REPUBLIC SERVICES

January 28, 2020

Ty L. Howard, Director
Utah Department of Environmental Quality
Division of Waste Management & Radiation Control
195 North 1950 West
Salt Lake City, Utah 84114-4880

Re: ECDC Environmental MSW Expansion 1 Cell

Dear Mr. Howard,

Please find enclosed a Project Manual (PM) for an MSW Cell Expansion at ECDC Environmental Landfill. The expansion encompasses a total of 7.6-acres, of which 2 acres are new liner area. The PM includes detailed Design Drawings, Technical Specifications and Construction Quality Assurance (CQA) plan prepared by Geo-Logic Associates.

The cell expansion project is scheduled to begin in March 2020 and finish up in August. A pre-construction meeting will be scheduled at the landfill once a contractor has been selected.

ECDC Environmental thanks the Division for timely review and approval of this submittal. If you have any questions or comments pleased contact me at 435-888-4115.

Sincerely,

Darin Olson
Republic Services, Environmental Manager

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PROJECT MANUAL

MSW EXPANSION 1 CELL

ECDC ENVIRONMENTAL LANDFILL

JANUARY 2020

PROJECT NO. AU19.1236.00

REPUBLIC SERVICES

SUBMITTED TO:

ECDC Environmental Landfill, L.C.
111 West Highway 123
East Carbon, Utah 84520

Geo-Logic ASSOCIATES

PREPARED BY:

Geo-Logic Associates
143E Spring Hill Drive
Grass Valley, California 95945
(530) 272-2448

TECHNICAL SPECIFICATIONS

DIVISION 1

GENERAL REQUIREMENTS

TABLE OF CONTENTS

DIVISION 1 - GENERAL REQUIREMENTS

END OF DOCUMENT

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

A. This section supplements the requirements specified in the General Conditions and Supplementary Conditions. If the requirements of this section and conditions noted above conflict, the CONTRACTOR shall adhere to the more stringent requirement as determined by the OWNER.

B. Section Includes:

1. Contract Description
2. Construction Water
3. CONTRACTOR Use of Site
4. Description of Work
5. CONTRACTOR's Work Scope

1.2 CONTRACT DESCRIPTION

A. Contract Type: Stipulated price as described in the Standard Form of Agreement between OWNER and CONTRACTOR on the Basis of a Stipulated Price.

1.3 CONSTRUCTION WATER

A. Construction water is available on-site. Construction water can be obtained by the CONTRACTOR from the site construction water pond and/or East Springs as shown on the drawings. CONTRACTOR to verify availability of water and access.

B. The CONTRACTOR shall be responsible for transporting and/or conveying all required construction water from the available source.

1.4 CONTRACTOR'S USE OF SITE

A. The CONTRACTOR cannot interfere with ongoing landfill operations, including the allowance of sufficient water supply for dust control and operational measures.

B. The CONTRACTOR should limit activities to the project area, as shown on the Drawings, stockpiles, staging area, and haul road as identified by the OWNER.

1.5 DESCRIPTION OF WORK

A. The work to be performed for this contract includes, but is not necessarily limited to, the construction of MSW Expansion 1 Cell at the ECDC Environmental Landfill. The cell liner area is just under 2 acres.

B. The liner system, from bottom to top, consists of the following constructed layers:

Floor:

- Excavated and prepared subgrade;
- 6-inch minimum soil cushion layer;
- Geosynthetic clay liner (GCL);
- 60-mil textured (both sides) HDPE geomembrane liner;
- Drainage geocomposite;
- Two foot thick protective soil cover layer.

Side Slope:

- Excavated and prepared subgrade or embankment;
- 6-inch minimum soil cushion layer;
- Geosynthetic clay liner (GCL);
- 60-mil textured (both sides) HDPE geomembrane liner;
- Two foot thick protective soil cover layer (placed 10' vertically up side slopes by the CONTRACTOR).

C. Other Construction Items Include:

- Placement and compaction of engineered fill to create subgrade and embankments;
- Road base for access roads and embankments;

- Install drainage culverts and rip rap;
- Leachate collection pipe, gravel, and geotextile wrap;
- and liner terminations and anchor trenches.

All work must be carried out and maintained per the Drawings and Specifications subject to the approval of the Design Engineer and Construction Quality Assurance consultant.

1.6 CONTRACTOR'S WORK SCOPE

A. CONTRACTOR shall furnish all labor, materials, tools, equipment, supervision, transportation, and installation services required for the following tasks as summarized below, and outlined in the Drawings and Specifications:

1. Excavating and stockpiling soils within the project area to the lines and grades shown on the Drawings. Stockpile locations to be determined by the OWNER.
2. Placement and compaction of engineered fill material to the lines and grades shown on the Drawings within the construction area.
3. Placement and grading of the soil cushion including excavating, loading, hauling, screening, moisture conditioning, spreading, and placement.
4. Preparing geosynthetic anchor trench including locating, excavating, fill placement, backfilling and compaction, and the installation of markers.
5. Provide all necessary construction staking to lay-out the work and other surveying to compute quantities and prepare as-built drawings for top of subgrade, and operations layer. Prepare all required Record Drawings and surveys necessary to document as-built quantities/conditions. Submit all required Record Drawings to OWNER. Record (as-built) drawings shall be signed and sealed by a Utah Registered Land Surveyor.
6. Supply and installation of leachate collection pipe and gravel, and installation of geotextile wrap –**geotextile supplied by owner**.
7. Supply and installation of geosynthetic clay liner (GCL) – **GCL supplied by owner and installed by others under separate contract.**
8. Placement and grading of the protective cover soil layer over geocomposite and geomembrane, including excavating, loading, hauling,

spreading, and placement. Protective cover to be placed on the geocomposite with an excavator to minimize the formation of wrinkles.

9. Supply and installation of 60-mil HDPE geomembrane – **geomembrane supplied by owner and installed by others under separate contract.**

10. Supply and installation of geocomposite – **geocomposite supplied by owner and installed by others under separate contract.**

11. Construction of road base sections for access roads and embankments, including supplying, hauling, spreading, grading, and compacting.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01019

CONTRACT CONSIDERATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. References and abbreviations of various industry associations, trade associations, societies, organizations, and regulatory agencies, as referenced in the Contract Documents.

1.2 DESCRIPTIONS

A. The Contract Documents contain references to various standard Specifications, codes, practices, and requirements for materials, workmanship, installation inspections, and tests. Which references are published and issued by the organizations, societies, and associations listed below by abbreviation and name. Such references are hereby made a part of the Contract Documents to the extent cited.

B. Any material, method, or procedure specified by reference to the number, symbol, or title of a specific Specification or standard, such as a Commercial Standard, American National Standard, Federal or State Specification, Industry or Government Code, a trade association code or standard, or other similar standard, shall comply with the requirements of the edition in effect on the date of Notice to Proceed.

C. The code, specification, or standard referred to, except as modified in these Specifications, shall have full force and effect as though printed in these Specifications. These Specifications and standards are not furnished to bidders since manufacturers and trades involved are assumed to be familiar with their requirements. The OWNER will furnish, upon request, information as to how copies of the Specifications and standards referred to may be obtained.

1.3 ABBREVIATIONS

A. Whenever in the Contract the following abbreviations are used, their meanings shall be as follows:

AASHTO American Association of State Highway and Transportation Officials

ACI American Concrete Institute

ANSI American National Standards Institute

ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
GRI	Geosynthetics Research Institute
FS	Federal Specifications
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PPI	Plastic Pipe Institute

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment methods for contract bid items.

1.2 MEASUREMENT OF QUANTITIES

A. Performed according to United States Measures.

B. Based on actual units installed or neat line dimensions of work completed.

1.3 CALCULATION OF QUANTITIES

A. Progress Payment Quantities:

1. CONTRACTOR will compute all quantities of Work performed, or of materials and equipment delivered to the site for progress payment purposes.

2. OWNER may at any time verify quantities calculated by CONTRACTOR.

B. Final Payment Quantities: CONTRACTOR will compute all quantities of Work performed, or of materials and equipment delivered and installed for final payment purposes. OWNER may perform an independent computation of all quantities of work performed, and of materials and equipment installed.

1.4 PAYMENT

A. In accordance with lump sum, unit prices, or force account rates shown on the CONTRACTOR'S final negotiated Bid Schedule.

B. Includes all costs for overhead and profit and for supplying materials, labor, equipment, and tools, and all applicable Federal, State, County, City, and local taxes, necessary to complete the Work in accordance with the Specifications, Drawings, and Contract Conditions.

1.5 VALUES OF UNIT PRICES

A. The number of units and quantities contained in the Bid Schedule are approximate only, and final payment will be made for the actual number of units

and quantities incorporated in the work or made necessary to complete the project. All unit and lump prices shall include applicable Federal, State, County, City, and local taxes.

B. In the event that work and materials or equipment are required to be furnished to a greater or lesser extent than is indicated by the Contract Documents, such work and materials or equipment shall be furnished in greater or lesser quantities.

1.6 CHANGES AND EXTRA WORK

A. Changes and extra work will be measured and paid for in accordance with the requirements of this Section.

1.7 REJECTED MATERIALS

A. Quantities of material wasted or disposed in a manner not called for in the Specifications; rejected loads of material, including material rejected after it has been placed by reasons of the failure of CONTRACTOR to conform to the provisions of the Specifications; material not unloaded from the transporting vehicle; material placed outside the limits indicated by the Drawings or established by OWNER; or material remaining on hand after completion of the Work, will not be paid for, and such quantities will not be included in the final total quantities. No compensation will be made for loading, hauling, and disposing of rejected material.

1.8 FORCE ACCOUNT WORK

A. Payment for Force Account work will be determined as follows:

B. Labor.

1. Payment for labor will be based on the Force Account Labor Rate Schedule submitted with the bid.

2. Payment constitutes full compensation for labor including wages, benefits, overhead, and profit for each individual.

C. Equipment.

1. Payment for equipment will be based on the Force Account Equipment Rate Schedule submitted with the bid.

2. Payment constitutes full compensation for supplying equipment and includes all costs for maintenance, fuel, insurance, overhead, profit and

any other costs necessary to provide and operate the equipment. Payment does not include operator labor cost.

D. Materials.

1. Payment for materials will be paid for at CONTRACTOR's invoiced cost plus 10 percent.

2. Payment will be based on invoices from suppliers documenting cost to CONTRACTOR.

3. Where invoices are not available a unit cost must be approved by the OWNER prior to use of the material.

1.9 PAY ITEMS

A. MSW Expansion 1 Cell

1. Mobilization/Demobilization **(Bid Item 1)**

a. Measurement by Lump Sum (LS), based on mobilization of equipment and labor to perform work and demobilizing from and cleaning the site after all work and testing has been performed and accepted by the OWNER.

b. Payment as follows: 50 percent of lump sum amount upon completion of 10 percent of the work, and 50 percent for demobilization and site cleanup. Payment includes all costs for mobilizing and demobilizing equipment, living expenses, bonds, all required permits, insurance, office and field overhead, geosynthetic installer management, development of work plans, Health and Safety Plans, submittals, and any other administrative costs necessary to complete the work. Includes work described in Sections 01200, 01300, 01310, 01400, 01500, 01560, 01600, 01630, and 01700; as well as management and coordination related to Sections 02771, 02776, 02778, and 02779.

2. NPDES **(Bid Item 2)**

a. Measured by Lump Sum (LS).

b. Payment includes all costs to prepare and submit the Construction Notice of Intent and to prepare and implement a

Storm Water Pollution Prevention Plan (SWPPP) in accordance with the requirements of Section 01560.

3. Surveying and As-built Drawings **(Bid Item 3)**

   a. Measured by Lump Sum (LS).

   b. Payment includes all costs to perform construction control and slope staking, surveys to complete quantities, surveys to document as-built conditions of the construction, and the preparation of Record Drawings as described in Section 01050 and 01052. CONTRACTOR shall provide an estimate of labor hours and expenses with this bid to support the lump sum price.

4. Clearing and Stripping **(Bid Item 4)**

   a. Measured by the Acre (AC). Measurement of clearing and stripping is based on a perimeter survey of the completed clearing limits necessary for construction.

   b. Payment will be made by the Acre (AC). Payment includes all costs to clear and strip the construction areas and to load, haul, and dispose of debris, as described in Section 02110.

5. Excavation and Removal of Existing Engineered Fill and Place as Engineered Fill **(Bid Item 5)**

   a. Measured by the bank Cubic Yard (CY). Measurement of excavation will be made by comparing pre-construction topography of the landfill cell construction area as depicted on the Drawings with post-excavation topography. Pre-construction topography will be established by field survey of existing grades. Survey will establish existing grades at a maximum 50-foot grid and establish major grade breaks. Post-construction topography will be established by similar survey at a maximum 50-foot grid and also establish major grade breaks. Calculations will be made on an average end area basis vertically by 2-foot contour interval.

   b. Payment includes all costs to excavate soil, including existing engineered fill within the construction area, load, haul, and place in as engineered fill as described in Sections 02221 and 02222, and as shown on the Drawings.

6. Haul and Place Engineered Fill **(Bid Item 6)**

a. Measured by in-place Cubic Yard (CY). Measurement of in-place engineered fill in the MSW Expansion 1 Area will be made by comparing pre-construction topography with post-construction topography within the construction area. Pre-construction topography will be established by field survey of existing grades. Survey will establish existing grades at a maximum 50-foot grid and establish major grade breaks. Post-construction topography will be established by similar survey at a maximum 50-foot grid and also establish major grade breaks. Calculations will be made on an average end area basis vertically by 2-foot contour interval.

b. Payment will be made by the Cubic Yard (CY). Payment includes all costs to excavate from the borrow area as shown on the Drawings or the OWNER designated area, haul, place, rough grade, process, moisture condition, and compact in the MSW Expansion 1 area as described in Sections 02221 and 02222, and as shown on the Drawings. Payment also includes all costs to stockpile screened oversized material as directed by OWNER.

7. 6" Thick Soil Cushion – Side Slopes **(Bid Item 7)**

a. Measurement by the Cubic Yard (CY). Measurement shall be based on the surveyed area multiplied by the neat line thickness for the soil cushion layer material meeting the gradation requirements of Section 02222 and as shown on the Drawings. CONTRACTOR will be responsible for verifying specified thickness by survey methods. The CONTRACTOR is also responsible for stockpiling any oversize material from the screening operation as directed by the OWNER. No adjustments will be made in the area for uneven contours.

b. Payment shall be by the Cubic Yard (CY) in-place. Payment includes all costs to furnish equipment and labor to screen, haul, place, moisture condition, compact, grade and smooth material as soil cushion as shown on the Drawings and as described in Section 02222. Payment also includes all costs to stockpile screened oversized material as directed by OWNER.

8. 6" Thick Soil Cushion - Floor **(Bid Item 8)**

a. Measurement by the Cubic Yard (CY). Measurement shall be based on the surveyed area multiplied by the neat line thickness for the soil cushion layer material meeting the gradation requirements of Section 02222 and as shown on the Drawings.

CONTRACTOR will be responsible for verifying specified thickness by survey methods. The CONTRACTOR is also responsible for stockpiling any oversize material from the screening operation as directed by the OWNER. No adjustments will be made in the area for uneven contours.

b. Payment shall be by the Cubic Yard (CY) in-place. Payment includes all costs to furnish equipment and labor to screen, haul, place, moisture condition, compact, grade and smooth drum roll material as soil cushion as shown on the Drawings and as described in Section 02222. Payment also includes all costs to stockpile screened oversized material as directed by OWNER.

9. Geosynthetic Subgrade Preparation **(Bid Item 9)**

a. Measured by the Acre (AC). Measurement based on perimeter survey; sloped areas will be equated based on actual area, not plan area.

b. Payment shall be by the Acre (AC). Payment includes all costs to complete subgrade preparation for the geosynthetic installation area as described in Section 02223.

10. Leachate Collection Gravel **(Bid Item 10)**

a. Measurement by the Cubic Yard (CY) of gravel installed, based on the field survey of the installed LCRS trenches multiplied by the neat line dimensions shown on the drawings.

b. Payment shall be by the Cubic Yard (CY). Payment includes all costs to purchase, supply, and install the leachate collection gravel in the LCRS trenches as shown on the Drawings and described in Section 02227. Also includes all costs to install OWNER supplied geotextile as shown on the Drawings and described in Sections 02227, 02710, and 02771.

11. Screen & Place 2 ft Protective Soil Cover Layer **(Bid Item 11)**

a. Measurement by the Cubic Yard (CY). Measurement shall be based on the surveyed area multiplied by the neat line thickness for the protective soil cover layer material meeting the gradation requirements of Section 02222 and as shown on the Drawings. CONTRACTOR will be responsible for verifying specified thickness by survey methods. The CONTRACTOR is also responsible for stockpiling any oversize material from the screening operation as

directed by the OWNER. No adjustments will be made in the area for uneven contours.

b. Payment shall be by the Cubic Yard (CY) in-place. Payment includes all costs to furnish equipment and labor to screen, haul and place material as protective soil cover layer as shown on the Drawings and as described in Section 02222. Payment also includes all costs to stockpile screened oversized material as directed by OWNER.

12. Screen and Stockpile Protective Soil Cover Material **(Bid Item 12)**

a. Measurement by the Cubic Yard (CY). Measurement shall be based on a survey of the screened protective soil cover material. Survey will establish stockpile grades at a maximum 50-foot grid and establish major grade breaks. Calculations will be made on an average end area basis vertically by 2-foot contour interval. The CONTRACTOR is also responsible for stockpiling any oversize material from the screening operation as directed by the OWNER.

b. Payment shall be by the Cubic Yard (CY). Payment includes all costs to furnish equipment and labor to screen, haul and stockpile material as protective soil cover layer as shown on the Drawings and as described in Sections 02221 and 02222. Payment also includes all costs to stockpile screened oversized material as directed by OWNER.

13. Existing Supercell 1A South/MSW 1 Side Slope Liner Tie-In **(Bid Item 13)**

a. Measurement by the Lineal Foot (LF) of the tie-in, based on the field survey.

b. Payment shall be by Lineal Foot (LF). Payment includes all costs to locate, excavate, prepare, shape, backfill, compact, or otherwise construct the tie-in as shown on the Drawings and described in Section 02222.

14. Existing Supercell 1A South/MSW 1 Floor Liner Tie-In **(Bid Item 14)**

a. Measurement by the Lineal Foot (LF) of the tie-in, based on the field survey.

b. Payment shall be by Lineal Foot (LF). Payment includes all costs to locate, excavate, prepare, shape, backfill, compact, or otherwise

construct the tie-in as shown on the Drawings and described in Section 02222.

15. Temporary Side Slope Liner Termination **(Bid Item 15)**

    a. Measurement by the Lineal Foot (LF) of the termination, based on the field survey.

    b. Payment shall be by Lineal Foot (LF). Payment includes all costs to locate, excavate, prepare, shape, backfill, compact, or otherwise construct the termination as shown on the Drawings and described in Section 02222. Payment also includes all costs to supply and install Plywood as shown on the Drawings.

16. Temporary Floor Liner Termination **(Bid Item 16)**

    a. Measurement by the Lineal Foot (LF) of the termination, based on the field survey.

    b. Payment shall be by Lineal Foot (LF). Payment includes all costs to locate, excavate, prepare, shape, backfill, compact, or otherwise construct the termination as shown on the Drawings and described in Section 02222. Payment also includes all costs to supply and install Plywood as shown on the Drawings.

17. Permanent Liner Termination **(Bid Item 17)**

    a. Measurement by the Lineal Foot (LF) of the termination, based on the field survey.

    b. Payment shall be by Lineal Foot (LF). Payment includes all costs to locate, excavate, prepare, shape, backfill, compact, or otherwise construct the termination as shown on the Drawings and described in Section 02222.

18. 6" Dia. Perforated HDPE SDR-11 Leachate Collection Pipe **(Bid Item 18)**

    a. Measurement by the Lineal Foot (LF) of pipe, based on the field survey.

    b. Payment shall be by Lineal Foot (LF). Payment includes all costs to purchase, supply, fusion weld, and install the leachate collection pipe as shown on the Drawings and described in Section 02710.

19. 24" Dia. Corrugated HDPE Culvert **(Bid Item 19)**

a. Measurement by the Lineal Foot (LF) of pipe, based on the field survey.

b. Payment shall be by Lineal Foot (LF). Payment includes all costs to purchase, supply, trench, install the pipe and associated flared ends and backfill with material as shown on the Drawings and described in Section 02711 and 02222.

20. Rip Rap **(Bid Item 20)**

a. Measured by Cubic Yard (CY). Measured by the neat line dimensions multiplied by the thickness as shown on the Drawings.

b. Payment includes all costs for install geotextile and rip rap energy dissipaters to the dimension cross-section shown on the drawing and as described in section 02230. Payment specifically excludes purchase and supply geotextile which is included in Bid Item 26.

21. Aggregate Base **(Bid Item 21)**

a. Measured by in-place Cubic Yard (CY). Measurement and calculation of in-place road base will be made by surveying the limits of the roads and ramps and multiplying the area times the neat line design thickness shown on the Drawings.

b. Payment will be made by the Cubic Yard (CY). Payment includes all costs to purchase, load, haul, place, moisture condition and compact as described in Sections 02222 and 02231, and as shown on the Drawings.

22. Geosynthetic Clay Liner (GCL) **(Bid Item 22, Owner Supplied) (Installed by Others)**

a. Measurement by the Square Foot (SF). Measurement by area installed including material in the anchor trenches in accordance with agreement between OWNER and SUPPLIER/INSTALLER, measured by the Square Foot (SF) based on a perimeter survey of the completed installation. No adjustment will be made for uneven contours or for overlap at seams or wastage. No measurement will be made for geosynthetic clay liner lost due to damage resulting from either the fault or the negligence of the CONTRACTOR. The perimeter is defined as the neat line dimension shown on the perimeter details.

b. Payment will be by the Square Foot (SF). Payment includes all costs to install GCL as shown on the Drawings and described in Section 02779.

23. 60-mil Double-Sided Textured Geomembrane **(Bid Item 23, Owner Supplied) (Installed by Others)**

a. Measurement by the Square Foot (SF). Measurement by area installed including material in the anchor trenches, flaps, and rub sheets in accordance with agreement between OWNER and SUPPLIER/INSTALLER, measured by the square foot (SF) based on a perimeter survey of the completed installation. No adjustment will be made for uneven contours or for overlap at seams, or wastage. No measurement will be made for geomembrane lost due to damage resulting from either the fault or the negligence of the CONTRACTOR. The perimeter is defined as the neat line dimension shown on the perimeter details.

b. Payment will be by the Square Foot (SF). Includes all costs to install geomembrane as shown on the Drawings and described in Section 02778.

24. Double-Sided Geocomposite **(Bid Item 24, Owner Supplied) (Installed by Others)**

a. Measurement by the Square Foot (SF). Measurement by area installed including anchor trenches in accordance with agreement between OWNER and SUPPLIER/INSTALLER, measured by the square foot (SF) based on a perimeter survey of the completed installation. No adjustment will be made for uneven contours or for overlap at seams or wastage. No measurement will be made for geocomposite lost due to damage resulting from either the fault or the negligence of the CONTRACTOR. The perimeter is defined as the neat line dimension shown on the perimeter details.

b. Payment will be by the Square Foot (SF). Includes all costs to install geocomposite as shown on the Drawings and described in Section 02776.

25. Geotextile Supply **(Bid Item 25, Owner Supplied)**

a. Measurement by the Square Foot (SF). Measurement based on the neat line design dimensions in accordance with agreement between OWNER and SUPPLIER.

b. Payment will be by the Square Foot (SF). Includes all costs to supply and deliver geotextile as shown on the Drawings and described in Section 02771. Payment specifically excludes installation which is included in Bid Item 10 and 21.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01035

MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Field Orders.

B. Work Directive Changes.

C. Change Orders.

1.2 CHANGE PROCEDURES

A. OWNER will issue Field Orders for minor changes in the Work not involving an adjustment to Contract Price or Contract Time.

B. OWNER may issue a Proposal Request which includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required, and the period of time during which the requested price will be considered valid. CONTRACTOR shall prepare and submit a Proposal with estimate within 5 days.

C. CONTRACTOR may request a change by submitting a Proposal to OWNER, describing the proposed change and its full effect on the Work. Include a statement describing the reason for the change, the effect on the Contract Price and Contract Time, and a statement describing the effect on Work by separate or other contractors in accordance with Section 00675 within the Project Manual.

D. OWNER may issue a Work Change Directive for any change which, if not processed expeditiously, might delay the Project. This is not a Change Order, but only a directive to proceed with Work that may be included in a subsequent Change Order.

E. Changes affecting Contract Price or Contract Time, resulting under paragraphs 1.2 B, C, and D of this Section, will be processed as a Change Order.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01050

FIELD ENGINEERING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General requirements for survey work to be performed by CONTRACTOR to layout Work under this Contract.

B. Before commencing any surveys, CONTRACTOR will give OWNER two working days advance notice so that OWNER may witness such work.

1.2 RELATED SECTIONS:

A. Section 01025 – Measurement and Payment.

1.3 DESCRIPTION

A. Reference points: Reference points to be provided by OWNER pursuant to the General Conditions will include referenced monuments and elevation benchmarks in the vicinity of the Project. If displaced by CONTRACTOR, replacement of these reference points will be at the expense of CONTRACTOR.

B. CONTRACTOR will furnish all necessary detail surveys including all lines, grades, and elevation appropriate to control construction. At a minimum, construction surveys are required for top of subgrade and top of drainage/operations layer.

C. Use by OWNER: OWNER may at any time use line and grade points and markers established by CONTRACTOR. CONTRACTOR's surveys are a part of the Work and may be checked by OWNER at any time. CONTRACTOR is responsible for any lines, grades, or measurements which do not comply with specified or proper tolerances, or which are otherwise defective, and for any resultant defects in the Work. CONTRACTOR will be required to conduct re-surveys or check surveys to correct errors indicated by review of the field notebooks or otherwise detected.

1.4 SURVEYS FOR MEASUREMENT FOR PAYMENT

A. When the Specifications or OWNER require Bid Schedule items of work to be measured by surveying methods, CONTRACTOR will perform the surveys. All such surveys, including control surveys for establishing the measurement reference lines, will be performed by a duly qualified and licensed surveyor in the presence of CONTRACTOR who will provide notice so OWNER may witness the surveying operation. OWNER may independently check calculations of final

quantities for payment purposes. A duplicate of the note reductions and calculations will be given to OWNER. All calculated quantities shall be certified by surveyor as to accuracy.

1.5 SURVEYING ACCURACY AND TOLERANCES IN SETTING OF SURVEY STAKES

A. Perform control traverse field surveys and computations to an accuracy of at least 1:10,000.

B. The tolerances applicable in setting survey stakes are as set forth below. Such tolerances cannot supersede stricter tolerances required by the Drawings or Specifications, and cannot otherwise relieve the CONTRACTOR of responsibility for measurements in compliance therewith.

Type of Mark	Horizontal Position	Elevation
Permanent reference points	1 in 10,000	±.01 ft.
General excavation and earthwork	1 in 2,000	±.10 ft.

C. Tolerances for the thickness of earthen layers shown on Drawings and for elevations shown on the Drawings are ±0.10 foot unless otherwise specified.

D. Surveyor must be licensed in the State of Utah.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01052

LAYOUT OF WORK AND SURVEYS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes requirements for survey work to be provided by the CONTRACTOR for the following:

1. Setting offset stakes, slope stakes, and grade stakes for field layout of features for performance of the Work.

2. Surveys for measurement of quantities for payment.

3. Record Drawings.

1.2 DESCRIPTION

A. **Reference Points**. The reference points provided by the OWNER include monuments and elevation bench marks in the vicinity of the Project. If displaced during the project, replacement of these reference points will be at the expense of the CONTRACTOR.

B. The OWNER reserves the right to perform any desired checking and correction of the CONTRACTOR's layout work relative to OWNER's surveys but this does not relieve the CONTRACTOR of the responsibility for adequate performance of their Work.

C. **Equipment and Personnel**. Provide instruments and other survey equipment that are accurate, suitable for the surveys required in accordance with recognized professional standards and in proper condition and adjustment at all times. Perform surveys under the direct supervision of a licensed surveyor.

D. **Field Notes and Records**. Record surveys in field notebooks.

E. **Use by the OWNER**. The OWNER may at any time use line and grade points and markers established by the OWNER or CONTRACTOR. The CONTRACTOR's surveys are a part of the Work and may be checked by the OWNER or representatives of the OWNER at any time.

1.3 RELATED SECTIONS

A. Section 01025 - Measurement and Payment

B. Section 01050 – Field Engineering

1.4 SURVEYS FOR LAYOUT AND PERFORMANCE OF WORK

A. CONTRACTOR will perform all surveys for layout of the Work, reduce the field notes, make necessary calculations, and prepare drawings necessary to carry out such work. CONTRACTOR's layout work will include the following:

1. Slope staking for cell grading at 50-foot grid and grade breaks.

2. Blue top for landfill subgrade at 50-foot grid and grade breaks.

3. Control staking for protective soil cover layer thickness at 50-foot grid, and grade breaks.

4. All as-built surveys specified here in.

5. Surveys to measure completed units of work specified here in.

B. CONTRACTOR must perform all additional slope staking, off-setting and other control staking necessary to perform the Work.

1.5 SURVEYS FOR RECORD DRAWINGS AND MEASUREMENT FOR PAYMENT

A. Provide the OWNER with as-built Record Drawings that show the following items:

1. Topography that depicts the landfill subgrade following excavation and engineered fills.

2. Anchor trench location with survey points every 200 feet and at alignment breaks, such as corners.

3. Limit of geomembrane liner (surface area).

4. Topography that depicts the top of the geosynthetic subgrade, and Protective Soil Cover Layer, including perimeter berms, signed and sealed by a Utah Registered Land Surveyor.

5. Topography of all constructed ditches.

6. Alignment, ends, and invert elevations of fence, pipes and culverts.

7. Topography that depicts the engineered fill placement of the embankments.

B. Submit survey information for items listed above to the OWNER before the items are covered.

1. Provide surveys to measure the following items:

a. Actual area (corrected for slope) of geosynthetics.

b. Length of channels.

c. Length of pipes and culverts.

d. Volume of excavation and engineered fill.

C. The OWNER may perform independent checks.

D. Provide Record Drawings on 22" x 34" size drawings, and on computer disk in AutoCAD version 2017 or later. Use the coordinate system shown on the drawings.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

A. Representatives of CONTRACTOR, subcontractors, and suppliers attending meetings must be authorized to act on behalf of organizations they represent.

1.2 PRE-CONSTRUCTION MEETING

A. Meeting will be held at a location selected by OWNER.

B. Attendance:

1. CONTRACTOR's Office Representative.
2. CONTRACTOR's On-Site Field Superintendent.
3. Any Subcontractors or Supplier's representatives whom CONTRACTOR may desire to invite or OWNER may request.
4. ENGINEER's Representatives.
5. OWNER's Representatives. (Includes Design Engineer and CQA Personnel)

C. A suggested format would include, but not be limited to, the following subjects:

1. Presentation of a proposed construction progress schedule and submittals as required by the Contract Documents.
2. Required bonds and insurance certifications prior to Notice to Proceed.
3. Liquidated Damages.
4. Procedures for handling submittals.
5. Direction of correspondence, and coordinating responsibility between CONTRACTOR and OWNER.
6. Request or scheduling of a weekly job meeting for all involved.
7. Laboratory testing of construction materials.

8. Applications for payment, and progress payment procedures.

9. Change Order procedures.

10. OWNER's site regulations.

D. The meeting will be documented by the OWNER or person designated by the OWNER. Copies of the minutes and relevant documents will be provided to all parties.

1.3 WEEKLY PROGRESS MEETINGS

A. OWNER'S Representative will schedule and administer progress meetings at a minimum of once per week and such additional meetings as required, or as requested by OWNER.

B. Attendance:

1. OWNER'S Representative.

2. ENGINEER, if requested by OWNER'S Representative.

3. CQA Officer.

4. CONTRACTOR's superintendent.

5. Subcontractors as appropriate to agenda.

6. Suppliers as appropriate to agenda.

C. Meeting requirements:

1. OWNER'S Representative will administer the following general requirements for progress meetings:

a. Prepare agenda for meetings.

b. Make physical arrangements for meetings.

c. Preside at meetings.

2. CONTRACTOR will administer the following general requirements for progress meetings:

a. Record significant proceedings and decisions of meeting.

b. Reproduce and distribute copies of meeting record within seven days after each meeting to participants in meeting and to parties affected by decisions made at meeting. Furnish one copy of minutes to participants. Revise and distribute revisions to meeting minutes as necessary.

D. Suggested Agenda:

1. Review and approval of record of previous meeting.
2. Review of Work progress since previous meeting.
3. Field observations, problems, and conflicts.
4. Problems which impede Work Schedule.
5. Review of off-site delivery schedules.
6. Corrective measures and procedures to regain projected schedule if a review of the schedule deems it necessary.
7. Revisions to Construction Progress Schedule.
8. Coordination of schedules between contractors.
9. Review submittal schedules; expedite as required.
10. Maintenance of quality and safety standards.
11. Pending changes and substitutions.
12. Review proposed changes for effect on construction schedule and completion date, and on other contracts of projects.
13. Review of drawings and specifications that govern the next two weeks of work.
14. Review of bid item quantities relative to original estimates.
15. Review and update of as-built drawings.
16. Other business.

1.4 DAILY PROGRESS MEETINGS

A. An informal progress meeting will be held daily before the start of work. At a minimum, this meeting will be attended by the OWNER'S Representative and CONTRACTOR's Project Manager or Job Foreman. The purpose of this meeting is to:

1. Review scheduled work activities.

2. Discuss problems and resolutions.

3. Review test data.

4. Discuss the CONTRACTOR's personnel and equipment assignments for the day.

5. Review the previous day's activities and accomplishments.

B. This meeting will be documented by the OWNER'S Representative.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.

B. Construction progress schedules.

C. Proposed Products list.

D. Shop Drawings.

E. Product Data.

F. Samples.

G. Manufacturers' installation instructions.

H. Manufacturers' certificates.

1.2 RELATED SECTIONS

A. Section 01310 - Construction Schedule

B. Section 01400 - Quality Control: Manufacturers' field services and reports.

C. Section 01700 – Contract Closeout: Contract warranties, bonds, manufacturers' certificates, and closeout submittals.

1.3 SUBMITTAL PROCEDURES

A. Transmit each submittal with a transmittal form. Provide a minimum of three copies of each submittal. OWNER will retain one copy of each submittal.

B. Sequentially number the transmittal form. For revised submittals add an alphabetic suffix to the original number.

C. Identify Project, CONTRACTOR, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate.

D. Apply CONTRACTOR's stamp, signed or initialed certifying review, verification of Products required, field dimensions, adjacent construction Work, and

coordination of information, is in accordance with the requirements of the Work and Contract Documents.

E. Schedule submittals to expedite review by the OWNER and delivery in the time frame specified. Coordinate submission of related items.

F. Allow 7 calendar days review time for each submittal excluding delivery time to and from the CONTRACTOR.

G. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.

H. Provide space for CONTRACTOR, OWNER and/or OWNER's Representative review stamps.

I. If revisions and re-submittals are required, identify all changes made since previous submission.

J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with provisions.

K. Submittals not requested will not be recognized or processed.

1. 4 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial schedule in duplicate within 5 days after date of Agreement.

B. Revise and resubmit as required but no less than every 7 days. The revised schedule must show the original target schedule.

C. Submit revised schedules during weekly progress meetings. If revisions to the schedule affect work by others (i.e., Liner Installer), the OWNER must be notified two weeks prior to the change. No changes may be initiated without the written approval of the OWNER.

D. Submit a computer-generated schedule with separate line for each item of Work or operation identifying first work day of each week.

E. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the critical path, start, and finish, float dates, and duration.

F. Indicate estimated percentage of completion for each item of Work at each submission.

G. Indicate submittal dates and review periods required for shop drawings, product data, samples, and product delivery dates, including those furnished by OWNER.

1.5 PROPOSED PRODUCTS LIST

A. Within 5 days after date of OWNER-CONTRACTOR Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.6 SHOP DRAWINGS

A. Submit the number of opaque reproductions which CONTRACTOR requires, plus 2 copies which will be retained by OWNER.

B. Shop Drawings: Submit for review. After review, produce copies and distribute in accordance with the SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01700 – CONTRACT CLOSEOUT.

1.7 PRODUCT DATA

A. Submit the number of copies which the CONTRACTOR requires, plus 2 copies which will be retained by the OWNER.

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

C. After review, distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01700 – CONTRACT CLOSEOUT.

1.8 SAMPLES

A. Submit a sample of the gravel and any other imported soil material that represents the specified products. Coordinate sample submittals for interfacing work.

B. For the soil samples, submit each sample in an air-tight sealed bucket and provide at least 50 pounds, unless otherwise stated in the individual specification sections.

C. Include identification on each sample including source identification and full project information.

D. Submit the number of samples specified in individual specification sections. The Owner may retain all or a portion of each sample as a record of the submittal.

1.9 MANUFACTURER INSTALLATION INSTRUCTIONS

A. When specified in individual specification sections, submit three copies of printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing to the Owner.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.10 MANUFACTURER CERTIFICATES

A. When specified in individual specification sections, submit manufacturer's certificates in specified quantities.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting data, affidavits, certifications, and quality control testing.

C. Certificates must be specific to the material or product delivered to the site.

END OF SECTION

SECTION 01310

CONSTRUCTION SCHEDULE

PART 1 GENERAL

1.1 DESCRIPTION

A. Prepare and submit with Bid, a preliminary construction schedule in compliance with Section 01300.

B. The CONTRACTOR shall provide a schedule demonstrating completion of all work items by project completion date listed in Document 00020 Invitation to Bid.

C. OWNER will review the preliminary construction schedule and incorporate it into their overall project schedule.

1.2 DELAYS AND RECOVERY

A. If, at any time during Project, CONTRACTOR fails to complete an activity by its latest scheduled completion date, CONTRACTOR must submit within two working days a written statement as to how and when CONTRACTOR will reorganize work force to return to current construction schedule.

B. Whenever it becomes apparent from progress evaluation and updated schedule data that milestone completion dates and/or contract completion dates will not be met, some or all of the following actions must be taken:

1. Increase construction staffing in such quantities and crafts to substantially eliminate backlog of work.

2. Increase number of working hours per shift, shifts per work day, work days per week, or amount of construction equipment, or combination of foregoing to substantially eliminate backlog of work.

3. Reschedule work items to achieve concurrence of accomplishment.

C. Under no circumstances will addition of equipment or construction forces, increasing working hours or any other method, manner or procedure to return to current Construction Progress Schedule be considered justification for contract modification or treated as acceleration.

1.3 PROJECT UPDATES

A. Update schedule weekly, or as requested by Owner.

B. Provide details for scheduled activities over the two weeks following the current day of the schedule. Changes affecting work by others shall be addressed per Section 01300, 1.4, C.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Acceptance or quality assurance testing by OWNER.

B. Quality control testing by CONTRACTOR.

C. Certificates of compliance.

1.2 SOURCE OF MATERIALS

A. CONTRACTOR must notify OWNER in writing of the sources from which it proposes to obtain material requiring approval, certification, or testing. Such notification must be made as soon as possible after award of Contract but no later than 5 days after receipt of the Notice to Proceed.

1.3 ACCEPTANCE TESTING OR QUALITY ASSURANCE TESTING

A. Acceptance testing is the testing of materials prior to their use in the Work and also any testing deemed necessary by OWNER for acceptance of the completed Work. OWNER will perform acceptance testing of materials and workmanship in accordance with the Contract Documents and reserves the right to perform additional testing at any time to determine conformance with the requirements of the Contract Documents.

B. Acceptance testing by OWNER is not to be considered as a replacement for control testing conducted by CONTRACTOR or a manufacturer producing materials for CONTRACTOR. Acceptance testing will be at the expense of OWNER.

1.4 QUALITY CONTROL TESTING

A. Quality control testing is the testing of materials prior to their delivery from a manufacturer, or during construction, such as geomembrane liner seam testing, and such other tests as are specified in the various sections of the Specifications to ensure compliance with the Contract Documents. CONTRACTOR must assume full responsibility for control testing and give sufficient notice to OWNER to permit it to witness the tests. Control testing is at the expense of CONTRACTOR and where specifically required, performed by an independent testing firm.

B. Submit the name, address, and qualifications, together with the scope of proposed services, of the proposed testing firm(s) submit to OWNER for approval at least 5 days prior to the scheduled commencement of any work involving such testing.

C. Within five days after completion of testing performed by or for CONTRACTOR, submit test results to OWNER. Identify test reports with the information specified for samples in Section 01300 and additionally, the name and address of the organization performing the test, and the date of the tests.

1.5 CERTIFICATES OF COMPLIANCE

A. CONTRACTOR may use certificates of compliance for certain materials and products in lieu of the specified sampling and testing procedures. Submit certificates required to demonstrate proof of materials compliance with specification requirements. Submit certificates in duplicate with each lot of material delivered to the Work or prior to delivery as required by the Contract. The lots so certified must be clearly identified by the certificate. Certificates must be signed by an authorized representative of the producer or manufacturer, and state that the material complies in all respects with the requirements of the Contract Documents. In the case of multiple shipments, each shipment must be accompanied or preceded by a Certificate of Compliance.

B. The Certificate of Compliance must be accompanied by a certified copy of tests results or state that such test results are on file with the producer or manufacturer and must be furnished to OWNER on request. The certificate must give the information specified for samples in Section 01300, the name and address of the organization performing the tests, the date of the tests, and the quantity of material shipped.

C. Materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. The fact that material is used on the basis of a Certificate of Compliance does not relieve CONTRACTOR of responsibility for incorporating material in the Work which conforms to the requirements of the Contract. Any such material not conforming to such requirements will be subject to rejection, whether in place or not.

D. OWNER reserves the right to refuse to permit the use of certain materials on the basis of a Certificate of Compliance.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction facilities required for the construction of the permanent facilities specified under the Scope of Work of this Contract.

B. Construction facilities include furnishing of all equipment, materials, tools, accessories, incidentals, labor, and performing all work for the installation of equipment and for construction of facilities, including their maintenance, operation, and removal, if required, at the completion of the Work under the Contract.

1.2 RELATED SECTIONS

A. Section 01560 – Temporary Controls.

1.3 DEFINITION

A. Construction facilities include, but are not be limited to, the following temporary offices, utilities, equipment, materials, facilities, areas, and services:

1. Field Office (Optional)
2. Parking Areas
3. Temporary Roads
4. Storage of Materials and Equipment
5. Construction Equipment
6. Temporary Sanitary Facilities
7. Temporary Electric Power
8. Temporary Water
9. First Aid Facilities
10. Security

1.4 REFERENCES

A. Construct/install, maintain and operate construction facilities in accordance with the applicable federal, state, and local laws, rules, and regulations.

1.5 GENERAL REQUIREMENTS

A. CONTRACTOR is responsible for furnishing, installing, constructing, operating, maintaining, removing and disposing of the construction related facilities, as specified in this Specification, and as required by OWNER for the completion of the Work under the Contract.

B. Locate and maintain construction facilities in a clean, safe and sanitary condition at all times until completion of the Contract.

C. The requirements specified herein are in addition to any requirements specified elsewhere in the Contract Documents. Construction facilities must meet the requirements for all-weather service.

D. Minimize land disturbances related to the construction facilities to the greatest extent possible and restore land to the extent reasonable and practical, to its original contours by grading to provide positive drainage and by seeding the area to match with existing vegetation, or as specified elsewhere. All debris or other disturbances resulting from the CONTRACTOR's actions shall be removed by the CONTRACTOR to the satisfaction of the OWNER.

E. Design and construct utilities to provide uninterrupted service.

1.6 FIELD OFFICE

A. CONTRACTOR may provide an office for his own staff.

B. The location of the office must be approved by OWNER.

1.7 PARKING AREAS

A. OWNER will provide parking area for maintenance and delivery vehicles, the OWNER's, ENGINEER's, and CONTRACTOR's representatives, and other authorized visitors.

1.8 TEMPORARY ROADS

A. General.

1. Temporary roads are existing roads that are improved or new roads constructed by CONTRACTOR for convenience of CONTRACTOR in the performance of the Work under the Contract.

2. Coordinate construction with OWNER.

3. If applicable, coordinate all road construction activities with local utilities, fire and police departments.

4. Keep erosion to a minimum and maintain suitable grade and radii of curves to facilitate ease of movement of vehicles and equipment.

5. Furnish and install longitudinal and cross drainage facilities including, but not limited to, the ditches, structures, pipes and the like.

6. Clean equipment so that mud or dirt is not carried onto public roads. Clean any mud or dirt transported by equipment onto paved roads both on site and off site.

1.9 STORAGE OF MATERIALS AND EQUIPMENT

A. Make arrangements for storage areas for materials and equipment. Locations and configurations of such facilities are subject to the acceptance of OWNER.

B. Confine all operations, including storage of materials, to approved area. CONTRACTOR is liable for any and all damage caused during such use of property of the OWNER or others. Store materials in accordance with manufacturer's instructions when applicable.

C. Store construction materials and equipment within boundaries of designated areas. Storage of gasoline or similar fuels must conform to state and local regulations and be limited to the areas approved for this purpose by the OWNER.

1.10 CONSTRUCTION EQUIPMENT

A. Erect, equip, and maintain all construction equipment in accordance with all applicable statutes, laws, ordinances, rules, and regulations of OWNER or other authority having jurisdiction.

B. Provide and maintain scaffolding, staging, runways, hoists, barricades, and similar equipment required for performance of the Contract. Provide hoists or similar equipment with operators and signals, as required.

C. Provide, maintain, and remove upon completion of the Work, all temporary rigging, scaffolding, hoisting equipment, debris boxes, barricades around openings and excavations, fences, ladders, and all other temporary work, as required for all work hereunder unless otherwise directed by OWNER.

D. Construction equipment and temporary work must conform to all the requirements of state, county, local authorities, OSHA, and underwriters which pertain to operation, safety, and fire hazard. Furnish and install all items necessary for conformity with such requirements, whether or not called for under separate sections of these Specifications.

1.11 TEMPORARY SANITARY FACILITIES

A. Provide temporary sanitary facilities for use by all employees and persons engaged in the work, including subcontractors, their employees and authorized visitors.

B. Sanitary facilities include enclosed chemical toilets and washing facilities. These facilities must meet the requirements of local public health standards. Open pit or trench latrines are not permitted.

C. Locate sanitary facilities as approved by OWNER, and maintain in a sanitary condition during the entire course of the work.

1.12 TEMPORARY ELECTRIC POWER (Optional)

A. Provide and maintain during the course and progress of the Work all electrical power and wiring requirements to facilitate the work of all trades and services associated with the work. Make arrangements with the applicable serving utility company or provide generators and pay all charges for providing and maintaining electrical service including usage costs at the site unless otherwise approved by the OWNER. Furnish all temporary wiring, feeders, and connections.

B. Routing of temporary conductors, including welding leads, must not create a safety hazard nor interfere with operation and maintenance of existing facilities.

C. Install all temporary wiring in accordance with the applicable requirements of the local electrical code.

D. Provide power and lighting to field office, and for Work as required, at no extra cost to OWNER.

1.13 TEMPORARY WATER

A. Potable water is not available on-site. Refer to Section 01010 for construction water.

B. Make all arrangements for water needs from an off-site supplier for emergencies.

1.14 FIRST AID FACILITIES

A. Provide first aid equipment and supplies to serve all CONTRACTOR personnel at the site.

1.15 SECURITY

A. Make all necessary provisions and be responsible for the security of the Work and the site until final inspection and acceptance of the Work unless otherwise approved by the OWNER. In no case shall the OWNER be responsible for the security of the CONTRACTOR's supplies, property, or equipment.

1.16 SHUT-DOWN TIME OF SERVICES

A. Do not disconnect or shut down any part of existing utilities and services, except by express permission of OWNER.

1.17 MAINTENANCE

A. Maintain all construction facilities, utilities, temporary roads, services to office, and the like in good working condition as required by OWNER during the term of the Contract.

1.18 STATUS AT COMPLETION

A. Upon completion of the Work, or prior thereto, when so required by OWNER:

1. Repair damage to roads caused by or resulting from the CONTRACTOR's work.

2. Remove and dispose of all construction facilities including office trailers, and other facilities and utilities including all concrete foundations. Similarly, return all areas utilized for temporary facilities to substantially their near original, natural state, or as otherwise indicated or directed.

B. Obliterate temporary roads built for CONTRACTOR's convenience and restore the area to near original conditions to the extent practicable unless otherwise approved by the OWNER.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01560

TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary controls required during the term of the Contract for the protection of the environment and the health and safety of workers and general public.

B. Furnishing all equipment, materials, tools, accessories, incidentals, and labor, and performing all work for the installation of equipment and construction of facilities, including their maintenance and operation during the term of the Contract.

C. Temporary controls include, but are not limited, to the following:

1. Dust Control

2. Pollution Control

3. Traffic and Safety Controls

D. Perform work as specified in this Specification and as required by OWNER. Maintain equipment and accessories in clean, safe and sanitary condition at all times until completion of the Contract.

1.2 RELATED SECTIONS

A. Section 01500 — Construction Facilities.

1.3 DUST CONTROL

A. Provide dust control measures if specified in the Contract. The CONTRACTOR shall obtain a dust control permit from Tooele County, if applicable.

B. Dust control consists of transporting water, furnishing required equipment, additives, accessories and incidentals, carrying out proper and efficient measures wherever and as often as necessary to reduce dust nuisance, and to prevent dust originating from construction operations throughout the duration of the Contract, as required by OWNER.

C. Apply water by means of pressure-type distributors or pipelines equipped with a spray system or hoses with nozzles that will insure a uniform application of water.

D. Provide all equipment used for the application of water with a positive means of shut-off.

E. Unless otherwise permitted by OWNER or unless all the water is applied by means of pipelines, provide at least one operations mobile unit with a minimum capacity of 3,500 gallons for applying water at the site during construction.

1.4 POLLUTION CONTROL

A. Erosion Control: Control sediment transport on sloped surfaces. Submit a NOI as required by NPDES regulations. CONTRACTOR shall prepare and implement a Storm Water Pollution Prevention Plan (SWPPP) which complies with all requirements of the applicable stormwater NPDES permit for construction activities.

B. Pollution of Waterways: Perform work using methods that prevent entrance or accidental spillage of solid or liquid matter, contaminants, debris and other objectionable pollutants and wastes into streams, watercourses, flowing or dry, and underground water sources. Such pollutants and wastes will include, but will not be restricted to refuse, earth and earth products, garbage, cement, concrete, sewage effluent, industrial waste, radioactive substances, hazardous chemicals, oil and other petroleum products, aggregate processing tailings, and mineral salts. Dispose of pollutants and wastes in accordance with applicable permit provisions or in a manner acceptable to and approved by the OWNER.

C. Storage and Disposal of Petroleum Products:

1. Petroleum products covered by this section include gasoline, diesel fuel, lubricants, heating oils, and refined and used oil. During project construction, store all petroleum products in such a way as to prevent contamination of all ground and surface waters.

2. Lubricating oil may be brought into the project area in steel drums or other means, as CONTRACTOR elects. Store used lubricating oil in steel drums, or other approved means, and return to the supplier for disposal. Do not burn or otherwise disposed of at the project area.

3. If the total capacity volume of stored petroleum products is greater than 1,320 gallons in total and/or 660 gallons in any single container and these products are stored above ground, CONTRACTOR shall prepare and

adhere to a Spill Prevention Control and Countermeasure Plan (SPCC Plan) in accordance with applicable EPA and other state regulations.

D. All chemicals stored on-site must be appropriately labeled as to its content and hazard rating.

1.5 TRAFFIC AND SAFETY CONTROLS

A. Post construction areas and roads with traffic control signs or devices used for protection of workmen, the public and equipment. The signs or devices must conform to the American National Standards Institute, Manual on Uniform Traffic Control Devices for Streets and Highways.

B. Remove signs or traffic control devices as soon as they have served their purpose. It is particularly important to remove any markings on road surfaces which under conditions of poor visibility could cause a driver to turn off the road or into traffic moving in the opposite direction.

C. Barricades for protection of employees must conform to the portions of the American National Standards Institute, Manual on Uniform Traffic Control Devices for Streets and Highways, relating to barricades.

D. Material Haul on Public Roads: Follow all requirements stated in the permits for using public roads for hauling materials to the site.

E. Provide flag persons, properly equipped with International Orange protective clothing and flags, as necessary, to direct or divert pedestrian or vehicular traffic.

F. Construct and maintain fences, planking, barricades, lights, shoring, and warning signs as required by local authorities, federal and state safety ordinances, and as required to protect OWNER's property from injury or loss, and as necessary for the protection of the public, and provide walks around any obstructions made in a public place for carrying on the Work covered in this Contract. Leave all such protection in place and maintained until removal is authorized.

G. Guard and protect all workers, pedestrians, and the public from excavations, blasting operations, construction equipment, all obstructions, and other dangerous items or areas by means of adequate railings, guard rails, temporary walks, barricades, warning signs, sirens, directional signs, overhead protection, planking, decking, danger lights, etc.

1.6 MAINTENANCE

A. Maintain all temporary controls in good working conditions during the term of the Contract for the safe and efficient transport of equipment and supplies, and for construction of permanent works, as required by OWNER.

1.7 STATUS AT COMPLETION

A. Upon completion of the Work, or prior thereto, when so required by OWNER, remove all temporary controls and restore disturbed areas as required by OWNER.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Transportation and handling.

C. Storage and protection.

1.2 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

C. Provide interchangeable components of the same manufacturer, for similar components.

1.3 TRANSPORTATION AND HANDLING

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, and/or damage.

D. Any damaged materials, whether as originally shipped or as a result of handling, shall be replaced at no additional cost to the OWNER and with no extension of contract time.

1.4 STORAGE AND PROTECTION

A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight,

climate controlled enclosures.

B. For exterior storage of fabricated products, place aboveground on sloped supports, if in accord with manufacturer's handling instructions.

C. Provide off-site storage and protection when site does not permit on-site storage or protection.

D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

E. Store loose granular materials on solid flat surfaces in a well-drained area.

F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

G. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

H. Any products that become damaged during storage shall be replaced at no additional cost to the OWNER and with no extension of contract time.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01630

PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 GENERAL

1.1 SUMMARY

This Section describes CONTRACTOR procedures for securing approval of proposed product options and substitutions.

1.2 PRODUCT OPTIONS

A. The Contract is based on standards of quality established in the Contract Documents.

1. In agreeing to the terms and conditions of the Contract, the CONTRACTOR has accepted a responsibility to verify that the specified products will be available and to place orders for all required materials in such a timely manner as is needed to meet his agreed construction schedule.

2. The OWNER does not agree to the substitution of materials or methods called for in the Contract Documents, except as they may specifically otherwise state in writing.

B. Materials and/or methods specified by name:

1. Where materials and/or methods are specified by naming one single manufacturer and/or model number, without stating that equal products will be considered, only the material and/or method named is approved for incorporation into the Work.

2. Should the CONTRACTOR demonstrate to the approval of the OWNER that a specified material or method was ordered in a timely manner and will not be available in time for incorporation into this Work, the CONTRACTOR shall submit to the OWNER such data on proposed substitute materials and/or methods as are needed to help the OWNER determine suitability of the proposed substitution.

C. Where materials and/or methods are specified by name and/or model number, followed by the words "or an equal approved in advance by the OWNER" or similar wording:

1. The material and/or method specified by name establishes the required standard of quality;

2. Materials and/or methods proposed by the CONTRACTOR to be used in lieu of materials and/or methods so specified by name must in all ways be equal or exceed the qualities of the named materials and/or methods;

D. The following products do not require further approval except for interface within the Work:

1. Products specified by reference to standard specifications such as ASTM and similar standards;

2. Products specified by manufacturer's name and catalog model number.

E. Where the phrase "or equal," or "or equal as approved by the OWNER," occurs in the Contract Documents, do not assume that the materials, equipment, or methods will be approved as equal unless the item has been specifically so approved in writing for this Work by the OWNER.

F. The decision of the OWNER shall be final.

1.3 DELAYS

A. Delays in construction arising by virtue of the non-availability of a specified material and/or method will not be considered by the OWNER as justifying of the agreed Time of Completion.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparation, maintenance, completion, and submission of all project record drawings, specifications and related documents.

1.2 RELATED SECTIONS

A. Section 01300 - Submittals.

B. Section 01560 - Temporary Controls.

1.3 MAINTENANCE OF RECORD DOCUMENTS

A. Maintain at the job site one copy of the following Project or Contract Documents for record purposes:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and Work Change Directives.
5. Field Orders.
6. Reviewed Shop Drawings.
7. Clarifications or Explanatory Drawings and Specifications.
8. Inspection Reports.
9. Laboratory Test Records.
10. Field Test Records.

B. Store documents used for record purposes in the field office or other approved location, apart from documents used for construction.

C. File documents in accordance with the Construction Specification sections.

D. Maintain documents in clean, dry, legible condition.

E. Do not use record documents for construction purposes.

F. Make documents available at all times for inspection by the OWNER and his authorized representatives.

1.4 RECORD DRAWINGS

A. Project Drawings:

1. Maintain record drawings of all work and subcontracts continuously as the job progresses. Keep a separate set of prints, for this purpose only and at the job site at all times.

2. Keep these drawings up-to-date.

3. During the course of construction identify on the drawings, the actual locations for all runs of mechanical and electrical work, including all site utilities and services installed underground or otherwise concealed. Show deviations from the drawings in detail. Locate all main runs, whether piping, or drain lines by dimension and elevation.

4. During the course of the construction record as-built information outlined in Section 01052.

5. Deliver the final and record set of "as-built" drawings to the OWNER prior to the OWNER's acceptance of the Project.

B. Addenda and Change Orders:

1. Incorporate changes to the Drawings affected by Addenda, Change Orders, or Field Orders. Identify change by Addendum, Change Order, or Field Order number and effective date.

2. When revised drawings are issued as the basis of or along with addenda or change order, incorporate these revised drawings into the record set with appropriate annotation.

C. Shop Drawings:

1. Collect and maintain one complete set of reviewed shop drawings, including manufacturer's printed catalog cuts and data, for record purposes.

2. Shop drawings must be filed and maintained separate from project drawings. Shop drawings must be filed in 9 inch by 12 inch file folders to the greatest extent possible and be indexed in accordance with the format as herein specified.

1.5 RECORD SPECIFICATIONS

A. Project Specifications:

1. Information, changes, and notes must be recorded in the specifications in blank areas, such as page margins or the backs of opposite pages, or on separate sheets inserted in the binder. All such information, changes, and notes must be recorded with red pen or red typewriter ribbon.

2. In each section, in an appropriate location, record the manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.

3. The record specifications book must be complete and include all documents and forms listed under Bidding Requirements, Contract Forms, Contract Conditions, and Specifications.

B. Addenda, Change Orders, Work Change Directives, and Field Orders

1. All Addenda, Change Orders, Work Change Directives, and Field Orders must be incorporated into the front of the specifications book in reverse chronological order. Use appropriate page dividers to identify addenda, change orders, and to separate addenda from the specifications.

2. In addition, the changes to the specifications effected by Addenda, Change Order, Work Change Directives, or Field Order must be annotated on the affected page or pages of the specifications, or adjacent thereto.

1.6 SUBMISSION OF DOCUMENTS

A. At completion of the project, and before submitting invoice for final payment, deliver record documents to OWNER.

B. Record documents must be delivered neatly and efficiently packaged.

C. Submission of record documents must be accompanied with a transmittal letter, in triplicate, containing the following information:

1. Date of submission.

2. Project title and number.

3. CONTRACTOR's name and address.

4. Title and number of each record document. (Shop drawings may be grouped in basic categories or divisions of work.)

5. Certification that each document as submitted is complete and accurate.

6. Signature of CONTRACTOR or his authorized representative.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

DIVISION 2

SITEWORK

TABLE OF CONTENTS

DIVISION 2 – SITEWORK

SECTION 02110

CLEARING AND STRIPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clearing and stripping grass and other organic material from landfill phase construction area as defined on the Drawings.

B. Stockpiling stripped material.

1.2 RELATED SECTIONS

A. Section 02221 - Excavating and Stockpiling.

B. Section 02222 - Engineered Fill, Protective Soil Cover, Soil Cushion, and Anchor Trench Backfill.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that any existing plant life designated to remain is tagged and identified.

B. Verify plants to be salvaged are tagged or identified.

3.2 PROTECTION

A. Protect plant growth and any features designated to remain.

B. Protect survey benchmarks from damage or displacement.

3.3 STRIPPING FOR LANDFILL PHASE

A. Strip grass, roots, organic soils, and other deleterious materials prior to excavating.

B. Strip to a maximum depth of 6 inches below existing ground surface.

C. Transport and place all materials in the designated stockpile location on the Drawings or as directed by the OWNER, and in accordance with Section 02221.

END OF SECTION

SECTION 02221

EXCAVATING AND STOCKPILING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavating soil to construct the landfill subgrade, and obtaining soils for engineered fill, protective soil cover, soil cushion, and anchor trench backfill and stockpiling surplus soils.

B. Excavating to construct stormwater collection pond.

1.2 RELATED SECTIONS

A. Section 02222 - Engineered Fill, Protective Soil Cover, Soil Cushion, and Anchor Trench Backfill.

B. Section 02223 – Geosynthetic Subgrade Preparation.

C. Section 02776 - Drainage Geocomposite.

D. Section 02778 - Geomembrane.

E. Section 02779 - Geosynthetic Clay Liner.

PART 2 PRODUCTS

2.1 ENGINEERED FILL

A. Soil meeting requirements of Section 02222, Part 2.1.

2.2 PROTECTIVE SOIL COVER

A. Soil meeting requirements of Section 02222, Part 2.2.

2.3 SOIL CUSHION

A. Soil meeting requirements of Section 02222, Part 2.3.

2.4 ANCHOR TRENCH BACKFILL

A. Soil meeting requirements of Section 02222, Part 2.4

2.5 SURPLUS SOILS

A. Remaining soils excavated.

PART 3 EXECUTION

3.1 PREPARATION

A. Set required lines, levels, contours, and datum by construction staking.

B. Locate, identify, and protect existing phase areas.

C. Notify utility company to locate utilities, if applicable.

D. Provide for dust control.

E. Protect benchmarks, existing structures, and fences from excavation equipment and vehicular traffic.

F. Coordinate operations with landfilling operations.

G. Provide for dewatering as necessary for finish excavation and fill placement.

H. CONTRACTOR shall note that topography shown on the Drawings may differ from topography at time of construction. The CONTRACTOR shall perform a pre-commencement survey to document site conditions prior to starting work.

3.2 EXCAVATION

A. Excavate soil and rock as required to the lines, grades, and elevations to construct the landfill, roads, surface waste drainage systems, and other structures as necessary as shown on the Drawings.

B. Machine grade slopes and base to design grades, in preparation for GCL placement.

C. Grade top perimeter of excavation to prevent surface water from draining into excavation.

D. Remove lumped subsoil, rocks with sharp edges, boulders, and rock larger than 1 inch in largest dimension from completed subgrade elevation.

E. Notify OWNER of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

F. Correct areas over excavated by placing engineered fill per Section 02222 and as approved by the OWNER.

G. Selectively excavate engineered fill, protective soil cover, soil cushion, and anchor trench backfill and stockpile near the landfill phase area.

H. Haul remaining material, surplus soils, to stockpile(s) designated by OWNER.

3.3 SOIL STOCKPILING

A. Coordinate selective soil stockpiling with OWNER.

B. Place soil such that maximum slope is 3H:1V, and minimum slope is 5 percent.

C. Placement and mass configuration of soil stockpiles shall be performed at the direction of the OWNER.

D. Provide uniform final graded surface for the surplus soil stockpile.

3.4 FIELD QUALITY ASSURANCE

A. Field quality assurance (QA) will be performed in accordance with the Construction Quality Assurance (CQA) Plan.

B. The OWNER may perform testing to determine the conformance of the materials with the Specifications and Drawings.

END OF SECTION

SECTION 02222

ENGINEERED FILL, PROTECTIVE SOIL COVER, SOIL CUSHION, AND ANCHOR TRENCH BACKFILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Engineered Fill Placement.

B. Production and placement of Protective Soil Cover.

C. Production and placement of Soil Cushion.

D. Backfill for Anchor Trench.

1.2 RELATED SECTIONS

A. Section 02221 - Excavating and Stockpiling.

B. Section 02223 - Geosynthetic Subgrade Preparation.

C. Section 02774 – Drainage Geocomposite.

D. Section 02778 - Geomembrane.

E. Section 02779 - Geosynthetic Clay Liner.

1.3 REFERENCES

A. ASTM C-136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

B. ASTM D-422 - Standard Test Method for Particle-Size Analysis of Soil.

C. ASTM D-698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

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

E. ASTM D-2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

F. ASTM D-2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).

G. ASTM D-2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

H. ASTM D-3017 - Standard Test Method of Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

PART 2 PRODUCTS

2.1 ENGINEERED FILL

A. Soil obtained from landfill excavation areas associated with landfill construction and from other borrow areas as directed by the OWNER.

B. Free of organic material.

C. Maximum particle dimension: 6 inches.

D. Free of frozen material, ice, snow, or excessive moisture.

2.2 PROTECTIVE SOIL COVER

A. Soils obtained from landfill excavation areas associated with landfill construction and from other borrow areas as directed by the OWNER.

B. Maximum particle size of 1 inch.

C. Be relatively uniform in gradation and free of rocks with sharp edges that could damage the geosynthetics.

2.3 SOIL CUSHION

A. Soils obtained from landfill excavation areas associated with landfill construction and from other borrow areas as directed by the OWNER.

B. Maximum particle size 1 inch.

C. Be relatively uniform in gradation and free of rocks with sharp edges that could damage the geosynthetics.

2.4 ANCHOR TRENCH BACKFILL

A. Select soils obtained from landfill excavation areas associated with landfill construction and from other borrow areas as directed by the OWNER.

B. Free of organic material.

C. Maximum particle size 3 inch.

PART 3 EXECUTION

3.1 ENGINEERED FILL PREPARATION

A. Scarify subgrade soils to a 6-inch depth prior to soil placement.

B. Prior to placement of engineered fill, verify that no substantial thickness of loose or uncompacted soil is present in the fill area.

C. Begin engineered fill only when the ENGINEER has accepted the underlying subgrade.

3.2 ENGINEERED FILL PLACEMENT

A. Place engineered fill to the lines and grades shown on the Drawings.

B. Place in loose lift thickness not exceeding 8 inches.

C. Compact each lift to a minimum of 95 percent relative compaction at a moisture content of ±4% of optimum as determined by ASTM D698. Completed lifts of fill cannot yield under equipment loads.

D. Moisture conditioned and smooth-drum rolled as specified in Section 02223 – Liner Subgrade Preparation.

E. Grade final surface to a vertical tolerance of ± 0.1 foot.

3.3 PLACEMENT OF PROTECTIVE SOIL COVER LAYER

A. Screen material of oversize materials if necessary to achieve the particle size requirements described in paragraph 2.2.

B. Verify that geosynthetic installations have been completed in accordance with deployment, seaming, and testing requirements.

C. Spread and place the protective soil cover layer material using low ground pressure dozers. Rubber tired equipment, such as scrapers, motor graders and water trucks may not operate on the drainage layer without prior approval of the specified equipment or unless there is a minimum 24 inches of material covering the HDPE liner and the ground pressure at the liner interface does not exceed 20 psi.

D. Place using an excavator bucket directly on geocomposite to prevent the propagation of wrinkles. Alternative equipment may be used with prior written approval of the OWNER or ENGINEER.

E. Spread and place using low ground pressure dozers and graders. Alternative equipment may be used with prior approval of the OWNER or ENGINEER. Alternative equipment may require increased thicknesses of haul routes over installed geosynthetics.

F. Place without damaging underlying geosynthetics. The CONTRACTOR shall repair any damage at no additional cost to the OWNER.

G. Place material during the cool part of the day when the liner is relatively tight and free of wrinkles.

H. Place material in an uphill direction.

3.4 SOIL CUSHION PLACEMENT

A. Place soil cushion to the lines and grades shown on the Drawings.

B. Place in a single loose lift.

C. Compact to a minimum of 95 percent relative compaction at a moisture content of ±4% of optimum as determined by ASTM D698. Completed lifts of fill cannot yield under equipment loads.

D. Moisture conditioned and smooth-drum rolled as specified in Section 02223 – Geosynthetic Subgrade Preparation.

E. Grade final surface to a vertical tolerance of ± 0.1 foot.

3.5 BACKFILL FOR ANCHOR TRENCH

A. Begin only when geosynthetic installations have been completed in accordance with deployment and seaming criteria.

B. Place earthfill to the lines and grades shown on the Drawings.

C. Place in loose lift thickness not exceeding 12 inches.

D. Compact each lift by wheel rolling with rubber-tired equipment or using approved compaction equipment.

E. Do not damage geosynthetic installation.

3.6 FIELD QUALITY ASSURANCE

A. Field quality assurance (QA) will be performed in accordance with the Construction Quality Assurance (CQA) Plan.

B. The OWNER will determine optimum moisture content and maximum density for all engineered fills in accordance with ASTM D-698.

C. The OWNER will determine in-place density and moisture content of the engineered fill by one or more of the following methods or approved equal: ASTM D-1556, ASTM D-2216, ASTM D-2922, and ASTM D-3017.

D. The OWNER may perform additional testing to determine the conformance of the materials with these Specifications and the Drawings.

E. The OWNER may perform sampling and testing of excavated materials as they are stockpiled.

F. The CONTRACTOR shall cooperate fully with the OWNER in performance of sampling and testing. Include costs for assistance in unit or lump sum prices.

END OF SECTION

SECTION 02223

GEOSYNTHETIC SUBGRADE PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Final grading and compaction of finished subgrade in preparation for geomembrane and GCL placement.

1.2 RELATED SECTIONS

A. Section 02221 - Excavating and Stockpiling.

B. Section 02222 - Engineered Fill, Protective Soil Cover, Soil Cushion, and Anchor Trench Backfill.

C. Section 2778 – Geomembrane.

D. Section 02779 - Geosynthetic Clay Liner.

1.3 REFERENCES

A. ASTM D-698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

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

C. ASTM D-2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

D. ASTM D-2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

E. ASTM D-2937 - Standard Test Method for Density of Soil in Place by the Drive Cylinder Method.

F. ASTM D-3017 - Standard Test Method of Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

PART 2 PRODUCTS

2.1 LINER SUBGRADE

A. The liner subgrade shall be smooth drum rolled to provide firm smooth surface.

B. The liner subgrade shall not contain any deleterious materials, debris, organic matter, ice, snow or frozen material.

C. The subgrade soils shall have a maximum particle size of 1 inch at the subgrade surface and in the uppermost lift adjacent to the liner materials.

2.2 SOURCE QUALITY CONTROL

A. Perform quality control planning and procedures to assure that deleterious materials are not incorporated into engineered fill.

B. Coordinate source quality control program with OWNER.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is complete and in compliance with slopes and dimensions shown on the Drawings.

B. Examine surface to determine whether unsuitable materials are present.

C. Verify surface is free of ponded water before geomembrane or GCL is placed.

D. The subgrade surface will be examined and accepted in writing by the liner INSTALLER and OWNER prior to placement of geosynthetics.

3.2 FIELD QUALITY ASSURANCE

A. Field quality assurance (QA) will be performed in accordance with the Construction Quality Assurance (CQA) Plan.

B. The OWNER may perform additional testing to determine the conformance of the materials with these Specifications and the Drawings.

3.3 FINISHED GRADING AND COMPACTION OF COMPOSITE LINER SUBGRADE

A. Moisture condition subgrade, if necessary, and smooth drum roll the material to provide smooth firm surface.

B. Finish grade soil within a vertical tolerance of ±0.1 feet of design grade.

C. Subgrade shall be steel-drum rolled to a smooth and level surface.

D. Surface shall be free of stones or protrusions greater than 1-inch diameter and organics or other deleterious material.

E. Fill voids and cracks.

F. Ruts shall be limited to 1-inch maximum depth.

G. After proof-rolling and compacting with a smooth drum roller, the Owner or Owner's representative will accept the liner subgrade surface if the surface is smooth, firm, and no materials greater than one inch in dimension are visible and no soft areas are present.

END OF SECTION

SECTION 02227

LEACHATE COLLECTION GRAVEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of granular drainage materials for the leachate collection and recovery system (LCRS) trenches.

B. Work includes furnishing, loading, hauling, and placing the drainage materials.

1.2 RELATED SECTIONS

A. Section 02711 - Polyethylene Pipe.

B. Section 02771 - Geotextile.

C. Section 02776 - Drainage Geocomposite.

C. Section 02778 - Geomembrane.

1.3 REFERENCES

A. ASTM C-136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

B. ASTM D-2434 - Standard Method for Permeability of Granular Soils (Constant Head).

C. ASTM D-2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

1.4 SUBMITTALS

A. Submit a 50-pound representative sample of the proposed granular drainage material within 10 days after contract award.

PART 2 PRODUCTS

2.1 Leachate Collection Gravel

A. Material obtained and imported from off-site.

B. Free of organic or other deleterious material.

C. Having a hydraulic conductivity greater than or equal to 0.5 cm/sec when placed in accordance with this specification

D. Rounded to sub-rounded gravel.

E. Required gradations as shown in Table 02227-1.

TABLE 02227-1
LEACHATE COLLECTION GRAVEL GRADATION

U.S. SIEVE SIZE	PERCENT PASSING
1½-inch	100
½-inch	0-5
No. 200	0-2

F. The permeability specification controls over the gradation specification.

G. Material must be hard, durable and not subject to grain crushing.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place materials only when underlying excavations, foundations, and geosynthetic installations are complete and accepted by OWNER in accordance with Specifications.

B. Install geotextile, then place the gravel to lines and grades shown on the Construction Drawings.

C. Place drainage gravel to the thickness and detail shown on the Construction Drawings.

D. Spread and place materials in a single lift meeting the minimum depth shown on the Construction Drawings.

E. Place in an uphill or cross-slope direction (not in a downhill direction) to prevent putting tension in the underlying geosynthetics.

F. Place in the cooler part of the day when underlying geosynthetics contain minimal wrinkles; however, granular material shall not be placed on geosynthetics that are under tension and/or are exhibiting trampolining.

G. Place in a manner that prevents the development of wrinkles in the underlying geosynthetics in front of the advancing granular material. Remove wrinkles in a manner approved by the ENGINEER. If folding does occur, repair at no additional cost to the OWNER.

H. Do not cause underlying geosynthetics to bridge across ditch or pipe alignments. If bridging does occur, repair at no additional cost to the OWNER.

I. Do not damage underlying geosynthetic materials or piping installations. If damage does occur, repair at no additional cost to the OWNER.

3.2 LEACHATE COLLECTION AND PIPE INSTALLATION

A. Comply with Section 02711 for assembly of pipe runs.

B. Install to the lines and grades shown on the Construction Drawings.

3.3 FIELD QUALITY CONTROL

A. Prior to beginning drainage layer material placement, demonstrate that placement techniques will not damage the underlying geomembrane material. Demonstrate this by constructing test fill over all affected geosynthetic types in an area not part of final construction.

B. Do not use pointed stakes as grade control devices. Only use devices that will not puncture underlying geomembrane.

C. Grade top perimeter of excavation to prevent surface water from draining into excavation.

3.4 FIELD QUALITY ASSURANCE

A. Sampling and testing of materials to determine material type may be performed by the OWNER at the stockpile, at the material source, or at the place of use in accordance with the CQA Plan.

B. The OWNER will perform gradation tests of materials before and during placement in accordance with ASTM C-136.

C. The OWNER will perform permeability tests of materials before and during placement operations in accordance with ASTM D-2434.

D. Assist the OWNER as necessary in collecting material samples and conducting tests.

E. OWNER reserves the option of waving gradation specifications if products submitted by CONTRACTOR meet design intent.

END OF SECTION

SECTION 02230

SURFACE WATER DRAINAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of associated appurtenances associated with the surface water drainage systems at the site as defined on the Drawings.

1.2. RELATED SECTIONS

A. Section 02221 - Excavating and Stockpiling.

B. Section 02222 – Engineered Fill, Protective Soil Cover, Soil Cushion, And Anchor Trench Backfill.

C. Section 02711 – Corrugated HDPE Pipe.

D. Section 02771 – Geotextile.

PART 2 PRODUCTS

2.1 CORRUGATED HDPE CULVERT

A. Corrugated HDPE pipe (CPE) shall conform to the requirements of corrugated HDPE pipe in accordance with Section 02711. All appurtenances for the pipe shall be of the type and size shown on the drawings.

2.2 PIPE ZONE BACKFILL

A. Pipe zone backfill shall be shall be Class I, II, or III backfill material as defined by the Plastic Pipe Institute. Earthfill may be used as pipe zone backfill if it meets the requirements for Class I, II, or III material.

B. Pipe zone backfill shall be material free of organic material or other deleterious material with a maximum particle size of 3/4-inch.

2.3 PIPE BEDDING MATERIAL

A. Bedding material for pipes shall consist of clean sand or gravel with a maximum particle size of 1/2 inch.

2.4 RIP RAP

A. Rip rap shall be hard, durable, stone or recycled (reclaimed) concrete meeting the D_{50} size requirements shown on the Drawings. The breadth and thickness of each

piece of rock shall be at least one third its length. The rip rap shall have less than 10 percent passing the No. 4 standard sieve.

PART 3 EXECUTION

3.1 PREPARATION

A. Set required lines, levels, contours, and datum by construction staking.

B. Notify utility company to locate utilities, if applicable.

C. Provide for dust control.

D. Protect bench marks, existing structures, and fences from excavation equipment and vehicular traffic.

E. Coordinate operations with landfilling operations.

F. Provide for dewatering as necessary for finish excavation and place fill.

G. Note that topography shown on the Drawings may differ from topography at time of construction. A pre-construction survey shall be performed by the CONTRACTOR to document site conditions prior to starting work.

3.2 PROTECTION

A. Protect structures, plants, and any existing features designated to remain.

B. Protect survey benchmarks from damage or displacement.

3.3 INSTALLATION OF DRAINAGE STRUCTURES

A. Excavate the drainage pond to the lines, grades, and dimensions shown on the Drawings.

B. Install the HDPE pipes, outlets, and all associated appurtenances by fastening all parts together as shown on the Drawings and as recommended by the supplier.

C. Backfill the culverts with compacted material as shown on the Drawings.

D. CONTRACTOR shall take care as to not damage the structures during installation and compaction. Any damage shall be repaired or the materials replaced (if necessary) by the CONTRACTOR at no additional cost to the OWNER.

3.4 RIP RAP PLACEMENT

A. The CONTRACTOR shall purchase, transport, and install the rip rap material as

per drainage structure as shown on the Drawings.

B. Rip rap shall be placed on top of a filter fabric of non-woven geotextile in accordance with Section 02771.

C. CONTRACTOR shall place rip rap so as to not damage the underlying geotextile. Damage shall be repaired at the CONTRACTOR's expense.

D. Place rip rap in a manner that will produce a reasonably well graded mass of rock with minimum percentage of voids.

E. Place rip rap to its full course thickness in one operation without using chutes or other methods which will cause segregation. Placing rock in layers will not be accepted.

F. Place rip rap such that surface irregularities do not cause more than a $0.5d_{50}$ variation in the layer thickness.

END OF SECTION

SECTION 02231

AGGREGATE BASE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Placing and grading aggregate base course.

B. Application of magnesium chloride binding and dust control agent.

1.2 RELATED SECTIONS

A. Section 02222 – Engineered Fill, Protective Cover Soil, Soil Cushion, and Anchor Trench Backfill.

1.3 REFERENCES

A. ASTM D-698 Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures.

B. ASTM D-2922 Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

C. ASTM D-3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

D. ASTM C-136 Standard Test Method for Sieve Analysis for Fine and Coarse Aggregates.

E. Utah Department of Transportation Standard Specifications, Section 02721 – Untreated Base Course.

PART 2 PRODUCTS

2.1 AGGREGATE BASE

A. Obtained from off-site source.

B. In accordance with Utah Department of Transportation Standard Specifications, Section 02721 – Untreated Base Course for 1" Aggregate Base.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that the substrate has been inspected, the grades and elevations are correct, and the surface is suitable for aggregate placement.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, to a minimum depth of 4 inches, reshaping, and re-compacting to a minimum of 95% of maximum dry density as detailed by ASTM D 698.

B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

A. Spread aggregate over prepared substrate in maximum 6 or 8-inch un-compacted lifts.

B. Steel drum roller compact to the thickness shown on the Drawings at 95% of maximum dry density as detailed by ASTM D-698.

C. Level and contour surfaces to elevations and grades indicated on Drawings.

D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

A. Flatness: Maximum variation of ½ inch measured with 10-foot straight edge.

B. Scheduled Compacted Thickness: Within ½ inch.

C. Variation From Design Elevation: Within 0.1 inch.

3.5 QUALITY ASSURANCE VERIFICATION TESTING

A. The OWNER's representative will perform the following quality assurance testing during road base placement.

1. Moisture-density relations (ASTM D-698) to determine the maximum dry density and optimum moisture content for road base material.

2. Nuclear density and moisture content (ASTM D-2992 and ASTM D-3017) to verify relative compaction.

3. Sieve Analysis (ASTM C-136) to verify product gradation requirements for road base.

B. Cooperate with the OWNER's representative in performance of quality assurance verification testing.

C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

END SECTION

SECTION 02270

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. As needed the installation of the following.

1. Silt Fence.

2. Straw Bale Barrier.

B. Areas to receive erosion and sediment controls shall be determined in the field as needed by the OWNER.

C. Areas requiring erosion and sediment control will include the soil stockpile.

1.2 RELATED SECTIONS

A. Section 02221 – Excavating and Stockpiling.

B. Section 02222 – Engineered Fill, Protective Soil Cover, Soil Cushion, and Anchor Trench Backfill.

1.3 REQUIREMENTS

A. Meet regulatory requirements, for construction of this project. Implement erosion control practices and procedures. If the erosion control measures are inadequately maintained, or are found to be inadequate in the field, install additional measures to prevent sediment laden runoff from leaving the site.

1.4 SEQUENCING AND SCHEDULING

A. All erosion control features must be approved by the OWNER before beginning site earthwork.

B. Route runoff from cleared or disturbed areas. Route through temporary sediment traps, straw bale barriers, or silt fences. Place erosion control facilities prior to any earthwork, clearing, and grubbing. It is preferable for construction to progress in an upstream direction starting with downstream erosion control facilities as the first items of construction.

C. Stabilize disturbed ground at the end of each work day. Perform surface roughening immediately upon reaching final grade of non-lined areas by uniformly

track-walking up and down the slope with a crawler tractor or sheepsfoot roller, leaving a pattern of cleat imprints that parallel the slope contours. Implement permanent soil stabilization and erosion/sedimentation controls upon reaching final grade.

D. Notify the OWNER of any soils showing signs of erosion.

E. Ensure that all waters from any dewatering operations reaching existing water courses meet or exceed the existing quality of the water course.

1.5 REMOVAL OF EROSION CONTROL FACILITIES

A. Remove all temporary control facilities, 30 days after final completion of work or upon approval of OWNER. Dispose of used silt fence and supports, straw bales, and sediment traps. Costs for removal of erosion control features are incidental, and shall be included in lump sum or unit costs. Final payment will not be released until this work is completed.

PART 2 PRODUCTS

2.1 GENERAL

A. Product specifications described below pertain to erosion control facilities shown on the Construction Drawings.

2.2 SILT FENCE

A. Woven geotextile supplied in minimum 3.5 foot widths and meeting the requirements of Table 02270-1:

TABLE 02270-1

WOVEN GEOTEXTILE PROPERTIES

TEST	TEST DESIGNATION	UNIT	REQUIREMENT
Grab Tensile Elongation	D-4632	%	50 - 114
Grab Tensile Strength	D-4632	lbs	100 min.
Puncture Resistance	D-4833	lbs	60 min.
Permitivity	D-4491	Sec^{-1}	0.1 - 0.5
Apparent Opening Size	D-4751	mm	0.5 - 0.85
Burst Strength	D-3786	psi	190 min.

B. Support Fence: 2-inch by 2-inch by 14-gage wire mesh fencing in 3-foot-wide rolls.

C. Posts: 2-inch by 2-inch by 4.5-foot-long standard (or better) hardwood posts, or 4.5-foot-long steel fence posts weighing 1.33 pounds per linear foot.

D. Fasteners: Heavy duty wire staples at least 1-inch-long, tie wires, or hog rings.

E. Gravel Backfill: LCRS Granular Material.

2.3 STRAW BALE BARRIER

A. Bales: Straw bales, minimum size 15-inch x 15-inch x 36 inch.

B. Posts: Per 2.2.C.

PART 3 EXECUTION

3.1 PREPARATION AND APPLICABILITY

A. CONTRACTOR will hydroseed all exposed soil surfaces not to receive any type of liner or finish course once finish grading is complete.

3.2 SILT FENCE INSTALLATION

A. Drive fence posts a minimum of 18 inches below the soil surface elevation (outside of finish cover system) at a maximum spacing of 6 feet in areas requiring silt fence. The fence line should be at a constant elevation for each continuous length of silt fence.

B. Place wire mesh support fencing and fabric back-to back (fabric on the upslope side) and extend 12 inches into the trench, leaving 24 inches of fencing and fabric above ground level. Fasten filter fabric and wire mesh support fencing to posts using heavy-duty 1-inch wire staples for wood posts, or wire rings for steel posts. At each post, place fasteners at the top of the fence, at ground level, and halfway in between.

C. Join wire support fence ends by overlapping a minimum of 6-inches and connecting the two sections with wire rings in four places. If fabric joints are necessary, cut the wire support fence, sandwich the wire and fabric ends between two wood posts, and bind the posts tightly together.

D. Lengthwise along the top of the silt fence and at ground level, tie fabric to wire support fencing with wire rings at a maximum spacing of 3 feet. Backfill trench with LCRS drainage gravel material.

3.3 STRAW BALE BARRIER CONSTRUCTION

A. Excavate a one bale wide strip of soil 4-inches-deep, perpendicular to the flow direction in the channel. Remove all grass and other materials that may allow underflow.

B. Install straw bales end-to-end, with the bindings oriented horizontally around the sides of the bales. Anchor each bale into trench. Push bales together as firmly as possible.

C. Chink the gaps between bales with straw to prevent water from escaping between bales. This must be done carefully to avoid separating the bales. Place and compact excavated soils against the upstream side of the straw bale barrier to a height of 4 inches to prevent piping under bales.

3.4 MAINTENANCE

A. General Requirements: Observe the facilities during the first storm following construction to ensure that the facilities are properly located, constructed, and operating as designed. Maintain and repair facilities as needed to ensure that they continue to work as designed.

B. Silt Fence: Check for sagging fences, torn fabric, and signs of erosion and/or sedimentation down slope of the fence. Make repairs as necessary. If the silt fence fails due to storm water runoff inundating the fence, construct additional erosion and sediment control measures to remove sediment from and convey the runoff to downstream drainage facilities. Remove accumulated sediment behind silt fences whenever it reaches approximately one-third the height of the fence.

C. Temporary Sediment Traps: Remove sediment before it reaches the rock weir outlet. The trap bottom may be over-excavated to provide additional sediment storage.

D. Straw Bale Barrier: Check for undercutting, damaged bales, evidence of erosion or sedimentation between bales, and "end run" erosion at the ends of the barrier. Make repairs, replace bales, and remove sediment before it reaches approximately one-half the height of the barrier.

END OF SECTION

SECTION 02710

POLYETHYLENE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install High Density Polyethylene (HDPE) solid pipe, HDPE perforated pipe, and associated pipe fittings for leachate collection and removal system (LCRS), per the construction plans. Pipe sizes are shown on the plans and Standard Dimensional Ratio (SDR) are shown on Part 2.1.C.

1.2 RELATED SECTIONS

A. Section 02222 – Engineered Fill, Operations Layer, Soil Cushion, and Anchor Trench Backfill.

B. Section 02227 – Leachate Collection Gravel.

C. Section 02771 - Geotextile.

D. Section 02774 - Drainage Geocomposite.

E. Section 02778 - Geomembrane.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM D-638 - Standard Test Method for Tensile Properties of Plastics.

2. ASTM D-696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics.

3. ASTM D-746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

4. ASTM D-790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

5. ASTM D-1238 - Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.

6. ASTM D-1248 - Specification for Polyethylene Plastics Molding and Extrusion Materials.

7. ASTM D-1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique.

8. ASTM D-1525 - Standard Test Method for Vicat Softening Temperature of Plastics.

9. ASTM D-1599 - Standard Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.

10. ASTM D-1603 - Standard Test Method for Carbon Black in Olefin Plastics.

11. ASTM D-1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

12. ASTM D-2122 - Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

13. ASTM D-2240 - Standard Test Method for Rubber Property Durometer Hardness.

14. ASTM D-2657 - Practice for Heat Joining of Polyolefin Pipe and Fittings.

15. ASTM D-2837 - Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

16. ASTM D-3035 - Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.

17. ASTM D-3261 - Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

18. ASTM D-3350 - Specification for Polyethylene Plastics Pipe and Fittings Materials.

19. ASTM D-4218 - Standard Test Method for Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.

20. ASTM F-1248 - Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe.

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

B. National Sanitation Foundation (NSF). NSF Standard Number 14 -Plastics Piping Components and Related Materials.

C. PPI -Plastic Pipe Institute.

D. ANSI -American National Standards Institute.

1.4 SUBMITTALS

A. Submit with each shipment of pipe to site, MANUFACTURER'S certification of compliance with specified requirements of this Section. Submit catalog cut sheet of pipe and fittings to be supplied prior to commencing work.

B. Provide written certification for qualified HDPE pipe fusion welders.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

A. High density polyethylene (HDPE) manufactured for pipe meeting the following minimum standards.

1. Material Designation: PE 3608/PE 3408.

2. Cell Classification: 345464 C.

B. All pipe sizes shown on the Construction Drawings and specified in this Section reference nominal diameter, unless otherwise indicated on the Construction Drawings or in this Section. Pipe sizing and workmanship to be in accordance with ASTM F-714 and ASTM D-3035.

C. SDR 11, unless otherwise shown

D. Conforming to the minimum requirements of Table 02710-1.

TABLE 02710-1

POLYETHYLENE PIPE MATERIAL PROPERTIES

PROPERTY	ASTM TEST DESIGNATION	UNIT	REQUIREMENTS
Density	D-1505	gm/cm^3	0.955 min.
Melt Index	D-1238	gm/10 minutes	0.1 (typ).
Flexural Modulus	D-790	psi	110,000 min.
Tensile Strength	D-638	psi	3,000 min.
Hydrostatic Design Basis at 73°F (23°C)	D-2837	psi	1,600 (typ.)
UV Stabilizer	D-1603	% Carbon Black	2% to 3%

PROPERTY	ASTM TEST DESIGNATION	UNIT	REQUIREMENTS
Elastic Modulus	D-638	psi	110,000 min.
Brittleness Temperature	D-746	°F	-103°F (typ.)
PENT	F-1473	hours	100 min.
Thermal Expansion Coefficient	D-696	in/in/°F	$1x10^{-4}$ max.

E. Containing no recycled compound except that generated in the Manufacturer's own plant and from resin of the same specification from the same raw material supplier.

F. Resin for pipe and fittings to be listed by both N.S.F. and P.P.I. and manufactured in accordance with ASTM D-3350 and ASTM F-714.

G. Homogeneous throughout and free of visible cracks, holes (except where specified or shown), foreign inclusions or other injurious defects. Being uniform in color, capacity, density, and other physical properties.

H. Provide pipe with the following information continuously marked on the pipe or spaced at intervals not exceeding 5 feet.

1. Name and/or trademark of the pipe manufacturer.

2. Nominal pipe size.

3. Standard Dimensional Ratio (SDR).

4. PE 3608 or PE3408.

5. Manufacturer's Standard Reference.

6. A production code from which the date and place of manufacture can be determined.

2.2 FITTINGS

A. Provide fittings, manufactured from the same class of materials and fully compatible with the HDPE pipe.

B. Provide fittings manufactured in accordance with ASTM D-3350 and ASTM D-3261. Provide fabricated fittings with pressure ratings matching or exceeding the HDPE

pipe.

2.3 PERFORATED PIPE

A. Pipe perforation details are shown on the Construction Drawings.

B. Remove all drill hole filings from the interior of the pipe prior to installation. OWNER will visually inspect all pipe prior to installation, fusion welding or slip coupling.

PART 3 EXECUTION

3.1 PIPE INSTALLATION GENERAL REQUIREMENTS

A. When shipping, delivering, and installing pipe, fittings, and accessories, do so in such manner to ensure a sound, undamaged installation.

B. Provide adequate storage for all materials and equipment delivered to the job site.

C. Handle and store pipe and fittings in accordance with the Manufacturer's recommendations.

3.2 PLACING AND LAYING PIPE

A. Provide required maintenance of all such materials and equipment used to handle, place, and lay pipe.

B. Follow the Manufacturer's recommendations when hauling, unloading and stringing the pipe.

C. Take precautions to prevent damage to the pipe.

D. Do not push, pull, or drag pipe and fittings over sharp projections, or drop, or have objects dropped on the pipe and fittings.

E. Inspect for defects before and during installation. Remove any piping showing kinks, buckles, cuts, gouges, or any other damage, which in the opinion of the OWNER will affect performance of the pipe.

F. Replace material found to be defective before or after laying with sound material at no additional expense to the OWNER.

G. Carefully lower pipe and accessories into the trench or onto the geosynthetics.

H. Under no circumstances drop or dump materials into the trench or onto the pipe or geosynthetics.

I. Rest the full length of each section of pipe solidly upon the pipe bedding, or on rub-sheets.

J. Take up or relay pipe that has had the grade disturbed while joining or laying the pipe.

3.3 JOINING PIPE

A. Join the HDPE pipe by the method of thermal butt or side wall fusion, as outlined in ASTM D-2657. Perform fusion joining of pipe and fittings in accordance with the procedures established by the pipe MANUFACTURER. Of particular importance is the use of proper interface pressures and heater plate temperatures.

B. Use fusion pressures, temperatures, and cycle times according to pipe Manufacturer's recommendations. Only use personnel adequately trained and qualified in the technique involved.

C. Do not perform pipe fusion in water or when trench conditions are unsuitable for the work. Keep water out of the trench until joining is completed. Secure open ends of pipe and close valves when work is not in progress, so that no trench water, earth, animals, or other substance will enter the pipe or fittings. Plug, cap or valve off pipe ends left for future connections as shown on the Construction Drawings.

D. Clear and grade fusion welding sites, if necessary, to provide enough space for pipe storage and fusion equipment. Keep the site free of rocks, stumps and debris which could cut, scar, or gouge the pipe. In order to allow the joining operation to continue in adverse weather conditions, a shelter may be required for the joining machine. Particular caution should be exercised to prevent water from entering the inside of the pipe and from coming in contact with the heater plate.

E. Polyethylene Fusion Qualification: All pipe fusion welding must be performed by the supplier, or a factory supplied and/or certified fusion welding operator.

F. Provide for instruction, testing, and installation training sessions as required to obtain training for welding personnel, including quality control personnel, in polyethylene fusion machine operation, instruction and familiarization with HDPE pipe and fitting fusion for the project. Only fully trained personnel will be allowed to perform the installation, supervision, or inspection of polyethylene-fusion joints. Submit to the OWNER, prior to beginning fusion welding, a list of those personnel authorized, instructed and certified for polyethylene fusion. Make all on-site training sessions conducted during the work available to quality assurance personnel at no charge to the OWNER.

G. Training: Provide assistance from the manufacturer/supplier in instructing welding

personnel in proper fusion welding procedures and techniques. Notifications will be required in writing, listing the names of those persons so familiarized. A Manufacturer's representative shall be certified in writing by the MANUFACTURER to be technically qualified and experienced in fusion welding of HDPE pipe.

H. After completion of the pipe fusion welding, the CONTRACTOR shall ream the inside of the pipes such that the inside bead of the weld is removed and the interior is smooth.

I. When two pipes of different diameters must be joined, the CONTRACTOR shall join the pipe with an appropriate transition fitting. Transition fittings shall be beveled and reamed, if necessary, to provide a relatively smooth inner surface at the joint.

END OF SECTION

SECTION 02711

CORRUGATED HDPE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install perforated Corrugated High Density Polyethylene (HDPE) pipe per the Construction Drawings. Pipe sizes are shown on the Construction Drawings.

1.2 RELATED SECTIONS

A. Section 02222 – Engineered Fill, Protective Soil Cover, Soil Cushion, And Anchor Trench Backfill.

B. Section 02230 – Surface Water Drainage Systems.

C. Section 02771 – Geotextile.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
2. ASTM D1238 - Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
3. ASTM D1248 - Specification for Polyethylene Plastics Molding and Extrusion Materials.
4. ASTM D1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique.
5. ASTM D1603 - Standard Test Method for Carbon Black in Olefin Plastics.
6. ASTM D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
7. ASTM D2412 – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

B. National Sanitation Foundation (NSF). NSF Standard Number 14 -Plastics Piping Components and Related Materials.

C. PPI -Plastic Pipe Institute.

D. ANSI -American National Standards Institute.

1.4 SUBMITTALS

A. Submit with each shipment of pipe to site, MANUFACTURER'S certification of compliance with specified requirements of this Section. Submit catalog cut sheet of pipe and fittings to be supplied prior to commencing work.

B. Provide written certification for qualified HDPE pipe fusion welders.

PART 2 PRODUCTS

2.1 PIPE

A. The collection piping shall be high quality, heavy-duty, corrugated HDPE pipe; containing no recycled compound except that generated in the Manufacturer's own plant and from resin of the same specification from the same raw material supplier.

B. Pipe shall be homogeneous throughout and free of visible cracks, holes (except where specified or shown), foreign inclusions or other injurious defects.

C. The pipe shall be uniform in color, capacity, density, and meeting the general physical properties shown in the following table.

TABLE 02711-1

HDPE PIPE PROPERTIES

PROPERTY	TEST DESIGNATION	UNIT	REQUIREMENTS
Density	D-1505	gm/cm^3	0.94 – 0.96
Melt Index	D-1238	gm/10 min(E)	< 0.15
Environmental Stress Crack Resistance	D-1693	Failure Hrs	> 5,000
UV Stabilizer	D-1603	% Carbon Black	2 – 3
Brittleness Temp.	D-746	°F	<-112
Pipe Stiffness	D-2412	Psi	>30

D. The CONTRACTOR shall submit Manufacturer's data and certifications to the OWNER for approval prior to construction.

E. Provide pipe with the following information continuously marked on the pipe or spaced at intervals not exceeding 5 feet.

1. Name and/or trademark of the pipe manufacturer.
2. Nominal pipe size.
3. Manufacturer's Standard Reference.

4. A production code from which the date and place of manufacture can be determined.

2.2 FITTINGS

A. Sections of the piping shall be joined with external couplers manufactured of high quality HDPE as provided by the pipe manufacturer.

B. CONTRACTOR shall provide fittings, manufactured from the same class of materials and fully compatible with the HDPE pipe.

C. The fabricated fittings shall have pressure ratings matching or exceeding the HDPE pipe.

PART 3 EXECUTION

3.1 PIPE INSTALLATION GENERAL REQUIREMENTS

A. When shipping, delivering, and installing pipe, fittings, and accessories, do so in such manner to ensure a sound, undamaged installation.

B. Provide adequate storage for all materials and equipment delivered to the job site.

C. Handle and store pipe and fittings in accordance with the Manufacturer's recommendations.

3.2 PLACING AND LAYING PIPE

A. Provide required maintenance of all such materials and equipment used to handle, place, and lay pipe.

B. Follow the Manufacturer's recommendations when hauling, unloading and stringing the pipe.

C. Take precautions to prevent damage to the pipe.

D. Do not push, pull, or drag pipe and fittings over sharp projections, or drop, or have objects dropped on the pipe and fittings.

E. Inspect for defects before and during installation. Remove any piping showing kinks, buckles, cuts, gouges, or any other damage, which in the opinion of the OWNER will affect performance of the pipe.

F. Replace material found to be defective before or after laying with sound material at no additional expense to the OWNER.

G. Carefully lower pipe and accessories onto the ground or liner.

H. Under no circumstances drop or dump materials onto the ground or liner.

I. Rest the full length of each section of pipe solidly upon the pipe bedding, or on rub-sheets.

J. Take up or relay pipe that has had the grade disturbed while joining or laying the pipe.

3.3 JOINING PIPE

A. Join the HDPE pipe using the external couplers supplied by the MANUFACTURER.

B. When two pipes of different diameters must be joined, the CONTRACTOR shall join the pipe with an appropriate transition fitting. Transition fittings shall be beveled and reamed, if necessary, to provide a relatively smooth inner surface at the joint.

END OF SECTION

SECTION 02771

GEOTEXTILE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installation of geotextile.

1.2 RELATED SECTIONS

A. Section 02222 – Engineered Fill, Protective Soil Cover, Soil Cushion, and Anchor Trench Backfill.

A. Section 02227 - Leachate Collection Gravel.

B. Section 02710 – Polyethylene Pipe.

C. Section 02774 - Drainage Geocomposite.

1.3 REFERENCES

A. GRI GT12(a) - Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials.

B. GRI GT13 - Test Methods and Properties for Geotextiles Used as Separation Between Subgrade Soil and Aggregate.

C. ASTM D-885 - Methods for Testing Industrial Filament Yarns Made From Man-made Fibers.

D. ASTM D-1777 - Method for Measuring Thickness of Textile Materials.

E. ASTM D-4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water.

F. ASTM D-4491 - Standard Test Method for Water Permeability of Geotextiles by Permittivity.

G. ASTM D-4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

H. ASTM D-4595 - Standard Test Method for Tensile Properties by the Wide-width Strip Method.

I. ASTM D-4632 - Standard Test Method for Breaking Load and Elongation of Geotextiles (grab method).

J. ASTM D-4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.

K. ASTM D-4833 - Standard Test Method for Index Puncture Resistance of Geotextiles and Geotextile-Related Products.

L. ASTM D-5216 - Standard Test Method for Mass Per Unit Area (weight) of Woven Fabric.

M. ASTM D-6241 - Standard Test Method for Index Puncture Strength of Geotextiles.

1.4 DEFINITIONS

A. MANUFACTURER: Responsible for the production of geotextile rolls

B. INSTALLER: The party responsible for field handling, storing, deploying, repairing, anchoring, and any other aspects of installing the geotextile

C. Construction Quality Assurance Consultant (CQAC): The party, independent from the manufacturer or installer, responsible for observing and documenting activities related to the quality assurance of the production and installation of the geosynthetic components of the geotextile. Also responsible for issuing a construction monitoring report, and certification sealed by a Registered Professional ENGINEER

1.5 SUBMITTALS

A. Submit, prior to confirmation of OWNER-CONTRACTOR Agreement, samples and complete description of geotextile fabric proposed for use that meets or exceeds the requirements of this section. Include certified minimum property values and test methods used to obtain property values. Also include production capacity available and projected delivery dates.

B. Submit, prior to installation, written instructions for storage, handling installation, and seaming of proposed geotextile.

C. Submit, prior to installation, written instructions for repair of geotextile.

D. Submit, prior to delivery, manufacturer's certificates of compliance with specified product requirements. This submittal includes Manufacturer's Quality Control (MQC) testing certificates signed by a responsible party. Include lot, batch, and

roll numbers, sampling procedures, test procedures, and test results. (Refer to paragraph 2.4 of this section).

E. Warranty: Submit to OWNER prior to installation, manufacturers, and installers written warranty against product and installation defects. Limits of liability must be accepted by the OWNER. Rinse

PART 2 PRODUCTS

2.1 GENERAL

A. Products comprised of non-woven, needle punched polypropylene or polyester fabric; oriented into a staple network that maintains its structure during handling, placement, and long-term service.

B. The product cannot be heat burnished.

C. Resistant to soil and leachate chemicals.

D. New product made from virgin materials.

2.2 GEOTEXTILE

A. Geotextile used for filtration shall conform to the minimum average roll values (MARV), as defined in Table 02771-1.

TABLE 02771-1

GEOTEXTILE PROPERTIES

TEST	TEST DESIGNATION	REQUIREMENT
Mass per Unit Area	ASTM D5261	8 oz/yd^2
Grab Tensile and Elongation	ASTM D4632	Minimum 205 lbs and 50%
CBR Puncture Resistance	ASTM D6241	Minimum 535 lbs
Trapezoidal Tear	ASTM D4533	Minimum 85 lbs
Water Flow	ASTM D4491	Minimum 90 gal/min/ft^2
Apparent Opening Size	ASTM D4751	< No. 80 U.S. opening size
UV Resistance	ASTM D4355	70/500 %/hours

2.3 MANUFACTURER SOURCE QUALITY CONTROL

A. The MANUFACTURER shall sample and test the geotextiles at a minimum of once for every 100,000 sq. ft. (10,000 sq. m). Test results shall demonstrate that the material conforms to all requirements in Part 2.2 of this Section except for UV Resistance, which shall be certified by the MANUFACTURER.

B. OWNER will reject rolls for which quality control requirements are not met.

C. Certify the quality of the rolls of geotextile.

D. Provide quality control certificates for each lot and each shift's production. The quality control certificates must include:

1. Roll numbers and identification.

2. Sampling procedures.

3. Results of quality control tests, including a description of test methods used.

2.4 LABELING

A. Mark or tag geotextile rolls with the following information:

1. Manufacturer's name.

2. Product identification.

3. Lot number or date

4. Roll number

5. Roll dimensions

B. Mark special handling requirements on rolls.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to installation of geotextile, examine underlying construction for conformance with specifications.

3.2 PROTECTION

A. When placing any materials over geotextile ensure the following:

1. No damage to geotextile.

2. No slippage of geotextile on underlying layers.

3. No excessive tensile stresses in the geotextile.

B. Ensure that geotextile filter is covered within 30 days.

3.3 DELIVERY, STORAGE, AND HANDLING

A. Protect geotextile from ultraviolet light exposure, precipitation, inundation, mud, dirt, dust, puncture, cutting, and other damaging or deleterious condition.

B. Ship geotextile in closed trailer.

C. Immediately restore damaged protective covering.

3.4 DEPLOYMENT

A. Follow Manufacturer's recommendations, standards, and guidelines.

B. Roll geotextile down slope keeping the geotextile sheet in sufficient tension to prevent folds and wrinkles.

C. Temporarily secure geotextile in-place with sandbags, or equivalent, to ballast during deployment. Leave ballast in place until geotextile is covered with succeeding construction layer.

D. Cut geotextile using approved cutter only. Take care to protect other in-place geosynthetic materials when cutting geotextile.

E. Do not trap excessive dust, stones, or moisture in geotextile that could damage or clog drains or filters, or hamper subsequent seaming.

F. Examine geotextile over entire completed surface to ensure that no potentially harmful foreign objects, such as needles, are present. Remove any foreign objects.

3.5 SEAMS AND OVERLAPS

A. Overlap geotextile as required by the seaming technique and as recommended by Manufacturer prior to seaming.

B. For slopes steeper than 10 percent, sew all seams for geotextile.

C. All seams shall be either "double prayer" or "single J" seam.

D. Ensure that no soil materials are inadvertently inserted beneath the seams of geotextiles.

E. For slopes less than 10 percent, geotextiles can be either sewn as indicated above, or heat welded.

F. Heat welded seaming shall be performed in a manner that does not damage the underlying geosynthetics and prevents burn-outs in the geotextile. All damage geosynthetics and burn-outs shall be repaired as provided in these specifications.

G. Sew with polymeric thread having chemical resistance and strength properties equal to or exceeding those of geotextile.

H. For sewing, use a 401 two-thread chain stitch, or equivalent.

3.6 REPAIRS

A. Repair holes or tears in geotextiles with a patch from the same geotextile material, by sewing or heat welding (as described above) in place with a minimum seam overlap of 12 inches in all directions.

B. Sew the geotextile within 1 inch of the outside edge of the patch materials.

C. If tear exceeds 50 percent of the roll width, remove and replace the roll.

D. No patches will be allowed within 1 inch of a panel edge.

E. Remove any soil or other material which may have penetrated the torn geotextile.

F. Notify OWNER of all repairs.

3.7 FIELD QUALITY ASSURANCE

A. Samples of geotextile delivered to the site shall be collected for conformance testing at a minimum frequency of one (1) per hundred thousand (100,000) square feet of geotextile, to determine product compliance with specified values.

B. Samples will be taken across the entire width excluding the first 3 feet of the roll unless otherwise approved. Sample size will be 3-feet-long by the roll width.

C. The CQA consultant shall observe all repair operations.

3.8 ACCEPTANCE

A. CONTRACTOR retains all ownership and responsibility for geotextiles until acceptance by OWNER.

B. OWNER accepts geotextiles when all the following have been completed:

1. The installation is complete.

2. Documentation of installation is complete including the CQA consultant's final report.

3. Verification of the adequacy of all seams and repairs, including associated testing, is complete.

4. Written certification documents have been received by the OWNER.

END OF SECTION

SECTION 02776

DRAINAGE GEOCOMPOSITE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing all labor, materials and equipment necessary for installing the Drainage Geocomposite for the site in accordance with the Specifications and the Drawings.

B. Geocomposite described in this section will be geonet with geotextile heat bonded on both sides prior to delivery to the site. This combination, which is pre-fabricated in the plant prior to shipment to the site, is termed as double-Sided Drainage Geocomposite.

1.2 RELATED SECTIONS

A. Section 02221 - Excavating and Stockpiling.

B. Section 02222 - Engineered Fill, Protective Soil Cover, Soil Cushion, and Anchor Trench Backfill.

C. Section 02778 - Geomembrane.

1.3 REFERENCES

A. GRI GC7 - Standard Guide for the Determination of Adhesion and Bond Strength of Geocomposites.

B. ASTM D-792 - Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

C. ASTM D-1603 - Standard Test Method for Carbon Black in Olefin Plastics.

D. ASTM D-4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

E. ASTM D-4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

F. ASTM D-4716 - Standard Test Method for Constant Head Hydraulic Transmissivity of Geotextiles and Geotextile Related Products.

G. ASTM D-4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.

H. ASTM D-4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

I. ASTM D-4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.

J. ASTM D-5035 - Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Strip Method).

K. ASTM D-5199 - Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

L. ASTM D-5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

1.4 DEFINITIONS

A. Batch: A quantity of resin, usually the capacity of one railcar, used in the fabrication of high density polyethylene (HDPE) geocomposite. A roll number corresponding to the particular quantity of resin used will identify the finished product.

B. Construction Quality Assurance Consultant (CQAC): The party, independent from MANUFACTURER or INSTALLER, that is responsible for observing and documenting activities related to the quality assurance of production and installation of the geosynthetic components of the lining system.

C. Construction Quality Assurance (CQA) Laboratory: The party, independent from the OWNER, MANUFACTURER, Fabricator, and INSTALLER, responsible for conducting tests on samples of geosynthetics obtained at the site.

D. Construction Quality Assurance (CQA) Monitor: The site representative of the CQAC.

E. Fabricator: The party responsible for the fabrication of geocomposite panels constructed from rolls received from the MANUFACTURER.

F. Geocomposite MANUFACTURER: The party responsible for the production of the geocomposite rolls from resin and for the quality control of the resin.

G. Geocomposite Subsurface: The surface on which the geocomposite lies.

H. INSTALLER: The party responsible for field handling, transporting, storing, deploying, seaming, temporarily restraining (against wind), and installing the geocomposite.

1.5 SUBMITTALS

A. Product Data: Submit the following to the OWNER prior to confirmation of OWNER CONTRACTOR Agreement.

1. Resin Data.

a. Statement of production date or dates.

b. Certification stating that the resin meets the product requirements (see Part 2.3).

c. Certification stating that all resin is from the same MANUFACTURER.

d. Copy of quality control certificates issued by MANUFACTURER.

e. Test reports from MANUFACTURER.

2. Geocomposite Rolls.

a. Statement of production date or dates, and MANUFACTURER's certificates for each day's production.

b. Laboratory test results and certification stating that the geocomposite meets the product requirements of Part 2.

c. Certification stating that all geocomposite rolls are furnished by one supplier, and that all rolls are manufactured from one resin type obtained from one resin supplier.

d. Copy of quality control certificates issued by MANUFACTURER and including designation of test methods used. Also include roll numbers, batch numbers, lot numbers, and roll identification.

e. Test reports from the MANUFACTURER.

f. Geocomposite delivery, storage, and handling instructions.

g. Geocomposite installation instructions.

1.6 QUALIFICATIONS

A. MANUFACTURER/Fabricator/Installation Qualifications

B. INSTALLER: Must have successfully installed a minimum of 1,000,000 square feet of drainage geocomposite with documented references.

1.7 QUALITY ASSURANCE

A. The OWNER will engage and pay for the services of (1) Construction Quality Assurance Consultant (CQAC), and (2) Construction Quality Assurance (CQA) Laboratory for monitoring the quality of geocomposite.

1.8 DELIVERY, STORAGE, AND HANDLING (MANUFACTURER)

A. General: Conform to the MANUFACTURER's requirements.

B. Delivery.

1. Deliver materials to the site only after the OWNER accepts required submittals.

2. Separate damaged rolls from undamaged rolls and store at locations designated by the OWNER until OWNER determines proper disposition of material.

3. OWNER will determine if rolls considered damaged.

4. Deliver in rolls, do not fold.

C. Storage on Site: (INSTALLER).

1. Store geocomposite rolls in the space allocated by the OWNER.

2. Store geocomposite rolls to protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

3. Store geocomposite rolls on prepared surface (not on wooden pallets).

4. Stack geocomposite rolls as per the manufacturer's recommendation.

D. Handling on Site: (INSTALLER).

1. Use appropriate handling equipment to load, move, and deploy geocomposite rolls. Appropriate handling equipment includes cloth

chokers and spreader bars for loading, and spreader and roll bars for deployment. Dragging panels on ground surface will not be permitted.

2. Do not fold geocomposite; folded material will be rejected.

3. CONTRACTOR is responsible for off loading, storage, and transporting material from storage area to installation site.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Submit substitutions in accordance with Section 01630, Product Options and Substitutions.

2.2 GEOCOMPOSITE LABELING

A. Provide the following information on geocomposite roll labels:

1. Length, width, and weight.

2. Name of MANUFACTURER and Fabricator.

3. Directions for unrolling.

4. Product identification; lot number, batch number, and roll number.

2.3 GEONET

A. The resin shall be first quality High Density Polyethylene (HDPE), manufactured specifically for producing geonet for use in drainage systems. Mixing of different resin types, recycled materials, or seconds will not be allowed.

B. The geonet shall meet the following requirements unless otherwise approved:

TABLE 02774-1

GEONET PROPERTIES

TEST	TEST DESIGNATION	REQUIREMENT
Density[(1)]	ASTM 1505	Minimum 0.94 g/cm^3
Carbon Black	ASTM D-4218	2% to 3%
Tensile Strength	ASTM D-7179	Minimum 45 lbs/in
Thickness	ASTM D-5199	Minimum 200 mil
Notes: (1) Measured on resin prior to addition of carbon black. Maximum 0.950 g/cm^3 with carbon black.		

2.4 GEOTEXTILE

A. Geotextile used for filtration conforming to the following minimum average roll values (MARV) as defined by the Federal Highway Administration for the following properties listed:

TABLE 02774-2

GEOTEXTILE PROPERTIES

TEST	TEST DESIGNATION	REQUIREMENT
Mass per Unit Area	ASTM D-5261	8 oz/yd^2
Grab Tensile and Elongation	ASTM D-4632	Minimum 220 lbs and 50%
CBR Puncture Resistance	ASTM D-6241	Minimum 600 lbs
Trapezoidal Tear	ASTM D-4533	Minimum 90 lbs
Water Flow	ASTM D-4491	Minimum 95 gal/min/ft^2
Apparent Opening Size	ASTM D-4751	< No. 80 U.S. opening size

2.5 GEOCOMPOSITE

A. Geonet shall be heat bonded to one layer of geotextile.

B. No delamination (separation between the geonet and geotextile) greater than 6 square feet area within a 6-foot radius of any point shall be allowed.

C. Unlaminated edge: 12" MAX allowable.

D. The geocomposite shall meet the following requirements unless approved otherwise:

TABLE 02774-3

GEOCOMPOSITE PROPERTIES

TEST	TEST DESIGNATION	REQUIREMENT
Hydraulic Transmissivity(1)	ASTM D4716	1x10^{-4} m^2/sec
Ply Adhesion	ASTM D7005	Minimum 0.5 lbs/in, Average 1.0 lbs/in (1-minute test)
Note: (1) Geocomposite measured at a load of 10,000 psf and a gradient of 0.1 sandwiched between steel plates.		

2.6 MANUFACTURER SOURCE QUALITY CONTROL

A. Perform the following quality control tests at the manufacturing plant or other laboratories on geonet, geotextile, and geocomposite products:

TABLE 02774-4

MANUFACTURER'S QUALITY CONTROL TESTING REQUIREMENTS

TEST	TEST DESIGNATION	FREQUENCY (SEE FOOTNOTES)
Geonet		
Density	ASTM 1505	(2)
Carbon Black	ASTM D-4218	(2)
Tensile Strength	ASTM D-7179	(2)
Thickness	ASTM D-5199	(2)
Geotextile		
Mass per Unit Area	ASTM D-5261	(3)
Grab Tensile and Elongation	ASTM D-4632	(3)
CBR Puncture Resistance	ASTM D-6241	(3)
Water Flow	ASTM D-4491	(1)
Apparent Opening Size	ASTM D-4751	(1)
Geocomposite		
Ply Adhesion	ASTM D-7005	(2)
Hydraulic Transmissivity	ASTM D-4716	(1)

Notes: (1) One per 540,000 square feet produced or one per resin batch, whichever results in the greatest number of tests.
(2) One per 50,000 square feet produced or one per resin batch, whichever results in the greatest number of tests.
(3) One per 90,000 square feet produced or one per resin batch, whichever results in the greatest number of tests.

PART 3 EXECUTION

3.1 PREPARATION

A. After the CQA Consultant and the OWNER approve the geocomposite, it shall be placed over the geomembrane as shown on the Drawings.

B. Installation shall be in accordance with the MANUFACTURER's instructions and these Specifications. Where a conflict arises, these Specifications will prevail.

3.2 GEOCOMPOSITE INSTALLATION

A. Deployment.

1. Deploy with the geonet side in contact with the geomembrane.

2. Daily Panel Deployment: Deploy no more panels in one shift than can be secured during that same shift.

3. Do not damage geocomposite by handling, by trafficking, leakage of hydrocarbons, or any other means.

4. Unroll geocomposite panels using methods that will not damage, stretch or crimp geocomposite. Protect underlying surface from damage.

5. Do not allow any vehicular traffic directly on geocomposite.

6. Visually inspect geocomposite for imperfections. Mark faulty or suspect areas for repair.

B. Connections (net) shall be overlapped a minimum of 6-inches along the length and one foot along the width.

C. Connections (net) shall be made using nylon ties secured at three-foot intervals along the length and 1-foot centers along the width.

D. Edge of geotextile shall be sewn for the entire length of geotextile. No geonet shall be exposed.

E. Defects and Repairs.

1. Examine areas of the geocomposite for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geocomposite must be clean at the time of the examination.

2. Damaged geocomposite shall be removed and repaired according to Part 3.4 of this Section.

3.3 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. MANUFACTURER, Fabricator, INSTALLER, and CONTRACTOR, will participate and conform with all terms and requirements of the Owners construction quality assurance program. The CONTRACTOR is responsible for assuring this participation.

B. Field construction quality control and quality assurance requirements shall be performed as specified in the CQA Plan.

C. The OWNER may perform additional testing to determine the conformance of the materials with these Specifications and the Drawings.

3.4 REPAIR PROCEDURES

A. Remove damaged geocomposite and replace with acceptable geocomposite materials if damage cannot be satisfactorily repaired.

B. Repair, removal, and replacement are at CONTRACTOR's expense if the damage results from the CONTRACTOR's, INSTALLER's, or the CONTRACTOR's subcontractor activities.

C. Repair any portion of the geocomposite exhibiting a flaw. Agreement upon the appropriate repair method will be determined between the OWNER's Representative, the CQAC and the INSTALLER. Repair procedures available include:

1. Patching: Used to repair large holes, tears, by overlapping geocomposite 6-inches in all directions and tying.

3.5 GEOCOMPOSITE ACCEPTANCE

A. CONTRACTOR retains all ownership and responsibility for the geocomposite until acceptance by the OWNER.

B. OWNER will accept geocomposite installation when:

1. All required documentation from the MANUFACTURER, Fabricator, and INSTALLER has been received and accepted.

2. The installation is finished.

END SECTION

SECTION 02778

GEOMEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes furnishing and installing double-side textured HDPE geomembrane for the landfill composite liner in accordance with the Specifications and the Construction Drawings.

1.2 RELATED SECTIONS

A. Section 02221 - Excavating and Stockpiling.

B. Section 02222 - Engineered Fill, Protective Soil Cover, Soil Cushion, and Anchor Trench Backfill.

C. Section 02776 - Drainage Geocomposite.

D. Section 02779 – Geosynthetic Clay Liner.

1.3 REFERENCES

A. GRI-GM 11 - Accelerated Weathering of Geomembranes using a Fluorescent UVA Condensation

B. GRI-GM 12 - Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage.

C. GRI-GM 13 - Standard Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.

D. ASTM D-746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

E. ASTM D-792 - Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.

F. ASTM D-1004 - Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

G. ASTM D-1238 - Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.

H. ASTM D-1505 - Standard Test Method for Density of Plastics by the Density Gradient Technique.

I. ASTM D-1603 - Standard Test Method for Carbon Black in Olefin Plastics.

J. ASTM D-3895 - Standard Test Method for Copper Induced Oxidative Induction Time of Polyolefins by Thermal Analysis.

K. ASTM D-4833 - Standard Test Method for Index Puncture of Geotextiles, Geomembranes, and Related Products.

L. ASTM D-4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.

M. ASTM D-5199 - Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

N. ASTM D-5397 - Standard Test Method for Evaluation of Stress Crack of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.

O. ASTM D-5617 - Test Method for Multi-Axial Tension Test for Geosynthetics.

P. ASTM D-5596 - Standard Test Method for Microscopic Evaluation of Dispersion of Carbon Black in Polyolefin Geosynthetics.

Q. ASTM D-5885 - Standard Test Method for Oxidation Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.

R. ASTM D-5994 - Standard Test Method for Measuring Core Thickness of Textured Geomembranes.

S. ASTM D-6243 - Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.

T. ASTM D-6392 - Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

U. ASTM D-6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.

1.4 DEFINITIONS

A. Batch: A quantity of resin, usually the capacity of one rail car, used in the manufacture of high density polyethylene (HDPE) geomembrane sheet. A roll

number corresponding to the particular lot of resin used will identify the finished sheet.

B. Bridging: The condition when geomembrane becomes suspended over its subgrade due to contraction of the material or poor installation.

C. Construction Quality Assurance Consultant (CQAC): The party, independent from MANUFACTURER or INSTALLER, that is responsible for observing and documenting activities related to the quality assurance of production and installation of the geosynthetic components of the lining system.

D. Construction Quality Assurance (CQA) Laboratory: The party, independent from the OWNER, MANUFACTURER, Fabricator, and INSTALLER, responsible for conducting tests on samples of geosynthetics obtained at the site.

E. Construction Quality Assurance (CQA) Monitor: The site representative of the CQAC.

F. Extrudate: The molten polymer that is emitted from an extruder during seaming using either extrusion fillet or extrusion flat methods. The polymer is initially in the form of a ribbon rod, bead or pellets.

G. Fabricator: The party responsible for the fabrication of geomembrane panels constructed from rolls received from the MANUFACTURER.

H. Geomembrane MANUFACTURER: The party responsible for the production of the geomembrane rolls from resin and for the quality of the resin.

I. Geomembrane: An essentially impermeable membrane used as a solid or liquid barrier. Synonymous term for flexible membrane liner (FML).

J. Geomembrane Subsurface: The soil or geosynthetic surface on which the geomembrane lies.

K. INSTALLER: The party responsible for field handling, transporting, storing, deploying, seaming, temporary restraining (against wind), and installation of the geomembrane.

L. Panel: The unit area of geomembrane that will be seamed in the field. A panel is identified as a roll or portion of a roll without any seams.

1.5 PRE-CONSTRUCTION SUBMITTALS (MANUFACTURER AND INSTALLER)

A. Submit the following to the OWNER, 7 days prior to receiving material at site.

B. Resin Data. (MANUFACTURER)

1. Statement of production date or dates.

2. Certification stating that the resin meets the product requirements of Part 2.2.

3. Certification stating that all resin is from the same MANUFACTURER.

4. Copy of the quality control certificates issued by MANUFACTURER.

5. Test reports from MANUFACTURER.

C. Geomembrane Roll. (MANUFACTURER)

1. Statement of production date or dates.

2. Laboratory test results and certification stating that the geomembrane meets the product requirements of Part 2.3.

3. Certification stating that all geomembrane rolls are furnished by one supplier, and that all rolls are manufactured from one resin type obtained from one resin supplier.

4. Copy of quality control certificates issued by MANUFACTURER.

5. Test reports from the MANUFACTURER.

6. Typical test results of complete notched constant tensile load test (ASTM D-5397) for specified resin and sheet thickness.

7. Statement certifying that no reclaimed polymer is added to the resin.

8. Statement listing percentages of processing aids, antioxidants, and other additives other than carbon black added to or in the resin.

9. Geomembrane delivery, storage, and handling instructions.

10. Geomembrane installation instructions.

11. Sample warranties for review.

D. Extrudate Beads and/or Rod. (MANUFACTURER)

1. Statement of the production date or dates.

2. Laboratory certification stating that the extrudate meets the product requirements of Part 2.4.

3. Certification stating that one MANUFACTURER manufactures all extrudate and one supplier supplies the resin.

4. Copy of the quality control certificates issued by MANUFACTURER.

5. Test reports from the MANUFACTURER.

6. Certification stating that the extrudate bead or rod resin is the same type, from the same MANUFACTURER and compatible with the resin used to manufacture the geomembrane supplied for this project.

E. Schedules and Drawings (INSTALLER).

1. Work schedule: Submit the installation schedule one week prior to installation. Include hours worked per day, per week and per shift. Indicate all weather delays built into schedule.

2. Installation layout drawings: Two weeks prior to installation of geomembrane, submit drawings showing the panel layout indicating both fabricated (if applicable) and field seams, and details not conforming to the Construction Drawings. All proposed rolls and panels shall be of sufficient length to match the project requirements and prevent horizontal seams on the side slopes of the project area. Therefore, unless otherwise shown on the Construction Drawings, rolls shall be produced and delivered and panels subsequently cut to a sufficient length to reach from 5 feet past the top (crest) hinge line of the slope to 5 feet past the bottom (toe) of the slope or the end of the anchor trench run-out whichever is greater. Upon acceptance of the panel layout, use these drawings for installation of geomembrane.

F. Qualifications (INSTALLER).

1. Submit, two weeks prior to installation, the name of INSTALLER, and resume of installation supervisor/field ENGINEER to be assigned to the project.

2. Submit, two weeks prior to installation, resume of master seamer(s).

3. Equipment and Personnel: Submit the following two weeks prior to installation: (INSTALLER).

a. Equipment list stating quantity and types.

b. List of personnel to perform field seaming operations.

1.6 SUBMITTALS DURING CONSTRUCTION (INSTALLER)

A. Submit quality control documentation prepared during the installation.

B. Submit daily prior to the start of installation, subgrade acceptance certificate signed by the installation supervisor for each area to be covered by geosynthetics.

1.7 SUBMIT UPON COMPLETION OF THE INSTALLATION (INSTALLER)

A. Certificate stating the liner has been installed in accordance with the Construction Drawings and Specifications.

B. The warranty obtained from the MANUFACTURER/Fabricator and the installation warranty.

C. As built drawings showing location of panels, seams, repairs, patches, and destructive samples, including measurements.

D. Copies of seam test results and statistical analysis of each welder's performance.

1.8 QUALIFICATIONS

A. INSTALLER: Must have successfully installed a minimum of 10,000,000 square feet of welded polyethylene geomembrane with documented references.

B. Master Welder Qualifications: Must have completed a minimum of 5,000,000 square feet of polyethylene geomembrane seaming work using the type of seaming apparatus proposed for use on this project.

C. Other Seamer's Qualifications: Must have seamed a minimum of 1,000,000 square feet of HDPE geomembrane.

1.9 QUALITY ASSURANCE

A. The OWNER will engage and pay for the services of (1) Construction Quality Assurance Consultant (CQAC), and (2) Construction Quality Assurance (CQA) Laboratory for monitoring the quality and installation of geomembrane material being installed unless otherwise specified.

1.10 DELIVERY, STORAGE, AND HANDLING (MANUFACTURER)

A. General: Conform to the MANUFACTURER's requirements.

B. Delivery.

1. Deliver materials to the site only after the OWNER accepts required submittals.

2. Separate damaged rolls from undamaged rolls and store at locations designated by the OWNER until OWNER determines proper disposition of material.

3. OWNER will determine the extent of damage to geomembrane.

4. Deliver in rolls, do not fold.

C. Storage on Site: (INSTALLER).

1. Store geomembrane rolls in the space allocated by the OWNER.

2. Store geomembrane rolls to protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

3. Store geomembrane rolls on prepared surface (not on wooden pallets).

4. Stack geomembrane no more than three rolls high.

D. Handling on Site: (INSTALLER).

1. Use appropriate handling equipment to load, move, or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader, and roll bars for deployment. Dragging panels on ground surface will not be permitted.

2. Do not fold geomembrane material; folded material will be rejected.

3. CONTRACTOR is responsible for off loading, storage, and transporting material from storage area to installation site.

1.11 WARRANTY (MANUFACTURER)

A. Provide MANUFACTURER's warranty for geomembrane material in compliance with provisions of the Conditions of the Contract. Provide a minimum 20 year pro rata warranty for the material against deterioration due to exposure to the elements, either exposed or buried. The warranty for material must cover costs of material replacement and installation; assuming the area is rendered in a clean, dry, unencumbered condition. In the event the area cannot be rendered as such, compensation for defective material will be provided to the OWNER on

a pro rata basis for the estimated cost to the OWNER at that time of supplying and installing material to a clean, dry, and unencumbered condition by a third party INSTALLER.

B. Installation: Provide an installation warranty for geomembrane material in compliance with the conditions of the Contract. Provide a minimum of 2 year, non-pro rata warranty for the installation against defects.

PART 2 PRODUCTS (MANUFACTURER)

2.1 GEOMEMBRANE RESIN

A. High Density Polyethylene (HDPE), new, first quality, and manufactured specifically for producing HDPE geomembrane.

B. Do not mix resin types during manufacturing.

C. Do not use recycled materials or seconds in manufacturing.

D. Meeting the following requirements unless otherwise approved:

TABLE 02778-1

HDPE RESIN PROPERTIES

TEST	TEST DESIGNATION	REQUIREMENT
Density(1)	ASTM D-792 Method B	Minimum 0.94 g/cm^3
Notes: (1) Measured on resin prior to addition of carbon black. Greater than 0.940 g/cm^3 with carbon black.		

2.2 DOUBLE-SIDE TEXTURED HIGH-DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

A. Manufacturing.

1. The resin supplied for the geomembrane will consist of compounded polyethylene specifically produced for geomembrane production and shall not include pipe resin or other resins not formulated for hydraulic containment. No recycled polymers or polymers mixed with other types of resin shall be accepted unless the recycling program has been approved the plant inspected by the ENGINEER.

2. Use only resins and additives produced in the United States, Canada or Western Europe from approved suppliers and manufacturers. All resin, masterbatch, anti-oxidant and other additives, as well as the complete formulation, to be approved by the ENGINEER

3. The base resin is to be pure material with no modifications. Factory blending of resins will only be allowed if the facility has been inspected and approved by the ENGINEER and in which case only when fully automated batching and control systems are used.

4. All resin for each type of geomembrane shall be manufactured by one single MANUFACTURER, and supplied by one single supplier. Each type of additive will also be manufactured and supplied by one single supplier.

5. The additive package, at a minimum, must include: carbon black, antioxidants and a HALS component. Non-slip agents shall not be used. The total combined percentage for all the additives, including carbon black, antioxidants, HALS, and others, shall be less than 3.5% of the geomembrane weight. From this 3.5%, no more than 1% shall correspond to additives other than carbon black.

6. All the additives shall be uniformly dispersed throughout the geomembrane. Additives shall not be extractable under water by leaching. There shall be no visual streaking or variation in additive distribution or dispersion.

7. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black or pigment.

8. The geomembrane shall be produced in rolls, and shall be free of holes, bumps, and not dispersed material, cuts, bents, and any other signs of foreign material. Every roll shall be identified with labels that supply information as to the thickness, length, width, roll number, and plant location.

9. Separation in plane (SIP) shall be examined during tensile testing. SIP is not allowed. Any rolls presenting SIP will be rejected.

10. The MANUFACTURER shall carry out laboratory tests on the geomembrane's quality control, in the frequency indicated in these specifications. The MANUFACTURER will certify that the proposed material complies with the requirements for the stress crack resistance due to environmental efforts. The most resent stress crack resistance testing results shall be enclosed with a MANUFACTURER'S certification, in order to verify that the supplied product fulfills the project requirements.

11. The HDPE geomembrane shall meet the minimum average roll values (MARV) and requirements Table 02778-2 for double sided textured geomembrane, unless otherwise specified or approved. Manufacturing

quality control (MQC) testing shall be conducted at the stated frequencies.

12. The minimum square footage of geomembrane delivered to the project from a single batch or lot shall be 75,000 square feet to control the cost of conformance sampling and testing. The cost of additional conformance testing performed as a result of a delivered.

TABLE 02778-2

PROPERTIES FOR 60 MIL TEXTURED DOUBLE-SIDED HDPE GEOMEMBRANE

TEST	TEST DESIGNATION	REQUIREMENT	MQC TEST FREQUENCY
Sheet Thickness	ASTM D-5994	Minimum average of 60 mils minus 5% (nominal). Lowest individual for 8 out of 10 values is 60 mils minus 10%. Lowest individual for any of the 10 values is 60 mils minus 15%.	One per roll
Sheet Density	ASTM D-792 Method B	0.940 to 0.950 g/cm^3	50,000 sq ft[5]
Oxidation Induction Time of Polyolefins[1]	ASTM D-3895, 200°C, 1 atm or ASTM 5885	Minimum 100 minutes Minimum 400 minutes	250,000 sq ft[6]
Tensile Strength at Yield	ASTM D6693, Type IV, 2 ipm	Minimum 132 lbs/in-width	50,000 sq ft[5]
Elongation at Yield	ASTM D-6693, Type IV, 2 ipm, 1.3 in. gage length	Minimum 13%	50,000 sq ft[5]
Tensile Strength at Break	ASTM D-6693, Type IV, 2 ipm	Minimum 132 lbs/in-width	50,000 sq ft[5]
Elongation at Break	ASTM D-6693, Type IV, 2 ipm, 2.0 in. gage length	Minimum 350%	50,000 sq ft[5]
Tear Resistance	ASTM D-1004, Die C	Minimum 45 lbs	50,000 sq ft[5]
Puncture Resistance	ASTM D-4833	Minimum 120 lbs	50,000 sq ft[5]

TEST	TEST DESIGNATION	REQUIREMENT		MQC TEST FREQUENCY
Stress Crack Resistance (SP-NCTL)	ASTM D-5397 Appendix	500 hrs.		One test per formulation
Carbon Black Content	ASTM D-4218	2% to 3%		50,000 sq ft[5]
Carbon Black Dispersion	ASTM D-5596	9 of 10 different views in Categories 1 or 2, and 1 of 10 in Category 3.		50,000 sq ft[5]
Asperity Height[3]	ASTM D-7466	20 mils (8 of 10 readings ≥20 mils, and lowest individual reading ≥ 16 mils)		One per roll
Post Peak Shear Strength[7]	ASTM D-5321 (against soil) ASTM D-6243 (against GCL)	Confining Stress (lbs/ft^2) 2,000 4,000 8,000 12,000	Shear Stress (lbs/ft^2) 576 935 1,561 1,700	One per project

Notes:

(1) The MANUFACTURER has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(2) The single point NCTL test is not appropriate for testing geomembranes with irregular rough surfaces. The test shall be conducted on smooth edge of textured rolls or on smooth sheets made from the same formulation as the textured material being evaluated.

(3) The ENGINEER may accept a lower value if it can be demonstrated that the proposed lower asperity height can achieve the interface strengths specified.

(4) UV resistance is based on percent retained value regardless of the original HP-OIT value.

(5) One test per 50,000 square feet or one per resin batch, whichever results in the greater number tests.

(6) One test per 250,000 square feet or a minimum of one per project, whichever results in the greater number of tests.

(7) Manufacturer is not required to certify the interface value. Requirements apply to the post-peak HDPE –GCL and HDPE geocomposite interface strength at 3 inches of displacement and performed in general accordance with Part 2.7 of Section 02778 these specifications.

2.3 EXTRUDATE ROD OR BEAD

A. Meeting the geomembrane MANUFACTURER requirements.

B. Made from same resin as the geomembrane.

C. Thoroughly disperse additives throughout rod or bead.

D. Containing 2 to 3 percent carbon black.

E. Free of contamination by moisture or foreign matter.

2.4 GEOMEMBRANE LABELING

A. Provide the following information on geomembrane roll labels.

1. Length, width, and weight.

2. Name of manufacturer and fabricator.

3. Directions for unrolling, if necessary.

4. Product identification; batch number, and roll number.

2.5 WELDING EQUIPMENT FOR INSTALLATION

A. Maintain sufficient operational seaming apparatus to continue work without delay.

B. Use power source capable of providing constant voltage under combined line load.

C. Provide protective lining and splash pad large enough to catch spilled fuel under electric generator, if located on liner.

D. Tensiometers capable of measuring seam strength, calibrated and accurate within 2 pounds. Tensiometers to be calibrated within 12 months of start of project.

E. Dies for cutting seam samples.

2.6 MANUFACTURER SOURCE QUALITY CONTROL

A. Perform the quality control tests listed in Table 02778-1, 02778-2, and 02778-3 at the manufacturing plant on geomembrane products.

2.7 SHEAR STRENGTH TESTING REQUIREMENTS

A. Upon award of the contract, the MANUFACTURER and/or INSTALLER shall provide to the third-party laboratory a minimum 3-foot by the roll width sample of the geomembrane and other geosynthetics for the project for testing of the interface strength between the overlying and underlying soil and/or geosynthetic materials for the project.

B. Upon award of the contract, the CONTRACTOR shall provide to the third party laboratory a 50 pound sample of each soil, sand, or gravel material to be used in contact with the geomembrane for testing of the interface strength.

C. The following interfaces shall be tested for the project:

1. 60-mil textured HDPE geomembrane surface against the reinforced GCL.

2. 60-mil textured HDPE geomembrane surface against the double sided geocomposite.

D. Prior to performing the shear testing, the third party laboratory shall sample and test textured geomembrane for asperity height, geocomposite ply adhesion, and GCL peel strength in accordance the product Specifications.

E. The testing of the interfaces shall be performed by the third party laboratory in general accordance with ASTM D-5321 and D-6243 using properly calibrated equipment and shall incorporate the following test parameters unless otherwise approved by the ENGINEER.

1. Interface strength shall be determined using 3 test specimens tested under the normal loads shown in Table 02778-2. These normal loads shall be used for the consolidation loading.

2. The test against the soil shall be set up with the geomembrane securely clamped to the bottom box and the soil material placed in the upper box of the direct shear apparatus.

3. The test against the geocomposite material shall be set up with the geomembrane clamped to the upper box and the geocomposite securely clamped in the bottom box of the direct shear apparatus.

4. The test against the GCL material shall be set up with the geomembrane clamped to the upper box and the GCL securely clamped in the bottom box of the direct shear apparatus with the non-woven geotextile in contact with the geomembrane.

5. The geomembrane shall be supported in the box using a rigid substrate with the contact unit consisting of a truss plate or other high friction grip plate approved by the ENGINEER.

5. The geocomposite and GCL to be tested in contact with the geomembrane shall be supported in the box using a rigid substrate with the contact unit consisting of a truss plate or other high friction grip plate approved by the ENGINEER.

6. Unless otherwise specified by the ENGINEER, the soil layer to be tested in contact with the geomembrane shall be a minimum of 1 inch thick, compacted to a minimum of 90 percent relative compaction at optimum moisture content based on ASTM D-1557. The remaining portion of the upper box may be filled with a relatively free-draining sand, gravel, or porous rigid material to allow for proper drainage in accordance with ASTM D-5321 and D-6243.

7. Each specimen used for geomembrane to soil or GCL interface testing shall be consolidated for minimum of 24 hours prior to shearing. A minimum 1 hr seating time may be used for the geomembrane to geocomposite test.

8. All specimens shall be tested in a flooded condition.

9. Flooding shall be performed immediately after the placement of the initial consolidating load and shall be maintained throughout the specimen consolidation and testing period.

10. Each specimen shall be sheared at a maximum strain rate of 0.04 inches per minute for geomembrane in contact with soil or GCL and at 0.4 inches per minute for geomembrane in contact with geocomposite.

11. The shear load and the shear displacement shall be logged continuously throughout the duration of the test.

12. Each test shall be terminated after 3 inches of displacement. The third party laboratory shall note if the test was terminated for any cause prior to reaching the 3-inch requirement.

13. At the completion of the test, the third party laboratory shall photograph or otherwise record the location where shearing occurred, and the general conditions of the samples. The third party laboratory shall also sample and measure the final moisture content of the soil.

14. The results of the test shall be reported in graphical and tabular forms including:

    a. shear force versus shear displacement curves for all normal loads;

    b. peak and post-peak or residual (at 3 inches shear displacement) shear strengths versus normal stress curves;

    c. best-fit straight lines to the shear versus normal stress curves;

d. actual values of normal stresses along with peak and post-peak shear strengths for each normal load;

e. friction angle and adhesion determined from the best fits to peak and post-peak shear strengths versus normal stress curves; and,

f. friction angles determined as the Secant to the specified normal stress point on the actual peak and the post-peak shear strength versus normal stress curves.

PART 3 EXECUTION (INSTALLER)

3.1 DELIVERY, STORAGE, AND HANDLING (MANUFACTURER)

A. General: Conform to the MANUFACTURER's requirements.

B. Delivery.

1. Deliver materials to the site only after the OWNER accepts required submittals.

2. Separate damaged rolls from undamaged rolls and store at locations designated by the OWNER until OWNER determines proper disposition of material.

3. OWNER will determine the extent of damage to geomembrane.

4. Deliver in rolls, do not fold.

C. Storage on Site: (INSTALLER).

1. Store geomembrane rolls in the space allocated by the OWNER.

2. Store geomembrane rolls to protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

3. Store geomembrane rolls on prepared surface (not on wooden pallets).

4. Stack geomembrane no more than three rolls high.

E. Handling on Site: (INSTALLER).

1. Use appropriate handling equipment to load, move, or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader, and roll bars for deployment. Dragging panels on ground surface will not be permitted.

2. Do not fold geomembrane material; folded material will be rejected.

3. CONTRACTOR is responsible for off loading, storage, and transporting material from storage area to installation site.

3.2 EXAMINATION OF GEOMEMBRANE SUBSURFACE

A. Verify that the clay liner has been installed, tested, and approved prior to placement of the geomembrane.

3.3 PREPARATION

A. Repair damage caused to the underlying materials during deployment.

B. Round edges of anchor trenches.

3.4 PERFORM TRIAL SEAM WELDS AS FOLLOWS:

A. Perform trial welds on samples of geomembrane to verify the performance of welding equipment, seaming methods, and conditions.

B. No seaming equipment or welder will be allowed to perform production welds until equipment and welders have successfully completed trial weld.

C. Frequency of trial welds:

1. Minimum of two trial welds per day per equipment and welder, with one prior to the start of work and one at mid shift.

2. When directed by the CQA Monitor.

3. Every two hours when using a wedge weld to weld across seams.

4. Minimum one trial weld per person per shift.

5. When ambient temperature changes more than 20°F since previous trial weld.

D. Make trial welds in the same surroundings and environmental conditions as the production welds, i.e., in contact with subgrade.

E. Make trial weld sample at least 2 feet long, 3 feet long for double wedge welding machines and 12 inches wide with the seam centered lengthwise.

F. Cut two test strips from opposite ends of the trial weld using a punch press with a 1-inch by 6-inch cutting die.

G. Test specimens for peel adhesion and shear strength in general accordance with ASTM D-6392 in the presence of the CQAC.

H. A specimen is considered passing when the following results are achieved. For double wedge welding, both welds must pass in peel and shear.

1. The break is a film tear bond (FTB).

2. The break is ductile.

3. The peel strength is a minimum of 70 percent of the specified sheet strength at yield for wedge welds or flat welds and a minimum of 60 percent of the specified sheet strength at yield for extrusion welds.

4. There is no more than 10 percent separation of the weld. For wedge welds, the width of the weld must be equal to the width of the nip roller.

5. The shear strength is 90 percent of the specified sheet strength at yield for all weld types. Minimum elongation between the grips is 2 inches based on an initial grip separation of 2 inches from the edge of the weld.

I. Repeat the trial weld in its entirety when any of the trial weld samples fail in either peel or shear.

J. When repeated trial welds fail, do not use welding apparatus and welder until deficiencies or conditions are corrected and two consecutive successful trial welds are achieved.

K. Maintain an up-to-date and complete record of the trial welds on an appropriate trial weld log form. Log shall include the date, time, QC technician, welder, welding machine number, ambient temperature, speed, and pass/fail results.

3.5 DEPLOYMENT

A. Ambient conditions: Give careful consideration to the timing and temperature during deployment. Ideally, deployment, welding, and covering would all occur at the same temperature. In a practical sense, the CONTRACTOR should strive to perform these activities within as narrow a temperature range as practical, and avoid these activities during peak hot or cold conditions.

B. Panel Identification: Assign each panel an identifying code number or letter consistent with the CONTRACTOR's submitted panel layout drawing. The coding is subject to approval by the CQA Monitor.

C. Daily Panel Deployment: Deploy no more panels in one shift than can be welded or secured during that same day.

D. Do not deploy in the presence of excessive moisture, precipitation, ponded water, or high winds.

E. Do not damage geomembrane by driving on the geomembrane, handling, trafficking, or leakage of hydrocarbons or any other means.

F. Do not wear damaging shoes or engage in activities that could damage the geomembrane.

G. Unroll geomembrane panels using methods that will not damage, stretch or crimp geomembrane. Protect underlying surface from damage.

H. Use methods that minimize wrinkles and differential wrinkles between adjacent panels.

I. Place ballast on geomembrane to prevent uplift from wind.

J. Use ballast that will not damage geomembrane such as sand bags.

K. Protect the geomembrane in areas of equipment or repeated foot traffic by placing protective cover which is compatible with and will not damage geomembrane.

L. Repair damage to the subgrade or other underlying materials prior to completing deployment of the geomembrane.

M. Do not allow any vehicular traffic directly on unprotected geomembrane.

N. Remove wrinkled or folded material.

O. Visually inspect geomembrane for imperfections. Mark faulty or suspect areas for repair.

P. Install material to account for shrinkage and contraction while avoiding wrinkles. Install material stress-free with no bridging before it is covered. Add material such as compensation wrinkles at the toe of the slope as needed to avoid bridging.

Q. Before wrinkles fold over, attempt to push them out. For wrinkles that cannot be pushed out, cut them out and repair cuts prior to burial or at the direction of the OWNER.

R. Immediately after panels running through drainage swales or other low points are welded, place sandbags end-to-end along the entire length of the bottom hinge lines to prevent geomembrane stress bridging.

3.6 SEAM LAYOUT

A. Orient the seams parallel to line of a maximum slope (i.e., orient down not across slope).

B. Minimize the number of field seams in corners, odd-shaped geometric locations and outside corners.

C. Unless otherwise approved by the ENGINEER, do not place horizontal seams on slopes steeper than 6 to 1, horizontal to vertical, and keep horizontal seams (seams running approximately parallel to slope contours) at least 5 feet away from toe or crest of slope.

D. Use seam numbering system compatible with panel number system.

E. Shingle panels on all slopes and grades as directed by OWNER.

3.7 SEAM WELDING PERSONNEL

A. Provide at least one welder (master welder) meeting the experience requirements of these Specifications.

B. Qualify personnel performing welding operations by experience and by successfully passing field welding tests performed on site.

C. The master welder will provide direct supervision over other welders.

3.8 SEAM WELDING EQUIPMENT

A. Extrusion welder: equipped with gauges showing temperatures in extruder apparatus at the barrel and at the nozzle. Temperature at nozzle may be measured by external temperature gauges.

B. Hot wedge welder: Automated variable speed vehicular mounted devices equipped with devices adjusting and giving temperatures of the wedges. Pressure controlled by spring, pneumatic, or other system that allows for variation in sheet thickness. Rigid frame fixed position equipment is not acceptable.

C. Maintain adequate quality of welding apparatus in order to avoid delaying the project.

D. Use power source capable of providing constant voltage under combined line load.

3.9 GENERAL WELDING PROCEDURES

A. Do not commence welding with welding equipment until the trial weld test sample, made by that equipment, passes the test weld.

B. Clean all geomembrane surface of grease, moisture, dust, dirt, debris, or other foreign material.

C. Overlap panels a minimum of 3 inches for extrusion welding and 4 inches for hot wedge welding.

D. Do not use solvents or adhesives.

E. Provide adequate material on each weld to allow peel testing of both sides of double wedge weld and extrusion welds.

F. Extend welding to the outside edge of all panels.

G. If required, provide a firm substrate by using a flat board, a conveyor belt, or similar hard surface directly under the weld overlap to achieve firm support.

H. Provide adequate illumination if welding operations are carried out at night.

I. Cut fishmouths or wrinkles along the ridge of the wrinkle in order to achieve a flap overlap. Extrusion weld the cut fishmouths or wrinkles where the overlap is more than 3 inches. When there is less than 3 inches overlap, patch with an oval or round patch extending a minimum of 6 inches beyond the cut in all directions.

J. Log the following every two hours:

1. Temperature directly on the geomembrane surface being welded.

2. Extrudate temperatures in barrel and at nozzle (extrusion welder).

3. Operating temperature of hot wedge (hot wedge welder) and any pressure adjustments made.

4. Preheat temperature.

5. Speed of hot wedge welder in feet per minute.

K. Weld only when ambient temperature, measured 6 inches above the geomembrane is between 40°F and 110°F.

L. If the INSTALLER wishes to use methods which may allow seaming at ambient temperatures below 40°F or above 110°F, then the INSTALLER shall demonstrate and certify that such methods produce seams which are entirely equivalent to seams produced at ambient temperatures above 40°F and below 110°F, and that the overall quality of the geomembrane is not adversely affected. Then, the temperatures in the above quality assurance procedure shall be modified accordingly.

3.10 EXTRUSION TYPE OF WELDING

A. Use procedures to tack-weld adjacent panels together that do not damage the geomembrane and allow quality control tests to be performed.

B. Purge welding apparatus of heat-degraded extrudate before welding. Dispose of heat-degraded extrudate off of the liner surface.

C. Bevel the top edges of the top geomembrane a minimum of 45° and full thickness of the geomembrane before extrusion welding.

D. Clean seam welding surfaces of oxidation by disc grinder or equivalent not more than 30 minutes before extruding weld. Change grinding discs frequently. Do not use clogged discs.

E. Do not remove more than 4 mils of material when grinding.

F. Grind across, not parallel to, welds.

G. Cover entire width of grind area with extrudate.

H. When restarting welding, grind ends of all welds that are more than five minutes old.

3.11 HOT WEDGE (FUSION) WELDING

A. Place a smooth insulating plate or fabric beneath hot welding apparatus after usage so as to not damage the geomembrane.

B. Protect against moisture build-up between panels.

C. If welding cross seams, conduct field test welds at least every two hours, otherwise, once prior to start of work and once at mid-day.

D. Bevel edges of top and bottom panels on cross seams.

E. Do not weld on geomembrane until equipment has passed trial weld test.

F. Extrusion-weld a repair patch over all seam intersections.

3.12 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. MANUFACTURER and INSTALLER will participate in and conform with all terms and requirements of the OWNER's quality control and quality assurance program as described here in and in the CQA Plan. The CONTRACTOR is responsible for assuring this participation. Quality control and quality assurance requirements are as specified in this paragraph.

3.13 DEFECTS AND REPAIRS

A. Examine all welds and non-weld areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of the examination.

B. Repair and non-destructively test each suspect location both in weld and non-weld areas. Do not cover geomembrane at locations which have been repaired until test results with passing values are available.

C. Extrusion weld a patch over all "cross" or "tee" welds.

3.14 CONFORMANCE TESTING (CQA LABORATORY)

A. Allow 7 days for conformance testing following the date material is available to the CQA Laboratory.

B. Perform conformance testing on geomembrane rolls.

C. Obtain 3-foot samples across entire roll width not including the first 3 feet of material. CQA Monitor will obtain samples with assistance from CONTRACTOR.

D. Forward samples to Construction Quality Assurance Laboratory.

E. Test samples for conformance with the Specifications and guaranteed properties in accordance with the CQA Plan.

3.15 FIELD TESTING (INSTALLER)

A. General: Non-destructively test all field seams over their full length using a vacuum test unit, air pressure (for double fusion seams only), spark testing, or other approved methods. Perform testing as the seaming progresses and not at the completion of all the field seaming. Complete all required repairs in accordance with this specification.

B. Maintain an up-to-date and complete record of all seam field testing and repairs. The record shall include the seam number, length, welding date, welding time, QC technician, welder, machine number, non-destructive test date, pass/fail results, and repair information.

C. Vacuum box testing equipment for extrusion welds

1. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole, or valve assembly, and a vacuum gauge.

2. A vacuum pump assembly equipped with a pressure control.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A soapy solution and an applicator.

D. Vacuum box test procedures

1. Place the box over the wetted seam area (soapy solution).

2. Ensure that a leak-tight seal is created.

3. Energize the vacuum pump and reduce the vacuum box pressure to approximately 10 inches of mercury, i.e., 5 psi gauge.

4. Examine the geomembrane through the viewing window for the presence of soap bubbles for a period of not less than 10 seconds.

5. All areas where soap bubbles appear shall be marked and repaired in accordance with repair procedures described in this specification.

E. Air pressure testing equipment for seaming processes producing a double seam with an enclosed open channel.

1. An air pump (manual or motor driven) equipped with a pressure gauge capable of generating and sustaining a pressure over 40 psi and mounted on a cushion to protect the geomembrane.

2. A rubber hose with fittings and connections.

3. A sharp hollow needle, or other approved pressure feed device.

4. A pressure gauge with an accuracy of plus or minus 1 psi.

F. Air pressure test procedures.

1. Seal both ends of the welded seam to be tested.

2. Insert needle or other approved pressure feed device into the tunnel created by the weld.

3. Energize the air pump to a minimum pressure of 30 psi or 1/2 psi per mil of liner thickness, whichever is greater, close valve and sustain pressure for at least 5 minutes.

4. If loss of pressure exceeds 3 psi (10 mm mercury), or otherwise approved, or does not stabilize, locate faulty area and repair in accordance with repair procedures described in this Specification.

5. Puncture opposite end of seam to release air. If blockage is present, locate and test seam on both sides of blockage.

6. Remove needle or other approved pressure feed device and seal the penetration holes.

G. Spark testing equipment and materials for penetrations or other difficult areas not accessible for vacuum box testing.

1. 24 gauge copper wire.

2. Low-amperage electric detector, 20,000 to 30,000 volt, with brush-type electrode capable of causing visible arc up to ¾ inch from copper wire.

H. Spark testing procedures

1. Place copper wire within 1/4 inch of the edge of extrusion seam or clamp seal.

2. Pass electrode over seam or clamp area and observe for spark. If a spark is detected perform a repair.

3.16 SEAM DESTRUCTIVE TESTING (CQAC AND THE INSTALLER)

A. Destructive testing of the field production seams will be performed on-site under the supervision of the CQAC or at the CQA Laboratory using a calibrated tensiometer.

B. Specimens will be tested for peel adhesion and shear strength in general accordance with ASTM D-6392.

C. Sampling and testing will be conducted at the frequency and in the manner described in the CQA Plan.

D. The INSTALLER shall cut samples at locations designated by the CQAC as the welding progresses in accordance with the following criteria.

1. The CQAC shall initially mark the sample location and the INSTALLER shall cut a one-inch wide strip from each end of the proposed sample location and test these for peel in the field.

2. Unless otherwise directed by the CQAC, samples shall be a minimum 12 inches wide by 18 inches long with the seam centered lengthwise. Additional sample materials maybe obtained for archive at the OWNER's request and for testing by the INSTALLER.

3. Upon passing results of the initial peel test coupons, the INSTALLER shall cut the main sample out of the seam divide it into three parts for distribution as follows:

a. One portion for the INSTALLER: 12 inches by 12 inches.

b. One portion for the CQAC: 12 inches by 18 inches.

c. One portion to the OWNER for archive storage: minimum 12 inches by 12 inches.

4. Upon failing results of the initial peel test coupons, the INSTALLER shall follow the failed test procedures outlined in this Section.

E. A sample shall pass when all coupons meet the criteria described in these Specifications.

F. The INSTALLER and CONTRACTOR shall verify that passing test results have been obtained before the geomembrane is covered.

G. If any destructive test sample fails, the INSTALLER shall follow the failed test procedures outlined in this Section.

3.17 FAILED WELD PROCEDURES

A. Follow these procedures when there is a destructive test failure. Procedures apply when the test failure is determined by the CQAC, the INSTALLER, or using a field tensiometer. Follow one of the following two options:

1. First Option.

a. Reconstruct or cap strip the seam between any two passing test locations. Can not extrusion weld flap.

2. Second Option.

a. Trace the weld at least 10 feet minimum in both directions from the location of the failed test, or to the end of the weld.

b. Obtain a small sample at both locations for an additional field test.

c. If these additional test samples pass field tests, then take laboratory samples.

d. If the laboratory samples pass, then reconstruct the weld or cap between the two test sample locations that bracket the failed test location.

e. If any sample fails, then repeat the process to establish the zone in which the weld must be reconstructed.

B. Whenever a sample fails, also provide additional testing for seams that were welded by the same welder, welding apparatus, and welded during the same time shift.

3.18 ACCEPTABLE WELDED SEAMS

A. Bracketed by two locations from which samples have passed destructive tests.

B. For reconstructed seams exceeding 50 feet, a sample taken from within the reconstructed weld passes destructive testing.

3.19 REPAIR PROCEDURES

A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

B. Repair, removal, and replacement is at CONTRACTOR's expense if the damage results from the CONTRACTOR's, INSTALLER's, or the CONTRACTOR's subcontractor activities.

C. Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive, non-destructive test, or found during the geomembrane leak location testing survey. Agreement upon the appropriate repair method will be determined between the CQAC'S Representative and the

INSTALLER. Do not commence welding on the liner until trial weld test sample, made by that equipment and operator, passes the trial weld test. Repair procedures available include:

1. Patching: Used to repair large holes (over 3/8-inch diameter), tears (over 2 inches long), undispersed raw materials, contamination by foreign matter, and to cover cross and tee connections.

2. Abrading and re-welding: Used to repair small sections of seams.

3. Spot welding or seaming: Used to repair small tears (less than 2 inches long), pin holes or other minor, localized flaws.

4. Capping: Used to repair large lengths of failed seams.

5. Removing the seam and replacing with a strip of new material.

D. In addition, satisfy the following procedures:

1. Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than one (1) hour prior to the repair.

2. Clean and dry all surfaces at the time of repair.

3. The repair procedures, materials, and techniques must be accepted in advance of the specific repair by the CQAC's Representative and INSTALLER.

4. Extend patches or caps at least 6 inches beyond the edge of the defect, and round all corners of material to be patched and the patches to a radius of at least 3 inches.

5. Unless otherwise instructed by the CQAC, cut geomembrane below large caps to avoid water or gas collection between the sheets.

E. Verification of repair:

1. Number and log each patch repair.

2. Non-destructively test each repair using methods specified in this Section.

3. Destructive tests may be required at the discretion of the CQAC's Representative.

4. Reconstruct repairs until tests indicate passing results.

3.20 GEOMEMBRANE ACCEPTANCE

A. CONTRACTOR retains all ownership and responsibility for the geomembrane until acceptance by the OWNER.

B. OWNER will accept geomembrane installation when:

1. All required documentation from the MANUFACTURER, fabricator, and INSTALLER has been received and accepted.

2. The installation is finished.

3. Test reports verifying completion of all field seams and repairs, including associated geomembrane leak detection testing, have been provided in accordance with these Specifications.

4. Written certification documents and drawings have been received by the OWNER.

END OF SECTION

SECTION 02779

GEOSYNTHETIC CLAY LINER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes furnishing and installing geosynthetic clay liner.

1.2 RELATED SECTIONS

A. Section 02221 - Excavating and Stockpiling.

B. Section 02222 - Engineered Fill, Protective Soil Cover, Soil Cushion, and Anchor Trench Backfill.

C. Section 02223 - Geosynthetic Subgrade Preparation.

D. Section 02778 - Geomembrane.

1.3 REFERENCES

A. GRI-GCL3 - Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners.

B. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

C. ASTM D422 - Standard Test Method for Particle-Size Analysis of Soil.

D. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

E. ASTM D1004 - Standard Test Method for Initial Tear Resistance of Plastic Film or Sheeting.

F. ASTM D2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-aggregate Mixtures.

G. ASTM D4354 - Standard Practice for Sampling of Geosynthetics for Testing.

H. ASTM D4632 - Standard Test Method for Breaking Load and Elongation of Geotextiles.

I. ASTM D4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.

J. ASTM D4759 - Standard Practice for Determining the Specification Conformance of Geosynthetics.

K. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.

L. ASTM D5084 - Standard Test Method of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

M. ASTM D5199 - Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

N. ASTM D5261 - Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.

O. ASTM D5887 - Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.

P. ASTM D5888 - Standard Guide for Storage and Handling of Geosynthetic Clay Liners.

Q. ASTM D5889 - Standard Practice for Quality Control of Geosynthetic Clay Liners.

R. ASTM D5890 - Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners.

S. ASTM D5891 - Standard Test Method for Fluid Loss of Clay Components of Geosynthetic Clay Liners.

T. ASTM D5993 - Standard Test Method for Measuring Mass per Unit of Geosynthetic Clay Liners.

U. ASTM D6102 — Standard Guide for Installation of Geosynthetic Clay Liners.

V. ASTM D6141 — Standard Guide for Screening the Clay Portion of a GCL for Chemical Compatibility to Liquids.

W. ASTM D6243 - Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.

X. ASTM D6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.

Y. ASTM D6766 — Standard Test Method for Evaluation of Hydraulic Properties of Geosynthetic Clay Liners Permeated with Potentially Incompatible Liquids.

Z. ASTM D6768 — Standard Test Method for Tensile Strength of Geosynthetic Clay Liners.

1.4 DEFINITIONS

A. Bentonite: Clay soil, comprised primarily of sodium montmorillonite, characterized by high-swelling potential and low-hydraulic conductivity.

B. Construction Quality Assurance Consultant (CQAC): The OWNER or the monitoring firm responsible for implementation of the CQA plan.

C. Construction Quality Assurance (CQA) Laboratory: The party, independent from the OWNER, MANUFACTURER, Fabricator, and INSTALLER, responsible for conducting tests on samples of geosynthetics obtained at the site. Also referred to as the Geosynthetics Laboratory.

D. Construction Quality Assurance (CQA) Officer: The professional representative of the CQA monitoring firm who shall be responsible for implementation of the CQA plan.

E. Construction Quality Assurance (CQA) Monitor: Site representative of the CQA Monitor responsible for documenting field observations and tests.

F. ENGINEER: The individual or firm responsible for the design and preparation of the Drawings and Specifications.

G. Geomembrane: An essentially impermeable synthetic membrane used as a solid or liquid barrier. Synonymous term for flexible membrane liner (FML).

H. Geosynthetic Clay Liner (GCL): Relatively thin factory-manufactured liner material consisting of bentonite supported by textile backing or geomembrane held together by needling, stitching, or chemical adhesives.

I. INSTALLER: The party responsible for field handling, transporting, storing, deploying, and temporary restraining (against wind) of the GCL.

J. Lot: Group of consecutively numbered rolls from the same manufacturing line.

K. GCL MANUFACTURER (MANUFACTURER): The party responsible for the production and quality of GCL.

L. Minimum Average Roll Value (MARV): Minimum value of a limited series of tests that represents a value two standard deviations lower than the overall average value. Ninety-five percent of any individual samples will have values greater than the MARV for any given property.

M. Textile Backing (textile or geotextile): Geosynthetic support material consisting of woven slit film, needle-punched nonwoven, or spunlaced polymer fabric, used for supporting bentonite in a GCL.

1.5 PRE-CONSTRUCTION SUBMITTALS

A. Product Data (MANUFACTURER): Submit the following 7 days prior to shipping material to the site.

1. Textile Backing:

a. Certification stating that the textiles meet the product requirements (Table 02779-1).

b. Copy of quality control tests performed by textile supplier (if different from GCL MANUFACTURER).

c. Copy of quality control tests performed by GCL MANUFACTURER.

2. Bentonite:

a. Certification stating that the bentonite meets the product requirements (Table 02779-1).

b. Copy of quality control tests performed by bentonite supplier.

c. Copy of quality control tests performed by GCL MANUFACTURER.

3. GCL:

a. Certification stating that the GCL meets the product requirements (Table 02779-1).

b. Copy of quality control tests performed by GCL MANUFACTURER.

c. Permeability testing on typical product by independent laboratory (not necessarily for product delivered to site).

d. Laboratory test data on typical product for:

1) Swell.

2) Permeability of overlapped GCL.

3) Freeze-thaw behavior of GCL.

e. The MANUFACTURER shall submit a certificate of compliance for the GCL to the ENGINEER for approval at least 14 days before the required delivery of the material. If the asperity height of the geomembrane is proposed to be less than the specified value, the certificate of compliance shall include shear strength test results conducted by a third-party soils laboratory for the GCL - geomembrane interface per ASTM D6243. The shear strengths must meet or exceed the minimum post-peak shear strength parameters presented in Section 02778, Table 02778-2 and tested in general conformance with Part 2.8 of Section 02778. The certificate of compliance does not need to include the certification of the interface shear strength if the asperity height requirement is not proposed to be modified.

4. Qualifications (INSTALLER):

a. Submit, three weeks prior to installation, name of INSTALLER, resume of installation supervisor/field ENGINEER to be assigned to the project, and list of projects completed by INSTALLER that involved GCLs.

5. Quality Control Plan and Installation Procedures (MANUFACTURER):

a. Submit, three weeks prior to installation, copy of MANUFACTURER's quality control plan including list of quality control tests performed and typical testing frequencies.

b. Submit, three weeks prior to installation, recommended installation procedures.

B. Submit, upon completion of the installation, MANUFACTURER's product warranty against MANUFACTURER defects (material not in compliance with this specification). The warranty shall cover the full material replacement cost not including installation.

1.6 QUALIFICATIONS

A. Product shall be obtained from a MANUFACTURER listed in Section 2.1 or a MANUFACTURER-approved distributor.

B. INSTALLER shall meet the following requirements:

1. Have experience in similar capacity involving GCLs on at least 3 landfill projects and have installed a minimum of 500,000 square feet of GCL.

1.7 QUALITY ASSURANCE

A. The OWNER will engage and pay for the services of (1) Construction Quality Assurance Consultant (CQAC) and (2) Construction Quality Assurance (CQA) Laboratory for monitoring the quality and installation of the GCL unless otherwise specified.

B. The MANUFACTURER shall not charge any time or material expenses to the OWNER, related to a plant visit during manufacturing.

C. The INSTALLER shall aid the OWNER in product sampling by providing personnel and equipment necessary to move, cut, and protect GCL rolls.

1.8 DELIVERY, STORAGE, AND HANDLING

A. General: Conform to the MANUFACTURER's requirements unless otherwise specified.

B. Delivery:

1. Deliver materials to the site only after the OWNER accepts required submittals.

2. Material shall be covered with a waterproof, tightly fitting, plastic covering resistant to ultraviolet degradation.

3. Ship less than one month prior to scheduled installation.

4. Each roll shall be marked with the following information:

a. MANUFACTURER's name.

b. Product identification.

c. Lot and roll numbers.

d. Roll dimensions and weight.

C. Storage:

1. Store rolls in space allocated by the OWNER. Space should be at high-ground level or elevated aboveground surface. Follow storage procedures outlined in ASTM D5888.

2. Stack no more than 3 rolls high.

3. Protect rolls from precipitation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

4. Preserve integrity and readability of roll labels.

D. Handling:

1. Use appropriate handling equipment following MANUFACTURER's recommendations to load, move, or deploy GCL rolls.

2. Handling of rolls shall be done in a competent manner such that damage does not occur to the product or to its protective wrapping. Follow handling procedures outlined in ASTM D5888.

3. Damage to protective covering due to mishandling or sampling must be repaired immediately. Repairs shall be such that the GCL roll is protected from moisture or other deleterious conditions.

4. INSTALLER is responsible for off-loading, storage, and transporting material from storage area to installation site.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Name, address, and telephone number of MANUFACTURER's given below (product names are shown in parenthesis):

1. Colloid Environmental Technologies Company (CETCO), 1500 West Shure Drive, Arlington Heights, IL 60004, (800) 527-9948. (Bentomat).

2. GSE, 19103 Gundle Road, Houston, TX 77073, (800) 435-2008.

3. AGRU/America, Inc., 600 Rockmead, Suite 300, Kingwood, Texas 77339, (800) 373-2478.

B. Material may be provided by a different office than shown above or by a MANUFACTURER-approved distributor.

C. Products other than those shown above may be used only with written pre-bid authorization from the ENGINEER.

2.2 BENTONITE

A. Supplied in granular form.

B. Meet the requirements of Table 02779-1.

TABLE 02779-1

PROPERTIES FOR BENTONITE

TEST	TEST DESIGNATION[1]	REQUIREMENT
Bentonite		
Swell Index	ASTM D5890	24 ml / 2 g minimum
Fluid Loss	ASTM D5891	Maximum 18 ml

Notes: (1) Alternate tests are allowed only with prior written approval of ENGINEER.

2.3 GEOTEXTILE BACKING

A. Both geotextiles shall be needle-punched nonwoven or other product approved by the OWNER.

B. Meet the requirements of Table 02779-2.

TABLE 02779-2

PROPERTIES FOR GEOTEXTILE

TEST	TEST DESIGNATION[1]	REQUIREMENT
Geotextile[2]		
Mass Per Unit Area	ASTM D5261	>5.0 oz/yd^2
Grab Strength	ASTM D4632	>40 lbs[2]

Notes: (1) Alternate tests are allowed only with prior written approval of ENGINEER.
(2) Required values for geotextile are MARV.
(3) Measured in weakest direction.

2.4 REINFORCED NEEDLE PUNCHED GCL

A. Consists of bentonite encapsulated by a non-woven geotextile and a woven geotextile.

B. Continuous waterproof laplines and matchlines shall be printed directly on the geotextile-type GCL at 6 and 9 inches from the edges of the rolls, respectively.

C. Wrapped around structurally sound core that can support weight of GCL without excessive bending or buckling. The core shall be accessible to stingers or rods placed full-length within the core.

D. Geotextiles shall be needle-punched or lock-stitched together through the bentonite layer to form a stable composite. Adhesives may be used in addition to, but not in lieu of, needle-punching, or lock-stitching.

E. Continuously inspected for presence of needles and certified to be "needle-free."

F. Meet the requirements of Table 02779-3.

TABLE 02779-3

PROPERTIES FOR REINFORCED GEOSYNTHETIC CLAY LINER

TEST	TEST DESIGNATION[1]	REQUIREMENT
GCL[2]		
Dried Clay Mass Per Unit Area	ASTM D5993	>0.85 lbs[3]
Peel Strength	ASTM D6496	>3.5 lbs/inch
Tensile Strength	ASTM D6768	>30 lb/inch
Hydraulic Conductivity	ASTM D5887	Maximum 5.0 x 10^{-9} cm/sec[4]

Notes: (1) Alternate tests are allowed only with prior written approval of ENGINEER.
(2) Required values for GCL are MARV.
(3) Weight of GCL minus weight of geotextiles and corrected to 0 percent bentonite moisture content.
(4) Measured under 5 psi confining pressure and 2 psi head pressure.

2.5 MANUFACTURER SOURCE QUALITY CONTROL

A. Perform the quality control tests at the frequencies shown on Table 02779-5.

B. Supply copies of testing to the OWNER.

TABLE 02779-5

MANUFACTURER'S TESTING FOR GEOSYNTHETIC CLAY LINER

TEST	FREQUENCY[1]
Bentonite[2]	
Swell Index	1 per 100 tons
Fluid Loss	1 per 100 tons
Geotextile	
Mass Per Unit Area	1 per 200,000 square feet
Grab Strength	1 per 200,000 square feet
GCL	
Dried Clay Mass Per Unit Area	1 per 40,000 square feet
Peel Strength	1 per 100,000 square feet
Hydraulic Conductivity[3]	1 per 500,000 square feet

Notes: (1) One test per quantity indicated; minimum one test per lot.
(2) Frequencies based on material with ten percent moisture content.
(3) Minimum of two tests for permeability.

PART 3 EXECUTION

3.1 PREPARATION OF FOUNDATION

A. Conformance testing of the GCL shall be performed and approved by the OWNER in accordance with the CQA plan.

B. The liner subgrade shall be prepared as specified in Section 02223.

3.2 DEPLOYMENT

A. General:

1. Deploy only after the OWNER and the INSTALLER accept the foundation.

2. Do not allow foot traffic on the GCL if the material is at the moisture content of 35 percent or greater.

3. Deploy manually or by use of spreader bar attached to loader or backhoe.

4. Take care not to entrap objects or moisture beneath GCL.

5. Beginning deployment implies acceptance of subgrade by the INSTALLER.

B. Vehicular traffic shall not be allowed on the GCL without the expressed written consent of the ENGINEER.

C. The installer shall not drag the GCL over areas that may damage the GCL, dislodge stones, or entrap materials such as rocks, sticks, grass, etc. beneath the GCL.

D. The installer shall place a rub sheet of smooth HDPE geomembrane or other acceptable material over areas that may damage the GCL or entrap foreign materials during deployment.

3.3 JOINING

A. Overlaps:

1. Using the lapline and matchline as guides, overlap a minimum of 6 inches along length.

2. Overlaps or seams are not allowed perpendicular to slopes greater than 10 percent. In these areas GCLs must be placed in one piece along the entire slope, unless otherwise approved by the OWNER.

B. Seams:

1. Spread loose bentonite or bentonite paste at the rate of 4 ounces per lineal foot of overlap. Bentonite along overlaps is not required if MANUFACTURER can document that the permeability at the overlaps is no greater than the permeability of the GCL material (5×10^{-9} cm/sec). Approval to forego the use of additional bentonite along seams must be received in writing from the ENGINEER before installation begins.

2. Bentonite shall be same material used in the GCL.

3. Use lime spreader if powdered bentonite is used to reduce wind-blown particles.

4. Do not sew or use mechanical connections (except for repairs).

3.4 RESTRAINING AND PROTECTING

A. Restrain GCL against wind using sandbags filled with fine-grained material.

B. Sandbags must remain until GCL is covered.

C. GCL must be covered with geomembrane the day it is installed. If overlying geomembrane is not seamed the same day, the OWNER may request geomembrane edges to be pulled back to inspect GCL at no additional cost to OWNER. Torn, punctured, or hydrated material shall be removed and replaced in accordance with Section 3.5 at no additional cost to OWNER.

D. The bentonite material that becomes hydrated to a moisture content greater than 40 percent before being covered by a seamed geomembrane will be rejected. Rejected material shall be removed and replaced at no additional cost to the OWNER.

3.5 REPAIR PROCEDURES

A. Remove punctured, torn, or hydrated material.

B. Cover area with same type of GCL material with same side up.

C. Overlap defective area by a minimum of 12 inches in all directions.

D. Adhesion tape may be used to keep patch in place.

E. Apply loose bentonite as with normal overlaps at 4 ounces per linear foot.

3.6 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. General:

1. Field quality control is the responsibility of the INSTALLER who must document that the installation proceeds in accordance with this specification.

2. Field quality assurance is the responsibility of the OWNER who is assisted by the INSTALLER.

B. The INSTALLER and OWNER shall inspect:

1. The underlying surface for entrapped particles that may impact the GCL.

2. The surface of the GCL for needles, punctures, tears, thinning, or other evidence of that the material may not meet specification requirements.

3. The GCL for evidence of premature hydration such as wet areas or swelling. Hydrated areas shall be removed and replaced with unhydrated material.

4. Overlaps using the laplines and matchlines as a guide. The OWNER shall periodically measure the distance of the laplines and matchlines from the edge of the GCL.

5. The bentonite seam (if necessary) to check the location of the seams over the overlap and the amount of bentonite being used.

6. The OWNER must approve each section of the GCL before the GCL is covered.

C. The INSTALLER shall aid the OWNER in collecting samples for testing:

1. Any roll that cannot be identified shall be rejected.

2. Samples shall be taken at a minimum frequency of one sample per 100,000 square feet.

3. A minimum of one sample shall be taken from each lot.

4. Sample shall be a minimum of two feet long and run the entire width of the roll.

5. Mark the roll number and machine direction on each sample.

D. Laboratory Testing:

1. The following laboratory tests shall be conducted, according to the test methods on Table 02779-4.

   a. Moisture content.

   b. Mass per unit area.

   c. Peel strength.

   d. Permeability.

2. The test results shall be evaluated according to ASTM D4759.

3. Testing shall be performed by a qualified laboratory.

3.7 ACCEPTANCE

A. CONTRACTOR shall retain ownership and responsibility of GCL until acceptance by the OWNER.

B. OWNER will accept GCL installation when:

1. All required documentation from the MANUFACTURER and INSTALLER has been received and accepted.

2. Test reports verifying material properties have been received and accepted.

3. The OWNER has completed final inspection and any noted defects have been repaired.

END OF SECTION

ATTACHMENTS

ATTACHMENT 1

CONSTRUCTION QUALITY ASSURANCE (CQA) PLAN

CONSTRUCTION QUALITY ASSURANCE / QUALITY CONTROL PLAN
MSW EXPANSION 1 CELL

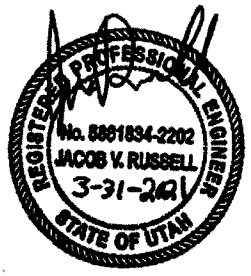
ECDC ENVIRONMENTAL LANDFILL

JANUARY 2020
PROJECT NO. AU19.1236.00

REPUBLIC SERVICES

SUBMITTED TO:

Republic Services, Inc.
1111 West Hwy 123
East Carbon, Utah 84520



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APPENDICES

1.0 CONSTRUCTION QUALITY ASSURANCE / QUALITY CONTROL

1.1 Introduction and Scope

This plan describes the liner system construction quality assurance and quality control (CQA/QC) requirements for MSW Expansion 1 Cell at the ECDC Environmental Landfill. CQA/QC refers to the duties of a third party CQA/QC Consultant hired by the Owner and the QC representatives of the contractor to monitor, inspect, and evaluate materials and workmanship during construction. The CQA/QC activities document the compliance of the Contractor with the Drawings and Specifications for the construction that has been approved by the Utah Department of Environmental Quality, Division of Waste Management and Radiation Control (UDEQ). For the purposes of this construction project and consistency with the Specifications, the following references shall refer to the people or groups as listed below:

1. *Owner* or *Company* refers to ECDC Environmental Landfill.
2. *Owner's representative* refers to either employees of ECDC Environmental Landfill or persons hired by the Owner to act as his or her representative during the construction project.
3. *CQA/QC Consultant* refers to an independent third party firm hired by the Owner to perform CQA/CQC during the construction project.
4. *CQA/QC Officer* refers to the licensed professional ultimately responsible for the CQA/CQC activities.
5. *CQA/QC Monitor* refers the person or persons responsible for monitoring and documenting the day to day CQA activities.
6. *Engineer* refers to the person or company responsible for the construction Drawings and Specifications.
7. *Contractor* refers to the company hired by the Owner to perform the construction activities.
8. *Geosynthetics Installer* refers to the firm hired by the Owner to install the geosynthetic material.

The overall goal of this CQA/QC Plan is to assure that proper construction techniques and procedures are used and that the project is built in accordance with the project Drawings and Specifications. The intent is to identify and define problems that may occur during construction and to verify that these problems are corrected before construction is complete. A written final report prepared by the CQA/QC Consultant will be prepared summarizing the construction activities and verifying that the installation was performed in general accordance with the project Drawings and Specifications.

All quality assurance activities shall be conducted in accordance with this CQA/QC Plan, and with the Drawings and Specifications. Where there is a discrepancy, the Specifications shall

govern unless otherwise specified by the Company and approved by UDEQ. The CQA/QC Monitor shall observe all field installation activities. The CQA/QC Consultant shall be responsible for ensuring that the proper number of personnel are on site and capable of observing construction activities as described in this document. The CQA/QC Monitor shall be present during all phases of construction that require CQA/QC observation. Documentation shall meet the requirements of this Plan and the Specifications.

1.2 Duties of CQA/QC Personnel

It is the duty and responsibility of the CQA/QC Consultant to implement the elements of this CQA/QC Plan in order to ensure that the construction and installation of the composite liner system at the site is performed in accordance with the approved Construction Drawings and Specifications, Utah Regulations, and 40 CFR 258 (Subtitle D). The CQA/QC personnel shall make every effort to communicate in an efficient and effective manner to the Contractor's representatives on issues concerning testing and observation procedures and results of materials or *in situ* tests performed.

The CQA/QC Consultant is not in a position to direct construction activities, but is encouraged to give advice to the Contractor, its employees, or the Company on items that may improve the quality or speed progress of the construction. As described previously, for the purposes of consistency with the Specifications, the Company may also be referred to as the Owner.

The CQA/QC Consultant and its representatives shall make every effort to furnish test results to the Contractor in a prompt manner. Test results shall be signed by both the CQA/QC Consultant and the contractor and made available to UDEQ within 1 week after completion of the test. The representatives of the CQA/QC Consultant shall report to the Company any nonconformance items that cannot be resolved promptly.

The CQA/QC monitor will be on site at all times during the construction project to ensure that all aspects of construction are monitored and documented.

1.3 Personnel Qualifications

1.3.1 CQA/QC Officer

The CQA/QC Officer will have formal academic training in civil engineering or a closely related discipline and will be a registered civil engineer in the State of Utah. The CQA/QC Officer will have experience in earthworks construction, landfill design and construction, and geomembrane and leachate collection system installations. The CQA/QC Officer will have practical technical and managerial experience that will allow the CQA/QC Plan to be properly implemented. The CQA/QC Officer must be able to communicate effectively with the Company personnel and the Contractor so that there will be a clear understanding of construction activities and the CQA/QC Plan.

1.3.2 CQA/QC Monitor

The CQA/QC Monitors will have formal training and practical experience in inspecting and testing earthworks construction, geosynthetic installations, and leachate collection system installations, including conducting and recording inspection activities, preparing daily reports, and performing field testing. In addition, knowledge shall be required of the specific field practices and construction techniques for landfill liner construction and all codes and regulations involving material handling, observation of testing procedures, equipment, and reporting procedures.

2.0 MEETINGS

2.1 General

Throughout the entire construction and installation of the liner system, close communication between all parties involved with the project is essential. In order to coordinate activities between the Company, CQA/QC Consultant, and Contractor, as well as set up proper lines of authority and reporting, meetings shall be held before and during construction. The type and purpose of meetings to be held for this project are described in this section.

2.2 Preconstruction Meeting

A preconstruction meeting shall be held prior to project start-up. The parties that shall attend this meeting are the Company, Contractor, and CQA/QC Consultant. The Company will notify UDEQ of the preconstruction meeting, although regulatory attendance is not mandatory. The purpose of this meeting is to:

1. Review the project Drawings and Specifications.
2. Review project tasks and responsibilities.
3. Review project schedule.
4. Review lines of communication and authority.
5. Review reporting and documenting procedures.
6. Review testing equipment and test methods.
7. Review protocol for submittal of CQA/QC conformance testing data sheets.
8. Conduct a site inspection to review work areas, lay-down areas, stockpile areas, access roads, and related project issues.

The CQA/QC Consultant shall document the preconstruction meeting and copies shall be provided to all persons present at the meeting and UDEQ. Preconstruction meeting documentation shall become part of the project documents.

2.3 Daily Progress Meetings

A progress meeting shall be held before the start of each construction shift. The daily progress meetings shall be attended by the CQA/QC Monitor and the Contractor. The purpose of this meeting shall be to:

1. Review the proposed activities scheduled by the Contractor for the day.
2. Discuss any problems or deficiencies that have arisen during construction.
3. Review the results of any test data.
4. Discuss the Contractor's deployment of personnel and equipment.
5. Review the previous day's activities including the effectiveness of procedures taken to alleviate any deficiencies.

All progress meetings shall be documented by the CQA/QC Monitor on his daily field construction inspection report.

2.4 Weekly Progress Meetings

Progress meeting will be held at the beginning or end of each week to review the previous week's activities or progress, discuss present and future work, and discuss any current or potential construction problems. At a minimum the CQA/QC Monitor, a Company representative, the Contractor, and all active subcontractors shall attend. If necessary, the CQA/QC Officer shall also attend. The Company will notify UDEQ of the progress meetings, although regulatory attendance is not mandatory. All weekly progress meetings will be documented by the CQA/QC Monitor who will transmit minutes by the end of the second working day to all parties including UDEQ.

2.5 Work Deficiency Meetings

As needed, meetings shall be held to discuss specific problems or deficiencies that occur during construction that cannot be easily resolved. Work deficiency meetings shall be attended by the CQA/QC Monitor, CQA/QC Officer, the Company, and the Contractor. The Company will notify UDEQ of any work deficiency meetings, although regulatory attendance is not mandatory. The purpose of these meetings is to:

1. Identify the nature and extent of the problem;
2. Discuss the means necessary to correct the deficiency or problem; and
3. Provide a solution to the problem and determine how the corrective action shall be implemented.

3.0 DESIGN CHANGES

3.1 Minor Design Changes

Minor changes to the Drawings and Specifications may be necessary to maintain or enhance quality during the project or to make adjustments to unforeseen field conditions. Minor changes must be approved by the Engineer.

Procedures for providing minor changes include the following:

1. The need for a design change may become apparent during the course of construction of the project and a request for a change may be initiated by any individual associated with the project.
2. All proposed design changes must be approved by the Engineer and submitted to the CQA/CQC Officer with necessary documentation supporting the change for approval. All design changes must meet the intended quality and technical requirements of the design.
3. Approved changes will be distributed to the Owner, CQA/CQC Monitor, CQA/CQC Officer, Contractor, Geosynthetics Installer, and the UDEQ.
4. Minor changes will not apply for changes that decrease the environmental protection of the unit such as decreasing the number or thickness of liners, changing the synthetic liner materials, etc.

3.2 Major Design Changes

Major changes to the plans and Specifications are unlikely to occur but may become necessary during the course of construction. Major changes may include elimination of landfill design components and drainage features and addition or changes to liner components and the extent of liner installation. The following procedures will be implemented for all major changes:

1. A special meeting will be scheduled immediately with the UDEQ to discuss the need for the change.
2. Owner and Engineer will both attend the meeting to present the basis for the change. Requested changes and supporting documentation will be provided at the meeting.
3. Major changes will not be implemented without the express written approval from the UDEQ.
4. Copies of approved changes will be distributed to Owner, Engineer, CQA/CQC Monitor, CQA/CQC Officer, Contractor, Geosynthetics Installer, and UDEQ.

4.0 EARTHWORK CQA/QC

4.1 General

This section outlines the requirements for earthwork CQA/QC operations for the construction of MSW Expansion 1 Cell. Earthwork includes, but is not limited to: (1) excavation, (2)

engineered fill placement; (3) soil cushion layer placement; (4) geosynthetic subgrade preparation; (5) anchor trench excavation and backfilling; (6) leachate collection and removal system installation; (7) placement of the protective soil cover, and (8) surface water drainage structures. Specifically excluded from this section are the GCL liner installation, geomembrane installation, geocomposite placement, and geotextile placement, which are addressed within Sections 5, 6, 7, and 8 of this CQA/QC Plan. The CQA/QC Monitor shall verify that the Contractor has conducted all surveying and As-Built Drawing preparation as required by the Specifications.

4.2 Excavation

The excavated materials shall be stockpiled in a location as directed by the CQA/QC Monitor or Company Representative. The Monitor shall observe that the stockpiles conform to the requirements of the Specifications.

4.3 Engineered Fill Placement

The CQA/QC Monitor shall verify that the embankment, roadways, ramp, and other engineered fills are placed to the approximate lines and grades shown on the Drawings. Prior to engineered fill placement, the CQA/QC Monitor shall observe and document the clearing, grubbing, and proof rolling as part of the foundation preparation.

The CQA/QC Monitor shall observe and document material placement and compaction. The relative compaction of each lift may be tested for nuclear density and moisture in accordance with ASTM D-2922 and ASTM D-3017. The maximum density of the soils will be determined as per ASTM D-698 in accordance with the Drawings and Specifications. Sand cone testing shall be conducted as a check to the nuclear density testing in accordance with ASTM D-1556. The testing frequency requirements of the engineered fill are included in Table 1. Results of all field testing shall be provided to the regulating agency within 2 days of test completion.

TABLE 1

ENGINEERED FILL TESTING FREQUENCY

TEST	MINIMUM FREQUENCY OF TESTING[1]
Moisture Density D-698	One per material type
Particle Size D-422 or C-136	One per material type
Nuclear Density and Moisture D-2922/D-3017	One per 1,000 cy
Moisture Content D-2216	One per 10,000 cy
Sand Cone D-1556	One per 20,000 cy

Note: [1]These testing frequencies may be increased at the discretion of Engineer.

Upon completion of engineered fill, the CQA/QC Monitor shall verify that survey had been performed by licensed surveyor to verify line and grade.

4.4 Soil Cushion Layer

The CQA/QC Monitor shall verify the soil cushion layer is placed to the approximate lines and grades shown on the Drawings. Prior to soil cushion layer placement, the CQA/QC Monitor shall observe and document the layer is suitable for geosynthetic installation as part of geosynthetic subgrade preparation.

The CQA/QC Monitor shall observe and document material placement and compaction including loose lifts not exceeding the thickness stated in the Specifications. The relative compaction will be tested for nuclear density and moisture in accordance with ASTM D-2922 and ASTM D-3017. The maximum density of the soils will be determined as per ASTM D-698 in accordance with the Drawings and Specifications. Sand cone testing shall be conducted as a check to the nuclear density testing in accordance with ASTM D-1556. The testing frequency requirements of the soil cushion layer are included in Table 2. Results of all field testing shall be provided to the regulating agency within 2 days of test completion.

TABLE 2

SOIL CUSHION LAYER TESTING FREQUENCY

TEST	MINIMUM FREQUENCY OF TESTING[1]
Moisture Density D-698	One per material type
Particle Size D-422 or C-136	One per material type
Nuclear Density and Moisture D-2922/D-3017	One per 500 cy
Moisture Content D-2216	One per 10 nuclear tests
Sand Cone D-1556	One per 20 nuclear tests

Note: [1]These testing frequencies may be increased at the discretion of Engineer.

Upon completion of soil cushion layer, the CQA/QC Monitor shall verify that survey had been performed by licensed surveyor to verify line and grade.

4.5 Geosynthetic Subgrade Preparation

The geosynthetic subgrade proof-rolling, smooth-drum compaction, and other preparation activities shall be observed by the CQA/QC Monitor as required by the Specifications and this CQA/QC Plan.

The completed subgrade for the geosynthetics liner shall be inspected by the CQA/QC Monitor, Contractor, and Geosynthetics Installer (Installer) to ensure that it will provide a firm and relatively smooth base for construction of the liner system in accordance with the Drawings and Specifications. Any areas observed to be excessively soft during proof-rolling should be excavated and reworked or removed and suitable materials placed by the Contractor in accordance with the project Specifications. If replacement fill is thicker than 6 inches, fill shall be treated as engineered fill or soil cushion layer and tested accordingly. At the conclusion of the subgrade preparation, the CQA/QC Monitor shall record on an appropriate form that the subgrade is acceptable to the Installer for placement of the overlying geosynthetic materials.

4.6 Anchor Trench Excavation and Backfilling

The CQA/QC Monitor shall verify that the anchor trenches are excavated to the approximate lines and grades shown on the Drawings. The CQA/QC Monitor shall observe trench excavation to ensure it has been excavated only the distance required to carry out the synthetic liner and GCL installation in an expeditious manner. The CQA/QC Monitor shall verify that the leading

edges of the anchor trenches are rounded to minimize sharp bends in the liner material.

The CQA/QC Monitor shall observe the backfill compaction and placement of soil in lifts to ensure that the work is performed in accordance with the Drawings and Specifications. The CQA/QC Monitor shall observe that the placement and compaction techniques employed by the Contractor to ensure that any damage (if it occurs) to the liner or GCL is recorded and repaired as necessary. Any damage to the synthetic materials shall be immediately repaired in accordance with this CQA/QC Plan and the Specifications. The Contractor shall be responsible for reworking and recompacting any areas that do not appear to be compacted properly as determined by the CQA/QC Monitor.

4.8 Leachate Collection and Removal System (LCRS)

4.8.1 General

This section sets forth the requirements for the CQA/QC testing and observation requirements for installing the LCRS components detailed on the Construction Drawings and Specifications. This work includes the materials for the leachate collection pipe installation, specifically, leachate collection gravel. Geotextile wrap CQA procedures are included in Section 8 of this CQA plan. The Contractor shall furnish submittals in compliance with this plan and conditions of warranty prior to construction for review by the CQA/QC Officer and CQA/QC Monitor. The Contractor shall also prepare and submit a time schedule for installation, including complete testing and acceptance of materials prior to construction.

4.8.2 Leachate Collection Piping

The Contractor shall provide a copy of the piping manufacture's data for this project prior to construction for review by the CQA/QC Monitor and CQA/QC Officer. Materials shall be delivered to the site only after the CQA/QC Monitor receives and approves the required submittals.

The CQA/QC Monitor shall ensure that the materials were packaged and shipped by appropriate means so that no damage was caused to the materials delivered to the site. Off-loading shall be done in the presence of the CQA/QC Monitor and any damage during off-loading shall be documented by the CQA/QC Monitor and the Contractor. The CQA/QC Monitor shall keep a log of all piping delivered to the site on a log of piping received form.

Damaged materials shall be separated from undamaged materials until the CQA/QC Monitor determines proper disposition of the material. Final authority on the determination of damage shall be the CQA/QC Monitor. The Contractor shall replace damaged or unacceptable material at no cost to the Owner.

The piping shall be stored on a prepared surface approved by the CQA/QC Monitor and shall be

protected from puncture, precipitation, dirt, grease, water, mechanical abrasions, or other damage. The CQA/QC Monitor shall observe that the Contractor uses appropriate handling equipment to load, move, or deploy the material to ensure that no damage is caused to the materials during handling of the piping.

No leachate collection piping shall be placed until the synthetic liner has been installed and approved by the CQA/QC Monitor. The CQA/QC Monitor shall observe placement to ensure that no materials are placed in a manner that could damage the underlying geomembrane liner. The CQA/QC Monitor shall record all observed damages and clearly mark their location for scheduled repair.

4.8.3 Leachate Collection Gravel

The Contractor shall provide samples of the leachate collection gravel material to the CQA/QC Monitor for conformance testing. As described in the Specifications, this conformance testing shall include, but may not be limited to, sieve analysis (ASTM D-422) and permeability (ASTM D-2434). Conformance testing shall be performed at a frequency of one test per 500 cubic yards of delivered material or one per source, whichever results in the greater number of tests.

No leachate collection gravel material shall be placed until the synthetic liner and leachate collection pipes have been installed and approved by the CQA/QC Monitor. The CQA/QC Monitor shall observe placement so that no materials are placed over wrinkles in the underlying geosynthetic liner materials and to ensure that the leachate collection piping is not damaged. The Contractor shall schedule placement of the leachate collection gravel material during cooler parts of the day in the event of warm weather in order to avoid placement of drainage materials when the liner is wrinkled. The CQA/QC Monitor shall record all observed damages and clearly mark their location for scheduled repair.

4.9 Protective Soil Cover

The CQA/QC Monitor shall perform visual observation and obtain samples for conformance testing on the protective cover soil layer materials in accordance with the Specifications prior to installation. This conformance testing may include, but not be limited to, sieve analysis (ASTM D-422) at a minimum frequency of 1 test per 5,000 cy to verify that oversize materials are not placed directly on the drainage geocomposite or geomembrane liner.

The CQA/QC Monitor shall observe the placement of the protective soil cover layer material to ensure that the Contractor follows the procedures described in the Specifications. The CQA/QC Monitor also need to review equipment list proposed for placement. No protective soil cover layer material shall be placed until the synthetic liner and leachate collection geocomposite and geotextile have been installed and approved by the CQA/QC Monitor. The CQA/QC Monitor shall continuously observe placement of the protective soil cover layer so that no materials are placed over wrinkles in the underlying geosynthetics. The thickness of the protective soil cover

layer shall also be observed to ensure compliance with the Specifications. The CQA/QC Monitor shall verify that the protective soil cover layer is placed in an up slope direction.

The Contractor shall schedule placement of the protective soil cover layer material during cooler parts of the day in the event of warm weather in order to avoid placement of materials when the liner is wrinkled. All observed damages shall be recorded by the CQA/QC Monitor and their location clearly marked for scheduled repair.

4.10 Surface Water Drainage Structures

The CQA/QC Monitor shall observe the installation of the surface water drainage structures for the proposed work in accordance with the Specifications and Drawings. Surface water drainage structures may include, but would not be limited to drainage channels, ponds, culverts, drop inlets, and risers. The CQA/QC Monitor shall test or otherwise review the test data for materials to be supplied by the Contractor in accordance with the Specifications. Materials requiring testing may include, but would not be limited to engineered fill, trench bedding and backfill, filter drain rock, and erosion control materials (rip rap etc.).

5.0 GEOSYNTHETIC CLAY LINER (GCL) CQA/QC

5.1 General

This section describes the observation and testing procedures required for the installation of the GCL. To monitor compliance, a quality assurance program shall be implemented that includes material conformance testing and construction observation. Conformance testing refers to those activities that can take place prior to geosynthetic installation. Construction observation testing includes those activities that occur during geosynthetics installation.

5.2 Shipping and Handling

The Contractor shall provide a copy of the QC certificates for production of each GCL roll manufactured for this project prior to construction for review by the CQA/QC Monitor and CQA/QC Officer. The certificate of compliance for the GCL must be received prior to installation as required by the Specifications. Materials shall be delivered to the site only after the CQA/QC Consultant or the Company receives, reviews, and approves the required submittals.

The Contractor is responsible for the transportation, off-loading, and storage of the GCL. The materials shall be packaged and shipped by appropriate means so that no damage is caused and shall be delivered to the site only after the CQA/QC Monitor receives and approves the required submittals. Off-loading shall be performed in the presence of the CQA/QC Monitor and any damage during off-loading shall be documented by him. The CQA/QC Monitor shall keep a log of all GCL delivered to the site on the appropriate form for review by the CQA/QC Officer.

5.3 GCL Conformance Testing

Immediately after delivery or at the point of manufacture and approval of required manufacturer's quality control data, the CQA/QC Monitor shall obtain 1 geosynthetic clay liner sample per 100,000 square feet, or 1 sample per lot, whichever results in the greater number of conformance tests. This sampling frequency may be increased as deemed necessary by the Company. Samples shall be forwarded to a qualified Third Party Laboratory for testing. The CQA/QC Consultant shall obtain test results in accordance with the Specifications prior to GCL deployment.

The CQA/QC Monitor shall review and summarize the test results and forward the test results and summary to the CQA/QC Officer within 24 hours of receipt. Deficiencies shall be handled in accordance with Section 9. At a minimum, the GCL shall be tested for the following:

1. Mass per Unit Area (ASTM D-5993)
2. Moisture content (ASTM D-2216)
3. Peel Strength (ASTM D-4632, modified)
4. Permeability (ASTM D-5084)
5. Interface Shear (ASTM D-6243) GCL and geomembrane interface shall be tested in accordance with the Specifications.

The number of specimens tested per conformance sample shall be in accordance with the respective ASTM Standard. All relevant ASTM Standards shall be readily available for review. The CQA/QC Monitor will review all test results and shall report any non-conformance to the CQA/QC Officer, the Company, and to the Contractor.

5.4 GCL Installation

5.4.1 Subgrade Surface Preparation

Prior to GCL installation, the CQA/QC Monitor shall verify that the following subgrade surface preparation activities are performed:

1. The Contractor has completed the required surveying of all lines and grades by a qualified surveyor;
2. The subgrade has been graded and rolled in accordance with the Documents, Specifications, and CQA/QC Plan;
3. The Contractor has verified, in writing, that the subgrade is acceptable for GCL installation;
4. The supporting surface does not contain rocks, other protrusions, or debris per the Specifications that could damage the GCL;
5. No excessively soft areas or depressions that could damage the GCL are present; and

6. All construction stakes and hubs have been removed.

5.4.2 GCL Panel Placement

The CQA/QC Monitor shall give each panel an identification number, which shall be agreed to and used by the CQA/QC Monitor and the Contractor. The CQA/QC Monitor shall establish a chart showing correspondence between roll numbers and panel numbers. The CQA/QC Monitor shall record the panel number on the Geosynthetic Clay Liner Panel Deployment Log. During panel placement, the CQA/QC Monitor shall:

1. Observe the GCL as it is deployed and record all defects and disposition of the defects (panel rejected, patch installed, etc.). Verify that all repairs are made in accordance with the Specifications.
2. Observe that equipment used does not travel on or damage the GCL by handling, trafficking, or by other means.
3. Observe that people working on the GCL do not smoke, wear shoes that could damage the GCL, or engage in any activities that could damage the GCL.
4. Observe that the GCL is anchored to prevent movement by the wind (the Contractor is responsible for any damage resulting to or from wind blown geosynthetics).
5. Observe there are no rocks, construction debris, or other items beneath the GCL which could cause damage and verify that the surface beneath the GCL has not deteriorated since previous acceptance.
6. Observe that the GCL is not dragged across the ground surface. If the GCL is dragged across the ground surface, it shall be inspected for damage and entrapped deleterious materials and repaired or rejected, if necessary.
7. Record weather conditions including temperature, approximate as wind, and humidity. Information shall be recorded at appropriate intervals throughout the day. The GCL shall not be deployed in the presence of moisture (fog, dew, mist, rain, etc.).

The CQA/QC Monitor shall inform the CQA/QC Officer and the Company if the above conditions are not met.

5.4.3 Field Seaming and Repairs

During GCL placement, the CQA/QC Monitor shall verify that the Contractor performs the following activities for the GCL:

1. The seams are overlapped in accordance with the Drawings and Specifications.
2. Bentonite is spread along the seam in accordance with the manufacturer's recommendations, Drawings, and Specifications.

The CQA/QC Monitor shall observe the placement and seaming activities for the GCL and

document all areas that require repair prior to placement of the overlying materials. All repairs are to be performed by the Contractor in accordance with the manufacturer's recommendations, the Drawings, and Specifications.

5.5 GCL Acceptance

The Contractor shall be responsible for maintaining the GCL (or portions thereof) until final acceptance by the CQA/QC Monitor. The CQA/QC Monitor shall recommend final acceptance when all seaming is complete, the Contractor has supplied all documentation, and all laboratory testing is complete and satisfactory. Prior to final acceptance, the Contractor, CQA/QC Monitor, and the Company (if necessary) shall review the installation of the GCL (or portions thereof) for completeness. Any areas that are found to deviate from the intended design, are incomplete, or in need of repair shall be recorded by the CQA/QC Monitor for correction by the Contractor. When all repairs have been completed, the CQA/QC Monitor shall release the GCL (or portions thereof) for installation of overlying materials.

The Contractor shall retain ownership of the GCL liner throughout the installation of overlying materials as defined within his scope of work and until the project is complete.

6.0 GEOMEMBRANE CQA/QC

6.1 General

This section sets forth the requirements for the CQA/QC testing and observation requirements for installing the geomembrane materials detailed on the Drawings and Specifications. This work includes the manufacturer's QC testing, conformance testing, shipping and handling, deployment, seaming, repairs, and non-destructive and destructive testing of the geomembrane liner. The Contractor shall furnish submittals in compliance with this Plan and conditions of warranty prior to construction for review by the CQA/QC Officer and CQA/QC Monitor.

6.2 Shipping and Handling

The Contractor shall provide a copy of the QC certificates for production of each geomembrane roll manufactured for this project prior to construction for review by the CQA/QC Monitor and CQA/QC Officer. The certificate of compliance for the geomembrane must be received prior to installation as required by the Specifications. Materials shall be delivered to the site only after the CQA/QC Consultant receives and approves the required submittals.

The Contractor is responsible for the transportation, off-loading, and storage of the geomembrane. The materials shall be packaged and shipped by appropriate means so that no damage is caused and shall be delivered to the site only after the CQA/QC Monitor receives and approves the required submittals. Off-loading shall be performed in the presence of the CQA/QC Monitor and any damage during off-loading shall be documented by him. The CQA/QC

Monitor shall keep a log of all geomembrane delivered to the site on the appropriate form for review by the CQA/QC Officer.

Damaged materials shall be separated from undamaged materials until the CQA/QC Monitor and CQA/QC Officer determine proper disposition of the material. Final authority on the determination of damage shall be the CQA/QC Monitor. The Contractor shall replace damaged or unacceptable material at no cost to the Company.

6.3 Geomembrane Conformance Testing

After delivery or at the point of manufacture, the CQA/QC Monitor shall obtain one geomembrane sample per 100,000 square feet delivered for conformance testing. The CQA/QC Monitor shall identify the roll numbers of the geomembrane, which are tested for conformance on the log of geomembrane received form. The samples shall be delivered to the third party geosynthetics laboratory to determine that the geomembrane properties conform to the requirements given in the Specifications. The CQA/QC Monitor shall review all test results and report any non-conformance test results to the Contractor and the CQA/QC Officer. Third party geosynthetics testing shall be performed by a qualified laboratory. Results of all geomembrane conformance testing shall be provided to the regulating agency within 2 days of receiving test results.

The CQA/QC Monitor shall collect samples for conformance testing across the entire width of the roll. This conformance sample shall not include the first 3 feet of the roll.

The conformance samples shall be three feet wide by the roll width in length. The CQA/QC Monitor shall mark on each roll the manufacturer's name, product identification, lot number, roll number, and roll dimensions. The Contractor shall provide the personnel and equipment to obtain the sample in the presence of the CQA/QC Monitor. No material shall be deployed until the CQA/QC Monitor receives passing conformance values and approves the liner for installation.

The conformance testing shall include the following parameters:

1. Thickness (ASTM D-5994);
2. Sheet Density (ASTM D-792 or ASTM D-1505);
3. Tensile Properties (ASTM D-6693);
4. Carbon Black (ASTM D-1603);
5. Carbon Dispersion (ASTM D-5596);
6. Asperity Height (ASTM D-7466); and
7. Interface Shear (ASTM D-6243) GCL vs. geomembrane and geomembrane vs. geocomposite interfaces shall be tested in accordance with the specifications.

6.4 Geomembrane Placement

Prior to placing the geomembrane panels, the Contractor and CQA/QC Monitor shall observe and verify that the GCL or clay liner has been properly placed and accepted. Once the GCL or clay liner has been approved, deployment of the geomembrane may begin. The Contractor's QC Technician shall give each panel an identification number that shall be used by all parties. The CQA/QC Monitor shall record the placement of each panel on a geomembrane panel deployment log form to be reviewed by the CQA/QC Officer. The CQA/QC Monitor shall observe that the Contractor has provided sufficient slack in the geomembrane to allow for contraction due to cold temperatures. The CQA/QC Monitor shall record the ambient temperatures during seaming operations. As the geomembrane panels are deployed in the field, the CQA/QC Monitor shall observe and verify the following:

1. That the GCL or clay liner has not deteriorated between acceptance and geomembrane panel placement.
2. That the equipment used to transport and deploy the geomembrane does not damage it, the GCL, or clay liner.
3. That there are no significant defects present in the sheet. Small defects shall be marked, along with the type of repair required (extrudate, patch, etc.).
4. That the sheet is not deployed under adverse weather conditions such as fog, rain, or high winds.
5. That the equipment and deployment methods do not cause excessive wrinkling of the geomembrane and that the sheet is not dragged along a rough surface. If the liner is dragged, the CQA/QC Monitor shall inspect the underside of the material for damage.
6. That personnel do not engage in activities that could damage the geomembrane.
7. That the Contractor's QC personnel properly record identification information including roll number, panel number, seam number, date, etc.

The CQA/QC Monitor shall record all of the above information in daily reports and log sheets and shall inform all parties of any deviations.

6.5 Geomembrane Test Welds

The Contractor shall conduct field test welds on pieces of scrap liner prior to production welding. The CQA/QC Monitor shall verify that the Contractor conducts test welds in accordance with the Specifications.

The CQA/QC Monitor shall record the shear and peel test results for the test weld coupons on a geomembrane start-up trial weld log form. The Contractor shall not begin welding of field seams unless the CQA/QC Monitor has verified that the trial welds are acceptable. Once a welding technician has been approved on a specific welding apparatus, he may not change

machines without first passing a test weld on the new equipment.

6.6 Seaming of the Geomembrane

The CQA/QC Monitor shall verify that the geomembrane is seamed between the ambient temperatures described within the Specifications. The CQA/QC Monitor shall measure and record the temperature in accordance with the Specifications.

The CQA/QC Monitor shall verify that the geomembrane is not being deployed during precipitation, in the presence of excessive moisture, in areas of ponded water, or in the presence of excessive winds.

The Contractor's QC Technician and the CQA/QC Monitor shall verify that geomembrane seams are oriented parallel to the maximum slope direction and that a seam numbering system compatible with the panel numbering system is used. The CQA/QC Monitor shall verify that the Contractor has taken the following steps prior to seaming the geomembrane:

1. That the liner surface has been cleaned of all foreign material including dirt, dust, debris, moisture, or oil.
2. That grinding has been performed to remove the oxidation (extrusion welds only).
3. That all areas where the sheet thickness has been thinned below the specified value from grinding are patched by the Contractor.
4. That any bead grooves are covered with single extrudate.
5. That wrinkles and fishmouths are cut out and the edges overlapped properly.
6. That all seaming takes place over a firm, dry surface.
7. That when the ambient temperature is below the prescribed temperature, a hot air device is used for preheating in front of the welder.
8. That the approved type and quantity of welding devices are used on the job.
9. That extrusion welders are purged of heat degraded material prior to use.
10. That for cross or tee seams, the edge of the seam is ground to a smooth incline.
11. That the seam numbering system and welding procedures agreed upon at the preconstruction meeting are strictly followed.

The CQA/QC Monitor shall record the above information in his daily reports along with panel placement and seaming log forms to be reviewed by the CQA/QC Officer.

6.7 Extrusion Welding

For extrusion welding, the CQA/QC Monitor shall observe that the welding devices are purged

of heat-degraded extrudate as described in the Specifications. All purged extrudate shall be disposed of off the liner. Each extruder shoe shall be inspected daily for wear to assure that its offset is equal to the liner thickness. All worn or damaged shoes or other parts shall be repaired. The CQA/QC Monitor shall verify that no equipment is allowed to begin welding until the test weld, made by that equipment, passes the weld test. All test weld results shall be reviewed and recorded by the CQA/QC Monitor.

6.8 Hot Wedge (Fusion) Welding

For hot wedge (fusion) welding, the CQA/QC Monitor shall verify that the welding devices are automated, vehicular mounted, and equipped with gauges giving applicable speed, temperatures, and pressures. The speed, temperature, and pressure of the welding device should be determined during the test welding conducted prior to seaming of the panels. If welding cross seams, field test welds shall be conducted at least every 2 hours or as described in the Specifications.

6.9 Nondestructive Testing of Geomembrane Seams

Prior to the start of construction, the Contractor shall submit to the CQA/QC Officer for approval as per the specifications a procedure for nondestructive testing of all field seams. When the seaming and testing begin in the field, the CQA/QC Monitor shall record the results of the geomembrane QC conducted by the Contractor on a geomembrane installer's field QC log form.

6.10 Vacuum Box Testing

For nondestructive seam testing, all extrusion welded field seams shall be tested over their full length using vacuum box test units. The vacuum testing shall be performed by the Contractor's QC Technician under the observation of the CQA/QC Monitor. The CQA/QC Monitor does not need to observe each vacuum box test, but shall check periodically on the methods and equipment used and record all results. The CQA/QC Monitor shall verify that the tests are conducted concurrently with the field seaming and that the vacuum box assembly consists of a rigid box with a transparent viewing window and a vacuum gauge. The CQA/QC Monitor shall verify that the Contractor's procedure for vacuum testing is as follows:

1. Clean window, gasket surfaces, and check box for leaks.
2. Energize vacuum pump and set to the proper pressure as required by the Specifications.
3. Place soapy solution on section of seam to be tested.
4. Place box over wetted area and press down.
5. Close bleed valve, open vacuum valve, and ensure that a leak tight seal is created.

6. Examine the length of weld through the viewing window for bubbles for the period described in the Specifications.
7. If no bubbles appear, the vacuum valve should be closed, the bleed valve opened, and the box should be moved to the next adjoining area with the specified overlap.
8. Areas where soap bubbles are detected shall be marked, repaired, and retested.

6.11 Air Pressure Testing

If the double hot wedge seaming system is employed, air pressure testing shall be used. The CQA/QC Monitor shall observe that air pressure testing is conducted by the Contractor as follows:

1. Seal both ends of the seam to be tested.
2. Insert a hollow needle or other approved pressure feed device into the tunnel created by the double hot wedge and insert a protective cushion between the air pump and geomembrane.
3. Energize the air pump to the pressure specified, close the valve, and sustain the pressure for the specified time period.
4. Check the entire seam being tested for indications that it has been fully pressurized. This shall be accomplished by opening the air channel at the opposite end of the seam and observing a loss of pressure.
5. If a loss of pressure exceeds the specified value or does not stabilize, locate the faulty area and repair.
6. Remove the approved pressure feed device and seal.

At a minimum the opening of the air channel of each seam shall be observed by the CQA/QC Monitor. Should a loss of pressure be detected along a seam, the faulty area shall be identified, repaired, and re-tested as provided within the Specifications.

If blockage occurs along the seam, the area shall also be identified, repaired and re-tested. The Contractor shall be responsible for all costs associated with the seam repair. The results of both vacuum box and air pressure testing shall be recorded on the seam and panel QC form by the CQA/QC Monitor for review by the CQA/QC Officer.

6.12 Destructive Testing of Geomembrane Seams

The CQA/QC Monitor shall determine the location of all destructive tests. The CQA/QC Monitor shall obtain a minimum of one sample per 500 feet of seam. The Contractor shall repair any suspicious looking welds before release of a seam for destructive sampling. Destructive samples shall be cut by the Contractor as the installation progresses and not at the completion of the project. The Contractor's QC Technician shall mark all destructive samples with

consecutive numbers along with the seam number. The CQA/QC Monitor shall keep a log with the date, time, location, seaming technician, apparatus, temperature, and pass or fail criteria. The CQA/QC Monitor shall verify that all destructive sample holes are repaired immediately by the Contractor.

The Contractor's QC Technician shall cut destructive samples at locations selected by the CQA/QC Monitor. The CQA/QC Monitor shall:

1. Mark each sample with the seam number, and the adjoining panel numbers.
2. Record the sample location on the geomembrane panel deployment log form and the geomembrane field seaming log form.
3. Record the sample location and reason for taking the sample (random sample, poor welding, etc.).

6.13 Repairs to the Geomembrane

For final seaming inspection, the CQA/QC Monitor and Contractor shall check the seams and surface of the geomembrane for defects, holes, blisters, undispersed raw materials, or signs of contamination by foreign matter. If dirt inhibits inspections, the Contractor shall brush, blow, or wash the geomembrane surface as required. The CQA/QC Monitor shall decide if cleaning the geomembrane surface and welds is needed to facilitate inspection. Repair areas shall be distinctively marked with a description of the required type of repair.

The CQA/QC Monitor shall verify that all identified holes, tears, blisters, undispersed raw materials, and contamination by foreign matter are patched. The CQA/QC Monitor shall verify that patches are not cut with the repair sheet in contact with the geomembrane and that the patches are extrusion welded to the geomembrane and then vacuum tested. The result of the vacuum test for the repair shall be marked by the Contractor's QC Technician with the date of the test and name of the tester on the sheet. Holes less than a quarter of an inch may be sealed with extrudate as described in the Specifications. The CQA/QC Monitor shall record all repair areas on the repair log form.

6.14 Geomembrane Final Walk-through

The Contractor shall be responsible for maintaining the geomembrane (or portions thereof) until final acceptance by the CQA/QC Monitor. The CQA/QC Monitor shall recommend final acceptance when all seams have passed destructive testing, the Contractor has supplied all documentation, and all field and laboratory testing is complete and satisfactory. Prior to final acceptance, the Contractor, CQA/QC Officer, CQA/QC Monitor, and the Company shall review the installation of the geomembrane (or portions thereof) for completeness. Any areas that are found to deviate from the intended design, are incomplete, or in need of repair shall be recorded by the CQA/QC Monitor for correction by the Contractor. When all repairs have been completed, the CQA/QC Monitor shall release the geomembrane (or portions thereof) for

installation of overlying materials.

The contractor shall retain ownership of the liner throughout the installation of overlying materials as defined within his scope of work and until the project is complete.

7.0 GEOCOMPOSITE CQA/QC

7.1 General

This section sets forth the requirements for the CQA/QC testing and observation requirements for installing the geocomposite detailed on the Drawings and Specifications. Geocomposite may be used as an option to the separate product geonet and geotextile drainage layer. The Contractor shall furnish submittals in compliance with this manual and conditions of warranty prior to construction for review by the CQA/QC Officer and CQA/QC Monitor. He shall also prepare and submit a time schedule for installation, including complete testing and acceptance of materials prior to construction.

7.2 Geocomposite Shipping and Handling

The Contractor shall provide a copy of the certificate of compliance and the QC certificates for production of each geocomposite roll manufactured for this project prior to construction for review by the CQA/QC Monitor and CQA/QC Officer. Materials shall be delivered to the site only after the CQA/QC Consultant or the Company receives, reviews, and approves the required submittals.

The CQA/QC Monitor shall ensure that the materials were packaged and shipped by appropriate means so that no damage was caused to the materials delivered to the site. Off-loading shall be done in the presence of the CQA/QC Monitor and any damage during off-loading shall be documented by the CQA/QC Monitor and the Contractor. The CQA/QC Monitor shall keep a log of all geocomposite delivered to the site on a geocomposite receiving log form.

Damaged materials shall be separated from undamaged materials until the CQA/QC Monitor determines proper disposition of material. Final authority on the determination of damage shall be the CQA/QC Monitor. The Contractor shall replace damaged or unacceptable material at no cost to the Company.
The geocomposite shall be stored on a prepared surface approved by the CQA/QC Monitor and shall be protected from puncture, precipitation, dirt, grease, water, mechanical abrasions, excessive heat, ultraviolet light exposure or other damage. The CQA/QC Monitor shall observe that the Contractor uses appropriate handling equipment to load, move or deploy the material to ensure that no damage is caused to the materials during handling of the geocomposite.

7.3 Geocomposite Conformance Testing

After delivery or at point of manufacture, the CQA/QC Monitor shall obtain one geocomposite sample per 100,000 square feet delivered. The CQA/QC Monitor shall identify the roll numbers of the geocomposite that are tested for conformance on the log of geocomposite received form. The samples shall be delivered to the geosynthetics laboratory to determine that the geocomposite properties conform to the requirements given in the Specifications. The CQA/QC Monitor shall review all test results and report any non-conformance test results to the Contractor and the CQA/QC Officer.

The CQA/QC Monitor shall collect samples for conformance testing across the entire width of the roll, but shall not include the first 3 feet of the roll. The conformance samples shall be 3 feet wide by the roll width in length. The CQA/QC Monitor shall mark on each roll the Manufacturer's name, product identification, lot number, roll number, and roll dimensions.

The Contractor shall provide the personnel and equipment to obtain the sample in the presence of the CQA/QC Monitor. The geosynthetics laboratory shall conduct the following conformance tests on the geocomposite:

1. Transmissivity: (ASTM D-4716); and
2. Ply Adhesion: (GRI GC7).

7.4 Geocomposite Installation

The CQA/QC Monitor shall not allow installation of the geocomposite until all conformance testing has been completed and passing results have been obtained. During geocomposite placement, the CQA/QC Monitor shall:

1. Observe the geocomposite as it is deployed and record all defects and disposition of the defects (panel rejected, patch installed, etc.);
2. Observe that equipment used does not damage the underlying geomembrane;
3. Observe that people working on the geocomposite do not engage in activities that could damage it;
4. Verify that the geocomposite is anchored to prevent movement by the wind (the Contractor is responsible for any damage resulting to or from wind blown geocomposite);
5. Observe that the seams are overlapped and seamed in accordance with the project Specifications;
6. Observe that the Contractor has repaired any holes or tears in the geocomposite; and
7. During installation, the Contractor and CQA/QC Monitor shall inspect the geocomposite as it is deployed for the presence of foreign materials and needles.

If any needles or other materials which the CQA/QC Monitor feels may be detrimental to the

underlying synthetic liner are present within the geotextile component of the geocomposite, the roll shall be rejected and shipped off-site permanently and the Contractor shall replace any rejected material at no additional cost to the Company. The CQA/QC Monitor shall notify the Contractor of any problem areas and observe and inspect the repair. The CQA/QC Monitor shall record all of the above information on log sheets and in daily reports.

7.5 Geocomposite Acceptance

The Contractor shall be responsible for maintaining the geocomposite (or portions thereof) until final acceptance by the CQA/QC Monitor. The CQA/QC Monitor shall recommend final acceptance when all seaming has been completed, the Contractor has supplied all documentation, and all laboratory testing is complete and satisfactory. Prior to final acceptance, the Contractor, CQA/QC Monitor, and the Company (if necessary) shall review the installation of the geocomposite (or portions thereof) for completeness. Any areas that are found to deviate from the intended design, are incomplete, or in need of repair shall be recorded by the CQA/QC Monitor for correction by the Contractor. When all repairs have been completed, the CQA/QC Monitor shall release the geocomposite (or portions thereof) for installation of overlying materials.

The Contractor shall retain ownership of the geocomposite throughout the installation of overlying materials as defined within his scope of work and until the project is complete.

8.0 GEOTEXTILE CQA/QC

8.1 General

This section sets forth the requirements for the CQA/QC testing and observation requirements for installing the geotextile detailed on the Drawings and Specifications. The Contractor shall furnish submittals in compliance with this manual and conditions of warranty prior to construction for review by the CQA/QC Officer and CQA/QC Monitor. The Contractor shall also prepare and submit a time schedule for installation, including complete testing and acceptance of materials prior to construction.

8.2 Geotextile Shipping and Handling

The Contractor shall provide a copy of the certificate of compliance and the QC certificates for production of each geotextile roll manufactured for this project prior to construction for review by the CQA/QC Monitor and CQA/QC Officer. Materials shall be delivered to the site only after the CQA/QC Consultant or the Company receives, reviews, and approves the required submittals.

The CQA/QC Monitor shall ensure that the materials were packaged and shipped by appropriate means so that no damage was caused to the materials delivered to the site. Off-loading shall be done in the presence of the CQA/QC Monitor and any damage during off-

loading shall be documented by the CQA/QC Monitor and the Contractor. The CQA/QC Monitor shall keep a log of all geotextile delivered to the site on a geotextile receiving log form.

Damaged materials shall be separated from undamaged materials until the CQA/QC Monitor determines proper disposition of material. Final authority on the determination of damage shall be the CQA/QC Monitor. The Contractor shall replace damaged or unacceptable material at no cost to the Company.

The geotextile shall be stored on a prepared surface approved by the CQA/QC Monitor and shall be protected from puncture, precipitation, dirt, grease, water, mechanical abrasions, excessive heat, ultraviolet light exposure or other damage. The CQA/QC Monitor shall observe that the Contractor uses appropriate handling equipment to load, move or deploy the material to ensure that no damage is caused to the material during handling of the geotextile.

8.3 Geotextile Conformance Testing

After delivery or at point of manufacture, the CQA/QC Monitor shall obtain one geotextile sample per 100,000 square feet delivered. The CQA/QC Monitor shall identify the roll numbers of the geotextile which are tested for conformance on the log of geotextile received form. The samples shall be delivered to the geosynthetics laboratory to determine that the geotextile properties conform to the requirements given in the Specifications. The CQA/QC Monitor shall review all test results and report any non-conformance test results to the Contractor and the CQA/QC Officer.

The CQA/QC Monitor shall collect samples for conformance testing across the entire width of the roll, but shall not include the first 3 feet of the roll. The conformance samples shall be 3 feet wide by the roll width in length. The CQA/QC Monitor shall mark on each roll the Manufacturer's name, product identification, lot number, roll number, and roll dimensions.

The Contractor shall provide the personnel and equipment to obtain the sample in the presence of the CQA/QC Monitor. The geosynthetics laboratory shall conduct the following conformance test on the geotextile:

1. Grab strength (ASTM D-4632)
2. Mass Per unit area (ASTM D-5261)
3. Permittivity (ASTM D-4491)
4. AOS (ASTM D-4751)
5. Puncture Resistance (ASTM D-4833)
6. Trapezoidal Tear (ASTM D-4533)

8.4 Geotextile Installation

The CQA/QC Monitor shall not allow installation of the geotextile until all conformance testing has been completed and passing results have been obtained. During geotextile placement, the CQA/QC Monitor shall:

1. Observe the geotextile as it is deployed and record all defects and disposition of the defects (panel rejected, patch installed, etc.).
2. Observe that equipment used does not travel on or damage the underlying geomembrane or geonet.
3. Observe that people working on the geotextile do not engage in activities that could damage it.
4. Verify that the geotextile is anchored to prevent movement by the wind (the Contractor is responsible for any damage resulting to or from wind blown geotextile).
5. Observe that the seams are overlapped and seamed in accordance with the project Specifications.
6. Observe that the Contractor has repaired any holes or tears in the geotextile.
7. During installation, the Contractor and CQA/QC Monitor shall inspect the geotextile as it is deployed for the presence of foreign materials and needles.

If any needles or other materials which the CQA/QC Monitor feels may be detrimental to the underlying synthetic liner are present within the geotextile, the roll shall be rejected and shipped off-site permanently and the Contractor shall replace any rejected material at no additional cost to the Company. The CQA/QC Monitor shall notify the Contractor of any problem areas and observe and inspect the repair. The CQA/QC Monitor shall record all of the above information on log sheets and in daily reports.

8.5 Geotextile Acceptance

The Contractor shall be responsible for maintaining the geotextile (or portions thereof) until final acceptance by the CQA/QC Monitor. The CQA/QC Monitor shall recommend final acceptance when all seaming has been completed, the Contractor has supplied all documentation, and all laboratory testing is complete and satisfactory. Prior to final acceptance, the Contractor, CQA/QC Monitor, and the Company (if necessary) shall review the installation of the geotextile (or portions thereof) for completeness. Any areas that are found to deviate from the intended design, are incomplete, or in need of repair shall be recorded by the CQA/QC Monitor for correction by the Contractor. When all repairs have been completed, the CQA/QC Monitor shall release the geotextile (or portions thereof) for installation of overlying materials.

The Contractor shall retain ownership of the geotextile throughout the installation of overlying

materials as defined within his scope of work and until the project is complete.

9.0 WORK DEFICIENCIES

When deficiencies are discovered, the CQA/QC Monitor shall immediately determine the nature and extent of the problem, notify the Contractor of the problem, and complete the required documentation. The CQA/QC Monitor shall notify the Contractor within 1/2 hour of discovering any deficiency or at the earliest time possible. If the deficiency will cause significant construction delays or require substantial rework, the CQA/QC Monitor shall notify the Company and the CQA/QC Officer.

The Contractor shall correct the deficiency to the satisfaction of the CQA/QC Monitor. If the Contractor is unable to correct the problem, the CQA/QC Monitor shall be asked to develop and recommend a solution to the CQA/QC Officer for his approval.

The corrected deficiency shall be retested before the Contractor performs additional work. All retests and the steps taken to correct the problem shall be documented by the CQA/QC Monitor on a field construction inspection report and on construction problem and solution data sheet forms.

10.0 DOCUMENTATION

10.1 Daily Records

At a minimum, daily records shall consist of field notes, a summary of the daily construction activities, associated testing activities, and observation and data sheets. All project records shall be maintained in a well organized project file at the job site and shall be available for review by the CQA/QC Officer, Contractor, the Company, and jurisdictional agencies at all times. The CQA/QC Officer shall review the reports and field notes prepared by the CQA/QC Monitor. Daily reports shall be provided to the regulating agency within 2 working days. The CQA/QC Monitor's daily summary report shall be available to the CQA/QC Officer and the Contractor for review and shall include the following information:

1. Date, project name, and location;
2. Weather data;
3. A description of on-going construction;
4. A summary of test results identified as passing, failing, or in the event of a failed test, retests;
5. Off-site materials received including geosynthetics or drainage materials, plus status of certificates or off-site testing for the materials;
6. A summary of decisions regarding acceptance of the work and/or corrective actions taken; and

7. The signature of the CQA/QC Monitor.

10.2 Observation and Test Data Sheets

The CQA/QC Monitor shall prepare observation and data sheets during all phases of construction of the liner system for review by the CQA/QC Officer. Observation and data sheets for this project may include, but may not be limited to the following:

1. Field Construction Inspection Reports;
2. Nuclear Field Density Data Sheets;
3. Field Density Summary;
4. Soil Laboratory Test Data Sheet (Sieve, Proctor, and Moisture Content);
5. Acceptance of Prepared Liner Subgrade Forms;
6. Log of Geomembrane Received;
7. Log of GCL Received;
8. Log of Geocomposite Received;
9. Log of Geotextile Received;
10. Log of Piping Received;
11. GCL Panel Deployment Log;
12. Geomembrane Field Seaming and Nondestructive Test Log;
13. Geomembrane Panel Deployment Log;
14. Geomembrane Start-up Trial Weld Log;
15. Geomembrane Panel Acceptance Form;
16. Geomembrane Repair Log;
17. Geomembrane Destructive Seam Strength Test Results; and
18. Photograph Log.

Additional observation and data sheets may be required. All entries shall be clear and legible. All documentation should be dated and signed or initialed clearly by the CQA/QC Monitor.

10.3 Weekly Progress Reports

The CQA/QC Monitor shall prepare a weekly progress report summarizing the construction quality assurance activities for the preceding period. The CQA/QC Officer shall review the daily reports and summaries of observation and data sheets in addition to the weekly progress reports. The CQA/QC Officer shall discuss progress and the results of all testing and CQA/QC observation and documentation with the CQA/QC staff to ensure that the construction is of excellent quality. Weekly progress reports shall be provided to the regulating agency within

two days of the end of the construction week.

10.4 Design Change Reports

Design and Specification changes may be required during construction. In such cases, procedures outlined in Section 3 shall be followed. Documentation of design changes shall be included in the final report.

10.5 Construction Difficulty Reports

In the event that the Contractor has extreme difficulty in the performance of any specified activities required, a special report shall be prepared to address the problem(s). The Company, the Contractor, CQA/QC Monitor, and CQA/QC Officer and Designer (if needed), shall meet to discuss any problems encountered and to address the solution. If changes to the construction Specifications are required, the CQA/QC Consultant, UDEQ, and the Company shall be notified and approve any changes in writing.

10.6 Final Report

At the completion of the project, the CQA/QC Consultant shall prepare a final construction documentation report suitable for presentation to UDEQ. Copies of all reports and test results prepared by the CQA/QC Monitor shall be submitted to the CQA/QC Officer for review. Copies of all the documents shall be maintained at the CQA/QC Consultant's office. This report shall verify that the work has been performed in compliance with the Drawings and the Specifications. At a minimum this report shall contain:

1. A summary of all construction activities;
2. All test results;
3. All logs, forms, and reports;
4. A description of significant construction problems and the resolution of these problems;
5. A list of changes (if any) from the Drawings and Specifications and the justification for these changes; and
6. A statement signed and sealed by a professional civil engineer registered in the State of Utah verifying that the project was constructed in general accordance with the Drawings and Specifications.

10.7 As-Built Drawings

A set of As-Built, or Record, Drawings shall be prepared by the Contractor during the course of construction as required by the Specifications. The As-Built Drawings shall accurately locate all construction items including the location of piping and the extent of lining and collection system components, etc. This information shall be included into the Final Construction

Documentation Report.

APPENDIX A

CQA FORMS

Geo-Logic
ASSOCIATES

MEETING MINUTES

PROJECT NAME	_____	DATE OF MEETING	_____
PROJECT NO.	_____	PREPARED BY	_____

MEETING NAME _____

ATTENDANCE	NAME	ORGANIZATION
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____

SUBJECTS

Geo-Logic
ASSOCIATES

WEEKLY CONSTRUCTION FIELD REPORT

Project Name:	Project No.	Weekly Field Report Sequence Number:	
Location of Work:	Client Or Manager	Date Period:	
General Contractor:	Liner Contractor:	Project Engineer:	Reviewed By:
General Foreman:	Liner Superintendent:	Other:	
Source and Description of Fill Material:	Weather:	CQA Technician:	
Equipment on site:			

NOTES (Describe construction and CQA completed during the week):

Prepared By:

Geo-Logic
ASSOCIATES

DAILY CONSTRUCTION FIELD REPORT

Project Name:	Project No.	Daily Field Report Sequence Number:	
Location of Work:	Client Or Manager	Date:	Day of The Week:
General Contractor:	Liner Contractor:	Project Engineer:	
General Foreman:	Liner Superintendent:	Other:	
Source and Description of Fill Material:	Weather:	CQA Technician:	
Equipment on site:			

NOTES (Describe work completed during the day, any problems and their solutions):

Prepared By:

Geo-Logic ASSOCIATES

GEOSYNTHETIC RECEIVING AND MANUFACTURING/CONFORMANCE LOG

(one type of material per sheet)

Project Name: _____ **Material Type:** _____

Project No: _____ **Review by:** _____

Receiving Date	Production Date	Shipping Date	Lot Number	Roll Number	Sheet Area (sf)	MQC Received Date	MQC Results (P/F)	CQA Conformance Test Date Ship (or NP if not perform)	Conformance Results (P/F or NA)	**Approved for Installation (Y/N)**	Storage Location

Geo-Logic
ASSOCIATES

SUBGRADE ACCEPTANCE FORM

Project Name

Location

Installer Name

Area To Be Accepted

I THE UNDERSIGNED, DULY AUTHORIZED REPRESENTATIVE OF THE INSTALLER DO HEREBY ACCEPT THE SUBGRADE SURFACE CONDITION AND SHALL BE RESPONSIBLE FOR MAINTAINING THE INTEGRITY AND SUITABILITY IN ACCORDANCE WITH THESE SPECIFICATIONS FROM THIS DATE TO COMPLETION OF THIS INSTALLATION. I DO NOT ACCEPT ANY RESPONSIBILITY FOR THE CONDITIONS OR CHARACTER OF THE SUBSURFACE SOIL.

NAME (PRINT)	SIGNATURE	TITLE	DATE

WITNESSED BY GLA Associates:

NAME (PRINT)	SIGNATURE	TITLE	DATE

Geo-Logic ASSOCIATES

PANEL DEPLOYMENT LOG

Project Name: _____
Project No.: _____

Material Type: _____
[ ] Primary [ ] Secondary [ ] Other

Date	Panel No.	Roll No.	Wind	Dimensions (L X W)	Area (FT^2)	Location	Remarks

TOTAL THIS PAGE _____ SF
CUMULATIVE TOTAL _____ SF

Geo-Logic
ASSOCIATES

START-UP(TRIAL) WELD LOG

Project Name:. _____ **Project No.:** _____

Material _____ **[ ] Primary [ ] Secondary [ ] Other**

Sample	Date	Time (am/pm)	Operator	Machine No.	Extrusion/Fusion	Temp.	Speed	Amb. Temp	Pass/Fail

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Geo-Logic
ASSOCIATES

SUBGRADE ACCEPTANCE FORM

Project Name

Location

Installer Name

Area To Be Accepted

I THE UNDERSIGNED, DULY AUTHORIZED REPRESENTATIVE OF THE INSTALLER DO HEREBY ACCEPT THE SUBGRADE SURFACE CONDITION AND SHALL BE RESPONSIBLE FOR MAINTAINING THE INTEGRITY AND SUITABILITY IN ACCORDANCE WITH THESE SPECIFICATIONS FROM THIS DATE TO COMPLETION OF THIS INSTALLATION. I DO NOT ACCEPT ANY RESPONSIBILITY FOR THE CONDITIONS OR CHARACTER OF THE SUBSURFACE SOIL.

NAME (PRINT)	SIGNATURE	TITLE	DATE

WITNESSED BY GLA Associates:

NAME (PRINT)	SIGNATURE	TITLE	DATE

Geo-Logic
ASSOCIATES

GEOMEMBRANE SEAMING LOG

Project Name: _____ Material Type: _____

Project No.: _____ [ ] Primary [ ] Secondary [ ] Other

WELDING DATA										TEST DATA					
Weld Date	Seam No.	Seam Length (ft)	Cumm. Length (ft)	Time am/pm	Operator Name	Machine No.	Machine Temp.	Machine Speed	Amb. Temp	Test Date	Test Type[1]	Pressure (psi)	Time (min)	Results P/F	CQA Monitor

Note 1: AT - Air Test
ST- Spark Test
VT - Vacuum Test

Remarks

Geo-Logic
ASSOCIATES

GEOMEMBRANE REPAIR LOG

Project Name: _____ Material Type: _____

Project No.: _____ [ ] Primary [ ] Secondary [ ] Other

Repair #	Seam/ Panel	Location	Description	REPAIR			TEST			
				Date	Equip #	Operator	Date	Type*	Pass/ Fail	CQA Monitor

*VT-VACCUM TEST
SP - SPARK TEST
AL - AIR LANCE

Geo-Logic
ASSOCIATES

BONDED SEAM STRENGTH TEST RESULTS (ASTM D6392)

PROJECT: GEO-LOGIC JOB NO.:

TESTED BY: REPORT DATE:

CHECKED BY: CLIENT JOB NO.:

TABLE I - SHEAR

SEAM ID		THICKNESS		BONDED SEAM STRENGTH (SHEAR)		
SAMPLE NO.	SEAM NO.	TOP (mil)	BOTTOM (mil)	LOAD (ppi)	BREAK TYPE	DUCTILE YES/NO

TABLE II - PEEL

SEAM ID		THICKNESS		SEAM PEEL ADHESION		
SAMPLE NO.	SEAM NO.	TOP (mil)	BOTTOM (mil)	LOAD (ppi)	BREAK TYPE	DUCTILE YES/NO

Geomembrane Type: Liner Mfr:

Seaming Method: Seaming Temp. °F:

Field Seam Date: Curing Time (if appl)

Tensile Machine Model: Crosshead Speed:

Grip Surface Texture: Seaming Apparatus ID:

Grip Dimensions: Seamer ID:

PROJECT SPECIFICATIONS:

SHEAR _____ pounds/inch (psi)

PEEL _____ pounds/inch (psi)

THICKNESS _____ mils

Geo-Logic ASSOCIATES

MASTER SOILS TESTING LOG

Project Name: _____ **Review by:** _____

Project No: _____

Sample No.	Date Sampled	Moisture Content microwave, w_m (D4643)	Moisture Content Oven, w_o (D2216)	Atterberg Limits, LL,PI (D4318)	Particle Size (-#200) (D422)	Modified Proctor, DD_{max}, W_{opt} (D1557)	Constant Head Permeability, k (D2434)	Test Results	Notes

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Test Requested

Geo-Logic ASSOCIATES

MOISTURE CONTENT

Project Name: _____

Project Number: _____

Test No.	Date	Drying Method	Tare No.	Tare Mass (g)	Tare + Wet Soil Mass (g)	Tare + Dry Soil Mass (g)	Mass of Water (g)	Dry Soil Mass (g)	Water Content (%)	Tested By	Notes

Checked By: _____

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Geo-Logic
ASSOCIATES

SUMMARY OF MOISTURE CONTENT CORRELATION

Project Name: ____________________

Project No.: ____________________

Reviewed by: ____________________

Nuclear Gauge		Oven		Microwave		Remarks
Test No.	Moisture (%)	Test No.	Moisture (%)	Test No.	Moisture (%)	

Geo-Logic ASSOCIATES

MOISTURE - DENSITY SUMMARY

Project Name: _____

Project No.: _____

Reviewed by: _____

Test No.	Date	Northing	Easting	Elevation	Sample No	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	Source Depth (in)	Density Count	Moisture Count	Wet Density (pcf)	Moisture Content (%)	Dry Density (pcf)	% Comp	P/F	Notes

Geo-Logic ASSOCIATES

FIELD DENSITY BY SANDCONE METHOD

Project Name: ________________
Project No.: ________________
Reviewed by: ________________

Date									
Test No.									
Corresponding Nuclear Test No									
Sand Density (g/cm^3)									
Volume of Cone (cm^3)									
Weight of Sand in Cone									
DENSITY									
Tare No.									
Tare Weight (g)									
Tare + Wet Soil (g)									
Wet Soil Mass (g):									
Cone + Sand Initial (g)									
Cone + Sand Final (g)									
Sand Used (Gross) (g)									
Sand Used (Net) (g)*									
Volume of Hole (cm^3)**									
Wet Density (pcf)***									
WATER CONTENT									
Tare No.									
Tare mass (g):									
Tare + Wet Soil mass (g):									
Tare + Dry Soil mass (g):									
Weight of Water (g)									
Dry Soil mass (g):									
Water Content (%):									
Notes									

*Sand Used (Net) = Sand Used (Gross) - Weight of Sand in Cone
** Volume of hole = (Sand Used (net) / sand density)
*** Wet Density = (Wet Soil Mass/Volume of Hole) x 62.4 pcf

Geo-Logic
ASSOCIATES

SAND CONE VS. NUCLEAR GAUGE CORRELATION

Project Name: ______________________________

Project No.: ______________________________

Reviewed by: ______________________________

Sand Cone Test No.	Nuclear Gauge Test No.	Sand Cone Wet Density (pcf)	Nuclear Gauge Wet Density (pcf)	Difference (+/-)	Remarks

Geo-Logic ASSOCIATES

EQUIPMENT CALIBRATION

WORKSHEET / RECORD

SAND DENSITY

CONTROL NO.

VECTOR IDENTIFICATION NO.

Calibration Date: *Next Due Date:*

Calibration Procedure No. : **CB- 1.15**

Equipment or Standards Used for Calibration:

Scale or Balance No.: _____ Last Calibration Date: _____

Unit Wt. Bucket No.: _____ Last Calibration Date: _____

Unit Wt. Bucket Vol.: (x) _____ cm^3

Procedure:

Vector determines the density (mass / vol) of sand used for calibration of Sand Cone Devices and used for determining the volume of holes for ASTM D-1556, by pouring the sand into a calibrated Unit wt. bucket with a known volume.

Calibration:

Detailed calibration procedures can be found in the Calibration Manual. See the referenced CB number.

Trial No.	Mass of Sand and Bucket,g (a)	Mass of Bucket, g (b)	Mass of Sand, g (a-b) = c	SAND DENSITY g / cm^3 (c / x)
1				
2				
3				

Test temperature, C: _____ **Average =** _____ g/cc _____ pcf

Note: The above individual trials shall agree within 1% of the average. Temperature shall be 20° +/- 2° C

Source of Sand: _____ Type of Sand: _____

Date Purchased: _____

Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

(1/10 ft. = 2831.7cm^3) (1/3 ft. = 9439cm^3) (1/2 ft. = 14158cm^3)

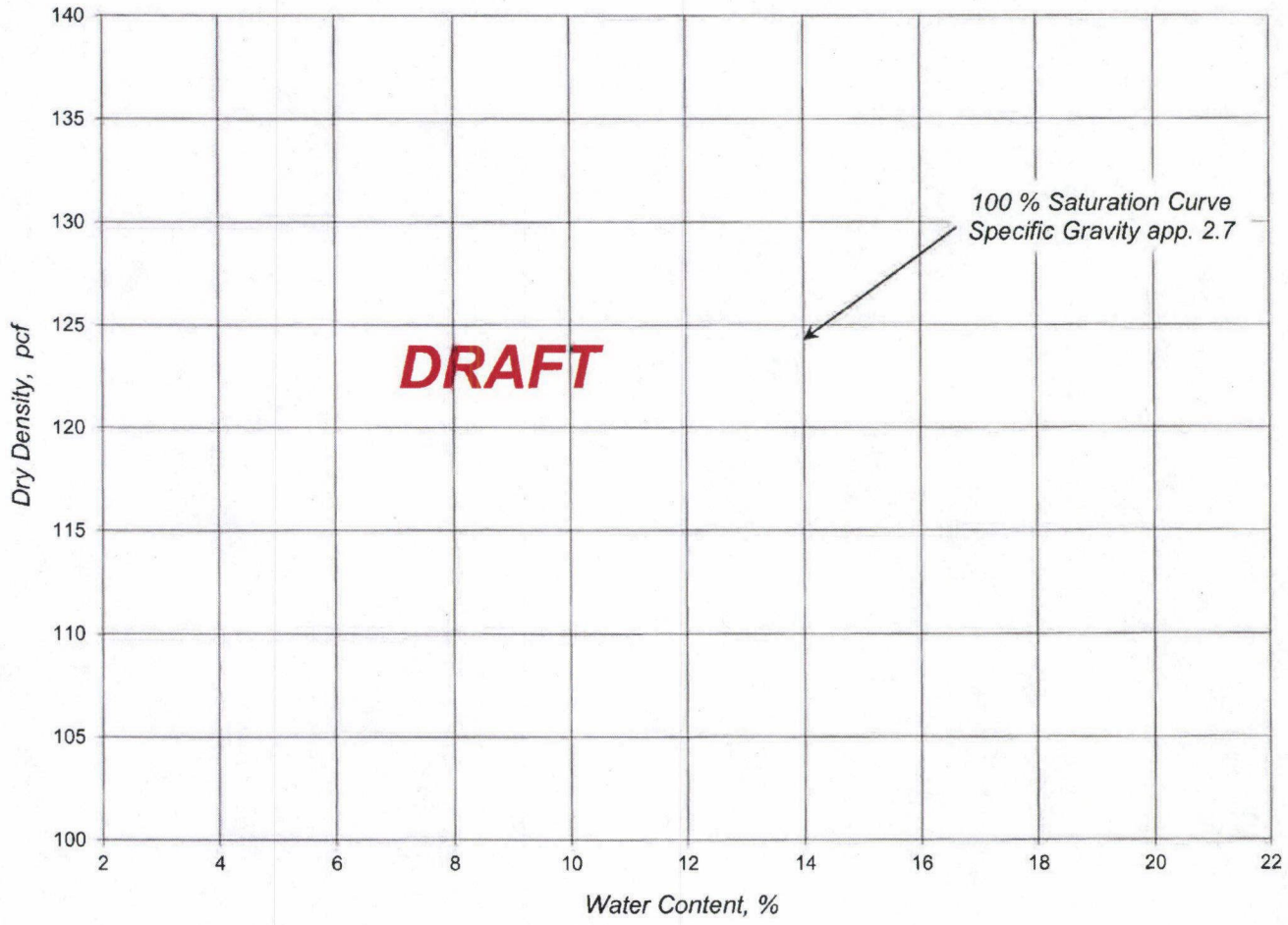
Geo-Logic ASSOCIATES

MOISTURE / DENSITY RELATIONSHIPS

TEST REPORT

ASTM D - 1557

Client:	Project No.:	Lab Log No.:
###	0.00	0
Project Name:		**Report Date:**
###		January 0, 1900



Symbol	Lab No.	Sample Identification	Description	Maximum Dry Density pcf	Maximum Dry Density kg / m³	Optimum Water Content %
■	0	(Rec'd 2/9/02)	0	#VALUE!	#VALUE!	#VALUE!

Corrected Values For Oversized Particles, per ASTM D-4718

■ 0 with 0 Percent + 3/4" Gravel, the maximum Dry Density =

Note: The test was conducted as method A with percent retained on the no. 4 sieve (minus 3/4")

Geo-Logic ASSOCIATES

PARTICLE SIZE ANALYSIS

TEST REPORT

ASTM D-422

Client :

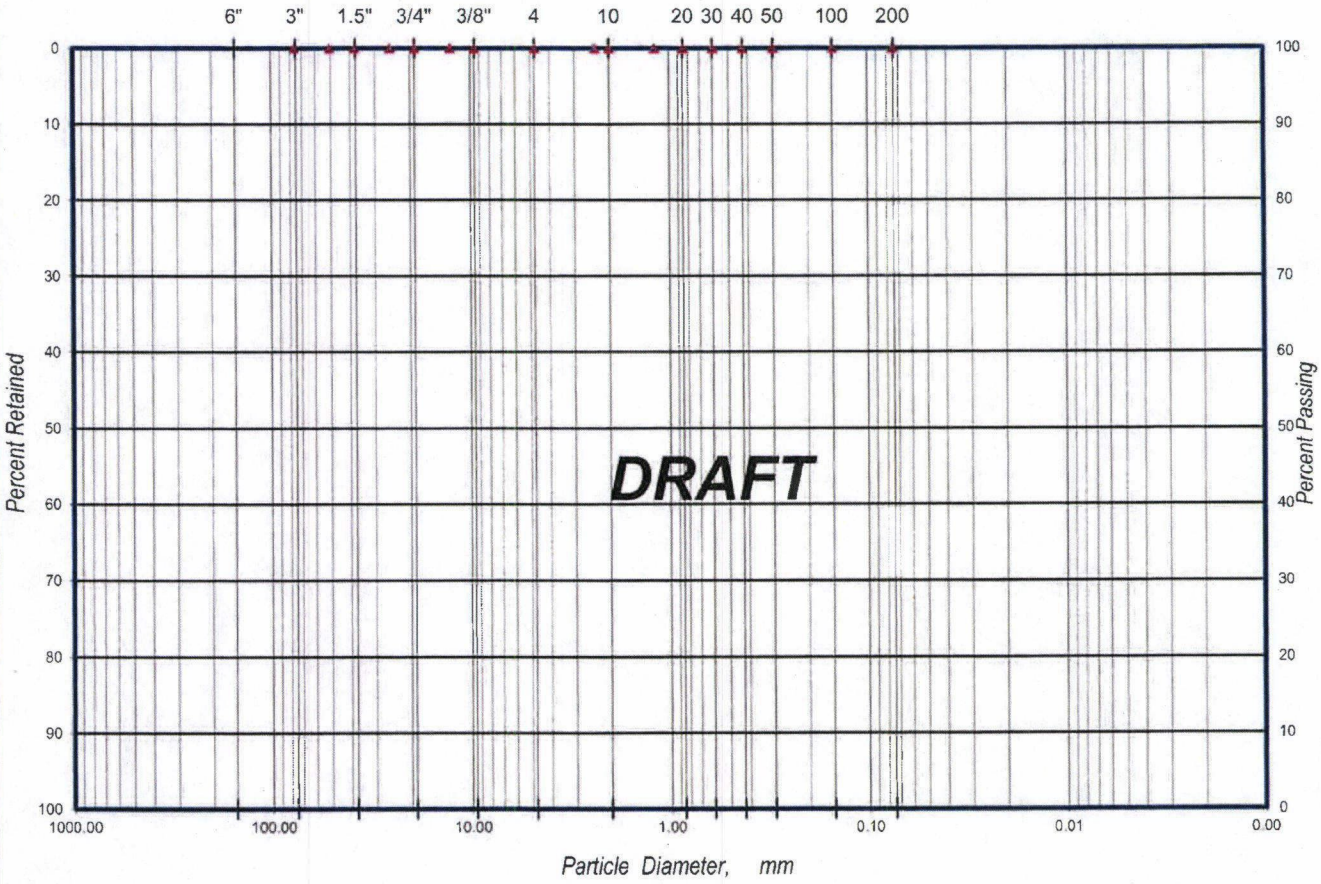
Project No:

Lab Sample No: N/A

Project Name:

Report Date:

BOLDERS	COBBLES	GRAVEL		SAND			SILT AND CLAY
		COARSE	FINE	COARSE	MEDIAN	FINE	
US SIEVE SIZE, INCHES				US STANDARD SIEVE SIZE No.			HYDROMETER



Symbol	Sample ID	Description	% Gravel	% Sand	% Silt - Clay
▲			0.0	0.0	100.0

Size Passing, mm D_{60} = N/A D_{30} = N/A D_{10} = N/A

Coefficient of Curvature, C_c: N/A Coefficient of Uniformity, C_u: N/A Fineness Modulus = 0.00

Geo-Logic ASSOCIATES

ATTERBERG LIMITS

Summary Report

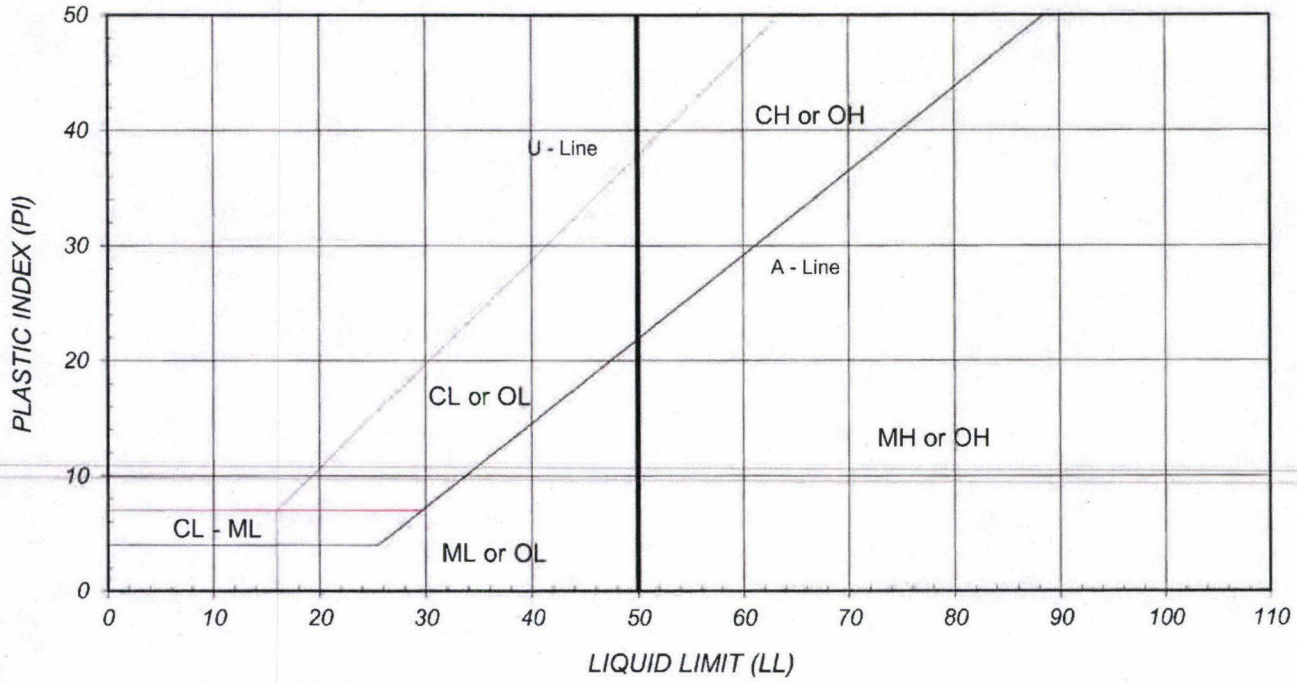
ASTM D-4318

Client : Project No: Lab Log No.:

Project Name: Report Date:

LSN	SYMBOL	SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	UNIFIED SYMBOL	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX

PLASTICITY CHART



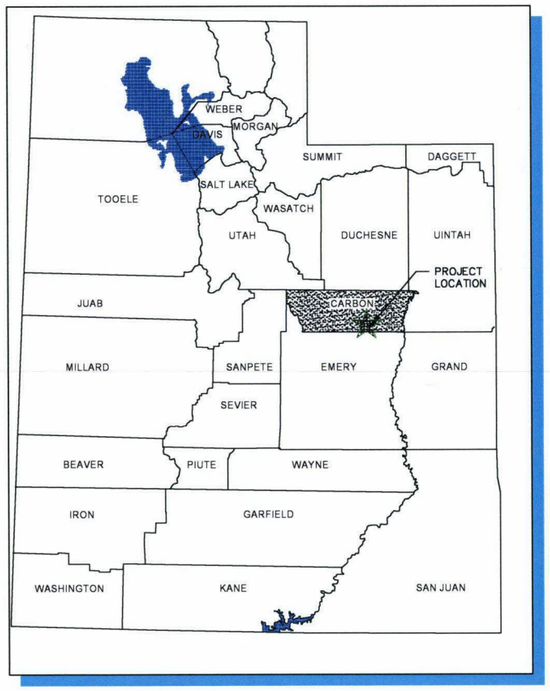
ATTACHMENT 2

REDUCED SCALE CONSTRUCTION DRAWINGS

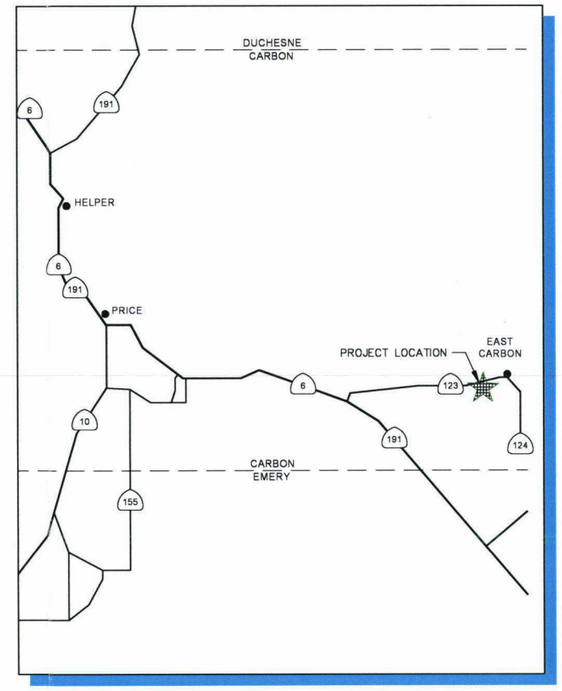
ECDC ENVIRONMENTAL LANDFILL MSW EXPANSION 1 CELL

PREPARED FOR:

ECDC ENVIRONMENTAL, L.C.



UTAH COUNTIES

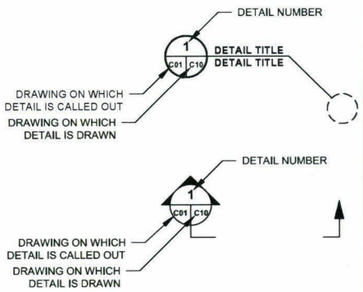


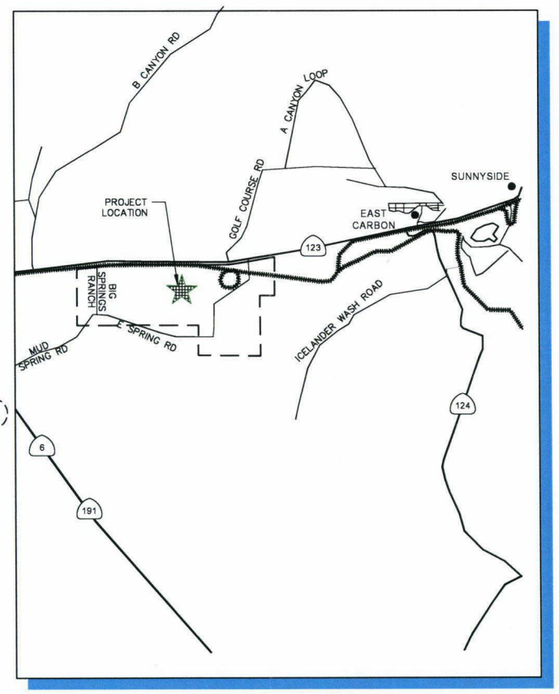
REGIONAL MAP

ABBREVIATIONS

℄	CENTERLINE	MIN	MINIMUM
Ø	DIAMETER	N	NORTHING
CY	CUBIC YARDS	NIS	NOT IN SECTION
E	EASTING	NTS	NOT TO SCALE
EL	ELEVATION	OC	ON CENTER
FT	FEET	oz	OUNCE
GCL	GEOSYNTHETIC CLAY LINER	SF	SQUARE FEET
HDPE	HIGH DENSITY POLYETHYLENE	TYP	TYPICAL
MAX	MAXIMUM	%	PERCENT

SYMBOLS





VICINITY MAP

DRAWING INDEX

DRAWING NUMBER	TITLE AND DESCRIPTION	LATEST REVISION NUMBER	LATEST REVISION DATE
GENERAL			
G01	TITLE PAGE	A	1/28/2020
G02	SITE PLAN & EXISTING CONDITIONS	A	1/28/2020
CIVIL			
C01	SUBGRADE & LINER PLAN	A	1/28/2020
C02	SECTIONS	A	1/28/2020
C03-C09	RESERVED		
C10	DETAILS	A	1/28/2020
C11	DETAILS	A	1/28/2020
C12	DETAILS	A	1/28/2020
C13	DETAILS	A	1/28/2020

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REV. NO.	DATE	DESCRIPTION	APPROVED BY
A	1/28/20	ISSUED FOR CONSTRUCTION	JVR

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DESIGNED BY: SAH
DRAWN BY: NAD/SAH
CHECKED BY: SAH
APPROVED BY: JVR

REGISTERED PROFESSIONAL ENGINEER — No. 5681634-2202 — JACOB V. RUSSELL — 3-31-21 — STATE OF UTAH

Geo-Logic ASSOCIATES
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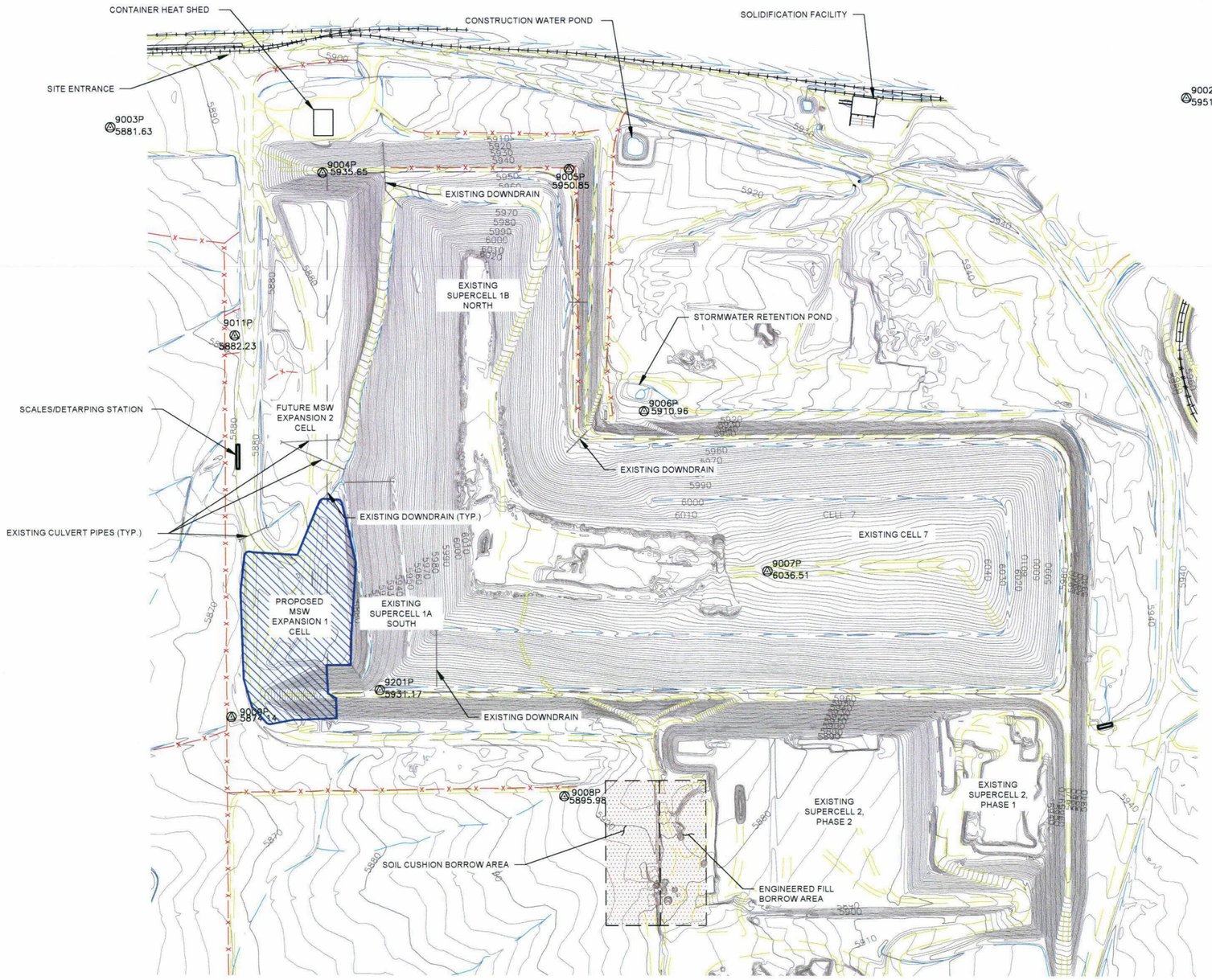
geo-logic.com | 530.272.2448

ECDC ENVIRONMENTAL, L.C.

ECDC ENVIRONMENTAL LANDFILL
MSW EXPANSION 1 CELL
EAST CARBON, UTAH
TITLE SHEET

DRAWING NO. **G01**
PROJECT NO. **AU19.1236.00**



250' 0' 125' 250' 500'

LEGEND

- EXISTING 10' CONTOUR[1]
- EXISTING 2' CONTOUR[1]
- EXISTING UNPAVED ROADS
- EXISTING PAVED ROADS
- EXISTING DRAINAGE
- EXISTING FENCE
- EXISTING PIPE
- EXISTING CULVERT
- EXISTING RETAINING WALL
- EXISTING RAILROAD
- EXISTING WALL
- EXISTING LINER LIMIT
- EXISTING BUILDING
- CONTROL POINT
- PROPOSED MSW EXPANSION 1 CONSTRUCTION AREA
- PROPOSED BORROW AREA

QUANTITIES

CONSTRUCTION AREA = 7.6 ACRES

NOTES

1. AERIAL SURVEY TOPOGRAPHY BASED ON APRIL 22, 2019 PERFORMED BY COOPER AERIAL SURVEYS CO.

ISSUED FOR CONSTRUCTION

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REGISTERED PROFESSIONAL ENGINEER No. 5881894-2202 JACOB V. RUSSELL 3-31-20 STATE OF UTAH

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ECDC ENVIRONMENTAL, L.C.

ECDC ENVIRONMENTAL LANDFILL

MSW EXPANSION 1 CELL

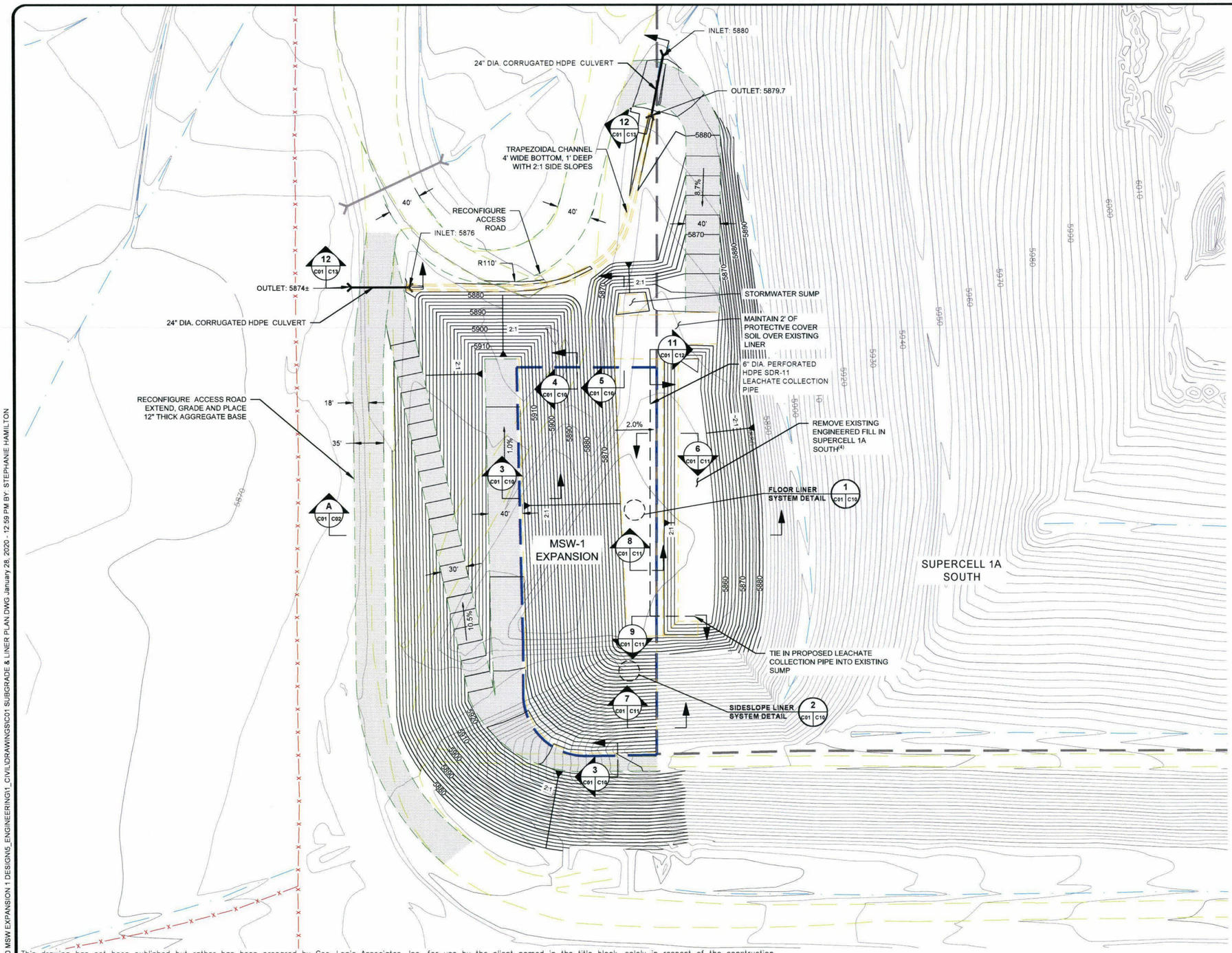
EAST CARBON, UTAH

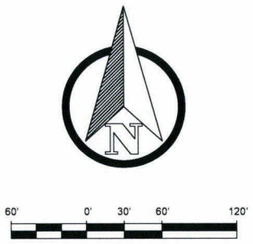
SITE PLAN & EXISTING CONDITIONS

DRAWING NO. **G02**

PROJECT NO. AU19.1236.00

N:\ECDC\2019 AU19.1236.00 MSW EXPANSION 1\DESIGNS_ENGINEERING\1_CIVIL\DRAWINGS\G02 SITE PLAN & EXISTING CONDITIONS.DWG January 22, 2020 - 3:17 PM BY: STEPHANIE HAMILTON





LEGEND

- EXISTING 10' CONTOUR[1]
- EXISTING 2' CONTOUR[1]
- EXISTING 10' CONTOUR[2]
- EXISTING 2' CONTOUR[2]
- EXISTING UNPAVED ROADS
- EXISTING PAVED ROADS
- EXISTING DRAINAGE
- EXISTING FENCE
- EXISTING CULVERT
- EXISTING LINER LIMIT[3]
- PROPOSED LINER LIMIT
- PROPOSED ROAD
- PROPOSED LCRS PIPE
- PROPOSED HINGE LINE
- PROPOSED CULVERT
- PROPOSED 12" THICK AGGREGATE BASE

QUANTITIES

EARTHWORKS TO CONSTRUCT MSW EXPANSION 1
CUT 35,000 CY
FILL 129,000 CY
NET 95,000 CY (IMPORT)

LINED AREA = 78,000 SF

NOTES

1. AERIAL SURVEY TOPOGRAPHY BASED ON APRIL 22, 2019 PERFORMED BY COOPER AERIAL SURVEYS CO.
2. DIGITAL SURFACES OF THE GRADING PLANS MAY BE PROVIDED TO CONTRACTOR. CONTRACTOR SHALL BE RESPONSIBLE FOR ANY IRREGULARITIES OR DEVIATIONS BETWEEN THE GRADING PLANS OR CONSTRUCTION COORDINATES AND THE DIGITAL SURFACE, AND SHALL NOTIFY ENGINEER OF THE DEVIATIONS PRIOR TO CONSTRUCTION.
3. VERIFY EXISTING LINER ELEVATIONS. IF DIFFERENT THAN SHOWN, NOTIFY ENGINEER.
4. CONTOURS SHOWING EXISTING ENGINEERED FILL REMOVAL ARE APPROXIMATE. VERIFY IN FIELD THE EXTENTS OF EXISTING ENGINEERED FILL WITH OWNER.

ISSUED FOR CONSTRUCTION

REV. NO.	DATE	DESCRIPTION	APPROVED BY
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APPROVED BY: JVR

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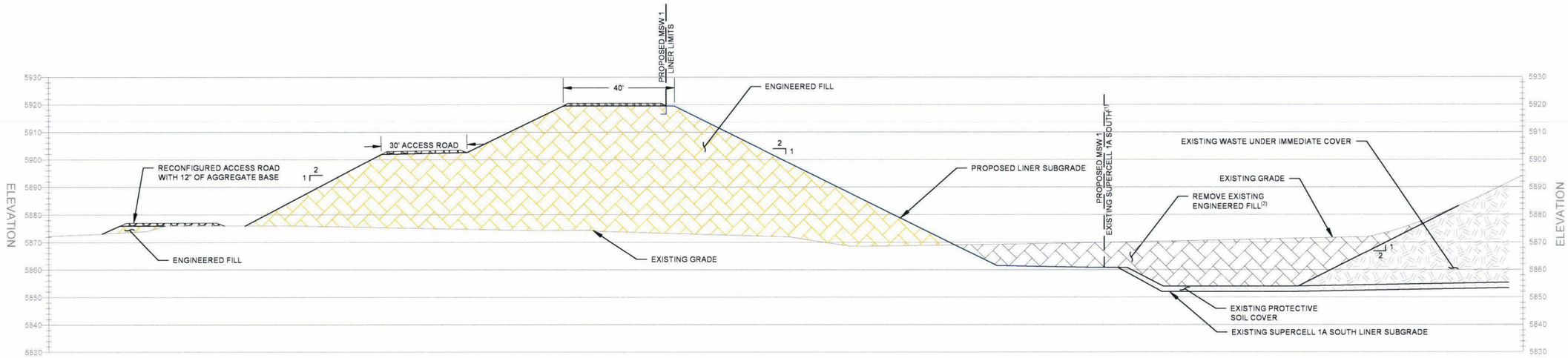
ECDC ENVIRONMENTAL, L.C.

ECDC ENVIRONMENTAL LANDFILL
MSW EXPANSION 1 CELL
EAST CARBON, UTAH
SUBGRADE & LINER PLAN

DRAWING NO. **C01**
PROJECT NO. **AU19.1236.00**

N:\ECDC\2019 AU19.1236.00 MSW EXPANSION 1 DESIGN\5_ENGINEERING\1_CIVIL\DRAWINGS\C01 SUBGRADE & LINER PLAN.DWG January 29, 2020 - 12:59 PM BY: STEPHANIE HAMILTON



MSW-1 EXPANSION
WEST TO EAST

SECTION

HORIZONTAL AND VERTICAL SCALE 1" = 20'

A | C01 | C02

NOTES

1. VERIFY EXISTING LINER ELEVATIONS. IF DIFFERENT THAN SHOWN, NOTIFY ENGINEER.
2. GRADES SHOWING EXISTING ENGINEERED FILL REMOVAL ARE APPROXIMATE. VERIFY IN FIELD THE EXTENTS OF EXISTING ENGINEERED FILL WITH OWNER.

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REGISTERED PROFESSIONAL ENGINEER
No. 5861634-2202
JACOB V. RUSSELL
3-31-2021
STATE OF UTAH

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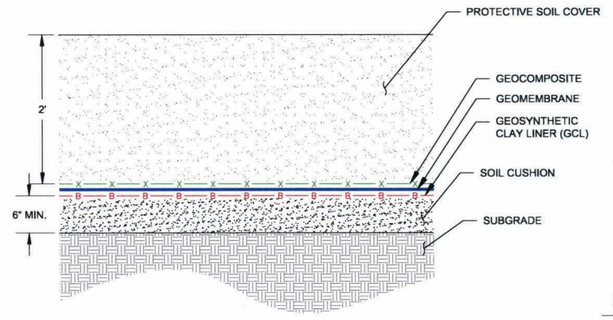
ECDC ENVIRONMENTAL, L.C.

ECDC ENVIRONMENTAL LANDFILL
MSW EXPANSION 1 CELL
EAST CARBON, UTAH
SECTIONS

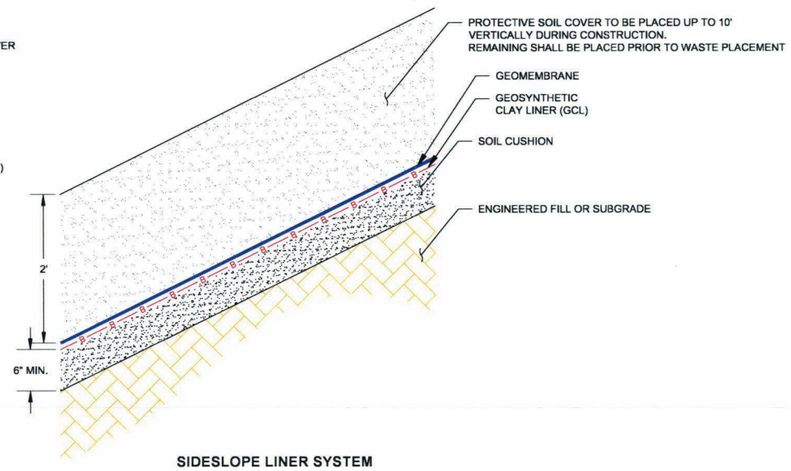
DRAWING NO. **C02**
PROJECT NO. AU19.1236.00



FLOOR LINER SYSTEM

DETAIL 1 (C01 | C10)

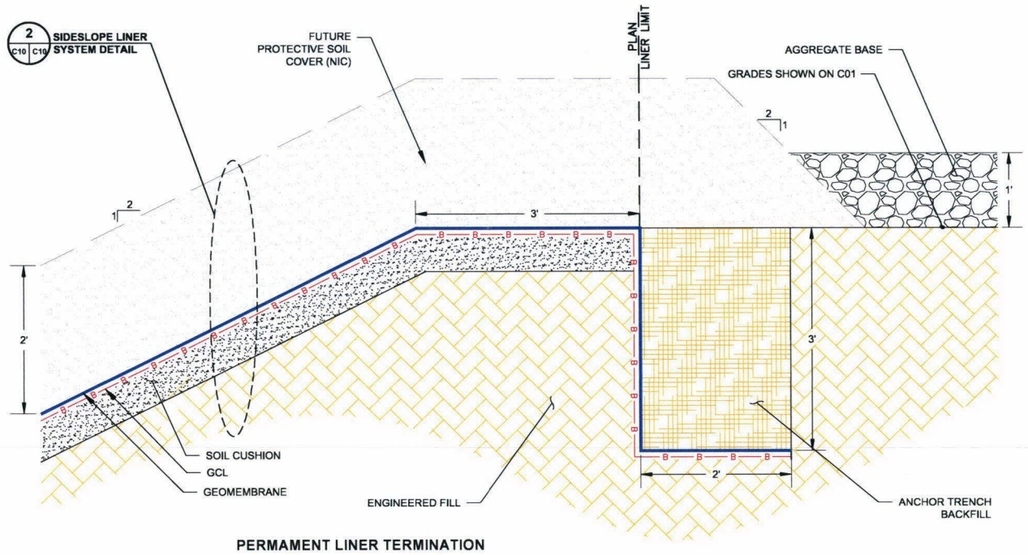
1" = 1'



SIDESLOPE LINER SYSTEM

DETAIL 2 (C01 | C10)

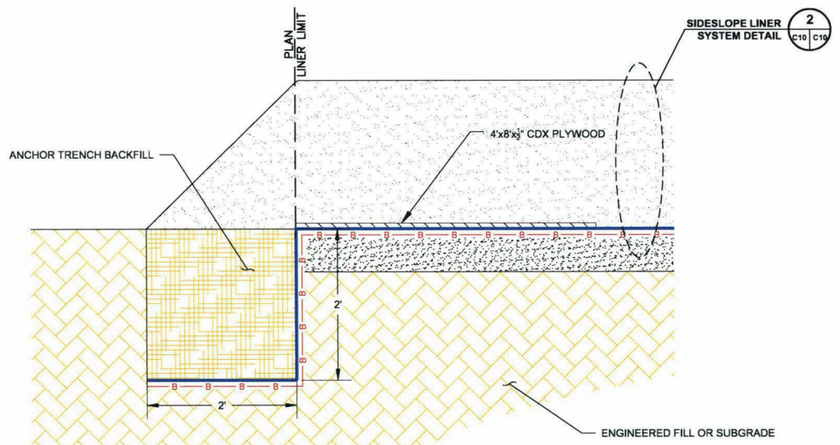
1" = 1'



PERMAMENT LINER TERMINATION

DETAIL 3 (C01 | C10)

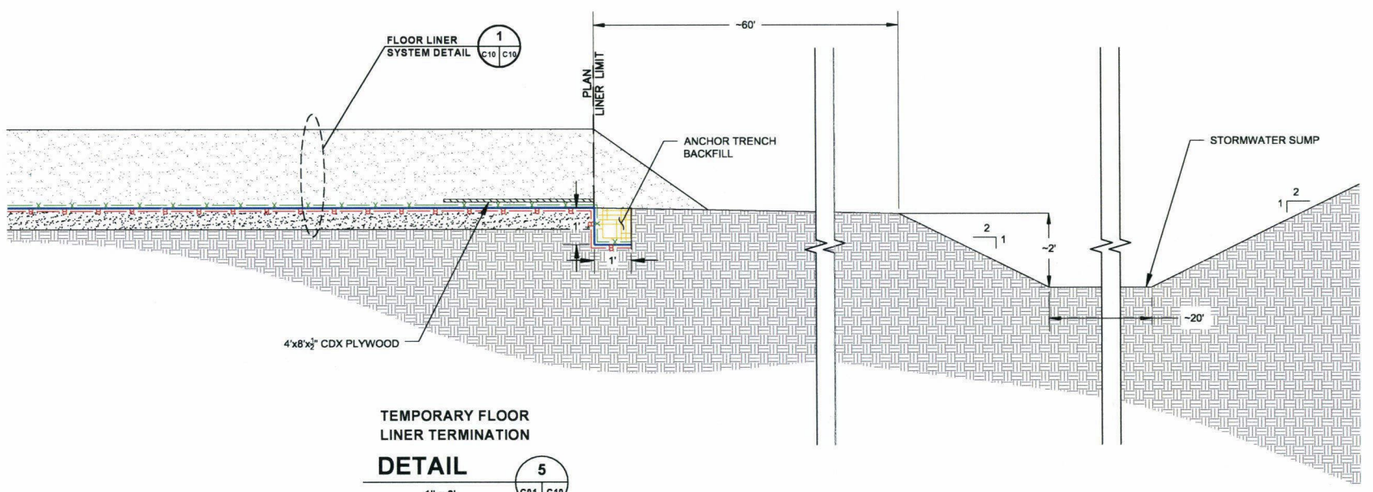
1" = 1'



TEMPORARY SIDESLOPE LINER TERMINATION

DETAIL 4 (C01 | C10)

1" = 1'



TEMPORARY FLOOR LINER TERMINATION

DETAIL 5 (C01 | C10)

1" = 2'

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Geo-Logic ASSOCIATES
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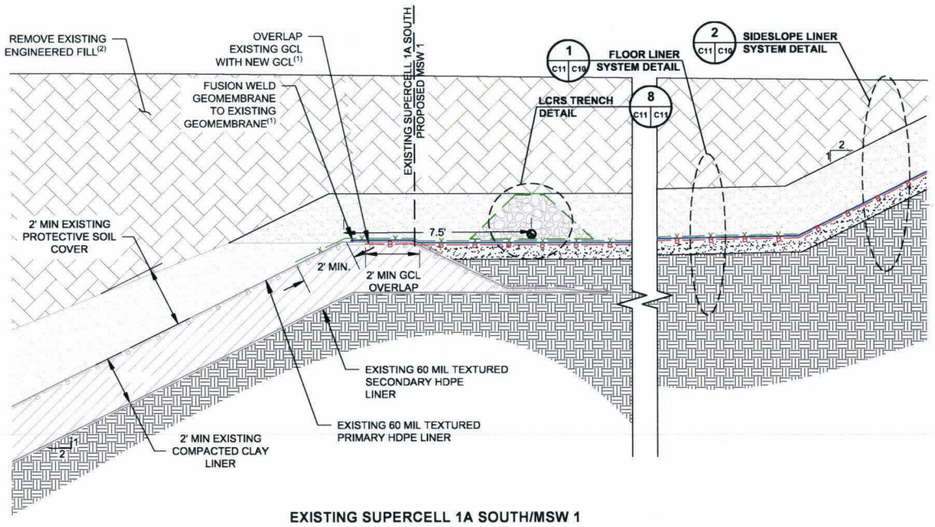
geo-logic.com | 530.272.2448

ECDC ENVIRONMENTAL, L.C.

ECDC ENVIRONMENTAL LANDFILL
MSW EXPANSION 1 CELL
EAST CARBON, UTAH
DETAILS

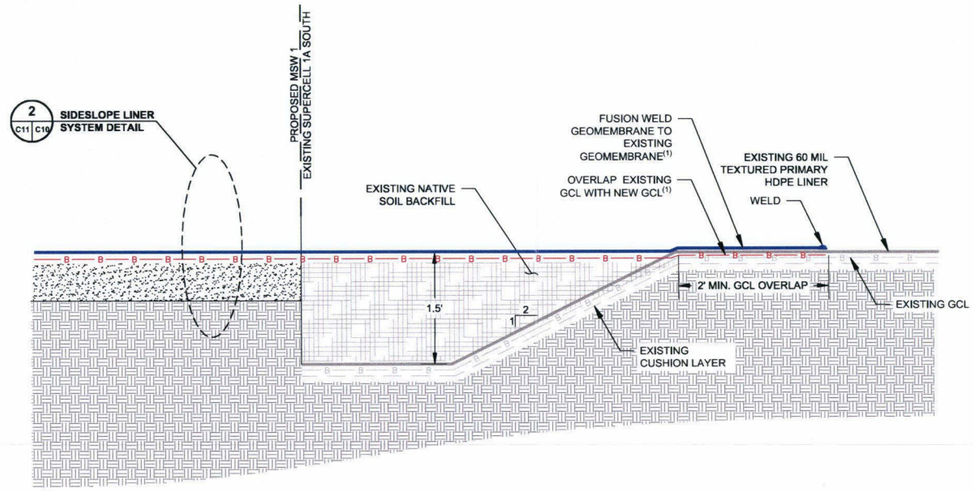
DRAWING NO. **C10**
PROJECT NO. AU19.1236.00



EXISTING SUPERCELL 1A SOUTH/MSW 1
FLOOR LINER TIE-IN

DETAIL 6 (C10 | C11)

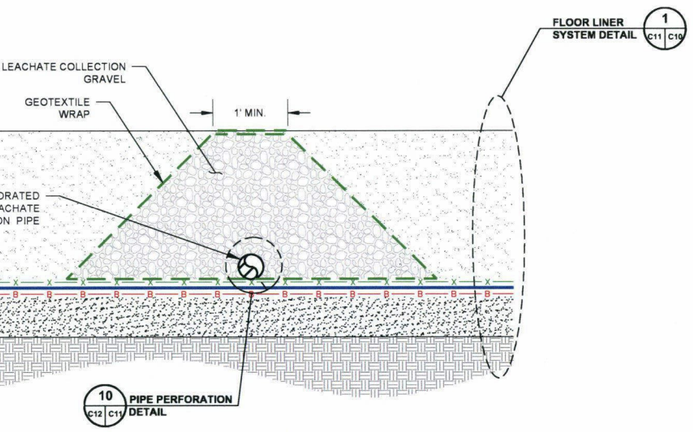
1" = 3'



EXISTING SUPERCELL 1A SOUTH/MSW 1
EXPANSION SIDE SLOPE LINER TIE-IN

DETAIL 7 (C01 | C11)

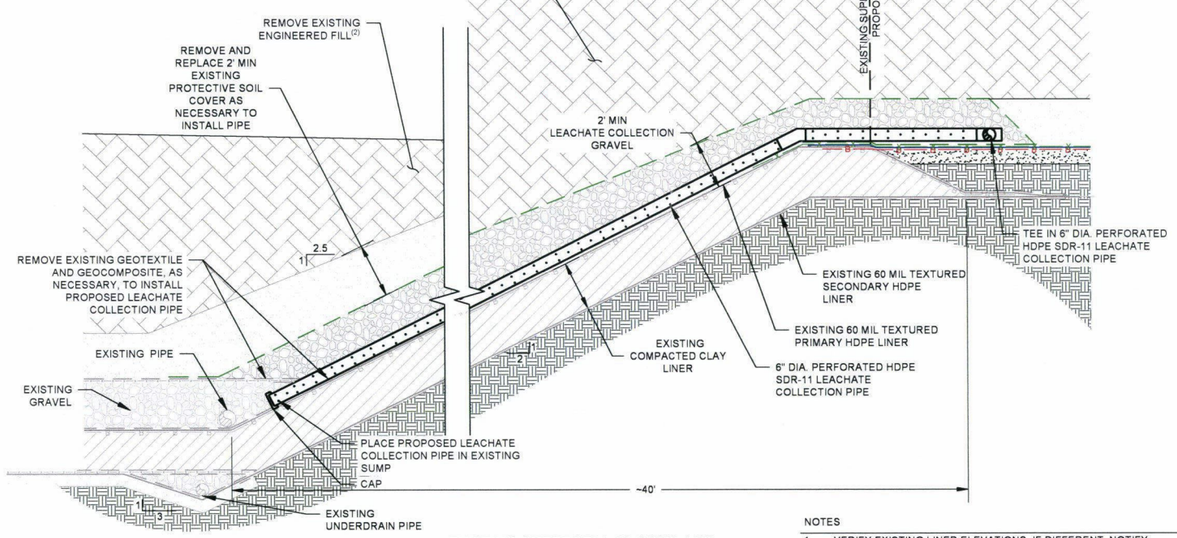
1" = 1'



LCRS TRENCH

DETAIL 8 (C10 | C11)

1" = 1'



EXISTING SUPERCELL 1A SUMP AND
MSW-1 LCRS TIE-IN

DETAIL 9 (C01 | C11)

1" = 3'

NOTES

1. VERIFY EXISTING LINER ELEVATIONS. IF DIFFERENT, NOTIFY ENGINEER.
2. LIMITS OF EXISTING ENGINEERED FILL REMOVAL IS APPROXIMATE. VERIFY IN FIELD THE EXTENTS OF EXISTING ENGINEERED FILL WITH CQA MONITOR.

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REGISTERED PROFESSIONAL ENGINEER No. 5881934-2202 JACOB V. RUSSELL 3-31-2021 STATE OF UTAH

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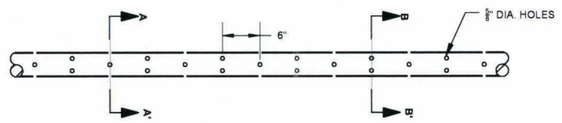
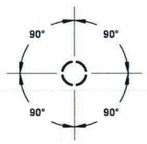
ECDC ENVIRONMENTAL, L.C.

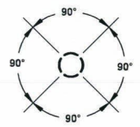
ECDC ENVIRONMENTAL LANDFILL
MSW EXPANSION 1 CELL
EAST CARBON, UTAH
DETAILS

DRAWING NO. **C11**
PROJECT NO. **AU19.1236.00**





SECTION A-A'

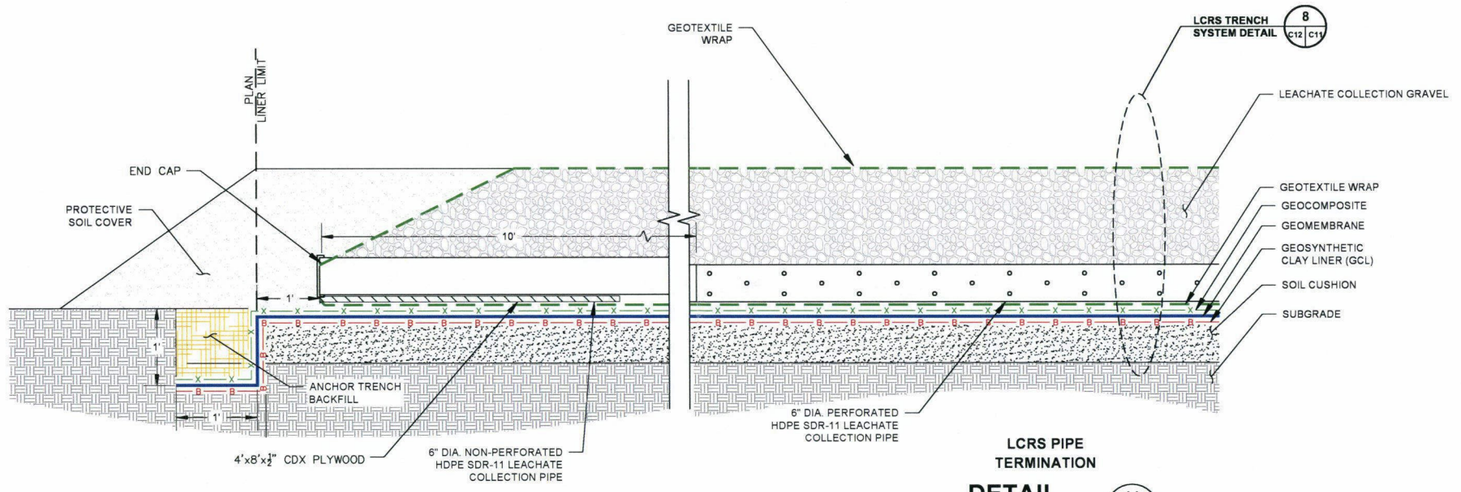


SECTION B-B'

PIPE PERFORATION

DETAIL 10 (C11 | C12)

1" = 1'



LCRS PIPE TERMINATION

DETAIL 11 (C10 | C12)

1" = 1'

ISSUED FOR CONSTRUCTION

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A	1/28/20	ISSUED FOR CONSTRUCTION	JVR

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No. 5681834-2202
JACOB V. RUSSELL
3-31-21
STATE OF UTAH

Geo-Logic ASSOCIATES
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geo-logic.com | 530.272.2448

ECDC ENVIRONMENTAL, L.C.

ECDC ENVIRONMENTAL LANDFILL

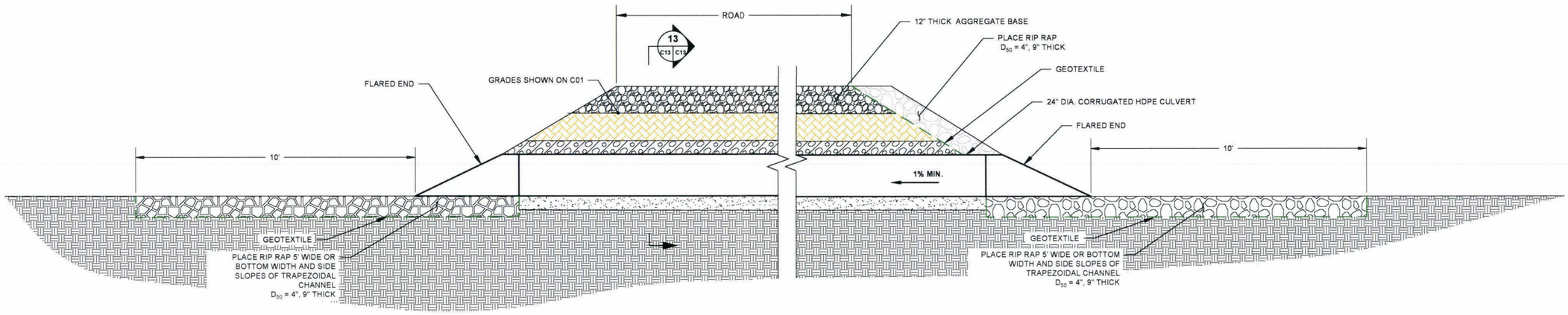
MSW EXPANSION 1 CELL

EAST CARBON, UTAH

DETAILS

DRAWING NO. **C12**

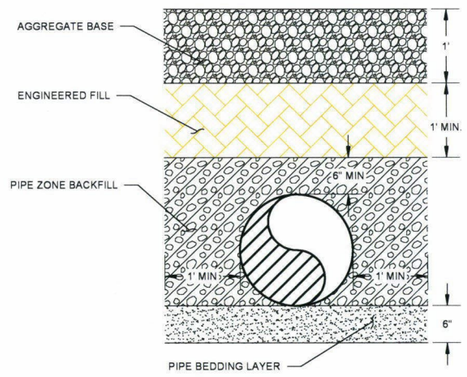
PROJECT NO. AU19.1236.00



STORMWATER CULVERT

DETAIL 12 (C01 | C13)

1" = 2'



TRENCH SECTION

DETAIL 13 (C13 | C13)

1" = 1'

ISSUED FOR CONSTRUCTION

REV. NO.	DATE	DESCRIPTION	APPROVED BY
A	1/28/20	ISSUED FOR CONSTRUCTION	JVR

DATE OF ISSUE:
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DRAWN BY:
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APPROVED BY:

REGISTERED PROFESSIONAL ENGINEER
No. 5881634-2202
JACOB V. RUSSELL
3-31-20
STATE OF UTAH

Geo-Logic ASSOCIATES
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ECDC ENVIRONMENTAL, L.C.

ECDC ENVIRONMENTAL LANDFILL

MSW EXPANSION 1 CELL

EAST CARBON, UTAH

DETAILS

DRAWING NO. **C13**

PROJECT NO. AU19.1236.00