Technical Specifications and Construction Quality Assurance Plan for Recycle Pond Expansion and Existing Lined Ponds Modifications

Orlando Utilities Commission
Stanton Energy Center
Orange County, Florida

OUC The Reliable One®

Prepared by:

Ardaman & Associates, Inc.
Geotechnical, Environmental, and Materials Consultants
A Tetra Tech Company

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Nadim F. Fuleihan, Sc.D., P.E.
Senior Consultant
Florida License No. 31953

Nadim F Fuleihan, Sc.D., P.E.

Digitally signed by Nadim F Fuleihan, Sc.D., P.E.
DN: cn=Nadim F Fuleihan, Sc.D., P.E., o=Ardaman Associates, ou, email=nfuleihan@ardaman.com, c=US
Date: 2014.08.28 16:41:33 -04'00'

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ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

SPECIFICATIONS

SECTION 2
INTENT

RECYCLE POND EXPANSION AND EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

These specifications present the minimum standards for providing the required materials and construction quality to ensure proper construction of a lined Recycle Pond Expansion and modification of the existing lined ponds (Recycle Pond, North Coal Storage Area Runoff Pond, and South Coal Storage Area Runoff Pond) at the Orlando Utilities Commission (OUC) Stanton Energy Center (SEC) in Orange County, Florida. They also specify the construction, field inspection, sampling, quality control/quality assurance testing, and maintenance procedures associated with site preparation, earthen dike construction, excavation and grading, seepage collection drain installation, soil subgrade and subbase construction, gas vent installation, geomembrane liner installation, geocomposite drainage layer installation, protective cover construction, soil cement construction, reinforced concrete slab, walls, and structures construction, and all other works associated with construction of the lined Recycle Pond Expansion and modification of the existing lined ponds.

Responsibilities of the parties involved and the minimum qualifications of each party to fulfill their responsibilities are included in these specifications. During the construction work, the following documents should be referred to: (i) technical specifications (Specifications), (ii) construction drawings (Drawings), (iii) applicable manufacturer's quality control/assurance manuals, (iv) Contractor's quality control plan, (v) applicable Florida Department of Environmental Protection (FDEP) regulations, (vi) applicable Occupational Safety and Health Administration (OSHA) safety regulations and OUC site specific safety policy; and (vii) applicable ASTM International (ASTM) and Florida Department of Transportation (FDOT) standards.

The work covered by these specifications includes construction of approximately 9-acre Recycle Pond Expansion, 13.5-acre existing lined Recycle Pond modification (modified Recycle Pond), 9-acre existing lined North Coal Storage Area Runoff Pond modification (Coal Storage Area Runoff Pond), 2.5-acre existing lined South Coal Storage Area Runoff Pond modification (Sedimentation Pond) and associated inlet and outlet structures.

Construction of the lined Recycle Pond Expansion and modification of the existing lined ponds will require construction of earthen dikes around the ponds, installation of seepage collection drain system, construction of clayey soil subbase, installation of gas vent system, installation of geomembrane liner, installation of geocomposite drainage layer, construction of 18-inch thick protective soil cover, construction of 8-inch thick soil-cement, construction of reinforced concrete slab, walls and structures, and installation of inlet and outlet pipes. The work consists of

furnishing all labor, materials, plant, equipment, tools, supervisory personnel, and Contractor's facilities to undertake construction for ponds to the lines, grades and dimensions shown on the Drawings and in accordance with the Specifications. The work shall include the following major tasks:

- Provide a dewatering system to facilitate the construction activities under dry condition.

- Stripping, grubbing, clearing; excavating, dewatering, borrowing, moisture conditioning, hauling, placing, and compacting soil for grading the bottom of the ponds and constructing earthen dike.

- Removal and disposal of silt deposit, bottom liner system, seepage collection drain, and inlet and outlet structures and associated inlet and outlet pipes from existing lined ponds.

- Supplying all materials and installing seepage collection drain system, which comprised of 6-inch diameter slotted DR 17 HDPE seepage collection pipes wrapped with gravel and 12 oz/yd^2 needle punched polypropylene geotextile, a geocomposite drainage layer placed on the entire side slope of the perimeter dike and extended below the drain pipe, and 18-inch diameter solid DR 17 HDPE drain cleanout pipes.

- Supplying, hauling, placing, conditioning, and compacting 1.5-foot thick cover soil layer on top of the seepage collection drain system.

- Supplying all materials and installing gas vent system with 200-mil HDPE geonet wrapped with 8 oz/yd^2 non-woven polyethylene geotextile as shown on the Drawings.

- Supplying, hauling, conditioning, placing, and compacting clayey soil material to construct a minimum 6-inch thick compacted soil subbase with a saturated hydraulic conductivity of no greater than 1x10^{-5} cm/sec as well as fine grading and maintenance of all surfaces to receive high density polyethylene (HDPE) liners until they are taken over by the Liner Contractor.

- Supplying all materials and installing a minimum 80-mil thick textured HDPE geomembrane liner to the lines and grades shown on the Drawings, including all required ancillary items. This HDPE geomembrane liner serves as the primary leakage barrier at the base of the Recycle Pond Expansion, modified Recycle Pond, Coal Storage Area Runoff Pond, and Sedimentation Pond.

- Supplying all materials and installing HDPE geocomposite drainage layer above the primary liner.

- Supplying, hauling, placing, conditioning, and compacting 1.5-foot thick protective sand layer for Recycle Pond Expansion, modified Recycle Pond, and

Coal Storage Area Pond, and 2-foot thick protective sand layer for Sedimentation Pond on top of the geocomposite layer.

- Supplying, hauling, placing, conditioning, and compacting 8-inch thick soil cement layer on top of the 1.5-foot thick protective sand layer for the Recycle Pond Expansion, Coal Storage Area Runoff Pond, and modified Recycle Pond.

- Supplying and installing reinforced concrete for Sedimentation Pond base slab and divider walls, coal emergency storage area retaining wall, distribution boxes and valve access boxes.

- Supplying and installing pumps and all miscellaneous facilities associated with removing seepage water from the seepage collection drains.

- Installing inlet/outlet pipes and associated valves and manholes.

- Connecting the inlet pipes to the existing conveyance.

- Sodding of exposed soil cover within the designated construction area.

Other works covered by the Specifications also include, but are not limited, to: (i) surveying; (ii) site preparation and stripping of designated areas; (iii) demolition and the incidental removal of debris or foreign objects from within the limits of construction; (iv) access road construction and maintenance; (v) repair to any facilities, equipment or property damaged by the Contractor; (vi) hauling and spraying water to control dusting; (vii) dewatering and control of surface water runoff; (viii) maintenance of completed work until accepted by the Owner; and (ix) site clean-up.

The work shall be executed in conformity with the Drawings and these Specifications and the best acceptable standard practices. The Contractor shall use only competent, skilled workers in all phases of construction.

The Recycle Pond Expansion and existing lined ponds modification will involve more than one contractor during the construction period. Each contractor shall coordinate his work activities with the Owner and all other contractors involved in the project.

SPECIFICATIONS

SECTION 3
LIST OF DRAWINGS

RECYCLE POND EXPANSION AND EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

The drawings listed below are for the Recycle Pond Expansion and modification of the existing lined ponds including Sedimentation Pond (originally designated as South Coal Storage Area Runoff Pond), modified Recycle Pond (originally designated as Recycle Pond), and Coal Storage Area Runoff Pond (originally designated as North Coal Storage Area Runoff Pond). Materials shall not be ordered or work started before receiving drawings marked Issued for Construction. The drawings may be revised later to change the location or arrangement of the work, provide additional details, or include additional information or changes in some features of the work. Such revisions shall not be deemed cause for a price change unless it can be shown that the Contractor's work has changed materially.

The drawings listed below are for **Recycle Pond Expansion**.

Drawing No.	Revision	Title
GENERAL DRAWINGS		
G-1	P0	COVER SHEET
G-2	P0	INDEX OF DRAWINGS AND LOCATION MAPS
G-3	P0	GENERAL NOTES, ABBREVIATIONS AND SYMBOLS
G-4	P0	AERIAL PHOTOGRAPH OF STANTON ENERGY CENTER
G-5	P0	TOPOGRAPHIC MAP OF SITE
G-6	P0	AERIAL PHOTOGRAPH OF PROPOSED RECYCLE POND EXPANSION
G-7	P0	SITE PLAN ON EXISTING TOPOGRAPHIC MAP
G-8	P0	EROSION CONTROL PLAN
G-9	P0	FINAL GRADING PLAN
SEEPAGE COLLECTION DRAIN DRAWINGS		
SD-1	P0	SEEPAGE COLLECTION DRAIN GRADING PLAN
SD-2	P0	SEEPAGE COLLECTION DRAIN LAYOUT
SD-3	P0	SEEPAGE COLLECTION DRAIN GRADING CROSS SECTIONS
SD-4	P0	CLEANOUT PLANS
SD-5	P0	CLEANOUT PLAN
SD-6	P0	DRAIN PROFILES
SD-7	P0	DRAIN PROFILE

Drawing No.	Revision	Title
SD-8	P0	DRAIN DETAILS
CONSTRUCTION DRAWINGS		
CS-1	P0	LINER SYSTEM GRADING PLAN
CS-2	P0	GAS VENT LAYOUT
CS-3	P0	CLAY SUB-BASE GRADING PLAN
CS-4	P0	HDPE LINER PLAN
CS-5	P0	GEOCOMPOSITE PLAN
CS-6	P0	SOIL COVER GRADING PLAN
CS-7	P0	SOIL CEMENT FINAL GRADING PLAN
CS-8	P0	LINER SYSTEM GRADING CROSS SECTIONS
CS-9	P0	CLAY SUB-BASE GRADING CROSS SECTIONS
CS-10	P0	HDPE LINER SYSTEM CROSS SECTIONS
CS-11	P0	SOIL COVER GRADING CROSS SECTIONS
CS-12	P0	SOIL CEMENT FINAL GRADING CROSS SECTIONS
DETAIL DRAWINGS		
D-1	P0	GAS VENT DETAILS
D-2	P0	LINER DETAILS
D-3	P0	EMERGENCY OVERFLOW AND OUTLET PIPES DETAILS
D-4	P0	INLET AND OUTLET PIPE PENETRATION DETAILS
D-5	P0	MISCELLANEOUS DETAILS
D-6	P0	SUMP DETAILS
D-7	P0	DISTRIBUTION BOX AND VALVE ACCESS BOX DETAILS

The drawings listed below are for the **Sedimentation Pond**.

Drawing No.	Revision	Title
GENERAL DRAWINGS		
G-1	P0	COVER SHEET
G-2	P0	INDEX OF DRAWINGS AND LOCATION MAPS
G-3	P0	GENERAL NOTES, ABBREVIATIONS AND SYMBOLS
G-4	P0	AERIAL PHOTOGRAPH OF STANTON ENERGY CENTER
G-5	P0	TOPOGRAPHIC MAP OF SITE
G-6	P0	AERIAL PHOTOGRAPH OF PROPOSED RECYCLE POND EXPANSION
G-7	P0	SITE PLAN ON EXISTING TOPOGRAPHIC MAP
G-8	P0	EROSION CONTROL PLAN
G-9	P0	FINAL GRADING PLAN
SEEPAGE COLLECTION DRAIN DRAWINGS		
SD-1	P0	SEEPAGE COLLECTION DRAIN GRADING PLAN

Drawing No.	Revision	Title
SD-2	P0	SEEPAGE COLLECTION DRAIN LAYOUT
SD-3	P0	SEEPAGE COLLECTION DRAIN CROSS SECTIONS A AND B
SD-4	P0	SEEPAGE COLLECTION DRAIN CLEANOUT PLAN
SD-5	P0	SEEPAGE COLLECTION DRAIN DETAILS
CONSTRUCTION DRAWINGS		
CS-1	P0	LINER SYSTEM GRADING PLAN
CS-2	P0	GAS VENT LAYOUT
CS-3	P0	COMPACTED CLAY SUB-BASE GRADING PLAN
CS-4	P0	HDPE LINER PLAN
CS-5	P0	GEOCOMPOSITE PLAN
CS-6	P0	SOIL COVER GRADING PLAN
CS-7	P0	FINAL GRADING PLAN
CS-8	P0	LINER SYSTEM GRADING CROSS SECTIONS C THROUGH F
CS-9	P0	CLAY SUB-BASE GRADING CROSS SECTIONS G THROUGH J AND DETAIL
CS-10	P0	HDPE LINER SYSTEM CROSS SECTIONS K THROUGH N AND DETAILS
CS-11	P0	SOIL COVER GRADING CROSS SECTIONS O THROUGH R AND DETAILS
CS-12	P0	FINAL GRADING CROSS SECTIONS S THROUGH V AND DETAILS
DETAIL DRAWINGS		
D-1	P0	GAS VENT DETAILS
D-2	P0	LINER DETAILS
D-3	P0	MISCELLANEOUS DETAILS

SPECIFICATIONS

SECTION 4
CONTRACTOR'S UNDERSTANDING, DESCRIPTION OF WORK, DEFINITIONS AND GENERAL CONDITIONS

RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

4.1 Description of Work

The work for this project involves construction of a lined Recycle Pond Expansion and modification of the existing lined ponds including Sedimentation Pond (originally designated as South Coal Storage Area Runoff Pond), modified Recycle Pond (originally designated as Recycle Pond), and Coal Storage Area Runoff Pond (originally designated as North Coal Storage Area Runoff Pond). The Contractor shall furnish all materials, equipment, supplies, tools, labor, and supervision necessary to perform the work covered by these Specifications and as shown on the Drawings. All work is to be performed and construction completed in accordance with the alignments, lines, grades, and dimensions defined in these Specifications and as shown on the Drawings. The Owner and the Engineer reserve the right to modify the design grade as well as any design elements during construction to maintain cut and fill balance and to expedite construction activities.

4.2 Definition of Parties Involved

Specific items and parties or individuals that are involved with construction of the Recycle Pond Expansion, Sedimentation Pond, modified Recycle Pond, and Coal Storage Area Runoff Pond are as follows:

- "Owner" refers to Orlando Utilities Commission.
- "Engineer" refers to the Design Engineer and/or the Construction Quality Assurance Engineer who is retained by the "Owner" to design and/or oversee any or all aspects of construction quality assurance.
- "Contractor" refers to the organization that is retained by the "Owner" for performance of site preparation, earthwork, liner system installation, drain system installation, soil cover, soil/cement, concrete work and other tasks associated with construction.
- "Liner Manufacturer" or "Manufacturer" refers to the organization that will manufacture and supply the geosynthetic drainage products and/or geomembrane liners.
- "Liner Contractor" refers to the organization that will be retained by the "Owner" or the "Contractor" for installation of the geosynthetic drainage products and geomembrane liners.
- "Regulatory Agency" or "Agency" refers to the Florida Department of Environmental Protection (FDEP), which has the regulatory authority to review this project.

4.3 Responsibility and Authority

The principal organizations involved in the design and construction works associated with the Recycle Pond Expansion and modification of the existing lined ponds, as defined in Section 4.2, will have the following responsibilities and authorities in construction quality assurance (CQA). Delineation of these responsibilities and authorities will establish the necessary lines of communication that will facilitate decision making during construction.

4.3.1 Owner

The Owner will oversee, manage, and approve execution of all works associated with construction of the Recycle Pond Expansion and modification of the existing lined ponds. To accomplish the above overall task, the Owner will hire/engage, as necessary, the parties defined in Section 4.2. The Owner also has the responsibility to ensure that the approved CQA Plan is adhered to during construction. The Owner has the authority to select and dismiss the Engineer, the Contractor, the Liner Contractor and/or the Liner Manufacturer. The Owner also has the authority to accept or reject design plans and specifications, recommendations of the Engineer, the materials supplied, and workmanship of the Contractor and Liner Contractor.

4.3.2 Engineer

The Engineer is responsible for the design and construction specifications and quality assurance activities as specified in this CQA Plan.

Specific responsibilities of the Engineer shall include:

- Reviewing design criteria, plans, specifications, and CQA Plan.
- Providing CQA field inspection personnel.
- Reviewing Contractor's quality control plan for conformance with the CQA Plan.
- Scheduling, directing, and coordinating the CQA activities.
- Providing results of the CQA activities to the Owner on a regular basis and at the end of the project. Additional responsibilities delegated to the Engineer by the Owner may include periodic review of CQA documentation and specifying corrective measures for any non-conformance with the project specifications.

The inspection personnel provided by the Engineer shall have the following responsibilities:

- Performing independent inspection of the work in progress to verify compliance with the design and construction criteria, Drawings, and Specifications.
- Verifying that all testing equipment used meet the test requirements and that the tests are conducted in accordance with standard procedures specified in the CQA Plan.
- Reporting to the Engineer the results of all inspections including the work that is not of acceptable quality or fails to meet the specification requirements.

4.3.3 Contractor

The responsibility of the Contractor is to supply all the materials and perform all the construction activities in accordance with the design and construction criteria, the Drawings, and Specifications. The Contractor shall submit all the shop drawings and other necessary documents for approval by the Engineer. The Contractor is also responsible to cooperate with the Engineer in conducting all CQA inspection and testing activities.

4.3.4 Liner Contractor

The responsibility of the Liner Contractor is to supply all the materials and install the geomembrane liners and geosynthetic drainage products in accordance with the Drawings and Specifications. The Liner Contractor shall submit all the shop drawings and other necessary documents for approval by the Engineer. The Liner Contractor is also responsible for cooperating with the Engineer to help conduct all CQA inspection and testing activities.

4.3.5 Regulatory Agency

The Regulatory Agency has the responsibility and authority to review CQA documentation during and/or after the completion of construction to confirm that the CQA Plan was adhered to during construction and that the construction procedures and quality conformed to the Specifications.

4.4 Qualifications

4.4.1 Engineer

The CQA Engineer and testing laboratory shall have the following minimum qualifications:

- The Engineer and the testing laboratory must have at least five continuous years of experience in similar projects immediately prior to the date of this project.

- The Engineer must have inspected and tested a minimum of five liner projects consisting of at least 5,000,000 square feet of geomembrane liner.

- The Engineer shall be familiar with the ASTM International, GRI, and other applicable testing standards. The testing laboratory shall possess testing equipment capable of testing geomembrane liner seams for peel and shear in accordance with ASTM Standard D6392. The laboratory shall have performed at least 5,000 sets of peel and shear tests on geomembrane liner seams.

- The Engineer shall be capable of providing qualified technicians to perform the required tests on geomembrane liner and able to provide test results within 48 hours of receipt of samples requiring laboratory testing. The Engineer shall also be capable of providing technicians to perform full-time inspection and testing during site preparation, earthwork construction, geomembrane liner, and drain installation.

- The Engineer must be a full-time registered Professional Engineer in the state of Florida and be able to sign, seal, and certify that the project was constructed in accordance with the requirements stipulated in the Specifications.

4.4.2 Contractor

To be considered qualified for this project, the Contractor and all subcontractors must be well experienced in earthwork construction, placement and compaction of the soil subbase below the geomembrane liners, and pipe installation. The Contractor must also be well experienced in project management, dike construction, earthwork excavation and grading, drain and culvert installation, dewatering, earthwork restoration, slope dressing, and fine grading of the liner subgrade.

At a minimum, the Contractor shall demonstrate the successful completion of at least three projects over the past 5 years similar in size and scope to this project. For each project submitted to document the Contractor's experience, the following information on the completed facility must be provided: (i) the name and purpose of the facility, and location and date of construction; (ii) the name of the facility owner and design engineer, and the name and telephone number of a contact person at the facility who can discuss the project; and (iii) description of the project, scope of work, and construction methods used.

The Contractor shall provide and maintain continually on the site of the work during its progress, adequate and competent superintendence of all operations for and in connection with the work

under the Specifications. The Contractor shall either personally superintend his work or shall cause it to be done by a capable superintendent acceptable to the Owner, and such representative shall be authorized to receive instructions from the Owner. The superintendent shall have authority to make sure that the work is carried out in accordance with the CQA Plan, Drawings, and Specifications in a first-class, thorough, and competent manner in every respect.

4.4.3 Liner Manufacturer

To be qualified by the Owner, the Manufacturer of HDPE liners shall provide documentation to the Owner of previously demonstrated ability to produce the specified liner by having successfully manufactured a minimum of 15 million square feet of HDPE liner installed in similar applications. The Manufacturer shall also provide documentation that he has satisfactorily produced textured HDPE liners, and that such production has been on-line for at least 6 months. The Manufacturer shall submit to the Owner, the Manufacturer's Quality Assurance - Quality Control Plan for review by the Owner. **Continuous spark testing of all liners manufactured for this project at the production facility is required prior to delivery of the liner rolls to the project site**.

The Manufacturer must provide to the Owner a written commitment that sufficient commercial quantities of the textured HDPE liners will be available for this project at the time of construction. The Manufacturer shall also submit specification sheets detailing minimum physical and chemical properties of the proposed 80-mil textured HDPE liner (including testing methods), field seaming methods and properties, and a certificate confirming compliance with the Specifications for this project.

4.4.4 Liner Contractor

To be considered qualified for this project, the Liner Contractor and all subcontractors must be well experienced in the installation of HDPE liners. The Liner Contractor shall be the Manufacturer of the HDPE liner or an approved Installer trained and/or licensed to install the HDPE liner supplied by one of the approved liner manufacturers. If the Liner Contractor is not the Manufacturer, then the Liner Contractor must submit a written certification, or license to install, provided by an approved Liner Manufacturer.

The Liner Contractor shall have installed HDPE liner in similar applications, for a period of not less than two years. The Liner Contractor shall submit to the Owner a list of at least ten completed facilities, totaling a minimum of 4 million square feet, for which the Liner Contractor has installed an HDPE geomembrane liner of the same type as specified in these Specifications. For each installation, the following information shall be provided:

- Name and purpose of facility, location, and date of installation.
- Name of Owner and Engineer, liner Manufacturer, and name and telephone number of contact at the facility who can discuss the project.
- Type and thickness of HDPE liner installed, and surface area covered (textured and smooth).

- Type of field seaming performed, and names of the Installation Supervisor and Master Seamer representing the Liner Contractor.

- Crew size and typical daily production per crew.

The Liner Contractor shall also submit to the Owner, for approval by the Engineer, a copy of the Manufacturer's standard specifications for liner handling and installation and any Quality Assurance - Quality Control Plans for review by the Owner. Moreover, the Liner Contractor must submit qualification resumes for the HDPE liner Installation Supervisor(s) and Master Seamer(s) to be assigned to, and will be present on site for this project, including documentation that each has similar experience on completed facilities totaling a minimum of 4 million square feet of HDPE liner installation.

All other seamers or welders and quality control/testing technicians representing the Liner Contractor who will be involved in the installation shall have a minimum of 1.5 million square feet of related HDPE liner installation experience.

4.5 Reports and Documentation

4.5.1 Contractor

Throughout the construction period, the Contractor shall maintain a careful record of any changes on the Drawings during actual construction. Any changes, in addition to the Contractor's field construction notes, shall be neatly and legibly prepared. The Contractor shall submit two copies of the notes and marked Drawings to the Engineer, on a monthly basis, or more frequently if requested by the Engineer. Upon completion of the work, and prior to acceptance by the Engineer, the Contractor shall file with the Engineer two sets of complete Drawings with all changes and the Contractor's field construction notes neatly and legibly recorded thereon. Such information will be used by the Engineer to prepare record Drawings for the Owner. Drawings may not be materially changed, except with the written approval of the Engineer, and the work cannot be considered as having been completed until the Engineer has approved it in writing.

4.5.2 CQA Engineer and Technician

Documentation of the CQA activities during construction shall consist of the following: (i) daily field reports, (ii) inspection and test data sheets and photographs, (iii) acceptance reports for completed components, and (iv) final report.

A daily field report shall be prepared by the lead CQA technician to document the CQA activities of the day. At a minimum, the daily field report shall include the following information: (i) date, project name, location and any other project identification, (ii) description of weather condition, (iii) description of work locations for the day, (iv) description of equipment and personnel used during the day, (v) description of work performed and CQA activities, (vi) description of materials received, (vii) any equipment calibrations, (viii) any approval of completed work and/or rejection of work that did not meet the project specifications, (ix) any supporting inspection data sheets, (x) reports of any meetings held and their results, (xi) description of any problems and suggested corrective measures, and (xii) signature of the CQA personnel. The CQA technician shall work under the supervision of the Engineer and consult daily with the Engineer on CQA activities and any associated problems.

Inspection and test data sheets used to document various CQA inspection and testing activities shall include the following information: (i) date, project name, location and any other project identification, (ii) description of inspection activity or test, (iii) location of inspection activity or test sample, (iv) result of inspection/test and comparison with project specifications, (v) personnel involved in the inspection/testing activity, and (vi) signature of the CQA personnel.

Upon acceptance of a completed component of work by the CQA inspector, appropriate acceptance forms shall be filled out and signed by the CQA inspector and the Contractor's or Installer's representatives. At a minimum, the acceptance report shall contain the following information: (i) date, project name, location and any other project identification, and (ii) location and description of the accepted component.

At the completion of the project, the Engineer shall submit a final report, which summarizes the results of the CQA inspection and testing activities for the project. This document shall be signed and sealed by the Engineer and will become a part of the CQA Plan documentation. The final CQA report shall be submitted within 60 days of completion of all construction associated with the project, as outlined within the scope of services and approved by the Owner.

4.6 Project Meetings

Weekly project meetings shall be conducted by the Owner who will arrange for the meetings, record minutes, and distribute copies to the participants and those affected by the decisions made at the meetings. The project meetings shall consist of pre-construction CQA meeting, progress meetings, and problems or work deficiency meetings.

The pre-construction CQA meeting shall be attended by the Owner, the Engineer, the Contractor and the Liner Contractor. Each participating organization will be provided with all relevant CQA documents and the following items shall be discussed at the meeting: (i) the role and responsibility of each organization in carrying out the CQA Plan, (ii) the authority and lines of communication for each organization, (iii) procedures for inspection, sampling, and testing, (iv) procedures for handling construction deficiencies, repairs, and re-testing, (v) methods for documenting and reporting inspection data, (vi) methods for distributing documents and reports, (vii) work area safety and security protocol, and (viii) storage and protection of construction materials. Following the pre-construction meeting, a site tour shall be conducted for visual observation of the site conditions by various organizations in relation to the above CQA Plan items.

Progress meetings shall be conducted weekly at a time determined at the pre-construction meeting. The progress meeting shall be attended by the Owner, the Engineer, the Contractor, and/or the Liner Contractor. The following items shall be discussed in the progress meeting: (i) activities and accomplishments of the previous week, (ii) overall progress of the project in relation to the project schedule, (iii) activities and goals for the week, and (iv) any construction problems/deficiencies.

Special meetings shall be conducted when problems and/or deficiencies occur or are anticipated to occur. These meetings shall be attended by the parties involved, which may include the Owner, the Engineer, the Contractor, and the Liner Contractor. In these meetings, the problems or deficiencies shall be defined, discussed, and resolved.

4.7 Scheduling and Coordination

All scheduling and coordination of the work outlined herein shall be undertaken through the Orlando Utilities Commission (OUC) Project Manager assigned to the project. The Contractor shall propose a construction schedule to the Owner at the pre-construction meeting. The schedule shall be in the form of a Gantt chart depicting all construction activities, and shall be updated weekly and provided to the Owner as work progresses.

The Contractor and Liner Contractor shall closely coordinate all planned and ongoing construction activities on a weekly basis, more frequent if warranted, with the OUC Project Manager and/or the other contractors to facilitate timely completion of all work at the project site.

4.8 Access, Inspection and Testing

All materials furnished by the Contractor shall be subject to the examination and approval of the Owner, or his representative, at all times during the progress of the work and until the completion of the same. As soon as the materials are examined and tested, the Contractor shall immediately remove all rejected materials from the work to a point such distance there from as the Owner may require. No material shall be used before being examined and approved by the Owner or his representative, but the failure on the part of the Owner or his representative to condemn or reject inferior materials or work shall not be construed to imply an acceptance of the same should their inferiority become evident at any time prior to final acceptance of the work.

The Contractor shall make necessary arrangement so that the Engineer may secure samples of materials used in construction for testing to ascertain whether any material to be included in the work meets the requirements of these specifications.

The Owner and his representative shall have free access to the work at all times. The Contractor shall furnish them with equipment, as needed, for ascertaining whether the work being performed, or the work which has been completed, is in accordance with the requirements of these specifications, even to the extent of uncovering, testing, or removing portions of finished work, if such is necessary.

The Owner may order the Contractor to suspend any work that may be affected, damaged, or endangered by climatic conditions. Further, the Owner may temporarily suspend any work at any time when acceptable results as defined by these Specifications cannot be obtained due to inclement weather or other unsatisfactory field conditions.

4.9 Survey Control

The Owner will establish reference points for horizontal and vertical control near the construction area. From these reference points, the Contractor shall provide all horizontal and vertical controls necessary to complete the work to the location, lines, and grades shown on the Drawings or as otherwise revised or approved by the Owner. It is the responsibility of the Contractor to verify all dimensions prior to fabrication, installation, and/or construction of any item of work. The Contractor shall maintain the survey control system, and shall provide all his alignment and grade control surveying of whatsoever nature.

4.10 Precedents and Discrepancies

Work indicated on the Drawings and not mentioned in the Specifications, or vice-versa, shall be performed as though fully set forth in both. Work not particularly detailed, marked, or specified, shall be performed in the same manner as similar work that is detailed, marked, or specified. In work drawings, the precedent shall be drawings of larger scale over those of smaller scale, figured dimensions over scaled dimensions, and noted material over graphic indications.

In the event of a discrepancy between the Drawings and the Specifications, or within either, the discrepancy shall immediately be brought to the attention of the Engineer and the Owner. The Engineer will specify the correct interpretation upon the Owner's approval.

4.11 Superintendence

The Contractor shall provide and maintain continually on the site of the work during its progress, adequate and competent superintendence of all operations for and in connection with the work under these Specifications. The Contractor shall either personally superintend his work or shall cause it to be done by a capable superintendent acceptable to the Owner. Such representative shall be able to read, write, and speak English fluently, and shall be authorized to receive instruction from the Owner. The Superintendent shall have the responsibility to make sure that the work is carried out in accordance with the Specifications and Drawings.

4.12 Contractor's Staging Area

The staging area for the Contractor will be designated by the Owner. The Contractor shall be responsible for electrical connections and other utilities, as needed, and approved by the Owner. The Owner will provide the water required for construction. However, it shall be the responsibility of the Contractor to transport or convey the water from the designated sources, and to meter the quantity of water used.

4.13 Contractor Safety

The Contractor, contractor employees, subcontractors, and subcontractor employees shall comply with the regulations of the Owner, the U.S. Department of Labor Occupational Safety and Health Administration (OSHA), and/or other applicable agencies. The Contractor shall show evidence for each employee, including employees of subcontractors, of Owner required site-specific safety training. The regular on-site safety meetings shall be documented, and the minutes of the meetings need to be submitted to the Owner.

4.14 Environmental Protection

The Contractor shall comply with all applicable regulations set forth by the Owner and the following governmental agencies:

1. Florida Department of Environmental Protection (FDEP)
2. U.S. Environmental Protection Agency (EPA)
3. St. Johns River Water Management District (SJRWMD)
4. Orange County, Florida
5. U.S. Army Corps of Engineers
6. Occupational Safety and Health Administration (OSHA)

The Contractor shall provide and maintain, during the life of the contract, environmental protection as defined herein. The Contractor shall provide environmental protective measures as required to control pollution that develops during normal construction practice and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. The Contractor shall comply with all federal, state, and local regulations pertaining to water, air, and noise pollution.

4.15 Protection of Natural Resources

Limits of Work: The natural resources outside the limits of permanent work performed under this contract shall be preserved in their existing condition or restored to an equivalent or improved condition upon completion of the work. The Contractor shall confine construction activities to areas defined by the scope of work, Drawings, and Specifications.

Land Resources: Except in those areas indicated on the construction plans to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy trees or shrubs without permission from the Owner.

Temporary Facilities: The Contractor shall eliminate all signs of temporary construction facilities such as work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and all other vestiges of construction except for access roads. All other areas shall be restored to their original conditions.

Water Resources: The Contractor shall perform all work in such a manner that any adverse environmental impacts on water resources are reduced to a level acceptable to FDEP, SJRWMD, Orange County, and EPA. Work must be performed in accordance with the applicable permit requirements. If water quality is compromised, all construction activities will cease until the problem is remedied and the contractor receives notification to proceed from the Owner.

Oily Substances: The Contractor shall take whatever measures necessary to prevent oily or other potentially hazardous substances from entering the ground, drainage areas, or local bodies of water. All temporary fuel oil, petroleum, or liquid chemical storage tanks shall be protected with a temporary high density polyethylene (HDPE) lined earthen berm and secondary containment area of sufficient size and strength to contain the contents of the tanks in the event of content leakage or spillage. At the request of the Contractor, other forms of containment with impervious liner will be considered. If any spill occurs, the Contractor is responsible for all cleanup expenses and notifying the Owner.

Fish and Wildlife Resources: The Contractor shall take all necessary steps, as required, to prevent interference or disturbance to fish and wildlife. The Contractor shall not alter water flows or otherwise significantly disturb native habitat, adjacent to the project area, which are critical to fish and wildlife, except as approved by the Owner. The contractor shall note that harming or harassing of the indigo snake, gopher tortoise, or other protected species is prohibited.

Fines: Any fines levied against the Contractor, or against the Owner that arise because of the Contractor’s work during the life of this contract will be borne by the Contractor.

Protection of Erodible Soils: All earthwork brought to a final grade shall be immediately finished as indicated or specified. The Contractor shall protect all slope areas upon completion of rough grading.

4.16 Protection of Existing Facilities

The Contractor is responsible, at no additional cost to the Owner, for timely repair or replacement of structures, equipment, pipelines, power lines, power poles, monitor wells, piezometers, pumps, or any OUC facilities damaged by the Contractor's operations and/or personnel during construction. All repairs and/or replacements shall be performed in a manner approved by the Owner.

4.17 Daily and Final Cleanup

The Contractor shall cleanup the work site and shall install all barricades, as needed, at the end of each workday to maintain the site in a clean and safe condition, as required by the Owner. The Contractor shall fully comply with the requirements set forth in this section and in Sections 4.15 and 4.16 pertaining to site maintenance.

Upon completion of the work, the Contractor shall remove and dispose of all trash, debris, unused materials, etc. Remaining unused clean soils shall be stockpiled in areas designated by the Owner. Soil surfaces disturbed because of construction activities shall be regraded to their original condition as directed by the Owner.

Waste oil, antifreeze, fuels, grease, or any other hazardous materials shall be disposed of, off-site, in accordance with applicable regulations, and shall not be dumped on the ground. The Contractor shall furnish proper records documenting the disposition of any such waste materials to the Owner.

4.18 Final Inspection and Acceptance

Upon completing all clean-up operations, the Contractor shall advise the Owner that he is ready for final inspection. The Owner will then set a specific date and time for final inspection. The Owner, Engineer, and Contractor shall jointly inspect the project area to verify that all work has been completed in accordance with the Drawings and Specifications. Any work found lacking in any way shall be corrected and re-inspected. The Contractor shall provide certified as-built drawings to the Owner. The as-built drawings shall include, but not limit to, earthwork, seepage collection drain system, liners, geocomposite drainage layer, final soil-cement grade, piping, and other items constructed by the Contractor. Upon final inspection and receipt of the as-built drawings, the Owner will issue a Letter of Acceptance to the Contractor, and the Contractor may then request final payment.

4.19 Applicable Specifications, Codes, and Standards

All work shall be performed in compliance with these Specifications unless otherwise approved in writing by the Engineer. In the event of a conflict between these Specifications and the referenced standards, these Specifications shall govern.

4.20 Engineering Data

The lined Recycle Pond Expansion will be constructed to the west of existing recycle pond and south of existing lime storage building. The modification of the existing lined ponds will take place around the current footprint of the existing ponds. Subsurface information is provided in soil boring logs. It is strongly emphasized that the subsurface soil information and condition are made available to the Contractor without a guarantee or obligation of any kind whatsoever on the part of the Owner. The Owner does not guarantee the correctness of the designations of any materials shown on the Drawings, nor any interpretations, deductions, or conclusions shown on any drawings or other documents relative to subsurface conditions. Conditions affecting the Contractor's performance and schedule may differ from those indicated or described. The Contractor shall assume all responsibility for deductions and conclusions as to the nature or condition of soil and other materials to be excavated, the difficulties of performing and maintaining the required excavations, filling, dewatering, and of doing other work affected by the existing conditions, geology, and geometry of the job site.

SPECIFICATIONS

SECTION 5
SITE PREPARATION AND EARTHWORK CONSTRUCTION

RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

5.1 Description of Work

Site preparation and earthwork activities shall include and cover all work for and in connection with: i) clearing, grubbing, and stripping and stockpiling of all vegetation, organics, and unsuitable materials from the construction area; ii) demolishing existing liner and underdrain system and removal and disposal of sediments from existing ponds; iii) proof-rolling and subgrade preparation; iv) excavating the ponds and constructing the perimeter dike to the lines and grades shown on the Drawings; and v) construction and maintenance of access roads and ramps.

5.2 Referenced Standards

The following ASTM standards are referenced in this Specification.

D698: Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

D1140: Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75 µm) Sieve

D2487: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2937: Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method

5.3 Site Preparation and Maintenance

5.3.1 Site Access

The Contractor shall, by his own inspection and by careful examination, fully convince himself as to the accessibility of the site for performing the work. The Contractor shall be responsible for modifying or preparing any access roads. Any modifications to the existing topography of the site (i.e., cut and/or fill) required for access during construction shall be submitted to the Owner for approval prior to actual construction.

Any fill material required for site access shall be obtained from on-site or off-site borrow areas designated and/or approved by the Owner. Fill for temporary access ramps and roads shall consist of fine sands, sand with silt, silty sands and clayey sands free of deleterious materials (organic matter, roots, wood, trash, debris, particles greater than 6 inches in size, etc.), and classifying as SP, SP-SM, SM, and SC-type soils in accordance with ASTM D2487.

All areas disturbed by the Contractor in constructing temporary access roads and ramps shall be re-graded and restored to pre-construction condition, or as otherwise approved by the Owner.

5.3.2 Site Dewatering

A dewatering system shall be designed for the construction of Recycle Pond Expansion, Sedimentation Pond, Coal Storage Area Runoff Pond, and modified Recycle Pond in order to maintain the groundwater levels over the entire excavation a minimum of 3 feet below the excavation grade at all times. Sufficient number of temporary monitoring wells shall be installed to confirm the performance of the dewatering system. Contractor shall submit a dewatering plan including type of dewatering system, shop drawings and design data. Design data for the dewatering system shall include: (i) depth of dewatering system components, locations and arrangements, (ii) description of equipment and instrumentation that will be used for installation, operation and maintenance, (iii) design calculations demonstrating the adequacy of the system, (iv) method of disposal, (v) method of monitoring the construction area during the construction. The Contractor shall also be responsible for transferring any standing water within the designated construction area to permit construction in the dry. Clean stormwater shall be discharged to on-site locations designated by the Owner. No water shall be released off-site or into adjacent ditches or streams without the Owner's written permission and appropriate discharge permits.

5.3.3 Clearing, Grubbing, and Stripping

The work shall consist of furnishing all tools, labor, materials, and equipment required for all clearing, grubbing, and stripping operations within the limits of construction. The work shall generally be performed in all areas designated for borrow and dike and general earthen construction.

The Contractor shall remove any debris from within the designated construction area. If required for disposal, these items shall be disposed of on-site at locations designated by the Owner.

Clearing shall consist of cutting, removing, and disposing of all grass, trees, brush, debris, and other objectionable organic material resting on or protruding above ground within the limits of grading as indicated on the Drawings.

Grubbing shall consist of the removal and disposal of stumps, roots, and other objectionable organic material within the limits of grading, as indicated on the Drawings. Stumps shall be removed entirely. Roots and matted roots shall be grubbed to at least 12 inches below the existing grade or proposed final subgrade surface, whichever is greater.

Stripping shall consist of the removal of organic top soils and muck from within the limits of grading. Over-stripping shall be avoided.

All organic or otherwise objectionable material removed by clearing, grubbing, and stripping shall be disposed of in areas designated by the Owner.

5.3.4 Demolition of Exiting Lined Pond

All material, including uniform section concrete mats, liner system, underdrain system and associated manholes, sediments, ash, any unsuitable materials, etc., shall be completely removed/excavated from the exiting lined pond areas and disposed of on-site at locations designated by the Owner.

5.3.5 Unsuitable Soils/Waste Removal

All organics, highly compressible, and other deleterious soils within the designated construction area, as determined by the Engineer, shall be excavated and removed from the construction area and disposed of on-site at locations designated by the Owner.

5.4 Earthwork for Site Grading

The subgrade on which the seepage collection drain and double liner system are to be installed and on which the earthen dikes are to be constructed shall be prepared through cut and fill to alter the existing contours of the site to the lines and grades indicated on the Drawings.

5.4.1 Existing and Excavated Base Surfaces

Existing surfaces and those exposed as a result of excavation shall be scarified, wetted, or dried as may be required, and compacted to a dry density of not less than 95 percent of the Standard Proctor maximum dry density (ASTM D698) to a depth of not less than 12 inches beneath the surface before placement of any fill materials.

5.4.2 Fill Placement for Site Grading

Earthen fill materials meeting the requirements of Section 5.4.4 and subject to approval by the Engineer shall be wetted or dried, as may be required, homogenized and placed in successive relatively horizontal layers not exceeding 12 inches in loose thickness. After a lift is placed and compacted per these Specifications, its surface shall be scarified just before placement and compaction of the next lift to permit proper bonding between lifts. The base shall be smoothly graded to the lines and grades shown on the Drawings, or as otherwise revised by the Owner.

The operation of site grading shall be suspended at any time when satisfactory results cannot be obtained because of rain, inclement weather, or other unsatisfactory conditions in the field.

5.4.3 Source of Fill Materials

Fill materials for site grading, and backfill of areas excavated to remove unsuitable material shall be obtained from excavation of the Recycle Pond Expansion, Sedimentation Pond, and Coal Storage Area Runoff Pond or off-site borrow sources approved by the Owner.

5.4.4 Fill Material Requirements

Fill materials used for construction shall consist of fine sands, sand with silt, sand with clay, silty sands and clayey sands classifying as SP, SP-SM, SP-SC, SM, or SC-type soils in accordance with ASTM D2487 and free from rocks, stones, and gravel in excess of 6 inches in diameter, and other deleterious materials (organic matter, roots, wood, trash, debris, sharp objects, etc.). Fill materials within the upper 12 inches of the final finished subgrade (i.e., finished grade on which the compacted soil subbase will be constructed) shall not contain particles larger than 1/4-inch in diameter. Materials from excavation of the Recycle Pond Expansion, Sedimentation Pond and Coal Storage Area Runoff Pond with an organic content less than 3 percent can be used for site grading. Excavated hardpan materials with an organic content up to 8 percent may be used for site grading at depths greater than 1 foot below the design grade of the bottom liner system.

5.4.5 Compaction Criteria

Existing surface and surfaces exposed by excavation shall be inspected by the Engineer and compacted to a dry density of not less than 95 percent of the Standard Proctor maximum dry density (ASTM D698) prior to the placement of any fill materials. Standard Proctor compaction tests (ASTM D698) should be performed on samples of the in situ and borrow soils, as needed, to determine the optimum moisture content, allowable range of placement moisture content, and the relationship between dry density and molding moisture content to be used for compaction control.

5.4.6 Dewatering

The project site has a high water table, especially during the wet season. Dewatering shall be expected during construction of Recycle Pond Expansion and modification of the existing lined ponds (Sedimentation Pond, Coal Storage Area Runoff Pond and Recycle Pond). As stated in Section 5.3.2, the dewatering methods shall be submitted by the Contractor to the Engineer for review and approval at least two weeks prior to the dewatering operation. The water from the dewatering operation shall be discharged to on-site locations designated by the Owner. The dewatering operation shall not be terminated until the underdrains become functional and there is sufficient load on top of the HDPE liner to resist hydrostatic uplift, as determined by the Engineer.

The seepage collection drain that will be installed as a part of the construction of the lined ponds shall be utilized for dewatering purpose after installation.

After the dewatering operation, the slopes of any temporary dewatering and runoff diversion ditches shall be cut back to a slope no steeper than 3H:1V, and the ditches shall be backfilled and compacted in lifts by the Contractor in accordance with Sections 5.5.3 and 5.5.4.

5.4.7 CQA Inspection and Testing

The Engineer will test and inspect the prepared base for compliance with the material and compaction criteria specified herein. The Engineer will perform in situ moisture content and density determinations a minimum of once per 22,500 square feet for compacted existing and excavated base surfaces and a minimum of once per 850 cubic yards of compacted fill using the drive cylinder method (ASTM D2937), or another method approved by the Engineer and deemed equivalent by him at his sole discretion.

5.4.8 Base Maintenance

It shall be the Contractor's responsibility to maintain, re-grade, and restore, as needed, the condition of the prepared base to the lines, grades, and degree of compaction noted above, and to maintain the surface to be lined smooth and free from deleterious materials.

5.5 Earthen Dike Construction

The earthen divider and perimeter dikes shall be constructed at the locations and to the lines and grades shown on the Drawings.

5.5.1 Source of Fill Materials

Fill materials shall be obtained from excavation of the Recycle Pond Expansion, Sedimentation Pond and Coal Storage Area Runoff Pond or from off-site borrow sources approved by the Owner.

5.5.2 Dike Fill Material Requirements

Fill materials used in dike construction shall be classified as clean granular fill, subject to approval by the Engineer. The fill materials shall be free from wood, roots, trash, rocks, debris, or other deleterious material.

The clean granular fill materials shall consist of clean, granular soils, which classify as SW, SP, SW-SM, SW-SC, SP-SM, and SP-SC in accordance with ASTM D2487. The soil shall not have more than 12 percent by dry weight passing the U.S. Standard No. 200 sieve in accordance with ASTM D1140. With prior approval by the Engineer, SC type soils with not more than 25 percent by dry weight passing the U.S. Standard No. 200 sieve size may also be utilized in dike construction.

The fill materials shall not contain any particles larger than 4 inches in diameter, with the exception of the upper 1-foot of the interior dike slope, which shall not contain particle sizes larger than 1/4-inch in diameter. Materials from excavation of the Recycle Pond Expansion,

Sedimentation Pond and Coal Storage Area Runoff Pond with an organic content less than 3 percent can be used for site grading. Excavated hardpan materials with an organic content up to 8 percent may be used for site grading at depths greater than 1 foot below the design grade of the bottom liner system.

5.5.3 Dike Construction

The earthen dikes shall be constructed upon a prepared subgrade meeting the requirements specified in Sections 5.4.1 and 5.4.5. Portions of the prepared base surface that no longer meet the specified compaction criteria shall be scarified, wetted or dried, as needed, and re-compacted prior to placement of dike fill materials. Just prior to placement of the initial lift of dike fill material; the prepared base shall be scarified to permit proper bonding between the two surfaces.

After a lift is placed and compacted per these specifications, its surface shall be scarified just before placement and compaction of the next lift to permit proper bonding between the two lifts. At no time shall a new lift of fill be placed over a non-scarified or dried surface. If a dried surface develops, it shall be rewetted and re-compacted or thoroughly and uniformly mixed with moist underlying soils prior to placement of a new lift of fill.

Dikes shall be constructed by placement and compaction of the selected fill materials in successive horizontal layers of not more than 12 inches in loose, vertical thickness. The fill materials shall be wetted or dried, and homogenized prior to compaction to obtain uniform moisture content in each lift. Each lift shall be compacted by rolling with a vibratory smooth drum roller, heavy rubber tire roller, steel wheel (sheep-foot) roller, or other suitable compaction equipment. The Contractor shall plan the traffic flow of equipment to provide a thorough and uniform compaction effort on each successive lift of fill.

5.5.4 Compaction Criteria

Earthen dike fill materials shall be compacted to a dry density of not less than 95 percent of the Standard Proctor maximum dry density (ASTM D698). The Engineer shall perform Standard Proctor compaction tests (ASTM D698) on samples of the borrow soils, as needed, to determine the optimum moisture content and maximum dry density to be used for compaction control.

5.5.5 CQA Inspection and Testing

The Engineer, retained by the Owner, will undertake observations and perform CQA tests to determine compliance of the dike construction with these specifications. Prior to placement, the Engineer shall observe that the base surface or surface of the previously compacted lift is satisfactorily prepared in accordance with Sections 5.5.3 and 5.5.4. The Engineer shall also verify that the borrow soils used for construction are free of deleterious materials and meet the requirements specified in Section 5.5.4 for the appropriate material classification required for dike construction. Fines content determinations (ASTM D1140) shall be performed, as needed, to verify conformance of the clean granular fill with the requirements specified in Section 5.5.2.

During placement, the dike fill materials will be inspected to verify that they have been thoroughly homogenized, uniformly placed and adequately compacted. The Engineer shall make the necessary penetration tests to quantify the uniformity of compaction and probe measurements to verify compliance with the maximum lift thickness specified herein.

After compaction of each lift is complete, the Engineer, will perform moisture content determinations and in situ density determinations at a minimum rate of once per 850 cubic yards of compacted fill using the drive cylinder method (ASTM D2937), or another method approved by the Engineer and deemed equivalent by him at his sole discretion. The Engineer shall compare results of these tests to the results of Standard Proctor tests to determine compliance with the specified compaction criteria.

5.5.6 Dike Maintenance

The Contractor shall maintain and restore, as needed, the condition of the completed earthen dike such that it conforms to the lines and grades shown on the Drawings and to the compaction criteria specified herein.

5.5.7 Erosion Control Features

Erosion and sedimentation control practices shall be employed by the Contractor to minimize erosion and sedimentation during construction until all work has been accepted by the Owner. Methods, which may be used, include, but are not limited to, vegetation, berms, and silt fences. An erosion control plan outlining the proposed erosion and sedimentation control measures to be undertaken during construction shall be submitted by the Contractor to the Owner for approval prior to construction.

All devices for erosion and sedimentation control shall be installed prior to beginning construction in an area. If the Owner determines that erosion or sedimentation is occurring because of the Contractor's construction activity despite implementation and maintenance of protective measures, the Contractor shall take additional protective measures as directed by the Owner.

Upon completion of the work or upon instruction by the Owner, the Contractor shall dismantle and remove erosion and sedimentation control measure implemented during construction.

SPECIFICATIONS

SECTION 6
GAS VENTING SYSTEM

**RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS**

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

6.1 Description of Work

This Specification covers the material installation requirements for high density polyethylene (HDPE) geocomposite venting strips, HDPE header pipe, vertical gas collector vents, quality control testing by the Contractor and quality assurance testing by the Engineer.

6.2 Referenced Standards

The following ASTM International (ASTM) and Federal Test Method (FTMS) standards are referenced in this Specification.

D421: Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants

D422: Standard Test Method for Particle-Size Analysis of Soils

D638: Standard Test Method for Tensile Properties of Plastics

D695: Standard Test Method for Compressive Properties of Rigid Plastics

D696: Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer

D698: Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

D746: Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

D790: Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D1238: Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

D1248: Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique

D1603: Standard Test Method for Carbon Black Content in Olefin Plastics

D1693: Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

D2240: Standard Test Method for Rubber Property - Durometer Hardness

D2513: Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings

D2837: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

D3786: Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method

D4491: Standard Test Methods for Water Permeability of Geotextiles by Permittivity

D4533: Standard Test Method for Trapezoid Tearing Strength of Geotextiles

D4632: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

D4716: Standard Test Method for Determining the (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

D4751: Standard Test Method for Determining Apparent Opening Size of a Geotextile

D4833: Standard Test Method for Index Puncture Resistance of Geotextiles and Geomembranes and Related Products

D4884: Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles

D5199: Standard Test Method for Measuring Nominal Thickness of Geosynthetics

D5261: Standard Test Method for Measuring Mass per Unit Area of Geotextiles

D7005: Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites

D7179: Standard Test Method for Determining Geonet Breaking Force

F714: Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

6.3 General

The gas venting system shall consist of double-sided geocomposite strips placed on the prepared soil subgrade beneath the clay subbase. The geocomposite will be connected to a 4-inch diameter slotted, HDPE header pipe wrapped in a filter sock along the perimeter dike of the Recycle Pond Expansion, Sedimentation Pond, Coal Storage Area Runoff Pond and modified Recycle Pond, with vertical vent pipe outlets provided at intervals indicated on the Drawings. The work shall include, but not be limited to, the placement and installation of the HDPE geocomposite venting strips, HDPE header pipe and vertical gas collector vents at the locations and to the dimensions shown on the Drawings.

6.4 Material Requirements

6.4.1 Geocomposite Physical Properties

The geocomposite used for the gas venting system shall consist of 200 mil HDPE geonet completely wrapped in 8 oz/yd^2 non-woven polypropylene or polyester geotextile fabric. The geonet shall be manufactured from unreinforced HDPE that is designed and manufactured for the purpose of drainage. The selected geocomposite shall have been satisfactorily demonstrated by prior use to be suitable and durable for such purpose.

The geotextiles must be heat bonded to both sides of the geonet. Sufficient geotextile shall be provided along all edges of the composite (i.e., the width and length of the geotextile shall be greater than those of the geonet) to provide ample fabric to sew or tie the bottom and top fabric together to prevent the edges of the geonet from being exposed, in accordance with the minimum dimensions shown on the Drawings.

6.4.1.1 Geonet Base Resin

The uncolored base resin shall be polyethylene having a minimum density of 0.932 g/cm^3 classifying as Group 2, Class 2, Grade 4 or Grade 5 (PE 224 or PE 225) medium density polyethylene in accordance with ASTM Standard D4976.

The formulated colored resin shall classify as a Group 2, Class 3, Grade 4 or Grade 5 high density polyethylene (PE 234 or PE 235) with physical properties meeting A46009 in accordance with ASTM Standard D4976 with environmental stress crack resistance (ASTM Standard D1693) F50 >1500 hours (Condition B; 50°C/100% Igepal) and F20 >192 hours (Condition C; 100°C/100% Igepal). The formulated colored resin shall contain not less than 97 percent of the base polymer, not less than 2.0 percent carbon black and not more than 3.0 percent carbon black, anti-oxidants and heat stabilizers combined with no other additives, fillers or extenders.

The geonet shall be manufactured from virgin resin, with no more than 3 percent regrind material. Regrind material, if used, shall be of the same formulation as the virgin resin. No post-consumer resin of any type shall be used.

6.4.1.2 Geonet Physical Appearance

The geonet shall be uniform in appearance and composition and shall be free of tears, cuts, gels, undispersed ingredients, any signs of contamination by foreign matter, or any defect that may affect serviceability.

The geotextile heat bonded to the geonet shall be uniform and homogeneous in appearance and composition, and free from tears, cuts, thin spots, or any defects that may affect serviceability.

6.4.1.3 Geonet Physical Properties

The HDPE geonet shall meet the following criteria:

Property	Test Method	Criteria
Melt Index (gm/10 mins)	ASTM D1238, (190°C/2.16 kg), Condition E	≤1.0
Carbon Black Content (%)	ASTM D1603 or D4218	≥2.0 & <3.0
Density (g/cm^3)	ASTM D1505 or D792	≥0.940
Thickness (mils)	ASTM D5199	≥200
Transmissivity* (m^2/sec)	ASTM D4716	≥3.0x10^{-3}
Tensile Strength** (lb/in)	ASTM D7179	≥45
Thickness Retention (%)	100 psi for 10,000 hours at 20°C temperature	≥75%

* The values represent the transmissivity of the geonet core in the primary flow direction under a compressive normal load of 10,000 lbs/ft^2 and a gradient of 0.1, with water at 70°F between steel plates for 15 minutes.
** Machine direction.

A complete description of the geonet proposed for use and the Manufacturer's product data sheets shall be submitted to the Engineer for approval at least two weeks prior to installation.

Certification from the Manufacturer that the geonet is in compliance with this Specification shall also be supplied to the Engineer at least two weeks prior to installation.

6.4.1.4 Geotextile Physical Properties

Geotextiles for the geocomposite shall be a non-woven, needle-punched fabric manufactured from 100 percent polyester or 100 percent polypropylene. The geotextiles shall be uniform and homogeneous in appearance and composition, and free from tears, cuts, thin spots, or any defects that may affect serviceability.

The geotextile shall meet the following criteria.

Property	Units	Test Method	Criteria
Mass per Unit Area	oz/yd^2	ASTM D5261	≥8
Apparent Opening Size	USSS†	ASTM D4751	≥80
Grab Tensile Strength*	lb	ASTM D4632	≥220
Grab Elongation*	%	ASTM D4632	≥50
Trapezoidal Tear Strength*	lbs	ASTM D4533	≥90
Puncture Resistance	lbs	ASTM D4833	≥120
CBR Puncture	lbs	ASTM D6241	≥575
Permittivity	sec^{-1}	ASTM D4491	≥1.1
UV Resistance [500 Hours]	%	ASTM D7355	≥70

* Machine and transverse directions.
† United States Standard Sieve Size.

A complete description of the geotextiles proposed for use and the Manufacturer's product data sheets shall be submitted to the Engineer for approval at least 2 weeks prior to installation. Certification from the Manufacturers that the geotextiles comply with this Specification shall also be supplied to the Engineer at least 2 weeks prior to installation.

6.4.1.5 Geocomposite Physical Properties

The geonet and geotextile in the composite shall meet the requirements of Sections **Error! Reference source not found.** and **Error! Reference source not found.**. The geocomposite shall also: (i) display a transmissivity (ASTM D4716 using a compressive load of 10,000 psf and a gradient of 0.1) equal to or greater than $5.0x10^{-4}$ m^2/sec in the machine direction; and (ii) the bond between the geotextile and the geonet shall have an average ply adhesion (ASTM D7005) of equal to or greater than 1.0 lb/in while the minimum ply adhesion shall be equal to or greater than 0.5 lb/in. Average and minimum ply adhesion shall comply with the above criteria and be sufficient to maintain the geotextile uniformly bonded to the geonet during handling and installation.

A complete description of the geocomposite proposed for use, the Manufacturer's product data sheet, and a 2.5-foot long by the full width of the roll sample of the geocomposite shall be submitted to the Engineer for approval at least two weeks prior to installation. Certification from the Manufacturer that the geocomposite is in compliance with this Specification shall also be supplied to the Engineer two weeks prior to installation.

6.4.1.6 Minimum Sheet Dimensions

The geocomposite shall be supplied by the Manufacturer in rolled sheets having a minimum width of 14 feet and a minimum length of 200 feet, or as otherwise approved by the Engineer.

6.4.1.7 Factory Testing

Factory quality control certificates for each batch of resin used to manufacture the geonet, including melt index and density, shall be submitted to the Engineer for approval at least two weeks prior to installation. The resin Manufacturer's certificate of analysis for each batch of resin shall also be provided to the Engineer at least two weeks prior to installation.

Factory quality control certificates for the geonet component of the geocomposite shall be provided to the Engineer by the Manufacturer at least two weeks prior to installation. As a minimum, the quality control certificates shall contain the roll identification number, date manufactured, resin batch number and roll length and roll width. The following factory quality control tests shall be provided for the geonet component of the geocomposite at the indicated minimum frequencies:

Property	Test Method	Frequency
Mass per Unit Area	ASTM D5261	Every 10 Rolls
Thickness	ASTM D5199	Every 10 Rolls
Tensile Strength*	ASTM D7179	Every 10 Rolls
Transmissivity*	ASTM D4716	Every 20 Rolls
Melt Index	ASTM D1238	Once per Batch of Resin
Carbon Black Content**	ASTM D1603	Every 20 Rolls
Density**	ASTM D1505	Every 20 Rolls
* Machine direction. ** Minimum of once per batch of resin.		

Failure of any of the tests shall result in rejection of the corresponding lot of geonet.

Factory quality control certificates for the non-woven geotextiles component of the geocomposite shall be provided to the Engineer by the Manufacturer at least 2 weeks prior to construction. The quality control certificates shall contain the geotextile roll number, date manufactured, roll length, and width. The following factory quality control tests shall be provided for the geotextile component of the composite at the indicated minimum frequencies:

Property	Test Method	Minimum Testing Frequency
Mass per Unit Area	ASTM D5261	Once per 5,000 yd^2 and minimum of once per lot
Thickness	ASTM D5199	
Grab Breaking Load	ASTM D4632	
Grab Elongation	ASTM D4632	
Apparent Opening Size	ASTM D4751	
Permittivity	ASTM D4491	

Failure of any of the tests shall result in rejection of the corresponding lot of geotextile.

Factory quality control certificates for the geocomposite shall be provided to the Engineer by the Manufacturer at least two weeks prior to installation. The quality control certificates shall contain the geotextile and geonet roll numbers, date manufactured, roll length and roll width. The following factory quality control tests shall be provided for the geocomposite at the indicated minimum frequencies:

Composite Property	Test Method	Minimum Testing Frequency
Ply Adhesion	ASTM D7005	Every 10 rolls
Transmissivity	ASTM D4716	Every 20 Rolls

6.4.1.8 Factory Inspection

The geocomposite shall be visually inspected at the factory prior to shipment for compliance with the physical appearance and property requirements indicated in Sections **Error! Reference source not found.** through **Error! Reference source not found.**. All necessary repairs shall be made by the Manufacturer at the factory prior to shipment.

6.4.1.9 Marking and Packaging

Each geocomposite roll shall be individually packaged at the factory to prevent damage during shipping and handling, and shall be completely wrapped by a protective ultraviolet resistant thin plastic film having a minimum thickness of 2 mils. The Manufacturer shall provide each roll with a label indicating the roll number, product name, length, width and date manufactured.

6.4.2 HDPE Pipes and Fittings

6.4.2.1 Base Resin

The base resin shall be high density, high molecular weight polyethylene (HDPE) with properties meeting or exceeding ASTM Standard D3350 cell classification 345464C (thermoplastic material designation code PE3608 or higher). The resin shall contain not less than 97 percent of the base resin and not less than 2.0 percent carbon black. The pipe material shall contain no more than 3 percent carbon black, anti-oxidants and heat stabilizers combined, and no other additives, fillers or extenders. Rework material from the manufacturer's pipe production may be used when blended with new resin of the same thermoplastic material designation code provided pipe containing rework material meets the requirements of ASTM Standard F714. Rework material shall be limited to a maximum of 30 percent by weight.

6.4.2.2 Physical Appearance

All pipes and fittings shall have good appearance qualities. The pipe and fittings shall be homogeneous throughout and uniform in color, opacity, density and physical properties. The inside and outside surfaces shall be smooth and uniform without chalking, sticky or tacky material, excessive bloom or visible defects. The pipe walls shall be free of holes, cracks, voids, nicks, cuts, gouges, scratches, blisters, gels, undispersed ingredients, any signs of contamination by foreign inclusions, or any defect that may affect serviceability.

6.4.2.3 Physical Properties

Pipe and fitting dimensions, workmanship, dimension ratio (DR) and corresponding pressure rating shall be in accordance with the requirements of ASTM Standard F714. Pipes shall be furnished in standard lengths equal to or greater than 40 feet. The pipe material shall meet the following criteria:

Property	Test Method	Criterion
Density [Natural Resin]	ASTM D1505 or D792	>0.945 g/cm^3
Density [Black]	ASTM D1505 or D792	>0.955 g/cm^3
Melt Index	ASTM D1238 [Cond.190/2.16]	<0.15 g/10 min
Flow Rate	ASTM D1238 [Cond.190/21.6]	>4.0 and <20 g/10 min.
Carbon Black Content	ASTM D1603 or D4218	>2.0% & <3.0%
Flexural Modulus	ASTM D790 [Method 1/Proc. B]	>120,000 psi
Tensile Strength at Yield	ASTM D638, Type IV, 2 ipm	>3,000 psi
Elongation at Break	ASTM D638, Type IV, 2 ipm	>400%
Hydrostatic Design Basis	ASTM D2837	>1,600 psi
Slow Growth Stress Crack Resistance [PENT]	ASTM F1473	>100 hours
Low Temperature Brittleness	ASTM D746	<-60°C
Thermal Expansion Coefficient	ASTM D696	<0.022%/°C

The Contractor or Supplier shall submit a complete description of the HDPE pipe and fittings proposed for use including the Manufacturer's name or trademark, pipe series designation and dimensions. Packaging, handling and shipment of the pipe shall also be in accordance with the pipe Manufacturer's standards, instructions and recommendations, subject to the approval of the Engineer. The Manufacturer's product data sheets and certification from the Manufacturer that the pipe and fittings are in compliance with this Specification shall also be supplied to the Engineer at least two weeks prior to installation.

6.4.2.4 Pipe Sizes

Both solid and slotted HDPE pipe shall have the nominal diameters and Standard Dimension Ratios (DR) shown on the Drawings. Dimensions, workmanship, DR and corresponding pressure rating shall be in accordance with ASTM Standard F 714.

6.4.2.5 Slotted Pipe

Where slotted pipe is specified on the Drawings, the slots shall be cleanly cut, identical in geometry, and evenly spaced. The slot length shall be located perpendicular to the longitudinal axis of the pipe. Slots shall be located in two straight rows along the length of the pipe. The rows of slots shall be spaced 180° on centers around the circumference of the pipe, and shall not be staggered. The slots shall satisfy the following criteria:

Dimension or Area	Criteria
Slot Width (inches)	>0.10 and <0.15
Slot Length Measured Along Outer Pipe Circumference (inches)	>1.50 and <2.50
Slotted Area (in^2/foot of pipe)	>2.0 (outer wall) >1.0 (inner wall)
Spacing Between Slots Along Pipe Length (c/c, inches)	>1.0 and <3.0

The Contractor or Supplier shall submit a 3-foot long sample of slotted pipe for each DR rating shown on the Drawings at least two weeks prior to construction. Slotted pipe shall not be delivered to the site without first receiving approval for delivery from the Owner.

6.4.2.6 Fabricated Fittings

Fabricated fittings made by butt fusing or sidewall fusing cut segments of pipe shall be used where shown on the Drawings. Fabricated fittings shall be made using pipe segments meeting the base resin, physical appearance and physical property requirements specified in Sections 6.4.2.1 through 6.4.2.3 of this Specification. Fabricated fittings shall be in compliance with ASTM Standard F2206 and butt-fusion welded in accordance with ASTM Standard D3261. Shop drawings for fabricated fittings shall be submitted to the Engineer for approval at least two weeks prior to fabrication.

6.4.2.7 Approved Manufacturers

The following manufacturers and corresponding pipe series designations are approved for use:

- Performance Pipe DriscoPlex PE3608/PE4710 Pipe
- PolyPipe EHMW PE3608/PE4710 Pipe

Other manufacturers producing equivalent pipes may be approved provided product data sheets and resin certificates are submitted to the Engineer to confirm compliance with this Specification.

The Manufacturer's product data sheets, resin certificates, and certification from the Manufacturer that the pipe and fittings comply with this Specification shall be submitted to the Engineer for approval at least two weeks prior to installation.

6.4.2.8 Marking and Packaging

The pipe Manufacturer shall mark each pipe length and each fitting with the Manufacturer's name or trademark, thermoplastic material designation code, diameter, dimension ratio and production code.

Packaging, handling and shipment shall be in accordance with the pipe Manufacturer's standards, instructions and recommendations.

6.4.2.9 Molded Fittings

Molded fittings, where shown on the Drawings, shall meet the base resin, physical appearance and physical property requirements specified in Sections 6.4.2.1 through 6.4.2.3 of this Specification. All fittings shall be pressure rated to match the highest pipe pressure rating to which it is connected. Molded butt fittings shall be in compliance with ASTM Standard D2513 and butt-fusion welded in accordance with ASTM Standard D3261.

6.4.2.10 Geotextile

The slotted sections of the gas venting collector pipe must be completed encapsulated in a geotextile as shown in the Drawings. The geotextile must meet the requirements of Section **Error! Reference source not found.**.

6.4.3 Filter Sand

The filter sand pack material specified for use all around the HDPE pipes in the gas vent outlets, in accordance with the minimum dimensions shown on the Drawings, shall consist of rounded, sub-rounded to sub-angular processed clean sand, preferably mined from an alluvial deposit. The filter sand shall exhibit the following gradation requirements as determined using ASTM D421 and D422:

U.S. Standard Sieve Size	Percent Passing (Dry Weight Basis)
3/4-inch	100
3/8-inch	85-100
No. 4	65-100
No. 10	35-100
No. 20	5-85
No. 40	0-38
No. 60	0-21
No. 200	0-7

A complete description of the Contractor's proposed gravel source, gradation test results, and mix proportions, if applicable, shall be submitted to the Engineer for approval at least two weeks prior to construction.

6.5 Gas Venting System Installation

6.5.1 Geotextile and Geocomposite

6.5.1.1 Storage and Handling

The Contractor shall be responsible for unloading and storing the geotextile and geocomposite rolls. During unloading, the Contractor shall obtain samples from the ends of rolls for testing by the Engineer at locations selected by the Engineer.

The geotextile and geocomposite shall remain wrapped in the protective cover and shall be stored, as recommended by the Manufacturer and approved by the Engineer, in an area of the site that protects the rolls from moisture, water, dirt, ultraviolet light, and mechanical damage until the time of installation. The rolls shall not be unwrapped more than one hour before use.

Handling of the rolls shall be in accordance with the Manufacturer's recommendations, and shall be as needed to protect the geotextiles from damage.

6.5.1.2 Laying and Installing

The geocomposite shall be installed in continuous strips below the clay subbase at the locations and to the lines and dimensions shown on the Drawings. The geocomposite shall be installed in a smooth and unwrinkled condition in uniform contact with the underlying material, and held in place as needed and approved by the Engineer.

During placement, care shall be exercised so as not to entrap excessive dirt, dust or debris that could result in clogging of the geotextile or geonet. If dirt, dust or debris is entrapped in the geonet or geotextile, it should be cleaned prior to placement of the HDPE liner. The Contractor shall provide temporary anchorage and/or ballast (e.g. sand bags), as necessary and approved by the Engineer, to hold the geocomposite in-place during installation.

The ends of the geonet shall be overlapped a minimum of 12 inches and tied together with polyethylene or polypropylene ties recommended by the Manufacturer and approved by the Engineer. Metallic ties shall not be used. A minimum of three ties shall be used at each joint, and the ties shall be of a color to allow easy inspection (e.g., white or yellow) against the black geonet. The upper and lower geotextiles of the composite shall be overlapped a minimum of 4 inches, and the overlap shall be sewn in accordance with Section 6.5.1.3.

The exposed edge of the geonet on all cut sides and ends of the geocomposite shall be covered with a piece of the same geotextile as on the composite overlapped 12 inches on the bottom and top of the composite. The edge of the top lap shall be held in-place until covered using spot thermal bonding or black PVC pipe wrapping tape as approved by the Engineer and temporary sand bags.

Field joints in the geotextile shall be made using a minimum overlap of 4 inches and the sheets shall be sewn together as recommended by the Manufacturer and approved by the Engineer, and specified in Section 6.5.1.3.

After installation, the geotextile and geocomposite shall not be left exposed for more than 48 hours prior to covering. No equipment, tools, or personnel that can cause damage to the geotextile or geocomposite shall be allowed on the installed materials during and after installation. The passage of construction equipment over any exposed materials shall be prohibited.

6.5.1.3 Geotextile Field Seams

Field seams in geotextiles shall be made using a minimum overlap of 4 inches. The geotextile shall be sewn together with a sewing machine using a flat sewn seam with one row of stitches with a minimum of 4 stitches per inch, or a seam and stitching pattern recommended by the Manufacturer and approved by the Engineer. The thread used to sew the seams shall be 2000 denier minimum, or as recommended by the Manufacturer and approved by the Engineer, and shall have the same composition as the geotextile. The strength of field seams shall not be less than 50 percent of that of the unaged geotextile in any principle direction when tested in accordance with ASTM D884 at a strain rate of 12 inches/minute. The Contractor shall submit details of the proposed sewing method (type of stitch, number of stitches per inch, number of

stitching rows, distance from the edge of the geotextile to the stitches, weight and type of thread, etc.) and a minimum 3 feet long sample of the sewn seam for approval by the Engineer at least one week prior to installation.

6.5.1.4 Geotextile Repairs

All tears, punctures, thinly stretched sections, or any other defect that may, as determined by the Engineer, render the geotextile unsuitable, shall be repaired by the Contractor. Repairs shall be made by overlaying a patch of geotextile over the damaged area with a 12-inch minimum lap all around. The patch shall be sewn to the geotextile, as specified in Section 6.5.1.3, all around the patch perimeter. Patches on geotextiles of the geocomposite shall be held in place by thermal bonding or 2-inch wide black PVC pipe wrapping tape, and sewn in accordance with Section 6.5.1.3 of this Specification where directed by the Engineer.

Geotextile and geocomposite rolls that require more than one repair to the geotextile from manufacturing defects or shipping/handling damage per roll shall be rejected and replaced at no cost to the Owner.

6.5.2 HDPE Pipes and Fittings

6.5.2.1 Storage and Handling

The Contractor shall comply with the pipe Manufacturer's recommendations for handling and storing pipe and fittings. The pipe shall be stored on clean, level ground to prevent undue scratching or gouging and as needed to protect the pipe from being covered with excessive dirt from water and moisture, and from mechanical abrasion. Care shall be taken to minimize the amount of soil or other debris collected inside the pipe while handling and installing. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp objects, and care shall be exercised during installation not to damage the pipes and fittings.

Any pipe section, fitting or joint, which becomes broken, cracked, crushed, cut, scratched, gouged or otherwise rendered unsuitable, as determined by the Engineer, shall be removed and replaced by the Contractor. Scratches greater than 6 inches in length and gouges exhibiting a depth in excess of 8 percent of the wall thickness of the pipe shall be cause for rejection of pipe or fittings to the extent designated by the Engineer.

6.5.2.2 Installation

Sediments shall be cleaned from the bottom of the excavated ditch bottom prior to placement of the filter gravel bedding.

Pipe sections shall be joined adjacent to the trench, prior to placing the pipe on the pipe bedding. Care shall be taken not to drop the pipe while moving it, and to avoid excess stress or strain during installation. When pulling the pipe, either a pulling head or a suitable wraparound sleeve with rubber protective cover shall be used to prevent the pulling cables from damaging the pipe. Immediately after placement, the pipe shall be thoroughly and completely embedded, supported, and covered, and the backfill compacted, in accordance with the Specifications, and the details shown on the Drawings. Pipe installation and placement of backfill around pipes shall

be performed when the pipe is in a contracted state, i.e., during the cool of morning, at night, or during periods of over-cast skies.

Geocomposite strips must be securely wrapped around the pipe at the locations shown in the Drawings, ensuring the geonet is in direct contact with the pipe.

Placement of the fill should ensure that no tears or breaks on the geotextile sock occur. Any portion of the geotextile that is rendered unsuitable, as determined by the Owner, shall be removed and replaced by the Contractor, at no additional cost to the Owner. The pipe shall be installed in a non-stretched condition and in accordance with the Manufacturer's recommendations regarding laying, handling, and installation.

The pipe and all joints shall comply with these Specifications. The pipe shall be installed to the grades and along the alignment indicated on the Drawings. The placement of the pipe and graded filter gravel shall be controlled such that the graded filter gravel completely surrounds the pipe and encompasses the dimensions shown on the Drawings.

The installation of the pipes and fittings shall be made by the Contractor coordinating his work with the Owner. The installation methods and handling shall be in accordance with the Manufacturer's recommendations as approved by the Engineer.

Immediately after placement, the pipe shall be thoroughly and completely embedded, supported, and covered, and the backfill compacted, in accordance with these Specifications and the details shown on the Drawings.

6.5.2.3 Protection and Repair

Care shall be exercised during construction not to damage the pipes and fittings. Construction equipment shall not be allowed to pass over any pipe culvert until a minimum of 2 feet of compacted cover is placed above the crown of the pipe.

Any pipe section, fitting or joint, which becomes broken, cracked, crushed, cut, scratched, gouged or otherwise rendered unsuitable, as determined by the Engineer, shall be removed and replaced by the Contractor. Scratches greater than 6 inches in length and gouges exhibiting a depth in excess of 8 percent of the wall thickness of the pipe or fitting shall be cause for rejection of a pipe section or fitting to the extent designated by the Engineer.

6.5.3 Gas Vent Outlet

The outlet vent system shall be constructed to the dimensions shown on the Drawings. The pipe fittings installation shall meet the requirements of Section 6.4.2. A layer of geotextile meeting the requirements of Section **Error! Reference source not found.** shall be laid to cover the bottom and all sides of the excavation for the filter pack. Filter gravel shall be placed atop the geotextile such that the bottom and all sides of the filter pack are covered by the geotextile. The filter pack shall be constructed to the dimensions shown on the Drawings. Care shall be exercised so as not to damage the pipe during placement and compaction of the gravel, or to contaminate the filter gravel with fines during stockpiling, handling, and placement. The gas vent geocomposite shall be placed atop the filter pack as shown on the Drawings.

When backfilling in areas adjacent to piping and gas vents, fill shall be placed and compacted by hand (i.e., hand-held vibratory or tamping equipment). Fill for these conditions shall be placed in loose lifts not exceeding 6 inches and shall be brought up evenly on each side of the piping, conduit, or structure. Construction equipment shall not be allowed to pass over any pipe until a minimum of 2 feet of approved compacted cover is placed. All fill materials shall be wetted or dried and homogenized prior to compaction in order to obtain a uniform moisture content throughout the lift.

The fill material shall be compacted to at least 95 percent of the material's Standard Proctor maximum dry density as determined by ASTM D698. The portions of the layer that do not meet the compaction criteria shall be scarified, wetted or dried and recompacted until the compaction criteria is obtained.

Following placement and compaction, the surface of the lift shall be scarified prior to placement of the next lift in order to permit proper bonding between the two layers. Fill materials shall not be placed on dried surfaces or on a surface that has not been scarified. All dried surfaces shall be rewetted and recompacted, or thoroughly and uniformly mixed with moist underlying soils, prior to placing additional fill.

6.6 Sampling and Inspection by Contractor

6.6.1 Sampling

The Contractor shall obtain and secure samples of the filter gravel and gas vent pipe for destructive testing by the Engineer when the materials are delivered to the site or subsequently during installation as requested by the Engineer. The samples shall be obtained from locations designated by the Engineer. All samples shall be properly marked and identified by the Contractor. The Contractor shall repair all openings created by sampling in accordance with Section 6.5.1.4 of these Specifications.

6.6.2 Visual Inspection

The Contractor shall visually inspect the surfaces of the geotextile and geocomposite for any defects including, but not limited to, rips, tears, punctures, and defective seams. The Contractor shall also identify, mark, and repair all noted defects, as well as defects designated by the Engineer. Repairs to geotextiles shall be made in accordance with Section 6.5.1.4. Geocomposite with damage to both geotextile surfaces at any location shall be removed and replaced.

The Contractor shall visually inspect the entire surface for any excessive dirt, dust or debris that could result in clogging of the geonet or geotextile. If dirt, dust or debris is entrapped in the geonet, it should be removed and replaced or the surfaces cleaned as approved by the Engineer.

6.7 Independent Quality Assurance Inspection and Testing

All aspects of the gas venting system installation shall be inspected on a full-time basis by the Engineer. The Engineer shall conduct his own inspections and tests in addition to those performed by the Contractor. The Engineer will undertake observations and perform CQA tests to determine compliance of the materials and work with the specification requirements. CQA by

the Engineer will include monitoring and/or inspecting: (i) Geotextile and geocomposite materials properties; (ii) handling and deployment of geotextile and geocomposite panels; (iii) overlapping and field joints between adjacent panels; (iv) anchorage and ballasting; (v) visual inspection for damage and excessive fine debris trapped within the geotextile and geonet; (vi) wrapping geotextile around edges of geocomposite; (vii) all HDPE pipe and fittings for correct size, DR rating, workmanship, fabrication, slot size and placement; (viii) all pipe installations including construction procedures and joining of all pipes and fittings; and (ix) placement, backfilling, and compaction operations involving filter gravel material around gas vent outlet pipes.

The Engineer shall also monitor repair work, and evaluate the adequacy and acceptability of all repair work.

The Contractor shall obtain and secure samples or coupons of the geonet and or geotextile for destructive testing by the Engineer from locations designated by the Engineer. The Contractor shall properly mark all test specimens as needed to identify the particular roll or area from which the specimen was obtained.

Openings created by removal of samples or coupons for testing shall be patched and properly fastened to the original sheet by the Contractor in accordance with Section 6.5.1.4 of these specifications.

The geonet and/or geotextile manufacturer shall obtain and secure samples of the geosynthetic material for destructive testing by the Engineer. One 2-foot wide sample representing the entire width of the roll shall be cut during production, and the samples shall be labeled, packaged, and shipped by the Manufacturer for delivery prior to shipment of the geonet and or geotextile rolls to the project site. The Manufacturer shall cut and send to the Engineer one sample per every 30 rolls.

The following sampling procedure shall be used in order to allow positive visual confirmation by the Engineer that samples supplied by the geonet/geotextile Manufacturer represent the geonet/geotextile roll indicated by the Manufacturer.

- Apply three or more randomly and uniquely located, permanent paint markings in the machine direction across the path of the knife on the geonet/geotextile sheet to be sampled prior to cutting the sample. The paint markings shall be generally located within 2 feet of the end of the roll bearing the Manufacturer’s roll label.

- Cut a minimum 24-inch wide sample across the entire roll width ensuring that the knife passes through the paint markings, leaving half of the marking on the geonet/geotextile roll and the other half on the sample.

- Roll the sample such that the end bearing the paint markings is on the outer end of the rolled sample. The outer end of each sample shall also be marked identifying the Manufacturer’s roll number.

Upon delivery of the geonet/geotextile rolls and the corresponding samples to the project site, the Engineer's representative will observe that the paint markings on each sample coincide with those on the corresponding geonet/geotextile roll to confirm that the samples are representative of the roll number indicated on the sample by the Manufacturer.

Samples of the filter gravel shall be tested by the Engineer as needed for grain size distribution to verify compliance with these Specification requirements.

Failure of any sample to meet the requirements specified herein shall be considered cause for rejection of the material or installed section from which the sample was collected to the extent designated by the Engineer. If the Contractor and or Manufacturer can establish to the Engineer, via additional tests performed by the Engineer, that the failed sample is representative of a smaller section of the installed material than the entire lot represented by the original test sample, then only that portion will be rejected, provided, however, that the additional tests are performed by the Engineer representing the Owner. The Contractor and or Manufacturer shall also reimburse the Owner for any such test that fails to meet the requirements specified herein.

SPECIFICATIONS

SECTION 7
CONSTRUCTION OF SOIL SUBBASE

RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

7.1 Description of Work

This Specification stipulates the material and installation requirements, including associated quality control/quality assurance inspection and testing requirements, for the soil subbase to be constructed as the bottom component of the liner system. The work shall include constructing the soil subbase to the lines and elevations shown on the Drawings, on a prepared soil subgrade (on top of the gas venting system) that has been accepted by the Engineer. The soil subbase shall consist of a minimum 6-inch thick layer of clayey soil having an in-place saturated hydraulic conductivity equal to or less than 1.0×10^{-5} cm/sec.

7.2 Referenced Standards

The following ASTM standards are referenced in this Specification.

D421: Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants

D422: Standard Test Method for Particle-Size Analysis of Soils

D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

D1140: Standard Test Method for Amount of Material in Soils Finer than No. 200 (75μm) Sieve

D1556: Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

D2216: Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2487: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2937: Standard Test Method for Density of Soil In Place by the Drive-Cylinder Method

D2974: Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

D4318: Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

D5084: Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

D6938: Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

7.3 Material Property Requirements

The soil subbase shall be constructed using clayey material that has the following characteristics:

- The material shall be relatively uniform in character, and free from deleterious materials such as wood, roots, trash, debris, etc.
- The material shall not contain any sharp or irregular objects, rocks, gravel, or particles in excess of ¼-inch in size.
- The material shall have an organic content of no greater than 2 percent, as determined by ASTM D2974.
- The material shall have a minimum fines content (i.e., percent of material by dry weight passing the U.S. No. 200 standard sieve) of 25 percent, as determined by ASTM D1140.
- The material shall have a liquid limit between 30 and 50 percent, and a plasticity index between 20 and 40 percent, as determined by ASTM D4318.
- The material shall classify as a clayey sand or sandy clay with a SC or CL designation in accordance with ASTM D2487.
- The material shall be capable of achieving a moisture content within the range that is required for effective compaction.
- The material shall be capable of achieving an in-place saturated hydraulic

conductivity equal to or less than $1.0x10^{-5}$ cm/sec, as determined by ASTM D5084.

7.4 Pre-Construction Material Testing

A minimum of three representative samples of the clayey material from each proposed borrow source shall be submitted by the Contractor to the Engineer for laboratory index, compaction, and permeability testing at least 4 weeks prior to construction.

Atterberg limit determinations (ASTM D4318), sieve analyses (ASTM D421 and D422), fines content determinations (ASTM D1140), and moisture content determinations (ASTM D2216) shall be performed on each representative sample submitted by the Contractor. If appropriate, one Standard Proctor compaction test (ASTM D698) shall be performed on a combined homogenized sample of the three representative samples. At least three laboratory permeability tests (ASTM D5084) shall be performed on test specimens prepared at different molding conditions determined by the Engineer. No material shall be used for construction of the soil subbase without meeting this Specification and the approval of the Engineer.

7.5 Construction Procedures

The following procedures shall be observed by the Contractor during construction of the soil subbase:

- The soil subbase shall be constructed by placing, spreading, wetting or drying (as needed), homogenizing, and then compacting the clayey material in one lift.

- The fill materials shall be compacted after placement of the gas vent system. For molding moisture contents within the range of 3 percent dry to 3 percent wet of the optimum Standard Proctor moisture content, the fill materials shall be compacted to a dry density equal to or greater than 95 percent of the Standard Proctor maximum dry density (ASTM D698). For molding moisture contents greater than 3 percent wet of the Standard Proctor optimum moisture content, the fill materials shall be compacted to a dry density equal to or greater than 98 percent of the Standard Proctor dry density corresponding to the molding moisture content.

- After compaction, the surface of the soil subbase shall be smoothened with a steel drum roller.

- A grader may be used to remove any excess material from the constructed soil subbase. Conversely, areas not meeting the thickness requirements shall be augmented with additional material. The added material shall be reworked into the constructed soil subbase to ensure homogeneity and proper bonding. This may be accomplished by scarification of the surface prior to addition of new material.

- The finished surface of the soil subbase shall be smooth, free from roller marks, holes, depressions more than 0.5 inches, or protrusions more than 1 inch. No object shall protrude above the finished soil subbase surface.

- The completed soil subbase shall be protected from traffic and erosion. Any damaged areas shall be repaired, and the grade shall be re-established.

- To prevent desiccation cracking, the Contractor shall maintain the moisture content of the completed soil subbase section by regularly spraying the surface of the constructed soil subbase with clean water until it is covered by the HDPE geomembrane liner.

7.6 Quality Assurance Inspection and Testing

The Engineer shall inspect and test the constructed soil subbase to determine compliance with this Specification. Samples for construction quality assurance testing shall be obtained by a field representative of the Engineer from random locations within the constructed soil subbase. The construction quality assurance test frequencies are specified below.

7.6.1 Field Test

- A minimum of two moisture content and field density (ASTM 1556, ASTM D2937 or ASTM D6938) determinations shall be conducted per acre.

- A minimum of four thickness measurements shall be conducted per acre.

7.6.2 Laboratory Test

- Percent fines (ASTM D1140) shall be determined at a minimum frequency of two tests per acre.

- Atterberg limits determinations (ASTM D4318) shall be at a minimum frequency of one test per acre.

- Hydraulic conductivity tests (ASTM D5084 using an isotropic effective confining stress of 5lb/in^2) shall be conducted at a minimum frequency of one test per acre.

If there are indications of a change in material quality or construction procedures, or if the test results are not consistently meeting the specification requirements, the test frequencies may be increased, at the discretion of the Engineer. All field density test and sampling locations shall be recorded by the Engineer.

Holes in the constructed soil subbase created because of field testing or sampling shall be backfilled and tamped uniformly in 2-inch thick lifts by the Contractor using a rod or other method approved by the Engineer. The backfill material shall be the same material used for construction of the soil subbase. At the surface, the backfill material shall extend slightly beyond the edge of the hole to ensure a good tie-in with the soil subbase. The Contractor shall be aware that laboratory hydraulic conductivity testing on samples of the soil subbase may take up to 5 days. If the hydraulic conductivity test result indicates that a sample does not meet the specification requirement, the Contractor shall remove, replace, re-work, and re-compact the area represented by the failing sample, as directed by the Engineer.

SPECIFICATIONS

SECTION 8
HDPE LINER MATERIALS

**RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS**

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

8.1 Description of Work

This Specification covers the material requirements for high density polyethylene (HDPE) geomembrane liner, factory inspection and testing requirements, and quality assurance testing by the Engineer.

8.2 Referenced Standards

The following Standards are referenced in this Specification.

8.2.1 ASTM International Standards

8.2.1.1 Geomembrane Standards

D570: Standard Test Method for Water Absorption of Plastics

D746: Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D1004: Standard Test Method for Initial Tear Resistance (Graves Tear) of Plastic Film and Sheeting

D1203: Standard Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods

D1204: Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature

D1238: Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique

D1603: Standard Test Method for Carbon Black Content in Olefin Plastics

D1693: Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

D3895: Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry

D4218: Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique

D4833: Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products

D4976: Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

D5199: Standard Test Method for Measuring the Nominal Thickness of Geosynthetics

D5321: Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear

D5397: Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test [Appendix X1- Procedure to Perform a Single Point Notched Constant Tensile Load (SP-NCTL) Test]

D5596: Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

D5721: Standard Practice for Air-Oven Aging of Polyolefin Geomembranes

D5994: Standard Test Method for Measuring Core Thickness of Textured Geomembranes

D6693: Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

D7466: Standard Test Method for Measuring Asperity Height of Textured Geomembranes

E96: Standard Test Methods for Water Vapor Transmission of Materials

8.2.1.2 Soils Standards

D422: Standard Test Method for Particle-Size Analysis of Soils

D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

D2216: Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2487: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

8.2.2 Geosynthetic Research Institute (GRI) Standards

GM-11: Accelerated Weathering of Geomembranes using a Fluorescent UVA-Condensation Exposure Device

8.3 Material Requirements

Two-sided textured geomembrane liner shall consist of unreinforced high density polyethylene (HDPE), designed and manufactured specifically for the purpose of liquid containment.

Product data sheets listing the minimum and nominal liner physical properties shall be provided to the Engineer for each type liner prior to shipment. Product data sheets for the HDPE resin, listing density, melt index, low temperature brittleness, environmental stress crack resistance and ASTM Standard D4976 classification, shall be provided for each type resin prior to shipment.

8.3.1 Base Resin

The uncolored base resin used to manufacture the liner shall be polyethylene having a minimum density of 0.932 g/cm^3 classifying as Group 2, Class 2, Grade 4 or Grade 5 (PE 224 or PE 225) in accordance with ASTM Standard D4976.

The formulated colored resin shall classify as a Group 2, Class 3, Grade 4 or Grade 5 high density polyethylene (PE 234 or PE 235) with physical properties meeting A46009 in accordance with ASTM Standard D4976 with environmental stress crack resistance (ASTM Standard D1693) F_{50} >1500 hours (Condition B; 50°C/100% Igepal) and F_{20} >192 hours (Condition C; 100°C/100% Igepal). The formulated colored resin shall contain not less than 97 percent of the base polymer, not less than 2.0 percent carbon black, and not more than 3.0 percent carbon black, anti-oxidants and heat stabilizers combined with no other additives, fillers or extenders.

Carbon black dispersion in the liner shall be rated as Category 1 or Category 2 in nine or ten of ten views, and as Category 3 in no more than one of ten views classified in accordance with ASTM Standard D5596. The variation in carbon black content within each resin batch shall be no greater than ±5 percent from the average carbon black content determined from factory tests performed on every fifth liner roll (see Section 8.4.4.2).

The liner shall be manufactured from virgin resin, with not more than 3 percent regrind material. Regrind material, if used, must be of the same formulation as the virgin resin. Post-consumer resin of any type may not be used.

Liner sheets shall be manufactured using one of the following base resins unless approved otherwise by the Engineer:

- Chevron Phillips Marlex K306 or K307
- Chevron Phillips Marlex HHM TR-400 or HHM TR-400G
- BP Solvay Fortiflex G36-10-150 (G36-24x1767)

Use of any of the approved base resins shall not relieve the Liner Manufacturer from complying with all other Specification criteria.

8.3.2 Welding Rod

Welding rod used for field joining liner sheets shall be manufactured from the same HDPE resin used to manufacture the liner.

8.3.3 Physical Appearance of Liner Sheets

All liner sheets shall have good appearance qualities. Texturing on the surface of textured sheets shall be uniform and homogeneously distributed, and shall be free from agglomerated texturing material.

All liner sheets shall be free of pinholes, holes, blisters, gels, undispersed ingredients, fish-eye blemishes, any signs of contamination by foreign matter, or any defect that may affect serviceability. The edges of the sheets shall be straight and free from nicks and cuts.

Liner rolls that require more than one patch per 5,000 square feet for repair of holes, blisters, gels, undispersed ingredients, blemishes, contamination by foreign matter, or any factory defect that may affect serviceability, shall be considered faulty, and shall be rejected and replaced at the Liner Manufacturer’s expense.

8.3.4 80-mil Textured Liner Physical Properties

Textured HDPE liner shall be textured on both sides unless indicated otherwise on the Drawings, and shall meet the following criteria.

Property	Test Method	Criteria
Minimum Thickness	ASTM D5994	≥ 72 mil
Average Thickness	ASTM D5994	≥ 80 mil
Average Asperity Height	ASTM D7466	≥ 10 mil*
Density	ASTM D792 (Method A) or D1505	> 0.940 g/cm^{3†}
Melt Index	ASTM D1238 (190°C/2.16 kg)	< 1.0 g/10 minutes
Carbon Black Content	ASTM D1603 or D4218***	≥ 2.0% & <3.0%
Carbon Black Dispersion	ASTM D5596 (10 views)	Category 1 or 2 (≥9 views) and Category 3 (≤1 view)
Tensile Strength at Yield	ASTM D6693**	> 168 lb/inch
Tensile Strength at Break	ASTM D6693**	> 160 lb/inch
Elongation at Yield	ASTM D6693**	> 12%
Elongation at Break	ASTM D6693**	> 200%
Tear Resistance	ASTM D1004**	> 56 lb
Puncture Resistance	ASTM D4833	> 158 lb

† The density of the uncolored base resin shall be greater than 0.932 g/cm^3.
* Asperity height shall be sufficient to provided specified interface frictional resistance.
** Tested in machine and transverse directions.
*** D4318 may be used only if an acceptable correlation with D1603 carbon black content is provided

All individual test specimens shall meet the minimum or maximum criterion tabulated above, with the following exceptions.

- The average tensile strength and elongation at break in the machine and transverse directions, determined from the average of five test specimens in each direction, shall comply with specified values.
- All individual test specimen results shall display tensile strengths at break equaling or exceeding 48 lb/inch and elongations at break equaling or exceeding 60 percent.

Textured liner shall also meet the criteria specified below for modulus of elasticity, water vapor transmission; dimensional stability; low temperature brittleness; volatile loss; water absorption; environmental stress crack resistance; constant tensile load stress crack resistance; and oxidative induction time.

Property	Test Method	Criteria
Modulus of Elasticity	ASTM D6693*	> 80,000 lb/in^2
Water Vapor Transmission	ASTM E96, Procedure BW	< 0.03 g/m^2/24 hours**
Dimensional Stability	ASTM D1204 (100° C for 1 hour)	± 2% (maximum)
Low Temperature Brittleness	ASTM D746, Procedure B	< -94°F (<-70°C)
Volatile Loss	ASTM D1203, Method A	< 0.1%
Water Absorption	ASTM D570	< 0.1%
Environmental Stress Crack Resistance	ASTM D1693, F_{50} (Cond. B; 50º C/100% Igepal)	> 1,500 hours
Constant Tensile Load Stress Crack Resistance (SP-NCTL at 30% of Yield Stress)	ASTM D5397 (SP-NCTL)	> 300 hours
Oxidative Induction Time	ASTM D3895 (200°C and 14.7 lb/in^2 O_2)	> 140 minutes
Oven Aging	ASTM D5721 (85ºC)	≥55% S-OIT retained at 90 days, or ≥80% HP-OIT retained at 90 days
Weathering (UV) Resistance	GM-11 [20 hour UV cycle at 75ºC with 4 hour condensation at 60ºC]	≥50% HP-OIT retained at 1,600 hours

* Tested in machine and transverse directions.
** The average water vapor transmission shall meet the specified value. Individual test specimens shall display a maximum water vapor transmission equal to or less than 0.05 gram/m2/24 hours.

Routine testing for modulus of elasticity, water vapor transmission, dimensional stability, low temperature brittleness, volatile loss, water absorption and environmental stress crack resistance will not be required from the Liner Manufacturer. Certification in writing shall be provided by the Liner Manufacturer that the liner meets the Specification requirements. In support of the certification, the Liner Manufacturer shall submit at least one test result for each property performed within one year prior to the date of the certification on liner manufactured with each resin formulation supplied to the project.

Routine testing for oven aging and weathering (UV) resistance will not be required from the Liner Manufacturer. Certification in writing shall be provided by the Liner Manufacturer that the liner meets the Specification requirements. In support of the certification, the Liner Manufacturer shall submit test results for each resin formulation supplied to the project.

8.3.5 Frictional Characteristics

The surface roughness of textured liner shall be such that the peak interface friction angle is equal to or greater than 21 degrees between the double-sided geocomposite and the HDPE liner used in the bottom liner systems and 28 degrees between the HDPE liner and the compacted soil subbase.

For determining compliance with the specified interface friction angles, direct shear tests will be performed by the Engineer in accordance with Standard ASTM D5321 using the geosynthetic products and the borrow clayey sand/sandy clay subbase materials (SC or CL designation in accordance with ASTM D2487) selected by the Contractor.

The direct shear tests shall be performed at normal stresses selected by the Engineer ranging from 5 to 15 lb/in^2. The soil shall be compacted to a dry density equal to 95 percent of the

Standard Proctor maximum dry density (ASTM D698) within ±2 percent of the Standard Proctor optimum water content. The interface and soil shall be tested submerged with water. The tests shall be performed using a horizontal displacement rate of 0.3 inches per hour.

8.4 Manufacturing and Factory Inspection and Testing

The Liner Manufacturer shall submit product data sheets and test data for each liner type to the Engineer presenting the liner minimum physical properties for each property listed in Section 8.3.4, and the resin type(s) and properties. Written certification shall be provided by the Liner Manufacturer confirming compliance of the resin and liner sheets with this Specification.

8.4.1 Minimum Sheet Dimensions

The HDPE liner shall be supplied in rolled sheets having a minimum width of 22 feet and minimum length of 385 feet. Variances for shorter roll lengths may be allowed at the discretion of the Engineer.

8.4.2 Marking and Packaging

The Liner Manufacturer shall label each roll with the roll number, thickness, length, width and date manufactured.

Each roll shall be individually packaged at the factory and protected to prevent damage during shipment. If the liner is not packaged and a roll is damaged during shipment, it shall be rejected. If only the outermost surface of the roll is affected, it shall be peeled back, cut and wasted (i.e., it shall be treated as if it were the protective packaging for the remainder of the roll). Rolled out liner stock that requires more than one repair patch per 5,000 square feet prior to installation to repair factory defects will be considered faulty, and will be rejected and replaced at the Liner Manufacturer's expense.

8.4.3 Factory Inspection and Spark Testing

The Liner Manufacturer shall inspect all liner sheets at the factory for compliance with the physical appearance requirements listed in Section 8.3.3. The Liner Manufacturer shall continuously spark test all liner sheets during manufacturing. The spark tester shall be capable of detecting defects or pinholes equal to or less than 10 mils (0.25 mm) in diameter. The Liner Manufacturer shall submit a complete description of the spark tester, operating protocols, factory QA/QC plan for operating the system and identifying defective liner, and methods for removing or patching liner with pinholes to the Engineer prior to shipping liner to the project. All necessary repairs to the liner shall be made by the Liner Manufacturer at the factory before shipment.

The Liner Manufacturer shall provide written certification that all liner rolls delivered to the project were continuously spark tested and do not contain pinhole defects.

8.4.4 Factory Testing

The Liner Manufacturer shall submit the factory testing QA/QC plan, and factory laboratory quality manual for all liner and resin tests required in this Specification to the Engineer prior to shipping liner to the project.

8.4.4.1 HDPE Resin

Factory test reports for the HDPE resin shall include the proportions of HDPE resin, carbon black and other additives, and test results for melt index, density, environmental stress crack resistance, low temperature brittleness and oxidative induction time. These reports shall be submitted for approval by the Engineer before installation of any liner material. The following tests at the indicated minimum frequency of testing shall be undertaken by the Liner Manufacturer.

Resin Property	Test Method	Minimum Frequency
Density	ASTM D1505 or D792 (Method A)	Once per Batch of Resin
Melt Index	ASTM D1238 (190°C/2.16 kg), Condition E	Once per Batch of Resin
Oxidative Induction Time	ASTM D3895 (200°C; 14.7 psi O_2)	Once per Batch of Resin

The resin density and melt index shall be reported for both the unblended resin and the blended resin after adding carbon black and antioxidants. The oxidative induction time shall be reported for the blended resin. Routine testing for low temperature brittleness and environmental stress crack resistance is not required. Certification of these properties, in accordance with the requirements in Section 8.3.4, will be accepted.

The resin manufacturer's certificate of analyses for each batch of resin shall also be provided to the Engineer for approval before installation of any liner material.

8.4.4.2 Liner Rolls

Factory test reports for each liner roll shall, at a minimum, include test results for the following properties:

- minimum thickness, average thickness and asperity height;
- density;
- carbon black content and carbon black dispersion
- tensile strength and elongation at yield and break;
- tear resistance; and
- puncture resistance.

The factory test reports shall be submitted to the Engineer for approval before installation of the liner. The following tests at the indicated minimum test frequencies shall be undertaken by the Liner Manufacturer on the liner rolls.

Liner Property	Test Method	Minimum Frequency
Core Thickness	ASTM D5994	Every Roll
Asperity Height	ASTM D7466	Every Other Roll
Tensile Strength at Yield	ASTM D6693	Every Roll
Tensile Strength at Break	ASTM D6693	Every Roll
Elongation at Yield	ASTM D6693	Every Roll
Elongation at Break	ASTM D6693	Every Roll
Tear Resistance	ASTM D1004	Every Roll
Puncture Resistance	ASTM D4833	Every Roll
Density	ASTM D792 or D1505	Every 5 Rolls
Carbon Black Content	ASTM D1603 or D4218	Every 5 Rolls
Carbon Black Dispersion	ASTM D5596	Every 5 Rolls
Notched Constant Load ESCR (Single Point at 30% of Yield Stress)	ASTM D5397 (SP-NCTL)	Every 20 Rolls

Failure of any of the factory tests to comply with Specification requirements shall result in rejection of the corresponding liner rolls.

Tensile tests and tear resistance tests shall be performed in the machine and transverse directions. Tensile, tear resistance and puncture resistance tests may be performed on one test specimen from each roll of smooth liner (in each direction, where applicable) and the moving average as well as the minimum value from each five consecutive rolls reported to the Engineer.

Five tensile test specimens shall be tested (in each direction) from each of the first 20 rolls of textured liner manufactured for delivery to this project. Tear and puncture tests may be performed on only one test specimen from each roll of textured liner (in each direction, where applicable) and the moving average as well as the minimum value from each five consecutive rolls reported. Provided all tensile test results are in compliance with the Specifications, the number of test specimens may then be reduced as allowed above for smooth liner if approved by the Engineer. All factory testing shall be at the Liner Contractor's or Liner Manufacturer's expense.

Certification of the modulus of elasticity, water vapor transmission, dimensional stability, low temperature brittleness, volatile loss, water absorption, environmental stress crack resistance, oven aging and weathering (UV) resistance shall be provided in accordance with Section 8.3.4.

8.5 Quality Assurance Testing by Engineer

8.5.1 Sampling by Liner Manufacturer

The Owner will arrange with the Liner Manufacturer for the sampling of liner rolls during manufacturing for independent testing by the Engineer prior to shipment of the rolls. One 2-foot wide sample across the full width of each roll shall be cut during production. The samples shall be labeled, packaged and shipped by the Liner Manufacturer to the Engineer for testing.

The following sampling procedure shall be used to allow positive visual confirmation by the Engineer that samples supplied by the Liner Manufacturer represent the liner rolls indicated by the Liner Manufacturer.

- Apply three or more randomly and uniquely located, permanent paint-stick markings in the machine direction across the path of the knife on the liner sheet to be sampled prior to cutting the sample. The markings shall be generally located within 2-foot of the end of the roll bearing the Liner Manufacturer's roll label.

- Cut a minimum 2-foot wide sample across the entire roll width ensuring that the knife passes through the paint markings, leaving half of the marking on the liner roll and the other half on the sample.

- Roll the sample such that the end bearing the paint markings is on the outer end of the rolled sample. The outer end of each sample shall also be marked with the roll number.

Upon delivery of the liner rolls to the project site, the Engineer's representative will observe that the paint markings on each sample provided for testing coincide with those on the corresponding liner roll.

Testing by the Engineer will be made for the following liner properties at the following minimum frequencies unless revised otherwise by the Engineer.

Property	Test Method	Sampling Frequency
Thickness	ASTM D5994	2 per acre
Asperity Height	ASTM D7466	2 per acre
Density	ASTM D792 or D1505	1 per acre
Carbon Black Content	ASTM D1603 or D4218	1 per acre
Tensile Strength at Yield	ASTM D6693*	2 per acre
Tensile Strength at Break	ASTM D6693*	2 per acre
Elongation at Yield	ASTM D6693*	2 per acre
Elongation at Break	ASTM D6693*	2 per acre
Tear Resistance	ASTM D1004*	2 per acre
Frictional Characteristics	ASTM D5321	1 per 10 acres
Other Properties	As requested by the Engineer	Up to 2 samples per acre
* Tested in both machine and transverse directions.		

Failure of any sample to meet or exceed the requirements specified herein shall be considered cause for rejection of the material or installed liner section from which the sample was collected to the extent designated by the Engineer. If the Liner Contractor or Liner Manufacturer can establish to the Engineer, via submittal of additional test results, that the failed sample is representative of a smaller section of the liner, then only that portion will be rejected, provided that such additional tests are performed, at the Liner Contractor's or Liner Manufacturer's expense, by the Engineer representing the Owner.

8.5.2 Sampling by Liner Contractor

The Liner Contractor shall obtain and secure samples of the liner during construction for testing by the Engineer at locations designated by the Engineer, and shall properly mark all samples as needed to identify the liner roll and panel from which the sample was obtained. The sample shall be 2-foot wide sample across the full width of the roll.

8.6 Warranty

A written warranty shall be provided to the Owner from the Liner Manufacturer. This document shall warrant the quality of the liner material for a period of not less than 20 years.

8.7 Submittals

The following submittals are required as part of the requirements of this Specification.

- Product data sheets and test data for each liner type listing the minimum liner physical properties, and the product data sheets for each type resin listing the resin properties.

- Written certification from the Liner Manufacturer that the resin and liner are in compliance with this Specification.

- Written certification from the Liner Manufacturer that the modulus of elasticity, water vapor transmission, dimensional stability, low temperature brittleness, volatile loss, water absorption, environmental stress crack resistance, oven aging and weathering (UV) resistance meet the requirements of this Specification.

- Description of the spark testing device, operating protocols, the factory QA/QC plan for operating the system and identifying defective liner, methods for removing or patching liner with pinholes and written certification from the Liner Manufacturer that all liner rolls have been factory spark tested and do not contain pinhole defects.

- Factory testing QA/QC plan and factory laboratory quality manual for all liner and resin tests required in this Specification.

- Written certification from the Liner Manufacturer that the HDPE resin low temperature brittleness and environmental stress crack resistance meet the requirements of this Specification.

- Factory test reports for each batch of HDPE resin used in the liner sheets including proportions of base polymer and additives, oxidative induction time, melt index and density. The resin manufacturer's certificate of analysis for each batch of resin shall also be provided.

- Factory quality control certificates for each liner roll including minimum and average thickness, asperity height, tensile strength and elongation at yield and break, tear resistance, puncture resistance, density, carbon black content and carbon black dispersion.

- Written warranty from the Liner Manufacturer to warrant the quality of the liner material for a period of not less than 20 years.

SPECIFICATIONS

SECTION 9
HDPE LINER INSTALLATION

RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

9.1 Description of Work

This Specification covers the installation of High Density Polyethylene (HDPE) geomembrane liner and associated ancillary work. The HDPE liner shall be installed in accordance with this Specification and as shown on the Drawings. Liner installation includes: (i) surface water control during liner installation; (ii) maintenance of the prepared compacted soil base for the liner; (iii) placement and seaming of 80-mil HDPE textured liner; (iv) excavation and backfilling liner anchor trenches; and (v) placement of temporary ballast loading.

9.2 Referenced Standards

The following ASTM International (ASTM) standards are referenced in this Specification.

D698: Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

D1556: Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

D2216: Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2937: Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method

D4437: Standard Practice for Non-Destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymetric Sheet Geomembranes

D4944: Standard Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester

D5641: Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber

D5820: Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes

D6365: Standard Practice for the Nondestructive Testing of Geomembrane Seams Using the Spark Test

D6392: Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

D6938: Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

9.3 Surface Water Control and Base Maintenance

The base of the construction area shall be maintained well-drained prior to and during liner installation. Liner work areas shall be maintained well-drained and dry to prevent uplift of the liner after installation. The Contractor's proposed methods for dewatering, surface water control and routing water shall be submitted to the Owner for approval at least two weeks prior to implementation.

The Liner Contractor shall maintain and restore, as needed, the condition of the prepared base prior to and during liner deployment and installation such that the prepared base is maintained in accordance with the Specifications in Section 7 at the time of liner deployment.

9.4 Liner Handling and Installation

Installation of the liner shall be in compliance with the Drawings and Specifications and with the Liner Manufacturer's standard guidelines and specifications for liner installation, subject to approval by the Engineer, including as applicable, but not limited to: liner roll handling and on-site storage; unrolling and laying of liner sheets; field seaming; anchor trench installation; temporary ballast loading; vent installation; and liner penetrations and connections to structures.

9.4.1 On-Site Storage

On-site storage shall be as needed to protect the liner rolls from excessive accumulations of soil on the liner surfaces, water, heat, mechanical abrasion, puncture and vehicular traffic. Liner rolls shall be stored on a firm, dry, elevated surface in a protected storage area approved by the Owner. Liner rolls shall not be stacked more than three rolls high, or as otherwise recommended by the Liner Manufacturer.

9.4.2 Handling and Panel Placement

Appropriate handling equipment shall be used when loading or moving rolled liner sheets from one place to another. Appropriate equipment includes spreader and roll bars for deployment, and cloth chokers with a spreader bar for off-loading.

Liner deployment shall not be performed when precipitation is occurring, when excessive moisture (i.e., fog, dew) or wet conditions exist, when the ambient air temperature is below 40° F or above 100°F, when high winds (>20 mph) are occurring, or when other adverse climatologic conditions exist that would, in the opinion of the Engineer and/or Owner, adversely affect liner installation.

The liner sheets shall be unrolled and deployed in a manner which minimizes wrinkles and prevents the occurrence of folds and creases. Liner panels shall be installed from high to low elevation to prevent runoff from flowing below installed liner panels, and shingled at seams with the upslope panel overlaying the downslope panel. All liner shall be ballasted immediately after deployment to prevent uplift by wind

“Vise-grips” or other tools, if used to grip the liner during handling and deployment, shall have clean, smooth grip faces, and corners on the grip faces shall be rounded. The pressure applied by the grips shall not be so great as to indent or otherwise damage the liner. The Liner Contractor shall demonstrate the methods for handling and deploying liner at the start of installation for approval by the Engineer.

The HDPE liner shall be installed at the locations and to the lines, grades and dimensions shown on the Drawings, or as otherwise approved by the Engineer. Panel layout and deployment shall be such that seams run down the slope of the dikes and are oriented perpendicular to the top of slope of the dikes. This seam orientation shall be maintained for a distance of not less than 10 feet from the inside toe of the dikes or as otherwise shown on the Drawings or approved by the Engineer.

The Liner Contractor shall submit a panel layout plan indicating the proposed liner panel configuration and field seams, and identifying (if applicable and shown on the Drawings) anchor trenches, vents, pipe penetrations, seepshields, structure connections, permanent wind ballast trenches, permanent bag wind ballast atop the liner, and other details needed to complete the work for approval by the Engineer at least two weeks prior to liner installation.

9.4.3 Field Seams

All liner shall be seamed the same day that the liner is deployed. Welding of field seams shall not take place unless suitable surface and weather conditions exist, the ambient air temperature is above 40° F and below 100°F, and satisfactory field seams can be made as confirmed by field trial test welds. The Liner Contractor may submit a procedure for welding in ambient air temperatures below 40°F and above 100°F for review and approval by the Engineer.

All liner sheets must be continuously and tightly bonded using continuous double-wedge fusion welds or extrusion fillet welds both made using automated welding equipment approved by the Engineer. The use of extrusion fillet welds shall be limited to patches at liner panel T-seams, patches at liner repairs, pipe penetrations or other detail work as approved by the Engineer.

Field seaming shall be conducted in the dry, on relatively smooth compacted surfaces, and in such a manner to prevent water, moisture, soil, dust, dirt or other foreign material from being included within the weld.

Adjoining liner sheets shall be overlapped a minimum of 4 inches by adequately lapping the edges of the sheets. The overlap shall not exceed 6 inches for double-wedge fusion welds. Seam overlaps on the bottom area shall be made such that the direction of flow over the lined surface is from the top sheet toward the bottom sheet to form a shingle effect.

Edges to be welded shall be wiped and cleaned thoroughly to remove any water, moisture, soil, dust, dirt or other foreign material. All field seams shall be: symmetric, and uniform in appearance and width satisfying the appearance criteria below and as shown on the Drawings, unless approved otherwise by the Engineer based on peel and shear test results; shall not exhibit heat distortion due to overheating from welding; and shall be uniform in physical properties meeting the seam strength, shear elongation, peel separation and failure mode criteria in Section 9.4.3.1 of this Specification.

(i) Extrusion Fillet Welds: The surface of extrusion fillet welds shall be uniform and smooth in appearance. The interior of the center extrudate bead shall be homogeneous and uniform in appearance. The weld shall be symmetric in width with the crown of the extrudate bead centered along the edge of the top liner sheet. The total width of the weld shall be between 1¼ and 1¾ inches with the center bead comprising approximately one-third of the total width. The total thickness of the center of the weld shall be 3 to 4 times the thickness of the liner sheets being welded. The squeeze-out lip along both edges of the weld shall be similar in shape and size.

(ii) Double-Wedge Fusion Welds: The surface of double-wedge fusion welds shall be uniform in appearance and slightly embossed from the nip rollers along the top and bottom surfaces of both fusion weld areas. The fusion weld areas shall be symmetric and each shall have a width equal to or greater than 5/8 inches and thickness reduction of 10 to 25 mils. The width of the air channel shall typically be 1/2 to 5/8 inches. Squeeze-out along the inside and outside edges of the fusion welded areas shall be similar in size and typically extend no more than about 1/8-inch.

The surface of both HDPE liner sheets along extrusion fillet welds shall be ground prior to welding to remove any oxidized surface film in accordance with the following criteria unless approved otherwise by the Engineer: (i) grind with 80 grit sand paper holding the grinding wheel such that the grinding marks are oriented perpendicular to the seam and made from the bottom sheet toward the top sheet to prevent gouging of the lower sheet; (ii) the edge of the upper sheet shall be beveled approximately 45 degrees by the grinding process; (iii) the depth of grinding shall be approximately 5 percent of the liner thickness and in no case more than 10 percent of the liner thickness; and (iv) the width of grinding shall be slightly less than the width of the extrusion weld such that grinding marks are not visible beyond the edges of the weld. Welding shall be completed within one hour of grinding the surface of the liner.

Heat-degraded resin in the barrel of the extrusion welder shall be purged prior to making extrusion welds.

Seams shall not exhibit heat distortion from overheating during welding (e.g., warping, excessive thermal puckering). The underside of field seams shall be inspected for heat distortion from welding at the end of all seams, wherever samples for destructive testing are cut from the field seam, and at locations identified by the Engineer wherever the appearance of the weld is indicative of potential heat distortion.

9.4.3.1 Field Seam Strength

All welded field seams shall meet the following criteria when tested in accordance with ASTM Standard D6392 except where noted otherwise:

(i) Shear Strength: The specimen shall exhibit: a strength in shear equal to or greater than 160 lb/inch (ppi); a film-tear bond failure (FTB) mode; and a shear elongation at break equal to or greater than 50 percent. The test shall be performed at a rate of displacement of 2 inches/minute (ipm) for the first 2 inches of displacement, and the test then continued at a rate of displacement of 20 ipm until rupture.

(ii) Peel Strength: The specimen shall exhibit: a peel strength equal to or greater than 121 ppi for double-wedge fusion welds and equal to or greater than 109 ppi for extrusion fillet welds; a film-tear bond failure (FTB) mode; and a peel separation (incursion area) less than or equal to 25 percent of the initial bonded area and everywhere across the specimen less than 100 percent of the width of the initial bonded area (excluding the area and width of the squeeze-out from the initial bonded area and width). The peel strength criteria shall apply to both the top and bottom welds of double-wedge fusion welds.

Double-wedge fusion welds exhibiting AD, AD-BRK [with >25% peel separation of the bonded area] or AD-BRK [with separation across 100% of the bonded width regardless of separation area] locus-of-break behavior shall be considered non-FTB failure modes. Extrusion fillet welds exhibiting AD1, AD2, AD-BRK [with >25% peel separation of the bonded area], AD-BRK [with separation across 100% of the bonded width regardless of separation area] or AD-WLD [with shear strength <160 ppi or peel strength <110 ppi] locus-of break behavior shall be considered non-FTB failure modes.

9.4.3.2 Pass/Fail Criteria

The following pass/fail criteria shall be used to determine compliance of field seams with the above strength criteria:

(i) All five specimens from a given sample tested in peel (both top and bottom for double-edge fusion welds) shall exhibit the specified strength, separation and FTB failure modes, and all five specimens tested in shear shall exhibit the specified strength, shear elongation at break ≥50 percent and FTB failure modes (i.e., 0 percent strength, shear elongation at break and peel separation failures, and 0 percent non-FTB failures); or

(ii) All five specimens from a given sample tested in peel and all five specimens tested in shear shall exhibit the specified strengths, all five specimens tested in shear shall exhibit elongation at break ≥50 percent, four of five specimens

tested in peel shall exhibit acceptable peel separation, and four of five test specimens, for each type of test, shall exhibit FTB failure modes (i.e., 0 percent strength and shear elongation at break failures, and up to 20 percent non-FTB failures); or

(iii) One specimen from a given sample tested in peel or shear may exhibit a non-FTB failure and a strength no less than 60 percent of the specified strength provided that all five field seam specimens tested from the duplicate (archive) sample exhibit the specified strength, all five specimens tested in shear exhibit an elongation at break ≥50 percent, four of five specimens tested in peel exhibit acceptable peel separation, and no more than one test specimen of the five additional specimens exhibits a non-FTB failure (i.e., 0 percent shear elongation at break failures, 10 percent strength failures, and up to 20 percent non-FTB failures).

If a field seam fails the criteria specified herein, and the Liner Contractor wishes to establish to the Engineer that the failed sample represents a smaller section of the field seam than designated by the Engineer, additional samples may be obtained at progressively increasing distances from both sides of the failed sample, at locations approved by the Engineer, until two consecutive samples on each side of the original sample pass the field seam criteria. At that point, the extent of the original defect in both directions along the field seam will be considered isolated and the Liner Contractor may then: (i) either cap, re-weld and re-test the seam up to and including the closest of the two passing samples, and patch and weld the hole of the furthest passing sample; or (ii) cap, re-weld and re-test the entire length of sampling.

If approved by the Engineer, double-wedge fusion welds may be repaired by extrusion welding the flap of the top sheet to the bottom sheet if the seam non-compliance is due only to a non-FTB failure of the destructive test sample.

Duplicate coupons of additional samples requested by the Liner Contractor for identifying the extent of a defective seam will not be tested, i.e., the seam shall meet either pass/fail criteria (i) or (ii). The Liner Contractor shall reimburse the Owner for the cost of any such requested additional tests which fail to meet the requirements of this Specification.

9.4.4 Anchor Trenches

The liner shall be anchored in anchor trenches at the locations shown on the Drawings. Field seams shall be welded continuously through the anchor trench.

Liner anchor trenches shall be no less than 18 inches in width and 24 inches in depth. The corners of the trenches shall be slightly rounded to minimize sharp bends in the liner. After placement of the liner along the side and across the bottom of the trench, the trench shall be backfilled with soil fill meeting the material requirements specified in Section 5. Anchor trench backfill shall be compacted to a dry density not less than 95 percent of the Standard Proctor maximum dry density (ASTM D698). The liner within the anchor trench shall not be damaged during placement and compaction of the backfill.

9.4.5 Temporary Ballast Loading

Adequate temporary ballast loading that will not damage the liner shall be placed by the Liner Contractor over the liner during installation as needed to prevent uplift by wind and by rapid changes in barometric pressure. The temporary ballast loading shall be in addition to anchor trenches and permanent wind ballast trenches if shown on the Drawings. Sufficient temporary ballast loading shall be placed along panel edges, in particular, as needed to minimize the risk of wind flow under the panels. Continuous loading shall be provided at all panel edges during days off, at night, and whenever inclement or stormy weather is anticipated.

Temporary ballast loading may consist of sand filled bags. Bags used for containing sand shall be non-abrasive and non-damaging to the liner, resistant to degradation by ultraviolet radiation, shall contain the selected material without leakage and shall be approved by the Engineer. Soil shall not be placed atop the liner for temporary ballast loading without being adequately and completely contained.

Temporary ballast loading shall be maintained as necessary or as otherwise directed by the Engineer. All temporary ballast loading shall be removed by the Liner Contractor prior to demobilizing from the site unless otherwise approved by the Engineer.

The Liner Contractor shall submit a complete description and details of the proposed temporary wind ballast at least two weeks prior to liner installation. Approval by the Engineer shall not relieve the Liner Contractor from responsibility to provide all temporary wind ballast loading as needed to prevent uplift during construction.

9.4.6 Pipe Penetrations

9.4.6.1 Flow Control Structures

Liner penetrations for inlet and outlet pipes shall be made in accordance with the details shown on the Drawings. Liner penetrations at inlet/outlet pipes shall be made using fabricated HDPE plates with the liner continuously extrusion welded to the plates.

9.4.6.2 Gas Vent Outlets

Penetrations through the HDPE liner at the gas vent outlet locations shall be made with a prefabricated sleeve and skirt in accordance with the details shown on the Drawings. The sleeve and skirt shall be extrusion welded to the HDPE liner and all around the outside of the pipe circumference. The sleeve and skirt shall consist of 80-mil textured HDPE liner complying with the requirements of Section 8.3 - Material Requirements. Extrusion welds shall comply with the requirements of Section 9.4.3 - Field Seams. The pipe penetrations shall be fabricated in accordance with the Manufacturer’s recommendations, subject to approval by the Engineer.

The Liner Contractor shall submit a shop drawing with the proposed pipe vent penetration sleeve and skirt detail at least two weeks prior to liner installation.

9.4.7 Repairs

All liner defects (scratches, blisters, rips, punctures, tears, holes, pinholes, creases, folds, strain-yielded areas, etc.) shall be marked and repaired by completely covering the defect or

hole with an oval-shaped piece of the corresponding HDPE liner material extending at least 4 inches beyond the edges of the defect/hole, and continuously welding the patch to the liner using an extrusion weld. Scratches shall be considered a defect when the depth is in excess of 5 percent of the liner thickness or as otherwise determined by the Engineer. Holes created by removal of samples for destructive testing shall be marked, patched and repaired as specified above for liner defects. The panel number, repair location, type of defect, description of repair made, and date repaired shall be documented for each liner repair.

9.4.8 Liner Protection

No equipment, tools or personnel that can readily cause damage to the HDPE liner shall be allowed on the liner during and after installation. Personnel working on the HDPE liner shall not smoke, wear potentially damaging shoes, dispose of trash or other debris, or engage in any activity that could damage the liner.

The passage of construction equipment, other than light rubber-tired equipment approved by the Engineer, over any exposed HDPE liner surface shall be prohibited. Light rubber-tired equipment exerting a contact stress less than 6 lb/in^2 will be allowed provided proper care is taken when operating the vehicle to avoid: pulling, displacing or damaging the liner; trafficking over wrinkles that become folded or creased by the tires; and making sharp turns and/or abrupt starts/stops.

Any damage to the liner (scratches, rips, punctures, tears, holes, creases, folds, strain-yielded areas, etc.) shall be immediately reported to the Engineer. Repairs shall be made in a manner approved by the Engineer at the expense of the Liner Contractor.

9.4.9 Fuel and Oil Spill Clean-Up

All spills or leaks of fuels or oils from equipment and vehicles on the surface of the liner shall be thoroughly cleaned with soap and water or, at the discretion of the Engineer, the affected liner shall be cut, removed and replaced with new liner material. Subgrade soils contaminated with fuel or oil shall be excavated and replaced to the extent designated by the Engineer. Contaminated soils shall be disposed of on site in an area designated by the Owner.

9.5 Inspection and Field Testing by Liner Contractor

9.5.1 Initial Qualifying Welds

All master seamers/welders and seamers/welders shall demonstrate their ability to consistently make successful seams prior to installation of any liner. Each seamer/welder shall prepare test strips for each type of seam between different liner types, and for both extrusion and double-wedge fusion welds. Each test strip shall have a minimum length of 20 feet. Qualifying welds shall be made using the same conditions that will exist during actual liner installation (i.e., same grinder operator(s) for extrusion welds and making the welds on similar ground conditions). Twelve test specimens shall be cut from the test strip at an approximately uniform spacing of 18 inches or at locations selected by the Engineer, and tested by the Liner Contractor in shear and peel (6 test specimens each) for compliance with the Specification requirements in Section 9.4.3. The test strip and test specimens shall satisfy the requirements of Section 9.4.3 before either the welder or welding apparatus are allowed to operate on production welds.

9.5.2 Daily Qualifying Welds

At the beginning of each work day, after any interruption in power, after any idle period of greater than 5 hours, and at the request of the Engineer at any other time during the day, each seamer/welder shall prepare a 3-foot long test strip for extrusion welds, and a 10-foot long test strip for double-wedge fusion welds, using their assigned welding apparatus. Ten test specimens shall be cut from the test strip at locations selected by the Engineer and tested by the Liner Contractor in shear and peel (5 test specimens each) for compliance with the Specification requirements in Section 9.4.3. The test strip and test specimens shall satisfy the requirements of Section 9.4.3 before either the welder or welding apparatus are allowed to operate on production welds.

9.5.3 Non-Destructive Testing of Welds

The Liner Contractor shall continuously test every field weld (i.e., 100 percent of the length of all field seams), including field welds around patches, using non-destructive testing techniques. These tests shall be performed in the presence of the Engineer. Extrusion welds shall be tested using a vacuum box (ASTM Standards D4437 and D5641). Once the soap solution is uniformly placed over the weld and suction applied to the seam, any bubble formation must be noted and the corresponding defective area identified, marked, and subsequently repaired.

Double-wedge fusion welds shall be non-destructively tested in general accordance with ASTM Standard D5820 by pressurizing the air channel between the two welds to a pressure between 25 and 30 lb/in^2 and monitoring the pressure for any decline with time. The pressure gauge shall be marked in increments of no greater than 1 lb/in^2. After allowing 2 minutes for relaxation, the pressure shall be monitored over a test period of not less than 5 minutes. A weld will be considered satisfactory if either of the following criteria are satisfied:

(i) the loss in pressure is equal to or less than 2 lb/in^2 and the pressure stabilizes within the 5-minute test period; or

(ii) if criteria (i) is not satisfied, the additional pressure drop is equal to or less than 1 lb/in^2 during an additional test period of 5 minutes (i.e., the total pressure drop is less than or equal to 3 lb/in^2 over a 10-minute test period), and the pressure stabilizes during the second test period.

The length of welded section tested by air pressure shall not exceed 560 feet, without prior approval by the Engineer. If a non-compliant pressure drop is noted, pressure testing may be repeated in a step fashion each time halving the length of weld being tested until the extent of the defective weld is determined. Vacuum box testing may also be used to locate a defect in the top weld or in the top of the air channel.

Once the defect is found, it shall be clearly identified, marked and repaired. Any defective seam shall be repaired so that it meets or exceeds the minimum requirements specified herein.

Welds in inaccessible areas, where the use of vacuum box testing is not possible, shall be spark tested in accordance with ASTM Standard D6365, subject to approval by the Engineer.

9.5.4 Sampling and Destructive Testing

The Liner Contractor shall obtain and secure samples of the liner and field seams for destructive testing by the Engineer at locations designated by the Engineer. Samples shall be obtained at the frequency specified in Section 9.6.3. The Liner Contractor shall obtain seam samples, in triplicate, from the designated location for laboratory testing. One portion of the sample shall be retained by the Liner Contractor for testing. If the results of field tests performed by the Liner Contractor, in the presence of the Engineer, indicate compliance with the criteria in Section 9.4.3, then the Liner Contractor shall provide the second portion of the sample to the Engineer for independent testing. The third portion will be retained by the Owner for archive storage. If the results of peel and shear tests performed by the Liner Contractor in the field do not meet the requirements specified herein, then the provisions of Section 9.4.3 shall apply for temporarily determining the extent of repairs pending performance of independent quality assurance tests by the Engineer.

The portions of seam samples provided to the Engineer for laboratory destructive testing and to the Owner for archive storage shall each be not less than 12 inches wide by 18 inches long in the direction of the seam. The seam shall be centered along the sample length. Each of the triplicate sample portions shall be properly marked and identified by the Liner Contractor. The Liner Contractor shall repair all holes created by sampling in accordance with Section 9.4.7.

9.5.5 Visual Inspection

The Liner Contractor shall visually inspect the entire liner surface for any defects including, but not limited to, seam imperfections, badly scuffed areas, scratches, blisters, rips, punctures, tears, holes, pinholes, creases, folds, strain-yielded areas, etc. The Liner Contractor shall identify, mark, and repair all noted defects, as well as defects designated by the Engineer. Repairs shall be made in accordance with Section 9.4.7.

9.5.6 Quality Assurance Forms

The Liner Contractor shall adopt and use quality assurance forms prepared by the Engineer, or other forms approved by the Engineer, during all applicable phases of liner installation, inspection and testing. The Liner Contractor can request to use their forms. The forms must be submitted to the Engineer at least two weeks prior to liner installation for review and approval.

9.5.7 Certification

The Liner Contractor’s installation supervisor shall observe and check all phases of liner installation. When the liner is accepted by the Owner, the Liner Contractor shall submit written certification to the Owner that the installation conforms to the requirements of the Liner Manufacturer.

9.6 Quality Assurance Inspection and Testing by Engineer

9.6.1 Base Maintenance and Repair During Liner Installation

The Engineer will undertake observations and perform quality assurance tests to determine compliance with these Specifications. Quality assurance by the Engineer will include monitoring soil placement to determine the suitability of subgrade materials and adequacy of compaction.

The Engineer will perform *in-situ* density tests: (i) after compaction of fill as needed to fine grade, maintain and restore the condition of the prepared soil base; (ii) after compaction of fill in excavations as needed to restore grade; and (iii) after compaction of backfill in anchor trenches. *In-situ* density tests will be performed by the drive cylinder method (ASTM D2937), sand cone method (ASTM D1556), nuclear methods (ASTM D6938), or other methods approved by the Engineer and deemed equivalent by him at his sole discretion. Water content tests made in the field using a calcium carbide gas pressure tester (ASTM D4944) may be used to provide water content information for construction assurance, but final acceptance of all liner subgrade material will be based upon ASTM Standard D2216 test method unless approved otherwise by the Engineer. Penetration test probes may also be performed as needed to verify the uniformity of compaction. The Engineer will perform Standard Proctor compaction tests (ASTM D698) as needed to determine compliance with compaction requirements.

Testing of the compacted soil base will be performed by the Engineer following final grading and compaction by the Earthwork Contractor before the surfaces are turned over to the Liner Contractor. Testing of the compacted soil base will be repeated, as needed, immediately prior to liner placement. Final documentation and results from these tests, however, will not be available prior to liner deployment. Such testing shall not relieve the Liner Contractor from his responsibility for restoration or repair of unsuitable areas following liner placement, in the event that such is deemed necessary by the Engineer.

9.6.2 Liner Installation

All aspects of the liner installation will be inspected on a full-time basis by the Engineer. The Engineer will conduct his own inspections and tests in addition to those performed by the Liner Contractor. The Engineer will undertake observations and perform quality assurance tests to determine compliance of the liner installation with these Specifications. Quality assurance by the Engineer will include monitoring: (i) liner handling and panel deployment; (ii) field welding of liner sheets and non-destructive testing of field welds; (iii) installation of anchor trenches; (iv) placement and maintenance of temporary ballast loading; (v) seepshield and liner penetrations; and (vi) installation of pipe and/or of flap vents. The Engineer will also monitor liner repair work and evaluate the adequacy and acceptability of all repair work.

9.6.3 Destructive Testing

The Liner Contractor shall obtain and secure samples of the liner and field seams for destructive testing by the Engineer from locations designated by the Engineer, and shall properly mark all samples to identify the particular seam or liner panel from which the sample was obtained.

(i) Testing and sampling of liner material will be performed as specified in Section 8.5.

(ii) Seam samples will be taken for destructive peel and shear testing by the Engineer at a minimum frequency of 1 sample per 500 feet of field seam. Samples for destructive testing will be obtained by the Liner Contractor at locations designated by the Engineer within 48 hours of the welding the field seam unless approved otherwise by the Engineer.

Duplicate samples of all HDPE liner material and all field seams tested destructively by the Liner Contractor shall also be secured by the Liner Contractor and submitted to the Engineer for independent testing. All samples shall be properly marked and identified.

Failure of any sample to meet or exceed the requirements specified herein shall be considered cause for rejection of the material, installed liner section, or field seam from which the sample was collected to the extent designated by the Engineer. If the Liner Contractor can establish to the Engineer, via submittal of additional test results, that the failed sample is representative of a smaller section of the liner or field seam, then only that portion will be rejected, provided, however, that the additional tests are performed by the Engineer representing the Owner. The Liner Contractor shall reimburse the Owner for the cost of any such additional tests that he requests and which fail to meet the requirements of the Specifications.

9.7 Insurance

The Liner Contractor shall provide the Owner insurance coverage against blowout or uplift of the liner during installation. The insurance coverage shall remain in effect until the Owner issues a Letter of Acceptance to the Liner Contractor.

The Liner Contractor shall agree to provide the Owner with a commitment to re-install or replace any liner that may blowout during the time when the insurance coverage is in effect, at the same rate as required during initial installation, without adversely affecting the rate of progress of work yet to be performed. Additional material, manpower and equipment shall be mobilized to the site within two weeks of a blowout occurrence as needed to comply with this commitment.

9.8 Warranty

A written warranty shall be provided to the Owner by the Liner Contractor. This document shall warrant the quality of the workmanship for a period of not less than 2 years beginning on the date of the Letter of Acceptance from the Owner.

9.9 As-Built Drawings

The Liner Contractor shall submit to the Engineer, within 30 days of completion of installation of the liner, an as-built plan in AutoCAD format showing the location and identification of all installed liner panels, anchor trenches, seepshields, liner penetrations, repairs and destructive test samples.

9.10 Submittals

The following submittals are required from the Liner Contractor as part of the requirements of the Specifications.

- The proposed methods for dewatering, surface water control, and routing water to Owner designated areas shall be submitted at least two weeks prior to implementation.

- Shop drawings showing the proposed liner panel configuration and field seams, and identifying (if applicable and shown on the Drawings) anchor trenches, vents, pipe penetrations, seepshields, structure connections, permanent wind

ballast trenches, permanent bag wind ballast atop the liner and other details needed to complete the work shall be submitted for approval at least two weeks prior to liner installation.

- A complete description and details of the proposed temporary ballast loading shall be submitted at least two weeks prior to liner installation.

- Quality assurance forms proposed for use by the Liner Contractor for all phases of liner installation, inspection and testing shall be submitted at least two weeks prior to liner installation.

- Certification by the Liner Contractor, when the liner is accepted by the Owner, that the liner installation complies with the requirements of the Liner Manufacturer.

- Workmanship warranty for a period of at least two years beginning on the date of the Letter of Acceptance from the Owner.

- As-built plan of the installed HDPE liner within 30 days of completion of liner installation.

SPECIFICATIONS

SECTION 10
GEOCOMPOSITES AND GEOTEXTILES

**RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS**

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

10.1 Description of Work

This Specification covers the material requirements and installations of the geocomposites and geotextiles in the seepage collection drain and the geocomposite drainage layer above HDPE geomembrane liner as shown on the Drawings.

10.2 Referenced Standards

The following ASTM standards are referenced in this Specification.

D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D1238: Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

D1248: Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique

D1603: Standard Test Method for Carbon Black Content in Olefin Plastics

D1693: Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

D4218: Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique

D4491: Standard Test Methods for Water Permeability of Geotextiles by Permittivity

D4533: Standard Test Method for Trapezoid Tearing Strength of Geotextiles

D4632: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

D4716: Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

D4751: Standard Test Method for Determining Apparent Opening Size of a Geotextile

D4833: Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

D4884: Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles

D4976: Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

D5199: Standard Test Method for Measuring the Nominal Thickness of Geosynthetics

D5261: Standard Test Method for Measuring Mass per Unit Area of Geotextiles

D6241: Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

D7005: Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites

D7179: Standard Test Method for Determining Geonet Breaking Force

D7355: Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus

10.3 Material Requirements

Three different types of geosynthetic drainage products shall be used in the Recycle Pond Expansion, Sedimentation Pond, Coal Storage Area Runoff Pond, and modified Recycle Pond for the seepage collection drain and the geocomposite drainage layer between the protective soil cover and the HDPE geomembrane liner. Classifications of these geosynthetic drainage products are as follows:

- Type A Geocomposite – Double-sided geocomposite comprised of 12 oz/yd^2 non-woven polyethylene or polyester geotextile, heat-bonded to both sides of the minimum 200-mil thick HDPE geonet to be used in seepage collection drain.

- Type B Geocomposite – Double-sided geocomposite comprise of 8 oz/yd^2 non-woven polyethylene or polyester geotextile heat bonded to both sides of minimum 300-mil thick geonet, to be used directly above the HDPE geomembrane liner on the side slopes and 25 feet from toe of the perimeter and divider dikes, as shown on the Drawings.

- Type C Geocomposite – Single-sided geocomposite comprise of 8 oz/yd^2 non-woven polyethylene or polyester geotextile heat bonded to one side of minimum 300-mil thick geonet, to be used directly above the HDPE geomembrane liner in the interior part of the ponds away from the slope area, as shown on the Drawings.

The Type A, B, and C geocomposite shall consist of an HDPE geonet core with non-woven geotextiles heat bonded to one (single-sided geocomposite) or both (double-sided geocomposite) sides of the geonet core. The geonet cores in the Type A, B, and C geocomposites shall be manufactured from unreinforced HDPE, and shall be designed and manufactured specifically for use as a drainage product. The geotextile used in the geocomposites and to wrap around the gravel pack in the seepage collection drain pipe trench and sump shall be manufactured from non-woven geotextile that is suitable for material separation.

A complete description of the geocomposites and geonet proposed for use with a minimum 1 square yard sample and the Manufacturer's product data sheets shall be submitted by the Contractor to the Engineer for approval at least 2 weeks prior to installation. Certifications from the Manufacturer that the geocomposites and geonet comply with this Specification shall also be supplied to the Engineer at least 2 weeks prior to installation.

10.3.1 Geonet

10.3.1.1 HDPE Resin

The uncolored base resin shall be polyethylene having a minimum density of 0.932 g/cm^3 classifying as Group 2, Class 2, Grade 4 or Grade 5 (PE 224 or PE 225) medium density polyethylene in accordance with ASTM Standard D4976.

The formulated colored resin shall classify as a Group 2, Class 3, Grade 4 or Grade 5 high density polyethylene (PE 234 or PE 235) with physical properties meeting A46009 in accordance with ASTM Standard D4976 with environmental stress crack resistance (ASTM Standard D1693) F_{50} >1500 hours (Condition B; 50°C/100% Igepal) and F_{20} >192 hours (Condition C; 100°C/100% Igepal). The formulated colored resin shall contain not less than 97 percent of the base polymer, not less than 2.0 percent carbon black and not more than 3.0 percent carbon black, anti-oxidants and heat stabilizers combined with no other additives, fillers or extenders.

The geonet shall be manufactured from virgin resin, with no more than 3 percent regrind material. Regrind material, if used, shall be of the same formulation as the virgin resin. No post-consumer resin of any type shall be used.

10.3.1.2 Physical Appearance

The geonet shall be uniform in appearance and composition and shall be free of tears, cuts, gels, undispersed ingredients, any signs of contamination by foreign matter, or any defect that may affect serviceability.

10.3.1.3 Physical Properties

The geonet cores of the Types A, B and C geocomposites shall meet the following criteria:

Property	Test Method	Criteria	
		Type A	Type B&C
Melt Index (gm/10 mins)	ASTM D1238, (190°C/2.16 kg), Condition E	≤1.0	≤1.0
Carbon Black Content (%)	ASTM D1603 or D4218	2.0-3.0	2.0-3.0
Density (g/cm^3)	ASTM D1505 or D792	≥0.940	≥0.940
Thickness (mils)	ASTM D5199	≥200	≥300
Transmissivity* (m^2/sec)	ASTM D4716	≥2.0x10^{-3}	≥8.0x10^{-3}
Tensile Strength** (lb/in)	ASTM D7179	≥45	≥75
Thickness Retention (%)	100 psi for 10,000 hours at 20°C temperature	≥75%	≥75%

* The values represent the transmissivities of the geonet core in the primary flow direction under a compressive normal load of 10,000 lbs/ft^2 and a gradient of 0.1, with water at 70°F between steel plates for 15 minutes.
** Machine direction.

A complete description of the geonet proposed for use and the Manufacturer's product data sheets shall be submitted to the Engineer for approval at least two weeks prior to installation. Certification from the Manufacturer that the geonet is in compliance with this Specification shall also be supplied to the Engineer at least two weeks prior to installation.

10.3.2 Geotextiles

Geotextiles for the geocomposite and where shown on the Drawings shall be a non-woven, needle-punched fabric manufactured from 100 percent polyester or 100 percent polypropylene. The geotextiles shall be uniform and homogeneous in appearance and composition, and free from tears, cuts, thin spots, or any defects that may affect serviceability. Geotextile shall be

supplied in rolls having a minimum width of 15 feet and minimum length of 300 feet.

Two types of geotextiles with different weights shall be used for this project. Geotextile with a mass of 12 oz/yd^2 shall be used in the Type A geocomposite and for wrapping of the gravel in the seepage collection drain. Geotextile with a mass of 8 oz/yd^2 shall be used in the Types B and C geocomposites. The geotextile shall meet the following criteria.

Property	Units	Test Method	Criteria	
			8 oz/yd^2 Geotextile	12 oz/yd^2 Geotextile
Mass per Unit Area	oz/yd^2	ASTM D5261	≥8	≥12
Apparent Opening Size	USSS†	ASTM D4751	≥80	≥100
Grab Tensile Strength*	lb	ASTM D4632	≥220	≥320
Grab Elongation*	%	ASTM D4632	≥50	≥50
Trapezoidal Tear Strength*	lbs	ASTM D4533	≥90	≥120
Puncture Resistance	lbs	ASTM D4833	≥120	≥190
CBR Puncture	lbs	ASTM D6241	≥575	≥900
Permittivity	sec^{-1}	ASTM D4491	≥1.1	≥0.8
UV Resistance [500 Hours]	%	ASTM D7355	≥70	≥70
* Machine and transverse directions. † United States Standard Sieve Size.				

A complete description of the geotextiles proposed for use and the Manufacturer's product data sheets shall be submitted to the Engineer for approval at least 2 weeks prior to installation. Certification from the Manufacturers that the geotextiles comply with this Specification shall also be supplied to the Engineer at least 2 weeks prior to installation.

10.3.3 Geocomposite

The geonet core and geotextile in the Types A, B, and C geocomposites shall meet the requirements of Sections 10.3.1 and 10.3.2.

Type A geocomposites shall have a transmissivity (ASTM D4716) of equal to or greater than 5.0x10^{-4} m^2/sec in the machine direction under a compressive load of 2,000 lb/ft^2, a gradient of 0.02, and a seating time of 100 hours.

Type B double-sided geocomposite that will be placed along the sideslope of the perimeter dike shall have a transmissivity (ASTM D4716) of equal to or greater than 2.0x10^{-3} m^2/sec in the machine direction under a compressive load of 2,000 lb/ft^2, a gradient of 0.02, and a seating time of 100 hours.

Type C single-sided geocomposite that will be placed directly above the HDPE liner at the bottom of the pond shall have a transmissivity (ASTM D4716) of equal to or greater than 4.0x10^{-3} m^2/sec in the machine direction under a compressive load of 2,000 lb/ft^2, a gradient of 0.02, and a seating time of 100 hours.

For Type A, B, and C geocomposites, the bond between the geotextile and the geonet shall have an average ply adhesion (ASTM D7005) of equal to or greater than 1.0 lb/in while the

minimum ply adhesion shall be equal to or greater than 0.5 lb/in. Average and minimum ply adhesion shall comply with the above criteria and be sufficient to maintain the geotextile uniformly bonded to the geonet during handling and installation.

A complete description of the geocomposite proposed for use, the Manufacturer's product data sheet, and a 2.5-foot long by the full width of the roll sample of the geocomposite shall be submitted to the Engineer for approval at least two weeks prior to installation. Certification from the Manufacturer that the geocomposite is in compliance with this Specification shall also be supplied to the Engineer two weeks prior to installation.

The minimum peak interface friction angle between the protective soil cover and the double-sided geocomposite shall be 28 degrees. For determining compliance with the specified interface friction angles, direct shear tests will be performed by the Engineer in accordance with Standard ASTM D5321 using a fine sand with silt fill materials (Group Symbol SP-SM in accordance with ASTM Standard D2487) from the site meeting the following gradation.

U.S. Standard Sieve Size	Percent Passing (Dry Mass Basis)
No. 4	100
No. 10	97-100
No. 20	95-100
No. 40	90-100
No. 60	60-95
No. 100	20-80
No. 140	7-25
No. 200	5-12

The direct shear tests shall be performed at normal stresses selected by the Engineer ranging from 5 to 15 lb/in^2 to duplicate field conditions. The soil shall be compacted to a dry density equal to 95 percent of the Standard Proctor maximum dry density (ASTM D698) within ±2 percent of the Standard Proctor optimum water content. The interface and soil shall be tested submerged with water. The tests shall be performed using a horizontal displacement rate of 0.3 inches per hour.

10.4 Factory Testing and Inspection

10.4.1 Factory Testing

10.4.1.1 Geonet

Factory quality control certificates for each batch of resin used to manufacture the geonet, including melt index and density, shall be submitted to the Engineer for approval at least two weeks prior to installation. The resin Manufacturer's certificate of analysis for each batch of resin shall also be provided to the Engineer at least two weeks prior to installation.

Factory quality control certificates for the geonet component of the geocomposite shall be provided to the Engineer by the Manufacturer at least two weeks prior to installation. As a minimum, the quality control certificates shall contain the roll identification number, date

manufactured, resin batch number and roll length and roll width. The following factory quality control tests shall be provided for the geonet component of the geocomposite at the indicated minimum frequencies:

Property	Test Method	Frequency
Mass per Unit Area	ASTM D5261	Every 10 Rolls
Thickness	ASTM D5199	Every 10 Rolls
Tensile Strength*	ASTM D7179	Every 10 Rolls
Transmissivity*	ASTM D4716	Every 20 Rolls
Melt Index	ASTM D1238	Once per Batch of Resin
Carbon Black Content**	ASTM D1603	Every 20 Rolls
Density**	ASTM D1505	Every 20 Rolls
* Machine direction. ** Minimum of once per batch of resin.		

Failure of any of the tests shall result in rejection of the corresponding lot of geonet.

10.4.1.2 Non-Woven Geotextile

Factory quality control certificates for the non-woven geotextiles, including the component of the geocomposite, shall be provided to the Engineer by the Manufacturer at least 2 weeks prior to construction. The quality control certificates shall contain the geotextile roll number, date manufactured, roll length, and width. The following factory quality control tests shall be provided for the geotextile component of the composite at the indicated minimum frequencies:

Property	Test Method	Minimum Testing Frequency
Mass per Unit Area	ASTM D5261	Once per 5,000 yd^2 and minimum of once per lot
Thickness	ASTM D5199	
Grab Breaking Load	ASTM D4632	
Grab Elongation	ASTM D4632	
Apparent Opening Size	ASTM D4751	
Permittivity	ASTM D4491	

Failure of any of the tests shall result in rejection of the corresponding lot of geotextile.

10.4.1.3 Geocomposite

Factory quality control certificates for the geocomposite shall be provided to the Engineer by the Manufacturer at least two weeks prior to installation. The quality control certificates shall contain the geotextile and geonet roll numbers, date manufactured, roll length and roll width. The following factory quality control tests shall be provided for the geocomposite at the indicated minimum frequencies:

Composite Property	Test Method	Minimum Testing Frequency
Ply Adhesion	ASTM D7005	Every 10 rolls
Transmissivity	ASTM D4716	Every 20 Rolls

Failure of any of the tests shall result in rejection of the corresponding lot of geocomposite.

10.4.2 Factory Inspection

The geotextiles and geocomposite shall be visually inspected at the factory prior to shipment for compliance with the physical appearance requirements in Sections 10.3.1.2 and 10.3.2. Any necessary repair shall be made by the Manufacturer at the factory prior to shipment.

10.4.3 Marking and Packaging

Each geotextile and geocomposite roll shall be individually packaged at the factory to prevent damage during shipping and handling, and shall be completely wrapped by a protective ultraviolet resistant thin plastic film having a minimum thickness of 2 mils. The Manufacturer shall provide each roll with a label indicating the roll number, product name, length, width and date manufactured.

10.5 Handling and Installation

10.5.1 Storage and Handling

The Contractor shall be responsible for unloading and storing the geotextile and geocomposite rolls. During unloading, the Contractor shall obtain samples from the ends of rolls for testing by the Engineer at locations selected by the Engineer.

The geotextiles and geocomposites shall remain wrapped in the protective cover and shall be stored, as recommended by the Manufacturer and approved by the Engineer, in an area of the site that protects the geotextiles from moisture, water, ash, dirt, ultraviolet light and mechanical damage until the time of installation. The rolls shall not be unwrapped more than 1 hour before use. Handling of the rolls shall be in accordance with the Manufacturer's recommendations, and shall be as needed to protect the geotextiles from damage.

10.5.2 Laying and Installation

The geocomposites and geotextiles shall be installed at the locations and to the lines and dimensions shown on the Drawings.

The geocomposite shall be deployed with the most transmissive direction oriented towards the down slope of the base area of the ponds (i.e., towards sump area). The geocomposites and geotextiles shall be installed in a smooth and unwrinkled condition in uniform contact with the underlying materials, and held in place as needed and approved by the Engineer until covered with the overlying material shown on the Drawings.

After installation, the geocomposite shall not be left exposed for more than 48 hours prior to covering with the overlying material shown on the Drawings. Equipment, tools or personnel that can damage the geocomposite shall not be allowed on the installed materials during and after installation. The traffic of construction equipment over any exposed materials shall be prohibited.

Geocomposite that requires more than one repair per roll to the geotextile or geonet from manufacturing defects or shipping damage that is discovered during deployment shall be rejected and replaced unless approved otherwise by the Engineer.

Joints and seams shall be made as followed:

- Geonet: Adjacent geonet panels shall be overlapped a minimum of 4 inches along sides and 1.0 feet along ends and tied together with polyethylene or polypropylene ties recommended by the Manufacturer and approved by the Engineer. Ties shall be of a color to allow easy inspection (e.g., white or yellow) against the black geonet. Metallic ties shall not be used. Ties shall be installed along the edges at a maximum spacing of 5 feet along the roll length and 1 feet along the roll ends, and shall be sufficient in number and tensile strength to prevent the joint from separating during handling and installation.

  Cut edges of the geonet without overlapping geotextile shall be covered with a piece of the same geotextile as on the composite overlapped 12 inches minimum on the bottom and top of the composite. The edge of the top lap shall be held in place until covered using thermal bonding or black PVC pipe wrapping tape as approved by the Engineer and, if needed, temporary ballast bag.

  For cut edges and ends of the geocomposite without overlapping geotextile, the upper and lower geotextiles shall be peeled back a minimum of 6 inches to expose the geonet core. The geonet core shall be trimmed back a minimum of 4 inches from the edge and the upper and lower geotextiles shall be overlapped a minimum of 4 inches and sewn.

- Geotextile: The upper and lower geotextiles of the composite at each connection shall overlap a minimum of 6 inches. Care should be taken so that soil or other debris is not trapped within the overlap. The upper and lower geotextile overlap shall be sewn in accordance with Section 10.5.3.

Geotextiles shall be installed where shown on the Drawings in a manner that minimizes seams. The geotextiles shall be cut to the dimensions shown on the Drawings, overlapped if needed, and installed in a smooth unwrinkled condition in contact with the underlying materials. The geotextiles shall be held in place as needed until covered, and shall always be covered within 48 hours of installation.

10.5.3 Geotextile Field Seams

Field seams shall be made using a minimum overlap of 6 inches unless shown otherwise on the Drawings. The geotextile shall be sewn together with a sewing machine using a flat sewn seam with one row of stitches with a minimum of 4 stitches per inch, or a seam and stitching pattern recommended by the Manufacturer and approved by the Engineer. The thread used to sew the seams shall be 2000 denier minimum, or as recommended by the Manufacturer and approved by the Engineer, and shall have the same composition as the geotextile. The strength of field seams shall not be less than 50 percent of that of the un-aged geotextile when tested in

accordance with ASTM Standard D4884.

The Contractor shall submit details of the proposed sewing method (type of stitch, number of stitches per inch, number of stitching rows, distance from the edge of the geotextile to the stitches, weight and type of thread, etc.) and a minimum 5-foot long sample of the sewn seam for approval by the Engineer at least two weeks prior to installation.

10.5.4 Geotextile Repairs

All tears, punctures, thinly stretched sections, or any other defect that may, as determined by the Engineer, render the geotextile unsuitable, shall be repaired by the Contractor. Repairs shall be made by overlaying a patch of geotextile over the damaged area with a 12-inch minimum lap all around. The patch shall be held in place by thermal bonding or 2-inch wide black PVC pipe wrapping tape. The patch shall be sewn to the geotextile in accordance with Section 10.5.3 of this Specification where directed by the Engineer.

10.6 Sampling and Inspection by Contractor

10.6.1 Sampling

The Contractor shall obtain and secure samples of the geotextile, geonet, and geocomposite for destructive testing by the Engineer when the rolls are delivered to the site or subsequently during installation as requested by the Engineer. The samples shall be 2.5-foot long by the full width of the roll, unless a smaller sample is requested by the Engineer, and shall be obtained from rolls or field locations designated by the Engineer. All samples shall be properly marked and identified by the Contractor. The Contractor shall repair all openings created by sampling in accordance with Section 10.5.4 or completely remove the full width of the roll at the sampling location.

10.6.2 Visual Inspection

The Contractor shall visually inspect the surfaces of the installed geotextiles and geocomposites for any defects including, but not limited to, rips, tears, punctures and defective seams. The Contractor shall identify, mark, and repair all noted defects, as well as defects designated by the Engineer. Repairs to geotextiles shall be made in accordance with Section 10.5.4. Geocomposite with damage to both geotextile surfaces at any location shall be removed and replaced.

The Contractor shall visually inspect the surfaces for soil, ash, dust or debris that could result in clogging of the geonet or geotextiles. If soil, ash, dust or debris is entrapped in the geonet, it shall be removed and replaced or the surfaces cleaned as approved by the Engineer.

10.7 Quality Assurance Inspection and Testing

The Engineer will undertake observations and perform quality assurance tests to determine compliance of the materials and work with this Specification. Quality assurance by the Engineer will include monitoring and/or inspecting: (i) placement for compliance with the lines, grades and dimensions shown on the Drawings; (ii) geocomposite/geotextile handling, installation, overlaps, geonet joints and field sewn seams; (iii) the geotextile and geonet for damage; and (iv)

geotextile and geonet for excessive entrapped soil, ash, dust or debris that could reduce the transmissivity of the composite.

Laboratory quality assurance tests shall be performed by the Engineer on the geonet, geotextiles, and geocomposites at the following minimum frequencies.

Material	Property	Test Method	Minimum Testing Frequency
Geonet Core of Geocomposite	Thickness	ASTM D5199	Every 10 Rolls
	Mass per Unit Area	ASTM D5261	
	Density	ASTM D1505	Every 20 Rolls
	Carbon Black Content	ASTM D1603	
	Tensile Strength	ASTM D7179	
	Transmissivity*	ASTM D4716	
Geotextile or Geotextile Component of Geocomposite	Thickness	ASTM D5199	Every 10 Rolls
	Mass Per Unit Area	ASTM D5261	
	Grab Strength & Elongation	ASTM D4632	Every 20 Rolls
	Apparent Opening Size	ASTM D4751	
	Permittivity	ASTM D4491	
	Field Seam Strength	ASTM D4884	Once per 1,000 feet of field seam (minimum 1 per day)
Geocomposite	Transmissivity*	ASTM D4716	Every 20 Rolls
	Ply Adhesion	ASTM D7005	Every 10 Rolls

* Transmissivities of the geonet cores of the Types A, B and C geocomposites shall be measured along the primary flow direction under a compressive normal load of 10,000 lbs/ft^2 and a gradient of 0.1 with water at 70°F between steel plates for 15 minutes. Test cross section for the Type A shall consist of, from top to bottom, sand, geocomposite, and sand under a compressive normal load of 2,000 lb/ft^2, a gradient of 0.02, and a seating time of 100 hours. Test cross section for the Types B and C geocomposites shall consist of, from top to bottom, protective sand, geocomposite, and textured HDPE liner under a compressive normal load of 2,000 lb/ft^2, a gradient of 0.02, and a seating time of 100 hours.

Failure of any sample to meet or exceed the requirements specified herein shall be considered cause for rejection of the material or installed section from which the sample was collected to the extent designated by the Engineer. If the Contractor can establish to the Engineer, via additional tests performed by the Engineer, that the failed sample is representative of a smaller section of the installed material than the entire lot represented by the original test sample, then only that portion will be rejected, provided, however, that the additional tests are performed by the Engineer representing the Owner. The Contractor shall also reimburse the Owner for any such test that fails to meet the requirements specified herein.

10.8 Submittals

The following submittals are required from the Contractor as part of the requirements of this Specification.

- A complete description of the nonwoven geotextile and HDPE geonet, the Manufacturer's product data sheets for each, and the Manufacturer's certification that the geotextile and HDPE geonet meets the requirements of this Specification.

- A complete description of the HDPE geocomposite, a minimum 1 square yard sample of the composite and 1 square yard sample of the nonwoven geotextile

used on the composite, the Manufacturer's product data sheets, and the Manufacturer's certification that the geonet-geotextile composite meets the requirements of this Specification.

- Resin certificates for each batch of HDPE resin, and factory quality control certificates for each roll of nonwoven geotextile, HDPE geonet, and geocomposite.

- Proposed sewing method for field seaming the nonwoven geotextiles and a minimum 5-foot long sample of sewn seam.

SPECIFICATIONS

SECTION 11
PRESSURE RATED HDPE PIPE AND FITTINGS

RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

11.1 Description of Work

This Specification covers material requirements, joint requirements, storage and handling, installation, protection and repairs, quality assurance inspection and testing, and required Contractor's submittals for HDPE pipe and fittings shown on the Drawings.

11.2 Referenced Standards

The following ASTM standards are referenced in this Specification.

D638: Standard Test Method for Tensile Properties of Plastics

D696: Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with Vitreous Silica Dilatometer

D746: Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

D790: Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D792: Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D1238: Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique

D1603: Standard Test Method for Carbon Black in Olefin Plastics

D2513: Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings

D2837: Standard Specification for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Pipe and Tubing

D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

D4218: Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle Furnace Technique

F714: Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

F1055: Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing

F1473: Standard Test Method for Notch Tensile Test to Measure the Resistance to Slow Growth of Polyethylene Pipes and Resins

F2206: Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Plate Stock or Block Stock

F2620: Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

11.3 Layout of Work

The Owner will establish reference points for horizontal and vertical controls near the designated construction area for the Recycle Pond Expansion, Sedimentation Pond, Coal Storage Area Pond and modified Recycle Pond. From these reference points, the Contractor shall provide all horizontal and vertical controls necessary to install the inlets, outlets, and seepage collection drain to the lines and grades shown on the Construction Drawings. It is the responsibility of the Contractor to verify all locations and dimensions prior to performance of any work.

11.4 Material Requirements

11.4.1 Base Resin

The base resin shall be high density, high molecular weight polyethylene (HDPE) with properties meeting or exceeding ASTM Standard D3350 cell classification 345464C (thermoplastic material designation code PE3608 or higher). The resin shall contain not less than 97 percent of the base resin and not less than 2.0 percent carbon black. The pipe material shall contain no more than 3 percent carbon black, anti-oxidants and heat stabilizers combined, and no other additives, fillers or extenders. Rework material from the manufacturer's pipe production may be used when blended with new resin of the same thermoplastic material designation code provided pipe containing rework material meets the requirements of ASTM Standard F714. Rework material shall be limited to a maximum of 30 percent by weight.

11.4.2 Physical Appearance

All pipes and fittings shall have good appearance qualities. The pipe and fittings shall be homogeneous throughout and uniform in color, opacity, density and physical properties. The inside and outside surfaces shall be smooth and uniform without chalking, sticky or tacky material, excessive bloom or visible defects. The pipe walls shall be free of holes, cracks, voids, nicks, cuts, gouges, scratches, blisters, gels, undispersed ingredients, any signs of contamination by foreign inclusions, or any defect that may affect serviceability.

11.4.3 Physical Properties

Pipe and fitting dimensions, workmanship, dimension ratio (DR) and corresponding pressure rating shall be in accordance with the requirements of ASTM Standard F714. Pipes shall be furnished in standard lengths equal to or greater than 40 feet. The pipe material shall meet the following criteria:

Property	Test Method	Criterion
Density [Natural Resin]	ASTM D1505 or D792	>0.945 g/cm^3
Density [Black]	ASTM D1505 or D792	>0.955 g/cm^3
Melt Index	ASTM D1238 [Cond.190/2.16]	<0.15 g/10 min
Flow Rate	ASTM D1238 [Cond.190/21.6]	>4.0 and <20 g/10 min.
Carbon Black Content	ASTM D1603 or D4218	>2.0% & <3.0%
Flexural Modulus	ASTM D790 [Method 1/Proc. B]	>120,000 psi
Tensile Strength at Yield	ASTM D638, Type IV, 2 ipm	>3,000 psi
Elongation at Break	ASTM D638, Type IV, 2 ipm	>400%
Hydrostatic Design Basis	ASTM D2837	>1,600 psi
Slow Growth Stress Crack Resistance [PENT]	ASTM F1473	>100 hours
Low Temperature Brittleness	ASTM D746	<-60°C
Thermal Expansion Coefficient	ASTM D696	<0.022%/°C

The Contractor or Supplier shall submit a complete description of the HDPE pipe and fittings proposed for use including the Manufacturer's name or trademark, pipe series designation and dimensions. Packaging, handling and shipment of the pipe shall also be in accordance with the pipe Manufacturer's standards, instructions and recommendations, subject to the approval of

the Engineer. The Manufacturer's product data sheets and certification from the Manufacturer that the pipe and fittings are in compliance with this Specification shall also be supplied to the Engineer at least two weeks prior to installation.

11.4.4 Pipe Sizes

The inlet pipes from the CWSA Runoff Pond shall consist of 24-inch diameter DR 17 HDPE pipes. The inlet pipes from the Coal Storage Area Runoff Pond and Sedimentation Pond shall consist of two 32-inch diameter DR 17 HDPE pipes. The outlet pipes from the Recycle Pond Expansion shall consist of 24-inch diameter DR 17 pipes. The cleanout pipes used for seepage collection drain shall consist of 18-inch diameter DR 17 HDPE pipes. The pipes used for seepage collection drain shall consist of 6-inch diameter DR 17 HDPE slotted pipe. The outlet pipes for the Sedimentation Pond shall consist of 32-inch diameter DR 17 pipes. The pipe sizes for the other inlet/outlet pipes from various existing inlet/outlet features shall be obtained from the Design Drawings.

11.4.5 Slotted Pipes

The slots in all slotted pipe shall be cleanly cut (inside and out), identical in geometry and evenly spaced. There shall be no burrs, tabs, or other remnant HDPE or debris within or protruding from the slots. The slot length shall be located perpendicular to the longitudinal axis of the pipe. Slots shall be located in two straight rows along the length of the pipe. The rows of slots shall be spaced 180 degrees on centers (o/c) around the circumference of the pipe, and shall not be staggered.

Slots in 6-inch diameter pipe shall satisfy the following criteria:

Dimension or Area	Criteria
	6-inch Diameter Pipe
Slot Width (inches)	>0.10 and <0.15
Slot Length Measured Along Outer Pipe Circumference (inches)	>1.50 and <2.50
Slotted Area (in^2/foot of pipe)	>2.0 (outer wall) >1.0 (inner wall)
Spacing Between Slots Along Pipe Length (c/c, inches)	>1.0 and <3.0

The Contractor or Supplier shall submit a 3-foot long sample of slotted pipe for each DR rating shown on the Drawings at least two weeks prior to construction. Slotted pipe shall not be delivered to the site without first receiving approval for delivery from the Owner.

11.4.6 Fabricated Fittings

Fabricated fittings made by butt fusing or sidewall fusing cut segments of pipe shall be used where shown on the Drawings. Fabricated fittings shall not be used elsewhere unless molded fittings are not available from the Manufacturer, and if approved by the Engineer. Fabricated fittings shall be made using pipe segments meeting the base resin, physical appearance and physical property requirements specified in Sections 11.4.1 through 11.4.3 of this Specification. All pipe segments in a fabricated fitting shall be pressure rated to exceed by 20 percent the highest pipe pressure rating to which it is connected.

Fabricated fittings shall be in compliance with ASTM Standard F2206 and butt-fusion welded in accordance with ASTM Standard D3261. Shop drawings for fabricated fittings shall be submitted to the Engineer for approval at least two weeks prior to fabrication.

11.4.7 Molded Fittings

Molded fittings, where shown on the Drawings, shall meet the base resin, physical appearance and physical property requirements specified in Sections 11.4.1 through 11.4.3 of this Specification. All fittings shall be pressure rated to match the highest pipe pressure rating to which it is connected. Molded butt fittings shall be in compliance with ASTM Standard D2513 and butt-fusion welded in accordance with ASTM Standard D3261.

Molded socket fittings shall not be used.

11.4.8 Electrofusion Fitting

Electrofusion fittings, if approved by the Engineer for use in repairs, shall meet the requirements of ASTM Standard F1055.

11.4.9 HDPE Plates for Liner Penetration

HDPE plate for the liner penetrations shall have the thicknesses and dimensions shown on the Drawings. The HDPE plate shall meet the material property requirements in Sections 11.4.1 through 11.4.3 of this Specification.

11.4.10 Approved Manufacturers

The following manufacturers and corresponding pipe series designations are approved for use:

- Performance Pipe DriscoPlex PE3608/PE4710 Pipe
- PolyPipe EHMW PE3608/PE4710 Pipe

Other manufacturers producing equivalent pipes may be approved provided product data sheets and resin certificates are submitted to the Engineer to confirm compliance with this Specification.

The Manufacturer’s product data sheets, resin certificates, and certification from the Manufacturer that the pipe and fittings comply with this Specification shall be submitted to the Engineer for approval at least two weeks prior to installation.

11.4.11 Marking and Packaging

The pipe Manufacturer shall mark each pipe length and each fitting with the Manufacturer’s name or trademark, thermoplastic material designation code, diameter, dimension ratio and production code.

Packaging, handling and shipment shall be in accordance with the pipe Manufacturer’s standards, instructions and recommendations.

11.5 Joint Requirements

The HDPE pipe, and pipe and fittings, shall be joined using butt, heat fusion welds in accordance with ASTM Standards D3261 and F2620. All joints shall be made in compliance with the Manufacturer's recommended practice for heater surface temperature, heating time, applied pressure and cooling time, subject to the Engineer's approval. All joints shall be made by trained technicians qualified by the Manufacturer and using equipment and controlled procedures approved by the Manufacturer.

All pipe joints shall be stronger than the pipe itself under both tension and hydrostatic loading conditions. The joints shall be leak-tight, homogeneous and uniform throughout. Butt fusion beads shall be rounded and uniformly sized all around the pipe circumference, and complying with the dimensional guidelines in ASTM Standard F2620. The Contractor shall submit written documentation certifying compliance with the Manufacturer's standard specifications and Quality Assurance/Quality Control plan for the butt, heat fusion technique. Bent strap tests (ASTM Standard F2620 Appendix X4) shall be performed at least once per day, or as requested by the Engineer, for each pipe diameter and DR to demonstrate the integrity of the fusion welds.

Bolted flange connections, where specified on the Drawings, shall be made in accordance with the Manufacturer's recommendations and the details shown on the Drawings. The flange outside diameter and drilling configuration shall conform to ANSI standards. Bolts, nuts and washers shall be AISI type 316 stainless steel. The HDPE flanges shall have AISI type 316 stainless steel back-up rings. Bolts shall be torqued in accordance with the Manufacturer's recommendations, and as approved by the Engineer. The torque of each bolt shall be checked when the bolts are cool. Flanged connections will not be allowed to be buried unless the bolts are cool and the torque of each bolt checked just prior to burial.

11.6 Storage and Handling

The Contractor shall comply with the pipe Manufacturer's recommendations for handling and storing pipe and fittings. The pipe shall be stored on clean, level ground to prevent undue scratching or gouging and as needed to protect the pipe from being covered with excessive dirt, from water and moisture, and from mechanical abrasion. Care shall be taken to minimize the amount of soil or ash collected inside the pipe while handling and installing. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp objects, and care shall be exercised during installation not to damage the pipes and fittings.

Any pipe section, fitting or joint, which becomes broken, cracked, crushed, cut, scratched, gouged or otherwise rendered unsuitable, as determined by the Engineer, shall be removed and replaced by the Contractor. Scratches greater than 6 inches in length and gouges exhibiting a depth in excess of 8 percent of the wall thickness of the pipe shall be cause for rejection of pipe or fittings to the extent designated by the Engineer.

11.7 HDPE Pipe Installation

11.7.1 Seepage Collection Drain and Inlet/Outlet Pipes

Pipe laying, handling and installation shall be in accordance with the pipe Manufacturer's recommendations as approved by the Engineer, these Specifications, and the details shown on the Drawings.

Pipe laying, handling and installation shall be in accordance with the pipe Manufacturer's recommendations as approved by the Engineer, these Specifications, and the details shown on the Drawings.

Prior to installation of the drain system, the Contractor shall carefully examine all HDPE pipe and fittings for any damage and defects. All defective materials shall be rejected and replaced. The Contractor shall also carefully inspect the base of the ponds and make sure that it is free of foreign objects or obstacles that may affect installation of the drain system. If water is present in the pipe trench area, it shall be dewatered prior to placement of the geotextile, gravel and HDPE pipes.

Pipe sections shall be joined adjacent to the trench, prior to placing the pipe on the pipe bedding. Care shall be taken not to drop the pipe while moving it, and to avoid excess stress or strain during installation. When pulling the pipe, either a pulling head or a suitable wraparound sleeve with rubber protective cover shall be used to prevent the pulling cables from damaging the pipe. The maximum pulling length shall be limited to 500 feet. Slotted pipe shall be installed with the two rows of slots centered at the pipe spring-line.

Pipe installation and placement of backfill around pipes shall be performed when the pipe is in a contracted state, i.e., during the cool of morning, at night, or during periods of over-cast skies.

The geotextile used for the gravel in the seepage collection drain shall remain wrapped and protected from moisture and ultraviolet light until the time of installation. Storage at the site shall be in a suitable area protected from sunlight and moisture. After installation, the geotextile shall not be left exposed for more than 48 hours before being covered with drainage sand or the upper liner.

During installation, the geotextile shall be loosely laid with the long direction of the geotextile roll placed along the length of the sump, as shown on the Construction Drawings. The liner or geocomposite surface shall be free from debris or objects that could damage the geotextile. The geotextile shall be in contact with the liner or geocomposite without excessive wrinkles or gaps. Field joints, where necessary, shall be made using a minimum lap length of 6 inches and flat sewn seams in accordance with the Manufacturer's recommendations, subject to approval by the Engineer. The thread used to sew the seams shall be of the same material as the geotextile.

At the pipe penetrations, the geotextile shall be cut to fit tightly around the pipe’s circumference.

Tears, punctures, thinly stretched sections, or any other damaged geotextile resulting from construction activities or as received from the Manufacturer which could allow the migration of the drainage sand or fine filter gravel through the geotextile shall be overlain by another section or patch of geotextile with a 6-inch lap all around the damaged area. The patch shall be field sewn to the geotextile all around the patch perimeter.

Care shall be exercised in handling and placing the HDPE pipes to avoid any damage. Under no circumstances shall the pipes be dropped or dumped into the trench. A 6-inch thick layer of coarse filter gravel at the perforated pipes shall be placed in the trenches prior to the placement of the pipes. As each section of the pipe is placed in the trenches, the joints shall be assembled

and the pipes shall be brought to the lines and grades shown on the Construction Drawings. After the pipes are in place, additional gravel shall be placed around and over the drainage pipes, as shown on the Construction Drawings. The geotextile shall then be wrapped around the gravel with a minimum overlap of 6 inches at all seams. At times when pipe laying is not in progress, the open ends of the drainage pipes shall be closed using a watertight plug or other means approved by the Engineer.

To prevent crushing of the HDPE pipes, sufficient backfill shall be placed over the pipes according to the Manufacturer's specifications before construction equipment is allowed to pass over the drainage pipes. Any pipe that is broken, cracked or otherwise rendered unsuitable, as determined by the Engineer, shall be removed and replaced by the Contractor.

11.7.2 Pipe Vents

Pipe vents shall be fabricated in accordance with the details on the Drawings and installed at the locations, dimensions and elevations shown on the Drawings. A shop drawing of the pipe vent shall be submitted to the Engineer prior to fabrication for approval.

11.7.3 Seep Shields

Pipe seepshields shall be field fabricated from HDPE liner to the lines and dimensions shown on the Drawings, and connected to the HDPE pipes with flanged connections in accordance with the details shown on the Drawings. HDPE seepshields shall be extrusion welded to the HDPE liner by the Liner Contractor in accordance with these Specifications and the details shown on the Drawings. Shop drawings of the pipe connections to the seepshield shall be submitted to the Engineer prior to fabrication for approval.

11.7.4 Pipe Penetration

The HDPE plates that shall be used at the inlet pipes penetration through HDPE geomembrane liner shall be fabricated and welded to the pipes in accordance with the details of the Drawings. The HDPE plates shall be fabricated and welded to the pipes by the Owner’s pipe supplier. Shop drawings of the liner penetrations shall be submitted to the Engineer prior to fabrication for approval.

11.8 Protection and Repairs

Care shall be exercised during construction not to damage the pipes and fittings. Construction equipment shall not be allowed to pass over any pipe culvert until a minimum of 2 feet of compacted cover is placed above the crown of the pipe.

Any pipe section, fitting or joint, which becomes broken, cracked, crushed, cut, scratched, gouged or otherwise rendered unsuitable, as determined by the Engineer, shall be removed and replaced by the Contractor. Scratches greater than 6 inches in length and gouges exhibiting a depth in excess of 8 percent of the wall thickness of the pipe or fitting shall be cause for rejection of a pipe section or fitting to the extent designated by the Engineer.

11.9 Pressure Testing

The joined outlet and inlet pipes shall be hydrostatically pressure tested prior to burial in accordance with the Manufacturer's recommendations. At a minimum, the pipes shall be filled with water, trapped air bled from the pipe, and the pipe then pressurized to 90 psi. The initial pressure shall be applied and allowed to stand for 3 hours. During this duration, water should be added at hourly increments to maintain the pressure. After the initial testing period, the pipe shall be filled with water, the pressure returned to 90 psi, and the pressure held for at least 2 hours. The pipeline and joints will be considered to have passed the pressure test if there are no visual leaks, and less than 8.9 gallons of water per 100 feet of 24-inch diameter pipe and less than 14.3 gallons of water per 100 feet of 32-inch diameter pipe is added at the end of the 2-hour test period (or 13.3 gallons of water per 100 feet of 24-inch pipe and 21.5 gallons of water per 100 feet of 32-inch pipe after 3 hours) to restore the pressure to 90 psi in order to compensate for expansion of the pipe under the final test pressure.

Bolted flange connections, where specified on the Drawings, shall be made in accordance with the Manufacturer's recommendations and the details shown on the Drawings. The flange outside diameter and drilling configuration shall conform to ANSI standards. The bolts, nuts and washers shall be AISI type 316 stainless steel. The HDPE flanges shall have AISI type 316 stainless steel back-up rings. Bolts shall be torqued in accordance with the Manufacturer's recommendations, and as approved by the Engineer. The torque of each bolt shall be checked when the bolts are cool. Flanged connections will not be allowed to be buried unless the bolts are cool and the torque of each bolt checked just prior to burial.

11.10 Construction Quality Assurance Inspection and Testing

The Engineer, representing the Owner, will undertake observations and inspections to determine compliance of the materials and work with the Drawings and Specifications. Quality assurance by the Engineer will include monitoring and/or inspecting: (i) HDPE pipe and fitting diameter, dimension ratio, material designation code, workmanship and fabrication; (ii) slot dimensions, spacing, orientation and workmanship; (iii) installation, alignment and fusion welding of pipe and fittings; (iv) backfilling around and cover placement over pipe and fittings; and (v) connections to seepshields and liner penetrations.

The Contractor shall obtain and secure samples of slotted pipe and fusion welds for testing by the Engineer. The Contractor shall obtain the samples from locations designated by the Engineer. All samples shall be properly marked and identified by the Contractor.

Quality assurance tests will be performed by the Engineer on slotted pipe and fusion weld samples at the following minimum frequencies.

Property	Test Method	Minimum Testing Frequency
Slot Dimensions and Slotted Area	Caliper Measurements	Once per 1,000 feet of Slotted Pipe
Fusion Weld Integrity	Bent Strap Test ASTM F2620 [App. X4]	Once per day per Pipe Diameter and DR

Failure of any sample to meet the requirements specified herein shall be considered cause for rejection of the material or installed section from which the sample was collected to the extent

designated by the Engineer. If the Contractor can establish to the Engineer, via additional tests performed by the Engineer, that the failed sample is representative of a smaller section of the installed material than the entire lot represented by the original test sample, then only that portion will be rejected. The additional tests, however, shall be performed by the Engineer representing the Owner. The Contractor shall reimburse the Owner for any such requested test that fails to meet the requirements specified herein.

11.11 Submittals

The following submittals are required from the Contractor as part of the requirements of this Specification.

- A complete description of the HDPE pipe and fittings with the Manufacturer's product data sheets, description of the HDPE resin, Manufacturer's certificate of analysis for the HDPE resin, and Manufacturer's certification that the pipe and fittings satisfy the requirements of this Specification.

- A complete description of the slot dimensions, spacing and orientation, and a three-foot long section of each type (DR) slotted pipe.

- Shop drawings for: fabricated pipe vents; pipe connections to the seepshields; liner pipe penetrations; sumps; and non-standard fabricated pipe fittings.

SPECIFICATIONS

SECTION 12
AGGREGATES

**RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS**

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

12.1 Description of Work

This Specification section covers the material requirements and installation of aggregate in seepage collection drain and sump, as shown on the Drawings. The Specification contains the following sections:

12.2 Referenced Standards

The following ASTM and Florida Department of Transportation (FDOT) standards are referenced in this Specification.

D422: Standard Test Method for Particle-Size Analysis of Soils

D2487: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2488: Practice for Description and Identification of Soils (Visual-Manual Procedure)

D2974: Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

D4253: Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

D4254: Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

D4373: Standard Test Method for Calcium Carbonate Content of Soils

FDOT Standard Specifications for Road and Bridge Construction

12.3 Silica Gravel

The silica gravel shall consist of rounded, sub-rounded to sub-angular processed clean silica gravel, and shall classify as poorly-graded fine gravel or fine gravel with coarse sand (Group Symbol GP) in accordance with ASTM Standard D2487. Particle angularity shall be determined in accordance with ASTM Standard D2488 criteria for coarse-grained particles. The silica gravel shall contain at least 98 percent silica (of which at least 50 percent is in the form of primary silica), less than 1 percent carbonate minerals (ASTM Standard D4373), and less than 0.1 percent organic material (ASTM Standard D2974 - Method C). Silica gravel shall meet the following gradation requirements, unless approved otherwise by the Engineer, determined in accordance with ASTM Standard D422.

U.S. Standard Sieve Size	Percent Passing (Dry Weight Basis)
2-inch	100
¾-inch	90 - 100
⅜-inch	30 - 70
No. 4	0 - 25
No. 8	0 - 8
No. 40	0 - 1
No. 200	0 - 0.3

A complete description of the proposed silica gravel, mineralogic composition, gradation test results, a 50 pound sample of aggregate, and the Supplier's certification confirming compliance with this Specification shall be submitted to the Engineer for approval at least two weeks prior to construction.

12.4 Coarse Sand

Coarse sand shall consist of clean silica sand containing at least 35 percent rounded, sub-rounded to sub-angular particles, and no more than 65 percent angular particles. The coarse sand shall contain at least 98 percent silica, no more than 1 percent carbonate minerals (ASTM Standard D4373), and shall classify as poorly-graded coarse sand with fine gravel to poorly-graded coarse to medium sand (Group Symbol SP) in accordance with ASTM Standard D2487. Particle angularity shall be determined in accordance with ASTM Standard D2488 criteria for coarse-grained particles. Coarse sand shall meet the following gradation requirements, unless approved otherwise by the Engineer, determined in accordance with ASTM Standard D422.

U.S. Standard Sieve Size	Percent Passing (Dry Weight Basis)
3/8-inch	100
No. 4	62-100
No. 6	35-87
No. 8	15-64
No. 10	12-50
No. 20	0-20
No. 40	0-10
No. 200	0-0.5

A complete description of the proposed coarse sand, mineralogic composition, gradation test results, a 25 pound sample of aggregate, and the Supplier's certification confirming compliance with this Specification shall be submitted to the Engineer for approval at least two weeks prior to construction.

12.5 Fine Sand

The fine sand shall consist of clean silica sand containing at least 98 percent silica, no more than 1 percent carbonate minerals (ASTM Standard D4373), and classifying as poorly-graded medium to fine sand (Group Symbol SP) in accordance with ASTM Standard D2487. Fine sand shall exhibit the following gradation requirements, unless approved otherwise by the Engineer, determined in accordance with ASTM Standard D422 unless approved otherwise by the Engineer.

U.S. Standard Sieve Size	Percent Passing (Dry Weight Basis)
No. 10	100
No. 20	60-100
No. 40	25-72
No. 60	10-41
No. 100	0-20
No. 140	0-11
No. 200	0-4
No. 270	0-1

A complete description of the proposed fine sand, mineralogic composition, gradation test results, a 25 pound sample of aggregate, and the Supplier's certification confirming compliance with this Specification shall be submitted to the Engineer for approval at least two weeks prior to construction

12.6 Placement

Placement of the aggregate in the gravel drain shall be in accordance with the locations, lines, grades, dimensions and details shown on the Drawings, and in compliance with this Specification.

A 6-inch thick layer of silica gravel shall be placed over the non-woven geotextile across the entire width of the gravel drain. The gravel bedding (on which the slotted HDPE pipe invert will rest) shall be carefully shaped to grade along the pipe length to be installed. Care shall be

exercised during placement of the gravel to prevent damaging, pulling or displacing the geotextile. Any damage to the geotextile shall be repaired by the Contractor at his expense.

Following installation of the HDPE pipe, silica gravel shall then be placed on both sides of the pipe and above the pipe to the minimum thickness and dimensions shown on the Drawings. Placement of the silica gravel shall be controlled such that the gravel completely surrounds the pipe. Sufficient silica gravel material shall be worked under the haunch of the pipe up to the springline to provide side support throughout. Precautions shall be taken to prevent lateral or vertical movement of the pipe during filling including holding the pipe in-place as needed. The silica gravel shall completely fill around and remain in contact with the entire pipe circumference, with particular care taken to ensure that voids are not present around the lower one-third of the pipe circumference. After placement, the gravel shall be compacted to an in-place dry density equal to or greater than 65 percent relative dry density determined in accordance with ASTM Standards D4253 and D4254. Care shall be exercised so as not to damage the pipes and geotextile.

Sand filter sections shall be placed at each end of each drain segment, as shown on the Drawings, and in accordance with the installation procedures described above for the gravel. After placement, the sand shall be compacted to an in-place dry density equal to or greater than 65 percent relative dry density determined in accordance with ASTM Standards D4253 and D4254.

Care shall be taken to prevent the silica gravel and sand materials from becoming contaminated, prior to and during placement. Care shall be exercised to prevent damaging, pulling or displacing the geotextile, or damaging or displacing the HDPE pipe. Any damage to HPDE pipe or geotextile resulting from placement and compaction of silica gravel and sand shall be repaired by the Contractor at his expense as directed by the Engineer.

12.7 Quality Assurance Inspection and Testing

The Engineer will undertake observations and perform quality assurance tests to determine compliance of the materials and work with this Specification. Quality assurance by the Engineer will include monitoring the suitability and placement of the aggregates. Laboratory quality assurance tests will be performed by the Engineer on samples of aggregate at the following minimum frequencies.

Material	Property	Test Method	Minimum Testing Frequency
Gravel	Mineralogic Composition	Visual Examination	Once per 1,000 yd^3
	Particle Shape	ASTM D2488	
	Gradation	ASTM D422	
	Classification	ASTM D2487	
	Total Carbonates	ASTM D4373	Once per 2,000 yd^3
	Soluble Silica	0.3M H_2SO_4 Extraction	
Sand	Particle Shape	ASTM D2488	Once per 500 yd^3
	Gradation	ASTM D422	
	Classification	ASTM D2487	
	Total Carbonates	ASTM D4373	

Failure of any sample to meet the requirements specified herein shall be considered cause for rejection of the material or installed section from which the sample was collected to the extent designated by the Engineer. If the Contractor can establish to the Engineer, via additional tests performed by the Engineer, that the failed sample is representative of a smaller section of the installed material than the entire lot represented by the original test sample, then only that portion will be rejected. The additional tests, however, shall be performed by the Engineer representing the Owner. The Contractor shall reimburse the Owner for any such requested test that fails to meet the requirements specified herein.

12.8 Submittals

The following submittals are required from the Contractor as part of the requirements of this Specification.

- A complete description of the Contractor's proposed silica gravel, mineralogic composition and gradation test results, a 50 pound sample of the silica gravel, and the Supplier's certification confirming compliance with the Specification requirements.

- A complete description of the Contractor's proposed coarse sand, mineralogic composition and gradation test results, a 25 pound sample of the coarse sand, and the Supplier's certification confirming compliance with the Specification requirements.

- A complete description of the Contractor's proposed fine sand, mineralogic composition and gradation test results, a 25 pound sample of the fine sand, and the Supplier's certification confirming compliance with the Specification requirements.

SPECIFICATIONS

SECTION 13
CONCRETE AND REINFORCING STEEL

**RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS**

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

13.1 Description of Work

This Specification covers the requirements for reinforced cast-in place concrete.

13.2 Referenced Standards

The following ASTM standards are referenced in this Specification.

A82: Standard Specification for Steel Wire, Plain for Concrete Reinforcement

A185: Specifications for Steel Welded Wire Reinforcement, Plain, for Concrete

A615: Specifications for Deformed and Plain Carbon - Steel Bars for Concrete Reinforcement

C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field

C33: Standard Specification for Concrete Aggregates

C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

C94: Standard Specification for Ready-Mixed Concrete

C143: Standard Test Method for Slump of Hydraulic Cement Concrete

C150: Standard Specification for Portland Cement

C171: Standard Specification for Sheet Materials for Curing Concrete

C192: Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan in Concrete

The following American Concrete Institute (ACI) standards are referenced in this Specification.

ACI 301: Specifications for Structural Concrete

ACI 304: Guide for Measuring, Mixing, Transporting and Placing Concrete

ACI 305R: Guide to Hot Weather Concreting

ACI 306R: Guide to Cold Weather Concreting

ACI 347: Guide to Formwork Concrete

ACI SP-66: Recommended Practice for Placing Reinforcing Bars

13.3 General Requirements

13.3.1 Product Handling

The Contractor shall use all means necessary to protect materials before, during and after installation and to protect any other completed work. In the event of damage, the Contractor shall immediately make all repairs and replacements specified by the Engineer at no additional cost.

Concrete reinforcement shall be stored in a manner to prevent excessive rusting and fouling with dirt, grease and other bond-breaking coatings. Precautions shall be taken to maintain reinforcing steel identification after the bundles are broken.

13.3.2 Formwork

Formwork, where required, shall comply with all pertinent codes and regulations, and all pertinent recommendations contained in ACI 347. Where provisions of pertinent codes and standards conflict with the requirements of this section of this Specification, the more stringent provisions shall govern.

All form lumber in contact with exposed concrete shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, tempered concrete-form-grade hardboard, metal, plastic, or other acceptable material capable of producing the desired finish. No selected form facing

materials shall be specified for rough form finish surfaces. Form sealers shall be first quality of their respective kinds and subject to approval by the Engineer.

Form ties shall be a type which do not leave an open hole through the concrete and which permit neat and solid patching at every hole. Wire ties and wood spreaders shall not be used. When forms are removed, no metal shall be less than 2-inches from the surface. Alternate forming systems may be used subject to approval by the Engineer.

All other materials not specifically described but required for proper completion of concrete formwork, shall be as selected by the Contractor subject to approval by the Engineer.

13.3.3 Design and Construction of Forms

Design and construction of all forms, where required, shall be sufficiently tight to prevent leakage of mortar, and able to prevent excessive deflection when filled with wet concrete. Design loads and pressures shall conform to those stipulated in ACI 347.

All required cast-in-place concrete shall be formed, where needed, to the shapes, sizes, lines, and dimensions indicated on the Drawings. The Contractor shall exercise care in the layout of forms to avoid the necessity for cutting of concrete after it is in place. Proper provisions shall be made for all openings, offsets, recesses, anchorage, blockings, and other features of the work as shown on the Drawings or as required. Reinforcement and other such items required to be anchored in the concrete shall be set before the concrete is placed. Reinforcement shall not be used to support forms or keyways.

The forms shall be braced and tied together to maintain position and shape and to ensure safety to personnel. Bracing and supporting members of ample size and strength shall be constructed to carry safely, without excessive deflection, all dead and live loads to which they may be subjected. The Contractor shall provide metal spreader ties that give positive tying and accurate spreading. Forms shall be constructed straight, true, plumb, and square within a tolerance horizontally of 1 in 400 and a tolerance vertically of 1 in 500. Forms shall be sufficiently wetted to prevent joints from opening up before concrete is placed.

13.3.4 Removal of Forms

Side forms of footings and foundations may be removed, with Engineer's approval, 24-hours after placement of concrete, but the time may be extended if deemed necessary. The Contractor shall use all means necessary to protect workers, the installed work and materials, and ensure the complete safety of the work. Nails and tie wires or form ties shall be cut off flush, and all surfaces left smooth and clean. Metal spreader ties on exposed concrete shall be removed by snapping off inside the wall surface, and pointing up and rubbing the resulting pockets to match the surrounding areas. Holes resulting from the use of the spreader rods and sleeve nuts shall be flushed using water and then solidly packed throughout the wall thickness with cement grout applied under pressure by means of a grouting gun. Grout shall be one (1) part Portland cement to two and one-half (2-1/2) parts sand. Grout shall be applied immediately after removing forms.

13.4 Reinforcing Steel

The Contractor shall comply with all pertinent codes and regulations, the pertinent recommendations contained in ACI SP-66 and "Recommended Practice for Placing Reinforcing Bars" of the Concrete Reinforcing Steel Institute. When provisions of pertinent codes and standards conflict with the requirements of this section of the Specification, the more stringent provisions shall govern.

The Contractor shall submit shop drawings he has reviewed and approved for each cast-in-place concrete structure to the Engineer for approval. Submittals shall include bending diagrams, assembly diagrams, splicing and laps of rebar, and shapes, dimensions and details of bar reinforcing and accessories.

All concrete reinforcement materials shall be new, free from rust, and comply with the following standards:

- Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement (ASTM A615, Grade 60).
- Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement (ASTM A82).
- Specifications for Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A185).

All materials shall be stored in a manner to prevent excessive rusting and fouling with dirt, ash, grease, and other bond-weakening coatings. All other materials not specifically described but required for a complete and proper installation of concrete reinforcement, shall be as selected by the Contractor subject to approval by the Engineer.

Reinforcement shall be fabricated in strict accordance with the approved shop drawings. The Contractor shall not use bars with kinks or bends not shown on the Drawings or on the accepted shop drawings. Bending or straightening steel, which has been partially embedded in hardened concrete or in any other manner that will injure the material will not be permitted. Any bending shall be done cold. Bends for stirrups and ties shall be made around a pin having a diameter not less than four times the minimum thickness of the bar. Bends for other bars, including hooks, shall be made around a pin having a diameter not less than six times the minimum thickness of the bar for bars up to 1 inch in diameter and eight times the minimum thickness of the bar for bars over 1 inch in diameter.

All concrete reinforcement shall be accurately placed, secured and supported with metal chairs, spacers or hangers before the start of concrete placement. The clear space between bars shall not be less than the nominal diameter of round bars. In no case shall the clear distance be less than 1 inch nor less than one and one-third times the maximum size of aggregate. The Contractor shall provide the following minimum concrete covering of reinforcement:

- Concrete placed against soil or ash: 3 inches.
- Concrete cover over all reinforcing steel: 3 inches

13.5 Cast-in-Place Concrete

13.5.1 General

The Contractor shall comply with all pertinent codes and regulations, and all pertinent recommendations of ACI 301 and ACI 304. Where provisions of pertinent codes and standards conflict with this Specification, the more stringent provisions shall govern.

13.5.2 Documentation

Before any concrete is delivered, the Contractor shall furnish to the Engineer for approval, a concrete mix design for each class of concrete to be used. The design mixes shall be proven by compression test cylinders, tested by a recognized testing laboratory or by certification and test results of a standard mix of the transit-mix concrete supplier in accordance with ACI 301. All material used in the design mixes shall be that proposed for this project. Tests shall be in accordance with ASTM C 39. The slump of the concrete used in these test cylinders shall not be less than the maximum slump specified.

The Contractor shall keep a record at the job-site showing time and location of each placement of concrete, together with transit-mix delivery slips certifying contents of the pour per ASTM C94. The record shall be made available to the Engineer for his use upon request. Upon completion of this portion of the work, the Contractor shall deliver the record and the delivery slips to the Engineer.

13.5.3 Concrete

All concrete, unless otherwise specifically permitted by the Engineer, shall be transit-mixed in accordance with ASTM C94. The control of concrete production and all tests of cement, aggregates, and water shall be by a recognized testing laboratory, approved by the Engineer.

Concrete shall be air entrained and shall conform to the following requirements:

Property	Criterion
Compressive Strength at 28 days	≥4000 psi
Cement Content	≥5.5 sacks (94 lbs) per cubic yard
Water to Cement Ratio	≤0.45
Percent Air by Volume	4 to 6
Slump	4 to 5 inches

Cement shall be Portland cement conforming to ASTM C150, modified Type II, Low C3A (5 percent max.), or equivalent approved by the Engineer.

Aggregates shall be non-reactive aggregates consisting of at least 95 percent silica (dry weight basis) and containing less than 1.0 percent total carbonates (dry weight basis) determined in accordance with ASTM D4373 on specimens ground to pass the U.S. Standard No. 60 sieve.

13.5.4 Preparation

The Contractor shall remove all debris from the areas in which concrete will be placed. To ensure proper placement and bonding of concrete, the area shall be thoroughly cleaned. Forms, if required, shall be thoroughly wet (except in freezing weather) or sprayed or brushed with a releasing agent and all standing water removed. All transporting and handling equipment shall be thoroughly cleaned. The Engineer shall be notified at least 24 hours before concrete is placed. Concrete shall not be placed until all forms, reinforcing steel and other items to be embedded within the concrete have been observed and approved by the Engineer.

13.5.5 Placing Concrete

Concrete shall be placed in conformance with ACI 304. Concrete shall be conveyed from mixer to place of final deposit by methods that will prevent separation and loss of materials. For chuting, pumping, and pneumatically conveying concrete, only equipment of such size and design as to ensure a practically continuous flow of concrete at the delivery end without loss or separation of materials shall be used. Concrete shall be deposited as nearly as possible in its final position to avoid segregation due to rehandling and flowing. Concrete shall be placed as dry as possible consistent with good workmanship, never exceeding the maximum specified slump. Concrete shall be placed in a manner that will avoid splashing forms or reinforcing bars and shall not be dropped freely more than 4 feet. Aluminum pump lines or tools shall not be allowed for concrete pumping and placement.

Concrete shall be placed at such a rate that it is at all times plastic and flows readily between bare bars. Once concrete placement is started, it shall be a continuous operation until placement is complete. When stoppage of concrete operations occurs for any reason, construction joints shall be placed as required. Construction joints shall be provided with shear key, and/or dowels, to resist shear and moment as specified by the Engineer.

All Concrete shall be thoroughly consolidated by mechanical vibration or other suitable means during placement, working it around all embedded fixtures and into corners of forms. A vibrator shall be inserted at many locations, from 5 to 15 seconds, until vibration is sufficient to bring a continuous film or mortar to the surface. Vibration shall stop before any segregation of the concrete occurs.

Concrete batches delivered to the job-site shall be kept as uniform as possible in consistency and strength. The following shall be considered a basis for the rejection of the concrete delivered to the site.

- Evidence that the concrete has been retempered.
- Concrete that has been contaminated with foreign material.
- Slump exceeding maximum specified.
- Percent of entrained air not within specified limits.
- Discharge from truck not within the 1.5-hour limitation of ASTM C94.

13.5.6 Finishing

After concrete has been screeded to grade, it shall be floated with a metal or wooden float followed by a steel trowel finish. Unless otherwise indicated on the Drawings, the Contractor shall finish all concrete to an even and uniform appearance and, where no slope is required, level within plus or minus 1/8 inch in 10 feet.

13.5.7 Curing

All concrete shall be cured regardless of temperature, weather, or season, to protect it from premature drying, excessively hot or cold temperatures, and mechanical injury. Immediately upon finishing the concrete or removing formwork, curing procedures shall be initiated. Curing shall be continued for at least seven days. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive strength has reached 70 percent of the specified strength. The curing procedure is used initially, may be replaced by any other procedures at any time after the concrete is one day old provided the concrete is not permitted to become surface dry during the transition.

Optional curing methods include:

1. Continuous sprinkling with fresh water.

2. Waterproof sheet materials conforming to ASTM C171:

   A. Immediately upon finishing an area, an acceptable curing membrane shall be applied.

   B. Lap and securely join all joints.

   C. Weight membrane down to prevent wind damage.

3. Curing Compound conforming to ASTM C309:

   A. Immediately upon finishing an area, an acceptable curing compound shall be applied to the entire area.

   B. The compound shall be applied in strict conformance to the recommendations of the Manufacturer.

Moisture loss from surfaces placed against wooden or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After form removal, the concrete shall be cured until the end of the time prescribed by one of the methods noted above. No traffic shall be allowed on concrete until it has been sufficiently cured.

13.5.8 Hot Weather Requirements

Concrete placement in hot weather shall be in accordance with ACI 305. Concrete with a placement temperature that will cause loss of slump, flash set or cold joints shall not be used. A concrete temperature during placement of less than 90°F shall be maintained. All means

necessary to avoid drying the concrete prior to finishing operations shall be used. All required windbreaks, sunshades, fog sprays, evaporation retardants and other devices to protect the concrete shall be provided and used by the Contractor.

13.5.9 Cold Weather Requirements

Concrete placement in cold weather shall be in accordance with ACI 306. Concrete shall be placed with the mix temperature between 50°F and 70°F. When the mean daily outdoor temperature is at or below 40°F, the concrete shall be maintained between 50°F and 70°F for the required curing period of Section 13.5.7 of this Specification. Concrete shall not be placed against or on frozen material.

The Contractor shall provide and use all required framework, cover, heating apparatus, and other devices to protect the concrete. Concrete and/or aggregates shall be protected during batching, transit and mixing, and before and after placing.

13.5.10 Defective Work

The Contractor shall inspect all concrete surfaces and patch all pour joints, voids, rock pockets, form tie holes, and other imperfections before the concrete is thoroughly dry. Defective areas shall not be patched until the concrete has been observed by the Engineer. If the defects are serious or affect the strength of the structure, or if patching does not satisfactorily restore the quality and appearance of the surface, the Engineer may require the concrete be completely removed and replaced in accordance with the provisions of this section, all at no additional cost.

13.6 Quality Assurance Inspection and Testing

The Engineer will undertake observations and perform quality assurance tests to determine compliance of the materials and work with this Specification. Quality assurance by the Engineer will include monitoring and/or inspecting: (i) reinforcing steel placement; (ii) concrete placement, finishing and curing; and (iii) sampling and testing of the concrete for compliance with this Specification including samples for testing in accordance with ASTM C31, ASTM C39 and ASTM C143.

13.7 Submittals

The following submittals are required from the Contractor as part of the requirements of this Specification: (i) shop drawings for reinforcing steel; (ii) concrete mix design; and (iii) transit-mix delivery slips.

SPECIFICATIONS

SECTION 14
CONCRETE EROSION CONTROL MAT

**RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS**

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

14.1 Description of Work

This Section covers the material requirements and installation of concrete uniform section mats.

14.2 Referenced Standards

The following ASTM standards are referenced in this Specification.

C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field

C33: Standard Specification for Concrete Aggregates

C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

C150: Standard Specification for Portland Cement

C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan in Concrete

D4884: Standard test Method for Strength of Sewn or Bonded Seams of Geotextiles

14.3 Material Requirements

The concrete erosion control mats shall consist of concrete-filled filter point synthetic fabric forms with thicknesses as shown on the Drawings installed atop a non-woven geotextile.

14.3.1 Fabric

The fabric forms shall consist of 100 percent woven polyester or polypropylene with a mass per unit area of no less than 6 oz/yd^2 and with a double-layer mass per unit area of no less than 12 oz/yd^2. Nylon fabric forms shall not be allowed. The fabric forms shall consist of multiple panels of double-layer woven fabric joined together by spaced, interwoven filter points in such a manner to provide an average thickness shown on the Drawings. Individual width panels shall be cut to suitable lengths and the two layers of fabric separately joined edge to edge by means of a heavy thread, double stitched. The tensile strength of stitched joints shall be not less than 100 pounds per inch determined in accordance with ASTM Standard D4884.

14.3.2 Grout

Grout shall consist of a mixture of Portland cement, fine aggregate and water proportioned and mixed to provide a pumpable slurry. Pozzolan and grout fluidizers conforming to this Specification may be used at the option of the Contractor. The mix shall obtain a minimum compressive strength of 2,000 lb/in^2 at 28 days when tested in accordance with ASTM Standards C31 and C39. The grout mix design shall be submitted to the Engineer for approval at least two weeks prior to installation of the mats.

Portland cement shall conform to ASTM Standard C150. Pozzolan, if used, shall conform to ASTM Standard C618. Only clean fresh water shall be used. Aggregate shall meet the requirements of ASTM Standard C33, except as to grading. Aggregate grading shall be reasonably consistent and shall be well-graded from the maximum size which can be handled with available pumping equipment.

14.3.3 Non-woven Geotextile

The non-woven geotextile underlying the fabric form shall meet the requirements for 12 oz/yd^2 geotextile in Section 10 of the Specifications.

14.3.4 Weep Holes

The mat shall contain weep holes at the specific locations shown on the Drawings. The weep holes, where specified, shall consist of 7/8-inch inside diameter polyethylene tubes through the mat on a 60-inch center-to-center spacing. The weep holes shall not protrude past the bottom surface of the mat to avoid damaging the HDPE liner.

14.4 Installation Procedures

Prior to placement of the fabric form panels, a layer of 12 oz/yd^2 non-woven geotextile shall be placed on the prepared subgrade to the lines and dimensions shown on the Drawings.

Prior to grout injection, the fabric form panels shall be positioned to the locations, lines and grades shown on the Drawings. Panels of fabric may be factory assembled in predetermined sizes and joined side-by side at the site by field sewing or by means of zipper closures attached to the upper and lower layers of fabric. Simple butt joints shall not be permitted.

Expansion joints shall be used at the locations shown on the Drawings.

Only approved grout mixing, pumping and agitating equipment shall be used in preparation and handling of the grout. All oil and other rust inhibitors shall be removed from the pumps and mixers. All materials shall be accurately measured by volume or weight as they are fed into the mixer or delivered to the pump. The quantity of water shall be such as to produce a grout having a pumpable consistency. Time of mixing shall be not less than 1 minute. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding 2.5 hours in temperatures below 70° F and for a period not exceeding two hours at higher temperatures. If there is a lapse in a pumping operation, the grout shall be re-circulated through the pump or through the mixer drum (or agitator) and pump.

Grout shall be introduced into the space between the layers of fabric and shall be injected in such a way that excessive pressure on the fabric envelope is avoided. The injection pipe shall be wrapped tightly at the point of injection with a strip of burlap and the burlap pushed into the slit as the injection pipe is withdrawn in order to minimize spillage of grout.

The thickness of the mat shall be measured by survey or other appropriate methods, approved by the Engineer. Measurement of thickness shall not be made by inserting anything through the mat that could damage the HDPE liner. Any mat measuring less than 90 percent of the average of all thickness measurements shall be re-injected with grout until the average thickness has been attained.

Foot traffic shall not be permitted on the freshly pumped mat when such traffic will cause permanent indentations in the mat surface. Walk boards shall be used where necessary.

14.5 Quality Assurance Inspection and Testing

The Engineer will undertake observations and perform quality assurance tests to determine compliance with this Specification. Quality assurance by the Engineer will include measuring the dimensions and locations of the fabric forms for compliance with the Drawings, measuring the thickness of the mat, and obtaining field samples of the grout for compressive strength tests in accordance with ASTM Standard C31 and C39. Quality assurance tests will be performed by the Engineer at the following minimum frequencies.

Property	Test Method	Minimum Testing Frequency
Grout Compressive Strength	ASTM C39	Once per Truck Load of Grout

14.6 Submittals

The Contractor shall submit a complete description of the erosion control mat, manufacturer's product data sheets, and proposed grout mixture to the Engineer for approval at least two weeks prior to installation.

SPECIFICATIONS

SECTION 15
PROTECTIVE SOIL COVER

**RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS**

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

15.1 General

This Specification covers the material requirements and installations of the soil cover that will be placed as part of the final cover system. The work shall include, placing an 18 to 24-inch thick layer of soil above the geocomposite drainage layer, which will be installed directly above the HDPE geomembrane liner, to the lines and elevations shown on the Drawings or as other directed by the Engineer.

15.2 Layout of Work

The Owner will establish reference points for horizontal and vertical controls near the designated construction areas of the Recycle Pond Expansion, Sedimentation Pond, Coal Storage Area Runoff Pond, and modified Recycle Pond. From these reference points, the Contractor shall provide all horizontal and vertical controls necessary to construct the protective soil cover to the lines and grades shown on the Drawings. It is the responsibility of the Contractor to verify all locations and dimensions prior to performance of any work.

15.3 Material Requirements

The soil used for construction of the protective cover layer shall meet the following requirements:

- The material shall have no particle retained on a U.S. Standard ¼-inch sieve.
- The material shall have a plasticity index of 0 percent (ASTM D4318).
- The material shall have an organic content no greater than 3 percent (ASTM D2974).

- The material shall classify as a sand, sand with silt or silty sand with an SP, SP-SM, SM designation in accordance with ASTM D2487.

- The material shall be relatively uniform in character and have a fines content equal to or less than 25 percent, as determined by ASTM D1130.

15.4 Pre-Construction Testing of Protective Cover Soil

Prior to placement of the protective cover soil, an appropriate borrow source that meets the material requirements listed in Section 15.3 shall be located by the Contractor. For determining the specification requirements, laboratory tests shall be performed on three representative samples of the proposed borrow.

15.5 Placement and Compaction Criteria for Protective Cover

Placement of the protective layer for the final cover system shall begin after the installation of the geocomposite and HDPE geomembrane. The protective soil cover shall be wetted or dried, as may be required, homogenized and placed in one single 18 or 24-inch thick lift above the geocomposite. Placement of the protective soil cover on the side slopes shall begin at the toe of the sideslope of the ponds and progress upslope to the crest of the sideslope of the ponds dikes. Placement of the protective soil cover directly over the geocomposite shall be performed by light track-mounted equipment (e.g., low ground pressure D-4 or D-5 dozers) and traveling on a minimum of 18 inches of sand. Care shall be exercised during placement so as not to damage the liner with the blade or tracks of the placement equipment. The protective soil cover shall be placed in such a manner to avoid pushing, pulling or otherwise stretching the geocomposite and the underlying HDPE liners.

The protective soil cover shall be compacted to a dry density of at least 95 percent of the Standard Proctor maximum dry density. Standard Proctor compaction tests (ASTM D698) shall be performed on samples of the selected protective soil cover materials, as needed, to determine the maximum dry density for compaction control.

15.6 Construction Quality Assurance Inspection and Testing

A field representative of the Engineer will be present at the site during installation of the top cover to:

- Ascertain that the materials are free of deleterious materials and that construction materials and procedures are in conformance with these specifications, particularly placement of the protective cover layer without damage to the HDPE liner.

- Perform *in situ* density tests in the protective cover after compaction and compare the results to the Standard Proctor compaction test (ASTM D698). Testing shall be performed by the dry density method (ASTM D2937) or any other methods approved by the Engineer. Field *in situ* density measurements shall be made at a minimum frequency of four tests per acre.

- A minimum of four thickness measurements shall be conducted per acre.

SPECIFICATIONS

SECTION 16
SOIL CEMENT

RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

16.1 Description of Work

This Specification covers the material and installation requirements for a 8-inch thick soil-cement layer. The work consists of furnishing all labor, materials, plant, equipment, tools, supervisory personnel, and Contractor's facilities for manufacturing transporting, placing, compacting, finishing, joining, and curing of soil-cement liner, to the layer, grades, and dimensions shown on the Drawings.

16.2 Layout of Work

The Owner will establish reference points for horizontal and vertical controls near the designated construction area of the Recycle Pond Expansion, modified Recycle Pond, and Coal Storage Area Runoff Pond. From these reference points, the Contractor shall provide all

horizontal and vertical controls necessary to construct the final soil-cement cover to the lines and grades shown on the Drawings. It is the responsibility of the Contractor to verify all locations and dimensions prior to performance of any work.

16.3 Referenced Standards

The following American Society for Testing and Materials (ASTM) standards are referenced in this Specification.

D422: Standard Test Method for Particle-Size Analysis of Soils

D558: Moisture-Density Relations of Soil-Cement Mixtures

D559: Wetting and Drying Compacted Soil-Cement Mixtures

D560: Standard Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures

D698: Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

D1140: Standard Test Method for Amount of Material in Soils Finer than the No. 200 Sieve

D1556: Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

D1633: Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders

D2216: Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock

D2487: Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2922: Standard Test Method for Density of Soil and Soil-Aggregate In-Place by Nuclear Method (Shallow Depth)

D2937: Standard Test Method for Density of Soil in Place by the Drive Cylinder Method

D4959: Determination of Water (Moisture) Content of Soil by the Direct Heating Method.

D5982: Determining Cement Content of Fresh Soil-Cement (Heat of Neutralization Method)

D6236: Standard Guide for Coring and Logging Cement- or Lime- Stabilized Soil

The following U.S. Army Corps of Engineers handbook is also referenced in this Specification.

CRD-C55 Handbook for Concrete and Cement with Designated Quarterly Supplement for Mixer Performance Test

16.4 Source of Soils Aggregates

Soil aggregate material for use in soil-cement mixture shall be obtained from the on-site soils or other borrow areas deemed suitable by the Owner and approved by the Engineer.

16.5 Material Requirements

16.5.1 Soil Aggregates

Soil aggregates for use in soil-cement mix shall be non-cemented soil, approved by the Engineer and free from trash, rocks, stones, debris, sharp objects, or other deleterious materials.

Soil aggregates shall be stored at the site of the mixing plant, as needed, in such a manner as to avoid segregation, or contamination by foreign materials. Soil aggregates shall remain in free-draining storage for at least 24 hours prior to use. Sufficient material shall be maintained at the site of the mixing plant at all times to maintain continuous, uninterrupted operation of the mixing plant during placement of the soil-cement mix.

Soil aggregate for use in soil-cement construction, when tested in accordance with ASTM D422, shall conform to the gradation indicated below.

U.S. Standard Sieve Size	Percent Passing (Dry Mass Basis)
⅜-inch	100
No. 200	<20

16.5.2 Cement

Cement shall be Portland cement conforming to ASTM C 150 modified Type II, low C3A (5 percent max.) or approved equivalent. Cement shall be stored in a manner to prevent the absorption of moisture.

Transportation of cement from the source or intermediate storage to the batching plant shall be accomplished in adequately designed weather-tight, conveyors, or other means that will protect the cement completely from exposure to moisture. Cement shall be stored in a dry and properly ventilated structure. All storage facilities shall be subject to approval and shall be such as to permit easy access for inspection and identification. Sufficient cement shall be kept in storage to maintain continuous operation of the mixing plant while the soil-cement is being placed. Cement that has been stored at the site for 60 days or more shall be used first before cement of lesser age to prevent aging.

16.5.3 Water

Water shall conform to the requirements of ASTM C 94 and shall be clean, fresh, and free from injurious amounts of oil, acid, salt, alkali, organic matter, and other substances deleterious to

the hardening of the soil-cement and shall be subject to approval by the Engineer.

16.6 Plants and Equipment

16.6.1 General

All plant, equipment, tools, and machines used in producing the soil-cement mix shall be maintained in satisfactory working conditions at all times. The mixing plant shall be located centrally near the project site. The Owner shall have free access at all times to all parts of the mixing plant for inspecting operation of the plant; for verifying weights, proportions and character of materials; and for sampling the soil-cement mixture and its components.

16.6.2 Mixing Plant

16.6.2.1 Plant

The mixing plant shall be a stationary-type plant having a twin-shaft pug mill mixer (either weigh-batch type or continuous type) and shall have a minimum capacity of 300 tons per hour. The plant shall be capable of maintaining the time of mixing constant and maintaining the speed of rotation of the pug mill shafts constant. In the absence of a track record of mixing soil-cement or testing records indicating that the proposed plant can produce a consistent uniform mix, a complete Mixer Performance Test shall be performed in accordance with CRD-C 55.

16.6.2.2 Cement Proportioning

The cement meter shall be capable of uniformly distributing the cement at the specified rate. Cement may be added in a dry form. If applied in a slurry form, or slurry, the slurry mixer shall be capable of completely dispersing the cement in the water to produce a uniform slurry, and shall continuously agitate the slurry once mixed. Silos and feeders shall be equipped and operated so that no caking of material or variation in feed will occur.

16.6.2.3 Soil Aggregate Bin

A bin, provided for soil aggregate storage, shall be of sufficient capacity to supply the mixer continuously, operating at full capacity. The soil aggregate bin shall be equipped with mechanical or electrical devices to indicate when the soil in the bin is below level to permit accurate proportioning. The bin shall be constructed such that a representative sample may be readily and safely obtained from the bin discharge during plant operations. If necessary, a screening device shall be used to remove oversized material from the raw soil feed prior to mixing.

16.6.2.4 Application of Water

Satisfactory means for weighing, metering, or volumetric measurements shall be provided to supply the required quantity of water in the mixture within tolerances specified.

16.6.2.5 Feeding Tolerances

Feeding of various components of the mixture shall meet the following tolerances:

Material	Plant Feeding Tolerances
Cement	Plus or minus 1.0%
Water	Plus or minus 1.0%
Soil Aggregate	Plus or minus 1.0%

Adequate mixing shall be performed to achieve a homogeneous, uniform mixture of the soil, cement and water within the specified tolerances. Soil and cement shall be mixed sufficiently to prevent cement balls from forming when water is added.

16.6.3 Transportation Vehicles

Vehicles for transporting the soil-cement mixture to the placement location shall have clean, smooth beds and protective covers for use at the Engineer's discretion to protect the soil-cement from moisture variations due to unfavorable weather. No track vehicles shall be allowed to transport the soil-cement onto the lift surfaces.

16.6.4 Spreading Equipment

Equipment for spreading the soil-cement mixture shall be capable of discharging the mixture in layers to produce reasonably smooth uniform surfaces. The equipment shall be able to produce layers, which when compacted, will each be approximately of the specified thickness, meeting the requirements of this Specification. Under no circumstances shall tracked vehicles be operated on compacted soil-cement.

16.6.5 Compaction Equipment

Compaction of soil-cement mix shall be achieved with the use of one or a combination of the following: tamping rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The equipment shall provide uniform compaction across the width of the equipment for each pass. Trucks, tractors, or other hauling equipment shall not be used for compaction of soil-cement mixtures.

Light, walk-behind, or similar sized vibratory rollers and mechanical tampers shall be used for compacting soil-cement mix in areas inaccessible to the large equipment. The roller's capability to compact the soil-cement to the required densities shall be demonstrated prior to the start of the soil-cement construction.

16.6.6 Water Curing Equipment

Adequate water curing equipment, e.g., pumps, tanks, sprinklers, and other approved equipment, shall be furnished by the Contractor, and shall be available at all times to provide water as required for curing and protection of permanently exposed surfaces and for moistening compacted surfaces scheduled to receive an overlying layer of soil-cement, if needed. Water trucks or sprinklers for applying water to compacted soil-cement shall be equipped with fog-type sprayers.

16.7 Soil-Cement Mix Proportioning and Requirements

The Contractor shall be responsible for designing the proportions of the soil aggregates, cement, and water and for furnishing the soil-cement mix conforming to the requirements of this Specification. The job-mix design with the supporting test results shall be made available for approval prior to construction.

16.7.1 Composition

Soil-cement shall be composed of cement, water, and soil aggregates. The cementitious materials shall be Portland cement meeting the requirements of Section 16.5.2. Admixtures shall not be used unless demonstrated by the Contractor to be beneficial in writing, including test data provided by the Contractor from an approved testing laboratory.

16.7.2 Cement Content

The Contractor shall determine the cement content on his own for use in construction based on the requirements of this Specification. A minimum cement content of 10.0 percent by dry weight of soil shall be maintained in all portions of the 8-inch thick soil-cement layer with the added provision that the cement content shall be increased, if needed, to achieve the specified compressive strength.

16.7.3 Compaction Requirements

Soil-cement shall be uniformly compacted to a minimum density greater than 98 percent of the ASTM D558 maximum density based on a moving average of five consecutive tests with no individual test below 96 percent. The placement moisture content shall be within 2 percent of the optimum moisture content.

16.7.4 Compressive Strength Requirements

The compacted in-place soil-cement shall achieve a 7-day soaked compressive strength greater than 750 lb/in^2 and 28-day soaked compressive strength greater than 1,100 lb/in^2, tested in accordance with ASTM D1633.

16.7.5 Durability Requirements

The compacted in-place soil-cement shall meet the following criteria for durability tests conducted in accordance with the standard wet-dry (ASTM D559) and the freeze-thaw (ASTM D560) tests.

Test	Maximum Weight Loss After 12 Cycles (percent)
Wet-Dry (ASTM D559)	6
Freeze-Thaw (ASTM D560)	8

16.8 Stockpiling of Soil Aggregates and Drainage

Soil aggregates proposed for use shall be stockpiled on level firm ground, well drained and free of debris, trash, organic material, and other deleterious material. Stockpiles shall be constructed in layers not exceeding 3 feet in thickness. Ramps for the construction of stockpiles shall be made of the same material as that being stockpiled, and shall be considered a part of the stockpile. Aggregates for soil-cement production shall be excavated from the stockpile in such a manner as to combine several layers of the stockpile in each sample. The gradation of the aggregate shall be representative of that used in the mix design tests. Soil aggregates shall not be used from any stockpile without completion of the mix design. A minimum of one series of tests shall be conducted for each stockpile for a mix design. During construction of stockpiles, the Contractor shall be responsible for monitoring the uniformity of the material to assure conformance with the gradation requirements of this Specification. Adequate drainage shall be provided to maintain the area to be stabilized dry.

16.9 Protective Cover Soil Preparation

Prior to initiating the processing of soil-cement, the protective cover soil above the lined area shall be graded and shaped to the lines, grades, and dimensions shown on the Drawings. Deficiencies in the underlying material shall be corrected and the protective cover soil shall be compacted to a minimum 95 percent of the Standard Proctor maximum dry density (ASTM D698).

16.10 Mixing and Handling

The soil aggregates and cement shall be fed to the mixer in proportions, as required. The water content may be varied as necessary, with the approval of the Engineer and shall in general be based on the action of the compactors on the freshly placed materials, and on the field density test results and on the surface texture being produced. The proportions of the soil-cement mix may be changed, as approved by the Engineer and as needed to adjust for variations in materials and plastic and hardened properties of the mix. Adjustments to mix proportions, except water, can be as frequent as once per shift. The Contractor shall make appropriate adjustments to the plant components immediately.

Mixing time in a continuous mixer shall not be less than 15 seconds and shall be as long as may be required to obtain a uniform and homogeneous mixture. Shaft speed of the pug mill shall be as recommended by the Manufacturer. Soil-cement shall not extend above the tips of the paddles of the pug mill mixer in vertical position. Mixer and mixer paddle surfaces shall be maintained free of hardened soil-cement and other materials. The Contractor shall replace mixer paddles that are worn down more than 10 percent from new paddles of the same type.

The soil-cement mix shall be transported from the mixing plant to the placement site in clean equipment provided with protective covers for use in unfavorable weather. The mix shall be dumped directly onto the final location or as near the final location as possible. Mix deliveries shall be scheduled so that the soil-cement mix will be spread and rolled within the time limit specified in Section 16.12. Spreading and compaction of the mix shall be completed during daylight hours unless adequate night lighting is provided. The mix loads that have crusted with partially hardened material or have become wet by rain, shall be rejected. Free fall of soil-cement more than 5 feet during placement or soil-cement mounds higher than 5 feet shall not

be allowed. Any damage to previously compacted surface from such operation shall be repaired by the Contractor at his expense.

The Contractor shall take all necessary precautions to avoid damage to completed soil-cement by the equipment and to prevent the deposition of raw earth or foreign materials between layers of soil-cement, if applicable.

The total elapsed time between the addition of water to the mixture and the start of compaction shall be the minimum possible. Haul time shall not exceed 30 minutes, and compaction shall start as soon as possible after spreading. In no case shall the total elapsed time exceed 45 minutes between the addition of water to the soil and cement and the start of compaction.

16.11 Placing and Spreading

The mixture shall be placed without segregation at a quantity per linear feet that will produce a single uniformly compacted layer conforming to the required grade and cross section. The mixture shall be spread by one or more approved spreading devices. Not more than 60 minutes shall elapse between placement of soil-cement in adjacent lanes at any location except at longitudinal and transverse construction joints.

Cold Weather Placement: Placement of the soil-cement mix shall be suspended when the air temperature reaches 45˚F (7.2˚C) and is falling and shall not be resumed until the air temperature reaches 40˚F (4.4˚C) and is rising. Soil-cement shall not be mixed or placed when soil aggregate or subgrade is frozen. Provision shall be made to protect the soil-cement from freezing during the specified curing period. The soil-cement shall be maintained at a temperature of at least 50˚F (10˚C) by covering or other means for not less than 72 hours after placing and at a temperature above freezing for the remainder of the curing period. Freeze-damaged soil-cement shall be replaced as directed.

Hot Weather Placement: The soil-cement shall be placed during the coolest part of the day practicable, and in no case shall the temperature of the soil-cement when placed exceed 90˚F (32.2˚C) unless prior approval by the Engineer. The finished surfaces of the newly placed soil-cement shall be kept damp by applying a waterfog or mist with approved spraying equipment. Streams of water shall not be allowed. When heat or wind is determined to be excessive by the Engineer, the Contractor shall immediately implement measures necessary to protect the soil-cement surfaces. If these measures are not effective, placement shall be immediately suspended until weather conditions improve.

Placement During Rain: The soil-cement shall not be placed during rainfall with intensity exceeding 5 millimeters per hour. During periods of lesser rainfall, placement of soil-cement may continue as approved by the Engineer. Work shall resume after the surface water has dried.

16.12 Compaction and Finishing

At the start of compaction, the soil-cement mixture shall be in a single uniform, loose condition throughout its full depth and no section shall be left undisturbed for longer than thirty (30) minutes during compaction operations. Compaction shall be completed in such a manner as to produce a dense surface, free of compaction planes, 1-1/2 hours from the start of mixing. The

compaction requirements specified in Section 16.7.3 shall be met.

As compaction nears completion, the surface of the soil-cement shall be shaped to the specified lines, grades, and cross sections. If necessary or as required by the Engineer, the surface shall be lightly scarified or broom-dragged to remove imprints left by equipment or to prevent compaction planes. Compaction shall then be continued until uniform and adequate density is obtained. During the finishing process the surface shall be kept moist by means of fog-type sprayers. Compaction and finishing shall be done in such a manner as to produce dense surface free of compaction planes, cracks, ridges, or loose material. All finishing operations shall be completed within 3 hours from the start of mixing.

16.13 Grading Tolerances

16.13.1 Vertical Tolerance

The thickness requirements shown on the Drawings will supersede the elevations shown on the Drawings when necessary and as approved by the Engineer. Vertical tolerances for all thicknesses shall be -½ and +1 inch.

16.13.2 Horizontal Tolerance

All lines and dimensions shall be constructed to within a horizontal tolerance of ±5 percent from the lines and dimensions shown on the Drawings, and within a maximum horizontal tolerance of ±0.5 foot.

16.14 Curing

All exposed soil-cement surfaces shall be moist cured for a minimum of 7 days. Water for curing shall comply with the requirements of Section 16.5. Traffic shall not be allowed on completed soil-cement surfaces during the curing period.

Soil-cement shall be cured and protected from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage and exposure to rain or flowing water. All soil-cement surfaces shall be protected from the damaging effects of rain for 8 hours and flowing water for 7 days. All equipment and materials needed for adequate curing and protection shall be subject to approval by the Engineer and shall be available and ready to install before actual placement begins.

Water trucks supplemented, as necessary, by mists from hand-held hoses may be used to keep soil-cement surfaces wet at all times. All spray nozzles shall produce a true fog spray that will not erode the surface of the soil-cement. Ponding of water at the surface shall be avoided.

An approved sprinkler system capable of producing a fine mist of water without eroding the soil-cement surface may also be used. The sprinkler system shall cover the entire soil-cement surface, and keep the surface wet at all times.

16.15 Construction and Crack Control Joints

At the end of each day's construction, or whenever construction operations are interrupted for more than two (2) hours, a straight transverse construction joint shall be formed by cutting back

into the completed work to form a full-depth, vertical face, free of loose or shaved material. The proportions of the bonding agent, mixing, and placement method shall be provided by the Contractor for approval at least 2 weeks prior to use in construction.

Crack control joints shall be established between construction joints to minimize random cracking of the soil-cement layer. The joints shall be spaced at 12-foot on center on each way. The induced crack joints shall be developed by creating a notch to a depth of 3 inches using vibratory half-inch wide steel plate. The notch shall be backfilled with asphalt emulsion or equivalent joint sealant.

16.16 Maintenance

The Contractor shall maintain the soil-cement in good condition until all work is completed and accepted. Maintenance shall include immediate repairs of any defects. If it is necessary to replace any soil-cement, the replacement shall be for the full depth, with vertical cuts, using either soil-cement or concrete. No skin patches will be allowed. This maintenance work shall be done by the Contractor at his own expense and repeated as often as necessary.

16.17 Quality Assurance Inspection and Testing

16.17.1 Quality Assurance Inspection and Testing by the Engineer

The Engineer with assistance and cooperation from the Contractor will undertake inspection and perform quality assurance tests to determine compliance of the materials and work with this Specification.

Quality assurance by the Engineer will include monitoring and/or inspecting:

(i) calibration of mixing plant;
(ii) operation of all equipment used on the work;
(iii) mixing and hauling of soil-cement
(iv) placement, spreading and compaction of soil-cement;
(v) thickness measurements;
(vi) construction joints; and
(vii) curing and maintenance of completed soil-cement surfaces.

Quality assurance tests by the Engineer will include testing of individual components of the soil-cement mix and the mix for compliance with this Specification, including moisture content and field density tests, laboratory compressive strength tests, and laboratory durability tests. Field density tests will be performed by the Engineer on the soil-cement in accordance with ASTM D2937 or D2922 as soon as possible, but within 30 minutes after the completion of compaction. The ASTM D2922 density test will be performed using a single probe nuclear density gauge operating in the direct transmission mode so density of the full depth of the soil-cement can be measured.

Samples of the soil-cement mix shall be moist-cured for 7 to 28 days for determining the unconfined compressive strengths. The Engineer will perform the following quality assurance tests on soil-cement at the indicated minimum testing frequency:

Material	Property	Test Method	Minimum Testing Frequency
Water	-	ASTM C94	Once per 5 days/source
Soil Aggregates	Sieve Analyses	ASTM D422	Once per shift
Soil-Cement	Wetting-Drying Test	ASTM D559	1 test/borrow area or as needed
	Freeze-Thaw Tests	ASTM D560	1 test/borrow area or as needed
	Thickness (Core)	ASTM D6236	Once per 10,000 ft^2 or 1 test/crew/shift
	In-Place Density In-Place Moisture Fines Content	ASTM D2937/ASTM D2922 ASTM D2216/4959/4944 ASTM D1140	Once per 300 yd^3 of compacted mix or 1 test/crew/shift
	Moisture-Density	ASTM D558	As needed
	Cement Content	ASTM D5982	Once every 2 days per mixer
	Compression Tests (on Molded Samples)	ASTM D1633	Once every 2 days per mixer
	Compression Tests (on Cored Samples)	ASTM D1633	Once per 950m^2 or Once/crew/shift

16.17.2 Contractor's Inspection Requirements

Whenever the accuracy of weighing or batching does not comply with this Specification, the plant shall be shut down until necessary adjustments or repairs have been made.

Accuracy of proportioning of the continuous-mixing plant for cement shall be checked by the Contractor in the presence of the Engineer every five (5) shifts, and for soil aggregate at the beginning of construction and after every ten (10) shifts. The accuracy of proportioning shall be checked by simultaneously obtaining timed samples of cement and soil aggregate as they are fed to the mixer and weighing each as appropriate.

The Contractor shall not permit placing to begin until adequate equipment and competent operators are available for compacting the soil-cement. Placement shall be temporarily suspended if any lift is found inadequately compacted until such time as that lift has been reworked, retested, and meets the density requirements.

The Contractor shall be responsible for recording soil-cement temperature, ambient temperature, weather conditions, time of placement, and method and location of placement, and shall notify the Engineer whenever the soil-cement temperature during the period of protection falls below 50˚ F (10˚C)or is above 90˚ F (32.2˚C).

The Contractor shall inspect all areas subject to cold weather protection, at least once during each shift. Deficiencies shall be noted. During removal of protection, the soil-cement and ambient temperature shall be recorded at least hourly.

When the maximum daily air temperature is likely to exceed 90˚ F (32.2˚C), the Contractor shall record the temperature of the soil-cement mixture at 30 minute intervals during placement. Placement shall be suspended when the soil-cement mixture exceeds 90˚ F (32.2˚C). The surface of the subgrade shall be sprinkled with water immediately before the soil-cement is placed and any deficiencies noted. The finished soil-cement surface shall be inspected to assure that it is maintained damp until the curing medium is applied and any deficiencies noted. The Contractor shall take immediate steps to correct any deficiencies.

The Contractor shall inspect the curing operation to assure that the surface of the permanently exposed soil-cement surface is maintained very moist (or wet) continuously until the end of the curing period. All temporarily exposed soil-cement surfaces shall be kept moist.

The Contractor shall notify the Engineer when any soil-cement surface is allowed to dry before the end of the curing period and shall take immediate steps to correct the situation.

16.17.3 Contractor's Reporting Requirements

All test results or measurements performed by the Contractor shall be reported daily to the Engineer. During periods of cold weather protection, reports of pertinent temperatures shall be made on a daily basis. The Contractor shall report any failures immediately, followed by reports of failure and the action taken in writing. The Engineer reserves the right to examine all records at any time.

The recorders in continuous mixing plants shall keep a record of the amount of cement and aggregates used on a daily basis, which will be used as a check on the soil-cement proportioning. If deficiencies are found in the proportioning control of the mixture, the Contractor shall take necessary action to correct the problem.

All measuring devices shall be calibrated prior to production of the soil-cement mix and as deemed appropriate by the Engineer. All calibration shall be subject to approval by the Engineer and performed at the Contractor's expense.

All permits associated with the operation of the on-site soil-cement mixing plant (e.g. air permit, runoff and wash watch permit, etc.) shall be obtained by the soil-cement Contractor prior to mobilize to the site.

16.18 Submittals

- Details of the soil-cement mixing plant, prior to assembly, including Manufacturer's literature on feed equipment used to deliver cement and aggregate, water controls, and pug mill mixers.

- Plan showing location of mixing plant and material storage areas.

- Description of the equipment proposed for transporting soil-cement mixture from the mixing plant to the placement site.

- Description of the equipment proposed for placing of the soil-cement mixture and method of control.

- Description of the compactors (i.e., rollers) proposed for use

- Description of the proposed methods of placement and protection in hot or cold weather conditions.

- Mill certifications for cement.

- Plan detailing methods to cure permanently exposed surfaces.

- Detailed plan and schedule for constructing the soil-cement layer, including, but not be limited to, showing the number of separate concurrent placement areas, area or length of sections to be placed prior to starting construction, and proposed work schedule, i.e., hours per day and days per week.

SPECIFICATIONS

SECTION 17
SEEDING AND MULCHING

RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

17.1 General

Seeding and mulching shall be completed on all designated and disturbed soil covered areas, including outside perimeter dike slopes, laydown areas, and other areas disturbed by the Contractor, within 30 days after completion of grading activities. All seeding operations shall be performed in accordance with these Specifications.

Seeding operations, including fertilizing, seeding, and mulching, will not be permitted when wind velocities exceed 15 miles per hour. Seed shall be sown only when the soil is moist and in proper condition to induce growth. No seeding shall be done when the ground is unduly wet or otherwise not in a tillable condition.

The Contractor shall be responsible for furnishing all labor, material, and equipment required to perform seeding and mulching activities, including ground preparation, placement of approved seed, mulching, and spreading of approved commercial fertilizer.

17.2 Ground Preparation and Fertilizer Application

All operations in connection with grassing shall be performed as soon as practicable after finish grade has been established. Prior to grading and tillage operations, the ground surface shall be cleared of all heavy vegetation, roots, rubbish, grade stakes, and other material which might hinder proper grading, tillage, or subsequent maintenance operations. Grades on areas to be seeded shall be maintained in a true and even condition, preventing the formation of depressions where water will stand.

The ground over which the seed is to be sown shall be prepared by disk harrowing and thoroughly pulverizing the soil to a depth of 6 inches. The prepared soil shall be loose and reasonably smooth. Harrows will not be allowed.

Fertilizer shall be spread uniformly over all areas to be seeded. A commercial fertilizer satisfying the requirements of Section 982 of the Standard Specifications for Road and Bridge Construction, Florida Department of Transportation, latest revision, or as specified by the Owner, shall be used and spread at a rate of 500 pounds per acre or as specified by the Owner. The device for spreading fertilizer shall be capable of uniformly distributing the material at the specified rate. Immediately after the fertilizer is spread, it shall be mixed into the soil, to a depth of approximately 6 inches.

17.3 Seeding

While the soil is still loose, the seed shall be distributed uniformly over the grassing area and immediately mixed into the seedbed to a depth of one-half inch. The seed spreader shall be an approved mechanical type of spreader. Seed shall be sown only when the soil is moist, but not too wet and in proper condition to induce growth. The Contractor shall water the surface, if needed, prior to seeding.

Permanent type grass seed shall be 30 pounds of common Bermuda seed and 50 pounds of Pensacola bahia seed per acre. Quick-growing type grass seed, such as rye or millet, shall be a species that will provide an early ground cover during the particular season when planting is done and will not later compete with permanent grass. The rate of sowing quick-growing grass seed shall be 50 pounds per acre. The separate types of seed used shall be thoroughly dry-mixed immediately before sowing. Seed that has become wet shall not be used.

All seed shall meet the requirements of the Florida Department of Agriculture and Consumer Services and all applicable State laws, and shall be approved by the Engineer before being sown. The seed shall have been harvested from the previous year's crop.

Each of the species or varieties of seed shall be furnished and delivered to the site in separate labeled bags. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents, and other causes. All permanent and temporary grass seed shall have been tested within a period of six months of the date of planting, and shall have a minimum percent of purity and germination as follows:

- Bahia grass seed shall have a minimum pure seed content of 98 percent with a minimum total germination of 85 percent.

- Bermuda grass seed shall be of common variety with a minimum pure seed content of 95 percent with a minimum total germination of 85 percent.

- Annual quick growing Rye grass seed (for planting between September 1 and January 31) shall have a minimum pure seed content of 95 percent with a minimum total germination of 90 percent.

- Quick-growing Millet seed (for planting between March 16 and August 31) shall be of the Brown Top variety with an minimum pure seed content of 90 percent with a minimum total germination of 85 percent.

17.4 Mulching

Two tons per acre of dry hay mulch material satisfying the requirements of Section 981 of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction shall be applied uniformly over the seeded area, and the mulch material cut into the soil. The mulching equipment shall be of a type capable of cutting the specified materials uniformly into the soil and to the required depth. Care shall be exercised that the materials are not cut too deeply into the soil. Only undeteriorated mulch that can be readily cut into the soil shall be used.

Immediately after completion of the seeding and mulching, the area shall be rolled thoroughly with a cultipacker or other equipment approved by the Engineer. At least two trips over the entire area will be required. The mulch shall be anchored to the ground as needed to minimize loss by wind and rain, by a V-type wheel land packer or similar equipment, and in accordance with Section 570 of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

17.5 Watering

Newly seeded areas shall be watered as required to prevent the grass from drying out, and to maintain the necessary soil moisture for a period of 60 days following planting or as otherwise approved by the Owner. The moistened condition shall extend to the full depth of the rooting zone. All seeded areas shall be watered, as needed and directed by the Owner, and maintained by the Contractor for a period of 60 days following planting until final acceptance of the work by the Owner. The irrigation water shall be obtained from locations designated by the Owner.

SPECIFICATIONS

SECTION 18
SITE LIMITATIONS

RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

18.1 Owner's Activities and Other Construction

Landfilling of waste materials hauling, limestone loading and unloading and other operation activities by the Owner are expected to occur around the areas of the Recycle Pond Expansion, Sedimentation Pond, Coal Storage Area Runoff Pond, modified Recycle Pond throughout the period of construction. The Owner will designate an access road to the construction area. All activities of the Contractor must be coordinated with the Owner to avoid conflicts with the Owner's activities.

Construction activities by other Contractor may be ongoing throughout the period of construction as part of other projects. The activities of the Contractor must be coordinated with the Owner to avoid conflicts with other contractors.

18.2 Existing Facilities

Any damage to existing facilities by the Contractor shall be repaired by the Contractor at his expense and as directed by the Owner.

SPECIFICATIONS

SECTION 19
GENERAL PROVISIONS

**RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS**

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

This Specification presents general provisions covering work performed for Recycle Pond Expansion, Sedimentation Pond, Coal Storage Area Runoff Pond, modified Recycle Pond at the OUC Stanton Energy Center.

19.1 General

19.1.1 Scheduling and Coordination

The Contractor shall keep the Owner informed, a reasonable time in advance, of the times and places at which he intends to do work. All work shall be scheduled and coordinated with the Owner as outlined in Section 21 of these Specifications.

19.1.2 Monthly Submittal of Worked Man-Hours

The Contractor shall keep records of the hours worked during each month. A report summarizing all work hours must be submitted to the OUC Project Manager by the third work day of the month.

19.1.3 Inspection and Sampling of Materials

All materials furnished by the Contractor shall be subject to the examination and approval of the of the Owner or the Engineer at all times during the progress of the work until completion of the project. As soon as the materials are examined and/or tested and approved, the Contractor shall immediately remove all rejected materials from the work to a point such distance there from as the Owner may require. No material shall be used before being examined and/ or tested and approved by the Owner or the Engineer. Failure on the part of the Owner, or the Engineer, to condemn or reject inferior materials or work shall not be construed to imply an

acceptance of the same should their inferiority become evident at any time prior to final acceptance of the work.

The Contractor shall make necessary arrangements so that the Engineer may secure sample specimens of materials on the job for testing to ascertain whether materials included, or to be included, in the work meet the requirements of the Specifications.

19.1.4 Access to Work

The Owner and Engineer shall have free access to the work at all times. The Contractor shall furnish the owner and the engineer with tools, equipment, labor and samples, as needed, for ascertaining whether the work being performed, or the work which has been completed, is in accordance with the requirements of the Specifications, even to the extent of uncovering, testing, or removing portions of finished work, if such is necessary.

19.1.5 Suspension of Work

The Owner may order the Contractor to suspend any or all work that may be affected, damaged, or endangered by climatic conditions. Further, the Owner may suspend any work at any time when acceptable results as defined in the Specifications cannot be obtained due to inclement weather or other unsatisfactory field conditions.

19.1.6 Utilities and Contractors Facilities

Utilities may not be available at the project locations. Utilities, electricity and fuel as may be required for construction and other purposes shall be secured and purchased by the Contractor. The Owner will make space available for Contractor's facilities for storage and for trailers. Fresh water (for non-potable use) shall be provided at a location selected by the Owner.

19.2 Drawings and Specifications

The Drawings and Specifications are intended to be coordinated. Anything shown on the Drawings but not mentioned in the Specifications, or vice-versa, or anything not expressly set forth in either, but which is reasonably implied, shall be furnished as though specifically shown and mentioned in both without any extra charge. Should anything be omitted from the Drawings, which is the subject of the Contract between the Owner and the Contractor, it shall be the duty of the Contractor so to notify the Owner before signing the Contract. The Contractor shall furnish such detailed plans and drawings as may be required for the execution of the work and which are not included in the Drawings furnished by the Engineer on behalf of the Owner; these shall include shop details.

Shop drawings for the compacted soil subbase, the HDPE geomembrane liner, and the geocomposite drainage products shall be prepared and submitted to the Engineer at least 2 weeks prior to installation, for approval. Shop drawings prepared by a subcontractor or supplier shall first be checked by the Contractor for compliance with the Specifications, and shall be initialed by the Contractor, prior to submittal to the Engineer for review and approval.

The Contractor shall submit all drawings and schedules with the supporting information sufficiently in advance of construction activities to allow ample time for engineer's review, recommendations and changes if any; applying the recommendations and changes of the

engineer and resubmitting them before final approval. No claim by the Contractor for delays, arising from his failure in this respect, shall be allowed.

All drawings submitted by the Contractor must bear the stamp of approval by the Contractor as evidence that the drawings have been checked by the Contractor. The approval by the Engineer of drawings submitted by the Contractor shall be only for conformance with the design of the project and shall not relieve the Contractor from the responsibility for adherence to the Contract, nor shall it relieve him of the responsibility for any error, which may exist.

19.3 Engineering Data

The background information provided on the Drawings is for informational purposes only, and the data should be reviewed in conjunction with the notes on the Drawings.

The Contractor must form his own opinion of the character of the work and of the waste materials, and must satisfy himself with his own investigations, explorations, tests or studies, of the conditions affecting the work to be done. The Contractor must assume all responsibility for deductions and conclusions as to the nature or condition of the in-place ash, soil, borrow materials, subsurface water conditions, the difficulties of making and maintaining the work area dewatered, and doing any work affected by the existing conditions in the Recycle Pond Expansion area and existing lined ponds areas.

19.4 Right to Change Location and Drawings

When additional information regarding the topography, subsurface, or other conditions becomes available from excavation, testing, data, or other work, the Engineer may find it desirable to change alignment, dimensions, or design of a portion of the work to conform to the newly disclosed conditions. Toward this end, the Owner reserves the right to make any such reasonable changes and the Contractor's operations shall be conducted to accommodate reasonable changes without additional expense.

19.5 As-Built Drawings

The Contractor shall maintain one set of prints of drawings issued for construction on the job site at all times for the preparation of As-Built Drawings. This set will be in addition to any sets needed and used in the actual construction operation. The As-Built Drawings are to be kept up to date by the Contractor, as approved by the Owner, on a daily basis. The plans shall show the actual as-built condition. As-built Drawings shall be submitted to the Owner upon final acceptance of the work.

SPECIFICATIONS

SECTION 20
FINAL INSPECTION AND ACCEPTANCE

RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

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20.1 Final Inspection

Upon completing all clean-up operations, the Contractor shall advise the Owner he is ready for final inspection. The Owner will then set a specific date and time for the final inspection. The Owner, Engineer and Contractor will jointly inspect the project area to verify that all work has been completed in accordance with the Drawings and Specifications. Any work found lacking in any way should be corrected by the Contractor and reinspected.

20.2 Letter of Acceptance

The Owner will issue a Letter of Acceptance for the work to the Contractor once all work has been satisfactorily completed and inspected. Final payment can be requested by the Contractor after receipt of the Letter of Acceptance.

20.3 Material and Workmanship Warranties

Warranties for HDPE liner, geosynthetic drainage net, and soil subbase material and workmanship shall take effect from the date of the Letter of Acceptance for the liner from the Owner.

SPECIFICATIONS

SECTION 21
SCHEDULING AND COORDINATION

RECYCLE POND EXPANSION AND
EXISTING LINED PONDS MODIFICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

All scheduling and coordination of the work shall be undertaken through the OUC Project Manager.

21.1 Pre-Construction Coordination Meeting

There will be at least one coordination meeting with the Contractor and subcontractors, the Engineer, and the Owner before construction begins.

Each contractor shall submit a construction schedule to the Owner at the first coordination meeting. The schedule shall be in the form of a bar chart showing all construction activities, and shall be updated weekly and provided to the Owner as the work progresses. Each contractor shall also designate a project manager at the first coordination meeting. Each contractor's designated site supervisor shall also attend the coordination meeting.

21.2 Correspondence with Owner

All correspondence with the Owner shall be directed to the following address:

Mailing Address:	Orlando Utility Commission Stanton Energy Center 5100 Alafaya Trail Orlando, FL 32831-2005
Attention:	Mr. Charlie Doud, P.E.
Telephone:	407-434-4289 (office); 407-719-6055 (cell)
E-mail:	cdoud@ouc.com

21.3 Correspondence with Engineer

All questions and correspondence regarding the Drawings and Specifications shall be directed to the Engineer, Ardaman & Associates, Inc., at the following address:

Mailing Address:	Ardaman & Associates, Inc. 8008 South Orange Avenue Orlando, Florida 32809
Attention:	Mr. Mohamad Al-hawaree, P.E.
Telephone:	407-855-3860 (office)
Fax:	407-859-8121
E-mail:	mal-hawaree@ardaman.com

21.4 Coordination with Other Contractors and Suppliers

Construction by other contractors may be ongoing through the period of construction. The schedule and activities of each contractor shall be approved by and coordinated with the Owner to avoid conflicts with other contractors. No contractor will be allowed additional payment for any delays in his work not coordinated through and approved by the Owner.