

August 28, 2009

093-82538

Mr. Michael Shrader
Lead Environmental Specialist
Progress Energy Florida
299 1st Avenue North
PEF 903
St. Petersburg, FL 33701

**RE: RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION ON
CRYSTAL RIVER PLANT UNITS 4 AND 5
FGD BLOWDOWN PONDS
SITE CERTIFICATION MODIFICATION N**

Dear Mr. Shrader:

Golder Associates Inc. (Golder), with input from Progress Energy Florida (PEF) has prepared the following responses to the request for additional information (RAI) from the Florida Department of Environmental Protection (FDEP) dated July 24, 2009. The numbering of the responses corresponds to the numbers in the RAI:

SOLID WASTE SECTION

1. In accordance with standard engineering practice, impoundments are required to be constructed with an emergency spillway for safety reasons. Additionally, any overtopping of the emergency spillway will flow into a previously permitted waste water treatment area, and thus meets the performance criteria.
2. In accordance with the Crystal River Energy Complex's Industrial Wastewater Permit Number FLA01690, issued January 9, 2007, groundwater monitoring data for the parameters listed in the permit are reported to the Department in accordance with the monitoring requirements contained in this permit. The former unlined north ash pond is part of the IWW permit and groundwater monitoring activities. Groundwater data has been reported to the Department during the time period when the unlined north ash pond was active and groundwater data continues to be reported though the pond has been inactive for years. This pond has been managed under the IWW permit as an industrial wastewater pond, not a solid waste management unit because of the ponds' function and purpose.

In preparation for conversion of the inactive unlined north ash pond to lined pond systems that will serve the flue gas desulfurization (FGD) scrubber, remaining ash material has been removed, thereby allowing for the voluntary installation of a liner system. The voluntary removal of ash material is complete. Ash material was removed so that the industrial waste water pond can be designed and configured as new FGD blowdown ponds for the collection of the FGD blowdown effluent. Liners are not required for these IWW ponds because they don't function as solid waste management units.

PEF contends that no additional plan for assessing impacts to groundwater in this area from historic ash management practices is necessary because the facility continues to assess groundwater in accordance with the FDEP approved groundwater monitoring plan and IWW permit conditions.

In addition, in March 2008, PEF submitted a characterization report for coal combustion products and other solid materials to the Department that included comprehensive sampling and analysis of the former north ash pond ash material before all the ash material in this pond was removed.

Based on PEF's compliance with the monitoring requirements contained in the IWW permit, the characterization of ash material as captured in the March 2008 characterization report, removal of existing solids from the inactive pond subsequent to sampling and analysis of the material for the Characterization Report, and voluntarily redesigning the pond to include liners, PEF believes a comprehensive assessment of this area is complete while groundwater monitoring continues to occur in accordance with the IWW permit requirements.

3. The following provides a more detailed description of the FGD Blowdown Ponds, along with the operation and maintenance procedures to be implemented. The information below will be incorporated into the Coal Combustion Product/Solid Waste Management Manual as appropriate.

FGD BLOWDOWN (SETTLING) PONDS DESCRIPTION

The blowdown from the FGD system will be pumped to one of two lined settling ponds (the Primary Pond and the Backup Pond) to allow the removal of the suspended solids from the waste stream. The Primary Pond will be the main location to which blowdown will be pumped, with the Backup Pond being available during cleanout or maintenance of the Primary Pond. Overflow effluent from the FGD blowdown ponds will flow into a manhole to be pumped to the existing south plant percolation ponds. The FGD blowdown ponds are lined with a 60-mil thick, linear low density polyethylene (LLDPE) liner. The pond berms are constructed of compacted soils with a top of berm elevation of 116.0 feet and 3 horizontal to 1 vertical (3H:1V) side slopes. The bottom of the Primary FGD blowdown pond is at elevation 94.0 feet; the bottom of the Backup Pond is at elevation 100 feet (site datum). An emergency spillway is located on the western side of the Primary Pond and will be constructed at elevation 112.0 feet.¹ Two (2) 12-inch diameter HDPE pipes are located between the two ponds and serve as an overflow outlet for the Backup Pond, to allow the Backup Pond to overflow into the Primary Pond, if necessary. The pipe invert elevations in the Backup Pond are at 113 feet and the invert elevation in the Primary Pond is at 112.0 feet.

The FGD blowdown will be pumped from the FGD system via fiberglass reinforced plastic (FRP) and ties in to the inlet piping at the FGD Blowdown Ponds. FGD blowdown flows into the FGD blowdown ponds through a HDPE inlet piping system that will enter the Primary Pond at four different locations; there is only one inlet location for the Backup Pond based on the limited service requirements anticipated. The inlet piping controls the direction of flow and inlet discharge location via valves and wyes installed inside a series of concrete vaults. Cleanouts are also provided in each vault to allow access to the inlet piping at critical locations. The wye sections allow flow in two directions. Each leg of the wye has a valve to close or open the section of wye in which flow is desired or cut off. The inlet flow either goes to the east or west side of the Primary Pond - there are two inlet pipes on each side. A vault is at each location at which an inlet pipe is installed to discharge into the pond. Each vault at these locations includes a wye to direct flow to the pond, valves to direct the flow to only one inlet pipe, and a cleanout.

¹ Discharge from the spillway will not occur under normal operating conditions. When discharge over the spillway occurs it will still be retained within the boundaries of the originally permitted pond.

The pond's outlet is located near the southwest corner of the Primary Pond and consists of an overflow pipe leading to a concrete manhole equipped with pumps and controls. An overflow pipe is also installed on the south side of the Backup Pond that gravity-flows to the manhole at the southwest corner of the Primary Pond. The overflow pipe for both ponds is set at elevation 111.24 feet which, under normal operating conditions, will be the normal pool elevation for the ponds. However, because the Backup Pond is only operated when the Primary Pond requires service, both outlets will not be flowing into the manhole simultaneously. Pumps remove the liquid from the manhole to outlet piping extends to the south percolation pond. The pumps in the manhole are controlled by liquid level sensors that are linked to a motor control center (MCC) that is set to the appropriate levels to maintain the pond at the desired level. The MCC readings are transmitted to the main plant for continuous evaluation of the operation. Additionally, the flow from the pumps is measured using a flow meter installed on the outlet piping outside the manhole.

Final grading for the exterior of the FGD Blowdown Ponds includes slopes that directs all surface water to the west end of the former ash pond. Surface water drainage from the outside slopes and to the east of the Backup Pond is routed to the south and west through a 30-inch diameter corrugated plastic pipe (CPP) culvert located at the southeast portion of the Primary Pond berm. Run-off from the outside slopes of the Primary Pond and from the area east of the Backup Pond (through the culvert) continues to the west until approximately 200 feet west of the base of the Primary Pond slope such that no stormwater is allowed to stand near the FGD Blowdown Ponds. The outlet for surface water for the FGD Ponds is the existing NPDES permitted overflow weir at the northwest corner of the area. Although there is an outlet for the flow, the intent of the design is to contain all the water from the 25-year, 24-hour storm within the former ash pond without discharging from the overflow weir.

FGD BLOWDOWN POND OPERATION

As described above, the blowdown from the FGD system will be pumped to the FGD blowdown Primary Pond or the Backup Pond via five outlet/discharge locations. The various locations for the inlet piping are provided to account for the anticipated settling characteristics of the blowdown. The various inlet locations allow the material to be distributed around the inlet end (north end) of the ponds more evenly. This will allow more time between required removal of solids from the bottom of the pond. The top of the sludge storage zone for both the Primary and Backup Ponds is elevation 105.0 feet. The elevations of the Primary Pond structure result in the following operational depths for the material in the Primary Pond:

- Freeboard: 4 feet (minimum before berm overtopping)
- Water depth: 17.24 feet (minimum)/18.0 feet (maximum w/o utilizing spillway)
- Sludge Depth: 11 feet (maximum)
- Water Column: 6.24 feet (minimum)

Based on the above, the estimated total pond storage volume at the overflow inlet of the Primary Pond is 1,982,600 cubic feet, or 45.5 acre-feet, or 14.8 million gallons.

Similarly, the Backup Pond has the following operational depths:

- Freeboard: 3 feet
- Water depth: 11.24 feet (minimum)/13.0 feet (maximum w/o utilizing overflow pipes)
- Sludge Depth: 5 feet (maximum)
- Water Column: 6.24 feet (minimum)

Based on these depths, the estimated total pond storage volume at the overflow inlet of the Backup Pond is approximately 400,300 cubic feet, or 9.2 acre-feet, or 3 million gallons.

Based on information provided by PEF, the following are the expected FGD blowdown characteristics:

- Influent Flow Rate of 300 gpm
- Chloride (Cl) concentrations of 20,000 to 25,000 mg/l (40,000 mg/l maximum)
- Total Suspended Solids (TSS) concentrations of 6,000 mg/l average; 20,000 mg/l peak
- pH will be approximately 7.0 to 7.5
- Maximum temperature of 140 degrees Fahrenheit

Given these characteristics, the FGD blowdown ponds are designed settle the solids out such that the TSS in the outflow will be less than 40 mg/l under average operating conditions (i.e., incoming TSS of 6,000 mg/l).

FGD BLOWDOWN POND MAINTENANCE

General maintenance of the FGD Blowdown Ponds includes routine redistribution of the FGD blowdown via the various inlet pipe locations. A schedule for changing the inlet location should be developed once the settling characteristics of the blowdown material have been evaluated; the goal is to allow even distribution of the blowdown material across the pond so that storage capacity is optimized. Maintenance of the inlet piping includes clean-out of the lines upon changing of the inlet location, i.e., inlet lines should be flushed with water via the cleanouts for any pipe length that could contain blowdown material and will not be in the flow path once changed. The outlet overflow pipes in each of the ponds are fitted with an anti-vortex device and trash rack that will require routine maintenance including removal of trash (expected to be leaves and other wind-blown debris) as it accumulates on the trash rack or gets through the trash rack and into the anti-vortex device. The build-up of debris or blowdown material in the base of the outlet manhole will also need to be monitored and cleaned as necessary. Other maintenance for the FGD Blowdown Ponds includes maintenance of the pumps, level switches, valves, meters, motor control center, and other appurtenances associated with the outlet manhole and outlet pumping system that should be performed per the manufacturer's recommendations.

Prior to the build-up of blowdown material to the maximum level in either pond, the material should be removed. The removal of the material includes taking the pond to be cleaned (typically the Primary Pond) out-of-service by redistributing the inlet flow into the other pond (typically Backup Pond). Once the pond is out of service, the blowdown liquid on top of the solids will be pumped out to a level as close as possible to the top of the solids. In preparation for solids removal, PEF will seek out qualified contractors to perform the solids removal. One of the primary requirements of the contractor will be the ability of the contractor to remove the solids without damaging the liner. At this time it is anticipated that the solids will be removed using hydraulic dredging (suction only) equipped such that the suction head will not damage the liner. Other technologies could be utilized as appropriate; however, the ultimate objective is to utilize a method that can remove the solids without jeopardizing the integrity of the liner.

4. Attachment A to these responses includes Technical Specifications for the Outlet Manhole components, as listed below:
 - 02605 Precast Vault Boxes and Pump Vault (Rev. 0)
 - 09980 Concrete and Masonry Coatings (Rev. 0)
 - 15250 Pumps and Pumping Systems (Rev. 0)
5. Section 01010 Summary of Work, Part 1.01 E has been revised to provide an accurate list of the drawings provided for the modification package. Attachment B to these responses includes the revised Section 01010.
6. Regarding the use of compaction grouting for repair of sinkholes formed during construction of the ponds (possible during vibratory rolling efforts), this is not considered a viable option. Compaction grouting is generally used to strengthen soft soils and/or fill small voids beneath the surface (i.e., having some degree of confinement) using pressure to distribute the grout into the existing formation. If a sinkhole opens up to the surface, or if evidence of subsidence is identified, the soft or loose material will be excavated in the area so that the extent of the sinkhole is clearly defined. Under these conditions, grouting under pressure is not possible as there is no confinement. The use of #57 stone is specified to fill the majority of the opening and provide a stable base for the pond liner construction. Please note that the specification requires that a filter geotextile be installed on top of the stone and then soil be installed and compacted above the filter geotextile to provide a smooth surface for the reinforcing geotextile placement (which provides additional subgrade support for the pond liner). This approach is considered appropriate for sinkhole repair; therefore no changes to the text will be made.
7. Section 02770 LLDPE Geomembrane Liner has been revised where appropriate per the below discussion. Attachment B to these responses includes the revised Section 02770.
 - a) Part 1.1.B. has been revised to show the material will be textured on both sides.
 - b) Part 3.02.D has been revised to include minimum overlaps.
 - c) Part 3.02.K.2. and 3.02.K.5 have been corrected with the appropriate references.
 - d) Part 3.02.K.3 has been corrected with the appropriate reference.
 - e) Although the CQA Plan discusses spark testing, as discussed in the specifications, the pipe boots will be pre-manufactured and certified by the manufacturer that the boot has been spark tested at the manufacturing facility. The boot attachment in the field will only include welding the boot skirt to the liner, which can be vacuum tested. Therefore, no spark testing will be required.
 - f) The Table in Attachment B of this specification has been revised to show a minimum peel strength requirement of 75 lb/in.
8. The comments on specific portions of Section 13080 Reinforcing Geotextile are addressed below; no revision is made to the specification based on these comments.
 - a) Drawings 5A and 5B provide the proposed panel layout for the reinforcing geotextile lower and upper layers, respectively. These drawings are included in Attachment C to these responses.
 - b) A shingle style lap seam refers to the installation of the material with a 1-foot overlap between panels that are placed with the direction of the overlap consistent from one panel to the next, i.e., the first panel installed is overlapped by the second panel and the third panel overlaps the second panel, and so on.

9. In Section 5.4 of the CQA Plan, it states that each geosynthetic material will be tested in accordance with the methods detailed in the appropriate sections of the project requirements. Technical Specification 02770 has been revised to include conformance testing, including interface shear testing of the geomembrane/soil interface. The revised specification is included in Attachment B. Interface shear testing has been completed on reinforcing geotextile (similar to that specified herein) and soils from the site and the results indicate that the friction angle is over 39 degrees. Attachment D includes the laboratory test results. Based on the changes made to the specifications and the above reference in the CQA Plan, the CQA Plan has not been revised based on these comments.
10. The CQA Plan has been revised to reflect the appropriate references and is included in Attachment E to these responses.
11. Based on our response to comment #1, we have not revised the drawings.
12. Boring logs for borings G-20 through G-25 are included in Attachment F to these responses. Drawing 4 has been revised to show the actual locations of these borings and the additional compaction grouting locations and is also included in Attachment C to these responses.
13. Drawing 6 has been revised to remove the "vault by others" as a vault will not be required at this location. The coordinates for the tie-in location are correct and the two pipes will be joined at this location. This drawing is included in Attachment C to these responses².
14. Drawing 7 has been revised to show the appropriate anchor trench references for each end of each cross section. This drawing is included in Attachment C to these responses³.
15. The following provide responses to the referenced details on Drawing 10; no revision was made to this drawing based on these comments.
 - a) Refer to the response to number 3 above.
 - b) The detail accurately depicts the reinforcing geotextile configuration where the east-west or north-south running panels are not anchored on the north/south or east/west, respectively. The reasoning behind not anchoring the material on the sides of the end panels is that the reinforcing characteristics intended to be required for this project are only in the machine direction (not the cross direction), thus anchoring for the purposes of tensioning the fabric in the cross direction is not necessary.
16. The HCT (Helper Cooling Tower Sump) is part of the original installation of the Helper Cooling Towers. The HCT is an unmanned site so sink and floor drains see very little flow. This sump receives intermittent low flow, low volume waste effluent from an oil water separator which receives waste water from the following:
 - Two transformer oil containment basins at the electrical services building
 - Sink and floor drains from the east and west analyzer buildings

² It is noted that revisions in addition to the removal of the vault have been included on Drawing 6. The other revision comprises including the existing conveyor on the east side of the FGD Ponds as well as a limerock road adjacent to the conveyor to be constructed by the Contractor. Drawing 8 also includes these revisions and has been included in Attachment C as it is utilized for revised calculations (see responses #1 and #3 under Environmental Resource Permitting).

³ See footnote 2 – Drawings 7 and 8 are revised accordingly.

- Sink and floor drains from the electrical services building
 - Floor drains from the water treatment building (out of service)
 - Condensate water from the service air line
 - Drain from the open pump vault directly south of the HCT
17. The leakage rate estimates are sensitive to the assumed hole size. Using a less conservative effective hole size of 0.1 sq.cm. (0.0155 sq. in.) as referenced in www.landfilldesign.com (after Giroud et al., 1994) the leakage rate previously calculated at 21,540 gallons/day is significantly reduced. Additionally, a 1-foot thick subgrade with a permeability of 5.8×10^{-4} cm/sec will be beneath the liner and, when this layer is factored in, the estimated leakage rate is further reduced (to a total of approximately 4,937 gallons/day). Revised calculations are included in Attachment G.
18. The following provide responses to the Anchor Trench Calculations – Reinforcing Geotextile questions.
- a) The original calculations were intended to be representative of the worst-case for determining the depth of the anchor trench. However, based on a review of the various conditions, the calculations have been revised to represent the expected conditions for geotextile anchored on the floor and on the slope. The revised calculations are provided in Attachment H.
 - b) To reflect the revised calculations as discussed in a. above, Details 8 and 9 have been revised. The revised Drawing 10 is included in Attachment C.

ENVIRONMENTAL RESOURCE PERMITTING

1. The 30" culvert is designed to convey stormwater runoff from the area within the former ash pond basin east of the east FGD pond to the western portion of the site. The contributing area and flow path are shown in the revised "FGD Pond Culvert" calculation package (Attachment I). Final grading for the area is shown in "FGD Blowdown Pond Final Grading Plan" (Drawing 8) which is included in Attachment C (with revisions as noted in footnote 3). There are no impervious surfaces within the contributing area, however, in the calculation package the entire area was assumed to be impervious to conservatively estimate the stormwater runoff and culvert size.
2. PEF believes that the ERP rules do not apply to this area. Stormwater will be contained within the confines of the existing pond area. If an emergency occurs, a discharge from the area can occur via two control weirs and ultimately through an existing NPDES permitted (FL0000159) monitored outfall D-0C1 to the site discharge canal. See the aerial included in Attachment J.
3. The FGD blowdown ponds are to be constructed within the limits of the former North Ash Pond. No modifications to the exterior of the perimeter berm side slopes is to be performed, thereby there will be no changes to stormwater runoff from the external side slopes of the perimeter berm surrounding the former ash pond basin. Stormwater calculations for non-contact water within the former ash pond basin are included in this response to comments (Attachment K). The calculations show that stormwater from within the former north ash pond basin will not discharge for 25-year, 24-hour and 100-year, 24-hour storm events, therefore the existing basin area and weir are capable of managing runoff and staging for these storm events.
4. PEF believes that the ERP rules do not apply to this area. Included in Attachment L is a Stormwater Management System Operations and Maintenance Plan that will apply to this area.

5. The peak flow was determined from the 100-year, 24-hour design storm hydrograph. The peak flow in the culvert sizing sheet has been revised to 16 cfs in the revised FGD Pond Culvert calculation package (Attachment K).
6. Please see Attachment J for the aerial photograph of the pond area.

INDUSTRIAL WASTE WATER PROGRAM

1. The following provide responses to the questions on Section 13100 Compaction Grouting in the technical specifications.
 - a) The grout for the compaction grouting component of the work will be mixed off-site by a supplier. Grout that requires rejection will be sent off site for disposal; no disposal will be performed on-site. Regarding pounds per load, the specifications required that the grout meet strength characteristics and did not require specific pounds per load; the supplier was tasked with developing the mix proportions to meet the required strength.
 - b) No mixing equipment is required to be on-site.
 - c) No dewatering will be required during the compaction grouting program.
2. There will be water required to perform hydrostatic testing on the piping to be installed as part of the FGD Ponds, both inlet and outlet. The source of water to be used will be treated plant service water. The water used for the testing will be discharged either to the lined FGD Ponds (which will help provide ballast for the liner, if needed prior to operations) or the percolation pond, as appropriate. Regarding testing procedures, specification 15410 has been revised to include the above information (source and disposal of test water) and additional clarification on the procedures to be used. The revised specification is included in Attachment B.

Based on a site inspection performed by FDEP on Monday, August 10, 2009, FDEP requested that PEF provide proposed additional monitoring well(s) to be installed to monitor the FGD Ponds and former ash pond area. Attachment M includes a figure that shows the existing monitoring wells that currently monitor this area and a proposed location for a new intermediate monitoring well. As shown, there are two existing monitoring wells that currently monitor the former ash pond area – MWC-28 and MWC-16. PEF considers the downgradient compliance well MWC-16 to be adequate for monitoring the former ash pond area. The proposed monitoring well, shown located along the south berm of the former ash pond, has been positioned to provide an intermediate monitoring point for the to-be-constructed lined FGD Ponds. It is noted that the groundwater flow direction is generally southwest in this area of the site, so the well will be located downgradient, i.e., southwest, of the FGD Ponds. The new intermediate monitoring well will be installed to the same depth interval and have the same screened interval as the existing monitoring wells for this area (approximately 20 feet deep, 10-foot screen length).

PEF and Golder have prepared the above responses to FDEP RAIs based on our understanding of the RAIs and the intent of the design. If there are any questions on the information provided herein, please contact Mr. Michael Shrader with PEF at 727-820-5588 or either of the undersigned.

GOLDER ASSOCIATES INC.

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Senior Consultant and Principal

Kenneth B. Karably, P.E., P.G.
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cc: Mike Halpin, FDEP – Siting Coordination Office
Danny Stubbs, FDEP – Southwest District Office

Attachments or Enclosures:

Attachment A	Outlet Manhole Specifications
Attachment B	Revised Specifications
Attachment C	Revised Drawings
Attachment D	Reinforcing Geotextile Laboratory Test Results
Attachment E	Revised CQA Plan
Attachment F	Boring Logs G-20 through G-25
Attachment G	Revised Leakage Rate Calculations
Attachment H	Anchor Trench Calculations - Reinforcing Geotextile
Attachment I	FGD Pond Culvert Calculations
Attachment J	Aerial Photograph of Former Ash Pond Limits
Attachment K	Non-Contact Surface Water Calculations - FGD Basin
Attachment L	Stormwater Management System Operations and Maintenance Plan
Attachment M	Proposed Monitoring Well Location

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ATTACHMENT A
OUTLET MANHOLE SPECIFICATIONS

SECTION 02605

PRECAST VAULT BOXES AND PUMP VAULT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The **CONTRACTOR** shall furnish all labor, materials, equipment, tools and appurtenances required to complete the work of furnishing and installing precast concrete pump vault and valve boxes as described herein and/or as shown, specified, and as otherwise required by the Contract Documents.
- B. The **CONTRACTOR** shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, State or Federal authorities having jurisdiction. The **CONTRACTOR** shall provide a "Competent Person" to implement, supervise, and inspect the Work.

1.02 DESIGN REQUIREMENTS

- A. Pump vault and valve boxes shall be constructed of specified materials to the sizes, shapes and dimensions and at the locations shown on the Drawings or as otherwise directed by the **ENGINEER**. The height or depth of valve boxes will vary with the location.

1.03 SUBMITTALS

- A. The **CONTRACTOR** shall submit to the **ENGINEER** Shop Drawings and engineering data on frames, covers, grates, steps and precast pump vault and valve boxes sections.
- B. The **CONTRACTOR** shall submit to the **ENGINEER** for favorable review, standard (typical) details showing joints and seals between precast pump vault riser sections and pipes, valve box and pipes, other manholes/vault walls, or concrete materials.

1.04 QUALITY ASSURANCE

- A. Prior to delivery, all basic materials specified herein shall be tested and inspected by an approved independent commercial testing laboratory or, if approved by the **ENGINEER**, certified copies of test reports prepared by the manufacturer's testing laboratory will be acceptable. Provide test results and certification from the supplier that the products meet the requirements of these Specifications. All materials which fail to conform to these Specifications shall be rejected.
- B. Upon delivery to the Site, the **OWNER**, or its representative, and the **ENGINEER** shall inspect pump vault and valve boxes, including coverage of interior and exterior coating systems. Any materials which have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected, removed from the Site, and replaced with suitable materials at the **CONTRACTOR's** own expense.

- C. The precast manufacturer is required to have 10 years successful experience in the fabrication of concrete manholes, tanks, vaults and boxes similar to this project.

PART 2 - PRODUCTS

2.01 MATERIALS AND CONSTRUCTION

- A. Concrete and Reinforcement:
 - 1. Concrete used in pump vault and valve boxes construction shall be Class A concrete.
 - 2. Steel reinforcement shall conform to the requirements of ASTM A615 and A185.
- B. Mortar: Mortar for precast construction shall be sand-cement mortar composed of one (1) part Portland cement to two (2) parts clean sand conforming to ASTM C144.
- C. Precast Concrete Pump Vault:
 - 1. Precast concrete pump vault shall consist of precast reinforced concrete sections, a flat slab top section, and a base section.
 - 2. Precast manhole sections shall be manufactured, tested and marked in accordance with the latest provisions of ASTM C478.
 - 3. The minimum 28-day compressive strength of the concrete for all sections shall be 4,000 psi.
 - 4. The maximum allowable absorption of the concrete shall not exceed eight percent of the dry weight.
 - 5. The circumferential reinforcement in the riser sections and base wall sections shall consist of one line of steel and shall be not less than 0.17 square inch per lineal foot.
 - 6. The ends of each reinforced concrete manhole riser section and the bottom end of the manhole top section shall be so formed that when the manhole risers and the top are assembled, they will make a continuous, uniform and water tight pump vault.
 - 7. Joints of the manhole sections shall be of the tongue and groove type. Sections shall be joined using O-ring rubber gaskets conforming to the applicable provisions of ASTM C443, latest revision, or filled with an approved preformed plastic gasket meeting the requirements of Federal Specifications SS-S-00210, "Sealing Compound, Preformed Plastic for Pipe Joints," Type 1, Rope Form.

8. Pipe penetration through the precast walls (pipe-to-manhole) shall be a cast-in-place flexible sleeve meeting the requirements of ASTM C-923. Two stainless steel pipe clamps shall be used to fix the pipe to the sleeve. The finished connection shall be capable of sealing to 13 PSIG minimum, and shall accommodate a pipe deflection of 5 degrees minimum without loss of seal.
9. Each section of the precast manhole shall have lift rings or non-penetrating lift holes provided for handling precast sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation of the precast sections.
10. Reinforced polypropylene plastic manhole steps shall be installed in each section of the manhole.

D. Precast Inlet Pipe Vaults:

1. Precast concrete inlet pipe vaults shall consist of precast reinforced concrete sections and a flat slab top section suitable for AASHTO HS-20 Traffic Loads conforming to the typical drop box details as shown on the Drawings.
2. Precast inlet pipe vault sections shall be manufactured, tested and marked in accordance with the latest provisions of C858.
3. The minimum 28-day compressive strength of the concrete for all sections shall be 4,000 psi.
4. The maximum allowable absorption of the concrete shall not exceed eight (8) percent of the dry weight.
5. The reinforcement in the wall sections and top section shall consist of one line of steel and shall not be less than 0.17 square inch per lineal foot.
6. Each section of the precast inlet pipe vault shall have not more than two holes for the purpose of handling and laying. These holes shall be tapered and shall be plugged with rubber stoppers or mortar after installation.
7. Joints of the inlet pipe vault sections, if any, shall be of the tongue and groove type. Sections shall be joined using O-ring rubber gaskets conforming to the applicable provisions of ASTM C443, latest revision, or filled with an approved preformed plastic gasket meeting the requirements of Federal Specifications SS-S-00210, "Sealing Compound", Preformed Plastic for Pipe Joints," Type 1, Rope Form.
8. Pipe penetration through the precast walls (pipe entrance and exit) shall be a cast-in-place 6-inch sleeve with link seal (TYP 2).

E. Frames, Covers and Steps:

1. Frames and covers shall be cast iron conforming to the minimum requirements of Federal Specifications WW01-652 or to ASTM A48 for Class 30 Gray Iron Castings. All castings shall be made accurately to the required dimensions, fully interchangeable, sound, smooth, clean, and free from blisters and/or other defects. Defective castings which have been plugged or otherwise treated shall not be used. Each casting shall have its actual weight in pounds stenciled or painted on it in white paint.
2. Pump vault and valve boxes access hatches/doors shall be cast-in-place in concrete top unit and shall be of type and dimension indicated on the Contract Drawings.
3. The contact surfaces of all manhole covers and hatches and the corresponding supporting frames shall be machined to provide full perimeter contact.
4. Interior steps shall be constructed of FRP and conform to the applicable provisions of ASTM C478 and AASHTO M-199. The steps shall be installed in preformed holes follow the step and precast manufacturers' recommendation.
5. All castings exposed to, or in contact with FGD effluent shall be thoroughly cleaned and an **OWNER** specified coating system shall be applied.

PART 3 - EXECUTION

3.01 PLACEMENT OF PRECAST CONCRETE INLET PIPE VAULT BOXES

- A. Prior to placing precast concrete inlet pipe vault boxes, a minimum 18-inch-thick layer of coarse aggregate (pea gravel), as defined on the Drawings, shall be placed as a level bedding for the drop box.
- B. After approval of bedding by the **ENGINEER** and the **OWNER** or its representative, vaults shall be placed, and their inverts shall be established and verified.
- C. The vault's exterior surfaces shall have a protective epoxy coal tar coating with a minimum dry mil thickness of nine (9) mils. Coatings shall be applied in two (2) applications by the vault manufacturer in strict accordance with the paint manufacturer's recommendations.
- D. Covers/hatches as indicated on the Drawings shall be set at the required elevation and properly anchored and sealed to the vault, as shown on the Drawings.

3.02 PLACEMENT OF PRECAST CONCRETE PUMP VAULT

- A. Prior to placing precast pump vault, a minimum of 12 inches of the material beneath the vault and an area extending one foot out from the base, shall be compacted to 100% of the standard Proctor as a bedding layer. After approval of bedding layer by the **ENGINEER**, the pump vault shall be placed and inverts/bottom elevations established and verified.
- B. After the base section has been set, the precast sections shall be placed thereon, care being exercised to form the incoming and outgoing pipes into the wall of the manhole at the required elevations. Provide flexible or non-flexible connections to the manholes as shown on, or required by, the Drawings and as otherwise directed by the **ENGINEER**.
- C. The top unit, with cast-in-place hatch/cover/grate for the vault, shall be set at the required elevation and properly anchored and sealed to the masonry.
- D. The pump vault's interior shall be coated following **OWNER** approved coating system. Exterior surfaces shall have a protective epoxy coal tar coating with a minimum dry mil thickness of nine (9) mils. Coatings shall be applied in two (2) applications by the manhole manufacturer in strict accordance with the paint manufacturer's recommendations.
- E. Concrete surfaces shall have form oil, curing compounds, dust, dirt and other interfering materials removed by brush sand blasting and shall be fully cured prior to the application of any coatings.

3.03 VACUUM TESTING OF PRECAST CONCRETE PUMP VAULT

- A. Following the installation of the precast vault and all inlet pipe connections, the **CONTRACTOR** shall test the precast assembly to verify the structure is leak-tight.
- B. Test procedures shall follow the ASTM-C1244 (Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure Test) methods.
- C. **CONTRACTOR** is responsible for all necessary repairs and retesting of the structure until it is determined the structure is leak-tight. Repairs and testing shall be done at **CONTRACTOR's** expense.

3.04 PUMP VAULT APPURTENANCES

- A. Pumps: The floor slab design shall allow for the installation of two submersible transfer pumps (Flygt Type CP/NP-3127). The vault shall include a pedestal for mounting the pump's discharge connection (Flygt Part no. 540-13-05). Pedestal shall be monolithic to base section and include cast-in-place anchor bolts.
- B. Pump Rail System: **CONTRACTOR** shall install pump rail/guide (Flygt) system including 2" guide bars, intermediate and upper guide bar brackets and lifting chains for pump retrieval. Lifting chain or similar means shall be provided for lifting the pumps. Chain shall be capable of lifting a minimum of 500 pounds.

- C. Level Instruments: Pump vault lids shall include a flange connection for the installation of level transmitter (Rosemount Model 5402).
- D. Level Sensor: Pump vault shall be furnished with a level sensor for detecting a High-High level condition.
- E. Openings: Pump vault lid shall contain several opening as depicted on the Drawings. The openings shall be furnished with fiberglass reinforced plastic (FRP) grating. The grating shall be suitable to withstand a uniform live load of 500 PSF plus anticipated dead loads. Grating shall be secured to the precast concrete lid using a fastening system (e.g. clips) fabricated from 316 stainless steel materials.
- F. **CONTRACTOR** shall verify interior pump layout, guiderail mounting requirements, pipe invert elevations and lid opening requirements prior to concrete vault fabrication.

END OF SECTION

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SECTION 09980

CONCRETE AND MASONRY COATINGS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This specification covers the general requirements for furnishing and applying linings for concrete sumps and concrete spillway areas for the Flue Gas Desulphurization Blowdown Pond system.
- B. This specification is intended to cover the general requirements for the installation, testing, and delivery necessary to supply coatings defined in Section 1.02 of this specification. It is not intended to cover the detail design.
- C. Compliance to this specification shall not release the **CONTRACTOR** from following normal industry requirements and good engineering practice.
- D. All components, features, and design parameters specified herein are minimum requirements. If the **CONTRACTOR**'s design dictates that these minimum requirements be exceeded to meet specified performance guarantees and to provide a safe, reliable operating unit, then he shall inform the **OWNER** of any required changes or deviations.
- E. All material supplied shall be new, unused, and undamaged.
- F. The attachments and references to this specification are an integral part of this specification and are binding with respect to the materials provided by the **CONTRACTOR**.
- G. In the event of a conflict between any portion of this specification and/or its attachments and references, the **CONTRACTOR** shall notify the **ENGINEER**. The **ENGINEER** will determine the proper course of action to follow, and **CONTRACTOR** will follow the determination at no additional cost.
- H. Performance of the work described in this specification may involve hazardous materials, operations, and equipment. This specification does not purport to address all of the safety problems associated with its use. It is the responsibility of the **CONTRACTOR** to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.02 SCOPE OF SUPPLY

- A. **CONTRACTOR**'s responsibilities include, but are not limited to the supply of all equipment, materials, temporary structures, and labor necessary to professionally install, test, and cure the liners in the sumps and concrete spillway areas.

B. **CONTRACTOR**'s scope of supply includes, but is not limited to the following:

1. Linings
2. Primers
3. Resins
4. Fillers
5. Hardeners
6. Grit blasting equipment and material
7. Safety equipment
8. Protective equipment
9. Tools, Brushes, Rollers, etc.
10. Scaffolding
11. Dehumidification equipment
12. Heaters
13. Repair equipment and supplies
14. Cleaners and Solvents
15. Spark Testers
16. Ventilation equipment
17. Documentation as required in this Specification or as required by the **ENGINEER** or **OWNER**.

C. **CONTRACTOR**'s scope of supply specifically excludes the following:

1. Paint on exterior of tanks including painted carbon steel agitator support structures except sump agitator supports and sump pump supports, which shall be lined as specified herein.
2. Work on any other sumps or other spillway areas not specified herein.
3. Platform and sump galvanized grating.
4. Surfaces indicated NOT to be lined.

1.03 CODES AND STANDARDS

A. NACE Standard RP0892-92, "Standard Recommended Practice for Linings over Concrete for Immersion Service".

- B. ASTM C307, "Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings".
- C. ASTM D4060, "Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser".
- D. ASTM D4263, "Standard Test Method for Indicating Moisture in Concrete by Plastic Sheet Method.
- E. ASTM D4285, "Standard Test Method for Indicating Oil or Water in Compressed Air".
- F. ASTM D4541, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Tester".
- G. ASTM D4787, "Standard Test Method for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates".
- H. ASTM E96, "Standard Test Methods for Water Vapor Transmission of Materials".
- I. ASTM STP (Special Technical Publication) 837, "Manual of Protective Linings for Flue Gas Desulfurization Systems", 1984.

1.04 DESIGN CRITERIA

- A. General Requirements
 - 1. **CONTRACTOR** shall submit a lining system determined by the Material and approved by the **ENGINEER**, that will provide or exceed requirements for proper adhesion, thickness, chemical and abrasion resistance, temperature resistance, thermal expansion, tensile strength, absorption properties, impact resistance, compressive strength, hardness, ability to withstand vibrations (where applicable), permeability, and longevity for the stated process and environmental conditions, standard industry practices, and this specification.
 - 2. The Society for Protective Coatings (SSPC) Guide 11 shall be incorporated into this specification. Moisture testing of concrete, Surface Preparation, as well as other requirements referenced in the Guide 11 shall be used.
 - 3. Qualified and experienced persons who specialize in such work shall apply lining materials. Only approved and trained installers shall be used.
 - 4. All work associated with the supply, surface preparation, installation, inspection and testing of linings shall be performed in accordance with project drawings, this specification and the lining material manufacturer's approved lining procedures.
- A. Design Criteria-Concrete Manhole and Spillway Surfaces to be lined
 - 1. Concrete surfaces to be lined must be thoroughly cured, free of oils, curing solutions, mold release agents, and dust.

2. Concrete must be dry at the time of application and in strict accordance with the manufacturer's requirements. (Minimum testing required is ASTM D 4263).
 3. Surfaces shall be abrasive blasted or scarified to remove laitance and surface contaminants. The resulting surface shall have a surface texture no less than heavy grit sand paper.
 4. Surfaces to be lined shall be included but not limited to:
 - I. Concrete Manhole floor, walls and ceilings.
 - II. Concrete Spillway.
 5. Sump surfaces not to be lined include:
 - I. Galvanized grating
 - II. Sump Pumps
 6. All concrete voids shall be repaired prior to lining and shall be made with the Coating Manufacturer's recommended filler material. A Pinhole free surface is REQUIRED.
- B. Design Criteria-Concrete Manhole Structural Support Steel to be coated
1. Structural steel members (which support the grating, agitators, and sump pumps) shall also be lined.
 2. Manhole structural support steel not to be lined include:
 - I. Galvanized grating shall not be coated.
 - II. Pumps equipment and components shall not be coated.

1.05 SUBMITTALS

- A. The CONTRACTOR shall provide an Operation & Maintenance Manual. The manual shall include the CONTRACTOR's QA Inspection Plan, all technical product data sheets and MSDS sheets for materials used, surface preparation and application procedures, repair procedures and final field records (As-built submittal). Manual shall have tab sections for each concrete surface lined identified in this Section.
- B. Information to be submitted afterward:
1. The documentation to be submitted for acceptance by the **CONTRACTOR** to the **OWNER**.
 2. Submittals required elsewhere in this specification or its attachments, but not listed, shall be submitted within a time frame such that the **OWNER** may review the information as necessary to meet design and construction schedules.

1.06 QUALITY ASSURANCE

- A. **CONTRACTOR** shall provide all material, components, and services in accordance with a Quality Assurance Program that assures compliance with the applicable codes, standards and this specification. **CONTRACTOR** shall be responsible for imposing the quality requirements of this specification onto any subcontractor proposed for the work included.
- B. Prior to the start of manufacture the **CONTRACTOR** shall submit its Quality Assurance Manual including those of subcontractors as applicable. This plan also identifies those points in the production and preparation, application, and testing processes that **OWNER** intends to witness, verify or perform inspection.
- C. Manufacturing Control – Each product item shall retain a unique identification marking so that test results are traceable to the individual item.
- D. All materials used shall not exceed the manufacturer's recommended shelf life or pot life. Pot life shall be monitored by the **CONTRACTOR** and will vary with temperature.
- E. All materials are to be stored at temperatures between 60°F to 80°F, and as recommended by the material **CONTRACTOR**.
- F. Material Receipt Inspection and Testing:

Each item of shipment from the material manufacturer shall be checked on arrival to verify that it is as specified. The receipt of the items shall be recorded in a formal quality control log. **CONTRACTOR's** quality control inspector shall track each item to assure that it is routed to the proper storage area, and that lots of items to be tested are sequestered in sealed storage separate from materials that have been released for use.
- G. Items that do not conform to the manufacturer's requirements shall be prominently marked and stored separate from approved for use items. A non-conformance report shall be issued, and the material secured to prevent its accidental use. In addition, the Quality Control Plan shall designate the chain of reporting events that initiate a quality control problem. The Quality Control Program shall require periodic documented inspections of the storage conditions, including temperature logs of storage areas. The surveillance program shall also create a traceable "audit trail" of the movements of materials used.
- H. Surface profile of the blasted surface shall be checked by random readings and the profile recorded on film.
- I. The approximate size and location of areas that require re-blasting shall be recorded. The thickness readings and their location shall be recorded.
- J. The number of pinholes and surface imperfections and fisheyes repaired shall be recorded for each area or item of equipment. Copies of the records shall be submitted to the **OWNER**. Photos or hand drawn diagrams are required to indicate any areas with defects.

- K. The amount of area and location of under-thickness requiring repair shall be recorded. Copies of the records shall be submitted to the **OWNER** on a daily basis.
- L. The **CONTRACTOR** or his delegate shall measure and record the wet bulb temperature, dry bulb temperature, substrate temperature, relative humidity, and dew point at the beginning of each shift and at the beginning of the second half of the shift. This record shall be dated and signed and the location specified. Copies of these records shall be submitted to the **OWNER** on a daily basis.
- M. Housekeeping:
 - 1. **CONTRACTOR** shall clean any part of the installation that may have become soiled with his lining materials. **CONTRACTOR** shall daily gather and dispose of any debris accumulated during lining and shall leave the area in a clean, orderly condition upon completion of the work to the satisfaction of the **OWNER**.
 - 2. Disposal of all debris including spent abrasives is the responsibility of the **CONTRACTOR**.

1.07 INSPECTION AND TESTING

Inspection and Testing shall follow the **CONTRACTOR**'s approved QA Plan and as already defined in the preceding section of this specification.

1.08 SPECIAL PACKAGING, PROTECTION AND SHIPPING INSTRUCTIONS

Storage and Handling:

Lining materials shall be stored in areas where they are not exposed to direct sunlight, oil (hydrocarbons), and where the temperature does not exceed 80°F. The materials shall be stored and handled in a manner such that at no time is there any possibility of the material being exposed to heat, flame, or sparks which could damage or ignite the material. Such procedures and precautions shall be submitted to the **OWNER** for review as part of the Storage, Handling, and Receiving Procedures. Materials which are out of the manufacturer's guides shall not be installed.

1.09 FIELD REPRESENTATIVE

The Material **CONTRACTOR** shall provide a field representative on the jobsite periodically throughout project.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Refer to Attachment A for product information and application requirements.
- B. Concrete Manhole lining material selections:

1. Concrete Filler: Blome 83-MP
 2. Primer: Blome 75 Primer
 3. Base Coat, Intermediate coat, Topcoat: Blome TL-495 AR trowel-applied abrasion resistant glass cloth reinforced epoxy, at 125-150 mils DFT (minimum).
- C. Manhole structural support coating material selection
1. Primer: Blome 75 Primer.
 2. Base Coat and Topcoat: Two (2) coats Blome TL-45S.
- D. Concrete Spillway lining material selections:
1. Concrete Filler: Blome CP-83MP
 2. Primer: Blome TL-45S Primer
 3. Base coat, Intermediate coat, Topcoat: Blome TL-45S, trowel-applied abrasion resistant glass cloth reinforced epoxy, at 125-150 mils DFT (minimum).
 4. Broadcast Material: Aluminum Oxide

PART 3 - EXECUTION

3.01 INSPECTION OF SURFACES TO BE LINED (PRIOR TO START OF WORK)

- A. Surface Inspection – Prior to the commencement of the lining operation, the **CONTRACTOR** and the Coating Manufacturer, shall visually inspect the surfaces for any defects that deviate from the requirements of this specification, the drawings, or which will preclude producing a satisfactory lining. The time for the visual inspection shall be coordinated with the **OWNER**.
- B. Any non-conformity discovered by visual surface inspection shall be brought to the attention of the **OWNER** by the **CONTRACTOR** for corrective action.
- C. The repaired surfaces shall be re-inspected after the repairs of the defects are performed. Upon final acceptance, sumps, trench, or floors will be turned over to the **CONTRACTOR**.
- D. Lining work shall not commence until all welding or other activities which may damage the coating system have been completed.
- E. Organic surface contaminants such as grease, oil, crayon markings, etc., shall be removed by approved solvents prior to blasting. Solvents shall be site approved prior to the job start.

- F. Organic surface contaminants deposited on any steel surface after blasting and before applying the first primer coat, shall also be removed with the approved solvent, and re-blasted if necessary.

3.02 PERFORMANCE GAURANTEES

- A. **CONTRACTOR** shall warrant and guarantee material thickness and performance of the field applied linings in accordance with the terms and conditions and as follows:
- Installed lining thickness shall be checked to verify compliance with the limits established by the **OWNER**. Installed lining shall be 100% holiday – free in accordance with the manufacturer’s instructions. A final report from the **CONTRACTOR** shall verify compliance to the specification. A drawing which maps out any repairs shall be supplied by the installer.
- B. Installed linings shall be free of lining discontinuities (defects) or latent discontinuities as further defined below.
1. Lining Discontinuity (Defect): The installed linings shall be free of all discontinuity (termed defect in this specification) or latent discontinuities (those defects which develop within the warranty period). A defect shall be defined in this specification to be any point or area on the installed lining at which the coating film does not cover the substrate or is detrimental to the lining and which has or will result in penetration by the process medium.
 2. Types of defects shall include but not be limited to:
 - I. Holidays (pin holes)
 - II. Cracks
 - III. Holes which expose the base substrate material
 - IV. Blisters which are a result of improper installation
 - V. Peeling which exposes the base substrate
 - VI. Excessive air entrapment
- C. **CONTRACTOR** (Installer) shall warrant labor and material for a period of 5 (five) years.

3.03 GENERAL REQUIREMENTS-SURFACE PREPARATION, PRIMING AND LINING

- A. Prior to Use and Periodic Testing of Compressed Air
1. Compressed air supply shall be free of oil, dirt and entrained water. Prior to using compressed air, the quality of the air shall be tested to check for oil or moisture. This test shall be performed at the beginning of each shift and at 4-hour intervals thereafter during blasting. If contaminants are found, the equipment shall be re-blasted with clean air and abrasives. Contamination of

the air shall be determined by wiping a clean white cloth over a clean smooth metal surface upon which the air stream has been projected for a period of not less than two minutes from a distance of not more than eighteen inches.

2. Grit shall be clean and dry. Grit shall not be reused.
3. All dust or grit from the blasted surface shall be removed by brushing with clean soft bristle brushes or air blasting with clean oil-free and moisture-free compressed air or vacuuming prior to priming.
4. Excess abrasive or grit shall be removed by **CONTRACTOR**.

B. Abrasive blasting and priming

1. Abrasive blasting shall not proceed if the surface temperature is less than 5°F above the dew point of the air in the work area, below 50° F or if the relative humidity is above 80 percent.
2. Primer shall not be applied if the surface temperature or work area is less than 5°F above the dew point or below 50°F or above 120°F, or relative humidity is more than 80 percent.
3. Skim coat and/or Primer coat shall be tack free but shall not have set any longer than recommended by the manufacturer, before intermediate coat application. Intermediate coat shall be applied after priming has developed maximum bond strength with substrate and shall not trap any solvent in the preceding coat. All primed surfaces shall be free of blush and verified so by testing. Test results must be submitted to the **OWNER** on a daily basis.
4. Primers shall be applied by rolling or brushing. Primers shall be applied at a thickness recommended by the manufacturer. Number of coats will be determined by the application method.
5. Random wet film thickness readings of linings shall be taken and recorded during installation.
6. Adequate ventilation shall be provided for safe working conditions.
7. Primer, resins, and other composite lining material containers and application utensils shall be kept isolated and well identified to prevent cross contamination of one material with another.
8. All materials shall be kept stirred or agitated to keep adhesive soils in suspension.
9. All test equipment shall be re-calibrated periodically to assure that the settings on the tester have not changed.
10. Spark testing (where applicable) shall be calibrated using the same power source, cable lengths from power source to probe, and probe to be used for testing the work piece.

11. Visual imperfections that are found shall be marked for repair using chalk that can be easily removed.
12. Defective areas shall be repaired with full system and the lining shall be retested and inspected after curing. Durometer hardness shall be checked to assure that it meets the manufacturer's specifications. All pinholes and other lining defects shall be repaired in accordance with the approved procedures.

3.04 LINING APPLICATION AND INSPECTION OF CONCRETE SURFACES

- A. Application of the lining system(s) shall comply fully with the lining material manufacturer's most recent application procedures specified thickness, technical bulletins and this specification.
- B. All materials for lining installation shall be furnished by the Coating Manufacturer to the **CONTRACTOR**.
- C. Cure time is temperature dependent and shall conform to the manufacturer's recommended schedule. Recoat and top coating shall be in accordance with the manufacturer's recommendations.
- D. After allowing adequate cure time based on the manufacturer's instructions for the actual substrate temperature, the surface should be checked for defects such as sags, blow holes, runs, foreign matter and under cured areas. Defects shall be repaired in accordance with the coating manufacturer's instructions. The resulting substrate shall have a continuous film with no voids.
- E. **OWNER's** representative has the authority to stop the work in progress when the **ENGINEER's** inspector reports and it is mutually agreed upon that the application procedures are not being properly adhered to and/or the climate conditions are not favorable for the lining installation.
- F. It shall be the responsibility of the **CONTRACTOR** to obtain the latest revision of each of the coating manufacturer's specification technical bulletins needed for the installation of the lining.
- G. **CONTRACTOR** is responsible for following the manufacturer's safety precautions relating to combustibility and personnel safety procedures. MSDS (material safety data sheets) shall be supplied with the shipment and shall be followed by the **CONTRACTOR**. Lining work areas shall be roped off and protected with fire extinguishers and prominently displayed safety signage. All pertinent safety regulations shall be followed whether reinforced here or not. All Federal, State and Local regulations must be followed. It is the **CONTRACTOR** responsibility to identify all regulations.
- H. Surfaces to be lined shall be prepared by abrasive blasting or scarification to remove laitance and surface contaminants. A minimum surface texture of Heavy Grit Sand paper is required.
- I. Concrete must be thoroughly cured, free of oils, curing solutions, or mold release agents, dust and must be dry at the time of lining application.

- J. ASTM D4263, Standard Method for Indicating Moisture in Concrete by Plastic Sheet Method shall be used to ensure concrete is moisture free. If moisture is detected, retest until dry. A test for moisture vapor shall demonstrate results less than 3 pounds.
- K. Completely follow lining material manufacturer's application instructions in applying the lining. Mechanically premix lining components individually prior to blending together.
- L. The Spillway Structure coating system shall include a broadcast of aluminum oxide into the intermediate coat immediately following application in areas designated on the drawings to provide a degree to traction and minimize the potential for personnel slipping on the coating system. The application of the aggregate shall be in compliance with the Coating Manufacturer's recommendations.
- M. Concrete Breathing: In order to minimize possibility of "gassing" phenomena in lined concrete structures where bubble or blisters may form in the uncured lined surface during periods when ambient temperature is increasing, should be followed:
 - 1. Prime and re-prime during a time when the concrete substrate temperature is dropping.
 - 2. Apply lining during a cooling period so that it can cure to obtain some strength before the air pressure in the concrete is positive.
 - 3. Full responsibility for a pinhole free surface rests with the **CONTRACTOR** (Installer).

END OF SECTION

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SECTION 15250

PUMPS AND PUMPING SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. The **CONTRACTOR** shall provide all labor, materials, and equipment to install the following to meet the requirements described in 1.01.B:
1. Pumps complete with specified accessories.
 2. Pump Vault with all related wiring, piping and accessories.
 3. Control panel, mounting, necessary conduits, and controls.
 4. Test and demonstrate the operation of the system.
 5. Submit operation and maintenance manuals, and warranties.
- B. The pumping systems shall consist of pumps, controls, alarms, and related electrical works. They shall be of material and construction to be compatible with the material to be pumped.

1.02 SUBMITTALS

- A. The **CONTRACTOR** shall submit the following information to **OWNER** for approval prior to fabrication or procurement:
1. All material submitted for review shall be contained in one submission. Partial submittals will not be reviewed.
 2. Pump Vault - Shop drawings of the required pump vault, showing pumps, piping, necessary valves, level transmitter and switches, related wiring, manways, ladders, slide rails, and other items as specified in Section 2.01 and as shown on the Drawings.
 3. Control Panels - Detailed electrical diagrams showing the panel enclosure, panel face and wiring diagrams to the **OWNER** for approval. **CONTRACTOR** shall also submit product data for panel displays, enclosures, relay modules, motor controllers and starters, circuit breakers, panel heaters, level transmitter and level switches and related controls, flow meter receptacles and devices, and other items as specified in 2.0 of this Section and as shown on the Drawings.
 4. Operation and Maintenance Data - **CONTRACTOR** shall provide five sets of operation and maintenance (O&M) manuals for each type of pumping vault. The O&M manuals shall include at a minimum, all drawings, equipment lists with manufacturer's name and model number, equipment manuals, recommended maintenance schedule, recommended spare parts inventory, printed warranty, manufacturer's equipment storage recommendations, manufacturer's recommended start-up report form, detailed description of controls sequence of operation and troubleshooting guide.

1.03 CODES AND REGULATIONS

- A. Comply with the latest editions of following works, including all supplements thereto and any other authority having jurisdiction within requirements of this specification.
1. Local Codes.
 2. National Electrical Code (NEC).
 3. Occupational Safety and Health Association (OSHA).
 4. Underwriters Laboratories, Inc. (UL).
 5. National Electrical Manufacturer's Association (NEMA).
 6. American Society for Testing and Materials (ASTM)
 7. American National Standards Institute (ANSI).
 8. National Electrical Safety Code (NESC).
 9. Institute of Electrical and Electronic Engineers (IEEE).
 10. Association of Edison Illuminating Companies (AEIC).
 11. National Fire Protection Association (NFPA).
 12. Florida Building Code.
 13. Electronic Industries Associations (EIA).
 14. Insulated Cables Engineers Association (ICEA).
 15. Instrumentation, Systems, and Automation Society (ISA)
- B. In addition, all specifically referenced standards and regulations as defined in individual sections of these Specifications shall apply.
- C. Provide all work and materials in compliance with latest rules, codes and regulations. Compliance with Codes shall be mandatory. The Drawings and Specifications shall not permit work that does not conform to these codes. Whenever Drawings or Specifications require materials, workmanship, arrangement or construction of higher standard or larger size than is required by codes and regulations, the Drawings and Specifications shall take precedence.
- D. Do not conceal work until after inspection and approval. If work is concealed without inspection and approval, **CONTRACTOR** shall be responsible for all work required to expose and restore the concealed work in addition to all required modification
- E. All electrical materials and equipment shall bear the label of Underwriter's Laboratories' listed by them in their list of electrical fittings; and approved by them for purpose for which they are to be used, unless material and equipment is of type for which Underwriter's Laboratories do not list or provide label.

1.04 QUALITY ASSURANCE

- A. Manufacturer of pumps and pumping systems shall provide a one year warranty on all products.
- B. The **CONTRACTOR** shall provide manufacturer's representative services at the Site to inspect the installation, review recommended operational and maintenance procedures, start-up pumps and check control panel logic and instruct the **OWNER's** personnel.
 - 1. Minimum one man-day for Pump Vault pumps
 - 2. Minimum one man-day for Tank Farm pump

PART 2 MATERIALS

2.01 PUMP VAULT

- A. General

These specifications are only an outline of the general requirements and the **CONTRACTOR** shall submit all necessary product data for the material proposed, for the **OWNER's** approval, for the construction and installation of Pump Vault as described in this Section (2.01) and as shown on the Drawings.

- B. Lift Pumps, Motors and Protection Devices– Supplied by **OWNER**

- 1. Manufacturer: Pumps will be ITT Flygt: Model N3127, 7.5HP, 460V, 3 phase.
- 2. Protection:
 - i. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125°C (260°F) the thermal switches shall open, stop to motor and activate the pump high temperature alarm on the control panel.
 - ii. All stator chambers shall incorporate a leakage sensor to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and activate the seal failure alarm on the Pump Vault control panel.

- C. Slide Rail - Supplied by **OWNER**

The pump vault shall include a duplex slide rail system to allow removal of the lift pumps without entering the manhole. The slide rail assembly shall be manufactured by the pump manufacturer specifically for use with the lift pumps. The pumping unit shall be guided by two stainless steel guide rails for each pump. A minimum of two non-sparking guide brackets, one integrally mounted to the pump casing and one, equipped with a lifting bracket, mounted on the discharge piping. The brackets shall wrap around the guide rails in excess of 180 degrees and shall provide smooth removal of the pump. A lifting chain (or cable) shall be provided for each pump.

The lifting chain shall be of sufficient length to remove the pump and shall be sized to the pump weight. The working load of the lifting system shall be minimum 50 percent greater than the pump weight.

D. Instruments

A. The **CONTRACTOR** shall furnish and install all necessary instrumentation as shown on the P&ID, which includes, but is not limited to, the following:

1. Level instrument, level switches and controllers.
2. Pressure gauges, including diaphragm seal to isolate fluid medium from gauge.

B. Flow Element and Controller

1. The flow element and controller shall be manufactured by Yokogawa Corporation or an approved equal.
2. Flow element and controller shall be listed by Underwriters Laboratories, bear the UL label and have the following specifications:

Type:	Magnetic inductive flow meter AXF200C
Suffix:	NNAL1L-BA11-2NB/FF1
Style:	S1
Material Factor:	L-1.0266/H-0.9668
Connection:	Flanged; ANSI Class 150
Flange Material:	304 Stainless Steel; AISI 304 SS; JIS SUS304
Lining:	Fluorocarbon PFA
Hazardous Area Class:	FM Explosion Proof
Fluid Temperature:	185 degree F maximum
Accuracy:	+ / - 0.5 %
Power Supply:	Remote Flowtube, 100V to 240VAC
Programming:	English
Display:	GPM

C. Instruments shall be compatible with the range of conditions that may be experienced. Operating ranges of instruments shall include the maximum and minimum conditions, while minimizing ranges that fall outside the maximum and minimum.

D. Instruments shall be heavy-duty, industrial-grade components and shall be compatible with the process operating environment. Instruments, or parts of instruments, in direct contact with the FGD pond water must be materials that are compatible with the pond water.

E. Electrical Controls and Appurtenances

1. Description of Operation

The Pump Vault shall be controlled by level transmitter and a float type level switch and shall interface with the **OWNER's** existing DCS. The following vault level statuses should be displayed: PUMPS OFF, LEAD PUMP ON, LAG PUMP ON and HIGH LEVEL. Each pump shall be equipped with a "Hand-Off Auto" (HOA) selector switch. Operation of the pumping system in Hand position shall bypass all level controls and interlocks. The design of the Pump Vault Control Panel shall incorporate the following control philosophy:

On Rising Water Level:

Both pumps shall be "OFF" when the vault's level is at or below the PUMPS OFF status. The lead pump shall start when the level rises above the LEAD PUMP ON level setting. If the level continues to rise, the lag pump shall start when the level rises above the LAG PUMP ON level setting, and both pumps shall be running simultaneously. If the level continues to rise above the HIGH-HIGH LEVEL float a high level alarm light located on the Pump Vault's Control Panel shall be lighted and a signal sent to the **OWNER's** DCS.

On Falling Water Level:

Both the lead and lag pump shall be turned off when the vault's level falls below the PUMPS OFF status.

Other Controls:

An automatic electric alternator, or alternating relay, shall equalize the wear and usage of the pumps by alternating the operational sequence of the pumps on successive starts. The alternator or relay system shall start the lag pump if the lead pump has failed to start within 30 seconds of the level rising above the LEAD PUMP ON float. Adjustable timers shall prevent both lift pumps from starting at the same time.

2. Control Panel and Controls

The **CONTRACTOR** shall provide detailed drawings, including ladder logic diagrams, panel face layout, enclosure layout, panel layout, and wiring diagrams for the fabrication of the control panel. The **CONTRACTOR** shall provide QA/QC services to inspect and test the control panels prior to shipment to the job site. The **CONTRACTOR** shall be responsible for all costs associated with design, procurement, fabrication, inspection, testing and shipping the control panels, not provided by Others

- a. A complete automatic pump control system shall be furnished by the pump manufacturer or certified representative and installed at the new Pump Vault by the **CONTRACTOR** as shown on the Drawings and specified herein. The control system shall consist of a pump control panel, one level transmitter, one (1) level sensor float, flow meter, necessary relays and electrical materials to operate the pumps and to interface with **OWNER's** DCS.

- b. The automatic pump control system shall be constructed to NEMA 4x standards. The incoming power supply at the pump Vault shall be 3 phase/60Hz/460V. The control system shall control the two pumps based on liquid level and relays as described in (2.01d).
- c. The Pump Vault Control Panel shall include the following:
 - 1. HOA controls for each of the two (2) pumps.
 - 2. NEMA 4x stainless steel enclosure.
 - 3. Separate circuit breaker for each lift pump.
 - 4. Motor starters for each lift pump. Starters shall have overload relays with ambient compensated, quick trip characteristics sized for the motors being used and manual reset. Each starter shall have a minimum of two auxiliary contacts.
 - 5. Level sensor and controller to start and stop pumps as required and for high level alarm.
 - 6. Level switch (float) for HIGH-HIGH alarm.
 - 7. Main disconnect and fuses to de-energize complete control panel.
 - 8. Automatic electric alternator or alternating relay to change pumping sequence after each cycle.
 - 9. Control circuit reconnect relay.
 - 10. Duplex 120v, 60Hz, 1-phase, 10 amp GFI receptacle.
 - 11. Green pump “running” lights, red “thermal overload” light, red “seal failure: light, and red “high level” light for each pump.
 - 12. Red flashing alarm light mounted on top of control panel (100 watts).
 - 13. Control panel door shall be equipped with catch and lock. Two milled keys shall be furnished with each lock.
 - 14. Alarm switch for on-off and test.
 - 15. Separate auxiliary circuit breakers for alarm and control circuits.
 - 16. Override circuit to start lag pump if lead pump fails.

17. Panel heater as manufactured by Watlow or an approved equal to provide a panel interior environment of 40° F.
 18. Ventilation system, as required, to protect the control panel components from overheating.
 19. Surge suppression on all incoming power and control lines.
 20. All necessary 24 volt coil relays (DPDT, dry contact relays rated for a minimum of 2 amps at 120 volts), timers, power supply, transformers and interlocks required for operation of the system as described in (2.01 d).
 21. The Control Panel shall be equipped with a terminal strip or making all input and output connections. The Control Panel supplier shall provide all connections between the panel mounted instrumentation to the terminal strip. The **CONTRACTOR** shall provide all wiring and conduit for electrical, instrumentation, and control wiring connections.
 22. Flow meter controller and local display readout
- d. The NEMA 4x stainless steel enclosure shall have a hinged outer door with locking hasp and an inner dead front door. All operating devices shall mount on or through the inner door. All components shall be clearly identified by suitable name plates. The enclosure shall be sized and assembled to provide 20 percent free space for future controls, relays and wires.

PART 3 EXECUTION

3.01 INSTALLATION OF PUMP VAULT

- A. All installation procedures for the specified pumping system component including but not limited to pumps, sliding rails, couplings, flow meters, valves, controls, pipes, manhole and electrical equipment shall be installed per manufacturer's recommendations and instructions.
- B. The installation of the Pump Vault manhole shall be in accordance with the Manufacturer's Specifications.
- C. The **CONTRACTOR** shall make all electrical power and control wiring connections between all new and existing electrical distribution equipment, control panels and equipment as specified in this Section.
- D. Upon completion of the installation, all circuits, control systems and devices, including all alarm condition signals, shall be tested in the presence of the **OWNER** by the **CONTRACTOR**. All apparatus shall be cleaned, adjusted and made ready for operation after testing. The **CONTRACTOR** shall make such changes in wiring or connections and such adjustments, repairs or replacements as are necessary to make the circuits, device or control system to function as specified and otherwise

comply with the specifications or data on Contract Drawings. The **CONTRACTOR** shall supply all necessary material, labor and equipment for these tests. The pumps shall be tested in the presence of the **OWNER** to insure that the pumps are adjusted and in proper running order and that said pumps will meet the rated capacities specified. The field test shall include pumping at least three cycles with two at the normal starting levels to check the operation and alternation of each pump, and one with both pumps running. Pump tests shall include plotting of pump curve based on field data for each pump. Points on pump curve shall include shutoff head and three (3) other points. During pump testing, inspections shall be performed in the presence of the **OWNER** to insure free passage of liquid into the pipeline. Any problems shall be promptly repaired at the **CONTRACTOR**'s expense.

END OF SECTION

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SECTION 09980
ATTACHMENT A

CONCRETE COATING SYSTEM INFORMATION



Blome CP-83MP **Epoxy Adhesive / Mortar**

PRODUCT DESCRIPTION

Blome CP-83MP is a two part, epoxy adhesive/mortar used for the installation of abrasion resistant brick and tile linings. CP-83MP is designed for bonding alumina ceramic and basalt tile in lining applications requiring resistance to abrasion and erosion, as well as acids, bleaches, alkalis, solvents and other corrosive chemicals. CP-83MP is especially suited for use in wear tile applications requiring high bond strength, physical properties and good chemical resistance. Blome CP-83MP is resistant to caustic solutions, most dilute acids, hypochlorite bleaches and other harsh chemicals. The material is also well suited for use as a concrete repair putty for filling form voids, crack repair and other concrete applications requiring high physical properties.

TYPICAL USES

Blome CP-83MP is suitable for bonding brick, tile and concrete in a variety of applications including:

- Chutes, Hoppers and Troughs
- Slurry Pipe Linings
- Pulverizers, Ball Mills and Classifier Cones
- Concrete Crack Repair and Form Void Filling

HANDLING CHARACTERISTICS

Blome CP-83MP offers excellent trowelling and handling characteristics, with sufficient body and thixotropy to butter brick in place and secure them from slipping or sliding while the mortar cures. CP-83MP cures rapidly and provides an excellent bond to brick and tile. This unique formulation produces excellent results while installing brick in horizontal, vertical and even overhead areas.

TYPICAL PROPERTIES

WET

Components:	Two (2) - Resin & Hardener
Wet mortar density:	11-12 lbs. per gallon
Mixed consistency:	Creamy mortar
Pot life:	50°F 60 minutes 77°F 40 minutes
Initial set:	50°F 4 - 6 hours 77°F 2 - 3 hours
Final cure	50°F 7 days minimum 77°F 5 days minimum

CURED

Absorption (ASTM C-413)	0.24%
Bond Strength to red shale brick (ASTM C-321)	brick failure
Coefficient of Thermal Expansion (ASTM C-531)	$12 - 14 \times 10^{-6}$ in/in/°F
Color	Gray
Compressive Strength (ASTM C-579)	10,500 psi
Tensile Strength (ASTM C-307)	4,100 psi

PACKAGING & STORAGE

Blome CP-83MP is supplied as a two (2)-component product, with Resin and Hardener paste components. CP-83MP Resin (Part A) is packaged in one gallon cans, CP-83MP Hardener (Part B) is also packaged in one gallon cans.

Unit Size	Two (2) gallons
Resin	One (1) gallon can
Hardener	One (1) gallon can

Shelf life for CP-83MP components is one (1) year. Keep CP-83MP components tightly sealed in original containers until ready for use. Store components in a cool, dry place, out of direct sunlight, and on pallets at temperatures between 50°F – 80°F.

ESTIMATED COVERAGE

One two-gallon unit of CP-83MP covers approximately 14 ft² of tile lining when used as a setting bed for tile with a nominal 1/16" joint thickness between the tile. This is an estimated coverage rate and does not allow for waste, bed or side joint variations, or other job site contingencies.

BID SPECIFICATION GUIDE

Use Blome CP-83MP Epoxy Adhesive/Mortar as manufactured by Blome International, O'Fallon, MO.

JOB SITE ENVIRONMENTAL CONDITIONS

Blome CP-83MP is best applied while ambient temperatures are between 50°F and 90°F. Blome CP-83MP components, brick, tile and substrate temperatures must also be maintained in this range. Installations of CP-83MP should be protected from water and weather during installation and curing.

SURFACE PREPARATION

Concrete must be adequately cured, structurally sound and dry. It must be free of dirt and contaminants and all defects should be repaired. All loose coatings must be removed. Concrete must be dry in accordance with ASTM D 4263 Plastic Sheet Test Method. Concrete surfaces must be free of all laitance, oil, curing compounds, and any dust or other loose materials prior to installation of materials. Concrete must be etched or roughened by abrasive blasting, shot blasting, grinding or in some instances, it may be acid etched. Check with Blome International for optional recommendations.

Brick and tile to be installed with Blome CP-83MP must be clean, dry and oil free. If brick or tile has been frozen, they must be thawed completely and allowed to dry prior to installation with Blome CP-83MP. Liquid or Sheet applied membrane surfaces should be clean and dry prior to installation of Blome CP-83MP bed joint. These surfaces should be swept clean and be free of dirt, dust, water or other jobsite contaminants.

SAFETY PRECAUTIONS

Blome CP-83MP Resin, Hardener, and mixes of them present various health hazards if handled improperly. CP-83MP Resin will cause eye injury and irritate skin and CP-83MP Hardener is a corrosive. Wear safety glasses with side shields, gloves and long sleeve shirts to prevent all contact with skin and eyes. After working with Blome CP-83MP, wash thoroughly before eating, drinking, smoking or other activities.

APPLICATION EQUIPMENT

Blome CP-83MP is best mixed with a trowel or mixing stick. It may also be mixed with a KOL, pail type mixer or in a pail using a drill motor driven paddle blade. This mixing equipment must be clean, dry and free of any contaminants including Portland Cement, other mortars or resins. When mixed, CP-83MP is applied to brick and substrate with a pointing or margin trowel.

MIXING AND APPLICATION

CP-83MP is mixed at a 1:1 ratio by volume. Mix together equal volumes of Resin (Part A) and Hardener (Part B) and blend thoroughly for 1-2 minutes. The components have contrasting colors; mix these two parts until a uniform color is achieved. Mix components for a minimum of 1-2 minutes, making sure there are no stripes or inconsistencies.

Place brick or tile in wet adhesive mortar in accordance with project specification. When laying brick, use a clean, dry pointing or margin trowel, butter brick or tile evenly on 4 or 5 sides. Slide buttered brick or tile into place, squeezing excess mortar from joints. Strike off excess mortar & remove. Joint thickness should be nominally 1/16".

CLEANUP

All tools, mixing equipment, gloves and application equipment should be cleaned up immediately using a citrus or biodegradable cleanser, with hot water, while material is still wet. If material begins to cure, solvent-based cleaners will be required for removal.

WARRANTY

We warrant that our goods will conform to the description contained in the order and that we have good title to all goods sold. Our material data sheets and other literature are to be considered accurate and reliable, but are used as guides only. WE GIVE NO WARRANTY OR GUARANTEE, WHETHER OF MERCHANT ABILITY OR FITNESS OF PURPOSE OR OTHERWISE, AND WE ASSUME NO LIABILITY IN CONNECTION THEREWITH. We are happy to give suggestions for applications; however, the user assumes all risks and liabilities in connection therewith regardless of any suggestion, we may give. We assume no liability for consequential or incidental damages. Our liability, in law and equity, shall be expressly limited to the replacement of non-conforming goods at our factory, or at our sole option, to repayment of the purchase price of the non-conforming goods.



Blome Primer 75

Moisture Tolerant Epoxy Primer

PRODUCT DESCRIPTION

Blome Primer 75 is a two-component, moisture-tolerant epoxy primer for steel, concrete and other substrates as specified. It is used to prime concrete, steel and other substrates prior to application of other Blome International coatings, linings, membranes, sealants and polymer concretes. It achieves a tenacious bond to the substrate and tolerates substrate dampness but not wet surfaces.

GENERAL USES

Blome Primer 75 is used as a primer for other Blome International materials in a wide variety of applications. Typical applications include:

- Secondary containment linings
- Tank linings
- Monolithic floor toppings
- In-situ polymer concrete installations
- Trench linings

HANDLING CHARACTERISTICS

- Blome 75 is available in convenient 2-parts resin to 1-part hardener kits. It is easily applied by brush, roller, spray or squeegee. Its excellent wetting characteristics and low viscosity facilitate application.
- Blome 75 is normally applied at 100 square feet per gallon on concrete and other porous surfaces.
- Blome 75 is normally applied at 150 square feet per gallon on steel and other non-porous substrates.
- Consult the data sheet for the Blome International overcoat material for additional details and revised film thickness requirements.
- Blome 75 is also available in a Low Temperature Curing version, which allows installation at temperatures as low as 40°F.

TYPICAL PROPERTIES

WET

Color: Milky White/Clear

Moisture Tolerance: Good

Solids (by weight): 100%

CURED

Water absorption: Very low, 0.16%

Adhesion to concrete: 500 psi (failure in concrete)

PACKAGING & STORAGE

Blome 75 is packaged in 1.5-gallon and 15-gallon kits. Each component is pre-measured and ready to use. Store unopened components in a dry place, out of direct sunlight and protected from the elements. Storage temperature should be 50-95°F. Properly stored, Blome 75 has a shelf life of 12 months. Refer to the date of manufacture printed on the label.

SPECIFICATION GUIDE

Prime all surfaces with a two-component, moisture-tolerant epoxy primer meeting the generic formulation and performance characteristics of Blome Primer 75 as manufactured by Blome International, O'Fallon, MO (800) 886-3455. Install in accordance with the latest data sheet for Blome Primer 75 and the corresponding Blome overcoat material as well as good industry practice.

APPLICATION GUIDELINES ENVIRONMENTAL CONDITIONS

Blome 75 should be applied at surface and air temperatures of 50°F minimum and 95°F maximum. The ideal temperature range is 60-90°F. Air temperature should always be at least 5°F greater than the current dew point. For applications at 40-60°F, we recommend using Blome 75 Low Temperature Cure. Applications below 40°F are not recommended because of the potential for coating over ice or frost; consult Blome for these low temperature applications.

JOBSITE STORAGE OF MATERIALS

Proper storage of Blome International products is important to a successful application. Follow these general storage procedures:

1. Store components (Part A and Part B) unopened, at 50-85°F, out of direct sunlight and protected from the elements.
2. Keep away from heat and flame. For the 24 to 48 hours just prior to use, adjust the storage temperature to 70-85°F to facilitate handling.

SURFACE PREPARATION- STEEL

The following recommendations generally apply to the proper surface preparation of steel for Blome 75 but consult the data sheet of the Blome overcoat material for any additional or superseding requirements for surface preparation.

1. Steel substrate must be free of all oil, grease, dirt, dust, mill scale, rust, existing coatings and other contamination.
2. All welds must be smooth and continuous. All weld splatter, buckshot, laminations, and slivers must be removed and ground smooth.
3. Undercuts and pinholes must be filled with weld metal and ground smooth.
4. *Atmospheric service:* Abrasive blast in accordance with SSPC-SP 10 Near White Blast Finish (NACE No. 2) and 2 to 4 mil dense, sharp anchor profile.
5. *Immersion service:* Abrasive blast in accordance with SSPC-SP 5 White Metal Blast Finish (NACE No. 1) and 2 to 4 mil dense, sharp anchor profile.

SURFACE PREPARATION- CONCRETE

The following recommendations generally apply to the proper surface preparation of concrete for Blome 75 but consult the data sheet of the Blome overcoat material for any additional or superseding requirements for surface preparation.

1. Concrete should be adequately cured, possess adequate integrity and not be expelling excess water of hydration. A rule of thumb for cure of new concrete is 28 days cure at 70°F but that is not an assurance that the concrete has achieved adequate physical properties.
2. Concrete should exhibit a compressive strength of 3,000 psi minimum and tensile strength of 300 psi or higher.

3. Ground slabs and new concrete should be tested for excess moisture in accordance with ASTM D 4263 Plastic Sheet Test Method; any water on the backside of the sheet after overnight exposure is an unacceptable surface for coating.
4. We recommend utilization of a low water-cement ratio, preferably 0.38 and adequate superplasticizers for placement is recommended, particularly when cure time to coat is critical.
5. New concrete must also be free of curing compounds, form release agents and any other contamination that might inhibit adhesion.
6. Old concrete must be free of existing coatings or toppings and any loose or unsound concrete must be removed. All concrete must be cleaned, as necessary, in accordance with ASTM D 4258. The resultant surface should be free of all oil, grease, and other contamination. Consult Blome International for special procedures for oil contaminated surfaces.
7. Upon completion of cleaning, the concrete surface shall be prepared in accordance with ASTM D4259.
8. The resultant surface should be free of laitance and efflorescence and have a surface texture similar to medium (60-80 grit sandpaper).

SURFACE PREPARATION- MISCELLANEOUS SURFACES

Consult Blome International for use over substrates other than steel or concrete.

MASKING & PROTECTION

Mask or remove adjacent surfaces and equipment that are not to be lined and all termination points.

APPLICATION EQUIPMENT

Blome 75 may be applied by brush, roller, squeegee or spray. Since brush application is often for small areas or touchup, disposable china bristle brushes are recommended. Roller covers should be phenolic core roller suitable for epoxies and the nap thickness should reflect the texture of the substrate. Flat squeegees may be used and solvent resistant squeegee blades will facilitate cleanup and reuse. Blome 75 may also be applied by spray using airless spray equipment or plural component spray equipment. A 30 to 1 ratio pump, 3/8" ID material line and a spray gun such as a Graco Silver Gun is suggested.

MIXING TECHNIQUE

We recommend using Jiffy type mixers for all mixing and stirring. When operating the mixer, avoid plunging it up and down in the bucket. This can fold air into the resin, which may cause bubbles to form in the coating after it has been applied. Be especially careful not to allow water to enter the mix.

WORKING TIME

The working time for Blome 75 is 30-35 minutes at 75°F in 1-½ gallon kits. Working time will be longer for cooler temperatures and will be much shorter at higher temperatures. Larger kit sizes will also reduce working time.

MIXING & APPLICATION

1. Add the hardener to the resin and thoroughly mix for at least 1-2 minutes. Uniform mixing is critical to uniform curing of the applied film.

2. Apply Blome 75 at a uniform thickness using the application method of choice. If applying by spray or squeegee to concrete surfaces, backroll to ensure adequate wetting of the substrate and encapsulation of any fines on the surface.
3. Topcoats are best applied within 24 hours after primer is applied. Topcoats may be applied while primer is tacky or after initial cure, within 24 hours at 75°F.

TOUCH-UP & RECOATING

Blome 75 may be recoated with itself or topcoated without special surface preparation within 24 hours. Beyond 24 hours, light sanding to de-gloss is recommended before recoating or topcoating. If Primer has cured for longer than seven (7) days, light sanding to de-gloss and repriming are recommended.

CLEAN-UP

The following tips will be helpful in cleaning hand tools and equipment after use. Before Blome 75 gels, it can be cleaned from hand tools and equipment using hot, soapy water. Spray equipment should be flushed periodically and at days end with solvent to avoid gelling in the equipment and hoses. Follow the equipment manufacturer's recommendations for proper cleaning and care instructions. After Blome 75 gels, xylene or MEK will be required for cleaning. Chlorinated solvents may be used if flammable solvents are not allowed.

CAUTION

Blome 75 may cause skin irritation with prolonged or repeated contact. Avoid skin contact and follow the material safety data sheet, which is available for each product.

WARRANTY

We warrant that our goods will conform to the description contained in the order and that we have good title to all goods sold. Our material data sheets and other literature are to be considered accurate and reliable, but are used as guides only. WE GIVE NO WARRANTY OR GUARANTEE, WHETHER OF MERCHANT ABILITY OR FITNESS OF PURPOSE OR OTHERWISE, AND WE ASSUME NO LIABILITY IN CONNECTION THEREWITH. We are happy to give suggestions for applications; however, the user assumes all risks and liabilities in connection therewith regardless of any suggestion, we may give. We assume no liability for consequential or incidental damages. Our liability, in law and equity, shall be expressly limited to the replacement of non-conforming goods at our factory, or at our sole option, to repayment of the purchase price of the non-conforming goods.



TL-45-S

High-Build Novolac Epoxy Coating and Lining System

DESCRIPTIONS AND USES

Blome International's Novolac Epoxy tank lining systems are formulated to offer superior resistance to some of the most aggressive chemicals found in the process industries. Blome TL-45-S exhibits excellent resistance to a broad range of harsh chemicals, including high concentrations of sulfuric acid, hydrochloric acid, phosphoric acid, strong caustic solutions, as well as many organic chemicals and solvents.

TL-45-S is a high performance Novolac epoxy tank lining/coating system for immersion service. Typically spray applied, its high build properties allow thicknesses of up to 80 mils to be achieved on vertical surfaces.

TL-45-S is a two component product with a 4:1 volumetric mix ratio. TL-45-S possesses the following properties:

- Excellent chemical resistance;
- Thermal shock, impact and wear resistance;
- 100% solids;
- Long Pot Life for airless spray application;
- Excellent bond strength;
- Resistance to chipping and cracking due to torsional twisting;
- Superior edge coat properties;
- High cohesive strength;
- Low permeability;
- Low odor

Typical uses include:
Tank Linings, External Tank Coatings, Coating
Structural Steel in harsh chemical vapor environments.

PACKAGING/COVERAGE

TL-45-S is available in 1-gallon, 5-gallon, and 25-gallon units. Each unit consists of premeasured Part A and Part B components.

Application thickness will vary depending on expected service conditions. Consult Blome International's Tank Lining Systems Guide or contact our technical service group for specific lining recommendations.

Coverage rates will be affected by the condition of surface being coated (degraded vs. smooth, steel vs. concrete, etc.). To calculate theoretical coverage per gallon, divide desired mil thickness into 1,604. (For example, theoretical coverage for a 30 mil thickness is: 1,604 divided by 30 = 53.46 square feet per gallon.) For practical coverage, make necessary allowances for condition of the substrate, temperatures, jobsite conditions, waste, overspray, etc.

TYPICAL PROPERTIES -WET

Solids by Volume:	100%
Weight per Mixed Gallon:	10 lbs
Pot Life @ 75°F:	40 to 45 min*
Cure Times @ 75°F:	Dry to Touch: 16 hrs
Firm:	24 hrs
Chemical Service:	72 hrs
Primer:	Not required on properly prepared steel
Flammability:	Nonflammable

*Significantly less at elevated temperatures

TYPICAL PROPERTIES -CURED

Color:	Medium Grey or Red
Hardness- ASTM D-2240 Shore D:	74
Compressive Strength -ASTM C-579:	15,000 psi
Tensile Strength -ASTM D-638:	7,900 psi
Flexural Strength -ASTM D-790:	13,500 psi
Flexural Modulus of Elasticity -ASTM D-790:	7.7 psi x 10 ⁵
Bond Strength -ASTM D-4541:	Concrete:concrete failure
	Steel: 1 ,500 psi
Water Vapor Transmission -ASTM E-96:	0.0120 grain per hr ft ²
Permeability:	0.0036 perm. - in.

STORAGE AND SHELF LIFE

Keep TL-45-S components tightly sealed in their original containers until ready for use. Store at 50°F to 75°F out of direct sunlight.

APPLICATION GUIDELINES

For applications on vertical surfaces, use TL-45-S within four months of its date of manufacture. Otherwise, Blome TL-45-S has a shelf life of one year, when properly stored.

TEMPERATURE CONSIDERATIONS

The temperature of the surface to be coated, and the ambient air temperature should be at least 55°F while applying TL-45-S and while it cures. If you attempt to apply TL-45-S in cooler temperatures, tarp and heat the area to be coated to maintain the minimum 55°F conditions.

Stop application if the temperature falls within 5°F of the dew point.

Outgassing bubbles may appear in TL-45-S if it is applied over concrete, particularly in direct sunlight, or when air and substrate temperatures are rising. This is due to the expansion of air and/or moisture trapped in the concrete. It is especially true of air entrained concrete. For best results, shade the work area and apply TL-45-S when the temperature of the concrete substrate is falling. A surface thermometer must be used to frequently monitor substrate temperature.

Twenty-four hours before application, all materials (components A and B) should be stored at a 75°F to 85°F, to facilitate handling and spraying.

SURFACE PREPARATION -GENERAL

Surfaces must be dry and free of dust, dirt, grease, oil, chemicals and contaminants immediately prior to applying each coat of either primer or TL-45-S.

SURFACE PREPARATION OF STEEL

1. Abrasive blast steel surfaces to white metal finish with a 2 to 3 mil anchor profile. (Ref. SSPC-SP-5)
2. All welds should be continuous and should be ground to remove all sharp edges, laps, under cuts and other surface irregularities. Relatively smooth, ripple finished welds are acceptable. Stripecoat all welds just prior to applying coating.
3. Steel in Non -Immersion Service
Abrasive blast steel surfaces to a near white metal finish with 1 to 2 mil anchor profile. (Ref. SSPC-SP-10)

MASKING

Mask surfaces that are not to be coated. TL-45-S is difficult to remove, once cured.

PRIMING

Steel -priming not required.

APPLICATION EQUIPMENT

TL-45-S may be applied using a spray rig, brush or notched trowel. Use Graco 45:1 King airless spray rig or Graco Hydro-Cat fixed at a 4:1 volumetric ratio.

CARE OF SPRAY RIG HOSES

Take care to prevent the mixed material from setting up in your hoses. For best results, keep hoses as short as possible, purge hoses immediately if work is interrupted. Keep hoses out of direct sunlight and insulated or away from hot surfaces.

MIXING AND APPLICATION

TL-45-S may be thinned for certain applications. Use up to 5% by weight of MEK. Refer to specifications for your project, or consult Blome International for alternate thinner recommendations. The mix ratio of Part A to Part B is 4:1 A to B by volume.

1. The components must be individually mixed immediately prior to use:
Part A: Blend Part A component to a uniform consistency in its individual container, using a Jiffy type mixer.
Part B: Blend Part B component to a uniform consistency in its individual container.
2. If you are using plural component equipment, skip this step. Otherwise:
Pour the entire contents of Part B into the container holding Part A and mix thoroughly for two minutes using a Jiffy type mixer. The temperature of the mixed material should be 75°F to 85°F for hot potting. The pot life of the mixture will be approximately 40 to 45 minutes at 75°F; significantly less time at elevated temperatures. The longer the material is in the bucket after mixing, the shorter its pot life will be. Therefore, use immediately once mixed.
3. Material should be applied in even coats.
If spraying, use multidirectional passes to ensure positive coverage and proper film build

4. Horizontal Surfaces

The entire thickness may be applied to horizontals in a single coat.

5. Vertical Surfaces

Minimum of 15 mils up to 80 mils may be applied to vertical surfaces.

6. Spark Testing Steel

Spark testing is recommended for coated steel in immersion service.

Test at 100 volts per mil.

7. Prepare surfaces for inter-coat adhesion as follows:

- a. Allow TL-45-S to cure until firm before applying subsequent coats.
- b. After the surface cures firm to the touch, but less than 24 hours, it must be washed with soap and water, rinsed and dried before re-coating.
- c. Surfaces cured beyond 24 hours must be washed with soap and water, rinsed, dried and lightly sanded or abrasive blasted.

8. If work is interrupted, or at the end of the day, terminate the coating in a straight line.

9. As it cures, TL-45-S will sometimes develop a thin, oily film on its surface. This film may be easily removed by washing with soap and water.

CLEANUP

Before material gels, tools and equipment should be cleaned using hot, soapy water. After TL-45-S begins to cure, thinners will be required. Chlorinated solvents may be used if flammable solvents are prohibited.

**SAFETY PRECAUTIONS
FOR INDUSTRIAL
USE ONLY**

Avoid contact with skin and eyes; do not ingest material or inhale vapors. When working with TL-45-S, always wear chemical goggles, appropriate rubber gloves, and other appropriate safety clothing. When spraying in confined areas, wear a fresh air hood and make provisions for forced air ventilation. When spraying in open areas, a NIOSH approved respirator suitable for organic vapors can replace fresh air hood. Prolonged or repeated exposure to the Part A and Part B components of TL-45-S may cause skin irritation and/or allergic reactions. Refer to Blome Material Safety Data Sheets for individual components.

WARRANTY

We warrant that our goods will conform to the description contained in the order and that we have good title to all goods sold. Our material data sheets and other literature are to be considered accurate and reliable, but are used as guides only. WE GIVE NO WARRANTY OR GUARANTEE, WHETHER OF MERCHANT ABILITY OR FITNESS OF PURPOSE OR OTHERWISE, AND WE ASSUME NO LIABILITY IN CONNECTION THEREWITH. We are happy to give suggestions for applications; however, the user assumes all risks and liabilities in connection there with regardless of any suggestion, we may give. We assume no liability for consequential or incidental damages. Our liability, in law and equity, shall be expressly limited to the replacement of non-conforming goods at our factory, or at our sole option, to repayment of the purchase price of the non-conforming goods.



TL-495 125-150 mil Woven Roving Glass Reinforced Novolac Epoxy Lining System

PRODUCT DESCRIPTION

TL-495 tank lining system is a high performance heavily reinforced Novolac Epoxy lining system. TL-495 consists of a primer, a trowel applied mortar basecoat, a layer of woven roving reinforcing glass saturated with TL-495 and trowel applied mortar topcoat.

TYPICAL USES:

TL-495 is a heavy duty, reinforced lining system that is crack resistant, impact resistant and is resistant to a wide variety of aggressive chemicals found in industrial plants. TL-495 is typically used to line steel and concrete tanks holding or processing various chemicals. Because of the systems wear resistance, impact resistance and crack bridging qualities it is also ideally suited for protecting concrete floors, walls, trenches and sumps exposed to aggressive chemicals.

HANDLING CHARACTERISTICS:

The basecoat and topcoat mortar of the TL-495 are applied by trowel. A medium nap roller is used to apply the saturant for the woven glass reinforcement.

TYPICAL PROPERTIES

	PROPERTY	TL-495
	Tensile strength ASTM C-307-83	2,250 psi
	Compressive strength ASTM C-579-82	11,380 psi
	Coefficient of thermal expansion	$12-15 \times 10^{-6}$ in/in/°F
	Color*	Red, gray

*carbon filled systems are only available in black

PACKAGING & COVERAGE

TL-495 is a multi component system consisting of Part A (resin) and Part B (hardener), 410 Filler, 10oz woven roving. TL-495 components are packaged as follows:

Component	Packaging Size	Coverage
TL-495 Resin & Hardener	1 gallon unit	16 sq. ft./gallon
Use for basecoat, saturant and top coat	5 gallon unit	
410 Filler Powder	50 lb. Bag	80 sq. ft./bag
Use for basecoat and top coat	(add 20-30 lbs./gal.)	40 mil basecoat
410C Filler Powder (carbon)	50 lb. Bag	100 sq. ft./bag
	(add 14-20 lbs./gal.)	40 mil basecoat
450 Woven Roving Reinforcement	Rolls	Area + 10%
443 Synthetic Cloth Reinforcement (for use with carbon filled systems)	Rolls	Area + 10%

**POT LIFE AND CURE
SCHEDULE @ 75°F***

Product	Pot life	Recoat	Chemical service
Primer 75	25-30 minutes	Min. 4 hrs, max. 72 hrs	N/A
TL-495 (basecoat, saturant and top coat)	20-30 minutes	Basecoat: min. N/A** max. 30 – 40 minutes Saturant: min. 5 hrs, max. 72 hrs. Topcoat: min. 4 hrs max. 24 hrs	FINISHED SYSTEM: 48 HOURS

*These materials may be applied between 50 – 90°F. The pot life will be longer at the lower temperature range and much shorter at the higher temperature range.

** Basecoat must be covered with glass reinforcement and glass reinforcement must be saturated before basecoat begins to gel.

BID SPECIFICATION GUIDE

Use Blome TL-495 System consisting of a 50-60 mil basecoat mortar applied by trowel, one layer of 10 ounce woven roving glass saturated with TL-495 resin and a 50-60 mil, trowel applied, aggregate filled TL-495 Novolac Epoxy top coat. Finished thickness of the system should be 125-150 mils.

**APPLICATION GUIDELINES
STORAGE OF MATERIALS**

Proper storage of these materials is critical to handling characteristics and performance. Store all components in unopened containers in a dry place, at 50-75°F, out of direct sunlight, and protect from the elements. Keep away from heat and flame. 24 hours before use, narrow the storage temperature to 70-80°F to facilitate handling of the product. This product has a shelf life of 12 months when properly stored.

**JOB SITE ENVIRONMENTAL
CONDITIONS**

The temperature of the surface to be lined and the ambient air temperature must be at least 50°F while applying this product and as it cures. Monitor weather conditions and dew point. Stop the application if the temperature falls within 5°F of the dew point. Use dehumidification and/or temperature control if necessary to meet this requirement.

SURFACE PREPARATION

STEEL: Steel surfaces intended for lining application must be clean and free of oil, grease, dirt, rust, mill scale, salts, other coatings, corrosion products and other deleterious substances. Welds and weld splatter must be ground smooth. Avoid skip welds. Grind all sharp projections and round all corners to a 1/8" radius. All steel to be lined must be abrasive blasted to white metal finish (NACE no. 1, SSPC SP5) with a 2-4 mil sharp anchor profile. Mask all areas that are not to be lined.

CONCRETE: New concrete must cure a minimum of 28 days. Concrete surfaces should be abrasive blasted to provide a sound surface with a texture similar to medium grit sandpaper. Surfaces must be dry.

PRIMING/SURFACE REPAIR

Mix and apply Primer 75 by brush, roller or spray. Apply at 6-8 mils. Do not allow primer to puddle. Coverage rate should be 150-175 square feet per gallon. Allow primer to cure until slightly tacky before proceeding with application of TL-495.

When priming concrete, it is important to apply the primer when ambient and substrate temperatures are declining. Apply sufficient amount of primer to seal the surface of the concrete without creating puddles. This may require more than one coat of primer depending on the porosity of the concrete. If more than one coat is necessary, allow each coat to cure tack free before applying the next coat.

After the last coat of primer has cured tack free, fill any voids in the concrete surface using Blome TL-495 basecoat material and allow to cure tack free before proceeding with application of the TL-495 lining system.

MIXING AND APPLICATION

Important note: Plan your work carefully. Pre-cut reinforcing glass into easy to handle pieces. It's a good idea to have at least a couple of pair of metal spiked shoes such as golf shoes on hand so that crew members can walk onto the wet basecoat without disturbing it and address minor problems that cannot otherwise be reached. Cover just enough area with basecoat that can be finished with glass and saturant before the basecoat begins to set. Areas in direct sunlight and in a warm environment will set much faster than shaded, cool areas. Also, working in direct sunlight may cause pinholes and bubbles to form in the basecoat.

TL-495 basecoat is a mortar mix. To make it you will need an empty, clean five-gallon pail and a mixing drill with a mixing paddle attached. Mix TL-495 resin and hardener together for 1-2 minutes, slowly add the 410 Filler Powder to the mixed resin and hardener and blend thoroughly. Immediately apply to prepared and primed surface using a notched trowel, dry wall blade or plaster trowel. Apply at an even thickness of 50-60 mils. As soon as an area is covered with the basecoat and before it begins to set up or gel, imbed a layer of Blome **#450 woven roving reinforcement** using a dry short nap or a ribbed roller to press the glass into the wet basecoat. Overlap seams of glass a min. of two inches.

TL-495 Saturant: Mix the Part A resin and Part B hardener in a clean 5-gallon pail. Immediately apply saturant to the glass reinforcement using a medium nap roller. Apply saturant coat at an approximate rate of 0.3 lbs per square foot. Work from the pail dipping the roller into the resin and applying in even coats to saturate the glass. Apply liberal coat between overlapped glass. DO NOT pour the resin onto the surface as this will greatly reduce coverage rates.

Glass reinforcement is saturated when the silver color of the glass disappears. Allow to cure until hard, usually about 12 hours at 75°F or above.

TL-495 Topcoat: Roughen the surface of the saturant coat and grind away any protrusions and imperfections. Remove all dust and debris by vacuuming and wiping with a clean cloth. Mix topcoat mortar material as described for the basecoat (Part A and Part B and #410 powder) for 2-3 minutes. Apply topcoat material by trowel at 50-60 mils thick. Check the thickness with a wet film gauge. A stiff bristle brush works well to remove trowel marks and aid in closing the surface of the mortar. A **smoothing liquid** is available from Blome and should be used sparingly so as not to create puddles. Allow to cure for 48 hours at above 75°F before placing in service.

TOUCH UP OR RE-COATING

Inter-coat prep for touch up or re-coating requires that the surface be clean, dry and roughened by sanding, grinding or abrasive blasting. Touch up or recoat as needed using TL-495 materials.

CLEANUP

Clean tools and equipment with nonflammable solvents before material begins to set.

SAFETY PRECAUTIONS

The various components of TL-495 products present health and safety hazards if they are handled improperly. Do not store, mix or use near open flame, sparks or heat source. Keep all containers closed when not in use. Always wear safety glasses, proper respirator, protective clothing and rubber gloves while mixing or applying these products. Refer to Material Safety Data Sheet prior to using these products.

CAUTION

TL-495 may cause skin irritation with prolonged or repeated contact. Handle with care and read the material safety data sheet, which is available for each product.

WARRANTY

We warrant that our goods will conform to the description contained in the order and that we have good title to all goods sold. Our material data sheets and other literature are to be considered accurate and reliable, but are used as guides only. WE GIVE NO WARRANTY OR GUARANTEE, WHETHER OF MERCHANTABILITY OR FITNESS OF PURPOSE OR OTHERWISE, AND WE ASSUME NO LIABILITY IN CONNECTION THEREWITH. We are happy to give suggestions for applications; however, the user assumes all risks and liabilities in connection therewith regardless of any suggestion, we may give. We assume no liability for consequential or incidental damages. Our liability, in law and equity, shall be expressly limited to the replacement of non-conforming goods at our factory, or at our sole option, to repayment of the purchase price of the non-conforming goods.

ATTACHMENT B
REVISED SPECIFICATIONS

SECTION 01010

SUMMARY OF WORK

PART 1 – GENERAL

1.01 LOCATION OF WORK

Work included in this Contract will be conducted at the Crystal River Units 4 & 5 coal fired power plant located approximately 10 miles north and west of Crystal River, Florida. The Crystal River Plant is operated by Progress Energy Florida, Inc. (PEF).

1.02 DESCRIPTION OF WORK

- A. The Work of this construction project, in general, is construction of Flue Gas Desulfurization (FGD) Blowdown Ponds and associated operating components to the limits and elevations shown on the drawings. The ponds include a primary pond and a backup pond to be used during interruptions in service to the primary pond. Engineering is complete for the primary pond and drawings are included. A preliminary sketch of the backup pond is also included; design drawings for the backup pond will be provided at a later date. The Work includes all initial grading; subsurface remediation (as defined by **ENGINEER**); all earthwork related to the construction of the pond berms and access roadway, installation of Linear Low Density Polyethylene (LLDPE) geomembrane as the pond liner, all work related to the installation of FGD Blowdown inlet piping (from identified point), all work related to installation of the outlet structure and piping (to an identified point), all work related to the final grading of exterior of pond berms and entire former ash pond area (as defined on the drawings), and all other incidentals as are required by drawings, specifications, contract documents and permits along with all other appurtenances and incidentals, complete in-place and ready for operation and use by the **OWNER**.

In so far as the power plant operations by the **OWNER** are required to be ongoing during the construction period, the **CONTRACTOR** is required to sequence the work to eliminate interruption of the **OWNER's** operations.

- B. In general, the work components for the approximate 4-acre Primary FGD blowdown pond and smaller backup pond include but are not limited to:
- Grading the existing former ash pond area to the lines and grades shown on the drawings, including the excavation and stockpile of material in the existing perimeter berms (and a limited amount on the base) for use as fill material on the FGD blowdown ponds. **CONTRACTOR** shall assume all of this material is suitable for re-use subject to **ENGINEER** approval. **CONTRACTOR** shall provide erosion control measures to ensure sediment is not allowed to discharge outside the former ash storage area;
 - The use of a heavy-duty vibratory smooth drum roller to compact the area of the footprint of the FGD blowdown ponds for the purpose of identifying potential weak areas in the near-surface subgrade that may form sinkholes;

- The performance of subsurface remediation in areas identified by the **ENGINEER** and as shown on the drawings as well as areas identified by the vibratory compaction efforts. This work shall be conducted by an **ENGINEER**-approved specialty contractor as a subcontractor to the **CONTRACTOR**;
 - Providing additional **ENGINEER**-approved fill material as required;
 - The installation of two layers of a reinforcing geotextile over the area of the FGD blowdown pond footprint and covering of same with a minimum of 1 foot of soil (each layer) to elevation 94 feet. The installation of the reinforcing geotextile shall be conducted by an **ENGINEER**-approved specialty contractor as a subcontractor to **CONTRACTOR**;
 - Construction of the FGD blowdown pond berms and access ramp;
 - Installation of the LLDPE pond liner system;
 - Installation of the inlet piping system from an identified point northeast of the access ramp, including valves, pipes, cleanouts and multiple vaults to provide four inlet locations for discharge into the ponds;
 - Installation of the outlet structure and appurtenances including overflow pipe, concrete manhole, pumps, piping, motor control center, communication system, and outlet piping to an identified point south of the former ash storage area;
 - Coating of the inside of the concrete manhole;
 - Construction and installation of the pond spillway and associated erosion protection on the west side of the pond;
 - Coating of the concrete spillway;
 - Grading and installation of surface water controls (culverts/ditches) and erosion controls (topsoil and seeding/sodding) to provide drainage away from the ponds base such that there will be no standing water within 200 feet of the outside toe of the pond berms; and
 - Installation of lighting and controls around the perimeter of the roadway at the top of the berm and in the area of the MCC and outlet pump manhole.
- C. **CONTRACTOR** shall cooperate with and not hinder work by other contractors or **OWNER** during the construction of the FGD blowdown ponds. Specifically, other work may include the installation of the FGD blowdown piping to the point of tie-in and the installation of the outlet piping from the point of tie-in to the south percolation pond (which is located outside the former ash storage area). If already in place, any damage to the tie-in points for the FGD blowdown piping and outlet piping is required to be reported to the **OWNER** at once and repaired immediately by **CONTRACTOR** at **CONTRACTOR's** expense. The **CONTRACTOR** is required to prepare a

specific plan for the tie-in of the two piping systems for **OWNER** approval and coordination.

- D. The **CONTRACTOR** shall complete all work described above and all other incidental work, whether specifically mentioned or not in accordance with the Drawings, Specifications, and Contract Documents. **OWNER** has an Approved Vendor List (attached) from which the **CONTRACTOR** shall obtain materials and equipment, if possible. If material or equipment is not available through one of the approved vendors, **CONTRACTOR** shall submit vendor to **OWNER** for approval.
- E. Work shall conform to the following Drawings that form a part of these Contract Documents.

<u>DRAWING NO.</u>	<u>TITLE</u>
1	COVER SHEET
2	Number Reserved for Future Use
3	TOPOGRAPHIC MAP ~~-OF THE~~ FORMER ASH POND AREA <u>FGD POND AREA</u>
4	SUBSURFACE BORINGS AND REMEDIATION LOCATIONS
5	INITIAL GRADING PLAN AND LIMITS OF REINFORCING GEOTEXTILE
6	PLAN VIEW OF POND LAYOUT
~~6A~~	~~BACKUP POND SKETCH~~
7	CROSS SECTIONS
8	FINAL GRADING PLAN
<u>8A</u>	<u>FORMER ASH POND LIMITS RELATIVE TO FGD PONDS DESIGN</u>
9	FINAL GRADING PLAN DETAILS
10	LINER SYSTEM AND ROADWAY DETAILS
11	INLET PIPING DETAILS (SHEET 1 OF 2)
12	INLET PIPING DETAILS (SHEET 2 OF 2)
13	OUTLET PIPING DETAILS
14	PROCESS AND INSTRUMENTATION DIAGRAM
15	ELECTRICAL SERVICE ROUTING AND DETAILS

1.03 WORK BY OWNER

- A. **OWNER** will continue the operation of the power facility during construction but the area of construction of the FGD blowdown ponds is generally isolated from plant activities. However, material deliveries, including soil, piping, concrete, etc., will require use of plant roadways outside the FGD blowdown ponds area. **CONTRACTOR** shall coordinate with **OWNER** regarding all deliveries, haul routes, etc. such that minimal interference with plant operation and all other construction activities occurs.
- B. **OWNER** will furnish the outlet pumps, Motor Control Center (MCC), radio control equipment for communication back to plant DCS, and transformer. **OWNER** will provide a pad-mounted transformer in the area of the new ponds. Transformer will be fed with underground service from an area outside the ponds. **CONTRACTOR** shall cooperate with **OWNER** for installation of the

transformer and feed. **CONTRACTOR** will be responsible for the transportation from on-site storage, installation and connections to the equipment supplied by **OWNER**. **CONTRACTOR** to also provide commissioning of **OWNER**-supplied equipment; also to provide installation, commissioning and connections for DCS equipment at pond including full loop path checks, HMI verification, and equipment testing. See attached List of **OWNER** Supplied Material for details.

- C. **OWNER** will furnish reinforcing geotextile. **CONTRACTOR** will be responsible to receive, unload, store, and install reinforcing geotextile (as above, installation shall be performed by an **ENGINEER**-approved specialty contractor). See attached List of **OWNER** Supplied Material for details.
- D. **OWNER** will provide Construction Quality Assurance (CQA) during construction activities. CQA activities will include on-site inspection and quality assurance during construction including scheduled checking of soil placement testing, liner testing, and construction observation of the materials and equipment component installation. The complete CQA Plan included as Appendix A to the Technical Specification package. Some of the functions are as follows:
- Inspection of materials,
 - Review of site layout,
 - Sub-grade compaction verification,
 - Verification of geosynthetic characteristics,
 - Geosynthetic deployment and seaming observation,
 - Observation of cover placement over geotextile,
 - Inspection of pipe placement and backfill compaction,
 - Review of pipe testing, and
 - Inspection of **CONTRACTOR**'s quality control procedures associated with soil classification, lift thickness, permeability, and compaction verification.

CONTRACTOR shall adhere to CQA procedures and work in cooperation with the **OWNER**'s representatives toward the successful completion of the project.

1.04 WORK BY CONTRACTOR

- A. The **CONTRACTOR** shall furnish all labor, materials, equipment (except as listed above to be provided by **OWNER**), tools, services and incidentals to complete all of the work required as shown on the Drawings and included in the Specifications.

- B. The **CONTRACTOR** shall complete the work, in place, ready for continuous service, and shall include repairs, testing, permits, cleanup, replacements, and restoration required as a result of damages caused during construction.
- C. All material, equipment, skills, tools, and labor which are reasonably and properly inferable and necessary for the proper completion of the work, in a substantial manner and in compliance with the requirements stated or implied by the Specifications or Drawings, shall be furnished (except as noted above) and installed by the **CONTRACTOR** without additional compensation, whether specifically indicated in the Contract Documents or not.
- D. The **CONTRACTOR** shall comply with all municipal, county, state, and federal laws, rules, guidelines, and codes, which are applicable to the work.
- E. The **CONTRACTOR** shall provide a Health and Safety Plan (HASP) prior to commencing work on site that provides the **CONTRACTOR**'s health and safety practices and any site specific health and safety requirements for work at this site. **CONTRACTOR** must provide a HASP that is acceptable to **OWNER** and that conforms to the **OWNER**'s health and safety requirements for the plant.
- F. The **CONTRACTOR** will be responsible for any and all traffic control around the construction area.
- G. The **CONTRACTOR** shall maintain dust control on all roads used for access to construction and all construction areas.
- H. The **CONTRACTOR** shall provide marked-up drawings to the **ENGINEER** necessary for the preparation of as-built drawings.
- I. The **CONTRACTOR** shall provide manufacturer recommended spare parts and all Operations and Maintenance Manuals.
- J. The **CONTRACTOR** shall provide a Storm Preparation Plan prior to commencing work on site. The Storm Preparation Plan shall be submitted for **OWNER** approval.

1.05 SITE CONDITIONS

- A. Test borings made at the FGD blowdown pond area for use in the design are included in Appendix B to the Technical Specification package for **CONTRACTOR**'s use.
- B. The **CONTRACTOR** shall be responsible for having determined to his satisfaction, prior to the submission of his Bid, the conformation of the ground, the character and quality of the substrate, the types and quantities of materials to be encountered, the nature of the ground water conditions, the execution of the work, the general and local conditions and all other matters which can, in any way, affect the work under this Contract. No claim for extras based on substrate or ground water table conditions will be allowed.
- C. The **OWNER** does not make any representation regarding the information at the time of Bidding and during construction, and Contractors are encouraged to

visit the site or obtain their own data and make their own judgment as to the existing conditions.

1.06 SCHEDULE OF ACTIVITIES

- A. The **CONTRACTOR** shall be responsible for all submittals and approvals required by the Technical Specifications. A summary of the required submittals, along with due date, are shown on the attached Schedule of Activities. However, it is the **CONTRACTOR's** responsibility to provide all submittals required by the Technical Specifications, regardless of their inclusion on the Schedule of Activities. All submittals and approvals must be in writing.
- B. Submittals to the attention of **OWNER** shall be sent to Mr. Dale Wilterdink, 15760 West Powerline Street, Crystal River, Florida 34428 or his designee.
- C. Submittals to the attention of **ENGINEER** shall be sent to Mr. Ken Karably, 9428 Baymeadows Road, Suite 400, Jacksonville, Florida 32256, or his designee. All submittals to the **ENGINEER** shall copy the **OWNER**.

PART 2 – PRODUCTS (Not used)

PART 3 – EXECUTION (Not used)

END OF SECTION

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SECTION 02770

LLDPE GEOMEMBRANE LINER

PART 1-GENERAL

1.1 SCOPE

- A. This Section includes the requirements for materials, installation and testing for geomembrane liner for installation in the FGD Blowdown Pond.
- B. The liner system geomembrane shall consist of minimum 60-mil thick, textured on both sides, linear low-density polyethylene (LLDPE) sheet.

1.2 REFERENCES

- A. Latest version of American Society for Testing and Materials (ASTM) Standards:
 - 1. ASTM D638 Standard Test Method for Tensile Properties of Plastics.
 - 2. ASTM D746 Standard Test Method for Brittleness, Temperatures of Plastics and Elastomers by Impact.
 - 3. ASTM D792 Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
 - 4. ASTM D1004 Standard Method of Initial Tear Resistance of Plastic Film and Sheeting.
 - 5. ASTM D1204 Standard Plastics Test Method for Lineal Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
 - 6. ASTM D1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
 - 7. ASTM D1505 Standard Test Methods for Density of Plastics by Density-Gradient Technique.
 - 8. ASTM D1603 Standard Test Method for Carbon Black in Olefin Plastics.
 - 9. ASTM D3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
 - 10. ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
 - 11. ASTM D5321 Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method.

12. ASTM D5323 Practice for Determination of 2% Secant Modulus for Polyethylene Geomembranes.
 13. ASTM D5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
 14. ASTM D5596 Recommended Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.
 15. ASTM D5199 Standard Test Method for Measuring the Thickness of Smooth Geomembrane.
 16. ASTM D6392 Test Methods for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
 17. ASTM D6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
- B. Latest version of Federal Test Method Standard (FTMS).
1. FTMS 101/2065 Federal Test Method Standard for Puncture Resistance and Elongation Test (1/8 Inch Radius Probe Method).
- C. Latest version of Geosynthetic Research Institute (GRI) standards.
1. GRI GM11 Accelerated Weathering of Geomembranes using a Fluorescent UVA-Condensation Exposure Device
 2. GRI GM12 Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage.
 3. GRI GM17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes.

1.03 SUBMITTALS

- A. Submit the following information to the **OWNER** and/or **ENGINEER** for review not less than 20 calendar days prior to geomembrane use.
1. Geomembrane Manufacturer capabilities, including:
 - a. daily production capacity available for this project; and
 - b. manufacturing quality control procedures.

2. A list of 10 completed facilities for which the Manufacturer has manufactured a minimum total of 10,000,000 square feet of polyethylene geomembrane. Provide the following information for each facility:
 - a. Name, location, purpose of facility, and date of installation;
 - b. Names of owner, project manager, design engineer, and installer; and
 - c. Thickness and surface area of geomembrane provided.
 3. Origin (resin supplier's name, resin production plant) and identification (brand name, number) of the polyethylene resin used.
 4. Certification of minimum average roll values (95 percent lower confidence limit) for physical, mechanical, and environmental properties and the corresponding test procedures for the geomembrane properties listed in the table in Attachment A. Submit values that are specific to the resin used in manufacture.
 5. Certification that welding rod is compatible with the specifications and consists of the same resin as the geomembrane.
 6. Manufacturer Warranty as specified in this Section.
- B. Submit to the **OWNER** and/or **ENGINEER** for review not less than 30 calendar days prior to geomembrane use the following documentation on the resin used to manufacture the geomembranes:
1. Copies of quality control certificates issued by the resin supplier including the production dates and origin of the resin used to manufacture the geomembrane for this project.
 2. Results of tests conducted by the Manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls assigned to the project.
 3. Certification that no reclaimed polymer is added to the resin during the manufacturing of the geomembrane to be used for this project.
- C. Submit to the **OWNER** and/or **ENGINEER** for review the following documentation on geomembrane roll production at least 14 calendar days prior to transporting any geomembrane to the site:
1. Manufacturing certificates for each shift's production of geomembrane, signed by the Manufacturer quality control manager, and notarized.
 2. Certificate shall include:
 - a. Roll numbers and identification;
 - b. Sampling procedures; and

- c. Results of Manufacturer quality control tests, including descriptions of the test methods used (the Manufacturer quality control tests to be performed are given in Part 2 of this Section).
- D. Submit to the **OWNER** and/or **ENGINEER** for review the following information from the **INSTALLER** at least 14 calendar days prior to mobilization of the **INSTALLER** to the site:
 - 1. Layout drawings showing the installation layout identifying geomembrane panel configurations, dimensions, details, locations of seams, as well as any variance or additional details which deviate from the Construction Drawings. The layout drawings shall be adequate for use as a construction plan and shall include dimensions, details, etc. The layout drawings, as modified and/or approved by the **OWNER** and/or **ENGINEER**, shall become part of the contract.
 - 2. Installation schedule.
 - 3. Copy of **INSTALLER's** letter of approval or license by the Manufacturer.
 - 4. Installation capabilities, including:
 - a. Information on equipment proposed for this project;
 - b. Average daily production anticipated for this project; and
 - c. Quality control procedures to include quality control organization.
 - 5. A list of 10 completed facilities for which the **INSTALLER** has installed a minimum of 5,000,000 square feet of polyethylene geomembrane. The following information shall be provided for each facility:
 - a. The name and purpose of the facility, its location, and dates of installation;
 - b. The names of the **OWNER**, project manager, and geomembrane manufacturer;
 - c. Name and qualifications of the supervisor of the installation crew;
 - d. Thickness and surface area of installed geomembrane;
 - e. Type of seaming and type of seaming apparatus used; and
 - f. Duration of installation.
 - 6. Resumes of the Installer Superintendent and quality control chief to be assigned to this project, including dates and duration of employment.

7. Resumes of all personnel who will perform seaming operations on this project, including dates and duration of employment.
8. Evidence that the installation crew has the following experience.
 - a. The Superintendent shall have supervised the installation of a minimum of 5,000,000 square feet of polyethylene geomembrane.
 - b. At least one seamer shall have experience seaming a minimum of 500,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Seamers with such experience will be designated “master seamers” and shall provide direct supervision over less experienced seamers.
 - c. All other seaming personnel shall have seamed at least 100,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Personnel who have seamed less than 100,000 square feet of seams shall be allowed to seam only under the direct supervision of the master seamer or Superintendent.
- E. Submit to the **OWNER** and/or **ENGINEER** for review at least 14 days prior to geomembrane placement, a Certificate of Calibration less than 12 months old for the field tensiometer. Tensiometer shall be calibrated within one year of date of test. Calibration shall be traceable to national or industry recognizable standards where possible.
- F. During installation, submit to the **OWNER** and/or **ENGINEER** daily reports summarizing the day’s activities. These reports will contain, at a minimum, the following items: weather conditions; areas worked; daily production (quantities installed and seam lengths); personnel on site; equipment used; type and results of quality control testing completed, including results of all non-destructive seam strength tests; results of all destructive seam tests; documentation of tracking, repair, and testing of all seam reconstructed as a result of failed non-destructive or destructive testing; problems encountered during construction; and resolution of problems.
- G. Upon completion of geomembrane installation, submit to the **OWNER** and/or **ENGINEER** the following:
 1. Certification that material installation is complete and in accordance with the Specifications.
 2. Record panel layout diagram.
 3. Summary and log of all laboratory quality control testing completed by the **CONTRACTOR/INSTALLER**.
 4. Summary and log of all field quality control testing completed by the **CONTRACTOR/INSTALLER**.

5. Statement of material warranty from the geomembrane manufacturer.
6. Statement of workmanship warranty from the **CONTRACTOR/INSTALLER**.

PART 2-PRODUCTS

2.01 RESIN

- A. Provide geomembrane manufactured from new, first-quality polyethylene resin. Do not add reclaimed polymer to the resin. The use of polymer recycled during the manufacturing process is permitted if performed with appropriate cleanliness and if the recycled polymer during the manufacturing process does not exceed 2 percent by weight of the total polymer weight.
- B. Use LLDPE resin having the following properties:
 1. Density: 0.915 minimum (0.939 maximum) (ASTM D792 Method B, or ASTM D1505)
 2. Melt Flow Index: 1.0 g/10 min., maximum (ASTM D1238, 190°C, 2.16 kg)

2.02 GEOMEMBRANE PROPERTIES

- A. Provide 60-mil LLDPE geomembrane having properties that comply with the required values shown in the table in Attachment A. Material shall be 60-mil LLDPE textured geomembrane manufactured by AgruAmerica or equivalent.
- B. In addition, provide geomembrane that:
 1. Contains a maximum of 1 percent by weight of additives, fillers, or extenders not including carbon black;
 2. Does not have striations, pinholes, bubbles, blisters, nodules, undispersed raw materials, or any sign of contamination by foreign matter on the surface or in the interior;
 3. Is free of holes, blisters, modules, undispersed raw materials, or any sign of contamination by foreign matter; and
 4. Is manufactured in a single layer (thinner layers shall not be welded together to produce the final required thickness).

2.03 MANUFACTURING QUALITY CONTROL

A. Resin:

1. Sample and test resin at a minimum frequency of one test per rail car (200,000 lbs) to demonstrate that the resin complies with the requirements of this Section. Perform tests on resin after the addition of additives to the virgin resin. Certify in writing that the resin meets the requirements of this Section.
2. Do not use any nonconforming resin.

B. Rolls:

1. Continuously monitor (including continuous spark testing) for geomembrane defects during manufacture.
2. Do not supply geomembrane that exhibits any defects.
3. Regularly monitor for geomembrane thickness during manufacture.
4. Do not supply geomembrane that fails to meet the specified thickness.
5. Sample and test the geomembrane, to demonstrate that its properties conform to the values specified in the table in Attachment A. The tests and frequencies are presented in the table in Attachment A.
6. If a geomembrane sample fails to meet the quality control requirements of this Section, sample and test rolls manufactured, in the same resin batch, or at the same time, as the failing roll. Continue to sample and test the rolls until the extent of the failing rolls are bracketed by passing rolls. Do not supply any failing rolls.

- C. Permit the CQA Consultant and/or **OWNER's** Representative to visit the manufacturing plant for project specific visits. If possible, such visits will be prior to, or during, the manufacturing of the geomembrane rolls for this project.

2.04 LABELING

A. Label the geomembrane rolls with the following information.

1. Thickness of the material;
2. Length and width of the roll;
3. Name of Manufacturer;
4. Product identification;
5. Lot number; and
6. Roll number.

- B. Geomembrane rolls not labeled in accordance with this Section or on which labels are illegible will be rejected and replaced.

2.05 TRANSPORTATION, HANDLING AND STORAGE

- A. Deliver geomembranes to the site at least 14 calendar days prior to the planned deployment date, or allow CQA Consultant to obtain samples from the manufacturing facility, to allow the CQA Consultant adequate time to perform conformance testing on the geomembrane samples.
- B. Provide proper handling and storage of the geomembrane at the site. Protect the geomembrane from excessive heat or cold, dirt, puncture, cutting, or other damaging or deleterious conditions. Provide any additional storage procedures required by the Manufacturer.
- C. Store geomembrane rolls on prepared surface. Do not store geomembrane rolls in mud, standing water or in areas prone to flooding. Do not store more than 3 rolls high.

2.06 GEOMEMBRANE MATERIAL ACCEPTABILITY

Geomembrane materials shall be accepted, by the **ENGINEER**, for installation only upon receipt and approval of the following:

- 1. Information received and approved, by the **ENGINEER**, regarding resin quality control for delivered materials.
- 2. Information received and approved, by the **ENGINEER**, regarding geomembrane manufacturing quality control for delivered materials.
- 3. Approved repair methods established for damaged materials.
- 4. Interface shear strength between the geomembrane and the actual soil subgrade shall pass the design requirements (minimum of 20 degrees) after it is tested with method ASTM D5321 or an equivalent test method.

PART 3-EXECUTION

3.01 GEOMEMBRANE DEPLOYMENT

- A. General:
 - 1. The **CONTRACTOR** shall produce layout drawings prior to geomembrane deployment. These drawings shall indicate the geomembrane configuration, dimensions, details, locations of seams, etc. The layout drawings must be approved by the **OWNER** and/or **ENGINEER** prior to the installation of any geomembranes. The layout drawings, as modified and/or approved by the **OWNER** and/or **ENGINEER**, shall become part of these specifications.

2. Do not deploy geomembrane until the layout drawings are approved by the **OWNER** and/or **ENGINEER**.
3. Do not deploy geomembranes until **CQA CONSULTANT** completes conformance evaluation of the geomembrane.
4. Deploy each geomembrane panel in accordance with the approved layout drawings.

B. Earthwork

1. Geomembrane Subgrade Preparation: **CONTRACTOR** shall be responsible for preparation of the soil subgrade and underlying geosynthetic reinforcement layers upon which the liner is to be installed. **CONTRACTOR** and **CQA CONSULTANT** shall approve the subgrade before geomembrane installation. The **CONTRACTOR** shall furnish a signed Certificate of Subgrade Acceptance prior to the installation over a particular area indicating acceptance of the subgrade in that area. The following conditions shall be a minimum for the subgrade:
 1. No foreign objects such as rocks, sticks, glass, sharp objects, stones larger than ½-inch diameter and any other harmful materials shall be on the area to be lined.
 2. The subgrade surface shall have a smooth, finished, even surface (to ensure that the area is free of irregularities), free from loose earth and abrupt changes in grade.
 3. Perimeter anchor trenches shall be excavated to the lines and width shown on the plans prior to geomembrane placement.
 4. The subgrade surface shall not be excessively wet or dry or in any condition which will impede proper installation. Under no circumstances shall the geomembrane be placed over standing water on the subgrade.

C. Field Panel Identification:

1. A geomembrane field panel is a roll or a portion of roll cut in the field.
2. Give each field panel an identification code (number or letter-number). This identification code shall be agreed upon by the **CQA CONSULTANT** and the **CONTRACTOR**.

D. Field Panel Placement:

1. Place each geomembrane panel one at a time and seam each panel immediately after its placement.
2. Do not place geomembrane panels when the ambient temperature is below 40° Fahrenheit (F), unless authorized in writing by the **OWNER** and/or **ENGINEER**.

3. Do not place geomembranes during any precipitation, in the presence of heavy fog or dew, in an area of ponded water, or in the presence of high wind (generally exceeding 20 miles per hour).
 4. Ensure that:
 - a. No vehicular traffic drives directly on the geomembrane.
 - b. Equipment used does not damage the geomembrane by handling, trafficking, or leakage of hydrocarbons (i.e., fuels).
 - c. Personnel working on the geomembrane do not smoke, bring glass onto the geomembrane, or engage in other activities that could damage the geomembrane.
 - d. The method used to unroll the panels does not scratch or crimp the geomembrane and does not damage lower geosynthetics or the supporting soil.
 - e. The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels). The method used to place the panels results in intimate contact with the underlying geomembrane. Adjust or repair any area of geomembrane wrinkles where the wrinkle height, measured perpendicular to the slope during the hottest portion of the day, is more than 4 inches.
 - f. The method used to place the panels does not cause the panels to lift up or trampoline during the coolest portion of the day.
 - g. The geomembrane is anchored or weighted with sandbags, or the equivalent, to prevent damage or uplift from wind. Install sufficient anchoring or weighting to prevent uplift and maintain such system until installation is complete.
 5. Replace any field panel or portion thereof that becomes damaged (torn, twisted, or crimped). Remove from the work area damaged panels or portions of damaged panels.
- E. Do not install geomembrane between one hour before sunset and one hour after sunrise unless approved by the **OWNER** and/or **ENGINEER**.

3.02 FIELD SEAMING

- A. Personnel shall be experienced as specified in this Section. Do not perform seaming unless a "master seamer" and the **CQA CONSULTANT** are on-site.
- B. On slopes exceeding 10 percent, orient seams parallel to the line of maximum slope (i.e., oriented down, not across, the slope). Minimize the number of seams in corners and at odd-shaped geometric locations. No horizontal seam shall be less than 5 feet from the toe or crest of slopes except where approved by the **OWNER** and/or **ENGINEER**. Do not locate seams at an area of potential stress concentration. Where horizontal seams are allowed (on slopes less than

10 percent), overlap seams in a shingle fashion such that the upper sheet is over the lower sheet in the direction of slope.

C. Weather Conditions for Seaming:

1. Do not seam geomembrane at ambient temperatures below 40°F or above 104°F, unless authorized in writing by the **OWNER** and/or **ENGINEER**.
2. Measure ambient temperatures between 0 to 6 inches above the geomembrane surface.
3. In all cases, the geomembrane seam areas shall be dry and protected from wind.

D. Overlapping and Temporary Bonding:

1. Sufficiently overlap geomembrane panels for welding and to allow peel tests to be performed on the seam. Any seams that cannot be destructively tested because of insufficient overlap shall be considered a failing seam. Minimum overlap for a fusion seam is 5 inches and for an extrusion seam is 3 inches (Part 3.02.K.4.b.iv requires that patches or caps (primary use of extrusion seams) extend a minimum of 6 inches from the defect, resulting in much greater overlap).
2. Control the temperature of the air at the nozzle of heat bonding apparatus such that the geomembrane is not damaged.

E. Seam Preparation:

1. Prior to seaming, clean the seam area and ensure that area to be bonded is free of moisture, dust, dirt, debris of any kind and foreign material.
2. If seam overlap grinding is required, complete the process according to the Manufacturer's instructions or within 20 minutes of the seaming operation. Do not grind to a depth that exceeds 5 percent of the geomembrane thickness. Grinding marks shall not appear beyond 1/8 inch of the extrudate after it is placed.
3. Align seams with the fewest possible number of wrinkles and "fish mouths".

F. General Seaming Requirements:

1. Extend seams to the outside edge of panels to be placed in the anchor trench.
2. If required, place a firm substrate such as a flat board or similar hard surface directly under the seam overlap to achieve proper support.
3. Cut fish mouths or wrinkles at the seam overlaps along the ridge of the wrinkle to achieve a flat overlap. Seam the cut fish mouths or wrinkles and patch any portion where the overlap is less than 6 inches with an

oval or round patch of geomembrane that extends a minimum of 6 inches beyond the cut in all directions.

4. Place the electric generator used for power supply to the welding machines outside the area to be lined or mount it on soft tires such that no damage occurs to the geomembrane. Properly ground the electric generator. Place a smooth insulating plate or fabric beneath the hot welding apparatus after use.

G. Seaming Process:

1. Approved processes for field seaming are extrusion welding and fusion welding. The primary method of welding shall be fusion. Seaming equipment shall not damage the geomembrane. Use only geomembrane Manufacturer-approved equipment.
2. Extrusion Equipment and Procedures:
 - a. Maintain at least one spare operable seaming apparatus on site.
 - b. Equip extrusion welding apparatus with gauges giving the temperature in the apparatus and at the nozzle.
 - c. Prior to beginning a seam, purge the extruder until all heat-degraded extrudate has been removed from the barrel. Whenever the extruder is stopped, purge the barrel of all heat-degraded extrudate.
3. Fusion Equipment and Procedures:
 - a. Maintain at least one spare operable seaming apparatus on site.
 - b. Fusion-welding apparatus shall be automated self-propelled devices equipped with gauges giving the applicable temperatures and pressures.
 - c. Fusion-welding apparatus shall produce a double-track seam.
 - d. Abrade the edges of cross seams to a smooth incline (top and bottom) prior to extrusion welding.

H. Trial Seams:

1. Make trial seams on excess pieces of geomembrane to verify that seaming conditions are adequate. Conduct trial seams on the same material to be installed and under similar field conditions as production seams. Conduct trial seaming at the beginning of each seaming period, and at least once each five hours, for each seaming apparatus used that day prior to seaming. Also, each seamer shall make at least one trial seam each day, for each day that seaming is performed by that seamer. Conduct trial seaming under the same conditions as the actual seaming. Prepare trial seams that are at least 5 feet long by 1 foot wide (after seaming) with the seam centered lengthwise for fusion equipment and at

least 3 feet long by 1 foot wide for extrusion equipment. Prepare seam overlap as indicated in Part 3.02.D of this Section.

2. Cut four specimens, each 1 inch wide, from the trial seam sample. Test two specimens in shear and two in peel, using a field tensiometer. The table in Attachment B includes the minimum values for passing seam tests. The test specimens shall not fail in the seam. If a specimen fails, repeat the entire operation. If the additional specimen fails, do not accept the seaming apparatus or seamer until the deficiencies are corrected and two consecutive successful trial seams are achieved. A seamer may start production seaming prior to testing of the trial seams. However, in the event the trial seam fails, all production seams by the seamer shall be considered a failed seam.

I. Nondestructive Seam Continuity Testing:

1. Nondestructively test for continuity field seams over their full length. Perform continuity testing as the seaming work progresses, not at the completion of field seaming. Complete any required repairs in accordance with Part 3.02.K of this Section. Apply the following procedures:
 - a. Use vacuum testing for extrusion welds or single-track fusion seams; and
 - b. Use air pressure testing for double-track fusion seams.

2. Vacuum Testing:

- a. Use the following equipment:
 - i. A vacuum box assembly consisting of a stiff housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.
 - ii. A system for applying 5 pounds per square inch (psi) gauge suction to the box.
 - iii. A bucket of soapy solution and applicator.
- b. Follow these procedures:
 - i. Energize the vacuum pump and reduce the tank pressure to 5 ± 1 psi gauge.
 - ii. Wet an area of the geomembrane seam larger than the vacuum box with the soapy solution.
 - iii. Place the box over the wetted area.
 - iv. Close the bleed valve and open the vacuum valve.

- v. Ensure that a leak tight seal is created.
- vi. Examine the geomembrane through the viewing window for the presence of soap bubbles for not less than 10 seconds.
- vii. If no bubbles appear after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inch overlap, and repeat the process.
- viii. Mark all areas where soap bubbles appear with a marker that will not damage the geomembrane and repair in accordance with Part 3.02.K of this Section.

3. Air Pressure Testing:

- a. Use the following equipment:
 - i. An air pump (manual or motor driven) or air reservoir, equipped with a pressure gauge, capable of generating and sustaining a pressure between 25 and 30 pounds per square inch;
 - ii. A rubber hose with fittings and connections; and
 - iii. A hollow needle, or other approved pressure feed device.
- b. Follow these procedures:
 - i. Seal both ends of the seam to be tested.
 - ii. Insert needle, or other approved pressure feed device, into the tunnel created by the fusion weld.
 - iii. Insert a protective cushion between the air pump and the geomembrane.
 - iv. Energize the air pump to a pressure between 25 and 30 pounds per square inch, close valve, and sustain the pressure for not less than 5 minutes.
 - v. If loss of pressure exceeds the specified value below, or does not stabilize, locate faulty area and repair in accordance with Part 3.02.K of this Section:

Geomembrane Sheet Thickness	Maximum Allowable Pressure Loss
60 mil	3 psi

- vi. Cut opposite end of air channel from pressure gauge and observe release of pressure to ensure air channel is not blocked.
- vii. Remove needle, or other approved pressure feed device, and seal both ends in accordance with the Part 3.02.K of this Section.

J. Destructive Testing:

1. Perform destructive seam tests to evaluate seam strength and integrity. Perform destructive testing as the seaming work progresses, not at the completion of field seaming.
2. Sampling and Testing:
 - a. Collect destructive test samples at a minimum average frequency of one test location per 500 feet of seam length and at additional locations of suspected nonperformance. The CQA Consultant will select test locations, including locations with evidence of excess geomembrane crystallinity, contamination, offset seams, or any other evidence of inadequate seaming.
 - b. Cut samples at the locations designated by the CQA Consultant at the time the locations are designated. Number each sample and identify the sample number and location on the panel layout drawing. Immediately repair all holes in the geomembrane resulting from the destructive seam sampling in accordance with the repair procedures described in Part 3.03.K of this Section. Test the continuity of the new seams in the repaired areas according to Part 3.02.I of this Section.
 - c. Cut two strips 1 inch wide and 12 inches long with the seam centered parallel to the width from either side of the sample location. Test the two 1-inch wide strips in the field tensiometer in the peel mode. The Table in Attachment B includes the minimum values for passing seam tests. The test specimens shall not fail in the seam. The CQA Consultant may request an additional test in the shear mode. If these samples pass the field test, prepare a laboratory sample at least 1 foot wide by 3.5 feet long with the seam centered lengthwise. Cut the laboratory sample into three parts and distribute as follows:
 - i. One portion 1 foot long to the Installer;
 - ii. One portion 1.5 feet long to the CQA Consultant for testing; and
 - iii. One portion 1 foot long to the **OWNER** and/or **ENGINEER** for archival storage.
3. In the event of failing field or laboratory test results (per values in the Table in Attachment B), the **CONTRACTOR** may reconstruct the entire

seam between two passing destructive tests; otherwise, the CQA Consultant will identify the extent of the nonconforming area. Obtain additional samples for testing as requested by the CQA Consultant.

K. Defects and Repairs:

1. Inspect the geomembrane before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. Sweep or wash the geomembrane surface if surface contamination inhibits inspection.
2. Test each suspect location, both in seam and non-seam areas, using the methods described in Part 3.02.~~K-I~~ of this Section. Repair each location that fails nondestructive testing.
3. Cut and reseat wrinkles not conforming to Part 3.01.~~CD(54)~~(e) of this Section. Test the seams thus produced like any other seam.

4. Repair Procedures:

- a. Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test. Use the most appropriate of the available procedures:
 - i. Patching, used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter;
 - ii. Abrading and reseaming, used to repair small sections of extruded seams;
 - iii. Spot seaming, used to repair minor, localized flaws;
 - iv. Capping, used to repair long lengths of failed seams;
 - v. Topping, used to repair areas of inadequate seams, which have an exposed edge of at least 4 inches; and
 - vi. Removing bad seam and replacing with a strip of new material seamed into place (used with long lengths of fusion seams).
- b. When making repairs, satisfy the following:
 - i. Abrade surfaces of the geomembrane (no more than 5 percent of the original sheet thickness) that are to be repaired no more than 20 minutes prior to the repair;
 - ii. Clean and dry all geomembrane surfaces immediately prior to repair;
 - iii. Only use approved seaming equipment;

- iv. Extend patches or caps at least 6 inches beyond the edge of the defect, and round comers of patches to a radius of at least 3 inches; and
- v. Cut the geomembrane below large caps to avoid potential for water or gas collection between the two sheets.

5. Repair Verification:

- a. Test each repair using the methods described in Part 3.02.~~KI~~. Repairs that pass the nondestructive test are adequate unless the CQA Consultant elects to also perform destructive tests. Re-repair and retest failed tests.

3.03 CREST ANCHORAGE SYSTEM

- A. The anchor trench shall be excavated prior to geomembrane placement to the lines, grades, and configuration indicated on the Drawings.
- B. Slightly rounded comers shall be provided in the trench where the geomembrane adjoins the trench to avoid sharp bends in the geomembrane.
- C. Temporarily anchor each geomembrane panel in the anchor trench at the crest of the slope as soon as the panel is deployed or positioned.
- D. Do not entrap loose soil, sand bags, or other materials beneath the geomembrane.
- E. Backfill in accordance with the Drawings. Do not damage the geomembrane when backfilling the anchor trench.

3.04 MATERIALS IN CONTACT WITH THE GEOMEMBRANE

- A. Take all necessary precautions to prevent damage to the geomembrane during the installation of other components of the pond system.
- B. Do not drive equipment directly on the geomembrane.

3.05 PENETRATIONS AND CONCRETE CONNECTIONS

- A. Install the geomembrane at penetrations, and connect the geomembrane to penetrating pipes in accordance with the Drawings. Take extreme care while seaming around appurtenances as neither nondestructive nor destructive testing may be feasible in certain areas. Penetrations shall be vacuum tested as the design provides for attaching the geomembrane to a pre-manufactured boot through which the pipe penetrations extend. The welds on the pre-manufactured boot and pipes will be tested and certified by the manufacturer.
- B. Install the geomembrane to concrete surfaces in accordance with the Drawings. Care shall be taken to assure that the bolt installation does not tear the liner and that for vertical structures/surfaces, there is sufficient slack in the liner below the connections to allow for expansion and contraction of the liner. Each anchor bolt assembly will include a closed cell neoprene sponge attached to the concrete with

neoprene adhesive. The liner will be extended across the neoprene sponge as shown on the Drawings and then covered with a batten strip, followed by a FRP washer and nut. Caulking will be added around the washer for additional sealing.

3.06 SURVEY CONTROL

- A. Survey the installed geomembrane liner in accordance with Section 01050.
- B. Locate panel seams and intersections as requested by the **CQA CONSULTANT**.

3.07 GEOMEMBRANE ACCEPTANCE

- A. The **CONTRACTOR** shall retain all ownership and responsibility of the geomembrane until acceptance by the **OWNER**.
- B. The geomembrane will be accepted by the **OWNER** when:
 - 1. The installation is completed;
 - 2. All documentation of installation is completed; and
 - 3. Verification of the adequacy of all field seams and repairs, including associated testing, is complete.

3.08 PROTECTION OF THE WORK

The **CONTRACTOR** shall use all means necessary to protect all prior work and all materials and completed work of other Sections.

ATTACHMENT A

Geomembrane Manufacturer's Specification Table

Linear Low Density Polyethylene (LLDPE) Geomembrane Specification Table

Property	Test Method	Test Value	Test Frequency
Thickness, nominal, mil		60	per roll
Thickness (min. average), mil	ASTM D5994	57	
Thickness (lowest individual for 8 out of 10 spec.), mil	ASTM D5994	54	
Thickness (lowest individual for 1 out of 10 spec.), mil	ASTM D5994	51	
Asperity Height (min. average), mil	GRI GM12	16	per roll
Density (maximum), g/cc	ASTM D792, Method B	0.939	200,000 lbs (railcar on finished liner)
Tensile Properties (Note 1)	ASTM D6693m Type IV		20,000 lbs
Strength at Break (min. avg.), lb/in. width	2 in/min	168	
Elongation at Break (min. avg.), %	5 specimens in each direction	400	
Tear Resistance (min. avg.), lbs.	ASTM D1004	36	45,000 lbs.
Puncture Resistance (min. avg.), lbs.	ASTM D4833	70	45,000 lbs.
Carbon Black Content (range in %)	ASTM D4812	2 - 3	20,000 lbs
Carbon Black Dispersion (Category)	ASTM D5596	(Note 2)	45,000 lbs.
Oxidative Induction Time, minutes	ASTM D3895, 200°C, 1 atm O ₂	≥ 100	200,000 lbs (railcar on finished liner)
Melt Flow Index, g/10 minutes	ASTM D1238, 190°C, 2.16 kg	≤ 1.0	200,000 lbs (railcar on incoming resin)
Over Aging with High Pressure Oxidative Induction Time (min avg), % retained after 90 days	ASTM D5721 ASTM D5885, 150°C, 500 psi O ₂	60	per resin formulation
UV Resistance (Note 3) with High Pressure Oxidative Induction Time (min avg), % retained after 1600 days	GRI GM11 ASTM D5885, 150°C, 500 psi O ₂	35	per resin formulation
2% Secant Modulus (max.), lb/in.	ASTM D5323	3600	per resin formulation
Axi-Symmetric Break Resistance Strain, % (min.)	ASTM D5617	30	per resin formulation
Notes: 1. Machine direction and cross machine direction average values should be on the basis of 5 test specimen each direction. Break elongation is calculated using a gage length of 2.0 in. at 2.0 in./min. 2. Carbon black dispersion (only neat spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3. 3. The condition of the test should be 20 hr. UV Cycle at 75°C followed by 4 hr. condensation at 60°C.			

ATTACHMENT B

Geomembrane Specification Strength Values

TABLE
REQUIRED LLDPE GEOMEMBRANE SEAM PROPERTIES

Properties	Qualifier	Units	Specified Values	Test Method
			60-MIL LLDPE	
<u>Shear Strength</u> ⁽¹⁾				
Fusion Seams	minimum	lb/in	90	ASTM D6392
Extrusion Seams	minimum	lb/in	90	ASTM D6392
<u>Peel Strength</u>				
Fusion Seams	minimum	lb/in	~~72-75~~ FTB ⁽²⁾	ASTM D6392
Extrusion Seams	minimum	lb/in	75 FTB ⁽²⁾	ASTM D6392

Notes:

1. Also called "Bonded Seam Strength".
2. Film Tear Bond. Seam separation shall not extend more than 10 percent into the seam. Testing shall be discontinued when the sample has visually yielded. Sample shall conform to a passing configuration as outlined in Figures A-4 (fillet extrusion) and A-6 (double wedge fusion) of the United States Environmental Protection Agency, "Lining of Waste Containment and Other Impoundment Facilities," EPA/600/2-88/052.

END OF SECTION

SECTION 15410

PIPE AND VALVES

PART I - GENERAL

1.01 DESCRIPTION OF WORK

- A. **CONTRACTOR** shall furnish, install, and properly label a complete piping system as shown on the Contract Drawings and as specified herein.
- B. Section includes, but is not limited to:
 - 1. Pipe and pipe fittings
 - 2. Valves

1.02 REFERENCES

- A. ASME - Boiler and Pressure Vessel Code
- B. ASTM A53 - Pipe, Steel, Black and Hot-Dipper Zone Coated, Welded Seals
- C. ASTM A120 - Pipe, Steel, Black and Hot-Dipper Zone Coated (Galvanized), Welded and Seamless
- D. ASTM A312 - Seamless and Welded Austenitic Stainless Steel Pipes
- E. ASTM D1784 – Rigid Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe, Schedules, 40, 80, and 120
- F. ASTM D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe Fittings
- G. ASTM D2241 – PVC Plastic Pipe
- H. ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40
- I. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe
- J. ASTM D2564 - Solvent Cements for PVC Plastic Pipe and Fittings
- K. ASTM D2855 - Making Solvent-Cemented Joints with PVC Pipe and Fittings
- L. ASTM F477 - Elastometric Seals (Gaskets) for Joining Plastic Pipe
- M. ANSI – B16.5 – Pipe Flanges and Flanged Fittings

1.03 SUBMITTALS

- A. **CONTRACTOR** shall submit under provisions of Section 01010 of these specifications.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide Manufacturers catalog information. Indicate valve data and ratings.
- C. Manufacturer's installation instructions. Indicate hanging and support methods, joining procedures.

1.04 PROJECT RECORD DOCUMENTS

- A. **CONTRACTOR** shall record actual locations of valves, pressure gauges, flow monitoring devices, and other monitoring and control devices.

1.05 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.06 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on the valve body.
- B. The **MANUFACTURER** must be regularly engaged in the design and fabrication of similar equipment with a minimum of 5 years experience.
- C. The pipe, valves, and other accessories shall be designed for a minimum plant operating life of ten years under service conditions.
- D. All components must be of an industrial quality.

1.07 QUALIFICATIONS

- A. **MANUFACTURER:** Company specializing in manufacturing the Products specified in this Section.
- B. **INSTALLER:** Company specializing in performing the Work of this Section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. **CONTRACTOR** shall deliver, store, protect, and handle products to Site.
- B. **CONTRACTOR** shall accept valves on-site in shipping containers with labeling in place. Inspect for damage.
- C. **CONTRACTOR** shall provide protective coating on metal valves.

- D. **CONTRACTOR** shall provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. **CONTRACTOR** shall protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. **CONTRACTOR** shall ensure that all underground piping be installed in a dry trench condition.

PART 2 - PRODUCTS

2.01 PVC AND CPVC PIPE

- A. Pipe and Fittings
 - 1. PVC: Type I, Grade I conforming to ASTM D1784.
 - 2. CPVC: Type IV, Grade I conforming to ASTM D1784
- B. Pressure Rating
 - 1. Schedule 80
- C. Flanges
 - 1. Flat faced, conforming to ANSI B16.5
 - 2. Class 150 Lbs.
- D. Gaskets
 - 1. PTFE full-face elastomeric gasket.
 - 2. Minimum 1/8-inch thick flat type.

2.02 STEEL PIPE

- A. Pipe and Fittings
 - 1. Galvanized and Carbon Steel: Seamless, conforming to ASTM A53, schedule 40; Threaded or Welded connections
 - 2. Stainless Steel: Seamless, conforming to ASTM A312, schedule 40; Welded connections.

- B. Pressure Rating
 - 1. Schedule 40.
 - 2. Class 150 Lbs.
- C. Flanges
 - 1. Raised faced, conforming to ANSI B16.5
 - 2. Class 150 Lbs.
- D. Gaskets
 - 1. PTFE ring gasket.
 - 2. Minimum 1/16-inch thick.

2.03 HDPE PIPE

- A. Pipe and Fittings
 - 1. Polyethylene pipe shall be made from high density, high molecular weight resin meeting the requirements of ASTM D3350-05. The cell classification according to ASTM D3350 shall be 345464C, and the pipe shall have a rating of PE3408 or better, according to the rating system of the Plastic Pipe Institute, a division of the Plastics Industry, Inc.
 - 2. The pipe shall be joined with thermal, butt fusion welds. All welds shall be made in strict compliance with the manufacturer's recommendations.
 - 3. Polyethylene fittings shall be made from high density, high molecular weight resin meeting the requirements of ASTM D 3350-05. The cell classification according to ASTM D3350-05 shall be 345464C, and the pipe shall have a rating of PE3408 or better, according to the rating system of the Plastic Pipe Institute, a division of the Plastics Industry, Inc.
- B. Pressure Rating
 - 1. SDR 11
 - 2. The pressure rating of the pipe fittings shall be equivalent to the pipe SDR rating.
- C. Flanges
 - 1. Backup rings for HDPE flange connections shall be ANSI B16.5 Class 150#, or AWWA C-207 Class D. Flange material shall be Epoxy Coated Carbon Steel.

2. Flanges used on the non-piped side of valves shall be carbon steel per ASTM A105, ASME Class 150, flat face, Standard 3.2/6.3 Ra facing per ASME B46.1, per ASTM B16.5 with a four inch diameter FNPT threaded connection.

D. Gaskets

1. Gaskets shall be full faced rubber gaskets, 55-75 Durometer Shore D Hardness.
2. Minimum 1/8 inch thick.

2.04 VALVES

A. Provide valves in sizes and locations as indicated on the Contract Drawings.

B. Butterfly – Inlet Piping

1. Cast carbon steel per ASTM A126 B, ASME Class 150, wafer style, Standard 3.2/6.3 Ra facing per ASTM B46.1, ASME B16.34, one piece stem and disc constructed of type 17-4 ph stainless steel and with EPDM elastomer molded to the disc and EPDM seat, lever handle.
2. Manufacturer: Bray 20-128, or equal.

B. Butterfly – Pump Vault and Outlet Piping

1. Fiberglass reinforced vinyl ester composite body, full-face lug style with EPDM/DCI coated discs, EPDM seats, multiple positions ductile iron handle. The valve shall be flanged and conform to the face-to-face dimensions of ANSI/ASME B16.10. Flange bolt sizes and spacing shall conform to ANSI B16.5 Class 150. Gear operator for 8" and 10" sizes. Valves located in pump vault shall be furnished with extension rod to allow for exterior operation.
2. Manufacturer: Nil-Cor 700 L-E-E-S-LD, or equal.

C. Ball

1. 1" through 6"
 - a. Fiberglass reinforced vinyl ester composite body, gland and stem Hastelloy-C, PTFE-coated seals and seats, ball compression molded graphite fiber and vinyl ester resin. The valve shall be flanged and conform to the face-to-face dimensions of ANSI/ASME B16.10. Flange bolt sizes and spacing shall conform to ANSI B16.5 Class 150. Lever handle operator.
 - b. Manufacturer: Nil-Cor 310 ST-T-H or equal.

- 2. 8" valves
 - a. Graphite fiber reinforced vinyl ester body, full-face wafer style, Hastelloy-C bolts, PFA encapsulated silicone seals and cavity filler seats, stainless steel handle adapter with locking provision and gear operator. Body shall be suitable for bolting between ANSI CLASS 150 flanges.
 - b. Manufacturer: Nil-Cor 300 CF-P-H or equal.
- D. Ball (if used with a diagram seal to isolate fluid medium)
 - 1. Cast stainless steel ball valve, threaded, reinforced TFE seats and stuffing box ring, adjustable packing gland, lever handle operator.
 - 2. Manufacturer: Apollo 76-100, or equal.
- E. Check
 - 1. Wafer Swing style with glass fiber-reinforced vinyl ester resin body and disc. Viton seats. Body shall be suitable for bolting between ANSI CLASS 150 flanges.
 - 2. Manufacturer: Nil-Cor SC-310-V or equal
- F. Valves shall be supplied with manual operators.
- G. Valves shall be capable of accepting a lock to comply with energy-isolation procedures (LOTO).

2.05 ACCESSORIES

- A. Flange Bolts
 - 1. Provide steel studs/bolts alloy steel bolts and studs, ASTM A193 Gr. B7, and ASTM A194 Gr. 2H heavy hex nuts, per ASTM B1.1.
 - 2. Fasteners shall be corrosion resistant.
 - 3. Bolts shall be tightened to recommended torque values.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. **CONTRACTOR** will provide shop drawings of all piping runs and connections.

3.02 GENERAL INSTRUCTIONS

- A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure that the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
- B. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

3.03 PREPARATION

- A. Remove scale and dirt, on inside and outside of piping, before assembly.
- B. Prepare piping connections to equipment with flanges or unions.

3.04 ABOVE GROUND PIPING INSTALLATION

- A. Install in accordance with Manufacturer's instructions or Contract documents as appropriate.
- B. **CONTRACTOR** shall route piping in orderly manner and maintain gradient, if required.
- C. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Provide clearance for access to valves and fittings.
- F. Where pipe support members are welded to structural fitting, **CONTRACTOR** shall scrape, brush clean, and apply one coat of zinc rich primer to welding.
- G. **CONTRACTOR** shall install valves with stems upright or horizontal, not inverted.

3.05 UNDERGROUND PIPING INSTALLATION

- A. Install in accordance with Manufacturer's instructions or Contract documents as appropriate.
- B. Excavate and backfill in accordance with Section 02200 of these specifications.

- C. Plastic Piping:
1. Install plastic piping in accordance with ASTM D2321.
 2. Pipe bedding shall meet the requirements of clean sand as defined in the Specifications.
 3. Install bedding at sides and top of pipe to minimum thickness of 3.0 inches over top of pipe and compact.
- D. Pipes shall be leak tested according to manufacturer's recommendations. Water for testing will be ~~supplied by OWNER-treated plant service water supplied by~~ OWNER.

3.06 CLEANING AND TESTING

- A. The pipes, ~~which that~~ are to be operated under pressure, shall be cleaned and pressure tested prior to backfilling of the trenches.
- B. CLEANING
1. The **CONTRACTOR** shall provide and install temporary connections, strainers, and other equipment to thoroughly clean the piping systems before start-up. Cleaning shall include a thorough rinsing with water to remove sediments of pipe material shavings and other debris. The **OWNER's Representative** shall visually observe a clean piping system free of shavings and/or other debris prior to start-up.
 2. The **CONTRACTOR** shall collect and dispose of cleaning agents in accordance with **OWNER's** requirements and shall remove all temporary connections and strainers after cleaning is complete.
 3. Piping shall be cleaned just prior to installation and again prior to start-up. Cleaned piping material shall be protected against contamination by sealing open ends with clear plastic sheets, metal foil, or other approved materials.
- C. TESTING
1. Upon completion of piping installation, but prior to covering concealing or burying piping, test all newly installed piping systems.
 2. The timing and sequence of testing shall be scheduled by the **CONTRACTOR**, subject to the favorable review by the **OWNER's Representative**. The **CONTRACTOR** shall provide the **OWNER's Representative** two (2) working days notice prior to all testing.
 3. Isolate equipment which may be damaged by the specified test conditions.
 4. Perform pressure tests using calibrated pressure gauges. Select each gauge so that the specified test pressure falls within the upper half of the gauge's range. The graduation of the gage should be in the appropriate increments for the intended test pressure.
 5. Unless otherwise specified, completely assemble and test new piping systems prior to connection to existing piping systems.

- ~~5.6.~~ An initial expansion phase will include raising the pressure in the test section of pipe gradually to stabilize, with additional filling with water and release of air as needed to stabilize the pressure for at least one hour. Examine all joints, valves, and connected equipment periodically during the expansion phase to check for visible leaks.
- ~~6.7.~~ All piping (in a completed system) shall be pressure tested to 1.5 times the maximum intended operating pressure. Gravity flow lines shall be tested at minimum pressure of 10 PSIG. Pressure testing shall be done in place, in the presence of the **OWNER's Representative**, for a period of 1 hour after completing the initial expansion phases of testing, with no noticeable loss of pressure. All pipe joints, valves and connected equipment will be examined during testing to check for visible leaks.
- ~~7.8.~~ **CONTRACTOR** shall provide **OWNER's Representative** a copy of proposed test procedures for review prior to conducting testing. **CONTRACTOR** shall receive **OWNER's Representative's** comments prior to conducting testing.
- ~~8.9.~~ No pipe installation will be accepted should there be evidence of exterior surface damage to the pipe that, in the option of the **OWNER's Representative**, may compromise the integrity of the piping system, even though it may pass the testing requirements.
- ~~9.10.~~ All tests shall be made before piping is painted, covered, or otherwise concealed. The **CONTRACTOR**, at the **CONTRACTOR's** own expense, shall uncover and retest any piping not satisfactorily tested in the presence of the **OWNER's Representative**. Testing shall be conducted after laying or modifying of the piping systems and prior to backfilling and then repeated after final grading.
- ~~11.~~ The testing requirements for the respective systems shall include all those of applicable Codes, Laws and Regulations. All code-required inspection certificates, if required, shall be furnished to the **OWNER's Representative**.
- ~~10.12.~~ Water used for testing shall be disposed of in the lined FGD Ponds or in the on-site percolation pond, as appropriate.

D. PIPE TEST SCHEDULE

1. Upon completion of each piping system or sub-system, clean and test the lines. All piping shall be tested:
 - a. After completion of a section or subsection prior to backfilling of trench
 - b. After completion of entire system after installation of any heat tracing and insulation cover.
2. Repair and retest any piping system found to be leaking until results are satisfactory to the **OWNER's Representative**.

E. REPAIRS

1. The point or points of leakage shall be sought out and remedied by the **CONTRACTOR** at the **CONTRACTOR's** expense.
2. All repairs will be observed by the **OWNER's Representative**.
3. Repair methods must be satisfactory to the **OWNER's Representative**.

F. FINAL ACCEPTANCE

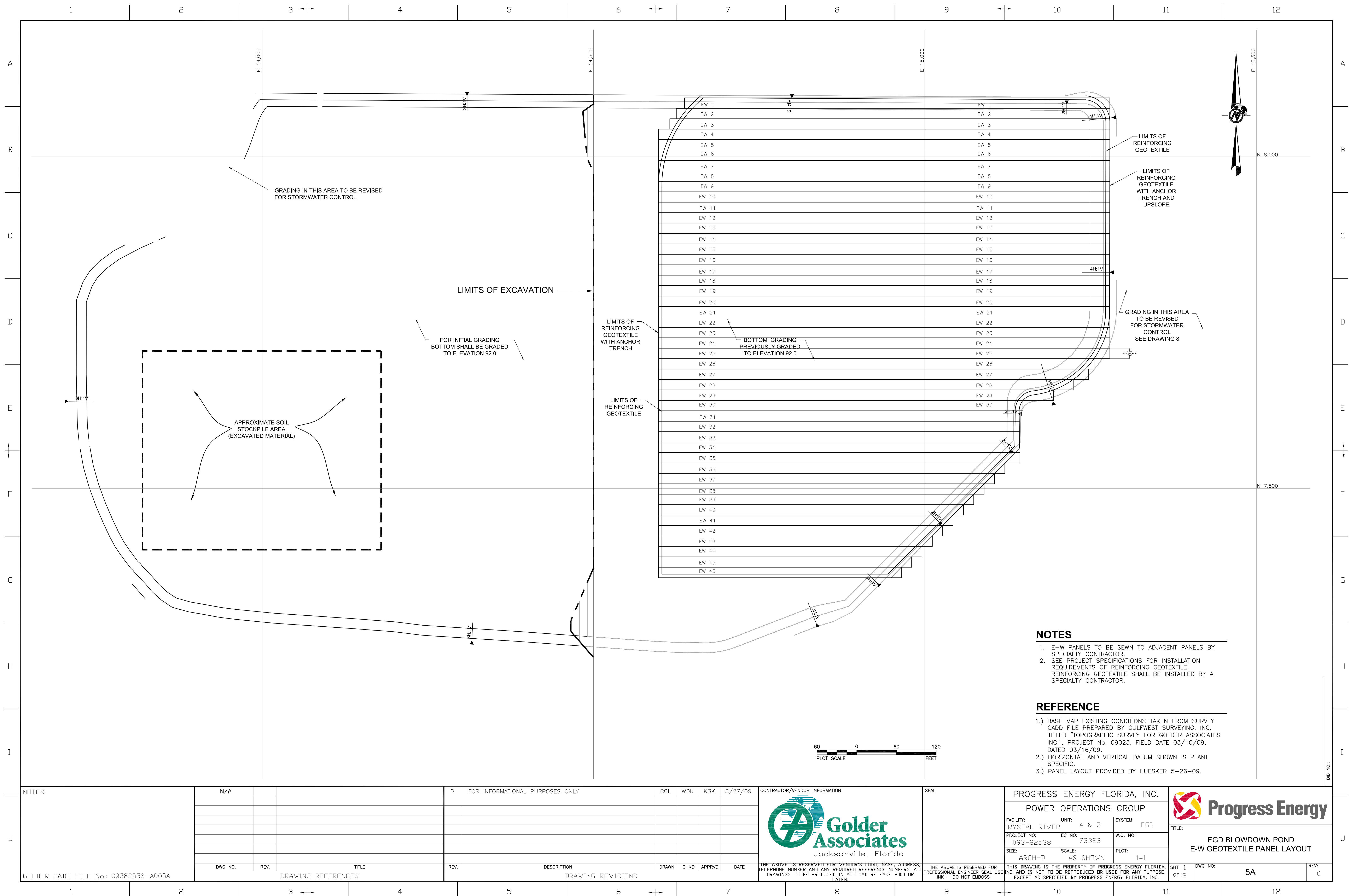
1. No pipeline installation or hydraulic structure will be accepted until all leaks have been repaired. All repairs will be observed by the **OWNER's Representative**.

- G. The **CONTRACTOR** shall provide the **OWNER's Representative** with written certification and test charts clearly identifying location of pipe being tested of equipment/system cleaning and testing in accordance with this Section. All test data and documentation shall be provided to the **OWNER's Representative** as part of the written certification.

END OF SECTION

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ATTACHMENT C
REVISED DRAWINGS



PROGRESS ENERGY — CRYSTAL RIVER FACILITY
FGD BLOWDOWN POND—REMEDIAL GROUTING
GOLDER ASSOCIATES

BORING	NORTHING	EASTING	TEMPORARY CASING DEPTH (ft)	COMPACTION GROUT LOCATION
G-1	8041.8	14723.5	60	—
G-2	8038.9	15008.5	40	—
G-3	7509.2	14725.2	64	—
G-4	7514.3	14985.6	60	—
G-5	7644.4	14889.7	60	—
G-6	7809.2	14877.9	65	YES
G-7	7689.4	14697.2	20	YES
G-8	7683.5	14996.7	60	—
G-8A	7700.9	14996	30	—
G-9	7687.7	14473.7	30	—
G-10	7890	14522.6	50	—
G-11	8037.9	14382.2	70	—
G-12	7483.7	14408.5	30	—
G-13	7726.8	14708.2	30	—
G-14	7723.4	14975.8	60	YES
G-15	7894.2	14724.7	20	YES
G-16	7927.2	14923.6	NA	—
G-17	7720	15018.1	60	—
G-18	7675.2	14955.2	NA	—
G-19	7935.9	14691.7	36	YES

COMPACTION GROUTING PATTERN

LEGEND

- BORING LOCATION
- BORING LOCATION WHERE COMPACTION GROUTING IS REQUIRED
- BORING LOCATION (BY OTHERS)
- PRIMARY GROUT INJECTION POINT
- SECONDARY GROUT INJECTION POINT
- NEW MANHOLE LOCATION WHERE COMPACTION GROUTING IS REQUIRED

NOTES

- ALL "G" BORINGS EXCEPT G-16 AND G-18 WILL REQUIRE PULLING OF 4" DIA. PVC CASING AND THEN GROUTING FROM CASING DEPTH TO SURFACE.
- BORING LOCATION AND PRIMARY AND SECONDARY GROUT INJECTION POINTS IN GROUT PATTERN TO BE GROUTED FROM A DEPTH OF 30 FEET BELOW GROUND SURFACE.
- SECONDARY GROUT INJECTION POINTS TO BE GROUTED IF NECESSARY IN ACCORDANCE WITH THE SPECIFICATIONS.

REFERENCE

1.) BASE MAP EXISTING CONDITIONS AND BORING LOCATIONS TAKEN FROM SURVEY CADD FILE PREPARED BY GULFWEST SURVEYING, INC. TITLED "TOPOGRAPHIC SURVEY FOR GOLDER ASSOCIATES INC.", PROJECT No. 09023, FIELD DATE 03/10/09, DATED 03/16/09. HORIZONTAL AND VERTICAL DATUM SHOWN IS PLANT SPECIFIC.

CONTRACTOR/VENDOR INFORMATION

PROGRESS ENERGY FLORIDA, INC.

POWER OPERATIONS GROUP

CRYSTAL RIVER 4 & 5 SYSTEM: FGD

PROJECT NO: 093-82538 EC NO: 73328 W.O. NO:

SIZE: ARCH-D SCALE: AS SHOWN PLOT: 1=1

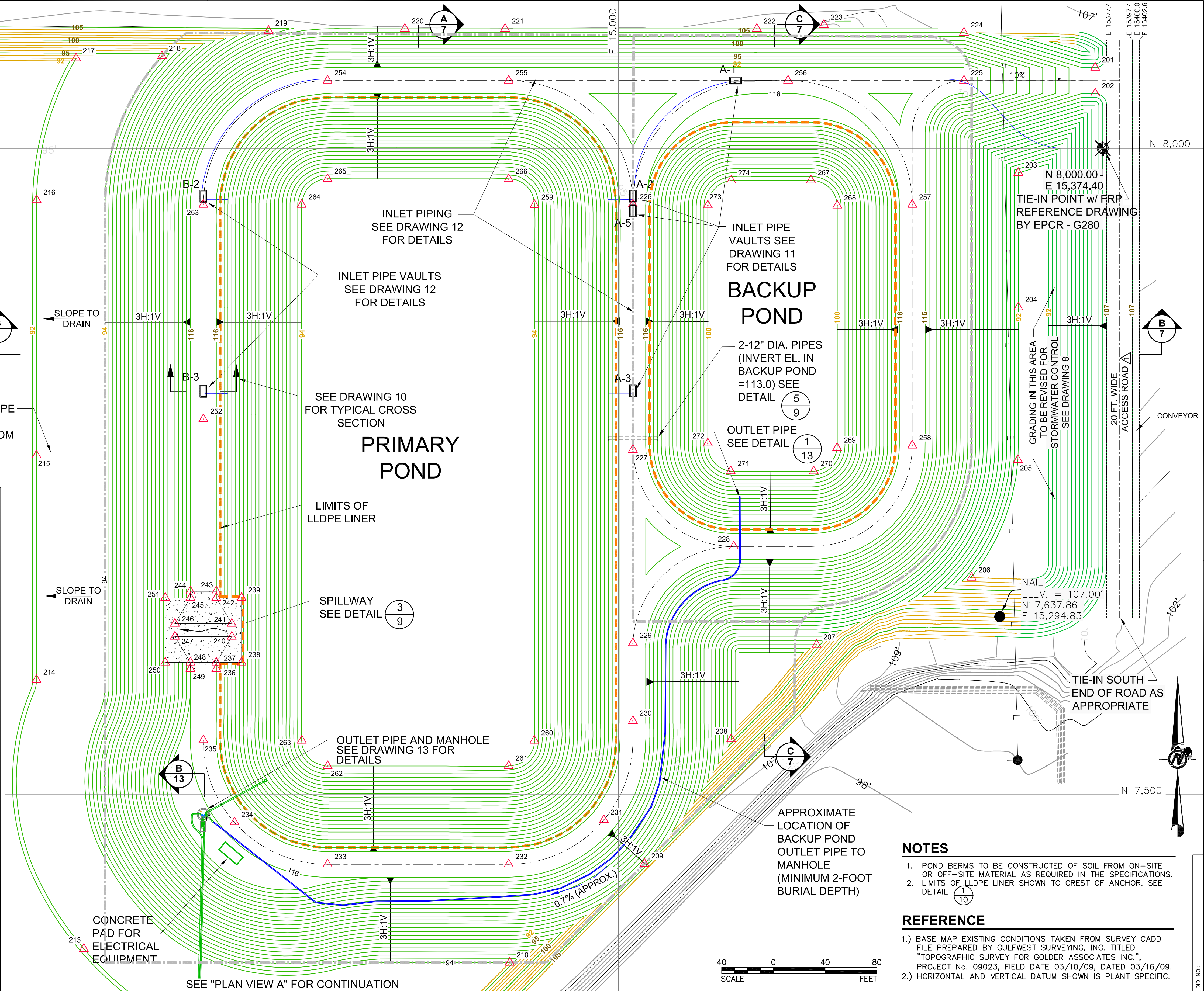
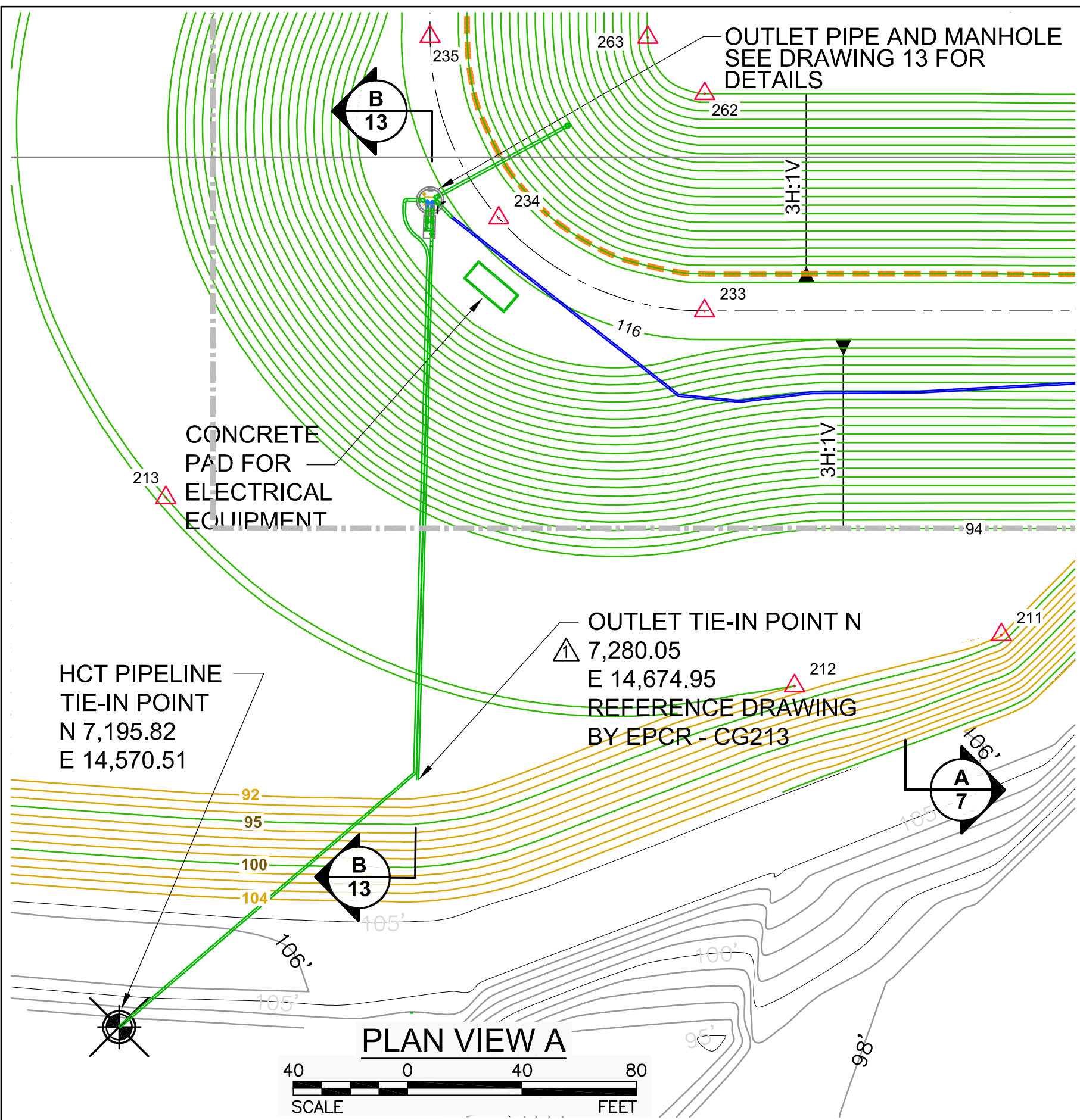
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SHIT 4 OF 15 DWG NO: 4 REV: 1

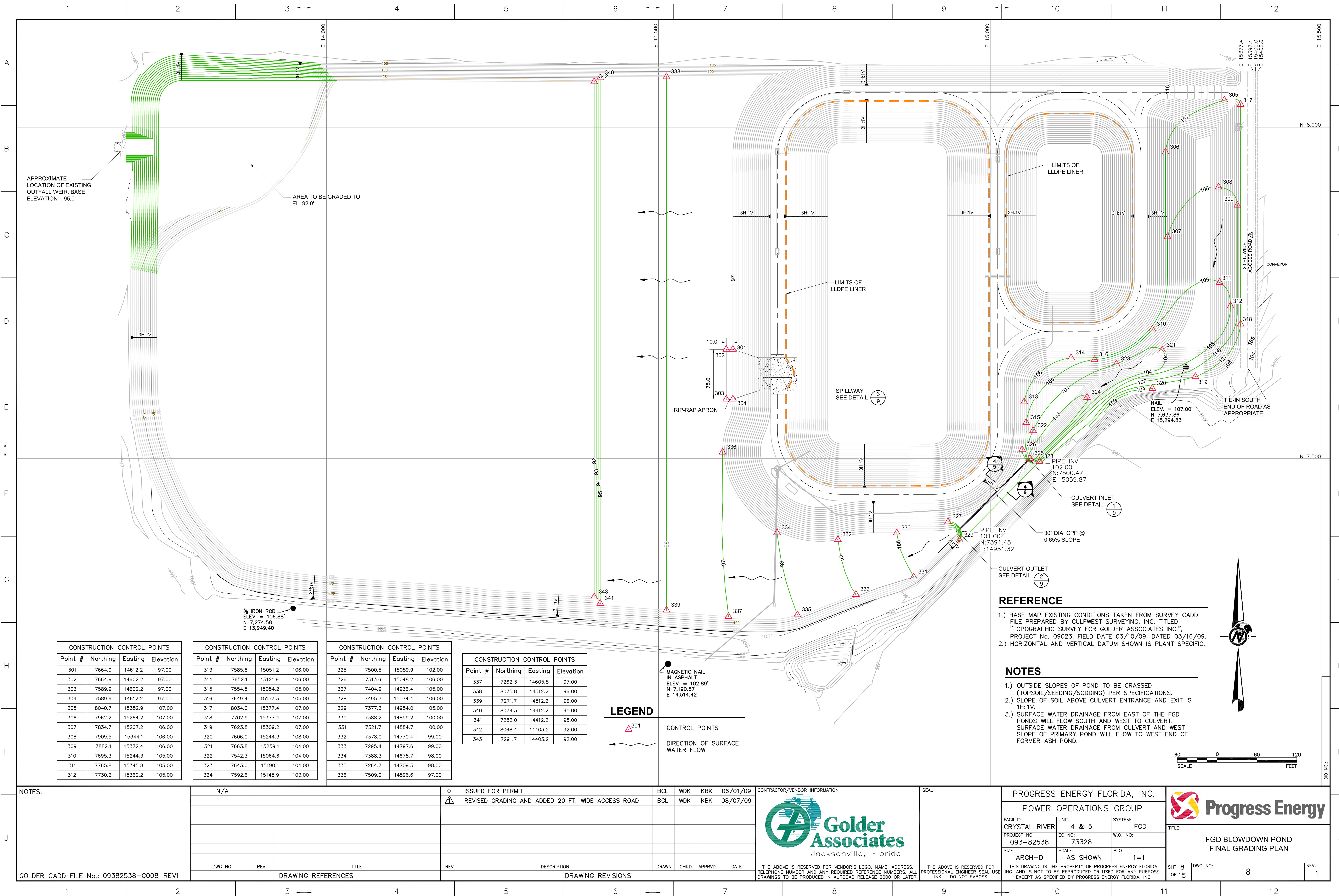
CONSTRUCTION CONTROL POINTS			
Point #	Northing	Easting	Elevation
201	8062.3	15368.5	106.00
202	8042.3	15368.5	106.00
203	7980.9	15309.2	92.00
204	7877.0	15309.2	92.00
205	7759.0	15308.8	92.00
206	7668.0	15273.0	92.00
207	7616.1	15153.2	94.00
208	7543.0	15087.2	94.00
209	7446.8	15020.2	104.00
210	7370.3	14916.1	94.00
211	7333.0	14879.0	94.00
212	7315.1	14806.7	93.00
213	7381.0	14586.8	93.00
214	7588.9	14550.2	93.00
215	7762.5	14550.2	93.00
216	7959.8	14550.3	93.00
217	8069.5	14580.8	93.00
218	8071.2	14647.2	94.00
219	8090.8	14729.5	104.00
220	8092.3	14835.0	106.00
221	8092.3	14912.4	106.00
222	8092.3	15107.0	106.00
223	8095.3	15158.9	103.00
224	8089.3	15267.2	107.00
225	8052.3	15267.2	116.50
226	7956.5	15011.2	116.50
227	7766.9	15011.2	116.50
228	7692.1	15089.2	116.50
229	7617.3	15011.2	116.50
230	7557.2	15011.2	116.50
231	7480.6	14988.7	116.50
232	7446.3	14915.2	116.50
233	7446.3	14775.2	116.50
234	7478.8	14703.3	116.50
235	7542.3	14679.2	116.00
236	7597.4	14689.2	116.00
237	7602.4	14689.2	116.00

CONSTRUCTION CONTROL POINTS			
Point #	Northing	Easting	Elevation
238	7602.4	14708.7	109.50
239	7652.4	14708.7	109.50
240	7622.4	14701.2	112.00
241	7632.4	14701.2	112.00
242	7652.4	14689.2	116.00
243	7657.4	14689.2	116.00
244	7657.4	14669.2	116.00
245	7652.4	14669.2	116.00
246	7632.4	14657.2	109.80
247	7622.4	14657.2	109.80
248	7602.4	14669.2	116.00
249	7597.4	14669.2	116.00
250	7602.4	14649.7	109.50
251	7652.4	14649.7	109.50
252	7790.6	14679.2	116.00
253	7956.3	14679.2	116.00
254	8052.3	14775.2	116.50
255	8052.3	14915.2	116.50
256	8052.3	15131.1	116.50
257	7956.3	15227.2	116.50
258	7770.1	15227.2	116.50
259	7956.2	14935.2	94.00
260	7542.0	14935.0	94.00
261	7522.4	14915.2	94.00
262	7522.3	14775.3	94.00
263	7542.0	14755.4	94.00
264	7956.3	14755.2	94.00
265	7976.2	14775.2	94.00
266	7976.1	14915.2	94.00
267	7975.1	15148.8	100.00
268	7955.7	15169.1	100.00
269	7768.3	15169.1	100.00
270	7750.2	15151.0	100.00
271	7750.2	15086.8	100.00
272	7771.8	15069.2	100.00
273	7955.9	15069.2	100.00
274	7975.0	15087.2	100.00



- NOTES**
- POND BERMS TO BE CONSTRUCTED OF SOIL FROM ON-SITE OR OFF-SITE MATERIAL AS REQUIRED IN THE SPECIFICATIONS.
 - LIMITS OF LLDPE LINER SHOWN TO CREST OF ANCHOR. SEE DETAIL 1/10
- REFERENCE**
- BASE MAP EXISTING CONDITIONS TAKEN FROM SURVEY CADD FILE PREPARED BY GULFWEST SURVEYING, INC. TITLED: "TOPOGRAPHIC SURVEY FOR GOLDER ASSOCIATES INC." PROJECT No. 09023, FIELD DATE 03/10/09, DATED 03/16/09.
 - HORIZONTAL AND VERTICAL DATUM SHOWN IS PLANT SPECIFIC.

NOTES:	N/A			0	ISSUED FOR PERMIT				BCL	WDK	KBK	06/01/09	CONTRACTOR/VENDOR INFORMATION Golder Associates Jacksonville, Florida	SEAL 	PROGRESS ENERGY FLORIDA, INC.			Progress Energy TITLE: FGD BLOWDOWN POND PLAN VIEW OF POND LAYOUT															
				1	REMOVED OUTLET TIE-IN VAULT "BY OTHERS". REVISED GRADING, AND ADDED 20 FT. WIDE ACCESS ROAD				BCL	WDK	KBK	08/07/09			POWER OPERATIONS GROUP																		
															FACILITY: CRYSTAL RIVER	UNIT: 4 & 5	SYSTEM: FGD																
															PROJECT NO: 093-82538	EC NO: 73328	W.O. NO:																
															SIZE: ARCH-D	SCALE: AS SHOWN	PLOT: 1=1																
GOLDER CADD FILE No.: 09382538-C006_REV1				DWG NO.	REV.	TITLE				REV.	DESCRIPTION				DRAWN	CHKD	APPRVD	DATE	THE ABOVE IS RESERVED FOR VENDOR'S LOGO, NAME, ADDRESS, TELEPHONE NUMBER AND ANY REQUIRED REFERENCE NUMBERS. ALL DRAWINGS TO BE PRODUCED IN AUTOCAD RELEASE 2000 OR LATER.				THE ABOVE IS RESERVED FOR PROFESSIONAL ENGINEER SEAL USE INK - DO NOT EMBOSS				THIS DRAWING IS THE PROPERTY OF PROGRESS ENERGY FLORIDA, INC. AND IS NOT TO BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT AS SPECIFIED BY PROGRESS ENERGY FLORIDA, INC.				SHT 6 OF 15	DWG NO: 6	REV: 1
DRAWING REFERENCES						DRAWING REVISIONS																											



REFERENCE

- 1.) BASE MAP EXISTING CONDITIONS TAKEN FROM SURVEY CADD FILE PREPARED BY GULFWEST SURVEYING, INC. TITLED "TOPOGRAPHIC SURVEY FOR GOLDER ASSOCIATES INC.", PROJECT No. 09023, FIELD DATE 03/10/09, DATED 03/16/09.
- 2.) HORIZONTAL AND VERTICAL DATUM SHOWN IS PLANT SPECIFIC.

NOTES

- 1.) OUTSIDE SLOPES OF POND TO BE GRASSED (TOPSOIL/SEEDING/SODDING) PER SPECIFICATIONS.
- 2.) SLOPE OF SOIL ABOVE CULVERT ENTRANCE AND EXIT IS 1H:1V.
- 3.) SURFACE WATER DRAINAGE FROM EAST OF THE FGD PONDS WILL FLOW SOUTH AND WEST TO CULVERT. SURFACE WATER DRAINAGE FROM CULVERT AND WEST SLOPE OF PRIMARY POND WILL FLOW TO WEST END OF FORMER ASH POND.

CONSTRUCTION CONTROL POINTS			
Point #	Northing	Easting	Elevation
301	7664.9	14612.2	97.00
302	7664.9	14602.2	97.00
303	7589.9	14602.2	97.00
304	7589.9	14612.2	97.00
305	8040.7	15352.9	107.00
306	7962.2	15264.2	107.00
307	7834.7	15267.2	106.00
308	7909.5	15344.1	106.00
309	7882.1	15372.4	106.00
310	7695.3	15244.3	105.00
311	7765.8	15345.8	105.00
312	7730.2	15362.2	105.00

CONSTRUCTION CONTROL POINTS			
Point #	Northing	Easting	Elevation
313	7585.8	15051.2	106.00
314	7652.1	15121.9	106.00
315	7554.5	15054.2	105.00
316	7649.4	15157.3	105.00
317	8034.0	15377.4	107.00
318	7702.9	15377.4	107.00
319	7623.8	15309.2	107.00
320	7606.0	15244.3	108.00
321	7663.8	15259.1	104.00
322	7542.3	15064.6	104.00
323	7643.0	15190.1	104.00
324	7592.6	15145.9	103.00

CONSTRUCTION CONTROL POINTS			
Point #	Northing	Easting	Elevation
325	7500.5	15059.9	102.00
326	7513.6	15048.2	106.00
327	7404.9	14936.4	105.00
328	7495.7	15074.4	106.00
329	7377.3	14954.0	105.00
330	7388.2	14859.2	100.00
331	7321.7	14884.7	100.00
332	7378.0	14770.4	99.00
333	7295.4	14797.6	99.00
334	7388.3	14678.7	98.00
335	7264.7	14709.3	98.00
336	7509.9	14596.6	97.00

CONSTRUCTION CONTROL POINTS			
Point #	Northing	Easting	Elevation
337	7262.3	14605.5	97.00
338	8075.8	14512.2	96.00
339	7271.7	14512.2	96.00
340	8074.3	14412.2	95.00
341	7282.0	14412.2	95.00
342	8068.4	14403.2	92.00
343	7291.7	14403.2	92.00

LEGEND

- △ 301 CONTROL POINTS
- DIRECTION OF SURFACE WATER FLOW

NOTES:

N/A

0

△

ISSUED FOR PERMIT
REVISED GRADING AND ADDED 20 FT. WIDE ACCESS ROAD

BCL

WDK

KBK

06/01/09

BCL

WDK

KBK

08/07/09

CONTRACTOR/VENDOR INFORMATION



SEAL

PROGRESS ENERGY FLORIDA, INC.

POWER OPERATIONS GROUP

FACILITY:	UNIT:	SYSTEM:
CRYSTAL RIVER	4 & 5	FGD
PROJECT NO:	EC NO:	W.O. NO:
093-82538	73328	
SIZE:	SCALE:	PLOT:
ARCH-D	AS SHOWN	1=1



TITLE:
FGD BLOWDOWN POND
FINAL GRADING PLAN

GOLDER CADD FILE No.: 09382538-C008_REV1

DWG NO. REV. TITLE

DRAWING REFERENCES

REV.

DESCRIPTION

DRAWING REVISIONS

DRAWN

CHKD

APPRVD

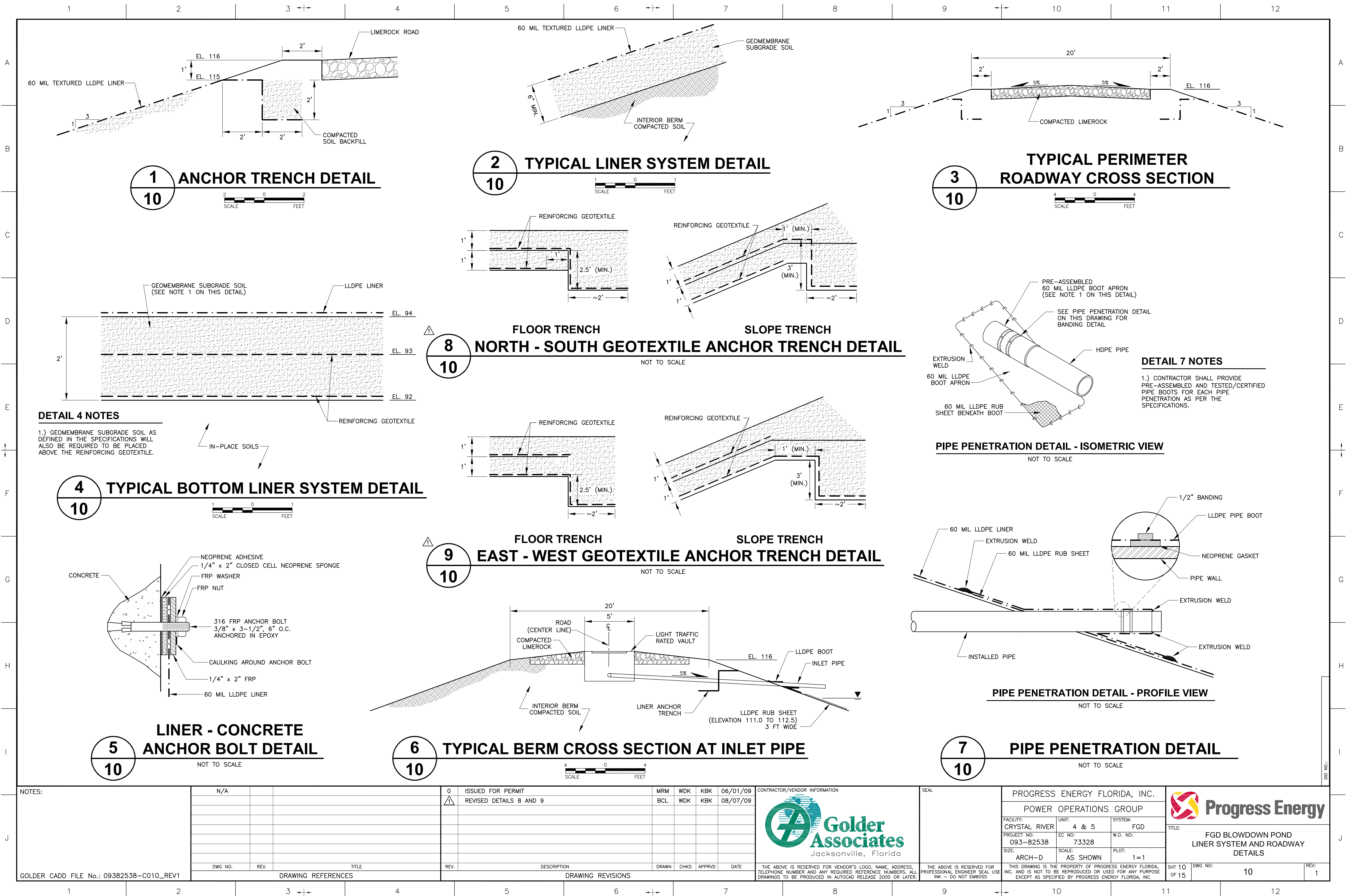
DATE

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SHT 8 OF 15 DWG NO: 8 REV: 1



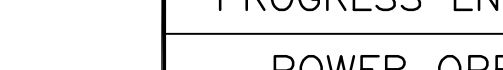
DETAIL 4 NOTES

1.) GEOMEMBRANE SUBGRADE SOIL AS DEFINED IN THE SPECIFICATIONS WILL ALSO BE REQUIRED TO BE PLACED ABOVE THE REINFORCING GEOTEXTILE.

IN-PLACE SOILS

DETAIL 7 NOTES

1.) CONTRACTOR SHALL PROVIDE PRE-ASSEMBLED AND TESTED/CERTIFIED PIPE BOOTS FOR EACH PIPE PENETRATION AS PER THE SPECIFICATIONS.

NOTES:	N/A				0	ISSUED FOR PERMIT			MRM	WDK	KBK	06/01/09	CONTRACTOR/VENDOR INFORMATION Golder Associates Jacksonville, Florida	SEAL	PROGRESS ENERGY FLORIDA, INC.			Progress Energy														
					△	REVISED DETAILS 8 AND 9			BCL	WDK	KBK	08/07/09			POWER OPERATIONS GROUP																	
															FACILITY:	UNIT:	SYSTEM:															
															CRYSTAL RIVER	4 & 5	FGD															
															PROJECT NO:	EC NO:	W.O. NO:															
															093-82538	73328																
																			TITLE:	FGD BLOWDOWN POND LINER SYSTEM AND ROADWAY DETAILS												
														SIZE:	SCALE:	PLOT:																
														ARCH-D	AS SHOWN	1=1																
GOLDER CADD FILE No.: 09382538-C010_REV1					DWG NO.		REV.	TITLE			REV.	DESCRIPTION			DRAWN	CHKD	APPRVD	DATE	THE ABOVE IS RESERVED FOR VENDOR'S LOGO, NAME, ADDRESS, TELEPHONE NUMBERS AND ANY REQUIRING REFERENCE NUMBERS. ALL DRAWINGS TO BE PRODUCED IN AUTOCAD RELEASE 2000 OR LATER.			THE ABOVE IS RESERVED FOR PROFESSIONAL ENGINEER SEAL USE INK - DO NOT EMBOSS			THIS DRAWING IS THE PROPERTY OF PROGRESS ENERGY FLORIDA, INC. AND IS NOT TO BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT AS SPECIFIED BY PROGRESS ENERGY FLORIDA, INC.			SHT 10 OF 15	DWG NO:	10	REV:	1
					DRAWING REFERENCES					DRAWING REVISIONS																						

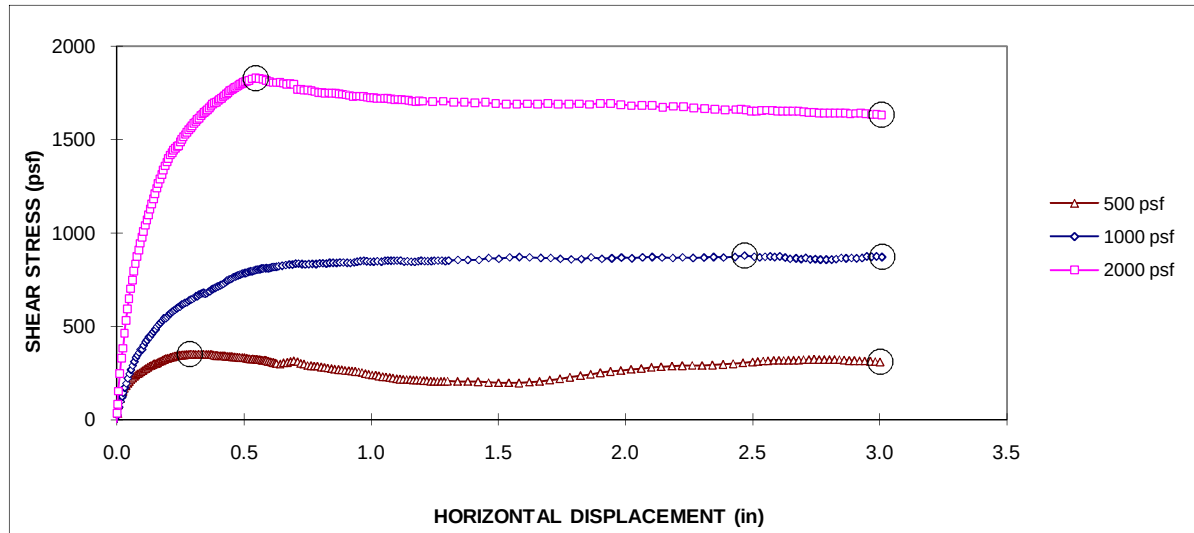
ATTACHMENT D
REINFORCING GEOTEXTILE LABORATORY TEST RESULTS

DIRECT SHEAR TEST RESULTS

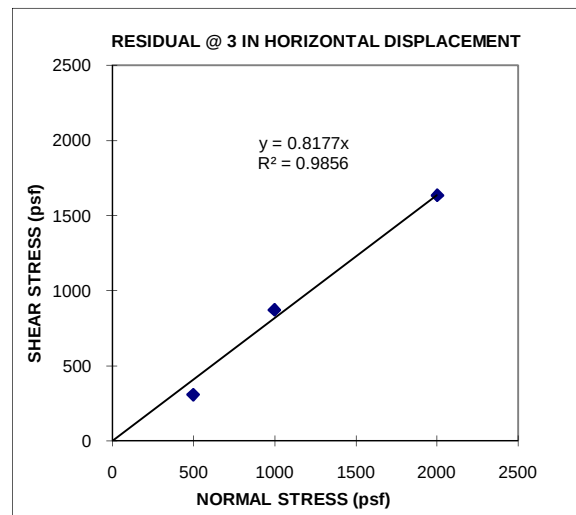
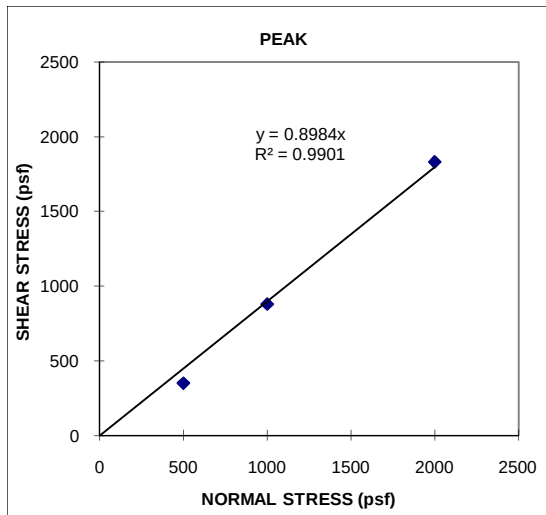
ASTM D5321

PROJECT NAME: PEF/FGD POND DESIGN & PERMIT/FL
 SAMPLE NUMBER: SHEAR #1

INTERFACE TESTED: TENCATE PET 1000/100 WOVEN GEOTEXTILE (cross machine direction) vs SOIL (Berm Near G-1)
SOIL DESCRIPTION: Brown, (Limestone) FINE SAND, little clayey silt, little coarse to fine gravel. (SP-SM)
SOIL CONDITIONS: REMOLDED TO 95% OF THE MAX DRY DENSITY OF 110.9 pcf AT A MOISTURE OF 14.0%
TEST CONDITIONS: SATURATED and CONSOLIDATED 24 hours AT THE NORMAL LOAD
SHEAR RATE: 0.04 in/min
SUBSTRATE: TEXTURED RIGID PLATES



Normal Stress (psf)	Shear Stress		Peak		Residual	
	Peak ¹ (psf)	Residual (psf)	Friction Angle	Adhesion ² (psf)	Friction Angle	Adhesion ² (psf)
500	351	310	41.9	0	39.3	0
1000	879	872				
2000	1831	1633				

**Observations After Test**

500 psf: Shearing occurred in the Soil
 1000 psf: Shearing occurred in the Soil
 2000 psf: Shearing occurred in the Soil

(1) The peak shear stresses for 500, 1000, and 2000 psf normal stresses were chosen at 0.286, 2.468, and 0.545 in horizontal displacements, respectively.

(2) The adhesion value is based on the "best-fit" line which may not show true adhesion.

ATTACHMENT E
REVISED CQA PLAN

**CONSTRUCTION QUALITY ASSURANCE PLAN
CRYSTAL RIVER ENERGY COMPLEX
FGD POND CONSTRUCTION
CRYSTAL RIVER, FLORIDA**

Prepared for:

*PROGRESS ENERGY FLORIDA, INC.
15760 WEST POWERLINE STREET
CRYSTAL RIVER, FLORIDA 34428*

Prepared by:

*Golder Associates Inc.
9428 Baymeadows Road, Suite 400
Jacksonville, Florida 32256*

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1.0 INTRODUCTION

1.1 Scope

The CQA Plan addresses the construction quality assurance procedures for the components of the FGD Blowdown Pond at Crystal River Energy Complex. The pond construction includes a combination of the following components: earthworks (grading and berm construction), reinforcing geotextile installation, flexible geomembrane (LLDPE) installation, and the installation of inlet and outlet piping and removal system (pumps, motor control center, etc.).

The purpose of this document is to achieve quality construction and installation of the various components of the FGD pond construction. This document describes the construction quality assurance procedures required for construction. The work will be performed to conform to the approved Drawings and the Technical Specifications, hereafter collectively referred to as the “project requirements”, including project-specific addenda and construction change orders.

1.2 Definitions

The terms, "quality assurance" (QA) or "construction quality assurance" (CQA) and “quality control” (QC) or “construction quality control” (CQC) are used in this document.

Quality Assurance (QA) or Construction Quality Assurance (CQA): A planned system of activities that provides Progress Energy Florida (PEF) and the permitting agencies assurance that the facility was constructed as specified in the permit. CQA includes inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. CQA refers to measures taken by PEF, through the CQA Consultant, to assess if the Installer or Contractor is in compliance with the plans and specifications for a project.

Quality Control (QC) or Construction Quality Control (CQC): A planned system of inspections that is used to directly monitor and control the quality of a construction project. CQC is typically performed by the Contractor or, for Geosynthetics, by the Geosynthetics Installer, and is necessary to achieve quality in the constructed or installed system. CQC refers to measures taken by the Contractor or Installer to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project.

2.0 QUALIFICATIONS AND RESPONSIBILITY OF CQA CONSULTANT

2.1 General

The CQA Consultant is the party, independent from PEF and the Contractor, responsible for observing, testing, and documenting activities related to the CQA and CQC of the soil, geotextile, geomembrane components, piping, pumps and controls, and other activities related to the construction of the FGD Pond described in this CQA Plan.

2.2 Qualifications

The CQA Consultant shall be a well-established firm specializing in liner system design, construction management, and CQA. The CQA Consultant shall possess the equipment, personnel, and licenses necessary to conduct the monitoring and testing activities required by this CQA Plan and the FGD Pond Drawings and Technical Specifications. The CQA Consultant shall also be experienced in the installation and CQA of soil and geosynthetic material similar to those materials being used for the FGD Pond. The CQA Consultant will be experienced in the preparation of CQA documentation including CQA plans, field documentation, field testing procedures, laboratory testing procedures, construction specification and plans, and CQA certification reports. A summary of the qualifications and specific experience guidelines for the each of the parties responsible for CQA is detailed in below:

	General	Soils	Geomembrane	Geotextile
CQA Consultant hired by the Client	CQA Consultant must have verifiable experience in providing quality assurance services. Must be a registered professional engineer in Florida.	Minimum of 5 projects of similar scope and with similar materials of construction.	Minimum of 10 projects totaling a minimum of 200,000 square feet of geomembrane installation of similar scope, in the past two (2) years.	Minimum of 10 projects totaling a minimum of 200,000 square feet of geotextile installation of similar scope, in the past two (2) years.
CQA Monitor	CQA Monitor(s) responsible for observation and documentation of the FGD pond will be quality assurance personnel specifically trained in the quality assurance of earthworks and geosynthetics.	Demonstrated ability to perform testing required.	At a minimum, one of every four CQA Monitors, or at least one per project, will have in excess of 110,000 square feet of geomembrane quality assurance field experience.	At a minimum, one of every four CQA Monitors, or at least one per project, will have in excess of 110,000 square feet of geotextile quality assurance field experience.

The following minimum information will be required to confirm the CQA Consultant's past experience in CQA:

- Name and location of project(s) of similar nature;
- Name and telephone number of project's owner;
- Contact person with first-hand knowledge of the project; and
- Size of and duties associated with the project.

In addition to the above, the CQA Consultant will also submit a diagram outlining the position, titles, names and pertinent experience of the individuals to be employed on CQA activities for the project. At a minimum, the CQA Consultant and the CQA Monitors will be specified. Resumes of these individuals are to be included. Once the CQA personnel have been selected, substitutions of any of these personnel during the project will not be permitted without prior notification and approval by PEF.

2.3 General CQA Responsibilities

2.3.1 Overview

The CQA Consultant is responsible for the implementation of the CQA requirements as set forth in this plan. In order to do this, the CQA Consultant is responsible for becoming thoroughly familiar with the permit and the technical and regulatory intent of the constructed FGD Pond. This familiarity will assist the CQA Consultant in identifying potential problems, suggesting solutions to problems, and identifying inadequacies discovered during the construction process, so that the technical requirements of the project are met during construction.

The CQA Consultant is responsible for providing senior technical oversight of the CQA process. The CQA Consultant is responsible for reviewing the CQA Plan as well as the project requirements for the project so that the CQA Plan can be implemented without contradictions or unresolved discrepancies. At the completion of pond construction, the CQA Consultant is responsible for a certification stating that the FGD Pond was constructed in general accordance with the approved project requirements, the CQA Plan, and the applicable rules of the governing state regulatory body.

The CQA Consultant will attend, participate, and document meetings related to the CQA activities of this project. The CQA Consultant is responsible for conducting the following meetings: implementation meeting, preconstruction meeting, daily progress meetings, weekly progress meetings, and/or problem or deficiency resolution meetings.

During implementation of the CQA Plan, the CQA Consultant, or a CQA monitor, will observe, document and report the daily project activities. The CQA Consultant will also be responsible for observing and documenting the completion of each component prior to placement of the subsequent layer. In addition, the CQA Consultant is responsible for the soil and/or geosynthetic material sampling and testing necessary to comply with the CQA Plan and the project requirements. This includes marking, packaging, and shipping of CQA laboratory and CQA test samples.

The CQA Consultant will record CQA/CQC activities and progress on a daily basis. The CQA Consultant will immediately report any activities, observations, or test results that indicate the construction activities are not in conformance with the project requirements to PEF, or designated PEF representative. The CQA Consultant is responsible for development and issuance of the final report.

The CQA Monitor(s) will be the CQA Consultant's official on-site CQA representative(s). The CQA Consultant is responsible for implementing the site-specific Health and Safety Plan for the CQA personnel.

2.3.2 Specific CQA Responsibilities of the CQA Consultant

The CQA responsibilities of the CQA Consultant include scheduling and coordination of daily CQA activities with the Contractor or the Geosynthetic Installer. Additionally, the CQA Consultant is responsible for the following:

- Educating the CQA Monitors as necessary on the requirements, procedures and any special steps that are needed,
- Verifying that the proper procedures are followed,
- Verifying that testing laboratories are conforming to the CQA requirements and procedures,

- Verifying that sample custody procedures are followed,
- Confirming that test data are accurately reported,
- Confirming that test data are maintained for later reporting,
- Preparing the daily summary report, and
- Preparing the final certification report.

In the event of non-conformance with the project requirements, the CQA Consultant is responsible for notifying the Contractor and/or Installer as to the details and, if appropriate, direct remedial action and/or work stoppage.

2.3.3 Responsibilities of the CQA Monitors

The CQA Monitors are responsible for making observations, sampling, and performing field tests to verify that the FGD Pond is constructed in accordance with the project requirements. Documentation of these activities is the primary responsibility of the CQA Monitor to assure that the CQA requirements are met.

3.0 SOIL PLACEMENT

3.1 General

CQA evaluation of the soil placement at the FGD Pond will consist of monitoring the daily construction activities for compliance with the project requirements. The soil components of the FGD Pond include excavation and stockpiling of existing soils, geotextile subgrade preparation, pond berm construction, geomembrane subgrade preparation, and site grading. In addition to conducting construction evaluations, the CQA Consultant is responsible for monitoring the construction activities, sampling, and testing soils in accordance with the project requirements. The prepared subgrade soils which will support the geotextile and geomembrane will require preparation in the form of grading, placement, and/or compaction prior to the installation of geosynthetics.

3.2 Borrow Source Evaluation

The CQA Consultant will observe, test, evaluate, and document that soil, rock and/or other earthen materials to be used for this project are obtained from borrow sources which have been evaluated in accordance with the project requirements. The CQA Consultant may visit the borrow sources to visually evaluate the quality and quantity of the borrow material available.

3.3 As-Built Surveys

During construction of the soil components of the FGD Pond, the CQA Consultant shall routinely review record drawings submitted by the Surveyor. The drawings are used to verify location of work, percent work completed, layer thickness, or final grades. Prior to placement of successive soil layers, the CQA Consultant shall review as-built surveys which indicate compliance of the preceding layer thickness, lines and grades. Once an as-built survey has been received, it will be the responsibility of the CQA Consultant to review the information in a timely manner and notify the Contractor and Construction Manager of any non-compliance.

3.4 Laboratory Testing

The laboratory test methods will be based on the requirements set forth in the project requirements and will be used to develop data to evaluate construction. The laboratory test results will be evaluated and compared with the field test results to confirm that the materials

being placed are in accordance with the project requirements. The CQA Consultant will confirm that the testing frequencies required by the project requirements are met. Soils placed which do not meet the specifications will be reworked or removed.

3.5 Field Testing

Unless soil characteristics preclude its use, direct or backscatter nuclear densimeter test methods will be used to determine the in-place moisture/density of the placed soils. Other suitable method(s) of determining the in-place moisture/density of the soil may be used as provided in the project requirements, if the nuclear densimeter method is not used. The nuclear densimeter should be calibrated and checked in accordance with the requirements of the project requirements on a regular basis. Similarly, the moisture content may be checked using the oven dry method (ASTM D-2216-90).

If field testing results indicate densities or moisture contents which do not comply with the project requirements, the CQA Consultant will document actions taken by the Contractor to rework the failing areas to meet the project requirements, and perform a re-test of the area.

Should test results indicate unacceptable soil characteristics despite the Contractor's efforts, the compaction characteristics of the borrow material will be re-evaluated by performing either a standard Proctor test (ASTM D-698-91) or a modified Proctor test (ASTM D-1557-91), as appropriate, on the failing material. Alternatively, the soils may be removed and replaced with acceptable material. In all cases, the failing areas will be reworked to achieve compliance with the project requirements.

3.6 Quality Assurance Testing

The terms "layer" and "lift" used throughout this document are defined as follows:

- A "lift" is a segment of a soil layer compacted in general to a nominal thickness as specified in the project requirements;
- A "layer" is compacted strata constructed of several lifts with no horizontal or vertical construction joints.

Increased testing frequencies may be instituted if observations by the CQA Consultant of specified testing frequency results indicate potential problems. Additional testing may be warranted when:

- The material repeatedly fails to meet specifications;
- The degree of compaction is doubtful;
- The materials appear to differ from those specified;
- Less than the required number of compaction equipment passes are made;
- The material moisture content differs from those specified;
- The lift thicknesses differ from those specified; or
- Adverse weather conditions occur.

3.7 Field Testing Sample Locations

Grid pattern sampling strategies will be used on placed and compacted material. Grids will be based on a 100-foot grid system superimposed on the construction plans. Grid patterns will have line spacings of 100 feet. Grids and stations will be clearly marked. Sample locations will be selected at random and coordinates identified on a daily field test result form and a reduced scale site plan.

Samples will be randomly located within a grid section and varied with each lift. Elevation or lift number will be identified.

3.8 Defective Work

The extent and nature of defective work will be determined through additional tests, observations, review of records and test results or other means that the CQA Consultant deems appropriate. After the extent and nature of the deficiency has been ascertained, the Contractor will implement corrective actions required to satisfy the project requirements. Areas that have been reworked will be retested. Retests must verify that the entire deficient area has been corrected prior to additional work being performed in that area.

3.9 Monitoring of the Soil Placement

The following construction activities will be monitored and documented by the CQA Consultant:

- Field testing (including CQC testing) as described in the project requirements and in Section 3.5 of this CQA Plan;
- Visual examination of the subgrade for areas that are unacceptable for geotextile and/or geomembrane placement;
- Method of final soil surface preparation;
- Loose lift thicknesses prior to compaction;
- Volume of soils placed and compacted from each borrow source and corresponding soil sampling frequencies;
- Compaction equipment (type and weight) and method;
- Removal of organic material, rocks, and other materials which do not meet the specifications;
- Observation of the number of equipment passes made during compaction of each lift;
- Areas or units of work being tested, identifying lift, or elevation and location. Test locations will be documented by increasing chronological order and, by approximate coordinates;
- Failed test areas defined by coordinate boundaries, corrective action under taken by the Contractor in these areas and results of retests. Retests will cross-reference the numbers and dates of failed tests;
- Fluid Leaks or spills from the Contractor's equipment or activities and corrective actions taken;
- Effectiveness of corrective actions for deficient work;
- Methods of adjusting soil moisture conditions, and;
- Documentation of compacted soil repair.

4.0 GEOSYNTHETICS MANUFACTURER'S QUALITY CONTROL DOCUMENTATION REVIEW

The CQA Consultant will review each of the geosynthetic manufacturer's quality control (MQC) data for conformance with the project requirements prior to deployment of the reinforcing geotextile and geomembrane material. The CQA Consultant may visit the Manufacturer's plant site during production of the geosynthetic materials to inspect production and/or obtain samples. A manufacturer's plant visit is optional. If a plant visit is performed, the CQA Consultant will prepare and submit a report of the plant visit.

The CQA Consultant will review, at a minimum, the following Manufacturer's QC information as appropriate for the material being manufactured at that particular plant:

For the geomembrane:

- Copies of QC Certificates issued by the Raw Materials Supplier. These certificates will contain the raw material supplier's name, production plant, brand name or type of raw material, resin chemical composition, resin number, and resin production date. Additionally, resin QC Certificate will provide test results at the frequencies specified in the project requirements for, at least, resin density, Melt Flow Index, and Carbon Black Content;
- Manufacturer's Statement certifying the geomembrane cleanliness and amount of reclaimed polymer;
- Composition of material;
- Manufacturer's Certificate guaranteeing minimum values required by the project requirements;
- Manufacturer's QC Certificates verifying the material properties of the geomembrane. These certificates must be reviewed to verify that test results are within acceptable ranges, the tests are performed at acceptable frequencies, proper tests are performed and they are certified by the manufacturer's representative. Typically, these QC Certificates will contain the roll (or panel) identification numbers, resin material batch, sampling procedures and results of geomembrane material testing as required in the project requirements.
- The CQA Consultant will review the Manufacturer's QC information and report any discrepancies from the project requirements. The purposes of the review of the MQC information are to verify that:

- o The properties of the geosynthetic materials certified by the manufacturer meet the guaranteed minimum values shown on the project requirements;
- o Measurement of the material properties is properly documented and tested by acceptable methods;
- o QC Certificates are provided at the specified frequencies for each roll, and are coordinated with the roll (or panel) identification; and
- o The rolls (or panels) are appropriately numbered.

For the reinforcing geotextile:

- Manufacturer's certified roll material data sheets. The certified data sheets shall be attested to by a person having legal authority to bind the manufacturing company.
- Manufacturer's warranty statement.
- Manufacturer's quality control (QC) manual which describes testing procedures, frequency of testing and acceptance/rejection criteria for QC testing.
- Manufacturer's, installer's, QC inspectors, and QC laboratory's qualification statements including resumes of key personnel involved in this project.
- Shear strength test results at least 25 days prior to deployment.
- Manufacturer's QC laboratory test results including description of equipment and test methods.

It is the ultimate responsibility of the Contractor/Installer to verify that the documentation required for the geosynthetic materials has been submitted. The CQA Consultant will not approve that a geosynthetic material be deployed until the MQC information for that material has been received, reviewed, and deemed acceptable.

5.0 GEOSYNTHETICS CONSTRUCTION QUALITY ASSURANCE PROCEDURES

5.1 General

For the geosynthetics components (reinforcing geotextile and flexible geomembrane liner) of the FGD Pond construction, the CQA evaluation will include the following general categories:

- Delivery evaluation;
- Material surface evaluation;
- Conformance testing;
- Monitoring of the geosynthetic layer installation; and
- Documentation of the daily construction activities related to the installation of the reinforcing geotextile and geomembrane for compliance with the project requirements.

General CQA procedures are discussed in the following sections.

5.2 Delivery Evaluation

The delivery evaluation of geosynthetic materials will be essentially the same for each type of geosynthetic, regardless of the specific product being delivered to the project site. The CQA Consultant will document the arrival of the geosynthetic material delivered to the site. During transportation, handling, and storage, the reinforcing geotextile shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. It will be the responsibility of the Contractor to protect the geosynthetics stored on-site from theft, vandalism, and damage.

Upon delivery at the site, the Contractor and CQA Consultant shall conduct an inspection of the geosynthetic rolls for defects and damage. This inspection shall be conducted without unrolling the materials unless defects or damages are found or suspected. The CQA Consultant shall indicate to PEF:

- Rolls, or portions thereof, which should be rejected and removed from the site because they have severe or nonrepairable flaws which may compromise geosynthetic quality; and

- Rolls which include minor or repairable flaws which do not compromise geosynthetic quality.

The CQA Consultant shall also monitor that on-site equipment used to handle the geosynthetics is adequate and does not pose any risk of damage to the geosynthetics when used properly.

5.3 Material Surface Evaluation

Material surface evaluation will consist of observation and documentation of deployment locations and procedures, as well as visual examination of the geosynthetic material surface during, and immediately after, deployment to assess material appearance, continuity, and integrity.

5.4 Conformance Testing

The CQA Consultant will observe the sampling of geosynthetic materials from the rolls (or panels) that are delivered to the site. These samples will be taken such that they are representative of the geosynthetic layer delivered to the project site.

Geosynthetic conformance samples shall be 3 feet long and taken across the entire width of the roll and shall not include the first 3 feet of material. The CQA Consultant will visually inspect the sample to verify that it is not damaged (scratches, crimps, blemishes, etc.). If damage is noted, the sample will be withdrawn from testing and the geosynthetic material will be resampled by the Contractor or the Geosynthetics Installer.

Each geosynthetic material will be tested in accordance with the methods detailed in the appropriate sections of the project requirements. The results of the tests performed on each sample will, at a minimum, meet the material property value detailed in the project requirements and the geosynthetic layer Manufacturer's minimum property values, as submitted in accordance with the project requirements.

If conformance testing indicates project criteria are not met, a retest of the sample will be conducted, if possible based on the test and the material available. If the material cannot be retested, or if the retest indicates failure, then two additional conformance samples from adjacent rolls on either side of the failing roll (based on roll numbers) will be tested and the process

continued until passing tests are achieved. Rolls between passing tests shall be rejected and not used for the project.

5.5 Monitoring of the Geosynthetic Material Installation

5.5.1 General

Geosynthetic materials installation will be monitored by the CQA Consultant. Monitoring will include: visual examination of the subgrade for unacceptable areas or materials; observation of deployment equipment operation to verify that none is allowed to travel directly on the geosynthetic material without adequate protection (as defined in the project requirements); observation and documentation of geosynthetic material placement procedures including sewing of the reinforcing geotextile and non-destructive and destructive testing of the geomembrane seams; observation of weather conditions during the installation of the geosynthetic; observation and documentation of geosynthetic material panel locations; observation, documentation, and periodic measurement of geosynthetic material overlaps and/or seams; observation and documentation of the locations of geosynthetic material cuts, tears, holes, or irregularities and the repair of such; observation and documentation of geosynthetic material temporary and permanent anchoring systems; observation that geosynthetic material is protected at the end of work day; and observation of the geosynthetic Installer's workmanship and performance of required tasks.

In the event that testing indicates the material or seam does not meet the required criteria, the test will be considered failing. The extent and nature of defective work will be determined through additional tests, observations, review of records and test results or other means as detailed in the project requirements. After the extent and nature of the deficiency has been ascertained, the Contractor or the Geosynthetics Installer will implement corrective actions required to satisfy the project requirements. Areas that have been repaired will be retested. Retests must verify that the entire deficient area has been corrected prior to additional work being performed in that area.

5.5.2 Reinforcing Geotextile Construction Quality Assurance

The installation of the reinforcing geotextile shall be monitored to assure that the installation is conducted in accordance with the project specifications. Monitoring requirements include the deployment of the material in accordance with the specification, i.e., with the end seams staggered and the ends (at the outside edges) anchored with soil as shown on the drawings. The

overlap provided during deployment should be monitored to assure the material overlap is sufficient for sewing. The sewing of the geotextile should be monitored to assure that the seams are installed in accordance with the specifications and that the sewing machine is operating properly, there are no areas of the seam that are skipped, and that the thread is not breaking too often.

5.5.3 Geomembrane Construction Quality Assurance

5.5.3.1 Geomembrane Placement

Field Panel Placement

The CQA Consultant shall verify that the Installer has taken all necessary precautions to protect the underlying geotextile during geomembrane deployment operations. The CQA Consultant shall verify that all geomembrane is handled in such a manner as to ensure it is not damaged in any way, and the following conditions are met:

- On slopes, the geomembrane is secured and then deployed down the slope in such a manner as to continually keep the geomembrane panel in tension;
- In the presence of wind, all geomembrane is weighted with sandbags or other method approved by the Engineer;
- Geomembrane panels are kept continually under tension to minimize the presence of wrinkles;
- The geomembrane is cut using a utility blade in a manner recommended by the manufacturer;
- During placement, care is taken not to entrap loose soil, sand, stones, or other debris under the geomembrane;
- The exposed geomembrane is protected from damage in heavily trafficked areas; and
- A visual examination of the geomembrane is carried out over the entire surface, after installation, to assure that damaged areas, if any, are identified and repaired.

The CQA Consultant shall verify that field panels are installed in substantial conformance with the Installer's panel layout plan, as approved or modified. The CQA Consultant shall record the

field panel identification code, manufacturers roll number, location, date of installation, and dimensions of each field panel.

Geomembrane installation shall not proceed at an ambient temperature below 40 degrees Fahrenheit (°F) or above 104°F unless authorized in writing by the Engineer. Geomembrane installation shall not proceed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds. The CQA Consultant shall monitor that the above conditions are fulfilled.

The CQA Consultant shall monitor geomembrane deployment for the following:

- Any equipment used does not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons or other means;
- Any geosynthetic elements immediately underlying the geomembrane are clean and free of foreign objects or debris;
- Personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane;
- The method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil and does not damage the underlying geotextile;
- The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);
- Adequate temporary loading and/or anchoring (e.g., sand bags, tires), not likely to damage the geomembrane, has been placed to prevent uplift by wind (in case of high winds, continuous loading, e.g., by adjacent sand bags, is recommended along edges of panels to minimize risk of wind flow under the panels); and
- Direct contact with the geomembrane is minimized; i.e., the geomembrane is protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected.

The CQA Consultant shall observe the geomembrane panels, after placement and prior to seaming, for damage. The CQA Site Manager shall advise PEF which panels, or portions of panels, should be rejected, repaired, or accepted.

Damaged panels or portions of damaged panels that have been rejected shall be marked and their removal from the work area recorded by the CQA Consultant. Repairs shall be made according to procedures described in this Section.

Field Panel Identification

A field panel is the unit area of geomembrane which is to be seamed in the field, i.e., a field panel is a roll or a portion of roll cut in the field. The CQA Consultant shall assure that each field panel is given an “identification code” (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by the Installer and CQA Consultant. This field panel identification code shall be as simple and logical as possible. The Geosynthetic Manufacturer’s roll numbers shall be traceable to the field panel identification code. The CQA Consultant shall document the correspondence between roll numbers, factory panels, and field panel identification codes. The field panel identification code shall be used for all quality assurance/quality control records.

5.5.3.2 Field Panel Seaming

Panel Layout Drawing

The CQA Consultant shall review the panel layout drawing submitted to PEF by the Installer and verify that it is consistent with accepted state of practice. In general, seams should be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams should be minimized. No horizontal seam should be less than 5 feet beyond the toe of the slope, or areas of potential stress concentrations, unless otherwise authorized by the Engineer. A seam numbering system compatible with the field panel identification numbering system shall be agreed upon prior to any seaming.

Seaming Equipment and Products

General

Approved processes for field seaming are extrusion welding and fusion welding. Proposed alternate processes shall be documented and submitted to PEF for approval. Only equipment which has been specifically recommended by the Geosynthetics Manufacturer by make and model shall be used. All seaming equipment shall be permanently marked with an identification number.

Fillet Extrusion Seam Process

The fillet extrusion welding apparatus shall be equipped with gauges giving the temperature in the apparatus and at the nozzle. The CQA Consultant shall verify that the extrudate is comprised of the same resin as the geomembrane sheeting. The CQA Consultant shall monitor extrudate temperatures, ambient temperatures, and geomembrane surface temperatures at appropriate intervals.

The CQA Consultant shall also monitor that:

- The number of spare operable seaming apparatus agreed by PEF are maintained on site;
- Equipment used for seaming is not likely to damage the geomembrane;
- The extruder is purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel;
- The electric generator is placed on a smooth base such that no damage occurs to the geomembrane; and
- A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage.

Fusion Seam Process

The fusion welding apparatus must be automated, self-propelled devices. The fusion welding apparatus shall be equipped with gauges giving the applicable temperatures and welding speed. The CQA Consultant shall monitor ambient temperatures, geomembrane surface temperatures, apparatus speed, and apparatus temperatures at appropriate intervals.

The CQA Consultant shall also monitor that:

- The number of spare operable seaming apparatus agreed by PEF are maintained on site;
- Equipment used for seaming will not damage the geomembrane;
- The electric generator is placed on a smooth base such that no damage occurs to the geomembrane;
- For cross seams, the edge of the cross seam is ground to a smooth incline (top and bottom) prior to welding;
- A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage; and
- A movable protective layer is used, as necessary, directly below each overlap of geomembrane that is to be seamed to prevent build-up of moisture between the sheets.

Seam Preparation

General

The CQA Consultant shall monitor that:

- Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material;
- Seams are overlapped a minimum of 5 inches for fusion seams and 3 inches for extrusion seams;
- If seam overlap grinding is required, the process is completed according to the Geosynthetics Manufacturer's instructions or Section 02770 of the Technical Specifications, whichever is the more stringent, prior to the seaming operation, and in a way that does not damage the geomembrane;
- The grind depth shall not exceed 5 percent of the nominal geomembrane thickness;
- Grinding marks shall not appear beyond the extrudate after it is placed; and
- Seams are aligned with the fewest possible number of wrinkles and fishmouths.

Overlapping and Temporary Bonding

The CQA Consultant shall monitor that:

- The panels of geomembrane have a finished overlap of a minimum of 5 inches for fusion seams and 3 inches for extrusion seams, but in any event sufficient overlap shall be provided to allow peel tests to be performed on the seam;
- No solvent or adhesive is used; and
- The procedure used to temporarily bond adjacent panels together does not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus is controlled such that the geomembrane is not damaged.

Trial Seams

The CQA Consultant shall verify that the Installer performs trial seam tests in accordance with Section 02770 of the Technical Specifications. The CQA Consultant shall observe and document the Installer's trial seam testing procedures. The trial seam samples shall be assigned an identification number and marked accordingly by the CQA Consultant. Each sample shall be marked with the date, time, machine temperature(s) and setting(s), number of seaming unit, and name of seaming technician. Trial seam samples shall be maintained until destructive seam testing of the applicable seams are tested and pass.

General Seaming Procedures

No geomembrane seaming shall be performed unless the CQA Consultant is on-site. The CQA Consultant shall monitor the general seaming procedure used by the Installer as follows:

- If required for fusion welding, a movable protective layer of plastic will be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded.
- If required, a firm substrate shall be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.
- Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same

geomembrane extending a minimum of 6 inches beyond the cut in all directions.

- If seaming operations are carried out at night, adequate illumination shall be provided by the Contractor to the satisfaction of the CQA Consultant.
- Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

Nondestructive Seam Continuity Testing

The CQA Consultant shall verify that the Installer nondestructively tests all field seams over their full length using a vacuum test unit (for extrusion or single-wedge fusion seams) or air pressure test (for double-wedge fusion seams). Spark testing may be performed if the seam cannot be tested using the vacuum or air pressure test methods, such as around geomembrane/pipe boots. The purpose of nondestructive tests is to check the continuity of seams. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all field seaming. The CQA Consultant shall:

- Monitor nondestructive testing;
- Document the results of the nondestructive testing; and
- Inform the Installer and PEF of any noncompliance.

Any required seam repairs shall be made in accordance with the Technical Specifications. The CQA Consultant shall:

- Observe the repair procedures;
- Observe the retesting procedures; and
- Document the results.

The seam number, date of observation, dimensions and/or descriptive location of the seam length tested, name of person performing the test, and outcome of the test shall be recorded by the CQA Consultant.

Destructive Testing

Overview

Destructive seam testing shall be performed during the geomembrane installation. The purpose of this testing is to evaluate seam strength. Destructive seam testing shall be done as the seaming work progresses, not at the completion of all field seaming.

Location and Frequency

The CQA Consultant shall select all destructive seam test sample locations. Sample locations shall be established as follows:

- A minimum frequency of one test location per 500 feet of seam length. This minimum frequency is to be determined as an average taken throughout the entire facility.
- A destructive test sample shall be obtained on all reconstructed seams or caps exceeding 150 feet in length. Other repairs will be sampled for destructive testing at the discretion of the CQA Consultant and at least once for every 500 feet of welding.
- Test locations shall be determined during seaming at the CQA Consultant's discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, off-set welds, or any other potential cause of defective welding.

The Installer shall not be informed in advance of the locations where the seam samples will be taken.

Sampling Procedures

Destructive seam testing shall be performed as the seaming progresses in order to obtain the Geosynthetic CQA Laboratory test results before the geomembrane is covered by overlying materials. The CQA Consultant shall:

- Observe sample cutting;
- Assign a number to each sample, and mark it accordingly; and
- Record sample location on the record panel layout drawing.

All holes in the geomembrane resulting from destructive seam test sampling shall be immediately repaired in accordance with repair procedures described in Section 02770 of the Technical Specifications. The continuity of the new seams in the repaired area shall be nondestructively tested as described in Section ~~4-3.75.5.3.2~~, Nondestructive Seam Continuity Testing.

Size of Samples

At a given sampling location, two types of samples (field test samples and laboratory test samples) shall be taken. First, a minimum of two field samples or test strips should be taken for field testing. Each of these test strips shall be 1 inch wide by 12 inches long, with the seam centered parallel to the width. The distance between these two specimens shall be 42 inches. If both specimens pass the field test described a full laboratory destructive sample shall be taken for testing by the Geosynthetics CQA Laboratory.

The test strips shall be tested in the field for peel adhesion using a calibrated tensiometer. In addition to meeting the strength requirements outlined in Section 02770 of the Technical Specifications, all specimens shall exhibit a Film Tear Bond (FTB) (i.e., the seam shall not fail in the weld). If any field test specimens fails to meet these requirements, the destructive sample will be considered failing. The CQA Consultant shall witness all field tests and mark all samples and portions with the sample number. The CQA Consultant shall also log the date, number of the seaming unit, seaming technician identification, destructive sample number and the test result (pass or fail).

The full destructive sample shall be located between the two field test strips. The sample shall be 12 inches wide by 42 inches long with the seam centered lengthwise. The sample shall be cut into three parts and distributed as follows:

- One 12-inch by 12-inch portion to the Installer;
- One 12-inch by 12-inch portion to PEF for archive storage; and
- One 12-inch by 18-inch portion for Geosynthetics CQA Laboratory testing.

Geosynthetics CQA Laboratory Testing

Destructive test samples shall be tested by the Geosynthetics CQA Laboratory. Testing shall include “bonded seam strength” (shear) and “peel adhesion” (peel) in accordance with ASTM D 4437. The minimum acceptable values to be obtained in these tests are listed in Section 02770 of the Technical Specifications. Five specimens shall be tested for each test method. Specimens shall be selected alternately by test from the samples (i.e., peel, shear, peel, shear...). Both the inside and outside tracks of the double-wedge fusion seams shall be tested for peel adhesion. A passing test shall meet the minimum required values in at least four out of five specimens for each test method (shear and peel).

The Geosynthetics CQA Laboratory shall provide test results no more than 24 hours after sample receipt. The CQA Site Manager shall review laboratory test results as soon as they become available, and make appropriate recommendations to PEF.

Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails a destructive test, whether that test was conducted in the field or by the Geosynthetics CQA Laboratory. The CQA Consultant will verify that the Installer follows one of the two options below:

- The Installer can reconstruct the seam (e.g., remove the old seam and reseat) between any two passing destructive test sample locations or between points judged by the CQA Consultant to represent conditions of the failed seam (e.g., a tie-in seam or a seam made by the apparatus and/or operator used in the failing seam); or
- The Installer can trace the welding path to an intermediate location a minimum of 10 feet from the point of the failed test in each direction and take a sample for additional field testing in accordance with the destructive test procedure at each location. If these additional isolation samples pass the field test, then full laboratory samples are taken at both locations. If these laboratory samples meet the specified strength criteria, then the seam is reconstructed between these locations. If either sample the field or laboratory sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed.

All failed seams must be bounded by two locations from which passing laboratory destructive test samples have been taken, unless the entire seam is reconstructed and retested. In cases exceeding 150 feet of reconstructed seam, a sample taken from the zone in which the seam has been

reconstructed must also pass destructive testing. Repairs shall be made in accordance with Section 4.3.25.5.3.3 Repair Procedures. The CQA Consultant shall document all actions taken in conjunction with destructive test failures.

5.5.3.3 Defects and Repairs

Identification

All seams and non-seam areas of the geomembrane shall be examined by the CQA Consultant for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of examination. PEF shall require the geomembrane surface to be broom cleaned or washed by the Installer if the amount of dust or mud inhibits examination.

Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Geosynthetics Installer in accordance with Section 02770 of the Technical Specifications. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between the Installer and CQA Consultant.

In addition, the following conditions shall be monitored by the CQA Consultant:

- Surfaces of the geomembrane which are to be repaired shall be abraded no more than one hour prior to the repair;
- All surfaces must be clean and dry at the time of the repair;
- All seaming equipment used in repairing procedures must be approved;
- The repair procedures, materials, and techniques shall be approved by the CQA Consultant in advance of the specific repair;
- Patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches; and
- The geomembrane below large caps should be appropriately cut to avoid trapped water or gas between the two sheets.

Verification of Repairs

Each repair shall be numbered and logged. Each repair shall be non-destructively tested using approved methods. Repairs which pass the non-destructive test shall be taken as an indication of an adequate repair. Reconstructed seams or caps exceeding 150 feet in length shall require destructive test sampling. Other repairs will be sampled for destructive testing at the discretion of the CQA Consultant and at least once for every 500 feet of welding. The CQA Consultant shall observe all non-destructive testing of repairs and shall record the number of each repair, date, and test result (pass or fail).

5.6 Liner System Acceptance

The Contractor shall retain all responsibility for the geosynthetics until acceptance by PEF. The terms for liner system acceptance are described in Section 02770 of the specifications.

6.0 DOCUMENTATION

6.1 General

The CQA Consultant will confirm that quality assurance requirements have been addressed and documented. Further, the CQA Consultant will provide field reports, data sheets and checklists to substantiate that required monitoring tasks have been completed. The CQA Consultant will maintain a job site file of plans, specifications, checklists, test procedures, daily reports, logs and other project relevant documents.

6.2 Daily Record Keeping

For the FGD pond system construction and/or installation activities, the daily record keeping by the CQA Consultant will include at a minimum the following CQA/CQC related information:

- Daily Summary Report, reporting meetings and/or discussions with the Contractor and/or the Installer and a summary of the daily reports completed by each CQA Monitor (if more than one);
- Daily reports from each of the CQA Consultant's site personnel (CQA Monitors) describing the observations made of construction/installation activities and CQA/CQC monitoring/testing;
- Permit modification and clarification documentation;
- Weather conditions, including maximum and minimum ambient temperatures and precipitation events (external to any enclosures that may be used to protect the work); and
- Name and title of Construction Supervisor.

When construction activities include earthworks, the CQA daily record keeping will also include:

- Daily soils field test result data sheets;
- Laboratory soils test result data sheets;
- Identification of borrow source and the associated optimum moisture content/maximum dry density;
- Compaction equipment (type and weight) and the typical number of passes;

- Equipment used to place and spread materials adjacent to geosynthetic materials;
- Reduced scale site plan showing locations of soil tests and procured samples; and
- Equipment calibration or recalibration forms as applicable.

When construction activities include the installation of the geosynthetics components, the CQA daily record keeping will also include:

- Conformance test result data sheets;
- Equipment used for deployment and welding, if any;
- Installation problem and resolution reports and summaries; and
- Installation progress reports.

These documents will be accessible on site for review by interested parties.

Each Daily Summary Report will include:

- Date, project name, project number, and location;
- Identification of parties and personnel on-site or participating in meetings and discussions;
- Start-Up and end times of daily construction activities;
- Documentation of observations of construction and CQA activities/test results;
- Methods used to correct construction/installation deficiencies;
- Installation/Construction activities completed that day and summary of progress;
- A summary of the CQA/CQC tests performed and an indication of the results (which passed and which failed the project requirements);
- Summary of problems and their resolutions;
- Summary of meetings and discussions;

- Proposed activities for the next day; and
- Relevant discussions and the outcome of each.

6.3 Construction/Installation Problem Resolution Documentation

Construction/Installation problem and resolution documents will reference specific observations and test result data forms. These documents will include the following information:

- A detailed description of the problem, non-conformance or deficiency;
- Location identified by coordinates (if appropriate), and probable cause for the problem, nonconformance or deficiency;
- Detailed description of how and when the problem was identified;
- Detailed description of how the problem, non-conformance or deficiency was solved or corrected;
- Reference to results of any retests performed; and
- Detailed description of measures implemented to prevent recurrence of the problem nonconformance or deficiency.

These documents or descriptions will be incorporated as part of the Daily Summary Report. Any resulting modification or clarification to the permit plans or specifications will be documented and approved by the Engineer and Owner.

6.4 Permit and/or Specification Modification/Clarifications

During the course of construction or the installation of the components of the cover system, modifications or clarifications to the Permit or project requirements will be documented by the CQA Consultant. The Design Engineer will be notified for review and approval of any modification or clarification prior to implementation.

6.5 Photographic Records

Photographic records will adequately represent work progress, construction problems and resolutions, observations, typical testing procedures, and construction procedures. Photographs will be logged by the photographer and include the date and a brief description of the location and situation. Electronic copies of the photographs will be provided to PEF upon completion of

the work, if requested. Photographs will be digitally recorded and filed on a CD or other appropriate electronic file, with the photograph log.

6.6 Final Report

Upon completion of the work, the CQA Consultant will submit a final certification report. The report will indicate that the work has been constructed in substantial compliance with the intent of the project permit and the project requirements, or any modification to same, and will be signed and sealed by the CQA Consultant representing the CQA responsible party. The final report will provide necessary supporting documentation compiled during the implementation of the CQA Plan.

The CQA final certification report will present the following information:

- Description of construction/installation activities;
- Summary of the project scope, materials used, observations, and sampling/testing procedures and criteria;
- List of construction/installation parties;
- Daily Inspection Summary Reports;
- Problem Identification/Resolution Reports;
- Permit and Specification Modification and Clarifications;
- Internal CQA memoranda with data interpretation or analyses, as applicable;
- Other pertinent data regarding the construction/installation; and
- A statement certifying that the project was completed in substantial compliance with the intent of the project and the project requirements under the signature and seal of the CQA Consultant.

The final certification report will include documentation related to the construction and the installation of the soils and geosynthetics components of the cover system, as follows:

- Description of construction equipment;
- Field test data summaries including sample numbers, test locations, lift, and pass or fail status for each test;

- Method of adjusting moisture, procedures used to control desiccation cracks, and method of repairing failing areas;
- Summary of laboratory test data;
- Geosynthetics conformance test data summaries;
- Subgrade surface acceptance forms;
- Observation of geosynthetic materials upon delivery;
- Inventory of geosynthetic rolls (or panels) shipped to the project;
- Resin and roll (or panel) certificates of analysis;
- Diagrams illustrating the location of tests; and
- Record drawings sealed by the Land Surveyor, including the elevation of the subgrade surface and the elevation of the top of each subsequent soil surface (including the USGS and site coordinate systems and the elevations and locations of vaults, manholes, trenches, piping, and other critical features).

Surveying, survey base maps and survey data supporting the record drawings will be developed by a Registered Land Surveyor. The record drawings will depict details pertaining to construction/installation, dimensions, elevations, final elevations, layer thicknesses, and appurtenance locations.

6.7 Acceptability of the Work

6.7.1 General

It is the responsibility of the CQA Consultant to determine and report to PEF whether the work, or a portion of the work, has been completed in substantial compliance with the intent of the permit, prevailing industry practice, and the project requirements.

6.7.2 Soils

Soil subgrades will be approved and accepted by the CQA Consultant prior to the installation of the geosynthetics. Density and moisture testing shall be complete such that any failing tests or areas have been retested to assure all areas have compliant test results.

6.7.3 Geosynthetics

Geosynthetic materials will be approved and accepted by the CQA Consultant prior to the installation of overlying layers, if any. Portions of a geosynthetic material installation which are to be approved as complete will be cleaned by the Geosynthetics Installer to remove any debris, scrap geosynthetics, mud or other material which would interfere with the inspection of the geosynthetic layer.

The CQA Consultant will inspect the geosynthetic materials for any damage that may have occurred during or after the initial installation activities and verify that identified repairs have been completed, non-destructive testing has been performed, and destructive test samples from the area to be approved have either been passed or are bound by passing destructive tests and the failed seams reconstructed.

Upon satisfactorily completing this review, and if no additional damage to the geosynthetic material is identified, the CQA Consultant will recommend the approval of the installation, or that specific portion of the installation. The approval process will be staged, and will occur as the work progresses rather than at the end of the installation process.

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ATTACHMENT F
BORING LOGS G-20 THROUGH G-25

RECORD OF BOREHOLE G-20

SHEET 1 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 73.0 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Core
DRILL RIG: CME 75
DATE STARTED: 6/1/2009
DATE COMPLETED: 6/2/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,675.2 E: 15,057.3
GS ELEVATION: 98.69
TOC ELEVATION: N/A
TEMPERATURE: 85°

INCLINATION: -90
DEPTH W.L.: 7
ELEVATION W.L.: 92
DATE W.L.: 6/2/2009
TIME W.L.: 8:40

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES						COMMENTS
		DESCRIPTION	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	
0		0.0 - 8.0 Brown to dark brown fine SAND; little fines, little gravel [fill]			1	SS	5-7-12-15	19		12.0 24.0	Install de-sander
					2	SS	13-20-20-32	40		22.0 24.0	
					3	SS	15-17-50/5"	REF		12.0 24.0	
					4	SS	13-20-27-25	47	N/A	18.0 24.0	
95				90.7							
		8.0 - 10.0 Dark brown fine SAND; some fines, trace gravel		8.0	5	SS	15-15-50/2"	REF		8.0 24.0	Drill to 15'; Prepare to core
				88.7							
10		10.0 - 14.5 Light tan calcareous SAND; little limestone gravel		10.0	6	SS	19-18-24-23	42		18.0 24.0	
					7	SS	15-34-50/4"	REF		10.0 24.0	
				84.2	N/A	N/A	N/A	N/A		N/A 12.0	
15		14.5 - 17.5 Light tan LIMESTONE GRAVEL		14.5					20 sec		
									25 sec		
		17.5 - 23.0 Light tan competent LIMESTONE		81.2	8	CORE	RQD= 47%	NA	1 min	32.0 60.0	
				17.5					1 min 25		
									1 min 15		
									1 min 30		
20									1 min 50		
				75.7	9	CORE	RQD= 70%	NA	1 min 25	60.0 60.0	
				23.0					1 min 10		
									1 min 10		
25		23.0 - 30.0 Light tan weathered LIMESTONE			10	SS	50/6"	REF	N/A	N/A 6.0	
									45 sec		
									45 sec		
					11	CORE	RQD= 24%	NA	1 min 15	48.0 54.0	
									1 min 35		
									1 min 40		
30		30.0 - 38.0 Light tan calcareous SAND; some silt, trace weathered limestone gravel		68.7					10 sec		
				30.0					15 sec		
					12	CORE	RQD= 0%	NA	25 sec	24.0 60.0	
									20 sec		
									30 sec		
35					13	SS	49-35-36	71	N/A	16.0 18.0	
									30 sec		
				60.7	14	CORE	RQD= 0%	NA	35 sec	0.0 48.0	
				38.0					50 sec		
40		38.0 - 50.0 Tan calcareous SAND and weathered LIMESTONE									

Log continued on next page

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-20

SHEET 2 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 73.0 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Core
DRILL RIG: CME 75
DATE STARTED: 6/1/2009
DATE COMPLETED: 6/2/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,675.2 E: 15,057.3
GS ELEVATION: 98.69
TOC ELEVATION: N/A
TEMPERATURE: 85°

INCLINATION: -90
DEPTH W.L.: 7
ELEVATION W.L.: 92
DATE W.L.: 6/2/2009
TIME W.L.: 8:40

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES						COMMENTS
		DESCRIPTION	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	
40		38.0 - 50.0 Tan calcareous SAND and weathered LIMESTONE (Continued)			14	CORE	RQD= 0%	NA	30 sec 1 min		SS= Split Spoon REF= Refusal RQD= Rock Quality Designation
									1 min 5		
					15	CORE	RQD= 15%	NA	1 min 10	36.0 54.0	
									1 min 5		
									1 min		
45									45 sec		
					16	CORE	RQD= 23%	NA	1 min 10	30.0 60.0	
									1 min		
									1 min 5		
50		50.0 - 51.5 Light tan SAND, some silt, trace weathered limestone		48.7 50.0 47.2	17	SS	16-17-35	52	N/A	18.0 18.0	
		51.5 - 62.3 Tan weathered LIMESTONE		51.5					45 sec 1 min 15		
					18	CORE	RQD= 0%	NA	1 min 30	12.0 60.0	
									45 sec		
									1 min 45		
55									30 sec		
									30 sec		
					19	CORE	RQD= 7%	NA	1 min 15	12.0 60.0	
									30 sec		
60		62.3 - 65.0 Light tan calcareous SAND and weathered LIMESTONE GRAVEL		36.4 62.3	20	SS	10-16-10	26	N/A	N/A 18.0	
									30 sec		
									20 sec		
65		65.0 - 69.0 Light tan Sandstone, Some Gravel		33.7 65.0	21	CORE	RQD= 0%	NA	55 sec	0.0 60.0	Loss circulation at 65'. Core barrel drop 1 ft (64-65') 63-68 No recovery
									30 sec		
									1 min 15		
									1 min 15		
70		69.0 - 73.0 Black hard to very stiff SILT		29.7 69.0	22	CORE	RQD=7%	NA	45 sec	48.0 48.0	Core barrel drop 1 ft (70-71') Driller clean out hole, Accidentally overdrill to 73'; Rock at 73'
									20 sec		
									45 sec		
				25.7							G-20 Grouted upon completion
75		73.0 - 73.0 Rock @ 73' Boring completed at 73.0 ft									
80											

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-21

SHEET 1 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 71.5 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Wireline Core
DRILL RIG: CME 75
DATE STARTED: 6/8/2009
DATE COMPLETED: 6/8/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,885.5 E: 15,119.4
GS ELEVATION: 100.19
TOC ELEVATION: N/A
TEMPERATURE: 85°

INCLINATION: -90
DEPTH W.L.: N/A
ELEVATION W.L.: N/A
DATE W.L.: N/A
TIME W.L.: N/A

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES						COMMENTS
		DESCRIPTION	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	
0	100	0.0 - 9.0 Brown SAND; little silt; little limestone fragments [Fill]			1	SS	7-7-11-18	18		18.0 24.0	SS= Split Spoon REF= Refusal RQD= Rock Quality Designation
					2	SS	9-16-21-26	37		14.0 24.0	
5	95				3	SS	8-4-5-6	9		14.0 24.0	
					4	SS	8-8-16-16	24		8.0 24.0	
				91.2							
		9.0 - 10.5 Light brown fine SAND; little silt		9.0	5	SS	6-8-24-22	32		6.0 24.0	
10	90			89.7							
		10.5 - 13.0 Tan LIMESTONE GRAVEL and SAND		10.5	6	SS	3-2-3-4	5		12.0 24.0	
				87.2							
		13.0 - 13.5 Brown fine SAND; some calcareous sand		86.7	7	SS	10-10-8-13	18		14.0 24.0	
				13.5							
		13.5 - 15.0 Tan LIMESTONE GRAVEL and SAND		85.2	N/A	N/A	NA	N/A		N/A 24.0	
15	85			15.0							
		15.0 - 20.0 Light tan competent LIMESTONE							25 sec		
					8	CORE	RQD= 56%	NA	1 min	15	
									1 min	36.0 48.0	
									1 min		
				80.2							
		20.0 - 30.0 Light tan weathered LIMESTONE GRAVEL; some sand		20.0					1 min		
					9	CORE	RQD= 17%	NA	30 sec	42.0 60.0	
									15 sec		
									30 sec		
25	75				10	SS	28-50/3"	REF	N/A	6.0 9.0	
									30 sec		
									1 min		
					11	CORE	RQD= 33%	NA	1 min	48.0 51.0	
									30 sec		
									45 sec		
30	70			70.2							
		30.0 - 34.0 Suspected void or flowing sands		30.0					30 sec		
					12	CORE	RQD= 0%	NA	15 sec	0.0 48.0	
									<15 sec		
									15 sec		
				66.2							
		34.0 - 45.0 Light tan weathered LIMESTONE GRAVEL		34.0	13	SS	3-6-9	15	N/A	8.0 18.0	
35	65								15 sec		
									15 sec		
					14	CORE	RQD= 0%	NA	15 sec	24.0 54.0	
									30 sec		
									15 sec		
40											

Log continued on next page

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-21

SHEET 2 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 71.5 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Wireline Core
DRILL RIG: CME 75
DATE STARTED: 6/8/2009
DATE COMPLETED: 6/8/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,885.5 E: 15,119.4
GS ELEVATION: 100.19
TOC ELEVATION: N/A
TEMPERATURE: 85°

INCLINATION: -90
DEPTH W.L.: N/A
ELEVATION W.L.: N/A
DATE W.L.: N/A
TIME W.L.: N/A

		SOIL PROFILE			SAMPLES							COMMENTS	
DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	SS= Split Spoon REF= Refusal RQD= Rock Quality Designation		
				DEPTH (ft)									
40	60	34.0 - 45.0 Light tan weathered LIMESTONE GRAVEL (Continued)		55.2	15	CORE	RQD= 0%	NA	15 sec 15 sec <15 sec <15 sec	8.0 60.0	Rod dropped from 46-46.5 ft. Add length rod and allow to drop to 47 ft		
45	55	45.0 - 55.0 Tan fine SAND, trace to little silt, trace limestone gravel		45.0	16	SS	2-3 WOH/12"	NA	N/A	12.0 24.0			
					17	CORE	RQD= 0%	NA	<15 sec <15 sec <15 sec	8.0 36.0			
50	50				18	CORE	RQD= 0%	NA	<15 sec <15 sec <15 sec 15 sec <15 sec	12.0 60.0			
55	45	55.0 - 65.0 Tan weathered LIMESTONE; some gravel; some sand		45.2	20	CORE	RQD= 0%	NA	15 sec 4 min 30 15 sec <15 sec <15 sec	6.0 60.0	Flush out borehole w/ tremie pipe		
60	40				21	CORE	RQD= 10%	NA	15 sec 30 sec 30 sec 30 sec 15 sec	24.0 60.0			
65	35	65.0 - 70.5 Brownish tan SAND; some weathered limestone fragments		35.2	22	SS	1-2-5	7	N/A	6.0 18.0			
				65.0	23	CORE	RQD= 0%	NA	<15 sec <15 sec <15 sec <15 sec	0.0 42.0			
70	30	70.5 - 71.5 Brown fine SAND and SILT		29.7	24	SS	2-8-15	23	N/A	8.0 18.0	S23 (66.5-70) No recovery likely flowing sands verified= set rod for 70-71.5 ft SS; but rod at 65 ft will flush out and try again =rod at 70 ft		
				70.5 28.7									
Boring completed at 71.5 ft												G-21 Grouted upon completion	

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-22

SHEET 1 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 43.0 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Core
DRILL RIG: CME 75
DATE STARTED: 6/3/2009
DATE COMPLETED: 6/10/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,787.6 E: 15,117.3
GS ELEVATION: 100.49
TOC ELEVATION: N/A
TEMPERATURE: 85°

INCLINATION: -90
DEPTH W.L.: N/A
ELEVATION W.L.: N/A
DATE W.L.: N/A
TIME W.L.: N/A

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES						COMMENTS
		DESCRIPTION	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	
0	100	0.0 - 8.0 Brown SAND; trace light tan limestone fragments; trace silt [Fill]			1	SS	5-8-12-16	20		16.0 24.0	
					2	SS	15-25-30-40	55		18.0 24.0	
5	95				3	SS	10-8-7-5	15		16.0 24.0	
					4	SS	9-5-14-20	19		16.0 24.0	
		8.0 - 10.0 Black fine SAND; some silt; trace organics; organic-like odor		92.5 8.0	5	SS	20-25-30-32	55		8.0 24.0	Clean out hole to 15 ft
10	90	10.0 - 11.0 Reddish brown fine SAND; little silt; trace organic root throughout		90.5 10.0 89.5 11.0	6	SS	7-8-8-12	16		18.0 24.0	
		11.0 - 14.5 Tan to light grey LIMESTONE GRAVEL and calcareous SAND			7	SS	10-19-26-30	45		12.0 24.0	
15	85	14.5 - 23.5 Tan competent LIMESTONE		86.0 14.5	N/A	N/A	N/A	N/A		N/A 12.0	
					8	CORE	RQD= 25%	N/A	30 sec 1 min 15 2 min 30	24.0 36.0	Lost circulation @ 18 ft Install Casing (4") to 18 ft
20	80				9	CORE	RQD= 22%	N/A	30 sec <15 sec <15 sec 1 min 30 2 min 30	24.0 60.0	
		23.5 - 31.0 Tan weathered LIMESTONE		77.0 23.5	10	SS	50/5*	REF	N/A 30 sec 30 sec	2.0 6.0	
25	75				11	CORE	RQD= 22%	N/A	<15 sec <15 sec 15 sec	14.0 54.0	
		31.0 - 35.0 Tan fine SAND; some silt		69.5 31.0	12	CORE	RQD= 17%	N/A	45 sec 45 sec 45 sec 20 sec 20 sec	24.0 60.0	31-32.5 ft Suspected void; no rig chatter
30	70				13	SS	2-4-4-5	8	N/A	12.0 24.0	
		35.0 - 43.0 Tan weathered LIMESTONE GRAVEL		65.5 35.0	14	CORE	RQD= 0%	N/A	15 sec 1 min 1 min	12.0 36.0	
35	65				15	CORE	RQD= 0%	N/A	>2 min	8.0 12.0	
					16	CORE	RQD= 0%	N/A	<15 sec	12.0 48.0	
40											

Log continued on next page

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-22

SHEET 2 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 43.0 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Core
DRILL RIG: CME 75
DATE STARTED: 6/3/2009
DATE COMPLETED: 6/10/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,787.6 E: 15,117.3
GS ELEVATION: 100.49
TOC ELEVATION: N/A
TEMPERATURE: 85°

INCLINATION: -90
DEPTH W.L.: N/A
ELEVATION W.L.: N/A
DATE W.L.: N/A
TIME W.L.: N/A

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES						COMMENTS
		DESCRIPTION	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	SS= Split Spoon REF= Refusal RQD= Rock Quality Designation
				DEPTH (ft)							
40	60	35.0 - 43.0 Tan weathered LIMESTONE GRAVEL (Continued)			16	CORE	RQD= 0%	NA	<15 sec <15 sec 15 sec	12.0 48.0	
Boring completed at 43.0 ft											16:05 Stop. Huss will outfit Rig with wireline system and return Monday June 8, 2009. G-22 Grouted and abandoned on 6/10/09. Move approx. 20' West of G-22. Drill G-25 with wireline system
45	55										
50	50										
55	45										
60	40										
65	35										
70	30										
75	25										
80											

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-23

SHEET 1 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 71.5 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Wireline Core
DRILL RIG: CME 75
DATE STARTED: 6/9/2009
DATE COMPLETED: 6/9/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,980.6 E: 15,243.5
GS ELEVATION: 102.19
TOC ELEVATION: N/A
TEMPERATURE: 90°

INCLINATION: -90
DEPTH W.L.: N/A
ELEVATION W.L.: N/A
DATE W.L.: N/A
TIME W.L.: N/A

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE		SAMPLES							COMMENTS
		DESCRIPTION	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	
0		0.0 - 1.5 Brown LIMESTONE GRAVEL some sand		100.7	1	SS	22-36-34-22	70		18.0 24.0	G-23 relocated approx. 25' East, approx. 13' South to avoid stockpile
100		1.5 - 13.0 Very dark gray SILT, some clay [Ash]		1.5	2	SS	11-12-17-14	29		12.0 24.0	
5					3	SS	4-2-6-3	8		6.0 24.0	
95					4	SS	1-1-1-2	2	N/A	12.0 24.0	
10					5	SS	2-2-4-4	6		6.0 24.0	
90					6	SS	4-3-2-1	5		12.0 24.0	
		~ Little calcareous sand									
		13.0 - 14.0 Grayish brown fine SAND; little silt		89.2 13.0 88.2	7	SS	7-6-3-2	9		22.0 24.0	Clean hole 14'; Rock at 14' = will Core (15-20)
15		14.0 - 25.5 Tan competent LIMESTONE and GRAVEL		14.0	N/A	N/A	N/A	N/A		N/A 12.0	
85					8	CORE	RQD= 18%	NA	30 sec 1 min 1 min 15	36.0 60.0	
20					9	CORE	RQD= 35%	NA	1 min 1 min 1 min 45 sec 45 sec <15 sec	48.0 60.0	
75		25.5 - 30.0 Light brown weathered LIMESTONE GRAVEL		76.7 25.5	10	CORE	RQD= 0%	NA	<15 sec 15 sec 15 sec 15 sec	10.0 60.0	
30		30.0 - 45.0 Tan weathered LIMESTONE GRAVEL		72.2 30.0	11	CORE	RQD= 0%	NA	<15 sec <15 sec <15 sec <15 sec	18.0 60.0	
65					12	SS	5-7-4	11	N/A	10.0 18.0	
40					13	CORE	RQD= 0%	NA	<15 sec <15 sec <15 sec <15 sec	6.0 42.0	

Log continued on next page

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-23

SHEET 2 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 71.5 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Wireline Core
DRILL RIG: CME 75
DATE STARTED: 6/9/2009
DATE COMPLETED: 6/9/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,980.6 E: 15,243.5
GS ELEVATION: 102.19
TOC ELEVATION: N/A
TEMPERATURE: 90°

INCLINATION: -90
DEPTH W.L.: N/A
ELEVATION W.L.: N/A
DATE W.L.: N/A
TIME W.L.: N/A

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES						COMMENTS					
		DESCRIPTION	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	SS= Split Spoon REF= Refusal RQD= Rock Quality Designation					
				DEPTH (ft)												
40		30.0 - 45.0 Tan weathered LIMESTONE GRAVEL (Continued)			14	CORE	RQD= 0%	NA	15 sec	18.0 60.0						
												<15 sec				
60														30 sec		
														1 min		
45		45.0 - 54.0 Tan calcareous SAND; some limestone fragments		57.2					<15 sec							
				45.0	15	SS	WOH/24"	WOH		6.0 24.0						
55						16	SS	10-5-14-15	19			24.0 24.0				
50				48.2		17	CORE	RQD= 35%	NA	15 sec		36.0 60.0				
													1 min 15			
50													1 min 15			
													30 sec			
									45 sec							
55		54.0 - 55.0 Tan SAND		54.0		18	CORE	RQD= 7%	NA	30 sec		36.0 60.0				
		55.0 - 59.0 Tan weathered LIMESTONE GRAVEL and sand		47.2										1 min		
45				55.0										15 sec		
														15 sec		
				43.2					45 sec							
60		59.0 - 70.0 Tan LIMESTONE		59.0		19	SS	50/5"	REF	N/A		3.0 12.0				
															1 min	
40												20	CORE	RQD= 8%	NA	1 min 36.0 60.0
														45 sec		
65										45 sec						
									30 sec							
35									30 sec							
							21	CORE	RQD= 13%	NA	15 sec 18.0 60.0					
										15 sec						
70		70.0 - 71.5 Light tan calcareous SAND; some limestone gravel		32.2						15 sec						
				70.0	22	SS	14-35-30	65	N/A	12.0 18.0						
				30.7												
30		Boring completed at 71.5 ft										G-23 Grouted upon completion				
75																
25																
80																

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-24

SHEET 1 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 71.0 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Wireline Core
DRILL RIG: CME 75
DATE STARTED: 6/10/2009
DATE COMPLETED: 6/10/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,738.5 E: 15,217.3
GS ELEVATION: N/A
TOC ELEVATION: N/A
TEMPERATURE: 90°

INCLINATION: -90
DEPTH W.L.: N/A
ELEVATION W.L.: N/A
DATE W.L.: N/A
TIME W.L.: N/A

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES						COMMENTS
		DESCRIPTION	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	
				DEPTH (ft)							
0		0.0 - 3.0 Brownish tan SAND; some calcareous sand			1	SS	4-9-10-9	19	N/A	8.0 24.0	G-24 Relocated approx. 3' East, approx. 3' South G-24 stake missing at time of survey. Coordinates shown as approximate. Elevation not available.
				2	SS	17-12-10-10	22	12.0 24.0			
		3.0 - 4.0 Very dark gray SAND; some calcareous sand		3.0							
		4.0 - 12.5 Very dark gray SAND; and calcareous SAND, little silt		4.0	3	SS	2-2-3-2	5		4.0 24.0	
					4	SS	4-2-2-2	4		10.0 24.0	
					5	SS	3-5-5-6	10		10.0 24.0	
					6	SS	4-5-10-14	15		4.0 24.0	
		12.5 - 13.5 gray LIMESTONE FRAGMENTS and SILT, some sand		12.5	7	SS	11-5-6-4	11		20.0 24.0	
		13.5 - 14.0 Very dark gray SILT		13.5							
		14.0 - 18.5 Very dark gray SAND and calcareous SAND, little silt		14.0	8	SS	3-6-6-5	12		10.0 24.0	
					9	SS	7-10-4-4	14		8.0 24.0	
		18.5 - 31.5 Tan competent LIMESTONE; some sand, some calcareous sand		18.5	10	SS	4-8-21-19	29	14.0 24.0	Install casing to 18'	
					11	CORE	RQD= 75%	N/A	60.0 60.0		(20-25) : Missed drill times
					12	CORE	RQD= 75%	N/A	1 min 1 min 1 min 1 min 15		
					13	SS	18-30-15	45	N/A 6.0 18.0		
		31.5 - 35.0 Light tan SAND and LIMESTONE FRAGMENTS and calcareous SAND and SILT [Marl]		31.5	14	CORE	RQD= 38%	N/A	30 sec 45 sec 1 min 1 min		
		35.0 - 45.0 Light tan fine SAND; little silt, some limestone fragments		35.0	15	CORE	RQD= 0%	N/A	45 sec 45 sec 45 sec 1 min 15 45 sec		
40		Log continued on next page									

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-24

SHEET 2 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 71.0 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Wireline Core
DRILL RIG: CME 75
DATE STARTED: 6/10/2009
DATE COMPLETED: 6/10/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,738.5 E: 15,217.3
GS ELEVATION: N/A
TOC ELEVATION: N/A
TEMPERATURE: 90°

INCLINATION: -90
DEPTH W.L.: N/A
ELEVATION W.L.: N/A
DATE W.L.: N/A
TIME W.L.: N/A

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES						COMMENTS
		DESCRIPTION	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	
40		35.0 - 45.0 Light tan fine SAND; little silt, some limestone fragments (Continued)			16	SS	4-10-6	16	N/A	8.0 18.0	Loss of circulation @ 53'
					17	CORE	RQD= 0%	NA	15 sec 1 min 30 sec 30 sec	12.0 42.0	
45		45.0 - 53.0 Tan LIMESTONE and SAND		45.0	18	CORE	RQD= 7%	NA	45 sec 45 sec 1 min 15 1 min 30 1 min	48.0 60.0	
					19	SS	7-10-16	26	N/A	8.0 18.0	
					20	CORE	RQD= 17%	NA	45 sec 45 sec 15 sec 30 sec	36.0 42.0	
55		53.0 - 60.0 Tan competent weathered LIMESTONE		53.0	21	CORE	RQD= 8%	NA	1 min 45 sec 30 sec 15 sec 15 sec	36.0 60.0	
					22	SS	WOR/30"	WOR		8.0 30.0	
					23	SS	WOH/54"	WOH	N/A	8.0 54.0	
65		60.0 - 66.5 Brown fine SAND, some silt, some clay		60.0	24	SS	9-10-3-5	13		10.0 24.0	
					25	SS	2-7-8-8	15		10.0 24.0	
		66.5 - 71.0 Brownish tan calcareous SAND; some limestone gravel		66.5							
		Boring completed at 71.0 ft									
		G-24 Grouted upon completion									
75											
80											

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-25

SHEET 1 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 71.5 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Wireline Core
DRILL RIG: CME 75
DATE STARTED: 6/11/2009
DATE COMPLETED: 6/11/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,789.6 E: 15,097.2
GS ELEVATION: 99.99
TOC ELEVATION: N/A
TEMPERATURE: 90°

INCLINATION: -90
DEPTH W.L.: N/A
ELEVATION W.L.: N/A
DATE W.L.: N/A
TIME W.L.: N/A

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES						COMMENTS
		DESCRIPTION	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	
0		0.0 - 8.0 Brown fine SAND; little limestone fragments [Fill]			1	SS	5-7-13-12	20		12.0 24.0	
					2	SS	9-11-12-12	23		18.0 24.0	
5	95				3	SS	15-23-13-10	36		16.0 24.0	
					4	SS	10-10-11-10	21		10.0 24.0	
				92.0							
		8.0 - 10.0 Very dark gray SAND and SILT		8.0	5	SS	10-10-21	31	N/A	6.0 24.0	
				90.0							
10	90	10.0 - 11.0 Reddish brown fine SAND; and SILT		10.0	6	SS	10-29-25-11	54		18.0 24.0	
		11.0 - 12.0 Brownish tan Limestone Gravel; some Sand, some Silt		11.0							
		12.0 - 16.0 White fine Sand, some Limestone Gravel		12.0	7	SS	9-11-18-17	29		12.0 24.0	
					8	SS	17-13-10-14	23		18.0 24.0	
15	85			84.0							
		16.0 - 17.0 White LIMESTONE GRAVEL, some sand, little silt		16.0	9	SS	43-50/5"	REF		8.0 12.0	
		17.0 - 30.0 Tan competent LIMESTONE; some sand and limestone gravel [thin (<6") zones]		17.0	10	CORE	RQD= 42%	NA	30 sec 2 min 15 2 min 15	24.0 36.0	Set casing to 18'
20	80				11	CORE	RQD= 37%	NA	15 sec 1 min 15 1 min 1 min 15 sec	26.0 60.0	Little resistance (20-21)' (24-25)'
25	75				12	CORE	RQD= 0%	NA	45 sec <15 sec <15 sec 30 sec 30 sec	12.0 60.0	Little resistance (26-28)'
30	70	30.0 - 32.0 Tan SAND and LIMESTONE GRAVEL		70.0	13	SS	1-7-13	20	N/A	8.0 18.0	
		32.0 - 34.5 Light tan fine SAND, little calcareous sand, little limestone fragments		68.0	14	CORE	RQD= 36%	NA	45 sec 1 min 15 30 sec <15 sec	42.0 42.0	Little resistance (34-35)'
35	65	34.5 - 36.0 Tan LIMESTONE		65.5							
		36.0 - 41.5 Light tan fine SAND; little calcareous sand, little limestone fragments		64.0	15	CORE	RQD= 20%	NA	30 sec 30 sec 30 sec 30 sec	36.0 60.0	
40	60			60.0							

Log continued on next page

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



RECORD OF BOREHOLE G-25

SHEET 2 of 2

PROJECT: PEF/FGD Blowdown Pond
PROJECT NUMBER: 093-82538
DRILLED DEPTH: 71.5 ft
AZIMUTH: N/A
LOCATION: Crystal River, FL

DRILL METHOD: SPT / Wireline Core
DRILL RIG: CME 75
DATE STARTED: 6/11/2009
DATE COMPLETED: 6/11/2009
WEATHER: sunny

DATUM: plant coordinates; ft NAVD 88
COORDS: N: 7,789.6 E: 15,097.2
GS ELEVATION: 99.99
TOC ELEVATION: N/A
TEMPERATURE: 90°

INCLINATION: -90
DEPTH W.L.: N/A
ELEVATION W.L.: N/A
DATE W.L.: N/A
TIME W.L.: N/A

DEPTH (ft)		ELEVATION (ft)		SOIL PROFILE			SAMPLES						COMMENTS	
				DESCRIPTION	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	DRILL TIME (min)	REC / ATT	SS= Split Spoon REF= Refusal RQD= Rock Quality Designation	
40		36.0 - 41.5		Light tan fine SAND; little calcareous sand, little limestone fragments (Continued)		58.5	16	SS	7-17-6	23	N/A	12.0 18.0	Little resistance (42-50)'	
		41.5 - 45.0		Tan weathered LIMESTONE; some sand		41.5	17	CORE	RQD= 21%	NA	15 sec 45 sec 45 sec	30.0 42.0		
						55.0					30 sec			
45	55	45.0 - 51.5		Tan very dense fine SAND; some limestone gravel		45.0	18	CORE	RQD= 57%	NA	30 sec 30 sec 30 sec 15 sec 15 sec	48.0 60.0		
						48.5	19	SS	13-20-13	33	N/A	12.0 18.0		
		51.5 - 60.0		Tan to brownish tan LIMESTONE		51.5	20	CORE	RQD= 19%	NA	15 sec 45 sec 30 sec 15 sec	22.0 42.0		
							21	CORE	RQD= 20%	NA	15 sec 15 sec 30 sec 15 sec	30.0 60.0		
						40.0								
60	40	60.0 - 64.0		Brownish tan weathered LIMESTONE and calcareous SAND		60.0	22	SS	9-23-1-WOH	24	N/A	8.0 24.0		Little resistance (55-57)' (58-60)'
							23	SS	2-13-16-3	29		10.0 24.0		
		64.0 - 65.0		Black CLAY		64.0	24	SS	1-2-2-1	4		6.0 24.0		
65	35	65.0 - 66.5		Brownish tan SILT		65.0	25	SS	4-6-7-22	13		12.0 24.0		
		66.5 - 67.5		Brown LIMESTONE GRAVEL; some silt		66.5	26	SS	1-2-1-1	3		12.0 24.0		
		67.5 - 68.5		Dark gray CLAY		67.5	27	SS	6-15-50/3"	REF		10.0 18.0		
		68.5 - 71.5		Brown SILT and fine SAND		68.5								
						28.5								
Boring completed at 71.5 ft													G-25 Grouted upon completion	

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Huss Drilling Inc.
DRILLER: K. Reffuse

INSPECTOR: J. Brown
CHECKED BY: J. Brown
DATE: 6/17/09



ATTACHMENT G
REVISED LEAKAGE RATE CALCULATIONS

SUBJECT FGD POND LEAKAGE RATE THROUGH POND LINER SYSTEM					
Job No.	093-82538	Made by	SFS	Date	August 2009
Ref.		Checked	WDK	Sheet	1 of 7
		Reviewed	KBK		

PURPOSE

The purpose of this calculation package is to estimate the leakage rate through the geomembrane pond liner leakage rate based on assumptions of hole density, size, and soil base beneath the liner. The pond liner system was modeled as a composite liner system with 1 foot of low-permeability soil underlying the geomembrane liner.

METHOD

The rate of leakage through the pond liner system was calculated only for leakage through geomembrane defects and underlying soil. The rate of leakage was calculated for a circular defect under the assumption that strict construction quality assurance is performed.

REFERENCES

"The Hydraulic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3." USEPA, 1994.

Qian, X., Koerner, R., Gray, D. (2002). Geotechnical Aspects of Landfill Design and Construction. Prentice Hall, Upper Saddle River, New Jersey.

Giroud, J.P. and Bonaparte, R. (1989). "Leakage through liners constructed with geomembrane liners - parts 1 and II and technical note." *Geotextiles and Geomembranes*.

Advanced Geotech Systems. Leakage Rate Through Composite Liner Calculator. www.landfilldesign.com. 2001.

Leakage Rate Through Composite Liner Calculator Additional References:

R. Bonaparte, J.P. Giroud, and B.A. Gross, "Rates of Leakage through Landfill Liners", Proceedings of Geosynthetics '89, Vol. 1, IFAI, San Diego, California, USA, February 1989, pp. 18-29, 1989.

J.P. Giroud and R. Bonaparte, "Leakage Through Liners Constructed with Geomembranes, Part I", Geomembrane Liners, Geotextiles and Geomembranes, 8, 1: 27-67, 1989.

J.P. Giroud, K. Badu-Tweneboah & K.L. Soderman, "Evaluation of Landfill Liners", Fifth International Conference on Geotextiles, Geomembranes and Related Products, Singapore, 5-9 September 1994.

J.P. Giroud, "Equations for Calculating the Rate of Liquid Migration Through Composite Liners Due to Geomembrane Defects", Geosynthetics International, Vol. 4, Nos. 3-4, pp.335-348, 1997.

ASSUMPTIONS

- The rate of leakage through geomembrane due to its permeability is minimal.
- Defects in the geomembrane will be circular defects.
- The pond will be constructed under strict construction quality control, thereby limiting the number of defects per acre and size of defect - 1 defect per acre with a typical defect diameter of 2 mm.
- The pond will be lined with textured 60 mil Agru America linear low density polyethylene (LLDPE) geomembrane.
- The pond liner system is underlain by 1-foot layer of soil with a permeability of 5.8×10^{-6} m/s (see Attachment 1).
- The hydraulic head on the bottom liner will be 17.24 feet (pond control elevation = 111.24 feet and pond bottom = 94.0 feet).
- The hydraulic head on the side-slope liner will average one-half of the hydraulic head on bottom of liner (8.62 feet).
- The geomembrane will be installed on a smooth, compacted subgrade with as few wrinkles as possible (good contact condition).

SUBJECT FGD POND LEAKAGE RATE THROUGH POND LINER SYSTEM					
Job No.	093-82538	Made by	SFS	Date	August 2009
Ref.		Checked	WDK	Sheet	2 of 7
		Reviewed	KSK		

CALCULATION RESULTS

The results of the leakage rate calculations are presented in Attachment 2.

The leakage rate for the bottom liner system was calculated at 1,975 gallons per acre per day.

The leakage rate for the side-slope liner was calculated at 752 gallons per acre per day.

The pond bottom area is 1.87 acres, therefore the leakage rate from the pond bottom is 3,691 gallons per day.

The side-slope area is 1.66 acres (control elevation area - bottom area), therefore the leakage rate from the pond side-slopes is 1,247 gallons per day.

Therefore, the leakage rate from the primary pond is estimated at 4,937 gallons per day. This is considered to be a conservative estimate. Actual construction includes 2 feet of compacted sub-base soil (rather than the 1 foot shown in the calculation) and the settled FGD materials will have a low-permeability effectively providing an additional low permeability layer to the system.

ATTACHMENT 1

FLEXIBLE WALL TRIAXIAL PERMEABILITY
ASTM D 5084
METHOD C, FALLING HEAD W/INCREASING TAIL WATER PRESSURE

PROJECT TITLE	PEF/FGD POND DESIGN & PERMIT/FL		Using Pipettes Only	YES		COMMENTS The sample was remolded to 97.5% of the Maximum Dry Density and OPTM + 0.7% (using ASTM D698). * Sample was too soft to take final measurements accurately.	
PROJECT NUMBER	093-82538		Using Pipettes & Burettes	NO			
SAMPLE ID	PC-072109-1		BOARD#	9	TECH		TW
SAMPLE TYPE	Bulk		CELL #	9	DATE		8/10/09

Sample Data, Initial Height, inches: 3.000 Diameter, inches: 2.790 Area, cm^2: 39.44 Volume, cm^3: 300.55 Mass, g: 590.46 Moisture Content, %: 13.08 Dry Density, pcf: 108.41 Spec. Gravity (assumed): 2.650 Volume Solids, cm^3: 197.03 Volume Voids, cm^3: 103.52 Void Ratio: 0.53 Saturation: 66.0%			B-Value, f: 0.86 Cell Pres: 92.0 Bot. Pres: 90.0 Top Pres: 90.0 Head, cm: 0.00 Max. Grad: 3.20 Min. Grad: 0.00 Max. E.S.: 2.00 Min. E.S.: 2.00			Sample Data, Final Height, inches: 3.000 * Diameter, inches: 2.790 * Area, cm^2: 39.44 Volume, cm^3: 300.55 Mass, g: 620.52 Moisture Content %: 18.84 Dry Density, pcf: 108.41 Saturation: 95.0% Inflow Volume per (1 cc): 1.00 Outflow Volume per (1 cc): 1.00			Water Contents <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">Initial</th> <th style="text-align: center;">Final</th> </tr> </thead> <tbody> <tr> <td>Wt soil&tare, i</td> <td style="text-align: center;">590.46</td> <td style="text-align: center;">628.89</td> </tr> <tr> <td>Wt soil&tare, f</td> <td style="text-align: center;">522.14</td> <td style="text-align: center;">530.51</td> </tr> <tr> <td>Wt Tare</td> <td style="text-align: center;">0.00</td> <td style="text-align: center;">8.37</td> </tr> <tr> <td>Wt Moisture Lost</td> <td style="text-align: center;">68.32</td> <td style="text-align: center;">98.38</td> </tr> <tr> <td>Wt Dry Soil</td> <td style="text-align: center;">522.14</td> <td style="text-align: center;">522.14</td> </tr> <tr> <td>Water Content</td> <td style="text-align: center;">13.08%</td> <td style="text-align: center;">18.84%</td> </tr> </tbody> </table>				Initial	Final	Wt soil&tare, i	590.46	628.89	Wt soil&tare, f	522.14	530.51	Wt Tare	0.00	8.37	Wt Moisture Lost	68.32	98.38	Wt Dry Soil	522.14	522.14	Water Content	13.08%	18.84%
	Initial	Final																														
Wt soil&tare, i	590.46	628.89																														
Wt soil&tare, f	522.14	530.51																														
Wt Tare	0.00	8.37																														
Wt Moisture Lost	68.32	98.38																														
Wt Dry Soil	522.14	522.14																														
Water Content	13.08%	18.84%																														
						DESCRIPTION Olive Brown, FINE SAND, little coarse to fine gravel, trace fines																										
						USCS SP																										
PERMEANT: Deaired Tap Water																																

TIME FUNCTION			READINGS			TIME IN MINUTES & SECONDS				(H1/H2)	Gradient	VOLUME		PERMEABILITY @ 20 Degrees C (cm/sec)
DATE	HOURL	MIN	Inflow (cc)	Outflow (cc)	Temp.	dt (min)	dt (sec)	dt, acc (sec)	Head (cm)			Inflow (cc)	Outflow (cc)	
08/10/09	15	29	0.0	25.0	22.8	0.0	0.0	0	24.42		3.20	0.00	0.00	0.0
08/10/09	15	30	4.0	21.0	22.8	1.0	60	60	16.62	1.47	2.18	4.00	4.00	5.8E-04
08/10/09	15	31	5.5	19.4	22.8	0.5	30	90	13.60	1.22	1.78	1.50	1.60	6.1E-04
08/10/09	15	31	6.8	18.3	22.8	0.5	30	120	11.26	1.21	1.48	1.30	1.10	5.7E-04
08/10/09	15	32	7.8	17.3	22.8	0.5	30	150	9.31	1.21	1.22	1.00	1.00	5.7E-04
08/10/09	16	0	0.0	25.0	22.8	28.5	1710	1860	24.42	0.38	3.20	0.00	0.00	-
08/10/09	16	1	4.0	21.0	22.8	1.0	60	1920	16.62	1.47	2.18	4.00	4.00	5.8E-04 *
08/10/09	16	2	5.5	19.5	22.8	0.5	30	1950	13.70	1.21	1.80	1.50	1.50	5.9E-04 *
08/10/09	16	2	6.8	18.3	22.8	0.5	30	1980	11.26	1.22	1.48	1.30	1.20	5.9E-04 *
08/10/09	16	3	7.8	17.3	22.8	0.5	30	2010	9.31	1.21	1.22	1.00	1.00	5.7E-04 *
Inflow Rate			0.0078	PERMEABILITY REPORTED AS 5.8E-04 cm/sec										
Outflow Rate			0.0077											
Outflow/Inflow Ratio			0.99											
														DATE
														8/10/09
														CHECK
														REVIEW

*TRANSCRIBED FROM ORIGINAL DATA SHEETS

ATTACHMENT 2

PRIMARY POND LEAKAGE RATE CALCULATION FOR BOTTOM LINER

Project: PEF CREC/FGD POND DESIGN/FL

Project No.: 093-82538

Leakage Rate Equation for Circular Defect:

$$\frac{Q}{A} = n \cdot 0.976 C_{qo} \cdot [1 + 0.1 \cdot (h/t_s)^{0.95}] \cdot d^{0.2} \cdot h^{0.9} \cdot k_s^{0.74}$$

Parameters:

Q = Leakage Rate through the considered geomembrane defect (m³/s)

A = Considered geomembrane area (m²) = 1 acre = 4050 m²

n = Number of defects per considered area (A) = 1 defect per acre = 1

C_{qo} = Contact quality factor (good contact) = 0.21

h = hydraulic head on top of geomembrane (m) = 17.24 feet = 5.26 m

t_s = thickness of low-permeability soil (m) = 1 foot = 0.305 m

d = diameter of defect with strict construction quality assurance = 2 mm = 0.002 m

k_s = permeability of low-permeability soil (m/s) = 5.8E-06 m/s

Results:

Leakage Rate (Q/A) = 2.16E-08 (m³/s)/m²

= 18705 liters per hectare per day

Leakage Rate = 1,975 gallons per acre per day

PRIMARY POND LEAKAGE RATE CALCULATION FOR SIDE-SLOPE LINER

Project: PEF CREC/FGD POND DESIGN/FL

Project No.: 093-82538

Leakage Rate Equation for Circular Defect:

$$\frac{Q}{A} = n \cdot 0.976 C_{qo} \cdot [1 + 0.1 \cdot (h/t_s)^{0.95}] \cdot d^{0.2} \cdot h^{0.9} \cdot k_s^{0.74}$$

Parameters:

Q = Leakage Rate through the considered geomembrane defect (m ³ /s)		
A = Considered geomembrane area (m ²) = 1 acre	=	4050 m ²
n = Number of defects per considered area (A) = 1 defect per acre	=	1
C _{qo} = Contact quality factor (good contact)	=	0.21
h = hydraulic head on top of geomembrane (m) = 8.62 feet (avg. head)	=	2.63 m
t _s = thickness of low-permeability soil (m) = 1 foot	=	0.305 m
d = diameter of defect with strict construction quality assurance = 2 mm	=	0.002 m
k _s = permeability of low-permeability soil (m/s)	=	5.8E-06 m/s

Results:

Leakage Rate (Q/A) =	8.25E-09 (m ³ /s)/m ²
=	7126 liters per hectare per day
Leakage Rate =	752 gallons per acre per day

ATTACHMENT H
ANCHOR TRENCH CALCULATIONS - REINFORCING GEOTEXTILE



Subject Anchor Trench Calculations - Reinforcing Geotextile (Floor)

Job No. 093-82538.0002

Ref. PEF/Crystal River FGD Pond

Made by BTH

Checked SFS/KH

Reviewed KBK

Date 08/06/2009

Sheet 1 of 3

OBJECTIVE

To verify that the proposed anchor trench dimensions are adequate for the reinforcing geotextile.

METHOD

Using the methodology outlined in Reference 1 by Koerner, verify the proposed anchor trench dimensions for the reinforcing geotextile.

REFERENCES

1. Koerner, R. (1999). Designing With Geosynthetics. Prentice Hall, Upper Saddle River, New Jersey.
2. Huesker Comtrac 600.100 Product Information

ASSUMPTIONS

1. The pond will be constructed above grade.
2. Berm will be 2 ft. high with 100:0.1 (H:V) side slopes.

berm height = 2 feet
slope: H: 100
V: 0.1
 $\beta = 0.1$ degrees

The resulting side slope angle is:

3. Pond will be underlain by a Woven High-Strength Geotextile (Comtrac 600.100 or equivalent).
4. The unit weight of the cover soil:
5. The depth of cover soil:
6. The allowable force in the geo-membrane stress (based on Comtrac 600.100 and Golder calculations of allowable tensile strength - see Evaluation of Pond Liners.xlsx):
7. The angle of shearing resistance between the reinforcing geotextile and adjacent material:
8. The frictional angle for the top of the geo-membrane under a soil-cracking assumption:
9. The angle of shearing resistance of the soil:
10. Length of geo-membrane runout:
11. Proposed depth of anchor trench:

$\gamma_{AT} = 120$ pcf
depth = 24 inches

$T_{allow} = 6,118$ lbs/ft
 $\delta_L = 35$ degrees
 $\delta_U = 0$ degrees
 $\phi = 35$ degrees

$L_{RO} = 20$ feet
proposed $d_{AT} = 2.5$ feet

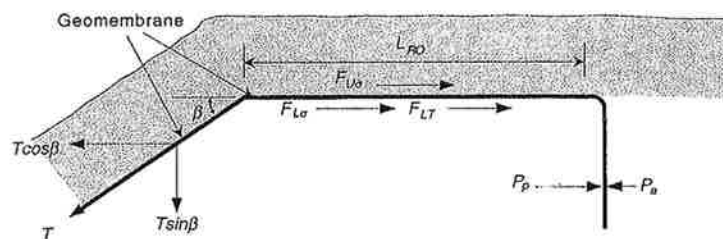
Notes: Interface shear data for Comtrac 600.100 and site soil = 39.3 degrees (residual)

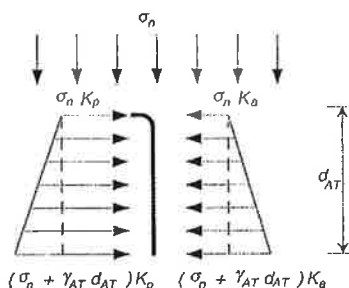
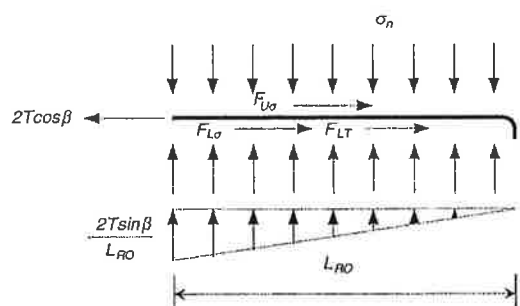
Reinforcing layer actually deployed horizontally. "Runout" is assumed to be about one-third of the width of pond embankment width (66 feet x 0.33 ~ 20 feet). This indicates that the full allowable tensile strength of the geotextile will be mobilized outside the limits of the geomembrane which is the goal of the reinforcing layer.

CALCULATION

1. The design methodology used hereafter is based on a method outlined in Reference 1. Figures are from Reference 1.

Free-body diagram for geo-membrane profile:





$$\Sigma F_x = 0$$

Therefore,

$$T_{\text{ALLOW}} \cos \beta = F_{U\sigma} + F_{L\sigma} + F_{LT} - P_A + P_P$$

where:

T_{ALLOW} = allowable force in geomembrane

β = side slope angle

$F_{U\sigma}$ = shear force above geomembrane due to cover soil

$F_{L\sigma}$ = shear force below geomembrane due to cover soil

F_{LT} = shear force below geomembrane due to vertical component of T_{ALLOW}

P_A = active earth pressure against the in-situ side of the anchor trench

P_P = passive earth pressure against the in-situ side of the anchor trench

L_{RO} = length of geo-membrane runout

$$P_A = 1/2(\gamma_{AT} d_{AT}) K_A d_{AT} + (\sigma_n) K_A d_{AT}$$

$$P_A = (0.5\gamma_{AT} d_{AT} + \sigma_n) K_A d_{AT}$$

$$P_P = (0.5\gamma_{AT} d_{AT} + \sigma_n) K_P d_{AT}$$

where:

γ_{AT} = unit weight of soil in anchor trench

d_{AT} = depth of anchor trench

σ_n = applied normal stress from cover soil

K_A = coefficient of active earth pressure = $\tan^2(45 - \phi/2)$

K_P = coefficient of passive earth pressure = $\tan^2(45 + \phi/2)$

ϕ = angle of shearing resistance of respective soil

δ_L = angle of resistance between the geo-membrane liner and

δ_U = frictional angle for the top of the geo-membrane



Subject Anchor Trench Calculations - Reinforcing Geotextile (Floor)

Job No. 093-82538.0002

Ref. PEF/Crystal River FGD Pond

Made by BTH

Checked SFS/KH

Reviewed KBK

Date 08/06/2009

Sheet 3 of 3

From free-body diagram: $\Sigma F_x = 0$

$$F_{U\sigma} = \sigma_n \tan \delta_U (L_{RO})$$

$$= 0 \quad \text{lb/ft}$$

$$F_{L\sigma} = \sigma_n \tan \delta_L (L_{RO})$$

$$= 3361.00 \quad \text{lb/ft}$$

$$F_{LT} = T_{ALLOW} \sin \beta \tan \delta_L$$

$$= 4.28 \quad \text{lb/ft}$$

$$P_A = (0.5 \gamma_{AT} d_{AT} + \sigma_n) K_A d_{AT}$$

$$= 218.17$$

$$P_P = (0.5 \gamma_{AT} d_{AT} + \sigma_n) K_P d_{AT}$$

$$= 2970.89$$

$$T_{ALLOW} \cos \beta = F_{U\sigma} + F_{L\sigma} + F_{LT} - P_A + P_P$$

$$T_{ALLOW} \cos \beta = 6,118$$

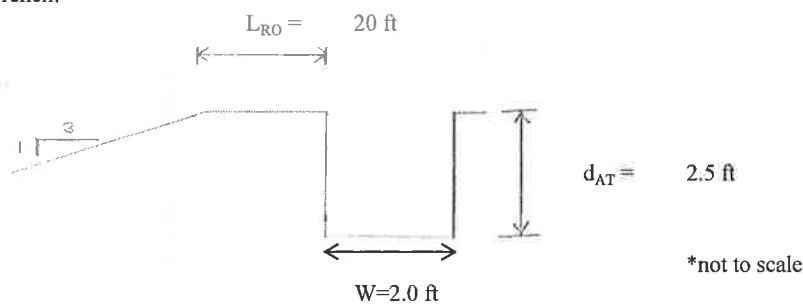
$$T_{ALLOW} \cos \beta = 6,118$$

$$d_{AT} = 2.2 \quad \text{ft}$$

Use Excel solver to solve for d_{AT}

$$d_{AT} < d_{AT_proposed} = 2.5 \quad \text{ft}$$

Proposed Anchor Trench:



CONCLUSION

From the assumptions stated in this calculation and the methodologies presented in the references, the proposed dimensions of the reinforcing geotextile were evaluated. The required depth of the anchor trench was calculated to be 2.2 feet, which is equivalent or less than the proposed anchor trench depth of 2.5 feet. Based on the calculations, the proposed anchor trench geometry is sufficient in providing stabilization for the reinforcing geotextile.



Subject Anchor Trench Calculations - Reinforcing Geotextile (Slopes)

Job No. 093-82538.0002

Ref. PEF/Crystal River FGD Pond

Made by BTH

Checked SFS/KH

Reviewed KBK

Date 08/06/2009

Sheet 1 of 3

OBJECTIVE

To verify that the proposed anchor trench dimensions are adequate for the reinforcing geotextile.

METHOD

Using the methodology outlined in Reference 1 by Koerner, verify the proposed anchor trench dimensions for the geomembrane pond liner and the reinforcing geotextile.

REFERENCES

1. Koerner, R. (1999). Designing With Geosynthetics. Prentice Hall, Upper Saddle River, New Jersey.
2. Huesker Comtrac 600.100 Product Information

ASSUMPTIONS

1. The pond will be constructed above grade.
2. Berm will be 13 ft. high with 3:1 (H:V) side slopes.

berm height = 13 feet
slope: H: 3
V: 1.0
 $\beta = 18.4$ degrees

The resulting side slope angle is:

3. Pond will be underlain by a Woven High-Strength Geotextile (Comtrac 600.100 or equivalent).
4. The unit weight of the cover soil:
5. The depth of cover soil:
6. The allowable force in the geo-membrane stress (based on Comtrac 600.100 and Golder calculations of allowable tensile strength - see Evaluation of Pond Liners.xlsx):
7. The angle of shearing resistance between the reinforcing geotextile and adjacent material:
8. The frictional angle for the top of the geo-membrane under a soil-cracking assumption:
9. The angle of shearing resistance of the soil:
10. Length of geo-membrane runout:
11. Proposed depth of anchor trench:

$\gamma_{AT} = 120$ pcf
depth = 24 inches

$T_{allow} = 6,118$ lbs/ft
 $\delta_L = 35$ degrees
 $\delta_U = 0$ degrees
 $\phi = 35$ degrees

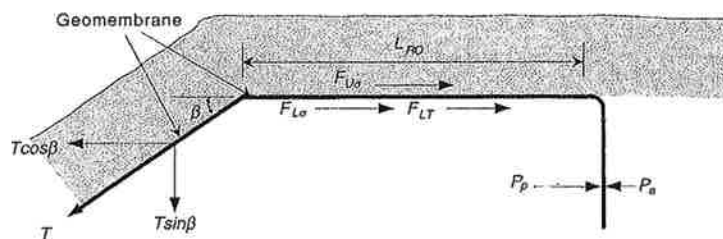
$L_{RO} = 1$ feet
proposed $d_{AT} = 3$ feet

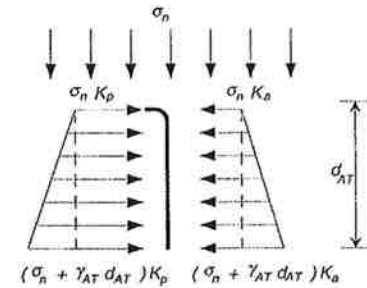
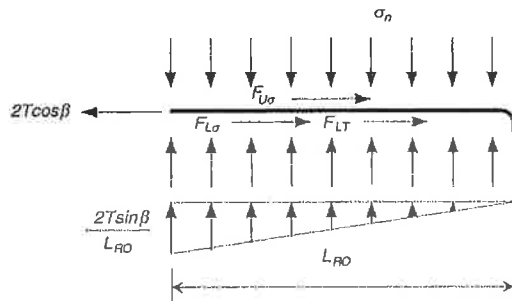
Notes: Interface shear data for Comtrac 600.100 and site soil = 39.3 degrees (residual)

CALCULATION

1. The design methodology used hereafter is based on a method outlined in Reference 1. Figures are from Reference 1.

Free-body diagram for geo-membrane profile:





$$\Sigma F_x = 0$$

Therefore,

$$T_{\text{ALLOW}} \cos \beta = F_{U\sigma} + F_{L\sigma} + F_{LT} - P_A + P_P$$

where:

T_{ALLOW} = allowable force in geomembrane

β = side slope angle

$F_{U\sigma}$ = shear force above geomembrane due to cover soil

$F_{L\sigma}$ = shear force below geomembrane due to cover soil

F_{LT} = shear force below geomembrane due to vertical component of T_{ALLOW}

P_A = active earth pressure against the in-situ side of the anchor trench

P_P = passive earth pressure against the in-situ side of the anchor trench

L_{RO} = length of geo-membrane runoff

$$P_A = 1/2(\gamma_{AT} d_{AT}) K_A d_{AT} + (\sigma_n) K_A d_{AT}$$

$$P_A = (0.5\gamma_{AT} d_{AT} + \sigma_n) K_A d_{AT}$$

$$P_P = (0.5\gamma_{AT} d_{AT} + \sigma_n) K_P d_{AT}$$

where:

γ_{AT} = unit weight of soil in anchor trench

d_{AT} = depth of anchor trench

σ_n = applied normal stress from cover soil

K_A = coefficient of active earth pressure = $\tan^2(45 - \phi/2)$

K_P = coefficient of passive earth pressure = $\tan^2(45 + \phi/2)$

ϕ = angle of shearing resistance of respective soil

δ_L = angle of resistance between the geo-membrane liner and

δ_U = frictional angle for the top of the geo-membrane



Subject Anchor Trench Calculations - Reinforcing Geotextile (Slopes)

Job No. 093-82538.0002

Ref. PEF/Crystal River FGD Pond

Made by BTH

Checked SFS/KH

Reviewed KBK

Date 08/06/2009

Sheet 3 of 3

From free-body diagram: $\Sigma F_x = 0$

$$F_{U\sigma} = \sigma_n \tan \delta_U (L_{RO})$$

$$= 0 \quad \text{lb/ft}$$

$$F_{L\sigma} = \sigma_n \tan \delta_L (L_{RO})$$

$$= 168.05 \quad \text{lb/ft}$$

$$F_{LT} = T_{ALLOW} \sin \beta \tan \delta_L$$

$$= 1354.68 \quad \text{lb/ft}$$

$$P_A = (0.5 \gamma_{AT} d_{AT} + \sigma_n) K_A d_{AT}$$

$$= 339.32$$

$$P_P = (0.5 \gamma_{AT} d_{AT} + \sigma_n) K_P d_{AT}$$

$$= 4620.59$$

$$T_{ALLOW} \cos \beta = F_{U\sigma} + F_{L\sigma} + F_{LT} - P_A + P_P$$

$$T_{ALLOW} \cos \beta = 5,804$$

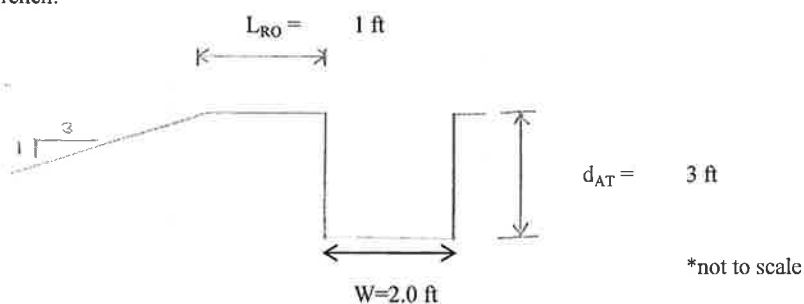
$$T_{ALLOW} \cos \beta = 5,804$$

$$d_{AT} = 3.0 \quad \text{ft}$$

Use Excel solver to solve for d_{AT}

$$d_{AT} < d_{AT_proposed} = 3 \quad \text{ft}$$

Proposed Anchor Trench:



CONCLUSION

From the assumptions stated in this calculation and the methodologies presented in the references, the proposed dimensions of the reinforcing geotextile were evaluated. The required depth of the anchor trench was calculated to be 3 feet, which is equivalent to the proposed anchor trench depth of 3 feet. Based on the calculations, the proposed anchor trench geometry is sufficient in providing stabilization for the reinforcing geotextile.

ATTACHMENT I
FGD POND CULVERT CALCULATIONS

SUBJECT		FGD POND CULVERT			
Job No.	093-82538	Made by	SFS	Date	August 2009
Ref.		Checked	KLH/BTH	Sheet	1 of 20
		Reviewed	KBK		

PURPOSE

The purpose of this calculation package is to design the culvert to convey runoff from the area east of the FGD Pond to the area west of the FGD pond at Crystal River Energy Complex (CREC).

AREAS

The watershed east of the FGD Pond is approximately 2.3 acres. The watershed is shown in Attachment 1. The watershed was assumed to be impervious.

TIME OF CONCENTRATION

The flow path (684 feet) for the time of concentration has an average slope of 0.70% (0.0070 ft/ft). It is assumed that the first 280 feet is under sheet flow regime and the remaining 404 feet is under shallow concentration flow. The Manning's roughness coefficient was estimated at $n=0.011$ (gravel) for sheet flow. The mid-point between paved and unpaved was used for the velocity for shallow concentration flow conditions, as shown in Fig. 3-1, Attachment 2. The time of concentration is presented in Attachment 2. The time of concentration was calculated at 8.7 minutes.

STORMWATER DISCHARGE

Stormwater discharges are estimated using the software package SMADA Version 6.43 for Windows written by Dr. R. D. Eaglin of the University of Central Florida. The program uses procedures presented in the Soil Conservation Service's TR-55 (SCS TR-55, 1986).

Stormwater runoff was calculated for a 100-yr return period and 24-hr duration design storm.

The peak discharge for the stormwater discharge hydrograph is 15.25 cubic feet per second (cfs).

SMADA program inputs and outputs are presented in Attachment 3.

CULVERT SELECTION

A culvert will be installed to convey stormwater from the area east of the FGD pond to an area west of the pond. The culvert location is shown in Attachment 1. The length of the culvert is 154 feet and the slope is 0.65% (0.0065 ft/ft).

Hancor HDPE corrugated exterior and smooth interior pipe was selected for the culvert. Based on the design peak discharge of 15.25 cfs and the slope of 0.65%, a minimum 24-inch diameter culvert was selected (see Attachment 4). However a 30-inch diameter culvert will be installed.

The inlet and outlet controls were checked using the charts and table presented in Attachment 5, based on a design flow of 20 cfs.

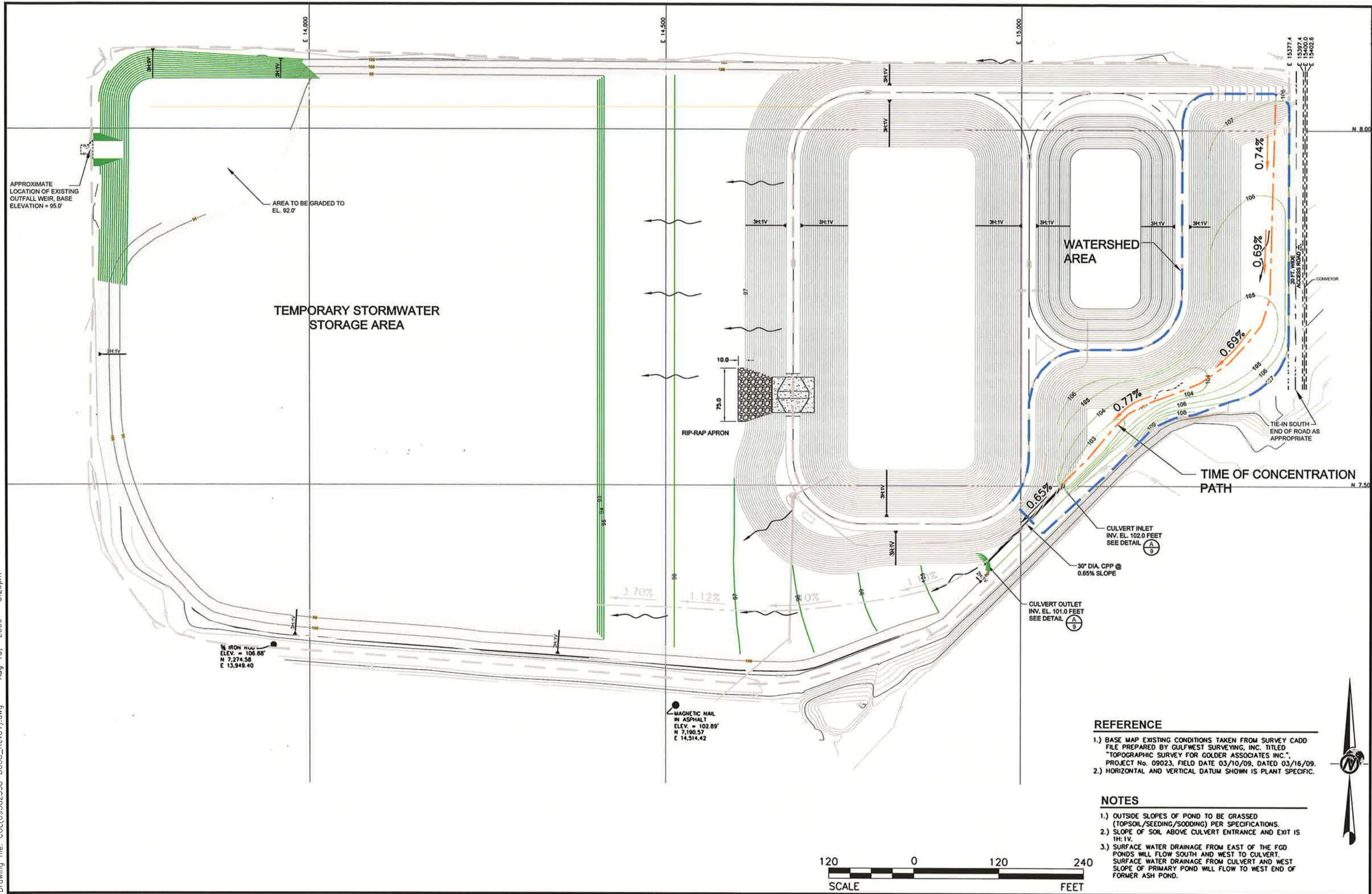
REFERENCES

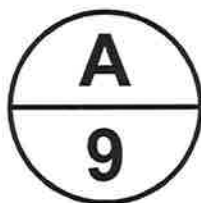
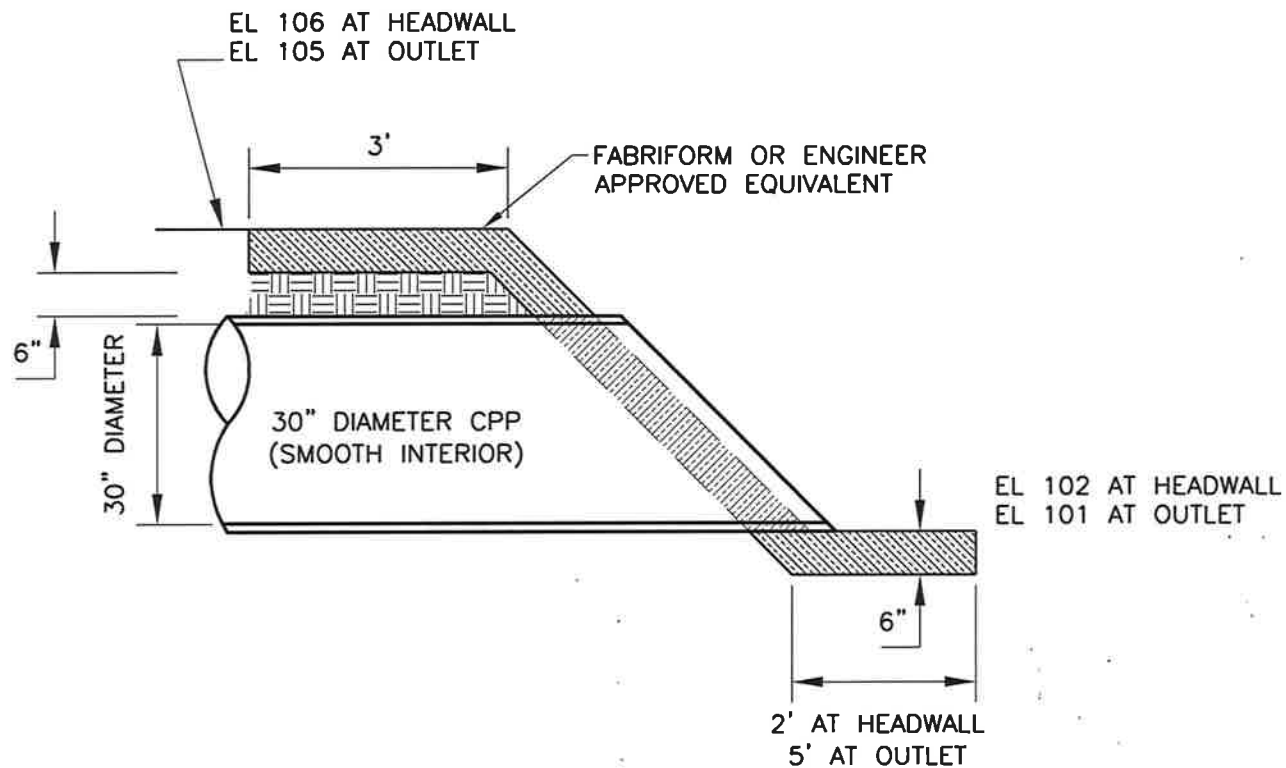
Soil Conservation Service, 1986, Urban Hydrology for Small Watersheds - Technical Release 55

St. Johns River Water Management District, 2001, St. Johns Applicant's Handbook - Regulation of Stormwater Management Systems

Malcom, H. Rooney, 1989; Elements of Urban Stormwater Design; North Carolina State University, Raleigh, NC

ATTACHMENT 1





CULVERT HEADWALL AND OUTLET CROSS SECTION

NOT TO SCALE

ATTACHMENT 2

2024-11-14 14:14:14

10/10/2024

Time of Concentration

Project:

PEF CREC FGD POND DESIGN

Project No.:

093-82538

Sheet flow (maximum 300 feet)

Flow length (ft)	L=	135
P for 2-year 24 hour storm (in)	P2=	5
Land slope (ft/ft)	s=	0.0074
Manning's roughness coefficient for sheet flow (bare soil)	n=	0.011
Tc sheet flow = $0.007 \cdot (n \cdot L)^{0.8} / (P2^{0.5} \cdot s^{0.4})$	Tc=	0.031 hour

Sheet flow (maximum 300 feet)

Flow length (ft)	L=	145
P for 2-year 24 hour storm (in)	P2=	5
Land slope (ft/ft)	s=	0.0069
Manning's roughness coefficient for sheet flow (bare soil)	n=	0.011
Tc sheet flow = $0.007 \cdot (n \cdot L)^{0.8} / (P2^{0.5} \cdot s^{0.4})$	Tc=	0.033 hour

Shallow concentrated flow

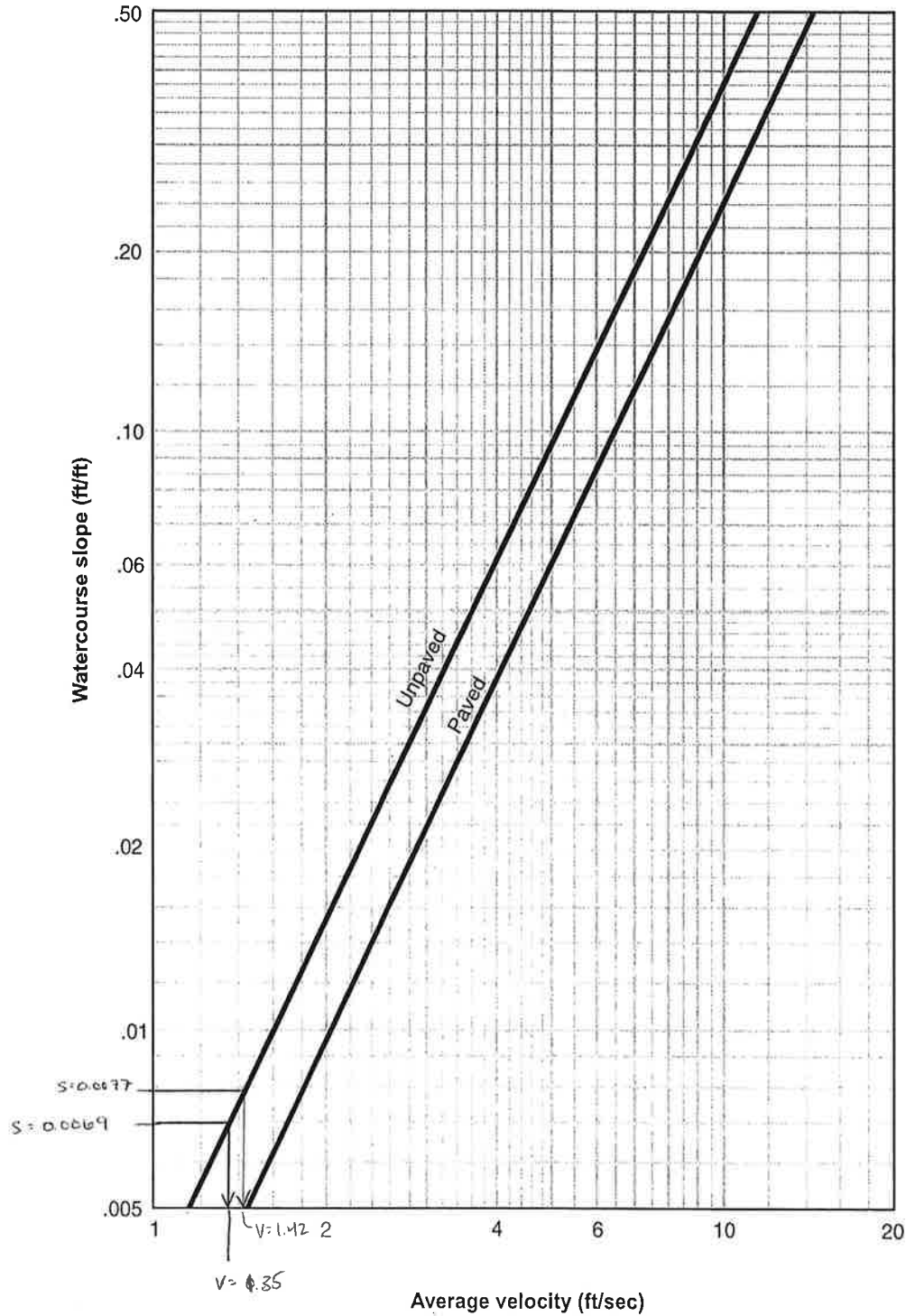
Flow length (ft)	L=	144
Water Course slope (ft/ft)	s=	0.0069
Average velocity (ft/s) from chart	v=	1.35
Tc shallow concentrated flow = $L / (v \cdot 3600)$	Tc=	0.030 hour

Shallow concentrated flow

Flow length (ft)	L=	260
Water Course slope (ft/ft)	s=	0.0077
Average velocity (ft/s) from chart	v=	1.42
Tc shallow concentrated flow = $L / (v \cdot 3600)$	Tc=	0.051 hour

Tc total =

Tc= 0.14 hour
8.7 minutes

Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n ^{1/}
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses ^{2/}	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: ^{3/}	
Light underbrush	0.40
Dense underbrush	0.80

¹ The n values are a composite of information compiled by Engman (1986).

² Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

³ When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t :

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \quad [\text{eq. 3-3}]$$

where:

- T_t = travel time (hr),
- n = Manning's roughness coefficient (table 3-1)
- L = flow length (ft)
- P_2 = 2-year, 24-hour rainfall (in)
- s = slope of hydraulic grade line (land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

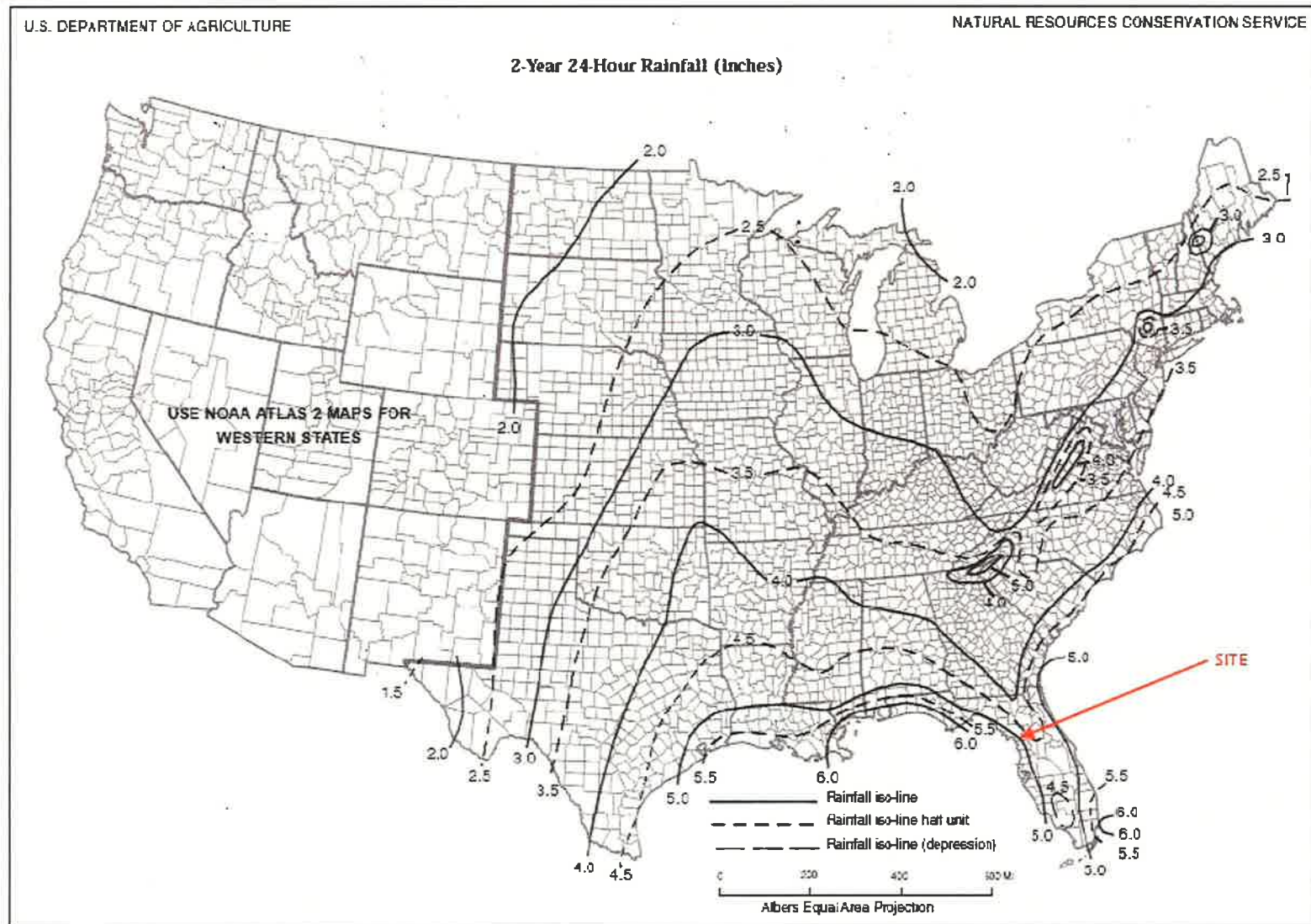
After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

Figure B-3 2-year, 24-hr rainfall



ATTACHMENT 3

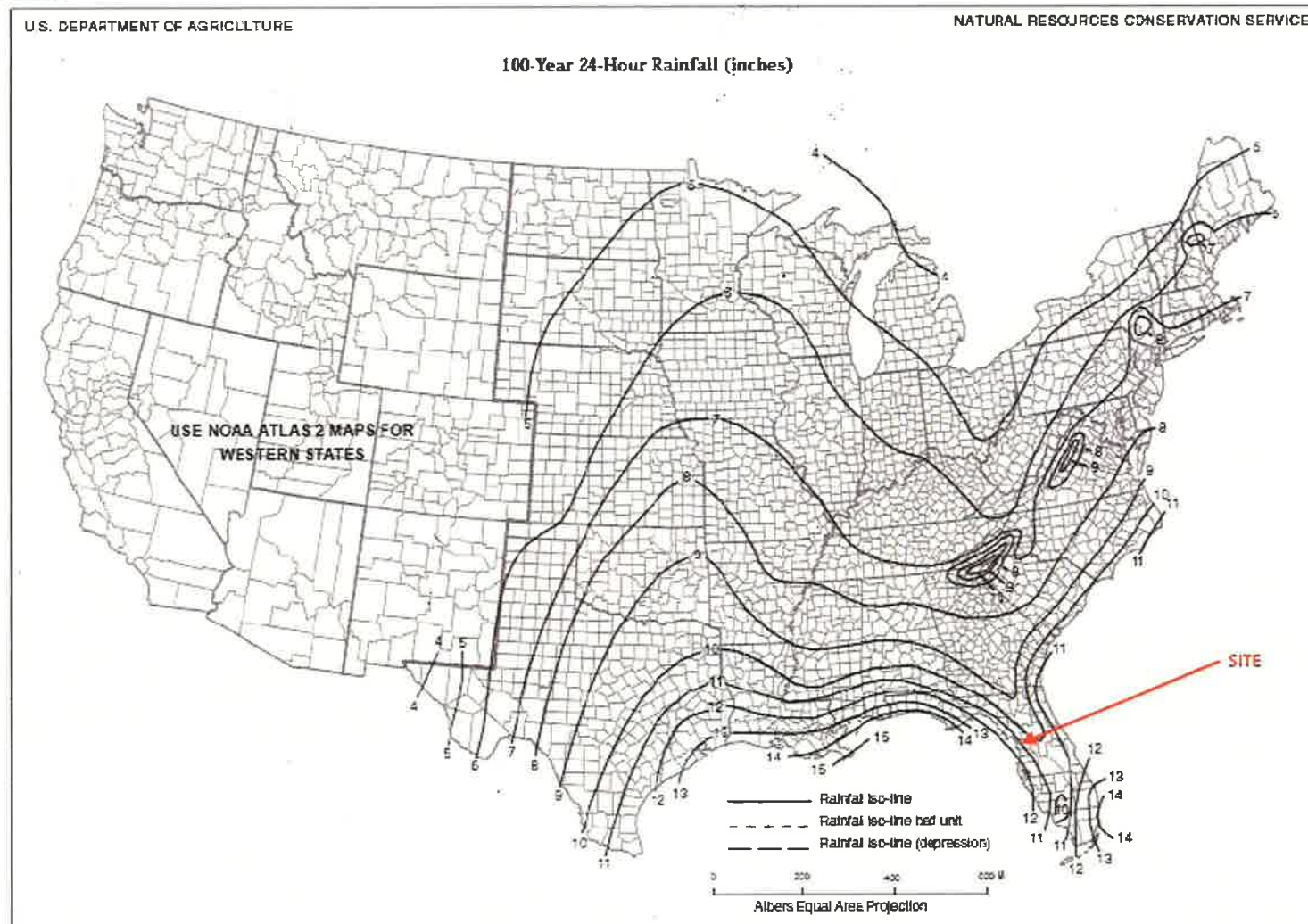
SMADA 6.0 for Windows
Watershed Information

Watershed Total Area (acres)	:2.30
Impervious Area (acres)	:2.30
Time of Concentration (min)	:8.7
% Impervious Directly Connected	:00.00

Additional Abstraction	
Over Pervious Area (inches)	:0.00
Over Impervious Area (inches)	:0.00

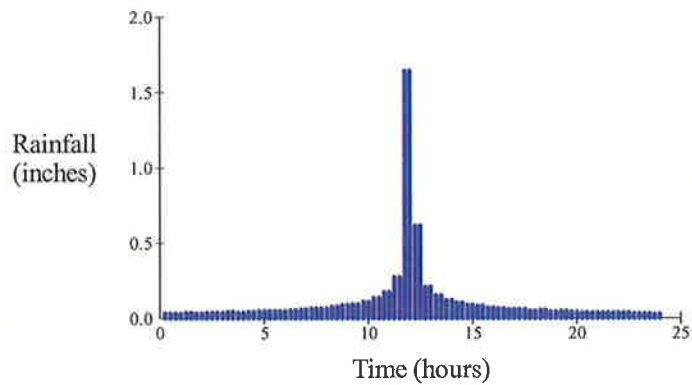
Infiltration Characteristics:	
Max Infiltration Capacity (in)	:0.00
SCS Curve Number for Pervious	:98
Initial Abstraction Factor	:0.20

Figure B-8 100-year, 24-hour rainfall



(210-VI-TR-55, Second Ed., June 1986)

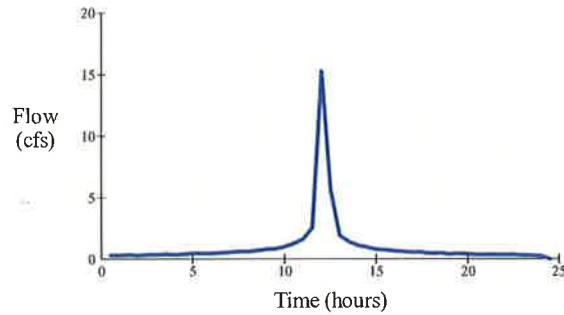
100-year, 24-hour Design Storm Rainfall



Time (hr)	Time HHMM	Rain (in)	Cumulative (in)
0.500	00030	0.066	0.066
1.000	00100	0.066	0.132
1.500	00130	0.077	0.209
2.000	00200	0.066	0.275
2.500	00230	0.077	0.352
3.000	00300	0.077	0.429
3.500	00330	0.088	0.517
4.000	00400	0.077	0.594
4.500	00430	0.088	0.682
5.000	00500	0.099	0.781
5.500	00530	0.099	0.880
6.000	00600	0.099	0.979
6.500	00630	0.110	1.089
7.000	00700	0.121	1.210
7.500	00730	0.132	1.342
8.000	00800	0.132	1.474
8.500	00830	0.154	1.628
9.000	00900	0.176	1.804
9.500	00930	0.187	1.991
10.00	01000	0.220	2.211
10.50	01030	0.275	2.486
11.00	01100	0.352	2.838
11.50	01130	0.550	3.388
12.00	01200	3.289	6.677
12.50	01230	1.232	7.909
13.00	01300	0.418	8.327
13.50	01330	0.308	8.635
14.00	01400	0.242	8.877
14.50	01430	0.209	9.086
15.00	01500	0.176	9.262
15.50	01530	0.165	9.427
16.00	01600	0.143	9.570
16.50	01630	0.132	9.702
17.00	01700	0.121	9.823
17.50	01730	0.121	9.944
18.00	01800	0.099	10.043
18.50	01830	0.110	10.153
19.00	01900	0.088	10.241
19.50	01930	0.099	10.340
20.00	02000	0.088	10.428
20.50	02030	0.077	10.505
21.00	02100	0.077	10.582
21.50	02130	0.077	10.659
22.00	02200	0.077	10.736
22.50	02230	0.077	10.813
23.00	02300	0.066	10.879
23.50	02330	0.066	10.945
24.00	00000	0.055	11.000

11.00

Watershed Hydrograph



Hydrograph Type :SCS 484 Hydrograph

Time (hr)	Time HHMM	Rain (in)	C Rain (in)	Infiltration (in)	Excess (in)	Excess (cfs)	Outflow (cfs)
0.500	00030	0.066	0.066	0.000	0.066	0.306	0.306
1.000	00100	0.066	0.132	0.000	0.066	0.306	0.306
1.500	00130	0.077	0.209	0.000	0.077	0.357	0.357
2.000	00200	0.066	0.275	0.000	0.066	0.306	0.306
2.500	00230	0.077	0.352	0.000	0.077	0.357	0.357
3.000	00300	0.077	0.429	0.000	0.077	0.357	0.357
3.500	00330	0.088	0.517	0.000	0.088	0.408	0.408
4.000	00400	0.077	0.594	0.000	0.077	0.357	0.357
4.500	00430	0.088	0.682	0.000	0.088	0.408	0.408
5.000	00500	0.099	0.781	0.000	0.099	0.459	0.459
5.500	00530	0.099	0.880	0.000	0.099	0.459	0.459
6.000	00600	0.099	0.979	0.000	0.099	0.459	0.459
6.500	00630	0.110	1.089	0.000	0.110	0.510	0.510
7.000	00700	0.121	1.210	0.000	0.121	0.561	0.561
7.500	00730	0.132	1.342	0.000	0.132	0.612	0.612
8.000	00800	0.132	1.474	0.000	0.132	0.612	0.612
8.500	00830	0.154	1.628	0.000	0.154	0.714	0.714
9.000	00900	0.176	1.804	0.000	0.176	0.816	0.816
9.500	00930	0.187	1.991	0.000	0.187	0.867	0.867
10.00	01000	0.220	2.211	0.000	0.220	1.020	1.020
10.50	01030	0.275	2.486	0.000	0.275	1.275	1.275
11.00	01100	0.352	2.838	0.000	0.352	1.632	1.632
11.50	01130	0.550	3.388	0.000	0.550	2.550	2.550
12.00	01200	3.289	6.677	0.000	3.289	15.250	15.250
12.50	01230	1.232	7.909	0.000	1.232	5.713	5.713
13.00	01300	0.418	8.327	0.000	0.418	1.938	1.938
13.50	01330	0.308	8.635	0.000	0.308	1.428	1.428
14.00	01400	0.242	8.877	0.000	0.242	1.122	1.122
14.50	01430	0.209	9.086	0.000	0.209	0.969	0.969
15.00	01500	0.176	9.262	0.000	0.176	0.816	0.816
15.50	01530	0.165	9.427	0.000	0.165	0.765	0.765
16.00	01600	0.143	9.570	0.000	0.143	0.663	0.663
16.50	01630	0.132	9.702	0.000	0.132	0.612	0.612
17.00	01700	0.121	9.823	0.000	0.121	0.561	0.561
17.50	01730	0.121	9.944	0.000	0.121	0.561	0.561
18.00	01800	0.099	10.043	0.000	0.099	0.459	0.459
18.50	01830	0.110	10.153	0.000	0.110	0.510	0.510
19.00	01900	0.088	10.241	0.000	0.088	0.408	0.408
19.50	01930	0.099	10.340	0.000	0.099	0.459	0.459
20.00	02000	0.088	10.428	0.000	0.088	0.408	0.408
20.50	02030	0.077	10.505	0.000	0.077	0.357	0.357
21.00	02100	0.077	10.582	0.000	0.077	0.357	0.357
21.50	02130	0.077	10.659	0.000	0.077	0.357	0.357
22.00	02200	0.077	10.736	0.000	0.077	0.357	0.357
22.50	02230	0.077	10.813	0.000	0.077	0.357	0.357
23.00	02300	0.066	10.879	0.000	0.066	0.306	0.306
23.50	02330	0.066	10.945	0.000	0.066	0.306	0.306
24.00	00000	0.055	11.000	0.000	0.055	0.255	0.255
24.50	00030	0.000	11.000	0.000	0.000	0.000	0.000

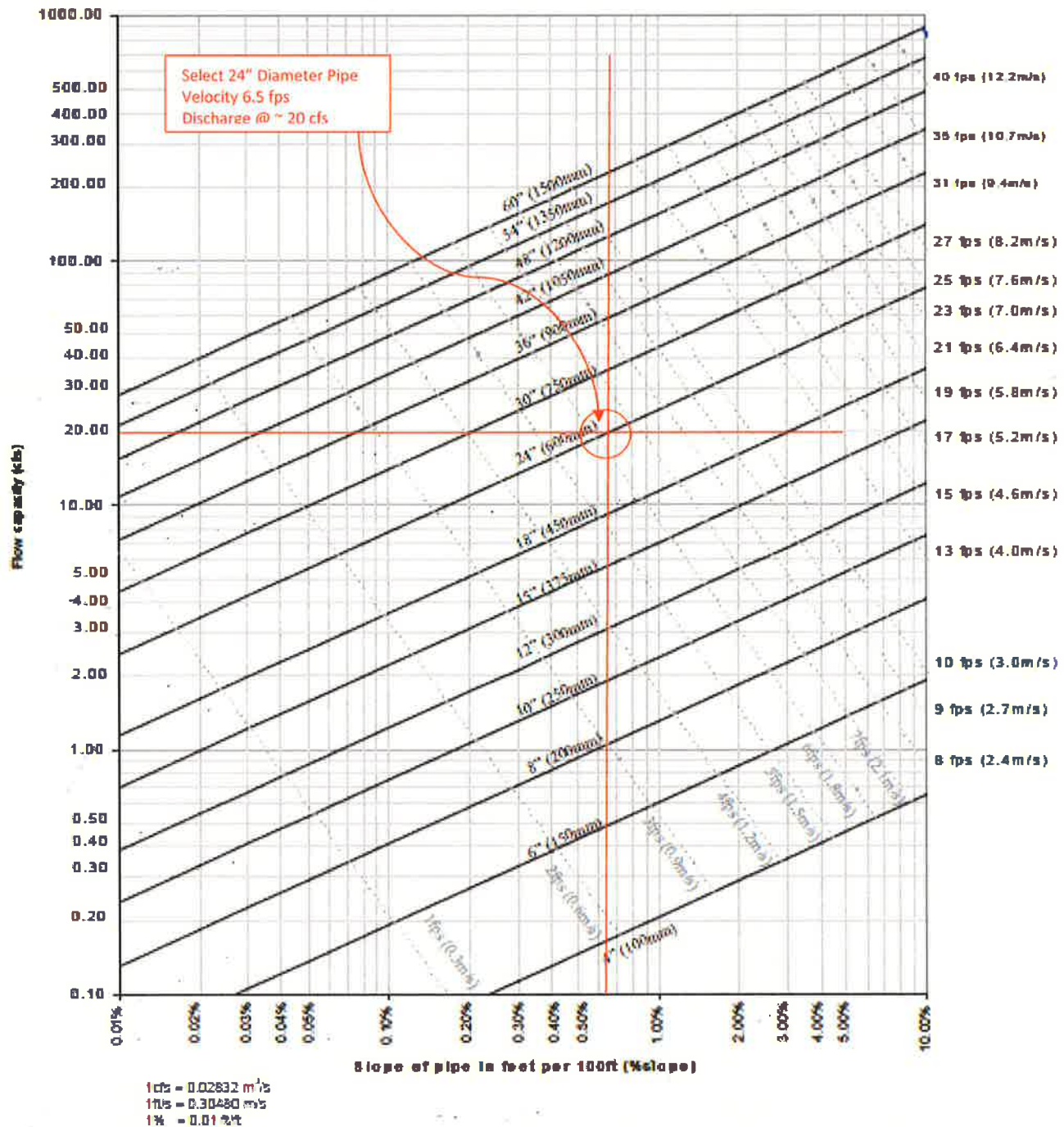
11.000 0.000 10.996 10.99

Totals for Watershed in inches over 2.30 acres
Rational Coefficient = 1.000 Peak Flow (cfs) = 15.25

ATTACHMENT 4

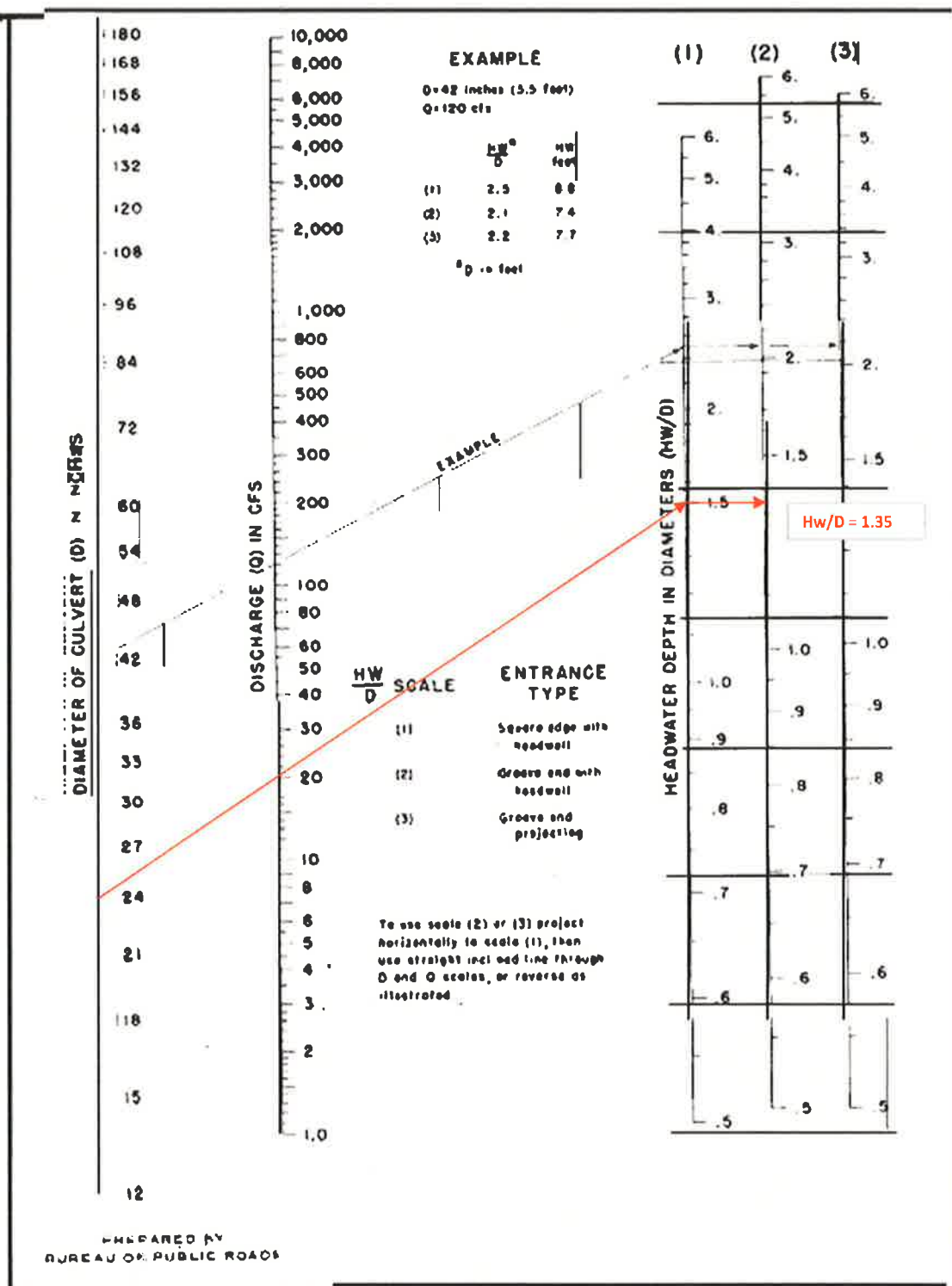
Figure 3-1

Discharge Rates for Hancor Hi-Q®, Sure-Lok® ST, BLUE SEAL® Pipe Products



Note: Based on a design Manning's "n" of 0.012.
Solid lines indicate pipe diameters. Dashed lines indicate approximate flow velocity.
Redeveloped from FHWA HDS 3 – Design Charts for Open-Channel Flow²

ATTACHMENT 5



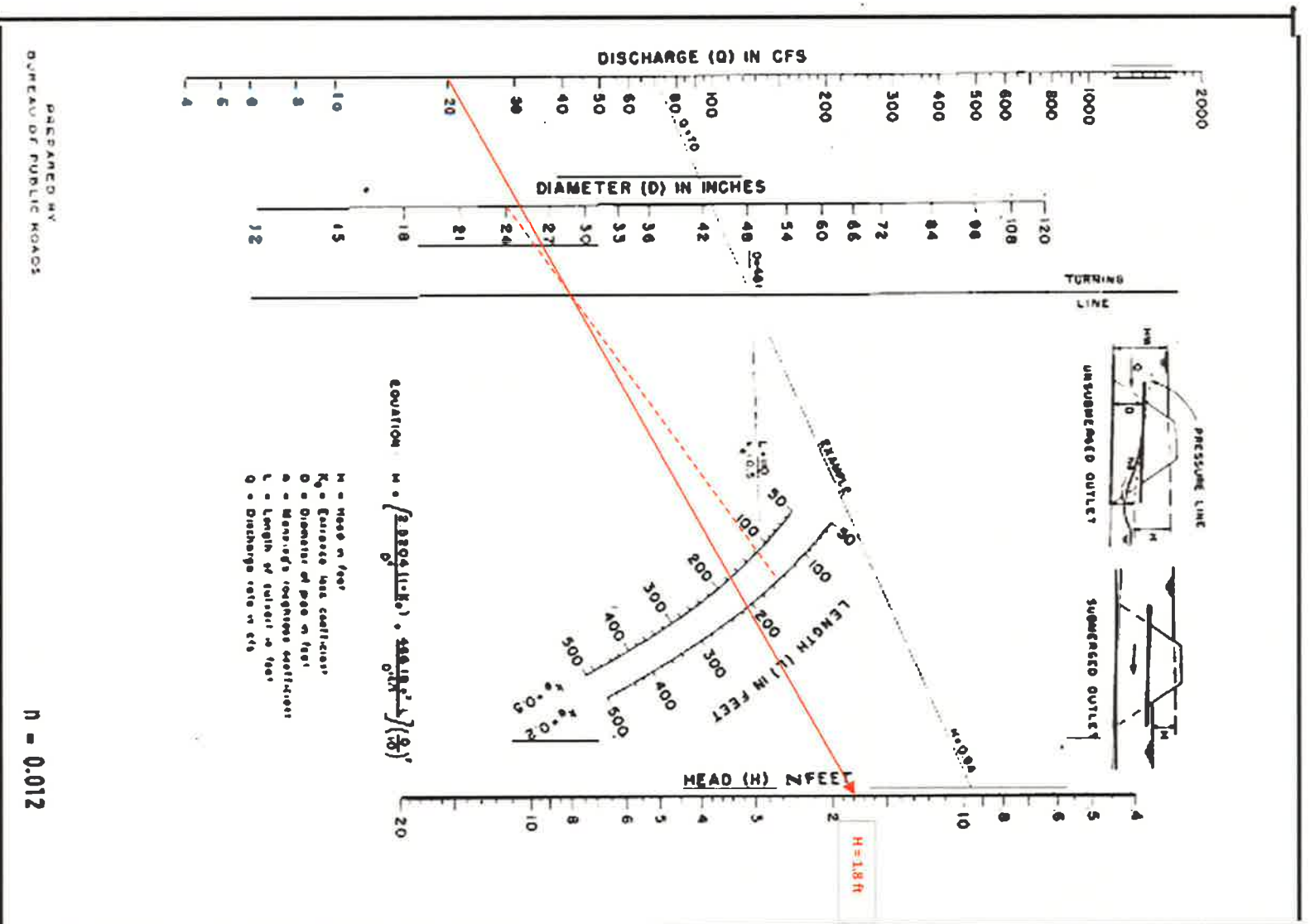


Figure B-11. Head for circular pipe culverts flowing full, $n = 0.012$.

CULVERT SIZING

Culvert ID	Inlet Invert Elevation (feet)	Inlet Berm Elevation (feet)	Outlet Invert Elevation (feet)	Outlet Berm Elevation (feet)	Tailwater Elevation (feet)	Peak Flow (cfs)	Number of Culverts	Culvert Size (B x D) (inches)	Design Flow each (cfs)	Total Design Flow (cfs)	Culvert Length (feet)	Culvert Slope	Inlet Control			Outlet Control			Type of Control	Freeboard (feet)	Check		
													h _w /D	D (ft)	Inlet H _w (ft)	Inlet Headwater Elevation	H (ft)	h _o (ft)				Outlet H _w (ft)	Outlet Headwater Elevation
EFGD	102.00	106.00	101.00	105.00	101.50	16.0	1	24	20	20	154	0.65%	1.35	2.00	2.70	104.70	1.80	0.50	1.30	103.30	Inlet	1.30	OK

hw/D - from inlet control nomograph

Inlet Control Hw = hw/D * D

H - From outlet control nomograph

Outlet Control Hw = H + ho - Length*slope

ATTACHMENT J
AERIAL PHOTOGRAPH OF FORMER ASH POND LIMITS

Response to RAI comment B.6

Red line indicates limits of existing pond berm. Pond construction will occur within the confines of the existing pond footprint. No wetlands will be impacted.



ATTACHMENT K
NON-CONTACT SURFACE WATER CALCULATIONS - FGD BASIN

SUBJECT NON-CONTACT STORMWATER CALCULATIONS - FGD BASIN					
Job No.	093-82538	Made by	SFS	Date	August 2009
Ref.		Checked	KLH/BTH	Sheet	1 of 20
		Reviewed	KBK		

PURPOSE

The purpose of this calculation package is to confirm that the installation of the east and west FGD ponds will not adversely affect the overall former North Ash Pond basin outfall, storage capacity (25-year, 24-hour and 100-year, 24-hour storm events) and the outfall for the former North Ash pond permitted under NPDES FL0000159 (D-0C1) at the Crystal River Energy Complex (CREC).

The East and West FGD ponds are to be constructed within the limits of the former North Ash Pond. Consistent with the conditions of the former ash pond area, the only outlet for stormwater will be the overflow weir at the northwest corner of the area.

AREAS

The watershed for the former ash pond existing basin (excluding the east and west FGD ponds) is approximately 23.3 acres. The watershed is shown in Attachment 1.

The composite curve number (CN) for the basin is 88 (See Attachment 2).

STAGE-AREA STORAGE

Stage-area information was determined for the basin. The software package SMADA Version 6.43 for Windows written by Dr. R.D. Eaglin of the University of Central Florida was used to determine the storage capacities. The following table presents the stage-area storage data for the basin.

Stage Elevation (feet)	Area (acres)	Storage (acre-feet)
92.0	11.10	0.0
93.0	11.28	11.19
94.0	11.46	22.56
95.0	11.63	34.10

TIME OF CONCENTRATION

The time of concentration path for the basin is shown in Attachment 1. The time of concentration path begins in the northeastern portion of the watershed and flows in a southwesterly direction. The initial 280 feet was assumed to be sheet flow, and Manning's equation of travel time was used to calculate travel times. The remaining time of concentration flow paths were assumed to be under shallow concentrated flow and slopes are shown in Attachment 2. The time of concentration for the basin was calculated at 16 minutes.

RAINFALL HYDROGRAPHS

Rainfall hydrographs for the watersheds were estimated using the software package SMADA Version 6.43 for Windows written by Dr. R. D. Eaglin of the University of Central Florida. The program uses procedures presented in the Soil Conservation Service's TR-55 (SCS TR-55, 1986).

Stormwater runoff was calculated for 25-year, 24-hour and 100-year, 24-hour design storms (Attachment 3).

The existing basin peak discharge of the 25-year, 24-hour hydrograph is 141.38 cubic feet per second (cfs) (see Attachment 3).

The existing basin peak discharge of peak of the 100-year, 24-hour hydrograph is 172.80 cubic feet per second (cfs) (see Attachment 3).

SUBJECT NON-CONTACT STORMWATER CALCULATIONS - FGD BASIN

Job No.	093-82538	Made by	SFS	Date	August 2009
Ref.		Checked	KLH/BTH	Sheet	2 of 20
		Reviewed			

WEST POND SPILLWAY DESIGN AND ROUTING

The 25-year, 24-hour and 100-year, 24-hour hydrograph was routed through the existing basin using the SMADA program. The overflow weir was set at elevation 95.0 feet with an estimated width of 11.5 feet.

There were no peak discharges for the 25-year, 24-hour and 100-year, 24-hour storm events, and therefore the existing basin area and weir are capable of managing the runoff and staging for these storm events. The following table presents peak rainfall and staging results for the design storm events (see Attachment 4).

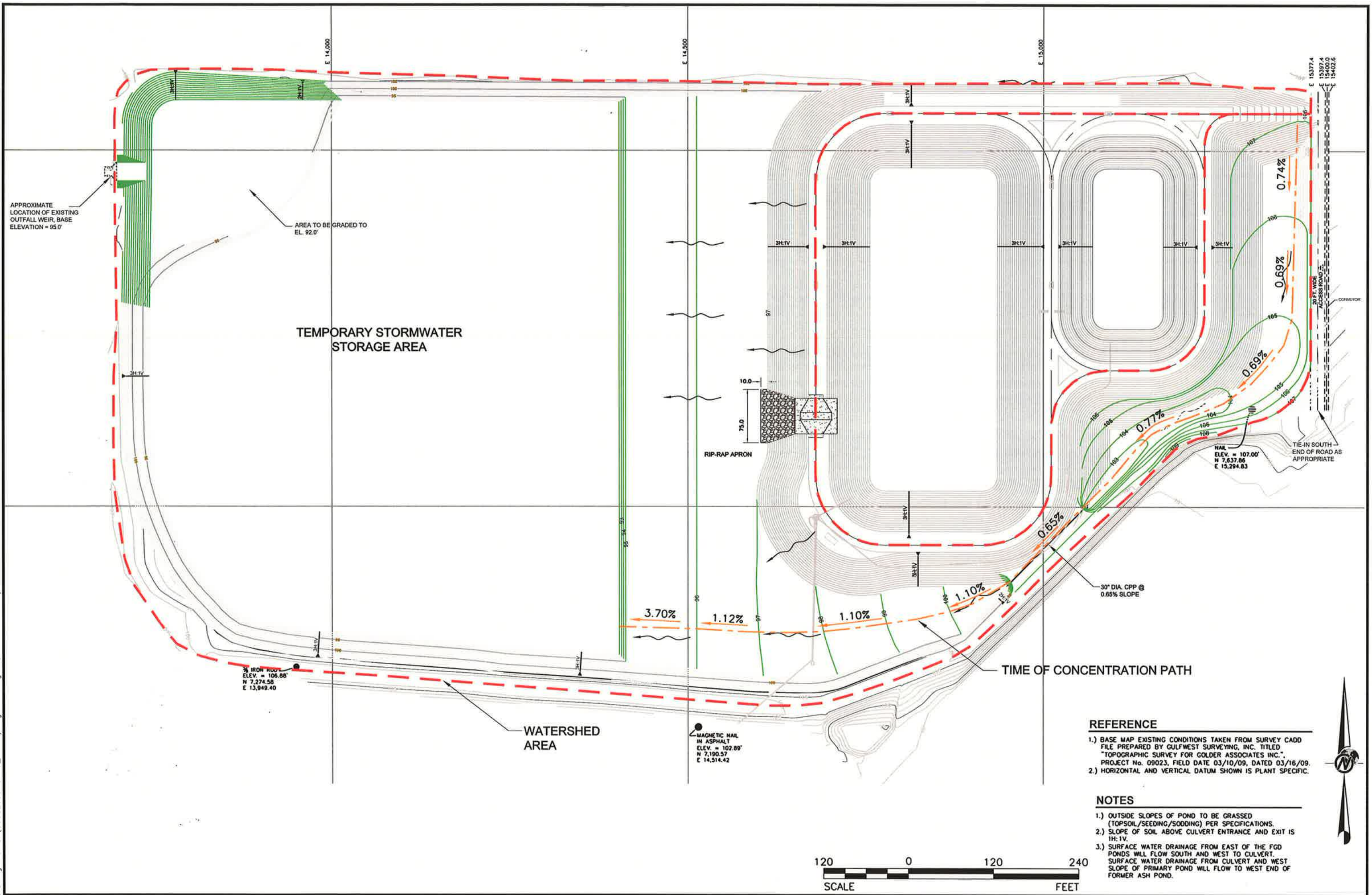
Design Storm	Rainfall (inches)	Peak Elevation (feet)	Peak Discharge (cfs)
25-year, 24-hour	9.0	93.53	0.0
100-year, 24-hour	11.0	93.87	0.0

REFERENCES

Soil Conservation Service, 1986, Urban Hydrology for Small Watersheds - Technical Release 55

Hann, Barfield, Hayes, 1994; Design Hydrology and Sedimentology for Small Catchments; Academic Press, San Diego, CA.

ATTACHMENT 1



REFERENCE

- 1.) BASE MAP EXISTING CONDITIONS TAKEN FROM SURVEY CADD FILE PREPARED BY GULFWEST SURVEYING, INC. TITLED "TOPOGRAPHIC SURVEY FOR GOLDER ASSOCIATES INC.", PROJECT No. 09023, FIELD DATE 03/10/09, DATED 03/16/09.
- 2.) HORIZONTAL AND VERTICAL DATUM SHOWN IS PLANT SPECIFIC.

NOTES

- 1.) OUTSIDE SLOPES OF POND TO BE GRASSED (TOPSOIL/SEEDING/SODDING) PER SPECIFICATIONS.
- 2.) SLOPE OF SOIL ABOVE CULVERT ENTRANCE AND EXIT IS 1H:1V.
- 3.) SURFACE WATER DRAINAGE FROM EAST OF THE FGD PONDS WILL FLOW SOUTH AND WEST TO CULVERT. SURFACE WATER DRAINAGE FROM CULVERT AND WEST SLOPE OF PRIMARY POND WILL FLOW TO WEST END OF FORMER ASH POND.

ATTACHMENT 2

COMPOSITE CURVE NUMBER

Project ID: PEF CREC/Exist FGD Basin Design/FL

Project #: 093-82538

DESCRIPTION:

EXIST-FGD-BASIN, Total = 23.30 Ac.

<u>CN:</u>	<u>Ac.</u>	<u>Land Cover</u>	<u>Soil Type</u>	<u>SCS CN</u>	<u>%</u>	<u>Weight %</u>
	20.08	Dirt	D	89	86.2%	77
	<u>3.22</u>	Pasture/Rangeland (good condition)	D	80	13.8%	11
					100.0%	
Area:	23.30	<u>OK</u>	Weighted SCS CN =			
						88

Time of Concentration

Project: **PEF CREC/Existing FGD Basin Design/FL**

Project No.: **093-82538**

Tc:

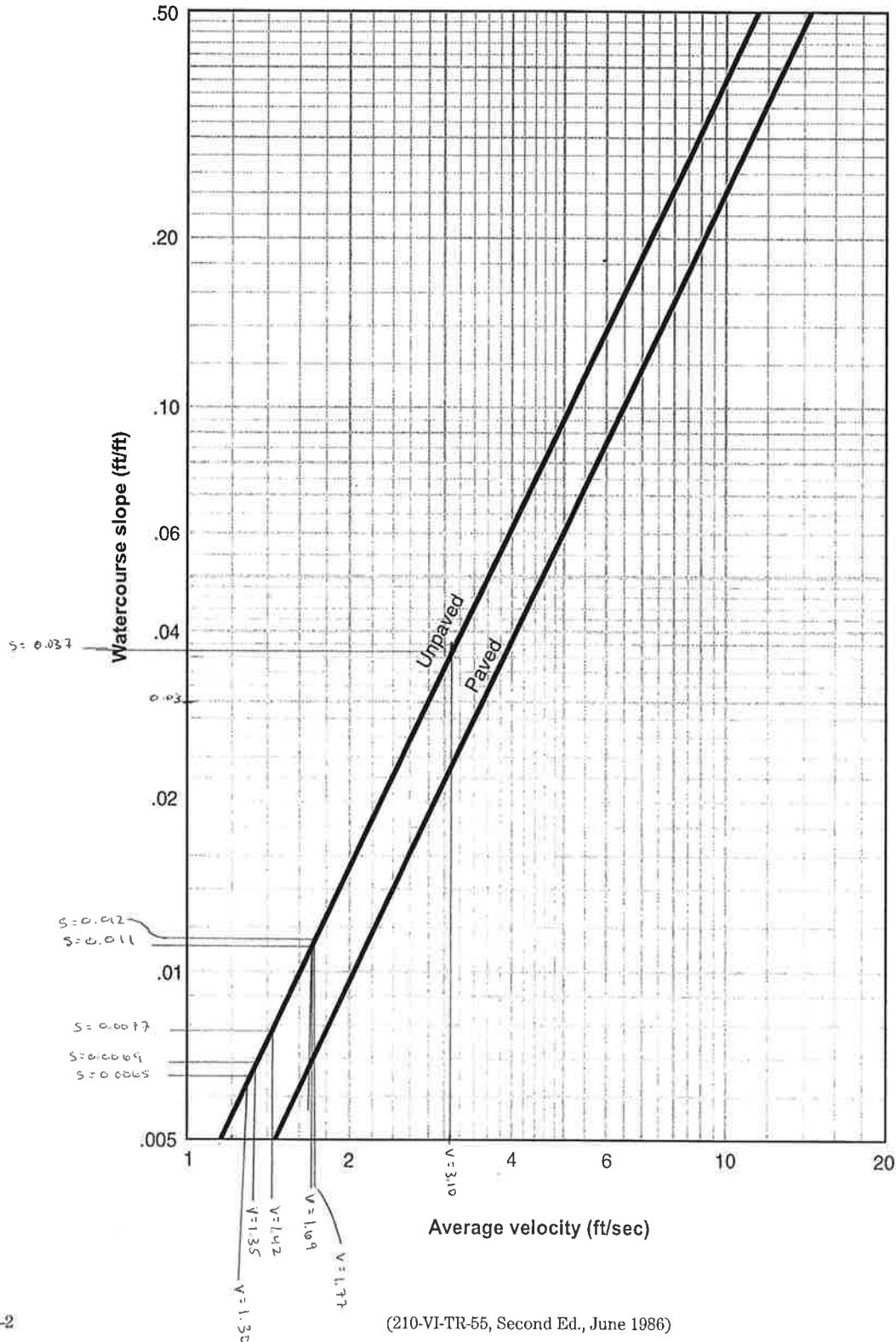
<u>Dist. (ft)</u>		<u>Slope (ft/ft)</u>	<u>Vel. (fps)</u>	<u>Time (min.)</u>
135	Sheet Flow (slope=0.0074, mannings formula)	0.0074	-	1.834
145	Sheet Flow (slope=0.0069, mannings formula)	0.0069	-	1.997
144	Shallow Conc. Flow (slope=0.0069) @	0.0069	1.35	1.778
260	Shallow Conc. Flow (slope=0.0077) @	0.0077	1.42	3.061
154	Shallow Conc. Flow (slope=0.0065) @	0.0065	1.30	1.973
186	Shallow Conc. Flow (slope=0.011) @	0.011	1.69	1.832
180	Shallow Conc. Flow (slope=0.011) @	0.011	1.69	1.773
87	Shallow Conc. Flow (slope=0.012) @	0.012	1.77	0.820
109	Shallow Conc. Flow (slope=0.037) @	0.037	3.10	0.585
1400				

Time of Concentration = 16 min.

Sheet Flow Time of Concentration parameters

n = 0.011 (bare soil)

P2 = 5" (2-yr, 24-hr rainfall event)

Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n ^{1/}
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses ^{2/}	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: ^{3/}	
Light underbrush	0.40
Dense underbrush	0.80

¹ The n values are a composite of information compiled by Engman (1986).

² Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

³ When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t :

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \quad [\text{eq. 3-3}]$$

where:

- T_t = travel time (hr),
- n = Manning's roughness coefficient (table 3-1)
- L = flow length (ft)
- P_2 = 2-year, 24-hour rainfall (in)
- s = slope of hydraulic grade line (land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

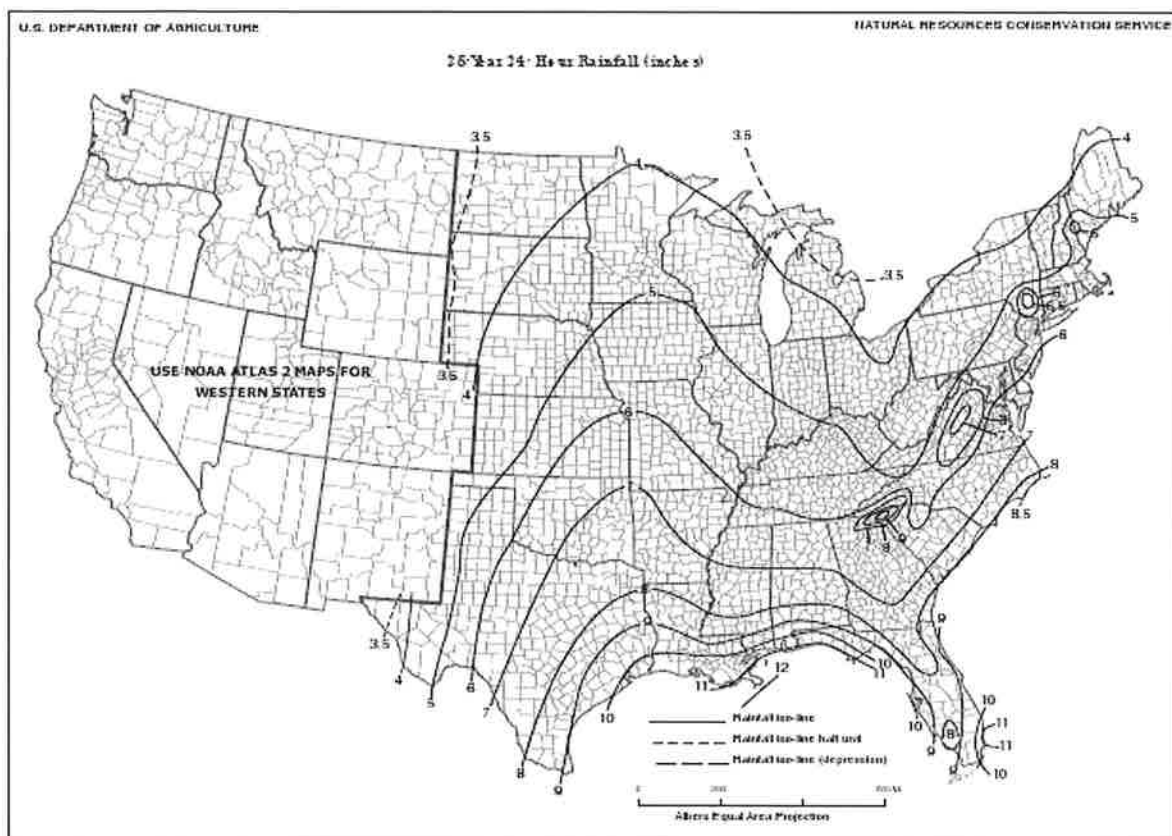
After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

ATTACHMENT 3

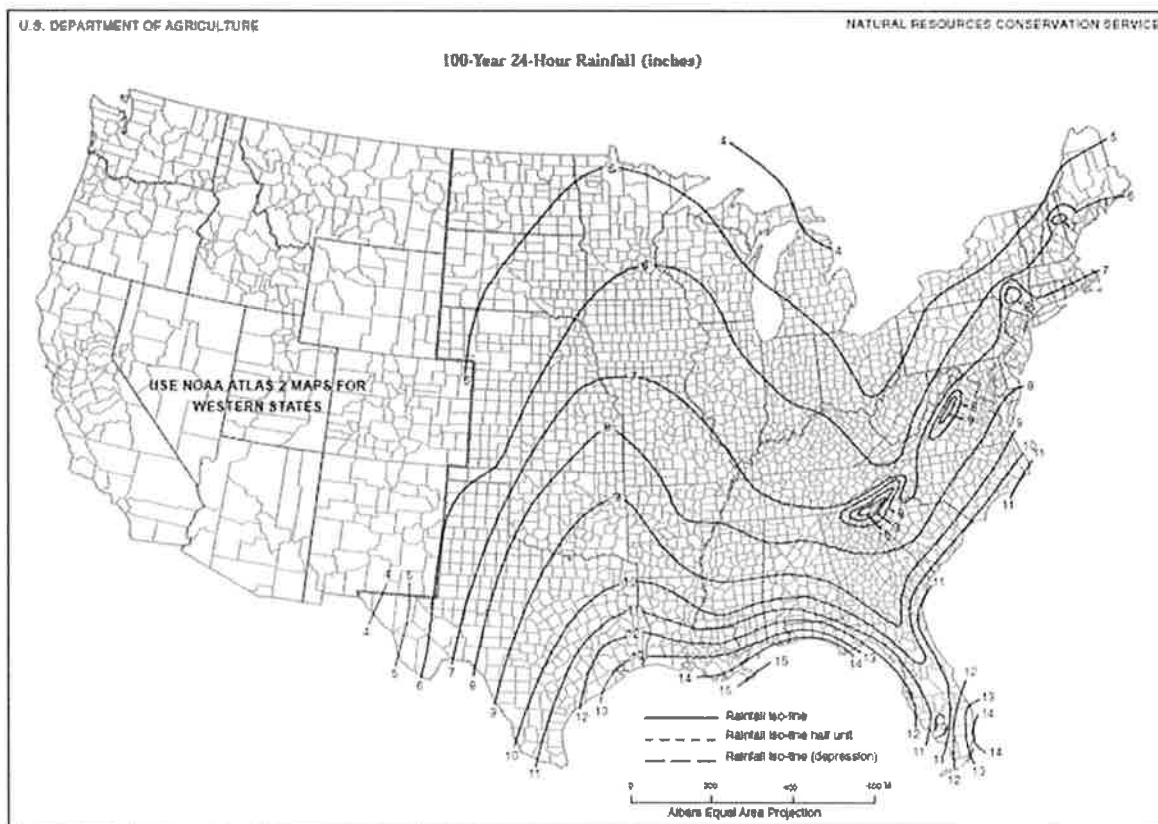
Figure B-6 26-year, 24-hour rainfall



B-4

(210-VI-TR-55, Second Ed., June 1986)

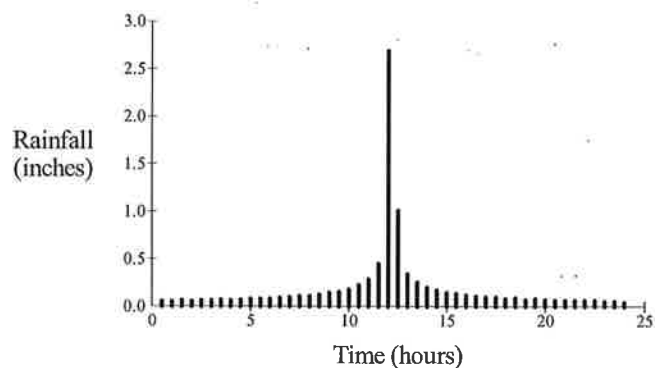
Figure B-8 100-year, 24-hour rainfall



(210-VI-TR-55, Second Ed., June 1986)

B-5

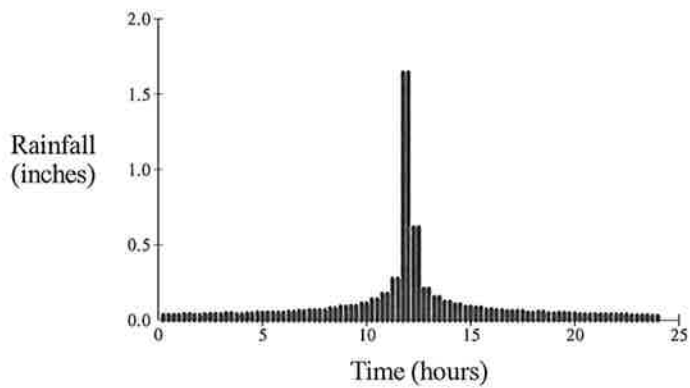
25-year, 24-hour Design Storm



Time (hr)	Time HHMM	Rain (in)	Cumulative (in)
0.500	00030	0.054	0.054
1.000	00100	0.054	0.108
1.500	00130	0.063	0.171
2.000	00200	0.054	0.225
2.500	00230	0.063	0.288
3.000	00300	0.063	0.351
3.500	00330	0.072	0.423
4.000	00400	0.063	0.486
4.500	00430	0.072	0.558
5.000	00500	0.081	0.639
5.500	00530	0.081	0.720
6.000	00600	0.081	0.801
6.500	00630	0.090	0.891
7.000	00700	0.099	0.990
7.500	00730	0.108	1.098
8.000	00800	0.108	1.206
8.500	00830	0.126	1.332
9.000	00900	0.144	1.476
9.500	00930	0.153	1.629
10.00	01000	0.180	1.809
10.50	01030	0.225	2.034
11.00	01100	0.288	2.322
11.50	01130	0.450	2.772
12.00	01200	2.691	5.463
12.50	01230	1.008	6.471
13.00	01300	0.342	6.813
13.50	01330	0.252	7.065
14.00	01400	0.198	7.263
14.50	01430	0.171	7.434
15.00	01500	0.144	7.578
15.50	01530	0.135	7.713
16.00	01600	0.117	7.830
16.50	01630	0.108	7.938
17.00	01700	0.099	8.037
17.50	01730	0.099	8.136
18.00	01800	0.081	8.217
18.50	01830	0.090	8.307
19.00	01900	0.072	8.379
19.50	01930	0.081	8.460
20.00	02000	0.072	8.532
20.50	02030	0.063	8.595
21.00	02100	0.063	8.658
21.50	02130	0.063	8.721
22.00	02200	0.063	8.784
22.50	02230	0.063	8.847
23.00	02300	0.054	8.901
23.50	02330	0.054	8.955
24.00	00000	0.045	9.000

9.00

100-year, 24-hour Design Storm Rainfall



Time (hr)	Time HHMM	Rain (in)	Cumulative (in)
0.500	00030	0.066	0.066
1.000	00100	0.066	0.132
1.500	00130	0.077	0.209
2.000	00200	0.066	0.275
2.500	00230	0.077	0.352
3.000	00300	0.077	0.429
3.500	00330	0.088	0.517
4.000	00400	0.077	0.594
4.500	00430	0.088	0.682
5.000	00500	0.099	0.781
5.500	00530	0.099	0.880
6.000	00600	0.099	0.979
6.500	00630	0.110	1.089
7.000	00700	0.121	1.210
7.500	00730	0.132	1.342
8.000	00800	0.132	1.474
8.500	00830	0.154	1.628
9.000	00900	0.176	1.804
9.500	00930	0.187	1.991
10.00	01000	0.220	2.211
10.50	01030	0.275	2.486
11.00	01100	0.352	2.838
11.50	01130	0.550	3.388
12.00	01200	3.289	6.677
12.50	01230	1.232	7.909
13.00	01300	0.418	8.327
13.50	01330	0.308	8.635
14.00	01400	0.242	8.877
14.50	01430	0.209	9.086
15.00	01500	0.176	9.262
15.50	01530	0.165	9.427
16.00	01600	0.143	9.570
16.50	01630	0.132	9.702
17.00	01700	0.121	9.823
17.50	01730	0.121	9.944
18.00	01800	0.099	10.043
18.50	01830	0.110	10.153
19.00	01900	0.088	10.241
19.50	01930	0.099	10.340
20.00	02000	0.088	10.428
20.50	02030	0.077	10.505
21.00	02100	0.077	10.582
21.50	02130	0.077	10.659
22.00	02200	0.077	10.736
22.50	02230	0.077	10.813
23.00	02300	0.066	10.879
23.50	02330	0.066	10.945
24.00	00000	0.055	11.000

11.00

SMADA 6.0 for Windows
Watershed Information

Watershed Total Area (acres)	:23.30
Impervious Area (acres)	:0.00
Time of Concentration (min)	:16.0
% Impervious Directly Connected	:00.00

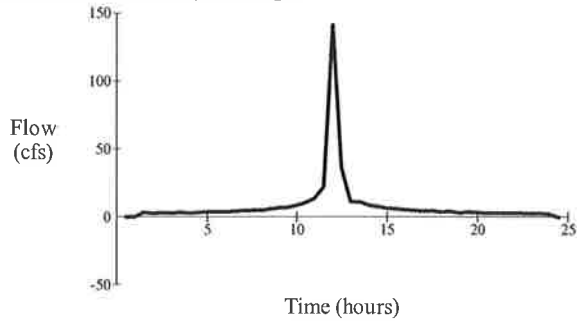
Additional Abstraction

Over Pervious Area (inches)	:0.00
Over Impervious Area (inches)	:0.00

Infiltration Characteristics:

Max Infiltration Capacity (in)	:0.10
SCS Curve Number for Pervious	:88
Initial Abstraction Factor	:0.20

25-year, 24-hour Hydrograph



Hydrograph Type :SCS 484 Hydrograph

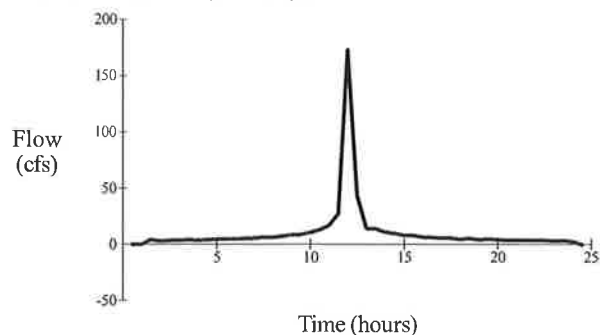
Time (hr)	Time HHMM	Rain (in)	C Rain (in)	Infiltration (in)	Excess (in)	Excess (cfs)	Outflow (cfs)
0.500	00030	0.054	0.054	0.054	0.000	0.000	0.000
1.000	00100	0.054	0.108	0.054	0.000	0.000	0.000
1.500	00130	0.063	0.171	0.000	0.063	2.959	3.380
2.000	00200	0.054	0.225	0.000	0.054	2.537	2.476
2.500	00230	0.063	0.288	0.000	0.063	2.959	3.019
3.000	00300	0.063	0.351	0.000	0.063	2.959	2.959
3.500	00330	0.072	0.423	0.000	0.072	3.382	3.442
4.000	00400	0.063	0.486	0.000	0.063	2.959	2.899
4.500	00430	0.072	0.558	0.000	0.072	3.382	3.442
5.000	00500	0.081	0.639	0.000	0.081	3.805	3.865
5.500	00530	0.081	0.720	0.000	0.081	3.805	3.805
6.000	00600	0.081	0.801	0.000	0.081	3.805	3.805
6.500	00630	0.090	0.891	0.000	0.090	4.228	4.288
7.000	00700	0.099	0.990	0.000	0.099	4.650	4.710
7.500	00730	0.108	1.098	0.000	0.108	5.073	5.133
8.000	00800	0.108	1.206	0.000	0.108	5.073	5.073
8.500	00830	0.126	1.332	0.000	0.126	5.919	6.039
9.000	00900	0.144	1.476	0.000	0.144	6.764	6.884
9.500	00930	0.153	1.629	0.000	0.153	7.187	7.247
10.00	01000	0.180	1.809	0.000	0.180	8.455	8.636
10.50	01030	0.225	2.034	0.000	0.225	10.569	10.870
11.00	01100	0.288	2.322	0.000	0.288	13.528	13.949
11.50	01130	0.450	2.772	0.000	0.450	21.138	22.220
12.00	01200	2.691	5.463	0.000	2.691	126.404	141.378
12.50	01230	1.008	6.471	0.000	1.008	47.349	36.103
13.00	01300	0.342	6.813	0.000	0.342	16.065	11.615
13.50	01330	0.252	7.065	0.000	0.252	11.837	11.236
14.00	01400	0.198	7.263	0.000	0.198	9.301	8.940
14.50	01430	0.171	7.434	0.000	0.171	8.032	7.852
15.00	01500	0.144	7.578	0.000	0.144	6.764	6.584
15.50	01530	0.135	7.713	0.000	0.135	6.341	6.281
16.00	01600	0.117	7.830	0.000	0.117	5.496	5.376
16.50	01630	0.108	7.938	0.000	0.108	5.073	5.013
17.00	01700	0.099	8.037	0.000	0.099	4.650	4.590
17.50	01730	0.099	8.136	0.000	0.099	4.650	4.650
18.00	01800	0.081	8.217	0.000	0.081	3.805	3.685
18.50	01830	0.090	8.307	0.000	0.090	4.228	4.288
19.00	01900	0.072	8.379	0.000	0.072	3.382	3.262
19.50	01930	0.081	8.460	0.000	0.081	3.805	3.865
20.00	02000	0.072	8.532	0.000	0.072	3.382	3.322
20.50	02030	0.063	8.595	0.000	0.063	2.959	2.899
21.00	02100	0.063	8.658	0.000	0.063	2.959	2.959
21.50	02130	0.063	8.721	0.000	0.063	2.959	2.959
22.00	02200	0.063	8.784	0.000	0.063	2.959	2.959
22.50	02230	0.063	8.847	0.000	0.063	2.959	2.959
23.00	02300	0.054	8.901	0.000	0.054	2.537	2.476
23.50	02330	0.054	8.955	0.000	0.054	2.537	2.537
24.00	00000	0.045	9.000	0.000	0.045	2.114	2.054
24.50	00030	0.000	9.000	0.000	0.000	0.000	- 0.301

9.000 0.108 8.889 8.889

Totals for Watershed in inches over 23.30 acres

Rational Coefficient = 0.988 Peak Flow (cfs) = 141.38

100-year, 24-hour Hydrograph



Hydrograph Type :SCS 484 Hydrograph

Time (hr)	Time HHMM	Rain (in)	C Rain (in)	Infiltration (in)	Excess (in)	Excess (cfs)	Outflow (cfs)
0.500	00030	0.066	0.066	0.066	0.000	0.000	0.000
1.000	00100	0.066	0.132	0.066	0.000	0.000	0.000
1.500	00130	0.077	0.209	0.000	0.077	3.617	4.131
2.000	00200	0.066	0.275	0.000	0.066	3.100	3.027
2.500	00230	0.077	0.352	0.000	0.077	3.617	3.690
3.000	00300	0.077	0.429	0.000	0.077	3.617	3.617
3.500	00330	0.088	0.517	0.000	0.088	4.134	4.207
4.000	00400	0.077	0.594	0.000	0.077	3.617	3.543
4.500	00430	0.088	0.682	0.000	0.088	4.134	4.207
5.000	00500	0.099	0.781	0.000	0.099	4.650	4.724
5.500	00530	0.099	0.880	0.000	0.099	4.650	4.650
6.000	00600	0.099	0.979	0.000	0.099	4.650	4.650
6.500	00630	0.110	1.089	0.000	0.110	5.167	5.241
7.000	00700	0.121	1.210	0.000	0.121	5.684	5.757
7.500	00730	0.132	1.342	0.000	0.132	6.200	6.274
8.000	00800	0.132	1.474	0.000	0.132	6.200	6.200
8.500	00830	0.154	1.628	0.000	0.154	7.234	7.381
9.000	00900	0.176	1.804	0.000	0.176	8.267	8.414
9.500	00930	0.187	1.991	0.000	0.187	8.784	8.857
10.00	01000	0.220	2.211	0.000	0.220	10.334	10.555
10.50	01030	0.275	2.486	0.000	0.275	12.918	13.285
11.00	01100	0.352	2.838	0.000	0.352	16.534	17.049
11.50	01130	0.550	3.388	0.000	0.550	25.835	27.158
12.00	01200	3.289	6.677	0.000	3.289	154.494	172.795
12.50	01230	1.232	7.909	0.000	1.232	57.870	44.126
13.00	01300	0.418	8.327	0.000	0.418	19.635	14.196
13.50	01330	0.308	8.635	0.000	0.308	14.468	13.733
14.00	01400	0.242	8.877	0.000	0.242	11.367	10.926
14.50	01430	0.209	9.086	0.000	0.209	9.817	9.597
15.00	01500	0.176	9.262	0.000	0.176	8.267	8.047
15.50	01530	0.165	9.427	0.000	0.165	7.751	7.677
16.00	01600	0.143	9.570	0.000	0.143	6.717	6.570
16.50	01630	0.132	9.702	0.000	0.132	6.200	6.127
17.00	01700	0.121	9.823	0.000	0.121	5.684	5.610
17.50	01730	0.121	9.944	0.000	0.121	5.684	5.684
18.00	01800	0.099	10.043	0.000	0.099	4.650	4.503
18.50	01830	0.110	10.153	0.000	0.110	5.167	5.241
19.00	01900	0.088	10.241	0.000	0.088	4.134	3.987
19.50	01930	0.099	10.340	0.000	0.099	4.650	4.724
20.00	02000	0.088	10.428	0.000	0.088	4.134	4.060
20.50	02030	0.077	10.505	0.000	0.077	3.617	3.543
21.00	02100	0.077	10.582	0.000	0.077	3.617	3.617
21.50	02130	0.077	10.659	0.000	0.077	3.617	3.617
22.00	02200	0.077	10.736	0.000	0.077	3.617	3.617
22.50	02230	0.077	10.813	0.000	0.077	3.617	3.617
23.00	02300	0.066	10.879	0.000	0.066	3.100	3.027
23.50	02330	0.066	10.945	0.000	0.066	3.100	3.100
24.00	00000	0.055	11.000	0.000	0.055	2.584	2.510
24.50	00030	0.000	11.000	0.000	0.000	0.000	0.368

11.000 0.132 10.864 10.86

Totals for Watershed in inches over 23.30 acres

Rational Coefficient = 0.988 Peak Flow (cfs) = 172.80

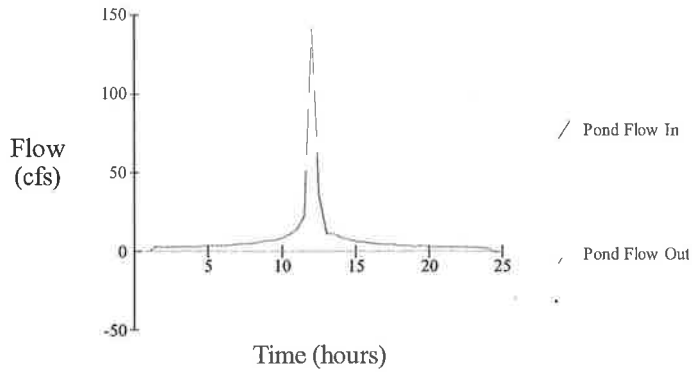
ATTACHMENT 4

Stage (ft)	Storage (ac-ft)	Weir 1 Q (cfs)	Weir 2 Q (cfs)	Discharge (cfs)
92.00	0.00	0.00	0.00	0.00
93.00	11.19	0.00	0.00	0.00
94.00	22.56	0.00	0.00	0.00
95.00	34.10	0.00	0.00	0.00

Weir Number1

Type : Broad Crested Rectangular
Equation : $Q = C \cdot H^n \cdot (B - 0.2H)$
Weir Invert (ft) : 95.00
C: 3.09 n: 1.50
Base Width (ft) : 11.50

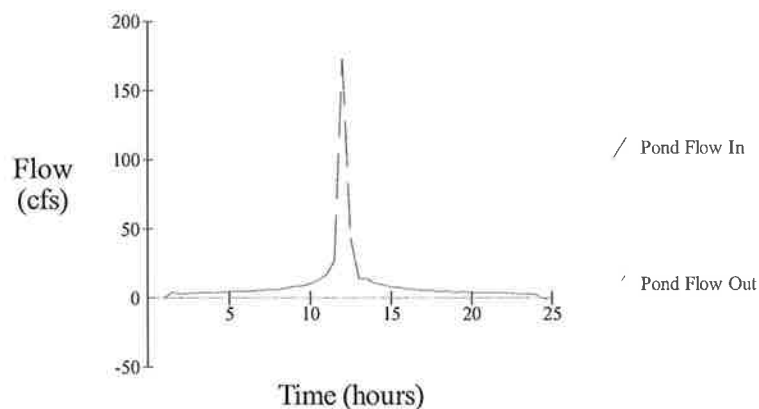
25-year, 24-hour Storm Routing



Time (hr)	Inflow (cfs)	Outflow (cfs)	Stage (ft)	Storage (ac-ft)
0.50	0.00	0.00	92.00	0.00
1.00	0.00	0.00	92.00	0.00
1.50	3.38	0.00	92.01	0.13
2.00	2.48	0.00	92.02	0.23
2.50	3.02	0.00	92.03	0.35
3.00	2.96	0.00	92.04	0.48
3.50	3.44	0.00	92.06	0.62
4.00	2.90	0.00	92.07	0.74
4.50	3.44	0.00	92.08	0.88
5.00	3.86	0.00	92.09	1.04
5.50	3.80	0.00	92.11	1.19
6.00	3.80	0.00	92.12	1.35
6.50	4.29	0.00	92.14	1.53
7.00	4.71	0.00	92.15	1.72
7.50	5.13	0.00	92.17	1.93
8.00	5.07	0.00	92.19	2.14
8.50	6.04	0.00	92.21	2.39
9.00	6.88	0.00	92.24	2.67
9.50	7.25	0.00	92.26	2.96
10.00	8.64	0.00	92.30	3.32
10.50	10.87	0.00	92.34	3.76
11.00	13.95	0.00	92.39	4.32
11.50	22.22	0.00	92.46	5.20
12.00	141.38	0.00	92.94	10.55
12.50	36.10	0.00	93.11	12.48
13.00	11.61	0.00	93.16	13.06
13.50	11.24	0.00	93.21	13.53
14.00	8.94	0.00	93.24	13.91
14.50	7.85	0.00	93.27	14.23
15.00	6.58	0.00	93.29	14.51
15.50	6.28	0.00	93.32	14.77
16.00	5.38	0.00	93.33	15.00
16.50	5.01	0.00	93.35	15.21
17.00	4.59	0.00	93.37	15.40
17.50	4.65	0.00	93.39	15.59
18.00	3.68	0.00	93.40	15.75
18.50	4.29	0.00	93.42	15.92
19.00	3.26	0.00	93.43	16.06
19.50	3.86	0.00	93.44	16.22
20.00	3.32	0.00	93.45	16.36
20.50	2.90	0.00	93.47	16.48
21.00	2.96	0.00	93.48	16.60
21.50	2.96	0.00	93.49	16.72
22.00	2.96	0.00	93.50	16.85
22.50	2.96	0.00	93.51	16.97
23.00	2.48	0.00	93.52	17.07
23.50	2.54	0.00	93.53	17.18
24.00	2.05	0.00	93.53	17.26
24.50	0.30	0.00	93.53	17.26
25.00	0.00	0.00	93.53	17.26
Max:	141.38	0.00	<u>93.53</u>	17.26

Total Inflow Volume : 017.260 ac-ft

100-year, 24-hour Storm Routing



Time (hr)	Inflow (cfs)	Outflow (cfs)	Stage (ft)	Storage (ac-ft)
0.50	0.00	0.00	92.00	0.00
1.00	0.00	0.00	92.00	0.00
1.50	4.13	0.00	92.01	0.15
2.00	3.03	0.00	92.03	0.28
2.50	3.69	0.00	92.04	0.43
3.00	3.62	0.00	92.05	0.58
3.50	4.21	0.00	92.07	0.75
4.00	3.54	0.00	92.08	0.90
4.50	4.21	0.00	92.10	1.07
5.00	4.72	0.00	92.11	1.27
5.50	4.65	0.00	92.13	1.46
6.00	4.65	0.00	92.15	1.65
6.50	5.24	0.00	92.17	1.87
7.00	5.76	0.00	92.19	2.10
7.50	6.27	0.00	92.21	2.36
8.00	6.20	0.00	92.23	2.62
8.50	7.38	0.00	92.26	2.92
9.00	8.41	0.00	92.29	3.26
9.50	8.86	0.00	92.32	3.62
10.00	10.55	0.00	92.36	4.05
10.50	13.29	0.00	92.41	4.59
11.00	17.05	0.00	92.47	5.28
11.50	27.16	0.00	92.57	6.36
12.00	172.80	0.00	93.15	12.90
12.50	44.13	0.00	93.36	15.25
13.00	14.20	0.00	93.42	15.96
13.50	13.73	0.00	93.47	16.53
14.00	10.93	0.00	93.51	17.00
14.50	9.60	0.00	93.55	17.40
15.00	8.05	0.00	93.58	17.74
15.50	7.68	0.00	93.60	18.06
16.00	6.57	0.00	93.63	18.33
16.50	6.13	0.00	93.65	18.59
17.00	5.61	0.00	93.67	18.82
17.50	5.68	0.00	93.69	19.06
18.00	4.50	0.00	93.71	19.25
18.50	5.24	0.00	93.73	19.46
19.00	3.99	0.00	93.74	19.63
19.50	4.72	0.00	93.76	19.82
20.00	4.06	0.00	93.77	19.99
20.50	3.54	0.00	93.79	20.14
21.00	3.62	0.00	93.80	20.29
21.50	3.62	0.00	93.81	20.44
22.00	3.62	0.00	93.83	20.59
22.50	3.62	0.00	93.84	20.74
23.00	3.03	0.00	93.85	20.87
23.50	3.10	0.00	93.86	20.99
24.00	2.51	0.00	93.87	21.10
24.50	0.37	0.00	93.87	21.10
25.00	0.00	0.00	93.87	21.10
Max:	172.80	0.00	<u>93.87</u>	21.10

Total Inflow Volume : 021.095 ac-ft

ATTACHMENT L
STORMWATER MANAGEMENT SYSTEM OPERATIONS AND MAINTENANCE PLAN

Stormwater Management System Operations and Maintenance Plan*

GENERAL MAINTENANCE

1. Have all stormwater pipes, inlets, catch basins, manholes, flumes, pond inflow and outflow structures (including oil skimmers), and discharge pipes inspected regularly (monthly or quarterly) and after major rainfalls. They should be maintained by removing built-up debris and vegetation and repairing deteriorating structures.
2. Do not throw grass clippings or other yard debris into the stormwater treatment pond. This will deteriorate the water quality and may restrict flow or clog the water-conveyance system.
3. Do not dispose of chemicals, oil, greases, or similar wastes directly into the stormwater facility or through storm sewers. Instead, dispose of these potentially dangerous materials at approved disposal or recycling facilities.
4. Periodically remove sediments that accumulate in the SWMS and dispose of them in a permitted solid waste landfill in accordance with applicable regulations.
5. During any repair or maintenance activity, use care to avoid causing erosion or siltation to adjacent or off-site areas.
6. Alterations (filling, enlarging, etc.) of any part of the SWMS are not permitted without prior approval from all applicable governing agencies.
7. Keep copies of the approved permit and as-built drawings at the plant where they will be readily available for reviewing additional restrictions, instructions, and conditions.

DRY RETENTION AREA & HYDRAULIC CONVEYANCES

1. Mow frequently enough to prevent thatch buildup. Pick up grass clippings after cutting. Limit fertilizer use around the pond, and do not fertilize grass in the pond area.
2. Spraying of herbicide is not allowed. This may harm or kill the grass that protects the bank and slopes from erosion and sediment built-up.
3. Overgrown nuisance vegetation may be occasionally cut down but must be removed and not allowed to decay in the pond.
4. Re-sod any areas (side or bottom) where grass or sod has been removed or eroded.
5. Keep the outfall structure clear of debris and vegetation. Periodically remove sediment accumulated in the discharge control structures and culverts.
6. If pollutant-retardant baffles deteriorate so much with time that they become nonfunctional, replace them.
7. Repair any sinkholes according to the attached plan (Figure 1).
8. Inspect the skimmer (as applicable) on the outfall structure regularly (monthly or quarterly) and after major rainfalls. Maintain it by removing built-up debris and vegetation and repairing deteriorating structures.

INSPECTIONS

The SWMS should be inspected routinely to ensure proper functioning. Inspections should be scheduled monthly or quarterly and following any major rain event. More frequent inspections may be necessary during the rainy season. Each stormwater system and related equipment will be inspected for cracks or structural failures, deterioration of the unit, stains, stressed or overgrown vegetation, and the need for cleaning the unit. Regular inspections of the SWMS should record observations on the following items (as applicable):

- 1 Bank stability for any indication of erosion;
- 2 Evidence of sinkholes;
- 3 Sod condition and any distress or coloration in vegetation;
- 4 Presence of wastes, debris, or pollutants; and
- 5 Cracks or structure failure for discharge control structure, culvert, and/or pollutant-retardant baffles.

Maintenance items identified during routine inspections should be reported and corrective actions should be initiated in a timely manner, but in no case later than seven calendar days following the identification of the problem. Copies of inspection records, including documentation of any required corrective actions, should be kept together with the permit and as-built drawings.

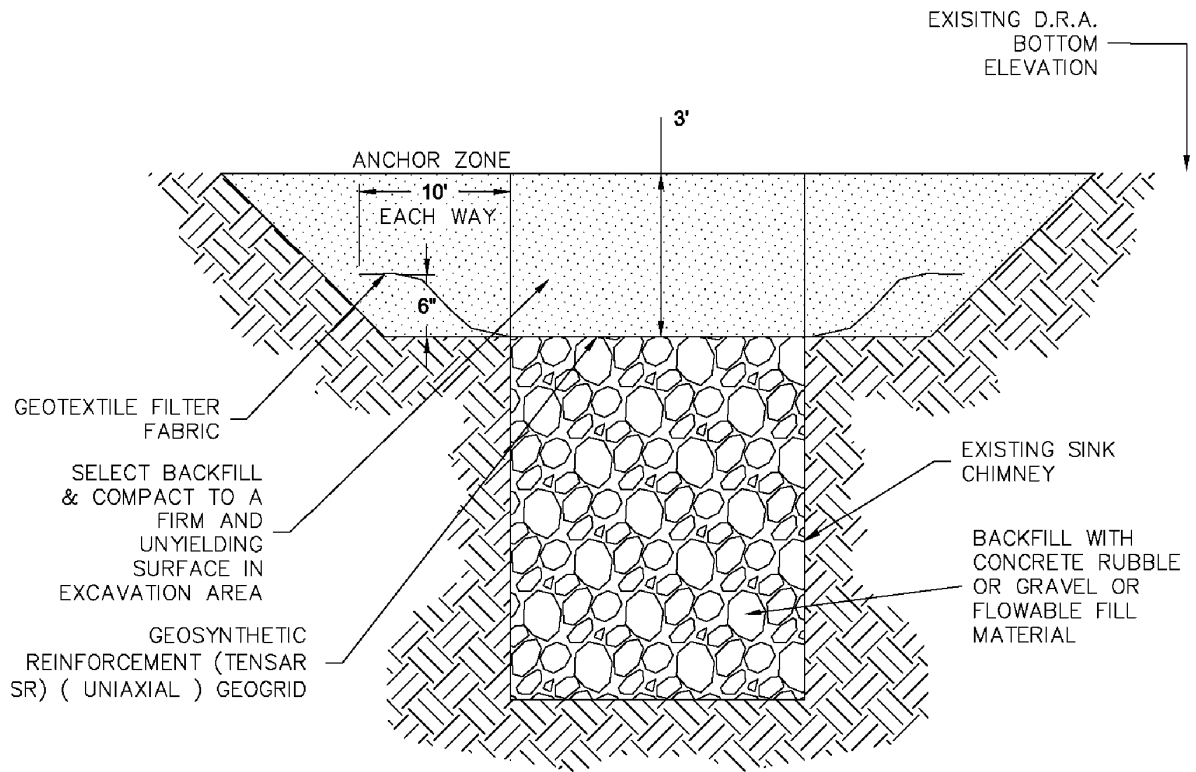
HOUSEKEEPING

Good housekeeping practices shall be implemented for laydown area operations to reduce the risk of exposure of materials to stormwater and/or coastal flooding associated with a 100 year flood event. These practices should include the following items (as applicable):

- 1 Neat and orderly storage of chemicals, pesticides, fertilizers, fuels, etc. that are being stored at the site.
- 2 Regular disposal of garbage and construction debris.
- 3 Elevated storage for certain materials as practical or necessary.
- 4 Prompt cleanup of any spills.
- 5 Cleanup of sediments that have been tracked by vehicles or have been transported by wind or stormwater.
- 6 Curbs or dikes to contain spills within liquid material storage areas.

*** This is a generic Stormwater Operations and Maintenance Plan. Not all guidance is applicable to every SWMS.**

Figure 1



ATTACHMENT M
PROPOSED MONITORING WELL LOCATION



LEGEND

-  Existing Monitoring Well
-  Proposed Monitoring Well
-  Proposed FGD Ponds Outline

REFERENCE

1. Imagery, Department of Revenue, 2007. 2. Crystal River plant features, Proposed stormwater ponds, Golder, 2008.

0 50 100 200 Feet
|-----|

SCALE AS SHOWN

PROJECT				PROGRESS ENERGY - CRYSTAL RIVER FACILITY	
				FGD PONDS SITE CERTIFICATION MODIFICATION	
TITLE				PROPOSED MONITORING WELL LOCATION	
		PROJECT No. 093-82538		REV. 0	
		DESIGN	WDK	28 Aug. 2009	FIGURE 1
		GIS	JRB	28 Aug. 2009	
		CHECK	WDK	28 Aug. 2009	
		REVIEW	KBK	28 Aug. 2009	