# Northeast C&D Landfill
# Permit No. 3555050

# Tier III Permit Modification Application for a Horizontal and Vertical Expansion of Existing C & D Landfill

# Volume 1 of 2

N.E. Land Fill, LLC (A subsidiary of WCA of Oklahoma, LLC,
A GFL Environmental Company)
2601 North Midwest Blvd
Spencer, OK 73084

SCS ENGINEERS

16219107.00 | August 2023

1901 Central Drive, Suite 550
Bedford, TX 76021
817-571-2288

# TIER III PERMIT MODIFICATION APPLICATION

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August 23, 2023
File No. 16219107.00

Ms. Kaylee Daneshmand, E.I.
Land Protection Division
Oklahoma Department of Environmental Quality
707 N. Robinson Avenue
Oklahoma City, OK 73101-1677

**Subject: Tier III Permit Modification Application**
**Northeast C&D Landfill**
**DEQ Permit No.: 3555050**

Dear Ms. Daneshmand:

On behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), SCS Engineers is submitting this Tier III permit modification application for your review to permit a horizontal and vertical expansion of its existing construction and demolition (C&D) debris landfill (DEQ Permit No. 3555050). The proposed expansion will be located on GFL-owned property, north of the existing C&D landfill footprint.

The expansion property occupies 73.2 acres, out of which 53.5 acres will be utilized for waste disposal operations. The proposed landfill expansion is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma County.

This Tier III permit modification application has been prepared in accordance with Oklahoma Administrative Code (OAC) 252:515-3-33 and includes the following information:

Volume 1 of 2, which includes:

1. Permit Application Form #515-020, and
2. Permit Modification Application, which address the following requirements of Title 252, Chapter 515:
    a. Subchapter 3 – Permit Provisions and Applications,
    b. Subchapter 5 – Location Restrictions,
    c. Subchapter 7 – Subsurface Investigation,

Volume 2 of 2, which includes:

d. Subchapter 9 – Groundwater Monitoring/Correction Action, and
e. Subchapter 11 – Liner Design
f. Subchapter 15 – Methane Gas Monitoring and Control,
g. Subchapter 17 – Stormwater Management,
h. Subchapter 19 – Operational Requirements,
i. Subchapter 25 – Closure and Post-Closure Care,
j. Subchapter 27 – Cost Estimates and Financial Assurance, and
k. Subchapter 29 – Exclusion of Prohibited Wastes.

As discussed during pre-application meeting on 05/08/2023, this application is being submitted as a stand-alone document and is intended to replace previously submitted application documents, as follows:

- Permit Application Narrative,
- Appendix A – Notification to Adjacent Property Owners, Location Restriction Correspondence Letters, Legal Description, and Proof of Property Ownership,
- Appendix B – Hydrogeological and Geotechnical Investigation,
- Appendix C – Slope Stability and Final Cover Veneer Slope Analysis,
- Appendix D – Explosive Gas Monitoring Plan,
- Appendix E – Surface Water Management System Design Plan,
- Appendix G – Operations Plan, and
- Appendix I – Closure and Post-Closure Care (C-PC) Plan.

Related to this submittal, the following documents are included as reference and **not proposed to be revised with this permit modification application**:

- Appendix I, Attachment A – Closure Cost Estimates, approved by DEQ on 3/9/2023.
- Appendix I, Attachment B – Quality Assurance/Quality Control (QA/QC) Plan for Final Cover System Installation, approved by DEQ on 10/13/2022.
- Appendix F – Construction Quality Assurance/Quality Control (QA/QC) Plan,
- Appendix H – Waste Exclusion Plan.

Information related to Permit Drawings and Maps, Subsurface Investigation, and Liner Design that support the proposed expansion are provided within various appendices of this permit application package. Included is one hard copy of the application for your review. Additionally, a PDF copy of the application is also separately provided for your use.

A draft “Notice of Application Filed” (Notice) was emailed to DEQ for approval on 08/22/2023 and a copy of this Notice is included in Attachment A of this letter for reference. In accordance with OAC 252:4-7-13, this Notice will be published in *The Oklahoman* within 2 weeks of receiving approval from DEQ.

Additionally, notification letter of permit application being filed with DEQ to be mailed to adjacent property and mineral right owners was emailed to DEQ for approval on 08/22/2023 and is included in Appendix A of the permit application for reference. This notification letter will be mailed to adjacent property and mineral rights owners upon receiving approval from DEQ. Proof of acknowledgement of this notification letter will be forwarded to DEQ for inclusion into Appendix A of the attached application.

We trust that you will find this permit application to be satisfactory. Please contact Sandeep Saraf, P.E. at (407) 923-7013 should you have questions related to this application.

Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
**SCS Engineers**

Ryan Kuntz, P.E.
Vice President / Satellite Unit Director
**SCS Engineers**

Attachment A: Draft Notice of Application Filed
Attachment B: Permit Application Form

cc: Robert Starke – GFL (e-copy and hard copy)
Marcos Elizondo – GFL (e-copy)
Lana Alderdice – GFL (e-copy)
Eduardo Choquis – GFL (e-copy)

# ATTACHMENT A

DRAFT NOTICE OF APPLICATION

**OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY**
**NOTICE OF APPLICATION FILED**

**Application filed.** A solid waste Tier III application has been filed with Oklahoma Department of Environmental Quality (DEQ). Interested persons now have the opportunity to meet with DEQ and learn how and where they may participate in the permitting process.

**Applicant:** Applicant is N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] Company), which owns and operates Northeast C&D Landfill.

**Type of final permit or permit action being sought:** Applicant seeks to modify an existing permit.

**Facility location:** Northeast C&D Landfill is located at 2601 N. Midwest Boulevard, Spencer, Oklahoma. See property legal description below*.

**Activities to be regulated if the application is approved:** Applicant seeks to modify the existing permit to expand the currently permitted boundary to the north. Facility operations will continue in the same manner as currently being conducted for the existing facility. The average volume of construction and demolition (C&D) waste received daily at the facility is not anticipated to increase as a result of this permit modification.

**Statutes and Rules:** DEQ will review the application for compliance with the Environmental Quality Code, including the Solid Waste Management Act, Title 27A of Oklahoma Statutes, Section 2-10-101, *et seq.*, and DEQ rules, Oklahoma Administrative Code, Title 252, Chapters 4 and 515.

**Permitting procedures explained:** Upon request, a DEQ representative will chair a meeting to explain DEQ's permitting process to interested persons. At that meeting, there will be discussions explaining when oral and written public comments can be made on the proposal. Administrative hearing opportunities will also be discussed. To request this process meeting, send a written request to DEQ representative named below within 30 days after the date this notice is published. Please note this is not a meeting for protests. Its purpose is to advise interested persons on participation opportunities during the permitting process. For more information about this process meeting, please contact the DEQ representative named below.

**Locations where application may be reviewed:**
1. Locally at Midwest City Library, 8143 E Reno Avenue, Midwest City, OK 73110
2. DEQ Central Records Division, located at 707 N. Robinson Avenue, Oklahoma City, OK 73101-1677
3. DEQ webpage: https://www.deq.ok.gov/permits-for-public-review/

**For more information, contact:**

1. For Applicant: Mr. Robert Starke, 2601 N. Midwest Blvd., Spencer, OK 73084; Ph: (405) 317-3912
2. For DEQ: Ms. Kaylee Daneshmand, E.I., Land Protection Division, 707 N. Robinson Avenue, Oklahoma City, OK 73101-1677; Ph: (405) 702-5196; Fax: (405) 702-5101

*Legal description of currently permitted area:

The NW/4 of the NE/4, SW/4 of the NE/4, and the SE/4 of the NE/4 of Section 24, Township 4 South, Range 2 East, Carter County, Oklahoma.

*Legal description of proposed expansion area:

The West Half (W/2) of the Northeast Quarter(NE/4) of the Southeast Quarter (SE/4) and the Southeast Quarter (SE/4) of the Northeast Quarter(NE/4) of the Southeast Quarter (SE/4) and the Northwest Quarter (NW/4) of the Southeast Quarter (SE/4) and the Northwest Quarter (NW/4) of the Southwest Quarter (SW/4) of the Southeast Quarter (SE/4) and the West Half (W/2) of the East Half (E/2) of the Southwest Quarter (SW/4) of the Southeast Quarter (SE/4) of Section 22, Township 12 North, Range 2 West of the Indian Meridian, Oklahoma County, Oklahoma.

AND

A part of the Northeast Quarter (NE/4) of Section 22, Township 12 North, Range 2 West of the Indian Meridian, Oklahoma County, Oklahoma, more particularly described as follows:

Commencing at the Northeast (NE) corner of said Northeast Quarter (NE/4), S 00°33'24" E of distance of 1420.60 feet to the Point of Beginning; thence continuing along said East Line of the Northeast Quarter (NE/4), S 00°33'24" E a distance of 1122.47 feet to a point which is 100 feet N 00°33'24" W from the Southeast (SE) corner of said Northeast Quarter (NE/4); thence S 89°39'49" W a distance of 330.00 feet; thence S 00°33'24" E a distance of 100.00 feet to a point on the South Line of said Northeast Quarter (NE/4); thence along said South Line of the Northeast Quarter (NE/4), S 89°34'49" W a distance of 2308.74 feet to the Southwest (SW) corner of said Northeast Quarter (NE/4); thence along the West Line of said Northeast Quarter (NE/4), N 00°28'20" W a distance of the 1219.31 feet, thence N 89°35'43" E a distance of 2636.93 feet to the Point of Beginning.

Described property being subject to easements and rights-of-way and to any and all easements and rights-of-way of record or fact.

# ATTACHMENT B

APPLICATION FORM

# APPLICATION FOR A C&D LANDFILL PERMIT

Date: August 18, 2023 County: Oklahoma County

Send to:

Solid Waste Permitting Unit
Waste Management Division
Dept. of Environmental Quality
707 N. Robinson (PO Box 1677)
Oklahoma City, OK 73101-1677

| FOR DEQ USE | |
|---|---|
| DEQ Log No. | ______ |
| No. Copies | ______ |
| Date Received: | ______ |

N.E. Land Fill, LLC proposes to establish, construct, operate, and maintain ,
*(Applicant's Name)*
the Northeast C&D Landfill located at Legal description attached after verification
(*Facility Name*) (*Exact legal description:*

*metes & bounds, platted lot, or land survey. Append extra sheets if necessary)*

in Oklahoma County, Oklahoma, and hereby makes application for a permit to establish, construct, operate, and maintain a C&D landfill as required by **Oklahoma Solid Waste Management Act** and Rules pursuant thereto.

Brief description of application:
Tier III permit modification application for a horizontal and vertical expansion of the Northeast C&D landfill (DEQ Permit No. 3555050) located on 2601 Midwest Blvd, Spencer in Oklahoma County.

| Applicant or Authorized Agent: | Preparing Engineer: |
|---|---|
| Marcos Elizondo (signature) | Sandeep Saraf (signature) |
| *Signature* | *Signature* |
| Marcos Elizondo | Sandeep Saraf, P.E. |
| *Typed Name* | *Typed Name* |
| Address: 2050 W. Sam Houston Pkwy S, Suite 1950 | Address: 1901 Central Drive, Suite 550 |
| City: Houston State: TX | City: Bedford State: TX |
| Date signed: August 28, 2023 | Date signed: 8-28-2023 |
| Phone: 713-292-2417 | Phone: 407-923-7013 |

Facility Address (if any): 2601 N. Midwest Blvd.
Spencer, OK 73084

| DEQ USE ONLY |
|---|
| |

## VERIFICATION[1]

STATE OF OKLAHOMA )
) ss
COUNTY OF Oklahoma )

Marcos Elizondo, of lawful age, being first duly sworn, upon oath state that I have read the foregoing APPLICATION FOR A C & D LANDFILL PERMIT, that I am familiar with the matters set forth therein, and that the same are true to the best of my information and belief.

Marcos Elizondo
Applicant

Subscribed and sworn to before me this 28th day of August, 2023 by Marcos Elizondo (Applicant or legal representative).

ANDREA ALLEN BARNES
Notary Public, State of Texas
Comm. Expires 12-05-2023
Notary ID 13227462-5

Andrea Allen Barnes
Notary Public

My commission expires:

12-05-23

[1] This Verification is required for a Tier III application.

July 2016
DEQ Form #515-010

**APPLICATION TO MODIFY A SOLID WASTE DISPOSAL FACILITY PERMIT LEGAL DESCRIPTION**

PROPERTY DESCRIPTION

The West Half (W/2) of the Northeast Quarter(NE/4) of the Southeast Quarter (SE/4) and the Southeast Quarter (SE/4) of the Northeast Quarter(NE/4) of the Southeast Quarter (SE/4) and the Northwest Quarter (NW/4) of the Southeast Quarter (SE/4) and the Northwest Quarter (NW/4) of the Southwest Quarter (SW/4) of the Southeast Quarter (SE/4) and the West Half (W/2) of the East Half (E/2) of the Southwest Quarter (SW/4) of the Southeast Quarter (SE/4) of Section 22, Township 12 North, Range 2 West of the Indian Meridian, Oklahoma County, Oklahoma.

AND

A part of the Northeast Quarter (NE/4) of Section 22, Township 12 North, Range 2 West of the Indian Meridian, Oklahoma County, Oklahoma, more particularly described as follows:
Commencing at the Northeast (NE) corner of said Northeast Quarter (NE/4), S 00°33'24" E of distance of 1420.60 feet to the Point of Beginning; thence continuing along said East Line of the Northeast Quarter (NE/4), S 00°33'24" E a distance of 1122.47 feet to a point which is 100 feet N 00°33'24" W from the Southeast (SE) corner of said Northeast Quarter (NE/4); thence S 89°39'49" W a distance of 330.00 feet; thence S 00°33'24" E a distance of 100.00 feet to a point on the South Line of said Northeast Quarter (NE/4); thence along said South Line of the Northeast Quarter (NE/4), S 89°34'49" W a distance of 2308.74 feet to the Southwest (SW) corner of said Northeast Quarter (NE/4); thence along the West Line of said Northeast Quarter (NE/4), N 00°28'20" W a distance of the 1219.31 feet, thence N 89°35'43" E a distance of 2636.93 feet to the Point of Beginning.

Described property being subject to easements and rights-of-way and to any and all easements and rights-of-way of record or fact.

# Permit Application Narrative

# Northeast C&D Landfill
# Tier III Permit Modification Application

N.E. Land Fill, LLC
(A subsidiary of WCA of Oklahoma, LLC, a GFL Environmental Company)
2601 North Midwest Blvd
Spencer, OK 73084

SCS ENGINEERS

16219107.00 | August 2023

1901 Central Drive, Suite 550
Bedford, TX 76021
817-571-2288

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Appendix D Explosive Gas Monitoring Plan
Appendix E Surface Water Management System Design Plan
Appendix F Construction Quality Assurance/Quality Control Plan
Appendix G Operations Plan
Appendix H Waste Exclusion Plan
Appendix I Closure and Post-Closure Care Plan

# Certification

This Tier III Permit Modification Application has been prepared in accordance with sound engineering practices, including consideration of industry standards, and the requirements of the Oklahoma Department of Environmental Quality (DEQ), as defined in Oklahoma Administrative Code (OAC), Title 252, Chapters 4 and 515.

Prepared by:


Sandeep Saraf, P.E.
Senior Project Manager
**SCS Engineers**

# 1.0 INTRODUCTION

SCS Engineers, on behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company) is submitting the necessary documents for a Tier III permit modification application to horizontally and vertically expand the existing construction and demolition (C&D) landfill. The existing C&D landfill (referred in this application as landfill) permit boundary contains approximately 90.1 acres, of which approximately 67.7 acres has been developed for C&D waste disposal under Permit No. 3555050. The proposed expansion will have a permit boundary of 73.2 acres, of which approximately 53.5 acres will be developed for disposal of C&D waste. The combined total property boundary area (existing and expansion) is approximately 163.3 acres, out of which approximately 121.2 acres will be available for C&D waste disposal upon obtaining approval of the permit application.

This Tier III permit application has been prepared consistent with the applicable sections of Title 252, Chapters 4 and 515, and establishes excavation, final grades, liner design, explosive gas monitoring, surface water drainage, and operations for the landfill. The proposed landfill expansion is located in Section 22, Township 12 North, Range 2 West of the Indian Meridian in Oklahoma County, Oklahoma (see Figures 1, 3, and 6).

# 2.0 GENERAL INFORMATION

The following is general information for the facility:

| | |
|---|---|
| Facility Name: | Northeast C&D Landfill |
| Mailing Address: | 2050 W. Sam Houston Parkway S, Suite 1950, Houston, TX 77042 |
| Physical Location: | 2601 N Midwest Blvd, Spencer, OK 73084 |
| Facility Owner/Operator: | N.E. Land Fill, LLC<br>(A subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company) |
| Facility Phone Number: | (405) 796-8081 |
| Hours of Operation: | Monday-Friday 7:00 am-5:00pm, Saturday 7:00am-1:00pm |
| Primary Contact: | Marcos Elizondo |

## 2.1 VERIFICATION

OAC 252:515-3-33 requires the applicant to sign the permit application under oath on forms provided by DEQ. The signed verification is attached to the application form.

## 2.2 LEGAL DESCRIPTION

Legal description and boundary survey of the existing and proposed landfill expansion is included in Appendix A.

## 2.3 LEGAL RIGHT TO PROPERTY

OAC 252:515-3-34(a)(1) requires that the owner of the landfill have a true and correct copy of a legal document filed in Oklahoma County, demonstrating that the applicant possesses a legal right to access and use the property in the manner outlined in this application. fDocumentation, showing that N.E. Land Fill, LLC owns the property containing both the existing and proposed landfill expansion, is included within Appendix A of this application.

## 2.4 ADJACENT PROPERTY OWNER NOTIFICATION

Notification of the proposed landfill expansion was provided to adjacent properties owners and copies of the notification letters and delivery confirmations are included in Appendix A.

## 2.5 AESTHETIC ENHANCEMENT

The proposed landfill expansion will be located directly north of the existing landfill, east of Midwest City Wastewater Treatment Plant, south of Arlington Memorial Park Cemetery, and west of Midwest Boulevard. To comply with the requirements of OAC 252:515-3-37, visual harmony of the proposed landfill expansion will be enhanced by (1) creating buffer zones greater than the required minimum of 100 feet, as discussed in Section 3.17 and shown on Drawing 3, and (2) by maintaining existing vegetation at the north and west property boundaries. Noise will be controlled by the established buffer zones and guidelines outlined in the facility's Operations Plan, included in Appendix G. Dust will be controlled as discussed in the facility's Operations Plan.

## 2.6 AIR QUALITY

Odors will be controlled at the site through proper operations and, more specifically, through proper application of weekly, intermediate, and final cover. Cover requirements are further discussed in Section 12. Dust control is discussed in the Operations Plan included in Appendix G.

# 3.0 LOCATION RESTRICTIONS

All solid waste disposal facilities are subject to the location restrictions set forth by DEQ in OAC 252:515-5. The following subsections show compliance with the location restrictions for solid waste disposal facilities.

## 3.1 SCENIC RIVERS

No area within the permit boundary of new solid waste disposal facility, or expansion of the permit boundary of an existing solid waste disposal facility, shall be located within the drainage basin of any river designated by the Oklahoma Scenic Rivers Commission Act in accordance with OAC 252:515-5-31(a).

Appendix A contains correspondence submitted to Oklahoma Scenic Rivers Commission (OSRC), dated August 23, 2023 requesting confirmation that the proposed landfill expansion will have no adverse impact on any of Oklahoma's Scenic River Areas. A copy of response received from OSRC will be provided to DEQ upon receipt.

## 3.2 RECREATION AND PRESERVATION AREAS

In accordance with OAC 252:515-5-3l(b), no area within the permit boundary of a new solid waste disposal facility, or expansion of the permit boundary of an existing solid waste disposal facility, shall be located within one-half mile of any area formally dedicated and managed for public recreation or natural preservation by a federal, state, or local government agency.

Appendix A contains correspondences submitted to Oklahoma Archeological Survey (OAS), dated August 23, 2023, the US Department of the Interior – Bureau of Reclamation (BOR), dated August 23, 2023, and the Oklahoma Tourism and Recreation Department (OTRD), dated August 23, 2023, requesting confirmation that the landfill expansion is not within one-half mile of any area formally dedicated and managed for public recreation or national preservation. A copy of response received from OAS, BOR, and OTRD will be provided to DEQ upon receipt.

## 3.3 ENDANGERED OR THREATENED SPECIES

For a new solid waste disposal facility, or expansion of the permit boundary of an existing solid waste disposal facility, a statement from the Oklahoma Department of Wildlife Conservation (ODWC) and the Oklahoma Biological Survey (OBS) shall be submitted regarding current information about endangered or threatened wildlife or plant species listed in state and federal laws that exist within one mile of the permit boundary, in accordance with OAC 252:515-5-31(c).

Correspondence letters, dated August 23, 2023, submitted to ODWC and OBS, respectively, requesting confirmation that endangered species or threatened wildlife or plant species listed in State and Federal laws will not be adversely affected due to the proposed landfill expansion are provided in Appendix A. A copy of response received from the ODWC and OBS will be provided to DEQ upon receipt.

## 3.4 100-YEAR FLOODPLAIN

OAC 252:515-5-32(a) prohibits, with exception, the location of waste management or disposal areas within the 100-year floodplain.

No portion of the landfill waste management or disposal areas is located within the 100-year floodplain, as shown in Figure 2. This figure was created using Federal Emergency Management Agency Flood Insurance Rate Maps of Oklahoma County, Oklahoma and Incorporated Areas (Flood Insurance Rate Maps Panel 0310H, Community Number 40109C0310H, Effective Date: December 18, 2009).

## 3.5 PUBLIC WATER SUPPLY

In accordance with OAC 252:515-5-32(b), no new waste management or disposal areas of a solid waste disposal facility shall be located within one mile up-gradient of an existing public water supply (PWS) surface intake, including those permitted for construction, or within a one-year time of travel of a PWS well.

The online geographic information system (GIS) Oklahoma DEQ database indicated that there are two PWS surface water intakes within one mile of the proposed landfill expansion (http://gis.deq.ok.gov/maps/); however, both wells are located up-gradient of the proposed landfill expansion. The locations of the recorded PWS wells and surface water intake are shown on Figure 4 of Appendix A.

Appendix A contains correspondence submitted to DEQ, dated August 23, 2023, requesting confirmation that the proposed landfill expansion is located **down-gradient** of existing PWS surface water intakes. A copy of response received from DEQ will be provided upon receipt.

## 3.6 WELLHEAD PROTECTION AREA

In accordance with OAC 252:515-5-32(c), if any new waste management or disposal area is located within two miles of a PWS well, a wellhead protection area shall be identified and submitted to DEQ, as specified by the State Wellhead Protection Plan.

Based on a search of DEQ's database, there are 23 PWS wells within two miles of the proposed landfill expansion, as shown on Figure 5. Of the 23 PWS wells, 12 have associated wellhead protection areas. Of the remaining 11, the closest PWS well is approximately 4,000 feet **down-gradient** of the proposed landfill expansion, and is not expected to be impacted by the landfill.

Appendix A contains correspondence submitted to DEQ, dated August 23, 2023, requesting confirmation that the nearest PWS without associated wellhead protection areas will not be impacted by the proposed landfill expansion. A copy of response received from DEQ will be provided upon receipt.

## 3.7 WETLANDS

In accordance with OAC 252:515-5-32(d), no new waste management or disposal areas of a solid waste disposal facility shall be located within wetland areas as designated by the Oklahoma Conservation Commission (OCC) or other appropriate agency, with exception.

Based on the conclusions of the jurisdictional determination letter, dated December 11, 2020, by the U.S. Army Corps of Engineers (USACOE) Tulsa District Office, the proposed landfill expansion poses an impact to the Waters of the United States (WOTUS) in the amount of 0.56 acres of scrub-shrub wetland impacts, 0.76 acres of open water impacts, 746 linear feet (0.05 acres) of intermittent stream impacts, and 1,359 linear feet (0.14 acres) of ephemeral stream impact. Therefore, GFL proposes to purchase stream and wetland credits from the Deep Fork Mitigation Bank (DFMB) to offset unavoidable, permanent impacts from the proposed landfill expansion.

Additionally, an application for individual permit was submitted to USACOE on May 28, 2021. Subsequently a mitigation plan was also submitted to USACOE on August 17, 2021. Appendix A contains a copy of the individual permit application and the mitigation plan, developed by Hydrex Environmental, and a copy of the Water Quality Certification Letter issued by DEQ on May 9, 2023. GFL acknowledges that no waste disposal operations will begin for the proposal landfill until the individual permit has been received from USACOE.

## 3.8 TERRACE DEPOSITS

In accordance with OAC 252:515-5-51(a), no area within the permit boundary of a new land disposal facility, or expansion of the boundary of an existing land disposal facility, shall be located within an area designated as alluvium or terrace deposits and their recharge areas, as shown on the *Map of Aquifers and Recharge Areas in Oklahoma*, compiled by Kenneth S. Johnson of the Oklahoma Geologic Survey (OGS) dated 1991.

According to the "Geologic Map of the Midwest City 7.5' Quadrangle, Cleveland and Oklahoma Counties, Oklahoma" compiled by Thomas M. Stanley and Neil H. Suneson, 2000 and the "Geologic Map of the Spencer 7.5' Quadrangle, Oklahoma County, Oklahoma" complied by Thomas M. Stanley and Neil H. Suneson, 1999; the proposed landfill expansion is not located in alluvium or terrace deposits. Further confirmation that the expansion area is not located within areas designated as alluvium or terrace deposits was obtained through hydrogeologic and geotechnical investigations performed for the proposed landfill expansion. Based on boring logs obtained during these investigations, the lithology underlying the landfill is consistent with weathered Garber sandstones. Please refer to Appendix B for the hydrogeological and geotechnical investigation report.

## 3.9 KARST TERRAIN

OAC 252:515-5-51(b) prohibits locating any area within the permit boundary of a new MSWLF in an area that is both within locally fractured or cavernous limestone or cherty limestone and within five miles of any water well owned by a rural water district that is used or has the potential to be used to provide water to customers of the district.

This location restriction does not apply to this facility because the Northeast C&D landfill expansion will not be an MSWLF.

## 3.10 EARTHQUAKE EPICENTER AREA

In accordance with OAC 252:515-5-5l(c), no area within the permit boundary of a new land disposal facility that accepts non-hazardous industrial waste (NHIW) shall be located within five miles of a known epicenter of an earthquake of more than 4.0 on the Richter Scale, or a number V on the modified Mercalli (MM) scale, as recorded by the Oklahoma Geological Survey.

This location restriction does not apply to this facility because the Northeast C&D landfill does not accept NHIW.

## 3.11 ASBESTOS MONOFILL

In accordance with OAC 252:515-5-5l(d), no area within the permit boundary of a new asbestos monofill shall be located within five hundred (500) yards of an occupied residence or within three (3) miles of the corporate boundaries of any city or town.

This location restriction does not apply to this facility because the Northeast C&D landfill is not an asbestos monofill.

## 3.12 UTILITY/TRANSMISSION LINES

In accordance with OAC 252:515-5-52(a), a minimum horizontal separation of 25 feet shall be maintained between disposal areas of land disposal facilities and any aboveground or underground pipeline or transmission line.

Several utilities are present within the proposed expansion area, as discussed below:

- Natural gas line owned by Plains Pipeline, LP will be relocated as shown on Drawing 3. Following pipeline relocation, a minimum horizontal separation distance of 25 feet will be maintained between disposal areas and this pipeline before the landfill is developed.
- Two (2) 30-foot electrical transmission line easements owned by Diamond A Inc., are currently located within the proposed landfill expansion, as shown on the boundary survey in Appendix A. These electrical transmission line easements will be released and assigned to GFL prior to landfill development.
- 20-foot pipeline easement owned by Midstates Natural Gas Company will be released and reassigned to GFL prior to landfill development.
- Magellan pipeline will be abandoned prior to landfill development.
- Additionally, existing Northport Production Co. Wells #1 and #3 shown on the boundary survey will be abandoned prior to landfill development.

## 3.13 FAULT AREAS

In accordance with OAC 252:5l5-5-52(b), no new waste management or disposal areas of a land disposal facility shall be located within 200 feet of a fault that has had displacement in Holocene time.

The landfill and the surrounding area were examined for the presence of Holocene (last 11,000 years) fault displacements. This included a physical inspection of the landfill and surrounding area, review of previous fault investigations, available literature and maps, and review of historical aerial photographs. No unusual Holocene scarps, topographic breaks, vegetation changes, or lineaments were interpreted within 200 feet of the landfill area. No apparent Holocene structural influence of stream courses were observed. Additionally, no unusual relief or topographic features, such as sag ponds, truncated alluvial spurs, or offset tributary alignments, were observed. The Tectonic Map of Oklahoma (Arbenz, 1956) indicates no mapped faults within Oklahoma County.

In summary, there is no evidence of Holocene faulting within 200 feet of the site. Therefore, the proposed expansion complies with the fault area location restriction.

## 3.14 SEISMIC IMPACT ZONES

In accordance with OAC 252:515-5-52(c)(1), no new waste management or disposal areas of a land disposal facility shall be located in a seismic impact zone, except as provided in OAC 252:515-5-52(c)(2).

The proposed landfill expansion is located within a seismic impact zone with a peak ground acceleration (PGA) of 0.17g from U.S. Geological Survey (USGS) Unified Hazard Tool and USGS Hazard Map 2014. Appendix C, related to Slope Stability and Final Cover Veneer Slope Analysis, addresses seismic issues in conjunction with the slope stability analyses for the landfill.

## 3.15 UNSTABLE AREAS

OAC 252:515-5-52(d) prohibits, with exception, locating new waste management or disposal areas of a land disposal facility over a subsurface mining area or any other unstable area.

The proposed landfill expansion is not located over a subsurface mining area or any other unstable area. Appendix A contains correspondence submitted to Oklahoma Department of Mines (ODM), dated August 23, 2023, requesting confirmation that the proposed landfill expansion meets this location restriction. A copy of response received from ODM will be provided to DEQ upon receipt

## 3.16 AIRPORTS

In accordance with OAC 252-515-52(e), if any waste management or disposal area of a new land disposal facility, or expansion of waste management or disposal areas of an existing land disposal facility, is to be located within 10,000 feet of any airport runway end used by turbojet aircraft or within 5,000 feet of any airport runway end used by only piston-type aircraft, a demonstration that the facility will not pose a bird hazard to aircraft shall be provided to DEQ.

The proposed landfill expansion is not located within 10,000 feet of any airport runway end used by turbojet aircraft or within 5,000 feet of any airport runway end used by only piston-type aircraft, as depicted in the airport location map (see Figure 6). Correspondence submitted to U.S. Federal Aviation Administration (FAA), dated August 23, 2023, requesting confirming that the proposed landfill expansion meets this location restriction and has no objection to the landfill expansion from the standpoint of potential bird hazards is provided in Appendix A. Tinker Air Force Base (TAFB) is located about 23,000 feet (4.4 miles) south of the proposed landfill expansion, as shown in Figure 7. Correspondence submitted to TAFB, dated August 23, 2023, requesting confirmation that there will be no negative impact from the proposed landfill expansion, is also provided in Appendix A. A copy of response received from the FAA and TAFB will be provided to DEQ upon receipt.

## 3.17 BUFFER ZONES

In accordance with OAC 252:515-19-38(b), all disposal facilities shall be designed and maintained with a waste-free buffer zone of at least 50 feet in width between all waste disposal and/or handling areas and adjacent property.

The proposed landfill expansion will be maintained with a waste-free buffer zone of at least 50 feet in width between all waste disposal and/or handling areas and adjacent property as depicted on Drawing 3.

## 3.18 LOCAL ZONING

The proposed landfill expansion will be located in the City of Spencer limits, and as such, is subject to local zoning ordinance requirements. An agreement between GFL and City of Spencer, dated March 30, 2023, authorizing GFL to expand the existing C&D landfill to accept C&D waste for disposal is provided in Appendix A.

# 4.0 SUBSURFACE INVESTIGATION

A geotechnical and hydrogeological investigation has been conducted within the proposed expansion of the landfill permit boundary. The field investigation for determining subsurface soil and groundwater characteristics consisted of drilling 16 exploratory borings, nine (9) of which were completed as piezometers. The results of the investigation are detailed in the report *Hydrogeologic and Geotechnical Investigation* prepared by SCS Engineers and included in Appendix B. Results of the subsurface investigation were considered while designing the proposed landfill expansion.

# 5.0 LANDFILL DEVELOPMENT

This section, in conjunction with the accompanying drawings and appendices, addresses the various design and operational elements of the proposed landfill expansion.

## 5.1 DESIGN CRITERIA

The development of the proposed landfill expansion was based on the following design criteria:

- Compliance with landfill requirements, including liner and final cover requirements, as described in Sections 9 and 12, respectively.

- Final sideslopes will be created at a maximum 4H:1V. The slope of the top of the landfill (crown) will be no less than 4 percent.

- The following surface water drainage management practices will be implemented at the landfill:

    - Drainage swales and downchutes will be constructed to improve surface water drainage.

    - Surface water diversionary structures and the perimeter stormwater management system will be capable of handling at a minimum a 25-year 24-hour storm event (see Appendix E).

- Seismic and stability design criteria established in the Slope Stability and Final Cover Veneer Slope Analysis (see Appendix C) have been incorporated into the design.

- Applicable sections of the regulations listed below are followed:

    - OAC 252:515

    - 40 CFR Part 257 and 258 (Subtitle D)

## 5.2 LANDFILL DEVELOPMENT

As described in Section 1, The existing C&D landfill (referred in this application as landfill) permit boundary contains approximately 90.1 acres, of which approximately 67.7 acres has been developed for C&D waste disposal under Permit No. 3555050. The proposed expansion will have a permit boundary of 73.2 acres, out of which 53.5 acres will be developed for disposal of C&D waste. The combined total area (existing and expansion) available for C&D waste disposal upon obtaining approval of the permit application will be 121.2 acres. The following subsections described the landfill waste capacity and general sequence of development of the proposed landfill expansion.

## 5.3 LANDFILL CAPACITY

The waste airspace for the landfill expansion is estimated by using AutoCAD Civil 3D to be **10,558,969 cubic yards** (10,277,350 cubic yards expansion plus 281,619 cubic yards within currently permitted boundary) by comparing the proposed top of waste grades to the top of protective cover grades.

Also, conservatively assuming an in-place waste density for C&D as 1,000 lb/cy, the available landfill capacity was estimated to be **5,279,485 tons**, as shown in Table 1.

Table 1. Waste Disposal Capacity Calculation

| Description Item | Volume |
|---|---|
| 1. Waste airspace volume = | **10,558,969 cubic yards** |
| 2. In-place waste density[1] = | 1,000 lb/cy |
| **3. Total waste disposal tonnage =** | **5,279,485 tons** |

Note 1. In-place waste density is assumed to be 1,000 lb/cy based on OAC 252:515-27-8.

### 5.3.1 Sequence of Development

The proposed landfill expansion will be developed in seven (7) primary phases with Phases 11 through 17. Phases may be constructed incrementally (e.g., Phase 11 constructed in two or more individual cells or sub-phases, such as Phase 11A, Phase 11B, etc.). Temporary drainage swales and channels may be constructed, as needed, on intermediate contours to control surface water.

Plans and cross-sections depicting the conceptual sequence of development are shown on Drawings 10 through 19.

# 6.0 GROUNDWATER MONITORING

The current groundwater monitoring system for the existing landfill consists of six monitoring wells designated as MW-1, MW-2, MW-3R, MW-4R, MW-5, and MW-6 as shown on Drawings 2 and 3. All six of the existing monitoring wells are completed within the Garber Sandstone. The proposed groundwater monitoring system to be utilized for the entire landfill will consist of a series of existing and new groundwater monitoring wells. Existing piezometer PZ-1 was installed to monitoring well specifications for the purpose of being utilized within the groundwater monitoring network. As such, PZ-1 will be converted to groundwater monitoring well MW-7 following approval of this permit application.

Additionally, three new monitoring wells (MW-8, MW-9, and MW-10) will be installed and two existing monitoring wells (MW-3R and MW-4R) will be decommissioned, in accordance with the "EPA Handbook of Suggested Practices for Design and Installation of Groundwater Monitoring Wells" and OAC 785:35-11-2, prior to waste disposal within the proposed landfill expansion. As such, monitoring system for existing and proposed landfill expansion will consist of eight monitoring wells, existing MW-1, MW-2, MW-5, and MW-6, and new MW-7, MW-8, MW-9, and MW-10.

It should be noted that MW-1 and MW-7 are located south and southeast of the disposal unit, respectively, and are considered up-gradient monitoring wells. MW-2, MW-5, MW-6, MW-8, MW-9, and MW-10 are considered down-gradient monitoring wells. The down-gradient wells will be screened within the uppermost saturated zone, similar to existing wells.

Groundwater monitoring wells will be subject to the sampling, testing, and reporting requirements of OAC 252:515-9 and the final permit. Four rounds of background data will be collected from new wells for groundwater quality constituents listed in OAC 252:515-9-31 (d)(1)(A) as well as Appendix A parameters in accordance with OAC 252:515-9-31(d)(1)(B). Additional sampling events may be required prior to the first statistical evaluation. The Ground Water Sampling and Analysis Plan (GWSAP) will include the requirements for detection monitoring and any required reporting for verified Statistically Significant Increases (SSIs) and subsequent testing programs. The monitoring program will include semi-annual sampling of Appendix A parameters.

Additional information related to the proposed groundwater monitoring network is provided in Section 6.0 of the hydrogeologic and geotechnical investigation (see Appendix B). The existing C&D landfill already has an existing Groundwater Sampling and Analysis Plan (GWSAP) that will be updated once the final permit is issued. The GWSAP is intended to be used as a standalone document, a copy of which will be maintained within the facility's operating record.

# 7.0 EXPLOSIVE GAS MONITORING

The decomposition of solid waste within a landfill is known to produce landfill gas, typically consisting of approximately 50% methane ($CH_4$) and 50% carbon dioxide ($CO_2$). Trace amounts of non-methane organic compounds (NMOCs), oxygen, hydrogen sulfide, and reactive organic gases are also present (*Engineering and Design Landfill Off-Gas Collection and Treatment Systems*, U.S. Army Corps of Engineers, 1995).

OAC 252:515-15-2 requires that the concentration of methane gas generated by the facility shall not exceed twenty-five percent (25%) of the lower explosive limit (LEL) for methane in all structures within the permit boundary and shall not exceed the LEL for methane at the permit boundary. The LEL is defined as the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25°C and atmospheric pressure. The LEL for methane is 5% by volume in air.

Additionally, OAC 252:515-15-3(a) requires an Explosive Gas Monitoring Plan to be submitted and approved by DEQ to demonstrate how compliance with the LEL mentioned in OAC 252:515-15-2 will be achieved. A copy of the Explosive Gas Monitoring Plan is included with this application as Appendix D. The Explosive Gas Monitoring Plan is intended to be used as a standalone document, a copy of which will be maintained within the facility's operating record.

Currently there are 17 existing gas monitoring probes (GP-1 through GP-4, GP-6A through GP-8A, and GP-9 through GP-18) around the perimeter of the existing C&D landfill.

Following approval of this permit application and prior to developing of adjacent cells within 1,000 feet of the gas monitoring probe locations, three existing gas probes will be decommissioned (GP-9, GP-10, and GP-11), and 10 additional gas probes (GP-9A, GP-10A, GP-11A, GP-19, GP-20, GP-21, GP-22, GP-23, GP-24, and GP-25) will be installed in accordance with OAC 252:515-15-4, as shown on Drawing 2 in Appendix D. As such, a combined total of 24 gas monitoring probes will be required around the perimeter of the expanded C&D landfill. The new gas probes will be registered online or by mail with the Oklahoma Water Resources Board (OWRB) by a licensed driller within 60 days after installation.

# 8.0 STORM WATER MANAGEMENT

## 8.1 OKR05 PERMIT REQUIREMENTS

State law requires an Oklahoma Pollutant Discharge Elimination System (OPDES) Permit be obtained to allow storm water to discharge from this facility. Under state regulations, the existing C&D landfill is subject to requirements of the Oklahoma DEQ Water Quality Division, Sector L, Industrial General Permit OKR05 (OKR05). Under the requirements of OKR05, the facility is to prepare and maintain a Storm Water Pollution Prevention Plan (SWPPP). The existing C&D landfill has an SWPPP for the permitted C&D disposal area and disturbed areas within the currently owned GFL properties.

As such, following permit issuance the existing authorization under the general permit will be updated (i.e., filing a Notice of Change) to reflect the new total property acreage (i.e., including the proposed expansion area of C&D landfill). Additionally, the existing SWPPP will be updated to describe the expanded C&D landfill and its operations, identify potential sources of storm water pollution at the facility, recommend appropriate Best Management Practices (BMPs) or pollution control measures to reduce the discharge of pollutants in storm water runoff, and provide procedures for regular inspections, storm water monitoring, recordkeeping and reporting, and periodic review of the SWPPP.

## 8.2 RUN-ON CONTROL SYSTEMS

In accordance with OAC 252:515-17-2(1), the expanded C&D landfill has been designed to have a run-on control system to prevent flow onto active portions of the facility during the peak discharge from a 24-hour, 25-year storm event. Temporary separation berms will be constructed, as needed, between phases as the landfill is expanded. Additional run-on control features such as diversion berms will be constructed up-gradient of the construction areas and active portions of the landfill.

## 8.3 RUN-OFF CONTROL SYSTEMS

In accordance with OAC 252:515-17-2(2), a run-off control system will be installed to collect and control contaminated stormwater run-off from active portions of the landfill resulting from a 24-hour, 25-year storm event.

Additionally, the expanded C&D landfill has been designed with a single comprehensive surface water drainage system to collect and control uncontaminated stormwater runoff from the landfill permit boundary resulting from a 24-hour, 25-year storm event. Stormwater runoff will be conveyed from the landfill sideslopes and topslopes within in-place final cover through a series of drainage swales discharging to downchutes (letdown channels), which will convey the stormwater to either perimeter drainage channels or detention ponds. Drainage channels will also convey stormwater to two future detention ponds located on the north side of the landfill (North and Northwest Detention Ponds), which will discharge stormwater from the facility through controlled outlet structures and two detention ponds located on the south side of the landfill (South Pond, which discharges into the Southeast Pond, which is a zero discharge pond). The ponds have been designed to discharge stormwater to the north or south such that previously existing drainage patterns are not adversely altered.

The peak volume and flows from the final grades of the landfill were calculated using the hydrologic modeling program HEC-HMS (Version 4.0). Hydraulic calculations were performed using Hydraflow Extension for AutoCAD Civil 3D 2020 for sizing the various surface water drainage controls and structures to convey a 24-hour, 25-year storm event. Hydrology model input parameters and output;

and the results of the hydraulic design calculations are included in the Surface Water Drainage System Design Plan in Appendix E.

The following surface water management structures will be constructed to control and route surface water runoff from the landfill:

- Drainage swales,
- Downchutes,
- Perimeter drainage channels, and
- Stormwater detention ponds.

Details of the surface water management structures are described in the following subsections, and detailed hydraulic calculations for sizing these structures are included in Appendix E.

### 8.3.1 Drainage Swales

The drainage swales are tack-on berms constructed on the landfill sideslopes and topslopes to convey surface water to installed downchutes. Drainage swales were designed as grass-lined V-shaped channels, with a 2:1 exterior sideslope (berm side) and 4:1 interior sideslope (landfill side). A majority of the drainage swales will have a minimum height of 2.5 feet, with exception to the lower drainage swales on the south side of the existing landfill will have a minimum height of 3.5 feet, and minimum slope of two-percent towards the downchutes, as shown on Drawings 7 and 13. Design calculations for drainage swales can be found in Appendix E, Attachment E-4.

### 8.3.2 Downchute Structures

The downchutes shall be geomembrane-lined or HydroTurf-lined trapezoidal shaped channels with 3:1 sideslopes, a minimum bottom width of 15 feet, and depth of 2.0 feet, as shown on Drawing 14. The downchute structures will be installed on the landfill sideslopes (maximum 25 percent (4:1) slope), and have been sized for the largest contributing drainage area discharging to the downchute. Design calculations for the downchutes are provided in Appendix E, Attachment E-4.

### 8.3.3 Perimeter Drainage Channels

The future perimeter channels will vary in dimension but generally will be either vegetated or armored channels (turf reinforcement mat or riprap) depending on calculated flow velocity, 2 to 4.5 feet deep with a bottom width of 2 to 10 feet and 2:1 or 3:1 side slopes. The channels will be sloped toward a discharge point at an approximate average slope of 0.25 to 1 percent. Design calculations for perimeter channels can be found in Appendix E, Attachment E-4.

Design and sizing calculations for existing perimeter channels are included in approved Tier I permit modification, dated September 2012, for Permit No. 3555050. The peak flows from drainage areas contributing stormwater runoff to the existing perimeter channels were evaluated to confirm that these channels are still adequately sized to convey the 24-hour, 25-year storm event.

### 8.3.4 Stormwater Detention Ponds

Two stormwater detention ponds (North and Northwest Ponds) have been designed to manage and detain stormwater runoff from the landfill for a 25-year, 24-hour rainfall event and discharge to an existing offsite discharge location to the north. Additionally, existing stormwater detention pond (South Pond) located south of the existing C&D landfill disposal area has been redesigned and analyzed for management of stormwater runoff from the proposed expanded landfill. Based on the peak flows from drainage areas contributing stormwater runoff to the existing South Pond, the pond was resized and discharges to the new Southeast Pond, which is a zero discharge pond. Both the South and Southeast Ponds have been sized for the 24-hour, 25-year storm event.

Design calculations for detention ponds can be found in Appendix E-1.

# 9.0 LINER CONSTRUCTION

The permitted liner system at the landfill comprises of the following, from top to bottom:

- 1-foot-thick soil protective cover,
- 36-inch-thick compacted clay liner (CCL, $k \leq 1x10^{-5}$ cm/sec), and
- Prepared subgrade (excavation grade).

**No changes to the approved liner system are being proposed with this permit modification application.**

Specific information pertaining to quality assurance and quality control testing during installation and construction of the liner system components is included in the QA/QC Plan, provided in Appendix F. **No changes to the QA/QC plan are proposed with this permit modification application.**

Additionally, Appendix C includes a slope stability and final cover veneer slope analysis of the liner and final cover systems, respectively. Based on these analyses, it can be concluded that the slope stability of the proposed landfill excavation slopes, interim fill sideslopes, and final grade sideslopes are acceptable as designed.

# 10.0 SITE OPERATIONS

In accordance with OAC 252:515-19, the landfill has an approved Operations Plan, which is included in Appendix G. The Operations Plan provides pertinent operational methods and procedures for public access control, controlling windblown litter, controlling odors, controlling disease vectors, acceptance, unloading and placement of waste, and placement of soil cover, including weekly, intermediate, and final cover. The Operations Plan outlines acceptable waste streams as well as limitations on incoming waste streams, as well as recordkeeping and reporting requirements for the landfill.

Acceptable and prohibited wastes for the landfill are outlined in the Waste Exclusion Plan, included with this application in Appendix H. The Waste Exclusion Plan is intended to be used as a standalone document, a copy of which is maintained within the facility's operating record. The Waste Exclusion Plan also provides information on restrictions for the disposal of bulk liquids, restrictions on the disposal of municipal sewages, as well as recordkeeping and reporting requirements for incoming waste streams.

**No changes to the waste exclusion plan are being proposed with this permit modification application.**

# 11.0 COVER AND SOIL BORROW REQUIREMENTS

Cover will be applied to reduce fire hazards, stormwater infiltration, odors, and windblown litter; to control vectors; to discourage scavenging; and to provide aesthetically pleasing appearance.

## 11.1 WEEKLY AND INTERMEDIATE COVER

Weekly soil cover will be applied at the end of each operating week, regardless of weather, as required by DEQ, to deter disease vectors, fires, odors, and windblown litter. The weekly soil cover material should consist of nominally compacted earthen material free of garbage, trash, or other unsuitable material. The minimum thickness of the weekly soil cover will be six (6) inches.

Intermediate cover will consist of at least one foot of nominally compacted soil over refuse. Proper surface grades and sideslopes will be maintained to promote stormwater runoff and minimize infiltration without excessive erosion. Internal sideslopes will not exceed a slope of 3H:1V and external side slopes will not exceed a slope of 4H:1V (25 percent) with the final top slope graded to a minimum of 4 percent.

## 11.2 FINAL COVER SYSTEM

The final cover system will be constructed once the landfill reaches final grade. The approved final cover system conforms to DEQ specifications and includes the following components from top to bottom:

- 12-inch-thick erosion layer of earthen material capable of sustaining plant growth;
- 24—inch-thick barrier layer ($k \leq 1x10^{-5}$ cm/sec hydraulic conductivity).

Once the final cover system and surface water control structures are constructed, the erosion layer will be seeded to establish vegetation. Final cover will be installed in accordance with the approved Closure and Post Closure (C-PC) Plan (Appendix I), Attachment B – Quality Assurance/Quality Control (QA/QC) Plan for Final Cover System Installation.

## 11.3 BORROW SOURCES

The active borrow area for the site will be located in the future disposal areas of the proposed landfill expansion. The areas will be excavated in a manner to provide positive drainage to onsite stormwater control features (channels, ponds, etc.). BMPs will be installed in accordance with the OPDES General Permit OKR05 to minimize erosion and offsite sedimentation. Disturbance of vegetation will be limited to the extent possible. Since the borrow source will be located within future disposal areas, reclamation of the area consistent with 252:515-19-55 will not be required.

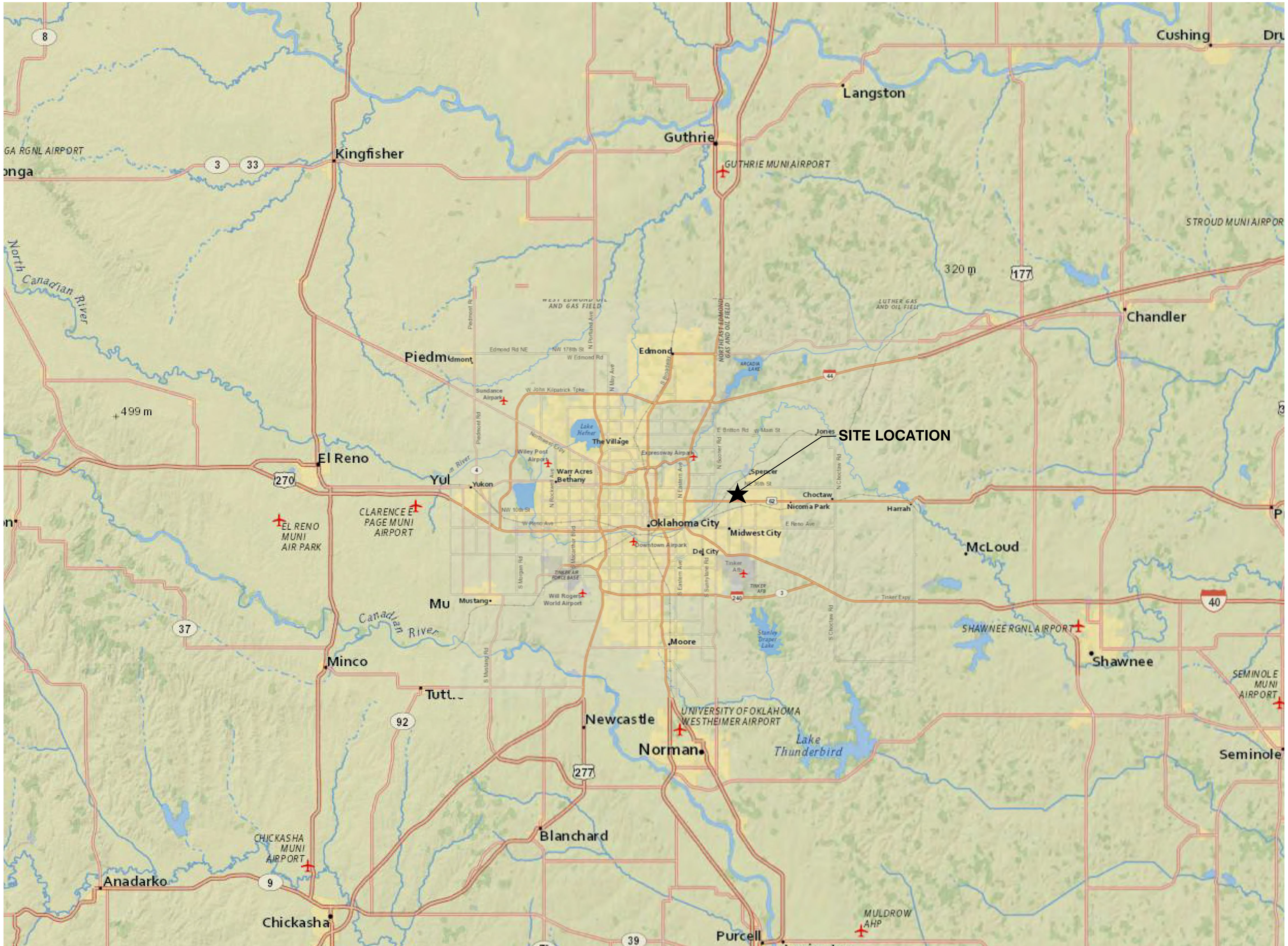
# 12.0 CLOSURE AND POST-CLOSURE PLAN

A C-PC Plan is included in Appendix I. The C-PC Plan is in general accordance with OAC 252:515-25. The C-PC Plan includes the necessary actions to be completed at the site before the facility can be certified closed and sets forth the maintenance and monitoring requirements during the post-closure period. The post-closure period will be 8 years following closure to verify that the closed landfill will continue to retain its integrity and will not pose a threat to human health or the environment.

The cost estimates and financial assurance requirements for closure and post-closure care for the landfill are included in Appendix I, Attachment A.

# Figures


| | |
|---|---|
| Figure 1 | General Location Map |
| Figure 2 | Floodplain Map |
| Figure 3 | Aerial Photograph |
| Figure 4 | Public Water Supply (PSW) Surface Water Intakes Map |
| Figure 5 | Wellhead Protection Areas Map |
| Figure 6 | General Topographic Map |
| Figure 7 | FAA Airport Vicinity Map |




**SOURCE:**

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

**FOR PERMITTING PURPOSES ONLY**

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DRAWING TITLE
**GENERAL LOCATION MAP**

PROJECT TITLE
**NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION**

CLIENT
**N.E. LAND FILL, LLC**
**NORTHEAST LANDFILL**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00
DSN. BY: SS
DWN. BY: NR
CHK. BY: RRK
Q/A RVW BY: SS
APP. BY: RRK

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DATE: 07/2023

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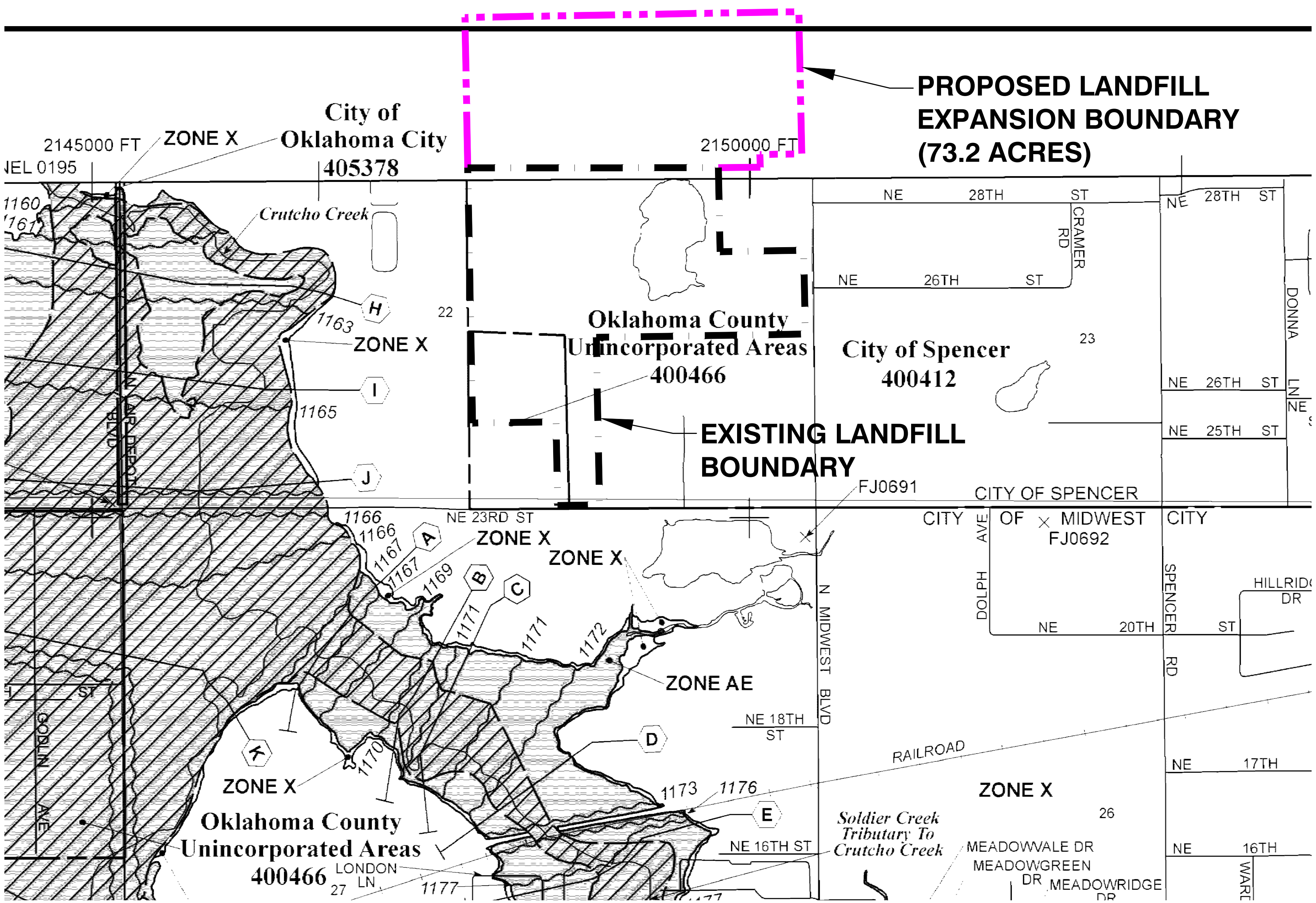


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## LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

| | |
|---|---|
| ZONE A | No Base Flood Elevations determined. |
| ZONE AE | Base Flood Elevations determined. |
| ZONE AH | Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined. |
| ZONE AO | Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined. |
| ZONE AR | Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood. |
| ZONE A99 | Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined. |
| ZONE V | Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined. |
| ZONE VE | Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined. |

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

| | |
|---|---|
| ZONE X | Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. |

OTHER AREAS

| | |
|---|---|
| ZONE X | Areas determined to be outside the 0.2% annual chance floodplain. |
| ZONE D | Areas in which flood hazards are undetermined, but possible. |

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

| | |
|---|---|
| | Floodplain boundary |
| | Floodway boundary |
| | Zone D boundary |
| | CBRS and OPA boundary |
| | Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities |
| 513 | Base Flood Elevation line and value; elevation in feet* |
| (EL 987) | Base Flood Elevation value where uniform within zone; elevation in feet* |

* Referenced to the North American Vertical Datum of 1988

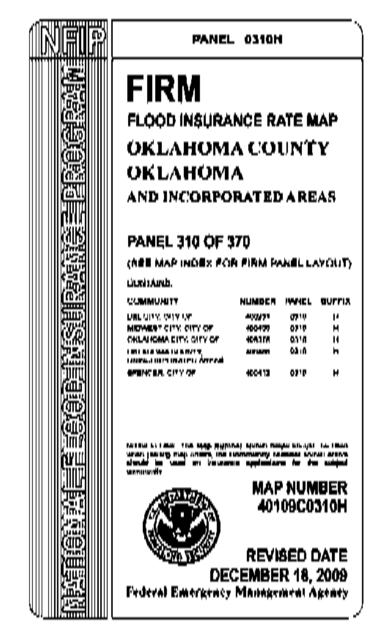
| | |
|---|---|
| A — A | Cross section line |
| 23 - - - 23 | Transect line |
| 97°07'30", 32°22'30" | Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere |
| 4275000mE | 1000-meter Universal Transverse Mercator grid ticks, zone 14 |
| 6000000 FT | 5000-foot grid values: Oklahoma State Plane coordinate system, North Zone (FIPSZONE = 3501), Lambert projection |
| DX5510 | Bench mark (see explanation in Notes to Users section of this FIRM panel) |
| • M1.5 | River Mile |

MAP REPOSITORIES
Refer to Repository Listing on Map Index

EFFECTIVE DATE OF
COUNTYWIDE FLOOD INSURANCE RATE MAP:
July 2, 2002

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:
December 18, 2009

December 18, 2009 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to revise vertical datum, to update roads and road names, to incorporate previously issued Letters of Map Revision, and to reflect updated topographic information.

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| △ | | | |
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DRAWING TITLE: FLOODPLAIN MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

| | | | |
|---|---|---|---|
| PROJ. NO. 16219107.00 | DWN. BY: DS | Q/A RVW BY: SDS | |
| DSN. BY: BJD | CHK. BY: SDS | APP. BY: RRK | |

CADD FILE: 02 FLOOD PLAIN MAP

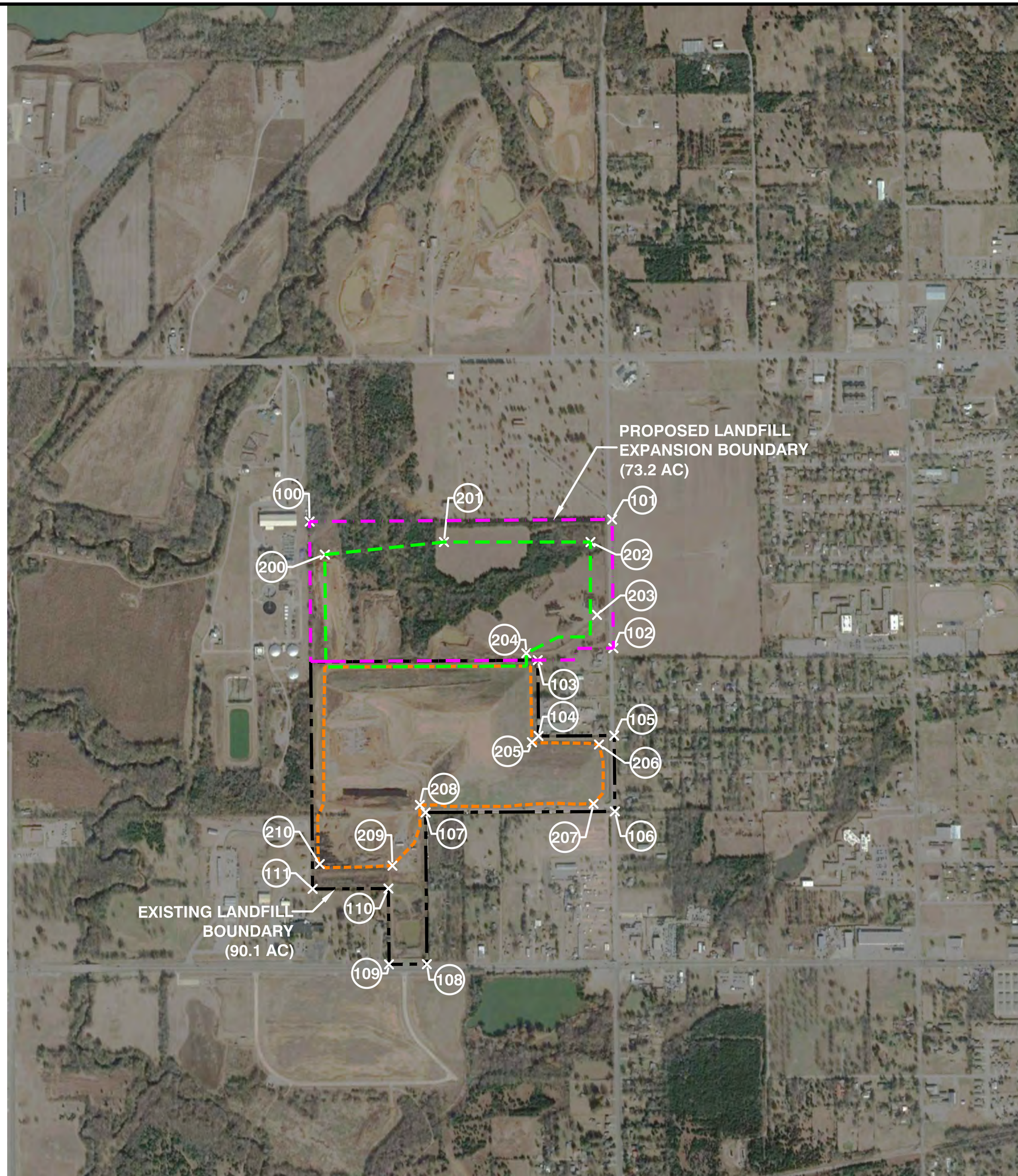
DATE: 08/2023

SCALE: AS SHOWN

FIGURE NO. 2

8/22/2023 12:58 PM C:\Northeast CAD\16219107.00 - Tier III Permit Mod Application\Location Restriction Letters Drawings\02 FLOOD PLAIN MAP

8/17/2023 7:14 PM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application\Location Restiction Letters Drawings\03 AERIAL PHOTO




N

0 500 1000
SCALE IN FEET

## LEGEND

EXISTING LANDFILL BOUNDARY
PROPOSED LANDFILL EXPANSION BOUNDARY
CURRENT LIMIT OF WASTE
PROPOSED LIMIT OF WASTE

**PERMIT BOUNDARY**

| POINT # | LATITUDE | LONGITUDE |
|---|---|---|
| 100 | N35° 30' 13.47" | W97° 23' 51.04" |
| 101 | N35° 30' 13.49" | W97° 23' 19.15" |
| 102 | N35° 30' 02.39" | W97° 23' 19.11" |
| 103 | N35° 30' 01.40" | W97° 23' 27.08" |
| 104 | N35° 29' 54.86" | W97° 23' 27.06" |
| 105 | N35° 29' 54.86" | W97° 23' 19.08" |
| 106 | N35° 29' 48.32" | W97° 23' 19.05" |
| 107 | N35° 29' 48.33" | W97° 23' 39.01" |
| 108 | N35° 29' 35.26" | W97° 23' 38.97" |
| 109 | N35° 29' 35.26" | W97° 23' 42.96" |
| 110 | N35° 29' 41.80" | W97° 23' 42.98" |
| 111 | N35° 29' 41.81" | W97° 23' 50.97" |

**LIMITS OF WASTE**

| POINT # | LATITUDE | LONGITUDE |
|---|---|---|
| 200 | N35° 30' 10.61" | W97° 23' 49.46" |
| 201 | N35° 30' 11.63" | W97° 23' 36.89" |
| 202 | N35° 30' 11.55" | W97° 23' 21.45" |
| 203 | N35° 30' 05.27" | W97° 23' 20.81" |
| 204 | N35° 30' 02.01" | W97° 23' 28.29" |
| 205 | N35° 29' 54.32" | W97° 23' 27.76" |
| 206 | N35° 29' 54.10" | W97° 23' 20.68" |
| 207 | N35° 29' 48.99" | W97° 23' 21.29" |
| 208 | N35° 29' 48.99" | W97° 23' 39.61" |
| 209 | N35° 29' 43.77" | W97° 23' 42.53" |
| 210 | N35° 29' 43.95" | W97° 23' 50.20" |

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8-18-23

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|---|---|---|---|
| | | | |

DRAWING TITLE
AERIAL PHOTO

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
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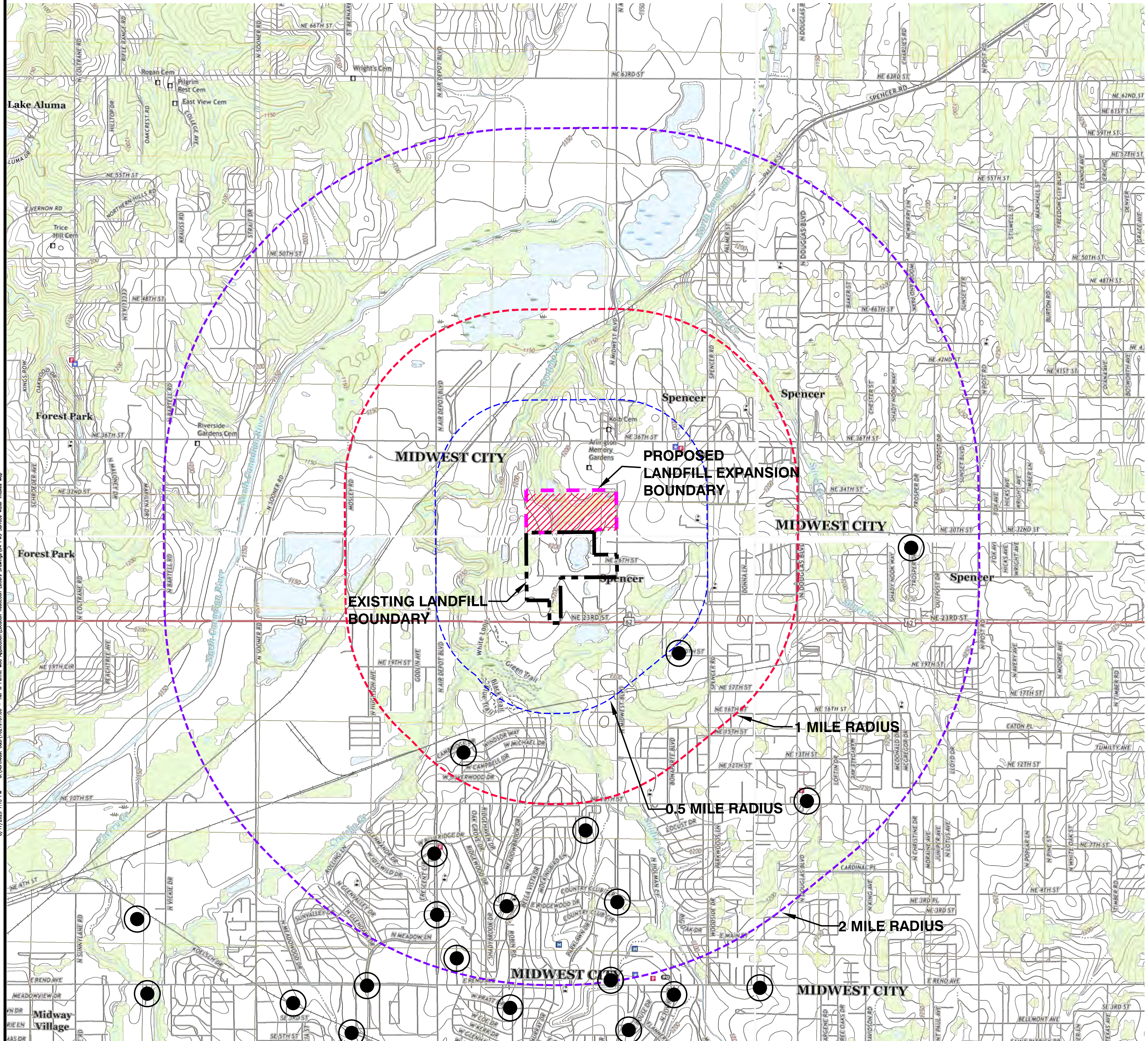
PROJ. NO. 16219107.00
DSN. BY: SS
DWN. BY: DS
CHK. BY: SDS
Q/A RVW BY: SS
APP. BY: RRK

CADD FILE: 03 AERIAL PHOTO
DATE: 08/2023
SCALE: AS SHOWN
DRAWING NO. 3

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0 1500 3000

SCALE IN FEET

## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- PROPOSED LANDFILL EXPANSION AREA
- 0.5 MILE RADIUS
- 1 MILE RADIUS
- 2 MILE RADIUS
- 1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- PUBLIC WATER SUPPLY (PWS) SURFACE WATER INTAKES (SEE NOTE 2)

## NOTE:

1. CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2018); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.
2. LOCATION OF PWS SURFACE WATER INTAKES WAS OBTAINED FROM OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY.

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8-18-23

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DRAWING TITLE
PWS SURFACE WATER INTAKES MAP

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
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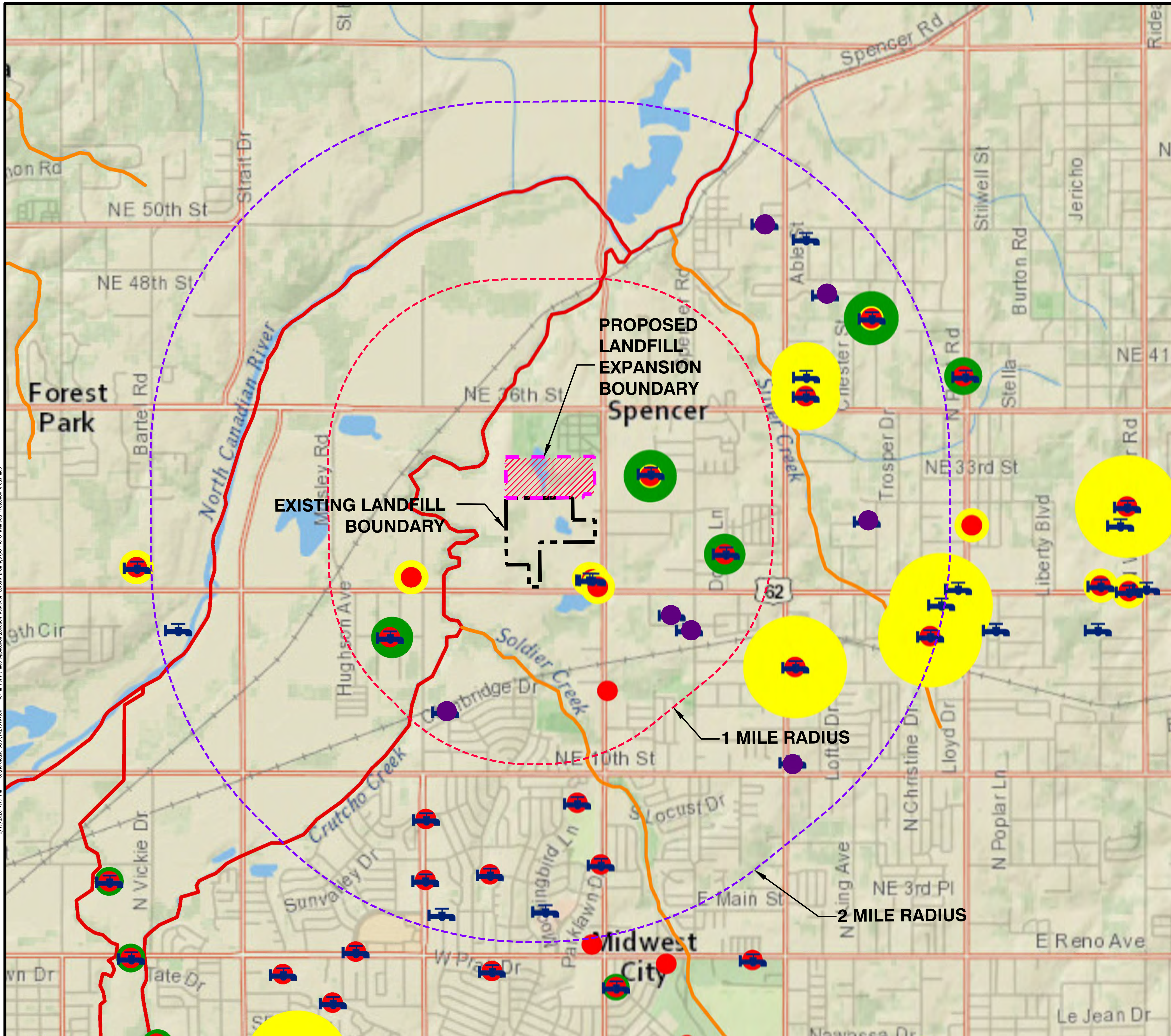
PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

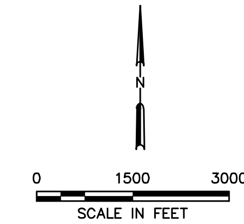
CADD FILE: 04 PWS SURFACE WATER INTAKES MAP

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 4




**LEGEND**

EXISTING LANDFILL BOUNDARY
PROPOSED LANDFILL EXPANSION BOUNDARY
PROPOSED LANDFILL EXPANSION AREA
1 MILE RADIUS
2 MILE RADIUS
PWS WELLS
NO WELLHEAD PROTECTION AREA

**WELLHEAD PROTECTION AREAS (WHPAs)**

ZONE A
ZONE B
ZONE C

**SOURCE:**

WELLHEAD PROTECTION AREAS INFORMATION OBTAINED FROM OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY.

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OKLAHOMA
8-18-23

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| DESCRIPTION | |
| BY | |

DRAWING TITLE
**WELLHEAD PROTECTION AREAS MAP**

PROJECT TITLE
**NORTHEAST LANDFILL**
**TIER III PERMIT MODIFICATION APPLICATION**

CLIENT
**N.E. LAND FILL, LLC**
**NORTHEAST LANDFILL**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**

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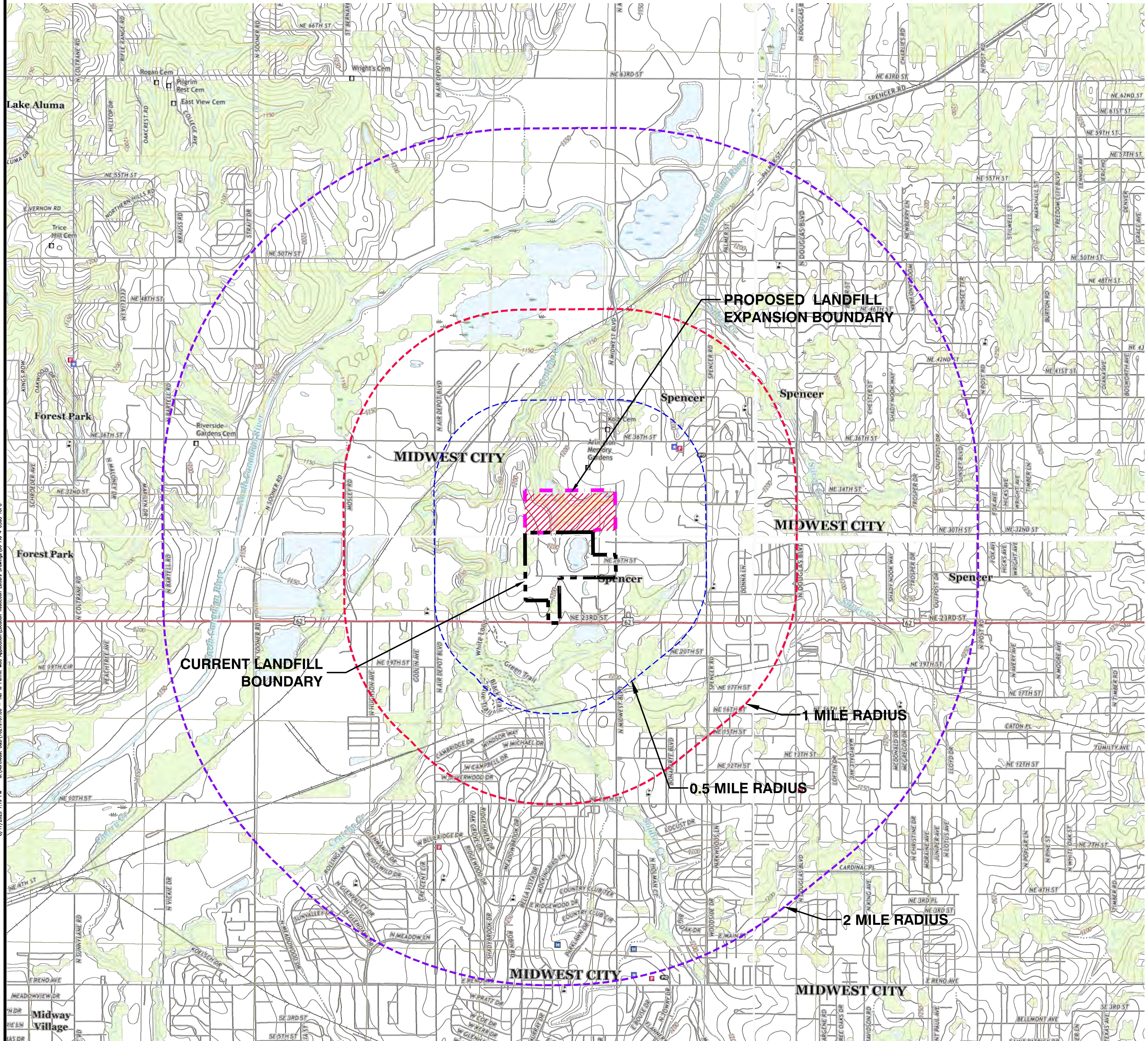
| DSN. BY: SDS | CHK. BY: SDS | APP. BY: RRK |

CADD FILE: 05 FIG 8 WELLHEAD PROTECTION AREAS MAP

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. **5**




N

0 1500 3000
SCALE IN FEET

## LEGEND

EXISTING LANDFILL BOUNDARY

PROPOSED LANDFILL EXPANSION BOUNDARY

PROPOSED LANDFILL EXPANSION AREA

0.5 MILE RADIUS

1 MILE RADIUS

2 MILE RADIUS

1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)

ROAD CLASSIFICATION

Expressway

Secondary Hwy

Ramp

Local Connector

Local Road

4WD

US Route

State Route

## SOURCE:

CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2022); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

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8-18-23

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| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: GENERAL TOPOGRAPHIC MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

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PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

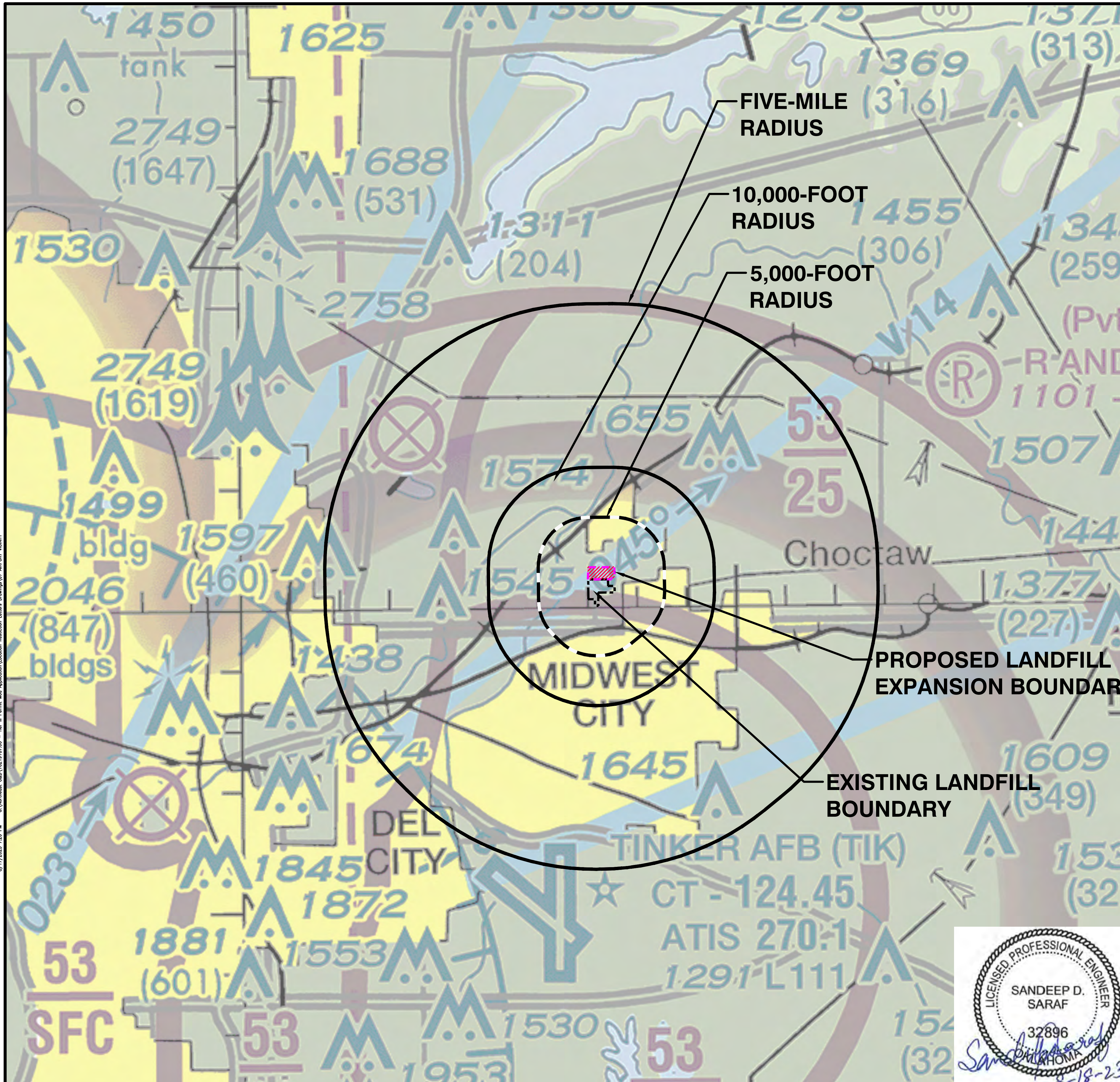
CADD FILE: 06 FIG 4 USGS TOPO

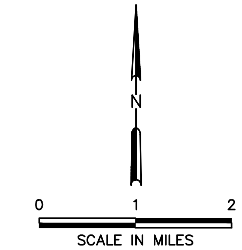
DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 6

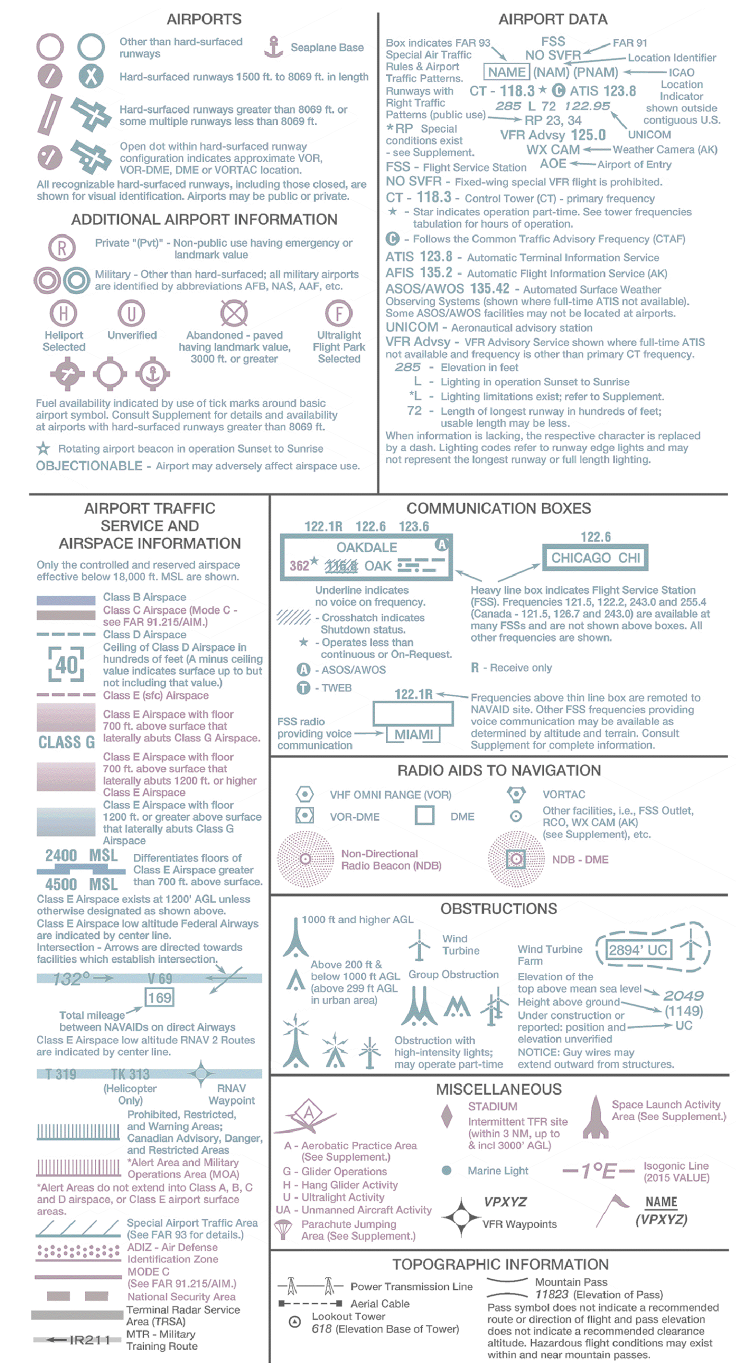
8/17/2023 7:19 PM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application\Location Restriction Letters Drawings\06 FIG 4 USGS TOPO




## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- PROPOSED LANDFILL EXPANSION AREA

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8-18-23

**NOTE:**

1. THIS MAP REPRODUCED FROM THE FAA DALLAS–FORT WORTH SECTIONAL AERONAUTICAL CHART 104TH EDITION, EFFECTIVE FEBRUARY 27, 2020.

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| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: FAA AIRPORT VICINITY MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
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PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SDS | CHK. BY: SDS | DWN. BY: NR | Q/A RVW BY: SDS | APP. BY: RRK

CADD FILE: 07 AIRPORT VICINITY

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 7

8/17/2023 7:20 PM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application\Location Restriction Letters Drawings\07 AIRPORT VICINITY

## Permit Drawings

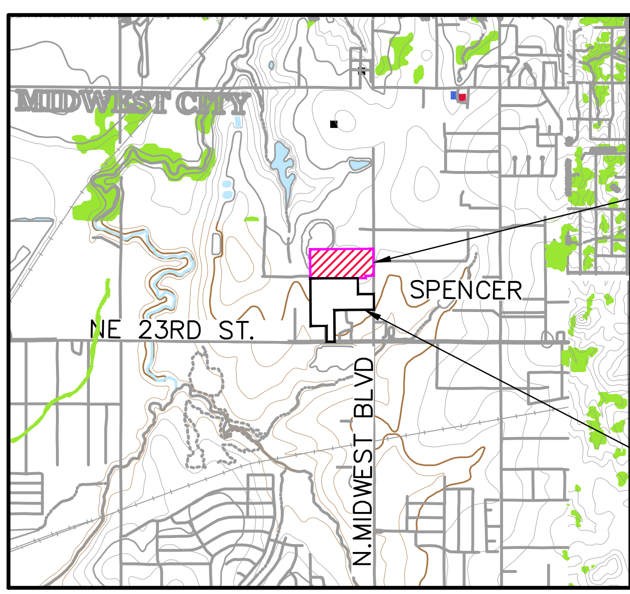
| | |
|---|---|
| Drawing 1 | Cover Sheet |
| Drawing 2 | Existing Topographic Map |
| Drawing 3 | Site Map |
| Drawing 4 | Highest Groundwater Contour Map |
| Drawing 5 | Top of Subgrade Grading Plan |
| Drawing 6 | Top of Protective Cover Grading Plan |
| Drawing 7 | Final Cover Grading Plan |
| Drawing 8 | Cross Section A-A' |
| Drawing 9 | Cross Section B-B' |
| Drawing 10 | Phase 11 Conceptual Phasing Plan |
| Drawing 11 | Phase 11 Conceptual Cross-section |
| Drawing 12 | Phase 12 Conceptual Phasing Plan |
| Drawing 13 | Phase 12 Conceptual Cross-section |
| Drawing 14 | Phase 13 Conceptual Phasing Plan |
| Drawing 15 | Phase 13 Conceptual Cross-section |
| Drawing 16 | Phase 14 Conceptual Phasing Plan |
| Drawing 17 | Phase 14 Conceptual Cross-section |
| Drawing 18 | Phase 15 Conceptual Phasing Plan |
| Drawing 19 | Phase 15 Conceptual Cross-section |
| Drawing 20 | Liner and Final Cover System Details |
| Drawing 21 | Perimeter Road Details |
| Drawing 22 | Stormwater Management Plan |
| Drawing 23 | Stormwater Details – 1 |
| Drawing 24 | Stormwater Details – 2 |

# NORTHEAST LANDFILL
# TIER III PERMIT MODIFICATION
# APPLICATION DRAWINGS
# AUGUST 2023

**PREPARED FOR:**

## N.E. LAND FILL, LLC
## 2601 NORTH MIDWEST BLVD.
## SPENCER, OK 73084

**SCS PROJECT # 16219107.00**




**PROPOSED C&D LANDFILL EXPANSION BOUNDARY**

**EXISTING C&D LANDFILL PERMIT BOUNDARY**

**LOCATION MAP**

0 4000 8000

SCALE IN FEET

**PREPARED BY:**


**SCS ENGINEERS**

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CONSULTING ENGINEERS
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| DRAWING NO. | DRAWING TITLE |
|---|---|
| 1 | COVER SHEET |
| 2 | EXISTING TOPOGRAPHIC MAP |
| 3 | SITE MAP |
| 4 | HIGHEST GROUNDWATER CONTOUR MAP |
| 5 | TOP OF SUBGRADE GRADING PLAN |
| 6 | TOP OF PROTECTIVE COVER PLAN |
| 7 | FINAL COVER GRADING PLAN |
| 8 | CROSS SECTION A-A' |
| 9 | CROSS SECTION B-B' |
| 10 | PHASE 11 CONCEPTUAL PHASING PLAN |
| 11 | PHASE 11 CONCEPTUAL CROSS-SECTION |
| 12 | PHASE 12 CONCEPTUAL PHASING PLAN |
| 13 | PHASE 12 CONCEPTUAL CROSS-SECTION |
| 14 | PHASE 13 CONCEPTUAL PHASING PLAN |
| 15 | PHASE 13 CONCEPTUAL CROSS-SECTION |
| 16 | PHASE 14 CONCEPTUAL PHASING PLAN |
| 17 | PHASE 14 CONCEPTUAL CROSS-SECTION |
| 18 | PHASE 15 CONCEPTUAL PHASING PLAN |
| 19 | PHASE 15 CONCEPTUAL CROSS-SECTION |
| 20 | LINER & FINAL COVER SYSTEM DETAILS |
| 21 | PERIMETER ROAD DETAILS |
| 22 | STORM WATER MANAGEMENT PLAN |
| 23 | STORM WATER DETAILS - 1 |
| 24 | STORM WATER DETAILS - 2 |



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OKLAHOMA
8-18-23

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| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: COVER SHEET

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

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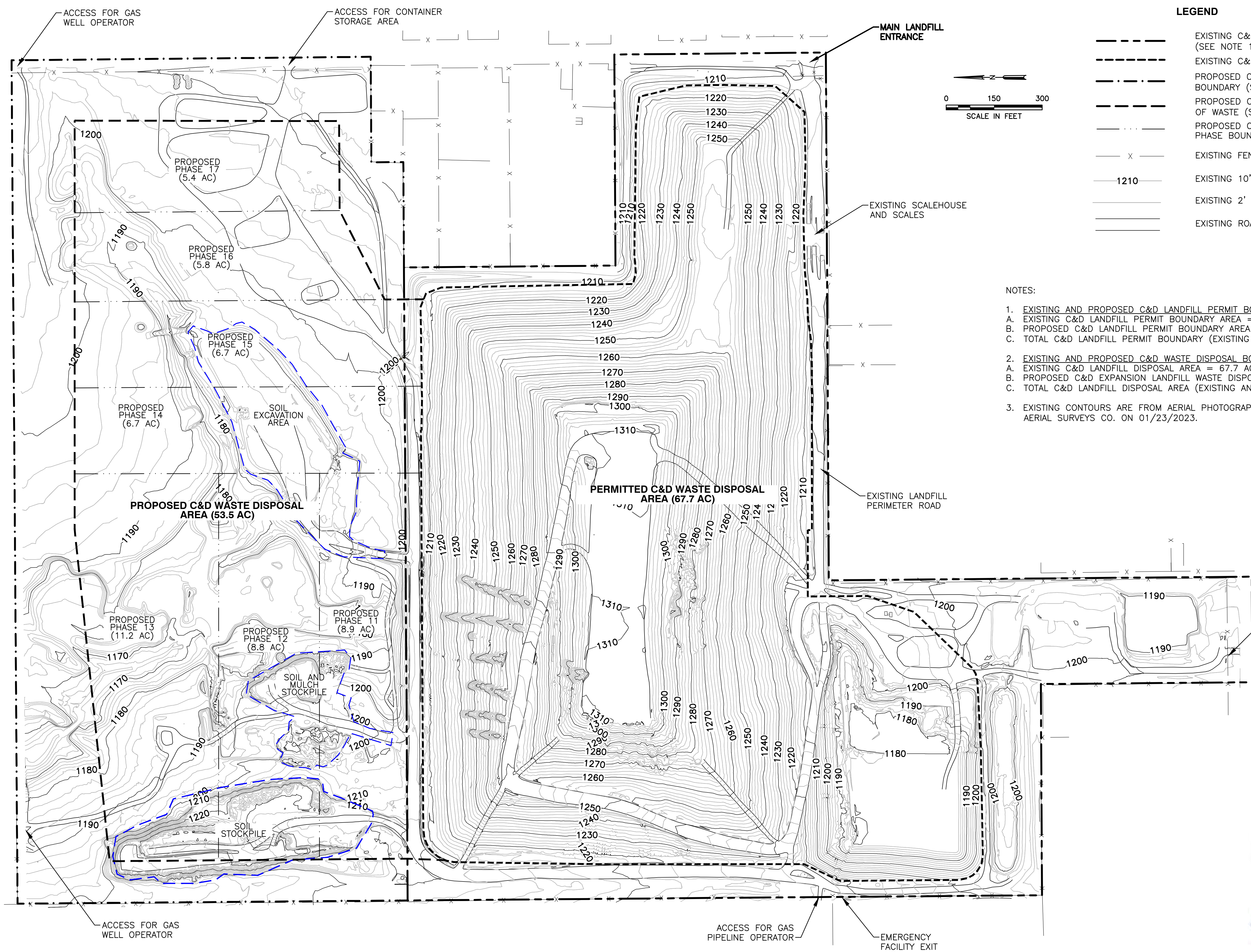
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 01 - COVER SHEET

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 1




## LEGEND

| | |
|---|---|
| | EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1) |
| | EXISTING C&D LANDFILL LIMITS OF WASTE |
| | PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1) |
| | PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2) |
| | PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY |
| x | EXISTING FENCE |
| 1210 | EXISTING 10' CONTOUR (SEE NOTE 3) |
| | EXISTING 2' CONTOUR (SEE NOTE 3) |
| | EXISTING ROADS |

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

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SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

REV | DATE | DESCRIPTION | BY

DRAWING TITLE
# EXISTING TOPOGRAPHIC MAP

PROJECT TITLE
**NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION**

CLIENT
**N.E. LAND FILL, LLC**
**NORTHEAST LANDFILL**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**


**SCS ENGINEERS**
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PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 02 – EXISTING CONDITIONS

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 2

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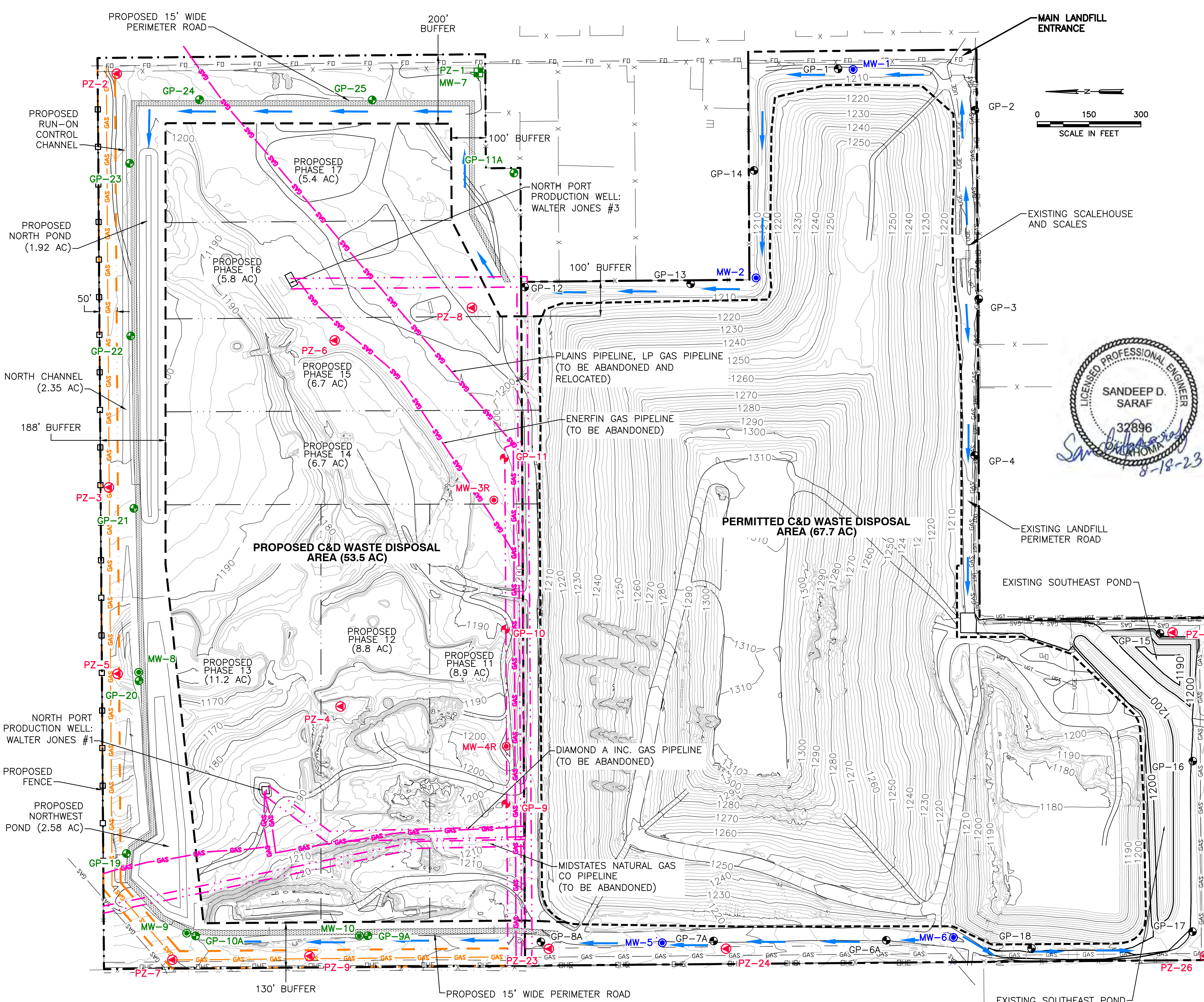



**LEGEND**

EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
EXISTING C&D LANDFILL LIMITS OF WASTE (SEE NOTE 2)
PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
PROPOSED EASEMENT
GAS — GAS — PROPOSED GAS LINE
PROPOSED PERIMETER ROAD
PROPOSED FENCE
MW-10 PROPOSED MONITORING WELL
GP-24 PROPOSED GAS PROBE
X EXISTING FENCE
1210 EXISTING 10' CONTOUR (SEE NOTE 3)
EXISTING 2' CONTOUR (SEE NOTE 3)
EXISTING ROADS
EXISTING EASEMENT (APPROX., SEE NOTE 4)
GAS EXISTING GAS LINE (APPROX., SEE NOTE 4)
GAS EXISTING GAS LINE (TO BE REMOVED)
OHE EXISTING OVERHEAD ELECTRIC LINE (APPROX., SEE NOTE 4)
FO EXISTING FIBER OPTIC LINE (APPROX., SEE NOTE 4)
SOIL STOCKPILE/EXCAVATION BOUNDARY
GP-14 EXISTING GAS PROBE (TO REMAIN)
MW-1 EXISTING MONITORING WELL (TO REMAIN)
PZ-1 MW-7 EXISTING PIEZOMETER (TO BE CONVERTED TO MONITORING WELL)
PZ-24 EXISTING PIEZOMETER (TO BE ABANDONED/DECOMMISSIONED)
MW-4R EXISTING MONITORING WELL (TO BE ABANDONED/DECOMMISSIONED)
GP-10 EXISTING GAS PROBE (TO BE ABANDONED, SEE NOTE 5)
EXISTING DRAINAGE CHANNEL AND FLOW DIRECTION
PROPOSED DRAINAGE CHANNEL AND FLOW DIRECTION (SEE NOTE 6)

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.
4. EXISTING EASEMENT AND UTILITY LINES INFORMATION ARE FROM THE PLAT OF SURVEY, DEVELOPED BY MASON SURVEYING & CONSULTING INC., DATED 02/17/2022.
5. EXISTING GAS PROBES WILL BE ABANDONED IN ACCORDANCE WITH SCHEDULE PROVIDED IN APPENDIX D.
6. REFER TO DRAWING 23 FOR PROPOSED DRAINAGE CHANNEL TABLE.

**FOR PERMITTING PURPOSES ONLY**

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: **SITE MAP**

PROJECT TITLE: **NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION**

CLIENT: **N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084**


**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188


PROJ. NO. 16219107.00 | DSN. BY: SS | CHK. BY: SDS | DWN. BY: DS | Q/A RVW BY: SS | APP. BY: RRK

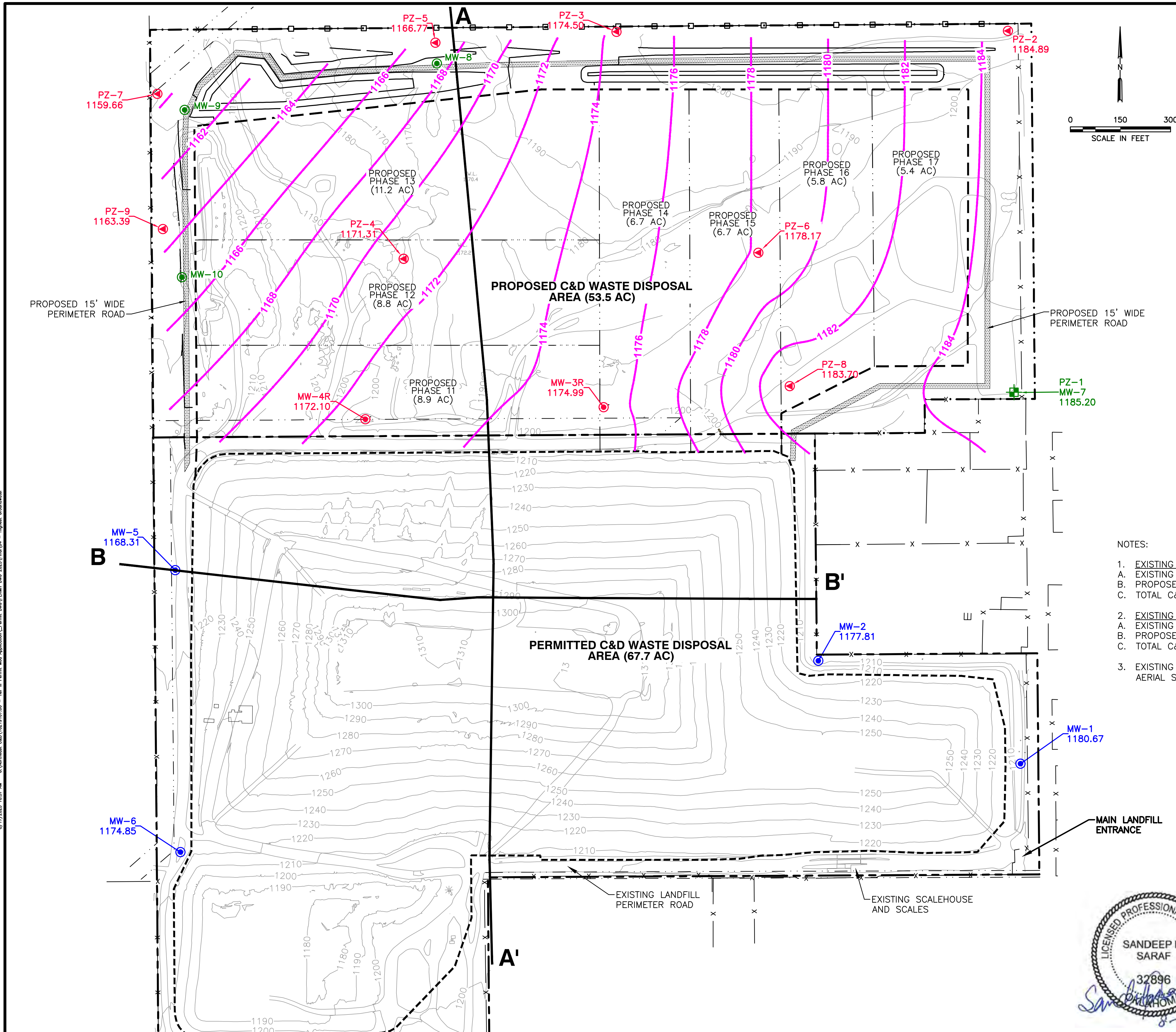
CADD FILE: 03 - SITE MAP

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 3

8/17/2023 10:55 AM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\03 - Site Map




## LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
- PROPOSED PERIMETER ROAD
- PROPOSED FENCE
- MW-10 PROPOSED MONITORING WELL
- EXISTING FENCE
- 1210 EXISTING 10' CONTOUR (SEE NOTE 3)
- 1182 HIGHEST GROUNDWATER ELEVATION CONTOURS
- EXISTING ROADS
- EXISTING EASEMENT (APPROX., SEE NOTE 4)
- GAS EXISTING GAS LINE (APPROX., SEE NOTE 4)
- MW-1 EXISTING MONITORING WELL (TO REMAIN)
- PZ-1 MW-7 EXISTING PIEZOMETER TO BE CONVERTED INTO MONITORING WELL
- PZ-24 EXISTING PIEZOMETER (TO BE ABANDONED/DECOMMISSIONED)
- MW-4R EXISTING MONITORING WELL (TO BE ABANDONED/DECOMMISSIONED)
- A — A' LANDFILL CROSS-SECTION LOCATION

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

**HIGHEST GROUNDWATER RECORDED**

| PIEZOMETER NAME | ELEVATION | DATE RECORDED |
|---|---|---|
| MW-1 | 1180.67 | APRIL 2020 |
| MW-2 | 1177.81 | MAY 2020 |
| MW-3R | 1174.99 | MAY 2020 |
| MW-4R | 1172.10 | APRIL 2020 |
| MW-5 | 1168.31 | MAY 2020 |
| MW-6 | 1174.85 | SEPTEMBER 2020 |
| PZ-1 | 1185.20 | MARCH 2020 |
| PZ-2 | 1184.89 | DECEMBER 2020 |
| PZ-3 | 1174.50 | MAY 2020 |
| PZ-4 | 1171.31 | MARCH 2020 |
| PZ-5 | 1166.77 | MARCH 2020 |
| PZ-6 | 1178.17 | MAY 2020 |
| PZ-7 | 1159.66 | MAY 2020 |
| PZ-8 | 1183.70 | MARCH 2020 |
| PZ-9 | 1163.39 | JUNE 2020 |

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA

8-18-23

FOR PERMITTING PURPOSES ONLY

REV DATE DESCRIPTION BY

DRAWING TITLE: HIGHEST GROUNDWATER CONTOUR MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

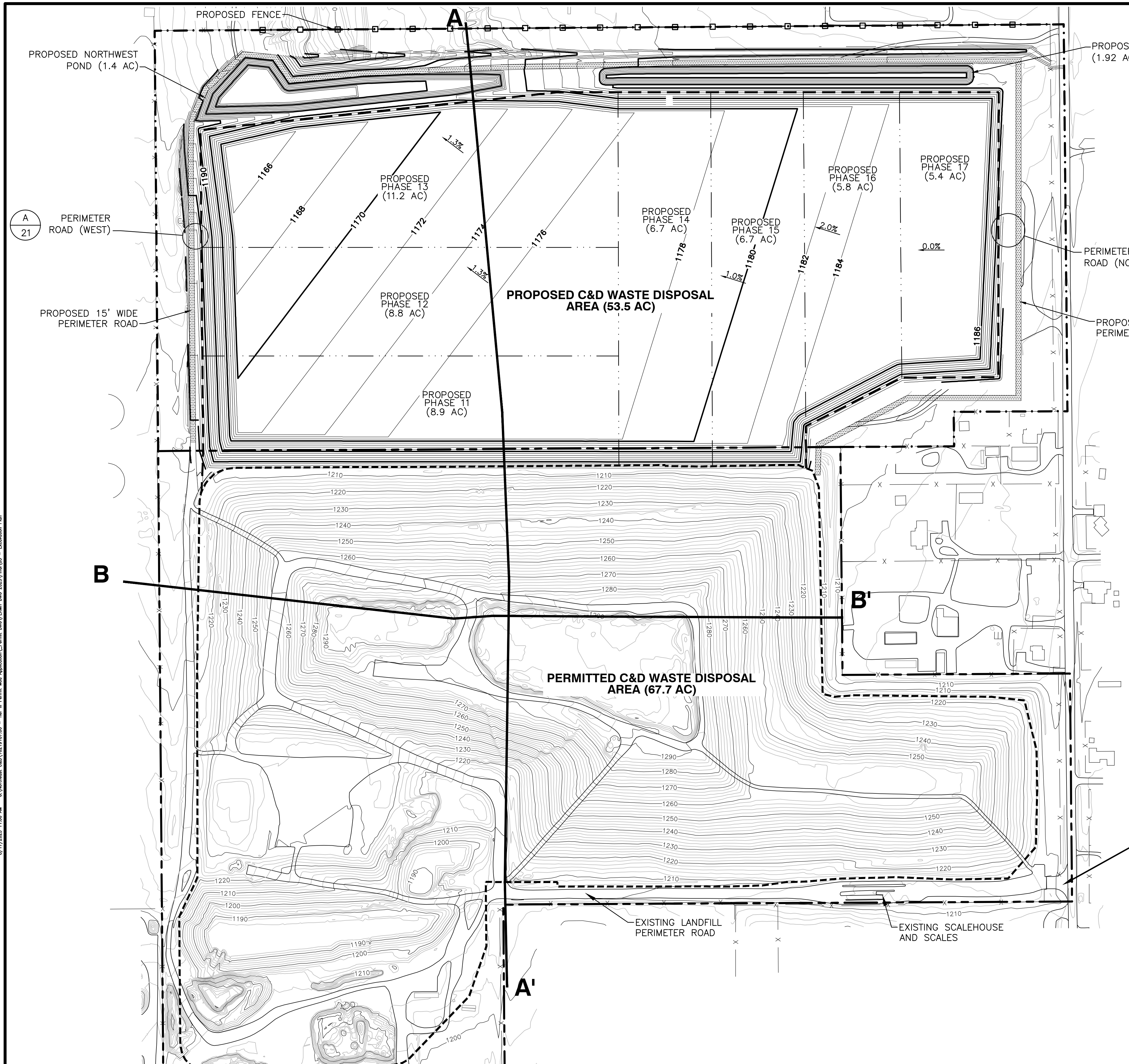
CADD FILE: 04 - HIGHEST GROUNDWATER

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 4

8/17/2023 10:57 AM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\04 - Highest Groundwater




## LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
- 1190 — PROPOSED 10' TOP OF SUBGRADE CONTOUR
- 1186 — PROPOSED 2' TOP OF SUBGRADE CONTOUR
- PROPOSED PERIMETER ROAD
- PROPOSED FENCE
- x — EXISTING FENCE
- 1210 — EXISTING 10' CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- EXISTING ROADS
- A — A' LANDFILL CROSS-SECTION LOCATION

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

FOR PERMITTING PURPOSES ONLY

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA

Sandeep Saraf 8-18-23

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| △ | | | |
| △ | | | |
| △ | | | |
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| △ | | | |
| △ | | | |

DRAWING TITLE: TOP OF SUBGRADE GRADING PLAN

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

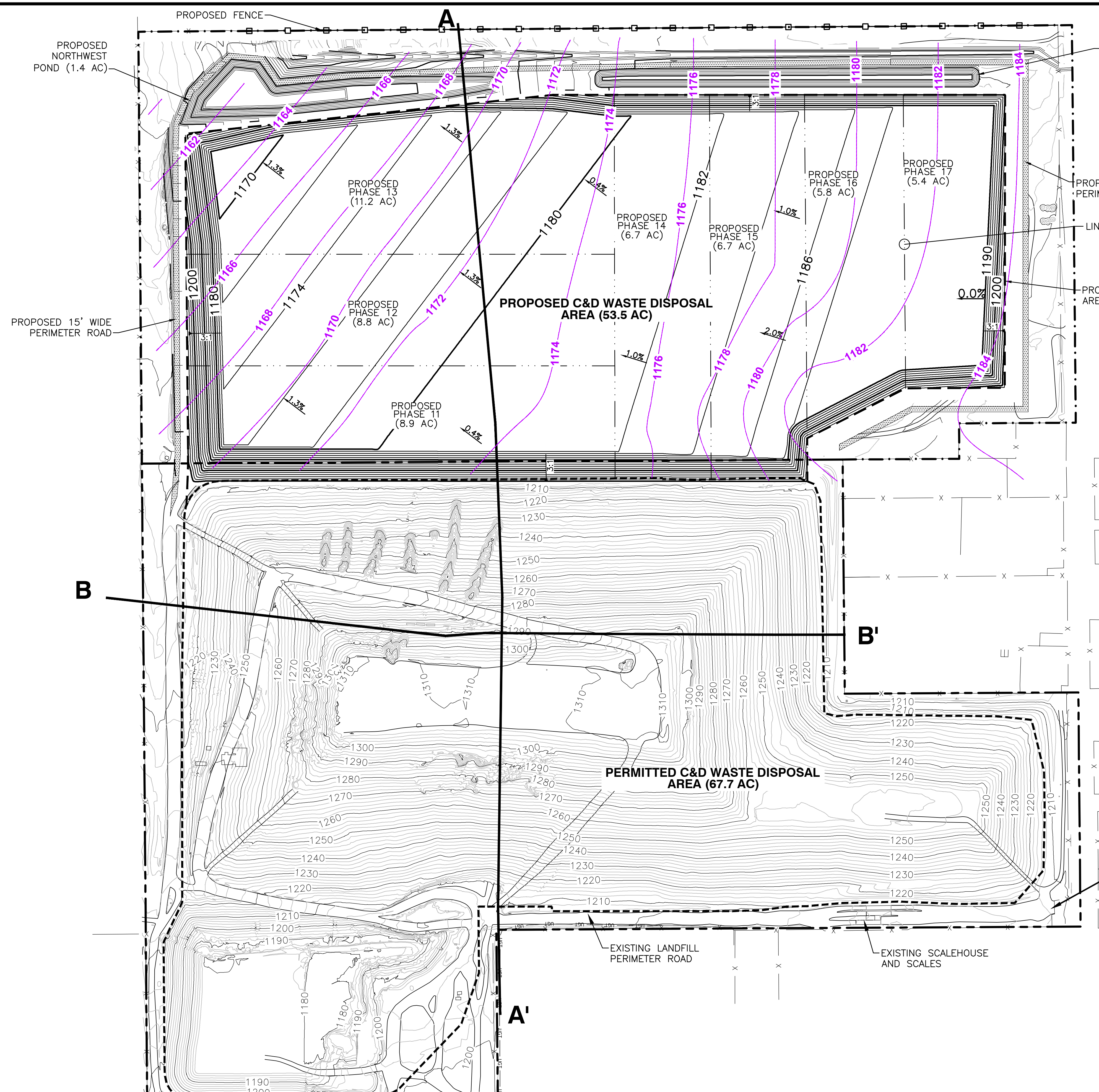
CADD FILE: 05 – EXCAVATION PLAN

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 5

8/17/2023 11:00 AM G:\Northeast C&D\16219107.00 – Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\05 – Excavation Plan




0 150 300
SCALE IN FEET

## LEGEND

| | |
|---|---|
| | EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1) |
| | EXISTING C&D LANDFILL LIMITS OF WASTE |
| | PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1) |
| | PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2) |
| | PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY |
| 1210 | PROPOSED 10' TOP OF PROTECTIVE COVER GRADES |
| 1186 | PROPOSED 2' TOP OF PROTECTIVE COVER GRADES |
| | PROPOSED PERIMETER ROAD |
| | PROPOSED FENCE |
| x | EXISTING FENCE |
| 1210 | EXISTING 10' CONTOUR (SEE NOTE 3) |
| | EXISTING 2' CONTOUR (SEE NOTE 3) |
| | EXISTING ROADS |
| A A' | LANDFILL CROSS-SECTION LOCATION |

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.

2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.

3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA 8-18-23

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: TOP OF PROTECTIVE COVER PLAN

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

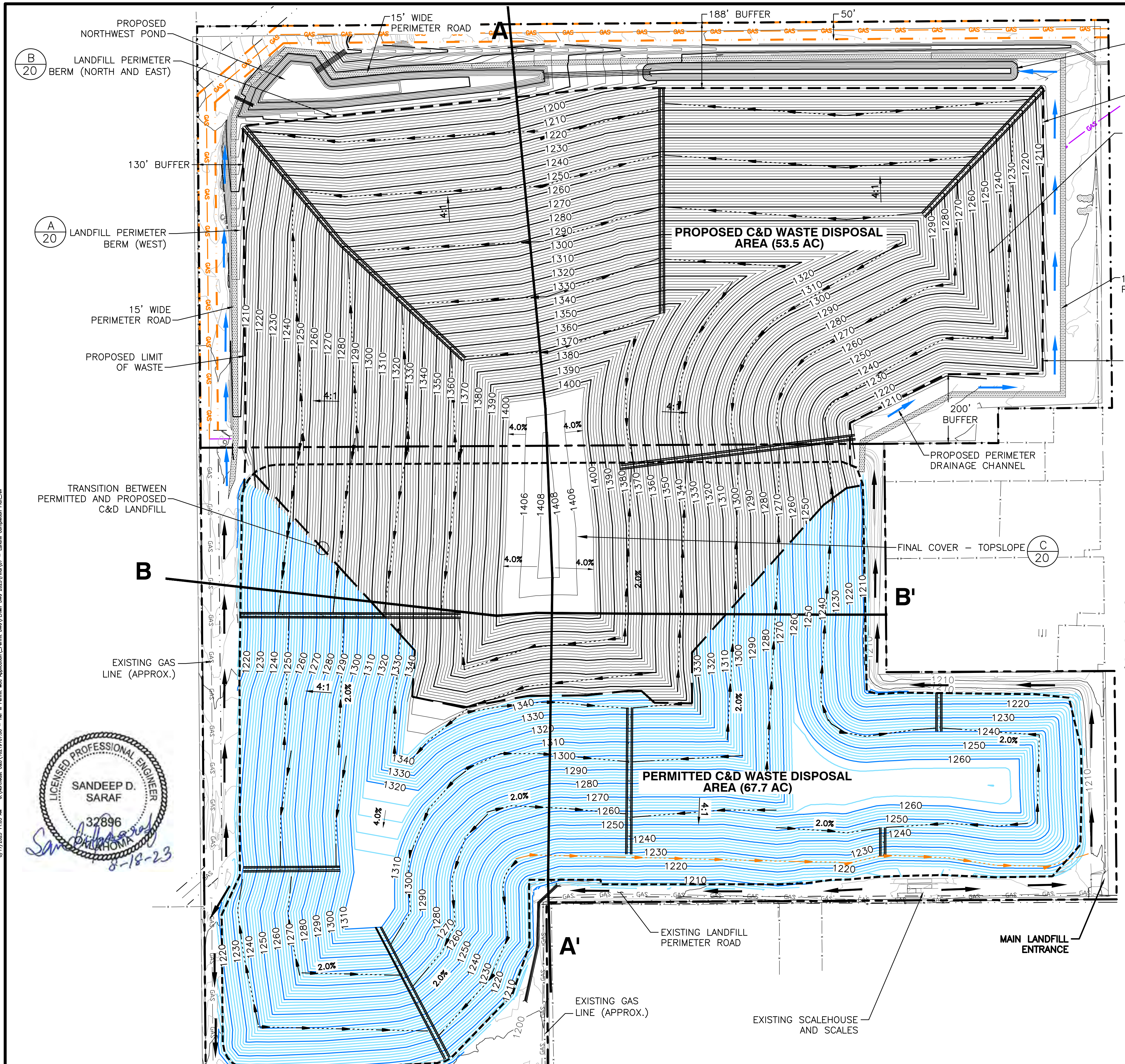
CADD FILE: 06 - TOP OF PROTECTIVE COVER PLAN(5-5-23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 6

8/17/2023 11:03 AM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\06 - Top of Protective Cover Plan(5-5-23)




N

0 150 300
SCALE IN FEET

**LEGEND**

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED EASEMENT
- GAS — PROPOSED GAS LINE
- PROPOSED PERIMETER ROAD
- PROPOSED DOWNCHUTES
- PROPOSED DRAINAGE SWALE (TYPE A)
- PROPOSED DRAINAGE SWALE (TYPE B)
- PROPOSED FENCE
- X — EXISTING FENCE
- 1340 — 10' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA
- 2' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA
- 1210 — PROPOSED 10' FINAL GRADES (C&D DISPOSAL AREA)
- PROPOSED 2' FINAL GRADES (C&D DISPOSAL AREA)
- EXISTING ROADS
- 1210 — EXISTING 10' CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- EXISTING EASEMENT (APPROX., SEE NOTE 4)
- GAS — EXISTING GAS LINE (APPROX., SEE NOTE 4)
- EXISTING DRAINAGE CHANNEL AND FLOW DIRECTION
- PROPOSED DRAINAGE CHANNEL AND FLOW DIRECTION (SEE NOTE 5)
- PROPOSED CULVERTS
- A—A' LANDFILL CROSS-SECTION LOCATION

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.
4. EXISTING EASEMENT AND UTILITY LINES INFORMATION ARE FROM THE PLAT OF SURVEY, DEVELOPED BY MASON SURVEYING & CONSULTING INC., DATED 02/17/2022.
5. REFER TO DRAWING 23 FOR PROPOSED STORMWATER CHANNEL TABLE.

**FOR PERMITTING PURPOSES ONLY**

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE
**FINAL COVER GRADING PLAN**

PROJECT TITLE
**NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION**

CLIENT
**N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084**

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

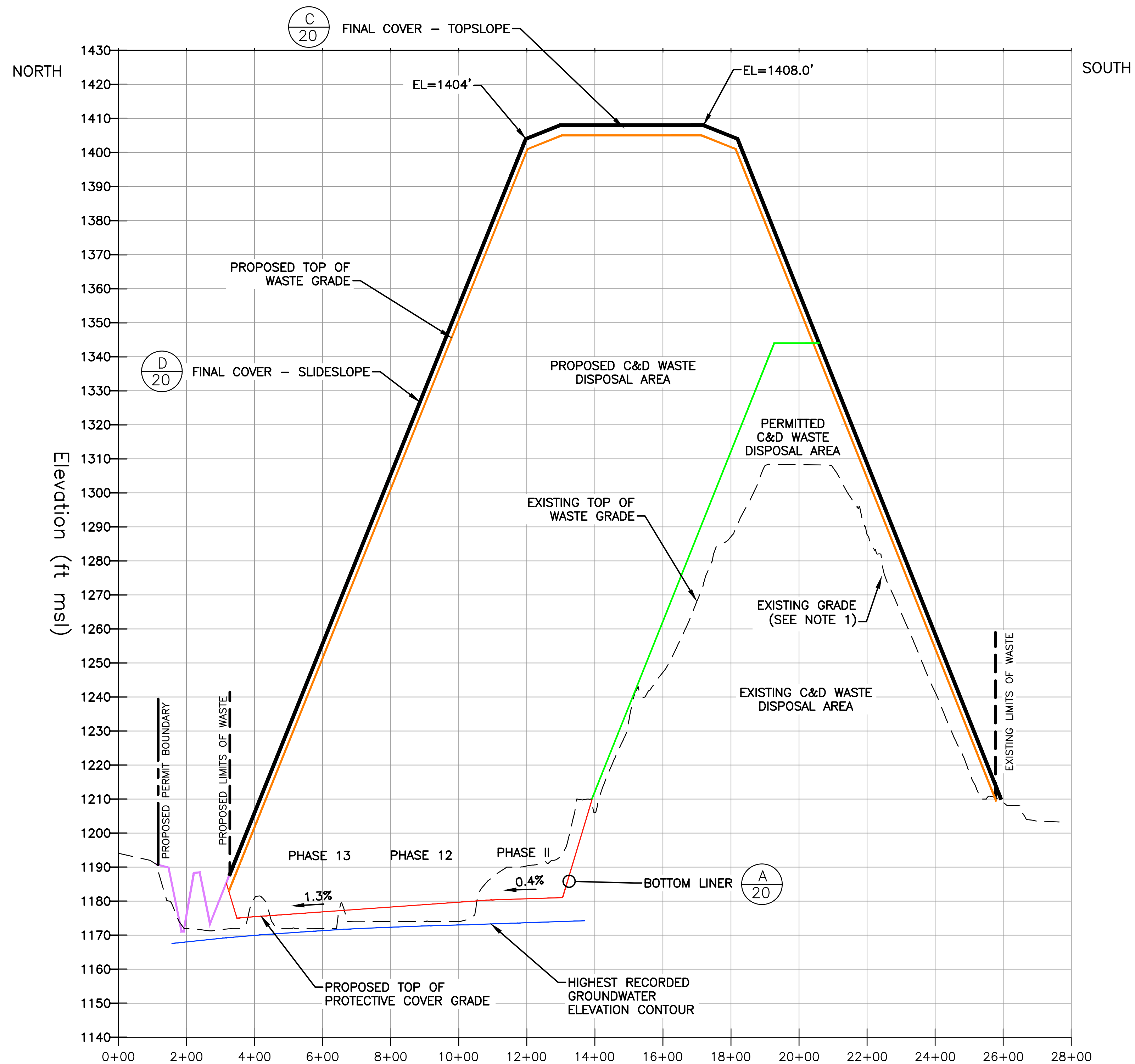
CADD FILE: 07 – LANDFILL COMPLETION PLAN_REV

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 7

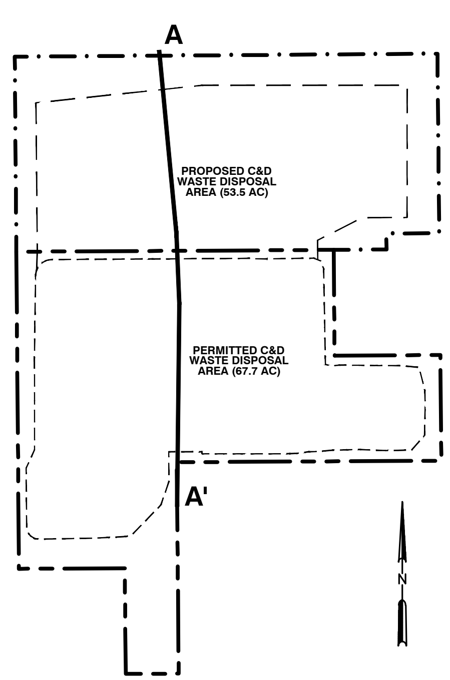
8/17/2023 11:05 AM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\07 - Landfill Completion Plan_rev




# CROSS SECTION A-A'

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET




KEY MAP
1"=4,000'

## LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- HIGHEST RECORDED GROUNDWATER ELEVATION CONTOUR
- PERMITTED TOP OF WASTE GRADE
- PROPOSED TOP OF PROTECTIVE COVER GRADE
- PROPOSED FINAL GRADE
- PROPOSED TOP OF WASTE GRADE
- PROPOSED DITCH/POND GRADE

NOTE:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION A-A'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

Q/A RVW BY: SS | APP. BY: RRK
DWN. BY: DS | CHK. BY: SDS
PROJ. NO. 16219107.00 | DSN. BY: SS

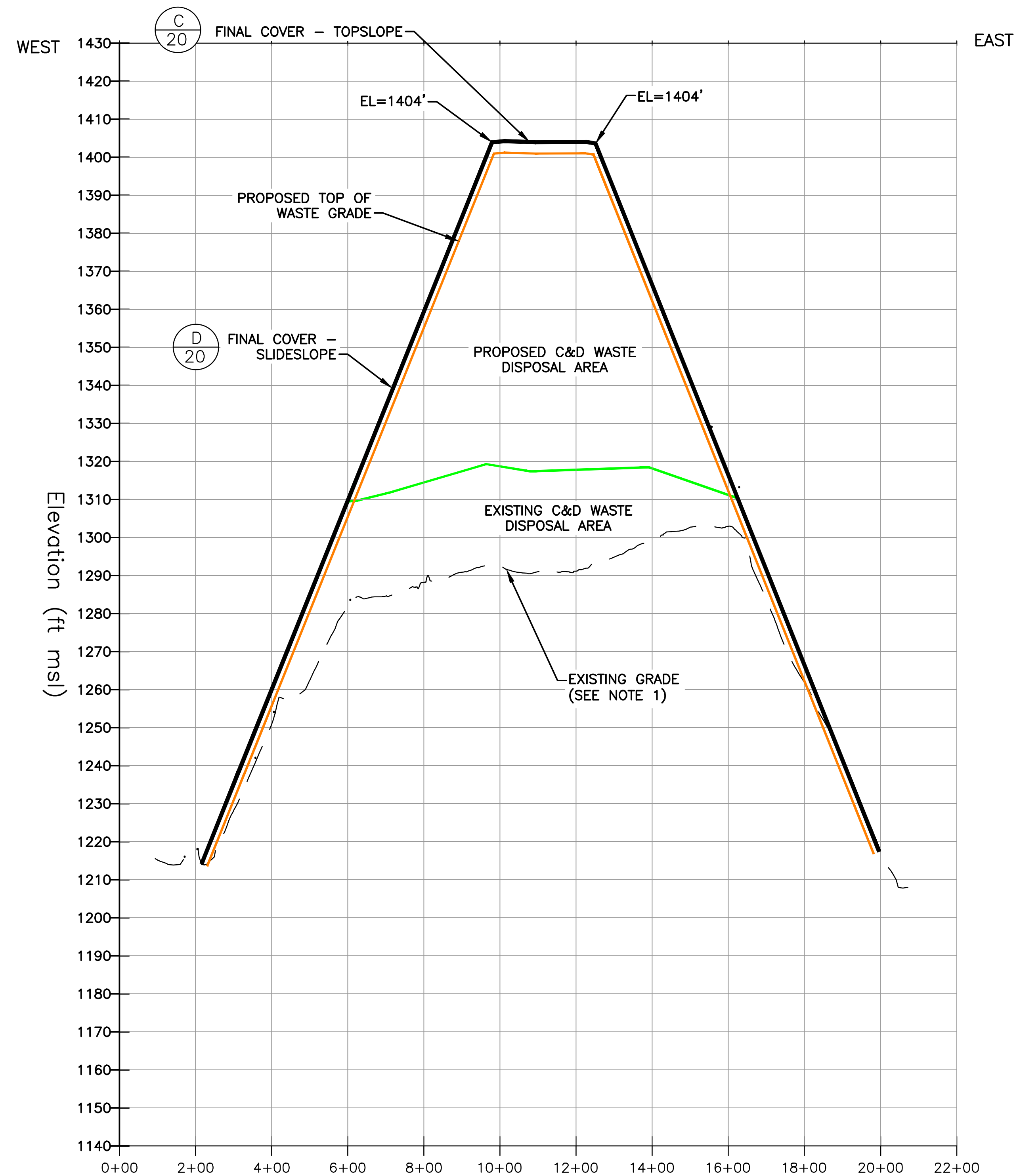
CADD FILE: 08-09 - CROSS SECTIONS(5-5-23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 8

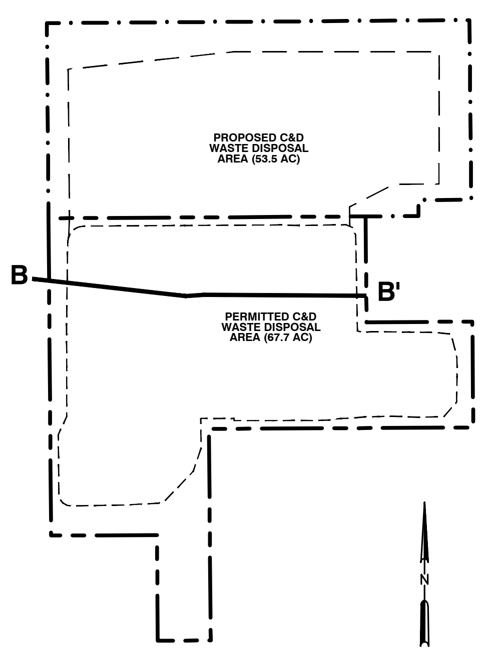
8/17/2023 11:13 AM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\08-09 - Cross Sections(5-5-23)




## CROSS SECTION B-B'

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET




KEY MAP
1"=4,000'

## LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- PERMITTED TOP OF WASTE GRADE
- PROPOSED FINAL GRADE
- PROPOSED TOP OF WASTE GRADE

NOTE:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.


FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE
CROSS-SECTON B-B'

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DWN. BY: DS | Q/A RVW BY: SS
DSN. BY: SS | CHK. BY: SDS | APP. BY: RRK

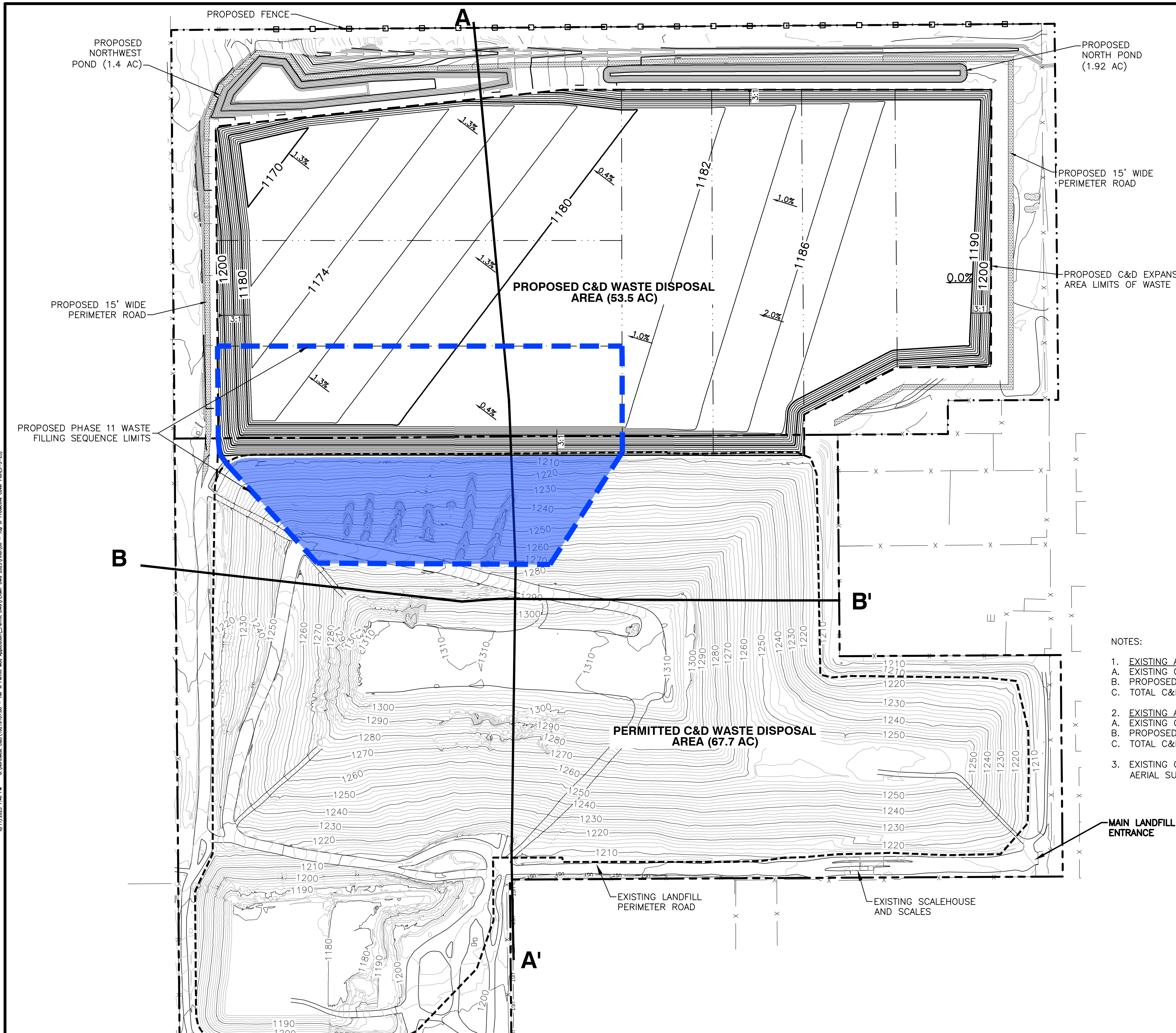
CADD FILE: 08–09 – CROSS SECTIONS(5–5–23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 9

8/17/2023 11:14 AM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\08-09 - Cross Sections(5-5-23)




0 150 300
SCALE IN FEET

## LEGEND

| | |
|---|---|
| | EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1) |
| | EXISTING C&D LANDFILL LIMITS OF WASTE |
| | PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1) |
| | PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2) |
| | PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY |
| 1210 | PROPOSED 10' TOP OF PROTECTIVE COVER GRADES |
| 1186 | PROPOSED 2' TOP OF PROTECTIVE COVER GRADES |
| | PROPOSED PERIMETER ROAD |
| | PROPOSED FENCE |
| x | EXISTING FENCE |
| 1210 | EXISTING 10' CONTOUR (SEE NOTE 3) |
| | EXISTING 2' CONTOUR (SEE NOTE 3) |
| | EXISTING ROADS |
| A A' | LANDFILL CROSS-SECTION LOCATION |
| | PROPOSED PHASE 11 WASTE DISPOSAL AREA |

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA
Sandeep Saraf 8-18-23

**FOR PERMITTING PURPOSES ONLY**

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: PHASE 11 CONCEPTUAL PHASING PLAN

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

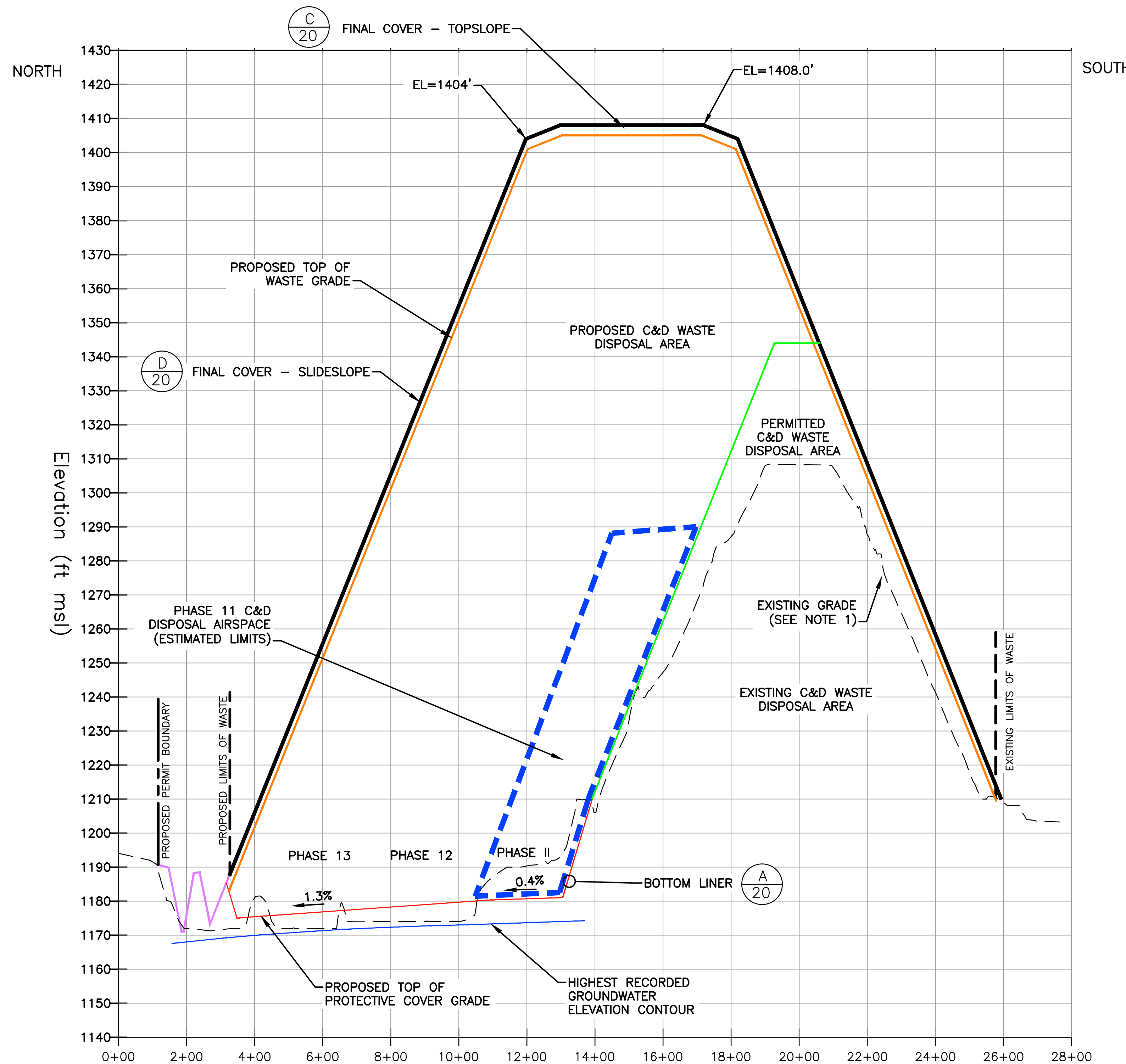
CADD FILE: 06 – TOP OF PROTECTIVE COVER PLAN(5-5-23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. **10**

8/17/2023 7:46 PM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\06 - Top of Protective Cover Plan(5-5-23)




## CROSS SECTION A-A'

0 20 40
VERTICAL SCALE IN FEET

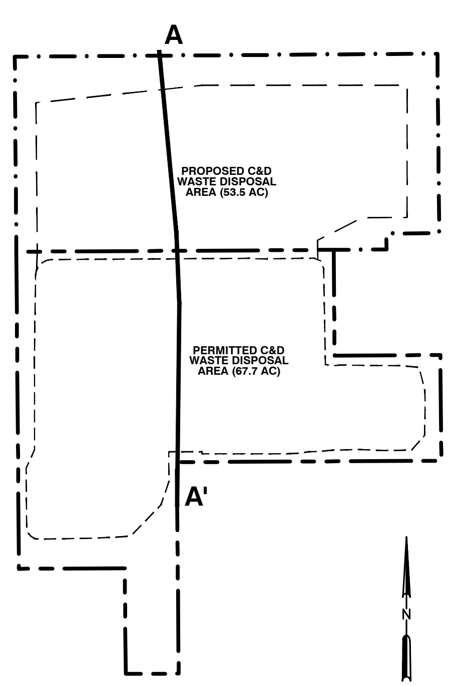
0 200 400
HORIZONTAL SCALE IN FEET

## LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- HIGHEST RECORDED GROUNDWATER ELEVATION CONTOUR
- PERMITTED TOP OF WASTE GRADE
- PROPOSED TOP OF PROTECTIVE COVER GRADE
- PROPOSED FINAL GRADE
- PROPOSED TOP OF WASTE GRADE
- PROPOSED DITCH/POND GRADE
- PROPOSED PHASE 11 WASTE LIMITS

NOTE:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.




KEY MAP
1"=4,000'

SANDEEP D. SARAF
LICENSED PROFESSIONAL ENGINEER
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: PHASE 11 CONCEPTUAL CROSS-SECTION

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

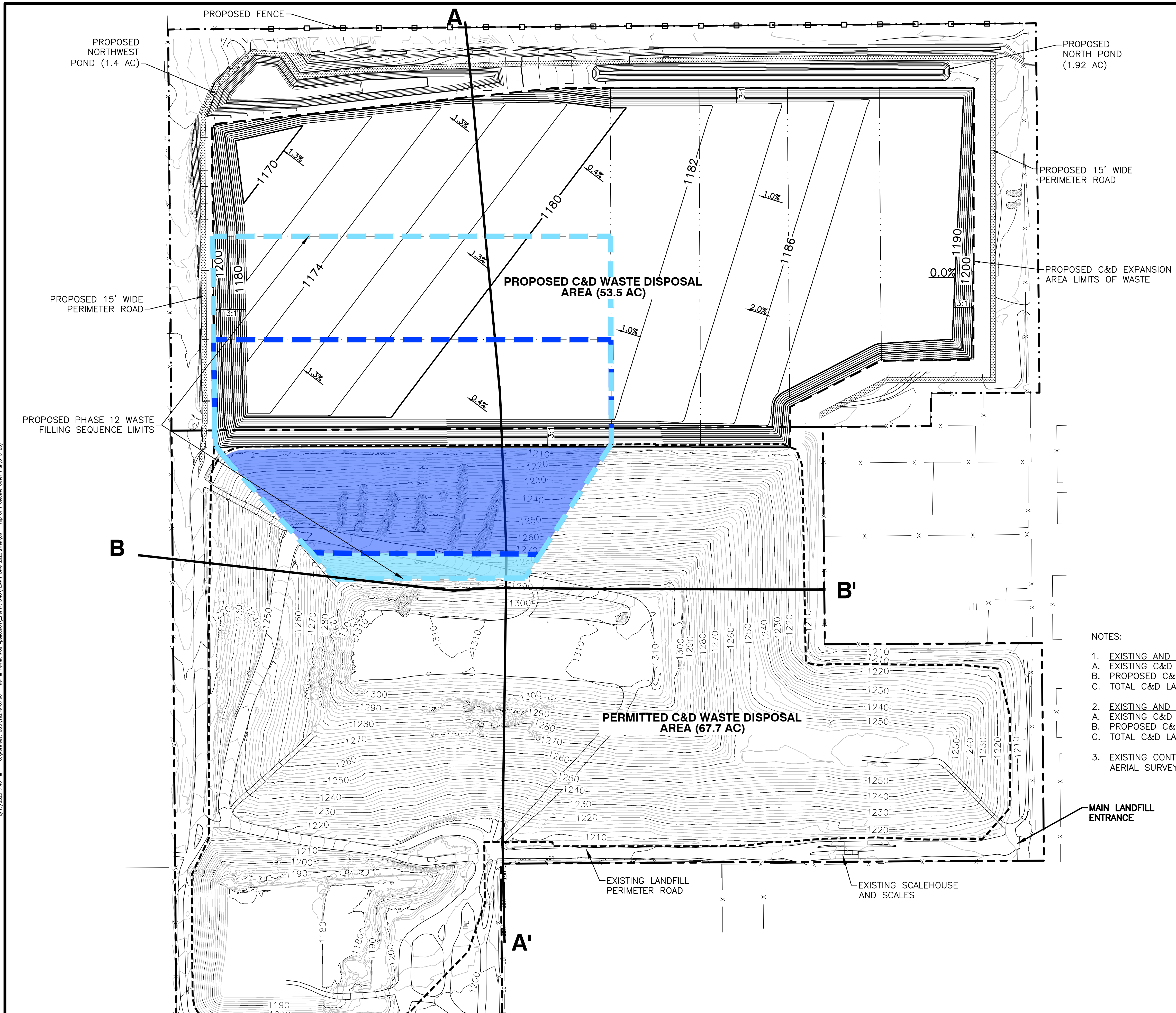
CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 08-09 - CROSS SECTIONS(5-5-23)
DATE: 08/2023
SCALE: AS SHOWN
DRAWING NO. 11

8/17/2023 11:13 AM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\08-09 - Cross Sections(5-5-23)




## LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
- 1210 — PROPOSED 10' TOP OF PROTECTIVE COVER GRADES
- 1186 — PROPOSED 2' TOP OF PROTECTIVE COVER GRADES
- PROPOSED PERIMETER ROAD
- PROPOSED FENCE
- EXISTING FENCE
- 1210 — EXISTING 10' CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- EXISTING ROADS
- A — A' LANDFILL CROSS-SECTION LOCATION
- PROPOSED PHASE 11 WASTE DISPOSAL AREA
- PROPOSED PHASE 12 WASTE DISPOSAL AREA

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: PHASE 12 CONCEPTUAL PHASING PLAN

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084


SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188


PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 06 – TOP OF PROTECTIVE COVER PLAN(5–5–23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 12

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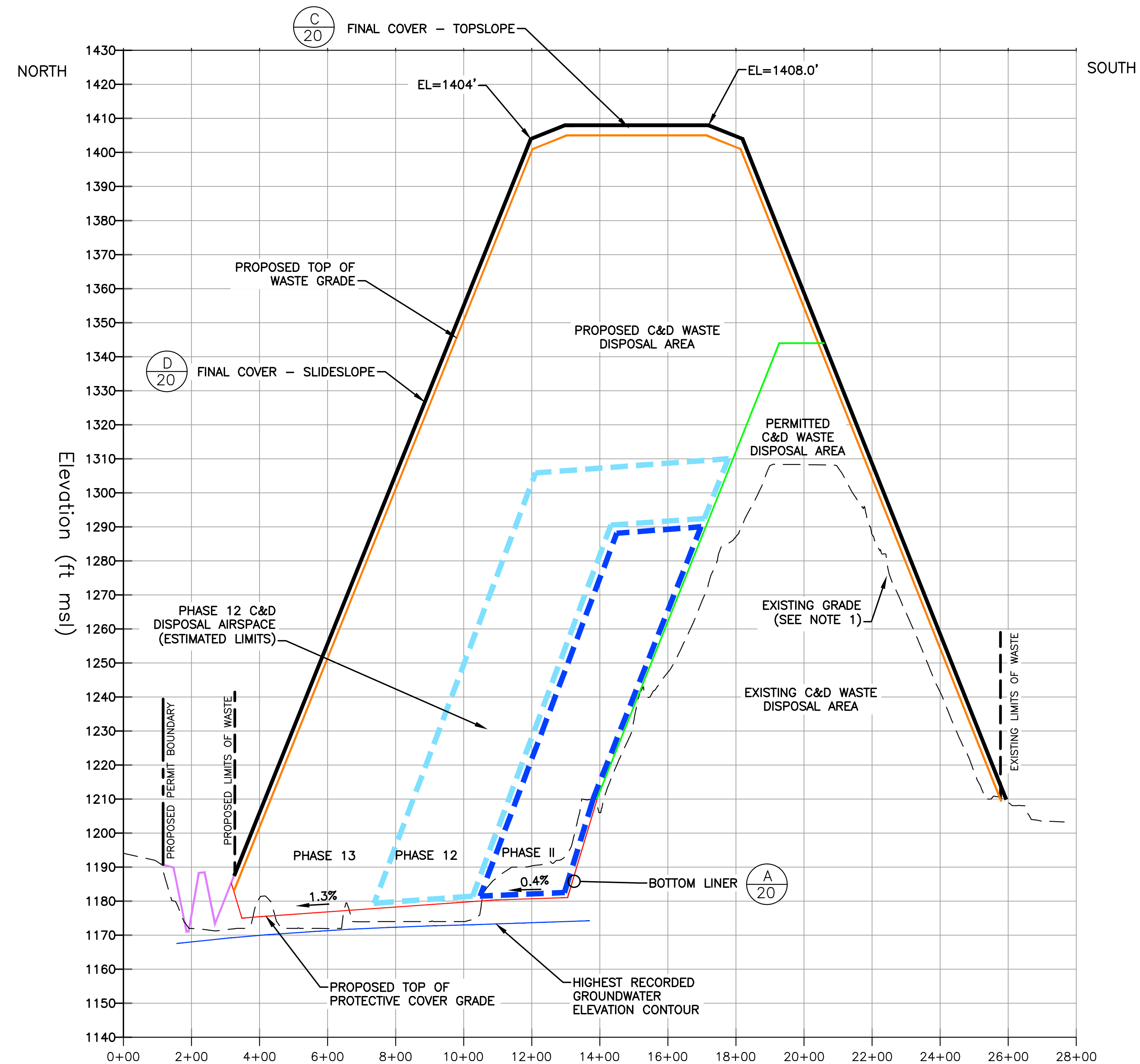



## CROSS SECTION A-A'

0 20 40
VERTICAL SCALE IN FEET

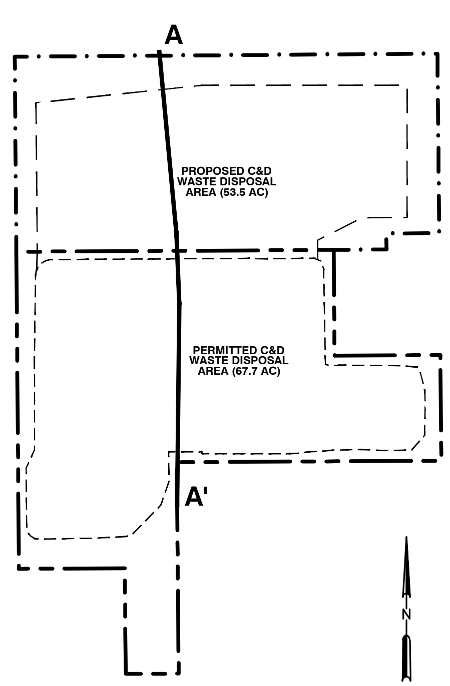
0 200 400
HORIZONTAL SCALE IN FEET

## LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- HIGHEST RECORDED GROUNDWATER ELEVATION CONTOUR
- PERMITTED TOP OF WASTE GRADE
- PROPOSED TOP OF PROTECTIVE COVER GRADE
- PROPOSED FINAL GRADE
- PROPOSED TOP OF WASTE GRADE
- PROPOSED DITCH/POND GRADE
- PROPOSED PHASE 11 WASTE LIMITS
- PROPOSED PHASE 12 WASTE LIMITS

NOTE:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.




KEY MAP
1"=4,000'

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: PHASE 12 CONCEPTUAL CROSS-SECTION

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

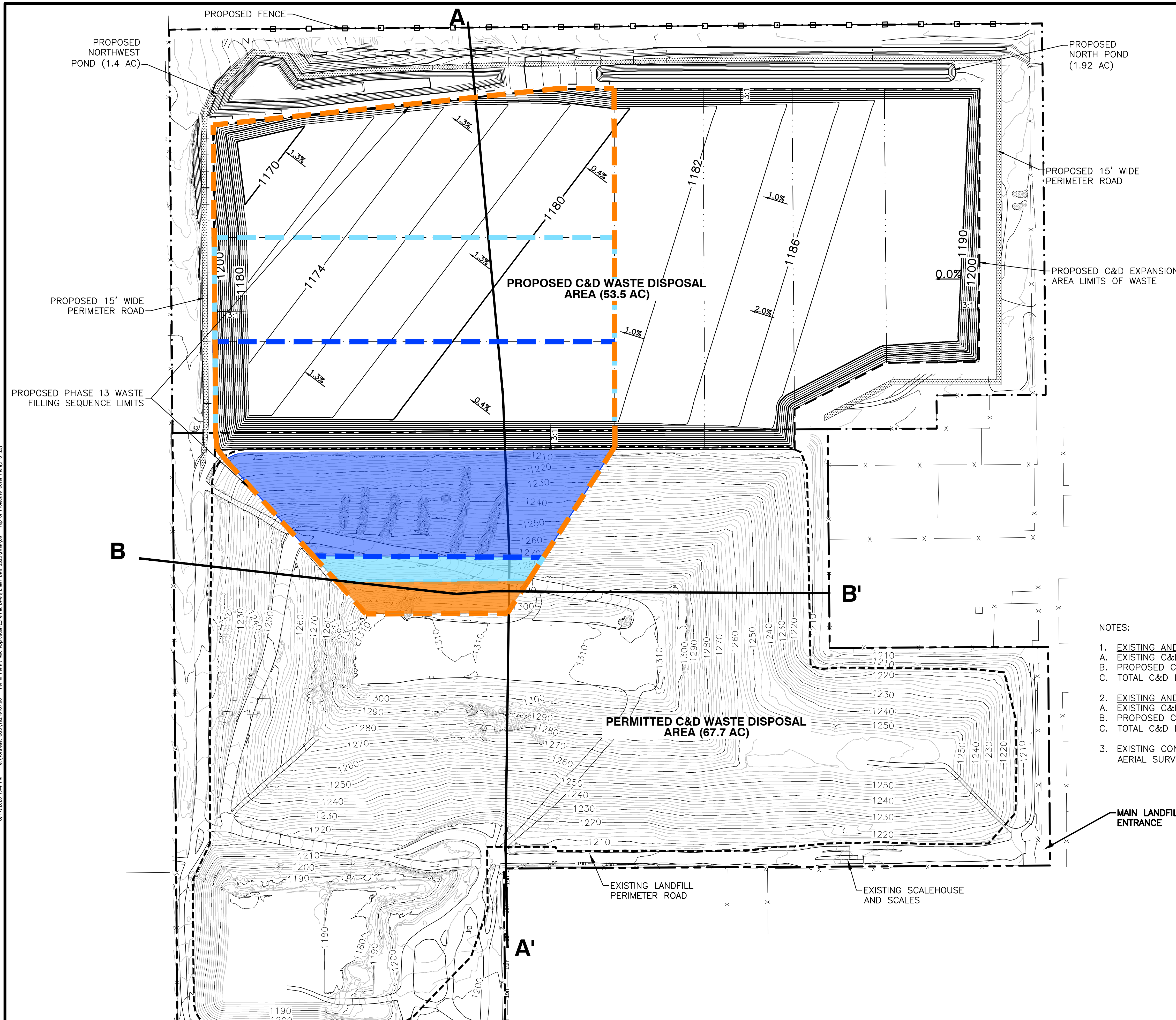
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 08-09 – CROSS SECTIONS(5-5-23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 13




0 150 300
SCALE IN FEET

**LEGEND**

| | |
|---|---|
| | EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1) |
| | EXISTING C&D LANDFILL LIMITS OF WASTE |
| | PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1) |
| | PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2) |
| | PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY |
| 1210 | PROPOSED 10' TOP OF PROTECTIVE COVER GRADES |
| 1186 | PROPOSED 2' TOP OF PROTECTIVE COVER GRADES |
| | PROPOSED PERIMETER ROAD |
| | PROPOSED FENCE |
| x | EXISTING FENCE |
| 1210 | EXISTING 10' CONTOUR (SEE NOTE 3) |
| | EXISTING 2' CONTOUR (SEE NOTE 3) |
| | EXISTING ROADS |
| A — A' | LANDFILL CROSS-SECTION LOCATION |
| | PROPOSED PHASE 11 WASTE DISPOSAL AREA |
| | PROPOSED PHASE 12 WASTE DISPOSAL AREA |
| | PROPOSED PHASE 13 WASTE DISPOSAL AREA |

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA 8-18-23

FOR PERMITTING PURPOSES ONLY

REV / DATE / DESCRIPTION / BY

DRAWING TITLE: PHASE 13 CONCEPTUAL PHASING PLAN

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

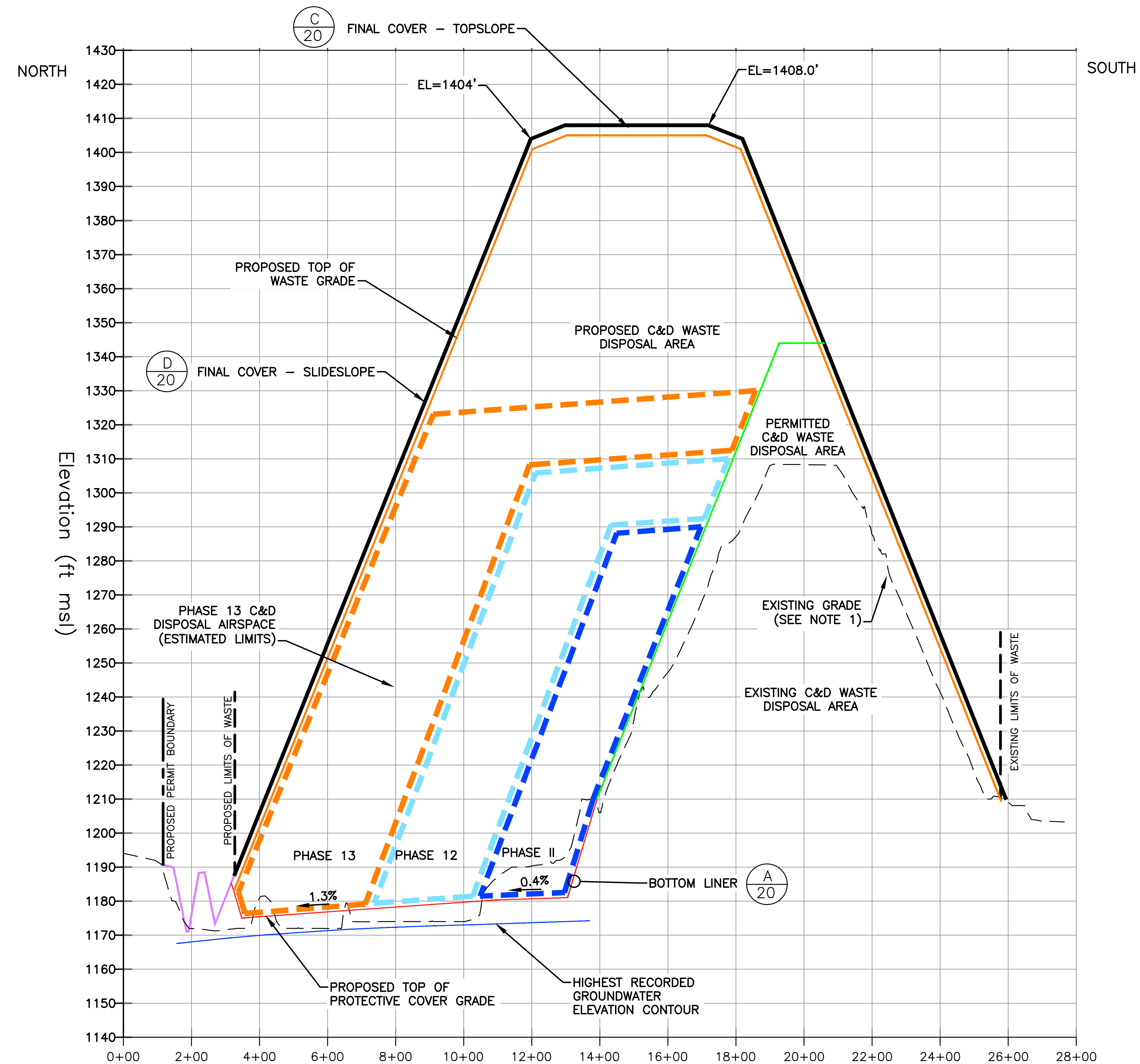
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 06 - TOP OF PROTECTIVE COVER PLAN(5-5-23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 14




# CROSS SECTION A-A'

0 20 40
VERTICAL SCALE IN FEET

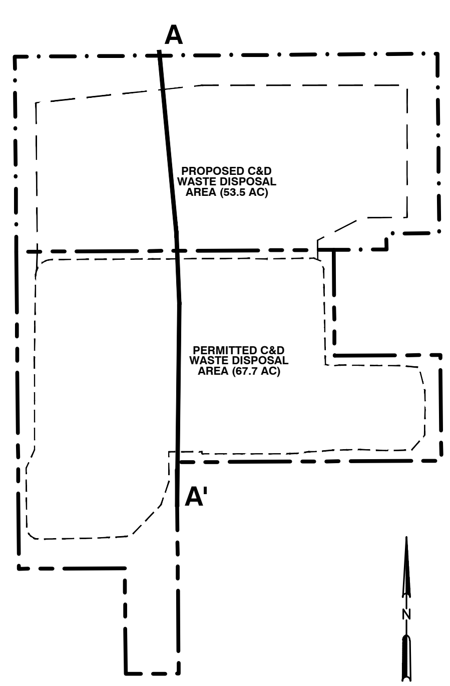
0 200 400
HORIZONTAL SCALE IN FEET

## LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- HIGHEST RECORDED GROUNDWATER ELEVATION CONTOUR
- PERMITTED TOP OF WASTE GRADE
- PROPOSED TOP OF PROTECTIVE COVER GRADE
- PROPOSED FINAL GRADE
- PROPOSED TOP OF WASTE GRADE
- PROPOSED DITCH/POND GRADE
- PROPOSED PHASE 11 WASTE LIMITS
- PROPOSED PHASE 12 WASTE LIMITS
- PROPOSED PHASE 13 WASTE LIMITS

NOTE:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.




KEY MAP
1"=4,000'

SANDEEP D. SARAF
32896
OKLAHOMA
LICENSED PROFESSIONAL ENGINEER
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: PHASE 13 CONCEPTUAL CROSS-SECTION

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

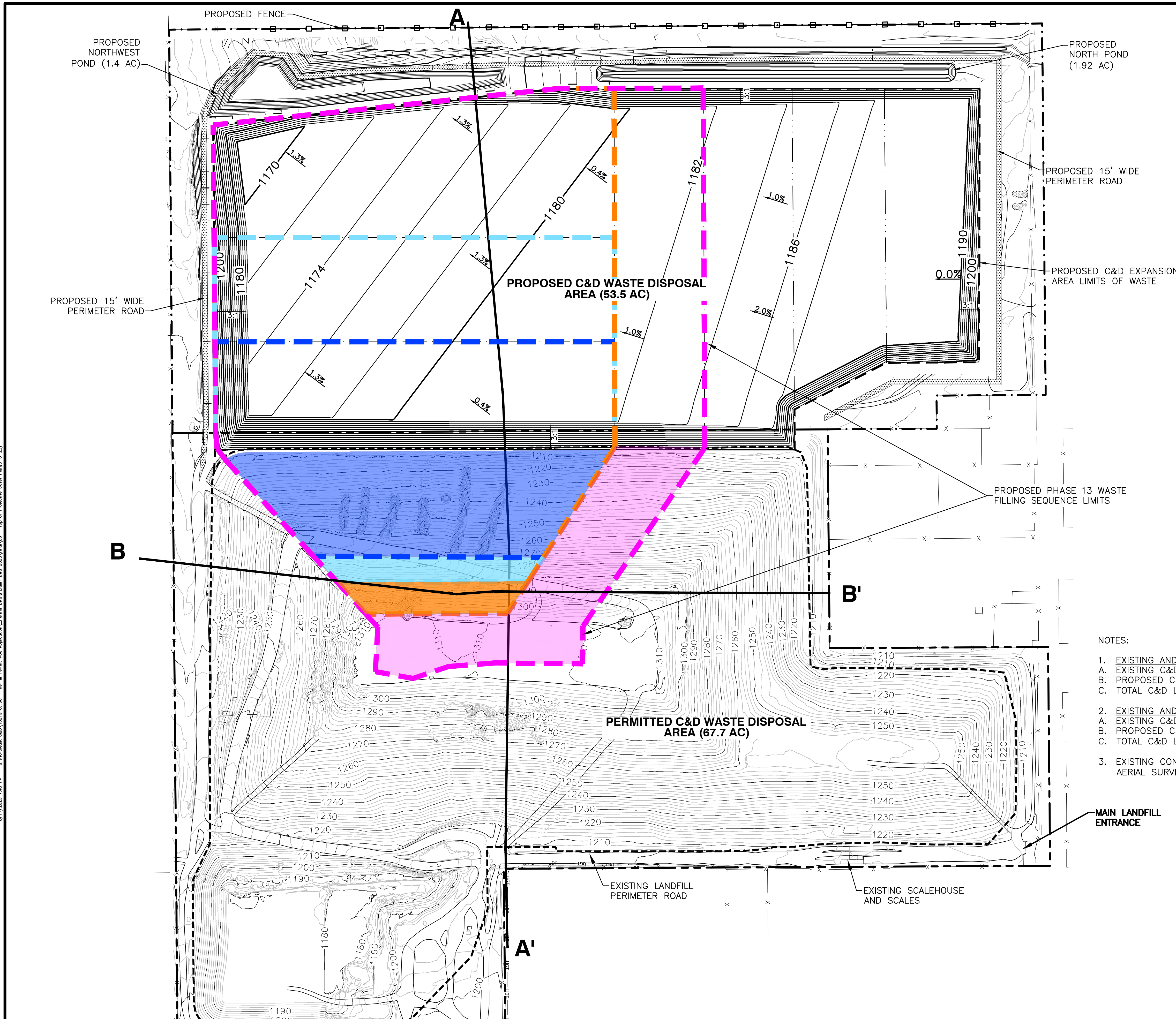
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 08-09 – CROSS SECTIONS(5-5-23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 15




## LEGEND

| | |
|---|---|
| | EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1) |
| | EXISTING C&D LANDFILL LIMITS OF WASTE |
| | PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1) |
| | PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2) |
| | PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY |
| 1210 | PROPOSED 10' TOP OF PROTECTIVE COVER GRADES |
| 1186 | PROPOSED 2' TOP OF PROTECTIVE COVER GRADES |
| | PROPOSED PERIMETER ROAD |
| | PROPOSED FENCE |
| x | EXISTING FENCE |
| 1210 | EXISTING 10' CONTOUR (SEE NOTE 3) |
| | EXISTING 2' CONTOUR (SEE NOTE 3) |
| | EXISTING ROADS |
| A — A' | LANDFILL CROSS-SECTION LOCATION |
| | PROPOSED PHASE 11 WASTE DISPOSAL AREA |
| | PROPOSED PHASE 12 WASTE DISPOSAL AREA |
| | PROPOSED PHASE 13 WASTE DISPOSAL AREA |
| | PROPOSED PHASE 14 WASTE DISPOSAL AREA |

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA 8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: PHASE 14 CONCEPTUAL PHASING PLAN

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

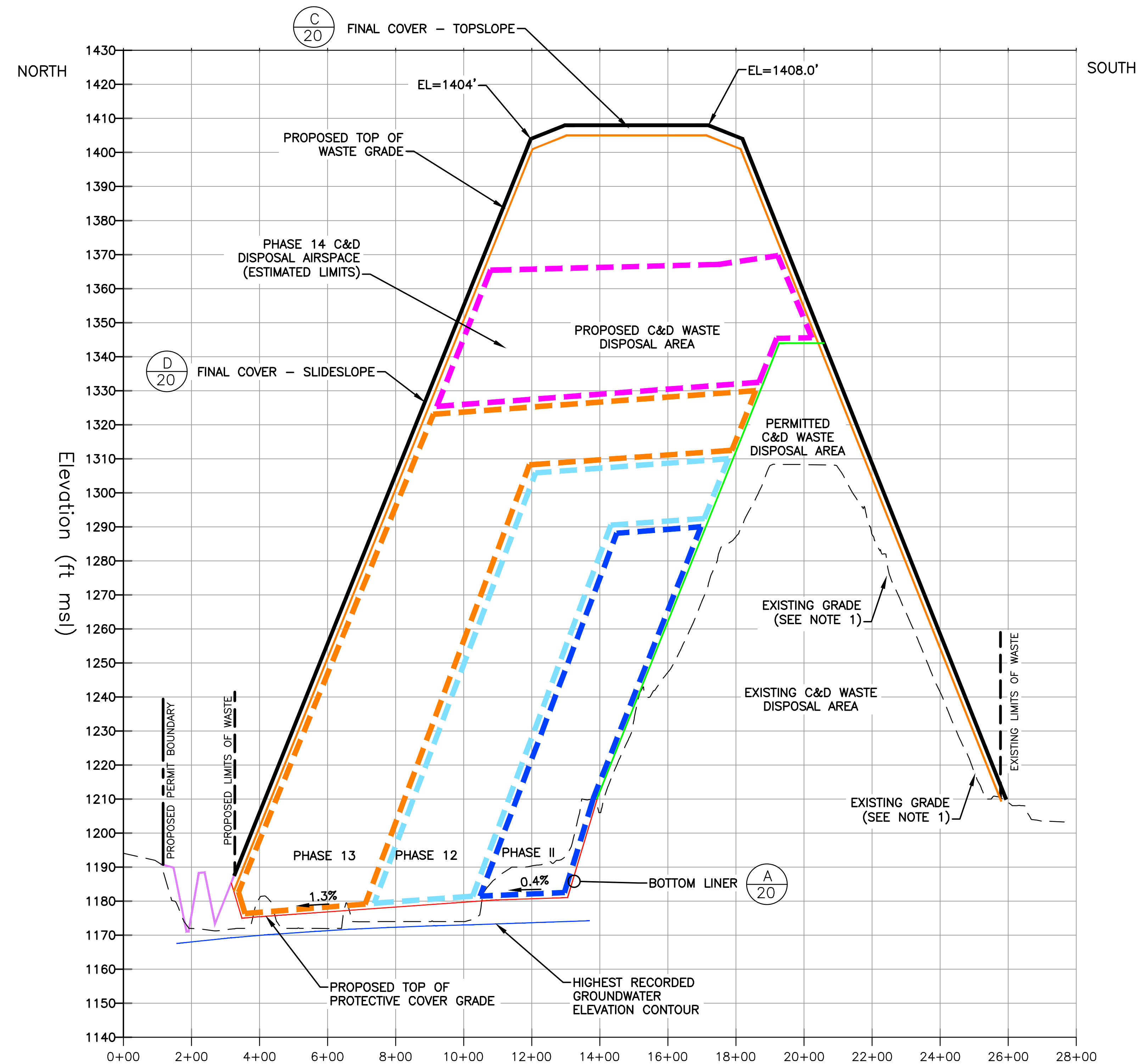
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 06 - TOP OF PROTECTIVE COVER PLAN(5-5-23)

DATE: 08/2023

SCALE: AS SHOWN

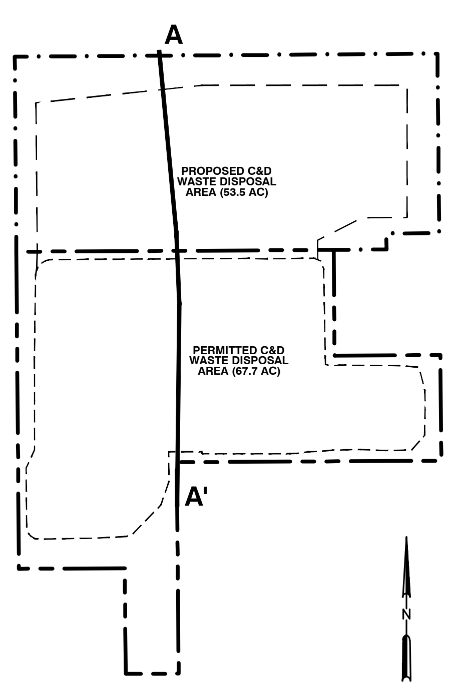
DRAWING NO. 16




# CROSS SECTION A-A'

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET




KEY MAP
1"=4,000'

## LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- HIGHEST RECORDED GROUNDWATER ELEVATION CONTOUR
- PERMITTED TOP OF WASTE GRADE
- PROPOSED TOP OF PROTECTIVE COVER GRADE
- PROPOSED FINAL GRADE
- PROPOSED TOP OF WASTE GRADE
- PROPOSED DITCH/POND GRADE
- PROPOSED PHASE 11 WASTE LIMITS
- PROPOSED PHASE 12 WASTE LIMITS
- PROPOSED PHASE 13 WASTE LIMITS
- PROPOSED PHASE 14 WASTE LIMITS

NOTE:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.


FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: PHASE 14 CONCEPTUAL CROSS-SECTION

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

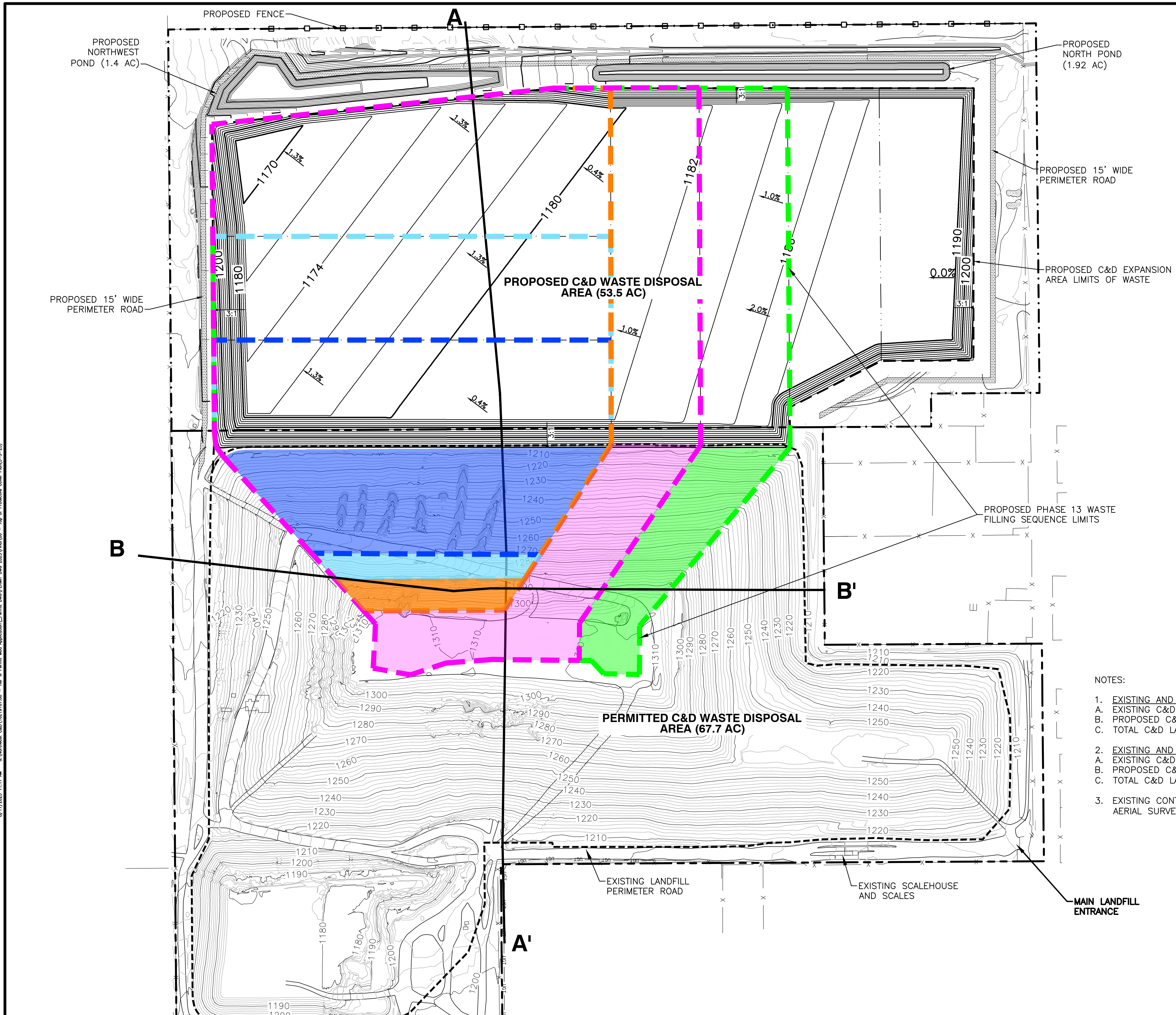
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 08-09 – CROSS SECTIONS(5-5-23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 17




## LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
- 1210 — PROPOSED 10' TOP OF PROTECTIVE COVER GRADES
- 1186 — PROPOSED 2' TOP OF PROTECTIVE COVER GRADES
- PROPOSED PERIMETER ROAD
- PROPOSED FENCE
- EXISTING FENCE
- 1210 — EXISTING 10' CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- EXISTING ROADS
- A — A' LANDFILL CROSS-SECTION LOCATION
- PROPOSED PHASE 11 WASTE DISPOSAL AREA
- PROPOSED PHASE 12 WASTE DISPOSAL AREA
- PROPOSED PHASE 13 WASTE DISPOSAL AREA
- PROPOSED PHASE 14 WASTE DISPOSAL AREA
- PROPOSED PHASE 15 WASTE DISPOSAL AREA

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.

2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.

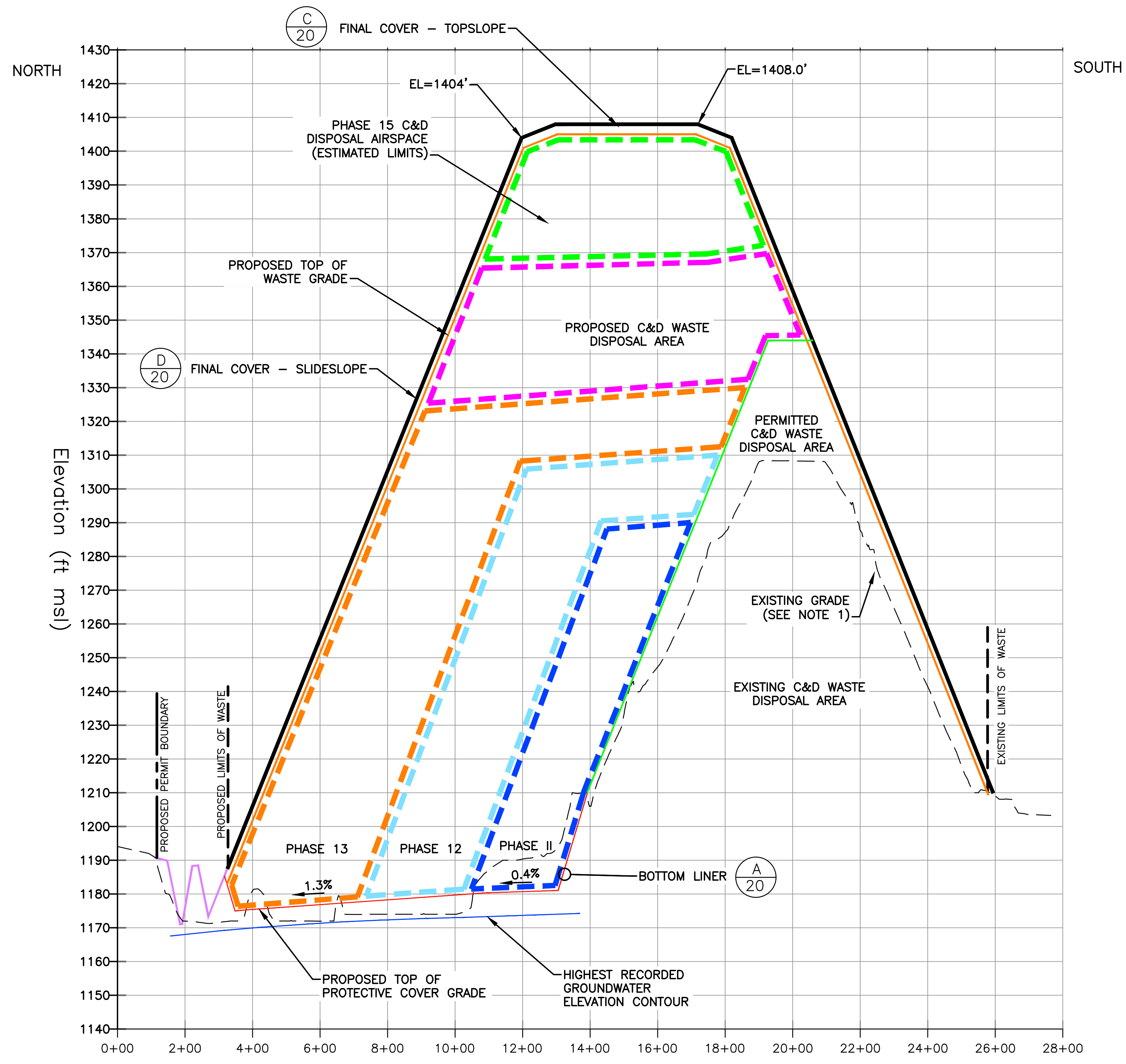
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA

8-18-23

FOR PERMITTING PURPOSES ONLY

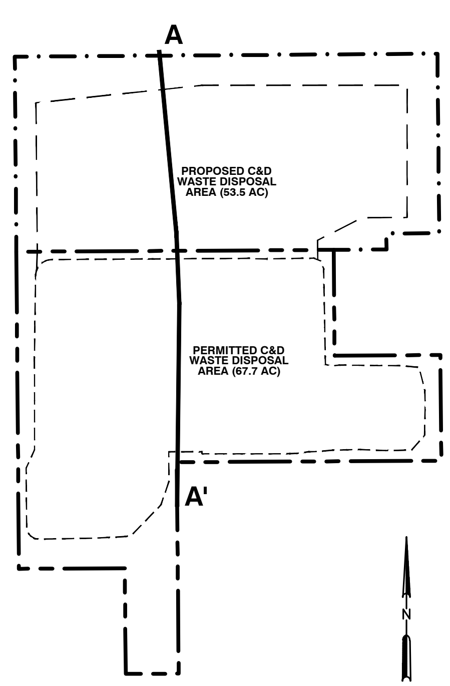
| | |
|---|---|
| REV | DATE / DESCRIPTION / BY |
| DRAWING TITLE | PHASE 15 CONCEPTUAL PHASING PLAN |
| PROJECT TITLE | NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION |
| CLIENT | N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084 |
| | SCS ENGINEERS STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS 1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021 PH (817) 571-2288 FAX NO. (817) 571-2188 |
| PROJ. NO. | 16219107.00 |
| DSN. BY: | SS |
| DWN. BY: | DS |
| CHK. BY: | SDS |
| Q/A RVW BY: | SS |
| APP. BY: | RRK |
| CADD FILE: | 06 – TOP OF PROTECTIVE COVER PLAN(5-5-23) |
| DATE: | 08/2023 |
| SCALE: | AS SHOWN |
| DRAWING NO. | 18 |




## CROSS SECTION A-A'

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET




KEY MAP
1"=4,000'

## LEGEND:

- EXISTING GRADE (SEE NOTE 1)
- HIGHEST RECORDED GROUNDWATER ELEVATION CONTOUR
- PERMITTED TOP OF WASTE GRADE
- PROPOSED TOP OF PROTECTIVE COVER GRADE
- PROPOSED FINAL GRADE
- PROPOSED TOP OF WASTE GRADE
- PROPOSED DITCH/POND GRADE
- PROPOSED PHASE 11 WASTE LIMITS
- PROPOSED PHASE 12 WASTE LIMITS
- PROPOSED PHASE 13 WASTE LIMITS
- PROPOSED PHASE 14 WASTE LIMITS
- PROPOSED PHASE 15 WASTE LIMITS

NOTE:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: PHASE 15 CONCEPTUAL CROSS-SECTION

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

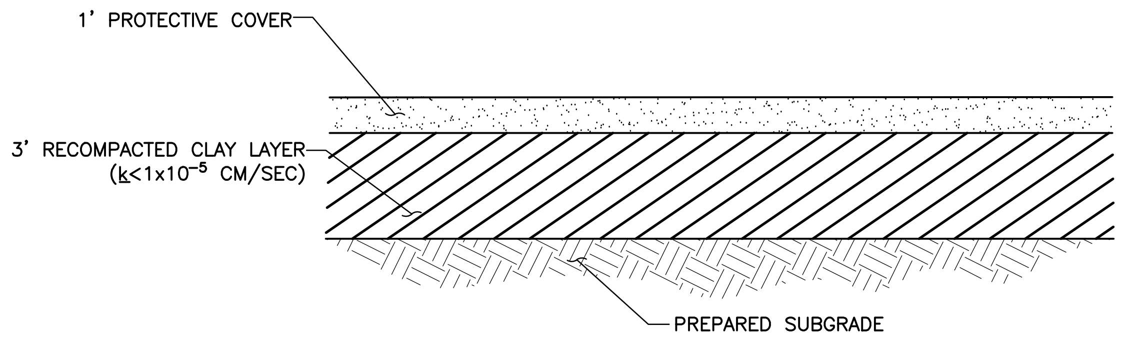
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 08-09 – CROSS SECTIONS(5-5-23)

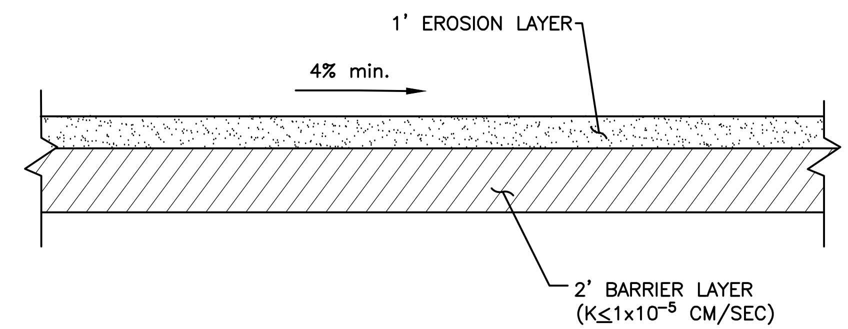
DATE: 08/2023

SCALE: AS SHOWN

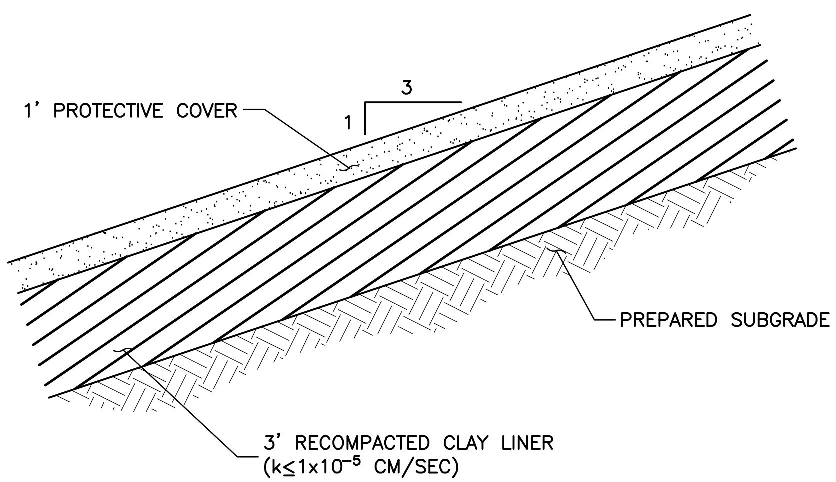
DRAWING NO. 19



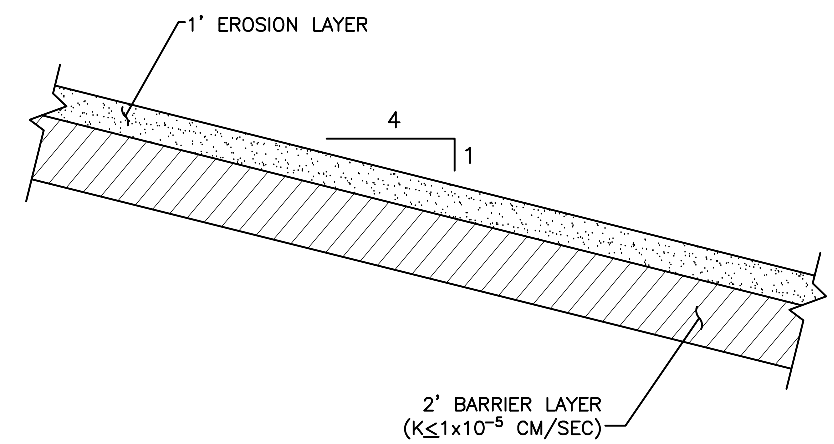

A 20 BOTTOM LINER
NTS



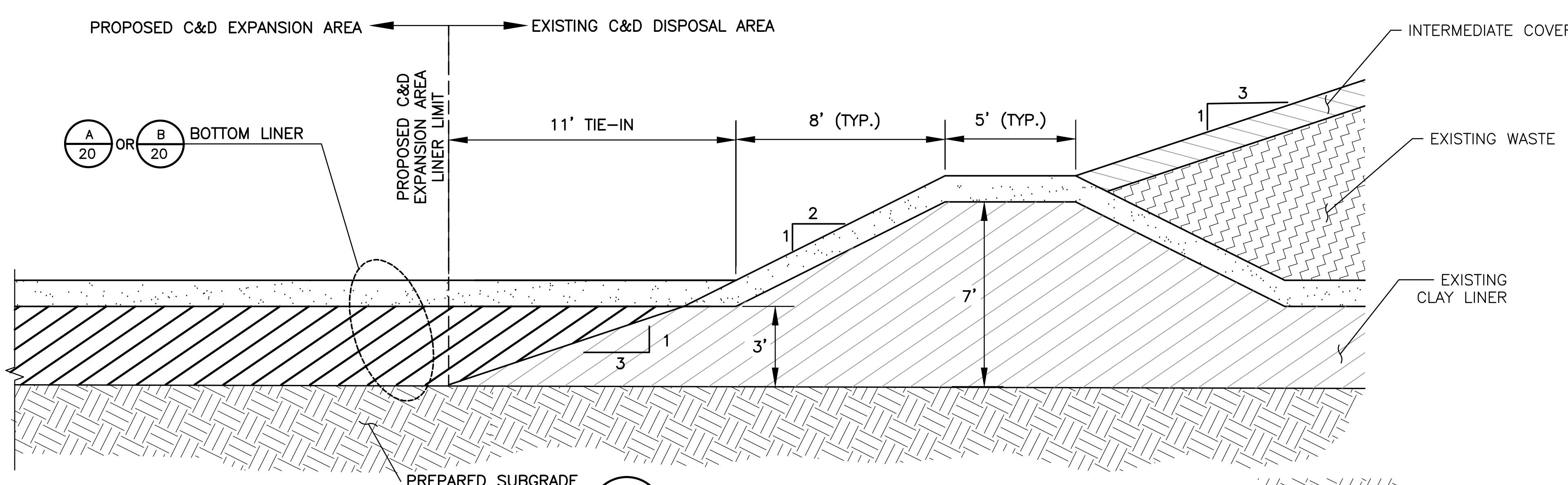

C 20 FINAL COVER – TOPSLOPE
NTS




B 20 SIDESLOPE LINER
NTS




D 20 FINAL COVER – SIDESLOPE
NTS




E 20 LINER TIE–IN
NTS

FOR PERMITTING PURPOSES ONLY

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA
8-18-23

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: LINER & FINAL COVER SYSTEM DETAILS

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

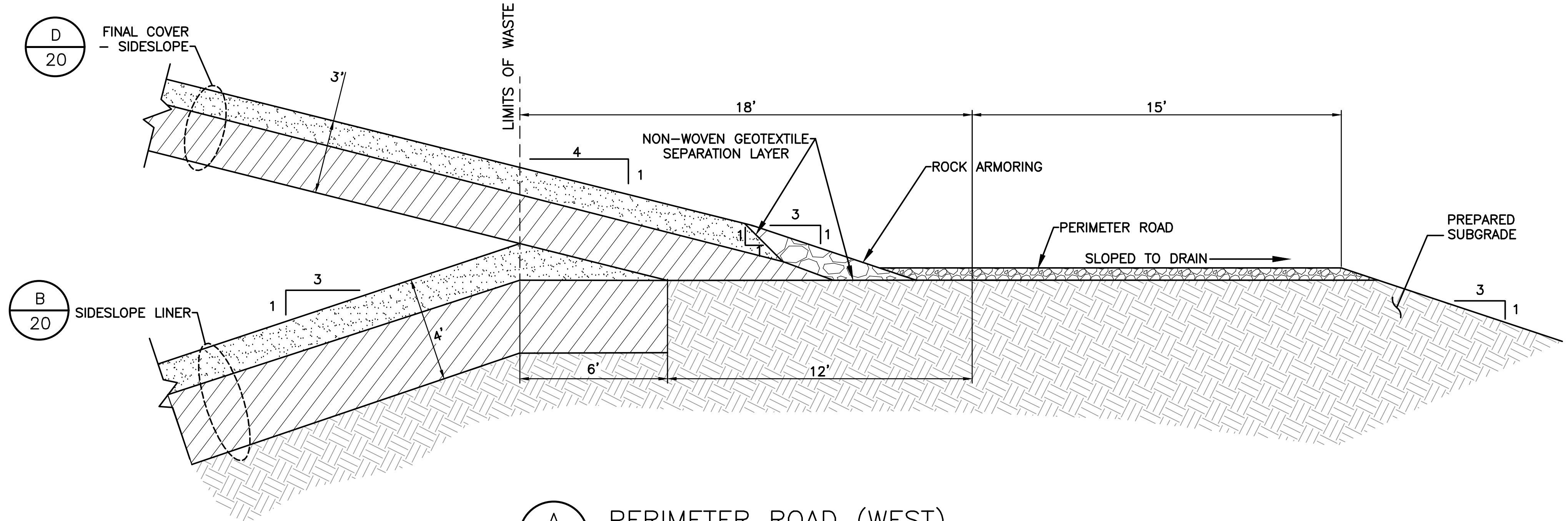
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 20–21 – LINER AND FINAL COVER DETAILS

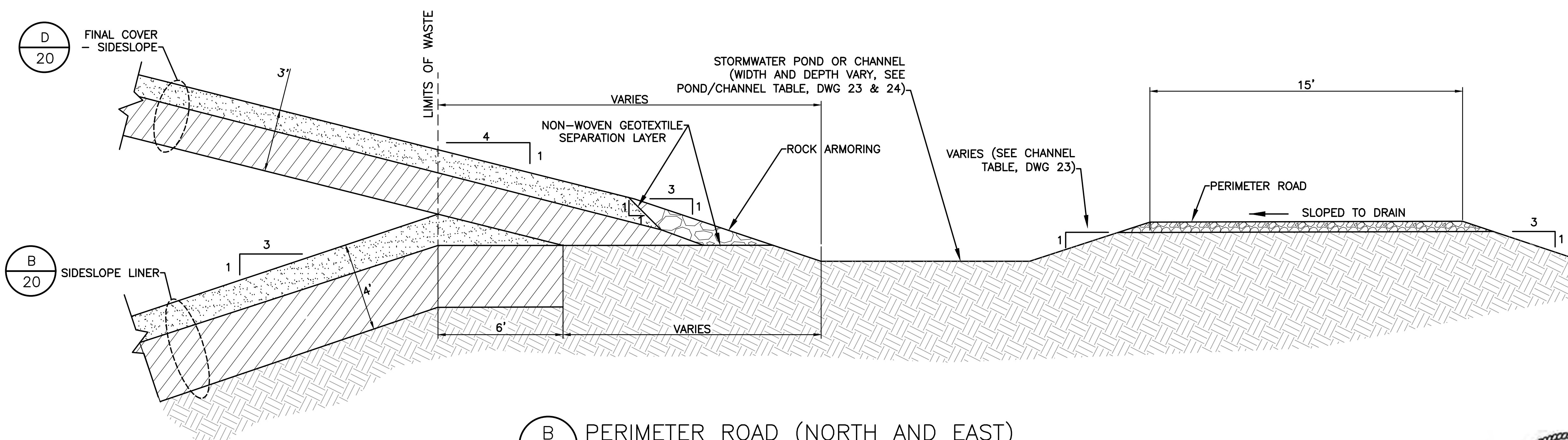
DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 20




A
21
PERIMETER ROAD (WEST)
NTS




B
21
PERIMETER ROAD (NORTH AND EAST)
NTS

8/17/2023 11:39 AM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\20-21 - Liner and Final Cover Details

REV | DATE | DESCRIPTION | BY

DRAWING TITLE
**PERIMETER ROAD DETAILS**

PROJECT TITLE
**NORTHEAST LANDFILL**
**TIER III PERMIT MODIFICATION**
**APPLICATION**

CLIENT
**N.E. LAND FILL, LLC**
**NORTHEAST LANDFILL**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**

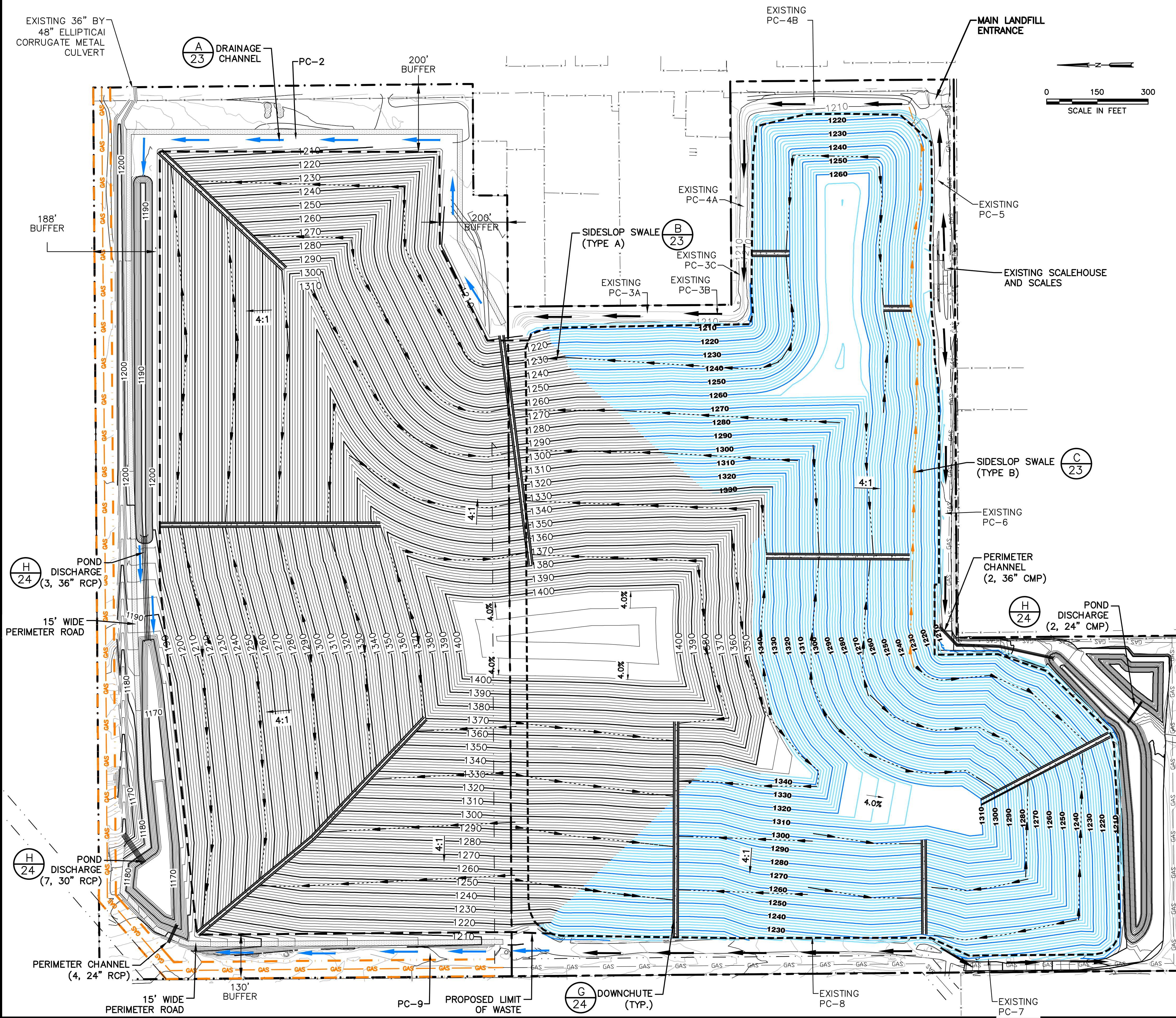
**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00
DSN. BY: SS
DWN. BY: DS
CHK. BY: SDS
Q/A RVW BY: SS
APP. BY: RRK

CADD FILE: 20-21 – LINER AND FINAL COVER DETAILS
DATE: 08/2023
SCALE: AS SHOWN
DRAWING NO.
**21**

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

**FOR PERMITTING PURPOSES ONLY**




## LEGEND

| | |
|---|---|
| | EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1) |
| | EXISTING C&D LANDFILL LIMITS OF WASTE |
| | PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1) |
| | PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2) |
| | PROPOSED EASEMENT |
| GAS | PROPOSED GAS LINE |
| | PROPOSED PERIMETER ROAD |
| | PROPOSED DOWNCHUTES |
| | PROPOSED DRAINAGE SWALE (TYPE A) |
| | PROPOSED DRAINAGE SWALE (TYPE B) |
| | PROPOSED FENCE |
| X | EXISTING FENCE |
| 1340 | 10' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA |
| | 2' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA |
| 1210 | PROPOSED 10' FINAL GRADES (C&D DISPOSAL AREA) |
| | PROPOSED 2' FINAL GRADES (C&D DISPOSAL AREA) |
| | EXISTING ROADS |
| 1210 | EXISTING 10' CONTOUR (SEE NOTE 3) |
| | EXISTING 2' CONTOUR (SEE NOTE 3) |
| | EXISTING EASEMENT (APPROX., SEE NOTE 4) |
| GAS | EXISTING GAS LINE (APPROX., SEE NOTE 4) |
| | EXISTING DRAINAGE CHANNEL AND FLOW DIRECTION |
| | PROPOSED DRAINAGE CHANNEL AND FLOW DIRECTION (SEE NOTE 5) |

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.
4. EXISTING EASEMENT AND UTILITY LINES INFORMATION ARE FROM THE PLAT OF SURVEY, DEVELOPED BY MASON SURVEYING & CONSULTING INC., DATED 02/17/2022.
5. REFER TO DRAWING 23 FOR PROPOSED STORMWATER CHANNEL TABLE.

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA

8-18-23

FOR PERMITTING PURPOSES ONLY

DRAWING TITLE: STORMWATER MANAGEMENT PLAN

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT APPLICATION

CLIENT: N.E. LANDFILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: NR | CHK. BY: RRK | Q/A RVW BY: SS | APP. BY: RRK

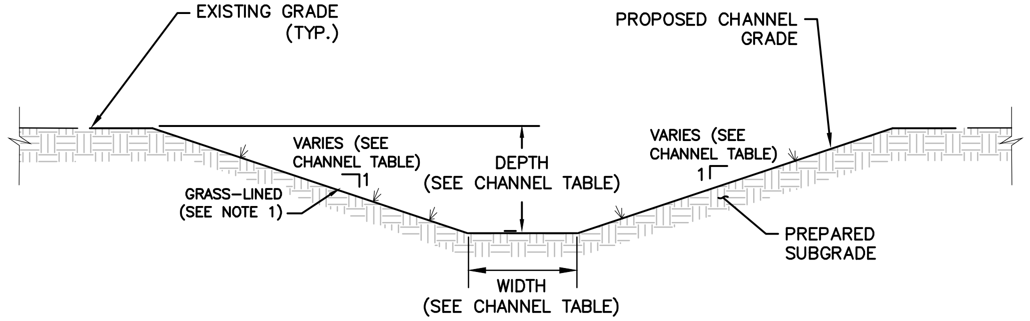
CADD FILE: 22 - SW MANAGEMENT PLAN (IA)

DATE: 07/2023

SCALE: AS SHOWN

DRAWING NO. 22

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|




NOTES:

1. CHANNELS MAY ALTERNATIVELY BE INSTALLED WITH AN ECB, TRM, OR RIP RAP.
2. DESIGNED DEPTH WILL INCLUDE MINIMUM 1-FOOT FREEBOARD ABOVE $D_{25}$ (DEPTH AT 25-YEAR, 24 HOUR STORM EVENT).

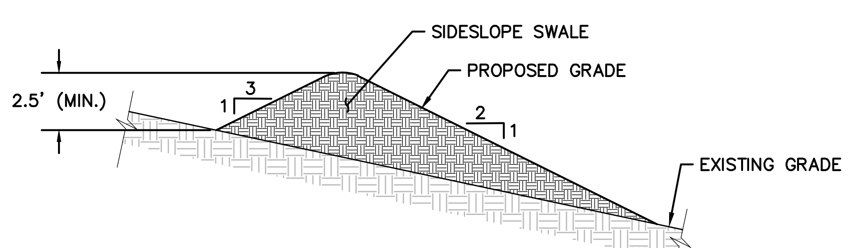
DRAINAGE CHANNEL A/23
NTS

## CHANNEL TABLE

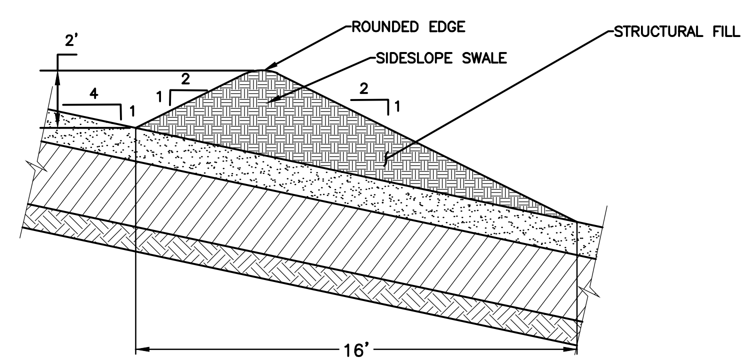
| CHANNEL NAME | OUTER SIDESLOPE (FT/FT) | INNER SIDESLOPE (FT/FT) | BOTTOM WIDTH (MIN., FT) | MIN. DEPTH (FT) | SLOPE (%) |
|---|---|---|---|---|---|
| PC-1 | 2 | 3 | 10 | 5.3 | 0.35 |
| PC-2 | 2 | 3 | 10 | 5.0 | 0.25 |
| PC-3A[1] | 2 | 3 | 5 | 4.5 | 0.25 |
| PC-3B[1] | 2 | 3 | 5 | 3.0 | 1.50 |
| PC-3C[1] | 2 | 3 | 5 | 4.5 | 0.25 |
| PC-4A[1] | 2 | 3 | 5 | 4.0 | 0.25 |
| PC-4B[1] | 2 | 3 | 5 | 3.5 | 1.00 |
| PC-7[1] | 2 | 3 | 5 | 3.0 | 0.50 |
| PC-8[1] | 2 | 3 | 2 | 2.0 | 1.00 |
| PC-9 | 2 | 3 | 6 | 3.3 | 1.00 |
| NC-1 | 2 | 2 | 6 | 3.1 | 2.50 |
| NC-2 | 2 | 2 | 6 | 4.3 | 0.30 |
| NC-3 | 2 | 2 | 6 | 3.3 | 2.00 |
| NC-4 | 2 | 2 | 6 | 3.0 | 4.00 |

NOTES:

1. IN PERIMETER CHANNELS WHERE THE CHANNEL VELOCITY EXCEEDS 5 FT/S, THE CHANNEL SHALL BE LINED WITH ECB, RIP-RAP, OR TRM, AS DISCUSSED IN APPENDIX E.



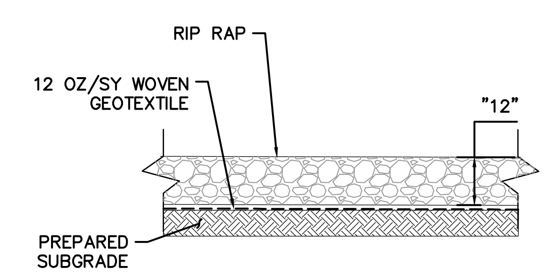

SIDESLOPE SWALE – TYPE A B/23
NTS




NOTES:

1. THIS DETAIL IS APPLICABLE TO THE SIDESLOPE SWALE WITH A 2% SLOPE

SIDESLOPE SWALE – TYPE B C/23
NTS




RIP RAP D/23
NTS

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE
STORM WATER DETAILS - 1

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

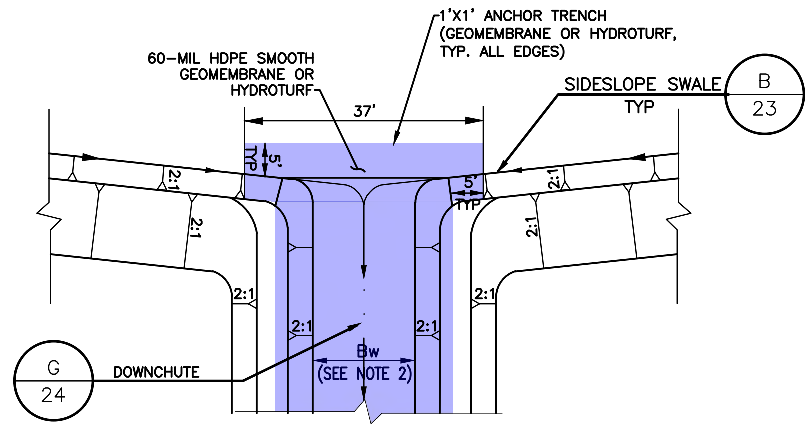
CADD FILE: 23-24 – STORMWATER DETAILS

DATE: 08/2023

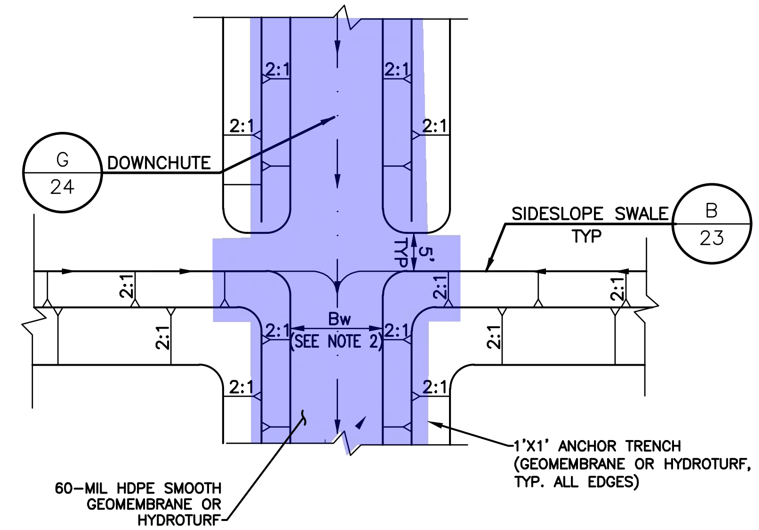
SCALE: AS SHOWN

DRAWING NO. 23

8/17/2023 11:42 AM G:\Northeast C&D\16219107.00 – Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\23-24 – STORMWATER DETAILS



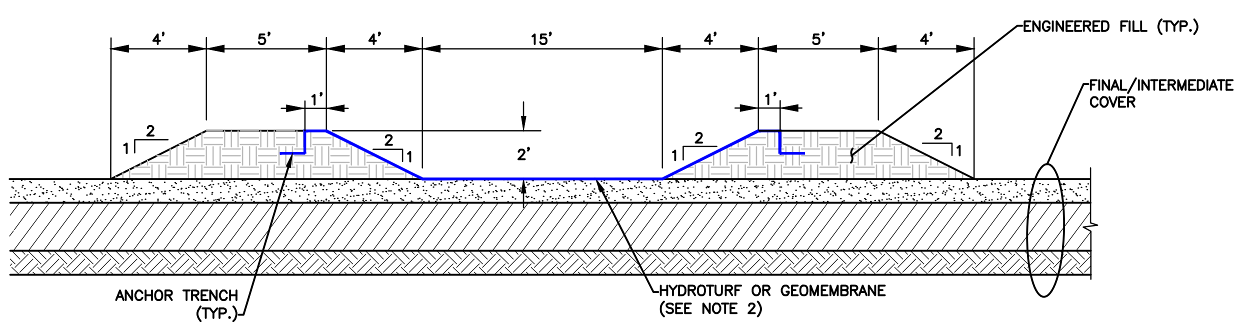

SWALE/DOWNCHUTE CONFLUENCE E 24
NTS




SWALE/DOWNCHUTE CONFLUENCE F 24
NTS

NOTES:

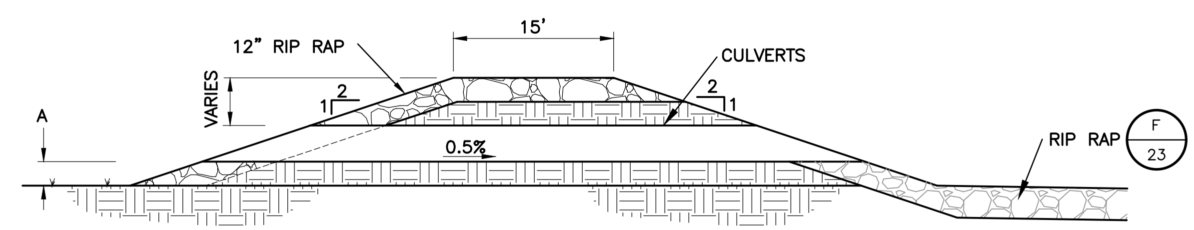
1. GRASS-LINED SIDESLOPE SWALES INSTALLED ON INTERMEDIATE COVER WILL BE CONSTRUCTED WITH A MINIMUM HEIGHT 2.5 FEET.
2. DESIGN OF DOWNCHUTES ARE PRESENTED IN APPENDIX E, ATTACHMENT E-4, DOWNCHUTES WILL BE CONSTRUCTED WITH A MINIMUM BOTTOM WIDTH, Bw, OF 15'.




DOWNCHUTE G 24
NTS

NOTES:

1. TYPICAL DOWNCHUTE DEPTH IS 2 FEET FOR INDIVIDUAL DOWNCHUTES. FINAL DEPTHS TO BE DETERMINED DURING CLOSURE DESIGN.
2. HYDROTURF OR GEOMEMBRANE SHALL BE INSTALLED CONSISTENT WITH MANUFACTURER'S RECOMMENDATION.
3. DESIGN OF DOWNCHUTES ARE PRESENTED IN APPENDIX E, ATTACHMENT E-4, DOWNCHUTES WILL BE CONSTRUCTED WITH A MINIMUM BOTTOM WIDTH, Bw, OF 15'.




POND OUTLET CULVERT H 24
NTS

| POND LOCATION | POND BOTTOM ELEVATION (FT) | CULVERT SIZE (INCH) | NO. CULVERTS | LENGTH (FT) | A (FT) | MATERIAL |
|---|---|---|---|---|---|---|
| NORTH POND | 1190 | 36 | 3 | 250 | 2.0 | RCP |
| NORTHWEST POND | 1165 | 30 | 7 | 100 | 2.0 | RCP |
| SOUTH POND | 1194 | 24 | 2 | 80 | 2.0 | CMP |

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: STORM WATER DETAILS - 2

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 23-24 - STORMWATER DETAILS

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 24

# Appendix A

## Notification to Adjacent Property Owners, Location Restriction Correspondence Letters, Legal Description, and Proof of Property Ownership

# Appendix A-1

# Notification to Adjacent Property Owners

August 22, 2023
Project No. 16219107.00

**Subject:** **Northeast C&D Landfill**
**Proposed Tier III Application Notification**
**DEQ Permit No. 3555050**

To whom it may concern:

As required by Oklahoma Department of Environmental Quality (DEQ) Oklahoma Administrative Code 252:515-5-52(e) and on behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), SCS Engineers is submitting this notification for a Tier III permit modification application for an expansion of its existing construction and demolition (C&D) waste landfill located at 2601 N. Midwest Blvd in Spencer, Oklahoma.

If you have any questions or need additional information, please contact Sandeep Saraf at (817) 571-2288.

Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
**SCS Engineers**

Ryan Kuntz, P.E.
Vice President / Satellite Office Manager
**SCS Engineers**

# Appendix A-2

# Location Restriction Correspondence Letters

# Scenic Rivers

August 23, 2023
Project No. 16219107.00

Mr. Darrell Townsend, Vice President
Ecosystems & Watershed Management
GRDA Scenic Rivers Commission
15971 OK-10
Tahlequah, Oklahoma 74465-0292

**Subject:** **Northeast C&D Landfill**
**Proposed Tier III Application Notification**
**Request for Scenic Rivers Evaluation**

Dear Mr. Townsend:

As required by Oklahoma Department of Environmental Quality (DEQ) Oklahoma Administrative Code 252:515-5-52(e) and on behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), SCS Engineers is submitting this notification for a horizontal and vertical expansion of its existing construction and demolition (C&D) debris landfill. The proposed landfill expansion is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma.

Three general site location maps (Figures 1, 3, and 6) are enclosed. Latitude/longitude of the corners of the permit boundaries are provided in Figure 3.

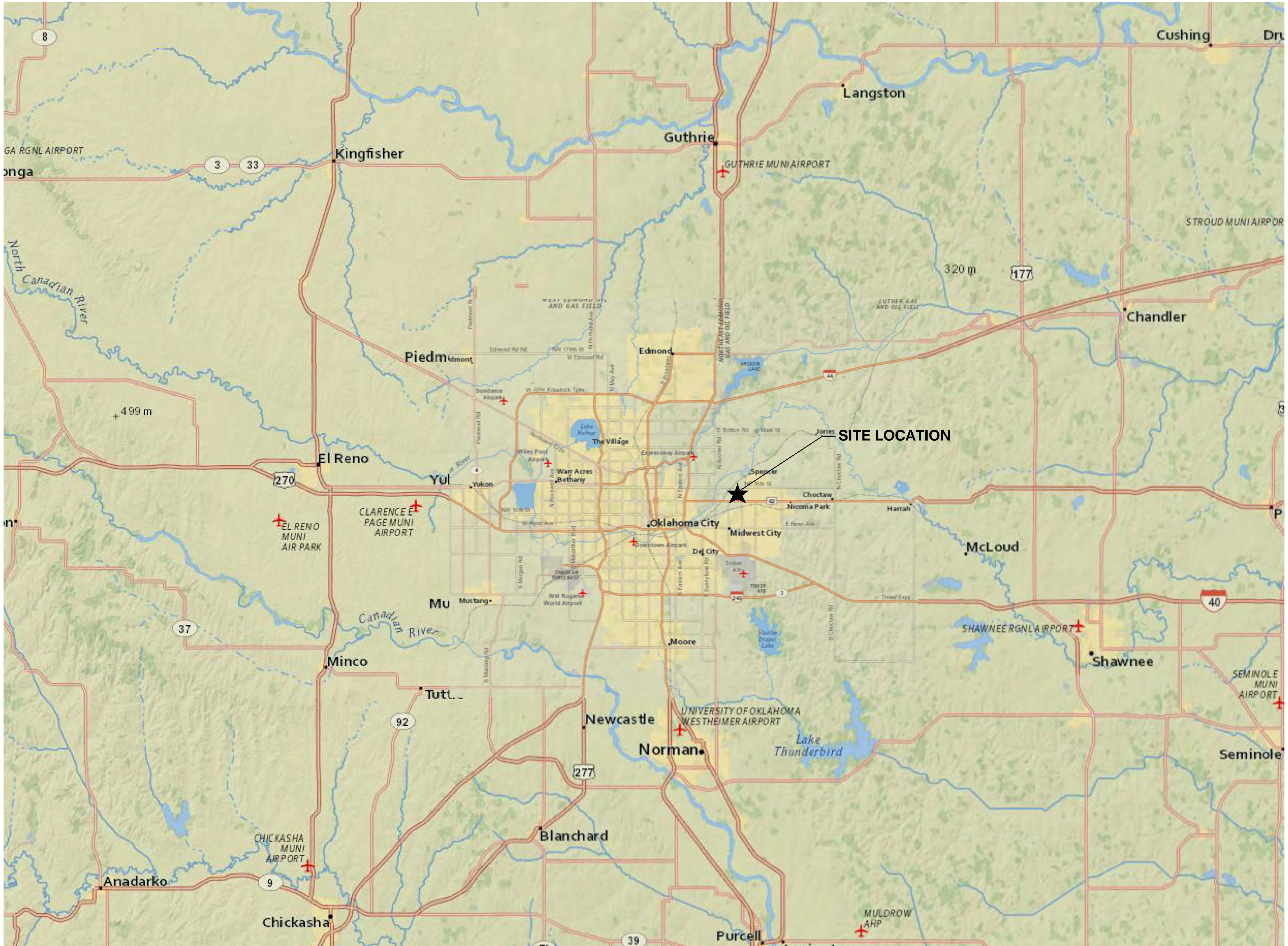
DEQ regulation states the following: *no area within the permit boundary of a new solid waste disposal facility, or expansion of the permit boundary of an existing solid waste disposal facility, shall be located within the drainage basin of any river designated under the Oklahoma Scenic Rivers Commission Act, unless the Scenic Rivers Commission that manages the affected river provides a statement that the proposed facility is not expected to adversely affect the river or any of the public purposes for which it was designated.*

On behalf of GFL, we request you to review the enclosed maps at your earliest convenience and confirm that the proposed landfill is in compliance with 252:515-5-31(a). If you have any questions or need additional information, please do not hesitate to contact Sandeep Saraf at (407) 923-7013. Thank you for your time and effort in this matter.

Sincerely,

| | |
|---|---|
| Sandeep Saraf, P.E. | Ryan Kuntz, P.E. |
| Senior Project Manager | Vice President / Satellite Office Manager |
| **SCS Engineers** | **SCS Engineers** |

Enclosures: Figures 1, 3, and 6




N

0 4 MILES 8 MILES

APPROXIMATE SCALE IN MILES

**SOURCE:**

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

FOR PERMITTING PURPOSES ONLY

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: GENERAL LOCATION MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

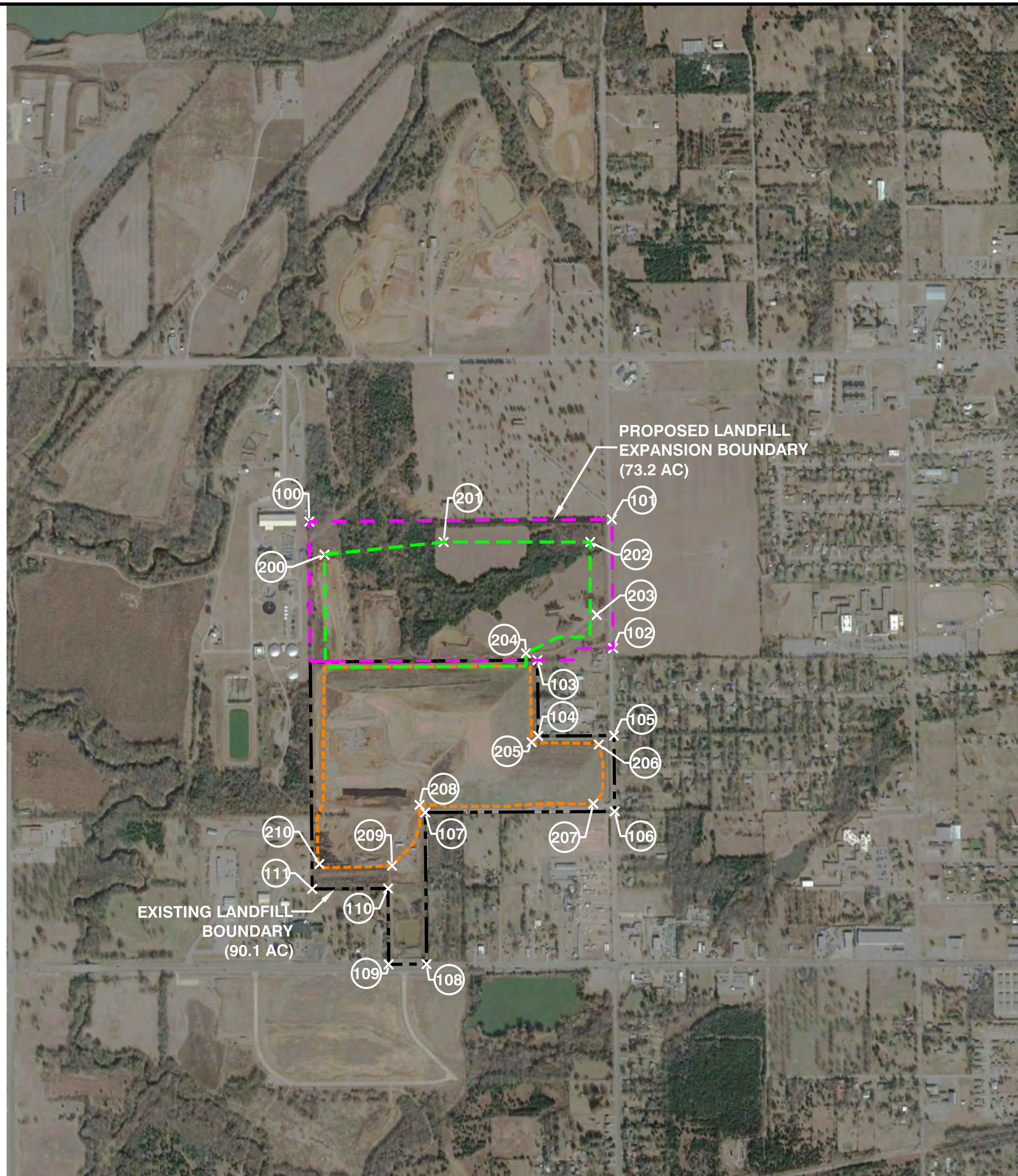
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: NR | CHK. BY: RRK | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 01 LOC MAP1

DATE: 07/2023

SCALE: AS SHOWN

DRAWING NO. 1




N

0 500 1000
SCALE IN FEET

## LEGEND

| | |
|---|---|
| black dash-dot line | EXISTING LANDFILL BOUNDARY |
| magenta dash-dot line | PROPOSED LANDFILL EXPANSION BOUNDARY |
| orange dashed line | CURRENT LIMIT OF WASTE |
| green dashed line | PROPOSED LIMIT OF WASTE |

| PERMIT BOUNDARY | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 100 | N35° 30' 13.47" | W97° 23' 51.04" |
| 101 | N35° 30' 13.49" | W97° 23' 19.15" |
| 102 | N35° 30' 02.39" | W97° 23' 19.11" |
| 103 | N35° 30' 01.40" | W97° 23' 27.08" |
| 104 | N35° 29' 54.86" | W97° 23' 27.06" |
| 105 | N35° 29' 54.86" | W97° 23' 19.08" |
| 106 | N35° 29' 48.32" | W97° 23' 19.05" |
| 107 | N35° 29' 48.33" | W97° 23' 39.01" |
| 108 | N35° 29' 35.26" | W97° 23' 38.97" |
| 109 | N35° 29' 35.26" | W97° 23' 42.96" |
| 110 | N35° 29' 41.80" | W97° 23' 42.98" |
| 111 | N35° 29' 41.81" | W97° 23' 50.97" |

| LIMITS OF WASTE | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 200 | N35° 30' 10.61" | W97° 23' 49.46" |
| 201 | N35° 30' 11.63" | W97° 23' 36.89" |
| 202 | N35° 30' 11.55" | W97° 23' 21.45" |
| 203 | N35° 30' 05.27" | W97° 23' 20.81" |
| 204 | N35° 30' 02.01" | W97° 23' 28.29" |
| 205 | N35° 29' 54.32" | W97° 23' 27.76" |
| 206 | N35° 29' 54.10" | W97° 23' 20.68" |
| 207 | N35° 29' 48.99" | W97° 23' 21.29" |
| 208 | N35° 29' 48.99" | W97° 23' 39.61" |
| 209 | N35° 29' 43.77" | W97° 23' 42.53" |
| 210 | N35° 29' 43.95" | W97° 23' 50.20" |

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE
AERIAL PHOTO

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

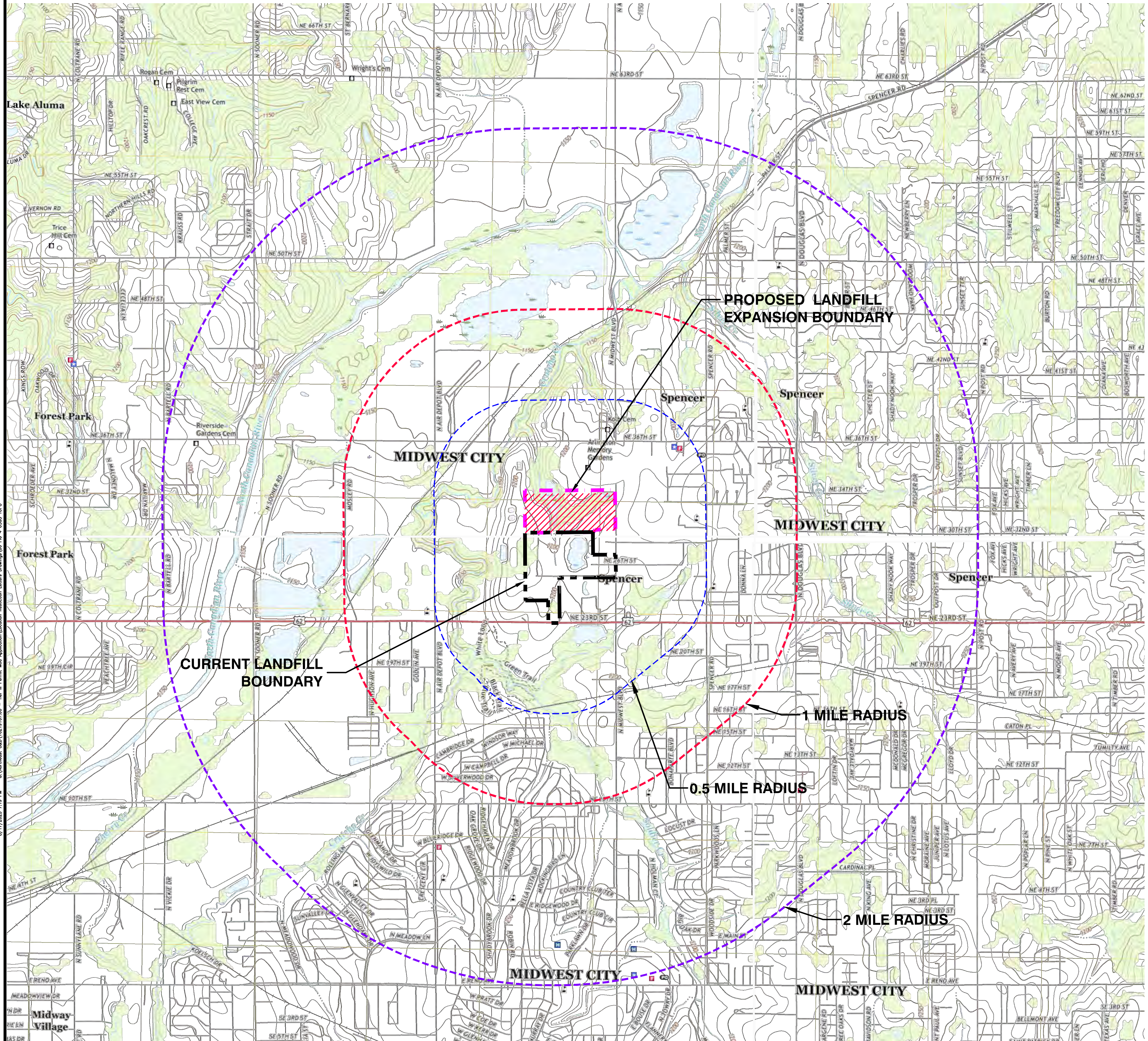
PROJ. NO. 16219107.00
DSN. BY: SS
DWN. BY: DS
CHK. BY: SDS
Q/A RVW BY: SS
APP. BY: RRK

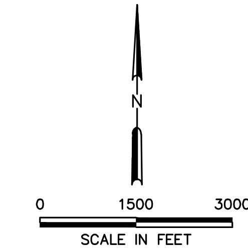
CADD FILE: 03 AERIAL PHOTO

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO.
3




## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- PROPOSED LANDFILL EXPANSION AREA
- 0.5 MILE RADIUS
- 1 MILE RADIUS
- 2 MILE RADIUS
- 1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)

### ROAD CLASSIFICATION

| | | | |
|---|---|---|---|
| Expressway | | Local Connector | |
| Secondary Hwy | | Local Road | |
| Ramp | | 4WD | |
| | US Route | | State Route |

## SOURCE:

CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2022); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: GENERAL TOPOGRAPHIC MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

| | | |
|---|---|---|
| PROJ. NO. 16219107.00 | DWN. BY: NR | Q/A RVW BY: SDS |
| DSN. BY: SDS | CHK. BY: SDS | APP. BY: RRK |

CADD FILE: 06 FIG 4 USGS TOPO

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 6

8/17/2023 7:19 PM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application\Location Restriction Letters Drawings\06 FIG 4 USGS TOPO

# Recreation and Preservation Areas

SCS ENGINEERS

Environmental Consulting & Contracting

August 18, 2023
Project No. 16219107.00

Ms. Shelley Zumwalt
Oklahoma Tourism and Recreation Department
123 Robert S Kerr Avenue, Suite 1000
Oklahoma City, OK 73102

**Subject:** **Northeast C&D Landfill**
**Proposed Tier III Application Notification**
**Request for Recreation/Preservation Areas Evaluation**

Dear Ms. Zumwalt:

As required by Oklahoma Department of Environmental Quality (DEQ) Oklahoma Administrative Code 252:515-5-52(e) and on behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), SCS Engineers is submitting this notification for a horizontal and vertical expansion of its existing construction and demolition (C&D) debris landfill. The proposed landfill expansion is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma.

Three general site location maps (Figures 1, 3, and 6) are enclosed. Latitude/longitude of the corners of the permit boundaries are provided in Figure 3.

DEQ regulation states the following: *No area within the permit boundary of a new solid waste disposal facility, or expansion of the permit boundary of an existing solid waste disposal facility, shall be located within one-half mile of any area formally dedicated and managed for public recreation or natural preservation by a federal, state, or local government agency, unless the appropriate management agency provides a statement that the proposed facility is not expected to adversely affect the existing recreation or natural preservation area.*

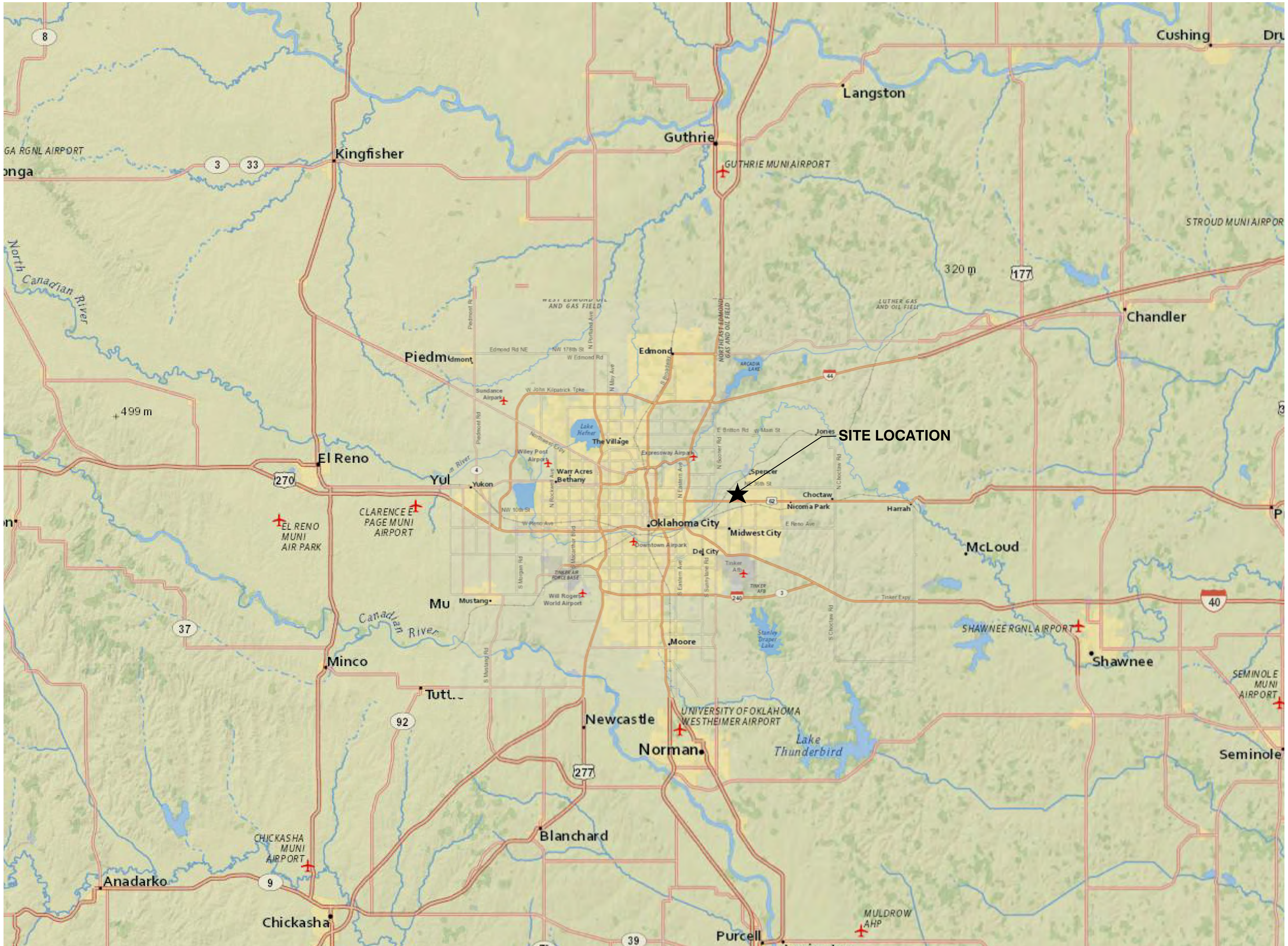
On behalf of GFL, we request you to review the enclosed maps and provide the above evaluation as required by DEQ, at your earliest convenience. If you have any questions or need additional information, please do not hesitate to contact Sandeep Saraf at (407) 923-7013. Thank you for your time and effort in this matter.

Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
**SCS Engineers**

Ryan Kuntz, P.E.
Vice President / Satellite Office Manager
**SCS Engineers**

Enclosures: Figures 1, 3, and 6




N

0 4 MILES 8 MILES

APPROXIMATE SCALE IN MILES

SOURCE:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

FOR PERMITTING PURPOSES ONLY

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

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DRAWING TITLE
GENERAL LOCATION MAP

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: NR | CHK. BY: RRK | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 01 LOC MAP1

DATE: 07/2023

SCALE: AS SHOWN

DRAWING NO.
1

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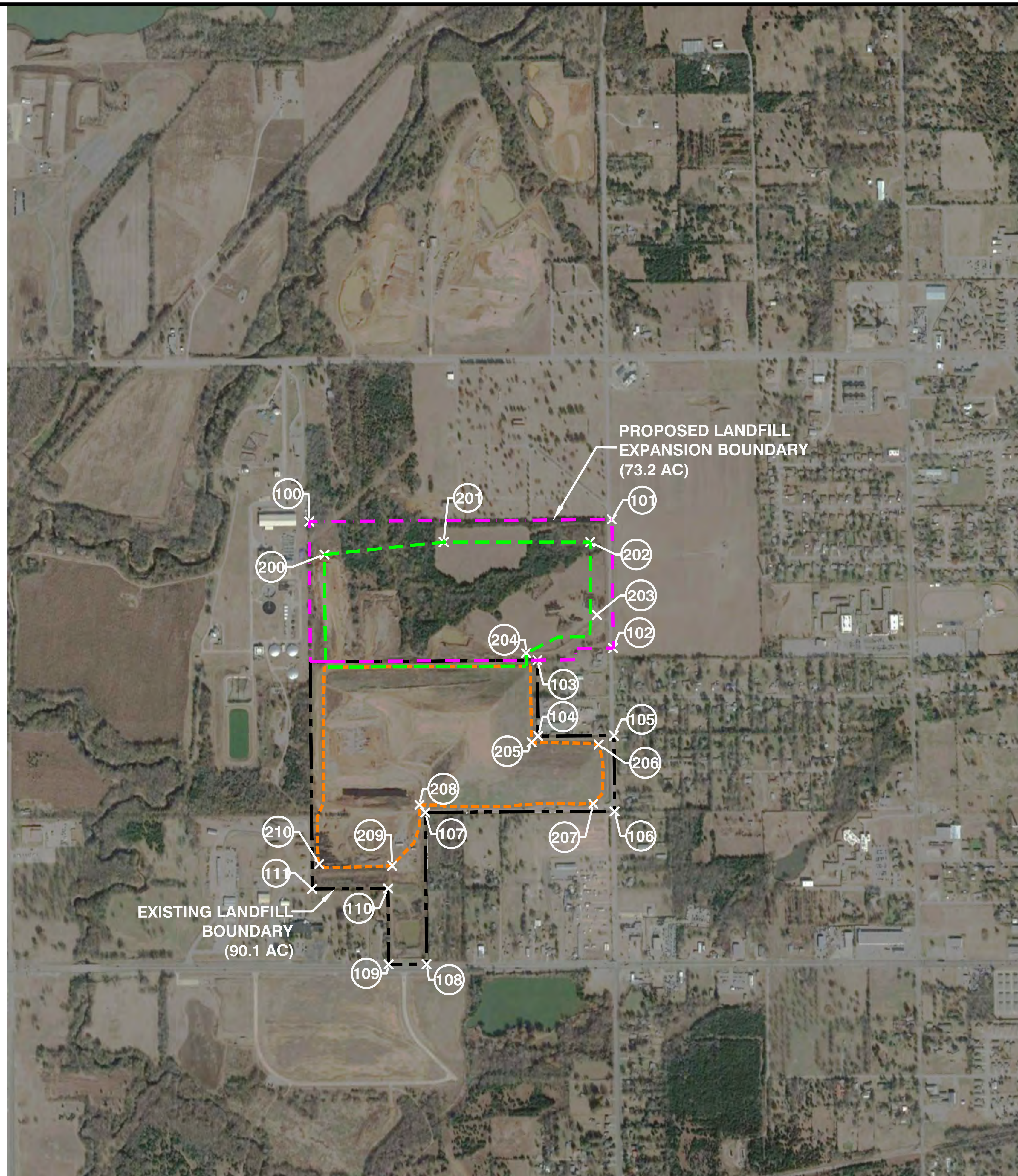


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0 500 1000
SCALE IN FEET

## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- CURRENT LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE

| PERMIT BOUNDARY | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 100 | N35° 30' 13.47" | W97° 23' 51.04" |
| 101 | N35° 30' 13.49" | W97° 23' 19.15" |
| 102 | N35° 30' 02.39" | W97° 23' 19.11" |
| 103 | N35° 30' 01.40" | W97° 23' 27.08" |
| 104 | N35° 29' 54.86" | W97° 23' 27.06" |
| 105 | N35° 29' 54.86" | W97° 23' 19.08" |
| 106 | N35° 29' 48.32" | W97° 23' 19.05" |
| 107 | N35° 29' 48.33" | W97° 23' 39.01" |
| 108 | N35° 29' 35.26" | W97° 23' 38.97" |
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| 110 | N35° 29' 41.80" | W97° 23' 42.98" |
| 111 | N35° 29' 41.81" | W97° 23' 50.97" |

| LIMITS OF WASTE | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 200 | N35° 30' 10.61" | W97° 23' 49.46" |
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| 209 | N35° 29' 43.77" | W97° 23' 42.53" |
| 210 | N35° 29' 43.95" | W97° 23' 50.20" |

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: AERIAL PHOTO

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 03 AERIAL PHOTO

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 3

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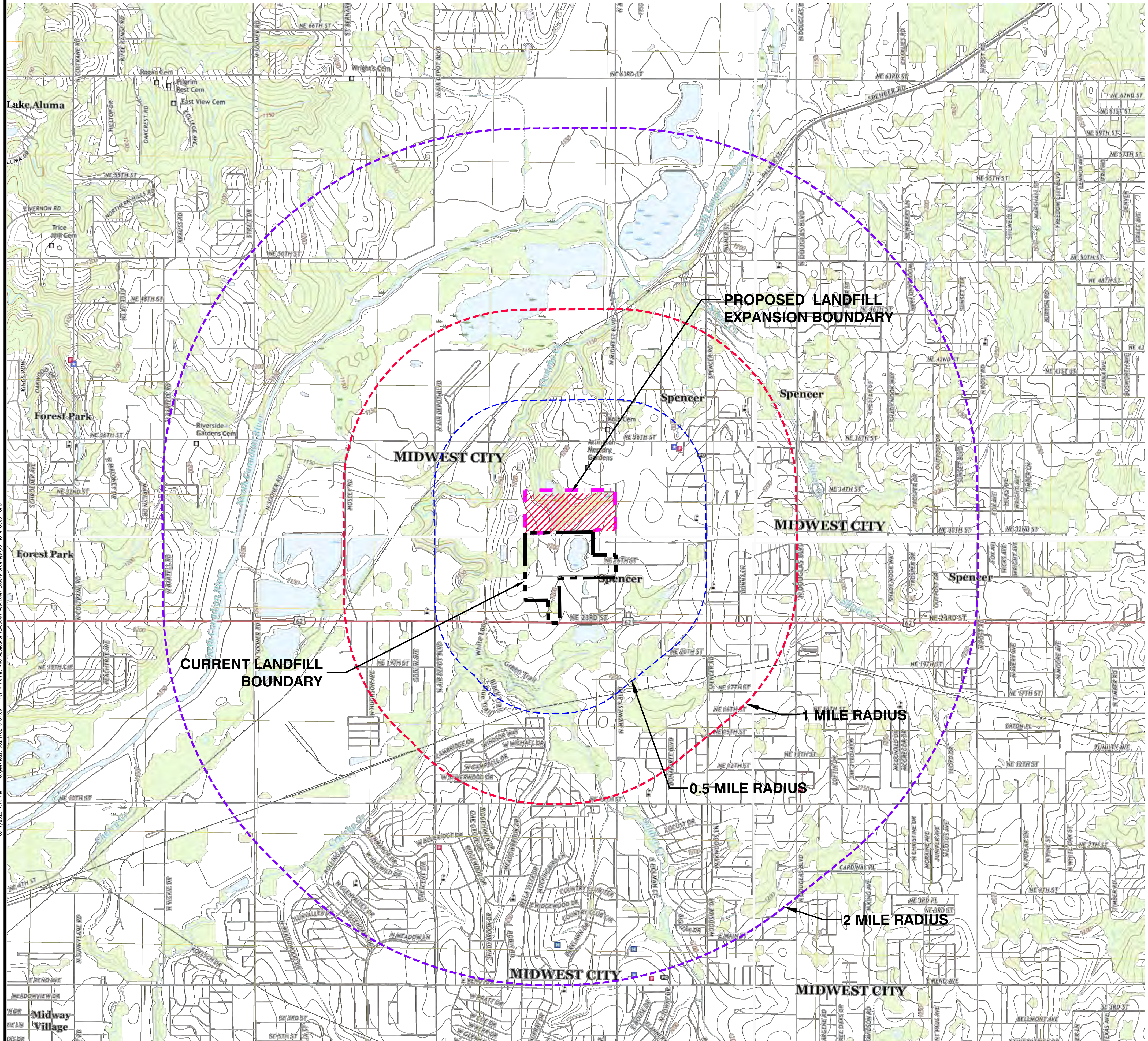


N

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SCALE IN FEET

## LEGEND

EXISTING LANDFILL BOUNDARY
PROPOSED LANDFILL EXPANSION BOUNDARY
PROPOSED LANDFILL EXPANSION AREA
0.5 MILE RADIUS
1 MILE RADIUS
2 MILE RADIUS
1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)

ROAD CLASSIFICATION

Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
US Route
State Route

**SOURCE:**

CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2022); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

| REV. | DATE | DESCRIPTION | BY |
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DRAWING TITLE
GENERAL TOPOGRAPHIC MAP

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
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PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SDS | CHK. BY: SDS | DWN. BY: NR | APP. BY: RRK | Q/A RVW BY: SDS

CADD FILE: 06 FIG 4 USGS TOPO

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO.
6

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SCS ENGINEERS

Environmental Consulting & Contracting

August 18, 2023
Project No. 16219107.00

Mr. Mark Trevino, Area Manager
Bureau of Reclamation
Oklahoma-Texas Area Office
5316 Highway 290 West, Suite 110
Austin, TX 78735

**Subject:** **Northeast C&D Landfill**
**Proposed Tier III Application Notification**
**Request for Recreation/Preservation Areas Evaluation**

Dear Mr. Trevino:

As required by Oklahoma Department of Environmental Quality (DEQ) Oklahoma Administrative Code 252:515-5-52(e) and on behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), SCS Engineers is submitting this notification for a horizontal and vertical expansion of its existing construction and demolition (C&D) debris landfill. The proposed landfill expansion is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma.

Three general site location maps (Figures 1, 3, and 6) are enclosed. Latitude/longitude of the corners of the permit boundaries are provided in Figure 3.

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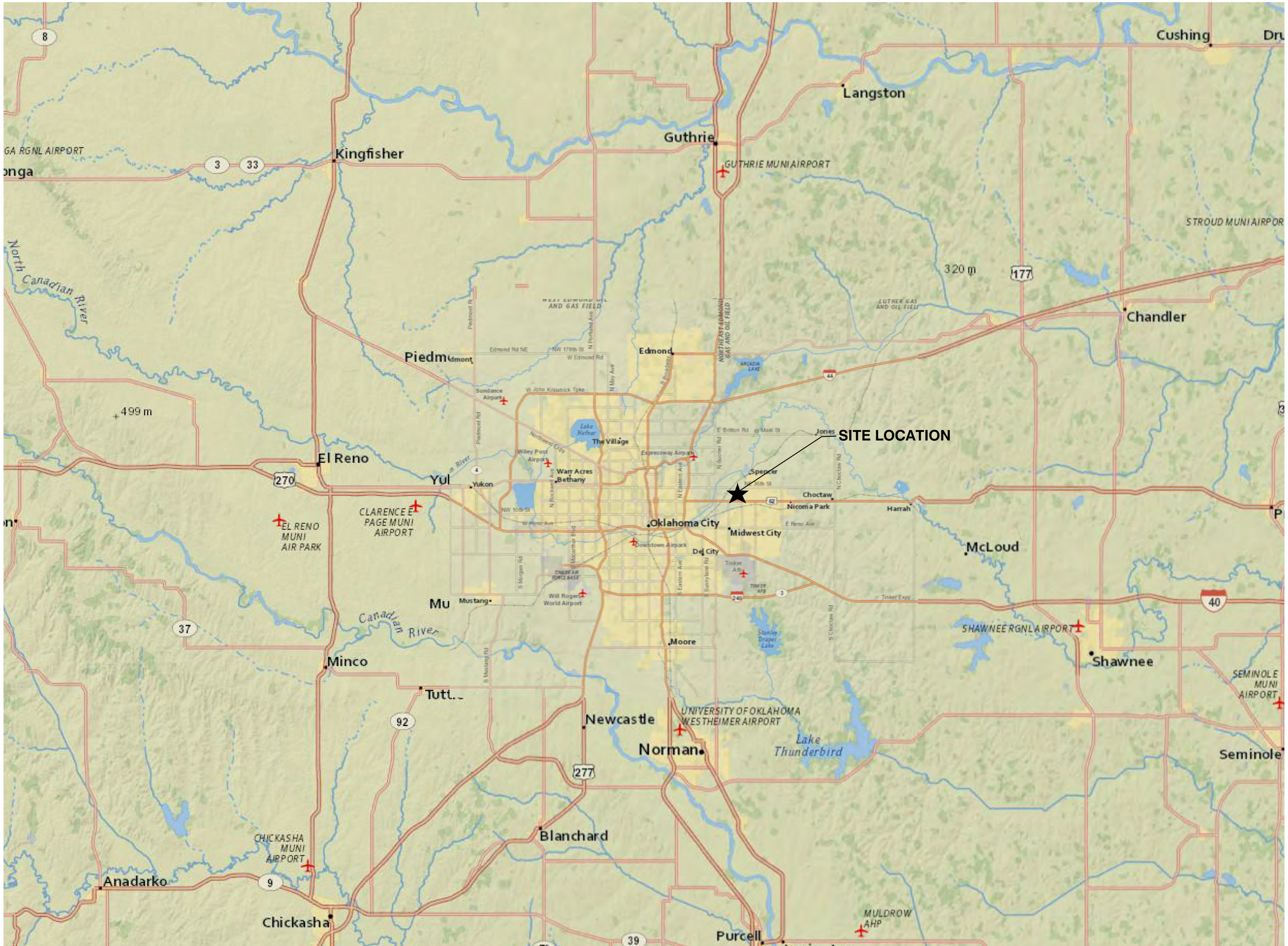
On behalf of GFL, we request you to review the enclosed maps and provide the above evaluation as required by DEQ, at your earliest convenience. If you have any questions or need additional information, please do not hesitate to contact Sandeep Saraf at (407) 923-7013. Thank you for your time and effort in this matter.

Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
**SCS Engineers**

Ryan Kuntz, P.E.
Vice President / Satellite Office Manager
**SCS Engineers**

Enclosures: Figures 1, 3, and 6




N

0 4 MILES 8 MILES

APPROXIMATE SCALE IN MILES

SOURCE:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY


FOR PERMITTING PURPOSES ONLY

| REV. | DATE | DESCRIPTION | BY |
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DRAWING TITLE
**GENERAL LOCATION MAP**

PROJECT TITLE
**NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION**

CLIENT
**N.E. LAND FILL, LLC**
**NORTHEAST LANDFILL**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DWN. BY: NR | Q/A RVW BY: SS
DSN. BY: SS | CHK. BY: RRK | APP. BY: RRK

CADD FILE: 01 LOC MAP1

DATE: 07/2023

SCALE: AS SHOWN

DRAWING NO. 1

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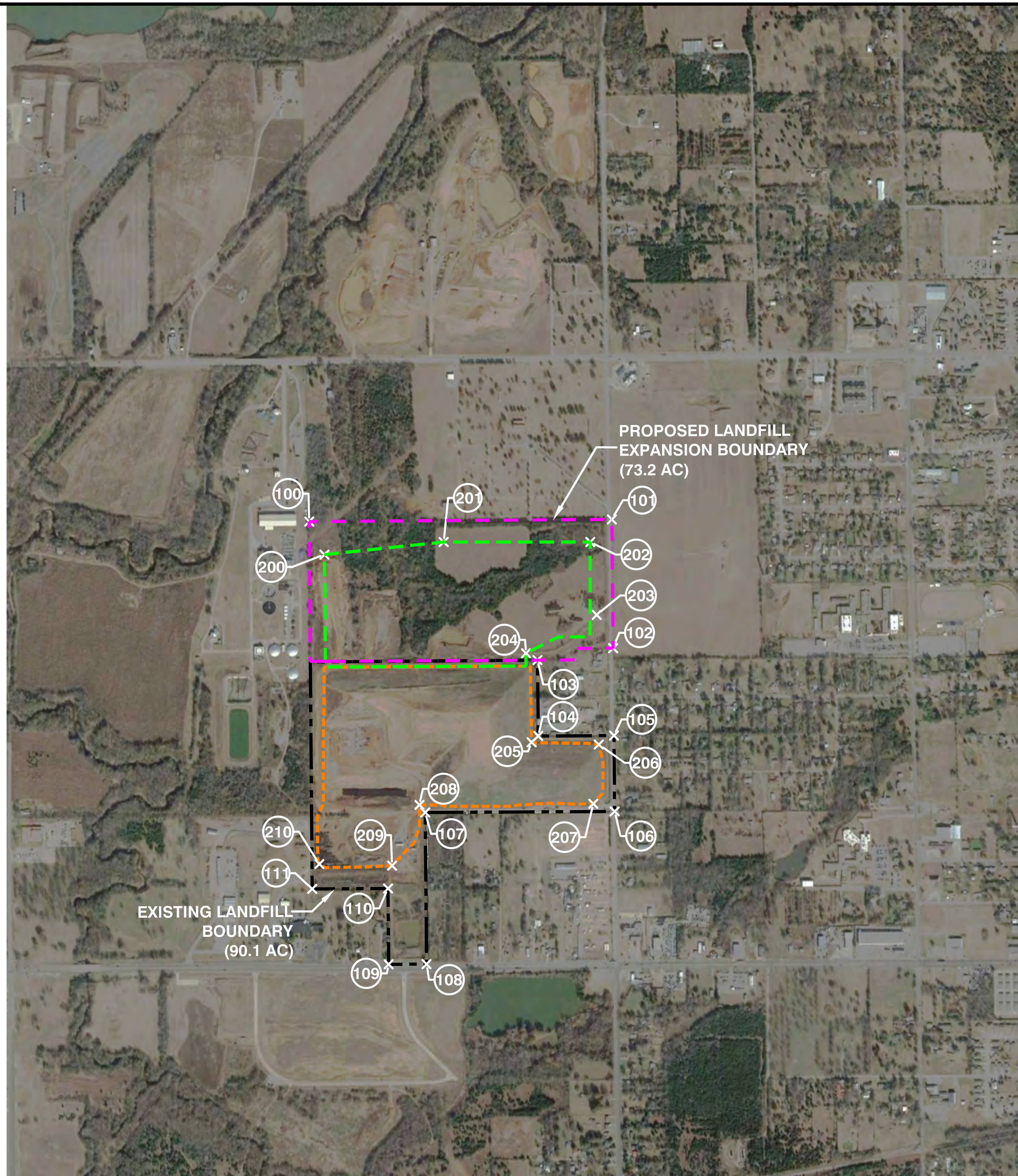


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SCALE IN FEET

## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- CURRENT LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE

| PERMIT BOUNDARY | | |
|---|---|---|
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LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA

Sandeep Saraf
8-18-23

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
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DRAWING TITLE
AERIAL PHOTO

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
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1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
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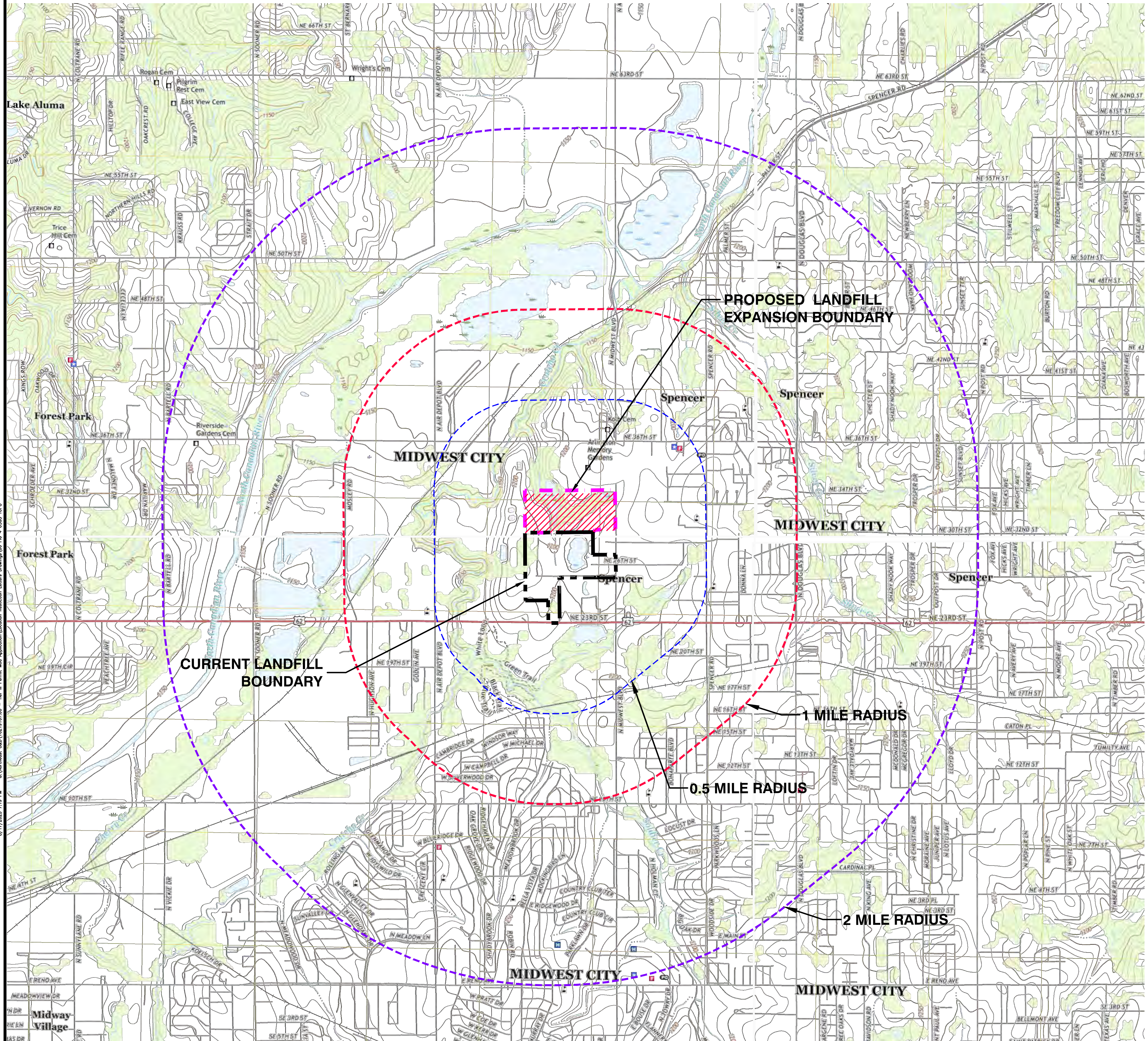
PROJ. NO. 16219107.00
DSN. BY: SS
DWN. BY: DS
CHK. BY: SDS
Q/A RVW BY: SS
APP. BY: RRK

CADD FILE: 03 AERIAL PHOTO

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 3

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0 1500 3000
SCALE IN FEET

## LEGEND

EXISTING LANDFILL BOUNDARY
PROPOSED LANDFILL EXPANSION BOUNDARY
PROPOSED LANDFILL EXPANSION AREA
0.5 MILE RADIUS
1 MILE RADIUS
2 MILE RADIUS
1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)

ROAD CLASSIFICATION

Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
US Route
State Route

**SOURCE:**

CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2022); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: GENERAL TOPOGRAPHIC MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

CADD FILE: 06 FIG 4 USGS TOPO

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO.

6

# Endangered or Threatened Species

## Daniel Morgan

**From:** Fullerton, Matthew <matthew.fullerton@odwc.ok.gov>
**Sent:** Thursday, April 23, 2020 4:10 PM
**To:** Daniel Morgan
**Subject:** Re: Northeast Landfill - Threatened and Endangered Species Statement

Hi Daniel,
Apologies for my lateness in getting back to you. I would blame it on COVID, but that really hasn't changed my day-to-day workload!

We don't have any concerns over this location and the site is outside of the range of any state-listed threatened or endangered species.

Please let me know if you need anything else from us.

Thanks,

**Matt Fullerton**
**Wildlife Biologist - Threatened & Endangered Species**
**Wildlife Diversity Program**
**Oklahoma Department of Wildlife Conservation**
**Cell: 580-571-5820**
**Email: matthew.fullerton@odwc.ok.gov**

On Mon, Apr 13, 2020 at 3:34 PM Daniel Morgan <dmorgan@hydrex-inc.com> wrote:

> Good afternoon Matt,
>
> Just following up on this letter.  Given the craziness of the last few weeks and focusing on other parts of this project, I had let the T&E statements sit on the backburner, so I wanted to see if I needed to provide any more info on this.
>
> Thanks again for your help,

**Daniel Morgan**

Environmental Scientist

Hydrex Environmental

1120 NW Stallings Dr.

Nacogdoches, TX 75964

Office: 936-568-9451

Cell: 936-553-8598

**From:** Fullerton, Matthew [mailto:matthew.fullerton@odwc.ok.gov]
**Sent:** Tuesday, March 10, 2020 9:08 AM
**To:** Daniel Morgan <dmorgan@hydrex-inc.com>
**Subject:** Re: Northeast Landfill - Threatened and Endangered Species Statement

Hi Daniel,

Apologies for the delayed response. Your email was somehow sent to my spam filter and I just now found it.

I should be able to complete this for you by the end of the day. Thank you for your patience!

Regards,

**Matt Fullerton**

**Wildlife Biologist - Threatened & Endangered Species**

**Wildlife Diversity Program**

**Oklahoma Department of Wildlife Conservation**

**Cell: 580-571-5820**

**Email: matthew.fullerton@odwc.ok.gov**

On Thu, Mar 5, 2020 at 5:10 PM Daniel Morgan <dmorgan@hydrex-inc.com> wrote:

Good Afternoon Matt,

This is Daniel Morgan with Hydrex Environmental, we spoke earlier regarding a threatened and endangered species statement for a project in Spencer (Oklahoma County), Oklahoma. I have attached a zipped shapefile of the project area, as well as a vicinity map showing the project area. The project area encompasses 163.3 acres, which includes an existing 90.3-acre landfill property and an approximate 73-acre expansion area to the north of the existing landfill. The existing landfill is currently operating as a construction and demolition (C&D) landfill, while the proposed expansion area is partially utilized for soil stockpile and borrow.

As part of complying with ODEQ regulations, I am requesting a statement regarding the existence of federal and state listed species within the vicinity of the permit area. Please let me know if I can provide any more information, I appreciate your help.

Thanks,

**Daniel Morgan**

Environmental Scientist

Hydrex Environmental

1120 NW Stallings Dr.

Nacogdoches, TX 75964

Office: 936-568-9451

Cell: 936-553-8598

Public Water Supply Surface Intake

August 18, 2023
Project No. 16219107.00

Ms. Ginger Sharkness
Oklahoma Department of Environmental Quality
Public Water Supply
707 North Robinson
Oklahoma City, OK 73101

**Subject:** **Northeast C&D Landfill**
**Proposed Tier III Application Notification**
**Request for Public Water Supply Evaluation**

Dear Ms. Sharkness:

As required by Oklahoma Department of Environmental Quality (DEQ) Oklahoma Administrative Code 252:515-5-52(e) and on behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), SCS Engineers is submitting this notification for a horizontal and vertical expansion of its existing construction and demolition (C&D) debris landfill. The proposed expansion will be located on GFL-owned property, north of the existing C&D landfill footprint.

The proposed landfill expansion is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma as shown on general site location maps (Figures 1, 3, and 6). Figure 4 depicts the locations of the public water supply (PWS) surface water intakes and public water supply wells relative to the site location.

DEQ regulation states the following: *Except for solid waste processing facilities where no waste is stored or placed on permeable surfaces, no new waste management or disposal areas of a solid waste disposal facility shall be located within: (1) one mile upgradient of an existing public water supply surface water intake, or one that is permitted for construction when a complete application has been filed with the DEQ; or (2) a one year time of travel of a public water supply well.*

Based on our review of Figure 4, there are two PWS surface water intakes within one mile of the proposed landfill expansion (http://gis.deq.ok.gov/maps/); however, both wells are located **up-gradient** of the proposed landfill expansion.

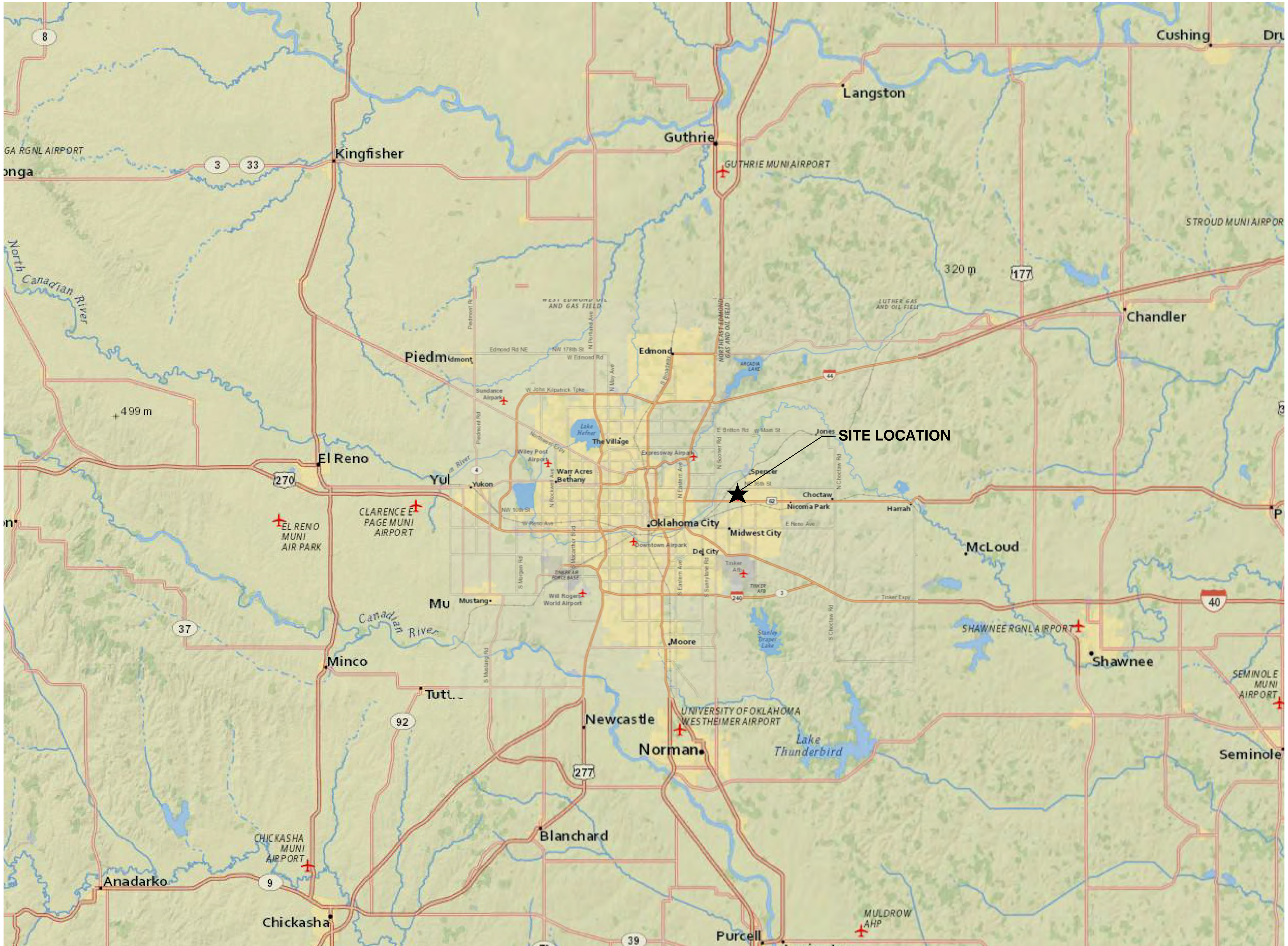
On behalf of GFL, we request you to review the enclosed maps at your earliest convenience and confirm that the proposed landfill is in compliance with OAC 252:515-5-32(b). If you have any questions or need additional information, please do not hesitate to contact Sandeep Saraf at (407) 923-7013. Thank you for your time and effort in this matter.

Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
**SCS Engineers**

Ryan Kuntz, P.E.
Vice President / Satellite Office Manager
**SCS Engineers**

Enclosures: Figures 1, 3, 4, 5, and 6




N

0 4 MILES 8 MILES

APPROXIMATE SCALE IN MILES

SOURCE:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

FOR PERMITTING PURPOSES ONLY

6/4/2023 8:37 PM G:\Northeast CAD\16219107.00 - Tier II Permit Mod Application\Location Restriction Letters Drawings\12-17-21\01 LOC MAP1

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: GENERAL LOCATION MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084


**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

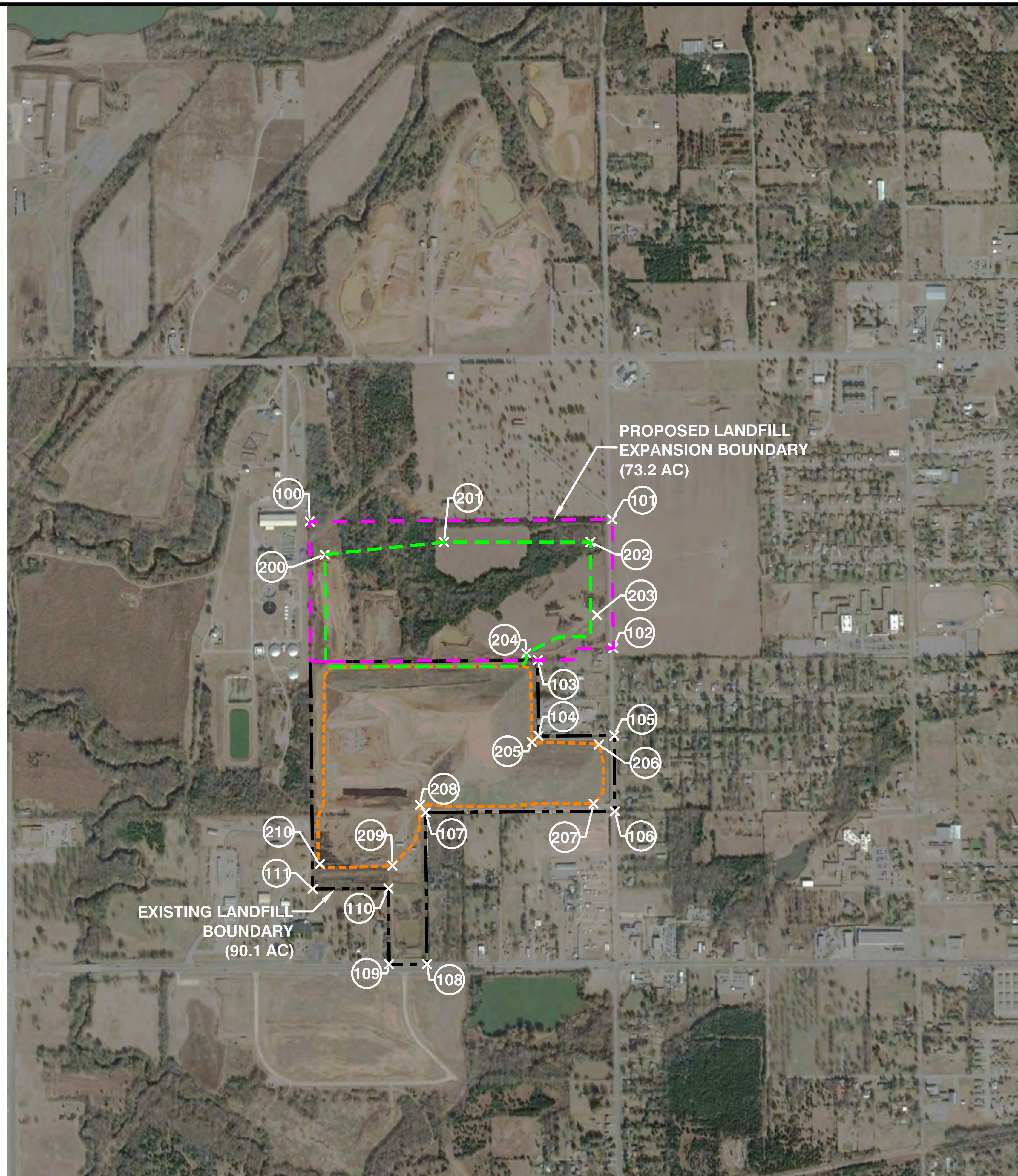

PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

CADD FILE: 01 LOC MAP1

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 1




N

0 500 1000

SCALE IN FEET

## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- CURRENT LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE

| PERMIT BOUNDARY | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 100 | N35° 30' 13.47" | W97° 23' 51.04" |
| 101 | N35° 30' 13.49" | W97° 23' 19.15" |
| 102 | N35° 30' 02.39" | W97° 23' 19.11" |
| 103 | N35° 30' 01.40" | W97° 23' 27.08" |
| 104 | N35° 29' 54.86" | W97° 23' 27.06" |
| 105 | N35° 29' 54.86" | W97° 23' 19.08" |
| 106 | N35° 29' 48.32" | W97° 23' 19.05" |
| 107 | N35° 29' 48.33" | W97° 23' 39.01" |
| 108 | N35° 29' 35.26" | W97° 23' 38.97" |
| 109 | N35° 29' 35.26" | W97° 23' 42.96" |
| 110 | N35° 29' 41.80" | W97° 23' 42.98" |
| 111 | N35° 29' 41.81" | W97° 23' 50.97" |

| LIMITS OF WASTE | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 200 | N35° 30' 10.61" | W97° 23' 49.46" |
| 201 | N35° 30' 11.63" | W97° 23' 36.89" |
| 202 | N35° 30' 11.55" | W97° 23' 21.45" |
| 203 | N35° 30' 05.27" | W97° 23' 20.81" |
| 204 | N35° 30' 02.01" | W97° 23' 28.29" |
| 205 | N35° 29' 54.32" | W97° 23' 27.76" |
| 206 | N35° 29' 54.10" | W97° 23' 20.68" |
| 207 | N35° 29' 48.99" | W97° 23' 21.29" |
| 208 | N35° 29' 48.99" | W97° 23' 39.61" |
| 209 | N35° 29' 43.77" | W97° 23' 42.53" |
| 210 | N35° 29' 43.95" | W97° 23' 50.20" |

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: AERIAL PHOTO

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

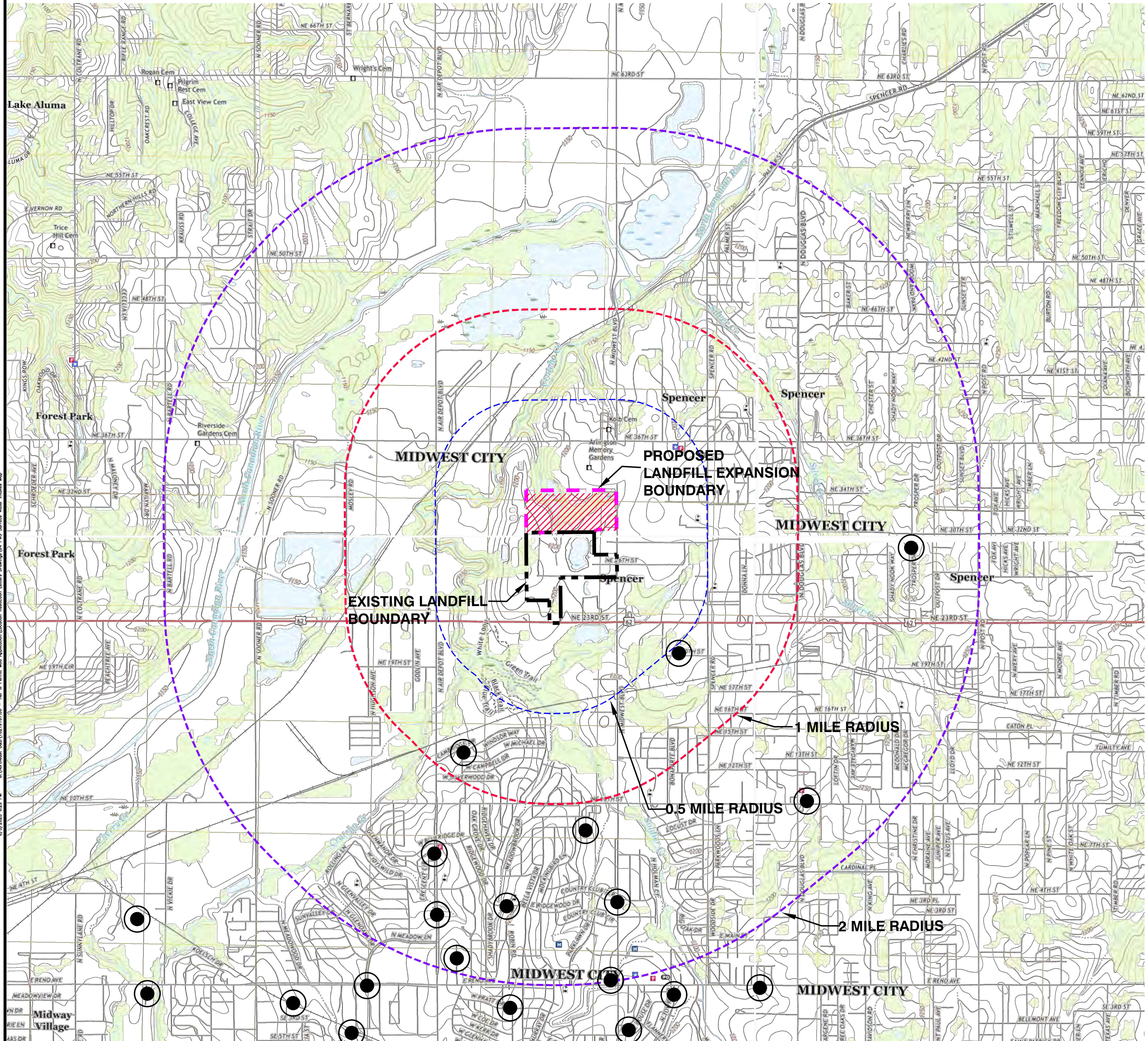
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 03 AERIAL PHOTO

DATE: 07/2023

SCALE: AS SHOWN

DRAWING NO. 3




N

0 1500 3000
SCALE IN FEET

## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- PROPOSED LANDFILL EXPANSION AREA
- 0.5 MILE RADIUS
- 1 MILE RADIUS
- 2 MILE RADIUS
- 1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- PUBLIC WATER SUPPLY (PWS) SURFACE WATER INTAKES (SEE NOTE 2)

## NOTE:

1. CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2018); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

2. LOCATION OF PWS SURFACE WATER INTAKES WAS OBTAINED FROM OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY.

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE
PWS SURFACE WATER INTAKES MAP

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
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1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

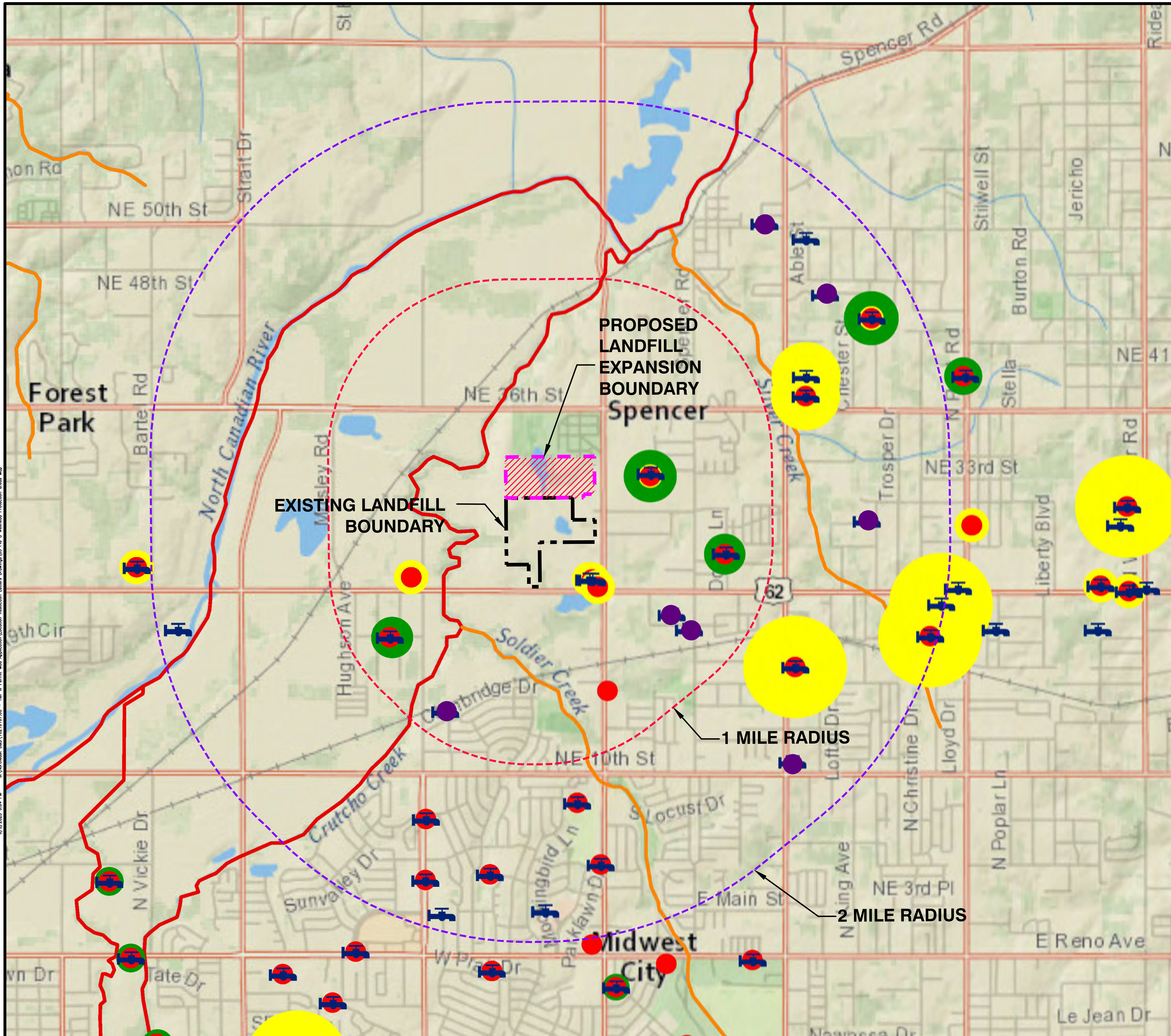
CADD FILE: 04 PWS SURFACE WATER INTAKES MAP

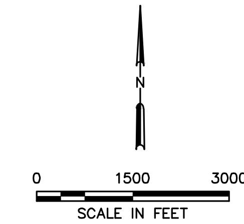
DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 4

6/5/2023 6:29 PM G:\Northeast CAD\16219107.00 – Tier III Permit Mod Application\Location Restriction Letters Drawings\04 PWS Surface Water Intakes Map




## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- PROPOSED LANDFILL EXPANSION AREA
- 1 MILE RADIUS
- 2 MILE RADIUS
- PWS WELLS
- NO WELLHEAD PROTECTION AREA

### WELLHEAD PROTECTION AREAS (WHPAs)

- ZONE A
- ZONE B
- ZONE C

**SOURCE:**

WELLHEAD PROTECTION AREAS INFORMATION OBTAINED FROM OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY.

**FOR PERMITTING PURPOSES ONLY**

REV. | DATE | DESCRIPTION | BY

DRAWING TITLE: **WELLHEAD PROTECTION AREAS MAP**

PROJECT TITLE: **NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION**

CLIENT: **N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084**

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

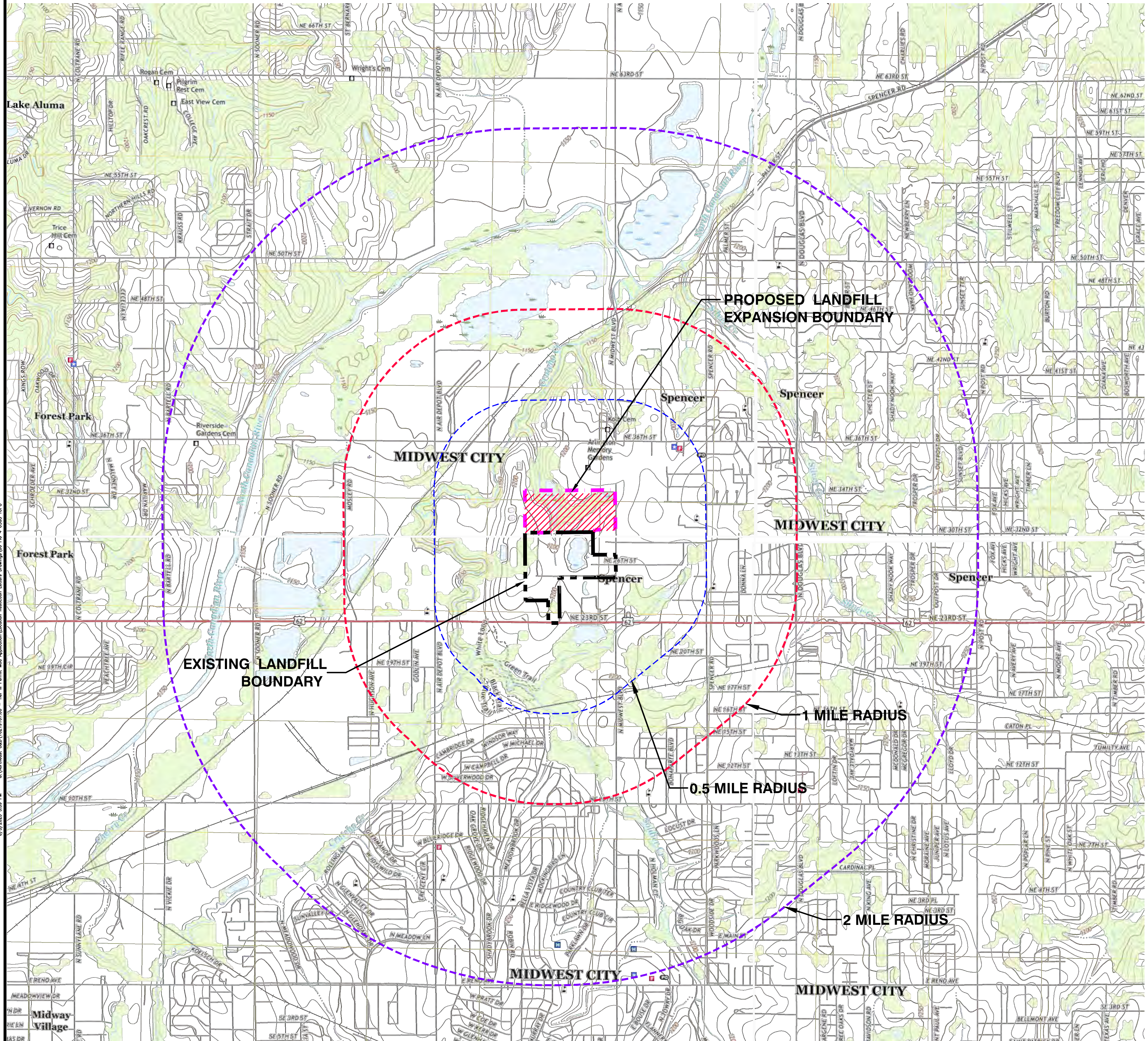
PROJ. NO. 16219107.00 | DWN. BY: NR | Q/A RVW BY: SDS
DSN. BY: SDS | CHK. BY: SDS | APP. BY: RRK

CADD FILE: 05 FIG 8 WELLHEAD PROTECTION AREAS MAP

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 5

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0 1500 3000
SCALE IN FEET

## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- PROPOSED LANDFILL EXPANSION AREA
- 0.5 MILE RADIUS
- 1 MILE RADIUS
- 2 MILE RADIUS
- 1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)

ROAD CLASSIFICATION

| | |
|---|---|
| Expressway | Local Connector |
| Secondary Hwy | Local Road |
| Ramp | 4WD |
| US Route | State Route |

## SOURCE:

CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2022); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

FOR PERMITTING PURPOSES ONLY

REV. | DATE | DESCRIPTION | BY

DRAWING TITLE: GENERAL TOPOGRAPHIC MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084


SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188


PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

CADD FILE: 06 FIG 4 USGS TOPO

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 6

6/5/2023 5:59 PM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application\Location Restriction Letters Drawings\06 FIG 4 USGS TOPO

# Wellhead Protection Areas

SCS ENGINEERS

Environmental Consulting & Contracting

August 18, 2023
Project No. 16219107.00

Mr. George Russell
Oklahoma Department of Environmental Quality
Wellhead Protection
707 North Robinson Avenue
Oklahoma City, OK 73101

**Subject:** **Northeast C&D Landfill**
**Proposed Tier III Application Notification**
**Request for Wellhead Protection Area Evaluation**

Dear Mr. Russell:

As required by Oklahoma Department of Environmental Quality (DEQ) Oklahoma Administrative Code 252:515-5-52(e) and on behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), SCS Engineers is submitting this notification for a horizontal and vertical expansion of its existing construction and demolition (C&D) debris landfill. The proposed landfill expansion is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma.

Three general site location maps (Figures 1, 3, and 6) are enclosed. Latitude/longitude of the corners of the permit boundaries are provided in Figure 3. Figure 4, showing the location of the site on DEQ Geographic Information Systems (GIS) Map downloaded from DEQ's GIS Maps and Data website, is also enclosed. Figure 4 also depicts the locations of the public water supply wells within two miles of the site.

DEQ regulation states the following: *If any new waste management or disposal areas will be located within two miles of a public water supply well, a wellhead protection area shall be identified, as specified by the State Wellhead Protection Plan, and information submitted to DEQ.*

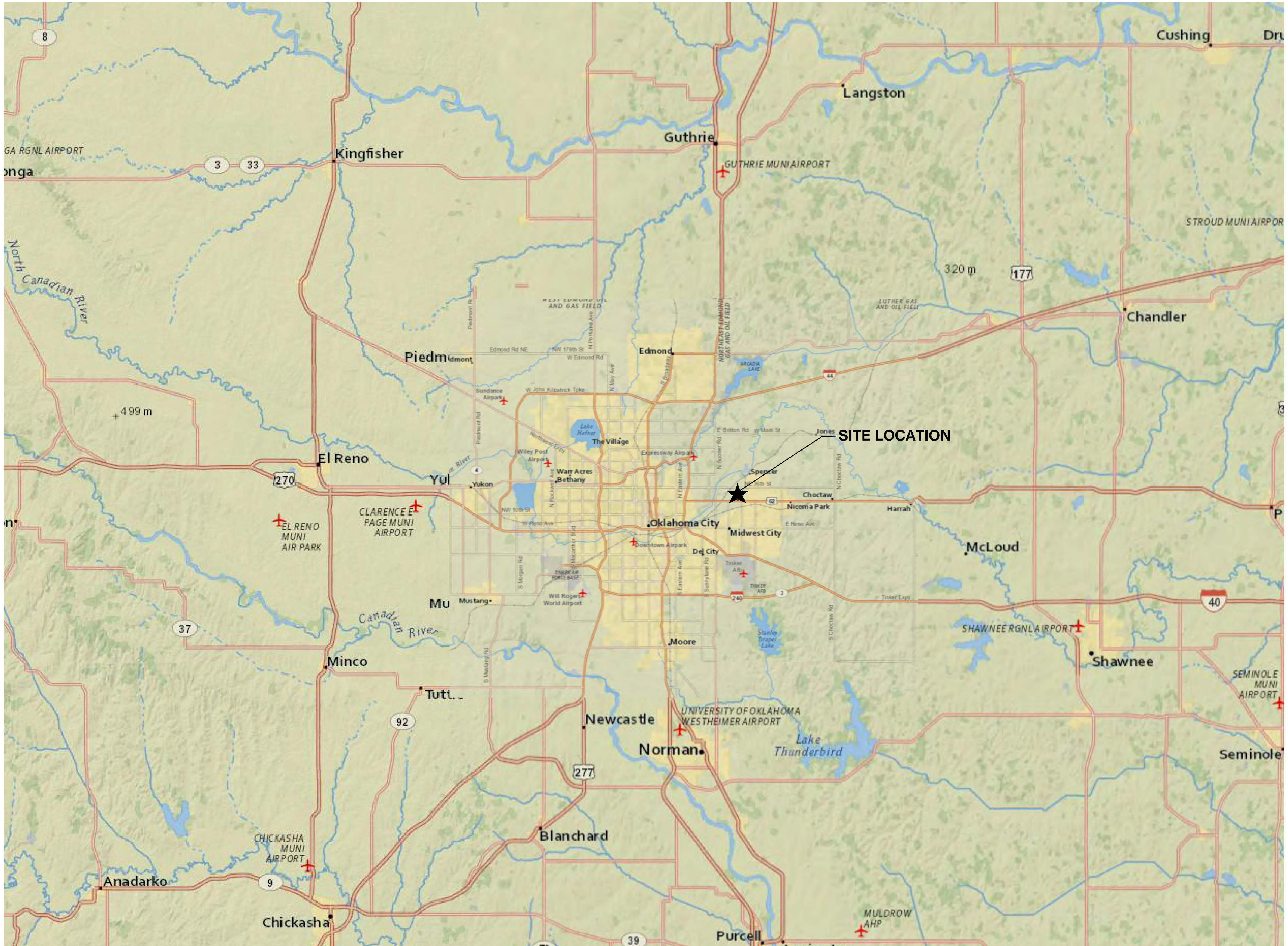
On behalf of GFL, we request you to review the enclosed maps and provide this evaluation as required by DEQ, at your earliest convenience. If you have any questions or need additional information, please do not hesitate to contact Sandeep Saraf at (407) 923-7013. Thank you for your time and effort in this matter.

Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
**SCS Engineers**

Ryan Kuntz, P.E.
Vice President / Satellite Office Manager
**SCS Engineers**

Enclosures: Figures 1, 3, 4, and 6




N

0 4 MILES 8 MILES
APPROXIMATE SCALE IN MILES

SOURCE:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: GENERAL LOCATION MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

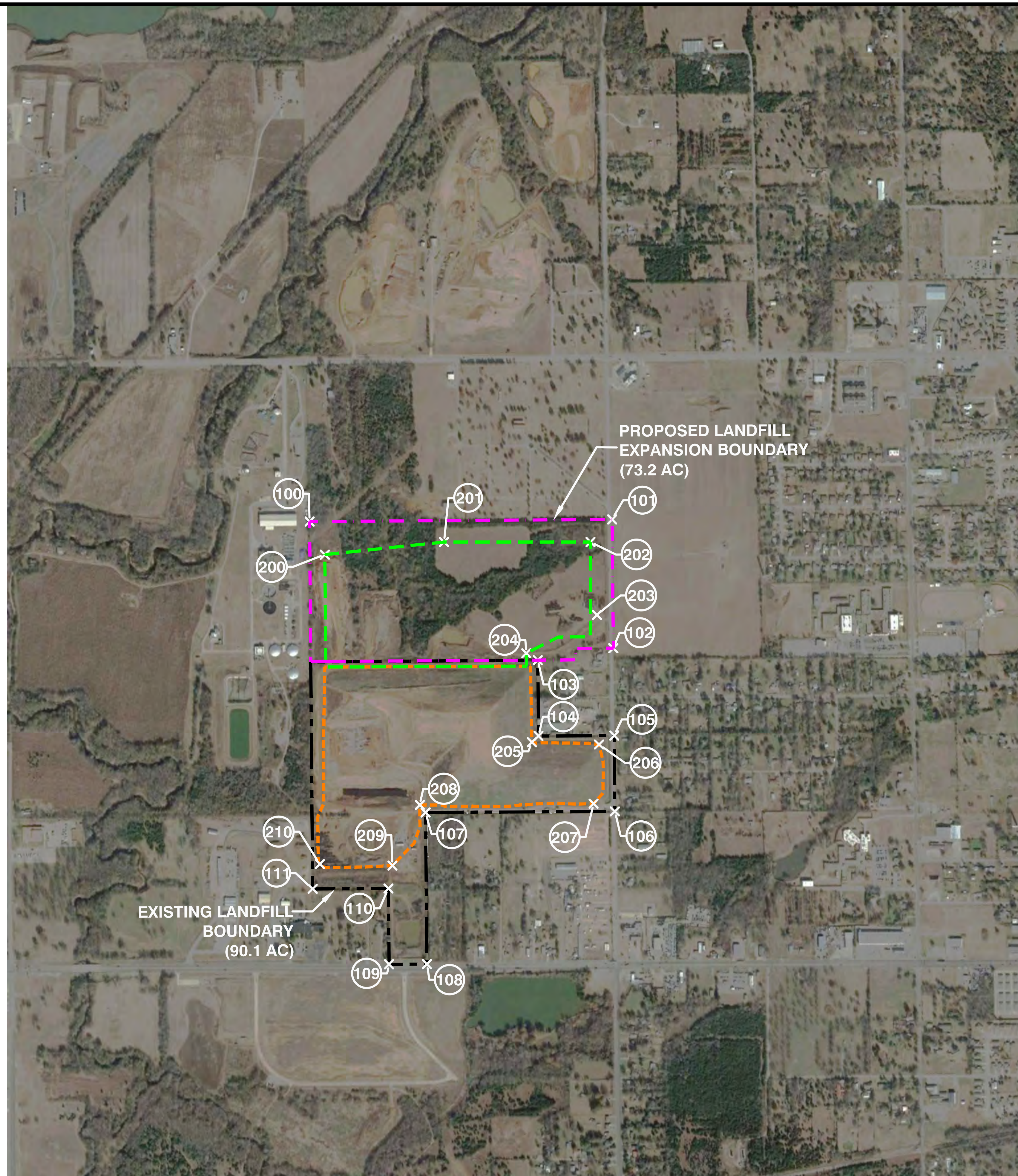
PROJ. NO.: 16219107.00 | DSN. BY: SS | DWN. BY: NR | CHK. BY: RRK | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 01 LOC MAP1

DATE: 07/2023

SCALE: AS SHOWN

DRAWING NO. 1




N

0 500 1000
SCALE IN FEET

## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- CURRENT LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE

| PERMIT BOUNDARY | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 100 | N35° 30' 13.47" | W97° 23' 51.04" |
| 101 | N35° 30' 13.49" | W97° 23' 19.15" |
| 102 | N35° 30' 02.39" | W97° 23' 19.11" |
| 103 | N35° 30' 01.40" | W97° 23' 27.08" |
| 104 | N35° 29' 54.86" | W97° 23' 27.06" |
| 105 | N35° 29' 54.86" | W97° 23' 19.08" |
| 106 | N35° 29' 48.32" | W97° 23' 19.05" |
| 107 | N35° 29' 48.33" | W97° 23' 39.01" |
| 108 | N35° 29' 35.26" | W97° 23' 38.97" |
| 109 | N35° 29' 35.26" | W97° 23' 42.96" |
| 110 | N35° 29' 41.80" | W97° 23' 42.98" |
| 111 | N35° 29' 41.81" | W97° 23' 50.97" |

| LIMITS OF WASTE | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 200 | N35° 30' 10.61" | W97° 23' 49.46" |
| 201 | N35° 30' 11.63" | W97° 23' 36.89" |
| 202 | N35° 30' 11.55" | W97° 23' 21.45" |
| 203 | N35° 30' 05.27" | W97° 23' 20.81" |
| 204 | N35° 30' 02.01" | W97° 23' 28.29" |
| 205 | N35° 29' 54.32" | W97° 23' 27.76" |
| 206 | N35° 29' 54.10" | W97° 23' 20.68" |
| 207 | N35° 29' 48.99" | W97° 23' 21.29" |
| 208 | N35° 29' 48.99" | W97° 23' 39.61" |
| 209 | N35° 29' 43.77" | W97° 23' 42.53" |
| 210 | N35° 29' 43.95" | W97° 23' 50.20" |

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE
AERIAL PHOTO

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084


SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188


PROJ. NO. 16219107.00
DSN. BY: SS
DWN. BY: DS
CHK. BY: SDS
Q/A RVW BY: SS
APP. BY: RRK

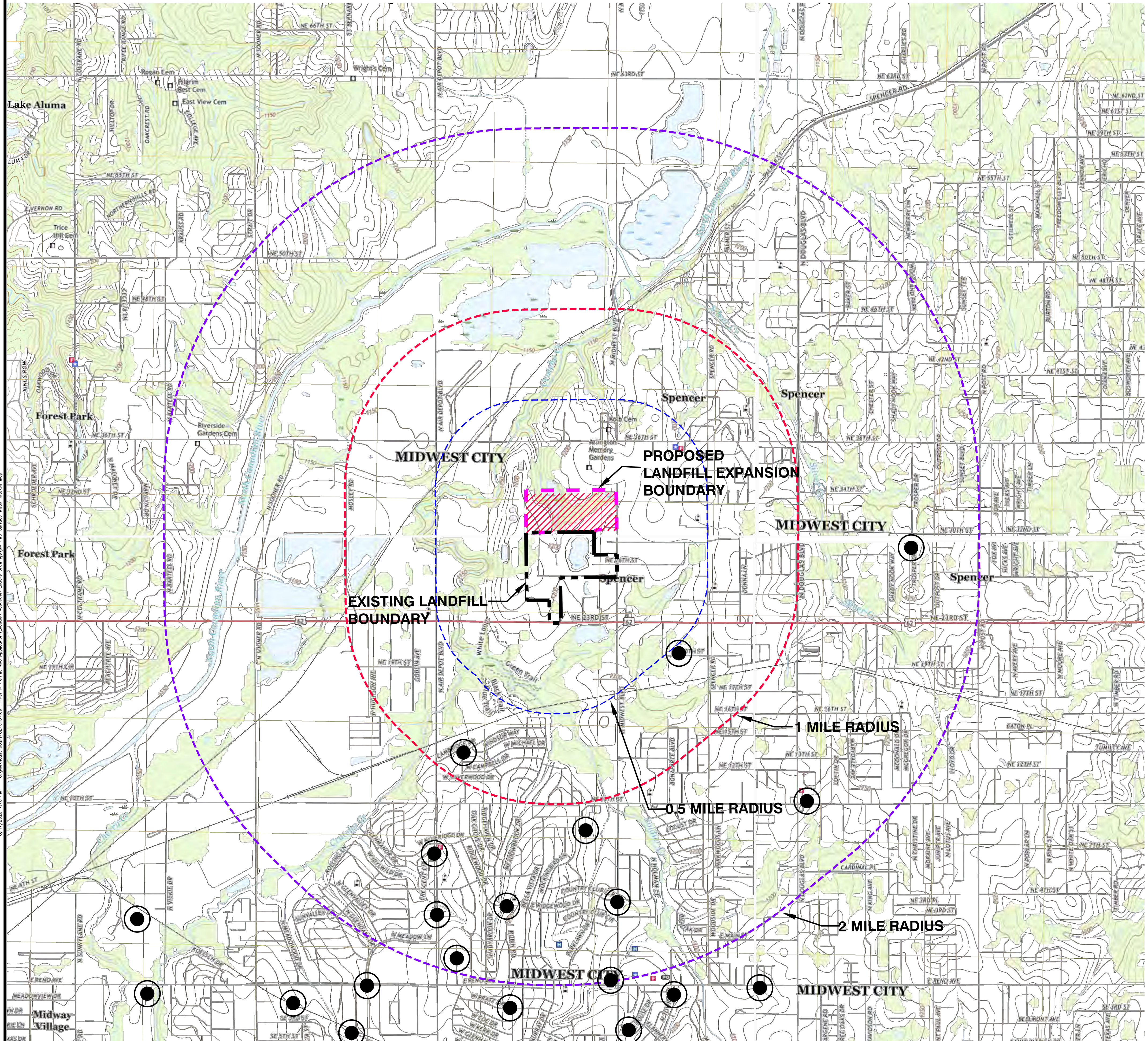
CADD FILE: 03 AERIAL PHOTO

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO.
3


8/17/2023 7:14 PM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application\Location Restriction Letters Drawings\03 AERIAL PHOTO




0 1500 3000
SCALE IN FEET

## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- PROPOSED LANDFILL EXPANSION AREA
- 0.5 MILE RADIUS
- 1 MILE RADIUS
- 2 MILE RADIUS
- 1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)
- PUBLIC WATER SUPPLY (PWS) SURFACE WATER INTAKES (SEE NOTE 2)

## NOTE:

1. CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2018); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.
2. LOCATION OF PWS SURFACE WATER INTAKES WAS OBTAINED FROM OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY.

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE
PWS SURFACE WATER INTAKES MAP

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
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PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

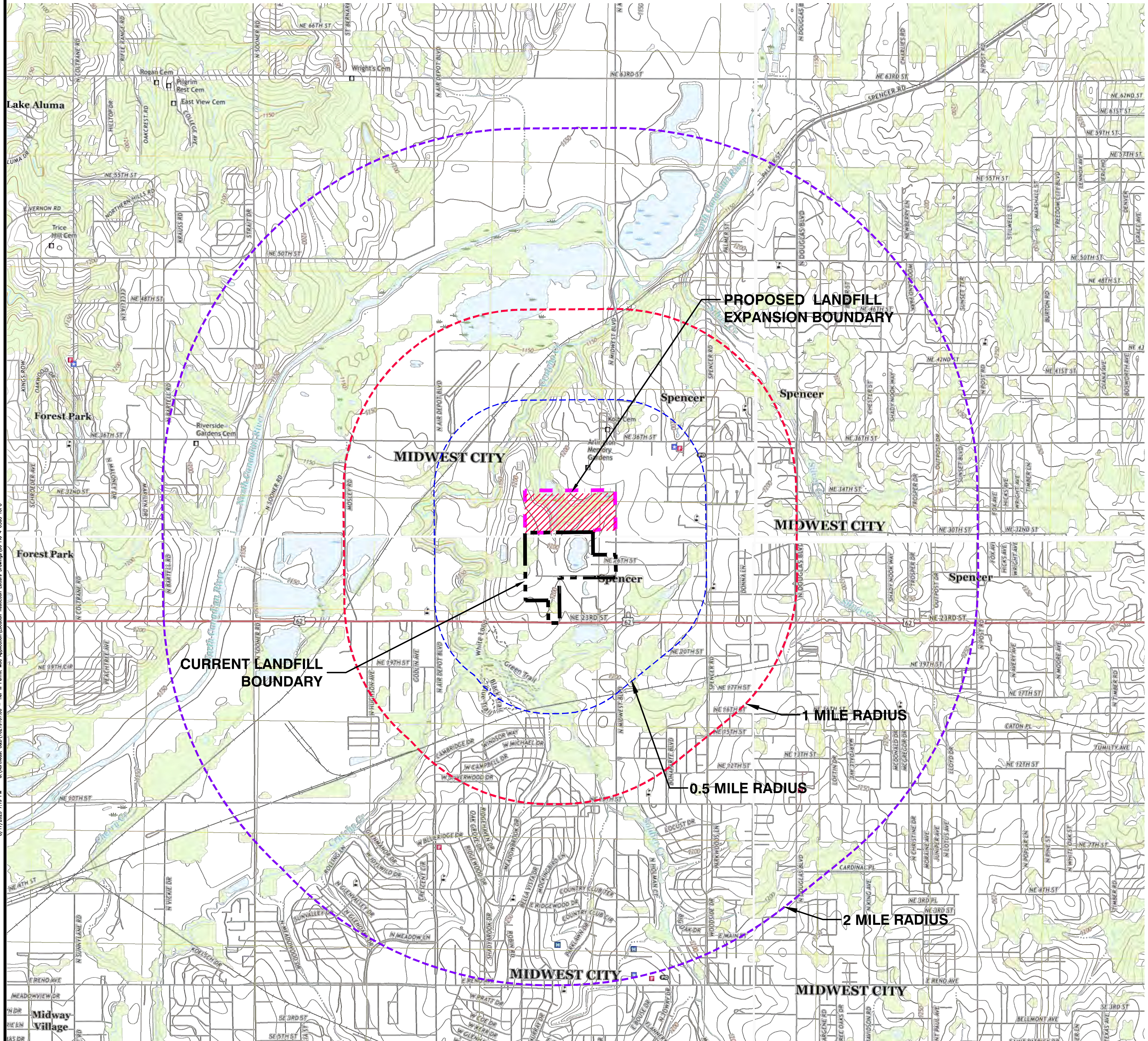
CADD FILE: 04 PWS SURFACE WATER INTAKES MAP

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 4

8/17/2023 7:15 PM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application\Location Restriction Letters Drawings\04 PWS Surface Water Intakes Map




0 1500 3000
SCALE IN FEET

## LEGEND

EXISTING LANDFILL BOUNDARY
PROPOSED LANDFILL EXPANSION BOUNDARY
PROPOSED LANDFILL EXPANSION AREA
0.5 MILE RADIUS
1 MILE RADIUS
2 MILE RADIUS
1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)

ROAD CLASSIFICATION

Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
US Route
State Route

## SOURCE:

CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2022); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|
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DRAWING TITLE: GENERAL TOPOGRAPHIC MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO.: 16219107.00
DSN. BY: SDS
DWN. BY: NR
CHK. BY: SDS
Q/A RVW BY: SDS
APP. BY: RRK

CADD FILE: 06 FIG 4 USGS TOPO

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 6

8/17/2023 7:19 PM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application\Location Restriction Letters Drawings\06 FIG 4 USGS TOPO

# Wetlands

Individual Permit

| U.S. Army Corps of Engineers (USACE)<br>**APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT**<br>33 CFR 325. The proponent agency is CECW-CO-R. | ***Form Approved - OMB No. 0710-0003 Expires: 02-28-2022*** |
|---|---|

The public reporting burden for this collection of information, OMB Control Number 0710-0003, is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or burden reduction suggestions to the Department of Defense, Washington Headquarters Services, at whs.mc-alex.esd.mbx.dd-dod-information-collections@mail.mil. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR APPLICATION TO THE ABOVE EMAIL.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned. System of Record Notice (SORN). The information received is entered into our permit tracking database and a SORN has been completed (SORN #A1145b) and may be accessed at the following website: http://dpcld.defense.gov/Privacy/SORNsIndex/DOD-wide-SORN-Article-View/Article/570115/a1145b-ce.aspx

**(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)**

| 1. APPLICATION NO. | 2. FIELD OFFICE CODE | 3. DATE RECEIVED | 4. DATE APPLICATION COMPLETE |
|---|---|---|---|
| | | | |

***(ITEMS BELOW TO BE FILLED BY APPLICANT)***

| 5. APPLICANT'S NAME | 8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required) |
|---|---|
| First - David Middle - Last - Bahrenburg | First - Clayton Middle - A. Last - Collier |
| Company - N.E. Land Fill, LLC | Company - Hydrex Environmental, LLC |
| E-mail Address - dbahrenburg@gflenv.com | E-mail Address - ccollier@hydrex-inc.com |
| 6. APPLICANT'S ADDRESS: | 9. AGENT'S ADDRESS: |
| Address- 1001 S Rockwell | Address- 1120 NW Stallings Drive |
| City - Oklahoma City State - OK Zip - 73128 Country - USA | City - Nacogdoches State - Texas Zip - 75964 Country - USA |
| 7. APPLICANT'S PHONE NOs. w/AREA CODE | 10. AGENTS PHONE NOs. w/AREA CODE |
| a. Residence b. Business (405) 492-8305 c. Fax | a. Residence b. Business 936-568-9451 c. Fax |

**STATEMENT OF AUTHORIZATION**

11. I hereby authorize, Clayton A. Collier to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

SIGNATURE OF APPLICANT DATE

**NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY**

12. PROJECT NAME OR TITLE (see instructions)
Northeast Landfill, 163.3-Acre Property, Including 73.2-Acre Landfill Expansion Area

| 13. NAME OF WATERBODY, IF KNOWN (if applicable) | 14. PROJECT STREET ADDRESS (if applicable) |
|---|---|
| Unnamed Tributary to Crutcho Creek | Address 2601 North Midwest Boulevard |
| 15. LOCATION OF PROJECT<br>Latitude: °N 35.496925 Longitude: °W 97.388838 | City - Spencer State- Oklahoma Zip- 73084 |

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID See Attachment. Municipality

Section - 22 Township - T12N Range - R2W

17. DIRECTIONS TO THE SITE

The Project Area is located immediately northwest of the intersection of North Midwest Boulevard and Northeast 23rd Street, at 2601 North Midwest Boulevard, within the city limits of Spencer (Oklahoma County), Oklahoma.

To access the site from the Oklahoma State Capitol building in Oklahoma City, travel east on Northwest 23rd Street for approximately 6.8 miles, then turn left onto North Midwest Boulevard. Continue for 0.3 miles and the site entrance will be on the left, marked by the Northeast Landfill sign.

18. Nature of Activity (Description of project, include all features)

The 163.3-acre Northeast Landfill property includes a 90.1-acre existing construction and demolition (C&D) landfill permitted under ODEQ Permit No. 3555050 and a proposed 73.2-acre lateral expansion area. N.E. Land Fill, LLC (NELF) is planning to expand the existing landfill vertically and horizontally into the 73.2-acre expansion area and provide disposal of C&D waste as well as municipal solid waste (MSW). The landfill expansion components include seven (7) proposed waste disposal cells, one (1) stormwater pond in the northwestern portion of the expansion area, one (1) stormwater pond in the eastern portion of the expansion area, one (1) run-on control channel spanning the northern property boundary, one (1) 15-foot screening berm along the eastern property boundary, three (3) perimeter drainage channels spanning the northern, eastern, and western property boundaries, and one (1) relocated natural gas pipeline extending north and then east along the perimeter of the expansion area.

See Attachment for further discussion.

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

The proposed landfill expansion will be constructed in order to meet the rising demand of waste storage capacity in the areas surrounding Oklahoma City. Based on county population growth projections performed in 2012, Oklahoma County is expected to experience an annual average growth rate of 0.69 percent until 2075 (Oklahoma Department of Commerce). With this increase in population, it will be necessary to increase the waste storage capacity of Oklahoma County.

The Northeast Landfill is approaching the maximum waste disposal capacity of its current designs, therefore presenting a need to increase waste disposal capacity. The purpose of this project is to provide additional waste disposal capacity for the Oklahoma City and the surrounding areas. The expansion of Northeast Landfill is not a water dependent activity.

**USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED**

20. Reason(s) for Discharge

In order to utilize the area north of the existing landfill, approximately 0.66 acres of scrub-shrub wetlands, 0.68 acres of open water, and approximately 0.05 acres (746 LF) of intermittent stream will need to be disturbed for the construction of the proposed landfill cells and stormwater pond.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

| Type<br>Amount in Cubic Yards | Type<br>Amount in Cubic Yards | Type<br>Amount in Cubic Yards |
|---|---|---|

See Attachment.

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres 0.56 acres of scrub-shrub wetlands; 0.68 acres of open water

or

Linear Feet 746 LF of intermittent stream

23. Description of Avoidance, Minimization, and Compensation (see instructions)

Due to the location of the existing landfill, the only available area for expansion of the Northeast Landfill is north of the currently permited landfill. Existing development, both residential and commercial, is located to the east, south, and west. Therefore, impacts to aquatic resources could not be avoided.

See Attachment for further discussion.

24. Is Any Portion of the Work Already Complete? ☐ Yes ☒ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (If more than can be entered here, please attach a supplemental list).

a. Address- 3400 N Midwest Blvd

City - Spencer State - OK Zip - 73084

b. Address- PO Box 50189

City - Midwest City State - OK Zip - 73140

c. Address- 5600 NW 83rd Street

City - Oklahoma City State - OK Zip - 73132

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

| AGENCY | TYPE APPROVAL* | IDENTIFICATION NUMBER | DATE APPLIED | DATE APPROVED | DATE DENIED |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT DATE SIGNATURE OF AGENT DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

**USACE Tulsa District**
**ENG 4345 Form Attachment**
**Request for Individual Permit**
**Northeast Landfill**

**Box 16. State Tax Parcel ID**
The Oklahoma County Assessor Account Numbers associated with the site are as follows:

R168553475
R191490500
R191497440
R191497430
R191497420
R191497400
R191497450
R191497460
R191497470
R191497490
R191497480
R191494200
R191493900
R191495000

**Box 18. Nature of Activity**

Furnished information indicates waste filling for the expansion area will piggyback onto the north slope of the existing C&D landfill to the south of the expansion area and extend northward into the 73.2-acre expansion area. The landfill liner and leachate collection system to be constructed for the expansion area will consist of the following components from bottom to top: a 2-foot thick layer of recompacted soil with a maximum permeability of 1.0 x $10^{-7}$ cm/sec; a 60-mil thick HDPE geomembrane (smooth on the bottom, textured on the side slopes); a leachate collection layer drainage geocomposite (single-sided on bottom, double-sided on side slopes); and a 2-foot thick layer of protective cover soil.

The initial cell construction will occur in the southwest portion of the lateral expansion area in the area designated as Phase 11 on the expansion layout plan. Subsequent landfill construction will advance to the north and then to the east in sequence with the designated Phases 12 through 17.

Designs for the project area, provided by SCS Engineers, are included in Attachment C.

**Box 21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards**

| | |
|---|---|
| **Proposed Landfill Expansion Waste Cells:** | |
| Wetland A: | Fill, 118,000 cubic yards |
| Wetland B: | Fill, 22,700 cubic yards |
| Open Water 5: | Fill, 147,000 cubic yards |
| Stream 2: | Fill, 3,000 cubic yards |
| **Proposed Stormwater Pond:** | |
| Stream 2: | Fill, 400 cubic yards |

**Total discharge volume: 291,100 cubic yards**

**USACE Tulsa District**
**ENG 4345 Form Attachment**
**Request for Individual Permit**
**Northeast Landfill**

## Box 23. Description of Avoidance, Minimization, and Compensation

In order to determine if reasonably practicable alternatives that avoided or minimized impacts were available, an alternatives analysis was conducted for the Northeast Landfill Expansion. In addition to the proposed designs outlined in the Project Details section of this report, several potential alternatives were considered.

**<u>Alternative #1: No Action Alternative</u>**
The No Action Alternative, which would not involve any additional construction activities beyond the continued use of the landfill, would result in the facility closing and ceasing to provide waste disposal services to business and communities that are currently under contract with the Northeast Landfill. Therefore, alternative plans for construction were considered.

**<u>Alternative #2: Off-Site Permitting of New Facility</u>**
Off-site permitting of a new facility was considered, but was deemed unreasonable due to several factors. Environmental impacts from construction of a new landfill site are substantially greater than an expansion of an existing facility. Other factors include high costs associated with property acquisitions, additional time for siting studies, and greater permitting timelines. Therefore, off-site permitting was deemed unreasonable or not viable for the Northeast Landfill.

**<u>Alternative #3: On-Site Configurations</u>**
On-site configurations that would reduce the potential impacts to WOTUS from the expansion were considered, but were deemed unreasonable due to several factors. The primary factor for this is a higher development cost per cubic yard of airspace and minimal increase in site operating life for cost spent. Therefore, alternative on-site configurations were deemed unreasonable or not viable for the Northeast Landfill.

**<u>Alternative #4: Currently Proposed Landfill Expansion</u>**
According to NELF, several alterations to the proposed waste cell configuration were considered. The proposed landfill expansion configuration is optimal for NELF's future capacity and operating life needs, and alterations to avoid WOTUS would greatly reduce the available disposal capacity and increase cost per cubic yard of airspace to a point that the expansion would not be viable. In addition, keeping the expansion area in such close proximity will allow for the soil excavated for construction of the proposed waste cells to be hauled to the existing landfill to be used for daily cover and constructions needs. The proposed design maximizes the amount of airspace produced by expanding the existing waste disposal cells (Phases 5 and 6) as well as constructing the cells deeper and higher to reduce lateral impacts. Therefore, there are no alternative designs that minimize impacts to WOTUS without drastically reducing cost effectiveness.

Based on the conclusions of the *Jurisdictional Determination* letter dated December 11, 2020 by the U.S. Army Corps of Engineers Tulsa District, proposed permanent impacts to waters of the U.S. amount to amount to 0.56 acres of scrub-shrub wetland impacts, 0.68 acres of open water impacts, and 746 linear feet (0.05 acres) of intermittent stream impacts. Therefore, NELF proposes to purchase stream and wetland credits from the Deep Fork Mitigation Bank (DFMB) in order to offset unavoidable, permanent impacts from the proposed landfill expansion.

The DFMB does not utilize any particular functional assessment method, therefore the *Texas Rapid Assessment Method* (TXRAM) 2.0, was conducted by Hydrex to evaluate wetland and stream quality. Utilizing TXRAM, Hydrex determined potential mitigation requirements for permanent impacts to the 0.56 acres of scrub-shrub Wetlands A and B and 746 linear feet (0.05 acres) of Stream 2 within the project site.

According to the TXRAM wetland functional assessment, Wetland A (0.40 acres) scored 49.2 out of a possible 115, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 4:1 for medium quality wetlands, therefore Wetland A will require the purchase of 1.6 wetland credits. Wetland B (0.16 acres) scored 49.3 out of a possible 115, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 4:1 for medium quality wetlands, therefore Wetland B will require the purchase of 0.64 wetland credits. Open Water 5 did not require a functional assessment, as DFMB utilizes the 3:1 ratio for low quality wetlands for open water features. Applying the 3:1 ratio for low quality wetlands, Open Water 5 will require the purchase of 2.04 wetland credits. Based on these scores, NELF will be required to purchase 4.28 wetland credits for impacts at the Northeast Landfill Expansion.

According to the TXRAM stream functional assessment, Stream 2 (746 linear feet) scored 39.5 out of a possible 105, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 2:1 for medium quality intermittent streams, therefore Stream 2 will require the purchase of 1,492 intermittent stream credits. However, at this time DFMB does not have sufficient intermittent stream credits to fulfill this compensatory mitigation requirement. Therefore, Hydrex is requesting approval for the purchase of perennial stream credits as needed to supplement the purchase of intermittent stream credits and satisfy mitigation requirements. At this time, DFMB has 366 intermittent stream credits available for purchase. Hydrex respectfully requests a 0.5:1 mitigation ratio for the purchase of perennial stream credits to satisfy the remainder of mitigation requirements. In the event that more intermittent stream credits become available during the permitting process, those will be purchased prior to any perennial stream credits.

In conclusion, the total required credits will be 4.28 wetland credits and 1,492 intermittent stream credits for the proposed landfill expansion. As of May 2021, RIBITS indicates that the DFMB only has 336 intermittent stream credits available, which will be purchased to satisfy mitigation requirements for Stream 2. Due to insufficient available intermittent stream credits, perennial stream credits will be purchased at a 0.5:1 ratio to satisfy the remainder of the compensatory mitigation needs for this project. The TXRAM functional assessment datasheets and final scoring sheets are attached.

# REQUEST FOR INDIVIDUAL PERMIT

## NORTHEAST LANDFILL
## 163.3-ACRE PROPERTY, INCLUDING 73.2-ACRE LANDFILL EXPANSION

### 2601 NORTH MIDWEST BLVD.
### SPENCER, OKLAHOMA COUNTY

**Hydrex Project No. A-12-1361**

**Report Date: May 28, 2021**

**Prepared for:**
**U.S. Army Corps of Engineers**
**Tulsa District**
**CEWST-RO**
**2488 81st Street**
**Tulsa, OK 74137-4290**


**Prepared by:**
**Hydrex Environmental**
**1120 NW Stallings Drive**
**Nacogdoches, Texas 75964**
**(936) 568-9451 FAX (936) 568-9527**


Hydrex
ENVIRONMENTAL

ENVIRONMENTAL

May 28, 2021

Mr. Robert Hoffman
U.S. Army Corps of Engineers
Tulsa District
CESWT-RO
2488 R. 81st Street
Tulsa, Oklahoma 74137-4290

**RE: REQUEST FOR INDIVIDUAL PERMIT**
**Northeast Landfill**
**163.3-Acre Property, Including 73.2-Acre Landfill Expansion**
**2601 North Midwest Blvd.**
**Spencer (Oklahoma County), Oklahoma**
**Hydrex Project No. A-12-1361**

Mr. Robert Hoffman,

The enclosed application package is a request for authorization under an Individual Permit for unavoidable impacts to waters of the U.S. (WOTUS) associated with the expansion of the Northeast Landfill ("Project Area"). This 163.3-acre Project Area consists of an existing 90.1-acre construction and demolition (C&D) landfill permitted under ODEQ Permit No. 3555050 and a proposed 73.2-acre lateral expansion area. The proposed plans involve a horizontal and vertical expansion of the landfill, which will be used for solid waste disposal. This request is being submitted by Hydrex Environmental (Hydrex) on behalf of N.E. Land Fill, LLC (NELF).

The Project Area is a 163.3-acre property currently owned by NELF, which consists of the 90.1-acre existing C&D landfill, and a proposed 73.2-acre lateral expansion area. The Project Area is located immediately northwest of the intersection of North Midwest Boulevard and Northeast 23rd Street, at 2601 North Midwest Boulevard, within the city limits of Spencer (Oklahoma County), Oklahoma, as depicted on Figure 1 in Attachment A. The approximate NAD 83 geographic coordinates for the site entrance are: N 35.496925, W 97.388838.

Oklahoma City and the surrounding Oklahoma County are expected to continue seeing growth in population, and as such will require an increase in waste storage capacity. The Northeast Landfill Expansion is proposed in order to meet the increase in demand. Due to the location of the existing landfill, the only available area for expansion of the Northeast Landfill is north of the current permit boundary. Existing development, both residential and commercial, is to the east, south, and west. Therefore, impacts to aquatic resources could not be avoided. The proposed Northeast Landfill Expansion components include seven (7) proposed waste disposal cells, one (1) stormwater pond in the northwestern portion of the expansion area, one (1) stormwater pond in the northern portion of the expansion area, one (1) run-on control channel spanning the northern property boundary, one (1) 15-foot screening berm along the eastern property boundary, three (3) perimeter drainage channels spanning the northern, eastern, and western property boundaries, and one (1) relocated natural gas pipeline extending north and then east along the perimeter of the expansion area. The location of project components are depicted on Figures 2 and 3 in Attachment A.

Based on the conclusions of the *Jurisdictional Determination* letter dated December 11, 2020 by the U.S. Army Corps of Engineers (USACE) Tulsa District, the following WOTUS were identified within the Project Area: two (2) scrub-shrub wetlands (Wetlands A and B), one (1) open water (Open Water 5),and one (1) intermittent stream (Stream 2). Scrub-shrub Wetland A (0.40 acres) is located within the proposed location of Phase 12 of the lateral expansion area. Scrub-shrub Wetland B (0.16 acres) is located within the proposed location of Phase 13 of the lateral expansion area. Open Water 5 (0.68 acres) is located within the proposed locations of Phase 12 and 13 of the lateral expansion area. Intermittent Stream 2 (746 linear feet, 0.05 acres) flows through proposed Phase 13 as well as the proposed stormwater pond in the lateral expansion area. Therefore, total impacts to waters of the U.S., including wetlands, amount to 0.56 acres of scrub-shrub wetland impacts, 0.68 acres of open water impacts, and 746 linear feet of intermittent stream impacts. To minimize impacts to any downgradient WOTUS, sediment and erosion controls will be implemented in accordance with the site's Stormwater Pollution Prevention Plan (SWP3).

Based on proposed impacts to WOTUS (approximately 1.29 acres), this project does not fall within the guidelines of any Nationwide Permits, and therefore requires the submission of a Request for an Individual Permit to the U.S. Army Corps of Engineers (USACE) Tulsa District. Therefore, on behalf of NELF, we respectfully request authorization under an Individual Permit for unavoidable impacts to WOTUS associated with the Northeast Landfill Expansion.

## DELINEATION OF WATERS OF THE U.S.

## AND APPROVED JURISDICTIONAL DETERMINATION

The area reviewed for this investigation was delineated March 16 to 18, 2020 by Hydrex to evaluate site conditions and identify potential WOTUS. The area reviewed includes the 163.3-acre Project Area, consisting of the 90.1-acre existing C&D landfill, and a proposed 73.2-acre lateral expansion area . The results of this delineation were submitted to the USACE Tulsa District as part of a July 8, 2020 *Approved Jurisdictional Determination Request*, which was resolved in the December 11, 2020 *Jurisdictional Determination*.

Based on the findings of the *Jurisdictional Determination* letter provided by the USACE Tulsa District, the following waters of the U.S. were identified within the 163.3-acre Project Area.

- **Wetland A (Scrub-Shrub, 0.40 acres)**
- **Wetland B (Scrub-Shrub, 0.16 ac)**
- **Stream 2 (Intermittent, 746 LF, 0.05 ac)**
- **Open Water 5 (Excavation; 0.68 acres)**

## PROJECT DETAILS

The 163.3-acre Northeast Landfill property includes a 90.1-acre existing construction and demolition (C&D) landfill permitted under ODEQ Permit No. 3555050 and a proposed 73.2-acre lateral expansion area. N.E. Land Fill, LLC (NELF) is planning to expand the existing landfill horizontally and vertically and horizontally into the 73.2-acre expansion area and provide disposal of C&D waste as well as municipal solid waste (MSW). The landfill expansion components include seven (7) proposed waste disposal cells, one (1) stormwater pond in the northwestern portion of the expansion area, one (1) stormwater pond in the northern portion of the expansion area, one (1) run-on control channel spanning the northern property boundary, one (1) 15-foot screening berm along the eastern property boundary, three (3) perimeter drainage channels spanning the northern, eastern, and western property boundaries, and one (1) relocated natural gas pipeline extending north and then east along the perimeter of the expansion area.

Furnished information from SCS Engineers indicates waste filling for the expansion area will piggyback onto the north slope of the existing C&D landfill and extend northward into the 73.2-acre expansion area. The landfill liner and leachate collection system to be constructed for the expansion area will consist of the following components from bottom to top: a 2-foot thick layer of recompacted soil with a maximum permeability of $1.0 \times 10^{-7}$ cm/sec; a 60-mil thick HDPE geomembrane (smooth on the bottom, textured on the side slopes); a leachate collection layer drainage geocomposite (single-sided on bottom, double-sided on side slopes); and a 2-foot thick layer of protective cover soil.

The initial cell construction will occur in the southwest portion of the lateral expansion area in the area designated as Phase 11 on the expansion layout plan. Subsequent landfill construction will advance to the north and then to the east in sequence with the designated Phases 12 through 17.

In order to minimize impacts to the environment, appropriate soil erosion and sediment controls (sediment fence, hay bales, rock riprap, vegetation mats, etc) will be used and maintained in effective operating conditions during the construction and during operation of all project elements. All development within this project will be designed to drain towards the stormwater management ditches and ponds. Stormwater will be routed through perimeter ditches towards the on-site detention ponds, where it will then be discharged into Stream 2. Construction is expected to be initiated following the approval of the ODEQ expansion permit in 2022. Designs for the project area, provided by SCS Engineers, are included in Attachment C.

The construction activities described above will require permanent fill within Wetlands A and B, Open Water 5, and Stream 2. Table 1 describes the volume of proposed fill to be placed in waters of the U.S., including wetlands.

**Table 1. Volume of Proposed Fill to be Placed in WOTUS.**

| Project Element | Feature ID | Material Fill (cubic yards) | Total Fill in WOTUS (cubic yards) |
|---|---|---|---|
| Landfill Expansion Waste Cells | Wetland A | **118,000** | **118,000** |
| Landfill Expansion Waste Cells | Wetland B | **22,700** | **22,700** |
| Landfill Expansion Waste Cells | Open Water 5 | **147,000** | **147,000** |
| Landfill Expansion Waste Cells | Stream 2 | **3,000** | **3,000** |
| Stormwater Pond | Stream 2 | **400** | **400** |
| | | **Total Fill in WOTUS (cubic yards)** | **291,100** |

## ALTERNATIVES ANALYSIS

In order to determine if reasonably practicable alternatives were available, an alternatives analysis was conducted for the Northeast Landfill Expansion. The Northeast Landfill is approaching the maximum waste disposal capacity of its current designs, therefore presenting a need to increase waste disposal capacity. The purpose of this project is to provide additional waste disposal capacity for the Oklahoma City Metro area. In addition to the proposed designs outlined in the Project Details section of this report, several potential alternatives were considered.

### Alternative #1: No Action Alternative

The No Action Alternative, which would not involve any additional construction activities beyond the continued use of the landfill, would result in the facility closing and ceasing to provide waste disposal services to business and communities that are currently under contract with the Northeast Landfill. Therefore, alternative plans for construction were considered.

**Alternative #2: Off-Site Permitting of New Facility**

Off-site permitting of a new facility was considered, but was deemed unreasonable due to several factors. Environmental impacts from construction of a new landfill site are substantially greater than an expansion of an existing facility. Other factors include high costs associated with property acquisitions, additional time for siting studies, and greater permitting timelines. Therefore, off-site permitting was deemed unreasonable or not viable for the Northeast Landfill.

**Alternative #3: On-Site Configurations**

On-site configurations that would reduce the potential impacts to WOTUS from the expansion were considered, but were deemed unreasonable due to several factors. The primary factor for this is a higher development cost per cubic yard of airspace and minimal increase in site operating life for cost spent. Therefore, alternative on-site configurations were deemed unreasonable or not viable for the Northeast Landfill.

**Alternative #4: Currently Proposed Landfill Expansion**

According to NELF, several alterations to the proposed waste cell configuration were considered. The proposed landfill expansion configuration is optimal for NELF's future capacity and operating life needs, and alterations to avoid WOTUS would greatly reduce the available disposal capacity and increase cost per cubic yard of airspace to a point that the expansion would not be viable. In addition, keeping the expansion area in such close proximity will allow for the soil excavated for construction of the proposed waste cells to be hauled to the existing landfill to be used for daily cover and constructions needs. The proposed design maximizes the amount of airspace produced by expanding the existing waste disposal cells (Phases 5 and 6) as well as constructing the cells deeper and higher to reduce lateral impacts. Therefore, there are no alternative designs that minimize impacts to WOTUS without drastically reducing cost effectiveness..

## THREATENED AND ENDANGERED SPECIES HABITAT SURVEY

In accordance with the requirements put forth by the USACE regarding impacts to federally-listed threatened and endangered species and their habitats, a threatened and endangered species habitat survey was performed by Hydrex concurrently with the delineation of WOTUS March 16 to 18, 2020 as part of this investigation. This habitat survey was based upon the U.S. Fish and Wildlife Service threatened and endangered species list and habitat descriptions provided by U.S. Fish and Wildlife Service - Oklahoma Ecological Services Field Office. The list indicates four (4) federally threatened and/or endangered species occur within Oklahoma County: Arkansas River shiner (*Notropis girardi*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and whooping crane (*Grus americana*).

In the best professional opinion of Hydrex, construction activities associated with the proposed project will have "no effect" on federally listed threatened or endangered species, species proposed for such designation, or critical habitat of such species for Oklahoma County, Oklahoma. Supporting documentation for the threatened and endangered species habitat survey is included in Attachment D.

As required by the Oklahoma Department of Environmental Quality (ODEQ) Administrative Code 252:515-5-31(c), the Oklahoma Biological Survey (OBS) and Oklahoma Department of Wildlife Consultation (ODWC) were consulted regarding threatened and endangered species determinations for species located near or within the Project Area of the Northeast Landfill. Coordination with OBS determined that no federally or state listed threatened, endangered, candidate, or non-regulatory rare species had habitat within the Project Area. It was noted that an occurrence of bald eagles (*Haliaeetus leucocephalus*) had been observed within the vicinity of the Project Area (Section 2 - Township T12N - Range R2W). It is likely that this specimen was observed near the Canadian River, which flows approximately 1.2 miles north of the Project Area. Coordination with ODWC determined that there were no concerns with the Project Area, and that the site is located outside of the range of any state-listed threatened or endangered species. Correspondence with OBS and ODWC representatives can be found in Attachment D.

## CULTURAL RESOURCE SURVEY

A Phase I Cultural Resource Survey (CRS) was conducted by Stone Point Services, LLC (Stone Point) for this project. Background research was conducted on February 13, 2020, during which no previously recorded cultural resources were identified in the Area of Potential Effects (APE). Background research also indicated no listed, eligible, or potentially eligible sites for the National Registry of Historic Places (NRHP) within one mile of the survey area. Stone Point performed field investigations March 16 to March 25, 2021, which included both pedestrian archaeological surveys and shovel tests, with surface inspections being conducted in the areas of significant disturbance. During field investigations, one historic storm shelter structure (circa 1950s) was identified within the southern portion of the survey area. Upon coordination with the Oklahoma Archaeological Survey (OAS), due to a lack of associated artifacts and disturbed integrity, this site was not given an Oklahoma site trinomial. As this structure does not fit the criteria for consideration as a histroic site, Stone Point recommends this structure as ineligible for inclusion in the NRHP. According to Stone Point, this project will not impact NRHP listed, eligible, or potentially eligible structures or sites. Therefore, Stone Point recommends that this project can proceed with no additional consideration of cultural resources. The results of Stone Point's review are included in Attachment E.

In the event of an inadvertent discovery of human remains and/or archaeological cultural deposits, all project activity near the location should cease immediately until proper notification of consulting parties has occurred and mitigative measures have been determined and implemented.

## COMPENSATORY MITIGATION PLAN

Based on the conclusions of the *Jurisdictional Determination* letter dated December 11, 2020 by the U.S. Army Corps of Engineers Tulsa District, proposed permanent impacts to waters of the U.S. amount to 0.56 acres of scrub-shrub wetland impacts, 0.68 acres of open water impacts, and 746 linear feet (0.05 acres) of intermittent stream impacts. Based on proposed impacts to WOTUS (>0.5 acres), this project does not fall within the guidelines of any Nationwide Permits, and as such will require compensatory mitigation. Therefore, N.E. Landfill, LLC proposes to purchase stream and wetland credits from the Deep Fork Mitigation Bank (DFMB) in order to offset unavoidable, permanent impacts from the proposed landfill expansion. The Northeast Landfill Expansion is located within the primary service area of the DFMB.

The DFMB does not utilize any particular functional assessment method, therefore the *Texas Rapid Assessment Method* (TXRAM) 2.0, was conducted by Hydrex to evaluate wetland and stream quality. Utilizing TXRAM, Hydrex determined potential mitigation requirements for permanent impacts to the 0.56 acres of scrub-shrub Wetlands A and B, 0.68 acres of Open Water 5, and 746 linear feet (0.05 acres) of Stream 2 within the project site.

.According to the TXRAM wetland functional assessment, Wetland A (0.40 acres) scored 49.2 out of a possible 115, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 4:1 for medium quality wetlands, therefore Wetland A will require the purchase of 1.6 wetland credits. Wetland B (0.16 acres) scored 49.3 out of a possible 115, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 4:1 for medium quality wetlands, therefore Wetland B will require the purchase of 0.64 wetland credits. Open Water 5 did not require a functional assessment, as DFMB utilizes the 3:1 ratio for low quality wetlands for open water features. Applying the 3:1 ratio for low quality wetlands, Open Water 5 will require the purchase of 2.04 wetland credits. Based on these scores, NELF will be required to purchase 4.28 wetland credits for impacts at the Northeast Landfill Expansion.

According to the TXRAM stream functional assessment, Stream (746 linear feet) scored 39.5 out of a possible 105, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 2:1 for medium quality intermittent streams, therefore Stream 2 will require the purchase of 1,492 intermittent stream credits. However, at this time DFMB does not have sufficient intermittent stream credits to fulfill this compensatory mitigation requirement. Therefore, Hydrex is requesting approval for the purchase of perennial stream credits as needed to supplement the purchase of intermittent stream credits and satisfy mitigation requirements. At this time, DFMB has 366 intermittent stream credits available for purchase. Hydrex respectfully requests a 0.5:1 mitigation ratio for the purchase of perennial stream credits to satisfy the remainder of mitigation requirements. In the event that more intermittent stream credits become available during the permitting process, those will be purchased prior to any perennial stream credits.

In conclusion, the total required credits will be 4.28 wetland credits and 1,492 intermittent stream credits for the proposed landfill expansion. As of May 2021, RIBITS indicates that the DFMB only has 336 intermittent stream credits available, which will be purchased to satisfy mitigation requirements for Stream 2. Due to insufficient available intermittent stream credits, perennial stream credits are proposed to be purchased at a 0.5:1 ratio to satisfy the remainder of the compensatory mitigation needs for this project. The TXRAM functional assessment datasheets and final scoring sheets are included in Attachment F.

## WATER QUALITY CERTIFICATION REQUIREMENTS

In order to minimize adverse effects to water quality, precautionary measures will be put in place. These include controls for minimizing sediment load as well as preventing the release of construction debris, fuels, lubricants, or other deleterious materials into impacted waterbodies.

In order to minimize erosion and sedimentation, best management practices (BMPs) will be used during the construction of landfill waste cells in accordance with Oklahoma Pollutant Discharge Elimination System (OPDES), General Permit No. OKR 10. During operation, the facility will mitigate significant erosion and sedimentation through the use of a perimeter storm water management system that will comply with Oklahoma Department of Environmental Quality (ODEQ) regulations. This storm water management system will include both structural controls (division berms, drainage conveyance swales, letdown structures, ditches, energy dissipation, detention/retention basins, etc) as well as non-structural controls (vegetation establishment on slopes, vegetative buffers near property boundaries, inspections and maintenance of in-place BMPs, etc.) that will be utilized during facility operation to reduce erosion/sedimentation and other potential pollutant sources from discharging offsite. This system will also be designed for compliance with OPDES, General Permit No. OKR05, including implementation of a Storm Water Pollution Prevention Plan (SWP3).

In addition to minimizing deleterious impacts from sediment runoff, controls will be put in place to prevent construction debris from impacting water quality. Operational soil cover (daily and/or intermediate cover) will be in place during facility development and operation, and final cover will be placed at facility closure consistent with applicable ODEQ regulations. Additionally, as indicated above, the facility will comply with OPDES, General Permit No. OKR05 during facility development/operation to protect surface water.

Additional controls will be put in place to prevent fuels and lubricants from impacting water quality. As outlined above, the facility will implement a SWP3 in compliance with OPDES, General Permit No. OKR05, and will implement a Spill Prevention, Containment, and Countermeasures (SPCC) Plan in compliance with 40 Code of Federal Regulations (CFR) Part 112 to manage and mitigate spills during landfill operations. There are no other obvious risks to water quality from the landfill expansion.

On behalf of N.E. Land Fill, LLC, we respectfully request authorization under an Individual Permit for the impacts described herein. Should you have any questions or need any additional information, please do not hesitate to contact me at ccollier@hydrex-inc.com or (936) 568-9451.

Sincerely,

**Hydrex Environmental**

Clayton A. Collier, REM, PWS

Senior Environmental Scientist

**ATTACHMENTS**

| | |
|---|---|
| ATTACHMENT A | SITE MAPS |
| Figure 1 | Vicinity Map |
| Figure 2 | Site Map |
| Figure 3 | Site Map (2020 Aerial Photograph) |
| ATTACHMENT B | JURISDICTIONAL DETERMINATION LETTER (DECEMBER 11, 2020) |
| ATTACHMENT C | SURVEY PLATS AND DESIGN DETAILS |
| ATTACHMENT D | THREATENED AND ENDANGERED SPECIES DOCUMENTATION AND CONCURRENCE |
| ATTACHMENT E | CULTURAL RESOURCE SURVEY |
| ATTACHMENT F | MITIGATION PLAN |
| ATTACHMENT G | LIMITATIONS |
| ATTACHMENT H | QUALIFICATIONS |

## DISTRIBUTION

Mr. Robert Hoffman
U.S. Army Corps of Engineers
Tulsa District
CESWT-RO
2488 R. 81st Street
Tulsa, Oklahoma 74137-4290

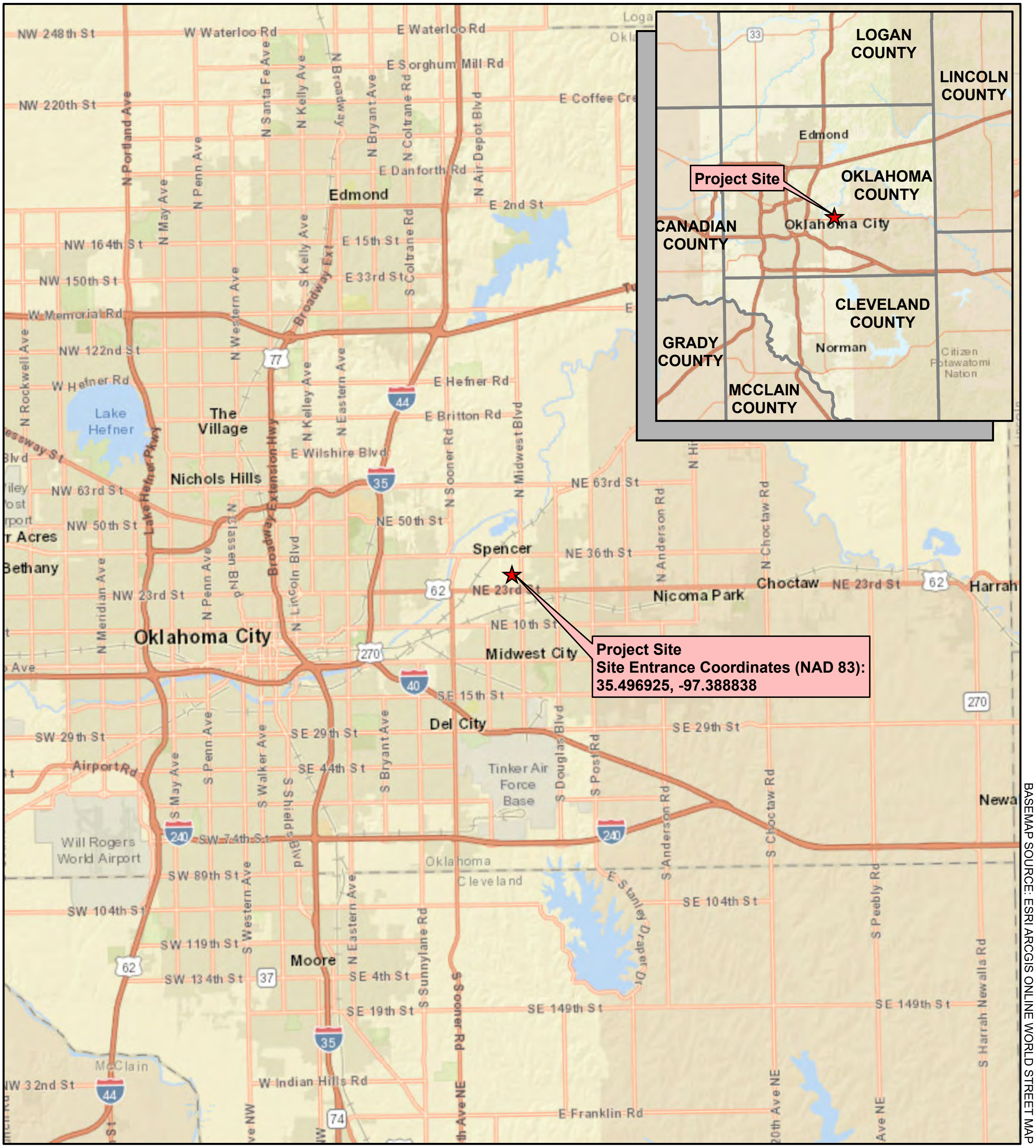
Mr. Clayton A. Collier, REM, PWS
Senior Environmental Scientist
Hydrex Environmental
1120 NW Stallings Drive
Nacogdoches, Texas 75964

Mr. David Bahrenburg
Senior District Manager
N.E. Land Fill, LLC
1001 S. Rockwell
Oklahoma City, Oklahoma 73128

Mr. Ryan Kuntz, P.E.
Vice President/Project Director
SCS Engineers
1901 Central Drive, Suite 550
Bedford, Texas 76021

# ATTACHMENT A

# SITE MAPS




★ Project Area

0 4
Miles

N

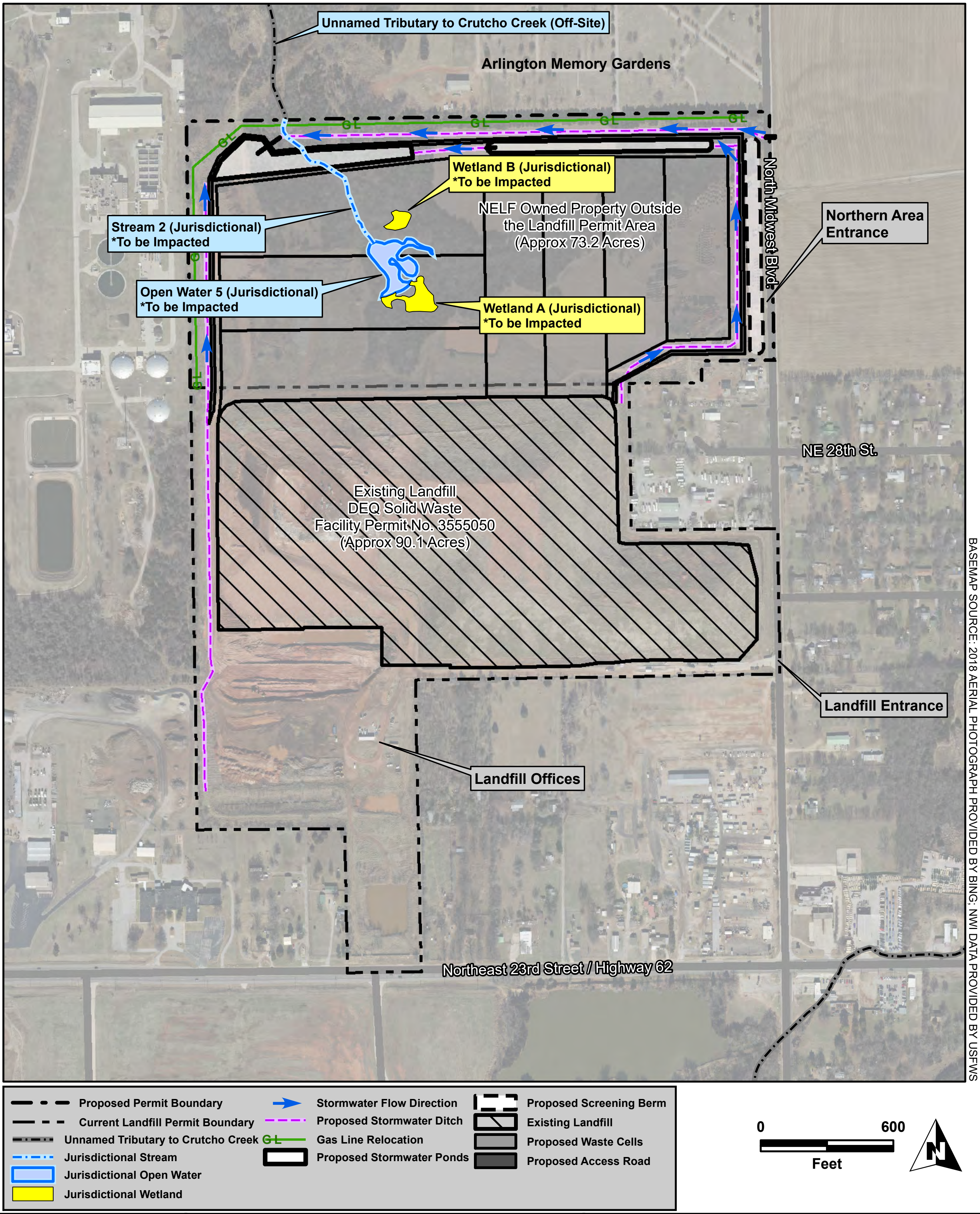
Hydrex ENVIRONMENTAL
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451

FIGURE 1

VICINITY MAP

Northeast Landfill
163.3-Acre Property, Including 73.2-Acre Landfill Expansion
2601 North Midwest Blvd.
Spencer (Oklahoma County), Oklahoma
Request for Individual Permit

| Map Revised: 05/27/2021 | Project Number: A-12-1361 | GIS Analyst: DTM |
|---|---|---|



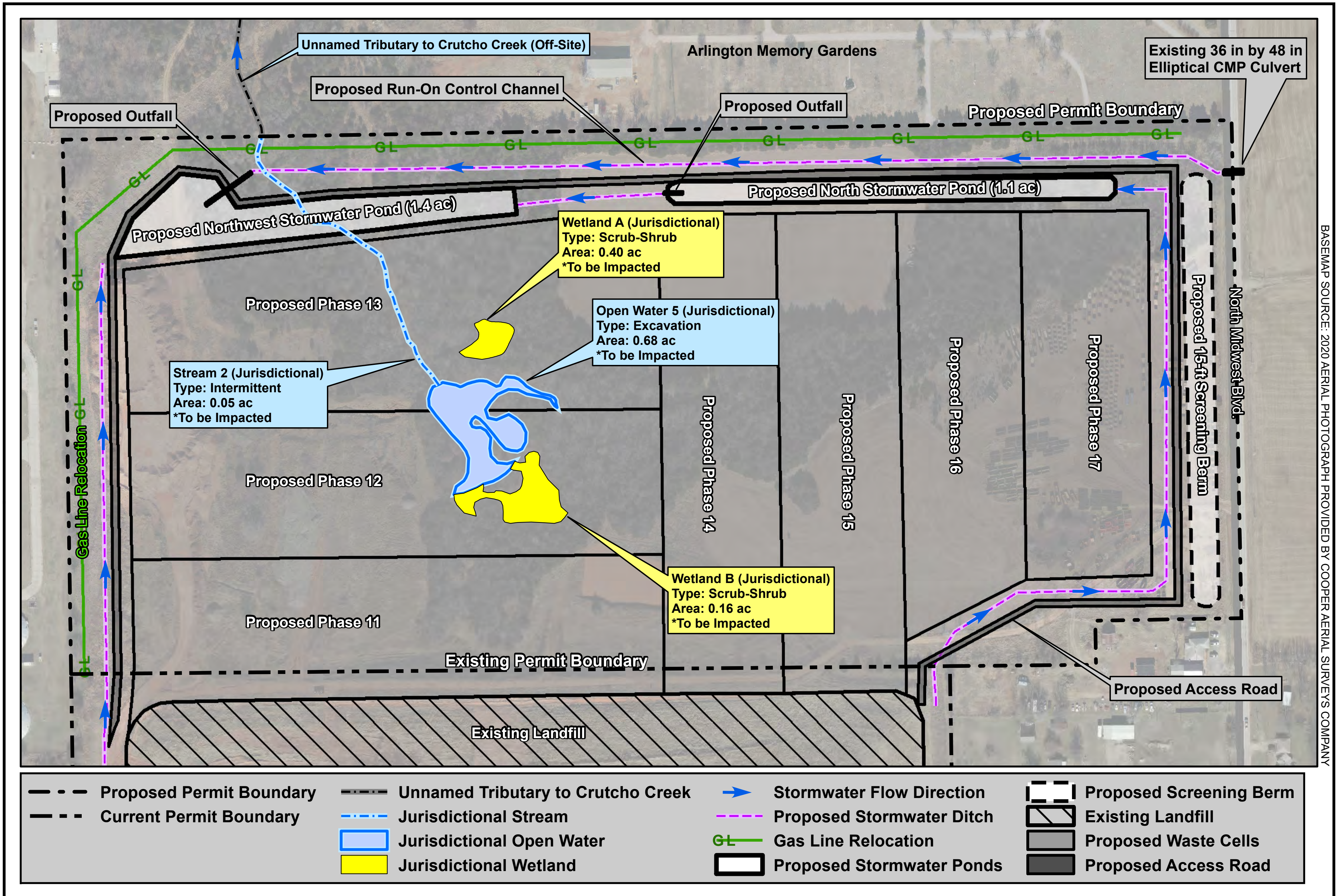

Hydrex ENVIRONMENTAL
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451

FIGURE 2

OVERVIEW MAP

Northeast Landfill
163.3-Acre Property, Including 73.2-Acre Landfill Expansion
2601 North Midwest Blvd.
Spencer (Oklahoma County), Oklahoma
Request for Individual Permit

| Map Revised: 05/27/2021 | Project Number: A-12-1361 | GIS Analyst: DTM |
|---|---|---|




Hydrex ENVIRONMENTAL
1120 NW Stallings Drive
Nacogdoches, Texas 75964
(936) 568-9451

FIGURE 3

EXPANSION AREA SITE MAP

Northeast Landfill
163.3-Acre Property, Including 73.2-Acre Landfill Expansion
2601 North Midwest Blvd.
Spencer (Oklahoma County), Oklahoma
Request for Individual Permit

Map Revised: 05/27/2021 | Project Number: A-12-1361 | GIS Analyst: DTM

# ATTACHMENT B

# JURISDICTIONAL DETERMINATION LETTER
# (DECEMBER 11, 2020)

**DEPARTMENT OF THE ARMY**
**CORPS OF ENGINEERS, TULSA DISTRICT**
**2488 EAST 81ST STREET**
**TULSA, OK 74137-4290**

December 11, 2020

Regulatory Office

Mr. Clayton Collier
Hydrex Environmental
1120 NW Stallings Drive
Nacogdoches, TX 75964-3428

Dear Mr. Collier:

This is in reference to your request for a jurisdictional determination (JD) on the Northeast Landfill property located in Section 22, Township 12 North, Range 2 West, in Oklahoma County, Oklahoma. The area marked in red on the enclosed map denotes the limits of the property examined under this request. We have reviewed the submitted data relative to Section 404 of the Clean Water Act (CWA).

We have examined the approximately 163-acre review area and concluded that Wetland A (0.40 acre), Wetland B (0.16 acre), Open Water 5 (0.68 acre), and Stream 2 (746 linear feet) are jurisdictional wetlands or other waters of the United States subject to Section 404 of the CWA.

We believe this determination to be an accurate assessment of the presence of jurisdictional wetlands and other waters on the site which are subject to Section 404 of the CWA. This is a final determination of federal jurisdiction on the property pursuant to Section 404 of the CWA. This determination is valid for 5 years from the date of this letter unless new information warrants revision of the determination before the expiration date.

This determination has been conducted to identify the limits of the Corps CWA jurisdiction for the particular site identified in this request. This determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985, as amended. If you or your tenant are USDA program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service prior to starting work.

This final determination constitutes an approved JD subject to the optional Corps Administrative Appeal Process. If you object to this determination, you may request an administrative appeal under Corps regulations at 33 CFR Part 331. Enclosed is a copy of the Notification of Administrative Appeal Options and Process (NAP) and Request for Appeal (RFA) form. If you request to appeal this determination you must submit a completed RFA form to the Southwestern Division Office at the following address:

Mr. Elliott Carman
Administrative Appeals Review Officer (CESWD-PD-O)
U.S. Army Corps of Engineers
1100 Commerce Street, Suite 831
Dallas, TX 75242-1317
Tel: 469-487-7061

In order for a RFA form to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR Part 331.5, and that it has been received by the Division Office within 60 days of the date of the NAP. Should you decide to submit a RFA form, it must be received at the above address by February 9, 2021. It is not necessary to submit a RFA form to the Division Office if you do not object to the determination in this letter.

If you desire to complete a “Customer Service Survey” on your experience with the Corps Regulatory Program, visit http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey on the internet at your convenience and submit your comments.

This case has been assigned Identification No. SWT-2020-00344. Please refer to this number during future correspondence. If you have any questions, please contact Mr. Rob Hoffmann at 918-669-7481.

Sincerely,

for Date: 2020.12.11 09:58:54 -06'00'

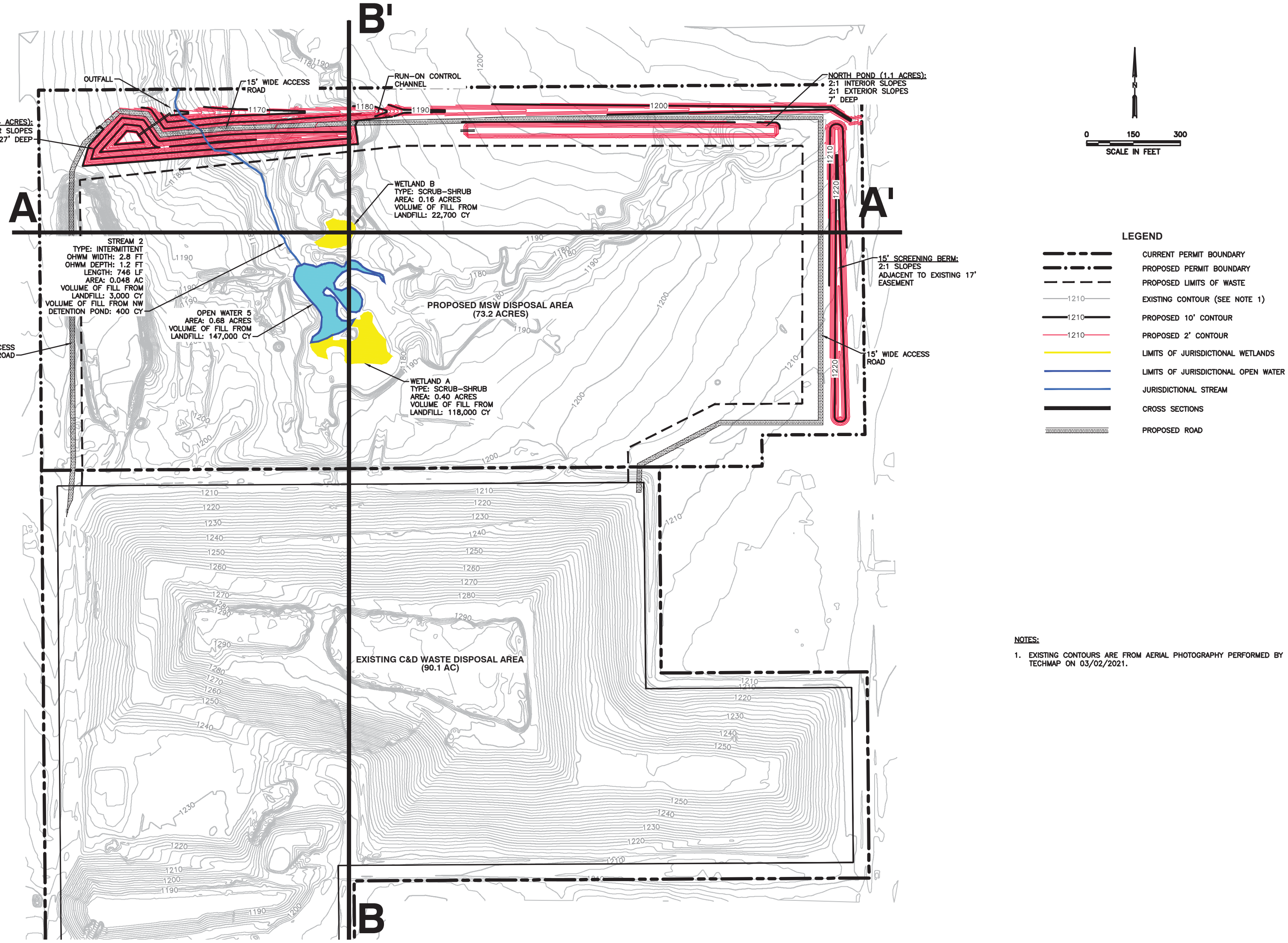
Andrew R. Commer
Chief, Regulatory Office

Enclosures

Stream 2 - Unnamed tributary of Crutcho Creek
Length: 746 linear feet
Wetland B - Scrub Shrub
Area: 0.16 acre
Open Water 5
Area: 0.68 acre
Wetland A - Scrub Shrub
Area: 0.40 acre
NE 28th St
Review Area Boundary = Approx. 163 acres
NE 26th St
SWT-2020-00344 Approved Jurisdictional Determination Map
*Only waters of the U.S. depicted
NE 23rd St
Google Earth
N
1000 ft

# ATTACHMENT C

# SURVEY PLATS AND DESIGN DETAILS

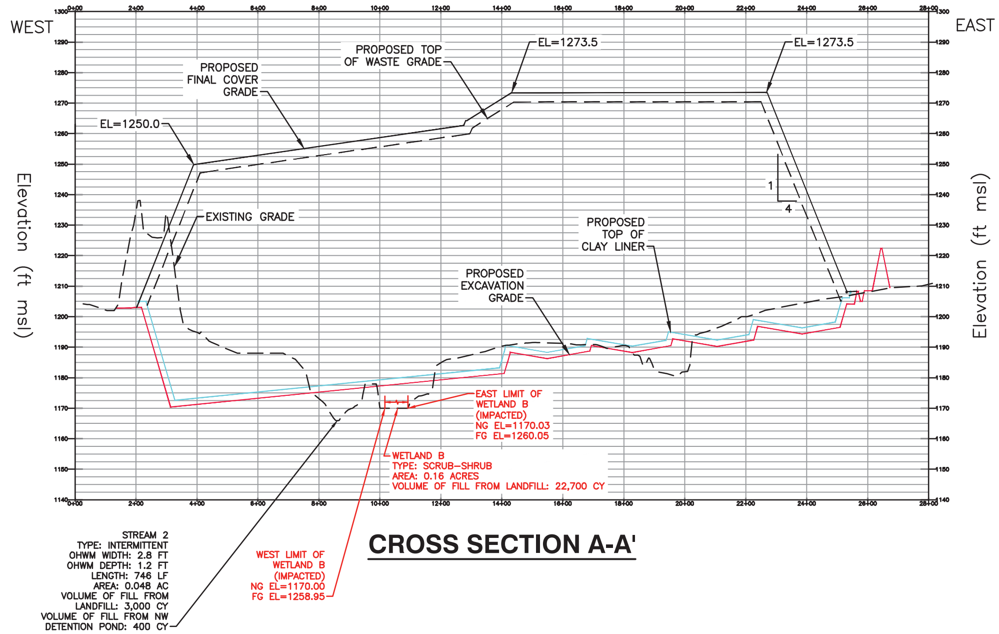



NOTES:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY TECHMAP ON 03/02/2021.

**EXHIBIT 1**
**NORTHEAST LANDFILL**
**CROSS SECTION LOCATIONS**

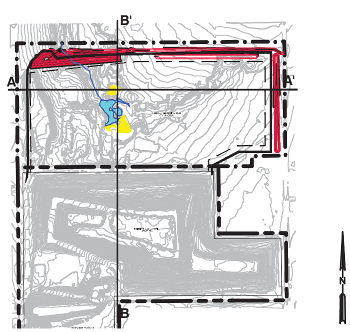
**SCS ENGINEERS**




## CROSS SECTION A-A'

## LEGEND:

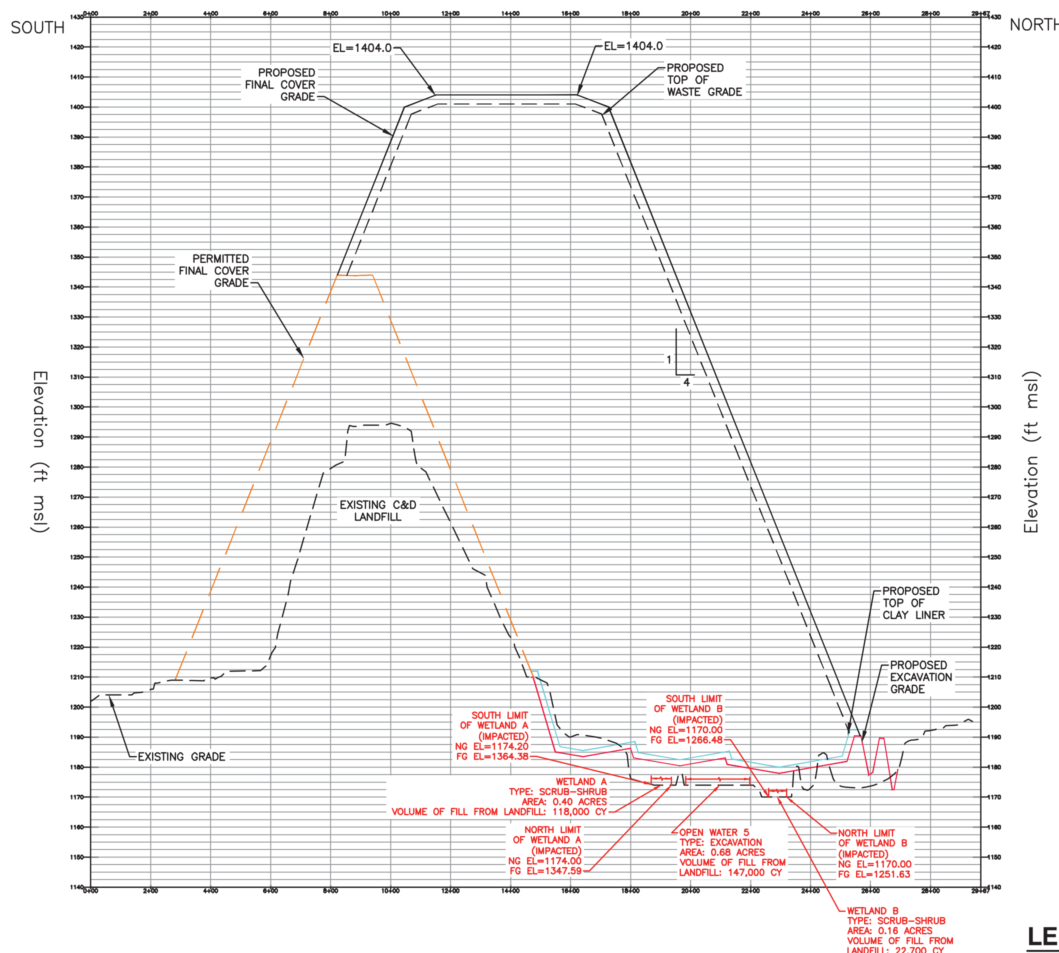
- EXISTING GRADE
- PROPOSED EXCAVATION GRADE
- PROPOSED TOP OF CLAY LINER GRADE
- PROPOSED FINAL COVER GRADE
- PROPOSED TOP OF WASTE GRADE



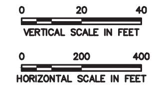

KEY MAP
1"=1,900'

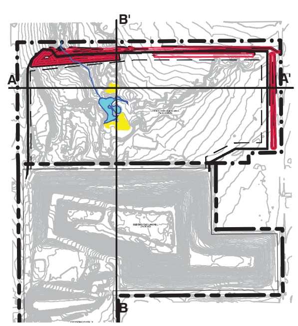
**EXHIBIT 2**
**NORTHEAST LANDFILL**
**CROSS SECTION LOCATIONS**

**SCS ENGINEERS**




## CROSS SECTION B-B'




KEY MAP
1"=1,900'

## LEGEND:

- EXISTING GRADE
- PERMITTED TOP OF WASTE GRADE
- PROPOSED EXCAVATION GRADE
- PROPOSED TOP OF CLAY LINER GRADE
- PROPOSED FINAL COVER GRADE
- PROPOSED TOP OF WASTE GRADE

**EXHIBIT 3**
**NORTHEAST LANDFILL**
**CROSS SECTION LOCATIONS**

**SCS ENGINEERS**

# ATTACHMENT D

# THREATENED AND ENDANGERED SPECIES DOCUMENTATION AND CONCURRENCE

# Oklahoma County, Oklahoma
# Federally Listed
# Threatened & Endangered Species
## Habitat Descriptions and Evaluation

**NORTHEAST LANDFILL**
**163.3-ACRE PROJECT AREA, INCLUDING 73.2-ACRE LANDFILL EXPANSION**

**Hydrex Project No. A-12-1361**

In accordance with the requirements put forth by the USACE regarding impacts to federally-listed threatened and endangered species and their habitats, a Threatened & Endangered Species Habitat Survey has been conducted. The following species were listed by the United States Fish & Wildlife Service (USFWS):

### Arkansas River shiner (*Notropis girardi*): THREATENED

**Habitat**: Arkansas River shiners historically occurred in large rivers throughout the Arkansas River basin, including the Arkansas, Cimarron, and Canadian rivers in Oklahoma. The Arkansas River shiner only inhabits wide and shallow prairie rivers with sandy bottoms, though it seems to use various microhabitats within these systems throughout its life cycle. These shiners often congregate in schools on the side of sandbars and ridges and rarely occur in the open water of the main river channel.. (Source: USFWS).

**Evaluation**: It is the opinion of **Hydrex Environmental** that there will be “no effect” to the Arkansas River shiner or its habitat by this project. The following reasons for a “no effect” determination are listed below:

- The project area does not contain any large rivers.
- The project area does not contain any wide and shallow prairie rivers with sandy bottoms.
- No specimens were observed during the investigation.

## **Piping Plover** (*Charadrius melodus*): **THREATENED**

**Habitat**: Many reservoirs throughout the state have harbored piping plovers for brief periods and single birds are usually documented at stopover sites. As with other plovers, piping plovers often select mudflats and sandbars to forage for invertebrates. The birds seen in Oklahoma are all part of the Northern Great Plains population and typically occur in the state from March to May, and July to September. (Source: USWFS)

**Evaluation**: It is the opinion of Hydrex Environmental that there will be "no effect" to the piping plover or its habitat by this project. The following reasons for a "no effect" determination are listed below:

- The project area does not contain mudflats or sandbars.
- No nests made of sandy substrate with pebble or shell lining were present.
- No specimens were observed during the investigation.

## **Red Knot** (*Calidris canutus rufa)*: **THREATENED**

**Habitat**: Red knots prefer to forage on mudflats and use their bills to probe the substrate for mollusks, invertebrates, and seeds. Ideal foraging habitat for this species is limited within the state; Oklahoma is not a critical breeding or staging area for the species. Fewer than five birds are reported in Oklahoma annually. Of those, 85 percent have been reported during fall migration. Inexperienced or malnourished birds likely comprise the majority of sightings, however inclement weather events can also ground long-distance migrants like these birds for periods of time. (Source: USFWS)

**Evaluation**: It is the opinion of Hydrex Environmental that there will be "no effect" to the red knot or its habitat by this project. The following reasons for a "no effect" determination are listed below:

- The project area did not contain medflats or coastlines.
- Oklahoma is not a critical breeding or staging area for the species.
- No specimens were observed during the investigation.

## **Whooping Crane** (*Grus americana*): **ENDANGERED**

**Habitat**: Whooping cranes most commonly migrate through the western half of the state, typically east of Guymon, OK and west of Interstate 35. Although rare, cranes have been known to land on sites in central Oklahoma, including reservoirs in the Oklahoma City metropolitan area. While moving through Oklahoma, whooping cranes typically use shallow wetlands, marshes, the margins of ponds and lakes, sandbars, shorelines of shallow rivers, wet prairies and crop fields near water. The Salt Plains National Wildlife Refuge, near Jet, OK is a very important migration stopover area and has been designated as critical habitat for the species. (Source: USFWS)

**Evaluation**: It is the opinion of **Hydrex Environmental** that there will be "no effect" to the Whooping Crane or its habitat by this project. The following reasons for a "no effect" determination are listed below:

- The project site is not located near the Salt Plains National Wildlife Refuge.
- The project site does not contain any lakes, marshes, sandbars, rivers, wet prairies or crop fields near water.
- No specimens were observed during the investigation.

**Sources**

(USWFS - OESFO) - United States Fish & Wildlife Service - Oklahoma Ecological Services Field Office, Species Fact Sheets https://www.fws.gov/southwest/es/Oklahoma/Species_Fact_Sheets.htm

(USFWS) - United States Fish & Wildlife Service, Environmental Conservation Online System, http://ecos.fws.gov/ecos/indexPublic.do

**United States Fish and Wildlife Service**
**Threatened and Endangered Species for Oklahoma County, Oklahoma** **Updated May 2021**

| Group | Common Name | Scientific Name | Population | Status |
|---|---|---|---|---|
| Birds | Piping Plover | *Charadrius melodus* | [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. | Threatened |
| Birds | Red knot | *Calidris canutus rufa* | Wherever found | Threatened |
| Birds | Whooping crane | *Grus americana* | Wherever found, except where listed as an experimental population | Endangered |
| Fishes | Arkansas River shiner | *Notropis girardi* | Arkansas River Basin (AR, KS, NM, OK, TX) | Threatened |

## Daniel Morgan

**From:** Fagin, Todd D. <tfagin@ou.edu>
**Sent:** Thursday, March 05, 2020 11:35 AM
**To:** Daniel Morgan
**Subject:** RE: Northeast Landfill Threatened and Endangered Species Statement
**Attachments:** 2020-133-BUS-HYD.pdf

The results are attached.

Thank you,

Todd Fagin

Oklahoma Natural Heritage Inventory/
Oklahoma Biological Survey

---

**From:** Daniel Morgan [mailto:dmorgan@hydrex-inc.com]
**Sent:** Thursday, March 5, 2020 11:16 AM
**To:** Fagin, Todd D.
**Subject:** Northeast Landfill Threatened and Endangered Species Statement

Todd,

This is Daniel Morgan with Hydrex Environmental. I have attached a zipped shapefile displaying the location of the Northeast Landfill and the proposed northern expansion. As part of complying with ODEQ regulations, we are requesting a statement from the Oklahoma Biological Survey regarding threatened and endangered species for the project area. Please let me know if I can provide any more information or documents.

Thank you,
**Daniel Morgan**
Environmental Scientist
Hydrex Environmental
1120 NW Stallings Dr.
Nacogdoches, TX 75964
Office: 936-568-9451
Cell: 936-553-8598

OBS Ref. 2020-133-BUS-HYD

Dear Mr. Morgan, Mar. 5, 2020

We have reviewed occurrence information on federal and state threatened, endangered or candidate species, as well as non-regulatory rare species and ecological systems of importance currently in the Oklahoma Natural Heritage Inventory database for the following location you provided:

Sec. 22-T12N-R2W, Oklahoma County

We found 1 occurrence(s) of relevant species within the vicinity of the project location as described.

| Species Name | Common Name | Federal Status |
|---|---|---|
| ***Haliaeetus leucocephalus*** | **Bald Eagle** | **Protected** |
| ***County*** | ***TRS*** | ***Count*** |
| Oklahome | Sec. 2-T12N-R2W | 1 |

Additionally, absence from our database does not preclude such species from occurring in the area.

If you have any questions about this response, please send me an email, or call us at the number given below.

Although not specific to your project, you may find the following links helpful.

ONHI, guide to ranking codes for endangered and threatened species:
http://vmpincel.ou.edu/heritage/ranking_guide.html

Information regarding the Oklahoma Natural Areas Registry:
http://www.oknaturalheritage.ou.edu/registry_faq.htm

Todd Fagin
Oklahoma Natural Heritage Inventory
(405) 325-4700
tfagin@ou.edu

## Daniel Morgan

**From:** Fullerton, Matthew <matthew.fullerton@odwc.ok.gov>
**Sent:** Thursday, April 23, 2020 4:10 PM
**To:** Daniel Morgan
**Subject:** Re: Northeast Landfill - Threatened and Endangered Species Statement

Hi Daniel,
Apologies for my lateness in getting back to you. I would blame it on COVID, but that really hasn't changed my day-to-day workload!

We don't have any concerns over this location and the site is outside of the range of any state-listed threatened or endangered species.

Please let me know if you need anything else from us.

Thanks,

**Matt Fullerton**
**Wildlife Biologist - Threatened & Endangered Species**
**Wildlife Diversity Program**
**Oklahoma Department of Wildlife Conservation**
**Cell: 580-571-5820**
**Email: matthew.fullerton@odwc.ok.gov**

On Mon, Apr 13, 2020 at 3:34 PM Daniel Morgan <dmorgan@hydrex-inc.com> wrote:

> Good afternoon Matt,
>
> Just following up on this letter. Given the craziness of the last few weeks and focusing on other parts of this project, I had let the T&E statements sit on the backburner, so I wanted to see if I needed to provide any more info on this.
>
> Thanks again for your help,
>
> **Daniel Morgan**
>
> Environmental Scientist
>
> Hydrex Environmental
>
> 1120 NW Stallings Dr.
>
> Nacogdoches, TX 75964

Office: 936-568-9451

Cell: 936-553-8598

**From:** Fullerton, Matthew [mailto:matthew.fullerton@odwc.ok.gov]
**Sent:** Tuesday, March 10, 2020 9:08 AM
**To:** Daniel Morgan <dmorgan@hydrex-inc.com>
**Subject:** Re: Northeast Landfill - Threatened and Endangered Species Statement

Hi Daniel,

Apologies for the delayed response. Your email was somehow sent to my spam filter and I just now found it.

I should be able to complete this for you by the end of the day. Thank you for your patience!

Regards,


**Matt Fullerton**

**Wildlife Biologist - Threatened & Endangered Species**

**Wildlife Diversity Program**

**Oklahoma Department of Wildlife Conservation**

**Cell: 580-571-5820**

**Email: matthew.fullerton@odwc.ok.gov**


On Thu, Mar 5, 2020 at 5:10 PM Daniel Morgan <dmorgan@hydrex-inc.com> wrote:

Good Afternoon Matt,

This is Daniel Morgan with Hydrex Environmental, we spoke earlier regarding a threatened and endangered species statement for a project in Spencer (Oklahoma County), Oklahoma. I have attached a zipped shapefile of the project area, as well as a vicinity map showing the project area. The project area encompasses 163.3 acres, which includes an existing 90.3-acre landfill property and an approximate 73-acre expansion area to the north of the existing landfill. The existing landfill is currently operating as a construction and demolition (C&D) landfill, while the proposed expansion area is partially utilized for soil stockpile and borrow.

As part of complying with ODEQ regulations, I am requesting a statement regarding the existence of federal and state listed species within the vicinity of the permit area. Please let me know if I can provide any more information, I appreciate your help.

Thanks,

**Daniel Morgan**

Environmental Scientist

Hydrex Environmental

1120 NW Stallings Dr.

Nacogdoches, TX 75964

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# ATTACHMENT E

# CULTURAL RESOURCE SURVEY

# Cultural Resources Survey of the 163.3-Acre Northeast C&D Landfill Project Oklahoma County, Oklahoma

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Submitted to:
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1120 NW Stallings Dr.
Nacogdoches, TX 75964

Stone Point Services, SPS19C1201

USACE Project Number: SWT-2020-344

Danny Welch
Principal Investigator

May 5, 2021

# Cultural Resources Survey of the 163.3-Acre Northeast C&D Landfill Project Oklahoma County, Oklahoma

***Submitted by***
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Survey Dates: March 16 – March 25, 2021
Total Area Surveyed: 163.3-acres (66.09-hectares)
Map: USGS Spencer, Midwest City 7.5' quadrangles

Stone Point Services, SPS19C1201

USACE Project Number: SWT-2020-344

May 5, 2021

# Abstract

In March of 2021 Stone Point Services, LLC conducted a cultural resource survey of the proposed 163.3-acre Northeast C&D Landfill Project in Oklahoma County, Oklahoma for Hydrex Environmental, Inc. The total area included in this archaeological survey consists of 163.3-acres (66-hectares), including an area designated as the North Area (73.2-acres/30-hectares) and an area designated as the South Area/existing landfill (90.1-acres/36.46-hectares). Survey methods included pedestrian archaeological survey and shovel testing at 15-meter (50-foot) intervals along the higher potential areas adjacent to the unnamed tributary of Crutcho Creek, 30-meter (100-foot) intervals across adjacent areas with intact soils, and pedestrian survey with selective shovel testing within areas of significant soil disturbances. Survey included surface investigations with limited shovel testing in the South Area, and surface investigations with intensive systematic shovel testing in the North Area. In total, 27 shovel tests were excavated within the heavily disturbed soils of the existing landfill in the South Area, representing approximately 0.3 shovel tests per acre (0.74 shovel tests per hectare). A total of 181 shovel tests were excavated in the North area, representing approximately 2.47 shovel tests per acre (6 shovel tests per hectare). Survey methods meet or exceed the minimum survey standards of the Oklahoma Archaeological Survey (OAS), the Oklahoma State Historic Preservation Office (OSHPO) and the and the United States Army Corps of Engineers (USACE) Corps Regulatory Office (SWT) as outlined in the Guidelines for Cultural Resources Investigations (Sept 2019). This cultural resources survey was conducted as part of USACE Project Number: SWT-2020-344. No shovel tests were positive for archaeological materials.

Background research was conducted on February 13, 2020, which indicated no National Register of Historic Places (NRHP) listed, eligible, or potentially eligible archeological sites within one mile of the survey area.

The archaeological survey encountered one historic storm shelter (Field ID # 1201-HS1), which does not qualify for OAS trinomial allocation. Shovel tests were systematically placed surrounding this feature and encountered no associated subsurface artifacts. As this storm shelter does not fit the criteria for consideration as a historic site, we recommend this structure as ineligible for inclusion in the NRHP. We therefore find that this project will not impact NRHP listed, eligible, or potentially eligible structures or sites. All records produced as a result of this project will be prepared to Oklahoma State Historic Preservation Office standards and submitted to the Oklahoma Archaeological Survey at the University of Oklahoma for curation.

# Executive Summary

Stone Point Services, LLC completed a cultural resource survey of the proposed Northeast Landfill 163.3-Acre Project Area located in Spencer, Oklahoma for Hydrex Environmental. The project area includes the “North Area,” which covers an approximately 73.2-acre (30-hectare) area and the “South Area” of the existing landfill, which consists of 90.1-acres (36.36-hectares). The total area surveyed for this project is approximately 163.3-acres (66-hectares). As the North Area, which contains a tributary of Crutcho Creek, may be used in the future for borrow material, landfill construction, and other landfill activities, it is anticipated disturbance in this area may be extensive. As a Federal nexus has been identified for this project, oversight by the U.S. Corps of Engineers is required and likewise the requirements of Section 106 of the National Historic Preservation Act (NHPA) will apply. The purpose of this cultural resources survey is to identify cultural resources (archaeological and historic) that may be impacted by the proposed borrowing, landfill construction and other associated landfill activities. This cultural resources survey was conducted as part of USACE Project Number: SWT-2020-344.

Background research was conducted on February 13, 2020, during which no previously recorded cultural resources were identified in the Area of Potential Effects (APE) for direct effects. Field investigations were conducted from March 16 through March 25, 2021, led by Danny Welch, Ph.D. of Stone Point Services. Survey methods included pedestrian archaeological survey and shovel testing at 15-meter (50-foot) intervals along the unnamed tributary of Crutcho Creek, 30-meter (100-foot) intervals across adjacent areas with intact soils, and pedestrian survey with selective shovel testing within areas of significant soil disturbances. Survey included surface investigations with limited shovel testing in the South Area, and surface investigations with intensive systematic shovel testing in the North Area. In total, 27 shovel tests were excavated within the heavily disturbed soils of the existing landfill in the South Area, representing approximately 0.3 shovel tests per acre (0.74 shovel tests per hectare). A total of 181 shovel tests were excavated in the North area, representing approximately 2.47 shovel tests per acre (6 shovel tests per hectare). Surface inspection at 10-meter (32-foot) transect intervals was employed in areas of heavy disturbance deemed not to contain in situ soils. A total of 208 shovel tests were completed as part of this cultural resources survey. No shovel tests returned positive results for subsurface artifacts.

Background research indicated no listed, eligible, or potentially eligible sites for the National Register of Historic Places (NRHP) within one mile of the survey area. Background research of historic aerial imagery indicated the presence of historic structures in the South Area and these areas were subjected to near-surface intensive survey. Archaeological survey encountered one historic storm shelter structure in one location identified in aerial imagery (Field ID # 1201-HS1). After coordination with the OAS, due to the lack of associated artifacts and disturbed integrity, this site was not given an Oklahoma site trinomial. Shovel tests were systematically placed surrounding this feature and encountered no associated subsurface artifacts. As this storm shelter does not fit the criteria for consideration as a historic site, we recommend this structure as ineligible for inclusion in the NRHP. We therefore find that this project will not impact NRHP listed, eligible, or potentially eligible structures or sites. All records produced as a result of this project will be prepared to OAS, OSHPO and USACE standards and submitted to the OAS at the University of Oklahoma for curation. Survey methods meet or exceed the minimum survey standards of the SWT Corps Regulatory Office outlined in the Guidelines for Cultural Resources Investigations (Sept 2019).

The survey included an assessment of direct effects. We find that this project will not impact NRHP listed, eligible, or potentially eligible structures or sites. All records produced as a result of this project will be prepared to Oklahoma State Historic Preservation Office standards and submitted to the Oklahoma Archaeological Survey at the University of Oklahoma for curation.

***Inadvertent Discovery Protocol***

In the event of an inadvertent discovery of human remains and/or archeological cultural deposits, all project activity near the location will cease immediately until proper notification of consulting parties has occurred and mitigative measures have been determined and implemented.

| *Northeast C&D Landfill Survey Project Summary* | | |
|---|---|---|
| **Client:** Hydrex Environmental, Inc. | | |
| **Project Location**:<br>2601 N Midwest Blvd<br>Spencer, OK 73084<br>County: Oklahoma | **Township:** 12N<br>**Range:** 2W<br>**Section:** 22<br>**Meridian:** Indian | |
| **Proposed Tract:**<br>73.2- acres (30-hectares) | **Area Surveyed:**<br>163.3- acres (66-hectares)<br>**North area:** 73.2-acres (30-hectares)<br>**South area:** 90.1-acres (36.36 hectares) | **Date(s) of Background Research**:<br>February 13, 2020 |
| **Field methods**:<br>North Area: 181 shovel tests = 2.47 ST/ac (6 ST/ha)<br><br>South Area 27 shovel tests =0.3 ST/ac (0.74 ST/ha)<br><br>10-meter (32-foot) pedestrian surface inspection transects in areas of significant disturbance or 20% slope<br><br>Staggered 15-meter (50-foot) and 30-meter (100-foot) shovel testing intervals with 30-meter transect spacing. | **Field Director:**<br>Danny Welch<br><br>**Crew Chief:**<br>Nicholas Smith<br><br>**Field Crew**:<br>Jenny M. Simpson<br>Emma Richburg<br>Blair Armstrong | **Date(s) of Field Visit**:<br>March 16 – March 25, 2021 |
| **Direct Effects Determination**:<br>Recommended ineligible for NRHP:<br><br>Storm Shelter 1201-HS1 | **Recommendations**:<br>This project is recommended to proceed with no additional consideration of cultural resources. | **Project Reference**<br>SPS #: SPS19C1201<br><br>**USACE Project Number**:<br>SWT-2020-344 |

# Acknowledgements

Stone Point Services would like to thank Hydrex Environmental, Inc. for providing us with necessary data to complete this survey. Danny Welch served as Principal Investigator and Field Director. Nicholas Smith served as Crew Chief. Danny Welch, Jenny M. Simpson, Emma Richburg, Nicholas Smith, and Blair Armstrong completed all fieldwork. Sally Victor served as Architectural Historian. Appreciation is also extended to Katherine McMakin, Jill Jodie and Danny Lewis, GIS Specialists for Stone Point Services.

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# Chapter 1: Introduction

Stone Point Services, LLC completed a cultural resource survey of the proposed Northeast Landfill 163.3-Acre Project Area located in Spencer, Oklahoma for Hydrex Environmental. The project area includes the "North Area," which covers an approximately 73.2-acre (30-hectare) area and the "South Area" of the existing landfill, which consists of 90.1-acres (36.36-hectares). The total area surveyed for this project is approximately 163.3-acres (66-hectares). As the North Area, which contains a tributary of Crutcho Creek, may be used in the future for borrow material, landfill construction, and other landfill activities, it is anticipated disturbance in this area may be extensive. As a Federal nexus has been identified for this project, oversight by the U.S. Corps of Engineers is required and likewise the requirements of Section 106 of the National Historic Preservation Act (NHPA) will apply. The purpose of this cultural resources survey is to identify cultural resources (archaeological and historic) that may be impacted by the proposed borrowing, landfill construction and other associated landfill activities. This cultural resources survey was conducted as part of USACE Project Number: SWT-2020-344.

The proposed project includes two main survey blocks, the North Area and the South Area consisting of the existing landfill (Figure 4). The existing landfill (South Area) is significantly disturbed with little in situ soils. The North Area also includes soil disturbance areas and will be used for future borrowing, landfill construction, and other associated landfill activity (Figure 4). The total proposed project area is approximately 163.3-acres (66-hectares). The maximum depth of proposed ground disturbance for the eastern portion of the North Area is 4.5 to 6-meters (15 to 20-feet). The maximum depth of ground disturbance on the western portion of The North Area will be 9 to 12-meters (30 to 40-feet).

Background research was conducted on February 13, 2020. Background research indicated no listed, eligible, or potentially eligible sites for the National Register of Historic Places (NRHP) within one mile of the survey area. Background research of historic aerial imagery indicated the presence of historic structures in the South Area and these areas were subjected to near-surface intensive survey.

Survey methods conducted at the proposed tract meet or exceed methods recommended by the Oklahoma Archaeological Survey (OAS) and the Oklahoma State Historic Preservation Office (SHPO) and the US Army Corps of Engineers SWT Corps Regulatory Office. Field investigations were conducted from March 16$^{th}$ through March 25th, 2021 led by Danny Welch, Ph.D. of Stone Point Services. Survey methods included surface investigations with limited shovel testing in the South Area, and surface investigations with intensive systematic shovel testing in the North Area. In total, 27 shovel tests were excavated within the heavily disturbed soils of the existing landfill in the South Area, representing approximately 0.3 shovel tests per acre (0.74 shovel tests per hectare). A total of 181 shovel tests were excavated in the North area, representing approximately 2.47 shovel tests per acre (6 shovel tests per hectare). Surface inspection at 10-meter transect intervals was employed in areas of heavy disturbance deemed not to contain in situ soils. A total of 208 shovel tests were completed as part of this cultural resources survey. No shovel tests returned positive results for subsurface artifacts.

Archaeological survey encountered one historic storm shelter structure in one location identified in aerial imagery (Field ID # 1201-HS1). After coordination with the OAS, due to the lack of associated artifacts and disturbed integrity, this site was not given an Oklahoma site trinomial. Shovel tests were systematically placed surrounding this feature and encountered no associated subsurface artifacts. As this storm shelter does not fit the criteria for consideration as a historic site, we recommend this structure as ineligible for inclusion in the NRHP. We therefore find that this project will not impact NRHP listed, eligible, or potentially eligible structures or sites. All records produced as a result of this project will be prepared to OAS, OSHPO and United States USACE standards and submitted to the OAS at the University of Oklahoma for curation. Survey methods meet or exceed the minimum survey standards of the SWT Corps Regulatory Office outlined in the Guidelines for Cultural Resources Investigations (Sept 2019).

The survey included an assessment of direct effects. We find that this project will not impact NRHP listed, eligible, or potentially eligible structures or sites. All records produced as a result of this project will be prepared to Oklahoma State Historic Preservation Office standards and submitted to the Oklahoma Archaeological Survey at the University of Oklahoma for curation.


Figure 1: General location overview map

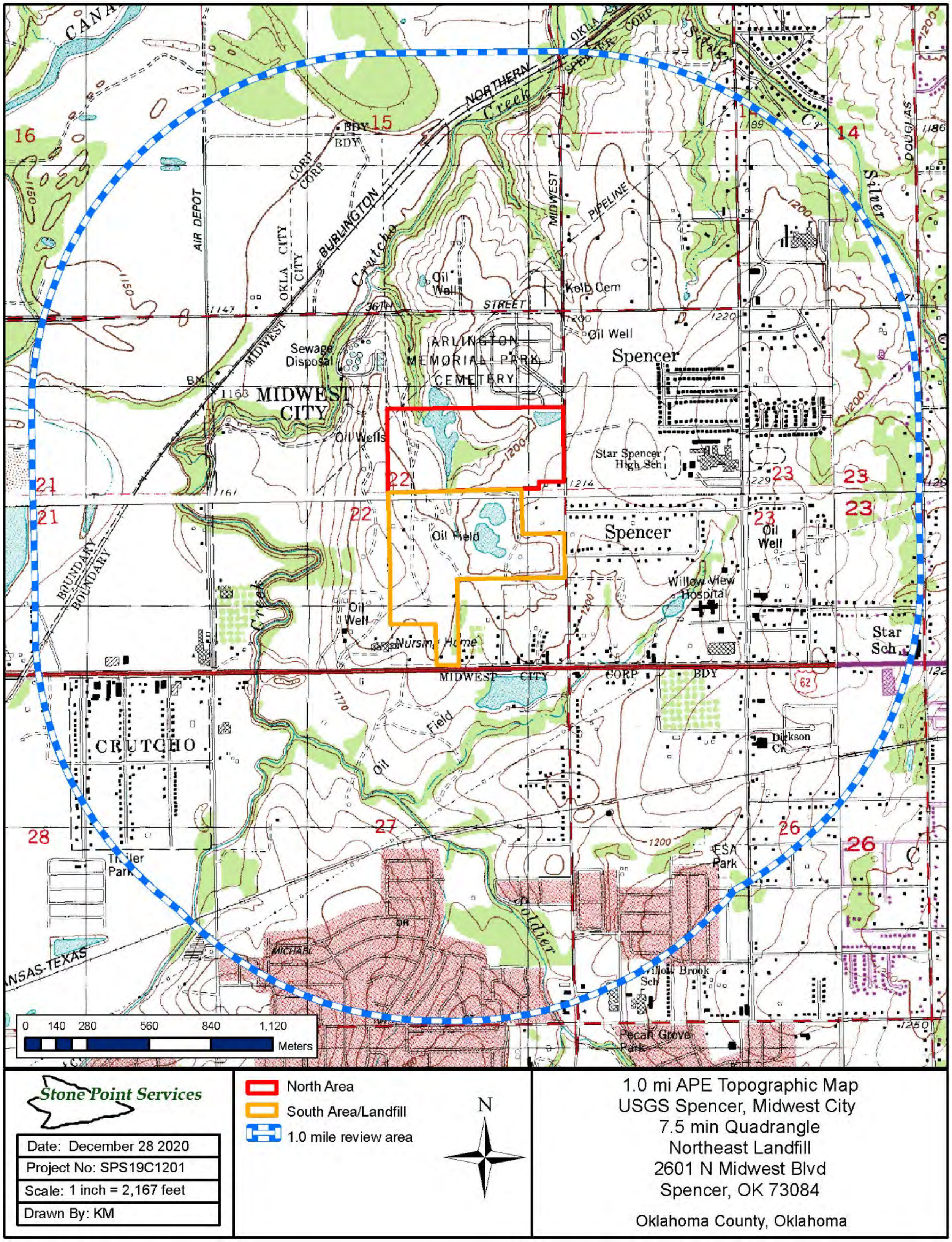


Figure 2: USGS Spencer, Midwest City 7.5-min quad map showing the project area

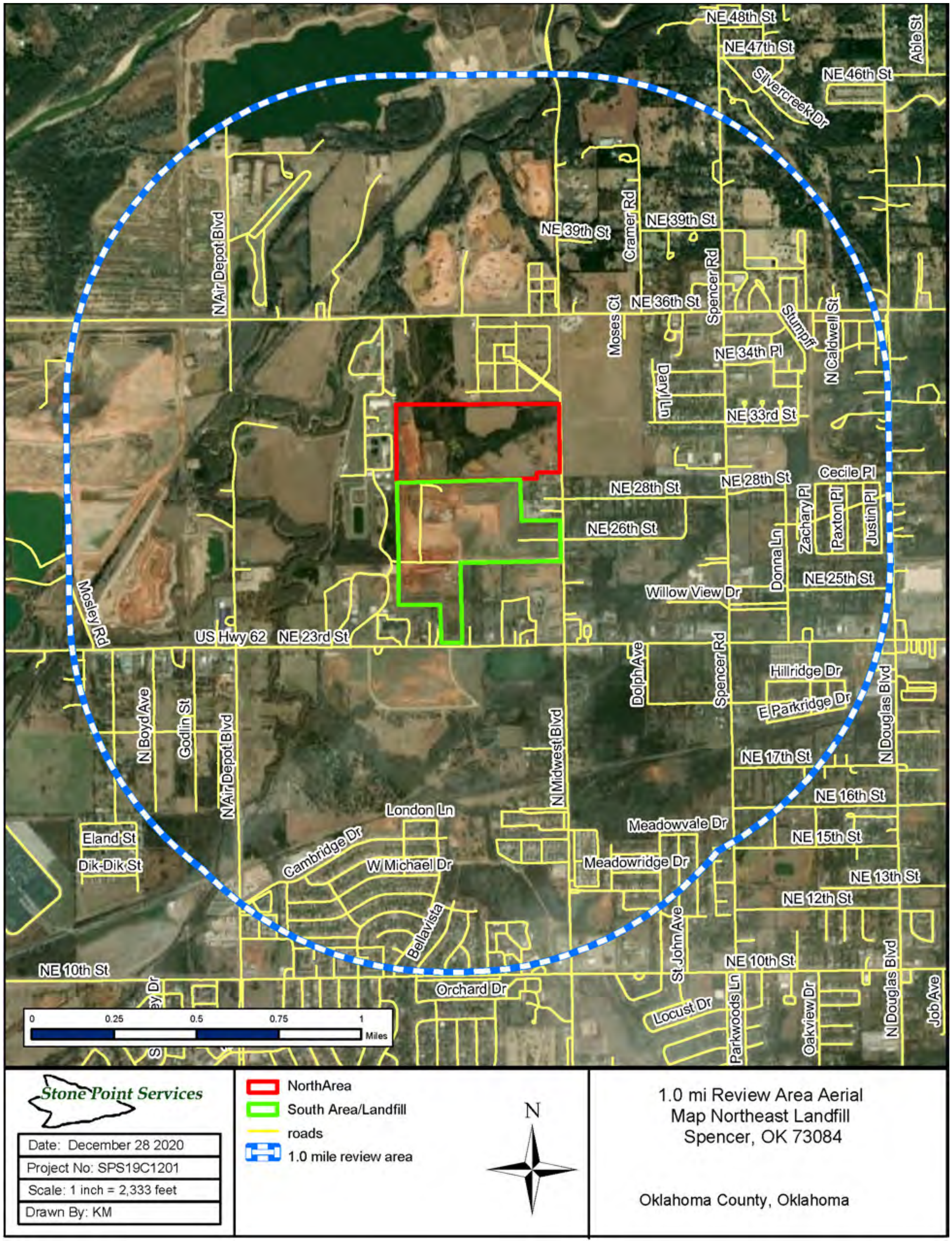


Figure 3: Aerial map showing the project area

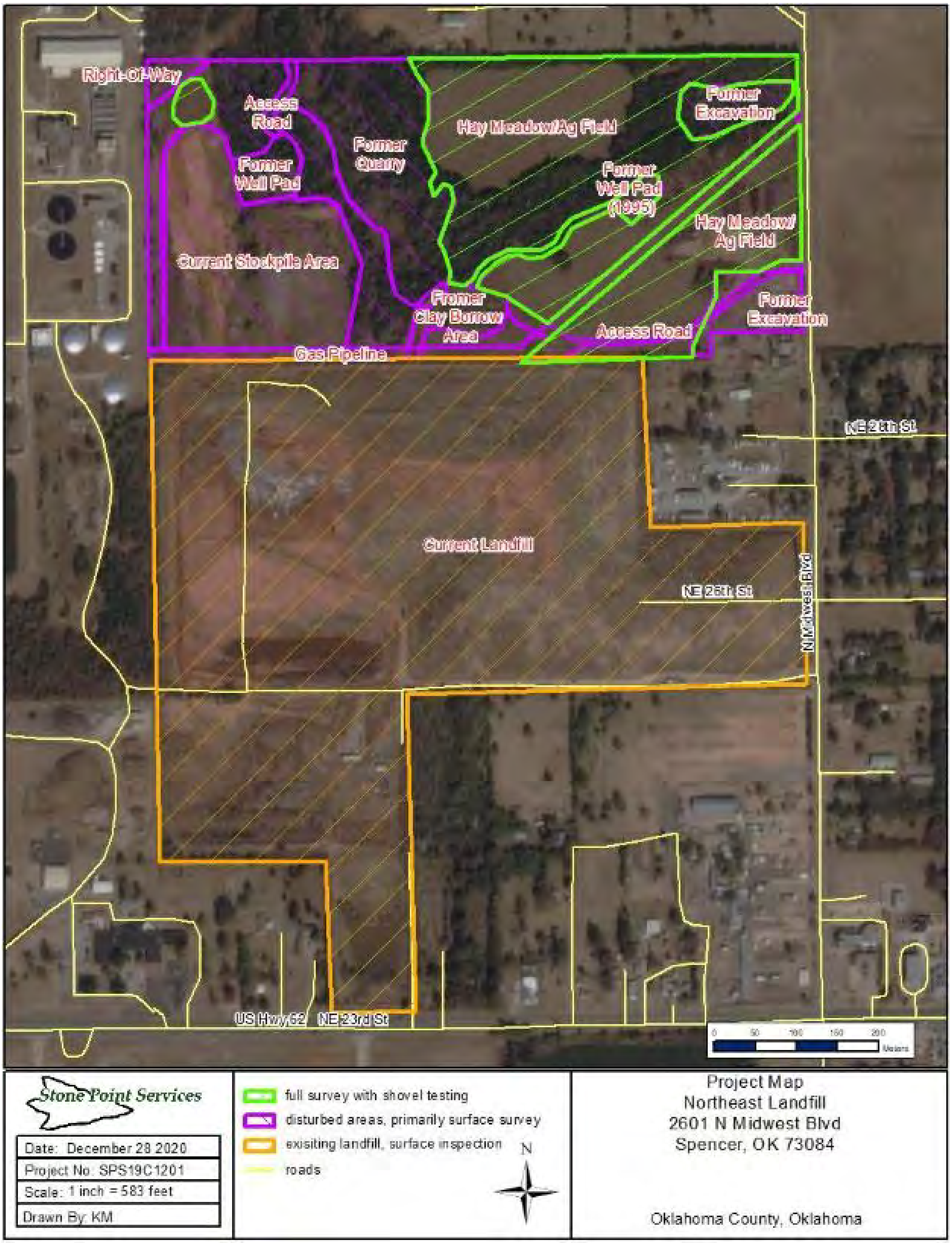

Figure 4: Project map showing general areas for surface survey and systematic shovel testing

# Chapter 2: Natural and Cultural Setting

## ENVIRONMENTAL SETTING

The survey area is located in Oklahoma County, within the town of Spencer, OK. Oklahoma County lies within the Central Great Plains ecological region (Oklahoma Forestry Service 2021). This area consists of scattered low trees and shrubs with the majority of vegetation being crops. The present survey lies partially within an existing landfill to the south, and includes hilly areas, level fields and a narrow steam within the norther survey area (Figures 5-10).

### Flora and Fauna

Animals that historically may have been used for food, shelter, and clothing (or perhaps for tools) in Oklahoma County include: white-tailed deer (*Odocoileus virginianus*), pronghorn (*Antilocapra americana*), bison (*Bison bison*), elk (*Cervus canadensis*), raccoon (*Procyon lotor*), beaver (*Castor canadensis*), rabbit (*Oryctolagus cuniculus*), opossum (*Didelphis marsupialis*), shrew (*Cryptotis parva*), moles (*Scalopus aquaticus*), armadillo (*Dasypodidae novemcinctus*), and rodents (Oklahoma Historical Society 2021b).

The Central Great Plains region consists of low trees and shrubs with the majority of the vegetation being crops. The main crops include small grains, grain sorghum, alfalfa, and soybeans. Trees noted in this region include blackjack oak (*Q. marilandica*), post oak (*Q. stellate*), and hickory (*Carya tomentosa; Carya cordiformis*). Common prairie grasses include little bluestem (*Schizachyrium scoparium*), side-oats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), Indiangrass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), and switchgrass (*Panicum virgatum*) (U.S. Environmental Protection Agency 2021; Oklahoma State University Extension Services 2021).

The climate of this part of Oklahoma is characterized by generally cool winters (34° F) and hot summers (82° F). Precipitation averages 34 inches (86-cm) per year (U.S. Environmental Protection Agency 2021; Oklahoma Climatological Survey 1997). This portion of Oklahoma experiences roughly between 210-217 frost free days a year (Oklahoma Climatological Survey 1997).

Figure 5: View west along unnamed tributary of Crutcho Creek

Figure 6: Typical density of vegetation within stream zone of North Area

Figure 7: View north toward old quarry in North Area

Figure 8: View south of level terrain and mulch pile in South Area


Figure 9: View north in North Area of parking lot and dumpsters


Figure 10: View southwest from North Area dumpsters toward South Area landfill

## Geology and Soils

The survey area is located in Oklahoma County, within the town of Spencer, OK within the Central Great Plains physiographic region of the Gulf Coastal Plains. This region is characterized by low rolling terrain underlain by siltstone, sandstone, and mudstone. The underlying geologic formations in the project consist of alluvium (Map Unit: Qal) and Garber sandstone (Map Unit: Pg) (Bureau of Economic Geology 2021). Much of the alluvial deposits consist of paleoterraces of Pleistocene age, with portions of alluvium dating within the Holocene. the Garber Sandstone unit (Pg), formed during the Permian Period. Weathered alluvial terraces in the survey area consist of deposits of gravel, sand, silt, and clay that ranges from light tan to gray in color. Thickness along streams ranges between 12 to 30-meters (40 to 100-feet) thick. Garber Sandstone is a mostly orange-brown fine-grained sandstone, irregularly bedded with red-brown shale, chert, and mudstone. Ancient alluvial terrace sediments and the Garber sandstone formation have weathered to produce soil profiles imprinted on residuum (Figure 11). Consolidated sandstone yielding to weathered sandy residuum is observable in cutbanks and mechanically-excavated portions across the survey area, as are ancient river terrace deposits with gravel and clay. Alluvium and sandstone appear to be intermingled in the survey area such that there is no well-defined lateral distinction between geologic units.

The US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) *Soil Survey of Oklahoma County, Oklahoma* (NRCS 2021) was used in determining soils within the project area (Table 1; Figures 15-23). Soils within the project area include the following map units:

Urban Land (Map Unit: URB)
Teller fine sandy loam, 5 to 8 percent slopes (Map Unit: TlrD)
Teller fine sandy loam, 3 to 5 percent slopes (Map Unit: TlrC)
Teller fine sandy loam, 1 to 3 percent slopes (Map Unit: TlrB)
Harrah fine sandy loam, 3 to 45 percent slopes (Map Unit: HarG)
Vanoss silt loam, 1 to 3 percent slopes (Map Unit: VanB)
Vanoss silt loam, 0 to 1 percent slopes (Map Unit: VanA)

The Teller series consists of very deep, well drained, moderately permeable soils that formed in loamy sediments of Pleistocene age. These soils are found on treads and risers of stream terraces with slopes ranging from 0 to 8 percent. Harrah soils are characterized by very deep soils atop sandstone that formed from sandy and loamy colluvium weathered from sandstone of Permian age. They can be found on backslopes and foot slopes of low hills with slopes that range from 3 to 45 percent. The Vanoss series contain very deep, well drained soils formed in loamy alluvium of Pleistocene age. Vanoss soils can be found on treads of stream terraces with slopes from 0 to 8 percent. Soils within the survey area typically exhibit the following horizonation (Table 1; Figures 11-15). Alluvial deposits are generally located within the east of the Subject Property, while Permian-aged sandstone is present within the western portion of the Subject Property (Figures 17-18). The underlying geology is the primary reason for the variation in soil types encountered during survey.

Table 1: Project area soil series and soil horizon data

| Soil type | Horizon | Depth | Color | Texture |
|---|---|---|---|---|
| ***Teller*** | Ap | 0-15 cm | brown (10YR 5/3) | Fine sandy loam |
| | A | 15-38 cm | brown (10YR 4/3) | Fine sandy loam |
| | BA | 38-51 cm | brown (7.5YR 4/4) | Fine sandy loam |
| | Bt1 | 51-81 cm | yellowish red (5YR 5/6) | Sandy clay loam |
| | Bt2 | 81-107 cm | yellowish red (5YR 5/6) | Sandy clay loam |
| | Bt3 | 107-152 cm | yellowish red (5YR 5/6) | Fine sandy loam |
| | C | 152-203 cm | yellowish red (5YR 5/6) | Fine sandy loam |
| ***Harrah*** | Ap | 0 to 23 cm | brown (7.5YR 5/2) | Fine sandy loam |
| | E | 23-48 cm | light brown (7.5YR 6/4) | Loamy fine sand |
| | Bt1 | 48-86 cm | red (2.5YR 5/6) | Sandy clay loam |
| | Bt2 | 86-132 cm | red (2.5YR 5/8) | Sandy clay loam |
| | Bt3b | 132-193 cm | red (2.5YR 4/6) | Sandy clay loam |
| | Bt4b | 193-218 cm | red (2.5YR 4/6) | Sandy clay loam |
| ***Vanoss*** | Ap | 0 -18 cm | grayish brown (10YR 5/2) | Loam |
| | B | 18-28 cm | grayish brown (10YR 5/2) | Loam |
| | BA | 28-38 cm | brown (10YR 5/3) | Loam |
| | Bt1 | 38-69 cm | dark yellowish brown (10YR 4/4) | Clay loam |
| | Bt2 | 69-94 cm | yellowish brown (10YR 5/4) | Clay loam |
| | Bt3 | 94-127 cm | yellowish brown (10YR 5/4) | Clay loam |
| | C | 127-241 cm | pale brown (10YR 6/3) | Loam |

Figure 11: Exposed profile of Harrah soil series in residuum formed from Garber sandstone


Figure 12: Shovel test profile within Teller fine sandy loam soil series in the South Area


Figure 13: Shovel test profile with disturbed Teller fine sandy loam in North Area

Figure 14: Shovel test profile to 85-cmbs within the Harrah fine sandy loam soil unit

Figure 15: Shovel test profile within disturbed Vanoss silt loam in North Area

**Understanding Soil Horizons**

The purpose of discussing soils within the context of an archaeological survey is to identify the types of deposition and subsequent soil transformations that have occurred on a site. Understanding the depositional environment provides a better understanding of how deep below the surface any archaeological materials may be anticipated and possible post-depositional processes that may affect archaeological interpretations. The following descriptions are noted from shallowest to deepest. These designations are intended to help the reader understand the master soil horizons and subordinate horizon designations noted in the above table. A brief description of master horizon types is provided below:

***O horizon***: This is generally a shallow litter or organic layer of soils on the ground surface, very recent in age.

***A horizon***: This is typically the layer exposed to the ground surface if no O horizon is present. As this horizon is the location of past and present human activity, archaeological artifacts are often present within this horizon.

***E horizon***: The E horizon consists of an intermediate horizon between the A horizon and the B (subsoil) horizon. The E horizon is a leached portion of a soil profile where silicate clays or minerals have been removed via soil forming processes and redeposited, typically within an underlying clay rich horizon.

***B horizon***: These are subsoil genetic horizons, meaning these horizons form in place through weathering processes. These portions of the soil column are often formed through illuviation (such as the vertical translocation of silicate clays by water).

***C horizon***: This is horizon describes unaltered parent material

***R horizon***: This is the bedrock layer.

Subordinate distinctions and numeric identifiers after a master horizon designation indicates that a master horizon has undergone specific soil forming processes and, in certain cases, exhibits vertical variation between related genetic horizons. As an example, a Btg1 horizon indicates a subsurface horizon where clays have been translocated from upper eluvial horizons and iron has been reduced or removed during soil formation, or that saturation with stagnant water has preserved a reduced state (gleying). This would be the first of at least two vertically subdivided horizons that exhibit general morphological attributes of silicate clay accumulation and gleying; yet are differentiated by depth on the basis of specific physical or chemical differences.

It must be noted that although archaeologists are experienced in determining soils types, we are not soil scientists, nor are we all geomorphologists. A field description of a soil type may vary/differ from the soils designated by the NRCS for a specific area. The degree of sunlight, soil moisture, and personal observations can lead to variation during soil profile descriptions. Additionally, topography, erosion, deposition, and/or artificial impacts may lead to differences in soil horizon thickness between NRCS data collected in advance of an archaeological survey and actual project area soil thicknesses observed during fieldwork. For an expanded description of soil forming factors, processes, and interpretive strategies, see Schoeneberger and colleagues (2012) and Goldberg and Macphail (2006).

**Project Soil Discussion**

Shovel testing and surface observations within the survey area noted soils generally consistent with the above soils during shovel testing (Figures 11-15; Table 1). As noted above, the soils contained within the APE are variable, however, they were dominated by the Teller fine sandy loam series, the Vanoss silt loam series and the Harrah fine sandy loam series. Soil profiles associated with the Teller soil series were typically moderately deep and contained fine sandy loam with lenses of alluvial gravels and weathered laminated parent material where exposed in cross section near excavated borrow pits. Topsoil horizons within the Teller series generally consisted of reddish brown and dark grayish brown fine sandy loam. Topsoil horizons generally measured no thicker than 20-centimeters (8-inches). Teller series subsoil horizons generally exhibited yellowish red sandy clay. The subsoil horizon was noted during shovel testing by the shift in color towards a more vibrant red soil color and an obvious change in texture from soft fine sandy loam to moderately hard sandy clay.

Soil profiles associated with the Vanoss silt loam soil series were typically disturbed across the survey area due to their position within active parking areas and roads, however, less-disturbed soils of the Vanoss series were observed to the south of the unnamed tributary within the former agricultural field. Topsoil horizons within the Vanoss series generally consisted of brown and reddish-brown loam and clay loam. Topsoil horizons generally measured no thicker than 35-centimeters (14-inches) atop a reddish brown and red clay loam subsoil horizon. The subsoil horizon was noted during shovel testing by the shift in color towards a lighter reddish brown to weak red soil color and an obvious change in texture with an increase in clay content from soft loam to moderately hard clay loam.

The Harrah fine sandy loam soil series was present within the central portion of the North Area, specifically within the stream zone. This soil series differs from the surrounding Teller and Vanoss series in that it formed in sandy and loamy colluvium weathered from Garber Formation sandstone of Permian age. Exposed soil cuts illustrate weathered residuum imprinted with a topsoil horizon overlying a weak leeched zone (E horizon), atop a clay-rich subsoil horizon (Bt). Soil mixing by heavy root activity obscured the A and E horizon boundary across much of the stream bank shovel tests. Due to the potential for alluvial veneers (flood deposits) atop the Harrah series along the stream banks, shovel tests penetrated to a depth of 80-cm (31-inches) along transects nearest the north and south stream banks. No alluvial veneers were encountered, and the Harrah series conformed well with the noted soils data provided by NRCS soil map unit information (NRCS 2020). Topsoil horizons within the Harrah series generally consisted of very dark gray and dark grayish brown sandy loam and fine sandy loam. Topsoil horizons generally measured no thicker than 35-centimeters (14-inches). An underlying weak albic horizon (E horizon) was noted in less-disturbed contexts and typically exhibited strong brown to dusky red sandy loam to sandy clay loam. The Harrah series subsoil was variable and contained brown, reddish brown and red sandy clay and sandy clay loam. Depth to sandstone parent material was variable and was shallow to subaerially-exposed within the eastern portion of the stream zone. The subsoil horizon was noted during shovel testing by the shift in color towards a lighter reddish brown to red soil color and an obvious change in texture with an increase in clay content from soft sandy loam to moderately hard clay loam and/or sandstone parent material.

Overall, the survey area exhibited extensive soil disturbances from prior agriculture, sediment mining (quarry), pond excavation, clay borrow pits, vehicle use, oil pad construction, gas pipeline trenching, and sand/mulch deposits from active landfill activity (see Survey Obstructions and Soil Disturbances section below). Shovel tests were excavated to sterile subsoil or 80 centimeters (31 inches) below ground surface, whichever was encountered first. The minimum shovel test depth was 14-centimeters (5.5-inches) atop construction fill, and the maximum shovel test depth was 87-centimeters (34-inches) within the stream bank of the unnamed tributary of Crutcho Creek. No shovel tests produced positive results for archaeological materials. Survey methods conducted during this cultural resources survey meet or exceed methods recommended by the OAS, OSHPO and USACE SWT office.

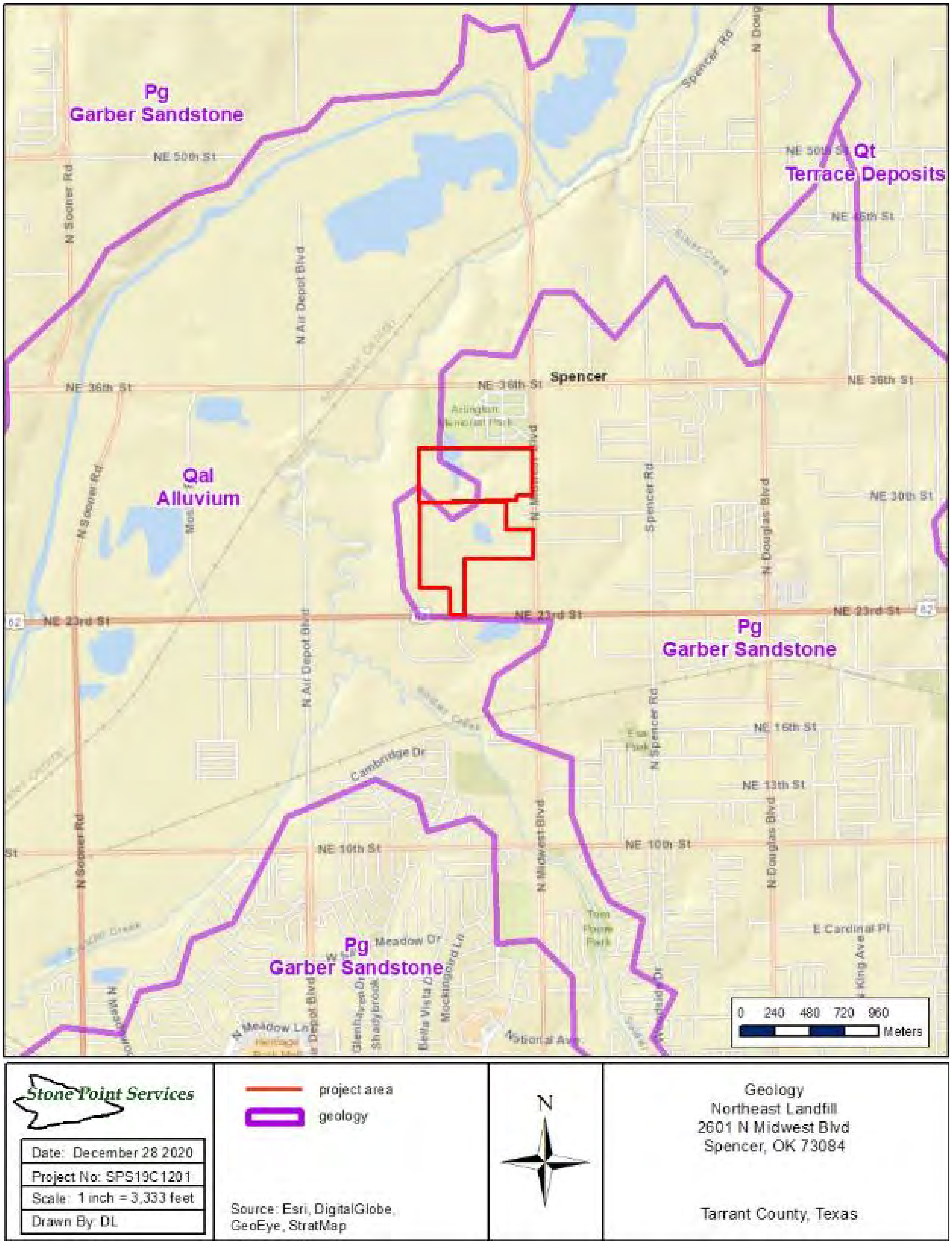

Figure 16: Underlying geologic unit within the survey area

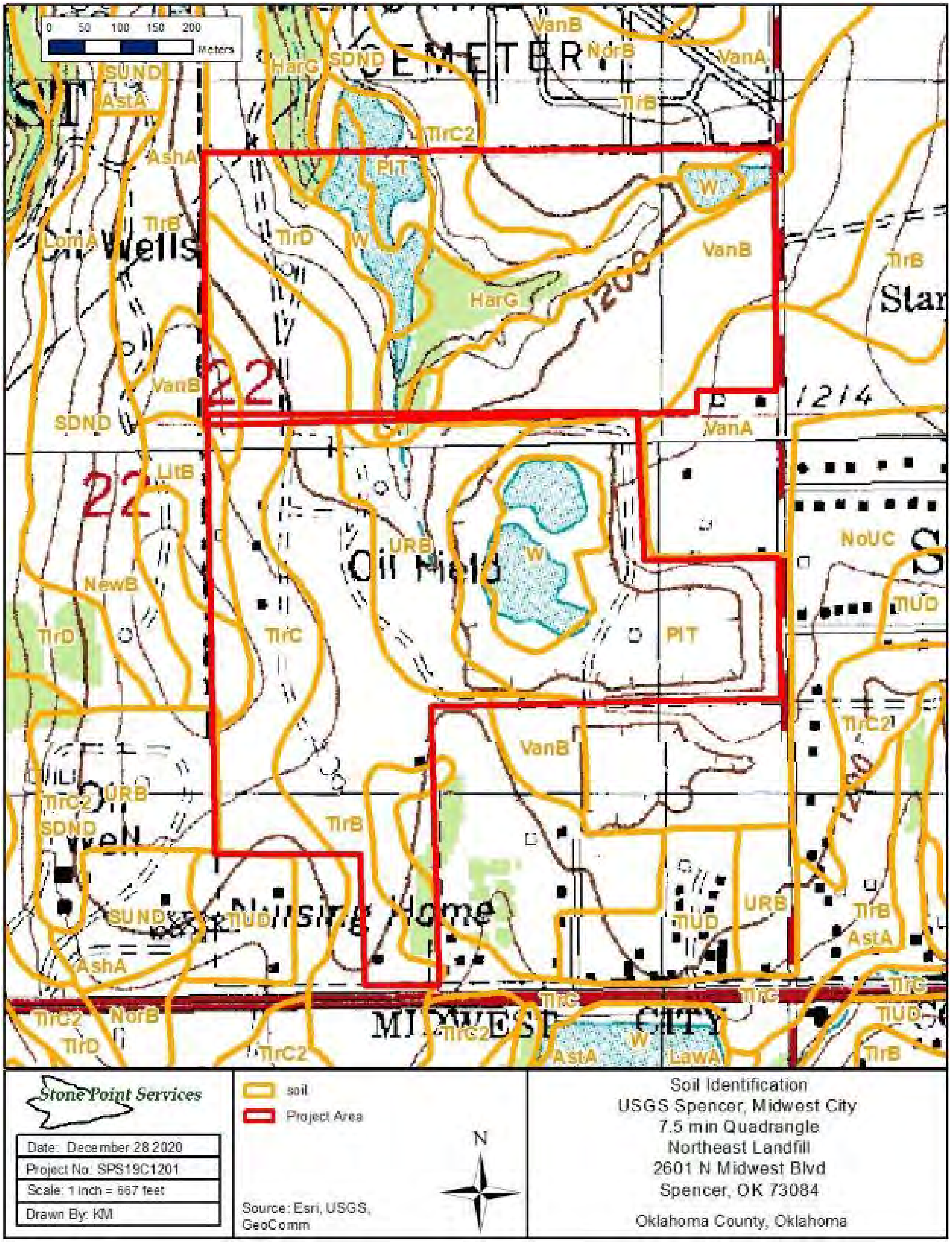


Figure 17: Soil types within the survey area

## CULTURAL SETTING

For a detailed overview of the prehistory and history of Oklahoma County, Oklahoma, the reader is referred to regional reports from larger surveys with positive results that focused on this general region. Because this survey resulted in the discovery of very limited cultural resources, the culture history section will be brief and will serve only as a very broad overview of regional prehistory and history (Table 2).

Table 2: Archaeological Periods in Southern Oklahoma

| Dates | Period |
|---|---|
| 30000 – 10000 BC | Pre-Clovis |
| 10000 – 6000 BC | Paleoindian (Clovis and Folsom) |
| 6000 BC – AD 1 | Archaic |
| AD 1 – 800 | Woodland |
| AD 800 – 1500 | Late Prehistoric/Villagers |
| AD 1500 – 1800 | Protohistoric |
| AD 1800 – present | Historic |

The following information is taken primarily from the Oklahoma Historical Society website (Oklahoma Historical Society 2021a, 2021c, 2021d, and 2021e), the University of Oklahoma's Prehistory Timeline (Oklahoma Prehistory Timeline 2019) and the American Indian Cultural Center and Museum website (Tribes-Brief History 2020).

***Pre-Clovis Period (30000 - 10000 BC)***

There are two Pre-Clovis sites in Oklahoma that have played a role in answering some questions about Pre-Clovis peoples. The archaeological sites include the 18,000-year-old Cooperton mammoth remains in Kiowa County and the Burnham site in Woods County with relevant radiocarbon dates ranging from 28,000 to 32,000 years ago. Both locations hold material associated with extinct Ice Age animals. What the sites lack, however, is the clear continuity and unquestionable context found with Clovis culture sites. Because the context is uncertain and the comparable sites are absent in Oklahoma and the surrounding region, archaeologists have difficulty characterizing these peoples' ways of life. The Pre-Clovis people were explorers at the edge of new frontiers, and their motivations, the nature of their society, and the full implications of their actions may never be fully comprehended.

***Paleo-Indian Period (10000 - 6000 BC)***

Much of the recorded evidence for the Paleo-Indian Period comes from kill/hunting sites. There are several Paleoindian sites in Oklahoma, including the Domebo mammoth kill site and the Cooper bison kill site. Other important Paleoindian sites in Oklahoma include the Perry Ranch site, the Roulston-Rogers site, the Jake Bluff Gully site, and the Packard site. These specialized hunters lived in small nomadic bands and adapted to their environment. The Paleoindian people hunted mammoth and giant bison, both of which are now extinct. Projectile points from this tradition include Clovis, Folsom, and Dalton.

***Archaic Period (6000 BC - AD 1)***

Archaic Period people were hunters who became less mobile than their Paleoindian ancestors. They hunted bison, deer, and small game. Subsistence activities focused on exploiting broader ecological resources, like wild plant foods. The climate was much warmer and dryer during this time period. Typical projectile points from this tradition include the Calf Creek points. Grinding stones also appear later in the Archaic period. Important Archaic period sites in Oklahoma include the Kiamichi Fish Weir site, the Certain site, the Lawrence site, the Primrose and Stillman Pit sites, and the Pumpkin Creek site.

***Woodland Period (AD 1 - 800)***

Pottery production begins in the Woodland Period. Spears are replaced by the bow and arrow. The Woodland period people adapted a more sedentary lifestyle than their ancestors. They lived in camps and moved as resources were used up. The first evidence of plant domestication appears during this time period. Native plant and grass seed were harvested for use. The bulk of the diet came from deer, bison, fish, and nuts. Important Woodland period sites in Oklahoma include the McCutchan-McLaughlin site and the Roulston-Rogers site.

***Late Prehistoric/Villagers Period (AD 800 – 1500)***

During the Late Prehistoric/Villagers period, permanent villages near stream valleys become common. The people of this period hunted deer and bison and grew corn, beans, and squash. Tobacco and other minor crops were also harvested. Fish and mussels were an important addition to their diet. In central and western Oklahoma, the Canadian and Washita Rivers and their tributaries had large populations of people living nearby. Villages of around 200 people were spaced every few miles along these river valleys. A trade network existed with turquoise and obsidian coming from New Mexico. Important sites in western Oklahoma include the Arthur site, the Brewer site, the Heerwald site, and the Zimms site. In eastern Oklahoma, all of the major stream valleys were farmed and ceremonial mound centers were common. A highly-ranked society developed in eastern Oklahoma during this time period. A large trade network also existed with copper coming from the Great Lakes, shells from the Gulf Coast, and obsidian from Central Mexico. Important sites in eastern Oklahoma include the Spiro Mounds site, the Tyler site, the Harlan Mound site, and the Norman Mound site.

***Protohistoric Period (AD 1500 – 1800)***

The Protohistoric period is marked by the arrival of new immigrant groups, including Native American tribes and European Americans. This brought profound changes to the people living on the Southern Plains. Spanish horses become an important part of Plains culture. The Wichita people were successful farmers with large villages at the time of Spanish contact in the early 1500s. By the 1700s, French traders brought European goods up the Arkansas River from Louisiana to trade with the Wichita. Important Protohistoric sites in Oklahoma include the Longest site, the Duncan site, and the Deer Creek/Bryson Paddock sites. Tribes present during the Protohistoric Period include the Wichita, Apache, Quapaw, Osage, Pawnee, Kiowa, Comanche, Delaware, Shawnee, and Kickapoo.

***Historic Period (AD 1800 – present)***
The United States negotiated the Louisiana Purchase in 1803. A region conceived as "the Indian country" was specified in 1825 as all the land lying west of the Mississippi. Eventually, Indian Territory would encompass the present states of Oklahoma, Kansas, Nebraska, and part of Iowa. The Indian Removal process had begun by treaties soon after 1800. Some of the Cherokee, for example, had begun moving west in the 1810s, with large migrations into west-central Arkansas in 1817 into a region they had exchanged for land in the Southeast. Shortly before the 1817 Cherokee treaty came "Lovely's Purchase" in 1816, and an 1818 Osage treaty theoretically cleared northeastern Oklahoma and added the land to the public domain. In 1820, the Choctaw agreed to accept land between the Arkansas and Canadian rivers and the Red River, in present Oklahoma.

During the 1820s and 1830s dozens of northeastern, midwestern, and southeastern tribes were removed by treaty and the 1830 Indian Removal Act (Carlson and Roberts 2006). An 1834 Trade Act further defined "the Indian country" as all that part of the United States west of the Mississippi and not within the states of Missouri, Louisiana, or Arkansas Territory, or any other organized territory. The Creek, Seminole, and Chickasaw also succumbed to forced migration. All of these southeastern tribes thereafter inhabited the southern part of "the Indian Territory."

The 1854 Kansas and Nebraska Act Congress formally organized those parts of northern Indian Territory into official territories that afterward became states. After the Civil War ended, Indians were moved further south into the part of the Indian Territory that is present Oklahoma. Plains tribes, including the Cheyenne, Arapaho, Comanche, Kiowa, and Apache, were concentrated on reservations in the western half of the territory (Chang 2010).

In March 1889, a law established a federal court system based at Muskogee, assuming judicial authority and jurisdiction that had been exercised since the 1834 Trade Act by the Western District of Arkansas. The 1889 measure for the first time specified enclosed boundaries for the Indian Territory, now officially reduced to an area bounded by Texas on the south, Arkansas and Missouri on the east, Kansas on the north, and New Mexico Territory on the west.

Soon this area was reduced again when Oklahoma Territory was created from part of it by the Organic Act in May 1890 (Burton 1997). A governor was appointed, and a two-house territorial assembly and a judicial system were set up. Oklahoma Territory would be eligible for statehood if its population grew large enough and if its leaders followed the process prescribed by federal law. The Oklahoma Territory Organic Act even more closely defined Indian Territory, reducing it to slightly more than the eastern half of the present state. In the 1905 Sequoyah Convention, Indian leaders sought to bypass the territorial process and bring about separate statehood for Indian Territory. However, with the 1907 union of the Indian nations and Oklahoma Territory as the State of Oklahoma, a separate, Indian-dominated territory or state was no longer viable. Oklahoma County was established with the passing of the Organic Act in 1890 with Oklahoma City the county seat.

An excerpt from Everett (2020f) from *The Encyclopedia of Oklahoma History and Culture*, provides the following information on the history of Spencer:

Spencer was one of the earliest towns in a region that was opened to settlement in the Land Run of 1889 into the Unassigned Lands. Spencer was developed in 1901 in Crutcho Township by Louis F. and Henry W. Kramer, early area settlers and businessmen of Oklahoma City. Crutcho Township was a fertile agricultural area within the flood plain of the North Canadian River. Local farmers grew wheat, some of which had been sent to Chicago for the World's Columbian Exposition in 1893 and won first place in the crop competition.

By 1909 Spencer had grown to approximately 300, with 1,111 in the surrounding township. Spencer grew after World War II, as nearby industries such as General Motors Assembly Plant and Tinker Air Force Base offered employment. In 1960, Spencer had approximately 1,189 residents. The population tripled to 3,713 in 1970. The population peaked at 4,604 in 1980. In 1990, the population was 3,972.

**Previous Investigations**

Stone Point Services, LLC completed an Oklahoma archaeological site file review February 13, 2020 for the 1.6-kilometer (1.0-mile) review area, utilizing the files housed at the Oklahoma Archeological Survey in Norman, OK. Eight archaeological sites and six surveys have been recorded within the one-mile review area (Tables 3-4).

The majority of the archaeological sites in the area are prehistoric in nature with no known NRHP status. The sites are predominantly located on an upland slope or ridge from a water source, namely the Canadian River and associated tributaries, and present as lithic scatters and encampments in nature.

Table 3: Archaeological sites within the one-mile review area

| Site # | Date | Description | NRHP Status | Distance from Tower |
|---|---|---|---|---|
| OK11 | 1977 | Prehistoric lithics | Unknown | 0.18-miles southwest |
| OK15 | 1971 | Ground surface lithic scatter | Unknown | 0.46-miles south |
| OK32 | 1972 | Prehistoric campsite | Unknown | 0.83-miles southwest |
| OK69 | 1974 | Prehistoric lithic workshop/camp | Unknown | 0.83-miles north |
| OK95 | 1977 | Prehistoric camp | Unknown | 0.93-miles south |
| OK224 | 2012 | Historic house (ruins) | Inventory Site | 0.46-miles south |
| OK225 | 2012 | Dairy Barn | Inventory Site | 0.55-miles south |
| OK226 | 2012 | Building slab | Inventory Site | 0.60-miles southwest |

With regard to the archaeological surveys in the 1.0-mile review area, Dycus' survey was the closest to the expansion area. This survey appears to have bound the expansion area to the west. No new archaeological sites resulted from this survey.

Table 4: Archaeological surveys within the one-mile review area

| Surveyor | Date | Description | Distance from Project Area |
|---|---|---|---|
| Dycus | 2004 | NE Landfill | 0.04-miles southwest |
| O'Shea | 2007 | Bridge replacement | 1.0-miles east northeast |
| Northcutt | 2012 | Industrial development | 0.46-miles south |
| ECA | 2014 | Unknown | Unknown |
| Goodwin | 2015 | Pipeline | 0.97-miles northwest |
| TRC | 2018 | Crutcho Creek Addition | 0.27-miles southwest |

Although neither an archaeological survey nor archaeological site, Arlington Memorial Gardens/Arlington Memorial Park cemetery adjoins the expansion area along the north border. Established in 1951, Arlington Memorial Gardens encompasses 86-acres (35-hectares) serving Oklahoma City, Midwest City, Spencer, and other surrounding communities as an interment facility. The cemetery is comprised of burial plots, cremation plots, a mausoleum, and dedicated military gardens.

# Chapter 3: Project Methodology

The methods for this project meet or exceed the minimum requirements for surveys in Oklahoma established by the Oklahoma Archaeological Survey (OAS) and the Oklahoma State Historic Preservation Office (SHPO) and the US Army Corps of Engineers. This project included three phases: 1) background research, 2) field investigations, and 3) laboratory analysis. Each phase of the investigations is described in detail below.

## BACKGROUND RESEARCH

The background literature and records search for the project area was conducted through the Oklahoma Archaeological Survey as well as through online map services, such as the historical aerial photography housed online at the US Department of Agriculture (USDA). The records examined at the Oklahoma Archaeological Survey included a review of their paper system containing information about previously recorded archeological resources in the vicinity of the present project. The literature review was used to determine if previously recorded cultural resources are in or near the project area and served to provide a historical context for the study area.

The background research also included information about standing historical structures and known cemeteries located near the survey area. As noted above, the purpose of the background research is to inform the Stone Point Services crew of potentially important cultural resources that have been previously identified near the survey area. Using data from the background research, our researchers can pinpoint those areas that are more likely to contain archeological sites.

### Land Use History

In addition to previous a study of previous archaeological investigations, historical aerial photography and topographic maps were searched for the presence of potential standing structures that may be present in the survey area, as well as location where former structures once stood. Historic aerial imagery from 1954 and 1969, as well as later imagery from 1975, 1984, 1985, 1990, 1995, 2003, 2005-2008, and 2010-2018 were reviewed in an effort to identify changes to the landscape, infrastructure, and the presence or absence of structures in the survey area (Figures 18-24). Additionally, topographic maps from 1892, 1934, 1935, 1938, 1940, 1957-1959, 1970, 1976, 1986-1987, 1999-200, 2012 and 2016 were reviewed in an effort to identify any existing structures, landscape changes, and infrastructure additions to the survey area (Figures 25-28) (USGS 2021). A General Land Office map (GLO) from 1873, 1889 and 1907 were also reviewed (Figures 28-30) (Barrett 1872). A combination of imagery and maps was used as a general background to guide field investigations and the resulting report. A review of historic aerial imagery of the project area indicated that potentially historical standing structures, buildings, or other features were not present within the survey area.

A review of topographic maps, historic aerial imagery, and satellite imagery indicated that there was a moderate potential for encountering prehistoric cultural resources across the survey area and a high-probability of encountering historic artifacts and/or structures in the survey area. The likelihood for archaeological sites is heightened near areas with flowing water and the natural resources that surround riparian zones (Verhagen and Whitley 2012, Hall 1988). In this case, Crutcho Creek is located approximately 300-meters (984-feet) west of the general Subject Property, and a small tributary of Crutcho Creek bisects the North Area.

The 1934 topographic map and 1954 historic aerial photograph (Figure 18) depicts two structures in the southern portion of the existing landfill extending down to Highway 62. These structures were razed between 2003 and 2008. By 1981, an additional three structures can be seen in the southwest portion of the existing landfill immediately west of the 1954 structures. The 1987 topographic map indicates that these structures were associated with an oil well. These three structures were razed by 1995. The location of these three structures appears to be located under mounds of landfill refuse at this time.

Historic imagery from 1954 and 1969 indicate that some land clearing had occurred in the central and western portion of the North Area, and a man-made pond is visible along the east end of the Crutcho Creek tributary. Mechanical excavations were underway within the quarry area by 1954. The 1957 topographic map indicates that this pond was created by the excavation of sandpits on the east side of the Crutcho Creek tributary. By 1981, two ponds were visible along the northeast boundary of the existing landfill in the South Area. The 1976 topographic map indicates that these two ponds were sandpits. By 2002, those two ponds were filled in. In the 1954 aerial, a pond is located at the northeast boundary of the North Area. A basin with intermittent ponding remains at that location to this day. Around 2010, an area was excavated in the existing landfill near Highway 62. The recently-excavated area south of the active landfill holds standing water at this time.

By 2002, much of the landscape was cleared except for small portions to the west and southwest in the existing landfill. By 2008, mounds of refuse appear in the southern portion of the existing landfill extending down to Highway 62 and the existing landfill appeared relatively similar to its appearance today. It is significant to note that the 2000 topographic map indicated that the north portion of the existing landfill was an oil field.

The North Area has witnessed landscape change in the form of quarrying, oil pad construction, two-track roads, excavated ponds, agricultural activity, landfill dumpster staging, and pipeline trench excavation. Some vegetation was cleared in the southwest corner of the North Area along the border with the existing landfill by 2013. The only area that appears somewhat undisturbed are the grassy fields within the North Area on the north and south side of the unnamed tributary.

## Historic Records and Deed History

According to the 1873 General Land Office (GLO) Map for the area, no person was patented the land in the survey area at that time (Figure 28). The Crutcho Township Plat for Range 12 North, Township 2 West in the Indian Meridian for 1889 indicated that the Southeast Quarter of Section 22 was owned by Marshall Crawford (Oklahoma Historical Society 2021) (Figure 29). Additionally, a 1907 Crutcho plat map indicates that two structures were present in the Southeast Quarter (Figure 30). The structures were located near the current intersection of NE 23rd St. and N. Midwest Blvd (Ancestry 2021l). Marshall Crawford was born in 1846 and served in the military in 1865. He was Fourth Mounted Infantry, Ci-Da and carried the rank of Private in the Civil War (Ancestry 2021k). He lived in Oklahoma City, Oklahoma and passed away in 1933 (Ancestry 2021a). The 1910 census indicated that Marshall Crawford was a farmer in Crutcho, Oklahoma. He was married to Malva Crawford (Ancestry 2021b). It seems that following Crawford's death in 1933, the land was sectioned off and sold.

According to the Oklahoma Tax Assessor's Office (2021) the survey area became five separate tracts of land after 1933. Tracts one and two were owned by the Fuchs family. Tract three was owned by Earl Knighton Senior. Tract four was owned by the Dolese Company. Tract five was owned by Catherine R. Jones. Each individual tract was assessed for history of ownership and persons of historic significance. The findings of the historic records investigations are presented below.

Regarding tract one, the 1940 U.S. Census indicated that Arthur C. Fuchs resided in Crutcho Township in Oklahoma with his wife, Minnie, daughters Anna, Mildred and Florence and son, Charles. Arthur was a Superintendent at a bottling firm (Ancestry 2021m). Historic deed information indicates that upon Arthur's death in 1943, Florence Fuchs-English became owner of Tract one and her sister, Mildred Fuchs-Wright, became the owner of Tract 2. Florence Fuchs-English was born in 1938 and passed away in 2016 (Kueteman 2021). Florence worked in the oil industry and retired from National Oilwell. The address associated with tract one was 7621 North 23rd Street. In 1994, ownership of tract one moved into the Florence E. English Living Trust. In 2003, tract one was sold to Northeast Landfill, Inc. by the trust.

Tract two was owned by Mildred Fuchs-Wright. Mildred was born in 1929 and passed away in 2017. Little else is known about Mildred Fuchs-Wright. Robert and Jane Wright took ownership of tract two in 1976. Robert was born in 1946 (Ancestry 2021e). Little else is known about Robert Wright. Jane Wright was born in 1949. According to the US Public Records Index from 1950-1993, the address associated with tract two was 7701 NE 23rd (Ancestry 2021f, g). The structures observed in aerial images for tracts one and two are likely associated with the Fuchs, English, and Wright families. None of the individuals listed as deeded owners appear to have significance to the history of the town, county, or the State of Oklahoma.

Tract three was owned by Earl Knighton Senior. The 1940 US Census listed Earl as a Geologist in the Oil Industry (Ancestry 2021h). Earl was a Lieutenant Colonel in the Air Force in World War

II. He received two Air Force Commendation medals and was inducted into the Kansas Oil Museum Hall of Fame (Ancestry 2021i). His residence was never listed as being on this tract of land. In 1987, Earl sold the tract to Midstates Natural Gas. In 1992, Midstates sold the land to Ted Dirickson. In 1997, Ted sold the land to Roy L Conley who sold the land to Northeast Landfill Inc. in 2000. None of the listed individuals appear to have significance to the history of the area or the State of Oklahoma.

Tract four was owned by the Dolese Company until 1997. In 1997, Dolese sold it to Northeast Landfill Inc. Dolese Company from its inception in the earliest days of Oklahoma Statehood, transformed the state's raw rock into buildings and foundations (Dolese 2021). They own more than 60 facilities and have more than 1,000 employees (Dolese 2021).

Tract five was owned by Catherine Leavitt Jones. Catherine married Walter Sloan Jones. According to the 1940 US Census, Walter was a port owner and realtor (ancestry 2021j). There is no indication that they ever lived on the property. Their son, Walter S. Jones, assumed ownership from Catherine. He lived in Dallas (Ancestry 2021j). In 1991, the land moved into a living trust for Walter S. Jones. In 1992, the trust sold the land to Terrance W. Mangan, nearly immediately sold the land to Billy J. Eisenhour. In 2005, Billy appears to have sold the land to his business, B.E. Land LLC. In 2009, B.E. Land sold the tract to Northeast Landfill Inc. No one appeared to have ever resided on the tract. None of the listed individuals appear to have significance to the history of the area or the State of Oklahoma.

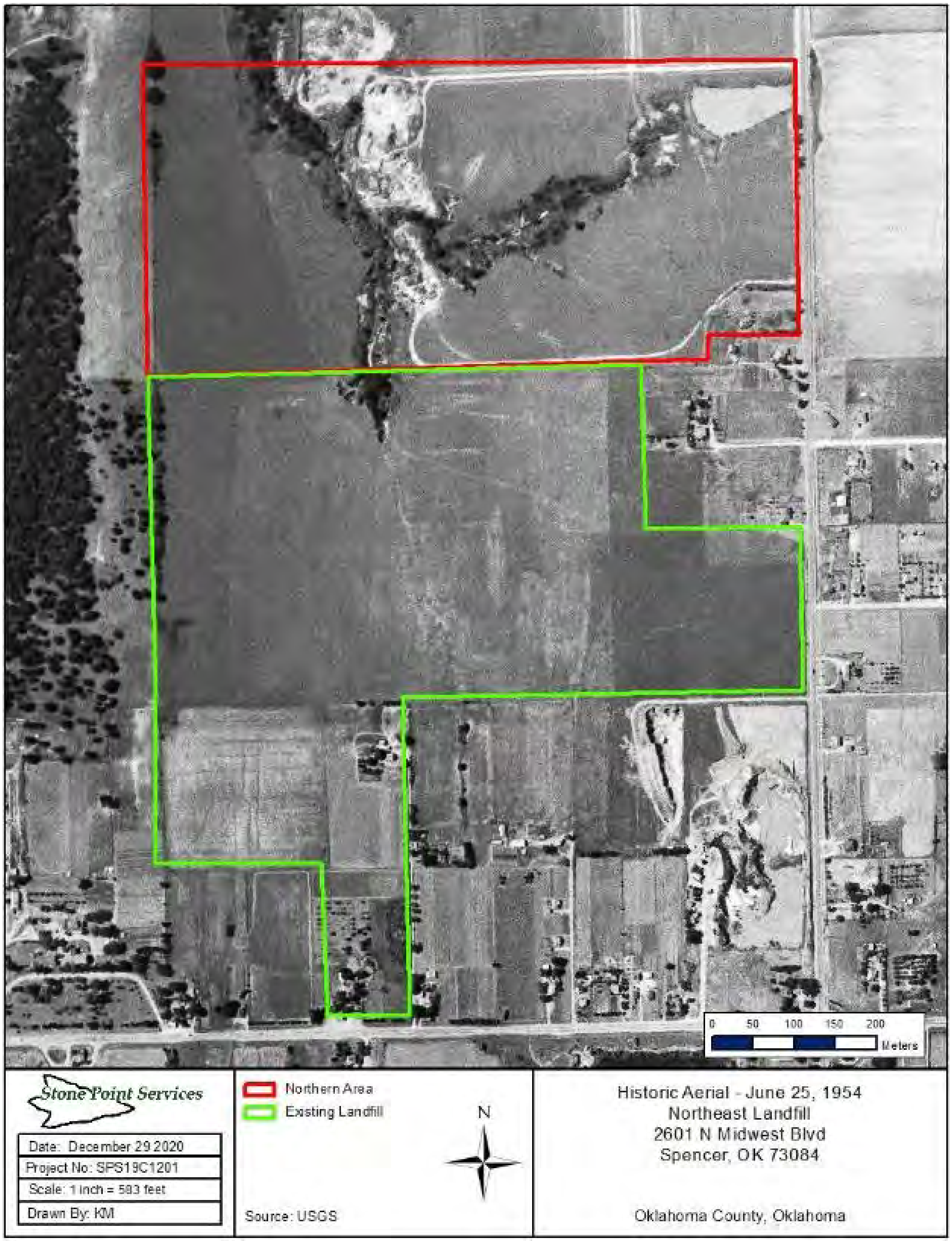


Figure 18: Historic 1954 aerial imagery map showing the project area

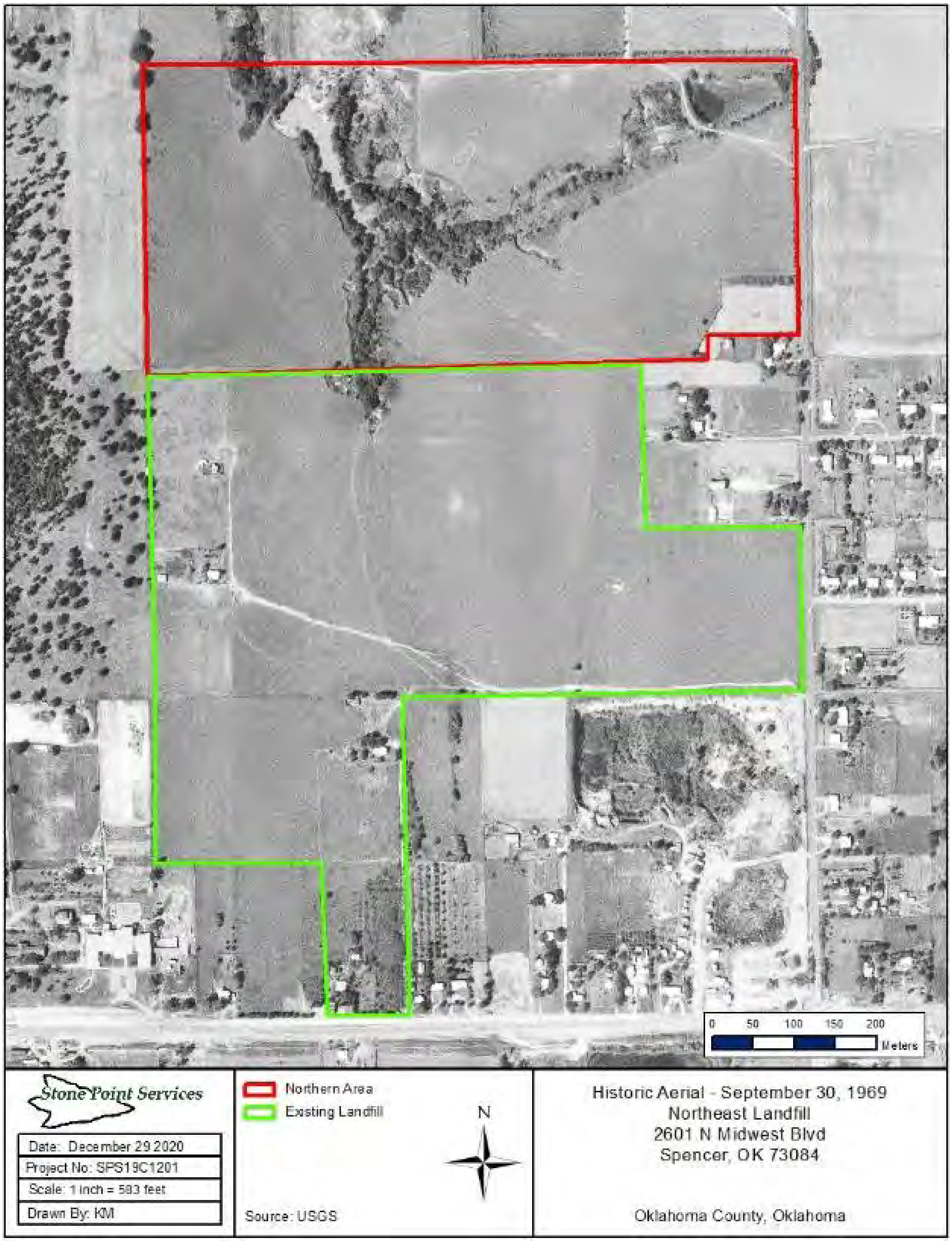


Figure 19: Historic 1969 aerial imagery map showing the project area

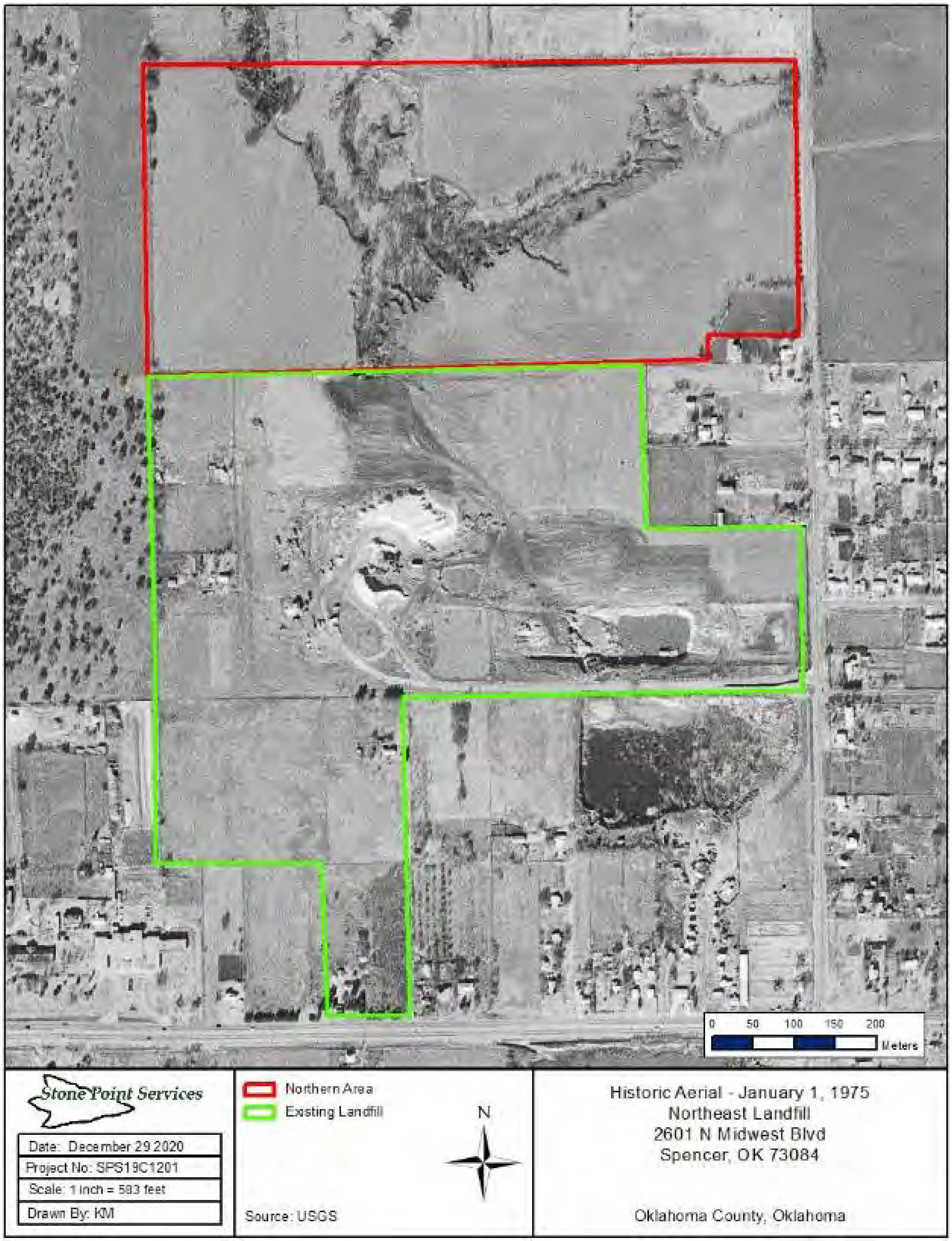


Figure 20: Historic 1975 aerial imagery map showing the project area

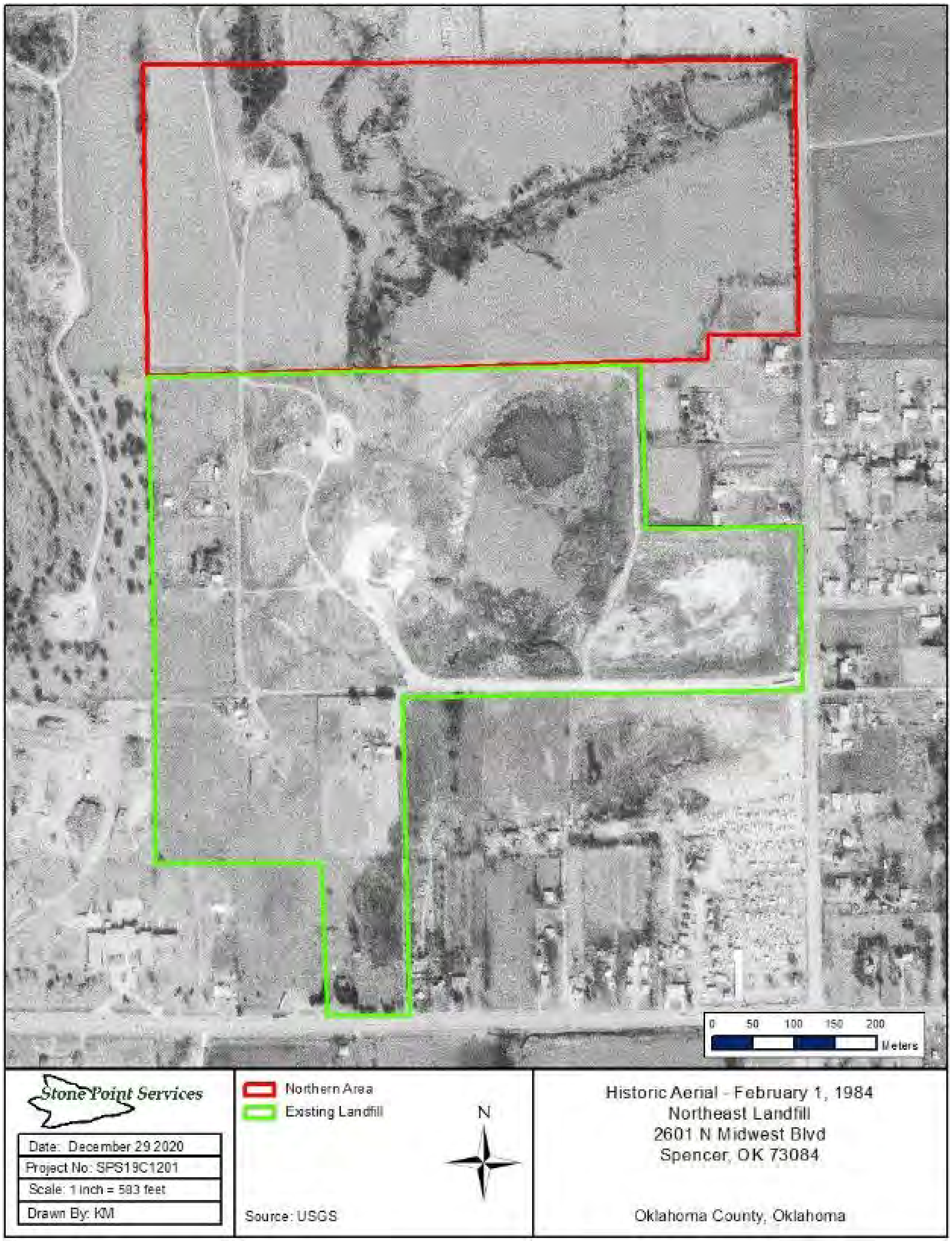


Figure 21: 1984 Historic aerial imagery map showing the project area


Figure 22: 1995 Historic aerial imagery map showing the project area

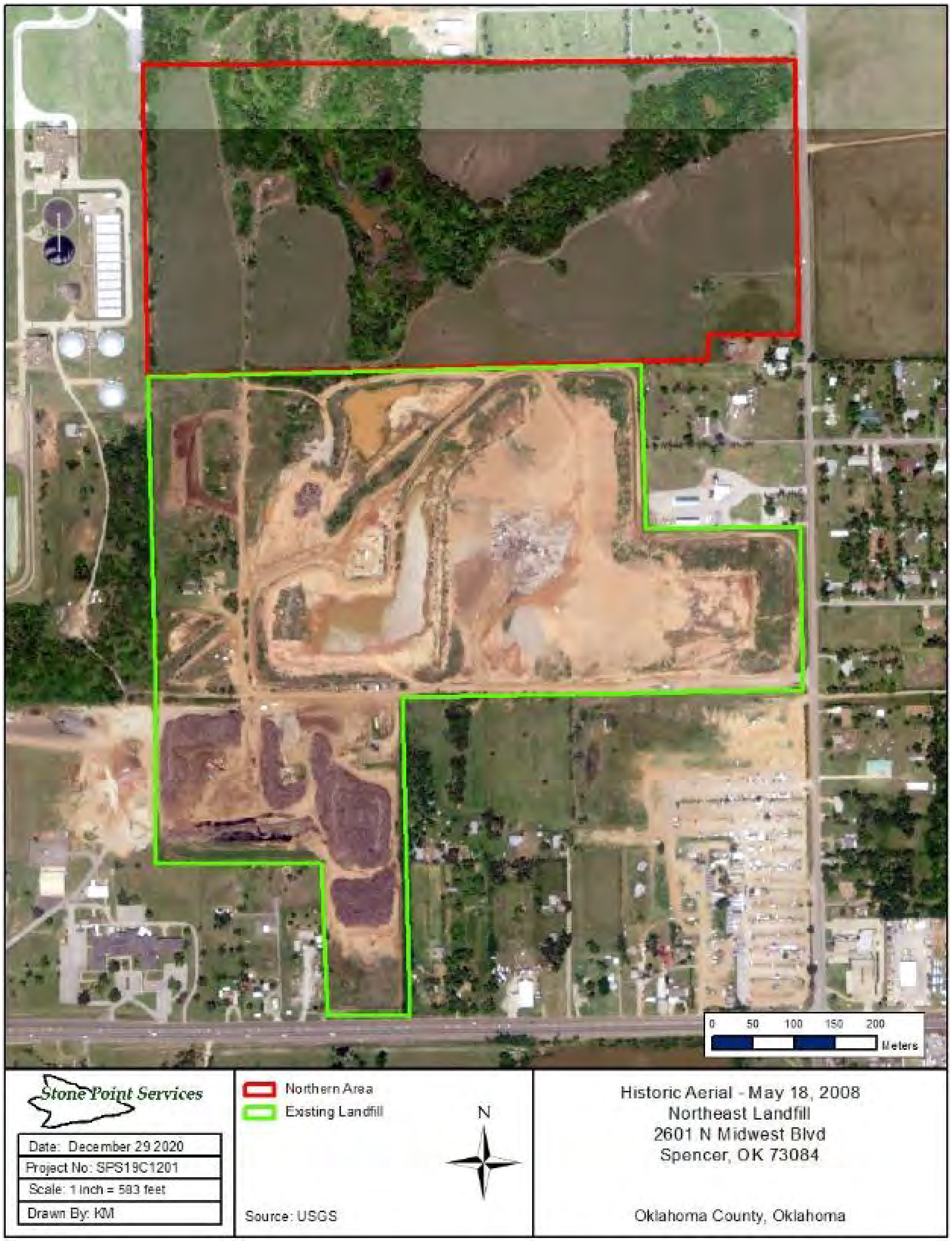


Figure 23: 2008 Historic aerial imagery map showing the project area

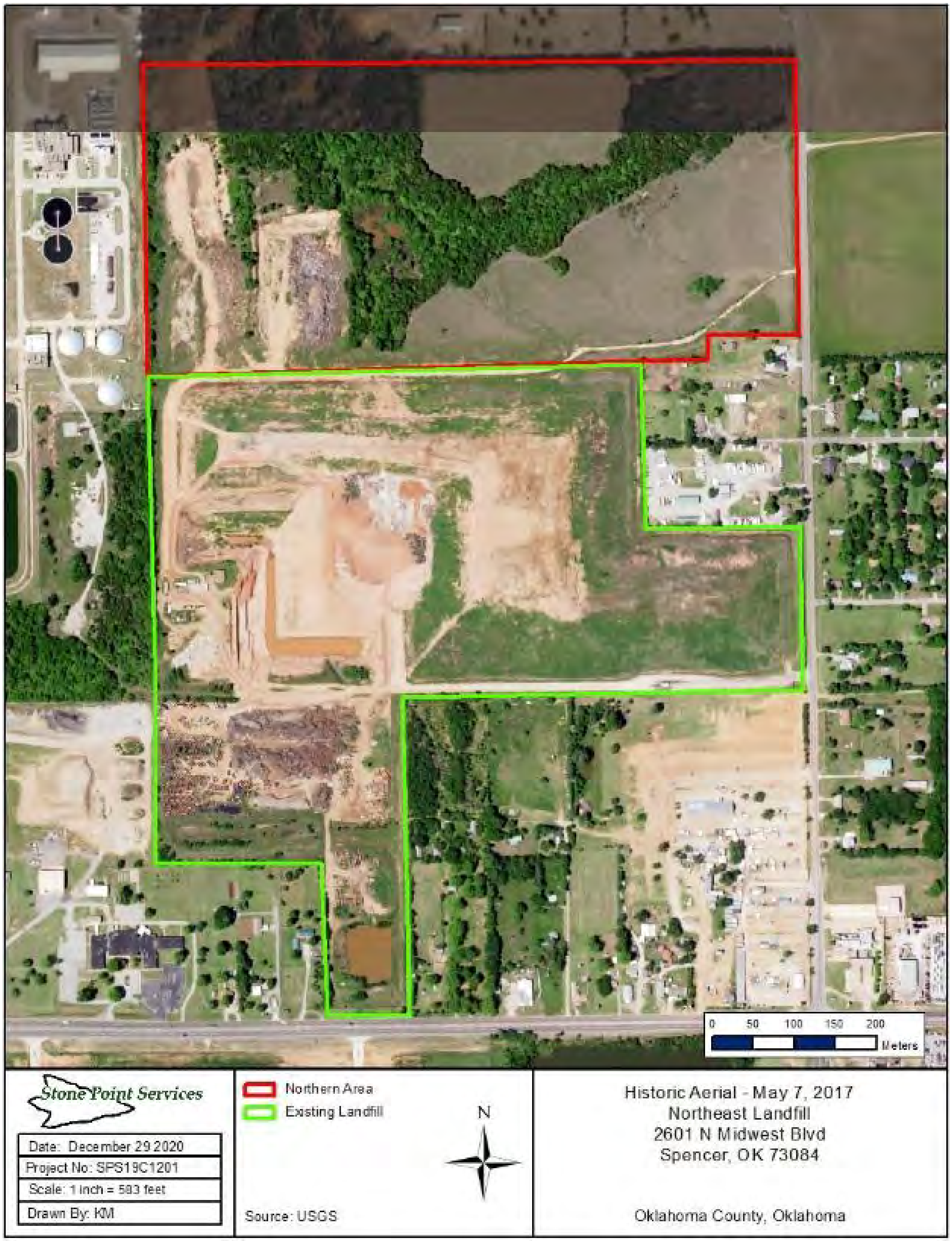


Figure 24: 2017 Historic aerial imagery map showing the project area

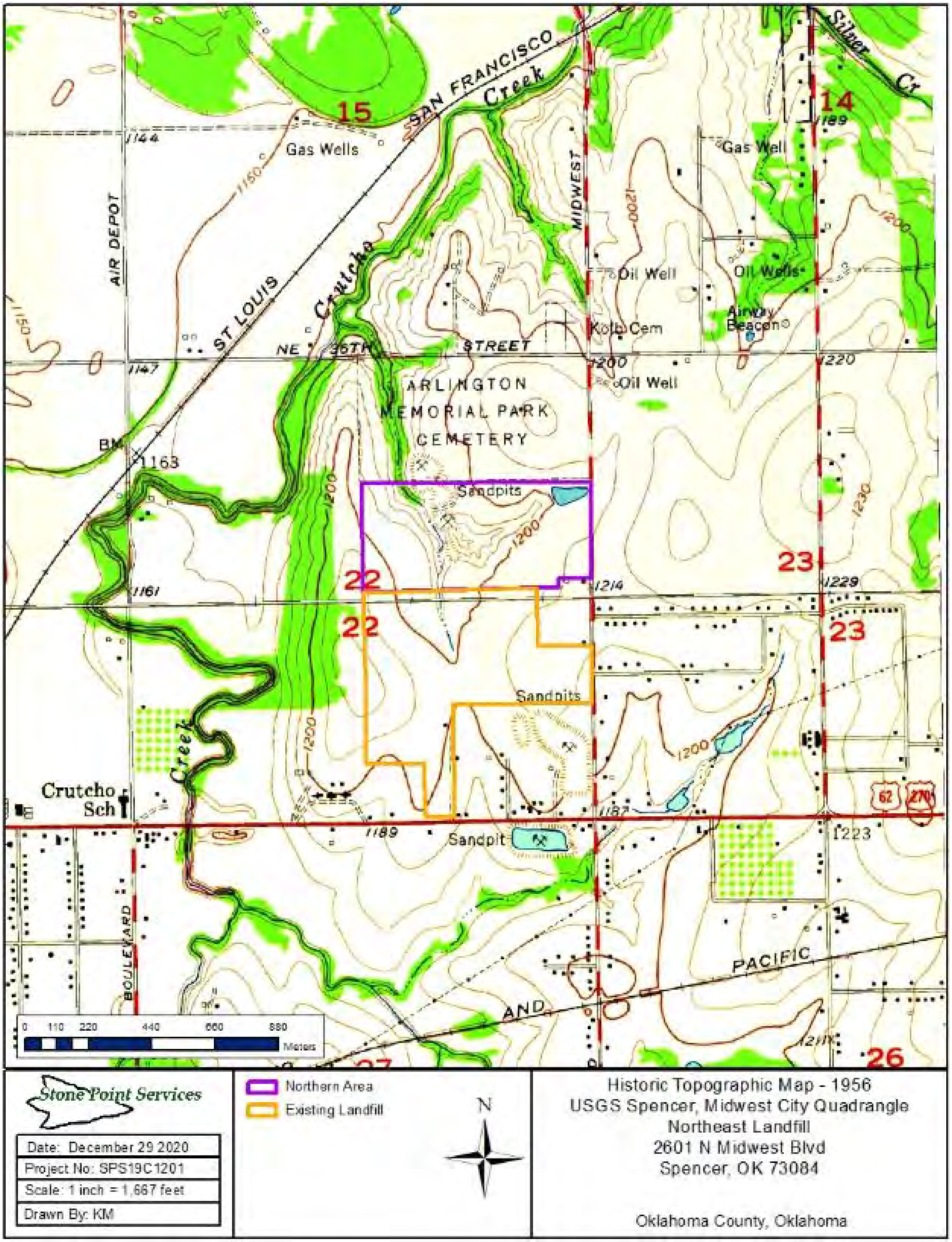


Figure 25: 1956 USGS Spencer, Midwest City topographic map showing the project area

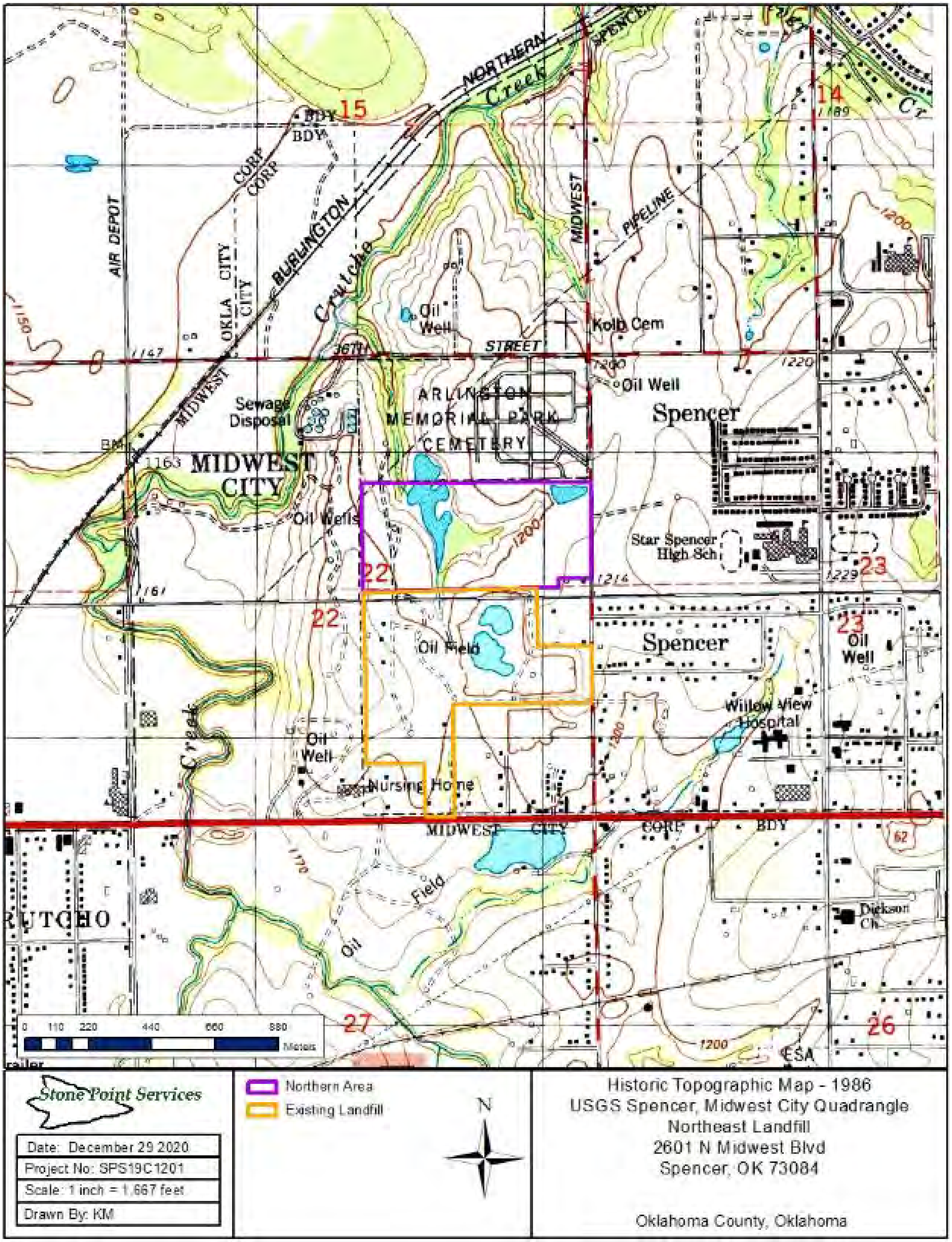


Figure 26: 1986 USGS Spencer, Midwest City topographic map showing the project area

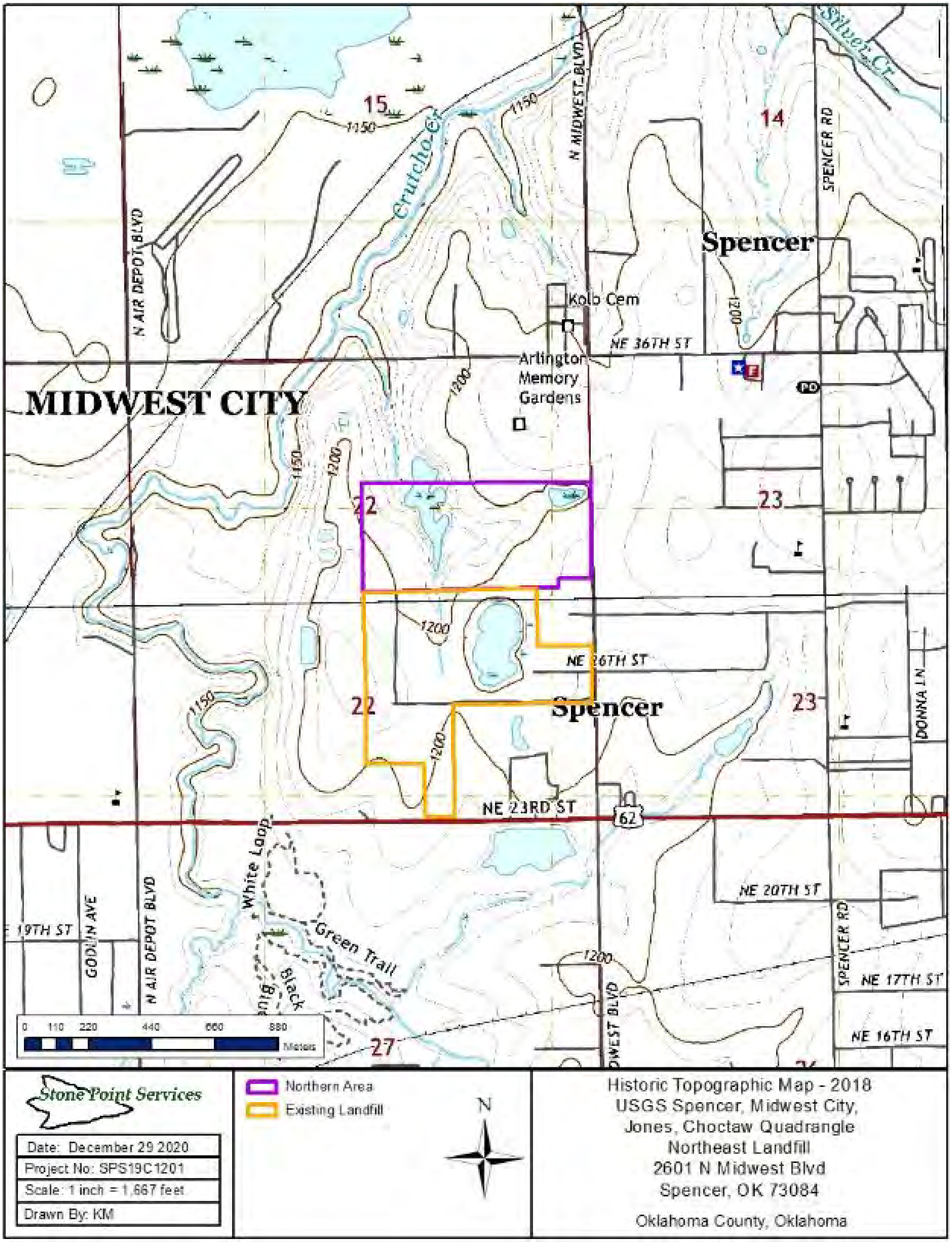


Figure 27: 2018 USGS topographic map showing the project area

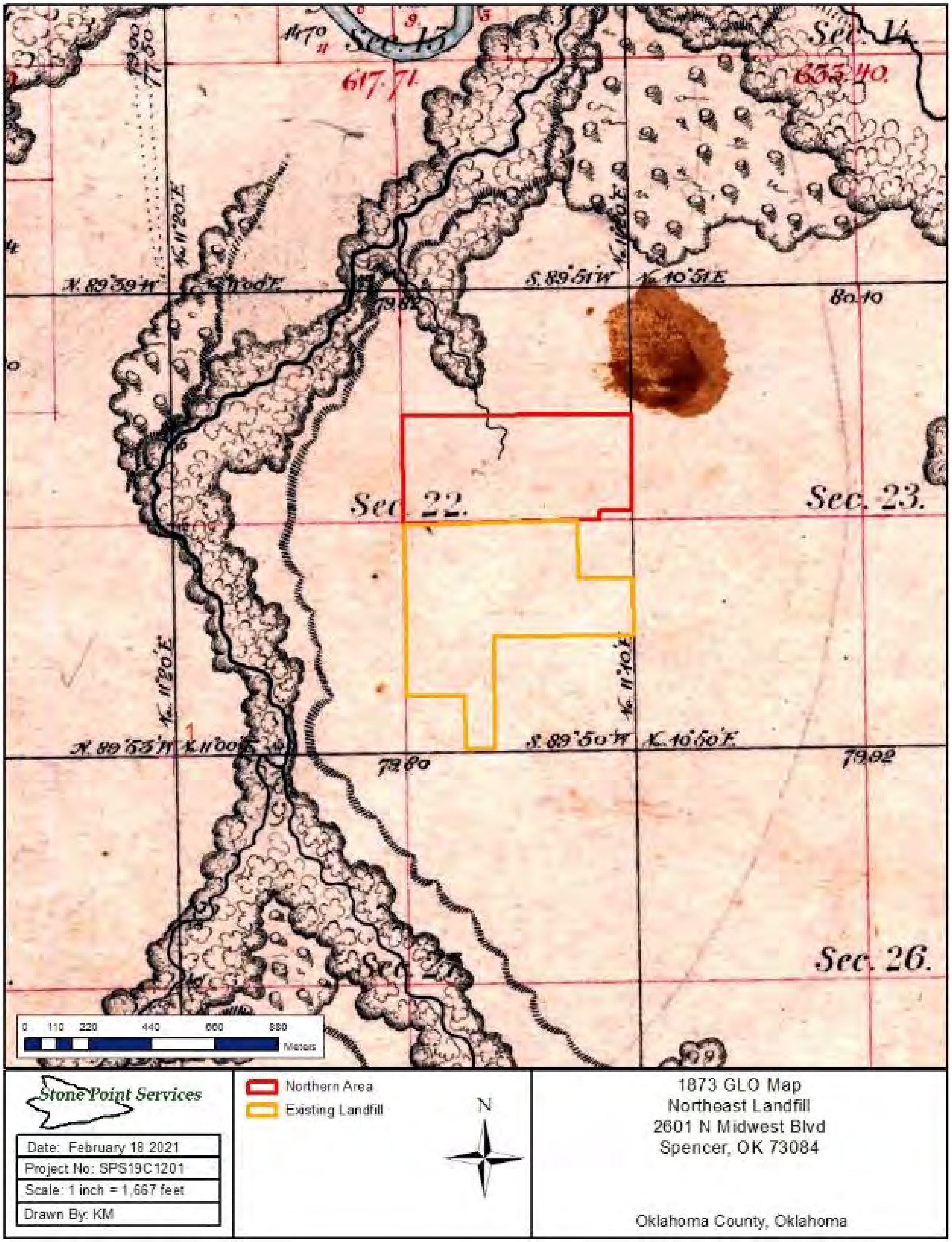


Figure 28: 1873 General Land Office map showing the project area

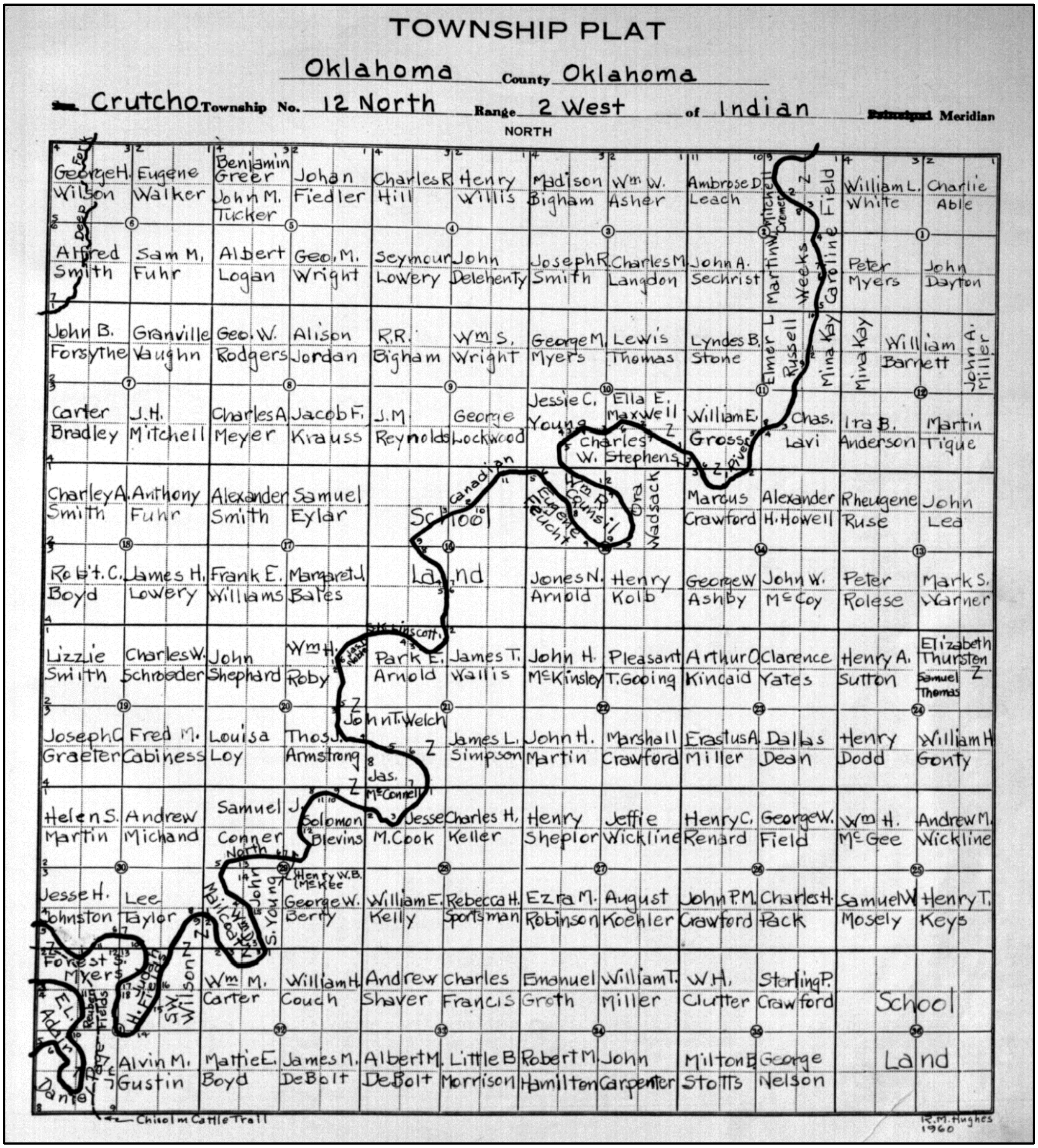


Figure 29: 1889 GLO Crutcho Township map

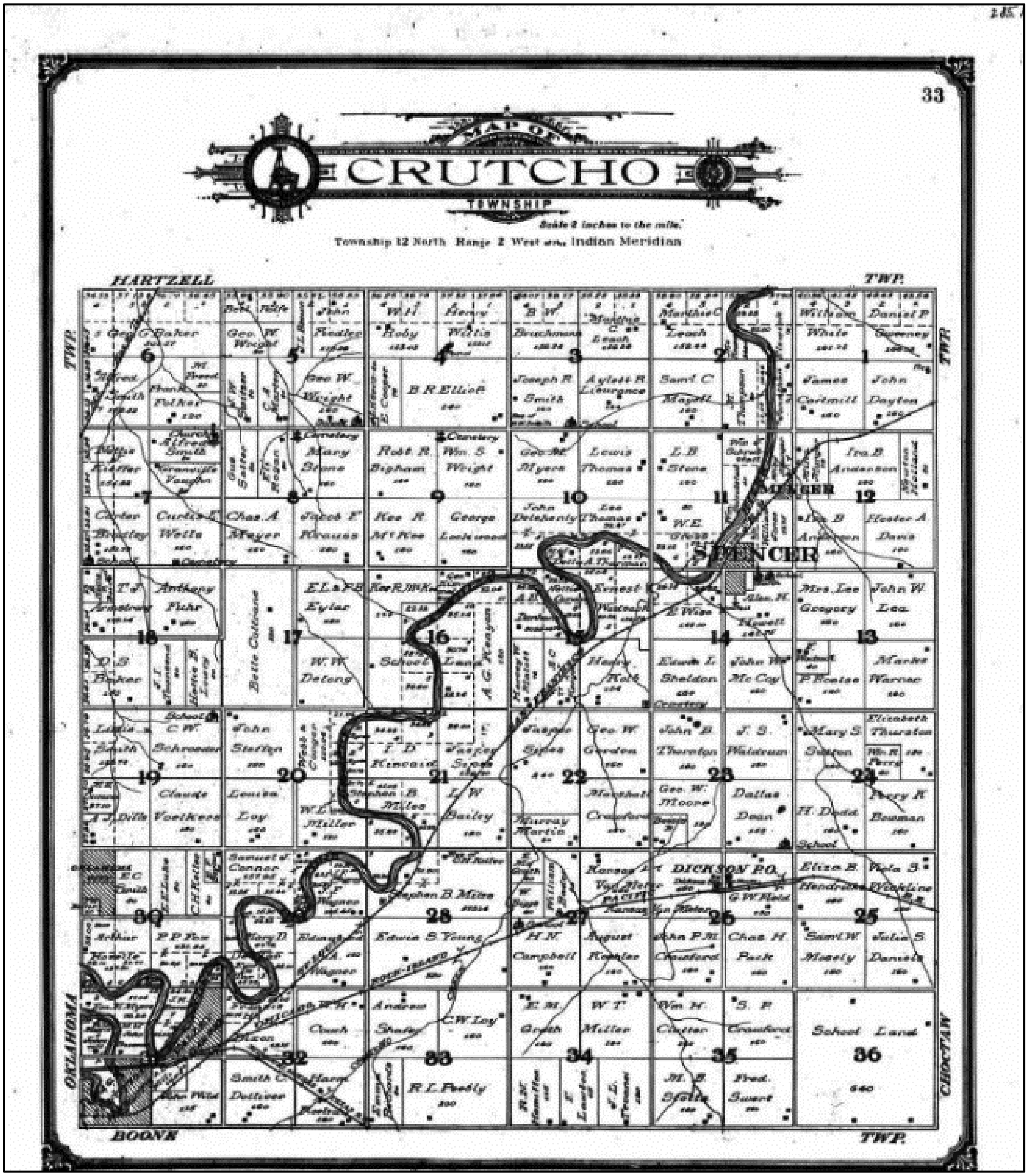


Figure 30: 1907 GLO Crutcho Township map with the Subject Property in Section 22

## FIELD METHODS

The archeological investigation of the project area included an intensive archeological survey using both pedestrian survey and shovel testing techniques. Pedestrian survey was used to locate quarries, cemeteries, chimneys, earthworks, and other above ground features, as well as artifacts lying on the ground surface. Shovel testing was used to identify potential subsurface artifacts and assess locations surrounding isolated surface artifacts. As the survey area exhibited widely-varying potential for the presence of archaeological sites, shovel testing strategies likewise shifted with the location to provide the appropriate horizontal and vertical coverage. The banks of the unnamed tributary of Crutcho Creek contained the area of highest potential for archaeological sites. Within the stream zone, systematic shovel testing was conducted along two transects on the north and south bank of the stream. Shovel tests in this area were spaced at 15-meter (50-foot) intervals along each survey transect. Shovel test survey transects along the banks of the unnamed tributary were spaced 15-meters (50-feet) apart. As two transects were placed on each bank of the tributary, shovel tests on adjacent transects in this high-probability area were offset (staggered) by 7.5-meters (24-feet) to provide greater surface coverage. The transects nearest the stream edge contained shovel tests excavated to a minimum of 80-centimeters (31-inches) below surface (unless obstructed by bedrock or coarse roots) to fully characterize the nature of the soil profile and investigate the potential for deep archaeological materials. Extremely dense vegetation within the stream zone provided a challenge to navigation and uniform shovel test placement, however, shovel test spacing did not exceed 15-meters (50-feet) between shovel tests unless obstructed by deep ditches, modern refuse pits, and/or mechanically-excavated quarry/pond basins (see Survey Obstructions and Soil Disturbances section below).

The north and south agricultural fields constituted moderate-probability areas for potential archaeological sites due to increased distance from the water source. Shovel tests within the moderate-probability areas were conducted at 30-meter (100-foot) intervals along transects spaced 30-meters (100-feet) apart. Shovel tests along parallel transects in moderate probability areas were staggered at a distance of 15-meters (50-feet) between transects to provide increased horizontal coverage. Staggering shovel tests between adjacent transects creates the diamond shape shovel test pattern observable in project overview maps.

Areas with significant disturbance or modern landforms (e.g., dredged deposits) do not require systematic shovel testing unless the disturbance/intrusive deposits are shallow and shovel testing can reach in situ deposits. In disturbed soil contexts where shovel testing is feasible, shovel tests will be executed to evaluate the level of disturbance, which may or may not have impacted any potential archaeological sites. Likewise, areas within the active landfill with significant disturbance were surface inspected and discretionary shovel testing was implemented to determine if intact soils were present. Locations of significant soil disturbance in the North Area were surface inspected and shovel tests were placed to determine the level of disturbance and whether any Holocene-aged remained which may hold archaeological materials. In many cases the upper 4-meters (13-feet) of sediment had been removed my mechanical excavation. Photographs were taken at all disturbance areas (see below). Shovel tests remained at a spacing of 30-meters (100-feet) between tests in areas of significant disturbance. In this case, significant soil disturbances were present as the result of deep quarry pits, dumpster staging areas, excavated ponds, sand/mulch piles, and landfill deposits. In disturbed soil contexts where shovel testing was feasible, shovel tests were used to evaluate the level of disturbance, which may or may not have impacted any potential archaeological sites. At least one shovel test was excavated in each environmental zone (e.g., flood plain, first terrace, up-slope, ridge top, etc.) on each side of water crossings even in areas of high ground surface visibility, or soil disturbance.

Transects were terminated once hill slope angle measured greater than 20 percent. For consistency in slope assessment, slope angles were measured with a clinometer across the survey area by the Field Director. Areas with greater than 20 percent slopes, and/or exposed bedrock generally do not need systematic shovel testing, however discretionary shovel tests were implemented in specific cases. Areas with a slope angle of 20 percent or greater were visually-inspected via pedestrian survey along transect intervals spaced no wider than 10-meters (32-feet) apart.

Shovel tests measured a minimum of 30-centimeters (12-inches) in diameter and were excavated to culturally sterile soil, if possible. Shovel tests fully assessed the topsoil horizon(s) and penetrated a minimum of 10-centimeters (4-inches) into underlying subsoil to confirm the nature of the soil horizon. In specific cases, shovel testing depths continued well into subsoil horizons to evaluate the potential for buried soils near creek banks. Once stream bedload gravels or sandstone parent material were encountered and no indication of buried soils was noted, shovel testing was terminated, and aspects of the shovel test were noted. Field notes were made for each soil horizon or layer encountered within shovel tests. Shovel test notes documented, at a minimum, soil horizon depth range, Munsell color, soil texture, presence or absence of archaeological materials and reason for termination at that depth (e.g., subsoil, bedrock, water table). Each shovel test was excavated in no greater than 20-centimeter (8-inch) levels. All shovel test fill was screened through ¼-inch hardware mesh, or thoroughly processed within the screen by hand when soils would not pass through the mesh as the result of clay or water content.

If sites or isolated finds were encountered, they were delineated by the distribution of surface artifacts/features and shovel tests typically placed in a cruciform pattern extending along perpendicular axes in cardinal directions. Limitations on access posed by the natural and built environment required adjustments to shovel testing strategies in certain cases, for instance a shovel test grid, rather than cruciform pattern due to spatial constraints. Delineation shovel tests were excavated at 5-meter (16-feet) intervals from an initial positive shovel test until two successive negative shovel tests were excavated in each direction. Given the above strategy, a minimum of eight shovel tests would be placed along perpendicular axes extending from the center of the initial subsurface artifact discovery location for a minimum total of nine shovel tests (e.g., one positive test with eight negative delineation shovel tests). No positive tests were encountered during this assessment. For sites encountered on the surface, delineation shovel tests would be deployed in a cruciform pattern from a central datum until two consecutive negative shovel tests are encountered in each cardinal direction. Shovel testing will not be conducted outside of the landfill or outside of the Northern Area boundary. Surface inspection at 10-meter (32-feet) transect spacing was employed coincident with shovel tests to delineate the horizontal and vertical extent of artifacts at each potential site. Depressions, possible middens, and other areas within sites that can be differentiated based on surface indications were shovel tested to the determine the potential nature of the anomaly. Artifacts were not collected as part of this survey. Artifacts were to be field analyzed (quantified and typed) and photographed (diagnostics and representative samples) and returned to the locations in which they were discovered. No artifacts were encountered during this survey.

All shovel test locations were recorded using a handheld GPS unit with an accuracy of 3-meters (10-feet) or less and plotted on project maps. Isolated find locations were plotted on USGS 7.5-minute topographic maps. All shovel test locations were mapped using ArcGIS 10 with standard shape file formats. Sites were documented using an Oklahoma Archeological Site Survey Form. After consultation with the Oklahoma Archaeological Survey, if a recorded feature did not warrant the allocation of a trinomial, then an Oklahoma Historic Preservation Resource Identification Form (HPRI) was completed and attached to this assessment (See Appendix B). As the feature recorded during this survey did not qualify for allocation of a trinomial, an associated HPRIF form is attached. The Field Director maintained detailed notes on survey methods, disturbances, photographs, and relevant environmental factors. Danny Welch, Ph.D., of Stone Point Services served as Field Director and executed the Work Plan. Danny Welch meets the U.S. Secretary of the Interior's Professional Qualification Standards for Archaeology (48FR 22716 or 36 CFR Part 61).

Each archeological site was to be evaluated for NRHP eligibility following the four evaluation criteria as outlined within 36 CFR 60.4. Site delineation activities were restricted to the survey boundary and therefore eligibility assessments of sites may be tentative. Recommendations for avoidance or additional testing would be made for each site. Any standing building and or structure that is 45 years old or older would be recorded on the HPRIF as outlined in the SHPOs Review and Compliance Manual. An assessment of integrity and significance will be provided with an opinion on NRHP eligibility.

**LABORATORY METHODS**

The following post-field activities meet SHPO guidelines. Upon completion of all field investigations, recovered artifacts were to be returned to the Stone Point Services Lab and washed, catalogued, and analyzed. Records for survey on private property will be submitted to the Oklahoma Archaeological Survey at the University of Oklahoma for curation. Laboratory methods for preparing artifacts, notes, and additional media will follow the guidelines set forth by the

Oklahoma Archaeological Survey and Oklahoma State Historic Preservation Office. Since no artifacts were collected during this survey, no artifacts will be curated as part of this project.

**NRHP ELIGIBILITY ASSESSMENTS**

Archeological resources identified during this survey were evaluated to determine their NRHP eligibility. As per 36 CFR 60.4, four broad criteria should be used when making a NRHP eligibility determination. In order to be considered eligible for the NRHP, a resource must possess integrity (location, design, setting, materials, workmanship, feeling, association), and it must meet at least ONE of the following criteria:

A. it is associated with events that have made a significant contribution to the broad pattern of history;
B. it is associated with the lives of persons significant in the past;
C. it embodies distinctive characteristics of a type, period, or method of construction, or represents the work of a master, possesses high artistic values, or represents a significant and distinguishable entity whose components may lack individual distinction;
D. it has yielded, or is likely to yield, information important to history or prehistory.

Criteria A, B, and C are usually applied to historic structures, features, and non-archeological resources (i.e., battlegrounds, etc.). Criterion D is most often used to determine the NRHP eligibility of archeological resources. In most instances, an archeological site or historical resources must be at least 50 years old when it is assessed. In some instances, especially in regard to particularly important resources (e.g., the World Trade Center Site), a structure or location may be nominated for the NRHP even if it does not meet the 50-year rule. As a general rule, any property or site greater than 50 years of age may be considered for the NRHP.

Criterion D is the most commonly applied criterion in archeological surveying. The surveyor must try to determine if the site in question has adequate context for it to answer important questions about history or prehistory. The ultimate decision of eligibility is generally determined by the State Historic Preservation Office (SHPO) and/or the federal agency requesting the survey. The surveyor can make recommendations, but ultimately the SHPO or the federal agency will make the final determination of eligibility, either through concurring with a recommendation or not.

Archeological survey, and associated site delineation, is rarely sufficient to make a final ruling of a site's NRHP eligibility. In most cases, the archeologist will recommend a site as either "potentially eligible" for the NRHP or "not eligible" for the NRHP. If a recommendation of "potentially eligible" is given, and the SHPO or federal agency concurs, the site should be treated as if it is "eligible" for nomination to the NRHP. Additional testing of the site will generally be sufficient to make the final determination of NRHP eligibility. If a recommendation of "not eligible" is made for the site, and if the SHPO and/or federal agency concur, the site is then considered to be unlikely to provide information important to our understanding of history or prehistory.

Archeologists generally look for a certain set of criteria to determine if a site possesses integrity. The most common keys in making this determination are location, setting, materials, and association. When archeologists speak of a site being "intact" or if they mention "context" they usually are referring to whether a site has sufficient deposits that appear to be undisturbed to answer the important questions about the prehistoric and historic past that will make it potentially eligible under Criterion D. The materials (artifacts) present can aid in dating the site and assigning cultural association. If a site is associated with a specific group or period, and that association can be determined through archeological research, then the site may retain sufficient integrity to be recommended potentially eligible for the NRHP. If a site is intact, this means that the site has retained its original location and setting and has not been disturbed. As an example, if an archeological site has buried deposits and ample time-diagnostic artifacts for dating the site, but there is evidence of disturbance, this would call into the question the reliability of any data recovered from the site. As such, a site may be recommended not eligible for the NRHP if it is highly disturbed. Another example would be a small prehistoric site with potentially intact deposits but no time-diagnostic artifacts or organic remains to help identify the age and association of the site. In this latter case, an eligibility determination of not eligible may be rendered. Small lithic (stone) scatters are often determined not eligible due to the lack of research potential.

Historic archeological sites pose a separate but similar set of issues. Although a prehistoric site may sometimes have evidence of a structure, they are far more common on historic sites. A historical structure on a site may be recommended not eligible for the NRHP due to it not meeting Criteria A, B, or C, and yet the archeological site that surrounds the structure may in fact be eligible for the NRHP under Criterion D (information potential). Although the structure is in poor condition and possibly not eligible for the NRHP, the archeological site might contain information about the period in which the structure was used. In this case, the structure may be a contributing element to the site's NRHP eligibility under Criterion D.

# Chapter 4: Results and Recommendations

Stone Point Services, LLC conducted a cultural resource survey of the proposed Northeast Landfill 163.3-Acre Project Area located in Spencer, Oklahoma for Hydrex Environmental. The project area includes the "North Area," which covers an approximately 73.2-acre (30-hectare) area north of the existing landfill and the "South Area"/existing landfill, which consists of 90.1-acres (36.36-hectares). The total area surveyed for this project is approximately 163.3-acres (66-hectares). The purpose of this cultural resources survey is to identify cultural resources (archaeological and historic) that may be impacted by the proposed sediment removal, landfill construction, and other associated landfill activities. The findings of the near-surface intensive survey are presented below, preceded by a description of limiting factors which effected survey coverage and a discussion of derivations from standard survey methods.

### Survey Obstructions and Soil Disturbances

Survey transect spacing was maintained at 30-meters (100-feet) between transects. Shovel tests were generally offset between parallel transects to provide increased surface coverage and were spaced at 15-meter (50-foot) and 30-meter (100-foot) intervals where feasible. Investigations at potential sites included shovel tests at 5-meter (16-foot) intervals where feasible. The spacing between shovel tests along these transects was hindered in certain cases by aspects of the built environment and excavations by heavy machinery (Figures 31-49). In the cases where significant modern sediment or refuse piles were present, surface investigations were conducted to assess the area. In locations where soils had been removed for quarrying or pond excavation, surface survey was conducted and cutbanks at the quarry boundary were inspected for potential buried archaeological deposits. Major disturbance areas which precluded systematic shovel testing included modern sediment piles, mulch piles, modern refuse deposits, property lines, and active staging areas associated with landfill activities. Removal of sediments included deep pits from mechanical quarrying activity, which measured up to 4-meters (13-feet) deep and had subsequently removed any former soils which would have contained any potential for artifacts. Other obstructions during survey included tall sediment berms near the former quarry dam and steep slopes (above 20%). Any location where site delineation was hindered by modern activity were noted on site maps and photographed (see below). Site delineation was hindered at the historic storm shelter (Field ID# 1201-HS1) by property boundaries (fences) and a mechanically excavated pond. While some impediments existed during site delineation and transect shovel testing, these limitations appear to be relatively minor, and did not significantly detract from the collection of data or the understanding of the site encountered during survey. A description of the limiting factors and deviation from standard shovel testing protocol, along with photographs of the natural and artificial features is presented below.

A large rectangular mechanically excavated pit with ponded water was present in the southern portion of the South Area which inhibited systematic shovel testing of this portion of the South Area. This modern soil disturbance provided a limiting factor to the typical cardinal-direction delineation method for the adjacent historic structure identified during background research (1201-HS1) (Figure 32, photo location 1). A deep bar ditch, mulch pile, and fence line was present along the eastern side of the southern mulch pile (Figure 33, photo location 2), which limited systematic shovel testing along this portion of the Subject Property. Landfill-related structures, machinery parts, fuel tanks, and redeposited sand covered the location of a second potential structure identified during background investigations (Figure 34, photo location 3). Investigative shovel tests were placed at 10-meter (32-foot) intervals in cardinal directions across this area in the case that artifacts remained. Shovel tests observed no artifacts, and shovel test profiles indicated a disturbed context with secondary sand deposits and mixed fill gravels. Soils across the southeast portion of the North Area were disturbed as the result of recent vehicle use and dumpster storage (Figure 35-36 photo location 4 and 5). Shovel tests placed within this area indicated an eroded topsoil with significant mixing of soil clasts between topsoil and subsoil horizons as the result of vehicle tires and dumpster movement. Systematic shovel testing was not undertaken in the basin of the excavated pond located in the northeast of the North Area (Figure 37, photo location 6). Surface survey was conducted across the dry portions and about the periphery of the basin. The clay borrow pit likewise posed limitations to systematic shovel testing (Figure 38, photo location 7). Shovel test were placed along the eastern edge of this obstruction, as the south and west held a gas pipeline, and deep quarry cuts were present to the north.

North of the clay borrow pit exhibited deep cuts from the sand quarry boundary and steep banks of the unnamed tributary (Figures 39-40, photo locations 8 and 9). These locations were surface surveyed, and systematic shovel testing terminated at contact with the quarry boundary. The depth of quarry-related sediment removal was well-expressed within the marshy quarry basin (Figure 41, photo location 10), and along the eastern edge where removal of sediment measured approximately 4-meters (13-feet) deep dependent on location (Figure 42, photo location 11). The width and depth of the quarry cut was illustrated well along the northern boundary (Figure 43, photo location 12). Shovel testing along the northern boundary encountered coarse, rounded, well-sorted sands associated with alluvial deposits of Pleistocene age. The sand exposed across the surface in this area would have been covered by ca. 4-meters (13-feet) of overlying sediment prior to quarrying activity. As such, this area contains no potential for archaeological materials. Shovel test transects along the northwest stream section were obstructed by a large earthen dam (Figure 44, photo location 13), which has been subsequently breached. The northwest corner of the North Area contained obstructions including sand piles, exposed and buried mulch, and gas pipelines (Figures 45-48, photo locations 14-17). The gas pipeline extended across the south portion of the North Area then diagonally towards the northeast (Figure 49, photo location 18)

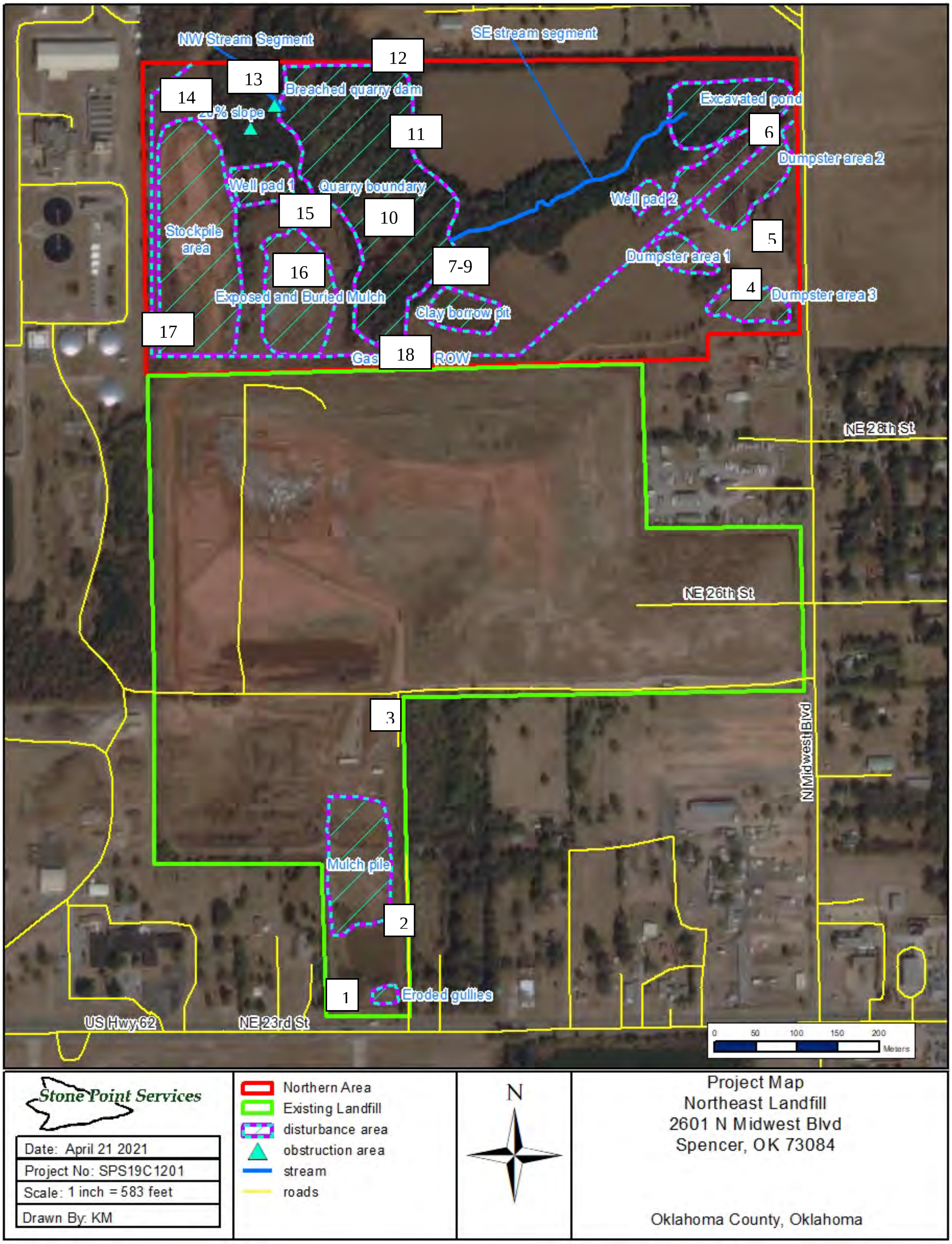


Figure 31: Overview map of obstructions and disturbances with photo locations marked


Figure 32: Photo location 1, view north from storm shelter to pond, mulch pile, and landfill


Figure 33: Photo location 2, view north along mulch pile, bar ditch and fenceline


Figure 34: Photo location 3, view SW toward redeposited sand, equipment, and mulch pile


Figure 35: Photo location 4, view south of disturbed soil and dumpster area 3


Figure 36: Photo location 5, view north of disturbed soil and dumpster area 2


Figure 37: Photo location 6, view NW of excavated pond


Figure 38: Photo location 7, view SE of clay pit and active landfill (right)


Figure 39: Photo location 8, view west of quarry edge and refuse dump


Figure 40: Photo location 9, view west of stream near quarry edge


Figure 41: Photo location 10, view NW of marshy areas in quarry basin


Figure 42: Photo location 11, view north indicating depth of cut on east side of quarry


Figure 43: Photo location 12, view west of northern boundary and quarry cross section


Figure 44: Photo location 13, view south of breached quarry dam and NW stream section


Figure 45: Photo location 14, view south towards NW shovel test area and sand stockpile


Figure 46: Photo location 15, view west of pipelines, sediment cuts, mulch, and stockpile area


Figure 47: Photo location 16, view north of exposed mulch (left) and buried mulch (right)


Figure 48: Photo location 17, view north of pipeline ROW and stockpile area


Figure 49: Photo location 18, view west of pipeline ROW south of clay pit

## Near-Surface Intensive Survey

The cultural resources assessment included an intensive archeological survey using both pedestrian survey and shovel testing techniques (Figures 50-61). Pedestrian survey was used across the ground surface to locate quarries, cemeteries, chimneys, earthworks, and other above ground features, as well as any artifacts lying on the ground surface. Shovel testing was used to identify potential subsurface artifacts and assess locations surrounding potential isolated surface artifacts. As the survey area exhibited widely-varying potential for the presence of archaeological sites, shovel testing strategies likewise shifted by location to provide the appropriate horizontal and vertical coverage. In total, 27 shovel tests were excavated within the heavily disturbed soils of the existing landfill in the South Area, representing approximately 0.3 shovel tests per acre (0.74 shovel tests per hectare). A total of 181 shovel tests were excavated in the North area, representing approximately 2.47 shovel tests per acre (6 shovel tests per hectare). Surface inspection at 10-meter transect intervals was employed in areas of heavy disturbance deemed not to contain in situ soils. A total of 208 shovel tests were completed as part of this cultural resources survey. No shovel tests returned positive results for subsurface artifacts. Subjective shovel tests were placed in areas with obvious soil disturbance to determine the nature of disturbance and the possibility for intact soils underlying disturbed portions.

Systematic shovel testing investigations focused primarily on those area with intact topsoil horizons. Systematic shovel testing was implemented along the stream zone with two transects on each bank, as well as within the northern agricultural field, within the southern agricultural field, and in the northwest corner of the North Area. Subjective shovel testing was employed in areas where disturbance was apparent, yet subsurface profiles were required to determine the nature and extent of any disturbances. Surface survey with limited shovel testing was conducted across areas where soil had been removed by sediment mining or had become deeply buried by sediments related to the landfill activities. Investigations recorded one historic structure (Field ID# 1201-HS1), which is a mid-20$^{th}$ century concrete storm shelter. After consultation with OAS, it was determined that this structure did not fit the criteria for allocation of a formal site trinomial. The HPRIF document which formally records the structure is provided in Appendix B. The site description for 1201-HS1 is presented below. The locations of shovel tests placed across the survey area are presented in the following figures. The obstacles which necessitated avoidance or impeded systematic shovel test grids are described in the section above.

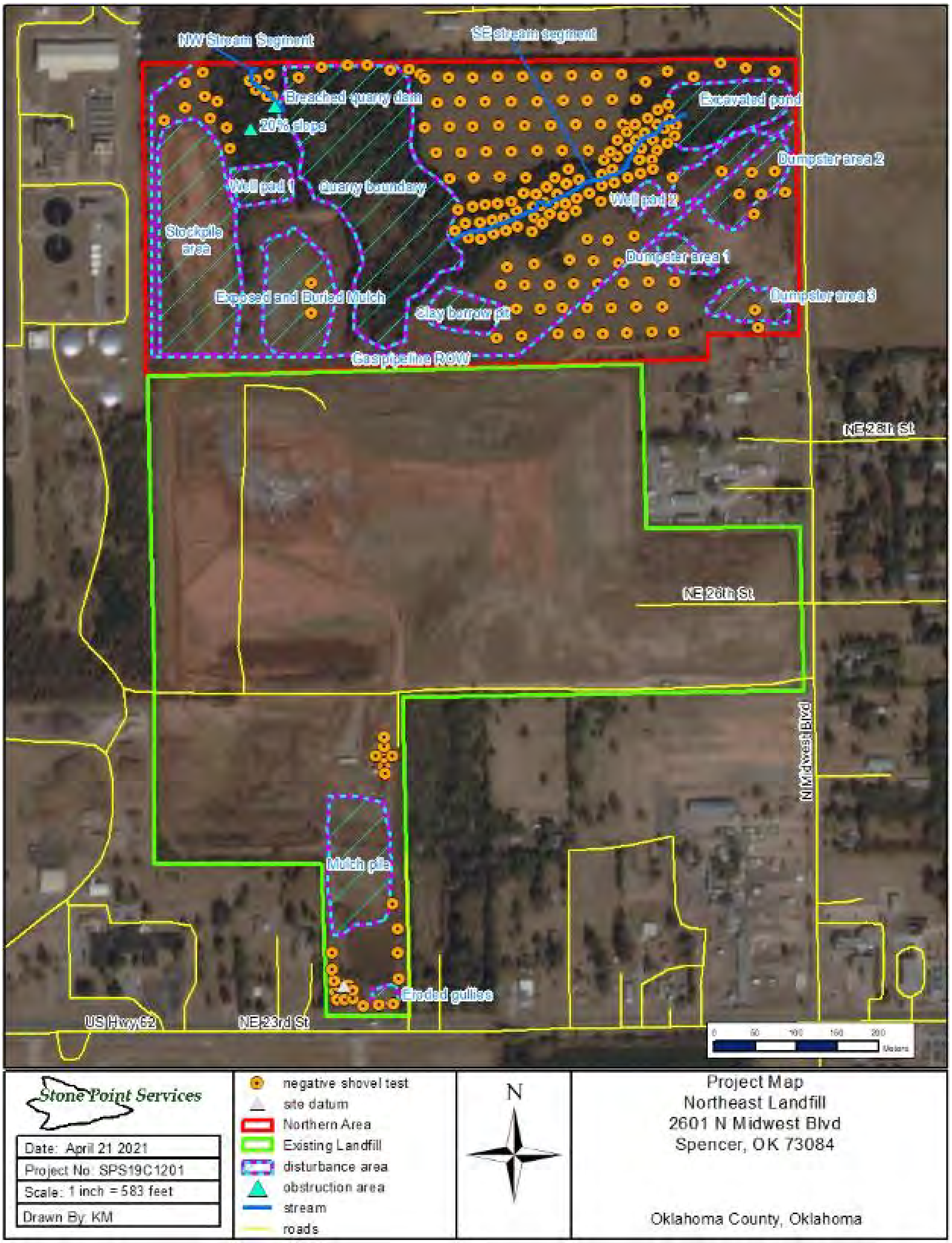


Figure 50: Aerial project overview map indicating disturbance areas and shovel tests

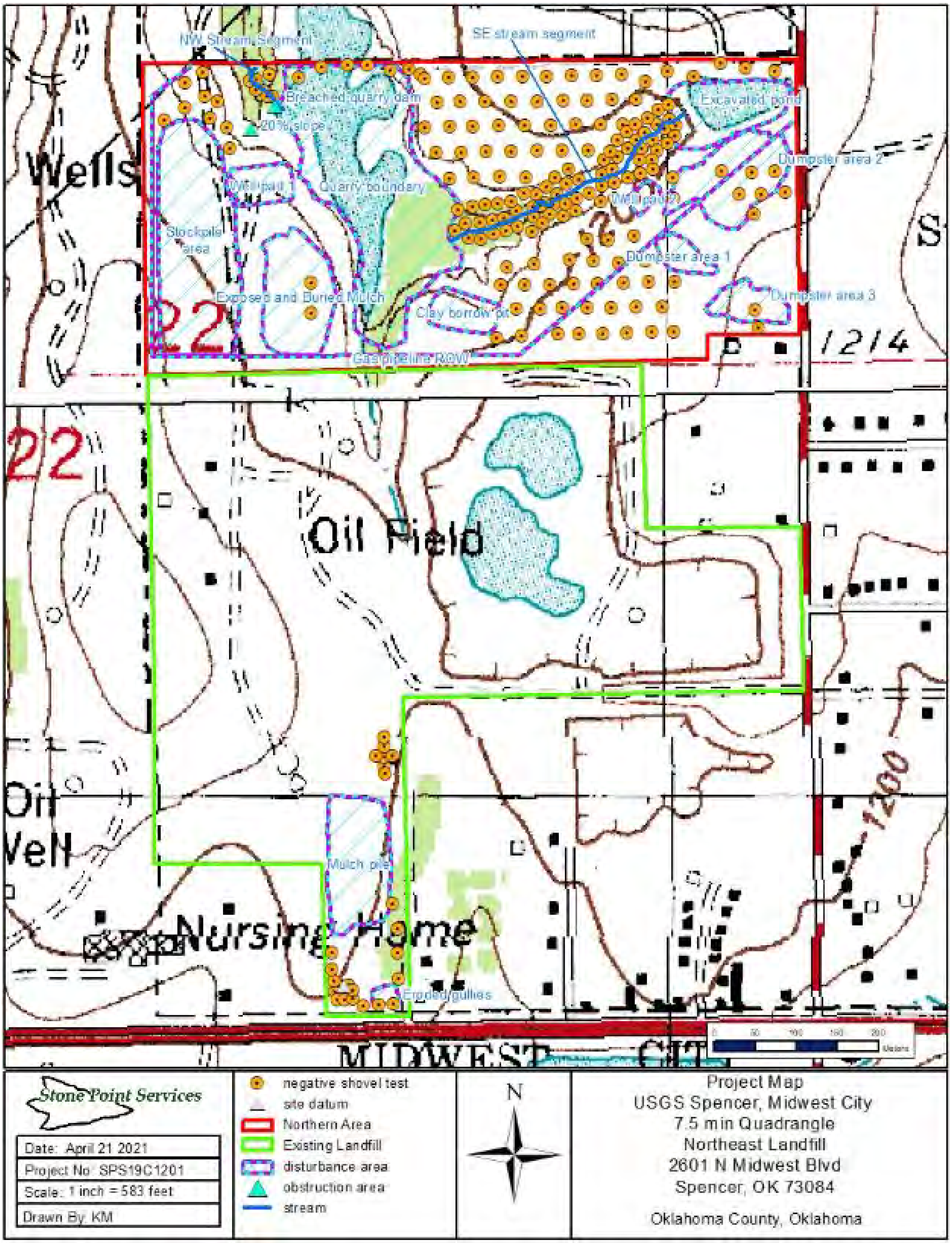


Figure 51: USGS Spencer/Midwest City 7.5 min topo quad project overview map

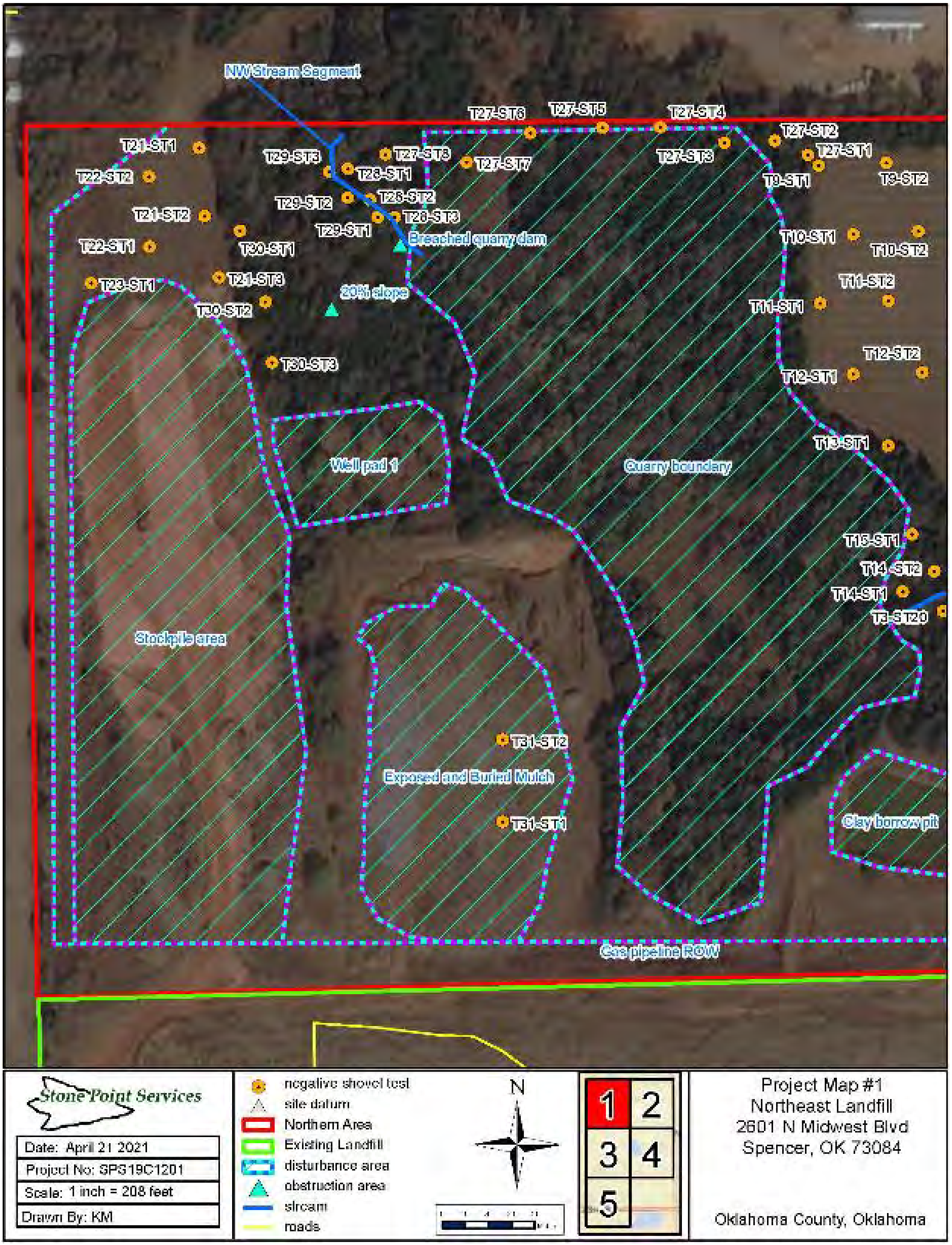


Figure 52: Aerial project map with disturbances and shovel test locations (aerial map 1 of 5)

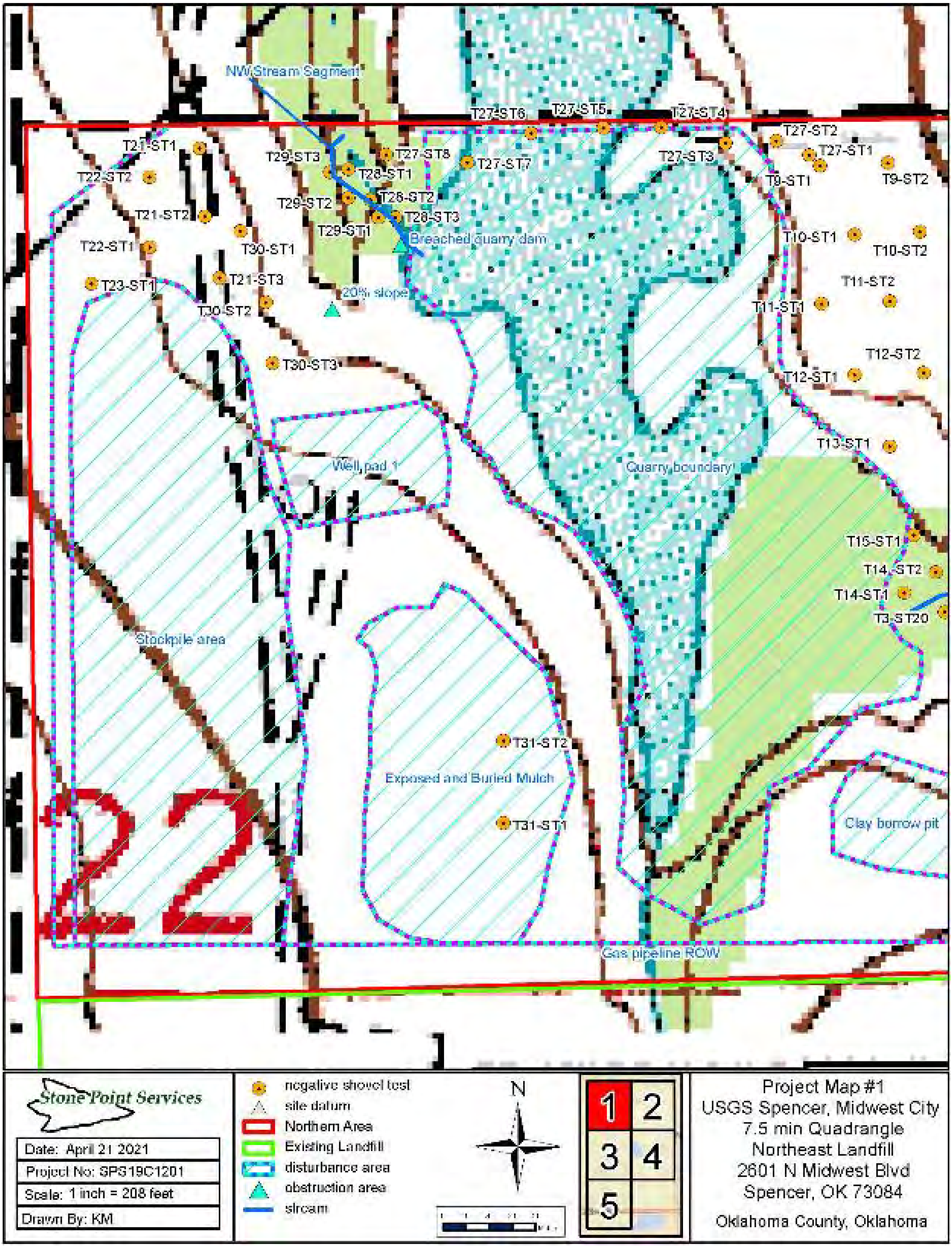


Figure 53: Topographic quad project map (topo map 1 of 5)

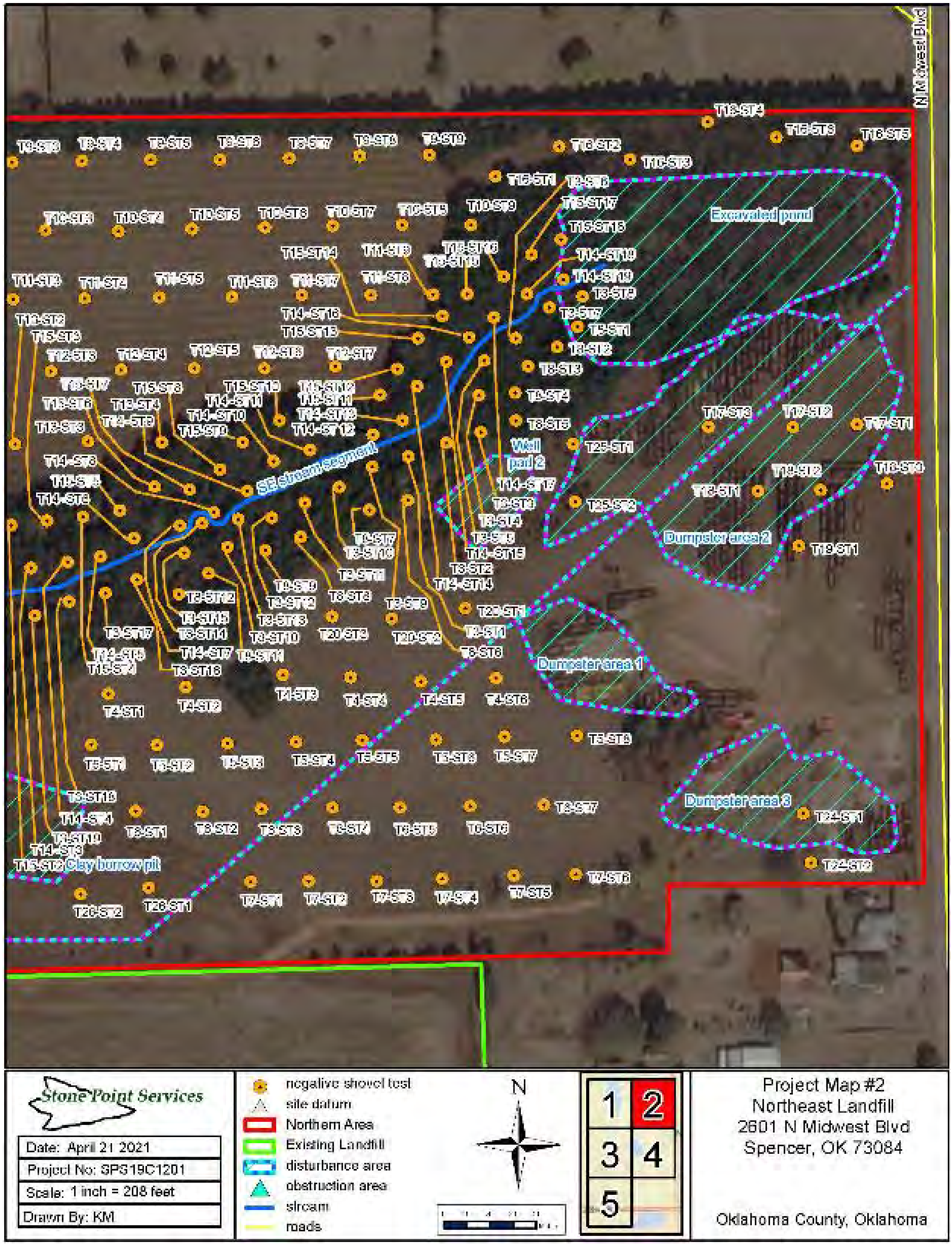


Figure 54: Aerial project map with disturbances and shovel test locations (aerial map 2 of 5)

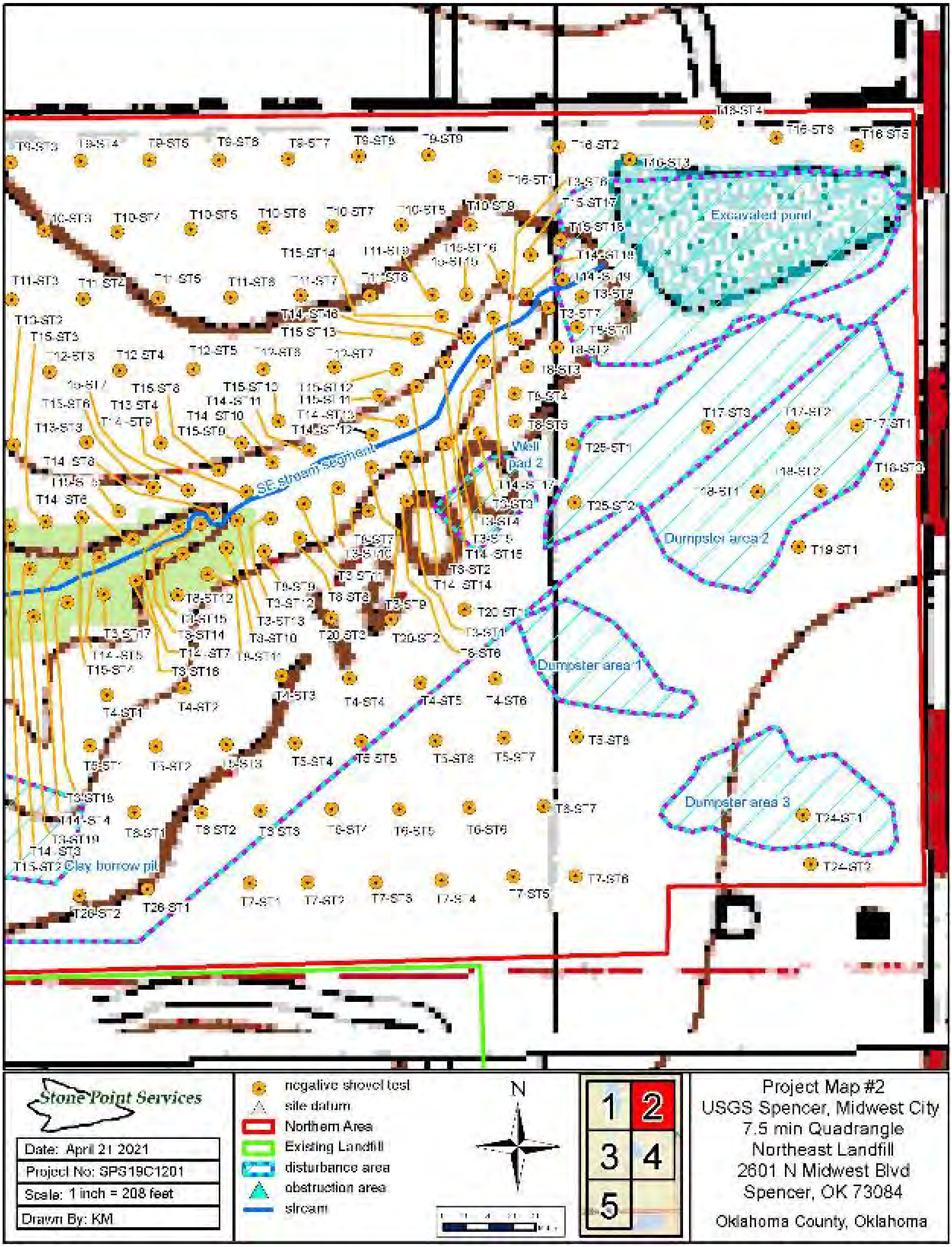


Figure 55: Topographic quad project map (topo map 2 of 5)


Figure 56: Aerial project map with disturbances and shovel test locations (aerial map 3 of 5)

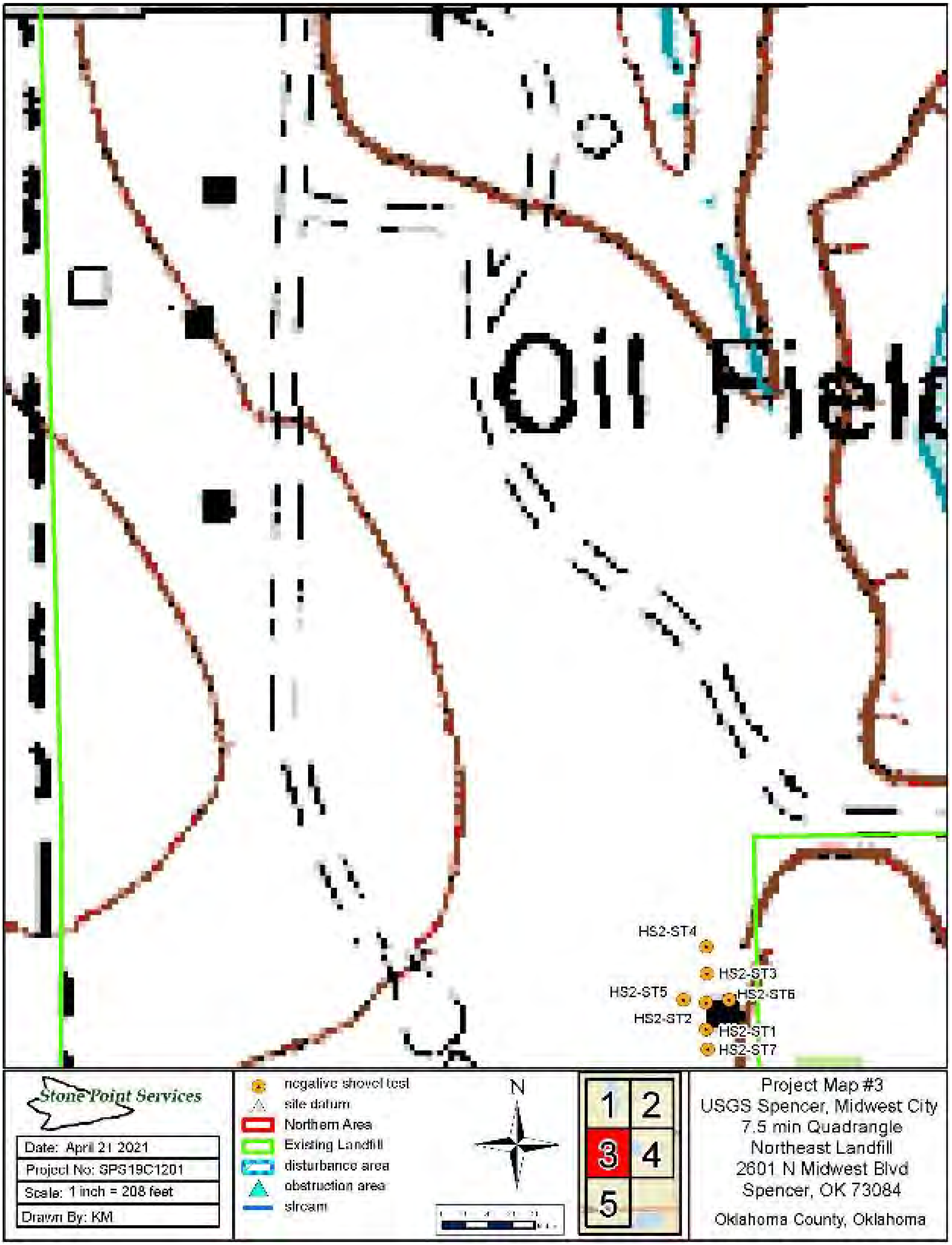


Figure 57: Topographic quad project map (topo map 3 of 5)


Figure 58: Aerial project map with disturbances and shovel test locations (aerial map 4 of 5)


Figure 59: Topographic quad project map (topo map 4 of 5)


Figure 60: Aerial project map with disturbances and shovel test locations (aerial map 5 of 5)

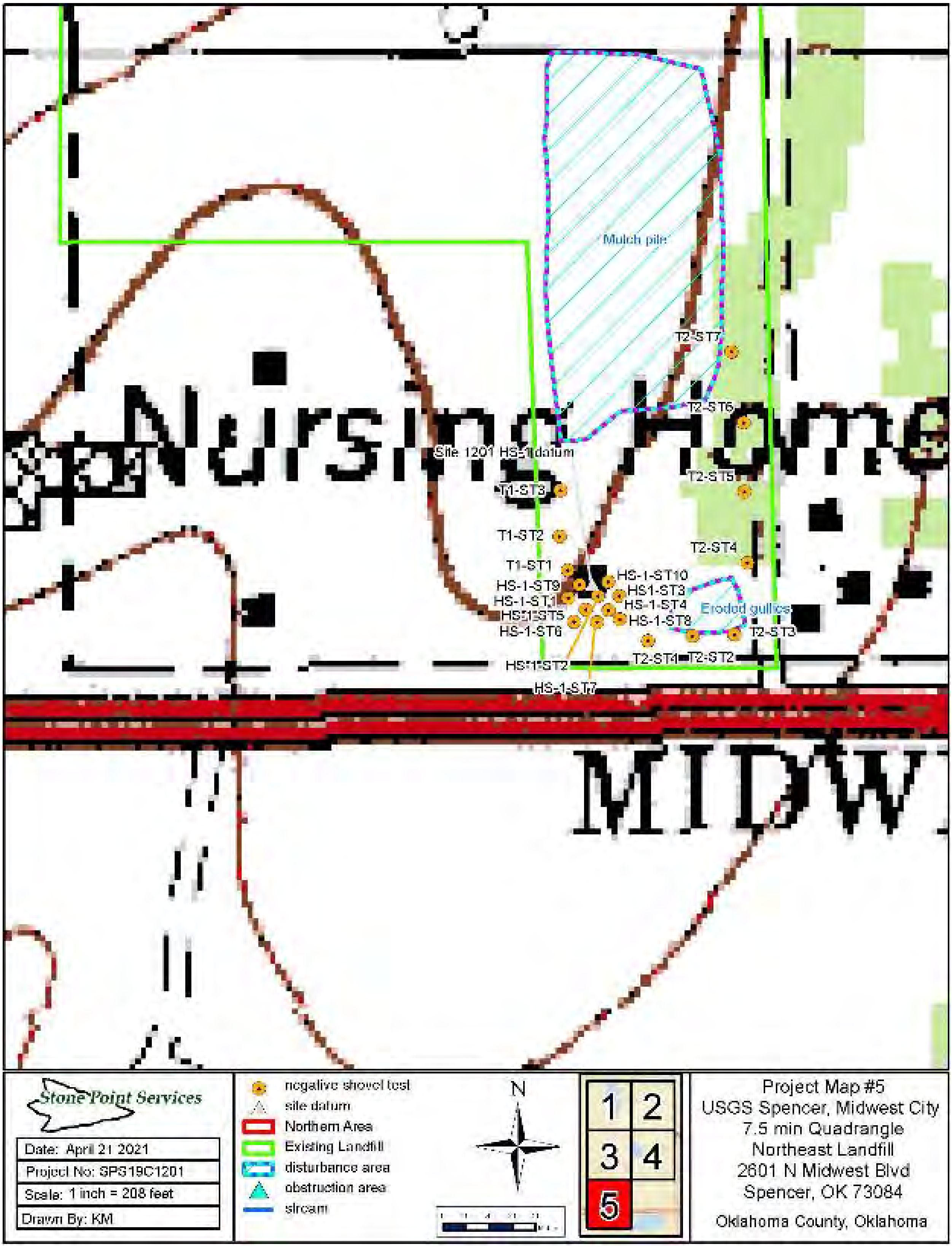


Figure 61: Topographic quad project map (topo map 5 of 5)

## 1201-HS1

This site was identified and recorded on March 16, 2021 during surface survey and shovel testing associated with the Cultural Resources Survey of Northeast C&D Landfill 163.3-Acre Project Oklahoma County, Oklahoma. This site area was visited and tested to investigate a cluster of potential structures evident in historic 1954 aerial imagery. The site is located a distance of 582-meters (1,909-feet) west of the intersection of N. Midwest Blvd and NE 23rd St. (Hwy 62) in Spencer, Oklahoma. At a distance of 582-meters west of the above intersection, the site is located 38-meters north of the north roadway lane (Figure 62). Specifically, at a distance of 582-meters (1,909-feet) west of the above intersection, continue a distance of 38-meters (125-feet) bearing 0-degrees. The storm shelter is situated between a wooden fence to the south and an excavated pond to the north on landfill property. Vegetation consists of tall grasses and hackberry trees (*Celtis occidentalis)*. Weather conditions at the time of recordation consisted of a sunny day with no adverse conditions. Tall grass obscured much of the ground with surface visibility at <25%.

No surface artifacts were observed during surface inspection spaced at 5-meter (16-feet) transect intervals. No subsurface artifacts were encountered in shovel tests placed around the storm shelter pad. Due to access restrictions by the built environment (property lines, ponds) survey methods included placing 11 shovel tests in a 10-meter (32-foot) offset grid, such that shovel tests were no more than 5-meters (16-feet) apart from one another, across the south portion of the storm shelter (Figure 63). Shovel tests measured a minimum of 30-centimeters (12-inches) in diameter and were excavated in 20-centimeter (8-inch) levels. Shovel test depths extended into the subsoil a minimum of 10-centimeters (4-inches) to accurately characterize the nature of the subsoil. All soil was screened through 1/4-inch mesh. Shovel test notes include soil color, texture and depth and any unique occurrences in soil profile.

The site includes a single structure (Figures 64-68) constructed of poured concrete, wood trim, and standard masonry units (SMUs), also known as cinder blocks. Below the concrete pad is a series of spiral stairs visible from the single rectangular entry door. The storm shelter pad measures 4-meters (13-feet) wide by 5-meters (16-feet) long. The SMU structure appears to have been constructed at a later date from the spiral stairs and subterranean void. The storm shelter is in the location of a cluster of structures visible in the historic 1954 aerial photograph. It is an isolated structure with no other structures extant in the immediate vicinity. Metal hardware located at the edges of the pad suggest a former superstructure was fastened to the pad.

The site boundary encompasses the storm shelter, adjacent utility poles and a low earthen mound that extends across the southern portion of the storm shelter. The site boundary measures approximately 30-meters (98-feet) E/W by 25-meters (82-feet) N/S for a site size of 750-square meters (8,036-square feet). Surface survey of the immediate and surrounding area was conducted at 5-meter (16-foot) transect intervals oriented north-south. No surface items were observed during surface inspections.

In total, eleven shovel tests were placed across the site to delineate the vertical and horizontal extent of deposits. No shovel tests encountered subsurface artifacts. 1202-HS1 is located within soils of the Teller fine sandy loam series (1 to 3 percent slopes, Soil Map Unit: TlrB) these soils are Mollisols and Argiustolls, which formed in loamy sediments (residuum) of Pleistocene age associated with treads and risers of ancient stream terraces (Figure 69).

The topsoil horizon extended from the surface to a maximum depth of 47-centimeters (18-inches) below surface within a disturbed soil context, yet soil color and textures were generally consistent with the Teller fine sandy loam series. Topsoil colors included dark brown, red, reddish brown and dark reddish gray and consisted of fine sandy loam, sandy loam, and sandy clay loam (Figure 69). Variability in topsoil textures across the area is likely the result mixing by heavy machinery. The subsoil horizon typically consisted of very dark brown, yellowish red and red clay loam, sandy clay loam and clay loam. The average shovel test depth measured 52-centimeters (20-inches) below surface. While topsoil exhibited mixed topsoil and subsoil elements, shovel tests were all terminated within the subsoil component of the profile once the soil color, ped structure, and soil texture were confirmed.

Table 5: Shovel test data from 1201-HS1

| **Shovel Test** | **Cultural Material** | **Depth and Soil Descriptions** |
|---|---|---|
| HS1-ST1 | None | 0-15 cm: 7.5YR 3/3 dark brown fine sandy loam<br>15-38 cm: 7.5YR 3/4 dark brown fine sandy loam<br>38-59 cm: 7.5YR 2.5/3 very dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| HS1-ST2 | None | 0-19 cm: red (2.5YR 4/6) sandy clay<br>19-31 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| HS1-ST3 | None | 0-12 cm: 7.5YR 3/4 dark brown sandy clay loam<br>12-15 cm: 5YR 4/6 yellowish red sandy clay loam<br>15-26 cm: 7.5YR 4/4 brown sandy clay loam<br>26-42 cm: 5YR 4/6 yellowish red compact sandy clay loam<br>Terminated in subsoil |
| HS1-ST4 | None | 0-31 cm: dark brown (7.5YR 3/4) sandy loam<br>31-50 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| HS1-ST5 | None | 0-28 cm: reddish brown (7.5YR 3/4) sandy loam<br>28-42 cm: dark reddish brown (5YR 3/4) sandy clay loam<br>42-60 cm: red (2.5YR 4/6) sandy clay<br>Terminated in subsoil |
| HS1-ST6 | None | 0-33 cm: dark brown (7.5YR 3/4) sandy loam<br>33-52 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| HS1-ST7 | None | 0-25 cm: 7.5YR 3/3 dark brown fine sandy loam<br>25-60 cm: 2.5YR 3/4 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| HS1-ST8 | None | 0-30 cm: 2.5YR 3/3 dark reddish gray fine sandy loam<br>30-55 cm: 2.5YR 4/4 reddish brown sandy clay<br>Shovel test terminated in subsoil |
| HS1-ST9 | None | 0-36 cm: reddish brown (5YR 4/3) sandy clay loam<br>mottled w/ reddish brown (2.5YR 4/4) sandy clay<br>Terminated at concrete - buried edge of storm shelter pad |

| | | |
|---|---|---|
| HS1-ST10 | None | 0-47 cm: dark brown (7.5YR 3/2) loam<br>47-65 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR1-ST1 | None | 0-36 cm: dark brown (7.5YR 3/4) sandy loam<br>36-61 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil. ST associated with HS1 delineation |

Deed information indicates the property was owned by the Fuchs family. The 1940 U.S. Census indicated that Arthur C. Fuchs resided in Crutcho Township in Oklahoma with his wife, Minnie, daughters Anna, Mildred and Florence and son, Charles. Arthur was a Superintendent at a bottling firm (Ancestry 2021l). Historic deed information indicates that upon Arthur's death in 1943, Florence Fuchs-English became owner of Tract 1 and her sister, Mildred Fuchs-Wright, became the owner of Tract 2. Florence Fuchs-English was born in 1938 and passed away in 2016 (Kueteman 2021). Florence worked in the oil industry and retired from National Oilwell. The address associated with tract one was 7621 North 23rd Street. In 1994, ownership of tract one moved into the Florence E. English Living Trust. In 2003, tract one was sold to Northeast Landfill, Inc. by the trust.

Overall, 1201-HS1 is the remnant of a concrete storm shelter with a modern cinder block addition. The site is situated in the South Area near Hwy 62, south of a modern excavated pond. Eleven shovel tests were placed within the vicinity of the site to determine the horizontal and vertical nature of potential archaeological deposits. No shovel tests encountered subsurface historic materials. Surface survey observed no historic artifacts on the ground surface. A cluster of standing structures, possibly containing the storm shelter, are visible on the earliest available aerial photographs, dated 1954. Given the general age of the structure in aerial imagery, the structure may have been constructed while the Fuchs family owned the property during the 1950s.

Historic integrity is the authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during the property's prehistoric or historic period. Historic integrity is a composite of seven qualities including location, design, setting, materials, workmanship, feeling, and association. Although the storm shelter remains intact, it does not display significant integrity. The location is intact however there is no strong design, workmanship, or feeling exhibited. The association with other structures visible on the 1954 historic aerial photograph has been compromised by current storm shelter isolation from former structures. The lack of association with persons of historical significance, diffuse material assemblage and the mixed nature of the soil placement indicates that 1201-HS1 cannot provide information important to understanding the historic past. The inability for this site to answer important research questions suggests that 1201-HS1 does not meet the requirements for NRHP eligibility under Criterion A through D (see Chapter 3). The storm shelter located at the NE Landfill in Spencer, Oklahoma, is therefore recommended ineligible for inclusion to the National Register of Historic Places.

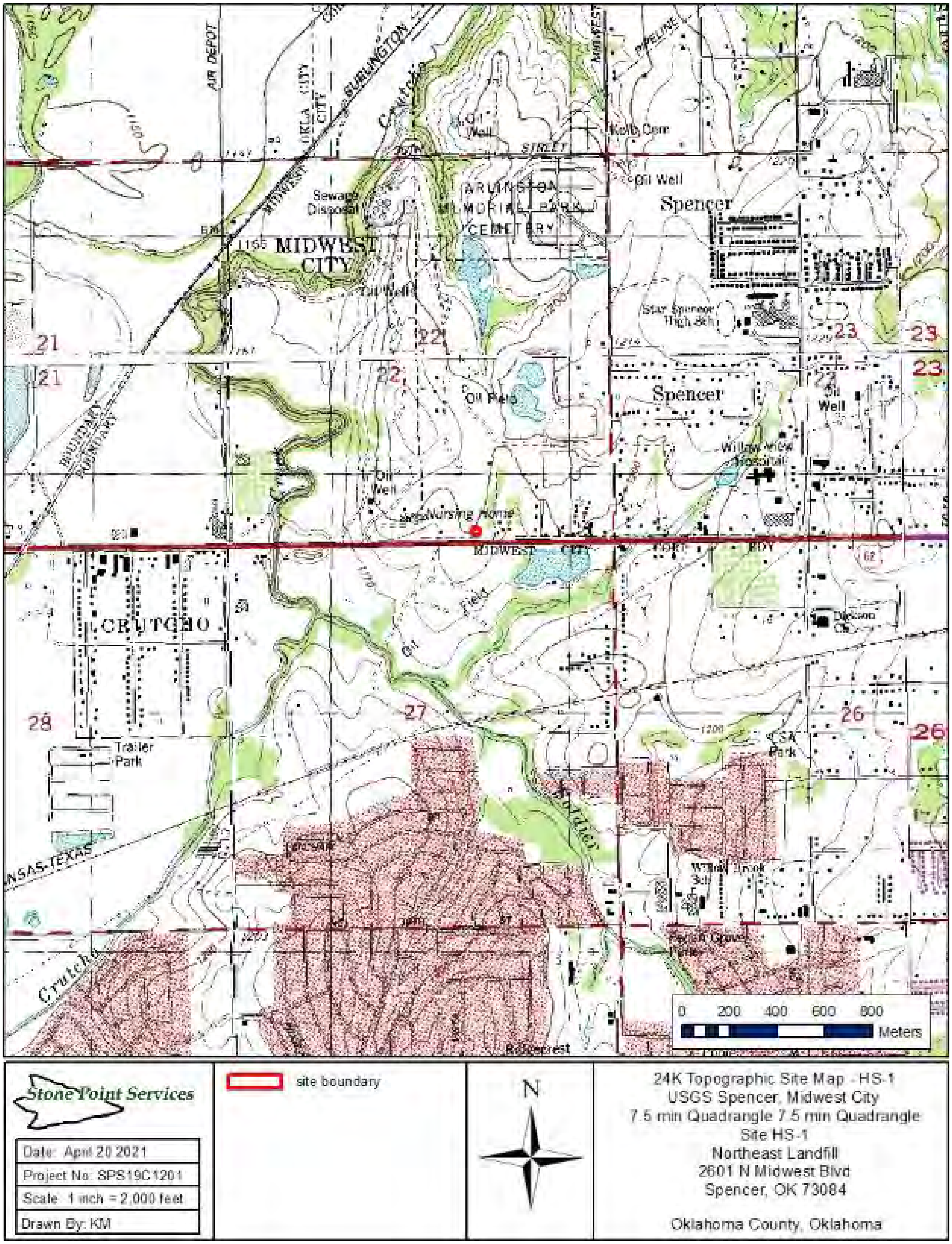


Figure 62: USGS Spencer, Midwest City 7.5 min quad with location of site 1201-HS1

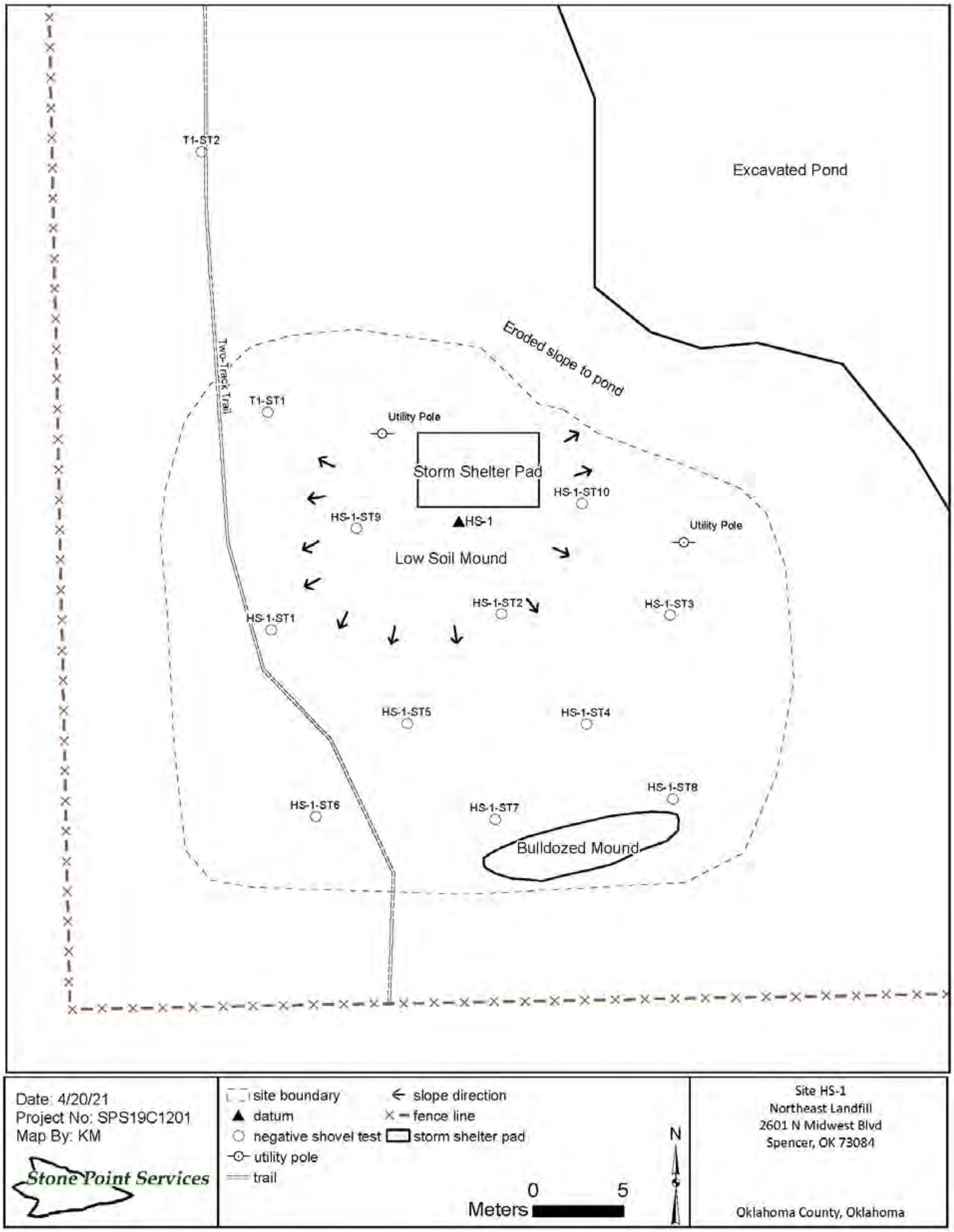


Figure 63: Site sketch map of 1201-HS1


Figure 64: View south toward the storm shelter and cinder block addition


Figure 65: View west toward the storm shelter opening


Figure 66: view west into the spiral stairway


Figure 67: View northeast of the concrete pad with metal fasteners


Figure 68: Closeup of concrete texture (scale = 1cm)


Figure 69: Representative soil profile from shovel test HS1-ST8 at site 1201-HS1

## SUMMARY OF FINDINGS AND MANAGEMENT RECOMMENDATIONS

Stone Point Services, LLC completed a cultural resource survey of the proposed Northeast Landfill 163.3-Acre Project Area located in Spencer, Oklahoma for Hydrex Environmental. The project area includes the “North Area,” which covers an approximately 73.2-acre (30-hectare) area and the “South Area” of the existing landfill, which consists of 90.1-acres (36.36-hectares). The total area surveyed for this project is approximately 163.3-acres (66-hectares). As the North Area, which contains a tributary of Crutcho Creek, may be used in the future for borrow material, landfill construction, and other landfill activities, it is anticipated disturbance in this area may be extensive. As a Federal nexus has been identified for this project, oversight by the U.S. Corps of Engineers is required and likewise the requirements of Section 106 of the National Historic Preservation Act (NHPA) will apply. The purpose of this cultural resources survey is to identify cultural resources (archaeological and historic) that may be impacted by the proposed borrowing, landfill construction and other associated landfill activities.

Background research was conducted on February 13, 2020. Background research indicated no listed, eligible, or potentially eligible sites for the National Register of Historic Places (NRHP) within one mile of the survey area. Background research of historic aerial imagery indicated the presence of historic structures in the South Area and these areas were subjected to near-surface intensive survey. Areas of high-probability for archaeological sites along the unnamed tributary of Crutcho Creek were subjected to reduced-interval testing and encountered no archaeological materials. Close-interval surface survey of the Subject Property encountered no surface artifacts.

After coordination with the OAS, due to the lack of associated artifacts and disturbed integrity, 1201-HS1 was not given an Oklahoma site trinomial. Shovel tests were systematically placed surrounding this feature and encountered no associated subsurface artifacts. As this storm shelter does not fit the criteria for trinomial allocation, we recommend this structure as not eligible for inclusion in the NRHP. We therefore find that this project will not impact NRHP listed, eligible, or potentially eligible structures or sites.

The survey included an assessment of direct effects. We find that this project will not impact NRHP listed, eligible, or potentially eligible structures or sites. All records produced as a result of this project will be prepared to OAS, OSHPO, and USACE standards and submitted to the Oklahoma Archaeological Survey at the University of Oklahoma for curation. Survey methods meet or exceed the minimum survey standards of the SWT Corps Regulatory Office outlined in the Guidelines for Cultural Resources Investigations (Sept 2019).

It is the recommendation of Stone Point Services that this project be allowed to proceed as planned. In the event of an inadvertent discovery of human remains and/or archeological cultural deposits, all project activity near the location will cease immediately until proper notification of consulting parties has occurred and mitigative measures have been determined and implemented.

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# Appendix A: Shovel Test Log

| Shovel Test | Cultural Material | Depth and Soil Descriptions |
|---|---|---|
| HS1-ST1 | None | 0-15 cm: 7.5YR 3/3 dark brown fine sandy loam<br>15-38 cm: 7.5YR 3/4 dark brown fine sandy loam<br>38-59 cm: 7.5YR 2.5/3 very dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| HS1-ST2 | None | 0-19 cm: red (2.5YR 4/6) sandy clay<br>19-31 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| HS1-ST3 | None | 0-12 cm: 7.5YR 3/4 dark brown sandy clay loam<br>12-15 cm: 5YR 4/6 yellowish red sandy clay loam<br>15-26 cm: 7.5YR 4/4 brown sandy clay loam<br>26-42 cm: 5YR 4/6 yellowish red compact sandy clay loam<br>Terminated in subsoil |
| HS1-ST4 | None | 0-31 cm: dark brown (7.5YR 3/4) sandy loam<br>31-50 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| HS1-ST5 | None | 0-28 cm: reddish brown (7.5YR 3/4) sandy loam<br>28-42 cm: dark reddish brown (5YR 3/4) sandy clay loam<br>42-60 cm: red (2.5YR 4/6) sandy clay<br>Terminated in subsoil |
| HS1-ST6 | None | 0-33 cm: dark brown (7.5YR 3/4) sandy loam<br>33-52 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| HS1-ST7 | None | 0-25 cm: 7.5YR 3/3 dark brown fine sandy loam<br>25-60 cm: 2.5YR 3/4 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| HS1-ST8 | None | 0-30 cm: 2.5YR 3/3 dark reddish gray fine sandy loam<br>30-55 cm: 2.5YR 4/4 reddish brown sandy clay<br>Shovel test terminated in subsoil |
| HS1-ST9 | None | 0-36 cm: reddish brown (5YR 4/3) sandy clay loam<br>mottled w/ reddish brown (2.5YR 4/4) sandy clay<br>Terminated at concrete - buried edge of storm shelter pad |
| HS1-ST10 | None | 0-47 cm: dark brown (7.5YR 3/2) loam<br>47-65 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| HS2-ST1 | None | 0-26 cm: brown (7.5YR 4/4) gravelly sandy clay loam<br>26-33 cm: yellowish red (5YR 5/8 sandy clay<br>33-44 cm: reddish brown (5YR 4/4) compact sandy clay<br>Terminated in subsoil |
| HS2-ST2 | None | 0-18 cm: red (2.5YR 4/6) sandy clay<br>18-37 cm: dark reddish brown (2.5YR 3/4) sandy clay<br>Terminated in compact subsoil |
| HS2-ST3 | None | 0-28 cm: 2.5YR 3/3 dark reddish brown fine sandy loam<br>28-51 cm: 5YR 3/4 dark reddish brown sandy clay loam<br>Heavily compacted 45 cm+<br>Shovel test terminated within subsoil horizon |

| | | |
|---|---|---|
| HS2-ST4 | None | 0-33 cm: 2.5YR 3/3 dark reddish brown sandy clay with construction gravels<br>33-56 cm: 2.5YR 4/4 reddish brown sandy clay loam.<br>Shovel test terminated in subsoil |
| HS2-ST5 | None | 0-14 cm: dusky red (2.5YR 3/2) sandy clay<br>14-41 cm: dark reddish brown (2.5YR 3/3) compact sandy clay<br>Terminated in subsoil |
| HS2-ST6 | None | 0-20 cm: 7.5YR 3/3 dark brown fine sandy loam<br>20-52 cm: 7.5YR 3/4 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| HS2-ST7 | None | 0-8 cm: brown (7.5YR 4/4) gravelly sandy clay loam<br>8-19 cm: red (2.5YR 4/8) gravelly sandy clay<br>19-44 cm: brown (7.5YR 4/4) compact sandy clay loam<br>Terminated in subsoil |
| TR1-ST1 | None | 0-36 cm: dark brown (7.5YR 3/4) sandy loam<br>36-61 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil. ST associated with HS1 delineation |
| TR1-ST2 | None | 0-13 cm: red (2.5YR 4/8) sandy loam<br>13-32 cm: brown (7.5YR 4/4) sandy clay<br>32-42 cm: reddish brown (5YR 4/4) sandy clay<br>Terminated in subsoil |
| TR1-ST3 | None | 0-30 cm: 7.5YR 3/4 dark brown fine sandy loam<br>30-59 cm: 5YR 3/4 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR2-ST1 | None | 0-20 cm: 7.5YR 3/3 dark brown fine sandy loam<br>20-53 cm: 5YR 3/4 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR2-ST2 | None | 0-16 cm: dark reddish brown (5YR 3/3) sandy clay<br>16-39 cm: reddish brown (2.5YR 4/4) sandy clay<br>39-53 cm: red (2.5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR2-ST3 | None | 0-31 cm: dark brown (7.5YR 3/4) sandy loam<br>31-52 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR2-ST4 | None | 0-10 cm: 5YR 3/2 dark reddish brown fine sandy loam<br>10-31 cm: 5YR 3/2 dark reddish brown sandy loam<br>31-58 cm: 5YR 2.5/2 dark reddish brown sandy clay loam with 2.5YR 4/6 red mottling<br>Shovel test terminated within subsoil horizon |
| TR2-ST5 | None | 0-12 cm: dark brown (7.5YR 3/3) loam<br>12-24 cm: mottled dark brown (7.5YR 3/3) and yellowish red (5YR 5/8) sandy clay loam<br>24-41 cm: dark brown (7.5YR 3/3) sandy clay loam<br>41-52 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR2-ST6 | None | 0-17 cm: dark brown (7.5YR 3/3) sandy clay<br>17-66 cm: very dark gray (5YR 3/1) sandy clay<br>mottled w/ red (2.5YR 4/8) sandy clay<br>Terminated in subsoil |

| | | |
|---|---|---|
| TR2-ST7 | None | 0-23 cm: 2.5YR 4/1 dark reddish gray fine sandy loam<br>23-58 cm: 2.5YR 4/4 reddish brown sandy clay<br>Shovel test terminated in subsoil |
| TR3-ST1 | None | 0-48 cm: brown (7.5YR 4/4) sandy loam<br>48-80 cm: brown (7.5YR 4/4) mottled with red (2.5YR 5/8) sandy clay loam<br>Terminated in subsoil |
| TR3-ST2 | None | 0-38 cm: dark reddish brown (5YR 3/2) sandy loam<br>38-80 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR3-ST3 | None | 0-12 cm: 10YR 3/3 dark brown fine sandy loam<br>12-38 cm: 10YR 3/4 dark yellowish brown sandy clay loam with 2.5YR 4/6 red mottling<br>38-80 cm: 5YR 4/6 yellowish red sandy clay loam with 2.5YR 4/6 red mottling<br>Shovel test terminated within subsoil horizon |
| TR3-ST4 | None | 0-12 cm: 5YR 3/2 dark reddish brown sandy loam<br>12-20 cm: 5YR 5/6 yellowish red sandy loam<br>20-66 cm: 5YR 3/3 dark reddish brown sandy loam<br>66-87 cm: 5YR 4/3 reddish brown sandy clay<br>Terminated in subsoil |
| TR3-ST5 | None | 0-15 cm: very dark gray (7.5YR 3/1) sandy loam<br>15-52 cm: strong brown (7.5YR 4/6) sandy loam<br>52-74 cm: yellowish red (5YR 4/6) sandy clay loam<br>74-80 cm: red (2.5YR 4/8) sandy clay loam<br>Terminated in subsoil |
| TR3-ST6 | None | 0-12 cm: dark reddish gray (5YR 4/2) sandy loam<br>12-59 cm: red (2.5YR 4/8) sandy clay<br>Terminated at bedrock |
| TR3-ST7 | None | 0-10 cm: 5YR 3/3 dark reddish brown fine sandy loam<br>10-20 cm: 5YR 3/4 dark reddish brown sandy loam<br>20-45 cm: 5YR 3/4 dark reddish brown sandy clay loam<br>Shovel test terminated at sandstone bedrock |
| TR3-ST8 | None | 0-33 cm: dark brown (7.5YR 3/3) sandy loam<br>33-80 cm: dark reddish brown (5YR 3/4) sandy clay loam<br>Terminated in subsoil |
| TR3-ST9 | None | 0-20 cm: 5YR 3/2 dark reddish brown fine sandy loam<br>20-50 cm: 5YR 3/3 dark reddish brown sandy clay loam<br>50-80 cm: 5YR 4/4 reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR3-ST10 | None | 0-35 cm: 5YR 3/2 dark reddish brown sandy loam<br>35-53 cm: 2.5YR 4/6 soft red weathered sandstone yielding to hard sandstone<br>Terminated at hard sandstone bedrock |
| TR3-ST11 | None | 0-11 cm: dusky red (2.5YR 3/2) sandy loam<br>11-48 cm: dusky red (2.5YR 3/2) sandy clay loam<br>48-68 cm: red (2.5YR 4/6) sandy clay<br>Terminated at sandstone bedrock |

| | | |
|---|---|---|
| TR3-ST12 | None | 0-43 cm: 5YR 3/1 very dark gray sandy loam<br>43-78 cm: 2.5YR 4/4 reddish brown sandy clay<br>Terminated at coarse roots within subsoil |
| TR3-ST13 | None | 0-8 cm: 5YR 2.5/2 dark reddish brown fine sandy loam<br>8-33 cm: 5YR 3/3 dark reddish brown sandy clay loam<br>33-80 cm: 5YR 3/2 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR3-ST14 | None | 0-14 cm: very dark brown (10YR 2/2) sandy loam<br>14-57 cm: yellowish red (5YR 4/6)<br>57-74 cm: red (2.5YR 5/8) sandy clay loam<br>Terminated at sandstone |
| TR3-ST15 | None | 0-12 cm: dark brown (7.5YR 3/2) sandy loam<br>12-37 cm: brown (7.5YR 4/3) sandy clay loam<br>37-80 cm: brown (7.5YR 5/4) sandy clay loam<br>Terminated in subsoil |
| TR3-ST16 | None | 0-31 cm: 5YR 3/1 very dark gray sandy clay loam<br>31-80 cm: 7.5YR 4/3 brown sandy clay<br>Terminated in subsoil |
| TR3-ST17 | None | 0-19 cm: dark brown (7.5YR 3/2) sandy loam<br>19-61 cm: dark reddish brown (5YR 3/3) sandy loam<br>61-72 cm: yellowish red (5YR 4/6) loamy sand<br>72-80 cm: red (2.5YR 4/8) sand<br>Terminated in subsoil |
| TR3-ST18 | None | 0-20 cm: 5YR 2.5/2 dark reddish brown fine sandy loam<br>20-62 cm: 5YR 4/4 reddish brown sandy clay loam<br>62-80 cm: 5YR 4/6 yellowish red sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR3-ST19 | None | 0-28 cm: dark reddish brown (5YR 3/2) sandy loam<br>28-80 cm: yellowish red (5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR3-ST20 | None | 0-23 cm: 2.5YR 3/1 dark reddish gray sandy loam<br>23-35 cm: 2.5YR 4/8 red gravelly sandy clay<br>35+ cm: 2.5YR 4/8 red extremely gravelly sandy clay<br>Terminated due to coarse natural stream gravels |
| TR4-ST1 | None | 0-33 cm: 5YR 3/2 dark reddish brown sandy loam<br>33-55 cm: 2.5YR 3/4 dark reddish brown sandy clay<br>Terminated in subsoil |
| TR4-ST2 | None | 0-31 cm: 2.5YR 4/2 weak red sandy loam<br>31-55 cm: 2.5YR 3/6 dark red sandy clay<br>Terminated in subsoil |
| TR4-ST3 | None | 0-34 cm: 2.5YR 4/2 weak red sandy loam<br>34-52 cm: 2.5YR 3/6 dark red sandy clay<br>Terminated in subsoil |
| TR4-ST4 | None | 0-36 cm: 2.5YR 4/2 weak red sandy loam<br>36-54 cm: 2.5YR 4/6 red sandy clay<br>Terminated in subsoil |
| TR4-ST5 | None | 0-26 cm: 5YR 4/2 dark reddish gray sandy loam<br>26-54 cm: 5YR 4/6 yellowish red sandy clay<br>Terminated in subsoil |

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| TR4-ST6 | None | 0-34 cm: 5YR 4/2 dark reddish gray sandy loam<br>34-48 cm: 5YR 4/6 yellowish red sandy clay<br>Terminated in subsoil |
| TR5-ST1 | None | 0-5 cm: 7.5YR 3/4 dark brown fine sandy loam<br>5-22 cm: 7.5YR 3/4 dark brown sandy clay loam<br>22-50 cm: 5YR 3/4 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR5-ST2 | None | 0-19 cm: 5YR 3/3 dark reddish brown fine sandy loam<br>19-52 cm: 2.5YR 3/6 dark red sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR5-ST3 | None | 0-5 cm: 10YR 4/4 dark yellowish brown fine sandy loam<br>5-27 cm: 7.5YR 3/4 dark brown fine sandy clay loam<br>27-51 cm: 2.5YR 3/6 dark red sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR5-ST4 | None | 0-12 cm: 7.5YR 3/4 dark brown fine sandy loam<br>12-23 cm: 7.5YR 3/4 dark brown fine sandy clay loam<br>23-50 cm: 7.5YR 3/4 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR5-ST5 | None | 0-4 cm: 7.5YR 3/4 dark brown loam<br>4-21 cm: 7.5YR 4/3 brown fine sandy clay loam<br>21-49 cm: 5YR 4/4 reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR5-ST6 | None | 0-8 cm: 5YR 3/2 dark reddish brown loam<br>8-29 cm: 5YR 3/3 dark reddish brown fine sandy clay loam<br>29-54 cm: 5YR 3/3 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR5-ST7 | None | 0-4 cm: 5YR 3/3 dark reddish brown loam<br>4-36 cm: 5YR 3/3 dark reddish brown fine sandy clay loam<br>36-52 cm: 5YR 3/3 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR5-ST8 | None | 0-4 cm: 5YR 3/2 dark reddish brown loam<br>4-30 cm: 5YR 4/3 reddish brown fine sandy clay loam<br>30-53 cm: 5YR 4/3 reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR6-ST1 | None | 0-27 cm: brown (7.5YR 4/3) loam<br>27-50 cm: reddish brown (5YR 4/3) clay loam<br>Terminated in subsoil |
| TR6-ST2 | None | 0-22 cm: brown (7.5YR 4/3) loam<br>22-36 cm: reddish brown (5YR 4/3) loam<br>36-47 cm: reddish brown (5YR 4/3) clay loam<br>Terminated in subsoil |
| TR6-ST3 | None | 0-24 cm: brown (7.5YR 4/3) loam<br>24-54 cm: reddish brown (5YR 4/3) clay loam<br>Terminated in subsoil |
| TR6-ST4 | None | 0-22 cm: brown (7.5YR 4/3) loam<br>22-53 cm: reddish brown (5YR 4/3) clay loam<br>Terminated in subsoil |
| TR6-ST5 | None | 0-20 cm: brown (7.5YR 4/3) loam<br>20-52 cm: reddish brown (5YR 4/3) clay loam<br>Terminated in subsoil |

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| TR6-ST6 | None | 0-13 cm: brown (7.5YR 4/3) loam<br>13-47 cm: reddish brown (5YR 4/3) clay loam<br>Terminated in subsoil |
| TR6-ST7 | None | 0-20 cm: brown (7.5YR 4/3) loam<br>20-52 cm: yellowish red (5YR 5/6) sandy clay loam<br>Terminated in subsoil |
| TR7-ST1 | None | 0-28 cm: reddish brown (5YR 5/4) sandy clay<br>28-49 cm: red (2.5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR7-ST2 | None | 0-36 cm: reddish brown (5YR 4/4) sandy clay<br>36-48 cm: red (2.5YR 4/6) clay<br>Terminated in subsoil |
| TR7-ST3 | None | 0-28 cm: reddish brown (5YR 4/4) sandy clay<br>28-42 cm: red (2.5YR 4/6) clay<br>Terminated in subsoil |
| TR7-ST4 | None | 0-36 cm: reddish brown (5YR 4/4) sandy clay<br>36-53 cm: yellowish red (5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR7-ST5 | None | 0-31 cm: reddish brown (5YR 4/4) sandy clay<br>31-44 cm: yellowish red (5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR7-ST6 | None | 0-37 cm: dark reddish brown (5YR 4/4) sandy clay<br>37-51 cm: yellowish red (5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR8-ST1 | None | 0-20 cm: dark brown (7.5YR 3/4) sandy loam<br>20-57 cm: brown (7.5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR8-ST2 | None | 0-13 cm: 5YR 4/4 reddish brown sandy loam<br>13-55 cm: 2.5YR 3/6 dark red soft sandstone clay loam<br>Shovel test terminated within subsoil horizon |
| TR8-ST3 | None | 0-7 cm: dark reddish brown (5YR 3/3) sandy loam<br>7-37 cm: red (2.5YR 5/8) sandy clay loam<br>Terminated at sandstone |
| TR8-ST4 | None | 0-23 cm: 2.5YR 5/4 reddish brown sandy loam<br>23-56 cm: 7.5YR 4/4 brown sandy clay<br>Terminated in subsoil |
| TR8-ST5 | None | 0-12 cm: dark brown (7.5YR 3/2) loam<br>12-50 cm: brown (7.5YR 4/4) sandy loam<br>50-60 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR8-ST6 | None | 0-14 cm: dark reddish brown (5YR 3/3) sandy clay loam<br>14-58 cm: dark reddish brown (5YR 3/3) sandy clay loam mottled w/ red (2.5YR 5/8) sandy clay<br>Terminated in subsoil |
| TR8-ST7 | None | 0-9 cm: strong brown (7.5YR 4/6) sandy loam<br>9-21 cm: red (2.5YR 5/8) soft sandstone<br>21-40 cm: dark brown (7.5YR 3/2) sandy loam<br>Terminated in subsoil |

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| TR8-ST8 | None | 0-17 cm: 7.5YR 2.5/2 very dark brown loam<br>17-31 cm: 7.5YR 3/2 dark brown sandy loam<br>31-42 cm: 7.5YR 2.5/2 very dark brown sandy clay loam<br>42-58 cm: 2.5YR 4/4 reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR8-ST9 | None | 0-15 cm: very dark grayish brown (10YR 3/2) loam<br>15-44 cm: brown (7.5YR 4/3) sandy loam<br>44-55 cm: yellowish red (5YR 5/6) sandy clay loam<br>Terminated in subsoil |
| TR8-ST10 | None | 0-29 cm: dark reddish gray (2.5YR 4/1) sandy clay loam<br>29-52 cm: reddish brown (2.5YR 4/4) sandy clay<br>Terminated in subsoil |
| TR8-ST11 | None | 0-31 cm: 2.5 YR 4/1 dark reddish gray sandy loam<br>31-60 cm: 2.5YR 4/4 reddish brown sandy clay<br>Terminated in subsoil |
| TR8-ST12 | | 0-36 cm: very dark brown (7.5YR 2.5/3) loam<br>36-52 cm: brown (7.5YR 4/4) loam<br>Terminated in subsoil |
| TR9-ST1 | None | 0-4 cm: 10YR 4/4 dark yellowish brown fine loam<br>4-19 cm: 7.5YR 3/4 dark brown fine sandy loam<br>19-60 cm: 7.5YR 3/4 dark brown sandy clay<br>Shovel test terminated within subsoil horizon |
| TR9-ST2 | None | 0-4 cm: 10YR 4/4 dark yellowish brown fine loam<br>4-20 cm: 7.5YR 3/3 dark brown fine sandy loam<br>20-59 cm: 7.5YR 3/3 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR9-ST3 | None | 0-5 cm: 7.5YR 3/3 dark brown fine loam<br>5-12 cm: 7.5YR 3/3 dark brown fine sandy loam<br>12-28 cm: 7.5YR 2.5/3 very dark brown fine sandy clay loam<br>28-55 cm: 7.5YR 4/3 brown Sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR9-ST4 | None | 0-17 cm: 7.5YR 4/3 brown fine sandy loam<br>17-35 cm: 5YR 4/3 reddish brown sandy clay loam<br>35-60 cm: 5YR 3/4 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR9-ST5 | None | 0-5 cm: 7.5YR 4/2 brown fine loam<br>5-18 cm: 7.5YR 4/3 brown fine sandy loam<br>18-38 cm: 7.5YR 3/3 dark brown fine sandy clay loam<br>38-61 cm: 7.5YR 2.5/3 very dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR9-ST6 | None | 0-6 cm: 10YR 4/3 brown fine loam<br>6-16 cm: 7.5YR 3/3 dark brown fine sandy loam<br>16-30 cm: 7.5YR 3/4 dark brown fine sandy clay loam<br>30-55 cm: 5YR 3/4 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR9-ST7 | None | 0-12 cm: 10YR 3/4 dark yellowish brown fine sandy loam<br>12-21 cm: 7.5YR 4/3 brown sandy clay loam<br>21-62 cm: 7.5YR 3/3 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |

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| TR9-ST8 | None | 0-15 cm: 7.5YR 3/3 dark brown fine loam<br>15-34 cm: 7.5YR 3/4 dark brown fine sandy clay loam<br>34-60 cm: 7.5YR 3/4 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR9-ST9 | None | 0-14 cm: 7.5YR 4/3 brown fine sandy loam<br>14-55 cm: 7.5YR 4/3 brown sandy clay loam<br>Mechanically disturbed<br>Shovel test terminated within subsoil horizon |
| TR10-ST1 | None | 0-45 cm: dark brown (7.5YR 3/4) loam<br>45-60 cm: brown (7.5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR10-ST2 | None | 0-44 cm: dark brown (7.5YR 3/4) loam<br>44-61 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR10-ST3 | None | 0-15 cm: dark brown (7.5YR 3/3) sandy loam<br>15-40 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR10-ST4 | None | 0-38 cm: brown (7.5YR 4/4) sandy loam<br>38-56 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR10-ST5 | None | 0-33 cm: brown (7.5YR 4/4) sandy loam<br>33-53 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR10-ST6 | None | 0-27 cm: brown (7.5YR 4/4) sandy loam<br>27-53 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR10-ST7 | None | 0-35 cm: brown (7.5YR 4/4) sandy loam<br>35-57 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR10-ST8 | None | 0-36 cm: brown (7.5YR 4/4) sandy loam<br>36-54 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR10-ST9 | None | 0-26 cm: brown (7.5YR 4/4) sandy loam<br>26-48 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR11-ST1 | None | 0-29 cm: reddish brown (5YR 4/4) sandy loam<br>29-47 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR11-ST2 | None | 0-29 cm: reddish brown (5YR 4/3) sandy loam<br>29-48 cm: yellowish red (5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR11-ST3 | None | 0-33 cm: reddish brown (5YR 4/4) sandy loam<br>33-46 cm: red (2.5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR11-ST4 | None | 0-32 cm: reddish brown (5YR 4/4) sandy loam<br>32-45 cm: red (2.5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR11-ST5 | None | 0-28 cm: reddish brown (5YR 4/4) sandy loam<br>28-41 cm: red (2.5YR 4/6) sandy clay<br>Terminated in subsoil |

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| TR11-ST6 | None | 0-29 cm: reddish brown (5YR 4/4) sandy loam<br>29-48 cm: red (2.5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR11-ST7 | None | 0-27 cm: reddish brown (5YR 4/3) sandy loam<br>27-49 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR11-ST8 | None | 0-31 cm: reddish brown (5YR 4/4) sandy loam<br>31-51 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR11-ST9 | None | 0-33 cm: reddish brown (5YR 4/4) sandy loam<br>33-48 cm: yellowish red (5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR12-ST1 | None | 0-19 cm: reddish brown (5YR 4/4) sandy loam<br>19-44 cm: yellowish red (5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR12-ST2 | None | 0-18 cm: 5YR 4/6 yellowish red sandy loam<br>18-55 cm: 5YR 3/4 dark reddish brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR12-ST3 | None | 0-28 cm: reddish brown (5YR 4/4) sandy loam<br>28-43 cm: red (2.5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR12-ST4 | None | 0-18 cm: 5YR 3/3 dark reddish brown fine sandy clay loam<br>18-52 cm: 5YR 4/6 yellowish red sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR12-ST5 | None | 0-23 cm: reddish brown (5YR 4/4) sandy loam<br>23-41 cm: red (2.5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR12-ST6 | None | 0-19 cm: 7.5YR 4/3 brown sandy loam<br>19-60 cm: 7.5YR 3/3 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR12-ST7 | None | 0-27 cm: reddish brown (5YR 4/4) sandy loam<br>27-46 cm: red (2.5YR 4/6) sandy clay<br>Terminated in subsoil |
| TR13-ST1 | None | 0-6 cm: dark brown (7.5YR 3/2) loam<br>6-11 cm: brown (7.5YR 4/4) sandy loam<br>11-37 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR13-ST2 | None | 0-14 cm: dark reddish brown (5YR 3/4) sandy clay loam<br>14-36 cm: yellowish red (5YR 5/8) sandy clay loam<br>Terminated in subsoil |
| TR13-ST3 | None | 0-8 cm: brown (7.5YR 4/4) sandy loam<br>8-30 cm: reddish brown (5YR 4/4) sandy clay loam<br>30-40 cm: red (2.5YR 4/8) sandy clay loam<br>Terminated in subsoil |
| TR13-ST4 | None | 0-21 cm: brown (7.5YR 4/3) clay loam<br>21-44 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |

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| TR14-ST1 | None | 0-10 cm: yellowish red (5YR 4/6) sand<br>10-46 cm: dark brown (7.5YR 3/2) sandy loam<br>46-72 cm: reddish brown (5YR 4/4) sandy clay loam<br>72-80 cm: red (2.5YR 4/8) soft sandstone<br>Terminated in subsoil |
| TR14-ST2 | None | 0-10 cm: 7.5YR 3/2 dark brown fine sandy loam<br>10-30 cm: 7.5YR 3/3 dark brown fine sandy loam<br>30-50 cm: 7.5YR 3/4 dark brown sandy clay loam<br>50-80 cm: 7.5 cm: 3/3 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR14-ST3 | None | 0-16 cm: dusky red (2.5YR 3/2) sandy loam<br>16-72 cm: dark reddish brown (5YR 3/4) sandy clay loam<br>Terminated at tree root |
| TR14-ST4 | None | 0-61 cm: dark brown (7.5YR 3/2) sandy loam<br>61-80 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR14-ST5 | None | 0-12 cm: 7.5YR 3/2 dark brown fine sandy loam<br>12-25 cm: 5YR 4/6 yellowish red sandy clay loam<br>25-45 cm: 2.5YR 4/6 red soft sandstone<br>45cm+ sandstone bedrock<br>Shovel test terminated at sandstone bedrock |
| TR14-ST6 | None | 0-18 cm: dark reddish brown (5YR 3/2) sandy clay loam<br>18-80 cm: dark reddish brown (5YR 3/4) sandy clay loam<br>Terminated at depth |
| TR14-ST7 | None | 0-11 cm: 7.5YR 3/2 dark brown fine sandy loam<br>11-22 cm: 7.5YR 3/3 dark brown fine sandy loam<br>22-45 cm: 5YR 4/6 yellowish red sandy clay loam<br>45-80 cm: 2.5YR 4/6 red clay loam<br>Shovel test terminated within subsoil horizon |
| TR14-ST8 | None | 0-16 cm: dark brown (7.5YR 3/2) loam<br>16-25 cm: yellowish red (5YR 5/6) sandy loam<br>25-71 cm: dark brown (7.5YR 3/2) sandy clay loam<br>71-80 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR14-ST9 | None | 0-42 cm: dark reddish brown (5YR 3/3) sandy loam<br>42-80 cm: red (2.5YR 4/6) sandy clay<br>Terminated at depth |
| TR14-ST10 | None | 0-15 cm: 7.5YR 3/2 dark brown fine sandy loam<br>15-40 cm: 7.5YR 3/3 dark brown sandy clay loam<br>40-80 cm: 7.5YR 4/3 brown clay loam<br>Shovel test terminated within subsoil horizon |
| TR14-ST11 | None | 0-12 cm: dark brown (7.5YR 3/2) loam<br>12-27 cm: brown (7.5YR 4/4) loam<br>27-50 cm: strong brown (7.5YR 5/8) clay loam<br>Terminated in subsoil |
| TR14-ST12 | None | 0-47 cm: dark reddish brown (5YR 3/3) sandy loam<br>47-68 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |

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| TR14-ST13 | None | 0-12 cm: dark brown (7.5YR 3/2) loam<br>12-59 cm: brown (7.5YR 4/4) sandy loam<br>59-80 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR14-ST14 | None | 0-18 cm: 7.5YR 3/2 dark brown fine sandy loam<br>18-42 cm: 7.5YR 3/3 dark brown fine sandy clay loam<br>42-80 cm: 7.5YR 3/4 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR14-ST15 | None | 0-22 cm: dark reddish brown (2.5YR 3/4) sandy loam<br>Terminated at sandstone |
| TR14-ST16 | None | 0-10 cm: dark reddish brown (5YR 3/2) sandy loam<br>10-58 cm: reddish brown (5YR 4/3) sandy loam<br>58-80 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated at depth |
| TR14-ST17 | None | 0-13 cm: very dark brown (7.5YR 2.5/2) loam<br>13-37 cm: yellowish red (5YR 4/6) sandy clay loam<br>37-80 cm: dark brown (7.5YR 3/3) clay loam<br>Terminated in subsoil |
| TR14-ST18 | None | 0-13 cm: very dark brown (7.5YR 2.5/2) loam<br>13-37 cm: yellowish red (5YR 4/6) sandy clay loam<br>37-80 cm: dark brown (7.5YR 3/3) clay loam<br>Terminated in subsoil |
| TR14-ST19 | None | 0-14 cm: very dark gray (5YR 3/1) sandy loam<br>14-62 cm: reddish brown (5YR 4/3) sandy loam<br>62-80 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated at depth |
| TR15-ST1 | None | 0-13 cm: very dark brown (10YR 2/2) sandy loam<br>13-54 cm: brown (7.5YR 4/3) sandy clay loam<br>Terminated in subsoil |
| TR15-ST2 | None | 0-15 cm: 7.5YR 3/3 dark brown fine loam<br>15-30 cm: 7.5YR 4/4 brown sandy loam<br>30-60 cm: 7.5YR 3/4 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR15-ST3 | None | 0-34 cm: dark reddish brown (5YR 3/4) sandy loam<br>34-52 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR15-ST4 | None | 0-23 cm: 5YR 4/2 dark reddish gray sandy loam<br>23-54 cm: 5YR 5/4 reddish brown sandy clay<br>Terminated in subsoil |
| TR15-ST5 | None | 0-8 cm: dark brown (7.5YR 3/3) sandy loam<br>8-43 cm: brown (7.5YR 4/4) sandy loam<br>43-55 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR15-ST6 | None | 0-25 cm: 7.5YR 2.5/2 very dark brown fine sandy loam<br>25-46 cm: 7.5YR 3/3 dark brown fine sandy clay loam<br>46-63 cm: 7.5YR 2.5/3 very dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR15-ST7 | None | 0-23 cm: very dark gray (5YR 3/1) sandy loam<br>23-56 cm: dark reddish brown (5YR 3/4) sandy clay loam<br>Terminated in subsoil |

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| TR15-ST8 | None | 0-19 cm: very dark gray (5YR 3/1) sandy loam<br>19-37 cm: dark reddish brown (5YR 3/4) sandy clay loam<br>Terminated at tree roots |
| TR15-ST9 | None | 0-32 cm: very dark brown (10YR 2/2) sandy loam<br>32-60 cm: brown (7.5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR15-ST10 | None | 0-19 cm: 7.5YR 3/3 dark brown fine sandy loam<br>19-36 cm: 7.5YR 3/4 dark brown fine sandy clay loam<br>36-60 cm: 7.5YR 2.5/3 very dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR15-ST11 | None | 0-35 cm: dark brown (10YR 3/3) sandy loam<br>35-51 cm: brown (7.5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR15-ST12 | None | 0-18 cm: 5YR 4/4 reddish brown fine sandy clay loam<br>18-50 cm: 5YR 4/6 yellowish red sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR15-ST13 | None | 0-24 cm: dark reddish brown (5YR 3/4) sandy loam<br>24-43 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR15-ST14 | None | 0-6 cm: dark brown (7.5YR 3/3) sandy loam<br>6-20 cm: yellowish red (5YR 4/6) sandy clay loam<br>20-31 cm: red (2.5YR 4/6) clay<br>Terminated in subsoil |
| TR15-ST15 | None | 0-34 cm: 2.5YR 3/1 dusky red sandy loam<br>34-52 cm: 5YR 3/6 dark red sandy clay<br>Terminated in subsoil |
| TR15-ST16 | None | 0-21 cm: 7.5YR 4/4 brown fine sandy loam<br>21-39 cm: 7.5YR 3/4 dark brown fine sandy clay loam<br>39-56 cm: 7.5YR 3/3 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR15-ST17 | None | 0-26 cm: very dark brown (10YR 2/2) sandy loam<br>26-51 cm: brown (7.5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR15-ST18 | None | 0-14 cm: 7.5YR 3/4 dark brown fine sandy loam<br>14-36 cm: 7.5YR 3/3 dark brown fine sandy clay loam<br>36-55 cm: 7.5YR 4/3 brown sandy clay loam<br>Shovel test terminated with subsoil horizon |
| TR16-ST1 | None | 0-13 cm: dark reddish brown (5YR 3/2) sandy loam<br>13-46 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR16-ST2 | None | 0-19 cm: brown (7.5YR 4/4) sandy loam<br>19-43 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR16-ST3 | None | 0-12 cm: 7.5YR 3/2 dark brown loam<br>12-30 cm: 7.5YR 2.5/3 very dark brown fine sandy clay loam<br>30-45 cm: 7.5YR 2.5/3 very dark brown sandy clay loam<br>Shovel test terminated at very large root 45 cmbs |
| TR16-ST4 | None | 0-30 cm: 5YR dark reddish brown sandy loam<br>30-45 cm: 5YR 4/4 reddish brown clay loam<br>Terminated subsoil with coarse roots |

| | | |
|---|---|---|
| TR16-ST5 | None | 0-21 cm: dark reddish brown (5YR 3/2) sandy loam<br>21-43 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR16-ST6 | None | 0-14 cm: dark brown (7.5YR 3/3) sandy loam<br>14-40 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR17-ST1 | None | 0-16 cm: 7.5YR 3/3 dark brown fine sandy loam<br>16-35 cm: 7.5YR 4/4 brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR17-ST2 | None | 0-6 cm: brown (7.5YR 5/4) compact sandy loam<br>6-37 cm: brown (7.5YR 4/4) compact sandy clay loam<br>Terminated in subsoil |
| TR17-ST3 | None | 0-17 cm: dark reddish brown (5YR 3/3) sandy clay loam<br>17-44 cm: reddish brown (5YR 4/3) sandy clay<br>Terminated in subsoil |
| TR18-ST1 | None | 0-24 cm: 7.5YR 4/2 Brown sandy loam.<br>24-44 cm: 5YR 4/6 yellowish red clay loam<br>Terminated in subsoil. Topsoil disturbed by machinery |
| TR18-ST2 | None | 0-10 cm: 7.5YR 3/3 dark brown fine sandy loam<br>10-23 cm: 7.5YR 4/4 brown fine sandy clay loam<br>23-42 cm: 7.5YR 2.5/2 very dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR18-ST3 | None | 0-28 cm: dark brown (7.5YR 3/4) compact sandy loam<br>28-43 cm: dark brown (7.5YR 3/4) compact sandy clay<br>Terminated in subsoil |
| TR19-ST1 | None | 0-14 cm: reddish brown (5YR 5/3) compact sandy loam<br>Terminated due to mechanical compaction |
| TR20-ST1 | None | 0-19 cm: reddish brown (5YR 4/3) sandy clay loam<br>19-46 cm: dark reddish brown (2.5YR 3/4) sandy clay<br>Terminated in subsoil |
| TR20-ST2 | None | 0-14 cm: 7.5YR 4/3 brown fine sandy loam<br>14-25 cm: 7.5YR 3/4 dark brown fine sandy clay loam<br>25-55 cm: 7.5YR 3/4 dark brown sandy clay loam<br>Shovel test terminated within subsoil horizon |
| TR20-ST3 | None | 0-16 cm: dark brown (7.5YR 3/4) sandy clay loam<br>16-37 cm: yellowish red (5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR21-ST1 | None | 0-24 cm: dark brown (7.5YR 3/3) sandy loam<br>24-47 cm: dark reddish brown (5YR 3/4) compact sandy loam<br>Terminated in subsoil |
| TR21-ST2 | None | 0-10 cm:2.5YR 5/6 red clay<br>10-50 cm: 2.5YR 3/2 dusky red gravelly sandy loam with 2.5YR 4/4 reddish brown sandy loam clasts in matrix<br>50-70 cm: 2.5YR 4/4 reddish brown sandy loam with 2.5YR 4/2 weak red sandy loam clasts in matrix<br>Terminated in disturbed subsoil |
| TR21-ST3 | None | 0-8 cm: red (2.5YR 5/6) wet sand<br>8-26 cm: dark brown (7.5YR 3/2) sandy loam<br>26-44 cm: red (2.5YR 5/6) sand<br>Terminated in slope wash |

| | | |
|---|---|---|
| TR22-ST1 | None | 0-16 cm: very dark brown (7.5YR 2.5/3) sandy loam<br>16-38 cm: dark brown (7.5YR 3/4) sandy loam<br>38-54 cm: strong brown (7.5YR 4/6) sandy clay loam<br>Terminated in subsoil |
| TR22-ST2 | None | 0-39 cm: 5YR 3/2 dark reddish brown sandy loam<br>39-57 cm: 5YR 4/4 reddish brown sandy clay loam<br>Terminated in subsoil |
| TR23-ST1 | None | 0-18 cm: red (2.5YR 5/6) sand<br>18-dark brown (7.5YR 3/4) sandy loam<br>Disturbed from slope wash |
| TR24-ST1 | None | 0-10 cm: dark brown (7.5YR 3/3) mottled with red (2.5YR 5/8) sandy loam<br>10-37 cm: very dark brown (7.5YR 2/5/3) sandy loam<br>37-55 cm: brown (7.5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR24-ST2 | None | 0-60 cm: Mottled 5YR 3/2 sandy loam with 5YR 5/6 yellowish red sandy clay<br>60-75 cm: 5YR 5/6 sandy clay<br>Terminated within disturbed mix of topsoil and subsoil |
| TR25-ST1 | None | 0-9 cm: brown (7.5YR 4/2) wet loam<br>9-31 cm: brown (7.5YR 4/4) sandy clay loam<br>31-57 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR25-ST2 | None | 0-30 cm: 5YR 4/2 dark reddish gray sandy loam<br>30-50 cm: 5YR 5/6 yellowish red sandy clay<br>Terminated in subsoil. Topsoil scraped and mixed for oil pad |
| TR26-ST1 | None | 0-27 cm: brown (7.5YR 4/4) sandy loam<br>27-50 cm: yellowish red (5YR 4/7) sandy clay loam<br>Terminated in subsoil |
| TR26-ST2 | None | 0-31 cm: 5YR 3/2 dark reddish brown sandy loam<br>31-50 cm: 5YR 5/6 yellowish red sandy clay<br>Terminated in subsoil below disturbed topsoil |
| TR27-ST1 | None | 0-8 cm: dark brown (7.5YR 3/2) sand<br>8-35 cm: dark brown (7.5YR 3/2) sandy loam<br>35-55 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR27-ST2 | None | 0-38 cm 5YR3/2 dark reddish brown sandy loam<br>38-48 cm 2.5YR3/3 dark reddish brown sandy clay<br>Terminated in B Horizon |
| TR27-ST3 | None | 0-37 cm: 5YR 3/2 dark reddish brown sandy loam<br>37-54 cm: 5YR 4/4 reddish brown sandy clay loam<br>Terminated in subsoil |
| TR27-ST4 | None | 0-12 cm: brown (7.5YR 4/3) sandy clay loam<br>12-41 cm: reddish brown (5YR 4/4) sandy clay loam<br>Terminated in subsoil |
| TR27-ST5 | None | 0-47 cm 5YR4/6 yellowish red sandy loam<br>47-63 cm 5YR4/2 dark reddish gray sandy clay<br>Terminated in B Horizon |

| | | |
|---|---|---|
| TR27-ST6 | None | 0-3 cm: 2.5 YR 3/2 dark reddish brown loam slopewash<br>3-35 cm: 2.5 YR 4/8 red coarse well rounded sand, quarry material<br>Terminated in quarry sand deposit |
| TR27-ST7 | None | 0-13 cm: dark brown (7.5YR 3/2) loamy sand<br>13-25 cm: brown (7.5YR 4/3) sand<br>25-32 cm: red (2.5YR 5/8) coarse sand<br>Terminated in sand quarry fill |
| TR27-ST8 | | 0-15 cm 2.5YR3/3 dark reddish brown coarse sand – quarry material |
| TR28-ST1 | None | 0-9 cm: reddish yellow (5YR 6/8) sand<br>9-43 cm: brown (7.5YR 4/3) sand<br>43-54 cm: reddish brown (5YR 5/4) sand<br>Terminated in subsoil |
| TR28-ST2 | None | 0-32 cm 5YR4/6 yellowish red sandy loam<br>32-50 cm 5YR4/2 dark reddish gray sandy clay<br>Terminated in B Horizon |
| TR28-ST3 | None | 0-33 cm: 5YR 5/6 yellowish red sand<br>33-57 cm: 5YR 4/3 reddish brown sandy loam<br>57-72 cm: 5YR 4/4 reddish brown sandy clay loam<br>Terminated in subsoil below quarry sand |
| TR29-ST1 | None | 0-28 cm 5YR4/6 yellowish red sandy loam<br>28047 cm 5YR4/2 dark reddish gray sandy clay<br>Terminated in B Horizon |
| TR29-ST2 | None | 0-6 cm: yellowish red (5YR 5/6) sand<br>6-27 cm: light red (2.5YR 6/6) sand<br>27-46 cm: dark reddish brown (5YR 3/3) sandy loam<br>Terminated in subsoil |
| TR29-ST3 | None | 0-28 cm 5YR4/6 yellowish red sandy loam<br>28-45 cm 5YR4/2 dark reddish gray sandy clay<br>Terminated in B Horizon |
| TR30-ST1 | None | 0-2 cm 2.5YR3/3 dark reddish brown sandy clay<br>2-21 cm 5YR3/2 dark reddish brown sandy loam<br>Terminated at 3-inch tree root. Moved ST twice and still encountered impenetrable roots. ST terminated due to obstructions |
| TR30-ST2 | None | 0-16 cm: red (2.5YR 5/8) sand<br>16-37 cm: dark reddish brown (5YR 3/2) sandy loam<br>Terminated in subsoil |
| TR30-ST3 | None | 0-35 cm: 2.5YR 5/8 red sand slopewash<br>35-40 cm: 2.5YR 3/2 dusky red sandy loam<br>40-50 cm: 2.5YR 3/3 dark reddish brown clay loam<br>Terminated in disturbed subsoil |
| TR31-ST1 | None | 0-40 cm: dark reddish brown (5YR 3/2) sandy loam with mulch<br>Terminated due to runoff from nearby mulch pile |
| TR31-ST2 | None | 0-25 cm 5YR4/6 yellowish red sandy loam<br>At 25 cm mulch of various sizes and hole filled with water. |

# Appendix B: 1201-HS1 HPRI Form

CLEAR FORM PRINT FORM

# HISTORIC PRESERVATION RESOURCE IDENTIFICATION FORM

PLEASE TYPE ALL DATA IN UPPERCASE - FIELDS IN RED ARE REQUIRED

1. PROPERTY NAME: STORM SHELTER 1201-HS1

2. RESOURCE NAME: STORM SHELTER 1201-HS1

3. ADDRESS: 7621 NORTH 23rd STREET.

4. CITY: MIDWEST CITY 5. VICINITY:

6. COUNTY NAME: OKLAHOMA

7. LOT: 8. BLOCK: 9. PLAT NAME:

10. SECTION: 22 11. TOWNSHIP: 12N 12. RANGE: 2W

13. LATITUDE (NORTH): (ENTER AS: "dd.dddddd") 35.4935663

14. LONGITUDE (WEST): (ENTER AS: "-dd.dddddd") -97.3950031

15. UTM ZONE: 14 16. NORTHINGS: 3928964 17. EASTINGS: 0645580

18. RESOURCE TYPE: STRUCTURE

19. HISTORIC FUNCTION: OTHER

20. CURRENT FUNCTION: OTHER

21. AREA OF SIGNIFICANCE, PRIMARY: NO DATA

22. AREA OF SIGNIFICANCE, SECONDARY: NO DATA

23. DESCRIPTION OF SIGNIFICANCE: THE STORM SHELTER AT THE NE LANDFILL IN SPENCER, OK IS RECOMMENDED NOT ELIGIBLE FOR NRHP.

24. DOCUMENTATION RESOURCE: CULTURAL RESOURCES SURVEY OF THE 163.3-ACRE NORTHEAST C&D LANDFILL PROJECT, OKLAHOMA COUNTY, OKLAHOMA

25. NAME OF PREPARER: DANNY WELCH

59. SURVEY PROJECT YES 26. PROJECT NAME: NE C&D LANDFILL SURVEY

27. DATE OF PREPARATION: 1/5/21 28. PHOTOGRAPHS ATTACHED

29. YEAR: 2021

30. ARCHITECT/BUILDER:

31. YEAR BUILT: UNKNOWN 40S-50S

32. ORIGINAL SITE: YES

33. DATE MOVED:

34. FROM WHERE:

35. ACCESSIBLE:

36. ARCHITECTURAL STYLE: MID 19TH CENTURY

37. OTHER ARCHITECTURAL STYLE:

38. FOUNDATION MATERIAL: CONCRETE

39. ROOF TYPE: OTHER (PLEASE SPECIFY

40. ROOF MATERIAL: CONCRETE

41. WALL MATERIAL, PRIMARY: CONCRETE

42. WALL MATERIAL, SECONDARY:

43. WINDOW TYPE: FIXED

44. WINDOW MATERIAL: UNCOLLECTED

45. DOOR TYPE:

46. DOOR MATERIAL: INAPPLICABLE

47. EXTERIOR FEATURES: MODERN CINDER BLOCK ADDITION TO SHELTER OPENING

48. INTERIOR FEATURES: CONCRETE SPIRAL STAIRWAY

49. DECORATIVE DETAILS:

50. CONDITION OF RESOURCE: POOR (BADLY IN NEED OF MAINTENANCE)

51. DESCRIPTION OF RESOURCE: CONCRETE STORM SHELTER WITH WINDOW AND SPIRAL STAIRCASE. IMAGERY INDICATES BUILD DATE PRIOR TO 1954

52. COMMENTS: INELIGIBLE FOR STATE TRINOMIAL. RECOMMENDED INELIGIBLE FOR NRHP

53. ATTACH LOCATION MAP

54. LISTED ON NATIONAL REGISTER: NO

55. NATIONAL REGISTER ENTRY:

56. CONTINUATION ROOF IS CONCRETE FOR STORM SHELTER WITH MODERN ADDITION OF CINDER BLOCKS AROUND THE OPENING. SHOVEL TESTS FOUND NO ASSOCIATED ARTIFACTS. NO SURFACE ARTIFACTS. SHELTER MEAURES 4M BY 5M. MAPS/IMAGES BELOW

CONTINUATION SHEET, IF APPLICABLE

References Cited:

Ancestry.com
2021 Arthur Fuchs. 1940 US Federal Census. Accessed 2021. https://www.ancestry.com/imageviewer/collections/2442/images/m-t0627-03317-00466?usePUB=true&usePUBJs=true&pId=90123161

Kueteman, K.
2021 Florence E. Fuchs English. Accessed 2021. https://www.findagrave.com/memorial/168908318/florence-e.-english


Figure 1: View south to shelter pad and cinder block door cover


Figure 2: View west to shelter door


Figure 3: View NW of stairs leading to subsurface shelter room


Figure 4: View NE of shelter pad corner with fastener hardware

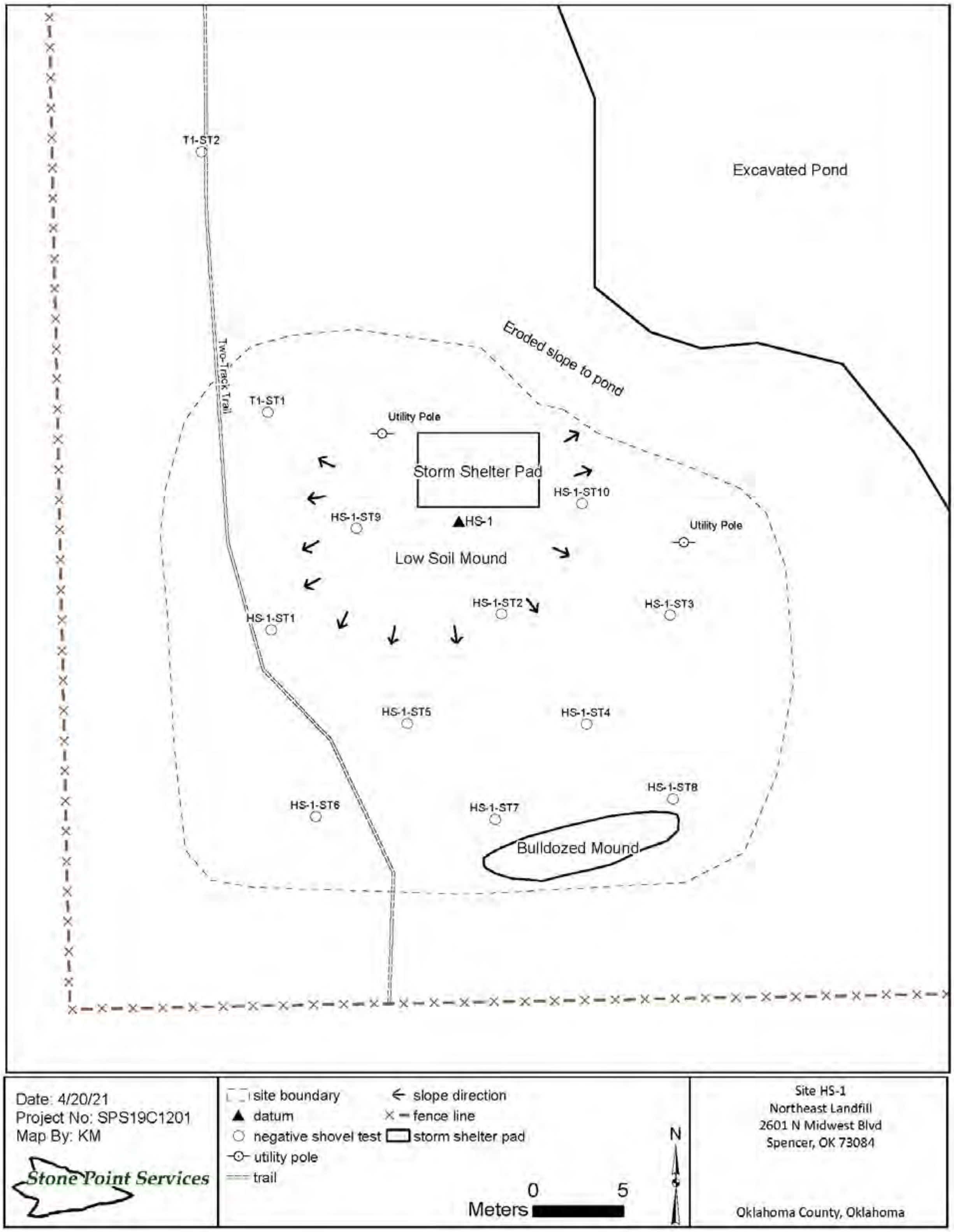



Figure 5: site sketch map of storm shelter site. Field ID: 1201-HS1

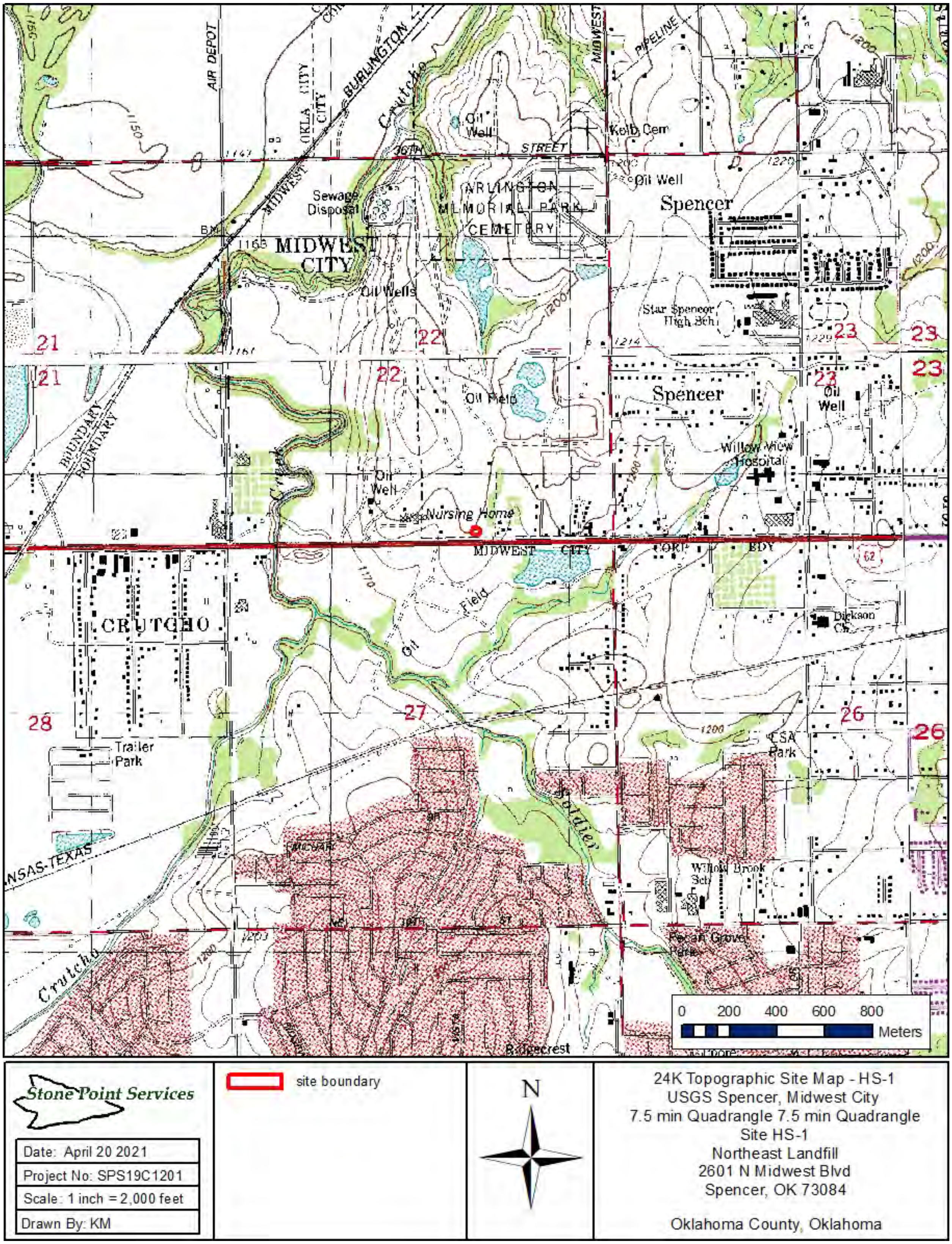



Figure 6: USGS Spencer and Midwest City quadrangle with location of site boundary in center

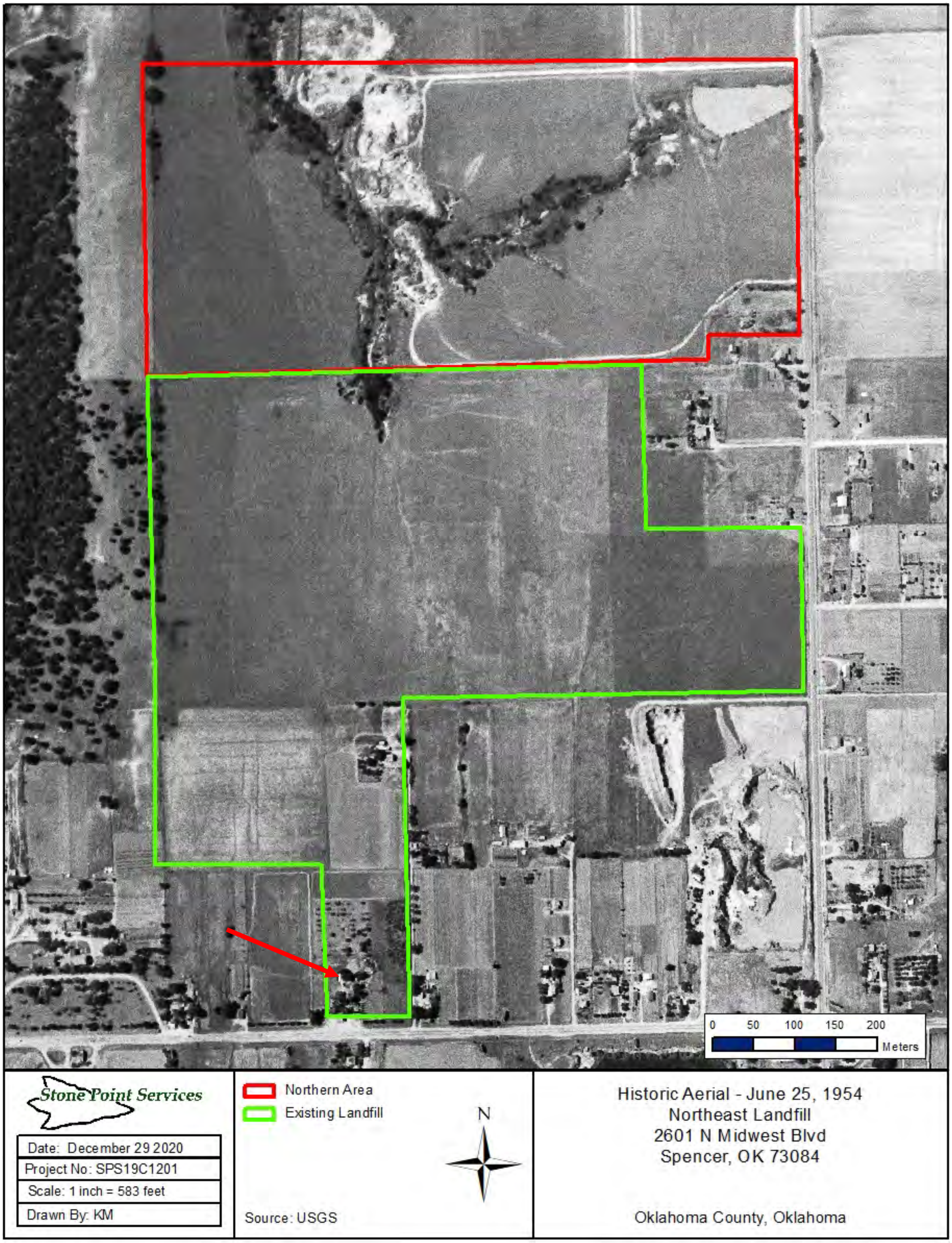



Figure 7: Historic 1954 aerial imagery with site area in southern cluster of structures (red arrow)

# ATTACHMENT F

# MITIGATION PLAN

Hydrex
ENVIRONMENTAL

May 28, 2021

U.S. Army Corps of Engineers
Tulsa District
CESWT-RO
2488 R. 81st Street
Tulsa, OK 74137-4290

**RE: COMPENSATORY MITIGATION PLAN**
**Northeast Landfill**
**163.3-Acre Property, Including 73.2-Acre Landfill Expansion**
**2601 North Midwest Blvd.**
**Spencer (Oklahoma County), Oklahoma**
**Hydrex Project No. A-12-1361**

Hydrex Environmental (Hydrex) has been contracted by N.E. Landfill, LLC to coordinate with the U.S. Army Corps of Engineers concerning the expansion of the Northeast Landfill 163.3-acre landfill expansion area ("Project Area"). This 163.3-acre Project Area consists of an existing 90.1-acre construction and demolition (C&D) landfill permitted under Oklahama Department of Environmental Quality (ODEQ) Permit No. 3555050 and a proposed 73.2-acre lateral expansion area. The proposed plans involve a horizontal and vertical expansion of the landfill, which will be used for municipal solid waste disposal. This mitigation plan addresses compensatory mitigation requirements at the above-referenced project site to satisfy the requirements of the requested Individual Permit.

Based on the conclusions of the *Jurisdictional Determination* letter dated December 11, 2020 by the U.S. Army Corps of Engineers Tulsa District, proposed permanent impacts to waters of the U.S. amount to 0.56 acres of scrub-shrub wetland impacts, 0.68 acres of open water impacts, and 746 linear feet (0.05 acres) of intermittent stream impacts. Based on proposed impacts to WOTUS (>0.5 acres), this project does not fall within the guidelines of any Nationwide Permits, and as such will require compensatory mitigation. Therefore, N.E. Landfill, LLC proposes to purchase stream and wetland credits from the Deep Fork Mitigation Bank (DFMB) in order to offset unavoidable, permanent impacts from the proposed landfill expansion. The Northeast Landfill Expansion is located within the primary service area of the DFMB.

The DFMB does not utilize any particular functional assessment method, therefore the *Texas Rapid Assessment Method* (TXRAM) 2.0, was conducted by Hydrex to evaluate wetland and stream quality. Utilizing TXRAM, Hydrex determined potential mitigation requirements for permanent impacts to the 0.56 acres of scrub-shrub Wetlands A and B, 0.68 acres of Open Water 5, and 746 linear feet (0.05 acres) of Stream 2 within the project site.

According to the TXRAM wetland functional assessment, Wetland A (0.40 acres) scored 49.2 out of a possible 115, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 4:1 for medium quality wetlands, therefore Wetland A will require the purchase of 1.6 wetland credits. Wetland B (0.16 acres) scored 49.3 out of a possible 115, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 4:1 for medium quality wetlands, therefore Wetland B will require the purchase of 0.64 wetland credits. Open Water 5 did not require a functional assessment, as DFMB utilizes the 3:1 ratio for low quality wetlands for open water features. Applying the 3:1 ratio for low quality wetlands, Open Water 5 will require the purchase of 2.04 wetland credits. Based on these scores, NELF will be required to purchase 4.28 wetland credits for impacts at the Northeast Landfill Expansion.

According to the TXRAM stream functional assessment, Stream 2 (746 linear feet) scored 39.5 out of a possible 105, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 2:1 for medium quality intermittent streams, therefore Stream 2 will require the purchase of 1,492 intermittent stream credits. However, at this time DFMB does not have sufficient intermittent stream credits to fulfill this compensatory mitigation requirement. Therefore, Hydrex is requesting approval for the purchase of perennial stream credits as needed to supplement the purchase of intermittent stream credits and satisfy mitigation requirements. At this time, DFMB has 366 intermittent stream credits available for purchase. Hydrex respectfully requests a 0.5:1 mitigation ratio for the purchase of perennial stream credits to satisfy the remainder of mitigation requirements. In the event that more intermittent stream credits become available during the permitting process, those will be purchased prior to any perennial stream credits.

In conclusion, the total required credits will be 4.28 wetland credits and 1,492 intermittent stream credits for the proposed landfill expansion. As of May 2021, RIBITS indicates that the DFMB only has 336 intermittent stream credits available, which will be purchased to satisfy mitigation requirements for Stream 2. Due to insufficient available intermittent stream credits, perennial stream credits are proposed to be purchased at a 0.5:1 ratio to satisfy the remainder of the compensatory mitigation needs for this project. The TXRAM functional assessment datasheets and final scoring sheets are attached.

If you have any questions regarding this plan, or if further clarification is necessary, please feel free to contact me at ccollier@hydrex-inc.com or (936) 568-9451.

Sincerely,

**Hydrex Environmental**

Clayton A. Collier, REM, PWS

Senior Environmental Scientist

## Attachments

**Scrub-Shrub Wetland A TXRAM 2.0 Final Scoring and Datasheets**

**Scrub-Shrub Wetland B TXRAM 2.0 Final Scoring and Datasheets**

**Intermittent Stream 2 TXRAM 2.0 Final Scoring and Assessment Datasheets**

# TXRAM WETLAND FINAL SCORING SHEET

Project/Site Name/No.: Northeast Landfill   Project Type: ■ Fill/Impact (☐ Linear ■ Non-linear) ☐ Mitigation/Conservation

Wetland ID/Name: A   WAA No.: 1   Size: 0.4 Acres   Date: 4-15-2020   Evaluator(s): CRK, DTM

Wetland Type: Riverine, PSS   Ecoregion: N/A   Delineation Performed: ☐ Previously ■ Currently

Aerial Photo Date and Source: 2018 (BING), 2017 (NAIP)   Site Photos: March 17, 2020   Representative: ■ Yes ☐ No

Notes: Permanent Scrub-Shrub Wetland Impact

| ***Core Element*** | ***Metric*** | ***Metric Score*** | ***Core Element Score Calculation*** | ***Core Element Score*** |
|---|---|---|---|---|
| Landscape | Aquatic Context | 2 | Sum of metric scores / 8 x 15 | 5.8 |
| | Buffer | 1.1 | | |
| Hydrology | Water source | 3 | Sum of metric scores / 12 x 30 | 12.5 |
| | Hydroperiod | 1 | | |
| | Hydrologic flow | 1 | | |
| Soils | Organic matter | 1 | Sum of metric scores / 12 x 15 | 6.3 |
| | Sedimentation | 2 | | |
| | Soil modification | 2 | | |
| Physical Structure | Topographic complexity | 3 | Sum of metric scores / 12 x 20 | 11.7 |
| | Edge complexity | 2 | | |
| | Physical habitat richness | 2 | | |
| Biotic Structure | Plant strata | 4 | Sum of metric scores / 28 x 20 | 12.9 |
| | Species richness | 2 | | |
| | Non-native/invasive infestation | 2 | | |
| | Interspersion | 3 | | |
| | Strata overlap | 2 | | |
| | Herbaceous cover | 2 | | |
| | Vegetation alterations | 3 | | |

| | |
|---|---|
| Sum of core element scores = overall TXRAM wetland score | 49.2 |
| Additional points for unique resources = overall TXRAM wetland score x 0.10 if:<br>☐ Area of Caddo Lake designated a "Wetland of International Importance" under the Ramsar Convention<br>☐ Bald cypress – water tupelo swamp<br>☐ Pitcher plant bog<br>☐ Spring | Not Applicable |
| Additional points for limited habitats = overall TXRAM wetland score x 0.05 if:<br>☐ Dominated by native trees greater than 24-inch diameter at breast height<br>☐ Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata | Not Applicable |
| Sum of overall TXRAM wetland score and additional points = **total overall TXRAM wetland score** | **49.2** |

***Representative Site Photograph:***

Scrub-shrub Wetland A looking northeast.

Scrub-shrub Wetland A looking west.

# TXRAM WETLAND DATA SHEET

Project/Site Name/No.: Northeast Landfill Project Type: ■ Fill/Impact (☐ Linear ■ Non-linear) ☐ Mitigation/Conservation

Wetland ID/Name: A WAA No.: 1 Size: 0.4 Acres Date: 4-15-2020 Evaluator(s): CRK, DTM

Wetland Type: Riverine, PSS Ecoregion: N/A Delineation Performed: ☐ Previously ■ Currently

Aerial Photo Date and Source: 2018 (BING), 2017 (NAIP) Site Photos: March 17, 2020 Representative: ■ Yes ☐ No

Notes:

## LANDSCAPE

***Aquatic Context – Confirm in office review. See figures in section 2.3.1.1 for examples.***

Notes on any barriers or alterations that prevent connection: ____________

Aquatic resources within 1,000 feet of WAA to which wetland connects (including number for other considerations): 3 **Score:** 2

***Buffer – Evaluate to 500 feet from WAA boundary. Confirm in office review. See figures in section 2.3.1.2 for examples.***

| *Buffer Type/Description* | *Score (See Narratives)* | *Percentage* | *Subtotal* |
|---|---|---|---|
| 1. Forested | 2 | 45% | 0.9 |
| 2. Landfill | 0 | 40% | 0.0 |
| 3. Pasture | 1 | 15% | 0.15 |
| 4. Open Water | N/A | N/A | N/A |
| 5. | | | |

**Score:** 1.1

## HYDROLOGY

***Water Source – Degree of natural or unnatural/artificial influence. Confirm in office review for watershed.***

Natural: ■ Precipitation ■ Groundwater ■ Overbank flow/stream discharge ■ Overland flow ☐ Beaver activity ☐ Other: ____

Unnatural/Manipulated: ☐ Impoundment ☐ Outfall ☐ Irrigation/pumping ☐ Other artificial influence or control: ____

Watershed: ■ Development ☐ Irrigated agriculture ☐ Wastewater treatment plant ☐ Impoundment ☐ Other: ____

Degree of artificial influence/control: ☐ Complete ■ High ☐ Low ☐ None

Wetland created/restored/enhanced: ☐ Sustainable/replicates natural ☐ Controlled **Score:** 3

***Hydroperiod – Variability and recent alteration of the duration, frequency, and magnitude of inundation/saturation.***

Evaluate the hydroperiod including natural variation: Low variability

Direct evidence of alteration: Natural: ☐ Log-jam ☐ Channel migration ☐ Other: ____

Human: ☐ Diversions ☐ Ditches ☐ Levees ■ Impoundments ■ Other: Berm

Riverine only: ■ Recent channel in-stability/dis-equilibrium (■ Degradation or ■ Aggradation)

Indirect evidence of alteration: ☐ Wetland plant stress: ____ ☐ Plant morphology: ____

☐ Upland species encroachment: ____ ☐ Plant Community: ____ ☐ Soil: ____

Change/Alteration of hydroperiod: ☐ None ☐ Due to natural events ■ Human influences (☐ Slight or ■ High)

Degree hydroperiod of wetland created/restored/enhanced replicates natural patterns: ____

Lacustrine fringe on human impoundment: ☐ High variability ☐ Low variability ☐ Recent changes to hydroperiod **Score:** 1

***Hydrologic Flow – Movement of water to or from surrounding area and openness to water moving through the WAA.***

Flow: ■ Inlets: 1 ☐ Outlets: 1 ☐ Signs of water movement to or from WAA: Flow through site (Rainfall)

Restrictions: ☐ Levee ■ Berm/dam ☐ Diversion ☐ Other: ____

High flowthrough: ☐ Floodplain ☐ Drift deposits ☐ Drainage patterns ☐ Sediment deposits ☐ Other: ____

Low flowthrough: ■ High landscape position ☐ Stagnant water ☐ Closed contours ☐ Other: ____ **Score:** 1

## SOILS

***Organic Matter – Use data and indicators from wetland determination data form(s) based on applicable regional supplement.***

☐ High (organic soil or indicator A1, A2, A3)

☐ Moderate (indicator A9, S1, F1 in AW or A9, S1, S2, F1 in GP or A6, A7, A9, S7, F13 in AGCP)

☐ Low (indicated by thin organic or organic-mineral layer) ■ None observable in surface layer as described herein **Score:** 1

***Sedimentation – Deposition of excess sediment due to human actions. Confirm in office review for landscape.***

Landscape with stress that could lead to excess sedimentation? ☒ Yes ☐ No    Landscape position: ☒ High ☐ Low

Magnitude of recent runoff/flooding events: ☒ High ☐ Low    Percent of WAA with excess sediment deposition: 50

☒ Sand deposits: 100 % of area, 4-6 average thickness    ☐ Silt/Clay deposits: ____% of area, ____ average thickness

Lacustrine fringe only: ☐ Upper end of impoundment ☐ Degrades wetland ☐ Contributes to wetland processes    **Score:** 2

***Soil Modification – Physical changes by human activities. Confirm in office review for past.***

Type (Check those applicable and circle R for recent or P for past): ☐ Farming R/P ☐ Logging R/P ☒ Mining R/P ☒ Filling R/P

☐ Grading R/P ☐ Dredging R/P ☐ Off-road vehicles R/P ☐ Other R/P: ____

Percent of WAA with recent soil modification: 0 %    Degree of modification: ☐ High ☐ Low

Indicators of past modification: ☐ High bulk density ☒ Low organic matter ☐ Lack of soil structure ☐ Lack of horizons ☐ Hardpan

☐ Dramatic change in texture/color ☐ Heterogeneous mixture ☐ Other: ____

Indicators of recovery: ☐ Organic matter ☐ Structure ☒ Horizons ☐ Mottling ☒ Hydric soil ☐ Other: ____

Percent of WAA with past modification: 100 %    Recovery: ☐ Complete ☐ High ☒ Moderate ☐ Low ☐ None    **Score:** 2

**PHYSICAL STRUCTURE**

***Topographic Complexity – See figures in section 2.3.4.1. Record % micro-topography and % WAA for each elevation gradient.***

Elevation gradients (EG): 2    Evidence: ☒ Plant assemblages ☒ Level of saturation/inundation ☐ Path of water flow ☒ Slope

Micro-topography: 15 % of WAA (By EG: EG1: 10%; EG2: 5%)

Types: ☐ Depressions ☐ Pools ☐ Burrows ☐ Swales ☐ Wind-thrown tree holes ☒ Mounds ☐ Gilgai ☐ Islands

☐ Variable shorelines ☐ Partially buried debris ☒ Debris jams ☐ Plant hummocks/roots ☐ Other: ____    **Score:** 3

***Edge Complexity – Confirm in office review. See figure in section 2.3.4.2 to evaluate wetland boundary.***

WAA: ☐ In seasonal floodplain ☐ Contiguous to other wetland    ☒ Edge vertical structure variation: 50

Horizontal variability: ☐ High ☒ Moderate ☐ Low ☐ None    **Score:** 2

***Physical Habitat Richness – See definitions and table in section 2.3.4.3 for habitat types applicable to each wetland type.***

Label of habitat types qualifying as present in WAA: A, J, L, N    Total: 4    **Score:** 2

**BIOTIC STRUCTURE**

***Plant Strata – Use applicable wetland delineation regional supplement and data from determination data form(s).***

Number of plant strata: ☒ ≥ 4 ☐ 3 ☐ 2 ☐ 1 ☐ 0    **Score:** 4

***Species Richness – Use data from determination data form(s) to count species with 5% or more relative cover in a stratum.***

Number of species across all strata and determination data forms (not counting a species more than once): 5    **Score:** 2

***Non-Native/Invasive Infestation – Use data from determination data form(s). See tables in section 2.3.5.3 for examples.***

Average total relative cover of non-native/invasive species across all strata and determination data forms: 15 %    **Score:** 2

***Interspersion – Confirm in office review. Use figure in section 2.3.5.4 to determine the degree of interspersion of plant zones.***

Degree of horizontal/plan view interspersion: ☐ High ☐ Moderate ☒ Low ☐ None ☐ Bottomland hardwood forest    **Score:** 3

***Strata Overlap – Use strata defined in plant strata metric using applicable regional supplement. See figures in section 2.3.5.5.***

High overlap (≥ 3 strata overlapping): 10 % of WAA    Moderate overlap (2 strata overlapping): 15 % of WAA

Herbaceous species/dense litter overlap (only in portion where there are no other strata overlapping): 15 % of WAA

Total percentage of WAA with some form of overlap (if more than one present): 40 % of WAA    **Score:** 2

***Herbaceous Cover – Estimate for entire WAA.*** In South Central Plains or East Central Texas Plains: ☐ Bottomland hardwood forest

Total cover of emergent and submergent plants: ☐ > 75% ☐ 51–75% ☒ 26–50% ☐ ≤ 25%    **Score:** 2

***Vegetation Alterations – Unnatural (human-caused) stressors. Confirm in office review for past.***

Type (Check those applicable and circle R for recent or P for past): ☐ Disking R/P ☐ Mowing/shredding R/P ☐ Logging R/P

☐ Cutting R/P ☐ Trampling R/P ☐ Herbicide treatment R/P ☐ Herbivory R/P ☐ Disease R/P ☐ Chemical spill R/P

☐ Pollution R/P ☒ Feral hog rooting R/P ☐ Woody debris removal R/P ☒ Other R/P: Clearing for Mining

Percent of WAA with recent vegetation alteration: 10 %    Severity of alteration: ☐ High ☒ Low

Percent of WAA with past vegetation alteration: 100 %    Degree of recovery: ☐ Complete ☒ High ☐ Moderate ☐ Low

☐ Alteration to improve wetland (degree of natural community recovery): ____    **Score:** 3

Version 2.0 – Final

# TXRAM WETLAND FINAL SCORING SHEET

Project/Site Name/No.: Northeast Landfill  Project Type: [x] Fill/Impact ([ ] Linear [x] Non-linear) [ ] Mitigation/Conservation

Wetland ID/Name: B  WAA No.: 2  Size: 0.16 Acres  Date: 4-15-2020  Evaluator(s): CRK, DTM

Wetland Type: Riverine, PSS  Ecoregion: N/A  Delineation Performed: [ ] Previously [x] Currently

Aerial Photo Date and Source: 2018 (BING), 2017 (NAIP)  Site Photos: March 17, 2020  Representative: [x] Yes [ ] No

Notes: Permanent Scrub-Shrub Wetland Impact

| ***Core Element*** | ***Metric*** | ***Metric Score*** | ***Core Element Score Calculation*** | ***Core Element Score*** |
|---|---|---|---|---|
| Landscape | Aquatic Context | 2 | Sum of metric scores / 8 x 15 | 5.9 |
| | Buffer | 1.15 | | |
| Hydrology | Water source | 3 | Sum of metric scores / 12 x 30 | 12.5 |
| | Hydroperiod | 1 | | |
| | Hydrologic flow | 1 | | |
| Soils | Organic matter | 1 | Sum of metric scores / 12 x 15 | 6.3 |
| | Sedimentation | 2 | | |
| | Soil modification | 2 | | |
| Physical Structure | Topographic complexity | 3 | Sum of metric scores / 12 x 20 | 11.7 |
| | Edge complexity | 2 | | |
| | Physical habitat richness | 2 | | |
| Biotic Structure | Plant strata | 4 | Sum of metric scores / 28 x 20 | 12.9 |
| | Species richness | 2 | | |
| | Non-native/invasive infestation | 2 | | |
| | Interspersion | 3 | | |
| | Strata overlap | 2 | | |
| | Herbaceous cover | 2 | | |
| | Vegetation alterations | 3 | | |
| | | | | |
| Sum of core element scores = overall TXRAM wetland score | | | | 49.3 |
| Additional points for unique resources = overall TXRAM wetland score x 0.10 if:<br>[ ] Area of Caddo Lake designated a "Wetland of International Importance" under the Ramsar Convention<br>[ ] Bald cypress – water tupelo swamp<br>[ ] Pitcher plant bog<br>[ ] Spring | | | | Not Applicable |
| Additional points for limited habitats = overall TXRAM wetland score x 0.05 if:<br>[ ] Dominated by native trees greater than 24-inch diameter at breast height<br>[ ] Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata | | | | Not Applicable |
| Sum of overall TXRAM wetland score and additional points = **total overall TXRAM wetland score** | | | | **48.5** |

***Representative Site Photograph:***


Scrub-shrub Wetland B looking west.

Scrub-shrub Wetland B looking north.

# TXRAM WETLAND DATA SHEET

Project/Site Name/No.: Northeast Landfill  Project Type: ☒ Fill/Impact (☐ Linear ☒ Non-linear) ☐ Mitigation/Conservation

Wetland ID/Name: B  WAA No.: 2  Size: 0.16 Acres  Date: 4-15-2020  Evaluator(s): CRK, DTM

Wetland Type: Riverine, PSS  Ecoregion: N/A  Delineation Performed: ☐ Previously ☒ Currently

Aerial Photo Date and Source: 2018 (BING), 2017 (NAIP)  Site Photos: March 17, 2020  Representative: ☒ Yes ☐ No

Notes:

## LANDSCAPE

***Aquatic Context – Confirm in office review. See figures in section 2.3.1.1 for examples.***

Notes on any barriers or alterations that prevent connection: ____

Aquatic resources within 1,000 feet of WAA to which wetland connects (including number for other considerations): 3  **Score:** 2

***Buffer – Evaluate to 500 feet from WAA boundary. Confirm in office review. See figures in section 2.3.1.2 for examples.***

| *Buffer Type/Description* | *Score (See Narratives)* | *Percentage* | *Subtotal* |
|---|---|---|---|
| 1. Forested | 2 | 50% | 1.0 |
| 2. Landfill | 0 | 35% | 0.0 |
| 3. Pasture | 1 | 15% | 0.15 |
| 4. Open Water | N/A | N/A | N/A |
| 5. | | | |

**Score:** 1.15

## HYDROLOGY

***Water Source – Degree of natural or unnatural/artificial influence. Confirm in office review for watershed.***

Natural: ☒ Precipitation ☒ Groundwater ☒ Overbank flow/stream discharge ☒ Overland flow ☐ Beaver activity ☐ Other: ____

Unnatural/Manipulated: ☐ Impoundment ☐ Outfall ☐ Irrigation/pumping ☐ Other artificial influence or control: ____

Watershed: ☒ Development ☐ Irrigated agriculture ☐ Wastewater treatment plant ☐ Impoundment ☐ Other: ____

Degree of artificial influence/control: ☐ Complete ☒ High ☐ Low ☐ None

Wetland created/restored/enhanced: ☐ Sustainable/replicates natural ☐ Controlled  **Score:** 3

***Hydroperiod – Variability and recent alteration of the duration, frequency, and magnitude of inundation/saturation.***

Evaluate the hydroperiod including natural variation: Low variability

Direct evidence of alteration: Natural: ☐ Log-jam ☐ Channel migration ☐ Other: ____

Human: ☐ Diversions ☐ Ditches ☐ Levees ☒ Impoundments ☒ Other: Berm

Riverine only: ☒ Recent channel in-stability/dis-equilibrium (☒ Degradation or ☒ Aggradation)

Indirect evidence of alteration: ☐ Wetland plant stress: ____ ☐ Plant morphology: ____

☐ Upland species encroachment: ____ ☐ Plant Community: ____ ☐ Soil: ____

Change/Alteration of hydroperiod: ☐ None ☐ Due to natural events ☒ Human influences (☐ Slight or ☒ High)

Degree hydroperiod of wetland created/restored/enhanced replicates natural patterns: ____

Lacustrine fringe on human impoundment: ☐ High variability ☐ Low variability ☐ Recent changes to hydroperiod  **Score:** 1

***Hydrologic Flow – Movement of water to or from surrounding area and openness to water moving through the WAA.***

Flow: ☒ Inlets: 1 ☐ Outlets: 1 ☐ Signs of water movement to or from WAA: Flow through site (Rainfall)

Restrictions: ☐ Levee ☒ Berm/dam ☐ Diversion ☐ Other: ____

High flowthrough: ☐ Floodplain ☐ Drift deposits ☐ Drainage patterns ☐ Sediment deposits ☐ Other: ____

Low flowthrough: ☒ High landscape position ☐ Stagnant water ☐ Closed contours ☐ Other: ____  **Score:** 1

## SOILS

***Organic Matter – Use data and indicators from wetland determination data form(s) based on applicable regional supplement.***

☐ High (organic soil or indicator A1, A2, A3)

☐ Moderate (indicator A9, S1, F1 in AW or A9, S1, S2, F1 in GP or A6, A7, A9, S7, F13 in AGCP)

☐ Low (indicated by thin organic or organic-mineral layer) ☒ None observable in surface layer as described herein  **Score:** 1

***Sedimentation – Deposition of excess sediment due to human actions. Confirm in office review for landscape.***

Landscape with stress that could lead to excess sedimentation? ■ Yes ☐ No — Landscape position: ■ High ☐ Low

Magnitude of recent runoff/flooding events: ■ High ☐ Low — Percent of WAA with excess sediment deposition: 50

■ Sand deposits: 100 % of area, 4-6 average thickness — ☐ Silt/Clay deposits: _____ % of area, _____ average thickness

Lacustrine fringe only: ☐ Upper end of impoundment ☐ Degrades wetland ☐ Contributes to wetland processes — **Score:** 2

***Soil Modification – Physical changes by human activities. Confirm in office review for past.***

Type (Check those applicable and circle R for recent or P for past): ☐ Farming R/P ☐ Logging R/P ■ Mining R/P ■ Filling R/P ☐ Grading R/P ☐ Dredging R/P ☐ Off-road vehicles R/P ☐ Other R/P: _____

Percent of WAA with recent soil modification: 0 % — Degree of modification: ☐ High ☐ Low

Indicators of past modification: ☐ High bulk density ■ Low organic matter ☐ Lack of soil structure ☐ Lack of horizons ☐ Hardpan ☐ Dramatic change in texture/color ☐ Heterogeneous mixture ☐ Other: _____

Indicators of recovery: ☐ Organic matter ☐ Structure ■ Horizons ☐ Mottling ■ Hydric soil ☐ Other: _____

Percent of WAA with past modification: 100 % — Recovery: ☐ Complete ☐ High ■ Moderate ☐ Low ☐ None — **Score:** 2

**PHYSICAL STRUCTURE**

***Topographic Complexity – See figures in section 2.3.4.1. Record % micro-topography and % WAA for each elevation gradient.***

Elevation gradients (EG): 2 — Evidence: ■ Plant assemblages ■ Level of saturation/inundation ☐ Path of water flow ■ Slope

Micro-topography: 15 % of WAA (By EG: EG1: 10%; EG2: 5%)

Types: ☐ Depressions ☐ Pools ☐ Burrows ☐ Swales ☐ Wind-thrown tree holes ■ Mounds ☐ Gilgai ☐ Islands ☐ Variable shorelines ☐ Partially buried debris ■ Debris jams ☐ Plant hummocks/roots ☐ Other: _____ — **Score:** 3

***Edge Complexity – Confirm in office review. See figure in section 2.3.4.2 to evaluate wetland boundary.***

WAA: ☐ In seasonal floodplain ☐ Contiguous to other wetland — ■ Edge vertical structure variation: 50

Horizontal variability: ☐ High ■ Moderate ☐ Low ☐ None — **Score:** 2

***Physical Habitat Richness – See definitions and table in section 2.3.4.3 for habitat types applicable to each wetland type.***

Label of habitat types qualifying as present in WAA: A, J, L, N — Total: 4 — **Score:** 2

**BIOTIC STRUCTURE**

***Plant Strata – Use applicable wetland delineation regional supplement and data from determination data form(s).***

Number of plant strata: ■ ≥ 4 ☐ 3 ☐ 2 ☐ 1 ☐ 0 — **Score:** 4

***Species Richness – Use data from determination data form(s) to count species with 5% or more relative cover in a stratum.***

Number of species across all strata and determination data forms (not counting a species more than once): 5 — **Score:** 2

***Non-Native/Invasive Infestation – Use data from determination data form(s). See tables in section 2.3.5.3 for examples.***

Average total relative cover of non-native/invasive species across all strata and determination data forms: 15 % — **Score:** 2

***Interspersion – Confirm in office review. Use figure in section 2.3.5.4 to determine the degree of interspersion of plant zones.***

Degree of horizontal/plan view interspersion: ☐ High ☐ Moderate ■ Low ☐ None ☐ Bottomland hardwood forest — **Score:** 3

***Strata Overlap – Use strata defined in plant strata metric using applicable regional supplement. See figures in section 2.3.5.5.***

High overlap (≥ 3 strata overlapping): 10 % of WAA — Moderate overlap (2 strata overlapping): 15 % of WAA

Herbaceous species/dense litter overlap (only in portion where there are no other strata overlapping): 15 % of WAA

Total percentage of WAA with some form of overlap (if more than one present): 40 % of WAA — **Score:** 2

***Herbaceous Cover – Estimate for entire WAA.*** In South Central Plains or East Central Texas Plains: ☐ Bottomland hardwood forest

Total cover of emergent and submergent plants: ☐ > 75% ☐ 51–75% ■ 26–50% ☐ ≤ 25% — **Score:** 2

***Vegetation Alterations – Unnatural (human-caused) stressors. Confirm in office review for past.***

Type (Check those applicable and circle R for recent or P for past): ☐ Disking R/P ☐ Mowing/shredding R/P ☐ Logging R/P ☐ Cutting R/P ☐ Trampling R/P ☐ Herbicide treatment R/P ☐ Herbivory R/P ☐ Disease R/P ☐ Chemical spill R/P ☐ Pollution R/P ■ Feral hog rooting R/P ☐ Woody debris removal R/P ■ Other R/P: Clearing for Mining

Percent of WAA with recent vegetation alteration: 10 % — Severity of alteration: ☐ High ■ Low

Percent of WAA with past vegetation alteration: 100 % — Degree of recovery: ☐ Complete ■ High ☐ Moderate ☐ Low

☐ Alteration to improve wetland (degree of natural community recovery): _____ — **Score:** 3

# TXRAM STREAM DATA SHEET

Project/Site Name/No.: Northeast Landfill  Project Type: ☒ Fill/Impact (☐ Linear ☒ Non-linear) ☐ Mitigation/Conservation

Stream ID/Name: Stream 2  SAR No.: 3  Size (LF): 746  Date: 3-18-2020  Evaluator(s): CRK, DTM

Stream Type: Intermittent  Ecoregion: N/A  Delineation Performed: ☐ Previously ☒ Currently

8-Digit HUC: 11100302  Watershed Condition (developed, pasture, etc.): Developed  Watershed Size: Approx. 150 ac

Aerial Photo Date and Source: 2017 NAIP; 2018 BING  Site Photos: Attached  Representative: ☒ Yes ☐ No

Stressor(s): Landfill  Are normal climatic/hydrologic conditions present? ☐ Yes ☒ No (If no, explain in Notes)

**Stream Characteristics**

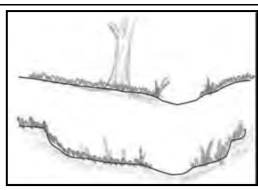
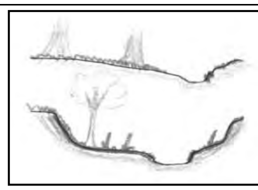
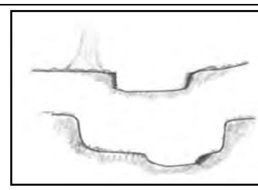
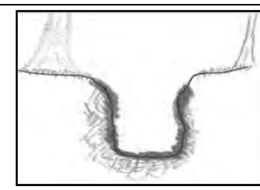
| *Stream Width (Feet)* (Bank to Bank Distance Used for Buffer Calculation) | *Stream Height/Depth (Feet)* |
|---|---|
| Avg. Bank to Bank 8 | Avg. Banks: 3.2 |
| Avg. Waters Edge: 2.8 | Avg. Water: 1.2 |
| Avg. OHWM: 2.8 | Avg. OHWM: 1.2 |

Notes: *Approximately 1.67 inches of precipitation during site visit. Parameters directly effected by this have had scores adjusted accordingly.

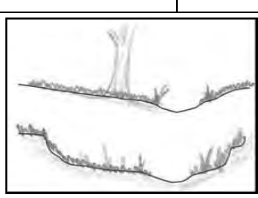
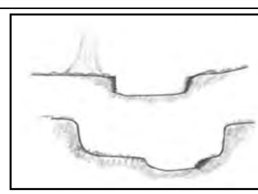
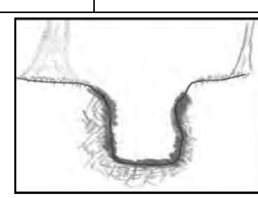
**CHANNEL CONDITION**

***Floodplain Connectivity***

**Perennial / Intermittent**

|  |  |  |  |  |
|---|---|---|---|---|
| 6 / 5 | 4 | 3 | 2 | 1 |
| Very little incision and access to the original floodplain or fully developed wide bankfull benches scores a "5" for this metric. ☐ Very little incision and access to the original floodplain with significant floodplain connection indications (i.e., riverine wetlands) score a "6" for this metric. ☐ | Slight incision and likely having regular (i.e., at least once a year) access to bankfull benches or newly developed floodplains along majority of the reach. ☐ | Moderate incision and presence of near vertical/ undercut banks; irregular (i.e., greater than 2 year return interval) access to floodplain or possible access to floodplain or bankfull benches at isolated areas. ☐ | Overwidened or incised channel and likely to widen further; majority of both banks near vertical/undercut; unlikely/rarely having access to floodplain or bankfull benches. ☐ | Deeply incised channel or channelized flow; severe incision with flow contained within the banks; majority of banks vertical/undercut. ☑ |

**Ephemeral**

|  |  |  |
|---|---|---|
| 3 | 2 | 1 |
| Slight incision and unlikely/rarely having access to floodplain or bankfull benches. ☐ | Moderate incision and no access to floodplain. ☐ | Deeply incised channel or channelized flow; majority of banks vertical/undercut. ☐ |

**Score:** 1

***Bank Condition***

Left Bank Active Erosion: 70 % Right Bank Active Erosion: 50 % Average: 60

Bank Protection/Stabilization: ☐ Natural ☐ Artificial: ______

**Score:** 1

***Sediment Deposition***

☐ Less than 10% of the bottom covered by excessive sediment deposition; bars with established vegetation (5)

☐ 10–20% of the bottom covered by excessive sediment deposition; few established bars with indicators of recently deposited sediments (4)

☐ 20–30% of the bottom covered by excessive sediment deposition; some deposition on old bars and creating new bars; some sediment deposits at in-stream structures; OR obstructed view of the channel bottom and a lack of other depositional features (3)

☒ 30–50% of the bottom covered by excessive sediment deposition; some newly created bars; moderate sediment deposits at in-stream structures (2)

☐ Greater than 50% of the bottom covered by excessive sediment deposition resulting in aggrading channel (1)

**Score:** 2

**RIPARIAN BUFFER CONDITION**

***Riparian Buffer - See Table 26 to determine appropriate buffer distance. Confirm in office review.***

***Identify each buffer type and score using the primary or secondary buffer method of evaluation (see sections 3.3.2.1.2 and 3.3.2.1.4).***

**Left Bank**

| *Primary Buffer Type* | *Canopy Cover* | *Vegetation Community* | *Land Use* | *Score* | *Percentage of Area* | *Subtotal* |
|---|---|---|---|---|---|---|
| 1. Forested Upland | 40 | Native/Undesirable | Moderate | 2 | 95 | 1.90 |
| 2. Scrub-Shrub Wetland | 20 | Native/Undesirable | Moderate | 1 | 5 | 0.05 |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

**Left Bank Primary Buffer Subtotal: 1.95 X 0.7 = Left Bank Primary Buffer Total 1.37**

| *Secondary Buffer Type* | *Canopy Cover* | *Land Use* | *Score* | *Percentage of Area* | *Subtotal* |
|---|---|---|---|---|---|
| 1. Forested Upland | 40 | Moderate | 3 | 90 | 2.70 |
| 2. Scrub-Shrub Wetland | 15 | Moderate | 2 | 10 | 0.20 |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |

**Left Bank Secondary Buffer Subtotal: 2.90 X 0.3 = Left Bank Secondary Buffet Total 0.87**

**Left Bank Primary Buffer Total + Left Bank Secondary Buffer Total = Composite Buffer Left Bank Metric Score 2.24**

**Right Bank**

| *Primary Buffer Type* | *Canopy Cover* | *Vegetation Community* | *Land Use* | *Score* | *Percentage of Area* | *Subtotal* |
|---|---|---|---|---|---|---|
| 1. Forested Upland | 35 | Native/Undesirable | Moderate | 2 | 90 | 1.80 |
| 2. Scrub-Shrub Wetland | 20 | Native/Undesirable | Moderate | 1 | 10 | 0.10 |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

**Right Bank Primary Buffer Subtotal: 1.90 X 0.7 = Right Bank Primary Buffer Total 1.33**

| *Secondary Buffer Type* | *Canopy Cover* | *Land Use* | *Score* | *Percentage of Area* | *Subtotal* |
|---|---|---|---|---|---|
| 1. Forested Upland | 50 | Moderate | 3 | 90 | 2.70 |
| 2. Scrub-Shrub Wetland | 25 | Moderate | 2 | 5 | 0.10 |
| 3. Landfill | 0 | Complete | 0 | 5 | 0 |
| 4. | | | | | |
| 5. | | | | | |

**Right Bank Secondary Buffer Subtotal: 2.80 X 0.3 = Right Bank Secondary Buffer Total 0.84**

**Right Bank Primary Buffer Total + Right Bank Secondary Buffer Total = Composite Buffer Right Bank Metric Score 2.17**

## IN-STREAM CONDITION

***Substrate Composition (estimate percentages)***

| | | | | |
|---|---|---|---|---|
| Boulder: | Gravel: | Fines (silt, clay, muck): | Artificial: | Large Woody Debris/Leaf Packs: |
| Cobble: | Sand: | Bedrock (smooth): | Bedrock (fractured): | |

**Default score due to excessive suspended sediment** ☒ **Default score due to depth** ☐ **Score:** 1

***In-stream Habitat (check all habitat types that are present and check box for appropriate percent cover at each transect)***

| ***Habitat Types by Presence and Cover*** | *T1* | *T2* | *T3* | *T4* | *T5* | *T6* | *T7* | *T8* | *T9* | *T10* | *T11* | *T12* | *T13* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Undercut Banks | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | |
| Overhanging Vegetation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | |
| Rootmats | | | | | | | | | | | | | |
| Rootwads | | | | | | | | | | | | | |
| Woody Debris/Leaf Packs | ✓ | ✓ | | | ✓ | ✓ | ✓ | | | | | | |
| Boulders/Cobbles | ✓ | | | | | | | | | | | | |
| Aquatic Macrophytes | | | | | | | | | | | | | |
| Bedrock with Interstitial Space | | | ✓ | ✓ | | | | | | | | | |
| Artificial Habitat Enhancement | | | | | | | | | | | | | |
| Other: | | | | | | | | | | | | | |
| ***Number Present*** | 4 | 3 | 3 | 3 | 3 | 3 | 3 | | | | | | |
| ***Percent Cover in Streams OHWM Width ≤ 15'*** | *T1* | *T2* | *T3* | *T4* | *T5* | *T6* | *T7* | *T8* | *T9* | *T10* | *T11* | *T12* | *T13* |
| Transect has 0% cover (0) | | | | | | | | | | | | | |
| Transect has 1-5% cover (1) | | | ✓ | ✓ | | ✓ | ✓ | | | | | | |
| Transect has 6-29% cover (2) | ✓ | ✓ | | | ✓ | | | | | | | | |
| Transect has 30-50% cover (3) | | | | | | | | | | | | | |
| Transect has > 50% cover (4) | | | | | | | | | | | | | |
| ***Percent Cover Score*** | 2 | 2 | 1 | 1 | 2 | 1 | 1 | | | | | | |
| ***Percent Cover in Streams OHWM Width > than 15'*** | *T1* | *T2* | *T3* | *T4* | *T5* | *T6* | *T7* | *T8* | *T9* | *T10* | *T11* | *T12* | *T13* |
| Transect has 0% cover (0) | | | | | | | | | | | | | |
| Transect has 1-5% cover (1) | | | | | | | | | | | | | |
| Transect has 6-14% cover (2) | | | | | | | | | | | | | |
| Transect has 15-30% cover (3) | | | | | | | | | | | | | |
| Transect has > 30% cover (4) | | | | | | | | | | | | | |
| ***Percent Cover Score*** | | | | | | | | | | | | | |
| ***Habitat Types by Presence*** | *T1* | *T2* | *T3* | *T4* | *T5* | *T6* | *T7* | *T8* | *T9* | *T10* | *T11* | *T12* | *T13* |
| Riffle/Pool Sequence | | | | | | | | | | | | | |
| Canopy Cover 70% or Greater | | | | | | | | | | | | | |
| Natural Step-pools | | | | | | | | | | | | | |
| ***Number Present*** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| **Total Score** | 6 | 5 | 4 | 4 | 5 | 4 | 4 | | | | | | |

Average: 4.6 **Score:** 3

## HYDROLOGIC CONDITION

***Flow Regime***

☐ Noticeable surface flow present (4)
☐ Continual pool of water but lacking noticeable flow (3)
☒ Isolated pools and interstitial (subsurface) flow (2)
☐ Isolated pools and no evidence of surface or interstitial flow (1)
☐ Dry channel and no observable pools or interstitial flow (0)
Artificial / altered water source ☐ No ☐ Yes: ________________

**Score:** 2*

***Channel Flow Status***

☐ Water covering greater than 75% of the channel bottom width; less than 25% of channel substrate is exposed (4)
☐ Water covering 50–75% of the channel bottom width; 25–50% of channel substrate is exposed (3)
☒ Water covering 25–50% of the channel bottom width; 50–75% of channel substrate is exposed (2)
☐ Water present but covering less than 25% of the channel bottom width; greater than 75% of channel substrate is exposed (1)
☐ No water present in the channel; 100% of channel substrate exposed (0)

**Score:** 2*

*Version 2.0 - Final*

## TXRAM STREAM FINAL SCORING SHEET

Project/Site Name/No.: Northeast Landfill Project Type: ☑ Fill/Impact (☐ Linear ☑ Non-linear) ☐ Mitigation/Conservation

Stream ID/Name: Stream 2 SAR No.: 3 Size (LF): 746 Date: 3-18-2020 Evaluator(s): CRK, DTM

Stream Type: Intermittent Ecoregion: N/A Delineation Performed: ☐ Previously ☑ Currently

8-Digit HUC: 11100302 Watershed Condition (developed, pasture, etc.): Developed Watershed Size: Approx. 150 ac

Aerial Photo Date and Source: 2017 NAIP; 2018 BING Site Photos: Attached Representative: ☑ Yes ☐ No

Stressor(s): Landfill Are normal climatic/hydrologic conditions present? ☐ Yes ☑ No (If no, explain in Notes)

Notes: *Approximately 1.67 inches of precipitation during site visit. Parameters directly effected by this have had scores adjusted accordingly.

**Stream Characteristics**

| *Stream Width (Feet)* (Bank to Bank Distance Used for Buffer Calculation) | *Stream Height/Depth (Feet)* |
|---|---|
| Avg. Bank to Bank: 8 | Avg. Banks: 3.2 |
| Avg. Waters Edge: 2.8 | Avg. Water: 1.2 |
| Avg. OHWM: 2.8 | Avg. OHWM: 1.2 |

**Scoring Table**

| *Core Element* | *Metric* | *Metric Score* | *Core Element Score Calculation* | *Core Element Score* |
|---|---|---|---|---|
| Channel condition | Floodplain connectivity | 1 | Sum of metric scores / 15 x 30 | 8.0 |
| | Bank condition | 1 | | |
| | Sediment deposition | 2 | | |
| Buffer condition | Composite buffer (left bank) | 2.24 | Sum of bank scores / 10 x 20 | 8.8 |
| | Composite buffer (right bank) | 2.17 | | |
| In-stream condition | Substrate composition | 1 | Sum of metric scores / 10 x 25 | 10.0 |
| | In-stream habitat | 3 | | |
| Hydrologic condition | Flow regime | 3 | Sum of metric scores / 8 x 25 | 12.5 |
| | Channel flow status | 2 | | |
| | | | | |
| Sum of core element scores = overall TXRAM stream score | | | | 39.3 |
| Additional points for limited habitats = overall TXRAM stream score x 0.025 for each bank (right/left) if:<br>L R<br>☐ ☐ Dominated by native trees greater than 24-inch diameter at breast height<br>☐ ☐ Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata | | | | - |
| Sum of overall TXRAM stream score and additional points = **total overall TXRAM stream score** | | | | 39.3 |

**Representative Site Photograph:**

View looking upstream along intermittent Stream 2.

View looking downstream along intermittent Stream 2.

# ATTACHMENT G

# LIMITATIONS

## LIMITATIONS

The work conducted by **Hydrex Environmental** and described in this report was performed in accordance with generally accepted scientific principles and practices, observing the same degree of care and skill generally exercised by the profession under similar circumstances and conditions. The opinions expressed in the report, together with the observations and findings are based on our professional judgment of the data developed and gathered during the course of this investigation and upon conditions that existed at the time of the specified field activities. Some of the information provided in this report may have been derived from a variety of published sources. It is not the intent or purpose of **Hydrex Environmental** to validate the precision of data generated by other parties.

The investigation is considered sufficient in detail and scope to form a reasonable basis for the conclusions presented in this report. Due to the nature of such investigations, interpretations and conclusions must be based on limited site data.

**Hydrex Environmental** is not responsible for the conclusions, opinions, or recommendations made by others based on the contents of this report. No other warranty, expressed or implied, is made in regard to the work performed by **Hydrex Environmental** during the course of this investigation.

# ATTACHMENT H

# QUALIFICATIONS

# Daniel Morgan
# Environmental Scientist

DISCIPLINE: Environmental Science

EDUCATION:

Henderson State University
Arkadelphia, AR
B.S. Biology, Philosophy Minor

Stephen F. Austin State University
Nacogdoches, TX
M.S., Environmental Science, Geographic Information Systems Minor

CERTIFICATIONS AND CONTINUING EDUCATION:

- Federal Aviation Administration (FAA), Certified Small Unmanned Aircraft System (sUAS) Remote Pilot
- Wetlands Plant Identification Course with Dr. Charles Allen
- Hydrex Mussel Survey Methodology and Identification Training

PROFESSIONAL EXPERIENCE:

- Wetland delineation
- Proficient in ArcGIS mapping
- Creating and analyzing maps with "ArcMap" software
- Processing and analyzing spatial data in Pix4D
- FEMA floodplain determination and development permitting

PUBLICATIONS:

- Evaluation of Groundwater Sodium and Sodium Uptake in *Taxodium* and its Hybrids on Galveston Island, Texas. 2020.

EXPERIENCE ACQUISITION:

Hydrex Environmental
Nacogdoches, Texas
Environmental Scientist

# Christina R. Keim, REM, PWS
# Biologist

DISCIPLINE: Biology

EDUCATION: Stephen F. Austin State University
Nacogdoches, Texas
B.S. Horticultural Sciences, Forestry minor

CERTIFICATIONS AND CONTINUING EDUCATION:

- National Registry of Environmental Professionals (NREP), Registered Environmental Manager (REM), No. 172290
- Society of Wetland Scientists (SWS), Professional Wetland Scientist (PWS), No. 2981
- Federal Aviation Administration (FAA), Certified Small Unmanned Aircraft System (sUAS) Remote Pilot,
- No. 3922373
- Wetlands Delineation Training (USACE 1987 Manual and Regional Supplements)
- SafeLand USA Certification
- Commonground University ASTM E1527 Phase I Environmental Site Assessment (ESA) Online Course
- GIS 551 - Introduction to Geographical Information Systems and Geospatial Analysis (SFASU-GIS 551)
- Advanced Plant Identification Course with Dr. Charles Allen
- Texas Freshwater Mussel Identification Workshop with TPWD
- GeoSearch Phase I ESA Online Training
- Hydrex Mussel Survey Methodology and Identification Training

PROFESSIONAL EXPERIENCE:

Experience emphasis on wetland delineation, stream assessment, biological assessments, environmental sampling, testing, and analyzing in addition to plant physiology, taxonomy, propagation and production. Committed to thorough professional reporting of waters of the United States (WOTUS) determinations, Environmental Site Assessments (ESAs), and Storm Water Pollution Prevention Plans (SWP3).

SPECIFIC EXPERIENCE:

WATERS OF THE UNITED STATES

Knowledgeable in the determination and classification of hydric soils, hydrophytic vegetation, wetland hydrology, as well as functional assessments and jurisdictional determinations of waters of the United States Projects (WOTUS) include well pad siting and linear determinations for pipelines and roads.

ECOLOGICAL

Experienced in assessing potential impacts of the proposed action on wildlife, including rare, threatened, and endangered species. Qualified in conducting habitat assessments and advancement of projects with the United States Fish and Wildlife Service (USFWS) in accordance with Section 7 of the Endangered Species Act.

ENVIRONMENTAL

Experienced in conducting and reporting Phase I and II ESA and SWP3. Practiced in a variety of environmental sampling and analysis techniques pertaining to soil and water.

GEOPGRAPHICAL INFORMATION SYSTEM (GIS) MAPPING/DRAFTING

Experienced in computer drafting with demonstrated proficiency in AutoCAD and ArcGIS.

PROFESSIONAL SOCIETIES:

- Society of Wetland Scientists (SWS)
- National Registry of Environmental Professionals (NREP)

EXPERIENCE ACQUISITION:

Hydrex Environmental
Nacogdoches, Texas
Biologist

Soil, Plant and Water Analysis Laboratory
Nacogdoches, Texas
Laboratory Technician

Stephen F. Austin State University
SFASU Gardens Nacogdoches, Texas
Student Research Associate

# Clayton A. Collier, REM, PWS
# General Manager, Sr. Environmental Scientist

DISCIPLINE: Environmental Science

EDUCATION:

Stephen F. Austin State University
Nacogdoches, Texas
B.S. Environmental Science, Geology minor

Stephen F. Austin State University
Nacogdoches, Texas
Graduate Studies
*Aquatic Vascular Plants*
*Water Resource Management*
*Geographic Information Systems*

CERTIFICATIONS AND CONTINUING EDUCATION:

- Registered Environmental Professional (REM) No. 918302383
- Professional Wetland Scientist (PWS) No. 2389
- NEPA and Environmental Review Training (HUD)
- Wetlands Delineation Course (1987 USACE Manual)
- Wetlands Delineation Course (Regional Supplement)
- Wetlands Permitting Course (USACE)
- Wetland Plant Identification
- Rosgen's Level I Applied Fluvial Geomorphology
- Rosgen's Level II River Morphology and Application
- Rosgen's Level III River Assessment and Monitoring
- Applied Groundwater Statistics Course
- Texas Risk Reduction Program Training
- SafeLand USA Certification
- 2012-2013 Leadership Nacogdoches Program
- Certified Small Unmanned Aircraft System (sUAS) Remote Pilot
- Member of the ATCOFA Advisory Council
- Hydrex Mussel Survey Methodology and Identification Training

PROFESSIONAL EXPERIENCE:

Over fifteen years have been dedicated to a range of environmental projects for government, commercial, industrial, and private entities. During these years, experience has been gained in a wide variety of projects pertaining to environmental sampling and analysis techniques for soil, gas, and water. Attention has been paid to the development of skills in the areas of wetlands delineation, permitting and mitigation, installation of monitoring systems, environmental site assessments, and geographic information system (GIS) mapping.

SPECIFIC EXPERIENCE:

WATERS OF THE UNITED STATES

Experienced in investigations and delineations concerning waters of the U.S. in accordance with the 1987 *Wetlands Delineation Manual* and 2010 *Regional Supplements*. Expertise in streamlining United States

Corps of Engineers (USACE) permitting and performing jurisdictional determinations. Proficient in mitigation ratios as well as to aid in feasibility studies for potential mitigation banks. Management performing functional analyses of waters of the U.S. for purposes of determining compensatory of projects related to the delineation, permitting and/or mitigation of Section 404 and Section 10 waters of the U.S. includes numerous large tracts proposed for development, multiple proposed mitigation banks, over 300 miles of linear projects (utility lines, roads, etc.) and over 200 multi-acre oil/gas facilities (well pads, comp, stations, frac pits, etc.).

ECOLOGICAL

Skilled in performing habitat surveys for rare, threatened, and endangered species and identifying the potential to affect their critical habitat. Qualified in advancing the project through consultation with the United States Fish and Wildlife Service (USFWS) in accordance with Section 7 of the Endangered Species Act.

ENVIRONMENTAL

Qualified in conducting Phase I Environmental Site Assessments (ESA), which are an integral part to many private, commercial, and industrial real estate transactions. Experienced in a variety of environmental sampling and analysis techniques along with the application and utilization of numerous sampling and monitoring devices. Accomplished in the sampling of groundwater monitor wells at solid waste facilities using both manual and low-flow purge techniques. Skilled in soil gas monitoring and sampling by way of the Summa canister method.

GIS MAPPING/DRAFTING

Qualified in GIS mapping and computer drafting with demonstrated proficiency in AutoCAD, AutoSketch, and various ESRI ArcGIS applications including ArcView and ArcPad. Accomplished in global positioning system (GPS) data collection and in the integration of collected data with ESRI Spatial Analyst and 3D Analyst mapping software.

GROUNDWATER

Accomplished in the installation, sampling, monitoring, statistical analysis, and reporting of groundwater monitoring systems.

## PROFESSIONAL SOCIETIES:

- Society of Wetland Scientists
- National Registry of Environmental Professionals (NREP)
- Texas Association of Environmental Professionals
- 2012-2015 Nacogdoches County Chamber of Commerce Board of Directors
- 2016-2017 City of Nacogdoches Parks Master Plan Steering Committee

## EXPERIENCE ACQUISITION:

Hydrex Environmental
Nacogdoches, Texas
Senior Environmental Scientist

# Mitigation Plan

Hydrex
ENVIRONMENTAL

August 17, 2021

U.S. Army Corps of Engineers
Tulsa District
CESWT-RO
2488 R. 81st Street
Tulsa, OK 74137-4290

**RE: COMPENSATORY MITIGATION PLAN**
**Northeast Landfill**
**163.3-Acre Property, Including 73.2-Acre Landfill Expansion**
**2601 North Midwest Blvd.**
**Spencer (Oklahoma County), Oklahoma**
**USACE Project No. SWT-2020-00344**

Hydrex Environmental (Hydrex) has been contracted by N.E. Landfill, LLC to coordinate with the U.S. Army Corps of Engineers concerning the expansion of the Northeast Landfill 163.3-acre landfill expansion area ("Project Area"). This 163.3-acre Project Area consists of an existing 90.1-acre construction and demolition (C&D) landfill permitted under Oklahama Department of Environmental Quality (ODEQ) Permit No. 3555050 and a proposed 73.2-acre lateral expansion area. The proposed plans involve a horizontal and vertical expansion of the landfill, which will be used for municipal solid waste disposal. This mitigation plan addresses compensatory mitigation requirements at the above-referenced project site to satisfy the requirements of the requested Individual Permit.

Based on the conclusions of the *Jurisdictional Determination* letter dated December 11, 2020 by the U.S. Army Corps of Engineers Tulsa District, proposed permanent impacts to waters of the U.S. amount to 0.56 acres of scrub-shrub wetlands, 0.68 acres of open waters, and 746 linear feet (0.05 acres) of intermittent stream. Based on proposed impacts to WOTUS this project will require compensatory mitigation. Therefore, N.E. Landfill, LLC proposes to purchase stream and wetland credits from the Deep Fork Mitigation Bank (DFMB) in order to offset unavoidable, permanent impacts from the proposed landfill expansion. The Northeast Landfill Expansion is located within the primary service area of the DFMB.

The DFMB does not utilize any particular functional assessment method for wetlands, therefore the Texas Rapid Assessment Method (TXRAM) 2.0 was conducted by Hydrex to evaluate wetland quality. In addition, the Oklahoma Stream Mitigation Method (OSMM) was published on June 16, 2021, and was recently implemented by the DFMB. Therefore the OSMM was performed for impacts to Stream 2. Utilizing TXRAM and the OSMM, Hydrex determined potential mitigation requirements for permanent impacts to the 0.56 acres of scrub-shrub Wetlands A and B, 0.68 acres of Open Water 5, and 746 linear feet (0.05 acres) of Stream 2 within the project site.

According to the TXRAM wetland functional assessment, Wetland A (0.40 acres) scored 44.5 out of a possible 115, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 4:1 for medium quality wetlands, therefore Wetland A will require the purchase of 1.6 wetland credits. Wetland B (0.16 acres) scored 44.6 out of a possible 115, which can be considered medium quality. DFMB utilizes a compensatory mitigation ratio of 4:1 for medium quality wetlands, therefore Wetland B will require the purchase of 0.64 wetland credits. Open Water 5 did not require a functional assessment, as DFMB utilizes the 3:1 ratio for low quality wetlands for open water features. Applying the 3:1 ratio for low quality wetlands, Open Water 5 will require the purchase of 2.04 wetland credits. Based on these scores, Northeast L.F., LLC will be required to purchase 4.28 wetland credits for impacts at the Northeast Landfill Expansion.

The OSMM was performed to provide the compensatory mitigation requirements for Stream 2. The OSMM involves the evaluation of following criteria: Stream Type Impacted, Priority Waters, Existing Condition, Impact Duration, Impact Activity, and Linear Impact Magnitude. These factors are evaluated to generate the Sum of Factors which is applied to the linear feet of stream impact to determined the required credits. Stream 2 is an intermittent stream that was determined to be neither a Secondary or Priority Water. The existing condition of Stream 2 was determined to be Severely Impaired primarily due to the extensive history of mining activities dating back to the 1950s. In addition, Stream 2 was part of a large impoundment until sometime prior to 1996 and has also been affected due to the adjacent landfill activities to the south. Stream 2 is also downgradient of a culvert and road crossing of North Midwest Boulevard. Proposed impacts to Stream 2 will consist of Permanent impacts via Fill for the entirety of Stream 2 (746 linear feet). Therefore, the OSMM determined the impacts to Stream 2 would require 2,666.1 stream credits.

In conclusion, the total required credits will be 4.28 wetland credits and 2,666.1 stream credits for the proposed landfill expansion. As of August 2021, the DFMB is working to determine the number of credits generated through the OSMM. The TXRAM functional assessment datasheets and final scoring sheets and the OSMM Adverse Impacts Factors Worksheet are attached.

If you have any questions regarding this plan, or if further clarification is necessary, please feel free to contact me at ccollier@hydrex-inc.com or (936) 568-9451.

Sincerely,

**Hydrex Environmental**

Clayton A. Collier, REM, PWS
Senior Environmental Scientist

## Attachments

**Scrub-Shrub Wetland A TXRAM 2.0 Final Scoring and Datasheets**

**Scrub-Shrub Wetland B TXRAM 2.0 Final Scoring and Datasheets**

**Oklahoma Stream Mitigation Method Adverse Impact Factors Worksheet**

# TXRAM WETLAND FINAL SCORING SHEET

Project/Site Name/No.: Northeast Landfill  Project Type: ☒ Fill/Impact (☐ Linear ☒ Non-linear) ☐ Mitigation/Conservation

Wetland ID/Name: A  WAA No.: 1  Size: 0.4 Acres  Date: 4-15-2020  Evaluator(s): CRK, DTM

Wetland Type: Riverine, PSS  Ecoregion: N/A  Delineation Performed: ☐ Previously ☒ Currently

Aerial Photo Date and Source: 2018 (BING), 2017 (NAIP)  Site Photos: March 17, 2020  Representative: ☒ Yes ☐ No

Notes: Permanent Scrub-Shrub Wetland Impact

| *Core Element* | *Metric* | *Metric Score* | *Core Element Score Calculation* | *Core Element Score* |
|---|---|---|---|---|
| Landscape | Aquatic Context | 2 | Sum of metric scores / 8 x 15 | 5.8 |
| | Buffer | 1.1 | | |
| Hydrology | Water source | 2 | Sum of metric scores / 12 x 30 | 10 |
| | Hydroperiod | 1 | | |
| | Hydrologic flow | 1 | | |
| Soils | Organic matter | 1 | Sum of metric scores / 12 x 15 | 6.3 |
| | Sedimentation | 2 | | |
| | Soil modification | 2 | | |
| Physical Structure | Topographic complexity | 3 | Sum of metric scores / 12 x 20 | 11.7 |
| | Edge complexity | 2 | | |
| | Physical habitat richness | 2 | | |
| Biotic Structure | Plant strata | 2 | Sum of metric scores / 28 x 20 | 10.7 |
| | Species richness | 2 | | |
| | Non-native/invasive infestation | 2 | | |
| | Interspersion | 3 | | |
| | Strata overlap | 2 | | |
| | Herbaceous cover | 2 | | |
| | Vegetation alterations | 2 | | |
| | | | | |
| Sum of core element scores = overall TXRAM wetland score | | | | 44.5 |
| Additional points for unique resources = overall TXRAM wetland score x 0.10 if:<br>☐ Area of Caddo Lake designated a "Wetland of International Importance" under the Ramsar Convention<br>☐ Bald cypress – water tupelo swamp<br>☐ Pitcher plant bog<br>☐ Spring | | | | Not Applicable |
| Additional points for limited habitats = overall TXRAM wetland score x 0.05 if:<br>☐ Dominated by native trees greater than 24-inch diameter at breast height<br>☐ Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata | | | | Not Applicable |
| Sum of overall TXRAM wetland score and additional points = **total overall TXRAM wetland score** | | | | **44.5** |

***Representative Site Photograph:***

Scrub-shrub Wetland A looking west.

Scrub-shrub Wetland A looking southeast.

# TXRAM WETLAND DATA SHEET

Project/Site Name/No.: Northeast Landfill Project Type: ■ Fill/Impact (☐ Linear ■ Non-linear) ☐ Mitigation/Conservation

Wetland ID/Name: A WAA No.: 1 Size: 0.4 Acres Date: 4-15-2020 Evaluator(s): CRK, DTM

Wetland Type: Riverine, PSS Ecoregion: N/A Delineation Performed: ☐ Previously ■ Currently

Aerial Photo Date and Source: 2018 (BING), 2017 (NAIP) Site Photos: March 17, 2020 Representative: ■ Yes ☐ No

Notes:

## LANDSCAPE

***Aquatic Context – Confirm in office review. See figures in section 2.3.1.1 for examples.***

Notes on any barriers or alterations that prevent connection: ______

Aquatic resources within 1,000 feet of WAA to which wetland connects (including number for other considerations): 3 **Score:** 2

***Buffer – Evaluate to 500 feet from WAA boundary. Confirm in office review. See figures in section 2.3.1.2 for examples.***

| *Buffer Type/Description* | *Score (See Narratives)* | *Percentage* | *Subtotal* |
|---|---|---|---|
| 1. Forested | 2 | 45% | 0.9 |
| 2. Landfill | 0 | 40% | 0.0 |
| 3. Pasture | 1 | 15% | 0.15 |
| 4. Open Water | N/A | N/A | N/A |
| 5. | | | |

**Score:** 1.1

## HYDROLOGY

***Water Source – Degree of natural or unnatural/artificial influence. Confirm in office review for watershed.***

Natural: ■ Precipitation ■ Groundwater ■ Overbank flow/stream discharge ■ Overland flow ■ Beaver activity ☐ Other: ______

Unnatural/Manipulated: ☐ Impoundment ☐ Outfall ☐ Irrigation/pumping ☐ Other artificial influence or control: ______

Watershed: ■ Development ☐ Irrigated agriculture ☐ Wastewater treatment plant ☐ Impoundment ☐ Other: ______

Degree of artificial influence/control: ☐ Complete ■ High ☐ Low ☐ None

Wetland created/restored/enhanced: ☐ Sustainable/replicates natural ☐ Controlled **Score:** 2

***Hydroperiod – Variability and recent alteration of the duration, frequency, and magnitude of inundation/saturation.***

Evaluate the hydroperiod including natural variation: Low variability

Direct evidence of alteration: Natural: ☐ Log-jam ☐ Channel migration ☐ Other: ______

Human: ☐ Diversions ☐ Ditches ☐ Levees ■ Impoundments ■ Other: Berm, Beaver Activity, Clearing for Mining

Riverine only: ■ Recent channel in-stability/dis-equilibrium (■ Degradation or ■ Aggradation)

Indirect evidence of alteration: ☐ Wetland plant stress: ______ ☐ Plant morphology: ______

☐ Upland species encroachment: ______ ☐ Plant Community: ______ ☐ Soil: ______

Change/Alteration of hydroperiod: ☐ None ☐ Due to natural events ■ Human influences (☐ Slight or ■ High)

Degree hydroperiod of wetland created/restored/enhanced replicates natural patterns: ______

Lacustrine fringe on human impoundment: ☐ High variability ☐ Low variability ☐ Recent changes to hydroperiod **Score:** 1

***Hydrologic Flow – Movement of water to or from surrounding area and openness to water moving through the WAA.***

Flow: ■ Inlets: 1 ☐ Outlets: 1 ☐ Signs of water movement to or from WAA: Flow through site (Rainfall)

Restrictions: ☐ Levee ■ Berm/dam ☐ Diversion ■ Other: Beaver activity

High flowthrough: ☐ Floodplain ☐ Drift deposits ☐ Drainage patterns ☐ Sediment deposits ☐ Other: ______

Low flowthrough: ■ High landscape position ☐ Stagnant water ☐ Closed contours ☐ Other: ______ **Score:** 1

## SOILS

***Organic Matter – Use data and indicators from wetland determination data form(s) based on applicable regional supplement.***

☐ High (organic soil or indicator A1, A2, A3)

☐ Moderate (indicator A9, S1, F1 in AW or A9, S1, S2, F1 in GP or A6, A7, A9, S7, F13 in AGCP)

☐ Low (indicated by thin organic or organic-mineral layer) ■ None observable in surface layer as described herein **Score:** 1

***Sedimentation – Deposition of excess sediment due to human actions. Confirm in office review for landscape.***

Landscape with stress that could lead to excess sedimentation? ■ Yes ☐ No Landscape position: ■ High ☐ Low

Magnitude of recent runoff/flooding events: ■ High ☐ Low Percent of WAA with excess sediment deposition: 50

■ Sand deposits: 85 % of area, 4-6 in. average thickness ■ Silt/Clay deposits: 5 % of area, 8-10 in. average thickness

Lacustrine fringe only: ☐ Upper end of impoundment ☐ Degrades wetland ☐ Contributes to wetland processes **Score:** 2

***Soil Modification – Physical changes by human activities. Confirm in office review for past.***

Type (Check those applicable and circle R for recent or P for past): ☐ Farming R/P ☐ Logging R/P ■ Mining R/P ■ Filling R/P ☐ Grading R/P ☐ Dredging R/P ☐ Off-road vehicles R/P ■ Other R/P: Past alteration - Impoundment

Percent of WAA with recent soil modification: 0 % Degree of modification: ☐ High ☐ Low

Indicators of past modification: ☐ High bulk density ■ Low organic matter ☐ Lack of soil structure ☐ Lack of horizons ☐ Hardpan ☐ Dramatic change in texture/color ☐ Heterogeneous mixture ☐ Other: ____

Indicators of recovery: ☐ Organic matter ☐ Structure ■ Horizons ☐ Mottling ■ Hydric soil ☐ Other: ____

Percent of WAA with past modification: 100 % Recovery: ☐ Complete ☐ High ■ Moderate ☐ Low ☐ None **Score:** 2

**PHYSICAL STRUCTURE**

***Topographic Complexity – See figures in section 2.3.4.1. Record % micro-topography and % WAA for each elevation gradient.***

Elevation gradients (EG): 2 Evidence: ■ Plant assemblages ■ Level of saturation/inundation ☐ Path of water flow ■ Slope

Micro-topography: 15 % of WAA (By EG: EG1: 10%; EG2: 5% )

Types: ☐ Depressions ☐ Pools ☐ Burrows ☐ Swales ☐ Wind-thrown tree holes ■ Mounds ☐ Gilgai ☐ Islands ☐ Variable shorelines ☐ Partially buried debris ■ Debris jams ☐ Plant hummocks/roots ☐ Other: ____ **Score:** 3

***Edge Complexity – Confirm in office review. See figure in section 2.3.4.2 to evaluate wetland boundary.***

WAA: ☐ In seasonal floodplain ☐ Contiguous to other wetland ■ Edge vertical structure variation: 50

Horizontal variability: ☐ High ■ Moderate ☐ Low ☐ None **Score:** 2

***Physical Habitat Richness – See definitions and table in section 2.3.4.3 for habitat types applicable to each wetland type.***

Label of habitat types qualifying as present in WAA: A, J, L, N Total: 4 **Score:** 2

**BIOTIC STRUCTURE**

***Plant Strata – Use applicable wetland delineation regional supplement and data from determination data form(s).***

Number of plant strata: ☐ ≥ 4 ☐ 3 ■ 2 ☐ 1 ☐ 0 **Score:** 2

***Species Richness – Use data from determination data form(s) to count species with 5% or more relative cover in a stratum.***

Number of species across all strata and determination data forms (not counting a species more than once): 5 **Score:** 2

***Non-Native/Invasive Infestation – Use data from determination data form(s). See tables in section 2.3.5.3 for examples.***

Average total relative cover of non-native/invasive species across all strata and determination data forms: 15 % **Score:** 2

***Interspersion – Confirm in office review. Use figure in section 2.3.5.4 to determine the degree of interspersion of plant zones.***

Degree of horizontal/plan view interspersion: ☐ High ☐ Moderate ■ Low ☐ None ☐ Bottomland hardwood forest **Score:** 3

***Strata Overlap – Use strata defined in plant strata metric using applicable regional supplement. See figures in section 2.3.5.5.***

High overlap (≥ 3 strata overlapping): 10 % of WAA Moderate overlap (2 strata overlapping): 15 % of WAA

Herbaceous species/dense litter overlap (only in portion where there are no other strata overlapping): 15 % of WAA

Total percentage of WAA with some form of overlap (if more than one present): 40 % of WAA **Score:** 2

***Herbaceous Cover – Estimate for entire WAA.*** In South Central Plains or East Central Texas Plains: ☐ Bottomland hardwood forest

Total cover of emergent and submergent plants: ☐ > 75% ☐ 51–75% ■ 26–50% ☐ ≤ 25% **Score:** 2

***Vegetation Alterations – Unnatural (human-caused) stressors. Confirm in office review for past.***

Type (Check those applicable and circle R for recent or P for past): ☐ Disking R/P ☐ Mowing/shredding R/P ☐ Logging R/P ☐ Cutting R/P ☐ Trampling R/P ☐ Herbicide treatment R/P ☐ Herbivory R/P ☐ Disease R/P ☐ Chemical spill R/P ☐ Pollution R/P ■ Feral hog rooting R/P ☐ Woody debris removal R/P ■ Other R/P: Clearing for Mining

Percent of WAA with recent vegetation alteration: 10 % Severity of alteration: ☐ High ■ Low

Percent of WAA with past vegetation alteration: 100 % Degree of recovery: ☐ Complete ☐ High ■ Moderate ☐ Low

☐ Alteration to improve wetland (degree of natural community recovery): ____ **Score:** 2

# TXRAM WETLAND FINAL SCORING SHEET

Project/Site Name/No.: Northeast Landfill Project Type: ■ Fill/Impact (☐ Linear ■ Non-linear) ☐ Mitigation/Conservation

Wetland ID/Name: B WAA No.: 2 Size: 0.16 Acres Date: 4-15-2020 Evaluator(s): CRK, DTM

Wetland Type: Riverine, PSS Ecoregion: N/A Delineation Performed: ☐ Previously ■ Currently

Aerial Photo Date and Source: 2018 (BING), 2017 (NAIP) Site Photos: March 17, 2020 Representative: ■ Yes ☐ No

Notes: Permanent Scrub-Shrub Wetland Impact

| *Core Element* | *Metric* | *Metric Score* | *Core Element Score Calculation* | *Core Element Score* |
|---|---|---|---|---|
| Landscape | Aquatic Context | 2 | Sum of metric scores / 8 x 15 | 5.9 |
| | Buffer | 1.15 | | |
| Hydrology | Water source | 2 | Sum of metric scores / 12 x 30 | 10 |
| | Hydroperiod | 1 | | |
| | Hydrologic flow | 1 | | |
| Soils | Organic matter | 1 | Sum of metric scores / 12 x 15 | 6.3 |
| | Sedimentation | 2 | | |
| | Soil modification | 2 | | |
| Physical Structure | Topographic complexity | 3 | Sum of metric scores / 12 x 20 | 11.7 |
| | Edge complexity | 2 | | |
| | Physical habitat richness | 2 | | |
| Biotic Structure | Plant strata | 2 | Sum of metric scores / 28 x 20 | 10.7 |
| | Species richness | 2 | | |
| | Non-native/invasive infestation | 2 | | |
| | Interspersion | 3 | | |
| | Strata overlap | 2 | | |
| | Herbaceous cover | 2 | | |
| | Vegetation alterations | 2 | | |
| | | | | |
| Sum of core element scores = overall TXRAM wetland score | | | | 44.6 |
| Additional points for unique resources = overall TXRAM wetland score x 0.10 if:<br>☐ Area of Caddo Lake designated a "Wetland of International Importance" under the Ramsar Convention<br>☐ Bald cypress – water tupelo swamp<br>☐ Pitcher plant bog<br>☐ Spring | | | | Not Applicable |
| Additional points for limited habitats = overall TXRAM wetland score x 0.05 if:<br>☐ Dominated by native trees greater than 24-inch diameter at breast height<br>☐ Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata | | | | Not Applicable |
| Sum of overall TXRAM wetland score and additional points = **total overall TXRAM wetland score** | | | | **44.6** |

***Representative Site Photograph:***

Scrub-shrub Wetland B looking west.

Scrub-shrub Wetland B looking north.

# TXRAM WETLAND DATA SHEET

Project/Site Name/No.: Northeast Landfill Project Type: ■ Fill/Impact (☐ Linear ■ Non-linear) ☐ Mitigation/Conservation

Wetland ID/Name: B WAA No.: 2 Size: 0.16 Acres Date: 4-15-2020 Evaluator(s): CRK, DTM

Wetland Type: Riverine, PSS Ecoregion: N/A Delineation Performed: ☐ Previously ■ Currently

Aerial Photo Date and Source: 2018 (BING), 2017 (NAIP) Site Photos: March 17, 2020 Representative: ■ Yes ☐ No

Notes:

## LANDSCAPE

***Aquatic Context – Confirm in office review. See figures in section 2.3.1.1 for examples.***

Notes on any barriers or alterations that prevent connection: ______

Aquatic resources within 1,000 feet of WAA to which wetland connects (including number for other considerations): 3 **Score:** 2

***Buffer – Evaluate to 500 feet from WAA boundary. Confirm in office review. See figures in section 2.3.1.2 for examples.***

| *Buffer Type/Description* | *Score (See Narratives)* | *Percentage* | *Subtotal* |
|---|---|---|---|
| 1. Forested | 2 | 50% | 1.0 |
| 2. Landfill | 0 | 35% | 0.0 |
| 3. Pasture | 1 | 15% | 0.15 |
| 4. Open Water | N/A | N/A | N/A |
| 5. | | | |

**Score:** 1.15

## HYDROLOGY

***Water Source – Degree of natural or unnatural/artificial influence. Confirm in office review for watershed.***

Natural: ■ Precipitation ■ Groundwater ☐ Overbank flow/stream discharge ■ Overland flow ■ Beaver activity ☐ Other: ______

Unnatural/Manipulated: ☐ Impoundment ☐ Outfall ☐ Irrigation/pumping ☐ Other artificial influence or control: ______

Watershed: ■ Development ☐ Irrigated agriculture ☐ Wastewater treatment plant ☐ Impoundment ☐ Other: ______

Degree of artificial influence/control: ☐ Complete ■ High ☐ Low ☐ None

Wetland created/restored/enhanced: ☐ Sustainable/replicates natural ☐ Controlled **Score:** 2

***Hydroperiod – Variability and recent alteration of the duration, frequency, and magnitude of inundation/saturation.***

Evaluate the hydroperiod including natural variation: Low variability

Direct evidence of alteration: Natural: ☐ Log-jam ☐ Channel migration ☐ Other: ______

Human: ☐ Diversions ☐ Ditches ☐ Levees ■ Impoundments ■ Other: Berm, Beaver Activity, Clearing for Mining

Riverine only: ■ Recent channel in-stability/dis-equilibrium (■ Degradation or ■ Aggradation)

Indirect evidence of alteration: ☐ Wetland plant stress: ______ ☐ Plant morphology: ______

☐ Upland species encroachment: ______ ☐ Plant Community: ______ ☐ Soil: ______

Change/Alteration of hydroperiod: ☐ None ☐ Due to natural events ■ Human influences (☐ Slight or ■ High)

Degree hydroperiod of wetland created/restored/enhanced replicates natural patterns: ______

Lacustrine fringe on human impoundment: ☐ High variability ☐ Low variability ☐ Recent changes to hydroperiod **Score:** 1

***Hydrologic Flow – Movement of water to or from surrounding area and openness to water moving through the WAA.***

Flow: ■ Inlets: 1 ☐ Outlets: 1 ☐ Signs of water movement to or from WAA: Flow through site (Rainfall)

Restrictions: ☐ Levee ■ Berm/dam ☐ Diversion ■ Other: Beaver activity

High flowthrough: ☐ Floodplain ☐ Drift deposits ☐ Drainage patterns ☐ Sediment deposits ☐ Other: ______

Low flowthrough: ■ High landscape position ☐ Stagnant water ☐ Closed contours ☐ Other: ______ **Score:** 1

## SOILS

***Organic Matter – Use data and indicators from wetland determination data form(s) based on applicable regional supplement.***

☐ High (organic soil or indicator A1, A2, A3)

☐ Moderate (indicator A9, S1, F1 in AW or A9, S1, S2, F1 in GP or A6, A7, A9, S7, F13 in AGCP)

☐ Low (indicated by thin organic or organic-mineral layer) ■ None observable in surface layer as described herein **Score:** 1

***Sedimentation – Deposition of excess sediment due to human actions. Confirm in office review for landscape.***

Landscape with stress that could lead to excess sedimentation? ■ Yes ☐ No Landscape position: ■ High ☐ Low

Magnitude of recent runoff/flooding events: ■ High ☐ Low Percent of WAA with excess sediment deposition: 50

■ Sand deposits: 75 % of area, 4-6 in. average thickness ■ Silt/Clay deposits: 10 % of area, 8-10 in. average thickness

Lacustrine fringe only: ☐ Upper end of impoundment ☐ Degrades wetland ☐ Contributes to wetland processes **Score:** 2

***Soil Modification – Physical changes by human activities. Confirm in office review for past.***

Type (Check those applicable and circle R for recent or P for past): ☐ Farming R/P ☐ Logging R/P ■ Mining R/P ■ Filling R/P ☐ Grading R/P ☐ Dredging R/P ☐ Off-road vehicles R/P ■ Other R/P: Past alteration - Impoundment

Percent of WAA with recent soil modification: 0 % Degree of modification: ☐ High ☐ Low

Indicators of past modification: ☐ High bulk density ■ Low organic matter ☐ Lack of soil structure ☐ Lack of horizons ☐ Hardpan ☐ Dramatic change in texture/color ☐ Heterogeneous mixture ☐ Other: ______

Indicators of recovery: ☐ Organic matter ☐ Structure ■ Horizons ☐ Mottling ■ Hydric soil ☐ Other: ______

Percent of WAA with past modification: 100 % Recovery: ☐ Complete ☐ High ■ Moderate ☐ Low ☐ None **Score:** 2

**PHYSICAL STRUCTURE**

***Topographic Complexity – See figures in section 2.3.4.1. Record % micro-topography and % WAA for each elevation gradient.***

Elevation gradients (EG): 2 Evidence: ■ Plant assemblages ■ Level of saturation/inundation ☐ Path of water flow ■ Slope

Micro-topography: 15 % of WAA (By EG: EG1: 10%; EG2: 5%)

Types: ☐ Depressions ☐ Pools ☐ Burrows ☐ Swales ☐ Wind-thrown tree holes ■ Mounds ☐ Gilgai ☐ Islands ☐ Variable shorelines ☐ Partially buried debris ■ Debris jams ☐ Plant hummocks/roots ☐ Other: ______ **Score:** 3

***Edge Complexity – Confirm in office review. See figure in section 2.3.4.2 to evaluate wetland boundary.***

WAA: ☐ In seasonal floodplain ☐ Contiguous to other wetland ■ Edge vertical structure variation: 50

Horizontal variability: ☐ High ■ Moderate ☐ Low ☐ None **Score:** 2

***Physical Habitat Richness – See definitions and table in section 2.3.4.3 for habitat types applicable to each wetland type.***

Label of habitat types qualifying as present in WAA: A, J, L, N Total: 4 **Score:** 2

**BIOTIC STRUCTURE**

***Plant Strata – Use applicable wetland delineation regional supplement and data from determination data form(s).***

Number of plant strata: ☐ ≥ 4 ☐ 3 ■ 2 ☐ 1 ☐ 0 **Score:** 2

***Species Richness – Use data from determination data form(s) to count species with 5% or more relative cover in a stratum.***

Number of species across all strata and determination data forms (not counting a species more than once): 5 **Score:** 2

***Non-Native/Invasive Infestation – Use data from determination data form(s). See tables in section 2.3.5.3 for examples.***

Average total relative cover of non-native/invasive species across all strata and determination data forms: 15 % **Score:** 2

***Interspersion – Confirm in office review. Use figure in section 2.3.5.4 to determine the degree of interspersion of plant zones.***

Degree of horizontal/plan view interspersion: ☐ High ☐ Moderate ■ Low ☐ None ☐ Bottomland hardwood forest **Score:** 3

***Strata Overlap – Use strata defined in plant strata metric using applicable regional supplement. See figures in section 2.3.5.5.***

High overlap (≥ 3 strata overlapping): 10 % of WAA Moderate overlap (2 strata overlapping): 15 % of WAA

Herbaceous species/dense litter overlap (only in portion where there are no other strata overlapping): 15 % of WAA

Total percentage of WAA with some form of overlap (if more than one present): 40 % of WAA **Score:** 2

***Herbaceous Cover – Estimate for entire WAA.*** In South Central Plains or East Central Texas Plains: ☐ Bottomland hardwood forest

Total cover of emergent and submergent plants: ☐ > 75% ☐ 51–75% ■ 26–50% ☐ ≤ 25% **Score:** 2

***Vegetation Alterations – Unnatural (human-caused) stressors. Confirm in office review for past.***

Type (Check those applicable and circle R for recent or P for past): ☐ Disking R/P ☐ Mowing/shredding R/P ☐ Logging R/P ☐ Cutting R/P ☐ Trampling R/P ☐ Herbicide treatment R/P ☐ Herbivory R/P ☐ Disease R/P ☐ Chemical spill R/P ☐ Pollution R/P ■ Feral hog rooting R/P ☐ Woody debris removal R/P ■ Other R/P: Clearing for Mining

Percent of WAA with recent vegetation alteration: 10 % Severity of alteration: ☐ High ■ Low

Percent of WAA with past vegetation alteration: 100 % Degree of recovery: ☐ Complete ☐ High ■ Moderate ☐ Low

☐ Alteration to improve wetland (degree of natural community recovery): ______ **Score:** 2

## ADVERSE IMPACT FACTORS WORKSHEET (A-1)

**Factors: Variables:**

| Factors | Variables | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Stream Type Impacted (ST)* | Ephemeral 0.3 | | | Intermittent 0.4 | | | Perennial 0.8 | | |
| *Priority Waters (PW)* | All Other 0.05 | | | Secondary 0.4 | | | Priority 0.8 | | |
| *Existing Condition (EC)* | Severely Impaired 0.1 | Impaired 0.4 | | Partially Impaired 0.6 | Moderately Functional 0.8 | | Fully Functional 1.6 | | |
| *Impact Duration (ID)* | Temporary 0.05 | | | Recurring 0.15 | | Permanent 0.3 | | | |
| *Impact Activity (IA)* | Clearing 0.05 or 0.1* | Utility Crossing/Bridge Footing 0.15 | Below Grade Culvert 0.3 | Armor 0.5 | Detention Facility 0.75 | Morpho-logic Change 1.5 | Impound-ment 2.0 | Pipe 2.2 | Fill 2.5 |
| *Linear Impact Magnitude (LIM)* | 0.0003 multiplied by linear feet (LF) of stream impact (recorded in each column below) | | | | | | | | |

**IMPACT FACTORS**

| | | | | | |
|---|---|---|---|---|---|
| Site Name | Northeast Landfill | | | | |
| Station ID | Stream 2 | | | | |
| Stream Type Impacted (ST) | 0.4 | Intermittent | | | |
| Priority Waters (PW) | 0.05 | All Other | | | |
| Existing Condition (EC) | 0.1 | Severely Impaired | | | |
| Impact Duration (ID) | 0.3 | Permanent | | | |
| Impact Activity (IA) | 2.5 | Fill | | | |
| Linear Impact Magnitude (LIM) | 0.22 | | | | |
| Sum of Factors (M ) = (ST+PW+EC+ID+IA+LIM) | 3.57 | | | | |
| Linear Feet of Stream Impact (LF) | 746 | | | | |
| Required Credits (C) = M * LF | 2,666.1 | | | | |
| Compensation Ratio[1] * (C) | 1:1 | | | | |

**Total Credits Required from all Columns=** 2,666.1

1. ***Compensation Ratio*** *- when the Corps determines that a third party mitigation source is acceptable to fulfill compensatory mitigation requirements the total credits determined on this worksheet shall be applied to mitigation banks or in-lieu fee programs at a 1:1 ratio when the impact area is within an approved service are, however, an increased compensation ratio may be used at the Corps discretion when an impact occurs beyond the geographic service area of an approved mitigation bank or in-lieu fee program.*

* Impact Activity - Clearing on both sides of stream double the clearing category to 0.1.

**Worksheet Factors for ADVERSE IMPACT FACTORS WORKSHEET (A-1)**
2.b.i. Adverse Impact Factors: The factors below are used to determine the credits for the Adverse Impact Factors Worksheet (Appendix A-1).
2.b.i(1). Stream Types (ST):

2.b.i(1)(a) Ephemeral Streams: Streams that have flowing water only during and for a short duration after precipitation events during a normal precipitation year. Ephemeral streambeds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from precipitation is the primary source of water for stream flow. Ephemeral streams typically support few aquatic organisms. When aquatic organisms are found they typically have a very short aquatic life stage.

2.b.i.(1)(b) Intermittent Streams: Streams that have flowing water during certain times of the year, when ground water provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow. The biological community of intermittent streams is composed of species that are aquatic during a part of their life history or move to perennial water sources.

2.b.i(1)(c) Perennial Streams: Streams that have flowing water year-round during a normal precipitation year. The water table is located above the streambed for most of the year. Groundwater is a primary source of water for stream flow. Runoff from precipitation is a supplemental source of water for stream flow. Perennial streams support aquatic organisms year-round.

2.b.ii. Priority Waters (PW) [Appendix B]: The priority waters are divided into three categories:

2.b.ii(1) Primary waters include:

- Outstanding National Resource Waters.
- State Outstanding Resource Waters and tributaries.
- High Quality Waters designated by the state.
- Mussel Beds.
- Waters with Federal Listed Endangered and Threatened species.
- Streams with high aquatic biodiversity.

2.b.ii(2) Secondary waters include:

- Sensitive Water Supply also known as OWRB Sensitive Public and Private Water Supplies (SWS).
- Abutting an approved consolidated mitigation site (banks and in-lieu fee).
- Rivers and streams of the same or lower order within 1.0 mile upstream or downstream of primary priority waters of a project site.
- Oklahoma 303(d) List of Impaired Waters.

2.b.ii(3) All other waters not described above: These areas include all other freshwater systems not ranked as primary or secondary waters.

2.b.iii. Existing Conditions (EC): The following describes the condition of each stream segment where an impact activity is proposed before any project impacts that would occur from an applicant proposed project. This measures the ability to support normal hydraulic and geomorphic functions relative to the physical, chemical, and biological integrity of the system. If a stream is impaired, it cannot be considered fully functional.

2.b.iii(1) Fully Functional: Describes those stream segments that have been shown to or are likely to support healthy aquatic communities indicative of the ecoregion and stream type. These stream segments also have natural hydrologic variability and responses to precipitation events. Fully functional stream segments are characterized by a combination of little modification, relatively stable bed and banks, good water quality, and undisturbed riparian corridors. A fully functional stream represents a least-disturbed condition and therefore exhibits the conditions used to establish performance standards for restoration and mitigation.

User Note: Streams with a Strahler stream order number 4 or greater are automatically designated as fully functional (see next example drawing). Example Drawing on **Page 6**

The evaluated stream segment is considered fully functional when 4 of 6 of the following criteria are met:

- Is unaltered in any major manner by human activities. It has not been channelized, impounded, or substantially constricted by structures, or had its flow substantially altered.
- Is not listed on the most current Clean Water Act 305 (b) Integrated lists as Category 4 or 5 developed by ODEQ. https://www.deq.ok.gov/water-quality-division/watershed-planning/integrated-report/
- Is stable and does not exhibit head cutting, incision, or excessive aggradation and the stream banks are not subject to excessive erosion or disturbance.
- Is connected to its overbank flood plain supporting normal hydrological functions.
- Has a riparian buffer of at least 50 feet in width on both sides of the stream that sustains deep-rooted, native vegetation that exceeds 50% cover. (3rd order stream or larger are expected to have wider riparian zones.)
- If a stream segment is impacted by a minor structural alteration along a stream that is otherwise considered fully functional, but does not substantially alter the stream reaches above and below the structure, the segment from 0.25 miles above to 0.25 miles below the alteration should be considered a separate segment that is moderately functional.

Exception: The Corps, at its discretion, may designate the largest streams within an 8-digit Hydrologic Unit Code (HUC) as fully functional, regardless of whether they meet the criteria above, based on the stream's recreational, commercial, or water supply values (see Appendix C).

2.b.iii(2) Moderately Functional: Streams have been altered; however, system recovery has a moderate probability of occurring naturally. These streams support many, but not all, of the hydraulic and geomorphic characteristics of fully functioning streams of similar order in the watershed. All stream segments that do not meet the definition of fully functional or do not have the characteristics of an impaired stream segment are considered moderately functional.

2.b.iii(3) Partially Impaired: Describes those streams that have been degraded in one of the following parameters below and lacks resilience characterized by loss of one integrity function. Recovery is unlikely to occur naturally unless a major rehabilitation project is undertaken.

2.b.iii(4) Impaired: Describes those streams that have been degraded in two or three of the following parameters below and lacks resilience characterized by loss of two to three of the integrity functions. Recovery is unlikely to occur naturally unless a major rehabilitation project is undertaken.

2.b.iii(5) Severely Impaired: Describes those streams that have been degraded in four or more parameters and lacks resilience characterized by loss of four or more of the integrity functions. Recovery is unlikely to occur naturally unless a major rehabilitation project is undertaken.

2.b.iii(6) Seven Factors of Stream Impairment: A stream segment is considered impaired if it fails to meet a Fully Functional or Moderately Functional conditions. The criteria for determining a stream impairment is listed below:

2.b.iii(6)(a) Has been channelized and shows no evidence of self-recovery.
2.b.iii(6)(b) Is levee protected, impounded, or artificially constricted?
2.b.iii(6)(c) Is entrenched
2.b.iii(6)(d) Contains active head cut (i.e. abrupt drops in stream bed, both banks failing).
2.b.iii(6)(e) Has little or no riparian buffer of deep-rooted vegetation on one or both sides of the stream channel.
2.b.iii(6)(f) Has banks that are extensively eroded or unstable, obvious bank sloughing, and erosional scars.
2.b.iii(6)(g) Has four or more stream impacts within 0.5 miles upstream of the proposed stream impact including culverts that convey stream flow, pipes, or other manmade modifications, and stream impacts individually or cumulatively exceeds 100 feet in length.

2.b.iv. Impact Duration (ID): This is the amount of time the impact activity is expected to last. For purposes of this method the duration of the impact activity is factored in the following categories: temporary impacts, recurring impacts, and permanent impacts.

2.b.iv(1) Temporary Impacts: Means the impact activity will remain for a period of less than 6 months with system integrity recovering after cessation of the permitted activity or restoration to pre- construction contours and elevations. Under certain circumstances impacts may remain within a stream for a period greater than 6 months but the decision is contingent upon activity type, impact area, effects to in-stream flows, biological communities, water quality, and best management practices to minimize adverse effects. Examples of activities suitable to receive a temporary duration factor includes utility line crossings where appropriate natural substrate is used to backfill an open cut trench, temporary road crossings, work pads, or cofferdams.

User Note: Compensatory mitigation is not normally required for temporary impacts, where the disturbed area is fully restored and there is no permanent reduction in ecological function following the completion of the project.

2.b.iv(2) Recurring Impacts: Means that impact activities have occurred at this location before. Impacts to some or all aquatic resource functions and/or services are not considered a permanent loss. Recurring impacts to the impact area occur in such a frequency, the impact area could obtain additional effects to in-stream flows, biological communities, water quality, and best management practices that could adversely affect existing aquatic resource functions. An example of activities suitable to receive recurring duration factor includes sand or gravel mining activities.

User Note: Compensatory mitigation may be required for recurring impacts at a project location.

2.b.iv(3) Permanent Impacts: Means the impact activity will result in the permanent loss of some or all aquatic resource function and/or services. Examples of activities suitable to receive a permanent duration factor includes armoring, culverting, detention facilities, morphological changes, impounding, and piping are examples of permanent impact activities.

2.b.v. Impact Activity (IA): This is the type of impact proposed that will diminish the functional integrity of the stream. The following nine categories are types of impacts:

2.b.v(1) Armor: To riprap one or both stream channel banks or use other hard methods (i.e. concrete or block retaining wall) on one bank alone leaving the stream bed unaltered. Keying riprap revetments along the toe is an acceptable installation practice under this parameter.

User Note: Armoring of the stream bed and banks with riprap or installing a retaining wall along both channel banks should be assessed as a "Morphologic change".

2.b.v(2) Below Grade (embedded) Culvert: To route a stream through pipes, box culverts, or other enclosed structures for the purpose of a transportation crossing (100 linear feet or less of stream be impacted per linear transportation crossing). New or replacement culverts should be designed to convey geomorphic bankfull discharge with a similar average velocity as upstream and downstream sections. The culvert should be embedded and backfilled below the grade of the stream at least 1 foot for culverts greater than 48 inches diameter. On culverts less than 48 inches in diameter, the bottom of the culvert should be placed at a depth below the natural stream bottom. Bottomless culverts are acceptable in streams with non-erodible beds (i.e. bedrock or stable clay). Culverts that fail to meet the above design criteria will be evaluated under the impact activity known as pipe (see definition below).

2.b.v(3) Clearing: The removal of streambank vegetation or other activities that reduce or eliminate the quality and functions of vegetation within riparian habitat without disturbing the existing topography or soil.

User Note: This factor is intended for use in combination were no other impact activity is being evaluated. Additional mitigation could be required if both sides of the stream are cleared as a result of the proposed project. Clearing both sides doubles the adverse impact factor.

2.b.v(4) Detention Facility: The installation of a storm water management facility within a stream channel. This facility consists of a detention structure and a temporary ponding area upstream of the detention structure. The detention structure (i.e. dam or berm) itself is considered a “fill” activity, as defined below. Water velocities entering the temporary ponding area are typically reduced and may be temporarily held back while outflow is slowly released back into the channel downstream of the detention structure.

User Note: If the stream channel upslope of the detention structure is straightened, widened, dredged, excavated, or relocated it will be left to the discretion of the Regulatory Project Manager to determine whether the “morphologic change” or “fill” impact activity factor will be used.

2.b.v(5) Fill: The filling of a stream channel including the relocation of a stream channel (even if a new stream channel is constructed), or other fill activities.

2.b.v(6) Impoundment: The conversion of stream(s) to open water (pond or lake) through the construction of a dam or similar structure that modifies the natural stream flow. Channel impacts where the structure is located is considered a “fill” activity and the inundation will be considered as an impoundment.

2.b.v(7) Morphologic Change: To alter the established or natural dimensions, depths, or limits of an existing stream channel through straightening, widening, dredging, excavating, or channelizing (leave the channel in the same alignment). Examples of morphologic change include creation of a concrete lined open channel, in channel grading upstream of a detention structure, conversion of a stream to a grassed waterway, lining parallel banks with gabion baskets, concrete or block retaining walls, or channel reaming activities.

2.b.v(8) Pipe: To route a stream through pipes, box culverts, or other enclosed structures for purposes other than transportation crossings.

2.b.v(9) Utility Crossings: Activities required for the construction, maintenance, repair, and removal of utility lines within waters of the United States.

2.b.v(10) Bridge Footings: Activities requiring fill in waters of the United States are also considered in this activity factor. This factor also includes drilled shaft, column/pier placement, cofferdam for footing/pier placement, temporary crossing, and work pad.

2.b.vi. Linear Impact Magnitude (LIM): This is a mathematical calculation that addresses the scope of linear impact for each individual column recorded on the Adverse Impact Factor Worksheet. The corresponding value for each column shall be determined by multiplying a 0.0003 constant by the length of stream impacted per column (0.0003 x length of stream impacted per column). This factor considers those columns with greater affected stream length to have more extensive adverse effects on stream function than those columns containing lesser amounts of affected stream length.

Certification Letter from DEQ

Scott A. Thompson
Executive Director

OKLAHOMA Environmental Quality

Kevin Stitt
Governor

May 9, 2023

Mr. David Bahrenburg
N.E Landfill, LLC
1001 S Rockwell
Oklahoma City, OK 73128

RE: Application No. SWT-2020-00344

Dear Mr. Bahrenburg:

The Department of Environmental Quality (DEQ) has received your request for a Water Quality Certification under Section 401 of the Federal Clean Water Act [33 U.S.C. §1251 et seq. (1972)], for activities in the unnamed tributary to Crutcho Creek and associated wetlands to be permitted under Section 404 of the Act. DEQ rules governing 401 Water Quality Certification are contained in Oklahoma Administrative Code (O.A.C.) § 252:611-3 (2011) pursuant to 27A O.S. § 2-6-103(C)(2) (OSCN 1999). DEQ rules and regulations related to the 401 procedures are available at 611.pdf (ok.gov) or through contacting the DEQ Office of Business and Regulatory Affairs (800) 869-1400.

We have reviewed and examined the proposed project as described in Public Notice No. SWT-2020-344 and your application. The unnamed tributary and associated wetlands are assigned the following default beneficial uses through the Oklahoma Water Quality Standards (WQS): Warm Water Aquatic Community, Agriculture: Livestock and Irrigation, Primary Body Contact Recreation, and Aesthetics (OAC 252:730-5-3). The current Oklahoma WQS are available from the Department of Environmental Quality at: https://www.deq.ok.gov/wp-content/uploads/deqmainresources/730.pdf.

The proposed project is for a 73.2-acre horizontal and vertical expansion of the existing 90.1-acre construction and demolition landfill. Additional features include stormwater management infrastructure, roads, and utilities to accommodate the landfill expansion. The proposed work involves the discharge of approximately 7,007 cubic yards of native soil into jurisdictional wetlands and streams resulting in permanent loss of waters of the United States (WOUS) including 0.56 acre of shrub-scrub wetlands, 746 linear feet of intermittent stream, 1,359 linear feet of ephemeral stream, and 0.76 acre of open water. The impacted streams will be replaced with a run-on channel designed for a peak flow associated with the 25-year, 24-hour storm event. The run-on channel will be grass and riprap-lined. The channel will discharge into an unnamed tributary to Crutcho Creek. Proposed compensatory mitigation for the proposed permanent impacts to the aquatic resources will consist of purchasing 686.3 perennial stream credits, 1,293.6 intermittent stream credits, 4,970.8 ephemeral stream credits and 3.92 wetland credits from Deep Fork Mitigation Bank.

The project is located in Section 22, Township 12 North, Range 2 West, in Oklahoma County, Oklahoma.

The conditions attached to this conditional Certification will be terms of the Section 404 permit. The state may require compliance with these conditions under state and/or federal law. Failure to comply with the conditions or any other applicable state requirements may result in proceedings brought by the state for the suspension, termination, modification or revocation of this Certification and/or for injunctive relief, damages and/or penalties as allowed by law. This Certification may be revoked or modified upon subsequent amendments or revisions to Oklahoma's Water Quality Standards requirements or upon expiration of the federal permit for the described activity.

This conditioned Water Quality Certification does not supersede the requirements of a Section 404 permit from the U.S. Army Corps of Engineers, a permit required by the local floodplain board, or any other permit required for this project.

This certification does not authorize the discharge of industrial stormwater runoff, stormwater runoff from construction sites, or municipal/domestic wastewater discharges. These discharges may require permits from DEQ.

The certification is granted subject to the following conditions:

1) Appropriate procedures shall be utilized during the construction of this project to prevent the release of construction debris, fuels and lubricants, or other deleterious materials into the aquatic resources to comply with CWA 301(a), OAC 252: 730-3-2(d), OAC 252: 730-5-9 (b), and OAC 252: 730-5-19.
2) All fueling and servicing of vehicles and equipment shall be done above the Ordinary High Water Mark (OHWM) to comply with CWA 301(a), OAC 252: 730-3-2, OAC 252: 730-5-12(f)(4) and (6), and OAC 252: 730-5-19.
3) Environmental control practices, including but not limited to, effective erosion control measures and sediment control measures, shall be utilized during construction to comply with OAC 252: 730-5-12(f)(8).
4) All construction shall be done in a manner that will minimize increased turbidity and prevent downstream deposition of bank material during or after construction to comply with OAC 252: 730-5-12(f)(8).
5) All excess fill material, waste materials, construction debris, etc., must be removed from the site upon completion of the project to avoid the introduction of pollutants into the aquatic resources and to comply with OAC 252: 730-5-9 (b) and OAC 252: 730-5-19.
6) Post-project condition should not result in surface water quality degradation which will interfere with the attainment or maintenance of an existing or designated beneficial uses to ensure compliance with WQS, OAC 252: 730-3-2(d).
7) The applicant shall follow the USACE Tulsa District mitigation requirements of purchasing stream and wetland credits from the Deep Fork Mitigation Bank to comply with OAC 252: 730-3-2(d).

If you have any questions concerning this matter, please contact Elena Jigoulina at 405-702-8200.

Sincerely,

Joe A. Long, Environmental Programs Manager
Watershed Planning Section
Water Quality Division

cc: Robert Hoffman, Regulatory Branch, U.S. Army Corps of Engineers, Tulsa
Kenneth Cunningham, Oklahoma Department of Wildlife Conservation
Brooks Tramell, Monitoring, Assessment and Wetlands Programs, Oklahoma Conservation Commission
Daniel Landeros, EPA Region 6 (6WQ-EM)
Jennifer Lewis, Assistant Attorney General, Conservation Unit, OK, Office of the Attorney General

# Unstable Areas

August 18, 2023
Project No. 16219107.00

Mr. Darrell Shults, Geologist
Oklahoma Department of Mines
2915 N. Classen Blvd., Suite 213
Oklahoma City, OK 73106-5406

**Subject:** **Northeast C&D Landfill**
**Proposed Tier III Application Notification**
**Request for Location Restrictions Evaluation – Unstable Areas**

Dear Mr. Shults:

As required by Oklahoma Department of Environmental Quality (DEQ) Oklahoma Administrative Code 252:515-5-52(e) and on behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), SCS Engineers is submitting this notification for a horizontal and vertical expansion of its existing construction and demolition (C&D) debris landfill. The proposed landfill expansion is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma.

Three general site location maps (Figures 1, 3, and 6) are enclosed. Latitude/longitude of the corners of the permit boundaries are provided in Figure 3.

DEQ regulation states the following: *no new waste management or disposal areas of a land disposal facility shall be located over a subsurface mining area or any other unstable area.*

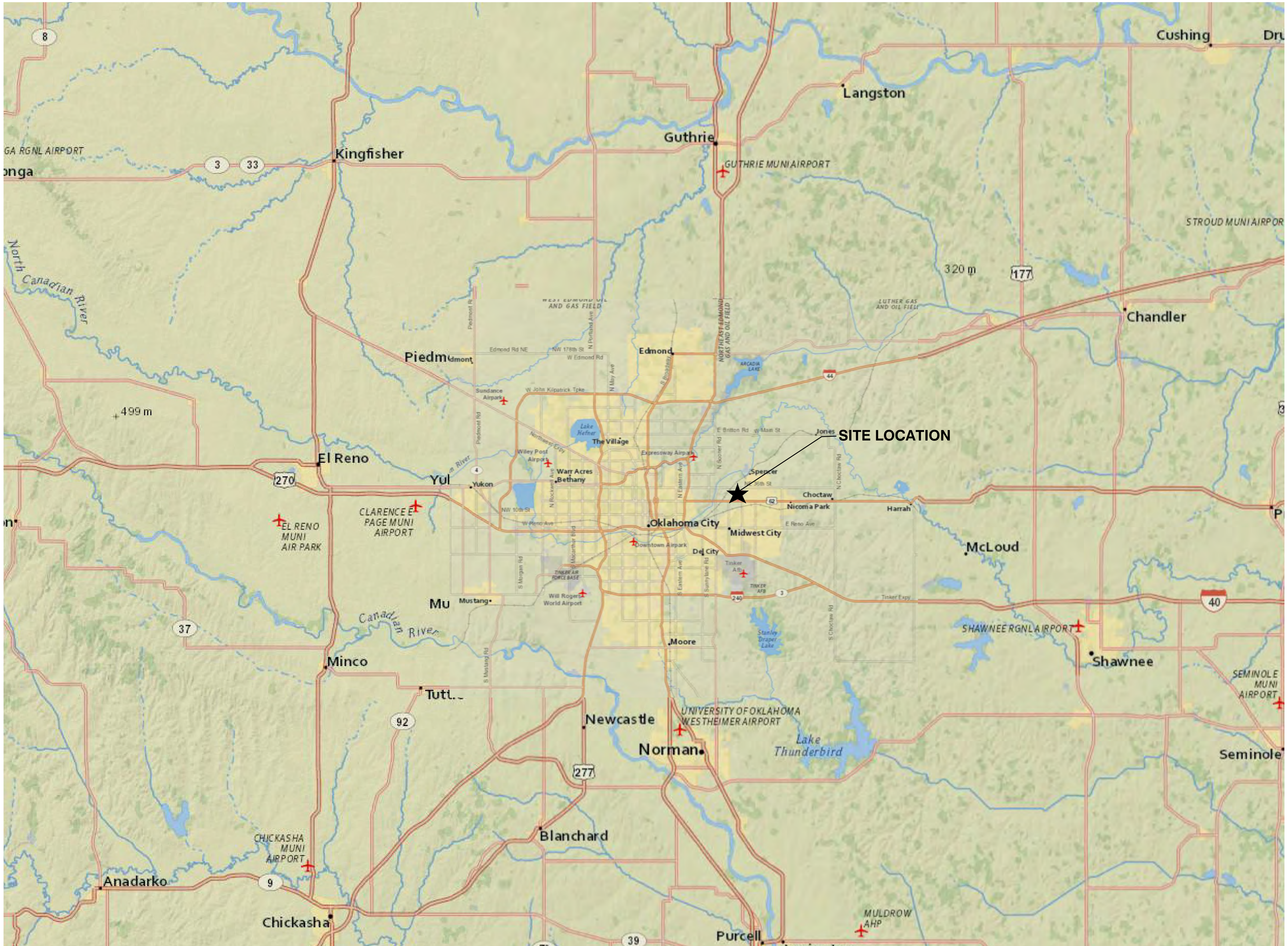
On behalf of GFL, we request you to review the enclosed maps and provide this determination as required by DEQ within 45 days of receipt of this letter. If you have any questions or need additional information, please do not hesitate to contact Sandeep Saraf at (407) 923-7013. Thank you for your time and effort in this matter. Thank you very much for your time and effort in this matter.

Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
**SCS Engineers**

Ryan Kuntz, PE
Vice President / Satellite Office Manager
**SCS Engineers**

Enclosures: Figures 1, 3, and 6




N

0 4 MILES 8 MILES

APPROXIMATE SCALE IN MILES

SOURCE:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

FOR PERMITTING PURPOSES ONLY

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

| REV | DATE | DESCRIPTION | BY |
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DRAWING TITLE
GENERAL LOCATION MAP

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00
DSN. BY: SS
DWN. BY: NR
CHK. BY: RRK
Q/A RVW BY: SS
APP. BY: RRK

CADD FILE: 01 LOC MAP1

DATE: 07/2023

SCALE: AS SHOWN

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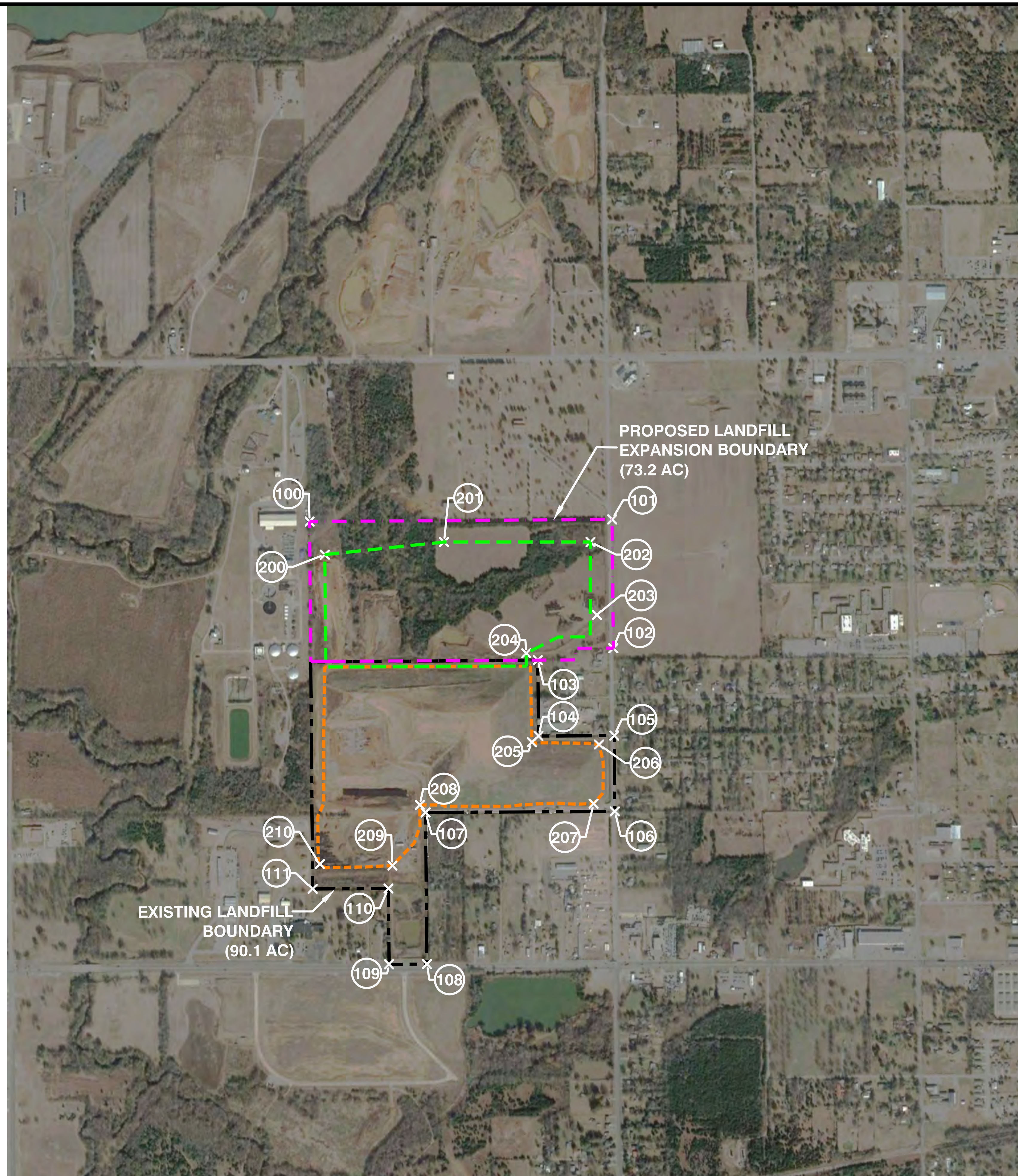


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SCALE IN FEET

## LEGEND

EXISTING LANDFILL BOUNDARY
PROPOSED LANDFILL EXPANSION BOUNDARY
CURRENT LIMIT OF WASTE
PROPOSED LIMIT OF WASTE

| PERMIT BOUNDARY | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 100 | N35° 30' 13.47" | W97° 23' 51.04" |
| 101 | N35° 30' 13.49" | W97° 23' 19.15" |
| 102 | N35° 30' 02.39" | W97° 23' 19.11" |
| 103 | N35° 30' 01.40" | W97° 23' 27.08" |
| 104 | N35° 29' 54.86" | W97° 23' 27.06" |
| 105 | N35° 29' 54.86" | W97° 23' 19.08" |
| 106 | N35° 29' 48.32" | W97° 23' 19.05" |
| 107 | N35° 29' 48.33" | W97° 23' 39.01" |
| 108 | N35° 29' 35.26" | W97° 23' 38.97" |
| 109 | N35° 29' 35.26" | W97° 23' 42.96" |
| 110 | N35° 29' 41.80" | W97° 23' 42.98" |
| 111 | N35° 29' 41.81" | W97° 23' 50.97" |

| LIMITS OF WASTE | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 200 | N35° 30' 10.61" | W97° 23' 49.46" |
| 201 | N35° 30' 11.63" | W97° 23' 36.89" |
| 202 | N35° 30' 11.55" | W97° 23' 21.45" |
| 203 | N35° 30' 05.27" | W97° 23' 20.81" |
| 204 | N35° 30' 02.01" | W97° 23' 28.29" |
| 205 | N35° 29' 54.32" | W97° 23' 27.76" |
| 206 | N35° 29' 54.10" | W97° 23' 20.68" |
| 207 | N35° 29' 48.99" | W97° 23' 21.29" |
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| 209 | N35° 29' 43.77" | W97° 23' 42.53" |
| 210 | N35° 29' 43.95" | W97° 23' 50.20" |

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: AERIAL PHOTO

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 03 AERIAL PHOTO

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 3

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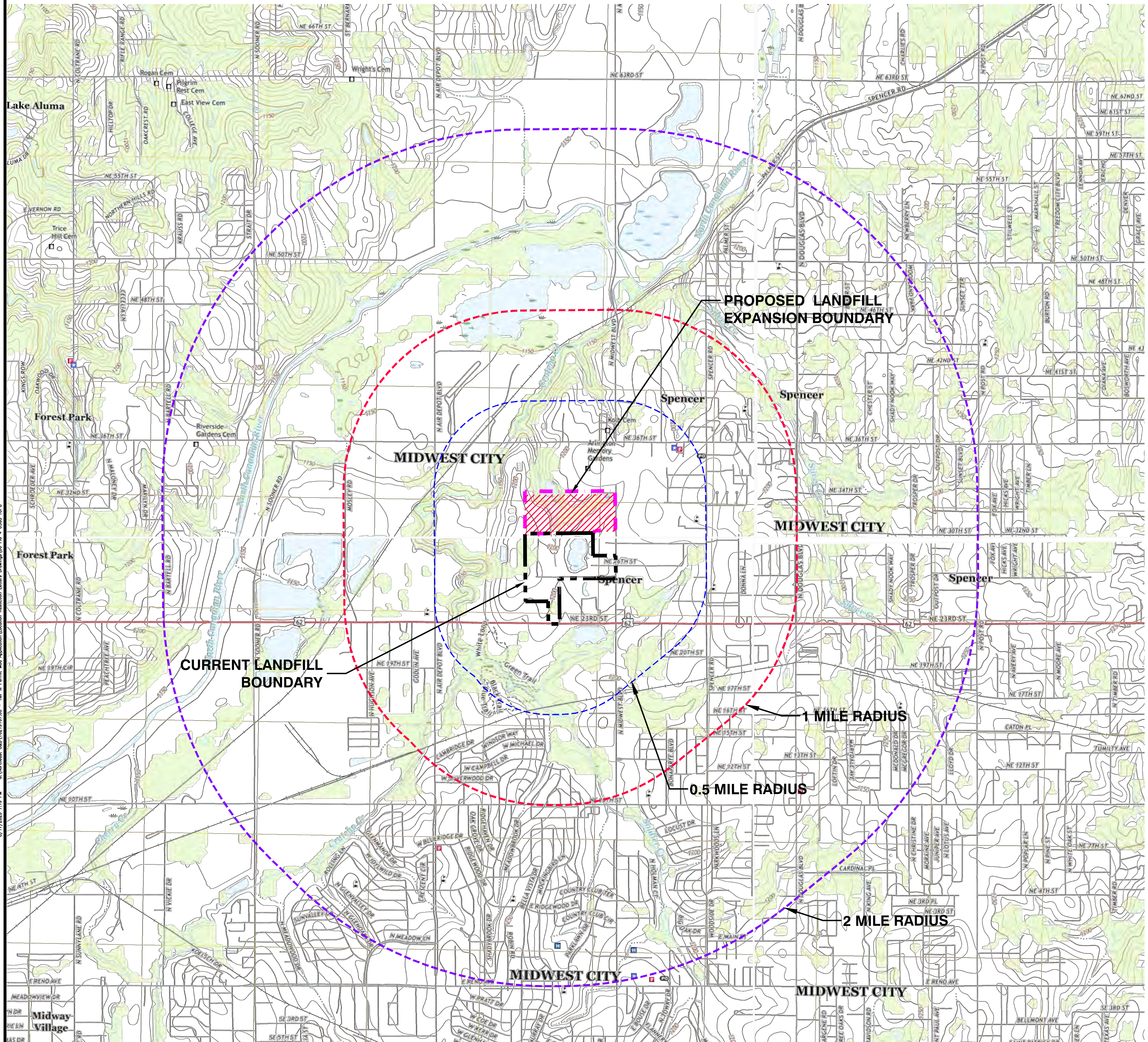


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SCALE IN FEET

## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- PROPOSED LANDFILL EXPANSION AREA
- 0.5 MILE RADIUS
- 1 MILE RADIUS
- 2 MILE RADIUS
- 1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)

ROAD CLASSIFICATION

| | |
|---|---|
| Expressway | Local Connector |
| Secondary Hwy | Local Road |
| Ramp | 4WD |
| US Route | State Route |

## SOURCE:

CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2022); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

DRAWING TITLE: GENERAL TOPOGRAPHIC MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

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1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

CADD FILE: 06 FIG 4 USGS TOPO

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 6

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Airports

SCS ENGINEERS Environmental Consultants & Contractors

August 23, 2023
Project No. 16219107.00

Mr. Kent Wheeler
Federal Aviation Administration
Central Obstruction Evaluation Team Manager
Southwest Region Office
10101 Hillwood Parkway
Fort Worth, TX 76177

**Subject:** **Northeast C&D Landfill**
**Proposed Tier III Permit Application Notification**
**Request for Location Restrictions Evaluation - Airports**

Dear Mr. Wheeler:

As required by Oklahoma Department of Environmental Quality (DEQ) Oklahoma Administrative Code 252:515-5-52(e) and on behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), SCS Engineers is submitting this notification for a horizontal and vertical expansion of its existing construction and demolition (C&D) debris landfill. The proposed landfill expansion is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma.

Three general site location maps (Figures 1, 3, and 6) are enclosed along with Figure 7, which shows the location of the site on Federal Aviation Administration's (FAA) Airport Vicinity Map (Dallas-Ft. Worth Sectional, 104th Edition). Latitude/longitude of the corners of the disposal area (i.e., limit of waste) are provided on Figure 3.

DEQ regulation 252:515-5-52(e) states the following: *if any waste management or disposal area of a new land disposal facility, or expansion of waste management or disposal areas of an existing land disposal facility, is to be located within 10,000 feet of any airport runway end used by turbojet aircraft or within 5,000 feet of any airport runway end used by only piston-type aircraft, a demonstration that the facility will not pose a bird hazard to* aircraft *shall be provided to the DEQ.*

*If any waste management or disposal areas of a new land disposal facility, or expansion of waste management or disposal areas of an active land disposal facility, will be located within a 5-mile radius of any airport runaway end used by turbojet or piston-type aircraft, the affected airport and the FAA must be notified and proof of such notification provided to DEQ (*252:515-5-52(e)(1)(A)*).*

Based on our review of the attached FAA Airport Vicinity Map (i.e., Figure 7), no airports are located within 10,000 feet of the landfill. Therefore, our evaluation indicates a demonstration that the facility will not pose a bird hazard to aircrafts is not applicable for this landfill expansion. As shown in Figure 4, Tinker Air Force Base is located about 23,000 feet (4.4 miles) south of the proposed landfill expansion. Therefore, SCS is submitting this notification to FAA and Tinker Air Force Base in compliance with DEQ rule 252:515-5-52(e)(1)(A).

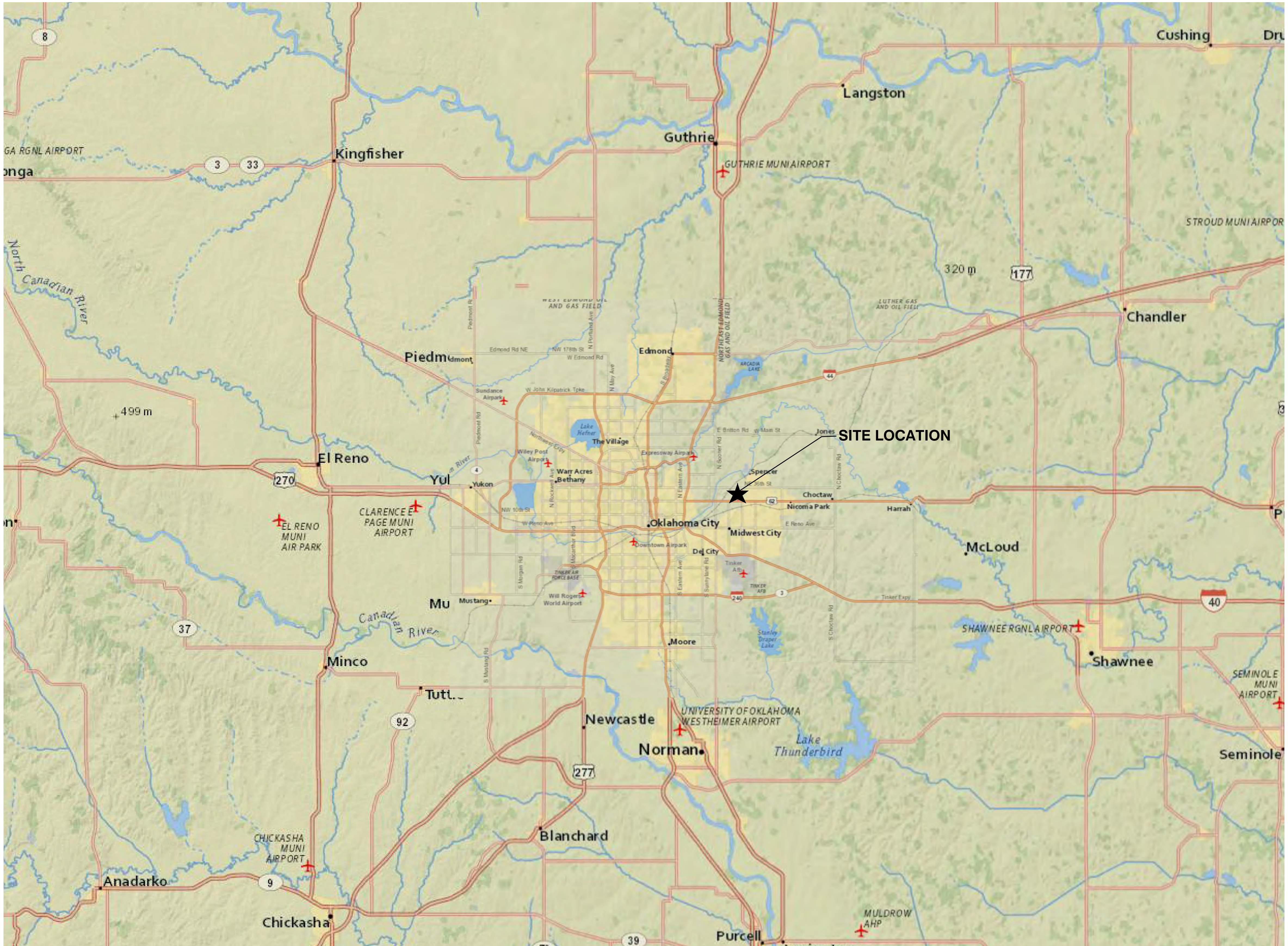
On behalf of GFL, we request your review of the enclosed maps. Please advise us of any concerns the FAA may have with the proposed landfill location at your earliest convenience. If you have any questions or need additional information, please do not hesitate to contact Sandeep Saraf at (407) 923-7013. Thank you for your time and effort in this matter.

Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
**SCS Engineers**

Ryan Kuntz, PE
Vice President / Satellite Office Manager
**SCS Engineers**

Enclosure: Figures 1, 3, 6, and 7

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APPROXIMATE SCALE IN MILES

SOURCE:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

FOR PERMITTING PURPOSES ONLY

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: GENERAL LOCATION MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: NR | CHK. BY: RRK | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 01 LOC MAP1

DATE: 07/2023

SCALE: AS SHOWN

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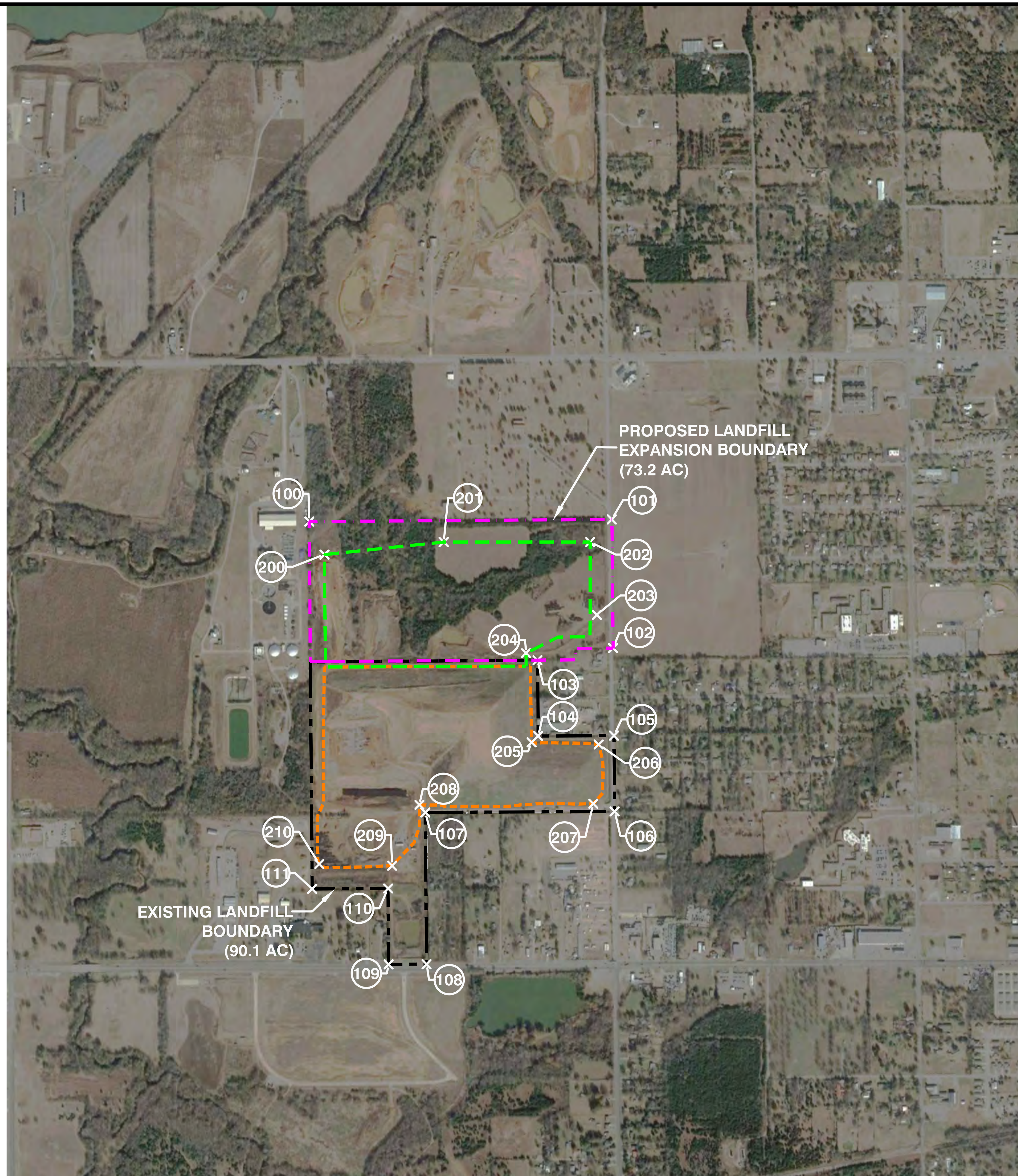


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## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- CURRENT LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE

**PERMIT BOUNDARY**

| POINT # | LATITUDE | LONGITUDE |
|---|---|---|
| 100 | N35° 30' 13.47" | W97° 23' 51.04" |
| 101 | N35° 30' 13.49" | W97° 23' 19.15" |
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**LIMITS OF WASTE**

| POINT # | LATITUDE | LONGITUDE |
|---|---|---|
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LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: AERIAL PHOTO

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
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PROJ. NO. 16219107.00 | DSN. BY: SS | CHK. BY: SDS | DWN. BY: DS | APP. BY: RRK | Q/A RVW BY: SS

CADD FILE: 03 AERIAL PHOTO

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 3

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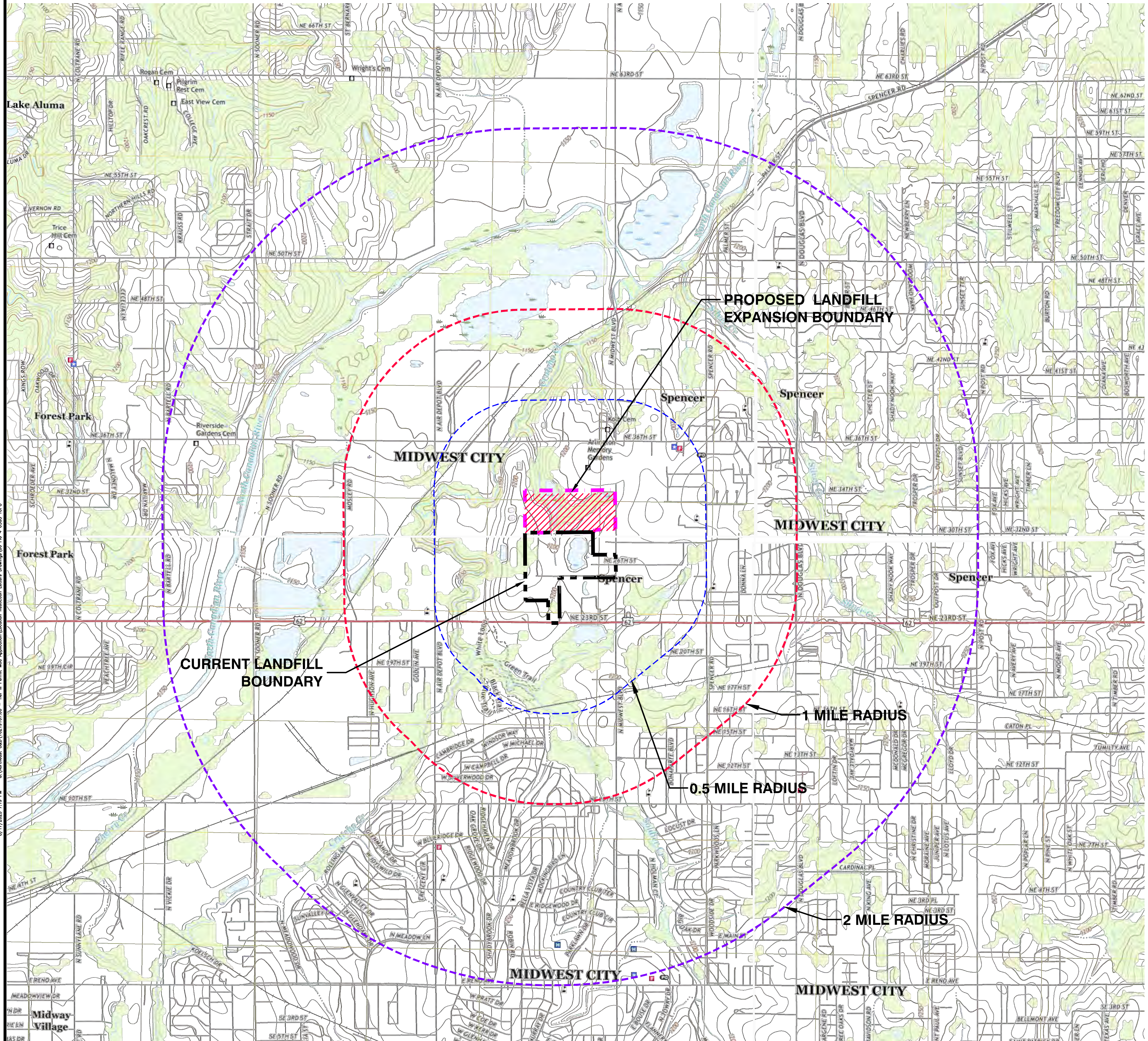


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SCALE IN FEET

## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- PROPOSED LANDFILL EXPANSION AREA
- 0.5 MILE RADIUS
- 1 MILE RADIUS
- 2 MILE RADIUS
- 1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)

ROAD CLASSIFICATION

| | |
|---|---|
| Expressway | Local Connector |
| Secondary Hwy | Local Road |
| Ramp | 4WD |
| US Route | State Route |

## SOURCE:

CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2022); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV. DATE DESCRIPTION BY

DRAWING TITLE: GENERAL TOPOGRAPHIC MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

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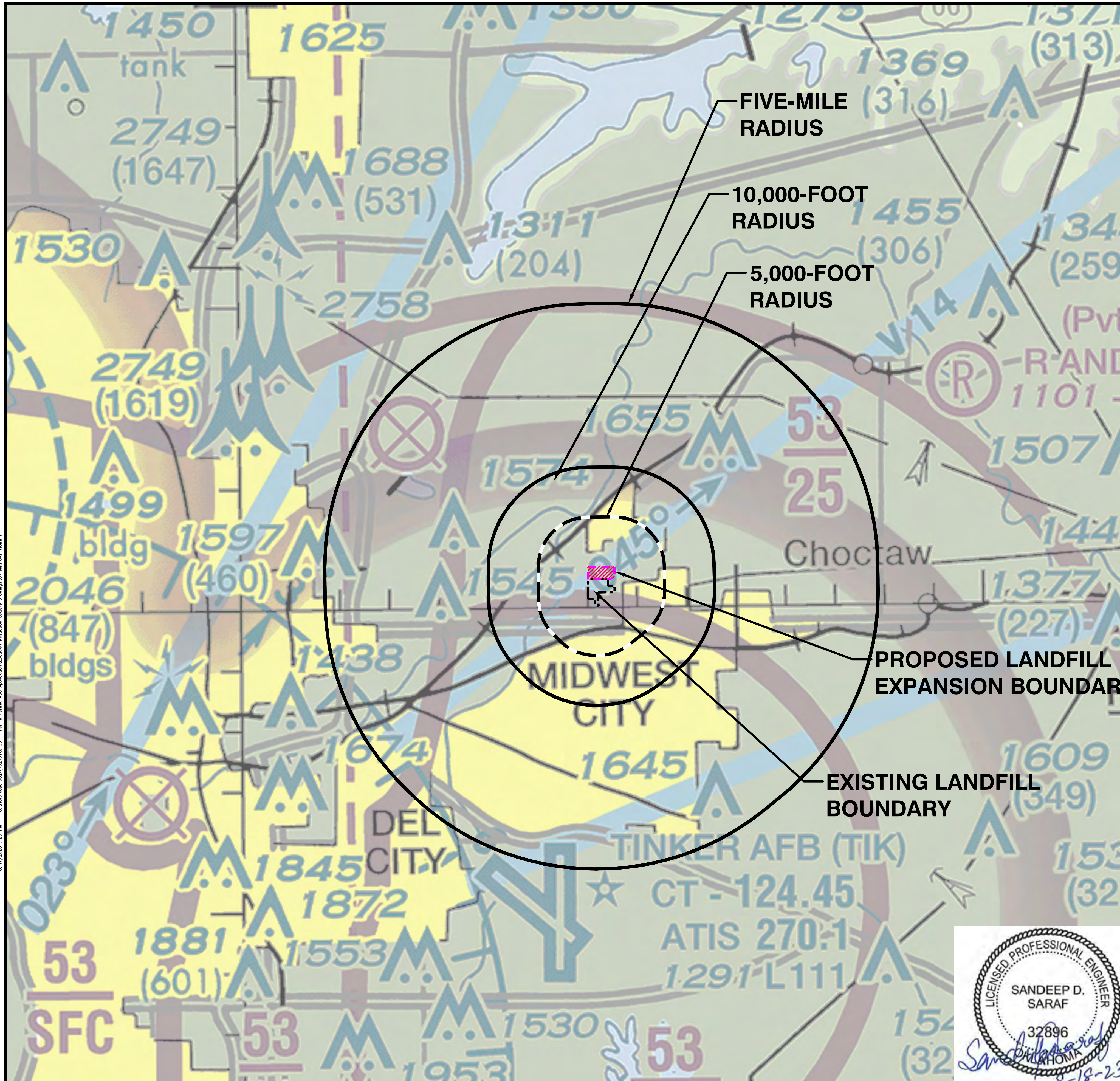
PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

CADD FILE: 06 FIG 4 USGS TOPO

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 6

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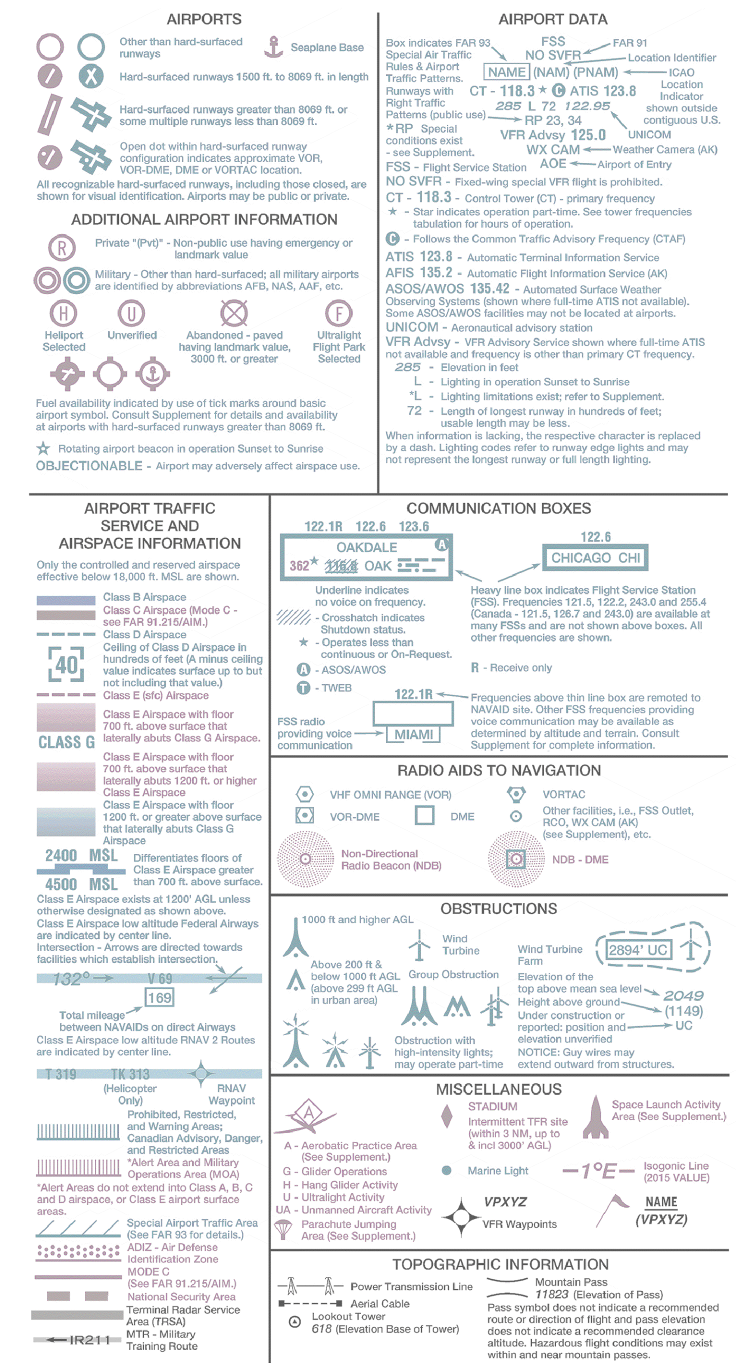
SCALE IN MILES

## LEGEND

EXISTING LANDFILL BOUNDARY
PROPOSED LANDFILL EXPANSION BOUNDARY
PROPOSED LANDFILL EXPANSION AREA




**NOTE:**

1. THIS MAP REPRODUCED FROM THE FAA DALLAS–FORT WORTH SECTIONAL AERONAUTICAL CHART 104TH EDITION, EFFECTIVE FEBRUARY 27, 2020.

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: FAA AIRPORT VICINITY MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DWN. BY: NR | Q/A RVW BY: SDS
DSN. BY: SDS | CHK. BY: SDS | APP. BY: RRK

CADD FILE: 07 AIRPORT VICINITY

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 7

8/17/2023 7:20 PM G:\Northeast CAD\16219107.00 – Tier III Permit Mod Application\Location Restriction Letters Drawings\07 AIRPORT VICINITY

August 18, 2023
Project No. 16219107.00

Tinker Air Force Base
Legal Office
7460 Arnold Avenue
Bldg. 72nd ABW Headquarters
Tinker AFB, OK 73145

**Subject:** **Northeast C&D Landfill**
**Proposed Tier III Application Notification**
**Request for Location Restrictions Evaluation - Airports**

To Whom It may Concern:

As required by Oklahoma Department of Environmental Quality (DEQ) Oklahoma Administrative Code 252:515-5-52(e) and on behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), SCS Engineers is submitting this notification for a horizontal and vertical expansion of its existing construction and demolition (C&D) debris landfill. The proposed expansion will be located on GFL-owned property, north of the existing C&D landfill footprint. The proposed landfill expansion is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma.

Three general site location maps (Figures 1, 3, and 6) are enclosed along with Figure 7, which shows the location of the site on Federal Aviation Administration's (FAA) Airport Vicinity Map (Dallas-Ft. Worth Sectional, 104th Edition). Latitude/longitude of the corners of the disposal area (i.e., limit of waste) are provided on Figure 3.

DEQ regulation 252:515-5-52(e) states the following: *if any waste management or disposal area of a new land disposal facility, or expansion of waste management or disposal areas of an existing land disposal facility, is to be located within 10,000 feet of any airport runway end used by turbojet aircraft or within 5,000 feet of any airport runway end used by only piston-type aircraft, a demonstration that the facility will not pose a bird hazard to* aircraft *shall be provided to the DEQ.*

*If any waste management or disposal areas of a new land disposal facility, or expansion of waste management or disposal areas of an active land disposal facility, will be located within a 5-mile radius of any airport runaway end used by turbojet or piston-type aircraft, the affected airport and the FAA must be notified and proof of such notification provided to DEQ (*252:515-5-52(e)(1)(A)).

Based on our review of the attached FAA Airport Vicinity Map (i.e., Figure 7), no airports are located within 10,000 feet of the landfill. Therefore, our evaluation indicates a demonstration that the facility will not pose a bird hazard to aircrafts is not applicable for this landfill expansion. As shown in Figure 4, Tinker Air Force Base is located about 23,000 feet (4.4 miles) south of the proposed landfill expansion. Therefore, SCS is submitting this notification to FAA and Tinker Air Force Base in compliance with DEQ rule 252:515-5-52(e)(1)(A).

On behalf of GFL, we request your review of the enclosed maps. Please advise us of any concerns the Tinker Air Force Base may have with the proposed landfill location at your earliest convenience. If you have any questions or need additional information, please do not hesitate to contact Sandeep Saraf at (407) 923-7013. Thank you for your time and effort in this matter.

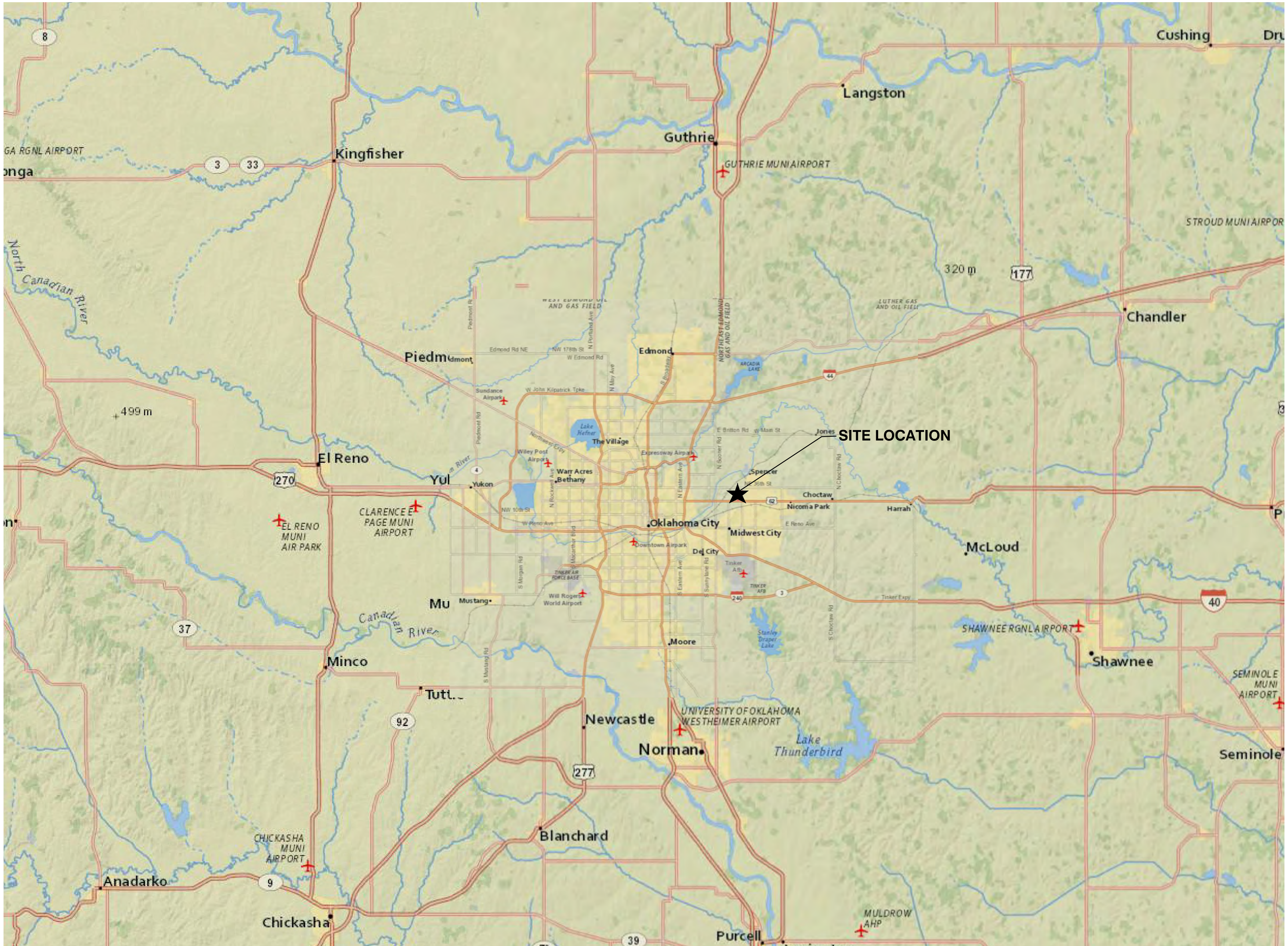
Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
**SCS Engineers**

Ryan Kuntz, PE
Vice President / Satellite Office Manager
**SCS Engineers**

Enclosure: Figures 1, 3, 6, and 7

8/17/2023 7:11 PM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application\Location Restiction Letters Drawings\01 LOC MAP1




N

0 4 MILES 8 MILES

APPROXIMATE SCALE IN MILES

**SOURCE:**

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA

Sandeep Saraf 8-18-23

**FOR PERMITTING PURPOSES ONLY**

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE
**GENERAL LOCATION MAP**

PROJECT TITLE
**NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION**

CLIENT
**N.E. LAND FILL, LLC**
**NORTHEAST LANDFILL**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

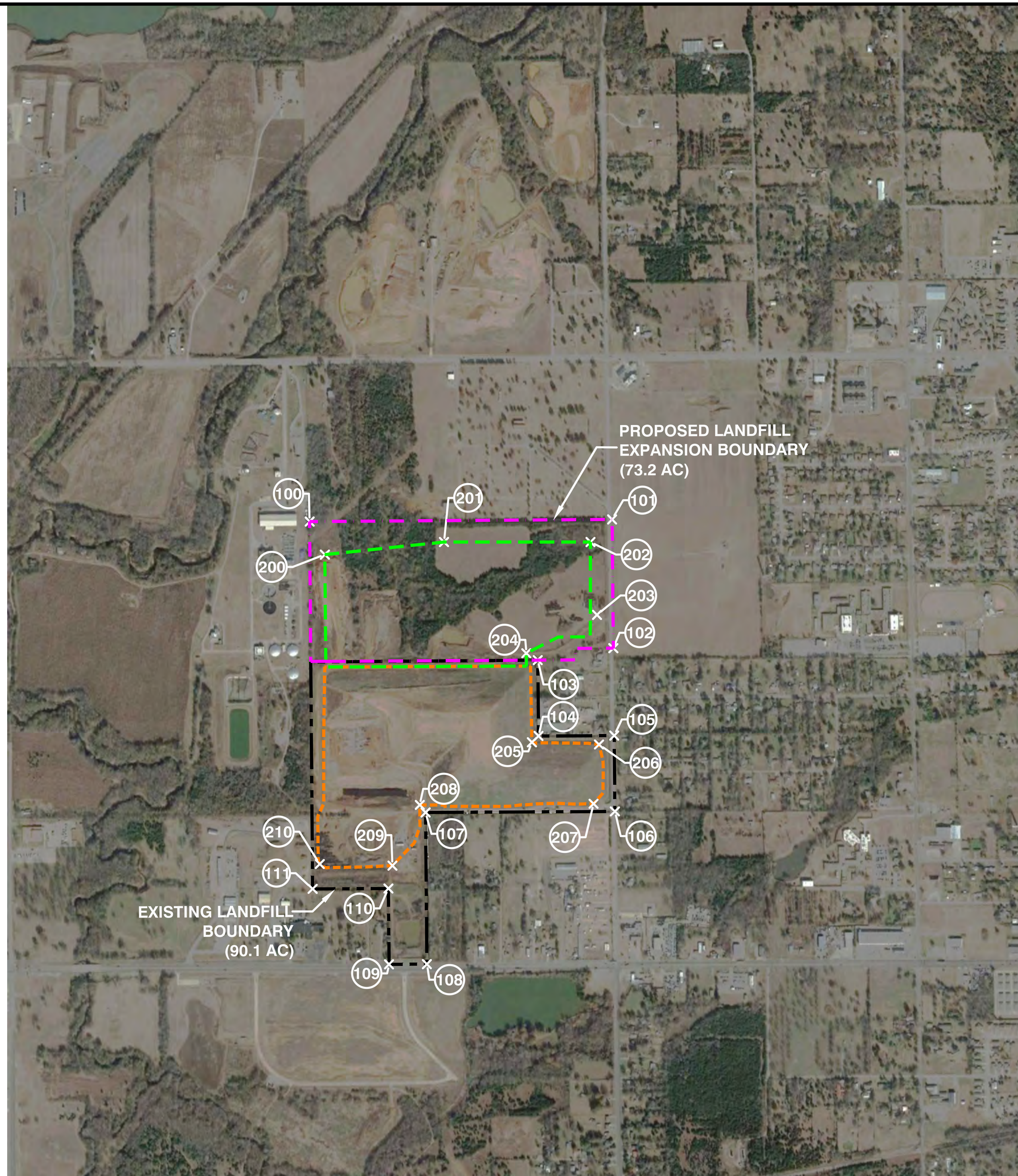
| PROJ. NO. 16219107.00 | DWN. BY: NR | Q/A RVW BY: SS |
|---|---|---|
| DSN. BY: SS | CHK. BY: RRK | APP. BY: RRK |

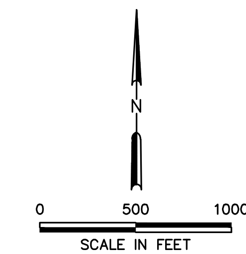
CADD FILE: 01 LOC MAP1

DATE: 07/2023

SCALE: AS SHOWN

DRAWING NO. 1




## LEGEND

- EXISTING LANDFILL BOUNDARY
- PROPOSED LANDFILL EXPANSION BOUNDARY
- CURRENT LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE

| PERMIT BOUNDARY | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 100 | N35° 30' 13.47" | W97° 23' 51.04" |
| 101 | N35° 30' 13.49" | W97° 23' 19.15" |
| 102 | N35° 30' 02.39" | W97° 23' 19.11" |
| 103 | N35° 30' 01.40" | W97° 23' 27.08" |
| 104 | N35° 29' 54.86" | W97° 23' 27.06" |
| 105 | N35° 29' 54.86" | W97° 23' 19.08" |
| 106 | N35° 29' 48.32" | W97° 23' 19.05" |
| 107 | N35° 29' 48.33" | W97° 23' 39.01" |
| 108 | N35° 29' 35.26" | W97° 23' 38.97" |
| 109 | N35° 29' 35.26" | W97° 23' 42.96" |
| 110 | N35° 29' 41.80" | W97° 23' 42.98" |
| 111 | N35° 29' 41.81" | W97° 23' 50.97" |

| LIMITS OF WASTE | | |
|---|---|---|
| POINT # | LATITUDE | LONGITUDE |
| 200 | N35° 30' 10.61" | W97° 23' 49.46" |
| 201 | N35° 30' 11.63" | W97° 23' 36.89" |
| 202 | N35° 30' 11.55" | W97° 23' 21.45" |
| 203 | N35° 30' 05.27" | W97° 23' 20.81" |
| 204 | N35° 30' 02.01" | W97° 23' 28.29" |
| 205 | N35° 29' 54.32" | W97° 23' 27.76" |
| 206 | N35° 29' 54.10" | W97° 23' 20.68" |
| 207 | N35° 29' 48.99" | W97° 23' 21.29" |
| 208 | N35° 29' 48.99" | W97° 23' 39.61" |
| 209 | N35° 29' 43.77" | W97° 23' 42.53" |
| 210 | N35° 29' 43.95" | W97° 23' 50.20" |

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE
AERIAL PHOTO

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

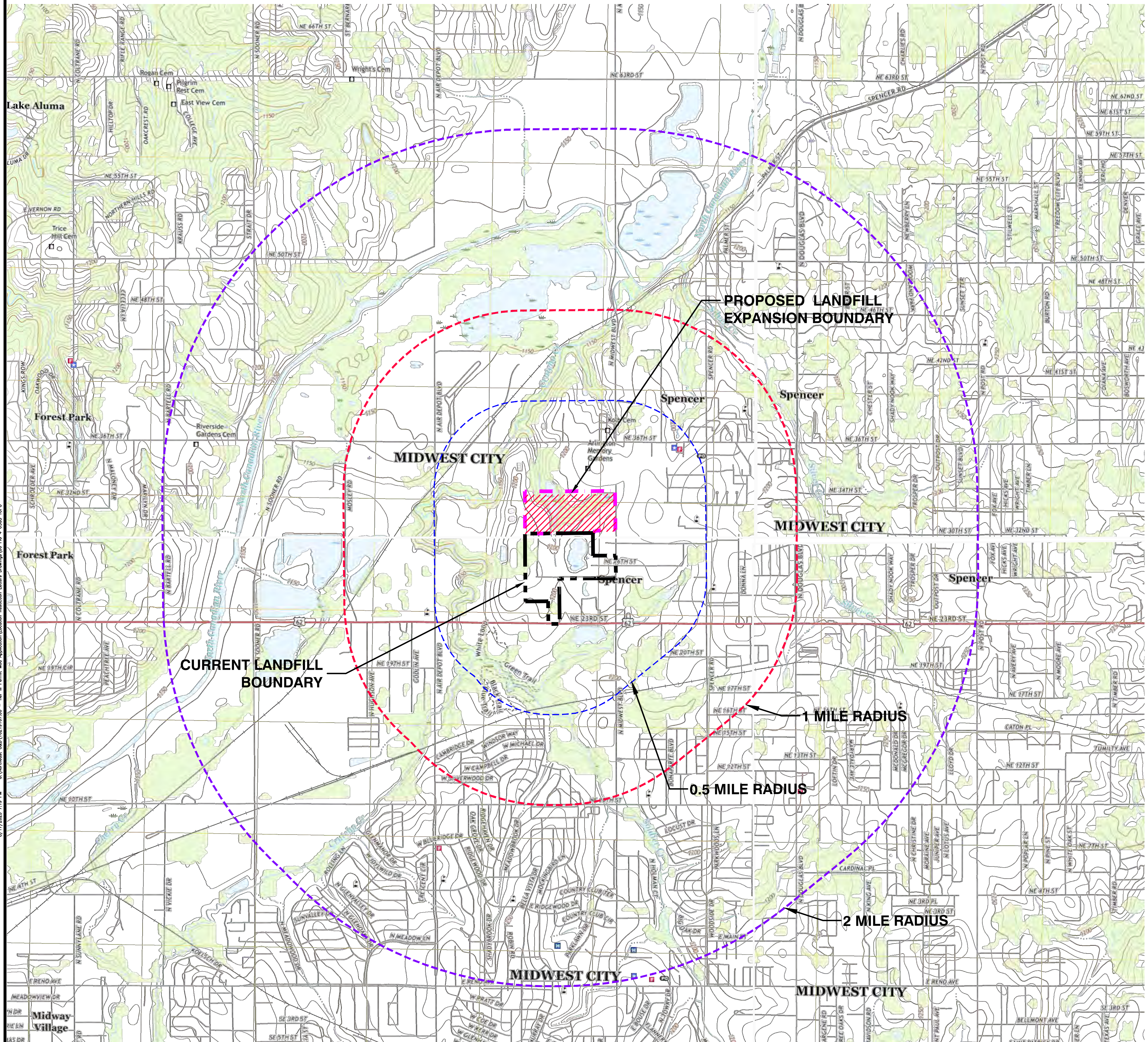
PROJ. NO. 16219107.00
DSN. BY: SS
DWN. BY: DS
CHK. BY: SDS
Q/A RVW BY: SS
APP. BY: RRK

CADD FILE: 03 AERIAL PHOTO

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 3




N

0 1500 3000
SCALE IN FEET

## LEGEND

| | |
|---|---|
| | EXISTING LANDFILL BOUNDARY |
| | PROPOSED LANDFILL EXPANSION BOUNDARY |
| | PROPOSED LANDFILL EXPANSION AREA |
| | 0.5 MILE RADIUS |
| | 1 MILE RADIUS |
| | 2 MILE RADIUS |
| 1200 | EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1) |

ROAD CLASSIFICATION

| | |
|---|---|
| Expressway | Local Connector |
| Secondary Hwy | Local Road |
| Ramp | 4WD |
| US Route | State Route |

**SOURCE:**

CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2022); JONES, OKLAHOMA (2022); CHOCTAW, OKLAHOMA (2022); AND MIDWEST CITY, OKLAHOMA (2022); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV. DATE DESCRIPTION BY

DRAWING TITLE: GENERAL TOPOGRAPHIC MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC.
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

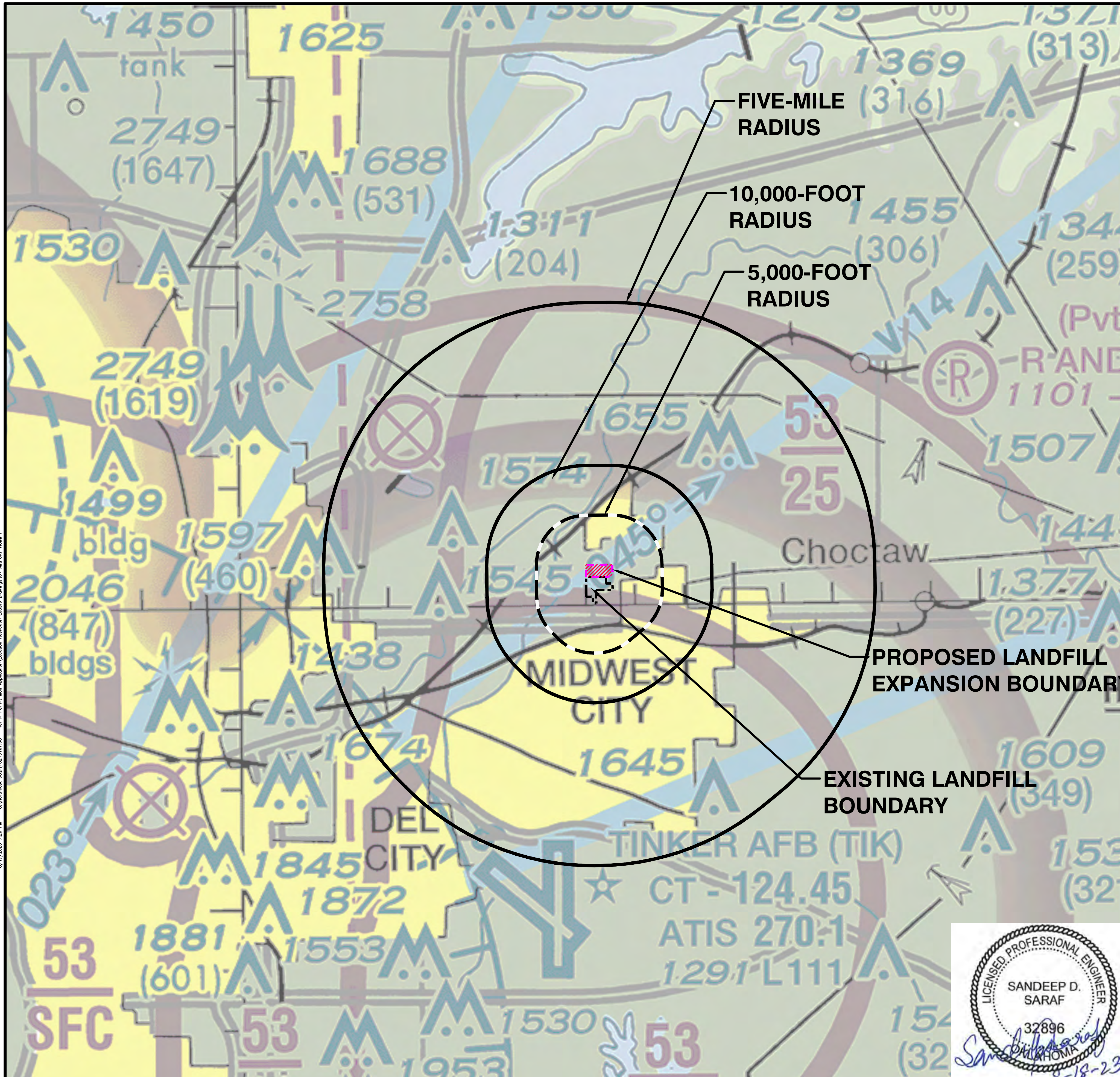
CADD FILE: 06 FIG 4 USGS TOPO

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 6

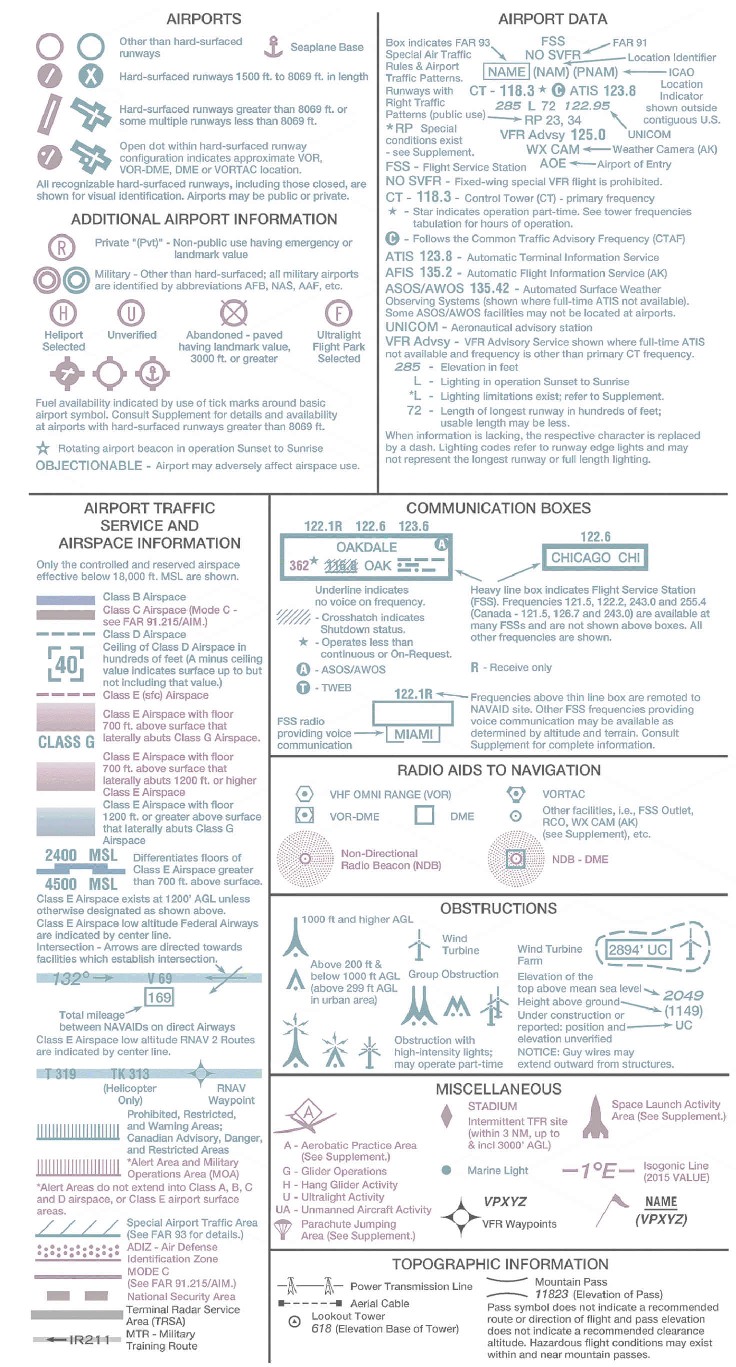
8/17/2023 7:19 PM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application\Location Restriction Letters Drawings\06 FIG 4 USGS TOPO




0 1 2
SCALE IN MILES

## LEGEND

| | |
|---|---|
| EXISTING LANDFILL BOUNDARY | |
| PROPOSED LANDFILL EXPANSION BOUNDARY | |
| PROPOSED LANDFILL EXPANSION AREA | |




**NOTE:**

1. THIS MAP REPRODUCED FROM THE FAA DALLAS-FORT WORTH SECTIONAL AERONAUTICAL CHART 104TH EDITION, EFFECTIVE FEBRUARY 27, 2020.

FOR PERMITTING PURPOSES ONLY

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DRAWING TITLE
**FAA AIRPORT VICINITY MAP**

PROJECT TITLE
**NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION**

CLIENT
**N.E. LAND FILL, LLC**
**NORTHEAST LANDFILL**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SDS | DWN. BY: NR | CHK. BY: SDS | Q/A RVW BY: SDS | APP. BY: RRK

CADD FILE: 07 AIRPORT VICINITY

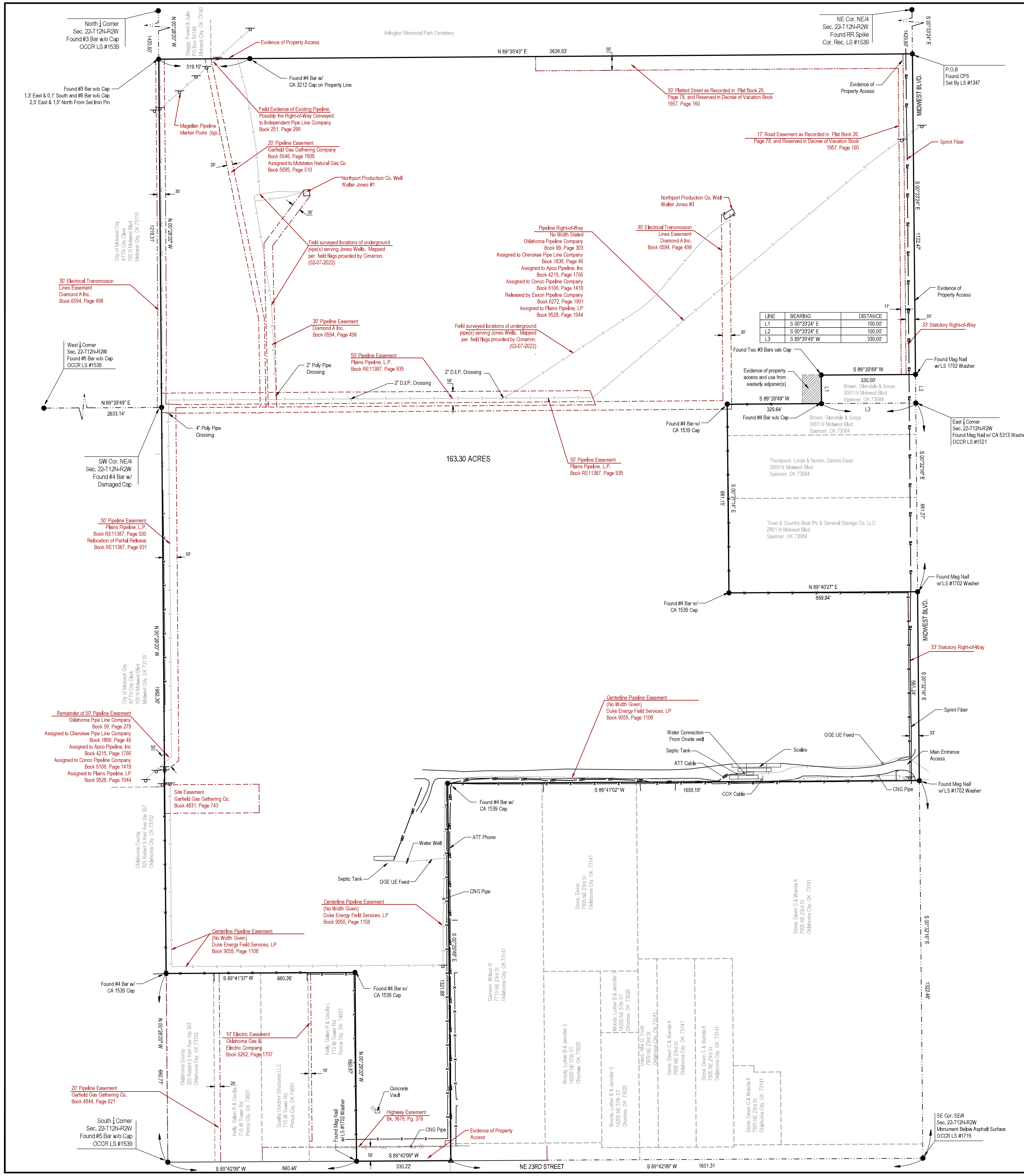
DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. **7**

# Appendix A-3

# Boundary Survey and Legal Description




PROPERTY DESCRIPTION

The West Half (W/2) of the Northeast Quarter (NE/4) of the Southeast Quarter (SE/4) and the Southeast Quarter (SE/4) of the Northeast Quarter (NE/4) of the Southeast Quarter (SE/4) and the Northwest Quarter (NW/4) of the Southeast Quarter (SE/4) and the Northwest Quarter (NW/4) of the Southwest Quarter (SW/4) of the Southeast Quarter (SE/4) and the West Half (W/2) of the East Half (E/2) of the Southwest Quarter (SW/4) of the Southeast Quarter (SE/4) of Section 22, Township 12 North, Range 2 West of the Indian Meridian, Oklahoma County, Oklahoma.

AND

A part of the Northeast Quarter (NE/4) of Section 22, Township 12 North, Range 2 West of the Indian Meridian, Oklahoma County, Oklahoma, more particularly described as follows:
Commencing at the Northeast (NE) corner of said Northeast Quarter (NE/4); thence along the East Line of said Northeast Quarter (NE/4), S 00°33'24" E a distance of 1420.60 feet to the Point of Beginning; thence continuing along said East Line of the Northeast Quarter (NE/4), S 00°33'24" E a distance of 1122.47 feet to a point which is 100 feet N 00°33'24" W from the Southeast (SE) corner of said Northeast Quarter (NE/4); thence S 89°39'49" W a distance of 330.00 feet; thence S 00°33'24" E a distance of 100.00 feet to a point on the South Line of said Northeast Quarter (NE/4); thence along said South Line of the Northeast Quarter (NE/4), S 89°39'49" W a distance of 2308.74 feet to the Southwest (SW) corner of said Northeast Quarter (NE/4); thence along the West Line of said Northeast Quarter (NE/4), N 00°28'20" W a distance of 1219.31 feet, thence N 89°35'43" E a distance of 2636.93 feet to the Point of Beginning.

Described property being subject to easements and rights-of-way shown hereon and to any and all easements and rights-of-way of record or fact.

LEGEND

- Found Existing Monument as Noted
- Set Mag Nail w/ LS 1702 Washer
- Light Pole
- Power Pole
- P.O.B. Point of Beginning
- Subject Tract Property Line
- Existing Easement
- Existing Right-of-Way
- USPLSS Reference Lines
- Adjoining Parcel Lines (Approx.)
- G — Gas Pipe Line
- X — Fence
- OHE — Overhead Electric
- FO — Fiber Optic Cable
- UGT — Underground Telephone
- E — Underground Electric
- UGC — Underground Cable

SURVEYOR'S PLAT NOTES

1. This survey meets or exceeds the requirements set forth by the "Oklahoma Minimum Standards for the Practice of Land Surveying" as adopted by the Oklahoma State Board of Registration for Professional Engineers and Land Surveyors.
2. Utility and pipeline information shown hereon was taken from above ground visual field observations and utility maps. No subsurface utilities were located in the field and it is recommended that before excavation is performed in any areas, a complete subsurface utility location be performed. Utility information shown hereon was only mapped to the extent discovered. Although no field evidence was found, there may be possible underground utilities connecting Walter Jones Well #1 and Walter Jones Well #3. This map is not intended to show/report all utilities affecting the property.
3. Abstracting services for this survey was provided by First American Title Company which included: Supplemental Abstract of Title No. 958619-OK99, Supplemental of Title No. 2644131-OK99, Title Policy 0-958619, and Title Policy O106-06-9100506. No investigation or independent research was conducted for easements, rights-of-way, restrictions, covenants, encumbrances or other facts that were not disclosed by above abstracting services. The location of each easement, right-of-way, servitude and other matters affecting the said property as provided by abstracting services has been shown on the survey to the extent that such matters can be located. NOTE: Easements are platted based on old descriptions and exhibit maps that were likely drafted before installation of utilities; therefore, the easements shown hereon are approximate in location. Utility owners should be notified prior to any improvements in around these easements.
4. Environmental, subsurface and flood conditions were not investigated as part of this survey.
5. Rights and interests in and to any oil, gas, coal, ores or other minerals were not investigated as part of this survey.
6. Adjoining parcel lines shown hereon were scaled from Oklahoma County GIS maps, and are not intended to represent true boundary lines.
7. This plat was prepared from a field survey completed on February 07, 2022, and is for the use and benefit of the party stated hereon.
8. This survey is only valid if the plat contains a seal with original signature signed in blue ink.

THE FOLLOWING EASEMENTS COULD NOT BE ACCURATELY PLOTTED, BUT APPEAR TO AFFECT THE SUBJECT PROPERTY:

Independent Pipe Line Company
Book 251, Page 266
NE/4
Assigned to Williams Pipe Line Company
Book 4978, Page 629
Released by Williams Pipe Line Company
Book 7238, Page 1562

Continental Pipe Line Company
Book 4793, Page 1196
Affects that part with NE/4 of Sec22
Assigned to Plains Pipeline, LP
Book 9528, Page 1944

Airport Zoning Book 3065, Page 621

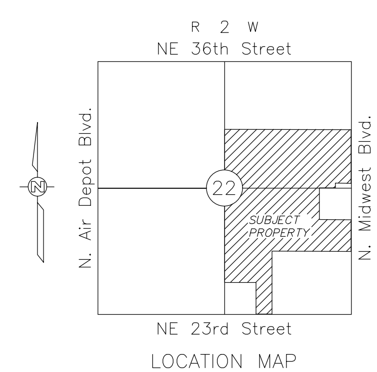
Oklahoma Dept of Environmental Quality
Access Easement Book 9351, Page 38

Cities Service Gas Company
Book 393, Page 328
NE/4, SE/4

Cities Service Gas Company
Book 396, Page 251
NW/4, SW/4, SE/4
Assigned to ONE Gas, Inc.
Book RE12813, Page 1408

Midstates Natural Gas Company
Book 5695, Page 510
E/2
Assigned to Associated Natural Gas, Inc.
Book 6312, Page 1457

Diamond Energy Operating Company
Book 6740, Page 1151
30' Pipeline R/W and Easement across:
N170 of W/2, NW/4, SE/4



LOCATION MAP

200 0 100 200 300
SCALE 1" = 200'

BASIS OF BEARING:
STATE PLANE COORDINATE SYSTEM
NAD 83 – OKLAHOMA NORTH ZONE

DISTANCES:
DIMENSIONS SHOWN HEREON ARE GRID DISTANCES

PROFESSIONAL LAND SURVEYOR
Johnny L. Mason
02/17/2022
1702
OKLAHOMA

CA NO. 7244
EXPIRES 6/30/23

PART OF THE EAST HALF (E/2), SEC. 22, T12N, R2W, I.M.,
OKLAHOMA COUNTY, OKLAHOMA

| REV. | DATE | DESCRIPTION |
| --- | --- | --- |
| | | |

mason
SURVEYING & CONSULTING, INC.
PO BOX 571 • GENTRY, AR 72734 • (479)238-3109

| | |
| --- | --- |
| Project No. | 21105 |
| Original Date: | 02-17-2022 |
| Drawn By: | JMLM |
| Approved By: | JMLM |

BOUNDARY SURVEY FOR:
GFL ENVIRONMENTAL
NE LAND FILL, LLC
2601 N. MIDWEST BLVD
SPENCER, OK 73084

SCS ENGINEERS

# Appendix A-4

# Proof of Property Ownership

20091211011634320
12/11/2009 01:17:57 PM
BK:RE11261 Pg:1969 DEED
State of Oklahoma
County of Oklahoma
Oklahoma County Clerk
Carolynn Caudill

**LIMITED LIABILITY COMPANY**
**QUIT CLAIM DEED**
**(Statutory Form)**

KNOW ALL MEN BY THESE PRESENTS:

THAT **B.E. Land, LLC, an Oklahoma Limited Liability Company,** party of the first part, in consideration of the sum of Ten dollars and Zero cents and other valuable considerations to it in hand paid, the receipt of which is hereby acknowledged does hereby quit claim, grant, bargain, sell and convey unto **NE Land Fill, LLC, an Oklahoma Limited Liability Company** party of the second part, all of its right, title, interest, estate, and every claim and demand, both at law and in equity, in and to all of the following described real property situate in Oklahoma County, State of Oklahoma, to-wit:

See Attached EXHIBIT A for Legal Description

together with all the improvements thereon and the appurtenances thereunto belonging.

TO HAVE AND TO HOLD the above described premises unto the said party of the second part, his/her heirs and assigns of the survivor forever.

Signed and delivered this 7th day of December, 2009.

K CAPITOL ABSTRACT AND TITLE COMPANY
6601 N. BROADWAY EXT., BLDG. #5
OKLAHOMA CITY, OKLAHOMA 73116
9100506 KC

B.E. Land, LLC

By: Gary M. Derryberry
Gary M Derryberry, Vice President of
Heritage Trust Company, Manager

STATE OF OKLAHOMA }
} ss. LLC ACKNOWLEDGMENT
COUNTY OF OKLAHOMA }

Before me, the undersigned, a Notary Public, in and for said County and State, on this 7th day of December, 2009 personally appeared Gary M Derryberry, Vice President of Heritage Trust Company, Manager of B.E. Land, LLC, an Oklahoma Limited Liability Company to me known to be the identical person who signed the name of the maker thereof to the within and foregoing instrument as its Manager and acknowledged to me that he executed the same as his free and voluntary act and deed for the uses and purposes therein set forth.

Given under my hand and seal the day and year last above written.

JENNIFER JOHNSON
NOTARY
# 05003731
EXP. 04/19/13
PUBLIC
STATE OF OKLAHOMA

My Commission Expires:

December 7, 2009

Notary Public
Jennifer Johnson

9100506

UNOFFICIAL

1068.00 2/15

## EXHIBIT A

A part of the Northeast Quarter (NE/4) of Section Twenty-two (22), Township Twelve (12) North, Range Two (2) West of the Indian Meridian, Oklahoma County, Oklahoma, more particularly described as follows: Beginning at a point which is 1420.6 feet South from the Northeast corner of said Quarter Section; thence South along the East line thereof a distance of 1120 feet to a point which is 100 feet North from the Southeast corner of said quarter section; thence West 330 feet to a point; thence South 100 feet to the South line of said Quarter Section; thence West along the South line to the Southwest corner of said Quarter Section; thence North along the West line of said Quarter Section a distance of 1220 feet to a point; thence East to the East line of said Quarter Section, the point or place of beginning.

UNOFFICIAL

20091211011634320
Filing Fee: $15.00
Doc. Stamps: $1,068.00
12/11/2009 01:17:57 PM
DEED

# Appendix A-5

# Copy of Agreement with City of Spencer

**RESOLUTION #23-**

**A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SPENCER AUTHORIZING THE ACCEPTANCE OF SETTLEMENT OF THE APPEAL REGARDING THE APPLICATION OF N.E. LAND FILL, LLC FOR A USE PERMITTED IN I-3, HEAVY INDUSTRIAL DISTRICT**

WHEREAS, on or about March 31, 2020, a hearing was held at Public Meeting to consider the Application of N.E. Land Fill, LLC for a Use Permitted on Review in the I-3 Heavy Industrial District. The Application was denied at the Public Meeting.

WHEREAS, subsequently N.E. Land Fill, LLC filed an Appeal with the Oklahoma County District Court in the case styled N.E. Land Fill, LLC v. The City of Spencer Board of Adjustment, CV-2020-1489.

WHEREAS, the parties attended Court ordered mediation with Joe Hampton, mediator with JH ADR and the matter was resolved between the parties per the terms contained within the attached Settlement Term Sheet attached hereto as Exhibit "A", pending City Council's approval.

NOW, THEREFORE, BE IT RESOLVED, that the CITY OF SPENCER:

Adopts in its entirety the Settlement reached between N.E. Land Fill, LLC and The City of Spencer per the terms contained within the Settlement Term Sheet attached hereto as Exhibit "A".

PASSED AND ADOPTED on this 30th day of March, 2023.

AYES: 4
NOES: 0
ABSENT: 0
ABSTAIN: 0

ATTEST:

MAYOR

Cecilia Taft
CITY CLERK

EXHIBIT "A" TO RESOLUTION #23-

NE LAND FILL, LLC — CITY OF SPENCER
SETTLEMENT TERM SHEET

1. NELF will not seek to include a permit for MSW disposal. Its expansion plans will be for its current operation as a C&D landfill.

2. NELF will make a one time lump sum payment of Two Hundred Thousand and no/100 Dollars ($200,000.00) to Spencer upon issuance of the expansion permit.

3. Upon issuance of the expansion permit and during the life of the landfill (while remaining capacity exists and waste being accepted), NELF will pay Spencer an annual fee of One Hundred Thousand and no/100 Dollars ($100,000.00). Over the estimated life of the landfill this delivers a potential benefit of Two Million and no/100 Dollars ($2,000,000.00) to Spencer.

4. Upon issuance of the expansion permit and during the life of the landfill (while remaining capacity exists and waste being accepted) NELF will pay Spencer a host fee of Fifty and no/100 Cents (.50) per ton for each ton of C&D waste disposal at the landfill.

5. Upon Spencer's approval of the agreement, NELF will pay Spencer a non-refundable, one tiine sponsorship payment of Seventy Five Thousand and no/100 Dollars ($75,000.0) for the football field project.

6. NELF Will complete a beautification project at the landfill consisting of a new gate, fencing (8') and trees consistent with the renderings attached hereto as Exhibits "A" and "B" for illustration. Supplemental tree plantings will be made along the north side and NE 23rd Street side of the landfill. Entrance gate to be no less than 50' from the center of Midwest Boulevard.

7. NELF commits to cooperate fully and in good faith with Spencer in its efforts to widen the existing roadway.

8. Spencer has the right to inspect the landfill on a weekly basis.

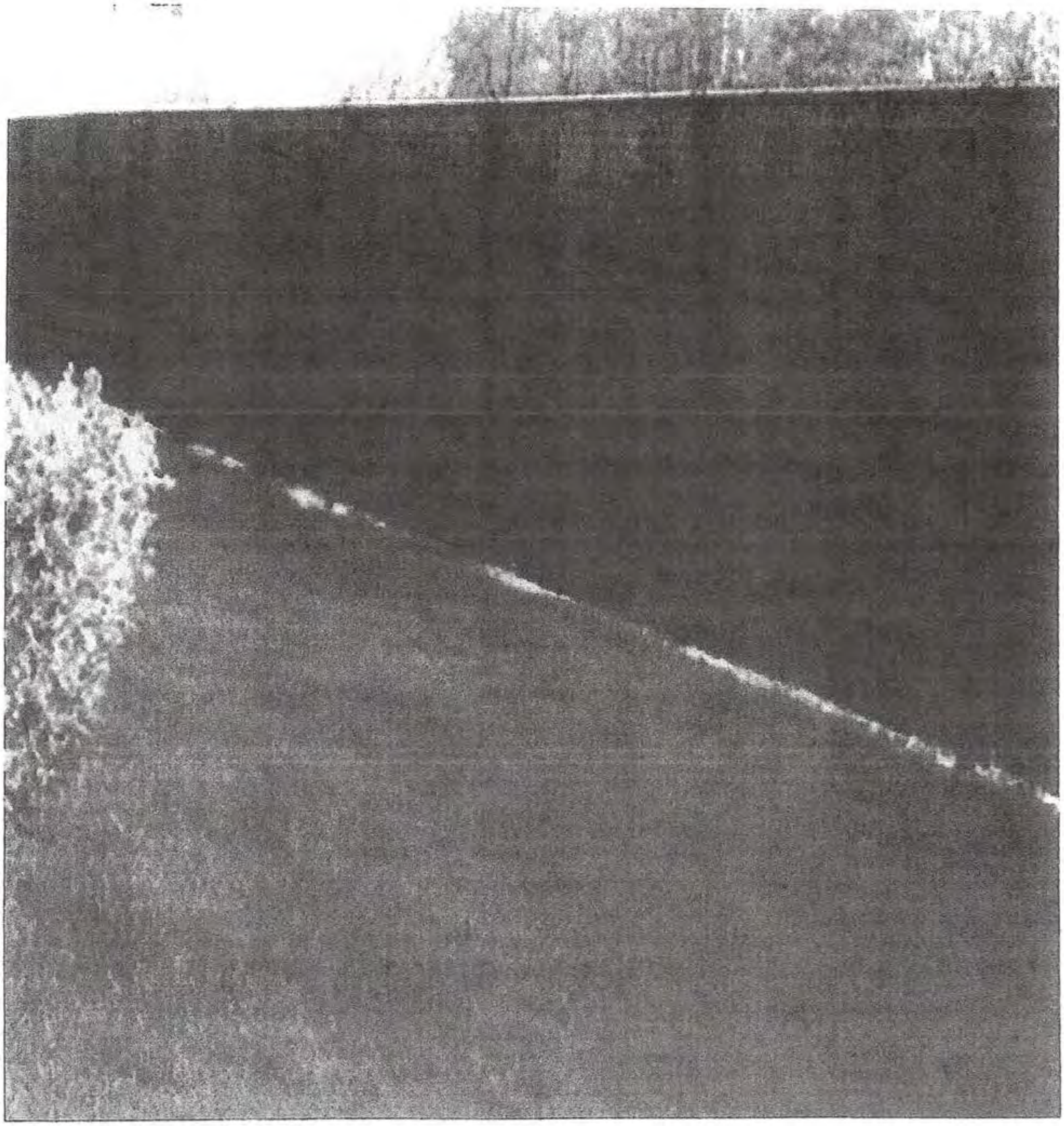
9. This matter and agreement is to be presented to the Spencer City Council at its meeting on March 23, 2023.

10. Upon approval of the agreement by the Spencer City Council and all required local approvals, the parties will dismiss the pending litigation.

11. Spencer agrees to cooperate with all ODEQ approvals and consent to C&D expansion.

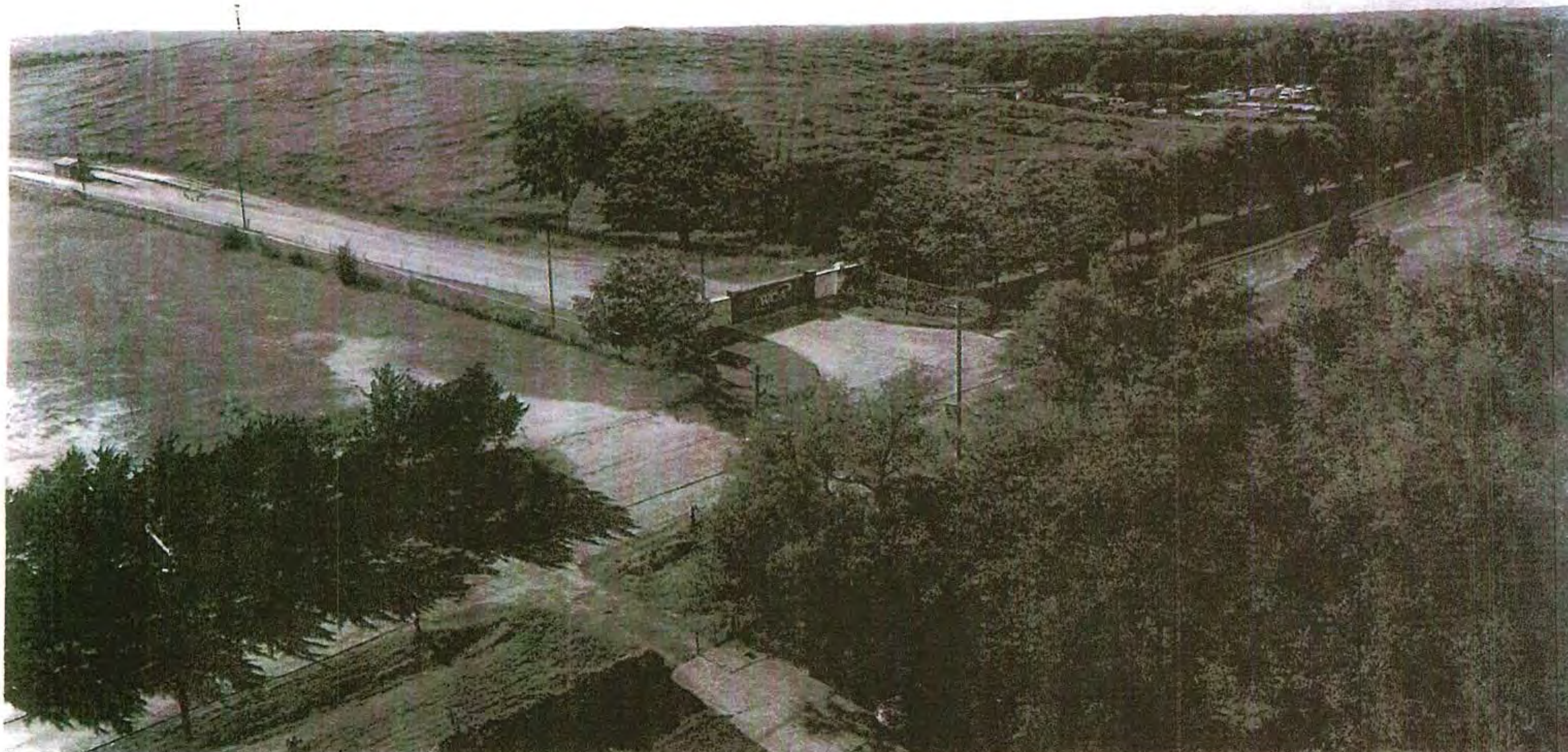
# EXHIBIT "A"


WCA



This next picture shows a close-up of black slats on a galvanized mesh. Notice the gap between the slats. Bottom locking slats obscure about 75% visibility. This will require post spacing to be reduced from the standard 10ft to 5-6 ft depending on the wind conditions in your area. Your fence is turning into a sail, it will need more bracing. They have a 25 year limited warranty and because each slat ties into the track at the bottom, they can be individually replaced if ever damaged. You'll never need to replace more than you need to.

**EXHIBIT "B"**



# Appendix B

# Hydrogeological and Geotechnical Investigation

# Appendix B
# Hydrogeological and Geotechnical Investigation

## Northeast C&D Landfill

Prepared for:

**N.E. Land Fill, LLC**
2601 North Midwest Blvd
Spencer, OK 73084

Prepared by:

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August 2023
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## Certification

This Hydrogeological and Geotechnical Investigation Report has been prepared in accordance with good engineering practice including consideration of industry standards and the requirements of the Oklahoma Department of Environmental Quality.

Prepared by:

8/21/23
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8/21/23
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# 1.0 INTRODUCTION

This hydrogeological report documents the investigation conducted for the Tier III permit modification application at the Northeast C&D landfill (landfill). The investigation was performed to meet the requirements of Title 252 Oklahoma Department of Environmental Quality (DEQ) chapter 515, "Management of Solid Waste." The investigation followed the DEQ approved Work Plan (SCS, December, 2019) and the specific references to DEQ Regulation 252:515 are included within applicable subsection titles of this report.

## 1.1 BACKGROUND

The combined total permit boundary (existing and expansion) will be 163.3 acres, and the combined total waste disposal area (existing and expansion) available for C&D waste disposal upon obtaining approval of the permit application will be 121.2 acres. A site location map is presented as Figure 1.1 and a facility layout, including the existing and proposed landfill, is presented as Figure 1.2.

## 1.2 WORKPLANS AND APPROVALS

A Drilling Work Plan (Plan) was submitted to DEQ for approval in December 2019 in accordance with OAC 252:515-7-4, which was approved by DEQ on February 10, 2020. This Plan included the name, address, and telephone number of the owner/operator, the consulting firm, and the person in charge of the project. In addition, the following maps were included in the Plan as per regulation 252:515-7-4:

- General location map, flood plan map, and quadrangle topographic map in accordance with OAC 252:515-3-52;
- Existing contour map in accordance with OAC 252:515-3-55, showing the locations, estimated elevations and total depths of any proposed or existing borings on site;
- Site specific maps showing any wetlands, fault areas, seismic impact zones, and alluvium or terrace deposits and their recharge areas; and
- Drawings of proposed piezometers and/or monitoring wells to demonstrate their construction will be in accordance with the requirements of the OWRB (OAC 252:515-7-3).

As outlined in the Plan, the locations and depths of the borings were completed in accordance with OAC 252:515-7-4(b)(3)&(4). The Plan, along with the DEQ approval letter, are included as Appendix A of this report.

In accordance with OAC 252:515-7-5, once approval was granted for the Plan, a Notice of Intent to Drill was prepared and submitted to DEQ prior to initiating drilling activities. All subsurface drilling activities were conducted in accordance with the approved Plan and were supervised by a qualified groundwater scientist.

# 2.0 REGIONAL CHARACTERIZATION

In accordance with OAC 252:515-7-38, this section discusses the regional climate, soils, hydrology, geology, hydrogeology, and water quality of the area surrounding the landfill. The information contained in these sections was compiled from published literature, previous studies conducted at the site, and from the borings advanced during the current investigation.

## 2.1 REGIONAL SOILS

According to the Soil Survey of Garvin County, Oklahoma, published by the U.S. Soil Conservation Service (USDA, 1985) and the review of information provided by the Web Soil Survey website (July 8, 2015), the soils in the vicinity of the landfill can be classified as seven distinct soil units:

- Vanoss silt loam (1 to 3% slopes) - (approximately 26.7%)
- Harrah fine sandy loam (3 to 45% slopes) - (approximately 15.7%)
- Teller fine sandy loam (5 to 8% slopes) - (approximately 13.1%)
- Teller fine sandy loam (3 to 5% slopes) – (approximately 11.4%)
- Teller fine sandy loam (1 to 3 % slopes) – (approximately 11.4%)
- Vanoss silt loam (0 to 1 % slopes) - (approximately 6.0%)
- Teller fine sandy loams eroded (3 to 5%) – (approximately 5.4%)

Figure 2.1 shows the locations of the soil units from USDA 1985 Soil Survey and the Web Soil Survey website (May 28, 2020) in relation to the landfill property boundary. The soils were mapped prior to activities within the proposed landfill area. Note the majority of soils on the landfill property consist of the Vanoss silt loam, Harrah fine sandy loam, and Teller fine sandy loam. A review of the Web Soil Survey also identified areas defined as pits or soils from mine spoils or earthy fill derived from sedimentary rocks (approximately 3.6%) which was located along the boundary of the site and the existing landfill property. The soil information described below is from the Soil Survey of Oklahoma County, Oklahoma USDA (2003) and Web Soil Survey Site (May 28, 2020).

The Vanoss series consists of very deep, well drained soils that formed in loamy alluvium of Pleistocene age. These soils occur on treads of stream terraces in the Central Rolling Read Prairies. Slopes range from 0 to 8 percent. The surface layer is comprised of grayish brown to very dark grayish brown loam. Surface soils have a weak fine granular structure that is slightly hard and friable and is approximately 11 inches thick. The sub soil is brown to dark brown with a medium sub angular blocky structure that is hard and friable.

The Harrah fine sandy loam series (3 to 45% slopes) consists of soils that are very deep, well drained, and moderately permeable. The Harrah series is formed from sandy and loamy colluvium weathered from sandstone of Permian age. These soils are on back slopes and foot slopes of low hills. The surface layer is a brown fine sandy loam that has a weak fine granular structure which is soft and friable and is approximately 9 inches thick. The sub soil is light brown loamy sand which is also soft and friable.

The Teller fine sandy loam series consists of very deep, well drained and moderately permeable soils that formed in loamy sediments of Pleistocene age. The Teller series soils are nearly level to gently sloping soil and are on treads and risers of stream terraces in the Central Rolling Red Prairies. Slope ranges from 0 to 8 percent. The surface layer is comprised of dark brown fine sandy loam that is weak fine and a medium granular structure that is slightly hard and very friable and is approximately 15 inches thick. The subsoil is brown to dark brown fine sandy loam that is weak with a medium sub angular blocky structure, which is slightly hard and friable.

## 2.2 REGIONAL GEOLOGY

The landfill is located within the Osage Plains, a section of the Central Lowland province, which in turn is part of the larger Interior Plains physiographic province. Three sub-regions make up the Osage Plains, the Flint Hills, Blackland Prairies, and the Cross Timbers. The sub-region that stretches across central Oklahoma is known as the Cross Timbers region. The woodland and savanna portions of the

Cross Timbers are mainly Post Oak and Blackjack Oak on coarse, sandy soils, while the prairie portions are chiefly tallgrass on finer, dry soils.

The landfill is located within the Permian-age sandstone known as the Garber Sandstone and is underlain by the Wellington Formation which is also of Permian age. Both the Garber Sandstone and the Wellington Formation consist of lenticular beds of massive appearing, cross-bedded sandstone irregularly inter-bedded with shale which is part sandy to silty. The sandstone layers are fine to very fine grained and loosely cemented. The sandstone is poorly cemented and crumbles easily. Color ranges from nearly white to pink, orange, deep red, or purple. Although some sandstone beds are relatively thick, beds five feet or less in thickness are common. The thickness of the Garber Sandstone is approximately 350 feet in Oklahoma County. The Wellington Formation is approximately 799 feet in thickness in the subsurface. Therefore, the two formations as a unit have a total thickness that ranges from 800 to 1000 feet (Wood/Burton, 1968). Table 2.1 shows the Geologic Column from surface to a 500 feet. Figure 2.2 depicts a Regional Geologic Map and Figure 2.3 depicts a Site Geologic Map.

OAC 252:515-5-5(a) states that no area within the permit boundary of a new land disposal facility, or expansion of the permit boundary of an existing land disposal facility, shall be located within an area designated as alluvium or terrace deposits and their recharge areas, as shown on “Map of Aquifers and Recharge Areas in Oklahoma” complied by Kenneth S. Johnson, Oklahoma Geological Survey (1991).

According to the “Geologic Map of the Midwest City 7.5’ Quadrangle, Cleveland and Oklahoma Counties, Oklahoma” compiled by Thomas M. Stanley and Neil H. Suneson, 2000 and the “Geologic Map of the Spencer 7.5’ Quadrangle, Oklahoma County, Oklahoma” complied by Thomas M. Stanley and Neil H. Suneson, 1999; the proposed landfill is not located in alluvium or terrace deposits. See Figure 2.3 for the Site Geologic Map

The “Map of Aquifers and Recharge Areas of Oklahoma” complied by Kenneth S. Johnson, Oklahoma Survey (1991) is at such a large scale that locating the site with precision as it relates to terrace deposits is not possible. The 7.5’ Quadrangle maps are much smaller scale than the Kenneth S. Johnson Map and the boundaries shown are more representative of actual conditions. In addition, site specific geologic conditions obtained during previous subsurface investigations and presented in the Tier III Permit Application, dated November 2005 for the Northeast C&D Landfill, indicate that the site is underlain by silty sands underlain by weathered sandstone. Information from these historic investigations in addition to the information presented in this current investigation as provided in the following sections of this report indicate the lithology underlying the site is consistent with weathered Garber Sandstones and not alluvium or terrace deposits.

### 2.2.1 Seismicity

Based on the USGS U.S. Seismic Hazard Map, Peak Horizontal Acceleration with 2% Probability of Exceedance in 50 Years (2014), the location of the site is depicted as exhibiting a maximum horizontal acceleration (or effective peak ground acceleration) in rock of between 0.005 and 2.2 percent of gravity with a 98 percent probability of not exceeding the horizontal acceleration within a 50-year reoccurrence.

The proposed landfill is located within a seismic impact zone with a peak ground acceleration (PGA) of 0.17g from U.S. Geological Survey (USGS) Unified Hazard Tool and USGS Hazard Map 2014. Appendix C (Slope Stability and Final Cover Veneer Slope Analysis) address seismic issues in conjunction with the slope stability analyses for the landfill.

## 2.3 REGIONAL HYDROLOGY AND WATER QUALITY

According to the Hydrologic Atlas (HA-4) Reconnaissance of the Water Resources of the Oklahoma City Quadrangle, the facility is located in areas which are comprised of numerous saturated layers of fine to medium grained sandstone. Yields of deeper wells are generally greater than shallower wells because more of the sandstone layers are penetrated. The Hydrologic Atlas also noted that wells within these areas yield less than 150 to 300 gallons per minute. See Figure 2.4 *Hydrologic Atlas Reconnaissance of the Water Resources of the Oklahoma City Quadrangle.*

The Garber Sandstone is one of the most transmissive geological units within the Central Oklahoma aquifer and yields substantial amounts of water. Groundwater quality within the Garber sandstone is generally good quality, yield water containing 500 mg/l or less of dissolved solids. The presence of an undesired constituent or excessive hardness may make the water unsuitable for some purposes.

According to the Oklahoma Water Resources Board, the site is underlain by the Central Oklahoma Aquifer. The Central Oklahoma Aquifer underlies about 3,000 square miles of central Oklahoma. The Central Oklahoma Aquifer is referred to as the Garber-Wellington Aquifer since it is dominantly composed of the Permian aged Garber Sandstone and Wellington Formation. The aquifer ranges in thickness from 300 feet in the south to about 800 feet in the north. Wells commonly yield 25 to 400 gallons per minute and are generally of good quality with total dissolved solids ranging from 200 to 1,000 parts per million. Recharge areas consist of outcrops of the aquifer and extend eastward to the approximate top of shales that make up much of the lower one-third of the Wellington Formation.

A Groundwater Resource Map has been provided as Figure 2.5. The Resource Map shows groundwater wells that are located in the vicinity of the landfill Property. As shown on the Figure 2.5, 71 monitoring wells, 45 groundwater wells, and 12 other wells are located within a mile of the landfill property. The imagery for the Resource map was taken from OWRB.OK.gov.

Surface elevations at the site range from approximately 1,170 to 1,220 feet above mean sea level (fmsl). Surface water drains primarily east and north through the property into an intermittent stream which flows to the northwest approximately 0.5 miles into Crutcho Creek.

The landfill is located in the watershed of Crutcho Creek. Crutcho Creek flows north to the North Canadian River and drains an area of approximately six square miles which includes a portion of Tinker Air Force Base. The Crutcho Creek watershed mainly consists of urban development with parking lots, businesses, and housing developments. Crutcho Creek is located in the Central Great Plains ecoregion.

# 3.0 BORING PROGRAM

In February-March 2020 a characterization of the subsurface and groundwater conditions in the area of the proposed landfill was conducted. The field work was conducted in accordance with OAC 252:515-7-4 and the DEQ approved Drilling Work Plan prepared by SCS dated December, 2019 (see Appendix A). A total of sixteen (16) borings were drilled and piezometers were installed in eleven (11) of these borings. The boreholes ranged in depth from approximately 31 feet below ground surface (bgs) to a maximum depth of approximately 101 feet bgs. Further discussion of the lithology encountered in these borings and groundwater elevations measured over time can be found in Sections 3.1 and 4.2 respectively. Construction details for each boring drilled can be found on Table 3.1 and boring logs in Appendix B. The location of each boring is included on Figure 3.1.

The drilling contractor for drilling activities was Anderson Engineering of Little Rock, Arkansas. A buggy mounted CME-45 drill rig was utilized to advance the borings. The soil borings were advanced utilizing 8.25 OD hollow stem augers with continuous sampling unless auger refusal was reached. When hollow stem auger refusal occurred, the borings were drilled utilizing air rotary drilling techniques to the specified depth below ground surface. During air rotary drilling samples were collected at five-foot interval utilizing a split-spoon sampler. A SCS Field Geologist logged each boring and a detailed field boring log for each soil boring is presented in Appendix B.

## 3.1 BORING LOGS

In accordance with OAC 252:515-7-32 and 33, boring and lithologic logs were completed for each borehole for its entire depth. Each log includes the following information:

- All pertinent information, such as the depth at which water was encountered,
- Depth of water at the time of drilling and again 24 hours later,
- Geotechnical information about drilling, such as penetration rates, hydraulic conductivity test intervals and results, and drill bit changes,
- Identification of all soil and rock layers encountered during drilling describing color, texture, thickness, degree of compaction or consolidation and amount of moisture present in each layer,

In accordance with OAC 252:515-35, soil samples were collected continuously utilizing a 5-foot soil core barrel within the hollow stem auger. Once auger refusal was reached and drilling with wash rotary methods began, samples were collected at five-foot intervals utilizing a split spoon. Samples were placed in plastic Ziploc bags to preserve the sample. Samples will be stored until obtaining approval of the permit from DEQ.

The site geology and hydrogeologic conditions were defined by the sixteen borings drilled within the proposed expansion area and two existing monitoring wells (MW-3R and MW-4R). The soil boring/lithologic logs are presented in Appendix B of this report. In addition, a series of cross-sections were prepared to provide a visual presentation of the lithology beneath the proposed landfill area. The cross-section location map is Figure 3.2. The six cross-sections are Figures 3.3 through 3.8.

As the boring logs and cross-section present, the lithology beneath the site is consistent with the Garber Sandstone and with the geology as discussed in Section 2.2 of this report. The site geology consists of loosely cemented sandstone ranging in color from orange to red (Garber Sandstone) along with clay, silty clay, sandy clay, silty sand, and sand.

As indicated on cross-sections D (Figure 3.6), E (Figure 3.7), and F (Figure 3.8), there was little to no sand encountered in the borings along the southern edge of the proposed expansion area. Borings within the west-central and western portion of the landfill area found sand with thickness ten feet or greater. In the majority of these borings the sand beds were entirely saturated. However, unsaturated sand was found in borings EB-8/PZ-9 and PZ-3 located along the western and northern edge of the expansion area respectively.

## 3.2 DOWNHOLE GEOPHYSICAL LOGS

Downhole geophysical logs were obtained in accordance with OAC 252:515-7-34 which states that for waste disposal areas of 20 acres or less, at least three boreholes shall be logged by geophysical tools, one of which must be run on the deepest drilled borehole. In addition, one additional borehole shall be logged for each additional 20 acres of waste disposal. Gamma ray/neutron logs from total depth to the surface were logged within the casing of 9 of the boreholes during this investigation. Geophysical Logs are included in Appendix C of this report.

In accordance with OAC 252:515-7-32(a) and OAC 252:515-7-34(a), borehole geophysical logging was performed within boreholes that were converted to piezometers along with the 100-foot deep boring (EB-1) per OAC 252:515-7-34(a). Logging was performed on 9 of the onsite borings. The geophysical logs were performed by Century Geophysical Corporation of Tulsa, Oklahoma and include natural gamma, resistivity, and conductivity.

The natural gamma log is the recording of a scintillation counter or detector to the natural gamma radiation emitted by naturally occurring formations, or materials placed in the well bore annulus. Higher gamma readings occur in the presence of clay and shale. The neutron log uses a 1.0 Ci, Americium Beryllium neutron emitting radioactive source to measure the relative porosity of the formation. In cased hole applications, raw counts are recorded and scaled proportionally with increasing counts to the right, which are indications of sands or limestone. Decreasing counts to the left of the scale show higher water content or more clay or shale type formations. The borehole geophysical logs are included in Appendix C. A further description of the borehole geophysical methods used is included in the *Report of Geophysical Logs, NELF, for SCS Engineering* (Century Geophysical Corporation, 2020) which is included as Appendix D.

The natural gamma logs indicate variable response (0-150 API units), indicating some interbedded and moderately clean sand zones, and higher response from clay type materials. The conductivity response is mostly related to the dissolved salts and permeability of the pore spaces of the material. The calculated resistivity log indicates clays and shales are to the left and sandstones are to the right.

## 3.3 SOILS TESTS

In order to characterize the proposed expansion area in terms of geotechnical properties, samples were collected from boreholes drilled during this investigation. A total of 17 samples were collected from 13 boreholes. These 17 samples were taken at various depths and locations at the site and submitted to Anderson Engineering, Inc. for geotechnical analysis. The purpose of these analyses was to gain information on the geotechnical properties of the samples and to properly characterize each individual soil type found on site.

The appropriate geotechnical lab tests outlined below were conducted for characterization purposes, and in accordance with OAC252:515-7-36(3):

- Soil classification according to the specifications of ASTM D2487
- Particle-size analysis of soil according to the specifications of ASTM D422
- Sieve analysis for the following screen sizes: #4, #10, #40, #200
- Percent fines (#200 sieve) according to the specifications of ASTM D1140
- Atterberg limits according to the specifications of ASTM D4318
- Moisture content according to the specifications of either the oven drying method of ASTM D2216 or the microwave drying method of ASTM D4643
- Moisture-density relationship according to the specifications of the standard proctor test of ASTM D698 or the modified proctor test of ASTM D1557
- Hydraulic conductivity according to the specifications of ASTM D5084

Appendix E contains all geotechnical laboratory test results associated with soils present in the proposed landfill area. The following sections summarize the results of the geotechnical testing conducted during this investigation.

### 3.3.1 Sieve Analysis

Particle size analyses were conducted on the samples collected during this investigation for the purpose of analyzing grain size distribution and classification associated with soils native to the proposed expansion area.

In the sieve analysis, a series of sieves (screens) differing in opening size are stacked with the larger sizes over the smaller. The soil sample being tested is dried, clumps are broken, and the sample is passed through the series of sieves by shaking. Larger particles are caught on the upper sieves, and the smaller particles filter through to be caught on one of the smaller underlying sieves. The weight of material retained on each sieve is conventionally presented as a grain or particle size distribution on tables presented in the results.

Sieve analysis was conducted in 17 samples from the onsite soils. The percent of particles passing the #200 sieve within the clays ranged from 57% to 72% and within the sand ranged from 7% to 41%. As indicated in Table 3.2, samples were analyzed in the laboratory for grain size distribution in accordance with ASTM D422 and ASTM D1140.

### 3.3.2 Atterberg Limits/Moisture Content

In the remolded state, the consistency of clay soil varies in proportion to the water content. At higher water content, the soil-water mixture possesses the properties of a liquid. At lesser water contents a soil-water mixture possesses properties that resemble a plastic. At still lesser water contents, soil-water mixtures approach a solid or semi-solid state. The water content indicating the division between the liquid and plastic state has been designated as the Liquid Limit. The division between the plastic and semi-solid state is referred to as the Plastic Limit. The numerical difference between the Liquid Limit and the Plastic Limit is identified as the Plasticity Index. These values are often referred to as Atterberg Limits. The Atterberg Limits test is used to obtain basic index information on soils and is used to estimate strength, settlement, and workability characteristics. It is the primary form of classification for cohesive soils properties for soils commonly used in the construction of landfill liner systems. As presented in Table 3.2, 11 samples were analyzed for Atterberg Limits during this investigation.

In general, on-site clays determined to have Plasticity Indices greater than 10 can be considered for use in the construction of any clay liner system. The Plasticity Indices within the onsite clays ranged from 7 to 22 percent with all but two of the samples being greater than 10%. Liquid Limits ranged from 23 percent to 37 percent and the plastic limits ranged from 13 to 16 percent within the onsite clays. The Atterberg Limits results are presented in Appendix E.

### 3.3.3 Standard Proctor Density Summary/Moisture Density Relationships

Standard Proctor density tests were performed on a sample taken during the investigation in order to better classify the geotechnical properties of the soils on-site. The sample was obtained from a representative soil (EB-7 5'-10') within the study area to determine the suitability in the construction of the clay liner system. The sample was obtained and analyzed by Anderson Engineering, Inc. for determining the moisture-density relationship as defined in ASTM D698. Based on Standard Proctor analyses taken from the sample, it is anticipated that the optimum moisture content will be approximately 14.1% with a maximum dry density of approximately 114.3 pounds per cubic foot (pcf). Standard proctor results are presented in Appendix E and Table 3.2.

### 3.3.4 Hydraulic Conductivity Summary

Soil samples were obtained from EB-6 (20'-25'), EB-7 (5'-7'), PZ-4 (5'-10'), and PZ-6 (2'-5') for the purpose of characterizing the permeability characteristics of area soils. Results of these samples are presented in Appendix E. Table 3.2 summarizes the results of remolded hydraulic conductivity analyses for local soils. All tests were completed on remolded specimens in accordance with ASTM D-5084. EB-6 (20'-25') was obtained within the onsite sand and PZ-4 (5'-10'), EB-7 (5'-10'), and PZ-6 (2'-5') were obtained from the onsite Clays. The values from the sand unit tested was $5.06 \times 10^{-4}$ cm/sec. The values obtained from the clay units tested were $2.83 \times 10^{-7}$ cm/sec, $1.28 \times 10^{-8}$ cm/sec and $2.05 \times 10^{-8}$ cm/sec with an average result of $1.67 \times 10^{-8}$ cm/sec.

### 3.3.5 Soil Classification Summary

The Unified Soil Classification System (USCS) is commonly used in engineering and construction applications. Soil Classifications are on the basis of coarse and fine grained soils and are categorized based on laboratory tests including the grain size distribution analyses and Atterberg Limits. In general, the following soil classifications were identified within and near the expansion area.

CL: Clay
SP: Poorly Graded Sand
SM: Silty Sand
SC: Clayey Sand
ML Silt

The samples collected for geotechnical analyses were from bulk samples. The Soil Classifications can be seen in Appendix E of this report.

### 3.3.6 Standard Penetration Test Summary

Standard Penetration Tests (SPT) were conducted on overburden soils in the borings drilled within the proposed expansion area. The boring logs completed by SCS, located in Appendix D, note the "field" blow counts associated with the SPT analyses in the Comments portion of the logs.

### 3.3.7 Suitability for Landfill Uses

There are liner and final cover quality soils located on the site that meet the requirements of OAC 252:515-11-33. A discussion of this material is presented in the Permit Application.

# 4.0 GROUNDWATER STUDY

## 4.1 PIEZOMETERS INSTALLED

As per OAC regulation 252:515-7-52&53, the piezometers were installed in the uppermost saturated zone at locations approved by DEQ in order that data collected is representative of the expansion area. The lateral expansion area is 67.7-acres, therefore a minimum of five (5) piezometers were required by OAC 252:515-7-53(a)&(b). During this investigation nine (9) piezometers were installed and water levels were obtained on a monthly basis at the nine (9) piezometers and six (6) existing onsite monitoring wells and continuously via in-situ water level troll at PZ-6 and PZ-7.

The piezometer construction consisted of a 2-inch diameter Schedule 40 PVC solid riser and ten feet of 0.010" slotted screen. The sand filter pack extends to a minimum of two (2) feet above the screened interval. A minimum 2-foot bentonite pellet seal was placed immediately above the filter pack. After placement of the entire bentonite seal, the pellets were allowed to hydrate prior to the placement of a cement/bentonite grout mixture from the top of the bentonite seal to approximately two (2) feet below grade level. The backfill material was mixed in accordance with the ratio requirements set forth in OAC 785:35-7-2(b)(6)(C).

The depth of sand or bentonite was measured with a cloth tape as the material was added to the borehole to ensure that bridging did not occur within any portion of the borehole. All piezometers were surveyed after completion. The piezometer installation diagrams are included in Appendix B. The monthly groundwater elevations measured in the piezometers are included on Table 4.1.

### 4.1.1 Piezometer Development

Once the piezometers were installed, each piezometer was developed utilizing a Waterra Hydrolift-2 inertial pump. Well development is necessary in order to remove silt and sediment in the bottom of the piezometer along with the fines from the sand pack and well screen that accumulated during drilling. Each piezometer was considered developed once a minimum of 5 well volumes were removed. Newly installed piezometers were developed no sooner than 24 hours after the installation of grout.

## 4.2 GROUNDWATER ELEVATIONS

Based on the results of these borings/piezometers it appears that onsite groundwater lies within onsite sands with high permeability.

During the current investigation, piezometers were installed within nine (9) of the boreholes to allow the gathering of additional information relative to the groundwater flow in the expansion area (PZ-1 through PZ-9). At borehole EB-3 moisture was noted shallower than expected. A piezometer (PZ-8) was installed and the piezometer was bailed until dry. Water level in the piezometer did not return back to its original elevation indicating that the moisture was not groundwater.

Attributes for each of these piezometers are listed in Table 3.1. The well construction diagrams are presented in Appendix B.

At each of the piezometers, groundwater depths were noted when they were encountered during drilling. The water levels were also obtained 24 hours after completion.

### 4.2.1 Monthly Measurements

In accordance with OAC 252:515-7-54, a groundwater elevation survey was conducted to determine the relationship between the highest water table and the lowest waste placement elevations. Groundwater measurements were taken monthly at piezometers PZ-1 through PZ-9 and existing wells monitoring wells MW-1, MW-2, MW-3R, MW-4R, MW-5 and MW-6 from April 2020 to March 2021. Groundwater measurements were recorded on approximately the same date each month. See Table 4.1 and Figures 4.1 through 4.5 for the recorded monthly groundwater data.

### 4.2.2 Highest Groundwater Elevations and Groundwater Flow Direction

During this investigation the highest groundwater elevation was measured in piezometer PZ-1 (1185.20 fmsl). PZ-1 is located on the southeast portion of the proposed expansion area. The lowest groundwater elevation recorded occurred in piezometer PZ-7 (1159.66 fmsl), located along the northwestern portion of the expansion area. A potentiometric surface map as Figure 4.6 was constructed utilizing the highest recorded elevation during the investigation. This potentiometric surface was utilized to show separation between highest groundwater elevation and the deepest excavation of the landfill bottom. The deepest placement of waste would therefore be 5 feet above this elevation which would be the top of protective cover. The potentiometric surface and the deepest elevation depth (landfill bottom) are presented on cross section (Figures 3.3 through 3.8)

A second potentiometric surface map utilizing the water levels taken at all of the piezometers in March 2021 was produced to show the groundwater flow across the site. The March 2021 potentiometric surface is depicted on Figure 4.7. As you can see in the figure groundwater flows from Southeast to North-Northwest across the expansion area.

### 4.2.3 Continuous Measurements

In accordance with OAC 252:515-7-54(b) and the approved Work Plan, an In-situ water level troll was installed in PZ-6 and PZ-7 and allowed to monitor water levels for a 12-month period beginning in April 2020 through March 2021. All groundwater elevations were measured in accordance with the specifications outlined in ASTM D4750. A Hydrograph depicting the data from the continuous water level monitoring system is included as Figure 4.8. As depicted on the figure, over the course of a year the water level showed very little variation between the highest recorded water level and the lowest recorded water level. It should be noted that, as depicted in Figure 4.8, variation that was observed in PZ-7 during May-June 2020 is due to the transducer being accidentally installed at a higher elevation within the piezometer.

### 4.2.4 Area Rainfall

The climate for Oklahoma County, Oklahoma is humid and temperate, and is characterized by warm summers and cold, dry winters. Temperatures average near 60 degrees Fahrenheit (°F), with a slight increase from north to south. Average temperatures range between 93°F in July to 26°F in January. The coolest month for Oklahoma County is typically January with a mean temperature of 37.5°F. The warmest months are July and August with a mean temperature of 81.3°F. Mean annual precipitation is approximately 34.5 inches, with approximately 219 days in the growing season. Wet months are usually May, June, and October. The driest months are December, January, and February. On average, about 33 percent of the annual precipitation is in spring, 29 percent in summer, 25 percent in fall, and 13 percent in winter.

In accordance with OAC 252:515-7-55, daily and monthly precipitation data was obtained from the climatological station closest to the proposed landfill area for the months of April 2020 through March 2021 along with the preceding 12 months. Table 4.2 shows the precipitation for Spencer. During the period from April 2020 through March 2021, July 2020 (5.92 inches) had the highest rainfall and November 2020 (0.58 inches) had the least rainfall. No significant increases or decreases were recorded in the water level data from those months at any of the piezometers.

Oklahoma has an average rainfall of 38.75 inches which is 0.4 inches of rain less than the national average of 39.17. Spencer has had an average rainfall of 36.78 inches over the last 30-years, which is 2.39 inches fewer than the average nationwide, and 1.97 inches fewer than the average in Oklahoma.

## 4.3 AQUIFER TESTING

During April 2020, slug tests were performed all seven (7) of the piezometers PZ-1 through PZ-7 and two (2) existing monitoring wells (MW-3R and MW-4R) located within the proposed expansion area. A falling and raising head test was performed in each of these piezometers/monitoring wells. The falling head test was performed by lowering a slug into the well and measuring the initial rise in water level followed by the gradual fall in water level to pre-slug conditions. The rising head tests were performed by removing the slug and measuring the initial fall in water level followed by the gradual rise in water level to pre-slug conditions. The slug test data were analyzed using the Bower and Rice method for unconfined aquifers. Data analysis was performed using the computer program AQTESOLV and analysis graphs are included in Appendix F.

As presented on Table 4.3, the hydraulic conductivity (K values) between $1.250 \times 10^{-3}$ cm/sec (3.544 ft/day) and $8.045 \times 10^{-5}$ cm/sec (0.02281 ft/day). The average hydraulic conductivity is $4.410 \times 10^{-4}$ cm/sec or 0.1250 ft/day. The site hydraulic conductivities ranges reported at the site are low for the reported range of hydraulic conductivities (0.09 to 60 ft/day) within the Garber Sandstone (USGS, 1993)

# 5.0 CONCLUSIONS

- The soils in the vicinity of the landfill can be classified as Seven distinct soil units:

    1. Vanoss silt loam (1 to 3% slopes) - (approximately 26.7%)
    2. Harrah fine sandy loam (3 to 45% slopes) - (approximately 15.7%)
    3. Teller fine sandy loam (5 to 8% slopes) - (approximately 13.1%)
    4. Teller fine sandy loam (3 to 5% slopes) – (approximately 11.4%)
    5. Teller fine sandy loam (1 to 3 % slopes) – (approximately 11.4%)
    6. Vanoss silt loam (0 to 1 % slopes) - (approximately 6.0%)
    7. Teller fine sandy loams eroded (3 to 5%) – (approximately 5.4%)

- The landfill is located within the Permian-age sandstone known as the Garber Sandstone and is underlain by the Wellington Formation which is also of Permian age. Both the Garber Sandstone and the Wellington Formation consist of lenticular beds of massive appearing, cross-bedded sandstone irregularly inter-bedded with shale which is part sandy to silty. The sandstone layers are fine to very fine grained and loosely cemented. The sandstone is poorly cemented and crumbles easily. Color ranges from nearly white to pink, orange, deep red, or purple.

- Information from historic investigations in addition to the information presented in this Hydrogeologic and Geotechnical investigation indicate the lithology underlying the site is consistent with weathered Garber Sandstones and not alluvium or terrace deposits.

- The Site is located in areas comprised of numerous saturated layers of fine to medium grained sandstone. Yields of deeper wells are generally greater than shallower wells because more of the sandstone layers are penetrated.

- The Garber Sandstone is one of the most transmissive geological units within the Central Oklahoma aquifer and yields substantial amounts of water. Groundwater quality within the Garber sandstone is generally good quality, yield water containing 500mg/l or less of dissolved solids.

- In February-March 2020, a characterization was conducted of the subsurface and groundwater conditions in the area of the proposed landfill. A total of sixteen (16) additional borings were drilled and piezometers were installed in eleven (11) of these borings. The boreholes ranged in depth from approximately 31 feet below ground surface (bgs) to a maximum depth of approximately 101 feet bgs.

- The site geology and hydrogeologic conditions were defined by the sixteen borings drilled within the proposed landfill area and two existing monitoring wells (MW-3R and MW-4R). The lithology beneath the site is consistent with the Garber Sandstone and with the geology as discussed in Section 2.2 of this report. The site geology consists of loosely cemented sandstone ranging in color from orange to red (Garber Sandstone) along with clay, silty clay, sandy clay, silty sand, and sand.

- Borehole geophysical logging was performed within the nine (9) of the 16 boreholes including the 100-foot deep boring (EB-1). The results of these logs indicated that the majority of the boreholes do not show a clear defined change in neutron counts which makes it difficult to determine the change to a saturated zone. The natural gamma logs for the site indicate alternating layers of clays, shales and sands.

- During this investigation nine (9) piezometers were installed and water levels were obtained on monthly at each of these piezometers and continuously via In-situ water level troll at PZ-6 and PZ-7.

- Groundwater elevation measurements were obtained monthly at piezometers PZ-1 through PZ-9 and monitoring wells MW-1, MW-2, MW-3R, MW-4R, MW-5 and MW-6 from April 2020 to March 2021.

- During this investigation the highest groundwater elevation was measured in piezometer PZ-1 (1185.20 fmsl). The lowest groundwater elevation recorded occurred in piezometer PZ-7, located along the northwestern portion of the expansion area.

- The highest potentiometric surface map was utilized to show separation between highest groundwater elevation and the deepest excavation of the landfill bottom. The deepest placement of waste would therefore be 5 feet above this elevation which would be the top of protective cover. The potentiometric surface and the deepest elevation depth (landfill bottom) are presented on cross section (Figures 3.3 through 3.8).

- Hydrographs depicting the data from the continuous water level monitoring system are included as Figure 4.8. As depicted on the figure, over the course of a year the water level showed very little variation between the highest recorded water level and the lowest recorded water level.

- During the period of investigation, July (5.92 inches) had the highest rainfall and November (0.58 inches) had the least rainfall. No significant increases or decreases were recorded in the water level data from those months at any of the piezometers.

- As presented on Table 4.3, the hydraulic conductivity (K values) between $1.250 \times 10^{-3}$ cm/sec (3.544 ft/day) and $8.045 \times 10^{-5}$ cm/sec (0.02281 ft/day). The average hydraulic conductivity is $4.410 \times 10^{-4}$ cm/sec or 0.1250 ft/day. The site hydraulic conductivities ranges are consistent with hydraulic conductivities reported (0.09 to 60 ft/day) within the Garber Sandstone (USGS, 1993)

# 6.0 PROPOSED GROUNDWATER MONITORING SYSTEM

As provided in OAC 252:515-9, a groundwater monitoring system must be installed that consists of a sufficient number of wells installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer that: 1) represent the quality of background groundwater that has not been affected by the disposal unit and 2) represent the quality of groundwater that has passed underneath the disposal facility.

The current groundwater monitoring system for the C&D disposal area of landfill consists of six (6) monitoring wells designated as MW-1, MW-2, MW-3R, MW-4R, MW-5, and MW-6 (Figure 5.1). All six of the existing monitoring wells are completed within the Garber Sandstone. The proposed groundwater monitoring system to be utilized for both the existing and the proposed landfill will consist of a series of existing and new groundwater monitoring wells designed to address the current site comprehensive hydrogeologic model. Existing piezometer PZ-1 was installed to monitoring well specifications to be utilized within the monitoring network as groundwater monitoring well MW-7. Three new monitoring wells (MW-8, MW-9, and MW-10) will be installed prior to waste disposal within the proposed expansion area. The new monitoring network is shown on Figure 5.2.

Specific details of the proposed groundwater monitoring system were designed to monitor the proposed landfill area and to add to the site-wide monitoring program and are shown on **Figure 5.2**. The proposed monitoring system will consist of existing monitoring wells MW-1, MW-2, MW-5, MW-6, with new wells MW-7, MW-8, MW-9, and MW-10.

It should be noted that MW-1 and MW-7 are located south or southeast of the disposal unit and are considered up-gradient monitoring wells. MW-2, MW-5, MW-6, MW-8, MW-9, and MW-10 are considered down-gradient monitoring wells. Each of these down-gradient wells are screened within the uppermost saturated zone.

The piezometer (PZ-1) that will be converted to monitoring well (MW-7) was installed in accordance with OAC 252:515-7-3 and OWRB 785:35-7-2. Monitoring wells MW-8, MW-9, and MW-10 will be installed in accordance with OAC 252:515-7-3. A drilling plan to install these monitoring wells will be submitted to DEQ for approval once the final permit is issued.

Existing monitoring wells, MW-3R and MW-4R, will be decommissioned in accordance with the "EPA Handbook of Suggested Practices for Design and Installation of Groundwater Monitoring Wells" and OAC 252:515-7-71 prior to waste disposal within the proposed expansion area. Additionally, existing piezometers will be plugged according to the requirements of the Oklahoma Water Resources Board (OWRB).

A work plan will be prepared and submitted to DEQ for approval that details the installation of the proposed monitoring wells and the decommissioning of monitoring wells MW-3R and MW-4R in addition to the decommission of piezometers that will not be included as part of the groundwater monitoring network.

The groundwater samples will be collected according to the approved Groundwater Sampling and Analysis Plan (GWSAP) for the facility. An updated GWSAP that will follow all aspects of OAC 252:515-9 will be submitted to DEQ for approval once the final permit is issued.

The permanent groundwater monitoring wells will be subject to the strict sampling, testing and reporting requirements of OAC 252:515-9 and the final permit. Four rounds of background data will be collected for groundwater quality constituents listed in OAC 252:515-9-31 (d)(1)(A) as well as Appendix A parameters in accordance with OAC 252:515-9-31(d)(1)(B). Additional sampling events may be required prior to the first statistical evaluation. As previously stated, an updated GWSAP will be submitted to DEQ for approval once the final permit has been issued. The GWSAP will include the requirements for detection monitoring and any required reporting for verified SSIs and subsequent testing programs. The monitoring program will include semi-annual sampling of Appendix A parameters.

The groundwater monitoring system will follow all aspects of DEQ OAC 252:515-9. A typical monitoring well construction diagram is included as Figure 5.3.

# 7.0 REFERENCES

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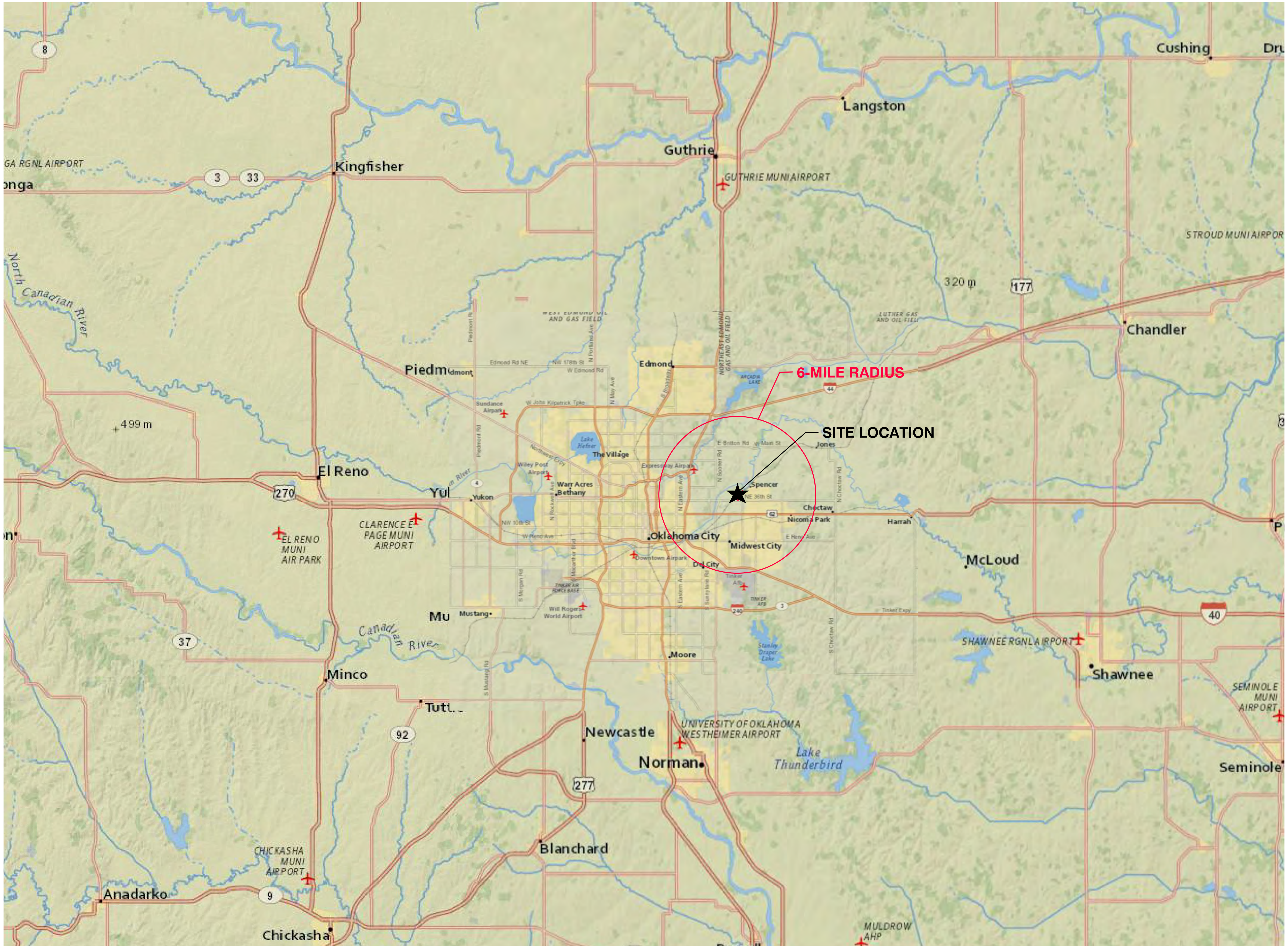
U.S. Geological Survey, 20181214, USGS US Topo 7.5-minute map for Spencer, OK 2018: USGS - National Geospatial Technical Operations Center (NGTOC).

# Figures

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APPROXIMATE SCALE IN MILES

SOURCE:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

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SANDEEP D. SARAF
32896
LICENSED PROFESSIONAL ENGINEER
OKLAHOMA
8-18-23

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: SITE LOCATION MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: BJD | CHK. BY: SDS | DWN. BY: DS | APP. BY: RRK | Q/A RVW BY: SDS

CADD FILE: 1.1 LOC MAP1

DATE: 08/2023

SCALE: AS SHOWN

FIGURE NO. 1

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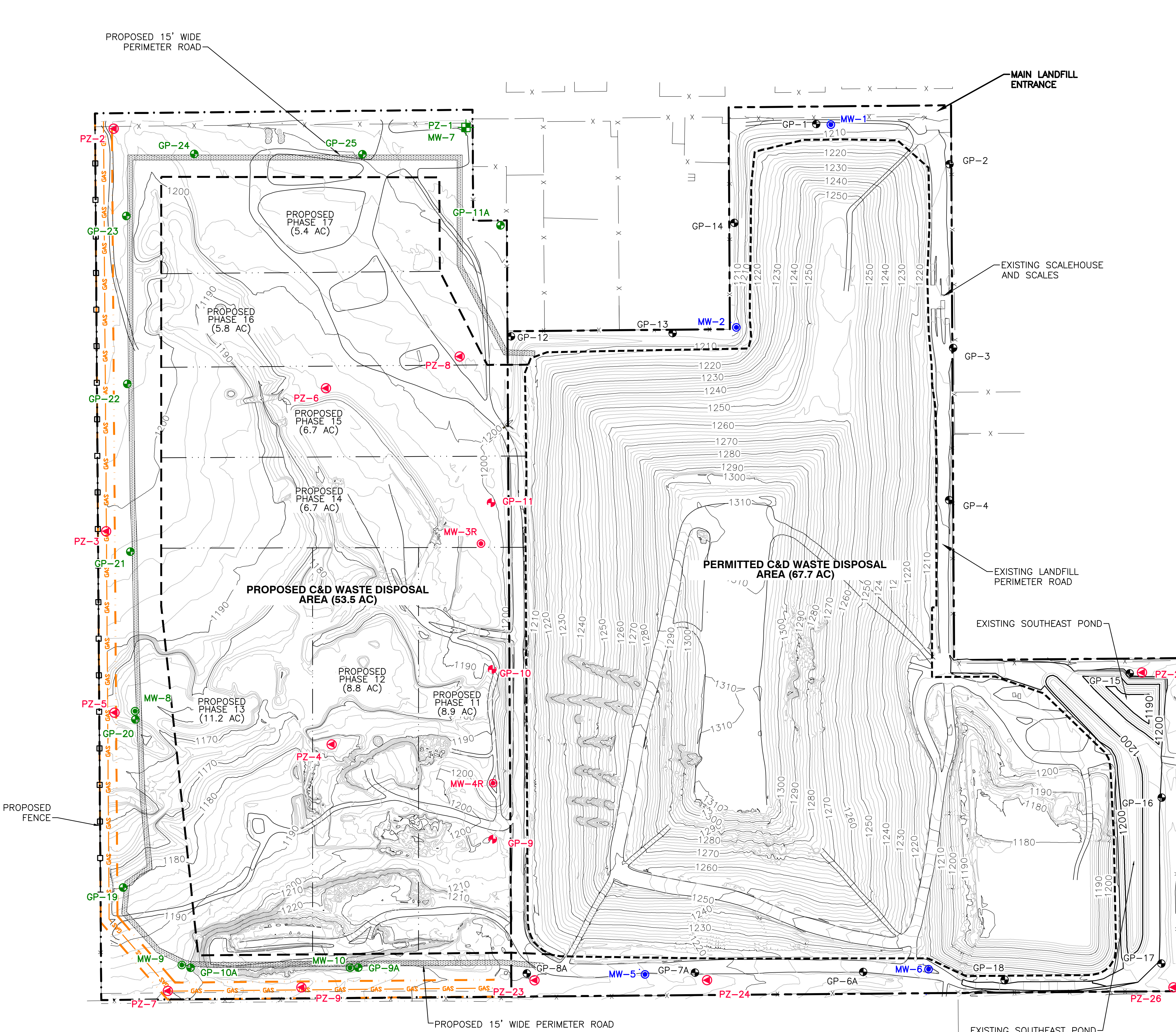


## LEGEND

| | |
|---|---|
| | EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1) |
| | EXISTING C&D LANDFILL LIMITS OF WASTE |
| | PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1) |
| | PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2) |
| | PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY |
| | PROPOSED EASEMENT |
| GAS — GAS | PROPOSED GAS LINE |
| | PROPOSED PERIMETER ROAD |
| | PROPOSED FENCE |
| MW-10 | PROPOSED MONITORING WELL |
| GP-24 | PROPOSED GAS PROBE |
| x | EXISTING FENCE |
| 1210 | EXISTING 10' CONTOUR (SEE NOTE 3) |
| | EXISTING 2' CONTOUR (SEE NOTE 3) |
| | EXISTING ROADS |
| GP-14 | EXISTING GAS PROBE (TO REMAIN) |
| MW-1 | EXISTING MONITORING WELL (TO REMAIN) |
| PZ-1 MW-7 | EXISTING PIEZOMETER (TO BE CONVERTED TO MONITORING WELL) |
| PZ-24 | EXISTING PIEZOMETER (TO BE ABANDONED/DECOMMISSIONED) |
| MW-4R | EXISTING MONITORING WELL (TO BE ABANDONED/DECOMMISSIONED) |
| GP-10 | EXISTING GAS PROBE |

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA 8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: SITE MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
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PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

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DATE: 08/2023

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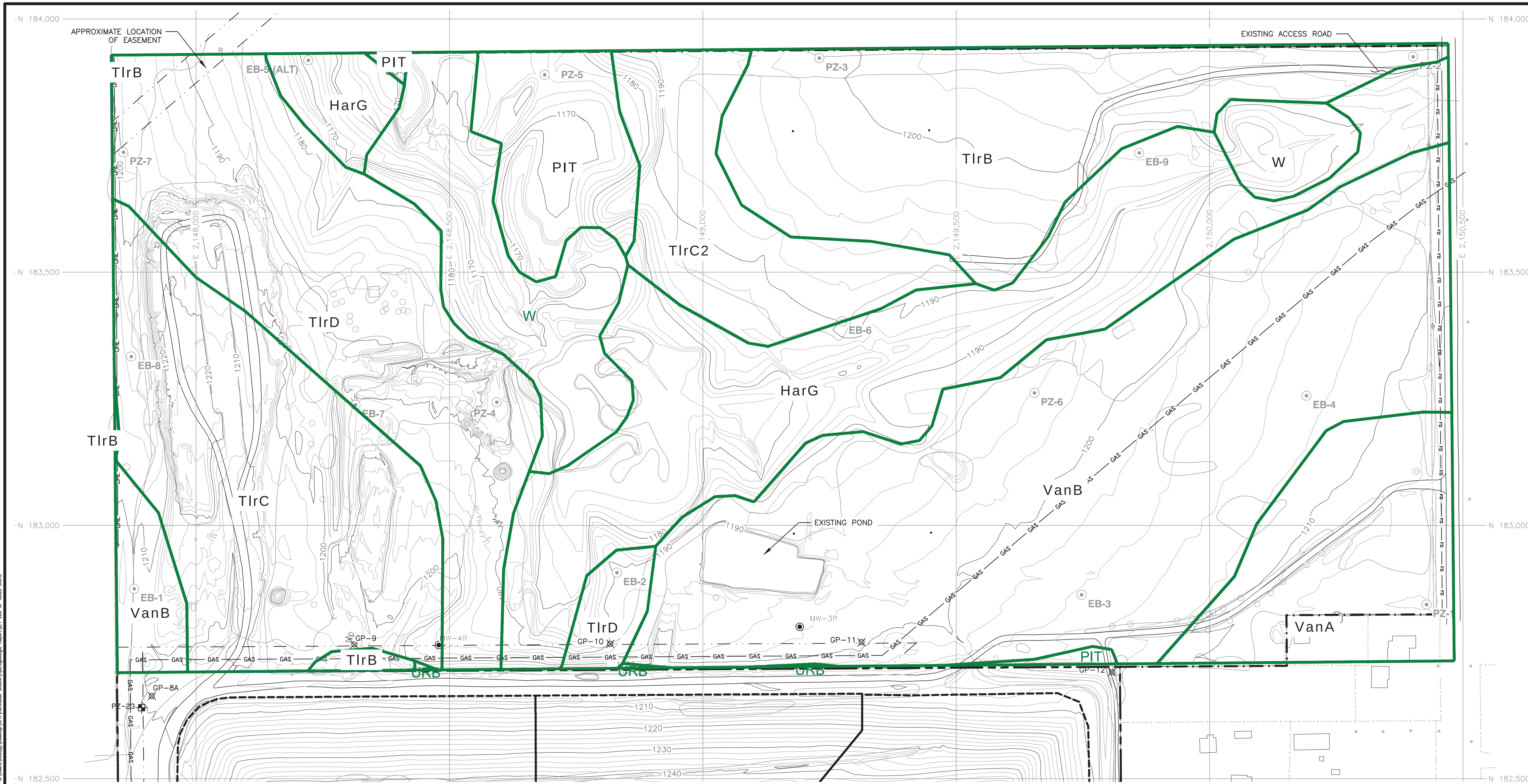


## LEGEND

| | |
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| CURRENT PERMIT BOUNDARY | |
| PROPOSED PERMIT BOUNDARY | |
| CURRENTLY PERMITTED LIMITS OF WASTE | |
| EXISTING PHASE BOUNDARY | |
| 1210 | EXISTING CONTOUR (SEE NOTE 1) |
| EXISTING ROADS | |
| MW-2 | EXISTING GROUNDWATER MONITORING WELL |
| GP-2 | EXISTING LANDFILL GAS MONITORING WELL |
| PZ-26 | EXISTING PIEZOMETER |
| | EXISTING EASEMENT (APPROX., SEE NOTE 2) |
| EB-5 | PROPOSED BORING LOCATION |
| PZ-5 | PROPOSED PIEZOMETER LOCATION |
| GAS | EXISTING GAS LINE (APPROX., SEE NOTE 2) |
| OHE | EXISTING OVERHEAD ELECTRIC LINE (APPROX., SEE NOTE 2) |
| FO | EXISTING FIBER OPTIC LINE (APPROX., SEE NOTE 2) |
| UGT | EXISTING UNDERGROUND TELEPHONE LINE (APPROX., SEE NOTE 2) |
| UGE | EXISTING UNDERGROUND ELECTRIC LINE (APPROX., SEE NOTE 2) |
| UGC | EXISTING UNDERGROUND CABLE (APPROX., SEE NOTE 2) |
| E 2,148,000 / N 183,000 | STATE PLANE GRID |
| | SOIL MAP UNIT BOUNDARY |

## Map Unit Legend

| Map Unit Symbol | Map Unit Name |
|---|---|
| HarG | Harrah fine sandy loam, 3 to 45 percent slopes |
| PIT | Pits |
| TlrB | Teller fine sandy loam, 1 to 3 percent slopes |
| TlrC | Teller fine sandy loam, 3 to 5 percent slopes |
| TlrC2 | Teller fine sandy loam, 3 to 5 percent slopes, eroded |
| TlrD | Teller fine sandy loam, 5 to 8 percent slopes |
| URB | Urban land |
| VanA | Vanoss silt loam, 0 to 1 percent slopes |
| VanB | Vanoss silt loam, 1 to 3 percent slopes |
| W | Water |

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8-18-23

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NOTES:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY TECHMAP ON 02/08/2019.
2. EXISTING EASEMENT AND UTILITY LINES INFORMATION ARE FROM THE PLAT OF SURVEY, DEVELOPED BY SHEPHERD ENGINEERING, DATED 03/06/2010.

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DRAWING TITLE: **LOCATION OF SOILS UNITS**

PROJECT TITLE: **NORTHEAST LANDFILL DRILLING PLAN**

CLIENT: **N.E. LANDFILL, LLC NORTHEAST C&D LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084**


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DATE: 12/2019

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FIGURE NO. **2.1**


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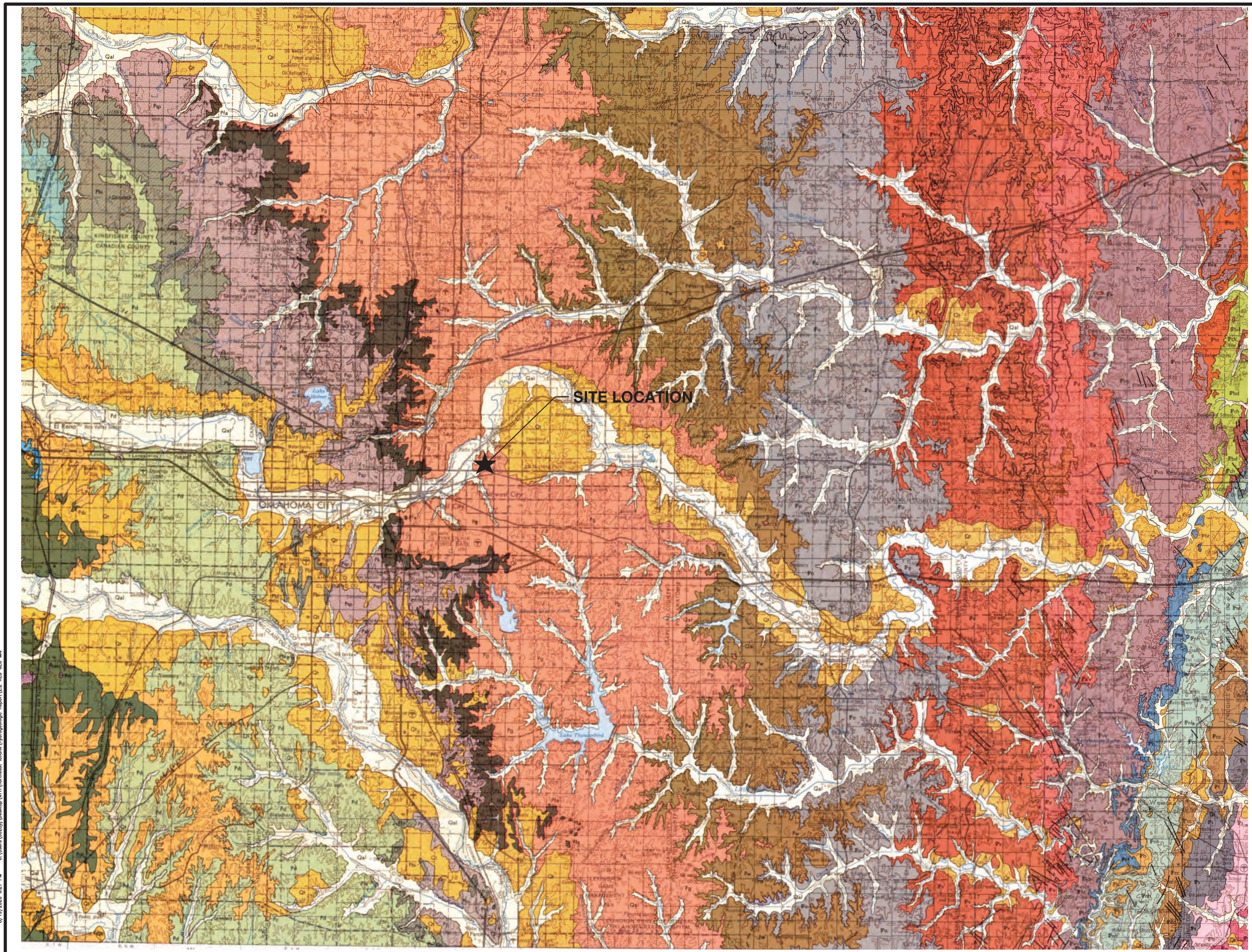



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DRAWING TITLE
REGIONAL GEOLOGIC MAP

PROJECT TITLE
NORTHEAST LANDFILL
HYDROGEOLOGIC REPORT

CLIENT
N.E. LANDFILL, LLC
NORTHEAST C&D LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

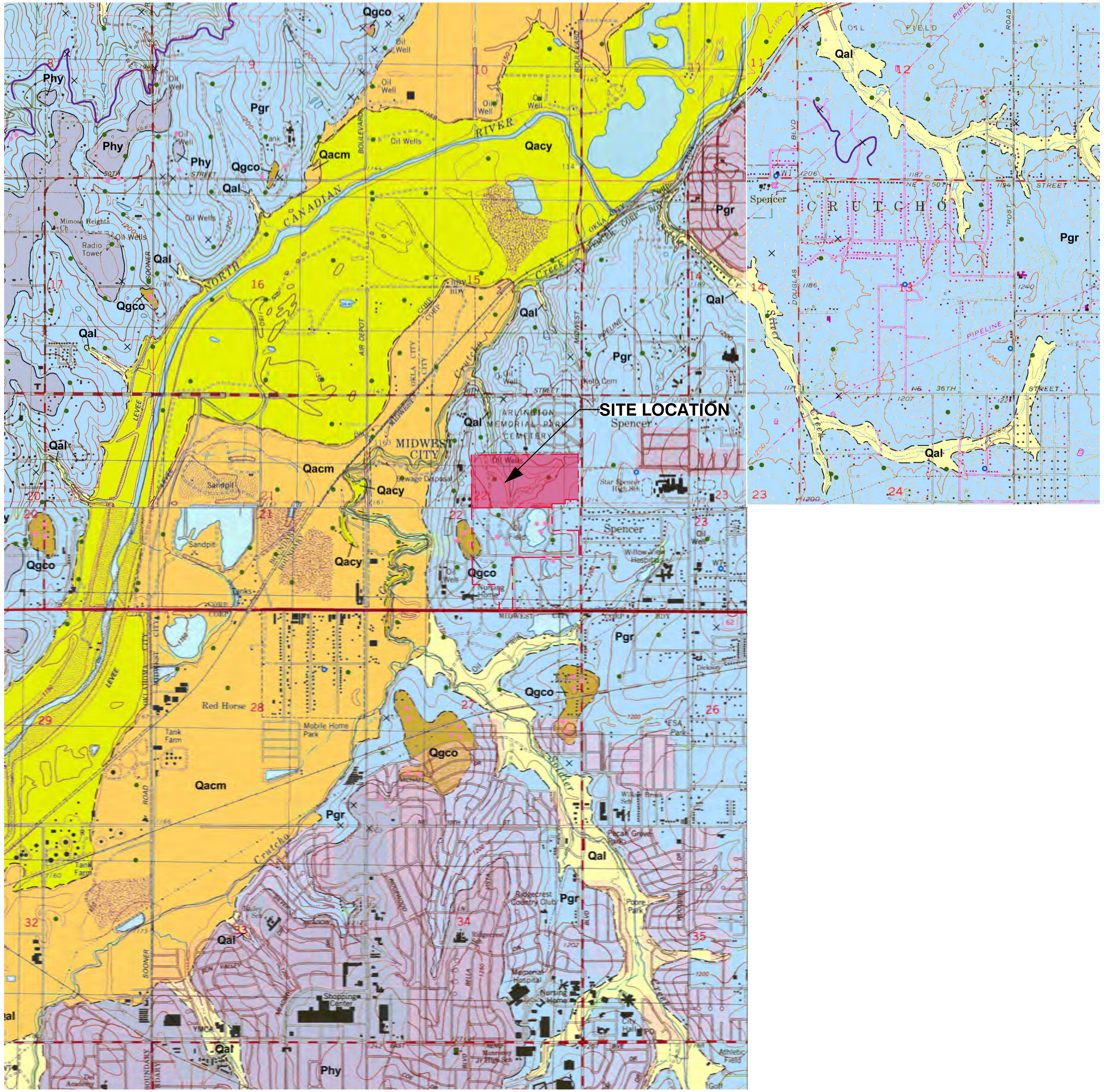
PROJ. NO. 16219107.00 | DSN. BY: BJD | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: BJD | APP. BY: RRK

CADD FILE: 2.2 REG GEO MAP

DATE: 07/2020

SCALE: AS SHOWN

FIGURE NO.
**2.2**




0 1500' 3000'
APPROXIMATE SCALE IN FEET

N

## DESCRIPTION OF UNITS

**Qal** ALLUVIUM (Holocene)–Clay, silt, sand, and gravel in channels and on flood plains of modern streams. Includes terrace deposits of similar composition located directly above and adjacent to modern channels and flood plains. Thickness: 0 to about 30 ft

**Qacy** ALLUVIUM OF NORTH CANADIAN RIVER (Holocene)–Clay, silt, sand, and gravel in channels and on modern flood plain of North Canadian River. Area probably subject to frequent flooding. Thickness: generally 0 to about 40 ft, rarely over 40 ft

**Qacm** ALLUVIUM OF NORTH CANADIAN RIVER (Holocene)–Clay, silt, sand, and gravel on Recent flood plain of North Canadian River about 5-10 ft above Qacy. Area rarely subject to flooding. Thickness: unknown, possibly as much as 50 ft

**$Qtg_4$** TERRACE DEPOSITS (Holocene)–Clay, silt, sand, and gravel on terraces immediately above and adjacent to modern channels and flood plains. Consists entirely of locally derived sediment. Thickness: unknown, possibly 0 to about 20 ft

**$Qtg_1$** REMNANTS OF TERRACE DEPOSITS (Pleistocene)–Concentrations of distally derived sediment, mostly subrounded quartz and quartzite cobbles and pebbles, more than 50 ft above modern flood plains. Deposits are in Cimarron River drainage basin. May represent former course of North Canadian River or eroded and redeposited Pleistocene gravel similar to Qgco. Thickness: 0 to about 10 ft

**Qgco** REMNANTS OF OLDER TERRACE DEPOSITS (Pleistocene)–Clay, silt, sand, and gravel adjacent to the flood plain of the North Canadian River. Sand commonly is medium- to coarse-grained and very light colored; gravel locally consists of concentrations of distally derived pebbles and cobbles, mostly subrounded quartz and quartzite. Base of unit is about 40-60 ft above the modern flood plain and ranges in elevation from 1190 ft above sea level to 1220 ft above sea level. Top of the unit is as much as 65 ft above the modern flood plain and is as high as 1245 ft above sea level. Unit includes small amount of sand and gravel washed down into small north-flowing streams. Present only on west side of the North Canadian River. Thickness: 0 to 10 ft

**Phy** HENNESSEY FORMATION (Permian)–Shale and siltstone, poorly exposed, mostly moderate reddish brown (10R4/6), moderate red (5R4/6), to moderate reddish orange (10R6/6) with conspicuous light greenish gray (5GY8/1) iron-reduction spots. The lower 20-30 ft is predominantly a blocky-weathering silty shale and clayshale that exhibits good paleosol development. A dusky yellow (5Y6/4) to moderate orange pink (10R8/2) dolomitic siltstone bed, 3-5 in. thick, overlain by shale with rare root clasts, is present locally near contact with the Garber Formation. Above the lower part, thin-bedded to laminated siltstones and very fine grained sandstones are more common. Occurs on tops of hills and ridges, generally expressed as highly weathered, muddy soil.

The lower part of the Hennessey Formation probably correlates with the Fairmont Shale Formation (Hennessey Group) of Bingham and Moore (1975), which is not recognized in this work because it is not mappable on a regional basis. Thickness: 0-60 ft, top eroded.

**Pgr** GARBER FORMATION (Permian)–Sandstone, mostly fine-grained to less commonly very fine to medium-fine-grained; appears to be very fine grained near base; moderate reddish brown (10R4/6), moderate reddish orange (10R6/6), moderate red (5R5/4), light brown (5YR5/6), and dark yellowish orange (10YR6/6); minor sandstone- and siltstone-pebble conglomerate and/or breccia, dolomite conglomerate and/or breccia, siltstone, and shale. Sandstone typically porous and friable. Commonly weathers to smooth, rounded outcrops; locally with platy to flaggy to rarely slabby appearance. Locally weathers to hard, dark-colored (grayish black [N2]) beds completely cemented with hematite, calcite, and/or silica. Dark-colored sandstone blocks locally form lag deposit over weathered outcrops. Large- and small-scale crossbeds, trough crossbeds common; many outcrops characterized by inclined beds and channelform deposits, although plane-parallel stratification also present. Shale and/or siltstone rip-up clasts uncommon; burrows extremely rare; one plant fossil observed. Sandstone locally color-banded (e.g. moderate reddish brown (10R4/6), grayish red purple (5RP4/2), and grayish yellow green (5GY7/2)) or with mottled appearance. Small calcareous iron-oxide spheres occur locally on weathered surfaces. Sandstone locally contains calcite-, dolomite-, and/or barite-cemented septarian nodules. Circular iron-reduction spots very rare. Sandstone, siltstone, and dolomite conglomerate and breccias appear to be of two types; one is clearly sedimentary, the other appears to be diagenetic and may represent incipient paleosol development on a sand. Conglomerates and breccias common near base of formation. A widespread moderate red (5R6/2) to pale red (5R3/2), 3-, to rarely 7-ft-thick conglomerate bed is also present near top of formation. The bed consists of coarse-granule to pebble-size siltstone, shale, and dolomite(?) clasts in a medium- to coarse-grained sandstone matrix. Siltstone and shale sandy, color-banded (e.g., moderate reddish brown (10R4/6) and yellowish gray (5Y7/2)), stratified to unstratified, and with uncommon iron-reduction spots as large as 2 in. in diameter. Typically soft, weather to "badlands"- type topography. Locally contain abundant septarian nodules similar to those found in sandstone. Siltstone and shale common near base and top of formation. In places, siltstone and shale contain evidence of paleosol development such as blocky weathering, fractures with fracture surfaces marked by small slickensides, through-going curved fractures, and calcareous concretions. Thickness: about 600 ft, based on cross section

**Pwe** WELLINGTON FORMATION (Permian)–Sandstone, mostly fine- to very fine grained, moderate orange pink (10R7/4) to moderate reddish brown (10R4/6), moderate reddish orange (10R6/6) to pale red (5R6/2); siltstone, typically color-banded consisting of, for example, pale reddish brown (10R5/4) and light greenish gray (5GY8/1); siltstone- and dolomite-breccia and conglomerate; and minor shale, moderate reddish brown (10R4/6) and light greenish gray (5GY8/1). Sandstone mostly porous and friable, locally with variable amounts of hematite and calcite cement. Sedimentary structures include large- and small-scale crossbeds, trough crossbeds, locally steeply inclined stratification and less common channelform features. In places, weathers to "slickrock" appearance. Sandstone locally color-banded and multicolored. Siltstone commonly contains abundant concretions and septarian nodules with conspicuous calcite, dolomite and possible barite crystals lining radiating fractures. Siltstone and dolomite breccias and conglomerates similar to those in overlying Garber Formation; some clearly are sedimentary in origin and may represent slightly reworked paleosols; others may represent autochthonous paleosols. Shale typically is color-banded.

Principal difference between Garber and Wellington Formations is generally coarser grain size of Garber, although lower part of Garber appears to contain finer-grained sandstones and more siltstone and shale than middle part. In the northeastern part of the Jones quadrangle, the top of the Wellington consists of a widespread shale at least 20 ft thick that is capped by a thick, well-developed paleosol horizon. Thickness: 105 ft, base not exposed

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: **SITE GEOLOGIC MAP**

PROJECT TITLE: **NORTHEAST C&D LANDFILL EXPANSION HYDROGEOLOGIC REPORT**

CLIENT: **N.E. LAND FILL, LLC**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**

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|---|---|---|
| DSN. BY: RF | CHK. BY: RF | APP. BY: RF |

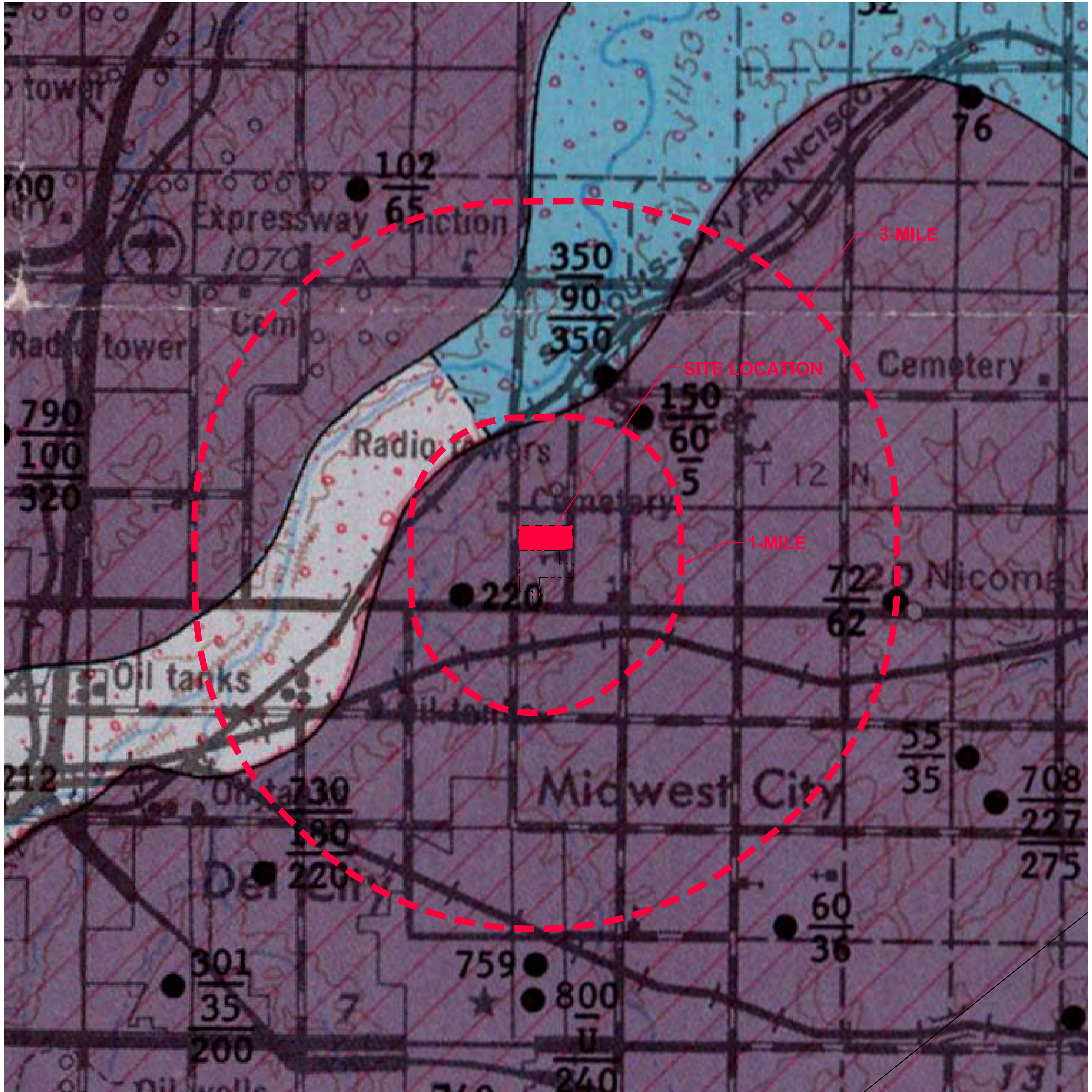
CADD FILE: 2.3 SITE GEO MAP(4-30-23)

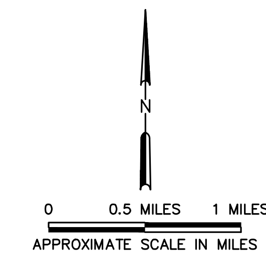
DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. **2.3**

5/2/2023 2:28 PM




# EXPLANATION

## MAJOR AQUIFERS

**Alluvium and terrace deposits**

Water is available from saturated layers of fine to coarse sand and gravel. Yields are highest along the Cimarron, North Canadian, and Canadian Rivers where the saturated layers of sand and gravel are thickest.

**Bedrock**

Water is available from numerous saturated layers of fine- to medium-grained sandstone. Yields of deeper wells are generally greater than shallower wells because more of the sandstone layers are penetrated. In some areas the bedrock aquifers are overlain by aquifers in alluvium and terrace deposits (shown on the map where the alluvium crosses the bedrock). In such areas, water is available from either of the two aquifers. The bedrock aquifer can be reached by drilling through the overlying alluvium and terrace deposits.

## RANGE IN YIELD OF MAJOR AQUIFERS, IN GALLONS PER MINUTE

More than 300

150 to 300

50 to 150

25 to 50

## YIELD IN REMAINING AREAS, IN GALLONS PER MINUTE

Generally less than 25

*Note: Locally, an individual well in one of the areas shown on the map might yield slightly more water than the yield pattern for that area indicates.*

Area boundary; dashed where approximately located

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA

Sandeep Saraf 8-18-23

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|---|---|---|---|
| | | | |

DRAWING TITLE: HYDROLOGIC MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

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CADD FILE: 2.4 HYDROLOGIC MAP

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. **2.4**

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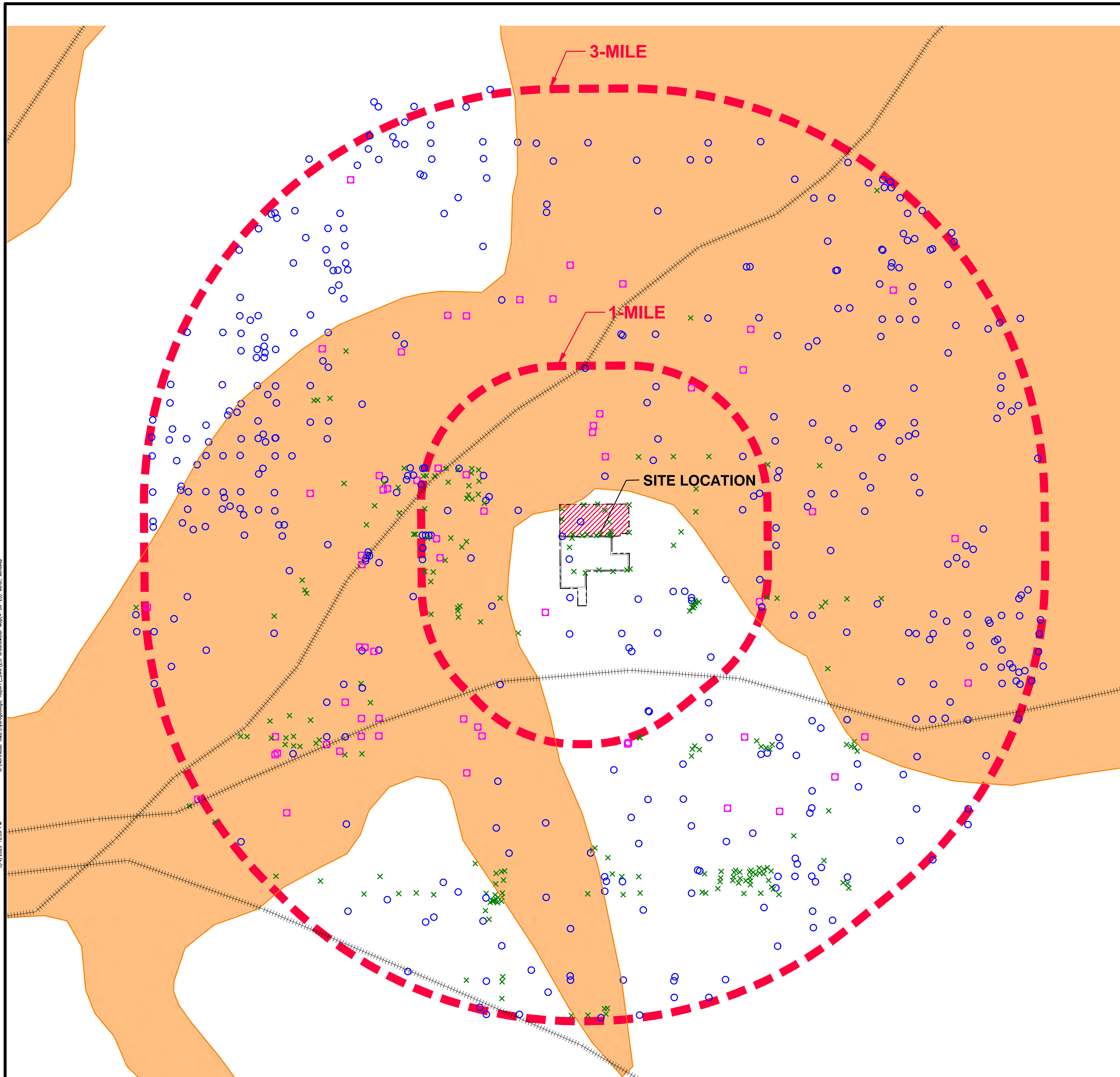


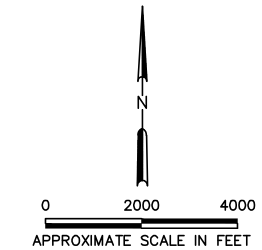


Alluvium and Terrace Deposits and Their Recharge Areas (Quaternary in age). Unconsolidated deposits of sand, silt, clay, and gravel that occur along or adjacent to modern and ancient streams. Thickness generally ranges from 10 to 50 ft (locally as much as 100 ft). Wells generally yield 10 to 500 gpm of water (locally several thousand gpm), and most water is of good quality (less than 1,000 mg/L dissolved solids). Recharge areas are essentially the same as distribution of the alluvium and terrace deposits.

OTHER WELLS

GROUNDWATER WELLS

MONITORING WELLS

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8-18-23

**SOURCE:**

MAP OF AQUIFERS AND RECHARGE AREAS IN OKLAHOMA, KENNETH S. JOHNSON
OKLAHOMA GEOLOGICAL SURVEY, DATED 1991.

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE
**GROUNDWATER RESOURCE MAP**

PROJECT TITLE
**NORTHEAST LANDFILL**
**TIER III PERMIT MODIFICATION**
**APPLICATION**

CLIENT
**N.E. LAND FILL, LLC**
**2601 NORTH MIDWEST BLVD.**
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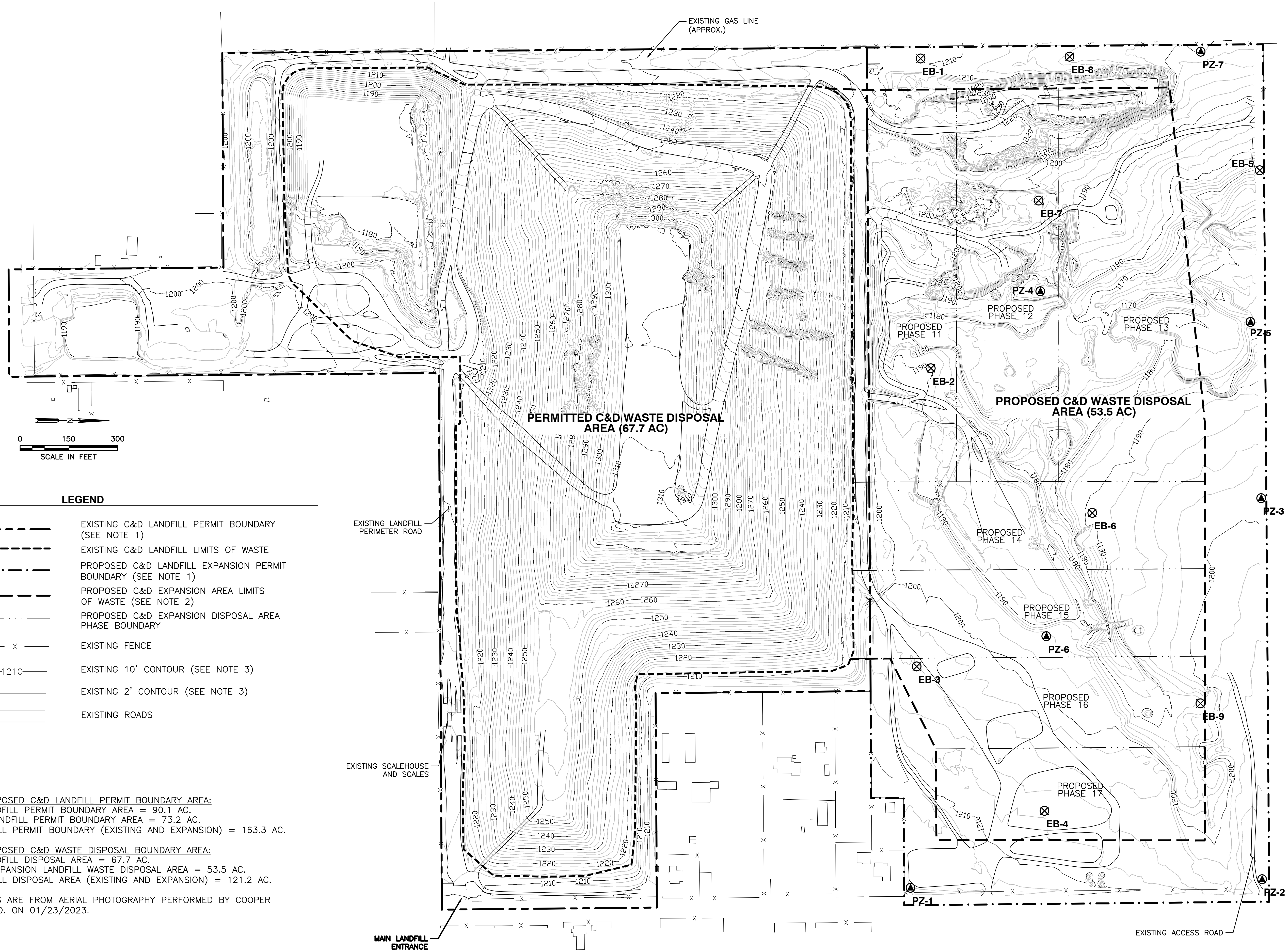
CADD FILE: 2.5 GROUNDWATER MAP(4-30-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. **2.5**

G:\Northeast C&D\Hydrogeologic Report_DWG\2.5 Groundwater Map(4-30-23) saraf, sandeep 5/4/2023 12:39 PM

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SANDEEP D. SARAF
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OKLAHOMA
8-18-23

## LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
- x EXISTING FENCE
- 1210 EXISTING 10' CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- EXISTING ROADS

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.

2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.

3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: BORING LOCATION MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

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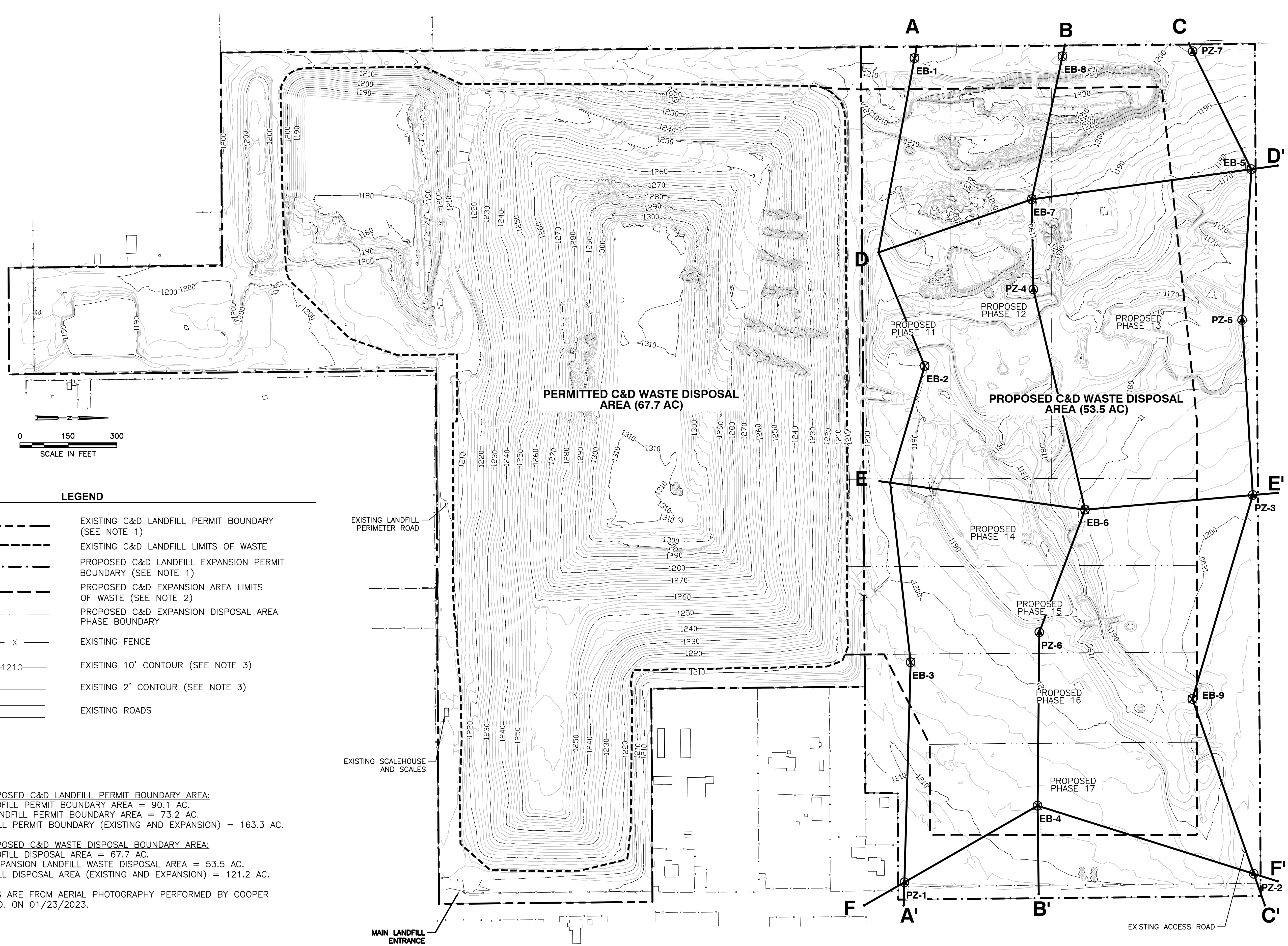
CADD FILE: 3.1 BORING LOCATION MAP(8-6-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.1




## LEGEND

| | |
|---|---|
| | EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1) |
| | EXISTING C&D LANDFILL LIMITS OF WASTE |
| | PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1) |
| | PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2) |
| | PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY |
| x | EXISTING FENCE |
| 1210 | EXISTING 10' CONTOUR (SEE NOTE 3) |
| | EXISTING 2' CONTOUR (SEE NOTE 3) |
| | EXISTING ROADS |

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   - A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   - B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   - C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   - A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   - B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   - C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION LOCATION MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
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CADD FILE: 3.2 CROSS SECTION LOCATION MAP(8-6-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.2

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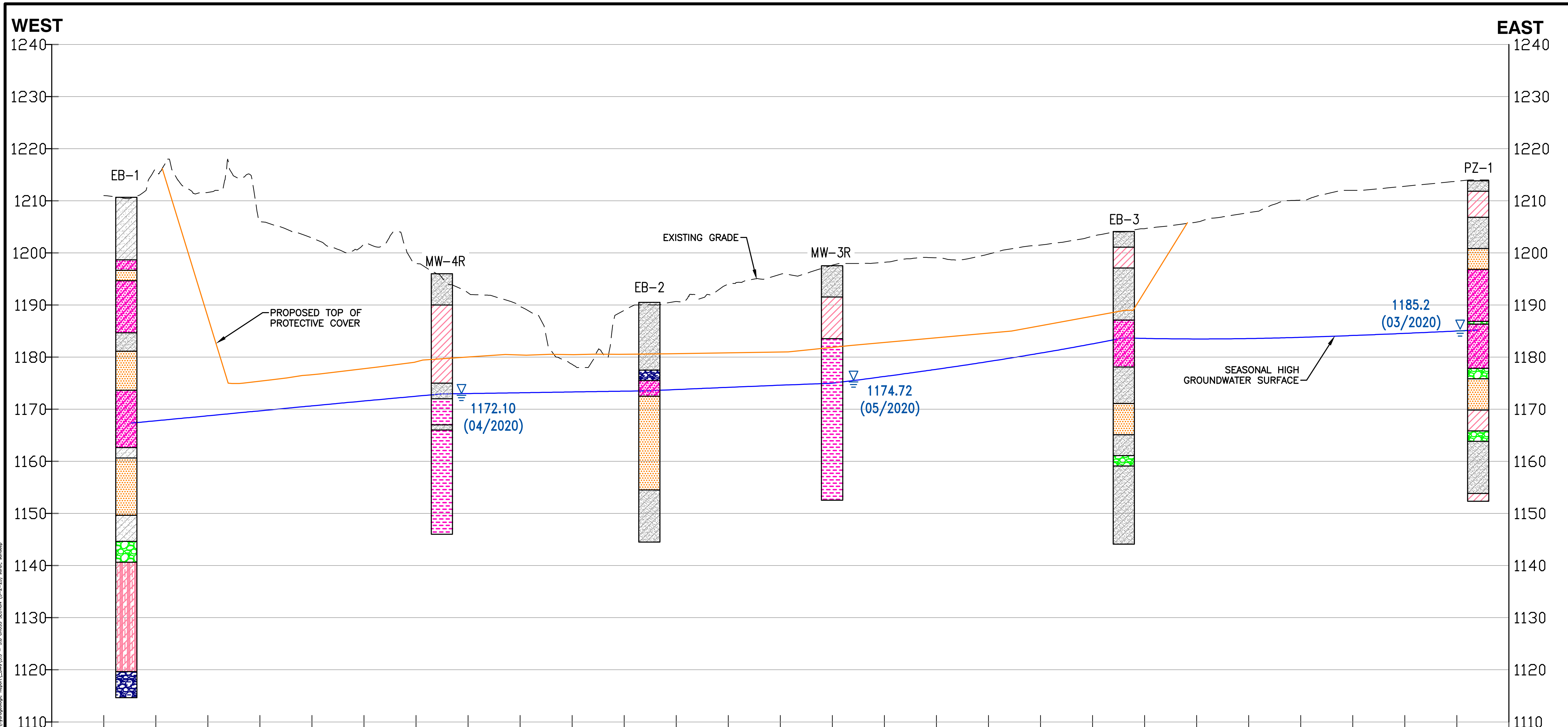
8/6/2023 4:35 PM

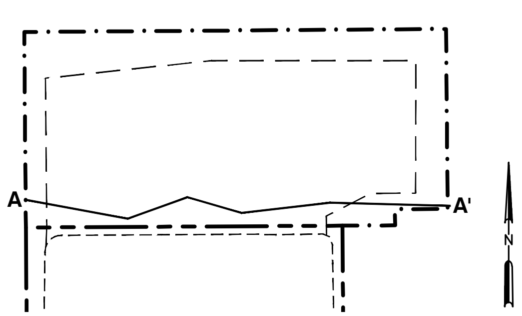



## CROSS SECTION A-A'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

| GROUNDWATER OBSERVED | | |
|---|---|---|
| BORING ID | DURING DRILLING | AFTER 24 HOURS |
| EB-1 | 1168.65 | 1170.22 |
| MW-4R | 1154.00 | NA |
| EB-2 | 1172.51 | 1173.85 |
| MW-3R | 1162.30 | NA |
| EB-3 | 1171.10 | 1180.76 |
| PZ-1 | 1179.84 | 1185.95 |




KEY MAP
1"=4,000'

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-12-23

## LEGEND:

- EXISTING GRADE
- PROPOSED TOP OF PROTECTIVE COVER
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- SANDSTONE
- CLAYEY SILT
- 1185.91 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER

REV | DATE | DESCRIPTION | BY

DRAWING TITLE
CROSS SECTION A-A'

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

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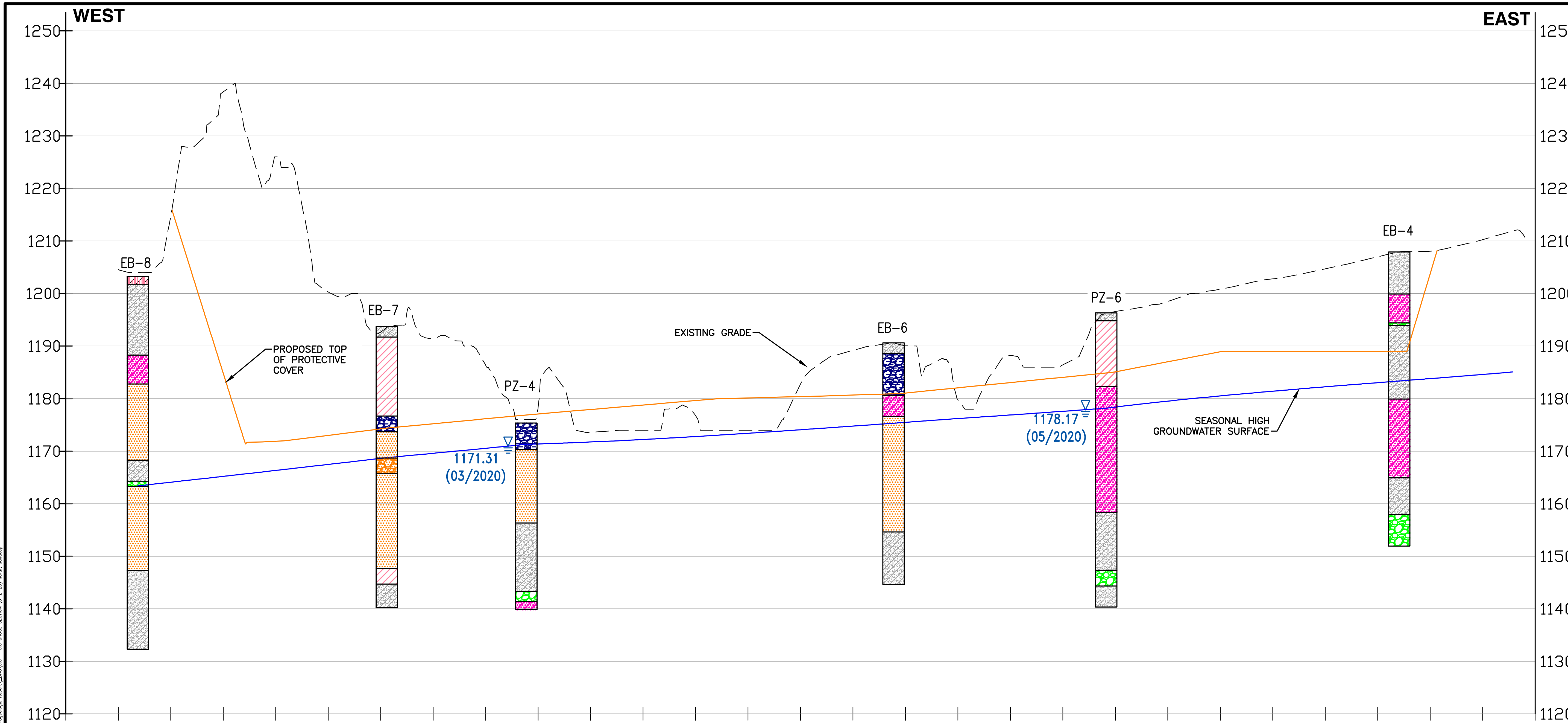
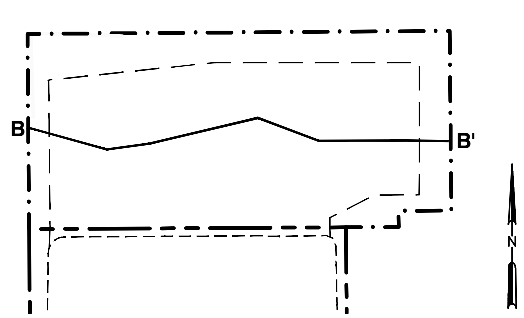
PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

CADD FILE: 3.3 - 3.8 CROSS SECTION (5-2-23)
DATE: 07/2023
SCALE: AS SHOWN
FIGURE NO. 3.3




# CROSS SECTION B-B'

| GROUNDWATER OBSERVED | | |
|---|---|---|
| BORING ID | DURING DRILLING | AFTER 24 HOURS |
| EB-8 | 1161.28 | 1162.67 |
| EB-7 | 1165.70 | 1168.78 |
| PZ-4 | 1169.32 | 1170.36 |
| EB-6 | 1170.12 | 1177.23 |
| PZ-6 | 1166.32 | 1177.45 |
| EB-4 | 1177.91 | 1183.50 |




KEY MAP
1"=4,000'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET


## LEGEND:

- EXISTING GRADE
- PROPOSED TOP OF PROTECTIVE COVER
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- SANDSTONE
- CLAYEY SILT
- WEATHERED SANDSTONE
- 1178.17 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION B-B'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
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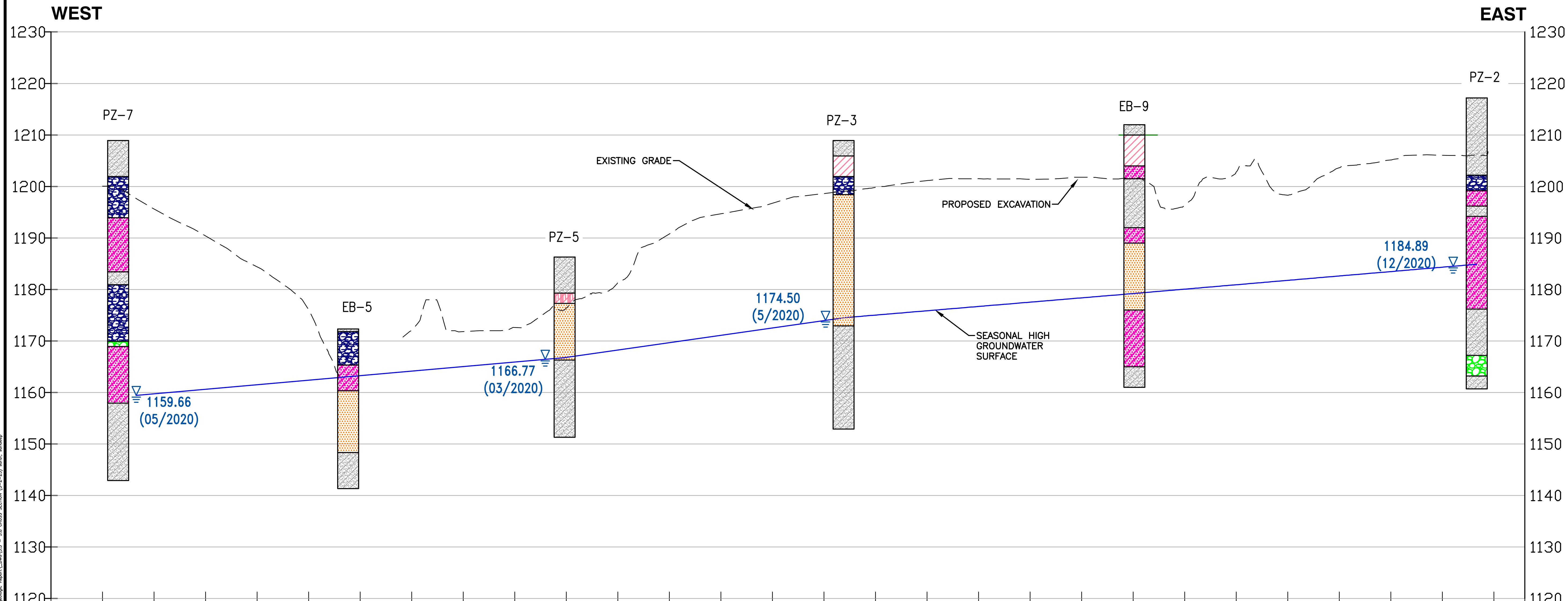
CADD FILE: 3.3 - 3.8 CROSS SECTION (5-2-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.4

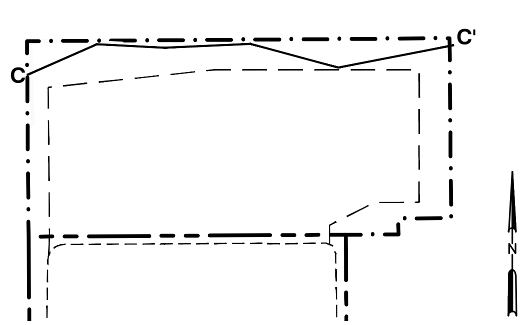



# CROSS SECTION C-C'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

| GROUNDWATER OBSERVED | | |
|---|---|---|
| BORING ID | DURING DRILLING | AFTER 24 HOURS |
| PZ-7 | 1158.91 | 1159.50 |
| EB-5 | 1157.83 | 1159.31 |
| PZ-5 | 1169.28 | 1166.54 |
| PZ-3 | 1168.41 | 1173.33 |
| EB-9 | 1176.00 | 1179.31 |
| PZ-2 | 1183.19 | 1183.70 |




KEY MAP
1"=4,000'


## LEGEND:

- EXISTING GRADE
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- SANDSTONE
- CLAYEY SILT
- 1183.81 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION C-C'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

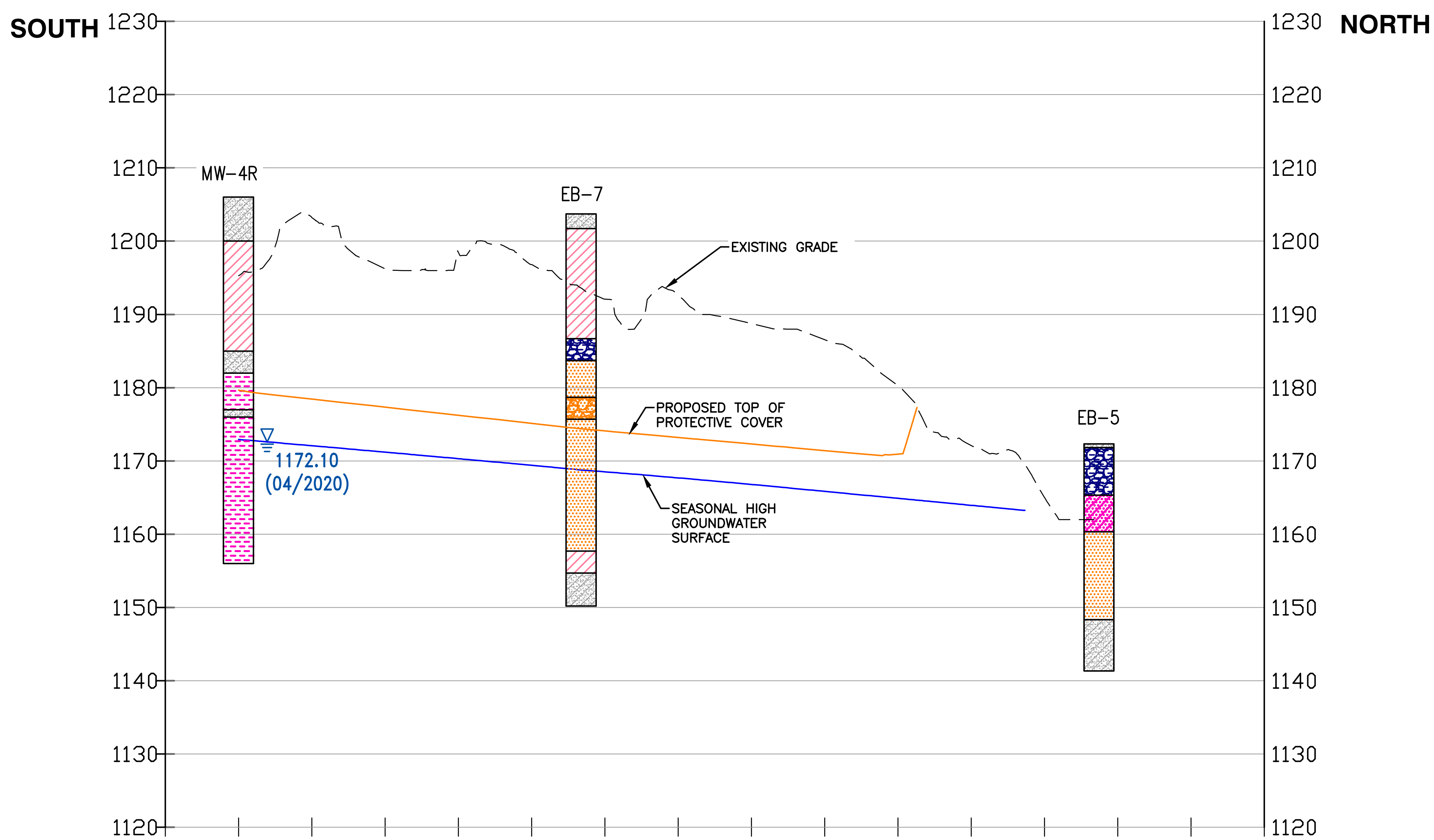
PROJ. NO.: 16219107.00 | DSN. BY: RF | CHK. BY: RRK | DWN. BY: JLJ | APP. BY: RRK | Q/A RVW BY: RF

CADD FILE: 3.3 - 3.8 CROSS SECTION (5-2-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.5

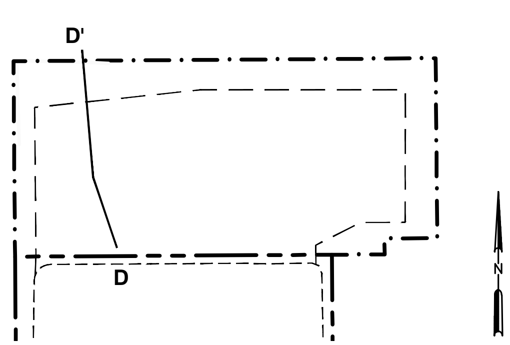



# CROSS SECTION D-D'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

| GROUNDWATER OBSERVED | | |
|---|---|---|
| BORING ID | DURING DRILLING | AFTER 24 HOURS |
| MW-4R | 1154.00 | NA |
| EB-7 | 1165.70 | 1168.78 |
| EB-5 | 1157.83 | 1159.31 |




KEY MAP
1"=4,000'

## LEGEND:

- EXISTING GRADE
- PROPOSED TOP OF PROTECTIVE COVER
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- CLAYEY SILT
- WEATHERED SANDSTONE
- 1165.15 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION D-D'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

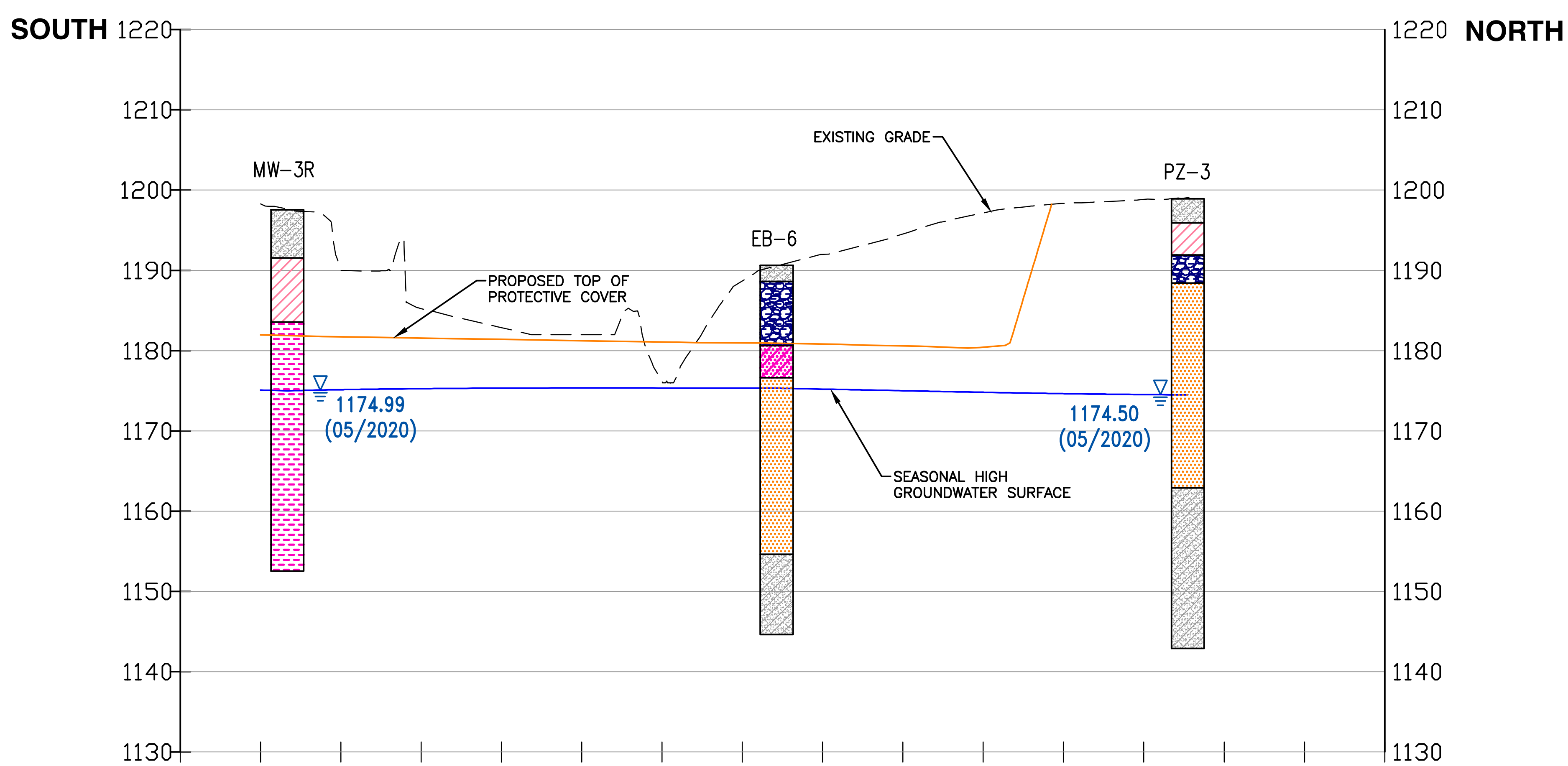
PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

CADD FILE: 3.3 - 3.8 CROSS SECTION (5-2-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.6

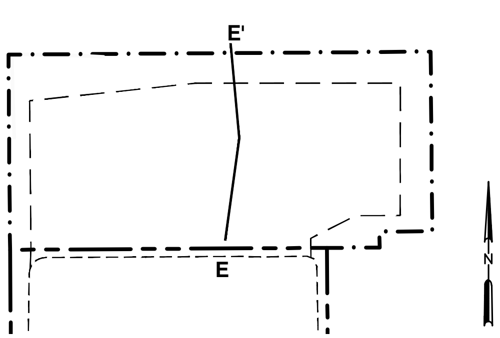



# CROSS SECTION E-E'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

| GROUNDWATER OBSERVED | | |
|---|---|---|
| BORING ID | DURING DRILLING | AFTER 24 HOURS |
| MW-3R | 1162.30 | NA |
| EB-6 | 1170.12 | 1177.23 |
| PZ-3 | 1168.41 | 1173.33 |




KEY MAP
1"=4,000'

## LEGEND:

- EXISTING GRADE
- PROPOSED TOP OF PROTECTIVE COVER
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- 1173.32 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER


REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION E-E'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

CADD FILE: 3.3 - 3.8 CROSS SECTION (5-2-23)

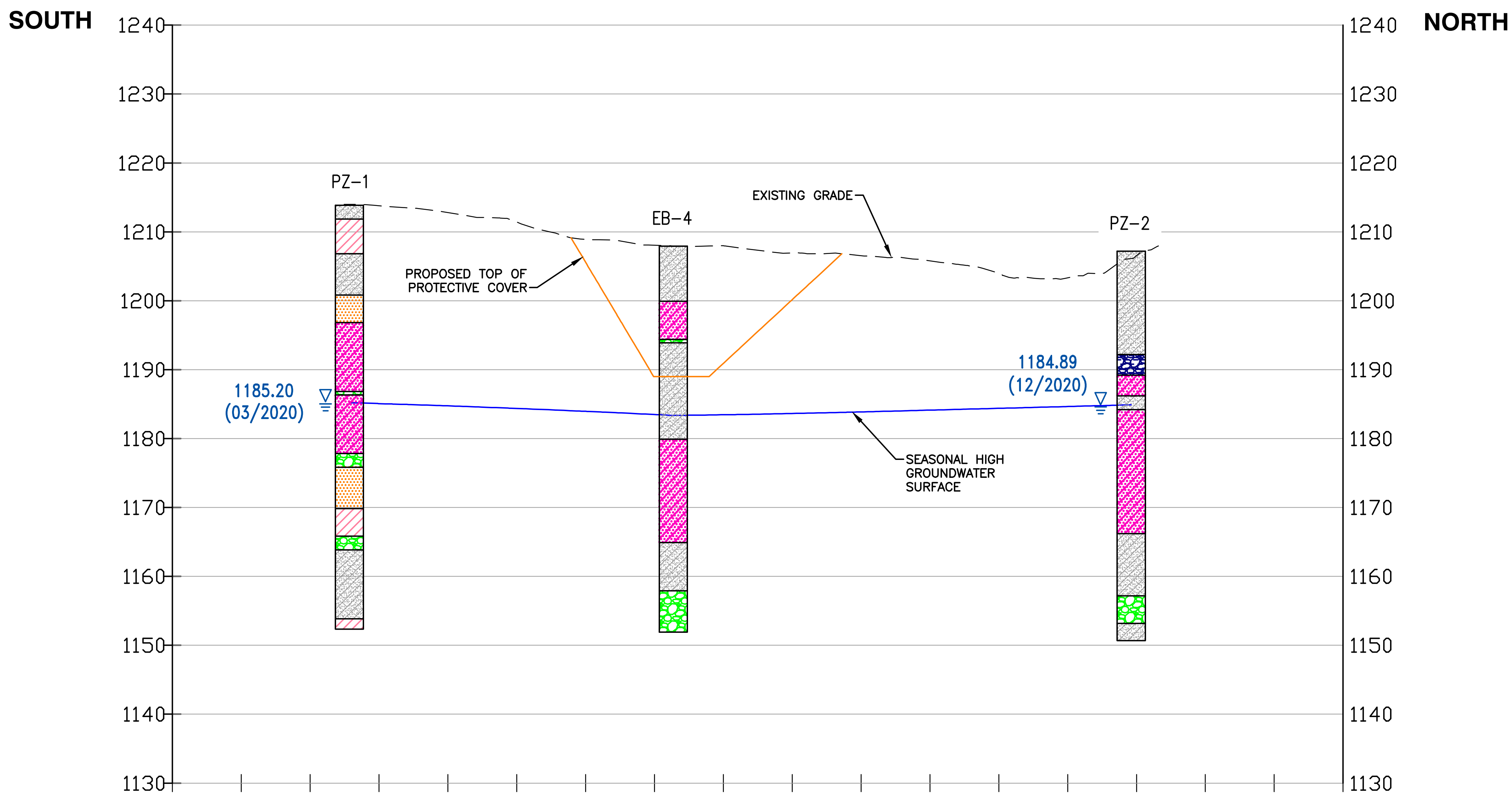
DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.7

G:\Northeast CAD\Hydrogeologic Report_DWG\3.3 - 3.8 CROSS SECTION (5-2-23) sprof, sandeep

5/3/2023 5:33 PM

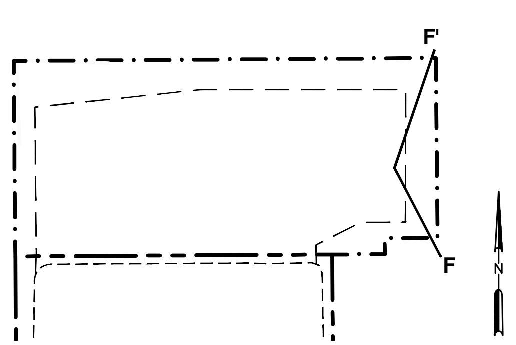



## CROSS SECTION F-F'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

| GROUNDWATER OBSERVED | | |
|---|---|---|
| BORING ID | DURING DRILLING | AFTER 24 HOURS |
| PZ-1 | 1179.84 | 1185.95 |
| EB-4 | 1177.91 | 1183.50 |
| PZ-2 | 1183.19 | 1183.70 |




KEY MAP
1"=4,000'

## LEGEND:

- EXISTING GRADE
- PROPOSED TOP OF PROTECTIVE COVER
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- SANDSTONE
- CLAYEY SILT
- 1183.81 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER


REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION F-F'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

CADD FILE: 3.3 – 3.8 CROSS SECTION (5-2-23)

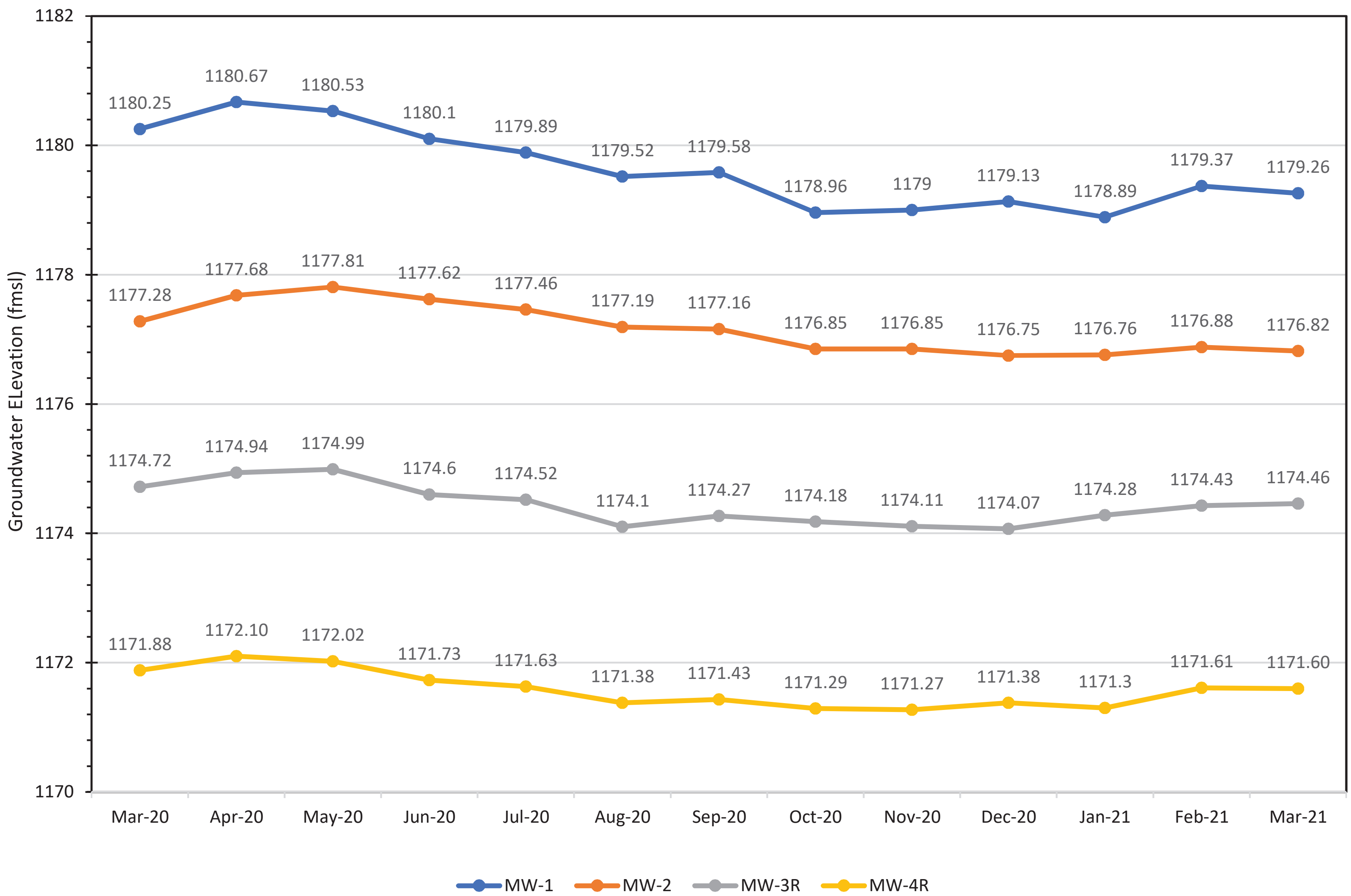
DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.8

5/3/2023 5:37 PM

Figure 4.1 Hydrograph
(MW-1, MW-2, MW-3R, MW-4R)



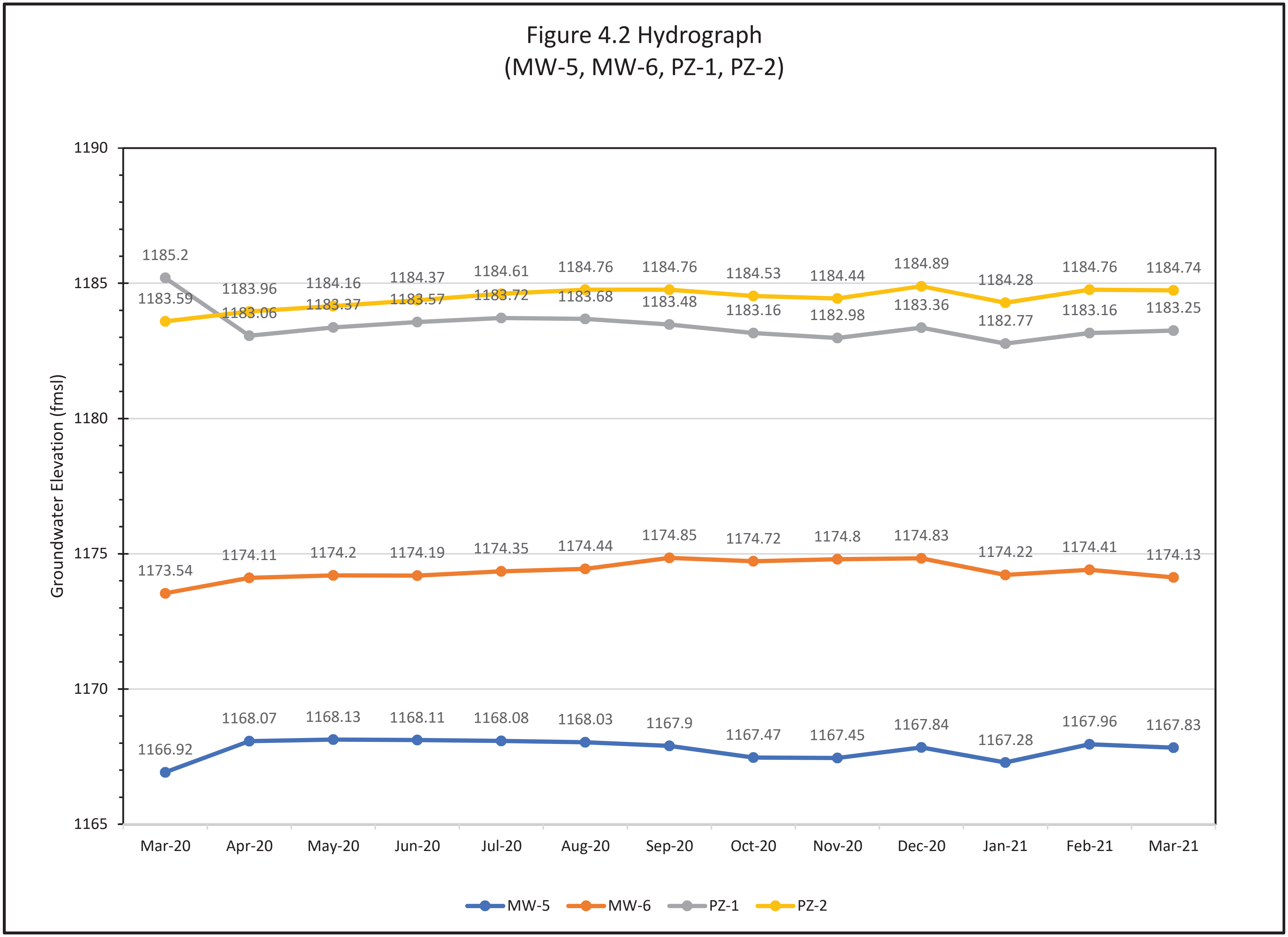


Figure 4.2 Hydrograph
(MW-5, MW-6, PZ-1, PZ-2)
Groundwater Elevation (fmsl)
1190
1185
1180
1175
1170
1165
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
1185.2
1183.59
1183.96
1183.06
1184.16
1183.37
1184.37
1183.57
1184.61
1183.72
1184.76
1183.68
1184.76
1183.48
1184.53
1183.16
1184.44
1182.98
1184.89
1183.36
1184.28
1182.77
1184.76
1183.16
1184.74
1183.25
1173.54
1174.11
1174.2
1174.19
1174.35
1174.44
1174.85
1174.72
1174.8
1174.83
1174.22
1174.41
1174.13
1166.92
1168.07
1168.13
1168.11
1168.08
1168.03
1167.9
1167.47
1167.45
1167.84
1167.28
1167.96
1167.83
MW-5
MW-6
PZ-1
PZ-2

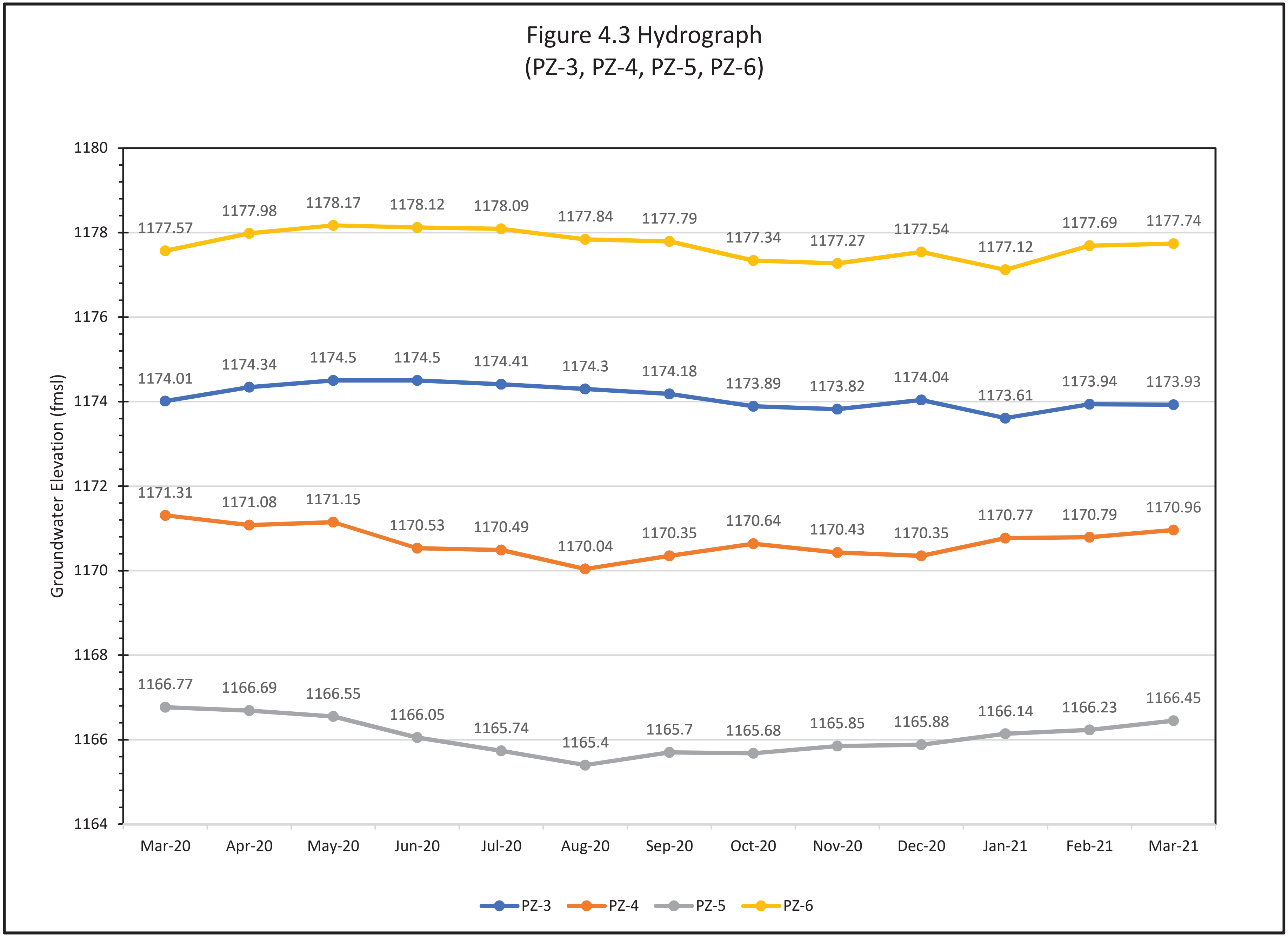


Figure 4.3 Hydrograph
(PZ-3, PZ-4, PZ-5, PZ-6)
Groundwater Elevation (fmsl)
1180
1178
1176
1174
1172
1170
1168
1166
1164
1177.57
1177.98
1178.17
1178.12
1178.09
1177.84
1177.79
1177.34
1177.27
1177.54
1177.12
1177.69
1177.74
1174.01
1174.34
1174.5
1174.5
1174.41
1174.3
1174.18
1173.89
1173.82
1174.04
1173.61
1173.94
1173.93
1171.31
1171.08
1171.15
1170.53
1170.49
1170.04
1170.35
1170.64
1170.43
1170.35
1170.77
1170.79
1170.96
1166.77
1166.69
1166.55
1166.05
1165.74
1165.4
1165.7
1165.68
1165.85
1165.88
1166.14
1166.23
1166.45
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
PZ-3
PZ-4
PZ-5
PZ-6

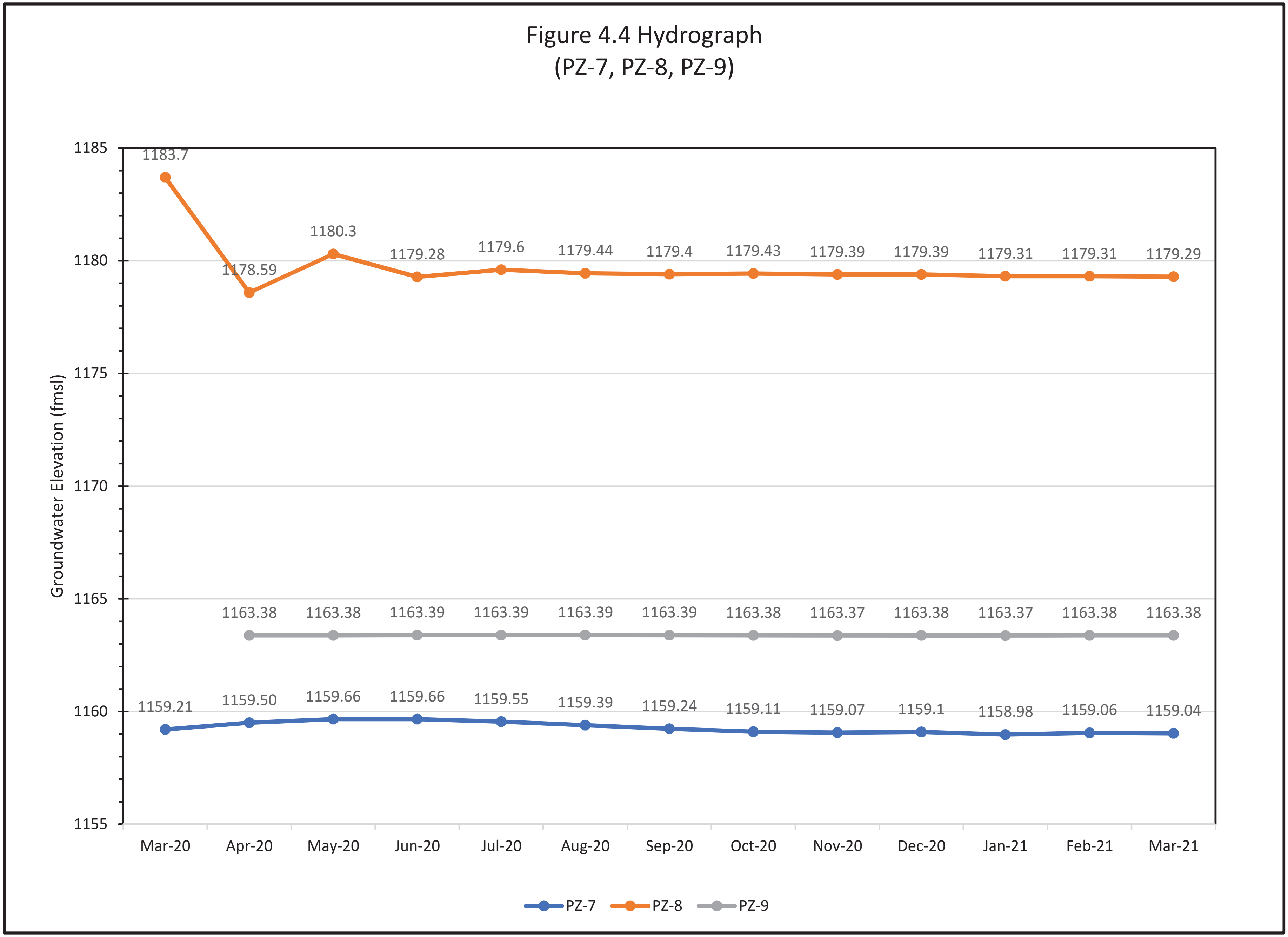


Figure 4.4 Hydrograph
(PZ-7, PZ-8, PZ-9)
Groundwater Elevation (fmsl)
1185
1180
1175
1170
1165
1160
1155
1183.7
1178.59
1180.3
1179.28
1179.6
1179.44
1179.4
1179.43
1179.39
1179.39
1179.31
1179.31
1179.29
1163.38
1163.38
1163.39
1163.39
1163.39
1163.39
1163.38
1163.37
1163.38
1163.37
1163.38
1163.38
1159.21
1159.50
1159.66
1159.66
1159.55
1159.39
1159.24
1159.11
1159.07
1159.1
1158.98
1159.06
1159.04
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
PZ-7
PZ-8
PZ-9

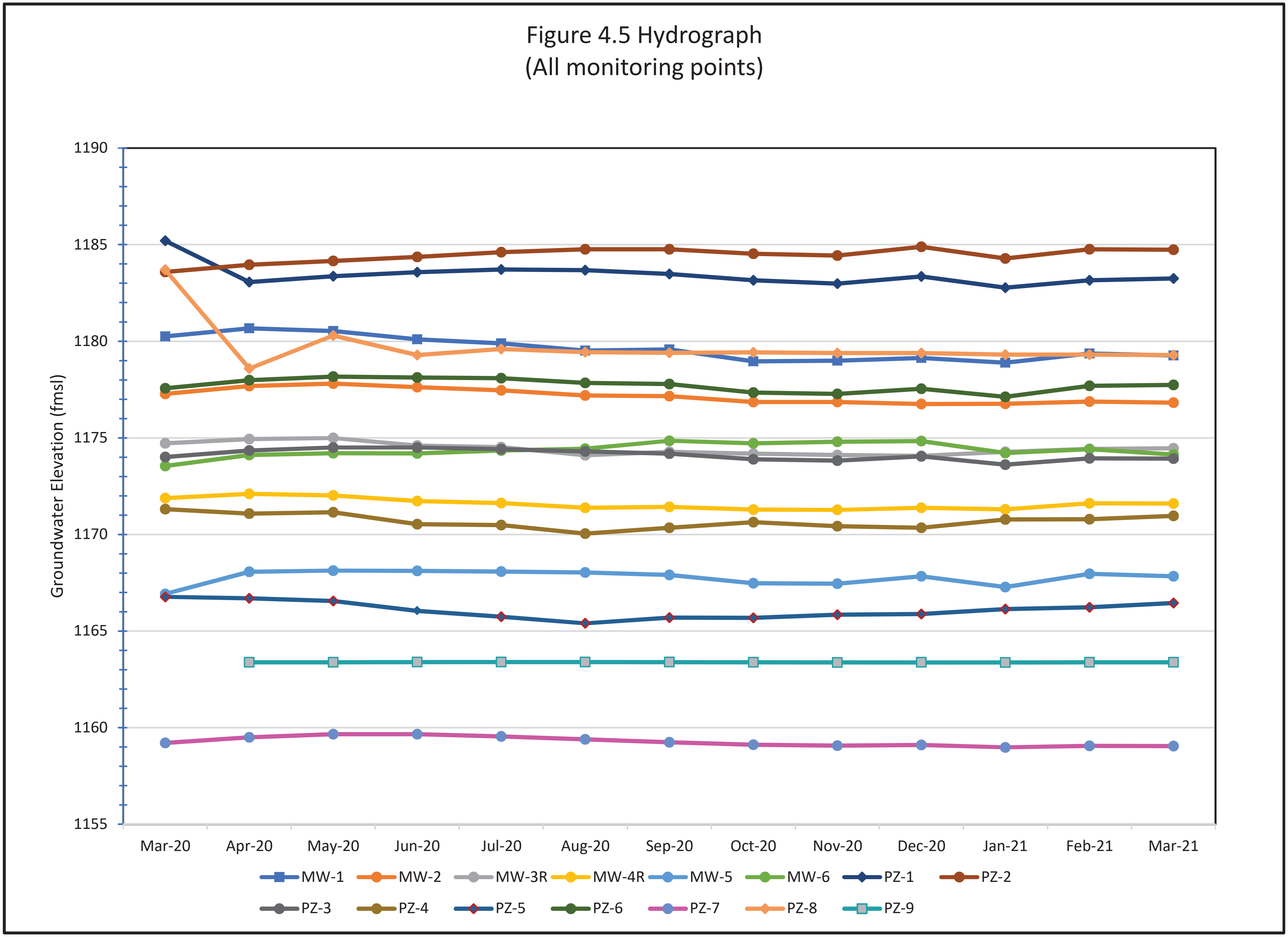


Figure 4.5 Hydrograph
(All monitoring points)
Groundwater Elevation (fmsl)
1190
1185
1180
1175
1170
1165
1160
1155
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
MW-1
MW-2
MW-3R
MW-4R
MW-5
MW-6
PZ-1
PZ-2
PZ-3
PZ-4
PZ-5
PZ-6
PZ-7
PZ-8
PZ-9

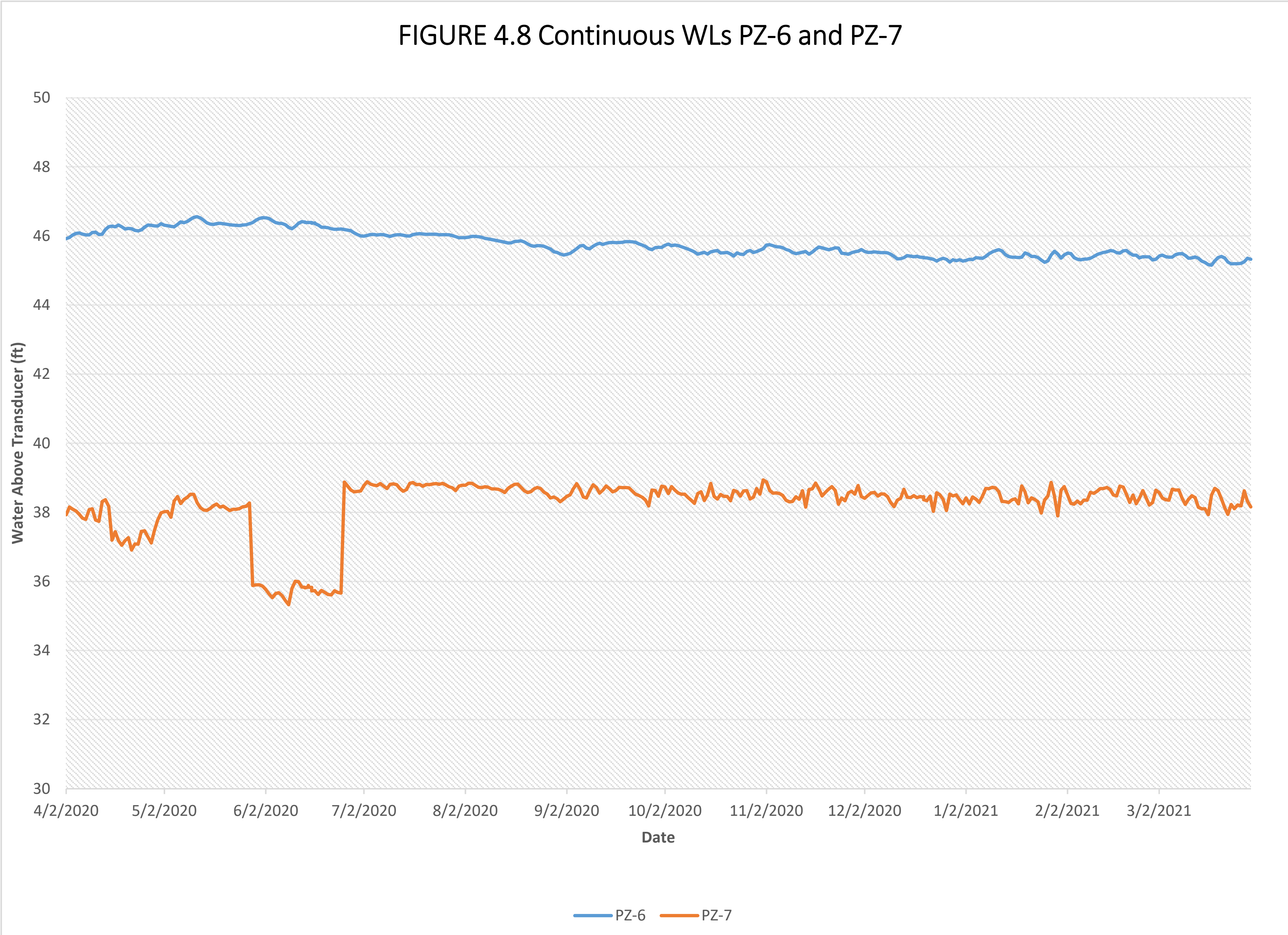
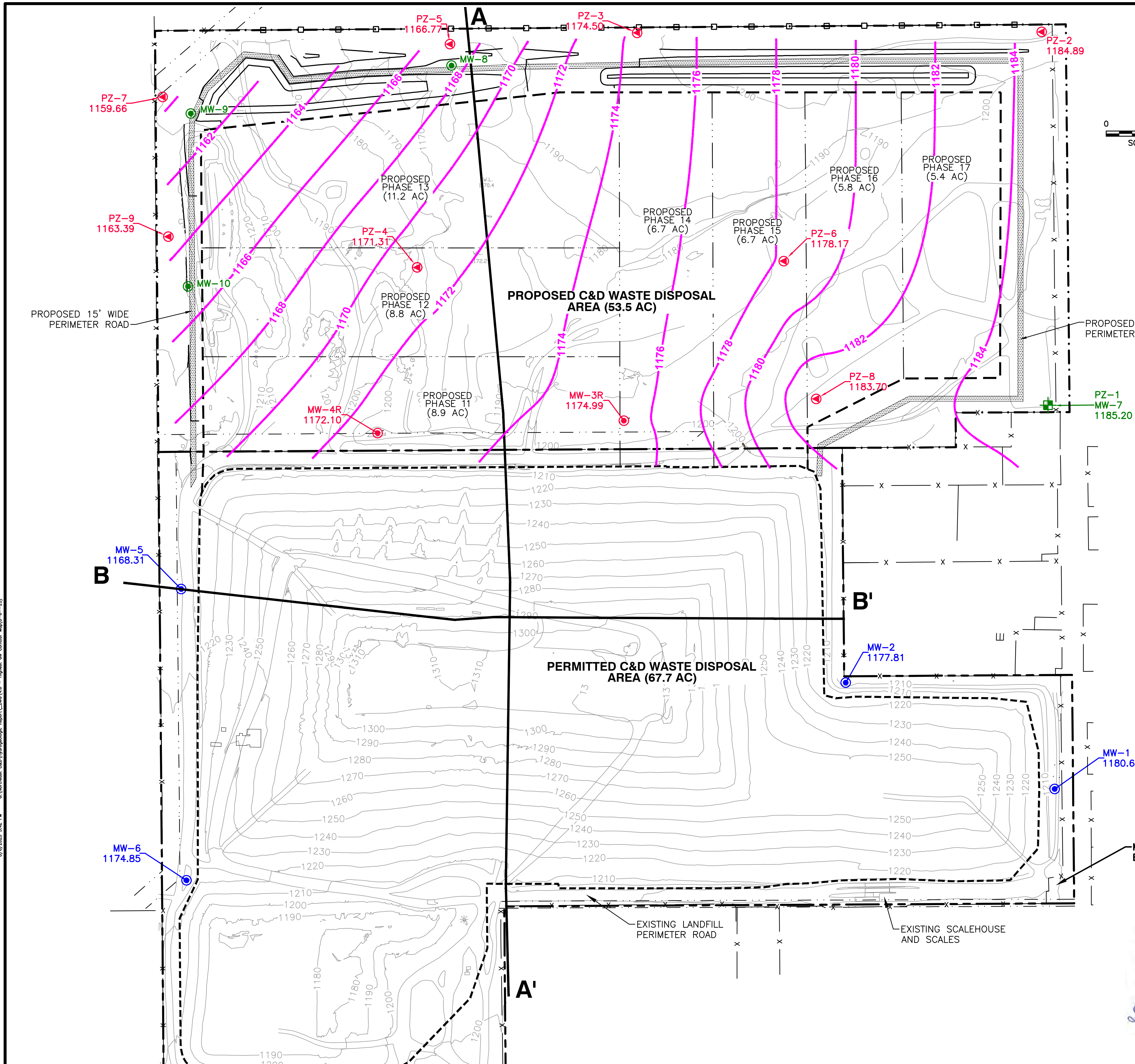


FIGURE 4.8 Continuous WLs PZ-6 and PZ-7
50
48
46
44
42
40
38
36
34
32
30
Water Above Transducer (ft)
4/2/2020
5/2/2020
6/2/2020
7/2/2020
8/2/2020
9/2/2020
10/2/2020
11/2/2020
12/2/2020
1/2/2021
2/2/2021
3/2/2021
Date
PZ-6
PZ-7




## LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
- PROPOSED PERIMETER ROAD
- PROPOSED FENCE
- MW-10 PROPOSED MONITORING WELL
- EXISTING FENCE
- 1210 EXISTING 10' CONTOUR (SEE NOTE 3)
- 1182 HIGHEST GROUNDWATER ELEVATION CONTOURS
- EXISTING ROADS
- EXISTING EASEMENT (APPROX., SEE NOTE 4)
- GAS EXISTING GAS LINE (APPROX., SEE NOTE 4)
- MW-1 EXISTING MONITORING WELL (TO REMAIN)
- PZ-1 MW-7 EXISTING PIEZOMETER TO BE CONVERTED INTO MONITORING WELL
- PZ-24 EXISTING PIEZOMETER (TO BE ABANDONED/DECOMMISSIONED)
- MW-4R EXISTING MONITORING WELL (TO BE ABANDONED/DECOMMISSIONED)
- A — A' LANDFILL CROSS-SECTION LOCATION

## NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

| HIGHEST GROUNDWATER RECORDED | | |
|---|---|---|
| PIEZOMETER NAME | ELEVATION | DATE RECORDED |
| MW-1 | 1180.67 | APRIL 2020 |
| MW-2 | 1177.81 | MAY 2020 |
| MW-3R | 1174.99 | MAY 2020 |
| MW-4R | 1172.10 | APRIL 2020 |
| MW-5 | 1168.31 | MAY 2020 |
| MW-6 | 1174.85 | SEPTEMBER 2020 |
| PZ-1 | 1185.20 | MARCH 2020 |
| PZ-2 | 1184.89 | DECEMBER 2020 |
| PZ-3 | 1174.50 | MAY 2020 |
| PZ-4 | 1171.31 | MARCH 2020 |
| PZ-5 | 1166.77 | MARCH 2020 |
| PZ-6 | 1178.17 | MAY 2020 |
| PZ-7 | 1159.66 | MAY 2020 |
| PZ-8 | 1183.70 | MARCH 2020 |
| PZ-9 | 1163.39 | JUNE 2020 |

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: HIGHEST GROUNDWATER CONTOUR MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

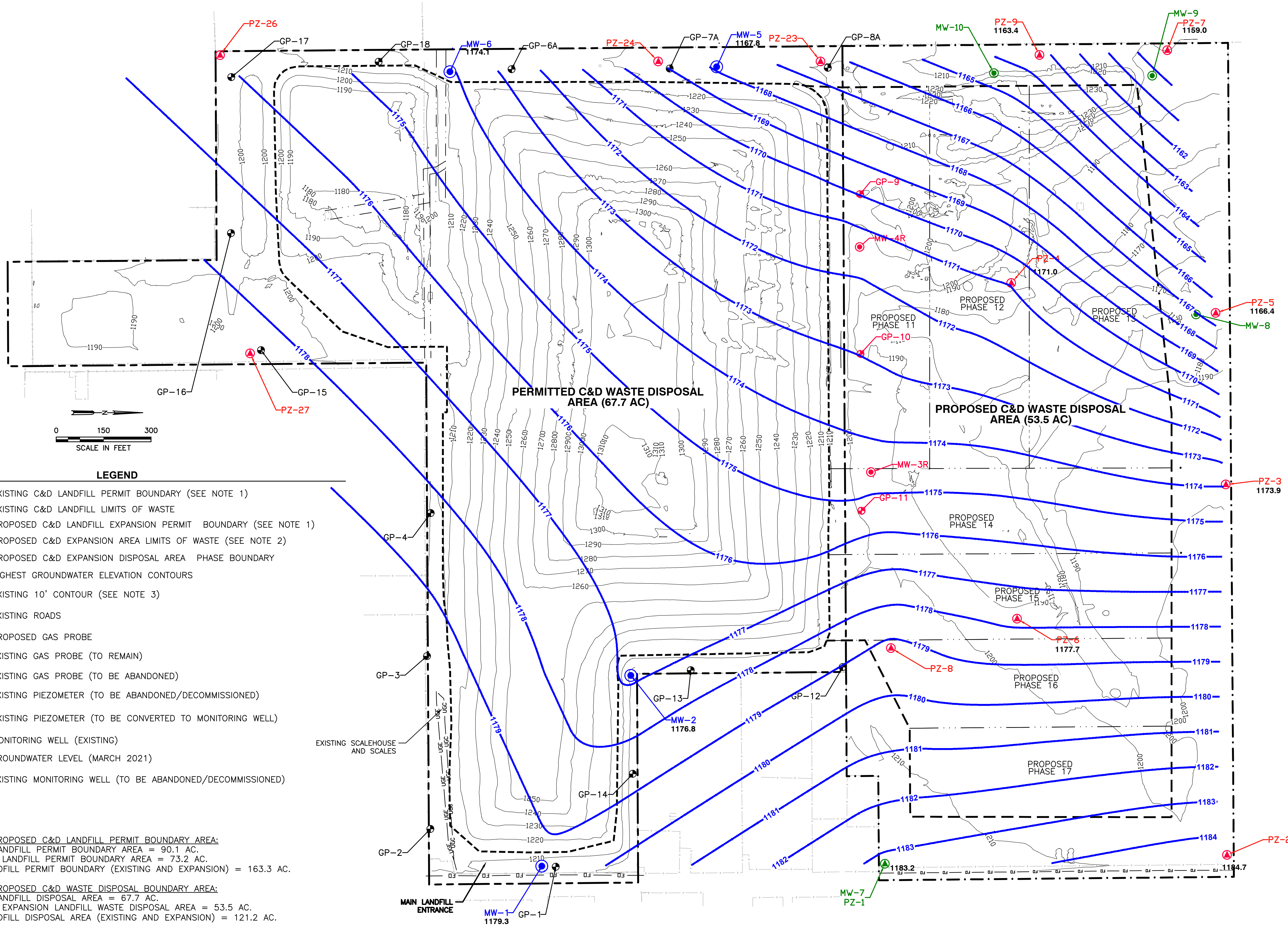
PROJ. NO. 16219107.00 | DWN. BY: DS | Q/A RVW BY: SS
DSN. BY: SS | CHK. BY: SDS | APP. BY: RRK

CADD FILE: 4.6 – HIGHEST GW CONTOUR MAP(8-6--23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 4.6




LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

## LEGEND

| | |
|---|---|
| — — — | EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1) |
| - - - - | EXISTING C&D LANDFILL LIMITS OF WASTE |
| — · — · | PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1) |
| — — | PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2) |
| — · · — | PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY |
| —1182— | HIGHEST GROUNDWATER ELEVATION CONTOURS |
| —1210— | EXISTING 10' CONTOUR (SEE NOTE 3) |
| | EXISTING ROADS |
| GP-14 | PROPOSED GAS PROBE |
| GP-14 | EXISTING GAS PROBE (TO REMAIN) |
| GP-10 | EXISTING GAS PROBE (TO BE ABANDONED) |
| PZ-24 | EXISTING PIEZOMETER (TO BE ABANDONED/DECOMMISSIONED) |
| PZ-1 MW-7 | EXISTING PIEZOMETER (TO BE CONVERTED TO MONITORING WELL) |
| MW-2 | MONITORING WELL (EXISTING) |
| 1179.3 | GROUNDWATER LEVEL (MARCH 2021) |
| MW-4R | EXISTING MONITORING WELL (TO BE ABANDONED/DECOMMISSIONED) |

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: POTENTIOMETRIC MAP MARCH 2021

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

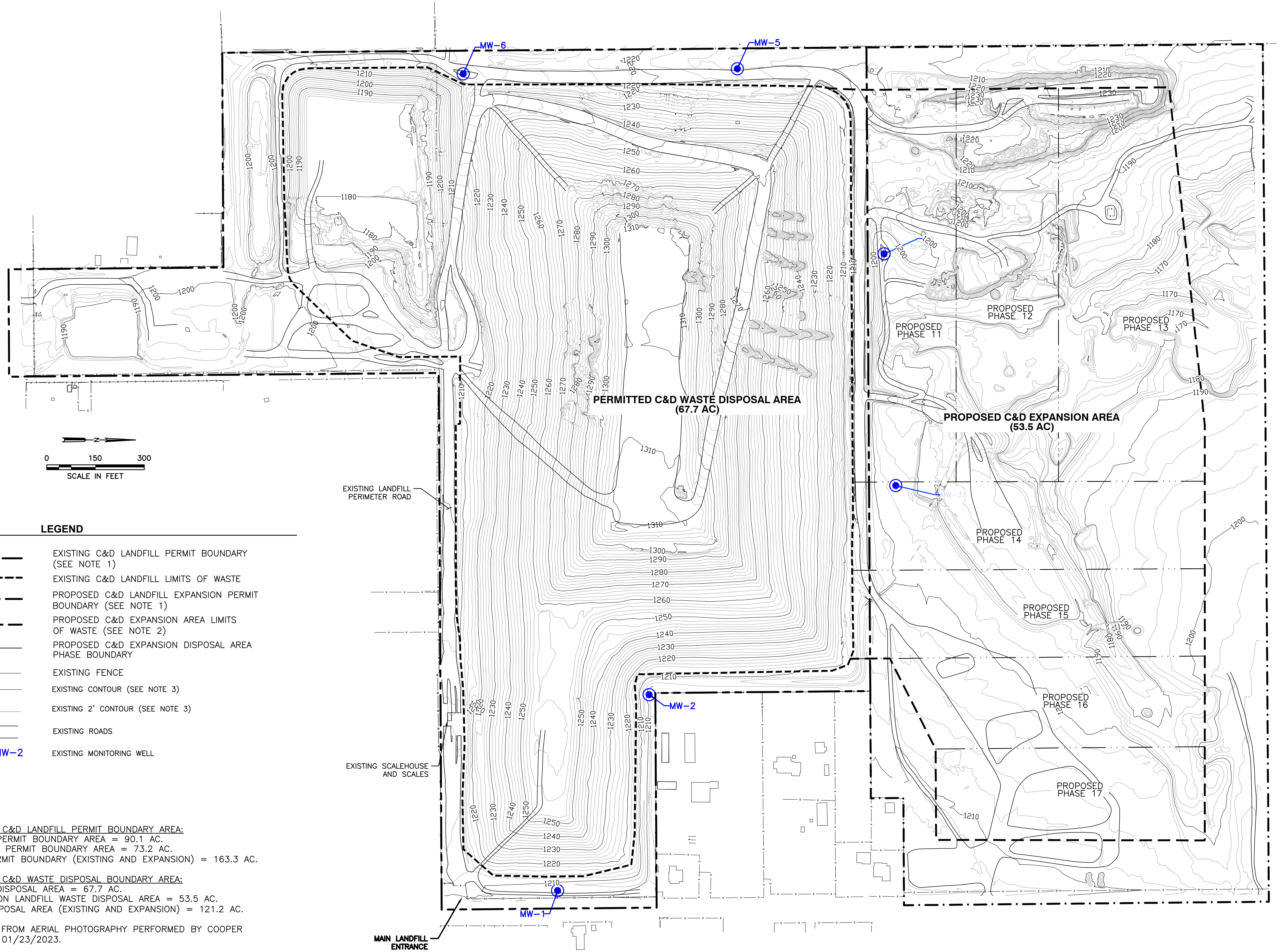
PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

CADD FILE: 4.7 - POT CONTOUR MAP (MARCH 2021)8-6-23

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 4.7




LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

## LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
- X — EXISTING FENCE
- 1210 — EXISTING CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- EXISTING ROADS
- MW-2 — EXISTING MONITORING WELL

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.

2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.

3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: CURRENT GROUNDWATER MONITORING NETWORK

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

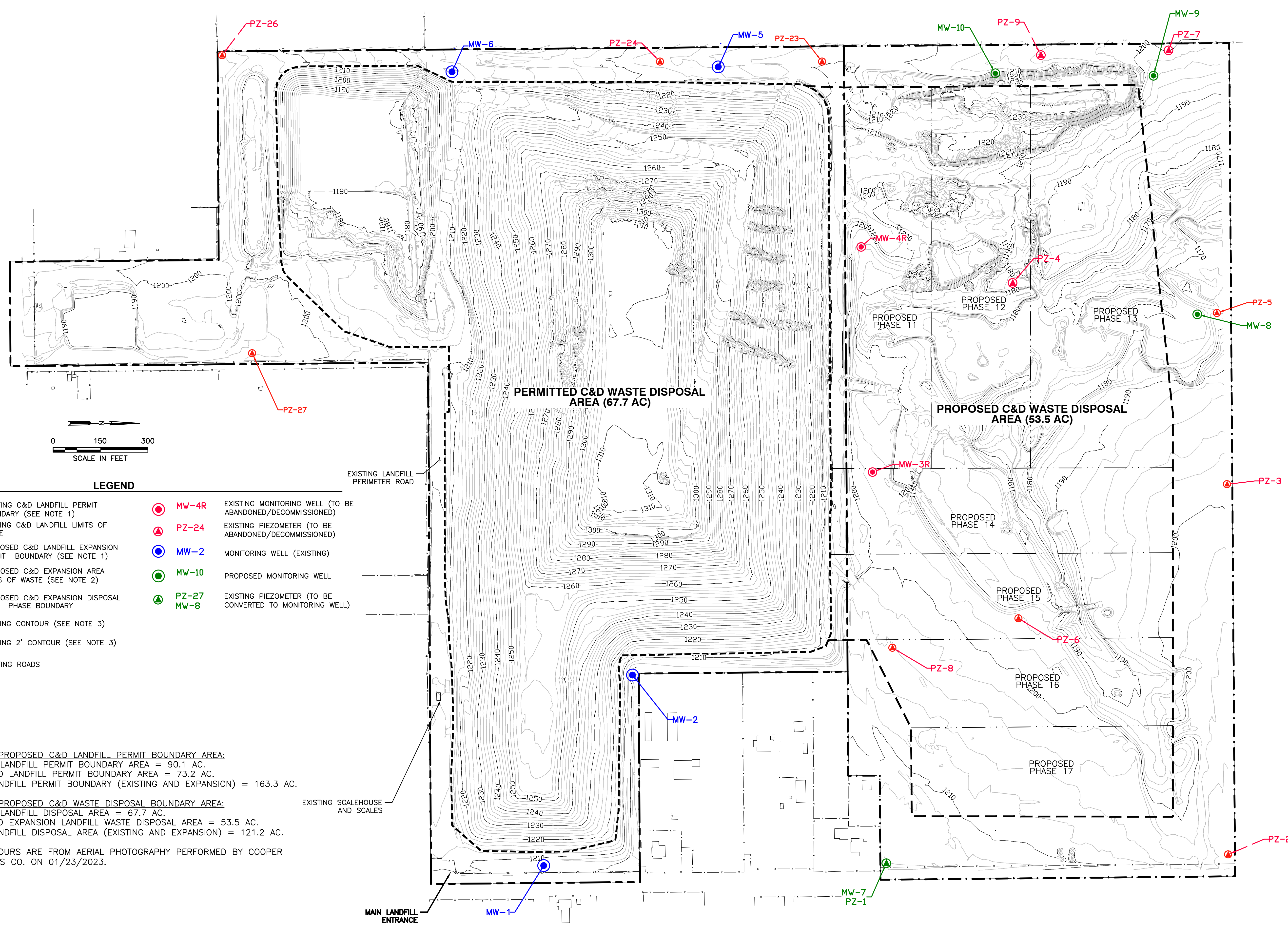
CADD FILE: 5.1 GW MONITOR(8-6-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 5.1

G:\Northeast C&D\Hydrogeologic Report_DWG\5.1 GW MONITOR(8-6-23) saraf, sandeep
8/6/2023 7:04 PM




## LEGEND

| | |
|---|---|
| EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1) | |
| EXISTING C&D LANDFILL LIMITS OF WASTE | |
| PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1) | |
| PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2) | |
| PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY | |
| EXISTING CONTOUR (SEE NOTE 3) | 1210 |
| EXISTING 2' CONTOUR (SEE NOTE 3) | |
| EXISTING ROADS | |
| MW-4R | EXISTING MONITORING WELL (TO BE ABANDONED/DECOMMISSIONED) |
| PZ-24 | EXISTING PIEZOMETER (TO BE ABANDONED/DECOMMISSIONED) |
| MW-2 | MONITORING WELL (EXISTING) |
| MW-10 | PROPOSED MONITORING WELL |
| PZ-27 MW-8 | EXISTING PIEZOMETER (TO BE CONVERTED TO MONITORING WELL) |

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.

2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.

3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

DRAWING TITLE: PROPOSED GROUNDWATER MONITORING NETWORK

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
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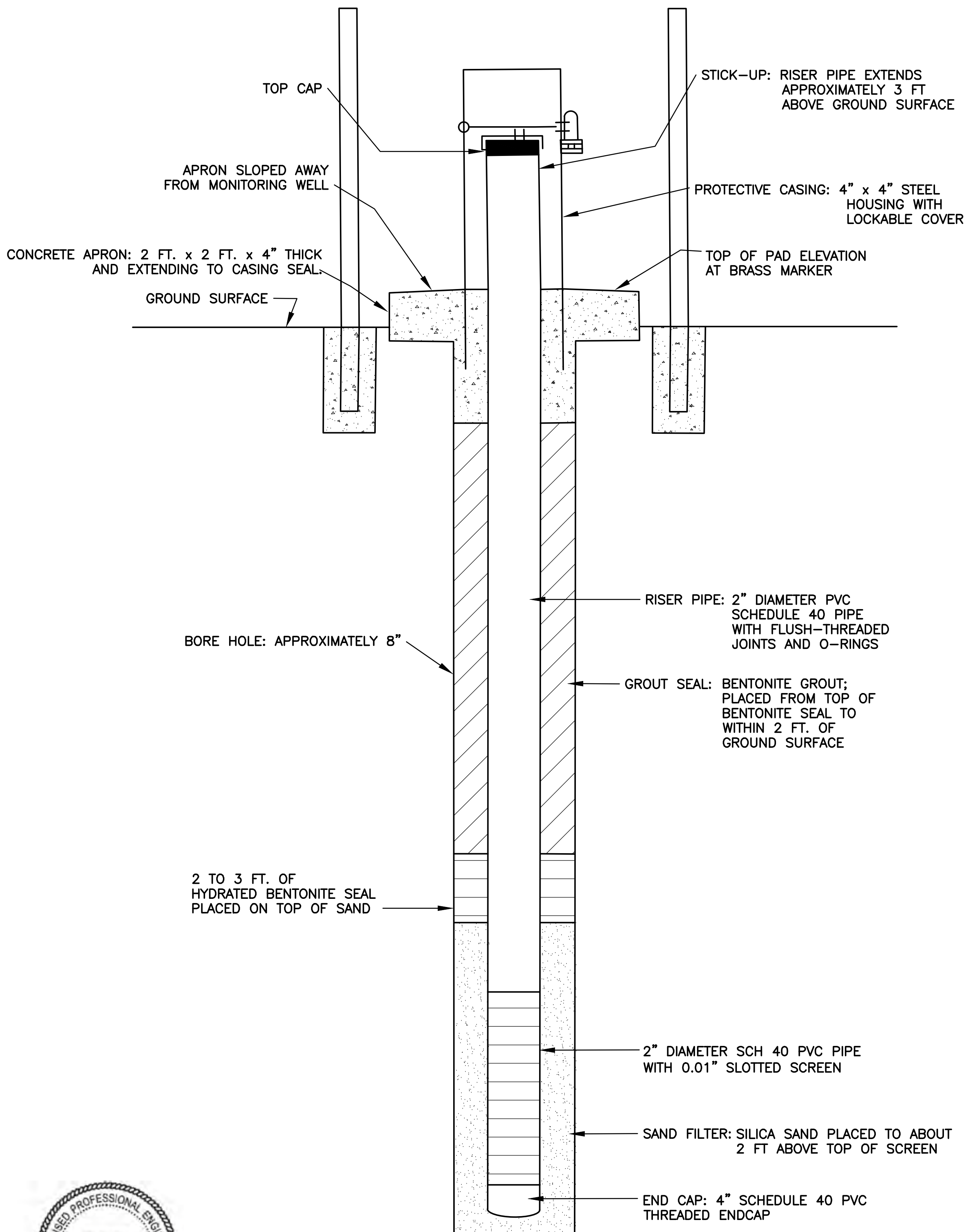
PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

CADD FILE: 5.2 PROP GW MONITOR(8-6-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 5.2




LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

**FOR PERMITTING PURPOSES ONLY**

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE
**TYPICAL MONITOR WELL DETAIL**

PROJECT TITLE
**NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION**

CLIENT
**N.E. LAND FILL, LLC**
**NORTHEAST LANDFILL**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**

**SCS ENGINEERS**
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PROJ. NO. 16219107.00 | DSN. BY: | DWN. BY: JLJ | CHK. BY: | Q/A RVW BY: BJD | APP. BY:

CADD FILE: 5.3 TYP. PIEZOMETER – DTL(8-6-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO.
**5.3**

G:\Northeast C&D\Hydrogeologic Report_DWG\5.3 TYP. PIEZOMETER – DTL(8-6-23)
8/6/2023 7:29 PM

# Tables

Table 2.1 - Stratigraphic Column

| Depth | Group | Age | Formation | Description |
|---|---|---|---|---|
| 0-50 | Sumner Group | Permian (Early) | Garber Sandstone (Pgr) | Orange-brown to red-brown fine grained Sandstone, irregularly bedded with red brown shale and some chert and mudstone congolomerates. Siltstones and shale are common near base and the top of the formation.  Estimated thickness is 350 ft bgs |
| 50-100 | | | | |
| 100-150 | | | | |
| 150-200 | | | | |
| 200-250 | | | | |
| 250-300 | | | | |
| 300-350 | | | | |
| 350-400 | | | Wellington Formation (Pw) | Reddish-brown to orange brown fine grained sandstone containing a maroon mudstone and chert conglomerate.  Base of formation is mapped at the base of the Fallis Sandstone, which is more of a fine- to locally medium-grained sandstone interval.  Total thickness is aproximately 799 ft thick in Oklhahoma County |
| 400-500 | | | | |

# TABLE 3.1
## Boring Construction Details

| Well | Northing | Easting | GS Elev. (fmsl) | Stick-up (ft) | TOC Elev. (fmsl) | Total Drilled Depth (bgs) | Bottom of Boring Elev. (fmsl) | PZ Installed Depth (bgs) | Screened Interval (fmsl) | Groundwater Observed during Drilling (bgs) | Observed GW Elev. (fmsl) | GW Stablilized (24 hrs) (bgs) | Date Stabilized WL Obtained | GW Stabilized (24hrs) Elev. (fmsl) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PZ-1 | 182844.43 | 2150429.36 | 1213.84 | 3.1 | 1216.94 | 61.5 | 1152.34 | 39.35 | 1184.49-1174.49 | 34 | 1179.84 | 27.89 | 3/13/2020 | 1185.95 |
| PZ-2 | 183891.08 | 2150425.85 | 1207.19 | 2.78 | 1209.97 | 56.5 | 1150.69 | 35.12 | 1182.07-1172.07 | 24 | 1183.19 | 23.49 | 3/16/2020 | 1183.70 |
| PZ-3 | 183913.50 | 2149229.41 | 1198.91 | 3.62 | 1202.53 | 56 | 1142.91 | 33.80 | 1175.11-1165.11 | 30.5 | 1168.41 | 25.58 | 3/25/2020 | 1173.33 |
| PZ-4 | 183242.87 | 2148594.06 | 1175.32 | 3.01 | 1178.33 | 35 | 1140.32 | 15.42 | 1169.90-1159.90 | 6 | 1169.32 | 4.96 | 3/9/2020 | 1170.36 |
| PZ-5 | 183888.17 | 2148688.62 | 1176.28 | 3.18 | 1179.46 | 35 | 1141.28 | 19.75 | 1166.53-1156.53 | 7 | 1169.28 | 9.74 | 3/25/2020 | 1166.54 |
| PZ-6 | 183260.11 | 2149653.36 | 1196.32 | 3.17 | 1199.49 | 56 | 1140.32 | 38.68 | 1167.64-1157.64 | 30 | 1166.32 | 18.87 | 3/12/2020 | 1177.45 |
| PZ-7 | 183731.02 | 2147860.91 | 1198.91 | 2.73 | 1201.64 | 66 | 1132.91 | 49.41 | 1159.50-1149.50 | 40 | 1158.91 | 39.41 | 3/30/2020 | 1159.50 |
| EB-1 | 182874.18 | 2147882.86 | 1210.65 | NA | NA | 101 | 1109.65 | NA | NA | 42 | 1168.65 | 40.43 | 3/26/2020 | 1170.22 |
| EB-2 | 182898.09 | 2148854.27 | 1190.51 | NA | NA | 46 | 1144.51 | NA | NA | 18 | 1172.51 | 16.66 | 3/9/2020 | 1173.85 |
| EB-3/PZ-8 | 182862.63 | 2149748.47 | 1204.10 | 3 | 1207.1 | 60 | 1144.10 | 24.90 | 1189.20-1179.20 | 33 | 1171.10 | 23.34 | 3/13.2020 | 1180.76 |
| EB-4 | 183261.62 | 2150212.06 | 1207.91 | NA | NA | 56 | 1151.91 | NA | NA | 30 | 1177.91 | 24.41 | 3/12/2020 | 1183.50 |
| EB-5 | 183810.96 | 2148269.44 | 1162.33 | NA | NA | 31 | 1131.33 | NA | NA | 4.5 | 1157.83 | 3.02 | 3/31/2020 | 1159.31 |
| EB-6 | 183403.46 | 2149274.23 | 1190.62 | NA | NA | 46 | 1144.62 | NA | NA | 20.5 | 1170.12 | 13.39 | 3/25/2020 | 1177.23 |
| EB-7 | 183206.75 | 2148329.74 | 1193.70 | NA | NA | 53.5 | 1140.20 | NA | NA | 28 | 1165.70 | 24.92 | 3/5/2020 | 1168.78 |
| EB-8/PZ-9 | 183332.65 | 2147872.18 | 1203.28 | 2.78 | 1206.06 | 71 | 1132.28 | 40.02 | 1173.26-1163.26 | 42 | 1161.28 | 40.61 | 4/1/2020 | 1162.67 |
| EB-9 | 183764.22 | 2149774.77 | 1202.00 | NA | NA | 51 | 1151.00 | NA | NA | 26 | 1176.00 | 22.69 | 4/1/2020 | 1179.31 |
| MW-3R | 182799.57 | 2149191.49 | 1197.30 | 3.2 | 1200.53 | 45 | 1152.30 | 45.00 | 1162.30-1152.30 | 35 | 1162.30 | NA* | NA* | NA* |
| MW-4R | 182763.61 | 2148479.06 | 1196.00 | 3.2 | 1199.22 | 49.5 | 1146.50 | 49.50 | 1156.50-1146.50 | 42 | 1154.00 | NA* | NA* | NA* |

*Monitoring well installed prior to this investigation

TABLE 3.2

Geotechnical Sample Summary

| Boring | Depth | Soil Classification | Soil Description | Moisture Content (%) | % Passing # 200 Sieve | Liquid Limit (%) | Plasitic Limit (%) | Plasticity Index (%) | Optimum Moisture (%) | Max Dry Density (pcf) | Hydraulic Conductivity (cm/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | | D2487 | D2487 | D2216 | D1140 | D4318 | D4318 | D4318 | D698 | D698 | D5084 |
| EB-2 | 4'-8' | CL | Reddish Brown & Brown Sandy Lean Clay | 8.9 | 59.1 | 28 | 13 | 15 | DNR | DNR | DNR |
| EB-3 | 0-3' | CL | Reddish Brown Lean Clay W/Sand | 16.8 | 71.5 | 35 | 15 | 20 | DNR | DNR | DNR |
| | 10'-14' | CL | Reddish Brown Sandy Lean Clay | 14.6 | 57 | 31 | 14 | 16 | DNR | DNR | DNR |
| | 25'-27' | SP-SM | Reddish Brown Poorly Graded Sand W/Silt | 6.7 | 10.2 | CNBD | CNBD | Non Plastic | DNR | DNR | DNR |
| EB-4 | 10'-12' | SM | Reddish Brown Silty Sand | 13.1 | 47.9 | CNBD | CNBD | Non Plastic | DNR | DNR | DNR |
| EB-6 | 0-5' | CL | Reddish Brown & Brown Sandy Lean Clay | 19 | 57.6 | 30 | 15 | 15 | DNR | DNR | DNR |
| | 20'-25' | SP-SM | Reddish Brown Poorly Graded Sand W/Silt | 21.7 | 7 | CNBD | CNBD | Non Plastic | DNR | DNR | $5.06X10^{-4}$ |
| EB-7 | 5'-10' | CL | Reddish Brown & Brown Sandy Lean Clay | 17.3 | 68.7 | 31 | 15 | 16 | DNR | DNR | $1.28X10^{-8}$ |
| EB-8 | 15'-20' | SM | Reddish Brown Silty Sand | 6.4 | 41.9 | CNBD | CNBD | Non Plastic | DNR | DNR | DNR |
| EB-9 | 5'-8' | CL | Reddish Brown & Brown Sandy Lean Clay | 15.1 | 50.6 | 23 | 15 | 8 | DNR | DNR | DNR |
| PZ-1 | 10'-13' | ML | Reddish Brown Sandy Silt | 11.5 | 59.1 | CNBD | CNBD | Non Plastic | DNR | DNR | DNR |
| PZ-2 | 2'-5' | CL-ML | Brown & Reddish Brown Sandy Silty Clay | 10.7 | 51.4 | 23 | 16 | 7 | DNR | DNR | DNR |
| | 15'-17' | SM | Reddish Brown Silty Sand | 9.2 | 33.4 | CNBD | CNBD | Non Plastic | DNR | DNR | DNR |
| PZ-4 | 5'-10' | SC | Reddish Brown Clayey Sand | 21.5 | 35.6 | 25 | 15 | 10 | DNR | DNR | $2.83X10^{-7}$ |
| PZ-5 | 0-5' | CL | Brown & Reddish Brown Sandy Lean Clay | 17.8 | 63.6 | 26 | 15 | 10 | DNR | DNR | DNR |
| PZ-6 | 2'-5' | CL | Reddish Brown & Brown Sandy Lean Clay | 17.6 | 68.8 | 37 | 15 | 22 | 15.4 | 112.1 | $2.05X10^{-8}$ |
| PZ-7 | 6'-8' | CL | Reddish Brown & Brown Lean Clay W/Sand | 18.4 | 72 | 32 | 16 | 16 | 14.1 | 114.3 | DNR |

DNR = Did Not Run on this Sample

CNBD = Could Not Be Determined

**Table 4.1 Monthly Groundwater Elevation Summary**
**Northeast Landfill**

| Well | Top of Casing Elevation (ft msl) | March 2020 Depth to Groundwater (ft below TOC) | March 2020 Groundwater Elevation (ft msl) | April 2020 Depth to Groundwater (ft below TOC) | April 2020 Groundwater Elevation (ft msl) | May 2020 Depth to Groundwater (ft below TOC) | May 2020 Groundwater Elevation (ft msl) | June 2020 Depth to Groundwater (ft below TOC) | June 2020 Groundwater Elevation (ft msl) | July 2020 Depth to Groundwater (ft below TOC) | July 2020 Groundwater Elevation (ft msl) | August 2020 Depth to Groundwater (ft below TOC) | August 2020 Groundwater Elevation (ft msl) | September 2020 Depth to Groundwater (ft below TOC) | September 2020 Groundwater Elevation (ft msl) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-1 | 1211.62 | 31.37 | 1180.25 | 30.95 | 1180.67 | 31.09 | 1180.53 | 31.52 | 1180.10 | 31.73 | 1179.89 | 32.10 | 1179.52 | 32.04 | 1179.58 |
| MW-2 | 1213.22 | 35.94 | 1177.28 | 35.54 | 1177.68 | 35.41 | 1177.81 | 35.60 | 1177.62 | 35.76 | 1177.46 | 36.03 | 1177.19 | 36.06 | 1177.16 |
| MW-3R | 1200.53 | 25.81 | 1174.72 | 25.59 | 1174.94 | 25.54 | 1174.99 | 25.93 | 1174.60 | 26.01 | 1174.52 | 26.43 | 1174.10 | 26.26 | 1174.27 |
| MW-4R | 1199.22 | 27.34 | 1171.88 | 27.12 | 1172.10 | 27.20 | 1172.02 | 27.49 | 1171.73 | 27.59 | 1171.63 | 27.84 | 1171.38 | 27.79 | 1171.43 |
| MW-5 | 1218.53 | 51.61 | 1166.92 | 50.46 | 1168.07 | 50.40 | 1168.13 | 50.42 | 1168.11 | 50.45 | 1168.08 | 50.50 | 1168.03 | 50.63 | 1167.90 |
| MW-6 | 1228.68 | 55.14 | 1173.54 | 54.57 | 1174.11 | 54.48 | 1174.20 | 54.49 | 1174.19 | 54.33 | 1174.35 | 54.24 | 1174.44 | 53.83 | 1174.85 |
| PZ-1 | 1216.94 | 31.74 | 1185.20 | 33.88 | 1183.06 | 33.57 | 1183.37 | 33.37 | 1183.57 | 33.22 | 1183.72 | 33.26 | 1183.68 | 33.46 | 1183.48 |
| PZ-2 | 1209.97 | 26.38 | 1183.59 | 26.01 | 1183.96 | 25.81 | 1184.16 | 25.60 | 1184.37 | 25.36 | 1184.61 | 25.21 | 1184.76 | 25.21 | 1184.76 |
| PZ-3 | 1202.53 | 28.52 | 1174.01 | 28.19 | 1174.34 | 28.03 | 1174.50 | 28.03 | 1174.50 | 28.12 | 1174.41 | 28.23 | 1174.30 | 28.35 | 1174.18 |
| PZ-4 | 1178.33 | 7.02 | 1171.31 | 7.25 | 1171.08 | 7.18 | 1171.15 | 7.80 | 1170.53 | 7.84 | 1170.49 | 8.29 | 1170.04 | 7.98 | 1170.35 |
| PZ-5 | 1179.46 | 12.69 | 1166.77 | 12.77 | 1166.69 | 12.91 | 1166.55 | 13.41 | 1166.05 | 13.72 | 1165.74 | 14.06 | 1165.40 | 13.76 | 1165.70 |
| PZ-6 | 1199.49 | 21.92 | 1177.57 | 21.51 | 1177.98 | 21.32 | 1178.17 | 21.37 | 1178.12 | 21.40 | 1178.09 | 21.65 | 1177.84 | 21.70 | 1177.79 |
| PZ-7 | 1201.64 | 42.43 | 1159.21 | 42.14 | 1159.50 | 41.98 | 1159.66 | 41.98 | 1159.66 | 42.09 | 1159.55 | 42.25 | 1159.39 | 42.40 | 1159.24 |
| PZ-8 | 1207.10 | 23.40 | 1183.70 | 28.51 | 1178.59 | 26.80 | 1180.30 | 27.82 | 1179.28 | 27.50 | 1179.60 | 27.66 | 1179.44 | 27.70 | 1179.40 |
| PZ-9 | 1206.06 | NA | NA | 42.68 | 1163.38 | 42.68 | 1163.38 | 42.67 | 1163.39 | 42.67 | 1163.39 | 42.67 | 1163.39 | 42.67 | 1163.39 |

Highest Recorded GW Elevation (12 Month Period)

ft below TOC - feet below top of casing

ft MSL - feet above mean sea level

| Well | Top of Casing Elevation (ft msl) | October 2020 Depth to Groundwater (ft below TOC) | October 2020 Groundwater Elevation (ft msl) | November 2020 Depth to Groundwater (ft below TOC) | November 2020 Groundwater Elevation (ft msl) | December 2020 Depth to Groundwater (ft below TOC) | December 2020 Groundwater Elevation (ft msl) | January 2021 Depth to Groundwater (ft below TOC) | January 2021 Groundwater Elevation (ft msl) | February 2021 Depth to Groundwater (ft below TOC) | February 2021 Groundwater Elevation (ft msl) | March 2021 Depth to Groundwater (ft below TOC) | March 2021 Groundwater Elevation (ft msl) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-1 | 1211.62 | 32.66 | 1178.96 | 32.62 | 1179.00 | 32.49 | 1179.13 | 32.73 | 1178.89 | 32.25 | 1179.37 | 32.36 | 1179.26 |
| MW-2 | 1213.22 | 36.37 | 1176.85 | 36.37 | 1176.85 | 36.47 | 1176.75 | 36.46 | 1176.76 | 36.34 | 1176.88 | 36.40 | 1176.82 |
| MW-3R | 1200.53 | 26.35 | 1174.18 | 26.42 | 1174.11 | 26.46 | 1174.07 | 26.25 | 1174.28 | 26.10 | 1174.43 | 26.07 | 1174.46 |
| MW-4R | 1199.22 | 27.93 | 1171.29 | 27.95 | 1171.27 | 27.84 | 1171.38 | 27.92 | 1171.30 | 27.61 | 1171.61 | 27.62 | 1171.60 |
| MW-5 | 1218.53 | 51.06 | 1167.47 | 51.08 | 1167.45 | 50.69 | 1167.84 | 51.25 | 1167.28 | 50.57 | 1167.96 | 50.70 | 1167.83 |
| MW-6 | 1228.68 | 53.96 | 1174.72 | 53.88 | 1174.80 | 53.85 | 1174.83 | 54.46 | 1174.22 | 54.27 | 1174.41 | 54.55 | 1174.13 |
| PZ-1 | 1216.94 | 33.78 | 1183.16 | 33.96 | 1182.98 | 33.58 | 1183.36 | 34.17 | 1182.77 | 33.78 | 1183.16 | 33.69 | 1183.25 |
| PZ-2 | 1209.97 | 25.44 | 1184.53 | 25.53 | 1184.44 | 25.08 | 1184.89 | 25.69 | 1184.28 | 25.21 | 1184.76 | 25.23 | 1184.74 |
| PZ-3 | 1202.53 | 28.64 | 1173.89 | 28.71 | 1173.82 | 28.49 | 1174.04 | 28.92 | 1173.61 | 28.59 | 1173.94 | 28.60 | 1173.93 |
| PZ-4 | 1178.33 | 7.69 | 1170.64 | 7.90 | 1170.43 | 7.98 | 1170.35 | 7.56 | 1170.77 | 7.54 | 1170.79 | 7.37 | 1170.96 |
| PZ-5 | 1179.46 | 13.78 | 1165.68 | 13.61 | 1165.85 | 13.58 | 1165.88 | 13.32 | 1166.14 | 13.23 | 1166.23 | 13.01 | 1166.45 |
| PZ-6 | 1199.49 | 22.15 | 1177.34 | 22.22 | 1177.27 | 21.95 | 1177.54 | 22.37 | 1177.12 | 21.80 | 1177.69 | 21.75 | 1177.74 |
| PZ-7 | 1201.64 | 42.53 | 1159.11 | 42.57 | 1159.07 | 42.54 | 1159.10 | 42.66 | 1158.98 | 42.58 | 1159.06 | 42.60 | 1159.04 |
| PZ-8 | 1207.10 | 27.67 | 1179.43 | 27.71 | 1179.39 | 27.71 | 1179.39 | 27.79 | 1179.31 | 27.79 | 1179.31 | 27.81 | 1179.29 |
| PZ-9 | 1206.06 | 42.68 | 1163.38 | 42.69 | 1163.37 | 42.68 | 1163.38 | 42.69 | 1163.37 | 42.68 | 1163.38 | 42.68 | 1163.38 |

Highest Recorded GW Elevation (12 Month Period)

ft below TOC - feet below top of casing

ft MSL - feet above mean sea level

# TABLE 4.2
# NORTHEAST LANDFILL PRECIPITATION

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 981 - 2010 Normal | 1.45 | 1.77 | 3.11 | 3.03 | 5.16 | 5.25 | 3.28 | 3.13 | 3.72 | 4.21 | 2.21 | 1.75 | 38.09 |
| Mesonet Average | 1.43 | 1.58 | 2.84 | 3.77 | 4.85 | 4.72 | 3.67 | 3.57 | 3.19 | 3.54 | 1.87 | 1.77 | 36.79 |
| 1994 | 0.22 | 3.28 | 3.51 | 3.26 | 3.66 | 2.15 | 2.92 | 2.16 | 2.52 | 2.82 | 6.85 | 1.73 | 35.08 |
| 1995 | 1.57 | 0.03 | 3.54 | 5.14 | 8.17 | 7.75 | 1.99 | 4.11 | 4.86 | 1.18 | 0.45 | 2.77 | 41.56 |
| 1996 | 0.1 | 0.06 | 2.15 | 2.23 | 1.71 | 2.72 | 8.52 | 4.65 | 5 | 3.26 | 4.6 | 0.01 | 35.01 |
| 1997 | 0.45 | 3.12 | 0.72 | 4.78 | 3.58 | 2.89 | 4.9 | 5.7 | 3.42 | 4.14 | 1.57 | 3.8 | 39.07 |
| 1998 | 4.71 | 0.45 | 6.61 | 3.37 | 2.3 | 1.93 | 0.79 | 0.22 | 3.28 | 4.63 | 3.6 | 0.85 | 32.74 |
| 1999 | 1.3 | 0.64 | 4.53 | 6.94 | 3.93 | 4.71 | 0.49 | 0.24 | 6.65 | 2.38 | 0.02 | 3.11 | 34.94 |
| 2000 | 0.95 | 1.64 | 2.43 | 5.32 | 2.13 | 6.48 | 3.25 | 0 | 1.25 | 8.78 | 3.73 | 1.53 | 37.49 |
| 2001 | 3.21 | 2.05 | 1.01 | 1.29 | 5.18 | 2.67 | 1.15 | 4.03 | 7.77 | 1.66 | 1.34 | 1.35 | 32.71 |
| 2002 | 2.12 | 1.54 | 2.01 | 4.82 | 2.35 | 3.16 | 4.02 | 4.16 | 3.79 | 4.03 | 0.55 | 3.36 | 35.91 |
| 2003 | 0.05 | 1.08 | 2.88 | 1.56 | 1.83 | 2.4 | 0.32 | 4.4 | 3.02 | 3.66 | 1.58 | 1.42 | 24.2 |
| 2004 | 1.91 | 1.47 | 6.01 | 1.43 | 1.67 | 8.85 | 4.47 | 6.33 | 0.55 | 6.38 | 4.92 | 0.7 | 44.69 |
| 2005 | 2.06 | 3.31 | 0.65 | 0.55 | 2.45 | 6.38 | 3.59 | 5.05 | 1.84 | 1.9 | 0.03 | 0.21 | 28.02 |
| 2006 | 0.5 | 0.32 | 2.17 | 2.94 | 1.82 | 3.82 | 1.24 | 3.78 | 2.02 | 1.68 | 1.45 | 2.93 | 24.67 |
| 2007 | 2.69 | 0.74 | 5.39 | 1.98 | 9.17 | 13.32 | 6.93 | 5.08 | 2.12 | 3.03 | 0.72 | 3.14 | 54.31 |
| 2008 | 0.71 | 2.42 | 3.87 | 3.44 | 5.1 | 6.25 | 0.89 | 4.6 | 0.86 | 2.05 | 1.1 | 0.66 | 31.95 |
| 2009 | 0.73 | 1.06 | 2.62 | 4.51 | 4.42 | 0.88 | 6.22 | 7.48 | 4.8 | 6.91 | 0.4 | 1.02 | 41.05 |
| 2010 | 1.37 | 3.79 | 1.23 | 3.5 | 6.85 | 10.08 | 6.62 | 0.18 | 3.24 | 1.17 | 0.99 | 0.53 | 39.55 |
| 2011 | 0.07 | 1.49 | 0.13 | 1.64 | 7.41 | 2.36 | 0.63 | 1.4 | 2.13 | 4.67 | 3.39 | 1.53 | 26.85 |
| 2012 | 1.17 | 1.29 | 5.04 | 3.58 | 1.99 | 2 | 0 | 3.47 | 3.49 | 3.09 | 0.99 | 0.76 | 26.87 |
| 2013 | 1.71 | 3.61 | 0.8 | 7.09 | 10.1 | 7.01 | 5.36 | 4.65 | 2.96 | 3.17 | 1.06 | 1.26 | 48.78 |
| 2014 | 0.09 | 0.21 | 1.73 | 1.95 | 4.8 | 5.69 | 10.85 | 1.19 | 1.84 | 2.97 | 2.35 | 1.01 | 34.68 |
| 2015 | 1.43 | 0.48 | 3.99 | 4.89 | 13.78 | 4.22 | 5.52 | 1.37 | 0.99 | 3.24 | 4.63 | 5.07 | 49.61 |
| 2016 | 0.37 | 1.53 | 0.99 | 6.52 | 2.96 | 1.06 | 6.19 | 1.02 | 2.23 | 0.49 | 0.8 | 0.71 | 24.87 |
| 2017 | 1.91 | 2.67 | 3.26 | 7.66 | 2.5 | 0.01 | 2.23 | 7.05 | 2.89 | 5.18 | 0.15 | 0.33 | 35.84 |
| 2018 | 0.31 | 3.16 | 0.48 | 2.57 | 4.8 | 8.1 | 3.01 | 2.67 | 5.97 | 4.38 | 0.79 | 4.18 | 40.42 |
| 2019 | 2.33 | 0.69 | 2.37 | 6.3 | 12.71 | 7.34 | 1.11 | 7.42 | 2.68 | 4.3 | 1.81 | 0.56 | 49.62 |
| 2020 | 3.92 | 1 | 6.91 | 2.54 | 3.55 | 3.09 | 5.92 | 3.89 | 4.08 | 4.49 | 0.58 | 3.3 | 43.27 |
| 2021 | 2.08 | 0.99 | 2.43 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

**Source: Mesonet (www.mesonet.org/index.php/weather/monthly_rainfall_table/spen**

**Station Information: Spencer (SPEN)**

**County** Oklahoma

**Commissioned** 1/1/1994

**Lat** N 34.542080°

**Lon** W -97.341460°

# TABLE 4.3
## Aquifer Test Results

| WELL | | K VALUE (ft/day) | K VALUE (cm/sec) | MEAN K VALUE (ft/day) | MEAN K VALUE (cm/sec) |
|---|---|---|---|---|---|
| PZ-1 | Slug In | 2.087E-01 | 7.362E-05 | 2.281E-01 | 8.045E-05 |
| | Slug Out | 2.474E-01 | 8.728E-05 | | |
| PZ-2 | Slug In | 3.827E-01 | 1.350E-04 | 1.036E+00 | 3.654E-04 |
| | Slug Out | 1.689E+00 | 5.958E-04 | | |
| PZ-3 | Slug In | 3.753E-01 | 1.324E-04 | 1.194E+00 | 4.213E-04 |
| | Slug Out | 2.013E+00 | 7.101E-04 | | |
| PZ-4 | Slug In | 6.378E-01 | 2.250E-04 | 6.688E-01 | 2.359E-04 |
| | Slug Out | 6.998E-01 | 2.469E-04 | | |
| PZ-5 | Slug In | 1.245E+00 | 4.392E-04 | 1.582E+00 | 5.579E-04 |
| | Slug Out | 1.918E+00 | 6.766E-04 | | |
| PZ-6 | Slug In | 1.076E+00 | 3.796E-04 | 1.513E+00 | 5.336E-04 |
| | Slug Out | 1.949E+00 | 6.876E-04 | | |
| PZ-7 | Slug In | 1.029E-01 | 3.630E-05 | 3.866E-01 | 1.364E-04 |
| | Slug Out | 6.702E-01 | 2.364E-04 | | |
| MW-3R | Slug In | 1.511E+00 | 5.330E-04 | 3.544E+00 | 1.250E-03 |
| | Slug Out | 5.577E+00 | 1.967E-03 | | |
| MW-4R | Slug In | 1.077E+00 | 3.799E-04 | 1.101E+00 | 3.882E-04 |
| | Slug Out | 1.124E+00 | 3.965E-04 | | |
| | **Average K Value** | | | **1.250E+00** | **4.410E-04** |

# Appendix A

# Workplan and Approvals

**SCS ENGINEERS** Environmental Consultants & Contractors

December 13, 2019

Ms. Kaylee Shiplet
Solid Waste Section
Land Protection Division
P.O. Box 1677
Oklahoma City, OK 73101-1677

Subject: Drilling Plan for Horizontal Expansion of the Northeast Landfill
Waste Corporation of Oklahoma, LLC., Northeast Landfill
Permit No.: 3555050

Dear Ms. Shiplet:

Stearns, Conrad, and Schmidt, Consulting Engineers, Inc. (dba SCS Engineers) on behalf of Waste Corporation of Oklahoma, LLC. (WCA) is pleased to present you with the Drilling Plan for Horizontal Expansion of the Northeast Landfill. The purpose of this Drilling Plan (Plan) is to provide guidance and rationale for the subsurface investigation proposed for the 73.2-acre horizontal expansion area for the Northeast Landfill. The attached Plan has been developed and prepared in accordance with the ODEQ, OAC 252:515.

Please contact us if you have any questions concerning this Plan.

Sincerely,

Robert Fowler
Project Geologist
SCS Engineers

Dan McCullough, PG
Project Director
SCS Engineers

RF

Encl. Drilling Plan for Horizontal Expansion of the Northeast Landfill

# DRILLING PLAN FOR HORIZONTAL EXPANSION OF THE NORTHEAST LANDFILL

WCA of Oklahoma, LLC.
2601 North Midwest Blvd
Spencer, OK 73084
405-495-0800

SCS ENGINEERS

16219107.00 | December 2019

11219 Richardson Drive
North Little Rock, AR 72113
501-812-4551

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# 1.0 INTRODUCTION

Waste Corporation of Oklahoma, LLC. (WCA) owns and operates the Northeast Landfill (landfill) located in Oklahoma County, near Spencer, Oklahoma. The landfill operates under Permit No. 3555050 issued, by the Oklahoma Department of Environmental Quality (ODEQ). WCA is planning to expand the existing landfill horizontally and vertically.

The current landfill has a permit boundary of approximately 90.1 acres, which includes approximately 67.7 acres which is utilized for construction and debris (C&D) waste disposal. The proposed landfill horizontal expansion area is approximately 73.2acres located north of the existing permit boundary. Therefore, following approval of a Tier III permit modification, in accordance with Oklahoma Department of Environmental Quality (ODEQ), Oklahoma Administrative Code (OAC) 252:4-7-60, the landfill permit boundary will be comprised of approximately 163.3 acres. The proposed horizontal expansion area and vertical expansion of existing disposal area will be utilized for a municipal solid waste (MSW) disposal area. A site location map is presented as Figure 1 and boring location map, including proposed horizontal expansion area and existing conditions, is presented as Figure 2.

## 1.1 PURPOSE

The purpose of this Drilling Plan (Plan) is to provide guidance and rationale for the subsurface investigation proposed for the 73.2-acre horizontal expansion area for the Northeast Landfill. This Plan has been developed and prepared in accordance with the ODEQ, OAC 252:515.

## 1.2 SCOPE AND OBJECTIVES

The Plan will involve obtaining geologic and hydrogeologic data to aid in the design and construction of the proposed landfill expansion. The work will entail the drilling of borings, the installation of piezometers, and aquifer testing along with the analysis of the conditions and materials present at the proposed horizontal expansion area. As indicated, the proposed horizontal expansion area is approximately 73.2acres, therefore, a total of eighteen (18) borings are required in accordance with OAC 252:515-7-4(b)(3)(C). Select borings will be completed as piezometers, dependent upon hydrogeologic conditions and spatial location. Existing data from borings and piezometers will be utilized to aid in characterizing the hydrogeologic and soil conditions at the site. Aquifer testing will be performed to evaluate the hydraulic properties of the materials that underlie the site. Groundwater levels and precipitation measurements will be collected to determine seasonal potentiometric surface variations and the effect of surficial recharge on the uppermost continuous aquifer beneath the site.

It should be noted that existing monitoring wells MW-3R and MW-4R are located within the footprint of the proposed expansion area. The borings for these two monitoring wells were drilled ten feet into the uppermost saturated zone, however, the total depths for these two monitoring wells will not meet the requirement stating that all borings should be a minimum of thirty feet below the deepest placement of waste. These borings are completed as described above within the uppermost saturated zone which will be the controlling factor in the final permitted design of the proposed lateral expansion area. WCA is therefore requesting a variance and approval to utilize MW-3R and MW-4R as two of the required borings even though depths will not be 30 feet below the deepest placement of waste. Therefore, this Plan proposes to install 16 additional borings at the Site for evaluating subsurface conditions.

In association with the preparation of this Plan, published regional information and the results of previous hydrogeologic investigations conducted at the landfill have been reviewed. Tasks performed as part of this Plan are proposed to build upon existing data and previously stated conclusions. Previously published information will continue to be reviewed and utilized during implementation of this Plan.

# 2.0 BACKGROUND INFORMATION

## 2.1 PHYSICAL SETTING

The proposed horizontal expansion area site (Site) is located north of the existing landfill permit boundary and is located on North Midwest Boulevard, west of Spencer in Oklahoma County, Oklahoma. The Site is more specifically located in the south half of the southeast ¼ of the northwest ¼ of Section 22, Township 12 North, Range 2 west in Oklahoma County, Oklahoma. Refer to **Figure 1** for the property location map.

The following site specific maps have been incorporated into this Plan in accordance with OAC 252:515-7-4(b)(2):

- **Figure 1** – Site Location Map
- **Figure 2** – General Topographic Map
- **Figure 3** – Boring Location Map
- **Figure 4** – Floodplain Map
- **Figure 5** – Alluvium and Terrace Deposits and Recharge Areas
- **Figure 6** - Wetland Map
- **Figure 7** – Typical Piezometer Detail
- **Appendix D** – USGS Seismic Hazards

## 2.2 CLIMATE

The climate for Oklahoma County, Oklahoma is humid and temperate, and is characterized by warm summers and cold, dry winters. Temperatures average near 60 degrees Fahrenheit (°F), with a slight increase from north to south. Average temperatures range between 93 °F in July to 26 °F in January. Mean annual precipitation is approximately 34.5 inches, with approximately 219 days in the growing season.

## 2.3 PHYSIOGRAPHY

The proposed Site is located within the Osage Plains, a section of the Central Lowland province, which in turn is part of the larger Interior Plains physiographic province. Three sub-regions make up the Osage Plains; the sub-region that stretches across central Oklahoma is known as the Cross Timbers region. The woodland and savanna portions of the Cross Timbers are mainly Post Oak and Blackjack Oak on coarse, sandy soils, while the prairie portions are chiefly tallgrass on finer, dry soils.

Surface elevations at the Site range from approximately 1170 to 1220 feet above mean sea level. Surface water drains primarily east and north through the property into an intermittent stream that flows to the northwest approximately 0.5 miles into the Crutcho Creek.

## 2.4 SOILS

Soils on the Site are primarily comprised of the Vanoss silt loam (approximately 27.0%) with slopes of 1 to 3 percent, and Harrah fine sandy loam (approximately 16.4%) with slopes of 3 to 45 percent. The

Site is also comprised of Teller fine sandy loam (approximately 13.7%) with 5 to 8 percent slopes, Teller fine sandy loams (approximately 12.1%) with 3 to 5 percent slopes, and Teller fine sandy loams (approximately 10.6%) with 1 to 3 percent slopes. A small portion of the Site consists of Vanoss silt loam (approximately 4.2%) with 0 to 1 percent slopes, and Teller fine sandy loams eroded (approximately 5.5%) with slopes of 3 to 5 percent. A review of the web soil survey also identified areas defined as Pits or soils from mine spoils or earthy fill derived from sedimentary rocks (approximately 3.5%) which was located along the boundary of the Site and the existing landfill property. Water was identified in approximately 5.0% of the expansion area.

## 2.5 GEOLOGY AND HYDROGEOLOGY

According to the Oklahoma Geological Survey, the local geology consists of the Permian-age sandstone known as the Garber Sandstone and is underlain by the Wellington Formation which is also of Permian age. Both the Garber Sandstone and the Wellington Formation consist of lenticular beds of massive appearing, cross-bedded sandstone irregularly inter-bedded with shale which is part sandy to silty. The sandstone layers are fine to very fine grained and loosely cemented. The sandstone is poorly cemented and crumbles easily. Color ranges from nearly white to pink, orange, deep red, or purple. Although some sandstone beds are relatively thick, beds five feet or less in thickness are common. The thickness of the Garber Sandstone is approximately 350 feet in Oklahoma County. The Wellington Formation is approximately 799 feet in thickness in the subsurface. Therefore, the two formations as a unit have a total thickness that ranges from 800 to 1000 feet (Wood/Burton, 1968)

According to the Oklahoma Water Resources Board, the site is underlain by the Central Oklahoma aquifer. The Central Oklahoma Aquifer underlies about 3,000 square miles of central Oklahoma. The Central Oklahoma aquifer is referred to as the Garber-Wellington aquifer since it is dominantly composed of the Permian aged Garber Sandstone and Wellington Formation. The aquifer ranges in thickness from 300 feet in the south to about 800 feet in the north. Wells commonly yield 25 to 400 gallons per minute and is generally of good quality with total dissolved solids ranging from 200 to 1,000 parts per million. Recharge areas consist of outcrops of the aquifer and extend eastward to the approximate top of shales that make up much of the lower one-third of the Wellington Formation.

## 2.6 SEISMICITY

Based on the USGS U.S. Seismic Hazard Map, Peak Horizontal Acceleration with 2% Probability of Exceedance in 50 Years (2014), the location of the Site is depicted as exhibiting a maximum horizontal acceleration (or effective peak ground acceleration) in rock of between 0.005 and 2.2 percent of gravity with a 98 percent probability of not exceeding the horizontal acceleration within a 50-year reoccurrence. This acceleration factor may be utilized during seismic analysis of soil performance to liquefaction and during design of structural elements to resist earthquake forces.

# 3.0 TECHNICAL APPROACH

## 3.1 PLAN STRATEGY

This Plan will utilize a strategy that will allow for flexibility while meeting the regulatory criteria for the proposed Site. This will allow the detail of information collected to be increased or decreased in order to accommodate specific situations encountered during the work.

## 3.2 SUBSURFACE INVESTIGATION

### 3.2.1 Soil and Bedrock

Data collected from previous investigations was utilized in determining placement of 16 additional borings, which will be drilled to aid in the characterization of the hydrogeologic and soil conditions underlying the proposed Site. As discussed in Section 1.2, WCA has requested approval to utilized MW-3R and MW-4R as borings and piezometers for this investigation. MW-3R has a completed depth elevation is 1155.53 fmsl or 9.47 feet below deepest placement of waste. MW-4R has a completed depth of 1149.22 fmsl or 15.78 feet below the deepest placement of waste. If approved, the total number of borings will be 18 and the total number of piezometers will be 9. Table 1 lists the 16 proposed borings (PZ-1 through PZ-7, and EB-1 through EB-9) with approximate locations and depths, and Figure 3 depicts the proposed boring and piezometer locations. Data from previously completed borings, existing wells, and piezometers will be used to aid in the characterization of the Site. The boring locations provided below will be advanced using a combination of hollow stem auger and air rotary drilling methods.

Per OAC 252:515-7-4(b)(4): all borings will be drilled a minimum of thirty feet below the deepest proposed placement of waste, the elevation of which shall be reported in relation to mean sea level; and at least six borings will be drilled a minimum of ten feet into the uppermost saturated zone.

Groundwater levels and precipitation measurements will be collected to determine seasonal potentiometric surface variations and the effect of surficial recharge on the uppermost continuous aquifer beneath the site pursuant to OAC 252:515-7-54(a). In addition, one boring (EB-1) will be drilled 100 feet below ground surface as required by OAC 252:515-7-4(b)(4)(C). Depth to water will be measured in each boring at the time of drilling and again 24 hours later per OAC 252:515-7-32(c).

Geophysical logging will be completed on the seven boreholes that will be converted to piezometers and EB-1 which will be drilled to 100 feet below ground surface. The geophysical logs will be obtained using gamma ray/neutron logs or an alternative method approved by ODEQ from the total depth to the surface, in either open hole or behind casing.

Soil/rock samples will be collected at a rate of 1 sample per 5 feet of soil/rock drilled and at soil and rock changes from the surface to the total depth drilled. The samples will be stored onsite until final action on the permit application is taken by ODEQ. Specific details concerning subsurface investigative methodologies and procedures are provided in Section 4.0 of this Plan.

Table 1. Proposed Boring Information

| Boring/PZ Number | Northing | Easting | Deepest Placement of Waste (ft msl) | Target Elevation (ft msl) | Approx. Ground Surface Elevation (ft msl) | Target Depth (ft bgs) |
|---|---|---|---|---|---|---|
| PZ-1 | 182843.6990' | 2150428.2777' | 1165 | 1135 | 1214.000' | 79 |
| PZ-2 | 183925.2176' | 2150401.7123' | 1165 | 1135 | 1207.007' | 73 |
| PZ-3 | 183922.4725' | 2149230.0025' | 1165 | 1135 | 1199.076' | 65 |
| PZ-4 | 183243.1652' | 2148593.5279' | 1165 | 1135 | 1175.348' | 41 |
| PZ-5 | 183889.5268' | 2148688.0282' | 1155 | 1125 | 1175.296' | 51 |
| PZ-6 | 183261.4811' | 2149654.6457' | 1155 | 1135 | 1196.037' | 62 |
| PZ-7 | 183736.5892' | 2147856.6854' | 1155 | 1125 | 1197.680' | 73 |
| EB-1 | 182874.7496' | 2147877.9945' | 1165 | 1109 | 1210.191' | 100 |
| EB-2 | 182906.5890' | 2148830.5602' | 1165 | 1135 | 1190.211' | 56 |
| EB-3 | 182862.8404' | 2149747.5998' | 1165 | 1135 | 1204.242' | 70 |
| EB-4 | 183256.0393' | 2150191.4214' | 1165 | 1135 | 1207.480' | 73 |
| EB-5 | 183915.9739' | 2148372.5951' | 1165 | 1135 | 1169.387' | 35 |
| EB-6 | 183402.9772' | 2149275.2847' | 1165 | 1135 | 1190.332' | 56 |
| EB-7 | 183237.9921' | 2148314.8039' | 1165 | 1135 | 1190.148' | 56 |
| EB-8 | 183333.1922' | 2147872.3289' | 1155 | 1125 | 1202.655' | 78 |
| EB-9 | 183735.3932' | 2149861.2142' | 1165 | 1135 | 1196.489' | 62 |

*The target elevation is the deepest proposed placement of waste minus 30' with exception of EB-1 which will be advanced to 100'.

### 3.2.2 Groundwater

At a minimum seven borings will be advanced into the uppermost water-bearing geologic unit beneath the Site. Seven borings will be completed as piezometers and are designated PZ-1 through PZ-7. These seven proposed piezometers will be logged with geophysical methods. See Figure 3 for approximate locations and surface elevations.

The water-bearing unit will need to yield sufficient quantities of groundwater for regular sampling events. Aquifer testing and/or field hydraulic conductivity (slug) tests will be performed on selected piezometers.

Details describing the specific procedures for installation and completion of the piezometers and performance of field testing are presented in Section 4.0.

## 3.3 SAMPLING AND GROUNDWATER ELEVATIONS

### 3.3.1 Soil Sampling

To aid in the subsurface characterization of the Site, soil samples will be collected for testing (see Appendix A). The samples will be shipped to a geotechnical laboratory and tested under the direction of a licensed professional engineer. The following tests will be conducted on each type of soil sampled:

- Soil classification according to the specifications of ASTM D2487
- Particle-size analysis of soil according to the specifications of ASTM D422
- Sieve analysis for the following screen sizes: #4, #10, #40, #200
- Percent fines (#200 sieve) according to the specifications of ASTM D1140
- Atterberg limits according to the specifications of ASTM D4318
- Moisture content according to the specifications of either the oven drying method of ASTM D2216 or the microwave drying method of ASTM D4643
- Moisture-density relationship according to the specifications of the standard proctor test of ASTM D698 or the modified proctor test of ASTM D1557
- Hydraulic conductivity according to the specifications of ASTM D5084

### 3.3.2 Groundwater Elevations

Groundwater elevations will be collected monthly for one year, to aid in establishment of groundwater flow direction and aquifer geometry underlying the proposed Site. WCA will install a continuous water level monitoring system in one piezometer, and will monitor the water levels in all other piezometers once each month for 12 consecutive months on approximately the same date each month. If significant changes in the water level in the continuous monitor are identified following heavy rainfall events, ODEQ may require additional measurements in other piezometers to further define the level of highest groundwater elevation. In the event that trends in the data indicate that groundwater characteristics are similar to previously collected data, a shortened potentiometric measurement period may be requested.

WCA will obtain daily and monthly precipitation data from the climatological station closest to the expansion area, for the months in which the on-site measurements were taken and for the preceding 12 months. CLIMOCS will be used to obtain the 30-year mean precipitation from the climatological station. The precipitation data will be used to interpret any fluctuations in the potentiometric surface throughout the site characterization period.

## 3.4 QUALITY ASSURANCE/QUALITY CONTROL

The quality assurance (QA) objective for analytical data is to collect environmental monitoring data of known and acceptable quality. To meet this objective, the following quality control (QC) parameters must be addressed:

- Precision
- Accuracy
- Representativeness
- Completeness
- Comparability

Each of these parameters will be briefly discussed in the following subsections.

### 3.4.1 Precision and Accuracy

The primary objective of field measurements is to obtain reproducible measurements to a degree of accuracy with the limits imposed by the intended use of the data. Thus, QC procedures for field measurements will be limited to checking the reproducibility of field measurements by taking readings and by calibration of the instruments.

### 3.4.2 Representativeness

The objective in addressing representativeness is to assess whether the information obtained during the investigation accurately represents the actual site conditions. Representativeness will be assessed after initial data validation and reduction and will be based only on validated data.

### 3.4.3 Completeness

The objective for completeness is to provide sufficient valid data to meet the goals of the investigation. Completeness will be assessed by comparing the number of valid sample results to the number of samples collected.

### 3.4.4 Comparability

The objective of comparability is to establish that the data developed during the investigation are comparable with applicable criteria and with data available from other scientific studies in the area.

## 3.5 REPORTING

Per OAC 252:515-7-38, WCA will complete a regional hydrogeologic study of the proposed Site and the results included with the Tier III permit modification application. WCA will collect the following information to be included:

- The formation underlying the deepest formation penetrated by the boreholes and/or piezometers;
- All formations exposed in the outcrop on or within 1/4 mile of the proposed permitted boundary;
- A geologic column and structural information of all rock formations occurring from surface to a depth of 500 feet;
- A regional surface geological map;
- Illustrations of the regional stratigraphic column and geologic or hydrogeologic cross sections;
- A description of regional groundwater quality; and
- References indicating the sources of information.

# 4.0 PROCEDURES

This section presents the details regarding specific types of field investigation procedures. These procedures include drilling, piezometer installation, aquifer testing, sample collection, and decontamination. In addition, health and safety measures, methods for managing investigation-derived waste, and sample-handling/chain of custody procedures are provided.

## 4.1 HEALTH AND SAFETY

Drilling and sampling personnel will conduct operations in accordance with promulgated Occupational Safety and Health Administration (OSHA) regulations. Upon arrival at the site work location, field personnel will record the time, location, and weather conditions in the field logbook. Field personnel will be suited in Modified Level D personal protective equipment (PPE), which consists of:

- Steel-toed boots
- Hard hat
- High-visibility vest or shirt
- Safety glasses, splash goggles, or face shield
- Hearing protection

## 4.2 DRILLING AND SAMPLING

Drilling and sampling procedures will be conducted by using a combination of auger drilling and air rotary methods. The variability of geologic and topographic conditions, in addition to the engineering or protocol requirements will dictate the type of equipment and methodologies to be employed on any specific location.

### 4.2.1 Auger Drilling

The borings will be advanced using an ATV-mounted drilling rig, equipped with hollow-stem augers that have an outside diameter (O.D.) of 8.25-inch inside diameter (I.D.) of 4.25-inch hollow-stem through overburden until auger refusal occurs. Auger drilling utilizes a spiral tool form to convey dug material to the surface. An auger is essentially a conveyor which has a drill head, or cutting bit, or combination head and bit at its bottom end to cut the formation, which is then conveyed upward. Auger drilling does not normally require the use of drilling fluids.

### 4.2.2 Air Rotary Drilling

In the event that auger refusal occurs, air rotary drilling methods will be utilized. Air rotary drilling is a drilling method in which drill pipe with an attached bit is continuously rotated against the face of the borehole while air is pumped through the pipe and bit to flush the cuttings to the surface. In air rotary drilling, air is compressed and circulated down through the drill rods and up the open hole. The rotary drill bit is attached to the lower end of the drill pipe, and as the bit cuts into the formation, cuttings are immediately removed from the bottom of the borehole and transported to the surface by the air that is circulating down through the drill pipe and up through the annular space.

### 4.2.3 Soil Sampling

Soil samples will be collected continuously on 5-foot intervals to total depth within the overburden using split spoon samplers, continuous split barrel samplers, and/or thin walled sampling tubes (Shelby Tubes). Geotechnical soil samples will be collected for chemical or geotechnical analysis using the following procedure:

1. For split spoon or continuous split barrel samplers, remove the sub and shoe and split open the two halves of the sampler. Samples collected using Shelby Tubes will be capped and extruded at the testing laboratory.
2. Visually examine and log the remaining geologic material.
3. Geotechnical samples will be collected as described in Appendix A.

4. Transfer the soil into the appropriate sample containers.

### 4.2.4 Borehole Abandonment

A temporary borehole not converted into a monitoring well or piezometer will be plugged in accordance with OAC 785:35-11.

## 4.3 PIEZOMETER INSTALLATION

### 4.3.1 Drilling Methods

Installation methods will include the use of hollow stem auger or air rotary drilling techniques with minimal introduction of drilling fluid into the borehole. All groundwater piezometers will be installed to yield representative water level and groundwater quality data.

### 4.3.2 Piezometer Materials

Piezometers installed for long term monitoring will be two inches in diameter and constructed of PVC. All joints will be flush-threaded without the use of cementing compounds. Piezometer completion will be in accordance with OAC 785:35-7-2.

### 4.3.3 Installation

Borehole Diameter and Depth

The nominal borehole diameter for piezometer installation will be determined as per subsurface conditions and potential use. It is anticipated that the borehole utilized during auger drilling will be 8.25 inches. If auger refusal occurs, the borehole utilized during air rotary will be 6 inches. The depth of each borehole will be based on the results of drilling activities.

Screen and Casing Placement

Well screens and well casings will be clean and free of foreign matter prior to use. Pre-washing will not be necessary if the materials have been packaged by the manufacturer and the packaging is intact up to the time of installation. Well casing will bear the manufacturer's markings that identify the material as that specified. Washed screens and casings will be stored in clean plastic sheeting or the manufacturer's packaging until insertion into the borehole.

Screen bottoms will be securely fitted with a threaded cap or plug of the same composition as the screen. No solvents or glues will be used for attachment.

In general, monitoring well screens will be no more than five feet in length. However, situations may arise where a greater length of well screen may be needed to fully monitor a specific zone.

Filter Pack Placement

The annular space between the screen and borehole will be filled with a filter pack, and aggregates used for the filter pack will consist of uncontaminated quartz sand, silica or other material that will not affect the groundwater quality. The filter pack will be selected to prevent or minimize infiltration of the formation fines. The filter pack will extend two feet above the top of the screen, and will be placed in the well annulus in such a manner that bridging of the filter pack material will not occur.

Bentonite Seal

A minimum of two feet of bentonite pellets, chips or granules between 0.25 and 0.75 inches in size will be placed immediately above the filter pack in the annular space between the well casing and borehole and properly hydrated.

Cement/Bentonite Grout Placement

Above the bentonite seal, a cement/bentonite grout mixture or other suitable backfill material will be placed from the top of the bentonite seal to approximately two feet below grade level. The backfill material will be mixed in accordance with the ratio requirements set forth in OAC 785:35-7-2(b)(6)(C).

When the placement of grout will exceed 20 feet, the grout will be placed using a tremie pipe and filled or pumped from the bottom upward.

Surface Seal

A concrete or cement grout surface seal will be placed around the casing immediately above the annular seal, from a depth of two feet to land surface.

Protective Cover and Concrete Pad

When the grout has cured to the proper depth below ground surface (bgs), a 3-foot diameter concrete pad with a minimum thickness of 3.5 inches will be placed around the piezometers. The surface pad will be sloped in a manner to ensure that all surface water flows away from the piezometer.

All protective casings will be free of extraneous openings, and devoid of any asphaltic, bituminous, encrusting, and/or coating except the paint or primer applied by the manufacturer.

A steel surface casing will be set a minimum of 12 inches through the cement or concrete surface pad and will extend a minimum of 24 inches above the pad or ground. The top of the protective casing will be fitted with a locking cap and will be marked to clearly identify the well as a piezometer or site assessment observation well.

Surveying

Upon completion of the drilling activities and installation of piezometers, the locations and casing elevations of each piezometer will be surveyed in accordance with criteria described in Section 7.0.

## 4.4 PIEZOMETER DEVELOPMENT

The purpose of well development is to remove fines (clay, silt, fine sand, rock flour) and drilling fluid residue from the filter pack and the natural formation in the vicinity of the screened interval in the monitoring well. Additionally, well development results in the settlement and stabilization of the material adjacent to the well screen.

### 4.4.1 Methods

Following well completion, well development will be performed to remove fluids used during drilling and to remove fines from the natural formation. This will provide a particulate-free discharge for sampling. When possible, development will be done by reversing flow direction or surging the well. If possible, no fluids other than natural formation water will be added during development. There are a number of different methods to develop a piezometer. Bailing, air lifting, pumping, and pumping and surging are all adequate methods for well development. The appropriate method that is actually utilized for a particular well is highly dependent upon hydrogeologic conditions, volume of groundwater produced by the formation, and the drilling method used for the installation.

Newly installed piezometers will be developed no sooner than 24 hours after the installation of grout. Wells can be developed by bailing, air lifting, pumping, and/or surging and pumping. If surging and pumping is used, a surge block will be used to force the groundwater in and out of the filter pack and surrounding native material. Water will be removed using a submersible pump, inertial pump, or bailer. Water will be removed from the entire water column in the well by periodically raising and lowering the pump. Surging and pumping will be repeated in cycles until the well development parameters are met.

## 4.5 WATER LEVEL MEASUREMENTS

An electronic water level meter will be used to gauge the piezometers. The following procedure will be used to measure to measure the water levels:

1. Decontaminate the cable and probe. Wipe the cable with paper towels as the cable is rewound onto the reel.
2. Turn on the water level indicator and press the instrument test button to check the batteries.
3. Lower the probe into the borehole or well by pulling the cable from the hand-held reel until the indicator light illuminates or the audible signal sounds.
4. Move the cable up and down to determine the upper groundwater surface. Note the exact length of the cable extended from the probe fluid sensor to the reference point at the top of the well casing. Record the measurement to the nearest 0.01 foot, the boring or well designation, and the date the measurement was taken.
5. Measure the total depth by gently lowering the probe or weighted tape to the bottom of the boring or well until the cable becomes slack. Reel in the slack cable and note the length of the cable extended from the tip of the probe to the reference point. Add the length of the distance between the end of the probe and the fluid sensor to the total depth measurement. Record the depth to the nearest 0.01 foot in the field logbook.
6. Decontaminate the probe prior to gauging the next boring or well.

## 4.6 IN-SITU HYDRAULIC CONDUCTIVITY TESTING

Determination of the in-situ hydraulic conductivity of a formation is an aspect in the characterization of a site. The usage of slug tests can provide data that will aid in understanding the dynamics of the geology and hydrogeology of the site.

### 4.6.1 Slug Test

Slug tests will be used to determine the hydraulic conductivity of distinct water bearing geologic horizons under in-situ conditions. Slug tests will be conducted on selected piezometers.

Water will not be added to any of the piezometers. All equipment to be used in piezometers will be decontaminated prior to the slug test to avoid cross-contamination. Slug tests will be conducted only on piezometers at which development has been completed. If a test is conducted on a well recently purged for water sampling, the measured water level must be within 0.1 foot of the static water level prior to testing.

The slug test may be conducted using an electronic data-logger and pressure transducer or by manually measuring well recovery. All data collected with the data-logger will be stored electronically. The information will be directly transferred to a computer and analyzed. A computer printout of the data will be kept in the project files for documentation. Manual readings will be recorded in the field logbook.

Slug testing will be performed in accordance with ASTM D 4044-96 Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers. Data analysis will be performed using the computer program AQTESOLV. The data analysis will be performed using the Hvorslev (1951) or the Bouwer and Rice (1976) method.

# 5.0 SAMPLE IDENTIFICATION

All samples will be identified with a unique sample number. The sample will be comprised of the sampling point, sample designator, and depth interval, as appropriate.

The sampling point indicates the location of sampling; e.g., B1, where "B" indicates a boring and "1" is the first boring.

The sample designator will be comprised of a matrix abbreviation followed by a consecutive sample number. The matrix abbreviations are as follows:

- SS - Soil
- CT - Rock / Soil Cuttings
- RC - Rock Core
- GW - Groundwater

Subsurface soil and rock samples will be further identified according to location and depth. Samples collected from each boring will be consecutively numbered by depth. The actual sample depth will be recorded in the field logbook and on the chain of custody record.

In summary, the sample numbering system will consist of the sampling point, sample designator, and depth interval (if necessary). The following are examples of the sample numbering systems:

| Sampling Point | Sample Designator | Depth Interval |
|---|---|---|
| EB-1 | SS1 | 0-4' |
| EB-1 | SS2 | 8-10' |
| EB-1 | GW1 | 10' |

If piezometers are installed in a boring, the identifier "B" will be converted to "PZ" for piezometer.

# 6.0 DOCUMENTATION, SAMPLE CUSTODY, PACKAGING AND SHIPPING

## 6.1 GENERAL REQUIREMENTS

The following are the general requirements for logging consolidated and unconsolidated geologic materials.

1. For each borehole, a geologic log will be prepared in the field by a qualified groundwater scientist. Logs will be prepared on forms specified by the client or on the SCS Drilling Log.
2. The drilling logs will be filled out as completely as possible, where appropriate information is available. At entry points on the form that are not applicable, write “N/A” (e.g., “N/A” is written in the bedrock footage section if bedrock is not encountered in the borehole).
3. Stratigraphic or lithologic changes will be identified under the description of material column as a solid horizontal line which corresponds to a measured borehole depth where the changes occur. Gradational changes in stratigraphy and lithology or changes identified from cuttings or methods other than direct observation will be represented as a horizontal dashed line at appropriate depth based upon the best judgment of the logger.
4. Borehole measurements (i.e., run depths and water levels) will be recorded to the nearest 0.1 foot.
5. The logs will show total depth of penetration and sampling. The bottom of the borehole will be represented with notation of “T.D. = __ ft. bgs”.
6. Any evidence of contamination will be noted in “Remarks,” including color, odor, etc.
7. The depth to groundwater will be recorded in the header box labeled “Depth Groundwater Encountered.” After drilling is completed and the water level has stabilized, a second water depth measurement will be recorded in the box labeled “Depth to Water and Elapsed time after Drilling Completed.”
8. The length of core or soil sample (recovery) will be measured with a tape measure to the nearest 0.1 foot and recorded in the “Recovery” column.
9. The size and type of sampler or coring bit and barrel will be recorded on the form in the header. Logs will show borehole and sample diameters and depths at which sampling method or equipment changes.
10. Logs will show the drilling fluid used, including, as appropriate: source of makeup water; drilling fluid additives by brand and product name; mixture proportions; and type of filter for compressed air.
11. The amount of water used during drilling will be noted and recorded on the form. Any water gains or losses estimated rates and depths will be noted in the “Remarks” column.
12. The depth and type of temporary casing used will be noted in the “Remarks” column.
13. Depth intervals of borehole instability that are encountered during drilling will be recorded on the drilling log. In addition, difficulties during drilling (e.g., drilling speed, rates or downhole torque) and special sampling problems will be noted, along with problem resolution.
14. Samples retained for lithologic or chemical analyses will be noted in the “Sample No.” column.

### 6.1.1 Logging Soils (Unconsolidated Materials)

1. Unconsolidated materials will be visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D2488. The visual field classification will provide principal and minor soil constituents along with approximate proportions.
2. The moisture content will be described in relative terms (e.g., dry, damp, moist, wet) and noted in the description. In addition, relative plasticity and consistency (cohesive soils), relative gradation and density (cohesionless soils), grain size, angularity, depositional environment, and structure will be recorded in the description column.
3. Bedding characteristics and evidence of bioturbation, root holes, or fractures will be recorded.

### 6.1.2 Logging Rock (Consolidated Materials)

1. Bedrock will be described based on visual observations, in accordance with standard geologic nomenclature.

2. This nomenclature includes, but is not limited to: formation name (if known); relative hardness; density; texture; grain size; weathering; bedding; fractures, joints, and cavities; and other descriptive features, such as fossils.
3. The moisture content will be described in relative terms (e.g., dry, damp, moist, wet) and noted in description.

# 7.0 SURVEYING

Following the completion of field activities, a surveyor will determine the positions of all unsurveyed sample locations, including subsurface sampling locations with piezometers and other discrete sampling points.

All sample locations will be surveyed horizontally to the nearest 0.1 foot and tied to the State Plane Coordinate System. The ground surface elevation of the sampling locations will be measured to the nearest 0.1 foot relative to mean sea level (MSL). For all piezometers, the top of the riser pipe will be used as a reference point and surveyed to the nearest 0.01 foot relative to MSL.

# 8.0 REFERENCES

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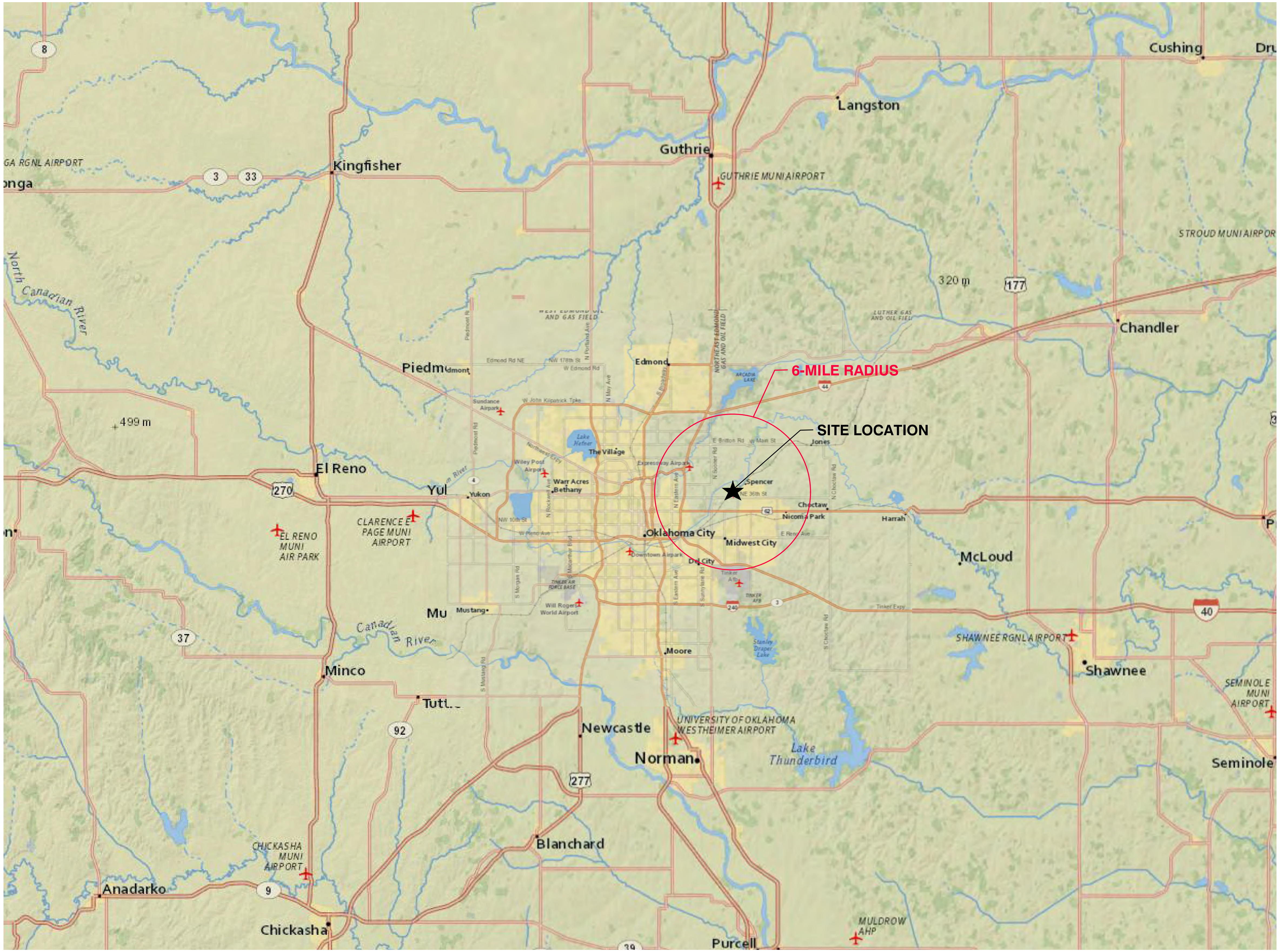
U.S. Geological Survey, 20181214, USGS US Topo 7.5-minute map for Spencer, OK 2018: USGS - National Geospatial Technical Operations Center (NGTOC).

# Figures

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0 4 MILES 8 MILES

APPROXIMATE SCALE IN MILES

SOURCE:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: SITE LOCATION MAP

PROJECT TITLE: NORTHEAST LANDFILL DRILLING PLAN

CLIENT: N.E. LANDFILL, LLC
NORTHEAST C&D LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: BJD | DWN. BY: BJ | CHK. BY: RRK | Q/A RVW BY: BJD | APP. BY: RRK

LICENSED PROFESSIONAL ENGINEER
RYAN KUNTZ
26326
OKLAHOMA

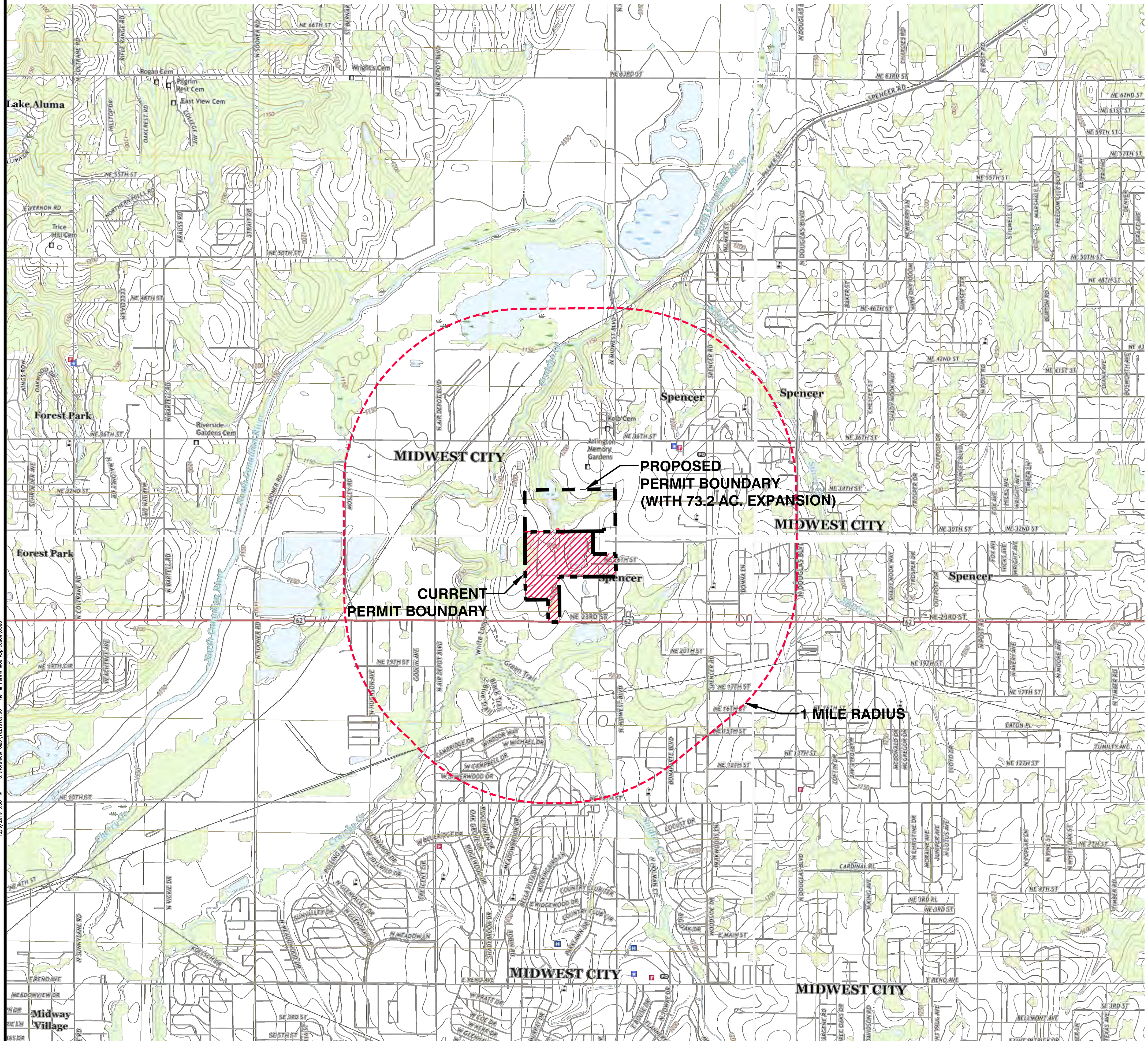
12/9/19

CADD FILE: 01 LOC MAP1

DATE: 12/2019

SCALE: AS SHOWN

FIGURE NO. 1

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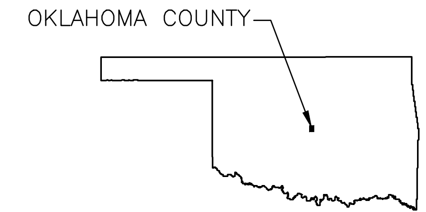
0 1500 3000

SCALE IN FEET




COUNTY LOCATION

## LEGEND

- CURRENT PERMITTED LANDFILL BOUNDARY
- PROPOSED PERMITTED LANDFILL BOUNDARY
- CURRENTLY PERMITTED LANDFILL PROPERTY
- 1 MILE RADIUS
- 1200 EXISTING TOPOGRAPHIC CONTOURS (SEE NOTE 1)

ROAD CLASSIFICATION

| | |
|---|---|
| Expressway | Local Connector |
| Secondary Hwy | Local Road |
| Ramp | 4WD |
| US Route | State Route |

**SOURCE:**

CONTOURS SHOWN ARE FROM THE 7.5K QUAD MAP FOR SPENCER, OKLAHOMA (2018); JONES, OKLAHOMA (2018); CHOCTAW, OKLAHOMA (2018); AND MIDWEST CITY, OKLAHOMA (2018); PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY.

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12/9/2019 6:56 PM G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application\USGS

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: GENERAL TOPOGRAPHIC MAP

PROJECT TITLE: NORTHEAST LANDFILL DRILLING PLAN

CLIENT: N.E. LANDFILL, LLC
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| | | |
|---|---|---|
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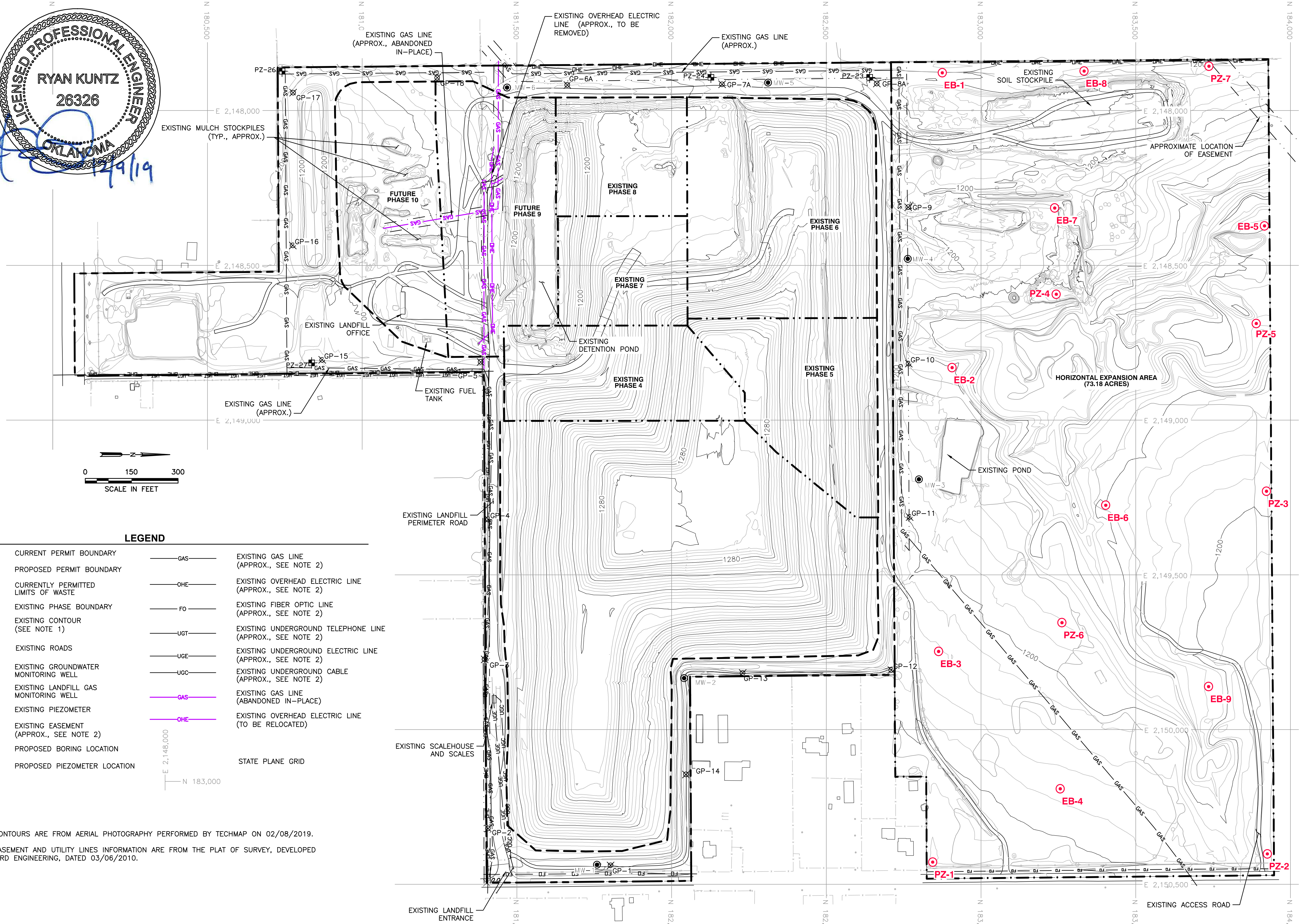
| DSN. BY: BJD | CHK. BY: RRK | APP. BY: RRK |

CADD FILE: USGS

DATE: 12/2019

SCALE: AS SHOWN

FIGURE NO. 2




## LEGEND

| | | | |
|---|---|---|---|
| | CURRENT PERMIT BOUNDARY | GAS | EXISTING GAS LINE (APPROX., SEE NOTE 2) |
| | PROPOSED PERMIT BOUNDARY | OHE | EXISTING OVERHEAD ELECTRIC LINE (APPROX., SEE NOTE 2) |
| | CURRENTLY PERMITTED LIMITS OF WASTE | FO | EXISTING FIBER OPTIC LINE (APPROX., SEE NOTE 2) |
| | EXISTING PHASE BOUNDARY | UGT | EXISTING UNDERGROUND TELEPHONE LINE (APPROX., SEE NOTE 2) |
| 1210 | EXISTING CONTOUR (SEE NOTE 1) | UGE | EXISTING UNDERGROUND ELECTRIC LINE (APPROX., SEE NOTE 2) |
| | EXISTING ROADS | UGC | EXISTING UNDERGROUND CABLE (APPROX., SEE NOTE 2) |
| MW-2 | EXISTING GROUNDWATER MONITORING WELL | GAS | EXISTING GAS LINE (ABANDONED IN-PLACE) |
| GP-2 | EXISTING LANDFILL GAS MONITORING WELL | OHE | EXISTING OVERHEAD ELECTRIC LINE (TO BE RELOCATED) |
| PZ-26 | EXISTING PIEZOMETER | | |
| | EXISTING EASEMENT (APPROX., SEE NOTE 2) | E 2,148,000 / N 183,000 | STATE PLANE GRID |
| EB-5 | PROPOSED BORING LOCATION | | |
| PZ-5 | PROPOSED PIEZOMETER LOCATION | | |

NOTES:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY TECHMAP ON 02/08/2019.
2. EXISTING EASEMENT AND UTILITY LINES INFORMATION ARE FROM THE PLAT OF SURVEY, DEVELOPED BY SHEPHERD ENGINEERING, DATED 03/06/2010.

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12/12/2019 4:27 PM \\BED-FS02\Data\Civil 3D Projects\CADD\Northeast C&D\16219107.00 - Tier III Permit Mod Application_dwg\03 BORING LOCATION MAP

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: BORING LOCATION MAP

PROJECT TITLE: NORTHEAST LANDFILL DRILLING PLAN

CLIENT: N.E. LANDFILL, LLC
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CADD FILE: 03 BORING LOCATION MAP

DATE: 12/2019

SCALE: AS SHOWN

FIGURE NO. 3


PROPOSED PERMIT BOUNDARY (WITH 73.2 AC. EXPANSION)

CURRENT PERMIT BOUNDARY

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0 300 600

SCALE IN FEET

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/19/2019 at 3:11:58 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

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12/9/19

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G:\Northeast C&D\16219107.00 - Tier III Permit Mod Application\FLOOD PLAIN MAP

12/9/2019 7:07 PM

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DRAWING TITLE: FLOODPLAIN MAP

PROJECT TITLE: NORTHEAST LANDFILL DRILLING PLAN

CLIENT: N.E. LANDFILL, LLC
NORTHEAST C&D LANDFILL
2601 NORTH MIDWEST BLVD.
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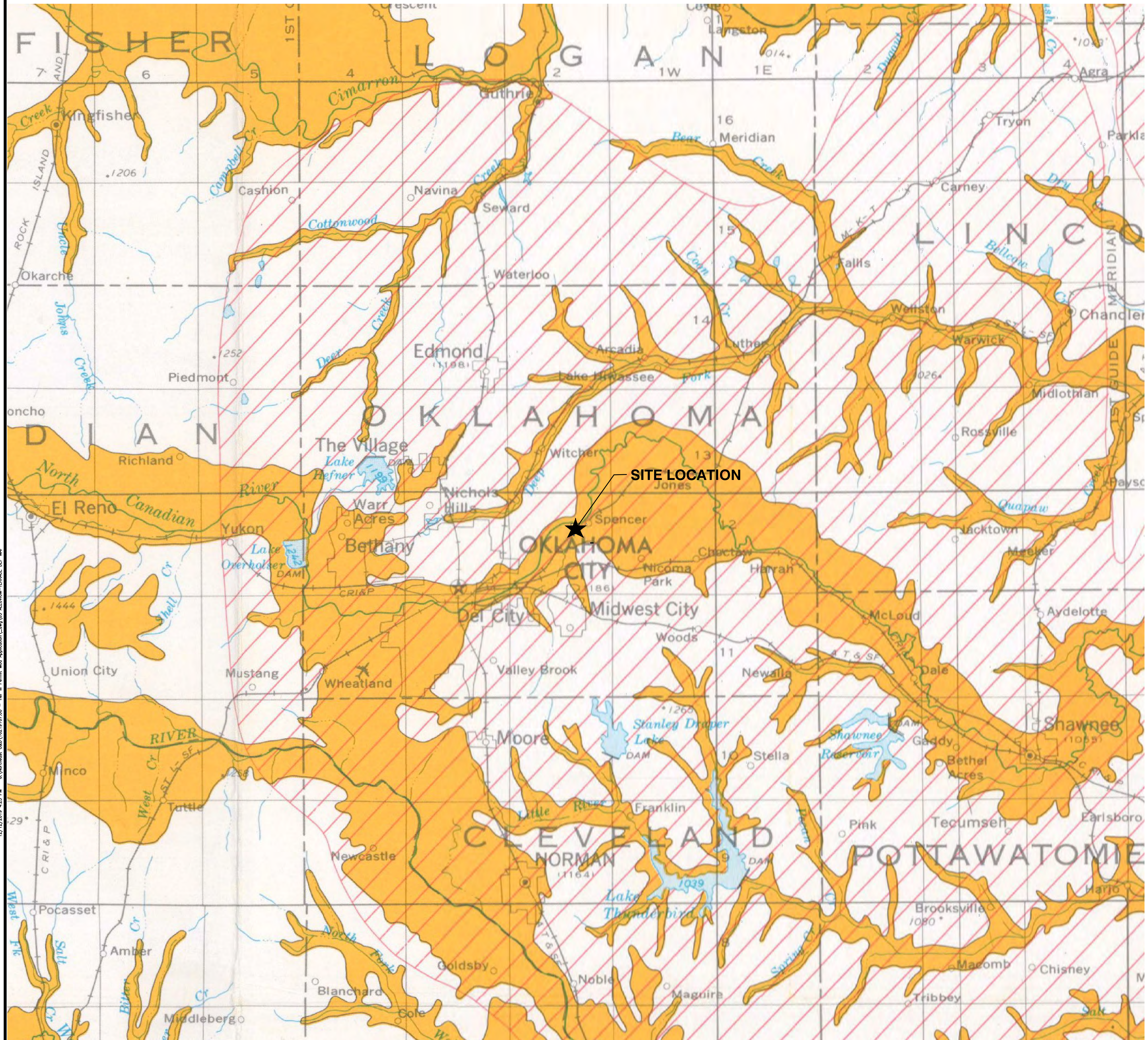
PROJ. NO. 16219107.00 | DWN. BY: JLJ | Q/A RVW BY: BJD
DSN. BY: BJD | CHK. BY: RRK | APP. BY: RRK

CADD FILE: FLOOD PLAIN MAP

DATE: 12/2019

SCALE: AS SHOWN

FIGURE NO. 4

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0 1.5 MILES 3 MILES
APPROXIMATE SCALE IN MILES

**Alluvium and Terrace Deposits and Their Recharge Areas** (Quaternary in age). Unconsolidated deposits of sand, silt, clay, and gravel that occur along or adjacent to modern and ancient streams. Thickness generally ranges from 10 to 50 ft (locally as much as 100 ft). Wells generally yield 10 to 500 gpm of water (locally several thousand gpm), and most water is of good quality (less than 1,000 mg/L dissolved solids). Recharge areas are essentially the same as distribution of the alluvium and terrace deposits.

**Bedrock Aquifers and Their Recharge Areas** (Cambrian through Tertiary in age). Rock units and sediments that generally are favorable or moderately favorable for development of groundwater resources. Thickness of aquifers generally ranges from 100 ft to several thousand ft. Depths to fresh water range from a few feet to more than 1,000 ft, with most wells 100-400 ft deep. Wells drilled into these aquifers generally yield 25–300 gpm, although wells in some aquifers yield up to 600–2,500 gpm. Water in most aquifers is of good to fair quality (300–1,500 mg/L dissolved solids). Pattern on map also includes known and potential recharge areas for bedrock aquifers.

**SOURCE:**

MAP OF AQUIFERS AND RECHARGE AREAS IN OKLAHOMA, KENNETH S. JOHNSON OKLAHOMA GEOLOGICAL SURVEY, DATED 1991.

LICENSED PROFESSIONAL ENGINEER
RYAN KUNTZ
26326
OKLAHOMA
12/9/19

FOR PERMITTING PURPOSES ONLY

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DRAWING TITLE: ALLUVIUM AND TERRACE DEPOSITS AND RECHARGE AREAS

PROJECT TITLE: NORTHEAST LANDFILL DRILLING PLAN

CLIENT: N.E. LANDFILL, LLC
NORTHEAST C&D LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

| PROJ. NO. 16219107.00 | DWN. BY: JLJ | Q/A RVW BY: BJD |
|---|---|---|
| DSN. BY: BJD | CHK. BY: RRK | APP. BY: RRK |

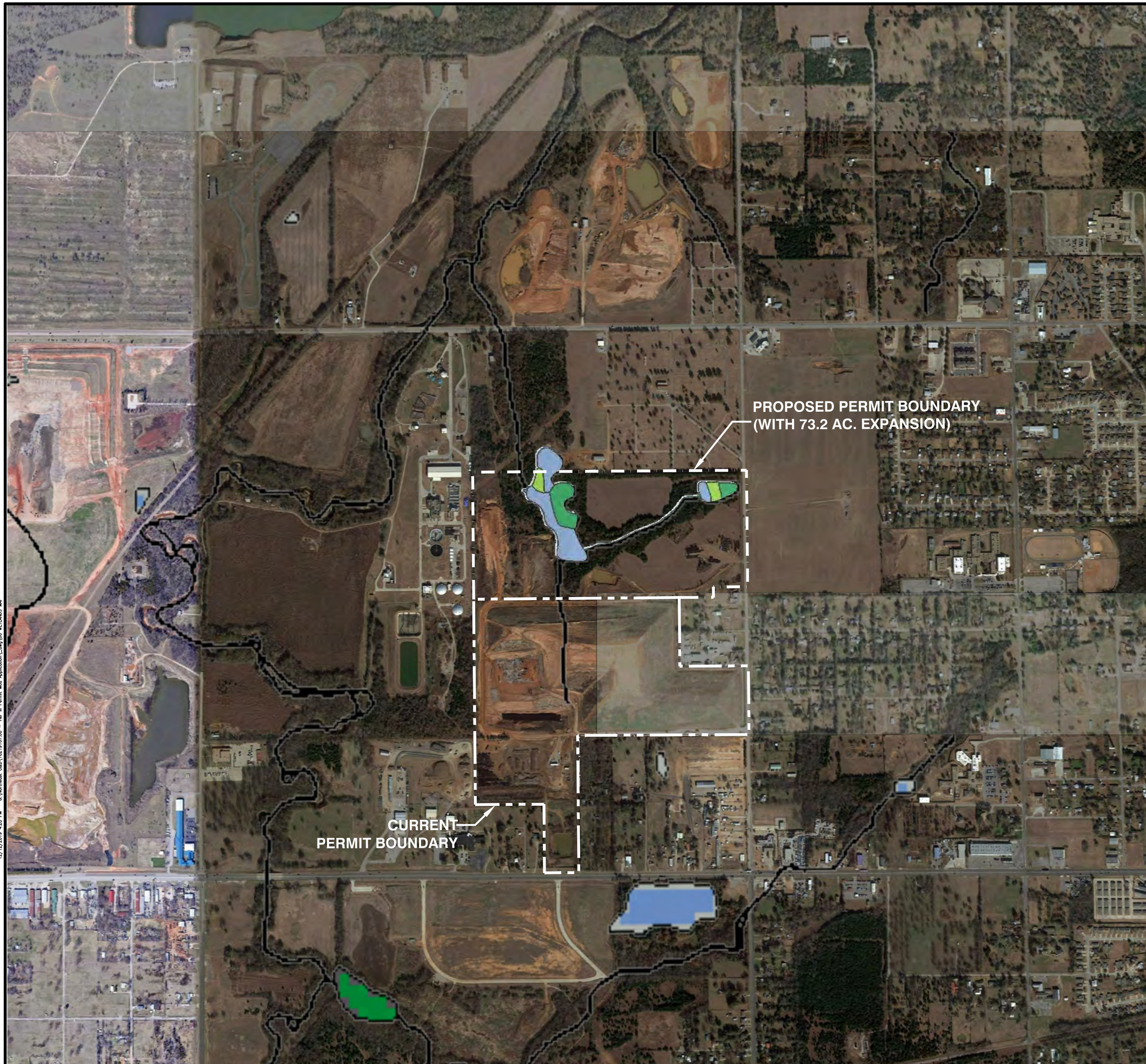
CADD FILE: 05 ALLUVIUM-TERRACE DEP MAP

DATE: 12/2019

SCALE: AS SHOWN

FIGURE NO. 5

12/12/2019 4:25 PM G:\Northeast C&D\16219107.00 – Tier III Permit Mod Application_dwg\05 ALLUVIUM-TERRACE DEP MAP




N

0 500 1000
SCALE IN FEET

## LEGEND

- CURRENT PERMITTED LANDFILL BOUNDARY
- PROPOSED PERMITTED LANDFILL BOUNDARY
- ESTUARINE AND MARINE DEEPWATER
- ESTUARINE AND MARINE WETLAND
- FRESHWATER EMERGENT WETLAND
- FRESHWATER FORESTED/SHRUB WETLAND
- FRESHWATER POND
- LAKE
- OTHER
- RIVERINE

**SOURCE:**

FISH AND WILDLIFE SERVICE, NATIONAL STANDARDS AND SUPPORT TEAM, WETLANDS TEAM@FWS.GOV | ESRI, HERE, GARMIN, IPC | USDA FSA

LICENSED PROFESSIONAL ENGINEER
RYAN KUNTZ
26326
OKLAHOMA

12/9/19

FOR PERMITTING PURPOSES ONLY

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: **WETLAND MAP**

PROJECT TITLE: **NORTHEAST LANDFILL DRILLING PLAN**

CLIENT: **N.E. LANDFILL, LLC**
**NORTHEAST C&D LANDFILL**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**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PROJ. NO. 16219107.00 | DWN. BY: JLJ | Q/A RVW BY: BJD
DSN. BY: BJD | CHK. BY: RRK | APP. BY: RRK

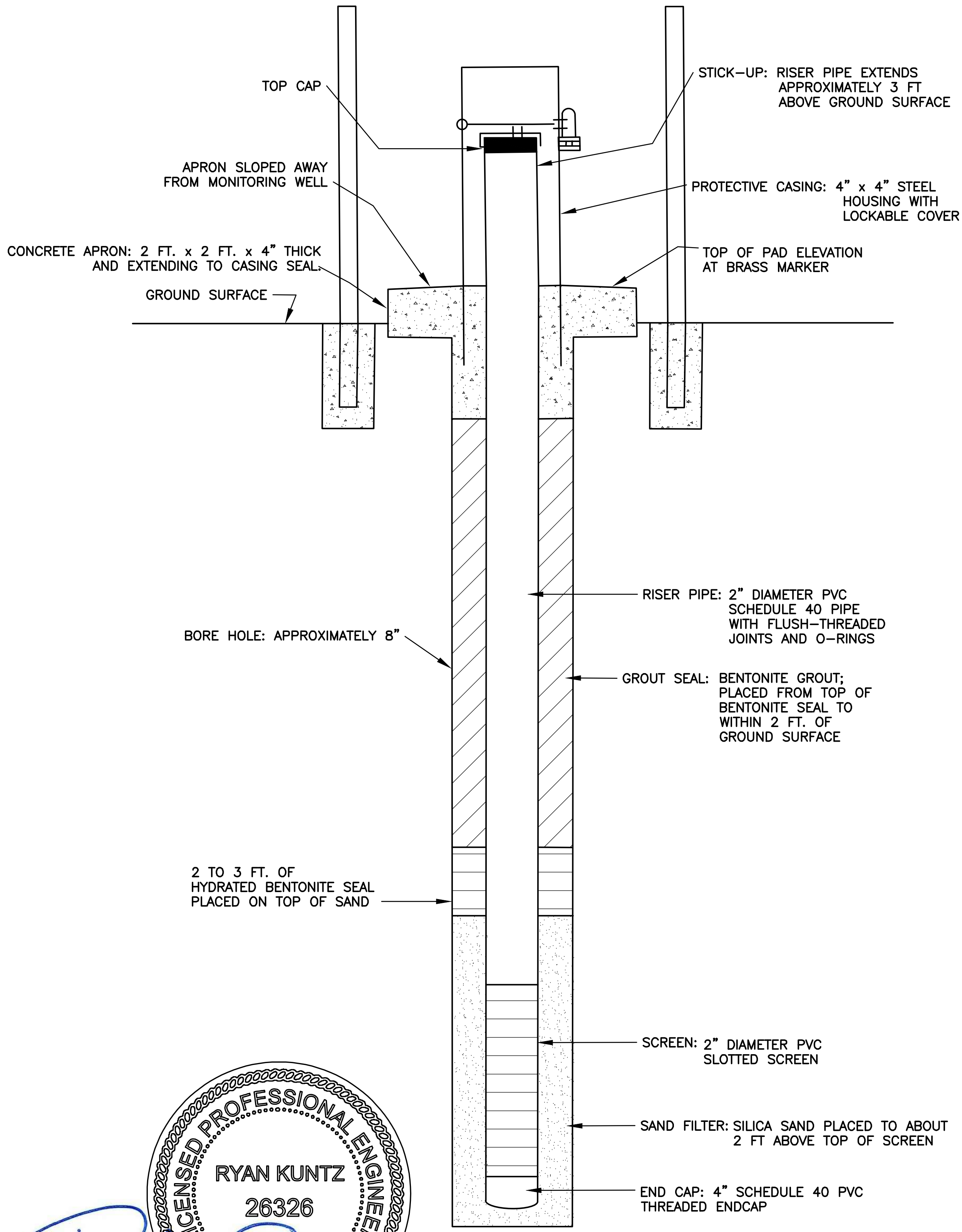
CADD FILE: 06 WETLANDS MAP

DATE: 12/2019

SCALE: AS SHOWN

FIGURE NO. 6

12/12/2019 4:28 PM




LICENSED PROFESSIONAL ENGINEER
RYAN KUNTZ
26326
OKLAHOMA

12/9/19

**FOR PERMITTING PURPOSES ONLY**

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE
**TYPICAL PIEZOMETER DETAIL**

PROJECT TITLE
**NORTHEAST LANDFILL DRILLING PLAN**

CLIENT
**N.E. LANDFILL, LLC**
**NORTHEAST C&D LANDFILL**
**2601 NORTH MIDWEST BLVD.**
**SPENCER, OK 73084**

**SCS ENGINEERS**
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: | DWN. BY: JLJ | CHK. BY: | Q/A RVW BY: BJD | APP. BY:

CADD FILE: 07 TYP. PIEZOMETER – DTL

DATE: 12/2019

SCALE: AS SHOWN

DRAWING NO. **7**

G:\Northeast C&D\16219107.00 – Tier III Permit Mod Application_dwg\07 TYP. PIEZOMETER – DTL
12/12/2019 4:34 PM

# Appendix A

# Soil Sampling for Geotechnical Analysis

# SOIL SAMPLING FOR GEOTECHNICAL ANALYSES

Soil samples collected from the borings or excavations may be retained for selected physical analyses that can be performed on disturbed soil samples. Representative samples for grain size analyses (ASTM International (ASTM) D-6913) can be obtained from the interval in which the screen for the monitoring well will be placed (if well is screened in unconsolidated materials).

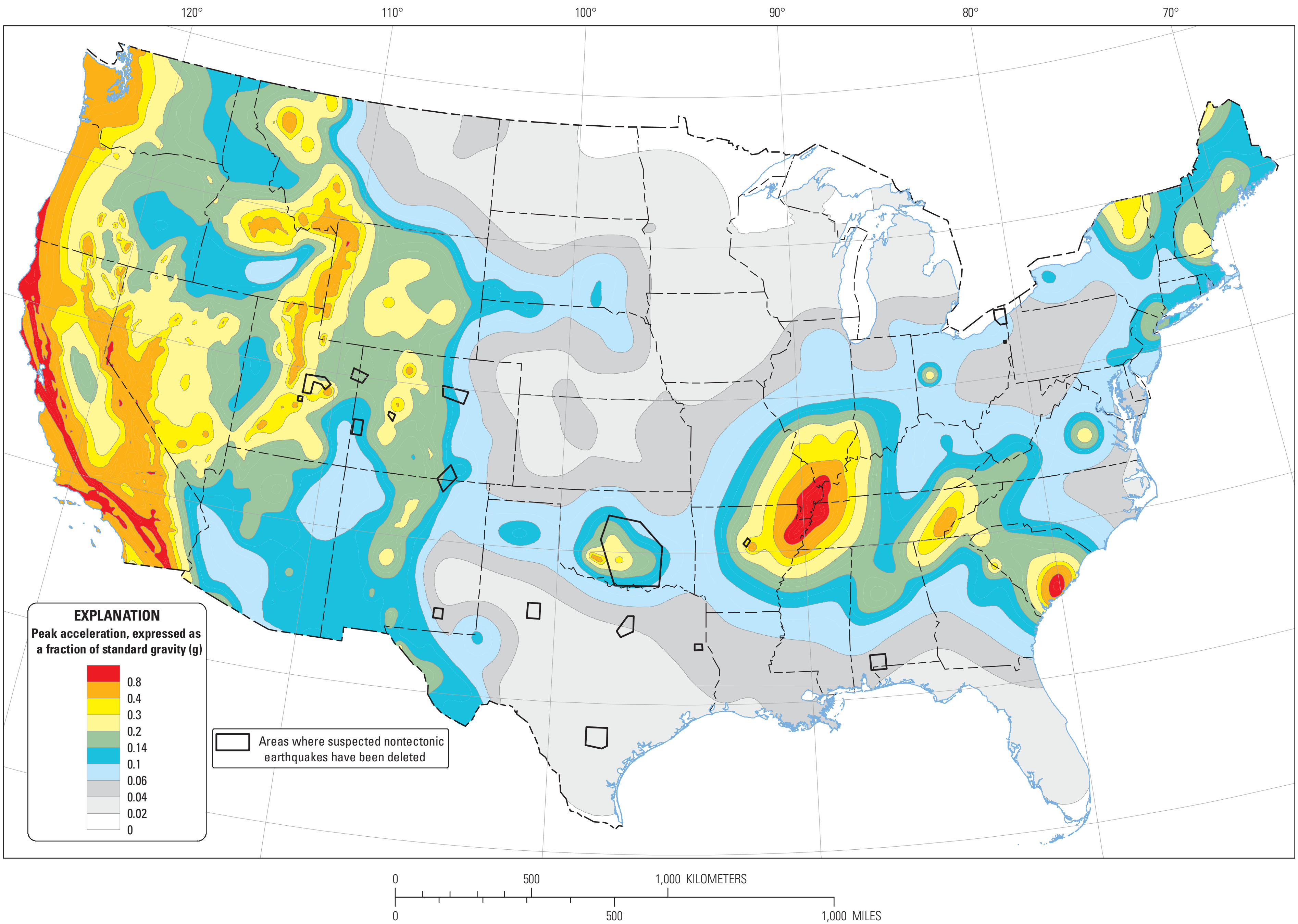
Disturbed soil samples collected for physical/geotechnical analysis will be placed in sealable plastic bags if moisture content analysis (ASTM D-2216) is requested. Remaining sample material will be placed in sealable plastic bags or buckets and labeled with the date, boring number, and depth of sample for Atterberg limits (ASTM D-4318) or grain size analysis.

In the event that undisturbed soil samples are collected, a thin-walled sample of "Shelby Tube" will be used to obtain these samples (ASTM D-1587). These samples can be taken in cohesive or granular material for laboratory classification and limited testing purposes. The sampling procedures when using a drilling rig are as follows:

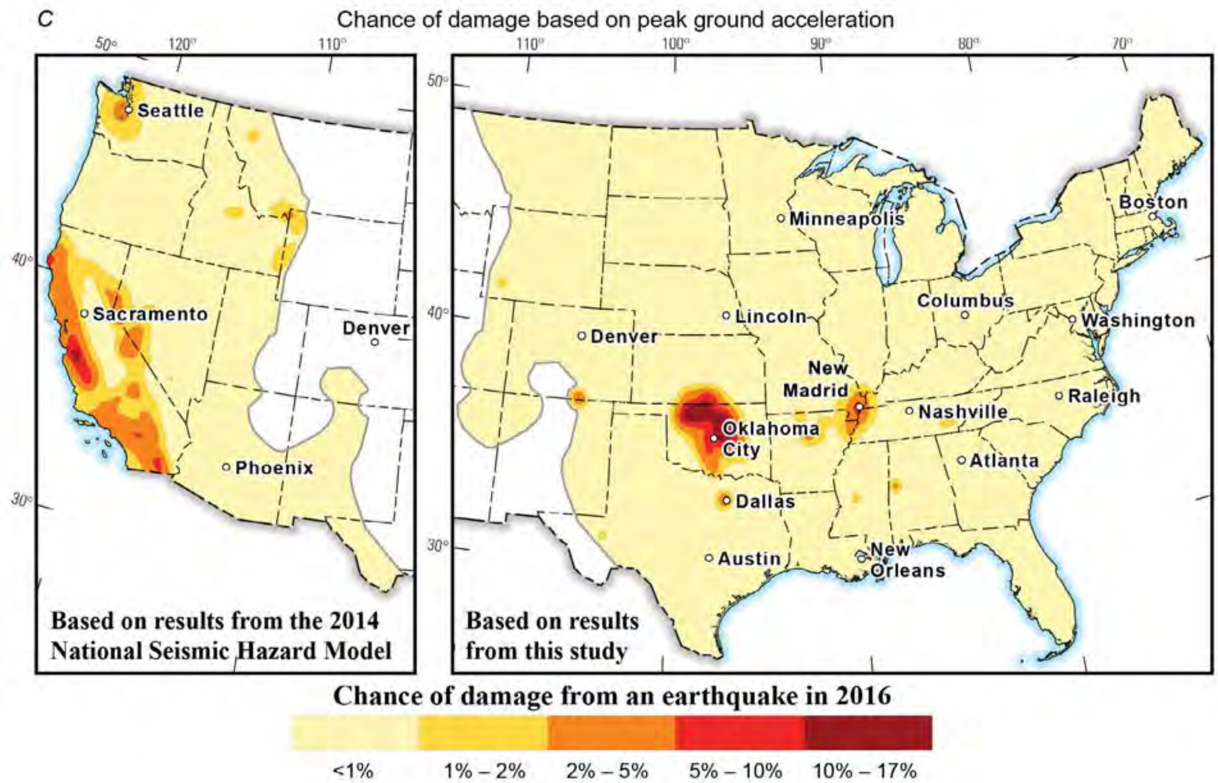
1. Advance the borehole to the required depth, taking care not to disturb material to be sampled.
2. Examine the thin-walled tube to determine that it is free of rust, dents or scratches. The cutting edge should be beveled and drawn-in slightly less than the outside diameter of the tube.
3. Attach the thin-walled sampler to the head assembly and drill rods.
4. Lower the sampler assembly to the required depth and press the sampler 2 feet into the soil.
5. To insure good recovery, leave the assembly in the borehole for 10 to 15 minutes, to allow buildup of skin friction within the thin-wall sampler. Then rotate entire assembly 1 or 2 revolutions to shear off sample from soil below withdraw assembly from the borehole and disassemble.
6. Remove any disturbed material from the tube ends and measure the recovery.
7. Seal, mark, and store the tube in an upright position during storage and shipment to testing laboratory.

# Appendix B

# USGS Seismic Hazards




**Two-percent probability of exceedance in 50 years map of peak ground acceleration**



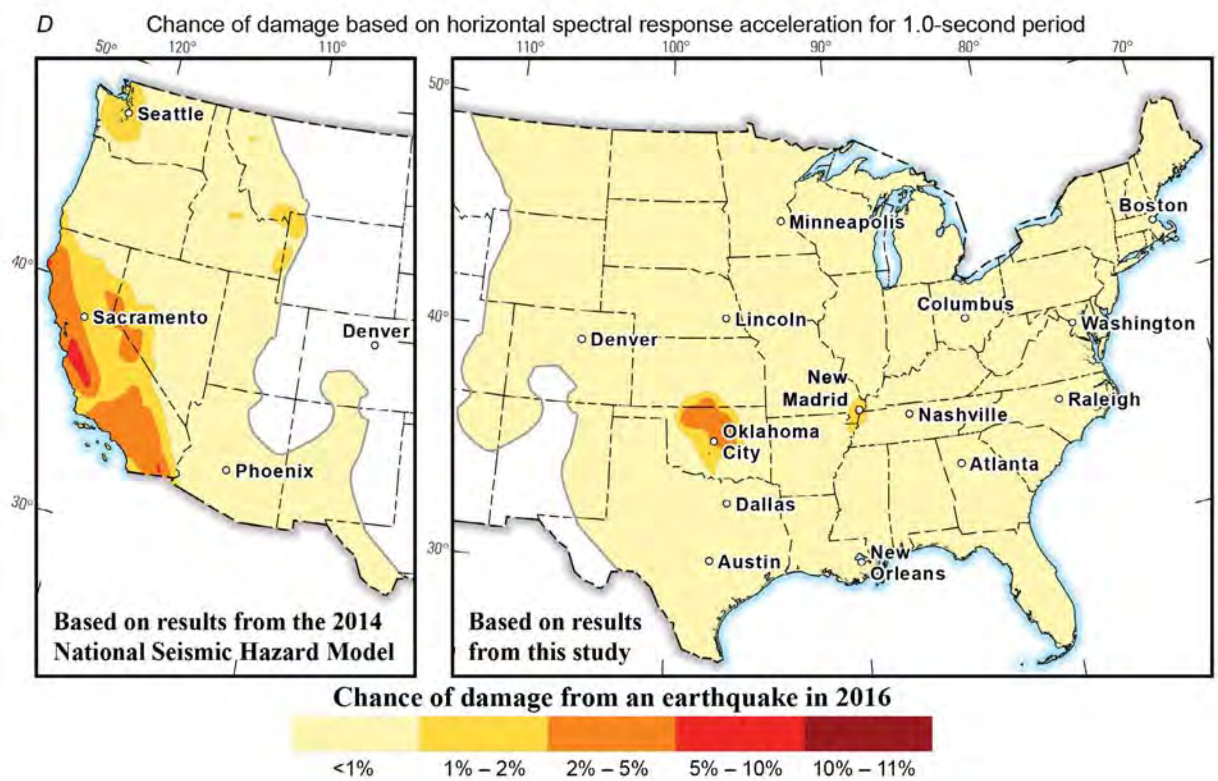




Figure caption on page 37.

**Figure 7.** Modified Mercalli Intensity maps and chance of damage for the Western United States and the Central and Eastern United States (CEUS) based on peak horizontal ground acceleration and 1-hertz spectral acceleration. For *A–D*, the map of the Western United States shows data based on the long-term 2014 National Seismic Hazard Model, and the map of the CEUS shows data based on the 2016 one-year model. *A–B*, Modified Mercalli Intensity (MMI) maps at 1-percent probability of exceedance in 1 year for the United States obtained (*A*) by converting peak horizontal ground acceleration (PGA) to MMI and (*B*) by converting 1-hertz (Hz; 1-second) spectral acceleration to MMI. These maps (*A* and *B*) are site amplified. *C–D*, Chance of damage (MMI greater than or equal to VI) from an earthquake in 2016, obtained from the rate of occurrence of (*C*) PGA ground motions and (*D*) 1-Hz (1-second) ground motions that are correlated with MMI VI for a uniform alluvial soil (National Earthquake Hazards Reduction Program site class D).

Figures 7*C* and 7*D* show maps of the United States that also include the 2014 NSHM long-term tectonic hazard for the Western United States for comparison with the 2016 model hazard for the CEUS. In these maps, we consider the chances of experiencing damaging earthquakes for a fixed ground shaking level that corresponds with MMI VI (0.12 g PGA and 0.10 g 1-Hz [1-s] spectral acceleration). As in figures 7*A* and 7*B*, figures 7*C* and 7*D* show higher hazard for the PGA-based MMI compared to MMI obtained from converting 1-Hz (1-s) spectral acceleration. A weighted combination (average) of these maps may provide a more robust estimate of the potential earthquake intensity (MMI).

## Final Maps

The final hazard maps show forecasts for MMI values and the chance of damaging earthquakes (MMI of VI or more). These parameters may be more comprehensible for many people than unconverted PGA or spectral acceleration values (fig. 8). Figure 8A presents an MMI map with a 1-percent probability of exceedance in 1 year for the United States obtained by averaging figures 7A and 7B. Sites in north-central Oklahoma, southernmost Kansas, central Arkansas, the Dallas-Fort Worth area, and the Raton Basin near the border of Colorado and New Mexico show MMI values that are greater than VI, VII, or VIII. Forecasted ground shaking in the north-central Oklahoma and Dallas, Tex., regions are consistent with damage levels observed over the past decade (Wald and others, 2011).

January 28, 2020

Mr. David Bahrenburg
WCA Waste Corporation – Northeast Landfill
1001 S. Rockwell Ave.
Oklahoma City, Oklahoma 73128

Re: Drilling Plan for Horizontal Expansion
WCA Northeast Landfill
ODEQ Permit #3555050

**NOTICE OF DEFICIENCY**

Dear Mr. Bahrenburg:

The Department of Environmental Quality (DEQ) received the Drilling Plan for Horizontal Expansion on December 16, 2019 by SCS Engineers on behalf of Northeast C&D Landfill.

Oklahoma Administrative Code (OAC) 252:515-7-1 requires a subsurface investigation and groundwater study prior to the landfill submitting a permit modification application for a lateral expansion. The subsurface investigation determines the location of the uppermost saturated zone and is designed to protect all saturated zones encountered while drilling. The Drilling Plan is the first step in the subsurface investigation and encompasses approximately 73.2 acres of future waste disposal area. The Drilling Plan, subsurface investigation, and groundwater study results will be submitted as part of a Tier III permit modification application. DEQ has reviewed the report and identified the following deficiencies:

1. WCA is requesting a variance and approval to use MW-3R and MW-4R as two of the required eighteen borings at the site for evaluating subsurface conditions. OAC 252:515-7-4(b)(3)(D) allows the landfill to substitute up to one-fourth of required borings with existing borings located within 200 feet of the proposed permit boundary. The report notes that the existing monitoring wells MW-3R and MW-4R are located within the footprint of the proposed expansion area; however, the total depths for these two monitoring wells (drilled ten feet into the uppermost saturated zone) will not meet the requirement of OAC 252:515-7-4(b)(4)(A) that all borings should be a minimum of 30 feet below the lowest placement of waste. During the evaluation of whether or not the two monitor wells can be used to replace two of the required borings, DEQ found that the estimated depth of waste placement near the wells would be in groundwater based on the water level elevations in the two wells given in the most recent groundwater monitoring report. Further, it appears if the estimated elevation of waste were corrected to be at least 5 feet above the water levels, then the two monitor wells would be acceptable replacements for two borings. Please reevaluate the estimated elevation of deepest

placement of waste and include the two monitor wells in Table 1. Note: a variance from the rules which is a Tier III permit modification requiring public participation and a demonstration of how the variance is at least as protective as the rule would be required for the original requested approval.

2. Currently, the proposed horizontal expansion does not meet the siting criteria in OAC 252:515-5-32(d); no new disposal areas shall be located in wetland areas. Also the expansion area does not meet the location restriction of OAC 252:515-5-51(a) Terrace deposits. A Tier III variance request and proposal will be required in the future permit modification application that demonstrates environmentally protective measures to be taken to justify the proposed expansion of the permit boundary into an area designated as alluvium or terrace deposits.

3. It appears the permit boundary on the south side may be incorrectly drawn on the figures. Please verify the existing permit boundary and modify the figures if necessary.

Lastly it is stated in the introduction that the proposed lateral expansion area and the vertical expansion of the existing disposal area will be utilized for a municipal solid waste (MSW) disposal area. If this is the plan, please discuss with DEQ as soon as possible prior to submitting the application. There are many regulatory and technical issues associated with merging of a MSW and a C&D landfill that will need to be addressed, including: liner construction materials, groundwater monitoring requirements, and post-closure monitoring period, etc. Also, DEQ would not approve a vertical expansion for disposal of MSW over a C&D landfill.

Please update the Drilling Plan addressing the deficiencies noted. If you have any questions, please contact Kaylee Shiplet at (405) 702-5196.

Sincerely,

Hillary Young, P.E.
Chief Engineer
Land Protection Division

HY/ks

cc: Robert Fowler, SCS Engineers

February 4, 2020

Ms. Hillary Young, P.E.
Oklahoma Department of Environmental Quality
Land Protection Division
P.O Box 1677
Oklahoma City, OK 73101-1677

Subject: **Response to Notice of Deficiency Letter**
**Drilling Plan for Horizontal Expansion**
**WCA Northeast Landfill – ODEQ Permit #3555050**

Dear Ms. Young:

Stearns, Conrad, and Schmidt, Consulting Engineers, Inc. (dba SCS Engineers) on behalf of WCA of Oklahoma, LLC. (WCA) is submitting the following response to the notice of deficiency (NOD) letter, dated January 28, 2020, related to the Drilling Plan for Horizontal Expansion, dated December 13, 2019. For ease of review, we have included your original NOD comments below (in *italics*), followed by our response (in **bold**):

1. *Comment #1: WCA is requesting a variance and approval to use MW-3R and MW-4R as two of the required eighteen borings at the site for evaluating subsurface conditions. OAC 252:515-7-4(b)(3)(D) allows the landfill to substitute up to one-fourth of required borings with existing borings located within 200 feet of the proposed permit boundary. The report notes that the existing monitoring wells MW-3R and MW-4R are located within the footprint of the proposed expansion area; however, the total depths for these two monitoring wells (drilled ten feet into the uppermost saturated zone) will not meet the requirement of OAC 252:515-7-4(b)(4)(A) that all borings should be a minimum of 30 feet below the lowest placement of waste. During the evaluation of whether or not the two monitor wells can be used to replace two of the required borings, DEQ found that the estimated depth of waste placement near the wells would be in groundwater based on the water level elevations in the two wells given in the most recent groundwater monitoring report. Further, it appears if the estimated elevation of waste were corrected to be at least 5 feet above the water levels, then the two monitor wells would be acceptable replacements for two borings. Please reevaluate the estimated elevation of deepest placement of waste and include the two monitor wells in Table 1. Note: a variance from the rules which is a Tier III permit modification requiring public participation and a demonstration of how the variance is at least as protective as the rule would be required for the original requested approval. .*

   **Response: Since groundwater elevations have not been defined across the proposed expansion area, the deepest placement of waste, as presented in Table 1, is approximate and conservative to ensure all proposed boring depths are drilled deep enough to satisfy OAC 252:515-7-4(b)(4)(A). The actual deepest placement of waste will be defined by information obtained during the subsurface investigation. Considering groundwater elevations will be the limiting factor in the design, all borings will be advanced 25 feet into the uppermost aquifer to confirm that the 30-foot requirement of OAC 252:515-7-4(b)(4)(A) is achieved. It is anticipated that in some areas waste placement could correspond to elevations as deep as 1155 feet**

above mean sea level (ft MSL) and in other areas it is anticipated that the deepest placement of waste would be much shallower (1180 ft MSL). Table 1 of the Drilling Plan has been updated to include existing monitoring wells MW-3R and MW-4R, as requested. Additionally, we have updated Table 1 to correct the "Deepest Placement of Waste" for PZ-6 to be 1165 ft MSL.

2. Comment #2*: Currently, the proposed horizontal expansion does not meet the siting criteria in OAC 252:515-5-32(d); no new disposal areas shall be located in wetland areas. Also the expansion area does not meet the location restriction of OAC 252:515-5-51(a) Terrace deposits. A Tier III variance request and proposal will be required in the future permit modification application that demonstrates environmentally protective measures to be taken to justify the proposed expansion of the permit boundary into an area designated as alluvium or terrace deposits.*

   Response: WCA is aware that wetlands and waters of the United States (WOTUS) may exist at the proposed expansion area. WCA plans to have an assessment performed by a qualified subconsultant to evaluate the extent of WOTUS at the proposed site, coordinate with the United States Army Corp of Engineers (USACE), and have the required USACE Section 404 of the Clean Water Act (CWA) approvals prepared and submitted, as necessary, for the proposed expansion area.

   OAC 252:515-5-5(a) states that no area within the permit boundary of a new land disposal facility, or expansion of the permit boundary of an existing land disposal facility, shall be located within an area designated as alluvium or terrace deposits and their recharge areas, as shown on "Map of Aquifers and Recharge Areas in Oklahoma" complied by Kenneth S. Johnson, Oklahoma Geological Survey (1991).

   According to the "Geologic Map of the Midwest City 7.5' Quadrangle, Cleveland and Oklahoma Counties, Oklahoma" compiled by Thomas M. Stanley and Neil H. Suneson, 2000 and the "Geologic Map of the Spencer 7.5' Quadrangle, Oklahoma County, Oklahoma" complied by Thomas M. Stanley and Neil H. Suneson, 1999; the proposed expansion area is not located in alluvium or terrace deposits.

   The "Map of Aquifers and Recharge Areas of Oklahoma" complied by Kenneth S. Johnson, Oklahoma Survey (1991) is at such a large scale that locating the site with precision as it relates to terrace deposits is not possible. The 7.5' Quadrangle maps are much smaller scale than the Kenneth S. Johnson Map and the boundaries shown are more representative of actual conditions. In addition, site specific geologic conditions obtained during previous subsurface investigations and presented in the Tier III Permit Application, dated November 2005 for the Northeast C&D Landfill indicate that the site is underlain by silty sands underlain by weathered sandstone. This is consistent with weather Garber Sandstones and not alluvium or terrace deposits. It is anticipated that information derived from the proposed subsurface investigation will provide similar site specific information and will be presented in the Tier III Permit Application for the proposed horizontal expansion described in our December 13, 2019 Drilling Plan.

3. Comment #3: *It appears the permit boundary on the south side may be incorrectly drawn on the figures. Please verify the existing permit boundary and modify the figures if necessary.*

<u>Response:</u> WCA owns all property designated as both existing permit boundary and proposed expansion area defined in the December 13, 2019 Drilling Plan. Based on review of a Tier I permit modification, entitled "Phase 5 Liner System Construction," dated May 2010 and submitted by Sheppard Engineering Design Co., Inc., the existing permit boundary depicted on the south side is correct as depicted on the figures presented in the drilling plan. However, in the event the property depicted on the south side of the property is not currently part of the existing permit boundary in DEQ records, please note that it is WCA's intentions to include this portion of the property into the permit boundary.

4. *<u>Comment #4:</u> Lastly it is stated in the introduction that the proposed lateral expansion area and the vertical expansion of the existing disposal area will be utilized for a municipal solid waste (MSW) disposal area. If this is the plan, please discuss with DEQ as soon as possible prior to submitting the application. There are many regulatory and technical issues associated with merging of a MSW and a C&D landfill that will need to be addressed, including: liner construction materials, groundwater monitoring requirements, and post-closure monitoring period, etc. Also, DEQ would not approve a vertical expansion for disposal of MSW over a C&D landfill.*

   <u>Response:</u> Comment noted. WCA and SCS Engineers have scheduled a pre-application meeting with DEQ on March 10, 2020 to discuss the required DEQ regulatory criteria and WCA proposed plans for the Northeast Landfill expansion. As such, we look forward to further discussions with DEQ on available options for lateral and vertical expansions of the Northeast Landfill, so that the design and application contents are prepared in accordance with DEQ regulations for MSW landfills in due consideration of the currently permitted C&D landfill area.

If you have any questions or comments regarding this document, please do not hesitate to contact Robert Fowler at (501) 812-4551 or rfowler@scsengineers.com or Ryan Kuntz, P.E. at 817-358-6117 or rkuntz@scsengineers.com.

Sincerely,

Robert Fowler
Project Geologist
**SCS Engineers**

Ryan Kuntz, P.E.
Vice President / Project Director
**SCS Engineers**

cc: Ms. Kaylee Shiplet – ODEQ
Ronald Poor – WCA
David Bahrenburg – WCA (e-copy only)
Eduardo Choquis – WCA (e-copy only)
Dan McCullough – SCS Engineers

Encl. – Table 1. Proposed Boring Information

Table 1. Proposed Boring Information

| Boring/PZ Number | Northing | Easting | Deepest Placement of Waste (ft msl) | Target Elevation (ft msl) | Approx. Ground Surface Elevation (ft msl) | Target Depth (ft bgs) |
|---|---|---|---|---|---|---|
| PZ-1 | 182843.6990' | 2150428.2777' | 1165 | 1135 | 1214.000' | 79 |
| PZ-2 | 183925.2176' | 2150401.7123' | 1165 | 1135 | 1207.007' | 73 |
| PZ-3 | 183922.4725' | 2149230.0025' | 1165 | 1135 | 1199.076' | 65 |
| PZ-4 | 183243.1652' | 2148593.5279' | 1165 | 1135 | 1175.348' | 41 |
| PZ-5 | 183889.5268' | 2148688.0282' | 1155 | 1125 | 1175.296' | 51 |
| PZ-6 | 183261.4811' | 2149654.6457' | 1165 | 1135 | 1196.037' | 62 |
| PZ-7 | 183736.5892' | 2147856.6854' | 1155 | 1125 | 1197.680' | 73 |
| EB-1 | 182874.7496' | 2147877.9945' | 1165 | 1109 | 1210.191' | 100 |
| EB-2 | 182906.5890' | 2148830.5602' | 1165 | 1135 | 1190.211' | 56 |
| EB-3 | 182862.8404' | 2149747.5998' | 1165 | 1135 | 1204.242' | 70 |
| EB-4 | 183256.0393' | 2150191.4214' | 1165 | 1135 | 1207.480' | 73 |
| EB-5 | 183915.9739' | 2148372.5951' | 1165 | 1135 | 1169.387' | 35 |
| EB-6 | 183402.9772' | 2149275.2847' | 1165 | 1135 | 1190.332' | 56 |
| EB-7 | 183237.9921' | 2148314.8039' | 1165 | 1135 | 1190.148' | 56 |
| EB-8 | 183333.1922' | 2147872.3289' | 1155 | 1125 | 1202.655' | 78 |
| EB-9 | 183735.3932' | 2149861.2142' | 1165 | 1135 | 1196.489' | 62 |
| MW-3R | 182799.5700' | 2149191.4900' | 1179** | NA*** | 1197.530' | NA*** |
| MW-4R | 182763.6100' | 2148479.0600' | 1176** | NA*** | 1196.220' | NA*** |

*The target elevation is the deepest proposed placement of waste minus 30' with exception of EB-1 which will be advanced to 100'.
**The deepest placement of waste elevation is five feet above the groundwater elevation as presented in the First Half 2019 (May 2019) Groundwater Monitoring Report.
***MW-3R and MW-4R are existing monitoring wells.

### 3.2.2 Groundwater

At a minimum seven borings will be advanced into the uppermost water-bearing geologic unit beneath the Site. Seven borings will be completed as piezometers and are designated PZ-1 through PZ-7. These seven proposed piezometers will be logged with geophysical methods. See **Figure 3** for approximate locations and surface elevations.

The water-bearing unit will need to yield sufficient quantities of groundwater for regular sampling events. Aquifer testing and/or field hydraulic conductivity (slug) tests will be performed on selected piezometers.

Details describing the specific procedures for installation and completion of the piezometers and performance of field testing are presented in **Section 4.0.**

OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

SCOTT A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

KEVIN STITT
Governor

February 10, 2020

Mr. David Bahrenburg
WCA Waste Corporation – Northeast Landfill
1001 S. Rockwell Ave.
Oklahoma City, Oklahoma 73128

Re: Response to Notice of Deficiency
Letter of Intent to Drill
WCA Northeast Landfill
ODEQ Permit #3555050

Dear Mr. Bahrenburg:

The Department of Environmental Quality (DEQ) issued a Notice of Deficiency (NOD) on January 28, 2020 for the WCA Northeast C&D Landfill's Drilling Plan for Horizontal Expansion, dated December 13, 2019. On February 4, 2020, DEQ received a response to the NOD (Response) and Intent to Drill, submitted by SCS Engineers via email.

In the Response, WCA provided updated information regarding MW-3R and MW-4R and included the wells in the Proposed Boring Information Table along with a revised estimation of the deepest placement of waste. The updated information shows the wells meet the requirement that borings must be drilled 30 feet below the deepest placement of waste as outlined in OAC 252:515-7-4(b)(4)(A). DEQ accepts the proposal to use MW-3R and MW-4R as two of the required borings.

The Response addressed the location restrictions associated with wetlands and terrace deposits. DEQ acknowledges that WCA plans to evaluate the expansion area for wetlands and work with the Army Corps of Engineers to obtain any required permits.

DEQ understands that alluvial or terrace deposits indicated on the 1991 Kenneth S. Johnson map may not actually exist in the expansion area due to the large map scale. Site specific information is needed to accurately depict the presence or absence of terrace deposits as proposed in the Response. It should be noted that, WCA must demonstrate clearly and convincingly, with site specific hydrological and geological data, as stated in OAC 252:515-5-51(a)(2), that the proposed expansion does not lie in alluvial or terrace deposits.If the subsurface investigation does not show the absence of alluvium and terrace deposits, a Tier III variance will be required that demonstrates (per OAC 252:515-3-32(b)) the variance proposal will equal or exceed the protection provided by the rule and will not result in a hazard to human health or the environment. Additional liner components may be needed in this case.

WCA and SCS Engineers scheduled a pre-application meeting with DEQ on March 10, 2020, to discuss the options for lateral and vertical expansions so that the design and application contents are prepared in accordance with DEQ regulations. The discussion will focus on available options for the lateral and vertical expansions of the Northeast Landfill so that the design and application meet regulatory requirements for MSW landfills considering the currently permitted area is for C&D disposal.

A notice of Intent to Drill was submitted with the Response in accordance with OAC 252:515-7-5(a). The proposed date to begin drilling is February 17, 2020, contingent on the approval of the drilling plan. This date is being requested based on the availability of the subcontractor and time constraints of the project. SCS anticipates drilling activities will take approximately three weeks to complete.

DEQ reviewed the Response and determined the deficiencies to be resolved. The drilling plan and intent to drill beginning February 17, 2020 are approved. If you have any questions, please contact Kaylee Shiplet at (405) 702-5196.

Sincerely,

Hillary Young

Hillary Young, P.E.
Chief Engineer
Land Protection Division

HY/ks

cc: Brett DeVries, SCS Engineers
Robert Fowler, SCS Engineers

SCS ENGINEERS    Environmental Consultants & Contractors

February 4, 2020

Ms. Kaylee Shiplet
Solid Waste Section
Land Protection Division
P.O. Box 1677
Oklahoma City, OK 73101-1677

Subject: Letter of Intent to Drill
WCA of Oklahoma, LLC, Northeast Landfill
Permit No.: 3555050

Dear Ms. Shiplet:

Stearns, Conrad, and Schmidt, Consulting Engineers, Inc. (dba SCS Engineers) on behalf of WCA of Oklahoma, LLC (WCA) is pleased to present this Letter of Intent to Drill at the Northeast Landfill to the Oklahoma Department of Environmental Quality (DEQ). SCS is providing DEQ with this intent to drill as per OAC Regulation 252:515-7-5(a) and in anticipation of approval of the "Drilling Plan for Horizontal Expansion" dated December 2019, and our letter response to Notice of Deficiency comments, dated February 5, 2020.

OAC 252:515-7-5(a) states that "after DEQ approval of the drilling plan, the DEQ shall be provided with written notice of intent to drill at least two (2) weeks prior to initiating drilling", however, SCS is respectfully requesting to conduct the drilling activities as outlined in the "Drilling Plan for Horizontal Expansion" at the Northeast Landfill beginning Monday February 17, 2020 following approval of the drilling plan and this letter of intent. This date is being requested based on the availability of the subcontractor and the time constraints of the project. SCS anticipates that drilling activities will take approximately three weeks to complete.

If you have any questions or comments on this request, please contact me 501-812-4551 or email at rfowler@scsengineers.com.

Sincerely,

Robert Fowler
Project Geologist
SCS Engineers

Dan McCullough, PG
Project Director
SCS Engineers

Cc; Ronald Poor, WCA
David Bahrenburg, WCA (e-copy only)
Eduardo Choquis, WCA (e-copy only)
Ryan Kuntz, SCS

SCS ENGINEERS Environmental Consultants & Contractors

March 2, 2019

Ms. Kaylee Shiplet
Solid Waste Section
Land Protection Division
P.O. Box 1677
Oklahoma City, OK 73101-1677

Subject: Request for alternate location of boring EB-5 at the Northeast Landfill
Waste Corporation of Oklahoma, LLC., Northeast Landfill
Permit No.: 3555050

Dear Ms. Shiplet:

Stearns, Conrad, and Schmidt, Consulting Engineers, Inc. (dba SCS Engineers) on behalf of Waste Corporation of Oklahoma, LLC. (WCA) is submitting this letter to request to relocate the proposed boring location for EB-5 approximately 150 feet west of the location as approved in the Drilling Plan for Horizontal Expansion of the Northeast Landfill. This request is being made since access to the approved EB-5 location is limited at this time. A map depicting the approved location as well as the alternate location for EB-5 has been included as an attachment to this letter. Page 5 of the drilling plan has also been updated to include the corrected location and elevations for the new EB-5 location and is included as an attachment to this letter.

Please contact us if you have any questions concerning this Plan.

Sincerely,

Robert Fowler
Project Geologist
SCS Engineers

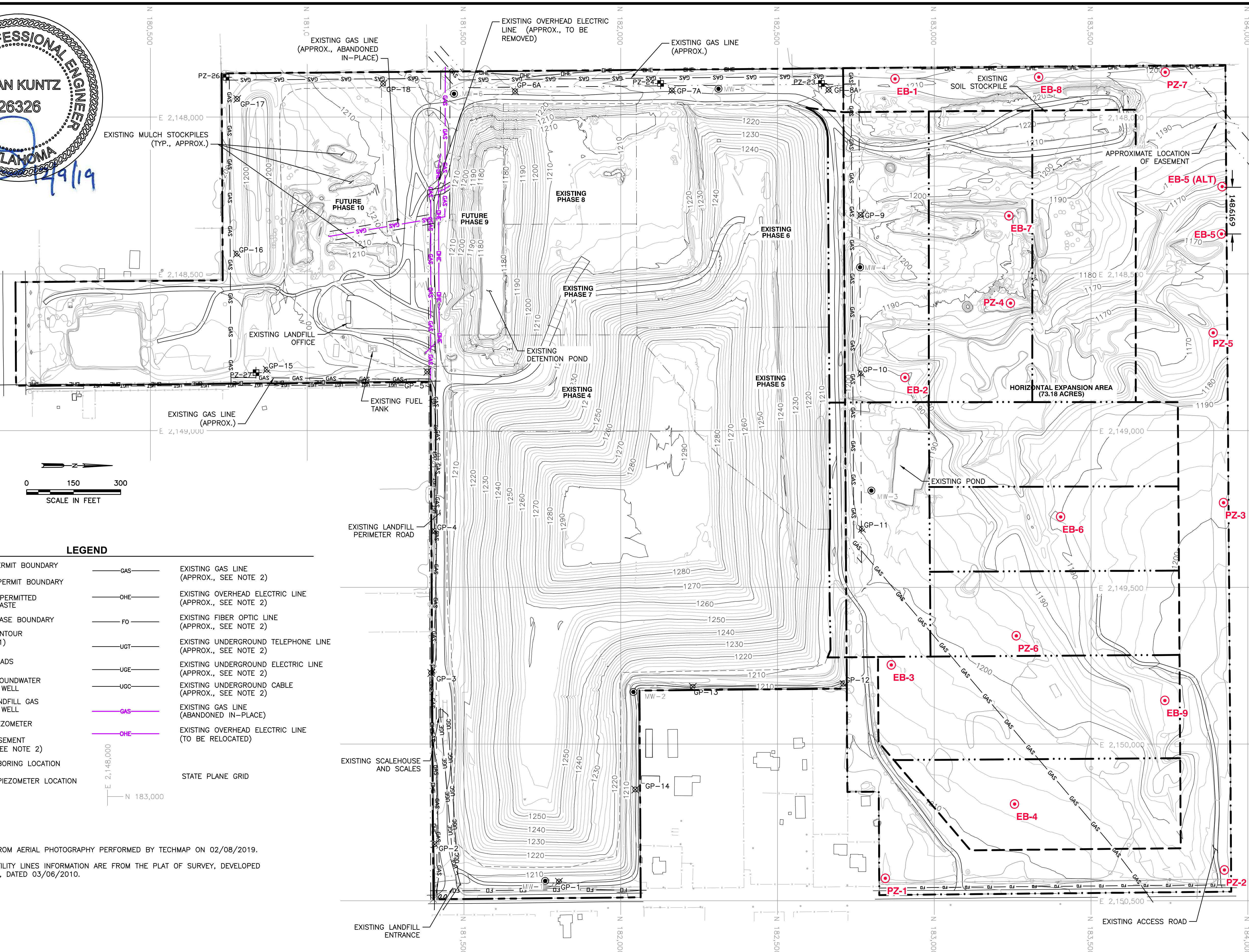
Dan McCullough, PG
Project Director
SCS Engineers

RF

Attachments: Boring Location Map

Revised Page 5 of the Drilling Plan for Horizontal Expansion

LICENSED PROFESSIONAL ENGINEER
RYAN KUNTZ
26326
OKLAHOMA
12/9/19




## LEGEND

| | |
|---|---|
| CURRENT PERMIT BOUNDARY | EXISTING GAS LINE (APPROX., SEE NOTE 2) |
| PROPOSED PERMIT BOUNDARY | EXISTING OVERHEAD ELECTRIC LINE (APPROX., SEE NOTE 2) |
| CURRENTLY PERMITTED LIMITS OF WASTE | EXISTING FIBER OPTIC LINE (APPROX., SEE NOTE 2) |
| EXISTING PHASE BOUNDARY | EXISTING UNDERGROUND TELEPHONE LINE (APPROX., SEE NOTE 2) |
| 1210 EXISTING CONTOUR (SEE NOTE 1) | EXISTING UNDERGROUND ELECTRIC LINE (APPROX., SEE NOTE 2) |
| EXISTING ROADS | EXISTING UNDERGROUND CABLE (APPROX., SEE NOTE 2) |
| MW-2 EXISTING GROUNDWATER MONITORING WELL | EXISTING GAS LINE (ABANDONED IN-PLACE) |
| GP-2 EXISTING LANDFILL GAS MONITORING WELL | EXISTING OVERHEAD ELECTRIC LINE (TO BE RELOCATED) |
| PZ-26 EXISTING PIEZOMETER | E 2,148,000 N 183,000 STATE PLANE GRID |
| EXISTING EASEMENT (APPROX., SEE NOTE 2) | |
| EB-5 PROPOSED BORING LOCATION | |
| PZ-5 PROPOSED PIEZOMETER LOCATION | |

NOTES:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY TECHMAP ON 02/08/2019.
2. EXISTING EASEMENT AND UTILITY LINES INFORMATION ARE FROM THE PLAT OF SURVEY, DEVELOPED BY SHEPHERD ENGINEERING, DATED 03/06/2010.

2/28/2020 10:04 AM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application\...dwg\03 BORING LOCATION MAP

FOR PERMITTING PURPOSES ONLY

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|

DRAWING TITLE: BORING LOCATION MAP

PROJECT TITLE: NORTHEAST LANDFILL DRILLING PLAN

CLIENT: N.E. LANDFILL, LLC
NORTHEAST C&D LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: BJD | DWN. BY: BJJ | CHK. BY: RRK | Q/A RVW BY: BJD | APP. BY: RRK

CADD FILE: 03 BORING LOCATION MAP

DATE: 12/2019

SCALE: AS SHOWN

FIGURE NO. 3

Table 1. Proposed Boring Information

| Boring/PZ Number | Northing | Easting | Deepest Placement of Waste (ft msl) | Target Elevation (ft msl) | Approx. Ground Surface Elevation (ft msl) | Target Depth (ft bgs) |
|---|---|---|---|---|---|---|
| PZ-1 | 182843.6990' | 2150428.2777' | 1165 | 1135 | 1214.000' | 79 |
| PZ-2 | 183925.2176' | 2150401.7123' | 1165 | 1135 | 1207.007' | 73 |
| PZ-3 | 183922.4725' | 2149230.0025' | 1165 | 1135 | 1199.076' | 65 |
| PZ-4 | 183243.1652' | 2148593.5279' | 1165 | 1135 | 1175.348' | 41 |
| PZ-5 | 183889.5268' | 2148688.0282' | 1155 | 1125 | 1175.296' | 51 |
| PZ-6 | 183261.4811' | 2149654.6457' | 1165 | 1135 | 1196.037' | 62 |
| PZ-7 | 183736.5892' | 2147856.6854' | 1155 | 1125 | 1197.680' | 73 |
| EB-1 | 182874.7496' | 2147877.9945' | 1165 | 1109 | 1210.191' | 100 |
| EB-2 | 182906.5890' | 2148830.5602' | 1165 | 1135 | 1190.211' | 56 |
| EB-3 | 182862.8404' | 2149747.5998' | 1165 | 1135 | 1204.242' | 70 |
| EB-4 | 183256.0393' | 2150191.4214' | 1165 | 1135 | 1207.480' | 73 |
| EB-5 | 183918.1728 | 2148221.6592 | 1165 | 1135 | 1168.171’ | 34 |
| EB-6 | 183402.9772' | 2149275.2847' | 1165 | 1135 | 1190.332' | 56 |
| EB-7 | 183237.9921' | 2148314.8039' | 1165 | 1135 | 1190.148' | 56 |
| EB-8 | 183333.1922' | 2147872.3289' | 1155 | 1125 | 1202.655' | 78 |
| EB-9 | 183735.3932' | 2149861.2142' | 1165 | 1135 | 1196.489' | 62 |
| MW-3R | 182799.5700’ | 2149191.4900’ | 1179** | NA*** | 1197.530’ | NA*** |
| MW-4R | 182763.6100’ | 2148479.0600’ | 1176** | NA*** | 1196.220’ | NA*** |

*The target elevation is the deepest proposed placement of waste minus 30’ with exception of EB-1 which will be advanced to 100’.
**The deepest placement of waste elevation is five feet above the groundwater elevation as presented in the First Half 2019 (May 2019) Groundwater Monitoring Report.
***MW-3R and MW-4R are existing monitoring wells.

### 3.2.2 Groundwater

At a minimum seven borings will be advanced into the uppermost water-bearing geologic unit beneath the Site. Seven borings will be completed as piezometers and are designated PZ-1 through PZ-7. These seven proposed piezometers will be logged with geophysical methods. See Figure 3 for approximate locations and surface elevations.

The water-bearing unit will need to yield sufficient quantities of groundwater for regular sampling events. Aquifer testing and/or field hydraulic conductivity (slug) tests will be performed on selected piezometers.

Details describing the specific procedures for installation and completion of the piezometers and performance of field testing are presented in Section 4.0.

SCOTT A. THOMPSON
Executive Director

KEVIN STITT
Governor

March 23, 2020

Mr. David Bahrenburg
WCA Waste Corporation – Northeast Landfill
1001 S. Rockwell Ave.
Oklahoma City, Oklahoma 73128

Re: Request for Alternate Location of boring EB-5
WCA Northeast Landfill
ODEQ Permit #3555050

Dear Mr. Bahrenburg:

The Oklahoma Department of Environmental Quality (DEQ) received the Request for Alternate Location of boring EB-5 on March 2, 2020, via email from SCS Engineers on behalf of Northeast C&D Landfill.

The purpose of the submittal is to request to relocate the proposed boring site for EB-5; approximately 150 feet to the west of the location as approved in the Drilling Plan for Horizontal Expansion of the Northeast Landfill. The request is being made since access to the previously approved location is limited at this time. The Drilling Plan has been updated to include the corrected location and elevations for the new EB-5 boring.

The request to relocate boring EB-5 is approved. If you have any questions, please contact Kaylee Shiplet at (405) 702-5196.

Sincerely,

Hillary Young, P.E.
Chief Engineer
Land Protection Division

HY/ks

cc: Brett DeVries, SCS Engineers
Robert Fowler, SCS Engineers

# Appendix B

# Boring Logs and Construction Diagrams

| SCS ENGINEERS | LOG OF BORING NO.: **EB-1** | SHEET NUMBER: 1 of 3 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1210.7 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 101 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 182874.18 EASTING: 2147882.86 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 40.43 fbgs |
| START DATE: 3/19/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1170.22 ft |
| FINISH DATE: 3/25/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/26/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown, with rootlets (topsoil) | SPT | 0-1.5 | 1,2,2 | 1 | | | 1210 |
| | | Silty Clay; reddish brown | Cont. | 1.5-5 | | 3.5 | | | |
| 5 | | | Cont. | 5-10. | | 2 | | | 1205 |
| 10 | | | Shelby | 10-12. | | 2 | | Backfilled boring 0 to TD (101 ft bgs) with bentonite plug once stabilized groundwater elevation was obtained | 1200 |
| | Clayey Sand | Clayey Sand; dark reddish brown transitions to reddish brown and then orange, fine to medium grained | SPT | 12-12.5 | 12,14,38 | 1.5 | | | |
| 15 | Sand | Sand; reddish brown to orange, fine grained, trace amounts of clay | Cont. | 12.5-15 | | 1.5 | | | 1195 |
| | Clayey Sand | Clayey Sand; reddish brown to tan, fine to medium grained with some cemented weathered sandstones | Cont | 15-20. | | 1 | | | |
| 20 | | | STP | 20-21.5 | 50/5" | 5" | | | 1190 |
| | | | Cont. | 21.5-25 | | 1.5 | | | |
| 25 | Silty Clay | Silty Clay; reddish brown, friable | Cont. | 25-30. | | 3.5 | | | 1185 |
| 30 | Sand | Sand; orange to brown sands with thinly bedded hard light tan to brown interbedded | Cont. | 30-35. | | 2 | | | 1180 |
| 35 | | | | | | | | | 1175 |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

**SCS ENGINEERS**

LOG OF BORING NO.: **EB-1**



11219 Richardson Drive
North Little Rock, AR

| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1210.7 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 101 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 182874.18 EASTING: 2147882.86 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 40.43 fbgs |
| START DATE: 3/19/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1170.22 ft |
| FINISH DATE: 3/25/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/26/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | | sandstones | | | | | | | |
| | Clayey Sand | Clayey Sand; reddish brown to light brown, some thin cemented sandstones, wet at 43' | Cont. | 35-40. | | 1 | | | |
| 40 | | | SPT | 40-41.5 | 50/5" | 5" | 40.43 | | 1170 |
| | | | Cont. | 41.5-45 | | 3 | | Wet @ 43' bgs | |
| 45 | | | Cont. | 45-50 | Cont. | 0.5 | | | 1165 |
| | Silty Clay | Silty Clay; reddish brown to light gray, very hard | | | | | | Switched to Wash Rotary at 48 ft bgs | |
| 50 | Sand | Sand; orange to reddish brown, fine to medium grained | SPT | 50-51.5 | 50/2" | 0 | | | 1160 |
| 55 | | | SPT | 56-57.5 | 50/1" | 0 | | | 1155 |
| 60 | | | SPT | 61-62.5 | 50/1" | 1" | | | 1150 |
| 65 | Silty Clay | Silty Clay; reddish brown with light gray silt seams | SPT | 66-67.5 | 50/1" | 1" | | | 1145 |
| 70 | | | | | | | | | 1140 |
| | | Sandstone; light | | 71-72. | | | | | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

**SCS ENGINEERS**

11219 Richardson Drive
North Little Rock, AR

LOG OF BORING NO.: **EB-1**



| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1210.7 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 101 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 182874.18 EASTING: 2147882.86 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 40.43 fbgs |
| START DATE: 3/19/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1170.22 ft |
| FINISH DATE: 3/25/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/26/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | Sandstone | gray, fine grained, competant, very hard | SPT | 5 | 50/3" | 3" | | Very hard drilling 71'-75' | |
| 75 | Silty Clay | Silty Clay; reddish brown with light gray silt seams, some thin interbedded sandstones | | | | | | | 1135 |
| | | | SPT | 76-77.5 | 50/5 | 5" | | | |
| 80 | | | | | | | | | 1130 |
| | | | SPT | 81-82.5 | 50/4" | 3" | | | |
| 85 | | | SPT | 86-87.5 | 50/2" | 1" | | | |
| 90 | | | SPT | 91-92.5 | 50/2" | 0 | | | |
| 95 | Sandy Clay | Sandy Clay; reddish brown, fine grained sands | SPT | 96-97.5 | 50/2" | 0 | | | |
| 00 | | | | | | | | | |
| | | | SPT | 101-101.5 | 50/3" | 3" | | TD Drilled 101' bgs | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

**SCS ENGINEERS**

11219 Richardson Drive
North Little Rock, AR



| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1190.5 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 46 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 182898.09 EASTING: 2148854.27 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 16.66 fbgs |
| START DATE: 3/4/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1173.85 ft |
| FINISH DATE: 3/5/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/9/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown (topsoil) | SPT | 0-1.5 | 2,4,4 | 100 | | | 1190 |
| | | | Cont. | 1.5-5 | | 86 | | | |
| 5 | | Silty Clay; brown | Bulk | 4-8. | | 60 | | Backfilled boring 0 to TD (46 ft bgs) with bentonite plug once stabilized groundwater elevation was obtained | 1185 |
| | | | Cont. | 5-10. | | | | | |
| 10 | | | SPT | 10-11.5 | 14,20,17 | 100 | | | 1180 |
| | | | Cont. | 11.5-14 | | 80 | | | |
| | Sandy Clay | Sandy Clay; orange | Shelby | 14-15. | | | | | |
| 15 | Clayey Sand | Clayey Sand; orange | Cont. | 15-20. | | 10 | 16.66 | Saturated at 18 ft bgs | 1175 |
| 20 | Sand | Sand; reddish brown to brown, course grained to fine grained, Some gravels between 31-36 feet (<5%) | | | | | | Very little recovery | 1170 |
| | | | SPT | 21-22.5 | 8,10,19 | 100 | | | |
| | | | Cont. | 21.5-25 | | 14 | | | |
| 25 | | | Cuttings | 25-31. | | | | | 1165 |
| 30 | | | SPT | 31-32.5 | 50/2" | 11 | | Switched to Wash Rotary | 1160 |
| | | | Cuttings | 31-36. | | | | | |
| 35 | | | | | | | | | 1155 |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

**SCS ENGINEERS**

11219 Richardson Drive
North Little Rock, AR

LOG OF BORING NO.: **EB-2**



| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1190.5 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 46 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 182898.09 EASTING: 2148854.27 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 16.66 fbgs |
| START DATE: 3/4/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1173.85 ft |
| FINISH DATE: 3/5/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/9/2020 |

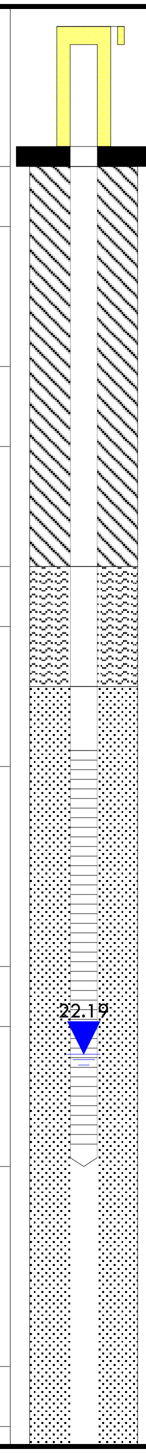
| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | Silty Clay | Silty Clay; reddish brown, stiff | SPT | 36-37.5 | 50/3" | 17 | | | |
| 40 | | | Cuttings | 36-41. | | | | Very hard drilling @ 39' | 1150 |
| | | | SPT | 41-42.5 | 50/5" | 28 | | | |
| 45 | | | Cuttings | 41-46. | | | | TD drilled to 46' bgs | 1145 |
| | | | SPT | 46-46.17 | 50/2" | 11 | | | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **EB-3/PZ-8** | SHEET NUMBER: 1 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1204.1 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 60 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION:<br>NORTHING: 182862.63<br>EASTING: 2149748.47 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 23.34 fbgs |
| START DATE: 3/6/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1180.76 ft |
| FINISH DATE: 3/9/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/13/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) |
|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown with rootlets | SPT | 0-1.5 | 4,6,7 | 1.5 |
| | | | Cont. (Bulk 0-3) | 0-3 | 4,6,7 | 3.5 |
| | Clay | Clay; reddish brown | | 1.5-5 | | |
| 5 | | | Shelby | 5-7. | | |
| | Silty Clay | Silty Clay; reddish brown to orange | Cont. | 7-10. | | 1 |
| 10 | | | SPT | 10-11.5 | 3,4,6 | 1.5 |
| | | | Cont. (Bulk 10-14) | 11.5-15 | 3,4,6 | 1 |
| 15 | | | Cont. | 15-20 | | 0.5 |
| 20 | Clayey Sand | Clayey Sand; orange | SPT | 20-21.5 | 10.22, 20 | 1.5 |
| | | | Cont. | 21.5-25 | 10,22, 20 | 1 |
| 25 | Silty Clay | Silty Clay; reddish brown with orange and light gray mottling, hard, dry | Cont. (Bulk 25-27) | 25-30 | | 4 |
| 30 | | | SPT | 30-31.5 | 35,50/2" | 8" |

MONITORING WELL CONSTRUCTION




MONITORING WELL DESCRIPTION/DRILLING NOTES

Stick Up (3.00 ft) Protective Cover

Concrete Pad (Approximately 6")

2 in dia. Sch. 40 PVC soild riser from 0 - 15 ft bgs
Wet at 33' bgs

Bentonite/portland grout from ground surface to 10 ft bgs

Bentonite pellet seal from 10 ft bgs to 13 ft bgs

Sand filter pack from 13 ft to 25 ft bgs

10 ft of 2 in dia, 0.010 slot, Sch. 40 PVC sreen
Installed depth = 25' bgs
End Cap

ELEVATION (FT): 1205, 1200, 1195, 1190, 1185, 1180, 1175

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **EB-3/PZ-8** | SHEET NUMBER: 2 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1204.1 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 60 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 182862.63 EASTING: 2149748.47 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 23.34 fbgs |
| START DATE: 3/6/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1180.76 ft |
| FINISH DATE: 3/9/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/13/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cont. | 31.5-35 | 35, 50/2" | 0.5" | | Backfilled boring 25 ft to total depth (60 ft bgs) | 1170 |
| 35 | Sand | Sand; reddish brown to brown, fine grained, wet | SPT | 35-36.5 | 50/6" | 0.5 | | | |
| | | | | | 50/6" | | | | |
| 40 | Silty Clay | Silty Clay; reddish brown with thin gray silt seams | SPT | 41-41.5 | 50/2" | 2" | | | 1165 |
| | | | | | 50/2" | | | | |
| 45 | Sandstone | Sandstone; reddish brown to tan | | | | | | | 1160 |
| | | | SPT | 46-47.5 | 50/6" | 0.5 | | | |
| 50 | Silty Clay | Silty Clay, reddish brown to brown with some gray silt seams | SPT | 51-51.5 | 50/5" | 5" | | | 1155 |
| 55 | | | SPT | 56-56.5 | 50/2" | 2" | | | 1150 |
| 60 | | | | | | 1" | | TD Drilled 60' bgs | 1145 |

***THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL***

# SCS ENGINEERS

**LOG OF BORING NO.: EB-4**



11219 Richardson Drive
North Little Rock, AR

| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1207.9 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 56 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183261.62 EASTING: 2150212.06 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 24.41 fbgs |
| START DATE: 3/10/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1183.5 ft |
| FINISH DATE: 3/11/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/12/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown with rootlets | SPT | 0-1.5 | 4,7,8 | 1.5 | | Backfilled boring 0 to TD (56 ft bgs) with bentonite plug once stabilized groundwater elevation was obtained | |
| | | SiltyClay; reddish brown to orange | Cont. | 1.5-5 | | 3.5 | | | 1205 |
| 5 | | | Cont. | 5-10. | | 1.5 | | | 1200 |
| 10 | Clayey Sand | Clayey Sand; reddish brown to orange, fine grained | Cont. (Bulk 10-12) | 10-15. | | 1 | | | 1195 |
| | Sandstone | Sandstone; tan to brown, competant | | 10-12. | | | | Very hard drilling @ 13' | |
| 15 | Silty Clay | Silty Clay; reddish brown with orange and gray silty seams | Cont. | 15-20. | | 3 | | Shelby Tube attemped pushed 1" and crushed tube | 1190 |
| 20 | | | Cont. | 20-25. | | 1 | 24.41 | | 1185 |
| 25 | | | Cont. | 25-26. | | 1 | | | |
| | Clayey Sand | | Cont. | 26-30. | | 2" | | Wet @ 28' bgs | 1180 |
| 30 | | | SPT | 30-31.5 | 39,50/2" | 8" | | | |
| | | | Cont. | 31.5-35 | | 3 | | | 1175 |
| 35 | Clayey Sand | Clayey Sand; reddish brown | | | | | | | |

***THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL***

| SCS ENGINEERS | LOG OF BORING NO.: **EB-4** | SHEET NUMBER: 2 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1207.9 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 56 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183261.62 EASTING: 2150212.06 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 24.41 fbgs |
| START DATE: 3/10/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1183.5 ft |
| FINISH DATE: 3/11/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/12/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | | to orange, fine grained | | | | | | Switched to Wash Rotary at 36 ft bgs | 1170 |
| 40 | | | SPT | 41-42.5 | 50/2" | 2" | | Hard drilling at 43' | 1165 |
| 45 | Silty Clay | Silty Clay; reddish brown to brown with thin interbedded sandstone layering | SPT | 46-47.5 | 50/2" | 1" | | | 1160 |
| 50 | Sandstone | Sandstone; reddish brown to tan, hard competant | SPT | 51-52.5 | 50/2" | 0 | | Hard drilling, sandstone pieces in cuttings | 1155 |
| 55 | | | SPT | 56-56.2 | 50/2" | 0 | | TD Drilled 56' bgs | 1150 |
| 60 | | | | | | | | | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

**SCS ENGINEERS**

11219 Richardson Drive
North Little Rock, AR

**LOG OF BORING NO.: EB-5**



| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1162.3 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 31 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183910.96 EASTING: 2148269.44 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 3.02 fbgs |
| START DATE: 3/27/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1159.31 ft |
| FINISH DATE: 3/27/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/31/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown with rootlets | SPT | 0-1.5 | WH,1, 1 | 8" | | | |
| | Sandy Clay | Sandy Clay; dark brown, fine grained sand, gravels <5% | Cont. | 1.5-5 | | 4 | 3.02 | Wet @ 4.5' bgs | 1160 |
| 5 | Clayey Sand | Clayey Sand; dark brown to orange, fine to course grained | Cont. | 5-10. | | 0.5 | | | 1155 |
| 10 | | | SPT | 10-11.5 | 3,3,3 | 1.5 | | Backfilled boring 0 to TD (31 ft bgs) with bentonite plug once stabilized groundwater elevation was obtained | |
| | Sand | Sand; brown to orange, fine to course grained, gravels <5% | Cont. | 11.5-15 | | 4 | | | 1150 |
| 15 | | | Cont. | 15-20. | | 2.5 | | | 1145 |
| 20 | | | SPT | 20-21.5 | 50/5" | 5" | | Switched to Wash Rotary at 20 ft bgs | 1140 |
| 25 | Silty Clay | Silty Clay; reddish brown with light gray clay, some thinly bedded cemented sandstone | SPT | 26-27.5 | 22,50/5" | 10" | | | 1135 |
| 30 | | | SPT | 31-31.5 | 50/4" | 2" | | TD Drilled 31' bgs | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

**SCS ENGINEERS**

11219 Richardson Drive
North Little Rock, AR

**LOG OF BORING NO.: EB-6** — SHEET NUMBER: 1 of 2

| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1190.6 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 46 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183403.46 EASTING: 2149274.23 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 13.39 fbgs |
| START DATE: 3/17/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1177.23 ft |
| FINISH DATE: 3/17/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/25/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown with rootlets | SPT | 0-1.5 | 1,1,1 | 1.5 | | | 1190 |
| | Sandy Clay | Sandy Clay; brown to orange | Cont. (Bulk 0-5) | 1.5-5 | | 3 | | | |
| 5 | | | SPT | 5-6.5 | 6,7,10 | 1.5 | | Backfilled boring 0 to TD (46 ft bgs) with bentonite plug once stabilized groundwater elevation was obtained Attempted Shelby at 5', pushed 1" and crushed tube | 1185 |
| | | | Cont. | 6.5-10 | | 2.5 | | | |
| 10 | Clayey Sand | Clayey Sand; orange to reddish brown, fine to medium grianed | SPT | 10-11.5 | 50/3" | 2" | | | 1180 |
| | | | Cont. | 11.5-15 | | 1 | 13.39 | | |
| 15 | Sand | Sand; orange to reddish brown , fine grained, saturated at 20.5' bgs | SPT | 15-16.5 | 50/4" | 4" | | | 1175 |
| | | | Cont. | 16.5-20 | | 1 | | | |
| 20 | | | SPT | 20-21.5 | 50/6" | 6" | | | 1170 |
| | | | Cont. (Bulk 20-25) | 21.5-25 | | 3.5 | | | |
| 25 | | | | | | | | | 1165 |
| | | | | | | | | Wet @ 28' bgs | |
| 30 | | | | | | | | Switched to Wash Rotary at 30 ft bgs | 1160 |
| | | | SPT | 31-31.5 | 50/6" | 0 | | | |
| 35 | | | | | | | | | 1155 |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **EB-6** | SHEET NUMBER: 2 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1190.6 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 46 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183403.46 EASTING: 2149274.23 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 13.39 fbgs |
| START DATE: 3/17/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1177.23 ft |
| FINISH DATE: 3/17/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/25/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | Silty Clay | Silty Clay; reddish brown with gray mottling, some small sandstone gravels | SPT | 36-37.5 | 50/3" | 3" | | | |
| 40 | | | | | | | | | 1150 |
| | | | SPT | 41-42.5 | 50/4" | 4" | | | |
| 45 | | | | | | | | TD Drilled 46' bgs | 1145 |
| | | | SPT | 46-46.5 | 50/2" | 1" | | | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **EB-7** | SHEET NUMBER: 1 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers<br>DRILLING RIG: CME-55 Rig | SURFACE ELEVATION: 1193.7 ft<br>TOC ELEVATION: NA ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 53.5 fbgs |
| PROJECT NAME: Northeast C&D Landfill<br>PROJECT NUMBER: 16219107.00<br>PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION:<br>NORTHING: 183206.75<br>EASTING: 2148329.74 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 24.92 fbgs |
| START DATE: 3/2/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1168.78 ft |
| FINISH DATE: 3/3/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/5/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; brown with black organics (topsoil) | SPT | 0-1.5 | 4, 6, 8 | 1.5 | | | |
| | Clay | | Cont. | 1.5-5 | | 3 | | | 1190 |
| 5 | | | Bulk | 5-10. | | 2.5 | | | 1185 |
| 10 | | Clay; reddish brown | SPT | 10-11.5 | 4, 5, 5 | 1.5 | | Backfilled boring 0 to TD (53.5 ft bgs) with bentonite plug once stabilized groundwater elevation was obtained | |
| | | | Cont. | 11.5-15 | | 2 | | | 1180 |
| 15 | Sandy Clay | Sandy Clay; reddish brown | Cont. | 15-20 | | 1.25 | | | 1175 |
| 20 | Sand | Sand; orange to tan, unconsolidated | Shelby | 20-21 | | | | | |
| | | | SPT | 21-22.5 | 12, 18, 17 | 1 | | | |
| | | | Cont. | 22.5-25 | | 1 | 24.92 | | 1170 |
| 25 | Weathered Sandstone | Weathered Sandstone; tan to brown, friable, slight mosture not saturated | Cont. | 25-30 | | 5 | | Very hard drilling @ 25'<br><br>Wet @ 28' bgs | 1165 |
| 30 | | | Cont. | 30-35 | | 3.5 | | | 1160 |
| 35 | | | | | | | | | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **EB-7** | SHEET NUMBER: 2 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1193.7 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 53.5 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183206.75 EASTING: 2148329.74 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 24.92 fbgs |
| START DATE: 3/2/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1168.78 ft |
| FINISH DATE: 3/3/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/5/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | Sand | Sand; reddish brown to orange, unconsolidated | Cont. | 35-40 | | 4 | | | 1155 |
| 40 | | | Cont. | 40-45 | | 0 | | Sampler stuck within augers, could not open sampler | 1150 |
| 45 | | | SPT | 45-46.5 | | 2" | | Switched to Wash Rotary | |
| | Clay | Clay; reddish brown, hard dry | | | | | | | 1145 |
| 50 | Silty Clay | Silty Clay; reddish brown with thin light gray to tan seams | SPT | 50-51.5 | | 3" | | | |
| | | | SPT | 52-53.5 | | | | | |
| | | Silty Clay; light gray | | | | | | TD Drilled 53.5' bgs | 1140 |
| 55 | | | | | | | | | |

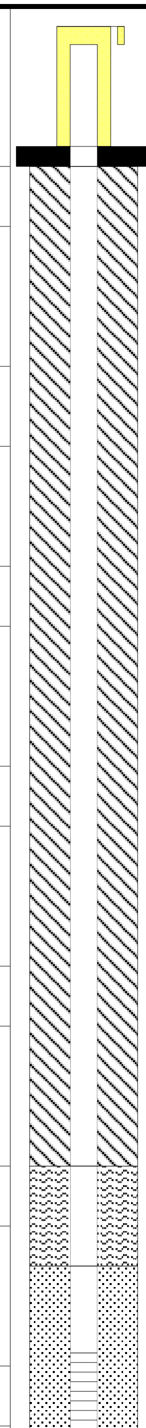
*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

# SCS ENGINEERS

| | | |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | LOG OF BORING NO.: **EB-8/PZ-9** | SHEET NUMBER: 1 of 3 |
| | DRILLER: Garry Moyers | SURFACE ELEVATION: 1203.3 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1206.1 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 71 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183332.65 EASTING: 2147872.18 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 40.61 fbgs |
| START DATE: 3/25/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1162.67 ft |
| FINISH DATE: 3/25/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/26/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) |
|---|---|---|---|---|---|---|
| 0 | Clayey Silt | Clayey silt; brown, with some rootlets | SPT | 0-1.5 | 2,2,2 | 1 |
| | Silty Clay | Silty Clay; reddish brown, with some fine sand (<10%) | Cont. | 1.5-5 | 2,2,2 | 3 |
| 5 | | | Shelby | 5-7. | | |
| | | | Cont. | 7-10. | | 1 |
| 10 | | | SPT | 10-11.5 | 2,3,5 | 1.5 |
| | | | Cont. | 11.5-15 | 2,3,5 | 2 |
| 15 | Clayey Sand | Clayey sand; reddish brown, fine grained sands | SPT | 15-16.5 | 4,10,12 | 1.5 |
| | | | Cont. (Bulk 15-20) | 16.5-20 | 4,10,12 | 2 |
| 20 | Sand | Sand; tan to reddish brown, coarse to fine grained, trace amounts of clay | SPT | 20-21.5 | 5,12,18 | 1 |
| | | | Cont. | 21.5-25 | 5,12,18 | 1.5 |
| 25 | | | SPT | 25-26.5 | 11,23,29 | 1.5 |
| | | | Cont. | 26.5-30 | 11,23,29 | 1 |
| 30 | | | SPT | 30-31.5 | 50/5" | 2" |

MONITORING WELL CONSTRUCTION



MONITORING WELL DESCRIPTION/ DRILLING NOTES

Stick Up (2.78 ft) Protective Cover

Concrete Pad (Approximately 6")

2 in dia. Sch. 40 PVC soild riser from 0 - 30 ft bgs

Portland/Bentonite grout from ground surface to 25 ft bgs

Bentonite pellet seal from 25 ft bgs to 27.5 ft bgs

Sand filter pack from 27.5 ft to 40 ft

ELEVATION (FT): 1205, 1200, 1195, 1190, 1185, 1180, 1175

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| | | |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1203.3 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1206.1 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 71 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183332.65 EASTING: 2147872.18 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 40.61 fbgs |
| START DATE: 3/25/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1162.67 ft |
| FINISH DATE: 3/25/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/26/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cont. | 31.5-35 | 50/5" | 2 | | bgs | 1170 |
| 35 | Silty Clay | Silty Clay; reddish brown to brown | SPT | 35-36.5 | 18,17, 50/2" | 1 | | | |
| | | | Cont. | 36.5-40 | 18,17, 50/2" | 2 | | 10 ft of 2 in dia, 0.010 slot, Sch. 40 PVC sreen End Cap Installed depth = 40' bgs Wet at 42' bgs | 1165 |
| | Sandstone | Sandstone; tan to brown, competant | | | | | 40.61 | | |
| 40 | Sand | Sand; reddish brown to tan; fine grained with some sandstone gravels | SPT | 40-41.5 | 50/1" | 1" | | | |
| | | | Cont. | 41.5-50 | 50/1" | 4 | | | 1160 |
| 45 | | | SPT | 45-46.5 | 50/5" | 4" | | | 1155 |
| 50 | | | SPT | 51-52.5 | 50/2" | 0 | | | |
| | | | | | 50/2" | | | | 1150 |
| 55 | Silty Clay | Silty Clay; reddish brown with light gray silt seams, some thin interbedded sandstones | SPT | 56-57.5 | 50/3" | 1" | | Backfilled boring 40 ft to total depth (71 ft bgs) | |
| | | | | | 50/3" | | | | 1145 |
| 60 | | | SPT | 61-62.5 | 50/2" | 1" | | | |
| | | | | | 50/2" | | | | 1140 |
| 65 | | | SPT | 66-67.5 | 50/3" | 3" | | | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **EB-8/PZ-9** | SHEET NUMBER: 3 of 3 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1203.3 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1206.1 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 71 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION:<br>NORTHING: 183332.65<br>EASTING: 2147872.18 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 40.61 fbgs |
| START DATE: 3/25/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1162.67 ft |
| FINISH DATE: 3/25/2020 | WELL DIAMETER: NA | WATER LEVEL DATE: 3/26/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 50/3" | | | | 1135 |
| 70 | | | | | | | | TD Drilled 71' bgs | |
| | | | SPT | 71-71.5 | 50/2"<br>50/2" | 0 | | | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

SCS ENGINEERS

LOG OF BORING NO.: **EB-9**



11219 Richardson Drive
North Little Rock, AR

| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1202 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 51 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183764.22 EASTING: 2149774.77 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 22.69 fbgs |
| START DATE: 3/30/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1179.31 ft |
| FINISH DATE: 3/31/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 4/1/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown with rootlets | SPT | 0-1.5 | 5,5,5 | 1.5 | | | |
| | | | Cont. | 1.5-5 | | 3.5 | | | 1200 |
| 5 | Clay | Clay; reddish brown to orange | Cont. (Bulk 5-8) | 5-10. | | 2.5 | | | 1195 |
| | Clayey Sand | Clayey Sand; reddish brown to orange, fine grained | | | | | | | |
| 10 | | | SPT | 10-11.5 | 7,22,45 | 1.5 | | Backfilled boring 0 to TD (51 ft bgs) with bentonite plug once stabilized groundwater elevation was obtained | |
| | Silty Clay | Silty Clay; reddish brown with orange and gray mottling, some rootlets | Cont. | 11.5-15 | | 2.5 | | | 1190 |
| 15 | | | Cont. | 15-20. | | 4 | | | 1185 |
| 20 | Clayey Sand | Clayey Sand; dark brown with thin cemented layers | SPT | 20-21.5 | 30,50/2" | 8" | | | |
| | | | Cont. | 21.5-25 | | 3 | 22.69 | | 1180 |
| 25 | Sand | Sand; reddish brown to orange with cemented layers | Cont. | 25-30. | | 1 | | Wet @ 26' bgs | 1175 |
| 30 | | | SPT | 30-31.5 | 50/3" | 3" | | Switched to Wash Rotary at 30 ft bgs | 1170 |
| 35 | | | | | | | | | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **EB-9** | SHEET NUMBER: 2 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1202 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: NA ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 51 fbgs |
| PROJECT NAME: Northeast C&D Landfill<br>PROJECT NUMBER: 16219107.00<br>PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION:<br>NORTHING: 183764.22<br>EASTING: 2149774.77 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 22.69 fbgs |
| START DATE: 3/30/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1179.31 ft |
| FINISH DATE: 3/31/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 4/1/2020 |

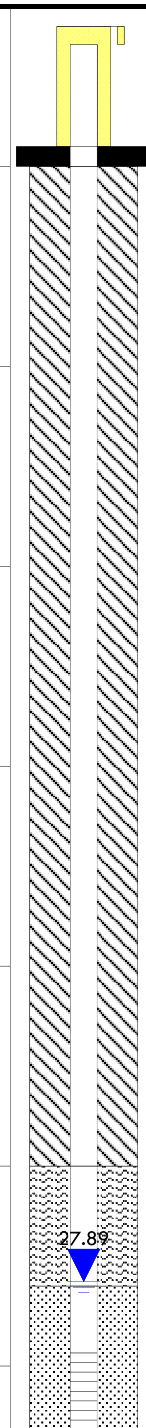
| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | Clayey Sand | Clayey Sand; reddish brown to orange | SPT | 36-37.5 | 50/5" | 5" | | | 1165 |
| 40 | | | SPT | 41-42.5 | 50/2" | 2" | | | 1160 |
| 45 | | | SPT | 46-46.5 | 50/2" | 0 | | | 1155 |
| 50 | Silty Clay | Silty Clay; reddish brown with interbedded sandstone layers | | | | | | | |
| | | | SPT | 51-51.5 | 50/3" | 1" | | TD Drilled 51' bgs | 1150 |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **PZ-1** | SHEET NUMBER: 1 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1216.9 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1216.9 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 61.5 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 182844.43 EASTING: 2150429.36 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 27.89 fbgs |
| START DATE: 3/11/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1185.95 ft |
| FINISH DATE: 3/12/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/13/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) |
|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown with rootlets | Cont. | 0-5 | | 5 |
| 5 | Clay | Clay; dark brown, fat | | | | |
| | | | Cont. | 5-10. | | 3 |
| 10 | Silty Clay | Silty Clay; brown with orange and gray mottling | Cont. (Bulk 10-13) | 10-15. | | 3 |
| 15 | Sand | Sand; orange to tan with some thin cemented layers | | | | |
| | | | Cont. | 15-20 | | 2 |
| 20 | Clayey Sand | Clayey Sand; reddish brown, fine grained with some cemented layering | Cont. | 20-25 | | 1 |
| 25 | Silty Clay | Silty Clay, reddish brown to gray, thinly bedded and competent. | Cont. | 25-30 | | 2 |
| 30 | Clayey Sand | Clayey Sand; | | | | |

MONITORING WELL CONSTRUCTION




MONITORING WELL DESCRIPTION/ DRILLING NOTES

Stick Up (3.10 ft) Protective Cover

Concrete Pad (Approximately 6") Portland/Bentonite grout from ground surface to 25 ft bgs Bentonite pellet seal from 25 ft bgs to 28 ft bgs Sand filter pack from 28 ft to 40 ft bgs

2 in dia. Sch. 40 PVC soild riser from 0 - 30 ft bgs

Backfilled boring 40 ft to total depth (61.5 ft bgs)

ELEVATION (FT): 1215, 1210, 1205, 1200, 1195, 1190, 1185

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **PZ-1** | SHEET NUMBER: 2 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1216.9 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1216.9 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 61.5 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 182844.43 EASTING: 2150429.36 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 27.89 fbgs |
| START DATE: 3/11/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1185.95 ft |
| FINISH DATE: 3/12/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/13/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION |
|---|---|---|
| to ~36 | | reddish brown to orange, fine grained. Wet at 34 ft bgs |
| ~36–38 | Sandstone | Sandstone; red with thin silty layers, competant |
| ~38–44 | Sand | Sand; orange to reddish brown with some thin consolidated layers |
| ~44–48 | Clay | Clay; reddish brown with thin interbedded sandstone |
| ~48–50 | Sandstone | Sandstone; red, competant |
| 50–60 | Silty Clay | Silty Clay; reddish brown with gray silty seams, hard, dry |
| 60–61.5 | Clay | Clay; reddish brown with dark gray mottling |

| Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) |
|---|---|---|---|
| Cont. | 30-35 | | 3 |
| Cont. | 35-40 | | 4 |
| SPT | 41-42.5 | 50/6" | 6" |
| SPT | 46-47.5 | 50/2" | 0 |
| SPT | 51-52.5 | 50/5" | 5" |
| SPT | 56-57.5 | 50/2" | 0 |
| SPT | 60-61.5 | 44,50/2" | 8" |

**MONITORING WELL DESCRIPTION/ DRILLING NOTES**

Wet at 34' bgs
10 ft of 2 in dia, 0.010 slot, Sch. 40 PVC sreen

End Cap Installed depth = 40' bgs
Switched to Wash Rotary at 40 ft bgs

TD Drilled 61.5' bgs

DEPTH (FT): 35, 40, 45, 50, 55, 60

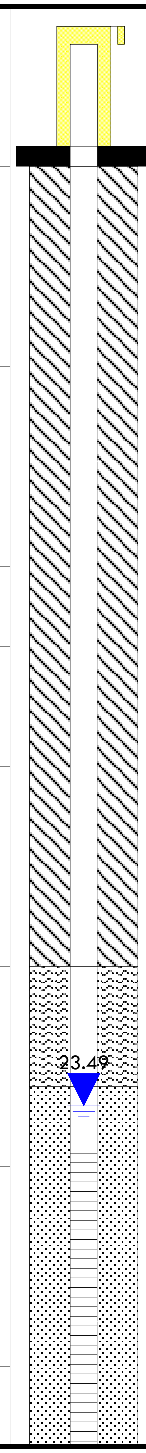
ELEVATION (FT): 1180, 1175, 1170, 1165, 1160, 1155, 1150

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **PZ-2** | SHEET NUMBER: 1 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1210 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1210 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 56.5 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION:<br>NORTHING: 183891.08<br>EASTING: 2150425.85 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 23.49 fbgs |
| START DATE: 3/12/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1183.7 ft |
| FINISH DATE: 3/13/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/16/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Stick Up (2.78 ft) Protective Cover | 1210 |
| 0 | Silty Clay | Silty Clay; dark brown with rootlets | Cont. (Bulk 2-5) | 0-5 | | 3 | Concrete Pad (Approximately 6") Portland/Bentonite grout from ground surface to 20 ft bgs Bentonite pellet seal from 20 ft bgs to 23 ft bgs Sand filter pack from 23 ft to 35 ft bgs | 1205 |
| 5 | | Silty Clay; orange with gray mottling | Cont. | 5-10. | | 0.5 | | 1200 |
| 10 | | | Shelby | 10-12. | | 2 | | |
| | | Silty Clay; reddish brown with gray mottling | Cont. | 12-15. | | 1 | | 1195 |
| 15 | Sandy Clay | Sandy Clay; reddish brown, fine grained | Cont (Bulk (15-17) | 15-20 | | 1 | 2 in dia. Sch. 40 PVC soild riser from 0 - 25 ft bgs | 1190 |
| | Clayey Sand | Clayey Sand; reddish brown, fine grained | | | | | | |
| 20 | Silty Clay | Silty Clay; reddish brown with orange and gray mottling | Cont. | 20-25 | | 4 | | 1185 |
| 25 | | | Cont. | 25-30 | | 2 | Wet at 24' bgs | 1180 |
| 30 | Clayey Sand | Clayey Sand; orange to | | | | | Backfilled boring 35 ft to total depth (56.5 ft bgs) | |

MONITORING WELL CONSTRUCTION




*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **PZ-2** | SHEET NUMBER: 2 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1210 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1210 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 56.5 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183891.08 EASTING: 2150425.85 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 23.49 fbgs |
| START DATE: 3/12/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1183.7 ft |
| FINISH DATE: 3/13/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/16/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | Clayey Sand | brown, wet at 24' | Cont. | 30-35 | | 5 | | 10 ft of 2 in dia, 0.010 slot, Sch. 40 PVC sreen<br>Installed depth = 35' bgs<br>End Cap<br>Switched to Wash Rotary at 35 ft bgs | 1175 |
| 35 | | | | | | | | | |
| | | | | | | | | | 1170 |
| 40 | | | | | | | | | |
| | Silty Clay | Silty Clay; reddish brown with thin gray silt seams and interbedded sandstones | SPT | 41-42.5 | 35,50/6" | 1 | | | 1165 |
| 45 | | | | | | | | | |
| | | | SPT | 46-47.5 | 50/2" | 1" | | | 1160 |
| 50 | | | | | | | | | |
| | Sandstone | Sandstone; red to tan, competent, dry | SPT | 51-52.5 | 50/2" | 0 | | | 1155 |
| 55 | Silty Clay | Silty Clay, reddish brown with thinly bedded light gray silt seams | | | | | | | |
| | | | SPT | 56-56.5 | 50/5" | 5" | | TD Drilled 56.5' bgs | 1150 |
| 60 | | | | | | | | | |

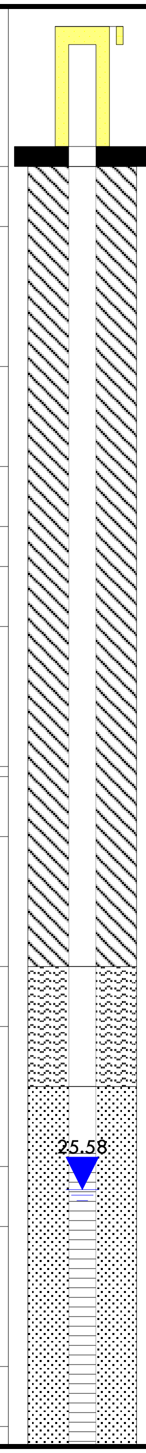
*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

**SCS ENGINEERS** — LOG OF BORING NO.: **PZ-3** — SHEET NUMBER: 1 of 2

11219 Richardson Drive
North Little Rock, AR

| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1198.9 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1202.5 ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 56 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183913.5 EASTING: 2149229.41 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 25.58 fbgs |
| START DATE: 3/17/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1173.33 ft |
| FINISH DATE: 3/18/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/25/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) |
|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown with rootlets | SPT | 0-1.5 | 1,2,5 | 1.5 |
| | | Silty Clay; brown | Cont. | 1.5-5 | | 3 |
| 5 | Clay | Clay; Reddish brown, stiff | Shelby | 5-7. | | |
| | Sandy Clay | Sandy Clay; reddish brown to orange, with rootlets, high clay content | SPT | 7.5-9 | 7,7,13 | 1.5 |
| | | | Cont. | 9-10. | | 1 |
| 10 | Sand | Sand; reddish brown to orange, fine to medium grained, some gravels | SPT | 10-11.5 | 6,7,7 | 1.5 |
| | | | Cont. | 11.5-15 | | 3.5 |
| 15 | | | SPT | 15.25-16.75 | 50/2" | 2" |
| | | | Cont. | 16.75-20 | | 3 |
| 20 | | | SPT | 20-21.5 | 32,50/2" | 1 |
| | | | Cont. | 21.5-25 | | 3 |
| 25 | | | SPT | 25-26.5 | 50/6" | 4" |
| | | | Cont. | 26.5-30 | | 3 |
| 30 | | | SPT | 30-31.5 | 50/3" | 3" |




MONITORING WELL DESCRIPTION/ DRILLING NOTES:

Stick Up (3.62 ft) Protective Cover

Concrete Pad (Approximately 6") Portland/Bentonite grout from ground surface to 20 ft bgs

Bentonite pellet seal from 20 ft bgs to 23 ft bgs

Sand filter pack from 23 ft to 35 ft bgs

2 in dia. Sch. 40 PVC soild riser from 0 - 25 ft bgs

Backfilled boring 35 ft to total depth (56.5 ft bgs)

ELEVATION (FT): 1200, 1195, 1190, 1185, 1180, 1175, 1170

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **PZ-3** | SHEET NUMBER: 2 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1198.9 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1202.5 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 56 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183913.5 EASTING: 2149229.41 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 25.58 fbgs |
| START DATE: 3/17/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1173.33 ft |
| FINISH DATE: 3/18/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/25/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|
| | | | Cont. | 32-35. | | 2 | 10 ft of 2 in dia, 0.010 slot, Sch. 40 PVC sreen<br>Wet at 30.5' bgs<br>Installed depth = 35' bgs<br>End Cap | 1165 |
| 35 | | | SPT | 35-36.5 | 50/3" | 3" | | |
| 40 | Silty Clay | Silty Clay; reddish brown to brown with thin interbedded sandstone layering | | | | | Switched to Wash Rotary at 35 ft bgs | 1160 |
| | | | SPT | 41-42.5 | 50/2" | 2" | | |
| 45 | | | | | | | | 1155 |
| | | | SPT | 46-47.5 | 50/2" | 2" | | |
| 50 | | | | | | | | 1150 |
| | | | SPT | 51-52.5 | 50/3" | 3" | | |
| 55 | | | | | | | TD Drilled 56' bgs | 1145 |
| | | | SPT | 56-57.5 | 50/2" | 2" | | |
| 60 | | | | | | | | 1140 |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

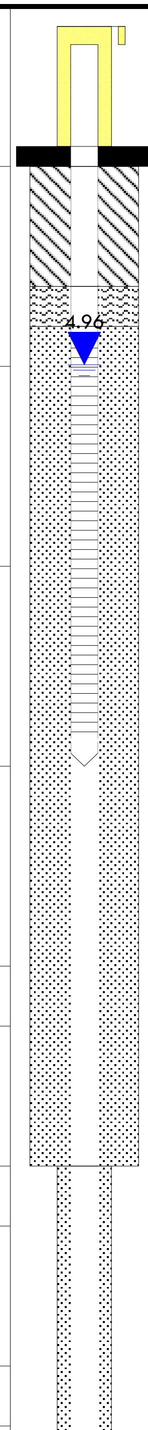
SCS ENGINEERS

| | | |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | LOG OF BORING NO.: **PZ-4** | SHEET NUMBER: 1 of 2 |
| | DRILLER: Garry Moyers | SURFACE ELEVATION: 1175.3 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1178.3 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 35 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183891.08 EASTING: 2148594.06 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 4.96 fbgs |
| START DATE: 3/4/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1170.36 ft |
| FINISH DATE: 3/4/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/9/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION |
|---|---|---|
| 0–5 | Sandy Clay | Sandy Clay; reddish brown to orange |
| 5–19 | Sand | Sand; reddish brown to orange, Saturated at 5' bgs, Coarse grained transitioning to fine grained at 12' |
| 19– | Silty Clay | Silty Clay; reddish brown with thin light gray seams, hard |

| Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) |
|---|---|---|---|
| Cont. | 0-5 | | 20 |
| Cont. (Bulk 5-10) | 5-10. | | 20 |
| Cont. | 10-15. | | 13 |
| Cont. | 15-20 | | 40 |
| | 20-21.5 | 42, 50/4" | 33 |
| Cont. | 21.5-25 | | 57 |
| SPT | 25-26.5 | 50/2" | 11 |
| SPT | 30-31.5 | 50/2" | 11 |

MONITORING WELL CONSTRUCTION




MONITORING WELL DESCRIPTION/ DRILLING NOTES

Stick Up (3.01 ft) Protective Cover

Concrete Pad (Approximately 6")
Portland/Bentonite grout from ground surface to 2 ft bgs
Bentonite pellet seal from 2 ft bgs to 4 ft bgs
2 in dia. Sch. 40 PVC soild riser from 0 - 5 ft bgs
Sand filter pack from 4 ft to 15 ft bgs
Wet at 6' bgs
10 ft of 2 in dia, 0.010 slot, Sch. 40 PVC sreen
End Cap
Installed depth = 15' bgs

Backfilled boring 15 ft to total depth (35.5 ft bgs)

ELEVATION (FT): 1210, 1205, 1200, 1195, 1190, 1185, 1180

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **PZ-4** | SHEET NUMBER: 2 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1175.3 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1178.3 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 35 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183891.08 EASTING: 2148594.06 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 4.96 fbgs |
| START DATE: 3/4/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1170.36 ft |
| FINISH DATE: 3/4/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/9/2020 |

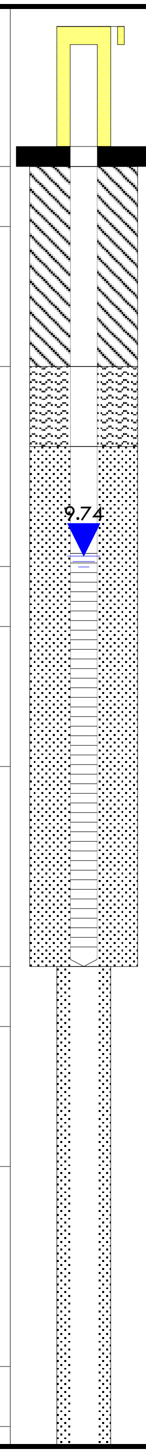
| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | Sandstone | Sandstone; reddish brown to tan | | | | | | TD Drilled 35.5' bgs | 1175 |
| 35 | Clayey Sand | Clayey Sand; reddish brown with course grained sand | SPT | 35-36.5 | 50/3" | 11 | | | |
| | | | | | | | | | 1170 |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

| SCS ENGINEERS | LOG OF BORING NO.: **PZ-5** | SHEET NUMBER: 1 of 2 |
|---|---|---|
| 11219 Richardson Drive<br>North Little Rock, AR | DRILLER: Garry Moyers | SURFACE ELEVATION: 1176.3 ft |
| | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1179.5 ft |
| CLIENT: WCA of Oklahoma, LLC | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 35 fbgs |
| PROJECT NAME: Northeast C&D Landfill | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183888.17 EASTING: 2148688.62 |
| PROJECT NUMBER: 16219107.00 | | |
| PROJECT LOCATION: Spencer, Oklahoma | | |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 9.74 fbgs |
| START DATE: 3/18/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1166.54 ft |
| FINISH DATE: 3/19/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/25/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) |
|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown , rootlets | SPT | 0-1.5 | 1,2,2 | 1 |
| | Silty Clay | Silty Clay; brown, trace medium to fine gravels | Cont. | 1.5-5 | | 3 |
| 5 | | | Cont. | 5-10. | | 2 |
| | Clayey Silt | Clayey Silt; brown, some rootlets, wet at 7' bgs | | | | |
| 10 | Sand | Sand; reddish brown to brown, fine grained, trace silts | SPT | 10-11.5 | 50/4" | 3" |
| | | | Cont. | 11.5-15 | | 2 |
| 15 | | | Cont. | 15-20. | | 4 |
| 20 | Silty Clay | Reddish brown with gray silt layers, trace amounts of sand | SPT | 20-21.5 | 16,50/2" | 4" |
| | | | Cont. | 21.5-25 | | 2 |
| 25 | | | Cont. | 25-30. | | 2 |
| 30 | | | SPT | 30-31.5 | 50/3" | 3" |

**MONITORING WELL CONSTRUCTION**




**MONITORING WELL DESCRIPTION/ DRILLING NOTES**

Stick Up (3.18 ft) Protective Cover

Concrete Pad (Approximately 6")

Portland/Bentonite grout from ground surface to 5 ft bgs

2 in dia. Sch. 40 PVC soild riser from 0 - 10 ft bgs

Bentonite pellet seal from 5 ft bgs to 7 ft bgs

Wet at 7' bgs

Attempted Shelby at 10', no recovery

Sand filter pack from 7 ft to 20 ft bgs

10 ft of 2 in dia, 0.010 slot, Sch. 40 PVC sreen

End Cap Installed depth = 20' bgs

Backfilled boring 20 ft to total depth (35 ft bgs)

**ELEVATION (FT)**: 1180, 1175, 1170, 1165, 1160, 1155, 1150, 1145

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

**SCS ENGINEERS**

11219 Richardson Drive
North Little Rock, AR

LOG OF BORING NO.: **PZ-5**



| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1176.3 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1179.5 ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 35 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183888.17 EASTING: 2148688.62 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 9.74 fbgs |
| START DATE: 3/18/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1166.54 ft |
| FINISH DATE: 3/19/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/25/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cont. | 31.5-35 | | 3.5 | | | |
| 35 | | | | | | | | TD Drilled 35' bgs | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

**SCS ENGINEERS**

11219 Richardson Drive
North Little Rock, AR

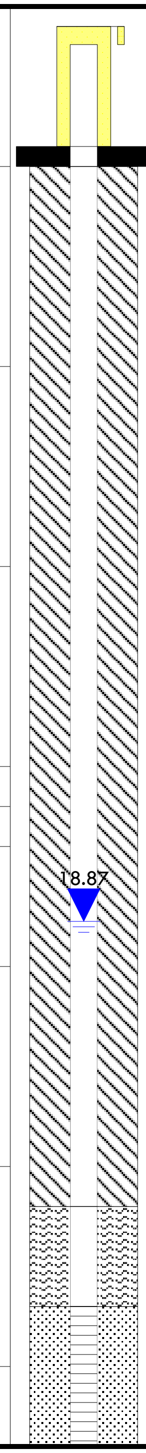
LOG OF BORING NO.: **PZ-6**



| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1196.3 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1199.5 ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 56 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183260.11 EASTING: 2149653.36 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 18.87 fbgs |
| START DATE: 3/10/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1177.45 ft |
| FINISH DATE: 3/10/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/12/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) |
|---|---|---|---|---|---|---|
| 0 | Silty Clay | Silty Clay; dark brown with rootlets | Cont. (Bulk 2-5) | 0-5 | | 5 |
| 5 | Clay | Clay; reddish brown | Cont. | 5-10. | | 3 |
| 10 | | | Cont. | 10-15. | | 3 |
| 15 | Clayey Sand | Clayey Sand; reddish brown to orange, fine grained | Cont. | 15-16 | | 1 |
| | | | Cont. | 17-20 | | 1.5 |
| 20 | | | Cont. | 20-25 | | 0.5 |
| 25 | | | Cont. | 25-30 | | 3 |
| 30 | | | | | | |

**MONITORING WELL CONSTRUCTION**




**MONITORING WELL DESCRIPTION/ DRILLING NOTES**

Stick Up (3.17 ft) Protective Cover

Concrete Pad (Approximately 6")

Portland/Bentonite grout from ground surface to 26 ft bgs

2 in dia. Sch. 40 PVC soild riser from 0 - 28.87 ft bgs

Bentonite pellet seal from 26 ft bgs to 28.87 ft bgs

10 ft of 2 in dia, 0.010 slot, Sch. 40 PVC sreen

**ELEVATION (FT)**: 1200, 1195, 1190, 1185, 1180, 1175, 1170, 1165

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

**SCS ENGINEERS**

11219 Richardson Drive
North Little Rock, AR

LOG OF BORING NO.: **PZ-6**



| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1196.3 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1199.5 ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 56 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183260.11 EASTING: 2149653.36 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 18.87 fbgs |
| START DATE: 3/10/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1177.45 ft |
| FINISH DATE: 3/10/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/12/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL CONSTRUCTION | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cont. | 30-35 | | 3 | | Sand filter pack from 28.5 ft to 38.87 ft bgs<br>Saturated at 30' bgs | |
| 35 | | | | | | | | | 1160 |
| 40 | Silty Clay | Silty Clay; reddish brown with orange and light gray mottling, hard, dry | | | | | | End Cap Installed depth = 38.87' bgs<br>Switched to Wash Rotary at 40 ft bgs | 1155 |
| | | | SPT | 41-42.5 | 50/3" | 3" | | | |
| 45 | | | | | | | | Backfilled boring 38.87 ft to total depth (56 ft bgs) | 1150 |
| | | | SPT | 46-47.5 | 50/2" | 2" | | | |
| 50 | Sandstone | Sandstone; reddish brown to tan | | | | | | | 1145 |
| | | | SPT | 51-52.5 | 50/2" | 2" | | | |
| 55 | Silty Clay | Silty Clay, reddish brown to brown with some gray silt seams | | | | | | TD Drilled 56' bgs | 1140 |
| | | | SPT | 56-56.5 | 50/2" | 1" | | | |
| 60 | | | | | | | | | |

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

# SCS ENGINEERS

**LOG OF BORING NO.: PZ-7**

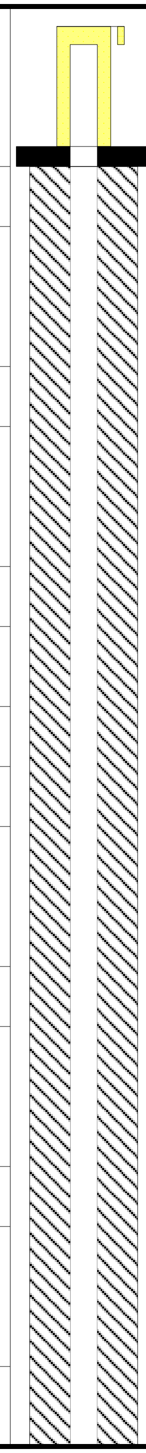


11219 Richardson Drive
North Little Rock, AR

| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1198.9 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1201.6 ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 66 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183731.02 EASTING: 2147860.91 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 39.41 fbgs |
| START DATE: 3/26/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1159.5 ft |
| FINISH DATE: 3/26/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/30/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Stick Up (2.73 ft) Protective Cover | 1200 |
| 0 | Silty Clay | Silty Clay; dark brown with rootlets | SPT | 0-1.5 | 1,1,2 | 1.5 | Concrete Pad (Approximately 6") | |
| | | Silty Clay; reddish brown to brown | Cont. | 1.5-5 | | 3 | | 1195 |
| 5 | | | SPT | 5-6.5 | 4,4,8 | 1.5 | | |
| | Sandy Clay | Sandy Clay; orange to reddish brown | Bulk | 6-8. | | | | |
| | | | Cont. | 6.5-10 | | 3 | 2 in dia. Sch. 40 PVC soild riser from 0 - 39 ft bgs | 1190 |
| 10 | | | SPT | 10-11.5 | 2,2,3 | 1.5 | Portland/Bentonite grout from ground surface to 34.5 ft bgs | |
| | | | Shelby | 11.5-13.5 | | | | |
| | | | Cont. | 13.5-15 | | 1.5 | | 1185 |
| 15 | Clayey Sand | Clayey Sand; reddish brown to tan, fine grained | SPT | 15-16.5 | 5,4,12 | 1.5 | | |
| | | | Cont. | 16.5-20 | | 2 | | 1180 |
| 20 | | | SPT | 20-21.5 | 8,14,15 | 1 | | |
| | | | Cont. | 21.5-25 | | 1 | | 1175 |
| 25 | Silty Clay | Silty Clay; reddish brown to brown, hard | SPT | 25-26.5 | 22,50/4" | 1 | | |
| | | | Cont. | 26.5-30 | | 3 | | 1170 |
| 30 | | | | | | | | |

MONITORING WELL CONSTRUCTION



*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

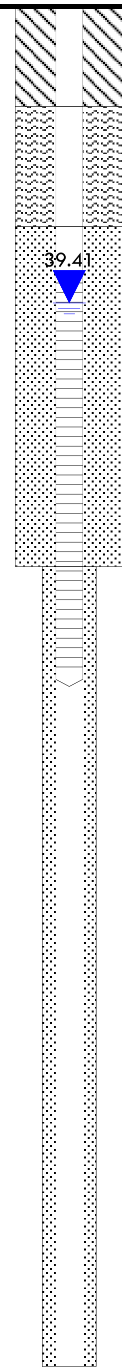
**SCS ENGINEERS** | LOG OF BORING NO.: **PZ-7** | SHEET NUMBER: 2 of 2

11219 Richardson Drive
North Little Rock, AR

| | | |
|---|---|---|
| CLIENT: WCA of Oklahoma, LLC | DRILLER: Garry Moyers | SURFACE ELEVATION: 1198.9 ft |
| PROJECT NAME: Northeast C&D Landfill | DRILLING RIG: CME-55 Rig | TOC ELEVATION: 1201.6 ft |
| PROJECT NUMBER: 16219107.00 | DRILLING METHOD: Auger/Wash Rotary | WELL DEPTH COMPLETION: 66 fbgs |
| PROJECT LOCATION: Spencer, Oklahoma | DRILLING CONTRACTOR: Anderson Engineering Consultants, Inc. | LOCATION: NORTHING: 183731.02 EASTING: 2147860.91 |
| GEOLOGIST: Robert Fowler | SAMPLING METHOD: 5' Sampler/Split Spoon | WATER LEVEL: 39.41 fbgs |
| START DATE: 3/26/2020 | BORING DIAMETER: 8.25"/4.25" | WATER ELEVATION: 1159.5 ft |
| FINISH DATE: 3/26/2020 | WELL DIAMETER: 2" | WATER LEVEL DATE: 3/30/2020 |

| DEPTH (FT) | LITHOLOGY | LITHOLOGY DESCRIPTION | Sample Type | Sample Depth | Blow Counts | RECOVERY (ft) | MONITORING WELL DESCRIPTION/ DRILLING NOTES | ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|
| | Sandy Clay | Sandy Clay; reddish brown to orange, fine grained, slight moisture, not saturated | Cont. | 30-35. | | 2 | | 1165 |
| 35 | | | SPT | 35-36.5 | 20,50/3" | 8" | Bentonite pellet seal from 34.5 ft bgs to 37.5 ft bgs | |
| | | | Cont. | 36.5-40 | | 3 | 10 ft of 2 in dia, 0.010 slot, Sch. 40 PVC sreen | 1160 |
| | Sandstone | Sandstone; reddish brown to dark brown, hard competant | | | | | | |
| 40 | Clayey Sand | | SPT | 40-41.5 | 50/6" | 6" | Sand filter pack from 37.5 ft to 49 ft bgs | |
| | | Clayey Sand; reddish brown, fine grained, Wet at 40 ft bgs | Cont. | 41.5-45 | | 6" | Wet at 40' bgs | 1155 |
| 45 | | | SPT | 45-46.5 | 32,50/2" | 8" | | |
| | | | Cont. | 46.5-51 | | | Installed depth = 49' bgs End Cap | 1150 |
| 50 | | | | | | | | |
| | Silty Clay | Silty Clay; reddish brown with light gray silty seams and thin interbedded sandstones | SPT | 51-52.5 | 50/2" | 2" | | 1145 |
| 55 | | | SPT | 56-57.5 | 50/2" | 2" | Backfilled boring 49 ft to total depth (50 ft bgs) | |
| 60 | | | | | | | | 1140 |
| | | | SPT | 61-62.5 | 50/3" | 3" | | 1135 |
| 65 | | | SPT | 66-66.5 | 50/3" | 2" | TD Drilled 66' bgs | |

MONITORING WELL CONSTRUCTION



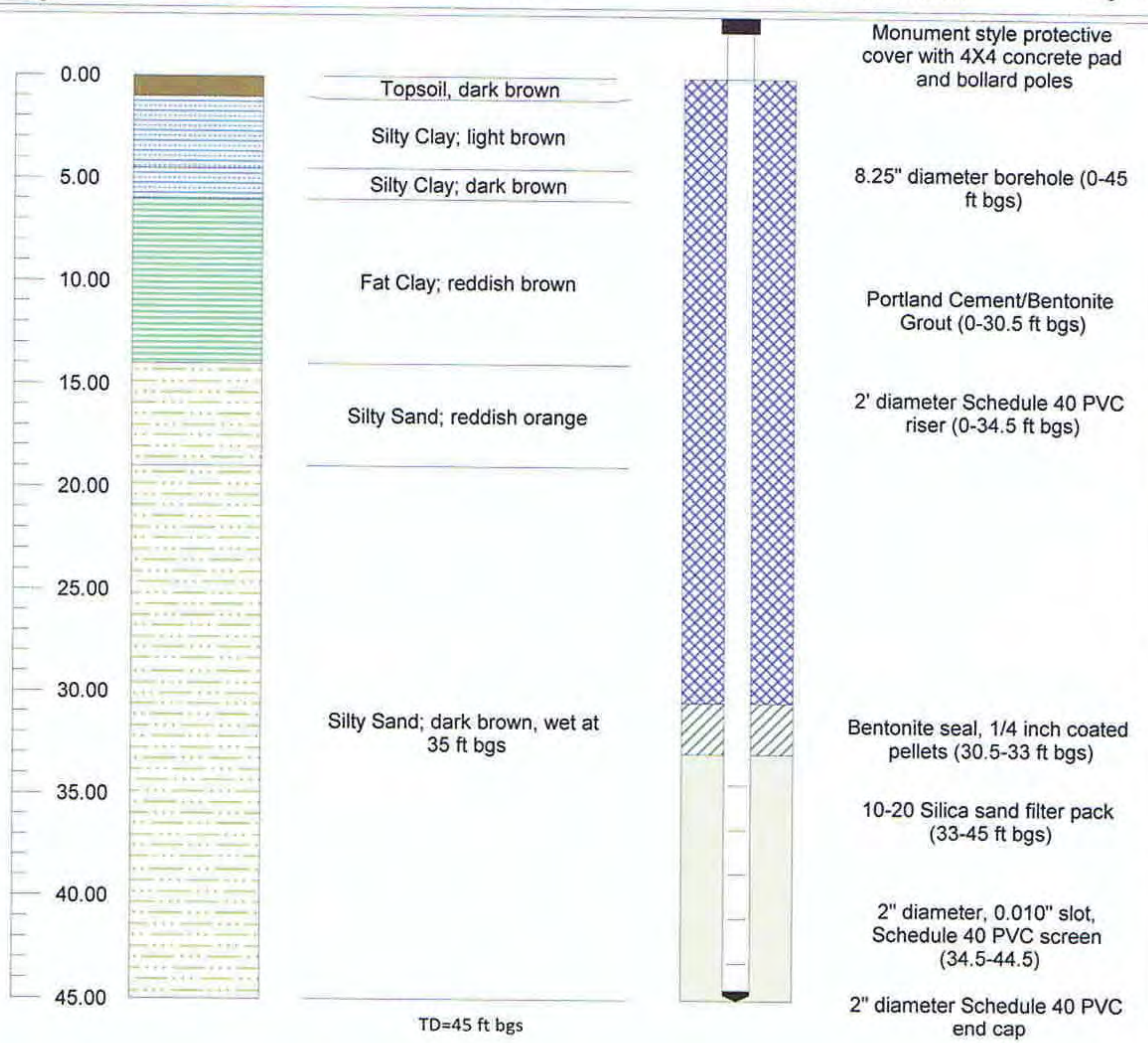

*THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL*

# Field Boring Log

| | | | |
|---|---|---|---|
| Field Boring Log | Boring No.: **MW-3R** | | |
| Client: Northwest C & D Landfill | Project No.: 10-011 | | |
| Logged By: Robert Fowler | Date Drilled: 9/9/10 | | |
| Total Depth: 45 Ft Below Ground Surface (bgs) | | | |
| Drilling Contractor: Anderson Engineering | | Driller: Gary Moyers | Rig Type: Truck Mounted CME-55 |
| Drilling Method: 8.25" Hollow Stem Augers | | Sampling Method: Continuous | |
| Location | Northing: 182,799.57' | Easting: 2,149,191.49' | TOC Elevation: 1,200.53' |

Shepherd Engineering
DESIGN COMPANY INCORPORATED

| Deph bgs | Litho. Symbol | Lithologic Description | Well Construction Details | Page 1 |
|---|---|---|---|---|



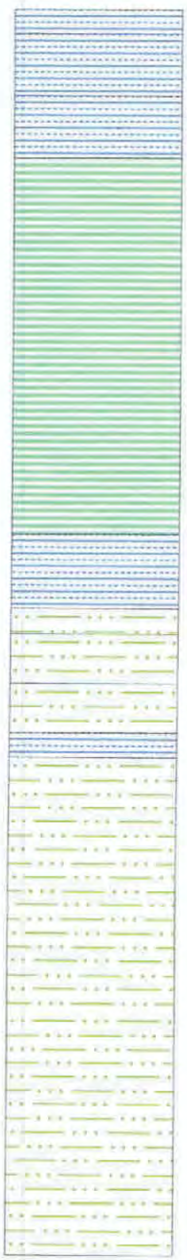
# Field Boring Log

| | | | |
|---|---|---|---|
| Field Boring Log | Boring No.: **MW-4R** | | |
| Client: Northwest C & D Landfill | Project No.: 10-011 | | |
| Logged By: Robert Fowler | Date Drilled: 9/8/10 | | |
| Total Depth: 50 Ft Below Ground Surface (bgs) | | | |
| Drilling Contractor: Anderson Engineering | | Driller: Gary Moyers | Rig Type: Truck Mounted CME-55 |
| Drilling Method: 8.25" Hollow Stem Augers | | Sampling Method: Continuous | |
| Location | Northing: 182,763.61' | Easting: 2,148,479.06' | TOC Elevation: 1,199.22' |

shepherd ENGINEERING DESIGN COMPANY INCORPORATED

| Deph bgs | Litho. Symbol | Lithologic Description | Well Construction Details | Page 1 |
|---|---|---|---|---|

Depth scale (ft bgs): 0.00, 5.00, 10.00, 15.00, 20.00, 25.00, 30.00, 35.00, 40.00, 45.00, 50.00



**Lithologic Description**

- Silty Clay; reddish brown with gravels
- Silty Clay; light brown
- Silty Clay; dark brown
- Fat Clay; reddish brown
- Silty Clay; redish orange
- Silty Sand; dark brown
- Silty Sand; reddish orange
- Silty Sand; brown
- Silty Clay; dark brown
- Silty Sand; brown,wet at 42 ft bgs

TD=50 ft bgs

**Well Construction Details**

- Monument style protective cover with 4X4 concrete pad and bollard poles
- 8.25" diameter borehole (0-50 ft bgs)
- Portland Cement/Bentonite Grout (0-46 ft bgs)
- 2' diameter Schedule 40 PVC riser (0-39.5 ft bgs)
- Bentonite seal, 1/4 inch coated pellets (36-38 ft bgs)
- 10-20 Silica sand filter pack (38-50 ft bgs)
- 2" diameter, 0.010" slot, Schedule 40 PVC screen (39.5-49.5)
- 2" diameter Schedule 40 PVC end cap

# Appendix C

# Geophysical Logs

**Century** WIRELINE SERVICES

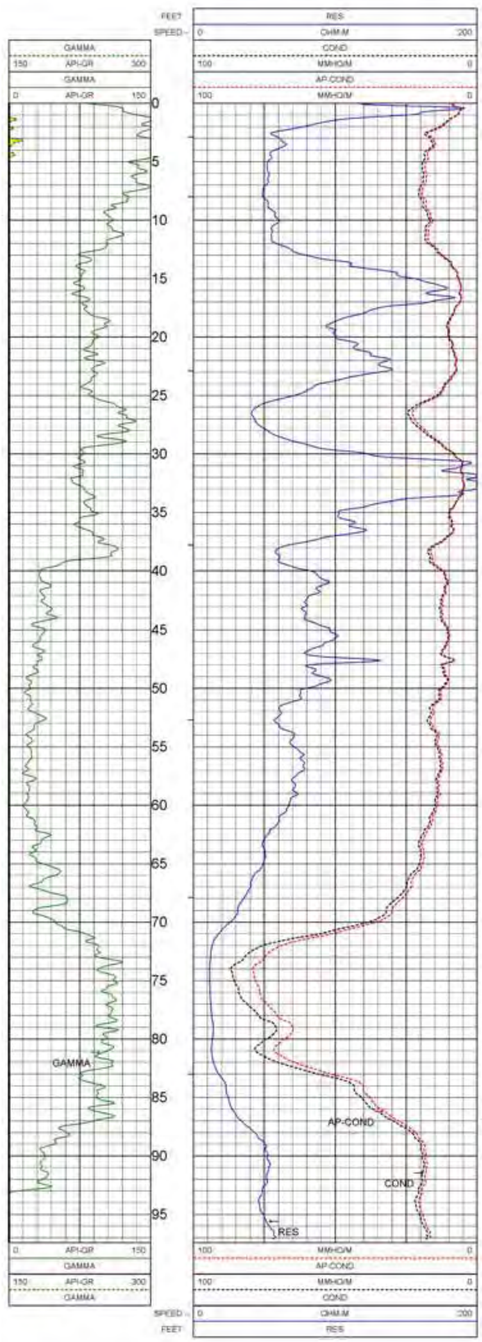
NE LANDFILL
MIDWEST CITY
EB-1

COMPANY NE LANDFILL
WELL EB-1
COUNTY OKLAHOMA
STATE OK
COUNTRY USA

## 1:60, GAMMA - CONDUCTIVITY EB-1 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59





## 1:60, GAMMA - CONDUCTIVITY EB-1 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59


TOOL CALIBRATION EB-1 04/16/20 09:57
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:18 | AP-COND | [MMHO/M] | 0.000 | 890.000 | 54845 | 91107 |
| 3 | Sep26,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep26,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

Century WIRELINE SERVICES

NE LANDFILL
MIDWEST CITY
PZ-1

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-1 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |

| | |
|---|---|
| COMPANY | : NE LANDFILL |
| WELL | : PZ-1 |
| WELL EXT | : |
| FIELD | : |
| COUNTY | : OKLAHOMA |
| STATE | : OK |
| COUNTRY | : USA |
| API NO. | : |
| UNIQ ID | : |
| LOCATION | : N/A SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| LATITUDE | : N/A |
| LONGITUDE | : N/A |
| DISPLAY7_JL59 | |

| | | | | | |
|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | Elevations: | | Other Services: |
| DRL MEASURED FROM | GL | KB | N/A | FT | |
| LOG MEASURED FROM | TC | DF | N/A | FT | |
| ELEV. PERM. DATUM | N/A FT | GL | N/A | FT | |

| | | |
|---|---|---|
| DATE | 04/16/20 11:27 | |
| DEPTH DRILLER | 39.35 | FT |
| DEPTH LOGGER | 37.09 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 39.35 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | |
| FLUID DENSITY | 8.35 | LB/GAL |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R.HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL 3.1 FT | |
| REMARKS 2 | N:182844.43 E:2150429.36 ELV:1213.84 | |
| REMARKS 3 | | |

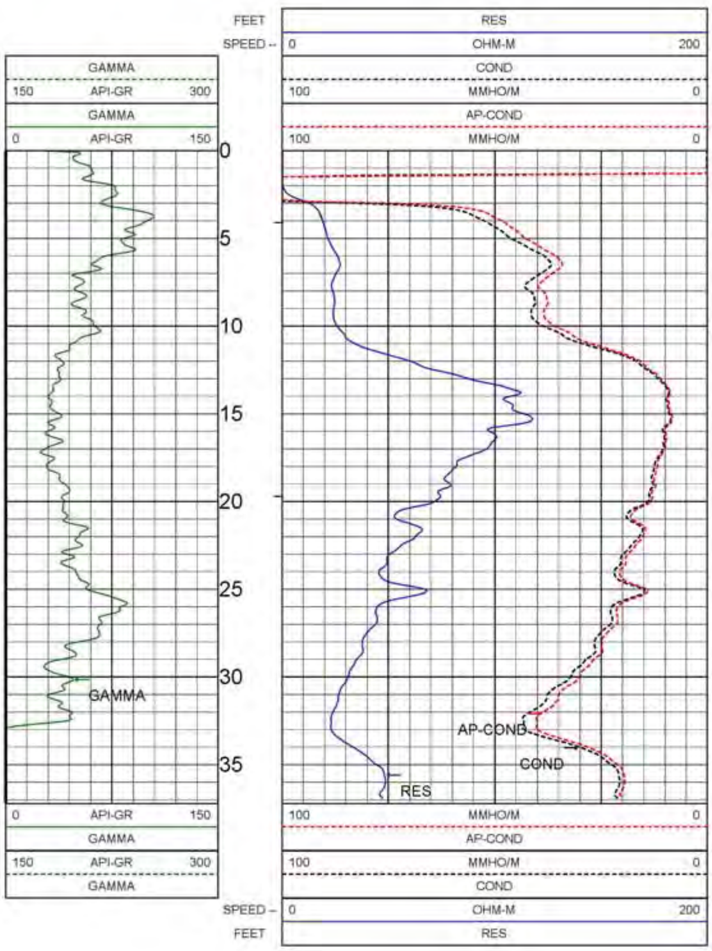
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

**1:60, GAMMA - CONDUCTIVITY PZ-1 04/16/20**

**LOG PARAMETERS**

| | | |
|---|---|---|
| MATRIX DENSITY : 2.71 | NEUTRON MATRIX : LIMESTONE | MATRIX DELTA T : 49 |
| MAGNETIC DECL : 0 | ELECT. CUTOFF : 99999 | BIT SIZE : 4.0 IN |

PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59




**1:60, GAMMA - CONDUCTIVITY PZ-1 04/16/20**

**LOG PARAMETERS**

| | | |
|---|---|---|
| MATRIX DENSITY : 2.71 | NEUTRON MATRIX : LIMESTONE | MATRIX DELTA T : 49 |
| MAGNETIC DECL : 0 | ELECT. CUTOFF : 99999 | BIT SIZE : 4.0 IN |

PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59

**TOOL CALIBRATION PZ-1 04/16/20 11:27**
**TOOL 9510A TM VERSION 2002**
**SERIAL NUMBER 747**

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

NE LANDFILL
MIDWEST CITY
PZ-2

COMPANY NE LANDFILL
WELL PZ-2
WELL EXT
FIELD
COUNTY OKLAHOMA
STATE OK
COUNTRY USA
API NO.

| | |
|---|---|
| COMPANY | : NE LANDFILL |
| WELL | : PZ-2 |
| WELL EXT | : |
| FIELD | : |
| COUNTY | : OKLAHOMA |
| STATE | : OK |
| COUNTRY | : USA |
| API NO. | : |
| UNIQ ID | : |
| | SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| LOCATION | : N/A |
| LATITUDE | : N/A |
| LONGITUDE | : N/A |

DISPLAY7_JL59

| | | | Elevations | | Other Services |
|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | KB | N/A FT | |
| DRL MEASURED FROM | GL | | DF | N/A FT | |
| LOG MEASURED FROM | TC | | GL | N/A FT | |
| ELEV. PERM. DATUM | N/A | FT | | | |

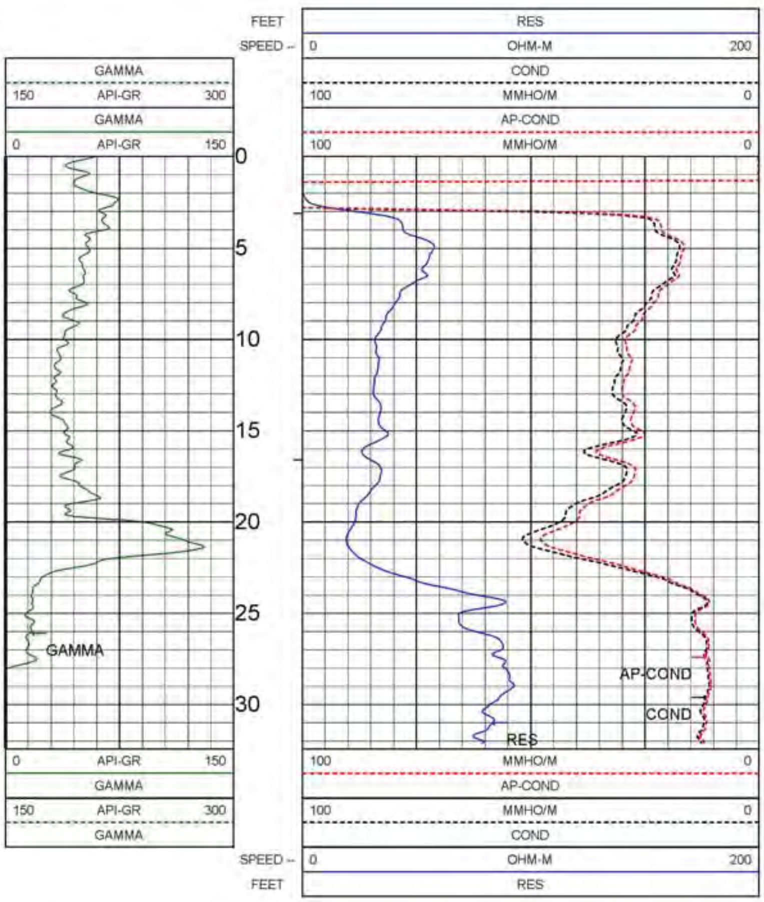
| | | |
|---|---|---|
| DATE | 04/16/20 11:47 | |
| DEPTH DRILLER | 35.12 | FT |
| DEPTH LOGGER | 32.30 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING -- DRILLER | 35.12 | FT |
| CASING -- LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | |
| FLUID DENSITY | 8.35 | LB/GAL |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R.HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL 2.78 FT | |
| REMARKS 2 | N:183891.08 E:2150425.85 ELV:1207.19 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-2 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020 DISPLAY7_JL59




## 1:60, GAMMA - CONDUCTIVITY PZ-2 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020 DISPLAY7_JL59

TOOL CALIBRATION PZ-2 04/16/20 11:47
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | | | | | STANDARD | | RESPONSE [CPS] | |
|---|---|---|---|---|---|---|---|---|
| | DATE | TIME | SENSOR | | Point1 | Point2 | Point1 | Point2 |
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

# NE LANDFILL
# MIDWEST CITY
# PZ-3

Century WIRELINE SERVICES

COMPANY NE LANDFILL
WELL PZ-3
WELL EXT
FIELD
COUNTY OKLAHOMA
STATE OK
COUNTRY USA
API NO.

| | |
|---|---|
| COMPANY | : NE LANDFILL |
| WELL | : PZ-3 |
| WELL EXT | : |
| FIELD | : |
| COUNTY | : OKLAHOMA |
| STATE | : OK |
| COUNTRY | : USA |
| API NO | : |
| UNIQ ID | : |
| LOCATION | : N/A SECTION: N/A TOWNSHIP N/A RANGE N/A |
| LATITUDE | : N/A |
| LONGITUDE | : N/A |

DISPLAY7_JL59

| | | | Elevations | | | Other Services |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | KB | N/A | FT | |
| DRL MEASURED FROM | GL | | DF | N/A | FT | |
| LOG MEASURED FROM | TC | | GL | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | | | | |

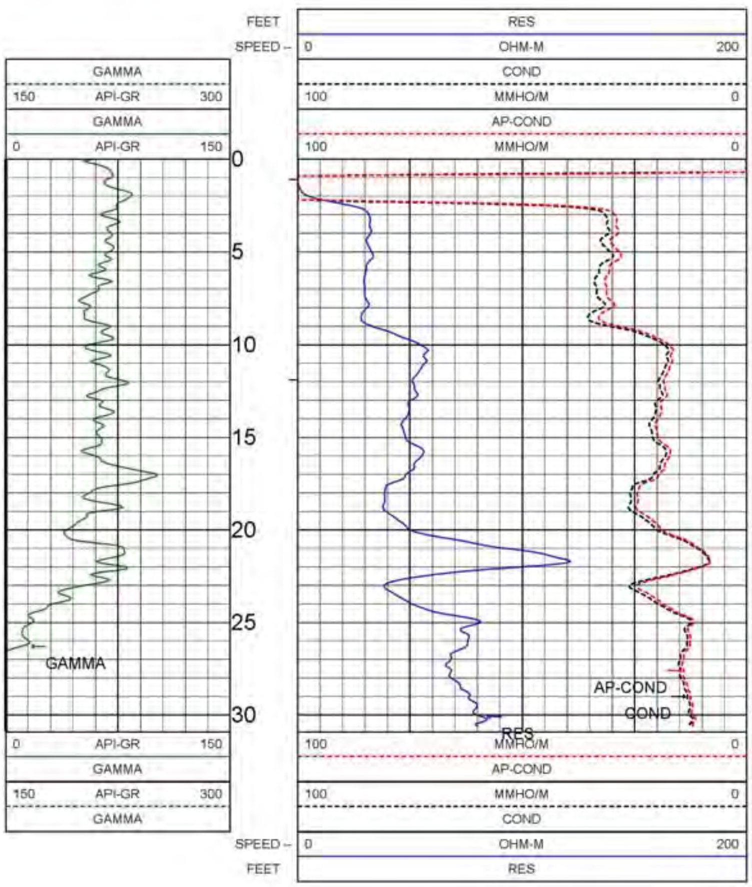
| | | |
|---|---|---|
| DATE | 04/16/20 12:11 | |
| DEPTH DRILLER | 33.80 | FT |
| DEPTH LOGGER | 30.79 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 33.80 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | |
| FLUID DENSITY | 8.35 | LB/GAL |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL 3.62 FT | |
| REMARKS 2 | N 183913.5 E 2149229.41 ELV 1198.91 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-3 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59





## 1:60, GAMMA - CONDUCTIVITY PZ-3 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59


TOOL CALIBRATION PZ-3 04/16/20 12:11
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | | | | | STANDARD | | RESPONSE [CPS] | |
|---|---|---|---|---|---|---|---|---|
| | DATE | TIME | SENSOR | | Point1 | Point2 | Point1 | Point2 |
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

# NE LANDFILL
# MIDWEST CITY
# PZ-4

Century WIRELINE SERVICES

COMPANY NE LANDFILL
WELL PZ-4
WELL EXT
FIELD
COUNTY OKLAHOMA
STATE OK
COUNTRY USA
API NO.

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-4 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |
| UNIQ ID | |
| LOCATION | N/A SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| LATITUDE | N/A |
| LONGITUDE | N/A |

DISPLAY7_JL59

| | | | Elevations: | | | Other Services: |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | KB | N/A | FT | |
| DRL MEASURED FROM | GL | | DF | N/A | FT | |
| LOG MEASURED FROM | TC | | GL | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | | | | |

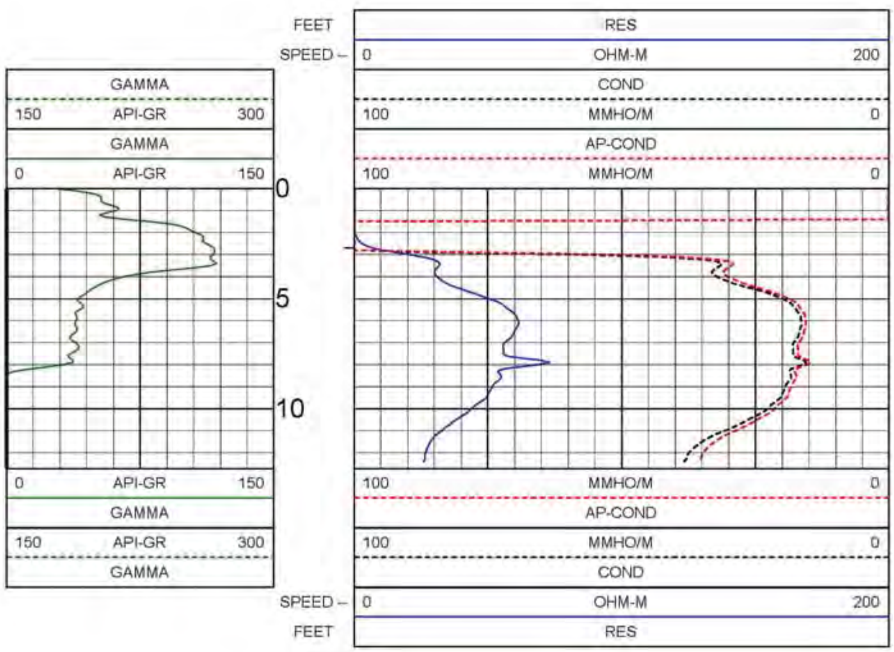
| | | |
|---|---|---|
| DATE | 04/16/20 11:05 | |
| DEPTH DRILLER | 15.42 | FT |
| DEPTH LOGGER | 12.65 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 15.42 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | |
| FLUID DENSITY | 8.35 | LB/GAL |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R.HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL: 3.01 FT | |
| REMARKS 2 | N:183242.87 E:2148594.06 ELV:1175.32 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-4 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59





## 1:60, GAMMA - CONDUCTIVITY PZ-4 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59


TOOL CALIBRATION PZ-4 04/16/20 11:05
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | | | | | STANDARD | | RESPONSE [CPS] | |
|---|---|---|---|---|---|---|---|---|
| | DATE | TIME | SENSOR | | Point1 | Point2 | Point1 | Point2 |
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

# NE LANDFILL
# MIDWEST CITY
# PZ-5

| | | | |
|---|---|---|---|
| COMPANY | NE LANDFILL | COMPANY | NE LANDFILL |
| WELL | PZ-5 | WELL | PZ-5 |
| WELL EXT | | WELL EXT | |
| FIELD | | FIELD | |
| COUNTY | OKLAHOMA | COUNTY | OKLAHOMA |
| STATE | OK | STATE | OK |
| COUNTRY | USA | COUNTRY | USA |
| API NO. | | API NO. | |
| | | UNIQ ID | |
| | | | SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| | | LOCATION | N/A |
| | | LATITUDE | N/A |
| | | LONGITUDE | N/A |
| | | DISPLAY7_JL59 | |

| | | Elevations: | | | Other Services: |
|---|---|---|---|---|---|
| PERMANENT DATUM | GL | KB | N/A | FT | |
| DRL MEASURED FROM | GL | DF | N/A | FT | |
| LOG MEASURED FROM | TC | GL | N/A | FT | |
| ELEV. PERM. DATUM | N/A FT | | | | |

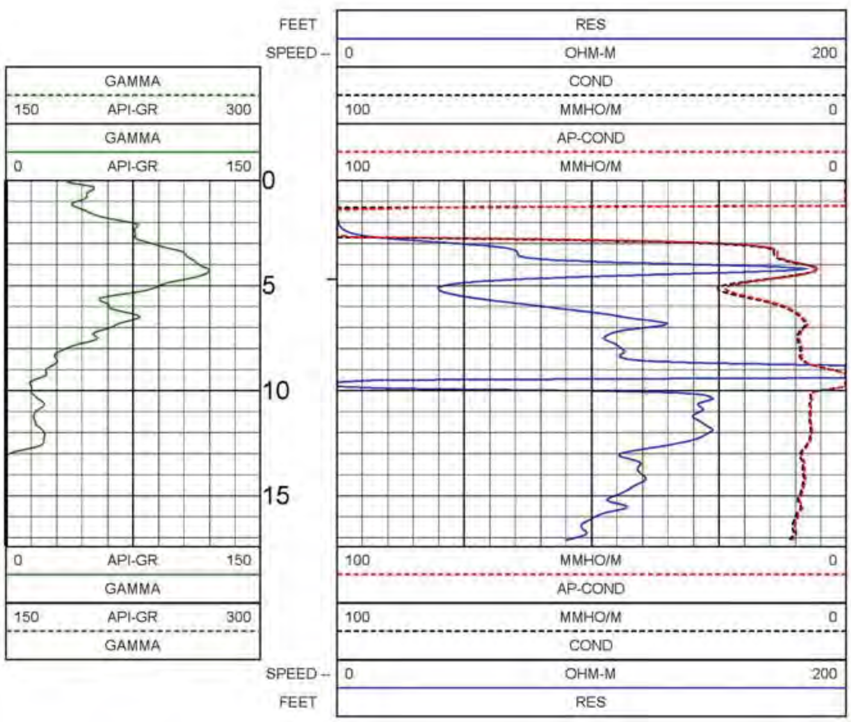
| | | |
|---|---|---|
| DATE | 04/16/20 12:30 | |
| DEPTH DRILLER | 19.75 | FT |
| DEPTH LOGGER | 17.28 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 19.75 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | LB/GAL |
| FLUID DENSITY | 8.35 | |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R.HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL: 3.18 FT | |
| REMARKS 2 | N:183888.17 E:2148688.62 ELV:1176.28 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-5 04/16/20

### LOG PARAMETERS

**MATRIX DENSITY : 2.71** **NEUTRON MATRIX : LIMESTONE** **MATRIX DELTA T : 49**
**MAGNETIC DECL : 0** **ELECT. CUTOFF : 99999** **BIT SIZE : 4.0 IN**
**PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59**





## 1:60, GAMMA - CONDUCTIVITY PZ-5 04/16/20

### LOG PARAMETERS

**MATRIX DENSITY : 2.71** **NEUTRON MATRIX : LIMESTONE** **MATRIX DELTA T : 49**
**MAGNETIC DECL : 0** **ELECT. CUTOFF : 99999** **BIT SIZE : 4.0 IN**
**PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59**


**TOOL CALIBRATION PZ-5 04/16/20 12:30**
**TOOL 9510A TM VERSION 2002**
**SERIAL NUMBER 747**

| | | | | | STANDARD | | RESPONSE [CPS] | |
|---|---|---|---|---|---|---|---|---|
| | DATE | TIME | SENSOR | | Point1 | Point2 | Point1 | Point2 |
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

NE LANDFILL
MIDWEST CITY
PZ-6

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-6 |
| WELL EXT | |
| FIELD | N/A |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |
| UNIQ ID | |
| | SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| LOCATION | N/A |
| LATITUDE | N/A |
| LONGITUDE | N/A |
| | DISPLAY7_JL59 |

| | | Elevations | | | Other Services |
|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | | | |
| DRL MEASURED FROM | GL | KB | N/A | FT | |
| LOG MEASURED FROM | TC | DF | N/A | FT | |
| ELEV. PERM. DATUM | N/A FT | GL | N/A | FT | |

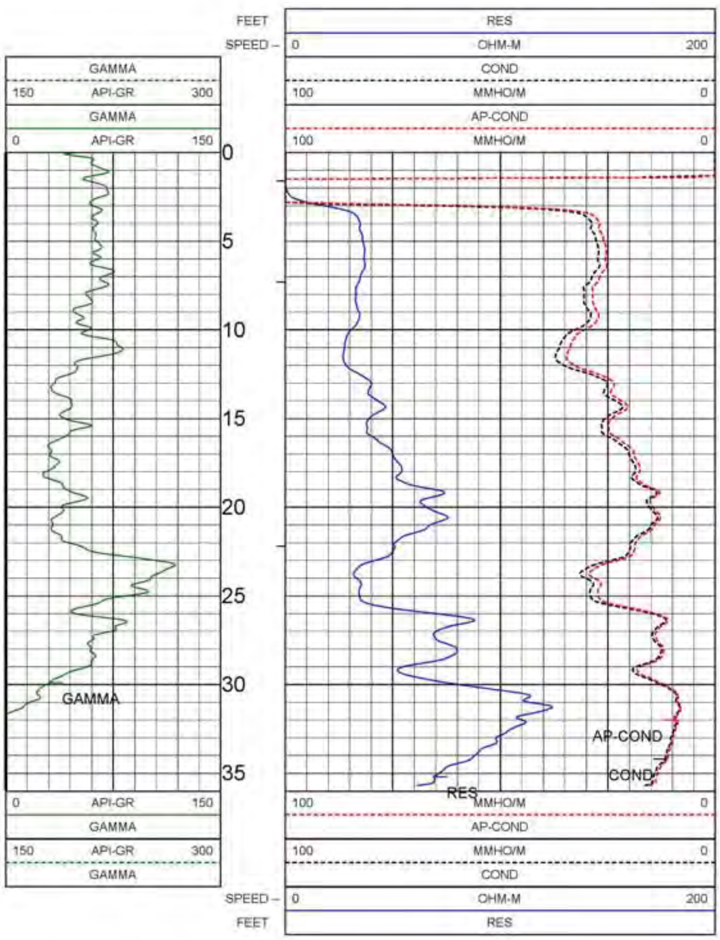
| | | |
|---|---|---|
| DATE | 04/16/20 09:16 | |
| DEPTH DRILLER | 38.68 | FT |
| DEPTH LOGGER | 35.88 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 38.68 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | LB/GAL |
| FLUID DENSITY | 8.35 | |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL: 3.17 FT | |
| REMARKS 2 | N:183260.11 E:2149653.36 ELV:1196.32 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-6 04/16/20

**LOG PARAMETERS**

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59





## 1:60, GAMMA - CONDUCTIVITY PZ-6 04/16/20

**LOG PARAMETERS**

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59


TOOL CALIBRATION PZ-6 04/16/20 09:16
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

NE LANDFILL
MIDWEST CITY
PZ-7

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-7 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-7 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |
| UNIQ ID | |
| LOCATION | N/A SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| LATITUDE | N/A |
| LONGITUDE | N/A |
| DISPLAY7_JL59 | |

| | | | Elevations | | | Other Services |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | KB | N/A | FT | |
| DRL MEASURED FROM | GL | | DF | N/A | FT | |
| LOG MEASURED FROM | TC | | GL | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | | | | |

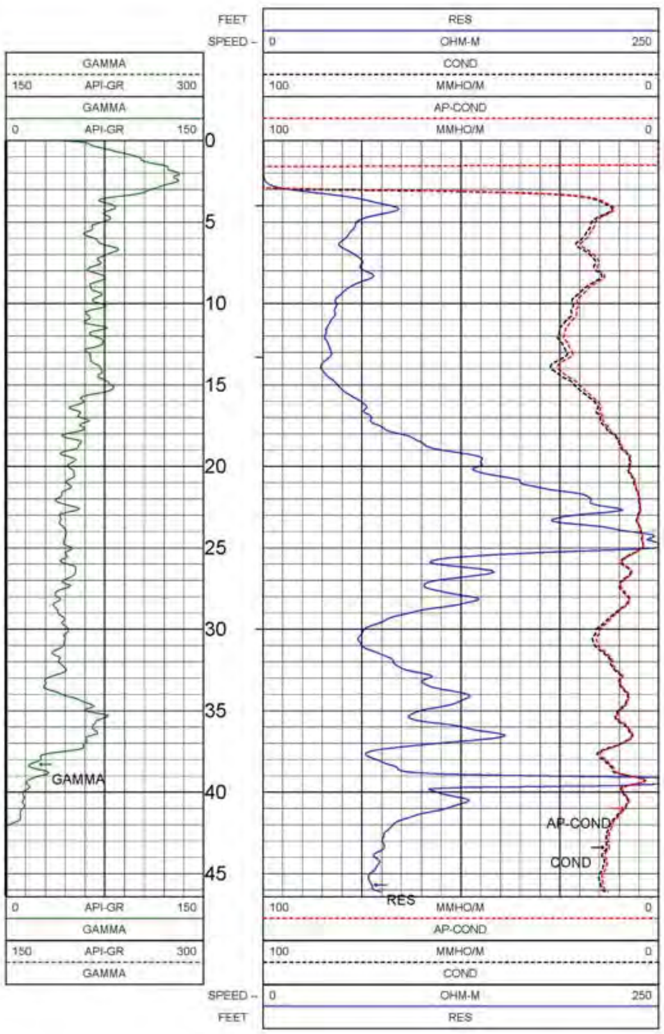
| | | |
|---|---|---|
| DATE | 04/16/20 10:37 | |
| DEPTH DRILLER | 49.41 | FT |
| DEPTH LOGGER | 46.32 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING - DRILLER | 49.41 | FT |
| CASING - LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | |
| FLUID DENSITY | 8.35 | LB/GAL |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R.HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL 2.73 FT | |
| REMARKS 2 | N:183731.02 E:2147880.91 ELV:1201.64 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-7 04/16/20

**LOG PARAMETERS**

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 – 04/17/2020DISPLAY7_JL59





## 1:60, GAMMA - CONDUCTIVITY PZ-7 04/16/20

**LOG PARAMETERS**

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 – 04/17/2020DISPLAY7_JL59


TOOL CALIBRATION PZ-7 04/16/20 10:37
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

# NE LANDFILL
# MIDWEST CITY
# PZ-8

COMPANY NE LANDFILL
WELL PZ-8
WELL EXT
FIELD N/A
COUNTY OKLAHOMA
STATE OK
COUNTRY USA
API NO.

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-8 |
| WELL EXT | |
| FIELD | N/A |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO | |
| UNIQ ID | |
| LOCATION | N/A SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| LATITUDE | N/A |
| LONGITUDE | N/A |
| DISPLAY7_JL59 | |

| | | Elevations | | Other Services |
|---|---|---|---|---|
| PERMANENT DATUM | GL | KB | N/A FT | |
| DRL MEASURED FROM | GL | DF | N/A FT | |
| LOG MEASURED FROM | TC | GL | N/A FT | |
| ELEV. PERM. DATUM | N/A FT | | | |

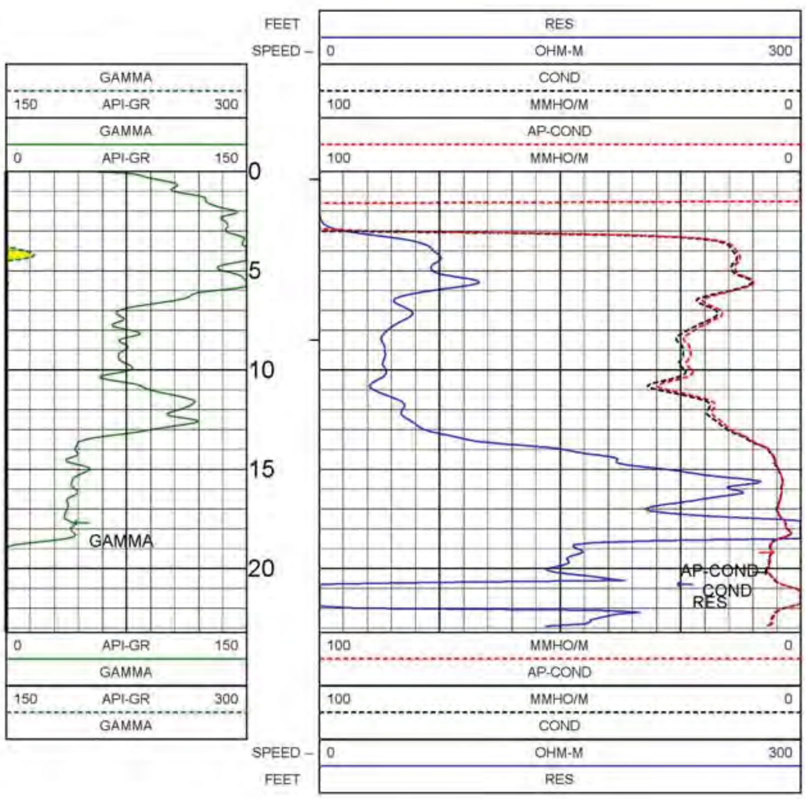
| | | | |
|---|---|---|---|
| DATE | 04/16/20 09:33 | | |
| DEPTH DRILLER | 24.90 FT | | |
| DEPTH LOGGER | 23.05 FT | | |
| FIRST READING | FT | | |
| LAST READING | FT | | |
| BIT SIZE | 4.0 IN | | |
| CASING – DRILLER | 24.90 FT | | |
| CASING – LOGGER | FT | | |
| CASING O.D. | IN | | |
| CASING THICKNESS | | | |
| CASING TYPE | SURFACE | | |
| FLUID TYPE | H2O | | |
| FLUID DENSITY | 8.35 LB/GAL | | |
| FLUID VISCOSITY | | | |
| FLUID PH | | | |
| MUD SOURCE | | | |
| RM @ MEAS TEMP | @ F | | |
| RMF @ MEAS TEMP | @ F | | |
| RMC @ MEAS TEMP | @ F | | |
| CIRC STOPPED | | | |
| RECORDED BY | R.HECK | | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL: 3.00 FT | | |
| REMARKS 2 | N:182862.63 E:2149748.47 ELV:12.04.1 | | |
| REMARKS 3 | | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-8 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59





## 1:60, GAMMA - CONDUCTIVITY PZ-8 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59


TOOL CALIBRATION PZ-8 04/16/20 09:33
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

NE LANDFILL
MIDWEST CITY
PZ-9

Century WIRELINE SERVICES

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-9 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |

COMPANY : NE LANDFILL
WELL : PZ-9
WELL EXT
FIELD
COUNTY : OKLAHOMA
STATE : OK
COUNTRY : USA
API NO
UNIQ ID
LOCATION : N/A SECTION: N/A TOWNSHIP: N/A RANGE: N/A
LATITUDE : N/A
LONGITUDE : N/A
DISPLAY7_JL59

| | | | Elevations: | | | Other Services: |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | KB | N/A | FT | |
| DRL MEASURED FROM | GL | | DF | N/A | FT | |
| LOG MEASURED FROM | TC | | GL | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | | | | |

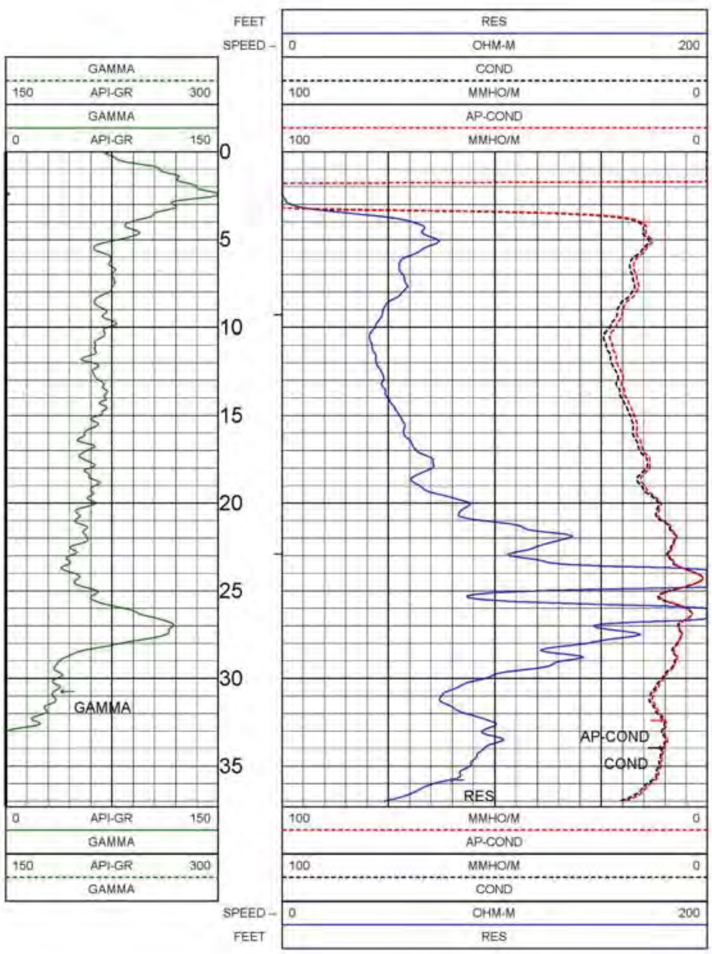
| | | |
|---|---|---|
| DATE | 04/16/20 10:18 | |
| DEPTH DRILLER | 40.72 | FT |
| DEPTH LOGGER | 37.15 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 40.72 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | |
| FLUID DENSITY | 8.35 | LB/GAL |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL 2.78 FT | |
| REMARKS 2 | N:183332.85 E:2147872.18 ELV:1203.28 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-9 04/16/20

**LOG PARAMETERS**

**MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49**
**MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN**
**PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59**





## 1:60, GAMMA - CONDUCTIVITY PZ-9 04/16/20

**LOG PARAMETERS**

**MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49**
**MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN**
**PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59**


**TOOL CALIBRATION PZ-9 04/16/20 10:18**
**TOOL 9510A TM VERSION 2002**
**SERIAL NUMBER 747**

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

# Appendix D

# Century Borehole Geophysical Report

# REPORT OF GEOPHYSICAL LOGS
# MIDWEST CITY LANDFILL, OKLAHOMA
# FOR SCS ENGINEERS

PERFORMED BY

CENTURY WIRELINE SERVICES

APRIL 16, 2020

## INTRODUCTION

The purpose of this report is to summarize the methods employed and present the data from the geophysical logs that were run for SCS Engineers at the Midwest Landfill site. Ten geotechnical wells were logged with one of Century's digital logging tools (see attached product description sheets). The purposes of the logging activities were as an aid to a geo-technical investigation of the potential landfill site.

## FIELD LOGGING ACTIVITIES

Field logging activities were conducted during the time period of April 16, 2020. Field logging was conducted by Mr. Richard Heck, of Century Geophysical Corporation, Tulsa, Oklahoma. Geophysical logs included: natural gamma and electromagnetic-induction, i.e. conductivity.

## GEOPHYSICAL LOG TYPES

### Natural Gamma

The natural gamma log is the recording of a scintillation counter or detector to the natural radiation emitted by naturally occurring formations, or materials placed in the well bore annulus (bentonite seals, grout, sand or gravel pack).

The standard unit of measurement is the “API gamma ray unit” which is defined as “1/100 of the radiation level of typical mid-continent shale”. The gamma ray API standard is a model at the University of Houston.

Clay materials, such as shale, bentonite, and even some concrete have a relatively high gamma radiation level from approximately 75 to 125 API units. Sands, limestones, dolomites have relatively low gamma readings of 15 to 30 API units. Of course, mixtures such as shaly sands, sandy shale or gravels, can have any level between the sand and shale levels, depending on the proportions and types of components in the mixture. The diameter of investigation of the gamma ray system will depend on the bulk density of the material surrounding the detector. In the usual sedimentary environment (density 2.2 to 2.6 grams per cubic centimeter, g/cc) the diameter is approximately 3 feet for 90% of the signal. In low-density formations, such as coal (1.3 g/cc) this diameter is increased to about 5 feet, while in dense formations such as a dolomite (2.8 g/cc) the diameter is about 2 feet. A gamma ray log is quite often used to correlate different tool runs to assure proper depth alignment.

### Electromagnetic-Induction

This three-coil slim hole induction tool was designed to provide conductivity and converted resistivity logs in open boreholes or PVC/plastic cased holes with casing sizes 2 inches are greater. The probe measures the rock conductivity in borings and wells within a zone of 10 to 50 inches from the well, but is not sensitive to the borehole fluid, casing or grouting materials.

The tool can be used in air filled holes to measure the conductivity response and is corrected for skin effect.

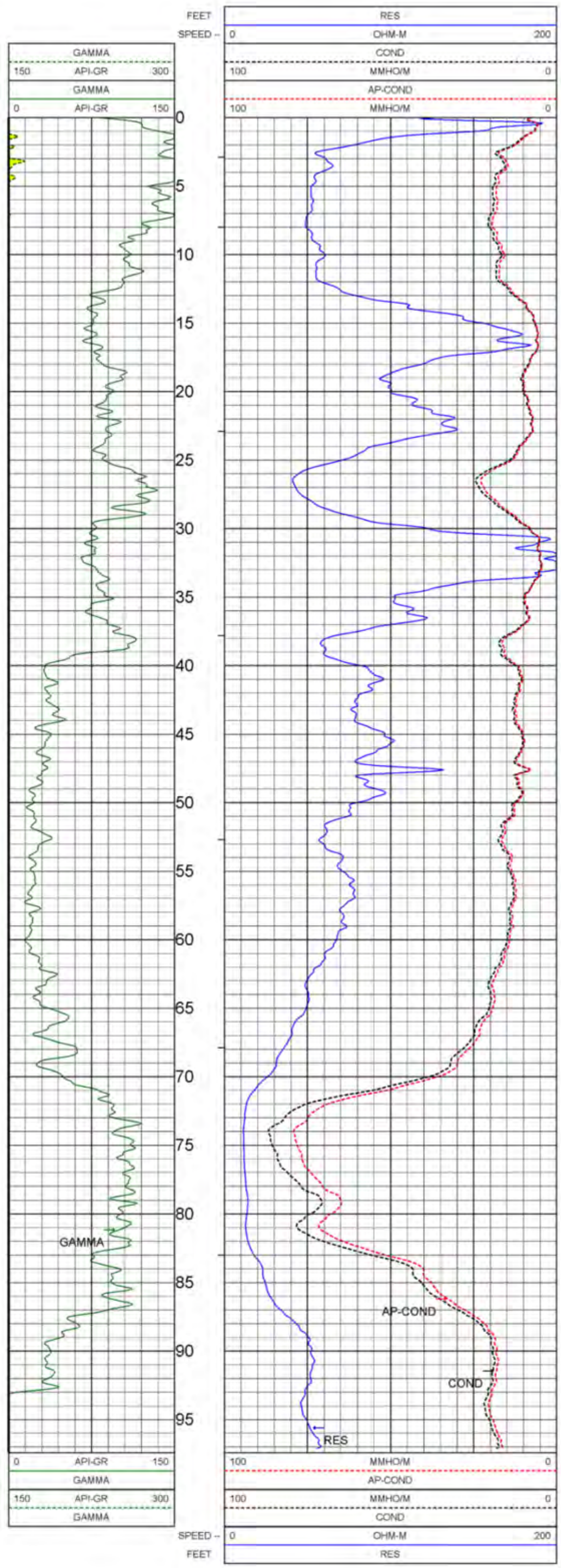
Electromagnetic-induction logs record the electrical conductivity or resistivity of the rocks and water surrounding the borehole. Electrical conductivity and resistivity are affected by the porosity, permeability and clay content of the rocks and by the dissolved-solids concentration of the water within the rocks.

.

**SUMMARY OF GEOPHYSICAL DATA**

The gamma ray log indicates variable response (0-150 API units), indicating some interbedded and moderately clean sand zones, and higher response from clay type materials.  The conductivity response is mostly related to the dissolved salts and permeability of the pore spaces of the material.  The calculated resistivity log indicates Clays/Shales are to the left, Sandstones to the right.

On the next page is the typical response of your holes in this landfill.  This is the log of the deepest hole drilled, EB-1.


FEET
SPEED
RES
0
OHM-M
200
COND
100
MMHO/M
0
AP-COND
100
MMHO/M
0
GAMMA
150
API-GR
300
GAMMA
0
API-GR
150
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
GAMMA
AP-COND
COND
RES

## INTERPRETATIONAL PLOTS

Natural Gamma and Electromagnetic Conductivity. 1:60 Plot Ratio, Vertical Scale at 5 feet per inch

## DISCLAIMER

Century assures that efforts are made to provide calibrated and accurate measuring Devices. Quality control and other procedures are methods employed to provide accurate instrumentation to gather information. However, any interpretation of such information by Century employees, or other individuals (whether made directly from logs or by electronic data processing from actual or digitized log data) or any recommendations based upon such interpretations are opinions based upon inferences from electrical or other measurements and empirical factors and assumptions, which inferences are not necessarily infallible, and with respect to which wireline log analysts may differ. In addition such measurements may be affected by unknown conditions within the borehole or surrounding formation, causing such measurements to be invalid or speculative. Accordingly, in no event should any such interpretation or recommendation from such information be relied upon as the sole basis for any drilling, completion, treatment or production of a well, or development of a mine, or a decision concerning any procedure involving the safety of any persons or equipment.

Prepared By:

Richard Heck
Senior Engineer
7-20-20

Century WIRELINE SERVICES

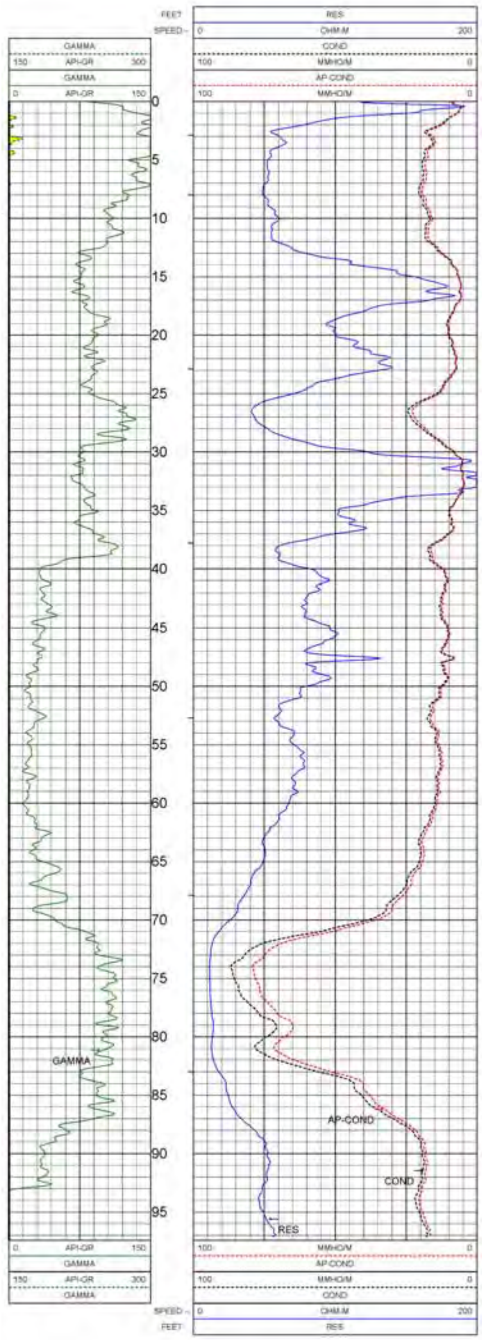
NE LANDFILL
MIDWEST CITY
EB-1

COMPANY NE LANDFILL
WELL EB-1
WELL EXT
FIELD
COUNTY OKLAHOMA
STATE OK
COUNTRY USA
API NO.

## 1:60, GAMMA - CONDUCTIVITY EB-1 04/16/20

**LOG PARAMETERS**

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59





## 1:60, GAMMA - CONDUCTIVITY EB-1 04/16/20

**LOG PARAMETERS**

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59


TOOL CALIBRATION EB-1 04/16/20 09:57
TOOL 9610A TM VERSION 2002
SERIAL NUMBER 747

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:18 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep26,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep26,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:20:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

NE LANDFILL
MIDWEST CITY
PZ-1

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-1 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |

COMPANY : NE LANDFILL
WELL : PZ-1
WELL EXT :
FIELD :
COUNTY : OKLAHOMA
STATE : OK
COUNTRY : USA
API NO :
UNIQ ID :
LOCATION : N/A SECTION: N/A TOWNSHIP: N/A RANGE: N/A
LATITUDE : N/A
LONGITUDE : N/A
DISPLAY7_JL59

| | | | Elevations: | | | Other Services: |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | | | | |
| DRL MEASURED FROM | GL | | KB | N/A | FT | |
| LOG MEASURED FROM | TC | | DF | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | GL | N/A | FT | |

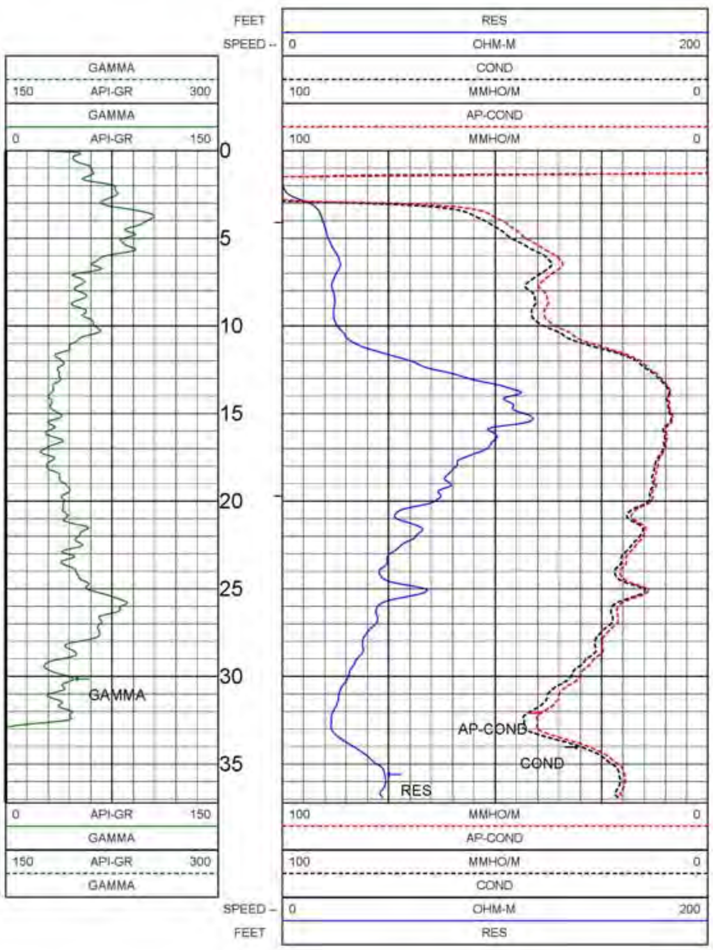
| | | |
|---|---|---|
| DATE | 04/16/20 11:27 | |
| DEPTH DRILLER | 39.35 | FT |
| DEPTH LOGGER | 37.09 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 39.35 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | |
| FLUID DENSITY | 8.35 | LB/GAL |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R HECK | |
| REMARKS 1 | LOGGING THRU 2.0' PVC, GL 3.1 FT | |
| REMARKS 2 | N:182544.43 E:2150429.36 ELV:1213.84 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-1 04/16/20

**LOG PARAMETERS**

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59




## 1:60, GAMMA - CONDUCTIVITY PZ-1 04/16/20

**LOG PARAMETERS**

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59

TOOL CALIBRATION PZ-1 04/16/20 11:27
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

NE LANDFILL
MIDWEST CITY
PZ-2

COMPANY NE LANDFILL
WELL PZ-2
WELL EXT
FIELD
COUNTY OKLAHOMA
STATE OK
COUNTRY USA
API NO.

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-2 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |
| UNIQ ID | |
| | SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| LOCATION | N/A |
| LATITUDE | N/A |
| LONGITUDE | N/A |
| | DISPLAY7_JL59 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | Elevations: | | | Other Services: |
| DRL MEASURED FROM | GL | | KB | N/A | FT | |
| LOG MEASURED FROM | TC | | DF | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | GL | N/A | FT | |

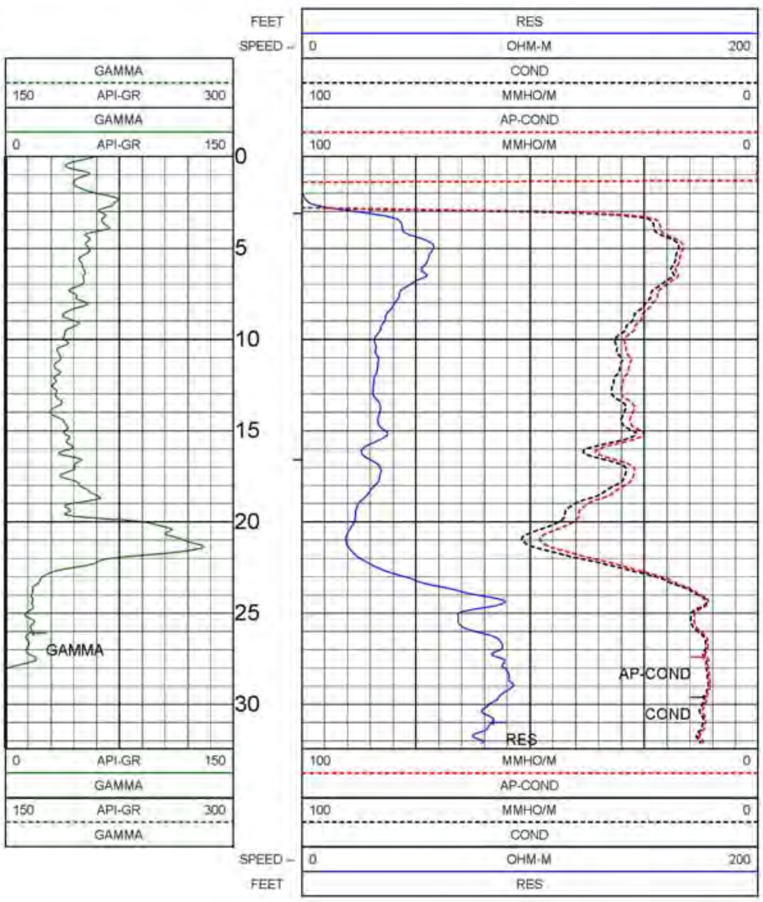
| | | |
|---|---|---|
| DATE | 04/16/20 11:47 | |
| DEPTH DRILLER | 35.12 | FT |
| DEPTH LOGGER | 32.30 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 35.12 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | LB/GAL |
| FLUID DENSITY | 8.35 | |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R.HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL: 2.78 FT | |
| REMARKS 2 | N:183891.08 E:2150425.85 ELV:1207.19 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS.

## 1:60, GAMMA - CONDUCTIVITY PZ-2 04/16/20

**LOG PARAMETERS**

**MATRIX DENSITY : 2.71** **NEUTRON MATRIX : LIMESTONE** **MATRIX DELTA T : 49**
**MAGNETIC DECL : 0** **ELECT. CUTOFF : 99999** **BIT SIZE : 4.0 IN**
**PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020 DISPLAY7_JL59**





## 1:60, GAMMA - CONDUCTIVITY PZ-2 04/16/20

**LOG PARAMETERS**

**MATRIX DENSITY : 2.71** **NEUTRON MATRIX : LIMESTONE** **MATRIX DELTA T : 49**
**MAGNETIC DECL : 0** **ELECT. CUTOFF : 99999** **BIT SIZE : 4.0 IN**
**PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020 DISPLAY7_JL59**


**TOOL CALIBRATION PZ-2 04/16/20 11:47**
**TOOL 9510A TM VERSION 2002**
**SERIAL NUMBER 747**

| | | | | | STANDARD | | RESPONSE [CPS] | |
|---|---|---|---|---|---|---|---|---|
| | DATE | TIME | SENSOR | | Point1 | Point2 | Point1 | Point2 |
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

# NE LANDFILL
# MIDWEST CITY
# PZ-3

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-3 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-3 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |
| UNIQ ID | |
| | SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| LOCATION | N/A |
| LATITUDE | N/A |
| LONGITUDE | N/A |
| | DISPLAY7_JL59 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | Elevations: | | | Other Services: |
| DRL MEASURED FROM | GL | | KB | N/A | FT | |
| LOG MEASURED FROM | TC | | DF | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | GL | N/A | FT | |

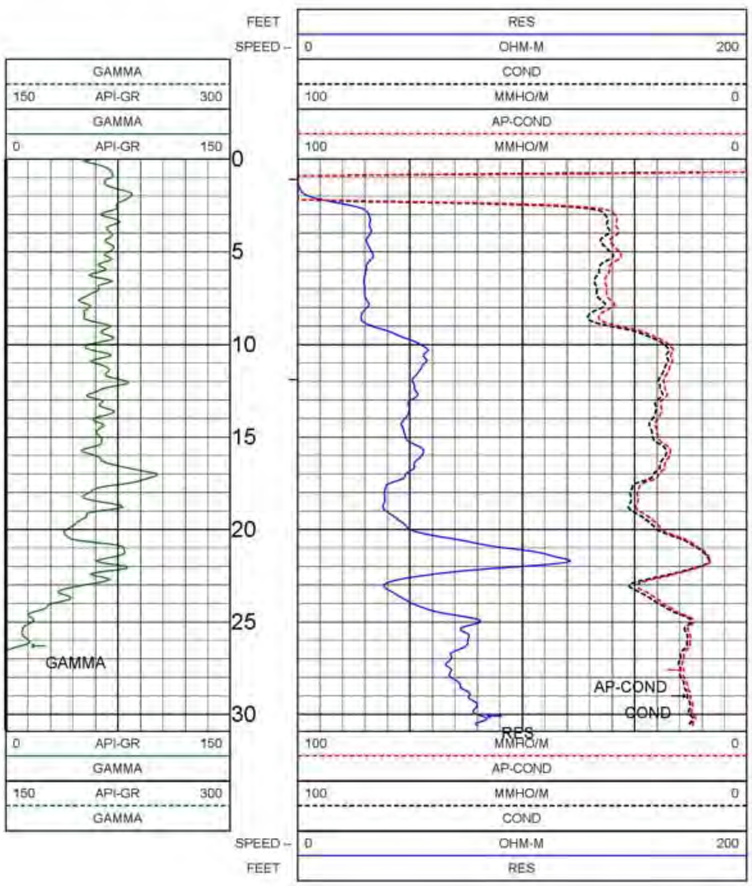
| | | |
|---|---|---|
| DATE | 04/16/20 12:11 | |
| DEPTH DRILLER | 33.80 | FT |
| DEPTH LOGGER | 30.79 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING -- DRILLER | 33.80 | FT |
| CASING -- LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | LB/GAL |
| FLUID DENSITY | 8.35 | |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL: 3.82 FT | |
| REMARKS 2 | N:183913.5 E:2149229.41 ELV:1198.91 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-3 04/16/20

**LOG PARAMETERS**

**MATRIX DENSITY : 2.71** **NEUTRON MATRIX : LIMESTONE** **MATRIX DELTA T : 49**
**MAGNETIC DECL : 0** **ELECT. CUTOFF : 99999** **BIT SIZE : 4.0 IN**
**PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59**





## 1:60, GAMMA - CONDUCTIVITY PZ-3 04/16/20

**LOG PARAMETERS**

**MATRIX DENSITY : 2.71** **NEUTRON MATRIX : LIMESTONE** **MATRIX DELTA T : 49**
**MAGNETIC DECL : 0** **ELECT. CUTOFF : 99999** **BIT SIZE : 4.0 IN**
**PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59**


**TOOL CALIBRATION PZ-3 04/16/20 12:11**
**TOOL 9510A TM VERSION 2002**
**SERIAL NUMBER 747**

| | | | | | STANDARD | | RESPONSE [CPS] | |
|---|---|---|---|---|---|---|---|---|
| | DATE | TIME | SENSOR | | Point1 | Point2 | Point1 | Point2 |
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

NE LANDFILL
MIDWEST CITY
PZ-4

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-4 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-4 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |
| UNIQ ID | |
| | SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| LOCATION | N/A |
| LATITUDE | N/A |
| LONGITUDE | N/A |
| DISPLAY7_JL59 | |

| | | | Elevations: | | | Other Services: |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | | | | |
| DRL MEASURED FROM | GL | | KB | N/A | FT | |
| LOG MEASURED FROM | TC | | DF | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | GL | N/A | FT | |

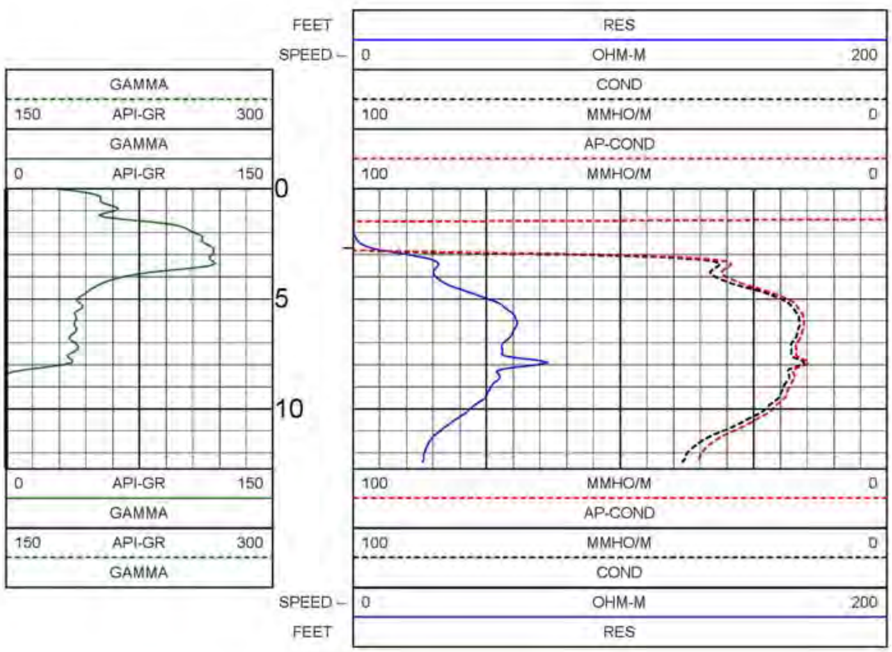
| | | |
|---|---|---|
| DATE | 04/16/20 11:05 | |
| DEPTH DRILLER | 15.42 | FT |
| DEPTH LOGGER | 12.65 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 15.42 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | LB/GAL |
| FLUID DENSITY | 8.35 | |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R.HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL: 3.01 FT | |
| REMARKS 2 | N:183242.87 E:2148594.06 ELV:1175.32 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-4 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59





## 1:60, GAMMA - CONDUCTIVITY PZ-4 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59


TOOL CALIBRATION PZ-4 04/16/20 11:05
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | | | | | STANDARD | | RESPONSE [CPS] | |
|---|---|---|---|---|---|---|---|---|
| | DATE | TIME | SENSOR | | Point1 | Point2 | Point1 | Point2 |
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

NE LANDFILL
MIDWEST CITY
PZ-5

COMPANY NE LANDFILL
WELL PZ-5
WELL EXT
FIELD
COUNTY OKLAHOMA
STATE OK
COUNTRY USA
API NO.

COMPANY = NE LANDFILL
WELL = PZ-5
WELL EXT
FIELD
COUNTY = OKLAHOMA
STATE = OK
COUNTRY = USA
API NO. =
UNIQ ID
LOCATION = N/A SECTION: N/A TOWNSHIP: N/A RANGE: N/A
LATITUDE = N/A
LONGITUDE = N/A
DISPLAY7_JL59

| | | | Elevations | | | Other Services |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | | | | |
| DRL MEASURED FROM | GL | | KB | N/A | FT | |
| LOG MEASURED FROM | TC | | DF | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | GL | N/A | FT | |

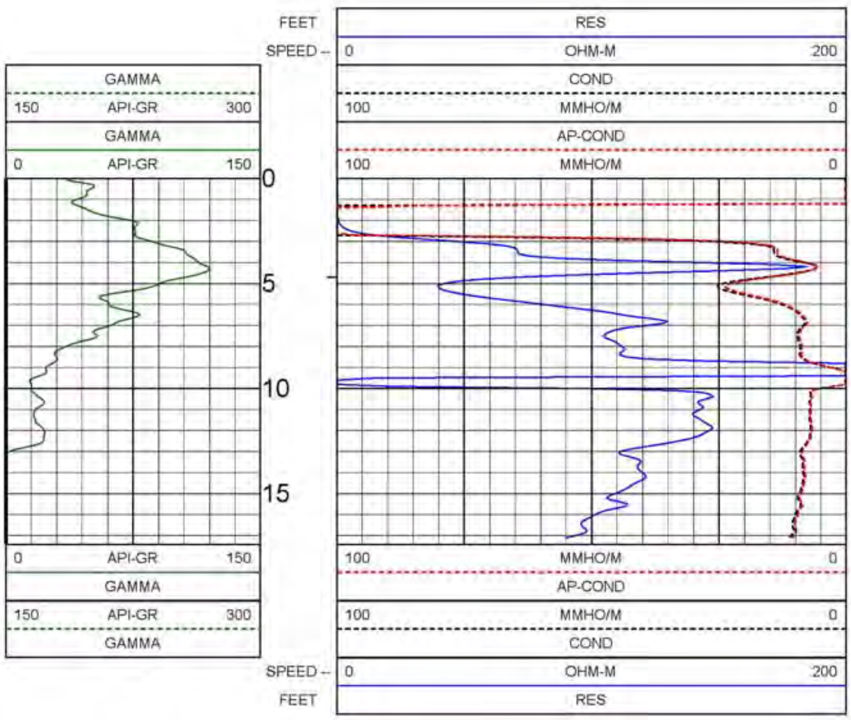
| | | |
|---|---|---|
| DATE | 04/16/20 12:30 | |
| DEPTH DRILLER | 19.75 | FT |
| DEPTH LOGGER | 17.28 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 19.75 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | |
| FLUID DENSITY | 8.35 | LB/GAL |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R.HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL: 3.18 FT | |
| REMARKS 2 | N:183888.17 E:2148688.62 ELV:1176.28 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-5 04/16/20

**LOG PARAMETERS**

**MATRIX DENSITY : 2.71** **NEUTRON MATRIX : LIMESTONE** **MATRIX DELTA T : 49**
**MAGNETIC DECL : 0** **ELECT. CUTOFF : 99999** **BIT SIZE : 4.0 IN**
**PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59**





## 1:60, GAMMA - CONDUCTIVITY PZ-5 04/16/20

**LOG PARAMETERS**

**MATRIX DENSITY : 2.71** **NEUTRON MATRIX : LIMESTONE** **MATRIX DELTA T : 49**
**MAGNETIC DECL : 0** **ELECT. CUTOFF : 99999** **BIT SIZE : 4.0 IN**
**PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59**


**TOOL CALIBRATION PZ-5 04/16/20 12:30**
**TOOL 9510A TM VERSION 2002**
**SERIAL NUMBER 747**

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

NE LANDFILL
MIDWEST CITY
PZ-6

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-6 |
| WELL EXT | |
| FIELD | N/A |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-6 |
| WELL EXT | |
| FIELD | N/A |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |
| UNIQ ID | |
| LOCATION | N/A SECTION: N/A TOWNSHIP N/A RANGE N/A |
| LATITUDE | N/A |
| LONGITUDE | N/A |

DISPLAY7_JL59

| | | | Elevations | | |
|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | KB | N/A | FT |
| DRL MEASURED FROM | GL | | DF | N/A | FT |
| LOG MEASURED FROM | TC | | GL | N/A | FT |
| ELEV. PERM. DATUM | N/A | FT | | | |

Other Services

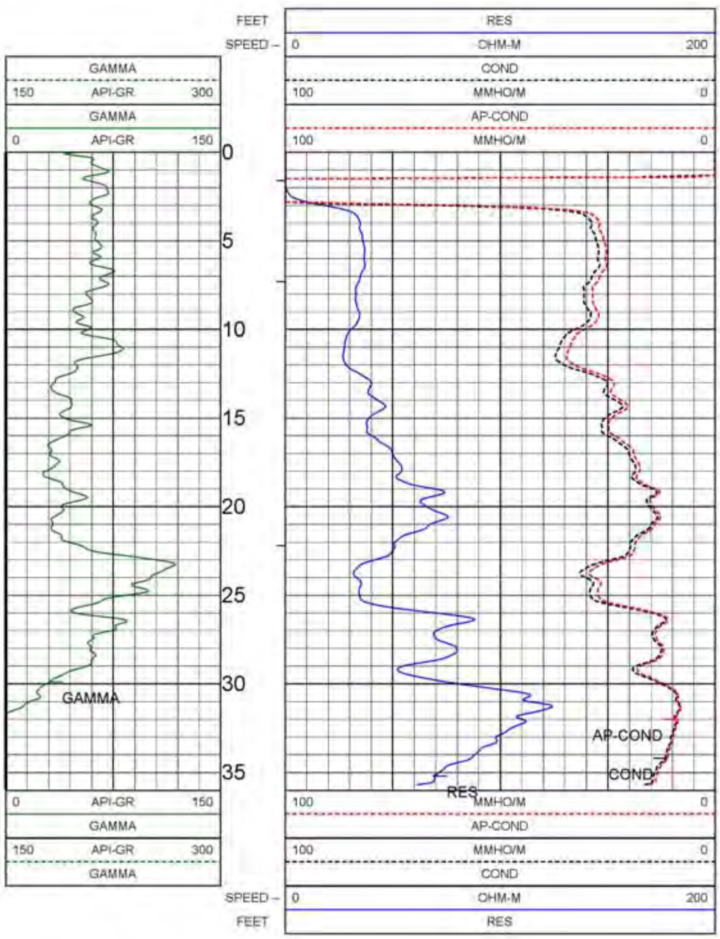
| | | |
|---|---|---|
| DATE | 04/16/20 09:16 | |
| DEPTH DRILLER | 38.66 | FT |
| DEPTH LOGGER | 35.84 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 38.66 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | |
| FLUID DENSITY | 8.35 | LB/GAL |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL 3.17 FT | |
| REMARKS 2 | N 183280.11 E 2146653.36 ELV 1186.32 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-6 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59





## 1:60, GAMMA - CONDUCTIVITY PZ-6 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59


TOOL CALIBRATION PZ-6 04/16/20 09:16
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

# NE LANDFILL
# MIDWEST CITY
# PZ-7

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-7 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |
| UNIQ ID | |
| | SECTION: N/A TOWNSHIP: N/A RANGE: N/A |
| LOCATION | N/A |
| LATITUDE | N/A |
| LONGITUDE | N/A |
| | DISPLAY7_JL59 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | Elevations: | | | Other Services: |
| DRL MEASURED FROM | GL | | KB | N/A | FT | |
| LOG MEASURED FROM | TC | | DF | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | GL | N/A | FT | |

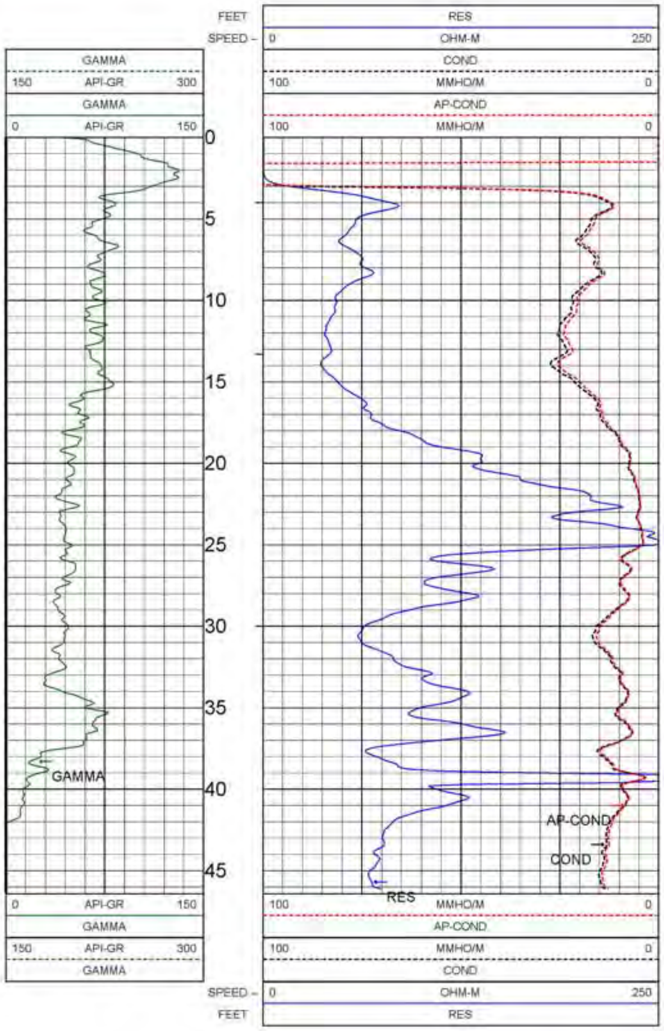
| | | |
|---|---|---|
| DATE | 04/16/20 10:37 | |
| DEPTH DRILLER | 49.41 | FT |
| DEPTH LOGGER | 46.32 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 49.41 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | LB/GAL |
| FLUID DENSITY | 8.35 | |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R.HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL: 2.73 FT | |
| REMARKS 2 | N:183231.02 E:2147860.91 ELV:1201.84 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-7 04/16/20

**LOG PARAMETERS**

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59




## 1:60, GAMMA - CONDUCTIVITY PZ-7 04/16/20

**LOG PARAMETERS**

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59

TOOL CALIBRATION PZ-7 04/16/20 10:37
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

**Century WIRELINE SERVICES**

# NE LANDFILL
# MIDWEST CITY
# PZ-8

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-8 |
| WELL EXT | |
| FIELD | N/A |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO. | |

| | | | | |
|---|---|---|---|---|
| COMPANY | NE LANDFILL | | | |
| WELL | PZ-8 | | | |
| WELL EXT | | | | |
| FIELD | N/A | | | |
| COUNTY | OKLAHOMA | | | |
| STATE | OK | | | |
| COUNTRY | USA | | | |
| API NO. | | | | |
| UNIQ ID | | | | |
| LOCATION | N/A | SECTION: N/A | TOWNSHIP: N/A | RANGE: N/A |
| LATITUDE | N/A | | | |
| LONGITUDE | N/A | | | |
| DISPLAY7_JL59 | | | | |

| | | | Elevations: | | | Other Services: |
|---|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | KB | N/A | FT | |
| DRL MEASURED FROM | GL | | DF | N/A | FT | |
| LOG MEASURED FROM | TC | | GL | N/A | FT | |
| ELEV. PERM. DATUM | N/A | FT | | | | |

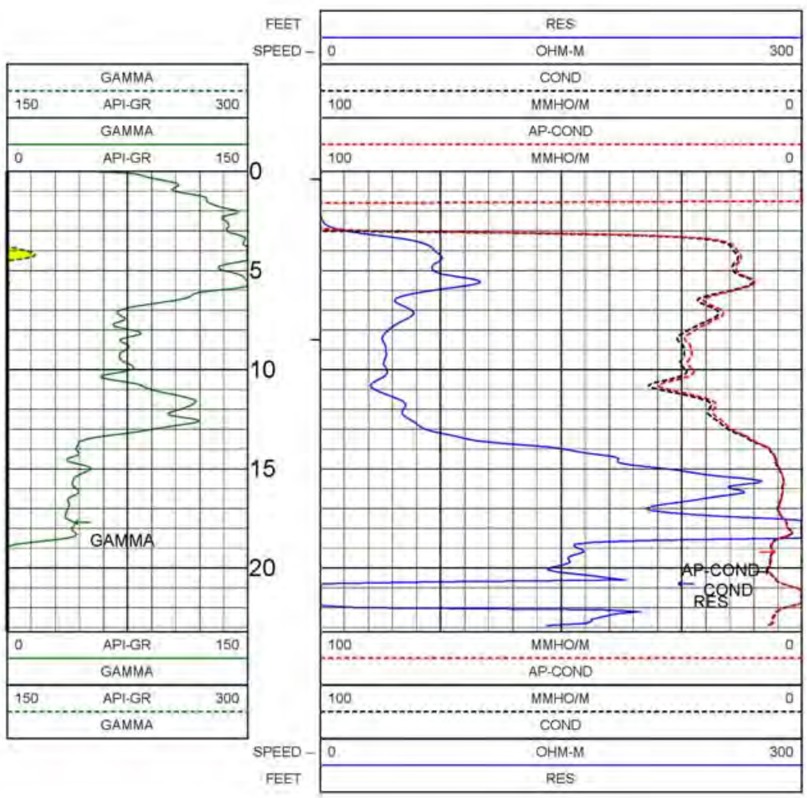
| | | | | |
|---|---|---|---|---|
| DATE | 04/16/20 09:33 | | | |
| DEPTH DRILLER | 24.90 | FT | | |
| DEPTH LOGGER | 23.05 | FT | | |
| FIRST READING | | FT | | |
| LAST READING | | FT | | |
| BIT SIZE | 4.0 | IN | | |
| CASING – DRILLER | 24.90 | FT | | |
| CASING – LOGGER | | FT | | |
| CASING O.D. | | IN | | |
| CASING THICKNESS | | | | |
| CASING TYPE | SURFACE | | | |
| FLUID TYPE | H2O | | | |
| FLUID DENSITY | 8.35 | LB/GAL | | |
| FLUID VISCOSITY | | | | |
| FLUID PH | | | | |
| MUD SOURCE | | | | |
| RM @ MEAS TEMP | @ F | | | |
| RMF @ MEAS TEMP | @ F | | | |
| RMC @ MEAS TEMP | @ F | | | |
| CIRC STOPPED | | | | |
| RECORDED BY | R.HECK | | | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL: 3.00 FT | | | |
| REMARKS 2 | N:182862.53 E:2149748.47 ELV:1204.1 | | | |
| REMARKS 3 | | | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-8 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59





## 1:60, GAMMA - CONDUCTIVITY PZ-8 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59


TOOL CALIBRATION PZ-8 04/16/20 09:33
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

NE LANDFILL
MIDWEST CITY
PZ-9

| | |
|---|---|
| COMPANY | NE LANDFILL |
| WELL | PZ-9 |
| WELL EXT | |
| FIELD | |
| COUNTY | OKLAHOMA |
| STATE | OK |
| COUNTRY | USA |
| API NO | |
| UNIQ ID | |
| LOCATION | : N/A |
| LATITUDE | : N/A |
| LONGITUDE | : N/A |

SECTION: N/A TOWNSHIP: N/A RANGE: N/A

DISPLAY7_JL59

| | | | Elevations | | |
|---|---|---|---|---|---|
| PERMANENT DATUM | GL | | KB | N/A | FT |
| DRL MEASURED FROM | GL | | DF | N/A | FT |
| LOG MEASURED FROM | TC | | GL | N/A | FT |
| ELEV. PERM. DATUM | N/A | FT | | | |

Other Services

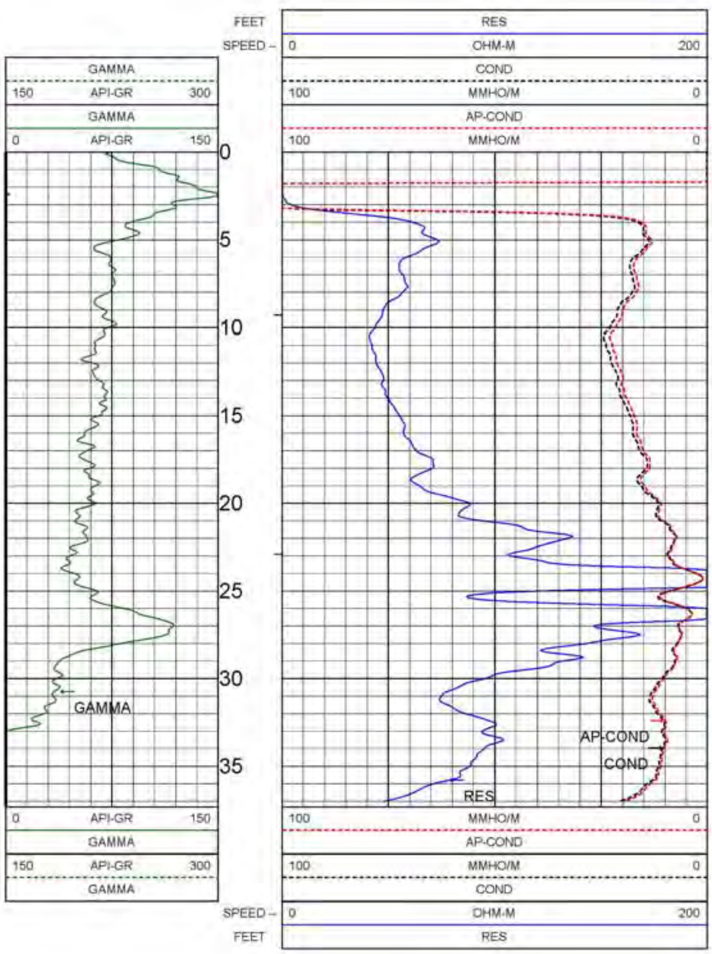
| | | |
|---|---|---|
| DATE | 04/16/20 10:18 | |
| DEPTH DRILLER | 40.72 | FT |
| DEPTH LOGGER | 37.15 | FT |
| FIRST READING | | FT |
| LAST READING | | FT |
| BIT SIZE | 4.0 | IN |
| CASING – DRILLER | 40.72 | FT |
| CASING – LOGGER | | FT |
| CASING O.D. | | IN |
| CASING THICKNESS | | |
| CASING TYPE | SURFACE | |
| FLUID TYPE | H2O | |
| FLUID DENSITY | 8.35 | LB/GAL |
| FLUID VISCOSITY | | |
| FLUID PH | | |
| MUD SOURCE | | |
| RM @ MEAS TEMP | @ F | |
| RMF @ MEAS TEMP | @ F | |
| RMC @ MEAS TEMP | @ F | |
| CIRC STOPPED | | |
| RECORDED BY | R HECK | |
| REMARKS 1 | LOGGING THRU 2.0" PVC, GL 2.78 FT | |
| REMARKS 2 | N:183332.65 E:2147672.18 ELV:1203.28 | |
| REMARKS 3 | | |

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

## 1:60, GAMMA - CONDUCTIVITY PZ-9 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59




## 1:60, GAMMA - CONDUCTIVITY PZ-9 04/16/20

### LOG PARAMETERS

MATRIX DENSITY : 2.71 NEUTRON MATRIX : LIMESTONE MATRIX DELTA T : 49
MAGNETIC DECL : 0 ELECT. CUTOFF : 99999 BIT SIZE : 4.0 IN
PRESENTATION : 9512_NE LANDFILL - MIDWEST CITY.0 -- 04/17/2020DISPLAY7_JL59

TOOL CALIBRATION PZ-9 04/16/20 10:18
TOOL 9510A TM VERSION 2002
SERIAL NUMBER 747

| | DATE | TIME | SENSOR | | STANDARD Point1 | STANDARD Point2 | RESPONSE [CPS] Point1 | RESPONSE [CPS] Point2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Apr15,20 | 11:32:25 | GAMMA | [API-GR] | 1.000 | 340.000 | 0.000 | 335 |
| 2 | Apr15,20 | 13:32:19 | AP-COND | [MMHO/M] | 0.000 | 690.000 | 54845 | 91107 |
| 3 | Sep25,14 | 13:19:22 | TEMP | [DEG-F] | 39.500 | 132.600 | 26556 | 31296 |
| 4 | Sep25,14 | 13:26:21 | A | [] | 0.350 | | 0.000 | |
| 5 | Mar27,03 | 10:28:37 | B | [CPS] | Default | | Default | |

# Appendix E

# Geotechnical Laboratory Results

ANDERSON ENGINEERING CONSULTANTS, INC.

10205 W ROCKWOOD ROAD
LITTLE ROCK, AR 72204
(501) 455-4545

3217 NEIL CIRCLE
JONESBORO, AR 72401
(870) 932-3700

620 E 3RD STREET
HOPE, AR 71801
(501) 515-4654

# MEMORANDUM

MAY 27, 2020

TO: MR. DAN MCCULLOUGH, P.G.
SCS ENGINEERS
DMCCULLOUGH@SCSENGINEERS.COM

FROM: MR. SCOTT W. ANDERSON, R.E.P., P.E.
PRINCIPAL ENGINEER/PRESIDENT
AECIGEO@COMCAST.NET

RE: LAB TEST RESULTS
WCA – NORTHEAST C&D LANDFILL
SPENCER, OKLAHOMA
AECI JOB NO. 15775

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Dan,
Attached herein are the requested laboratory test results for the project referenced above. The testing included classification testing of all bulk samples per ODEQ guidelines. Additionally, testing requested by Ms. Basak Gulec, PhD, P.E. via her email on May 5, 2020 was performed. It should be noted that we are still holding nine 3" Shelby tubes that no testing has been assigned on. We will hold all samples an additional 60 days in the event other testing is required.

Let me know if we can be of further assistance.

Very truly yours,

Scott W. Anderson, R.E.P., P.E.
Principal Engineer

# MOISTURE CONTENT DETERMINATION
## ASTM D 2216

**Project:** WCA NORTHEAST C & D LANDFILL **Project No.:** 5/9/2020
**Location:** SPENCER, OKLAHOMA **Date:** 05/09/20

### MOISTURE CONTENT

| Sample Number | EB2;4'-8' | EB3;0'-3' | EB3;10'-14' | EB3;25'-27' | EB4;10'-12' | EB6;0'-5' | EB6;20'-25' |
|---|---|---|---|---|---|---|---|
| Tare Number | B2 | Z | 775 | B5 | ACH | 10 | MS-2 |
| Tare + Wet Soil (g) | 182.3 | 159.1 | 159.9 | 194.8 | 178.1 | 172.7 | 212.2 |
| Tare + Dry Soil (g) | 168.2 | 138.0 | 140.9 | 183.2 | 158.6 | 146.7 | 176.1 |
| Tare (g) | 10.2 | 12.2 | 10.5 | 10.8 | 10.3 | 9.9 | 9.7 |
| Water (g) | 14.1 | 21.1 | 19.0 | 11.6 | 19.5 | 26.0 | 36.1 |
| Dry Soil (g) | 158.0 | 125.8 | 130.4 | 172.4 | 148.3 | 136.8 | 166.4 |
| Water Content (%) | **8.9** | **16.8** | **14.6** | **6.7** | **13.1** | **19.0** | **21.7** |

### MOISTURE CONTENT

| Sample Number | EB7;5'-10' | EB8;15'-20' | EB9;5'-8' | PZ1;10'-13' | PZ2;2'-5' | PZ2;15'-17' | PZ4;5'-10' |
|---|---|---|---|---|---|---|---|
| Tare Number | SS# | 777 | SMD | B10 | AI | 773 | 11 |
| Tare + Wet Soil (g) | 183.3 | 189.6 | 167.7 | 191.1 | 176.5 | 150.3 | 178.5 |
| Tare + Dry Soil (g) | 157.8 | 178.8 | 147.0 | 172.4 | 160.6 | 138.5 | 148.7 |
| Tare (g) | 10.4 | 10.2 | 9.9 | 10.3 | 12.0 | 10.5 | 10.0 |
| Water (g) | 25.5 | 10.8 | 20.7 | 18.7 | 15.9 | 11.8 | 29.8 |
| Dry Soil (g) | 147.4 | 168.6 | 137.1 | 162.1 | 148.6 | 128.0 | 138.7 |
| Water Content (%) | **17.3** | **6.4** | **15.1** | **11.5** | **10.7** | **9.2** | **21.5** |

### MOISTURE CONTENT

| Sample Number | PZ5;0'-5' | PZ6;2'-5' | PZ7;6'-8' |
|---|---|---|---|
| Tare Number | SMS | BC1 | C1 |
| Tare + Wet Soil (g) | 205.9 | 196.3 | 195.3 |
| Tare + Dry Soil (g) | 177.3 | 169.0 | 167.1 |
| Tare (g) | 16.8 | 14.1 | 13.9 |
| Water (g) | 28.6 | 27.3 | 28.2 |
| Dry Soil (g) | 160.5 | 154.9 | 153.2 |
| Water Content (%) | **17.8** | **17.6** | **18.4** |

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** EB2

**DEPTH:** 4'-8'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN & BROWN SANDY LEAN CLAY (CL)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | 81F | TARE NO. | 74 |
| NUMBER OF BLOWS | 21 | TARE + WET SOIL (g) | 17.91 |
| TARE + WET SOIL (g) | 19.21 | TARE + DRY SOIL (g) | 16.74 |
| TARE + DRY SOIL (g) | 16.42 | TARE (g) | 8.01 |
| TARE (g) | 6.78 | DRY SOIL (g) | 8.73 |
| WATER (g) | 2.79 | WATER (g) | 1.17 |
| DRY SOIL (g) | 9.64 | WATER CONTENT (%) | 13.40 |
| WATER CONTENT (%) | 28.9 | PLASTIC LIMIT | **13** |
| LIQUID LIMIT | **28** | | |

**LIQUID LIMIT:** **28** **PLASTIC LIMIT:** **13**

**PLASTICITY INDEX:** **15**

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 0.4 | 0.4 | 0 | 100 | N/A |
| #10 | 0.7 | 1.1 | 0 | 100 | N/A |
| #40 | 35.2 | 36.3 | 7 | 93 | N/A |
| #200 | 186.6 | 222.9 | 40.9 | 59.1 | N/A |
| **Original Sample Weight:** | | 545.0 | | | |

**Percent Gravel:** 0.1
**Percent Sand:** 40.8
**Percent Silt/Clay:** 59.1

## UNIFIED SOIL CLASSIFICATION (USCS): CL

ANDERSON ENGINEERING CONSULTANTS, INC.
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# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** EB3

**DEPTH:** 0'-3'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN LEAN CLAY W/ SAND (CL)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | FAJ | TARE NO. | 48 |
| NUMBER OF BLOWS | 29 | TARE + WET SOIL (g) | 17.66 |
| TARE + WET SOIL (g) | 24.82 | TARE + DRY SOIL (g) | 16.39 |
| TARE + DRY SOIL (g) | 20.55 | TARE (g) | 8.00 |
| TARE (g) | 8.18 | DRY SOIL (g) | 8.39 |
| WATER (g) | 4.27 | WATER (g) | 1.27 |
| DRY SOIL (g) | 12.37 | WATER CONTENT (%) | 15.14 |
| WATER CONTENT (%) | 34.5 | PLASTIC LIMIT | **15** |
| LIQUID LIMIT | **35** | | |

**LIQUID LIMIT:** 35 **PLASTIC LIMIT:** 15

**PLASTICITY INDEX:** 20

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 1.4 | 1.4 | 0 | 100 | N/A |
| #10 | 1.0 | 2.4 | 0 | 100 | N/A |
| #40 | 35.5 | 37.9 | 7 | 93 | N/A |
| #200 | 109.3 | 147.2 | 28.5 | 71.5 | N/A |
| **Original Sample Weight:** | | 515.6 | | | |

**Percent Gravel:** 0.3
**Percent Sand:** 28.3
**Percent Silt/Clay:** 71.5

## UNIFIED SOIL CLASSIFICATION (USCS): CL

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** EB3

**DEPTH:** 10'-14'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN SANDY LEAN CLAY (CL)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

**LIQUID LIMIT DETERMINATION**

| | |
|---|---|
| TARE NO. | 65 |
| NUMBER OF BLOWS | 25 |
| TARE + WET SOIL (g) | 18.16 |
| TARE + DRY SOIL (g) | 15.73 |
| TARE (g) | 7.79 |
| WATER (g) | 2.43 |
| DRY SOIL (g) | 7.94 |
| WATER CONTENT (%) | 30.6 |
| LIQUID LIMIT | **31** |

**PLASTIC LIMIT DETERMINATION**

| | |
|---|---|
| TARE NO. | 63 |
| TARE + WET SOIL (g) | 18.45 |
| TARE + DRY SOIL (g) | 17.17 |
| TARE (g) | 8.26 |
| DRY SOIL (g) | 8.91 |
| WATER (g) | 1.28 |
| WATER CONTENT (%) | 14.37 |
| PLASTIC LIMIT | **14** |

**LIQUID LIMIT:** 31 **PLASTIC LIMIT:** 14

**PLASTICITY INDEX:** 16

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 0.2 | 0.2 | 0 | 100 | N/A |
| #10 | 3.0 | 3.2 | 1 | 99 | N/A |
| #40 | 80.8 | 84.0 | 16 | 84 | N/A |
| #200 | 144.7 | 228.7 | 43.0 | 57.0 | N/A |
| **Original Sample Weight:** | | 532.2 | | | |

**Percent Gravel:** 0.0
**Percent Sand:** 42.9
**Percent Silt/Clay:** 57.0

**UNIFIED SOIL CLASSIFICATION (USCS):** CL

**ANDERSON ENGINEERING CONSULTANTS, INC.**
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775
**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** EB3
**DEPTH:** 25'-27'
**SOURCE:** BULK
**MATERIAL DESCRIPTION:** REDDISH BROWN POORLY GRADED SAND W/ SILT (SP-SM)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | | TARE NO. | |
| NUMBER OF BLOWS | | TARE + WET SOIL (g) | |
| TARE + WET SOIL (g) | | TARE + DRY SOIL (g) | |
| TARE + DRY SOIL (g) | | TARE (g) | |
| TARE (g) | | DRY SOIL (g) | |
| WATER (g) | | WATER (g) | |
| DRY SOIL (g) | | WATER CONTENT (%) | |
| WATER CONTENT (%) | | PLASTIC LIMIT | CNBD |
| LIQUID LIMIT | CNBD | | |

**LIQUID LIMIT:** CNBD **PLASTIC LIMIT:** CNBD
**PLASTICITY INDEX:** NON-PLASTIC

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 5.5 | 5.5 | 1 | 99 | N/A |
| #10 | 26.6 | 32.1 | 6 | 94 | N/A |
| #40 | 317.0 | 349.1 | 62 | 38 | N/A |
| #200 | 159.7 | 508.8 | 89.8 | 10.2 | N/A |
| **Original Sample Weight:** | | 566.4 | | | |

**Percent Gravel:** 1.0
**Percent Sand:** 88.9
**Percent Silt/Clay:** 10.2

## UNIFIED SOIL CLASSIFICATION (USCS): SP-SM

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** EB4

**DEPTH:** 10'-12'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN SILTY SAND (SM)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | | TARE NO. | |
| NUMBER OF BLOWS | | TARE + WET SOIL (g) | |
| TARE + WET SOIL (g) | | TARE + DRY SOIL (g) | |
| TARE + DRY SOIL (g) | | TARE (g) | |
| TARE (g) | | DRY SOIL (g) | |
| WATER (g) | | WATER (g) | |
| DRY SOIL (g) | | WATER CONTENT (%) | |
| WATER CONTENT (%) | | PLASTIC LIMIT | CNBD |
| LIQUID LIMIT | CNBD | | |

**LIQUID LIMIT:** CNBD **PLASTIC LIMIT:** CNBD

**PLASTICITY INDEX:** NON-PLASTIC

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 3.6 | 3.6 | 1 | 99 | N/A |
| #10 | 3.2 | 6.8 | 1 | 99 | N/A |
| #40 | 0.9 | 7.7 | 1 | 99 | N/A |
| #200 | 272.1 | 279.8 | 52.1 | 47.9 | N/A |

**Original Sample Weight:** 537.3

**Percent Gravel:** 0.7
**Percent Sand:** 51.4
**Percent Silt/Clay:** 47.9

**UNIFIED SOIL CLASSIFICATION (USCS):** SM

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** EB6

**DEPTH:** 0'-5'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN & BROWN SANDY LEAN CLAY (CL)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | LTB | TARE NO. | 97 |
| NUMBER OF BLOWS | 24 | TARE + WET SOIL (g) | 18.02 |
| TARE + WET SOIL (g) | 24.43 | TARE + DRY SOIL (g) | 16.73 |
| TARE + DRY SOIL (g) | 20.39 | TARE (g) | 8.23 |
| TARE (g) | 6.86 | DRY SOIL (g) | 8.50 |
| WATER (g) | 4.04 | WATER (g) | 1.29 |
| DRY SOIL (g) | 13.53 | WATER CONTENT (%) | 15.18 |
| WATER CONTENT (%) | 29.9 | PLASTIC LIMIT | **15** |
| LIQUID LIMIT | **30** | | |

**LIQUID LIMIT:** 30 **PLASTIC LIMIT:** 15

**PLASTICITY INDEX:** 15

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 0.9 | 0.9 | 0 | 100 | N/A |
| #10 | 1.2 | 2.1 | 0 | 100 | N/A |
| #40 | 30.4 | 32.5 | 6 | 94 | N/A |
| #200 | 195.9 | 228.4 | 42.4 | 57.6 | N/A |
| **Original Sample Weight:** | | 538.7 | | | |

**Percent Gravel:** 0.2
**Percent Sand:** 42.2
**Percent Silt/Clay:** 57.6

## UNIFIED SOIL CLASSIFICATION (USCS): CL

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** EB6

**DEPTH:** 20'-25'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN POORLY GRADED SAND W/ SILT (SP-SM)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

**LIQUID LIMIT DETERMINATION**

| | |
|---|---|
| TARE NO. | |
| NUMBER OF BLOWS | |
| TARE + WET SOIL (g) | |
| TARE + DRY SOIL (g) | |
| TARE (g) | |
| WATER (g) | |
| DRY SOIL (g) | |
| WATER CONTENT (%) | |
| LIQUID LIMIT | CNBD |

**PLASTIC LIMIT DETERMINATION**

| | |
|---|---|
| TARE NO. | |
| TARE + WET SOIL (g) | |
| TARE + DRY SOIL (g) | |
| TARE (g) | |
| DRY SOIL (g) | |
| WATER (g) | |
| WATER CONTENT (%) | |
| PLASTIC LIMIT | CNBD |

**LIQUID LIMIT:** CNBD **PLASTIC LIMIT:** CNBD

**PLASTICITY INDEX:** NON-PLASTIC

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 0.0 | 0.0 | 0 | 100 | N/A |
| #10 | 0.0 | 0.0 | 0 | 100 | N/A |
| #40 | 19.4 | 19.4 | 4 | 96 | N/A |
| #200 | 475.4 | 494.8 | 93.0 | 7.0 | N/A |
| Original Sample Weight: | | 532.2 | | | |

**Percent Gravel:** 0.0
**Percent Sand:** 93.0
**Percent Silt/Clay:** 7.0

## UNIFIED SOIL CLASSIFICATION (USCS): SP-SM

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** EB7

**DEPTH:** 5'-10'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN & BROWN SANDY LEAN CLAY (CL)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|---|
| TARE NO. | 430 | | TARE NO. | XA |
| NUMBER OF BLOWS | 21 | | TARE + WET SOIL (g) | 18.13 |
| TARE + WET SOIL (g) | 24.08 | | TARE + DRY SOIL (g) | 16.78 |
| TARE + DRY SOIL (g) | 19.93 | | TARE (g) | 8.01 |
| TARE (g) | 6.94 | | DRY SOIL (g) | 8.77 |
| WATER (g) | 4.15 | | WATER (g) | 1.35 |
| DRY SOIL (g) | 12.99 | | WATER CONTENT (%) | 15.39 |
| WATER CONTENT (%) | 31.9 | | PLASTIC LIMIT | **15** |
| LIQUID LIMIT | **31** | | | |

**LIQUID LIMIT:** 31 **PLASTIC LIMIT:** 15

**PLASTICITY INDEX:** 16

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 1.7 | 1.7 | 0 | 100 | N/A |
| #10 | 1.3 | 3.0 | 1 | 99 | N/A |
| #40 | 22.6 | 25.6 | 5 | 95 | N/A |
| #200 | 136.9 | 162.5 | 31.3 | 68.7 | N/A |
| **Original Sample Weight:** | | 518.6 | | | |

**Percent Gravel:** 0.3
**Percent Sand:** 31.0
**Percent Silt/Clay:** 68.7

## UNIFIED SOIL CLASSIFICATION (USCS): CL

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** EB8

**DEPTH:** 15'-20'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN SILTY SAND (SM)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | | TARE NO. | |
| NUMBER OF BLOWS | | TARE + WET SOIL (g) | |
| TARE + WET SOIL (g) | | TARE + DRY SOIL (g) | |
| TARE + DRY SOIL (g) | | TARE (g) | |
| TARE (g) | | DRY SOIL (g) | |
| WATER (g) | | WATER (g) | |
| DRY SOIL (g) | | WATER CONTENT (%) | |
| WATER CONTENT (%) | | PLASTIC LIMIT | CNBD |
| LIQUID LIMIT | CNBD | | |

**LIQUID LIMIT:** CNBD **PLASTIC LIMIT:** CNBD

**PLASTICITY INDEX:** NON-PLASTIC

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 2.2 | 2.2 | 0 | 100 | N/A |
| #10 | 2.8 | 5.0 | 1 | 99 | N/A |
| #40 | 92.3 | 97.3 | 17 | 83 | N/A |
| #200 | 233.2 | 330.5 | 58.1 | 41.9 | N/A |
| **Original Sample Weight:** | | 569.0 | | | |

**Percent Gravel:** 0.4
**Percent Sand:** 57.7
**Percent Silt/Clay:** 41.9

## UNIFIED SOIL CLASSIFICATION (USCS): SM

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** EB9

**DEPTH:** 5'-8'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN & BROWN SANDY LEAN CLAY (CL)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

**LIQUID LIMIT DETERMINATION**

| | |
|---|---|
| TARE NO. | 18 |
| NUMBER OF BLOWS | 28 |
| TARE + WET SOIL (g) | 19.18 |
| TARE + DRY SOIL (g) | 17.16 |
| TARE (g) | 8.16 |
| WATER (g) | 2.02 |
| DRY SOIL (g) | 9.00 |
| WATER CONTENT (%) | 22.4 |
| LIQUID LIMIT | **23** |

**PLASTIC LIMIT DETERMINATION**

| | |
|---|---|
| TARE NO. | 76 |
| TARE + WET SOIL (g) | 17.54 |
| TARE + DRY SOIL (g) | 16.31 |
| TARE (g) | 7.84 |
| DRY SOIL (g) | 8.47 |
| WATER (g) | 1.23 |
| WATER CONTENT (%) | 14.52 |
| PLASTIC LIMIT | **15** |

**LIQUID LIMIT:** 23 **PLASTIC LIMIT:** 15

**PLASTICITY INDEX:** 8

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 0.0 | 0.0 | 0 | 100 | N/A |
| #10 | 0.8 | 0.8 | 0 | 100 | N/A |
| #40 | 14.5 | 15.3 | 3 | 97 | N/A |
| #200 | 255.2 | 270.5 | 49.4 | 50.6 | N/A |
| **Original Sample Weight:** | | 547.6 | | | |

**Percent Gravel:** 0.0
**Percent Sand:** 49.4
**Percent Silt/Clay:** 50.6

## UNIFIED SOIL CLASSIFICATION (USCS): CL

## CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
### ASTM D 2487
### (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL　　**JOB NO.:** 15775
**LOCATION:** SPENCER, OKLAHOMA　　**DATE:** 05/11/20

**SAMPLE NO.:** PZ1
**DEPTH:** 10'-13'
**SOURCE:** BULK
**MATERIAL DESCRIPTION:** REDDISH BROWN SANDY SILT (ML)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | | TARE NO. | |
| NUMBER OF BLOWS | | TARE + WET SOIL (g) | |
| TARE + WET SOIL (g) | | TARE + DRY SOIL (g) | |
| TARE + DRY SOIL (g) | | TARE (g) | |
| TARE (g) | | DRY SOIL (g) | |
| WATER (g) | | WATER (g) | |
| DRY SOIL (g) | | WATER CONTENT (%) | |
| WATER CONTENT (%) | | PLASTIC LIMIT | CNBD |
| LIQUID LIMIT | CNBD | | |

**LIQUID LIMIT:** CNBD　　**PLASTIC LIMIT:** CNBD
**PLASTICITY INDEX:** NON-PLASTIC

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 0.4 | 0.4 | 0 | 100 | N/A |
| #10 | 0.7 | 1.1 | 0 | 100 | N/A |
| #40 | 35.2 | 36.3 | 7 | 93 | N/A |
| #200 | 186.6 | 222.9 | 40.9 | 59.1 | N/A |
| **Original Sample Weight:** | | 545.0 | | | |

**Percent Gravel:** 0.1
**Percent Sand:** 40.8
**Percent Silt/Clay:** 59.1

## UNIFIED SOIL CLASSIFICATION (USCS): ML

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775
**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** PZ2
**DEPTH:** 2'-5'
**SOURCE:** BULK
**MATERIAL DESCRIPTION:** BROWN & REDDISH BROWN SANDY SILTY CLAY (CL-ML)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | MC | TARE NO. | 56 |
| NUMBER OF BLOWS | 23 | TARE + WET SOIL (g) | 18.18 |
| TARE + WET SOIL (g) | 20.36 | TARE + DRY SOIL (g) | 16.75 |
| TARE + DRY SOIL (g) | 17.98 | TARE (g) | 8.04 |
| TARE (g) | 7.85 | DRY SOIL (g) | 8.71 |
| WATER (g) | 2.38 | WATER (g) | 1.43 |
| DRY SOIL (g) | 10.13 | WATER CONTENT (%) | 16.42 |
| WATER CONTENT (%) | 23.5 | PLASTIC LIMIT | **16** |
| LIQUID LIMIT | **23** | | |

**LIQUID LIMIT:** 23 **PLASTIC LIMIT:** 16
**PLASTICITY INDEX:** 7

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 3.3 | 3.3 | 1 | 99 | N/A |
| #10 | 2.6 | 5.9 | 1 | 99 | N/A |
| #40 | 17.1 | 23.0 | 4 | 96 | N/A |
| #200 | 244.8 | 267.8 | 48.6 | 51.4 | N/A |
| **Original Sample Weight:** | | 550.8 | | | |

**Percent Gravel:** 0.6
**Percent Sand:** 48.0
**Percent Silt/Clay:** 51.4

## UNIFIED SOIL CLASSIFICATION (USCS): CL-ML

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** PZ2

**DEPTH:** 15'-17'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN SILTY SAND (SM)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | | TARE NO. | |
| NUMBER OF BLOWS | | TARE + WET SOIL (g) | |
| TARE + WET SOIL (g) | | TARE + DRY SOIL (g) | |
| TARE + DRY SOIL (g) | | TARE (g) | |
| TARE (g) | | DRY SOIL (g) | |
| WATER (g) | | WATER (g) | |
| DRY SOIL (g) | | WATER CONTENT (%) | |
| WATER CONTENT (%) | | PLASTIC LIMIT | CNBD |
| LIQUID LIMIT | CNBD | | |

**LIQUID LIMIT:** CNBD **PLASTIC LIMIT:** CNBD

**PLASTICITY INDEX:** NON-PLASTIC

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 0.0 | 0.0 | 0 | 100 | N/A |
| #10 | 0.8 | 0.8 | 0 | 100 | N/A |
| #40 | 2.6 | 3.4 | 1 | 99 | N/A |
| #200 | 366.1 | 369.5 | 66.6 | 33.4 | N/A |
| **Original Sample Weight:** | | 554.7 | | | |

**Percent Gravel:** 0.0
**Percent Sand:** 66.6
**Percent Silt/Clay:** 33.4

**UNIFIED SOIL CLASSIFICATION (USCS):** SM

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL — **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA — **DATE:** 05/11/20

**SAMPLE NO.:** PZ4

**DEPTH:** 5'-10'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN CLAYEY SAND (SC)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | 17 | TARE NO. | 33 |
| NUMBER OF BLOWS | 24 | TARE + WET SOIL (g) | 17.92 |
| TARE + WET SOIL (g) | 24.27 | TARE + DRY SOIL (g) | 16.68 |
| TARE + DRY SOIL (g) | 20.98 | TARE (g) | 8.42 |
| TARE (g) | 7.92 | DRY SOIL (g) | 8.26 |
| WATER (g) | 3.29 | WATER (g) | 1.24 |
| DRY SOIL (g) | 13.06 | WATER CONTENT (%) | 15.01 |
| WATER CONTENT (%) | 25.2 | PLASTIC LIMIT | **15** |
| LIQUID LIMIT | **25** | | |

**LIQUID LIMIT:** 25 **PLASTIC LIMIT:** 15

**PLASTICITY INDEX:** 10

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 0.5 | 0.5 | 0 | 100 | N/A |
| #10 | 20.9 | 21.4 | 3 | 97 | N/A |
| #40 | 239.0 | 260.4 | 34 | 66 | N/A |
| #200 | 230.1 | 490.5 | 64.4 | 35.6 | N/A |
| **Original Sample Weight:** | | 762.0 | | | |

**Percent Gravel:** 0.1
**Percent Sand:** 64.3
**Percent Silt/Clay:** 35.6

**UNIFIED SOIL CLASSIFICATION (USCS):** SC

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** PZ5

**DEPTH:** 0'-5'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** BROWN & REDDISH BROWN SANDY LEAN CLAY (CL)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | 68A | TARE NO. | 67 |
| NUMBER OF BLOWS | 23 | TARE + WET SOIL (g) | 18.05 |
| TARE + WET SOIL (g) | 20.02 | TARE + DRY SOIL (g) | 16.65 |
| TARE + DRY SOIL (g) | 17.55 | TARE (g) | 7.57 |
| TARE (g) | 8.09 | DRY SOIL (g) | 9.08 |
| WATER (g) | 2.47 | WATER (g) | 1.40 |
| DRY SOIL (g) | 9.46 | WATER CONTENT (%) | 15.42 |
| WATER CONTENT (%) | 26.1 | PLASTIC LIMIT | **15** |
| LIQUID LIMIT | **26** | | |

**LIQUID LIMIT:** 26 **PLASTIC LIMIT:** 15

**PLASTICITY INDEX:** 10

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 2.3 | 2.3 | 0 | 100 | N/A |
| #10 | 5.6 | 7.9 | 1 | 99 | N/A |
| #40 | 50.7 | 58.6 | 11 | 89 | N/A |
| #200 | 133.7 | 192.3 | 36.4 | 63.6 | N/A |
| **Original Sample Weight:** | | 528.4 | | | |

| | |
|---|---|
| **Percent Gravel:** | 0.4 |
| **Percent Sand:** | 36.0 |
| **Percent Silt/Clay:** | 63.6 |

## UNIFIED SOIL CLASSIFICATION (USCS): CL

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

## CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
### (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** PZ6

**DEPTH:** 2'-5'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN & BROWN SANDY LEAN CLAY (CL)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | |
|---|---|
| TARE NO. | 024 |
| NUMBER OF BLOWS | 21 |
| TARE + WET SOIL (g) | 22.05 |
| TARE + DRY SOIL (g) | 17.90 |
| TARE (g) | 6.93 |
| WATER (g) | 4.15 |
| DRY SOIL (g) | 10.97 |
| WATER CONTENT (%) | 37.8 |
| **LIQUID LIMIT** | **37** |

| PLASTIC LIMIT DETERMINATION | |
|---|---|
| TARE NO. | 75 |
| TARE + WET SOIL (g) | 17.66 |
| TARE + DRY SOIL (g) | 16.38 |
| TARE (g) | 7.99 |
| DRY SOIL (g) | 8.39 |
| WATER (g) | 1.28 |
| WATER CONTENT (%) | 15.26 |
| **PLASTIC LIMIT** | **15** |

**LIQUID LIMIT: 37** **PLASTIC LIMIT: 15**

**PLASTICITY INDEX: 22**

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 0.0 | 0.0 | 0 | 100 | N/A |
| #10 | 0.8 | 0.8 | 0 | 100 | N/A |
| #40 | 29.2 | 30.0 | 6 | 94 | N/A |
| #200 | 129.2 | 159.2 | 31.2 | 68.8 | N/A |
| **Original Sample Weight:** | | 510.9 | | | |

**Percent Gravel:** 0.0
**Percent Sand:** 31.2
**Percent Silt/Clay:** 68.8

## UNIFIED SOIL CLASSIFICATION (USCS): CL

Geotechnical Engineering – Environmental Assessments – Quality Control of Construction Materials

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
## ASTM D 2487
## (UNIFIED SOIL CLASSIFICATION SYSTEM)

**PROJECT:** WCA NORTHEAST C & D LANDFILL **JOB NO.:** 15775

**LOCATION:** SPENCER, OKLAHOMA **DATE:** 05/11/20

**SAMPLE NO.:** PZ7

**DEPTH:** 6'-8'

**SOURCE:** BULK

**MATERIAL DESCRIPTION:** REDDISH BROWN & BROWN LEAN CLAY W/ SAND (CL)

## LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
### ASTM D 4318

| LIQUID LIMIT DETERMINATION | | PLASTIC LIMIT DETERMINATION | |
|---|---|---|---|
| TARE NO. | 008 | TARE NO. | GI |
| NUMBER OF BLOWS | 24 | TARE + WET SOIL (g) | 16.94 |
| TARE + WET SOIL (g) | 25.66 | TARE + DRY SOIL (g) | 15.70 |
| TARE + DRY SOIL (g) | 21.37 | TARE (g) | 7.76 |
| TARE (g) | 8.06 | DRY SOIL (g) | 7.94 |
| WATER (g) | 4.29 | WATER (g) | 1.24 |
| DRY SOIL (g) | 13.31 | WATER CONTENT (%) | 15.62 |
| WATER CONTENT (%) | 32.2 | PLASTIC LIMIT | **16** |
| LIQUID LIMIT | **32** | | |

**LIQUID LIMIT: 32** **PLASTIC LIMIT: 16**

**PLASTICITY INDEX: 16**

## PARTICLE SIZE ANALYSIS OF SOILS
### ASTM D 422 / D 1140

| Sieve or Screen | Weight Retained (Grams) | Cummulative Weight Retained (Grams) | Percent Retained | Percent Finer | Specification |
|---|---|---|---|---|---|
| 1.5" | 0.0 | 0.0 | 0 | 100 | N/A |
| 3/4" | 0.0 | 0.0 | 0 | 100 | N/A |
| #4 | 0.0 | 0.0 | 0 | 100 | N/A |
| #10 | 0.2 | 0.2 | 0 | 100 | N/A |
| #40 | 20.4 | 20.6 | 4 | 96 | N/A |
| #200 | 123.8 | 144.4 | 28.0 | 72.0 | N/A |

**Original Sample Weight:** 516.1

**Percent Gravel:** 0.0
**Percent Sand:** 28.0
**Percent Silt/Clay:** 72.0

**UNIFIED SOIL CLASSIFICATION (USCS):** CL

ANDERSON ENGINEERING CONSULTANTS, INC.
LITTLE ROCK ▲ JONESBORO ▲ HOPE

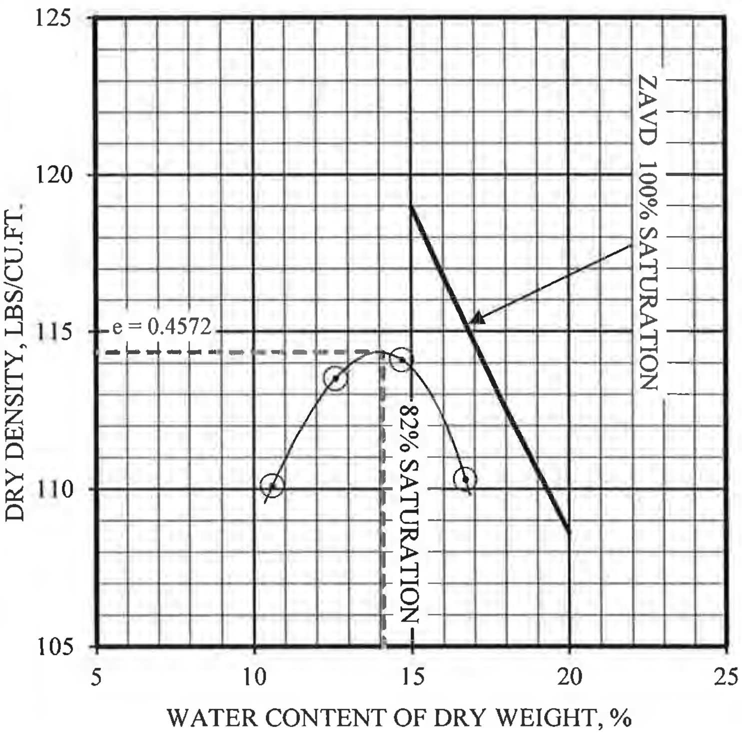
# PROCTOR COMPACTION TEST

**Project:** WCA NORTHEAST C & D LANDFILL  **Date:** 05/11/20
**Location:** SPENCER, OKLAHOMA  **AECI Job No.:** 15775
**Source:** EB7;5'-10'

**Sample Description:** REDDISH BROWN & BROWN SANDY LEAN CLAY (CL)

[X] **STANDARD COMPACTION** ASTM D 698
[ ] **MODIFIED COMPACTION** ASTM D 1557

Volume of Mold
0.0332 Cu.Ft.

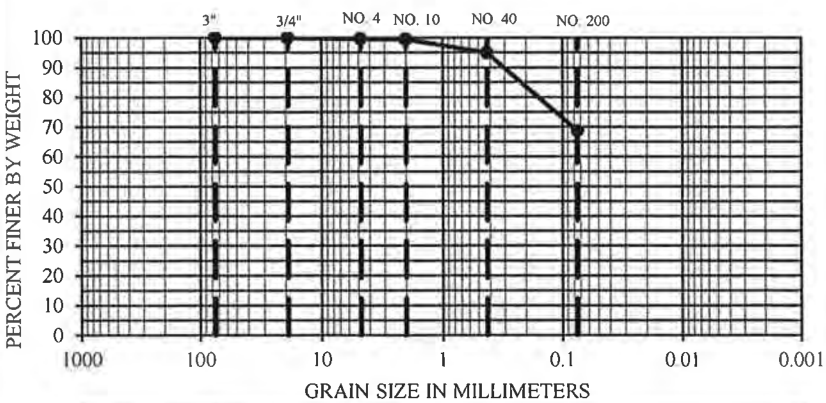



## SAMPLE INFORMATION

| | |
|---|---|
| Proctor No.: | 1 |
| - #40 Classification:* | CL |
| USCS Classification: | CL |
| Sp. Gr. (G):** | 2.67 |
| Liquid Limit: | 31 |
| Plastic Limit: | 15 |
| Plasticity Index: | 16 |
| **Opt. Water Content, %:** | **14.1** |
| **Max. Dry Density, pcf:** | **114.3** |

As-Received Moisture Content = 17.3%
* Based on ASTM D 2487
** Assumed Specific Gravity

U.S STANDARD SIEVE SIZES




| COBBLE | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | COARSE | FINE | CRS | MEDIUM | FINE | |

## SAMPLE GRADATION

| Sieve (mm) | Passing (%) |
|---|---|
| 3" (75) | 100 |
| 3/4" (19) | 100 |
| #4 (4.75) | 100 |
| #10 (2) | 99 |
| #40 (0.425) | 95 |
| #200 (0.075) | 69 |

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LITTLE ROCK ⅄ JONESBORO ⅄ HOPE

# PROCTOR COMPACTION TEST

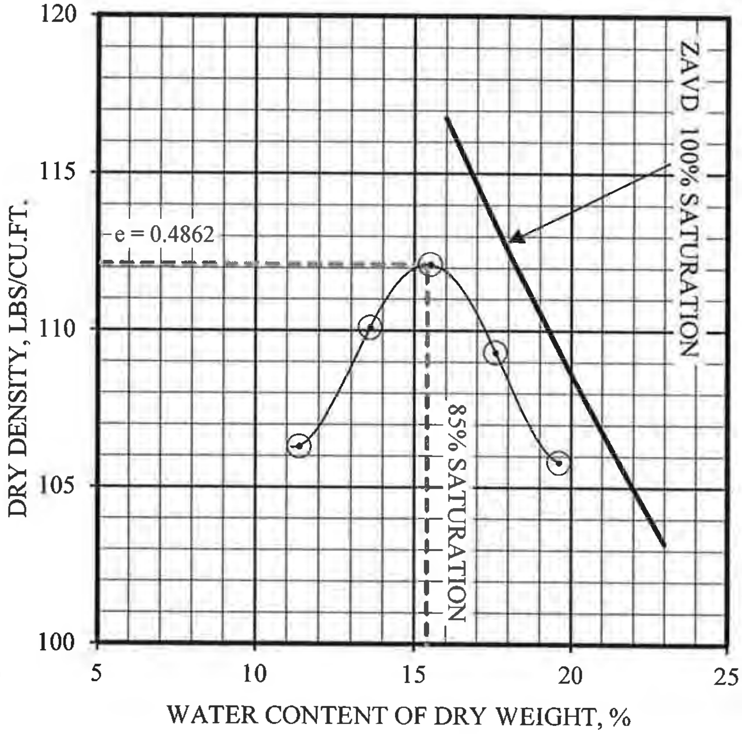
**Project:** WCA NORTHEAST C & D LANDFILL
**Location:** SPENCER, OKLAHOMA
**Source:** PZ6;2'-5'

**Date:** 07/14/20
**AECI Job No.:** 15775

**Sample Description:** REDDISH BROWN & BROWN SANDY LEAN CLAY (CL)

[X] **STANDARD COMPACTION** ASTM D 698
[ ] **MODIFIED COMPACTION** ASTM D 1557

Volume of Mold
0.0332 Cu.Ft.

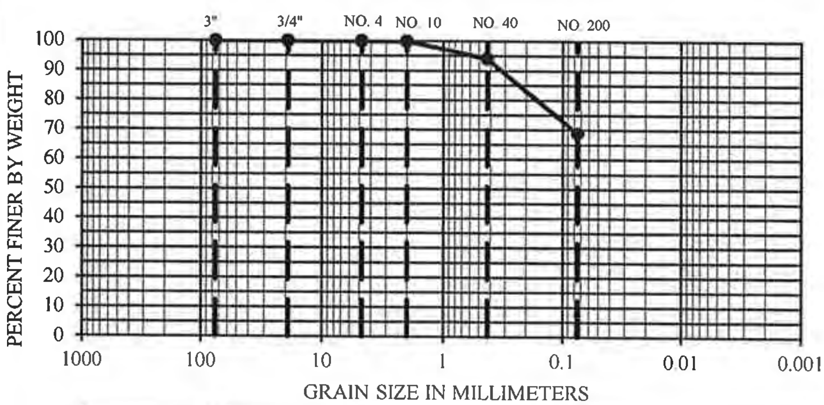



## SAMPLE INFORMATION

| | |
|---|---|
| Proctor No.: | 2 |
| - #40 Classification:* | CL |
| USCS Classification: | CL |
| Sp. Gr. (G):** | 2.67 |
| Liquid Limit: | 37 |
| Plastic Limit: | 15 |
| Plasticity Index: | 22 |
| **Opt. Water Content, %:** | **15.4** |
| **Max. Dry Density, pcf:** | **112.1** |

As-Received Moisture Content = 17.6%
* Based on ASTM D 2487
** Assumed Specific Gravity

U.S STANDARD SIEVE SIZES




| COBBLE | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | COARSE | FINE | CRS | MEDIUM | FINE | |

## SAMPLE GRADATION

| Sieve (mm) | Passing (%) |
|---|---|
| 3" (75) | 100 |
| 3/4" (19) | 100 |
| #4 (4.75) | 100 |
| #10 (2) | 100 |
| #40 (0.425) | 94 |
| #200 (0.075) | 69 |

AECI COPYRIGHT 2020

# COEFFICIENT OF PERMEABILITY
# (CONSTANT HEAD)
# ASTM D 5084 - FLEXIBLE WALL

| | | | |
|---|---|---|---|
| **Project:** | WCA NORTHEAST C & D LANDFILL | **Project No.:** | 15775 |
| **Location:** | SPENCER, OKLAHOMA | **Date:** | |
| **Sample No.:** | EB7 | **Sample Depth:** | 5'-10' |
| **Soil Description:** | REDDISH BROWN & BROWN SANDY LEAN CLAY (CL) | | |
| **Elevation:** | NA | **Lift No.:** | NA |

## CLASSIFICATION DATA

| | | | |
|---|---|---|---|
| Liquid Limit: | 31 | - No. 4 Sieve: | 100% |
| Plastic Limit: | 15 | - No. 40 Sieve: | 95% |
| PI: | 16 | - No. 200 Sieve: | 69% |

USCS Classification: CL

Percent Dry Density: 95.2

## PHYSICAL PROPERTIES

| | | | |
|---|---|---|---|
| Diameter, Inch.................. | 2.800 | Diameter, Cm................ | 7.11 |
| Height, Inch...................... | 2.800 | Height, Cm.................... | 7.11 |
| Area, Square Inch............. | 6.16 | Area Sq. Cm................ | 39.73 |
| Volume, Cubic Inch........... | 17.24 | Volume, Cubic Cm.......... | 282.58 |
| Initial Wt., Gram............... | 571.3 | Est. SP. GR..................... | 2.67 |
| Water Content................... | **16.0** | Void Ratio...................... | 0.5317 |
| Wet Unit Wt., PCF........... | **126.2** | Water Head: | |
| Dry Unit Wt., PCF............ | **108.8** | Cm............................... | 140.68 |
| | | Ft................................. | 4.62 |

| TIME, MIN (T) | WATER DEG.,C | TEMP. ++ (RT) | HEAD PRESS psi (h) | FLOW ML (Q) | K20 CM./SEC |
|---|---|---|---|---|---|
| 905 | 24.5 | 0.900 | 2.0 | 0.60 | **1.28E-08** |

# COEFFICIENT OF PERMEABILITY
## (FALLING HEAD)
## ASTM D 5084

| | | | |
|---|---|---|---|
| **Project:** | WCA NORTHEAST C & D LANDFILL | **Project No.:** | 15775 |
| **Location:** | SPENCER, OKLAHOMA | **Date:** | 05/12/20 |
| **Sample No.:** | EB6 | **Sample Depth:** | 20'-25' |
| **Soil Description:** | REDDISH BROWN POORLY GRADED SAND W/ SILT (SP-SM) | | |
| **Elevation:** | NA | **Lift No.:** | NA |

### PHYSICAL PROPERTIES

| | | | |
|---|---|---|---|
| Diameter, Inch | 2.500 | Diameter, Cm | 6.35 |
| Height, Inch | 1.875 | Height, Cm | 4.76 |
| Area, Square Inch | 4.91 | Area Sq. Cm | 31.67 |
| Volume, Cubic Inch | 9.20 | Volume, Cubic Cm | 150.85 |
| Initial Wt., Gram | 305.8 | Burette Area, Sq. Cm | 1.60 |
| Water Content | **21.7** | Est. SP. GR | 2.65 |
| Wet Unit Wt., PCF | **126.6** | Void Ratio | 0.5901 |
| Dry Unit Wt., PCF | **104.0** | | |

| TIME, MIN. (T) | WATER DEG., C | TEMP. ++ (Rt) | HEAD START (hi) | HEAD END (hf) | hi/hf | ln hi/hf | K20* CM./SEC |
|---|---|---|---|---|---|---|---|
| 2 | 21.5 | 0.970 | 191.1 | 147.4 | 1.2968 | 0.2599 | **5.06E-04** |

# COEFFICIENT OF PERMEABILITY
# (CONSTANT HEAD)
# ASTM D 5084 - FLEXIBLE WALL

**Project:** WCA NORTHEAST C & D LANDFILL **Project No.:** 15775
**Location:** SPENCER, OKLAHOMA **Date:** 07/23/20
**Sample No.:** PZ6 **Sample Depth:** 2'-5'
**Soil Description:** REDDISH BROWN & BROWN SANDY LEAN CLAY (CL)
**Elevation:** NA **Lift No.:** NA

## CLASSIFICATION DATA

| | | | |
|---|---|---|---|
| Liquid Limit: | 37 | - No. 4 Sieve: | 100% |
| Plastic Limit: | 15 | - No. 40 Sieve: | 94% |
| PI: | 22 | - No. 200 Sieve: | 69% |

USCS Classification: CL

Percent Dry Density: 95.1

## PHYSICAL PROPERTIES

| | | | |
|---|---|---|---|
| Diameter, Inch.................. | 2.800 | Diameter, Cm................ | 7.11 |
| Height, Inch...................... | 2.800 | Height, Cm.................... | 7.11 |
| Area, Square Inch............. | 6.16 | Area Sq. Cm................ | 39.73 |
| Volume, Cubic Inch.......... | 17.24 | Volume, Cubic Cm.......... | 282.58 |
| Initial Wt., Gram............... | 566.2 | Est. SP. GR..................... | 2.67 |
| Water Content.................. | **17.3** | Void Ratio...................... | 0.5625 |
| Wet Unit Wt., PCF........... | **125.1** | Water Head: | |
| Dry Unit Wt., PCF............ | **106.6** | Cm.............................. | 140.68 |
| | | Ft................................ | 4.62 |

| TIME, MIN (T) | WATER DEG.,C | TEMP. ++ (RT) | HEAD PRESS psi (h) | FLOW ML (Q) | K20 CM./SEC |
|---|---|---|---|---|---|
| 925 | 21.0 | 0.980 | 2.0 | 0.90 | **2.05E-08** |

# COEFFICIENT OF PERMEABILITY
# (FALLING HEAD)
# ASTM D 5084

| | | | |
|---|---|---|---|
| **Project:** | WCA NORTHEAST C & D LANDFILL | **Project No.:** | 15775 |
| **Location:** | SPENCER, OKLAHOMA | **Date:** | 07/23/20 |
| **Sample No.:** | PZ4 | **Sample Depth:** | 5'-10' |
| **Soil Description:** | REDDISH BROWN CLAYEY SAND (SC) | | |
| **Elevation:** | NA | **Lift No.:** | NA |

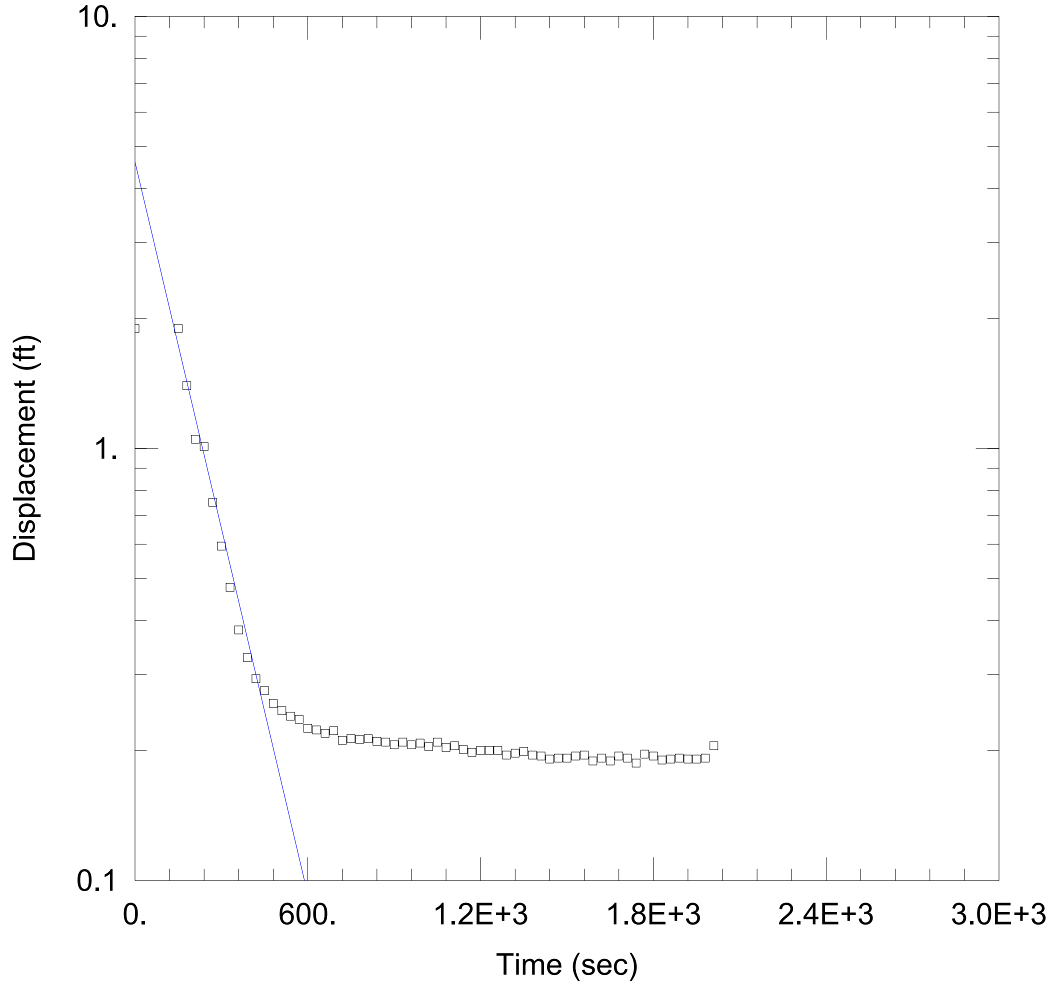
## PHYSICAL PROPERTIES

| | | | |
|---|---|---|---|
| Diameter, Inch.................... | 2.500 | Diameter, Cm....................... | 6.35 |
| Height, Inch........................ | 1.875 | Height, Cm............................ | 4.76 |
| Area, Square Inch............. | 4.91 | Area Sq. Cm........................... | 31.67 |
| Volume, Cubic Inch........... | 9.20 | Volume, Cubic Cm...................... | 150.85 |
| Initial Wt., Gram................ | 340.3 | Burette Area, Sq. Cm........... | 1.60 |
| Water Content.................. | **22.6** | Est. SP. GR............................. | 2.66 |
| Wet Unit Wt., PCF........... | **140.9** | Void Ratio............................ | 0.4453 |
| Dry Unit Wt., PCF............ | **114.8** | | |

| TIME, MIN. (T) | WATER DEG., C | TEMP. ++ (Rt) | HEAD START (hi) | HEAD END (hf) | hi/hf | ln hi/hf | K20* CM./SEC |
|---|---|---|---|---|---|---|---|
| 925 | 21.0 | 0.980 | 191.1 | 178.8 | 1.0688 | 0.0665 | **2.83E-07** |

# Appendix F

# AQTESOLV Analysis Graphs




## WELL TEST ANALYSIS

Data Set: T:\...\PZ-1 Slug In.aqt
Date: 04/15/20 Time: 15:57:01

## PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK

## AQUIFER DATA

Saturated Thickness: 15.52 ft Anisotropy Ratio (Kz/Kr): 1.

## WELL DATA (PZ-1 Slug In)

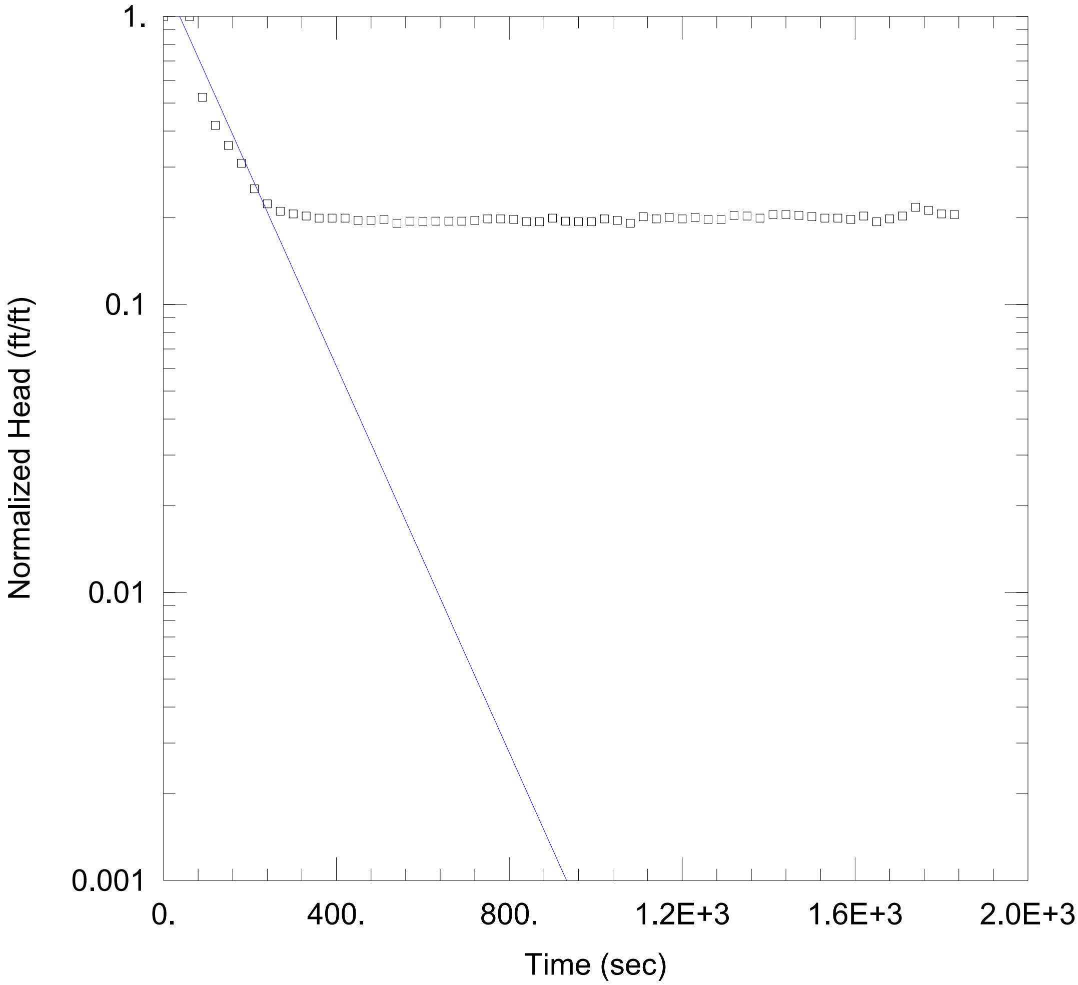
Initial Displacement: 1.895 ft
Total Well Penetration Depth: 10.87 ft
Casing Radius: 0.0853 ft

Static Water Column Height: 10.87 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.2087 ft/day y0 = 4.606 ft




WELL TEST ANALYSIS

Data Set: T:\...\PZ-1 Slug Out.aqt
Date: 04/15/20 Time: 16:29:22

PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK

AQUIFER DATA

Saturated Thickness: 15.52 ft Anisotropy Ratio (Kz/Kr): 1.

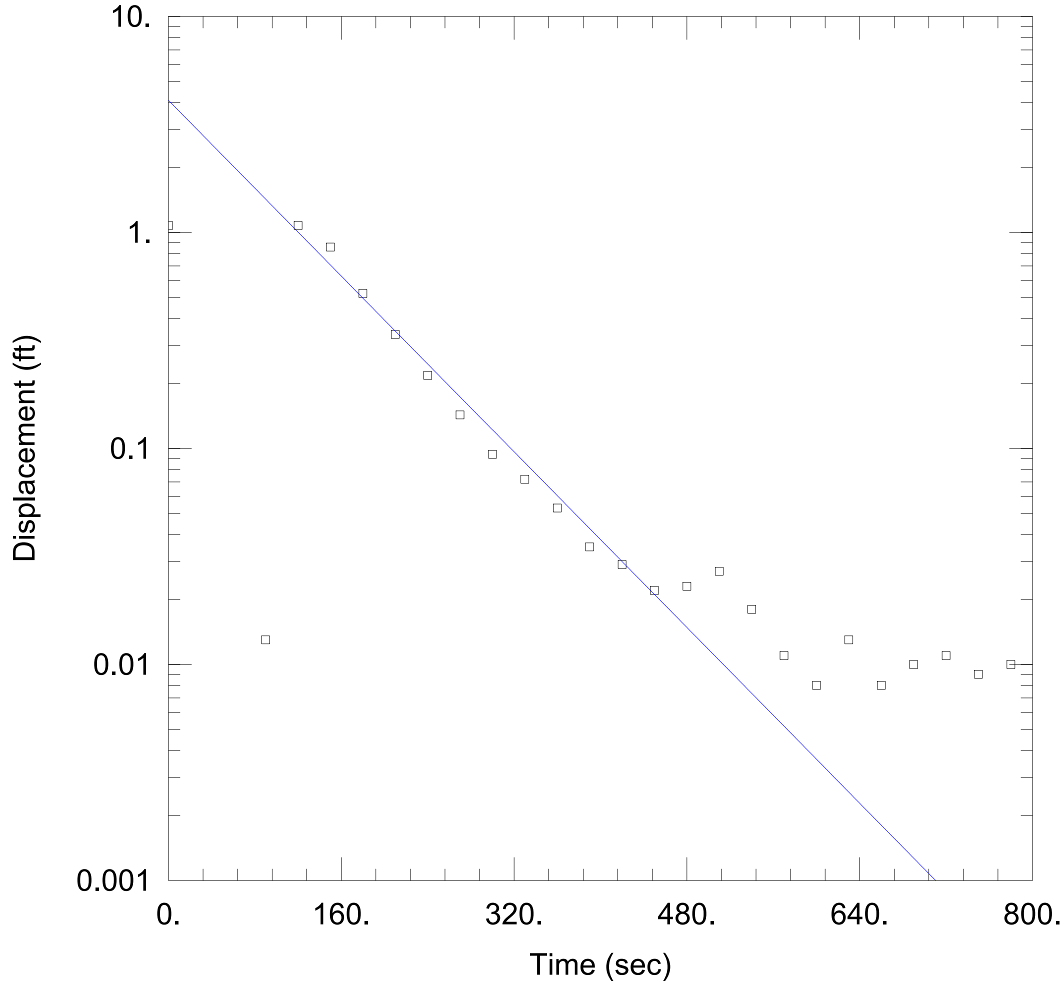
WELL DATA (PZ-1 Slug Out)

Initial Displacement: 0.873 ft
Total Well Penetration Depth: 10.87 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 10.87 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.2474 ft/day y0 = 1.165 ft




WELL TEST ANALYSIS

Data Set: T:\...\PZ-2 Slug In.aqt
Date: 04/15/20
Time: 16:16:47

PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK

AQUIFER DATA

Saturated Thickness: 18. ft
Anisotropy Ratio (Kz/Kr): 1.

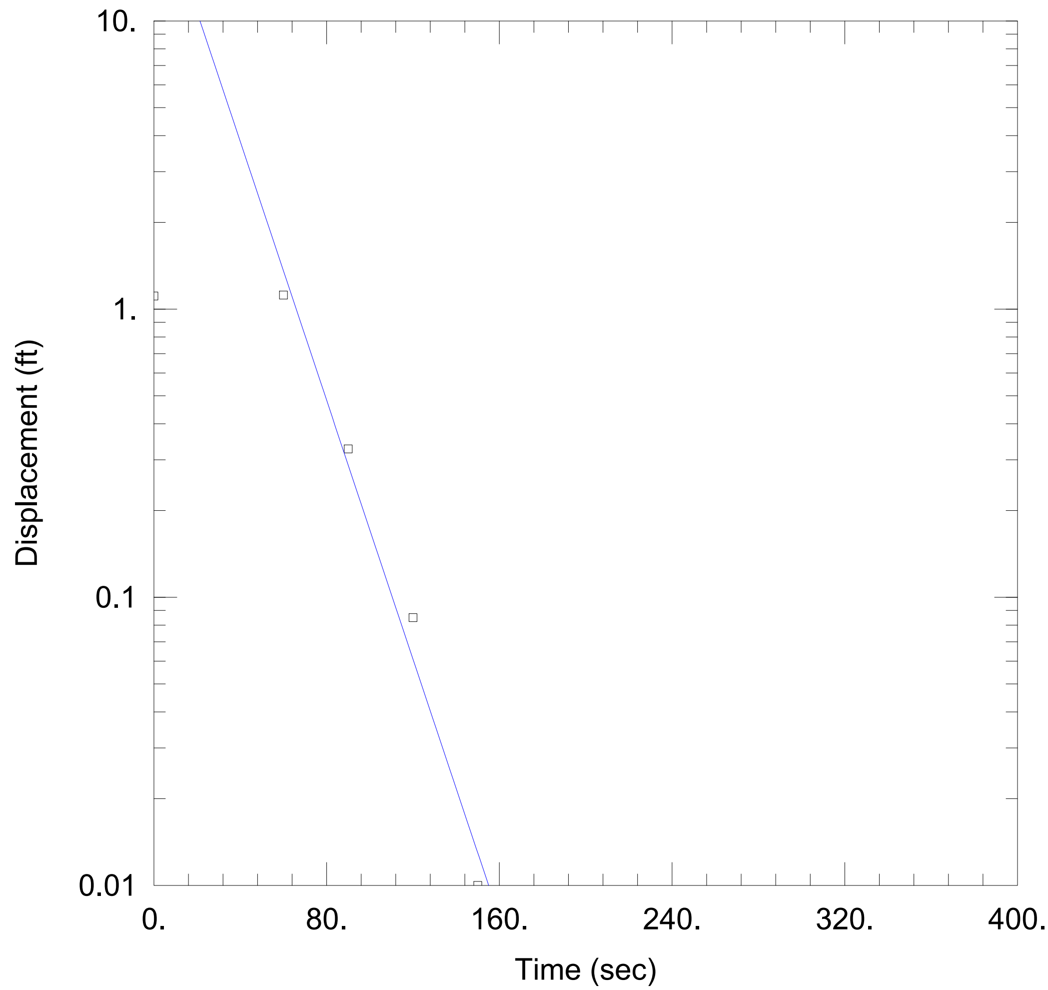
WELL DATA (PZ-2 Slug In)

Initial Displacement: 1.077 ft
Total Well Penetration Depth: 12.18 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 12.18 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.3827 ft/day
y0 = 4.087 ft




WELL TEST ANALYSIS

Data Set: T:\...\PZ-2 Slug Out.aqt
Date: 04/15/20 Time: 16:26:00

PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK

AQUIFER DATA

Saturated Thickness: 18. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-2 Slug Out)

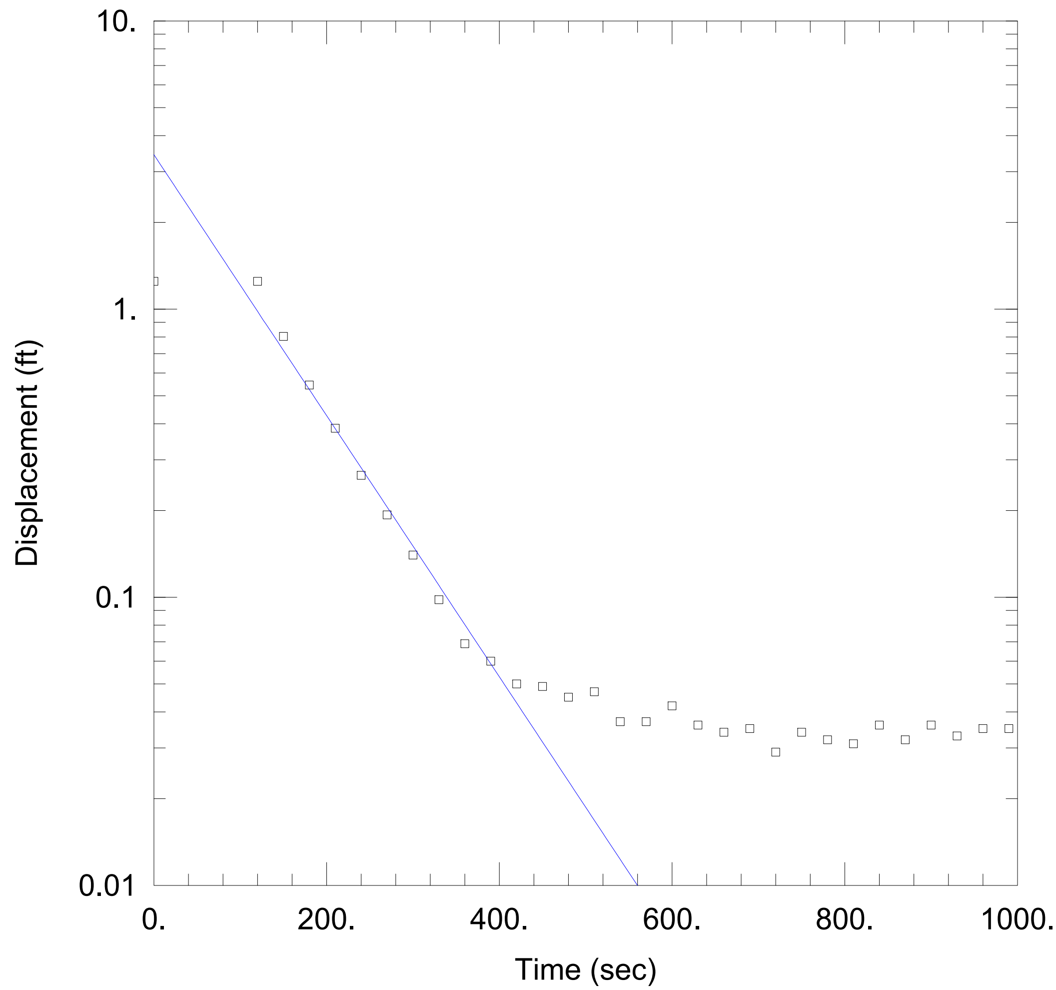
Initial Displacement: 1.11 ft
Total Well Penetration Depth: 12.18 ft
Casing Radius: 0.0853 ft

Static Water Column Height: 12.18 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.689 ft/day y0 = 30.12 ft




WELL TEST ANALYSIS

Data Set: T:\...\PZ-3 Slug In.aqt
Date: 04/15/20 Time: 16:38:53

PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

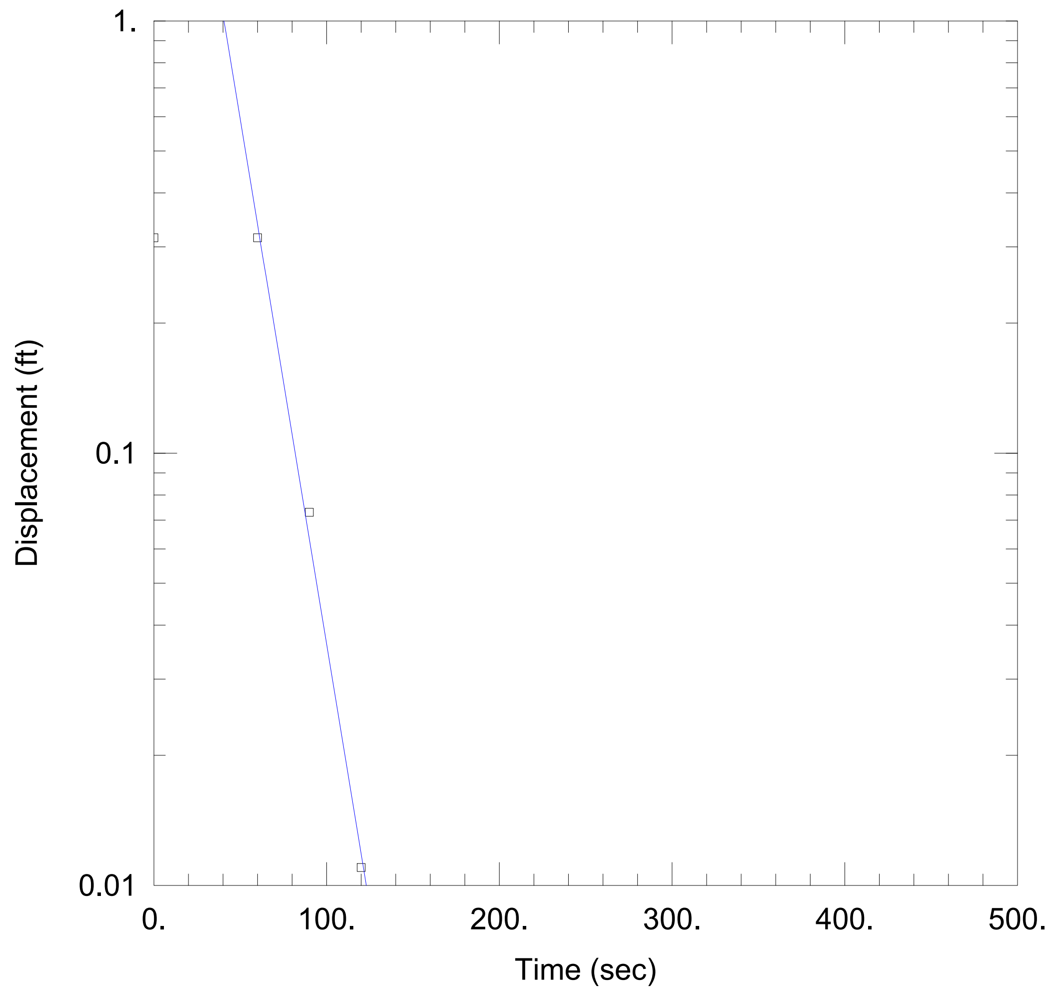
WELL DATA (PZ-3 Slug In )

Initial Displacement: 1.248 ft Static Water Column Height: 9.064 ft
Total Well Penetration Depth: 10. ft Screen Length: 10. ft
Casing Radius: 0.0853 ft Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.3753 ft/day y0 = 3.433 ft




WELL TEST ANALYSIS

Data Set: T:\...\PZ-3 Slug Out.aqt
Date: 04/15/20 Time: 16:43:12

PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

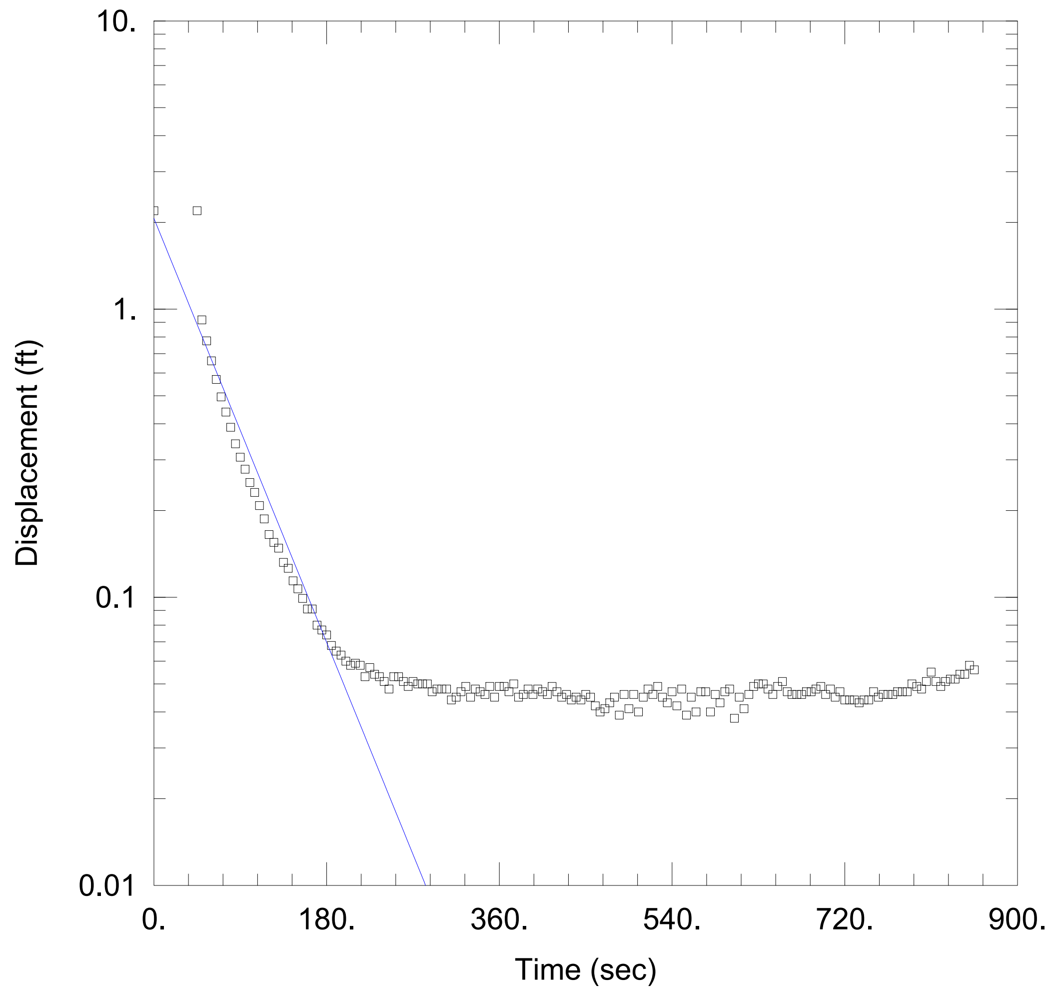
WELL DATA (PZ-3 Slug Out)

Initial Displacement: 0.315 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0853 ft
Static Water Column Height: 9.064 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.013 ft/day y0 = 9.691 ft




WELL TEST ANALYSIS

Data Set: T:\...\PZ-4 Slug In.aqt
Date: 04/16/20 Time: 09:02:47

PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK

AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

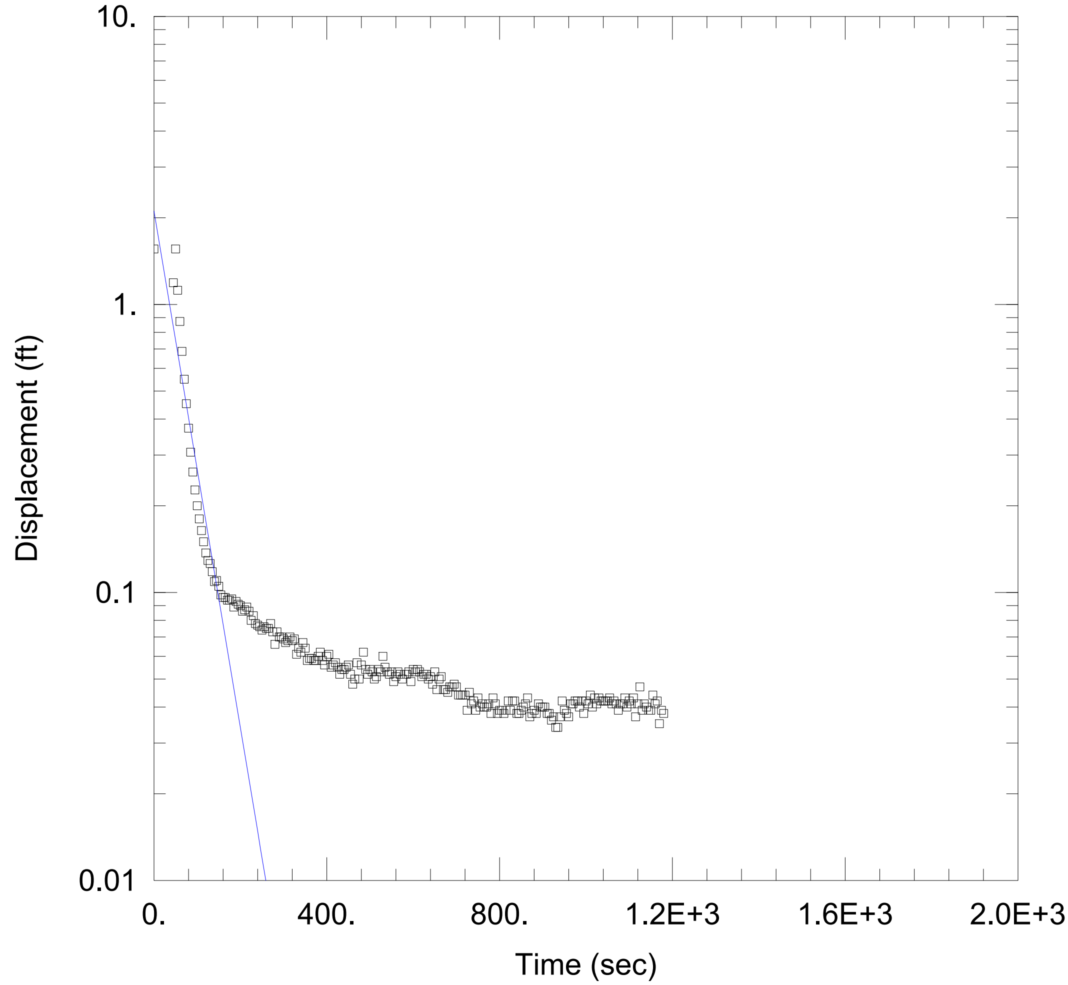
WELL DATA (PZ-4 Slug In)

Initial Displacement: 2.194 ft
Total Well Penetration Depth: 11.49 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 11.49 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.6378 ft/day y0 = 2.064 ft




WELL TEST ANALYSIS

Data Set: T:\...\PZ-4 Slug Out.aqt
Date: 04/16/20 Time: 09:11:38

PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK

AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

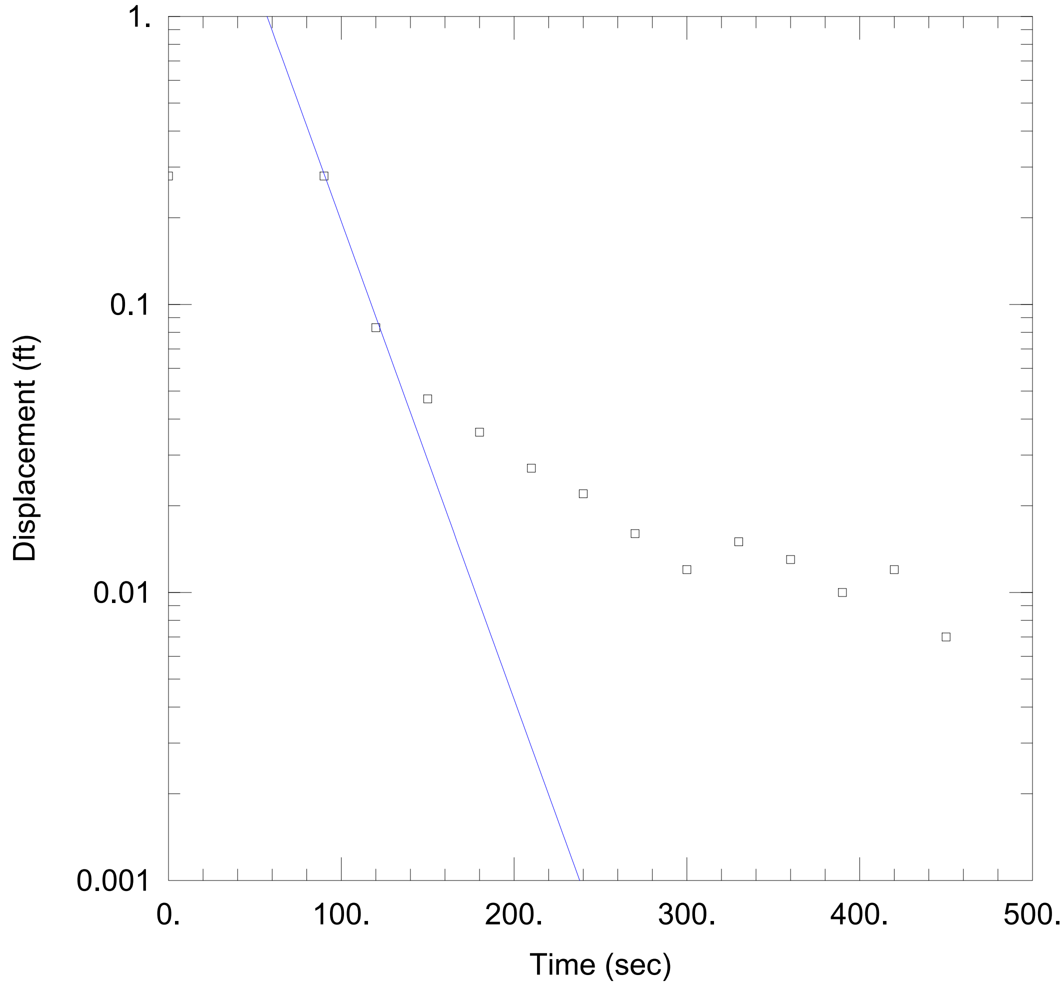
WELL DATA (PZ-4 Slug Out)

Initial Displacement: 1.558 ft
Total Well Penetration Depth: 11.49 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 11.49 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.6998 ft/day y0 = 2.108 ft




## WELL TEST ANALYSIS

Data Set: T:\...\PZ-5 Slug In.aqt
Date: 04/16/20 | Time: 09:35:41

## PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK

## AQUIFER DATA

Saturated Thickness: 13. ft | Anisotropy Ratio (Kz/Kr): 1.

## WELL DATA (PZ-5 Slug In)

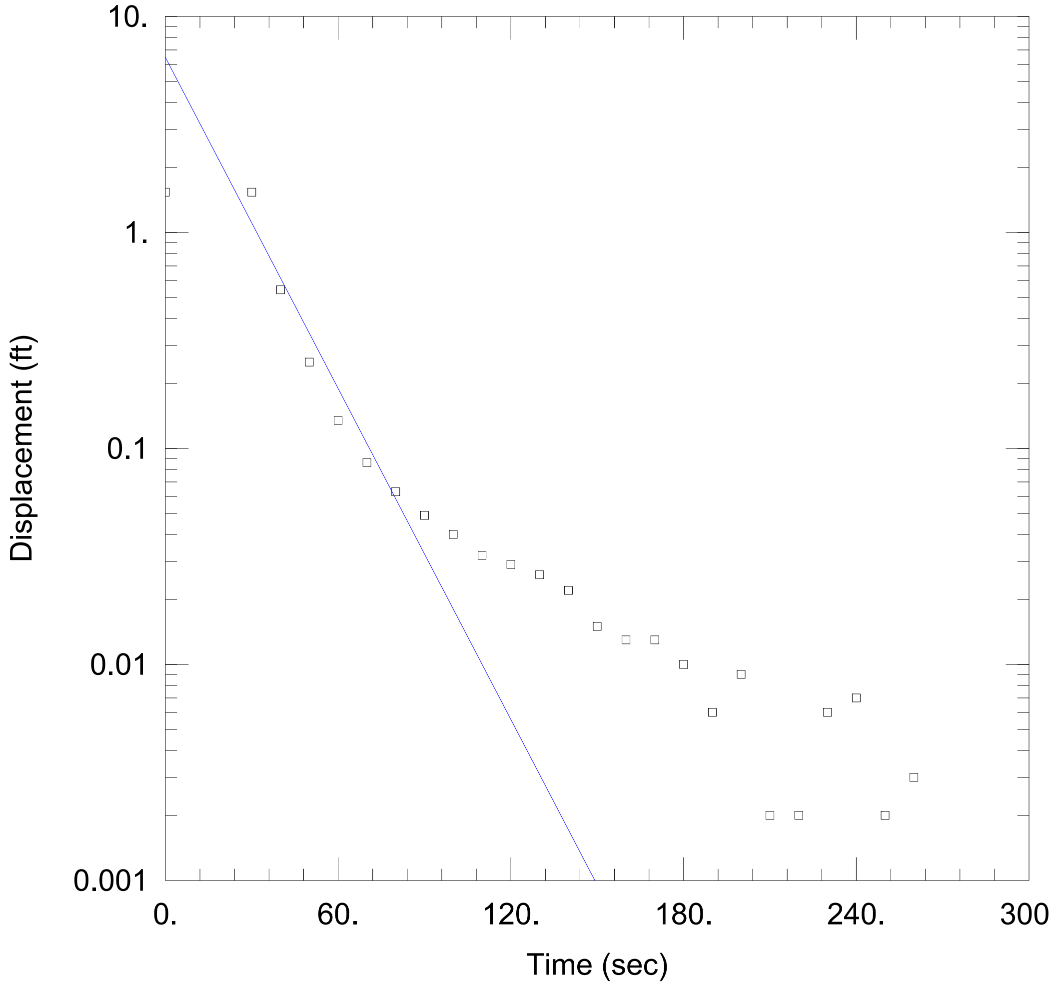
Initial Displacement: 0.279 ft
Total Well Penetration Depth: 10.59 ft
Casing Radius: 0.0853 ft

Static Water Column Height: 10.59 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined | Solution Method: Bouwer-Rice

K = 1.245 ft/day | y0 = 8.822 ft




## WELL TEST ANALYSIS

Data Set: T:\...\PZ-5 Slug Out.aqt
Date: 04/16/20 Time: 09:41:43

## PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK

## AQUIFER DATA

Saturated Thickness: 13. ft Anisotropy Ratio (Kz/Kr): 1.

## WELL DATA (PZ-5 Slug Out)

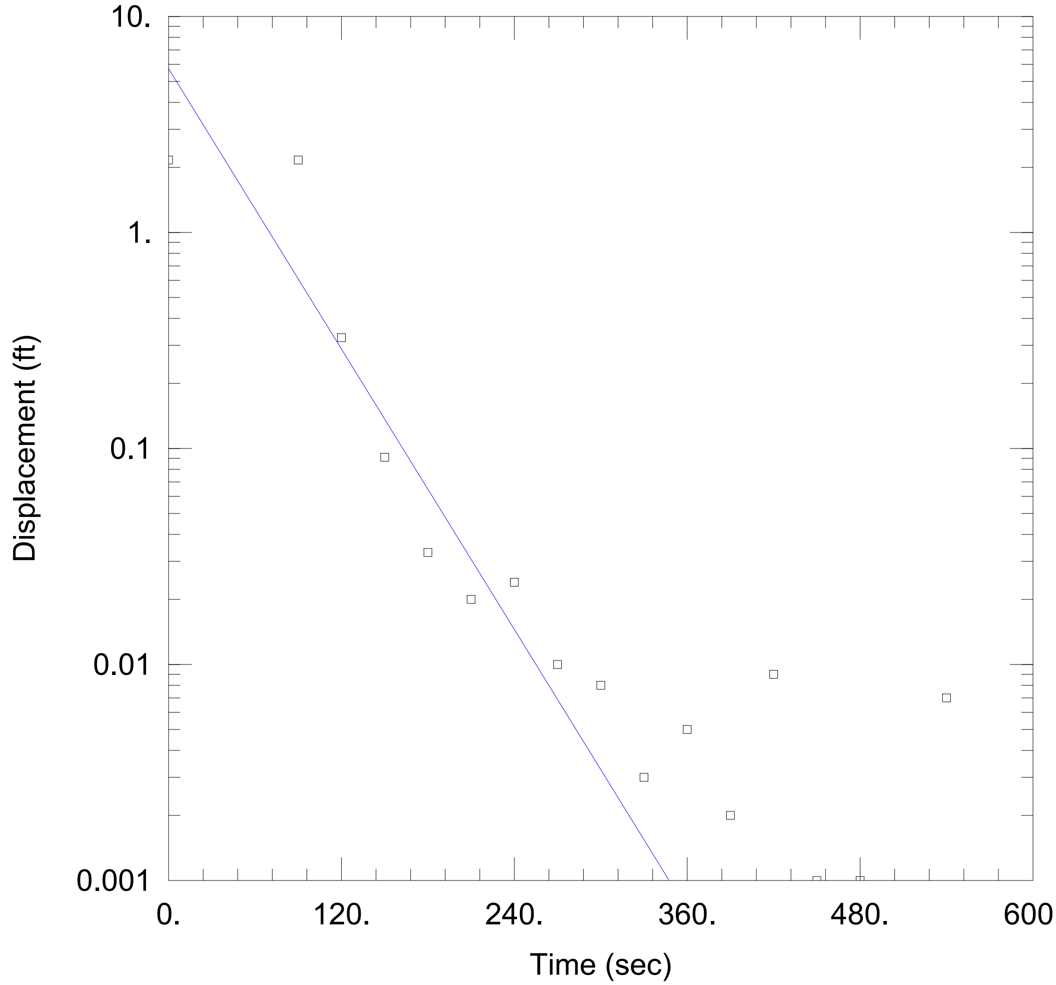
Initial Displacement: 1.536 ft
Total Well Penetration Depth: 10.59 ft
Casing Radius: 0.0853 ft

Static Water Column Height: 10.59 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.918 ft/day y0 = 6.458 ft




WELL TEST ANALYSIS

Data Set: T:\...\PZ-6 Slug In.aqt
Date: 04/16/20 Time: 09:49:21

PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK
Test Date: 4/1/20

AQUIFER DATA

Saturated Thickness: 19. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-6 Slug In)

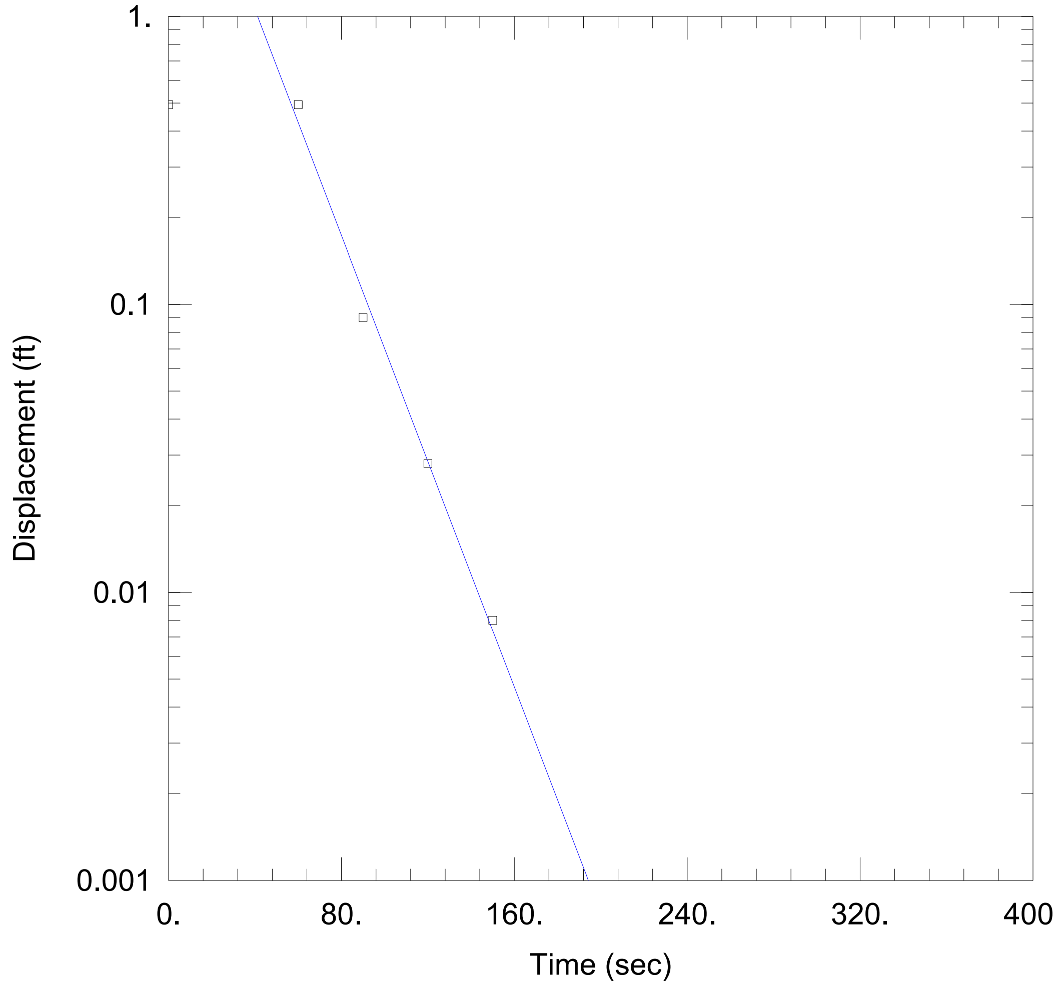
Initial Displacement: 2.164 ft
Total Well Penetration Depth: 20.18 ft
Casing Radius: 0.0853 ft

Static Water Column Height: 20.18 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.076 ft/day
y0 = 5.728 ft




## WELL TEST ANALYSIS

Data Set: T:\...\PZ-6 Slug Out.aqt
Date: 04/16/20 Time: 09:55:21

## PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK
Test Date: 4/1/20

## AQUIFER DATA

Saturated Thickness: 19. ft
Anisotropy Ratio (Kz/Kr): 1.

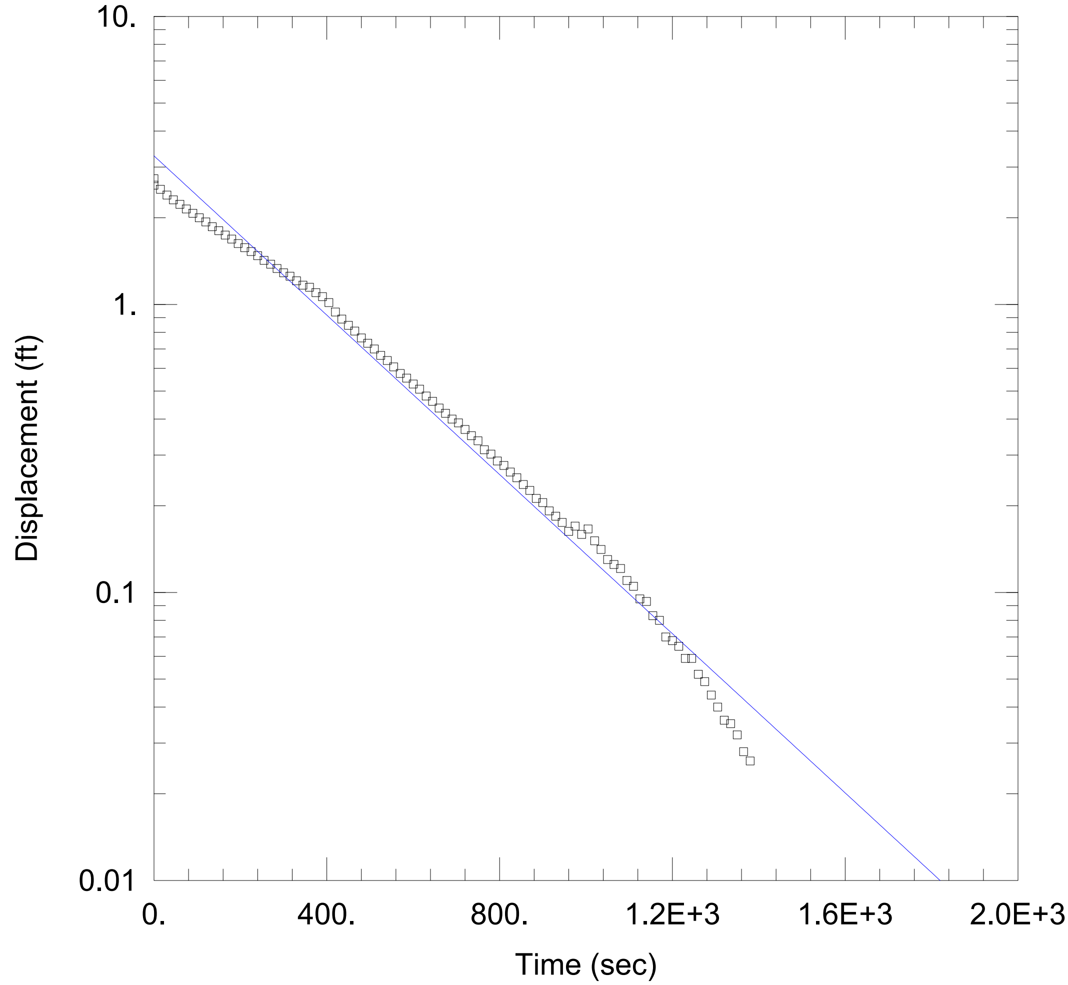
## WELL DATA (PZ-6 Slug Out)

Initial Displacement: 0.494 ft
Total Well Penetration Depth: 20.18 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 20.18 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.949 ft/day
y0 = 6.415 ft




WELL TEST ANALYSIS

Data Set: T:\...\PZ-7 Slug In.aqt
Date: 04/16/20 Time: 10:03:26

PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK
Test Date: 4/1/20

AQUIFER DATA

Saturated Thickness: 12. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-7 Slug In)

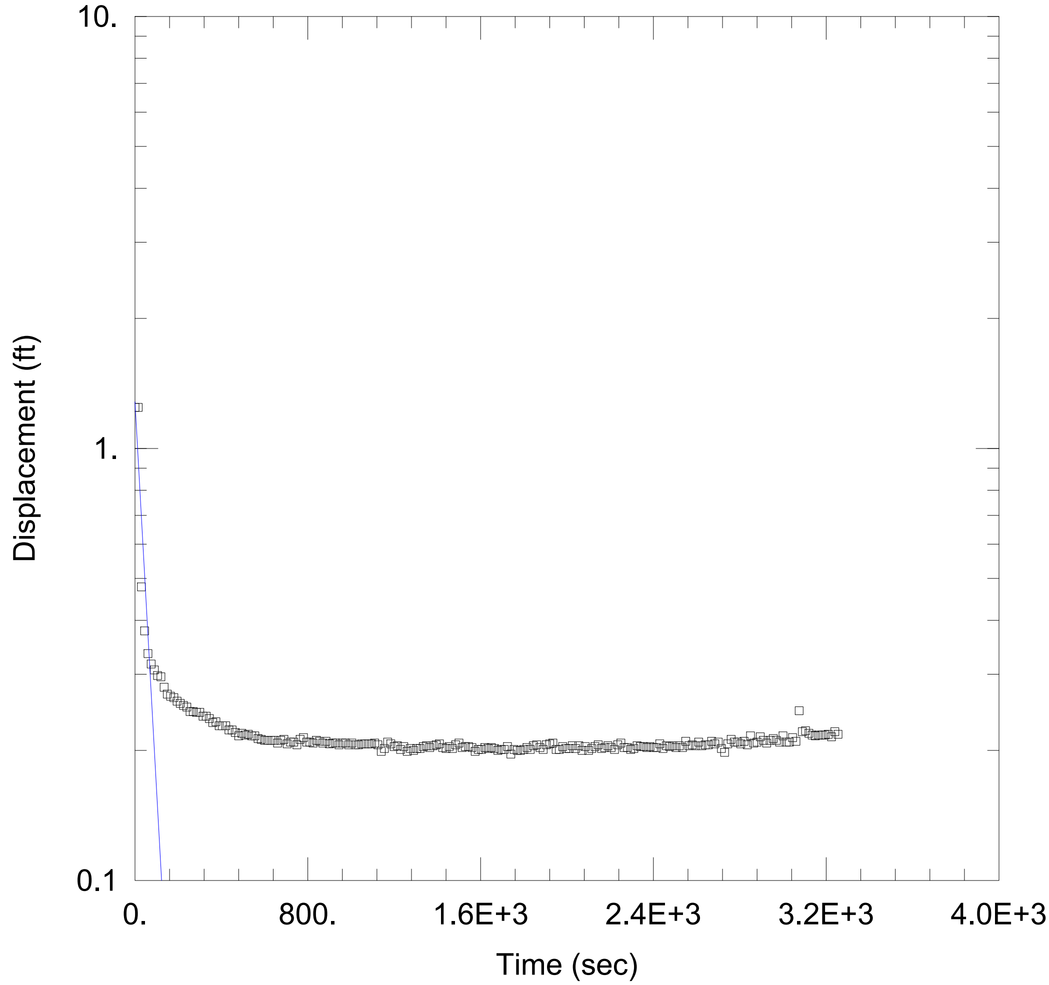
Initial Displacement: 2.732 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0853 ft

Static Water Column Height: 9.878 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.1029 ft/day y0 = 3.279 ft




## WELL TEST ANALYSIS

Data Set: T:\...\PZ-7 Slug Out.aqt
Date: 04/16/20 Time: 10:10:00

## PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK
Test Date: 4/1/20

## AQUIFER DATA

Saturated Thickness: 12. ft Anisotropy Ratio (Kz/Kr): 1.

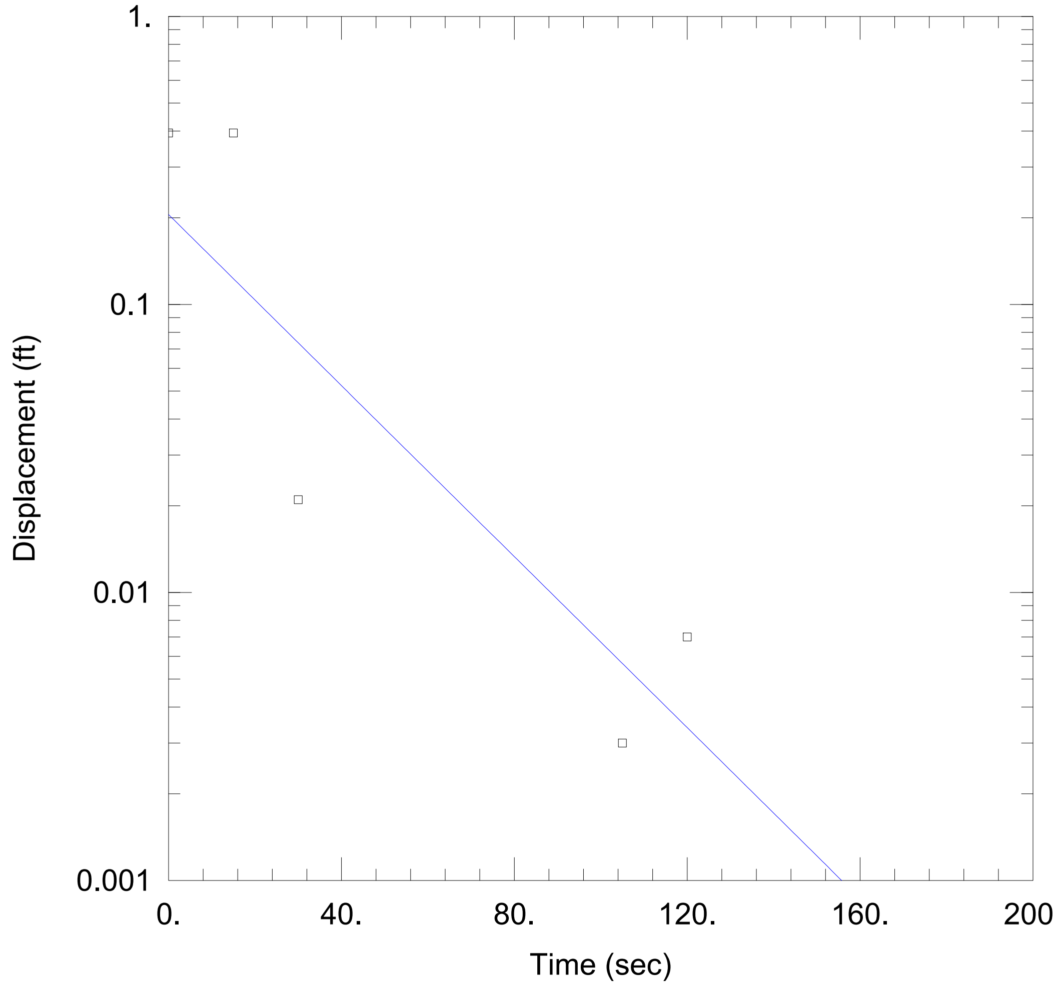
## WELL DATA (PZ-7 Slug Out)

Initial Displacement: 1.245 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0853 ft
Static Water Column Height: 9.878 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.6702 ft/day y0 = 1.282 ft




## WELL TEST ANALYSIS

Data Set: T:\...\MW-3R Slug In.aqt
Date: 04/16/20 Time: 11:42:17

## PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK
Test Date: 4/1/20

## AQUIFER DATA

Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

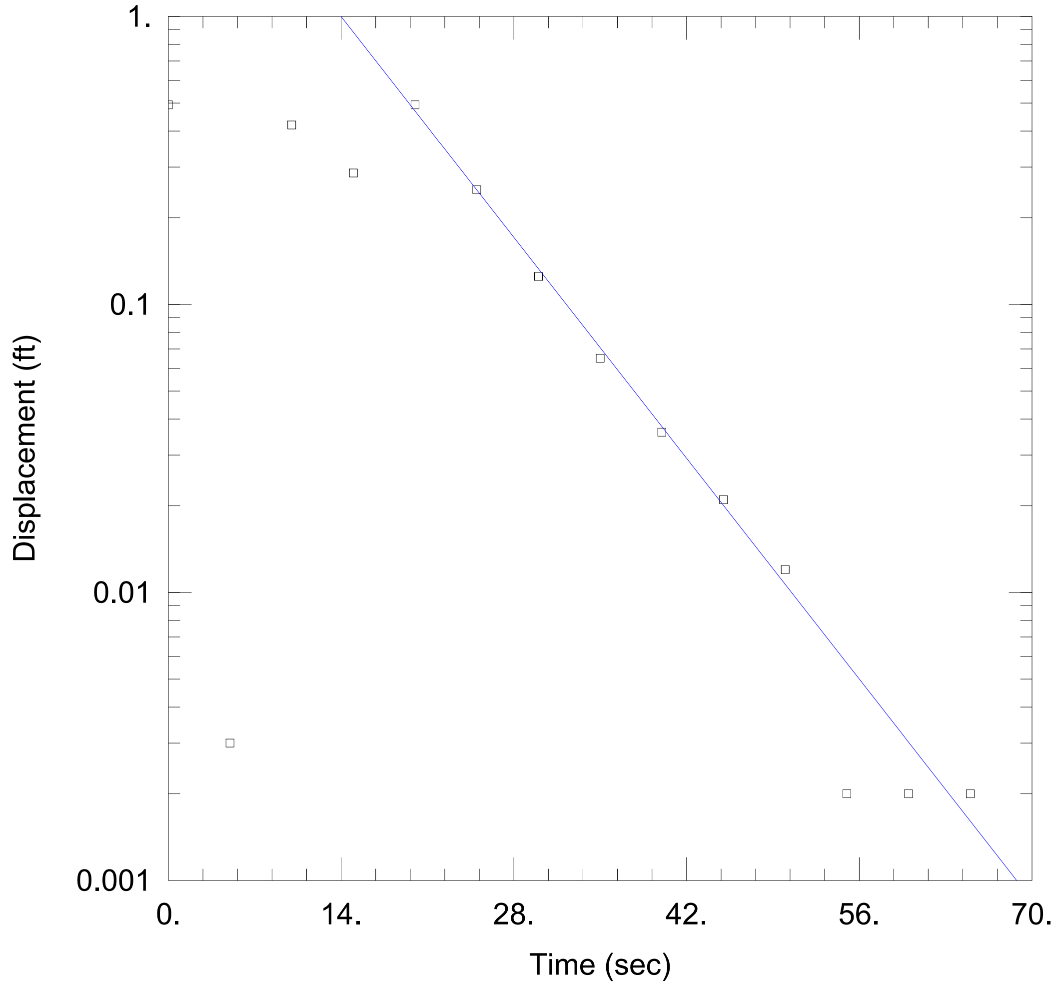
## WELL DATA (MW-3R Slug In)

Initial Displacement: 0.394 ft Static Water Column Height: 22.42 ft
Total Well Penetration Depth: 22.42 ft Screen Length: 10. ft
Casing Radius: 0.0853 ft Well Radius: 0.6875 ft

## SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.511 ft/day y0 = 0.2051 ft




## WELL TEST ANALYSIS

Data Set: T:\...\MW-3R Slug Out.aqt
Date: 04/16/20 Time: 11:47:08

## PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK
Test Date: 4/1/20

## AQUIFER DATA

Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

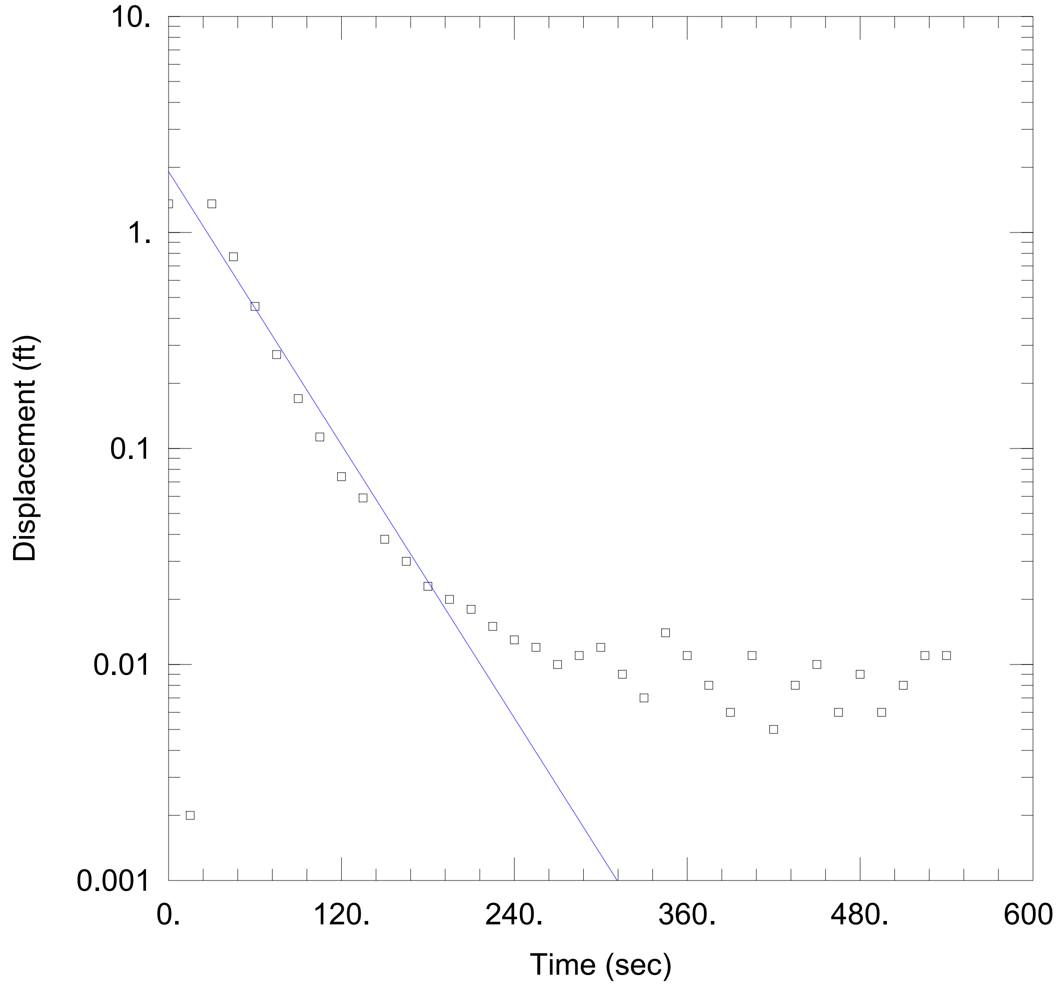
## WELL DATA (MW-3R Slug Out)

Initial Displacement: 0.493 ft
Total Well Penetration Depth: 22.42 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 22.42 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 5.577 ft/day y0 = 5.852 ft




## WELL TEST ANALYSIS

Data Set: T:\...\MW-4R Slug In.aqt
Date: 04/16/20 Time: 11:57:41

## PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK
Test Date: 4/1/20

## AQUIFER DATA

Saturated Thickness: 25. ft Anisotropy Ratio (Kz/Kr): 1.

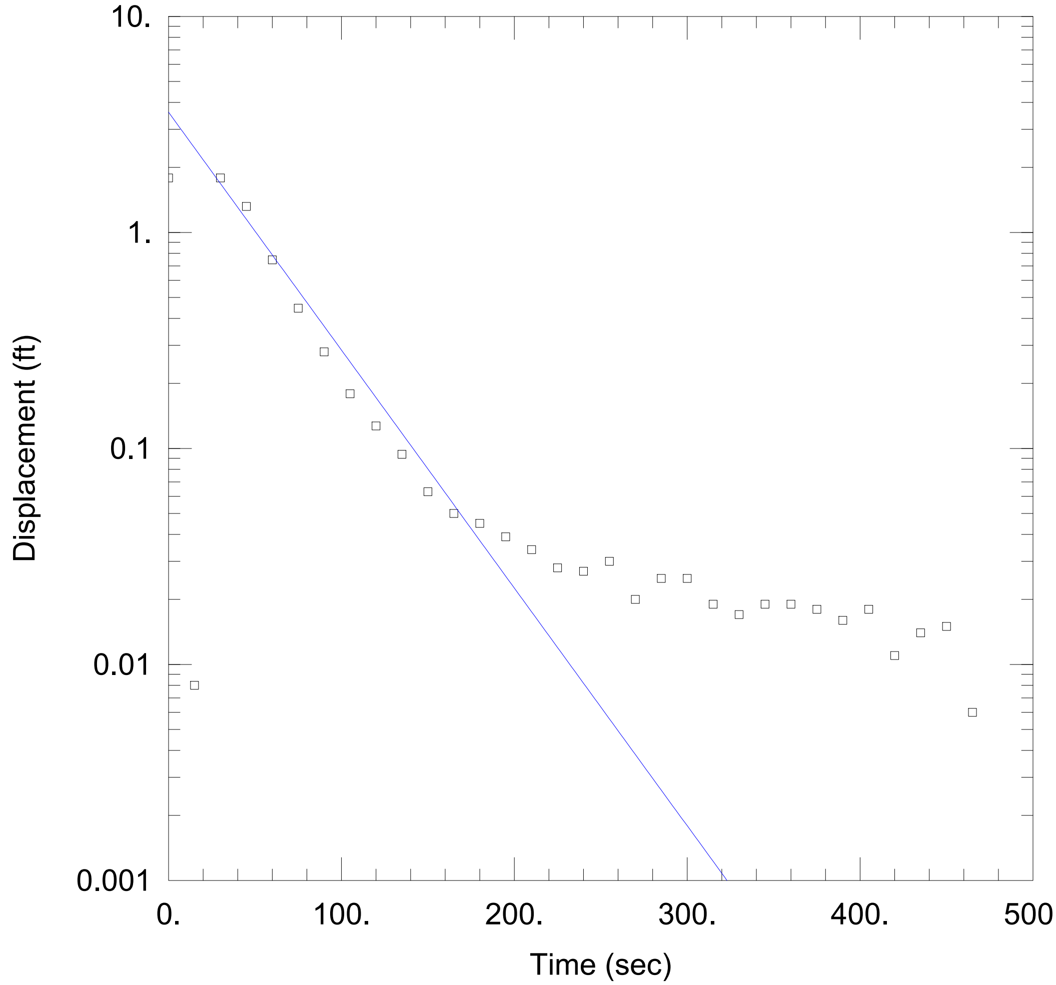
## WELL DATA (MW-4R Slug In)

Initial Displacement: 1.357 ft
Total Well Penetration Depth: 24.83 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 24.83 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.077 ft/day y0 = 1.913 ft




## WELL TEST ANALYSIS

Data Set: T:\...\MW-4R Slug Out.aqt
Date: 04/16/20 Time: 14:10:21

## PROJECT INFORMATION

Company: SCS Engineers
Client: WCA-Northeast Landfill
Project: 16219107.00
Location: Spencer, OK
Test Date: 4/1/20

## AQUIFER DATA

Saturated Thickness: 25. ft Anisotropy Ratio (Kz/Kr): 1.

## WELL DATA (MW-4R Slug Out)

Initial Displacement: 1.787 ft
Total Well Penetration Depth: 24.83 ft
Casing Radius: 0.0853 ft

Static Water Column Height: 24.83 ft
Screen Length: 10. ft
Well Radius: 0.6875 ft
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.124 ft/day y0 = 3.6 ft