

**HISTORY OF CONSTRUCTION FOR EXISTING CCR SURFACE IMPOUNDMENT  
PLANT BARRY GYPSUM POND  
40 CFR 257.73(c)(1)(i)-(xii)**

**(i) Site Name and Ownership Information:**

Site Name: James M. Barry Electric Generating Plant

Site Location: Bucks, Alabama

Site Address: 15300 U.S Highway 43 North  
Bucks, Alabama 36512

Owner: Alabama Power Company

Owner Address: 600 North 18th Street; Birmingham, AL 35203

CCR Impoundment Name: Plant Barry Gypsum Pond

NID ID: NA

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities" Final Rule (40 C.F.R. Part 257 and Part 261), §257.73(c)(1), requires the owner or operator of an existing CCR surface impoundment to compile a history of construction. To the extent feasible, the following information is provided:

**(ii) Location of CCR Unit:**

30.995992, -88.014690  
See Location Map in the Appendix

**(iii) Purpose of CCR Impoundment:**

The James M. Barry Electric Generating Plant is a 7 unit electric generating facility, including 5 coal-fired units. The Plant Barry Gypsum Pond is designed to receive and store coal combustion residuals produced during the electric generating process at Plant Barry.

**(iv) Watershed Description:**

Plant Barry is located within the Big Chippewa Lake HUC-12 watershed which has a total area of 48,052 acres. The Big Chippewa Lake Watershed is located within the Mobile-Tensaw HUC-8 watershed which has a drainage area of 583,948 acres. However, there is no uncontrolled run-on into the gypsum pond from the surrounding watershed. The only water that enters the pond is rainwater that falls directly into the pond.

**(v) Description of physical and engineering properties of CCR impoundment foundation/abutments:**

The Plant Barry Gypsum Pond is located on the Quaternary-age alluvial geographic area which is indicative of alluvial, coastal, and low terrace deposits consisting of very fine to coarse sands and gravelly sands with some localized instances of clay and sandy clay. Borings performed in the area surrounding the gypsum pond indicate it is founded on silty sand, poorly-graded sand and sandy clay.

**(vi) Summary of Site Preparation and Construction Activities:**

The Plant Barry Gypsum Pond was designed and constructed between 2007 and 2010 and consists of a 21.3-acre gypsum storage cell and a 10.4-acre sedimentation pond. The Gypsum Pond dikes were constructed using clayey sands, sandy silts, and silty sand compacted to a minimum 95% maximum dry density. The bottom of the pond is lined with 2 feet of compacted clay having a maximum in-place permeability of  $1 \times 10^{-7}$  cm/s overlain by a manufactured 60-mil HDPE geomembrane.

**(vii) Engineering Diagram:**

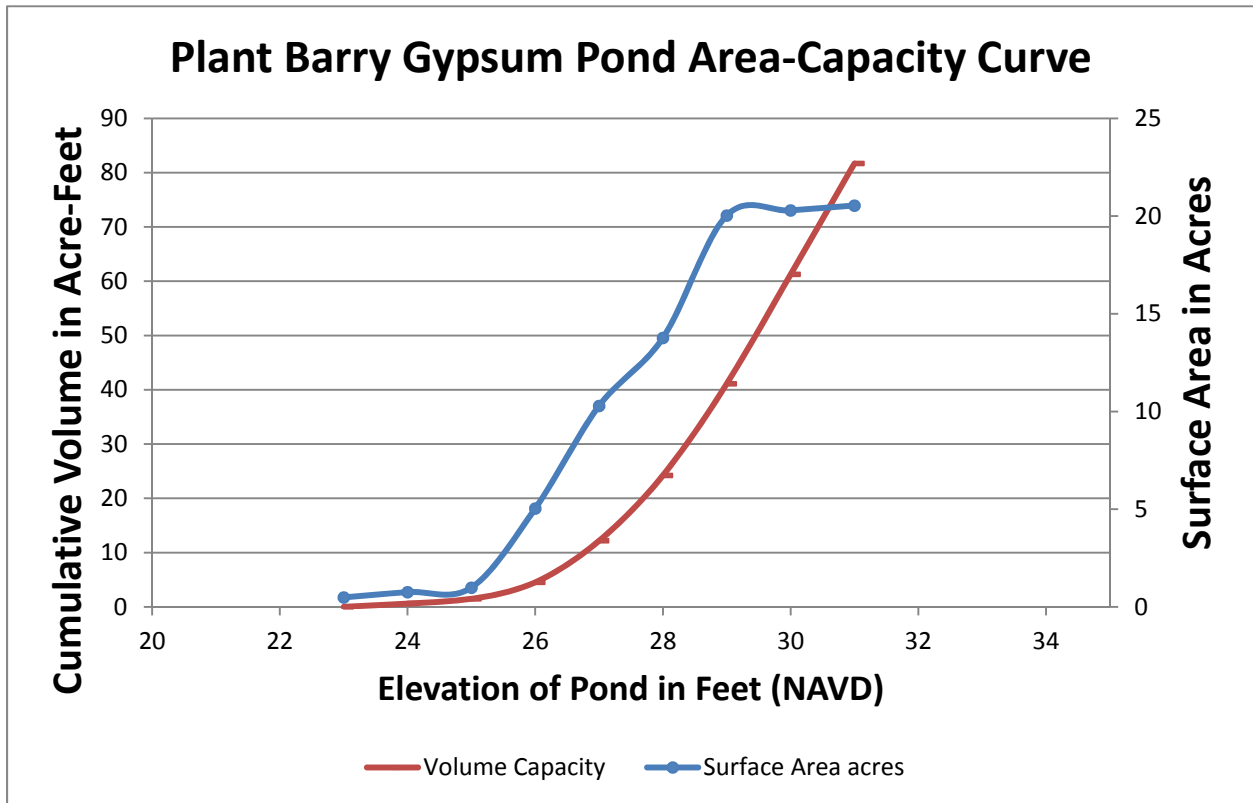
The following drawings reflecting the construction of the Plant Barry Gypsum Pond can be found in the Appendix:

- General Arrangement
- Gypsum Cell Detail Plan
- Sedimentation Pond Detail Plan
- Gypsum Cell Typical Sections
- Gypsum Cell Riser and Decant Pipe Sections and Details
- Gypsum Cell Sections and Details
- Gypsum Cell Detail Plans
- Gypsum Cell Miscellaneous Sections and Details
- Operations and Construction Perimeter Rim Ditch Plan

**(viii) Description of Instrumentation:**

There is currently no instrumentation associated with the Plant Barry Gypsum Pond.

**(ix) Area-capacity curves:**



**(x) Spillway/Diversion design features and capacity calculations:**

The Gypsum Pond receives sluiced flows for gypsum transport as well as rainfall that falls within the limits of the surface impoundment. Stormwater is temporarily stored within the limits of the surface impoundment and discharged through a 6-foot square concrete riser connected to a 36-inch diameter HDPE pipe that discharges into the sedimentation pond. During the design storm, this pipe has a maximum capacity of 177 cfs. Decant water from the Gypsum Pond is collected in the sedimentation basin before being routed to and collected in the Plant Barry Ash Pond. The pond has a capacity of 81.7 acre-feet above the normal operating pool of 23.0 feet MSL. Rainfall volume during the 100-year, 24-hour storm event is 23.5 acre-feet.

**(xi) Provisions for surveillance, maintenance and repair:**

Inspections of dams and dikes are critical components and are conducted on a regular basis—at least annually by professional dam safety engineers and at least weekly by trained plant personnel. In addition, inspections are performed after unusual events such as storms. The inspections provide assurance that structures are sound and that action is taken, as needed, based on the findings. Safety inspections include numerous checklist items. Specific items vary from site to site but may include observations of such things as pond levels, weather conditions, rainfall since the prior inspection, conditions of slopes and drains, erosion, animal damage, ant hills, alignment of retaining structures and more. Dam safety engineers assess any maintenance or remediation performed since the previous inspection, check the status of work

recommended at prior inspections, ensure that the posting of emergency notification information is up to date and evaluate any items noted during plant personnel inspections.

***Construction specifications:***

The following specifications relevant to the construction of the Plant Barry Gypsum Pond can be found in the Appendix:

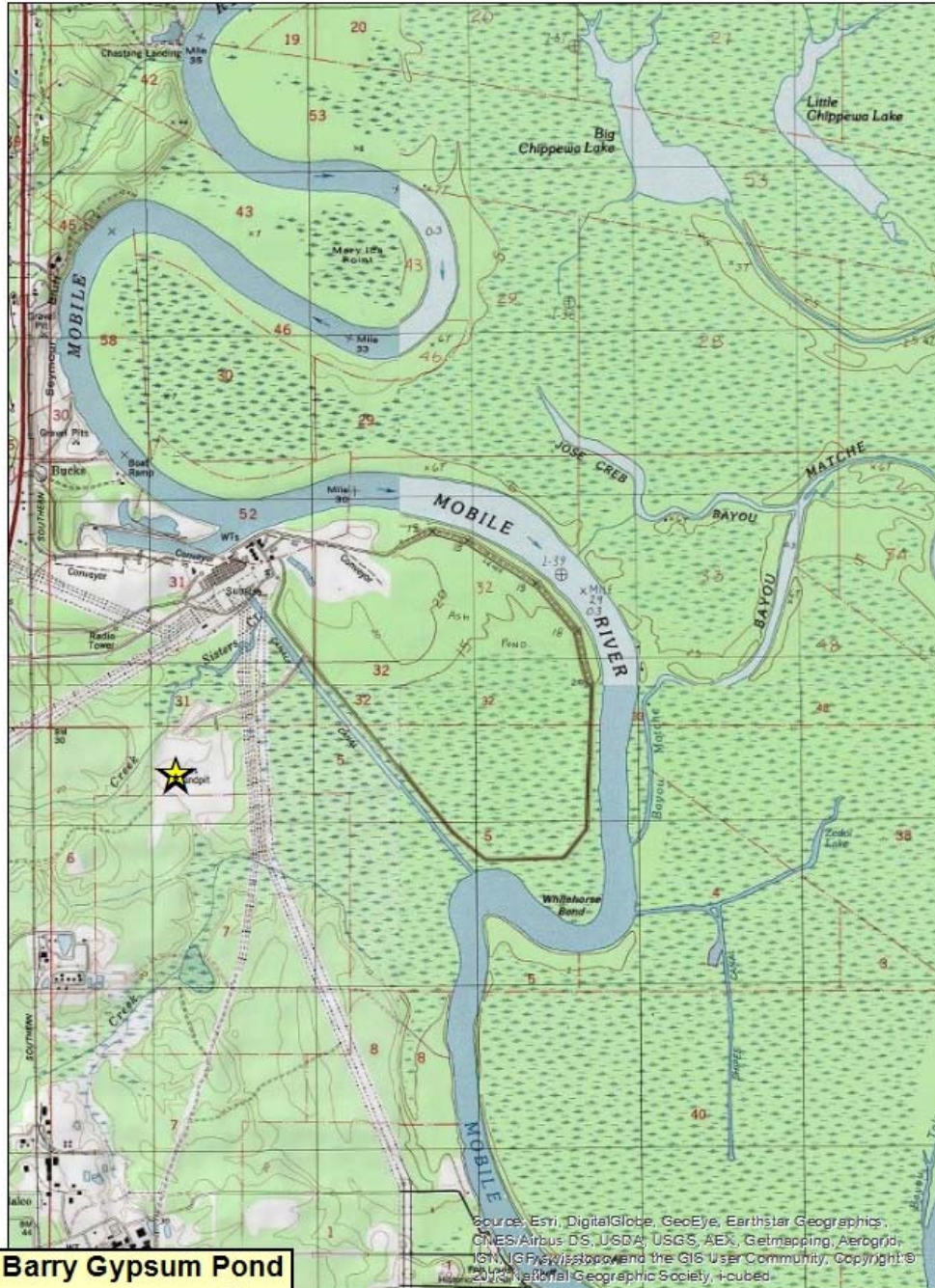
- Technical Specifications for Construction of Gypsum Cell, Sedimentation Pond and Emergency Gypsum Slurry Pond

***(xii) Known record of structural instability:***

There are no known instances of structural instability at the CCR unit.



## **Appendix**

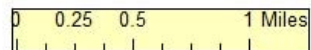


**Plant Barry Gypsum Pond**

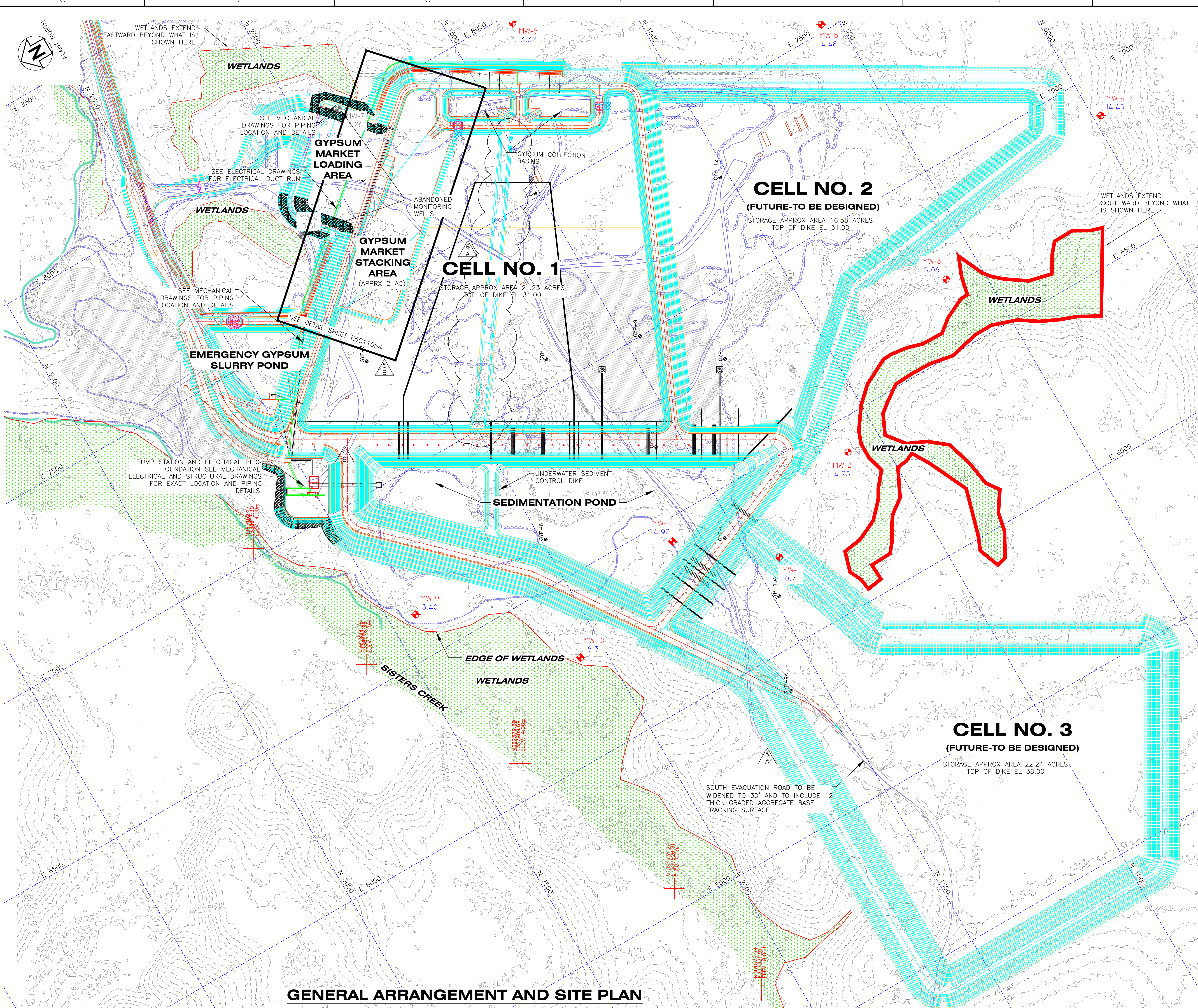
★ Pond Location

USA Topo Maps

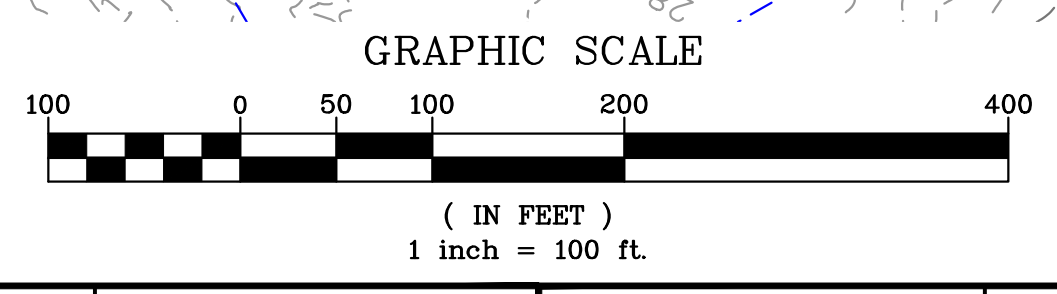
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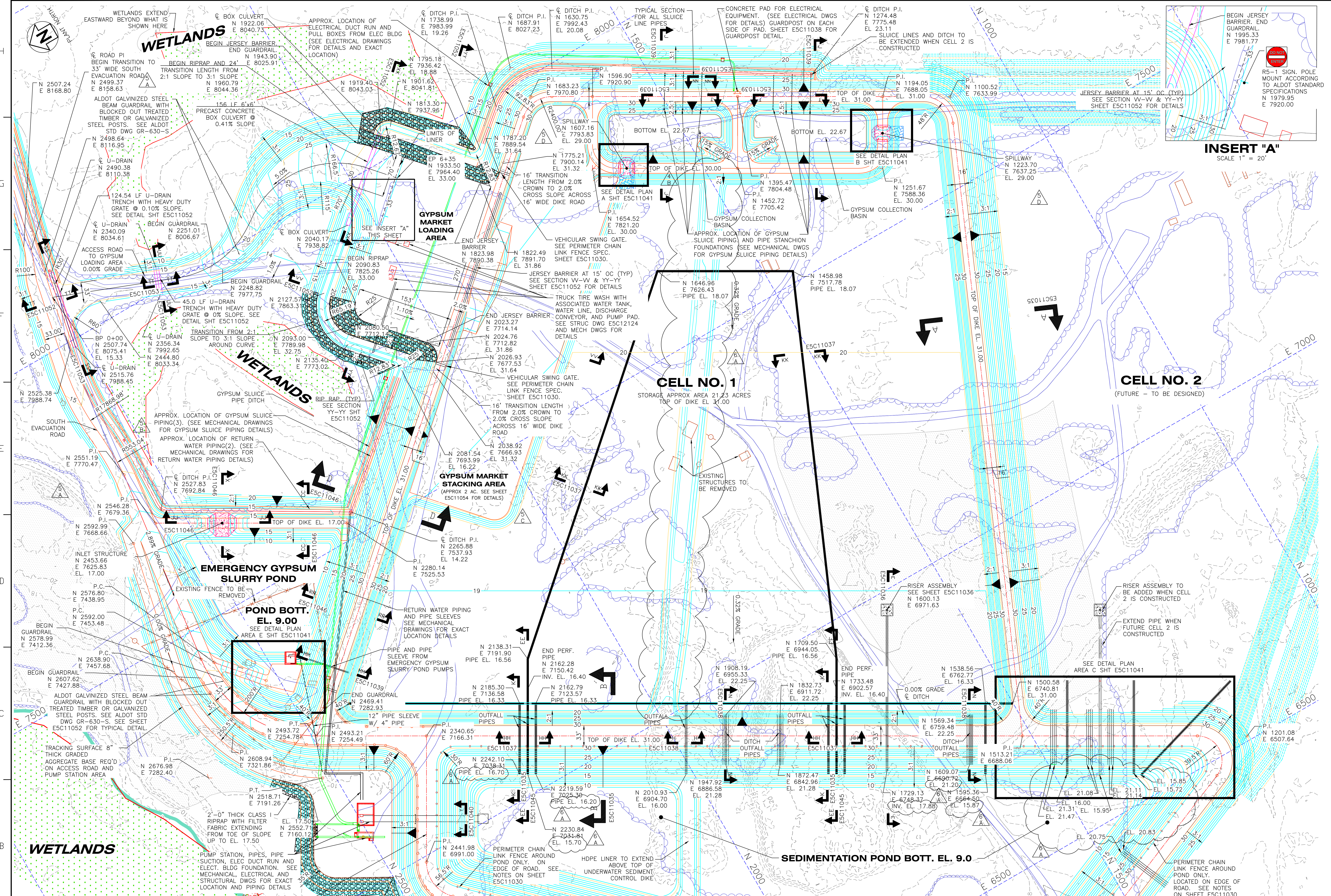
**GENERAL ARRANGEMENT AND SITE PLAN**



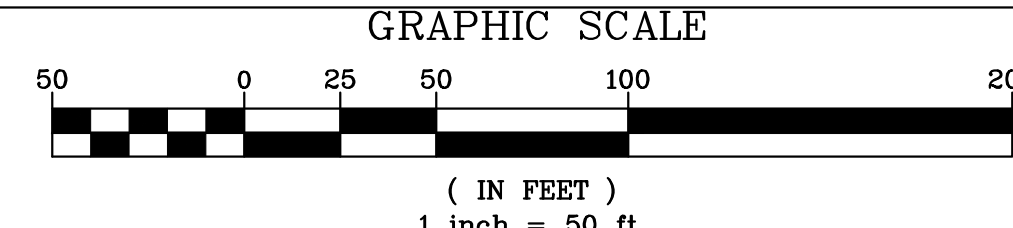
- NOTES:**
- GRID LINES AND COORDINATES SHOWN ARE IN PLANT GRID.
- LEGEND:**
- MW-1 10.71 MONITORING WELLS

REVISION	DATE	REVISION 6	DATE	REVISION 5	DATE	REVISION 4	DATE	REVISION 3	DATE	REVISION 2	DATE	REVISION 1	DATE	REVISION 0	DATE
		A. ADDED AS-BUILT CONDITIONS	12-19-11	A. C-4 CHANGED GAB TO 12" AREA B. G-6 ADDED GYPSUM MARKET LOADING AREA AND GYPSUM MARKET STACKING AREA	08-14-09	A. G-7 ADDED GYPSUM MARKET LOADING AREA B. E-6 ADDED ALDOT STANDARD GUARDRAIL	07-02-09	A. G-7 ADDED ELECTRICAL DUCT	03-05-09	ISSUED FOR CONSTRUCTION GENERAL REVISION	11-14-08	ISSUED FOR CONSTRUCTION GENERAL REVISION	04-11-08	ISSUED FOR CONSTRUCTION	12-3-07
BY		BY		BY		BY		BY		BY		BY		BY	
CSM	DPK	JBS		EEU	PMG	BRH	JTM	KAH	TDU	CKT	JWM	PMG	BRH	JTM	KAH
ECS5517		ECS5517		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE	
<p style="text-align: center;"><b>Alabama Power Company</b></p> <p style="text-align: center;">PLANT BARRY UNIT 5 GYPSON STORAGE AREA GENERAL ARRANGEMENT AND SITE PLAN CELL NO. 1 THROUGH CELL NO. 3</p> <p style="text-align: right;">SCALE: 1"=100' DRAWING NUMBER: <b>E5C11032</b> SHEET: 1 CONT'D: 6 REV: FINAL</p>															





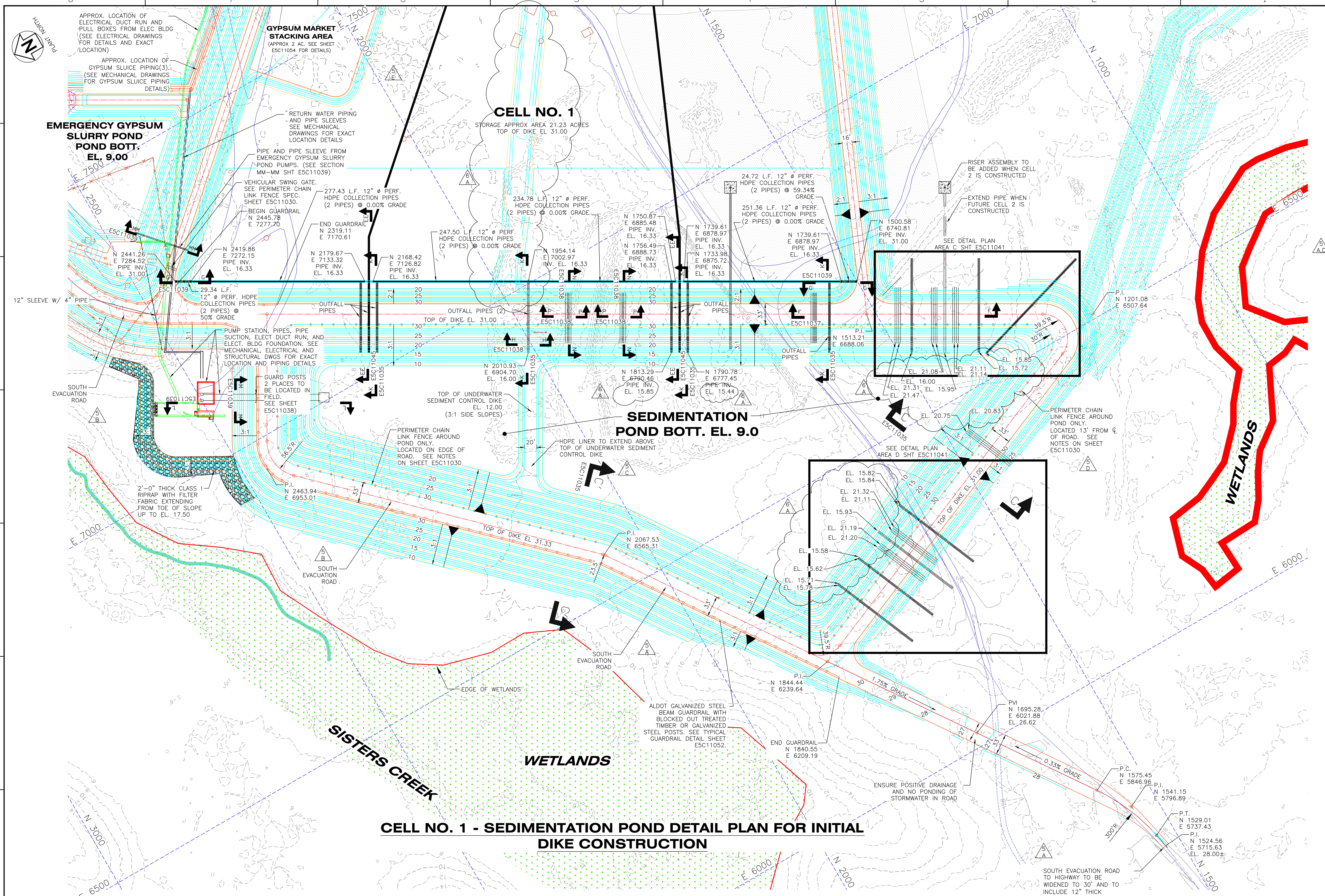
**CELL NO. 1 - DETAIL PLAN FOR INITIAL DIKE CONSTRUCTION**



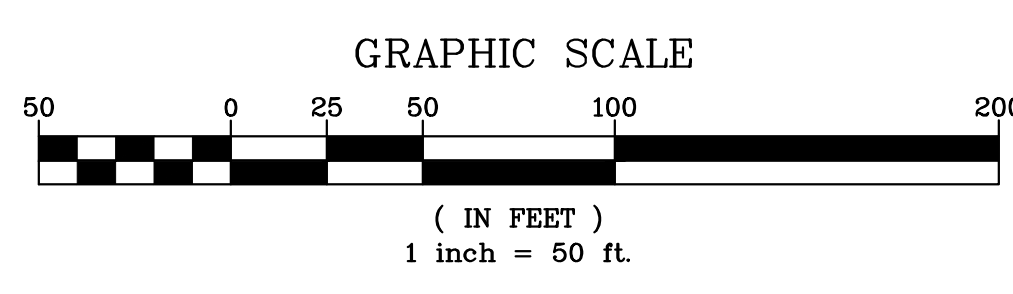
NOTES:  
1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

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REVISION 6	12-19-11	REVISION 5	08-14-09	REVISION 4	07-02-09	REVISION 3	03-05-09	REVISION 2	11-14-08	REVISION 1	4-11-08	REVISION 0	12-3-07			
A. ADDED AS-BUILT CONDITIONS		A. A-7, E-8, H-8, ADDED SOUTH EVACUATION ROAD NOTE		A. G-6, H-1 ADDED GYPSUM MARKET LOADING AREA		A. D-6 ADDED PIPE SLEEVES AND PIPING		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION GENERAL REVISION		Alabama Power Company		
B. H-8, CHANGED RADIUS		B. H-8, CHANGED RADIUS		B. G-6, C-6, C-7 ADDED GUARDRAIL		B. G-6 ADDED ELECT DUCT RUN								PLANT BARRY UNIT 5		
C. F-5 ADDED GYPSUM MARKET STACKING AREA		C. F-5 ADDED GYPSUM MARKET STACKING AREA		C. G-5 CHANGED SPILLWAY LOCATION		C. H-4 ADDED PIPES, CONCRETE PAD, AND GUARDPOSTS								CELL NO. 1 - DETAIL PLAN FOR INITIAL DIKE CONSTRUCTION		
D. G-3, G-5 REVISED SPILLWAY COORDINATES AND ELEVATIONS		D. G-3, G-5 REVISED SPILLWAY COORDINATES AND ELEVATIONS				D. B-6 ADDED ELECT DUCT RUN								DRAWING NUMBER: E5C11033		
						E. C-6 ADDED PIPE SLEEVE AND PIPING								SHEET: 1		
														CONT'D: 6		





**CELL NO. 1 - SEDIMENTATION POND DETAIL PLAN FOR INITIAL DIKE CONSTRUCTION**



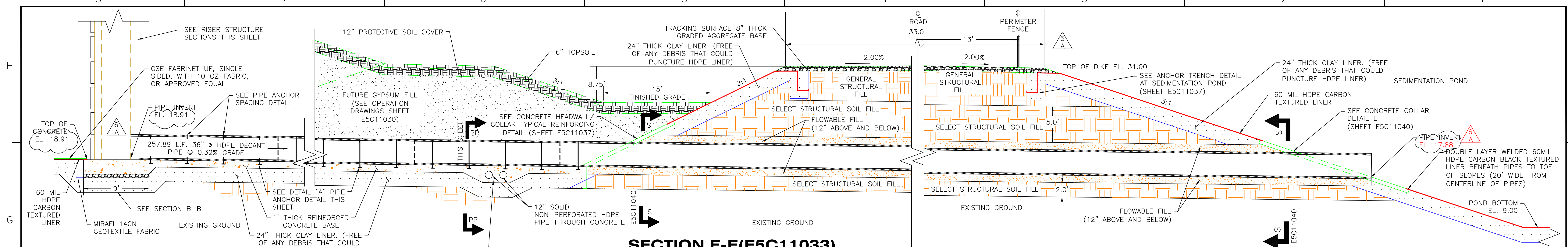
NOTES:  
1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	
6	12-19-11	5	08-14-09	4	07-02-09	3	03-05-09	2	11-14-08	1	04-11-08	0	12-03-07	Southern Company Generation Engineering and Construction Services FOR		
A. ADDED AS-BUILT CONDITIONS		A. B-2 CHANGED GAB TO 12"		A. C-4, F-7 ADDED GUARDRAIL AND SWING GATE		A. G-7 ADDED PIPE SLEEVES AND PIPING		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION		Alabama Power Company		
B. C-3, E-6, F-B, ADDED SOUTH EVACUATION NOTE.		B. C-3, E-6, F-B, ADDED SOUTH EVACUATION NOTE.		C. A-4, F-7 ADDED GUARDRAIL AND SWING GATE		B. H-7 ADDED ELECT DUCT RUN		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION		PLANT BARRY UNIT 5		
C. D-5, CHANGED SECTION C-C TO C'-C'		C. D-5, CHANGED SECTION C-C TO C'-C'		A. C-4, F-7 ADDED GUARDRAIL AND SWING GATE		C. B-6 ADDED ELECT DUCT RUN		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION		GYPSSUM STORAGE AREA		
D. E-2, REVISED DISTANCE TO CL		D. E-2, REVISED DISTANCE TO CL		A. C-4, F-7 ADDED GUARDRAIL AND SWING GATE		D. F-7 ADDED ELECT DUCT RUN AND EDITED NOTE		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION		CELL NO. 1-SEDIMENTATION POND DETAIL PLAN FOR INITIAL DIKE CONSTRUCTION		
E. H-7, ADDED GYPSUM MARKET STACKING AREA EWO 2161DE		E. H-7, ADDED GYPSUM MARKET STACKING AREA EWO 2161DE		A. C-4, F-7 ADDED GUARDRAIL AND SWING GATE		E. F-8 ADDED PIPE SLEEVE AND PIPING		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION		PROJECT		
EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		DRAWING NUMBER		
EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		SCALE		
EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		1"=50'		
EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		SHEET		
EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		1 FINAL		
EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		REV		
EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		EWO 2161DE		6		

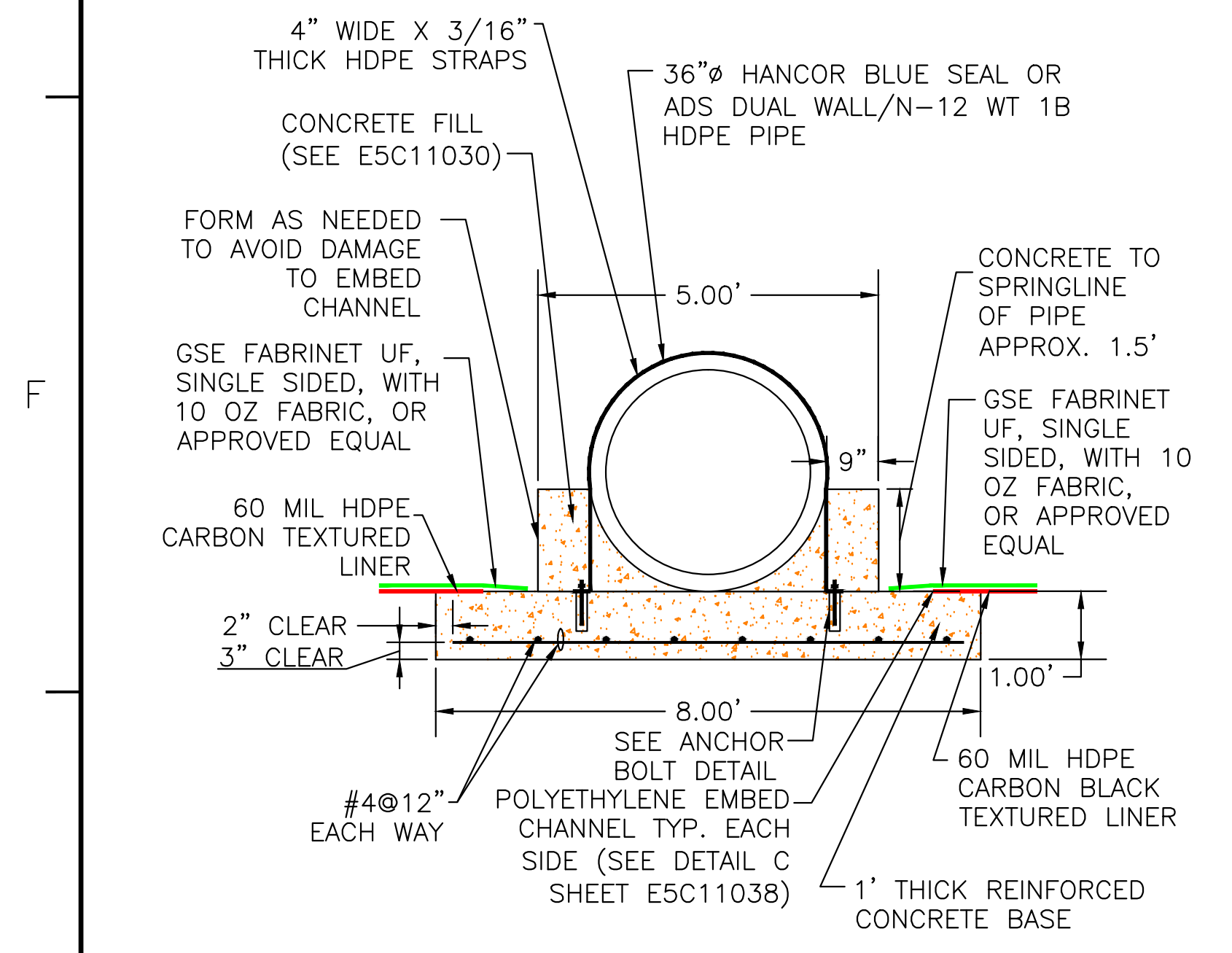




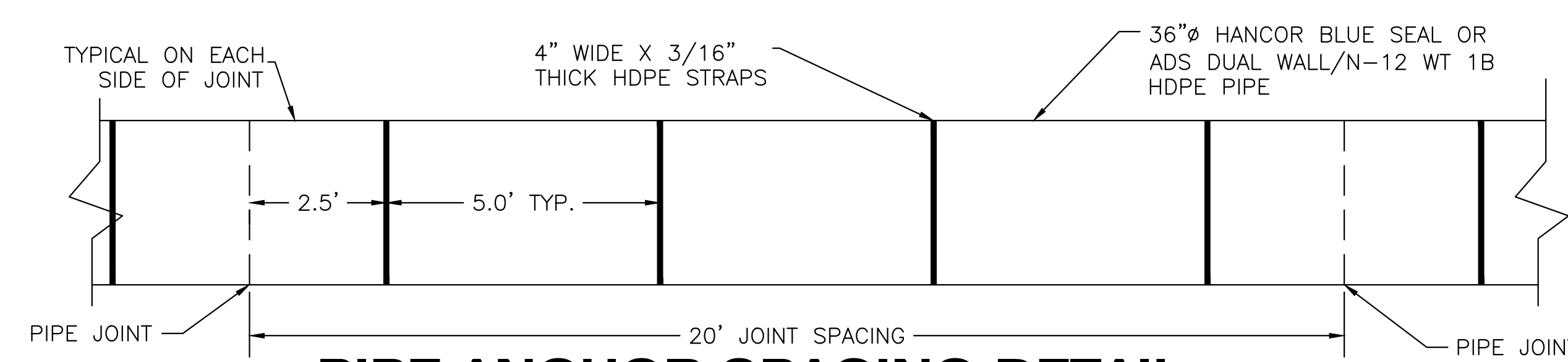




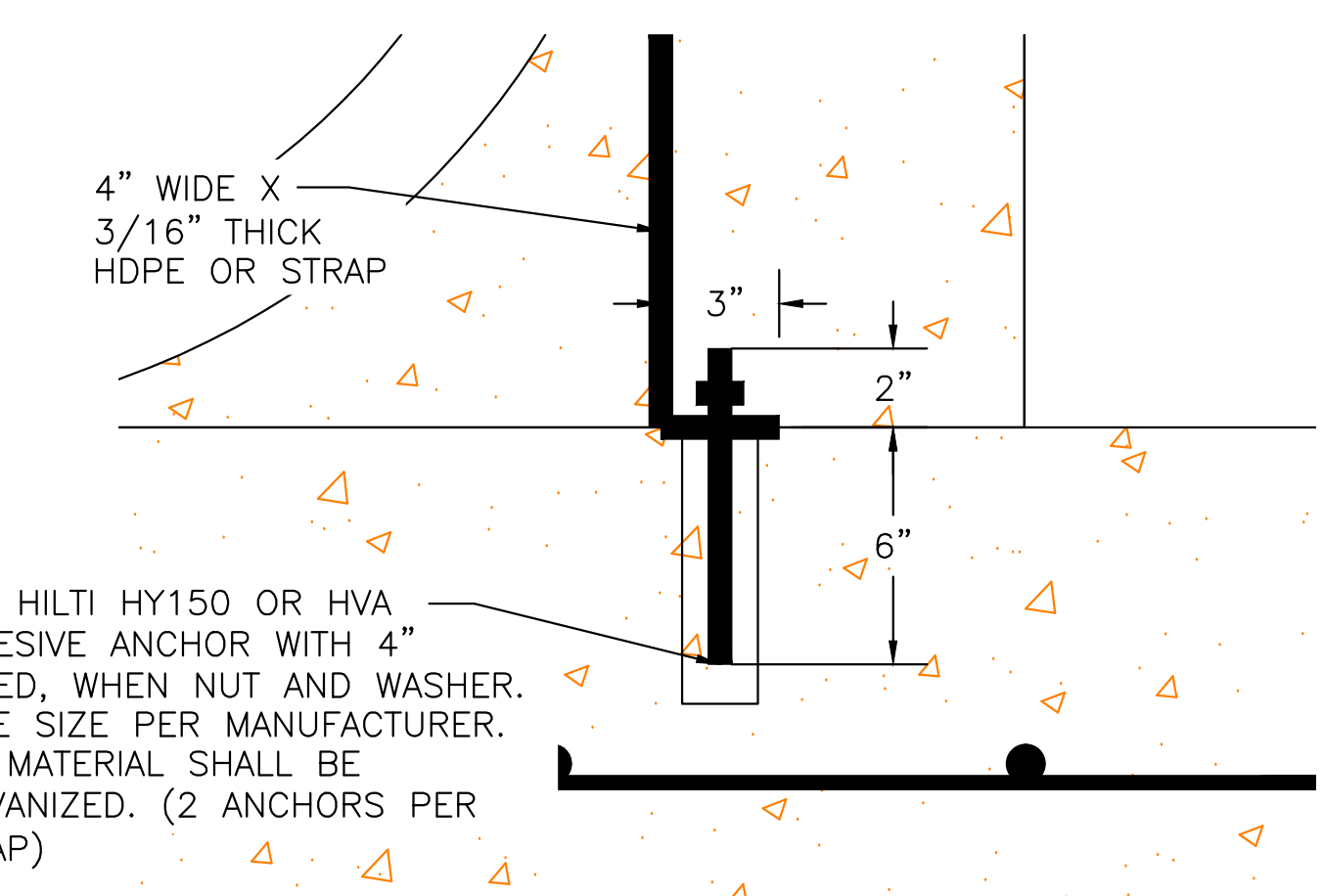
**SECTION E-E (E5C11033)  
CELL NO. 1 RISER STRUCTURE AND DECANT PIPE  
N.T.S.**



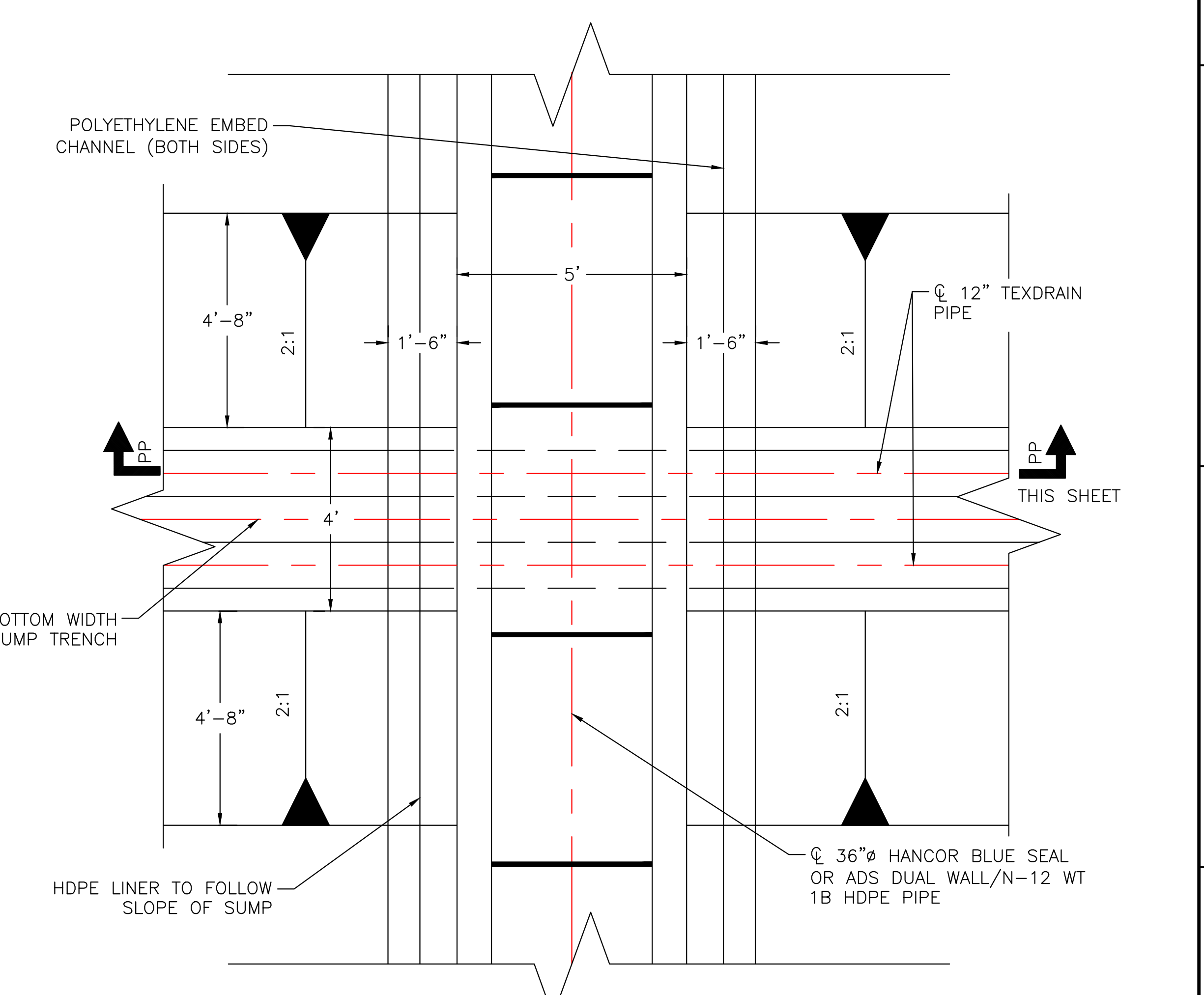
**DETAIL A  
PIPE ANCHOR DETAIL  
N.T.S.**



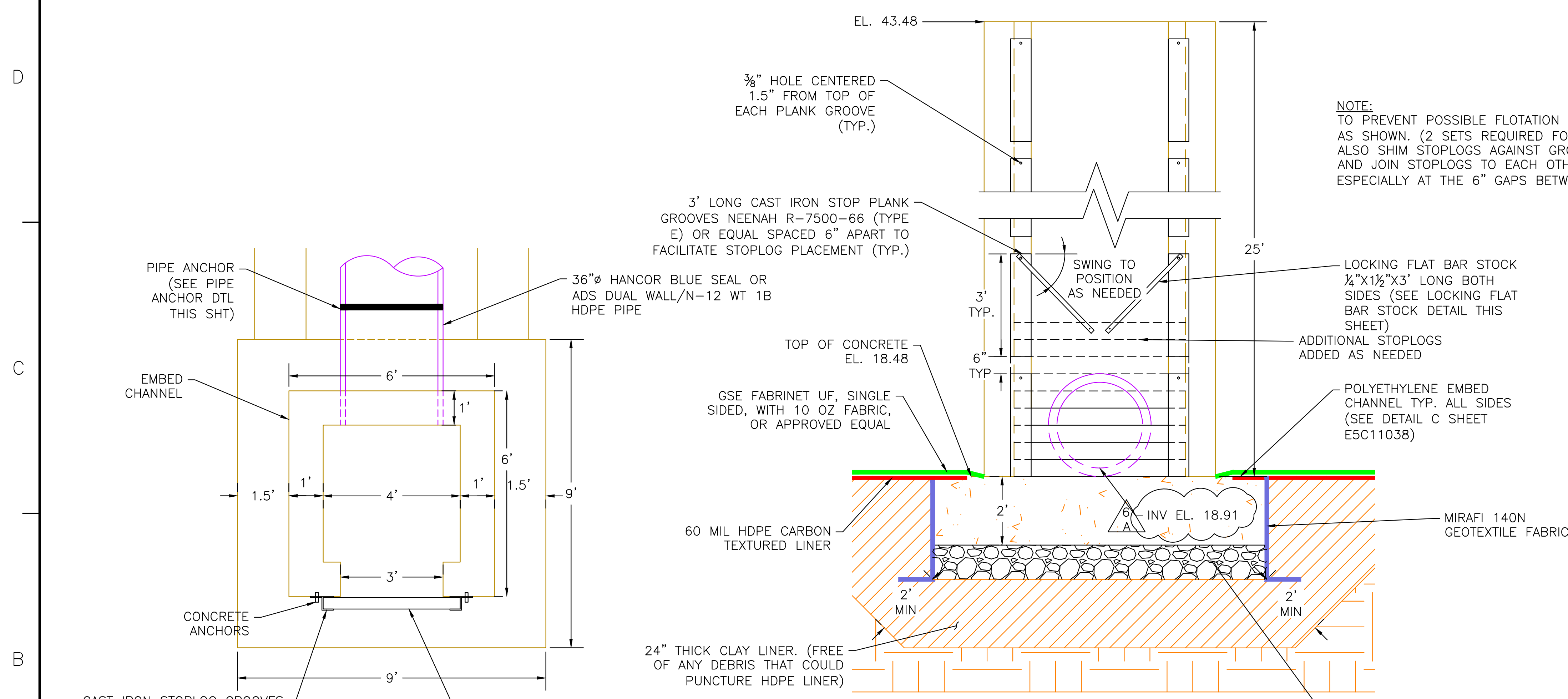
**PIPE ANCHOR SPACING DETAIL  
N.T.S.**



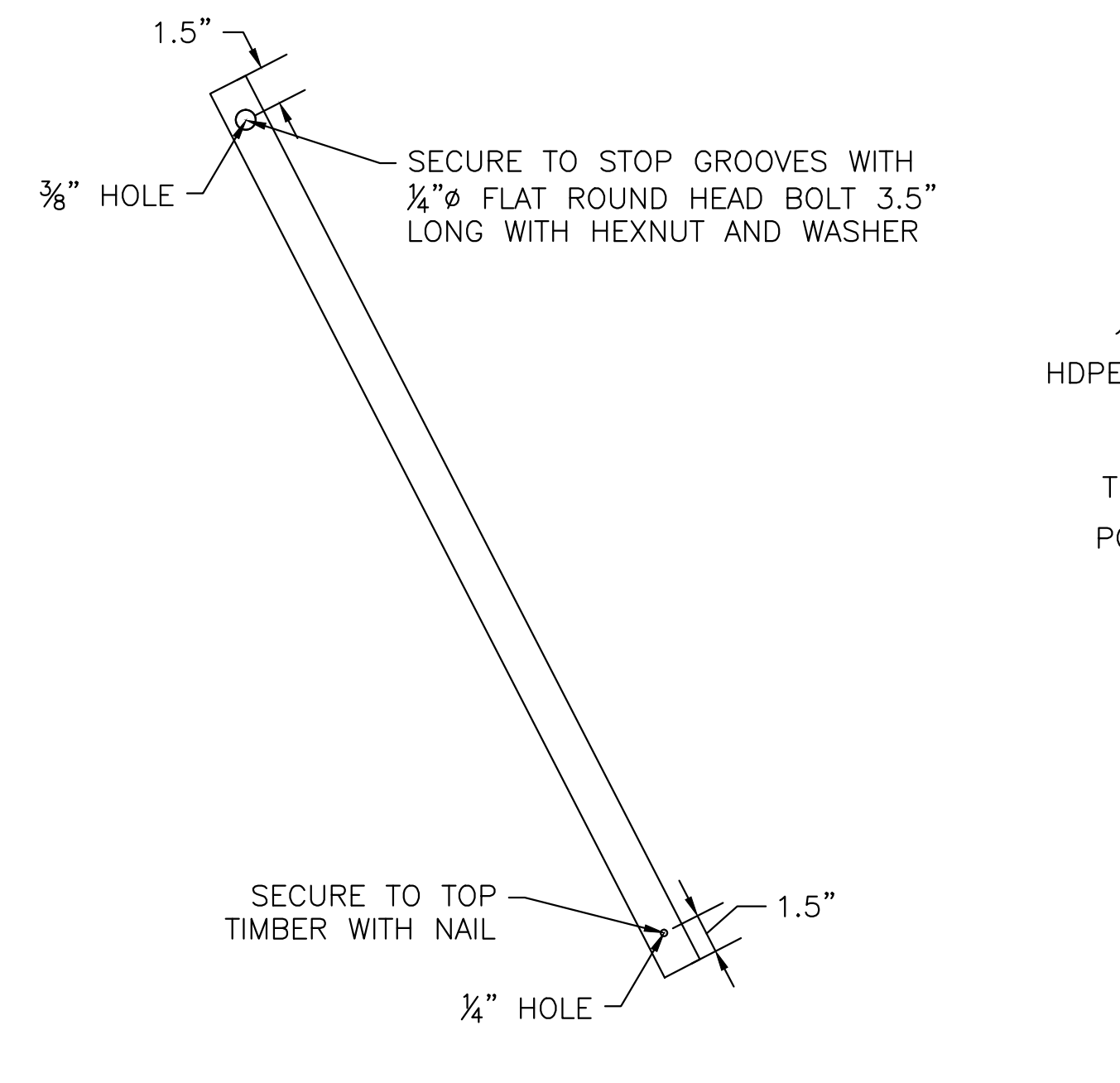
**ANCHOR BOLT DETAIL  
N.T.S.**



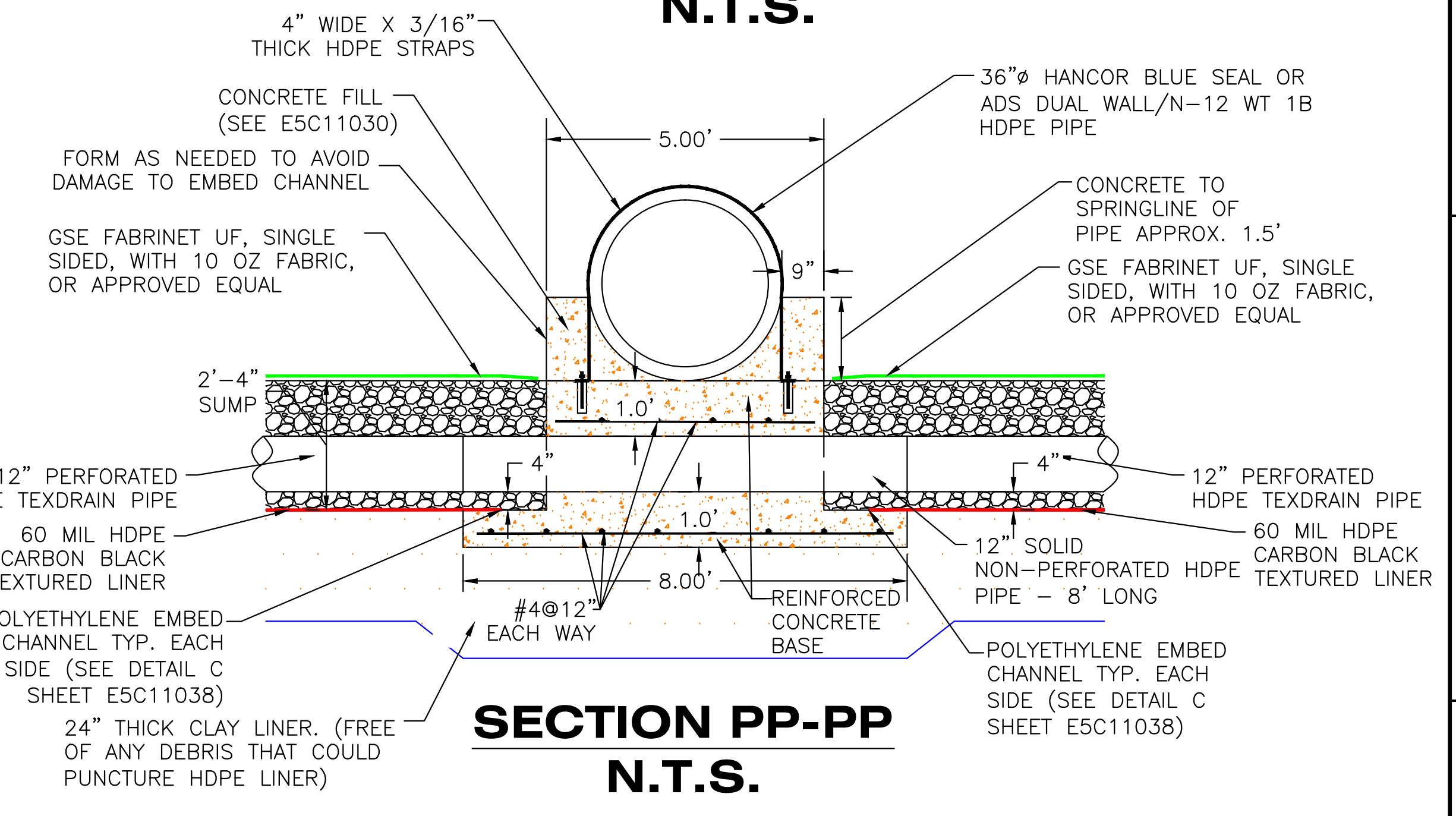
**SUMP/DECANT PIPE CROSSING PLAN VIEW  
N.T.S.**



**RISER STRUCTURE SECTION  
N.T.S.**



**LOCKING FLAT BAR STOCK DETAIL  
N.T.S.**

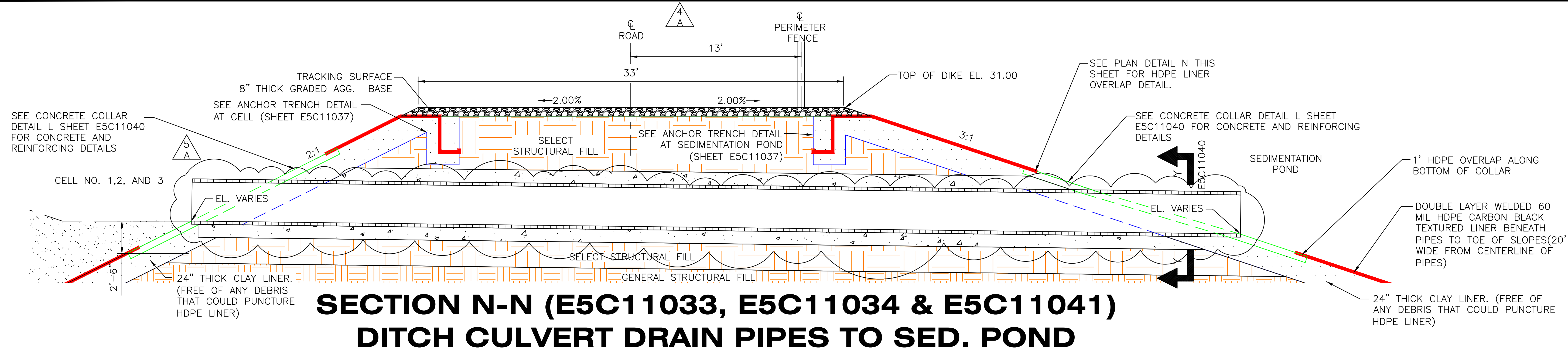


**SECTION PP-PP  
N.T.S.**

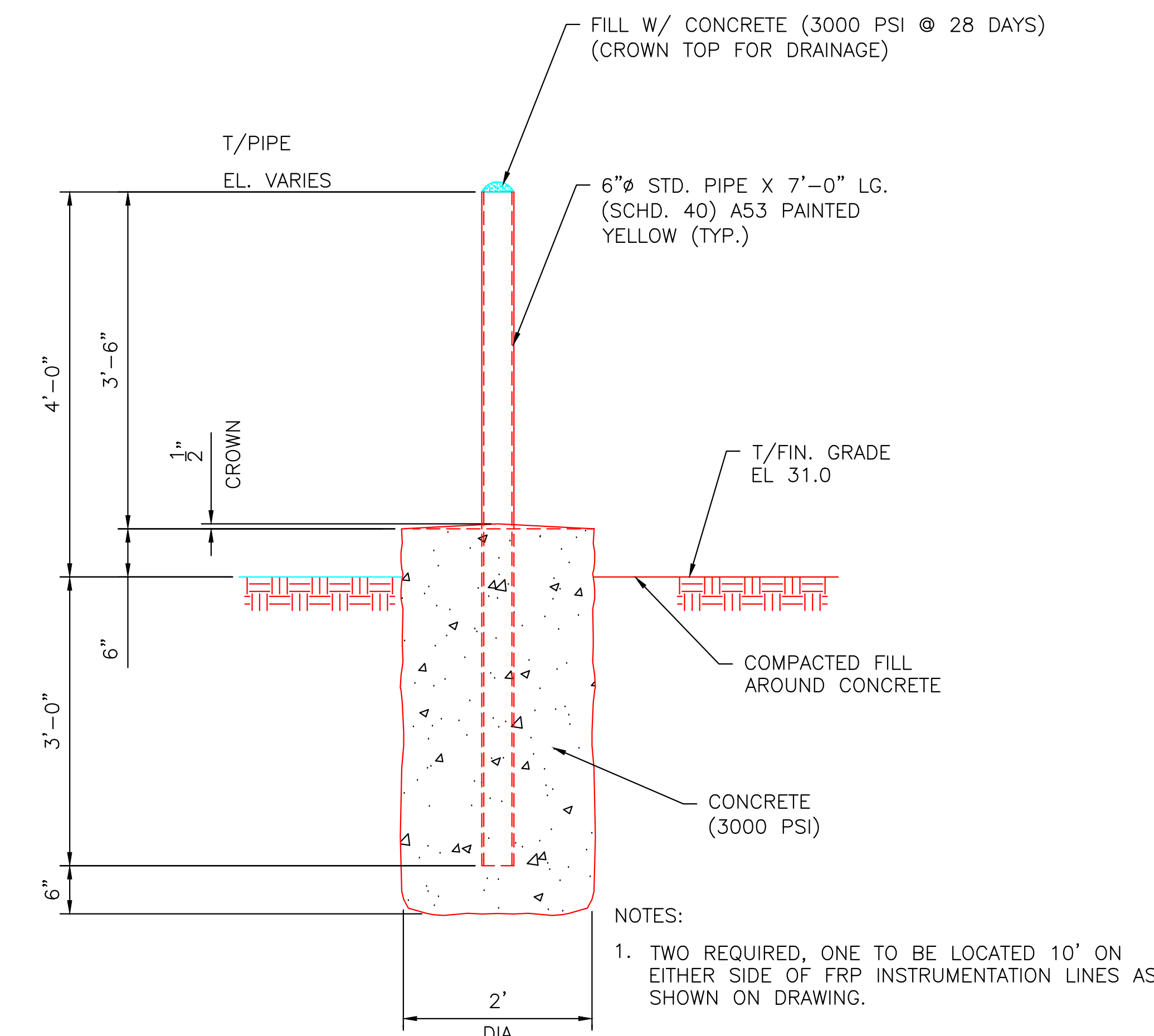
- NOTES:
- FOR DESCRIPTION AND CLASSIFICATION OF GENERAL STRUCTURAL FILL, SELECT STRUCTURAL FILL, CLEAN EARTH FILL, AND CLAY LINER MATERIAL SEE TECHNICAL SPECIFICATIONS.
  - ALL CONCRETE AND METAL THAT WILL BE EXPOSED TO OR IN CONTACT WITH GYPSUM AND/OR GYPSUM SLURRY WATER SHALL BE COATED WITH CHEMPURF 2410 LINING SYSTEM BY ATLAS MINERALS & CHEMICALS, INC. OR APPROVED EQUAL.
  - RISER STRUCTURE REINFORCEMENT SCHEDULE SEE SHEET E5C12122

REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE
REVISION 6	12-19-11	REVISION 5	8-14-09	REVISION 4	4-27-09	REVISION 3	03-05-09	REVISION 2	11-14-08	REVISION 1	04-11-08	REVISION 0	12-3-07	Southern Company Generation Engineering and Construction Services FOR			
A. ADDED AS-BUILT CONDITIONS		A. N-3 ADDED PERIMETER FENCE		GENERAL REVISION		A. G-3, F-7, F-8, E-5 REVISED SECTION D-D AND E-E TO SHOW CONCRETE COVER AND NOT FLOWABLE FILL ABOVE CUSTOM TEE, AND REVISED ELEVATIONS OF NYLOPLAST DRAIN BASIN TOPS AND PVC EXTENSIONS. ADDED COATING NOTE.		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION GENERAL REVISION		ISSUED FOR CONSTRUCTION		Alabama Power Company			
ECS5517														PLANT BARRY UNIT 5 GYPSUM STORAGE AREA CELL NO. 1 SECTIONS AND DETAILS RISER STRUCTURE AND DECANT PIPE			
EWO 2161DE														DRAWING NUMBER: <b>E5C11036</b>			
EWO 2161DE														SHEET: 1 OF 6			
EWO 2161DE														ANSI E: 44x34			

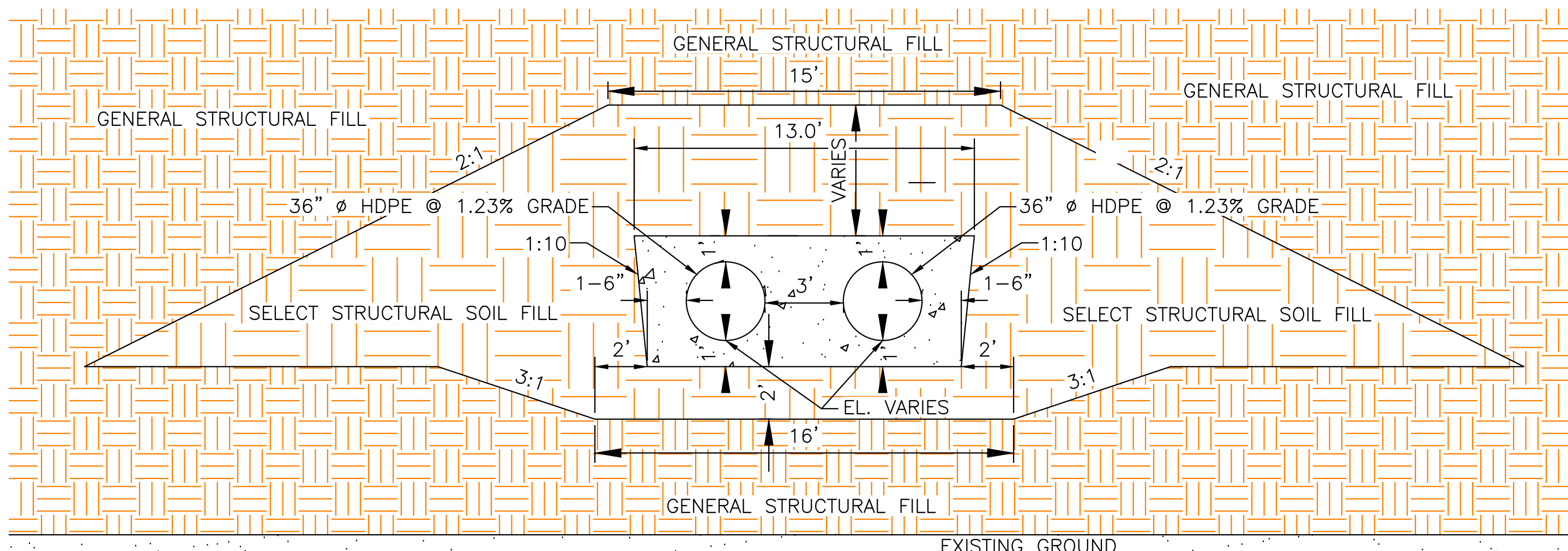




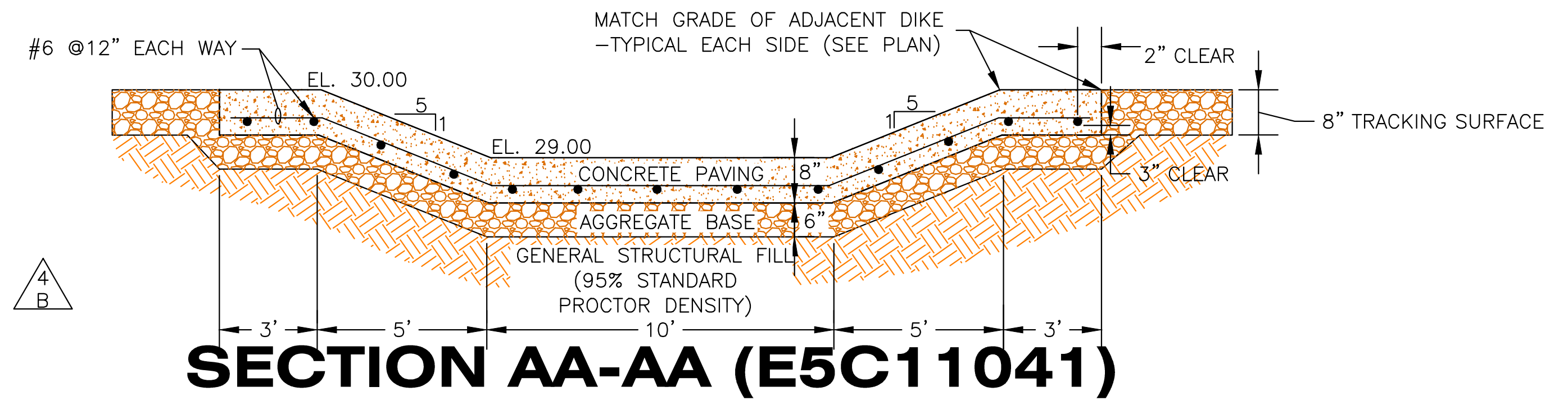
**SECTION N-N (E5C11033, E5C11034 & E5C11041)  
DITCH CULVERT DRAIN PIPES TO SED. POND**



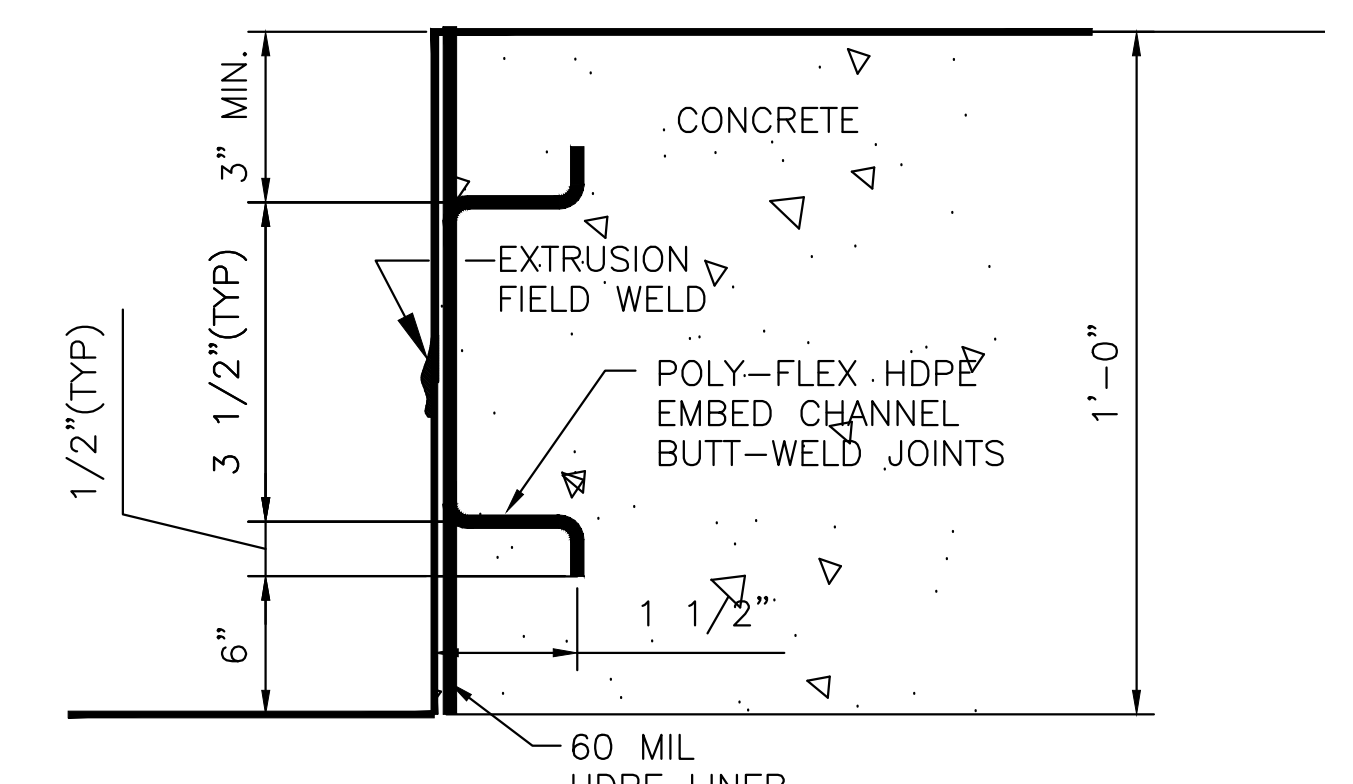
**TYP. GUARDPOST DETAIL**



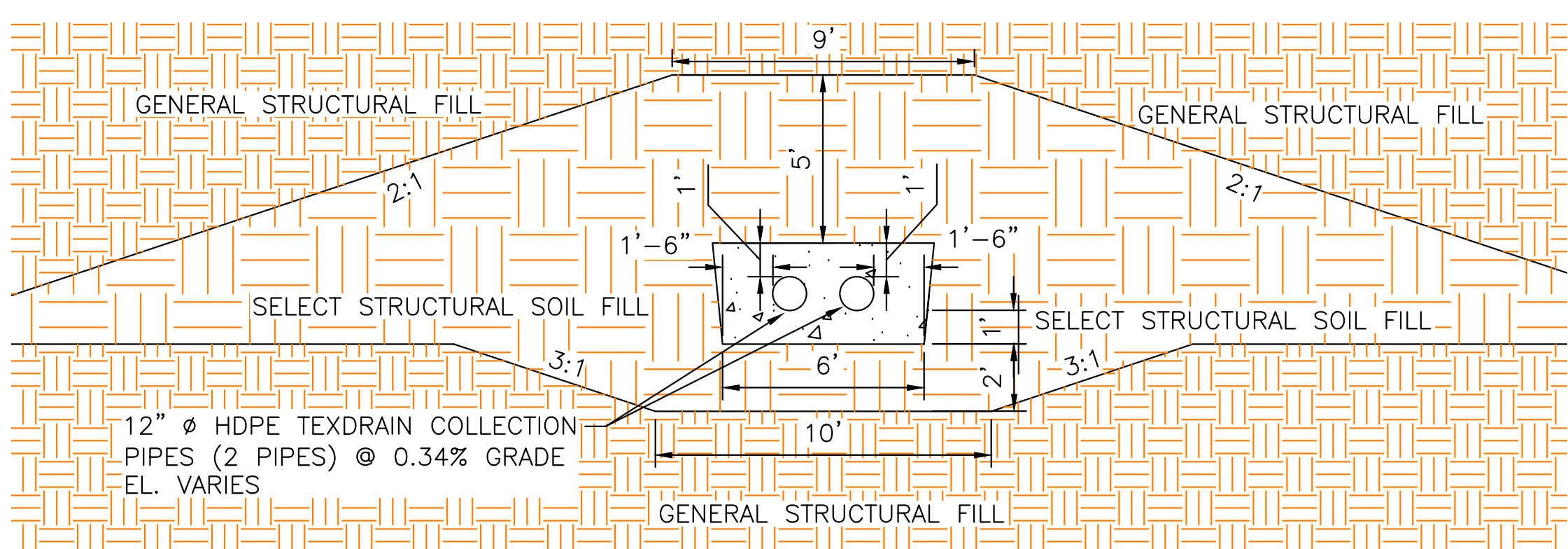
**SECTION P-P (E5C11034 & E5C11041)  
DITCH CULVERTS TO SEDIMENTATION POND**



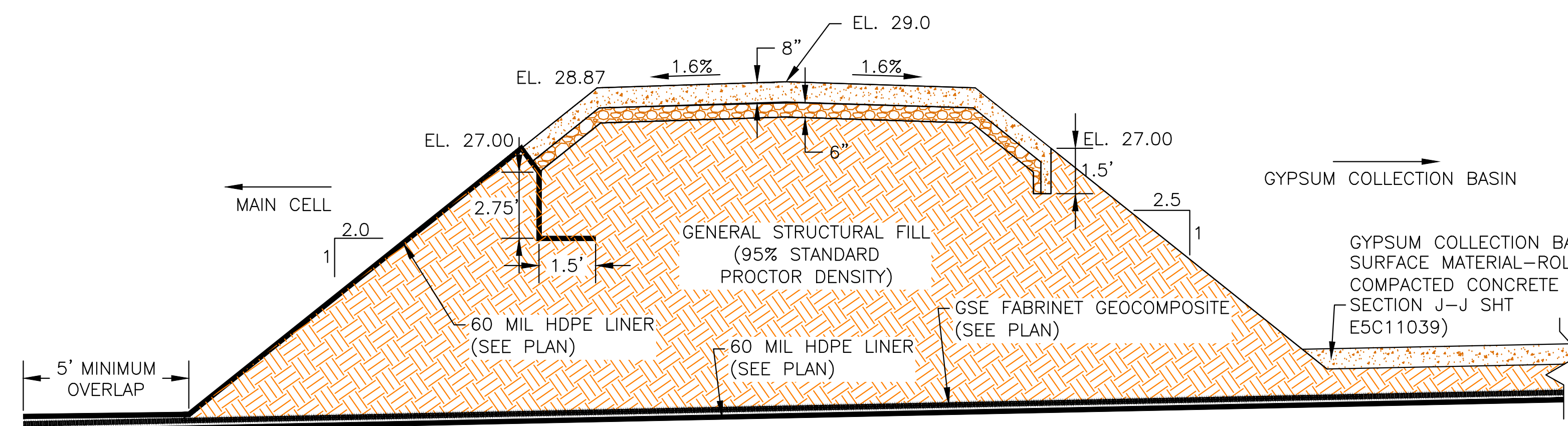
**SECTION AA-AA (E5C11041)**



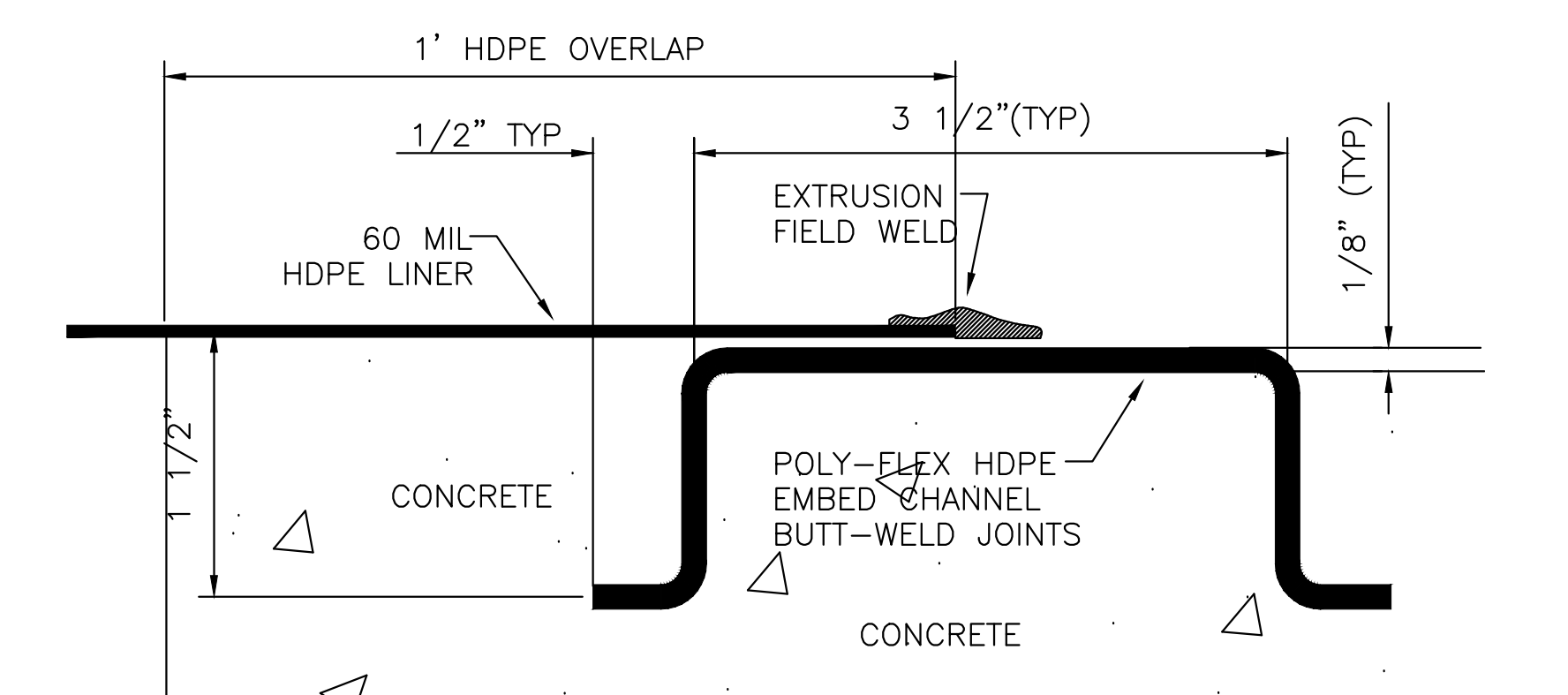
**DETAIL D POLYFLEX HDPE EMBED VERTICAL CHANNEL INSTALLATION**



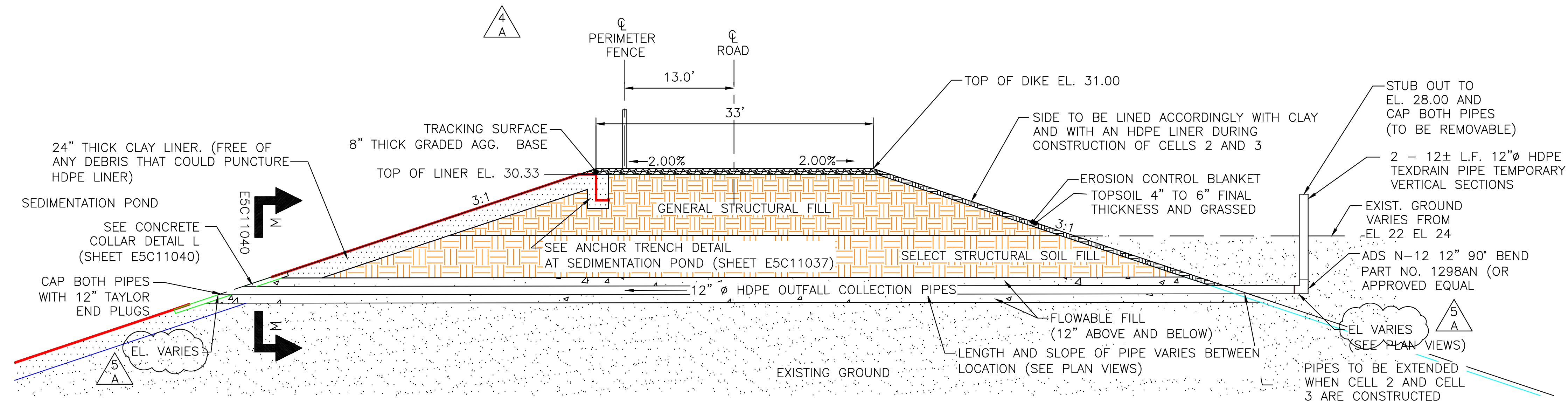
**SECTION H-H (E5C11033, E5C11034 & E5C11041)  
12\"/>**



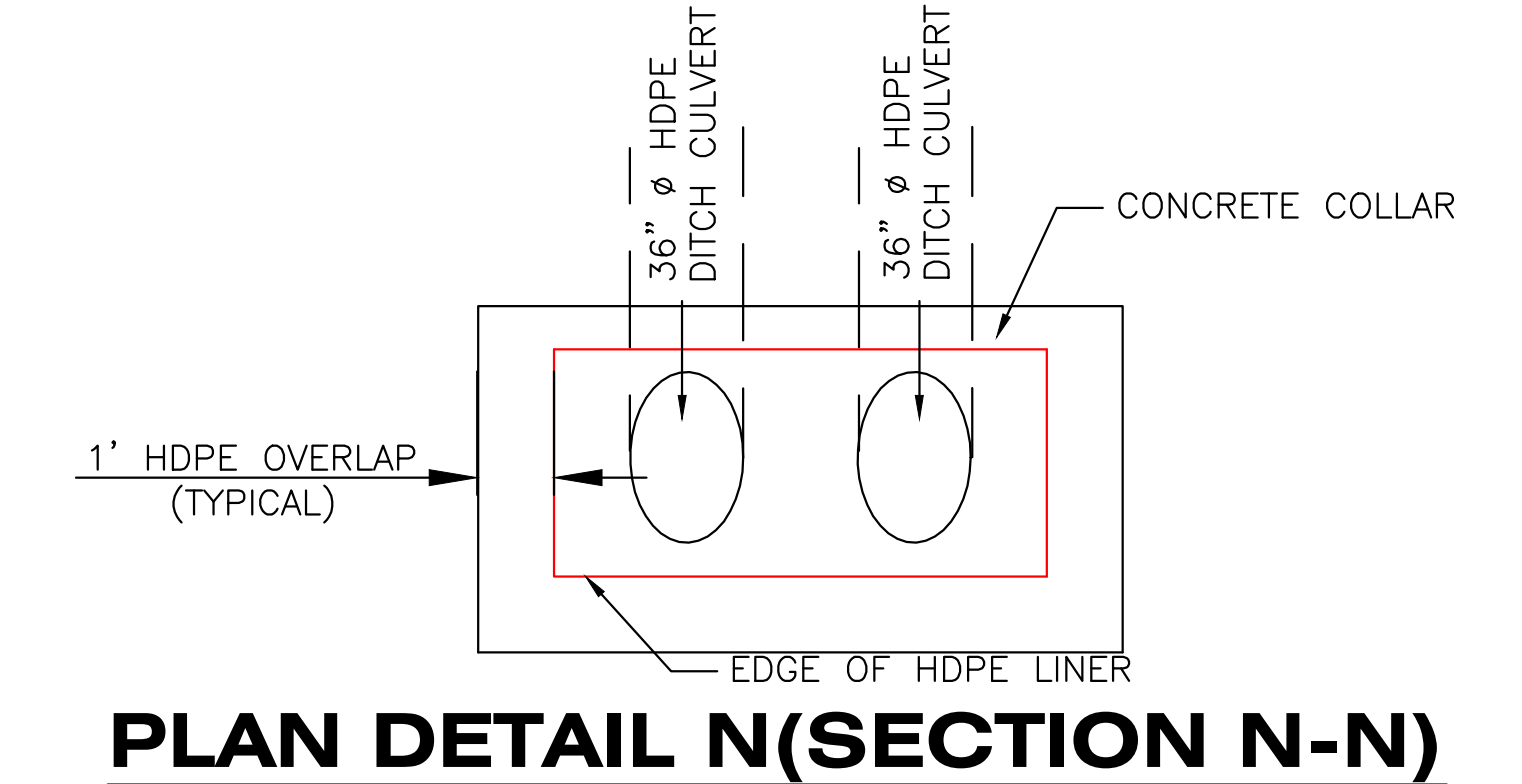
**SECTION BB-BB (E5C11041)  
GYPSUM COLLECTION BASIN  
SPILLWAY DETAIL  
N.T.S.**



**DETAIL C POLYFLEX HDPE EMBED HORIZONTAL CHANNEL INSTALLATION**



**SECTION Q-Q (E5C11041)  
OUTFALL COLLECTION PIPES TO FUTURE CELL NO. 2 AND TO FUTURE CELL NO. 3**



**PLAN DETAIL N (SECTION N-N)**

REVISION	DATE	REVISION	DATE	REVISION 5	DATE	REVISION 4	DATE	REVISION 3	DATE	REVISION 2	DATE	REVISION 1	DATE	REVISION 0	DATE													
				A. ADDED AS-BUILT CONDITIONS	12-19-11	A. C-7 & H-6 ADDED PERIMETER FENCE AND DIMENSIONS B. F-4 UPDATED ELEVATIONS	8-14-09	A. H-3 & H-8 CORRECTED CONCRETE COLLAR	3-5-09	ISSUED FOR CONSTRUCTION GENERAL REVISION	11-14-08	ISSUED FOR CONSTRUCTION GENERAL REVISION	04-11-08	ISSUED FOR CONSTRUCTION	12-3-07													
ECS5517																												
EWO 2161DE																												
EWO 2161DE																												
EWO 2161DE																												
EWO 2161DE																												
BY	CHK'D	CIVIL APPR	ELECT APPR	L/C APPR	MECH APPR	SECC NBR	BY	CHK'D	CIVIL APPR	ELECT APPR	L/C APPR	MECH APPR	SECC NBR	BY	CHK'D	CIVIL APPR	ELECT APPR	L/C APPR	MECH APPR	SECC NBR	BY	CHK'D	CIVIL APPR	ELECT APPR	L/C APPR	MECH APPR	SECC NBR	
							CSM	DPK	JBS																			
SCALE																												
DRAWING NUMBER																												
SHEET																												
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<b>E5C11038</b>																												

Southern Company Generation  
Engineering and Construction Services  
FOR

**Alabama Power Company**

PLANT BARRY UNIT 5  
GYPSON STORAGE AREA  
CELL NO. 1

ANSI E: 44x34  
Acad2004

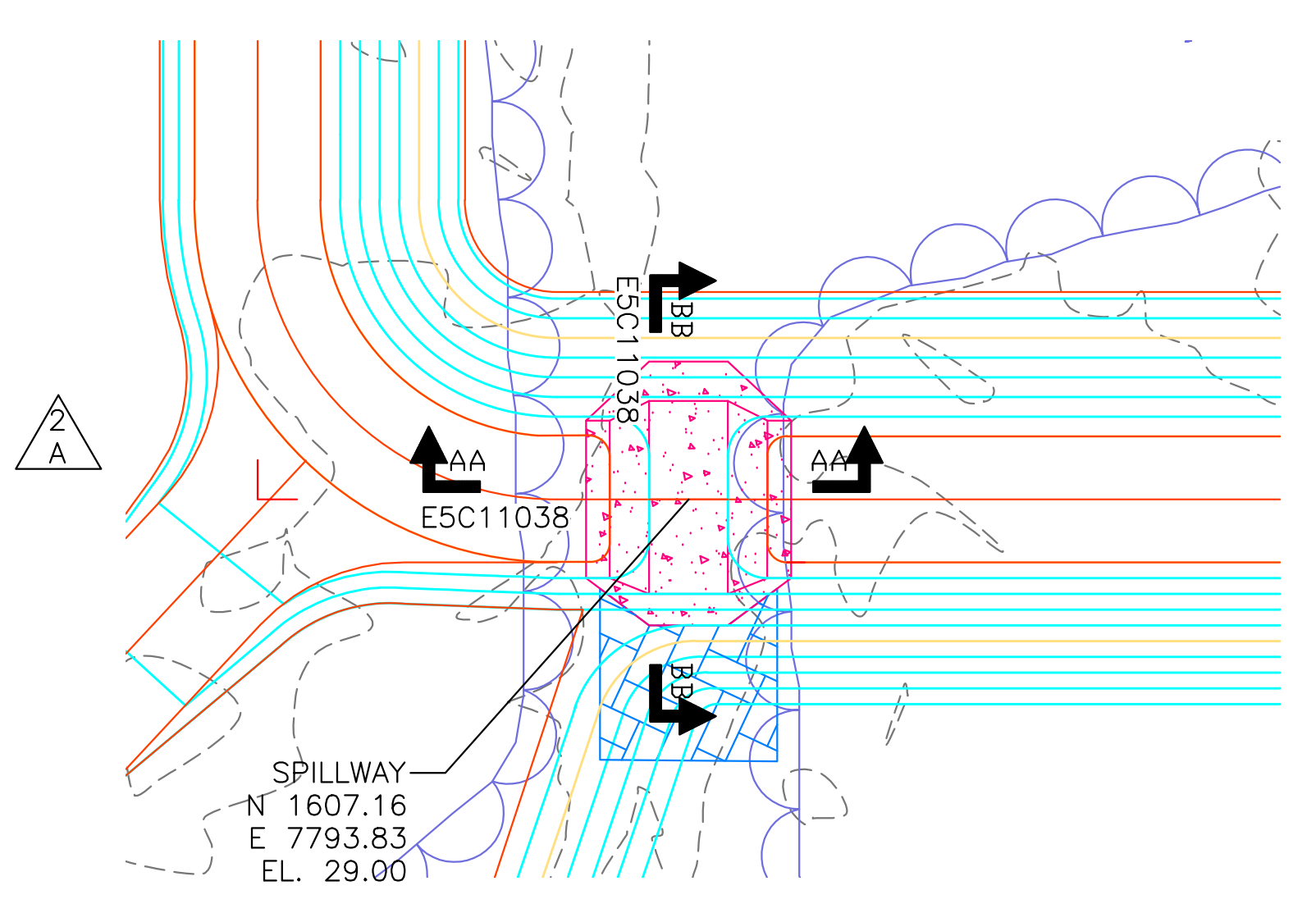




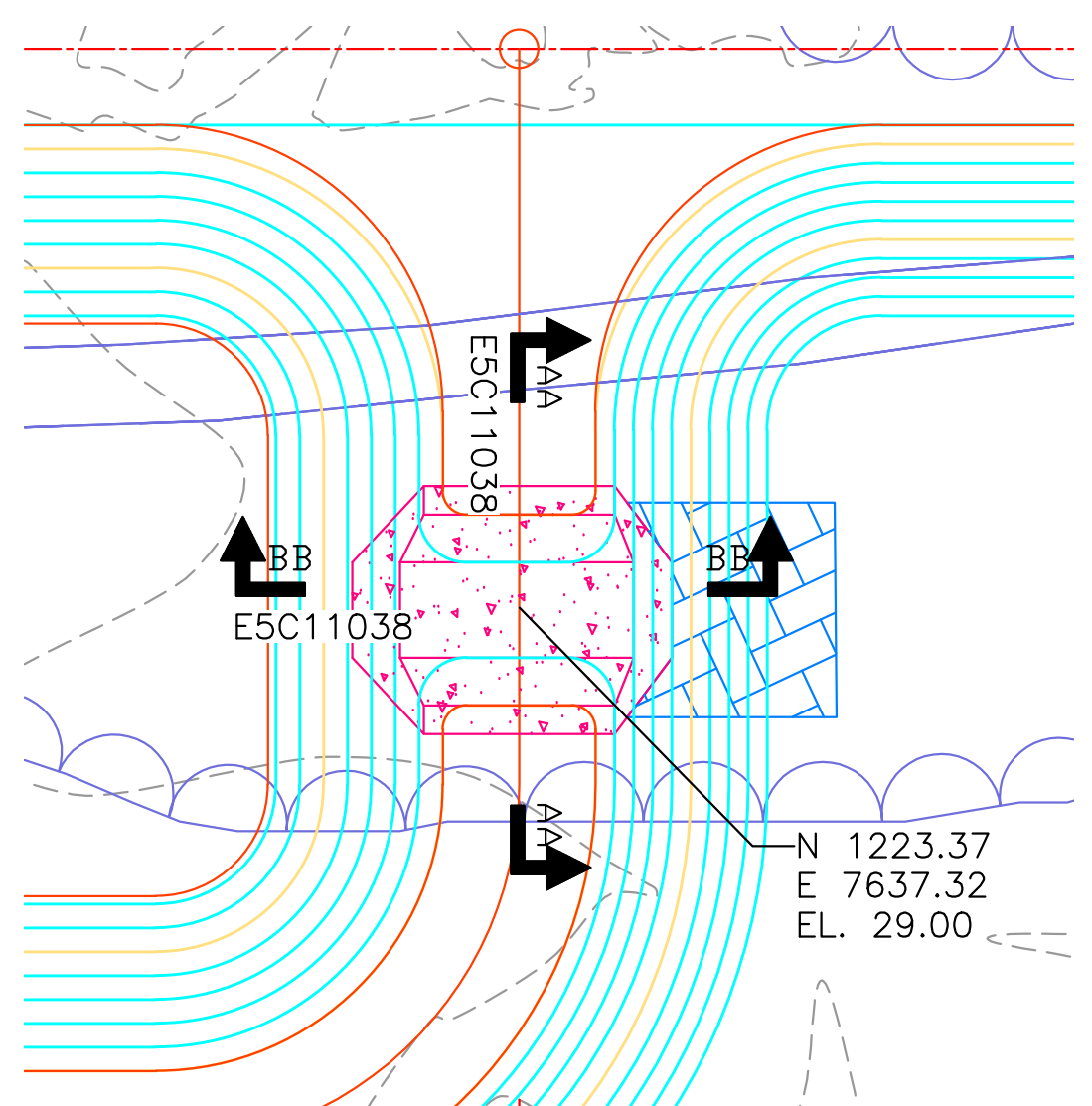




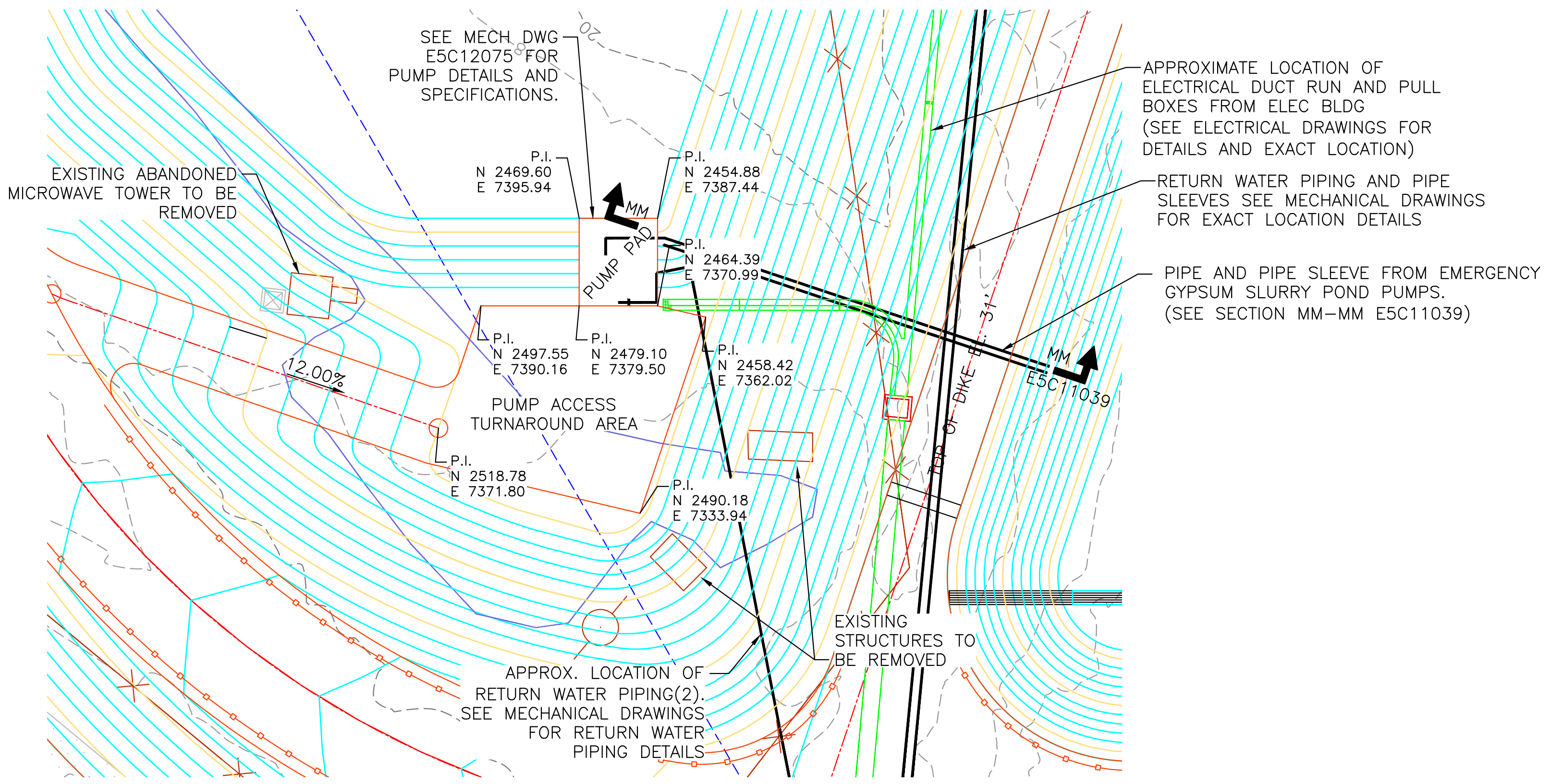




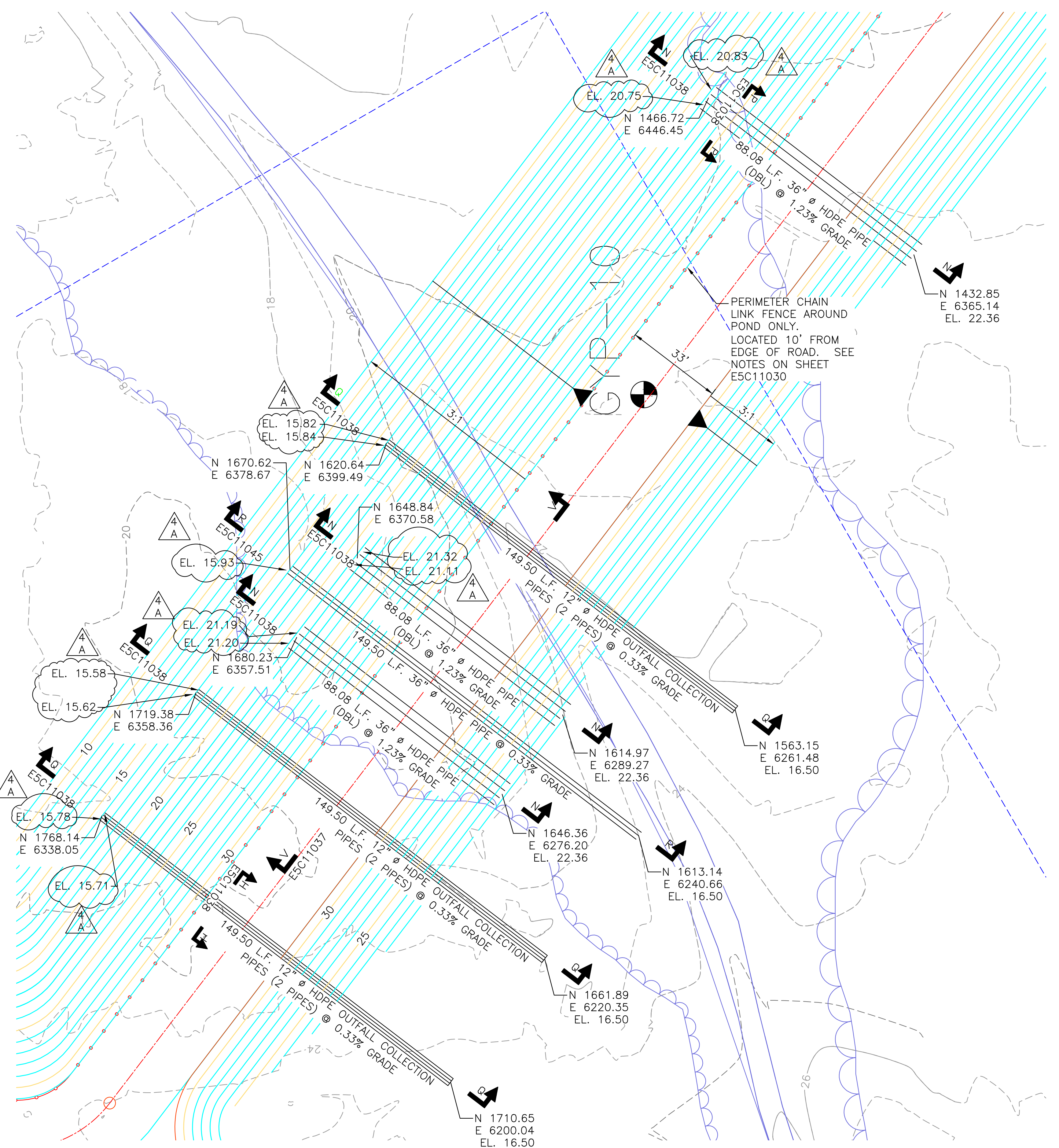
**DETAIL PLAN A**  
SCALE: 1"=20'



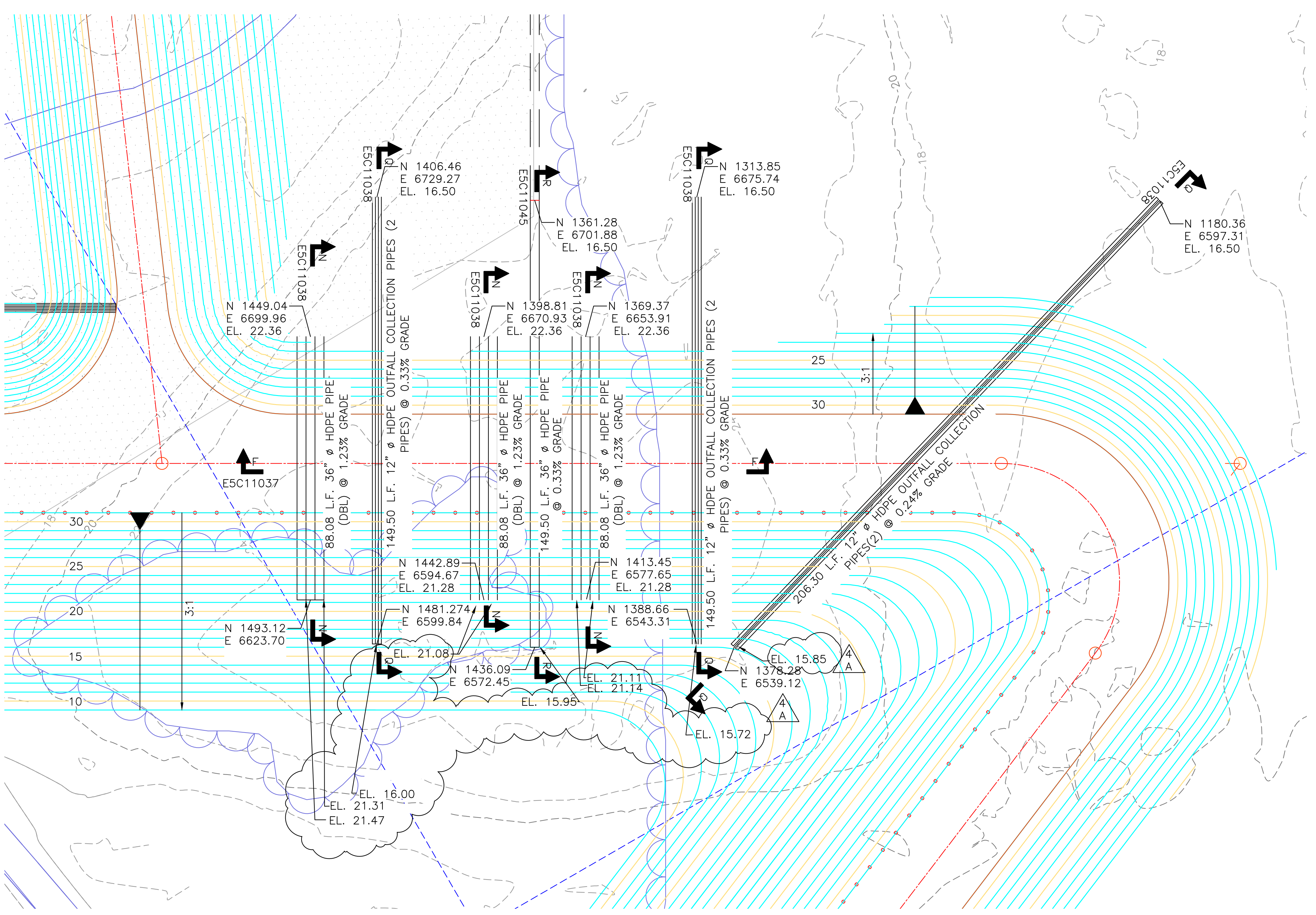
**DETAIL PLAN B**  
SCALE: 1"=20'



**DETAIL PLAN E**  
SCALE: 1"=20'



**DETAIL PLAN D**  
SCALE: 1"=20'



**DETAIL PLAN C**  
SCALE: 1"=20'

NOTES:  
1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

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**Southern Company Generation Engineering and Construction Services FOR**

REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION 4	DATE	REVISION 3	DATE	REVISION 2	DATE	REVISION 1	DATE	REVISION 0	DATE													
						A. ADDED AS-BUILT CONDITIONS	12-19-11	A. G-5, G-7 REVISED DETAIL PLAN A TO SHOW NEW LOCATION AND ELEVATIONS OF EMERGENCY SPILLWAYS	8-14-09	A. G-7 REVISED DETAIL PLAN A TO SHOW NEW LOCATION OF EMERGENCY SPILLWAY B. C-7 UPDATED COORDINATES AND ADDED MECHANICAL REFERENCE	7-2-09	A. G-3 REVISED DETAIL PLAN E TO SHOW MECHANICAL PIPE SLEEVES AND PIPES, AND ELECTRICAL DUCT RUN	3-5-09	ISSUED FOR CONSTRUCTION	11-14-08													
BY	CHK'D	CIVIL APPR	ELECT APPR	L/C APPR	MECH APPR	SEC MGR	BY	CHK'D	CIVIL APPR	ELECT APPR	L/C APPR	MECH APPR	SEC MGR	BY	CHK'D	CIVIL APPR	ELECT APPR	L/C APPR	MECH APPR	SEC MGR	BY	CHK'D	CIVIL APPR	ELECT APPR	L/C APPR	MECH APPR	SEC MGR	
							CSM	DPK	JBS																			

**Alabama Power Company**

PLANT BARRY UNIT 5  
GYPSON STORAGE AREA  
DETAIL PLANS A THROUGH E  
CELL NO. 1 THROUGH CELL NO. 3

SCALE: 1"=20'  
DRAWING NUMBER: **E5C11041**  
SHEET: 1  
CON'T: 4









**INQUIRY NUMBER 000082099**

**SOUTHERN COMPANY GENERATION  
ENGINEERING AND CONSTRUCTION SERVICES**

**TECHNICAL SPECIFICATION SECTION 31**

**FOR THE**

**CONSTRUCTION OF CELL 1, SEDIMENTATION POND AND  
EMERGENCY GYPSUM SLURRY POND**

**OF THE**

**GYPSUM STORAGE AREA**

**AT**

**PLANT BARRY**

**ALABAMA POWER COMPANY**

Prepared By: Terri H. Hartsfield Date: 12/3/2007

Reviewed By:

Name – Discipline	Initials	Date
A. James C. Pegues – ES&EE	JCP	12/3/2007
B. Patrick M. Gordon – Civil Design	PMG	12/3/2007

Approved By: Tammy Upchurch  
Civil Design Supervisor Date: 12/3/2007

**REVISIONS**

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4	Added RCC Section	THH	JCP/PMG	JBS	4/7/2009
5	Added GCL Section	THH	JCP/PMG	JBS	7/10/2009

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**TECHNICAL SPECIFICATION SECTION 31  
FOR THE CONSTRUCTION OF CELL 1,  
SEDIMENTATION POND AND  
EMERGENCY GYPSUM SLURRY POND  
OF THE  
GYPSUM STORAGE AREA  
AT  
PLANT BARRY  
ALABAMA POWER COMPANY**

**1.0 GENERAL**

Plant Barry is an electric fossil fueled plant located in Mobile County, Alabama, north of City of Mobile. The purpose of this work is to develop the first of four planned cells as a disposal area for gypsum.

**1.1 GENERAL INFORMATION**

- 1.1.1 These Specifications, all related attachments and associated documents cover the furnishing of all materials (unless otherwise noted), labor, supervision, equipment, and tools required for the construction of the Gypsum Storage Cell 1 at Plant Barry. The technical and construction requirements, including notes, Specifications, and design data continue on the Drawings. The Drawings and Notes are an integral part of these Specifications.
- 1.1.2 The provisions of these Specifications shall govern unless otherwise specified in the contract documents. In case of conflicting requirements, the contract documents shall govern. Discrepancies between the Drawings and the Specifications shall be brought to the attention of the Purchaser for resolution before the performance of the work. In the case of discrepancies between the scale dimensions on the Drawings and the dimensions the written dimensions shall govern.
- 1.1.3 The Contractor shall ensure that all work is performed in accordance with the Occupational Safety and Health Act of 1970 and other Standards and Codes listed herein (latest revision).
- 1.1.4 The Contractor shall receive, unload, haul to site, handle, store, place, and secure all materials and equipment. Any security measures taken for the protection of the Contractor's equipment shall be at his expense.

- 1.1.5 The Contractor shall furnish and keep in good working condition at all times sufficient equipment of the proper design and capacity to do all work described under these Specifications and in accordance with the established schedule.
- 1.1.6 The Contractor shall furnish appropriate equipment for minimizing fugitive dust.
- 1.1.7 The Contractor shall comply with all applicable state and county regulations concerning hazardous material disposal and burning operations, if allowed by the Purchaser. The Contractor shall have the responsibility for obtaining any necessary permits for these activities.
- 1.1.8 All earthwork, including ramps and access roads, done for the convenience of the Contractor shall be done at his expense. Such work will be restored to its original elevation at the Contractor's expense if the Purchaser so desires.
- 1.1.9 The Contractor shall install, at his expense, any drainage piping required because of the Contractor's mode of operation including his ramps and roads.
- 1.1.10 The Contractor shall provide traffic control during roadway related construction activities and material deliveries. This shall be coordinated with other activities ongoing at the plant. If within active and congested areas around the plant, traffic control shall include flag persons, barriers, and other control aids to provide for the safe routing of traffic in the affected area.
- 1.1.11 The Contractor shall inform the Purchaser of any existing wells encountered within the footprint of the construction that have not been previously abandoned. If present, these wells shall be abandoned by the Purchaser. Monitoring wells located outside the footprint of the cell shall not be damaged or destroyed by construction activities. Any monitoring well damaged or destroyed by the Contractor and his activities shall be replaced at no cost to the Purchaser.

## **1.2 APPLICABLE DOCUMENTS**

- 1.2.1 Drawings – Reference Inquiry Package for Drawing List.
- 1.2.2 The following Codes, Standards, Specifications, Publications, and/or Regulations shall be made part of these Specifications and will become part of the contract entered into for performance of the work covered herein. The latest edition in effect at the time of the contract shall apply. Other codes and standards shall be incorporated as referenced in this document. The omission of any Codes and/or Standards from this list does not relieve the Contractor of his responsibility to follow the latest revision of all applicable codes and standards for conducting the work.

Occupational Safety and Health Administration

- Occupational Safety and Health Act of 1970

American Society for Testing and Materials (ASTM)

- ASTM D 422 – Standard Test Method for Particle-Size Analysis of Soils
- ASTM D 698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
- ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil In - Place by the Sand Cone Method
- ASTM D 2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D 2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
- ASTM D 2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D 2488 - Description and Identification of Soils (Visual-Manual Procedure)
- ASTM D 6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil – Aggregate In Place by Nuclear Methods
- ASTM D 2937 - Standard Test Method for Density of Soil In Place by the Drive Cylinder Method
- ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
- ASTM D 4959 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method
- ASTM D 1587 - Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
- ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

- ASTM D 792 – Standard Test Methods for Density and Specific Gravity (relative density) and Density of Plastics by Displacement
- ASTM D 1004 - Standard Test Method for Tear Resistance of Plastic Film and Sheeting
- ASTM D 1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- ASTM D 1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique
- ASTM D 1603 - Standard Test Method for Carbon Black in Olefin Plastics
- ASTM D 3895 - Standard Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry
- ASTM D 4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
- ASTM D 5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- ASTM D 5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- ASTM D 5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- ASTM D 5721 - Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
- ASTM D 5885 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
- ASTM D 5994 - Standard Test Method for Measuring Core Thickness of Textured Geomembranes

- ASTM D 6392 – Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- ASTM D 6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- ASTM C 33 - Standard Specification for Concrete Aggregates
- ASTM C 138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- ASTM C 150 - Standard Specification for Portland Cement
- ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete
- ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- ASTM C 1040 - Standard Test Methods for In-Place Density of Unhardened and Hardened Concrete, Including Roller Compacted Concrete, By Nuclear Methods
- ASTM D 5890 – Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
- ASTM D 5891 – Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
- ASTM D 5993 – Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners
- ASTM D 6768 – Standard Test Method for Tensile Strength of Geosynthetic Clay Liners
- ASTM D 5887 – Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter
- ASTM D 5321 – Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

- ASTM D 6243 – Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method

Geosynthetic Research Institute GRI Standards

- GM 10 - The Stress Crack Resistance of HDPE Geomembrane Sheet
- GM 11 - Accelerated Weathering of Geomembranes using a Fluorescent UVA Device
- GM 12 - Asperity Measurement of Textured Geomembranes Using a Depth Gage
- GM 13 - Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Geomembranes

Corps of Engineers EM-LST, Appendix VII, Falling-Head Permeability Test

Codes specific to the local county

Alabama Department of Environmental Management regulations

Environmental Protection Agency (EPA) regulations

## **2.0 EARTHWORK**

### **2.1 SITE CONDITIONS**

- 2.1.1 The Contractor shall visit the site and acquaint himself with site conditions, utility locations, and the proposed scope of work.
- 2.1.2 Soil borings have been performed at the gypsum disposal site. The locations of these borings are shown on the Drawings. The boring logs for the borings are available to the Contractor.
- 2.1.3 Test pit excavations and bulk samples obtained have been performed in the borrow area. The general areas of the locations of the test pits are available for inspection by the Contractor. The results of soil laboratory testing on bulk samples from the borrow area are also available to the Contractor.
- 2.1.4 The field testing, measurements, and associated laboratory testing performed by the Purchaser have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions. The Purchaser assumes no responsibility for the

accuracy of the investigations, the resulting data, or the interpretation; nor does the Purchaser guarantee that the materials and conditions will not vary from those indicated by the investigations. In addition, the Purchaser will not be responsible for any deduction, interpretation, or conclusion drawn by the Contractor.

## **2.2 LINES AND GRADES**

- 2.2.1 The project shall be constructed to the elevations, lines, grades and cross sections shown on applicable Drawings. The Purchaser reserves the right to increase the foundation widths, change the embankment slopes, and to make such other changes in the embankment sections as conditions indicate are necessary for the construction of a safe and permanent structure. The Contractor shall be compensated for changes in plan and/or sections resulting in changes of quantities of materials.
- 2.2.2 The soil that has been placed in the proposed dike footprint shall be removed down to base grade. The soil may be used for dike construction material if it meets the specifications of Section 2.5. The Contractor should expect to encounter some unsuitable material for dike construction when removing this soil.

## **2.3 CLEARING, GRUBBING, AND STRIPPING**

- 2.3.1 Clearing, grubbing and stripping will be required to prepare the work area for construction.
- 2.3.2 Vegetated areas within the construction footprint shall be cleared, grubbed, and stripped of any vegetation, organic matter and/or any other debris. Stripped topsoil shall be stockpiled at a location on the site to be designated by the Project Construction Manager.
- 2.3.3 The grubbed area shall be harrowed and raked with a tractor-mounted root rake to collect all small material previously overlooked. The tractor shall be of adequate size to achieve a minimum of 4 inches penetration of the root rake teeth. The root rake teeth shall not be more than 12 inches apart.
- 2.3.4 Trees, stumps, and brush cleared from the above areas shall be disposed of by burning, if allowed by the Purchaser, by mulching, or by removal from the site. All burning shall be performed in accordance with state and local regulations. Burn pits shall be located outside of the construction area, borrow area, outside of future cell construction, and off right-of-ways.
- 2.3.5 Burning operations, if permitted by the Purchaser, shall be conducted only in previously cleared areas and away from standing timber, structures, or other

flammable materials. Materials to be burned shall be properly stacked, by dozers, in piles sufficiently large enough to facilitate the complete burning of all the materials in the pile. The Contractor shall be subject to all public laws governing such burning operations and shall be responsible for any damage to life or property as a result of burning either on the Purchaser's property or the property of others. Fires shall not be started unless tractors are available in the immediate vicinity to check the spread of fire outside the cleared area. Fires shall be guarded at all times and shall be under constant attendance until they have burned out or have been extinguished.

- 2.3.6 Spoil material shall be disposed of only in areas to be designated by the Purchaser. The Contractor shall slope the spoil area for drainage, implement necessary erosion control measures, and provide a perennial stand of vegetation.

## **2.4 SUBGRADE PREPARATION**

- 2.4.1 Proof-roll the entire cell subgrade utilizing loaded, off-road trucks with a gross machine weight, including payload of 40 tons of soil, that will impart approximately 7600 psf subgrade loading over a minimum tire width of 2 feet. Prior to receiving earth fill, the foundation area shall be scarified by harrowing or other suitable means.
- 2.4.2 Any areas failing proof roll shall be undercut and replaced with structural soil fill and re-rolled.
- 2.4.3 No fill shall be placed on any part of the subgrade until such areas have been proof rolled and approved by the Purchaser.
- 2.4.4 Work flow shall be planned such that the first fill lift is placed soon after subgrade compaction to minimize subgrade exposure to inclement weather.
- 2.4.5 The Contractor shall be required to prepare the base and interior dike slopes, including the sedimentation ponds, for installation of the HDPE liner surface as shown on the Drawings. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than 1/2-inch in diameter, or debris of any kind. These surfaces shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade.



## **2.5 STRUCTURAL EARTH FILL**

- 2.5.1 Compacted dike material shall consist of the clayey sands (SC), sandy silts (ML), and silty sands (SM) from the excavation of the borrow area and shall be placed and compacted in accordance with these Specifications and Drawings.
- 2.5.2 Pipe penetrations shall be encapsulated in flowable fill then surrounded with select structural soil fill as shown on the Drawings. The select structural fill material shall have a plasticity index (PI) of greater than 12, a minimum of 35% by weight passing the #200 sieve (per ASTM D-422), and a Unified Soil Classification System (USCS) designation of SC, CL, ML, or CH. The fill shall be tested using appropriate ASTM methods and be approved by the Project Construction Manager.
- 2.5.3 No particle greater in size than 3 inches shall be used as dike fill.
- 2.5.4 Fill materials from other places other than the borrow area may be used if they meet the requirements named in this section or if approved by the Project Construction Manager. The spoil material located within the footprint of the gypsum cell or previously stockpiled near the site by others may be used as dike material if the total organic carbon (TOC) content is less than 5% and if approved by the Project Construction Manager. If the TOC results are greater than 5%, the material may be used as fill material in the interior of the cell. Material with greater than 5% TOC may not be used under the footprint of the dike or as structural dike fill. The contractor must provide laboratory analysis for approval by the Project Construction Manager.
- 2.5.5 Material from the spoil area or stockpile containing greater than 5% TOC may be used as structural dike fill if it is blended with other soil to fulfill the TOC requirement.
- 2.5.6 No earth fill shall be placed on any part of the dike foundation until such areas have been inspected and approved by the Project Construction Manager.
- 2.5.7 Earth fill shall be placed in uniform layers of 8 to 10 inches, nominal thickness, loose measurement. The fill material shall be placed one foot beyond the full width of the dike on each side. Each layer shall be kept level with the necessary grading equipment. Upon completion of compaction, fill slopes shall be cut back to the final slope. Particular care must be used to obtain the required compaction along the edges of the dike.
- 2.5.8 Quality control testing shall be performed on all earth fill in accordance with Section 2.8 of this Specification. No earth fill layer may be placed until the

- Project Construction Manager has verified that the underlying layer has met the compaction and/or moisture requirements.
- 2.5.9 If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or as directed by the Project Construction Manger, before the succeeding layer is placed.
- 2.5.10 During the dumping and spreading processes, the Contractor shall maintain at all times a force of men adequate for removal of roots and debris from all earth fill materials and all stones greater than 3-inch maximum dimension.
- 2.5.11 Earth fill material for the dike shall be compacted to a minimum 95% maximum dry density, as determined by the Standard Proctor compaction test (ASTM D698). The moisture content of the earth fill at the time of placement shall be between -1% and +2% of the optimum moisture obtained by Standard Proctor compaction test. The Contractor shall strive to place the earth fill material on the wet side of optimum.
- 2.5.12 When moisture content is too low, the moisture content shall be adjusted to within the above specification prior to compaction. Moisture adjustment shall be by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and disking of the layer shall be done after deposition, but before compaction.
- 2.5.13 If the moisture content is too high, the Contractor will be permitted to stockpile and disk the earth fill material to promote drying to bring it back within the allowable moisture range. This drying must be done prior to placement.
- 2.5.14 Earth fill which cannot be compacted with roller equipment because of inadequate clearances shall be spread in 4-inch layers and compacted with power tampers to the extent required by the specifications for embankment material.
- 2.5.15 The Contractor will be required to remove any compacted material that does not comply with the compaction and/or moisture requirements and replace the compacted earth fill to comply with these Specifications at his own expense.
- 2.5.16 Excavations required for density and moisture tests shall be repaired by scarifying the walls of the excavation, backfilling, and compacting the fill material to the criteria specified in this Section.
- 2.5.17 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to insure that the correct reference Proctor curves are being used for compaction check.

- 2.5.18 If the construction of the dike is interrupted, the Contractor shall be required to shape and smooth the last layer of earth fill material placed on the fill to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the Contractor shall be required to level, scarify and compact the last layer of earth fill material before placing additional layers.
- 2.5.19 Dike slopes shall be grassed upon reaching final grade in accordance with the Vegetation Schedule.

## **2.6 COMPACTED CLAY LINER**

- 2.6.1 A compacted clay liner shall be installed as the upper two feet of earth fill underlying the HDPE liner. The clay liner shall be placed and compacted in accordance with these Specifications and Drawings.
- 2.6.2 Compacted clay liner material shall have a in-place permeability equal to or less than  $1 \times 10^{-7}$  cm/sec, shall contain a minimum of 20% material passing the #200 sieve, shall have a plasticity index (PI) of between 10 and 30, shall have a maximum clod size of 2 inches, and shall be free of organics or other debris.
- 2.6.3 Prior to placement of the clay liner, the borrow material shall be sampled to verify the soil characteristics. A minimum of three soil samples of clay shall be obtained for laboratory testing from the borrow area actively being utilized for the clay liner placement. Laboratory testing on the soil samples shall include the Standard Proctor density (ASTM D 698), permeability by constant head (ASTM D 2434) or falling head test, grain size distribution and hydrometer analysis (ASTM D 422), Atterberg Limits (ASTM D 4318) and in-place moisture (ASTM D 2216). The density and in-place moisture data should be used to make adjustments in the moisture level of the clay prior to and during placement of the material
- 2.6.4 Clay liner material shall be placed in uniform layers of 8 inches, nominal thickness, loose measurement. Each layer shall be kept level with the necessary grading equipment. Upon completion of compaction, fill slopes shall be cut back to the final slope.
- 2.6.5 Quality control testing shall be performed on the liner in accordance with Section 2.8 of this Specification. No clay liner layer may be placed until the Project Construction Manager has verified that the underlying layer has met the compaction, permeability, and/or moisture requirements.
- 2.6.6 If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or

- as directed by the Project Construction Manger, before the succeeding layer is placed.
- 2.6.7 Clay liner material shall be compacted to a minimum 95% maximum dry density, as determined by the Standard Proctor compaction test (ASTM D 698), or to the percent compaction required to achieve the specified permeability, whichever is greater. The moisture content of the clay liner at the time of placement shall be wet of optimum as determined by the Standard Proctor compaction test.
- 2.6.8 When moisture content is too low, the moisture content shall be adjusted to within the above specification prior to compaction. Moisture adjustment shall be by sprinkling and diking sufficiently to bring the moisture content within the specified range. Sprinkling and diking of the layer shall be done after deposition, but before compaction.
- 2.6.9 If the moisture content is too high, the Contractor will be permitted to stockpile and disk the liner material to promote drying to bring it back within the allowable moisture range. This drying must be done prior to placement.
- 2.6.10 Liner material which cannot be compacted with roller equipment because of inadequate clearances shall be spread in 4-inch layers and compacted with power tampers to the extent required by the specifications in this Section.
- 2.6.11 The Contractor will be required to remove any compacted material that does not comply with the compaction, moisture, and/or permeability requirements and replace the compacted earth fill to comply with these Specifications at his own expense.
- 2.6.12 Excavations required for density and moisture tests shall be repaired by scarifying the walls of the excavation, backfilling, and compacting the fill material to the criteria specified in this Section.
- 2.6.13 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to insure that the correct reference Proctor curves are being used for compaction check.
- 2.6.14 If the construction of the soil liner is interrupted, the Contractor shall be required to shape and smooth the last layer of earth fill material placed on the fill to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the Contractor shall be required to level, scarify and compact the last layer of liner material before placing additional layers.
- 2.6.15 The Contractor shall be required to repair erosion features, desiccation cracks, and other defects in the clay liner. All soils and sediments that have been transported onto the active clay liner placement areas from storm runoff shall be removed or

graded away from the clay liner. All repairs to the liner shall be completed prior to the subsequent lift of clay material placed.

## **2.7 EARTHWORK EQUIPMENT**

### **2.7.1 General**

The Earthwork Contractor shall be responsible for providing all earthwork equipment necessary to perform the work set forth in these Specifications. The Contractor shall be responsible for maintaining the equipment during the contract period. Any delays in work activities due to equipment maintenance must be reported to the Project Construction Manager for determination of impacts on the schedule.

The Contractor shall be responsible for the cleaning of haul vehicles. The Contractor shall wash down the wheels, outside body, cab, undercarriage, etc. of all haul vehicles to prevent spreading material during transit of the equipment out of the boundary of the working area.

All of the Contractor's equipment shall be operated in a safe, careful manner in accordance with these Specifications.

### **2.7.2 Tamping Roller**

The use of self-propelled, non-vibratory tamping rollers, conforming to the following specification, shall be permitted to compact the backfill material. Their design and operation shall be subject to the approval of the Project Construction Manager. If use of self-propelled tamping rollers causes shearing planes in the fill, laminations in the fill, or results in inadequate compaction, the Project Construction Manager may direct that such rollers be removed from the fill. Two-drum or four-drum equipment separated by cab and differential and arranged in tandem must have its static weight equally distributed to all compaction drums and must have the tandem drums positioned such that the prints of the tamping feet produced by the tandem drums are staggered. The surface on which the tamping feet are mounted shall have a minimum outside diameter of four feet and one (1) tamping foot for approximately each 100 square inches of drum surface. The distance between the centers of any two adjacent tamping feet shall be not less than nine inches. The length of each tamping foot from the outside mounting surface of the drum shall be not more than eight inches and shall be maintained at not less than six inches based on compaction of the clay fill placed in eight (8) inch loose lifts. During rolling operations, the spaces between the tamping feet shall be maintained clear of materials which would impair the effectiveness of the tamping roller.

The weight of all roller drums during compaction of fill material shall be maintained uniform with weight per foot of drum length of approximately 3,000 pounds. For self-propelled rollers in which steering is accomplished through the use of rubber-tired wheels, the tire pressure shall not exceed 40 psi. The use of a compactor shall be discontinued if the rubber tires leave ruts that prevent uniform compaction by the tamping roller and the substitution of appropriate towed tamping rollers shall be operated at a speed not to exceed 5.0 miles per hour.

### 2.7.3 Pneumatic Rubber-Tired Roller

Pneumatic rubber-tired rollers shall be permitted to compact the backfill and shall have a minimum of four wheels equipped with pneumatic tires. The tires shall be of such size and ply as can be maintained at tire pressure between 65 and 85 pounds per square inch for 20,000 pound wheel load during roller operations. The roller wheels shall be located abreast and be so designed that each wheel will carry approximately equal load in traversing uneven ground. The spacing of the wheels will be such that the distance between the nearest edges of adjacent tires will not be greater than 50 percent of the tire width of a single tire at the operating pressure for a 25,000 pound wheel load. The roller shall be provided with a body suitable for ballast loading such that the load per wheel may be varied from 18,000 to 25,000 pounds.

### 2.7.4 Tamping Compactors

Compaction of materials in areas where it is impractical to utilize conventional compaction equipment shall be performed by the use of hand tampers or manually-guided sled/plate-type vibratory or ramming tampers which have been approved for use by the Project Construction Manager.

### 2.7.5 Vibratory Rollers

Vibratory rollers, utilized for compacting sand shall be equipped with a smooth steel compaction drum and shall be operated at a frequency of vibration during compaction operations between 1,100 and 1,500 vibrations per minute. Vibratory rollers may be either towed or self-propelled and shall have an unsprung drum weight that is a minimum of 60 percent of the rollers' static weight. Towed rollers shall have at least 90 percent of their weight transmitted to the ground through the compaction drum hitched to the towing vehicle. Rollers shall have a minimum static weight of 20,000 pounds and a minimum dynamic force no less than 27,000 pounds when operating at 1,400 vibrations per minute and a total applied force not less than 5,500 pounds per foot of compaction drum length.

The vibratory mode may not be required for compacting some fill material. The Contractor shall operate the compactor in the vibratory and non-vibratory modes to determine the mode which effectively compacts and densifies the material.

The level and amplitude and vibration frequency during compaction will be maintained uniform. Rollers shall be operated at speeds not to exceed 1.5 miles per hour. The Contractor shall furnish sufficient data, drawings, and computations for verification of the above specifications to the Project Construction Manager and the character and efficiency of this equipment shall be subject to the approval of the Project Construction Manager.

## **2.8 QUALITY CONTROL TESTING**

- 2.8.1 Field density and moisture content testing shall be performed by the Purchaser's Representative to verify that compaction requirements have been achieved. In-place field density testing of the compacted soil shall be performed in accordance with the procedure ASTM D 1556-00, the sand cone method. Test results reports should include both the moisture content and dry density, along with other data such as location, elevation, Proctor curve used for comparison, etc.
- 2.8.2 Testing procedures of in-place density and moisture content by nuclear methods is described in ASTM D 6938. The procedure may be used provided: 1) acceptable correlation with sand cone density test results can be obtained according to the guidelines of Section 7, "Calibration", of ASTM D 6938, and 2) the initial correlation results are reviewed and use of the nuclear device is approved by the Project Construction Manager. In addition, it shall be required that the testing agency or representative have the necessary licenses to operate a nuclear energy source, and to take all safety precautions per Section 6 of ASTM D 6938.
- 2.8.3 In the event of repeated failures, or water content and density test values plotting far from the Proctor curves used for comparison in computing percent compaction, it shall be the option of the Project Construction Manager to require one or two point Proctor checks (on the dry side of optimum) to verify that the proper Proctor curve is being referenced. If not, a new Proctor curve determined by a five-point test shall be required. The Contractor shall sample and perform the five-point testing, all at the Contractor's expense.
- 2.8.4 If the compaction requirements for a lift have not been achieved, the Purchaser's Representative shall direct the Contractor to either rework the lift to obtain the compaction requirements or remove and replace with a new lift for compaction, all at the Contractor's expense.
- 2.8.5 The in-place density testing frequency for the soil shall be one test for each 20,000 square feet of lift area or portion thereof for each lift, with a minimum of one test performed for each 200 lineal feet of dike per lift as measured parallel to the dike axis.

- 2.8.6 Laboratory confirmation testing for the compacted embankment fill shall be performed to record the in-place shear strength properties of the fill and to verify that the permeability of the compacted fill surrounding the flowable fill is equal to or less than that specified in these Specifications. The confirmation testing shall consist of obtaining duplicate, undisturbed samples of the compacted fill for laboratory confirmation of field density, moisture content, shear strength (by consolidated-undrained triaxial method with pore-pressure measurements) and hydraulic conductivity of field compacted material. The undisturbed samples shall be obtained by pushing a thin walled drive cylinder into the compacted fill at a frequency of one (1) tube per 400 lineal feet of dike for every 10 vertical feet of fill.
- 2.8.7 Laboratory confirmation testing for the compacted clay liner material placed in the upper two (2) feet below the final grade shall be performed to verify that the permeability of the compacted liner is equal to or less than  $1 \times 10^{-7}$  cm/sec using either the falling head or back pressure permeability test. The confirmation testing shall consist of obtaining undisturbed samples of the compacted fill for laboratory confirmation of field density, moisture content, and hydraulic conductivity of field compacted material. The undisturbed samples shall be obtained by pushing a thin walled drive cylinder into the compacted liner at a frequency of one (1) tube per 8,000 cu. yd. of liner material or one (1) tube per 2 ft. lift per acre and one (1) tube per lift per 800 linear feet of side slope.
- 2.8.8 The drive tubes used to collect the undisturbed samples shall be cleaned and paraffin sealed to preserve the moisture content and delivered to the independent soil testing laboratory. The location, lift, and depth below the surface should be recorded with each sample. The undisturbed samples shall be stored and handled in such a manner as to prevent damage to the sample from freezing, transporting or other means. After the undisturbed samples are taken, the holes shall be filled with bentonite (powder, chips, or pellets) to maintain the integrity of the fill.
- 2.8.9 The results of all permeability tests by the testing laboratory shall be reported to the Owner's Engineer. If any permeability test result is higher than the minimum required value of  $1 \times 10^{-7}$  cm/sec, the Contractor shall rework or replace a section or entire lift of the clay layer being constructed, at the Contractor's expense. All reworked or replaced sections of clay liner shall be retested and meet the minimum permeability requirements.



### **3.0 DRAINAGE DITCHES, CHANNELS AND SLOPES**

#### **3.1 GENERAL**

- 3.1.1 The gypsum slurry pipe containment ditch and all drainage channels and perimeter drainage ditches shall be excavated to the lines, grades, cross-sections, and elevations indicated on the Drawings. The waterways shall be free of bank projections or other irregularities which will impede normal flow.
- 3.1.2 All earth removed and not used in construction shall be disposed of so that it will not interfere with the functioning of the waterway.
- 3.1.3 The perimeter drainage ditch for the future gypsum raise located on the inside crest of the dike shall be lined with a 60 mil high density polyethylene (HDPE) liner as shown on the Drawings.
- 3.1.4 The gypsum slurry pipe containment ditch located from the canal bridge to the emergency gypsum slurry pond shall be lined with a 60 mil, smooth, high density polyethylene (HDPE) liner as shown on the drawings.
- 3.1.5 The gypsum slurry pipe containment ditch shall be constructed using select structural fill as specified in Section 2.5.2. The fill shall be placed and compacted as specified in Section 2.5. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than ½-inch in diameter, or debris of any kind.

### **4.0 HDPE LINER**

#### **4.1 QUALIFICATIONS OF CONTRACTOR WORK ACTIVITIES**

- 4.1.1 The manufacturer shall have at least 5 years continuous experience in manufacturing polyethylene geomembrane and/or experience totaling 10,000,000 square feet of manufactured polyethylene geomembrane.
- 4.1.2 The installation contractor shall be the manufacturer or a dealer trained to install the manufacturer's geomembrane. Installation shall be performed under the constant direction of a field installation supervisor who shall remain on site and be responsible, throughout the liner installation, for liner layout, seaming, testing, repairs, and all other activities by the Installer. The field installation supervisor shall have installed or supervised the installation of a minimum of 2,000,000 square feet of polyethylene geomembrane. Seaming shall be performed under the direction of a master seamer (who may also be the field installation supervisor) who has seamed a minimum of 2,000,000 square feet of polyethylene

geomembrane, using the same type of seaming apparatus specified for this project. The field installation supervisor and/or master seamer shall be present whenever seaming is performed.

## 4.2 MATERIALS

- 4.2.1 The geomembrane used for Cell 1 and the ponds shall be 60 mil thick, textured, high density polyethylene (HDPE), a minimum 22.5 feet seamless width, as manufactured by the Gundle/SLT (GSE) or Poly-America companies, or an approved equal. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.
- 4.2.2 The geomembrane used for the gypsum slurry containment ditch shall be 60 mil thick, smooth, HDPE, as manufactured by the Gundle/SLT (GSE) or Poly-America companies, or an approved equal. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.
- 4.2.3 The Contractor shall provide QC certificates for both the liner and the welding rods.
- 4.2.4 The surface of the geomembrane shall not have striations, roughness, pinholes, or bubbles and shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter except that if in the opinion of the Purchaser the blemish will not adversely affect properties and use of the liner, the Inspector may accept the liner after sufficient laboratory test data are provided to support such acceptance, and further provided all such testing is done at the sole expense of the Contractor.
- 4.2.5 The geomembrane shall be supplied in rolls. Labels on each roll shall identify the thickness of the material, the length and width of the roll, batch and roll numbers, and the name of the manufacturer.
- 4.2.6 Gasket material shall be neoprene, closed cell medium, ¼-inch thick, 2 inches wide, 50 foot lengths with adhesive on one side.
- 4.2.7 Metal battens or straps and hardware shall be ASTM A-276 Grade 316 or 317 stainless steel. Water cut-off mastic shall be a Neoprene Flashing Cement.
- 4.2.8 Sealant shall be General Electric Silicone, RTV 103, or approved equal.

### 4.3 GEOMEMBRANE RAW MATERIALS

The geomembrane shall be manufactured of polyethylene resins produced in the United States and shall be compounded and manufactured specifically for the intended purpose. The Contractor shall submit a certification from the manufacturer of the geomembrane that the sheeting meets the following physical property requirements.

Property	Test Method	HDPE Requirements
Density, g/cm <sup>3</sup>	ASTM D 1505	>0.932
Melt Index, g/10 min.	ASTM D 1238 (190/2.16)	<0.4
OIT (minutes)	ASTM D3895	100

### 4.4 ROLLS

The geomembrane rolls shall meet or exceed the following specifications. Certification shall be provided for each roll stating that these items have been met or exceeded. The certification shall reference the manufacturer's batch and roll number and shall indicate the name of the manufacturer.

TEXTURED HDPE GEOMEMBRANE - 60 MIL		
Property	Test Method	Min. Average Value
Thickness	ASTM D 5994	
Minimum Average		57
Lowest individual of 8 of 10 readings		54
Lowest individual of 10 readings		51
Asperity Height <sup>1</sup>	GRI GM12	10
Sheet Density, g/cm <sup>3</sup>	ASTM D 1505	0.94
Tensile Properties <sup>2</sup>	ASTM D 6693	
Strength at Yield, lb/in		126
Strength at Break, lb/in	Dumbell, 2 ipm	90
Elongation at Yield, %	G.L. 1.3 in	12
Elongation at Break, %	G.L. 2.0 in	100
Tear Resistance, lb	ASTM D 1004	42
Puncture Resistance, lb	ASTM D 4833	90
Notched Constant Tensile Load, hrs	ASTM D 5397 App	300
Carbon Black Content, %	ASTM D 1603	2.0 – 3.0
Carbon Black Dispersion	ASTM D 5596	Note 1
Oxidative Induction Time , minutes	ASTM D 3895	>100
Seam Properties	ASTM D 6392	
Shear Strength, lb/in		121
Peel Strength (fusion), lb/in		98
Peel Strength (extrusion), lb/in		78
Note 1 – Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.		

SMOOTH HDPE GEOMEMBRANE - 60 MIL		
Property	Test Method	Min. Average Value
Thickness	ASTM D 5199	
Minimum Average		60
Lowest minimum reading		54
Density, g/cm <sup>3</sup>	ASTM D 1505	0.94
Tensile Properties <sup>2</sup>	ASTM D 6693	
Strength at Yield, lb/in		126
Strength at Break, lb/in	Dumbell, 2 ipm	228
Elongation at Yield, %	G.L. 1.3 in	12
Elongation at Break, %	G.L. 2.0 in	700
Tear Resistance, lb	ASTM D 1004	42
Puncture Resistance, lb	ASTM D 4833	108
Notched Constant Tensile Load, hrs	ASTM D 5397 App	300
Carbon Black Content, %	ASTM D 1603	2.0 – 3.0
Carbon Black Dispersion	ASTM D 5596	Note 1
Oxidative Induction Time, min	ASTM D 3895	>100
Seam Properties	ASTM D 6392	
Shear Strength, lb/in		121
Peel Strength (fusion), lb/in		98
Peel Strength (extrusion), lb/in		78
Note 1 – Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.		

#### 4.5 GEOMEMBRANE INSTALLATION

- 4.5.1 The geomembrane shall be packaged and shipped by appropriate means to ensure that no damage is incurred. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. The rolls shall be stored on a prepared smooth surface (not wooden pallets) and shall not be stacked.
- 4.5.2 Off-loading and storage of the materials shall be the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or

- unacceptable material at no cost to the Purchaser. No off-loading shall be done unless monitored by the Purchaser. Damage occurring during off-loading shall be documented by the Purchaser and the Contractor. The Purchaser shall be the final authority on determination of damage.
- 4.5.3 The Contractor shall inspect the subgrade preparation prior to liner installation. The subgrade shall be compacted in accordance with the project specifications. Weak or compressible areas which cannot be satisfactorily compacted should be removed and replaced with properly compacted fill. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, or debris of any kind. The subgrade shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. Standing water or excessive moisture shall not be allowed.
- 4.5.4 The Contractor, on a daily basis, shall approve the surface on which the geomembrane will be installed. After the supporting surface has been approved, it shall be the Contractor's responsibility to indicate to the Purchaser any changes to its condition that may require repair work.
- 4.5.5 The Contractor shall certify in writing that the subgrade on which the geomembrane is to be installed is acceptable. This shall be done prior to commencing work.
- 4.5.6 The installation of the geomembrane shall be in accordance with the manufacturer's recommendations. The Contractor shall submit a panel layout drawing and a detailed, written procedure for the Purchaser's review.
- 4.5.7 All seams and non-seam areas of the geomembrane shall be inspected by the inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.
- 4.5.8 The anchor trench shall be excavated to the line, grade, and width shown on the project construction drawings, prior to liner system placement. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the geomembrane.
- 4.5.9 The Contractor is responsible for ensuring that the geomembrane is handled and installed in such a manner that it is not damaged.
- 4.5.10 The rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the Purchaser. The installer shall be responsible for the following:
- Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

- Personnel working on the geomembrane shall not smoke or wear damaging shoes.
- The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil.
- Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).
- Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F. Placement can proceed below 32° F only after it has been verified by the inspector that the material can be seamed according to the specification. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the installation supervisor.

#### **4.6 FIELD SEAMING**

- 4.6.1 Field seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit the proposed seaming procedures for the Purchaser's review.
- 4.6.2 Approved seaming processes are fusion and extrusion welding. On side slopes, seams shall be oriented in the general direction of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized.
- 4.6.3 No base T-seam shall be closer than 5 feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a fishmouth or wrinkle is found, it shall be relieved and cap-stripped.
- 4.6.4 Geomembrane panels must have a finished minimum overlap of 4 inches for fusion welding and 6 inches for extrusion welding.
- 4.6.5 Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

#### **4.7 FIELD TEST SEAMS**

- 4.7.1 Field test seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit the proposed testing procedures for the Purchaser's review.
- 4.7.2 Field test seams shall be conducted on the liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each seaming period and at least once every 4 hours, for each seaming apparatus and personnel used that day.
- 4.7.3 All test seams shall be made in contact with the subgrade. Welding rod used for extrusion welding shall have the same properties as the resin used to manufacture the geomembrane. The Contractor shall provide QC certificates for the welding rods.
- 4.7.4 The Installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing or Air Pressure Testing (for double fusion seams only).

#### **4.8 DESTRUCTIVE SEAM TESTING**

- 4.8.1 Destructive seam testing should be minimized to preserve the integrity of the liner. The Contractor shall provide the Purchaser with one destructive test sample once per 500 feet of seam length from a location specified by the inspector.
- 4.8.2 Sampling Procedure

In order to obtain test results prior to completion of liner installation, samples shall be cut by the Installer as the seaming progresses. The Installer shall also record the date, location, and pass or fail description. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately patched and vacuum tested.

- 4.8.3 Size and Disposition of Samples

The samples shall be 12 inches wide by 36 inches long with the seam centered lengthwise. The sample shall be cut into three equal-length pieces, one to be given to the Inspector, one to be given to the Purchaser, and one to the Installer.



#### 4.8.4 Field Laboratory Testing

The inspector shall test ten 1-inch wide specimens from his sample, 5 specimens for shear strength and five for peel strength.

#### 4.8.5 Independent Laboratory Testing

The Purchaser, at his discretion and expense, may send seam samples to a laboratory for testing. The test method and procedures to be used by the independent laboratory shall be the same as used in field testing.

#### 4.8.6 Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails the field destructive test:

- The Installer shall cap strip the seam between the failed location and any passed test locations.
  - The Installer can retrace the welding path to an intermediate location (usually 10 feet from the location of the failed test), and take a sample for an additional field test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, then the process is repeated.
  - Over the length of seam failure, the Installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip.
- 4.8.7 Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the inspector. Each location that fails the non-destructive testing shall be marked by the Inspector, and repaired accordingly.

#### 4.8.8 Repair Procedures

- Defective seams shall be cap stripped or replaced.
- Small holes shall be repaired by extrusion welding a bead of extrudate over the hole. If the hole is larger than 1/4 inch, it shall be patched.
- Tears shall be repaired by patching. If the tear is on a slope or an area susceptible to stress and has a sharp end it must be rounded prior to patching.
- Blisters, large cuts and undispersed raw materials shall be repaired by patches.

- Patches shall be completed by extrusion welding. The weld area shall be ground no more than 10 minutes prior to welding. No more than 10% of the thickness shall be removed by grinding. Welding shall commence where the grinding started and must overlap the previous seam by at least 2 inches. Reseaming over an existing seam without regrinding shall not be permitted. The welding shall restart by grinding the existing seam and rewelding a new seam.
- Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of defects.

#### 4.8.9 Verification of Repairs

Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.

The Inspector shall keep daily documentation of all non-destructive and destructive testing. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested.

### **4.9 BACKFILLING OF ANCHOR TRENCH**

- 4.9.1 The anchor trench shall be backfilled by the Contractor. Trench backfill material shall be placed in accordance with the Manufacturer's recommendations.
- 4.9.2 Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. If damage occurs, it shall be repaired prior to backfilling.

### **4.10 GEOMEMBRANE ACCEPTANCE**

The Installer shall retain all ownership and responsibility for the geomembrane until accepted by the Purchaser. Final acceptance is when all of the following conditions are met:

- Installation is finished
- Verification of the adequacy of all field seams and repairs, including associated testing, is complete.

## 5.0 GEOCOMPOSITE DRAINAGE

### 5.1 MATERIAL

- 5.1.1 The geocomposite shall consist of one layer of HDPE drainage net overlain by one layer of geotextile to create a single sided geocomposite. The drainage layer shall be GSE Fabrinet UF, single sided, with 10 oz. fabric, or approved equal.
- 5.1.2 The drainage net manufacturer shall have successfully manufactured 5,000,000 square feet of polyethylene drainage net. The drainage net shall be manufactured of polyethylene resin in the United States by extruding two sets of polyethylene strands to form a three dimensional structure to provide planar flow and shall be compounded and manufactured specifically for the intended application.
- 5.1.3 The geotextile shall be a non-woven needle punched polyethylene manufactured in the United States specifically for the intended application.
- 5.1.4 The minimum average properties of the drainage layer shall be as follows:

<b>Drainage Net Properties</b>	<b>Test</b>	<b>Units</b>	<b>Typical Value</b>
Thickness	ASTM D 5199	mil	300
Carbon Black Content, min.	ASTM D 1603 mod.	%	2
Density, min.	ASTM D 1505	g/cc	0.94
Tensile Strength	ASTM D 5035	lbs/inch	75
Transmissivity	ASTM D 4716	gal/min/ft	14.5
Transmissivity	ASTM D 4716	m <sup>2</sup> /sec	3 x 10 <sup>-3</sup>
<b>Geotextile</b>			
Mass Per Unit Area	ASTM D 5261	oz/yd <sup>2</sup>	10

The above property values are the minimum acceptable average test results for any roll based on the specified test method.

### 5.2 INSTALLATION

- 5.2.1 The material shall be deployed in such a manner as to continually keep the geocomposite sheet in sufficient tension to reduce folds and wrinkles.
- 5.2.2 In the presence of high wind, all material shall be weighted with sandbags or the equivalent.
- 5.2.3 The geocomposite shall be cut using a hook blade. If the material is being cut in place, special care must be taken to protect the underlying HDPE liner.

- 5.2.4 The material shall be connected to all drainage pipes as shown on the Drawings.
- 5.2.5 Care shall be taken not to entrap stones or excessive dust that could damage the geocomposite, or generate clogging of the drains or filters.
- 5.2.6 The material may be seamed by overlapping and tying the geonet with ties and overlapping the geotextile by either thermal bonding or sewing.
- 5.2.7 When overlapping the rolls side to side, the geonet shall be overlapped a minimum of 4 inches and tied. Tying shall be every 5 feet to 10 feet across the bottom of the panel and every 5 feet along the length of the geonet panel. The geocomposite in the drainage ditch shall be tied at one foot intervals.
- 5.2.8 When connecting geocomposite rolls end to end, the geonet shall be overlapped a minimum of one foot and tied every 12 inches across the roll. The geotextiles shall be overlapped and thermal bonded or sewn.
- 5.2.9 Tying of the geonet will be with plastic fasteners as recommended by the Manufacturer. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed.
- 5.2.10 If the geocomposite is damaged and the tear or hole is less than 3 feet by 3 feet, the roll shall be cut and a butt joint placed. If the geonet is undamaged and the geotextile is damaged, a patch of geotextile shall be placed and shall be thermally bonded a minimum of 12 inches in all directions.

## **6.0 ROLLER COMPACTED (ZERO SLUMP) CONCRETE**

### **6.1 MATERIAL**

6.1.1 Roller compacted (zero slump) concrete (RCC) will be used to line the gypsum collection basins for the gypsum cell. The intent of the RCC is to provide a protective layer over the liner system in the starting cells. The RCC shall be proportioned by the Contractor so as to attain a compressive strength at 28 days of 3000 psi. The RCC shall be composed of cementitious materials, water, fine and coarse aggregate, and admixtures.

#### **6.1.2 Cementitious Materials**

6.1.2.1 Cementitious materials shall consist of Portland cement and pozzolan. The Portland cement shall conform to ASTM C 150, Type II.

6.1.2.2 Pozzolan shall conform to ASTM C 618, Type F Fly Ash. The pozzolan percentage of cementitious material shall not exceed 50 percent.

6.1.3 Water

Water shall be free of injurious amounts of oil, acid, salt, alkali, organic material or other deleterious substances.

6.1.4 Fine Aggregate

6.1.4.1 Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two.

6.1.4.2 The requirements for deleterious substances and soundness as required by ASTM C 33 shall govern.

6.1.4.3 Gradation of the fine aggregate shall be as follows:

<b>Gradation Requirements RCC Fine Aggregate</b>	
<b>Sieve Size</b>	<b>Percent Passing by Weight</b>
3/8-in	100
No. 4	95 – 100
No. 8	75 – 95
No. 16	55 – 80
No. 30	35 – 60
No. 50	24 – 40
No. 100	12 – 28
No. 200	8 - 18

In addition, the fine aggregate, as delivered to the mixer, shall have a fineness modulus of not less than 2.1 and not more than 2.75.

6.1.5 Coarse Aggregate

6.1.5.1 Coarse aggregate shall consist of crushed stone.

6.1.5.2 Limits for deleterious substances and physical property requirements shall meet the requirements of Table 3 of ASTM C 33 for Class Designation 4M.

6.1.5.3 Gradation of the coarse aggregate shall generally conform to the gradation requirements for ASTM C 33 No. 57 stone.

### 6.1.6 Admixtures

6.1.6.1 Admixtures to serve as a water reducing agent (WRA) shall be used. The WRA shall meet the requirements of ASTM C 494 Type A (water reducing) or Type D (water reducing and retarding.) Any WRA shall be added to and trial mix tested with the RCC mix to be used prior to its use in the field.

6.1.6.2 Admixtures for air-entrainment shall not be used.

## 6.2 **INSTALLATION**

### 6.2.1 Placement

6.2.1.1 The RCC shall be transported to the site in an open bed dump truck or similar equipment.

6.2.1.2 The RCC shall be end dumped in the designated area of use and shall be spread with a bulldozer, a front-end loader or other similar equipment. At no time shall the spreading equipment be allowed to operate directly on the surface of the liner system.

### 6.2.2 Compaction

6.2.1.1 After spreading, the RCC shall be compacted with a self-propelled, vibratory steel drum roller. Rollers shall not be operated in the vibratory mode unless they are moving. The target number of passes with the roller required to achieve the specified density will be determined at the time of construction. The actual density achieved during construction will be determined using a nuclear moisture-density gauge in accordance with ASTM C 1040.

6.2.1.2 The RCC should be compacted to a minimum of 95 percent of the theoretical maximum density. The theoretical density will be determined using job mix proportions and Contractor supplied materials, using compaction techniques suitable for RCC and following the appropriate testing procedures used to determine theoretical unit weight of concrete as described in ASTM C 138. As an alternative, maximum dry density may be determined using the procedures described in ASTM D 698.

6.2.1.3 The Contractor shall be responsible for the cleaning of haul and other vehicles. The Contractor shall wash down the wheels, outside body, cab, undercarriage, etc., of all haul vehicles to prevent spreading of material during transit of the equipment out of the boundary of the working area or onto the RCC surface.

### **6.3 TESTING**

- 6.3.1 Field density testing shall be performed to verify that compaction requirements have been achieved. In-place field density testing of the compacted RCC shall be performed in accordance with the procedures of ASTM C 1040. Test results reported should include test method used (direct transmission or backscatter), density values, and other requirements of the ASTM standard. The testing equipment shall be calibrated as per the standard.
- 6.3.2 The Contractor shall provide a third party inspector to ensure quality control plans, programs, and practices are followed, and shall institute any additional controls or procedures in accordance with proven industry practice to assure compliance with the Special Conditions, Scope of Work, Technical Specifications, and Drawings.
- 6.3.3 The in-place density testing frequency for the RCC shall be one test for each 2,500 square feet of lift area or portion thereof for each lift, with a minimum of five tests per lift.

## **7.0 GEOSYNTHETIC CLAY LINER (GCL)**

### **7.1 GENERAL**

- 7.1.1 A geosynthetic clay liner (GCL), overlying the six (6)-inch compacted clay/silt layer, shall be used as part of the composite liner system for the site. The GCL shall be placed underlying the HDPE in the area of the gypsum loading area, as shown on the Drawings.
- 7.1.2 The GCL shall be placed in accordance with these Specifications, the manufacturer's recommendations, and the details indicated on drawings.
- 7.1.3 The Contractor shall provide panel placement and GCL connection details to the Purchaser fourteen (14) days prior to the start of GCL installation.
- 7.1.4 The Contractor shall furnish the GCL Manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the product's specifications.

### **7.2 MATERIAL**

- 7.2.1 The GCL to be used shall be a CETCO non-reinforced Bentomat 200CR (equivalent to Bentomat 200R with a polymer additive) or equal material,

approved by the Purchaser.

7.2.2 The GCL and its components shall have the following properties:

<b>NON-REINFORCED GCL</b>			
<b>Material Property</b>	<b>Test Method</b>	<b>Test Frequency</b>	<b>Required Values</b>
<b>Bentonite Properties</b>			
Bentonite Swell Index <sup>1</sup>	ASTM D 5890	1 per 115,000 lbs	24 mL/2g min.
Bentonite Fluid Loss <sup>1</sup>	ASTM D 5891	1 per 115,000 lbs	18 mL max.
<b>Finished GCL Properties</b>			
Bentonite Mass/Area <sup>2</sup>	ASTM D 5993	40,000 ft <sup>2</sup>	0.75 lb/ft <sup>3</sup> min
GCL Grab Strength <sup>3</sup>	ASTM D 6768	200,000 ft <sup>2</sup>	40 lbs/in MARV
GCL Index Flux <sup>4</sup>	ASTM D 5887	Weekly	1 x 10 <sup>-8</sup> m <sup>3</sup> /m <sup>2</sup> /sec max
GCL Hydraulic Conductivity <sup>4</sup>	ASTM D 5887	Weekly	5 x 10 <sup>-9</sup> cm/sec max
GCL Hydrated Internal Shear Strength <sup>5</sup>	ASTM D 5321 ASTM D 6243	Periodically	100 psf typical

**Notes**

- 1 Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.
- 2 Bentonite mass/area reported at 0 percent moisture content.
- 3 All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using four (4) inch grips.
- 4 Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of 5x10<sup>-9</sup> cm/sec for typical GCL thickness. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.
- 5 Peak values measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

**7.3 LABELING AND PACKAGING**

7.3.1 Prior to shipment, the GCL manufacturer shall label each roll, identifying the product identification information (manufacturer's name and address, brand product code), lot number, roll number, roll length, width and weight.

7.3.2 The GCL shall be wound around a rigid core whose diameter is sufficient to



facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

- 7.3.3 All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

#### **7.4 SHIPPING, HANDLING, AND STORAGE**

- 7.4.1 The manufacturer assumes responsibility for initial loading the GCL. Shipping will be the responsibility of the party paying the freight. Unloading, on-site handling and storage of the GCL are the responsibility of the Contractor. The Contractor should contact the manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

- 7.4.2 A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

- 7.4.3 Storage of the GCL rolls shall be the responsibility of the Contractor. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry and well drained.

- 7.4.4 Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four (4) feet).

- 7.4.5 All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

- 7.4.6 The integrity and legibility of the labels shall be preserved during storage.

#### **7.5 SURFACE PREPARATION**

- 7.5.1 Any surface upon which the GCL is installed shall be prepared and compacted in accordance with these Specifications and the Drawings. The finished surface shall be smooth, firm, and unyielding, without abrupt elevation changes, voids, cracks, ice, or standing water. The surface shall be free of vegetation, debris, sticks, sharp rocks, and any other foreign matter that could damage the GCL.

- 7.5.2 The Contractor, on a daily basis, shall approve the surface on which the GCL will be installed. After the supporting soil surface has been approved, it shall be the Contractor's responsibility to indicate to the Purchaser any changes to its

condition that may require repair work.

- 7.5.3 The Contractor shall certify in writing that the subgrade on which the GCL is to be installed is acceptable. This shall be done prior to commencing work. It shall be the Contractor's responsibility thereafter to indicate to the Purchaser any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in this Section.
- 7.5.4 Immediately prior to GCL deployment, the subgrade shall be finish-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than one-half inch (12 mm) from the surface shall be either removed, crushed or pushed into the surface with a smooth-drum compactor.
- 7.5.5 The Contractor shall submit certificates of subgrade acceptance, signed by the Contractor and the Purchaser's Representative, for each area prepared for GCL placement.
- 7.5.6 At the top of sloped areas of the job site, an anchor trench for the GCL, HDPE, and geocomposite shall be excavated. The trench shall be excavated and approved by the Purchaser's Representative prior to GCL placement. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist anywhere within the trench.

## **7.6 GCL PLACEMENT**

- 7.6.1 The GCL shall be placed in accordance with guidelines and specifications provided by the manufacturer of the material.
- 7.6.2 GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL.
- 7.6.3 Equipment which could damage the GCL shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.
- 7.6.4 Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL.
- 7.6.5 The GCL panels shall be placed parallel to the direction of the slope. All GCL panels should lie flat on the underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.

- 7.6.6 Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The Purchaser's Representative and GCL supplier should be consulted for specific guidance if premature hydration occurs.
- 7.6.7 As directed by the project drawings and specifications, the end of the GCL roll shall be placed in an anchor trench at the top of the slope. When utilizing an anchor trench design, the front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench. The GCL should cover the entire trench floor and the rear trench wall.

## **7.7 SEAMING**

- 7.7.1 The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is required for reinforced GCL.
- 7.7.2 The minimum dimension of the longitudinal overlap should be six (6) inches. End-of-roll overlapped seams should be similarly constructed, but the minimum overlap should measure 24 inches.
- 7.7.3 Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.
- 7.7.4 Unless the GCL contains bentonite grooves to facilitate seaming without additional bentonite, bentonite-enhanced seams are constructed between the overlapping adjacent panels described above. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the six (6)-inch line. A similar bead of granular sodium bentonite is applied at the end-of-roll overlap. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.4 kg/m).
- 7.7.5 The granular bentonite sealing clay used for overlap seaming, penetration sealing, and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer.

## **7.8 DAMAGE REPAIR**

- 7.8.1 Any GCL that is damaged during delivery or handling operations and cannot be used in the liner installation shall be replaced by the Contractor at no additional cost to the Purchaser.
- 7.8.2 If any GCL is damaged during installation, to include placement of the overlying HDPE liner and placement and compaction of the protection soil cover and topsoil, and the Purchaser determines the GCL will not perform for the liner system, then the affected installed GCL shall be replaced by the Contractor at no additional cost to the Purchaser.
- 7.8.3 If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 inches is achieved around all of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.

## **8.0 RISERS AND DISCHARGE PIPES**

### **8.1 GENERAL**

- 8.1.1 Riser and discharge pipes shall be of size and specifications as indicated in the Drawings.
- 8.1.2 Discharge pipes shall be placed on a concrete base and encased with concrete up to the springline as shown on the Drawings. Hold down straps shall be attached to the base.
- 8.1.3 All pipes penetrating the dike structure shall be encased in a minimum of 12 inches of flowable fill above and below and 18 inches of flowable fill on the sides. Flowable fill shall meet the specifications shown on the Drawings.
- 8.1.4 Hold down straps shall be used on the pipe while placing the concrete.
- 8.1.5 The compacted fill material shall meet the requirements of Section 2.5.2 of this Specification and shall be placed in accordance with the same. It shall be clean soil, free of roots, vegetation, rocks greater than 3 inches maximum dimension, or other objectionable material. If machine placement and compaction is not

feasible, the fill material shall be placed in 4-inch lifts and hand compacted under and around the pipe to at least the same density as the adjacent fill material.

## 9.0 VEGETATION

### 9.1 GENERAL

- 9.1.1 A layer of topsoil 4-inches to 6-inches in final thickness shall be placed on all areas to be grassed. All disturbed areas not covered with liner material, as shown on the Drawings, shall be grassed. Topsoil shall be free of subsoil, clay, weeds, roots, and impurities. Hydroseeding methods may be used.
- 9.1.2 The Contractor shall produce a satisfactory stand of perennial grass in accordance with the vegetation schedule below. If it is necessary to repeat any or all the work, including plowing, fertilizing, watering, mulching and seeding, the Contractor shall repeat these operations until a satisfactory stand is obtained at no additional cost to the Purchaser.
- 9.1.3 Final stabilization shall be defined as follows: all soil disturbing activities at the site have been completed, and that for unpaved areas and areas not covered by permanent structures, 100% of the soil surface is uniformly covered in permanent vegetation with a density of 70% or greater, or equivalent permanent stabilization measures (such as the use of rip rap, gabions, permanent mulches or geotextiles) have been employed.
- 9.1.4 After placement of the topsoil, the area to be vegetated shall be fertilized and limed, then seeded with a perennial grass as indicated in the vegetation schedule shown below:

Vegetation Schedule

Variety	Seeding Rates Per Acre	Seeding Dates
Bahiagrass, Pensacola	40 lbs	Feb. 1 – Nov. 1
Bermudagrass, Common	10 lbs	March 1 – July 15
Bahiagrass, Pensacola & Bermudagrass, Common	30 lbs 5 lbs	March 1 – July 15
Sericea	40 – 60 lbs	Feb. 15 – July 15
Sericea & Bermudagrass, Common	40 – 60 lb 10 lbs	Feb. 15 – July 15

In the absence of soil test data, the following fertilization rates shall be used:

Vegetation	N-P-K	Fertilizer Rates Per Acre
Grass Alone	8-24-24	400 lbs
Grass-Legume Mixture	8-24-24	400 lbs
Legume Alone	0-20-20	500 lbs

- 9.1.5 Measures shall be taken to prevent erosion of the topsoil layer and vegetation until a full vegetative growth has been obtained. The Contractor shall make daily inspections of the seeded areas and repair all eroded areas to the satisfaction of the Purchaser.
- 9.1.6 After seeding, an erosion control biodegradable straw blanket shall be installed on the exterior slopes of the dikes and any areas that have slopes of 3:1 or greater. This material shall be a BioNet S150BN Double Net Straw Blanket by North American Green, or approved equal. The blanket shall be installed per manufacturer's installation instructions. However, the blanket shall be tacked as necessary to the ground to withstand the upward growth of grass and to permit the establishment of grass through the blanket. Failure to accomplish this will require that the effected area be re-grassed and redone to the satisfaction of the Project Construction Manager.
- 9.1.7 Graded areas that are to be grassed, which have slopes less than 3:1, shall be mulched with straw or other suitable material.
- 9.1.8 Water required to promote a satisfactory growth shall be furnished by the Purchaser and applied by the Contractor.

## 10.0 RECORDS

The quality control records of inspection and testing shall be compiled by the Contractor's Quality Control Inspector and provided to the Purchaser upon completion of the Project. Furthermore, copies of the daily inspection records and field quality control records shall be provided to the Purchaser on a weekly basis. All records shall be forwarded to the Plant's permanent file to be retained as a record of the project.