July 17, 2019
Cow Palace Safety Debris Catch Basin
Administrative Order on Consent Docket No. SDWA-10-2013-0080

ANCHOR QEA

Cow Palace Safety Debris Catch Basin
Basis of Design Report
100% Design Submittal

Prepared for Cow Palace, LLC

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Basis of Design Report
100% Design Submittal

Prepared for
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Granger, Washington 98932

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Project Number: 190995-01.01
\\tuji\anchor\Projects\Yakima Dairies\SDWA AOC\Engineering\Lagoon Lining Design\2019 Lagoon Design\Cow Palace\SDCB\100% Design\BODR\Cow Palace SDCB BODR_100pct_06192019.docx

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ABBREVIATIONS

ASTM	ASTM International
bgs	below ground surface
Dairy	Cow Palace, LLC
EPA	U.S. Environmental Protection Agency
FML	flexible membrane liner
H:V	horizontal to vertical (ratio)
HDPE	high-density polyethylene
mil	thousandth of an inch
OMMP	*Operations, Maintenance, and Monitoring Plan*
NAVD83	North American Vertical Datum of 1983
psf	pounds per square foot
QA	quality assurance
SDCB	Safety Debris Catch Basin
SPT	standard penetration test
WA NRCS	Washington State Natural Resources Conservation Service

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1 Introduction

1.1 Purpose

This *Basis of Design Report* was prepared by Anchor QEA, LLC, on behalf of Cow Palace, LLC (herein referred to as the Dairy), as required by the U.S. Environmental Protection Agency (EPA) Region 10 Administrative Order on Consent SDWA-10-2013-0080. Under the Consent Order, the Dairy will be lining the following:

- One existing catch basin, historically designated as the Safety Debris Catch Basin (SDCB)

1.2 Design Objective

The objective of the catch basin liner system design is to meet the requirements of Washington State Natural Resources Conservation Service (WA NRCS) *Conservation Practice Standard 521A – Pond Sealing or Lining – Flexible Membrane* (WA NRCS 2013) and demonstrate compliance with permeability requirements of WA NRCS *Conservation Practice Standard No. 313 – Waste Storage Facility* (WA NRCS 2015). Catch basin lining will also include design criteria contained in the *Agricultural Waste Management Field Handbook* (NRCS 2009).

1.3 Report Organization

The remaining sections of this report are organized as follows:

- **Section 2 – Existing Conditions.** This section describes the existing conditions of the proposed catch basin lining area and details the pre-design geotechnical investigation.
- **Section 3 – Basis of Design.** This section discusses the basis of design components of the SDCB lining.
- **Section 4 – Compliance Monitoring.** This section outlines the procedures for quality assurance (QA) during construction activities and the details of the long-term monitoring program.
- **Section 5 – Construction Schedule.** This section outlines the design and construction schedule.
- **Section 6 – References.** This section provides references for the materials cited in this report.

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2 Existing Conditions

This section describes the existing conditions of the site, as well as the geotechnical investigation conducted as part of the lagoon lining design. The geotechnical investigation was conducted at the Dairy on March 27, 2019, per the EPA-approved *Lagoon Pre-Design Data Collection Quality Assurance Project Plan* (Anchor QEA 2017a). The purpose of the geotechnical investigation was to confirm the soil handling properties within the lagoon to be lined. The geotechnical investigation did not include permeability testing.

As part of the investigation, standard penetration tests (SPTs) were conducted every 5 feet for each of the borings, while soil samples were collected along the entire depth of the boring for subsequent laboratory analysis. The standard penetration resistance (N-value) was calculated as the total number of blows needed (using a 140-pound hammer falling a distance of 30 inches) for the sampler to penetrate the final 12 inches of an 18-inch sampler. Results of the SPTs (included on the boring logs) and laboratory testing are included in Appendix A.

2.1 Safety Debris Catch Basin

The SDCB is located at 1631 N Liberty Road in Granger, Washington, in the southeast corner of the Dairy's main operation (Figure 1).

2.1.1 Existing Site Conditions

The SDCB lining project will be roughly within the same footprint of the existing lagoon. The existing dimensions of the SDCB are approximately 150 feet wide by 150 feet long by 11 feet deep. The capacity of the basin is approximately 3.3 acre-feet (1.1 million gallons). The lagoon is constrained by a corral on the north, west, and south and an asphalt-paved access road on the east. The interior side slopes of the lagoon have a slope inclination of approximately 2 horizontal to 1 vertical (2H:1V), with no exterior slopes.

2.1.2 Soil Conditions

The geotechnical investigation included a total of four soil borings along the proposed perimeter of the SDCB. Soil boring locations are shown in Figure 2 and in the Construction Drawings included in Appendix B. The four borings were extended to depths of 21.5 feet below ground surface (bgs). Figure 3 shows lithology cross sections derived from the soil boring data.

The general lithology of the subsurface for the SDCB consists of a gravelly, silty sand overlying a poorly graded sand on the south and west sides and a sandy silt overlying a poorly graded sand on the north and east side. Based on this soil lithology, as well as results of the SPTs and laboratory

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analysis, engineering parameters were defined for each soil layer for subsequent analysis.[1] The soil characteristics and engineering properties of each soil layer are described as follows:

- **Gravelly Silty Sand.** The surface layer on the south and west sides of the basin was a gravelly, silty sand, which serves as a roadway surface. Layers of gravelly silty sand were also observed in the west boring at depths of 5.7 and 7.5 feet and are assumed to be fill layers. This fill material was found to have an inflated N-value due to the gravel content. Due to this and the amount of silt present, the internal friction angle is assumed to be 32 degrees.
- **Sandy Silt.** The surficial layer found at the north and east borings was a dry to moist sandy silt and was identified to a depth of 13.0 to 15.8 feet bgs. It is light brown to brown, stiff, and has no plasticity. The N-value for this material ranged from 8 to 26, which correlated to an undrained shear strength of approximately 1,500 pounds per square foot (psf). Due to the amount of sand that likely increased the blow counts, along with occasional gravel, a value of 1,250 psf was used for the slope stability analysis.
- **Sandy Gravel.** A lense of sandy gravel was identified in three of the four borings. This lense ranged from 1.0 to 4.6 feet thick, and the N-value for this material ranged from 10 to 50. Due to this large range, a conservative friction angle of 35 degrees was used in the stability analyses.
- **Sand.** Underlying the sandy silt and gravelly silty sand layers in each boring is a poorly graded sand. The top of this layer was identified at 7.5 to 19.5 feet bgs and terminates below the extent of the borings. The sand layer was identified to be medium-dense to dense, with N-values ranging from 15 to 44. Based on these blow counts, the internal friction angle is assumed to be 33 degrees.

2.1.3 Groundwater Conditions

Groundwater is approximately located at an elevation of 903 to 947 feet North American Vertical Datum of 1983 (NAVD83) near the SDCB based on groundwater elevation measurements taken in the first quarter of 2019 at the closest monitoring wells (DC-14 and YVD-06), which are located southwest and north of the basin, respectively. Groundwater levels in monitoring wells DC-14 and YVD-06 exhibit seasonal fluctuations of approximately 1 foot (Anchor QEA 2017b). The designed bottom elevation of the SDCB is 1,013 feet, approximately 66 feet above the highest observed groundwater level.

[1] The SPT N-values were correlated to drained friction angles and undrained shear strengths using methods by Terzaghi and Peck (1967) and Peck, Hanson, and Thornburn (1974).

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3 Basis of Design

Major components of the lagoon liner design were selected and developed to comply with design criteria and additional considerations identified in WA NRCS *Conservation Practice Standard No. 313 – Waste Storage Facility* (WA NRCS 2015) and *Agricultural Waste Management Field Handbook* (NRCS 2009) and to address EPA requirements to include both a double-liner system and a leak detection system. The major components of the design are similar to previously lined Cow Palace lagoons that were examined to assess the performance of past designs. Based on the assessments, there was no need to change any major components of the design. Some minor adjustments to past designs were made to lower costs were possible while maintaining lagoon function, reliability, and safety. The drain liner used for Lagoon No. 2, completed in 2017, has proved to be more cost-effective than the drain layer design used for the NW Catch Basin project completed in 2016; hence the drain liner used for Lagoon No. 2 was used for this design. The design components, as well as other analyses conducted, are described in the subsequent sections.

3.1 Lagoon Preparation and Consolidation

The SDCB will be prepared for liner installation by regrading the lagoon bottom and side slopes and routing inlet pipes through a new pre-cast concrete sump that will pump to nearby Lagoon No. 1 and overflow to the SDCB as needed to accommodate high flows. The SDCB will be approximately 160 feet long (as measured from north to south) and 160 feet wide (as measured from east to west) with a 9-foot operating level depth and 1 foot of freeboard. The approximate capacity at the maximum operating level is 3.2 acre-feet (1 million gallons). See Appendix B for more details regarding the layout of the lagoon. The interior side slopes of the SDCB will be 3H:1V to improve constructability and promote liner longevity.

3.2 Liner Design

Based on past project performance, historical field observations, and permeability results of similar site soils, the lagoon liner selected for the SDCB will be a double flexible membrane liner (FML) over a geotextile fabric and will include a leak detection system.

The liner system will consist of the following, listed from the bottom up:

- 10-ounce (minimum) geotextile fabric
- 200-thousandth of an inch (mil) geocomposite venting strips
- 50-mil high-density polyethene (HDPE) drain liner (serves as secondary liner and leak detection/collection system)
- 60-mil HDPE textured geomembrane primary liner

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The geotextile fabric will be placed over a compacted soil foundation consistent with the requirements of WA NRCS *Conservation Practice Standard No. 521A – Pond Sealing or Lining – Flexible Membrane* (WA NRCS 2013).

The 50-mil HDPE geomembrane drain layer will be placed directly over the geotextile fabric and welded per WA NRCS *Conservation Standard No. 521A – Pond Sealing or Lining – Flexible Membrane* (WA NRCS 2013) and *Material Specification MS-594: Geomembrane Liner* (WA NRCS 2014) and the *Technical Specifications* (Appendix C). The textured 60-mil HDPE geomembrane primary liner will be placed over the drain liner and welded per the specifications mentioned previously in this paragraph. A leak detection/collection sump will be installed between the primary and secondary liner.

3.3 Anchor Trench

The dimensions of the anchor trench will meet WA NRCS standards and will be between 18 and 24 inches deep, between 18 and 24 inches wide, and located 3 feet from the top of the slope. To further validate the anchor trench design, a geotechnical analysis was conducted on the proposed anchor trench dimensions. The anchor trench design was evaluated to determine the amount of resistance present on the HDPE geomembrane liner. For this analysis, it was assumed that all lagoon slopes are 3H:1V and the anchor trench will be backfilled with site material with a unit weight of 115 pounds per cubic foot and an internal friction angle of 26 degrees, representative of the sandy silt observed. The HDPE was assumed to have an interface friction angle with the soil of 18 degrees and a tensile yield strength of 1,000 pounds per foot width (Koerner 2012). A 3-foot run-out length of liner will extend beyond the crest of the lagoon slope. An anchor trench with dimensions of 24 inches deep and 24 inches wide resulted in a pull-out resistance of 772 pounds per linear foot. As indicated by Koerner (2012), the resistance should be equal to or less than the yield strength of the geomembrane liner to mitigate tearing or ripping. Results from the analysis indicated that the proposed dimensions meet the design criteria and are consistent with general practice.

3.4 Foundation Preparation

Liquid and solid manure will be removed from the SDCB by the Owner prior to liner installation. Manure solids will either be removed to the facility composting area, placed in an area that drains to another lagoon, or placed in another lagoon that is not currently identified for lining in 2019. Solids will be removed down to the soil foundation material. For the grading of the SDCB, excavation will cut back the slopes of the catch basin to meet the design drawings. Grading the SDCB will achieve the designed side slopes, lagoon bottom, and embankment conditions. The existing subgrade will be prepared as required by the lining design and site conditions. Sections 3.4.1 through 3.4.3 include additional details on foundation preparation.

In areas where fill is required to meet the final grade, fill will be compacted to a minimum of 92% of the maximum dry density and to within 2% of the optimum moisture content as determined using the

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Modified Proctor (ASTM International [ASTM] D1557); this will reduce the potential for settlement, reduce soil permeability, and provide a suitable subgrade for liner construction. Subgrades in excavation areas will be proof-rolled using construction equipment to verify the subgrade is in a non-yielding condition. Areas with soils that are soft (yielding) will be over-excavated, and suitable fill material will be placed, compacted, and tested as described in this section.

3.4.1 Side Slopes

Interior side slopes have been evaluated for compliance with requirements contained in WA NRCS *Conservation Practice Standard No. 313 – Waste Storage Facility* (WA NRCS 2015). Current standards for embankments require that the combined side slopes for the embankment shall not be less than 5H:1V and neither slope shall be steeper than 2H:1V unless additional slope stability provisions are provided (WA NRCS 2015). As stated previously, the interior side slopes of the SDCB will be 3H:1V. Due to the site topography, there are no exterior slopes for the SDCB.

Slope stability modeling was performed using Rocscience Slide 8.0 software that uses limit equilibrium methods of analysis. The soil model for limit equilibrium analysis assumes rigid, perfectly plastic soil behavior, which is a simplification of real soil behavior. The assumptions inherent to this model are that the anticipated sliding mass remains rigid (i.e., non-deformable) and the soil strength along the slip plane is fully mobilized at failure. Although this analysis method does not directly represent the true behavior of the soil during a slope failure, it is intended to provide a reasonable indication of the overall stability of a slope and is generally accepted as the standard of practice for this type of assessment.

The slope stability was evaluated for the SDCB under three conditions, as summarized in Table 1. The three conditions include the short-term condition during lagoon grading and consolidation, the long-term condition following construction, and the expected condition when the SDCB is filled. The target factors of safety consider the intended use of the structure, the potential consequences of failure, and the limitations and understanding of the anticipated subgrade soils. Target factors of safety of 1.3 for the short-term condition and 1.5 for the long-term and filled conditions were considered appropriate for use in this analysis based on U.S. Army Corps of Engineers-recommended slope stability guidelines (USACE 2003).

Table 1
Safety Debris Catch Basin Slope Stability Analysis

Boring Reference	Proposed Basin Side Slope	Proposed Basin Depth (feet)	Short-Term Factor of Safety	Long-Term Factor of Safety	Filled Lagoon Factor of Safety
CP-SDCB-BW	3H:1V	10	1.3	1.6	1.7
CP-SDCB-BE	3H:1V	9.5	2.0	1.6	8.0

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Fill material will be compacted to a level equal to or greater than 92% of the Modified Proctor (ASTM D1557) density for those soils to reduce the potential for settlement, promote slope stability, reduce soil permeability below the lagoons, and provide a suitable subgrade for liner construction. Additionally, fill material placed above the anchor trenches that serve as access roadways will need to meet the same compaction requirements.

3.4.2 Lagoon Bottom

As described in Section 2, groundwater is not anticipated to influence the performance of the SDCB. The lagoon bottoms will be regraded to create a relatively uniform bottom with a slight grade to promote the migration of gases produced underneath the liner system. The lagoon bottom foundation material is expected to be either in situ soil or soil generated from on-site earthwork that is suitable for reuse.

3.4.3 Embankment

The top of the SDCB slopes will remain at-grade and will not extend higher than the surrounding grade. The minimum design top width at the crest of the SDCB is 5 feet to allow access around the lagoon.

The top of the lagoon liner system will extend 1 foot above the lagoon's maximum operating level as freeboard depth to reduce the potential for overflow and allow for settlement that may occur. The minimum freeboard depth included in WA NRCS *Conservation Practice Standard No. 313 – Waste Storage Facility* (WA NRCS 2015) is 1 foot plus an additional depth not less than 5%.

3.5 Leak Detection/Collection System

Any leachate passing the primary liner will be collected and directed to a collection sump through the drain liner system. The collection sump will consist of a depression on the bottom of the pond that includes washed rock and a riser conduit that will house the sump pump. This pump will serve as a means for the leak detection (by means of a transducer and magnetic flow meter) and collection. Any leachate pumped out of the sump will be directed back into the lagoon via a 1.5-inch HDPE discharge pipe. Details for the leak detection/collection system are provided in Appendix B.

3.6 Gas Venting

Aerobic and anaerobic degradation of organic material can produce gases at the manure storage lagoons. This can also occur underneath the lagoon liner system if organic matter is present. Gas production below the liner system can lead to damage or failure of the flexible membranes and may present itself as an uplifting or bubbling of the liners. To minimize this condition, the liquid and solid manure will be removed from the SDCB to native foundation material prior to installation of the

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lagoon liner system. While every effort will be made to remove the presence of organic matter from the lagoons, some organic matter may be present below the liner. As such, a gas venting system will be constructed below the secondary drain liner and geotextile layer to collect and convey soil gases under the liner to vent openings located along the crest of the lagoon.

The venting system will consist of a grid of 200-mil geocomposite strips between 3 and 5 feet wide that will be spaced 50 feet apart and vented to the atmosphere. The geocomposite is a geonet that is encapsulated with geotextiles to minimize the potential for soil to clog the geonet, which serves as the vent conveyance.

Vent pipes will be located above the lagoons' freeboard height (i.e., above the maximum operating level at the top of the embankment). Vents will be constructed above holes cut in the HDPE liners.

3.7 Inlet and Outlet Piping

Inlet and outlet piping associated with the SDCB will be minimized to what is necessary for the proper function of the lagoons. Modifications to the existing inlet and outlet piping will be as follows:

- All inlet pipes will be routed to a cast-in-place concrete sump with one 18-inch HDPE overflow pipe entering the lagoon. No outlet pipes will be installed. See Sheet C-03 in Appendix B for the location of the inlet piping.

Penetrations in the lagoon liner will be constructed in accordance with manufacturer recommendations and WA NRCS *Conservation Standard No. 521A – Pond Sealing or Lining – Flexible Membrane* (WA NRCS 2013). HDPE pipe joints and connections will be joined together by thermal butt-fusion, electrofusion, or couplers. At the locations where HDPE piping penetrates the liner, a pipe sleeve (constructed of the same material as the HDPE liner) will be installed around the HDPE piping. Once secured, a continuous extrusion weld will be applied along the perimeter of the skirt, at the location where the skirt and sleeve meet, and at the location where the pipe and the sleeve meet. Each pipe penetration will undergo construction quality control/construction QA testing to ensure no leaks are present at the interface between the pipe and the liner.

Periodic cleanouts of the SDCB to remove liquid and suspended solids will occur as necessary for crop fertilization and liner inspection and maintenance. It is anticipated that the lagoon will be equipped with a floating pontoon agitator pump to remove liquid and solids from the lagoon.[2]

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[2] The floating pontoon agitator pump will be connected to existing piping to convey lagoon contents to Lagoon No. 1. This system was selected to eliminate traffic on the liner, eliminate the need for a ramp, and allow the pump to sit on the pontoons when the lagoon is empty. HDPE geomembrane rub sheet(s) will be used to protect the primary liner as the agitator enters and exits the lagoon or as the lagoon empties. Prior to emptying the lagoon, the agitator will be positioned above the rub sheet so the pontoons sit on the rub sheet when the lagoon is empty.

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3.8 Lagoon Access, Safety, and Protection

Lagoon access by a ramp will not be necessary. Solids buildup will be removed with a floating agitator as described in Section 3.7.

Proposed safety features include a barrier or fencing and posted warning signs around the perimeter of the lagoon.

The following measures will be taken to minimize the risk of the liner being punctured after installation:

- **No Vehicle Traffic on Liner.** Following construction, vehicle traffic will not be allowed on the liner system.
- **Perimeter Protection.** A fence or barrier will be installed along the lagoon perimeter to deter access to the lagoon by animals, personnel, and vehicles.
- **Signage.** Signs will be placed around the lagoon notifying individuals to stay off the liner. Foot traffic on the liner will be permitted on an as-needed basis for operational and maintenance needs only.
- **HDPE Rub Sheets.** Rub sheets will be installed in a location designated for the floating agitator pump's entrance to and exit from the lagoon. These sheets will be installed on the primary liner from the edge of the anchor trench, downslope, and along the bottom of the lagoon. Rub sheets are anticipated to be made of smooth 40-mil HDPE liner and will be installed one on top of the other.

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4 Compliance Monitoring

4.1 Construction Quality Assurance

QA measures will be implemented during construction of the liner system at the SDCB to confirm that the liner is installed in accordance with the *Construction Drawings* in Appendix B, *Technical Specifications* in Appendix C, and manufacturer recommendations. The *Construction Quality Assurance Plan* in Appendix D identifies the roles and responsibilities of the project team during construction. It also describes the performance monitoring of the construction activities in accordance with the 100% design documents through a QA program. Further, it delineates the QA methods and protocols for the project team to encourage a thorough understanding of construction monitoring, feedback, and adjustments.

4.2 Long-Term Monitoring Program

A long-term monitoring program will be implemented to verify the effectiveness of the lagoon lining and demonstrate that design objectives are being attained. The long-term monitoring program is outlined in the *Operations, Maintenance, and Monitoring Plan* (OMMP) in Appendix E.

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5 Construction Schedule

Construction is anticipated to start in July 2019 with the goal of completing construction before November 2019. Considerations that have determined the timing of the construction include design and EPA review time, bidding timing, procurement, and acceptable field conditions (i.e., before the ground freezes).

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6 References

Anchor QEA (Anchor QEA, LLC), 2017a. *Lagoon Pre-Design Data Collection Quality Assurance Project Plan*. Prepared for Liberty/H&S Bosma Dairies. February 2017.

Anchor QEA, 2017b. *Groundwater Monitoring Data Report*. Fourth Quarter 2016. Prepared for Cow Palace, LLC; George DeRuyter & Son, LLC/D&A Dairy, LLC/George & Margaret, LLC; and Liberty Dairy, LLC/H&S Bosma Dairy. February 2017.

Koerner, R.M., 2012. *Designing with Geosynthetics, Vol. 2*. Sixth Edition. Bloomington: Xlibris Corporation.

NRCS (Natural Resources Conservation Service), 2009. *National Engineering Handbook*. Part 651 – *Agricultural Waste Management Field Handbook*. Amendment 31. August 2009.

Peck, R.B., W.E. Hanson, and T.H. Thornburn, 1974. *Foundation Engineering*. Second Edition. New York City: John Wiley & Sons.

Terzaghi, K., and R.B. Peck, 1967. *Soil Mechanics in Engineering Practice*. Second Edition. New York City: John Wiley & Sons.

USACE (U.S. Army Corps of Engineers), 2003. *Slope Stability*. EM 1110-2-1902. October 2003.

WA NRCS (Washington State Natural Resources Conservation Service), 2013. *Conservation Practice Standard No. 521A – Pond Sealing or Lining – Flexible Membrane*. January 2013.

WA NRCS, 2014. *Material Specification, MS-594: Geomembrane Liner*. January 2014.

WA NRCS, 2015. *Conservation Practice Standard No. 313 – Waste Storage Facility*. January 2015.

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Figures

SOURCE: Aerial from Microsoft (Bing) 5/14/2019
HORIZONTAL DATUM: Washington State Plane South Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet

0 400
Feet

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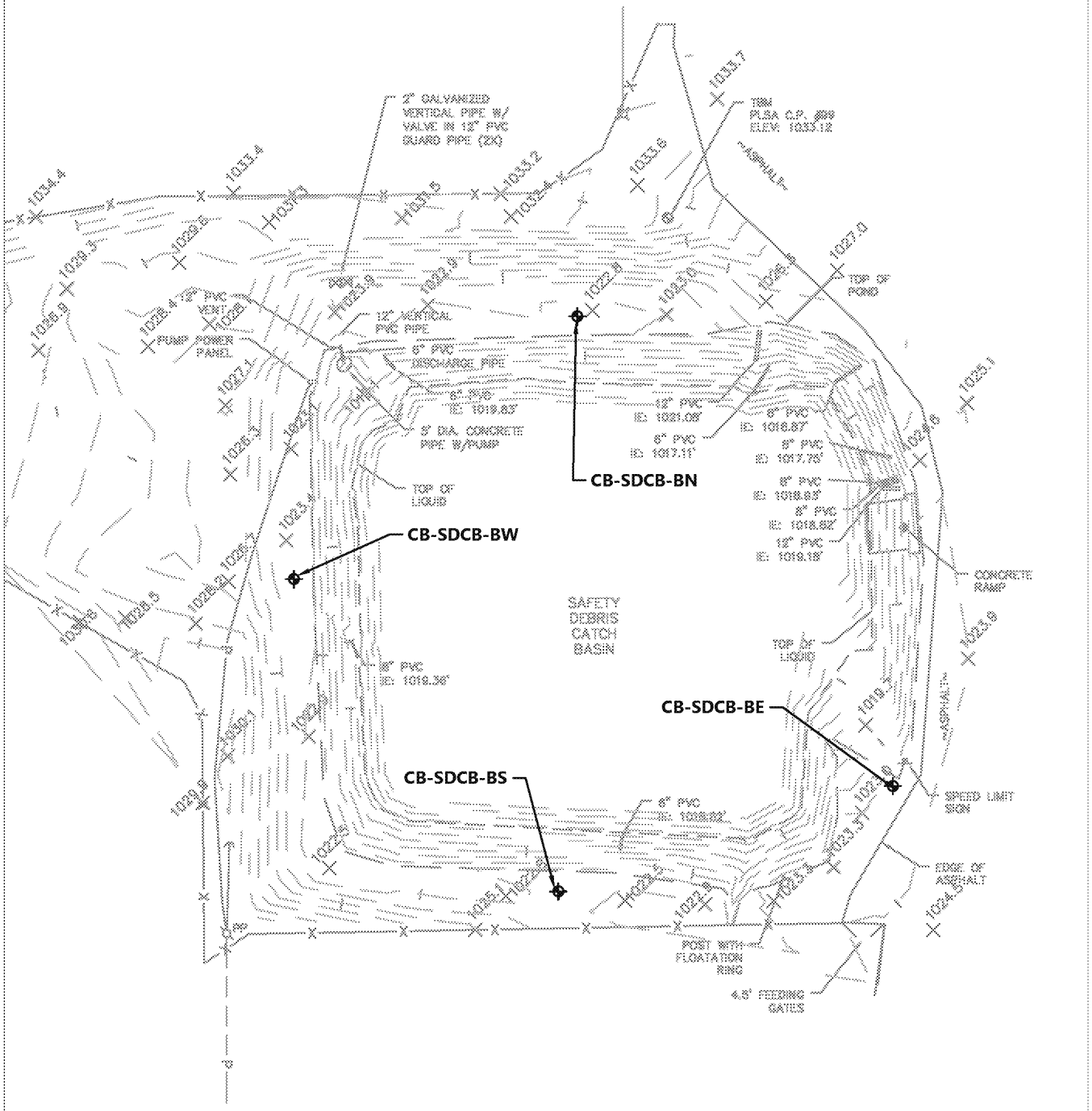
Figure 1
Cow Palace Dairy Lagoon Map

Basis of Design Report
Cow Palace Dairy Safety Debris Catch Basin



HORIZONTAL DATUM: Washington State Plane South Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet
VERTICAL DATUM: Mean Lower Low Water (MLLW)

NOTE:
1. Soil borings conducted on March 27, 2019

0 50
Feet

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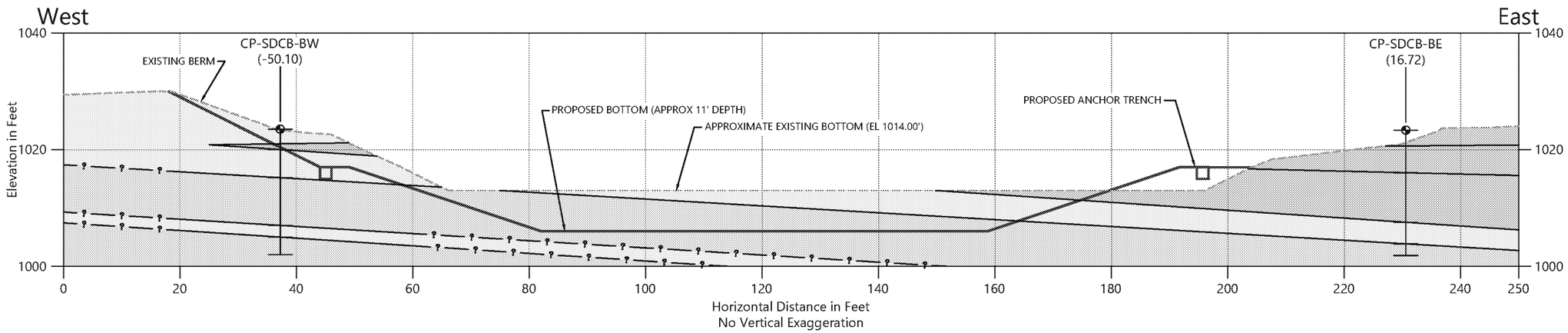
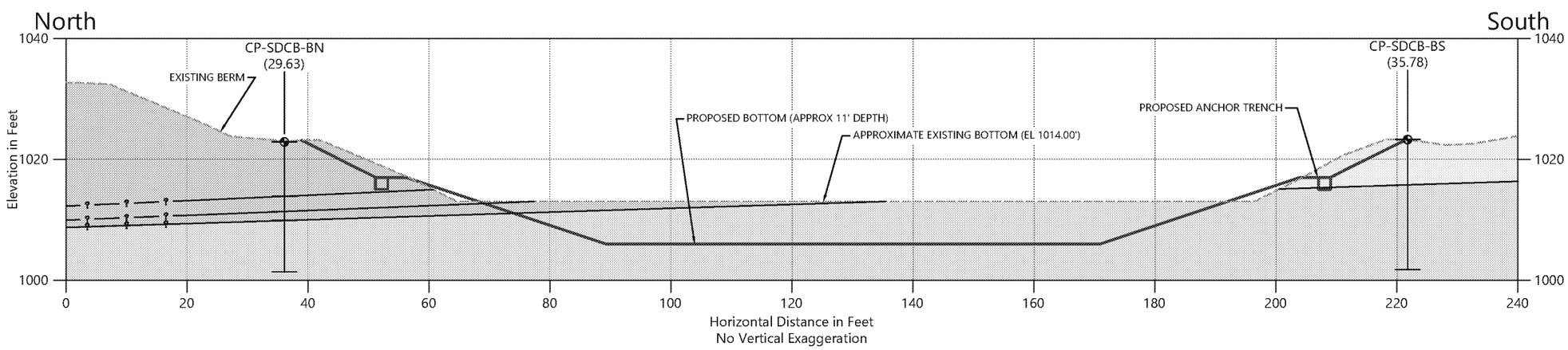
Figure 2
Soil Boring Locations

Basis of Design Report
Cow Palace Dairy Safety Debris Catch Basin





LEGEND:

- Silt
- Gravel
- Gravelly Silty Sand
- Sand
- Lithologic Contact (Dashed where inferred)
- Existing Ground Surface
- Proposed Lagoon Profile
- No Subsurface Information Present (Provided for Visual Purposes Only)
- CP-SDCB-BN (29.63) — Boring Identification (Approximate Distance in Feet)
- Boring Location

Stratigraphy Note:
Soil layers presented are based on a limited number of subsurface explorations; therefore conditions during construction may vary from that shown.

0 20
Feet

HORIZONTAL DATUM: Washington State Plane NAD83 South, U.S. feet
VERTICAL DATUM: NAVD88, U.S. feet

Publish Date: 2019/06/14 5:07 PM | User: rperrie
Filepath: K:\Projects\0996-Perkins Cole\Yakima Dairies Project\Lagoons - 2019\SDCB Borings\0996-CD02-YVD 2019-Cow Palace SDCB (Borings).dwg Figure 3 - Sections

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Figure 3
Cross Sections

Basis of Design Report
Cow Palace Dairy Safety Debris Catch Basin

Appendix A
Soil Boring Logs and Geotechnical Laboratory Results

LOG OF EXPLORATORY BORING

PROJECT NAME	**Yakima Valley Dairies**	BORING NO.	**CP-SDCB-BE**
LOCATION	**Zilah, Washington**	PAGE	**1 of 2**
DRILLED BY	**Cascade Drilling, Inc.**	GROUND SURFACE ELEVATION	**1023.0**
DRILLING METHOD	**Geoprobe Direct Push 7730 DT**	TOTAL DEPTH	**21.5 ft.**
LOGGED BY	**Casey Janisch**	DATE COMPLETED	**3/27/19**
BOREHOLE DIAMETER	**3.0 inches**	PERMIT/STARTCARD NO.	
SAMPLING METHOD	**2.0-in by 1.5-ft split-spoon (SS)**	WA STATE DEPT OF ECOLOGY WELL ID	

SAMPLING METHOD	RECOVERY (FEET)	DEPTH SAMPLED (FEET)	BLOW COUNTS	SAMPLE ID	DEPTH (FEET)	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	FINES %
CB	3.0	0-5.0		CP-SDCB-BE-0-7.3			0 to 2.7 feet: moist, stiff, brown gravelly sandy SILT.	10	30	60
							2.7 to 7.3 feet: dense, dry, light gray, sandy GRAVEL.	70	20	10
SS	0	5.0-6.5	4 5 5		5					
CB	3.5	6.5-10.0		CP-SDCB-BE-7.3-15			7.3 to 15.8 feet: stiff, gray, moist, slightly sandy SILT.	--	5	95
SS	1.2	10.0-11.5	6 5 3		10					
							@ 11.1 feet: wood debris 1.5- by 1.0-inches.			
CB	3.5	11.5-15.0								
SS	1.3	15.0-16.5	5 10 12	CP-SDCB-BE-15-21.5	15					
							@ 15.5 feet: transition zone.			
							15.8 to 19.5 feet: medium dense, moist, gray, silty, gravelly, fine to coarse SAND.	15	75	10
CB	3.1	16.5-20.0								
							@ 17.5 to 18.0 feet: lense of gray SILT.			
					20		19.5 to 21.5 feet: dense, moist, gray, poorly graded SAND.			

REMARKS

ANCHOR QEA

YAKIMA-7.gds:3.5/7/19.YAKIMA-7...190996-01.01

LOG OF EXPLORATORY BORING

PROJECT NAME	**Yakima Valley Dairies**	BORING NO.	**CP-SDCB-BE**
LOCATION	**Zilah, Washington**	PAGE	**2 of 2**
DRILLED BY	**Cascade Drilling, Inc.**	GROUND SURFACE ELEVATION	**1023.0**
DRILLING METHOD	**Geoprobe Direct Push 7730 DT**	TOTAL DEPTH	**21.5 ft.**
LOGGED BY	**Casey Janisch**	DATE COMPLETED	**3/27/19**
BOREHOLE DIAMETER	**3.0 inches**	PERMIT/STARTCARD NO.	
SAMPLING METHOD	**2.0-in by 1.5-ft split-spoon (SS)**	WA STATE DEPT OF ECOLOGY WELL ID	

SAMPLING METHOD	RECOVERY (FEET)	DEPTH SAMPLED (FEET)	BLOW COUNTS	SAMPLE ID	DEPTH (FEET)	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	FINES %
SS	1.2	20.0-21.5	9 6 6				19.5 to 21.5 feet: dense, moist, gray, poorly graded SAND, continued.	--	100	--
							Total Depth = 21.5 feet.			
					25					
					30					
					35					
					40					

REMARKS

ANCHOR QEA

YAKIMA-7.gds:3.5/7/19.YAKIMA-7...190996-01.01

LOG OF EXPLORATORY BORING

PROJECT NAME	**Yakima Valley Dairies**	BORING NO.	**CP-SDCB-BN**
LOCATION	**Zilah, Washington**	PAGE	**1 of 2**
DRILLED BY	**Cascade Drilling, Inc.**	GROUND SURFACE ELEVATION	**1023.0**
DRILLING METHOD	**Geoprobe Direct Push 7730 DT**	TOTAL DEPTH	**21.5 ft.**
LOGGED BY	**Casey Janisch**	DATE COMPLETED	**3/27/19**
BOREHOLE DIAMETER	**3.0 inches**	PERMIT/STARTCARD NO.	
SAMPLING METHOD	**2.0-in by 1.5-ft split-spoon (SS)**	WA STATE DEPT OF ECOLOGY WELL ID	

SAMPLING METHOD	RECOVERY (FEET)	DEPTH SAMPLED (FEET)	BLOW COUNTS	SAMPLE ID	DEPTH (FEET)	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	FINES %
SS	1.5	0-1.5	5 6 7	CP-SDCB-BN-0-9			0 to 9.0 feet: stiff, dry to damp, slightly sandy, light brown SILT.	--	15	85
CB	3.3	1.5-5.0					@ 2.5 feet: no sand, damp.	--	--	100
SS	1.5	5.0-6.5	13 13 13		5		@ 5.0 feet: trace gravel, one piece.			
CB	3.6	6.5-10.0								
				CP-SDCB-BN-9-11.5			9.0 to 11.5 feet: dense, damp, light gray, brown mottled, sandy, silty, fine to coarse GRAVEL.	40	30	30
SS	1.5	10.0-11.5	25 22 28		10					
CB	3.5	11.5-15.0		CP-SDCB-BN-11.5-13			11.5 to 13.0 feet: stiff, damp, light brown SILT.	--	10	90
				CP-SDCB-BN-13-21.5			13.0 to 21.5 feet: medium dense, moist, light brown to tan, fine to medium SAND.	--	95	5
SS	1.3	15.0-16.5	12 12 13		15		@ 15.0 to 15.5 feet: greenish-gray staining.			
CB	3.5	16.5-20.0					@ 16.5 to 17.8 feet: lense of light grayish-brown, damp, medium stiff, very sandy SILT.	5	35	60
					20					

REMARKS

ANCHOR QEA

YAKIMA-7.gds:3.5/7/19.YAKI

LOG OF EXPLORATORY BORING

PROJECT NAME	**Yakima Valley Dairies**	BORING NO.	**CP-SDCB-BN**
LOCATION	**Zilah, Washington**	PAGE	**2 of 2**
DRILLED BY	**Cascade Drilling, Inc.**	GROUND SURFACE ELEVATION	**1023.0**
DRILLING METHOD	**Geoprobe Direct Push 7730 DT**	TOTAL DEPTH	**21.5 ft.**
LOGGED BY	**Casey Janisch**	DATE COMPLETED	**3/27/19**
BOREHOLE DIAMETER	**3.0 inches**	PERMIT/STARTCARD NO.	
SAMPLING METHOD	**2.0-in by 1.5-ft split-spoon (SS)**	WA STATE DEPT OF ECOLOGY WELL ID	

SAMPLING METHOD	RECOVERY (FEET)	DEPTH SAMPLED (FEET)	BLOW COUNTS	SAMPLE ID	DEPTH (FEET)	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	FINES %
SS	1.2	20.0-21.5	13 10 11				13.0 to 21.5 feet: medium dense, moist, light brown to tan, fine to medium SAND, continued.			
							Total Depth = 21.5 feet @ 1005.			
					25					
					30					
					35					
					40					

REMARKS

ANCHOR QEA

YAKIMA-7.gds:3.5/7/19.YAKI

LOG OF EXPLORATORY BORING

PROJECT NAME	**Yakima Valley Dairies**	BORING NO.	**CP-SDCB-BS**
LOCATION	**Zilah, Washington**	PAGE	**1 of 2**
DRILLED BY	**Cascade Drilling, Inc.**	GROUND SURFACE ELEVATION	**1023.0**
DRILLING METHOD	**Geoprobe Direct Push 7730 DT**	TOTAL DEPTH	**21.5 ft.**
LOGGED BY	**Casey Janisch**	DATE COMPLETED	**3/27/19**
BOREHOLE DIAMETER	**3.0 inches**	PERMIT/STARTCARD NO.	
SAMPLING METHOD	**2.0-in by 1.5-ft split-spoon (SS)**	WA STATE DEPT OF ECOLOGY WELL ID	

SAMPLING METHOD	RECOVERY (FEET)	DEPTH SAMPLED (FEET)	BLOW COUNTS	SAMPLE ID	DEPTH (FEET)	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	FINES %
CB	4.0	0-5.0		CP-SDCB-BS-0-7.5			0 to 7.5 feet: dense, damp, light brown, gray, white, very gravelly, silty SAND. @ 2.0 feet: grades to very dense.	30	50	20
SS	0	0.1	50/1.5"		5					
CB	5.0	5.0-10.0		CP-SDCB-BS-7.5-15			7.5 to 21.5 feet: very dense, moist, light brown with reddish hue, grayish-brown, fine SAND, trace gravel laminations within.	5	90	5
SS	1.2	10.0-15.0	38 49 48		10		@ 10.7 feet: lense of orangish-brown sandy SILT.			
CB	2.8	11.5-15.0					@ 11.5 feet: lense of greenish-gray SAND.	--	95	5
SS	1.3	15.0-16.5	23 19 24	CP-SDCB-BS-15-21.5	15		@ 15.0 feet: grades to dense.			
CB	3.2	16.5-20.0					@ 18.0 ito 18.5 feet: lense of dense, moist, green SAND overlying brown SAND.			
					20					

REMARKS

ANCHOR QEA

YAKIMA-7.gds:3.5/7/19.YAKI

LOG OF EXPLORATORY BORING

PROJECT NAME	**Yakima Valley Dairies**	BORING NO.	**CP-SDCB-BS**
LOCATION	**Zilah, Washington**	PAGE	**2 of 2**
DRILLED BY	**Cascade Drilling, Inc.**	GROUND SURFACE ELEVATION	**1023.0**
DRILLING METHOD	**Geoprobe Direct Push 7730 DT**	TOTAL DEPTH	**21.5 ft.**
LOGGED BY	**Casey Janisch**	DATE COMPLETED	**3/27/19**
BOREHOLE DIAMETER	**3.0 inches**	PERMIT/STARTCARD NO.	
SAMPLING METHOD	**2.0-in by 1.5-ft split-spoon (SS)**	WA STATE DEPT OF ECOLOGY WELL ID	

SAMPLING METHOD	RECOVERY (FEET)	DEPTH SAMPLED (FEET)	BLOW COUNTS	SAMPLE ID	DEPTH (FEET)	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	FINES %
SS	1.2	20.0-21.5	16 15 17				7.5 to 21.5 feet: very dense, moist, light brown with reddish hue, grayish-brown SAND, fine, trace gravel laminations within, continued.			
							Total Depth = 21.5 feet @ 1230.			
					25					
					30					
					35					
					40					

REMARKS

ANCHOR QEA

YAKIMA-7.gds:3.5/7/19.YAKI

LOG OF EXPLORATORY BORING

PROJECT NAME	**Yakima Valley Dairies**	BORING NO.	**CP-SDCB-BW**
LOCATION	**Zilah, Washington**	PAGE	**1 of 2**
DRILLED BY	**Cascade Drilling, Inc.**	GROUND SURFACE ELEVATION	**1023.5**
DRILLING METHOD	**Geoprobe Direct Push 7730 DT**	TOTAL DEPTH	**21.5 ft.**
LOGGED BY	**Casey Janisch**	DATE COMPLETED	**3/27/19**
BOREHOLE DIAMETER	**3.0 inches**	PERMIT/STARTCARD NO.	
SAMPLING METHOD	**2.0-in by 1.5-ft split-spoon (SS)**	WA STATE DEPT OF ECOLOGY WELL ID	

SAMPLING METHOD	RECOVERY (FEET)	DEPTH SAMPLED (FEET)	BLOW COUNTS	SAMPLE ID	DEPTH (FEET)	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	FINES %
CB	4.0	0-5.0		CP-SDCB-BW-0-8.2			0 to 2.5 feet: medium dense, moist, light brown to reddish-brown, gravelly, silty SAND. @ 1.5 feet: lense of gray gravel, 1.5 inches.	25	60	15
							2.5 to 3.5 feet: dense, moist, light gray and brown sandy GRAVEL and gravelly SAND, interbedded.	40	50	10
							3.5 to 8.2 feet: dense, moist, light brown to reddish-brown, gravelly silty SAND.	25	60	15
SS	1.0	5.0-6.5	50 26 33		5					
CB	3.5	6.5-10.0		CP-SDCB-BW-8.2-15			8.2 to 16.5 feet: dense to very dense, moist, slightly gravelly, light browns, fine SAND. @ 9.0 feet: grades to greenish-gray.	5	90	5
SS	1.3	10.0-11.5	30 22 50		10					
CB	3.5	11.5-15.0						--	95	5
SS	1.3	15.0-16.5	33 17 18	CP-SDCB-BW-15-21.5	15		@ 15.0 to 15.7 feet: lense of dense, brown, moist, gravelly SAND.	10	75	15
CB	3.3	16.5-20.0					16.5 to 18.5 feet: dense, brown, moist, gravelly SAND.	10	75	15
							18.5 to 21.5 feet: dense, moist, light brown, slightly gravelly, fine SAND.	5	90	5
					20					

REMARKS

"50" Blow counts observed hitting rock then pushed through.

ANCHOR QEA

YAKIMA-7.gds:3.5/7/19.YAKI

LOG OF EXPLORATORY BORING

PROJECT NAME	**Yakima Valley Dairies**	BORING NO.	**CP-SDCB-BW**
LOCATION	**Zilah, Washington**	PAGE	**2 of 2**
DRILLED BY	**Cascade Drilling, Inc.**	GROUND SURFACE ELEVATION	**1023.5**
DRILLING METHOD	**Geoprobe Direct Push 7730 DT**	TOTAL DEPTH	**21.5 ft.**
LOGGED BY	**Casey Janisch**	DATE COMPLETED	**3/27/19**
BOREHOLE DIAMETER	**3.0 inches**	PERMIT/STARTCARD NO.	
SAMPLING METHOD	**2.0-in by 1.5-ft split-spoon (SS)**	WA STATE DEPT OF ECOLOGY WELL ID	

SAMPLING METHOD	RECOVERY (FEET)	DEPTH SAMPLED (FEET)	BLOW COUNTS	SAMPLE ID	DEPTH (FEET)	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	FINES %
SS	0.8	20.0-21.5	34 21 23				18.5 to 21.5 feet: dense, moist, light brown, slightly gravelly fine SAND, continued. @ 21.0 feet: grades to light gray.			
							Total Depth = 21.5 feet.			
					25					
					30					
					35					
					40					

REMARKS

"50" Blow counts observed hitting rock then pushed through.

ANCHOR QEA

YAKIMA-7.gds:3.5/7/19.YAKI

Budinger & Associates

Geotechnical Engineering
Environmental Engineering
Construction Materials Testing
Subsurface Exploration
Special Inspection

Proudly serving the Inland Northwest for since 1976

Cindy Fields
Anchor QEA, LLC
720 Olive Way, Suite 1900
Seattle, WA 98101

April 15, 2019

Project Number L19142

PROJECT: **Yakima Valley Dairies**
Yakima Valley, WA

SUBJECT: **Results of Laboratory Testing**
Report #1

At your request, we provided laboratory testing services for the subject project. Services were limited to the performance of specific laboratory tests, selected at your discretion.

For this period our involvement was limited to laboratory testing of seventeen samples delivered to us in Yakima, and returned to our laboratory on March 28, 2019. Laboratory tests were performed in general accordance with methods listed in the attached *Laboratory Summary, Moisture-Unit Weight Relationship* and *Particle Size Distribution* sheets.

If you have questions regarding this report, please call.

Respectfully Submitted,
Budinger & Associates, Inc.

Terri Ballard

Terri Ballard
Laboratory Manager

TJB/kh/Addressee -
Cindy Fields – cfields@anchorqea.com
Casey Janisch – cjanisch@anchorqea.com

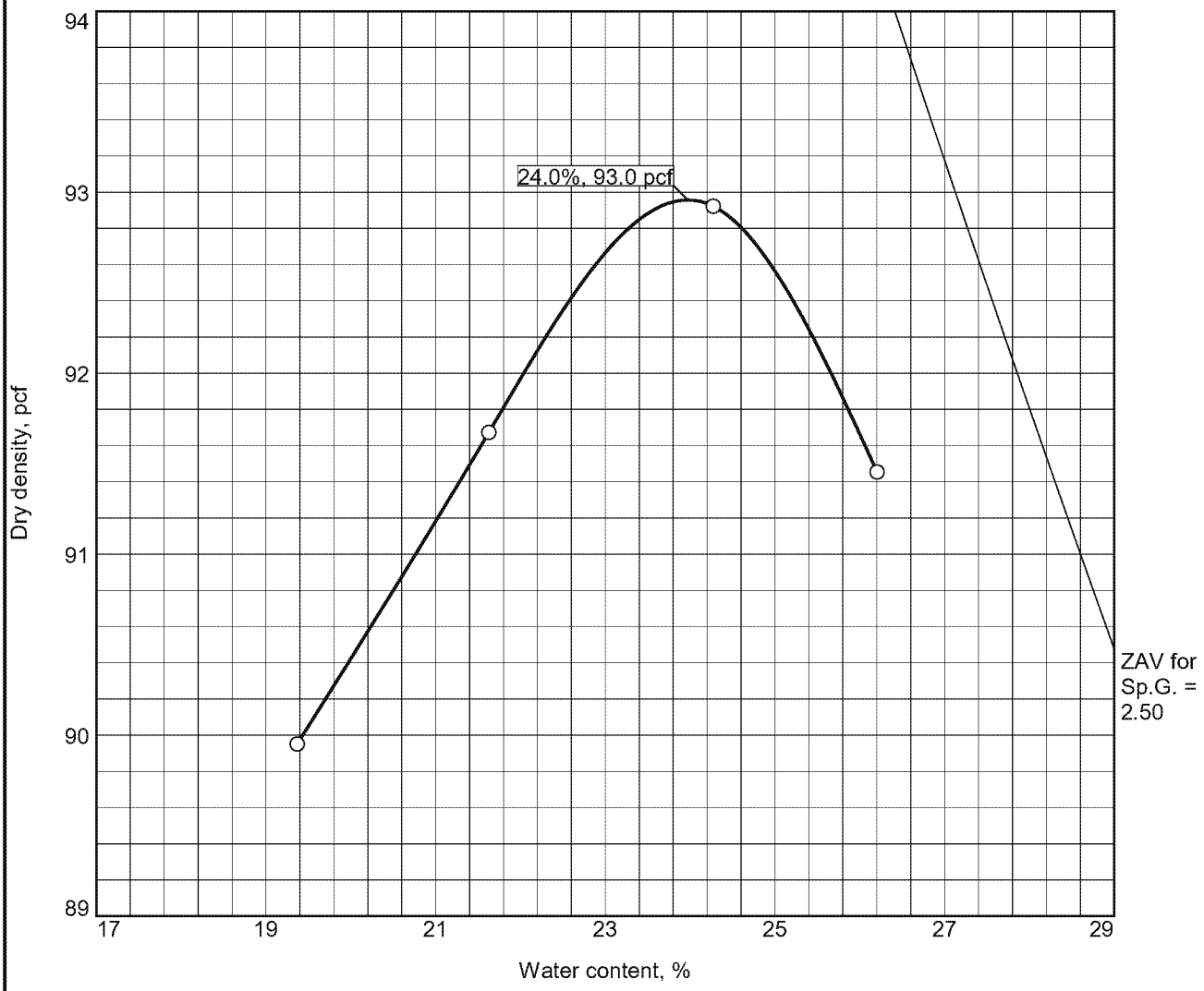
Attachments:
Soils Laboratory Summary – (1 page)
Moisture-Unit Weight Relationship - (4 pages)
Particle Size Distribution Report - (1 page)

SOILS
LABORATORY SUMMARY

LABORATORY NUMBER			19-0106	19-0107	19-0108	19-0109	19-0110	19-0111	19-0112	19-0113	19-0114	19-0115	19-0116	19-0117	19-0118	19-0119	19-0120	19-0121	19-0122
SAMPLED BY			Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client
SAMPLE TYPE			Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk
DATE RECEIVED			3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19	3/28/19
FIELD SAMPLE ID			CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB	CB-SDCB
			BN-0-9	BN-9-11.5	BN-11.5-13	BN-13-21.5	BW-0-8.2	BW-8.2-15	BW-15-21.5	BS-0-7.5	BS-7.5-15	BS-15-21.5	BE-0-7.3	BE-7.3-15	BE-15-21.5	BN-0-5	BW-0-5	BS-0-5	BE-0-5
	Units	Test Method																	
PROCTOR		ASTM D698																	
Maximum Unit Weight	pcf															93.0	123.1	112.1	110.0
Optimum Moisture	%															24.0	10.3	14.1	16.9
Sample Moisture	%	ASTM D2216	16.4	4.2	18.9	7.6	8.7	9.3	10.4	12.8	12.6	9.0	9.6	22.0	11.4	23.8	8.2	12.8	2.7
Bulk Specific Gravity (+3/4")																	2.534	2.540	2.508
Maximum Unit Weight, Corrected	pcf																129.4	129.4	116.1
Optimum Moisture, Corrected	%																8.6	8.6	14.5
ATTERBERG LIMITS		ASTM D4318																	
Liquid Limits	%		25											28					
Plastic Limits	%		20											23					
Plasticity Index	%		5				NP				NP			5					
SIEVE ANALYSIS		ASTM D6913																	
	3"	ASTM D7928																	
	1 1/2"																		
S	1"	%					100	100		100					100				
I	3/4"						93	96		93					90				
E	1/2"	P					83	93		83					82				
V	3/8"	A				100	76	91		76					79				
E	#4	S				99	62	87		60					71				
	#10	S				98	50	83		47					66				
S	#16	I				98	46	81		43					64				
I	#30	N				91	32	73		38					59				
Z	#40	G				72	26	50		34					54				
E	#100					23	13	15		19					24				
	#200					18	12	9		14					19				
	0.05mm					16	11	7.5		12					16				
	0.01mm					8.3	4.8	4.3		6.4					8.0				
	0.005mm					6.1	3.7	2.5		4.1					5.7				
	0.001mm					3.1	2.1	1.7		2.0					3.5				

NP = non-plastic*

Moisture-Unit Weight Relationship



Test specification: ASTM D 698-07 Method B Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
			23.8				0.1	

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 93.0 pcf Optimum moisture = 24.0 %	silt with gravel some sand

Project No. L19142 **Client:** Anchor QEA
Project: Yakima Valley Dairies

○ **Source of Sample:** Cow Palace **Sample Number:** 19-0119

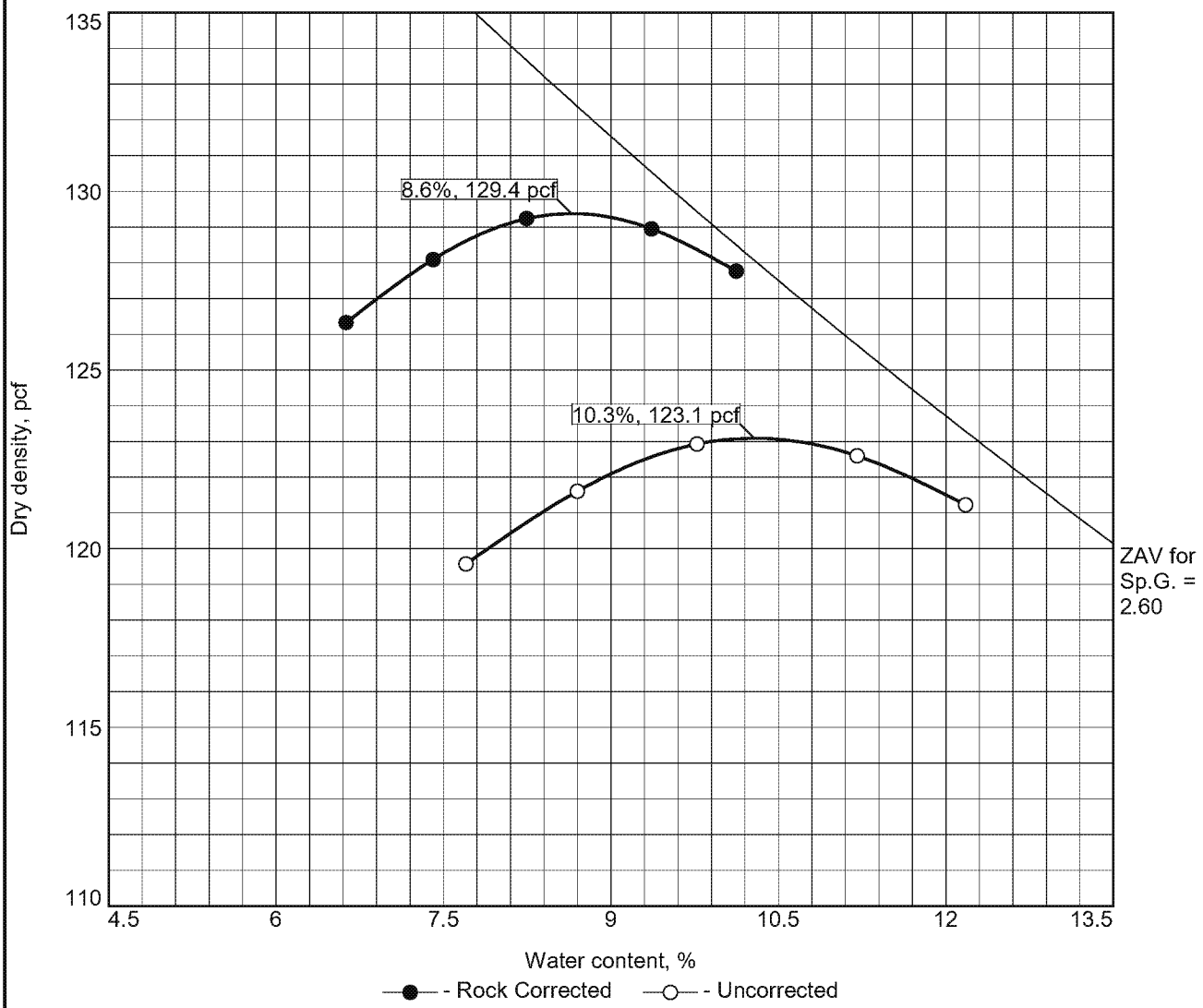
Remarks:
Sampled by Client from BN-0-5

BUDINGER & ASSOCIATES, INC.

Date 4/12/19

Tested By: KS **Checked By:** TB

Moisture-Unit Weight Relationship



Test specification: ASTM D 698-07 Method C Standard
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
			8.2	+3/4"= 2.534			21.9	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 129.4 pcf	123.1 pcf	sandy gravel trace silt
Optimum moisture = 8.6 %	10.3 %	

Project No. L19142 **Client:** Anchor QEA
Project: Yakima Valley Dairies

○ **Source of Sample:** Cow Palace **Sample Number:** 19-0120

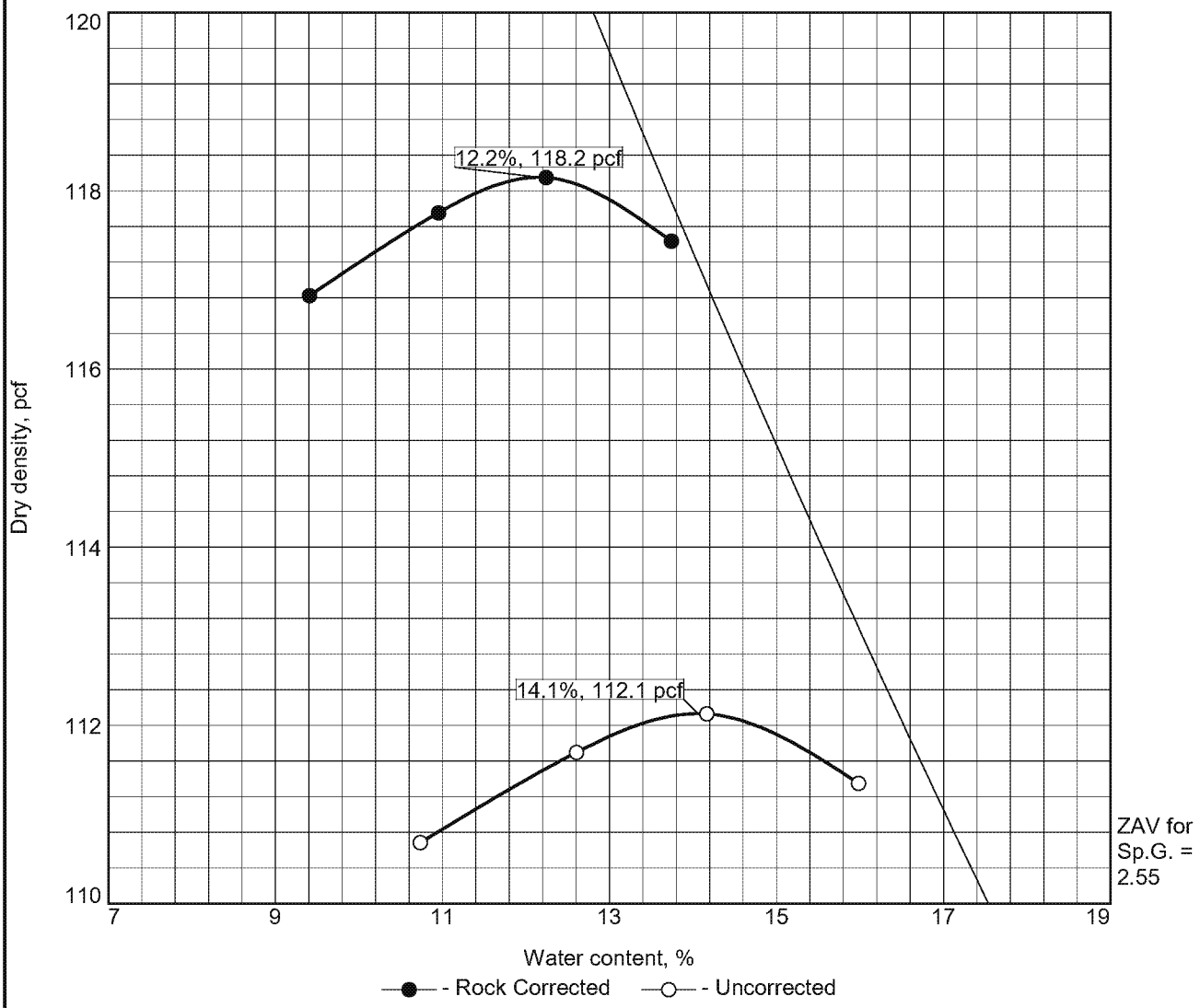
Remarks:
Sampled by Client from BW-0-5

BUDINGER & ASSOCIATES, INC.

Date 4/12/19

Tested By: KS **Checked By:** TB

Moisture-Unit Weight Relationship



Test specification: ASTM D 698-07 Method C Standard
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
			12.8	+3/4"= 2.540			17.4	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 118.2 pcf	112.1 pcf	gravely sand
Optimum moisture = 12.2 %	14.1 %	

Project No. L19142 **Client:** Anchor QEA
Project: Yakima Valley Dairies

○ **Source of Sample:** Cow Palace **Sample Number:** 19-0121

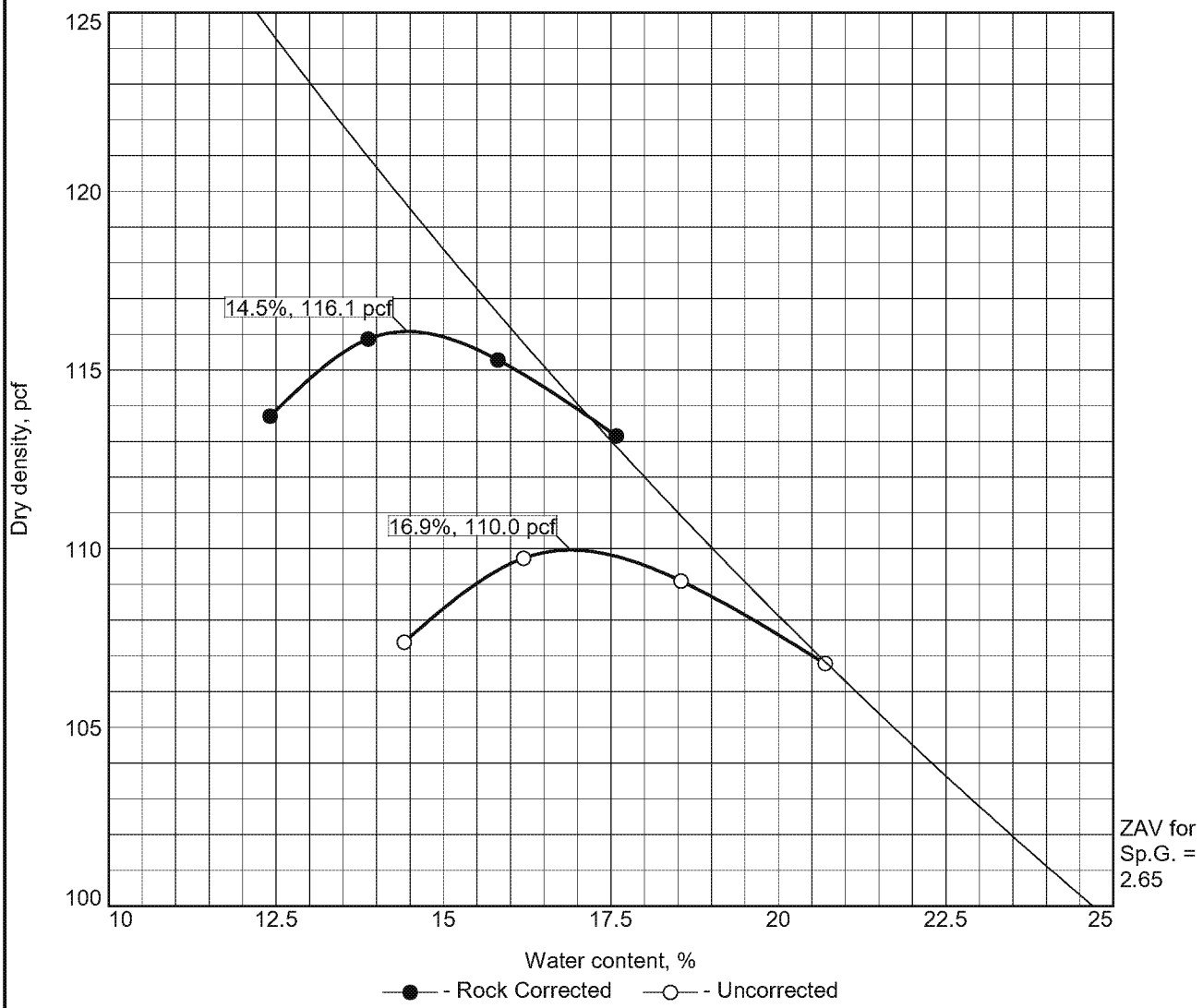
Remarks:
Sampled by Client from BS-0-5

BUDINGER & ASSOCIATES, INC.

Date 4/12/19

Tested By: TS **Checked By:** TB

Moisture-Unit Weight Relationship



Test specification: ASTM D 698-07 Method C Standard
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
			2.7	+3/4"= 2.508			17.7	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 116.1 pcf	110.0 pcf	silt with gravel
Optimum moisture = 14.5 %	16.9 %	

Project No. L19142 **Client:** Anchor QEA
Project: Yakima Valley Dairies

○ **Source of Sample:** Cow Palace **Sample Number:** 19-0122

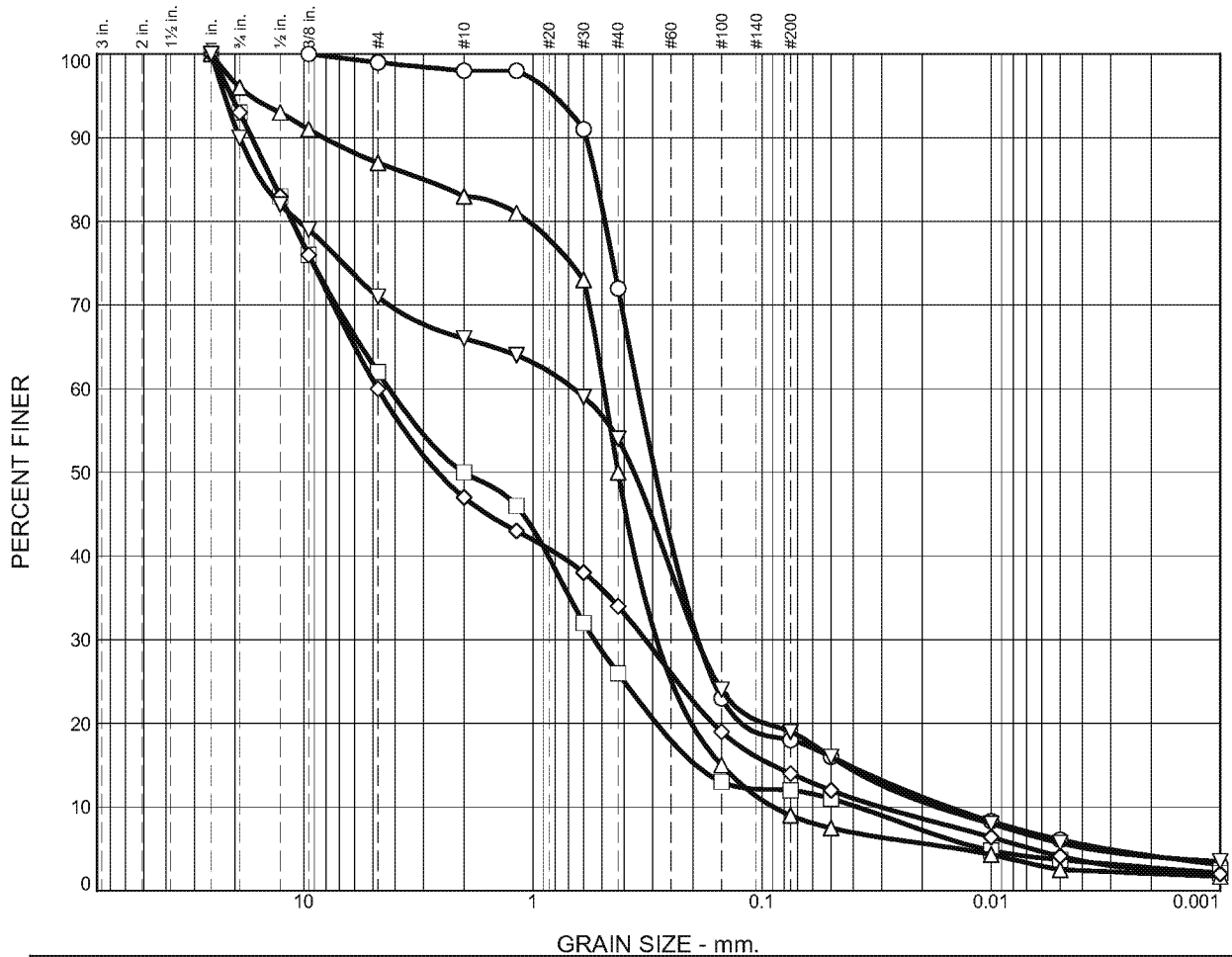
Remarks:
sampled by Client from BE-0-5

BUDINGER & ASSOCIATES, INC.

Date 4/12/19

Tested By: TS **Checked By:** TB

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	1	1	26	54	12	6
□	0	7	31	12	24	14	8	4
△	0	4	9	4	33	41	7	2
◇	0	7	33	13	13	20	10	4
▽	0	10	19	5	12	35	13	6

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	Cow Palace	19-0109	BN 13-21.5	sand with silt some clay	
□	Cow Palace	19-0110	BW 0-8.2	gravely sand some silt and clay	
△	Cow Palace	19-0111	BW 8.2-15	sand little gravel some silt and clay	
◇	Cow Palace	19-0113	BS 0-7.5	gravely sand with silt some clay	
▽	Cow Palace	19-0118	BE 15-21.5		

BUDINGER & ASSOCIATES, INC.

Client: Anchor QEA
Project: Yakima Valley Dairies
Project No.: L19142 **Date** 4/12/19

Tested By: KC **Checked By:** TB

Appendix B
Cow Palace Safety Debris Catch Basin Construction Drawings

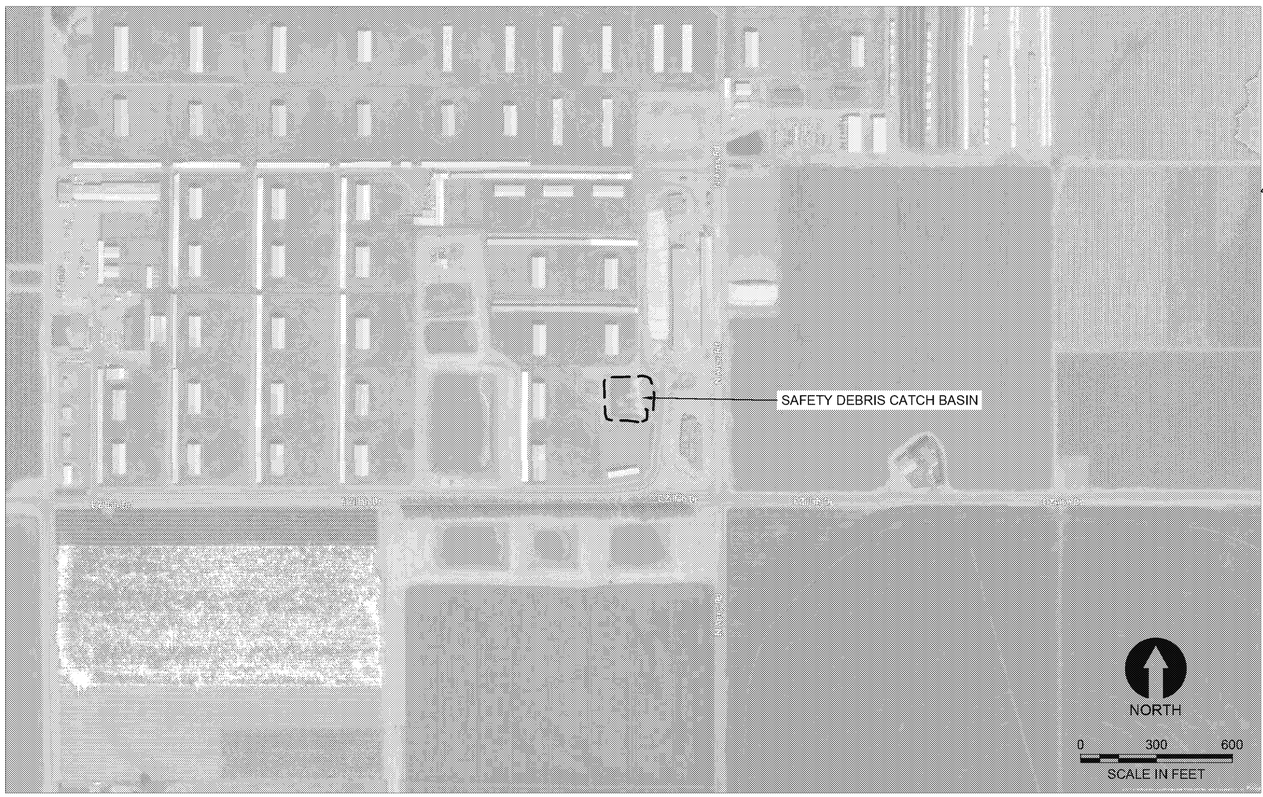
100% DESIGN SUBMITTAL

COW PALACE SAFETY DEBRIS CATCH BASIN

COW PALACE DAIRY

Site Address:
1631 North Liberty Road
Granger, Washington 98932

SDWA-10-2013-0080



SITE LOCATION MAP
SCALE: 1" = 300'

	DRAWING INDEX		
	SHEET #	DRAWING #	TITLE
	1	G-01	COVER SHEET
	2	G-02	GENERAL NOTES
	3	C-01	SITE MAP
	4	C-02	EXISTING CONDITIONS PLAN
1	5	C-03	SITE PLAN
1	6	C-04	FINAL GRADING PLAN
1	7	C-05	VENTING PLAN
1	8	C-06	LAGOON PROFILES
1	9	C-07	LAGOON PROFILES
	10	C-08	DETAILS (1 OF 5)
	11	C-09	DETAILS (2 OF 5)
	12	C-10	DETAILS (3 OF 5)
	13	C-11	DETAILS (4 OF 5)
	14	C-12	DETAILS (5 OF 5)

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	REVISED SHEETS INDICATED

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

COVER SHEET

G-01

SHEET NO. 1 OF 14

Jul 10, 2019 2:40pm rpetrie

ED_002369M_00000063-00039

PROJECT DESCRIPTION:

THE PROJECT SHOWN ON THESE CONSTRUCTION DRAWINGS AND DESCRIBED IN THE CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS CONSISTS OF WORK TO LINE A DAIRY LAGOON. THE WORK REQUIRES SITE PREPARATION, EARTHWORK, TEMPORARY EROSION AND SEDIMENT CONTROL MANAGEMENT, AND SUBGRADE PREPARATION FOR A LEAK DETECTION SYSTEM; INSTALLATION OF SECONDARY AND PRIMARY HDPE GEOMEMBRANE LINERS, GEOCOMPOSITE VENT STRIPS; AND RESTORATION OF DISTURBED AREAS. IN ADDITION, HDPE GEOMEMBRANE LINER INSTALLATION WILL REQUIRE WELDING AND TESTING AS PART OF THE CONSTRUCTION QUALITY CONTROL PLAN EXECUTION. THE WORK IS SUBJECT TO THE OWNER, AGENCY, AND/OR PERMIT CONDITIONS.

PREPARED FOR:

COW PALACE DAIRY
1631 NORTH LIBERTY ROAD
GRANGER, WASHINGTON 98932

PREPARED BY:

ANCHOR QEA, LLC.
1119 PACIFIC AVE
TACOMA, WASHINGTON 98402
PROJECT ENGINEER: JOSH SEXTON, P.E.
PHONE: 206-903-3349
EMAIL: JSEXTON@ANCHORQEA.COM

SURVEY NOTES:

PROJECT VERTICAL DATUM IS NAVD 88, US FT.

PROJECT HORIZONTAL DATUM IS WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, US FT.

1. UTILITIES AND STRUCTURES ARE APPROXIMATE AND ARE LOCATED FROM ABOVE GROUND EVIDENCE ONLY. THERE MAY BE ADDITIONAL UTILITY LINES AND STRUCTURES WITHIN SURVEYED AREAS THAT ARE NOT SHOWN HEREIN.

PLSA ENGINEERING AND SURVEYING
521 N. 20TH AVE., SUITE 3
YAKIMA WASHINGTON, 98902
PHONE: 509-575-6990
EMAIL: JBAKER@PLSAOFYAKIMA.COM

THE ELEVATIONS FOR THIS PROJECT WERE DERIVED BY GPS OBSERVATION USING THE WASHINGTON STATE REFERENCE NETWORK. THE PROJECT BENCHMARK IS A PLSA CONTROL POINT WITH CAP NUMBER 99 AS SHOWN ON THESE DRAWINGS. ELEVATION 1033.12 (NAVD88).

DETAIL REFERENCE NUMBER — 1
DRAWING ON WHICH DETAIL APPEARS ("-" INDICATES TYPICAL OR ON SAME DRAWING) — C-1

DETAIL REFERENCE NUMBER — 1 / - DETAIL SCALE:1" = 10'

GENERAL NOTES:

1. A PRE-CONSTRUCTION SURVEY WILL BE COMPLETED BY THE OWNER OR ENGINEER TO ESTABLISH AND CONFIRM EXISTING CONDITIONS, INCLUDING PIPE INVERT ELEVATIONS AND TOPOGRAPHIC INFORMATION, PRIOR TO THE START OF THE WORK BY THE CONTRACTOR.
2. CONTRACTOR SHALL BECOME FULLY INFORMED OF ALL CONDITIONS AT THE WORK SITE THAT MAY OR COULD DELAY PROJECT COMPLETION, RESULT IN EXTRA WORK, OR COST AND SHALL ACCOUNT FOR THESE CONDITIONS IN THE PRICE BID. NO ADDITIONAL COMPENSATION WILL BE ALLOWED FOR NEGATIVE CONDITIONS THAT COULD REASONABLY HAVE BEEN IDENTIFIED BY A DILIGENT EXAMINATION OF THE SITE AND EXISTING CONDITIONS.
3. CONTRACTOR SHALL PROTECT ALL MATERIALS BOTH PURCHASED AND SALVAGED, FOR THE DURATION OF THE WORK. MATERIALS LOST OR DAMAGED BY CONTRACTORS OPERATIONS OR THROUGH IMPROPER STORAGE SHALL BE REPAIRED OR REPLACED AS DIRECTED BY THE OWNER AT NO ADDITIONAL COST TO THE OWNER.
4. CONTRACTOR SHALL MAINTAIN AND PROVIDE AS-BUILT/RECORD DRAWINGS PER THE TECHNICAL SPECIFICATIONS.
5. CONTRACTOR SHALL COMPLY WITH ALL STATE, COUNTY, AND CITY LAWS, PERMITS AND ORDINANCES RELATED TO SAFETY AND CHARACTER OF WORK, EQUIPMENT AND LABOR PERSONNEL. THIS SHALL INCLUDE, BUT IS NOT LIMITED TO, THE SECURING OF THE WORK AREA AND PREVENTION OF DEBRIS DISCHARGE OUTSIDE THE LIMITS OF CONSTRUCTION.
6. CONTRACTOR SHALL CONTACT THE NORTHWEST UTILITY NOTIFICATION CENTER "CALL BEFORE YOU DIG" HOTLINE AT 1-800-424-5555 (OR 811) AND VERIFY THE EXACT LOCATION OF ANY EXISTING UTILITIES. ANY UTILITIES EXPOSED OR DAMAGED BY THE CONTRACTOR SHALL BE REPAIRED AT CONTRACTORS EXPENSE.
7. ANY CONFLICTS WITH THE DESIGN OR CHANGES TO THE CONSTRUCTION DRAWINGS OR SHOP DRAWINGS SHALL BE AUTHORIZED AND APPROVED BY THE OWNER BEFORE CONTINUING WORK IN THAT AREA.

ABBREVIATIONS	
AC-FT	ACRE-FEET
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AT	ANCHOR TRENCH
BGS	BELOW GROUND SURFACE
CQA	CONSTRUCTION QUALITY ASSURANCE
DIA	DIAMETER
EA	EACH
EL, ELEV	ELEVATION
ESC	EROSION AND SEDIMENT CONTROL
EX	EXISTING
FT	FEET
GA	GAUGE
H, HORIZ	HORIZONTAL
HDPE	HIGH DENSITY POLYETHYLINE
IE	INVERT ELEVATION
IPS	IRON PIPE SIZE
IRR	IRRIGATION
IV	IRRIGATION VALVE
LA	LAGOON ACCESS ROAD
LB	LINER BOTTOM
LC	LINER CREST
LF	LINEAR FEET

CONSTRUCTION NOTES:

1. CONTRACTOR IS RESPONSIBLE FOR ADHERING TO THE STANDARDS SET FORTH IN THE CONTRACT DOCUMENTS AND AS PROVIDED BY THE MANUFACTURER.
2. CONTRACTOR SHALL PROTECT IN-PLACE ALL EXISTING SITE FEATURES, UNLESS OTHERWISE DIRECTED.
3. EXISTING LAGOONS SHALL BE RE-GRADED AS SHOWN IN THE CONSTRUCTION DRAWINGS TO THE DIMENSIONS, GRADES, AND ELEVATIONS SHOWN.
4. CONTRACTOR SHALL MAINTAIN SUBGRADE TO MEET REQUIREMENTS SET IN THE TECHNICAL SPECIFICATIONS PRIOR TO INSTALLATION OF GEOSYNTHETICS.
5. LINER SHALL BE INSTALLED BY AN EXPERIENCED AND CERTIFIED INSTALLER. LINER INSTALLATION SHALL BE EXECUTED TO THE GUIDELINES IN THE TECHNICAL TECHNICAL SPECIFICATIONS AND THE CONSTRUCTION QUALITY ASSURANCE AND CONSTRUCTION QUALITY CONTROL CONSTRUCTION DRAWINGS.
6. LINER INSTALLERS SHALL COMPLY WITH ALL MANUFACTURERS RECOMMENDATIONS AND SPECIFICATIONS FOR INSTALLING, WELDING, AND TESTING TECHNIQUES FOR THE LINER.
7. CONTRACTOR SHALL PROTECT THE LINER FROM VEHICLE OR OTHER CONSTRUCTION TRAFFIC DURING THE COURSE OF THE PROJECT. ANY DAMAGE TO THE LINER OR LINER COMPONENTS FROM THE CONTRACTOR SHALL BE REPLACED OR REPAIRED AT THE CONTRACTOR'S EXPENSE.

811 Know what's below. Call 811 before you dig.

ABBREVIATIONS	
MAX	MAXIMUM
MG	MILLION GALLONS
MIL	0.001 INCH
MIN	MINIMUM
NAD 83	NORTH AMERICAN DATUM, 1983
NAVD 88	NORTH AMERICAN VERTICAL DATUM, 1988
NW	NORTHWEST
O.C.	ON CENTER
PLSA	PLSA ENGINEERING AND SURVEYING
PP	POWER POLE
PVC	POLYVINYL CHLORIDE
SCH	SCHEDULE
SF	SQUARE FEET
SY	SQUARE YARDS
TBD	TO BE DETERMINED
UG	UNDERGROUND
US	UNITED STATES
V, VERT	VERTICAL

EROSION AND SEDIMENT CONTROLS (ESC) NOTES:

1. IMPLEMENTATION OF ESC FACILITIES, MAINTENANCE, REPLACEMENT, AND UPGRADING OF ESC FACILITIES ARE THE RESPONSIBILITY OF THE CONTRACTOR'S ESC SUPERVISOR UNTIL FINAL STABILIZATION IS ESTABLISHED AND SUBSTANTIAL COMPLETION IS ACHIEVED,
2. ESC FACILITIES MUST BE CONSTRUCTED PRIOR TO OR IN CONJUNCTION WITH ALL SUBGRADE PREPARATION SO AS TO MINIMIZE THE TRANSPORT OF SEDIMENT TO SURFACE WATERS, DRAINAGE SYSTEMS, AND ADJACENT PROPERTIES.
3. DURING THE CONSTRUCTION PERIOD, ESC FACILITIES SHALL BE UPGRADED AS NEEDED OR REQUESTED BY CONSTRUCTION MANAGER FOR UNEXPECTED STORM EVENTS AND MODIFIED TO ACCOUNT FOR CHANGING SITE CONDITIONS (E.G., SUMP PUMPS, DITCHES AND SILT FENCES).
4. ESC FACILITIES SHALL BE INSPECTED BY THE CONTRACTOR'S ESC SUPERVISOR AND MAINTAINED TO ENSURE CONTINUED PROPER FUNCTIONING THROUGH PROJECT STABILIZATION.
5. ANY AREAS OF EXPOSED SOILS THAT WILL NOT BE DISTURBED FOR TWO (2) DAYS DURING THE WET SEASON OR SEVEN (7) DAYS DURING THE DRY SEASON SHALL BE IMMEDIATELY STABILIZED WITH APPROVED ESC METHODS (E.G., SEEDING, MULCHING, PLASTIC COVERING).
6. SOILS THAT WILL BE STOCKPILED FOR TWO (2) DAYS DURING THE WET SEASON OR SEVEN (7) DAYS DURING THE DRY SEASON SHALL BE IMMEDIATELY STABILIZED WITH PLASTIC COVERING PER WA DEPT OF ECOLOGY BMP C123E.
7. THE ESC FACILITIES ON AREAS WITHIN THE CONSTRUCTION LIMITS THAT WILL REMAIN UNWORKED FOR SEVEN (7) OR MORE DAYS SHALL BE INSPECTED AND MAINTAINED BY THE CONTRACTOR A MINIMUM OF ONCE A MONTH OR WITHIN FORTY-EIGHT (48) HOURS FOLLOWING A STORM EVENT.
8. MAINTAIN ALL EXISTING STORM DRAINS, CHANNELS, CULVERTS, AND STRUCTURES THAT RECEIVE FLOW UNTIL WORK IS COMPLETE. WHENEVER EXISTING STORM DRAINS, CHANNELS, CULVERTS, OR STRUCTURES ARE DISTURBED; PROVIDE SUITABLE MEANS FOR DIVERTING AND MAINTAINING ALL FLOWS AT CONTRACTOR'S EXPENSE.

BEST MANAGEMENT PRACTICES (BMP) AND MONITORING NOTES:

1. DURING ALL PHASES OF THE WORK, CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PREVENT CONSTRUCTION TRASH AND DEBRIS FROM FOULING LOCAL WATERS AND COMPLY WITH YAKIMA COUNTY BEST MANAGEMENT PRACTICES (BMP) GUIDELINES. THE CONTRACTOR SHALL PROMPTLY CLEAN UP ALL MATERIALS DISCHARGED INTO LOCAL WATERS. IF CONTRACTOR FAILS TO CLEAN UP SPILLS, IT MAY CAUSE THE OFFENDING MATERIALS TO BE REMOVED BY THE OWNER, AND THE COST OF THAT REMOVAL WILL BE DEDUCTED FROM THE CONTRACT PRICE.
2. APPROPRIATE BMPS WILL BE IMPLEMENTED BY THE CONTRACTOR TO REDUCE CONSTRUCTION-RELATED IMPACTS TO NEARBY WATER BODIES.
3. NO CONSTRUCTION MATERIALS, EQUIPMENT, DEBRIS OR WASTE SHALL BE PLACED OR STORED OUTSIDE THE OWNER DESIGNATED STAGING/STOCKPILING AREA OR CONSTRUCTION BOUNDARIES NOTED IN THE DRAWINGS.
4. CONTRACTOR SHALL ENSURE NO UNWANTED DEBRIS, SOIL, SILT, SAND, SAWDUST, RUBBISH, CEMENT OR CONCRETE WASHINGS, OIL OR PETROLEUM PRODUCTS, FROM CONSTRUCTION, ENTERS INTO OR IS PLACED WHERE IT MAY BE INADVERTENTLY WASHED BY RAINFALL OR RUNOFF INTO LOCAL WATER BODIES.
5. REASONABLE AND PRUDENT MEASURES SHALL BE TAKEN BY THE CONTRACTOR TO PREVENT ANY DISCHARGE OF FUEL OR OILY WASTE FROM HEAVY MACHINERY, CONSTRUCTION EQUIPMENT OR POWER TOOLS INTO LOCAL WATER BODIES. CONTRACTOR SHALL HAVE ADEQUATE EQUIPMENT AVAILABLE TO CONTAIN ANY DISCHARGE IMMEDIATELY.

LEGEND:

- 1021 — EXISTING ELEVATION CONTOUR
- EXISTING EMBANKMENT TOP/TOE
- 1213.8 — EXISTING SURVEY SPOT ELEVATION
- EXISTING OVERHEAD POWER
- PP — EXISTING POWER POLE (PP)
- EXISTING 4X4 POST WITH POWER BOX
- IV — EXISTING IRRIGATION WATER VALVE
- IRRIGATION RISER (IRR)
- LD-SB-L6N — EXISTING BORING LOCATION
- UNDERGROUND POWER
- EXISTING FENCE
- WV — WATER VALVE
- SIGN — SIGN
- CONCRETE

LEGEND:

- A A' — PROFILE SECTION LINE
- 1020 — PROPOSED 10&2 FT LINER ELEVATION CONTOURS
- PROPOSED INNER&OUTER EDGES OF ANCHOR TRENCH
- 1020 — PROPOSED 10&2 FT FINAL GRADING ELEVATION CONTOURS OUTSIDE LAGOON CREST
- LA-1 — PROPOSED LINER CONSTRUCTION POINT
- 3:1 — PROPOSED SURFACE GRADE, DIRECTION AND RUN:RISE
- PROPOSED LEAK DETECTION WIRING
- PROPOSED LEAK DETECTION POTENTIAL/CURRENT ELECTRODE
- PROPOSED LEAK DETECTION POTENTIAL ELECTRODE LOCATION
- AL04 — PROPOSED ARTIFICIAL LEAK ELECTRODE LOCATION
- PROPOSED GEOCOMPOSITE GAS VENTING STRIP
- ACCESS ROUTE

ONE INCH — AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON — STATE OF WASHINGTON — 57013 — REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

GENERAL NOTES

G-02

SHEET NO. 2 OF 14

Jul 10, 2019 2:40pm rpetrie

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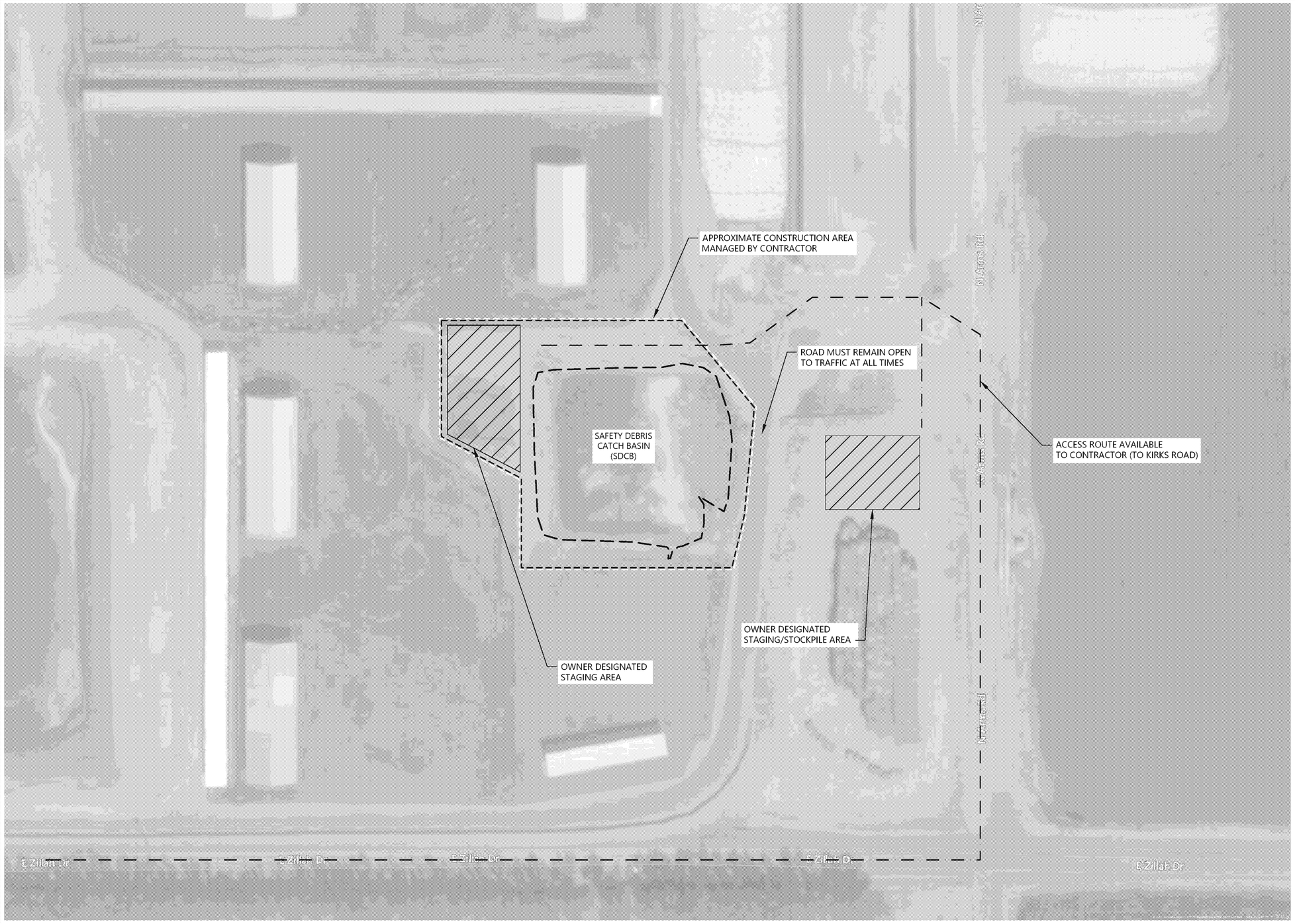

LEGEND:

- ACCESS ROUTE
- APPROXIMATE CONSTRUCTION AREA
- OWNER DESIGNATED STAGING/STOCKPILING AREA
- SAFETY DEBRIS CATCH BASIN

NOTES:

1. THE WORK WILL OCCUR WITHIN AN ACTIVE DAIRY FARM. THE CONTRACTOR SHALL MINIMIZE ITS IMPACTS TO THE OPERATIONS OF THE DAIRY. ROADWAY TO THE EAST OF THE PROJECT AREA MUST REMAIN OPEN TO TRUCK TRAFFIC AT ALL TIMES.
2. THE OWNER DESIGNATED STAGING AND STOCKPILING AREAS ARE THE ONLY AREAS ALLOWED FOR THE CONTRACTOR TO STAGE, STORE, AND PARK EQUIPMENT AND VEHICLES; STAGE AND STORE SUPPLIES, MATERIALS, AND TOOLS; AND STOCKPILE SOILS AND DEBRIS.
3. ACCESS ROUTES ARE PROVIDED TO THE CONTRACTOR BY THE OWNER FOR THE DURATION OF THE WORK AND ARE LIMITED TO VEHICLE AND EQUIPMENT ACCESS ONLY BETWEEN THE STAGING AND STOCKPILING AREA AND THE CONSTRUCTION AREA AS SHOWN, HEREON. MATERIALS, SUPPLIES, VEHICLES, AND EQUIPMENT SHALL NOT OCCUPY THE ACCESS ROUTES, OTHERWISE, WITHOUT PRIOR WRITTEN APPROVAL BY THE OWNER.

NORTH

0 50 100
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S FT.
2. VERTICAL DATUM: NAVD 88.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

SITE MAP

C-01

SHEET NO. **3** OF **14**

Jul 10, 2019 2:40pm rpetrie

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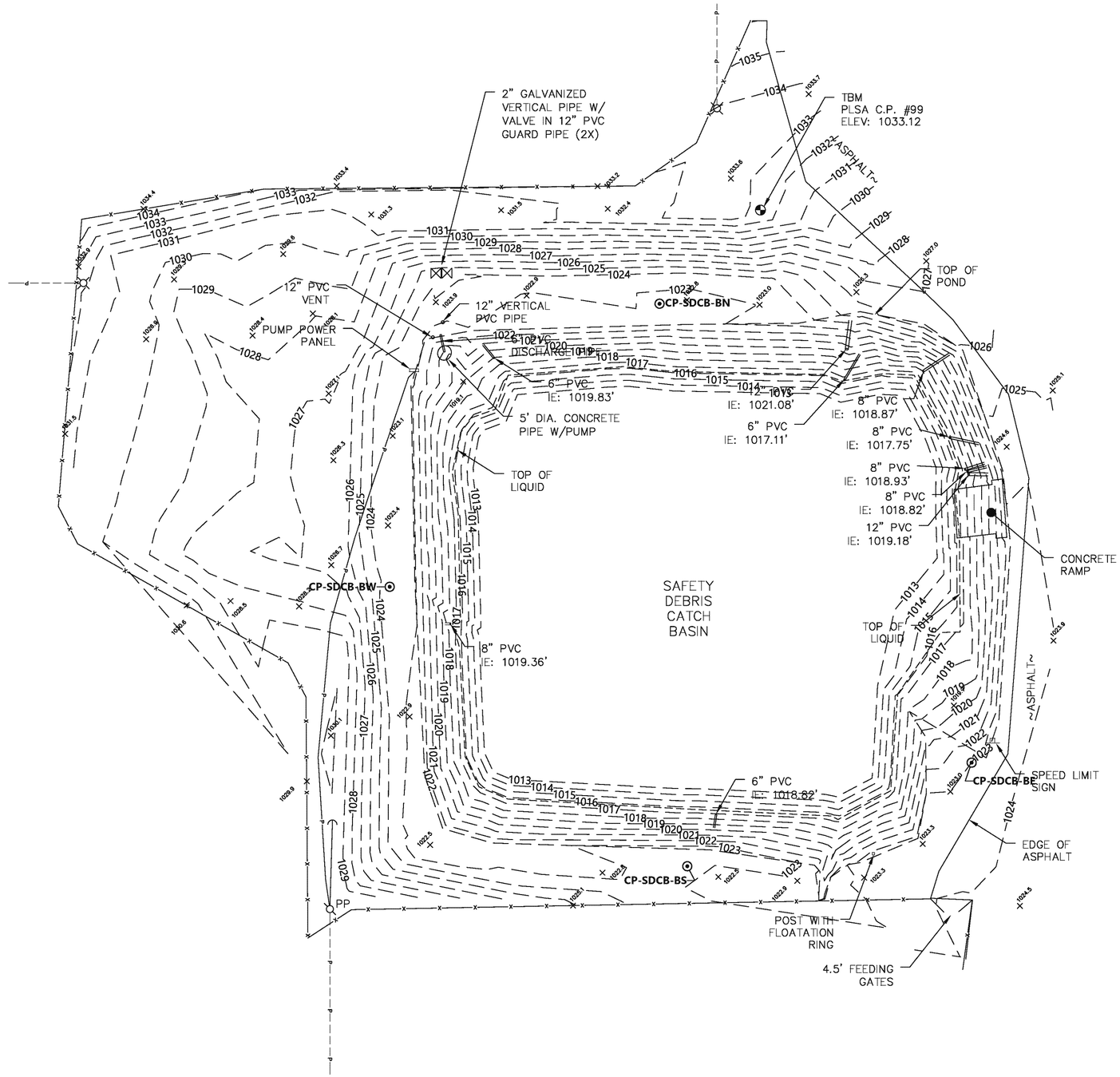

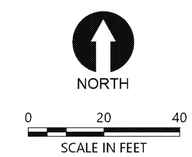

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S. FT.
2. VERTICAL DATUM: NAVD 88.
3. SURVEY BY PLSA, 4/8/2019.
4. SURVEY SHOWN, HEREON, COMPLETED PRIOR TO EMPTYING OF THE LAGOONS AND DID NOT EXTEND BELOW LIQUID DEPTH. LAGOON CONTOURS BELOW 1017 ESTIMATED BY ANCHOR QEA.
5. OWNER WILL EMPTY LIQUID AND SOLID MANURE FROM SDCB PRIOR TO THE START OF THE WORK BY THE CONTRACTOR.
6. OWNER WILL REMOVE ALL PIPING AND APPURTENANCES PRIOR TO THE START OF THE WORK BY THE CONTRACTOR.
7. PRIOR TO THE START OF THE WORK BY THE CONTRACTOR, THE OWNER OR ENGINEER SHALL COMPLETE A PRE-CONSTRUCTION SURVEY OF LAGOON TO BE USED FOR BASIS OF CONTRACT MEASUREMENT AND PAYMENT.
8. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER
6/17/2019

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

EXISTING CONDITIONS PLAN

C-02

SHEET NO. 4 OF 14

Jul 10, 2019 2:40pm rpetrie

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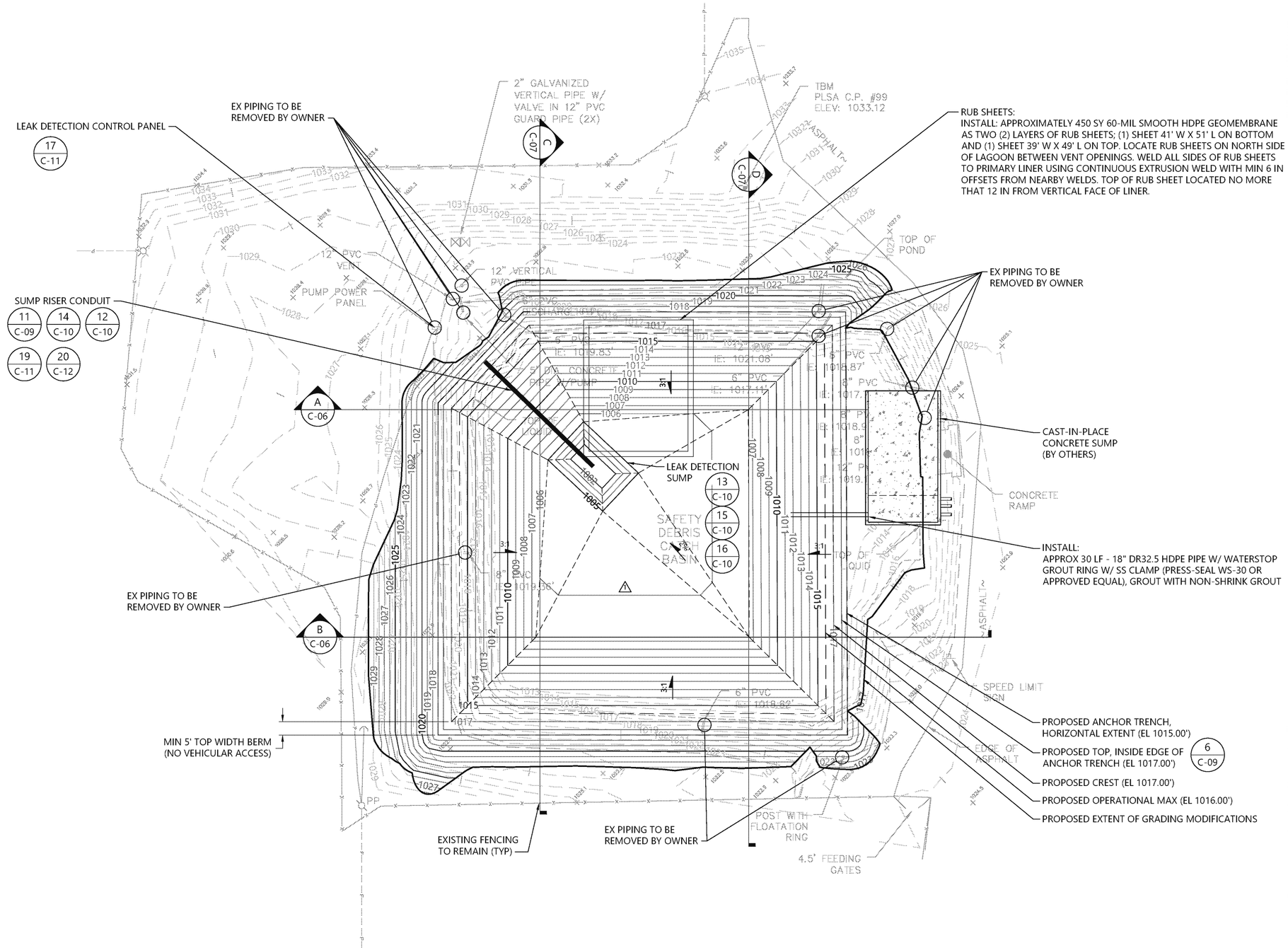
SAFETY DEBRIS CATCH BASIN
3H:1V INTERIOR SIDE SLOPE
BOTTOM EL: 1005.5'
MAX OPERATIONAL EL = 1016.00'
TOP (CREST) EL = 1017.00'
FREEBOARD = 1.00'
MAX OPERATIONAL SURFACE AREA APPROX 18,951 SF
MAX OPERATIONAL VOLUME APPROX 0.92 MG = 2.82 AC-FT
EMERGENCY MAX VOLUME APPROX 1.07 MG = 3.27 AC-FT



NORTH

0 20 40
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S.'.
2. VERTICAL DATUM: NAVD 88.
3. SURVEY BY PLSA, 4/8/2019.
4. SURVEY SHOWN, HEREON, COMPLETED PRIOR TO EMPTYING OF THE LAGOONS AND DID NOT EXTEND BELOW LIQUID DEPTH. LAGOON CONTOURS BELOW 1017 ESTIMATED BY ANCHOR QEA.
5. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SELTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER
7/10/2019

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	REVISED BOTTOM GRADING

DESIGNED BY: K SKELLENGER
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

SITE PLAN

C-03

SHEET NO. 5 OF 14

Jul 10, 2019 2:40pm rpetrie

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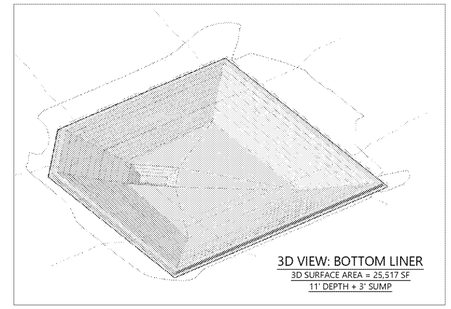
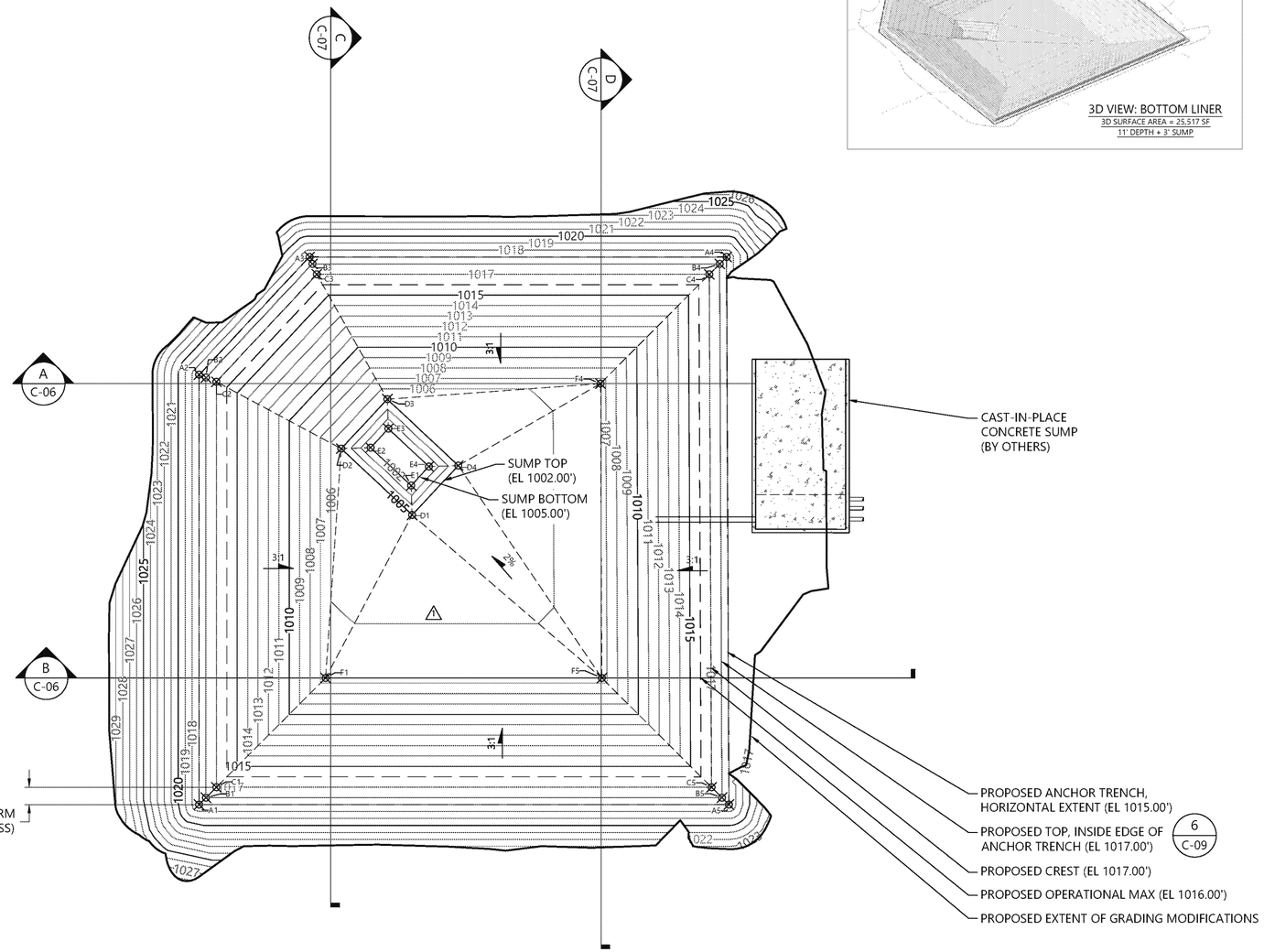
ANCHOR TRENCH (A,B) POINT TABLE				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
155	391075.83	1731818.05	1015.00 FT	A1
156	391199.79	1731818.05	1015.00 FT	A2
157	391233.69	1731849.93	1015.00 FT	A3
153	391233.69	1731970.19	1015.00 FT	A4
154	391075.83	1731970.84	1015.00 FT	A5
159	391077.82	1731820.04	1015.00 FT	B1
160	391198.96	1731820.04	1015.00 FT	B2
161	391231.70	1731850.76	1015.00 FT	B3
162	391231.70	1731968.20	1015.00 FT	B4
158	391077.82	1731968.85	1015.00 FT	B5

LINER CREST (C) POINT TABLE				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
164	391080.83	1731823.05	1017.00 FT	C1
165	391197.72	1731823.05	1017.00 FT	C2
166	391228.69	1731852.00	1017.00 FT	C3
167	391228.69	1731965.19	1017.00 FT	C4
163	391080.83	1731965.84	1017.00 FT	C5

SUMP (D,E) POINT TABLE				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
171	391159.33	1731879.50	1005.00 FT	D1
168	391178.45	1731859.05	1005.00 FT	D2
169	391192.69	1731872.36	1009.25 FT	D3
170	391173.57	1731892.82	1005.00 FT	D4
175	391167.81	1731879.21	1002.00 FT	E1
172	391178.73	1731867.53	1002.00 FT	E2
173	391184.21	1731872.65	1002.00 FT	E3
174	391173.28	1731884.34	1002.00 FT	E4

LINER BOTTOM (F) POINT TABLE				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
176	391112.33	1731854.55	1006.50 FT	F1
178	391197.19	1731933.82	1006.50 FT	F4
177	391112.33	1731934.21	1006.50 FT	F5





SEQUENCING AND SELECT WORK REQUIREMENTS:

1. NOT ALL WORK IS DESCRIBED BELOW; REFER TO THESE DRAWINGS, TECHNICAL SPECIFICATIONS, AND OTHER CONTRACT DOCUMENTS.
2. PRIOR TO THE START OF THE WORK THE OWNER SHALL COMPLETE A PRECONSTRUCTION SURVEY OF LAGOON TO BE USED FOR BASIS OF CONTRACT MEASUREMENT AND PAYMENT.
3. CONTRACTOR SHALL PREPARE FINAL GRADE TO THE LINES, EXTENTS, AND ELEVATIONS SHOWN HEREON.
4. EXCESS IN-SITU SOILS FROM THE LAGOON SHALL BE STOCKPILED IN THE DESIGNATED AREA (SHOWN ON DRAWING C-01) AND MANAGED IN ACCORDANCE WITH STORMWATER REQUIREMENTS; SEE TECHNICAL SPECIFICATIONS FOR FURTHER DETAILS.
5. THE FINISH GRADE SHALL BE A SMOOTH, UNYIELDING SURFACE FREE OF ORGANICS, DEBRIS, AND ROCK 3/8 INCH DIA OR LARGER.
6. UNLESS OTHERWISE REQUIRED IN THE TECHNICAL SPECIFICATIONS, PLACED FILL SHALL BE COMPACTED TO 92% OF THE MAX DRY DENSITY AS DETERMINED USING ASTM D1557 (MODIFIED PROCTOR).
7. UNLESS OTHERWISE REQUIRED IN THE TECHNICAL SPECIFICATIONS, SUBGRADES IN EXCAVATION AREA SHALL BE PROOF-ROLLED USING CONSTRUCTION EQUIPMENT TO VERIFY THE SUBGRADE IS IN A NONYIELDING CONDITION. THE ENGINEER SHALL DETERMINE WHAT EQUIPMENT IS SUITABLE FOR PROOF-ROLLING. THE ENGINEER SHALL MONITOR PROOF-ROLLING FOR YIELDING SUBGRADE SOILS. THE CONTRACTOR SHALL REMOVE SOFT SOILS TO A DEPTH RECOMMENDED BY THE ENGINEER AND REPLACE THE OVEREXCAVATION WITH ONSITE FILL MATERIAL OR IMPORT FILL MATERIAL TO BE COMPACTED AND TESTED IN ACCORDANCE WITH NOTE 6 AND THE TECHNICAL SPECIFICATIONS.
8. CONTRACTOR SHALL THEN COMMENCE INSTALLATION OF THE VENT SYSTEM GEOCOMPOSITE STRIPS, HDPE GEOMEMBRANE COVER STRIPS, GEOTEXTILE FABRIC, WELDED HDPE SECONDARY LINER, AND WELDED HDPE GEOMEMBRANE PRIMARY LINER IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS, THESE DRAWINGS, AND THE APPROVED CQA PLAN.

NORTH

0 20 40
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S.'.
2. VERTICAL DATUM: NAVD 88.
3. SURVEY BY PLSA, 4/8/2019.
4. SURVEY SHOWN, HEREON, COMPLETED PRIOR TO EMPTYING OF THE LAGOONS AND DID NOT EXTEND BELOW LIQUID DEPTH. LAGOON CONTOURS BELOW 1017 ESTIMATED BY ANCHOR QEA.
5. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SELTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER
6/10/2019

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	REVISED BOTTOM GRADING

DESIGNED BY: K SKELLENGER
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

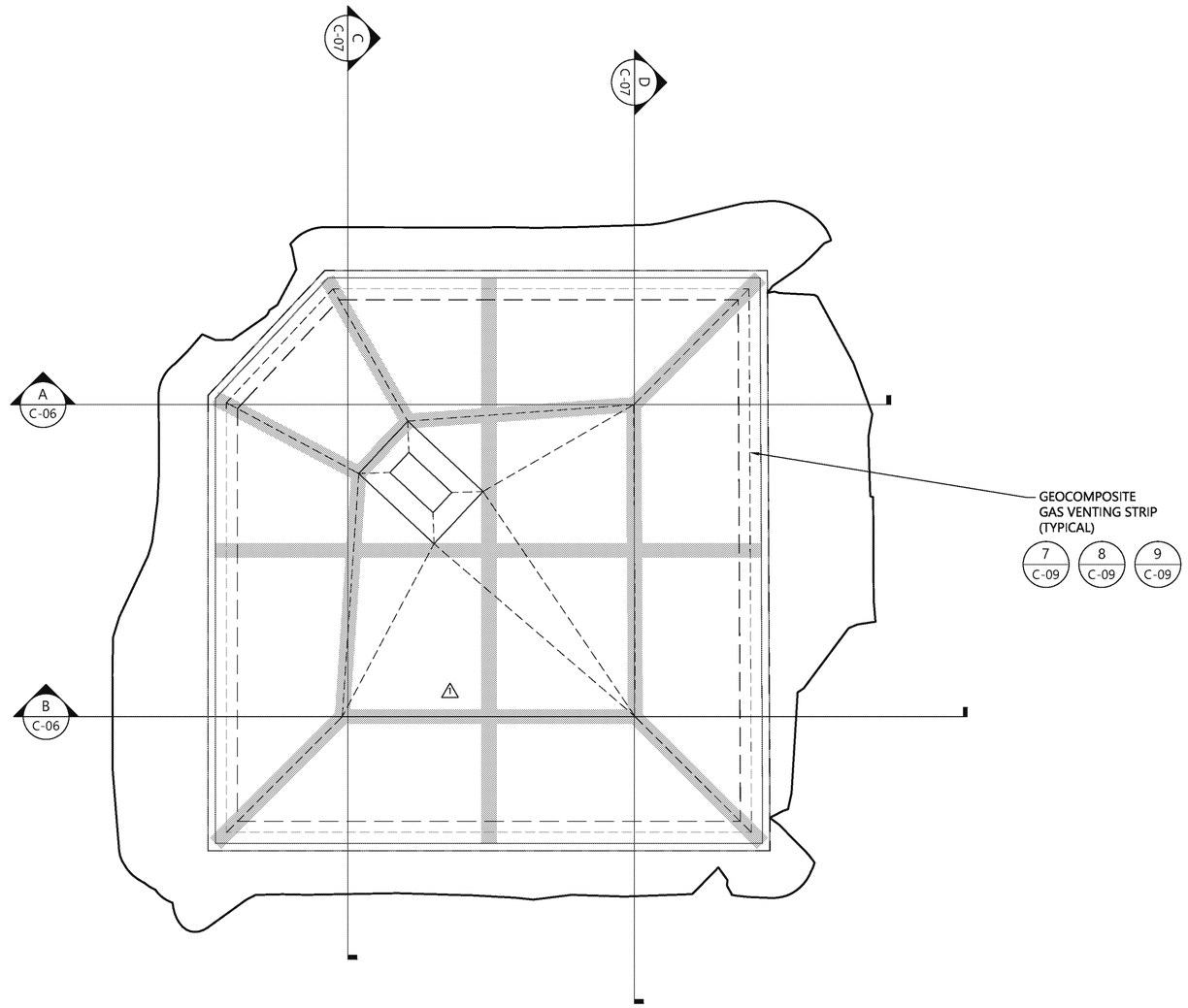
FINAL GRADING PLAN

C-04

SHEET NO. 6 OF 14

Jul 10, 2019, 2:41pm repetrie

ED_002369M_00000063-00044



NORTH

0 20 40
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S.'.
2. VERTICAL DATUM: NAVD 88.
3. SURVEY BY PLSA, 4/8/2019.
4. SURVEY SHOWN, HEREON, COMPLETED PRIOR TO EMPTYING OF THE LAGOONS AND DID NOT EXTEND BELOW LIQUID DEPTH. LAGOON CONTOURS BELOW 1017 ESTIMATED BY ANCHOR QEA
5. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED
PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	ADJUSTED VENT STRIPS TO MATCH REVISED BOTTOM GRADING

DESIGNED BY: K SKELLENGER
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

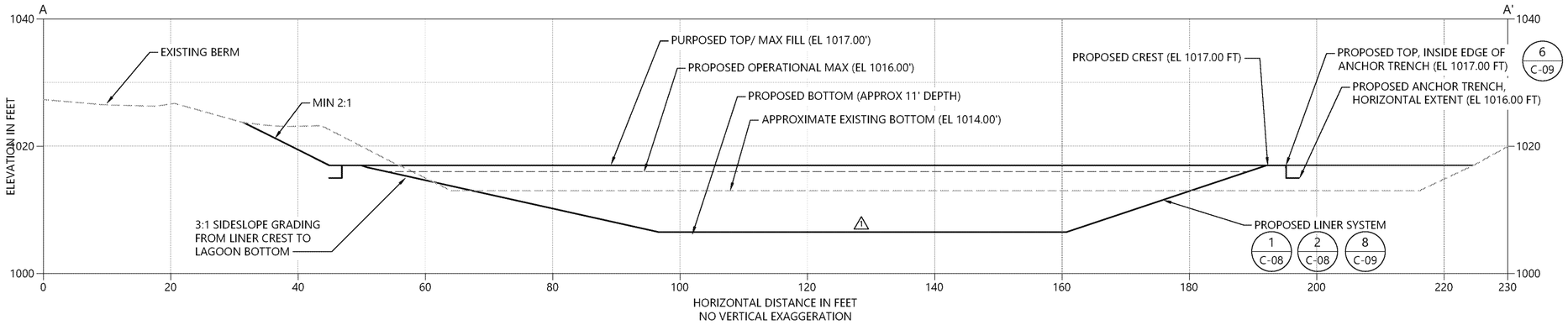
COW PALACE SAFETY DEBRIS CATCH BASIN

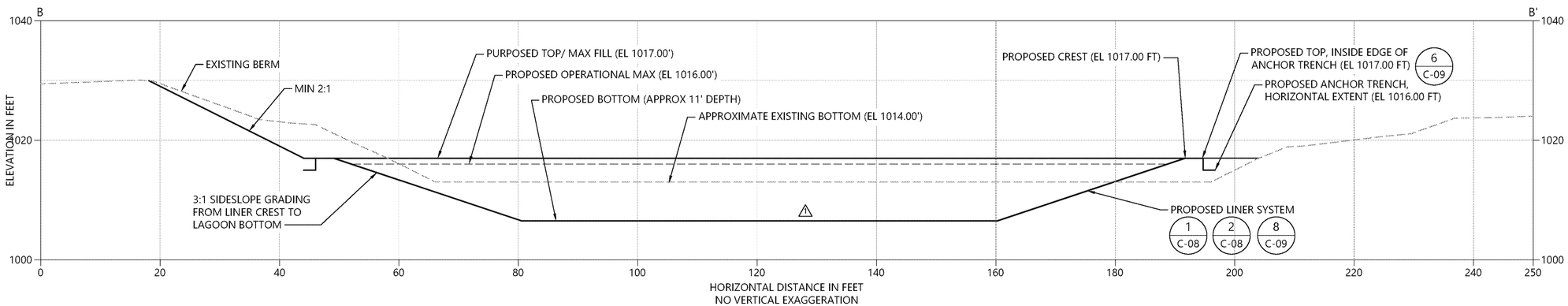
VENTING PLAN

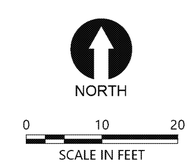
C-05

SHEET NO. 7 OF 14

Jul 10, 2019 2:43pm rpetrie







NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S.'.
2. VERTICAL DATUM: NAVD 88.
3. SURVEY BY PLSA, 4/8/2019.
4. SURVEY SHOWN, HEREON, COMPLETED PRIOR TO EMPTYING OF THE LAGOONS AND DID NOT EXTEND BELOW LIQUID DEPTH. LAGOON CONTOURS BELOW 1017 ESTIMATED BY ANCHOR QEA.
5. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER
7/10/2019

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	REVISED BOTTOM GRADING

DESIGNED BY: K SKELLENGER
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

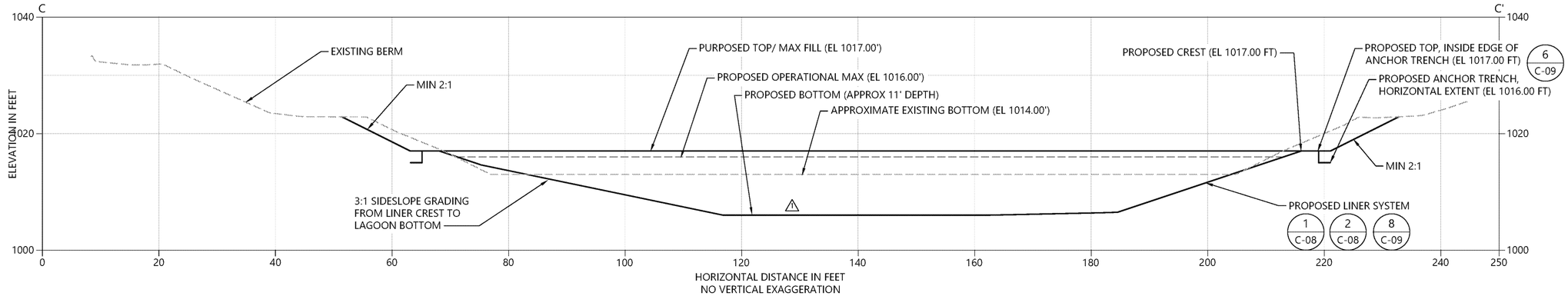
COW PALACE SAFETY DEBRIS CATCH BASIN

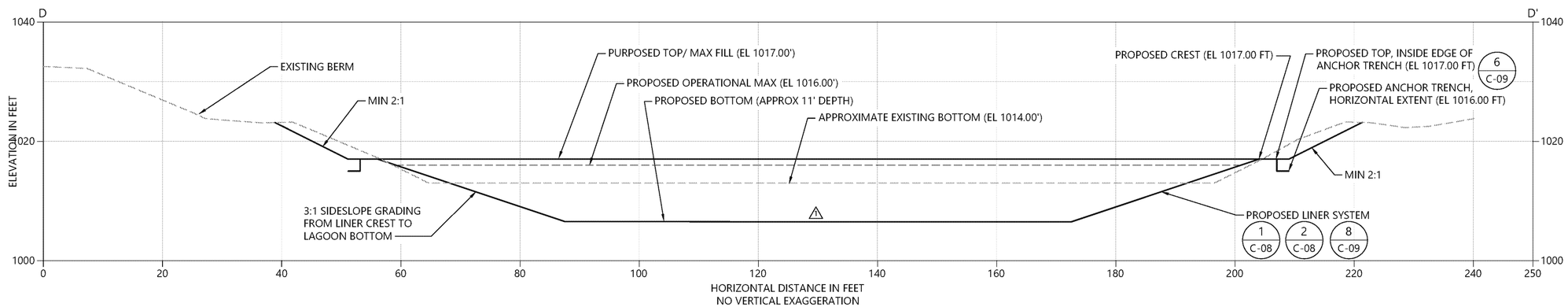
LAGOON PROFILES

C-06

SHEET NO. 8 OF 14

Jul 10, 2019 2:41pm rpetrie





NORTH

0 10 20
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S.'.
2. VERTICAL DATUM: NAVD 88.
3. SURVEY BY PLSA, 4/8/2019.
4. SURVEY SHOWN, HEREON, COMPLETED PRIOR TO EMPTYING OF THE LAGOONS AND DID NOT EXTEND BELOW LIQUID DEPTH. LAGOON CONTOURS BELOW 1017 ESTIMATED BY ANCHOR QEA.
5. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	REVISED BOTTOM GRADING

DESIGNED BY: K SKELLENGER
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

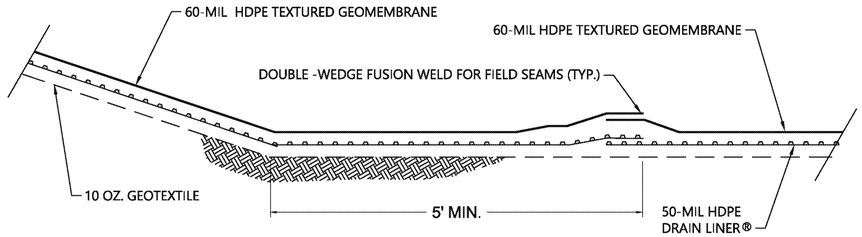
COW PALACE SAFETY DEBRIS CATCH BASIN

LAGOON PROFILES

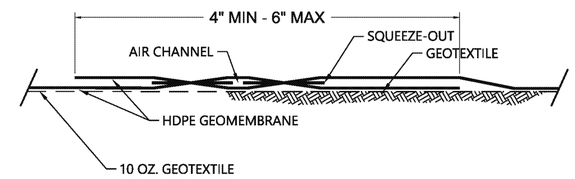
C-07

SHEET NO. 9 OF 14

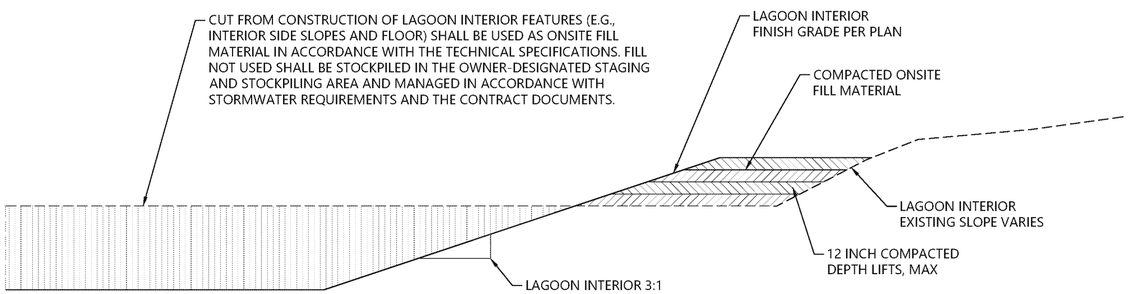
Jul 10, 2019 2:41pm rpetrie



1 / C-08 TYPICAL SLOPE TRANSITION WELDS
SCALE: NOT TO SCALE

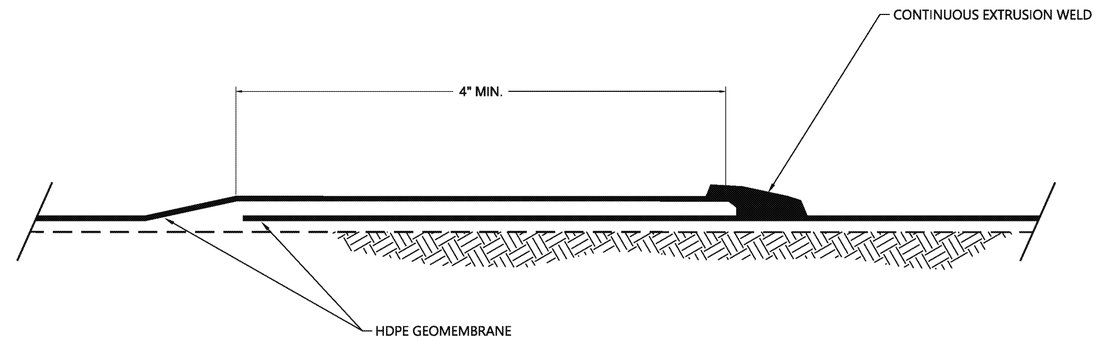


3 / C-09 TYP HOT WEDGE DBL TRACK FUSION WELD
SCALE: NOT TO SCALE

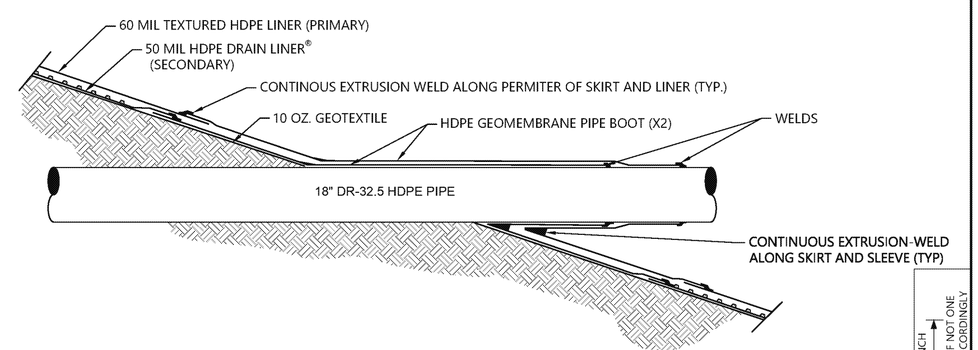


NOTES:
1. THE FINISH GRADE SHALL BE A SMOOTH, UNYIELDING SURFACE FREE OF ORGANICS, DEBRIS, AND ANGULAR ROCK 3/8-INCH DIA OR LARGER. COBBLES ACCEPTABLE IN SUBGRADE (BELOW FINISH GRADE).
2. UNLESS OTHERWISE REQUIRED IN THE TECHNICAL SPECIFICATIONS, FILL SHALL BE COMPACTED TO 95% OF THE MAX. DRY DENSITY AND TO WITHIN 2% OF THE OPTIMUM MOISTURE CONTENT, AS DETERMINED USING ASTM D1557 (MODIFIED PROCTOR).

2 / C-08 INTERIOR GRADING DETAILS
SCALE: NOT TO SCALE



4 / C-09 TYPICAL FILLET EXTRUSION WELD
SCALE: NOT TO SCALE



5 / C-08 DOUBLE BOOT PIPE PENETRATION SEAL
SCALE: NOT TO SCALE

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57033
REGISTERED
PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

DETAILS (1 OF 5)

C-08

SHEET NO. **10** OF **14**

Jul 10, 2019 2:41pm rpetrie

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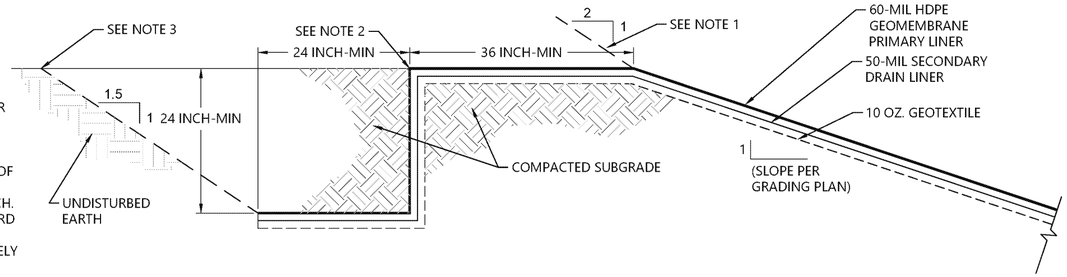
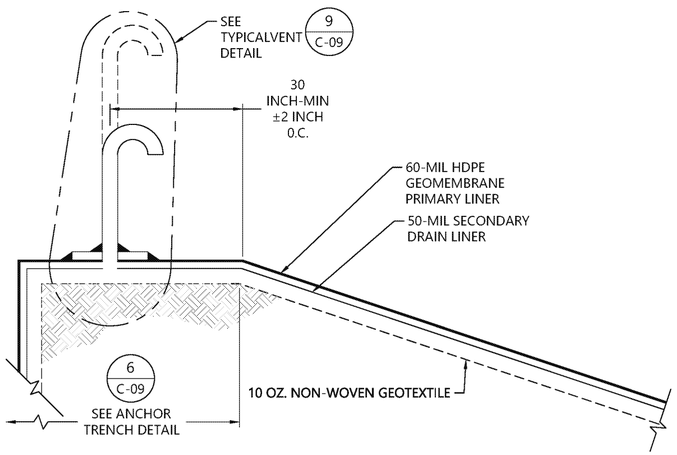
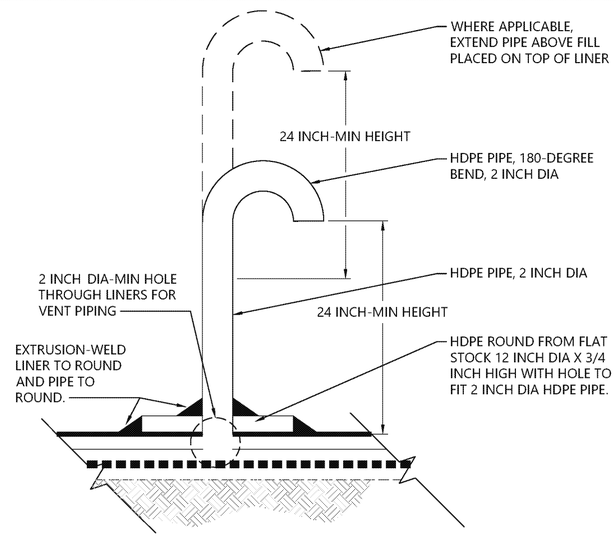
NOTES:
1. WHERE GRADING FROM CREST IS INDICATED ON PLAN, REPLACE EXCAVATED MATERIAL ABOVE LINER AT A SLOPE OF 2:1 TO EXISTING GRADE.
2. WHERE ABUTTING ACCESS ROAD IS INDICATED ON PLAN, INNER EDGE OF ACCESS ROAD SHALL BEGIN AT VERTICAL EDGE OF ANCHOR TRENCH. ACCESS ROAD SHALL SLOPE TOWARD LAGOON AT 1% GRADE.
3. WHERE GRADING TO APPROXIMATELY LEVEL EXISTING GRADE, THE OUTER EDGE OF TRENCH SHALL BE SLOPED AT APPROXIMATELY 1.5:1. THE TRENCH FILL SHALL BE SLOPED EVENLY FROM THE VERTICAL EDGE OF THE LINER TO THE EXISTING GRADE.



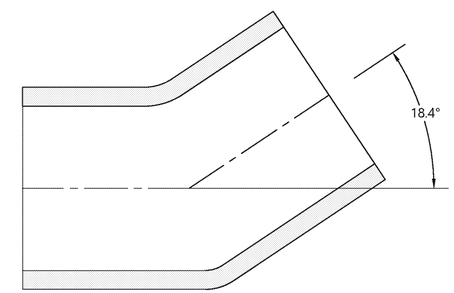
6 / C-03 TYPICAL ANCHOR TRENCH
SCALE: NOT TO SCALE



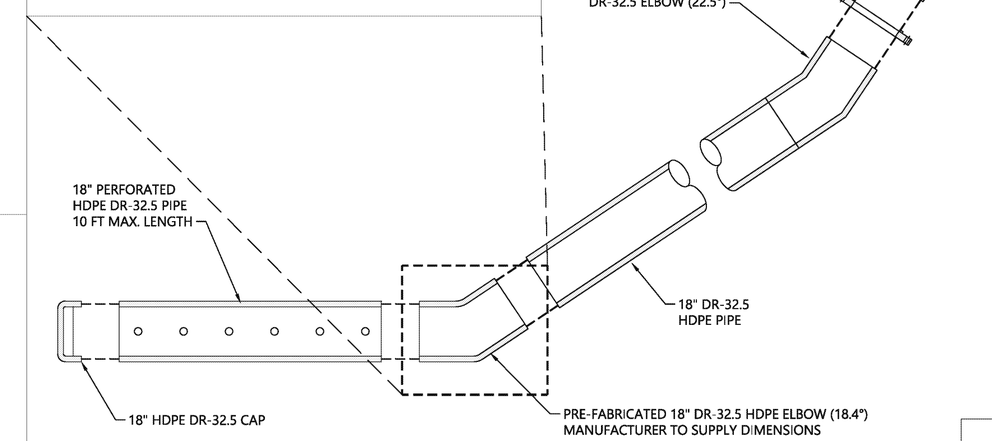
7 / C-05 TYPICAL LINER GAS VENT
SCALE: NOT TO SCALE



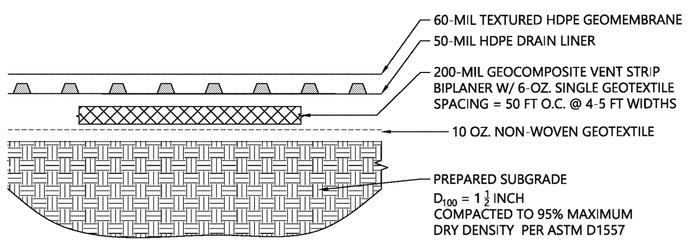
9 / C-05 TYPICAL VENT DETAIL
SCALE: NOT TO SCALE



10 / - INSET DETAIL - 18" DR-32.5 HDPE ELBOW
SCALE: NOT TO SCALE



11 / C-03 HDPE SLOPE RISER CONDUIT ASSEMBLY
SCALE: NOT TO SCALE



8 / C-05 TYPICAL LINER AND VENTING DETAIL - SECTION VIEW
SCALE: NOT TO SCALE

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

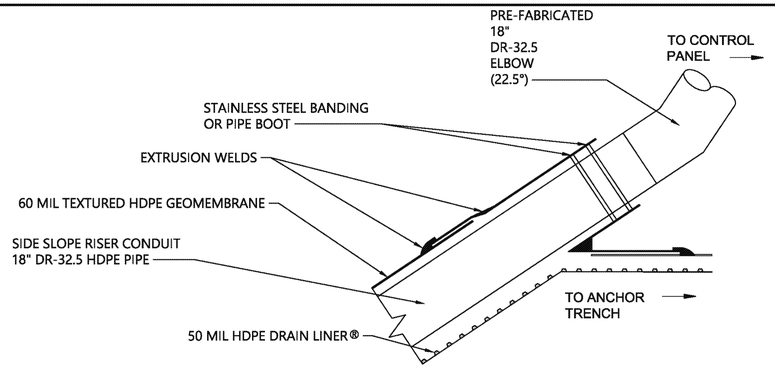
COW PALACE SAFETY DEBRIS CATCH BASIN

DETAILS (2 OF 5)

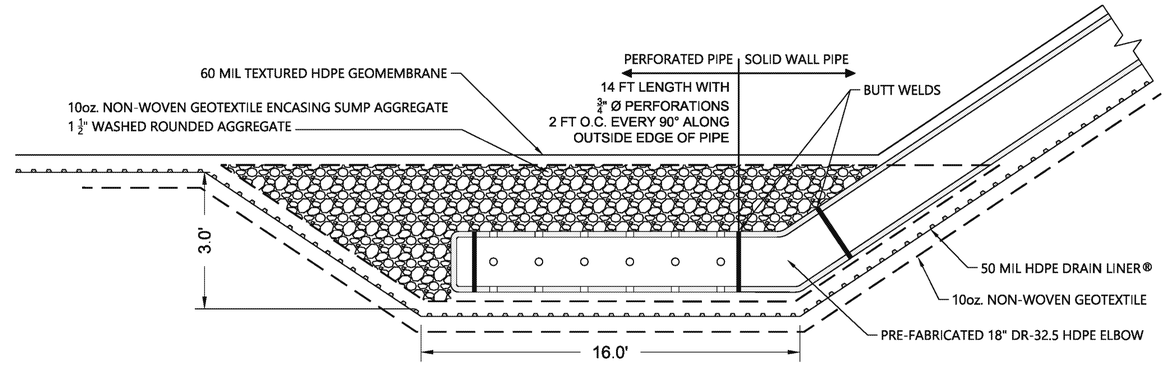
C-09

SHEET NO. 11 OF 14

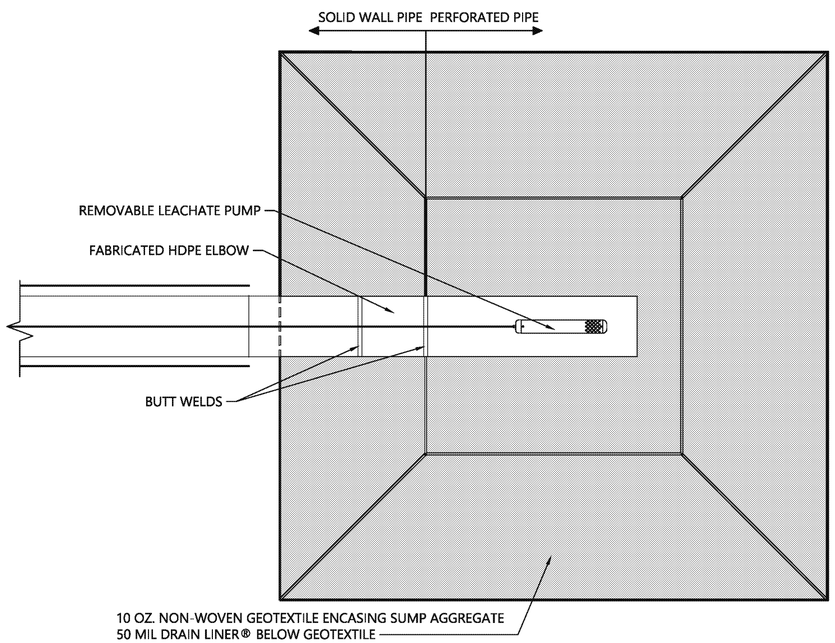
Jul 10, 2019 2:41pm rpetrie



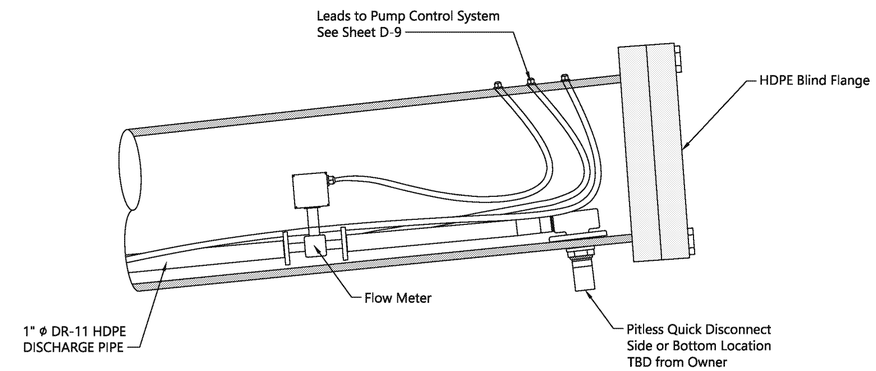
12 / C-03 HDPE CONDUIT - LINER CONNECTION DETAIL
SCALE: NOT TO SCALE



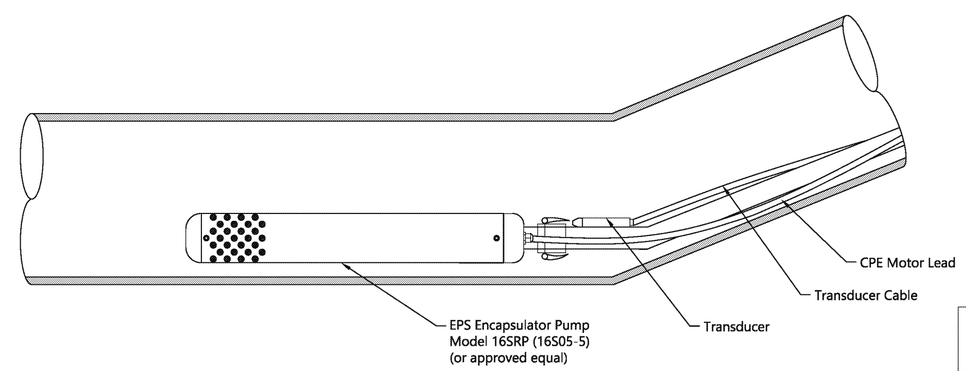
13 / C-03 LEAK DETECTION SUMP (TYP. SECTION)
SCALE: NOT TO SCALE



16 / C-03 LEAK DETECTION SUMP (PLAN VIEW)
SCALE: NOT TO SCALE



14 / C-03 LEACHATE PUMP SYSTEM - DISCHARGE DETAIL
SCALE: NOT TO SCALE



15 / C-03 LEACHATE PUMP SYSTEM - SUMP DETAIL
SCALE: NOT TO SCALE

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

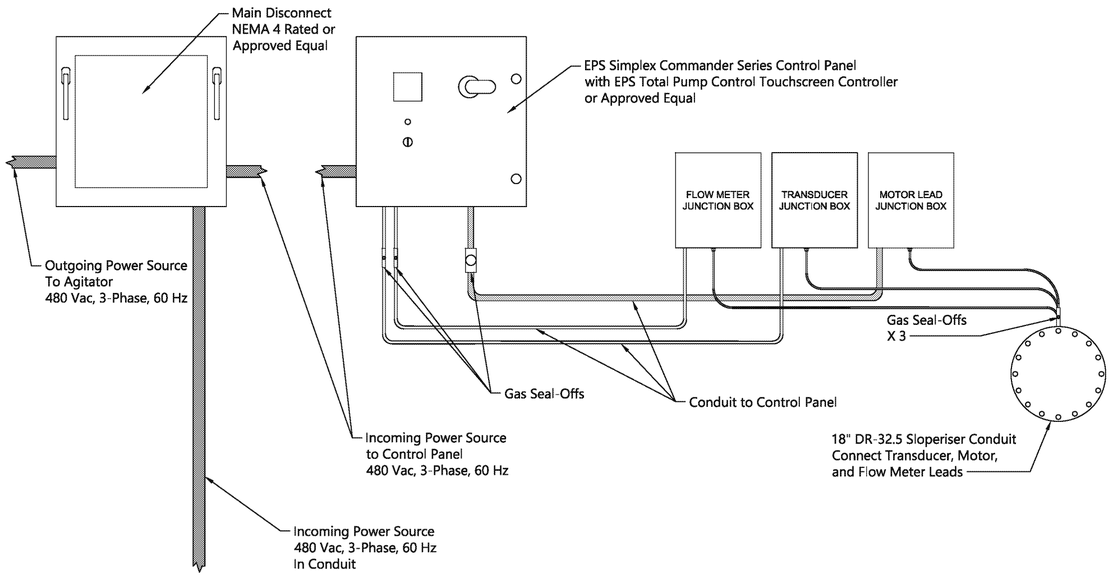
COW PALACE SAFETY DEBRIS CATCH BASIN

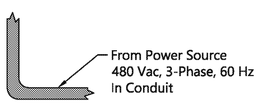
DETAILS (3 OF 5)

C-10

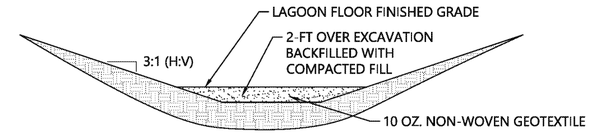
SHEET NO. **12** OF **14**

Jul 10, 2019 2:41pm rpetrie





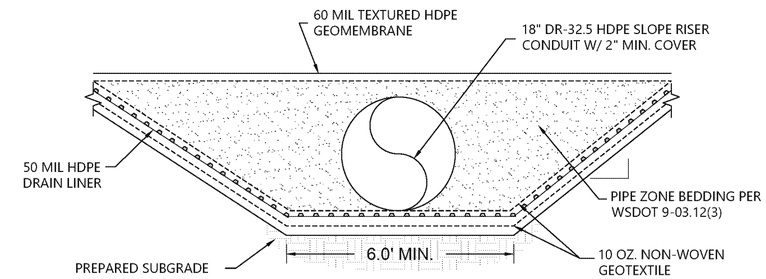
17 / C-03 PUMP CONTROL SYSTEM SCHEMATIC
SCALE: NOT TO SCALE



18 / - LAGOON FLOOR OVER-EXCAVATION
SCALE: NOT TO SCALE

DETAIL NOTES:

1. 2-FT OVER-EXCAVATION OF LAGOON FLOOR WILL BE REQUIRED IF UNSUITABLE SUB-GRADE IS ENCOUNTERED. OVER-EXCAVATION WILL BE BACKFILLED WITH COMPACTED FILL MATERIAL MEETING PROJECT SPECIFICATION FOR PREPARED SUBGRADE ON TOP OF 10 OZ. NON-WOVEN GEOTEXTILE.



19 / C-03 TYPICAL SLOPE RISER SECTION
SCALE: NOT TO SCALE

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED
PROFESSIONAL ENGINEER

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

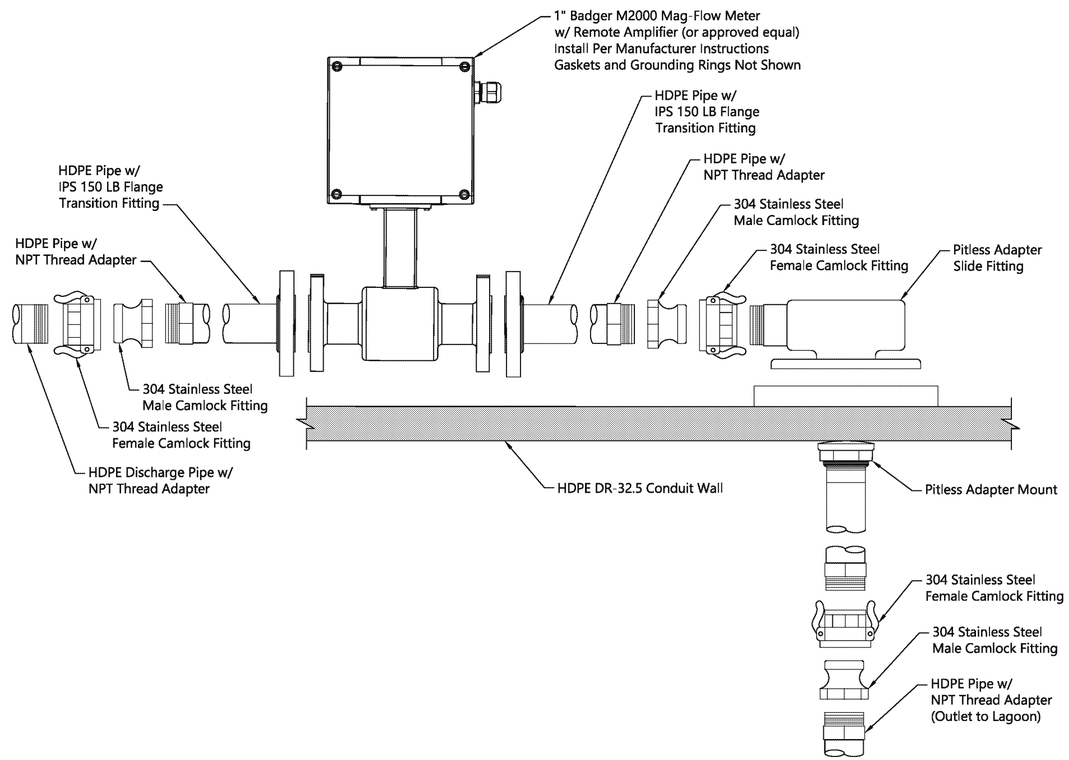
COW PALACE SAFETY DEBRIS CATCH BASIN

DETAILS (4 OF 5)

C-11

SHEET NO. **13** OF **14**

Jul 10, 2019 2:41pm rpetrie



20 / C-03 LEACHATE PUMP SYSTEM DISCHARGE ASSEMBLY
SCALE: NOT TO SCALE

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER
6/18/2019

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

DETAILS (5 OF 5)

C-12

SHEET NO. **14** OF **14**

Jul 10, 2019 2:41pm rpetrie

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Appendix C
Technical Specifications

SECTION 01 01 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. The purpose of this project is to install a high-density polyethylene (HDPE) liner system in the Cow Palace Safety Debris Catch Basin, herein referred to as "SDCB." The project generally consists of the following:

1. Work to be completed by the Contractor that includes, but is not limited to, the following:

   a) Mobilization of equipment, materials, supplies, labor, and other Work-related elements necessary to execute the Contract. Other Work-required elements may include, but are not limited to, utility locates, developing pre-construction submittals and construction submittals, and securing necessary construction permits and bonds.

   b) Site preparation Work including, but not limited to, procuring and installing temporary erosion and sediment controls, establishing topographical survey control, establishing temporary staging and stockpiling area(s), and providing temporary facilities, as needed.

   c) Construction staking and As-Built Drawings.

   d) Excavation/fill to the lines and grades shown on the Construction Drawings; Work will involve placement and compaction of suitable on-site fill material and imported fill material (if required).

   e) Stabilization of lagoon floor, if required.

   f) Final grading of the lagoon subgrade; compaction and compaction testing are required.

   g) Excavation for the side slope riser pipe, inlet piping, and anchor trenches as shown on the Construction Drawings.

   h) Construction of a lagoon double-liner system (with a perimeter anchor trench) by qualified and certified installers in accordance with the Contract Documents. The liner system includes, but is not limited to, the following major elements:

      1) Geocomposite vent strips to be installed over the prepared subgrade

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2) Geotextile to be installed over the geocomposite vent strips as a cushion under the secondary liner

3) 50-thousandth-of-an-inch (mil) HDPE secondary drain liner to be installed over the geotextile

4) 60-mil HDPE primary liner to be installed over the secondary liner

i) Leak detection sump, including geotextile and aggregate.

j) Side-slope riser piping and fittings.

k) Leak detection pump, pump discharge piping and fittings, flow meter and level transducer with associated control wiring, pump power wiring and retrieval system, power and control panels, and other Work necessary to produce a complete turnkey leak detection system.

l) Inlet piping.

m) Demobilization of equipment, excess materials, supplies, labor, and other Work-required elements necessary to close out the Contract. Other Work-required elements include, but are not limited to, cleanup of Work areas; pump system commissioning; and submittal of drawings, manuals, warranties, and other required information.

2. Work to be completed by the Owner shall include the following:

a) Removal of liquids and solids from the base and side slopes of the existing lagoon prior to any Contract Work.

b) Removal, demolition, and disposal of other structures, obstructions, and features shown or described in the Contract Documents.

B. Comply with applicable codes and regulations of authorities having jurisdiction.

C. Field-verify dimensions indicated on drawings before fabricating or ordering materials. Do not scale Construction Drawings.

D. Notify the Project Engineer of existing conditions differing from those indicated on the Construction Drawings. Verify the existence and location of underground utilities in the area of the proposed Work. Omission of an existing utility location on the Construction Drawings is not to be considered as its nonexistence. Inclusion of existing utility locations on the Construction Drawings is not to be

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considered as utilities' definite locations. Do not remove or alter existing utilities without prior approval.

E. The Contract Documents are intended to provide the basis for proper completion of the Work suitable for the intended use of Owner. Anything not expressly set forth but which is reasonably implied or necessary for proper performance of the project shall be included.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 01 00

ED_002369M_00000063-00056

SECTION 01 02 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 RELATED WORK DESCRIBED ELSEWHERE

A. Individual submittals are required in accordance with the pertinent sections of the following Specifications:

1. Section 01 01 00 – Summary of Work

2. Section 01 29 73 – Schedule of Values

1.02 PAYMENT PROCEDURES

A. Monthly pay estimates shall be addressed to the Owner, Adam Dolsen, and hand-delivered to the Cow Palace front office; mailed to Cow Palace, 1631 N Liberty Road, Granger, WA 98932; or submitted electronically using PDF file format. PDF files may be emailed to the Owner at adam@dolsenco.com.

B. Monthly pay estimates shall clearly identify the Work performed for the given time period based on a percentage of Work completed for lump sum bid items, as in the approved Schedule of Values and actual quantities installed for unit price items.

1.03 PAYMENT PRICING

A. Pricing for the various lump sum or unit prices in the Bid Proposal Form shall include full compensation to be received by the Contractor for furnishing all plans, tools, equipment, supplies, and manufactured articles and for all labor, operations, materials, incidentals, and applicable sales tax for materials and equipment, appurtenant to the items of Work being described, as necessary to perform all operations required to complete the various items of the Work in accordance with the requirements of the Contract Documents or as otherwise directed.

B. Pricing also includes all costs of compliance with the regulations of public agencies having jurisdiction, including safety and health requirements of the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor.

C. Notwithstanding the omission or mention of any incidental Work, the Contract Price and payment shall also constitute full compensation for all Work incident or incidental to completion of the item, unless such Work is otherwise specifically mentioned for separate payment under another bid item. No separate payment will be made for any item that is not specifically set forth in the Bid Proposal Form,

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and all costs therefore shall be included in the prices named in the Bid Proposal Form for the various appurtenant items of Work. All other Work not specifically mentioned in the measurement and payment sections identified herein shall be considered incidental to the Work performed and merged into the various unit and lump sum bid prices. Payment for Work under one item will not be paid for under any other item.

D. Unless a specific bid item for the following Work has been provided in the Proposal/Construction Contract, or the Work has been specifically included in a bid item, such Work shall be considered **incidental to** and **included in** the following various bid items of Work:

1. Contractor furnishing required submittals, including Manufacturer's Certificates of Compliance
2. Stormwater pollution prevention
3. Clearing and grubbing
4. Disposal of waste materials
5. Haul
6. Dewatering
7. Dust control
8. Trimming and cleanup
9. Pre-construction photographs
10. Locating existing underground facilities and determining their precise location (i.e., "potholing") of the underground facilities, which have been marked in advance of the Work, in order to determine their horizontal and vertical location in accordance with Revised Code of Washington 19.122.040

E. The Owner reserves the right to make changes should unforeseen conditions necessitate such changes. Where Work is on a unit-price basis, the actual quantities occasioned by such changes shall govern the compensation.

1.04 MEASUREMENT AND PAYMENT

A. Measurement for payment will be at the Lump Sum or Unit Price as stipulated in the Bid Proposal Form for the items listed herein. Payment shall be considered full compensation for furnishing all labor, materials, and equipment to complete the Work specified. For lump sum pay items, see Section 01 29 73 – Schedule of Values.

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B. Schedule 1 – Lagoon Lining Base Bid

1. Bid Item No. 1: Mobilization and Demobilization (5% of Base Bid Maximum)

a) Payment for "Mobilization and Demobilization" will be for preparatory Work and operations performed by the Contractor including, but not limited to, those necessary for the movement of its personnel, equipment, supplies and incidentals to the project site; for the establishment of its offices, buildings, and other facilities necessary for Work on the project; for premiums on bonds and insurance for the project; and for other Work and operations that it must perform or costs it must incur before beginning production Work on the various items on the project site.

b) "Mobilization and Demobilization" will be paid at the Lump Sum price listed in the Bid, but not to exceed a maximum of 5% of the Total Base Bid. Incremental payment shall be made as follows:

1) 40% after completion of 5% of the total contract amount of other bid items have been earned

2) 40% after completion of 20% of the total contract amount of other bid items have been earned

3) 20% after completion of all Work on the project has been completed, including cleanup and acceptance of the project by the Owner

c) Execute the "Mobilization and Demobilization" Work as required by the various sections of Division 00 and Division 01 and other parts of the Contract Documents.

2. Bid Item No. 2: Construction Surveying

a) Measurement: Lump sum item and shall not be measured for payment.

b) The unit contract price shall constitute full compensation for labor, materials, and equipment required to complete the Work, including, but not limited to, the following:

1) Establishing horizontal and vertical control

2) Pre-construction survey

3) Construction staking

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4) Post-construction survey

5) As-built surveys.

c) Payment: Payment for surveying will be in a lump sum based on percent complete on accomplishing surveying Work for the preceding referenced stages of construction and overall progress of construction.

3. Bid Item No. 3: Earthwork and Grading

a) Quantities shall be measured in in-place bank cubic yards by survey. Quantities shall be computed based on surveyed material excavated. Volume shall be computed based on pre-construction topographic survey versus post-construction survey.

b) The unit contract price shall constitute full compensation for labor, materials, and equipment required to complete the Work, including, but not limited to the following:

1) Site excavation, stockpiling, grading, filling and compaction of soils to achieve the following Work and meet the lines and grades shown on the Construction Drawings

2) Excavation, grading, and subgrade preparation for the installation of liner system and leak detection system

3) Haul and stockpile of excess soils excavated that are not reused as fill on site

c) No separate payment will be made for clearing, grubbing, and demolition and shall be considered incidental to this bid item.

d) Anchor trench excavation and safety shall be included in Bid Item No. 4: Anchor Trench.

e) Trenching for the installation of leak detection system piping shall be included in Bid Item No. 11: Leak Detection System.

f) Trenching for the installation of inlet piping shall be included in Bid Item No. 10: Inlet Pipe.

g) Unsuitable foundation excavation and backfill shall be included in Bid Item No. A1: Extra Excavation, Fill, and Compaction.

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4. Bid Item No. 4: Anchor Trench

   a) Measurement will be the number of linear feet of anchor trench excavated. Quantities shall be computed based on the surveyed length measured along the centerline of the trench.

   b) The unit contract price shall constitute full compensation for labor, materials, and equipment required to complete the Work, including, but not limited to, the following:

      1) Trench dewatering

      2) Trench backfill and compaction

5. Bid Item No. 5: Non-Woven Geotextile

   a) Measurement will be the number of square feet as measured parallel to the lagoon surface, including designed anchor trench material, and is based on net lined area of non-woven geotextile installed.

   b) The unit contract price shall constitute full compensation for labor, materials, and equipment required to complete the Work, including, but not limited to, furnishing, deploying, and joining non-woven geotextile.

   c) Geotextile within the leak detection sump (which encapsulates the sump aggregate) shall be included in and considered incidental to Bid Item No. 11: Leak Detection System. The square foot price offered in the schedule for "Non-Woven Geotextile" shall include all materials, labor, and equipment needed to complete the Work in accordance with the Construction Drawings, Specifications, and Construction Quality Assurance (CQA) and Construction Quality Control (CQC) requirements.

6. Bid Item No. 6: Geocomposite Vent Strip

   a) Measurement will be the number of linear feet as measured parallel to the liner surface, including designed anchor trench material, and is based on net linear footage of geocomposite vent strip installed.

   b) The linear foot price offered in the schedule for "Geocomposite Vent Strip" shall include all materials, labor, and equipment needed to complete the following Work in accordance with the Construction Drawings, Specifications, and CQA and CQC requirements as follows:

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1) Procuring, deploying, and joining geocomposite strips as shown on the Construction Drawings and as described in the Specifications

2) Installing vent pipes along the top of the lagoon near the anchor trench as shown on the Construction Drawings and as described in the Specifications

7. Bid Item No. 7: 50-Mil HDPE Secondary Drain Liner

a) Measurement will be the number of square feet as measured parallel to the liner surface, including designed anchor trench material and is based on net lined area of liner installed.

b) The square foot price offered in the schedule for "50-Mil [thousandth of an inch] HDPE [high-density polyethylene] Secondary Drain Liner" shall include all materials, labor, and equipment needed to complete the following Work in accordance with the Construction Drawings, Specifications, and CQA and CQC requirements as follows:

1) Procuring, fabricating, and installing 50-mil HDPE secondary drain liner as shown on the Construction Drawings and as described in the Specifications

8. Bid Item No. 8: 60-Mil HDPE Textured Primary Liner

a) Measurement will be the number of square feet as measured parallel to the liner surface, including designed anchor trench material, and is based on net lined area of liner installed.

b) The square foot price offered in the schedule for "60-Mil HDPE Textured Primary Liner" shall include all materials, labor, and equipment needed to complete the following Work in accordance with the Construction Drawings, Specifications, and CQA and CQC requirements as follows:

1) Procuring, fabricating, and installing 60-mil HDPE textured primary liner as shown on the Construction Drawings and as described in the Specifications

9. Bid Item No. 9: HDPE Rub Sheets

a) Measurement will be the number of square feet as measured parallel to the liner surface, including designed anchor trench material, and is based on net lined area of liner installed.

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b) The square foot price offered in the schedule for "HDPE Rub Sheets" shall include all materials, labor, and equipment needed to complete the following Work in accordance with the Construction Drawings, Specifications, and CQA and CQC requirements as follows:

1) Procuring, fabricating, and installing 60-mil HDPE rub sheets as shown on the Construction Drawings and as described in the Specifications

10. Bid Item No. 10: Inlet Pipe

a) The Lump Sum price offered in the schedule for "Inlet Pipe" shall include all materials, labor, and equipment needed to install HDPE inlet piping from the concrete sump to the lagoon, including the following:

1) Furnishing and installing HDPE piping, fittings, connections, valves, other appurtenances, HDPE pipe boots, and related equipment

2) Trench dewatering

3) Trench backfill and compaction

4) Installing/welding pipe boots to the primary and secondary liner systems to provide a leak-free attachment

5) Other miscellaneous Work required to complete the Work shown on the Construction Drawings and outlined in the Specifications

b) Payment for "Inlet Pipe" will be made at the contract Lump Sum price as stated in the Bid and will be full compensation for furnishing all labor, materials, equipment, and incidentals required to accomplish the Work of the Contract Documents.

11. Bid Item No. 11: Leak Detection System

a) The Lump Sum price offered in the schedule for the "Leak Detection System" shall include all materials, labor, and equipment needed to install a turnkey leak detection system in accordance with the Construction Drawings and Specifications.

b) The lump sum price offered in the schedule for the "Leak Detection System" shall include all materials, labor, and equipment needed to complete the following Work:

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1) Furnishing and installing HDPE piping, fittings, connections, valves, other appurtenances, and related equipment

2) Furnishing, installing, startup, and testing of a leak detection pump in accordance with the Specifications

3) Furnishing, installing, startup, and testing of a pump control system in accordance with the Specifications

4) Furnishing, installing, startup, and testing of an electromagnetic flow meter in accordance with the Specifications

5) Furnishing, installing, compacting, and testing of leak detection sump course aggregate and non-woven geotextile

6) Other miscellaneous Work required to complete the Work shown on the Construction Drawings and outlined in the Specifications

c) Payment for the "Leak Detection System" will be made at the contract Lump Sum price as stated in the Bid and will be full compensation for furnishing all labor, materials, equipment, and incidentals required to accomplish the Work of the Contract Documents.

12. Bid Item No. A1: Unsuitable Foundation Excavation

a) Measurement for "Unsuitable Foundation Excavation" shall be made on a per bank cubic yard basis for unsuitable on-site soils and imported replacement soils. Measurement of the quantities of authorized unsuitable foundation excavation shall be computed from in-place field measurements made by the Owner.

The Contract Price per Bank Cubic Yard shall include, but not be limited to, the following:

1) Excavating and disposing of the unsuitable subgrade material

2) Placing geotextile prior to placing and compacting backfill material

3) Furnishing, placing, and compacting foundation material (or other approved backfill material) as directed by the Owner

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4) Placing geotextile over compacted foundation material

b) Payment for "Unsuitable Foundation Excavation" at the Contract Price bid per bank cubic yard shall be full compensation for furnishing all labor, materials, equipment, and incidentals required to accomplish the Work of the Contract Documents.

c) "Unsuitable Foundation Excavation" is a contingent item of Work and must be authorized by the Owner or Project Engineer prior to conducting any additional excavation. No additional payment will be made for Work performed without prior written authorization from the Owner or Project Engineer.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 02 00

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SECTION 01 03 00
MOBILIZATION

PART 1 GENERAL

1.01 SCOPE

A. The Work shall consist of mobilizing equipment, supplies, and securing bonds and permits necessary to do the Work as stated in the Contract and/or Agreement and demobilizing excess materials and equipment from the Work site.

1.02 MOBILIZATION

A. Mobilization includes the resources needed to prepare for the start of Work. Mobilization includes, but is not limited to, the following:

1. Moving personnel, equipment, supplies, and incidentals to the site
2. Other preparatory Work and operations
3. Permits and other incidentals related to the transport of equipment and supplies to the site

1.03 DEMOBILIZATION

A. Demobilization includes the resources required to prepare for completion of the Work. Demobilization includes, but is not limited to, the following:

1. Moving personnel, equipment, supplies, and incidentals from the site
2. Other preparatory Work and operations
3. Permits and other incidentals related to the transport of equipment and supplies from the site

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 03 00

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SECTION 01 04 00
PROJECT COORDINATION

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall schedule a preconstruction conference to be held within 20 days of the Notice of Award. The Contractor's assigned supervisory personnel shall attend this conference.

B. Conduct all construction activities between the hours of 7:00 a.m. and 6:00 p.m., Monday through Friday, except for emergencies or as authorized by the Owner. No work will be allowed on Saturdays without the Owner's permission, and no Work, except for emergencies, will be allowed on Sundays.

C. Water for use during construction will be obtained by the Contractor at the Contractor's expense if a supply is not readily available from the Owner.

1.02 COORDINATION WITH PUBLIC AND PRIVATE AGENCIES

A. If other utility companies elect to repair or replace their lines in the project area, their crews will be permitted access to the area to accomplish their work.

B. Contact all utility companies for location of their facilities. Call at least 48 hours prior to excavation.

C. The Contractor is responsible for dust control and shall provide all equipment and personnel necessary to meet the requirements of this responsibility. The Contractor will provide the Project Engineer with the name(s) and telephone number(s) of the person(s) designated to maintain dust control during evenings and weekends. In the event that the Contactor does not fulfill the dust control obligations, the Owner may elect to provide dust control for the project. The costs incurred by the Owner for dust control will be deducted from retainage of the Contractor's final pay application.

D. Do not park vehicles or equipment on private property without written permission from the property Owner.

1.03 COORDINATION WITH OWNER AND PROJECT ENGINEER

A. Construct all work in accordance with the lines and grades shown on the Drawings, and as designated by the Project Engineer. These lines and grades may be modified by the Project Engineer on a case-by-case basis.

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B. The Owner will employ and pay for the services of an independent testing laboratory to perform all tests required by the Contract Documents. Notify the Project Engineer a minimum of 24 hours in advance to request testing.

C. When requested by the Contractor, digital files for use in machine controls or by a third-party surveyor will be made available by the Project Engineer to the Contractor. The Contractor will coordinate with the Project Engineer to ensure the digital files for machine control use have not deviated from those supplied by the Project Engineer.

D. The Contractor will coordinate with the Owner to maintain safe working conditions.

E. Where construction activities may impact the day-to-day facility traffic operations of the Owner, the Contractor will provide appropriate traffic control including, but not limited to, jersey barriers, traffic candles, flashers, and/or night flashers. Traffic control measures will be considered incidental to the Work, and no separate payment will be made.

1.04 CONSTRUCTION SCHEDULING

A. Site Work shall not be allowed until the Approved Construction Schedule is submitted to and approved by the Owner's Representative and following Contractor receipt of Notice to Proceed by the Owner.

B. All scheduling is the responsibility of the Contractor. The Approved Construction Schedule, in tandem with the Unit Cost Bid and Work items shown on the Construction Schedule, shall be used as the basis of progress reporting and payments.

C. All schedules shall include the date that the schedule was prepared and shall include "DRAFT," "PROGRESS," "APPROVED," or "FINAL" in the title of the schedules, as is appropriate.

D. The following items shall be included in the development and maintenance of the Construction Schedule.

E. Contractor shall develop a DRAFT Construction Schedule and submit for review and approval by the Owner's Representative as described herein. The first DRAFT Construction Schedule shall include the following elements and be the baseline for the project timeline and implementation plans. The Construction Schedule shall be approved and titled "APPROVED Construction Schedule" prior to initiating field construction Work.

F. The Construction Schedule organization is as follows:

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1. The Contractor Construction Schedule shall arrange scheduled tasks by major project feature, and the subsequent bid item numbers listed on the Bid Forms and Unit Prices section of the Specifications.

2. The Construction Schedule shall show all Bid Form Work elements augmented with subtasks performed by specific subcontractors and trades.

G. The Construction Schedule shall start on the Notice to Proceed date and extend through the project completion date specified in the Contract.

H. Activity Durations: The duration of construction activity shall be shown at a minimum for the project feature level of construction. Further detail on subtask durations is at the leisure of the Contractor and not required. Project features shall include, but are not limited to, the following:

1. Mobilization

2. Site preparation and construction facilities establishment

3. Final grade preparation

4. Geotextile installation

5. Geocomposite venting system installation

6. Secondary drain liner installation

7. Geomembrane primary liner installation

8. High-density polyethylene (HDPE) pipe inlet and outlet installation (includes related appurtenances)

9. Liner welding testing

10. Leak detection system installation, startup, and testing

11. Site cleanup and punch list

12. Demobilization

I. The Construction Schedule shall include procurement lead times and delivery dates for major purchase items.

J. Sequencing: Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components of the Work before or after its own installation.

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K. Float and Contingencies: The Contractor shall document and communicate in the Weekly Progress Report when Construction Schedules are exceeded and potential delays may occur.

1.05 WEEKLY PROGRESS REPORT

A. The Contractor shall submit on a weekly basis a Weekly Progress Report to the Owner's Representative.

B. Weekly reports shall include, but not be limited to, the following:

1. Summary of the week's construction activities completed, including documentation of weekly quantities of Work performed

2. Copies of inspections and approvals

3. Construction Survey Reports

4. Report of any schedule delays or exceedances

5. Health and Safety Incident Reports

C. Weekly Progress Reports shall be submitted before noon on Monday following the previous week's Work.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 04 00

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SECTION 01 05 00
CONSTRUCTION SURVEYING AND STAKING

PART 1 GENERAL

1.01 GENERAL

A. The Contractor will not begin Work until the lines and grades that will control the Work are staked. The Contractor will preserve existing project control benchmarks, stakes, and marks.

1.02 CONTRACTOR SURVEY

A. The Contractor will be responsible for construction staking the project and performing survey Work under the supervision of a Professional Land Surveyor or Professional Engineer registered in the State of Washington.

B. The Owner has established horizontal and vertical control for the project. The elevations for the is project were derived by GPS observation using the Washington State Reference Network. The project benchmark shown on the Construction Drawings was set by PLSA Engineering and Surveying, Yakima, Washington.

C. Keep survey notes in a clear, orderly, neat manner. Ensure survey records are available to the Project Engineer for inspection or reproduction at all times. When directed by the Project Engineer, correct deficiencies and transmit survey records to the Project Engineer for inclusion in the project records before final project acceptance.

D. The Contractor will notify the Project Engineer of apparent errors in or discrepancies with previous surveys. The Contractor will obtain corrections or interpretations before proceeding.

E. The Contractor will correct deficient Work due to incorrect staking or failure to report errors or inaccuracies in Work previously performed. The Contractor will reset grade stakes, benchmarks, reference points, or property comers lost, damaged, or destroyed by traffic or construction.

1.03 MACHINE CONTROLS

A. Machine controls include any equipment properly equipped to establish the lines and grades of the project without the use of traditional construction staking equipment.

B. If the Contractor elects to use machine controls to establish the lines and grades of the project, the Project Engineer will make available to the Contractor digital terrain model (DTM) electronic files (files) for use by the Contractor.

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C. Any manipulation of DTM files supplied by the Project Engineer to the Contractor by the Contractor, or any third-party providing machine control services to the Contractor, will not be allowed unless authorized by the Project Engineer.

D. If any manipulation of the DTM files supplied by the Project Engineer for software compatibility with the machine controls is required, the Contractor will coordinate with the Engineer in accordance with Section 01 04 00 – Project Coordination.

E. In the event that design information provided by the Project Engineer's DTM files conflicts with design information indicated by DTM files in the machine controls equipment, the Project Engineer's design information will govern.

F. Any Work completed due to errors in the Contractor's design files that deviates from the design files provided by the Project Engineer will be corrected by the Contractor. If the Contractor fails to correct the deviations from the design, costs incurred by the Owner to correct the deviations from the Engineer's design will be deducted from the Contractor's pay applications.

1.04 AS-BUILT DRAWINGS

A. On-Site Drawing Set

1. At all times, maintain one set of Construction Drawings at the site for the preparation of As-Built Drawings.

2. Supplement the As-Built Drawings by any detailed sketches as necessary or as directed in order to fully indicate the Work as actually constructed.

3. The As-Built Drawings are the Contractor's representation of as-built conditions and shall include revisions made by Addenda and Change Orders and be maintained on an up-to-date basis during the progress of the Work.

4. Use red ink for alterations and notes.

5. Notes shall identify relevant Change Orders by number and date.

B. Submittal

1. Upon completion of all activities, the Contractor shall prepare As-Built Drawings showing the location of all features as constructed. The As-Built Drawings shall be produced full size (ANSI D) on bond paper signed by the Contractor. A paper copy of half-size As-Built Drawings shall also be created by the Contractor. The Contractor is to submit As-Built Drawings in paper and electronic formats.

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2. Contractor electronic files for the As-Built Drawings shall be fully editable so as to allow future changes by the Owner. The Contractor shall submit the electronic version of the As-Built Drawings with hard copies as specified.

C. Unacceptable As-Built Drawings

1. Disorganized or incomplete As-Built Drawings will not be accepted.

2. The Contractor shall revise As-Built drawings deemed to be unacceptable and resubmit within 10 days.

D. As-Built Drawings shall be accessible to the Owner and Project Engineer during the construction period.

E. Information submitted by the Contractor will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide personnel, materials, and equipment necessary to perform the work. Calibrate equipment before starting, and submit calibration data, information from field checks of the calibration, and results (including location and dates performed) to the Project Engineer.

B. Provide wooden lathe, wooden stakes, paint, tape, and wooden hub stakes as needed.

PART 3 EXECUTION

3.01 GRADE STAKING

A. Set grade stakes required to control the work. Establish the grade stake elevation for the subgrade using elevation or grade information provided by the Project Engineer.

B. Set reference points and reference lines to control the alignment and grade elevations at the subgrade. Establish additional lines as required for offsets, berms in fill, and profile grade breaks.

C. Set reference points and lines to produce the typical sections specified.

D. Set subgrade grade stakes for tangent sections at intervals no greater than 100 feet, no greater than 50 feet for curves, and at other miscellaneous break points as specified.

END OF SECTION 01 05 00

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SECTION 01 11 00
PROTECTION OF EXISTING FACILITIES

PART 1 GENERAL

1.01 GENERAL

A. The Contractor will preserve all public and private property during the execution of the Work. The Contractor will take responsibility for any and all damage or injury resulting from the following:

1. Any act, omission, negligence, or misconduct in the execution of the Work

2. Defective work or materials

3. The work of a Subcontractor

B. The Contractor will immediately restore or replace any real property damaged in the course of the Work to its prior or a similar condition. The Contractor will coordinate repairs, replacements, or both with the affected property owner and obtain his or her written approval when the final Work is complete. Submit a copy of the property owner's approval to the Owner. If the Contractor fails to perform the restoration within a 3-month time frame, the Owner may elect to deduct the cost incurred by the Owner from any payment due to the Contractor from the Contractor's pay application.

C. The Contractor will not remove, relocate, or damage any land monuments, property markers, or comers without direction from the Project Engineer.

D. The Contractor will install temporary fencing or other measures approved by the Owner and/or Project Engineer to control access of unauthorized vehicles onto adjacent private property.

1.02 VEHICLE DAMAGE CLAIMS

A. If a vehicle owner makes a claim of vehicle damage, send a written response to the claimant addressing the claim and the actions that will be taken. Send a copy of the response letter to the Owner.

1.03 RESPONSIBILITY FOR DAMAGE CLAIMS

A. Indemnify and hold harmless the Owner, its officers, and its employees and the Engineer, its officers, and its employees from suits, actions, or claims arising from the following:

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1. Injury or damage to any person, persons, or property resulting from acts, errors, or omissions by the Contractor including, but not limited to, the following:

   a) Neglect in safeguarding the worksite or work in progress

   b) Use of unacceptable materials

   c) Acts, errors, omissions, or misconduct causing injury or damage to a third party

   d) Work outside of the construction limits

2. The Washington Workers' Compensation Act or any other state or federal law, ordinance, order, or decree

B. If such a suit, action, or claim is initiated against the Owner, the Owner may withhold money due to the Contractor from the Contractor's payment application. If no money is due, the Owner may hold the Contractor's surety until such suit(s), action(s), or claim(s) for injuries or damages are settled. The Owner will pay or release such money or surety when it receives evidence of settlement.

C. The Owner will not withhold money due to the Contractor when the Owner is provided with evidence of the Contractor's adequate protection by public liability and property damage insurance. The Contractor's lack of response to a third-party claimant may affect the Contractor's prequalification status.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 11 00

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SECTION 01 21 00
STORMWATER POLLUTION PREVENTION

PART 1 GENERAL

1.01 SUMMARY

A. This section describes the requirements for control of pollutants and discharges of stormwater from construction and industrial activities, including temporary and permanent measures to control erosion.

B. The Contract Documents are intended to provide the basis for proper completion of the Work suitable for the intended use of the Owner. Anything not expressly set forth but which is reasonably implied or necessary for proper performance of the project shall be included.

PART 2 PRODUCTS

2.01 PLASTIC COVERING

A. Plastic sheeting shall meet the requirements of ASTM International D4397 for polyethylene having a minimum thickness of 6 thousandths of an inch (mils).

B. Sandbags shall be used as a ballast system for plastic covering. Bags shall be as follows:

1. Made from woven polypropylene with a minimum rating of 1,600 hours of ultraviolet inhibitor (UVI) protection
2. A minimum unfilled size of 14 inches by 26 inches with a 50-pound capacity
3. Completely filled with a granular soil (sand or pea gravel)
4. Closed using an attached tie string
5. Dark green in color

C. Rope shall be 0.25-inch polypropylene.

D. Wood stakes shall be 2 inches by 2 inches and No. 2 or better lumber, and they shall have a minimum length of 3 feet.

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PART 3 EXECUTION

3.01 GENERAL

A. Coordinate temporary and permanent soil erosion Work. Stage permanent erosion control Work to minimize the need for temporary Work—the purpose of which is to supplement the permanent Work and provide effective control throughout the construction period. Protect locations of exposed, erodible earth with functional erosion control measures installed correctly. Maintain measures to ensure maximum sediment reduction.

B. Complete erosion control Work (temporary and permanent) as soon as practical, in conjunction with other construction Work, and subject to seeding date restrictions. Restore and seed haul roads, material sources, staging areas, and other disturbed areas as Work is completed and subject to seeding date restrictions.

C. When permanent soil erosion control is established, remove the temporary measures, spread the accumulated sediment, and seed the disturbed area caused by the removal of the temporary measure as specified for the project reclamation.

3.02 STORMWATER CONTROL

A. Develop, implement, and monitor a stormwater control plan for the project including any temporary erosion control measures necessary, in addition to those specified, and associated labor, materials, equipment, and incidentals needed to fully implement the plan and comply with all rules, regulations, and restrictions imposed by Yakima County and the State of Washington.

B. Throughout the Work, implement the stormwater control plan, modifying as necessary.

C. Upon project completion, remove and dispose of temporary soil erosion control measures not specified or designated by the Project Engineer to remain as permanent erosion control measures.

3.03 TEMPORARY SOIL EROSION MEASURES

A. Plastic Covering

1. Provide plastic covering over stockpiles immediately following the completion of stockpiling Work to prevent erosion of stockpile slopes.

2. Provide, install, and maintain plastic covering and associated ballast material (sand bags, stakes, and rope) consistent with BMP C123E as

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described in the *Stormwater Management Manual for Eastern Washington* (Ecology 2019).[1]

3. Maintain sheeting until the stockpile is removed or until the final acceptance of the project.

END OF SECTION 01 21 00

[1] Ecology (Washington State Department of Ecology), 2019. *Stormwater Management Manual for Eastern Washington*. Publication Number 18-10-044. February 2019.

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SECTION 01 22 00
ENVIRONMENTAL REQUIREMENTS

PART 1 GENERAL

1.01 ENVIRONMENTAL PROTECTION

A. Become familiar with and adhere to all laws relevant to minimizing damage to the environment and risks to human health. If a requirement of this section conflicts with an environmental or pollution control requirement of another federal, State of Washington, or local agency, the more restrictive requirement applies.

B. Implement best management practices to minimize pollution and soil erosion. Promptly revegetate disturbed areas. Notify the Owner and Project Engineer promptly upon receiving notice, in any form, of noncompliance with a pollution or erosion control requirement, and modify or cooperate in modifying the manner of Work to bring about compliance. Cooperate with inspections by federal or State of Washington agencies to determine the status of the project with regard to environmental issues.

1.02 EROSION AND POLLUTION CONTROLS

A. Do not pollute surface waters or wetlands with sediment or other harmful materials.

B. Service and fuel equipment away from streams and riparian areas. Ensure staging areas are a minimum of 150 feet from riparian areas. Dispose of fuels, oils, cement, or other potential surface or groundwater contaminants in a licensed disposal site only. Prepare a spill contingency plan for petroleum products, solvents, and other hazardous materials to be used or stored at the Work site and submit it to the Owner and Project Engineer at the preconstruction meeting; include plans for emergency spills as appropriate.

C. Maintain a collection system for garbage, rubbish, and salvaged material collected from the project. Remove such waste and dispose of it at licensed landfills or other recognized salvage sites only; do not use the right-of-way, adjoining property, or material sources for disposal.

D. Do not disturb lands outside the construction limits without authorization from the Owner.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 22 00

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SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

A. This section includes details on the preparation, format, and submittal of the Schedule of Values.

B. The Schedule of Values will establish unit prices for individual items of Work.

C. The Schedule of Values will be the basis for payment of Contract Work.

1.02 RELATED WORK ELSEWHERE

A. Section 01 02 00 – Price and Payment Procedures

B. The provisions and intent of the Contract apply to this Work as if specified in this section. Work related to this section is described throughout the Specifications.

1.03 PREPARATION

A. To facilitate monthly pay requests, the lump sum prices stipulated in the Bid Schedule shall be divided up to reflect the elements of Work identified in these Specifications and in the Contractor's Bid Proposal. The Contractor shall submit for approval a Preliminary Schedule of Values for the major components of the work at the preconstruction meeting in accordance with Section 01 33 00 – Submittal Procedures. The submittal shall include, at a minimum, the proposed value for the major components of the Work. The detailed summary provided in the Schedule of Values shall separately include material costs (as appropriate by unit), installation costs (labor and equipment components) and other incremental breakouts. The total of the costs for each of the major components of Work listed for each bid item shall equal each lump sum price offered in the Bid Schedule.

B. The quantity for payment for each element of Work indicated in the Schedule of Values shall be an estimated percentage of the lump sum amount, substantiated by the Contractor to the extent necessary and agreed to between the Owner and Contractor, and payable in monthly progress payments in increments proportional to the Work performed.

1.04 SUBMITTAL

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Schedule of Values

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a) Submit a preliminary Schedule of Values to the Project Engineer for review at the preconstruction meeting.

b) Submit a corrected Schedule of Values within 10 days of receiving review comments from the Project Engineer.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 29 73

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the administrative and procedural requirements for submittals.

B. The Contractor shall be required to provide submittals to the Project Engineer and Owner's Representative in advance of and throughout the duration of the Work.

C. This section specifies general requirements and procedures for the Contractor's submissions of all required submittals following award of the Contract to the Project Engineer and Owner's Representative for review. Additional specific requirements for submissions are specified in the individual Specifications.

D. No separate payment will be made for effort associated with Work described in this section. Work required to comply with this section is considered to be inclusive to all other activities described in the Contract Documents.

1.02 SUBMITTAL PROCEDURES

A. The Contractor shall make all submittals in accordance with this procedure and the requirements of the Contract Documents.

B. The Contractor shall certify all submittals for accuracy, completeness, and compliance with Contract requirements. The Contractor shall indicate approval on each submittal as evidence of coordination and review.

C. Submittals provided without evidence of the Contractor's approval will not be reviewed.

D. Where construction or erection procedures require design and calculations, a Professional Engineer licensed in the State of Washington shall perform these services, affix their seal, and provide their signature.

E. The review of submittals by the Project Engineer and Owner's Representative will be limited to general design requirements only and shall in no way relieve the Contractor from responsibility for errors or omissions contained therein.

F. Acceptance of submittals shall not relieve the Contractor from responsibility for the safety of their method or equipment or from responsibility for complying with the requirements of all applicable codes and of this Contract, except with respect to specifically approved variations.

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G. Work done prior to submittal approval shall be at the Contractor's risk.

H. Delays, resequencing, or other impacts to Work resulting from the Contractor's submission of unchecked or unreviewed, incomplete, inaccurate or erroneous, or nonconforming submittals (which will require the Contractor's resubmission of a submittal review) shall not constitute a basis of claim for adjustment in Contract price or Contract time.

I. The Project Engineer and Owner's Representative reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

J. Provide a "Priority List" when submitting several submittals at one time.

K. The Contractor shall allow for review coordination with regulatory agencies as specifically called out in the Contract Documents.

L. Allow necessary time for the following:

1. Review of product and sample data

2. Review of resubmissions as necessary

3. Ordering of accepted materials and/or products

M. The Contractor shall allow a minimum of 7 calendar days for Owner's Representative review of each submittal and an additional 7 calendar days for Owner's Representative review of resubmittals. Unless stated otherwise in the Specifications, the Contractor shall be allowed 7 calendar days for revising initial submittals and providing resubmittals to the Owner's Representative. The Contract time shall not be extended on the basis that the Contractor experienced delays due to rejection of submittals.

1.03 SUBMITTAL REQUIREMENTS

A. Identify each submittal and resubmittal by showing the following information:

1. Name and address of submitter and name and telephone number of the individual who may be contacted for additional information

2. Project name and schedule (as applicable) as it appears in the Contract Documents

3. Contractor, Subcontractor, or supplier name and address

4. Drawing sheet and detail number(s) and Specifications section number to which the submittal applies

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5. When applicable, the name, address, and telephone number of the local manufacturer's representative

6. Submit only pertinent catalog pages, and mark each copy of standard printed data to identify pertinent products. All options, models, or other unnecessary information shall be clearly lined/crossed out, or the pertinent information shall be highlighted. Submittals received that do not clearly show the material being submitted shall be returned to the Contractor unreviewed.

7. Address no more than one topic or related topics under a single identification number.

B. The submittal format is as follows:

1. The Contractor shall transmit and receive documents electronically.

2. Print size shall be 22 inches by 34 inches, 8.5 inches by 11 inches, or 11 inches by 17 inches.

3. Make all Shop Drawings accurate to a scale sufficiently large to show the pertinent features of the item and its method of connection.

4. Transmit each submittal with a sequentially numbered identification.

5. Resubmittals shall have the original number with an alphabetic suffix.

6. Submittals received from sources other than the Contractor will be returned without action.

7. Record relevant information, deviations, and requests for data, including minor variations and limitations from the Contract Documents.

8. In the event of the need to "Revise and Resubmit" a submittal, resubmit the same in acceptable form/content, clearly identifying deviations from previous submittal content.

1.04 SUBMITTAL INFORMATION

A. Shop Drawings

1. Submit for review to check for conformance with information given and the design concept expressed in the Contract Documents.

2. Indicate special utility and electrical characteristics and utility connection requirements.

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B. Product Data

1. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this project.

2. For manufactured products other than the brand name specified in the Contract, submit a complete catalog for the product and obtain the approval prior to ordering.

3. Indicate product utility and electrical characteristics and utility connection requirements.

C. Samples

1. Submit samples as specified in individual Specification sections.

2. Include identification on each sample with project information.

D. Manufacturer's Instructions

1. When specified in individual Specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, adjusting, and finishing before the item is delivered to the project site.

2. Identify any conflicts between manufacturers' instructions and Contract Documents.

E. Manufacturer's Certificates

1. When specified in individual Specification sections, submit manufacturers' certificate(s) for review.

2. Indicate that the material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

3. Certificates may be based on recent or previous test results on the material or product.

F. Submit Test Reports as required in individual Specification sections.

G. Submit all other items as specified in individual Specification sections.

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1.05 SUBMITTAL REVIEW

A. Make all submittals far enough in advance of scheduled installation to provide time for review and approval, possible revision and resubmittal, and orders and delivery.

B. Only those items required by the Contract Documents will be reviewed. Information submitted by the Contractor that is not required will be returned marked "Information Only."

C. In the event a single submittal contains both required and nonrequired information, only the required information is subject to review.

D. Submittals will be checked for conformance with the design concept of the project and compliance with the information given in the Contract Documents.

E. Review of drawings or data prepared by a Professional Engineer licensed in the State of Washington will be limited to the submittal's effect on the integrity of the completed project.

F. Submittals will be marked to indicate the result of the review as follows:

1. "NO EXCEPTION TAKEN" – Revision of Shop Drawing or data will not be required.

2. "MAKE CORRECTION NOTED" – Contractor shall revise the Shop Drawing or data as indicated. Resubmittal is not required.

3. "REVISE AND RESUBMIT" – Contractor shall revise the Shop Drawing or data and shall resubmit the revised Shop Drawing or data for review and approval.

4. "REJECTED" – Submittal does not conform to Contract Documents. Contractor shall resubmit in a form that conforms to Contract Documents for review and approval.

G. Copies marked "NO EXCEPTION TAKEN" or "MAKE CORRECTION NOTED" authorize the Contractor to proceed with construction or fabrication covered by those Shop Drawings or data sheets with corrections, if any, incorporated.

H. No revision in any way shall be made to a submittal marked "NO EXCEPTION TAKEN" without resubmitting for review.

I. When prints of Shop Drawings have been marked "REVISE AND RESUBMIT," the Contractor shall make the necessary corrections and resubmit. Every revision shall be shown by number, date, and subject in a revision block, and in addition, each revised Shop Drawing shall have its latest revision clearly indicated by

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clouding around the revised areas. Resubmittals without these indications will be considered nonconforming.

1.06 VARIATIONS FROM CONTRACT REQUIREMENTS

A. Variations from the Contract Documents shall be specifically and separately approved by the Project Engineer.

B. If working Shop Drawings show variations from the Contract requirements, describe such variations in writing and submit for approval.

1.07 SUBMITTALS LIST

A. Individual submittals are required in accordance with the pertinent sections of the Specifications. Other submittals may be required during the course of the project and are considered part of the normal work to be completed under the Contract.

B. These summary lists are presented for the Contractor's convenience only, but no warranty is given to its accuracy or completeness. In the event of any discrepancies with the requirements of the individual sections, those individual sections apply.

Table 1. Pre-Construction Submittal List

Section	Submittal Title	Submittal Schedule
01 04 00	Draft Construction Schedule	Within 20 calendar days after Notice of Award and prior to commencing Work at the site
01 04 00	Approved/Baseline Construction Schedule	Within 10 calendar days upon receipt of reviewed Draft Construction Schedule
01 29 73	Preliminary Schedule of Values	At the preconstruction meeting
01 29 73	Corrected Schedule of Values	Within 10 calendar days upon receipt of reviewed Preliminary Schedule of Values
01 35 00	Site Health and Safety Plan	Within 20 calendar days after Notice of Award and prior to commencing Work at the site

Table 2. Progress Submittal List

Section	Submittal Title	Submittal Schedule
01 04 00	Revised Construction Schedule	As part of monthly Application for Payment; more often as necessary
01 04 00	Weekly Progress Report	Before noon (12:00 p.m.) on the Monday following the previous week's Work

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Section	Submittal Title	Submittal Schedule
02 19 00	Leak Detection Sump Aggregate Gradation	Prior to shipment to site; prior to installation
02 74 00	High-Density Polyethylene Piping Submittals	Prior to shipment to site; prior to installation
02 80 00	Geotextile Product Data	Prior to shipment to Site
02 81 00	Geocomposite Submittals	Prior to shipment to Site
02 82 00	Geomembrane Submittals	Prior to shipment to Site
02 82 00	Geomembrane Destructive Testing Samples	During geomembrane installation; 1 sample per 500 feet of seam length
02 82 00	Panel Layout Drawings	Following installation
04 10 00	Pump Submittals	Prior to shipment to site
04 20 00	Pump Control System Technical Specifications	Prior to shipment to site
04 30 00	Flow Meter Submittals	Prior to shipment to site

Table 3. Post-Construction Submittal List

Section	Submittal Title	Submittal Schedule
01 05 00	As-Built Drawings and Record Information	Prior to Project closeout and within 30 calendar days following receipt of Substantial Completion
01 80 00	Warranties	As part of the Record Information
04 10 00 04 20 00 04 30 00	Operations and Maintenance Manuals	As part of the Record Information

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 33 00

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SECTION 01 35 00
HEALTH AND SAFETY

PART 1 GENERAL

1.01 SUMMARY

A. The Work includes the requirements for health and safety provisions necessary for all work for this project. The Work also includes compliance with all laws, regulations, and ordinances with respect to safety, noise, dust, fire and police action, civil disobedience, security, emergency response, or traffic.

B. It is the Contractor's responsibility to ensure that all workers are qualified, competent, and certified to perform the Work.

C. No separate payment will be made for effort associated with Work described in this section. Work required to comply with this section is considered to be inclusive to all other activities described in the Contract Documents.

D. Construction of this project is being performed on, within, and adjacent to active dairy operations involving the storage of liquid and solid dairy cattle manure.

1. It is the responsibility solely of the Contractor to independently verify all hazards associated with working in proximity to and with cattle manure and to provide its employees with necessary training, engineering controls, work practices, and personal protective equipment related to the same.

2. As manure waste decomposes, it may generate gases that normally consist of carbon dioxide (CO_2), methane (CH_4), occasionally hydrogen sulfide (H_2S), and other gases, dependent on the composition of the stored liquid and solid manure.

3. Hazardous conditions due to gases include, but are not limited to, fires, explosions, oxygen deficiency, and toxic environments.

4. Gases have the potential to create hazardous conditions if not controlled or recognized. Some of the hazards include the following:

a) Fires and explosions that may occur in the presence of methane gas

b) Gases that may have toxic effects or create an oxygen deficiency in trenches, vaults, conduits, and structures

c) Hydrogen sulfide, a highly toxic and flammable gas that may be present

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E. Other hazards at the site include, but are not limited to, working near heavy equipment, slips/trips/falls, working near pesticide and/or fertilizer applications, extreme weather conditions, noise, and biological hazards.

F. This Work is included as part of, but not limited to:

1. Bid Item Number 1: Mobilization and Demobilization.

1.02 RELATED SECTIONS

A. NOT USED

1.03 REFERENCES

A. Comply with the requirements of the following standards referenced in this section:

1. Federal Water Pollution Control Act

2. Hazardous Waste Operations and Emergency Response (HAZWOPER) – 29 Code of Federal Regulations (CFR) 1910.120

3. National Institute for Occupational Safety and Health (NIOSH)/Occupational Safety and Health Administration (OSHA)/ U.S. Coast Guard/U.S. Environmental Protection Agency (EPA): *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH/OSHA/USCG/EPA 1985)[1]

4. Puget Sound Clean Air Agency Regulations

5. Revised Code of Washington (RCW)

a) RCW 49.17: Washington Industrial Safety and Health Act.
b. 70.105: Hazardous Waste Disposal Act

b) RCW 70.105: Hazardous Waste Disposal Act

c) RCW 70.105D: Hazardous Waste Cleanup-Model Toxic Control Act

[1] NIOSH/OSHA/USCG/EPA (National Institute for Occupational Safety and Health/Occupational Safety and Health Administration/U.S. Coast Guard/U.S. Environmental Protection Agency), 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. Publication 85-115. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health. October 1985.

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6. Washington Administrative Code (WAC)

a) WAC 173-303: Dangerous Waste Regulations

b) WAC 173-351: Criteria for Municipal Solid Waste Landfills

c) WAC 296-24: Safety Standards for General Safety and Health

d) WAC 296-62: General Occupational Health Standards

e) WAC 296-155: Safety Standards for Construction Work

f) WAC 296-842: Respirators

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Site Health and Safety Plan

a) Submit a Site Health and Safety Plan in accordance with Section 01 33 00 – Submittal Procedures prior to commencing work at the site or within 20 days following the Notice to Proceed, whichever comes first.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall comply with health and safety rules, regulations, and ordinances promulgated by local, state, and federal governments; the various construction permits; and other sections of the Contract Documents.

B. In addition to complying with health and safety rules, regulations, and ordinances promulgated by the local, state, and federal governments; the various construction permits; and other sections of the Contract Documents, the Contractor shall inform its employees and Subcontractors and their employees of the hazards and attendant mitigating measures associated with working on and near dairy lagoons/operations.

C. The Contractor shall perform whatever Work is necessary for safety and be solely and completely responsible for conditions of the site within the Construction Limits, including safety of all persons (including employees of the Owner, Project Engineer, the Owner's Representative, any site visitors, and the Contractor) and

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property during the Contract period. This requirement applies continuously and is not limited to normal working hours.

D. The Project Engineer's review of the Contractor's performance does not include a review or approval of the adequacy of the Contractor's safety supervisor; the safety program; or any safety measures taken in, on, or near the construction site.

E. The Contractor shall provide for the protection of employees and all others from fire, explosion, or asphyxiation caused by any gases encountered during construction and other hazards that are present or may be present at the existing lagoons.

F. The Contractor shall provide at all times proper facilities for safe access to the work by authorized government officials and all others.

G. Accidents causing death, injures, or damage must be reported immediately to the Owner's Representative by telephone or messenger.

H. The Contractor must promptly report in writing to the Owner's Representative all accidents, near misses, or stop work events whatsoever arising out of or in connection with the performance of the Work, whether on or adjacent to the site, giving full details and witness statements.

I. If a claim is made by anyone against the Contractor or any Subcontractor related to any accident, the Contractor shall promptly report the facts in writing within 24 hours after occurrence to the Owner's Representative, giving full details of the claim.

3.02 SITE HEALTH AND SAFETY PLAN

A. Develop, implement, and maintain for the duration of this Contract a Site Health and Safety Plan that will effectively incorporate and implement all required county, state, and federal safety provisions.

1. The Site Health and Safety Plan shall be consistent with all applicable local, state, and federal health standards and guidelines, including, but not limited to, OSHA, the Washington Industrial Safety and Health Act, NIOSH, the American Conference of Governmental Industrial Hygienists, and EPA. Where these are in conflict, the more stringent requirements shall be followed.

2. The Site Health and Safety Plan shall be sufficient to protect personnel from the potential physical, chemical, and/or biological hazards particular to the site.

3. The Contractor shall provide a written Site Health and Safety Plan for the construction prior to commencing Work at the site or within 10 days after receiving a Notice to Proceed, whichever comes first.

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4. At least one copy of the written Site Health and Safety Plan shall be maintained at the Work site.

5. The Contractor shall assign an individual to serve as a Site Health and Safety Officer at the site at all times during the Work that is responsible and authorized to supervise and enforce compliance with the Site Health and Safety Plan in accordance with this section.

B. Preparation of the written Site Health and Safety Plan is the Contractor's responsibility, and no statement made in these provisions relieves the Contractor of responsibility for the information included in and the implementation of the Site Health and Safety Plan.

C. The Contractor's written Site Health and Safety Plan shall include, but not be limited to, the following:

1. A list of names of key personnel and alternates responsible for site health and safety, including the Site Health and Safety Officer

2. A list of chemical and physical hazards, allowable OSHA exposure levels, threshold limit values, other regulatory exposure levels, and the emergency response should an exposure or injury occur

3. Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used

4. Personal protective equipment to be used by employees for each of the site tasks and operations and criteria for upgrading level of worker protection from Level D to Levels C and B

5. A list of safety and monitoring equipment at the site and locations where equipment is stored or maintained

6. An emergency evacuation plan for immediate removal to a hospital or a doctor's care any person who may be injured on the site, including routes to medical treatment and emergency telephone numbers including hospital, ambulance, fire, sheriff/police, poison control, the Project Engineer, and others as deemed necessary

7. Employee training assignments

8. Medical surveillance requirements

9. Decontamination procedures

10. Confined space entry procedures

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11. A spill containment program for handling contaminated liquids

12. Copies of individual OSHA 40-hour and 8-hour HAZWOPER annual refresher certificates for every employee that is to work in contact with waste material, if applicable

13. Documentation of participation in ongoing respiratory protection program, as per Part E of WAC 296-842, including results of fit-testing conducted within the past 6 months

14. Any and all other components that may be required by regulation

D. The Contractor shall inform all workers and members of the public visiting the site of the potential for the presence of methane and other gases emanating from the natural decomposition of waste buried at or near the site, any other hazards, and the importance of safety precautions to ensure the safety of workers and the public.

E. Failure on the part of the Contractor to follow the Site Health and Safety Plan or to continue any work in an unsafe manner may result in suspension of the Work by the Owner. The Contractor shall not be entitled to extra compensation for health-and-safety-related suspensions, nor shall the Contract Time be extended.

3.03 CONTRACTOR SAFETY EQUIPMENT

A. The Contractor shall maintain at the site safety equipment applicable to the Work as prescribed by the governing safety authorities in quantities that are adequate for the construction workers, as well as the Owner's Representative's team, and all articles necessary for giving first aid to the injured.

B. The Contractor shall train all personnel in use of the appropriate safety equipment that would be utilized during the course of the work. It is the responsibility of the Site Health and Safety Officer, or person(s) in authority, to ascertain that all safety equipment is being used when appropriate.

3.04 SITE HEALTH AND SAFETY OFFICER

A. The Contractor shall provide a person designated as the Site Health and Safety Officer who is thoroughly trained in rescue procedures, the use of safety equipment and gas detectors, and the potential hazards that may be present at dairy lagoons. The person must be present at all times while Work is being performed, implement the written Site Health and Safety Plan, and conduct testing.

B. The Contractor shall provide the resume and qualification of the Site Health and Safety Officer for Owner's review prior to assignment.

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C. The Contractor's Site Health and Safety Officer shall be delegated the authority to require any person or worker on the lagoon site to follow the safety rules. Failure to observe these rules is sufficient cause for removal of the person or worker(s) from the project.

D. The Site Health and Safety Officer shall have taken a course satisfying the training requirements of 29 CFR 1910.120 for Hazardous Waste Site Operations for supervisory personnel. A copy of the Site Health and Safety Officer's OSHA 40-hour and 8-hour Supervisory HAZWOPER Certificates shall be included in the Contractor's Health and Safety Plan.

E. The Site Health and Safety Officer is responsible for determining the extent to which any safety equipment must be utilized, depending on conditions encountered at the site.

END OF SECTION 01 35 00

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SECTION 01 40 00
SITE ACCESS AND STORAGE

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the project. It shall be the Contractor's responsibility to construct and maintain any haul roads required for construction operations.

1.02 CONTRACTOR'S WORK AND STORAGE AREA

A. The Contractor shall make all arrangements for any necessary off-site storage or shop areas necessary for the proper execution of the project.

B. The Contractor shall construct and use a separate storage area for hazardous materials used in constructing the project.

1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are all products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, Flammable, Corrosive, Reactive, or Explosive. In addition, whether or not they are so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, two-part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.

2. The separate storage area shall meet all the requirements of all authorities having jurisdiction over the storage of hazardous materials.

3. The separate storage area shall be inspected by the Owner prior to construction of the area, upon completion of construction of the area, and upon cleanup and removal of the area.

4. All hazardous materials which are delivered in containers shall be stored in the original containers until use. Hazardous materials that are delivered in bulk shall be stored in containers that meet the requirements of authorities having jurisdiction.

1.03 PARKING

A. The Contractor shall direct its employees to park in areas as directed by the Owner/Project Engineer.

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B. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The Contractor shall repair breaks, potholes, low areas that collect standing water, and other deficiencies.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 40 00

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SECTION 01 41 00
BID FORM

1. BID PROPOSAL

PROJECT: COW PALACE DAIRY
SAFETY DEBRIS CATCH BASIN LINER PROJECT
GRANGER, WASHINGTON

TO: Cow Palace Dairy
1631 N Liberty Road
Granger, WA 98932

From: _____
Mailing Address: _____
City, State, Zip: _____
Contact Phone #: _____
Contact E-Mail Address: _____

The undersigned proposes and agrees to furnish all plant, labor, materials, tools, supplies, equipment, transportation, supervision, design, services, goods, and other items in strict conformity with the Bid Document and Addenda, if any, for the price listed in the attached Bid Schedule.

The undersigned represents and warrants the following:

1. This bid constitutes a firm offer which cannot be withdrawn for 60 consecutive calendar days unless by mutual agreement after the Sponsor opens the bids.

2. It has carefully examined the Bid Documents (which includes the Contract Specifications, Bid Forms, and Contract Drawings) and any Addenda.

3. By careful examination of the Bid Documents; any Addenda; all applicable federal, state, tribal, and local statutes, regulations, and codes; and the requirements imposed on the Work by any entity providing funding for the Work, and by careful investigation of all other pertinent general local conditions and matters, it has satisfied itself as to the nature, location, character, quality, and quantity of the Work and as to the conditions and other matters that may be encountered or that may affect performance of the Work or its cost.

4. It is thoroughly experienced in and competent to fully perform all tasks specified in the Bid Document in full conformity with that document.

5. It has carefully checked all words and figures shown in the attached Bid Schedule.

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6. Its bid meets or exceeds the requirements of and fully complies with the Bid Documents and Addenda. If the Bidder's proposal contains or includes any statements or documents that do not fully comply with the representation and warranty of the preceding sentence (e.g., Bidder's standard terms and conditions, sales policy, etc.), the Bidder authorizes the Sponsor to consider the statements or documents as null, void, and of no effect in the award of the contract.

7. If awarded the contract, it will execute and deliver to the Sponsor the written contract, with the required Payment and Performance Bond, Certificates of Insurance (if applicable), and proof of proper submittal of its Statement of Intent to Pay Prevailing Wages (if applicable), all in the form required by the Bid Document, within 10 calendar days after the written notice of award.

DATE: _____

NAME OF BIDDER: _____

FOR CORPORATIONS/LIMITED LIABILITY COMPANIES,
STATE OF INCORPORATION/FORMATION _____

FOR PARTNERSHIPS,
FULL NAMES OF ALL PARTNERS: _____

_____

BY: _____

TITLE: _____

ADDRESS: _____

_____

_____

WA STATE CONTRACTOR REG. NO: _____

UBI NO.: _____

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2. BID SCHEDULE

PROJECT: COW PALACE DAIRY
SAFETY DEBRIS CATCH BASIN LINER PROJECT
GRANGER, WASHINGTON

The amounts listed in the Bid Schedule are firm, fixed prices. All prices are in U.S. dollars. The undersigned proposes to furnish all labor, materials, tools, supplies, equipment, transportation, supervision, design, services, goods, and other items to complete the Work in strict compliance with the Contract Documents for the following price:

TOTAL BID AMOUNT: $_____

NAME OF BIDDER: _____

BY: _____
(Title and Signature)

ADDRESS: _____

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SCHEDULE OF ITEMS AND PRICES

Schedule – Cow Palace Dairy Safety Debris Catch Basin					
Item Number	**Item Description**	**Bid Quantity**	**Unit**	**Unit Price (In Figures)**	**Item Total (In Figures)**
Schedule– Base Bid Items (Bid Price Mandatory)					
1.0	Mobilization and Demobilization	1	LS	$	$
2.0	Construction Surveying	1	LS	$	$
3.0	Earthwork and Grading	4,000	BCY	$	$
4.0	Anchor Trench	610	LF	$	$
5.0	Non-woven Geotextile	30,000	SF	$	$
6.0	Geocomposite Vent Strip	1,000	LF	$	$
7.0	50-mil HDPE Secondary Drain Liner	30,000	SF	$	$
8.0	60-mil HDPE Textured Primary Liner	30,000	SF	$	$
9.0	HDPE Rub Sheets	2,100	SF	$	$
10.0	Inlet Pipe	1	LS	$	$
11.0	Leak Detection System	1	LS	$	$
Line 1: Schedule 1 – Base Bid Subtotal Amount				*$*	
Schedule – Additive Bid Items (Bid Price Mandatory)					
A1	Unsuitable Foundation Excavation	250	BCY	$	$
Line 2: Schedule 1 – Additive Bid Subtotal Amount				*$*	
Line 3: Schedule 1 – Total Bid Amount (Line 1 Plus Line 2)				*$*	

Notes:
BCY: bank cubic yard
LF: linear foot
LS: lump sum
SF: square foot

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ALL WORK SHALL BE SUBSIDIARY TO ONE OR MORE OF THE PAY ITEMS ABOVE. PLEASE SEE THE CONTRACT SPECIFICATIONS FOR FURTHER DESCRIPTION OF EACH ITEM.

Signature_____

Taxpayer ID No._____

Date_____

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3. ACKNOWLEDGEMENT OF ADDENDA

PROJECT: COW PALACE DAIRY
SAFETY DEBRIS CATCH BASIN LINER PROJECT
GRANGER, WASHINGTON

I hereby acknowledge the receipt of the following:

Signature_____

Taxpayer ID No._____

Date_____

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SECTION 01 43 00
QUALITY ASSURANCE AND CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. This section specifies administrative and procedural requirements for quality control measures by the Contractor and references quality assurance duties that have combined responsibilities.

1.02 GENERAL

A. The Contractor shall be fully responsible for the quality of its Work.

B. Quality control services include inspections, tests, and related actions, including reports performed by independent agencies, government authorities, and the Contractor. They do not include Contract enforcement activities performed by the Owner's Representative.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.

D. Quality control requirements for individual construction activities are shown in the sections that specify those activities.

E. Inspections, tests, and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.

F. Requirements for the Contractor to provide quality control services required by the Owner's Representative, Owner, or authorities having jurisdiction are not limited by provisions of this section.

1.03 DEFINITIONS

A. **Construction Quality Control (CQC):** Refers to those actions taken by the Contractor (including those parties charged with the manufacture, supply, fabrication, delivery, and installation) to demonstrate and sometimes quantify the characteristics of the product. The results of the CQC program are compared to the Contract Documents and any other contractual or regulatory requirements. During each aspect of the Work, quality control shall be provided by the Contractor to ensure and document that the materials and workmanship conform to the Contract Documents.

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B. **Construction Quality Assurance:** Refers to those actions (including inspections, verifications, audits, testing, and evaluation) taken by the Owner's Representative on behalf of the Owner and intended to provide adequate confidence that the materials and workmanship provided by the Contractor conform to the Contract Documents and any applicable regulatory requirements.

1.04 SAMPLES AND CERTIFICATION

A. Samples:

1. The Contractor shall supply samples when required by the Contract Documents or the Owner's Representative.

2. Samples or test specimens shall be prepared and furnished with information as to their source in such quantities and size as may be required for proper examination and tests, with all freight charges prepaid.

3. Samples shall be submitted in ample time to permit the making of proper tests, analysis, examination, rejections, and resubmissions prior to shipping or installation or continued construction or as otherwise required by the Contract Documents.

4. Samples of materials shall be retained by the Owner's Representative for reference and comparison purposes.

B. Certification:

1. Producers and associations that have instituted accepted systems of quality control and have been accepted by accepted associations may submit certifications of compliance in lieu of further testing.

2. Materials from which samples have been taken shall not be incorporated in the Work or accepted as part of the Work until the samples testing results have been accepted in writing by the Owner's Representative.

1.05 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures.

B. The Contractor shall submit Weekly Construction Reports; see Section 01 04 00 – Project Coordination for further details.

C. The Contractor shall provide inspections, tests, and similar quality control services specified in individual Specification sections and required by governing authorities, except where they are specifically indicated to be the Owner's Representative's responsibility or are provided by another identified entity.

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D. The Contractor shall employ and pay an independent agency to perform quality control services as specified in the Contract Documents. No separate payment will be made for quality control services specified by the Contract Documents. Additional inspection and tests required because of defective Work or ill-timed notices shall be performed at the Contractor's expense.

E. Coordination:

1. The Contractor and each agency engaged by the Contractor to perform inspections, tests, and similar services shall coordinate the sequence of activities to accommodate required services with a minimal delay.

a) In addition, the Contractor shall coordinate activities with the Owner's Representative to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

b) The Contractor is responsible for scheduling times for observations, tests, taking samples, and similar activities as described by this section.

F. Access:

1. The Contractor shall furnish free access to various parts of the Work and assist the Owner's Representative in performance of their duties, at no additional cost to the Owner.

G. Data:

1. The Contractor shall furnish all samples, records, Construction Drawings, certificates, and similar data as may be required to assure compliance with the Contract Documents.

H. Retesting:

1. The Contractor is responsible for the cost of the Owner's Representative's retesting where results of required inspections, tests, or similar services prove unsatisfactory and do not indicate compliance with the Contract Documents.

a) The cost of retesting construction revised or replaced by the Contractor shall be at the Contractor's cost, where required tests were performed on original construction.

2. The Owner's Representative will separately track and accumulate all such extra Work. The costs incurred by the Owner's Representative will be reported and deducted from the subsequent payments to the Contractor.

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a) The Contractor may request copies of the Owner's Representative's documentation of the cost of extra Work, but the amounts are not subject to negotiation or reduction.

b) The Contractor shall not be entitled to a change in Contract time or price due to delays caused by testing or rejected work or materials.

I. Associated services:

1. The Contractor shall cooperate with the Owner's Representative or their agents performing required observations, tests, and similar services and provide reasonable auxiliary services as requested. Auxiliary services required include, but are not limited to, the following:

a) Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate observations and tests

b) Taking adequate quantities of representative samples of materials at locations directed by the Owner's Representative

c) Providing facilities for storage of test samples

d) Ensuring security and protection of samples and test equipment at the site

1.06 OWNER'S REPRESENTATIVE'S RESPONSIBILITIES

A. The Owner's Representative will perform observations and tests specified in the Contract Documents.

B. Where the Owner's Representative has engaged a testing agency or other entity for testing and observation of a part of the Work, the Contractor shall not employ the entity engaged by the Owner's Representative unless otherwise agreed in writing with the Owner's Representative.

1.07 DEFECTIVE WORK

A. Remove, replace, and retest any Work found defective or not complying with requirements of Contract Documents, at no additional cost to the Owner.

B. Work will be observed as it progresses, but failure to detect any defective Work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Owner's Representative for Final Acceptance.

C. All observation and testing required because of defective Work or ill-timed notices shall be performed at the Contractor's expense.

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PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 REPAIR AND PROTECTION

A. Upon completion of observation, testing, sampling, and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes.

B. Protect construction exposed by or for quality control and quality assurance activities, and protect repaired construction.

C. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for observation, testing, or similar services.

END OF SECTION 01 43 00

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SECTION 01 45 00
STAGING AND STOCKPILE AREAS

PART 1 GENERAL

1.01 GENERAL

A. The Contractor will use staging and stockpiling sites for any and all of the Contractor's equipment as approved by the Owner. The Project Drawings may show approved staging and stockpiling locations. Notify the Owner 5 business days prior to mobilization activities for approval of staging and stockpiling sites not shown on the Construction Drawings.

1.02 CLEANUP

A. Cleanup for each item of work will be fully completed and accepted before the item is considered final. If the Contractor fails to perform the cleanup within 10 business days, the Owner reserves the right to withhold payment from pay applications submitted by the Contractor until the cleanup has been fully completed.

B. If the cleanup is not fully completed by the Contractor before final project closeout, the Owner reserves the right to hold any retainage for costs incurred by the Owner to complete the cleanup.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 45 00

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SECTION 01 50 00
TEMPORARY FACILITIES

PART 1 GENERAL

1.01 SUMMARY

A. Furnish the following temporary services and utilities, including use fees and operation costs:

1. Potable and non-potable water
2. Lighting and power
3. Materials storage

B. Furnish the following construction facilities, including utility costs:

1. Construction equipment
2. Dewatering and pumping

C. Furnish the following security and protection requirements:

1. Fire extinguishers
2. Site enclosure fence, barricades, warning signs, and lights
3. Snow and ice removal, if applicable

D. Furnish the following personnel support facilities:

1. Sanitary facilities
2. Drinking water
3. First aid facilities
4. Emergency medical services
5. Trash removal
6. Field office (if needed)
7. Lay down and staging area

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PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 50 00

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SECTION 01 80 00
PROJECT CLOSEOUT

PART 1 GENERAL

1.01 FINAL CLEANUP

A. The Contractor will promptly remove all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Project by the Owner will be withheld until the Contractor has satisfactorily completed the requirements for final cleanup of the Project site.

1.02 CLOSEOUT TIMETABLE

A. The Contractor will establish dates for equipment testing, acceptance periods, and on-site instructional periods as required under the contract. Such dates will be established not less than 1 week prior to beginning any of the foregoing items in order to allow the Owner, the Project Engineer, and their authorized representatives sufficient time to schedule attendance at such activities.

1.03 FINAL SUBMITTALS

A. The Contractor, prior to requesting final payment, will obtain and submit the following items to the Project Engineer for transmittal to the Owner:

1. Written guarantees and warranties, where required
2. Maintenance stock items, spare parts, and special tools where required
3. Completed As-Built Drawings
4. Other submittals as required by Section 01 33 00 – Submittal Procedures

1.04 WARRANTY AND GUARANTEE

A. The Contractor will comply with the warranty and guarantee requirements outlined in these Specifications.

B. In the event that the Owner or Engineer determines that repairs and/or replacements covered under the warranty period are required, a written order from the Owner will be issued to the Contractor.

C. The Contractor will have 10 business days to respond to the Owner's written order. The Contractor's response will include the following: 1) acknowledgement that the repair or replacement is covered under the warranty and workmanship

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guarantee; 2) an estimated timeline for replacement or repair; and 3) written guarantee of replacement or repair workmanship.

D. If the Contractor fails to make such repairs or replacements within 90 days of the Contractor's response, the Owner reserves the right to make the necessary repairs. The Contractor and the Contractor's surety will be liable for costs incurred by the Owner for repair and replacement costs.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 80 00

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SECTION 02 10 00
SITE PREPARATION

PART 1 GENERAL

1.01 SUMMARY

A. This section includes details on the furnishing of all labor, materials, equipment, and services required for the clearing and grubbing, removal, and disposal of items as specified herein and on the Construction Plans.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 CLEARING AND GRUBBING

A. Clearing and grubbing will consist of the removal of all natural and artificial objectionable materials from the Project site or from limited areas of construction as per Section 02 11 00 – Clearing and Grubbing.

3.02 MINOR DEMOLITION

A. There may be certain items on the Project site such as fences, concrete, and other undetermined structures and improvements that must be removed before construction can commence. Unless otherwise specified, such items become the property of the Contractor for subsequent disposal.

3.03 USE OF EXPLOSIVES

A. The use of explosives will not be permitted in Project site preparation operations.

3.04 BACKFILLING

A. All holes, cavities, and depressions in the ground caused by Project site preparation operations will be backfilled and tamped to the compaction requirements of Section 02 20 00 – Earthwork and Grading and will be graded to prevent ponding of water and promote drainage. Should any excavated hole or cavity be required to be left open, the Contractor will be responsible for providing barriers and/or coverings to enhance on-site accident prevention measures.

3.05 DISPOSAL OF WASTE MATERIALS

A. Unless otherwise stated, materials generated by clearing, grubbing, removal, and demolition will be known as "waste" or "spoils" and will be removed from the site and legally disposed of by the Contractor. Similar materials may be unearthed or

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generated by earthwork operations or subgrade preparation. Unless otherwise specified, any merchantable items become the property of the Contractor.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Site preparation is considered incidental to the Work, and no separate payment will be made for this item.

END OF SECTION 02 10 00

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SECTION 02 11 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.01 SUMMARY

A. This section consists of details on clearing, grubbing, removing, and disposing of all vegetation and debris within the limits of the construction area. Vegetation and objects designated to remain are to be preserved from injury or defacement.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 CONSTRUCTION

A. Unless otherwise established by the Project Engineer, all areas between the lines of cut or fill areas constitute the clearing and grubbing limits. The clearing limits are to be 2 feet within the neat lines of cut or fill areas.

B. All stumps, roots, logs, or other timber more than 3 inches in diameter and all brush, matted roots, and other debris within the grubbing limits will be pulled or otherwise removed to a depth of not less than 6 inches below the original ground or 12 inches below subgrade.

C. The refuse resulting from the clearing and grubbing operations may be hauled to an available waste site approved by the Owner and must be disposed of in such a manner as to meet all requirements of state, county, municipal, or Owner regulations regarding health, safety, and public welfare. When authorized by the proper fire and air quality authorities, the Contractor may dispose of such refuse by burning on the Project site, provided all requirements set forth by the authorities are met.

D. In all cases, the authority to burn will not relieve the Contractor in any way from damages which may result from burn operations. In no case will any material be left on the Project site, shoved onto abutting private properties, or buried in embankments or trenches.

E. The Contractor will avoid, as far as practicable, injury to shrubbery, vines, plants, grasses, and other vegetation growing on areas outside of the grading limits.

END OF SECTION 02 11 00

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SECTION 02 19 00
LEAK DETECTION SUMP AGGREGATES

PART 1 GENERAL

1.01 SUMMARY

A. This section covers the requirements for preparing course aggregate for use in leak detection sumps meeting the gradation and other quality criteria specified herein.

1.02 REFERENCES

A. ASTM International (ASTM)

1. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

2. ASTM D6913 – Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.

1.03 SUBMITTALS

A. The Contractor will submit to the Project Engineer gradations and other test results for sources to be used for course aggregate prior to delivery to the site for approval by the Project Engineer. If on-site materials are proposed, test data must be submitted to the Project Engineer to assure consistency with the design requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate shall be clean, naturally occurring, water-rounded gravel material.

B. The Contractor will furnish course aggregate meeting the applicable gradation and other quality requirements.

C. The Contractor will furnish course aggregate that has been washed to reduce sand and fine content to the maximum practicable extents conforming to the following gradation detailed in Table 1.

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Table 1. Aggregate Gradation Requirements

Standard Sieve Size	Percent Passing
2 inches	100%
1.5 inches	95% to 100%
0.75 inch	10% to 20%
No. 4	0% to 5%
No. 200	0% to 2%

D. Up to 5% "oversized" material is permitted, provided that the "oversized" material passes the screen size immediately larger than the 1.5-inch sieve.

E. Suitability of the course aggregate is based on samples obtained during placement in the Project within limits allowed in the table for the particular grading specified.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor will smooth and shape the surface of the underlying subgrade to the cross-section lines and grades shown on the plans prior to placing geotextile and sump aggregate.

3.02 GEOTEXTILE

A. The Contractor will provide and install geotextile conforming to Section 02 80 00 – Non-Woven Geotextiles prior to placement of the sump aggregate. At no time will course aggregate be allowed to come into direct contact with the geomembrane.

B. The Contractor will place geotextile directly on the geomembrane and will provide a minimum of 36 inches of overlap after placement, spreading, and consolidation of sump aggregate.

3.03 PLACEMENT AND SPREADING

A. The sump aggregate will be placed by the Contractor in maximum 12-inch-thick loose layers to the lines and grades shown in the Project plan sheets.

B. The use of wheeled or tracked equipment in direct contact with the geomembrane will not be allowed. The Contractor will be responsible for ensuring that course aggregate is transported and installed in a manner as to not damage the underlying geomembrane.

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3.04 COMPACTION REQUIREMENTS

A. Field density requirements will not be applicable to sump aggregate installations.

3.05 ELEVATION TOLERANCES

A. The aggregate course must be installed by the Contractor within elevation deviations of no more than 0.1 foot at any point within the course aggregate installation area.

END OF SECTION 02 19 00

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SECTION 02 20 00
EARTHWORK AND GRADING

PART 1 GENERAL

1.01 SUMMARY

A. This section describes the excavation and grading requirements designated on the Plan Drawings and specified herein.

1.02 REFERENCES

A. ASTM International (ASTM)

1. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort

2. ASTM D 2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

3. ASTM D 4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

4. ASTM D 6913 – Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

5. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

6. ASTM D 6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 DENSITY CONTROL TESTING

A. Field density testing details are as follows:

1. In-place field density tests for quality assurance are at the Owner's expense and will be coordinated by the Project Engineer. The field density testing will meet the requirements of ASTM Dl557.

2. The frequency of field density testing will be at the discretion of the Project Engineer.

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PART 2 PRODUCTS

2.01 ON-SITE FILL MATERIAL

A. Native material excavated on site will exhibit the following characteristics:

1. Maximum particle size shall be 12 inches in any direction. Larger-sized particles shall be removed during excavation.

2. Material shall be free from mud, refuse, construction debris, organic material, and frozen or otherwise unsuitable material. Organic or unsuitable material encountered during excavation shall be removed and stockpiled at an on-site location approved by the Owner.

2.02 FOUNDATION MATERIAL

A. Foundation material for unsuitable foundation excavation shall be imported material consistent with Washing State Department of Transportation Standard Specification 9-03.9(2).

2.03 GEOTEXTILE

A. Geotextile for unsuitable foundation excavation shall be consistent with Section 02 80 00 – Non-Woven Geotextiles.

2.04 EQUIPMENT

A. The Contractor will furnish the necessary equipment to apply sufficient compactive effort to meet the requirements of the Project specified herein.

B. The Contractor will provide compaction equipment having the ability to traverse slopes of 3:1 (horizontal to vertical).

2.05 WATERING

A. The Contractor will use uncontaminated water free of organics.

PART 3 EXECUTION

3.01 PLACEMENT AND COMPACTION OF MATERIALS

A. The Contractor will perform excavation and filling activities in a manner and sequence that will provide drainage at all times. All excavations must be kept free from excessive or standing water by the Contractor. If the Contractor fails to provide adequate dewatering and any material becomes too wet and cannot be properly compacted, the wet material will be removed and replaced with satisfactory on-site material or approved imported material from approved

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sources, or the wet material shall be dried and recompacted as directed by the Project Engineer by the Contractor at no additional cost to the Owner.

B. The Contractor will place material in maximum 12-inch-thick loose lifts, compacted as specified herein, to the lines and grades shown in the Plan Drawings. The Contractor will deposit and spread lifts continuously and without breaks.

C. The Contractor will use equipment that will distribute the material in a uniform layer without causing segregation.

D. The Contractor will add water uniformly, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. The Contractor must maintain an adequate water supply during the work. The Contractor will assure the equipment used for watering is of the capacity and design to provide uniform water application.

E. The Contractor will apply water during the work to control dust.

F. The Contractor will compact the material using appropriate tamping equipment or power rollers.

G. The Contractor will compact the fill material to 95% of the material's maximum dry density as determined by ASTM D1557.

H. If field density tests indicate that compaction is not being achieved by the Contractor, the fill will be scarified, moisture-conditioned, and recompacted by the Contractor.

3.02 FINISHED GRADES

A. General:

1. All areas covered by the project, including excavated and filled sections and adjacent transition areas, will be uniformly smooth-graded by the Contractor.

2. **Tolerances:** Finished grades and subgrade surfaces shall be within 0.1 foot of design elevations.

B. Surface preparation for geosynthetic products:

1. The Contractor will finish the subgrade surface using a smooth-drum rollers to a smooth state, free from irregular surface changes.

2. Subgrade shall be free of coarse particles, earth clods, and debris. The Contractor shall rake or remove by hand any rocks or debris that protrude from the surface greater than 3/8 inch.

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C. Unsuitable foundation material:

1. In areas of soft or otherwise unsuitable material identified during proof-rolling, the Contractor shall excavate the unsuitable material to a depth approved by the Project Engineer.

2. Geotextile will be placed over the bottom of the excavation and backfill with foundation material. Foundation material will be backfilled and compacted in 12-inch lifts. Geotextile shall be placed over each successive lift and over the final lift.

3.03 PROTECTION

A. The Contractor will protect final graded areas from traffic and from erosion. Any settlement or washing away that may occur from any cause prior to acceptance must be repaired by the Contractor, and the grades must be re-established to the required elevations and slopes.

3.04 FIELD QUALITY CONTROL

A. Field testing:

1. Field density testing will be conducted by a third-party retained by the Owner. All coordination for field testing activities will be the responsibility of the Project Engineer.

B. Testing frequency:

1. Field density tests will be performed at the Project Engineer's discretion.

C. Proof-rolling:

1. The Contractor will demonstrate to the Project Engineer that the subgrade does not contain previously unidentified soft areas by proof-rolling. Proof-rolling will consist of rolling the entire surface with approved mechanical equipment while observing the subgrade for displacement or deformation.

D. Final inspection:

1. The Installer shall visually examine and accept the subgrade surface prior to geotextile placement.

END OF SECTION 02 20 00

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SECTION 02 22 00
TRENCH EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 SUMMARY

A. This section consists of excavation and trenching for pipelines, handling and storage of materials and preparation of subgrade, pumping and dewatering as necessary, and dressing and surface restoration cleanup of the site.

1.02 REFERENCES

A. ASTM International (ASTM)

1. ASTM Dl557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort

2. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

3. ASTM D43 l 8 – Standard Practice for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

4. ASTM D6913 – Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

5. ASTM Dl556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

6. ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe Bedding Material

1. Bedding material shall be consistent with Washington State Department of Transportation (WSDOT) Standard Specification 9-03.13(3).

PART 3 EXECUTION

3.01 CONSTRUCTION

A. During excavation, materials suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading

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and to prevent slides or cave-ins. Excavated material shall be piled on one side of the trench only to permit ready access to existing fire alarm boxes, fire hydrants, valves, manholes, and other appurtenances. Surface drainage of adjoining areas shall be unobstructed.

B. All excavated materials not required or suitable for backfill shall be removed from the site and disposed of in a manner and/or by methods acceptable to the Owner.

C. Grading shall be done as may be necessary to prevent surface water from flowing into excavations, and any other water accumulating therein shall be promptly removed. Under no circumstances shall water be permitted to rise in un-backfilled trenches until after the pipe has been placed, tested, and covered to final grade with backfill. Any pipe having its alignment or grade changed as a result of a flooded trench shall be relayed at no additional cost to the Owner.

D. Adequate provisions shall be made for maintaining the flow of sewers, drains, and water courses encountered during construction. Culverts, ditches, fences, crosswalks, and structures which are disturbed by this construction shall be satisfactorily restored to their original condition upon completion of the Work.

3.02 SITE CONDITIONS

A. The Contractor shall be responsible for enforcing safety and maintaining safe working conditions in all trenching, shoring, and blasting operations to conform to Occupational Safety and Health Administration (OSHA) regulations.

B. The Contractor shall employ qualified, properly trained personnel to design shoring, perform safety inspections of the trenches, and supervise the handling of operations involving safety procedures, as prescribed by OSHA.

C. The Contractor shall obtain all required permits prior to trench excavation.

3.03 TRAFFIC CONTROL AND WARNING DEVICES

A. The Contractor shall plan and construct the Project in such a manner as to minimize the interruption of the use of roads, highways, streets, and sidewalks involved and shall provide for emergency access to adjacent property and fire hydrant access at all times.

B. The Contractor is responsible for providing and maintaining adequate barricades of high-visibility design, flares, lanterns, signs, flaggers, and pre-warning devices to alert the public, motorists, and pedestrians of hazardous conditions in accordance with the latest edition of the *Manual on Uniform Traffic Control Devices for Streets and Highways* published by the U.S. Department of Transportation, applicable Yakima County Standards, and State Highway Standards.

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C. If required, the Contractor shall submit its traffic control plan to the Owner and Project Engineer.

3.04 STRUCTURES

A. The Contractor shall exercise every precaution to prevent damage to existing buildings or structures in the vicinity of its Work. In the event of such damages, it shall repair them to the satisfaction of the Owner of the damaged structure and at no cost to the Owner.

3.05 OVERHEAD UTILITIES

A. The Contractor shall use extreme caution to avoid a conflict, contact, or damage to overhead utilities, such as power lines, street lights, telephone lines, television lines, poles, or other appurtenances during the course of construction of this Project.

3.06 SURVEY MARKERS AND MONUMENTS

A. The Contractor shall use every care and precaution to protect and not disturb any survey marker or monuments, such as those that might be located at lot or block comers, property pins, intersection of street monuments, or addition line demarcation. Such protection shall include marking with flagged high lath and close supervision. No monuments shall be disturbed without prior approval of the Owner and Project Engineer. Any survey marker or monument that is disturbed or destroyed by the Contractor without approval during the construction of this Project shall be replaced at no cost to the Owner by a licensed land surveyor.

3.07 CLEANUP

A. As Work progresses, that portion of the Work completed shall be cleared of debris and brought to the finished grade. Upon completion of the Work, the entire site shall be cleared of all debris and ground surfaces shall be finished to smooth, uniform slopes and shall present a neat and workmanlike appearance. All rocks brought to the ground surface by excavation or backfilling operations shall be removed.

B. At all times during construction, the Contractor shall be responsible for dust control as directed by the Owner and Project Engineer.

3.08 TRENCH EXCAVATION

A. Trench excavation shall be performed in accordance with minimum requirements of Washington State OSHA Regulations.

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3.09 PREPARATION

A. Protection of Existing Properties

1. Existing utilities that intersect with the new pipelines or structures will be relocated by the Contractor, unless expressly noted otherwise in the Special Provisions.

2. Notify the Project Engineer and Owner immediately if any utility conflicts are encountered.

3.10 PRIVATELY OWNED UTILITIES

A. Gas mains, underground electrical and telephone cables, telephone poles, light poles, etc. required to be moved to make way for new construction will be moved by others. The Contractor shall assure that all necessary arrangements are made with the appropriate utility Owner(s) prior to beginning Work in the affected area, and it shall assure that all required Work is coordinated with the appropriate utility Owner(s) as Work progresses.

3.11 EXPLORATORY EXCAVATION

A. Location of buried utilities that might interfere with alignment or grade shall be verified by exploratory excavation prior to construction. If any existing utility interferes with the Work in either alignment or grade and has to be moved, such Work shall be done by the Contractor.

3.12 SHORING, SHEETING AND BRACING

A. The Contractor shall do all shoring, bracing, and tight-sheeting required to prevent caving and to protect its workmen in accordance with OSHA regulations and to protect adjacent property and structures.

3.13 DEWATERING

A. Where groundwater is encountered in excavation, it shall be removed to avoid interfering with pipe-laying and other construction operations.

B. Discharge from dewatering operations shall be directed to appropriate areas as approved by the Owner/Project Engineer.

3.14 GENERAL EXCAVATION OPERATIONS

A. The Contractor shall excavate as necessary at the locations shown on the Construction Drawings, staked in the field, or otherwise specified for the installation of pipelines.

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B. The Contractor shall take precautions and protect all adjoining private and public property and facilities, including underground and overhead utilities, structures, and fences. Any disturbed or damaged facilities will be suitably restored or replaced by the Contractor.

C. Excavation for Appurtenances

1. Excavations for manholes, structures and other appurtenances shall be sufficient to leave clearance adequate for proper compactive effort on all sides. The depth, provisions for removing water, and other applicable portions of these specifications shall apply to excavation for appurtenances.

3.15 TRENCH DIMENSIONS

A. Pipe Trench

1. Trench dimensions shall be consistent with WSDOT Standard Plan B-55.20-02 and WSDOT Standard Specification 2-09.4.

2. When soft or unstable material is encountered at the trench bottom and will not uniformly support the pipe, such material shall be excavated and backfilled consistent with Section 02 20 00 (Subsection 3.02.C).

3. Unauthorized overexcavation depths shall be backfilled with bedding material at the Contractor's expense.

B. Anchor Trench

1. The Anchor trench will be constructed to the dimensions shown in the Construction Drawings.

a) Trench Depth: The trench depth will be as shown on the Construction Drawings. The minimum depth of the trench is 30 inches.

b) Trench Width: The trench width will be a minimum of 24 inches wide as measured at the bottom of the trench.

3.16 TIME OF OPEN TRENCHES

A. The Contractor will be required to conduct its Work so that trenches will remain open a minimum possible time.

B. No trench excavating will begin until approved compaction equipment is at the site where the excavating is to take place. All backfill and compacting shall be completed in all trenching and structural excavations within a maximum distance of 400 feet behind the end of newly installed pipe, and the maximum distance

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between the newly installed pipe and the excavator shall be 200 feet. For each Work group consisting of trench excavator, a pipe-laying crew, and a backfilling and compacting crew, the maximum allowable open ditch at any time will be 400 feet.

C. Certain conditions may necessitate the closing of certain sections of trench prior to daily, weekend, or holiday shutdown.

3.17 EQUIPMENT

A. The use of trench-digging machinery will be permitted except in places where its operation will cause damage to existing structures or features, in which case hand methods shall be employed.

B. Any equipment on tracks that is to be used on pavement shall be equipped with suitable pads to prevent damage to the pavement. All pavement damaged during construction by the Contractor's equipment shall be restored to its original condition by the Contractor.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for trench excavation and backfill. Costs for trench excavation and backfill shall be included in, and considered incidental to, the bid items for the following:

1. Anchor Trench
2. Inlet Pipe
3. Leak Detection System

END OF SECTION 02 22 00

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SECTION 02 23 00
DEWATERING

PART 1 GENERAL

1.01 SUMMARY

A. This section includes information on furnishing and implementing temporary dewatering systems.

1.02 SYSTEM DESCRIPTION

A. Remove water (if any) that accumulates in excavations during the progress of the Work so that all Work can be done in dry conditions (unless otherwise approved by the Project Engineer).

B. At all times, have sufficient pumping equipment on the Work site for immediate use, including standby pumps for use in case other pumps become inoperable. Dispose of water in accordance with the detailed requirements specified herein and in such a manner as to cause no injury to personnel or the public, damage to public or private property, nor menace to the public health.

C. Furnish sufficient numbers of pumps, lengths of discharge pipe, and lengths of suction hoses to provide dewatering service to the areas of the Project requiring water removal.

D. The dewatering system shall be designed to pump exclusively to the Northwest Catch Basin, located to the north of the Safety Debris Catch Basin. Under no circumstances will discharges from the dewatering system be allowed to discharge directly off property.

PART 2 PRODUCTS

2.01 PUMPS

A. Supply pumping system that can provide water removal at a minimum rate of 100 gallons per minute.

B. Pumps shall be equipped with appropriate valves and fittings as recommended by the pump manufacturer(s).

C. If electrical pumps will be used, the Contractor shall be responsible for providing adequate generator(s) to supply power to the pump(s).

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2.02 DISCHARGE PIPE/SUCTION HOSE

A. Discharge pipe shall be high-density polyethylene (HDPE) pipe with an appropriate diameter to convey the design flow rate(s) of the pump(s) at flow velocities less than or equal to 10 feet per second. Pipe material other than HDPE may be used upon approval by the Project Engineer.

B. HDPE pipe shall have appropriate thickness to withstand internal pipe pressures.

C. Provide filters for suction hose(s) per manufacturer recommendations.

PART 3 EXECUTION

3.01 DEWATERING

A. Except as otherwise indicated in the Contract Documents, perform dewatering to accomplish the lowering of static water levels to an elevation that is suitable for construction activities.

B. For dewatering in trenches and structure excavations, provide adequate space for the installation of sumps and pumps. Sumps will be installed by the Contractor at a sufficient elevation below subgrade to ensure a dry working surface.

3.02 DISCHARGE

A. The Contractor will coordinate with the Owner on a suitable discharge location for dewatering pipe. The Contractor will not be allowed to discharge to any locations not approved by the Owner. The Contractor may connect to existing piping upon approval of the Owner.

END OF SECTION 02 23 00

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SECTION 02 29 00
WATERING

PART 1 GENERAL

1.01 SUMMARY

A. This section consists of details on furnishing and applying water required in the compaction of embankments, subgrades, base courses, and surface courses or used for the control of dust for the safety and convenience of the public, for the reduction of the dust nuisance with adjacent property, or for other purposes as directed by the Project Engineer and in accordance with the requirements of these specifications.

PART 2 PRODUCTS

2.01 WATER SOURCE

A. Water required for compaction, dust control, or other purposes shall be the responsibility of the Contractor to obtain. Water quality shall meet or exceed that required by federal, state or local government agencies of authority.

B. Only Owner-approved water sources located on site may be used.

PART 3 EXECUTION

3.01 WATER ADDED

A. Deficiencies in moisture content of embankment materials, aggregate subbase, base, or surfacing courses shall be corrected by the addition of water by approved water distribution equipment. Water for dust control, finishing operations, and seeding shall be applied by approved distributor equipment.

1. **Grading Operations:** Pre-wetting does not guarantee that additional water will not be required. Water added to embankment material during grading operations shall be distributed in a manner that will avoid ponding or over-wetting materials for the full width of each layer of material placed.

2. **Aggregate Courses:** Water added to aggregate courses shall be applied to the material immediately prior to mixing and placing the material.

3. **Finishing Operations:** Water added during finishing operations shall be uniformly applied in a fine spray across the full width of the course by means of controllable pressures and spray bars or nozzles.

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4. **Dust Control:** Water ordered for dust control measures for the protection and safety of traffic, abatement of air pollution, or other purposes shall be applied in a manner that will best accomplish the elimination of dust.

END OF SECTION 02 29 00

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SECTION 02 74 00
HDPE PIPE, FITTINGS, AND JOINTS

PART 1 GENERAL

1.01 SUMMARY

A. This specification covers the material (pipe and fittings), joining methods and general installation practice for high-density polyethylene pipe (HDPE) piping systems for use as indicated in the Project Documents.

1.02 SUBMITTALS

A. Submit product data to the Project Engineer for review in accordance with the Specifications for all pipe and appurtenances.

B. Furnish in duplicate to the Project Engineer confirmation that product shipped meets or exceeds the standards set forth in this specification. This must be in the form of a written document from the manufacturer attesting to the manufacturing process meeting the standards.

C. Provide a statement in writing from the HDPE pipe manufacturer that it is listed with the Plastic Pipe Institute as a qualified extruder for the polyethylene resin being used to manufacture the pipe for this project.

D. Provide a statement that personnel responsible for fusing the pipe have been trained and qualified.

E. Contractor must also submit the following to the Project Engineer for approval:

1. Certified dimensional as-built drawings/profile of all installed pipe, specials and fittings.

2. Details of fittings and specials such as elbows, wyes, tees, outlets, connections, test bulkheads, bosses and nozzles or other specials where shown on the Construction Drawings, which indicate amount and position of reinforcement. All fittings and specials must be properly reinforced to withstand the internal pressure both circumferential and longitudinal, and the external loading conditions as indicated in the Contract Documents. Shop Drawings must clearly detail special castings indicating all pertinent dimensions.

3. The Supplier of the material must submit, through the Contractor, a Certificate of Compliance that the pipe, fittings and other products or materials furnished for this project have been inspected at the plant and comply with all applicable provisions of these Specifications. The

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Contractor must submit these certificates to the Project Engineer prior to installation of the pipe materials.

1.03 REFERENCES

A. Unless otherwise specified, references to documents must mean the latest published edition of the referenced document in effect at the bid date of the project.

B. ANSI/AWWA

1. ANSI/AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm) for Water Service

2. ANSI/AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission

3. AWWA M55 Manual of Water Supply Practices, PE Pipe-Design and Installation

C. Plastic Pipe Institute (PPI)

1. PPI Handbook of Polyethylene Pipe – 2009 (2ndEdition)

2. PPI Municipal Advisory Board (MAB) Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe

3. PPI Material Handling Guide for HDPE Pipe and Fittings

4. PPI TR-38 Bolt Torque for Polyethylene Flanged Joints

5. PPI TN-42 Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects

6. PPI TR-46 Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe

D. ASTM International (ASTM)

1. ASTM F 585 – Standard Guide for Insertion of Flexible Polyethylene Pipe Into Existing Sewers

2. ASTM F 714 – Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

3. ASTM F 905 – Standard Practice for Qualification of Polyethylene Saddle-Fused Joints

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4. ASTM F 1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe

5. ASTM F 1290 – Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings

6. ASTM F 1417 – Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

7. ASTM F 1962 – Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings

8. ASTM F 2164 – Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure

9. ASTM F 2206 – Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock

10. ASTM D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

11. ASTM F 2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

12. ASTM D 2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping

13. ASTM F 2880 – Standard Specification for Lap-Joint Type Flange Adapters for Polyethylene Pressure Pipe in Nominal Pipe Sizes 3/4 In. to 65 In.

14. ASTM D 3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

15. ASTM D 3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

16. ASTM D 1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

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PART 2 PRODUCTS

2.01 MATERIALS

A. HDPE Pipe Products

1. IPS 18-inch DR 32.5

2. IPS 1-inch DR 11

B. Resin and Material Requirements

1. All material will be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material must meet the specifications of ASTM D3350 with a minimum cell classification of 445474C.

2. HDPE pipe and fittings must contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.

3. HDPE products must be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

C. C HDPE Pipe

1. All pipe will be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2.01.A. The polyethylene compound must be suitably protected against degradation by ultraviolet light by means of carbon black of not less than 2 percent. The manufacture of the HDPE resin must certify the cell classification indicated.

2. Pipe sizes 3-inch and larger must have a manufacturing standard of ASTM F714, while pipe smaller than 3-inch must be manufactured to the dimensional requirements listed in ASTM D 3035. Dimension Ratio (DR) and/or Outside Diameter (IPS/DIPS) must be as specified on plans.

3. Pipe must meet AWWA C901 (1/2-inch to 3-inch) or AWWA C906 (4-inch to 63-inch) and must be listed as meeting NSF-61.

4. Pipe must be manufactured by an ISO 9001 certified manufacturer. The pipe manufacturer must have an ongoing Quality Control program for incoming and outgoing materials and must assure that the pipe will meet the material requirements of this specification. HDPE resins for manufacturing of pipe must be checked for density, melt flow rate, and contamination. The facility must have the necessary testing equipment to verify that pipe meets the AWWA and NSF standards. Pipe must be

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checked for outside diameter, wall thickness, length, and surface finish on the inside and outside. The Manufacturer's production facilities must be open for inspection by the Owner or Project Engineer.

D. HDPE Fittings

1. Butt Fusion Fittings – Fittings must be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2.01.A. Fittings must have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans or accepted by Owner/ Project Engineer. All fittings must meet the requirements of AWWA C901 or C906.

   a) Molded fittings must comply with the requirements of ASTM D 3261.

   b) All fabricated elbows, tees, reducing tees and end caps must be produced and meet the requirements of ASTM F2206, as manufactured by ISCO Industries, Inc or other approved manufacturer holding an ISO 9001 quality system certificate. Each fitting will be marked per ASTM F2206 section 10 including the nominal size and fitting EDR, which will meet or exceed the pipe DR identified for the project. Fabricated fittings must be manufactured using a McElroy Data Logger or approved equal to record fusion pressure and temperature and must be stamped with unique joint number that corresponds to the joint report. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings must be maintained for a minimum of 5 years as part of the quality control and will be available upon request of owner. Test results to validate ASTM F2206 section 7.3 and 9 must be provided to owner or owner's representative upon request.

   c) Socket fittings must meet ASTM D2683.

2. Electrofusion Fittings – Fittings must be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as noted in 2.01.A. Electrofusion Fittings must have a manufacturing standard of ASTM Fl055. Fittings must have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans. For potable water systems, all electrofusion fittings must have AWWA approval.

3. Bolted Connections – Flanged and Mechanical Joint Adapters can be made to ASTM D3261 or if machined, must meet the requirements of ASTM F2206. Flanges and MJ Adapters must be fused onto the pipe and

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have a minimum pressure rating equal to or greater than the pipe unless otherwise specified on the plans.

a) Flange Adapters must meet the dimensional and material requirements of ASTM F2880.

b) Metallic back-up rings (Van-Stone style lap joint flanges), must have a radius on the inside diameter of the bore so as to be compatible with HDPE Flanges. Back up rings must have bolt pattern that will mate with AWWA C207 Class D (or B or E), ASME/ANSI B 16.5 Class 150, ASME/ANSI B 16.1 Class 125, or ASME/ANSI B16.47 Series A.

c) Flange assemblies must be assembled and torqued according to PPI TN-38 – Bolt Torque for Polyethylene Flanged Joints.

d) Where shown on the drawings, 4-inch and larger transitions to mechanical joint fittings and valves must be accomplished using a MJ Adapter with kit. The D.1./HDPE mechanical joint adaptor must consist of:

1) A molded or fabricated HDPE mechanical joint transition fitting.

2) A rubber gasket.

3) A mechanical joint backup drive ring.

4) Carten mechanical joint tee bolts.

4. Mechanical Fittings: The use of mechanical coupling and saddles must be approved by the Owner or Project Engineer prior to installation. Mechanical Fittings must be designed for use and compatible with HDPE pipe. Mechanical fittings must have a pressure rating equal to or greater than the pipe.

a) Couplings without self-restraining capabilities (integrated serrated teeth or grippers) must include a plan for external restraint or isolation from pipeline generated forces.

b) Mechanical Saddles must have wide straps for distribution of clamping loads. No U- bolts must be allowed.

c) When required by mechanical coupling manufacturer, pipe stiffeners must be employed to support the interior wall of the HDPE. The stiffeners must support the pipe's end and control the "necking down" reaction to the pressure applied during normal installation. The pipe stiffeners must be formed of 304 or 316

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stainless steel, with a wedged style design to fit the HDPE manufacturers published average inside diameter of the specific size and DR of the HDPE.

E. Discharge Assembly Fittings

1. NPT thread adapter shall be Transition Fitting HDPE to Male Threaded Metal, DR11, 304 stainless steel, as manufactured by or approved equal.

2. Male and female camlock fittings shall be Tough-TITE Industrial stainless steel part numbers 0400657 and 0400684 as manufactured by American Packing and Gasket Company or approved equal.

3. Pitless Adapter. Slide Fitting shall be Model JD Stainless Steel Pitless Adapter as manufactured by Maass Midwest or approved equal.

F. Fusion Unit Requirements

1. All Fusion Equipment, whether new or used, rented or owned, must comply with the requirements of ISO 12176-1 – Equipment for Fusion Jointing Polyethylene Systems.

2. If the Contractor owns butt fusion equipment, the equipment must be serviced within 3 months prior to use for this project. The machine must be environmentally friendly and in satisfactory working order. The hydraulic system must be leak free. The pressure gage and thermometer must be checked for accuracy. For projects with pipe quantities of 5,000 feet or longer, the fusion equipment should be serviced by a McElroy Authorized Service and Repair Center with at least one McElroy Certified Master Mechanic on staff within 3 months from the first fusion on the project.

3. Rental Fusion Equipment must be maintained by a McElroy Authorized Service and Repair Center with at least one McElroy Certified Master Mechanic on staff When requested by owner or his authority, an inspection report detailing the components inspected within 3 months prior to arrival at jobsite will be provided.

G. Manufacturer

1. All Pipe, Fittings, and Fusion Equipment must be provided by one manufacturer.

2.02 PIPELINE LOCATING MATERIALS

A. Detectable Marker Tape: Plastic marker tape must be 5 mil minimum thickness with a solid aluminum core of .35mil minimum thickness and a minimum width of 2 inches. The background of the tape must be colored based on pipe service

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with black lettering continuously printed. Marker tape must have a minimum 35 lbs./inch tensile strength. The installation of the tape must be at 18 inches below finish grade.

B. Tracer Wire: All HDPE pipe 4 inches and greater must be installed with an extra high-strength, copper clad steel tracer wire including 45 mil HDPE jacket that has a minimum average break load of at least 1150 lbs. The jacket must be colored based on pipe service, with blue for potable water or green for sewer. Tracer wire gauge must be 12 AWG, 10 AWG, or 8 AWG depending upon application and installation procedure. This wire must to be continuous and brought up in the valve boxes at the ends of each line segment with splices made only by methods per the equipment manufacturer's recommendation. All miscellaneous splicing components must be furnished and installed by the Contractor.

PART 3 EXECUTION

3.01 GENERAL

A. All HDPE pipe and fittings must be cut, joined, and installed in accordance with the manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe must be accomplished by personnel experienced in working with polyethylene pipe systems.

3.02 TRANSPORTATION, UNLOADING, AND STORAGE

A. The manufacturer must package product in a manner designed to deliver the pipe and fittings to the project neatly, intact and without physical damage. During transportation each pipe must rest on suitable pads, strips skids, or blocks securely wedged or tied in place. The transportation carriers must use appropriate methods and intermittent checks to insure the pipe is properly supported, stacked and restrained during transportation such that the pipe is not nicked, gouged, or physically damaged. The transportation carrier must provide tarpaulins to cover any potable water pipe subject to exposure to diesel exhaust or smoke.

B. During loading, transportation, and unloading, every precaution should be taken to prevent damage to the pipe. Cuts or gouges that reduce the wall thickness by more than 10% is not acceptable and must be cut out and discarded.

C. Handle the pipe in accordance with the PPI Handbook of Polyethylene Pipe (2nd Edition), Chapter 2. All pipe and accessories must be loaded and unloaded by lifting with hoists or by skidding in order to avoid shock or damage. Under no circumstances must materials be dropped. Pipe handled on skidways must not be rolled or skidded against pipe on the ground. Slings, hooks or pipe tongs must be padded and used in such a manner as to prevent damage to the exterior surface or interior of the pipe. All pipe and fittings must be subjected to visual inspection at time of delivery and before they are lowered into the trench to be laid. Joints or

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fittings that do not conform to these specifications will be rejected and must be removed immediately by the Contractor.

D. Materials, if stored, must be kept safe from damage. The Contractor must be responsible for all security, damage and loss of pipe, excluding Acts of God. The interior of the pipe as well as all sealing surfaces of mating components (i.e. flange faces) must be kept free from dirt or foreign matter at all times.

E. Pipe must not be stacked higher than the limits recommended by the manufacturer. The bottom tiers must be kept off the ground on timbers, rails, or concrete. Pipe must not be stored close to heat sources.

F. The open ends of all sections of joined and/or installed pipe (not in service) must be plugged to prevent animals or foreign material from entering the pipe line or pipe section. The practice of stuffing cloth or paper in the open ends of the pipe will not be permitted. Waterproof nightcaps of approved design may be used but they must be so constructed that they will prevent the entrance of any type of natural precipitation into the pipe and will be secured to the pipe in such a manner that the wind cannot blow them loose.

G. Where possible, the pipe must be raised and supported at a suitable distance from the open end such that the open end will be below the level of the pipe at the point of support.

3.03 PIPE INSPECTION

A. All pipe and fittings must be subjected to visual inspection at time of delivery and before they are installed or lowered into the trench to be laid. Defective, damaged, or unsound pipe will be rejected. Cuts, punctures, or gouges that penetrate or reduce the wall thickness by 10% or more are not acceptable and must be removed and discarded. Joints or fittings that do not conform to these specifications will be rejected and must be removed immediately by the Contractor.

3.04 HANDLING PIPE

A. The handling of the pipeline must be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Sections of the pipes with cuts and gouges exceeding 10 percent of the pipe wall thickness or kinked sections must be removed and the ends rejoined.

B. Refer to the PPI Material Handling Guide for HDPE Pipe and Fittings for recommendations, guidelines and instructions regarding the handling, lifting, loading, storing and installing polyethylene pipe and fittings.

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3.05 PIPE JOINING AND INSTALLATION

A. Direct Burial

1. Buried HDPE pipe and fittings must be installed in accordance with ASTM D2321 or ASTM D 2774 for pressure systems and AWWA Manual of Practice M55 Chapter 8. The Design Window identified in AWWA M55 Chapter 5 (page 65 of 2006 version) must be considered acceptable design and installation conditions.

2. Pipe embedment – Embedment material should be Class I, Class II, or Class III materials as defined by ASTM D-2321 Section 6 or Type 1 and 2 per Section 02220. The use of Class IV and Class V materials is not recommended; however, it may be used only with the approval of the Project Engineer and appropriate compaction.

3. Bedding: Pipe bedding must be in conformance with ASTM D2321 Section 8. Compaction rates should be as specified in ASTM D232 l. Deviations must be approved by the Project Engineer.

4. Haunching and backfill must be as specified in ASTM D 2321 Section 9 with Class I, II, or III materials. Compaction must be in excess of 85% Proctor.

B. Trenchless Installation Methods

1. Installation of HDPE Pipe by Directional Boring must follow the guidelines for ASTM F 1962 or PPI TR-46.

C. Fusion Joining Requirements:

1. All HDPE pipe must be joined to itself by the heat fusion process which produces homogeneous, seal, leak tight joints. Tie-ins between sections of HDPE pipe must be made by butt fusion whenever possible.

2. Butt Fusion: The pipe must be joined by the butt fusion procedure outlined in ASTM F2620 or PPI TR-33. All fusion joints must be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints must be made by qualified fusion technicians per PPI TN-42. A record or certificate of training for the fusion operator must be provided that documents training to the fundamentals of ASTM F2620. Considerations should be given to and provisions made for adverse weather conditions, such as temperatures below freezing, precipitation, or wind, which is accepted by the Owner/Project Engineer.

3. Electrofusion: Electrofusion joining must be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion

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joining information are ASTM Fl290, PPI TN 34, and PPI Municipal Advisory Board (MAB) Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe. The process of electrofusion requires an electric source, commonly called an electrofusion processor that has wire leads and a method to read electronically (by laser) or otherwise input the barcode of the fitting. The electrofusion processor must be capable of reading and storing the input parameters and the fusion results for later download to a record file. Qualification of the fusion technician must be demonstrated by evidence electrofusion training within the past year on the equipment to be utilized for this project.

D. Fusion Operators:

1. The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. The employer is responsible for documenting all qualification and training records of that individual.

2. All HDPE fusion equipment operators must be qualified to the procedure used to perform pipe joining. Fusion equipment operators must have current, formal training on all fusion equipment employed on the project. Training received more than two years prior to operation with no evidence of activity within the past 6 months must not be considered current.

3. Operators or their supervisor must have a current McElroy Fusion Training Certificate for the equipment to be used on the project.

4. When the fusion machine operator is employed by the HDPE pipe and fusion machine supplier, the supplier must maintain an ISO 9001 Certified Quality Management System.

E. Butt Fusion Equipment:

1. For 6-inch and larger pipe sizes, the pipe butt fusion machine must be a self-contained hydraulic fusion machine capable of butt fusing HDPE pipe. The carriage must be removable from the chassis for in-ditch use. The machine must be compatible with an electronic data recording device. Accessories will include all butt fusion inserts for the specified range of pipe sizes, a pyrometer kit for checking the surface temperature of the heater, extension cord (25-foot minimum), and hydraulic extension hoses (minimum of four). The butt fusion machine will be McElroy, or approved equivalent.

2. In areas where there may be insufficient space to lay out the entire length of fused pipe to be pulled-back, the Contractor must utilize a continuous HDPE pipe fusion equipment such as a PolyHorse by McElroy or other

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means in order to fuse the length of pipe necessary for the installation. The Contractor must be responsible for securing and obtaining permission/permits from adjacent property if necessary, for staging and/or fusing of the pipe and HDD equipment at no additional cost to the Owner.

F. Fusion Data Recording:

1. For 6-inch and larger pipe sizes, McElroy DataLogger or equivalent fusion data recorder must be used to record all fusion welds on hydraulically operated fusion machines. The device must be capable of meeting the requirements of ASTM F3124 – Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints in Plastic Piping Systems or Fittings. The device, or combination of devices, must record the following variables of each fused joint:

   a) Heater surface temperature immediately before inserting the heater plate. Alternatively, the heater plate may be measured with a pyrometer and entered into the weld record.

   b) Gauge pressure during the initial heat cycle.

   c) Gauge pressure and elapsed time during the heat-soak cycle.

   d) Heater removal (dwell) time.

   e) Gauge pressure and elapsed time during the fusing/cool cycle.

   f) Drag pressure.

   g) Pipe diameter and wall thickness.

   h) Type of HDPE material (Specification and Classification) and manufacturer.

G. Fusion Machine Identification

1. The device must record the operator, a unique operator ID number, the date and time of each weld.

2. Records showing the device is up to date on all required calibration should be available for presentation when requested.

3. All fusion welds should be traceable to the report (via operator and weld ID) with an indentation weld stamp or by permanent paint marker/pen next to fusion weld.

4. When requested prior to commencement of Work, a weld location map may be requested by the owner or owner's representative.

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H. Butt Fusion Examination and Testing:

1. Examinations

a) Visual: For pipe sections, examine the full exterior circumference for bead uniformity before cutting. After cutting the pipe section, review the interior bead. All beads should have visually acceptable bead formation as shown in Fig 4 and Appendix X2 of ASTM F 2620. In addition, the following characteristics are expected:

1) There must be no evidence of cracks or incomplete fusing.

2) There must be no evidence of captured objects (e.g., pipe shavings, facer ribbons) between bonded surfaces.

3) Variations in upset bead heights on opposite sides of the cleavage and around the circumference of fused pipe joints are acceptable.

4) The apex of the cleavage between the upset beads of the fused joint must remain above the base material surface.

5) Fused joints must not display visible angular misalignment, and outside diameter mismatch must be less than 10% of the nominal wall thickness.

6) Fusion data record review that meet criteria of section 6-2.1 can be used as additional verification of visual indicators.

b) Fusion Data Record Review: The fusion date record for each fused joint must be compared to the approved fusion procedure. The reviewer must verify the following:

1) That all data required by section 6-1.1 was recorded

2) Interfacial pressure was within the acceptable range

3) Heater surface temperature was within the acceptable range

4) Butt fusion pressure applied during the fusing/cool cycle was correctly calculated to include drag pressure, fell within the acceptable range for the applicable size and agrees with the recorded hydraulic fusing pressure.

5) Butt fusing pressure was reduced to a value less than or equal to drag pressure at the beginning of the heat soak cycle.

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6) Fusing machine was opened at the end of the heat soak cycle, the heater was removed, and the end were brought together at the fusion pressure with the acceptable time range

7) Cooling time at butt fusing pressure met the minimum time specified

c) If the recorded data in Subsection 3.05.G.l.b is outside the limits of the acceptable range, the joint is unacceptable.

d) Frequency. Records for test fusion joints should be reviewed immediately after the joint is completed. Fusion joints for jobsite fusions should be reviewed daily or before being covered with backfill.

2. Mechanical Tests

a) Contractor must mechanically test the first fusion of each operator and each machine used on the project. Installation must not continue until a fusion test has passed the test. Additional mechanical tests are not required as long as long as the fusion are reviewed with the frequency specified in section 3.05.G. l .d. Testing of fusion joints with no fusion data record review must be at a frequency specified by the Owner or Project Engineer.

b) The fusion must be allowed to cool completely, then fusion test straps must be cut out.

c) All samples must be labeled with operator information. Testing must be done at 73 degrees F plus or minus 5 degrees. The test temperature and sample size are critical to testing. Testing performed at cold or elevated temperatures may not give similar results to tests performed at ambient temperatures.

d) Each pipe sample weld must be subjected to testing at two locations 180 degrees apart from each other in the joint weld. All specimens must be tested by the following method:

1) Hydrostatic Burst Test is allowed for pipe sizes 2-inch-24-inch. The specimen length should measure 6 times pipe diameter with the butt fusion joint in the center of the specimen. The specimen should be tested in a tank filled with water, and testing conditions monitored and recorded with computerized equipment. The specimen will be tested at 4 times pipe rated pressure for 5 minutes with no failure of joint allowed.

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e) Results of any mechanical test should be documented. Information on the weld and operator should be transferred from the sample to the testing record.

3.06 TESTING AND LEAKAGE

A. All pumps, valves, temporary connections, meters, gauges and other measuring devices must be furnished, installed and operated by the Contractor and all such equipment and devices and their installation must be approved by the Owner's Engineer. The Contractor must restrain pipe, components, and test equipment as required to insure testing can be accomplished in a safe manner, including protection of personnel, equipment, and public in the event of a failure during testing.

B. The pressure gauges or data recorders should be calibrated and sufficiently sized to provide mid-range data (pressure tested will not be below 10% or greater than 90% of gauge capacity) that result in easy reading, interpretation. Gauges must be accurate to within 2% of full scale with increments no greater than 10 psi.

C. Gravity Pipelines-The Contractor must perform a low pressure air test for gravity flow pipelines to the requirements and specifications of ASTM Fl 473. Warning: All pneumatic test, regardless of pressure, can be dangerous and safety procedures must be identified, documented, approved by the Owner and Project Engineer, and followed.

D. Pressure Pipelines-Pressure testing must be conducted in accordance with requirements and recommendations of ASTM F2164 (Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure), AWWA Manual of Practice M55 Chapter 9, and PPI Handbook of Polyethylene Pipe Chapter 2 (2nd Edition). Pneumatic (compressed air) leakage testing of HDPE pressure piping is prohibited for safety reasons.

1. The section of pipe to be tested must be filled with potable or generally clean water (uncontaminated river/lake water) approved by the Owner/ Project Engineer. While the system is being filled with water, air must be carefully and completely exhausted. If permanent air vents are not located at all high points, the Contractor must install fittings and valves at such points so the air can be expelled as the pipe system is slowly filled with water.

2. If the Contractor elects to perform hydrostatic testing against valves in an existing distribution system, it does so at his own risk and will bear the cost of any damages to the existing valve, piping system, private or public property, or the new pipeline under test.

3. The test procedure for HDPE pipe consists of two steps: l) the initial phase or expansion phase and 2) the test phase. During the initial/expansion

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phase, sufficient make-up water must be added hourly for 3 hours to return to the test pressure. During the test phase, the expansion phase pressure is reduced by 10 psi to test phase pressure and monitored for at least one hour (3 hours maximum).

4. Under no circumstances must the total time under test exceed 8 hours. If the test is not completed due to leakage, equipment failure or any other reason, depressurize the test section and permit the system to "relax" for 8 hours prior to the next testing sequence.

5. The test pressure should be related to the lowest point in elevation along the test section's vertical pipeline profile.

6. All pressure and leakage testing must be done in the presence of a representative of the Owner and Project Engineer.

7. The test pressure must be 1.5 times the operating pressure at the lowest point in the system. In accordance with section 9.8 of ASTM F 2164, the pipe must pass if the final pressure is within 5% of the test phase pressure for the testing period (3 hours maximum). If the test section fails this test, the Contractor must repair or replace all defective materials and/or workmanship at no additional cost to the Owner.

END OF SECTION 02 74 00

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SECTION 02 80 00
NON-WOVEN GEOTEXTILES

PART 1 GENERAL

1.01 SUMMARY

A. This section covers the technical requirements for the manufacturing and installation of non-woven geotextiles. All materials must meet or exceed the requirements of these Specifications, and all Work shall be performed in accordance with the procedures recommended by the manufacturer and provided in these Specifications.

1.02 REFERENCES

A. ASTM International (ASTM)

1. ASTM D5261 – Standard Test Method for Measuring Mass per Unit Area of Geotextiles

2. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

3. ASTM D4533 – Standard Test Method for Index Trapezoidal Tearing Strength of Geotextiles

4. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

5. ASTM D449 l – Standard Test Method for Water Permeability of Geotextiles by Permittivity

6. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile

7. ASTM D4354 – Standard Practice for Sampling of Geosynthetics for Testing

8. ASTM D4759 – Standard Practice for Determining the Specifications Conformance of Geosynthetics

1.03 SUBMITTALS

A. Prior to material delivery to the Project site, the Contractor must provide the Engineer with a written certification or manufacturer's quality control data that displays that the geotextile meets or exceeds minimum average roll values specified herein.

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B. The Contractor must submit, if required by the Project Engineer, the manufacturer's quality control manual for the geotextile to be delivered to the site.

1.04 QUALITY ASSURANCE

A. Provide products of acceptable manufacturers that have been in satisfactory use in similar service for 3 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions. All test methods must be in accordance with latest ASTM procedures.

PART 2 PRODUCTS

2.01 MATERIALS

A. The nonwoven needle-punched geotextile specified herein must be made from staple fiber and must have a minimum average roll mass density of 10 ounces per square yard.

B. The geotextile must be manufactured from prime-quality virgin polymer.

C. The geotextile must be able to withstand direct exposure to ultraviolet radiation from the sun for up to 30 days without any noticeable effect on index or performance properties.

D. Geotextile must meet or exceed all material properties listed in Table 1.

Table 1. Geotextile Material Property Requirements

Property	Test Method	Frequency	Min. Average Roll Value
Mass per Unit Area, oz/yd^2	ASTM D5261	1/90,000 ft^2	10
Grab Tensile Strength, lb	ASTM D4632	1/90,000 ft^2	260
Grab Elongation, %	ASTM D4632	1/90,000 ft^2	50
CBR Puncture Strength, lb	ASTM D6241	1/540,000 ft^2	725
Trapezoidal Tear Strength, lb	ASTM D4533	1/90,000 ft^2	100
AOS, U.S. sieve, mm	ASTM D4751	1/540,000 ft^2	100 (0.150)
Permittivity, sec·1	ASTM D4491	1/540,000 ft^2	1.00
Water Flow Rate, gpm/ft^2	ASTM D4491	1/540,000 ft^2	75
UV Resistance,% retained	ASTM D4355 (after 500 hours)	Per formulation	70

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Property	Test Method	Frequency	Min. Average Roll Value
TYPICAL ROLL DIMENSIONS			
Roll Length, ft			500
Roll Width, ft			15
Roll Area, ft^2			7,500

2.02 MANUFACTURER

A. All rolls of the geotextile must be identified with permanent marking on the roll or packaging, with the manufacturer's name, product identification, roll number, and roll dimensions.

2.03 TRANSPORT

A. Transportation of the geotextile must be the responsibility of the Contractor.

B. During shipment, the geotextile must be protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, or other damaging or deleterious conditions.

C. Upon delivery at the Project Site, the Contractor must ensure that the geotextile rolls are handled and stored in accordance with the manufacturer's instructions so as to prevent damage.

PART 3 EXECUTION

3.01 PACKAGING AND ON-SITE STORAGE

A. Geotextile must be uniformly rolled onto a cardboard core and wrapped in plastic to protect the material from moisture and damage during shipment. Protective wrapping must be left on the fabric until installation. The product must not be allowed to get wet prior to installation to prevent weakening of the cardboard core. Rolls must be externally tagged for easy field identification. External tagging must include the following:

1. Name of manufacturer
2. Product type
3. Product grade
4. Lot number

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5. Physical dimensions

3.02 QUALITY ASSURANCE

A. The Project Engineer must examine the geotextile rolls upon delivery to the site and report any deviations from project specifications to the Contractor.

B. The Project Engineer may decide to arrange conformance testing of the rolls delivered to the job site. For this purpose, the Project Engineer must take a sample 3 feet (along roll length) by roll width according to ASTM D4354. The sample must be properly marked, wrapped, and sent to an independent laboratory for conformance testing.

C. The pass or fail of the conformance test results must be determined according to ASTM D4759.

3.03 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with Work of other sections.

B. The geotextile must be handled in such a manner as to ensure that it is not damaged in any way. Should the Contractor damage the geotextile to the extent that it is no longer usable as determined by these specifications or by the Project Engineer, the Contractor must replace the geotextile at no additional cost to the Owner.

C. The geotextile must be installed to the lines and grades as shown on the Project Drawings and as described herein.

D. The geotextile must be rolled down the slope in such a manner as to continuously keep the geotextile in tension by self-weight. The geotextile must be securely anchored in an anchor trench, where applicable, or by other approved or specified methods.

E. Where overlaps occur, the geotextile shall be properly overlapped in accordance with the manufacturer's recommendations. Heat-tacking the overlap will be acceptable; however, the Contractor shall ensure that no damage is caused to the geotextile by this practice. Any geotextile found to be damaged shall be replaced at no additional cost to the Owner.

F. In the presence of wind, all geotextiles must be weighted by sandbags or an approved equivalent. Such anchors must be installed during placement and must remain in place until replaced with cover material.

G. The Contractor must take necessary precautions to prevent damage to adjacent or underlying materials during placement of the geotextile. If damage to such

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material occurs due to the fault of the Contractor, the latter must repair the damaged materials at no additional cost to the Owner and to the satisfaction of the Project Engineer.

H. During placement of the geotextile, care must be taken not to entrap soil, stones, or excessive moisture that could hamper subsequent seaming of the geotextile as judged by the Project Engineer.

I. The geotextile must not be exposed to precipitation prior to being installed and must not be exposed to direct sunlight for more than 15 days after installation.

J. The Contractor must not use heavy equipment to traffic above the geotextile without approved protection.

K. The geotextile must be covered as soon as possible after installation and approval. Installed geotextile must not be left exposed for more than 15 days.

L. Material overlying the geotextile must be carefully placed to avoid wrinkling or damage to the geotextile.

END OF SECTION 02 80 00

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SECTION 02 81 00
HDPE GEOCOMPOSITES

PART 1 GENERAL

1.01 SUMMARY

A. This section covers the technical requirements for the manufacturing and installation of the geocomposite vent strips. All materials must meet or exceed the requirements of this specification, and all Work will be performed in accordance with the procedures provided in these project specifications.

1.02 REFERENCES

A. ASTM International (ASTM)

1. ASTM Dl238 – Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

2. ASTM Dl505-98 – Standard Test Method for Density of Plastics by the Density-Gradient Technique

3. ASTM D42 l 8 – Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle Furnace Technique D 1603-94 Standard Test Method for Carbon Black in Olefin Plastics

4. ASTM D4355-02 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus

5. ASTM D449 l-99 – Standard Test Method for Water Permeability of Geotextiles by Permittivity

6. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles

7. ASTM D4716-00 – Standard Test Method for Determining the (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

8. ASTM D475 l-99 – Standard Test Method for Determining Apparent Opening Size of a Geotextile

9. ASTM D624 l – Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile- Related Products Using a 50-mm Probe D 4833-88 (1996) Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

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10. ASTM D5261-92 (1996) – Standard Test Method for Measuring the Mass per Unit Area of Geotextiles

11. ASTM D7005-03 – Determining the Bond Strength (Ply-Adhesion) of Geocomposites

12. ASTM D7179 – Standard Test Method for Determining Geonet Breaking Force

B. Relevant publications from the U.S. Environmental Protection Agency:

1. Daniel, D.E., and R.M. Koerner, 1993. *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities*. EPA/600/R- 93/182. 1993.

1.03 QUALIFICATIONS

A. Manufacturer

1. Manufacturer must have manufactured a minimum of 10,000,000 square feet of polyethylene geocomposite material during the last year.

B. Installer

1. Installer must have installed a minimum of 50,000 square feet of geocomposite in the last 5 years.

2. Installer must have worked in a similar capacity on at least three projects similar in complexity to the project described in the contract documents, and within at least 50,000 square feet of geonet and/or geocomposite installation on each project.

3. The Installation Supervisor must have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.

1.04 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

A. Labeling – Each roll delivered to the site must be wrapped and labeled by the Manufacturer. The label will identify:

1. Manufacturer's name

2. Product identification

3. Length

4. Width

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5. Roll number

B. Delivery – Rolls will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

C. Storage – The on-site storage location provided by the Contractor to protect the geonet from abrasions, excessive dirt, and moisture must have the following characteristics:

1. Level (no wooden pallets)

2. Smooth

3. Dry

4. Protected from theft and vandalism

5. Adjacent to the area being lined

D. Handling

1. The Contractor and Installer must handle all rolls in such a manner to ensure they are not damaged in any way.

1.05 SUBMITTALS

A. Prior to material delivery to project site, the Contractor must provide the Engineer with a written certification or manufacturer's quality control data which displays that the geocomposite meets or exceeds minimum average roll values (MARV) specified herein.

B. The Contractor must submit the manufacturer's quality control manual for the geocomposite to be delivered to the site.

1.06 QUALITY ASSURANCE

A. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for 3 years. Use experienced Installers. Deliver, handle, and store materials in accordance with manufacturer's instructions. All test methods must be in accordance with latest ASTM procedures.

1.07 WARRANTY

A. Material must be warranted, on a pro-rata basis, against defects for a period of 1 year from the date of the geocomposite installation.

B. Installation must be warranted against defects in workmanship for a period of 1 year from the date of geocomposite completion.

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PART 2 PRODUCTS

2.01 GENERAL

A. The geocomposite will be used as a part of a subgrade gas venting system and must consist of a 200-thousandth of an inch (mil)-thick geonet bonded to a single 6-ounce non-woven geotextile.

2.02 GEOCOMPOSITE PROPERTIES

A. A geocomposite must be manufactured by extruding two crossing strands to form a biplanar drainage net structure with a nonwoven geotextile bonded to a single side.

B. The geocomposite specified must have properties that meet or exceed the values listed in the following Table.

Table 1. 200-mil Geocomposite Property Requirements

Property	Test Method	•Frequency	Value
Geonet			
Thickness, mil (mm)	ASTM D5199	50,000 sf	200(5.1)
Peak Tensile Strength MD, lbs/in (N/mm)	ASTM D5035/7179	50,000 sf	45 (7.9)
Density, g/cm3	ASTM D792, B	50,000 sf	0.94
Carbon Black Content (%)	ASTM D4218	50,000 sf	2-3
Transmissivity, gal/min/ft (m2/sec)	ASTM D4716	500,000 sf	9.6 (2x10-3)
Geotextile			
Mass per Unit Area, oz/yd2 (g/m^2)	ASTM D5261	100,000 sf	6.0 (203)
Grab Tensile Strength, lb. (N)	ASTM D4632	100,000 sf	170 (757)
Grab Elongation, %	ASTM D4632	100,000 sf	50
Trapezoidal Tear Strength, lb. (N)	ASTM D4533	100,000 sf	65 (289)
CBR Puncture Strength, lb. (N)	ASTM D6241	500,000 sf	435 (1935)
Permittivity, sec-1	ASTM D4491	500,000 sf	1.5
Water Flow Rate, gpm/ft2 (l/min/m2)	ASTM D4491	500,000 sf	110(4479)
AOS, U.S. Sieve Max (mm)	ASTM D4751	500,000 sf	70 (0.212)

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Property	Test Method	•Frequency	Value
Geocomposite – Single Sided w/6-oz			
Ply Adhesion, lbs/in (g/cm)	ASTM D7005	50,000 sf	1 (178)
Transmissivity, m2/sec (gal/min/ft)	ASTM D4716	500,000 sf	1x10-3 (4.8)
Typical Role Dimensions			
Roll Length, ft			250
Roll Width, ft			14.5
Roll Area, sf			3,625

C. Resin

1. Resin must be new first quality, compounded polyethylene resin.

2. Natural resin (without carbon black) must meet the following additional minimum requirements in Table 2.

Table 2. Resin Property Requirements

•Property	Test Method	Value
Density (g/cm^3)	ASTM D1505	0.94
Melt Flow Index (g/10 min)	ASTM D1238	≤1.0

2.03 MANUFACTURING QUALITY CONTROL

A. The geocomposite must be manufactured in accordance with the manufacturer's Quality Control Plan and must be submitted to and approved by the Project Engineer prior to Project execution.

B. The geocomposite must be tested according to the test methods and frequencies listed in Table 1, which has been prepared based on product data sheets.

2.04 TRANSPORT

A. Transportation of the geocomposite to the project site must be the responsibility of the Contractor.

B. During shipment, the geocomposite must be protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, or other damaging or deleterious conditions.

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C. Upon delivery at the job site, the Contractor must ensure that the geocomposite rolls are handled and stored in accordance with the manufacturer's instructions as to prevent damage.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Inspection

1. Prior to implementing any of the Work in the Section to be lined, the Installer must carefully inspect the installed Work of all other Sections and verify that all Work is complete to the point where the installation of the Section may properly commence without adverse impact.

2. If the Installer has any concerns regarding the installed Work of other Sections, he must notify the Project Engineer immediately.

3.02 PLACEMENT

A. The geocomposite roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the Engineer.

B. The geocomposite roll shall be installed with the geotextile side facing down.

C. If the project contains long, steep slopes, special care should be taken so that only full-length rolls are used at the top of the slope.

D. In the presence of wind, all geocomposites must be weighted down with sandbags or the equivalent. Such sandbags must be used during placement and remain until replaced with cover material.

E. If the project includes an anchor trench at the top of the slopes, the geocomposite must be properly anchored to resist sliding. Anchor trench compacting equipment must not come into direct contact with the geocomposite.

3.03 SEAMS AND OVERLAPS

A. Each component of the geocomposite will be secured or seamed to the like component at overlaps.

B. Geonet components:

1. Adjacent edges of the geonet along the length of the geocomposite roll must be placed with the edges of each geonet butted against each other.

2. The overlaps must be joined by tying the geonet structure with cable ties. These ties must be spaced every 5 feet along the roll length.

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3. Adjoining geocomposite rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite a minimum of 12 inches across the roll width.

4. The geonet portion should be tied every 6 inches in the anchor trench or as specified by the Project Engineer.

3.04 REPAIR

A. Prior to covering the deployed geocomposite, each roll must be inspected for damage resulting from construction.

B. Any rips, tears or damaged areas on the deployed geocomposite must be removed and patched. The patch must be secured to the original geonet by tying every 6 inches with the approved tying devices. If the area to be repaired is more than 50% of the width of the panel, the damaged area must be cut out and the two portions of the geonet must be cut out, and the two portions of the geonet must be joined in accordance with Subsection 3.03.

END OF SECTION 02 81 00

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SECTION 02 82 00
HDPE GEOMEMBRANES

PART 1 GENERAL

1.01 SUMMARY

A. This section covers the technical requirements for the manufacturing and installation of HDPE geomembranes. All materials must meet or exceed the requirements of this specification, and all work will be performed in accordance with the procedures provided in these project specifications.

1.02 REFERENCES

A. ASTM International (ASTM)

1. ASTM D526 l – Standard Test Method for Measuring Mass per Unit Area of Geotextiles ASTM Dl004 – Test Method for Initial Tear Resistance of Plastic Film and Sheeting

2. ASTM Dl238 – Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

3. ASTM Dl505 – Test Method for Density of Plastics by the Density-Gradient Technique

4. ASTM Dl603 – Test Method for Carbon Black in Olefin Plastics

5. ASTM D3895 – Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry

6. ASTM D42 l 8 – Standard Test Method for Determination of Carbon Black in Polyethylene Compounds

7. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

8. ASTM DS 199 – Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

9. ASTM D5397 – Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test

10. ASTM D5596 – Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

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11. ASTM D5994 – Standard Test Method for Measuring Core Thickness of Textured Geomembranes

12. ASTM D7179 – Standard Test Method for Determining Geonet Breaking Force

13. ASTM D6693 – Standard Test Method for Determining Tensile Properties of Non-reinforced Polyethylene and Non-reinforced Flexible Polypropylene Geomembranes

14. ASTM D7240 – Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test)

B. Geosynthetic Research Institute (GRI)

1. GRI GM 13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

1.03 SUBMITTALS

A. Furnish the following product data, in writing, to the Project Engineer prior to installation of the geomembrane material:

1. Transmissivity data (where applicable)

2. Resin Data must include the following:

3. Certification stating that the resin meets the specification requirements.

4. Geomembrane Roll

a) Statement certifying no recycled polymer and no more than 10% rework of the same type of material is added to the resin (product run may be recycled).

B. The Installer must furnish the following information to the Project Engineer prior to installation:

1. Installation layout drawings

a) Must show proposed panel layout including field seams and details.

b) Must be approved prior to installing the geomembrane.

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2. Approved drawings will be for concept only; actual panel placement will be determined by site conditions.

3. Installer's Geosynthetic Field Installation Quality Assurance Plan.

C. The Installer will submit the following to the Project Engineer upon completion of installation:

1. Certificate stating the geomembrane has been installed in accordance with the Contract Documents.

2. Material and installation warranties.

3. As-built drawings showing actual geomembrane placement and seams, including typical anchor trench detail.

1.04 QUALITY ASSURANCE

A. The Owner may engage and pay for the services of a Geosynthetic Quality Assurance Consultant and Laboratory to monitor geomembrane installation.

B. The Contractor will deliver, handle, and store materials in accordance with manufacturer's instructions. All test methods must be in accordance with latest ASTM procedures.

1.05 QUALIFICATIONS

A. MANUFACTURER

1. Manufacturer must have manufactured a minimum of 10,000,000 square feet of polyethylene geocomposite material during the last year.

B. INSTALLER

1. Installer must be certified by the Manufacturer.

2. Installer must have installed a minimum of 5,000,000 square feet of HDPE geomembranes in the last 5 years.

3. Installer must have worked in a similar capacity on at least 3 projects similar in complexity to the project described in the contract documents, and with at least 5,000,000 square feet of geonet installation on each project.

4. The Installation Supervisor must have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.

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5. The Installer must provide a minimum of one Master Seamer for work on the project.

   a) Master Seamer must have completed a minimum of 1,000,000 square feet of geomembrane seaming work using the type of seaming apparatus required for the welds proposed for the use on this Project.

1.06 MATERIAL LABELING, DELIVERY, STORAGE, AND HANDLING

A. LABELING

1. Each roll delivered to the site must be wrapped and labeled by the Manufacturer. The label will identify:

   a) manufacturer's name

   b) product identification

   c) length

   d) width

   e) roll number

B. DELIVERY

1. Rolls will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

C. STORAGE

1. The on-site storage location provided by the Contractor to protect the geomembrane from abrasions, excessive dirt, and moisture must have the following characteristics:

   a) level (no wooden pallets)

   b) smooth

   c) dry

   d) protected from theft and vandalism

   e) adjacent to the area being lined

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D. HANDLING

1. The Contractor and Installer must handle all rolls in such a manner as to ensure they are not damaged in any way and conform to Manufacturer.

E. The Installer must take any necessary precautions to prevent damage to underlying layers during placement of the drainage material.

1.07 WARRANTY

A. Material must be warranted, on a pro-rata basis, against defects for a period of 5 years from the date of the geomembrane installation.

B. Installation must be warranted against defects in workmanship for a period of 1 year from the date of geomembrane completion.

PART 2 PRODUCTS

2.01 MATERIALS

A. Material must be polyethylene geomembrane as shown on the project drawings and as stated as follows:

1. Primary Liner: The primary liner must be a 60-mil textured HDPE geomembrane. Textured surface must be single-side only.

2. Secondary Liner: The secondary liner must be a 50-mil Agru Drain Liner® HDPE geomembrane or approved equal.

B. Resin

1. Resin must be new first quality, compounded polyethylene resin.

2. Natural resin (without carbon black) must meet the following additional minimum requirements:

•Property	Test Method	Value
Density (g/cm^3)	ASTM D1505	$\geq$ 0.94
Melt Flow Index (g/10 min)	ASTM D1238	$\leq$ 1.0
OIT (minutes)	ASTM D3895	$\geq$ 100

C. Geomembrane Rolls

1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.

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2. Geomembrane must be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.

3. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating roll number, thickness, length, width and Manufacturer.

4. All liner sheets produced at the factory must be inspected prior to shipment for compliance with the physical property requirements listed in this specification and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

D. Geomembranes must meet the requirements shown in the following data sheet:

Property	**Test Method**	**Frequency**	**Minimum Average Roll Values**	
Liner Type			**Primary**	**Secondary**
Thickness, mil (mm) Lowest Individual Reading	ASTM D5994	Per Roll	60 (1.5) 51 (1.28)	50 (1.25) 42.5 (1.06)
Drainage Stud Height, mil (mm)	ASTM D7466	2nd Roll	N/A	130 (3.3)
Asperity Height, mil (mm)	ASTM D7466	2nd Roll	20 (0.51)	N/A
Density, g/cc	ASTM D792 (B)	200,000 lb	0.94	0.94
Strength @ Yield, lb/in width	ASTM D6693 Type IV	20,000 lb	725	110
Elongation @ Yield, % (GL=l.3 in)			100	13
Strength @ Break, lb/in width			100 (0.150)	110
Elongation@ Break, % (GL=l.3 in)			1.00	300
Tear Resistance, lbs.	ASTM D1004	45,000 lb	45	38
Puncture Resistance, lbs.	ASTM D4833	45,000 lb	120	80
Carbon Black Content, %	ASTM D4218	20,000 lb	2-3	2-3
Carbon Black Dispersion	ASTM D5596	45,000 lb	Only near-spherical agglomerates	
Stress Crack Resistance, hrs	ASTM D5397	200,000 lb	500	500
Oxidation Induction Time, min	ASTM D3895	200,000 lb	≥ 140	≥ 140
Typical Roll Dimensions				
Roll Length, ft.			550	300
Roll Width, ft.			23	23
Roll Area, ft^2			12,420	6,900

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1. Secondary geomembrane must have the following transmissivity requirements:

•Property	Test Method	Value
Minimum Transmissivity (m^2/sec)	ASTM D14716	$1.69x10^{-3}$

E. Extrudate Rod or Bead

1. Extrudate material must be made from same type resin as the geomembrane.

2. Additives must be thoroughly dispersed.

3. Materials must be free of contamination by moisture or foreign matter.

2.02 EQUIPMENT

A. All rolls of the geotextile must be identified with permanent marking on the roll or packaging, with the Manufacturer's name, product identification, roll number and roll dimensions.

PART 3 EXECUTION

3.01 DEPLOYMENT

A. Assign each panel a simple and logical identifying code. The coding system must be subject to approval and must be determined at the job site.

B. Visually inspect the geomembrane during deployment for imperfections and mark faulty or suspect areas.

C. Deployment of geomembrane panels must be performed in a manner that will comply with the following guidelines:

1. Geomembranes must be installed according to site-specific specifications, and the Manufacturer.

2. Unroll geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage (spreader bar, protected equipment bucket).

3. Place ballast (commonly sandbags) on geomembrane which will not damage geomembrane to prevent wind uplift.

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4. Personnel walking on geomembrane must not engage in activities or wear shoes that could damage it. Smoking will not be permitted on the geomembrane.

5. Do not allow heavy vehicular traffic directly on geomembrane. Rubber-tired ATV's and small utility vehicles are acceptable if wheel contact is less than 8 psi (1150 psf).

6. Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.

3.02 FIELD SEAMING

A. Seams must meet the following requirements:

1. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.

2. Minimize number of field seams in comers, odd-shaped geometric locations and outside comers.

3. Slope seams (panels) must extend a minimum of five-feet beyond the grade break into the flat area.

4. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the Consultant and Installer.

5. Align seam overlaps consistent with the requirements of the welding equipment being used. A 6-inch minimum overlap is commonly suggested.

B. Welding Operations

1. Provide at least one Master Seamer who must provide direct supervision over other welders as necessary.

C. Extrusion Welding

1. Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.

2. Clean geomembrane surfaces by disc grinder or equivalent.

3. Purge welding apparatus of heat-degraded extrudate before welding.

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D. Hot Wedge Welding

1. Welding apparatus must be a self-propelled device equipped with an electronic controller which displays applicable temperatures.

2. Clean seam area of dust, mud, moisture and debris immediately ahead of hot wedge welder.

3. Protect against moisture build-up between sheets.

E. Trial Welds

1. Perform trial welds on geomembrane samples to verify welding equipment is operating properly.

2. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.

3. Minimum of one test per 500 linear feet of welds, per welding apparatus.

4. Cut four, one-inch wide by six-inch long test strips from the trial weld as directed by the Owner's Representative.

5. Quantitatively test specimens for peel adhesion, and then for shear strength.

6. Trial weld specimens must pass when the results shown in the following table for HDPE and LLDPE are achieved in both peel and shear test.

Property	Test Method	30	40	60	80	100	120
Peel Strength (fusion), ppi	ASTM D 6392	49	65	98	130	162	196
Peel Strength (extrusion), ppi	ASTM D 6392	39	52	78	104	130	157
Shear Strength (fusion & ext.), ppi	ASTM D 6392	61	81	121	162	203	242

a) The break, when peel testing, occurs in the liner material itself, not through peel separation (FTB).

b) The break is ductile

7. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.

8. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.

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F. Seaming must not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. Installer must demonstrate that acceptable seaming can be performed by completing acceptable trial welds.

G. Defects and Repairs

1. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.

2. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

3.03 FIELD QUALITY ASSURANCE

A. Manufacturer and Installer must participate in and conform to all terms and requirements of the Owner's quality assurance program. Contractor must be responsible for assuring this participation.

B. Quality assurance requirements are as specified in this Section and in the Field Installation Quality Assurance Manual if it is included in the contract.

C. Field Testing

1. Non-destructive testing may be carried out as the seaming progresses or at completion of all field seaming.

a) Vacuum Testing

1) Must be performed in accordance with ASTM D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.

b) Air Pressure Testing

1) Must be performed in accordance with ASTM D 5820, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.

c) Other approved methods

2. Destructive Testing (performed by Installer)

a) Location and Frequency of Testing

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1) Collect destructive test samples at a frequency of one per every 500 lineal feet of seam length.

2) Test locations will be determined after seaming.

3) Exercise Method of Attributes as described by GRI GM-14 (Geosynthetic Research Institute, http://www.geosynthetic-institute.org) to minimize test samples taken.

b) Sampling Procedures are performed as follows:

1) The Installer must cut samples at locations approved by the Project Engineer as the seaming progresses in order to obtain field laboratory test results before the geomembrane is covered.

2) Installer will number each sample, and the location will be noted on the installation as-built.

3) Samples must be 12 inches wide by minimal length with the seam centered lengthwise.

4) Cut a 2-inch wide strip from each end of the sample for field-testing.

5) Cut the remaining sample into two parts for distribution as follows:

a. One portion for Installer, 12 inches by 12 inches

b. One portion for the Third-Party laboratory, 12 inches by 18 inches

c. Additional samples may be archived if required.

6) Destructive testing must be performed in accordance with ASTM D 6392 – Standard Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

7) The Installer must repair all holes in the geomembrane resulting from destructive sampling.

8) Repair and test the continuity of the repair in accordance with these Specifications.

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3.04 REPAIR PROCEDURES

A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

B. Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test.

C. The Installer must be responsible for repair of defective areas.

D. Agreement upon the appropriate repair method must be decided between Consultant and Installer by using one of the following repair methods:

1. Patching – Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter.

2. Abrading and Re-welding – Used to repair short section of a seam.

3. Spot Welding – Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.

4. Capping – Used to repair long lengths of failed seams.

5. Flap Welding – Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.

6. Remove the unacceptable seam and replace with new material.

E. The following procedures must be observed when a repair method is used:

1. All geomembrane surfaces must be clean and dry at the time of repair.

2. Surfaces of the polyethylene which are to be repaired by extrusion welds must be lightly abraded to assure cleanliness.

3. Extend patches or caps at least 6 inches for extrusion welds and 4 inches for wedge welds beyond the edge of the defect, and around all comers of patch material.

F. Repair Verification

1. Number and log each patch repair (performed by Installer).

2. 2. Non-destructively test each repair using methods specified in this Specification.

END OF SECTION 02 82 00

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SECTION 04 10 00
LEAK DETECTION PUMP

PART 1 GENERAL

1.01 SUMMARY

A. Description

1. The leak detection pumping system(s) outlined in this section will perform to the design operating requirements within the conditions and dimensions as described and will be complete and at a minimum consist of the following:

   a) A pump and motor assembly with power cable

   b) Control panel and level sensor and cable with gages and meters as required

   c) Deployment and retrieval assembly to include pump carriage

   d) Discharge pipe assembly

   e) Appropriate exit fitting for gas-tight transition through the sump or riser wall

   f) All appropriate fasteners, fittings and accessories necessary for turnkey operation

2. The system will be designed for primary leakage detection service.

1.02 QUALITY ASSURANCE

A. **Hydraulic Institute Compliance:** Design, manufacture, and install pumps in accordance with Hydraulic Institute Standards.

B. **National Electrical Code Compliance:** Components will comply with NFPA 70 – National Electrical Code.

C. **Underwriter's Laboratories (UL) Compliance:** Pumps will be listed and labeled by UL and comply with UL Standard 778 – Motor-Operated Water Pumps.

D. **Sewage Pump Manufacturers Association (SSPMA) Compliance:** Test and rate sump and sewage pumps in accordance with SSPMA standards.

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E. **Single-Source Responsibility:** Obtain pumps of the same type from a single manufacturer.

F. **Experience:** Pumping manufacturer will have a **minimum** of 5 years of experience with their proposed type of pumping system in a leachate application .

G. **Design Criteria:** The Construction Drawings indicate sizes, profiles, connections, and dimensional requirements of pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Project Engineer. The burden of proof for equality of pumps is on the proposer.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Store pumps in a dry location.

B. Retain shipping flange protective covers and protective coatings during storage.

C. Protect equipment and couplings against damage from sand, grit, and other foreign matter.

D. Comply with manufacturer's rigging instructions for handling.

1.04 MANUFACTURER'S WARRANTY

A. The pump manufacturer will warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty will include the following specific details:

1. All equipment, apparatus, and parts furnished will be warranted for 1 year, excepting only those items that are normally consumed in service, such as lightbulbs, oils, grease, packing, gaskets, a-rings, etc. The pump manufacturer will be solely responsible for warranty of all pump components.

B. Components failing to perform as specified by the Project Engineer, or as represented by the manufacturer, or as proven defective in service during warranty period, will be replaced, repaired, or satisfactorily modified by the manufacturer.

C. It is not intended that the manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor-supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design or delays in delivery are also beyond the manufacturer's scope of liability.

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D. The warranty will become effective upon acceptance by the purchaser or the purchaser's authorized agent, or 60 days after installation, or 90 days after shipment, whichever occurs first.

1.05 SUBMITTALS

A. The Contractor will submit pump technical specifications including, but not limited to, pump performance curves, shop drawings, electrical diagrams, and any other pertinent information to the Project Engineer prior to Project execution.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The Contractor will furnish and install a complete leachate pumping system as manufactured by the following:

1. Environmental Pump Solutions, Inc. (EPS)
   PO Box 3726
   Ann Arbor, MI 48106-3726
   1-888-512-1110

2. Any system manufacturer or supplier not specifically named as an approved manufacturer must provide a complete submittal package to the Project Engineer prior to the bid date for pre-approval as an equal system provider. To simplify comparison, the manufacturer seeking approval will provide references and documentation of experience and a thorough technical brief addressing each specifying paragraph as either "no exception taken" (acceptance of both the fact and spirit of the designer's intent) or "exception taken" with arguments for equality to the specification.

B. **Available Products:** Subject to compliance with requirements, products that may be incorporated in the work include the following (or approved equal):

1. Leachate Riser Pumps (Collection and Detection):

   a) EPS Model No. 16SRP05-5 rated for 20 gallons per minute at 50 feet of total dynamic head

   b) **Motor Horsepower:** Motor horsepower will be a minimum of 1/2 horsepower and will operate on 480-volt, three-phase, 60-hertz supply power.

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2.02 LEACHATE RISER PUMPS

A. Pump construction:

1. The materials of pump construction will be as follows:

a) Impeller: 304 Stainless Steel

b) Impelled Seal Ring: Teflon®

c) Motor Adaptor: 304 Stainless Steel

d) Inlet Screen: 304 Stainless Steel

e) Pump Shaft: 431 Stainless Steel

f) Coupling: 316 Stainless Steel

g) Check Valve Housing: 304 Stainless Steel

h) Check Valve: 304 Stainless Steel

i) Check Valve Seat: 304 Stainless Steel

j) Diffuser Chamber: 304 Stainless Steel

k) Fasteners: 304 Stainless Steel

l) Bearings: Teflon®

m) Suspension Cables: 3/16"–7x19" Braided 304 Stainless Steel

B. Submersible motors:

1. Motors will be 4-inch, corrosion-resistant motors having the following characteristics:

a) Temperature and time rating:

1) Continuous duty with 0.25 foot per second flow past motor, temperature 30°C ambient

b) Enclosure:

1) Hermetically sealed windings (no arc producing devices), corrosion-resistant materials, stainless steel, splined shaft

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c) Bearings:

1) Thrust bearing: (Stationary) Carbon

2) Radial bearing: (Complete) Ceramic

3) Thrust bearing: (Rotating) Ceramic

d) Lubrication

e) Water bases

C. Carriage system:

1. Pump will be mounted in a high-density polyethylene (HDPE) carriage designed for side slope riser leachate applications. Wheels will **not** be acceptable due to wear, failure, and/or immobility caused by lack of contact with the inside diameter of the riser pipe.

D. Check valve:

1. Check valve will be pre-drilled with a 1/8-inch-diameter hole to prevent freezing in discharge line.

E. Submersible transducer:

1. A submersible transducer will be provided with an adequate size cable for each pump (including spare). The transducer will be constructed from 316 stainless steel.

2. The unit will provide a 4-20mA signal output to the control unit. Static accuracy rating will be no less than ±0.1% of full scale. Cable will be the same length as the pump power cable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, equipment foundations, and conditions with Installer present for compliance with requirements for installation and other conditions affecting performance of pumps. Do **not** proceed with installation until unsatisfactory conditions have been corrected.

B. Examine rough-in for piping systems to verify actual locations of piping connections prior to installation.

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3.02 INSTALLATION

A. Comply with the manufacturer's written installation and alignment instructions.

B. Install pumps in indicated locations.

3.03 CONNECTIONS

A. Install discharge pipe sizes equal to the diameter of the pump discharge.

B. Discharge pipe will be l-inch DR-11 HDPE hard piped directly to the discharge exit connection.

C. Discharge exit connection will be minimum 304 stainless steel "pitless" style quick disconnect fitting.

3.04 COMMISSIONING

A. After installation of pumps and related piping and controls, the manufacturer's representative will perform system startup and testing to ensure proper functioning of pumping systems.

END OF SECTION 04 10 00

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SECTION 04 20 00
PUMP CONTROL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Furnish one control system to operate 1/2 HP pump motor and auxiliary equipment in manual or automatic mode.

B. The control panel enclosure shall be NEMA Type 4X.

C. The enclosure shall be equipped with a window in the outer door, an inner door, and a drip shield. The NEMA 4X enclosure can be either stainless-steel (standard) or non-metallic.

D. The control system will operate from a 480-volt, 60-hertz, 3-phase power supply. Pump control components shall be sized to operate a pump motor of specified horsepower.

E. Multiple systems shall ideally be identical and interchangeable and, if not identical, will share as many identical, similar, and interchangeable components and characteristics as possible.

1.02 MANUFACTURER'S WARRANTY

A. The control system manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described as follows:

1. All equipment, apparatus, and parts furnished shall be warranted for 1 year, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets , O-rings, etc. The control system manufacturer shall be solely responsible for warranty of all control system components.

B. Components failing to perform as specified by the Project Engineer or as represented by the manufacturer, or as proven defective in service during warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

C. It is not intended that the manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design or delays in delivery are also beyond the manufacturer's scope of liability.

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D. The warranty shall become effective upon acceptance by the purchaser or the purchaser's authorized agent, or 60 days after installation, or 90 days after shipment, whichever occurs first.

1.03 SUBMITTALS

A. The Contractor shall submit to the Project Engineer full Technical Specifications of the control system prior to Project execution.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The Contractor shall furnish and install a complete control system as manufactured by:

1. Environmental Pump Solutions, Inc. (EPS)
   PO Box 3726
   Ann Arbor, MI 48106-3726
   1-888-512-1110

2. Any system manufacturer or supplier not specifically named as an approved manufacturer must provide a complete submittal package to the Project Engineer prior to the bid date for pre-approval as an equal system provider. To simplify comparison, the manufacturer seeking approval will provide references and documentation of experience and a thorough technical brief addressing each specifying paragraph as either "no exception taken" (acceptance of both the fact and spirit of the designer's intent) or "exception taken" with arguments for equality to the specification.

B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include the following (or approved equal):

1. Control System

   a) EPS Model No. 50892, Simplex l00S PLC Commander Controller.

   b) Control system will operate from a 480-volt, 60-hertz, 3-phase power supply.

   c) Pump control components shall be sized to operate a pump motor of the specified horsepower.

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2.02 CONTROL PANEL

A. Control Panel Construction Standards

1. The control panel shall be constructed in accordance with Underwriter's Laboratories (UL) Standard 508 "Industrial Control Equipment" and UL Standard 698A Industrial Control Panels Relating to Hazardous (Classified Locations). The panel shall be shop inspected by UL or constructed in a UL-recognized facility. The panel shall bear a serialized UL label indicating acceptance under Standards 508 and 698A.

B. Pump Controller

1. The level controller shall be mounted on the inner door and viewable by the enclosure outer door window. The controller shall have a 4-digit, 13.8-millimeter (mm), 14-segment readout, scrolling help text and the capability to monitor and maintain liquid levels as well as output a high-level indication. Level controller shall be accurate to within 0.1 inch.

C. Level Transducer

1. A submersible level transducer shall be provided in the sump. The transducer shall be of a suspended type and shall be constructed from 316 stainless steel. A 4-20 mA signal shall be output to the controller for display and control of sump level.

2. The pressure transmitter level sensor shall have a range of 0 to 5 PSI with a 4-20 mA output signal proportional to the required sump level.

D. Flow Meter

1. The flow meter for the system is detailed in Section 04 30 00 – Electromagnetic Flow Meter.

E. Main Disconnect Switch

1. The main disconnect switch shall be UL 98 rated and will prevent opening of the control panel inner door while the power is on, and includes 230-volt, 2.5-amp dual-element fuses.

F. Control Circuit Breaker

1. A UL 489-type current limiting circuit breaker shall be provided on the control circuit.

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G. Hand-Off-Auto Selector Switch

1. Allows manual or automatic operation of the pump motor. The selector switch shall be a heavy duty, oil tight, NEMA 4-rated switch mounted on the inner door and shall be viewable by the enclosure outer door window.

H. Motor Starter

1. Provide full voltage non-reversing, circuit breaker combination type with adjustable electronic overload relay.

I. Wire Markers

1. Brady type printed wire markers shall be provided on both ends of all conductors to correlate with manufactures drawings.

J. Terminal Blocks

1. Provide terminal blocks sized for the wire used for all field terminations. Clearly mark all terminal blocks with a typewritten marking system. Terminal blocks shall be DIN rail mounted, screw clamp, feed-through type with 600-volt minimum rating.

K. Control Relays

1. Control relays shall be general purpose type, contacts rated 10 amps at 120 VAC, coil voltage as required, and include indicator lamp.

L. Control Transformer

1. A transformer with UL 489 type current limiting circuit breakers on the primary and secondary circuits shall be provided where required. If fuses are used provide 10 of each type used as spare parts.

M. Run Light

1. A pump running indicator lamp shall be provided. It shall be heavy duty, LED, oil tight, NEMA 4-rated. The light shall be connected to the motor starter auxiliary contacts and shall be mounted on the inner door and will be green in color and viewable by the enclosure outer door window.

N. Run Time Meter

1. A pump run time meter shall be provided and incorporated into the controller. The runtime meter shall be connected to the motor starter auxiliary contacts and shall be mounted on the inner door and viewable by the enclosure outer door window.

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O. Alarm Light

1. A red 25-watt high intensity alarm beacon shall be provided on top of the enclosure to provide high alarm indication. The lamp shall be replaceable from the inside of the enclosure so not to disrupt water tightness of the light fixture.

P. Intrinsically Safe Barrier

1. The level sensor circuit shall be protected by an intrinsically safe barrier.

Q. Heater with Adjustable Thermostat

1. A heater with adjustable thermostat shall be provided; it shall maintain the minimum temperature required for the operation of the level controller.

R. Lightening Arrestor

1. Eaton CHSA type or equal shall be provided.

S. Pass Along Circuit

1. A pass along circuit shall be provided to enable a shutdown of the pump in the event of a high-level alarm at a storage facility.

T. Breakout Junction Box

1. An EPSBOB junction box with terminals shall be provided for connections of field devices to the control panel, one EPSBOB shall be provided for the pump power connection, and one shall be provided for the level transducer and flow meter. A poured seal-off shall be installed between the EPSBOB and the control panel to prevent migration of gasses into the control panel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with the manufacturer's written installation instructions.

B. Install control systems in location indicated on the plans.

C. Set control.

END OF SECTION 04 20 00

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SECTION 04 30 00
ELECTROMAGNETIC FLOW METER

PART 1 GENERAL

1.01 SUMMARY

A. An electromagnetic flow meter is intended for fluid metering in industries including water, wastewater, food and beverage, pharmaceutical, and chemical and measures fluid flow of water or fluids which are highly corrosive, very viscous, contain a moderate amount of solids, or require special handling. No moving parts are in the flow stream. An amplifier can be integrally mounted to the detector or remote-mounted. This unit is ideally suited for measuring dynamic, non-continuous flow, and in applications where a minimum and/or maximum flow rate must be tracked and monitored, the unit provides pulse signals that can be fed to dedicated batch controllers, programmable logic controllers (PLCs), and other more specialized instrumentation.

1.02 MANUFACTURER'S WARRANTY

A. The manufacturer of the previously specified equipment shall provide a written warranty that warrants the product to be free from defects in materials and workmanship appearing within the earlier of either 1 year after installation or 1 year and 6 months after shipment from manufacturer.

1.03 QUALITY ASSURANCE

A. Referenced Standards and Guidelines – Complies with applicable portions of American National Standards Institute (ANSI)/American Water Works Association (AWWA) Standards and National Science Foundation (NSF)/ANSI Standard 61, Annex G. There are currently no AWWA standards that specifically address electromagnetic metering.

1. Flow measurement function to comply with the following industry Standards:

   a) ANSI Bl6.5 Class 150 RF

   b) AWWA Class B

   c) National Electrical Manufacturers Association (NEMA) 4x/6P (IP66/IP67)

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1.04 SUBMITTALS

A. The following information shall be included in the submittal for this section:

1. Outline dimensions, conduit entry locations, and weight
2. Customer connection and power wiring diagrams
3. Data sheets and catalog literature for microprocessor-based transmitter and transducer
4. Interconnection drawings
5. Installation and operations manual
6. List of spare parts
7. Complete technical product description, including a complete list of options provided
8. Any portions of this Section not met must be clearly indicated, or the supplier and Contractor shall be liable to provide all additional components required to meet this specification.

1.05 DEFINITIONS

A. Amplifier – Device used for increasing the power of a signal. It does this by taking energy from a power supply and controlling the output to match the input signal shape but with larger amplitude.

B. ANSI – A private nonprofit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. The organization also coordinates U.S. standards with international standards so that American products can be used worldwide.

C. AWWA – An international nonprofit professional organization founded to improve water quality and supply.

D. Detector coils – Also called an "induction loop," an electromagnetic communication or detection system that uses a moving magnet to induce an electrical current in a nearby wire.

E. Electrode – An electrical conductor used to make contact with a nonmetallic part of a circuit (e.g., a semiconductor, an electrolyte, or a vacuum)

F. Modbus RTU – A serial communications protocol published by Modicon (Schneider Electric) in 1979 for use with its PLCs. This is used in serial

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communication and makes use of a compact, binary representation of the data for protocol communication.

G. NEMA – The Association of Electrical Equipment and Medical Imaging Manufacturers in the United States. Its approximately 450 member companies manufacture products used in the generation, transmission, distribution, control, and end-use of electricity. These products are used in utility, industrial, commercial, institutional, and residential applications.

H. NSF – A U.S. government agency that supports fundamental research and education in all the non-medical fields of science and engineering.

I. PLC – A digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines.

J. PTFE (polytetrafluoroethylene) – A synthetic fluoropolymer of tetrafluoroethylene that finds numerous applications. The best-known brand name of PTFE is Teflon by DuPont Co.

K. Serial communications – In telecommunication and computer science, serial communication is the process of sending data one bit at a time, sequentially, over a communication channel or computer bus. This is in contrast to parallel communication, where several bits are sent as a whole on a link with several parallel channels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The Contractor shall furnish and install a complete control system as manufactured by basis-of-design product. Subject to compliance with these specifications, provide flow measurement equipment by one of the following:

1. Badger meter

2. Approved equivalent

2.02 OPERATING CONDITIONS

A. System Components

1. Metering Tube (Detector)

a) Consists of stainless-steel tube lined with a non-conductive material. Energized detector coils around tube create a magnetic field across the diameter of the pipe. As a conductive fluid flows through the magnetic field, a voltage is induced across two

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electrodes; this voltage is proportional to the average flow velocity of the fluid.

2. Signal Amplifier

a) Consists of a unit that receives, amplifies, and processes the detector's analog signal. Signal is converted to both analog and digital signals that are used to display rate of flow and totalization. Processor controls zero-flow stability, analog and frequency outputs, serial communications, and a variety of other parameters. An integrated LCD display indicates rate of flow, forward and reverse totalizers, and diagnostic messages. The display guides user through programmable routines.

B. Operational Requirements

1. Electromagnetic Flow Meter

a) The flow meter system shall operate with a pulsed DC excitation frequency and shall produce a signal output that is directly proportional and linear with the volumetric flow rate of the liquid flowing through the metering tube. The metering system shall include a metering sensor tube (detector), a signal amplifier, and the necessary connecting wiring. The metering system shall have the ability to incorporate a meter mounted or remote mounted amplifier.

2. Engineering Units

a) The signal amplifier shall be program-selectable to display the following units of measure: U.S. gallons, imperial gallons, million gallons (U.S.), cubic feet, cubic meters, liters, hector-liters, oil barrels, pounds, ounces, or acre-feet.

C. Operating Principle: Electromagnetic Induction

1. Metering Tube (Detector)

a) The metering tube (detector) shall be constructed of 316 stainless-steel and rated for a maximum allowable non-shock pressure and temperature for steel pipe flanges, according to ANSI Bl6.5.

b) The metering tube (detector) shall be available in line size from 0.25 inch (6 millimeters [mm]) to 54 inches (1400 mm).

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c) The metering tube (detector) end connections shall be carbon steel or 316 stainless-steel flanged, according to ANSI Bl 6, Class 150, and AWWA Class B standards.

d) The insulating liner material of the metering tube (detector) shall be made of a hard rubber elastomer and NSF-listed for meter sizes 4 inches and above, in conformance with manufacturer's recommendation for the intended service or an NSF-listed meter option with a PTFE liner.

e) The metering tube (detector) shall include two self-cleaning measuring electrodes. The electrode material shall be corrosion-resistant and available in Alloy C or 316 stainless-steel.

f) The metering tube (detector) shall include a third "empty pipe detection" electrode located in the upper portion of the inside diameter of the flow tube in order to detect an empty pipe condition when the flow tube is running partially empty. Empty pipe detection that is not activated until the pipe is 50% empty is not acceptable.

g) The metering tube (detector) housing shall be constructed of carbon steel, welded at all joints, and rated to meet NEMA 4X/6P (IP66/IP67) ratings.

h) For remote amplifier applications, the metering tube (detector) junction box enclosure shall be constructed of cast aluminum (powder-coated paint) and shall meet NEMA 4X/6P (IP66/IP67) ratings.

i) When installed in non-metallic or internally lined piping, the metering tube (detector) shall be provided with a pair of corrosion resistant grounding rings. The grounding ring material shall be 316 stainless-steel.

j) Fluid Temperature Range

1) For remote amplifier applications, the fluid temperature range shall be 32°F to l 78°F [0°C to 80°C] at a maximum ambient temperature of 122°F [50°C] for the hard rubber liner material.

2. Signal Amplifier

a) The signal amplifier shall be microprocessor based and shall energize the detector coils with a digitally controlled pulsed DC. The excitation frequency shall be program-selectable for the

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following: l hertz (Hz), 3.75 Hz, 7.5 Hz, or 15 Hz (factory-optimized to pipe size and application).

b) The signal amplifier electrical power requirement shall be 85 to 265 VAC and 45 to 65 Hz. The power consumption shall not exceed 15 watts.

c) The signal amplifier shall have an ambient temperature rating of -4°F to l 40°F [-20°C to 60°C].

d) The signal amplifier shall include non-volatile memory capable of storing all programmable data and accumulated totalizer values in the event of a power interruption.

e) Automatic zero stability, low flow cutoff, empty pipe detection, and bidirectional flow measurement shall be inherent capabilities of the signal amplifier.

f) All signal amplifier outputs shall be galvanically isolated to 250 volts (V).

g) The signal amplifier and remote junction enclosures shall be constructed of cast aluminum (powder-coated paint) and shall meet NEMA 4X/6P (IP66/IP67) ratings.

h) Outputs: The signal amplifier shall provide the following outputs:

1) Up to four open collector digital outputs, program-selectable from the following: forward pulse, reverse pulse, AMR pulse, flow set point, empty pipe alarm, flow direction, reset output, error alarm, and 24-V supply.

2) Up to two active digital (24-V) outputs, program-selectable from the following: forward pulse, reverse pulse, AMR pulse, flow set point, empty pipe alarm, flow direction, preset output, error alarm, and 24-V supply.

3) Up to two AC solid-state relay outputs, program-selectable from the following: frequency output, flow set point, empty pipe alarm, flow direction, preset amount, and error alarm.

4) One digital input, program-selectable from the following: remote reset, batch reset, and positive return to zero.

5) Advanced protocol support using Modbus RTU.

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6) One analog output programmable and scalable from 4 to 20 milliamperes. Voltage sourced and isolated. Maximum loop resistance = 800 ohms.

3. Control and Programming

a) The signal amplifier shall be programmed via three function buttons. The programming functions shall be available in a user-friendly, menu-driven software through the four-line LCD interface. The signal amplifier shall accommodate the following languages: English, German, Czech, French, or Spanish.

b) Programmable parameters of the amplifier include, but are not limited to, the following: calibration factors, totalizer resets, unit of measure, analog and pulse output scaling, flow-alarm functions, language selection, low-flow cutoff, noise dampening factor, and excitation frequency selection.

c) The signal amplifier shall have a programming option allowing entry of a selected numeric password value for tamper protection.

4. System Performance

a) The metering system shall operate over a flow range of 0.10 to 39.4 feet per second (ft/s) (0.03 to 12.0 meters per second [m/s]).

b) The metering system shall perform to an accuracy of ±0.25 percent of rate for velocities greater than 1.64 ft/s (0.50 m/s), ± 0.004 ft/s (±1 mm/s)] for velocities less than 1.64 ft/s (0.50 m/s).

c) The metering system shall be capable of measuring the volumetric flow rate of liquids having an electrical conductivity as low as 5.0 micromhos per centimeter.

d) The system measuring repeatability shall be <0.10% of full scale.

5. Indication

a) The signal amplifier shall include a four-line, 20-character, backlit LCD interface to display the following values:

1) Flow rate in selectable rate units

2) Forward totalizer in selectable volume units

3) Reverse totalizer in selectable volume units

4) Net totalizer in selectable volume units

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5) Error or alarm messages

6) Software revision level

PART 3 EXECUTION

3.01 INSTALLATION

A. Follow manufacturer's recommendation for installation. Installation will conform to the guidelines provided by the Installation and Operation Manual.

B. Straight pipe requirement shall be an equivalent of three diameters on the inlet (upstream) side and two diameters on the outlet (downstream) side.

C. For best performance, place meter vertically, with liquid flowing upward and meter electrodes in a closed, full pipe.

3.02 CALIBRATION

A. Each meter shall be hydraulically calibrated in an ISO 9000-certified testing facility, which utilizes a computerized gravimetric testing method with a measuring uncertainty of 0.1%.

B. Each meter shall be provided with a calibration certificate indicating the measured error (percent deviation) at three different flows, respectively equivalent to 25%, 50%, and 75% of the nominal flow rate for each size.

END OF SECTION 04 30 00

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Appendix D
Construction Quality Assurance Plan

June 25, 2019
Cow Palace Safety Debris Catch Basin
Administrative Order on Consent Docket No. SDWA-10-2013-0080

Cow Palace Safety Debris Catch Basin Construction Quality Assurance Plan

Prepared for Cow Palace, LLC

June 25, 2019
Cow Palace Safety Debris Catch Basin
Administrative Order on Consent Docket No. SDWA-10-2013-0080

Cow Palace Safety Debris Catch Basin Construction Quality Assurance Plan

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Project Number: 190996-01.01
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ABBREVIATIONS

ASTM	ASTM International
CHASP	Construction Health and Safety Plan
CQA	construction quality assurance
CQAP	*Construction Quality Assurance Plan*
CQC	construction quality control
EPA	U.S. Environmental Protection Agency
GC	General Contractor
HDPE	high-density polyethylene
mil	thousandth of an inch
OR	Owner's Representative
Owner	Cow Palace, LLC
QA	quality assurance
QC	quality control
SDCB	Safety Debris Catch Basin

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1 Introduction

This *Construction Quality Assurance Plan* (CQAP) for the grading and lining of the Cow Palace, LLC, Safety Debris Catch Basin (SDCB) was prepared by Anchor QEA, LLC, on behalf of Cow Palace as part of the 100% lagoon lining design.

1.1 Purpose

The purpose of this document is to provide construction quality assurance (CQA) during construction of the liner system to confirm that the liner it is installed in accordance with the *Construction Drawings* (Anchor QEA 2019a), *Technical Specifications* (Anchor QEA 2019b), and manufacturer recommendations. It also identifies the responsibilities during construction and performance monitoring of the construction activities in accordance with the 100% design documents through a quality assurance (QA) program. Furthermore, it delineates the QA methods and protocols for project personnel to confirm they have a complete understanding of monitoring, feedback, and adjustment mechanisms. Construction quality control (CQC) is the responsibility of the Contractor and will be conducted in accordance with the Construction Health and Safety Plan described in Section 4.1.2.1. Definitions of CQA and CQC are provided in Section 1.2.

1.2 Quality Control and Quality Assurance Defined

In the context of this document, CQC and CQA are not equivalent. Instead, CQC and CQA are defined as follows:

- CQA is a planned and systematic pattern of actions intended to yield confidence that the materials and procedures conform to the *Construction Drawings* and *Technical Specifications* and any applicable regulatory requirements. CQA will be provided by Anchor QEA on behalf of the Owner (Cow Palace). Because field conditions are variable and difficult to control, CQA is a critical component of an overall QA program.
- CQC refers to actions taken by the Contractor (including parties charged with the manufacture, fabrication, delivery, and installation of the materials) to determine and sometimes quantify the characteristics of the product. The results of a quality control program are compared to the *Technical Specifications* or other contractual or regulatory requirements. During the handling of the materials, CQC is provided by the manufacturer, fabricator, supplier, and Contractor, as appropriate, to confirm that the materials and craftsmanship conform to the *Construction Drawings* and *Technical Specifications*. The Contractor will perform the work in accordance with Specification 01 06 00 – Quality Assurance and Quality Control in the *Technical Specifications* and will support CQA activities as described therein.

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1.3 Construction Components

A brief description of major work/construction activities that will occur during the project is presented in this section. This CQAP is directed to the CQA of the various construction components of the project, as is described in the following paragraphs.

The SDCB will roughly be constructed within its current footprint as shown in the *Construction Drawings*. The SDCB will be lined with the following layers, listed from bottom to top:

- **Prepared Subgrade:** Consists of compacted existing embankment or screened embankment meeting the requirements of the *Construction Drawings* and *Technical Specifications* if placed as fill. The work includes screening out oversized material larger than 3/8 inch, leveling, compacting, and smoothing the soil surface to remove protrusions prior to placement of the leak detection system, geocomposite gas venting, and geotextile.
- **Geocomposite Gas Venting:** A composite drainage material consisting of polymer drainage core protected by a geotextile. The geocomposite strips are located under the geotextile and allow any gas buildup from the subgrade to be vented to the surface.
- **Geotextile:** A separation and protection layer placed above the prepared subgrade and below the secondary drain liner.
- **Secondary Geomembrane Drain Liner:** A barrier layer consisting of a 50-thousandth-of-an-inch (mil) high-density polyethylene (HDPE) drain layer, located directly above the geotextile.
- **Primary Geomembrane:** A barrier layer consisting of a textured 60-mil HDPE layer, located directly above the secondary drain liner.
- **Leak Detection/Collection System:** Consists of a sump, pump, piping, and controls to collect and convey any leachate back to the SDCB and will be placed between the primary and secondary geomembrane liners.
- **Anchor System:** Consists of a continuous compacted soil trench that will be constructed as part of the double liner system to terminate and secure the liners along the perimeter of the lagoon.
- **Piping:** Consists of HDPE pipe sealed to the primary and secondary liners for the lagoon inlet.

1.4 Plan Organization

The remainder of this CQAP is organized as follows:

- **Section 2 – Project Role and Responsibilities.** This section identifies the roles, responsibilities, and authorities of the parties involved in the construction and quality control (QC).
- **Section 3 – Quality Assurance Program.** This section describes the QA measures, inspection and verification activities, and contingency actions for each component of the liner system.

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- **Section 4 – Documentation, Meetings, and Reporting.** This section outlines documentation requirements for construction QA activities, including daily summary reports, as well as procedures, documentation, and reporting for project modifications and change orders.
- **Section 5 – References.** This section provides references for the materials cited in this report.

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2 Project Role and Responsibilities

2.1 Roles and Responsibilities of Key Parties

The roles and responsibilities of key parties are described in the following subsections.

2.1.1 Owner (Cow Palace)

The Owner is the primary responsible party for construction. The Owner has ultimate responsibility for implementing and ensuring that the design criteria are met. The Owner, or their consultant, will be responsible for construction management and contract administration. The Owner will hire the General Contractor (GC) and, indirectly, its subcontractors specializing in the required construction activities. The Project Engineer and Owner's Representative (OR) will also be contracted by the Owner to fulfill the responsibilities identified in the following subsections.

2.1.2 Project Coordinator (Anchor QEA)

The Project Coordinator is responsible for administration of all actions by the Owner required by the Consent Order and has overall authority over the project team. The Project Coordinator will be responsible for ensuring that the construction is performed according to the approved *Construction Drawings* and *Technical Specifications*. In addition, the Project Coordinator will ensure that any changes to the approved *Construction Drawings* and *Technical Specifications* necessitated by field conditions are approved by the U.S. Environmental Protection Agency (EPA) prior to implementation in accordance with Consent Order Paragraph 45.

2.1.3 Project Engineer (Anchor QEA)

The Project Engineer is the project designer. Responsibilities include design engineering, design modifications, clarification of design intent, and field engineering. The Project Engineer will communicate with the Owner, OR, Contractor, and Project Coordinator and review submittals, Daily Field Reports, and meeting notes. The Project Engineer will do the following:

- Review the design, *Construction Drawings*, and *Technical Specifications* for the project, as well as any reports referenced in these documents.
- Review the CQAP for the project and confirm that any project-specific revisions are incorporated into the *Technical Specifications*.
- Administer the CQA Program, including the supervision of the on-site OR (and any other CQA personnel), weekly review of progress, review of all daily reports, review and interpretation of all laboratory test data, and engineering review of all aspects of the project during construction. The Project Engineer will provide periodic on-site support to the OR as needed, based on the activities being conducted.

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- Attend the Pre-Construction Meeting, site Progress Meetings, and any other meetings as requested by either the Contractor or EPA.
- Review any changes to the design, *Construction Drawings*, or *Technical Specifications* necessitated by field conditions and report recommendations to the Owner and the Project Coordinator. After obtaining EPA approval, implement any changes to the design, *Construction Drawings*, or *Technical Specifications*.
- Review the As-Built Drawings prepared by the Contractor and confirm that all changes to the design made during construction have been properly applied.
- Oversee the generation of the Final Completion Report and certify the construction was completed in conformance with the *Construction Drawings*, *Technical Specifications*, Addenda, Work Change Directives, and this CQAP.

2.1.4 Owner's Representative

The OR will be on site full time and will be in direct charge of the CQA Program. The OR will be responsible for overseeing the implementation of this CQAP on site. In overseeing implementation of this CQAP, the OR is responsible for monitoring construction performance for compliance with construction performance standards and design requirements during implementation of the design; the OR is also responsible for overseeing the required inspection and verification activities. The OR will work closely with the Project Engineer, providing updates on the field activities and variances which require attention. The OR will do the following:

- Serve as the on-site CQA representative and supervise other on-site CQA personnel (such as the third-party materials laboratory checking compaction and the third-party liner CQA subcontractor), which may be brought in for inspections that require additional expertise.
- Review the quality of the materials and qualifications of personnel for conformance with the *Technical Specifications*.
- Review the CQAP, *Construction Drawings*, and *Technical Specifications* for the site and confirm that other CQA personnel are informed of the requirements of the work.
- Assign the daily responsibilities of CQA personnel to confirm that relevant activities of the Contractor are monitored and documented.
- Review daily reports by CQA personnel and prepare daily reports.
- Attend the Pre-Construction Meeting and site Progress Meetings, in addition to any CQA-specific meetings necessary to review the installation and CQA activities.
- Collect and review documentation provided by the Contractor.
- Document and forward conformance samples to the laboratory, as appropriate, and review results for conformance and acceptability.
- Record on-site activities that could result in damage to the construction work.
- Prepare, with the Project Engineer, the Final Completion Report.

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In addition to the duties listed in this section, the OR regularly reports, on both a verbal basis and through periodic submittals of the daily and weekly reports, to the Project Engineer to confirm that any problems are identified on a timely basis and acted on to minimize any potential negative effects. Examples of forms that will be used by the OR are included in Attachment A. These forms may be modified as appropriate, based on the activity being reported on and through coordination with the Owner.

Additionally, subcontracted CQA field inspectors may be assigned to the project to confirm that the Contractor's activities are adequately monitored and documented (such as for compaction testing and inspection of the liner installation). The OR (and/or CQA field inspectors) will, at minimum, monitor the following activities and carry out the following duties within the scope of the overall CQA Program:

- Oversee materials logistics, including material handling, storage, and protection prior to deployment.
- Confirm that the materials received match the approved lot number and shipping papers provided by the Contractor.
- Examine soils (including on-site soils and soils delivered to the site) for use as components of the project and collect independent samples, if necessary, for laboratory testing to confirm conformance with the *Technical Specifications*.
- Monitor and document the liner installation.
- Monitor and document pipe installation and testing.
- Monitor deployment of all geosynthetic materials for damage or flaws; mark any such areas for repair; and document the location, size, time, and date of these activities.
- Monitor and document the seaming, joining, and overlap (as appropriate) of all geosynthetic materials.
- Perform a final walk-over of all completed areas before deployment of the overlying layer to confirm that, in the case of geosynthetics, all seams have been tested and flaws and damage have been identified, repaired, tested, and passed.
- Monitor and document all soils used in the lagoon lining system to confirm that the correct materials are used; specified thickness is maintained; and proper compaction is achieved with minimum material densities attained, as determined through in situ testing.
- Note and document on-site activities that could result in damage to the lining system and report to the Project Manager/OR so that corrective action can be expedited.
- Monitor and document the excavation, geosynthetics placement, backfilling, and compaction to meet specification requirements of all anchor trenches.

Attachment B includes a summary of the required construction inspection and verification activities and frequencies of inspections for each construction activity.

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2.1.5 General Contractor

The GC will be retained under direct contract with the Owner to perform the work described in the contract documents. The GC will do the following:

- Hold on-site responsibility for managing the construction and contract administration. The GC will have total authority and responsibility to deal with all contractual matters and to confirm that the work complies with the final *Construction Drawings* and *Technical Specification* requirements and provides all necessary QC information.
- Implement the design by either performing tasks or contracting with subcontractors. As part of the design implementation, the GC will be responsible for CQC. Included with this responsibility is the implementation of the QC activities to confirm that project construction is conducted in accordance with the *Construction Drawings* and *Technical Specifications*.
- Provide all submittals discussed in the *Technical Specifications* for the approval of the Project Engineer and/or OR. The GC will be responsible for providing the submittals for approval with enough time as to not affect the project schedule (while awaiting approval). A list of submittals required by the GC is included in Attachment B.

The GC will use key personnel to help with the tasks described in this section, including an on-site superintendent, a CQC manager, and a health and safety manager.

The GC will either perform construction elements or contract with subcontractors to perform selected phases of the work for which they have special expertise. The subcontractors are responsible to the GC for the quality of their work, protection of the environment, and compliance with the Construction Health and Safety Plan (CHASP). The subcontractor's principals will designate a job foreman with responsibility to see that the work is conducted in accordance with the contract requirements.

2.2 Qualifications

Qualifications that will be required of the Project Engineer, OR, supporting CQA inspection personnel, and the GC firm and personnel are provided in Sections 2.2.1 and 2.2.2.

2.2.1 Project Engineer, Owner's Representative, and Supporting Construction Quality Assurance Inspector Qualifications

The Project Engineer and OR will be determined prior to start of work and will have experience managing synthetic liner construction projects with similar QA requirements. The OR will be required to have current federal and state health and safety training. Additionally, the Project Engineer and OR will be sufficiently familiar with the final design and the construction operations to recognize deviations from that design. Additional inspectors may be used to help the OR, and these inspectors

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will have experience inspecting construction activities for related projects and will have current federal and state health and safety training.

2.2.2 General Contractor Qualifications

The GC will employ, as part of its permanent organization, senior, knowledgeable, and experienced personnel to oversee the project. The journeyman operators, surveyors, and other GC personnel performing key jobs must also have the demonstrated ability and skills to satisfactorily perform their respective assignments.

Any subcontractors utilized in the work must have demonstrated to the Owner's satisfaction that they are qualified and have performed the type of work for which they will be engaged. However, responsibility for subcontractor performance rests with the GC.

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3 Quality Assurance Program

The QA program, which will be implemented during construction to confirm compliance with the approved design documents and *Technical Specifications*, is described in this section by construction component. Specific activities to be implemented during construction are described, along with specific performance objectives, performance criteria, QA measures, inspection and verification activities, and contingency actions. Major construction components include the following:

- Earthwork
- Geocomposite gas venting system
- Geotextiles
- Leak detection system
- Geomembrane
- Pipes, fittings, and wall penetrations

During construction, the QA process will progress as follows:

- The GC will provide documentation to the OR and Project Engineer to demonstrate that specific components of the final design have been properly implemented.
- The GC and the OR will conduct inspection and verification activities (i.e., testing and monitoring) to confirm compliance with the approved design documents.

3.1 Earthwork

This section discusses and outlines the CQA activities to be performed for earthwork activities at the SDCB. Earthwork activities include excavation, grading, subgrade preparation, fill placement and compaction, and anchor trench excavation and backfill. Prior to earthwork activities, the GC will submit a construction plan and schedule to the OR and Project Engineer for acceptance. This plan will include a description of the methods to be used for all material processing, excavation, backfilling, soil placement, compaction, and grading operations. The OR and Project Engineer will review this plan for conformance with the *Technical Specifications*.

3.1.1 Performance Objectives and Criteria

Performance objectives and criteria for earthwork tasks include the following:

- **Monitoring of Import Soil Material Quality.** Identify proposed sources of soil for fill (if any is needed) and confirm that the proposed material meets the *Technical Specifications*.
- **Monitoring of Subgrade Preparation.** Confirm that the subgrade soil at each lagoon has been excavated, placed, graded, and compacted in a manner consistent with the *Construction Drawings* and *Technical Specifications*.

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- **Monitoring of Anchor Trench Construction.** Confirm that the anchor trench excavation at each lagoon for the geotextiles and backfill methods are consistent with the *Construction Drawings* and *Technical Specifications*.

3.1.2 Quality Assurance Measures, Inspection and Verification Activities, and Contingency Actions

QA measures described in this section will be implemented during earthwork activities at the SDCB to confirm performance objectives are met and construction is completed per the *Construction Drawings* and *Technical Specifications*. Inspection and verification activities will be implemented and compared to appropriate criteria to determine if performance objectives have been achieved at the SDCB. If performance standards have not been achieved, the contingency actions will be implemented.

3.1.2.1 Monitoring of Import Fill Material Quality

If applicable after excavation activities, the Contractor will identify proposed sources of import fill material (if necessary) and submit test results to demonstrate that the proposed materials meet the *Technical Specifications*. The OR or the Project Engineer will review the soil material submittals, determine if the material is in conformance with the *Technical Specifications*, and either accept or reject the material. This review must be taken before any deliveries of the fill material to the SDCB.

Laboratory testing of the soil materials to be used will be carried out for the purpose of materials selection QA during construction operations. All testing will be done in accordance with the associated ASTM International (ASTM) standard or other procedures as listed in this CQAP and the *Technical Specifications*.

To confirm that the imported fill material meets the gradation listed in the *Technical Specifications*, the GC will collect samples for conformance testing from materials delivered to the site. The GC will be responsible for shipping samples to the laboratory responsible for conformance testing of soil materials. Additional testing may be performed by the OR (using a third-party materials laboratory) during construction for QA purposes. This testing confirms that the materials do not vary significantly or adversely during the work and that the materials consistently meet the *Technical Specifications*.

Table 1 summarizes the minimum frequency for collecting and testing imported fill material samples. Additionally, the OR will visually inspect import fill materials delivered to the site. If import fill materials do not meet requirements, the material may be rejected, and a different material will need to be obtained.

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Table 1
Import Fill Material Sampling and Testing Frequency

Test	Frequency
Unified Soil Classification System (Method ASTM D2487 or equivalent)	One per 2,000 cubic yards placed or three minimum for the project
Moisture Density Relationship (Method ASTM D2216 or equivalent)	One per 2,000 cubic yards placed or three minimum for the project
Particle Size (Method ASTM D422 or equivalent)	One per 2,000 cubic yards placed or three minimum for the project

3.1.2.2 Monitoring of Subgrade Preparation

During construction, the OR will monitor the subgrade excavation, soil placement, fine grading, and compaction at the SDCB to confirm methods are consistent with the requirements specified in the *Construction Drawings* and *Technical Specifications*. The OR will monitor, at a minimum, that the following procedures are carried out:

- Soft, organic, and otherwise undesirable material has been removed from the SDCB.
- The materials identified at the SDCB for reuse as backfill are properly segregated and stockpiled.
- No soil particles greater than specified limits are exposed on the finished surface beneath any geosynthetic material (i.e., geotextile) at the SDCB.
- The subgrade surface of the SDCB is smooth (free of clods, rocks, sticks, abrupt changes in grade, ruts, protrusions, standing water, sharp objects, and other conditions) and uniform by visually monitoring proof-rolling activities and by the compaction testing conducted by the third-party CQA soils laboratory per the schedule presented in Table 2. The OR may elect to conduct their own compaction testing (using a third-party CQA soils laboratory).
- Prior to placement of any fill at the SDCB, it will be confirmed that the subgrade has been prepared (scarified, moisture-conditioned, and compacted, as appropriate) in accordance with *Technical Specification* requirements.
- The subgrade soil and final grading at the SDCB has been completed to the general lines and grades shown in the *Construction Drawings*.

Observations of the OR will be recorded on daily field monitoring report forms, including As-Built Drawings or photographs, as appropriate.

Regarding the placement of fill materials, the GC, OR, or third-party liner CQA subcontractor will be responsible for scheduling a third-party CQA soils laboratory, which will be responsible for providing in situ testing of the prepared subgrade after fill placement and compaction at the SDCB to determine as-compacted properties and to confirm conformance with the *Technical Specifications*

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(through use of a nuclear moisture density gauge and the results of previously conducted proctor compaction tests). In situ testing frequency will be in accordance with the schedule presented in Table 2. Regarding undisturbed in situ soils within the subgrade, the Contractor will proof-roll those areas; the OR will monitor the soils for yielding surfaces.

Table 2
In Situ Testing Frequency

Test	Material	Frequency
In-place density/moisture content (ASTM D6938 or equivalent)	Prepared subgrade surface using on-site fill material or import fill material	One per 10,000 square feet per lift
Proof-rolling using heavy equipment (field call)	Excavated, undisturbed in situ soils as subgrade surface	All non-fill areas

Any deficiencies of the subgrade at the SDCB found by the OR will be corrected by the GC prior to the placement of the geotextile. If a *Technical Specifications* criterion cannot be met or unusual weather conditions hinder work, the OR will work with the Project Engineer to develop and present suggested solutions to the Owner and GC. Re-evaluations by the OR will continue until it is verified that defects have been corrected before the subgrade will be approved. Once the subgrade preparation has been completed to the satisfaction of the OR, the OR will obtain the liner installer's acceptance of the subgrade in writing.

3.1.3 Monitoring of Anchor Trench Construction

An anchor trench is required along the outer limits of the double liner system at the SDCB. The anchor trench will be utilized to effectively anchor the liner in place. During anchor trench construction, the OR will monitor the excavation and backfill methods (following placement of the liner) to confirm they are consistent with the requirements specified in the *Technical Specifications* and *Construction Drawings*. The OR will monitor, at a minimum, that the following procedures are carried out:

- Each anchor trench is free of debris and other undesirable materials prior to the placement of the liner.
- Each anchor trench is constructed to the general lines and grades shown in the *Construction Drawings*.
- Compaction requirements are met, through visual observations, as specified in the *Technical Specifications*.

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3.2 Geocomposite Vent Strips

This section presents information regarding the QA for the geocomposite vent strips at the SDCB. The geosynthetic will act as a gas venting system and will consist of a grid of geocomposite vent strips with spacing as shown in the *Construction Drawings* and outlined in the *Technical Specifications*. The vent strips installed at the SDCB will convey gases that may potentially collect under the liner system to vent pipes located around the top perimeter of the lagoon.

3.2.1 Performance Objectives and Criteria

Performance objectives and criteria for the geocomposite vent strips installed at the SDCB include the following:

- **Material Acceptance.** Confirm through conformance testing that the geocomposite vent strips meet the *Technical Specifications*.
- **Material Delivery, Unloading, and Storage.** Observe the handling and storage procedures of the geotextile used by the GC.
- **Monitoring of Installation.** Confirm the deployment procedures utilized to install the geocomposite.

3.2.2 Quality Assurance Measures, Inspection Activities, and Contingency Actions

QA measures described in this section will be implemented during geocomposite installation activities at the SDCB to confirm performance objectives are met and construction is completed per the *Construction Drawings* and *Technical Specifications*. Inspection activities will be implemented and compared to criteria to determine if performance objectives have been achieved at each lagoon. If performance standards have not been achieved, the contingency actions will be implemented.

3.2.2.1 Material Acceptance

Prior to the installation of the geocomposite vent strips at the SDCB, certifications of the material properties will be obtained, and conformance testing will be conducted by the GC's third-party materials laboratory. The OR and Project Engineer will review all geocomposite vent strip manufacturer QC certificates and other submittals required by the *Technical Specifications* and provided by the GC for conformance with the *Technical Specifications* prior to material shipment to the site.

Once documentation is confirmed, the OR (or third-party liner CQA subcontractor) will document that the materials on site correspond to the materials for which the manufacturing documentation has been prepared. Any discrepancies will be reported to the GC with details of the discrepancies and the nature of the materials on site. Conformance certifications will be included in the Final Completion Report.

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3.2.2.1.1 Conformance Testing

Conformance testing will be completed by a third-party materials laboratory selected and subcontracted by the OR and/or Project Engineer to confirm that the geocomposite vent strips shipped to the site have the required physical and mechanical properties required by the *Technical Specifications*.

Geocomposite vent strip conformance samples will be collected by the OR or third-party liner CQA subcontractor at a minimum rate of one per 100,000 square feet of geosynthetic supplied. Samples will only be collected from material delivered to the site. After sample collection, the OR or third-party liner CQA subcontractor shall forward the samples to the third-party materials laboratory for testing. Based on the results of the conformance testing, the Project Engineer (in consultation with the third-party CQA subcontractor) may provide corrective actions to the GC.

Conformance testing will be carried out by the third-party materials laboratory in accordance with the ASTM test methods shown in the Project Engineer/OR-approved product specifications. These conformance tests should include, at a minimum, those listed in Table 3.

Table 3
Conformance Tests for Geocomposite Vent Strips

Test	Test Designation
Geocomposite	
Transmissivity	ASTM D4716
Geonet	
Thickness, Minimum	ASTM D5199
Density	ASTM D1505
Tensile Strength	ASTM D7179
Carbon Black Content	ASTM D4218
Geotextile	
Thickness, Minimum	ASTM D1117
Mass per Unit Area	ASTM D5261
Grab Tensile Strength	ASTM D4632
Trapezoidal Tear Strength	ASTM D4533

3.2.2.1.2 Conformance Test Results

Conformance test results will be reported to the OR and third-party liner CQA subcontractor, who will review the results for conformance with the *Technical Specifications*. Conformance test results will be reported to the Project Engineer and the GC.

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Nonconformance test results may require the following corrective actions:

- If the GC has installed all or a portion of the geocomposite test strips, they will be required to uncover the strips for additional resampling and retesting.
- Geocomposite vent strips represented by nonconformance test results may not be deployed (if not deployed already) until conformance with the *Technical Specifications* has been demonstrated.
- If a second round of tests confirms nonconformance of the sample, the roll from which the sample was taken will be rejected, as well as any other rolls represented by that sample. The OR (or third-party liner CQA subcontractor) will determine which rolls are represented by the sample from a review of the geosynthetic material manufacturer's QC testing and certification.

Additional sampling and testing may be conducted on unsampled rolls represented by the nonconforming sample. Additional sampling and testing, as well as any additional labor or materials, will be conducted at the expense of the GC to determine conformance of those rolls with the *Technical Specifications*. If the GC elects to deploy the material prior to the receipt of the conformance testing results, all additional labor and materials to remove, replace, and reinstall the material shall be borne by the GC.

The OR will include the results of all conformance testing in the Final Completion Report.

3.2.2.2 Material Delivery, Unloading, and Storage Procedures

The OR (or third-party liner CQA subcontractor) will perform receiving inspection on all geocomposite vent strip material in compliance with procedures described in the *Technical Specifications*. The OR (or third-party liner CQA subcontractor) will also confirm that transportation, handling, and storage of geocomposite vent strips are performed in accordance with the *Technical Specifications* and will determine the condition of rolls of geocomposite upon delivery to the SDCB.

During delivery to the SDCB, the OR (or third-party liner CQA subcontractor) will monitor and document, at a minimum, the following:

- Inventory of all materials delivered to each lagoon
- Logging of roll numbers on inventory checklist
- Confirmation that the rolls delivered to the SDCB match the lot numbers of those included in the conformance testing
- Cross-reference with the bill of lading supplied by the manufacturer
- Visual inspection of materials for damage; suspect rolls will be marked, recorded on inventory checklist, and set aside for further inspection

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3.2.2.3 Observation of Installation

The OR (or third-party liner CQA subcontractor) will monitor and document the deployment of the geocomposite vent strips at the SDCB and confirm compliance with the *Technical Specifications*. The OR (or third-party liner CQA subcontractor) will document the time and location of material placement and make note of any damage to the materials. Weather and subgrade conditions will also be recorded by the OR to confirm conformance with the *Technical Specifications*.

For any damage to the materials, the GC's liner installer will prescribe the method of repair to be used (for the approval of the OR or third-party liner CQA subcontractor), based on the nature and size of the problem. All repairs will be performed in accordance with the *Technical Specifications*.

The OR (or third-party liner CQA subcontractor) will periodically monitor the geocomposite vent strip operations for proper overlap technique and overlap length. Upon completion, the third-party liner CQA subcontractor will confirm that all geotextiles have been properly overlapped in accordance with the *Technical Specifications*.

3.3 Geotextile

This section presents information regarding QA for geotextiles at the SDCB. This geosynthetic material will primarily act as a separation layer between the secondary geomembrane drain liner and earthen subgrade.

3.3.1 Performance Objectives and Criteria

Performance objectives and criteria for the geotextile include the following:

- **Material Acceptance.** Confirm through conformance testing that the geotextile meets the *Technical Specifications*.
- **Material Delivery, Unloading, and Storage.** Observe the handling and storage procedures of the geotextile utilized by the GC at each lagoon.
- **Monitoring of Installation.** Confirm the deployment procedures used when installing the geotextile at each lagoon.

3.3.2 Quality Assurance Measures, Inspection Activities, and Contingency Actions

QA measures described in this section will be implemented during geotextile installation activities at the SDCB to confirm performance objectives are met and construction is completed per the *Construction Drawings* and *Technical Specifications*. Inspection activities will be implemented and compared to performance criteria to determine if performance objectives have been achieved. If performance standards have not been achieved, the contingency actions will be implemented.

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3.3.2.1 Material Acceptance

Prior to the installation of the geotextile at the SDCB, certifications of the material properties will be provided by the GC. The OR/Project Engineer (or third-party liner CQA subcontractor) will review all geotextile manufacturer QC certificates and other submittals required by the *Technical Specifications* and provided by the Contractor for conformance with the *Technical Specifications* prior to material shipment to the site.

Once documentation is confirmed and the materials have arrived at the site, the OR (or third-party liner CQA subcontractor) will document that the materials on site correspond to the materials for which the manufacturing documentation has been prepared. Any discrepancies will be reported to the GC with details of the discrepancies and the nature of the materials on site. Material property certifications will be included in the Final Completion Report.

3.3.2.1.1 Conformance Testing

Conformance testing will be completed by a third-party materials laboratory selected and subcontracted by the OR and/or Project Engineer to confirm that the geocomposite vent strips shipped to the site have the required physical and mechanical properties required by the *Technical Specifications*.

Geotextile samples will be collected by the OR or third-party liner CQA subcontractor at a minimum rate of one per 100,000 square feet of geosynthetic supplied. Samples will only be collected from material delivered to the site. After sample collection, the OR or third-party liner CQA subcontractor shall forward the samples to the third-party materials laboratory for testing. Based on the results of the conformance testing, the Project Engineer (in consultation with the third-party CQA subcontractor) may provide corrective actions to the GC.

Conformance testing will be carried out by the third-party materials laboratory in accordance with the ASTM test methods shown in the Project Engineer/OR-approved product specifications. These conformance tests should include, at a minimum, those listed in Table 4.

Table 4
Conformance Tests for Geotextiles

Test	Test Designation
Thickness, Minimum	ASTM D1117
Mass per Unit Area	ASTM D5261
Grab Tensile Strength	ASTM D4632
Trapezoidal Tear Strength	ASTM D4533

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3.3.2.1.2 Conformance Test Results

Conformance test results will be reported to the OR and third-party liner CQA subcontractor, who will review the results for conformance with the *Technical Specifications*. Conformance test results will be reported to the Project Engineer and the GC.

Nonconformance test results may require the following corrective actions:

- If the GC has installed all or a portion of the geotextile, they will be required to uncover the material for additional resampling and retesting.
- Geotextile represented by nonconformance test results may not be deployed (if not deployed already) until conformance with the *Technical Specifications* has been demonstrated.
- If a second round of tests confirms nonconformance of the sample, the roll from which the sample was taken will be rejected, as well as any other rolls represented by that sample. The OR (or third-party liner CQA subcontractor) will determine which rolls are represented by the sample from a review of the geosynthetic material manufacturer's QC testing and certification.

Additional sampling and testing may be conducted on unsampled rolls represented by the nonconforming sample. Additional sampling and testing, as well as any additional labor or materials, will be conducted at the expense of the GC to determine conformance of those rolls with the *Technical Specifications*. If the GC elects to deploy the material prior to the receipt of the conformance testing results, all additional labor and materials to remove, replace, and reinstall the material shall be borne by the GC.

The OR will include the results of all conformance testing in the Final Completion Report.

3.3.2.2 Material Delivery, Unloading, and Storage

The OR (or third-party liner CQA subcontractor) will perform receiving inspection on all geocomposite vent strip material in compliance with procedures described in the *Technical Specifications*. The OR (or third-party liner CQA subcontractor) will also confirm that transportation, handling, and storage of geotextile are performed in accordance with the *Technical Specifications* and will determine the condition of rolls of geotextile upon delivery to the SDCB.

During delivery to the SDCB, the OR (or third-party liner CQA subcontractor) will monitor and document, at a minimum, the following:

- Inventory of all materials delivered to each lagoon
- Logging of roll numbers on inventory checklist
- Confirmation that the rolls delivered to the SDCB match the lot numbers of those included in the conformance testing
- Cross-reference with the bill of lading supplied by the manufacturer

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- Visual inspection of materials for damage; suspect rolls will be marked, recorded on inventory checklist, and set aside for further inspection

3.3.2.3 Observation of Installation

The OR (or third-party liner CQA subcontractor) will monitor and document the deployment of the geotextile at the SDCB. Deployment of the geotextile will be in accordance with the *Technical Specifications*. The OR (or third-party liner CQA subcontractor) will document the time and location of material placement and make note of any damage to the materials. Weather and subgrade conditions will also be recorded by the OR to confirm conformance with the *Technical Specifications*.

For any damage to the materials, the GC's liner installer will prescribe the method of repair to be used (for the approval of the OR), based on the nature and size of the problem. All repairs will be performed in accordance with the *Technical Specifications*.

The OR will periodically monitor the geotextile operations for proper overlap technique and overlap length. Upon completion, CQA personnel will confirm that all geotextiles have been properly overlapped in accordance with the *Technical Specifications*. Heat-tacking the overlap will be acceptable; however, the OR should observe these activities to confirm that no damage is caused to the geotextile by this practice.

3.4 Leak Detection System

This section discusses and outlines the CQA activities to be performed for leak detection system installation at the SDCB. The leak detection system at each lagoon will consist of a collection sump. The sump will be equipped with a submersible (collection) pump that will return the collected water back into SDCB through a HDPE discharge pipe.

The collection pump will be operated automatically by means of a level transducer and controller. The controller will activate the pump when the sump water level exceeds the design high liquid level and will turn the pump off when the liquid level in the sump drops to the design low liquid level.

A flow meter will be installed in line with the discharge line and connected to the controller. The controller will log flow rates as well as total volume pumped, and it will be the primary means by which Cow Palace personnel will detect and monitor leaks in the primary liner.

Prior to installation of the geotextile and geomembrane liners, the GC will trench the subgrade of the SDCB for placement of the sump and sump riser conduit. Applicable components will be connected to a control system located near the crest of the SDCB. The OR will review the *Construction Drawings*, *Technical Specifications*, and any approved Addenda regarding this material.

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3.4.1 Performance Objectives and Criteria

Performance objectives and criteria for leak detection system include the following:

- **Monitoring of Installations.** Observe the leak detection system installations to confirm that the installation is carried out in accordance with the *Construction Drawings*, *Technical Specifications*, and manufacturer's recommendations.
- **Monitoring of Start-Up and Calibration Procedures.** The start-up and calibration process of the leak detection systems will consist of performing tests to determine that the system is operating in accordance with the *Technical Specifications*.

3.4.2 Quality Assurance Measures, Inspection and Monitoring Activities, and Contingency Actions

QA measures described in this section will be implemented during leak detection system installation activities to confirm performance objectives are met and construction is completed per the *Construction Drawings* and *Technical Specifications*. Inspection and monitoring activities will be implemented and compared to appropriate criteria to determine if performance objectives have been achieved at each lagoon. If performance standards have not been achieved, the contingency actions will be implemented.

3.4.2.1 Monitoring of Installation

The OR will monitor the installation of the leak detection system components to confirm compliance with the *Construction Drawings*, *Technical Specifications*, and manufacturer's recommendations. CQA monitoring activities during installation of the leak detection system will include the following:

- Observing that trenching at the SDCB has been excavated as shown in the *Construction Drawings*
- Confirming that all components and wires have been installed in the general locations at the SDCB, as shown in the *Construction Drawings*
- Confirming that the start-up and performance testing has been conducted and that all systems are operational

3.5 Geomembrane Liners

This section discusses and outlines the CQA activities to be performed for HDPE geomembrane installation at the SDCB; the HDPE geomembrane shall act as the primary liner and secondary drain liner. The geomembrane material, consisting of polyethylene resin, is manufactured in 50-mil-thick (for the secondary liner) and 60-mil-thick (for the primary liner) sheets and delivered to the site in rolls. The OR (or third-party liner CQA subcontractor) will review the *Construction Drawings*, *Technical Specifications*, and any approved Addenda regarding this material.

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3.5.1 Performance Objectives and Criteria

Performance objectives and criteria for geomembrane at the SDCB include the following:

- **Material Acceptance.** Confirm material conformance through the review of the manufacturer's submittals for compliance with the *Technical Specifications* and conduct conformance testing of the rolls before the geomembrane is installed.
- **Material Delivery, Unloading, and Storage.** Document the delivery and proper storage of geomembrane rolls.
- **Monitoring of Installation.** Observe the geomembrane installation to confirm the installation is carried out in accordance with the *Construction Drawings*, *Technical Specifications*, and manufacturer's recommendations.

3.5.2 Quality Assurance Measures, Inspection Activities, and Contingency Actions

QA measures described in this section will be implemented during geomembrane installation at the SDCB to confirm performance objectives are met and construction is completed according to the *Construction Drawings* and *Technical Specifications*. If performance standards have not been achieved, the contingency actions will be implemented.

3.5.2.1 Material Acceptance

Prior to the installation of the geomembrane at the SDCB, certifications of the material properties will be obtained, and conformance testing will be conducted by the GC's third-party materials laboratory. The OR and Project Engineer (or third-party liner CQA subcontractor) will review all geomembrane manufacturer QC certificates and other submittals required by the *Technical Specifications* and provided by the GC for conformance with the *Technical Specifications* prior to material shipment to the site.

Once documentation is confirmed and the materials have arrived at the site, the OR (or third-party liner CQA subcontractor) will document that the materials on site correspond to the materials for which the manufacturing documentation has been prepared.

Any discrepancies will be reported to the GC with details of the discrepancies and the nature of the materials on site. Conformance certifications will be included in the Final Completion Report.

3.5.2.1.1 Conformance Testing

Conformance testing will be completed by a third-party materials laboratory selected and subcontracted by the OR and/or Project Engineer to confirm that the geomembrane shipped to the site have the required physical and mechanical properties required by the *Technical Specifications*.

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Geomembrane conformance samples will be collected by the OR or third-party liner CQA subcontractor at a minimum rate of one per 100,000 square feet of geomembrane supplied. Samples will only be collected from material delivered to the site. After sample collection, the OR or third-party liner CQA subcontractor shall forward the samples to the third-party materials laboratory for testing. Based on the results of the conformance testing, the Project Engineer (in consultation with the third-party CQA subcontractor) may provide corrective actions to the GC.

Conformance testing will be carried out by the third-party materials laboratory in accordance with the ASTM test methods shown in the Project Engineer/OR-approved product specifications. These conformance tests should include, at a minimum, those listed in Table 5.

Table 5
Conformance Tests for HDPE Geomembrane

Test	Test Designation
Sheet Thickness	ASTM D5994
Density	ASTM D1505
Tensile Properties (Type IV at 2 inches per minute): Yield Stress Break Stress Yield Elongation Break Elongation	ASTM D638
Tear Resistance	ASTM D1004
Puncture Resistance	ASTM D4833
Carbon Black Content	ASTM D1603
Carbon Black Dispersion	ASTM D5596

3.5.2.1.2 Conformance Test Results

Conformance test results will be reported to the OR (or third-party liner CQA subcontractor), who will review the results for conformance with the *Technical Specifications*. Conformance test results will be reported to the Project Engineer and the Contractor.

Nonconformance test results may require the following corrective actions:

- If the GC has installed all or a portion of the geomembrane, they will be required to uncover the material for additional resampling and retesting.
- Geomembrane represented by nonconformance test results may not be deployed (if not deployed already) until conformance with the *Technical Specifications* has been demonstrated.
- If a second round of tests confirms nonconformance of the sample, the roll from which the sample was taken will be rejected, as well as any other rolls represented by that sample. The

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OR (or third-party liner CQA subcontractor) will determine which rolls are represented by the sample from a review of the geosynthetic material manufacturer's QC testing and certification.

Additional sampling and testing may be conducted on unsampled rolls represented by the nonconforming sample. Additional sampling and testing, as well as any additional labor or materials, will be conducted at the expense of the GC to determine conformance of those rolls with the *Technical Specifications*. If the GC elects to deploy the material prior to the receipt of the conformance testing results, all additional labor and materials to remove, replace, and reinstall the material shall be borne by the GC.

The OR will include the results of all conformance testing in the Final Completion Report.

3.5.2.2 Material Delivery, Unloading, and Storage

The OR (or third-party liner CQA subcontractor) will perform receiving inspection on all geomembrane material for the SDCB in compliance with procedures described in the *Technical Specifications*. The OR (or third-party liner CQA subcontractor) will also confirm that transportation, handling, and storage of geomembrane are performed in accordance with the *Technical Specifications* and will determine the condition of rolls of geomembrane upon delivery to the site.

During delivery, the OR (or third-party liner CQA subcontractor) will monitor and document, at a minimum, the following:

- Inventory of all materials delivered to the lagoons
- Logging of roll numbers on inventory checklist
- Confirmation that the rolls delivered match the lot numbers of those included in the conformance testing
- Cross-reference with the bill of lading supplied by the manufacturer
- Visual inspection of materials for damage; suspect rolls will be marked, recorded on inventory checklist, and set aside for further inspection

The QA Installation Manual will describe the packaging requirements from the manufacturer.

3.5.2.3 Observation of Geomembrane Installation

The OR (or third-party liner CQA subcontractor) will document that geomembrane placement and seaming activities are performed in accordance with the *Technical Specifications*, particularly confirming that required materials, methods, and testing procedures are employed. Seams or repaired areas that do not pass the tests will be repaired and retested, as described in the *Technical Specifications*, until a passing result is achieved. Requirements for geomembrane installation and testing are described in detail in the *Technical Specifications* and are summarized in the following subsections.

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3.5.2.3.1 Deployment

The OR (or third-party liner CQA subcontractor) will monitor and document geomembrane deployment. Prior to deployment, the OR (or third-party liner CQA subcontractor) and installer will confirm that the surface upon which the geomembrane will be installed is suitably prepared and will not damage the geomembrane. Deployment will be in accordance with the *Technical Specifications* and the accepted seam and panel layout drawings submitted by the GC prior to construction. The OR (or third-party liner CQA subcontractor) will document the time and location of material placement and make note of any damage to the materials. The OR (or third-party liner CQA subcontractor) will record weather, ambient temperature, temperature of the geomembrane, and subgrade conditions to confirm conformance with the *Technical Specifications*.

For any damage to the materials, the *Technical Specifications* define the repair method to be used, based on the nature and size of the damage. All repairs will be performed in accordance with the *Technical Specifications*.

3.5.2.3.2 Seaming/Welding

All field seaming will conform to the accepted seam and panel layout drawings for each lagoon. Field seaming operations must be completely monitored and documented by the OR (or third-party liner CQA subcontractor) to confirm conformance with the *Technical Specifications*. The OR (or third-party liner CQA subcontractor) will do the following:

- Confirm that only seaming methods and equipment that have been previously accepted are used and that equipment and gages are in current calibration, as applicable. Obtain copies of calibration certificates for project files.
- Observe the trial seaming procedure and record test results. If questions arise concerning seam failure or other aspects of the trial seam, the OR (or third-party liner CQA subcontractor) will make the final determination as to whether the seam is acceptable.
- Monitor weather conditions, measure ambient temperature, and notify the installer if conditions are outside of the acceptable limits or if conditions have changed so that new trial seams are required.
- Prior to seaming, confirm that panels have been prepared in accordance with the *Technical Specifications* and are clean and dry.
- During seaming, monitor and record nozzle, preheat extrudate, wedge, or other temperatures, as appropriate for the particular apparatus. For automated apparatus, record seaming apparatus speed.

Documentation at the SDCB, at a minimum, will include the following:

- A record of the trial seams, including date, time, welder ID, machine ID and settings, and associated test results

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- The seam number, based on a seam numbering system agreed to by the OR and Contractor
- The date, time, welder ID, machine ID, and settings for each seam
- The ambient temperature and temperature of the material

3.5.2.3.3 Seam Testing

For seam testing at the SDCB, the OR (or third-party liner CQA subcontractor) will perform the following activities:

- Confirm with the GC's geomembrane installer that test equipment is suitable and in working order and that gages are in current calibration, as applicable. Obtain copies of calibration certificates for project files.
- Continuously monitor and record the results of all nondestructive testing at both lagoons.
- Determine locations for destructive test samples based on the required sampling frequency and seaming observations. Destructive samples will not be taken from places that would be hard to patch. The installer will not be informed in advance of the locations where the seam samples will be taken.
- Observe removal of destructive test samples. Assign a number to each sample and record the sample number and location in the geomembrane layout drawings.
- The OR or the third-party liner CQA subcontractor will send the destructive test sample to the third-party material testing laboratory. The results of the laboratory destructive testing will be made available to the Project Engineer and GC.
- The GC's liner subcontractor will conduct on-site destructive testing for QC purposes. The results of the QC destructive testing will be made available to the Project Engineer and OR.
- Observe all repair procedures and destructive testing of sample locations.
- Determine whether additional sampling and testing is required, such as in tie-in areas or when there is cause to suspect the presence of excess crystallinity, contamination, offset welds, or any other potential defect.
- Document all actions taken in conjunction with destructive test failures.

3.5.2.3.3.1 Nondestructive Seam Testing

The purpose of nondestructive testing is to detect discontinuities or holes that may exist in the seams and to indicate whether a seam is continuous or has non-welded sections. Nondestructive tests for geomembrane include vacuum testing and/or air pressure testing. Nondestructive testing at the SDCB must be performed over the entire length of all seams in accordance with the *Technical Specifications*. The GC's liner subcontractor will perform nondestructive seam testing.

The OR (or third-party liner CQA subcontractor) will observe and document the testing to confirm conformance with the *Technical Specifications* and document any seam defects and necessary repairs. Documentation will include, at a minimum, the date, time, location, and pass or fail

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determination for each test. The GC's liner subcontractor and/or OR (or third-party liner CQA subcontractor) will identify the failed areas by marking the area with a waterproof marker compatible with the geomembrane, notify the GC of any required repairs, and record the repair needed.

3.5.2.3.3.2 Destructive Seam Testing

Destructive seam tests will be performed at the SDCB at a minimum interval of at least one test per 500 linear feet for geomembrane seams. The OR (or third-party liner CQA subcontractor) may require additional tests if there are seams that do not appear to meet specification requirements. Reasons for selecting test locations may include, but are not limited to, the following:

- Wrinkling in seam area
- Excess crystallinity
- Suspect seaming equipment or techniques
- Weld contamination
- Insufficient overlap
- Adverse weather conditions
- Possibility of moisture, dust, dirt, debris, or other foreign material in the seam
- Failing tests

The OR (or third-party liner CQA subcontractor) will select locations where seam samples will be cut for destructive testing as follows:

- The minimum testing frequency of one test per 500 feet of seam length is an average frequency for the entire installation. Individual samples may be taken at greater or lesser intervals.
- If the number of failed samples exceeds 5% of the tested samples, this frequency may be increased solely at the discretion of the OR. Samples taken as a result of failed tests do not count toward the total number of required tests.

The OR (or third-party liner CQA subcontractor) will not inform the GC in advance of destructive sample locations. The GC will collect samples in accordance with the *Technical Specifications*. The OR (or third-party liner CQA subcontractor) will do the following:

- Observe the sample cutting operations.
- Mark each sample with an identifying number that contains the seam number, destructive test number, welder ID, machine ID, date, and time.
- Record the sample location and reason for taking the sample.

Destructive testing must be performed concurrently with seaming operations, not at the completion of the entire installation.

The GC's liner subcontractor will divide each sample into four parts, of which one part will be field-tested by the GC in accordance with the *Technical Specifications*. The OR (or third-party liner CQA

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subcontractor) must observe the tests. A geomembrane seam sample passes when the break is a ductile, film-tearing bond. A film-tearing bond means the test strip must break at the edge or the outside of the seam, but not within the seam. In addition, the seam strength must meet the values listed in the *Technical Specifications*. If any field-test sample fails, the GC will follow the failed weld procedures outlined in the *Technical Specifications*.

Of the remaining three parts, the OR or third-party liner CQA subcontractor will submit one part of the sample to the third-party materials laboratory for testing (laboratory testing is discussed in Section 3.5.2.3.4). The GC will retain one part for their records, and the OR (or third-party liner CQA subcontractor) will retain one part on behalf of the Owner.

3.5.2.3.4 Laboratory Testing

The OR or third-party liner CQA subcontractor will forward one part of all samples for destructive testing to the third-party materials laboratory to confirm seam quality. Qualities tested include bonded seam strength ("shear" per ASTM D4437) and peel adhesion ("peel" per ASTM D4437). Both tests will be completed in accordance with the *Technical Specifications*. The purpose of the shear and peel tests is to evaluate seam strength and long-term performance. Shear strength measures the continuity of tensile strength through the seam and into the parent material. Peel strength addresses weld quality. At least five specimens from each sample must be tested in each method used. Minimum test values are presented in the *Technical Specifications*.

The OR (or third-party liner CQA subcontractor) must record the results of the laboratory testing on a destructive seam test form, the panel/seam log, and the panel layout drawing. If the laboratory test fails in either peel or shear, the GC's liner subcontractor will follow the failed weld procedures outlined in the *Technical Specifications*. This process will be repeated until passing tests bracket the failed seam section. All seams must be bounded by locations from which passing laboratory tests have been taken. Laboratory testing governs seam acceptance. In no case can field-testing of repaired seams be used for final acceptance.

3.5.2.3.5 Repairs

Any portion of the geomembrane with a flaw that fails a nondestructive or destructive test (where destructive tests were cut or where nondestructive tests left cuts or holes) must be repaired in accordance with the *Technical Specifications*. The GC's liner subcontractor and OR (or third-party liner CQA subcontractor) must locate and record all repairs to be included in the Record Drawings. The OR (or third-party liner CQA subcontractor) will monitor and document all repairs to ensure that they are completed in accordance with the *Technical Specifications*.

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3.6 Pipes, Fittings, and Wall Penetrations

The project includes solid HDPE pipe, fittings, couplings, and wall penetrations at the SDCB. CQA procedures for the selection, installation, and testing of these materials are presented in the following subsections. Wall penetrations require QA observation.

3.6.1 Performance Objectives and Criteria

Performance objectives and criteria for pipes and fittings at the SDCB include the following:

- **Material Acceptance.** Verify that the pipes and components meet the *Technical Specifications*.
- **Monitoring of Pipe Installation.** Monitor pipe installation, including all pipe joining and placement, to confirm the installation is in compliance with the *Technical Specifications*.

3.6.2 Quality Assurance Measures, Inspection Activities, and Contingency Actions

QA measures described in this section will be implemented during pipe installation activities to confirm performance objectives are met and construction is completed per the *Construction Drawings* and *Technical Specifications*. Inspection and verification activities will be implemented and compared to appropriate criteria to determine if performance objectives have been achieved. If performance standards have not been achieved, the contingency actions will be implemented.

3.6.2.1 Material Acceptance

The OR will inspect all pipe, equipment, and components when they are delivered to the site to confirm that they conform to the *Construction Drawings* and *Technical Specifications*. Specific activities performed by the OR will include the following:

- Review GC submittals concerning joining methods, personnel qualifications, and testing procedures.
- Review manufacturer QC data and certifications.
- When materials arrive at the site, inspect all pipe components to confirm (from appearance, labels, and shipping documents) that they are constructed of materials as listed in the *Construction Drawings*, *Technical Specifications*, and procurement documents and that they are not damaged.
- Take periodic measurements to confirm that pipe is of the specified size and wall thickness and perforations are sized and spaced as specified.
- Confirm that non-HDPE piping systems are not damaged. Inspection will include visual observation of any corrosion-resistant coatings to document that they are present and without flaw.

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- Inspect to confirm that all prefabricated materials, equipment, and parts are as specified in the design documents, including, but not limited to, pipe fittings, wall penetration appurtenances, and pipe sleeves.

3.6.2.2 Monitoring of Pipe Installation

The OR will monitor and inspect all pipe installation, including all pipe joining and placement, to confirm compliance with the *Technical Specifications*. CQA monitoring activities during construction of the inlet and outlet piping will include the following:

- Observe and measure to confirm that pipes are placed at the specified locations and configurations and that all pipe grades are as specified. The GC will be required to maintain a complete and accurate set of As-Built Drawings of the piping systems.
- Visually observe that all pipes are joined together in accordance with the accepted procedures.
- Observe acceptance testing by the GC and review acceptance test results of all piping prior to being buried.
- Observe that backfilling and compaction are completed as specified and that, in the process, the piping is not damaged.

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4 Documentation, Meetings, and Reporting

Documentation and reporting for construction QA activities will include pre-construction, construction, and post-construction documentation, as detailed in this section. The GC, Project Engineer, and OR will work closely during construction to complete the project as specified in the final design and collect the documentation required. The following subsections describe documentation, meetings, and reporting that will be required throughout construction.

4.1 Prior to Construction

4.1.1 Pre-Construction Meeting

A Pre-Construction Meeting will be held between the Owner, GC, Project Engineer, and OR before construction activities begin. The purpose of the pre-construction meeting will be to review the following information:

- Project layout, including *Construction Drawings* and *Technical Specifications*
- Project schedule and critical path items
- Project work areas, staging areas, and haul roads
- Roles, responsibilities, and lines of communication and authority
- Standards for QC procedures used for the geosynthetics in the context of this CQAP, including review of the requirements for seaming, testing, monitoring, and documenting installation and repairs and the repair procedures that will be required for different types of flaws or damages
- Manufacturer material submittals required from the Contractor prior to items being shipped to the site
- Specific methods of deployment to be used for geosynthetic material and various pipe materials
- Confirmation of the timing and distribution of reports for the work schedule and CQA documentation

4.1.2 Pre-Construction Submittals

4.1.2.1 Construction Health and Safety Plan

The GC will submit its CHASP presenting the minimum health and safety requirements for job site activities and the measures and procedures to be employed for protection of on-site personnel. The plan will cover the controls, work practices, personal protective equipment, and other health and safety requirements that will be implemented by the GC in connection with the remedial action construction activities.

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4.1.2.2 Project Construction Schedule

A detailed project schedule will be submitted by the Contractor for each construction element prior to construction. Schedule updates will be submitted weekly by the Contractor following site Progress Meetings.

4.2 Construction

During construction activities, the GC will be required to provide a variety of documentation to the OR, including testing results of materials received, survey results, and documentation of pay items completed. The GC will also maintain a Corrective Action Log and a Field Report of daily activity. These records are described in more detail in the following sections and will be maintained in the project files.

4.2.1 Weekly Meetings

An informal Weekly Meeting will be held at the site or by telephone conference with the Project Engineer, Contractor, and OR. Discussion topics at Weekly Meetings will include safety issues, potential problems and their resolutions, CQA, the resolution of nonconforming work, the Contractor's proposals, design revisions, the previous week's accomplishments, and the status of the schedule. Minutes from the weekly meetings will be documented by the OR or the Project Engineer and distributed to attendees.

4.2.2 General Contractor's Daily Activity Report

During construction activities, the GC will prepare a Daily Activity Report and submit it to the OR on the day following the report date. The GC's Daily Activity Report will record, at a minimum, the following information:

- ID of personnel on site, including visitors
- Weather
- Work hours
- Activities completed
- Any changes to best management practices or environmental controls
- Materials delivered or used
- Equipment used
- Debris material removed and disposed of off site
- Results of any QC inspections, tests, or other monitoring activities
- Problems encountered and problem resolutions
- Any EPA-authorized deviations from the final design

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4.2.3 Owner's Representative Daily Field Log

The OR will maintain a Daily Field Log when on site to record observations, measurements, inspections completed, data received, communications with other members of the project team, additional environmental controls that were implemented, problems encountered, and problem resolutions. The Daily Field Log will be supported by submittals received from the GC, such as survey results and weigh tickets, laboratory data received, inspection reports, and written communications from members of the project team or EPA.

4.3 Post Construction

When construction activities are complete, the Project Engineer will generate a Final Completion Report, which will include the following:

- Results of the final inspection, including a brief description of any problems discovered during the final inspection and the resolution of those problems, as necessary
- A detailed description of all work conducted in accordance with the approved final *Construction Drawings* and *Technical Specifications* and certification by a Washington State-registered Professional Engineer and the OR that the work was performed in accordance with all approved plans and *Technical Specifications*
- An explanation of any modifications to the approved plans and *Technical Specifications* and why these modifications were necessary
- Final As-Built Drawings, if different from final *Construction Drawings*
- Results of confirmation and verification sampling

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5 References

Anchor QEA (Anchor QEA, LLC), 2019a. *Construction Drawings*. 100% Design Submittal. Prepared for Cow Palace, LLC. May 2019.

Anchor QEA, 2019b. *Technical Specifications*. 100% Design Submittal. Prepared for Cow Palace, LLC. May 2019.

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Attachment A
Construction Documentation Forms

ANCHOR QEA

CHANGE ORDER NO. CO#

C.O. TITLE: **DATE:**

PROJECT NAME: Cow Palace Dairy Safety Debris Catch Basin

CONTRACTOR: **PROJECT NO:**

OWNER: Cow Palace Dairy

Change Order Description:

Summary of Changes:

Bid Item No.	Description	Est. Quantity	Unit	Unit Price	Amount
				Total Amount of Change	

The Contract is Modified as Follows:

Contractor is hereby directed to, upon receipt of an approved copy of this change order; execute the work as detailed herein. The work covered by the Change Order shall be performed under the same terms and conditions as those included in the original Contract, unless otherwise described herein. The payment and/or additional time specified and agreed to in this Change Order constitutes full adjustment for, and settlement of, all costs and time relating to the performance of the Work described herein.

Original Contract Amount:	$ 0,000,000.00
Current Contract Amount:	$ 0,000,000.00
Amount of this Change:	**$**
Revised Contract Amount:	$ 0,000,000.00

Contract time is: ☐ Unchanged ☐ **Increased** ☐ **Decreased** by +/- days ☐ Work Days ☐ Cal. Days

New Contract Duration: +/- days ☐ Work Days ☐ Calendar Days

Approved By *(Not valid until signed by Owner)*

Approval Recommended – Construction Manager

RE Name

(Print name) *Signature* *Date*

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Approved by Owner – H&S Bosma and Liberty Dairy

Owner Name		
(Print name)	*Signature*	*Date*

Contractor – TBD

Contractor Name		
(Print name)	*Signature*	*Date*

Justification of Change:

Changes to the Contract Documents: (Cite attachments, if any.)

Plans	
Sheet #	**Change:**
Contract Provisions / Project Manual	
Section #	**Change:**

Attachments:

Copies:

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ANCHOR QEA

CONSTRUCTION FIELD MEMO: XXX

PROJECT NAME: Cow Palace Dairy Safety Debris Catch Basin

CONTRACTOR: _____ **DATE:** _____

SUBJECT: _____

Message

_____ _____ _____

(Print/Type Name) *Signature* *Date*

Construction Manager *Anchor QEA*

Title *Company*

Reply: By: _____ ☐ As Soon as Possible ☐ No Reply is Required

Date

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ANCHOR QEA

INCIDENT REPORT

PROJECT NAME: Cow Palace Dairy Safety Debris Catch Basin
INITIATOR OF REPORT: _____ **DATE OF INCIDENT:** _____
LOCATION OF INCIDENT: _____ **TIME OF INCIDENT:** _____
CONTRACTOR: _____
CONTRACTOR REPRESENTATIVE: _____ **REVIEWED BY:** *(initials/date)* _____

Notification (see attached notification reports)

Notifying Party	Agency(ies) Notified	When Notified (time)

Description of Incident

☐ **Utility**
If a utility strike, was utility located? ☐ Yes ☐ No ☐ N/A Comment:
If "yes," were marks within 2 feet of actual location? ☐ Yes ☐ No

☐ **Property**

☐ **Personal**

☐ **Other**: *(specify)*

Were emergency services called to site? ☐ Yes (*If yes, describe in below*) ☐ No

Narrative *(Provide a chronological accounting of the incidents and events leading up to the incident, if applicable. Attach photos if necessary)*:

Recommendations

Attachments

ED_002369M_00000063-00236

INSPECTOR'S DAILY REPORT (IDR)

CONTRACT NO.: _____
REPORT DATE: _____
REPORT NO.: _____

ANCHOR QEA FIELD REP.: _____
PROJECT NAME/LOCATION: Cow Palace Dairy Safety Debris Catch Basin

REPORT SUBMITTED TO	CONTRACTOR NAME AND CONTACT	WEATHER TEMP. AND PRECIPITATION	
Client: Henry Bosma	General:	AM:	
CC:	Subs:	PM:	
		TIME OF SITE VISIT/OBSERVATION	
		From:	To:

CONSTRUCTION ACTIVITY

CONSTRUCTION TASK	LOCATION OF WORK	COMMENT/NOTES

PERSONNEL ON SITE

NAME (or labor category)	PRIME/SUB/OTHER	NOTES (quantity, apprentice, training)

EQUIPMENT ON SITE

PRIME/SUB	EQUIP. ID	EQUIPMENT DESCRIPTION	HOURS			
			Oper.	Stdby.	Down	Idle

PHOTOS AND VIDEO

Were photos/video taken today? ☐Yes ☐No	Subject:

ACTIVITY LOG

TIME	DISCUSSION

UNIT PRICE WORK

Item	Description	Qty.	Location/Comment

LIMITATIONS: The Anchor QEA field representative is present on site solely to observe the field activities of the contractor identified and keep our client informed of the progress and quality of the work. The presence and activities of the Anchor QEA field representative and our acceptance of any non-conforming work does not relieve the contractor from complying with its contract documents. Any information provided by the Anchor QEA field representative is intended solely to advise the contractor of the technical requirements of the plans and specifications and/or design concept. The contractor is solely responsible for its means, methods, sequences, procedures, construction site safety, quality of the work, and adherence to the contract documents.

REVIEWED BY: *(PM initial/date)*

FIELD REP. SIGNATURE: _____ DATE: _____

(Rev. 5/17)

ANCHOR QEA

INSPECTOR'S DAILY REPORT (IDR)

CONTRACT NO.: _____

REPORT DATE: _____

REPORT NO.: _____

ANCHOR QEA FIELD REP.: _____

PROJECT NAME/LOCATION: Cow Palace Dairy Safety Debris Catch Basin

OTHER OBSERVATIONS

(Note any force account, changes, material testing, problems encountered, production rates, material delivery, etc.)

PHOTOS

Comment:	**Comment**:
Comment:	**Comment**:

LIMITATIONS: The Anchor QEA field representative is present on site solely to observe the field activities of the contractor identified and keep our client informed of the progress and quality of the work. The presence and activities of the Anchor QEA field representative and our acceptance of any non-conforming work does not relieve the contractor from complying with its contract documents. Any information provided by the Anchor QEA field representative is intended solely to advise the contractor of the technical requirements of the plans and specifications and/or design concept. The contractor is solely responsible for its means, methods, sequences, procedures, construction site safety, quality of the work, and adherence to the contract documents.		REVIEWED BY: *(PM initial/date)*
FIELD REP. SIGNATURE: _____	DATE: _____	Page 2 of 2

(Rev. 5/17)

ANCHOR QEA

MEETING NOTES

Type of Meeting:			
Project Name:	Cow Palace Dairy Safety Debris Catch Basin		
Meeting Location:		**AQEA #:**	
Call-In Number			

Date	**Start**	**End**	**Meeting Led By:**	
			Meeting Note-Taker:	

Attendees:

H&S Bosma Dairy	Agency Staff	Construction Management	Contractor
☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐

1. **Item 1**
2. **Item 2**

Follow-up Actions

Item #	Meeting # Ref.	Description	Action/ Responsible Party	Due Date

Next meeting:

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ANCHOR QEA

NONCONFORMANCE REPORT

Date Submitted:		**NCR No:**	
Project:	Cow Palace Dairy Safety Debris Catch Basin		
Contractor:		**Response Due Date:**	
Location:		**Project No:**	

Nonconformance Issue

Contract Requirement: Describe

Reference (*Spec or Drawing*): Reference

Description of Non-Conformance: Describe

Corrective Action Required: Describe

Attachments (*list as applicable*): Attachments

Nonconformance Noted by:

Name		
Construction Manager, Anchor QEA, LLC	*Signature*	*Date*
Name		
Project Engineer, Anchor QEA, LLC	*Signature*	*Date*

Contractor's Response

Corrective Action Proposed: Describe

Contractor's Response Provided by:

Name		
Contractor's Representative (Print/Type Name & Title)	*Signature*	*Date*

Resolution

Construction Manager's Response to Contractor's Proposed Action:

☐ **Accept** ☐ **Accept with Conditions** ☐ **Reject**

Conditions/Comments: Describe

Name		
Construction Manager (Print/Type Name)	*Signature*	*Date*

Verification of Corrective Action Taken

Name		
Owner's Representative (Print/Type Name & Title)	*Signature*	*Date*
Name		
Contractor's Representative (Print/Type Name & Title)	*Signature*	*Date*

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ANCHOR QEA

SUBMITTAL LOG

PROJECT NAME: Cow Palace Dairy Safety Debris Catch Basin

CONTRACTOR:

OWNER: Adam Dolsen

PROJECT NO: 190996-01.01

CONTRACT NO:

LAST UPDATED:

CODE KEY: AP = Approved NE = No Exceptions RJ = Rejected/Re-Submit RR = Revise & Re-Submit MC = Make Changes SI = Submit Specified Item

Submittal Info						Review Schedule				Response	
Submit. No.	Bid Item	Spec. Section	Submittal Category/Description	Submit. Type Req.	Man./ Supplier	Due to Cont.	Sent out for Rev.	Rev. Rec'd	Ret'd to Contr.	Code	Notes (Red Requires Action)

CODE KEY: AP = Approved NE = No Exceptions RJ = Rejected/Re-Submit RR = Revise & Re-Submit MC = Make Changes SI = Submit Specified Item

Submittal Info						Review Schedule				Response	
Submit. No.	Bid Item	Spec. Section	Submittal Category/Description	Submit. Type Req.	Man./ Supplier	Due to Cont.	Sent out for Rev.	Rev. Rec'd	Ret'd to Contr.	Code	Notes (Red Requires Action)

ANCHOR QEA

SUBMITTAL REVIEW TRANSMITTAL

Contractor:		**Project Name:**	Cow Palace Dairy Safety Debris Catch Basin
		Project Number:	
Date:		**Transmittal Number:**	

Check:

☐Original Submittal ☐ Resubmittal ☐ Other

Item No.	Specification No.	Subsection	Description

Review action:

☐ No Exceptions Taken ☐ Rejected

☐ Revise and Resubmit ☐ Submit Specified Item

☐ Approved as Noted (Resubmittal Not Required)

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications and does not relieve the contractor from compliance with contract requirements. Contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

Comments:	
By:	Date:

Cc:

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ANCHOR QEA

TRANSMITTAL

To:	**From:**
	Date:
Re:	**Project:** Cow Palace Dairy Safety Debris Catch Basin

No. of Copies	Description

Comments:

Attachment B
Summary of Inspections and Submittals

Table B-1
Summary of Construction Inspections and Verification Activities

Construction Element*	Specification Section	Monitoring, Testing, and Inspection Requirements	Monitoring Frequency
Heath and Safety	01 35 00	Supervise and enforce compliance with the Site Health and Safety Plan	Daily
Construction Facilities and Temporary Controls	01 50 00	Progress cleaning and waste disposal	Daily
		Collect and remove trash	Weekly
		Maintain signs and supports	Throughout duration of project
		Remove signs, framing, supports, and foundations	At completion of project
		Environmental protection	Throughout duration of project
		Surface water control	Throughout duration of project
		Dust control measures	Throughout duration of project
Closeout Procedures	01 80 00	Punch List corrections	Prior to certification of Substantial Completion
Earthwork	31 00 00	Quality control for earthwork	Throughout duration of project
		Verification of existing utilities and facilities	Prior to starting work in this section
		Inspection for additional utilities	Throughout duration of project
		Protection of placed soil layers	Throughout duration of project
		Pre-construction material quality evaluations	Prior to starting work in this section
		Verifications of conditions	Prior to starting work in this section
		Inspect stockpile best management practices	Daily
Geotextiles for Earthwork	31 05 19.13	Construction quality control inspection of geotextile	Throughout duration of project
		Protection of geotextile	Throughout duration of project
Geomembranes for Earthwork	31 05 19.16	Quality control of HDPE	Throughout duration of project
		Inspection surfaces of all rolls for defects and damage	Upon delivery of GCL
		Subgrade inspection	Prior to HDPE installation
		Inspection of installation and welds	During GCL installation
Trenching and Backfilling	31 21 33	Verifications of survey benchmarks and intended elevations	Prior to starting work in this section
		Verifications of the adequacy and accuracy of the control surveys and data	Prior to starting work in the section
		Verify the materials excavated and processed on site meet the specified requirements	Throughout duration of project
		Locate and lay out required lines, levels, contours, and data	Prior to starting work in the section
		Identify, flag, and protect known utilities	Prior to starting work in the section
		Protect benchmarks, existing structures, and fences from excavation equipment and vehicular traffic unless identified for removal	Throughout duration of project
		Protect above- and below-grade utilities that are to remain	Throughout duration of project
HDPE Piping	33 31 19	Quality control for HDPE pipe and fittings	Throughout duration of project
		Inspect materials delivered to site	Prior to installation
		Handling, storage, and care of materials	Throughout duration of project
		Solid pipe leak test	After pipe installation

Notes:

* This table summarizes the divisions of the *Construction Specifications* (Anchor QEA 2019a) that are most relevant to the *Construction Quality Assurance Plan* (Anchor QEA 2019b).

GCL: geosynthetic clay liner

HDPE: high-density polyethylene

Table B-2
Summary of Contractor Submittals

Construction Element*	Specification Section	Submittal**	Due Date
Construction Progress Documentation	01 04 00	Draft Construction Schedule	20 calendar days from Notice to Proceed; prior to commencing Work at the Site
	01 04 00	Approved Construction Schedule	Within 10 calendar days upon receipt of reviewed Draft Construction Schedule
	01 29 73	Preliminary Schedule of Values	At Pre-Construction Meeting
	01 29 73	Corrected Schedule of Values	Within 10 calendar days upon receipt of reviewed Preliminary Schedule of Values
	01 04 00	Revised Construction Schedule	As part of monthly Application for Payment; more often as necessary
Health and Safety	01 35 00	Health and Safety Plan	Prior to commencing work or within 20 days after receiving Notice to Proceed
Quality Assurance and Control	01 04 00	Contractor Weekly Progress Report	Before noon (12:00 p.m.) on the Monday following the previous week's Work
Closeout Procedures	01 05 00	Record Drawings on Bond	Prior to Project closeout and within 30 calendar days following receipt of Substantial Completion
	01 05 00	Record Specifications	Prior to Project closeout and within 30 calendar days following receipt of Substantial Completion
	01 80 00	Warranty for Geotextiles	As part of the Record Information
	01 80 00	Warranty for HDPE Geomembrane	As part of the Record Information
	01 80 00	Contract Closeout Documents	When directed by the Owner
Geotextiles	02 80 00	Manufacturer's material specifications, product literature, and product sample for all materials	Prior to shipment to Site
	02 80 00	Manufacturer's certifications for all geotextiles used	Prior to shipment to Site
	02 80 00	Manufacturer's source quality control testing results	Prior to shipment to Site
	02 80 00	Geotextile sample for material conformance testing	Prior to shipment to Site
Geocomposites	02 81 00	Manufacturer's material specifications, product literature, and product sample for all materials	Prior to shipment to Site
	02 81 00	Manufacturer's certifications for all geotextiles used	Prior to shipment to Site
	02 81 00	Manufacturer's source quality control testing results	Prior to shipment to Site
	02 81 00	Geotextile sample for material conformance testing	Prior to shipment to Site
Geomembranes	02 82 00	Panel layout drawing	Following installation
	02 82 00	Geomembrane roll data	Prior to shipment to Site
	02 82 00	HDPE samples	Prior to shipment to Site
	02 82 00	Quality control documentation from the previous day's geomembrane installation	Prior to shipment to Site
HDPE Piping	02 74 00	Manufacturer's product data and manufacturer's certificates	Prior to shipment to Site
	02 74 00	Sample for each solid and perforated pipe	Prior to shipment to Site
	02 74 00	Shop drawings for any specialty fabricated fittings	Prior to shipment to Site
	02 74 00	Pipe Testing Plan	Prior to shipment to Site

Notes:

* This table summarizes the divisions of the *Construction Specifications* (Anchor QEA 2019a) that are most relevant to the *Construction Quality Assurance Plan* (Anchor QEA 2019b).

** These submittals constitute the submittals required of the General Contractor and will be approved by the Construction Manager/Project Engineer prior to the start of work.

HDPE: high-density polyethylene

Appendix E
Operations, Maintenance, and Monitoring Plan

June 25, 2019
Cow Palace Safety Debris Catch Basin
Administrative Order on Consent Docket No. SDWA-10-2013-0080

Cow Palace Safety Debris Catch Basin Operations, Maintenance, and Monitoring Plan

Prepared for Cow Palace, LLC

June 25, 2019
Cow Palace Safety Debris Catch Basin
Administrative Order on Consent Docket No. SDWA-10-2013-0080

Cow Palace Safety Debris Catch Basin Operations, Maintenance, and Monitoring Plan

Prepared for
Cow Palace, LLC
1631 North Liberty Road
Granger, Washington 98932

Prepared by
Anchor QEA, LLC
1119 Pacific Ave, Suite 1600
Tacoma, Washington 98402

Project Number: 190996-01.01
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Figure 1 Cow Palace Dairy Lagoon System

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Attachment B Agitator Cut Sheet
Attachment C Lagoon Inspection Form – Example
Attachment D Construction Drawings
Attachment E GRI White Paper No. 6

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ABBREVIATIONS

ASTM	ASTM International
EPA	U.S. Environmental Protection Agency
gpad	gallons per acre per day
gpd	gallons per day
H:V	horizontal to vertical (ratio)
HDPE	high-density polyethylene
ILR	intermediate leak rate
LLR	large leak rate
MLR	monitoring leak rate
OMMP	*Operations, Maintenance, and Monitoring Plan*
SDCB	Safety Debris Catch Basin

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1 Introduction

This *Operations, Maintenance, and Monitoring Plan* (OMMP) was prepared by Anchor QEA, LLC, on behalf of Cow Palace, LLC, to meet requirements set forth by the U.S. Environmental Protection Agency (EPA) Region 10 Administrative Order on Consent SDWA 10-2013-0080 for the Cow Palace Safety Debris Catch Basin (SDCB).

This OMMP describes the operations to be conducted at the SDCB to safely operate the lagoon and maintain the integrity of the various lagoon components through inspection, maintenance, repair, monitoring, and reporting procedures.

The objectives of this OMMP are as follows:

- Describe the components of the SDCB and its normal operating conditions.
- Provide a plan for operation of the lagoon that minimizes the chance of damage to the liner system.
- Provide a plan for the lagoon that details long-term operation of the lagoon that will maximize lagoon materials life and eliminate the chance for a release of wastewater.
- Establish action levels that trigger various response procedures, including the following:
  - Maximum operating lagoon liquid level
  - Monitoring leak rate (MLR)
  - Intermediate leak rate (ILR)
  - Large leak rate (LLR)
- Establish monitoring procedures to identify whether action levels have been reached.
- Describe response procedures to return the lagoon to its normal operating condition.
- Establish a reporting schedule and required report components.

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2 Lagoon Summary

The SDCB is located approximately 300 feet to the north of E Zillah Drive near 1631 N Liberty Road in Granger, Washington. The approximate geographic coordinates of the lagoon are 46.405395N and 120.137287W. Figure 1 shows the lagoon's location within the Cow Palace dairy facility.

Primary inflows into the SDCB are stormwater runoff from the dairy operations and precipitation falling directly into the lagoon's interior.

The SDCB has average dimensions of 150 feet wide (as measured from east to west along the interior crests) and 150 feet long (as measured from north to south along the interior crests). Interior side slopes will be 3 horizontal to 1 vertical (3H:1V), with exterior slopes ranging from 3H:1V to 2H:1V. Maximum depth of the SDCB is 12 feet.

The maximum design capacity of the SDCB, maintaining 1 foot of freeboard, is approximately 2.8 acre-feet (about 0.9 million gallons).

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3 Operating Personnel Responsibilities

Overall Responsibility for Facility	Adam Dolsen – Facilities Manager adam@dolsenco.com
Equipment Operation at Lagoon	Jeff Boivin – Dairy General Manager jeffb@dolsenco.com (509) 728-1061
Setting Reservoir Levels and Irrigation Outflows	Levi Gassaway – Assistant General Manager levig@dolsenco.com (509) 731-5962
Weekly Inspections	Levi Gassaway
Annual Inspections	Jeff Boivin Levi Gassaway
Routine Maintenance Work	Jeff Boivin
Reading and Recording Monitoring Data	Levi Gassaway

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4 Reservoir Operation Plan

4.1 Supply Operation

The primary purpose of the SDCB will be to provide overflow storage for liquid animal waste being pumped from an adjacent sump to Cow Palace Lagoon No. 1.

4.1.1 *Filling Schedule*

The filling schedule will vary depending on time of year, but it will generally be greatest during the non-irrigation months (October through February). The lagoon will fill to a maximum operational elevation of 1,016 feet, which is 1 foot below the lagoon crest of 1,018 feet.

4.1.2 *Release Schedule*

Contents from the SDCB will be pumped to Cow Palace Lagoon No. 1.

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5 Lagoon Components

5.1 Liner System

The following components comprise the SDCB liner section. Listed from the bottom up, they are as follows:

- Compacted subgrade meeting project specifications
- Non-woven geotextile fabric meeting project specifications
- Geocomposite vent strips meeting project specifications
- High-density polyethylene (HDPE) geomembrane secondary liner with integrated studs meeting project specifications
- HDPE geomembrane primary liner meeting project specifications

The following measures will be taken to minimize the risk of the liner puncture after installation:

- Protective fencing will be installed around the lagoon to discourage access to the lagoon by animals and unauthorized persons by foot or vehicle.
- Signage will be placed around the lagoon notifying individuals to stay off the liner. Foot traffic on the liner will be permitted on an as-needed basis for operational and maintenance needs only.
- A thickened rub sheet will be placed on the liner for added protection when taking the agitator in or out of the lagoon.

5.2 Leak Collection/Detection System

The leak collection/detection system will convey any leaks in the primary liner to a leachate collection sump by means of the secondary geomembrane integrated drainage system. This system uses studs integrated into the liner to form a pathway for leachate conveyance. Leachate levels within the sump will be monitored by a level transducer attached to the leachate collection pump meeting project specifications. In the event of a leak, once the leakage depth reaches the pump start depth, the collection pump will remove liquid from the sump and return it to the lagoon. The pump will have a control system that monitors and tracks the volume of leachate entering the sump. Pump specifications are provided in Attachment A.

5.3 Lagoon Outlet System

5.3.1 *Agitator*

The SDCB will be equipped with a floating agitator (cut sheet presented in Attachment B) pump to pump liquid and solids from the lagoon during irrigation season.

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The agitator is designed to be dedicated to this lagoon. A rub sheet will be used to protect the liner as the agitator enters and exits the lagoon or as the lagoon empties. The agitator will be tethered to the lagoon embankments per manufacturer recommendations.

Prior to emptying the lagoon, the agitator will be moved directly onto the rub sheet when the lagoon is empty.

5.3.2 *Outlet Structure*

No outlet structure exists for the SDCB.

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6 Lagoon Inspection Procedures and Action Levels

Several components of the SDCB will be inspected on a routine basis by Cow Palace personnel. An example lagoon inspection form is provided in Attachment C.

6.1 Lagoon System Maintenance Schedule

The lagoon system maintenance schedule is detailed in Table 1.

Table 1
Lagoon System Maintenance Schedule

Dam Embankment	Frequency	Description
Vegetation Control	Biannually	Cut grass and weeds, if present, to allow visual surveillance of the embankment surface.
Control of Burrowing Animals	Monthly	Repair animal burrows by compacting fill into the excavated areas. If the burrowing is extensive, seek the advice of a qualified professional engineer. Eradicate or remove rodents as needed to prevent further damage.
Maintain Crest Roadway	Annually	Regrade eroded areas and add gravel as needed.
Maintain Crest Design Elevation	Annually	Maintain the design elevation of unimproved crest surfaces by leveling and grading the crest to design specifications. Fill any ruts or minor depressions.
Erosion Control on Downstream Face	Monthly	Repair erosion gullies by removing loose materials and replacing them with compacted fill. Protect toes of slopes from damage from powered equipment.

6.2 Lagoon Liquid Level Monitoring

6.2.1 *Maximum Lagoon Liquid Level*

The maximum allowable liquid level during emergency conditions will not exceed the crest elevation of 1,018 feet, which corresponds to a depth of 13 feet.

6.2.2 *Maximum Operating Liquid Level*

The maximum operating liquid level is the elevation the lagoon must maintain in order to operate as designed. This elevation is 1,017 feet, which corresponds to a freeboard of 1 foot. Table 2 summarizes the maximum liquid limit and maximum operating limit.

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Table 2
Safety Debris Catch Basin Operational Levels

Item	Liquid Elevation (feet)	Design Freeboard (feet)	Required Freeboard (feet)	Storage (acre-feet)	Storage (million gallons)
Maximum Liquid Limit	1,018	0.0	0.0	3.2	1.0
Maximum Operating Level	1,017	1.0	0.0	2.8	0.9

6.3 Leak Detection System Monitoring

6.3.1 *Leak Detection System*

Any leaks through the upper geomembrane liner will be conveyed to the collection sump. The sump will be equipped with a submersible (collection) pump that will return the collected water back into the SDCB through an HDPE discharge pipe.

The collection pump will be operated automatically by means of a level transducer and controller. The controller will activate the pump when the sump water level exceeds the design high liquid level, and it will turn the pump off when the liquid level in the sump drops to the design low liquid level.

A flow meter will be installed in line with the discharge line and connected to the controller. The controller will log flow rates as well as total volume pumped, and it will be the primary means by which Cow Palace personnel will detect and monitor leaks in the primary liner.

6.3.2 *Leak Detection System Monitoring Procedures*

As discussed in Section 6.3.3, Cow Palace personnel will conduct routine monitoring following installation. The weekly measurements will be used to corroborate the pump's data recorder and will alert personnel to a pump failure if the water level is above the known level of the high pump switch.

6.3.3 *Leakage Monitoring Schedule*

The lagoon leak detection systems will be monitored weekly for an initial period, followed by routine monthly monitoring for extended periods. The purpose of the initial weekly monitoring is to determine whether any leaks or defects are present immediately after installation, cleaning, or repair, as well as to verify proper function of the leak detection and pump-back system. The lagoon liner will not pass construction quality assurance inspection if any leaks are present after installation.

Weekly post-construction monitoring will begin on the date the newly lined lagoon begins to receive wastewater or stormwater. It is anticipated that weekly monitoring can conclude when the lagoon

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has contained liquid for at least 1 month. If no liquid accumulates in the sump or the liquid level does not change in the sump, monitoring will continue on a monthly basis.

6.3.4 *Leakage Trigger Values and Response Actions*

As discussed in Section 3, the drainage layer for the SDCB conveys flows to a sump located in the lagoon. An automatic sump pump with high- and low-level settings will pump collected leakage water from the sump back to the lagoon via an HDPE discharge pipe through the slope riser conduit (see the *Construction Drawings* for details [Attachment D]). The high-level setting will activate the pump when water levels read by the transducer indicate 22 inches of liquid. This level was selected to ensure the pump has adequate running time to prevent short-cycling. The low-level switch will be set to deactivate the sump pump when water levels read 18 inches from the pump's level transducer. The stage and storage of the collection sump is presented in Table 3. Note that the total storages indicated assume the rock within the sump contains 35% voids and the transducer sits 6 inches above the bottom of the sump (the pump has a 6-inch diameter casing).

Table 3
Safety Debris Catch Basin Leak Detection/Collection Sump Stage/Storage

Stage (feet)	Total Storage (cubic feet)	Total Storage (gallons)
0.00	0.00	0.00
0.30	26.0	407
0.60	57.1	771
0.90	93.5	1,095
1.20	136	1,381
1.50	183	1,632
1.80	238	1,849
2.00*	278	1,976
2.10	298	2,034
2.40**	366	2,191
2.70	441	2,321
3.00	523	2,427

Notes:
*: static liquid level
**: pump start level
Highlighted rows indicate the static liquid and pump action levels within the sump.
The following subsections identify several leakage rates and the response actions that will be triggered if those rates are exceeded.

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6.3.4.1 De Minimus Leak Rate – 6 Gallons per Acre per Day: No Action Required

A study of allowable leak rate regulations in the United States reports that vapor diffusion through a perfect geomembrane with no flaws can be up to 2 gallons per acre per day (gpad) (Geosynthetic Institute 2009). As a result, some leakage is to be expected to reach the collection sump and be pumped back to the lagoon. The SDCB has a lined waste-to-liner contact area of 27,500 square feet (approximately 0.63 acres). Therefore, the de minimus leak rate of 2 gpad corresponds to approximately 1.3 gallons per day (gpd). Based on the collection sump and pump-back system design discussed previously, a leak of 1.3 gpd would fill the sump and trigger the high-level switch approximately once every 165 days. The de minimus rate will not trigger any response action.

6.3.4.2 Monitoring Leak Rate – 20 Gallons per Acre per Day: Weekly Monitoring, Leachate Comparison

The selected MLR is roughly 10 times the de minimus rate discussed in Section 6.3.4.1; therefore, leakage rates exceeding 20 gpad should be an indication that one or more defects are present in the upper liner and are resulting in a leak. This rate corresponds to a total flow rate of approximately 13 gpd. Based on the collection sump and pump-back system design discussed previously, a leak of 13 gpd would fill the sump and trigger the high-level switch approximately every 17 days.

Since this leak rate represents less than 0.5% of the leak collection system's design drainage capacity of 3,000 gpd, leaks of this magnitude should not trigger a repair. Rather, if the leak rate in the SDCB exceeds the MLR of 20 gpad, Cow Palace personnel will conduct weekly inspections of the pump-back system components to ensure they are continuing to function properly and not allowing liquid to back up into the drainage layer.

In addition, leakage rates above the MLR will trigger the collection of two liquid samples from the lagoon for visual comparison: one from the collection sump and one from the lagoon itself. The two samples will be compared for odor, color, and turbidity.

6.3.4.3 Intermediate Leak Rate – 150 Gallons per Acre per Day: Weekly Monitoring, Analytical Sampling

The ILR of 150 gpad corresponds to approximately 95 gpd for the SDCB, and a leak of this magnitude represents approximately 3.2% of the leak collection system's design drainage capacity. A leak of 95 gpd would fill the sump and trigger the high-level switch approximately every 2.3 days.

Similar to the MLR, flows in excess of the ILR will not trigger a repair. Rather, leakage in excess of 150 gpad will trigger weekly monitoring of the pump-back system components to ensure they are continuing to function properly and not allowing liquid to back up into the drainage layer.

In addition, Cow Palace personnel will continue to monitor the system and document a weekly leak rate correlated to lagoon elevation. If practicable, the liquid elevation will be decreased to determine

if the leak rate shows a marked decrease. If so, the liquid elevation will be recorded to identity the location/liquid elevation of the expected leak.

Leakage rates above the ILR will also trigger the collection of two liquid samples from the lagoon for laboratory analysis: one from the collection sump and one from the lagoon itself. The two samples will be submitted to Cascade Analytical, Inc.'s laboratory in Yakima, Washington, for analysis of total suspended solids, total nitrogen, ammonia, and chloride so that a comparison can be made between the primary lagoon contents and the liquid leachate collecting in the sump. This may provide information as to the source of the liquid in the leak detection sump (e.g., precipitation, stormwater, or lagoon liquid).

6.3.4.4 Large Leak Rate – 1,000 Gallons per Acre per Day: Increased Monitoring, Schedule Inspection and Repair

The LLR of 1,000 gpad corresponds to a total flow rate of approximately 630 gpd or 0.4 gallons per minute for the SDCB. This represents approximately 21% of the design capacity of the liner system's drainage layer. A leak of 630 gpd would fill the sump and trigger the high-level switch approximately once every 8 hours.

Due to the operational constraints of the Cow Palace dairy facility, it may not be possible to stop using the lagoon until the next scheduled draining. As a result, the leak detection material and pump are oversized to allow draining of the leak detection sump and prevent liquid and pressure accumulation on the bottom liner.

Given the design capacity of the drainage system and the leak removal sump, the lagoon could operate at a maximum leakage rate of 3,000 gpd. A leak of 3,000 gpd would fill the sump and trigger the high-level switch approximately once every 1 to 2 hours.

Leakage in excess of the LLR will trigger response actions that include the following:

- Monitor pumping rates daily.
- Perform daily monitoring to ensure the pumping system is operating.
- Isolate and drain the lagoon as much as necessary to conduct repairs as soon as operationally practical.

Once the lagoon liquid level can be reduced as part of the normal dairy operations, the following actions will occur:

- Clean any residual solids that may impede liner repair.
- Retain an independent liner inspection company to identify leaks.
- Conduct a thorough inspection of the liner system.
- Retain and independent liner repair company to repair any identified leaks.
- Test any repair for integrity.

6.3.5 *Liner Testing*

The testing of the liner shall follow the procedure described in ASTM International (ASTM) D5820 – Standard Practice for Pressurized Air Channel Evaluation of Dual-Seamed Geomembranes. Manufacturer specifications will be included in the attachments of this OMMP once a manufacturer has been selected through competitive bidding.

6.3.6 *Liner Repair*

After the project is constructed, repair procedures for the specific liner chosen will be obtained from the manufacturer. The repair of any defects in the liner will be performed in accordance with manufacturer specifications. Manufacturer specifications will be included in the attachments of this OMMP once a manufacturer has been selected through competitive bidding.

The liner will be retested in accordance with ASTM D5820 to ensure that all holes have been repaired before the lagoon is placed back into service.

6.4 Liner Inspection Procedure

Routine inspections will be performed by Cow Palace personnel on a regular schedule. As the lagoon starts to fill, weekly inspections will be conducted. After four weekly inspections with no leakage, the schedule will be reduced to monthly inspections. The lagoon inspection form in Attachment C will be completed and retained after each inspection.

Routine inspections will include the following:

1. Visual inspection of the perimeter of the lagoon that looks specifically for signs of access from animals or workers, wind damage, or rodent activity
2. Visual inspection of the embankments that looks for signs of erosion
3. Visual inspection of the protective fence and signage
4. Visual inspection of inlets or outlets
5. Visual inspection of solids accumulation in the SDCB
6. Recording of lagoon liquid level
7. Recording of sump pumping rate and liquid level

The liner system is subject to inspection if one of the following criteria is met:

- An LLR (greater than 630 gpd) has been detected, triggering increased monitoring and inspection.
- Solids have accumulated that significantly decrease the useable pond volume.

If a liner inspection is to be performed, the owner will hire a qualified contractor for the following:

- Perform a thorough visual liner inspection.

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- Leak-test the liner per ASTM D5820.

Testing of HDPE liner life expectancy is ongoing. Several manufacturers indicate a lifespan of 20 to 30 years, depending on exposure. GRI White Paper No. 6, provided in Attachment E, indicates a life expectancy of greater than 36 years. After the life expectancy has passed, the liner system may need to be replaced. Liner replacement will be required following manufacturer specifications and criteria.

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7 Reporting

Cow Palace will prepare an initial Operations and Maintenance Report for submittal to EPA after 1 full calendar year of lagoon operation. The Operations and Maintenance Report shall include record drawings of the lagoon construction and be due on or before January 31, 2021. The Operations and Maintenance Report will summarize operations and maintenance activities and data from the previous calendar year.

After the first report, lagoon monitoring data will be archived at the Cow Palace office, and a brief summary of the operations during the year will be provided in the facility's Annual Report.

In the event of a large leak, the EPA will be notified within 7 days of confirmation. Response action will be taken according to this plan, and an Annual Report will be issued to EPA documenting the leak, the action taken, and verification that the leak had been repaired and the lagoon is fully operational with all leaks repaired.

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8 References

Geosynthetic Institute, 2009. GRI White Paper No. 15. "Survey of U.S. State Regulations on Allowable Leakage Rates in Liquid Impoundments and Wastewater Ponds." Written by Robert M. Koerner and Jamie R. Koerner. May 6, 2009.

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Figure

SOURCE: Aerial from Microsoft (Bing) 5/14/2019
HORIZONTAL DATUM: Washington State Plane South Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet

0 400
Feet

ANCHOR QEA

Figure 1
Cow Palace Dairy Lagoon Map

Operations, Maintenance, and Monitoring Plan
Cow Palace Dairy Safety Debris Catch Basin

Attachment A
Torpedo Pump Specifications

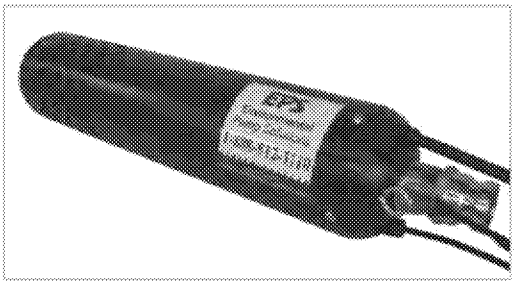
Torpedo Encapsulator Sloperiser Pump — *Model 16SRP*

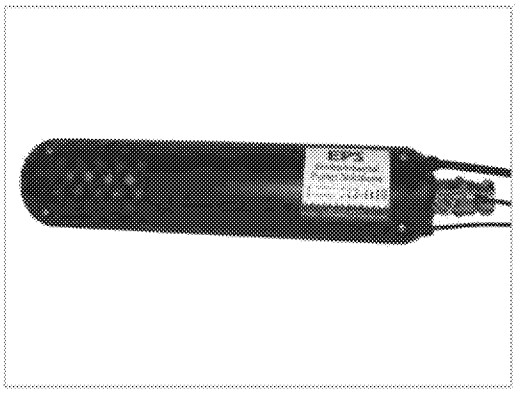
EPS submersible pumps are made of stainless steel and fitted with teflon seals and bearings to handle the rigors of contaminated groundwater pumping and continuous operation in landfill/remediation applications. Built to deliver optimum efficiency during periods of high demand, all EPS pumps provide low, long-term operating costs and high operating reliability.

EPS environmental submersibles meet government guidelines for environmental equipment and have been proven through extensive use in the field.

FEATURES

- **Made For 12" and Larger Wells**
  Flow rates of 10 to 20 GPM (37.8 to 75.7 LPM).
- **State-of-the-art Hydraulics**
  Pump efficiency is maximized by constant improvement of the high-performance hydraulic design, and precise manufacturing process.
- **Manufactured With High-grade Stainless Steel**
  Rugged stainless steel construction inside and out resists corrosion and attack from aggressive liquids.
- **Wear-resistant Design**
  Designed to flush abrasive particles from the pump, and made from stainless steel to resist wear caused by abrasives.
- **Built-in Check Valve**
  Prevents back-flow into the well once the pump is shut down.
- **1/2 to 10 HP Motors**
  Stainless steel construction and quality design.
- **Motor Controls and Protection**
  Available controls to protect the motor against burnout and dry-running, plus the ability to monitor the system allowing the user to optimize settings.





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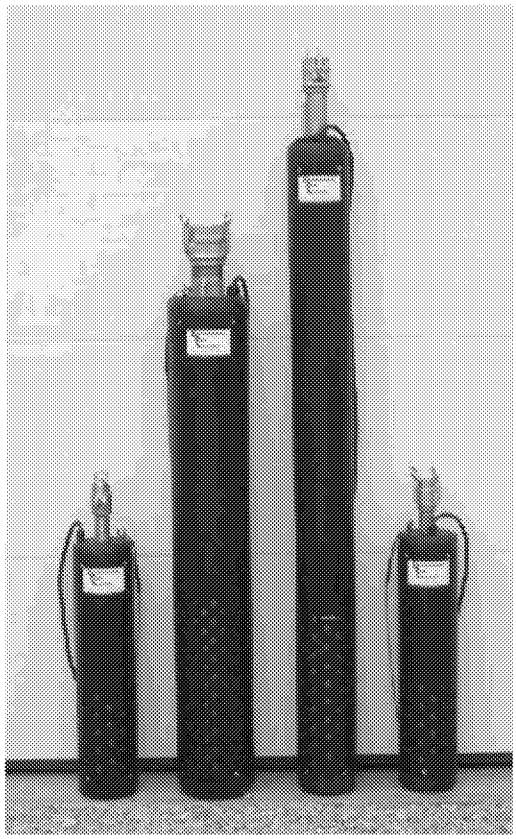
Vertical Drawdown Pump — *Model 16VSP*

EPS vertical drawdown pumps are made of stainless steel and fitted with teflon seals and bearings to handle the rigors of contaminated groundwater pumping and continuous operation in landfill/ remediation applications. Built to deliver optimum efficiency during periods of high demand, all EPS pumps provide low, long-term operating costs and high operating reliability.

EPS vertical drawdowns meet government guidelines for environmental equipment and have been proven through extensive use in the field.

FEATURES

- **Made For 10" and Larger Wells**
  Flow rates of 10 to 20 GPM (37.8 to 75.7 LPM).
- **State-of-the-art Hydraulics**
  Pump efficiency is maximized by constant improvement of the high-performance hydraulic design, and precise manufacturing process.
- **Manufactured With High-grade Stainless Steel**
  Rugged stainless steel construction inside and out resists corrosion and attack from aggressive liquids.
- **Wear-resistant Design**
  Designed to flush abrasive particles from the pump, and made from stainless steel to resist wear caused by abrasives.
- **Built-in Check Valve**
  Prevents back-flow into the well once the pump is shut down.
- **1/2 to 10 HP Motors**
  Stainless steel construction and quality design.
- **Motor Controls and Protection**
  Available controls to protect the motor against burnout and dry-running, plus the ability to monitor the system allowing the user to optimize settings.
- **Special Modifications virtually eliminate air locking**



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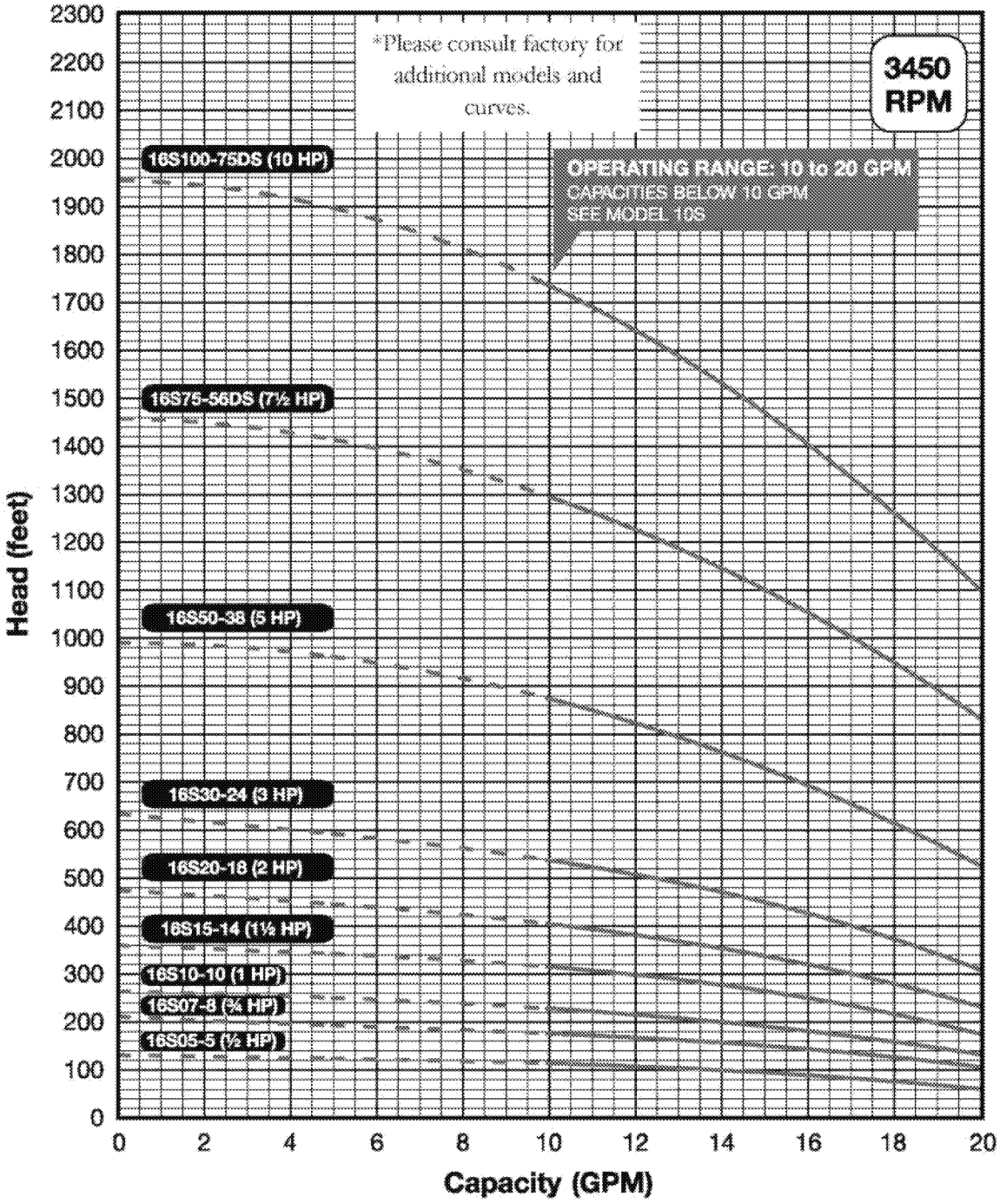
Model 16SRP — 16 GPM — Performance Curves

FLOW RANGE: 10 - 20 GPM | OUTLET SIZE: 1¼" NPT | NOMINAL DIA. 4"



Specifications subject to change without notice.
4" motor standard, .5-5 HP/3450 RPM.
6" motor standard, 7.5-10 HP/3450 RPM.
DS = Deep Set model version for high head requirements.
Performance conforms to ISO 2548 Annex B @ 2 ft. minimum submergence.

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Model 16SRP — 16 GPM — Technical Data

DIMENSIONS & WEIGHTS

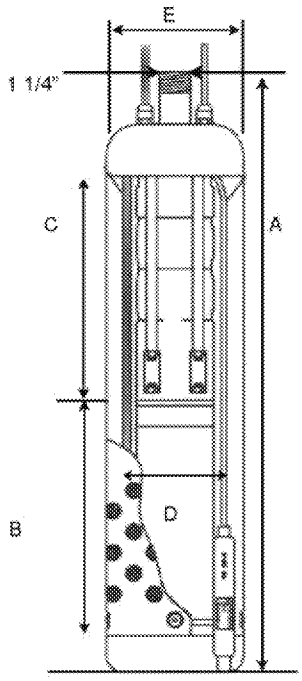
Model No.	Fig.	HP	Motor Size In.	Discharge Size	Dimensions A In.	B In.	C In.	D In.	E In.	Approximate Shipping Wt. Lbs.
16SRP05-5	A	½	4	1 ¼" NPT	27.7	9.5	10.2	3.8	6.5	32
16SRP07-8	A	¾	4	1 ¼" NPT	31.4	10.7	12.7	3.8	6.5	34
16SRP10-10	A	1	4	1 ¼" NPT	34.2	11.8	14.4	3.8	6.5	37
16SRP15-14	A	1 ½	4	1 ¼" NPT	40.8	15.1	17.7	3.8	6.5	41
16SRP20-18	A	2	4	1 ¼" NPT	44	15.1	20.9	3.8	6.5	45
16SRP30-24	A	3	4	1 ¼" NPT	54.5	20.6	25.9	3.8	6.5	69
16SRP50-38	A	5	4	1 ¼" NPT	69.1	23.6	37.5	3.8	6.5	99
16SRP75-56DS*	B	7 ½	6	1 ¼" NPT	101	24.2	68.8	5.4	8.5	225
16SRP100-75DS*	B	10	6	1 ¼" NPT	117.9	25.4	84.5	5.4	8.5	250

Weights include pump end with motor in lbs.

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT (5-24 Stgs.)	CYLINDRICAL SHAFT (38 Stgs.)	DEEP SET (56-75 Stgs)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Pump Shaft	304 Stainless Steel	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	316 Stainless Steel	316 Stainless Steel
Coupling	329/420/431 Stainless Steel	329/420/431 Stainless Steel	329/416 Stainless Steel**
Check Valve Seat	Teflon/304 Stainless Steel	Teflon/316 Stainless Steel	Teflon/316 Stainless Steel
Top Bearing	Teflon/304 Stainless Steel	Teflon/316 Stainless Steel	Teflon/316 Stainless Steel
Impeller Seal Ring	Teflon	Teflon	Teflon
Intermediate Bearings	Teflon	304 Stainless Steel	Teflon /316 Stainless Steel
Shaft Washer	Teflon	Teflon	Teflon
Split Cone	Not Required	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	Not Required	316 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	Not Required	Zincless Bronze*
Coupling Key	Not Required	Not Required	302/304 Stainless Steel**

NOTES: Specifications subject to change without notice.



* Stainless Steel option available

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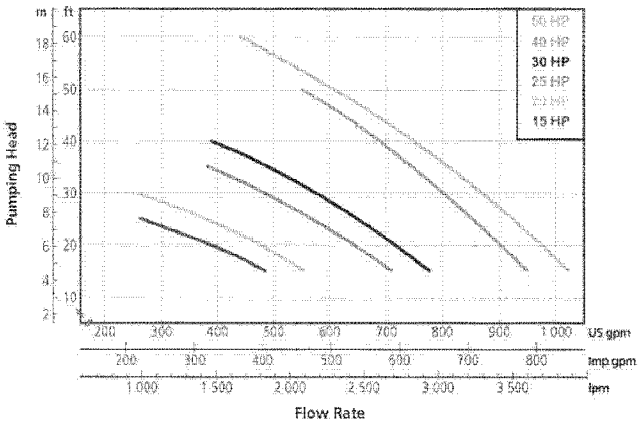
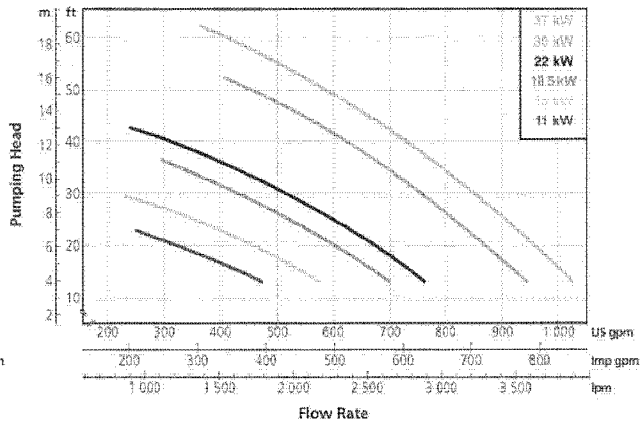
Attachment B
Agitator Cut Sheet

Working Range

4" Agi-Pompe with 60 Hz Motor



4" Agi-Pompe with 50 Hz Motor

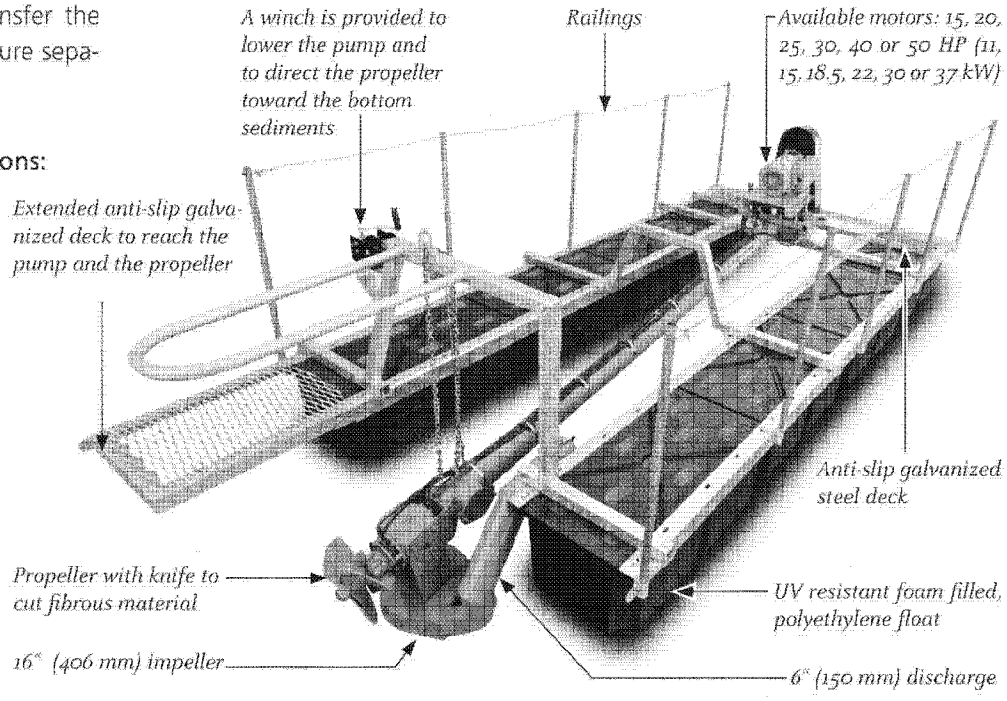


4" Horizontal Agi-Pompe on Pontoon

Typical Application

Used to agitate and transfer the rejected liquid from manure separators.

Float overall dimensions:
Width: 7'-8" (2.3 m)
Length: 16' (4.9 m)



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Attachment C
Lagoon Inspection Form – Example

Safety Debris Catch Basin Inspection Form

General Information

O&M Plan: Cow Palace Dairy Facility Operations, Mainenance and Monitoring Plan
Safety Debris Catch Basin (5/15/2019)

Date of This Inspection: _____

Date of Last Inspection: _____

Inspector's Name/Signature: _____

Inspection Schedule

Current Known Leakage Rate (circle one):

< 40 gal/day	40-400 gal/day	400-2,000 gal/day	> 2,000 gal/day
Choose from routine schedule below	Weekly inspections Samples for visual	Weekly inspections Samples for lab analysis	Drain and clean **Find and repair leak**

Routine Schedule

1 Routine Weekly Inspection
(Begin when lagoon begins receiving waste, end one month after lagoon level reaches 5 -ft)

2 Routine Monthly Inspection
(Begin one month after level reaches 5 -ft, end once lagoon is emptied, cleaned, or repaired)

Inspection Checklist

Verify the items below were inspected by placing check mark or filling in value.

Site Perimeter: _____ Total Gallons Pumped:* _____

Embankments: _____ Sump Liquid Level (in): _____

Inlets/Outlets: _____ Lagoon Liquid Level (ft): _____

Discuss any maintenance you performed: _____

_____

_____

Discuss any items that require future maintenance: _____

_____

_____

* See Page 3 for procedure to read total gallons pumped from meter.

Safety Debris Catch Basin Inspection Form

Lagoon Data

Lagoon Level at Time of Inspection: _____ (feet below dam crest)

Lagoon Inflow at Time of Inspection: _____ (cfs/gpm)

Lagoon Outflow at Time of Inspection: _____ (cfs/gpm)

Condition of Embankment

Crest: _____

_____

_____

(Check for surface cracking, animal burrows, low areas, ruts, trees, brush)

Upstream Face: _____

_____

_____

(Check for slumps, slides, liner cracks, sinkholes)

Downstream Face: _____

_____

_____

(Check for wet areas, seepage, slides, slumps, change in slopes, animal burrows, erosion, trees, brush)

Spillway
Drop Inlet _____

_____

_____

(Check for concrete cracks, spalding, undermining, movement, trashrack, conduit)

Outlet Works _____

_____

_____

(Check for seepage, undermining, erosion, corrosion)

Additional Comments _____

_____

_____

_____

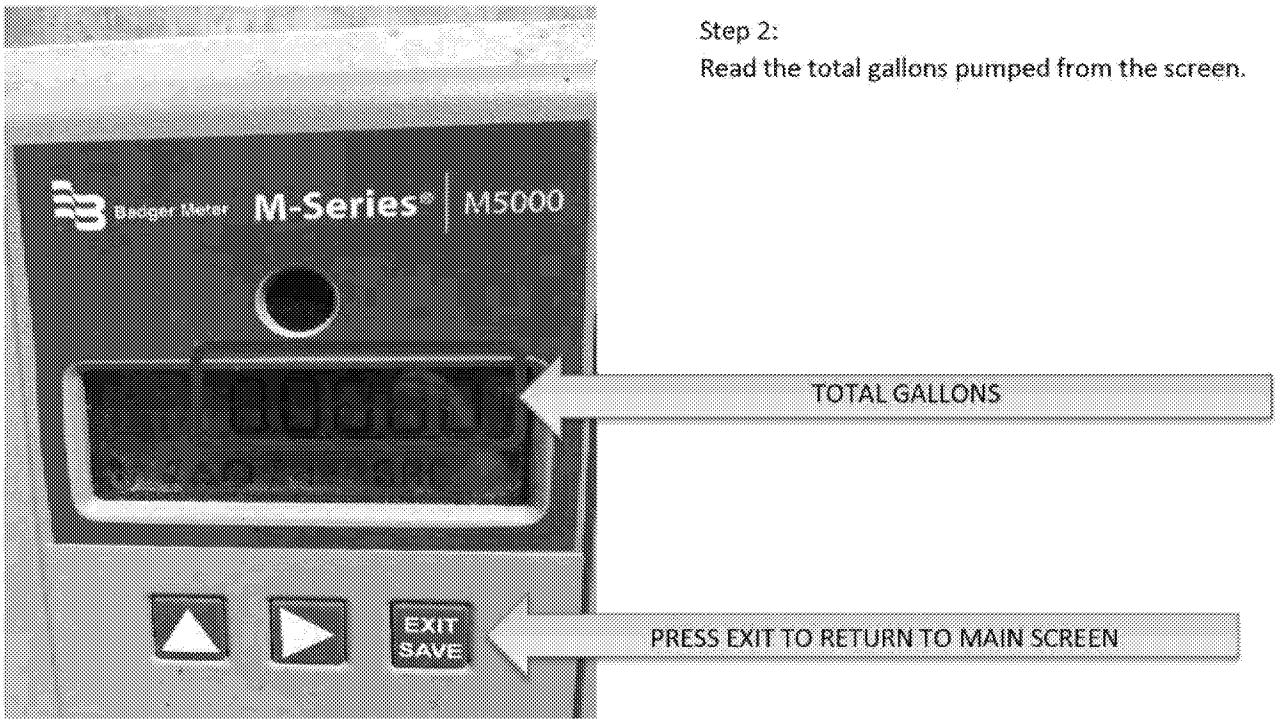
_____

_____

Procedure for Reading Total Gallons Pumped

Note:
This picture shows the default readout of the flow rate meter. The screen should read EmptyP (for empty pipe) when the pump is not running. The error message on the bottom is normal.

Step 1:
Press the "UP" arrow 3 times to bring up the total gallons pumped screen.



Step 2:
Read the total gallons pumped from the screen.

Step 3:
Press "Exit Save" bottom to return to main screen.

Attachment D
Construction Drawings

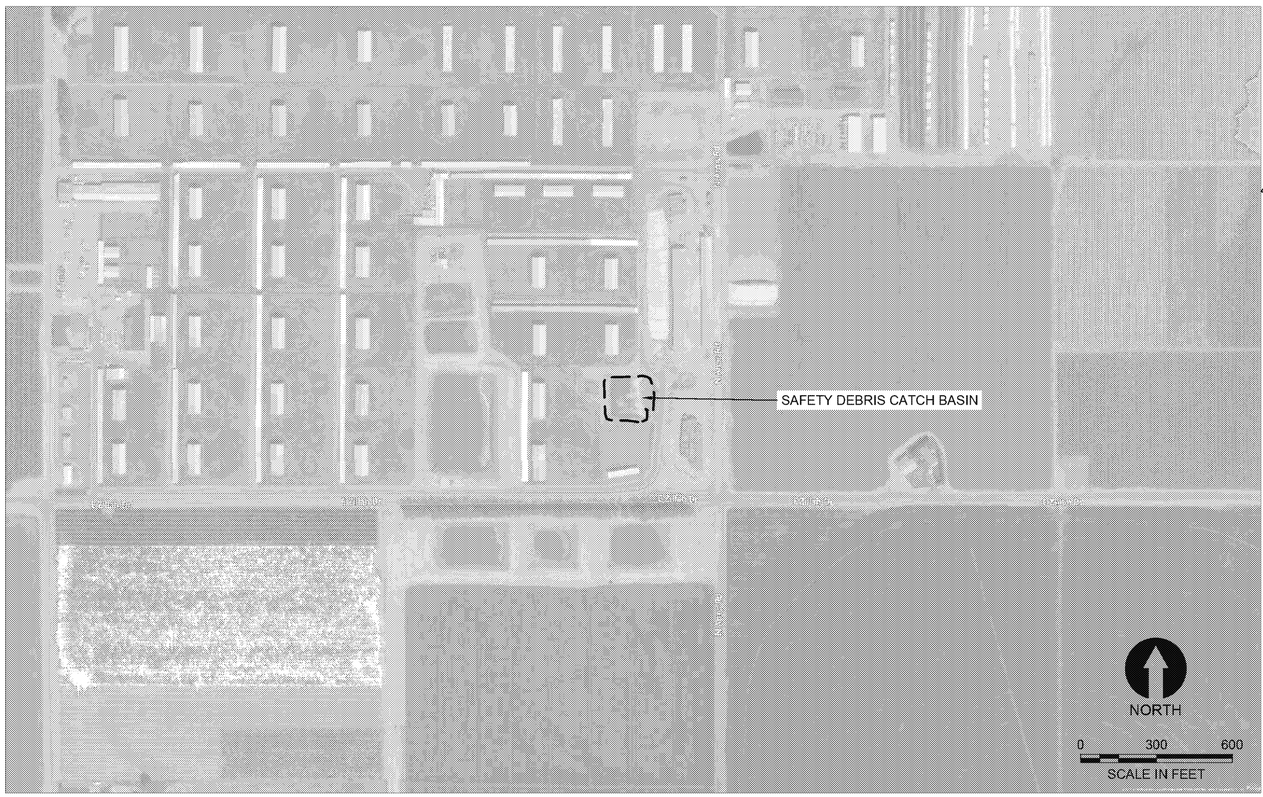
100% DESIGN SUBMITTAL

COW PALACE SAFETY DEBRIS CATCH BASIN

COW PALACE DAIRY

Site Address:
1631 North Liberty Road
Granger, Washington 98932

SDWA-10-2013-0080



SITE LOCATION MAP
SCALE: 1" = 300'

	DRAWING INDEX		
	SHEET #	DRAWING #	TITLE
	1	G-01	COVER SHEET
	2	G-02	GENERAL NOTES
	3	C-01	SITE MAP
	4	C-02	EXISTING CONDITIONS PLAN
1	5	C-03	SITE PLAN
1	6	C-04	FINAL GRADING PLAN
1	7	C-05	VENTING PLAN
1	8	C-06	LAGOON PROFILES
1	9	C-07	LAGOON PROFILES
	10	C-08	DETAILS (1 OF 5)
	11	C-09	DETAILS (2 OF 5)
	12	C-10	DETAILS (3 OF 5)
	13	C-11	DETAILS (4 OF 5)
	14	C-12	DETAILS (5 OF 5)

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	REVISED SHEETS INDICATED

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

COVER SHEET

G-01

SHEET NO. 1 OF 14

Jul 10, 2019 2:40pm rpetrie

ED_002369M_00000063-00283

PROJECT DESCRIPTION:

THE PROJECT SHOWN ON THESE CONSTRUCTION DRAWINGS AND DESCRIBED IN THE CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS CONSISTS OF WORK TO LINE A DAIRY LAGOON. THE WORK REQUIRES SITE PREPARATION, EARTHWORK, TEMPORARY EROSION AND SEDIMENT CONTROL MANAGEMENT, AND SUBGRADE PREPARATION FOR A LEAK DETECTION SYSTEM; INSTALLATION OF SECONDARY AND PRIMARY HDPE GEOMEMBRANE LINERS, GEOCOMPOSITE VENT STRIPS; AND RESTORATION OF DISTURBED AREAS. IN ADDITION, HDPE GEOMEMBRANE LINER INSTALLATION WILL REQUIRE WELDING AND TESTING AS PART OF THE CONSTRUCTION QUALITY CONTROL PLAN EXECUTION. THE WORK IS SUBJECT TO THE OWNER, AGENCY, AND/OR PERMIT CONDITIONS.

PREPARED FOR:

COW PALACE DAIRY
1631 NORTH LIBERTY ROAD
GRANGER, WASHINGTON 98932

PREPARED BY:

ANCHOR QEA, LLC.
1119 PACIFIC AVE
TACOMA, WASHINGTON 98402
PROJECT ENGINEER: JOSH SEXTON, P.E.
PHONE: 206-903-3349
EMAIL: JSEXTON@ANCHORQEA.COM

SURVEY NOTES:

PROJECT VERTICAL DATUM IS NAVD 88, US FT.

PROJECT HORIZONTAL DATUM IS WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, US FT.

1. UTILITIES AND STRUCTURES ARE APPROXIMATE AND ARE LOCATED FROM ABOVE GROUND EVIDENCE ONLY. THERE MAY BE ADDITIONAL UTILITY LINES AND STRUCTURES WITHIN SURVEYED AREAS THAT ARE NOT SHOWN HEREIN.

PLSA ENGINEERING AND SURVEYING
521 N. 20TH AVE., SUITE 3
YAKIMA WASHINGTON, 98902
PHONE: 509-575-6990
EMAIL: JBAKER@PLSAOFYAKIMA.COM

THE ELEVATIONS FOR THIS PROJECT WERE DERIVED BY GPS OBSERVATION USING THE WASHINGTON STATE REFERENCE NETWORK. THE PROJECT BENCHMARK IS A PLSA CONTROL POINT WITH CAP NUMBER 99 AS SHOWN ON THESE DRAWINGS. ELEVATION 1033.12 (NAVD88).

DETAIL REFERENCE NUMBER — 1
DRAWING ON WHICH DETAIL APPEARS ("-" INDICATES TYPICAL OR ON SAME DRAWING) — C-1

DETAIL REFERENCE NUMBER — 1 / - DETAIL SCALE:1" = 10'

GENERAL NOTES:

1. A PRE-CONSTRUCTION SURVEY WILL BE COMPLETED BY THE OWNER OR ENGINEER TO ESTABLISH AND CONFIRM EXISTING CONDITIONS, INCLUDING PIPE INVERT ELEVATIONS AND TOPOGRAPHIC INFORMATION, PRIOR TO THE START OF THE WORK BY THE CONTRACTOR.
2. CONTRACTOR SHALL BECOME FULLY INFORMED OF ALL CONDITIONS AT THE WORK SITE THAT MAY OR COULD DELAY PROJECT COMPLETION, RESULT IN EXTRA WORK, OR COST AND SHALL ACCOUNT FOR THESE CONDITIONS IN THE PRICE BID. NO ADDITIONAL COMPENSATION WILL BE ALLOWED FOR NEGATIVE CONDITIONS THAT COULD REASONABLY HAVE BEEN IDENTIFIED BY A DILIGENT EXAMINATION OF THE SITE AND EXISTING CONDITIONS.
3. CONTRACTOR SHALL PROTECT ALL MATERIALS BOTH PURCHASED AND SALVAGED, FOR THE DURATION OF THE WORK. MATERIALS LOST OR DAMAGED BY CONTRACTORS OPERATIONS OR THROUGH IMPROPER STORAGE SHALL BE REPAIRED OR REPLACED AS DIRECTED BY THE OWNER AT NO ADDITIONAL COST TO THE OWNER.
4. CONTRACTOR SHALL MAINTAIN AND PROVIDE AS-BUILT/RECORD DRAWINGS PER THE TECHNICAL SPECIFICATIONS.
5. CONTRACTOR SHALL COMPLY WITH ALL STATE, COUNTY, AND CITY LAWS, PERMITS AND ORDINANCES RELATED TO SAFETY AND CHARACTER OF WORK, EQUIPMENT AND LABOR PERSONNEL. THIS SHALL INCLUDE, BUT IS NOT LIMITED TO, THE SECURING OF THE WORK AREA AND PREVENTION OF DEBRIS DISCHARGE OUTSIDE THE LIMITS OF CONSTRUCTION.
6. CONTRACTOR SHALL CONTACT THE NORTHWEST UTILITY NOTIFICATION CENTER "CALL BEFORE YOU DIG" HOTLINE AT 1-800-424-5555 (OR 811) AND VERIFY THE EXACT LOCATION OF ANY EXISTING UTILITIES. ANY UTILITIES EXPOSED OR DAMAGED BY THE CONTRACTOR SHALL BE REPAIRED AT CONTRACTORS EXPENSE.
7. ANY CONFLICTS WITH THE DESIGN OR CHANGES TO THE CONSTRUCTION DRAWINGS OR SHOP DRAWINGS SHALL BE AUTHORIZED AND APPROVED BY THE OWNER BEFORE CONTINUING WORK IN THAT AREA.

ABBREVIATIONS	
AC-FT	ACRE-FEET
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AT	ANCHOR TRENCH
BGS	BELOW GROUND SURFACE
CQA	CONSTRUCTION QUALITY ASSURANCE
DIA	DIAMETER
EA	EACH
EL, ELEV	ELEVATION
ESC	EROSION AND SEDIMENT CONTROL
EX	EXISTING
FT	FEET
GA	GAUGE
H, HORIZ	HORIZONTAL
HDPE	HIGH DENSITY POLYETHYLINE
IE	INVERT ELEVATION
IPS	IRON PIPE SIZE
IRR	IRRIGATION
IV	IRRIGATION VALVE
LA	LAGOON ACCESS ROAD
LB	LINER BOTTOM
LC	LINER CREST
LF	LINEAR FEET

CONSTRUCTION NOTES:

1. CONTRACTOR IS RESPONSIBLE FOR ADHERING TO THE STANDARDS SET FORTH IN THE CONTRACT DOCUMENTS AND AS PROVIDED BY THE MANUFACTURER.
2. CONTRACTOR SHALL PROTECT IN-PLACE ALL EXISTING SITE FEATURES, UNLESS OTHERWISE DIRECTED.
3. EXISTING LAGOONS SHALL BE RE-GRADED AS SHOWN IN THE CONSTRUCTION DRAWINGS TO THE DIMENSIONS, GRADES, AND ELEVATIONS SHOWN.
4. CONTRACTOR SHALL MAINTAIN SUBGRADE TO MEET REQUIREMENTS SET IN THE TECHNICAL SPECIFICATIONS PRIOR TO INSTALLATION OF GEOSYNTHETICS.
5. LINER SHALL BE INSTALLED BY AN EXPERIENCED AND CERTIFIED INSTALLER. LINER INSTALLATION SHALL BE EXECUTED TO THE GUIDELINES IN THE TECHNICAL TECHNICAL SPECIFICATIONS AND THE CONSTRUCTION QUALITY ASSURANCE AND CONSTRUCTION QUALITY CONTROL CONSTRUCTION DRAWINGS.
6. LINER INSTALLERS SHALL COMPLY WITH ALL MANUFACTURERS RECOMMENDATIONS AND SPECIFICATIONS FOR INSTALLING, WELDING, AND TESTING TECHNIQUES FOR THE LINER.
7. CONTRACTOR SHALL PROTECT THE LINER FROM VEHICLE OR OTHER CONSTRUCTION TRAFFIC DURING THE COURSE OF THE PROJECT. ANY DAMAGE TO THE LINER OR LINER COMPONENTS FROM THE CONTRACTOR SHALL BE REPLACED OR REPAIRED AT THE CONTRACTOR'S EXPENSE.

811 Know what's below. Call 811 before you dig.

ABBREVIATIONS	
MAX	MAXIMUM
MG	MILLION GALLONS
MIL	0.001 INCH
MIN	MINIMUM
NAD 83	NORTH AMERICAN DATUM, 1983
NAVD 88	NORTH AMERICAN VERTICAL DATUM, 1988
NW	NORTHWEST
O.C.	ON CENTER
PLSA	PLSA ENGINEERING AND SURVEYING
PP	POWER POLE
PVC	POLYVINYL CHLORIDE
SCH	SCHEDULE
SF	SQUARE FEET
SY	SQUARE YARDS
TBD	TO BE DETERMINED
UG	UNDERGROUND
US	UNITED STATES
V, VERT	VERTICAL

EROSION AND SEDIMENT CONTROLS (ESC) NOTES:

1. IMPLEMENTATION OF ESC FACILITIES, MAINTENANCE, REPLACEMENT, AND UPGRADING OF ESC FACILITIES ARE THE RESPONSIBILITY OF THE CONTRACTOR'S ESC SUPERVISOR UNTIL FINAL STABILIZATION IS ESTABLISHED AND SUBSTANTIAL COMPLETION IS ACHIEVED,
2. ESC FACILITIES MUST BE CONSTRUCTED PRIOR TO OR IN CONJUNCTION WITH ALL SUBGRADE PREPARATION SO AS TO MINIMIZE THE TRANSPORT OF SEDIMENT TO SURFACE WATERS, DRAINAGE SYSTEMS, AND ADJACENT PROPERTIES.
3. DURING THE CONSTRUCTION PERIOD, ESC FACILITIES SHALL BE UPGRADED AS NEEDED OR REQUESTED BY CONSTRUCTION MANAGER FOR UNEXPECTED STORM EVENTS AND MODIFIED TO ACCOUNT FOR CHANGING SITE CONDITIONS (E.G., SUMP PUMPS, DITCHES AND SILT FENCES).
4. ESC FACILITIES SHALL BE INSPECTED BY THE CONTRACTOR'S ESC SUPERVISOR AND MAINTAINED TO ENSURE CONTINUED PROPER FUNCTIONING THROUGH PROJECT STABILIZATION.
5. ANY AREAS OF EXPOSED SOILS THAT WILL NOT BE DISTURBED FOR TWO (2) DAYS DURING THE WET SEASON OR SEVEN (7) DAYS DURING THE DRY SEASON SHALL BE IMMEDIATELY STABILIZED WITH APPROVED ESC METHODS (E.G., SEEDING, MULCHING, PLASTIC COVERING).
6. SOILS THAT WILL BE STOCKPILED FOR TWO (2) DAYS DURING THE WET SEASON OR SEVEN (7) DAYS DURING THE DRY SEASON SHALL BE IMMEDIATELY STABILIZED WITH PLASTIC COVERING PER WA DEPT OF ECOLOGY BMP C123E.
7. THE ESC FACILITIES ON AREAS WITHIN THE CONSTRUCTION LIMITS THAT WILL REMAIN UNWORKED FOR SEVEN (7) OR MORE DAYS SHALL BE INSPECTED AND MAINTAINED BY THE CONTRACTOR A MINIMUM OF ONCE A MONTH OR WITHIN FORTY-EIGHT (48) HOURS FOLLOWING A STORM EVENT.
8. MAINTAIN ALL EXISTING STORM DRAINS, CHANNELS, CULVERTS, AND STRUCTURES THAT RECEIVE FLOW UNTIL WORK IS COMPLETE. WHENEVER EXISTING STORM DRAINS, CHANNELS, CULVERTS, OR STRUCTURES ARE DISTURBED; PROVIDE SUITABLE MEANS FOR DIVERTING AND MAINTAINING ALL FLOWS AT CONTRACTOR'S EXPENSE.

BEST MANAGEMENT PRACTICES (BMP) AND MONITORING NOTES:

1. DURING ALL PHASES OF THE WORK, CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PREVENT CONSTRUCTION TRASH AND DEBRIS FROM FOULING LOCAL WATERS AND COMPLY WITH YAKIMA COUNTY BEST MANAGEMENT PRACTICES (BMP) GUIDELINES. THE CONTRACTOR SHALL PROMPTLY CLEAN UP ALL MATERIALS DISCHARGED INTO LOCAL WATERS. IF CONTRACTOR FAILS TO CLEAN UP SPILLS, IT MAY CAUSE THE OFFENDING MATERIALS TO BE REMOVED BY THE OWNER, AND THE COST OF THAT REMOVAL WILL BE DEDUCTED FROM THE CONTRACT PRICE.
2. APPROPRIATE BMPS WILL BE IMPLEMENTED BY THE CONTRACTOR TO REDUCE CONSTRUCTION-RELATED IMPACTS TO NEARBY WATER BODIES.
3. NO CONSTRUCTION MATERIALS, EQUIPMENT, DEBRIS OR WASTE SHALL BE PLACED OR STORED OUTSIDE THE OWNER DESIGNATED STAGING/STOCKPILING AREA OR CONSTRUCTION BOUNDARIES NOTED IN THE DRAWINGS.
4. CONTRACTOR SHALL ENSURE NO UNWANTED DEBRIS, SOIL, SILT, SAND, SAWDUST, RUBBISH, CEMENT OR CONCRETE WASHINGS, OIL OR PETROLEUM PRODUCTS, FROM CONSTRUCTION, ENTERS INTO OR IS PLACED WHERE IT MAY BE INADVERTENTLY WASHED BY RAINFALL OR RUNOFF INTO LOCAL WATER BODIES.
5. REASONABLE AND PRUDENT MEASURES SHALL BE TAKEN BY THE CONTRACTOR TO PREVENT ANY DISCHARGE OF FUEL OR OILY WASTE FROM HEAVY MACHINERY, CONSTRUCTION EQUIPMENT OR POWER TOOLS INTO LOCAL WATER BODIES. CONTRACTOR SHALL HAVE ADEQUATE EQUIPMENT AVAILABLE TO CONTAIN ANY DISCHARGE IMMEDIATELY.

LEGEND:

- 1021 — EXISTING ELEVATION CONTOUR
- EXISTING EMBANKMENT TOP/TOE
- 1213.8 — EXISTING SURVEY SPOT ELEVATION
- EXISTING OVERHEAD POWER
- PP — EXISTING POWER POLE (PP)
- EXISTING 4X4 POST WITH POWER BOX
- IV — EXISTING IRRIGATION WATER VALVE
- IRRIGATION RISER (IRR)
- LD-SB-L6N — EXISTING BORING LOCATION
- UNDERGROUND POWER
- EXISTING FENCE
- WV — WATER VALVE
- SIGN — SIGN
- CONCRETE

LEGEND:

- A A' — PROFILE SECTION LINE
- 1020 — PROPOSED 10&2 FT LINER ELEVATION CONTOURS
- PROPOSED INNER&OUTER EDGES OF ANCHOR TRENCH
- 1020 — PROPOSED 10&2 FT FINAL GRADING ELEVATION CONTOURS OUTSIDE LAGOON CREST
- LA-1 — PROPOSED LINER CONSTRUCTION POINT
- 3:1 — PROPOSED SURFACE GRADE, DIRECTION AND RUN:RISE
- PROPOSED LEAK DETECTION WIRING
- PROPOSED LEAK DETECTION POTENTIAL/CURRENT ELECTRODE
- PROPOSED LEAK DETECTION POTENTIAL ELECTRODE LOCATION
- AL04 — PROPOSED ARTIFICIAL LEAK ELECTRODE LOCATION
- PROPOSED GEOCOMPOSITE GAS VENTING STRIP
- ACCESS ROUTE

ONE INCH — AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON — STATE OF WASHINGTON — 57013 — REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

GENERAL NOTES

G-02

SHEET NO. 2 OF 14

Jul 10, 2019 2:40pm rpetrie

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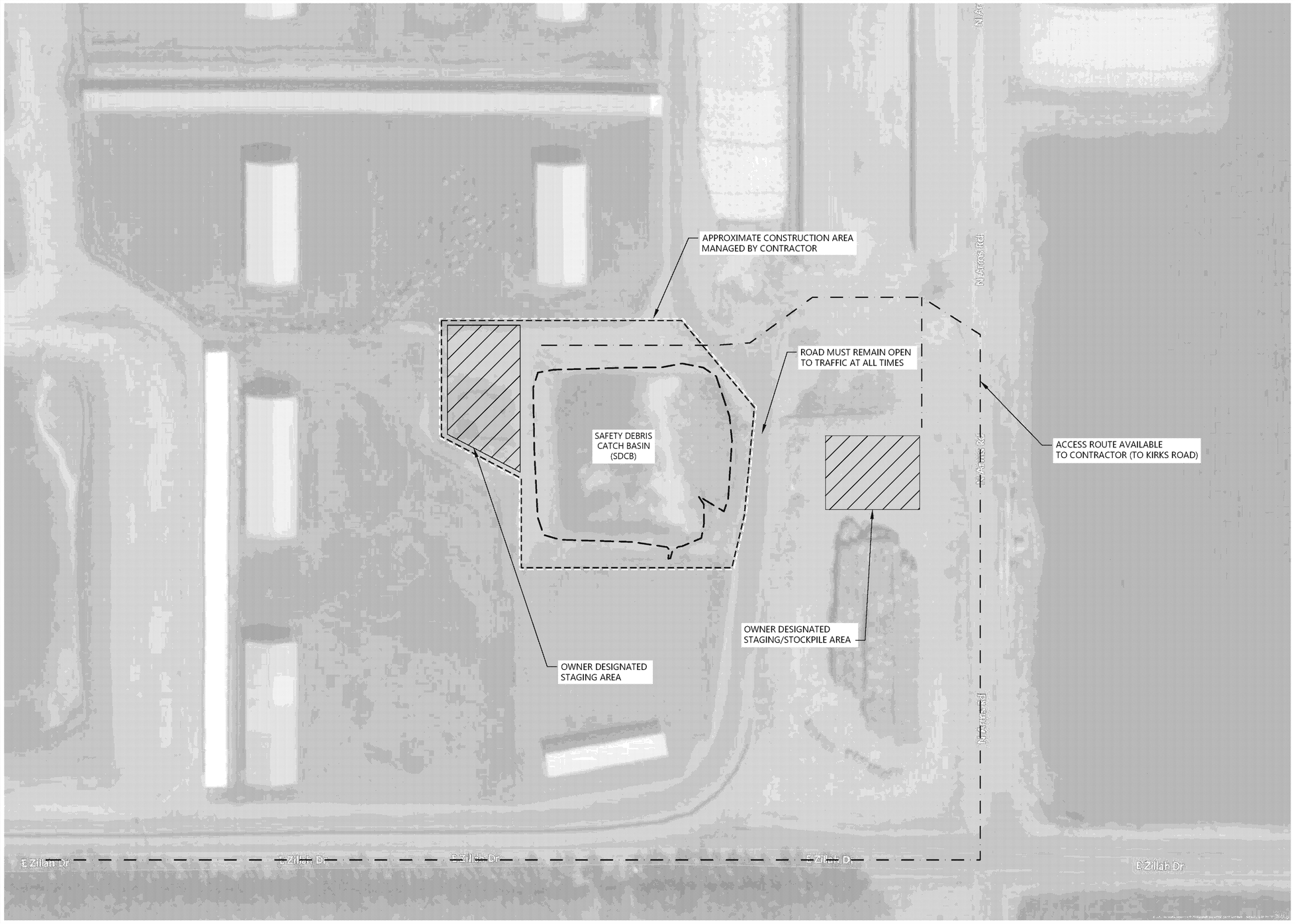


LEGEND:

- ACCESS ROUTE
- APPROXIMATE CONSTRUCTION AREA
- OWNER DESIGNATED STAGING/STOCKPILING AREA
- SAFETY DEBRIS CATCH BASIN

NOTES:

1. THE WORK WILL OCCUR WITHIN AN ACTIVE DAIRY FARM. THE CONTRACTOR SHALL MINIMIZE ITS IMPACTS TO THE OPERATIONS OF THE DAIRY. ROADWAY TO THE EAST OF THE PROJECT AREA MUST REMAIN OPEN TO TRUCK TRAFFIC AT ALL TIMES.
2. THE OWNER DESIGNATED STAGING AND STOCKPILING AREAS ARE THE ONLY AREAS ALLOWED FOR THE CONTRACTOR TO STAGE, STORE, AND PARK EQUIPMENT AND VEHICLES; STAGE AND STORE SUPPLIES, MATERIALS, AND TOOLS; AND STOCKPILE SOILS AND DEBRIS.
3. ACCESS ROUTES ARE PROVIDED TO THE CONTRACTOR BY THE OWNER FOR THE DURATION OF THE WORK AND ARE LIMITED TO VEHICLE AND EQUIPMENT ACCESS ONLY BETWEEN THE STAGING AND STOCKPILING AREA AND THE CONSTRUCTION AREA AS SHOWN, HEREON. MATERIALS, SUPPLIES, VEHICLES, AND EQUIPMENT SHALL NOT OCCUPY THE ACCESS ROUTES, OTHERWISE, WITHOUT PRIOR WRITTEN APPROVAL BY THE OWNER.

NORTH

0 50 100
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S FT.
2. VERTICAL DATUM: NAVD 88.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

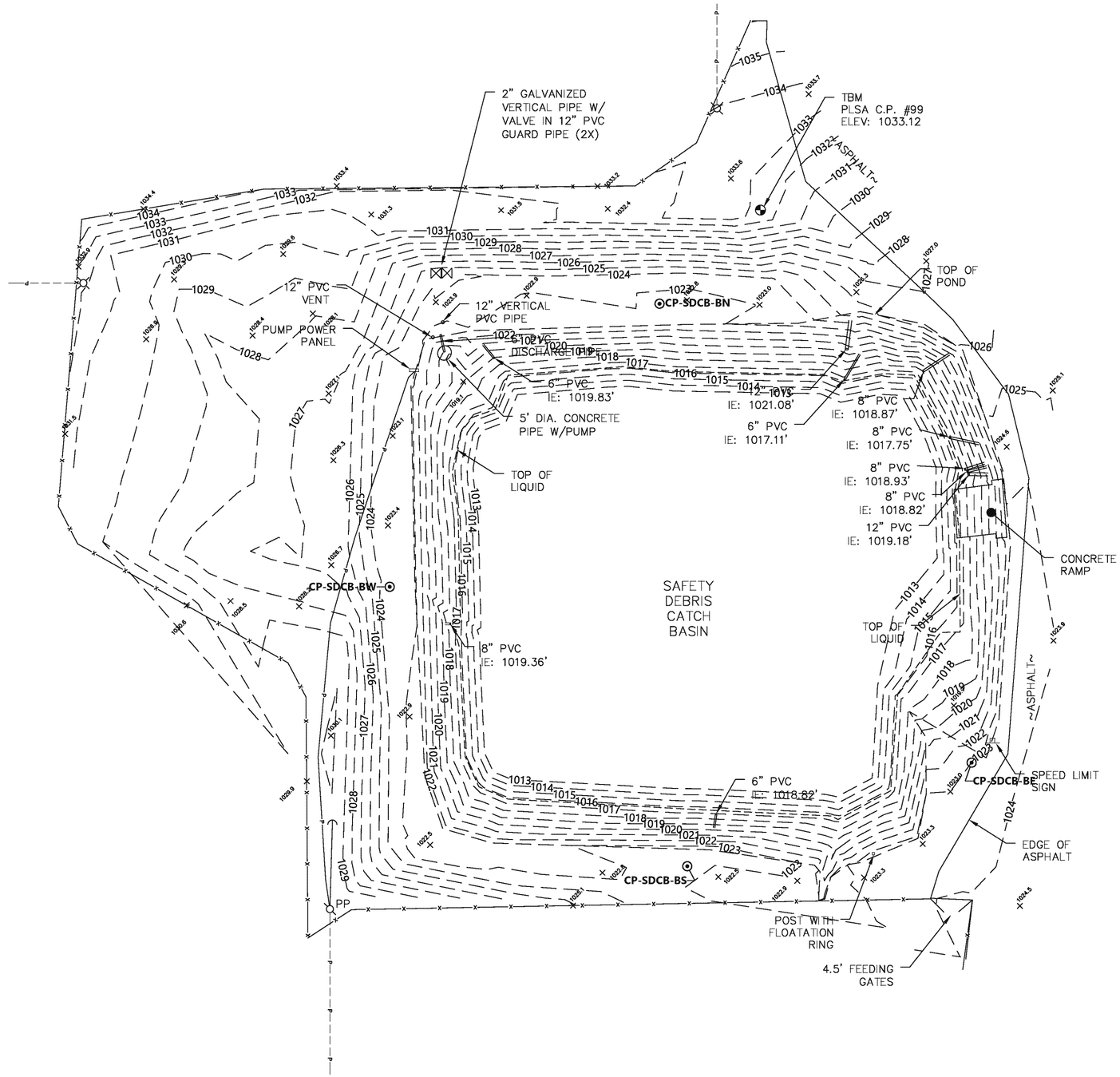
SITE MAP

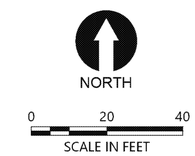
C-01

SHEET NO. 3 OF 14

Jul 10, 2019 2:40pm rpetrie

ED_002369M_00000063-00285





NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S. FT.
2. VERTICAL DATUM: NAVD 88.
3. SURVEY BY PLSA, 4/8/2019.
4. SURVEY SHOWN, HEREON, COMPLETED PRIOR TO EMPTYING OF THE LAGOONS AND DID NOT EXTEND BELOW LIQUID DEPTH. LAGOON CONTOURS BELOW 1017 ESTIMATED BY ANCHOR QEA.
5. OWNER WILL EMPTY LIQUID AND SOLID MANURE FROM SDCB PRIOR TO THE START OF THE WORK BY THE CONTRACTOR.
6. OWNER WILL REMOVE ALL PIPING AND APPURTENANCES PRIOR TO THE START OF THE WORK BY THE CONTRACTOR.
7. PRIOR TO THE START OF THE WORK BY THE CONTRACTOR, THE OWNER OR ENGINEER SHALL COMPLETE A PRE-CONSTRUCTION SURVEY OF LAGOON TO BE USED FOR BASIS OF CONTRACT MEASUREMENT AND PAYMENT.
8. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER
6/17/2019

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

EXISTING CONDITIONS PLAN

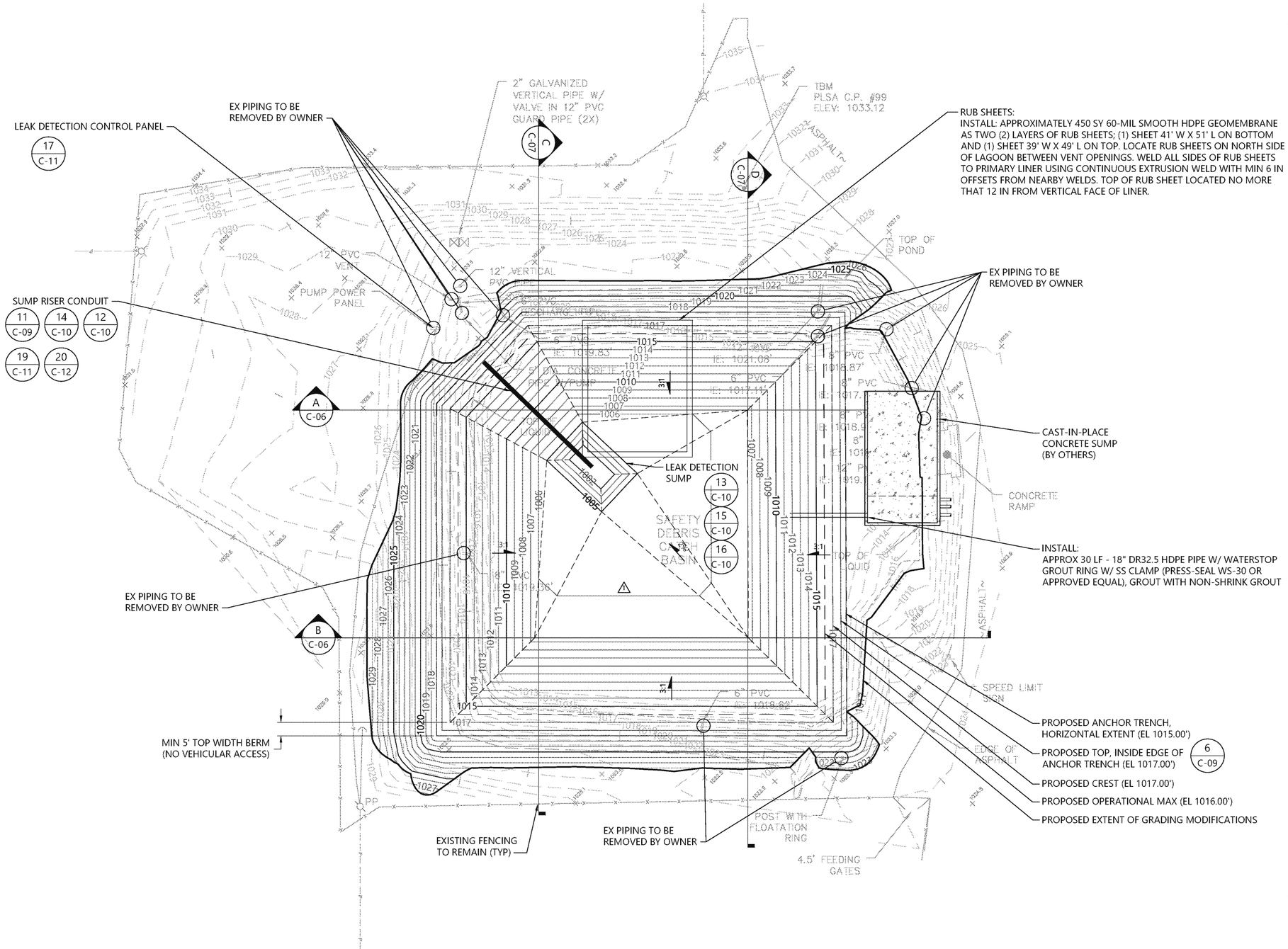
C-02

SHEET NO. 4 OF 14

Jul 10, 2019 2:40pm rpetrie

ED_002369M_00000063-00286

SAFETY DEBRIS CATCH BASIN
3H:1V INTERIOR SIDE SLOPE
BOTTOM EL: 1005.5'
MAX OPERATIONAL EL = 1016.00'
TOP (CREST) EL = 1017.00'
FREEBOARD = 1.00'
MAX OPERATIONAL SURFACE AREA APPROX 18,951 SF
MAX OPERATIONAL VOLUME APPROX 0.92 MG = 2.82 AC-FT
EMERGENCY MAX VOLUME APPROX 1.07 MG = 3.27 AC-FT



NORTH

0 20 40
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S.'.
2. VERTICAL DATUM: NAVD 88.
3. SURVEY BY PLSA, 4/8/2019.
4. SURVEY SHOWN, HEREON, COMPLETED PRIOR TO EMPTYING OF THE LAGOONS AND DID NOT EXTEND BELOW LIQUID DEPTH. LAGOON CONTOURS BELOW 1017 ESTIMATED BY ANCHOR QEA.
5. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SELTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER
7/10/2019

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	REVISED BOTTOM GRADING

DESIGNED BY: K SKELLENGER
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

SITE PLAN

C-03

SHEET NO. 5 OF 14

Jul 10, 2019 2:40pm rpetrie

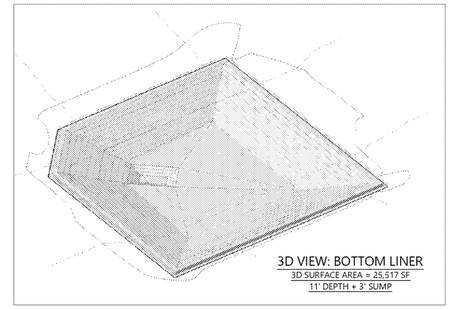
ED_002369M_00000063-00287

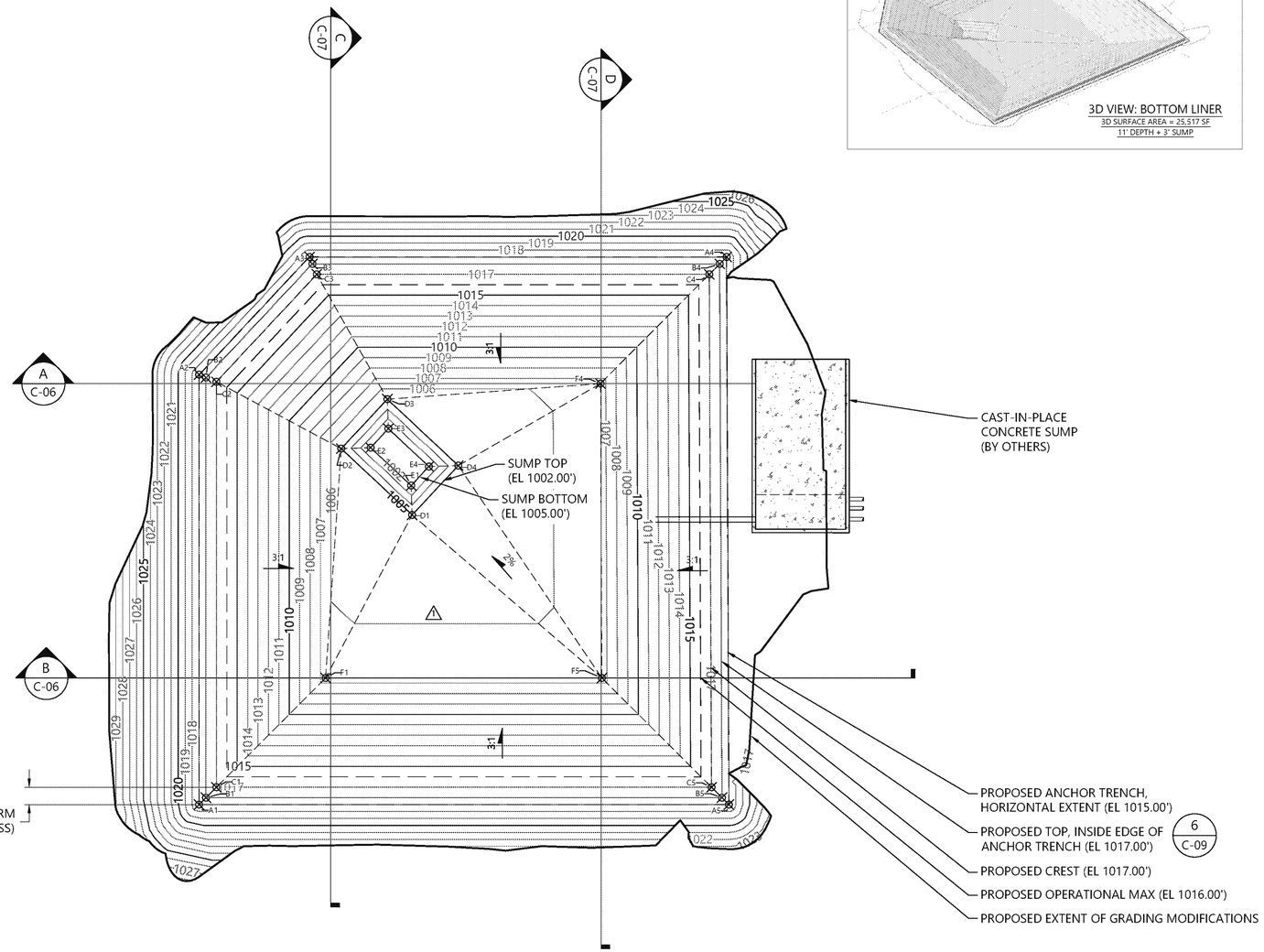
ANCHOR TRENCH (A,B) POINT TABLE				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
155	391075.83	1731818.05	1015.00 FT	A1
156	391199.79	1731818.05	1015.00 FT	A2
157	391233.69	1731849.93	1015.00 FT	A3
153	391233.69	1731970.19	1015.00 FT	A4
154	391075.83	1731970.84	1015.00 FT	A5
159	391077.82	1731820.04	1015.00 FT	B1
160	391198.96	1731820.04	1015.00 FT	B2
161	391231.70	1731850.76	1015.00 FT	B3
162	391231.70	1731968.20	1015.00 FT	B4
158	391077.82	1731968.85	1015.00 FT	B5

LINER CREST (C) POINT TABLE				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
164	391080.83	1731823.05	1017.00 FT	C1
165	391197.72	1731823.05	1017.00 FT	C2
166	391228.69	1731852.00	1017.00 FT	C3
167	391228.69	1731965.19	1017.00 FT	C4
163	391080.83	1731965.84	1017.00 FT	C5

SUMP (D,E) POINT TABLE				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
171	391159.33	1731879.50	1005.00 FT	D1
168	391178.45	1731859.05	1005.00 FT	D2
169	391192.69	1731872.36	1009.25 FT	D3
170	391173.57	1731892.82	1005.00 FT	D4
175	391167.81	1731879.21	1002.00 FT	E1
172	391178.73	1731867.53	1002.00 FT	E2
173	391184.21	1731872.65	1002.00 FT	E3
174	391173.28	1731884.34	1002.00 FT	E4

LINER BOTTOM (F) POINT TABLE				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
176	391112.33	1731854.55	1006.50 FT	F1
178	391197.19	1731933.82	1006.50 FT	F4
177	391112.33	1731934.21	1006.50 FT	F5





SEQUENCING AND SELECT WORK REQUIREMENTS:

1. NOT ALL WORK IS DESCRIBED BELOW; REFER TO THESE DRAWINGS, TECHNICAL SPECIFICATIONS, AND OTHER CONTRACT DOCUMENTS.
2. PRIOR TO THE START OF THE WORK THE OWNER SHALL COMPLETE A PRECONSTRUCTION SURVEY OF LAGOON TO BE USED FOR BASIS OF CONTRACT MEASUREMENT AND PAYMENT.
3. CONTRACTOR SHALL PREPARE FINAL GRADE TO THE LINES, EXTENTS, AND ELEVATIONS SHOWN HEREON.
4. EXCESS IN-SITU SOILS FROM THE LAGOON SHALL BE STOCKPILED IN THE DESIGNATED AREA (SHOWN ON DRAWING C-01) AND MANAGED IN ACCORDANCE WITH STORMWATER REQUIREMENTS; SEE TECHNICAL SPECIFICATIONS FOR FURTHER DETAILS.
5. THE FINISH GRADE SHALL BE A SMOOTH, UNYIELDING SURFACE FREE OF ORGANICS, DEBRIS, AND ROCK 3/8 INCH DIA OR LARGER.
6. UNLESS OTHERWISE REQUIRED IN THE TECHNICAL SPECIFICATIONS, PLACED FILL SHALL BE COMPACTED TO 92% OF THE MAX DRY DENSITY AS DETERMINED USING ASTM D1557 (MODIFIED PROCTOR).
7. UNLESS OTHERWISE REQUIRED IN THE TECHNICAL SPECIFICATIONS, SUBGRADES IN EXCAVATION AREA SHALL BE PROOF-ROLLED USING CONSTRUCTION EQUIPMENT TO VERIFY THE SUBGRADE IS IN A NONYIELDING CONDITION. THE ENGINEER SHALL DETERMINE WHAT EQUIPMENT IS SUITABLE FOR PROOF-ROLLING. THE ENGINEER SHALL MONITOR PROOF-ROLLING FOR YIELDING SUBGRADE SOILS. THE CONTRACTOR SHALL REMOVE SOFT SOILS TO A DEPTH RECOMMENDED BY THE ENGINEER AND REPLACE THE OVEREXCAVATION WITH ONSITE FILL MATERIAL OR IMPORT FILL MATERIAL TO BE COMPACTED AND TESTED IN ACCORDANCE WITH NOTE 6 AND THE TECHNICAL SPECIFICATIONS.
8. CONTRACTOR SHALL THEN COMMENCE INSTALLATION OF THE VENT SYSTEM GEOCOMPOSITE STRIPS, HDPE GEOMEMBRANE COVER STRIPS, GEOTEXTILE FABRIC, WELDED HDPE SECONDARY LINER, AND WELDED HDPE GEOMEMBRANE PRIMARY LINER IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS, THESE DRAWINGS, AND THE APPROVED CQA PLAN.

NORTH

0 20 40
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S.'.
2. VERTICAL DATUM: NAVD 88.
3. SURVEY BY PLSA, 4/8/2019.
4. SURVEY SHOWN, HEREON, COMPLETED PRIOR TO EMPTYING OF THE LAGOONS AND DID NOT EXTEND BELOW LIQUID DEPTH. LAGOON CONTOURS BELOW 1017 ESTIMATED BY ANCHOR QEA.
5. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SELTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER
7/10/2019

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	REVISED BOTTOM GRADING

DESIGNED BY: K SKELLENGER
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

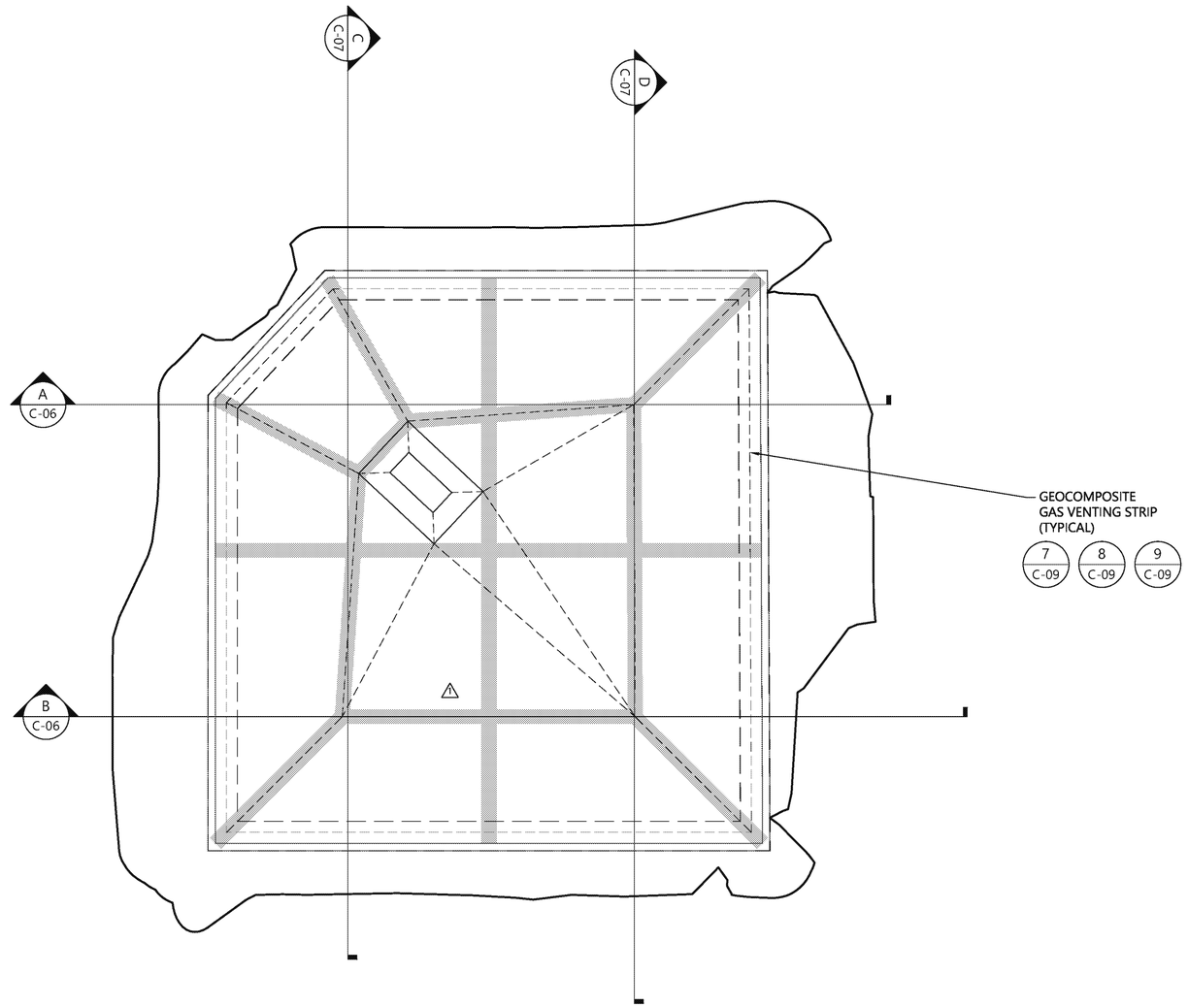
COW PALACE SAFETY DEBRIS CATCH BASIN

FINAL GRADING PLAN

C-04

SHEET NO. 6 OF 14

Jul 10, 2019, 2:41pm repetrie



NORTH

0 20 40
SCALE IN FEET

NOTES:

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5. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED
PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	ADJUSTED VENT STRIPS TO MATCH REVISED BOTTOM GRADING

DESIGNED BY: K SKELLENGER
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

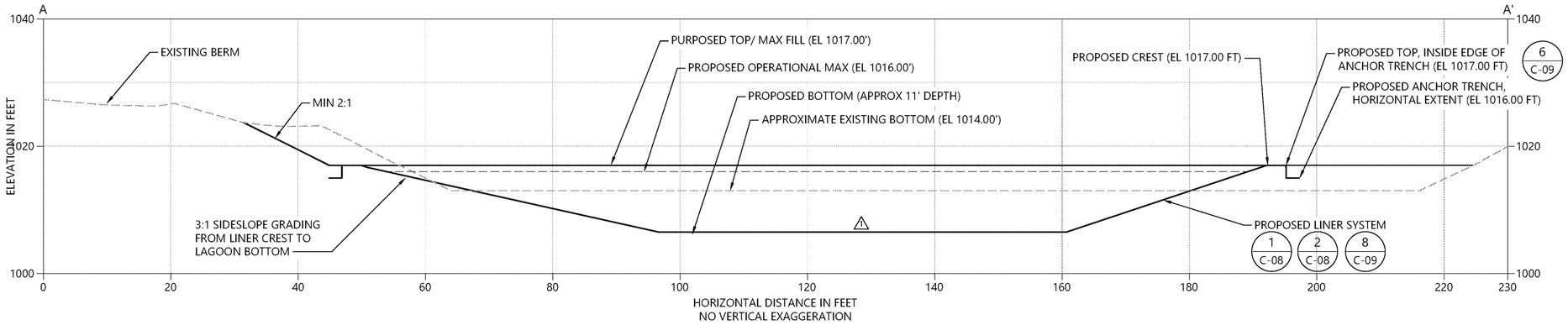
COW PALACE SAFETY DEBRIS CATCH BASIN

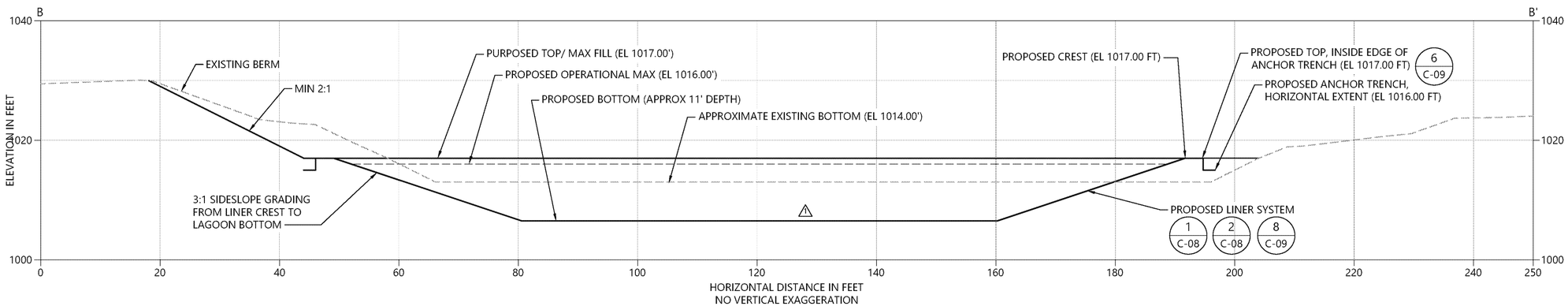
VENTING PLAN

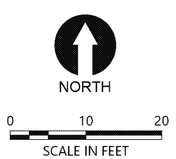
C-05

SHEET NO. 7 OF 14

Jul 10, 2019 2:43pm rpetrie







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5. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER
7/10/2019

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	REVISED BOTTOM GRADING

DESIGNED BY: K SKELLENGER
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

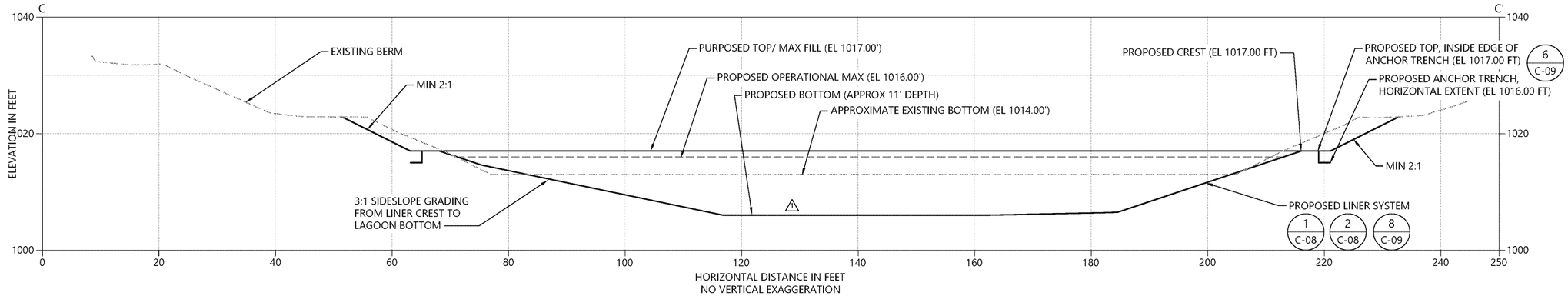
COW PALACE SAFETY DEBRIS CATCH BASIN

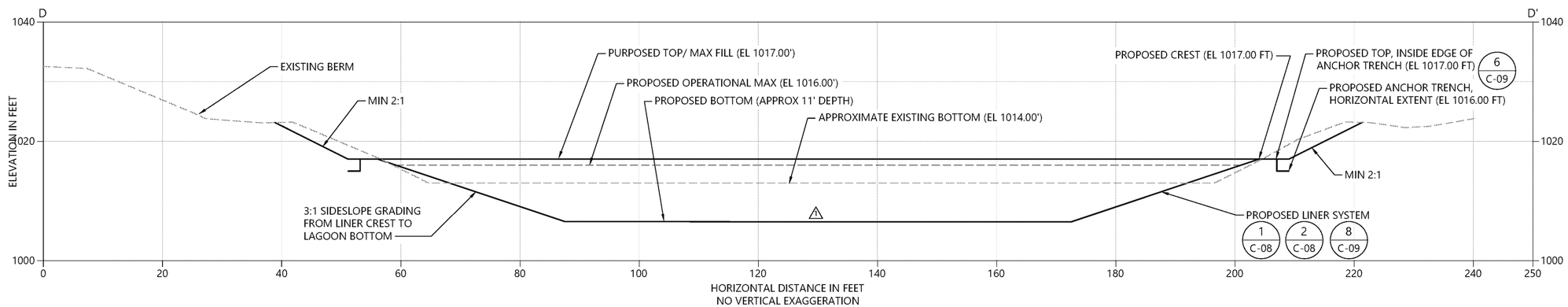
LAGOON PROFILES

C-06

SHEET NO. 8 OF 14

Jul 10, 2019 2:41pm rpetrie





NORTH

0 10 20
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S.'.
2. VERTICAL DATUM: NAVD 88.
3. SURVEY BY PLSA, 4/8/2019.
4. SURVEY SHOWN, HEREON, COMPLETED PRIOR TO EMPTYING OF THE LAGOONS AND DID NOT EXTEND BELOW LIQUID DEPTH. LAGOON CONTOURS BELOW 1017 ESTIMATED BY ANCHOR QEA.
5. SEE LEGEND ON DRAWING G-02.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/10/2019	RLP	JTS	REVISED BOTTOM GRADING

DESIGNED BY: K SKELLENGER
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

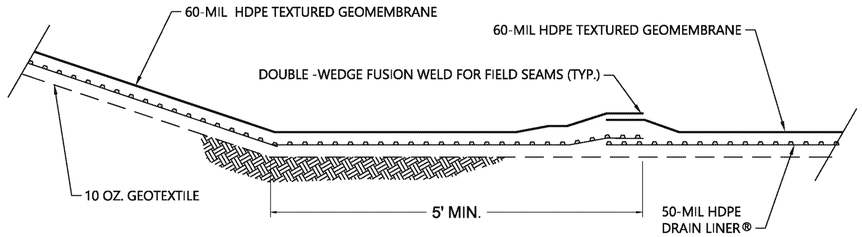
COW PALACE SAFETY DEBRIS CATCH BASIN

LAGOON PROFILES

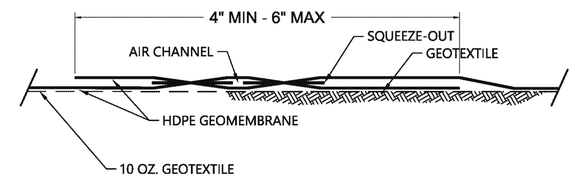
C-07

SHEET NO. 9 OF 14

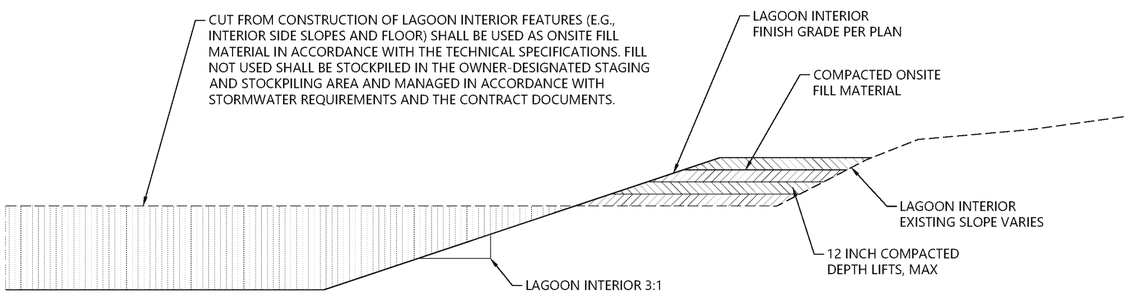
Jul 10, 2019 2:43pm rpetrie



1 / C-08 TYPICAL SLOPE TRANSITION WELDS
SCALE: NOT TO SCALE

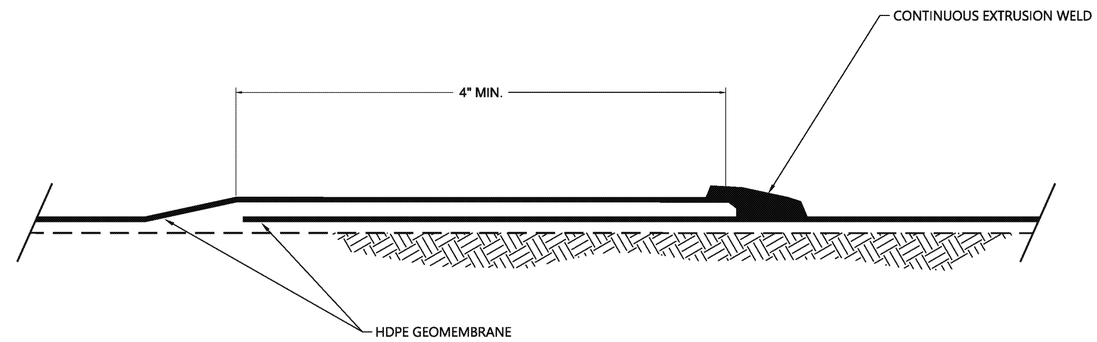


3 / C-09 TYP HOT WEDGE DBL TRACK FUSION WELD
SCALE: NOT TO SCALE

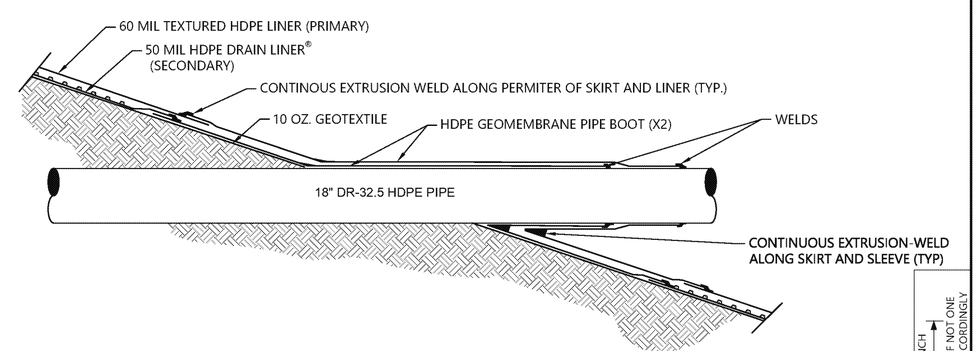


NOTES:
1. THE FINISH GRADE SHALL BE A SMOOTH, UNYIELDING SURFACE FREE OF ORGANICS, DEBRIS, AND ANGULAR ROCK 3/8-INCH DIA OR LARGER. COBBLES ACCEPTABLE IN SUBGRADE (BELOW FINISH GRADE).
2. UNLESS OTHERWISE REQUIRED IN THE TECHNICAL SPECIFICATIONS, FILL SHALL BE COMPACTED TO 95% OF THE MAX. DRY DENSITY AND TO WITHIN 2% OF THE OPTIMUM MOISTURE CONTENT, AS DETERMINED USING ASTM D1557 (MODIFIED PROCTOR).

2 / C-08 INTERIOR GRADING DETAILS
SCALE: NOT TO SCALE



4 / C-09 TYPICAL FILLET EXTRUSION WELD
SCALE: NOT TO SCALE



5 / C-08 DOUBLE BOOT PIPE PENETRATION SEAL
SCALE: NOT TO SCALE

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57033
REGISTERED
PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

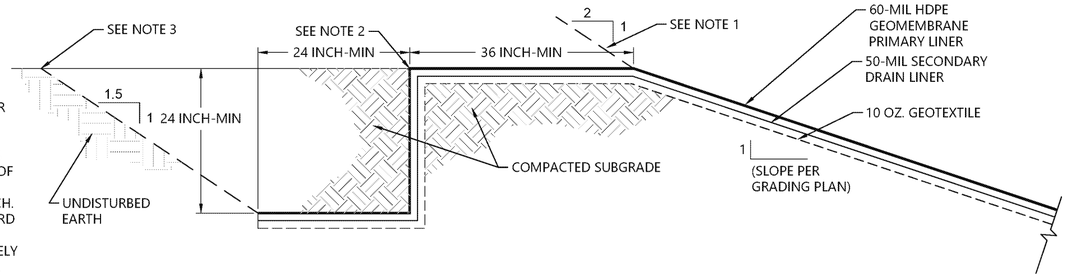
DETAILS (1 OF 5)

C-08

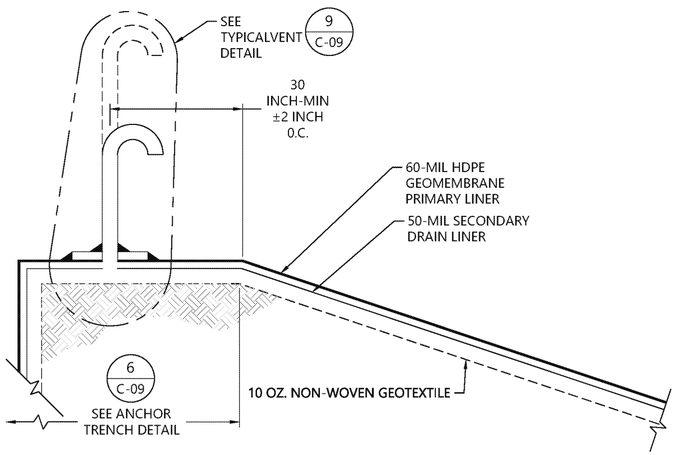
SHEET NO. **10** OF **14**

Jul 10, 2019 2:41pm rpetrie

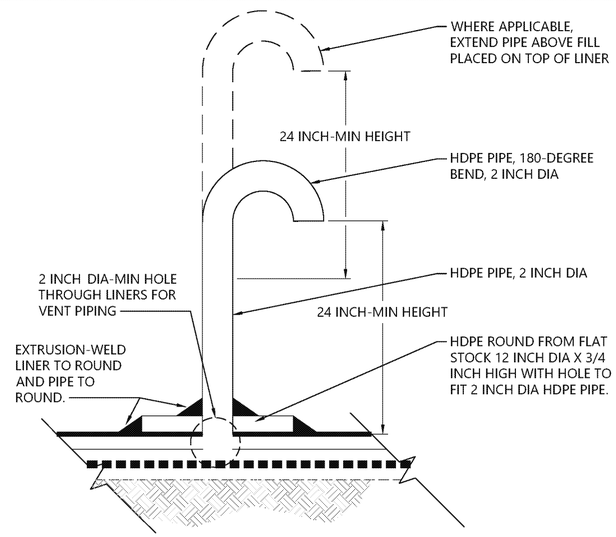
NOTES:
1. WHERE GRADING FROM CREST IS INDICATED ON PLAN, REPLACE EXCAVATED MATERIAL ABOVE LINER AT A SLOPE OF 2:1 TO EXISTING GRADE.
2. WHERE ABUTTING ACCESS ROAD IS INDICATED ON PLAN, INNER EDGE OF ACCESS ROAD SHALL BEGIN AT VERTICAL EDGE OF ANCHOR TRENCH. ACCESS ROAD SHALL SLOPE TOWARD LAGOON AT 1% GRADE.
3. WHERE GRADING TO APPROXIMATELY LEVEL EXISTING GRADE, THE OUTER EDGE OF TRENCH SHALL BE SLOPED AT APPROXIMATELY 1.5:1. THE TRENCH FILL SHALL BE SLOPED EVENLY FROM THE VERTICAL EDGE OF THE LINER TO THE EXISTING GRADE.



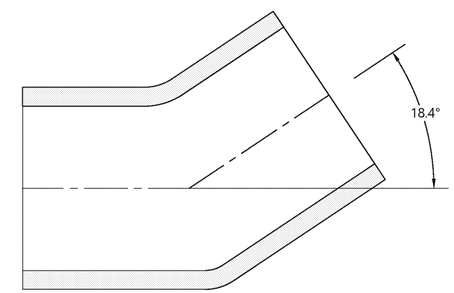
6 / C-03 TYPICAL ANCHOR TRENCH
SCALE: NOT TO SCALE



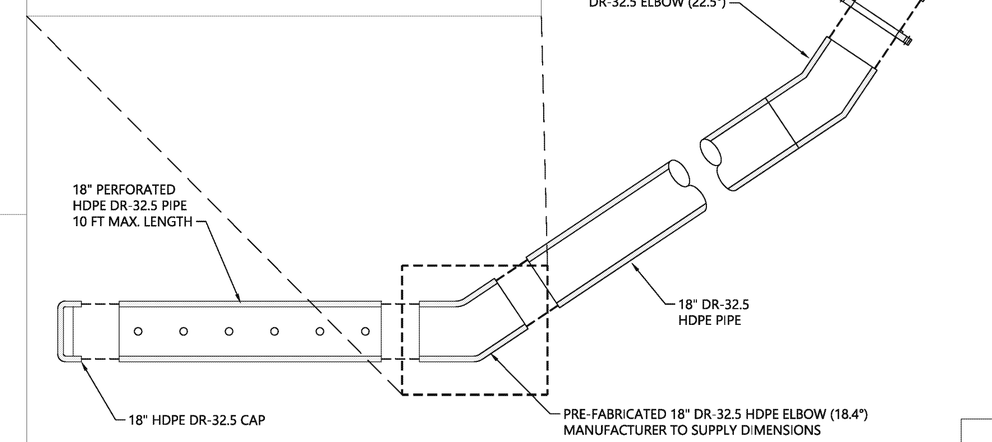
7 / C-05 TYPICAL LINER GAS VENT
SCALE: NOT TO SCALE



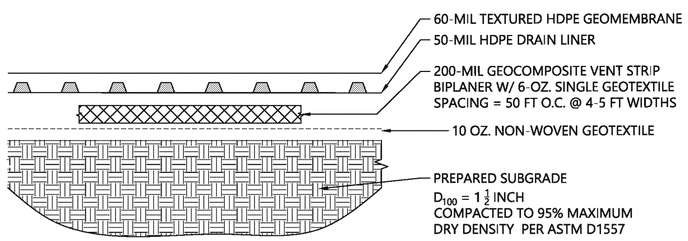
9 / C-05 TYPICAL VENT DETAIL
SCALE: NOT TO SCALE



10 / - INSET DETAIL - 18" DR-32.5 HDPE ELBOW
SCALE: NOT TO SCALE



11 / C-03 HDPE SLOPE RISER CONDUIT ASSEMBLY
SCALE: NOT TO SCALE



8 / C-05 TYPICAL LINER AND VENTING DETAIL - SECTION VIEW
SCALE: NOT TO SCALE

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
57013
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

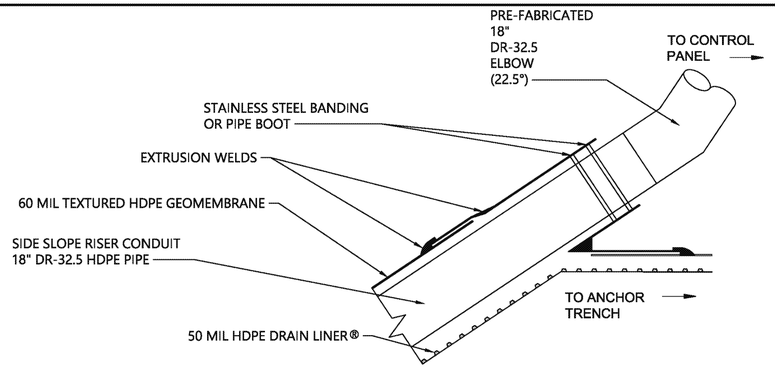
COW PALACE SAFETY DEBRIS CATCH BASIN

DETAILS (2 OF 5)

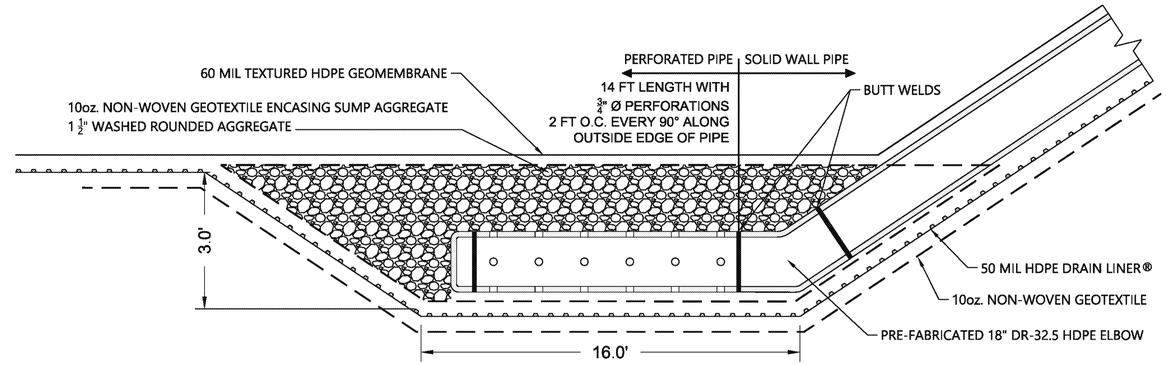
C-09

SHEET NO. 11 OF 14

Jul 10, 2019 2:41pm rpetrie



12 / C-03 HDPE CONDUIT - LINER CONNECTION DETAIL
SCALE: NOT TO SCALE



13 / C-03 LEAK DETECTION SUMP (TYP. SECTION)
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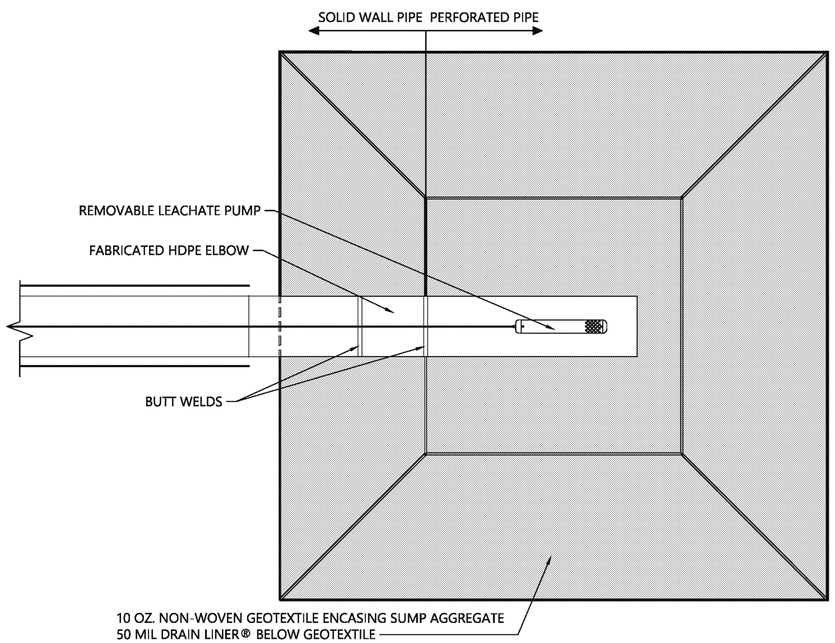

16 / C-03 LEAK DETECTION SUMP (PLAN VIEW)
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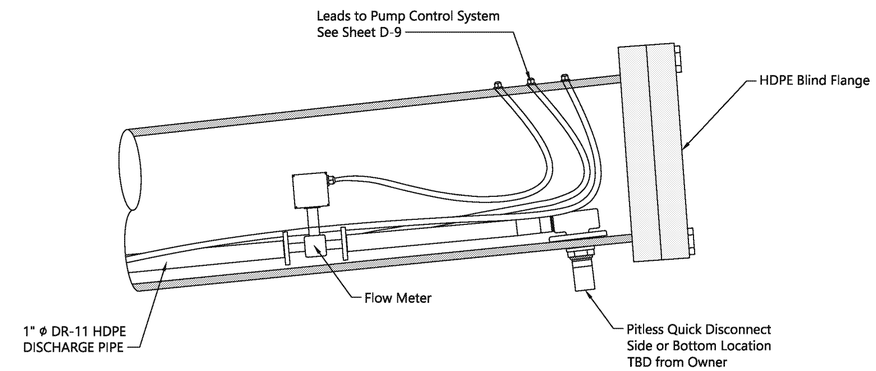

14 / C-03 LEACHATE PUMP SYSTEM - DISCHARGE DETAIL
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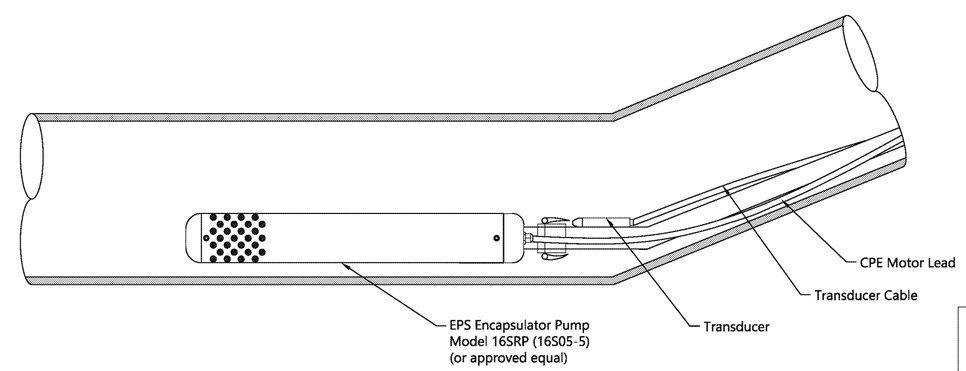

15 / C-03 LEACHATE PUMP SYSTEM - SUMP DETAIL
SCALE: NOT TO SCALE

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

JOSHUA THOMAS SEXTON
STATE OF WASHINGTON
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REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

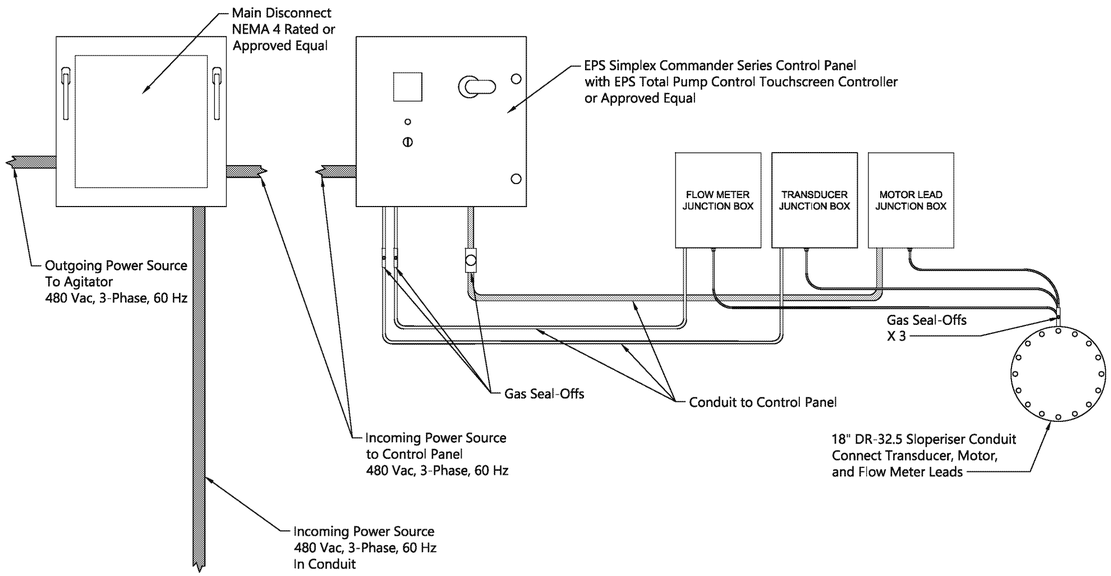
COW PALACE SAFETY DEBRIS CATCH BASIN

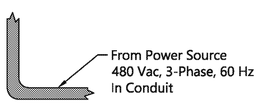
DETAILS (3 OF 5)

C-10

SHEET NO. **12** OF **14**

Jul 10, 2019 2:41pm rpetrie





17 / C-03 PUMP CONTROL SYSTEM SCHEMATIC
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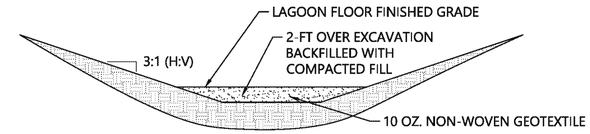

18 / - LAGOON FLOOR OVER-EXCAVATION
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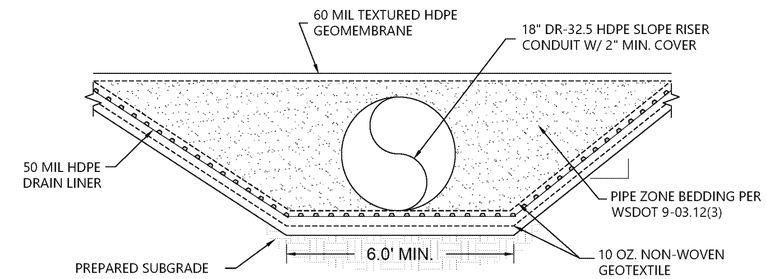
DETAIL NOTES:

1. 2-FT OVER-EXCAVATION OF LAGOON FLOOR WILL BE REQUIRED IF UNSUITABLE SUB-GRADE IS ENCOUNTERED. OVER-EXCAVATION WILL BE BACKFILLED WITH COMPACTED FILL MATERIAL MEETING PROJECT SPECIFICATION FOR PREPARED SUBGRADE ON TOP OF 10 OZ. NON-WOVEN GEOTEXTILE.



19 / C-03 TYPICAL SLOPE RISER SECTION
SCALE: NOT TO SCALE

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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DESIGNED BY: J. SEXTON
DRAWN BY: R PETRIE
CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

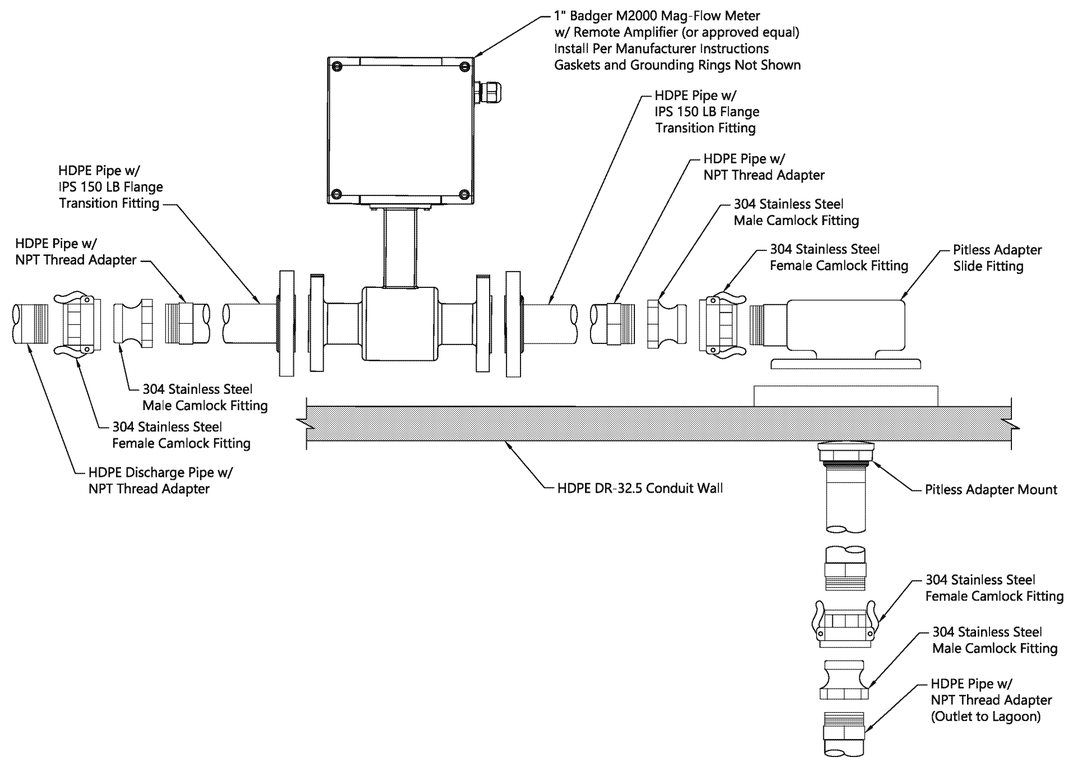
COW PALACE SAFETY DEBRIS CATCH BASIN

DETAILS (4 OF 5)

C-11

SHEET NO. **13** OF **14**

Jul 10, 2019 2:41pm rpetrie



20 / C-03 LEACHATE PUMP SYSTEM DISCHARGE ASSEMBLY
SCALE: NOT TO SCALE

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA

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CHECKED BY: D. CISAKOWSKI
APPROVED BY: D. CISAKOWSKI
SCALE: AS NOTED
DATE: JUNE 2019

COW PALACE SAFETY DEBRIS CATCH BASIN

DETAILS (5 OF 5)

C-12

SHEET NO. **14** OF **14**

Jul 10, 2019 2:41pm rpetrie

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Attachment E
GRI White Paper No. 6

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GRI White Paper #6

- on -

Geomembrane Lifetime Prediction:
Unexposed and Exposed Conditions

by

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Updated: February 8, 2011

Geomembrane Lifetime Prediction: Unexposed and Exposed Conditions

1.0 Introduction

Without any hesitation the most frequently asked question we have had over the past thirty years' is "how long will a particular geomembrane last".* The two-part answer to the question, largely depends on whether the geomembrane is covered in a timely manner or left exposed to the site-specific environment. Before starting, however, recognize that the answer to either covered or exposed geomembrane lifetime prediction is neither easy, nor quick, to obtain. Further complicating the answer is the fact that all geomembranes are formulated materials consisting of (at the minimum), (i) the resin from which the name derives, (ii) carbon black or colorants, (iii) short-term processing stabilizers, and (iv) long-term antioxidants. If the formulation changes (particularly the additives), the predicted lifetime will also change. See Table 1 for the most common types of geomembranes and their approximate formulations.

Table 1 - Types of commonly used geomembranes and their approximate formulations (based on weight percentage)

Type	Resin	Plasticizer	Fillers	Carbon Black	Additives
HDPE	95-98	0	0	2-3	0.25-1
LLDPE	94-96	0	0	2-3	0.25-3
fPP	85-98	0	0-13	2-4	0.25-2
PVC	50-70	25-35	0-10	2-5	2-5
CSPE	40-60	0	40-50	5-10	5-15
EPDM	25-30	0	20-40	20-40	1-5

HDPE = high density polyethylene
LLDPE = linear low density polyethylene
fPP = flexible polypropylene
PVC = polyvinyl chloride (plasticized)
CSPE = chlorsulfonated polyethylene
EPDM = ethylene propylene diene terpolymer

* More recently, the same question has arisen but focused on geotextiles, geogrids, geopipe, turf reinforcement mats, fibers of GCLs, etc. This White Paper, however, is focused completely on geomembranes due to the tremendous time and expense of providing such information for all types of geosynthetics.

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The possible variations being obvious, one must also address the degradation mechanisms which might occur. They are as follows accompanied by some generalized commentary.

- Ultraviolet Light - This occurs only when the geosynthetic is exposed; it will be the focus of the second part of this communication.
- Oxidation - This occurs in all polymers and is the major mechanism in polyolefins (polyethylene and polypropylene) under all conditions.
- Ozone - This occurs in all polymers that are exposed to the environment. The site-specific environment is critical in this regard.
- Hydrolysis - This is the primary mechanism in polyesters and polyamides.
- Chemical - Can occur in all polymers and can vary from water (least aggressive) to organic solvents (most aggressive).
- Radioactivity - This is not a factor unless the geomembrane is exposed to radioactive materials of sufficiently high intensity to cause chain scission, e.g., high level radioactive waste materials.
- Biological - This is generally not a factor unless biologically sensitive additives (such as low molecular weight plasticizers) are included in the formulation.
- Stress State – This is a complicating factor which is site-specific and should be appropriately modeled in the incubation process but, for long-term testing, is very difficult and expensive to acheive.
- Temperature - Clearly, the higher the temperature the more rapid the degradation of all of the above mechanisms; temperature is critical to lifetime and furthermore is the key to

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time-temperature-superposition which is the basis of the laboratory incubation methods which will be followed.

2.0 Lifetime Prediction: Unexposed Conditions

Lifetime prediction studies at GRI began at Drexel University under U. S. EPA contract from 1991 to 1997 and was continued under GSI consortium funding until ca. 2002. Focus to date has been on HDPE geomembranes placed beneath solid waste landfills due to its common use in this particular challenging application. Incubation of the coupons has been in landfill simulation cells (see Figure 1) maintained at 85, 75, 65 and 55°C. The specific conditions within these cells are oxidation beneath, chemical (water) from above, and the equivalent of 50 m of solid waste mobilizing compressive stress. Results have been forthcoming over the years insofar as three distinct lifetime stages; see Figure 2.

Stage A - Antioxidant Depletion Time

Stage B - Induction Time to the Onset of Degradation

Stage C - Time to Reach 50% Degradation (i.e., the Halflife)

2.1 Stage A - Antioxidant Depletion Time

The dual purposes of antioxidants are to (i) prevent polymer degradation during processing, and (ii) prevent oxidation reactions from taking place during Stage A of service life, respectively. Obviously, there can only be a given amount of antioxidants in any formulation. Once the antioxidants are depleted, additional oxygen diffusing into the geomembrane will begin to attack the polymer chains, leading to subsequent stages as shown in Figure 2. The duration of the antioxidant depletion stage depends on both the type and amount of the various antioxidants, i.e., the precise formulation.

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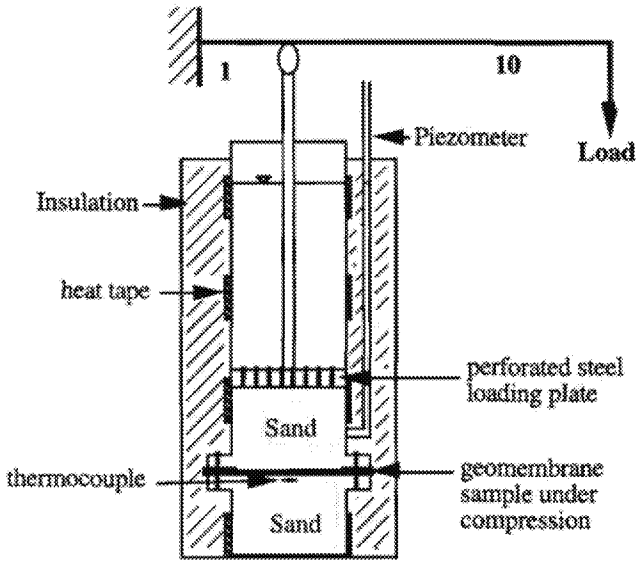

Figure 1. Incubation schematic and photograph of multiple cells maintained at various constant temperatures.

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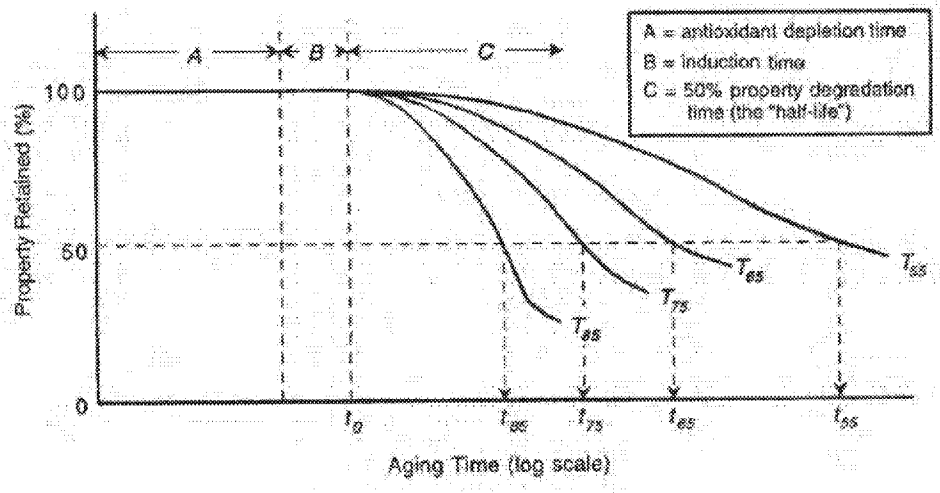

Figure 2. Three individual stages in the aging of most geomembranes.

The depletion of antioxidants is the consequence of two processes: (i) chemical reactions with the oxygen diffusing into the geomembrane, and (ii) physical loss of antioxidants from the geomembrane. The chemical process involves two main functions; the scavenging of free radicals converting them into stable molecules, and the reaction with unstable hydroperoxide (ROOH) forming a more stable substance. Regarding physical loss, the process involves the distribution of antioxidants in the geomembrane and their volatility and extractability to the site-specific environment.

Hence, the rate of depletion of antioxidants is related to the type and amount of antioxidants, the service temperature, and the nature of the site-specific environment. See Hsuan and Koerner (1998) for additional details.

2.2 Stage B - Induction Time to Onset of Degradation

In a pure polyolefin resin, i.e., one without carbon black and antioxidants, oxidation occurs extremely slowly at the beginning, often at an immeasurable rate. Eventually, oxidation occurs more rapidly. The reaction eventually decelerates and once again becomes very slow.

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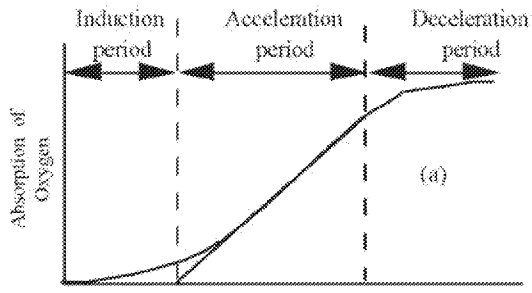
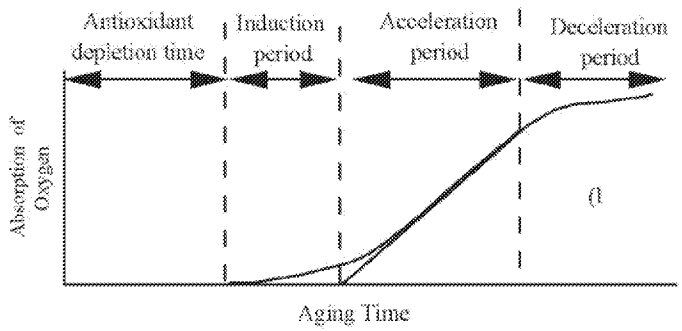
This progression is illustrated by the S-shaped curve of Figure 3(a). The initial portion of the curve (before measurable degradation takes place) is called the induction period (or induction time) of the polymer. In the induction period, the polymer reacts with oxygen forming hydroperoxide (ROOH), as indicated in Equations (1)-(3). However, the amount of ROOH in this stage is very small and the hydroperoxide does not further decompose into other free radicals which inhibits the onset of the acceleration stage.

In a stabilized polymer such as one with antioxidants, the accelerated oxidation stage takes an even longer time to be reached. The antioxidants create an additional depletion time stage prior to the onset of the induction time, as shown in Figure 3(b).



(a) Pure unstabilized polyethylene



(b) Stabilized polyethylene

Figure 3. Curves illustrating various stages of oxidation.

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$$RH \rightarrow R\bullet + H\bullet \quad (1)$$

(aided by energy or catalyst residues in the polymer)

$$R\bullet + O2 \rightarrow ROO\bullet \quad (2)$$

$$ROO\bullet + RH \rightarrow ROOH + R\bullet \quad (3)$$

In the above, RH represents the polyethylene polymer chains; and the symbol "•" represents free radicals, which are highly reactive molecules.

2.3 Stage C - Time to Reach 50% Degradation (Halflife)

As oxidation continues, additional ROOH molecules are being formed. Once the concentration of ROOH reaches a critical level, decomposition of ROOH begins, leading to a substantial increase in the amount of free radicals, as indicated in Equations (4) to (6). The additional free radicals rapidly attack other polymer chains, resulting in an accelerated chain reaction, signifying the end of the induction period, Rapopport and Zaikov (1986). This indicates that the concentration of ROOH has a critical control on the duration of the induction period.

$$ROOH \rightarrow RO\bullet OH\bullet \text{ (aided by energy)} \quad (4)$$

$$RO\bullet + RH \rightarrow ROH + R\bullet \quad (5)$$

$$OH\bullet + RH \rightarrow H2O + R\bullet \quad (6)$$

A series of oxidation reactions produces a substantial amount of free radical polymer chains (R•), called alkyl radicals, which can proceed to further reactions leading to either cross-linking or chain scission in the polymer. As the degradation of polymer continues, the physical and mechanical properties of the polymer start to change. The most noticeable change in physical properties is the melt index, since it relates to the molecular weight of the polymer. As for mechanical properties, both tensile break stress (strength) and break strain (elongation) decrease.

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Ultimately, the degradation becomes so severe that all tensile properties start to change (tear, puncture, burst, etc.) and the engineering performance is jeopardized. This signifies the end of the so-called "service life" of the geomembrane.

Although quite arbitrary, the limit of service life of polymeric materials is often selected as a 50% reduction in a specific design property. This is commonly referred to as the halflife time, or simply the "halflife". It should be noted that even at halflife, the material still exists and can function, albeit at a decreased performance level with a factor-of-safety lower than the initial design value.

2.4 Summary of Lifetime Research-to-Date

Stage A, that of antioxidant depletion for HDPE geomembranes as required in the GRI-GM13 Specification, has been well established by our own research and corroborated by others, e.g., Sangram and Rowe (2004). The GRI data for standard and high pressure Oxidative Induction Time (OIT) is given in Table 2. The values are quite close to one another. Also, as expected, the lifetime is strongly dependent on the service temperature; with the higher the temperature the shorter the lifetime.

Table 2 - Lifetime prediction of HDPE (nonexposed) at various field temperatures

In Service Temperature (°C)	Stage "A" (years)			Stage "B" (years)	Stage "C" (years)	Total Prediction* (years)
	Standard OIT	High Press. OIT	Average OIT			
20	200	215	208	30	208	446
25	135	144	140	25	100	265
30	95	98	97	20	49	166
35	65	67	66	15	25	106
40	45	47	46	10	13	69

*Total = Stage A (average) + Stage B + Stage C

Stage "B", that of induction time, has been obtained by comparing 30-year old polyethylene water and milk containers (containing no long-term antioxidants) with currently

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produced containers. The data shows that degradation is just beginning to occur as evidenced by slight changes in break strength and elongation, but not in yield strength and elongation. The lifetime for this stage is also given in Table 2.

Stage "C", the time for 50% change of mechanical properties is given in Table 2 as well. The data depends on the activation energy, or slope of the Arrhenius curve, which is very sensitive to material and experimental techniques. The data is from Gedde, et al. (1994) which is typical of the HDPE resin used for gas pipelines and is similar to Martin and Gardner (1983).

Summarizing Stages A, B, and C, it is seen in Table 2 that the halflife of covered HDPE geomembranes (formulated according to the current GRI-GM13 Specification) is estimated to be 449-years at 20°C. This, of course, brings into question the actual temperature for a covered geomembrane such as beneath a solid waste landfill. Figure 4 presents multiple thermocouple monitoring data of a municipal waste landfill liner in Pennsylvania for over 10-years, Koerner and Koerner (2005). Note that for 6-years the temperature was approximately 20°C. At that time and for the subsequent 4-years the temperature increased to approximately 30°C. Thus, the halflife of this geomembrane is predicted to be from 166 to 446 years within this temperature range. The site is still being monitored, see Koerner and Koerner (2005).

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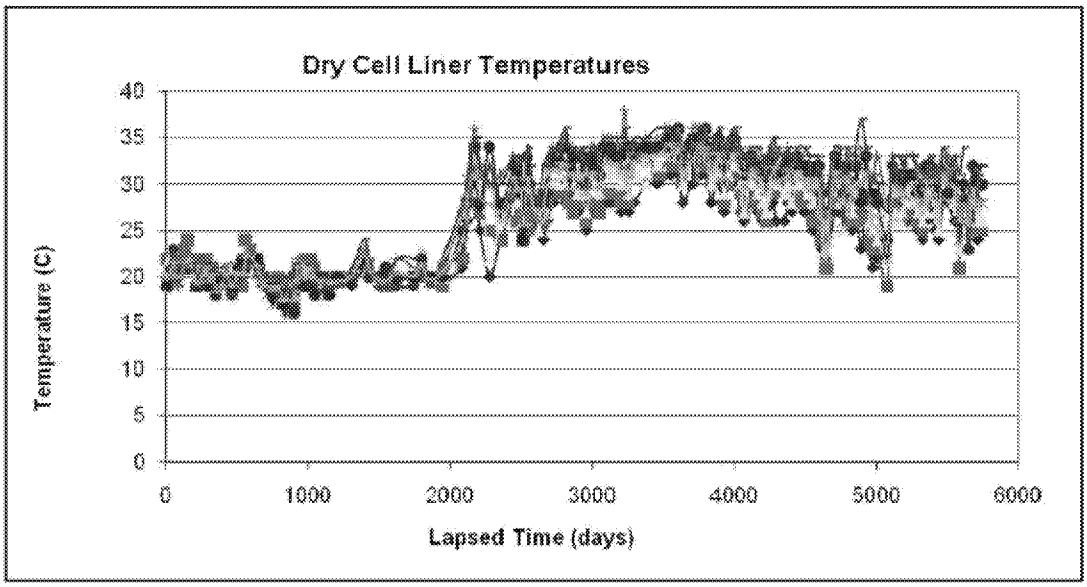

Figure 4. Long-term monitoring of an HDPE liner beneath a municipal solid waste landfill in Pennsylvania.

2.5 Lifetime of Other Covered Geomembranes

By virtue of its widespread use as liners for solid waste landfills, HDPE is by far the widest studied type of geomembrane. Note that in most countries (other than the U.S.), HDPE is the required geomembrane type for solid waste containment. Some commentary on other-than HDPE geomembranes (recall Table 1) follows:

2.5.1 Linear Low Density Polyethylene (LLDPE) geomembranes

The nature of the LLDPE resin and its formulation is very similar to HDPE. The fundamental difference is that LLDPE is a lower density, hence lower crystallinity, than HDPE; e.g., 10% versus 50%. This has the effect of allowing oxygen to diffuse into the polymer structure quicker, and likely decreases Stages A and C. How much is uncertain since no data is available, but it is felt that the lifetime of LLDPE will be somewhat reduced with respect to HDPE.

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2.5.2 Plasticizer migration in PVC geomembranes

Since PVC geomembranes necessarily have plasticizers in their formulations so as to provide flexibility, the migration behavior must be addressed for this material. In PVC the plasticizer bonds to the resin and the strength of this bonding versus liquid-to-resin bonding is significant. One of the key parameters of a stable long-lasting plasticizer is its molecular weight. The higher the molecular weight of the plasticizer in a PVC formulation, the more durable will be the material. Conversely, low molecular weight plasticizers have resulted in field failures even under covered conditions. See Miller, et al. (1991), Hammon, et al. (1993), and Giroud and Tisinger (1994) for more detail in this regard. At present there is a considerable difference (and cost) between PVC geomembranes made in North America versus Europe. This will be apparent in the exposed study of durability in the second part of this White Paper.

2.5.3 Crosslinking in EPDM and CSPE geomembrmaes

The EPDM geomembranes mentioned in Table 1 are crosslinked thermoset materials. The oxidation degradation of EPDM takes place in either ethylene or propylene fraction of the co-polymer via free radical reactions, as expressed in Figure 5, which are described similarly by Equations (4) to (6).

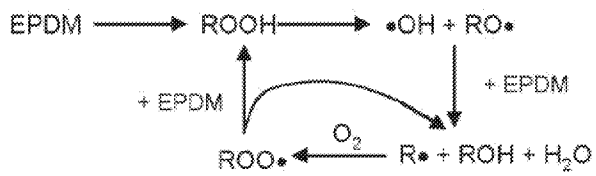

Figure 5. Oxidative degradation of crosslinked EPDM geomembranes, (Wang and Qu, 2003).

For CSPE geomembranes, the degradation mechanism is dehydrochlorination by losing chlorine and generating carbon-carbon double bonds in the main polymer chain, as shown in Figure 6.

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The carbon-carbon double bonds become the preferred sites for further thermodegradation or cross-linking in the polymer, leading to eventual brittleness of the geomembrane.

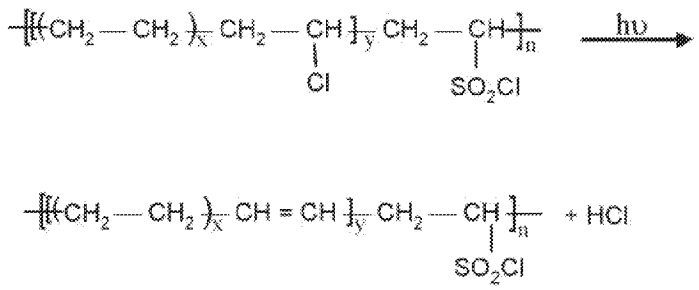

Figure 6. Dechlorination degradation of crosslinked CSPE geomembranes (Chailan, et al., 1995).

Neither EPDM nor CSPE has had a focused laboratory study of the type described for HDPE reported in the open literature. Most of lifetime data for these geomembranes is antidotal by virtue of actual field performance. Under covered conditions, as being considered in this section, there have been no reported failures by either of these thermoset polymers to our knowledge.

3.0 Lifetime Prediction: Exposed Conditions

Lifetime prediction of exposed geomembranes have taken two very different pathways; (i) prediction from anecdotal feedback and field performance, and (ii) from laboratory weathering device predictions.

3.1 Field Performance

There is a large body of anecdotal information available on field feedback of exposed geomembranes. It comes form two quite different sources, i.e., dams in Europe and flat roofs in the USA.

Regarding exposed geomembranes in dams in Europe, the original trials were using 2.0 mm thick polyisobutylene bonded directly to the face of the dam. There were numerous problems encountered as described by Scuero (1990). Similar experiences followed using PVC

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geomembranes. In 1980, a geocomposite was first used at Lago Nero which had a 200 g/m^2 nonwoven geotextile bonded to the PVC geomembrane. This proved quite successful and led to the now-accepted strategy of requiring drainage behind the geomembrane. In addition to thick nonwoven geotextiles, geonets, and geonet composites have been successful. Currently over 50 concrete and masonry dams have been rehabilitated in this manner and are proving successful for over 30-years of service life. The particular type of PVC plasticized geomembranes used for these dams is proving to be quite durable. Tests by the dam owners on residual properties show only nominal changes in properties, Cazzuffi (1998). As indicated in Miller, et al. (1991) and Hammond, et al. (1993), however, different PVC materials and formulations result in very different behavior; the choice of plasticizer and the material's thickness both being of paramount importance. An excellent overview of field performance is recently available in which 250 dams which have been waterproofed by geomembranes is available from ICOLD (2010).

Regarding exposed geomembranes in flat roofs, past practice in the USA is almost all with EPDM and CSPE and, more recently, with fPP. Manufacturers of these geomembranes regularly warranty their products for 20-years and such warrants appear to be justified. EPDM and CSPE, being thermoset or elastomeric polymers, can be used in dams without the necessity of having seams by using vertical attachments spaced at 2 to 4 m centers, see Scuero and Vaschetti (1996). Conversely, fPP can be seamed by a number of thermal fusion methods. All of these geomembrane types have good conformability to rough substrates as is typical of concrete and masonry dam rehabilitation. It appears as though experiences (both positive and negative) with geomembranes in flat roofs should be transferred to all types of waterproofing in civil engineering applications.

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3.2 Laboratory Weatherometer Predictions

For an accelerated simulation of direct ultraviolet light, high temperature, and moisture using a laboratory weatherometer one usually considers a worst-case situation which is the solar maximum condition. This condition consists of global, noon sunlight, on the summer solstice, at normal incidence. It should be recognized that the UV-A range is the target spectrum for a laboratory device to simulate the naturally occurring phenomenon, see Hsuan and Koerner (1993), and Suits and Hsuan (2001).

The Xenon Arc weathering device (ASTM D4355) was introduced in Germany in 1954. There are two important features; the type of filters and the irradiance settings. Using a quartz inner and borosilicate outer filter (quartz/boro) results in excessive low frequency wavelength degradation. The more common borosilicate inner and outer filters (boro/boro) shows a good correlation with solar maximum conditions, although there is an excess of energy below 300 nm wavelength. Irradiance settings are important adjustments in shifting the response although they do not eliminate the portion of the spectrum below 300 nm frequency. Nevertheless, the Xenon Arc device is commonly used method for exposed lifetime prediction of all types of geosynthetics.

UV Fluorescent devices (ASTM D7238) are an alternative type of accelerated laboratory test device which became available in the early 1970's. They reproduce the ultraviolet portion of the sunlight spectrum but not the full spectrum as in Xenon Arc weatherometers. Earlier FS-40 and UVB-313 lamps give reasonable short wavelength output in comparison to solar maximum. The UVA-340 lamp was introduced in 1987 and its response is seen to reproduce ultraviolet light quite well. This device (as well as other types of weatherometers) can handle elevated temperature and programmed moisture on the test specimens.

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Research at the Geosynthetic Institute (GSI) has actively pursued both Xenon and UV Fluorescent devices on a wide range of geomembranes. Table 3 gives the geomembranes that were incubated and the number of hours of exposure as of 12 July 2005.

Table 5 - Details of the GSI laboratory exposed weatherometer study on various types of geomembranes

Geomembrane Type	Thickness (mm)	UV Fluorescent Exposure*	Xenon Exposure*	Comment
1. HDPE (GM13)	1.50	8000 hrs.	6600 hrs.	Basis of GRI-GM13 Spec
2. LLDPE (GM17)	1.00	8000	6600	Basis of GRI-GM-17 Spec
3. PVC (No. Amer.)	0.75	8000	6600	Low Mol. Wt. Plasticizer
4. PVC (Europe)	2.50	7500	6600	High Mol. Wt. Plasticizer
5. fPP (BuRec)	1.00	2745**	4416**	Field Failure at 26 mos.
6. fPP-R (Texas)	0.91	100	100	Field Failure at 8 years
7. fPP (No. Amer.)	1.00	7500	6600	Expected Good Performance

*As of 12 July 2005 exposure is ongoing
**Light time to reach halflife of break and elongation

3.3 Laboratory Weatherometer Acceleration Factors

The key to validation of any laboratory study is to correlate results to actual field performance. For the nonexposed geomembranes of Section 2 such correlations will take hundreds of years for properly formulated products. For the exposed geomembranes of Section 3, however, the lifetimes are significantly shorter and such correlations are possible. In particular, Geomembrane #5 (flexible polypropylene) of Table 3 was an admittedly poor geomembrane formulation which failed in 26 months of exposure at El Paso, Texas, USA. The reporting of this failure is available in the literature, Comer, et al. (1998). Note that for both UV Fluorescent and Xenon Arc laboratory incubation of this material, failure (halflife to 50% reduction in strength and elongation) occurred at 2745 and 4416 hours, respectively. The comparative analysis of laboratory and field for this case history allows for the obtaining of acceleration factors for the two incubation devices.

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3.3.1 Comparison between field and UV Fluorescent weathering

The light source used in the UV fluorescent weathering device is UVA with wavelengths from 295-400 nm. In addition, the intensity of the radiation is controlled by the Solar Eye irradiance control system. The UV energy output throughout the test is 68.25 W/m^2.

The time of exposure to reach 50% elongation at break was as follows:

= 2745 hr. of light
= 9,882,000 seconds

Total energy in MJ/m^2 = 68.25 $W/m^2 \times 9{,}882{,}000$
= 674.4 MJ/m^2

The field site was located at El Paso, Texas. The UVA radiation energy (295-400 nm) at this site is estimated based on data collected by the South Florida Testing Lab in Arizona (which is a similar atmospheric location). For 26 months of exposure, the accumulated UV radiation energy is 724 MJ/m^2 which is very close to that generated from the UV fluorescent weatherometer. Therefore, direct comparison of the exposure time between field and UV fluorescent is acceptable.

Field time = 26 Months vs. Fluorescent UV light time: = 3.8 Months **Thus, the acceleration factor is 6.8.**

3.3.2 Comparison between field and Xenon Arc weathering

The light source of the Xenon Arc weathering device simulates almost the entire sunlight spectrum from 250 to 800 nm. Depending of the age of the light source and filter, the solar energy ranges from 340.2 to 695.4 W/m^2, with the average value being 517.8 W/m^2.

The time of exposure to reach 50% elongation at break

= 4416 hr. of light
= 15,897,600 seconds

Total energy in MJ/m^2 = 517.8 $W/m^2 \times 15{,}897{,}600$
= 8232 MJ/m^2

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The solar energy in the field is again estimated based on data collected by the South Florida Testing Lab in Arizona. For 26 months of exposure, the accumulated solar energy (295-800 nm) is 15,800 MJ/m^2, which is much higher than that from the UV Fluorescent device. Therefore, direct comparison of halflives obtained from the field and Xenon Arc device is not anticipated to be very accurate. However, for illustration purposes the acceleration factor based on Xenon Arc device would be as follows:

Field	vs.	Xenon Arc	:	**Thus, the acceleration factor is 4.3.**
= 26 Months		= 6.1 Months		

The resulting conclusion of this comparison of weathering devices is that the UV Fluorescent device is certainly reasonable to use for long-term incubations. When considering the low cost of the device, its low maintenance, its inexpensive bulbs, and ease of repair it (the UV Fluorescent device) will be used exclusively by GSI for long-term incubation studies.

3.3.3 Update of exposed lifetime predictions

There are presently (2011) four field failures of flexible polypropylene geomembranes and using unexposed archived samples from these sites their responses in laboratory UV Fluorescent devices per ASTM D7328 at 70°C are shown in Figure 5. From this information we deduce that the average correlation factor is approximately *1200 light hours ≃ one-year in a hot climate.* This value will be used accordingly for other geomembranes.

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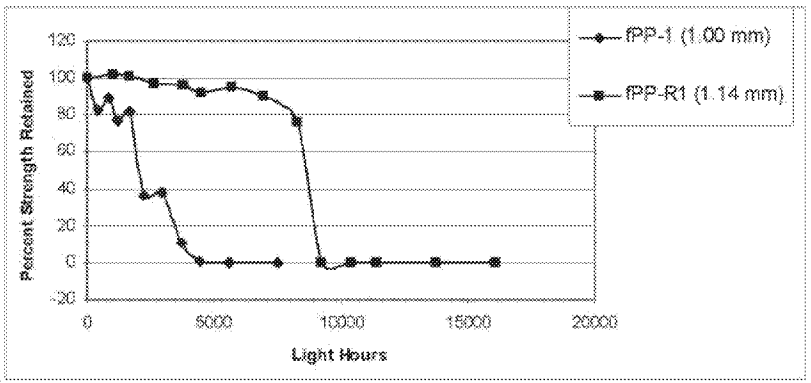
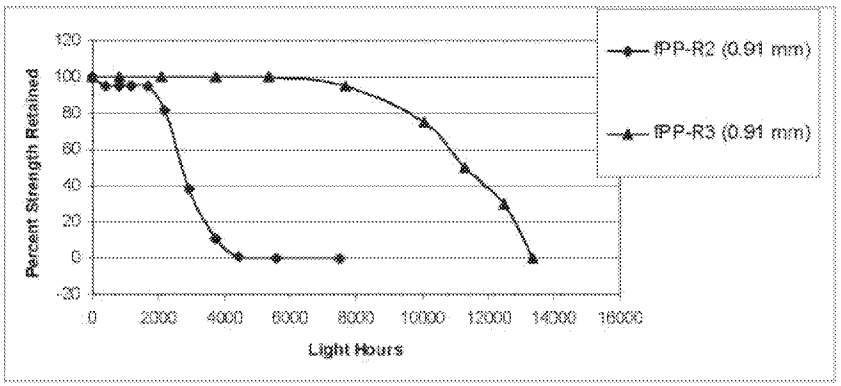


(a) Two Sites in West Texas



(b) Two Sites in So. Calif.

Lab-to-Field Correlation Factors
(ASTM D7238 @ 70°C)

Method	Thickness (mm)	Field (yrs.)	Location	Lab (lt. hr.)	Factor (lt. hrs./1.0 yr.)
fPP-1	1.00	≃ 2	W. Texas	1800	900
fPP-R1	1.14	≃ 8	W. Texas	8200	1025
fPP-R2	0.91	≃ 2	So. Calif.	2500	1250
fPP-R3	0.91	≃ 8	So. Calif.	11200	1400
					1140*

*Use 1200 lt. hr. = 1.0 year in hot climates

Figure 5. Four field failures of fPP and fPP-R exposed geomembranes.

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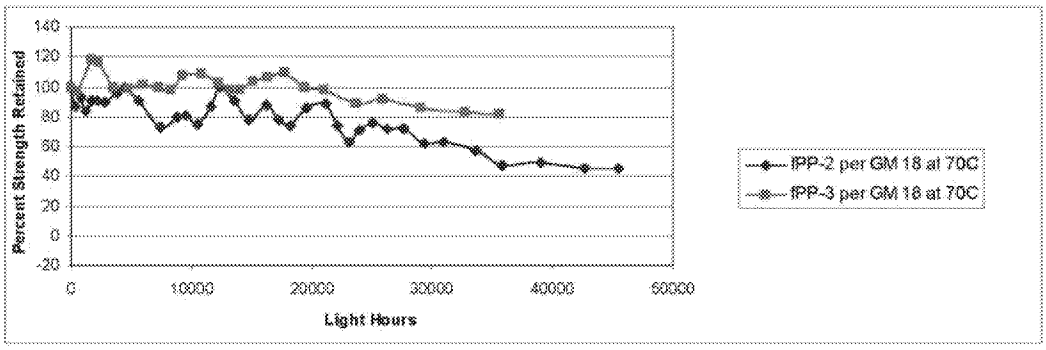
Exposure of a number of different types of geomembranes in laboratory UV Fluorescent devices per ASTM D7238 at 70°C has been ongoing for the six years (between 2005 and 2011) since this White Paper was first released. Included are the following geomembranes:

- Two black 1.0 mm (4.0 mil) unreinforced flexible polypropylene geomembranes formulated per GRI-GM18 Specification; see Figure 6a.
- Two black unreinforced polyethylene geomembranes, one 1.5 mm (60 mil) high density per GRI-GM13 Specification and the other 1.0 mm (40 mil) linear low density per GRI-GM17 Specification; see Figure 6b.
- One 1.0 (40 mil) black ethylene polypropylene diene terpolymer geomembrane per GRI-GM21 Specification; see Figure 6c.
- Two polyvinyl chloride geomembranes, one black 1.0 mm (40 mil) formulated in North America and the other grey 1.5 mm (60 mil) formulated in Europe; see Figure 6d.



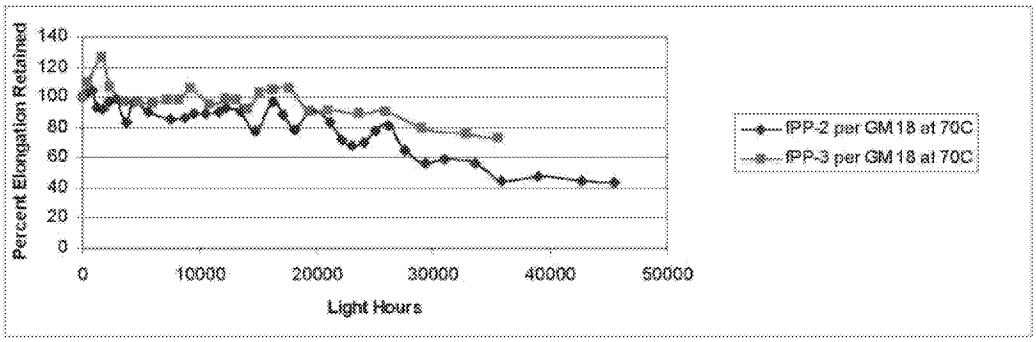


Figure 6a. Flexible polyethylene (fPP) geomembrane behavior.

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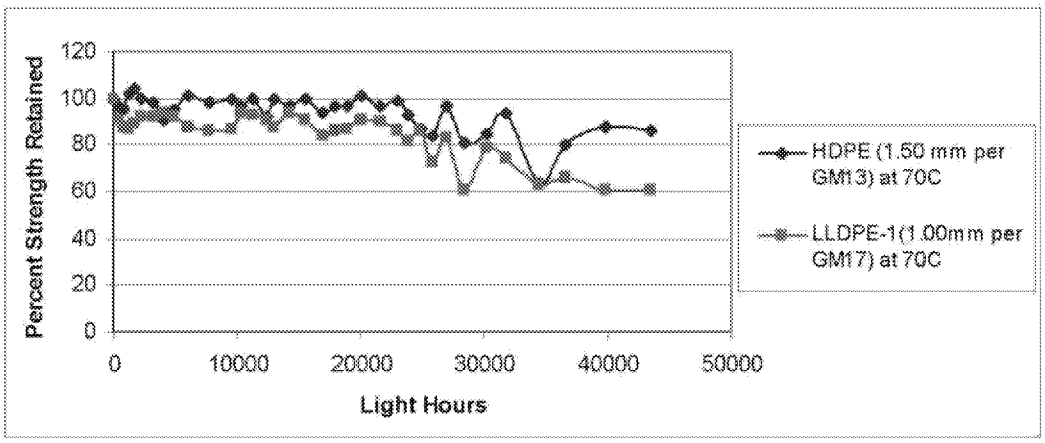


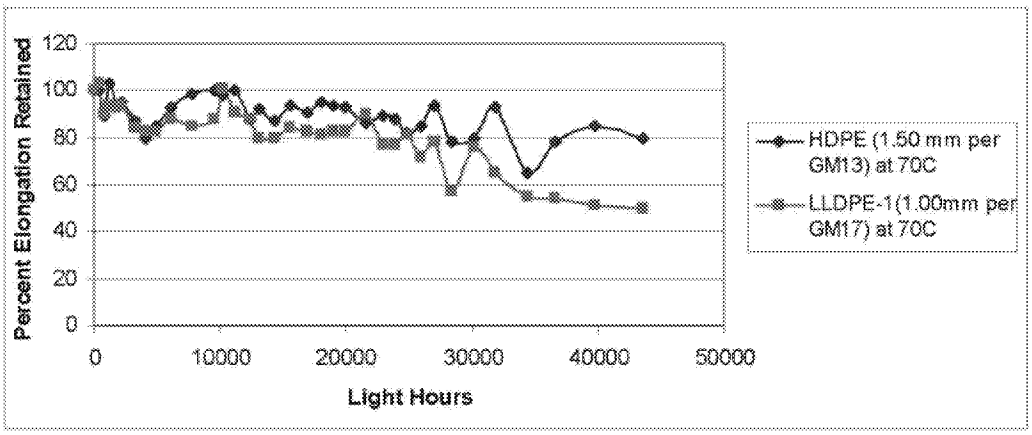
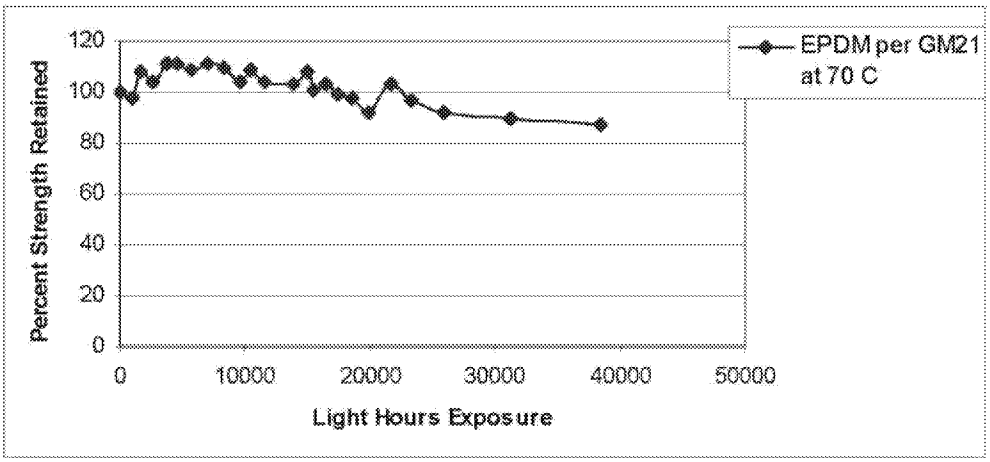


Figure 6b. Polyethylene (HDPE and LLDPE) geomembrane behavior.



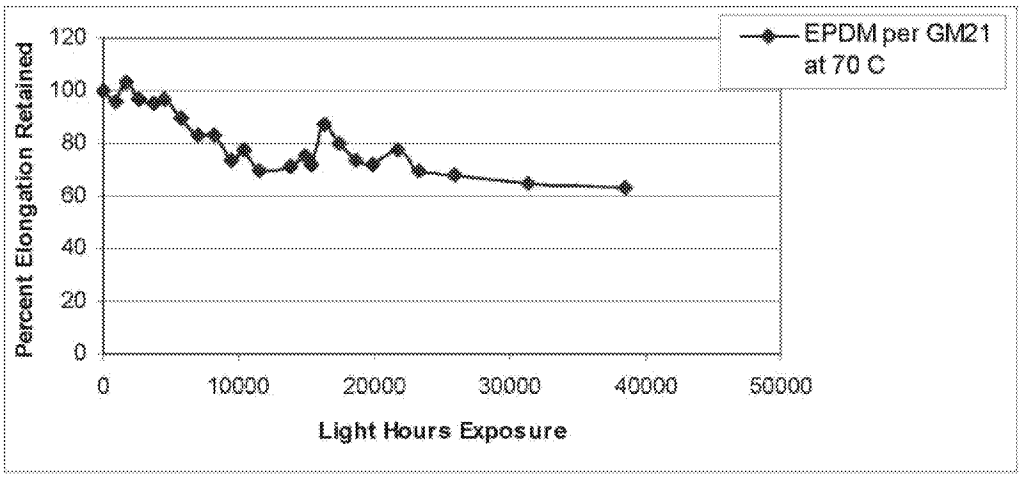


Figure 6c. Ethylene polypropylene diene terpolymer (EPDM) geomembrane.

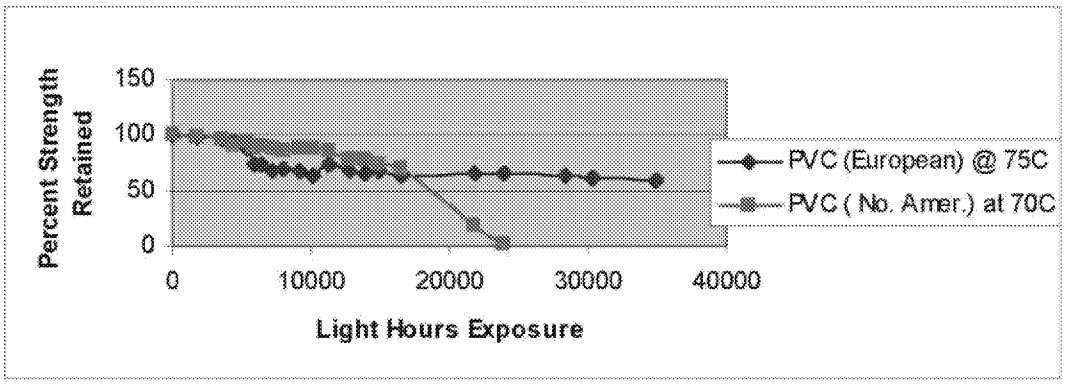


Figure 6d. Polyvinyl chloride (PVC) geomembranes.

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From the response curves of the various geomembranes shown in Figure 6a-d, the 50% reduction value in strength or elongation (usually elongation) was taken as being the "halflife". This value is customarily used by the polymer industry as being the materials lifetime prediction value. We have done likewise to develop Table 6 which is our predicted values for the designated exposed geomembrane lifetimes to date.

Table 6 – Exposed lifetime prediction results of selected geomembranes to date

Type	Specification	Prediction Lifetime in a Dry and Arid Climate
HDPE	GRI-GM13	> 36 years (ongoing)
LLDPE	GRI-GM17	≃ 36 years (halflife)
EPDM	GRI-GM21	> 27 years (ongoing)
fPP-2	GRI-GM18	≃ 30 years (halflife)
fPP-3	GRI-GM18	> 27 years (ongoing)
PVC-N.A.	(see FGI)	≃ 18 years (halflife)
PVC-Eur.	proprietary	> 32 years (ongoing)

4.0 Conclusions and Recommendations

This White Paper is bifurcated into two very different parts; covered (or buried) lifetime prediction of HDPE geomembranes and exposed (to the atmosphere) lifetime prediction of a number of geomembrane types. In the covered geomembrane study we chose the geomembrane type which has had the majority of usage, that being HDPE as typically used in waste containment applications. Invariably whether used in landfill liner or cover applications *the geomembrane is covered.* After ten-years of research Table 2 (repeated here) was developed which is the conclusion of the covered geomembrane research program. Here it is seen that HDPE decreases its predicted lifetime (as measured by its halflife) from 446-years at 20°C, to 69-years at 40°C. Other geomembrane types (LLDPE, fPP, EPDM and PVC) have had

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essentially no focused effort on their covered lifetime prediction of the type described herein. That said, all are candidates for additional research in this regard.

Table 2 - Lifetime prediction of HDPE (nonexposed) at various field temperatures

In Service Temperature (°C)	Stage "A" (years)			Stage "B" (years)	Stage "C" (years)	Total Prediction* (years)
	Standard OIT	High Press. OIT	Average OIT			
20	200	215	208	30	208	446
25	135	144	140	25	100	265
30	95	98	97	20	49	166
35	65	67	66	15	25	106
40	45	47	46	10	13	69

*Total = Stage A (average) + Stage B + Stage C

Exposed geomembrane lifetime was addressed from the perspective of field performance which is very unequivocal. Experience in Europe, mainly with relatively thick PVC containing high molecular weight plasticizers, has given 25-years of service and the geomembranes are still in use. Experience in the USA with exposed geomembranes on flat roofs, mainly with EPDM and CSPE, has given 20+-years of service. The newest geomembrane type in such applications is fPP which currently carries similar warranties.

Rather than using the intricate laboratory setups of Figure 1 which are necessary for covered geomembranes, exposed geomembrane lifetime can be addressed by using accelerating laboratory weathering devices. Here it was shown that the UV fluorescent device (per ASTM D7238 settings) versus the Xenon Arc device (per ASTM D 4355) is equally if not slightly more intense in its degradation capabilities. As a result, all further incubation has been using the UV fluorescent devices per D7238 at 70°C.

Archived flexible polypropylene geomembranes at four field failure sites resulted in a correlation factor of 1200 light hours equaling one-year performance in a hot climate. Using this

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value on the incubation behavior of seven commonly used geomembranes has resulted in the following conclusions (recall Figure 6 and Table 6);

- HDPE geomembranes (per GRI-GM13) are predicted to have lifetimes greater than 36-years; testing is ongoing.
- LLDPE geomembranes (per GRI-GM17) are predicted to have lifetimes of approximately 36-years.
- EPDM geomembranes (per GRI-GM21) are predicted to have lifetimes of greater than 27-years; testing is ongoing.
- fPP geomembranes (per GRI-GM18) are predicted to have lifetimes of approximately 30-years.
- PVC geomembranes are very dependent on their plascitizer types and amounts, and probably thicknesses as well. The North American formulation has a lifetime of approximately 18-years, while the European formulation is still ongoing after 32-years.

Regarding continued and future recommendations with respect to lifetime prediction, GSI is currently providing the following:

(i) Continuing the exposed lifetime incubations of HDPE, EPDM and PVC (European) geomembranes at 70°C.

(ii) Beginning the exposed lifetime incubations of HDPE, LLDPE, fPP, EPDM and both PVC's at 60°C and 80°C incubations.

(iii) With data from these three incubation temperatures (60, 70 and 80°C), time-temperature-superposition plots followed by Arrhenius modeling will eventually provide information such as Table 2 for covered geomembranes. This is our ultimate goal.

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(iv) Parallel lifetime studies are ongoing at GSI for four types of geogrids and three types of turf reinforcement mats at 60, 70 and 80°C.

(v) GSI does not plan to duplicate the covered geomembrane study to other than the HDPE provided herein. In this regard, the time and expense that would be necessary is prohibitive.

(vi) The above said, GSI is always interested in field lifetime behavior of geomembranes (and other geosynthetics as well) whether covered or exposed.

Acknowledgements

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References

Cazzuffi, D., "Long-Term Performance of Exposed Geomembranes on Dams in the Italian Alps," Proc. 6th Intl. Conf. on Geosynthetics, IFAI, 1998, pp. 1107-1114.

Chailan, J.-F., Boiteux, C., Chauchard, J., Pinel, B. and Seytre, G., "Effect of Thermal Degradation on the Viscoelastic and Dielectric Properties of Chlorosulfonated Polyethylene (CSPE) Compounds," Journal of Polymer Degradation and Stability, Vol. 48, 1995, pp. 61-65.

Comer, A. I., Hsuan, Y. G. and Konrath, L., "The Performance of Flexible Polypropylene Geomembranes in Covered and Exposed Environments," 6th International Conference on Geosynthetics, Atlanta, Georgia, USA, March, 1998, pp. 359-364.

Gedde, U. W., Viebke, J., Leijstrom, H. and Ifwarson, M., "Long-Term Properties of Hot-Water Polyolefin Pipes - A Review," Polymer Engineering and Science, Vol. 34, No. 24, 1994, pp. 1773-1787.

Giroud, J.-P. and Tisinger, L. G., "The Influence of Plasticizers on the Performance of PVC Geomembranes," PVC GRI-17 Conference, IFAI, Roseville, MN, 1994, pp. 169-196.

Hammon, M., Hsuan, G., Levin, S. B. and Mackey, R. E., "The Re-examination of a Nine-Year-Old PVC Geomembrane Used in a Top Cap Application," 31st Annual SWANA Conference, San Jose, CA, 1993, pp. 93-108.

Hsuan, Y. G. and Guan, Z., "Evaluation of the Oxidation Behavior of Polyethylene Geomembranes Using Oxidative Induction Time Tests," ASTM STP 1326, Riga and Patterson, Eds., ASTM, 1997, pp. 138-149.

Hsuan, Y. G. and Koerner, R. M., "Can Outdoor Degradation be Predicted by Laboratory Acceleration Weathering?," GFR, November, 1993, pp. 12-16.

Hsuan, Y. G. and Koerner, R. M., "Antioxidant Depletion Lifetime in High Density Polyethylene Geomembranes," Jour. Geotech. and Geoenviron. Engr., ASCE, Vol. 124, No. 6, 1998, pp. 532-541.

ICOLD (2010), "Geomembrane Sealing Systems for Dams: Design Principles and Return of Experience," Intl. Committee on Large Dams, Bulletin 135, Paris, France.

Koerner, G. R. and Koerner, R. M., "In-Situ Temperature Monitoring of Geomembranes," Proc. GRI-18 Conf. at GeoFrontiers, Austin, TX, 2005, 6 pgs.

Martin, J. R. and Gardner, R. J. (1983), "Use of Plastics in Corrosion Resistant Instrumentation," 1983 Plastics Seminar, NACE, October 24-27.

Miller, L. V., Koerner, R. M., Dewyea, J. and Mackey, R. E., "Evaluation of a 30 mil PVC Liner and Leachate Collection System," Proc. 29th Annual GRCDA/SWANA Conf., Cincinnati, OH, 1991.

Müeller, W. and Jakob, I., "Oxidative Resistance of High-Density Polyethylene Geomembranes," Jour. Polymer Degradation and Stability," Elsevier Publ. Co., No. 79, 2003, pp. 161-172.

Rapoport, N. Y. and Zaikov, G. E., "Kinetics and Mechanisms of the Oxidation of Stressed Polymer," Developments in Polymer Stabilization—4, G. Scott, Ed., Applied Science Publishers Ltd., London, U.K., 1986, pp. 207-258.

Sangam, H. P. and Rowe, R. K., "Effects of Exposure Conditions on the Depletion of Antioxidants from HDPE Geomembranes", Canadian Geotechnical Journal, Vol. 39, 2002, pp. 1221-1230.

Scuero, A., "The Use of Geocomposites for the Rehabilitation of Concrete Dams," Proc. 4th Intl. Conf. on Geosynthetics, The Hague, Balkema Publ. Co., 1990, pg. 474.

Scuero, A. M. and Vaschetti, G. L., "Geomembranes for Masonry and Concrete Dams: State-of-the-Art Report," Proc. Geosynthetics Applications, Design and Construction, M. B. deGroot, et al., Eds., A. A. Balkema, 1996, pp. 889-898.

Suits, L. D. and Hsuan, Y. G., "Assessing the Photo Degradation of Geosynthetics by Outdoor Exposure and Laboratory Weatherometers," Proc. GRI-15 Conference, Hot Topics in Geosynthetics II, GII Publ., Folsom, PA, 2001, pp. 267-279.

Wang, W. and Qu, B., "Photo and Thermo-Oxidative Degradation of Photocrosslinked Ethylene-Propylene-Diene Terpolymer," Journal of Polymer Degradation and Stability, Vol. 81, 2003, pp. 531-537.

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