

**DIVISION 2  
SITE WORK**

# PIÑON RIDGE PROJECT TECHNICAL SPECIFICATIONS

## **SECTION 02200.0 EARTHWORKS**

### **PART 1: GENERAL**

#### **1.01 SUMMARY:**

This SPECIFICATION describes site preparation, excavation, stockpiling of soils for earthwork if necessary, and placement of Structural Fill, Coarse Underdrain Fill, Fine Underdrain Fill, Leak Detection Fill, Anchor Trench Fill, Cushion Material, Roadway Subgrade Fill, Pipe Bedding Fill, Aggregate Base Course Material, Diversion Berm Fill, Stormwater Diversion Pipe Backfill, Riprap, and Random Fill.

#### **1.02 RELATED SECTIONS:**

Refer to the following Sections for related work:

Section 01050.0 – Construction Staking and Construction Certification Documentation  
Section 01400.1 – Earthworks CQA Plan  
Section 02621.0 – Drainage Geocomposite and Geonet  
Section 02710.0 – Piping  
Section 02776.0 – Geomembrane  
Section 02776.1 – Geosynthetic Clay liner  
Section 02777.0 – Geotextile

#### **1.03 TOLERANCES:**

- A. Limits of excavation, Structural Fill, Coarse Underdrain Fill, Fine Underdrain Fill, Leak Detection Fill, Anchor Trench Fill, Cushion Material, Roadway Subgrade Fill, Pipe Bedding Fill, Aggregate Base Course Material, Diversion Berm Fill, Stormwater Diversion Pipe Backfill, Riprap, and Random Fill for site construction are defined by the lines and elevations shown on the DRAWINGS. All fill shall be placed to the minimum thicknesses shown on the DRAWINGS.
- B. Finished grades shown on the DRAWINGS are given in feet, and shall slope uniformly between given spot and contour elevations, without sag or humps. All grades shall provide for natural runoff.
- C. The Cushion Material thickness over the five-acre ore pad liner shall have a minimum thickness of two and a half (2.5) feet, with an additional minimum thickness of one (1) foot of Aggregate Base Course Material overlying the Cushion Material.
- D. Correction of over-excavation and backfilling shall be to **CONTRACTOR's** account.
- E. Cut and fill activities shall be performed to achieve the lines, grades, and design requirements as shown on the DRAWINGS. Tolerances for all facility grades (i.e., embankment crests, etc.) will be plus or minus two tenths of a foot ( $\pm 0.2$  ft) unless approved otherwise by **ENGINEER OF RECORD** and **MANAGER**.
- F. The **CONTRACTOR** will ensure that the diversion channels maintain positive drainage without sags or humps. Invert elevations defined on the DRAWINGS will be maintained to within plus or minus one tenth of a foot ( $\pm 0.1$  ft) between regular 50-foot stationing (i.e., plus or minus 0.2 percent slope), unless approved otherwise by the **ENGINEER OF RECORD**.

#### **1.04 CONSTRUCTION QUALITY ASSURANCE:**

- A. All work shall be monitored and tested in compliance with the requirements of the Earthworks CQA Plan (Section 01400.1).
- B. **CONTRACTOR** shall be aware of all testing activities outlined in the CQA Plan, and shall account for these activities in the construction schedule.

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- C. All CQA soils testing (both field and laboratory testing) will be the responsibility of **ENGINEER OF RECORD** and CQA Monitor, as identified in the Earthworks CQA Plan. **CONTRACTOR** shall be responsible for cooperating with CQA Monitor during all testing activities. **CONTRACTOR** shall provide equipment and labor to assist CQA Monitor in sampling, if requested, and shall also provide access to all areas requiring testing activities. Quality Control testing shall be the responsibility of the **CONTRACTOR**.
- D. Excavation, backfill and grading operations shall be carried out under the observation of **MANAGER** and CQA Monitor.
- E. Any work found unsatisfactory or any work disturbed by subsequent operations before acceptance is granted shall be corrected by **CONTRACTOR**, at its sole cost.

## **PART 2: PRODUCTS**

### **2.01 MATERIALS:**

- A. Fill materials will be soils, gravels, or rockfill approved by **MANAGER** and **ENGINEER OF RECORD**. There is considerable variability in the nature of the borrow materials and the **CONTRACTOR** must assume all responsibility for becoming familiar with the nature, moisture content, texture, and percentage of oversize materials; the difficulties of excavation, of breaking down or removing the oversize materials; and of obtaining satisfactory moisture content. All fill materials shall be free of organic and inorganic debris, organic soils, frozen material, and other deleterious materials, and shall be excavated and/or processed, as required, as follows:
  - 1. Structural Fill – consists of on-site colluviums and alluvium materials as approved by **MANAGER** and **ENGINEER OF RECORD** that are designated for use on DRAWINGS. Structural Fill may be derived from local excavation within the Mill Pad, Tailings Cells, Evaporation Ponds, Stormwater Collection Ponds, or other approved borrow sources. Structural Fill shall consist of material having Unified Soil Classification of SP, SW, SC, SM, GP, GW, GC, GM, ML, or CL. Structural Fill will have a maximum particle size of eight (8) inches or sixty-seven (67) percent of the approved lift height, whichever is smaller, except Structural Fill within the Mill Pad area shall have a maximum particle size of three (3) inches. Material greater than the allowable size shall be broken down or removed. Structural Fill containing rock greater than three (3) inches should be incorporated into a soil matrix that meets the following SPECIFICATION.

<b>U.S. Standard Sieve Size</b>	<b>Percent Passing by Dry Weight</b>
3-inch	95 – 100
No. 4	20 – 100
No. 200	0 – 60

Plasticity Index:

15 Maximum

- 2. Coarse Underdrain Fill – free-draining material imported from off-site for use in Underdrain trench and Underdrain sump for the Tailings Cells, where designated for use on the DRAWINGS and as approved by **MANAGER** and **ENGINEER OF RECORD**. Coarse Underdrain Fill shall consist of ASTM C-33 Size 8 coarse aggregate, screened and processed to conform to the following minimum SPECIFICATION:

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U.S. Standard Sieve Size	Percent Passing by Dry Weight
1/2-inch	100
3/8-inch	80 – 100
No. 4	10 – 30
No. 8	0 – 10
No. 16	0 – 5

Point load tensile strength: > 300 psi  
 Plasticity Index: Non-Plastic

3. Fine Underdrain Fill – free-draining material imported from off-site for use in underdrain trench and underdrain sump for the Tailings Cells, where designated for use on the DRAWINGS and as approved by **MANAGER** and **ENGINEER OF RECORD**. Fine Underdrain Fill shall consist of ASTM C-33 fine aggregate, which is well-graded sand meeting the following gradation Specification:

U.S. Standard Sieve Size	Percent Passing by Dry Weight
3/8-inch	100
No. 4	95 – 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 60
No. 50	10 – 30
No. 100	0 – 10
No. 200	0 – 5

Plasticity Index: Non-Plastic

4. Leak Detection Fill – free-draining, processed drainage gravels or imported material approved by **MANAGER** and **ENGINEER OF RECORD** for placement in the Leak Detection System (LDS) for the tailings cells and evaporation ponds, as shown on the DRAWINGS. Leak Detection Fill shall conform to the following minimum SPECIFICATION:

U.S. Standard Sieve Size	Percent Passing by Dry Weight
3/4-inch	100
3/8-inch	40 – 70
No. 4	5 – 55
No. 200	0 – 10

Plasticity Index: Non-plastic

5. Cushion Material – Cushion Material shall be placed over the Ore Stockpile Pad geosynthetic clay liner (GCL), as indicated in the DRAWINGS, to provide protection to the liner from equipment working on the Ore Pad. Cushion Material shall not consist of soils with high concentrations of calcium (e.g., derived from limestone or dolomite). Cushion Material shall consist of on-site sandy and silty soils, or other sources approved by the **ENGINEER OF RECORD** and will conform to the following minimum SPECIFICATION:

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U.S. Standard Sieve Size	Percent Passing by Dry Weight
2-inch	100
1-inch	80 – 100
No. 100	0 – 70
No. 200	10 – 60

Plasticity Index: 5 Maximum

6. Pipe Bedding Fill – Pipe Bedding Fill shall be placed to backfill around pipes, as indicated in the DRAWINGS. Pipe Bedding Fill shall conform to the following minimum SPECIFICATION:

U.S. Standard Sieve Size	Percent Passing by Dry Weight
2-inch	100
No. 4	30 – 100
No. 200	5 – 20

Plasticity Index: 5 Maximum

7. Anchor Trench Fill – shall consist of local borrow materials excavated from the anchor trench excavation, placed and compacted in accordance with a method specification, as approved by **MANAGER** and **ENGINEER OF RECORD** and where shown on the DRAWINGS. Anchor Trench Fill shall have a maximum particle size of six (6) inches and a lift thickness no greater than two (2) feet.
8. Random Fill - shall consist of local borrow materials placed and compacted in accordance with a method specification, as approved by **MANAGER** and **ENGINEER OF RECORD** and where shown on the DRAWINGS. Random Fill shall have a maximum particle size of 18 inches and a lift thickness no greater than three (3) feet.
9. Roadway Subgrade Fill – shall consist of material having Unified Soil Classification SP, SW, SC, SM, GP, GW, GC, GM, ML, or CL. Maximum particle size shall be less than three (3) inches).
10. Aggregate Base Course Material – shall consist of materials meeting Colorado Department of Transportation (CDOT), Section 703.03 of the Standard Specifications for Road and Bridge Construction, latest Edition, for Class 2 and Class 6 material as designated on the DRAWINGS, with the exception of the percent passing the No. 200 sieve for Class 6 material which shall have a minimum percent passing the No. 200 sieve of seven (7) percent.
11. Diversion Berm Fill – shall consist of material having Unified Soil Classification SP, SW, SC, SM, GP, GW, GC, GM, or CL. Maximum particle size shall be less than eight (8) inches.
12. Stormwater Diversion Pipe Backfill – shall consist of material having Unified Soil Classification SP, SW, SC, SM, GP, GW, GC, GM, or CL. Maximum particle size shall be less than three (3) inches.
13. Riprap – shall have a nominal stone size of twelve (12) inches and meet the requirements of CDOT Section 506 of the Standard Specifications for Road and Bridge Construction, latest Edition.

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## **PART 3: EXECUTION**

### **3.01 CLEARING AND GRUBBING:**

- A. Clearing and grubbing shall be done within the footprint limits of the construction area, as delineated on the DRAWINGS. Clearing shall extend a maximum of 15 ft and a minimum of 10 ft outside of the construction limits, or as directed by **MANAGER**. Areas for clearing shall be released to **CONTRACTOR** by **MANAGER**. No pioneering of roads across undisturbed areas shall be allowed without prior approval of **MANAGER**.
- B. No clearing shall be performed until written permission is given by **MANAGER** and until the **CONTRACTOR** has provided construction staking for the proposed work. Clearing shall consist of cutting brush to the ground level, removing such material, along with wood, rubbish, tree stumps, and any other vegetation with roots in excess of 1-inch diameter, and other deleterious materials, and disposing of all such material in the accepted manner described below.
- C. In areas designated to be stripped of unsuitable or objectionable material, said materials shall be stripped to the full depth of organic or other unsuitable material as determined by **MANAGER** and **ENGINEER OF RECORD**, whichever is greater.
- D. Stripped and grubbed vegetation shall be removed and disposed in stockpiles or other approved methods in an area designated by **MANAGER**.

### **3.02 TOPSOIL REMOVAL:**

- A. If areas of suitable topsoil are encountered, it will be stripped and stockpiled as directed by the **MANAGER**. Topsoil is defined as an acceptable growth medium as approved by **MANAGER** and **ENGINEER OF RECORD** that has no chemical or physical characteristics which will exclude its use as such.
- B. **CONTRACTOR** shall excavate and remove topsoil in a manner that will minimize contamination with other soil horizons, and will take such measures as are necessary to ensure that the removal of topsoil does not result in erosion or excessive sedimentation.
- C. **CONTRACTOR** shall stockpile topsoil at locations designated by **MANAGER**. Stored topsoil shall not be disturbed by milling or construction activities, and shall be protected from wind and water erosion, compaction, and contamination.
- D. **CONTRACTOR** shall grade topsoil stockpiles to prevent erosion and ponding of precipitation in the stockpile areas. The maximum topsoil stockpile height will be approved by **MANAGER**. The **CONTRACTOR** shall protect stockpiled topsoil by an effective cover of non-noxious, quick-growing, annual and perennial plants, approved by **MANAGER**, which shall be seeded or planted during the first appropriate growing season after removal.

### **3.03 TEMPORARY SURFACE WATER CONTROLS:**

- A. The **CONTRACTOR** shall be responsible for providing temporary surface water and seepage inflow controls during construction and shall be responsible for, and shall repair at his own expense, any damage to the foundation, structures or other parts of the Work caused by stormwater runoff, or failure of any temporary surface water controls.
- B. All temporary surface water controls not part of the permanent facilities shall be removed, leveled and graded by the **CONTRACTOR**.
- C. The **CONTRACTOR** shall have full responsibility for the adequacy of the temporary surface water controls. The sizing for temporary surface water controls should consider the duration of the construction activities, the time of the year of construction, characteristics of the storms during

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the construction seasons, cost of possible damage, cost of delay to the construction completion of the Work, and the safety of workers.

- D. The **CONTRACTOR** shall dewater any stormwater from the construction area during the time required to complete construction. Acceptable dewatering measures include, but are not limited to the pumping and removal of collected water from low areas within the construction area and impoundment footprints. The method of dewatering, which is not limited to the measures listed above, shall be subject to approval by **MANAGER**. If dewatering is unsuccessful in maintaining access to the construction area and stable working areas, stabilization will be required and shall be at the **CONTRACTOR**'s expense.

### 3.04 SURFACE PREPARATION:

- A. **CONTRACTOR** shall remove surface cobbles and boulders larger than six (6) inches (two [2] inches for surfaces to be lined) in the minimum dimension to the limits shown on the **DRAWINGS**.
- B. Boulders, cobbles and gravels may be utilized for fill materials, provided they meet or are processed to meet the **SPECIFICATIONS** for these items.
- C. Surface preparation will be performed by the **CONTRACTOR** to the limits shown on the **DRAWINGS**.

### 3.05 EXCAVATION:

- A. **CONTRACTOR** shall perform excavation to the lines and grades shown on the **DRAWINGS** or as directed by **MANAGER**. No excavation shall begin until the **CONTRACTOR** has provided construction staking for the proposed Work.
- B. **CONTRACTOR** shall prevent the disturbance of surrounding areas during excavation. Where selective excavations are required to obtain materials for fill, the material removed from the excavations shall be taken directly to the fill areas or, if required, stockpiled by material types. The stockpiles shall be approved by **MANAGER**.
- C. **CONTRACTOR** shall grade all excavations to ensure grades are maintained to provide adequate drainage at all times. Work shall be suspended by **CONTRACTOR** when, in the opinion of **MANAGER** and **ENGINEER OF RECORD**, the site is overly wet, muddy, or otherwise unsuitable for proper maintenance, until directed otherwise by **MANAGER**, at no cost to **OWNER**. **CONTRACTOR** may elect to stabilize overly wet, muddy, or otherwise unsuitable areas to allow work to continue, at no expense to the **OWNER**.
- D. In excavations where Structural Fill is to be placed on slopes steeper than 2.75H:1V, horizontal benches shall be excavated into the slope to allow fill to be placed in horizontal lifts. The **CONTRACTOR** shall continuously bench and key embankment material into the existing material a minimum of 2 feet.
- E. The **CONTRACTOR** will be responsible for the safety of temporary construction slopes. **CONTRACTOR** shall inspect all temporary and permanent open-cut excavations on a regular basis for signs of instability. Should signs of instability be noted, **CONTRACTOR** shall immediately undertake remedial measures and shall notify **MANAGER** immediately. Permanent cut slopes shall be left in smooth, safe, and stable condition at the end of the workday.
- F. **CONTRACTOR** shall conduct all excavation and shoring operations in compliance with applicable government laws and regulations.
- G. Non-rippable or Rock Excavation: This classification includes all solid rock that cannot be removed until loosened by blasting, boring, or wedging. It is further defined as rock of such hardness and texture that it cannot be loosened or broken down by a single shank ripper mounted on a Caterpillar

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Model D-9 Bulldozer (or equivalent) in good operating condition handled by an experienced operator. In areas where it is impractical to classify materials by use of the ripper described, rock excavation is defined as sound material of such hardness and texture that is cannot be excavated with a Caterpillar Model 235 Backhoe (or equivalent) in good operating condition handled by an experienced operator.

### 3.06 SUBGRADE PREPARATION:

- A. The **MANAGER** and CQA Monitor will inspect and approve the exposed subgrade prior to any fill or geosynthetics being placed to confirm that the requirements of this article and of Articles 3.01 through 3.05 of this section have been completed. CQA Monitor will confirm that the surface of the subgrade is smooth and free of debris, grade stakes, rocks (larger than the maximum allowed dimensions per Article 3.04), roots, branches, vegetation, mud, ice, frozen material, or cracks larger than one-quarter inch (0.25 in) in width. If the subgrade is determined to be frozen, using the criteria identified in Article 3.07 of these SPECIFICATIONS, the **CONTRACTOR** may either remove and replace the frozen subgrade or wait until subsequent temperature monitoring indicates the fill is unfrozen, at no cost to **OWNER**. The subgrade shall have no sudden sharp or abrupt changes in grade. Protrusions extending more than one-half inch (0.5 in) from the surface shall be either removed, crushed, or pushed into the surface with a smooth-drum compactor.
- B. **CONTRACTOR** is responsible for maintaining subgrades in a condition satisfactory to **ENGINEER OF RECORD**. **CONTRACTOR** shall protect prepared subgrades, including previously approved subgrade, from weather, construction equipment, or other factors as outlined in this Article of these SPECIFICATIONS. Subgrade surfaces, including previously approved subgrade, that become softened or otherwise unsuitable for placement of fill, shall be repaired to the satisfaction of **ENGINEER OF RECORD** and **MANAGER**, at no cost to **OWNER**.
- C. Prior to placement of fill materials, **CONTRACTOR** shall scarify all in-situ materials to a depth of 6 inches, moisture condition, and recompact the subgrade. Compactive effort shall be adequate to obtain a minimum of ninety-five (95) percent of maximum dry density as determined by the standard Proctor test (ASTM D698) for the particular fill material. Moisture conditioning shall be adequate to achieve a uniform moisture and density. In rock areas, the **CONTRACTOR** shall prepare the subgrade by removing loose rock fragments until competent foundation material is encountered as approved by **ENGINEER OF RECORD**.
- D. If the underlying material is unsuitable to permit proper compaction of the subgrade, **CONTRACTOR** shall loosen, aerate (or excavate and remove), and recompact the subgrade until the top layer can be compacted as required. The recompacted surface shall then be scarified, as needed, to provide a good bond between the foundation and overlying fill or geosynthetic materials.

### 3.07 FILL PLACEMENT:

- A. The following general guidelines shall be followed except as noted elsewhere in this Section.
  1. No fill materials shall be placed until the foundation and subgrade preparations have been completed as specified herein, in Articles 3.04 and 3.06 of this Section. The procedures for fill placement shall be approved by **MANAGER** and **ENGINEER OF RECORD** prior to start of fill placement.
  2. No brush, roots, sod, frozen material, or other deleterious or unsuitable materials shall be incorporated in the fills. The suitability of all materials intended for use in the fill shall be subject to approval by **MANAGER** and **ENGINEER OF RECORD**. Fill placement shall be temporarily stopped by **CONTRACTOR** due to weather conditions, if materials and installation do not meet the SPECIFICATIONS, at no cost to **OWNER**. Fill shall not be placed upon frozen material, such as frozen soil, snow or ice.

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3. If the surface of the prepared foundation or the surface of any layer where fill materials will be placed is too dry or too smooth to bond properly with the layer of material to be placed thereon, it shall be moisture-conditioned and/or worked with harrow, scarifier, disc, or other suitable equipment to provide a satisfactory bonding surface before fill material is placed thereon. If the surface of the prepared foundation or the rolled surface of any layer is excessively wet for fill materials to be placed thereon, it shall be removed and allowed to dry or worked with a harrow, scarifier, disc, or other suitable equipment to reduce the moisture content to an acceptable level, or stabilized by other approved means, to meet project SPECIFICATIONS as determined by **MANAGER** and **ENGINEER OF RECORD**. It shall then be compacted before the next layer of fill material is placed. Determination of such dry or wet conditions shall be made by **ENGINEER OF RECORD**.
4. The distribution of materials shall be such that the fill is free from voids, lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. The composition of a fill shall be as described in Article 2.01 of this Section.
5. The fill shall be leveled prior to compaction by means of a dozer or grader, or other suitable approved equipment, to obtain a surface free from depressions.
6. **CONTRACTOR** shall apply water required for moisture conditioning on the fill or in the borrow areas.

**CONTRACTOR** shall maintain fill materials within the moisture content range required to permit proper compaction to the specified density with the equipment being used. The moisture content of the fill materials, prior to and during compaction, shall be uniform throughout each layer of the material.

Prior to mixing of wet and dry material on the fill to obtain the proper moisture content, approval shall be obtained from **ENGINEER OF RECORD**. Mixed material shall have a uniform distribution of the moisture content prior to placement on the subsequent lift.

When fill materials are too dry for proper compaction, **CONTRACTOR** shall spray water on each layer of the fill and shall work the moisture into the fill by harrowing or other approved means, until a uniform distribution of moisture is obtained. Material that is too wet for proper compaction, as determined by the **ENGINEER OF RECORD**, shall be removed from the fill and/or spread out and permitted to dry, assisted by discing and harrowing or mixing in dry material when permitted by the **ENGINEER OF RECORD**, if necessary, until the moisture content is reduced to an amount suitable for obtaining the specified degree of compaction, at no cost to **OWNER**.

7. After each layer of fill has been placed, spread, and moisture-conditioned, the layer shall be compacted by passing compaction equipment over the entire surface of the layer a sufficient number of times to obtain the required density, as specified herein.  
  
Compaction shall be accomplished with equipment and by methods approved by **ENGINEER OF RECORD**. If such equipment or methods are found unsatisfactory for the intended use, **CONTRACTOR** shall replace the unsatisfactory equipment with other types or adjust methods until proper compaction is achieved.
8. The CQA Monitor will measure the ambient air temperature on a minimum twice per shift basis. If the ambient air temperature is less than 32 degrees Fahrenheit (0 degrees Celsius) for more than two (2) hours over the preceding twenty-four (24) hours, the CQA Monitor will measure the temperature of any fill materials being placed to determine if the fill is frozen. "Frozen" is defined as a mean temperature of thirty-two degrees Fahrenheit (32°F) or less. The CQA Monitor will measure the temperature of in-place fill at depths of 3 inches and 6 inches, recording the lower of the two. Six (6) measurements will be taken per

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acre, and if the average is below thirty-two degrees Fahrenheit (32°F), the fill will be considered frozen. If the fill is determined to be frozen, the **CONTRACTOR** may either remove and replace the frozen fill or wait until subsequent temperature monitoring indicates the fill is unfrozen, prior to placing additional materials, at no cost to **OWNER**. Under no circumstances can frozen soil materials be placed or incorporated as fill materials.

### B. Structural Fill

1. Areas to receive Structural Fill will include, but are not limited to, Mill Pad, Tailings Cells, Evaporation Ponds, Ore Pads, Roadways, grading fills greater than or equal to two feet (2 ft) in thickness, slope reductions, embankment construction, Stormwater Collection Pond construction, and miscellaneous site grading as shown on the DRAWINGS.
2. **CONTRACTOR** shall condition Structural Fill to a moisture content that allows compaction to the required density and that results in a firm, unyielding surface capable of allowing the movement of vehicles and equipment over the surface without causing rutting or other deleterious effects.
3. **CONTRACTOR** shall place Structural Fill materials in maximum eight (8) inch loose lifts, and compactive effort shall be adequate to obtain the maximum dry density (as determined by the standard Proctor test, ASTM D698) in accordance with the following table:

Fill Location	Percent Compaction (%)
Mill Pad Area	98
All Other Areas (i.e., Tailings Cells, Evaporation Ponds, Ore Pads, Roadway Subgrade, etc.)	95

Structural Fill shall be moisture conditioned to within two (2) percent of optimum moisture content (ASTM D698), unless specifically approved otherwise by **ENGINEER OF RECORD**.

4. In the event that the fill materials contain greater than thirty-five (35) percent rock materials above three-quarter-inch (3/4-inch) size, the CQA Monitor may elect to use a method specification for the determination of suitability and may adjust the moisture range specification.
5. Maximum rock size shall be two-thirds of the compacted lift thickness, unless otherwise approved by **MANAGER, DESIGN ENGINEER** and **ENGINEER OF RECORD**. **CONTRACTOR** shall remove oversize materials from fills at no additional cost to **OWNER**.
6. Structural Fill within the Mill Pad area shall not contain rock particles larger than three (3) inches in size.

### C. Cushion Material

1. Cushion Material for the Ore Stockpile Pads shall be placed over the geosynthetic clay liner (GCL) in a maximum of two lifts to result in a minimum 2.5-foot-thick layer after construction is complete.
2. Condition to a moisture content which allows compaction to the required density without an excessive amount of effort and that results in a stable non-yielding surface.
3. Cushion Material shall be placed by dumping with trucks, loaders, or approved equipment, at the edge of the GCL and spreading over the GCL liner with construction

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equipment that minimizes stresses on the GCL. A minimum thickness of 1 foot of Cushion Material should be maintained between the equipment tires/tracks and the GCL at all times during the covering process. This thickness does not apply to frequently trafficked areas or roadways for which a minimum thickness of 2 feet is required.

4. **CONTRACTOR** shall place Cushion Material in maximum twelve (12) inch loose lifts, and compacted to ninety-two (92) percent of the maximum dry density (as determined by the standard Proctor test) at plus or minus three (3) percent of optimum moisture content (ASTM D698), unless specifically approved otherwise by the **ENGINEER OF RECORD**.
5. Cushion Material shall be free of angular stones or other foreign material that could damage the GCL. Cover soils with high concentrations of calcium (e.g., limestone, dolomite) are not acceptable.
6. Cushion Material should be placed in a manner that prevents the soil from entering the GCL overlap zones. Cushion Material shall be pushed up slopes, not down slopes, to minimize tensile forces on the GCL.

### D. Coarse Underdrain Fill and Fine Underdrain Fill

1. Coarse Underdrain Fill and Fine Underdrain Fill shall be placed in the Underdrains as shown in the DRAWINGS.
2. **CONTRACTOR** shall place Coarse Underdrain Fill and Fine Underdrain Fill by a method compaction technique. The specifics of the method specification, including the lift thickness, will be dependent upon the contractor's equipment.
3. Provisions shall be made by **CONTRACTOR** for removal of oversize materials from fills, at no additional cost to **OWNER**.
4. Prior to placing the Coarse Underdrain Fill or Fine Underdrain Fill, **CONTRACTOR** shall verify by visual inspection that the underlying geosynthetics are free of holes, tears, wrinkles, or foreign objects. **MANAGER** and CQA Monitor will inspect the geosynthetic for wrinkles prior to placement of Coarse Underdrain Fill or Fine Underdrain Fill. As instructed by **MANAGER**, **CONTRACTOR** shall "work out" wrinkles to the satisfaction of **MANAGER** and **ENGINEER OF RECORD** prior to placement of the Coarse Underdrain Fill or Fine Underdrain Fill. In all cases, wrinkles shall not be of a size that they could fold back on themselves. Wrinkles greater than six (6) inches shall be removed and repaired by the **INSTALLER**.
5. When placing Coarse Underdrain Fill or Fine Underdrain Fill, the maximum acceptable drop height is three (3) feet.
6. **CONTRACTOR** shall operate equipment in a manner that is protective of underlying geomembrane. If **MANAGER** or **ENGINEER OF RECORD** suspects the occurrence of any damage to the underlying geomembrane, **MANAGER** will instruct **CONTRACTOR** to remove Coarse Underdrain Fill or Fine Underdrain Fill to expose the geomembrane. **CONTRACTOR** shall uncover, repair any observed damage of the underlying geosynthetics, in accordance with the repair requirements of Sections 02621.0, 02776.0, 02776.1, and 02777.0 of these SPECIFICATIONS, and recover, at no cost to **OWNER**.
7. **CONTRACTOR** shall coordinate closely with Geosynthetic Installation **CONTRACTOR** and **MANAGER** for the placement of the Coarse Underdrain Fill or Fine Underdrain Fill materials.

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8. **CONTRACTOR** shall provide close Construction Quality Control (CQC) continuous monitoring at the point of placement during the placement of the Coarse Underdrain Fill or Fine Underdrain Fill over geomembrane.
  9. Coarse Underdrain Fill or Fine Underdrain Fill placement shall not be carried out at night.
  10. **CONTRACTOR** shall assist CQA Monitor in obtaining soil samples for CQA testing. Coarse Underdrain Fill or Fine Underdrain Fill sampling shall be scheduled by CQA Monitor with **CONTRACTOR** to facilitate CQA field testing.
- E. Leak Detection Fill
1. Leak Detection Fill shall be placed over the lower geomembrane in the locations shown on the DRAWINGS.
  2. Prior to placing the Leak Detection Fill, **CONTRACTOR** shall verify by visual inspection that the underlying geosynthetics are free of holes, tears, wrinkles, or foreign objects. **MANAGER** and CQA Monitor will inspect the geosynthetic for wrinkles prior to placement of Leak Detection Fill. As instructed by **MANAGER**, **CONTRACTOR** shall "work out" wrinkles to the satisfaction of **MANAGER** and **ENGINEER OF RECORD** prior to placement of the Leak Detection Fill. In all cases, wrinkles shall not be of a size that they could fold back on themselves. Wrinkles greater than six (6) inches shall be removed and repaired by the **INSTALLER**.
  3. **CONTRACTOR** shall place Leak Detection Fill in approximately one (1) foot loose lifts to achieve the minimum layer thickness shown in the DRAWINGS. **CONTRACTOR** shall not operate equipment directly on geosynthetics.
  4. When placing Leak Detection Fill, the maximum acceptable drop height is three (3) feet.
  5. **CONTRACTOR** shall operate equipment in a manner that is protective of underlying geomembrane. If **MANAGER** or **ENGINEER OF RECORD** suspects the occurrence of any damage to the underlying geomembrane, **MANAGER** will instruct **CONTRACTOR** to remove Leak Detection Fill to expose the geomembrane. **CONTRACTOR** shall uncover, repair any observed damage of the underlying geosynthetics, in accordance with the repair requirements of Sections 02776.0, 02776.1, and 02777.0 of these SPECIFICATIONS, and recover, at no cost to **OWNER**.
  6. **CONTRACTOR** shall coordinate closely with Geosynthetic Installation **CONTRACTOR** and **MANAGER** for the placement of the Leak Detection Fill materials.
  7. **CONTRACTOR** shall provide close Construction Quality Control (CQC) continuous monitoring at the point of placement during the placement of the Leak Detection Fill over geomembrane.
  8. Leak Detection Fill placement shall not be carried out at night.
  9. **CONTRACTOR** shall assist CQA Monitor in obtaining soil samples for CQA testing. Leak Detection Fill sampling shall be scheduled by CQA Monitor with **CONTRACTOR** to facilitate CQA field testing.
  10. **CONTRACTOR** shall trim the surface of the Leak Detection Fill, if required, to the design grades shown on the DRAWINGS.
  11. **CONTRACTOR** shall compact the surface of the Leak Detection Fill to remove ridges and surface irregularities greater than one (1) inch in height. **ENGINEER OF RECORD** shall determine if surface preparation is sufficient to place overlying geosynthetics. Wheel

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ruts on the surface of the Leak Detection Fill from grading equipment shall be repaired by **CONTRACTOR** prior to placement of the geomembrane by rolling and or grading of the surface as approved by CQA Monitor.

### F. Anchor Trench Fill

1. **CONTRACTOR** shall supervise the anchor trench excavation for conformance to the line, grade, and width shown on the DRAWINGS, prior to liner system placement. The CQA Monitor shall verify that the anchor trench has been constructed according to the DRAWINGS. Anchor trenches will not be excavated more than seven (7) days' work ahead of the installation **CONTRACTOR**, and will be backfilled within two (2) days of geomembrane deployment. Seams within limits of the anchor trench do not require CQC/CQA testing, and backfilling of anchor trenches should not be delayed for CQC or CQA activities.

Rounded corners shall be provided in the trench where the geosynthetic materials adjoin the trench so as to avoid sharp bends (greater than sixty [60] degrees) in the geosynthetic materials.

2. The anchor trench shall be backfilled and compacted with a method specification as approved by the **MANAGER** and **ENGINEER OF RECORD**. Anchor Trench Fill material shall be compacted to ninety-two (92) percent of the maximum dry density (as determined by the standard Proctor test) at plus or minus three (3) percent of optimum moisture content (ASTM D698), unless specifically approved otherwise by the **ENGINEER OF RECORD**. Anchor Trench Fill shall be placed in eight (8) to twelve (12) inch thick loose lifts by wheel rolling with light, rubber-tired or other light compaction equipment.

Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. At no time shall construction equipment come into direct contact with the geomembrane. If damage occurs, it shall be repaired by the **CONTRACTOR** prior to the completion of backfilling.

### G. Random Fill

1. Random Fill will be placed as road safety berms, diversion berms, and unspecified incidental fills.
2. **CONTRACTOR** shall moisture condition, place and compact Random Fill by a method compaction technique. The specifics of the method specification, including the lift thickness, the method of compaction, and degree of compaction will be dependent of the specific component of the Work.
3. Random Fill will be nominally compacted with the intent of generally achieving a density approximating 92 percent of the standard Proctor maximum dry density (ASTM D698) at a moisture content within two (2) percent of the optimum moisture content, with a smooth surface not subject to erosion or wheel rutting or settlement.

### H. Pipe Bedding Fill

1. Pipe Bedding Fill shall be placed around Leak Detection System (LDS) riser pipes, as shown on the DRAWINGS.
2. **CONTRACTOR** shall place Pipe Bedding Fill in maximum twelve (12) inch loose lifts. Pipe Bedding Fill shall be worked under pipe haunches by hand to provide uniform support of the piping.

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3. Pipe Bedding Fill shall be compacted by wheel rolling with light rubber-tired equipment, or other light compaction equipment, as approved by the **ENGINEER OF RECORD**.

### I. Aggregate Base Course Material

1. Areas to receive Aggregate Base Course Material shall be placed on properly scarified, moisture conditioned, and compacted subgrade constructed to the elevations shown on the DRAWINGS.
2. Prior to placement of the Aggregate Base Course Material, the prepared subgrade shall be proofrolled with a heavily loaded rubber-tired vehicle. Any areas deflecting under the weight of the vehicle shall be removed to firm material as determined by the **ENGINEER OF RECORD**, and replaced with compacted Structural Fill.
3. **CONTRACTOR** shall moisture condition Aggregate Base Course Material to within two (2) percent of the optimum moisture content (per ASTM D1557). **CONTRACTOR** shall place Aggregate Base Course in maximum six (6) inch loose lifts and compact to ninety-five (95) percent of the maximum modified Proctor dry density (ASTM D1557).

### J. Riprap

1. Place Riprap in accordance with Section 506 of the CDOT Standard Specifications for Road and Bridge Construction, latest Edition.

### K. Diversion Berm Fill and Stormwater Diversion Pipe Backfill

1. Diversion Berm Fill or Stormwater Diversion Pipe Backfill shall be placed at the locations indicated on the DRAWINGS.
2. Diversion Berm Fill and Stormwater Diversion Pipe Backfill shall be placed in maximum eight (8) inch loose lifts, and compacted to ninety-five (95) percent of the maximum dry density (as determined by the standard Proctor test) at plus or minus two (2) percent of optimum moisture content (ASTM D698), unless specifically approved otherwise by the **ENGINEER OF RECORD**.

### L. Roadway Subgrade Fill

1. Roadway Subgrade Fill shall be placed in maximum eight (8) inch loose lifts, and compacted to ninety-five (95) percent of the maximum dry density (as determined by the standard Proctor test) at plus or minus two (2) percent of optimum moisture content (ASTM D698), unless specifically approved otherwise by the **ENGINEER OF RECORD**.

### 3.08 EQUIPMENT:

**CONTRACTOR** may use any type of earthmoving or excavating equipment unless otherwise noted in the SPECIFICATIONS, provided the equipment is in a satisfactory condition, complies with applicable rules and regulations, is of such capacity that the construction schedule can be maintained as planned by **CONTRACTOR**, and is approved by **MANAGER**.

\*\*\* END OF SECTION \*\*

# PIÑON RIDGE PROJECT TECHNICAL SPECIFICATIONS

## **SECTION 02608.0 PIPE BOLLARDS**

### **PART 1: GENERAL**

#### **1.01 SUMMARY:**

Pipe bollards shall consist of steel pipe placed in excavation and backfilled with concrete.

#### **1.02 RELATED SECTIONS:**

Refer to the following Sections for related work:

Section 03300.0 – Cast-In-Place Concrete

#### **1.03 SUBMITTALS:**

**CONTRACTOR** shall provide product data to allow evaluation by **MANAGER** and **ENGINEER OF RECORD**.

#### **1.04 TOLERANCES:**

Pipe bollards shall be constructed and placed as shown on the **DRAWINGS**.

#### **1.05 QUALITY ASSURANCE:**

Any work found unsatisfactory or any work disturbed by subsequent operations before acceptance is granted shall be corrected by **CONTRACTOR** as directed by **MANAGER**.

### **PART 2: PRODUCTS**

#### **2.01 MATERIALS:**

- A. Cast-in-place concrete used to fill pipe bollards shall be concrete as specified in Section 03300.0.
- B. Pipe shall be thirty-six (36) kips per square inch (ksi) standard steel pipe, with a nominal diameter of six (6) inches, and a minimum wall thickness of 0.28 inches.

### **PART 3: SUMMARY**

#### **3.01 EXECUTION:**

- A. Install pipe bollards to depths and in locations as shown on **DRAWINGS**.
- B. Backfill pipe bollards with concrete as specified in Section 03300.0 to the lines and grades shown on **DRAWINGS**.

\*\*\* END OF SECTION \*\*\*

# PIÑON RIDGE PROJECT TECHNICAL SPECIFICATIONS

## **SECTION 02621.0 DRAINAGE GEOCOMPOSITE AND GEONET**

### **PART 1: GENERAL**

#### **1.01 SUMMARY:**

This SPECIFICATION describes requirements for the manufacture, supply, and installation of the geonet and geocomposite drainage layers for placement as the Leak Detection Systems (LDS) in the Tailings Cells and Evaporation Ponds, as shown on the DRAWINGS. All procedures, operations and methods shall be in strict compliance with the SPECIFICATIONS, the CQA Plan, and the DRAWINGS.

#### **1.02 SUBMITTALS:**

##### **A. Submittals with Bid Documents**

**CONTRACTOR** shall provide the following information relating to the geosynthetic MANUFACTURER with its proposal:

1. Information from MANUFACTURER including company name, address, telephone number, the names of the company president and quality control manager, and narrative of the company history.
2. Description of MANUFACTURER'S manufacturing capabilities:
  - a. Information on plant size, equipment, personnel, number of shifts per day, and capacity per shift.
  - b. A list of standard material properties and test methods employed to arrive at the values for each. As a minimum, the list shall include properties given in Part 2 of this Section.
3. Quality Control Manuals from the MANUFACTURER for the installation and testing of the drainage materials.

##### **B. CONTRACTOR shall provide the following information after contract award but at a minimum fourteen (14) days prior to shipping of geosynthetics for review and approval by MANAGER and ENGINEER OF RECORD:**

1. The MANUFACTURER shall provide written certification that the drainage geocomposite and geonet to be used meets the requirements of these SPECIFICATIONS.
2. A copy of the MANUFACTURER's drainage geocomposite and geonet QC test results of properties outlined in Part 2 of this Section. The MANAGER reserves the right to refuse use of any drainage materials supplied without the proper QC documentation.
3. A detailed list of performance criteria for the geosynthetic material being produced for this project. (Note: Performance criteria are sometimes referred to as "minimum property values." Refer to Part 2 of this Section for drainage geocomposite and geonet properties and test methods.)

#### **1.03 QUALITY ASSURANCE:**

- ##### **A. All Work shall be constructed, monitored, and tested in compliance with requirements in the CQA Plan (Section 01400.2). CONTRACTOR and MANUFACTURER shall participate and comply with all items in these SPECIFICATIONS and requirements of the CQA Plan.**

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- B. **CONTRACTOR** shall ensure that the drainage geocomposite and geonet MANUFACTURER has an internal product quality control program that meets Contract requirements.
- C. **CONTRACTOR** shall be aware of all activities outlined in the CQA Plan, and the **CONTRACTOR** shall account for these activities in the construction schedule.
- D. **CONTRACTOR** shall assure that drainage geocomposite and geonet is delivered to the site at least five (5) calendar days prior to installation. Conformance testing must be completed, reviewed and approved by **ENGINEER OF RECORD** prior to installation of drainage geocomposite and geonet, as outlined in Section 01400.2.
- E. Drainage geocomposite and geonet rolls that do not meet the requirements of this SPECIFICATION will be rejected. **CONTRACTOR** will be required to replace the rejected material with new material that complies with the SPECIFICATIONS, at no additional cost to **OWNER**.
- F. In order to prevent weather damaged drainage geocomposite and geonet from being placed, the following Quality Assurance procedures shall be followed:
  - 1. **CONTRACTOR** shall perform its Work and utilize sufficient ballast as necessary to prevent wind uplift of the drainage geocomposite and geonet panels.
  - 2. If weather damage should occur, **ENGINEER OF RECORD** shall determine if the drainage geocomposite or geonet shall be repaired or replaced. Weather damage to the drainage geocomposite or geonet will include tears and dirty fabric, as determined by the **ENGINEER OF RECORD**.
  - 3. Repair or replacement of the weather-damaged drainage geocomposite or geonet shall be completed by **CONTRACTOR** at no additional cost to **OWNER**.
  - 4. As determined by **MANAGER** and **ENGINEER OF RECORD**, the drainage geocomposite or geonet panel may be rejected at no cost to **OWNER**.

### 1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Packing and Shipping
  - 1. Drainage geocomposite or geonet shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers, with straps for unloading.
  - 2. Drainage geocomposite or geonet rolls shall be marked or tagged with the following information.
    - a. MANUFACTURER's name
    - b. Manufacturing facility and date of manufacture
    - b. Product information
    - c. Roll and lot numbers
    - d. Roll dimensions
  - 3. **CONTRACTOR** shall ensure that drainage geocomposite or geonet rolls are properly loaded and secured to prevent damage during transit.
  - 4. **CONTRACTOR** shall protect drainage geocomposite or geonet from excessive heat, cold, puncture, cutting, or other damaging or deleterious conditions.
  - 5. **CONTRACTOR** shall ensure personnel responsible for loading, transport, and unloading of drainage geocomposite or geonet are familiar with handling and transport constraints imposed by MANUFACTURER.

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### B. Acceptance at Site

1. CQA Monitor shall perform inventory and surface inspection for defects and damage of all drainage geocomposite or geonet rolls upon delivery.
2. **CONTRACTOR** shall unroll and inspect any drainage geocomposite or geonet roll that may be damaged below the exposed surface of the roll.
3. **CONTRACTOR** shall repair damage resulting from handling and transport of drainage geocomposite or geonet at no cost to **OWNER**. If irreparable, in the opinion of **ENGINEER OF RECORD**, damaged materials shall be replaced at no cost to **OWNER**.

### C. Storage and Protection

1. **MANAGER** will provide on-site storage area for drainage geocomposite or geonet rolls from time of delivery until installation.
2. The storage of the materials is the responsibility of **CONTRACTOR** from the time the materials are manufactured until the time the completed installation is accepted. **CONTRACTOR** is responsible for preparing the storage location and for the protection of the material from the elements (e.g. ultraviolet light, moisture, temperature, etc.).
3. After **CONTRACTOR** has removed material from storage area, protect drainage geocomposite or geonet from puncture, dirt, groundwater, moisture, mud, mechanical abrasion, excessive heat, ultraviolet light exposure, and other sources of damage.
4. Drainage geocomposite or geonet shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers, with straps for unloading.
5. **CONTRACTOR** shall preserve integrity and readability of the drainage geocomposite or geonet roll labels, and store such that **MANAGER** and **ENGINEER OF RECORD** have access to the package slips or roll labels for each roll to verify roll acceptance.

## **PART 2: PRODUCTS**

### **2.01 MATERIALS:**

#### A. HDPE Geonet:

1. Geonet shall be manufactured by extruding two crossing strands to form a bi-planar drainage net structure.
2. The geonet supplied for the project shall meet or exceed the minimum (unless noted otherwise) roll values shown in Table 02621.0-1.

#### B. Drainage Geocomposite:

1. Drainage geocomposite shall be manufactured by extruding two crossing strands to form a bi-planar drainage net structure with a non-woven geotextile bonded to both sides.
2. The drainage geocomposite supplied for the project shall meet or exceed the minimum (unless noted otherwise) roll values shown in Table 02621.0-2.

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**TABLE 02621.0-1**

**MINIMUM AVERAGE ROLL VALUES FOR GEONET MATERIAL**

Property	Test Method	Tailings Cell Geonet <sup>2</sup>	Evaporation Pond Geonet <sup>3</sup>
Transmissivity, gal/min/ft (m <sup>2</sup> /sec)	ASTM D4716	28.98 (6x10 <sup>-3</sup> ) (See Note 1)	9.7 (2x10 <sup>-3</sup> ) (See Note 1)
Thickness, mil	ASTM D5199	275	200
Density, g/cm <sup>3</sup>	ASTM D1505	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D5035	65	45
Carbon Black Content, %	ASTM D1603/4218	2	2

Notes:

- 1 Gradient of 0.1, normal load of 10,000 psf, water at 70°F, between steel plates for 15 minutes.
- 2 Geonet for Tailings Cell construction shall consist of HyperNet HS geonet manufactured by GSE, or equivalent approved by the **ENGINEER OF RECORD, DESIGN ENGINEER, and MANAGER.**
- 3 Geonet for Evaporation Pond construction shall consist of HyperNet geonet manufactured by GSE, or equivalent approved by the **ENGINEER OF RECORD, DESIGN ENGINEER, and MANAGER.**

**TABLE 02621.0-2**

**MINIMUM AVERAGE ROLL VALUES FOR DRAINAGE GEOCOMPOSITE MATERIAL**

Property	Test Method	Tailings Cell Drainage Geocomposite <sup>2</sup>
<b>Geocomposite</b>		
Transmissivity <sup>1</sup> , gal/min/ft (m <sup>2</sup> /sec)	ASTM D4716	12.1 (2.5x10 <sup>-3</sup> )
Ply Adhesion, lb/in	ASTM D7005	1.0
<b>Geonet Core</b>		
Transmissivity <sup>2</sup> , gal/min/ft (m <sup>2</sup> /sec)	ASTM D4716	43.5 (9.0x10 <sup>-3</sup> )
Density, g/cm <sup>3</sup>	ASTM D1505	> 0.94
Tensile Strength <sup>4</sup> , lb/in	ASTM D5035	75
Carbon Black Content, %	ASTM D1603/4218	> 2.0
<b>Geotextile (Prior to lamination)</b>		
Mass per Unit Area (oz/yd <sup>2</sup> )	ASTM D5261	6
Grab Tensile, lb	ASTM D4632	170
Puncture Strength, lb	ASTM D4833	90
Apparent Opening Size (AOS), U.S. Sieve	ASTM D4751	70
Permittivity, sec <sup>-1</sup>	ASTM D4491	1.5
Flow Rate, gpm/ft <sup>2</sup>	ASTM D4491	110
UV Resistance, % retained	ASTM D4355 (after 500 hours)	70

Notes:

- 1 This is an index transmissivity value measured at stress = 1,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geocomposite/plate.
- 2 This is an index transmissivity value measured at stress = 1,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geonet/plate.
- 3 All properties are minimum average roll values based on the cumulative results of specimens tested except AOS which is a maximum average roll value (MaxARV); and UV resistance which is a typical value.
- 4 Tested in machine direction (MD).
- 5 Drainage geocomposite for Tailings Cell construction shall consist of FabriNet TRx manufactured by GSE, or equivalent approved by the **ENGINEER OF RECORD, DESIGN ENGINEER, and MANAGER.**

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## C. Resin:

1. Resin shall be new first quality, compounded polyethylene resin.
2. Natural resin (without carbon black) shall meet the additional minimum requirements presented in Table 02621.0-3.

**TABLE 02621.0-3**

### MINIMUM RESIN PROPERTIES

Property	Test Method	Value
Density (g/cm <sup>3</sup> )	ASTM D1505	>0.94
Melt Flow Index (g/10 min)	ASTM D1238	≤1.0

## **PART 3: EXECUTION**

### **3.01 FAMILIARIZATION:**

#### A. Inspection

1. Prior to implementing any of the Work in this Section, the **INSTALLER** shall carefully inspect the installed Work of all other Sections and verify that all Work is complete to the point where installation of the materials outlined in this Section may properly commence without adverse impact.
2. If the **INSTALLER** has any concerns regarding the installed Work of other Sections, the **INSTALLER** shall notify the CQA Monitor who will then notify the **MANAGER**.

### **3.02 MATERIAL PLACEMENT:**

#### A. Geocomposite

1. The geocomposite roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the **ENGINEER OF RECORD**.
2. If the project contains long, steep slopes, special care should be taken so that only full length rolls are used at the top of the slope.
3. In the presence of wind, all geocomposites shall be weighted down with sandbags or other means approved by the **MANAGER** and **ENGINEER OF RECORD**. Sandbags, or other means, shall be used during placement and remain until replaced with cover material.
4. Geocomposite shall be properly anchored to resist sliding in anchor trenches, per the design **DRAWINGS**. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.

#### B. Geonet

1. The geonet roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the **ENGINEER OF RECORD**.
2. If the project contains long, steep slopes, special care should be taken so that only full length rolls are used at the top of the slope.

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3. In the presence of wind, all geonet shall be weighted down with sandbags or other means approved by the **MANAGER** and **ENGINEER OF RECORD**. Sandbags, or other means, shall be used during placement and remain until replaced with cover material.
4. Geonet shall be properly anchored to resist sliding in anchor trenches, per the design DRAWINGS. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.

### 3.03 SEAMS AND OVERLAPS:

#### A. Geocomposite

1. Each component of the geocomposite will be secured to the like component at overlaps.
2. Adjacent edges of the geonet along the length of the geocomposite roll shall be placed with the edges of each geonet butted against each other, or as recommended by the **ENGINEER OF RECORD**.
3. The overlapped edges shall be joined by tying the geonet structure with cable ties. These ties shall be spaced every five (5) feet along the roll length.
4. Adjoining geocomposite rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite a minimum of twelve (12) inches across the roll width.
5. The geonet portion of the geocomposite should be tied every six (6) inches in the anchor trench or as specified by the **ENGINEER OF RECORD**.

#### B. Geonet

1. Each component of the geonet will be secured to the like component at overlaps.
2. Adjacent edges along the length of the geonet roll shall be overlapped a minimum of six (6) inches, or as recommended by the **ENGINEER OF RECORD**.
3. The overlapped edges shall be joined by tying the geonet structure with cable ties. These ties shall be spaced every five (5) feet along the roll length.
4. Adjoining rolls across the roll width should be shingled down in the direction of the slope and joined together with cable ties spaced every one (1) foot along the roll width.

### 3.04 REPAIR:

#### A. Geocomposite

1. Prior to covering the deployed geocomposite, each deployed roll shall be inspected for damage resulting from construction.
2. Any rips, tears, or damaged areas on the deployed geocomposite shall be removed and patched. The patch shall be secured to the original geocomposite by tying every six (6) inches with the approved tying devices. If the area to be repaired is more than fifty (50) percent of the width of the panel, the damaged area shall be cut out and the two portions of the geocomposite shall be joined in accordance with Article 3.03.

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### B. Geonet

1. Prior to covering the deployed geonet, each deployed roll shall be inspected for damage resulting from construction.
2. Any rips, tears, or damaged areas on the deployed geonet shall be removed and patched. The patch shall be secured to the original geonet by tying every six (6) inches with the approved tying devices. If the area to be repaired is more than fifty (50) percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be joined in accordance with Article 3.03.

\*\*\* END OF SECTION \*\*

# PIÑON RIDGE PROJECT TECHNICAL SPECIFICATIONS

## **SECTION 02710.0 PIPING**

### **PART 1: GENERAL**

#### **1.01 RELATED SECTIONS:**

Refer to the following Sections for related work:

- Section 02200.0 – Earthworks
- Section 02621.0 – Drainage Geocomposite and Geonet
- Section 02776.0 – Geomembrane
- Section 02777.0 – Geotextile

#### **1.02 SUBMITTALS:**

- A. **CONTRACTOR** shall abide by all qualification and submittal requirements.
- B. **CONTRACTOR** shall provide product data including MANUFACTURER's technical data (resin), test data (strength), and SPECIFICATIONS sufficient to allow evaluation by **MANAGER** and **ENGINEER OF RECORD**.

#### **1.03 QUALITY ASSURANCE:**

- A. All work shall be constructed, monitored, and tested in accordance with the requirements of the CQA Plan.
- B. Any work found unsatisfactory or any work disturbed by subsequent operations before acceptance is granted shall be corrected by **CONTRACTOR** as directed by **MANAGER** at no additional cost to **OWNER**.

### **PART 2: PRODUCTS**

#### **2.01 MATERIALS:**

- A. Collection and conveyance pipe for construction of the tailings cell underdrain system, tailings cell liner buttressing, and pond leak detection systems shall consist of:
  - 1. Dual Wall Perforated Corrugated Polyethylene (PCPE) Pipe – This pipe designation referred to in the SPECIFICATIONS and on the DRAWINGS is a high density polyethylene corrugated pipe with an integrally formed smooth interior as manufactured by Advanced Drainage Systems, Inc., or an equivalent approved by **ENGINEER OF RECORD**. Perforations shall be according to AASHTO Class II specifications and the maximum slot width shall not exceed 0.157 inches (4 mm). Pipe shall be made of polyethylene compounds which meet or exceed the requirements of Cell Class 324420C (min.) per ASTM D3350. Minimum parallel plate pipe stiffness shall be as follows:

<b>Diameter</b>	<b>Pipe Stiffness</b>
8-inch	50 psi
18-inch	40 psi

The nominal size for the pipe and fittings is based on the nominal inside diameter of the pipe. The pipe and fittings will be free of foreign inclusions and visible defects. Fittings supplied by manufacturers other than the supplier of the pipe shall not be permitted without the approval of the **MANAGER**. The ends of the pipe shall be cut squarely and cleanly so as not to adversely affect joining. Joints shall be split couplings, corrugated to engage the pipe corrugations and shall engage a minimum of four (4) corrugations, two (2) on each

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side of the pipe joint. Where required by the **MANAGER**, a neoprene gasket shall be utilized with the coupling to provide a soil-tight joint.

2. HDPE Pipe – High density polyethylene pipe, Performance Pipe™ as manufactured by Chevron Phillips Chemical Company or equivalent, with a standard dimension ratio (SDR) of 11 or 17 as indicated on the DRAWINGS. The resin, pipe, and fittings will comply with the following industry standards: Pipe Standard, ASTM F-714; Fittings Standard, ASTM D3261; Cell Classification ASTM 3350, PE345434C. Perforated portions of pipe shall be slotted with a maximum slot width not exceeding 0.157 inches (4 mm).

### **PART 3: EXECUTION**

#### **3.01 INSTALLATION:**

- A. **CONTRACTOR** shall install pipe according to MANUFACTURER's recommendations.
- B. **CONTRACTOR** shall take all precautions necessary to not damage the pipe or underlying geosynthetics during material placement. **CONTRACTOR** may periodically be requested by **MANAGER** to verify that covered pipe has not been crushed. Costs associated with proving pipes have not been crushed shall be borne by **CONTRACTOR**.
- C. Piping shall be placed to the lines and elevations shown on the DRAWINGS, with no sags or humps, as approved by **MANAGER** and **ENGINEER OF RECORD**. Underdrain collection pipe shall be installed with a minimum positive slope of 1.0 percent.

#### **3.02 PIPE CONNECTIONS:**

- A. All connections for non-perforated pipe shall be watertight under maximum anticipated pressure head.
- B. The ends of all pipes shall be capped with manufactured pipe caps.
- C. HDPE pipe will be butt-heat-fusion welded in accordance with the MANUFACTURER's guidelines.
- D. PCPE pipe joints shall conform to MANUFACTURER's recommendations.

#### **3.03 BEDDING AND BACKFILL:**

- A. Underdrain collection pipe shall be placed on top of the geomembrane, as shown on the DRAWINGS.
- B. **CONTRACTOR** shall backfill underdrain collection piping with Coarse Underdrain Fill as indicated on the DRAWINGS, ensuring that backfill is placed under and around the pipe haunches.
- C. Placement of piping shall be coordinated with other operations such as Coarse Underdrain Fill, Fine Underdrain Fill, Leak Detection Fill, and Pipe Bedding Fill placement. Equipment access directly on geomembrane is prohibited, unless specifically approved by the **MANAGER** and **ENGINEER OF RECORD** (i.e., wheelbarrow). Any damage to the geomembrane caused by **CONTRACTOR** during pipe placement shall be repaired at the expense of **CONTRACTOR**.
- D. **CONTRACTOR** is responsible to ensure that the minimum fill requirements are placed over the pipes, as shown in the DRAWINGS before crossing with construction equipment. If pipe becomes crushed during or after installation by **CONTRACTOR**'s equipment or methods of construction, the pipe shall be replaced by **CONTRACTOR**, at no additional cost to **OWNER**. The **CONTRACTOR** will be required to demonstrate to the **MANAGER** that the equipment and procedures used are not detrimental to the piping, at no additional cost to **OWNER**.

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- E. **CONTRACTOR** shall hold pipes in place with sand bags, or other methods approved by the **MANAGER**, until the fill has been placed. Immediately prior to placement of fill adjacent to piping, the sand bags will be removed.
- F. Pipes used for liner buttressing shall be backfilled with sand, or other soil approved by **ENGINEER OF RECORD** and **MANAGER** that is not prone to bridging. Pipes used for liner buttressing shall be held in place with sand bags, or other methods approved by the **MANAGER**.

\*\*\* END OF SECTION \*\*\*

# PIÑON RIDGE PROJECT TECHNICAL SPECIFICATIONS

## SECTION 02776.0 GEOMEMBRANE

### PART 1: GENERAL

#### **1.01 SUMMARY:**

This SPECIFICATION describes requirements for the manufacture, fabrication (if needed), supply, and installation of polyethylene geomembrane for lining of the Tailings Cells, Evaporation Ponds, Stormwater Collection Ponds, and other areas as shown on the DRAWINGS; and construction quality control monitoring and testing. All procedures, operations and methods shall be in strict compliance with the SPECIFICATIONS, Construction Quality Assurance (CQA) Plan, and the DRAWINGS.

#### **1.02 SUBMITTALS:**

- A. **CONTRACTOR** shall provide the following information relating to the geomembrane MANUFACTURER and **INSTALLER** with its proposal.
1. Information from the MANUFACTURER including company name, address, telephone number, the names of the company president and quality control manager, and narrative of the company history.
  2. Information from the MANUFACTURER on factory size, equipment, personnel, number of shifts per day, and capacity per shift.
  3. Quality Control Manuals from the MANUFACTURER and **INSTALLER** for the installation and testing of the geomembrane, including trial seams, seaming, nondestructive testing, destructive testing procedures, repair procedures and in-field quality control forms. Upon review of the Quality Control Manuals, **MANAGER** may request additional testing during the manufacturing process at no additional cost to **OWNER**.
  4. A list of at least five (5) completed facilities from the MANUFACTURER totaling a minimum of 5,000,000 square feet between all five (5) facilities of the type of geomembrane that is being installed at the Piñon Ridge Project. Each entry in this list should specify the name and purpose of the facility, its location and date of installation, the name of the owner, the project manager, designer, fabricator (if any), and the geomembrane installation contractor and the name and telephone number of the contact at the facility who can discuss the project. In addition, the geomembrane thickness and total square footage of the installation surface should be included.
  5. Installation capabilities of the **INSTALLER**.
  6. Information on equipment and personnel from the **INSTALLER**.
  7. A list of at least five (5) completed facilities, totaling 5,000,000 square feet for which **INSTALLER** has installed the type of geomembrane that is being installed at the Piñon Ridge Project. For each installation, the following information shall be provided:
    - a. Name and purpose of facility, its location, and date of installation.
    - b. Name of Owner, Design Engineer, MANUFACTURER, Fabricator, if applicable, and name and telephone number of contact at the facility who can discuss the project.
    - c. Thickness of geomembrane and surface area of the installed geomembrane.
    - d. Type of seaming, patching, and tacking equipment.

## PIÑON RIDGE PROJECT TECHNICAL SPECIFICATIONS

- e. A copy of the MANUFACTURER's and/or Fabricator's approval letter(s) and/or license(s), if applicable.
- B. **CONTRACTOR** shall provide the following information for approval after contract award but within ten (10) days prior to geomembrane arrival on site and prior to commencement of the Work:
1. A copy of each of the Quality Control Certificates on each lot of resin issued by the resin Supplier for the specific material for this project including certification of the resin for extrusion welding.
  2. The results of Quality Control testing conducted by the MANUFACTURER on the resin used in manufacturing the specific material for this project.
  3. A listing that correlates the resin to the individual geomembrane rolls and welding rods.
  4. A copy of the geomembrane roll Quality Control Certificates. These certificates shall be supplied at a minimum frequency of one (1) per every fifty thousand (50,000) square feet of geomembrane material produced. These certificates shall be issued only for the individual geomembrane rolls sampled and tested by the MANUFACTURER or its representative. The certificates will contain test results of properties outlined in Article 2.01 of this Section. **MANAGER** reserves the right to refuse use of any geomembrane supplied without the proper quality control documentation at no cost to **OWNER**.
  5. A detailed list of performance criteria for the geomembrane material being produced for this project. (Note: Performance criteria are sometimes referred to as "minimum property values." Refer to Articles 2.01 and 2.02 of this Section for geomembrane properties and Test Methods.)
  6. Resume from the **INSTALLER** of the Installation Superintendent, Master Seamer, and Quality Control Inspector to be assigned to the Work, including dates and duration of employment.
  7. Certification from the **INSTALLER** that both the Installation Supervisor, Quality Control Inspector, and Master Seamer have reviewed the SPECIFICATIONS, Construction Quality Assurance Plan, and the DRAWINGS.
  8. A panel layout drawing showing the proposed installation layout identifying field seams and including areas such as sumps, trenches and pipe penetrations as well as any variance or additional details that deviate from the DRAWINGS. The layout shall be adequate for use as a construction plan and shall include dimensions, details, etc. Any proposed variance or deviation from these documents shall be submitted to **MANAGER** in writing a minimum of seven (7) working days prior to the scheduled start of geomembrane installation and will be accepted/rejected by **ENGINEER OF RECORD** prior to start of installation.
  9. A list of personnel performing field seaming operations along with pertinent experience information.
  10. All geosynthetic Quality Control Certificates required by these SPECIFICATIONS.
  11. Certification that extrudate to be used is comprised of the same resin as the geomembrane to be used.
- C. Submittals by **CONTRACTOR** to **MANAGER** during the course of the Work.
1. Daily reports detailing arrival and departure times, the personnel present on-site, the progress of the Work, the arrival of materials, daily square footage deployed and seamed,

## PIÑON RIDGE PROJECT TECHNICAL SPECIFICATIONS

- daily square footage of geomembrane approved by the CQA Monitor and any problems encountered.
2. Subgrade surface acceptance certificates for each area to be covered by the lining system, signed by **CONTRACTOR**.
- D. Without limiting the provisions of the Contract, the **CONTRACTOR** shall warrant the Work to **MANAGER** in accordance with the following:
1. Provide a written warranty similar to that included in Geosynthetics Research Institute (GRI) Test Method GM-13.
  2. The geomembrane supplied meets or exceeds all published SPECIFICATIONS as referenced by this SPECIFICATION.
  3. The geomembrane are free of defects in materials and workmanship.
  4. The **CONTRACTOR** shall repair or replace all defects in the material detected on-site, including uncovering and recovering the Work, in compliance with the **SPECIFICATIONS** at no additional cost to **OWNER**.
  5. The **CONTRACTOR** shall repair any detected leaks in any seams (Manufactured or field joined), including uncovering and recovering the Work, in compliance with the SPECIFICATIONS at no additional cost to **OWNER**.

### 1.03 QUALITY ASSURANCE:

- A. Manufacturing Qualifications
1. The MANUFACTURER(s) shall have experience in the manufacture of the type of geomembrane that is being installed at the Piñon Ridge Project totaling at least five (5) completed facilities with a minimum of 5,000,000 square feet between all five facilities.
  2. The MANUFACTURER shall provide sufficient production and qualified personnel to meet the demands of the Work and shall have an internal quality control program for its product.
  3. The MANUFACTURER shall permit **MANAGER**, **DESIGN ENGINEER**, and/or **ENGINEER OF RECORD** or their authorized representative to visit the manufacturing plant.
- B. Geomembrane Installation Qualifications (**INSTALLER**)
1. **INSTALLER** shall be the MANUFACTURER or an approved **CONTRACTOR** trained and licensed to install the MANUFACTURER's geomembrane.
  2. Installation shall be performed under the constant direction of single Installation Superintendent who shall remain on-site and be responsible, throughout the geomembrane installation, for geomembrane layout, seaming, patching, testing, repairs, and all other activities by **INSTALLER**.
  3. The Installation Superintendent shall have installed or supervised, at a minimum of three (3) installation projects that entailed the installation of at least a total of 1,000,000 square feet of the type of geomembrane that is being installed at the Piñon Ridge Project, using the same type of seaming apparatus specified for the Work.

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4. Actual seaming shall be performed under the direction of a Master Seamer (who may also be the Installation Superintendent) who has seamed a minimum of 1,000,000 square feet of the type of geomembrane that is being installed at the Piñon Ridge Project, using the same type of seaming apparatus specified for the Work.
5. The Installation Superintendent and/or Master Seamer shall be present whenever seaming is performed.

### C. Quality Assurance Program

1. All Work shall be constructed, monitored, and tested in compliance with the requirements of the CQA Plan (Section 01400.2). **CONTRACTOR** and **MANUFACTURER** shall participate in and comply with all items in these SPECIFICATIONS and requirements of the CQA Plan.
2. **CONTRACTOR** shall ensure that each geomembrane **MANUFACTURER** that supplies materials to this project has an internal product quality control program that meets these SPECIFICATIONS.
3. During manufacturing of the geomembrane, samples of geomembrane shall be removed for laboratory testing to ensure compliance with this SPECIFICATION. Conformance sampling and testing will be performed in accordance with the CQA Plan.
4. **CONTRACTOR** shall assure that the geomembrane is delivered to the site at least ten (10) calendar days prior to installation. **CONTRACTOR** shall provide required Quality Control information ten (10) calendar days prior to geosynthetics being delivered to the site, and on delivery of geosynthetics to the site.
5. Geomembrane rolls that do not meet the requirements of this SPECIFICATION will be rejected. **CONTRACTOR** shall replace the rejected material with new material that conforms to the SPECIFICATION requirements, at no additional cost to **OWNER**.
6. **CONTRACTOR** shall ensure that all personnel performing geomembrane seaming operations are qualified by experience or by successfully passing seaming tests (see Article 3.08(D) of this Section). **MANAGER** reserves the right to reject any welding technician whose performance is unsatisfactory.
7. **INSTALLER**'s Superintendent and QC Inspector shall attend the pre-construction meeting.

### D. Field Samples

1. Geomembrane sampling and testing shall be conducted in accordance with the project SPECIFICATIONS for the following:
  - a. Trial seam testing (Article 3.07 of this Section).
  - b. Destructive seam testing (Article 3.09 of this Section).
2. **CONTRACTOR** shall maintain on-site a minimum of one spare operable tensiometer and provide documentation indicating that all tensiometers used at the project were calibrated within sixty (60) days prior to the tensiometer arriving on-site for testing field samples.

- E. In order to prevent wind damaged geomembranes from being placed, the following Quality Assurance procedures shall be followed:

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1. **CONTRACTOR** shall perform its Work and utilize sufficient ballast as necessary to prevent wind uplift of the geomembrane panels.
2. If wind damage should occur, **ENGINEER OF RECORD** shall determine if the geomembrane shall be repaired or replaced. Wind damage to the geomembrane will include wrinkles, creases, and tears, as determined by **ENGINEER OF RECORD**.
3. Repair or replacement of the wind-damaged geomembrane shall be completed by **CONTRACTOR** at no additional cost to **OWNER**.
4. As determined by **MANAGER** and **ENGINEER OF RECORD**, the geomembrane panel may be rejected at no cost to **OWNER**.

### 1.04 DELIVERY, STORAGE, AND HANDLING:

#### A. Packing and Shipping

1. Labels on each roll delivered to Site shall identify the following.
  - a. MANUFACTURER's name
  - b. Product Identification
  - c. Thickness
  - d. Roll number
  - e. Batch or lot number
  - f. Panel number (when applicable)
  - g. Roll dimensions
2. **CONTRACTOR** shall ensure that geomembrane rolls are properly loaded and secured to prevent damage during transit.
3. **CONTRACTOR** shall protect geomembrane from excessive heat, cold, puncture, cutting, or other damaging or deleterious conditions.
4. **CONTRACTOR** shall ensure personnel responsible for loading, transport, and unloading of geomembrane are fully aware of the consequences of damage to geomembrane, and are familiar with handling and transport constraints imposed by MANUFACTURER.
5. Geomembrane delivered to the project shall be protected by a relatively impermeable and opaque protective cover, with individual straps for unloading.

#### B. Acceptance at Site

1. CQA Monitor shall perform inventory and surface inspection for defects and damage of all geomembrane rolls upon delivery.
2. **CONTRACTOR** shall unroll and inspect any geomembrane roll that may be damaged below the exposed surface of the geomembrane roll.
3. **CONTRACTOR** shall repair damage resulting from handling and transport of geomembranes at no additional cost to **OWNER**. If irreparable, in the opinion of **ENGINEER OF RECORD**, damaged materials shall be replaced at no additional cost to **OWNER**.

#### C. Storage and Protection

1. **MANAGER** will provide area for on-site storage of the geomembrane rolls from time of delivery until installation.

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2. The storage and handling of the materials is the responsibility of **CONTRACTOR** from the time the materials are manufactured until the time the completed installation is accepted. **CONTRACTOR** is responsible for preparing the storage location and for the protection of the materials from the elements (e.g., ultraviolet light, moisture, temperature, etc.).
3. After **CONTRACTOR** has removed material from storage, **CONTRACTOR** shall protect geomembrane from puncture, dirt, grease, water, moisture, mud, mechanical abrasion, excessive heat or cold, and other sources of damage.
4. **CONTRACTOR** shall preserve integrity and readability of the geomembrane roll labels, and store the rolls such that **MANAGER** and **ENGINEER OF RECORD** have access to the package slips or roll labels for each roll to verify roll acceptance.
5. The geomembrane rolls shall be stored on a prepared surface (not wooden pallets) and should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four rolls).

### 1.05 SITE CONDITIONS:

#### A. Geomembrane Deployment

1. Do not proceed with deployment at an ambient temperature below 14°F or above 100°F unless otherwise authorized, in writing, by **MANAGER**, **DESIGN ENGINEER**, and **ENGINEER OF RECORD**. Temperature monitoring shall be performed by the CQA Monitor.
2. Do not deploy during precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds.
3. Do not undertake deployment if weather conditions will preclude material seaming on same day as deployment.

#### B. Seaming

##### 1. Normal Weather Conditions

Normal seaming procedures may take place if the following weather conditions exist:

- a. Ambient temperature between 35°F and 100°F.
- b. Dry conditions, i.e., no precipitation or other excessive moisture, such as fog or dew.
- c. No excessive winds.

##### 2. Adverse Weather Conditions

- a. Do not seam if ambient temperature is below 14°F or above 100°F.
- b. Do not seam during precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds.
- c. If the ambient air temperature is between 14°F and 35°F for the entire shift, Cold Weather Seaming provisions will govern:

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1. The **INSTALLER** will be required to perform a minimum of four trial seams during the planned Work shift, at approximately the same time interval throughout the scheduled Work day.
2. If the subgrade materials are considered frozen as outlined in Item 3.07 of Section 2200.0, the **INSTALLER** must place seaming boards or slip sheets when seaming. Seaming boards or slip sheets shall be removed by **INSTALLER**.

## **PART 2: PRODUCTS**

### **2.01 MATERIALS:**

- A. The geomembrane shall be a high density polyethylene (HDPE). The geomembrane shall be manufactured of new, first-quality resin and shall be manufactured specifically for this type of application. No inclusion of reclaimed polymer is acceptable.
- B. The resin MANUFACTURER shall certify each batch of raw material for the following properties:

**TABLE 02776-1  
HDPE GEOMEMBRANE RESIN PROPERTIES**

<b>Property</b>	<b>Test Method</b>	<b>Requirements</b>
Base Resin Specific Gravity (g/cm <sup>3</sup> )	ASTM D1505	0.935 – 0.941
Melt Flow Index (g/10 min.)	ASTM D1238	≤1.0
Oxidation Induction Time (min.)	ASTM D3895	100

The MANUFACTURER of HDPE products is required to meet the GRI GM13 standards.

- D. The geomembrane sheet shall be comprised of a minimum ninety-six (96) percent pure polyethylene. The remaining portion shall be made up of materials necessary for the performance of the liner (such as carbon black, anti-oxidants, etc.). The geomembrane rolls shall meet the following SPECIFICATIONS:
  1. The surface of the geomembrane shall not have striations, roughness (except texture as specified), pinholes, or bubbles and shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter. **MANAGER** and **ENGINEER OF RECORD** may request additional testing in order to support such acceptance. All such testing shall be done at the sole expense of the **CONTRACTOR**.
  2. Textured surfaced geomembrane shall meet the requirements shown in the following tables for the following materials:
    - a. Table 02776-2A for white-surfaced coextruded textured HDPE geomembrane.
      1. The geomembrane shall be white-surfaced, coextruded geomembrane.
      2. The white surface shall be installed upwards.
      3. The textured surface shall be the bottom black surface.
      4. The white geomembrane shall be conductive for installation within the Tailings Cells to facilitate spark testing.
    - b. Table 02776-2B for black coextruded textured HDPE geomembrane.

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3. Smooth surfaced geomembrane shall meet the requirements shown in the following tables for the following materials:
  - a. Table 02776-2C for black HDPE geomembrane.
    1. The upper primary geomembrane for installation within the Evaporation Ponds shall be conductive to facilitate spark testing.

**TABLE 02776-2A  
TYPICAL 60 MIL WHITE SINGLE-SIDED  
TEXTURED HDPE GEOMEMBRANE PROPERTIES**

Property	Test Method	Textured 60 mil White HDPE
Thickness (minimum average), mil	ASTM D5994	57
Lowest individual for 8 out of 10 values		54
Lowest individual for any of the 10 values		51
Compound Density (g/cm <sup>3</sup> ) <sup>3</sup>	ASTM D1505	0.940
Carbon Black Dispersion	ASTM D5596	(See Note 1)
Carbon Black Content (%) <sup>3,4</sup>	ASTM D1603/4218	2.0 – 3.0
Asperity Height	GRI GM12	(See Note 2)
Tensile Properties (each direction) <sup>5</sup>	ASTM D6693, Type IV	
Strength at Break, lb/in-width	Dumbell, 2 ipm	90
Strength at Yield, lb/in-width		126
Elongation at Break, %	G.L. = 2.0 in	100
Elongation at Yield, %	G.L. = 1.3 in	12
Puncture Resistance (lb)	ASTM D4833	90 (min. ave.)
Tear Resistance (lb)	ASTM D1004	42 (min. ave.)

Notes:

- 1 Carbon Black dispersion (only applies to near spherical agglomerates) for 10 different views:
  - a. 9 or 10 views shall be Category 1 or 2; and
  - b. No more than 1 view from Category 3.
- 2 10 mil average. 8 of 10 readings ≥ 7 mils. Lowest individual ≥ 5 mils.
- 3 The values apply to the black layer only.
- 4 White texturing may have an overall ash content greater than 3 percent due to the white layer.
- 5 The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.

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**TABLE 02776-2B  
TYPICAL 60 MIL BLACK DOUBLE-SIDED  
TEXTURED HDPE GEOMEMBRANE PROPERTIES**

Property	Test Method	Textured 60 mil Black HDPE
Thickness (minimum average), mil	ASTM D5994	57
Lowest individual for 8 out of 10 values		54
Lowest individual for any of the 10 values		51
Compound Density (g/cm <sup>3</sup> )	ASTM D1505	0.940
Carbon Black Dispersion	ASTM D5596	(See Note 1)
Carbon Black Content (%)	ASTM D1603/4218	2.0 – 3.0
Asperity Height	GRI GM12	(See Note 2)
Tensile Properties (each direction) <sup>3</sup>	ASTM D6693, Type IV	
Strength at Break, lb/in-width	Dumbell, 2 ipm	90
Strength at Yield, lb/in-width		126
Elongation at Break, %	G.L. = 2.0 in	100
Elongation at Yield, %	G.L. = 1.3 in	12
Puncture Resistance (lb)	ASTM D4833	90 (min. ave.)
Tear Resistance (lb)	ASTM D1004	42 (min. ave.)

Notes:

- 1 Carbon Black dispersion (only applies to near spherical agglomerates) for 10 different views:
  - a. 9 or 10 views shall be Category 1 or 2; and
  - b. No more than 1 view from Category 3.
- 2 10 mil average. 8 of 10 readings ≥ 7 mils. Lowest individual ≥ 5 mils.
- 3 The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.

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**TABLE 02776-2C  
TYPICAL 60 MIL SMOOTH  
HDPE GEOMEMBRANE PROPERTIES**

Property	Test Method	Smooth 60 mil HDPE
Thickness (minimum average), mil Lowest individual for any of the 10 values	ASTM D5994	60 54
Compound Density (g/cm <sup>3</sup> ) Carbon Black Dispersion Carbon Black Content (%)	ASTM D1505 ASTM D5596 ASTM D1603/4218	0.940 (See Note 1) 2.0 – 3.0
Tensile Properties (each direction) <sup>3</sup> Strength at Break, lb/in-width Strength at Yield, lb/in-width Elongation at Break, % Elongation at Yield, %	ASTM D6693, Type IV Dumbell, 2 ipm  G.L. = 2.0 in G.L. = 1.3 in	228 126 700 12
Puncture Resistance (lb)	ASTM D4833	108 (min. ave.)
Tear Resistance (lb)	ASTM D1004	42 (min. ave.)

Notes:

- 1 Carbon Black dispersion (only applies to near spherical agglomerates) for 10 different views:
  - a. 9 or 10 views shall be Category 1 or 2; and
  - b. No more than 1 view from Category 3.

**2.02 SEAMING AND TESTING EQUIPMENT:**

A. Seaming

1. Approved field seaming processes are hot shoe double fusion welding and extrusion welding, when approved by **ENGINEER OF RECORD**. Use double fusion welding as primary method of seaming adjacent field panels.
2. **CONTRACTOR** shall maintain on-site a minimum of two spare operable seaming apparatuses.
3. Seaming equipment shall not damage the geomembrane.
4. **CONTRACTOR** may use a hot air device ("Leister") to temporarily bond geomembrane panels that are to be extrusion welded.
5. **CONTRACTOR** shall use extrusion welding apparatus equipped with gauges giving temperature of preheat and extrudate at nozzle of apparatus.
6. Welding rods or beads used for extrusion welding shall have the same physical properties as the resin used in the manufacture of the type of geomembrane that is being installed at the Piñon Ridge Project.
7. **CONTRACTOR** shall use fusion welding apparatus which are self-propelled devices equipped with a gauge indicating temperature of heating element, and a gauge indicating the speed of the welding apparatus.

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### B. Vacuum Testing (for extrusion seam only)

The equipment shall consist of the following:

1. Vacuum box assembly consisting of: rigid housing, transparent viewing window, soft neoprene gasket attached to bottom of housing or port hole and valve assembly, and vacuum gauge;
2. Pump assembly equipped with pressure controller and pipe connections;
3. Rubber pressure/vacuum hose with fittings and connections;
4. Bucket of soapy solution; and
5. Wide paint brush, or other means of applying soapy solution.

### C. Air Pressure Testing (for double fusion seam only)

The equipment shall consist of the following:

1. Air pump (manual or motor driven), equipped with a pressure gauge, capable of generating, sustaining, and measuring pressure between 25 and 30 psi and mounted on a cushion to protect geomembrane;
2. Rubber hose with fittings and connections;
3. Sharp hollow needle, or other approved pressure feed device; and
4. An air pressure monitoring device.

### D. Spark Testing of Conductive Geomembrane (primary geomembrane liner of Tailings Cells and Evaporation Ponds only)

The equipment shall consist of the following:

1. A power source with a range of voltage from 15,000 to 35,000 volts, or greater if approved by **MANAGER** and **ENGINEER OF RECORD**. The power source shall be equipped with a ground terminal, high voltage terminal, sensitivity dial, voltage dial, and alarm buzzer;
2. A test wand with a brass (i.e., conductive) brush connected to the power source via a high voltage lead; and
3. Electrically conductive grounding pad connected to the power source via a ground lead.

## **PART 3: EXECUTION**

### **3.01 SUBGRADE:**

**CONTRACTOR**, on a daily basis, shall certify in writing that the surface on which the geomembrane will be installed is acceptable. It will be the **CONTRACTOR**'s responsibility to maintain, protect, and if required return, the subgrade in the condition that was originally accepted, prior to geosynthetic deployment until accepted by **OWNER**, under criteria identified in Sections 02200.0 as per the subgrade SPECIFICATIONS, in Section 02776.1 as per the geosynthetic clay liner (GCL) SPECIFICATIONS, or in Sections 02778.0 as per the drainage SPECIFICATIONS.

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### 3.02 ACCEPTANCE:

**CONTRACTOR** shall retain all ownership and responsibility for the geomembrane until final acceptance. The geomembrane shall be accepted by **OWNER** when all of the following conditions are met:

1. Installation is finished;
2. Verification of the adequacy of all seams and repairs, including associated testing, is complete;
3. Certification, including QC documentation is provided by **CONTRACTOR** to **MANAGER**;
4. Recommended acceptance by **MANAGER** and **ENGINEER OF RECORD**; and
5. The entire Project, including Underdrain construction and Diversion Channel construction, is completed.

### 3.03 ANCHOR TRENCH:

- A. The anchor trenches shall be excavated to the lines, grades, and widths shown on the DRAWINGS, prior to geosynthetic placement. **ENGINEER OF RECORD** shall verify that the anchor trench has been constructed according to the DRAWINGS.

Slightly rounded corners shall be provided in the trench where the geomembrane adjoins the trench so as to avoid sharp bends in the geomembrane.

- B. The anchor trench shall be backfilled and compacted as approved by **MANAGER**, **DESIGN ENGINEER** and **ENGINEER OF RECORD**. Trench backfill material shall be placed in eight (8) to twelve (12) inch thick loose lifts and compacted by wheel rolling with light, rubber-tired or other light compaction equipment per the requirements of Section 02200.0, as approved by **ENGINEER OF RECORD**.

Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. At no time shall construction equipment come into direct contact with the geomembrane. If damage occurs, it shall be repaired by **CONTRACTOR** prior to the completion of backfilling, at no cost to **OWNER**.

- C. Extend geomembrane into the anchor trench as shown in the DRAWINGS. The geomembrane shall be seamed along the entire distance of the anchor trench to the termination of the geomembrane sheet.

### 3.04 PROTECTION:

- A. **CONTRACTOR** shall control access to Work areas during geomembrane deployment.
- B. Do not use equipment or tools which damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons, or other means.
- C. Ensure prepared surface underlying geomembrane has not deteriorated since previous acceptance, and remains acceptable until acceptance by **OWNER**, as detailed in Section 3.02.
- D. Keep geosynthetic elements (i.e., geonet, geocomposite, geosynthetic clay liner, etc.) immediately underlying the geomembrane clean and free of debris.
- E. Do not permit personnel to smoke or wear damaging shoes while working on geomembrane.

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- F. Unroll panels in a manner which prevents scratches or crimps in geomembrane and does not damage underlying materials (i.e., geonet, geosynthetic clay liner, etc.).
- G. Place panels in a manner that prevents wrinkles (especially differential wrinkles between adjacent panels).
- H. Prevent wind uplift and damage to geomembrane subgrade by providing temporary and permanent loading and/or anchoring that will not damage geomembrane, which may include placement of sand bags. Sand bags (or other temporary anchoring devices) shall be disposed in a location approved by the **MANAGER**, but not within in the Tailings Cells or Evaporation Ponds.
- I. Minimize direct contact of equipment and personnel with geomembrane.
- J. Protect geomembrane in areas where excessive traffic is expected with geotextiles, extra geomembrane, or other materials acceptable to **MANAGER**, **DESIGN ENGINEER** and **ENGINEER OF RECORD**.
- K. Provide adequate ballast to geomembrane in a timely manner to prevent wind damage.

### 3.05 FIELD PANEL DEPLOYMENT:

- A. **CONTRACTOR** shall install field panels at locations indicated on **CONTRACTOR**'s layout plan, as approved by **MANAGER**, **DESIGN ENGINEER** and **ENGINEER OF RECORD**.
- B. **CONTRACTOR** shall replace damaged (i.e., torn, twisted, or crimped) field panels, or portions thereof, at no cost to **OWNER**. **CONTRACTOR** shall repair less serious damage according to Article 3.10 of this Section, at no cost to **OWNER**. **ENGINEER OF RECORD** shall determine if material is to be repaired or replaced.
- C. **CONTRACTOR** shall remove damaged panels, portions of damaged panels, and other geomembrane scrap.
- D. **CONTRACTOR** shall not deploy more geomembrane field panels in one day than can be seamed during the day of deployment unless specifically authorized by the **ENGINEER OF RECORD** for specific field conditions.
- E. Geomembrane deployment shall proceed between ambient temperatures of fourteen degrees (14°F) Fahrenheit to one hundred degrees (100°F) Fahrenheit. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the CQA Monitor.
- F. Following the installation of the geomembrane, an examination of the entire surface shall be conducted to detect potentially harmful rocks or other objects. Any such objects will be removed and the geomembrane repaired by the **CONTRACTOR**, at no cost to **OWNER**.

### 3.06 FACTORY SEAMS:

**MANAGER** and **ENGINEER OF RECORD** may require **CONTRACTOR** to test up to as much as twenty (20) percent of factory fusion welds (non-destructive air pressure test) in the field to verify factory test results. Additional testing at **CONTRACTOR**'s expense will be required if failed tests are obtained in the field.

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### 3.07 FIELD SEAMS:

#### A. Seam Layout

1. Seams shall be oriented parallel to the line of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized.
2. No horizontal or base T-seam or tie-in seams shall be closer than five (5) feet from the toe of the slope. Seams shall be aligned to prevent wrinkles and "fishmouths." If a fishmouth or wrinkle is found, it shall be relieved and capped.
3. Panels of geomembrane will have sufficient overlap provided to allow peel tests to be performed on the seam.

#### B. Seaming Method

1. The procedure used to temporarily bond adjacent panels together shall not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus shall be controlled such that the geomembrane is not damaged.
2. **CONTRACTOR** shall use double fusion welding as primary method of seaming adjacent field panels.
  - a. For cross seam tees associated with fusion welding, **CONTRACTOR** shall patch panel intersections consisting of three (3) or more panels and extrusion weld to a minimum distance of four (4) inches on each side of patch. The edge of the sheet shall be ground to a 45 degree angle prior to welding.
  - b. Place a protective layer, e.g., insulating plate or fabric, beneath hot welding apparatus after usage.
  - c. When subgrade conditions dictate, use a moveable protective layer directly below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between sheets and prevent debris from collecting around pressure rollers.
  - d. Remove seaming sheets and excess geomembrane trimmed to provide required overlap.
3. Use conventional extrusion welding as a secondary method for seaming between adjacent panels and as a primary method of welding for detail and repair work.
  - a. Purge heat-degraded extrudate from barrel of extruder under the following conditions:
    1. Prior to beginning a seam;
    2. Whenever extruder has been inactive.
  - b. Place a smooth insulating plate or fabric beneath hot welding apparatus after usage.
  - c. Use clean and dry welding rods or extrudate pellets.

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- d. Complete grinding process without damaging geomembrane according to MANUFACTURER's instructions no more than one (1) hour prior to seaming operations.
- e. Prevent exposed grinding marks adjacent to an extrusion weld. Do not extend exposed grinding marks more than one-quarter (1/4) inch from seam area. **ENGINEER OF RECORD** may request that any and all abraded areas be covered with extrudate.
- f. Extrusion weld all cross seam tees to a minimum distance of four (4) inches on each side of the tee.
- g. For extrusion welds, the edge of the top sheet shall be beveled by grinding the edge of the sheet to approximately a 45 degree angle. Extrusion welds cannot be placed on previous extrusion welds.

### C. Seaming Procedures

#### 1. General Seaming Procedures

- a. Areas to be seamed shall be cleaned and free of moisture, debris, or any marking on the geomembrane.
- b. Use a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support if required.
- c. Cut fishmouths or wrinkles at the seam overlap along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of six (6) inches beyond the cut in all directions.
- d. Extend seaming to the outside edge of panels placed in the anchor trench.
- e. Do not field seam without the Seaming Supervisor present.

### D. Field Trial Seams

1. Trial seams shall be conducted at the beginning of each seaming period and within thirty (30) minutes of commencement of seaming, at the **ENGINEER OF RECORD'S** discretion, and immediately following any work stoppage (i.e., lunch, weather conditions, etc.) of thirty (30) minutes or more for each seaming apparatus used that day. Each Seamer shall make at least one trial seam each day.
2. Testing shall include visual observation of a trial seam on the geomembrane material. The **INSTALLER** will mark the trial seam with date, ambient air temperature, welding machine number, welding technician identification, and machine temperature and speed. For extrusion welding, the **INSTALLER** will include the nozzle and extrusion settings and welding technician identification. The remainder of trial seam should be cut in two pieces; one to be retained in **OWNER's** archive; and one to be retained by the **INSTALLER**.
3. All trial seams shall be made at a location selected by the **ENGINEER OF RECORD** in the area of the seaming and in contact with the subgrade. The trial seam samples shall be ten (10) feet long for fusion seaming and five (5) feet long for extrusion seaming, with the seam centered lengthwise. Specimens one (1) inch wide shall be cut from opposite ends of the test seam by **CONTRACTOR**. **CONTRACTOR** shall use a tensiometer to

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test these specimens for shear and peel. Both inside and outside tracks of fusion welds will be tested for peel. For both fusion and extrusion welds, two (2) coupons will be tested for peel and one (1) coupon for shear. The tensiometer shall have a grip separation of four (4) inches plus the width of the seam. The seam is to be centered between the clamps. These tests shall not fail according to the criteria in Section 2.01. A break through the weld or at the weld/sheet interface shall be considered a failure in both shear and peel strength tests unless the weld strength exceeds the sheet strength, as discussed in Section 2.01. If a trial seam fails to meet field seam SPECIFICATIONS, the seaming apparatus and/or Seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full trial seams are achieved.

4. **CONTRACTOR** shall mark the test weld with date, ambient temperature, welding machine number, welding technician identification, machine temperature and speed. For extrusion welding, **CONTRACTOR** shall record the nozzle and extrusion settings.
5. **CONTRACTOR** shall cut remainder of successful trial seams into two pieces, one to be retained in **OWNER's** archives and one to be retained by **CONTRACTOR**.

### 3.08 NONDESTRUCTIVE TESTING:

- A. **CONTRACTOR** shall non-destructively test all field seams over their full length. All test equipment shall be furnished by **CONTRACTOR**.
- B. The following vacuum box procedures are applicable to extrusion seaming and shall be followed by **CONTRACTOR**:
  1. Excess sheet overlap shall be trimmed away.
  2. Clean the vacuum box window, gasket surfaces and check for leaks.
  3. Energize the vacuum pump and reduce the tank pressure to approximately five (5) psi.
  4. Wet a strip of geomembrane the approximate dimensions of the vacuum box with the soapy solution.
  5. Place the box over the wetted area and compress.
  6. Close the bleed valve and open the vacuum valve.
  7. Ensure that a leak-tight seal is created.
  8. For a period of not less than ten (10) seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
  9. If no bubbles appear after ten (10) seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum three (3) inches overlap and repeat the process.
  10. All areas where soap bubbles appear shall be marked and repaired and then retested.
  11. Test locations, documentation number, date and tester will be indicated with an indelible marker on the geomembrane for each repair or seam section. The color code for indelible markers is to be determined at the pre-construction meetings, and strictly adhered to.

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- C. The following nondestructive test procedures are applicable to fusion seaming and shall be followed by **CONTRACTOR**.
1. Seal one end of the seam to be tested.
  2. Insert needle or other approved pressure feed device through the sealed end of the channel created by the double wedge fusion weld.
  3. Energize the air pump to verify the unobstructed passage of air through the channel.
  4. Seal the other end of the channel.
  5. Energize the air pump to the pressure of approximately thirty (30) psi, close valve, and sustain pressure for approximately five (5) minutes.
  6. If loss of pressure exceeds three (3) psi, or pressure does not stabilize, locate faulty area, repair and retest.
  7. Puncture opposite end of the seam to release air. If blockage is present, locate and test seam on both sides of blockage.
  8. Remove needle or other approved pressure feed device.
  9. Repair pressure test locations as described in Section 3.10.
  10. Beginning and ending pressures and times, test locations, documentation number, date and tester will be indicated with an indelible marker on the liner at each test interval location.
- D. The following procedures shall apply to locations where seams cannot be non-destructively tested, as determined by **ENGINEER OF RECORD**:
1. If the seam is accessible to testing equipment prior to final installation, the seam shall be non-destructively tested prior to final installation.
  2. If the seam cannot be tested prior to final installation, the seaming operations shall be observed by CQA Monitor for uniformity and completeness.
- E. In the event that seam continuity cannot be demonstrated for a non-destructive test of a fusion seam as outlined above, the **CONTRACTOR** shall perform the non-destructive testing over smaller areas as a means of defining the questionable area, and shall:
1. Extrusion weld the outside edge of the questionable seam area and vacuum box test the extrusion weld; or
  2. Cap the questionable area and vacuum test the cap.

### 3.09 DESTRUCTIVE TESTING:

- A. **CONTRACTOR** shall test a minimum of one (1) destructive test sample per seven hundred fifty (750) feet of seam length from a location specified by **ENGINEER OF RECORD**. **CONTRACTOR** shall not be informed in advance of the sample location. The samples shall be taken centered over the seam and prioritized as follows:
1. All areas identified as suspect during seaming, non-destructive testing/monitoring, and in unusual working conditions.

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2. A minimum of one sample for each geomembrane seamer.
  3. A minimum of one sample every seven hundred fifty (750) feet of seaming.
- B. Samples shall be cut by **CONTRACTOR** as the seaming progresses. Sampling locations shall be determined by **ENGINEER OF RECORD**. CQA Monitor must witness the obtainment of all destructive test samples by **CONTRACTOR**. **CONTRACTOR** shall mark all samples with their seam number, date, welding machine number, welding technician identification, extruder and nozzle/wedge temperature, and ambient air temperature. **CONTRACTOR** shall document the date, time, roll and seam number, ambient temperature, and pass or fail description. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately repaired. All patches shall be vacuum tested.
- C. The samples shall be a minimum twelve (12) inches wide by twenty-four (24) inches long with the seam centered lengthwise. The sample shall be cut into two equal length pieces, half to be given to **OWNER** and the other half kept by **CONTRACTOR**.
- D. **CONTRACTOR** shall cut and test ten (10) one (1) inch wide specimens from the destructive test sample. All testing shall be conducted in a facility provided by the **CONTRACTOR** with a controlled environment, including temperature control such that testing occurs at room temperature (60°F to 80°F). **CONTRACTOR** shall test five (5) specimens for seam shear strength and five (5) for peel strength. Both inside and outside tracks of fusion seams will be tested for peel strength. To be acceptable, four (4) out of the five (5) specimens must pass according to criteria established in Article 2.01. Any specimen that fails through the weld or at the weld/sheet interface shall be considered a failure, unless the weld strength exceeds the sheet strength, as discussed in Section 02776.0, Article 2.01. The tensiometer shall have a grip separation of four (4) inches plus the width of the seam. The seam is to be centered between the clamps. These tests shall not fail according to the criteria in Article 2.01.
- E. CQA Monitor will witness the testing of destructive samples obtained by CQC personnel on a spot check basis in accordance with the CQA Plan. Destructive tests shall be performed within two (2) days of the samples being obtained.
- F. Failing tests shall be subjected to additional testing until a passing area is found. A passing area is defined as a seam(s) bounded at each end by a passing destructive test. Seams will be tracked in each direction until a passing destructive test is found or until a previous passing destructive test is reached. Seams will be tracked according to the welding apparatus and the machine operator. The following procedures shall apply whenever a sample fails the field destructive test:
1. **CONTRACTOR** can retrace the welding path to an intermediate location (at a minimum of ten (10) feet from the location of the failed test), at **ENGINEER OF RECORD** discretion, and take a small sample for an additional field test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, the process shall be repeated.
  2. Over the length of seam failure, **CONTRACTOR** shall either cut out the old seam, reposition the panel and reseam, or add a cap strip, as required by **ENGINEER OF RECORD**.
  3. After reseaming or placement of the cap strip, additional destructive field test(s) shall be taken within the reseamed area. The reseamed sample shall be found acceptable if test results are approved by **ENGINEER OF RECORD**. If test results are not acceptable, this process shall be repeated until the reseamed length is judged satisfactory by **MANAGER** and **ENGINEER OF RECORD**.
  4. Samples taken as the result of failed tests do not count toward the total number of destructive tests required.

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- G. **CONTRACTOR** shall document all actions taken in conjunction with destructive test failures, with **ENGINEER OF RECORD** providing Quality Assurance documentation.
- H. Cap strips shall be non-destructively tested as described in Article 3.08.

### 3.10 DEFECTS AND REPAIRS:

- A. All seams and non-seam areas of the geomembrane shall be observed by CQA Monitor 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 observation. The geomembrane surface shall be brushed, blown, or washed by **CONTRACTOR** if the amount of dust or mud inhibits inspection. **MANAGER** and **ENGINEER OF RECORD** shall determine if cleaning of the geomembrane is needed to facilitate observation at no additional cost to **OWNER**.
- B. Each suspect location in seam and non-seam areas shall be non-destructively tested as determined appropriate by CQA Monitor, in the presence of CQA Monitor. Each location that fails the non-destructive testing shall be marked by **CONTRACTOR**, and repaired accordingly.
- C. Repair Procedures
  1. Defective seams shall be reconstructed as described in these SPECIFICATIONS.
  2. Small holes shall be repaired by abrading the sheet surface and welding an extrusion bead. If the hole is larger than one-quarter (1/4) inch in diameter, it shall be patched.
  3. Tears shall be repaired by patching. Where the tear is on a slope or an area of stress and has a sharp end, it must be rounded prior to patching.
  4. Blisters, large holes, undispersed raw materials, and contamination by foreign matter shall be repaired by patches.
  5. Surfaces of geomembrane that are to be patched shall be abraded and cleaned no more than fifteen (15) minutes prior to the repair. No more than ten (10) percent of the thickness shall be removed.
- D. Patches shall be round or oval in shape, and extend a minimum of six (6) inches beyond the edge of defects. All patches shall be of the same compound and thickness as the geomembrane specified. All patches shall have their top edge beveled to an approximately 45 degree angle with an angle grinder prior to placement of the patch. Patches shall be applied using approved methods only.
- E. The extrusion welding process shall restart by grinding the existing seam and rewelding a new seam. Welding shall commence where the grinding started and must overlap the previous seam by at least two (2) inches. Reseaming over an existing seam without regrinding shall not be permitted.
- F. Each repair shall be non-destructively tested, except when **ENGINEER OF RECORD** requires a destructive seam sample be obtained from a repaired seam. Repairs that pass the destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.

Recording the results: Daily documentation of all non-destructive and destructive testing shall be provided to **MANAGER** by CQA Monitor. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested.

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## 3.11 CONFORMANCE TESTING:

- A. During manufacturing of the geomembrane, CQA Monitor will coordinate sampling and forwarding of samples to the Quality Assurance Testing Laboratory for testing to ensure conformance with the SPECIFICATIONS.
- B. Samples will be taken across the entire width of the roll and shall not include the first three (3) feet. Unless otherwise stated, samples will be three (3) feet long by the width of the roll. CQA Monitor will mark the machine direction on the samples with an arrow. Unless otherwise stated, samples shall be taken at a frequency of no less than one per one hundred fifty thousand (150,000) square feet. As a minimum, the following tests will be performed to verify conformance to the design SPECIFICATIONS with minimum values specified in Section 02776.0, Article 2.01:

PROPERTY	TEST METHOD
Thickness (mils)	ASTM 5994
Compound Density (g/cm <sup>3</sup> )	ASTM D1505
Tensile Strength (Both yield and ultimate strength and elongation, as specified)	ASTM D6693
Carbon Black Content (%)	ASTM D1603/4218

## 3.12 PLACEMENT OF SOIL OR GRANULAR MATERIALS:

Soil materials located on top of a geomembrane shall be placed in such a manner as to ensure:

- A. The geomembrane and any underlying geosynthetics are not damaged.
- B. Minimal slippage of the geomembrane on underlying layer occurs.
- C. Minimal movement and wrinkling or folding of the underlying geosynthetics layer(s) occurs.
- D. No excess tensile stresses shall occur in the geomembrane, such as by earth moving equipment making sudden starts, stops, turns. The allowable ground pressure for equipment shall be prescribed by **DESIGN ENGINEER** for the material type and layer thickness as identified in Section 02200.0.

\*\*\* END OF SECTION \*\*\*

# PIÑON RIDGE PROJECT TECHNICAL SPECIFICATIONS

## SECTION 02776.1 GEOSYNTHETIC CLAY LINER (GCL)

### PART 1: GENERAL

#### 1.01 SUMMARY

This SPECIFICATION covers the technical requirements for the furnishing and installation of the geosynthetic clay liner described herein. All materials used shall meet the requirements of this specification, and all Work shall be performed in accordance with the procedures provided herein and the contract DRAWINGS.

#### 1.02 RELATED SECTIONS

- A. Section 02200.0 – Earthworks
- B. Section 02776.0 – Geomembrane
- C. Section 02777.0 – Geotextile

#### 1.03 DEFINITIONS

- A. Geosynthetic Clay Liner (GCL) - A manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetics.
- B. Geomembrane – An essentially impermeable geosynthetic composed of one or more geosynthetic sheets.
- C. Geotextile – Any permeable geosynthetic comprised solely of textiles.
- D. Minimum Average Roll Value – For geosynthetics, the value calculated as the typical value minus two (2) standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property.
- E. Overlap – Where two adjacent GCL panels contact, the distance measuring perpendicular from the overlying edge of one panel to the underlying edge of the other.
- F. Typical Value – The mean value calculated from documented manufacturing quality control test results for a defined population obtained from one test method associated with one specific property.

#### 1.04 SUBMITTALS

- A. Submittals with Bid Documents

**CONTRACTOR** shall provide the following information relating to the GCL MANUFACTURER with its proposal:

1. Conceptual description of the proposed plan for placement of the GCL panels over the area of installation.
2. GCL MANUFACTURER's MQC Plan for documenting compliance to Articles 2.01 and 2.02 of these SPECIFICATIONS.
3. A copy of GCL MANUFACTURER's ISO quality Certificate of Registration.
4. GCL MANUFACTURER's historical data for reinforced GCL including:
  - a. 10,000-hour creep shear testing per Article 2.01.

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- b. Seam flow data at two (2) pounds per square inch (psi) confining pressure per Article 2.01.
- B. At the **ENGINEER OF RECORD's** or **OWNER's** request the **CONTRACTOR** shall furnish:
  - 1. Representative samples of the GCLs specified.
  - 2. A project reference list for the GCL(s) consisting of the principal details of at least ten (10) projects totaling at least ten million (10,000,000) square feet in size.
- C. Upon shipment, the **CONTRACTOR** shall furnish the GCL MANUFACTURER's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this SPECIFICATION.
- D. As installation proceeds, the **CONTRACTOR** shall submit certificates of subgrade acceptance, signed by the **CONTRACTOR** and CQA Monitor (see Articles 1.06 and 3.03) for each area that is covered by the GCL.

### 1.05 QUALIFICATIONS

- A. GCL MANUFACTURER must have produced at least ten million (10,000,000) square feet of GCL, with at least eight million (8,000,000) square feet installed.
- B. The GCL **INSTALLER** must either have installed at least one million (1,000,000) square feet of GCL, or must provide to the **OWNER** satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the GCL will be installed in a competent, professional manner.

### 1.06 CONSTRUCTION QUALITY ASSURANCE (CQA)

- A. The **OWNER** shall provide a third-party inspector for CQA of the GCL installation, per the requirements of Section 1400.2 of these SPECIFICATIONS.
- B. Conformance testing of the GCL as necessary to support the CQA effort (Section 1400.2) shall be performed by a third party laboratory retained by the **OWNER** and independent from the GCL MANUFACTURER and **INSTALLER**. The laboratory shall have provided GCL CQA testing of the proposed or similar GCL for at least five (5) completed projects totaling not less than one million (1,000,000) square feet.

## **PART 2: PRODUCTS**

### 2.01 MATERIALS

- A. The GCLs shall consist of a layer of natural sodium bentonite clay encapsulated between two geotextiles and shall comply with all of the criteria listed in this Section.
- B. Prior to using an alternate GCL, the **CONTRACTOR** must furnish independent test results demonstrating that the proposed alternate material meets all requirements of this SPECIFICATION. The **CONTRACTOR** also must obtain prior approval of the GCL by the **OWNER** and the **ENGINEER OF RECORD**.
- C. Acceptable reinforced GCL products are Bentomat® ST or Bentomat® DN, as indicated on the DRAWINGS, and as manufactured by CETCO, 1350 West Shure Drive, Arlington Heights, Illinois 60004 (847-392-5800), or an equivalent approved by the **ENGINEER OF RECORD** and **DESIGN ENGINEER**.

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- D. The reinforced GCL and its components shall have the properties shown in Table 02776.1-1.
- E. The reinforced GCL shall have 10,000 hour test data for large-scale constant-load (creep) shear testing under hydrated conditions. The displacement shall be 0.07 inches or less at a constant shear load of 250 pounds per square foot (psf) and a normal load of 500 psf.
- F. The reinforced GCL shall have seam test data from an independent laboratory showing that the seam flow with a grooved cut in one of the nonwoven geotextiles is less than  $1 \times 10^{-8} \text{ m}^3/\text{m}^2/\text{sec}$  at 2 psi hydraulic pressure.

**TABLE 02776.1-1  
GCL PROPERTIES**

Material Property	Test Method	Test Frequency (ft <sup>2</sup> )	Required Values
Bentonite Swell Index <sup>1</sup>	ASTM D5890	1 per 50 tons	24 mL/2g min.
Bentonite Fluid Loss <sup>1</sup>	ASTM D5891	1 per 50 tons	18 mL max.
Bentonite Mass/Area <sup>2</sup>	ASTM D5993	40,000 ft <sup>2</sup>	0.75 lb/ft <sup>2</sup> min
GCL Grab Strength <sup>3</sup>	ASTM D6768	200,000 ft <sup>2</sup>	50 lbs/in MARV
GCL Peel Strength <sup>3</sup>	ASTM D6496	40,000 ft <sup>2</sup>	3.5 lb/in min
GCL Index Flux <sup>4</sup>	ASTM D5887	Weekly	$1 \times 10^{-8} \text{ m}^3/\text{m}^2/\text{sec}$ max
GCL Hydraulic Conductivity <sup>4</sup>	ASTM D5887	Weekly	$5 \times 10^{-9} \text{ cm}/\text{sec}$ max
GCL Hydrated Internal Shear Strength <sup>5</sup>	ASTM D5321 ASTM D6243	Periodic	500 psf typical

Notes:

- 1 Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.
- 2 Bentonite mass/area reported at 0 percent moisture content.
- 3 All tensile strength testing is performed in the machine direction using ASTM D 6768. Upon request, tensile results can be reported per modified ASTM D 4632 using 4 inch grips.
- 4 Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of  $5 \times 10^{-9} \text{ cm}/\text{sec}$  for typical GCL thickness. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.
- 5 Peak value measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

### 2.02 PRODUCT QUALITY DOCUMENTATION

- A. The GCL MANUFACTURER shall provide the **OWNER** and **ENGINEER OF RECORD** with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the GCL MANUFACTURER and shall include:
  - 1. Certificates of analysis for the bentonite clay used in GCL production demonstrating compliance with the parameters swell index and fluid loss shown in Table 02776.1-1.
  - 2. MANUFACTURER's test data for finished GCL product(s) of bentonite mass/area, GCL tensile strength and GCL peel strength (reinforced only) demonstrating compliance with the index parameters shown in Table 02776.1-1.
  - 3. GCL lot and roll numbers supplied for the project (with corresponding shipping information).
- B. Prior to shipment, the GCL MANUFACTURER shall label each roll, identifying:
  - 1. Product identification information (MANUFACTURER's name and address, brand product code).

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2. Lot number and roll number.
3. Roll length, width and weight.

### 2.03 PACKAGING

- A. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.
- B. All rolls shall be labeled and bagged in packaging that is resistant to photo degradation by ultraviolet (UV) light.

### 2.04 ACCESSORY BENTONITE

- A. The granular bentonite sealing clay used for overlap seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL MANUFACTURER. Seaming of GCLs shall be conducted in accordance with the MANUFACTURER's guidelines for each particular GCL.

## PART 3: EXECUTION

### 3.01 SHIPPING AND HANDLING

- A. The MANUFACTURER assumes responsibility for initial loading of the GCL. Unloading, on-site handling and storage of the GCL are the responsibility of the **CONTRACTOR, INSTALLER** or other designated party.
- B. A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.
- C. The party responsible for unloading the GCL should contact the MANUFACTURER prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

### 3.02 STORAGE

- A. Storage of the GCL rolls shall be the responsibility of the **INSTALLER**. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry and well drained.
- B. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).
- C. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.
- D. The integrity and legibility of the labels shall be preserved during storage.

### 3.03 GCL PLACEMENT

- A. GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) should be in accordance with the design DRAWINGS. Packaging waste shall be disposed of daily into landfill or dumpster as designated by **OWNER**.

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- B. Equipment, which could damage the GCL, shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.
- C. Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.
- D. The GCL panels shall be placed parallel to the direction of the slope.
- E. All GCL panels should lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels.
- F. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The GCL supplier should be consulted for specific guidance if premature hydration occurs.
- G. When a textured geomembrane is installed over the GCL, a temporary geosynthetic covering known as a slip sheet or rub sheet should be used to minimize friction during placement to allow the textured geomembrane to be more easily moved into its final position.
- H. Although direct vehicular contact with the GCL is to be avoided, lightweight, low ground pressure vehicles such as four-wheel all-terrain vehicles (ATVs) may be used to facilitate the installation of any geosynthetic material placed over the GCL. The GCL MANUFACTURER or CQA Monitor should be contacted with specific recommendations on the appropriate procedures in this situation.
- I. Soil cover, where applicable, shall be placed in a manner that prevents the soil from entering the GCL overlap zones. Cover soil shall be pushed up slopes, not down slopes, to minimize tensile forces on the GCL.

### 3.04 EARTHWORKS

- A. Any earthen surface upon which GCL is installed shall be prepared and compacted in accordance with the SPECIFICATIONS and DRAWINGS. The surface shall be smooth, firm, and unyielding, and free of vegetation, construction debris, sticks, sharp rocks, void spaces, ice, abrupt elevation changes, standing water, cracks larger than one-quarter inch (0.25 in) in width, and any foreign matter that could contact the GCL.
- B. Immediately prior to GCL deployment, the subgrade shall be final-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. Prior to smooth-rolling, moisture shall be applied to the surface of the subgrade by a water truck or other means approved by the **ENGINEER OF RECORD** to facilitate hydration of the GCL upon placement. At completion of this activity, no wheel ruts, footprints, or other irregularities shall exist in the subgrade. Protrusions extending more than one-half inch (0.5 in) from the surface shall be either removed, crushed, or pushed into the surface with a smooth-drum compactor.
- C. On a continuing basis, the CQA Monitor and **INSTALLER** shall observe acceptance of the subgrade prior to GCL placement. Thereafter, it shall be the **INSTALLER**'s responsibility to indicate to the CQA Monitor any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in this Section.

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### 3.05 ANCHORAGE

- A. The end of the GCL roll shall be placed in an anchor trench at the top of the slope or an equivalent runout design shall be utilized. When utilizing an anchor trench design, the front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench. The GCL should cover the entire trench floor but does not extend up the rear trench wall.

### 3.06 SEAMING

- A. The GCL seams are constructed by overlapping adjacent panel edges and ends. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris.
- B. Longitudinal seams should be overlapped a minimum of six (6) inches for Bentomat ST and Bentomat DN, or per the MANUFACTURER's recommendations for an approved equivalent GCL. The longitudinal seam overlap shall be increased to a minimum of twelve (12) inches where GCL will not be covered with cover soils during the construction phase, which includes GCL installation for construction of the Evaporation Pond and Tailings Cell liner systems in their entirety. If the GCL is manufactured with a grooved cut in the nonwoven geotextile that allows bentonite to freely extrude into the longitudinal overlap, then no bentonite-enhanced seam is required for this overlap. If the GCL does not have a grooved cut in one of the nonwoven geotextiles in the longitudinal overlap, then longitudinal bentonite-enhanced seams are required as described below.
- C. End-of-roll overlapped seams should be constructed with a minimum overlap of twenty-four (24) inches for Bentomat ST and Bentomat DN, or per the MANUFACTURER's recommendations for an approved equivalent GCL. The end-of-roll seam overlap shall be increased to a minimum of 48 inches where the GCL will not be covered with cover soils during the construction phase, which includes GCL installation for construction of the evaporation pond and tailings cell liner systems in their entirety. Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.
- D. Bentonite-enhanced seams are constructed between the overlapping adjacent panels described above. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel. A similar bead of granular sodium bentonite is applied at the end-of-roll overlap. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.25 lb/ft).

### 3.07 DETAIL WORK

- A. The GCL shall be sealed around penetrations and embedded structures embedded in accordance with the GCL MANUFACTURER recommendations.
- B. Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process.

### 3.08 DAMAGE REPAIR

- A. If the GCL is damaged (pre-hydrated, torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of twelve (12) inches is achieved around all of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.

\*\*\*END OF SECTION\*\*\*

# PIÑON RIDGE PROJECT TECHNICAL SPECIFICATIONS

## SECTION 02777.0 GEOTEXTILE

### PART 1: GENERAL

#### 1.01 SUMMARY:

This SPECIFICATION describes requirements for the manufacture, supply, and installation of the geotextile in the Underdrains for the Tailings Cells, and in other locations, as shown on the DRAWINGS. All procedures, operations and methods shall be in strict compliance with the SPECIFICATIONS, the Construction Quality Assurance (CQA) Plan, and the DRAWINGS.

#### 1.02 SUBMITTALS:

##### A. Submittals with Bid Documents

**CONTRACTOR** shall provide the following information relating to the geotextile MANUFACTURER with its proposal:

1. Information from MANUFACTURER including company name, address, telephone number, the names of the company president and quality control manager, and narrative of the company history.
2. Description of MANUFACTURER's manufacturing capabilities:
  - a. Information on plant size, equipment, personnel, number of shifts per day, and capacity per shift.
  - b. A list of standard material properties and test methods employed to arrive at the values for each. As a minimum, the list shall include properties given in Article 2.0 of this Section.
3. The Quality Control Manual followed during the manufacturing process including those for the polymer material and for detecting foreign objects in the finished goods, and a description of the quality control laboratory facilities, including the name and telephone number of the quality control manager. Upon review of the Quality Control Manual, the **MANAGER** and **ENGINEER OF RECORD** may request additional testing during the manufacturing process at no additional cost to **OWNER**.

##### B. **CONTRACTOR** shall provide the following information after contract award but at a minimum fourteen (14) days prior to shipping of geotextile for review and approval by **MANAGER** and **ENGINEER OF RECORD**:

1. The geotextile MANUFACTURER shall provide written certification that the geotextile to be used meets the requirements of these SPECIFICATIONS and has been continuously inspected for the presence of needles and geotextile was found to be needle free.
2. A copy of the MANUFACTURER's geotextile QC test results of properties outlined in Article 2.0 of this Section. The **MANAGER** reserves the right to refuse use of any geotextile supplied without the proper QC documentation.
3. A detailed list of performance criteria for the geosynthetic material being produced for this project. (Note: Performance criteria are sometimes referred to as "minimum property values." Refer to Article 2.0 of this Section for geotextile properties and test methods.)

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### 1.03 QUALITY ASSURANCE:

- A. All Work shall be constructed, monitored, and tested in compliance with requirements in the CQA Plan (Section 01400.2). **CONTRACTOR** and **MANUFACTURER** shall participate and comply with all items in these **SPECIFICATIONS** and requirements of the CQA Plan.
- B. **CONTRACTOR** shall ensure that geotextile **MANUFACTURER** has an internal product quality control program that meets Contract requirements.
- C. **CONTRACTOR** shall be aware of all activities outlined in the CQA Plan, and the **CONTRACTOR** shall account for these activities in the construction schedule.
- D. **CONTRACTOR** shall assure that geotextile is delivered to the site at least five (5) calendar days prior to installation. Conformance testing must be completed, reviewed and approved by **ENGINEER OF RECORD** prior to shipping of geotextile to the site per the requirements of Section 01400.2 (CQA Plan).
- E. Geotextile rolls that do not meet the requirements of this **SPECIFICATION** will be rejected. **CONTRACTOR** will be required to replace the rejected material with new material that complies with the **SPECIFICATIONS**, at no additional cost to **OWNER**.
- F. In order to prevent weather damaged geotextile from being placed, the following Quality Assurance procedures shall be followed:
  - 1. **CONTRACTOR** shall perform its Work and utilize sufficient ballast as necessary to prevent wind uplift of the geotextile panels.
  - 2. If weather damage should occur, **ENGINEER OF RECORD** shall determine if the geotextile shall be repaired or replaced. Weather damage to the geotextile will include tears and dirty fabric, as determined by the **ENGINEER OF RECORD**.
  - 3. Repair or replacement of the weather-damaged geotextile shall be completed by **CONTRACTOR** at no additional cost to **OWNER**.
  - 4. As determined by **MANAGER** and **ENGINEER OF RECORD**, the geotextile panel may be rejected at no cost to **OWNER**.

### 1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Packing and Shipping
  - 1. Geotextile shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers, with straps for unloading.
  - 2. Geotextile rolls shall be marked or tagged with the following information.
    - a. **MANUFACTURER's** name
    - b. Product information
    - c. Roll number
    - d. Batch of lot number
    - e. Roll dimensions
  - 3. **CONTRACTOR** shall ensure that geotextile rolls are properly loaded and secured to prevent damage during transit.
  - 4. **CONTRACTOR** shall protect geotextile from excessive heat, cold, puncture, cutting, or other damaging or deleterious conditions.

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5. **CONTRACTOR** shall ensure personnel responsible for loading, transport, and unloading of geotextile are familiar with handling and transport constraints imposed by **MANUFACTURER**.
- B. Acceptance at Site
1. CQA Monitor shall perform inventory and surface inspection for defects and damage of all geotextile rolls upon delivery.
  2. **CONTRACTOR** shall unroll and inspect any geotextile roll that may be damaged below the exposed surface of the geotextile roll.
  3. **CONTRACTOR** shall repair damage resulting from handling and transport of geotextile at no cost to **OWNER**. If irreparable, in the opinion of **ENGINEER OF RECORD**, damaged materials shall be replaced at no cost to **OWNER**.
- C. Storage and Protection
1. **MANAGER** will provide on-site storage area for geotextile rolls from time of delivery until installation.
  2. The storage of the materials is the responsibility of **CONTRACTOR** from the time the materials are manufactured until the time the completed installation is accepted. **CONTRACTOR** is responsible for preparing the storage location and for the protection of the material from the elements (e.g. ultraviolet light, moisture, temperature, etc.).
  3. After **CONTRACTOR** has removed material from storage area, protect geotextile from puncture, dirt, groundwater, moisture, mud, mechanical abrasion, excessive heat, ultraviolet light exposure, and other sources of damage.
  4. Geotextile shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers, with straps for unloading.
  5. **CONTRACTOR** shall preserve integrity and readability of the geotextile roll labels, and store such that **MANAGER** and **ENGINEER OF RECORD** have access to the package slips or roll labels for each roll to verify roll acceptance.

### **PART 2: PRODUCTS**

#### **2.01 MATERIALS:**

- A. Twelve-ounce Non-Woven Needle Punched Geotextile:
1. Geotextile shall be comprised of polyester or polypropylene fibers.
  2. Rolls shall be free of holes, contamination, and foreign matter.
  3. The geotextile supplied for the project shall meet or exceed the minimum (unless noted otherwise) roll values shown in Table 02777.0-1:

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TABLE 02777.0-1

MINIMUM AVERAGE ROLL VALUES FOR  
GEOTEXTILE MATERIAL

Property	ASTM Test Method	Specification
Mass Per Unit Area (oz./yd <sup>2</sup> )	ASTM D5261	11.9
Puncture (lb)	ASTM D4833	130
Apparent Opening Size (AOS) (U.S. Sieve)	ASTM D4751	No. 80 to 140 Sieve

**PART 3: EXECUTION**

**3.01 INSTALLATION:**

A. Geotextile Deployment

**CONTRACTOR** shall handle geotextile in a manner to ensure that geotextile is not damaged, and shall comply with the following:

1. No equipment or tools shall damage the geotextile by handling, transporting, or other means.
2. No personnel working on the geotextile shall smoke, wear damaging shoes or engage in other activities that could damage the geotextile.
3. Cross seams between two (2) panels of geotextile shall be staggered by a minimum distance of five (5) feet on slopes greater than ten (10) percent.
4. In the presence of wind, all geotextiles shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during deployment and shall remain until replaced with cover material.
5. Geotextile panels shall be deployed in such a manner as to preclude wrinkles and folds. Any wrinkle or fold that may manifest itself into other geosynthetic layers shall be removed.
6. Geotextile within the lined area shall be cut with a cutter approved by **ENGINEER OF RECORD**, such as scissors. Unshielded razor knives are not acceptable.
7. Take necessary precautions to prevent damage to the underlying geomembrane or subgrade materials during placement of the geotextile.
8. During placement of geotextiles, care shall be taken not to entrap, in or beneath the geotextile, stones, excessive dust, or moisture that could damage the underlying or overlying geosynthetic, cause clogging of drains or filters, or hamper subsequent seaming.
9. Following the installation of all geotextile, an examination of the entire surface shall be conducted to detect potentially harmful foreign objects. Any such foreign objects found shall be removed or the panel shall be replaced by the **CONTRACTOR**, at no cost to **OWNER**.
10. Geotextile panels shall not be deployed over frozen ground, unless approved by **ENGINEER OF RECORD**.

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11. Geotextile panels shall be either seamed or overlapped as approved by **ENGINEER OF RECORD**. Where overlaps are approved, the overlap must be in accordance with **MANUFACTURER'S** recommendations or **DRAWINGS**, whichever is more stringent.

### B. Seaming Procedures

1. On slopes steeper than ten (10) percent, and in all cases in which soil or granular materials are to be placed over the geotextile, all seams shall be continuously sewn. In all other applications, sewing is the preferred seaming method.
2. Seams to be sewn shall be overlapped a minimum of six (6) inches and shall be sewn with a locking stitch. Seams to be thermally bonded shall be overlapped a minimum of twelve (12) inches.
3. The thread used in sewing shall be of polymeric material having chemical resistance, and if the geotextile is to be exposed for more than thirty (30) days, ultraviolet resistance equal to or exceeding that of the geotextile.
4. **CONTRACTOR** shall take measures to prevent soil, granular materials, or foreign materials from entering or becoming trapped beneath the geotextile both during and following installation.

### C. Defects and Repairs

Repair holes or tears in geotextile as follows:

1. Remove any soil or other material that may have penetrated the torn geotextile.
2. Should any tear exceed ten (10) percent of the width of the roll, that section of the roll shall be removed from the slope and replaced.
3. On slopes steeper than 10H:1V (horizontal:vertical), sew into place, in accordance with Article 3.01(B) of this Section, a patch made from same geotextile. Use continuous sewing.
4. On slopes shallower than 10H:1V (horizontal:vertical), sew geotextile patch into place using continuous (preferred) or spot seam in place a patch made from same geotextile, with a minimum two (2) foot overlap in all directions.

\*\*\* END OF SECTION \*\*