:10 PM	0	0	0	0	0	2:10 PM	0	0	0	0	0
2:15 PM	0	0	0	0	0	2:15 PM	0	0	0	0	0	2:15 PM	0	0	0	0	0
2:20 PM	0	0	0	0	0	2:20 PM	0	0	0	0	0	2:20 PM	0	0	0	0	0
2:25 PM	0	0	0	0	0	2:25 PM	0	0	0	0	0	2:25 PM	0	0	0	0	0
2:30 PM	0	0	0	0	0	2:30 PM	0	0	0	0	0	2:30 PM	0	0	0	0	0
2:35 PM	0	0	0	0	0	2:35 PM	0	0	0	0	0	2:35 PM	0	0	0	0	0
2:40 PM	0	0	0	0	0	2:40 PM	0	0	0	0	0	2:40 PM	0	0	0	0	0
2:45 PM	0	0	0	0	0	2:45 PM	0	0	0	0	0	2:45 PM	0	0	0	0	0
2:50 PM	0	0	0	0	0	2:50 PM	0	0	0	0	0	2:50 PM	0	0	0	0	0
2:55 PM	0	0	1	0	1	2:55 PM	0	0	0	0	0	2:55 PM	0	0	0	0	0
3:00 PM	1	0	0	0	1	3:00 PM	0	0	0	0	0	3:00 PM	0	0	0	0	0
3:05 PM	0	0	0	1	1	3:05 PM	0	0	0	0	0	3:05 PM	0	0	0	0	0
3:10 PM	0	0	0	0	0	3:10 PM	0	0	0	0	0	3:10 PM	0	0	0	0	0
3:15 PM	0	0	0	0	0	3:15 PM	0	0	0	0	0	3:15 PM	0	0	0	0	0
3:20 PM	0	0	0	0	0	3:20 PM	0	0	0	0	0	3:20 PM	0	0	0	0	0
3:25 PM	0	0	0	0	0	3:25 PM	0	0	0	0	0	3:25 PM	0	0	0	0	0
3:30 PM	0	0	0	0	0	3:30 PM	0	0	0	0	0	3:30 PM	0	0	0	0	0
3:35 PM	0	0	0	0	0	3:35 PM	0	0	0	0	0	3:35 PM	0	0	0	0	0
3:40 PM	0	0	0	0	0	3:40 PM	0	0	0	0	0	3:40 PM	0	0	0	0	0
3:45 PM	0	0	0	0	0	3:45 PM	0	0	0	0	0	3:45 PM	0	0	0	0	0
3:50 PM	0	0	0	0	0	3:50 PM	0	0	0	0	0	3:50 PM	0	0	0	0	0
3:55 PM	0	0	0	0	0	3:55 PM	0	0	0	0	0	3:55 PM	0	0	0	0	0
4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
4:05 PM	0	0	0	0	0	4:05 PM	0	0	0	0	0	4:05 PM	0	0	0	0	0
4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0
4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0
4:20 PM	0	1	0	0	1	4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0
4:25 PM	0	0	0	0	0	4:25 PM	0	0	0	0	0	4:25 PM	0	0	0	0	0
4:30 PM	1	0	0	0	1	4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0
4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0
4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0
4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0
4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0
4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0
5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0
5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0
5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0
5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0
5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0
5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	2	1	2	1	6	Count Total	0	0	0	0	0	Count Total	0	0	0	0	0
Peak Hour	1	1	0	0	2	Peak Hour	0	0	0	0	0	Peak Hour	0	0	0	0	0

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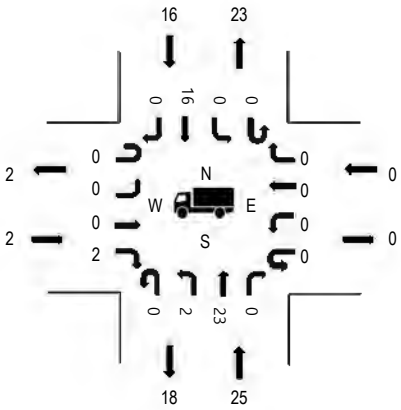
Location: 3 Hwy 99 & Tampico Rd PM
Date: Monday, January 18, 2021
Peak Hour: 03:40 PM - 04:40 PM
Peak 15-Minutes: 04:10 PM - 04:25 PM

Peak Hour

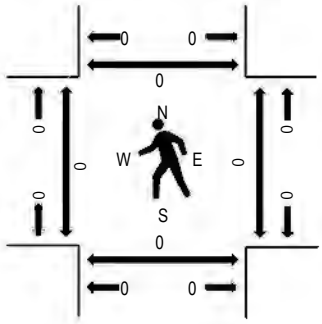
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	4.9%	0.79
WB	0.0%	0.00
NB	5.3%	0.91
SB	5.8%	0.88
All	5.4%	0.90

Traffic Counts - Motorized Vehicles

Interval Start Time	Tampico Rd Eastbound				Tampico Rd Westbound				Hwy 99 Northbound				Hwy 99 Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
2:00 PM	0	1	0	3	0	0	0	0	0	5	26	0	0	0	21	0	56	618
2:05 PM	0	0	0	7	0	0	0	0	0	1	21	0	0	0	19	0	48	616
2:10 PM	0	0	0	1	0	0	0	0	0	9	22	0	0	0	12	0	44	633
2:15 PM	0	1	0	3	0	0	0	0	0	2	18	0	0	0	26	0	50	641
2:20 PM	0	0	0	0	0	0	0	0	0	1	13	0	0	0	22	0	36	658
2:25 PM	0	0	0	4	0	0	0	0	0	6	27	0	0	0	19	1	57	668
2:30 PM	0	0	0	2	0	0	0	0	0	3	21	0	0	0	30	0	56	690
2:35 PM	0	0	0	2	0	0	0	0	0	1	20	0	0	0	24	1	48	682
2:40 PM	0	0	0	4	0	0	0	0	0	4	26	0	0	0	18	0	52	680
2:45 PM	0	0	0	4	0	0	0	0	0	1	23	0	0	0	24	0	52	697
2:50 PM	0	0	0	4	0	0	0	0	0	3	26	0	0	0	21	0	54	717
2:55 PM	0	0	0	5	0	0	0	0	0	4	31	0	0	0	25	0	65	733
3:00 PM	0	0	0	2	0	0	0	0	0	2	28	0	0	0	22	0	54	723
3:05 PM	0	0	0	2	0	0	0	0	0	5	36	0	0	0	22	0	65	727
3:10 PM	0	0	0	0	0	0	0	0	0	3	31	0	0	0	18	0	52	717
3:15 PM	0	0	0	2	0	0	0	0	0	4	33	0	0	0	28	0	67	752
3:20 PM	0	0	0	3	0	0	0	0	0	2	25	0	0	0	16	0	46	750
3:25 PM	0	0	0	2	0	0	0	0	0	4	36	0	0	0	37	0	79	772
3:30 PM	0	0	0	2	0	0	0	0	0	4	32	0	0	0	10	0	48	759
3:35 PM	0	0	0	3	0	0	0	0	0	8	20	0	0	0	15	0	46	767
3:40 PM	0	1	0	6	0	0	0	0	0	7	31	0	0	0	24	0	69	790
3:45 PM	0	0	0	2	0	0	0	0	0	8	41	0	0	0	21	0	72	777
3:50 PM	0	0	0	0	0	0	0	0	0	5	43	0	0	0	21	1	70	765
3:55 PM	0	0	0	2	0	0	0	0	0	6	32	0	0	0	15	0	55	766
4:00 PM	0	0	0	4	0	0	0	0	0	3	27	0	0	0	24	0	58	776
4:05 PM	0	0	0	3	0	0	0	0	0	6	24	0	0	0	22	0	55	776
4:10 PM	0	1	0	5	0	0	0	0	0	6	45	0	0	0	30	0	87	781
4:15 PM	0	0	0	2	0	0	0	0	0	7	39	0	0	0	16	1	65	759

Location: 3 Hwy 99 & Tampico Rd PM

4:20 PM	0	0	0	3	0	0	0	0	0	2	36	0	0	0	27	0	68	766
4:25 PM	0	1	0	2	0	0	0	0	0	4	40	0	0	0	19	0	66	777
4:30 PM	0	0	0	4	0	0	0	0	0	4	24	0	0	0	23	1	56	756
4:35 PM	0	0	0	5	0	0	0	0	0	0	32	0	0	0	32	0	69	771
4:40 PM	0	0	0	2	0	0	0	0	0	5	28	0	0	0	21	0	56	756
4:45 PM	0	0	0	2	0	0	0	0	0	4	30	0	0	0	24	0	60	760
4:50 PM	0	0	0	3	0	0	0	0	0	3	42	0	0	0	23	0	71	766
4:55 PM	0	0	0	1	0	0	0	0	0	8	35	0	0	0	21	0	65	748
5:00 PM	0	0	0	4	0	0	0	0	0	5	29	0	0	0	20	0	58	726
5:05 PM	0	0	0	2	0	0	0	0	0	8	34	0	0	0	16	0	60	
5:10 PM	0	0	0	2	0	0	0	0	0	4	34	0	0	0	25	0	65	
5:15 PM	0	0	0	2	0	0	0	0	0	6	47	0	0	0	17	0	72	
5:20 PM	0	0	0	4	0	0	0	0	0	6	37	0	0	0	32	0	79	
5:25 PM	0	0	0	2	0	0	0	0	0	5	20	0	0	0	18	0	45	
5:30 PM	0	0	0	3	0	0	0	0	0	9	38	0	0	0	21	0	71	
5:35 PM	0	0	0	0	0	0	0	0	0	4	33	0	0	0	17	0	54	
5:40 PM	0	0	0	3	0	0	0	0	0	3	40	0	0	0	14	0	60	
5:45 PM	0	0	0	3	0	0	0	0	0	5	35	0	0	0	23	0	66	
5:50 PM	0	0	0	0	0	0	0	0	0	7	28	0	0	0	18	0	53	
5:55 PM	0	0	0	0	0	0	0	0	0	5	25	0	0	0	13	0	43	
Count Total	0	5	0	126	0	0	0	0	0	217	1,464	0	0	0	1,026	5	2,843	
Peak Hour	0	3	0	38	0	0	0	0	0	58	414	0	0	0	274	3	790	

Location: 3 Hwy 99 & Tampico Rd PM

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
2:00 PM	1	3	0	2	6	2:00 PM	0	0	0	0	0	2:00 PM	0	0	0	0	0
2:05 PM	0	2	0	3	5	2:05 PM	0	0	0	0	0	2:05 PM	0	0	0	0	0
2:10 PM	0	2	0	1	3	2:10 PM	0	0	0	0	0	2:10 PM	0	0	0	0	0
2:15 PM	0	3	0	1	4	2:15 PM	0	2	0	0	2	2:15 PM	0	0	0	0	0
2:20 PM	0	1	0	3	4	2:20 PM	0	0	0	0	0	2:20 PM	0	0	0	0	0
2:25 PM	0	3	0	1	4	2:25 PM	0	0	0	0	0	2:25 PM	0	0	0	0	0
2:30 PM	0	3	0	3	6	2:30 PM	0	0	0	0	0	2:30 PM	0	0	0	0	0
2:35 PM	0	3	0	1	4	2:35 PM	0	0	0	0	0	2:35 PM	0	0	0	0	0
2:40 PM	0	3	0	1	4	2:40 PM	0	0	0	0	0	2:40 PM	0	0	0	0	0
2:45 PM	0	1	0	2	3	2:45 PM	0	0	0	0	0	2:45 PM	0	0	0	0	0
2:50 PM	0	2	0	1	3	2:50 PM	0	0	0	0	0	2:50 PM	0	0	0	0	0
2:55 PM	0	4	0	7	11	2:55 PM	0	0	0	0	0	2:55 PM	0	0	0	0	0
3:00 PM	0	2	0	2	4	3:00 PM	0	0	0	0	0	3:00 PM	0	0	0	0	0
3:05 PM	0	4	0	4	8	3:05 PM	0	0	0	0	0	3:05 PM	0	0	0	0	0
3:10 PM	0	1	0	0	1	3:10 PM	0	0	0	0	0	3:10 PM	0	0	0	0	0
3:15 PM	0	3	0	0	3	3:15 PM	0	0	0	0	0	3:15 PM	0	0	0	0	0
3:20 PM	0	2	0	1	3	3:20 PM	0	0	0	0	0	3:20 PM	0	0	0	0	0
3:25 PM	0	2	0	2	4	3:25 PM	0	0	0	0	0	3:25 PM	0	0	0	0	0
3:30 PM	0	4	0	2	6	3:30 PM	0	0	0	0	0	3:30 PM	0	0	0	0	0
3:35 PM	0	3	0	1	4	3:35 PM	1	0	0	0	1	3:35 PM	0	0	0	0	0
3:40 PM	1	1	0	2	4	3:40 PM	0	0	0	0	0	3:40 PM	0	0	0	0	0
3:45 PM	0	4	0	1	5	3:45 PM	0	0	0	0	0	3:45 PM	0	0	0	0	0
3:50 PM	0	3	0	2	5	3:50 PM	0	0	0	0	0	3:50 PM	0	0	0	0	0
3:55 PM	0	5	0	1	6	3:55 PM	0	0	0	0	0	3:55 PM	0	0	0	0	0
4:00 PM	0	2	0	1	3	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
4:05 PM	0	2	0	0	2	4:05 PM	0	0	0	0	0	4:05 PM	0	0	0	0	0
4:10 PM	0	2	0	0	2	4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0
4:15 PM	0	0	0	2	2	4:15 PM	0	1	0	0	1	4:15 PM	0	0	0	0	0
4:20 PM	0	1	0	2	3	4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0
4:25 PM	0	2	0	1	3	4:25 PM	0	0	0	0	0	4:25 PM	0	0	0	0	0
4:30 PM	0	2	0	2	4	4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0
4:35 PM	1	1	0	2	4	4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0
4:40 PM	0	3	0	1	4	4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0
4:45 PM	0	1	0	2	3	4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0
4:50 PM	0	2	0	0	2	4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0
4:55 PM	0	1	0	0	1	4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0
5:00 PM	0	0	0	1	1	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	0	2	0	2	4	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
5:10 PM	0	1	0	1	2	5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0
5:15 PM	0	1	0	2	3	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
5:20 PM	0	2	0	0	2	5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0
5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0
5:30 PM	0	1	0	0	1	5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0
5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0
5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	0	2	0	0	2	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	0	1	0	0	1	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	0	1	0	0	1	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	3	94	0	63	160	Count Total	1	3	0	0	4	Count Total	0	0	0	0	0
Peak Hour	2	25	0	16	43	Peak Hour	0	1	0	0	1	Peak Hour	0	0	0	0	0

Rally Traffic

N/S street:	***OR 99W***
E/W street:	***Coffin Butte Rd***
City, State	Adair Village OR
Study ID #	1020
Location	44.69957 -123.2
Start Date	Tuesday, September 19, 2023
Start Time	02:00:00 PM
Peak Hour Start	
Peak 15 Min Start	
PHF (15-Min Int)	

Peak-Hour Volumes (PHV)

Northbound				Southbound				Eastbound				Westbound				Entering				Leaving			
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	NB	SB	EB	WB	NB	SB	EB	WB
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				

Percent Heavy Vehicles

PHV- Bicycles

Northbound				Southbound				Eastbound				Westbound					PHV - Pedestrians in Crosswalk				
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	**Sum**	NB	SB	EB	WB	**Sum**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

All Vehicle Volumes

	Northbound OR 99W				Southbound OR 99W				Eastbound Coffin Butte Rd				Westbound Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	2	21	0	1	4	19	2	0	3	3	0	0	0	1	0	0		
02:05:00 PM	3	17	0	0	5	15	4	0	1	5	1	0	2	5	0	0		
02:10:00 PM	2	28	0	0	1	19	1	0	1	2	1	0	0	2	0	0	164	
02:15:00 PM	3	20	0	0	6	18	2	0	1	1	3	0	1	10	0	0	172	
02:20:00 PM	1	22	0	0	6	25	0	0	4	2	2	0	2	4	0	0	184	
02:25:00 PM	3	33	0	0	4	18	1	0	2	3	2	0	0	4	0	0	196	
02:30:00 PM	2	26	0	0	4	16	4	0	1	1	0	0	1	5	0	0	192	
02:35:00 PM	2	27	0	0	2	26	4	0	0	5	2	0	0	2	0	0	193	
02:40:00 PM	1	24	0	0	1	28	2	0	1	3	3	0	2	0	0	0	190	
02:45:00 PM	0	23	0	0	1	17	1	0	1	3	3	0	0	0	0	0	181	
02:50:00 PM	2	20	0	0	8	14	2	0	3	5	3	0	0	3	1	0	172	
02:55:00 PM	3	28	0	0	2	13	0	0	4	1	3	0	0	1	1	0	161	1805
03:00:00 PM	2	21	0	0	1	17	0	0	0	4	0	0	1	2	0	0	158	1963
03:05:00 PM	3	28	0	0	4	20	0	0	2	2	1	0	2	2	0	0	160	2123
03:10:00 PM	2	37	0	0	3	18	0	0	1	4	2	0	0	0	1	0	173	2132
03:15:00 PM	3	44	0	0	8	42	4	0	0	2	3	0	1	2	1	0	234	2194
03:20:00 PM	2	19	0	0	7	20	4	0	1	8	2	0	1	6	0	0	241	2251
03:25:00 PM	0	12	0	0	5	18	0	0	3	1	2	0	0	1	0	0	217	2272
03:30:00 PM	5	50	0	0	7	19	1	0	1	0	3	0	0	2	0	0	193	2273
03:35:00 PM	1	39	0	0	5	16	1	0	3	3	2	0	1	4	1	0	200	2280
03:40:00 PM	0	19	0	0	3	18	0	0	3	3	2	0	0	4	0	0	210	2300
03:45:00 PM	0	5	0	0	11	20	1	0	1	5	2	0	0	2	0	0	174	2293
03:50:00 PM	2	40	0	0	4	17	0	0	1	3	1	0	1	1	0	0	167	2288
03:55:00 PM	2	73	0	0	1	30	0	0	0	4	1	0	0	2	0	0	226	2353
04:00:00 PM	4	45	0	0	6	28	0	0	0	2	1	0	1	2	0	0	264	2459

Rally Traffic

04:05:00 PM	1	26	0	0	3	25	0	0	0	4	3	0	1	1	0	0	259	2558
04:10:00 PM	2	41	0	0	4	25	1	0	0	1	0	0	0	1	0	0	221	2606
04:15:00 PM	2	41	0	0	5	24	0	0	1	3	1	0	0	1	0	0	212	2584
04:20:00 PM	0	36	0	0	4	17	0	0	0	2	2	0	0	1	0	0	211	2554
04:25:00 PM	0	33	0	0	1	5	0	0	2	1	2	0	0	2	0	0	184	2521
04:30:00 PM	1	29	0	0	1	12	0	0	0	0	2	0	0	2	0	0	154	2482
04:35:00 PM	0	24	0	0	12	46	1	0	1	2	1	0	2	0	0	0	181	2463
04:40:00 PM	3	39	0	0	2	27	0	0	0	3	3	0	1	1	0	0	211	2464
04:45:00 PM	3	43	0	0	6	21	1	0	1	1	0	0	1	0	0	0	239	2529
04:50:00 PM	0	28	0	0	3	19	1	0	1	1	1	0	0	1	1	0	206	2568
04:55:00 PM	0	39	0	0	2	30	0	0	0	1	1	0	3	0	0	0	206	2548
05:00:00 PM	0	48	0	0	6	27	0	0	1	3	1	0	0	0	0	0	218	2502
05:05:00 PM	0	36	0	0	2	14	2	0	1	2	0	0	0	1	0	0	220	2463
05:10:00 PM	0	46	0	0	0	23	0	0	1	1	1	0	1	1	0	0	218	2460
05:15:00 PM	0	38	0	0	9	24	0	0	0	0	1	0	1	0	1	0	206	2454
05:20:00 PM	0	49	0	0	2	19	0	0	2	0	1	0	5	0	0	0	226	2469
05:25:00 PM	0	41	0	0	5	28	0	0	2	1	3	0	0	1	0	0	233	2518
05:30:00 PM	0	52	1	0	9	31	0	0	2	3	6	0	3	1	0	0	267	2631
05:35:00 PM	1	39	0	0	2	20	1	0	1	2	2	0	0	0	0	0	256	2706
05:40:00 PM	0	21	0	0	4	30	0	0	1	0	1	0	0	0	1	0	233	2728
05:45:00 PM	0	36	0	0	8	16	0	0	0	3	0	0	1	0	1	0	190	2679
05:50:00 PM	0	34	0	0	5	17	0	0	0	1	0	0	0	0	0	0	180	2653
05:55:00 PM	0	26	0	0	3	16	0	0	0	4	1	0	0	1	0	0	173	2620

Bicycles on Road

	Northbound				**Southbound**				**Eastbound**				**Westbound**					
	OR 99W				OR 99W				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
02:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
02:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	
02:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
02:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
02:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
03:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
03:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	4
03:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5
03:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5
03:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
03:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
03:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
03:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
03:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	4

Rally Traffic

03:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5
03:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
03:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
04:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
04:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
04:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
04:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	4
04:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5
04:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
04:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
04:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
04:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
04:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
04:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
04:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
05:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
05:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	4
05:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5
05:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5
05:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
05:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
05:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
05:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
05:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	4
05:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5
05:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
05:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6

Passenger vehicles and light trucks

	Northbound				**Southbound**				**Eastbound**				**Westbound**					
	OR 99W				OR 99W				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	0	19	0	1	4	18	1	0	1	1	0	0	0	0	0	0		
02:05:00 PM	2	16	0	0	1	14	0	0	0	2	0	0	2	2	0	0		
02:10:00 PM	0	25	0	0	0	19	0	0	0	0	0	0	0	1	0	0	127	
02:15:00 PM	1	20	0	0	5	18	2	0	1	1	2	0	0	6	0	0	137	
02:20:00 PM	0	21	0	0	4	24	0	0	2	1	1	0	1	1	0	0	155	
02:25:00 PM	1	32	0	0	4	16	1	0	1	2	0	0	0	3	0	0	169	
02:30:00 PM	1	25	0	0	4	14	2	0	0	0	0	0	1	3	0	0	163	
02:35:00 PM	1	27	0	0	2	25	0	0	0	1	2	0	0	1	0	0	166	
02:40:00 PM	1	24	0	0	1	27	1	0	0	2	2	0	2	0	0	0	166	
02:45:00 PM	0	21	0	0	0	16	0	0	0	1	2	0	0	0	0	0	157	
02:50:00 PM	1	19	0	0	6	13	0	0	1	2	1	0	0	0	1	0	142	
02:55:00 PM	2	27	0	0	2	13	0	0	1	0	1	0	0	1	0	0	128	1510
03:00:00 PM	0	17	0	0	1	15	0	0	0	3	0	0	0	0	0	0	124	1634
03:05:00 PM	1	26	0	0	4	19	0	0	1	1	1	0	2	1	0	0	136	1770
03:10:00 PM	2	34	0	0	3	17	0	0	0	2	1	0	0	0	1	0	149	1792
03:15:00 PM	0	43	0	0	6	40	2	0	0	0	1	0	1	1	1	0	208	1863
03:20:00 PM	2	16	0	0	5	17	2	0	0	2	1	0	1	1	0	0	198	1906

Rally Traffic

03:25:00 PM	0	12	0	0	5	16	0	0	3	0	1	0	0	0	0	0	177	1914
03:30:00 PM	4	48	0	0	6	19	1	0	0	0	1	0	0	0	0	0	157	1908
03:35:00 PM	1	37	0	0	5	16	1	0	0	1	1	0	1	2	0	0	176	1918
03:40:00 PM	0	18	0	0	2	18	0	0	2	0	1	0	0	1	0	0	181	1933
03:45:00 PM	0	4	0	0	11	19	1	0	1	2	1	0	0	1	0	0	146	1922
03:50:00 PM	1	38	0	0	4	15	0	0	0	1	1	0	1	0	0	0	142	1922
03:55:00 PM	0	68	0	0	1	30	0	0	0	2	1	0	0	2	0	0	204	1998
04:00:00 PM	3	43	0	0	6	28	0	0	0	1	1	0	1	2	0	0	246	2120
04:05:00 PM	1	25	0	0	3	22	0	0	0	2	3	0	1	1	0	0	243	2227
04:10:00 PM	2	40	0	0	4	25	1	0	0	1	0	0	0	1	0	0	211	2289
04:15:00 PM	2	40	0	0	5	21	0	0	0	2	1	0	0	1	0	0	199	2280
04:20:00 PM	0	35	0	0	4	17	0	0	0	0	0	0	0	0	0	0	198	2280
04:25:00 PM	0	32	0	0	1	5	0	0	2	0	1	0	0	1	0	0	168	2271
04:30:00 PM	1	29	0	0	0	11	0	0	0	0	2	0	0	1	0	0	141	2255
04:35:00 PM	0	24	0	0	12	46	1	0	1	2	1	0	2	0	0	0	174	2253
04:40:00 PM	3	38	0	0	2	27	0	0	0	3	3	0	1	0	0	0	206	2278
04:45:00 PM	2	41	0	0	5	20	1	0	1	0	0	0	1	0	0	0	232	2364
04:50:00 PM	0	28	0	0	3	18	1	0	1	0	1	0	0	0	1	0	196	2418
04:55:00 PM	0	38	0	0	1	28	0	0	0	1	1	0	2	0	0	0	193	2407
05:00:00 PM	0	47	0	0	6	26	0	0	1	2	1	0	0	0	0	0	207	2368
05:05:00 PM	0	34	0	0	2	13	2	0	1	1	0	0	0	1	0	0	208	2333
05:10:00 PM	0	45	0	0	0	23	0	0	1	0	0	0	1	1	0	0	208	2330
05:15:00 PM	0	38	0	0	9	23	0	0	0	0	1	0	1	0	0	0	197	2328
05:20:00 PM	0	48	0	0	2	19	0	0	2	0	1	0	5	0	0	0	220	2350
05:25:00 PM	0	40	0	0	5	25	0	0	2	1	2	0	0	1	0	0	225	2407
05:30:00 PM	0	52	1	0	9	30	0	0	2	3	6	0	3	0	0	0	259	2525
05:35:00 PM	1	39	0	0	2	20	1	0	1	2	2	0	0	0	0	0	249	2600
05:40:00 PM	0	20	0	0	3	28	0	0	1	0	1	0	0	0	1	0	227	2621
05:45:00 PM	0	35	0	0	8	16	0	0	0	3	0	0	1	0	1	0	185	2574
05:50:00 PM	0	32	0	0	4	17	0	0	0	1	0	0	0	0	0	0	172	2550
05:55:00 PM	0	26	0	0	3	16	0	0	0	3	1	0	0	1	0	0	168	2525
	FHWA 4-13 -Truck/Multi-Unit/Heavy Trucks																	
	Northbound				**Southbound**				**Eastbound**				**Westbound**					
	OR 99W				OR 99W				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	2	2	0	0	0	1	1	0	2	2	0	0	0	1	0	0		
02:05:00 PM	1	1	0	0	4	1	4	0	1	3	1	0	0	3	0	0		
02:10:00 PM	2	3	0	0	1	0	1	0	1	2	1	0	0	1	0	0	37	
02:15:00 PM	2	0	0	0	1	0	0	0	0	0	1	0	1	4	0	0	35	
02:20:00 PM	1	1	0	0	2	1	0	0	2	1	1	0	1	3	0	0	29	
02:25:00 PM	2	1	0	0	0	2	0	0	1	1	2	0	0	1	0	0	27	
02:30:00 PM	1	1	0	0	0	2	2	0	1	1	0	0	0	2	0	0	29	
02:35:00 PM	1	0	0	0	0	1	4	0	0	4	0	0	0	1	0	0	27	
02:40:00 PM	0	0	0	0	0	1	1	0	1	1	1	0	0	0	0	0	24	
02:45:00 PM	0	2	0	0	1	1	1	0	1	2	1	0	0	0	0	0	24	
02:50:00 PM	1	1	0	0	2	1	2	0	2	3	2	0	0	3	0	0	30	
02:55:00 PM	1	1	0	0	0	0	0	0	3	1	2	0	0	0	1	0	33	295
03:00:00 PM	2	4	0	0	0	2	0	0	0	1	0	0	1	2	0	0	34	329

Rally Traffic

03:05:00 PM	2	2	0	0	0	1	0	0	1	1	0	0	0	1	0	0	24	353
03:10:00 PM	0	3	0	0	0	1	0	0	1	2	1	0	0	0	0	0	24	340
03:15:00 PM	3	1	0	0	2	2	2	0	0	2	2	0	0	1	0	0	26	331
03:20:00 PM	0	3	0	0	2	3	2	0	1	6	1	0	0	5	0	0	43	345
03:25:00 PM	0	0	0	0	0	2	0	0	0	1	1	0	0	1	0	0	40	358
03:30:00 PM	1	2	0	0	1	0	0	0	1	0	2	0	0	2	0	0	36	365
03:35:00 PM	0	2	0	0	0	0	0	0	3	2	1	0	0	2	1	0	24	362
03:40:00 PM	0	1	0	0	1	0	0	0	1	3	1	0	0	3	0	0	29	367
03:45:00 PM	0	1	0	0	0	1	0	0	0	3	1	0	0	1	0	0	28	371
03:50:00 PM	1	2	0	0	0	2	0	0	1	2	0	0	0	1	0	0	25	366
03:55:00 PM	2	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	22	355
04:00:00 PM	1	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	18	339
04:05:00 PM	0	1	0	0	0	3	0	0	0	2	0	0	0	0	0	0	16	331
04:10:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	317
04:15:00 PM	0	1	0	0	0	3	0	0	1	1	0	0	0	0	0	0	13	304
04:20:00 PM	0	1	0	0	0	0	0	0	0	2	2	0	0	1	0	0	13	274
04:25:00 PM	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	16	250
04:30:00 PM	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	13	227
04:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	210
04:40:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5	186
04:45:00 PM	1	2	0	0	1	1	0	0	0	1	0	0	0	0	0	0	7	165
04:50:00 PM	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	10	150
04:55:00 PM	0	1	0	0	1	2	0	0	0	0	0	0	1	0	0	0	13	141
05:00:00 PM	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	11	134
05:05:00 PM	0	2	0	0	0	1	0	0	0	1	0	0	0	0	0	0	12	130
05:10:00 PM	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	10	130
05:15:00 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	9	126
05:20:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	119
05:25:00 PM	0	1	0	0	0	3	0	0	0	0	1	0	0	0	0	0	8	111
05:30:00 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	8	106
05:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	106
05:40:00 PM	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	6	107
05:45:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	105
05:50:00 PM	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8	103
05:55:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	95

Pedestrians Crossing					15 Min	1 HR
Time	NB	SB	EB	WB	Sum	Sum
02:00:00 PM	0	0	0	0		
02:05:00 PM	0	0	0	0		
02:10:00 PM	0	0	0	0	0	
02:15:00 PM	0	0	0	0	0	
02:20:00 PM	0	0	0	0	0	
02:25:00 PM	0	0	0	0	0	
02:30:00 PM	0	0	0	0	0	
02:35:00 PM	0	0	0	0	0	
02:40:00 PM	0	0	0	0	0	
02:45:00 PM	0	0	0	0	0	
02:50:00 PM	0	0	0	0	0	

Rally Traffic

02:55:00 PM	0	0	0	0	0	0
03:00:00 PM	0	0	0	0	0	0
03:05:00 PM	0	0	0	0	0	0
03:10:00 PM	0	0	0	0	0	0
03:15:00 PM	0	0	0	0	0	0
03:20:00 PM	0	0	0	0	0	0
03:25:00 PM	0	0	0	0	0	0
03:30:00 PM	0	0	0	0	0	0
03:35:00 PM	0	0	0	0	0	0
03:40:00 PM	0	0	0	0	0	0
03:45:00 PM	0	0	0	0	0	0
03:50:00 PM	0	0	0	0	0	0
03:55:00 PM	0	0	0	0	0	0
04:00:00 PM	0	0	0	0		
04:05:00 PM	0	0	0	0		
04:10:00 PM	0	0	0	0	1	
04:15:00 PM	0	0	0	0	1	
04:20:00 PM	0	0	0	0	1	
04:25:00 PM	0	0	0	0	2	
04:30:00 PM	0	0	0	0	2	
04:35:00 PM	0	0	0	0	1	
04:40:00 PM	0	0	0	0	0	
04:45:00 PM	0	0	0	0	1	
04:50:00 PM	0	0	0	0	1	
04:55:00 PM	0	0	0	0	2	5
05:00:00 PM	0	0	0	0	1	5
05:05:00 PM	0	0	0	0	1	4
05:10:00 PM	0	0	0	0	0	4
05:15:00 PM	0	0	0	0	2	6
05:20:00 PM	0	0	0	0	2	5
05:25:00 PM	0	0	0	0	2	4
05:30:00 PM	0	0	0	0	0	4
05:35:00 PM	0	0	0	0	0	4
05:40:00 PM	0	0	0	0	0	4
05:45:00 PM	0	0	0	0	0	3
05:50:00 PM	0	0	0	0	0	3
05:55:00 PM	0	0	0	0	0	2

Rally Traffic

N/S street:	***Landfill Entrance***
E/W street:	***Coffin Butte Rd***
City, State	Adair Village OR
Study ID #	1020
Location	44.69942 -123.2
Start Date	Tuesday, September 19, 2023
Start Time	04:00:00 PM
Peak Hour Start	
Peak 15 Min Start	
PHF (15-Min Int)	

Peak-Hour Volumes (PHV)

Northbound				Southbound				Eastbound				Westbound				Entering				Leaving			
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	NB	SB	EB	WB	NB	SB	EB	WB
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				

Percent Heavy Vehicles

PHV- Bicycles

Northbound				Southbound				Eastbound				Westbound					PHV - Pedestrians in Crosswalk				
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	**Sum**	NB	SB	EB	WB	**Sum**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

All Vehicle Volumes

	Northbound Landfill Entrance				Southbound Landfill Entrance				Eastbound Coffin Butte Rd				Westbound Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	0	0	0	0	2	0	1	0	2	4	0	0	0	2	4	0		
02:05:00 PM	0	0	0	0	3	0	0	0	0	4	0	0	0	7	4	0		
02:10:00 PM	0	0	0	0	1	0	0	0	0	2	0	0	0	1	6	0	43	
02:15:00 PM	0	0	0	0	4	0	0	0	1	1	0	0	0	5	9	0	48	
02:20:00 PM	0	0	0	0	5	0	0	0	2	4	0	0	0	1	4	0	46	
02:25:00 PM	0	0	0	0	3	0	0	0	0	2	0	0	0	4	6	0	51	
02:30:00 PM	0	0	0	0	1	0	0	0	0	3	0	0	0	3	7	0	45	
02:35:00 PM	0	0	0	0	5	0	0	0	0	3	0	0	0	0	7	0	44	
02:40:00 PM	0	0	0	0	7	0	1	0	1	3	0	0	0	1	2	0	44	
02:45:00 PM	0	0	0	0	3	0	1	0	0	2	0	0	0	0	1	0	37	
02:50:00 PM	0	0	0	0	6	0	0	0	0	1	0	0	0	3	4	0	36	
02:55:00 PM	0	0	0	0	8	0	0	0	0	1	0	0	0	1	3	0	34	428
03:00:00 PM	0	0	0	0	3	0	0	0	0	2	0	0	0	2	2	0	36	464
03:05:00 PM	0	0	0	0	4	0	0	0	0	2	0	0	0	2	3	0	33	497
03:10:00 PM	0	0	0	0	4	0	0	0	1	0	0	0	0	1	3	0	29	483
03:15:00 PM	0	0	0	0	4	0	0	0	0	3	0	0	0	5	5	0	37	472
03:20:00 PM	0	0	0	0	7	0	0	0	0	4	0	0	0	4	5	0	46	472
03:25:00 PM	0	0	0	0	5	0	0	0	0	0	0	0	0	1	0	0	43	464
03:30:00 PM	0	0	0	0	3	0	1	0	0	2	0	0	0	4	4	0	40	459
03:35:00 PM	0	0	0	0	6	0	1	0	0	2	0	0	0	4	2	0	35	450
03:40:00 PM	0	0	0	0	6	0	0	0	0	3	0	0	0	1	3	0	42	448
03:45:00 PM	0	0	0	0	5	0	1	0	0	1	0	0	0	3	0	0	38	449
03:50:00 PM	0	0	0	0	3	0	0	0	0	2	0	0	0	3	1	0	32	445
03:55:00 PM	0	0	0	0	2	0	0	0	1	3	0	0	0	2	2	0	29	440
04:00:00 PM	0	0	0	0	0	0	1	0	0	4	0	0	0	4	1	0	29	433

Rally Traffic

04:05:00 PM	0	0	0	0	1	0	0	0	0	4	0	0	0	1	2	0	28	428
04:10:00 PM	0	0	0	0	2	0	1	0	0	2	0	0	0	1	3	0	27	426
04:15:00 PM	0	0	0	0	0	0	0	0	0	2	0	0	0	1	1	0	21	410
04:20:00 PM	0	0	0	0	3	0	0	0	0	2	0	0	0	1	0	0	19	383
04:25:00 PM	0	0	0	0	2	0	1	0	0	2	0	0	0	2	0	0	17	357
04:30:00 PM	0	0	0	0	3	0	0	0	0	0	0	0	0	1	2	0	19	336
04:35:00 PM	0	0	0	0	3	0	0	0	0	2	0	0	0	0	1	0	19	320
04:40:00 PM	0	0	0	0	1	0	0	0	0	2	0	0	0	4	0	0	19	297
04:45:00 PM	0	0	0	0	0	0	0	0	0	4	0	0	0	1	3	0	21	280
04:50:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	18	266
04:55:00 PM	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	13	250
05:00:00 PM	0	0	0	0	4	0	0	0	0	1	0	0	0	0	0	0	10	231
05:05:00 PM	0	0	0	0	2	0	0	0	0	2	0	0	0	2	1	0	14	217
05:10:00 PM	0	0	0	0	0	0	3	0	0	2	0	0	0	1	0	0	18	208
05:15:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	14	201
05:20:00 PM	0	0	0	0	0	0	0	0	0	5	0	0	0	1	0	0	13	195
05:25:00 PM	0	0	0	0	3	0	0	0	0	5	0	0	0	0	0	0	15	193
05:30:00 PM	0	0	0	0	2	0	1	0	0	8	0	0	0	1	0	0	26	200
05:35:00 PM	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	24	205
05:40:00 PM	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	21	207
05:45:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	10	196
05:50:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	7	185
05:55:00 PM	0	0	0	0	0	0	0	0	0	4	0	0	0	1	0	0	7	179

Bicycles on Road

	Northbound				**Southbound**				**Eastbound**				**Westbound**					
	Landfill Entrance				Landfill Entrance				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
02:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
02:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Rally Traffic

03:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2
05:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4
05:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6
05:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
05:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6

Passenger vehicles and light trucks

	Northbound				**Southbound**				**Eastbound**				**Westbound**					
	Landfill Entrance				Landfill Entrance				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	0	0	0	0	1	0	1	0	2	2	0	0	0	2	0	0		
02:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		
02:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	11	
02:15:00 PM	0	0	0	0	2	0	0	0	0	1	0	0	0	3	6	0	15	
02:20:00 PM	0	0	0	0	3	0	0	0	2	2	0	0	0	0	1	0	22	
02:25:00 PM	0	0	0	0	2	0	0	0	0	0	0	0	0	2	4	0	28	
02:30:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	1	4	0	22	
02:35:00 PM	0	0	0	0	2	0	0	0	0	2	0	0	0	0	2	0	20	
02:40:00 PM	0	0	0	0	4	0	1	0	1	1	0	0	0	1	1	0	21	
02:45:00 PM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	16	
02:50:00 PM	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	14	
02:55:00 PM	0	0	0	0	3	0	0	0	0	0	0	0	0	1	2	0	11	180
03:00:00 PM	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	14	194
03:05:00 PM	0	0	0	0	2	0	0	0	0	0	0	0	0	1	1	0	14	208
03:10:00 PM	0	0	0	0	2	0	0	0	1	0	0	0	0	1	2	0	14	211
03:15:00 PM	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	0	14	210
03:20:00 PM	0	0	0	0	1	0	0	0	0	3	0	0	0	0	3	0	17	205

Rally Traffic

03:25:00 PM	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	13	190
03:30:00 PM	0	0	0	0	1	0	1	0	0	0	0	0	0	3	2	0	16	184
03:35:00 PM	0	0	0	0	1	0	1	0	0	1	0	0	0	2	2	0	16	180
03:40:00 PM	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	18	177
03:45:00 PM	0	0	0	0	4	0	0	0	0	0	0	0	0	2	0	0	17	178
03:50:00 PM	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	13	177
03:55:00 PM	0	0	0	0	2	0	0	0	1	2	0	0	0	2	0	0	16	182
04:00:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	13	181
04:05:00 PM	0	0	0	0	1	0	0	0	0	3	0	0	0	1	1	0	16	183
04:10:00 PM	0	0	0	0	1	0	1	0	0	1	0	0	0	1	3	0	16	185
04:15:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	16	187
04:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	180
04:25:00 PM	0	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	7	174
04:30:00 PM	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	9	167
04:35:00 PM	0	0	0	0	2	0	0	0	0	2	0	0	0	0	1	0	14	165
04:40:00 PM	0	0	0	0	1	0	0	0	0	2	0	0	0	3	0	0	16	163
04:45:00 PM	0	0	0	0	0	0	0	0	0	2	0	0	0	1	2	0	16	162
04:50:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	13	162
04:55:00 PM	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	9	155
05:00:00 PM	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	7	149
05:05:00 PM	0	0	0	0	1	0	0	0	0	1	0	0	0	2	1	0	10	143
05:10:00 PM	0	0	0	0	0	0	3	0	0	1	0	0	0	1	0	0	13	140
05:15:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	11	135
05:20:00 PM	0	0	0	0	0	0	0	0	0	5	0	0	0	1	0	0	12	137
05:25:00 PM	0	0	0	0	2	0	0	0	0	5	0	0	0	0	0	0	14	144
05:30:00 PM	0	0	0	0	2	0	1	0	0	8	0	0	0	0	0	0	24	159
05:35:00 PM	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	22	167
05:40:00 PM	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	20	171
05:45:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	10	165
05:50:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	7	159
05:55:00 PM	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	6	156
	FHWA 4-13 -Truck/Multi-Unit/Heavy Trucks																	
	Northbound				**Southbound**				**Eastbound**				**Westbound**					
	Landfill Entrance				Landfill Entrance				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	0	0	0	0	1	0	0	0	0	2	0	0	0	0	4	0		
02:05:00 PM	0	0	0	0	3	0	0	0	0	4	0	0	0	6	4	0		
02:10:00 PM	0	0	0	0	1	0	0	0	0	2	0	0	0	1	4	0	32	
02:15:00 PM	0	0	0	0	2	0	0	0	1	0	0	0	0	2	3	0	33	
02:20:00 PM	0	0	0	0	2	0	0	0	0	2	0	0	0	1	3	0	24	
02:25:00 PM	0	0	0	0	1	0	0	0	0	2	0	0	0	2	2	0	23	
02:30:00 PM	0	0	0	0	1	0	0	0	0	2	0	0	0	2	3	0	23	
02:35:00 PM	0	0	0	0	3	0	0	0	0	1	0	0	0	0	5	0	24	
02:40:00 PM	0	0	0	0	3	0	0	0	0	2	0	0	0	0	1	0	23	
02:45:00 PM	0	0	0	0	2	0	1	0	0	2	0	0	0	0	1	0	21	
02:50:00 PM	0	0	0	0	3	0	0	0	0	1	0	0	0	3	3	0	22	
02:55:00 PM	0	0	0	0	5	0	0	0	0	1	0	0	0	0	1	0	23	248
03:00:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	2	2	0	22	270

Rally Traffic

03:05:00 PM	0	0	0	0	2	0	0	0	0	2	0	0	0	1	2	0	19	289
03:10:00 PM	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	15	272
03:15:00 PM	0	0	0	0	3	0	0	0	0	3	0	0	0	3	4	0	23	262
03:20:00 PM	0	0	0	0	6	0	0	0	0	1	0	0	0	4	2	0	29	267
03:25:00 PM	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	30	274
03:30:00 PM	0	0	0	0	2	0	0	0	0	2	0	0	0	1	2	0	24	275
03:35:00 PM	0	0	0	0	5	0	0	0	0	1	0	0	0	2	0	0	19	270
03:40:00 PM	0	0	0	0	3	0	0	0	0	3	0	0	0	1	2	0	24	271
03:45:00 PM	0	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	21	271
03:50:00 PM	0	0	0	0	1	0	0	0	0	2	0	0	0	3	0	0	19	268
03:55:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	13	258
04:00:00 PM	0	0	0	0	0	0	1	0	0	3	0	0	0	3	0	0	16	252
04:05:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	12	245
04:10:00 PM	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	11	241
04:15:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	223
04:20:00 PM	0	0	0	0	3	0	0	0	0	2	0	0	0	1	0	0	9	203
04:25:00 PM	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	10	183
04:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	10	169
04:35:00 PM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	155
04:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	134
04:45:00 PM	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	5	118
04:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5	104
04:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	95
05:00:00 PM	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	3	82
05:05:00 PM	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	4	74
05:10:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	68
05:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	66
05:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	58
05:25:00 PM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	49
05:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	41
05:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	38
05:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	36
05:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
05:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
05:55:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	23

Pedestrians					15 Min	1 HR
Time	NB	SB	EB	WB	Sum	Sum
02:00:00 PM	0	0	0	0		
02:05:00 PM	0	0	0	0		
02:10:00 PM	0	0	0	0	0	
02:15:00 PM	0	0	0	0	0	
02:20:00 PM	0	0	3	0	3	
02:25:00 PM	0	0	3	0	6	
02:30:00 PM	0	0	0	0	6	
02:35:00 PM	0	0	0	0	3	
02:40:00 PM	0	2	0	0	2	
02:45:00 PM	0	0	2	0	4	
02:50:00 PM	0	0	0	0	4	

Rally Traffic

02:55:00 PM	0	0	1	0	3	31
03:00:00 PM	0	0	2	0	3	34
03:05:00 PM	0	0	0	0	3	37
03:10:00 PM	0	0	0	0	2	39
03:15:00 PM	0	0	2	0	2	41
03:20:00 PM	0	0	0	0	2	40
03:25:00 PM	0	0	0	0	2	36
03:30:00 PM	0	0	2	0	2	32
03:35:00 PM	0	0	0	0	2	31
03:40:00 PM	0	0	0	0	2	31
03:45:00 PM	0	0	1	0	1	28
03:50:00 PM	0	0	1	0	2	26
03:55:00 PM	0	0	0	0	2	25
04:00:00 PM	0	0	0	0		
04:05:00 PM	0	0	0	0		
04:10:00 PM	0	0	0	0	1	
04:15:00 PM	0	0	0	0	1	
04:20:00 PM	0	0	0	0	1	
04:25:00 PM	0	0	0	0	2	
04:30:00 PM	0	0	0	0	2	
04:35:00 PM	0	0	0	0	1	
04:40:00 PM	0	0	0	0	0	
04:45:00 PM	0	0	0	0	1	
04:50:00 PM	0	0	0	0	1	
04:55:00 PM	0	0	0	0	2	5
05:00:00 PM	0	0	0	0	1	5
05:05:00 PM	0	0	0	0	1	4
05:10:00 PM	0	0	0	0	0	4
05:15:00 PM	0	0	2	0	2	6
05:20:00 PM	0	0	0	0	2	5
05:25:00 PM	0	0	11	0	2	4
05:30:00 PM	0	0	0	0	0	4
05:35:00 PM	0	0	0	0	0	4
05:40:00 PM	0	0	0	0	0	4
05:45:00 PM	0	0	0	0	0	3
05:50:00 PM	0	0	0	0	0	3
05:55:00 PM	0	0	0	0	0	2

Rally Traffic

N/S street:	***NW Soap Creek Rd***
E/W street:	***Coffin Butte Rd***
City, State	Adair Village OR
Study ID #	1020
Location	44.69598 -123.2
Start Date	Tuesday, September 19, 2023
Start Time	02:00:00 PM
Peak Hour Start	
Peak 15 Min Start	
PHF (15-Min Int)	

Peak-Hour Volumes (PHV)

Northbound				Southbound				Eastbound				Westbound				Entering				Leaving			
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	NB	SB	EB	WB	NB	SB	EB	WB
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				

Percent Heavy Vehicles

PHV- Bicycles																	PHV - Pedestrians				
Northbound				Southbound				Eastbound				Westbound					in Crosswalk				
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	NB	SB	EB	WB	Sum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

All Vehicle Volumes

	Northbound				Southbound				Eastbound				Westbound					
	NW Soap Creek Rd				NW Soap Creek Rd				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	0	0	0	0	0	0	0	0	3	0	1	0	0	0	4	0		
02:05:00 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0		
02:10:00 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	1	3	0	17	
02:15:00 PM	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	0	14	
02:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	16	
02:25:00 PM	0	1	0	0	0	0	0	0	3	0	0	0	0	1	1	0	16	
02:30:00 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	14	
02:35:00 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	13	
02:40:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	10	
02:45:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	11	
02:50:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	9	
02:55:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	9	129
03:00:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	8	137
03:05:00 PM	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	9	146
03:10:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	1	2	0	11	140
03:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	11	137
03:20:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	10	131
03:25:00 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	1	3	0	11	126
03:30:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	2	3	0	15	127
03:35:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	1	1	0	17	131
03:40:00 PM	0	0	0	0	0	0	0	0	3	0	0	0	0	1	1	0	16	137
03:45:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	14	140
03:50:00 PM	0	2	0	0	0	0	0	0	1	0	1	0	0	2	2	0	18	149
03:55:00 PM	0	1	0	0	0	0	0	0	3	0	0	0	0	1	1	0	19	159
04:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	17	168

Rally Traffic

04:05:00 PM	0	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0	14	173
04:10:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	9	171
04:15:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	8	168
04:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	162
04:25:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	156
04:30:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	145
04:35:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	3	2	0	9	137
04:40:00 PM	0	2	0	0	0	0	0	0	1	0	0	0	0	1	1	0	12	133
04:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	12	131
04:50:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	7	120
04:55:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	104
05:00:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	6	93
05:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	6	85
05:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	81
05:15:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	4	77
05:20:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	77
05:25:00 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	6	78
05:30:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1	7	81
05:35:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	79
05:40:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	73
05:45:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	64
05:50:00 PM	0	1	0	0	0	0	0	0	2	0	0	0	0	1	0	0	6	63
05:55:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	6	66

Bicycles on Road

	Northbound				**Southbound**				**Eastbound**				**Westbound**					
	NW Soap Creek Rd				NW Soap Creek Rd				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
02:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
02:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
02:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Rally Traffic

03:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2
05:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4
05:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6
05:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
05:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6

Passenger vehicles and light trucks

	Northbound				**Southbound**				**Eastbound**				**Westbound**					
	NW Soap Creek Rd				NW Soap Creek Rd				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0		
02:05:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
02:10:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	5	
02:15:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	
02:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	6	
02:25:00 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	6	
02:30:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	7	
02:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	7	
02:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	
02:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
02:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	
02:55:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	45
03:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	47
03:05:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	49
03:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	46
03:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	43
03:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	38

Rally Traffic

03:25:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3	35
03:30:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	2	1	0	8	36
03:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	10	39
03:40:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	9	44
03:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	46
03:50:00 PM	0	2	0	0	0	0	0	0	0	0	1	0	0	2	1	0	8	53
03:55:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	58
04:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	10	66
04:05:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	7	71
04:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	75
04:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	77
04:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	77
04:25:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	76
04:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	69
04:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	4	63
04:40:00 PM	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	6	60
04:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	7	63
04:50:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	59
04:55:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	54
05:00:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	4	48
05:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5	46
05:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	44
05:15:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	4	44
05:20:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	47
05:25:00 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	6	51
05:30:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1	7	57
05:35:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	60
05:40:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	60
05:45:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	56
05:50:00 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	5	57
05:55:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	60

FHWA 4-13 -Truck/Multi-Unit/Heavy Trucks

	Northbound				**Southbound**				**Eastbound**				**Westbound**					
	NW Soap Creek Rd				NW Soap Creek Rd				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
02:00:00 PM	0	0	0	0	0	0	0	0	3	0	0	0	0	0	4	0		
02:05:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0		
02:10:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	12	
02:15:00 PM	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0	9	
02:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	10	
02:25:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	10	
02:30:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	7	
02:35:00 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	6	
02:40:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	6	
02:45:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	9	
02:50:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	8	
02:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	7	84
03:00:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	6	90

Rally Traffic

03:05:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7	97
03:10:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	9	94
03:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	9	94
03:20:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	9	93
03:25:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	8	91
03:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	7	91
03:35:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7	92
03:40:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	7	93
03:45:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	10	94
03:50:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	10	96
03:55:00 PM	0	0	0	0	0	0	0	0	3	0	0	0	0	1	1	0	12	101
04:00:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	102
04:05:00 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7	102
04:10:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	96
04:15:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	91
04:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	85
04:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	80
04:30:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	76
04:35:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	5	74
04:40:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	6	73
04:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	68
04:50:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	61
04:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	50
05:00:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	45
05:05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	39
05:10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	37
05:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
05:20:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
05:25:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
05:30:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
05:35:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
05:40:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
05:45:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
05:50:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	6
05:55:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6

Pedestrians					15 Min	1 HR
Time	NB	SB	EB	WB	Sum	Sum
02:00:00 PM	0	0	0	0		
02:05:00 PM	0	0	0	0		
02:10:00 PM	0	0	0	0	0	
02:15:00 PM	0	0	0	0	0	
02:20:00 PM	0	0	0	0	0	
02:25:00 PM	0	0	0	0	0	
02:30:00 PM	0	0	0	0	0	
02:35:00 PM	0	0	0	0	0	
02:40:00 PM	0	0	0	0	0	
02:45:00 PM	0	0	0	0	0	
02:50:00 PM	0	0	0	0	0	

Rally Traffic

02:55:00 PM	0	0	0	0	0	0
03:00:00 PM	0	0	0	0	0	0
03:05:00 PM	0	0	0	0	0	0
03:10:00 PM	0	0	0	0	0	0
03:15:00 PM	0	0	0	0	0	0
03:20:00 PM	0	0	0	0	0	0
03:25:00 PM	0	0	0	0	0	0
03:30:00 PM	0	0	0	0	0	0
03:35:00 PM	0	0	0	0	0	0
03:40:00 PM	0	0	0	0	0	0
03:45:00 PM	0	0	0	0	0	0
03:50:00 PM	0	0	0	0	0	0
03:55:00 PM	0	0	0	0	0	0
04:00:00 PM	0	0	0	0	0	0
04:05:00 PM	0	0	0	0	0	0
04:10:00 PM	0	0	0	0	0	0
04:15:00 PM	0	0	0	0	0	0
04:20:00 PM	0	0	0	0	0	0
04:25:00 PM	0	0	0	0	0	0
04:30:00 PM	0	0	0	0	0	0
04:35:00 PM	0	0	0	0	0	0
04:40:00 PM	0	0	0	0	0	0
04:45:00 PM	0	0	0	0	0	0
04:50:00 PM	0	0	0	0	0	0
04:55:00 PM	0	0	0	0	0	0
05:00:00 PM	0	0	0	0	0	0
05:05:00 PM	0	0	0	0	0	0
05:10:00 PM	0	0	0	0	0	0
05:15:00 PM	0	0	0	0	0	0
05:20:00 PM	0	0	0	0	0	0
05:25:00 PM	0	0	0	0	0	0
05:30:00 PM	0	0	0	0	0	0
05:35:00 PM	0	0	0	0	0	0
05:40:00 PM	0	0	0	0	0	0
05:45:00 PM	0	0	0	0	0	0
05:50:00 PM	0	0	0	0	0	0
05:55:00 PM	0	0	0	0	0	0

Rally Traffic

N/S street:	***Knife River Quarry***
E/W street:	***Coffin Butte Rd***
City, State	Adair Village OR
Study ID #	1020
Location	44.69638 -123.2
Start Date	Tuesday, September 19, 2023
Start Time	02:00:00 PM
Peak Hour Start	
Peak 15 Min Start	
PHF (15-Min Int)	

Peak-Hour Volumes (PHV)

Northbound				Southbound				Eastbound				Westbound				Entering				Leaving			
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	NB	SB	EB	WB	NB	SB	EB	WB
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				

Percent Heavy Vehicles

PHV- Bicycles

Northbound				Southbound				Eastbound				Westbound					PHV - Pedestrians in Crosswalk				
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	**Sum**	NB	SB	EB	WB	**Sum**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

All Vehicle Volumes

	Northbound Knife River Quarry				Southbound Knife River Quarry				Eastbound Coffin Butte Rd				Westbound Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0		
##	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0		
##	0	0	0	0	6	0	0	0	0	0	0	0	0	0	3	0	16	
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	16	
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	15	
##	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	11	
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	0	14	
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	13	
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	10	
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	6	
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	6	
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	6	113
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	8	121
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	9	130
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8	122
##	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	8	114
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	7	106
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	10	105
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	10	101
##	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	10	98
##	0	0	0	0	4	0	0	0	0	0	0	0	0	0	3	0	13	101
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	12	107
##	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	14	115
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	10	119

Rally Traffic

##	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	1	13	124
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	10	125
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	9	126
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	122
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	118
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	3	111
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	104
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	97
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	87
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	6	81
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6	73
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	67
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	56
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	49
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	44
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	43
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	41
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	39
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	38
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	37
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	35
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
##	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	24
##	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	23

	Bicycles on Road																	
	Northbound				**Southbound**				**Eastbound**				**Westbound**					
	Knife River Quarry				Knife River Quarry				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
##	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Rally Traffic

##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Rally Traffic

##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	18
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	17
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	15
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	12
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	4	13
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	16
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	21
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	23
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	24
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	24
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	24
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	3
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	7
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	9
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	11
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	12
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	13
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	16

FHWA 4-13 -Truck/Multi-Unit/Heavy Trucks

		Northbound				**Southbound**				**Eastbound**				**Westbound**					
		Knife River Quarry				Knife River Quarry				Coffin Butte Rd				Coffin Butte Rd				15 Min	1 HR
Time		Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Sum	Sum
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0		
##		0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0		
##		0	0	0	0	5	0	0	0	0	0	0	0	0	0	3	0	15	
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	14	
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	13	
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	9	
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	11	
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	9	
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	7	
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	6	
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	6	95

Rally Traffic

##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	7	102
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	8	110
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	7	102
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	7	95
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	6	88
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	9	88
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	9	86
##		0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	9	86
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	9	88
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8	91
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	9	94
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	8	96
##		0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	11	100
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	9	101
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	8	102
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	99
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	96
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	3	90
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	84
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	78
##		0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	72
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	6	70
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6	67
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	63
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	54
##		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	47
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	41
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	38
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
##		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7

Pe de					15 Min	1 HR
Time	NB	SB	EB	WB	Sum	Sum
##	0	0	0	0		
##	0	0	0	0		
##	0	0	0	0	0	
##	0	0	0	0	0	
##	0	0	0	0	0	
##	0	0	0	0	0	
##	0	0	0	0	0	
##	0	0	0	0	0	
##	0	0	0	0	0	
##	0	0	0	0	0	

Rally Traffic

##	0	0	0	0	0	
##	0	0	0	0	0	0
##	0	0	0	0	0	0
##	0	0	0	0	0	0
##	0	0	0	0	0	0
##	0	0	0	0	0	0
##	0	0	0	0	0	0
##	0	0	0	0	0	0
##	0	0	0	0	0	0
##	0	0	0	0	0	0
##	0	0	0	0	0	0
##	0	0	0	0	0	0
##	0	0	0	0		
##	0	0	0	0		
##	0	0	0	0	1	
##	0	0	0	0	1	
##	0	0	0	0	1	
##	0	0	0	0	2	
##	0	0	0	0	2	
##	0	0	0	0	1	
##	0	0	0	0	0	
##	0	0	0	0	1	
##	0	0	0	0	1	
##	0	0	0	0	2	5
##	0	0	0	0	1	5
##	0	0	0	0	1	4
##	0	0	0	0	0	4
##	0	0	0	0	2	6
##	0	0	0	0	2	5
##	0	0	0	0	2	4
##	0	0	0	0	0	4
##	0	0	0	0	0	4
##	0	0	0	0	0	4
##	0	0	0	0	0	3
##	0	0	0	0	0	3
##	0	0	0	0	0	2

Intersection	
Int Delay, s/veh	4.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	36	0	28	30	1	27
Future Vol, veh/h	36	0	28	30	1	27
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	250	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	61	0	100	57	100	100
Mvmt Flow	44	0	34	37	1	33

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	44	0	149	44
Stage 1	-	-	-	-	44	-
Stage 2	-	-	-	-	105	-
Critical Hdwy	-	-	5.1	-	7.4	7.2
Critical Hdwy Stg 1	-	-	-	-	6.4	-
Critical Hdwy Stg 2	-	-	-	-	6.4	-
Follow-up Hdwy	-	-	3.1	-	4.4	4.2
Pot Cap-1 Maneuver	-	-	1112	-	659	805
Stage 1	-	-	-	-	777	-
Stage 2	-	-	-	-	723	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1112	-	639	805
Mov Cap-2 Maneuver	-	-	-	-	639	-
Stage 1	-	-	-	-	777	-
Stage 2	-	-	-	-	701	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4	9.7
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	798	-	-	1112	-
HCM Lane V/C Ratio	0.043	-	-	0.031	-
HCM Control Delay (s)	9.7	-	-	8.3	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.1	-

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	6	57	28	57	21	30
Future Vol, veh/h	6	57	28	57	21	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	17	84	61	60	0	93
Mvmt Flow	7	68	33	68	25	36

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	101	0	-	0	149	67
Stage 1	-	-	-	-	67	-
Stage 2	-	-	-	-	82	-
Critical Hdwy	4.27	-	-	-	6.4	7.13
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.353	-	-	-	3.5	4.137
Pot Cap-1 Maneuver	1403	-	-	-	848	792
Stage 1	-	-	-	-	961	-
Stage 2	-	-	-	-	946	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1403	-	-	-	844	792
Mov Cap-2 Maneuver	-	-	-	-	844	-
Stage 1	-	-	-	-	956	-
Stage 2	-	-	-	-	946	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	9.8
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1403	-	-	-	813
HCM Lane V/C Ratio	0.005	-	-	-	0.075
HCM Control Delay (s)	7.6	-	-	-	9.8
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.2

Intersection	
Int Delay, s/veh	4.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	36	0	28	30	1	27
Future Vol, veh/h	36	0	28	30	1	27
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	250	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	61	0	100	57	100	100
Mvmt Flow	66	0	51	55	2	49

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	66	0	223	66
Stage 1	-	-	-	-	66	-
Stage 2	-	-	-	-	157	-
Critical Hdwy	-	-	5.1	-	7.4	7.2
Critical Hdwy Stg 1	-	-	-	-	6.4	-
Critical Hdwy Stg 2	-	-	-	-	6.4	-
Follow-up Hdwy	-	-	3.1	-	4.4	4.2
Pot Cap-1 Maneuver	-	-	1088	-	591	780
Stage 1	-	-	-	-	757	-
Stage 2	-	-	-	-	680	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1088	-	563	780
Mov Cap-2 Maneuver	-	-	-	-	563	-
Stage 1	-	-	-	-	757	-
Stage 2	-	-	-	-	648	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4.1	10
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	769	-	-	1088	-
HCM Lane V/C Ratio	0.067	-	-	0.047	-
HCM Control Delay (s)	10	-	-	8.5	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.1	-

Intersection	
Int Delay, s/veh	2.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	6	57	28	57	21	30
Future Vol, veh/h	6	57	28	57	21	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	17	84	61	60	0	93
Mvmt Flow	11	102	50	102	38	54

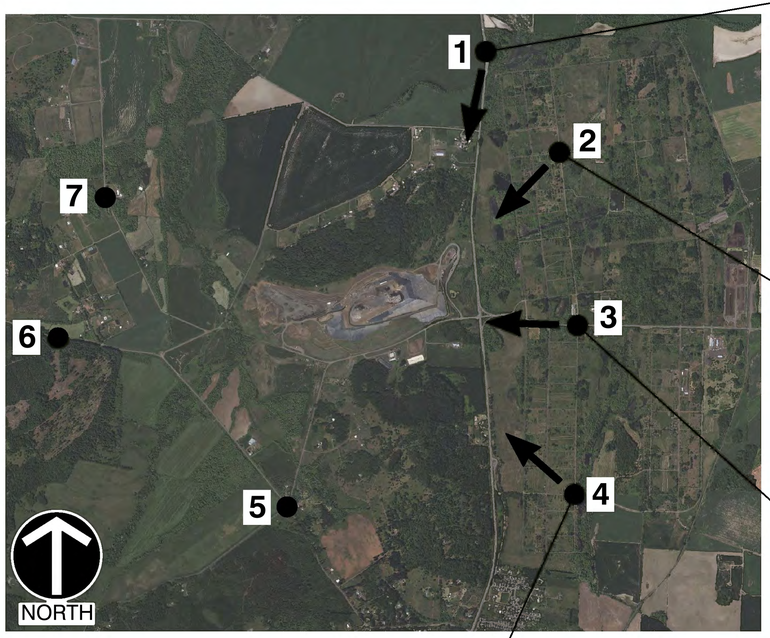
Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	152	0	-	0	225	101
Stage 1	-	-	-	-	101	-
Stage 2	-	-	-	-	124	-
Critical Hdwy	4.27	-	-	-	6.4	7.13
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.353	-	-	-	3.5	4.137
Pot Cap-1 Maneuver	1342	-	-	-	768	755
Stage 1	-	-	-	-	928	-
Stage 2	-	-	-	-	907	-
Platoon blocked, %			-	-	-	
Mov Cap-1 Maneuver	1342	-	-	-	762	755
Mov Cap-2 Maneuver	-	-	-	-	762	-
Stage 1	-	-	-	-	921	-
Stage 2	-	-	-	-	907	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	10.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1342	-	-	-	758
HCM Lane V/C Ratio	0.008	-	-	-	0.12
HCM Control Delay (s)	7.7	-	-	-	10.4
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.4

EXHIBIT 18

CURRENT VIEWS OF LANDFILL AND AERIAL RENDERINGS OF COFFIN BUTTE LANDFILL





1. LOOKING SOUTH–SOUTHWEST TOWARDS THE LANDFILL FROM PACIFIC HIGHWAY (99W).



2. LOOKING SOUTHWEST TOWARDS THE LANDFILL FROM LOCAL ROAD.



4. LOOKING NORTHWEST TOWARDS THE LANDFILL FROM QUINLAN ROAD.



3. LOOKING WEST TOWARDS THE LANDFILL FROM CAMP ADAIR ROAD.

REFERENCE

REGISTERED PROFESSIONAL ENGINEER
92360PE
OREGON
JULY 13, 2007
JEFF A. SHEPHERD
EXPIRES: 06/30/2026

REVISION RECORD

NO	DATE	DESCRIPTION

Civil & Environmental Consultants, Inc.
11811 N. Tatum Blvd., Suite 3057 · Phoenix, AZ 85028
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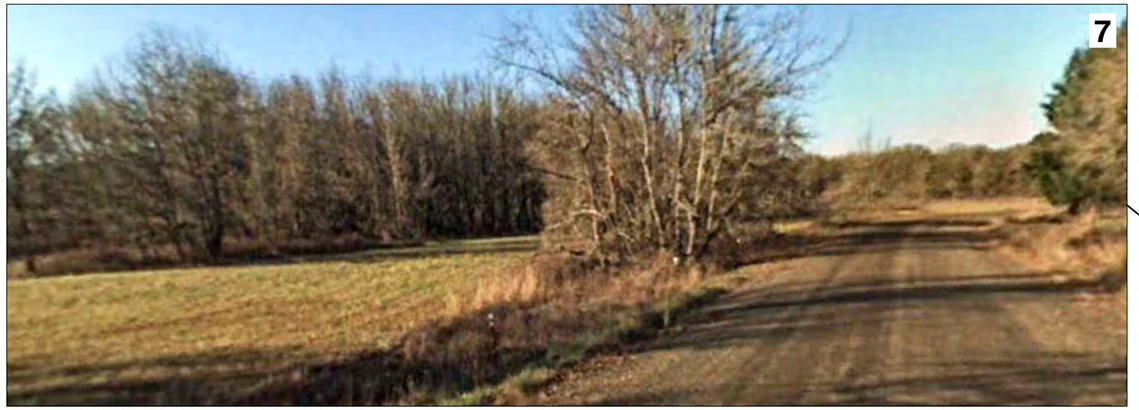
VALLEY LANDFILLS, INC.
COFFIN BUTTE LANDFILL
CONDITIONAL USE PERMIT
APPLICATION
CORVALLIS, OR 97330

EXHIBIT 18 - VISUAL DOCUMENTATION OF LANDFILL VIEWS

DATE:	JULY 2024	DRAWN BY:	JS
DWG SCALE:	AS SHOWN	CHECKED BY:	JAS
		PROJECT NO:	322-142
		APPROVED BY:	JAS

DRAWING NO.:
A

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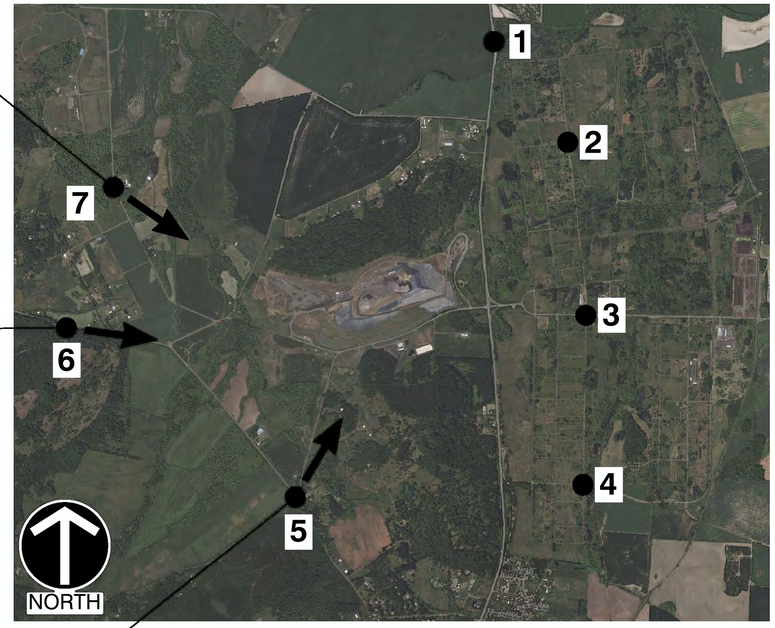
7. LOOKING SOUTHEAST TOWARDS THE LANDFILL FROM RIFLE RANGE ROAD.



6. LOOKING EAST TOWARDS THE LANDFILL FROM TAMPICO ROAD.



5. LOOKING NORTHEAST TOWARDS THE LANDFILL FROM INTERSECTION OF TAMPICO ROAD AND NW SOAP CREEK ROAD.



REFERENCE

REGISTERED PROFESSIONAL ENGINEER
92360PE
OREGON
JULY 13, 2011
JEFF A. SHEPHERD
EXPIRES: 06/30/2026

REVISION RECORD

NO	DATE	DESCRIPTION

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DWG SCALE:	AS SHOWN	CHECKED BY:	JAS
		PROJECT NO:	322-142
		APPROVED BY:	JAS

DRAWING NO.:
B

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Artist renderings of Coffin Butte Landfill (with Proposed Expansion)



Build-out of Coffin Butte Landfill, with approved expansion

1. Northwest view towards the landfill from Pacific Highway (99 W)



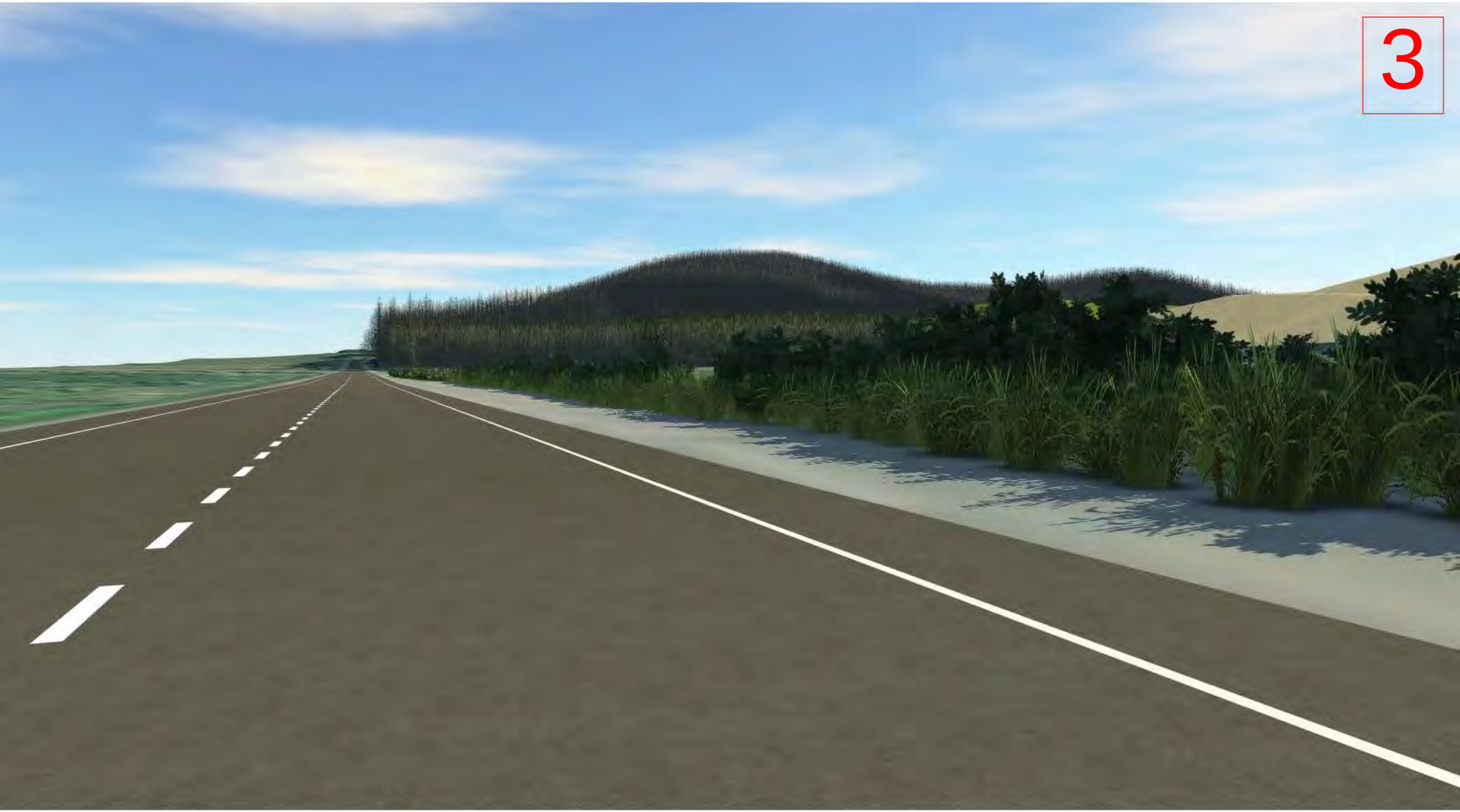
Build-out of Coffin Butte Landfill, with approved expansion.

2. Southwest view towards the landfill from Pacific Highway (99 W)



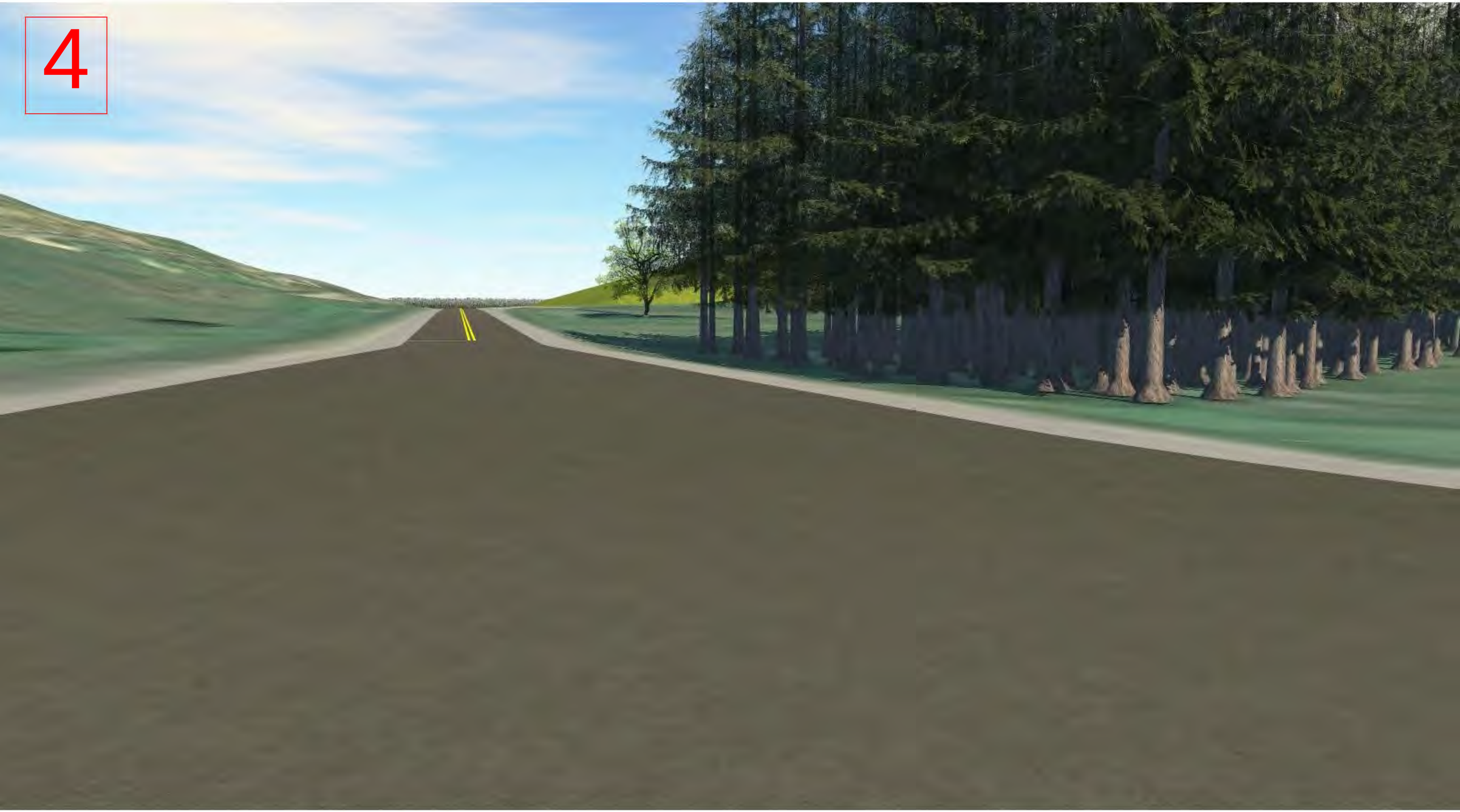
Build-out of Coffin Butte Landfill, with approved expansion.

3. Southwest view towards the landfill from Pacific Highway (99 W)



Build-out of Coffin Butte Landfill, with approved expansion.

4. Southwest view towards the landfill from Coffin Butte Rd



Build-out of Coffin Butte Landfill, with approved expansion.

EXHIBIT 19
SITE LIGHTING SUMMARY

SITE LIGHTING SUMMARY

The current operation of the Coffin Butte Landfill allows the site to open around 4:30 AM and ceases waste acceptance at 5:00 PM, Monday through Saturday. The site uses temporary lights or mobile lighting plants at the tipping face to allow for the landfill operations to be safely conducted, to see what is being disposed of at the tipping face, and complete daily cover placement. These lights are only used when natural light is insufficient to conduct safe operations. This same operation would eventually be moved to the expansion area.

The only additional lights that would be added to the Coffin Butte Landfill, would be security lights near the new parking lot for the new locker room building. These lights would be shielded or hooded so that they only face down towards the ground. These new lights would be designed and installed in accordance with all Benton County code requirements.

Other lights that might be installed, including some at the new scale house and leachate storage ponds would be activated by motion or be motion censored lights. They would also be shielded or hooded so that they only face down towards the ground.

EXHIBIT 22
RECLAMATION PLAN FOR EXPANSION AREA

RECLAMATION PLAN FOR EXPANSION AREA

COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

APRIL 2022

PREPARED FOR:
VALLEY LANDFILLS, INC.
28972 Coffin Butte Road
Corvallis, Oregon 97330

Civil & Environmental Consultants, Inc.

PREPARED BY:
Civil & Environmental Consultants, Inc.
11811 N. Tatum Boulevard, Suite 3057
Phoenix, Arizona 85028

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LIST OF FIGURES

FIGURE 1 **SITE LAYOUT**

FIGURE 2 **PROPOSED FILL PLAN**

1.0 INTRODUCTION

1.1 General

This Reclamation Plan documents the procedures necessary to completely close the Expansion Area of the Coffin Butte Landfill (CBLF) located in Corvallis, Oregon. This report was prepared as part of the CBLF's Conditional Use Permit for Landfill Expansion South of Coffin Butte Road dated April 2022 in accordance with Oregon Administrative Rules (OAR) 340-094-0110 and 40 Code of Federal Regulations (CFR), Part 258, Subpart F, and is a submittal to the Oregon Department of Environmental Quality (ODEQ). This report is to be periodically updated as the landfill footprint grows and should be replaced by a Final Engineered Site Closure Plan within five years before the anticipated final closure date of the entire landfill [OAR 340-094-0110(1)(b)]

1.2 Site Description

The CBLF is located in Benton County, Oregon, approximately 10 miles north of the city of Corvallis. The CBLF is owned and operated by Valley Landfills, Inc. (VLI), a subsidiary of Republic Services (RS). The CBLF is an active municipal solid waste landfill (MSWLF) operating under ODEQ Solid Waste Permit No. 306. The site address is 28972 Coffin Butte Road, Corvallis, Oregon. Valley Landfills, Inc. is applying for a Conditional Use Permit to expand the Coffin Butte Landfill to the south of the existing permitted landfill on property that Valley Landfills, Inc. owns. This expansion area will include a new cell of approximately 41.2 acres in size. The proposed development plan, and general site layout are shown in Figure 1.

2.0 RECLAMATION PLAN

2.1 General

OAR 340-094-0110(2)(a) states that the requirements for the reclamation plan shall include all elements specified in 40 CFR §258.60, and consist of at least the following:

- A description of the steps necessary to close all municipal solid waste landfill units at any point during their active life;
- A description of the final cover system that is designed to minimize infiltration and erosion;
- An estimate of the largest area of the municipal solid waste landfill unit ever requiring a final cover;
- An estimate of the maximum inventory of wastes ever on-site over the active life of the landfill facility; and
- A schedule for completing all activities necessary to satisfy the closure criteria in 40 CFR §258.60.

2.2 Final Cover System

The final cover system for closure of the expansion area at CBLF is detailed below. This final cover system is the same that is detailed in the site's most recent Site Development Plan (SDP) authored by Geo-Logic Associates (2021). The planned final cover is a geosynthetic composite cover system that will be constructed over the entire lined waste footprint, consisting of the following from top to bottom:

- Vegetative Cover (1.5 Feet Thick)
- Drainage Layer
- Geomembrane Liner
- Soil Barrier Layer (1.5 Feet Thick)
- Geocomposite Gas Collection Layer
- Existing Waste/Interim Cover

Primary drainage of the expansion area proposed final cover system may be achieved with the same drain liner system, and may also be achieved by using a double sided geocomposite drainage layer over a double textured geomembrane liner. The soil barrier layer will be a compacted fill and is specified to have a saturated hydraulic conductivity of 1.0×10^{-5} cm/s or less. Hydroseeding of the vegetative cover layer will be performed using the site's native grass and wildflower seed mix from Willamette Valley Ecoregion stocks between August 15th and October 15th, or during periods when successful growth results can be obtained.

2.3 Areas to Receive Final Closure

The present reclamation plan consists of constructing a final cover over the proposed development area. The new proposed cell south of the existing permitted landfill is approximately 41.2 acres. Therefore, the area to receive final cover is 41.2 acres.

2.4 Inventory of Waste

Based on the proposed grading plan, the new cell in the expansion area south of the existing permitted landfill will have an airspace volume of 6,524,162 cubic yards (CY). The proposed fill plan is shown in Figure 2.

2.5 Closure Schedule

In terms of schedule, the CBLF will be closed in accordance with OAR and CFR requirements. The closure reclamation schedule is defined in 40 CFR §258.60 (f), (g), and (h) as follows:

> The owner or operator must begin closure activities no later than 30 days after the date on which the MSWLF unit receives the known final receipt of wastes or, if the MSWLF unit has remaining capacity and there is a reasonable likelihood that the MSWLF unit will receive additional wastes, no later than one year after the most recent receipt of wastes. Extensions beyond the one-year deadline for beginning closure may be granted by the Director of an approved State if the owner or operator demonstrates that the MSWLF unit has the capacity to receive additional wastes and the owner or operator has taken and will continue to take all steps necessary to prevent threats to human health and the environmental from the unclosed MSWLF unit.

> The owner or operator of all MSWLF units must complete closure activities of each MSWLF unit in accordance with the closure plan within 180 days following the beginning of closure. Extensions of the closure period may be granted by the Director of an approved State if the owner or operator demonstrates that closure will, of necessity, take longer than 180 days and he has taken and will continue to take all steps to prevent threats to human health and the environment from the unclosed MSWLF unit.

Following closure of each MSWLF unit, the owner or operator must notify the State Director that a certification, signed by an independent registered professional engineer or approved by Director of an approved State, verifying that closure has been completed in accordance with the reclamation plan, has been placed in the operating record.

3.0 RECLAMATION POST-CLOSURE PLAN

3.1 General

OAR 340-094-0115(1) defines the requirements for two types of written reclamation post-closure plans as follows:

- "Subtitle D" reclamation post-closure plan as required by 40 CFR §258.61(c)
- A Final Engineered Reclamation Post-Closure Plan as required by OAR 340-094-0100 (Closure and Post-Closure Care: Closure Permits)(2)(b). When prepared, this shall include all requirements of and replace the "Subtitle D" reclamation post-closure plan

This document was written in accordance with the "Subtitle D" reclamation post-closure plan, which OAR 340-094-0115(3)(a) requires to address the following:

- Maintaining the integrity and effectiveness of any final cover;
- Maintaining and operating the leachate collection system;
- Monitoring the groundwater;
- Maintaining and operating the gas monitoring system;
- Monitoring and providing security for the landfill site; and
- Description of the planned uses of the property during the post-closure care period.

3.2 Maintenance Requirements

Maintenance activities associated with landfill closure systems are described in this section. A record of all maintenance activities at the CBLF will be kept at VLI's office throughout the reclamation post-closure care period, and such information will be included with monitoring results in annual reports.

- Reclamation Post-closure maintenance will consist of the following activities:
    - Maintaining the integrity and effectiveness of the final cover system including the effects of settlement, subsidence, erosion, and/or vegetative coverage;
    - Maintaining and operating the leachate collection system;
    - Maintaining and operating the landfill gas monitoring system;
    - Maintaining the integrity and effectiveness of stormwater drainage features; and
    - Maintaining the integrity and effectiveness of miscellaneous site infrastructure such as active buildings, security fences, survey monuments, and roads.

3.3 Reclamation Post-Closure Monitoring Requirements

Reclamation Post-Closure monitoring requirements are described in this section. A record of all monitoring activities at the CBLF will be reported in annual report which will be kept at VLI's office throughout the post-closure care period. Reclamation Post-Closure monitoring requirements consist of the following activities:

- Groundwater monitoring;
- Landfill gas monitoring;
- Inspecting the integrity of the final cover system;
- Inspecting the integrity and effectiveness of stormwater drainage features; and
- Inspecting the integrity and effectiveness of miscellaneous site infrastructure such as active buildings, security fences, survey monuments, and roads.

Monitoring programs are described in the site's Environmental Monitoring Plan (Tuppan Consultants, 2014). Monitoring events and inspections will be performed at the frequencies listed in the CBLF's most recent Environmental Monitoring Plan. Immediate inspections will also be conducted after any major event such as significant earthquakes, fires, storms, and other unforeseen significant events that may impact the integrity of the landfill and it control systems, human health or the environment.

3.4 Reclamation Post-Closure Land Use

The final closed surface of the completed landfill will appear to be a sloped grassy savanna that blends with, and appears to be part of, the adjacent butte. Planned land use for the property will be open space grassland. Any development over filled areas of the CBLF should not include permanent enclosed structures where differential settlement and/or methane gas may cause risk.

3.5 Reclamation Post-Closure Contact Person

At the start of post-closure activities, CBLF will create a roster of contact persons responsible for post-closure care. The list will be updated as necessary to reflect changes in personnel throughout the post-closure period. The current contact for post-closure is:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330
541-745-5792

3.6 Reclamation Post-Closure Schedule

Reclamation Post-Closure care is to be conducted for 30 years following closure. The length of the reclamation post-closure period may be decreased by ODEQ if the owner or operator demonstrates that the reduced period is sufficient to protect human health and the environment and this demonstration is approved by the ODEQ. The length of the reclamation post-closure period may be increased by ODEQ if the ODEQ determines that the lengthened period is necessary to protect human health and the environment.

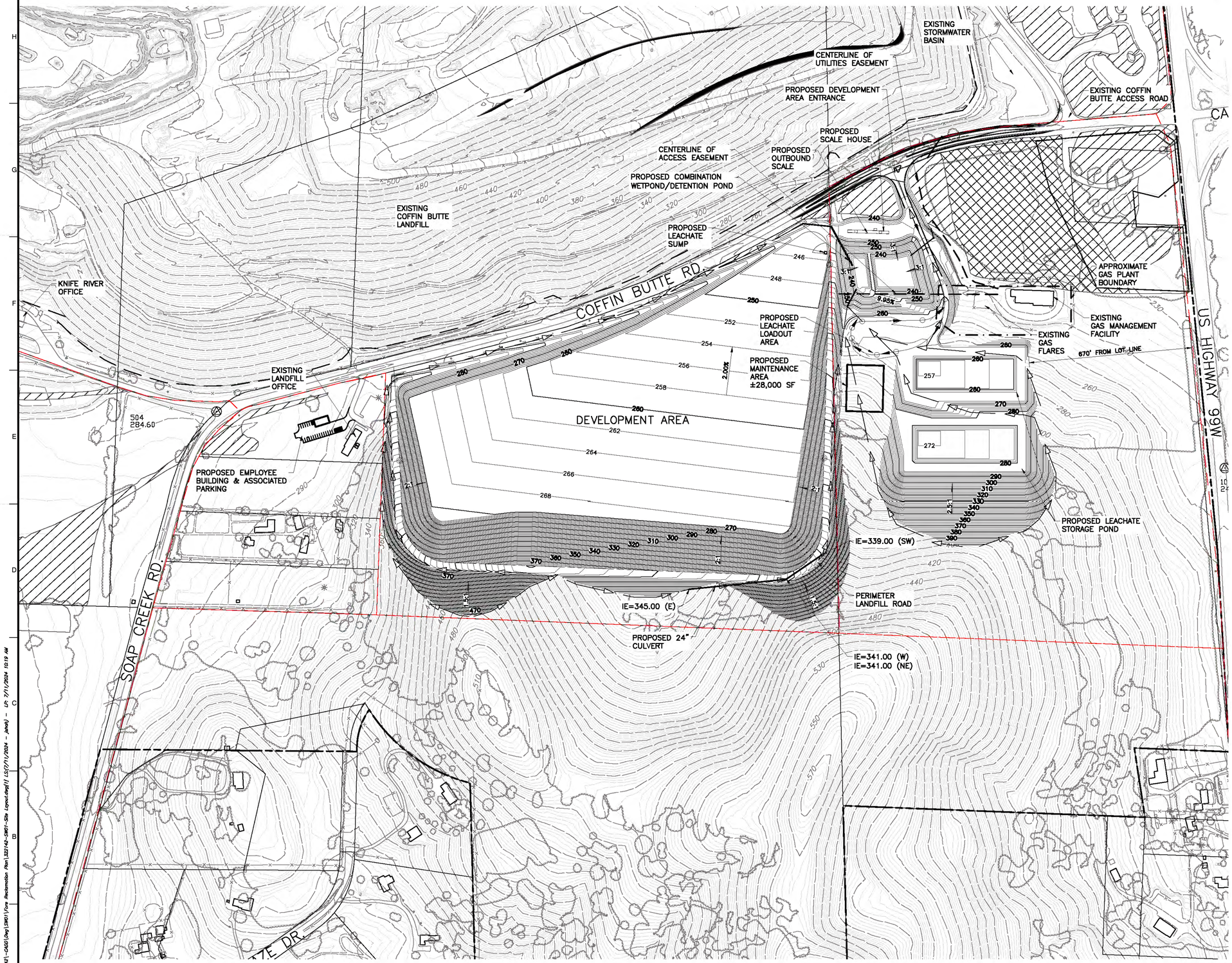
4.0 REFERENCES

Geo-Logic Associates (2021). “Site Development Plan,” Coffin Butte Landfill, Benton County, Oregon, Prepared for Valley Landfills, Inc., December 30, 2021.

Tuppan Consultants (2014). “Environmental Monitoring Plan,” Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc. by Tuppan Consultants LLC, Lake Oswego,
Oregon, Rev.3, June 27, 2014.

FIGURE 1

SITE LAYOUT



LEGEND

- PROPERTY BOUNDARY
- EXISTING LANDFILL BOUNDARY
- TAX LOT BOUNDARY
- ZONING BOUNDARY
- WETLAND MITIGATION BOUNDARY
- 300 — EXISTING 10-FT CONTOUR
- EXISTING 2-FT CONTOUR
- EXISTING PALUSTRINE FORESTED WETLAND
- EXISTING PALUSTRINE EMERGENT WETLAND
- 250 — PROPOSED 10-FT CONTOUR
- 254 — PROPOSD 2-FT CONTOUR
- FLOW PATH

NOTES

1. TAX LOT BOUNDARIES FROM BENTON COUNTY ZONING MAP PANEL 41047C0975G, DATED 01/19/2000 (TAX LOT BOUNDARIES MAY DIFFER FROM ZONING DATED 2021).
2. PERIMETER LANDFILL ROAD WILL ONLY BE FOR PICKUP TRUCKS OR SMALLER VEHICLES.

REFERENCE

AERIAL PHOTOGRAPH, TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY AND GRID BY COOPER AERIAL SURVEYS COMPANY; DATE OF PHOTOGRAPHY: OCTOBER 07, 2021.

REVISION RECORD

NO	DATE	DESCRIPTION

CEC
Civil & Environmental Consultants, Inc.
11811 N. Tatum Blvd., Suite 3057 · Phoenix, AZ 85028
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www.cecinc.com

VALLEY LANDFILLS, INC.
COFFIN BUTTE LANDFILL
CONDITIONAL USE PERMIT APPLICATION
CORVALLIS, OR 97330

SITE LAYOUT

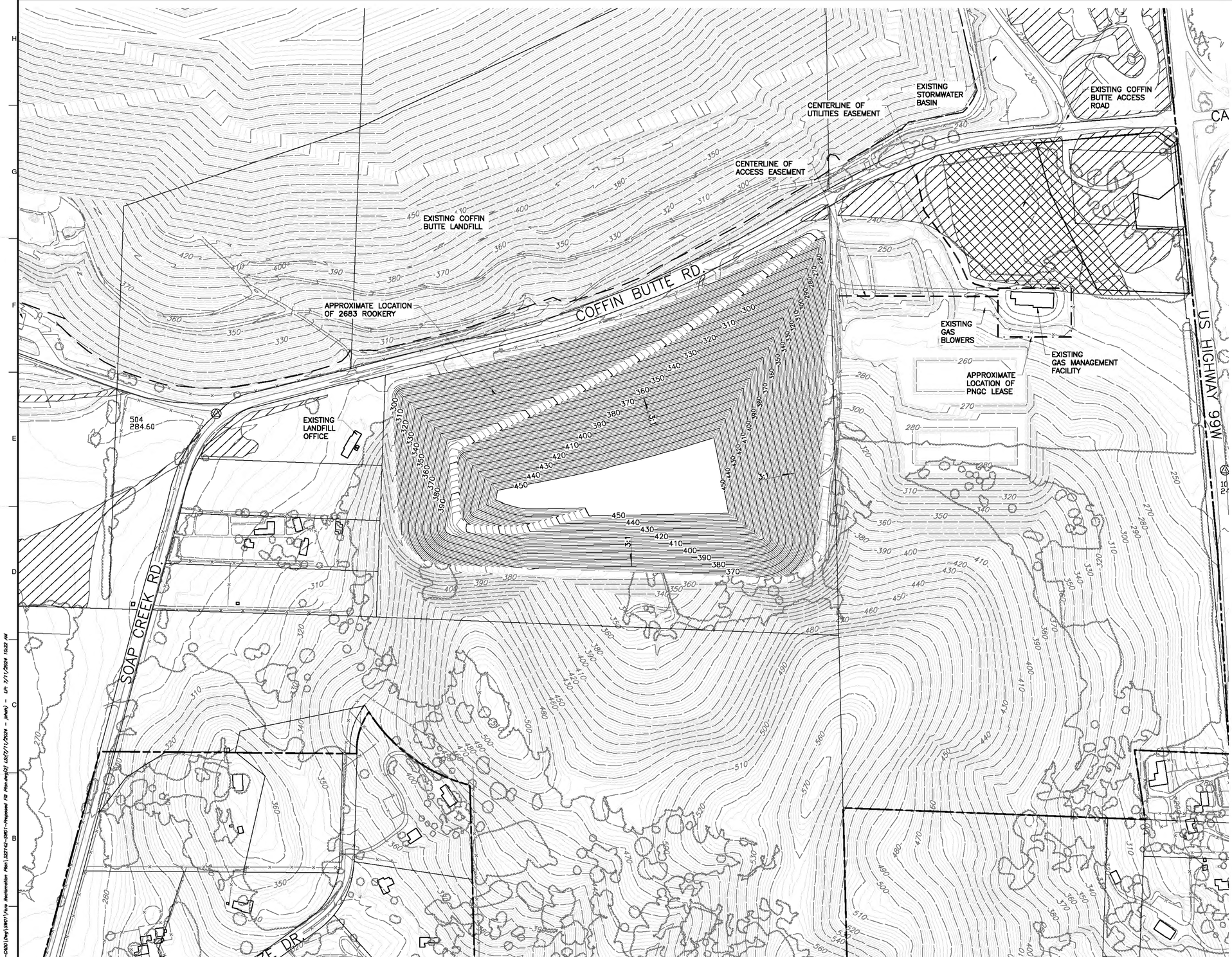
DATE:	JULY 2024
DWG SCALE:	AS SHOWN
PROJECT NO:	322-142
DRAWN BY:	JS
CHECKED BY:	JAS
APPROVED BY:	JAS

DRAWING NO.: 1

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FIGURE 2

PROPOSED FILL PLAN

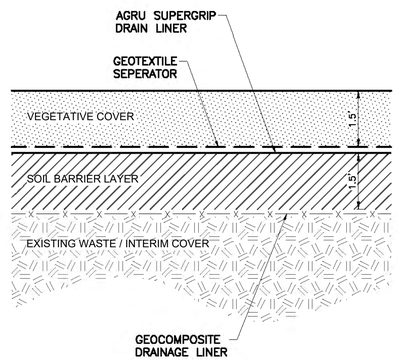


LEGEND

- PROPERTY BOUNDARY
- EXISTING LANDFILL BOUNDARY
- TAX LOT BOUNDARY
- WETLAND MITIGATION BOUNDARY
- 300 — EXISTING 10–FT CONTOUR
- EXISTING 2–FT CONTOUR
- EXISTING PALUSTRINE FORESTED WETLAND
- EXISTING PALUSTRINE EMERGENT WETLAND
- 250 — PROPOSED 10–FT TOP OF WASTE CONTOUR
- 254 — PROPOSD 2–FT TOP OF CONTOUR

NOTES

1. TAX LOT BOUNDARIES FROM BENTON COUNTY ZONING MAP PANEL 41047C0975G, DATED 01/19/2000 (TAX LOT BOUNDARIES MAY DIFFER FROM ZONING DATED 2021).
2. PERIMETER LANDFILL ROAD WILL ONLY BE FOR PICKUP TRUCKS OR SMALLER VEHICLES.



FINAL COVER SYSTEM

NORTH

SCALE IN FEET
0 200 400

REFERENCE

AERIAL PHOTOGRAPH, TOPOGRAPHIC INFORMATION FROM AERIAL SURVEY AND GRID BY COOPER AERIAL SURVEYS COMPANY; DATE OF PHOTOGRAPHY: OCTOBER 07, 2021.

REVISION RECORD

NO	DATE	DESCRIPTION

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VALLEY LANDFILLS, INC.
COFFIN BUTTE LANDFILL
CONDITIONAL USE PERMIT APPLICATION
CORVALLIS, OR 97330

PROPOSED FILL PLAN

DATE:	JULY 2024
DWG SCALE:	AS SHOWN
PROJECT NO:	322-142
DRAWN BY:	JS
CHECKED BY:	JAS
APPROVED BY:	JAS

DRAWING NO.: **2**

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EXHIBIT 23
OREGON DEQ PERMIT #306 MATERIALS

SOLID WASTE DISPOSAL SITE PERMIT:

Municipal Solid Waste Landfill

Oregon Department of Environmental Quality
165 E. Seventh Ave., Suite 100
Eugene, OR 97401-3049
541-687-7465

Issued as authorized by ORS 459.245 and in accordance with the provisions of Oregon Revised Statutes Chapter 459, 459A, Oregon Administrative Rules 340 Divisions 64, 90, 93, 95, 96 and 97 and subject to the Land Use Compatibility Statement referenced below.

ISSUED TO:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

541-745-5792

FACILITY NAME AND LOCATION:

Coffin Butte Landfill
28972 Coffin Butte Road
Corvallis, OR 97330

Section 13&18, T10S, R5&4W, Benton County

OWNER:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

541-745-5792

OPERATOR:

Coffin Butte Landfill
28972 Coffin Butte Road
Corvallis, OR 97330

541-230-5546

ISSUED IN RESPONSE TO:

- Solid waste permit renewal application received Dec 6, 2019
- Land Use Compatibility Statement from Benton County dated Dec. 20, 2000.

The determination to issue this permit is based on findings and technical information included in the permit record.

ISSUED BY THE OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

Brian Fuller
Material Management Manager
Western Region

July 28, 2020
Date

Permitted Activities

Until this permit expires or is modified or revoked, the permittee is authorized to establish, operate, and maintain a solid waste land disposal site in conformance with the requirements, limitations, and conditions set forth in this document, including all attachments.

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INTRODUCTION

This document is a solid waste permit issued by the Oregon Department of Environmental Quality in accordance with Oregon Revised Statutes (ORS) 459 and Oregon Administrative Rules (OAR), Chapter 340.

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PERMIT ADMINISTRATION

1.0 PERMIT ISSUANCE

1.1 Permittee

This permit is issued to Valley Landfills, Inc.

1.2 Permit number

This permit is DEQ Solid Waste Permit Number 306.

1.3 Permit term

The permit is issued on the date it is signed. The permit's expiration date is June 30, 2030.

1.4 Facility type

The facility is permitted as a municipal solid waste landfill.

1.5 Facility owner/ operator

The owner of this facility is:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

The operator of this facility is:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

1.6 Basis for permit issuance:

This permit is issued based upon the following documents submitted by the permittee:

- Solid waste permit application received Dec. 6, 2019
- Land Use Compatibility Statements from Benton County dated Dec. 20, 2000

1.7 Definitions

Unless otherwise specified, all terms are as defined in OAR 340-093-0030.

1.8 Legal control of property

The permittee shall at all times maintain legal control of the disposal site property; including maintaining a current permit, contract or agreement that allows the operation of the facility if the site is not owned by the permittee.

1.9 Submittal & notification address

Unless otherwise specified, all submittals and notifications to DEQ under this permit must be sent to:

Oregon Department of Environmental Quality
Manager, Materials Management Program
165 E Seventh Ave., Suite 100
Eugene, OR 97401-3049

Telephone: 541-687-7465

All submittals must include, at a minimum, one paper copy and one electronic copy in a format that is approved by the DEQ project manager. Note that some submittals may require more paper copies. Therefore, the permittee must confirm with the permit manager how many copies are necessary prior to submittal of a document.

Note: Whenever possible, the permittee should submit two-sided paper copies of all reports. DEQ may accept electronic submittals for portions of some reports, as approved in the Environmental Monitoring Plan or by DEQ.

2.0 DISCLAIMERS

2.1 Property rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights.

2.2 Department liability

DEQ, its officers, agents or employees do not sustain any liability on account of the issuance of this permit or on account of the construction, maintenance or operation of facilities pursuant to this permit.

3.0 AUTHORITY

3.1 Ten year permit

This permit is issued for a maximum of 10 years as authorized by Oregon Revised Statutes 459.245 (2).

3.2 Documents superseded

This document is the primary solid waste permit for the facility, superseding all of other solid waste permits issued for Coffin Butte Landfill by DEQ.

3.3 Permittee responsibility and liability

Conditions of this permit are binding upon the permittee. The permittee must conduct all facility activities in compliance with the provisions of the permit. The permittee is liable for all acts and omissions of the permittee's contractors and agents in carrying out the operations and other responsibilities pursuant to this permit.

3.4 Other compliance

This permit's issuance does not relieve the permittee from the responsibility to comply with all other applicable federal, state, or local laws or regulations, including the following solid waste requirements, and any future updates or additions to these requirements:

- Solid waste permit application received Dec. 6, 2019
- Oregon Revised Statutes, Chapters 459 and 459A
- Oregon Administrative Rules Chapter 340
- Any documents submitted by the permittee and approved by DEQ

3.5 DEQ access to disposal site

The permittee shall allow representatives of DEQ access to the disposal facility at all reasonable times for the purpose of making inspections, surveys, collecting samples, obtaining data and carrying out other necessary functions related to this permit.

Reference: OAR 340-093-0050(6).

3.6 Penalties

Violation of permit conditions will subject the permittee to civil penalties of up to $25,000 for each day of each violation.

Reference: ORS 459.995(1)(a)

4.0 PERMIT MODIFICATION

4.1 Five year review

In the permit's 4th to 6th year, DEQ will review the permit and amend it if necessary. DEQ will consider the following factors in making this determination:

- Compliance history of the facility
- Changes in volume, waste composition, or operations at the facility
- Changes in state or federal rules which should be incorporated into the permit

- A significant release of leachate or landfill gas to the environment from the facility
- Significant changes to a DEQ-approved site development plan, and/or conceptual design
- Other significant information or events

4.2 Permit modification

DEQ or the permittee may, at any time during the permit's term, propose to change the permit.

Once approved by DEQ, any permit-required plans become part of the permit by reference. DEQ may provide notice and opportunity for review of permit-required plans.

4.3 Modification and revocation by DEQ

DEQ may, at any time before the expiration date, modify, suspend or revoke this permit in whole or in part, in accordance with Oregon Revised Statutes 459.255, for reasons including but not limited to the following:

- Violation of any terms or conditions of this permit or any applicable statute, rule, standard or order of the Commission;
- Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts
- A significant change in the quantity or character of solid waste received or in the operation of the disposal site

4.4 Modification by permittee

The permittee must apply for a modification to this permit if there is a significant change in facility operations or a deviation from permitted activities.

4.5 Public participation

DEQ will issue a public notice to inform the public of any significant changes to the permit.

4.6 Changes in ownership or address

At least 10 days in advance, the permittee must report to DEQ any change in the facility's ownership or the permittee's or operator's name and/or address.

Reference: OAR 340-093-0070(6)(a)(A)

ALLOWABLE ACTIVITIES

5.0 AUTHORIZATIONS

5.1 Wastes authorized for receipt

This permit authorizes the facility to accept:

- Solid waste as defined in OAR 340-093-0030(91)
- The following waste, when special handling and management requirements for their disposal are included in a special waste management plan approved by DEQ:
    - Cleanup Materials Contaminated with Hazardous Substances as defined in OAR 340-093-0030(19), in accordance with OAR 340-093-0170
    - Waste requiring special management as defined in OAR 340-093-0190
    - Industrial solid wastes as defined in OAR 340-093-0030(53)

5.2 Authorization of other wastes

DEQ may authorize the permittee to accept other waste if:

- The permittee develops a Special Waste Management Plan and submits it to DEQ for review and approval;
- DEQ approves the Special Waste Management Plan
- The permittee can demonstrate that the materials are not hazardous waste, as defined by state and federal regulations or otherwise a threat to human health or waters of the state.

5.3 Tires for recycling

This permit authorizes the permittee to accept up to 100 whole tires at this facility for storage and removal.

This permit authorizes the permittee to accept up to 2,000 whole tires at this facility for storage and removal if the permittee maintains a continuous contract with a waste tire carrier to remove the tires from the site.

5.4 Salvaging and recycling

This permit authorizes the permittee to conduct salvaging and recycling in a controlled and orderly manner. The permittee must notify DEQ prior to changing salvaging and recycling operations. These operations must be described in the site Operations Plan.

6.0 PROHIBITIONS

6.1 Hazardous waste disposal

The permittee must not accept any regulated hazardous waste.

Reference: 40 CFR 258.20 (b).

In the event discovered waste is hazardous or suspected to be hazardous, the permittee must, within 24 hours, notify DEQ and initiate procedures to identify and remove the waste. Hazardous waste must be removed within 90 days, unless DEQ approves otherwise. The permittee's temporary storage and transportation practices must comply with DEQ rules.

6.2 Liquid waste disposal

The permittee must not accept liquid waste for disposal.

Definition: Liquid waste is waste that does not pass the paint filter test performed in accordance with EPA Method 9095B.

6.3 Vehicle disposal

The permittee must not accept discarded or abandoned motor vehicles, including trailers or mobile homes, for disposal.

6.4 Used oil disposal

The permittee must not accept used oil for disposal.

6.5 Battery disposal

The permittee must not accept lead-acid batteries for disposal.

6.6 Tire disposal

The permittee must not accept waste tires for disposal.

6.7 Recyclable material disposal

The permittee must not landfill or dispose of any source separated recyclable material brought to the disposal site.

Exception: If the source separated material is unusable or not recyclable it may be landfilled. DEQ must agree to such disposal and pre-approve the identified sources of unusable source separated material prior to its disposal.

6.8 Open burning

The permittee must not conduct any open burning at the site.

6.9 Electronic waste disposal

The permittee must not knowingly accept the following covered electronic devices for disposal:

- Computer monitors having a viewable area greater than four inches diagonally
- Televisions having a viewable area greater than four inches diagonally

- Desktop computers
- Portable computers

Reference: Oregon Revised Statutes 459.247 and 459A.300-365.

OPERATIONS AND DESIGN

7.0 OPERATIONS PLAN

7.1 Operations plan submittal

Within 270 days of the permit issue date, the permittee must review and submit any necessary updates to the site Operations Plan to DEQ for review and approval. The updated plan must be consistent with the conditions of this permit. A DEQ-approved plan becomes an integral part of the permit.

7.2 Plan content

The Operations Plan must describe facility operations, including the elements listed below, and demonstrate how the facility will comply with all regulatory and permit requirements:

General Topics	Describe plans or procedures for:
General operations	• Screening incoming waste to detect unauthorized or prohibited waste as required by 40 CFR 258.20(a) • Handling and removing unauthorized wastes discovered at the facility • Managing landfill gas • Managing landfill leachate in compliance with Subsection 9.15 • Recirculating landfill leachate & gas condensate in compliance with Subsections 5.5 and 9.15 • Monitoring landslide stability in compliance with Subsection 9.22 • Designing surface water and erosion control structures • Responding to non-compliance events or situations
Disposal operations	• Placing daily and interim cover • Detecting and preventing the disposal of regulated hazardous waste, and any other DEQ-prohibited waste • Disposing of putrescible waste • Disposal, handling and recordkeeping of cleanup materials contaminated with hazardous substances • Waste unloading and handling • Disposing of special waste • Using, stockpiling and tracking the receipt and use of waste approved for use as alternative daily cover • Reducing and controlling the risk of a landfill fire • Fill progression and phasing that is consistent with landslide stability recommendations, and takes into account other operational considerations
Special Waste Management Plan	• Identifying and characterizing special waste (i.e., waste which requires special management or waste streams not otherwise authorized by this permit) • Identifying the source of all special waste • Determining appropriate handling and disposal procedures • Documenting plan implementation, including waste characterization and location of waste disposition References: OAR 340-093-0190, OAR 340-094-0040[11][b][J]
Ancillary operations	• Waste unloading and handling • Solidifying liquid waste prior to disposal

General Topics	Describe plans or procedures for:
	• Handling and removal of waste tires • Placing and maintaining interim cover over inactive landfill areas • Managing transfer containers
Inspection and maintenance	• Washing equipment • Maintaining leachate and gas collection systems • Maintaining monitoring stations and devices • Periodically inspecting the continuity and integrity of primary leachate collection pipes • Maintaining surface water control structures
Operating record	• Establishing and maintaining the operating record
Contingency	• Backup methods for storing and/or disposing of leachate • Providing fire protection equipment, and arrangements made with local fire control agency • Notifying DEQ about emergencies and fires

7.3 Operations and maintenance manual

Within 60 days of the Operations Plan's approval the permittee must prepare and submit an updated Operations and Maintenance Manual which includes detailed inspection and maintenance procedures and an associated schedule for all facility components that require periodic inspection. The manual must include specific procedures for routine preventative maintenance and repairs and for response to emergency situations. The preventative inspection and maintenance program should address the following equipment and facilities: personnel safety equipment, operating equipment, support facilities, environmental control systems, environmental monitoring systems, and the transportation system. The permittee must keep a copy of the Operations and Maintenance Manual with the Operating Record, readily available for DEQ inspection and review.

7.4 Plan and manual updates

The permittee must update and revise both the Operations Plan and the Operations and Maintenance Manual as necessary to reflect current and future facility conditions and procedures.

The permittee must submit any associated revisions or updates to DEQ for review and approval.

7.5 Plan and manual compliance

The permittee must operate the facility in accordance with the approved Operations Plan and Operations and Maintenance Manual, and any amendments to these documents.

8.0 RECORDKEEPING AND REPORTING – OPERATIONS

8.1 Non-compliance reporting

The permittee must take immediate corrective action for any violations of permit conditions or DEQ rules and notify DEQ.

DEQ response: DEQ may investigate the nature and extent of the compliance problem and evaluate the adequacy of the permittee's corrective action plans.

8.2 Permit display

The permittee must display this permit where operating personnel can easily refer to it.

8.3 Access to records

DEQ must have access, when requested, to all records and reports related to the permitted facility.

8.4 Procedures

The permittee's recordkeeping and reporting procedures are as follows:

Step	Action
1	Keep the Operating Record at the facility or at another DEQ-approved location.
2	Place information required by 40 CFR 258.29 and this permit in the Operating Record.
3	During facility operations, record the daily amount of each waste type received and approved alternative daily cover - qualified waste used for daily cover. Record 0 if the waste is not received. *Identify the following waste types received and categorize them as either in- or out-of-state waste:* • Domestic solid waste and construction and demolition waste • Industrial solid waste • Asbestos • Contaminated cleanup materials (except materials counted as alternative daily cover qualified waste) • Approved alternative daily cover qualified waste received • Other (i.e., specify any waste type not included in the above list).
4	If applicable, every quarter, record the amount of each material recovered for recycling or other beneficial purpose.
5	Submit the information collected in Step 3 above on the Solid Waste Disposal Report/Fee Calculation form provided by DEQ. Pay solid waste fees as required by OAR 340-097. Date due: last day of the month following the end of the calendar quarter.
6	Submit the information collected in Steps 3 & 4 above to the Wasteshed Representative on DEQ provided or approved form. Date due: Jan. 25 of each year.
7	Retain copies of all records and reports for 10 years after their creation.
8	Update all records to reflect current conditions at the facility.

8.5 Submittal address

Send required submittals to:

Oregon Department of Environmental Quality
Materials Management Section
Environmental Solutions Division
700 NE Multnomah St., Suite 600
Portland OR 97232

503-229-5913

9.0 SPECIFIC OPERATING CONDITIONS

9.1 Discovery of prohibited waste

If the permittee discovers prohibited wastes, the permittee must notify DEQ within 24 hours and begin to isolate or remove the waste. In addition, the permittee must take digital photos of the prohibited waste to document its quantity, nature, identity and source.

Within 60 days following the discovery, the permittee must transport non-putrescible, non-hazardous prohibited waste to a disposal or recycling facility authorized to accept such waste, unless otherwise approved or restricted by DEQ. The permittee must obtain DEQ's written approval to store putrescible, non-hazardous, prohibited waste.

9.2 Spills notification

Oregon Revised Statue 466.635 and Oil and Hazardous Materials Emergency Response Requirements, Chapter 340, Division 142 require immediate notification to Oregon Emergency Response System (OERS) after taking any required emergency actions to protect human health and the environment when

oil or hazardous materials are spilled. The spill must be immediately reported to OERS at 1-800-452-0311 if the spill is of a reportable quantity. Reportable quantities include:

- *Any* amount of oil spilled to waters of the state
- Oil spills on land in excess of 42 gallons
- Two hundred pounds (25 gallons) or more of spilled pesticide residue
- Spills of hazardous materials that are equal to, or greater than, the quantity listed in the Code of Federal Regulations, 40 CFR Part 302 (List of Hazardous Substances and Reportable Quantities), and amendments adopted before July 1, 2002.

For a complete list of hazardous materials required to be reported, please refer to OAR 340-142-0050.

9.3 Access roads

The permittee must provide all-weather access roads from the landfill property line to the active operational area and the environmental monitoring stations, and maintain them in a manner that prevents traffic hazards, dust and mud.

The permittee must use appropriate means, including truck washing, as needed to prevent haul trucks from tracking mud on external roadways outside the landfill boundaries. Any truck washing activities must be conducted on a hard surface and any disposal of wastewater must be accomplished in a manner approved by DEQ.

9.4 Unloading area

The area(s) for unloading incoming waste must be clearly defined by signs, fences, barriers or other devices. The permittee must minimize width of the unloading area to the maximum extent practicable.

9.5 Daily cover

At the end of each working day the permittee must cover all solid waste with a six inch, or thicker, layer of compacted soil or with a DEQ-approved, alternative daily cover.

9.6 Interim cover

As specified in DEQ-approved design and operations plans, the permittee must place and maintain interim cover over fill areas that will not receive additional waste for an extended period of time [i.e., greater than 120 days] and actively revegetate, in a DEQ-approved manner, any interim cover that will remain exposed for more than two years.

9.7 Surface water structures

The permittee must maintain all stormwater drainage structures in good functional condition, report to DEQ any significant malfunctions or damage and complete repairs within 60 days of discovery the problem.

9.8 Stormwater pollution control plan

The permittee must update and implement the Storm Water Pollution Control Plan consistent with site conditions and the stormwater permit requirements. Refer to the National Pollutant Discharge Elimination System Stormwater Discharge Permit No. 1200-Z. In addition, the permittee must keep a current copy of the permit in the facility Operating Record.

9.9 Asbestos waste management

The permittee must offload and dispose of friable asbestos-containing solid waste as specified in DEQ-approved Operations Plan, Operations & Maintenance Manual, and in OAR 340-248.

9.10 Leachate management systems

The permittee must operate the disposal site in a manner that deters leachate production to the maximum extent practicable, and construct, operate and maintain in good functional condition all DEQ-approved leachate containment, collection, detection, removal, storage and treatment systems. The permittee must remove leachate continuously from all landfill leachate collection systems, to minimize fluid buildup on the bottom liner and prevent the hydraulic head (fluid depth) from exceeding one foot.

9.11 Leachate surface impoundments

The permittee must: 1) completely contain leachate stored within lined surface impoundments; 2) maintain a minimum dike freeboard of two (2) feet above the maximum leachate level in those impoundments unless otherwise approved by DEQ; 3) fence the impoundments to control public access; and 4) lock all gates when no attendant is on duty. In addition, the permittee must post clearly legible, visible signs that describe the surface impoundment's contents and display the words "no trespassing".

9.12 Litter control

The permittee must at all times minimize windblown litter and collect it quickly and effectively to prevent scattering, nuisance conditions and unsightliness.

9.13 Vector control

The permittee must minimize vectors in the active disposal area, including insects, rodents and birds.

9.14 Air emissions

The permittee must control air emissions, including dust, malodors, air toxics, etc. related to disposal site construction, operation and other activities, and comply with DEQ air quality standards.

9.15 Access control

The permittee must control public access to the landfill as necessary to prevent unauthorized entry and dumping.

9.16 Landfill entrance sign

A prominently displayed sign must indicate the following:

- The name of facility
- The emergency telephone number
- The days and hours of operation
- The authorized and prohibited waste
- The Solid Waste Permit number
- The operator's address
- The consequences to haulers if they attempt to dispose of prohibited materials
- Any other information critical to the safe and efficient operation of the facility.

9.17 Fire protection and reporting

The permittee must provide complete and sufficient protection equipment and facilities in accordance with DEQ-approved Operations Plan.

Arrangements must be made with the local fire control agency to immediately acquire their services when needed. The permittee must implement preventative measures to ensure adequate on-site fire control, as determined by the local fire control agency. Fires must be immediately and thoroughly extinguished.

Fires shall be reported to DEQ within 24 hours.

9.18 Water supply

The permittee must provide water in sufficient quantities for fire protection, dust suppression, establishment of vegetation, and other site operations requiring water.

9.19 Landfill gas management

The permittee must control landfill gas in accordance with the requirements of 40 CFR Parts 51, 52 and 60 and OAR 340-094-0060(4).

9.20 Landfill gas control system operation and maintenance

The permittee must operate and maintain the landfill gas control and monitoring systems in good working order as required to prevent nuisance odors, air emissions and landfill gas migration (see methane compliance limits in Section 18).

If critical landfill gas equipment is significantly damaged or compromised, the permittee must replace or repair that equipment, within 60 days of discovering the problem, and submit a written inspection report to DEQ.

10.0 SITE DEVELOPMENT AND DESIGN

10.1 Site development plan

Within 360 days of the permit issue date, the permittee must submit any necessary update to the long-term Site Development Plan to DEQ for review and approval. Once approved, the plan becomes an integral part of this permit.

Reference: The *Solid Waste Landfill Guidance, September 1996,* describes the basic elements of a Site Development Plan. Organizing the plan in accordance with the Guidance will expedite DEQ's review.

10.2 Baseline design criteria

New municipal landfill waste landfill disposal units must include the following engineering controls:

- A composite liner system, including a DEQ-approved geomembrane liner (at least 60 mils thick for high density polyethylene, and at least 30 mils thick for approved alternative geomembranes) and at least two feet of compacted soil with an in-place permeability of 1 X 10^{-7} cm/sec or less, or a DEQ-approved alternative liner pursuant to 40 CFR Part 258.40(a)(1);
- A primary leachate collection and removal system (LCRS) which fully covers the liner system and maintains a leachate depth of less than a one foot above the liner, per 40 CFR 258.40(a)(2). All leachate collection pipes must be serviceable by clean outs;
- A secondary leachate collection and removal system(s) designed to effectively monitor the overlying composite-liner system's performance and (1) detect and collect leachate at locations of maximum leak probability; and (2) prevent groundwater intrusion and related monitoring biases;
- A leachate collection sump(s) with a double composite liner system and a leak detection and removal system. Each composite liner must meet the minimum design criteria previously cited in this subsection;
- An operations layer that covers and protects the primary LCRS and liner system from physical damage; and
- A leachate surface impoundment (if applicable) with a double liner and leak detection and removal system. One liner must meet the minimum composite liner criteria described above.

10.3 Design plans

At least six months prior to the anticipated construction date for new disposal units, closure of existing units, or development of other ancillary facilities, the permittee must submit engineering design plans to DEQ for review and approval. The design plans must be prepared and stamped by a qualified Professional Engineer with current Oregon registration and specify and/or provide the following:

- All applicable performance criteria, construction material properties and characteristics, dimensions and slopes
- The design basis and all relevant engineering analyses and calculations

10.4 Construction requirements

The permittee must construct all improvements in accordance with:

- The approved plans and specifications
- Any DEQ imposed conditions of approval
- Any future DEQ approved amendments to the plans and specifications
- Construction work must begin within 18 months of plan approval

10.5 Construction documents

Prior to constructing any landfill engineering controls (e.g., final cover, new disposal unit, or other waste containment facilities or improvements), the permittee must submit complete construction documents and receive DEQ's written approval. The construction documents must:

- Define the construction project team
- Specify material and workmanship requirements to guide the constructor in executing work and furnishing products
- Include a Construction Quality Assurance Plan that describes how the project team will monitor the quality of materials and the constructor's work performance and assure compliance with project specifications and contract requirements.

Reference: Follow the current *Solid Waste Guidance* to expedite DEQ review of the construction documents.

10.6 Construction inspection

During construction of a new landfill disposal unit, final cover system, or any other landfill controls or engineered features, the permittee must provide DEQ with a summary and schedule of planned construction activities to facilitate DEQ's inspection and oversight.

10.7 Construction report submittal

Within 90 days of completing construction of a new landfill disposal unit, a final cover system, or other engineering controls, the permittee must submit to DEQ a Construction Certification Report prepared by a qualified independent party. The report must document and certify that the construction of all required components and structures complies with this permit and DEQ-approved design specifications.

10.8 Construction report content

The construction report must include:

- An executive summary describing the construction project and any major problems encountered
- A list of the governing construction documents
- A summary of all construction and construction quality assurance activities
- The manufacturer's written certifications that all geosynthetic materials conform with project specifications
- Test data documenting that soil materials conform with project specifications
- A summary of all construction quality assurance observations, including daily inspection records and test data sheets documenting that materials deployment and installation conform with project specifications
- A description of the problems encountered and the corrective measures implemented
- The designer's acceptance reports for errors and inconsistencies
- A list/description of any deviations from the design and material specifications, including justification for the deviations, copies of change orders and recorded field adjustments, and copies of DEQ's written approvals for deviations and change orders
- Signed certificates for subgrade acceptance prior to placement of soil liner and for acceptance of the soil liner prior to deployment of geomembrane liner
- Photographs and as-constructed drawings, including record surveys of the subgrade, soil liner, granular drainage layer and protective soil layer
- The certification statement(s) and signatures of the construction quality assurance consultant, designer, and facility owner. One of these representatives must be a professional engineer with current Oregon registration.

10.9 Approval to use new disposal units

The permittee must not dispose of solid waste in newly constructed disposal units until DEQ has accepted the Construction Certification. If DEQ does not respond to the Construction Certification Report within 30 days of its receipt, the permittee may place waste in the unit.

11.0 RECYCLING REQUIREMENTS

11.1 Materials

The permittee must provide a place for receiving the following recyclable materials:

☒	ferrous scrap metal	☒	mixed paper
☒	motor oil	☒	non-ferrous scrap metal (including aluminum)

☒	newspaper	☒	corrugated cardboard and kraft paper (brown paper bags)
☒	container glass	☒	tin cans

11.2 Receiving location

The place for receiving recyclable material must be located at the disposal site or at another location more convenient to the population served by the disposal site. The recycling center must be available to every person whose solid waste enters the disposal site.

11.3 Material use

All source separated recyclable materials must be reused or recycled.

11.4 Recycling information

The permittee must provide, to disposal site users, the following recycling information on printed handbills:

- The on-site or off-site location of the recycling center
- The recycling center's hours of operation
- A list of acceptable materials for recycling
- Instructions for preparing source separated recyclable material
- Reasons why people should recycle

11.5 Sign

A prominently displayed sign must indicate the following:

- The availability of recycling at the disposal site or another location

Note: The sign must indicate the recycling center location, if not at the disposal site

- The materials accepted at the recycling center
- The recycling center's hours of operation (if different than disposal site hours)

11.6 Storage

Unless DEQ approves otherwise, all recyclable materials, except car bodies, white goods and other bulky items must be stored in containers.

SITE CLOSURE

12.0 CLOSURE CONSTRUCTION AND MAINTENANCE

12.1 Worst-case closure plan development

Within 90 days of permit issuance, the permittee must develop a conceptual "worst-case" closure plan and a conceptual post-closure plan(s), obtain DEQ approval of the plan(s), and maintain up-to-date copies of these plan(s) in the facility file.

Reference: The plans must comply with 40 CFR, Part 258, Subpart F, and OAR 340-094-0110.

12.2 Notification

The permittee must notify DEQ and receive DEQ approval when the conceptual "worst-case" closure and conceptual post-closure care plans are updated and placed in the file.

12.3 Closure permit

In accordance with OAR 340-094-0100, the permittee must apply for a closure permit at least five years prior to the landfill's anticipated final closure.

12.4 Closure plan approval

At least six months prior to final closure of any portion of the landfill, the permittee must submit detailed engineering plans, specifications, and a closure schedule to DEQ for review and approval.

The design plans must be prepared and stamped by a qualified professional engineer with a current Oregon registration and specify and/or provide the following:

- All applicable performance criteria, construction material properties and characteristics, dimensions and slopes
- The design basis and all relevant engineering analyses and calculations

Reference: The *Solid Waste Landfill Guidance, September 1996,* describes Closure Plan preparation. Following that format will expedite DEQ review of the plan.

12.5 Closure schedule

The permittee must initiate and complete closure of each landfill disposal unit in accordance with 40 CFR 258.60(f)&(g), or an alternate schedule approved by DEQ.

12.6 Final cover

Unless DEQ approves otherwise, the final landfill cover must be:

- At least three feet thick {OAR 340-094-0120(2)(a)}
- Designed to minimize infiltration of precipitation as required by 40 CFR Part 258.60
- Graded to compensate for estimated differential settlement and maintain positive drainage. Final (post-settlement) slopes must range between two percent and 30 percent.

12.7 Vegetation

The permittee must establish and maintain a dense, healthy growth of native vegetation over the closed areas of the landfill consistent with the proposed final use.

12.8 Final cover maintenance.

The permittee must maintain the final surface contours of the landfill cover such that:

- Erosion is minimized and ponding of water is prevented
- The integrity of the cover system is preserved in accordance with the approved plans

The permittee must reconstruct the cover system with approved materials and grade and seed all areas that have settled or where water ponds, and all areas where the cover soil has been damaged or thinned by cracking or erosion. Areas where vegetation has not been fully established shall be fertilized, re-seeded and maintained. Any damage repair or other reconstruction of a geomembrane barrier component in the final cover system shall be conducted in accordance with a construction quality assurance plan approved by the DEQ.

12.9 Slope stability

The permittee must maintain the stability of the landfill slopes and the overall structural integrity of the landfill.

12.10 Deed record

Within 30 days after the disposal site's final closure, the permittee must record a notation on the deed to the facility property as required by 40 CFR 258.60(i) and OAR 340-094-0130(1)(a), and submit a copy of the notation on the deed to DEQ.

13.0 FINANCIAL ASSURANCE

13.1 Financial assurance plan

The permittee must submit an updated financial assurance plan to the DEQ for review and approval and provide financial assurance for the costs of site closure, post-closure care, and potential corrective action. In addition, the permittee must place the plan in the facility file.

Reference: The plan must be prepared in accordance with OAR 340-094-0140. Acceptable mechanisms are described in OAR 340-094-0145.

13.2 Financial assurance required.

The permittee must comply with applicable financial assurance criteria requirements prescribed by OAR 340-094-0140. The permittee must maintain an up-to-date Financial Assurance Plan in the facility Operating Record, and provide financial assurance for landfill closure, post-closure care and, if required, corrective action. The financial assurance provided must:

- Be in the amount required by OAR 340-094-0140(5)
- Be updated, annually, in accordance with OAR 340-094-0140(6)(e)
- Consist of a financial assurance mechanism complying with OAR 340-094-0145

13.3 Recertification of financial assurance.

The permittee must annually review and update their financial assurance in accordance with OAR 340-094-0140(6)(e).

By April 1 of each year, a notarized annual recertification of financial assurance must be submitted to DEQ demonstrating that this review has been completed. If a discount rate is used to estimate costs, the annual update must also include the certifications listed in OAR 340-094-0140(6)(d).

13.4 Use of financial assurance

The permittee must not use the financial assurance for any purpose other than to finance the permitted facility's approved closure, post-closure, and corrective action activities or to guarantee that those activities will be completed.

13.5 Continuous nature

The permittee must continuously maintain financial assurance for the facility until the permittee or other person owning or controlling the site is no longer required by DEQ to demonstrate financial responsibility for closure, post-closure care or corrective action.

ENVIRONMENTAL MONITORING

14.0 SITE CHARACTERIZATION

14.1 Workplan

At least 270 days prior to any new landfill construction or expansion beyond the currently characterized and approved footprint, the permittee must submit two (or more) copies of a detailed workplan to DEQ for review and approval. The workplan must summarize all site characterization completed to date, describe further site characterization that will be accomplished and include at least the following elements:

- A description of the landfill expansion
- A proposal for monitoring all relevant media within the expansion area
- An update to the Environmental Monitoring Plan that reflects all approved changes to the facility
- A detailed description of the planned investigation
- A detailed project schedule

14.2 Site characterization report

Within 180 days of DEQ's approval of the workplan, the permittee must submit at least two copies of the report to DEQ for review and approval. This report must be based on DEQ-approved workplan and any conditions of the approval. The report must be prepared and stamped an Oregon registered geologist or an Oregon registered engineering geologist. The permittee must submit the report and receive DEQ's approval before starting construction or operation of the new landfill area. Once approved, this report and any conditions of approval become an integral part of the permit.

Reference: The *Solid Waste Landfill Guidance, September 1996,* describes the applicable elements of a Site Characterization Report. Organizing the report in that manner will expedite DEQ's review of the plan.

15.0 ENVIRONMENTAL MONITORING PLAN

15.1 Environmental Monitoring Plan Submittal

Within 120 days when requested by DEQ, the permittee must submit an updated Environmental Monitoring Plan to DEQ for approval.

Major changes in updates to the original plan require that the entire plan be submitted as a stand-alone document; at a minimum, this must be done at least once every 10 years. The plan, or any updates to the plan, must be prepared and stamped by an Oregon registered geologist or an Oregon registered engineering geologist. Upon approval, this plan is incorporated into this permit by reference.

15.2 Environmental Monitoring Plan contents

The updated plan must include plans (other than monitoring that is already handled by an NPDES permit) implementing an environmental monitoring program that will characterize potential facility impacts, including leachate collection, containment, treatment and disposal. The updated plan may incorporate parts of the previous approved plan with any changes or additions since that time (i.e., approved permit-specific concentration limits, revised parameter lists, revised schedules and new wells).

The updated plan must include the following contents, as well as applicable elements from the reference document:

- Monitoring Network Design and Construction
- Sampling and Analysis Plan
- Field QA/QC Procedures
- Lab QA/QC Procedures
- Data Analysis and Evaluation
- Report Format and Executive Summary

Reference: The *Solid Waste Landfill Guidance, September 1996,* provides information on applicable elements of an Environmental Monitoring Plan. Following the organizational format provided in the Guidance will expedite DEQ review of the plan.

15.3 Environmental Monitoring Plan revisions and updates

The permittee must revise the current plan as necessary to reflect current and future environmental conditions, facility development and regulatory requirements. A geologist or certified engineering geologist, with current Oregon registration, must prepare and stamp the plan revisions and submit two copies (one printed and one electronic) to DEQ for review and approval.

15.4 Environmental Monitoring Plan public comment period

Plan changes may require a public comment period.

15.5 Long-term monitoring plan

After DEQ approves any Risk-Based Concentration Limits (RBCs), Permit-Specific Concentration Limits (PSCLs), Concentration Limit Variances (CLVs), Action Limits (ALs), or Site-Specific Limits (SSLs), the permittee must update the EMP to reflect the long-term monitoring program and submit the updated plan for DEQ review and approval.

Note: Also see this permit's requirements for establishing PSCLs, ALs, or SSLs and OAR 340-040-0030(4) for procedures to establish CLVs.

15.6 Leak Detection System

Any significant increase in flow rate in the leak detection system (or degradation of water quality) that have not been corrected (or significant progress made) within two years, also require an updated plan submittal. This plan update is required if a statistical analysis indicates that normal monitoring of detection and compliance sampling points have shown a degradation of water quality. The analysis should cover the period of time from before the changes to after the increased leakage (or degradation of water quality) occurred. The updated plan submittal must detail any proposed increases in frequency or parameter monitoring, as well as any additional monitoring points.

15.7 Additional monitoring points

The permittee must incorporate any new or replacement monitoring point or device into the Environmental Monitoring Plan and submit the updated plan to DEQ for review and approval.

15.8 Environmental Monitoring Plan Compliance

The permittee must conduct all environmental monitoring at the facility in accordance with the approved plan, including any conditions of approval, amendments and updates.

16.0 ENVIRONMENTAL SAMPLING REQUIREMENTS

16.1 Notification of sampling events

The permittee must notify DEQ, in writing, at least 10 working days prior to a scheduled sampling event.

16.2 Split sampling events

The permittee must split samples with DEQ at DEQ's request, and schedule split-sampling events with DEQ's laboratory at least 45 days ahead of time.

Oregon Department of Environmental Quality
Laboratory, Groundwater Monitoring Section
7202 NE Evergreen Parkway, Suite 150
Hillsboro, OR 97124
Phone: 503-693-5700 Fax: 503-693-4999

The permittee must conduct the following split sampling events with DEQ:

Fall or Spring 2024 (TBD)
Fall or Spring 2029 (TBD)
Other sampling events if requested by DEQ

16.3 Monitoring schedule

The permittee must refer to the approved EMP for environmental monitoring procedures. Quarterly monitoring benchmarks are defined below:

If sampling in the...	Schedule the sampling event	
	On, or after....	But on, or before...
Winter	Jan. 1	Feb. 28
Spring	April 1	May 31
Summer	July 1	Aug. 31
Fall	Oct. 1	Nov. 30

16.4 Monitoring after Environmental Monitoring Plan approval

The permittee must monitor the facility in accordance with: 1) the approved plan; 2) any conditions of DEQ's approval; and 3) any DEQ-approved amendments and updates.

16.5 Changes in sampling or split sampling

The permittee must submit a written request and obtain DEQ's written approval before changing the sampling program, including sampling frequency, parameters, or locations. Approved changes will become an integral part of the plan.

DEQ reserves the right to add to or delete from the list of scheduled sampling events, sampling locations, and sampling parameters, and to conduct unscheduled sampling or split sampling events.

If the split-sampling schedule changes, DEQ will try to notify the permittee at least 30 days prior to the next scheduled event.

17.0 ESTABLISHING PERMIT-SPECIFIC CONCENTRATION LIMITS (PSCLs), ACTION LIMITS (ALs), CONCENTRATION LIMIT VARIANCES (CLVs) AND SITE-SPECIFIC LIMITS (SSLs)

17.1 Gathering data

The permittee must monitor the designated background wells in accordance with the approved Environmental Monitoring Plan or propose an alternative intrawell approach. Site specific limits (SSLs) exist for several parameters at two wells and remedial action concentration limits exist for additional parameters at some other wells. Background monitoring shall continue until all necessary data sets have been collected, and may be used for creation of additional PSCLs, ALs and/or SSLs for parameters of concern. The permittee then must demonstrate to DEQ's satisfaction that the selected background-data set is valid and unaffected by facility releases.

17.2 Future disposal units or cells

Before using a new landfill unit or cell for waste disposal, the permittee must collect enough samples to determine background groundwater quality. Alternatively, the permittee may develop a program, to be approved by DEQ, for determining background groundwater quality with wells installed at the time of landfill cell construction.

17.3 Statistical analysis

To establish compliance concentration limits (PSCLs, ALs, and SSLs), the permittee must perform statistical evaluations of the monitoring results for each sampling event.

Use methods outlined in 40 CFR 258.53 or other DEQ accepted statistical methods.

References:

The permittee should use methods outlined in Environmental Protection Agency's "Statistical Analysis of Groundwater Monitoring at RCRA facilities" (March 2009) or other DEQ accepted statistical methods. DEQ's 2011 Guidance Document "Developing Concentration Limits at Permitted Solid Waste Facilities" provides some examples of acceptable methods.

17.4 Proposing PSCLs, ALs, and/or SSLs

The permittee must propose for DEQ's review and approval, a PSCL, AL or SSL pursuant to the guidelines specified in OAR 340-040. The proposal must address all required parameters. Once a statistically valid data set (at least nine acceptable data points) are established from the appropriate background well(s), the permittee may generate a PSCL, AL, or SSL for each designated, long-term monitoring parameter.

17.5 Changing PSCLs, ALs, and/or SSLs

If the permittee demonstrates to DEQ's satisfaction that background groundwater quality has significantly changed since the PSCL, AL or SSL was established, and if the change is unrelated to the permitted facility's influence, the permittee can propose to DEQ a revised level for the affected PSCL(s), AL(s) or SSL(s).

17.6 Establishing and changing CLVs

The permittee should refer to DEQ's Groundwater Quality Protection Rules [OAR 340-040-0030(4)] for guidance in establishing and changing Concentration Limit Variances (CLVs).

18.0 ENVIRONMENTAL MONITORING STANDARDS

18.1 Applicable regulatory standard

The permittee must not allow the release of any substance from the landfill into groundwater, surface water, or any other media which will result in a violation of any applicable federal or state air or water limit, drinking water rules, or regulations, beyond the solid waste boundary of the disposal site or an alternative boundary specified by DEQ. Refer to OAR 340-094-0080.

18.2 Compliance points

Compliance wells are defined in the most current site Environmental Monitoring Plan.

18.3 Review of results

The permittee must review the analytical results after each monitoring event according to the protocols established in the most currently approved site-specific Environmental Monitoring Plan.

18.4 Resampling results

Upon receipt of data from resampling, the permittee must review the analytical results according to the protocols established in the most currently approved site-specific Environmental Monitoring Plan.

18.5 Secondary leachate collection system (SLCS)

If the permittee observes liquids in the leak detection system, the permittee must respond in accordance with the approved plan procedures for sampling, analysis and reporting. If testing confirms landfill impacts

in the leak detection or secondary leachate collection system, and that system is compromised as a compliance point, DEQ may require the permittee to install additional detection or compliance wells and conduct further investigations.

The permittee must design each secondary leachate collection system-equipped landfill cell or sub-unit to allow for discrete sampling of the secondary leachate collection system without mixing, co-mingling or compositing of samples with other leachate sources.

18.6 Methane limits

The methane concentration must not exceed:

- Twenty-five percent of methane's Lower Explosive Limit in onsite structures (excluding gas control structures or gas recovery system components)
- Methane's Lower Explosive Limit at the facility property boundary

Note: Methane's Lower Explosive Limit is equal to a concentration of five percent by volume in air.

18.7 Methane exceedance

If methane levels exceed the specified limits, the permittee must:

1. Take immediate steps to protect human health and safety and notify DEQ within 24 hours
2. Within seven days of detection, confirm the measures taken to protect human health and safety (unless DEQ approves an alternative schedule), and describe the methane test results and response measures in the facility operating record
3. Within 60 days of the methane exceedance, develop and implement a remediation plan, incorporate the plan into the monitoring records, and submit a progress report to DEQ.

18.8 Certified environmental laboratory data

To assure the best possible data quality, DEQ requests that the permittee contract with environmental labs certified under the Oregon Environmental Laboratory Accredited Program (ORELAP) or the National Environmental Laboratory Accreditation Program (NELAP). The permittee should include a copy of the lab's certification with every data submittal. Use of an ORELAP or NELAP approved lab will facilitate DEQ's future review of Environmental Monitoring Plan updates, Annual Environmental Monitoring Reports, and RI/FS documents.

19.0 RECORDKEEPING AND REPORTING – ENVIRONMENTAL MONITORING

19.1 Annual Environmental Monitoring Report (AEMR)

Prior to March 31 of each year, the permittee must submit to DEQ two copies (one paper copy and one electronic copy) of an annual monitoring report for the previous calendar year's monitoring period. The report must conform to the format detailed in the approved plan and be prepared and stamped by a geologist or a certified engineering geologist, with current Oregon registration. Extensive ancillary information such as laboratory reports, and the historical analytical database, may be provided only in the electronic copy and not in the printed copy.

Note: The permittee should submit two-sided copies of all reports and may submit electronic submittals of reports.

19.2 Statement of compliance

The Annual Environmental Monitoring Report must include a brief (approximately one-page) cover letter that:

- Compares the analytical results with the relevant monitoring standards (RBCs, PSCLs, CLVs, ALs, or SSLs)
- Documents any exceedances of or federal or state standards for relevant media
- Documents any significant change in water quality, land quality, air quality or methane levels in monitored media

19.3 Annual Environmental Monitoring Report contents

The Annual Environmental Monitoring Report must reflect the facility's current conditions, present accurate data that correspond with the original field and lab data, and include the elements presented in the most recently approved plan.

19.4 Annual leachate treatment report

Prior to March 31 of each year, the permittee must submit an annual leachate monitoring report.

Reference: The report format should reflect DEQ's guidance: *Solid Waste Landfill Guidance*, September 1996, or the format presented in the most recently approved plan.

19.5 Annual leachate treatment report contents

This annual report must include the elements presented in the most recently approved plan.

Reference: The report format should reflect DEQ's guidance: *Solid Waste Landfill Guidance*, September 1996, or the format presented in the most recently approved plan.

19.6 Split sampling submittal

Within 90 days of any split sampling event, the permittee must submit the following information to DEQ's laboratory:

- A copy of all information pertinent to the sample collection handling, transport and storage, including field notes
- Copies of all laboratory analytical reports
- Copies of all laboratory Quality Assurance Quality Control reports
- A copy of the lab certification (ORLAP or NVLAP, see Certified Environmental Lab Data condition above)
- A hydrogeologic map of the site showing groundwater flow directions and water table contours
- Any other data or reports requested by DEQ

19.7 Lab address

Report all required split sampling information to:

Oregon Department of Environmental Quality
Laboratory, Groundwater Monitoring Section
7202 NE Evergreen Parkway, Suite 150
Hillsboro, OR 97124

Phone: 503-693-5700 Fax: 503-693-4999

19.8 DEQ response to split samples

If the permittee submits all required split sampling data and requests DEQ's results, DEQ's lab may provide, to the permittee, copies of the following information:

- DEQ's analysis of the split sample
- The QA/QC report
- The analytical report
- The field data sheets

20.0 ENVIRONMENTAL MONITORING NETWORK

20.1 Monitoring device installation

For future disposal units or cells, the permittee must install DEQ-approved background and detection and/or compliance wells at least 12 months before refuse disposal occurs in the new cells. A Site Characterization Report may also be required for any proposed new cell. DEQ may waive or modify this requirement if the permittee provides adequate justification for an alternative approach.

20.2 Monitoring stations and equipment

To assure that every sample is representative of the site's environmental conditions, the permittee must protect, operate, and maintain all environmental monitoring stations and equipment in accordance with DEQ's requirements.

20.3 Access to monitoring stations and equipment

To facilitate sample collection and/or inspection and maintenance activities, the permittee must maintain reasonable all-weather access to all monitoring stations and associated equipment.

20.4 Reporting equipment damage

Within 14 days of discovering any damaged monitoring equipment or station, the permittee must submit to DEQ a report describing the damage, the proposed repair or replacement measures, and the schedule to complete this work.

Example: a well's impaired function or altered position/location.

20.5 Monitoring well construction

The permittee must complete any monitoring well or gas monitoring probe abandonment (decommissioning), replacement, repair, or installation in a manner that complies with the Water Resources Rules, OAR 690-240, and with DEQ's *Guidelines for Groundwater Monitoring Well Drilling, Construction, and Decommissioning*, dated August 1992.

20.6 Reporting well construction and repairs

The permittee must document all monitoring well or gas probe repair and construction activities, including driller's logs, well location information, and construction information in a report prepared and stamped by a geologist or certified engineering geologist, with current Oregon registration. The permittee must submit the report to DEQ within 30 days of the action and include this documentation in the next Annual Environmental Monitoring Report.

20.7 Well decommissioning or replacement

The permittee must submit a written recommendation to DEQ prior to decommissioning or replacing any well or gas monitoring probe in the monitoring network. After receiving DEQ's approval, the permittee must decommission or replace any well or gas probe that meets the following criteria:

- The well or gas probe was installed in a borehole that hydraulically intersects two saturated stratas
- The permittee lacks supporting documentation demonstrating that the well or gas probe was properly installed and constructed
- The well or gas probe was damaged beyond repair or destroyed
- Other reasons as determined by either the permittee or DEQ

COMPLIANCE SCHEDULE

21.0 SUMMARY OF DUE DATES

21.1 Summary

The permittee must comply with the event-driven schedule shown below. This compliance schedule does not apply to many of the routine reporting requirements specified in other sections of the permit.

Due Date	Activity	See section...
120 days prior to new landfill construction or expansion	Submit updated Environmental Monitoring Plan	15.1 Environmental Monitoring Plan submittal
Within 90 days of permit issuance	Review and submit conceptual "worst-case" closure and post closure plan	12.1 Worst case closure plan development

April 1st of each year	Submit financial assurance plan and mechanism	13.3 Recertification of financial assurance
Within 360 days of permit issuance	Review and submit site development plan update	10.1 Site development plan
Within 270 days of permit issuance	Submit updated Operations Plan	7.1 Operations plan submittal
Within 60 days of Operations Plan approval	Submit updated Operations and Maintenance Manual	7.3 Operations and Maintenance Manual
By March 31 for each year	Submit an Annual Environmental Monitoring Report	19.1 Annual Environmental Monitoring Plan
By March 31 for each year	Submit an Annual Leachate Treatment Report	19.4 Annual leachate treatment report
SAMPLING:		
At least 10 working days prior to scheduled sampling event	Notify DEQ	16.1 Notification of sampling events
At least 45 days prior to split sampling event	Schedule split sampling event with DEQ laboratory	16.2 Split sampling events
Within 90 days of split sampling event	Submit required data/documents to DEQ laboratory	19.6 Split sampling submittal
EVENTS:		
Within 30 days of DEQ notification of need to install monitoring well or probe	Install groundwater monitoring well and/or probe	20.1 Monitoring device Installation
Within 30 days of any well construction	Submit well construction report	20.6 Reporting well construction and repairs
At least 6 months before any new disposal unit and/or closure construction	Submit engineering design plans and, if applicable, closure schedule	10.3 Design plans 12.4 Closure plan approval
At least 270 days prior to new construction or expansion	Submit a Site Characterization Report Workplan	14.1 Workplan
Within 180 days of DEQ approval of SCR workplan	Submit a Site Characterization Report	14.2 Site characterization report
Within 90 days after completion of any major construction	Submit Construction Certification Report	10.7 Construction report submittal
Within 18 months of plan approval	Begin construction	10.4 Construction requirements

ATTACHMENTS

22.0 ATTACHMENT

Attachments to the permit include:

Number	Description
1	Parameter Groups
2	Permit-specific concentration limits

22.1 Attachment 1: Parameter Groups

Overview

This attachment describes the environmental-monitoring parameter groups and associated requirements

Due to the duration of this permit, suggested analytical methods may change. If that is the case, use the most currently promulgated EPA method or DEQ-approved equivalent.

Note: Method means EPA SW 846 Method [suggested methods are in square brackets].

Group 1a: Field indicators

The field indicators parameter group includes the following parameters:

Elevation of water level
pH
Temperature
Specific Conductance
Dissolved Oxygen
Eh

With instruments calibrated to relevant standards, measure these parameters in the field when collecting samples. Acceptable methods include:

- Down-hole in situ
- In a flow-through well
- Immediately following sample recovery

Group 1b: Leachate indicators

The laboratory indicators parameter group includes the following parameters:

Total Dissolved Solids (TDS)
Total Suspended Solids (TSS)
Total Organic Carbon (TOC)
Chemical Oxygen Demand (COD)

Proper techniques for sample handling, preservation, and analysis are specific to each individual analyte: Follow appropriate EPA techniques or AWWA Standard Methods.

Group 2a: Common anions and cations

The common anions and cations parameter group includes the following parameters:

Calcium (Ca)
Sulfate (SO_4)
Total Ammonia (NH_3+NH_4)
Sodium (Na)
Nitrate (NO_3)
Silicon (Si)
Iron (Fe)
Manganese (Mn)
Magnesium (Mg)
Chloride (Cl)
Carbonate (CO_3)
Potassium (K)
Bicarbonate (HCO_3)

Dissolved concentrations must be measured. Field-filter and field-preserve samples according to standard DEQ and/or EPA guidelines and analyze by appropriate EPA or AWWA Standard Methods techniques. Report results in mg/L and meq/L.

Group 2b: Trace metals

The trace metals parameter group includes the following parameters:

Antimony (Sb)	Chromium (Cr)	Selenium (Se)
Arsenic (As)	Cobalt (Co)	Silver (Ag)
Barium (Ba)	Copper (Cu)	Thallium (Tl)
Beryllium (Be)	Lead (Pb)	Vanadium (V)
Cadmium (Cd)	Nickel (Ni)	Zinc (Zn)

If the Total Suspended Solids concentration is...	analyze for...
less than or equal to 100.0 mg/L in the sample	total concentrations (unfiltered)
Greater than 100.0 mg/L in the sample	both total (unfiltered) and dissolved (field-filtered)

Field-preserve samples according to standard DEQ and/or EPA guidelines and analyze by EPA Method 6010C or DEQ-approved equivalent.

Group 3: Volatile organic constituents

Analyze for all compounds detectable by EPA Method 8260B (C- other method 8/06) or EPA Method 524.2, include a library search to identify any unknown compounds present. The volatile-organic-compounds parameter group is equivalent to the EPA Method 8260B list.

DEQ must pre-approve alternative methods like EPA Method 8021B

Group 4: Assessment monitoring

The assessment monitoring parameter group includes the following parameters:

Semi-volatile Organic Constituents, including Phenols, EPA Method 8270D
Mercury, EPA Method 7470A
Cyanide, EPA Method 9010C (manual distillation) or 9012B (automated distillation)
Nitrite

All Method 8270D analyses must include a library search to identify any unknown compounds present.

Group 5: Surface water and leachate

The surface water parameter group includes the following parameters:

Total Kjeldahl Nitrogen (TKN)	Total Coliform Bacteria [EPA Method 9131]
Total Phosphorus (P)	Fecal Coliform Bacteria [EPA Method 9131]
Orthophosphate (PO_4)	E. Coli
Biological Oxygen Demand (BOD)	

22.2 Attachment 2: Remedial Action Concentration Limits and Permit Specific Concentration Limits

In accordance with OAR 340-040-0050(2) and as defined in the site Record of Decision (dated October 2004); Remedial Action Concentration Limits are established for the "west side" monitoring points specified in Section 18.2 of this permit as follows:

Compound	RACL	Basis	COPC
Volatile Organic Compounds (µg/L)			
1,4-Dichlorobenzene (1,4-DCB)	75	MCL/RL	Yes
Tetrachloroethene (PCE)	5	MCL	Yes
Trichloroethene (TCE)	5	MCL/RL	Yes
Vinyl chloride	2	MCL/RL	Yes
Trace Metals (µg/L)			
Antimony	6	MCL	No
Arsenic	10	MCL	Yes
Barium	1,000	RL	No
Beryllium	4	MCL	No
Cadmium	5	MCL	Yes
Chromium	50	RL	No
Lead	50	RL	No
Nickel	100	MCL	No
Selenium	10	RL	No
Silver	50	RL	No
Thallium	2	MCL	No
Dissolved Metals (µg/L)			
Iron	300	SMCL	Yes
Manganese	50	SMCL	Yes
Inorganic Compounds (mg/L)			
Chloride	250	SMCL	Yes
Total Dissolved Solids (TDS)	500	SMCL	Yes

RACL: Remedial Action Concentration Limit

Basis: The lower of either Federal primary Maximum Contaminant Level (MCL) or State Reference Level (OAR 340-040-0020, Tables 1 through 3).

SMCL: Secondary MCL

COPC: Chemical of Potential Concern

In accordance with Section 17 of this permit, Permit-Specific Concentration Limits are established for the "east side" monitoring points specified in Section 18.2 of this permit as follows:

Site Specific Limits for MW 26 and 27
Assumes 2 Compliance Wells, 7 or 8 COCs, Semiannual Sampling

Indicator Parameters (Date set: 2011-2018)	Statistical Distribution	Prediction Limits (mg/L)		Retesting
		MW-26	MW-27	
Bicarbonate	Normal	175[a]	495	1 of 2
Chloride	Normal	6.2	15.0	1 of 2
TDS	Normal	246[a]	499	1 of 2
Calcium	Normal	32.0[a]	100	1 of 2
Iron	NP/Normal	4.5	17.6	1 of 2
Magnesium	Normal	10.1	46.0	1 of 2
Manganese	Normal	0.74	8.9	1 of 2
Sodium	Normal	30.0	44.4	1 of 2

Note: [a] surrogate value calculated from MW-22.
Retesting scenario achieves annual site wide false positive rate of 10% per EPA Unified guidance.

EXHIBIT 24
OREGON DEQ PERMIT WORK PLAN

DEVELOPMENT AREA HYDROGEOLOGIC AND GEOTECHNICAL CHARACTERIZATION WORKPLAN

COFFIN BUTTE LANDFILL

BENTON COUNTY, OREGON

Prepared for

Republic Services, Inc.
Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, Oregon 97330

July 9, 2021

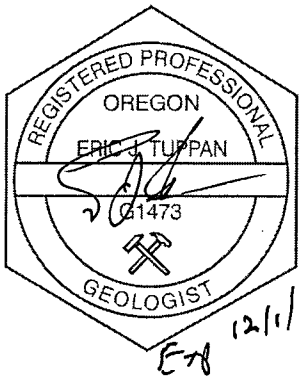
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Project CEC-001-002

Development Area
Hydrogeologic and Geotechnical Characterization Workplan
Coffin Butte Landfill
Benton County, Oregon

The material and data in this report were prepared under the supervision and direction of the undersigned.



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1 INTRODUCTION

This document presents a plan for site characterization at the Coffin Butte Landfill in Benton County, Oregon, which is owned and operated by Valley Landfills, Inc., a subsidiary of Republic Services, Inc. Republic is in the process of permitting, site characterization, and preliminary planning and design to develop the landfill south of Coffin Butte Road. In addition to the landfill development, Republic is also planning to move or build new support areas and structures for the landfill, including: a new access road around the south side of the landfill, leachate ponds proposed for east of the landfill footprint, an employee building area, and pump stations.

1.1 Background and Plan Organization

Past investigations have extensively characterized site hydrogeology and geotechnical parameters for the area north of Coffin Butte Road, where a multiunit landfill has been operating since the mid 1970s. The area south of Coffin Butte Road is currently used for ancillary structures and buildings that support landfill operations. Hydrogeologic and geotechnical characterization has also occurred in the area south of the road, primarily as it relates to the construction and operations of the leachate holding ponds. Currently, characterization includes ongoing groundwater quality monitoring.

The workplan is organized in roughly three parts. The first describes the goals of site characterization as defined in Oregon Department of Environmental Quality's (DEQ) *Solid Waste Guidance, Municipal Solid Waste Landfills* (DEQ, 1996), including the elements specifically listed in Sections 2, 3, and 4 of that guidance. Second, the workplan summarizes information from past studies for Coffin Butte Landfill that focuses on the development area, and identifies elements where additional data are needed to refine our understanding of the site hydrogeology and geotechnical attributes of soil and bedrock. Last, we develop a scope of work that addresses the data gaps, provides the types of technical information that will be needed for a conceptual design for the landfill, and as appropriate, for developing design-level information that satisfies the permit requirement for hydrogeologic and geotechnical characterization.

1.2 Project Objectives

Over a period of over 40 years, consultants have studied the surface soils and subsurface geology of the site, as well as the groundwater hydrogeology and geochemistry. With this substantial historical record, at least for the area north of Coffin Butte Road, much of the site character for surface soils and for shallow and deep water-bearing zones, is known. However, south of Coffin Butte Road, less is known regarding the constructability of a landfill. Given this amount of known information, objectives for this study include:

- Update information to satisfy DEQ's Phase I site characterization elements which focus on regional and area-wide data needs.

- Evaluate the site geology and hydrogeology, including stratigraphic units and the water-bearing zones as part of Phase II site characterization. More specifically, this aspect will examine subsurface conditions that include the depth and extent of the water bearing hydrogeologic units, the hydraulic connection between units, the lithologic and hydraulic properties of these units, groundwater flow patterns, and other factors. It should be noted that the groundwater-related investigation will be phased later with a separate workplan as described in Section 4.3.

- Acquire geotechnical information about the site to satisfy both a Phase I and II geotechnical assessment, including design-level data on the distribution of overburden (i.e., alluvium), depth of bedrock, and competency of units in the south development area. This aspect of study will include:
  - Characterize the variability, depth, aerial extent and engineering properties of onsite soils and other overburden deposits.
  - Inventory soils and other overburden deposits suitable for use in construction, and identify a proposed use for these materials.
  - Identify geotechnical considerations (such as settlement and slope stability) which must be addressed in the engineering design.

- In a future phase, Republic will augment the groundwater monitoring network in the south development area. We anticipate that this will include installing upgradient, and cross- and down-gradient wells along the perimeter of the landfill footprint as well as decommissioning several wells along Coffin Butte Road that are within the planned footprint of the landfill.

1.3 Project Team

The characterization project will be overseen by Tuppan Consultant who will coordinate office and field tasks, and be the primary author of the site characterization report. The

Wallace Group, Inc., of Bend, Oregon, will provide field personnel for test pits and borings, in addition to performing geotechnical analyses necessary for the site characterization report. Civil & Environmental Consultants, Inc. (CEC) will provide CAD support for preparing figures for the report.

2 GOALS OF INVESTIGATION

This section provides background and context to the scope of work that will be developed later in the workplan. The primary goal of the site characterization report is to satisfy the various elements outlined in the DEQ's guidance on landfill characterization. In the guidance, these are organized into two phases that focus on geology and hydrogeology, plus another phase for the geotechnical evaluation.

2.1 Phase I Site Characterization

The main objectives of the Phase I site characterization study are to describe existing site conditions, determine if the site is suitable for landfill construction, provide sufficient base-line information for developing the facility design, construction program, operations plan, and the environmental monitoring program. As the site has already been zoned and developed as a landfill, many of the site suitability elements have been provided in past reports. Specific topics taken from the Section 2 of the DEQ guidance are described below.

2.1.1 Existing Conditions

Much of this information on existing conditions at the site has been presented in documents listed in the references. This includes:

- Site Location. Describe the site location with respect to known or easily identifiable landmarks, include the section, township, and range location for the site. Describe access to the site from the nearest U.S. or State Highway.

- Legal Description. Provide a legal description of the tract or tracts of land which have been or are proposed to be used for waste disposal activities.

- Vicinity Map. This will include a map or series of maps showing the facility and the area within at least a five-mile radius of the site boundary. Additional elements to be included on the vicinity map are provided in the guidance.

- Aerial Photographs. Prepare a stereo pair of standard size (9 inches by 9 inches) recent vertical aerial photographs with a scale up to 1:40,000, which

shows the site and the area within at least a one-mile radius of the site boundary.

- Adjacent Landowners. Show on a location map or on County Tax Lot map(s), the names and mailing addresses of all landowners within one-quarter mile of the property and any other landowners identified as being affected by the proposed facility.

- Site Map. Prepare a detailed site map scaled at not more than one inch equals 200 feet (or other scale approved by the Department) that shows existing conditions in addition to the proposed landfill development footprint, soil borrow areas, and wells.

2.1.2 Climate and Meteorology

Current information based on or extrapolated from data collected at the closest reporting weather station or stations including:

- Average annual precipitation and monthly distribution of precipitation.
- Average annual evaporation and monthly distribution of evaporation.
- Average annual prevailing wind direction and monthly variation in wind direction.
- Average and maximum wind velocities and monthly variations in wind velocity.
- Average annual temperature and monthly variations in temperature.

2.1.3 Hydrology

Evaluate and describe the surface water drainages of the site and of the surrounding area within at least a one-mile radius of the site. This information should include a map or maps at a scale of 1:24,000 showing major perennial, ephemeral and intermittent drainage channels, and their tributaries.

2.1.4 Water Balance

Analyze the average annual site water budget including precipitation, runoff, infiltration and evapotranspiration. Determine the monthly variations of each of these parameters for a one-year period. Acceptable water balance methods include Thornthwaite-Mather (1957), the EPA Water Balance (1975), the EPA Help Model (1984), and/or other methods approved in advance by the Department.

2.1.5 Water Use Inventory

Identify all active and inactive water wells, irrigation wells, and surface water usage points within the targeted radius. As needed, identify and field check water usages within this radius which are listed in the drillers' log files or other records of the Oregon Water Resources Department (WRD). Areas within the radius of investigation that are served by a municipal water supply should be included in the WRD well records search.

2.1.6 Geology and Hydrogeology Investigation

Conduct a preliminary geology and hydrogeology investigation. Evaluate the regional geology and hydrogeology based on geological reconnaissance field mapping and existing published or unpublished reports and data from state and federal agencies, universities, consultants or other sources.

In addition to the hydrogeology, describe the geologic hazards that may include seismic impacts, mass movement (e.g., landslides), unstable soils, flood inundation, shallow groundwater levels, tsunami, and volcanic eruptions. Location restrictions under OAR 340-94-030 address considerations such as Holocene fault zones, seismic impact areas and unstable areas.

Assessment of geologic hazards will also evaluate the earthquake safety of the site, including:

- A description of the seismotectonic setting and seismic history of the area, including size, frequency, and location of historic earthquakes. ·
- Potential for area to be affected by surface rupture, including sense and amount of displacement, and width of surface deformation zone.
- Probable response of site to likely earthquakes, including estimated ground motion, maximum ground acceleration, velocity and displacement.
- Potential for area to be affected by earthquake-induced landslides or soil liquefaction.
- Potential for area to be affected by regional tectonic deformation (subsidence or uplift).

Finally, to the extent possible, identify and evaluate other known or suspected geologic hazards which may affect the design, construction, and operation of the facility.

2.2 Phase II Characterization

The main objective of the Phase II site characterization is to describe and evaluate the site geology and hydrogeology, including stratigraphic units encountered, the uppermost

aquifer or water-bearing zone, and other potential zones of contaminant transport. Elements will include:

- Surface investigations such as surface geologic mapping and excavating test pits.
- Subsurface investigations will include geotechnical borings, and, in a later phase, groundwater monitoring wells.
- Hydrogeologic testing to provide aquifer parameters, also as part of subsequent phase for future monitoring wells.
- Environmental testing to assess groundwater and surface water quality.

2.3 Geotechnical Characterization

Section 4 of landfill guidance calls for characterizing the variability, depth, aerial extent, and engineering properties of onsite soils and other overburden deposits. This should include:

- Inventory soils and other overburden deposits suitable for use in construction, and identify the proposed use for these materials.
- Identify geotechnical considerations, such as settlement and slope stability as listed in Phase I geotechnical investigation guidance.
- Perform additional geotechnical investigations as required by a Phase II work scope that includes design calculations and analyses, and that could include:
  - Potentially unstable natural slopes and other on-site areas that could be destabilized by construction activities such as excavation, regrading or other site modifications.
  - Stability of the landfill foundation considering site-specific topographic and geologic conditions, static and dynamic loads, pore-water pressures at the subgrade-liner interface, and any other relevant factors.
  - Compressibility of underlying geologic units and potential settlement of the landfill unit. Estimate total and differential settlement based on appropriate field and laboratory methods and design parameters.

3 SITE BACKGROUND

The information summarized in this section provides the framework for identifying data needs and in developing the proposed scope of work. Technical details are provided in several reports cited in the references section. Much of the information discussed below was summarized in the *Site Characterization - Cell 3 Coffin Butte Landfill* (EMON, 1999), the *Environmental Monitoring Plan* (EMP)(Tuppan, 2014), and the *2020 Annual Environmental Monitoring Report* (Tuppan, 2021), and the reader is referred to those documents for more details.

3.1 Site Location and History

Coffin Butte Landfill is in the west-central Willamette Valley, eleven miles north of Corvallis, Oregon (see Figure 1). Topographic elevations in the area range from 220 to over 740 feet above mean sea level (msl) at the summit of Coffin Butte. The landfill is in a predominantly agricultural area. The land adjacent to the site is zoned exclusive farm use, forest conservation, and rural residential with either a 5- or 10-acre lot minimum.

Landfilling began in 1945 on the southwest flank of Coffin Butte and has continued to the east along the southern flank (Figure 2). The first area of landfilling (referred to as the Closed Landfill) was initially quarried for crushed rock after which it received waste from 1945 to 1977. In 1977, the Closed Landfill was capped with soil and closed. Subsequent landfill development progressed eastward across the site. Recently, in 2019, VLI began source removal of the Closed Landfill, which physically removed the old waste and hauled it to Cell 5 in the active part of the landfill. This process continued into 2021 at which time the entire waste mass of the Closed Landfill will have been removed.

In 1975, VLI began filling Cells 1 and 1A, with most waste being placed in Cell 1 beginning in 1977. Cell 1A (approximately 4 acres) primarily handled waste from Teledyne Wah Chang and was not used for disposal after 1988. Cell 1 (approximately 30 acres) has a clay bottom liner and leachate collection system that conveyed the leachate to an adjacent holding pond. Placement of waste in Cell 1 stopped in early 1993, when cell 2B was constructed. Cell 1A has gone through final closure, and Cell 1 has been closed along the southern, central, and western parts. A “piggyback” liner system was constructed over the east side of Cell 1 as part of the development of Cell 3D. The lower half was constructed in 2006, and the upper half constructed in 2008. Final stages of

filling Cell 2 ended in 2004 with final cover constructed along its southern flank in summer 2003.

Cell 3 has also been filled, and final closure construction has occurred over a portion of the south face of Cell 3. Cell 4 was constructed in summer 2011 with operations moving into the northern half of that cell in fall 2011. In summer 2012, the remaining features of Cell 4 were completed, including moving the primary and secondary leachate sumps to their locations on the southern perimeter of the cell. Cell 5A was excavated north of Cell 4 in summer 2012 with construction completed in 2013**.** Cells 5B, 5C, 5D and 5E were excavated over the summers of 2015 to 2017. Cell 5B was subsequently completed in the summer of 2017, Cell 5C during the summer of 2019, and Cell 5D completion is currently under construction. Filling operations are currently taking place in Cell 5C.

Coffin Butte serves Benton, Linn, Polk, Lincoln, and Tillamook counties. The facility is permitted as a municipal solid waste disposal site and is authorized under Section 5 of its solid waste permit to accept domestic, commercial, industrial, construction, demolition, and agricultural waste, sewage sludge and grit, petroleum contaminated soil, and asbestos.

3.2 Site Geology and Hydrogeology

The geology and hydrogeology of the site have been described in a number of documents. One of the most comprehensive was the site characterization report for Cell 3 (EMCON, 1999), which synthesized the regional and site geology and hydrogeology from a number of earlier reports and the scientific literature. Discussions of water quality conditions at the site are summarized in annual reports (since 1992), the remedial investigation and its addendum (EMCON, 1994, 1996b), the preliminary assessment for the area downgradient of the 1977-closed landfill (EMCON, 1996a), previous versions of the EMP (EMCON, 1997; TC, 2005, 2011a, 2012b) and the focused risk assessment and feasibility study (TC, 2003a). The following descriptions are taken primarily from the EMP, and has been updated to include information from more recent drilling associated with Cell 5, and with regard to current trends in groundwater quality at the site as it is relevant to the south development area.

3.2.1 Hydrogeologic Units

The current cells of the landfill are situated along the south flank of Coffin Butte (Figure 2). In undeveloped areas, the upper third (approximately) of the butte consists of steep grass-covered slopes, the middle third of exposed bedrock with little vegetation, and the lower third of gentle, soil-covered slopes. The development area borders an interior, north-facing drainage of Poison Oak Hill. The upper part of the hill is steeper, forest-covered slopes, with the lower areas either grassy or developed as part of the landfill infrastructure. Generally, the upper slopes from the top of Poison Oak Hill to

approximately the current locations of the leachate ponds are underlain by basalt bedrock and the lower, flatter slopes underlain by alluvium that generally consist of silty clay to clayey silt with variable amounts of thin, interbedded sands and silty to sandy gravel (commonly referred to as Willamette Silt). The lower slope transitions eastward to the relatively flat Willamette Valley where alluvium is transected by small drainages or creeks. For the current landfill, solid waste in Cells 1/1A and the Closed Landfill is generally inferred to rest on bedrock, which in places was lined with clay (e.g., in Cell 1). Cells 2 through 5 are constructed with composite liners and leak detection systems, with Cells 3 through 5 also designed with underdrains. The vertical relationship of alluvium, bedrock, and waste units in the east side of the landfill, Cell 2 and 4 area is illustrated in Appendix A, Figure 2-2 from the EMP.

There are two principal water-bearing units: unconsolidated alluvium and bedrock volcanics. Groundwater occurs in both units, although the alluvial deposits are absent or unsaturated over much of the site where the development area occurs. Where both units are present, they are not separated by a confining layer but are hydraulically interconnected. The two units are monitored separately by groundwater monitoring wells.

3.2.2 Groundwater Occurrence and Flow

Depth to groundwater depends on season and topography. In site wells, the groundwater depths can range from over 80 feet below the ground surface midway up the slopes of Coffin Butte (in bedrock) to less than 1 foot in the flat lowland area southeast of the butte (in alluvium). For wells MW-8S, MW-8D, MW-15, and MW-16 (now decommissioned), which are within or adjacent to the development area, seasonal fluctuations vary, depending on the hydrogeologic position of the monitoring point (see Figure 3 for monitoring well locations). Typically, the lowest groundwater elevations are in late summer to fall and the highest in winter and spring. This is illustrated in Figure 4, which are historical hydrographs for those wells.

The direction of groundwater flow is controlled by the topographic setting of Coffin Butte and Poison Oak Hill and the intervening low areas. Groundwater in the bedrock generally flows downslope from the hills until it reaches a groundwater divide near the southeast corner of Cell 1 and southwest part of Cell 3. At the divide, groundwater flows toward the east and west, generally following the long axes of the valleys (Appendix A, Figure 2-3). Groundwater flow direction in the saturated portion of the alluvium mimics the underlying bedrock (Appendix A, Figure 2-4). In areas dissected by surface drainages, groundwater in the upper part of the alluvial aquifer discharges to surface creeks, such as Soap Creek west of the landfill, or Luckiamute Creek to the east, and during the summer months provides base flow. Near upland areas, groundwater in bedrock also can provide base flow to surface creeks, for instance, in Soap Creek, weathered basalt bedrock is exposed in the stream bed between surface water locations

S-2 and S-4. Groundwater contours for the entire site for the most recent sampling events in April and October 2020 are shown in Appendix A, Figures 3-5 and 3-6.

Estimates of horizontal groundwater velocity (Vh) are typically calculated at the Coffin Butte Landfill for the east side, beneath Cell 4. Beneath this part of the landfill, Vh is calculated at approximately 6.4 ft/yr, given a hydraulic conductivity of 0.22 ft/day for the alluvium, an estimated effective porosity of 25 percent (literature values in Morris and Johnson, 1967), and a hydraulic gradient of 0.02 ft/ft.[1] Current estimates of groundwater flow for other parts of the site can be found in the 2020 annual report (Tuppan, 2021).

3.3 Water Quality

The discussion of water quality focuses on the east side of the landfill, and includes current monitoring and underdrains in the development area. For the east side of the landfill, monitoring is in the detection mode, focusing on characteristics of the natural or baseline water quality and how to recognize impacts from the landfill. Additional water quality information and time-series concentration plots for groundwater and underdrains can be found in the 2020 annual report (Tuppan, 2021).

3.3.1 East Side – North of Coffin Butte Road

Cell 2 and Cell 3 – Detection Well MW-24. Wells near Cell 2 include detection well MW-24 at the southern intersection of Cells 2A and 3, and MW-23 discussed below. Well MW-24 is completed in shallow weathered bedrock (the alluvium is not saturated in this area). Trends for indicator parameters in MW-24 are stable and reflect natural water quality in the area.

Cell 2 – Detection Well MW-23. Early in its history, detection well MW-23 had shown increases for bicarbonate alkalinity, chloride, hardness, total dissolved solids (TDS), for five of the major dissolved metals, and for arsenic. This had been attributed to localized seepage of leachate from the south side of the landfill that was remedied soon thereafter. Since 2000 to 2001, the upward trends for indicator parameters have peaked, and after about 2009 to 2011, most of these constituents declined to within or just above the range of background concentrations. With the exception of chloride, which is a few milligrams per liter higher than background, the concentrations in 2020 were at these lower values near or within background levels.

Cell 4 – Compliance Wells MW-26 and MW-27. These wells were first sampled in November 2011 and accumulated quarterly baseline water quality data throughout 2013.

[1] The mean hydraulic conductivity for alluvium and bedrock was evaluated from pumping and slug test data collected from 1985 to 1993 as reported in the remedial investigation (EMCON, 1994). Geometric means were calculated for each unit after examining boring logs to verify hydrogeologic unit. Values used in annual reports are as follows: alluvium, 0.22 ft/day; bedrock, 2.7 ft/day.

Examination of the trends show relatively lower and stable concentrations at MW-26 than at MW-27, which typically has a wider range of concentrations. Concentrations for several parameters at MW-27 can be quite variable. This is likely caused by two conditions at MW-27. First, the water bearing zone that the well monitors has very low permeability, requiring the well to be purged one day and then sampled the following after it recharges adequately. This does not allow the purge water to stabilize during sampling, so that water samples can be affected unevenly from sampling event to sampling event. The second condition is the mineral composition of the formation opposite the screened interval, which is composed of organic clay with up to 10 percent fine sand. The presence of the organics is likely from an ancient bog that was mapped in the base of the Cell 4 excavation.

3.3.2 Development Area – North Slope of Poison Oak Hill

In wells MW-8S and MW-15, concentrations of inorganic indicators in 2020 continued longer-term trends of past years. At MW-8S, an earlier increasing trend for chloride peaked in 2001 and is now declining gradually, while at MW-15, chloride concentrations have been more variable to upward since 2010; other indicatory parameters have been relatively stable or declining. Trace metals were detected at low to trace concentrations, or were not detected in 2020 and no VOCs were detected. Before it was decommissioned in 2004, concentrations of chloride and sodium at MW-16, which was upgradient of MW-15, were typically lower than at MW-15. This is likely due to naturally occurring saline, connate water in the fine-grained sediments in this area, in which MW-15 is screened. This water quality contrasts with MW-16, which is screened in fresh bedrock, and has naturally lower concentrations for site indicator compounds than the alluvium.

3.3.3 Surface Water and Underdrains

Surface water is not sampled in the development area. However, underdrains that daylight to surface water are sampled in two location: S-U4 that drains from below the East Leachate Pond and S-U5, which drain from below the West Leachate Pond.

Water quality from underdrain S-U4 represents baseline concentrations, with values for inorganic compounds and dissolved metals comparable to or lower than concentrations at MW-16, which was the background well that monitored bedrock in the pond location before it was decommissioned in 2004. Since monitoring began, concentrations for the indictor parameters have been steady and exemplify a condition of no leakage from the overlying pond.

Beginning in October 2010, VLI began sampling S-U5, which drains from below the West Leachate Pond. The drain pipe also connects with another pipe that drains from below the concrete pad of the non-operational Leachate Treatment Plant. It should be noted that minor differences are expected between underdrain S-U5 water quality and

groundwater quality at MW-16, since these two monitoring points are not immediately proximal to each other. Nevertheless, trend plots illustrate that water quality at the two points is very close. Similar to water quality results at S-U4, the steady trends at S-U5 suggest no leakage from the overlying liner system for the West Leachate Pond.

3.4 Existing Monitoring Network

The water quality monitoring network at Coffin Butte Landfill has five components: (1) groundwater monitoring wells, which include compliance and detection wells, (2) water level observation wells and piezometers, (3) the secondary leachate collection system (SLCS), (4) leachate sumps, and (5) surface water monitoring points. In addition to water quality, landfill gas is monitored at probes surrounding the landfill, and in buildings or structures near the landfill. The rationale for the network design and the media monitored was presented in the EMP (Tuppan, 2014b). The water quality monitoring locations are summarized on Table 1. A summary of the well construction, survey information, and lithologic completion intervals is provided in Table 2. Boring logs and construction diagrams for wells in the development and adjacent area are provided in Appendix B.

3.5 Geotechnical Information

Information about geotechnical considerations and landfill liner designs can be found in design or characterization reports for Cell 3 (Thiel, 1999), Cell 4 (Tuppan, 2011), Cell 5A (Thiel, 2012), the west leachate pond (Thiel, 1998), and from site development reports completed in 2000 (Thiel, 2000), 2011 (Ausenco-Vector, 2011), with an amendment to the 2011 plan in 2013 (Thiel, 2013). These reports contain geotechnical data, calculations, stability analyses, groundwater seepage estimates, geotechnical laboratory testing results, logs for test pits and boring logs, and design drawings for the landfill cells or pond. While potentially relevant to the current development project, much of the specific data is for soil or areas outside the planned landfill footprint. Therefore, more site-specific data will be collected as part of the scope of work to be developed in Section 4 of this plan.

As part of locating the test pits and geotechnical borings, we will incorporate information from past site investigations, specifically for boring and test pits from the west leachate pond study which are shown on Figure 5 along with the proposed locations. We will also be using information from monitoring wells drilled within the development area or along Coffin Butte Road to assist with identifying potential depths of borings based on existing knowledge. Finally, surface geologic mapping of the subgrade of the East Leachate Pond will be used as the starting point for extending surface mapping to other areas of the development footprint.

4 DATA GAPS AND PROPOSED CHARACTERIZATION

This section reviews the available hydrogeologic and geotechnical data reported in past investigations and compares it with the elements of DEQ's site characterization guidance to identify data gaps as the basis for the proposed scope of work and approach. We intend to mine the trove of available documents to meet these data needs where possible. In addition, this section discusses goals of the proposed characterization, the types of information to be gathered, and the rationale for the proposed work scope. The intent is to define general tasks that will be described in more detail in Section 5.

4.1 Phase I Data Elements Evaluation

4.1.1 Existing Conditions

Information from earlier documents, Benton County assessors office, and mapping done for previous studies will be consolidated for the development area. Tasks will include:

- Prepare the report sections on the site location, legal description, and the vicinity, including area and site maps, from earlier documents, as available. If information is out of date, then provide current data.

- Aerial photographs of the site are typically taken annually to evaluate amount of fill at the active landfill area. Depending on the year, these images also include areas outside the landfill area. For this task we will find recent aerial views of the site and vicinity, using either custom images or those from readily available sources such as from the University of Oregon or from Google.

4.1.2 Climate and Meteorology

This information has been included in both the Cell 3 report (EMCON, 1999) and West Leachate Pond report (Thiel, 1998). Tasks will include summarizing this earlier information and, if available from the Oregon Climate Service at Oregon State University's webpage, updating it to include data through the year 2020.

4.1.3 Hydrology

Information on surface water drainages at the site and of the surrounding area was included in the Cell 3 report and can be found as Figure 1 in Appendix A. Tasks for this element will be to include a figure similar to Figure 1, and in addition, include larger scale maps (1:24,000) from the U.S. Geological Survey. These topographic quadrangle maps (Airlie South and Lewisburg 7.5 minute quadrangles) show the drainages and topography of the surrounding area. The landfill development area will be indicated on the maps.

4.1.4 Water Balance

Analysis of the site area's water balance presented in the Cell 3 site characterization report (EMCON, 1999). The purpose of the water balance calculated in the report was to evaluate the landfill's predevelopment environment (i.e., if no landfill was present at the site), and to predict the relative amount of recharge to groundwater expected in the area. The Thornwaite and Mather (1957) method was used to estimate the average annual balance between precipitation, evapotranspiration, runoff, and percolation (groundwater recharge). This analysis is still valid for the area and will be used for the development area site characterization report. The task for this element will be to include the water balance as an appendix to the development area report.

4.1.5 Water Use Inventory

As part of the Cell 3 characterization, a door-to-door survey of water wells was performed for residences within a one-mile radius of the Coffin Butte Landfill in May and June 1999. That survey was an update of water well surveys previously submitted, which included the original survey conducted in 1986 by Sweet, Edwards & Associates (SEA, 1986), the Cell 2 site characterization report (EMCON, 1992) the response to review of Cell 2 site characterization report (EMCON, 1993a), and the remedial investigation and additional hydrogeologic report (EMCON, 1994). The 1999 survey consisted of obtaining copies of well logs from the Oregon WRD and interviewing the residences within a one-mile radius of the landfill. Interviews were documented in an appendix to that report.

Given that a door-to-door survey was already completed in 1999, and since then, documentation by drillers for the installation of new water supply wells is required, this new well information is part of the database kept by the WRD. Therefore, no door-to-door survey is proposed for this phase of development. However, the following tasks will be completed to update the older water use inventory:

- Search the WRD website for wells drilled since 1999 within the area of interest, and then download copies of those wells and create a table that lists the wells and information from both the earlier survey and the new well search.

- Develop a drawing that illustrates locations of wells by property within a one-mile radius of the development area. Well identifications will be cross-indexed to the compiled table with the well information.

- Compile an appendix with well logs and survey sheets from the 1999 survey, and well logs from the 2021 WRD database search. Because of its volume, this appendix will be in a portable document format (PDF) only.

4.1.6 Geology, Hydrogeology and Geologic Hazards Summary

Most of the information required for a preliminary geology and hydrogeology investigation is available from past studies at the site. Sections 3.2 and 3.3 briefly summarized some of the available information. Tasks for this part of the development area report will include:

- Describe the regional site setting for the landfill as augmented by available geologic and hydrogeologic maps from technical literature and from site specific studies completed for the site.

- Provide supporting documentation and figures illustrating the relationship between hydrogeologic units at the site and the proposed landfill.

Geologic hazards and earthquake safety have been discussed in site development plans (SDP) and a SDP amendment (Thiel, 2000; Ausenco, 2011; Thiel, 2013) as part of reviewing location criteria for siting municipal solid waste landfills. These reports found that there were no known Holocene faults within 200 feet of the landfill boundary, and that landfill cells have been, and will continue to be, designed for potential seismic events as described in the solid waste rules. In addition, there were no unusual unstable areas or foundation conditions known to exist that would adversely impact landfill development. Moreover, detailed geotechnical evaluations had been routinely conducted as part of each new cell development.

These earlier planning documents will be used to initially support our understanding for the geologic hazards analysis. Tasks for this element as they relate to the development area include:

- Discuss geologic hazards that could potentially be relevant to the site consistent with guidance Section 2.7 and that includes location restrictions under OAR 340-94-030 to address considerations such as Holocene fault zones, seismic impact areas and unstable areas.

- Evaluate the earthquake safety of the site, including relative to its seismotectonic setting and seismic history of the area, the potential for area to be affected by surface rupture, probable response of site to likely earthquakes, including estimated ground motion, maximum ground acceleration, velocity and displacement, the potential for area to be affected by earthquake-induced landslides or soil liquefaction, and the potential for the area to be affected by regional tectonic deformation (subsidence or uplift). This evaluation will be presented as part of the geotechnical investigation for the site.

4.2 Phase II Characterization Goals and Tasks

The Phase II site characterization will combine a compilation of the known data for the development area with a scope of work to acquire and assess new field data. Goals of the field work are to round out our knowledge of the geology and hydrogeology of this area, including stratigraphic units encountered; the depth to the uppermost water-bearing zone, and other potential zones of contaminant transport; and acquiring geotechnical data that will be used to support an engineering analysis for the landfill design. The following sections briefly summarize some the of existing information and then propose tasks to fill data gaps. A detailed scope of work that describes field tasks, including locations and depths of borings and test pits is provided in Section 5.

4.2.1 Distribution of Geologic and Hydrogeologic Units

The surficial soil in the development area is alluvium which is underlain by bedrock that is weathered to varying degrees. The goal of geologic characterization is to supplement existing lithologic information with regard to the horizontal and vertical extent of geologic units in the development area and to characterize their engineering properties. One of the products of this work will be to create an isopach map of the alluvium and identify the horizontal and vertical extent relative to the underlying bedrock. Another goal will be to further characterize the degree of weathering in the basalt bedrock. In areas across the site, the degree of bedrock weathering ranges from clay and silt to sand, gravel, a mix of sand and gravel, or a combination of weathered rock fine-grained rock and unweathered, hard rock.

Office and field tasks will include:

- Review lithologic data from test pits, boreholes, and surface mapping.

- Supplement surface geologic mapping as needed, beginning with existing mapping done for the east leachate pond.

- Log lithology of cores or cuttings from the proposed borings and test pits and test samples as described below.

- Note groundwater and moisture conditions in test pits and borings.

4.2.2 Geotechnical Evaluation

The site is founded on a firm, competent geologic formation comprised of fresh basalt, weathered basalt, and some thin veneers of alluvium in the flatter areas away from Poison Oak Hill. At other areas of landfill development north of Coffin Butte Road, the only geotechnical constraints at the site were global slope stability issues driven by the relative geometries of the bottom liner system, and the height and slope of the final landfill (Ausenco, 2011).

The proposed scope of work was developed to provide design-level data for relevant engineering analyses. The data will be used to assess the suitability of on-site material for facility construction and the integrity of the soil and underlying material for stability in constructing the landfill. Types of data collected during field tasks include mapping the types and distribution of soils at the site, as well as noting the engineering properties of soil structure in test pits and borings. Wallace Group staff will oversee tasks that will include:

- Review and evaluate available geologic, hydrogeologic, and geotechnical data for the Coffin Butte Landfill and surrounding Benton County area.

- Drill borings within the proposed landfill footprint, proposed leachate ponds area, and a new access road. The borings will be drilled to depths of approximately 25 to 150 feet below ground surface (bgs).

- Excavate test pits within the proposed landfill footprint and leachate ponds area. Exploration depth(s) are estimated at 10 to 12 feet bgs.

- Measure and record the depth to groundwater, if encountered, at each exploration location.

- Perform laboratory testing to evaluate and confirm the engineering and index properties of the soil and rock materials encountered. We anticipate laboratory testing will include grain-size analysis, moisture content, Atterberg limits, hydraulic conductivity, consolidation, unconsolidated undrained triaxial testing (TxUU), and consolidated undrained triaxial testing (TxICU).

- Conduct a design-level geotechnical engineering analyses focused on providing site-specific design criteria based on the project design documents.

4.3 Groundwater Characterization Elements

The solid waste guidance provides for characterization of the groundwater aspects of the proposed landfill development. Objectives of tasks typically include determining the direction and rate of groundwater flow beneath the site, as well as testing the water quality. While not included with this workplan, these site characterization elements are planned for future phases as described below.

4.3.1 Monitoring Network Modifications

The scope of work and details for modifying the groundwater monitoring network in the development area are contingent on the design for the landfill and ancillary structures. After these designs are further along and the timing (e.g., for earthwork and construction) has been finalized, we will be able to better determine the phasing and details of the tasks, such as well installation or decommissioning, and water quality sampling.

Having said that, in general we anticipate the following changes to the monitoring network:

- Install upgradient piezometers. Up to four piezometers will be installed along the new access road that is planned south of the landfill footprint. These piezometers will provide piezometric control along the upgradient boundary of the landfill.

- Install one cross/downgradient well along the eastern side of the landfill, approximately 500 feet upslope of existing wells MW-8S/8D.

- Re-designate wells MW-8S/8D, on the northeast perimeter of the development area, as compliance wells.

- Install one downgradient compliance well on the west side of the landfill, at the approximate location of the landfill office.

- Potentially re-designate MW-14S/14D, which are along the northwest edge of the development footprint, as compliance wells.

- Decommission wells along Coffin Butte Road that are within the development area footprint. These include: MW-23 and MW-24, and methane probes GP-5A, and GP-6.

4.3.2 Water Quality Monitoring

As noted earlier, installation of new groundwater monitoring wells is not proposed for this phase of site characterization for several reasons. First, the locations being considered for upgradient wells are along the new access road that will be constructed south of the landfill footprint. The wells can only be installed after the road is constructed because of the amount of excavation (over 100 feet vertical) from the current topography to the proposed road elevation. Second, cross gradient to potentially downgradient locations will be in the way of earthwork activities if they are installed too soon—and could be destroyed. Therefore we advise to install these wells after most of the landfill construction is complete. And last, two wells that we are considering at a downgradient location (MW-8S and MW-8D) will hopefully be preserved during landfill and infrastructure construction. During the interim, we will continue to monitor them consistent with the current monitoring program.

4.3.3 Hydraulic Testing

Hydraulic properties of site hydrogeologic units have been estimated in the past from pumping tests and slug tests. Pumping tests indicate that shallow (weathered) and deeper (unweathered) parts of the bedrock hydrogeologic unit are hydraulically interconnected. During the remedial investigation, slug tests were conducted in seven site wells. Results for horizontal hydraulic conductivity were consistent with those estimated from earlier pumping tests.

The differences in hydraulic properties between units can be accounted for by observing variations in site lithology (EMCON, 1999). In wells completed in alluvial sediments, soils consist of clays and clayey gravels or sands, and the associated hydraulic conductivity is relatively low. The range of values for bedrock can be attributed to the degree of weathering and fracturing in the bedrock. In wells completed in basalt that is intensely fractured with deep to moderate weathering, and where fractures are not filled with clays, the hydraulic conductivity values are higher. In wells completed in rocks that are deeply weathered or decomposed to clay and sand, and that are intensely fractured with clay minerals filling the fractures, the values for hydraulic conductivity are lower.

It is expected that the hydraulic properties from the existing landfill wells will be similar to those proposed for the development area because of the comparable range of rock types. Therefore, on a preliminary basis, values for hydraulic conductivity from the site will be assumed for the development area. However, as part of future scope of work after new upgradient and cross/down gradient wells are installed, we will develop a testing program to verify that this assumption is valid.

5 SCOPE OF WORK

The scope of work outlined in this section describes tasks that will be completed during the 2021 field season in anticipation of site development in subsequent years. Expanding into the area south of Coffin Butte Road is currently planned for summers of 2023 (earthwork) and 2024 (liner construction). The first two sections below provide the rationale and criteria for lateral distribution and depths of geotechnical borings in the investigation areas. Later sections described in more detail the procedures for field activities and laboratory testing. Data collected during field tasks include mapping the types and distribution of soils, as well as noting the presence of soil structure in test pits and borings.

5.1 Distribution of Test Pits and Geotechnical Borings

Objectives of the field work will be to identify thickness of alluvium and soil conditions at depth, provide information on the types of soils in areas of cut or fill, and better understand limits of bedrock weathering and soil stability at depth. Findings will be used to develop geologic cross sections that can then be used to identify what to expect with earthwork excavation, design of the engineered excavation, and road construction phases of development, as well feed into design considerations for the landfill.

The proposed distribution of new borings and test pits balances the need for equally-spaced locations across the development area with existing information from borings, test pits, and mapping. We also considered access and the presence of existing structures or soil stockpile, which occupies an area along Coffin Butte Road in the northeast sector of the landfill footprint. The locations shown in Figure 5 are preliminary, and may be moved depending on access issues such as steepness of existing slopes and forest cover. In addition, the depth of the borings may be adjusted depending on the formation, resistance to drilling, and soil moisture content noted during drilling.

Overall, fourteen geotechnical borings from approximately 20- to 140-feet deep and at least 10 test pits are planned in the following areas:

- **Landfill Footprint Borings.** Seven geotechnical borings are spaced throughout the area consistent with existing information from geotechnical borings and wells previously constructed. Borings are shown for areas with

both saturated and unsaturated alluvium, as well as uphill of the surface contact with alluvium in basalt.

- **Landfill Footprint Test Pits.** Up to seven test pits are planned for this area. The locations focus on defining the thickness of the alluvium and competence of soils below alluvial clay, as well as thickness of colluvium or weathered soil above competent bedrock.

- **Leachate Pond Borings.** Three geotechnical borings are spaced throughout the area, with one of the borings (BH-12) also serving to inform the conditions below the new access road.

- **Leachate Pond Test Pits.** Three test pits are planned for this area, one of which also will be placed along the new access road.

- **Access Road Boring.** Along the new access road located on the south side of the development area, cuts are planned for over 100 feet. To better understand the rock quality at these depths, in addition to other locations along the road, four geotechnical borings are planned.

5.2 Proposed Boring Depths

The anticipated depths are based on existing borehole information that indicates depth to basalt bedrock (i.e., to competent soils or rock) below alluvium within the footprint could be up to 23 feet deep. As needed, the borings will be extended deeper until competent soils, or refusal, are encountered, or to more fully characterize rock conditions potentially associated with cut slopes associated with the new access road.

The borings will be drilled to the approximate depths shown on Table 3, which lists the existing ground elevation and the design elevation, the expected boring depth, as well as coordinates. The table is meant to provide borehole details relative to the landfill liner, but also to assist the field geologist with regard to the depth at which to expect lithologic units. Several criteria were considered in estimating borehole depth. These include:

- For boreholes within areas of cut/excavation, based on our current understanding of site geology, it is likely that the cut will be in bedrock, which could be hard basalt or weathered to varying degrees. The target depth is to drill at least 20 feet below the estimated liner base and penetrate deep enough to encounter competent soil or rock.

- For boreholes in areas of fill, drill through the thickness of alluvium into underlying bedrock until competent soils are encountered or refusal at bedrock, this is estimated at approximately 25 feet. This will allow estimating the

thickness of the underlying hydrogeologic unit (alluvium) below the fill and liner, as well as note groundwater conditions within the underlying unit.

- For the borings along the access road or deepest cut, drill to the elevation of the proposed road or cut, which is estimated at a depth of 140 feet (e.g., BH-5).

5.3 Field Activities

Preliminary locations for test pits and borings may be moved as field conditions dictate on the basis of access or the presence of overhead obstructions. In addition, the depth of the borings may be adjusted depending on the formation and soil moisture content noted during drilling.

5.3.1 Geologic Mapping

The purpose of geologic mapping will be to better understand the lateral continuity of lithologic units, the transition laterally between units, and how geologic material and structural fabric could affect the flow of groundwater in the subsurface. In the development area, exposures of weathered basalt pillow structures are present along southwest embankment of the West Leachate Pond. Mapping of the East Leachate Pond subgrade in 2004 found basalt weathered to varying degrees: from extremely weathered zones consisting of plastic clay with abundant secondary minerals, to less weathered zones that contained fine- to coarse-grained sand with cobbles. The weathered zones transition from clay above sandy and friable soil, which is underlain by fresh basalt that is hard.

A geologist will map the surface geology of the northern side of Poison Oak Hill to identify any features of geologic interest and to help optimize placement of geotechnical borings or test pits. The mapping will extend from existing surface mapping that was completed in 2004. Ultimately, the goal of surface mapping will be integrate this information with subsurface exploration that includes the test pits and borings.

5.3.2 Test Pits

The primary purpose of test pits is to acquire information on the engineering properties of shallow soils in a rapid fashion to assess the distribution, character, and geotechnical properties of shallow soil. For the development project, the test pits will be excavated with three goals: (1) define the upper limit of alluvium against Poison Oak Hill, (2) explore the geotechnical properties of the alluvium in landfill areas that will be founded on alluvium, and (3) explore the area where the new leachate ponds will be constructed.

Up to ten test pits will be excavated with a backhoe within the proposed landfill and leachate pond areas. Total exploration depth(s) are estimated at 10 to 12 feet bgs. The geologist will log the soil and collect bulk samples for geotechnical evaluation and lab testing. Soil and rock conditions logged during excavation will be recorded in the field on test pit logs. If groundwater is encountered during excavation, the level at which the water was first encountered and the water level at the end of excavation activities will be recorded. We will also perform Dynamic Cone Penetrometer (DCP) tests to evaluate relative density or strength of near-surface alluvial soils. An example of a test pit log can be found in Appendix C.

5.3.3 Borehole Drilling and Soil Sampling

Borings will be drilled within the proposed landfill development and proposed leachate pond areas using a track-mounted drilling rig equipped with mud-rotary drilling/rock coring equipment. The field geologist will collect soil samples during drilling using Shelby tube, modified California, and standard penetration testing (SPT). Sampling and SPT testing will be performed at approximate 2.0-foot intervals until auger refusal is encountered.

Boreholes will be abandoned consistent with applicable rules and guidelines described in "Construction, Maintenance and Abandonment of Monitoring Wells and Other Holes in Oregon" (OAR 690-240; 1995) and the DEQ guidelines for Groundwater monitoring well drilling, construction, and decommissioning (DEQ, 1992).

The borings will be drilled with 6-inch-outside diameter solid-flight auger or using rotary wash methods to a minimum depth of 25 feet. This depth should adequately penetrate the alluvium in all areas of proposed exploration. The borings will be sampled at an approximately 2.0-foot interval using one of four sampling techniques, depending on the depth interval, soil type, and requirements of the geotechnical testing program. These include:

- Standard penetration test (SPT) split spoon samples with autohammer: test every 2 feet as conditions allow or until refusal.
- 2.5-inch-diameter modified California sampler: test every 2 feet as conditions allow or until refusal.
- Undisturbed 3-inch-diameter Shelby Tube samples: test as needed where soft to medium stiff silt and clay are encountered.
- HQ-wireline rock coring: advance after auger refusal is encountered to the proposed boring refusal depth.

A geologist or professional engineer, registered in Oregon, will log the soil samples or cores consistent with the procedures of the American Society for Testing and Materials. The logging will describe texture, color, mineralogy, moisture content, degree of weathering, or other relevant characteristics of the sampled material. Field procedures will follow Wallace quality assurance and quality control standards. Drilling and soils information will be recorded in the field on boring-log forms (example of the form can be found in Appendix C). The borehole will be backfilled with bentonite chips and hydrated with clean water.

5.3.4 Laboratory Testing

Table 4 outlines the proposed geotechnical laboratory testing program for test pit soil and borehole core samples. The testing will used to evaluate and confirm the engineering and index properties of the soil and rock materials encountered. We anticipate laboratory testing will include grain-size analysis, moisture content, Atterberg limits, hydraulic conductivity, consolidation, unconsolidated undrained triaxial testing (TxUU), and consolidated undrained triaxial testing (TxICU).

Test Pits. Tests will be assigned by the engineer based on a review of the test pit logs. A typical suite of tests could include grain size (ASTM D422), Atterberg limits (ASTM D4318), and moisture content (ASTM D2216). If the material will be used for fills, then it is possible that moisture-density relations testing will be performed ("proctor" curve, ASTM D1557). If a local deposit of soft soil is encountered, it is possible that the engineer may assign additional testing from test pit samples.

Soil Borings. At a minimum, samples from each lithologic unit from each boring will be tested for the following:

- Particle size distribution by both sieve and hydrometer following ASTM methods D422 and D1140
- Atterberg limits following ASTM method D4318
- Classification by unified soil classification system following ASTM standard D2487.

In the event that soft soils are encountered that may affect foundation settlement and strength, additional sampling may be performed so that samples can be tested for consolidation and shear strength, as deemed appropriate by the geotechnical engineer. This may require deepening borings beyond the prescribed depths.

5.3.5 Surveying

Locations for borings and test pits will initially be laid out as described above on Figure 5. The northing and easting coordinates referenced to the Oregon State Plane Coordinate System will be estimated from the base map and then the locations surveyed and staked in the field for the drilling and test pit exploration. These locations can then be used to create site-specific cross sections that depict the geology of the development area.

6 REPORTING

A report documenting the investigation's findings will be submitted after completing site characterization activities and data interpretation. Hydrogeologic aspects, geotechnical findings, and laboratory testing results of the study will be reported in the following general format:

- Introduction
- Site background
- Investigation methods and procedures
- Discussion of findings
- Summary and conclusion

The report will be supported by necessary tables, figures, and appendices to provide detailed information. This will include boring logs and test pit logs, a geologic map and cross sections, piezometric map of the site as estimated from existing wells, hydrographs for site wells in the area of interest. The Wallace Group will prepare a separate report documenting the field and laboratory testing and providing geotechnical analyses or conclusions. The Wallace report will be an appendix to the site characterization report.

The geotechnical exploration report will include the following elements:

- Report text that characterizes and describes subsurface conditions and engineering properties of overburden deposits and on-site soils.
- Discussion of regional geology and seismicity.
- Vicinity and site maps illustrating development plans and exploration locations.
- Test pit and boring logs.
- Results of the laboratory testing program.
- Seismic site class, and discussion of seismic-induced hazards per 2019 OSSC Section 1803.7.

- Slope stability and settlement analysis.
- Retaining wall and lateral load design criteria.
- Guidelines for earthwork construction including recommendations for engineered excavations, site preparation, fill placement, and compaction.
- Site drainage recommendations.
- Supplemental Phase II Geotechnical Investigation scope recommendations, if warranted.

One bound copy of the report and a PDF version will be submitted to the DEQ.

7 SCHEDULE

The field activities are staged depending on the type of activity. In general, drilling activities are scheduled for drier summer months to avoid saturated surface soil. Tentative schedule is as follows, but will depend on the availability of the driller and constructing road access to the locations on the northern slope of Poison Oak Hill.

- Excavate test pits: mid August 2021
- Drill geotechnical borings: late August – early September 2021
- Laboratory testing: fall and winter of 2021

A report will be submitted to the DEQ within 180 days of completing the 2021 field activities.

REFERENCES

Ausenco Vector. 2011. Valley Landfills, Inc., Year 2011 Site Development Plan. Prepared for Valley Landfills, Inc., by Ausenco Vector, Grass Valley, California. Draft, November.

DEQ. 1992. Groundwater Monitoring Well Drilling, Construction, and Decommissioning. State of Oregon, Department of Environmental Quality. August 24.

DEQ. 1996. Solid Waste Guidance, Municipal Solid Waste Landfills. State of Oregon, Department of Environmental Quality. September 1.

DEQ. 2020. Solid Waste Disposal Site Permit No. 306. Issued by the Oregon Department of Environmental Quality, Western Region. Signed by Brian Fuller, July 28.

EMCON. 1992. Cell 2 Site Characterization Report. Prepared for Valley Landfills, Inc., by EMCON Northwest, Inc., Portland, Oregon. August.

EMCON. 1993. Letter (re: Response to Review of Cell 2 Site Characterization Report for the Coffin Butte Landfill) to A. Eldridge, Oregon Department of Environmental Quality, Portland, from E. Tuppan and D. Atwood, EMCON Northwest, Inc., Portland, Oregon. May 21.

EMCON. 1994. Remedial Investigation and Additional Hydrogeologic Investigation Report, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON Northwest, Inc., Portland, Oregon. February 4.

EMCON. 1996a. Preliminary Assessment, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON, Portland, Oregon. February 28.

EMCON. 1996b. Remedial Investigation Addendum, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON, Portland, Oregon. February 28.

EMCON. 1997. Environmental Monitoring Plan, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON, Portland, Oregon. February 25.

EMCON. 1999. Site Characterization – Cell 3, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON, Portland, Oregon. June 11.

EPA. 1975. Use of the Water Balance Method for Predicting Leachate Generation from Solid Waste Disposal Sites. U.S. Environmental Protection Agency, Office of Solid Waste Management Programs. Report SW-168.

EPA. 1984. The Hydrologic Evaluation of Landfill Performance (HELP) Model. U.S. Environmental Protection Agency, Office of Solid Waste & Emergency Response. EPA/530-SW-84-009. June.

OWRD. 1995. Administrative Rules for Construction, Maintenance and Abandonment of Monitoring Wells and Other Holes in Oregon, Chapter 690, Division 240. July.

SEA. 1986. Coffin Butte Landfill, Geotechnical Investigation. Prepared for Valley Landfills, Inc., by Sweet, Edwards & Associates, Inc., Kelso, Washington. May 19.

Thiel. 1998. Design Report, Leachate Surge Pond, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Thiel Engineering, Oregon House, California. March 16.

Thiel. 1999. Design Report, Cell 3A, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Thiel Engineering, Oregon House, California. March 25.

Thiel. 2000. Year 2000 Site Development Plan, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Thiel Engineering, Oregon House, California. February 29.

Thiel. 2012. Coffin Butte Landfill Cell 5A Expansion Construction Drawings (Earthworks Only). Prepared for Valley Landfills, Inc., by Thiel Engineering, Oregon House, California. May 10.

Thiel. 2013. Year 2011 Site Development Plan Amendment 1, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Thiel Engineering, Oregon House, California. November.

Tuppan. 2003. Focused risk assessment and feasibility study, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc. Corvallis, by Tuppan Consultants LLC, Lake Oswego, Oregon. September 23.

Tuppan. 2005. Environmental Monitoring Plan, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Tuppan Consultants LLC, Lake Oswego, Oregon. December 16.

Tuppan. 2011a. Letter (re: Site Characterization, Cell 4, Coffin Butte Landfill) to H. Gao, Oregon Department of Environmental Quality, Salem, from E. Tuppan, Tuppan Consultants LLC, Lake Oswego, Oregon. March 22.

Tuppan. 2011b. Environmental Monitoring Plan, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Tuppan Consultants LLC, Lake Oswego, Oregon. March 23.

Tuppan. 2012. Environmental Monitoring Plan, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Tuppan Consultants LLC, Lake Oswego, Oregon. October 26 (Rev. 2).

Tuppan. 2014. Environmental Monitoring Plan, Coffin Butte Landfill, Benton County, Oregon, Revision 3. Prepared for Valley Landfills, Inc., by Tuppan Consultants LLC, Lake Oswego, Oregon. June 27.

Tuppan. 2021. 2020 Annual Environmental Monitoring Report, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Tuppan Consultants LLC, Lake Oswego, Oregon. March 4.

Thornwaite, C. W., and J. R. Mather. 1957. The Water Balance. Centerton, N.J.: Laboratory of Climatology Publication 8.

Vector. 2010. Year 2010 site development plan, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Vector Engineering, Inc., Grass Valley, California. Draft, January.

LIMITATIONS

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

The purpose of a geologic/hydrogeologic study is to reasonably characterize existing site conditions based on the geology/hydrogeology of the area. In performing such a study, it is understood that a balance must be struck between a reasonable inquiry into the site conditions and an exhaustive analysis of each conceivable environmental characteristic. The following paragraphs discuss the assumptions and parameters under which such an opinion is rendered.

No investigation is thorough enough to describe all geologic/ hydrogeologic conditions of interest at a given site. If conditions have not been identified during the study, such a finding should not therefore be construed as a guarantee of the absence of such conditions at the site, but rather as the result of the services performed within the scope, limitations, and cost of the work performed.

We are unable to report on or accurately predict events that may change the site conditions after the described services are performed, whether occurring naturally or caused by external forces. We assume no responsibility for conditions we were not authorized to evaluate, or conditions not generally recognized as predictable when services were performed.

Geologic/hydrogeologic conditions may exist at the site that cannot be identified solely by visual observation. Where subsurface exploratory work was performed, our professional opinions are based in part on interpretation of data from discrete sampling locations that may not represent actual conditions at unsampled locations.

TABLES

Table 1
Description of Monitoring Network
Hydrogeologic and Geotechnical Characterization Workplan
Coffin Butte Landfill

Monitoring Program	Monitored Area	Position
Landfill Water Quality Monitoring Program		
Compliance Wells		
MW-1D, MW-3D, MW-12S, MW-12D	Cell 1	Downgradient
MW-10S, MW-10D, MW-11S, MW-11D	Cell 1A	Downgradient
MW-20, MW-21	Closed Landfill	Downgradient
MW-26, MW-27	Cells 2/3/4/5	Downgradient
Detection Wells		
MW-8S, MW-15	Former Leachate Irrigation Fields A/B	Downgradient
MW-17, MW-18, MW-19	Cells 1/1A	Downgradient
MW-23	Cell 2	Crossgradient
MW-24	Cells 2/3	Crossgradient
P-8	Cell 1	
Phillips	Domestic Water Quality	—
Other Monitoring Well Sites		
MW-9S	East boundary of property	—
Observation Wells/Piezometers		
MW-1S, MW-3S, MW-8D, MW-14S, MW-14D, PW-2, P-8, P-9, P-10, P-19, P-22, P-23 Duplex, Merril, Berkland	Various	—
Wetland Piezometers		
WP-1, WP-3, WP-5, WP-6, WP-8, WP-9	Fields South of Coffin Butte Road	Various
Quarry Piezometers		
QP-3S, QP-4S, QP-5N, QP-6N, QP-7N	Knife River Quarry and Coffin Butte	Various
Secondary Leachate Collection System		
LDS-2B	Cells 2B, 2C	Underneath
LDS-3	Cell 3	Underneath
LDS-4	Cell 4	Underneath
LDS-5	Cell 5	Underneath
LDS-WLP (formerly LDS-SP)	West Leachate Pond	Underneath
LDS-ELP	East Leachate Pond	Underneath
Leachate		
L-1	Cell 1	—
L-2B	Cells 2A, 2B, 2C, 2D	—
L-3	Cell 3	—
L-4	Cell 4	—
L-5	Cell 5	—
L-Pond	Active Leachate Pond (composite of cells)	
Surface Water		
S-1	Background (Soap Creek)	Upstream
S-2, S-4	Cell 1, 1A, Closed Landfill	Downstream
Underdrains		
S-U2 (end of pipe not accessible for sampling)	Cell 2C/D & Cell 4 (north half)	Underneath
S-U3	Cell 3	Underneath
S-U4	East Leachate Pond	Underneath
S-U5	West Leachate Pond	Underneath
S-U6 (typically dry-disharges to ditch)	Cell 4 (south half)	Underneath
S-U7 (Manhole east of cell-not accessible)	Cell 5A	Underneath
Stormwater Monitoring Program (1200Z Permit)		
Outfall (monitored by rock quarry operator)	Quarry/part of Cell 1A & Closed Landfill	Downstream
Outfall 001 (west end of western bioswale)	Cell 1	Downstream
Outfall 002 (northeast end of eastern bioswale)	Cells 2/3/4/5	Downstream

Table 2
Well Construction Summary
Hydrogeologic and Geotechnical Characterization Workplan
Coffin Butte Landfill

Location	Status	Northing	Easting	Ground Surface Elevation (ft msl)	Surveyed Reference Elevation (ft msl)	Casing Total Depth (ft bgs)	Screened Interval (ft bgs)	Filter Pack Interval (ft bgs)	Seal (ft bgs)	Well Casing Diameter (Inches)	Drilling Method	Date Well Installed	Lithology Screened
MONITORING/OBSERVATION WELLS													
MW-1S[a]		387,416.66	7,491,201.90	288.50	289.87	23.0	18-23	16-23	0-16	2	Air Rotary	1977	Weathered basalt
MW-1D[a]		387,416.66	7,491,201.90	288.50	289.89[b]	40.0	35-40	34-40	23-34	2	Air Rotary	1977	Weathered/fresh basalt
MW-3S[a]		387,396.95	7,490,459.59	284.70	285.86	26.0	21-26	20-26	0-20	2	Air Rotary	1977	Weathered basalt
MW-3D[a]		387,396.95	7,490,459.59	284.70	285.94[b]	54.3	49-54	47-54	26-47	2	Air Rotary	1977	Weathered/fresh basalt
MW-8S		388,038.13	7,493,295.09	240.63	244.01[b]	30.8	21-31	16-31	0-16	2	Air Rotary	07/30/85	Weathered basalt
MW-8D		388,052.73	7,493,306.08	240.50	244.04	75.0	65-75	60-75	0-60	2	Air Rotary	07/30/85	Fresh basalt
MW-9S		388,845.65	7,494,648.37	221.50	223.27	35.0	25-35	20-35	0-20	2	Air Rotary	08/02/85	Clay
MW-10S[c]		387,660.77	7,489,746.08	289.03	291.42[b]	41.1	30.1-40.1	25.8-41.1	0-25.8	2	Air Rotary	08/02/85	Weathered basalt
MW-10D[c]		387,643.53	7,489,746.11	289.02	291.38[b]	82.2	73.0-82.2	60.1-82.2	0-60.1	2	Air Rotary	08/02/85	Fresh basalt
MW-11S		387,680.08	7,489,428.44	274.80	274.71[b]	31.8	22-32	20-32	0-20	2	Air Rotary	08/05/85	Weathered basalt
MW-11D		387,686.42	7,489,409.28	274.80	274.96[b]	75.0	65-75	55-75	0-55	2	Air Rotary	08/05/85	Fresh basalt
MW-12S		387,336.24	7,490,830.96	283.80	285.59[b]	26.1	21-26	18.9-26.2	2-18.9	2	Air Rotary	09/19/91	Weathered/fresh basalt
MW-12D		387,334.96	7,490,848.71	283.80	285.43[b]	60.3	55-60	52.6-61.3	1.5-52.6	2	Air Rotary	09/19/91	Fresh basalt
MW-14S		387,482.52	7,491,484.81	287.50	289.58	30.1	19.5-29.5	16.5-30	1.5-16.5	4	Air Rotary	07/27/92	Weathered basalt
MW-14D		387,479.36	7,491,474.42	287.80	290.27	70.6	60-70	57.5-71	1-57.5	2	Air Rotary	07/24/92	Fresh basalt
MW-15		387,833.16	7,493,923.82	233.45	235.66[b]	28.9	19.0-28.0	16.5-29.0	0-16.5	2	HSA	07/14/93	Silt and gravel
MW-16	Decom. 5/24/04	113.19	2,052.21	281.70	284.03[b]	27.3	17.2-26.6	15.6-27.3	0-15.6	2	HSA	07/19/93	Fresh basalt
MW-17		387,070.74	7,490,136.83	277.45	279.67[b]	26.9	16.7-26.2	15.0-27.0	0-15.0	2	HSA	07/15/93	Weathered basalt and silt
MW-18		387,375.30	7,489,529.13	267.70	269.90[b]	20.9	11.2-20.8	9.0-21.4	0-9.0	2	HSA	07/15/93	Weathered basalt
MW-19		387,488.50	7,489,035.48	261.00	263.29[b]	23.0	13.5-23.0	11.7-24.1	0-11.7	2	HSA	07/16/93	Weathered basalt
MW-20		388,119.00	7,488,673.03	256.81	259.22[b]	21.4	11.3-20.7	9.5-22.5	0-9.5	2	HSA	07/15/93	Clay and gravel
MW-21		388,628.80	7,488,408.71	254.25	256.67[b]	16.9	11.0-16.7	9.0-17.0	0-9.0	2	HSA	07/15/93	Fresh basalt
MW-22	Decom. 5/24/11	1,275.42	2,857.32	232.73	235.30[b]	24.2	14.0-23.6	11.0-24.2	0-11.0	2	HSA	07/22/94	Silt
MW-23		388,063.30	7,493,044.16	242.81	244.76[b]	22.7	12.4-22.1	9.6-22.7	0-9.6	2	HSA	08/02/94	Silt, clay, and gravel
MW-24		387,649.83	7,492,104.33	273.94	276.76[b]	34.9	19.5-34.5	18.0-35.0	0-18.0	2	HSA	08/31/98	Weathered basalt
MW-25	Decom. 5/24/11	1,181.50	2,626.80	240.39	242.79[b]	32.5	13.5-23.5	11.0-24.0	0-11.0	2	HSA	06/04/99	Silt and clayey silt
MW-26		388,531.15	7,493,967.51	235.18	237.91	27.2	17.1-26.9	15.5-28.0	0-15.5	2	Sonic	10/17/11	Silt
MW-27		388,887.59	7,493,881.47	252.12	254.76	35.1	25.0-34.8	23.5-35.5	0-23.5	2	Sonic	10/17/11	Clay with organics
LANDFILL WATER SUPPLY													
PW-2		390,336.45	7,494,030.76	248.90	250.27	199.0	95-199 OH	none	0-95	8	Air Rotary	07/30/92	Fresh basalt
PRIVATE WATER SUPPLY													
Duplex		387,387.70	7,491,474.23	289.01	289.01	74.0	26-74 OH	none	0-20	6	Rotary	07/17/72	Basalt (?)
Berkland		386,460.23	7,491,290.65	327.63	327.63	220.0	20-220 OH	none	0-20	6	Rotary	05/01/78	Basalt and sandstone
Phillips		386,788.95	7,490,951.64	291.00	291.00	—	—	—	—	—	—	—	(?)
PIEZOMETERS													
P-8		387,080.97	7,490,932.94	282.40	284.02	28.4	18.7-27.6	16.4-29.0	0-16.4	2	HSA	07/13/93	Weathered basalt
P-9		388,471.86	7,488,728.28	273.66	276.01	23.3	17.2-23.0	15.0-23.3	0-15.0	2	HSA	07/15/93	Fresh basalt

Table 2
Well Construction Summary
Hydrogeologic and Geotechnical Characterization Workplan
Coffin Butte Landfill

Location	Status	Northing	Easting	Ground Surface Elevation (ft msl)	Surveyed Reference Elevation (ft msl)	Casing Total Depth (ft bgs)	Screened Interval (ft bgs)	Filter Pack Interval (ft bgs)	Seal (ft bgs)	Well Casing Diameter (Inches)	Drilling Method	Date Well Installed	Lithology Screened
P-10		388,460.45	7,488,223.46	243.00	245.12	18.0	7.7-17.2	5.7-18.5	0-5.7	2	HSA	07/20/93	Weath. basalt, gravel, silt
P-19		389,840.33	7,492,921.45	383.15	385.65	106.5	96.3-106.1	94.2-106.5	0-94.2	2	Air Rotary	08/17/12	Fresh basalt
P-22		389,903.79	7,492,050.39	636.87	638.60	77.5	57.5-77.1	53.9-77.5	0-53.9	2	Air Rotary	09/10/15	Fresh basalt
P-23		389,618.74	7,491,365.81	690.96	693.11	183.5	163.5-183.2	160.0-183.5	0-160.0	2	Air Rotary	09/10/15	Fresh basalt
QP-3S		389,271.51	7,489,751.98	601.70	502.02	354.4	333.4-353.8	330.5-354.4	0-330.5	2	Air Rotary	09/09/98	Fresh basalt
QP-4S	Domestic supply	389,331.43	7,490,639.37	717.15	718.95	403.1	363.1-403.1	NA	0-28.4	5	Air Rotary	09/15/98	Fresh basalt
QP-5N		389,743.36	7,490,857.39	601.48	601.53	230.9	200.3-230.3	197.7-230.9	0-197.7	2	Air Rotary	09/16/98	Fresh basalt
QP-6N		390,259.59	7,490,886.35	445.39	445.82	150.0	119.4-149.4	117.3-150.0	0-117.3	2	Air Rotary	09/18/98	Fresh basalt
QP-7N		390,199.84	7,490,195.48	374.43	374.80	119.6	89.0-119.0	85.2-119.6	0-85.2	2	Air Rotary	09/09/98	Fresh basalt
WP-1		387,199.43	7,488,891.35	257.33	259.83	13.8	8.6-13.1	Prepack	0-1	2	Push probe	01/18/08	Clay
WP-3		386,661.80	7,489,643.80	271.01	273.39	9.8	4.6-9.2	Prepack	0-1	2	Push probe	01/18/08	Clay-sandy silt
WP-5		386,542.49	7,488,194.58	258.94	261.55	12.0	6.8-11.3	Prepack	0-2	2	Push probe	01/18/08	Sandy clay - clay
WP-6		385,925.20	7,487,996.18	262.17	264.85	13.0	7.8-12.3	Prepack	0-1	2	Push probe	01/19/08	Silty clay - clay
WP-8		387,861.89	7,487,856.57	253.15	255.80	10.3	5.1-9.7	Prepack	0-1	2	Push probe	01/19/08	Silty clay
WP-9		387,470.03	7,486,845.01	255.21	257.90	10.1	4.9-9.4	Prepack	0-1	2	Push probe	01/19/08	Clay

Notes: msl = mean sea level; bgs = below ground surface; OH= open hole; na = not available.
Drilling methods: HSA = hollow stem auger; SSA = solid stem auger

[a] Multiple well completion in single borehole.

[b] Measuring point is 0.02' higher than surveyed reference elevation shown due to installation of bladder pump enclosure. Groundwater elevations calculated from corrected elevation.

[c] Ground level and casing elevation were raised in June 1996 as part of regrading for truck scale. Wells and ground level elevation were resurveyed by Darryl Harms of Corvallis, OR.

[d] Estimated 20 feet higher than original elevation (added two 10-foot long pieces of 2-inch PVC pipe in 8/12/99 and 10/12/99). Well completion depths relative to original ground surface.

Table 3
Proposed Soil Boring and Test Pit Program
Hydrogeologic and Geotechnical Characterization Workplan
Coffin Butte Landfill

	Current Ground Level Elevation	Design Elevation	Below/ Above GL to Design Ele.[a]	Boring in Cut or Fill	Depth to Bottom of Boring (BGL)	Boring Bottom Depth-Elevation	Northing	Easting
Boring ID								
BH-1	291.7	314.3	-22.6	Fill	50.0	241.7	386,993.30	7,491,228.00
BH-2	244.0	244.6	-0.6	Fill	50.0	194.0	387,994.86	7,493,125.12
BH-3	510.0	502.3	7.7	Cut	110.0	400.0	386,177.39	7,491,884.63
BH-4	343.9	362.5	-18.6	Fill	50.0	293.9	386,458.65	7,492,451.61
BH-5	443.4	324.0	119.4	Cut	140.0	303.4	386,726.13	7,491,792.60
BH-6	291.2	307.4	-16.2	Fill	25.0	266.2	386,966.17	7,492,565.95
BH-7	338.9	321.6	17.3	Cut	25.0	313.9	367,015.13	7,493,175.46
BH-8	309.3	292.6	16.7	Cut	25.0	284.3	387,329.59	7,491,740.75
BH-9	359.1	301.9	57.1	Cut	100.0	259.1	387,151.79	7,491,742.28
BH-10	263.1	279.9	-16.8	Fill	25.0	238.1	387,441.49	7,492,703.58
BH-11	274.8	265.0	9.8	Cut	50.0	224.8	387,429.86	7,493,839.53
BH-12	270.7	278.5	-7.8	Fill	25.0	245.7	387,429.88	7,493,839.53
BH-13	390.2	376.9	13.2	Cut	50.0	340.2	388,760.08	7,493,861.25
BH-14	239.0	253.0	-14.0	Fill	25.0	214.0	387,972.34	7,493,517.97
Total Footage					**750.0**			
Test Pit ID								
TP-1	323.7	331.6	-7.9	Fill	12.0	311.7	386,961.84	7,491,410.53
TP-2	302.0	297.8	4.1	Cut	12.0	290.0	387,254.49	7,491,572.23
TP-3	306.3	311.0	-4.7	Fill	12.0	294.3	386,912.70	7,492,395.46
TP-4	334.2	345.5	-11.4	Fill	12.0	322.2	386,643.02	7,492,745.75
TP-5	297.8	298.6	-0.8	Fill	12.0	285.8	387,100.73	7,492,831.97
TP-6	274.2	289.5	-15.3	Fill	12.0	262.2	387,296.90	7,492,529.39
TP-7	260.0	266.4	-6.4	Fill	12.0	248.0	387,678.75	7,492,637.64
TP-8	247.7	248.6	-0.9	Fill	12.0	235.7	387,926.99	7,492,978.07
TP-9	253.2	265.4	-12.2	Fill	12.0	241.2	387,697.22	7,493,843.05
TP-10	256.3	265.0	-8.7	Fill	12.0	244.3	387,516.53	7,494,061.62
Total Footage					**120.0**			

Notes:

[a] negative number indicates liner above current ground level, boring in area of fill.

All measurements in feet

BGL: below ground level

GL: current ground level

Borings in fill, assume boring depth of 25 ft.

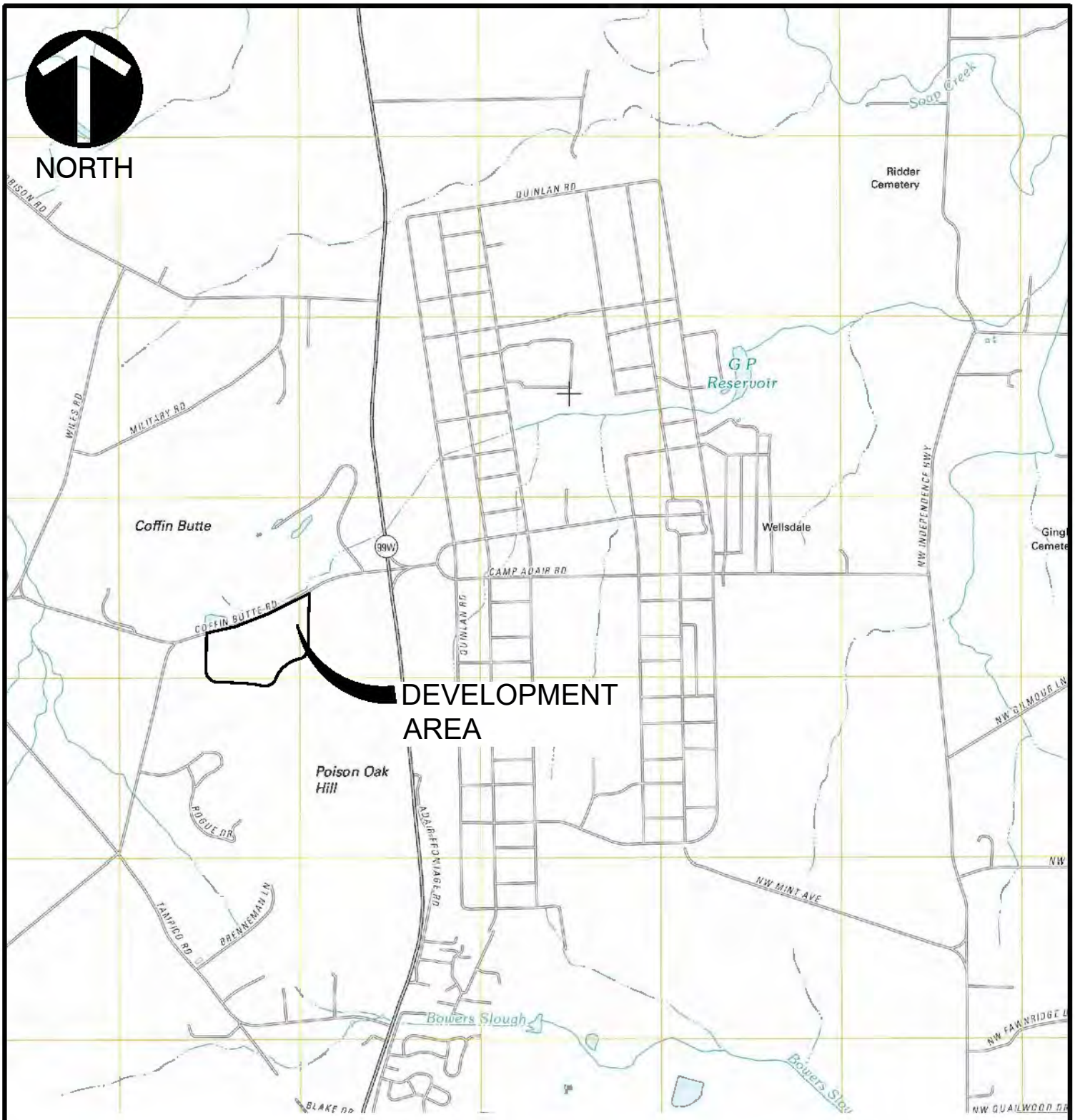
Borings in cut, depth is 20 feet below base of liner

Table 4
Geotechnical Testing Program
Hydrogeologic and Geotechnical Characterization Workplan
Coffin Butte Landfill

ASTM Test Number	Sample Type	Atterburg Limits D4318	Particle Size Distribution D422	Standard Classification D2487	Moisture Content D2216	Ring Shear Testing D6467	Triaxial Shear Testing (CU) D2664	Consolidation Testing D2435	Rock Core Compressive Strength D7012
Geotechnical Boreholes									
Landfill Footprint: BH-4, BH-5, BH-6, BH-7, BH-8, BH-9, BH-10	Core/bulk	X	X	X	X	X	X	X	X
Leachate Ponds: BH-11, BH-12, BH-13		X	X	X	X	X	X	X	X
Access Road: BH-1, BH-2, BH-3, BH-14		X	X	X	X	X	X	X	X
Test Pits									
Landfill Footprint: TP-2 to TP-8	Bulk/ composite	X	X	X	X	—	—	—	—
Leachate Pond: TP-9, TP-10		X	X	X	X	—	—	—	—
Access Road: TP-1, TP-9		X	X	X	X	—	—	—	—

Typical suite of tests; actual testing to be determined by engineer based on review of test pit log.
ED: engineer to determine based on review of log.

FIGURES



REFERENCE

1. U.S.G.S. 7.5' TOPOGRAPHIC MAP, LEWISBURG QUADRANGLE, OR DATED: 2011.

SCALE IN FEET

0 2500 5000

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REPUBLIC SERVICES, INC.
COFFIN BUTTE LANDFILL
29175 COFFIN BUTTE ROAD
CORVALIS, OR 97330

SITE LOCATION MAP

DRAWN BY:	LAR	CHECKED BY:	PFB	APPROVED BY:	PFB	FIGURE NO.:	1
DATE:	JUN. 2021	DWG SCALE:	1"=2,500'	PROJECT NO:	310-145		

\\swr-okc\Projects\310-000\310-145\-CADD\Dwg\310145-1-Site Location.dwg LS:(7/1/2021 - Informa) - LP: 7/1/2021 8:53 AM

NORTH



SCALE IN FEET

0 1000 2000

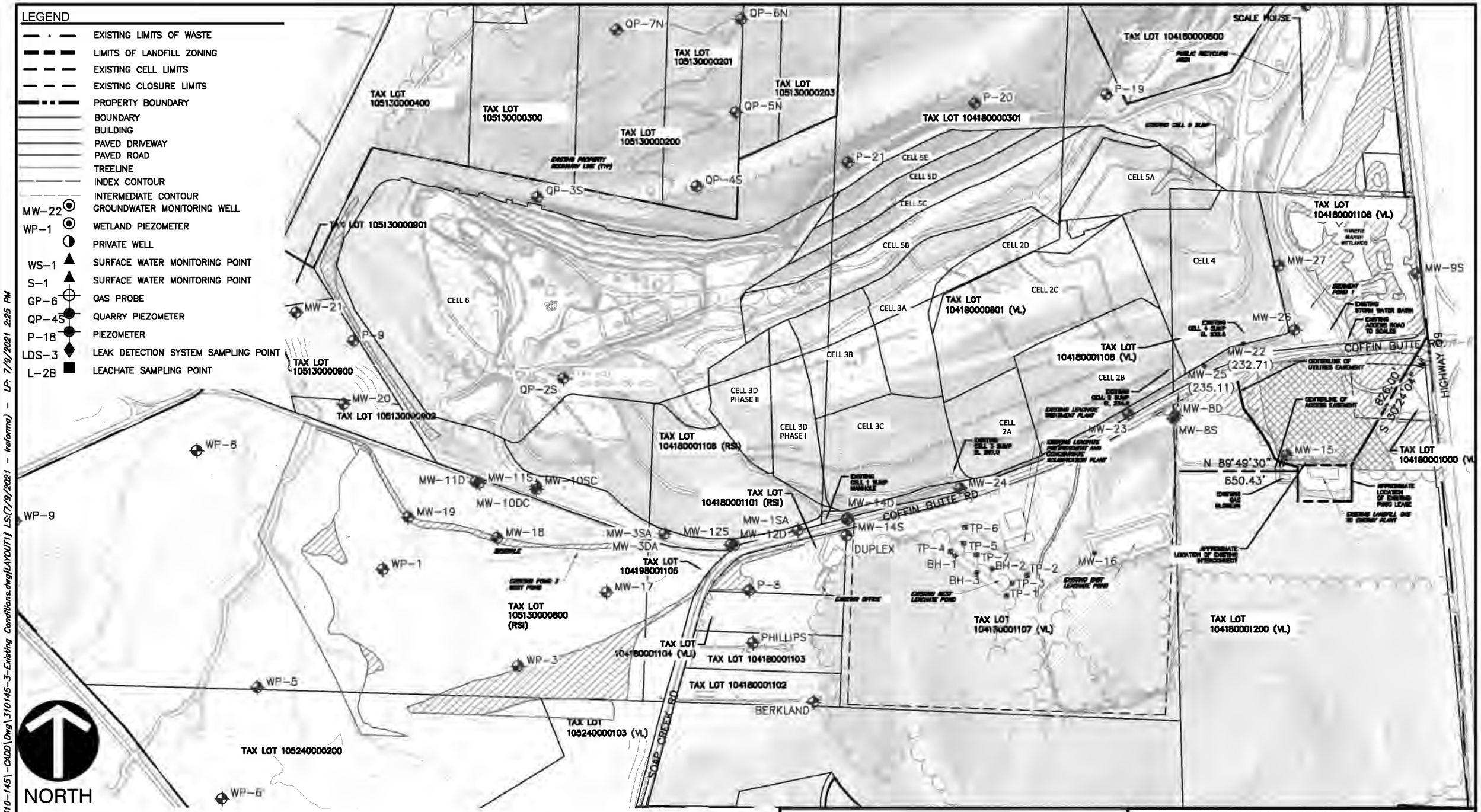
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CORVALIS, OR 97330

LANDFILL CELLS - AERIAL VIEW

DRAWN BY:	LAR	CHECKED BY:	PFB	APPROVED BY:	PFB	FIGURE NO.:	2
DATE:	JUL. 2021	DWG SCALE:	1"=1000'	PROJECT NO:	310-145		

\\svr-okc\Projects\310-000\310-145\-CADD\Dwg\310145-2-Landfill Cells - Aerial View.dwg LS:(7/1/2021 - Ireforma) - LP: 7/9/2021 2:12 PM



REFERENCE

1. EXISTING TOPOGRAPHY FROM AERIAL SURVEY BY COOPER AERIAL SURVEYS CO. ON APRIL 3, 2013, UPDATED WITH GROUND SURVEY BY NORTHSTAR SURVEYING, INC. ON MAY 23, 2013.

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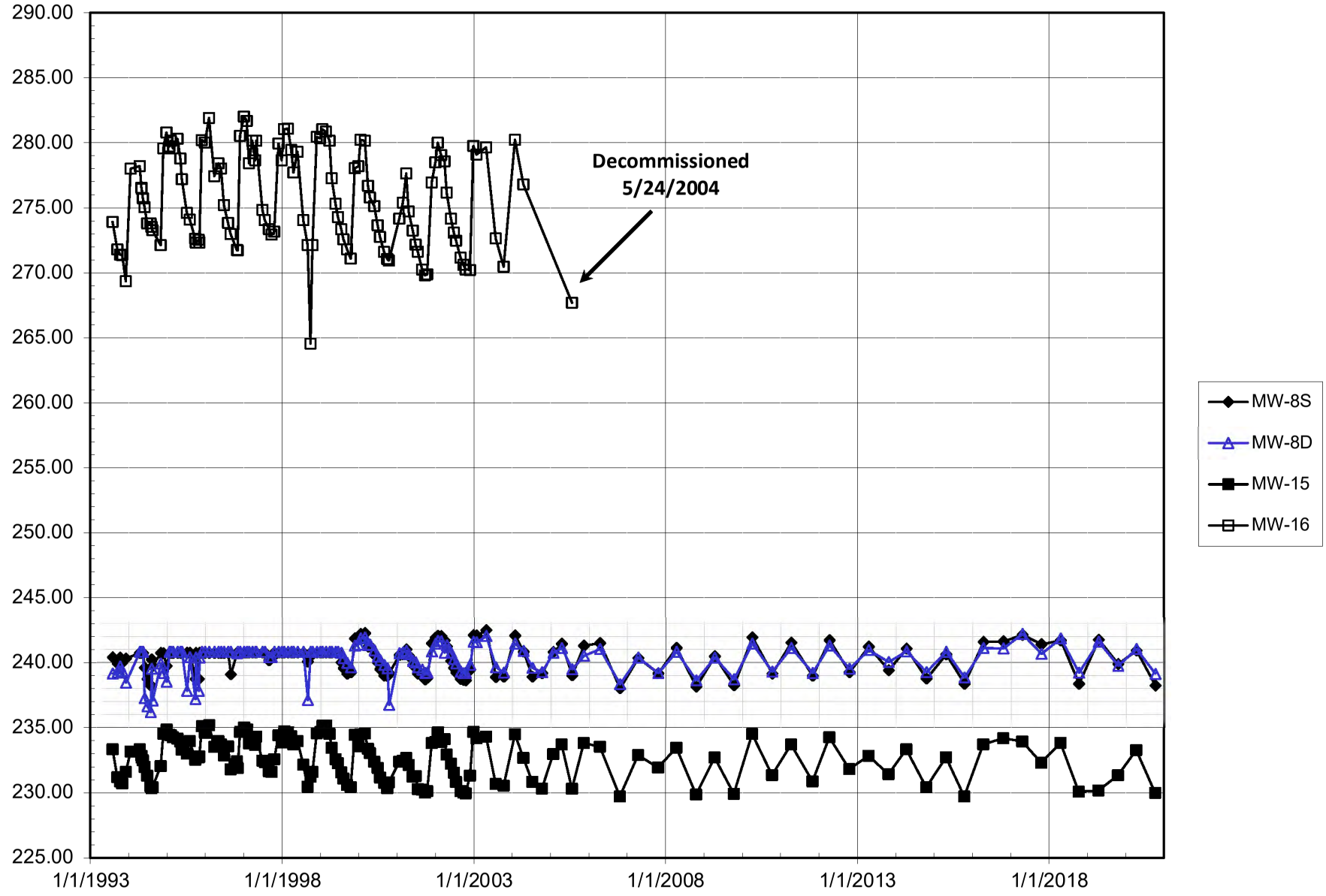
REPUBLIC SERVICES, INC.
COFFIN BUTTE LANDFILL
29175 COFFIN BUTTE ROAD
CORVALIS, OR 97330

DEVELOPMENT AREA
EXISTING CONDITIONS

DRAWN BY:	LAR	CHECKED BY:	PFB	APPROVED BY:	PFB	FIGURE NO.:	3
DATE:	JUL.2021	DWG SCALE:	1" = 500'	PROJECT NO:	310-145		

\\svr-okc\Projects\310-000\310-145\-CADD\Dwg\310145-3-Existing Conditions.dwg[LAYOUT1] LS(7/9/2021 - Ireforma) - LP: 7/9/2021 2:25 PM

Figure 4
Hydrographs for Development Area Wells
Hydrogeologic and Geotechnical Characterization Workplan
Coffin Butte Landfill



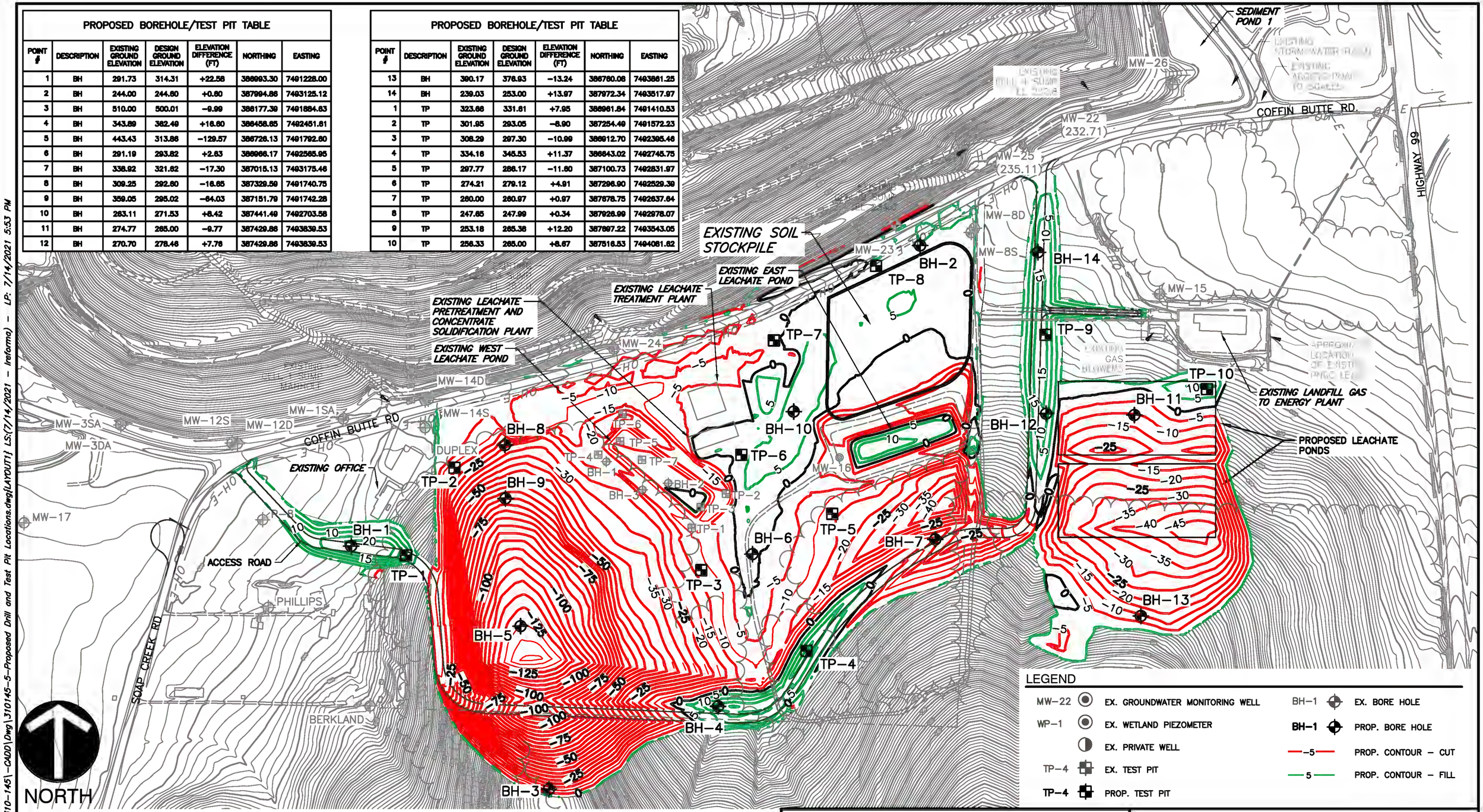
H20MASTER-Dev.xlsx\MW-8S-15-16

PROPOSED BOREHOLE/TEST PIT TABLE

POINT #	DESCRIPTION	EXISTING GROUND ELEVATION	DESIGN GROUND ELEVATION	ELEVATION DIFFERENCE (FT)	NORTHING	EASTING
1	BH	291.73	314.31	+22.58	386993.30	7491228.00
2	BH	244.00	244.60	+0.60	387994.86	7493125.12
3	BH	510.00	500.01	−9.99	386177.39	7491884.63
4	BH	343.89	362.49	+18.60	386456.65	7492451.61
5	BH	443.43	313.86	−129.57	386726.13	7491792.60
6	BH	291.19	293.82	+2.63	386966.17	7492565.95
7	BH	338.92	321.62	−17.30	387015.13	7493175.46
8	BH	309.25	292.60	−16.65	387329.59	7491740.75
9	BH	359.05	295.02	−64.03	387151.79	7491742.28
10	BH	283.11	271.53	+8.42	387441.49	7492703.58
11	BH	274.77	265.00	−9.77	387429.86	7493839.53
12	BH	270.70	278.48	+7.78	387429.86	7493839.53

PROPOSED BOREHOLE/TEST PIT TABLE

POINT #	DESCRIPTION	EXISTING GROUND ELEVATION	DESIGN GROUND ELEVATION	ELEVATION DIFFERENCE (FT)	NORTHING	EASTING
13	BH	390.17	376.93	−13.24	386760.08	7493861.25
14	BH	239.03	253.00	+13.97	387972.34	7493517.97
1	TP	323.66	331.61	+7.95	386961.84	7491410.53
2	TP	301.95	293.05	−8.90	387254.49	7491572.23
3	TP	308.29	297.30	−10.99	386912.70	7492395.46
4	TP	334.16	345.53	+11.37	386843.02	7492745.75
5	TP	297.77	286.17	−11.60	387100.73	7492831.97
6	TP	274.21	279.12	+4.91	387296.90	7492529.39
7	TP	280.00	280.97	+0.97	387678.75	7492637.64
8	TP	247.65	247.99	+0.34	387926.99	7492978.07
9	TP	253.18	265.38	+12.20	387897.22	7493543.05
10	TP	256.33	265.00	+8.67	387516.53	7494081.62



LEGEND

MW-22	EX. GROUNDWATER MONITORING WELL	BH-1	EX. BORE HOLE
WP-1	EX. WETLAND PIEZOMETER	BH-1	PROP. BORE HOLE
	EX. PRIVATE WELL	−5	PROP. CONTOUR – CUT
TP-4	EX. TEST PIT	5	PROP. CONTOUR – FILL
TP-4	PROP. TEST PIT		

SCALE IN FEET

0 300 600

REFERENCE

1. EXISTING TOPOGRAPHY FROM AERIAL SURVEY BY COOPER AERIAL SURVEYS CO. ON APRIL 3, 2013, UPDATED WITH GROUND SURVEY BY NORTHSTAR SURVEYING, INC. ON MAY 23, 2013.

Civil & Environmental Consultants, Inc.
11811 N. Tatum Blvd., Suite 3057 - Phoenix, AZ 85028
Ph: 602.760.2324 · 877.231.2324 · Fax: 602.760.2330
www.cecinc.com

REPUBLIC SERVICES, INC.
COFFIN BUTTE LANDFILL
29175 COFFIN BUTTE ROAD
CORVALIS, OR 97330

DEVELOPMENT AREA
PROPOSED DRILLING AND TEST PIT LOCATIONS

DRAWN BY:	LAR	CHECKED BY:	PFB	APPROVED BY:	PFB	FIGURE NO.:	5
DATE:	JUL.2021	DWG SCALE:	1"=300'	PROJECT NO:	310-145		

\\svr-okc\Projects\310-000\310-145\-CADD\Dwg\310145-5-Proposed Drill and Test Pit Locations.dwg[LAYOUT1] LS:(7/14/2021 - Ireforma) - LP: 7/14/2021 5:53 PM

APPENDIX A

INFORMATION FROM OTHER REPORTS

A (NORTHWEST) — (EAST) **A'**

ELEVATION (MSL)

550 500 450 400 350 300 250 200 150 100

Note: Top of liner and subgrade for cell 2 are schematic and are not meant to accurately represent composite liner system at scale of drawing.

BEND IN SECTION

BEND IN SECTION

CELL 2D

CELL 2C

CELL 2B

P–18

TD 74.5'

HAUL ROAD

EXISTING GRADE

TOP OF LINER

SUBGRADE

CELL 2 SUMP

P–15 (Decom 5/95)

P–5 (38' Offset) (Decom 5/93)

Waste

P–3 (Decom 5/93)

Tsr

SEDIMENTATION BASIN

TOKETE MARSH

HWY 99W

MW–22 (13' Offset)

MW–9S (25' Offset)

TD 31.6'

TD 126.8'

Siletz River Volcanics (Tsr)

Quaternary Alluvium (Qal)

Explanation

MW–4 Monitoring Well

Screened Interval

Groundwater Elevation Measured 4/19/99

Sand Pack Interval

TD 17.5' Total Depth

0 300 600

SCALE IN FEET

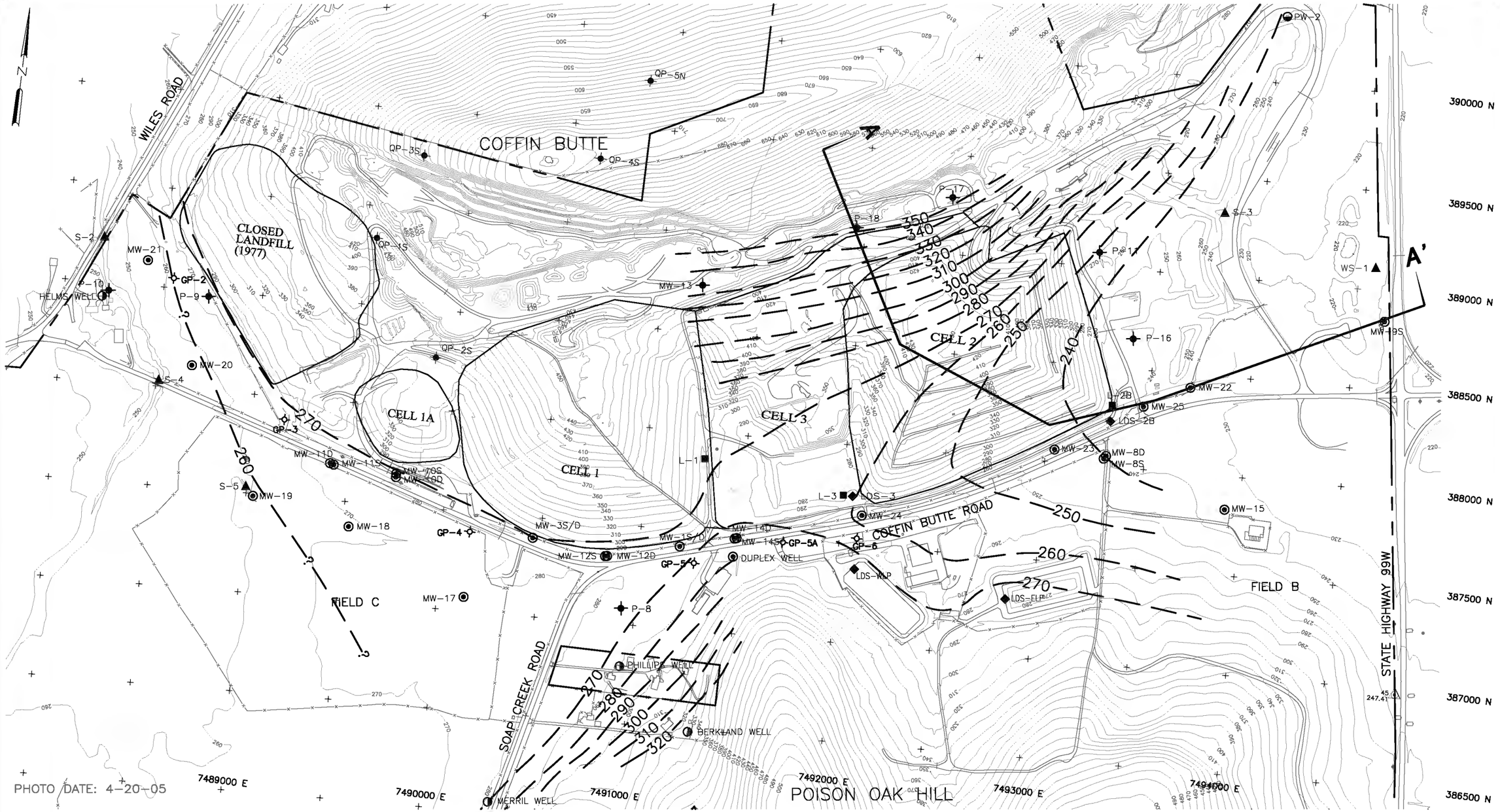
VERTICAL EXAGGERATION = 5X

Tuppan Consultants LLC
680 Iron Mountain Blvd.
Lake Oswego, Or 97034
Ph. 503.675.9103 Fax. 503.675.9107

DATE 11–12–03
DWN G. Haffner
APP
REV
PROJECT NO.
VLI–001–005

FIGURE 2-2
VALLEY LANDFILLS, INC.
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

GEOLOGIC CROSS SECTION A-A'



EXPLANATION

- MONITORING WELL
- PRIVATE WELL
- OBSERVATION WELL/PIEZOMETER
- LANDFILL WATER SUPPLY WELL
- SURFACE WATER MONITORING STATION
- GAS PROBE
- LEACHATE SUMP
- LEAK DETECTION SYSTEM
- PROPERTY LINE
- GROUNDWATER ELEVATION CONTOUR (FT-MSL) IN BEDROCK (4-19-99)

0 500 1000
SCALE IN FEET

Tuppan Consultants, LLC
460 Second Street, Suite 103
Lake Oswego, Or 97034
Ph. 503.675.1335 Cell 503.866.2551

DATE 12-14-05
DWN GRH
APP
REV
PROJECT NO.
VL1-001-005

FIGURE 2-3
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

BEDROCK GROUNDWATER CONTOURS

March 17, 2011
C:\000Projects\00Tuppan\Coffin Butte\Envir. mon. plan 2005\fig2-3.dwg

N

WILES ROAD

COFFIN BUTTE

CLOSED LANDFILL (1977)

CELL 1A

CELL 1

CELL 2

CELL 3

FIELD B

FIELD C

COFFIN BUTTE ROAD

SOAP CREEK ROAD

STATE HIGHWAY 99W

POISON OAK HILL

QP-5N
QP-3S
QP-4S
QP-1S
QP-2S
P-17
P-18
P-11
P-16
P-10
P-9
P-8
S-2
S-3
S-4
S-5
WS-1
PW-2
MW-21
GP-2
HELMS WELL
MW-20
GP-3
MW-11D
MW-11S
MW-7DS
MW-19D
MW-19
MW-18
GP-4
MW-3S/D
MW-1S/D
MW-12S
MW-12D
MW-14D
MW-14S
GP-5A
GP-6
DUPLEX WELL
MW-13
L-1
L-2B
LDS-2B
MW-22
MW-25
MW-23
MW-8D
MW-8S
L-3
LDS-3
MW-24
MW-15
LDS-WLP
LDS-FLP
MW-17
MW-9S
PHILLIPS WELL
BERKLAND WELL
MERRIL WELL
A
A'

390000 N
389500 N
389000 N
388500 N
388000 N
387500 N
387000 N
386500 N

7489000 E
7490000 E
7491000 E
7492000 E
7493000 E
7494000 E

220
230
240
250

Limit of Saturated Alluvium (Approx.)

PHOTO DATE: 4-20-05

EXPLANATION

- MONITORING WELL
- PRIVATE WELL
- OBSERVATION WELL/PIEZOMETER
- LANDFILL WATER SUPPLY WELL
- SURFACE WATER MONITORING STATION
- GAS PROBE
- LEACHATE SUMP
- LEAK DETECTION SYSTEM
- PROPERTY LINE
- GROUNDWATER ELEVATION CONTOUR (FT-MSL) IN ALLUVIUM (4-19-99)

0 500 1000
SCALE IN FEET

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Lake Oswego, Or 97034
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DATE 12-14-05
DWN GRH
APP
REV
PROJECT NO. VL1-001-005

FIGURE 2-4
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

ALLUVIUM GROUNDWATER CONTOURS

March 17, 2011
C:\000Projects\00Tuppan\Coffin Butte\Envir. mon. plan 2005\fig2-4.dwg

N

QP-7N 364.92
QP-6N 392.11
QP-5N 503.36
QP-4S 608.31
QP-3S 336.14
QP-2S 275.81
COFFIN BUTTE
P-22 592.53
P-23 583.81
P-20
P-21
P-19 369.69
PW-2 236.96
SEDIMENT POND 2
PUBLIC DISPOSAL & RECYCLING
TRUCK SCALE
BIOSWALE
Wiles Road
S-2 236.28
MW-21 253.04
P-10 245.12
P-9 266.85
MW-20 255.87
S-4 239.58
WP-8 250.55
CLOSED LANDFILL (1977)
Knife River Quarry
CELL 5A
CELL 4
CELL 2
CELL 1A
CELL 1
CELL 3
MW-27 233.42
TOKETIE MARSH WETLANDS
WS-1
MW-9S 219.89
SEDIMENT POND 1
MW-26 230.58
LDS-4
L-4
S-U6
Coffin Butte Road
L-2B
LDS-2B
MW-23 242.89
MW-8D
MW-8S 240.92
S-U4
MW-11D
MW-10S 265.39
MW-11S 264.60
MW-10D
MW-19 258.82
MW-18 263.58
WP-1 255.88
LDS-3
L-3
MW-24 267.20
S-U3
S-U5
MW-3D 264.88
MW-12S
MW-12D 264.31
MW-1S
L-1
MW-14D 272.36
MW-14S
DUPLEX WELL 272.16
LDS-WLP
MW-15 233.29
PNGC
State Hwy. 99W
EAST LEACHATE POND
LDS-ELP
WEST LEACHATE POND
MW-17 264.99
P-8 265.57
Landfill Office
PHILLIPS WELL 263.53
WP-3 269.18
WP-5 255.04
S-1
WP-6 258.55
Poison Oak Hill
BERKLAND WELL 323.7*
MERRIL WELL 268.17

PHOTO DATE: 2017

MONITORING WELL/PIEZOMETER
OBSERVATION WELL/PIEZOMETER
LANDFILL WATER SUPPLY WELL
GAS PROBE
AVERAGE FOR APRIL
PRIVATE WELL
LEACHATE SUMP
LEAK DETECTION SYSTEM
SURFACE WATER MONITORING STATION
?— GROUNDWATER ELEVATION CONTOUR (FT-MSL) QUERIED WHERE PROJECTED

0 500 1000
SCALE IN FEET

3-1-21\Tuppan\Coffin Butte\GW APRIL 2000.dwg

Tuppan Consultants LLC
460 Second Street, Suite 103
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Ph. 503.675.1335

DATE 2-23-21
DWN GRH
APP
REV
PROJECT NO.
VLI-001-002

FIGURE 3-5
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON
APRIL 18, 2020
GROUNDWATER CONTOURS

N

QP-7N 361.96
QP-6N 391.35
QP-5N 502.15
COFFIN BUTTE
P-22 589.51
P-20
P-19 365.04
P-23 579.02
QP-4S 603.92
QP-3S 335.6*
P-21
PW-2 233.94
SEDIMENT POND 2
PUBLIC DISPOSAL AREA CLOSING
BIOSWALE
FRENCH DRAIN
Wiles Road
S-2 236.31
MW-21 248.52
CLOSED LANDFILL (1977)
P-10 242.24
GP-2
P-9 265.01
Knife River Quarry
CELL 5A
L-5
SU-7
LDS-5
MW-27 232.17
TOKETIE MARSH WETLANDS
CELL 4
WS-1
MW-9S 217.67
MW-20 250.72
S-4 239.21
QP-2S 267.9*
CELL 2
MW-26 229.13
SEDIMENT POND 1
LDS-4
L-4
WP-8 245.73
GP-3
CELL 1A
CELL 1
CELL 3
MIL-2B
S-U6
Coffin Butte Road
LDS-2B
MW-11S 259.99
MW-10S 260.73
S-5
MW-19 256.91
MW-23 242.20
MW-8D
MW-8S 238.25*
S-U4
LDS-3
MW-18 259.11
GP-4
MW-3D 262.3*
MW-1D 262.4*
MW-2* 254.06
S-U3
S-U5
MW-15 229.99
ENGC
WP-1 247.18
MW-12S
MW-12D 260.29
MW-13D 269.17
MW-13S
GP-5A
GP-5
DUPLEX WELL 268.31
GP-6
LDS-WLP
L-POND
EAST LEACHATE POND
LDS-ELP
WEST LEACHATE POND
State Hwy. 99W
MW-17 260.76
P-8 261.34
Landfill Office
WP-5 250.92
PHILLIPS WELL 261.49
WP-3 261.82
Poison Oak Hill
S-1
BERKLAND WELL 317.8*
WP-6 256.14
MERRIL WELL 257.71

600 550 500 450 400 350 340 320 310 300 290 280 270 260 250 240 230 220 350 300 250 240 250 260 270 280 290 300 310

PHOTO DATE: 2017

MONITORING WELL/PIEZOMETER
OBSERVATION WELL/PIEZOMETER
LANDFILL WATER SUPPLY WELL
GAS PROBE
AVERAGE FOR OCTOBER

PRIVATE WELL
LEACHATE SUMP
LEAK DETECTION SYSTEM
SURFACE WATER MONITORING STATION
GROUNDWATER ELEVATION CONTOUR (FT-MSL) QUERIED WHERE PROJECTED

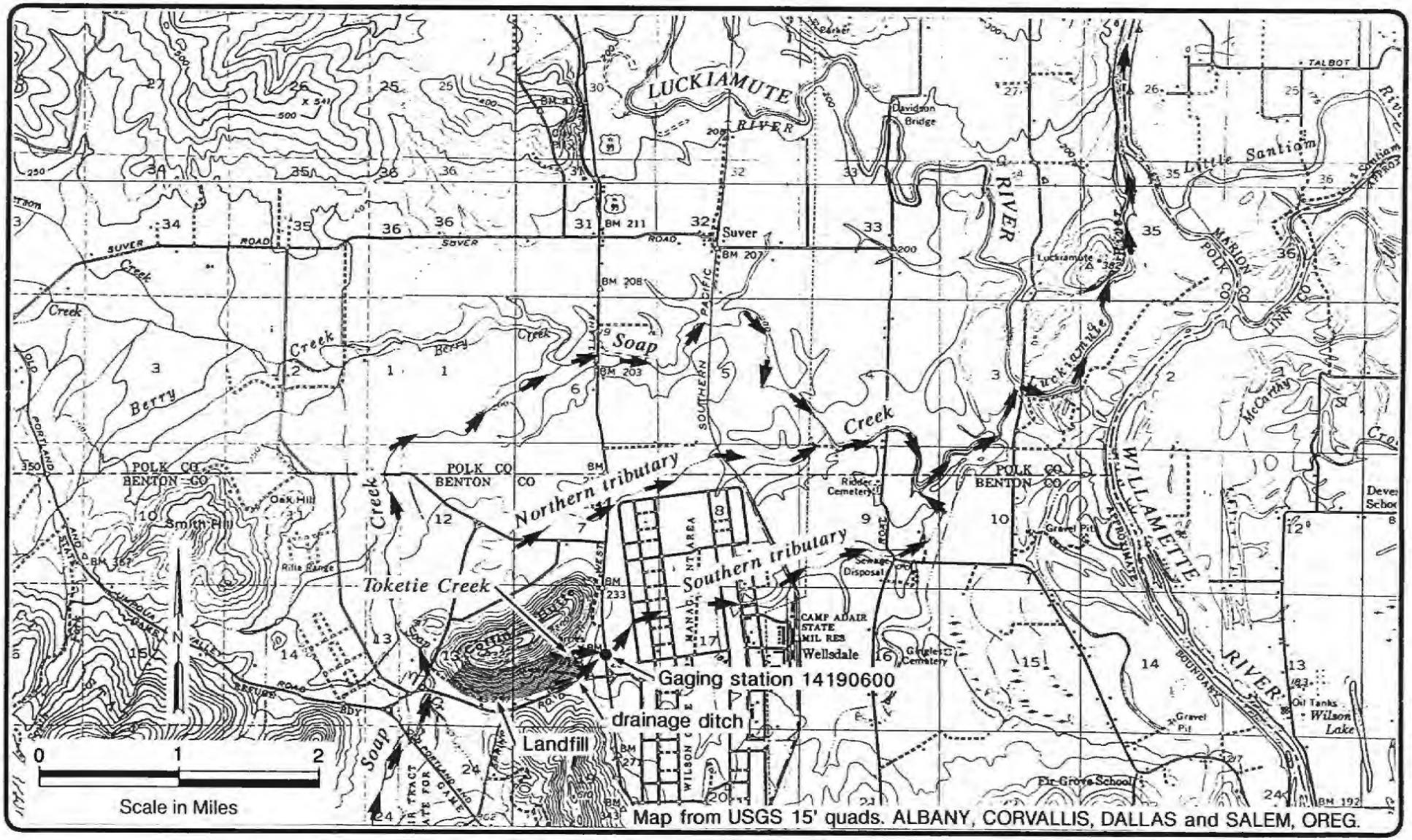
0 500 1000
SCALE IN FEET

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Ph. 503.675.1335

DATE 2-21-21
DWN GRH
APP
REV
PROJECT NO. VLI-001-002

FIGURE 3-6
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON
OCTOBER 8, 2020
GROUNDWATER CONTOURS

3-1-21:\Tuppan\Coffin Butte\GW OCTOBER 2020.dwg



Map from USGS 15' quads. ALBANY, CORVALLIS, DALLAS and SALEM, OREG.

EMCON Northwest, Inc.

DATE 5/93
DWN. mk
APPR.
REVIS.
PROJECT NO. 0139001.12

Figure 1
VALLEY LANDFILLS, INC.
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

SURFACE WATER FEATURES

APPENDIX B

BORNG LOGS – DEVELOPMENT AND ADJACENT AREAS

Appendix B
Boring Logs, Test Pit Logs, and Well Construction Diagrams
Coffin Butte Landfill
Development and Adjacent Areas

MW-8S, MW-8D
MW-9S, MW-9D
MW-14S, MW-14D
MW-15
MW-16
MW-22
MW-23
MW-24
MW-25
Berkland Domestic Well (2 wells)
Duplex Well
West Leachate Pond Borings and Test Pits
- **BH-1**
- **BH-2**
- **BH-3**
- **TP-1**
- **TP-2**
- **TP-3**
- **TP-4**
- **TP-5**
- **TP-6**

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Location SE of Landfill

Boring No. MW-8S

Surface Elevation

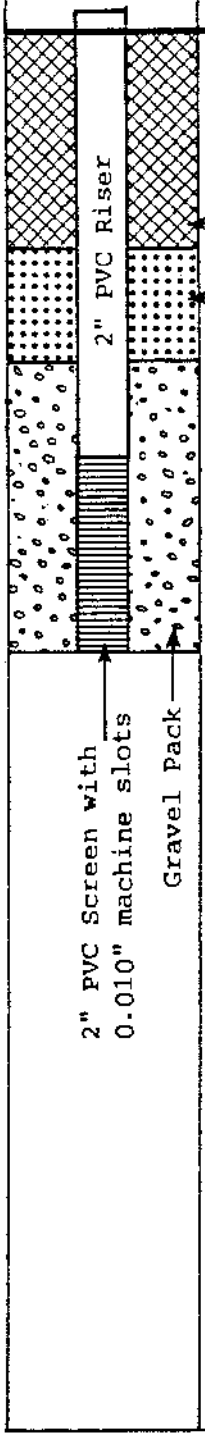
Drilling Method Air Rotary

Total Depth 32 feet

Drilled By Jones Drilling Co.

Date Completed 7/30/85

Logged By S.R. Henshaw

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		0 10 20 30 40					See boring log MW-8D for lithologic details.	

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Location SE of Landfill **Boring No.** MW-8D

Surface Elevation _____ **Drilling Method** Air Rotary

Total Depth 75 feet **Drilled By** Jones Drilling Co.

Date Completed 7/30/85 **Logged By** S.R. Henshaw

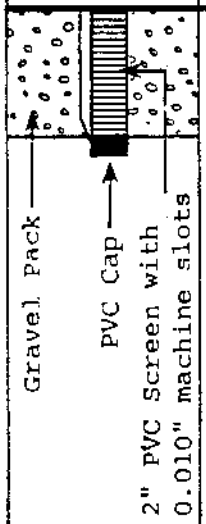
WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
2" PVC Riser; Bentonite; Bentonite Chips; 2" PVC Screen with 0.010" machine slots; Gravel Pack		0					0-5.0' CLAYEY-GRAVEL, light brown.	
		10					5.0-22.0' CLAY to CLAYEY-SILT, light brown to gray to black, cohesive, highly plastic lens of gravel and color transition from brown to gray-black at 15'.	
		20						▽
		30					22.0-62.0' TUFFACEOUS BASALIC CONGLOMERATE, brown to black, transition from weathered and poorly consolidated at top to well indurated at bottom. Some larger gravel at 40'.	600 conductivity micromohs/cm
		40						475 conductivity micromohs/cm
		50						500 conductivity micromohs/cm
		60						480 conductivity micromohs/cm
		70					62.0-75.0' BASALT, black to blue gray, hard.	

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Boring No. MW-8D

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		70					62.0-75.0' See previous page for lithology description.	500 conduc-tivity micro-mohs/cm

Sweet, Edwards & Associates, Inc.

BORING LOG

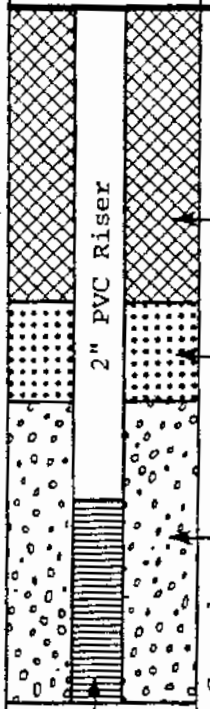
PROJECT COFFIN BUTTE LANDFILL **Page** 1 **of** 1

Location East of Landfill **Boring No.** MW-9S

Surface Elevation _____ **Drilling Method** Air Rotary

Total Depth 35 feet **Drilled By** Jones Drilling Co.

Date Completed 8/2/85 **Logged By** S.R. Henshaw

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		0					See boring log MW-9D for lithologic details.	
		10						
		20						
		30						
		40						

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Location East of Landfill

Boring No. MW-9D

Surface Elevation

Drilling Method Air Rotary

Total Depth 125 Feet

Drilled By Jones Drilling Co.

Date Completed 8/1/85

Logged By S.R. Henshaw

WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
ABANDONED RISER Cement slurry backfilled from 115' to 0'. Settled to ___ and backfilled with bentonite chips.		0 10 20 30 40 50 60 70					0-5.0' FILL, brown, soil and gravel. 5.0-19.0' CLAYEY SILT to CLAY, light brown, cohesive, hard, very plastic, sticky, some gravel. 19.0-36.0' CLAY, blue gray, hard, very plastic, sticky. 36.0-110.0' CLAYEY-SILT to SILTY-CLAY, light gray to light brown and red, firm, exhibits shale properties as observed from cuttings, moderately plastic, some small rock fragments 1-2 mm. Little sample recovered due to mixing.	1000 conductivity micromohs/cm 1000 conductivity micromohs/cm 1075 conductivity micromohs/cm 1050 conductivity micromohs/cm

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Boring No. MW-9D

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
ABANDONED RISER; Cement Slurry backfilled from 115' to 0'. Settled to ___ and backfilled with bentonite chips.		70					36.0-110.0' CLAYEY-SILT to SILTY CLAY. See previous page for lithology detail.	
		80						
		90						
		100						
		110					110.0-125.0' WEATHERED COLLUVIAL MATERIAL, characterized by angular rock fragments (1-4mm) and clay matrix. Some sand and clay stringers, good water yield, Artesian flow. Conductivity on 8/6/85 = 11,000 micro-mohs/cm.	2500 conduc-tivity micro-mohs/cm
2" PVC Screen with 0.010" machine slots		120						5000
								6000 conduc-tivity micro-mohs/cm.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	MW- 14S
LOCATION	Benton County, Oregon	PAGE	1 OF 3
DRILLED BY	Staco Well Services	REFERENCE ELEV.	287.50'
DRILL METHOD	Air Rotary	TOTAL DEPTH	35.50'
LOGGED BY	Creig Fanshier	DATE COMPLETED	7/27/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
				5				0-10 feet: SILTY CLAY (CL), yellowish brown, soft, damp, trace (<5%) 3/8-inch angular gravel. (COLLUVIUM)
S-1 GRAB				10				10-27 feet: BASALT, brown to orange brown, slightly fractured, strongly weathered on fractures, carbona.. veinlets. (Siletz River Volcanics)
S-2 GRAB				15				
S-3 GRAB			22.2' 7/27/92 ▽ 23.79' 8/5/92 ▼	20				
				25				

REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14S drilled approx. 20 feet east of B-14 by air rotary with 8-inch downhole hammer from surface to 35.5 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	MW- 14S
LOCATION	Benton County, Oregon	PAGE	2 OF 3
DRILLED BY	Staco Well Services	REFERENCE ELEV.	287.50'
DRILL METHOD	Air Rotary	TOTAL DEPTH	35.50'
LOGGED BY	Craig Fanshier	DATE COMPLETED	7/27/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-4 GRAB								**10-27 feet:** BASALT, brown to orange brown, slightly fractured, strongly weathered on fractures, carbonate veinlets. (Siletz River Volcanics)
								27-35.5 feet: BASALT, greenish gray to dark green, highly fracture, propylitic alteration, fine carbonates, (quartz) veinlets, trace pyrite.
S-5 GRAB				30				
S-6 GRAB				35				Bottom of boring at 35.5 feet below ground surface.
				40				WELL COMPLETION DETAILS:
								+2.08-19.5 feet: 4-inch dia. schedule 40 PVC flush threaded blank casing with "O" rings.
								19.5-29.5 feet: 4-inch dia. schedule 40 PVC screen with 0.020-inch machine slots.
								29.5-30.1 feet: 4-inch dia. schedule 40 PVC end cap.
								0-1.5 feet: Concrete.
								1.5-16.5 feet: 4.5 - 50 pound bags of 3/4-inch bentonite chips.
								16.5-30.5 feet: 4.5 - 100 bags of 8x12 graded silica sand. (FILTER PACK)
								30.5-35.5 feet: 2.25 - 50 pound bags of 3/4-inch bentonite chips.
				45				SURFACE COMPLETION DETAILS:
								6-inch steel locking protective casing, surrounded by 3 - 5-foot long, 3-inch dia. protective posts.
								Ground surface elevation: 287.5 feet MSL.
								Top of casing elevation: 289.58 feet MSL.
								Coffin Butte base map coordinates:
								Eastings: 674.78 feet.
								Northings: 251.74 feet.
				50				

REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14S drilled approx. 20 feet east of B-14 by air rotary with 8-inch downhole hammer from surface to 35.5 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	MW-14S
LOCATION	Benton County, Oregon	PAGE	3 OF 3
DRILLED BY	Staco Well Services	REFERENCE ELEV.	287.50'
DRILL METHOD	Air Rotary	TOTAL DEPTH	35.50'
LOGGED BY	Craig Fanshier	DATE COMPLETED	7/27/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
				55				Sample depth indicates where a discrete interval sample was collected and archived. Air rotary cuttings were semi-continuously monitored at the discharge during the drilling process.
				60				
				65				
				70				
				75				

REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 fee Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14S drilled approx. 20 feet east of B-14 by air rotary with 6-inch downhole hammer from surface to 35.5 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	MW- 14D
LOCATION	Benton County, Oregon	PAGE	1 OF 4
DRILLED BY	Staco Well Services	REFERENCE ELEV.	287.80'
DRILL METHOD	Air Rotary	TOTAL DEPTH	75.00'
LOGGED BY	Craig Fenshier	DATE COMPLETED	7/24/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-1 GRAB				5				**0-10 feet:** SILTY CLAY (CL), brown, soft, damp, trace (5%) 3/8-inch angular gravel. (COLLUVIUM)
S-2 GRAB				10				**10-27 feet:** BASALT, brown to orange brown, slightly fractured, strongly weathered on fractures, carbonate veinlets. (Siletz River Volcanics)
S-3 GRAB				15				
S-4 GRAB				20				
			23.27' 7/29/92	25				

REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14D drilled approx. 10 feet east of B-14 by air rotary with 6-inch downhole hammer from surface to 75 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	MW- 14D
LOCATION	Benton County, Oregon	PAGE	2 OF 4
DRILLED BY	Staco Well Services	REFERENCE ELEV.	287.80'
DRILL METHOD	Air Rotary	TOTAL DEPTH	75.00'
LOGGED BY	Craig Fanshier	DATE COMPLETED	7/24/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-5 GRAB								**10-27 feet:** BASALT, brown to orange brown, slightly fractured, strongly weathered on fractures, carbonate veinlets. (Siletz River Volcanics)
S-6 GRAB								**27-71 feet:** BASALT, greenish gray to dark green, intensely fractured, propylitic alteration, fine-grained carbonates, (quartz) veinlets, trace pyrite.
S-7 GRAB	–	–		30				
S-8 GRAB				35				@ 36 feet: 5% gray ash, tuff. @ 37 feet: 5% gray ash, tuff.
S-9 GRAB								
S-10 GRAB				40				
S-11 GRAB				45				
				50				

REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14D drilled approx. 10 feet east of B-14 by air rotary with 6-inch downhole hammer from surface to 75 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	MW- 14D
LOCATION	Benton County, Oregon	PAGE	3 OF 4
DRILLED BY	Staco Well Services	REFERENCE ELEV.	287.80'
DRILL METHOD	Air Rotary	TOTAL DEPTH	75.00'
LOGGED BY	Craig Fanshier	DATE COMPLETED	7/24/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-12 GRAB								27-71 feet: BASALT, greenish gray to dark green, intensely fractured, propylitic alteration, fine-grained carbonates, (quartz) veinlets, trace pyrite.
								@ 51-60 feet: Harder drilling.
S-13 GRAB				55				@ 56-71 feet: Trace (5%) white calcite filling small fractures.
S-14 GRAB				60				@ 60-64 feet: Easier drilling.
			▽ 64.0' 7/24/92					@ 64 feet: Minor water produced at surface cuttings discharge pipe.
S-15 GRAB				65				
								@ 69-71 feet: Easier drilling, produces approx. 0.2 gpm.
S-16 GRAB				70				
								71-75 feet: TUFFACEOUS BASALT, fine grain, greenish gray, 20% light gray ash-tuff, discharge water turns gray.
				75				

REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14D drilled approx. 10 feet east of B-14 by air rotary with 6-inch downhole hammer from surface to 75 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	MW- 14D
LOCATION	Benton County, Oregon	PAGE	4 OF 4
DRILLED BY	Staco Well Services	REFERENCE ELEV.	287.80'
DRILL METHOD	Air Rotary	TOTAL DEPTH	75.00'
LOGGED BY	Craig Fanshier	DATE COMPLETED	7/24/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-17 GRAB				80 85 90 95 100				Bottom of boring at 75.0 feet below ground surface. WELL COMPLETION DETAILS: +2.47-60 feet: 2-inch dia. schedule 40 PVC flush threaded blank casing with "O" rings. 60-70 feet: 2-inch dia. schedule 40 PVC screen with 0.020-inch machine slots. 70-70.6 feet: 2-inch dia. schedule 40 PVC end cap. 0-3 feet: Concrete. 3-57.5 feet: 13.5 - 50 pound bags of 3/4-inch bentonite chips. 57.5-71 feet: 2.6 - 100 bags of 8x12 graded silica sand. (FILTER PACK) 71-75 feet: 0.8 50 pound bag of 3/4-inch bentonite chips. SURFACE COMPLETION DETAILS: 6-inch steel locking protective casing, surrounded by 3 - 5-foot long, 3-inch dia. protective posts. Ground surface elevation: 287.8 feet MSL. Top of casing elevation: 290.27 feet MSL. Coffin Butte base map coordinates: Eastings: 664.50 feet. Northings: 248.23 feet. Notes: Sample depth indicates where a discrete interval sample was collected and archived. Air rotary cuttings were semi-continuously monitored at the discharge during the drilling process.

REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14D drilled approx. 10 feet east of B-14 by air rotary with 6-inch downhole hammer from surface to 75 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-15
PAGE 1 OF 2
GROUND ELEV.
TOTAL DEPTH 29.00'
DATE COMPLETED 07/14/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)
CCB	100	1
		0.8
		2
CCB	102	1.3
		1.5
		2
		1.3
		1.2
CCB	102	0.8
		1.6
		1.8
		1.5
		1.8
CCB	98	
		2
		2.5
		3.8
CCB	102	3

GROUND WATER LEVELS | DEPTH IN FEET | SAMPLES | LITHOLOGIC COLUMN | WELL DETAILS

LITHOLOGIC DESCRIPTION

0 to 13.0 feet: CLAYEY SILT (MH), very dark gray to black (0 to 1.5 feet), dark grayish brown (1.5 to 2.6 feet), mottled brown and orange (2.6 to 13.0 feet), 75 percent silt, 25 percent clay, trace fine sand, soft to firm, moist, roots to 3.0 feet, micaceous, pore wetness at 13.0 feet. (ALLUVIUM)

13.0 to 20.4 feet: CLAYEY SILT (MH), dark grayish brown (13.0 to 15.9 feet), gray to dark reddish brown (15.9 to 18.0 feet), strong brown (18,0 to 20.4 feet), 75 percent silt, 20 percent clay, 5 percent fine to coarse gravel, soft to firm (overall somewhat crumbly), moist to wet. (ALLUVIUM)

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-15
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 29.00'
DATE COMPLETED 07/14/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
CCB	94	2 1 2		25 30 35 40				13.0 to 20.4 feet: CLAYEY SILT (MH), continued. 20.4 to 21.8 feet: SANDY GRAVEL (GP), strong brown, 60 percent fine to coarse decomposed well-rounded gravel, occasional cobbles, 30 percent fine to coarse sand, 10 percent clay and silt. (ALLUVIUM) 21.8 to 29.0 feet: SANDY GRAVELLY SILT (ML), reddish brown to brown, 50 percent silt, 30 percent decomposed fine to medium gravel, 20 percent fine to coarse sand, mostly crumbly, soft to firm, moist. (ALLUVIUM)

Total depth drilled = 29.0 feet.
Total depth sampled = 29.0 feet.

WELL COMPLETION DETAILS:
0 to 19.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe.
19.0 to 28.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.010-inch machined slots.
28.0 to 29.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank sump pipe.

0 to 3.0 feet: Concrete.
3.0 to 16.5 feet: Bentonite chips hydrated with potable water.
16.5 to 29.0 feet: 20 - 40 Colorado Silica Sand.

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. **MW-16**
PAGE **1 OF 2**
GROUND ELEV.
TOTAL DEPTH **27.30'**
DATE COMPLETED **07/19/93**

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
CCB	98							**0 to 3.0 feet:** CLAYEY SILT (MH), very dark grayish brown, 70 percent silt, 30 percent clay, trace fine sand, stiff to very stiff, dry to damp, crumbly dry from 0 to 1.0 foot. (ALLUVIUM)
CCB	104			5				**3.0 to 9.0 feet:** CLAYEY SILT (ML), dark yellowish brown, 60 percent silt, 25 percent clay, 10 percent fine to medium gravel, 5 percent fine to coarse sand, stiff (crumbly from 7.0 to 9.0 feet), moist. (COLLUVIUM)
CCB	50			10				**9.0 to 15.2 feet:** CLAYEY GRAVELLY SILT (ML), dark yellowish brown, 50 percent silt, 30 percent fine to coarse, fresh to slightly weathered, subangular basalt gravel, 20 percent clay, stiff, moist. (COLLUVIUM)
CCB	100			15				**15.2 to 16.2 feet:** SANDY SILTY GRAVEL (GP), orangy brown, 60 percent fine to coarse angular weathered basalt gravel, 20 percent basalt sand, 20 percent silt and clay. (COLLUVIUM)
CCB	68		▽					**16.2 to 27.3 feet:** BASALT, black to very dark bluish gray, aphanitic, equigranular, crushed to intensely fractured, hard, fresh. (BEDROCK)
CCB	100			20				

REMARKS

Augered with center bit from 20.8 to 27.3 feet; hard drilling.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-16
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 27.30'
DATE COMPLETED 07/19/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
CCB	100			25				**16.2 to 27.3 feet: BASALT**, continued.
				30				Total depth drilled = 27.3 feet. Total depth sampled = 27.3 feet. **WELL COMPLETION DETAILS:** 0 to 17.2 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe. 17.2 to 26.6 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.020-inch machined slots. 26.6 to 27.3 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank sump pipe. 0 to 3.0 feet: Concrete. 3.0 to 15.6 feet: Bentonite chips hydrated with potable water. 15.6 to 27.3 feet: 10 - 20 Colorado Silica Sand.
				35				
				40				

REMARKS

Augered with center bit from 20.8 to 27.3 feet; hard drilling.

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**	BORING NO.	**MW-22**
LOCATION	**Benton County, Oregon**	PAGE	**1 OF 2**
DRILLED BY	**Geo-Tech Explorations, Inc.**	GROUND ELEV.	**232.73'**
DRILL METHOD	**Hollow Stem Auger**	TOTAL DEPTH	**29.00'**
LOGGED BY	**Eric Tuppan**	DATE COMPLETED	**07/22/94**

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENETRO-METER	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
CCB	75%							**0 to 1.0 foot:** GRAVEL FILL, grass at surface.
		3.3						**1.0 to 9.3 feet:** SILTY CLAY (CL), very dark grayish brown (10YR 3/2), some mottling with dark gray brown (10YR 2/6); medium plasticity fines; silty, minor fine to medium sand; root hairs; very stiff to stiff; damp. (ALLUVIUM)
CCB	100%	1.75	▼ 7/22/94	5				@ 5.5 feet: dark brown (10YR 3/3) with oxidized medium sand grains. @ 6.0 feet: root holes; moist to wet.
CCB	100%	2.5		10				@ 9 to 9.3 feet: basal layer of sandy clay. **9.3 to 14.0 feet:** CLAYEY SILT (ML), dark olive gray (5Y 3/2); very clayey; medium plasticity; trace fine to medium sand; very stiff; root hairs and root holes are wet to moist; crumbly texture. (ALLUVIUM)
CCB	100%	0.75	▽ 7/22/94	15				**14.0 to 24.7 feet:** SILT (MH), dark olive gray (5Y 3/2); minor clay; high plasticity; roots and organic matter common; root holes are wet. (ALLUVIUM) @ 17.0 feet: zones of very dark grayish brown (2.5Y 3/2); twigs horizontal to core axis; roots and root holes abundant; firm to very stiff; wet in root holes.
CCB	100%	3.25		20				

REMARKS

Boring drilled with 3.75-inch I.D. hollow-stem augers to 29 feet and sampled with continuous core barrel. Backfilled hole from 24 to 29 feet with bentonite chips and pulled augers. Reamed out hole with 6.25-inch hollow-stem auger to 24.2 feet and installed well.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**	BORING NO.	**MW-22**
LOCATION	**Benton County, Oregon**	PAGE	**2 OF 2**
DRILLED BY	**Geo-Tech Explorations, Inc.**	GROUND ELEV.	**232.73'**
DRILL METHOD	**Hollow Stem Auger**	TOTAL DEPTH	**29.00'**
LOGGED BY	**Eric Tuppan**	DATE COMPLETED	**07/22/94**

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENETRO-METER	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								14.0 to 24.7 feet: SILT (MH), continued.
		3.0						@ 20.0 feet: dark gray (5Y 4/1); uniform silt with abundant roots; very stiff; damp to moist.
CCB	100%							
				25				**24.7 to 29.0 feet: CLAY (CL)**, dark olive gray (5Y 3/2); low plasticity clay with minor silt; trace fine to medium sand; relict intergranular basalt texture; few roots; crumbly and breaks apart along what appear to be relict fractures(?); very stiff; moist. (WEATHERED BEDROCK)
		2.0						
				30				Boring terminated at 29.0 feet; sufficient data.
				35				
				40				

REMARKS

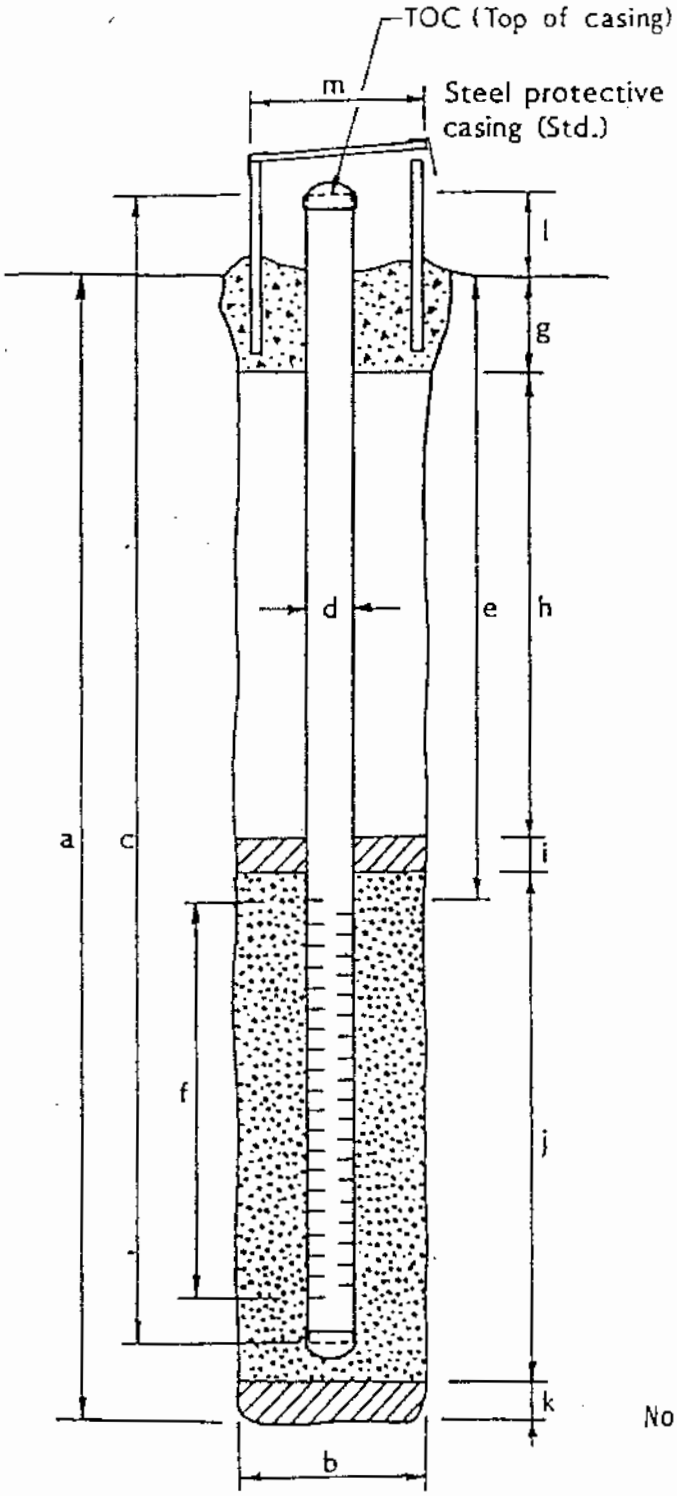
Boring drilled with 3.75-inch I.D. hollow-stem augers to 29 feet and sampled with continuous core barrel. Backfilled hole from 24 to 29 feet with bentonite chips and pulled augers. Reamed out hole with 6.25-inch hollow-stem auger to 24.2 feet and installed well.

EMCON

WELL DETAILS

PROJECT NUMBER 0139-001.47
PROJECT NAME Coffin Butte Landfill
LOCATION Benton County , Or
WELL PERMIT NO. 67395

BORING / WELL NO. MW-22
TOP OF CASING ELEV. 235.30
GROUND SURFACE ELEV. 232.73
DATUM Mean Sea level
INSTALLATION DATE 7-22-94



EXPLORATORY BORING

a. Total depth 29.0 ft.
b. Diameter 10 1/4 in.
Drilling method Hollow-stem auger

WELL CONSTRUCTION

c. Total casing length 26.7 ft.
Material Sch. 40 PVC
d. Diameter 2 in.
e. Depth to top perforations 14.0 ft.
f. Perforated length 9.6 ft.
Perforated interval from 14.0 to 23.6 ft.
Perforation type Machine Slotted
Perforation size 0.010 inch
g. Surface seal (0-2.0) 2.0 ft.
Seal material Concrete
h. Backfill ____ ft.
Backfill material NA
i. Seal (2.0 - 11.0) 9.0 ft.
Seal material Bentonite Chips
j. Gravel pack (11.0-24.2) 13.2 ft.
Pack material 20X40 Silica Sand
k. Bottom seal (24.2 - 29.0) 4.8 ft.
Seal material Bentonite Chips
l. Casing stickup 2.46 ft.
m. Protective casing diameter 6.5 in.

Note: SS Centralizers at 8.7' and 24.0'

Prepared by: Eric Tuppan

Reviewed by: [signature] Date: 8/12/94

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**	BORING NO.	**MW-23**
LOCATION	**Coffin Butte, Benton County, Oregon**	PAGE	**1 OF 2**
DRILLED BY	**Geo-Tech Explorations, Inc.**	GROUND ELEV.	**242.81'**
DRILL METHOD	**Hollow Stem Auger**	TOTAL DEPTH	**24.30'**
LOGGED BY	**Mike Free**	DATE COMPLETED	**08/02/94**

SAMPLE TYPE	RECOVERY PERCENT	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
CCB	45	▽ 8/2/94					**0 to 3.0 feet: CLAYEY SILT (ML)**, very dark grayish brown, some black; medium plasticity fines; 10 percent fine to coarse sand; 10 percent medium gravel; firm, moist, few roots. (FILL) @ 1.0 foot: soft. @ 2.0 feet: wet.
CCB	100		5				**3.0 to 10.5 feet: SANDY CLAYEY SILT (ML)**, very dark grayish brown; medium plasticity fines; 15 percent fine to coarse sand, mostly medium; few roots; firm, wet (root holes wet). (ALLUVIUM) @ 4.8 feet: grayish brown and orange mottling.
CCB	90						@ 7.0 to 8.0 feet: crumbly, low plasticity.
CCB	100		10				**10.5 to 16.2 feet: CLAYEY SILT (ML)**, dark gray to dark greenish gray; breaks with massive, fine grained texture; trace fine rootlets; micaceous; stiff to firm; wet. (ALLUVIUM) @ 12.0 feet: core barrel wet on outside.
CCB	100		15				@ 15.5 to 16.5 feet: few fine rootlets.
CCB	100		20				**16.2 to 20.4 feet: SANDY SILTY CLAY (CL)**, very dark greenish gray; medium plasticity fines; 20 percent fine to coarse sand; trace fine gravel; breaks with massive, textured surface; trace fine rootlets; stiff; wet. (ALLUVIUM) @ 17.0 feet: low plasticity.

REMARKS

Drilled to 24.3 feet with 3 3/4-inch I.D. augers and sampled with continuous core barrel. Backfilled with bentonite chips from 21.0 to 24.3 feet. Reamed with 6 1/4-inch I.D. auger with PVC plug to 22.8 feet and installed well. Added 30 gallons of potable water during well installation.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**	BORING NO.	**MW-23**
LOCATION	**Coffin Butte, Benton County, Oregon**	PAGE	**2 OF 2**
DRILLED BY	**Geo-Tech Explorations, Inc.**	GROUND ELEV.	**242.81'**
DRILL METHOD	**Hollow Stem Auger**	TOTAL DEPTH	**24.30'**
LOGGED BY	**Mike Free**	DATE COMPLETED	**08/02/94**

SAMPLE TYPE	RECOVERY PERCENT		GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION

16.2 to 20.4 feet: SANDY SILTY CLAY (CL), continued.

20.4 to 23.2 feet: CLAYEY SANDY GRAVEL (GC), dark greenish gray; 30 percent fines; 10 percent fine to coarse sand; 60 percent well graded fine to coarse gravel; sand and gravel subangular to well rounded; loose; wet. (ALLUVIUM)

23.2 to 24.3 feet: BASALT, light to very dark brown, some yellow; crushed; 50 percent friable, 50 percent low to moderate hardness; weakly to deeply weathered; wet. (BEDROCK)

Boring terminated at 24.3 feet; sufficient data.

25

30

35

40

WELL COMPLETION DETAILS:

0 to 12.4 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.

12.4 to 22.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.010-inch machined slots.

22.1 to 22.7 feet: 2-inch-diameter flush-threaded end cap.

0 to 2.0 feet: Concrete.

2.0 to 9.6 feet: Bentonite chips hydrated with potable water.

9.6 to 22.7 feet: 20 - 40 Colorado Silica Sand.

22.7 to 22.8 feet: Slough

22.8 to 24.2 feet: Bentonite chips.

24.2 to 24.3 feet: Slough.

REMARKS

Drilled to 24.3 feet with 3 3/4-inch I.D. augers and sampled with continuous core barrel. Backfilled with bentonite chips from 21.0 to 24.3 feet. Reamed with 6 1/4-inch I.D. auger with PVC plug to 22.8 feet and installed well. Added 30 gallons of potable water during well installation.

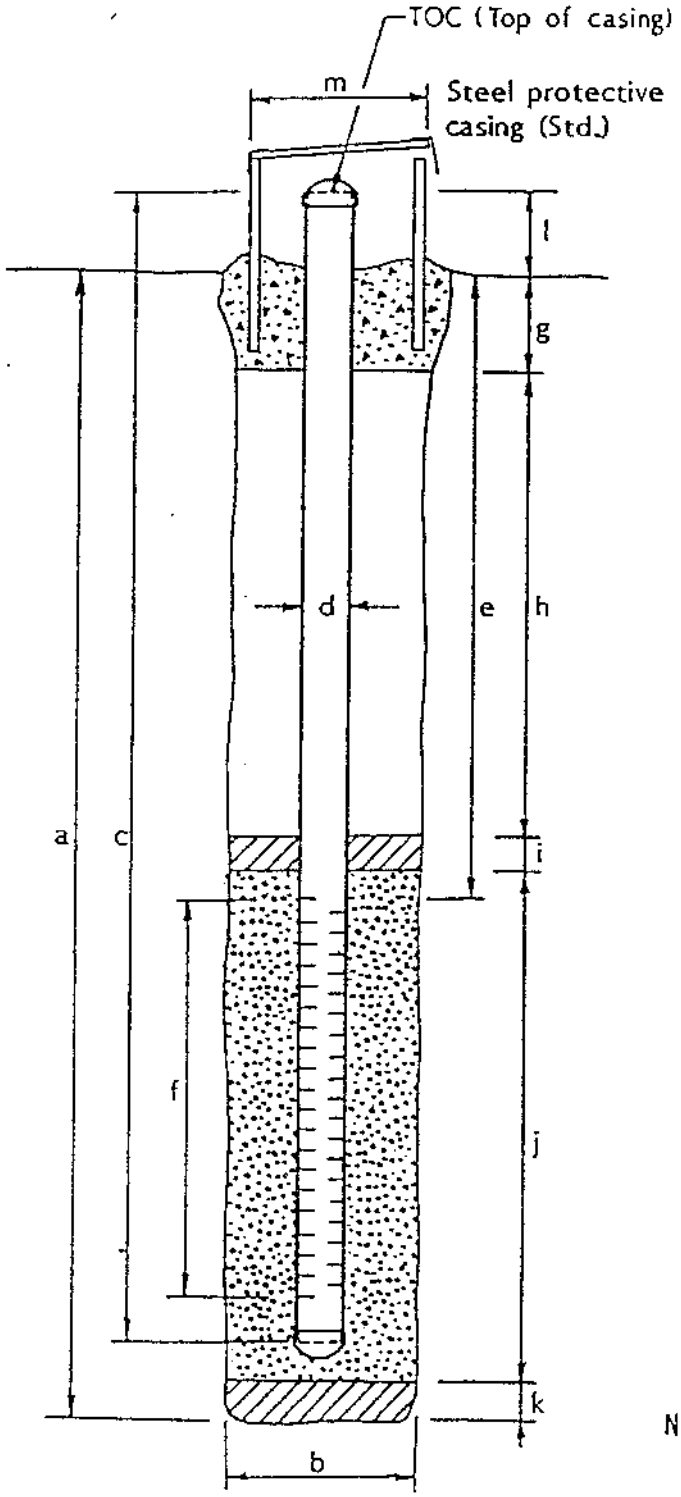
EMCON

WELL DETAILS

EMCON ASSOCIATES

PROJECT NUMBER 0139-001.47
PROJECT NAME Coffin Butte Landfill
LOCATION Benton County, Or
WELL PERMIT NO. 67396

BORING / WELL NO. MW 23
TOP OF CASING ELEV. 244.71
GROUND SURFACE ELEV. 242.81
DATUM Mean Sea Level
INSTALLATION DATE 8-2-94



EXPLORATORY BORING

a. Total depth 24.3 ft.
b. Diameter 10 1/4 in.
Drilling method Hollow Stem Auger

WELL CONSTRUCTION

c. Total casing length 24.7 ft.
Material Sch 40 PVC
d. Diameter 2 in.
e. Depth to top perforations 12.4 ft.
f. Perforated length 9.7 ft.
Perforated interval from 12.4 to 22.1 ft.
Perforation type Machine Slotted
Perforation size 0.010 inch
g. Surface seal (0-2.0) 2.0 ft.
Seal material Concrete
h. Backfill ft.
Backfill material NA
i. Seal (2.0- 9.6) 7.6 ft.
Seal material Bentonite Chips
j. Gravel pack (9.6-22.7) 13.1 ft.
Pack material 20-40 Silica Sand
k. Bottom seal 1.5 ft.
Seal material Bentonite Chips
l. Casing stickup 2.0 ft.
m. Protective casing diameter 6.5 in.
Note: SS Centralizers at 7.2' and 21.2'.

Prepared by: Mike Free

Reviewed by: EQ Date: 8/12/94

Form F-11 Rev. 12/90

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte/Valley Landfills		
LOCATION	Benton County, Oregon	PAGE	1 OF 2
DRILLED BY	GeoTech Explorations, Inc.	BORING NO.	MW-24
DRILL METHOD	Hollow Stem Auger	TOTAL DEPTH	35'
LOGGED BY	John Renda	DATE COMPLETED	8/31/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS/6"	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
1 SS	67	6-11-16						**0.0 to 13.5 feet: SILTY CLAY (CL)**; yellowish-brown (10 YR, 6/6); 95% medium to high plasticity fines, trace coarse sand; 5% organics (roots); very stiff; dry. (ALLUVIUM)
2 SS	33	10-7-5						
3 SS	100	3-6-8		5				
4 SS	20	3-3-6						
5 SS	100	3-5-8						
6 SS	100	3-3-7		10				
7 SS	100	3-8-11						
8 SS	100	3-9-24						@ 12.0 feet: sand content increases to 5%.
9 SS	100	24-23-17						**13.5 to 35.0 feet: BASALT WEATHERED TO SILTY CLAY (CL) WITH SAND (SW) AND GRAVEL (GC)**; brown (7.5 YR, 4/6); 50% medium to high plasticity fines, 40% deeply weathered basaltic gravel; friable; 10% fine to medium sand; dense. (WEATHERED BASALT)
10 SS	33	16-24-50/0.4'		15				
11 SS	100	8-25-36						
12 SS	100	19-22-44	8/31/98 ▼					@ 18.0 feet: moist.
				20				

REMARKS

EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte/Valley Landfills		
LOCATION	Benton County, Oregon	PAGE	2 OF 2
DRILLED BY	GeoTech Explorations, Inc.	BORING NO.	MW-24
DRILL METHOD	Hollow Stem Auger	TOTAL DEPTH	35'
LOGGED BY	John Renda	DATE COMPLETED	8/31/98

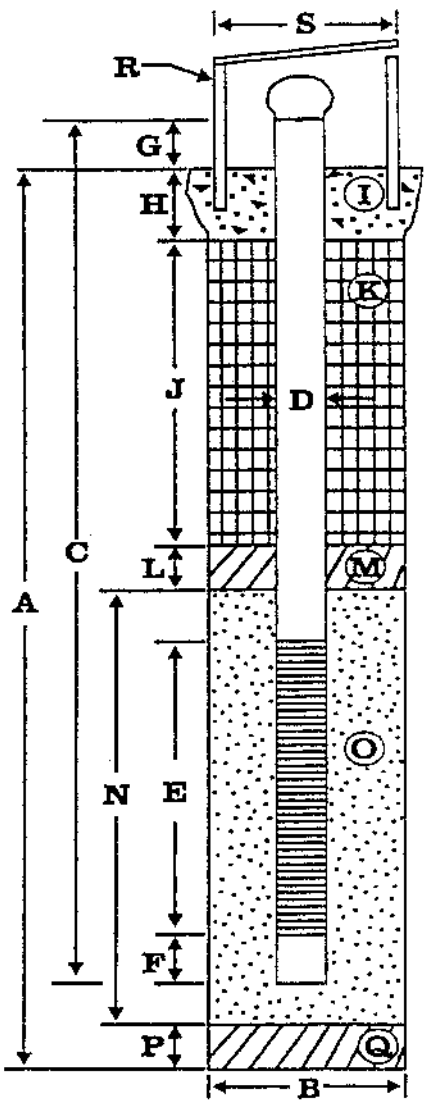
SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS/6"	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
13 SS	100	12-50/0.4'						
14 SS	67	21-24-50/0.4'						
15 SS	100	19-50/0.4'	▽					
16 SS	40	50/0.4'						@ 24.0 feet: wet.
17 SS	40	50/0.4'		25				@ 25.0 feet: split spoon refusal.
				30				
18 SS	100	50/0.4'		35				@ 35.0 feet: fractured basalt; auger refusal. @ 35.0 feet: boring terminated.
				40				

REMARKS

EMCON

WELL DETAILS

Project Number:	40139-001.065	Boring/Well No.:	MW-24
Client Name:	Valley Landfills, Inc	Top of Casing Elev.:	276.76
Project Name:	Coffin Butte Landfill	Ground Surface Elev.:	273.94
Location:	Benton County, Oregon	Installation Date:	8/31/98
Driller:	Geo-Tech Explorations, Inc.	Permit/Start Card No.:	112462



	Depth (feet)	Elev. (ft, msl)
	3.0	276.94
	2.8	276.76
	0.0	273.94
	1.0	272.94
	1.0	272.94
	18.0	255.94
	19.5	254.44
	34.5	239.44
	35.0	238.94
	35.0	238.94

EXPLORATORY BORING

A. Total depth:	35.0 ft.
B. Diameter	10 in.
Drilling method:	Hollow Stem Auger

WELL CONSTRUCTION

C. Well casing length:	37.7 ft.
Well casing material:	Sched 40 PVC
D. Well casing diameter:	2.0 in.
E. Well screen length:	15.0 ft.
Well screen type:	Machine Slotted
Well screen slot size:	0.020 in.
F. Well sump/end cap length:	0.5 ft.
G. Well casing height (stickup):	2.7 ft.
H. Surface seal thickness:	1.0 ft.
I. Surface seal material:	Concrete
J. Annular seal thickness:	NA ft.
K. Annular seal material:	NA
L. Filter pack seal thickness:	18.0 ft.
M. Filter pack seal material:	Bentonite Chips
N. Sand pack thickness:	17.0 ft.
O. Sand pack material:	8X12 Silica Sand
P. Bottom material thickness:	NA ft.
Q. Bottom material:	NA
R. Protective casing material:	Steel
Well centralizer depths:	20 and 34 ft.
S. Protective casing diameter:	6.5 in.

NOTES:

Installed by: John J. Renda

Reviewed by: [signature]

Date: 2/8/98

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**	BORING NO.	**MW-25**
LOCATION	**Benton County, Oregon**	PAGE	**1 OF 2**
DRILLED BY	**Geo-Tech Explorations, Inc.**	REFERENCE ELEV.	**242.79**
DRILL METHOD	**Hollow Stem Auger**	TOTAL DEPTH	**32.5 feet**
LOGGED BY	**John Renda**	DATE COMPLETED	**6/4/99**

SAMPLE NUMBER	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FEET	SOIL SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
							0.0 to 7.0 feet: GRAVEL FILL.
SS-1	3-4-6 (10)						**7.0 to 11.0 feet:** SILTY CLAY (CL); very dark grayish brown (2.5YR 3/2); medium plasticity fines; silty; trace fine to medium sand; root hairs; firm to stiff; damp. (ALLUVIUM)
SS-2	2-3-4 (7)	▼					
SS-3	1-2-3 (5)						
SS-4	4-6-10 (16)						**11.0 to 14.5 feet:** CLAYEY SILT (ML); dark gray (2.5YR 4/1); medium plasticity fines; trace fine to medium sand; root hairs; stiff, crumbly texture. (ALLUVIUM)
SS-5	4-6-8 (14)	▼					@ 13.0 feet: wet.
SS-6	4-7-10 (17)						**14.5 to 24.0 feet:** SILT (MH); dark greenish gray (10GY 4/1); medium to high plasticity fines; root hairs; moist. (ALLUVIUM)
SS-7	3-5-5 (10)						
SS-8	5-11-11 (22)						
SS-9	3-4-6						

5 10 15 20

REMARKS

SS = samples collected with a split-spoon stainless steel sampler.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte Landfill	BORING NO.	MW-25
LOCATION	Benton County, Oregon	PAGE	2 OF 2
DRILLED BY	Geo-Tech Explorations, Inc.	REFERENCE ELEV.	242.79
DRILL METHOD	Hollow Stem Auger	TOTAL DEPTH	32.5 feet
LOGGED BY	John Renda	DATE COMPLETED	6/4/99

SAMPLE NUMBER	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FEET	SOIL SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
	(10)						**14.5 to 24.0 feet: SILT (MH);** continued.
SS-10	3-6-8 (14)						
SS-11	4-8-7 (15)						
SS-12	2-3-5 (8)						**24.0 to 32.5 feet: CLAY (CL);** dark greenish gray (10Y 3/1); medium to high plasticity clay; trace fine to coarse, subrounded to well-rounded sand; relict basalt texture visible; root hairs; stiff; moist. (WEATHERED BASALT)
SS-13	3-4-6 (10)		25				
SS-14	4-8-12 (20)						
SS-15	5-10-13 (23)						
SS-16	8-13-15 (28)		30				
SS-17	4-6-7 (13)						
							Boring terminated at 29.5 feet. Split-spoon sampler advanced to 32.5 feet.
			35				
			40				

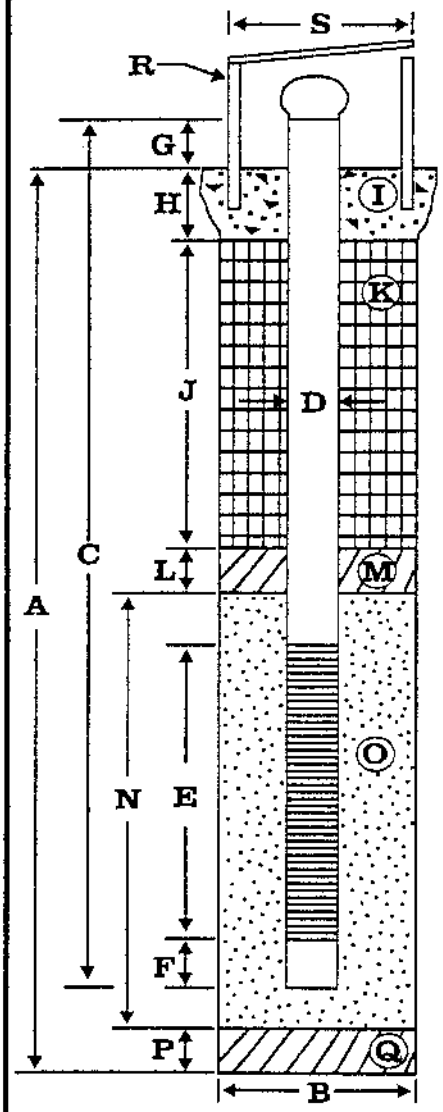
REMARKS

SS = samples collected with a split-spoon stainless steel sampler.

EMCON®

WELL DETAILS

Project Number:	40139-001.071	Boring/Well No.:	MW-25
Client Name:	Valley Landfills, Inc.	Top of Casing Elev.:	242.79
Project Name:	Coffin Butte Landfill	Ground Surface Elev.:	240.39
Location:	Benton County, Oregon	Installation Date:	6/4/99
Driller:	Geo-Tech Explorations	Permit/Start Card No.:	122965



	Depth (feet)	Elev. (ft, msl)
	2.6	243.0
	2.4	242.8
	0.0	240.4
	2.0	238.4
	11.0	229.4
	13.5	226.9
	23.5	216.9
	24.0	216.4
	24.0	216.4
	32.5	207.9

Installed by: J. Renda

Reviewed by: ET

Date: 7/20/99

EXPLORATORY BORING

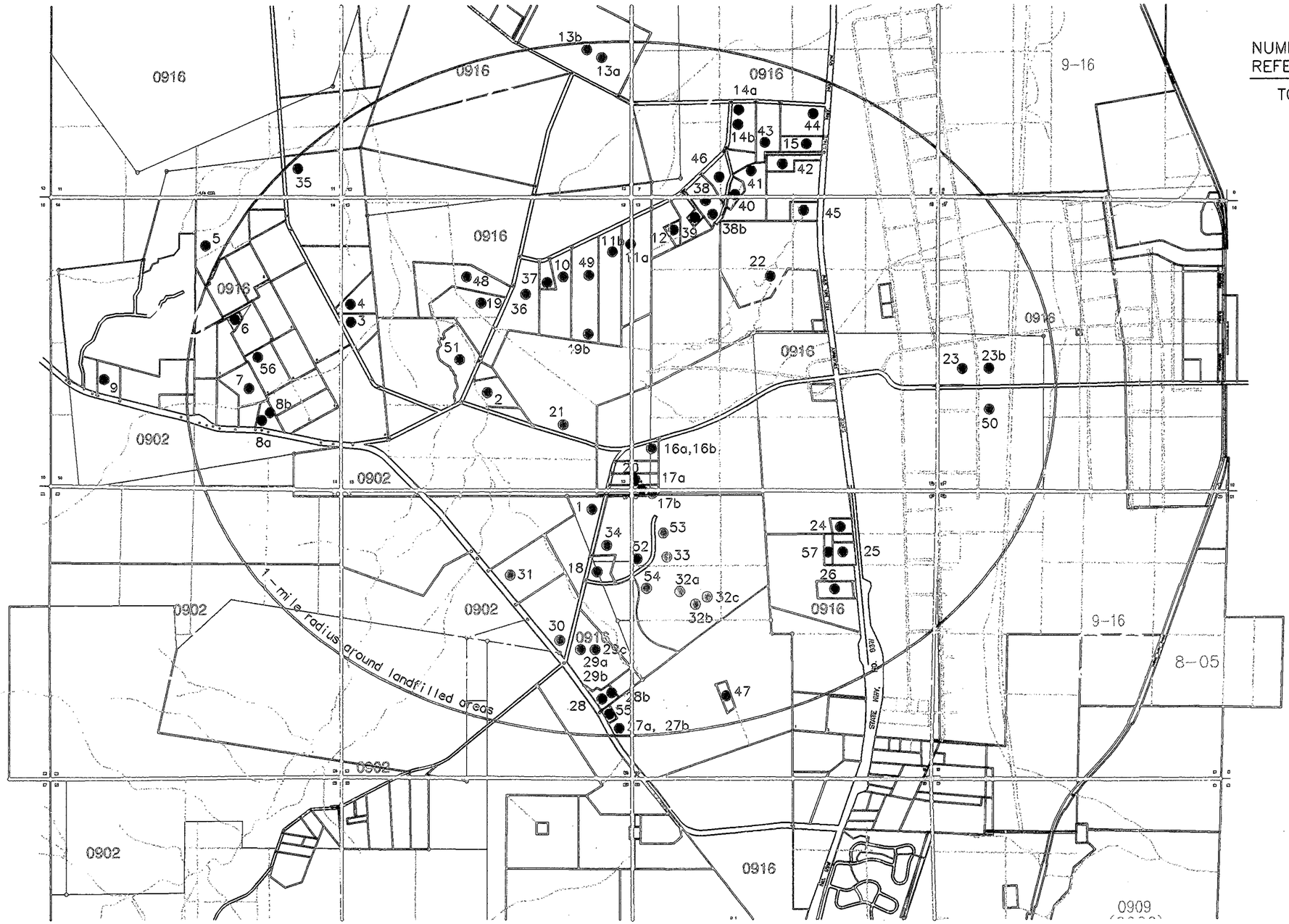
A.	Total depth:	32.5 ft.
B.	Diameter	10 in.
	Drilling method:	Hollow Stem Auger

WELL CONSTRUCTION

C.	Well casing length:	26.7 ft.
	Well casing material:	Schedule 40 PVC
D.	Well casing diameter:	2 in.
E.	Well screen length:	10 ft.
	Well screen type:	Machine Slotted
	Well screen slot size:	0.020 in.
F.	Well sump/end cap length:	0.5 ft.
G.	Well casing height (stickup):	1.5 ft.
H.	Surface seal thickness:	2.0 ft.
I.	Surface seal material:	Cement
J.	Annular seal thickness:	9 ft.
K.	Annular seal material:	Bentonite Chips
L.	Filter pack seal thickness:	NA ft.
M.	Filter pack seal material:	NA
N.	Sand pack thickness:	13 ft.
O.	Sand pack material:	10 x 20 Silica Sand
P.	Bottom material thickness:	8.5 ft.
Q.	Bottom material:	Bentonite Chips
R.	Protective casing material:	Steel
	Well centralizer depths:	13.0 ft.
		23.5 ft.
S.	Protective casing diameter:	6.5 in.

NOTES:

Well coordinates: Northing: 1181.5 Easting: 2626.8



NUMBER OF WELLS NOT REFERENCED TO FIELD LOCATIONS

TOWNSHIP 10S

RANGE 4W

- SECTION 7 = 6 WELLS
- SECTION 8 = 0 WELLS
- SECTION 17 = 3 WELLS
- SECTION 18 = 13 WELLS
- SECTION 19 = 16 WELLS
- SECTION 20 = 2 WELLS

RANGE 5W

- SECTION 11 = 0 WELLS
- SECTION 12 = 3 WELLS
- SECTION 13 = 16 WELLS
- SECTION 14 = 19 WELLS
- SECTION 23 = 0 WELLS
- SECTION 24 = 11 WELLS

0 2000 4000

SCALE IN FEET

DATE 5/15/00
DWN JAC
APP ET 5/15/00
REV
PROJECT NO. 793036

Figure 2-3b
VALLEY LANDFILLS, INC.
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

BENEFICIAL USE MAP

IMAGE t. . . <No Images>
XREF Files: <No Xrefs>
Dimscale: 1 Ltscale: 2000 Psltscale: 1
15/May/00 jctugston
N:\Cad\Drawings\401390\01.070\070f2-5.dwg

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED
OCT 4 1972
STATE ENGINEER
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

Bent EMGN 160 1760

State Well No. 10S/4W-1
State Permit No.

(1) OWNER:
Name Robert Westfall
Address RT 1 Box 303E
Corvallis, Oregon

(2) TYPE OF WORK (check):
New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☑ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED:
Threaded ☐ Welded ☑
6" Diam. from 0 ft. to 26 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? ☐ Yes ☑ No.
Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☑ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☑ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " "
" " "
AIR
Bailer test 20 gal./min. with 47 ft. drawdown after 2 hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Cement
Well sealed from land surface to 20 ft.
Diameter of well bore to bottom of seal 9 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 1 sacks
Number of sacks of bentonite used in well seal — sacks
Brand name of bentonite —
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☐ Yes ☑ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Benton Driller's well number
SW ¼ SW ¼ Section 18 T. 10S R. 4W W
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 48
Static level 17 ft. below land surface. Date 9/15
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 74 ft. Depth of completed well 74

Formation: Describe color, texture, grain size and structure of materi and show thickness and nature of each stratum and aquifer penetra with at least one entry for each change of formation. *Report each chang position of Static Water Level and indicate principal water-bearing str*

MATERIAL	From	To	SW
Soil	0	2	
Clay, yellow	2	16	
Broken Sandrock	16	20	
in clay yellow			
Sandrock, hard, blue	20	48	
Sandrock, blue, broken	48	56	
water stratum			
Sandrock, blue	56	74	

Work started Sept 14 19 72 Completed Sept 14 19
Date well drilling machine moved off of well Sept 15 19

Drilling Machine Operator's Certification:
This well was constructed under my direct supervisi Materials used and information reported above are true to best knowledge and belief.
[Signed] Leroy W Mutschler Date 9/15, 19
(Drilling Machine Operator)
Drilling Machine Operator's License No. 80

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report true to the best of my knowledge and belief.
Name L.W. Mutschler well Drilling
(Person, firm or corporation) (Type or print)
Address 7355 N.W. Oak Creek Dr. Corvallis Oregon
[Signed] Leroy W Mutschler
(Water Well Contractor)
Contractor's License No. 237 Date Sept 15, 19

NOTICE TO WATER WELL CONTRACTOR: The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED AUG 28 1972 STATE ENGINEER SALEM, OR.

WATER WELL REPORT
STATE OF OREGON
(Please type or print) (Do not write above this line)

Bent EMCON 166 1773

State Well No. 10S/4W-18

State Permit No. .....

(1) OWNER:
Name Robert Westfall
Address Rt 1 Box 303E Corvallis, Oregon

(2) TYPE OF WORK (check):
New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☑ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) CASING INSTALLED:
Threaded ☐ Welded ☑
6 " Diam. from 0 ft. to 36 ft. Gage .250
..... " Diam. from ..... ft. to ..... ft. Gage .....
..... " Diam. from ..... ft. to ..... ft. Gage .....

(6) PERFORATIONS:
Perforated? ☐ Yes ☑ No.
Type of perforator used
Size of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☑ No
Manufacturer's Name .....
Type ..... Model No. .....
Diam. ..... Slot size ..... Set from ..... ft. to ..... ft.
Diam. ..... Slot size ..... Set from ..... ft. to ..... ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom?
Yield: ..... gal./min. with ..... ft. drawdown after ..... hrs.
" " "
" " "
Bailer test 22 gal./min. with Full ft. drawdown after 1 hrs.
Artesian flow ..... g.p.m.
Temperature of water ..... Depth artesian flow encountered ..... ft.

(9) CONSTRUCTION:
Well seal—Material used Cement
Well sealed from land surface to 20 ft.
Diameter of well bore to bottom of seal 9 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 1 sacks
Number of sacks of bentonite used in well seal ..... sacks
Brand name of bentonite .....
Number of pounds of bentonite per 100 gallons of water ..... lbs./100 gals.
Was a drive shoe used? ☐ Yes ☐ No Plugs ..... Size: location ..... ft.
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? ..... depth of strata .....
Method of sealing strata off .....
Was well gravel packed? ☐ Yes ☑ No Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

(10) LOCATION OF WELL:
County Benton Driller's well number .....
¼ ¼ Section 18 T. 10S R. 4W W.
Bearing and distance from section or subdivision corner .....

(11) WATER LEVEL: Completed well.
Depth at which water was first found 43
Static level 15 ft. below land surface. Date 8/17/
Artesian pressure ..... lbs. per square inch. Date .....

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 74 ft. Depth of completed well 74

Formation: Describe color, texture, grain size and structure of materia and show thickness and nature of each stratum and aquifer penetrat with at least one entry for each change of formation. *Report each change position of Static Water Level and indicate principal water-bearing stra*

MATERIAL	From	To	SWI
Soil	0	2	
Clay, yellow	2	30	
Sandrock, blue	30	43	
Sandrock, blue, broken WATER STRATUM	43	74	

Work started Aug 17 1972 Completed Aug 17 19
Date well drilling machine moved off of well Aug 17 19

Drilling Machine Operator's Certification:
This well was constructed under my direct supervisi Materials used and information reported above are true to best knowledge and belief.
[Signed] Leroy Mutschler (Drilling Machine Operator) Date 8/18, 19
Drilling Machine Operator's License No. 80

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report true to the best of my knowledge and belief.
Name L.W. Mutschler well Drilling (Person, firm or corporation) (Type or print)
Address 7555 N.W. Oak Creek Dr. Corvallis Oregon
[Signed] Leroy W. Mutschler (Water Well Contractor)
Contractor's License No. 237 Date Aug 18, 19

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON within 30 days from the date of well completion.

RECEIVED
OCT - 7 1971
STATE ENGINEER
SALEM OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

Ben + ENCON 17a
2146

State Well No. 10/5W-24

State Permit No. _____

(1) OWNER:
Name Don Helm
Address 966 N. W. Sequoia St Corvallis, Oregon

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) CASING INSTALLED:
Threaded ☐ Welded ☒
6 " Diam. from 0 ft. to 41 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(6) PERFORATIONS:
Perforated? ☐ Yes ☒ No.
Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " "
" " "
Tested with air estimated 300 GPH "could fluctuate
Bailer test gal./min. with 347 ft. drawdown after 1 hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Cement Grout
Well sealed from land surface to 39 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 6 sacks
Number of sacks of bentonite used in well seal sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Benton Driller's well number
¼ ¼ Section 24 T. 10S R. 5W W.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 76
Static level 43 ft. below land surface. Date 9-18-71
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 400 ft. Depth of completed well 400

Formation: Describe color, texture, grain size and structure of materials and show thickness and nature of each stratum and aquifer penetrated with at least one entry for each change of formation. *Report each change position of Static Water Level and indicate principal water-bearing stra*

MATERIAL	From	To	SWI
Top Soil	0	3	
Yellow Clay	3	11	
Clay & Boulders	11	24	
Brown Sandstone soft	24	33	
Blue Sandstone	33	37	
Black Basalt	37	109	
Blue Black Cong.	109	163	
Black Basalt (Broken)	163	171	
Black Basalt	171	296	
Bleu Black Sandstone Cong	296	400	

Work started 9-16-71 19 Completed 9-18-71 19
Date well drilling machine moved off of well 9-18-71 19

Drilling Machine Operator's Certification:
This well was constructed under my direct supervisio
Materials used and information reported above are true to m
best knowledge and belief.
[Signed] Lawrence A. Kinsey (Drilling Machine Operator) Date 9-30-71, 19
Drilling Machine Operator's License No. 160

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report
true to the best of my knowledge and belief.
Name Casey Jones Well Drilling Co Inc (Person, firm or corporation) (Type or print)
Address R 8 Box 695 Pleasant Hill, Oregon
[Signed] Delbert L Jones (Water Well Contractor)
Contractor's License No. 103 Date 9-30-71, 19

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

Bert 2144

WATER WELL REPORT

STATE OF OREGON
(Please type or print)
(Do not write above this line)

EMCON 176

RECEIVED
MAY 24 1978
WATER RESOURCES DEPT.
SALEM, OREGON

State Well No. 10S/5W-2
State Permit No.

(1) OWNER:
Name John Wilkenson
Address 27460 Fern Ridge Rd.
Sweet Home Ore.

(2) TYPE OF WORK (check):
New Well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary [X] Driven [ ]
Cable [ ] Jetted [ ]
Dug [ ] Bored [ ]

(4) PROPOSED USE (check):
Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

CASING INSTALLED:
Threaded [ ] Welded [X]
6" Diam. from 0 ft. to 20 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? [ ] Yes [X] No
Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? [ ] Yes [X] No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [X] No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " "
"Tested w/Air 15gpm" " "
Bailer test gal./min. with 89 ft. drawdown after 1 hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Cement
Well sealed from land surface to 18 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 12 sacks
How was cement grout placed? poured
Was a drive shoe used? [X] Yes [ ] No Plugs Size: location ft.
Did any strata contain unusable water? [ ] Yes [X] No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? [ ] Yes [X] No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Benton Driller's well number
¼ ¼ Section 24 T. 10S R. 5W W
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 196
Static level 31 ft. below land surface. Date 5/1
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6"
Depth drilled ft. Depth of completed well
Formation: Describe color, texture, grain size and structure of materi and show thickness and nature of each stratum and aquifer penetra with at least one entry for each change of formation. Report each chang position of Static Water Level and indicate principal water-bearing str

MATERIAL	From	To	SW
Topsoil	0	5	
Brown Broken Basalt	5	18	
Blue basalt	18	114	
Blue sandstone	114	138	
Blue basalt	138	158	
Blue sandstone	158	220	

Work started 4/27/78 19 Completed 5/1/78 19
Date well drilling machine moved off of well 5/1/78 19

Drilling Machine Operator's Certification:
This well was constructed under my direct supervisi Materials used and information reported above are true to best knowledge and belief.
[Signed] Claude Imbrie (Drilling Machine Operator) Date 5/8, 19
Drilling Machine Operator's License No. 1133

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report true to the best of my knowledge and belief.
Name Bert Jones (Person, firm or corporation) (Type or print)
Address 29400 Santiam Hwy Lebanon
[Signed] Bert Jones (Water Well Contractor)
Contractor's License No. 514 Date 5/8/78, 19

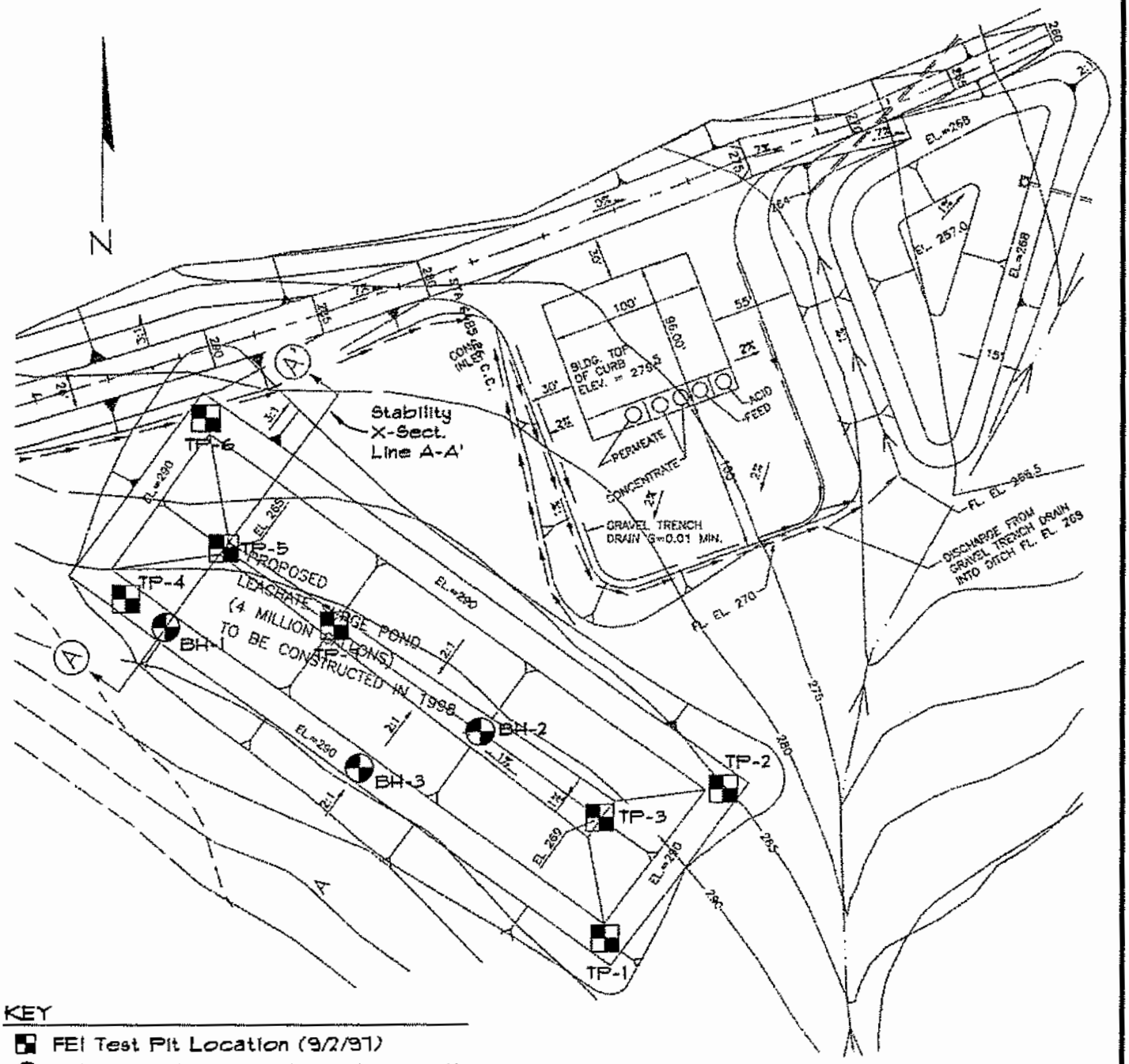
(USE ADDITIONAL SHEETS IF NECESSARY)

Appendix A

Figures

Professional Geotechnical Services

Foundation Engineering, Inc.



KEY

- FEI Test Pit Location (9/2/97)
- FEI Boring Location (9/4/97 & 9/5/97)

Notes:
1. Site Plan Provided by Thiel Engineering
2. Test Pit and Boring Locations are Approximate

Scale: 1" = 100'

DATE 10/2/97
DWN. WLN
APPR. _____
REVIS. _____
PROJECT NO.
97100184

FOUNDATION ENGINEERING INC.
PROFESSIONAL GEOTECHNICAL SERVICES
5030 SW PHILOMATH BLVD.
CORVALLIS, OR 97333-1044
BUS. (541) 757-7646 FAX (541) 757-7650

SITE PLAN
COFFIN BUTTE LEACHATE POND

BENTON COUNTY, OREGON

FIGURE NO.
1

NAME: COFFIN

Appendix B

Boring & Test Pit Logs

Professional Geotechnical Services

Foundation Engineering, Inc.

Depth Feet	Soil and Rock Description and Comments	Log	Elev. Depth 293.0	Samples	SPT, N-Value / Recovery / Moisture, % / RQD, %	Installations/ Water Table
1	Soft to medium stiff, fat CLAY; brown, dry to damp (Topsoil).		0.0			18-inch stick-up with no monument.
2			291.0			
3	Very stiff, silty CLAY; brown mottled orange, moist (Residual soil).		2.0	SS-1-1	19	
4			289.0			
5	Stiff, clayey SILT; brown mottled orange, moist, relict jointing (Residual soil).		4.0	SS-1-2	12	1-inch PVC pipe.
6						
7						
8			284.5	SH-1-3		
9	Dense, silty SAND; grey mottled brown, iron-stained relict jointing, moist, zones of highly weathered rock (Decomposed to highly weathered submarine basalt).		8.5			
10				SS-1-4	36	Bentonite chips.
11						
12						(9-22-97)
13						
14						
15	Extremely weak to strong SUBMARINE BASALT; grey-brown mottled orange, moderately to highly weathered, very close to close jointed, sand and silt-filled joints (Siletz River Volcanics).		278.2 14.8	SS-1-5	50/4	
16						
17						
18						Sand.
19						5-foot field slot.
20				SS-1-6	50/5	
21						
22						
23						
24	Rock becomes slightly weathered and blue-black below 24 feet.					Sand.
25			267.7	SS-1-7	50/3.5"	
	BOTTOM OF BORING		25.3			

0 50 100

Project No.: 97100184

Surface Elevation: 293 feet (Approx.)

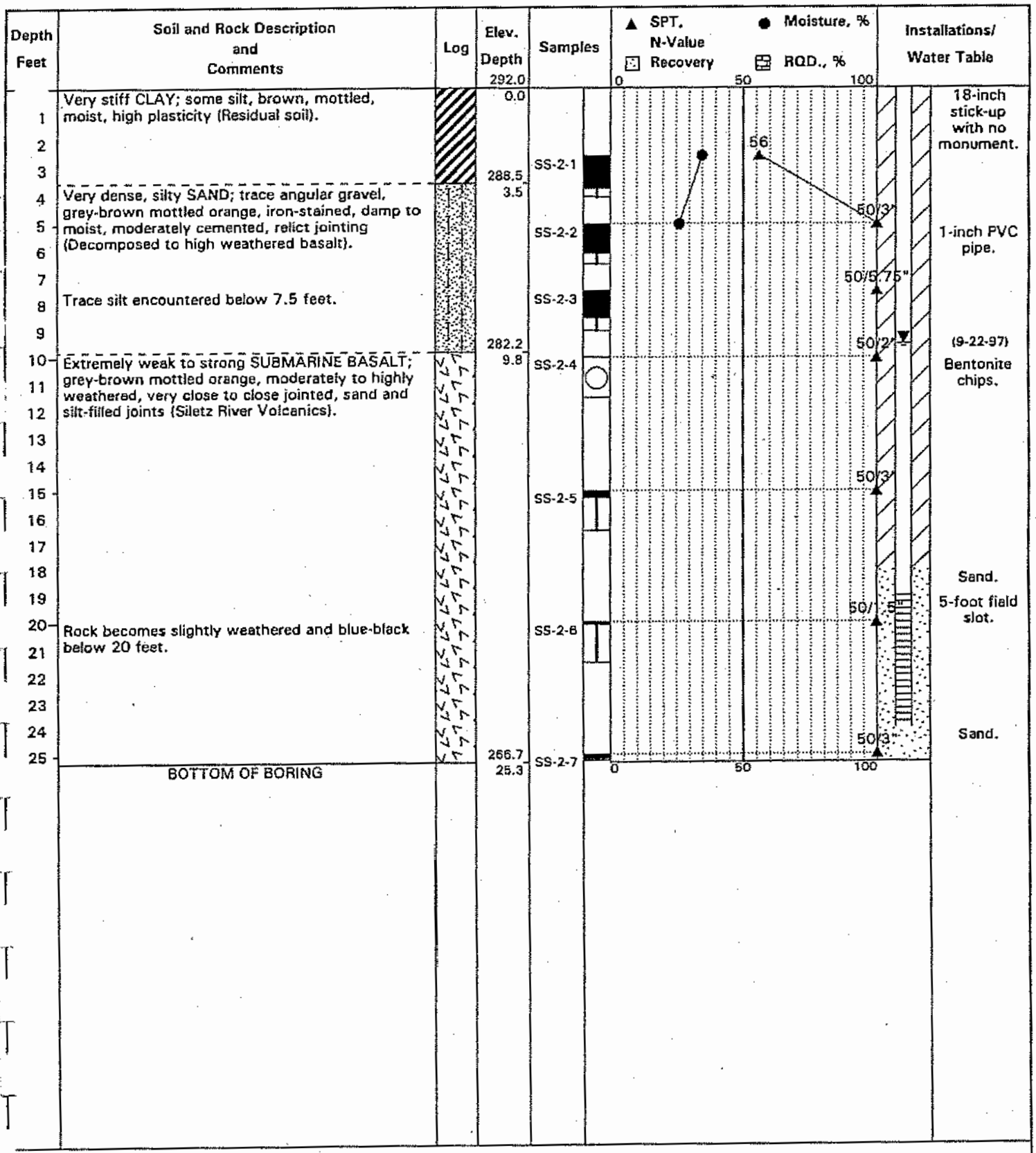
Date of Boring: September 4, 1997

Boring Log: BH-1

Coffin Butte Leachate Pond

Corvallis, Oregon

Foundation Engineering, Inc.



Project No.: 97100184

Surface Elevation: 292 feet (Approx.)

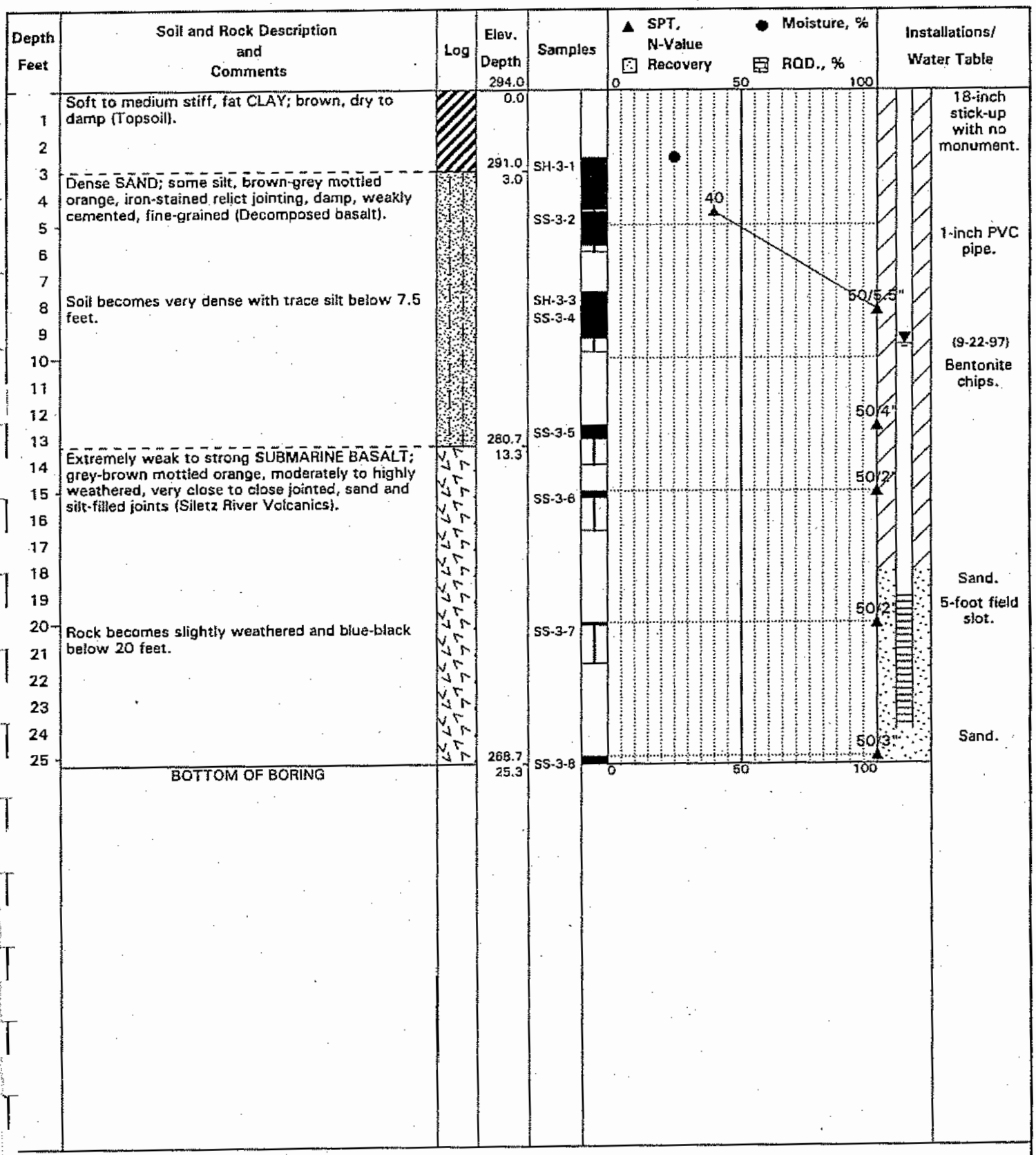
Date of Boring: September 4, 1997

Boring Log: BH-2

Coffin Butte Leachate Pond

Corvallis, Oregon

Foundation Engineering, Inc.



Project No.: 97100184

Surface Elevation: 294 feet (Approx.)

Date of Boring: September 5, 1997

Boring Log: BH-3

Coffin Butte Leachate Pond

Corvallis, Oregon

Foundation Engineering, Inc.

Comments	Depth, Inches	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
6 inches of ground water infiltration after 4 hours.	1-							Very stiff CLAY; some silt, dark brown, dry to damp, high plasticity, numerous roots, fissured (Residual soil).
	2-	S-1-1						
Small to medium-sized roots extend to 3 feet.	3-	WC = 19.4						
	4-	S-1-2						Dense SAND; some cobbles, trace silt and boulders, light orange-brown, iron-stained, dry to damp, weakly cemented, seams of high plasticity clay. Soil is composed of spheroidally weathered corestones in matrix of decomposed basalt.
	5-							
Hard digging encountered below 6 feet. 2-foot diameter boulder encountered at 6.5 feet.	6-							
	7-							
	8-							Very dense COBBLES and BOULDERS; some sand and gravel, orange-brown, dry to damp, relict volcanic texture, rock is rounded to angular (Slight to highly weathered basalt in a decomposed matrix).
	9-							
	10-							
	11-							
	12-							Weak to strong SUBMARINE BASALT; dark grey mottled orange, slightly to highly weathered, very close to close jointed, stained and sand filled joints (Siletz River Volcanics).
Test pit sidewalls remained vertical.	13-							
	14-							
Encountered digging refusal at 15 feet.	15-							
	16-							BOTTOM OF TEST PIT
	17-							
	18-							
	19-							

Project No.: 97100184

Surface Elevation: 293 feet (Approx.)

Date of Test Pit: September 2, 1997

Test Pit Log: TP-1

Coffin Butte Leachate Pond

Corvallis, Oregon

Comments	Depth, Inches	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
12 inches of ground water infiltration after 4 hours.	1-							Very stiff CLAY; some silt, dark brown, damp, fissured, slickensides, high plasticity (Residual soil).
Fine roots encountered to 2 feet.	2-	S-2-1						
	3-	WC = 26.9						
	4-	S-2-2						Dense SAND; some cobbles, trace silt, orange brown, iron-stained, damp, weakly cemented, seams of high plasticity clay to 4.5 feet. Soil is composed of spheroidally weathered corestones in a matrix of decomposed basalt.
	5-							
	6-							
	7-							
	8-							
	9-							
	10-							
Hard digging encountered at 10.5 feet.	11-							Weak to strong SUBMARINE BASALT; dark grey mottled orange, slightly to highly weathered, very close to close jointed, stained and sand-filled joints (Siletz River Volcanics).
	12-							
Test pit sidewalls remained vertical.	13-							
Encountered digging refusal at 14 feet.	14-							
	15-							BOTTOM OF TEST PIT
	16-							
	17-							
	18-							
	19-							

Project No.: 97100184

Surface Elevation: 285 feet (Approx.)

Date of Test Pit: September 2, 1997

Test Pit Log: TP-2

Coffin Butte Leachate Pond

Corvallis, Oregon

Comments	Depth, Inches	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No ground water infiltration encountered.	1- 2- 3- 4- 5- 6- 7- 8- 9- 10- 11- 12- 13- 14- 15- 16- 17- 18- 19-	S-3-1 WC=25.1 S-3-2				+/-1.6		Very stiff CLAY; some silt, dark brown, damp, fissured, slickensides, high plasticity (Residual soil). Dense SAND; some cobbles, trace silt, orange-brown, iron-stained, damp, weakly cemented, seams of high plasticity clay. Soil is composed of spheroidally weathered corestones in a matrix of decomposed basalt. Weak to strong SUBMARINE BASALT; dark grey mottled orange, slightly to highly weathered, close to very close jointed, stained and sand-filled joints (Siletz River Volcanics).
Test pit sidewalls remained vertical. Encountered digging refusal at 15 feet.								BOTTOM OF TEST PIT

Project No.: 97100184

Surface Elevation: 291 feet (Approx.)

Date of Test Pit: September 2, 1997

Test Pit Log: TP-3

Coffin Butte Leachate Pond

Corvallis, Oregon

Comments	Depth, Inches	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No ground water infiltration encountered. Fine roots encountered to 2 feet.	1- 2- 3- 4- 5- 6- 7- 8- 9- 10- 11- 12- 13- 14- 15- 16- 17- 18- 19-	S-4-1 WC=18.3 S-4-2 WC=33.5 S-4-3 S-4-4				+/-1.3		Soft to medium stiff SILT; brown, dry to damp (Topsoil). Very stiff CLAY; some silt, brown, damp, high plasticity, fissured, slickensides (Residual soil). Medium stiff SILT; orange-brown, moist, relict jointing, blocky (Residual soil). Extremely weak to very weak SUBMARINE BASALT; brown, highly weathered, close to very close jointed, joints are wet and stained (Siletz River Volcanics).
Test pit sidewalls remained vertical. Digging terminated at 17 feet due to excavator limitations.								BOTTOM OF TEST PIT

Project No.: 97100184

Surface Elevation: 292 feet (Approx.)

Date of Test Pit: September 2, 1997

Test Pit Log: TP-4

Coffin Butte Leachate Pond

Corvallis, Oregon

Comments	Depth, Inches	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No ground water infiltration encountered.	1-	S-5-1						Medium stiff to stiff SILT; brown, dry to damp (Topsoil).
	2-	WC = 19.7						
Fine roots encountered to 3 feet.	3-							Dense, silty SAND; orange-brown, damp, fine-grained (Decomposed basalt).
	4-					0.48		
	5-	S-5-2						
	6-							
	7-							
	8-							
Test pit sidewalls remained vertical.	9-							
	10-							Very dense, sandy COBBLES and GRAVEL; brown, moist, angular to rounded clasts. Soil is composed of spheroidally weathered corestones in a matrix of decomposed basalt.
Encountered digging refusal at 11 feet on rock shelf.	11-							
	12-							BOTTOM OF TEST PIT
	13-							
	14-							
	15-							
	16-							
	17-							
	18-							
	19-							

Project No.: 97100184

Surface Elevation: 289 feet (Approx.)

Date of Test Pit: September 2, 1997

Test Pit Log: TP-5

Coffin Butte Leachate Pond

Corvallis, Oregon

Comments	Depth, Inches	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No ground water infiltration encountered.	1-					0.2		Soft to medium stiff SILT; brown, dry to damp (Topsoil).
	2-					0.4		
Fine roots encountered to 3 feet.	3-							Very stiff CLAY; some silt, moist, brown, high plasticity, fissured, slickensides (Residual soil).
	4-					1.3		
	5-	S-6-1						
	6-	WC = 36.1						
	7-							
	8-							
	9-							Medium stiff SILT; trace to some clay, orange-brown, residual volcanic texture (Decomposed basalt).
	10-							
Test pit sidewalls remained vertical.	11-							
	12-							
	13-							Hard SILT; grey-brown, damp, relict jointing (Decomposed basalt). Soil breaks into angular, gravel-sized chunks.
	14-							
	15-	WC = 27.7						
	16-	S-6-2						
Digging terminated at 17 feet due to excavator limitations.	17-							
	18-							BOTTOM OF TEST PIT
	19-							

Project No.: 97100184

Surface Elevation: 282 feet (Approx.)

Date of Test Pit: September 2, 1997

Test Pit Log: TP-6

Coffin Butte Leachate Pond

Corvallis, Oregon

Comments	Depth, Inches	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
No ground water infiltration encountered.	1- 2- 3- 4- 5- 6- 7- 8- 9- 10- 11- 12- 13- 14- 15- 16- 17- 18- 19-							Soft to medium stiff SILT; brown, dry to damp (Topsoil and residual soil). Medium dense to dense SAND; some cobbles, orange-brown, damp. Soil is composed of spheroidally weathered corestones in a matrix of decomposed basalt. Dense to very dense, sandy COBBLES and GRAVEL; orange-brown, moist (Moderately to highly weathered basalt in a decomposed matrix). Medium strong to strong SUBMARINE BASALT; dark brown mottled orange, moderately to highly weathered, close to very close jointed (Siletz River Volcanics). BOTTOM OF TEST PIT
Hard digging encountered below 8 feet. Test pit sidewalls remained vertical.								

Project No.: 97100184

Surface Elevation: 291 feet (Approx.)

Date of Test Pit: September 2, 1997

Test Pit Log: TP-7

Coffin Butte Leachate Pond

Corvallis, Oregon

APPENDIX C

FIELD FORMS

The Wallace Group
62915 NE 18th Street, Suite 1
Bend, OR 97701
(541) 382-4707

BORING NUMBER B-01

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED _____ **COMPLETED** _____
GROUND ELEVATION _____
DRILLING CONTRACTOR _____
GROUND WATER LEVELS:
DRILLING METHOD _____
AT TIME OF DRILLING ---
LOGGED BY _____ **CHECKED BY** _____
24HRS AFTER DRILLING ---
NOTES _____

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION
0			
5			
10			
15			
20			

TWG-BORING LOGS - WALLACE GROUP DATA TEMPLATE.GDT - 6/24/21 11:22 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 1

The Wallace Group
62915 NE 18th Street, Suite 1
Bend, OR 97701
(541) 382-4707

TEST PIT NUMBER TP-01

CLIENT CEC, Inc.
PROJECT NAME Coffin Butte Landfill
PROJECT NUMBER 21129-1
PROJECT LOCATION Corvallis, OR
DATE STARTED _____ **COMPLETED** _____
GROUND ELEVATION _____
EXCAVATION CONTRACTOR _____
GROUND WATER LEVELS:
EXCAVATION METHOD _____
AT TIME OF EXCAVATION ---
LOGGED BY _____ **CHECKED BY** _____
24HRS AFTER EXCAVATION ---
NOTES _____

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION
0			
5			
10			
15			
20			

TWG-TEST PITS - WALLACE GROUP DATA TEMPLATE.GDT - 6/24/21 11:24 - W:\GINT PRO - FILES\BENTLEY\GINT\PROJECTS\21129-1 COFFIN BUTTE LANDFILL.GPJ

Figure: A - 1

EXHIBIT 25
OREGON DEQ APPROVAL OF WORK PLAN

From: SADOFSKY Seth * DEQ <seth.sadofsky@deq.state.or.us>
Sent: Monday, August 9, 2021 3:56 PM
To: Eric Tuppan <eric@tuppanconsultants.com>; GAO Hugh * DEQ <hugh.gao@deq.state.or.us>
Subject: RE: Coffin Butte Expansion Area workplan

Hi Eric,
DEQ agrees with and approves this work plan for site characterization.
I'm out the rest of this week, but let me know when you get the field work scheduled and I will try and get out there.
Seth

Seth Sadofsky, PhD, RG
Hydrogeologist, Materials Management
Oregon Department of Environmental Quality
165 E. 7th Avenue, Suite 100
Eugene, Oregon 97405
Seth.Sadofsky@deq.state.or.us
541-687-7329 office - Forwards to cell during work hours
He/Him

From: Eric Tuppan <eric@tuppanconsultants.com>
Sent: Wednesday, August 4, 2021 3:27 PM
To: SADOFSKY Seth * DEQ <seth.sadofsky@deq.state.or.us>
Subject: Coffin Butte Expansion Area workplan

Seth,

Just checking in to see where you/DEQ is with review of the workplan. At the moment, we are tentatively scheduled for starting the test pits on August 16 for several days and then the borings will begin after Labor Day.

Hope you're doing well.

Eric

Eric J. Tuppan, R.G.
TUPPAN CONSULTANTS LLC
460 Second Street, Suite 103, Lake Oswego, OR 97034
t 503 675 1335 | c 503 866 2551
eric@tuppanconsultants.com | www.tuppanconsultants.com

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EXHIBIT 26
ARCHAEOLOGICAL REPORT

Archaeological Investigations Northwest, Inc.

3510 N.E. 122nd Ave. • Portland, Oregon 97230
Phone (503) 761-6605 • Fax (503) 761-6620

Vancouver Phone (360) 696-7473
E-mail: ainw@ainw.com
Web: www.ainw.com

MEMO

Date: December 19, 2023

To: Jeff Shepherd, P.E., Civil & Environmental Consultants, Inc.

From: Eva Hulse, Ph.D., R.P.A., Senior PM/Senior Geoarchaeologist
Kristen Heasley, Ph.D., R.P.A., Assistant PM/Supervising Archaeologist

Re: Coffin Butte Landfill Expansion Project
Benton County, Oregon
Cultural Resource Survey and Archaeological Testing and Evaluation
AINW Report No. 5127

Archaeological Investigations Northwest, Inc. (AINW), has conducted a cultural resource survey and archaeological testing and evaluation of 85 acres on behalf of Valley Landfills, Inc., for proposed landfill expansion. The Coffin Butte Landfill Expansion project study involved background review, pedestrian survey, excavation of 76 shovel tests, and excavation of five quarter test units. The survey was conducted to comply with the Oregon State Historic Preservation Office (SHPO) standards, with Benton County land use conditions, and with Section 106, as amended, for the portion of the project that will be subject to review by the U.S. Army Corps of Engineers. A portion of the archaeological shovel testing and all of the quarter test unit excavations were conducted under SHPO permit AP-3341.

As a result of the survey, AINW identified and recorded twelve archaeological resources.

- The project area does not overlap any recorded elements of the former 1941 Camp Adair/Adair Air Force Station, and no archaeological deposits pertaining to the Camp Adair site were encountered. No historic-period buildings or structures are within the project area.
- There are eight pre-contact (Native American) isolates consisting of between one and nine artifacts.
- There are two multi-component isolates with both historic-period and pre-contact artifacts. The sparse historic-age artifacts are from casual debris disposal, as well as from municipal compost spread in portions of the project area.
- There are two pre-contact archaeological sites composed primarily of stone fragments that were left behind when Native people made stone tools.

AINW excavated quarter test units at the two archaeological sites to evaluate their significance and integrity. The archaeological findings suggest that the area was used as long as 3,000 years ago by Native people, for making stone tools and possibly for plant gathering.

Project Recommendations

AINW recommends a finding of No Adverse Effect on Historic Properties as long as conditions are met.

- AINW recommends that the 10 isolates identified during survey are not eligible for listing in the National Register of Historic Places (NRHP), and no further work is needed at those locations.
- AINW's excavations found that one of the archaeological sites is disturbed and lacks integrity, and AINW recommends that it is not eligible for listing in the NRHP. Inadvertent discoveries are likely at this location, and AINW recommends construction monitoring to the depth of the archaeological deposit, which is up to 20 inches (in) below the surface.
- AINW's excavations found that the other archaeological site is disturbed to a depth of 12 in, below which are artifacts in intact soil. The portion of the archaeological site below 12 in is eligible for listing in the NRHP due to its potential to retain important information about the past. AINW recommends that the project avoid grading below a depth of 12 in below the surface at this location. AINW recommends monitoring of organic topsoil grading at this location to the depth of project impacts, which is anticipated to a depth of 12 in below the current surface.
- AINW recommends that a monitoring plan and Inadvertent Discovery Plan be developed for the project.
- AINW recommends that graded archaeological soils not be taken offsite for disposal, to avoid creation of a new archaeological deposit at another location.

EXHIBIT 30
PROPOSED COFFIN BUTTE LANDFILL SEISMIC DESIGN

MEMORANDUM

To: Ian Macnab – Republic Services, Inc. (Republic)

From: Timothy D. Mitchell, P.E. – Civil & Environmental Consultants, Inc. (CEC)
Jeff Shepherd, P.E. – CEC

Date: July 9, 2024

Subject: Seismic Design
Coffin Butte Landfill
Corvallis, Benton County, Oregon
Republic Services
CEC Project 322-142

The purpose of this memorandum (memo) is to address the engineering scope regarding slope stability and earthquake response for the newly proposed cell at the Coffin Butte Landfill operated by Republic. CEC understands that the Benton County Neighborhood Tour posed questions relative to the impact of an earthquake and the performance of the various landfill systems (liner, methane capture, etc.) during potential seismic events. This memo intends to explain the process for considering earthquakes and seismicity during the design of a municipal solid waste landfill.

The criteria for the design of a solid waste landfill is described in a document by the United States Environmental Protection Agency (USEPA) in Title 40 CFR Part 258 (Seismic Design Guidance for Municipal Solid Waste Landfill Activities). Oregon has codified its implementation of these rules under the Oregon Administrative Rules (OAR), specifically OAR 340-094. CEC will design the proposed landfill cell to meet the regulatory requirements for seismic impact zones and for potential seismic events as described in the rules.

The code requires that landfill containment structures, including liners, leachate collection systems, and surface water control systems are designed to resist the maximum horizontal acceleration in rock at the site. In addition to the waste itself, the landfill design for this project will take into account the performance of the liner system and leachate collection system in response to seismic loads. This was one point of concern from the neighborhood tour summary letter.

CEC will work closely with Republic and regulators to develop appropriate earthquake and seismic models for use in the design of the landfill cell. According to the USGS, the seismic probability map can be used as a basis to obtain site specific seismic parameters for design. This method provides a high degree of protection to the environment against earthquakes reasonably expected over the life and post-closure maintenance period of the landfill.

The code also requires that the landfill or expansions to the landfill not be located within 200 feet of a fault that has had displacement in Holocene time (11,700 years ago). There are no known faults that have had displacement within 200 feet of the landfill.

In regards to general slope stability considerations, the static and seismic stability will be checked in detail for acceptable factors of safety for the proposed expansion. The stability calculations will consider the geometry of the landfill, the proposed liner system, the anticipated leachate, and leachate drainage. The steepest outer slope allowed by state regulation is 3 Horizontal:1 Vertical (3H:1V).

In summary, CEC will work with Republic to develop a thorough landfill design that addresses possible seismic implications in accordance with applicable codes and requirements and in conjunction with the appropriate regulators.

TDM:JS/ad

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