



October 2016

Illinois Power Resources Generating, LLC
17751 North Cilco Road
Canton, IL 61520

**RE: History of Construction
USEPA Final CCR Rule, 40 CFR § 257.73(c)
Duck Creek Power Station
Canton, Illinois**

On behalf of Illinois Power Resources Generating, LLC, AECOM has prepared the following history of construction for the Ash Pond No. 1, Ash Pond No. 2, and GMF Pond at the Duck Creek Power Station in accordance with 40 CFR § 257.73(c). The Bottom Ash Basin is an incised pond with a storage volume of less than 20 acre-feet. A history of construction is not required for the Bottom Ash Basin as specified in § 257.73(b).

BACKGROUND

40 CFR § 257.73(c)(1) requires the owner or operator of an existing coal combustion residual (CCR) surface impoundment that either (1) has a height of five feet or more and a storage volume of 20 acre-feet or more, or (2) has a height of 20 feet or more to compile a history of construction by October 17, 2016 that contains, to the extent feasible, the information specified in 40 CFR § 257.73(c)(1)(i)–(xii).

The history of construction presented herein was compiled based on existing documentation, as reasonably and readily available (see 80 Fed. Reg. 21302, 21380 [April 17, 2015]), AECOM's site experience, and discussion with plant engineers. AECOM's document review included construction drawings, geotechnical investigations, observation reports, etc. for the Ash Pond No. 1, Ash Pond No. 2, and GMF Pond at the Duck Creek Power Station.

HISTORY OF CONSTRUCTION

§ 257.73(c)(1)(i): The name and address of the person(s) owning or operating the CCR unit; the name associated with the CCR unit; and the identification number of the CCR unit if one has been assigned by the state.

Owner: Illinois Power Resources Generating, LLC

Address: 1500 Eastport Plaza Drive
Collinsville, IL 62234

CCR Units: Ash Pond No. 1
Ash Pond No. 2, IDNR Dam ID No. IL50014
GMF Pond, IDNR Dam ID No. IL50573

Ash Pond No. 1 does not have a state assigned identification number.

§ 257.73(c)(1)(ii): The location of the CCR unit identified on the most recent USGS 7¹/₂ or 15 minute topographic quadrangle map or a topographic map of equivalent scale if a USGS map is not available.

The locations of the Ash Pond No. 1, Ash Pond No. 2, and the GMF Pond have been identified on an USGS 7-1/2 minute topographic quadrangle map in **Appendix A**.

§ 257.73(c)(1)(iii): A statement of the purpose for which the CCR unit is being used.

The following captures the purpose of each CCR unit:

- The Ash Pond No. 1 (inactive) was used to store and dispose of fly ash and bottom ash.
- The Ash Pond No. 2 (inactive) was used to store and dispose of fly ash and bottom ash and to clarify CCR contact stormwater prior to discharge in accordance with the station's Water Pollution Control Permit (#2015-EO-59369).
- The GMF Pond is being used to store and dispose of gypsum and to clarify recycled process water for plant operations.

Notice of intent to close Ash Pond No. 1 and Ash Pond No. 2 was provided in November, 2015.¹

¹ This history of construction report was prepared on a facility-wide basis for CCR surface impoundments at the Duck Creek Power Station. The inclusion of Ash Pond No. 1 and Ash Pond No. 2 in this history of construction report does not concede and should not be construed to concede that Ash Pond No. 1 and Ash Pond No. 2 are subject to the Design Criteria or all Operating Criteria in the CCR Rule.

§ 257.73(c)(1)(iv): The name and size in acres of the watershed where the CCR unit is located.

Ash Pond No. 1, Ash Pond No. 2, and the GMF Pond are located at the western edge of the Rice Lake-Illinois River Watershed with a 12-digit Hydrologic Unit Code (HUC) of 071300030603 and a drainage area of 21,203 acres (USGS, 2016).

§ 257.73(c)(1)(v): A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is constructed.

Physical properties of the foundation materials for Ash Pond No. 1 and Ash Pond No. 2 are primarily strip-mine spoils with variable thickness overlying shale bedrock. The mine spoils consist of a mixtures of native loess and glacial till and, to a lesser extent, the underlying (primarily shale) bedrock. The loess is classified as silty low plastic clay, with a zone of high plastic clay identified in the upper few feet of the stratum. The glacial till is classified as medium stiff to stiff, silty low plastic clay with trace sand and gravel.

Physical properties of the foundation materials for the GMF Pond are (from top to bottom) native loess, glacial till, and bedrock (primarily shale). The loess is classified as silty low plastic clay, with a zone of high plastic clay identified in the upper few feet of the stratum. The glacial till is classified as medium stiff to stiff, silty low plastic clay with trace sand and gravel.

An available summary of foundation material engineering properties for Ash Pond No.1, Ash Pond No. 2, and the GMF Pond is presented in **Table 1** below. The foundation material engineering properties are based on previous geotechnical explorations and laboratory testing.

Table 1. Summary of Foundation Material Engineering Properties

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c' (psf)	Φ' (°)	c (psf)	Φ (°)
Loess	116	100	32	1,250	0
Glacial Till	125	200	30	1,900	0
Mine Spoils	120	100	30	250	15
Shale Bedrock	130	300	26	600	13

Ash Pond No.1, Ash Pond No. 2, and the GMF Pond are enclosed impoundments with embankments and do not have abutments.

§ 257.73(c)(1)(vi): A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR unit; the method of site preparation and construction of each zone of the CCR unit; and the approximate dates of construction of each successive stage of construction of the CCR unit.

The embankments of the Ash Pond No. 1 and Ash Pond No. 2 were constructed with mine spoils excavated from within the center of the existing pond footprints. The mine spoils consist of a mixture of native loess and glacial till and, to a lesser extent, the underlying (primarily shale) bedrock. The loess is classified as silty low plastic clay, with a zone of high plastic clay identified in the upper few feet of the stratum. The glacial till is classified as medium stiff to stiff, silty low plastic clay with trace sand and gravel.

The embankments of the GMF Pond generally consists of silty, low plastic clay and generally had a stiff to very stiff consistency and appeared to be well-compacted material. The liner system within the GMF Pond consists of (from top to bottom) a 60-mil textured high density polyethylene (HDPE) geomembrane, 1-foot-thick layer of “cushion dirt”, 4-ounce geotechnical filter fabric, 1-foot-thick drainage layer, 10-ounce geotextile cushion, 60-mil textured HDPE geomembrane, a Bentomat SDN reinforced geosynthetic clay liner (GCL), and 3-foot-thick layer of compacted clay. A typical cross section profile of the liner system is shown on drawing C180-C102-8 presented in **Appendix B**.

An available summary of construction material engineering properties is presented in **Table 2** below. The construction material engineering properties are based on previous geotechnical investigations and laboratory testing.

Table 2. Summary of Construction Material Engineering Properties

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c' (psf)	Φ' (°)	c (psf)	Φ (°)
Liner-Cushion Material	116	0	38	660	0
Liner-Granular Drainage Layer	120	0	33	0	33
Liner-Geotextile /Geomembrane	75	100	25	100	25
Embankment Fill	116	150	32	2,150	0

The methods used for preparation and construction of Ash Pond No. 1 and Ash Pond No. 2 are not reasonably and readily available.

The site preparation work for the GMF Pond included stripping and stockpiling the topsoil. The subsoil was then excavated to approximately 5.4 feet above the proposed foundation grade and stockpiled. Temporary and permanent erosion control measures were also installed. The site was later excavated to the proposed subgrade and proof rolled to inspect for unsuitable soils. Any unsuitable soils were either removed or reworked. A sheepfoot roller was used to compact suitable backfill material placed in 8-inch lifts. Compaction testing was performed using a nuclear density gauge at a minimum rate of one test per 10,000 cubic yards (minimum one test per lift). Backfill was compacted to at least 95% of standard proctor maximum dry density and with a moisture content of -2% to +2% of optimum. Embankment

construction was performed using similar compacting and testing techniques as for the subgrade preparation.

Prior to constructing the clay liner for the GMF Pond, two test pad liners were constructed using separate borrow material. Testing of both liners indicated that the construction practice and material used were acceptable. The full scale clay liner was constructed with fill placed in 8-inch lifts and compacted with a sheepsfoot roller. Placed fill was compacted to at least 95% of standard proctor maximum dry density and with a moisture content of optimum to +5%. Compaction testing was performed using a nuclear density gauge at a minimum rate of one test per 1,000 cubic yards (minimum one test per lift). After the minimum clay liner thickness was achieved, the surface was smooth rolled in preparation of the GCL. The GCL and lower geomembrane were then placed sequentially followed by the 10-ounce geotextile cushion. A leak detection/leachate collection and recovery system (LD/LCRS) was then installed which includes a 1-foot-thick sand drainage layer and collection pipes. The sand was graded to minimum thickness using a dozer. The LD/LCRS was completed by placing a 4-ounce geotechnical filter fabric on top of the sand. A 1-foot-thick "cushion dirt" layer was then placed using a dozer to spread general fill. The liner was completed by placing the upper geomembrane on top.

The approximate dates of each successive event stage of construction of Ash Pond No. 1, Ash Pond No. 2, and the GMF Pond are provided in **Table 3** below.

Table 3. Approximate dates of construction of each successive stage of construction.

Date	Event
1976	Ash Pond No. 1 was commissioned
1986	Ash Pond No. 2 was commissioned
2007	Surface preparation for GMF Pond began
2008-2009	Construction of GMF Pond

§ 257.73(c)(1)(vii): At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection, in addition to the normal operating pool surface elevation and the maximum pool surface elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment, and any identifiable natural or manmade features that could adversely affect operation of the CCR unit due to malfunction or mis-operation.

Drawings that contain items pertaining to the requested information for Ash Pond No. 1, Ash Pond No. 2, and the GMF Pond are listed in **Table 4** below. Items marked as "Not Available" are items not found during review of reasonably and readily available record documentation

Table 4. List of drawings containing items pertaining to the information requested in § 257.73(c)(1)(vii).

	Ash Pond No. 1	Ash Pond No. 2	GMF Pond
Dimensional plan view (all zones)	C180-G1916-3	C180-G1916-4, C180-G1916-6	C180-C102-8 thru -11
Dimensional cross sections	C180-G1916-3	C180-G1916-7	C180-C102-12 thru -14
Foundation Improvements	C180-G1916-3	C180-G1916-7	Not Applicable
Drainage Provisions	Not Applicable	C180-G1916-9 thru -11, M-1001	C180-C102-12 thru -14 C180-C102-30 thru -31
Spillways and Outlets	C180-G1916-3	C180-G1916-8	C180-C102-15, C180-C102-29
Diversion Ditches	Not Applicable	Not Applicable	Not Applicable
Instrument Locations	Figure in Appendix C, Plate 2	Figure in Appendix C, Plate 2	Not Applicable
Slope Protection	C180-G1916-3	Not Available	C180-C102-12
Normal Operating Pool Elevation	Not Available	Not Available	Not Available
Maximum Pool Elevation	C180-G1916	C180-G1916-7	Not Available
Approximate Maximum Depth of CCR in 2016	68 feet	59 feet	25 feet

All drawings referenced in the table above can be found in **Appendix B** and **Appendix C**.

Based on the review of the drawings listed above, no natural or manmade features that could adversely affect operation of these CCR units due to malfunction or mis-operation were identified.

§ 257.73(c)(1)(viii): A description of the type, purpose, and location of existing instrumentation.

Existing instrumentation at Ash Pond No. 1 and Ash Pond No. 2 consists of open-standpipe piezometers. The purpose of the piezometers is to measure the pore water pressures within and around the CCR units. Two (2) piezometers (B-2 and B-5) were installed in 2010 and the locations are presented on Plate 2 in **Appendix C**. Five (5) additional piezometers were installed in 2010 and the locations are presented in **Appendix C**.

The GMF Pond does not contain existing instrumentation used for monitoring the operation of the CCR unit.

§ 257.73(c)(1)(ix): Area-capacity curves for the CCR unit.

Area-capacity curves for the Ash Pond No. 1 and Ash Pond No. 2 are not reasonably and readily available. The area-capacity curve for the GMF Pond is presented in **Figure 1** below. “Area-capacity curves”, as defined by 40 CFR § 257.53, “means graphic curves which readily show the reservoir water surface area, in acres, at different elevations from the bottom of the reservoir to the maximum water surface, and the capacity or volume, in acre-feet, of the water contained in the reservoir at various elevations.”

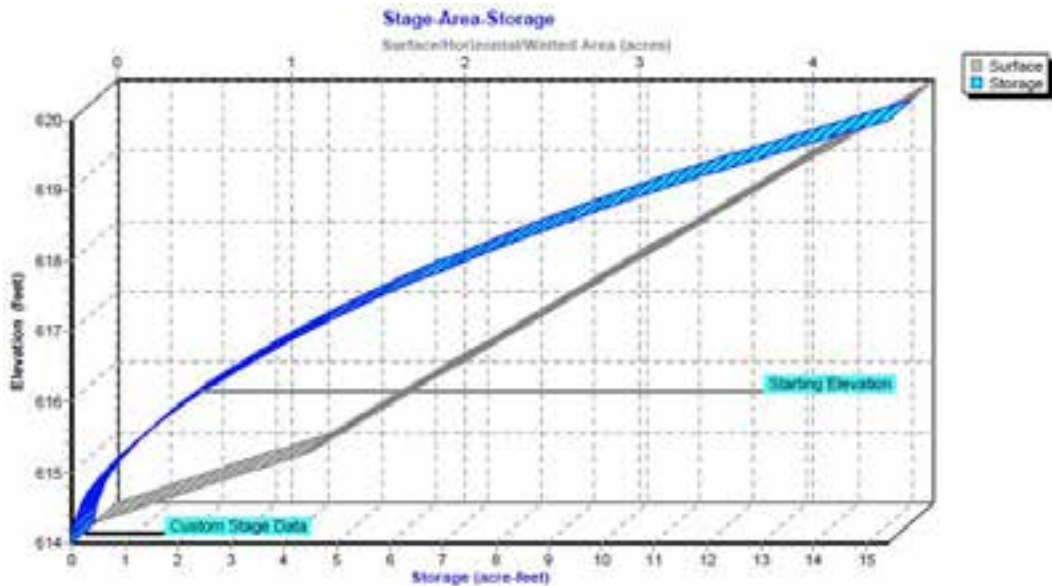


Figure 1. Area-capacity curve for GMF Pond prepared in 2016

§ 257.73(c)(1)(x): A description of each spillway and diversion design features and capacities and calculations used in their determination.

Ash Pond No. 1 does not contain an active spillway or diversion feature. Stormwater collected in Ash Pond No. 1 is manually pumped to Ash Pond No. 2 at the judgement of plant personnel. Current discharge capacity and calculation information for Ash Pond No. 1 is not reasonably and readily available.

Stormwater collected in Ash Pond No. 2 is drained via a 36-inch diameter (dia.) steel morning glory spillway, formed by 2-foot tall stacked sections, located in the northeast corner of the pond. The spillway transitions to a 36-inch dia. reinforced concrete pipe (RCP) and drains towards the return water pumphouse and discharges in accordance with the station’s Water Pollution Control Permit. Current discharge capacity and calculation information for Ash Pond No. 2 is not reasonably and readily available.

The GMF Pond contains a transfer channel that discharges clear water into the GMF Recycle Pond. The transfer channel is trapezoidal in shape with 3H:1V side slopes. The channel transitions from a 16-foot bottom width at an invert elevation of 616 feet at the upstream end to a 35-foot bottom width at an invert elevation of 609 feet at the downstream end. In 2016 the discharge capacity of the GMF Pond was evaluated using HydroCAD 8.50 software modeling a 1,000-year, 24-hour rainfall event. The results of the HydroCAD 8.50 analysis are presented below in **Table 5**.

Table 5. Results of HydroCAD 8.50 analyses

	GMF Pond
Approximate Minimum Berm Elevation ¹ (ft)	620.0
Approximate Emergency Spillway Elevation ¹ (ft)	616.0
Starting Pool Elevation ¹ (ft)	616.0
Peak Elevation ¹ (ft)	618.3
Time to Peak (hr)	12.0
Surface Area (ac)	3.5
Storage ² (ac-ft)	8.3

- Notes: 1. Elevations are based on NAVD88 datum.
 2. Storage given is from Starting Pool Elevation to Peak Elevation

§ 257.73(c)(1)(xi): The construction specifications and provisions for surveillance, maintenance, and repair of the CCR unit.

The construction specification for Ash Pond No. 1 is located in Technical Specification Section 21, however the construction specification is not reasonably and readily available. The construction specification for the Ash Pond No. 2 is not reasonably and readily available. The construction specification for the GMF Pond is located in *Project Manual; Specification No's.: C180-C102* (presented in **Appendix D**).

The provisions for surveillance, general maintenance, and repair of the GMF Pond are presented in **Appendix E**.

The operations and maintenance plans for Ash Pond No. 1, Ash Pond No. 2, and GMF Pond are currently either being generated or being revised by Illinois Power Resources Generating,

LLC. This section will be updated when the new operations and maintenance plans are available.

§ 257.73(c)(1)(xii): Any record or knowledge of structural instability of the CCR unit.

There is no record or knowledge of structural instability of Ash Pond No. 1, Ash Pond No. 2, and the GMF Pond at Duck Creek Power Station.

LIMITATIONS

The signature of AECOM's authorized representative on this document represents that to the best of AECOM's knowledge, information and belief in the exercise of its professional judgment, it is AECOM's professional opinion that the aforementioned information is accurate as of the date of such signature. Any recommendation, opinion or decisions by AECOM are made on the basis of AECOM's experience, qualifications and professional judgment and are not to be construed as warranties or guaranties. In addition, opinions relating to environmental, geologic, and geotechnical conditions or other estimates are based on available data and that actual conditions may vary from those encountered at the times and locations where data are obtained, despite the use of due care.

Sincerely,



Claudia Prado
Project Manager



Victor Modeer, P.E., D.GE
Senior Project Manager

REFERENCES

United States Environmental Protection Agency (USEPA). (2015). *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule*. 40 CFR Parts 257 and 261, 80 Fed. Reg. 21302, 21380 April 17, 2015.

United States Geological Survey (USGS). (2016). The National Map Viewer. <http://viewer.nationalmap.gov/viewer/>. USGS data first accessed in March of 2016.

APPENDICES

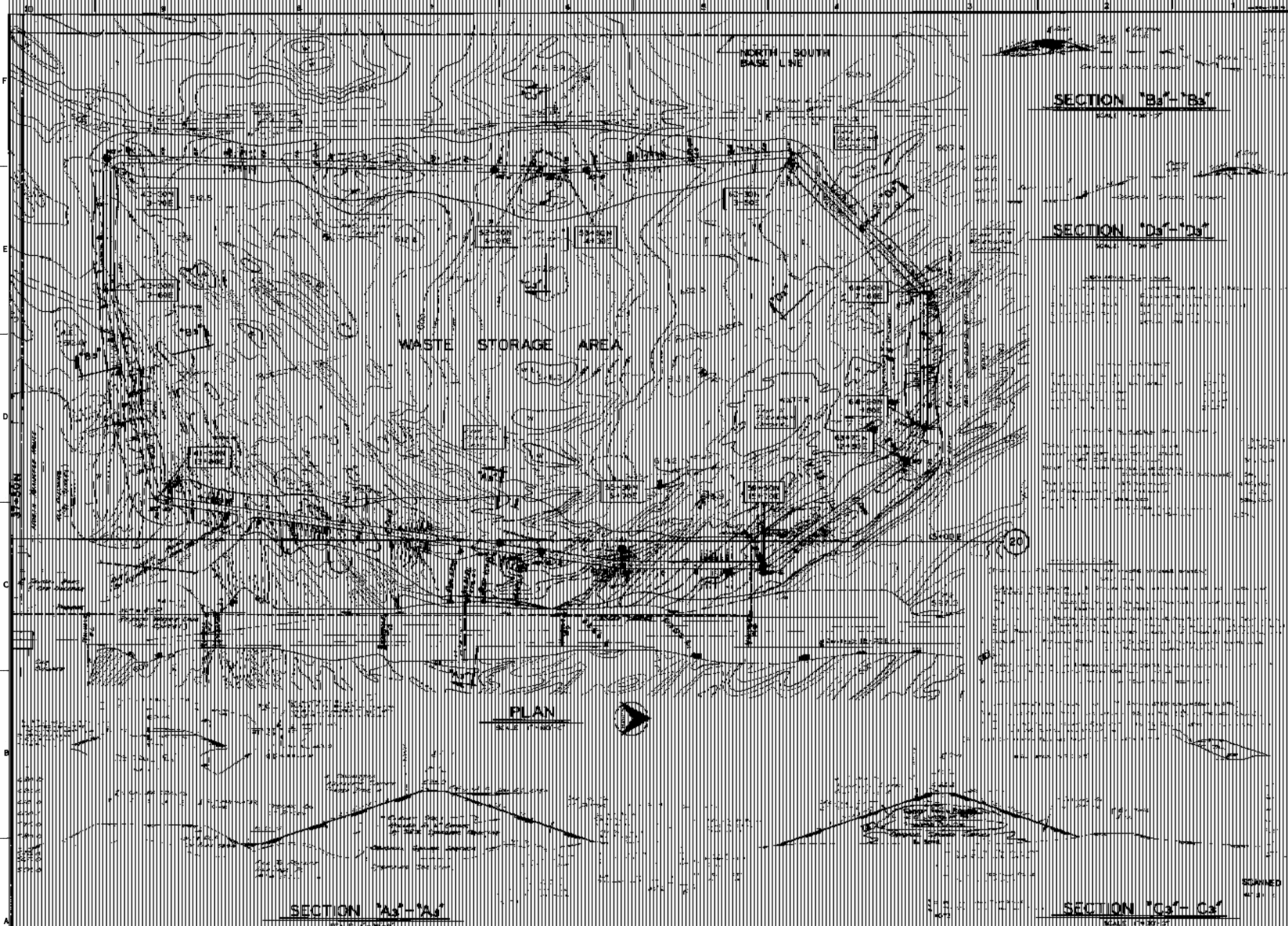
- Appendix A: History of Construction Vicinity Map
- Appendix B: Duck Creek Power Station Drawings
- Appendix C: Duck Creek Power Station Boring and Piezometer Locations
- Appendix D: Project Manual; Specification No's.: C180-C102 (excerpt)
- Appendix E: Operation and Maintenance Manual, Duck Creek Energy Center, Gypsum Management Facility



Appendix A: History of Construction Vicinity Map

Appendix B: Duck Creek Power Station Drawings

1. "Waste Storage System, Plan and Details of Dike Embankment", Drawing No. C180-G1916-3, Revision D, 13 February, 1975, Commonwealth Associates Inc.
2. "Waste Disposal System, Site Plan", Drawing No. C180-G1916-4, Revision C, 16 October, 1984, Commonwealth Associates Inc.
3. "Waste Disposal Area II, Site Plan", Drawing No. C180-G1916-6, Revision G, 16 October, 1984, Commonwealth Associates Inc.
4. "Waste Disposal System, Dike Sections and Details", Drawing No. C180-G1916-7, Revision D, 16 October, 1984, Commonwealth Associates Inc.
5. "Waste Disposal System, Inlet and Outlet Details", Drawing No. C180-G1916-8, Revision E, 16 October, 1984, Commonwealth Associates Inc.
6. "Waste Disposal Area II, Outlet Pipe Plan & Profile", Drawing No. C180-G1916-9, Revision E, 11 October, 1984, Commonwealth Associates Inc.
7. "Waste Disposal System, Pipe Profile and Details", Drawing No. C180-G1916-10, Revision E, 10 October, 1984, Commonwealth Associates Inc.
8. "Waste Disposal System, Miscellaneous Details", Drawing No. C180-G1916-11, Revision E, 10 October, 1984, Commonwealth Associates Inc.
9. "Pipe Plan & Profile, Recycle Pond Bypass", Drawing No. M-1001, Revision 0, 30 July, 2004, Sargent & Lundy LLC.
10. "Gypsum Stack – Foundation Grade", Drawing No. C180-C102-8, Revision 6, 5 March, 2009, Hanson Professional Services, Inc.
11. "Gypsum Stack – Clay Layer Grade", Drawing No. C180-C102-9, Revision 4, 5 March, 2009, Hanson Professional Services, Inc.
12. "Gypsum Stack – LD/LCRS Drainage Layer Grade", Drawing No. C180-C102-10, Revision 6, 5 March, 2009, Hanson Professional Services, Inc.
13. "PWRS-Ring Drain System Cushion Dirt Layer Grade", Drawing No. C180-C102-11, Revision 6, 5 March, 2009, Hanson Professional Services, Inc.
14. "PWRS-Ring Drain Details", Drawing No. C180-C102-12, Revision 5, 5 March, 2009, Hanson Professional Services, Inc.
15. "PWRS-Ring Drain Details", Drawing No. C180-C102-13, Revision 2, 5 March, 2009, Hanson Professional Services, Inc.
16. "LD/LCRS Sections & Details", Drawing No. C180-C102-14, Revision 3, 5 March, 2009, Hanson Professional Services, Inc.
17. "Recycle Pond Plan", Drawing No. C180-C102-15, Revision 5, 5 March, 2009, Hanson Professional Services, Inc.
18. "Miscellaneous Details", Drawing No. C180-C102-29, Revision 2, 5 March, 2009, Hanson Professional Services, Inc.
19. "LD/LCRS Underdrain Dewatering System-Seep 1", Drawing No. C180-C102-30, Revision 2, 5 March, 2009, Hanson Professional Services, Inc.
20. "LD/LCRS Underdrain Dewatering System-Seep 2", Drawing No. C180-C102-31, Revision 2, 5 March, 2009, Hanson Professional Services, Inc.



SECTION "B1-B1"
SCALE 1"=100'

SECTION "D1-D1"
SCALE 1"=100'

PLAN
SCALE 1"=100'

SECTION "A1-A1"
SCALE 1"=100'

SECTION "C1-C1"
SCALE 1"=100'

SEWED
4-1-1

<p>DATE: 11/1/54</p> <p>BY: [Signature]</p> <p>CHECKED: [Signature]</p> <p>SCALE: 1"=100'</p>	<p>PROJECT: [Text]</p> <p>DESCRIPTION: [Text]</p> <p>LOCATION: [Text]</p>	<p>DESIGNED BY: [Text]</p> <p>DRAWN BY: [Text]</p> <p>CHECKED BY: [Text]</p>	<p>APPROVED BY: [Text]</p> <p>DATE: [Text]</p>
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GENERAL NOTES

1. SITE SURVEY FROM DEBRIS SERIAL SURVEY HAPPEN ON OCTOBER 1991 (BOOKS 1-11, 17-20).
2. THE AREA WITH WASTE DISPOSAL AREA I, RECYCLE POND AND ALL DYE FOUNDATIONS, FILL AREAS, WASHING AREAS AND BRAM ENCLOSURES SHALL BE CLEARED PRIOR TO ANY SUBSEQUENT WORK.
3. ALL SUBMITTERS SHALL BE APPROVED BY THE OWNER. REPRESENTATIVE WORK TO THE PLACEMENT OF CULVERT.
4. ALL DYE ENCLOSURE SHALL BE COMPACTED TO 98% OF MAXIMUM DENSITY AS OBTAINED BY ASTM D 1557.
5. ALL RANDOM FILL AREAS SHALL BE COMPACTED TO 90% OF MAXIMUM DENSITY AS OBTAINED BY ASTM D 1557. RANDOM FILL SHALL BE SLOPED AWAY FROM DEBRIS AREA AND WASHING POND & TOWARDS WASHING POND. FILL SHALL BE AS FOLLOWS:
 - AREA (1) MINIMUM ELEVATION 580.0 AND SLOPE TO TRACKS.
 - AREA (2) MINIMUM ELEVATION 580.0 AND SLOPE TO TRACKS.
 - AREA (3) AS REQUIRED FOR THE PURPOSE OF VENTILATION IN SUITABLE FOR CONNECTION.
 - AREA (4) MINIMUM ELEVATION 580.0 AND SLOPE TO TRACKS.
 - AREA (5) MINIMUM ELEVATION 580.0 AND SLOPE TO ROAD.

EXIST. FUTURE WATERLINE

WASTE DISPOSAL AREA I

WASTE DISPOSAL AREA II

RECYCLE POND

EMERGENCY DRAINAGE

CONTRACT No. 42078
USE OF DRAWINGS

DESCRIPTION	DATE
1. 100% DESIGN	10/1/91
2. 90% DESIGN	10/1/91
3. 80% DESIGN	10/1/91
4. 70% DESIGN	10/1/91
5. 60% DESIGN	10/1/91
6. 50% DESIGN	10/1/91
7. 40% DESIGN	10/1/91
8. 30% DESIGN	10/1/91
9. 20% DESIGN	10/1/91
10. 10% DESIGN	10/1/91

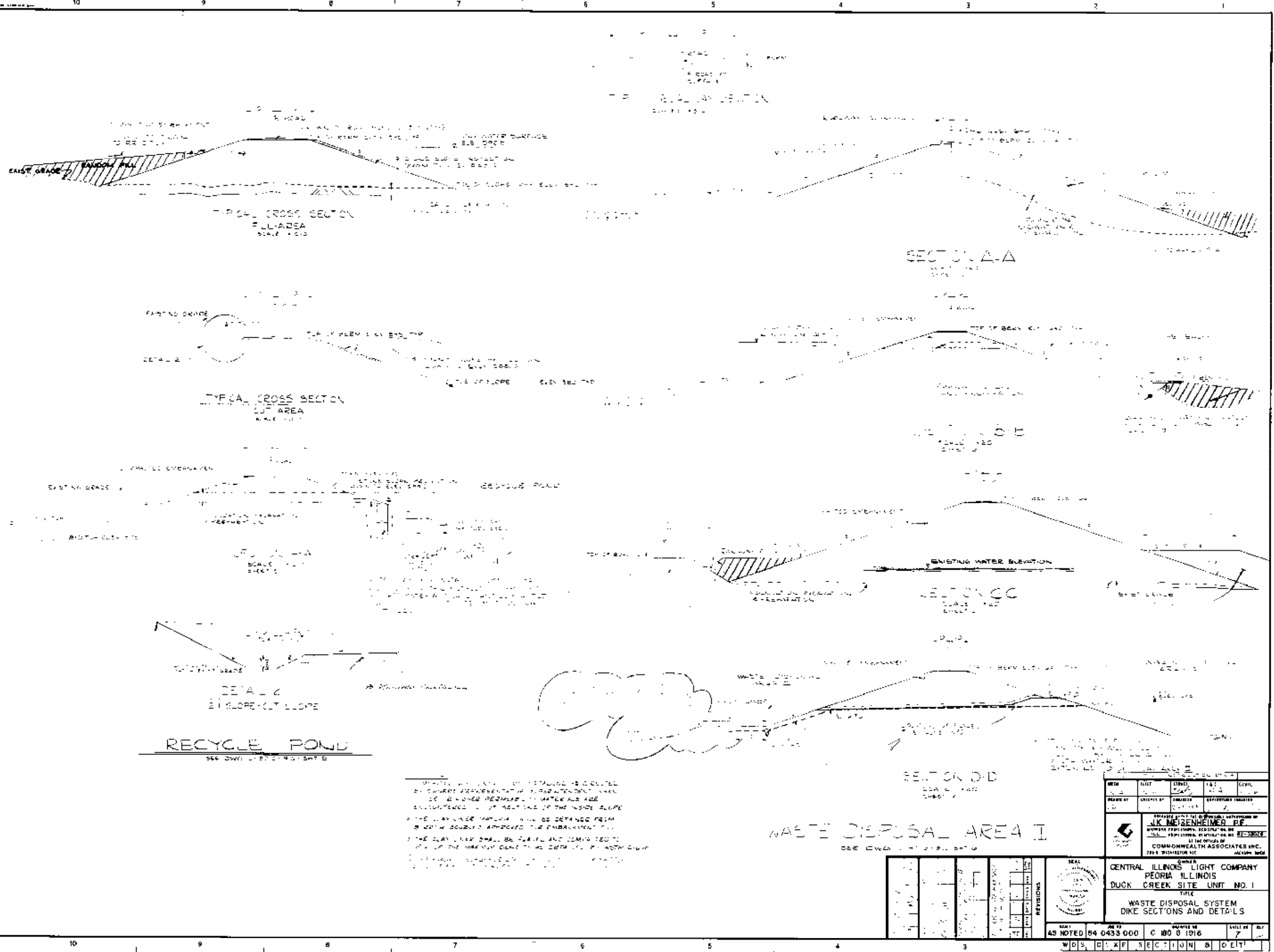
- LEGEND**
- WASTE DISPOSAL AREA AND RECYCLE POND BOUNDARY
 - ▨ WASTE DISPOSAL FILL AREAS
 - EXISTING UTILITIES, DRAINAGE
 - WASTEWATER WELL
 - EMERGENCY AREA OR DYE BOUNDARY
 - WASHING AREA BOUNDARY

PLAN

SCALE: 1" = 40'

DATE	BY	CHKD	APP'D
10/1/91	J. J. [Signature]	[Signature]	[Signature]
<p>DESIGNER: [Signature]</p> <p>CHECKED: [Signature]</p> <p>APPROVED: [Signature]</p>			


CENTRAL ILLINOIS LIGHT COMPANY
 PEORIA, ILLINOIS
 DUCK CREEK SITE - UNIT NO. 1
 WASTE DISPOSAL SYSTEM
 SITE PLAN
 17-200 64-0433-000 080-21106



SECTION A-A
SCALE 1/4" = 1'-0"

SECTION B-B
SCALE 1/4" = 1'-0"

SECTION C-C
SCALE 1/4" = 1'-0"

SECTION D-D
SCALE 1/4" = 1'-0"

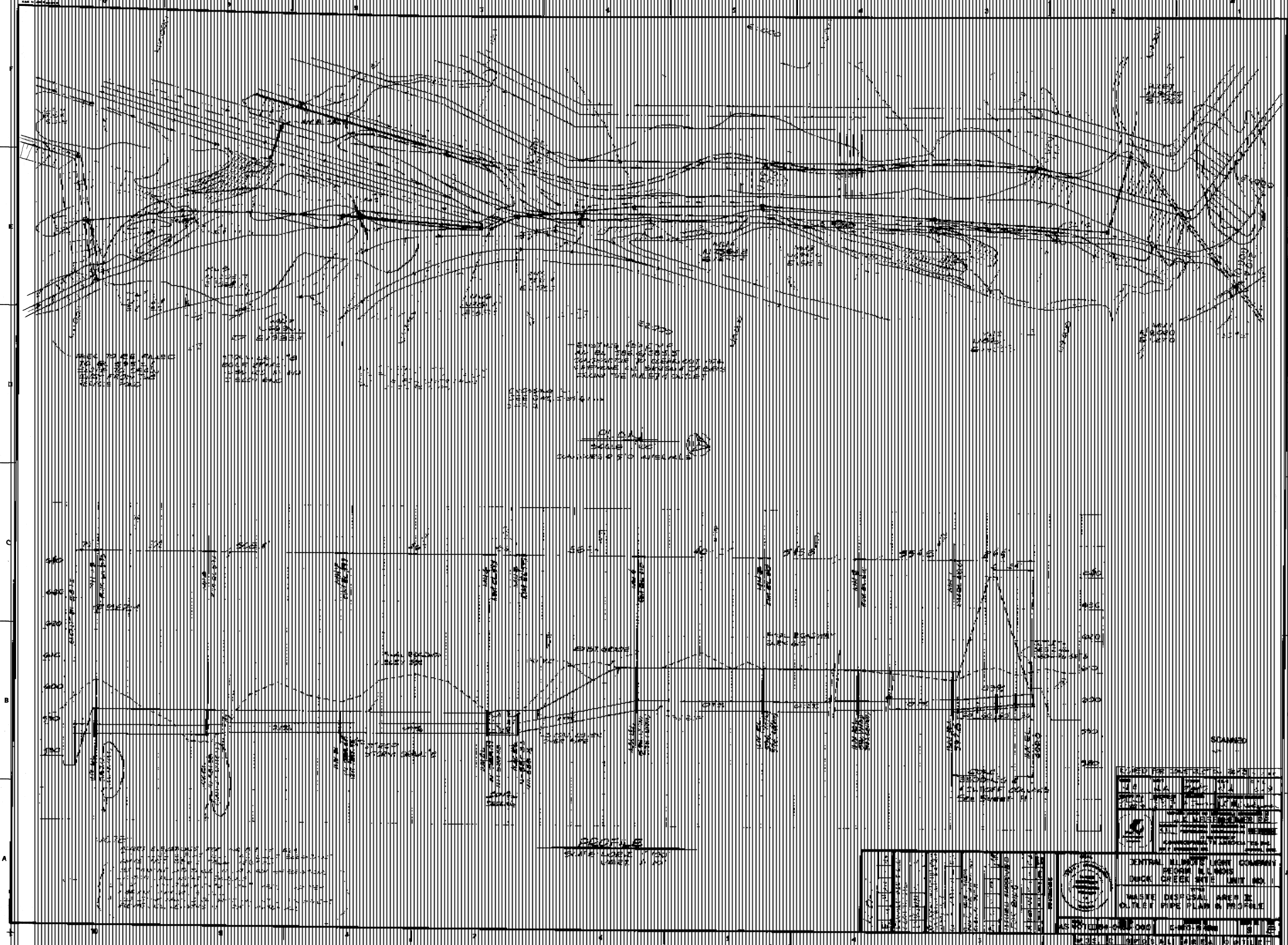
RECYCLE POND
SEE DWG. 141-219-SHT B

WHEN THE CLAY LAYER IS DETACHED FROM THE SOIL AS SHOWN IN THE EMBANKMENT, THE CLAY LAYER SHALL BE CURLED AND LAMINATED TO THE TOP OF THE MAXIMUM DRAINAGE DETAIL. THE CLAY LAYER SHALL BE CURLED AND LAMINATED TO THE TOP OF THE MAXIMUM DRAINAGE DETAIL. THE CLAY LAYER SHALL BE CURLED AND LAMINATED TO THE TOP OF THE MAXIMUM DRAINAGE DETAIL.

WASTE DISPOSAL AREA I
SEE DWG. 141-219-SHT B

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MECH	ELECT	PLUMB	PAV	CIVIL
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CENTRAL ILLINOIS LIGHT COMPANY PEORIA, ILLINOIS DUCK CREEK SITE UNIT NO. 1 TITLE WASTE DISPOSAL SYSTEM DIKE SECTIONS AND DETAILS				
SCALE	AS NOTED	PROJECT NO.	84 0433 000	DATE OF ISSUE
				7/19/16
WDS - D - X - F - SECTION 8 - 0 - 11				



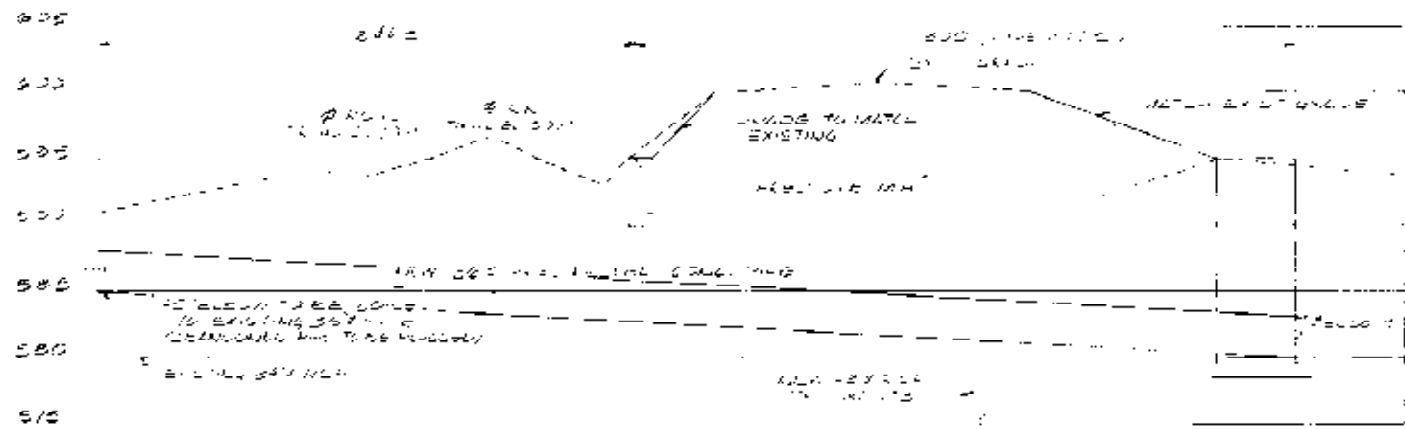
PLAN
SCALE 1" = 100'
DRAINAGE DIST. APPROXIMATE

PROFILE
SCALE 1" = 100'
VERT. CURVE 100'

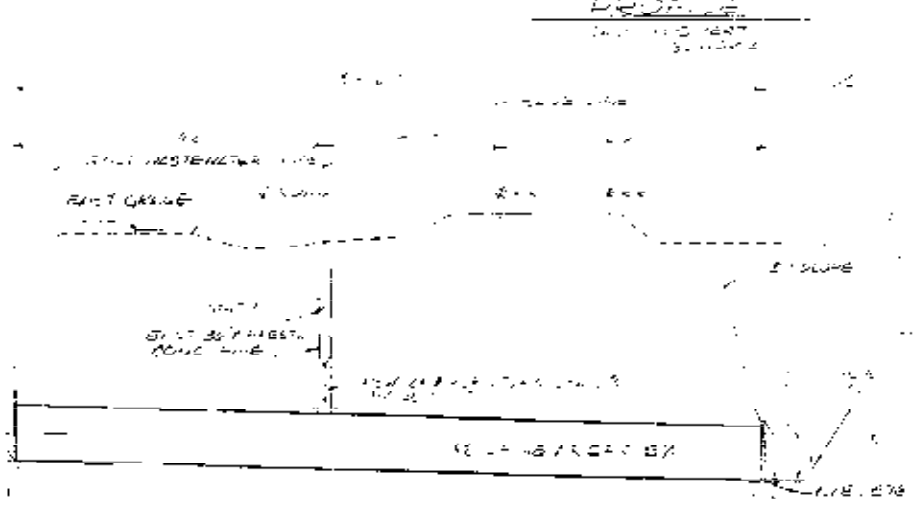
MANHOLE NO. 1
VALVE NO. 1
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VALVE NO. 48
VALVE NO. 49
VALVE NO. 50
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VALVE NO. 84
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VALVE NO. 86
VALVE NO. 87
VALVE NO. 88
VALVE NO. 89
VALVE NO. 90
VALVE NO. 91
VALVE NO. 92
VALVE NO. 93
VALVE NO. 94
VALVE NO. 95
VALVE NO. 96
VALVE NO. 97
VALVE NO. 98
VALVE NO. 99
VALVE NO. 100

STAMPED

PROJECT NO.	DATE
SCALE	BY
CHECKED	DATE
APPROVED	DATE
CENTRAL ILLINOIS LIGHT COMPANY PEORIA, ILLINOIS DUCK CREEK SITE UNIT NO. 1 WASTE DISPOSAL AREA II OUTLET PIPE PLAN & PROFILE	



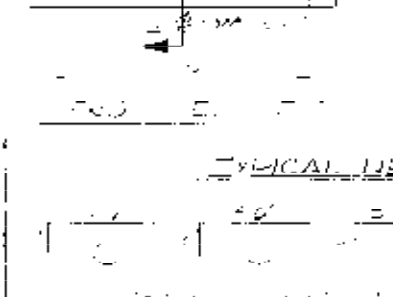
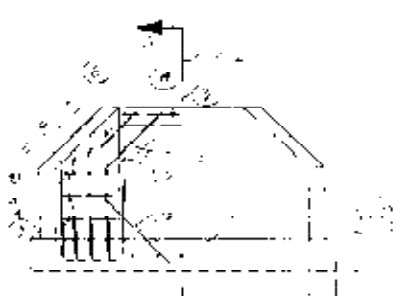
REINFORCE HOW RETURN INTERLACE



STORM DRAIN #2

NO.	SIZE	LENGTH	TYPE	INVERT	OUTLET	END CONDITION
1	18"	100'	24"	578.00	588.00	MANHOLE
2	18"	100'	24"	588.00	598.00	MANHOLE
3	18"	100'	24"	598.00	608.00	MANHOLE
4	18"	100'	24"	608.00	618.00	MANHOLE
5	18"	100'	24"	618.00	628.00	MANHOLE
6	18"	100'	24"	628.00	638.00	MANHOLE
7	18"	100'	24"	638.00	648.00	MANHOLE
8	18"	100'	24"	648.00	658.00	MANHOLE
9	18"	100'	24"	658.00	668.00	MANHOLE
10	18"	100'	24"	668.00	678.00	MANHOLE
11	18"	100'	24"	678.00	688.00	MANHOLE
12	18"	100'	24"	688.00	698.00	MANHOLE
13	18"	100'	24"	698.00	708.00	MANHOLE
14	18"	100'	24"	708.00	718.00	MANHOLE
15	18"	100'	24"	718.00	728.00	MANHOLE
16	18"	100'	24"	728.00	738.00	MANHOLE
17	18"	100'	24"	738.00	748.00	MANHOLE
18	18"	100'	24"	748.00	758.00	MANHOLE
19	18"	100'	24"	758.00	768.00	MANHOLE
20	18"	100'	24"	768.00	778.00	MANHOLE

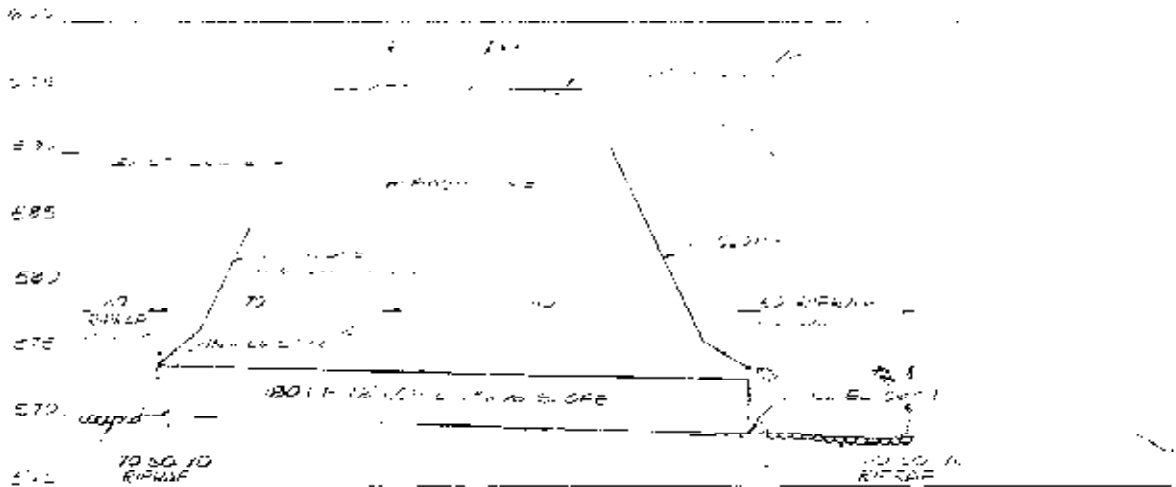
NO.	DESCRIPTION	QUANTITY	UNIT	TOTAL
1	2# BARS	100	LINEAL FEET	100
2	4# BARS	100	LINEAL FEET	100
3	6# BARS	100	LINEAL FEET	100
4	8# BARS	100	LINEAL FEET	100
5	10# BARS	100	LINEAL FEET	100
6	12# BARS	100	LINEAL FEET	100
7	14# BARS	100	LINEAL FEET	100
8	16# BARS	100	LINEAL FEET	100
9	18# BARS	100	LINEAL FEET	100
10	20# BARS	100	LINEAL FEET	100
11	22# BARS	100	LINEAL FEET	100
12	24# BARS	100	LINEAL FEET	100
13	26# BARS	100	LINEAL FEET	100
14	28# BARS	100	LINEAL FEET	100
15	30# BARS	100	LINEAL FEET	100
16	32# BARS	100	LINEAL FEET	100
17	34# BARS	100	LINEAL FEET	100
18	36# BARS	100	LINEAL FEET	100
19	38# BARS	100	LINEAL FEET	100
20	40# BARS	100	LINEAL FEET	100
21	42# BARS	100	LINEAL FEET	100
22	44# BARS	100	LINEAL FEET	100
23	46# BARS	100	LINEAL FEET	100
24	48# BARS	100	LINEAL FEET	100
25	50# BARS	100	LINEAL FEET	100
26	52# BARS	100	LINEAL FEET	100
27	54# BARS	100	LINEAL FEET	100
28	56# BARS	100	LINEAL FEET	100
29	58# BARS	100	LINEAL FEET	100
30	60# BARS	100	LINEAL FEET	100
31	62# BARS	100	LINEAL FEET	100
32	64# BARS	100	LINEAL FEET	100
33	66# BARS	100	LINEAL FEET	100
34	68# BARS	100	LINEAL FEET	100
35	70# BARS	100	LINEAL FEET	100
36	72# BARS	100	LINEAL FEET	100
37	74# BARS	100	LINEAL FEET	100
38	76# BARS	100	LINEAL FEET	100
39	78# BARS	100	LINEAL FEET	100
40	80# BARS	100	LINEAL FEET	100
41	82# BARS	100	LINEAL FEET	100
42	84# BARS	100	LINEAL FEET	100
43	86# BARS	100	LINEAL FEET	100
44	88# BARS	100	LINEAL FEET	100
45	90# BARS	100	LINEAL FEET	100
46	92# BARS	100	LINEAL FEET	100
47	94# BARS	100	LINEAL FEET	100
48	96# BARS	100	LINEAL FEET	100
49	98# BARS	100	LINEAL FEET	100
50	100# BARS	100	LINEAL FEET	100



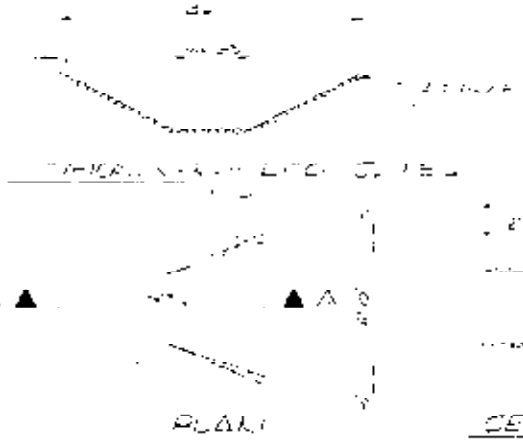
SECTION AA

TYPICAL HEADWALL DETAILS

PIPE BAR DETAILS



STORM DRAIN #4



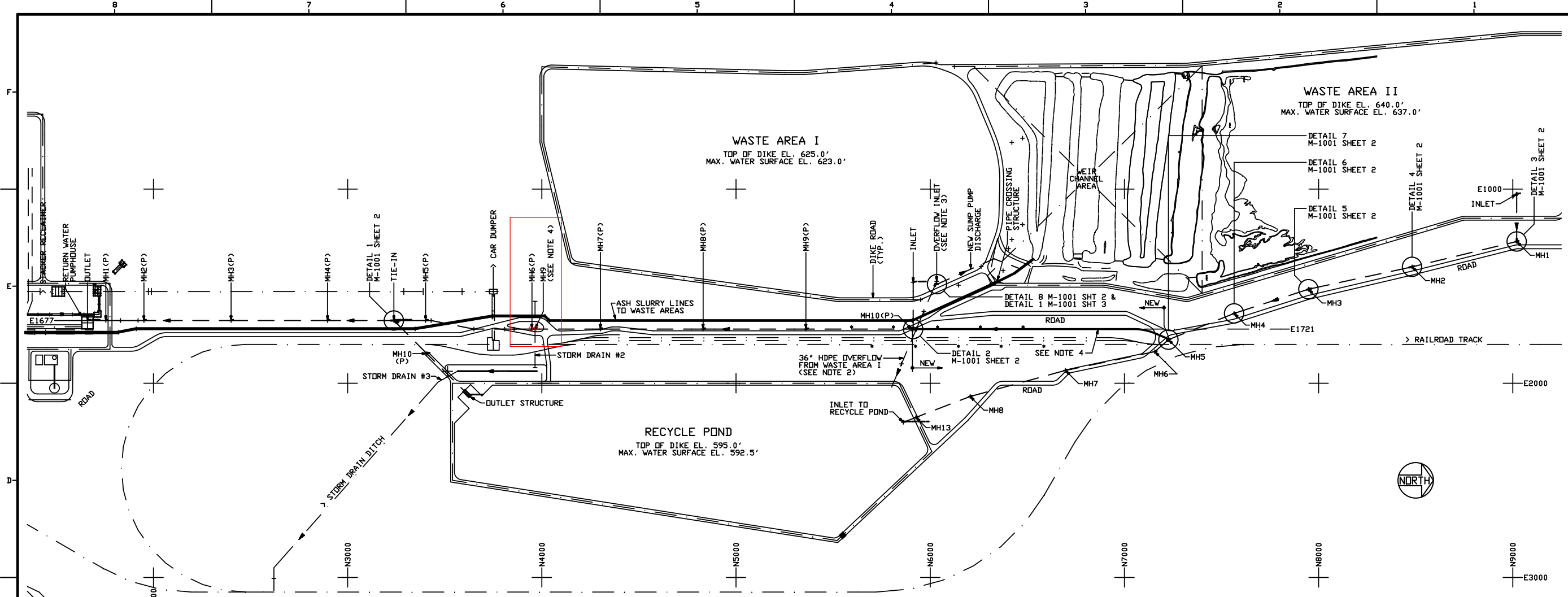
SECTION AA

24\"/>

NO.	DESCRIPTION	QUANTITY	UNIT	TOTAL
1	2# BARS	100	LINEAL FEET	100
2	4# BARS	100	LINEAL FEET	100
3	6# BARS	100	LINEAL FEET	100
4	8# BARS	100	LINEAL FEET	100
5	10# BARS	100	LINEAL FEET	100
6	12# BARS	100	LINEAL FEET	100
7	14# BARS	100	LINEAL FEET	100
8	16# BARS	100	LINEAL FEET	100
9	18# BARS	100	LINEAL FEET	100
10	20# BARS	100	LINEAL FEET	100
11	22# BARS	100	LINEAL FEET	100
12	24# BARS	100	LINEAL FEET	100
13	26# BARS	100	LINEAL FEET	100
14	28# BARS	100	LINEAL FEET	100
15	30# BARS	100	LINEAL FEET	100
16	32# BARS	100	LINEAL FEET	100
17	34# BARS	100	LINEAL FEET	100
18	36# BARS	100	LINEAL FEET	100
19	38# BARS	100	LINEAL FEET	100
20	40# BARS	100	LINEAL FEET	100
21	42# BARS	100	LINEAL FEET	100
22	44# BARS	100	LINEAL FEET	100
23	46# BARS	100	LINEAL FEET	100
24	48# BARS	100	LINEAL FEET	100
25	50# BARS	100	LINEAL FEET	100
26	52# BARS	100	LINEAL FEET	100
27	54# BARS	100	LINEAL FEET	100
28	56# BARS	100	LINEAL FEET	100
29	58# BARS	100	LINEAL FEET	100
30	60# BARS	100	LINEAL FEET	100
31	62# BARS	100	LINEAL FEET	100
32	64# BARS	100	LINEAL FEET	100
33	66# BARS	100	LINEAL FEET	100
34	68# BARS	100	LINEAL FEET	100
35	70# BARS	100	LINEAL FEET	100
36	72# BARS	100	LINEAL FEET	100
37	74# BARS	100	LINEAL FEET	100
38	76# BARS	100	LINEAL FEET	100
39	78# BARS	100	LINEAL FEET	100
40	80# BARS	100	LINEAL FEET	100
41	82# BARS	100	LINEAL FEET	100
42	84# BARS	100	LINEAL FEET	100
43	86# BARS	100	LINEAL FEET	100
44	88# BARS	100	LINEAL FEET	100
45	90# BARS	100	LINEAL FEET	100
46	92# BARS	100	LINEAL FEET	100
47	94# BARS	100	LINEAL FEET	100
48	96# BARS	100	LINEAL FEET	100
49	98# BARS	100	LINEAL FEET	100
50	100# BARS	100	LINEAL FEET	100

CENTRAL ILLINOIS LIGHT COMPANY
 GEORGE ILLINOIS
 CUCK CREEK SITE UNIT NO. 1
 WASTE DISPOSAL SYSTEM
 PIPE PROFILE AND DETAILS

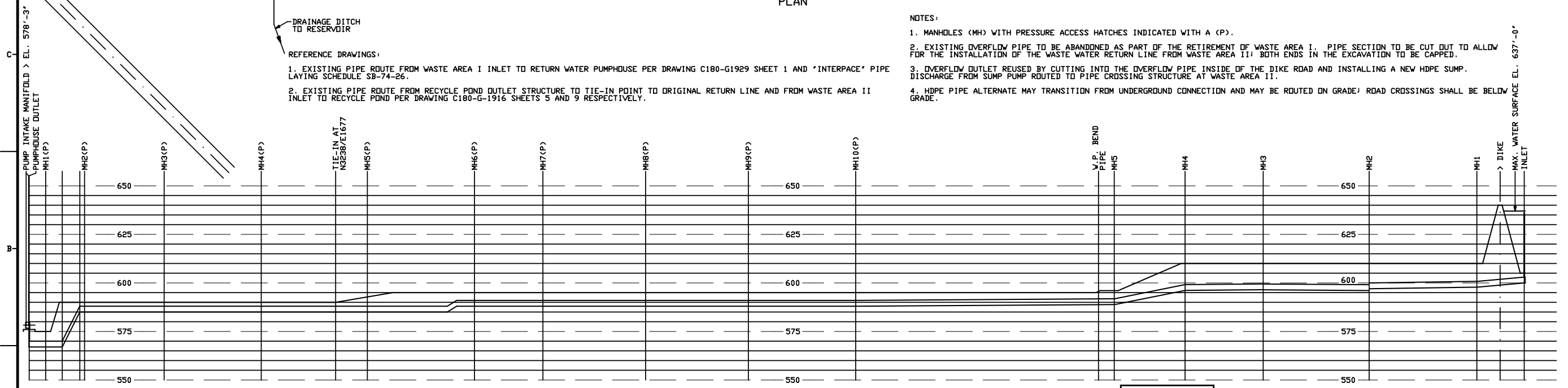
DATE: AS NOTED 64 0433-000
 DRAWING NO: C 180 6 1916
 SHEET NO: 10 OF 2



PLAN

- NOTES:
1. MANHOLES (MH) WITH PRESSURE ACCESS HATCHES INDICATED WITH A (P).
 2. EXISTING OVERFLOW PIPE TO BE ABANDONED AS PART OF THE RETIREMENT OF WASTE AREA I. PIPE SECTION TO BE CUT OUT TO ALLOW FOR THE INSTALLATION OF THE WASTE WATER RETURN LINE FROM WASTE AREA II. BOTH ENDS IN THE EXCAVATION TO BE CAPPED.
 3. OVERFLOW OUTLET REUSED BY CUTTING INTO THE OVERFLOW PIPE INSIDE OF THE DIKE ROAD AND INSTALLING A NEW HDPE SUMP. DISCHARGE FROM SUMP PUMP ROUTED TO PIPE CROSSING STRUCTURE AT WASTE AREA II.
 4. HDPE PIPE ALTERNATE MAY TRANSITION FROM UNDERGROUND CONNECTION AND MAY BE ROUTED ON GRADE. ROAD CROSSINGS SHALL BE BELOW GRADE.

- REFERENCE DRAWINGS:
1. EXISTING PIPE ROUTE FROM WASTE AREA I INLET TO RETURN WATER PUMPHOUSE PER DRAWING C180-G1929 SHEET 1 AND 'INTERPACE' PIPE LAYING SCHEDULE SB-74-26.
 2. EXISTING PIPE ROUTE FROM RECYCLE POND OUTLET STRUCTURE TO TIE-IN POINT TO ORIGINAL RETURN LINE AND FROM WASTE AREA II INLET TO RECYCLE POND PER DRAWING C180-G-1916 SHEETS 5 AND 9 RESPECTIVELY.



PROFILE
 SCALES: HORIZONTAL 1" = 200' / VERTICAL 1" = 20'

ANY MODIFICATION OR ADDITION TO THIS DRAWING BY AN ORGANIZATION OTHER THAN SARGENT & LUNDY IS NOT THE RESPONSIBILITY OF SARGENT & LUNDY

FILE I.D.: M1001 01.DGN

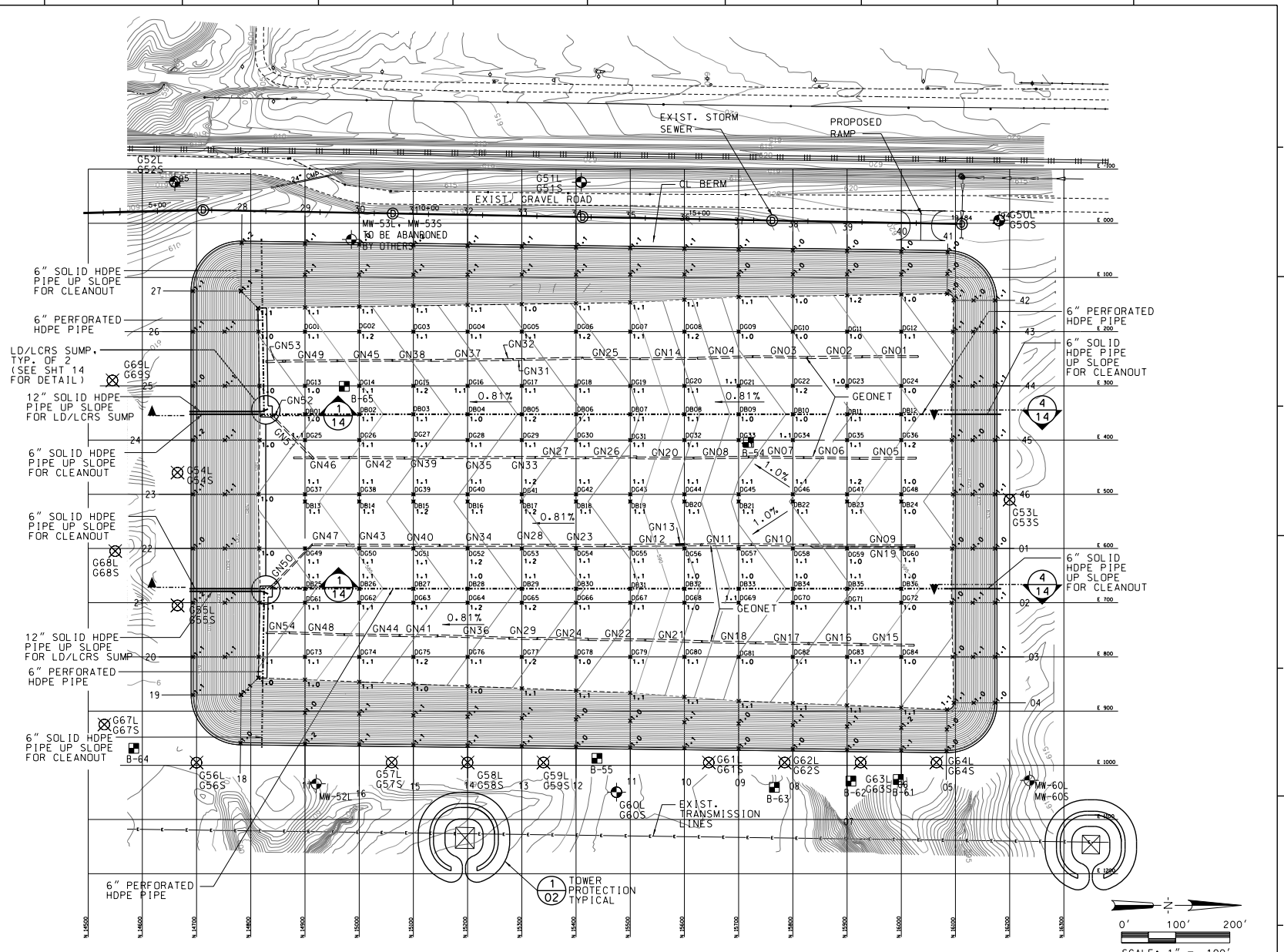
DRAWING RELEASE RECORD					DRAWING RELEASE RECORD						
REV.	DATE REL'D.	PREPARED	REVIEWED	APPROVED	PURPOSE	REV.	DATE REL'D.	PREPARED	REVIEWED	APPROVED	PURPOSE
0	07/30/04	J. ALCANTARA	M. MAZZAFERRO			0	07/30/04	J. ALCANTARA	M. MAZZAFERRO		FOR RECORD/SENT TO CLIENT

SCALE	1"=200'
PROJECT NUMBER	11478-006
PIPE PLAN & PROFILE RECYCLE POND BYPASS	
DUCK CREEK SITE UNIT 1 CANTON, ILLINOIS AMEREN CILCO	
DRAWING NO.	M-1001
REV.	0
SHEET	1 OF 1

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF CLAY LAYER DESIGN	TOP OF CLAY LAYER RECORD	CLAY LAYER THICKNESS	CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF CLAY LAYER DESIGN	TOP OF CLAY LAYER RECORD	CLAY LAYER THICKNESS	CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF CLAY LAYER DESIGN	TOP OF CLAY LAYER RECORD	CLAY LAYER THICKNESS
S0101	16994.01	600.00	594.92	595.29	3.4	S4001	16000.00	131.30	595.02	595.38	3.8	SG01	14900.00	700.00	582.99	582.99	3.4
S0102	16131.93	600.00	605.75	605.94	3.4	S4002	16000.00	93.78	605.74	605.83	3.3	SG02	15000.00	700.00	583.79	583.88	3.4
S0103	16176.55	600.00	618.50	618.66	4.8	S4003	16000.00	49.11	618.50	618.58	4.7	SG03	15100.00	700.00	584.60	584.62	3.3
S0201	16924.00	700.00	584.62	585.01	3.8	S4101	16000.00	130.71	584.62	585.01	3.4	SG04	15200.00	700.00	585.41	585.45	3.1
S0202	16131.96	700.00	605.75	605.83	3.3	S4102	16005.04	92.92	606.31	606.49	3.3	SG05	15300.00	700.00	586.22	586.24	3.2
S0203	16176.58	700.00	618.50	618.59	4.8	S4103	16085.61	50.25	618.50	618.66	4.8	SG06	15400.00	700.00	587.02	587.09	3.5
S0301	16095.16	800.00	595.23	595.72	3.6	S4201	16096.74	142.27	595.74	596.24	3.7	SG07	15500.00	700.00	587.83	587.92	3.3
S0302	16132.64	800.00	605.94	606.32	3.4	S4202	16133.75	142.26	606.31	606.47	3.5	SG08	15600.00	700.00	588.64	588.73	3.4
S0303	16176.61	800.00	618.50	618.68	4.8	S4203	16176.41	142.25	618.50	618.70	4.9	SG09	15700.00	700.00	589.45	591.50	3.4
S0401	16096.98	884.70	595.74	596.05	3.4	S4301	16095.54	200.00	595.39	595.74	3.4	SG10	15800.00	700.00	592.26	592.34	3.4
S0402	16133.97	884.69	606.31	606.33	3.4	S4302	16132.87	200.00	606.05	606.20	3.4	SG11	15900.00	700.00	593.06	593.07	3.1
S0403	16176.68	884.68	618.50	618.70	4.8	S4303	16176.43	200.00	618.50	618.70	4.7	SG12	16000.00	700.00	593.87	594.03	3.3
S0501	16084.47	896.97	595.71	596.24	3.6	S4401	16083.45	300.00	594.79	595.08	3.5	SG13	14900.00	800.00	583.57	583.57	3.1
S0502	16084.06	934.06	606.31	606.41	3.5	S4402	16131.83	300.00	605.75	605.94	3.5	SG14	15000.00	800.00	584.38	584.45	3.2
S0503	16083.58	976.73	618.50	618.65	4.7	S4403	16176.46	300.00	618.50	618.64	4.8	SG15	15100.00	800.00	585.19	585.20	3.2
S0601	16000.00	893.58	595.01	595.08	3.2	S4501	16083.38	400.00	594.75	595.01	3.3	SG16	15200.00	800.00	586.00	586.00	3.1
S0602	16000.00	931.11	605.73	605.74	3.3	S4502	16131.87	400.00	605.73	605.91	3.4	SG17	15300.00	800.00	586.81	586.82	3.2
S0603	16000.00	975.79	618.50	618.51	4.6	S4503	16176.49	400.00	618.50	618.68	5.1	SG18	15400.00	800.00	587.61	587.70	3.2
S0701	15900.00	889.55	594.18	594.28	3.2	S4601	16095.53	500.00	595.36	595.55	3.2	SG19	15500.00	800.00	588.42	588.52	3.2
S0702	15900.00	928.54	605.32	605.41	3.1	S4602	16131.90	500.00	605.75	605.92	3.4	SG20	15600.00	800.00	590.23	590.29	3.1
S0703	15900.00	974.68	618.50	618.50	4.7	S4603	16176.52	500.00	618.50	618.59	4.8	SG21	15700.00	800.00	592.04	592.13	3.4
S0801	15800.00	885.53	593.35	593.44	3.1	S01	14900.00	352.42	582.83	582.85	3.4	SG22	15800.00	800.00	592.84	592.90	3.4
S0802	15800.00	925.97	604.90	604.98	3.2	S02	15000.00	352.42	583.64	583.71	3.3	SG23	15900.00	800.00	593.65	593.69	3.2
S0803	15800.00	973.56	618.50	618.55	4.8	S03	15100.00	352.42	584.45	584.49	3.3	SG24	16000.00	800.00	594.46	594.76	3.3
S0901	15700.00	881.50	592.61	592.67	3.3	S04	15200.00	352.42	585.26	585.32	3.1						
S0902	15700.00	923.40	604.46	604.46	3.2	S05	15300.00	352.42	586.07	586.10	3.1						
S0903	15700.00	972.45	618.50	618.57	4.8	S06	15400.00	352.42	586.87	586.97	3.3						
S1001	15600.00	873.90	590.66	590.75	3.5	S07	15500.00	352.42	587.68	587.76	3.3						
S1002	15600.00	920.83	604.07	604.16	3.2	S08	15600.00	352.42	588.49	588.54	3.3						
S1003	15600.00	971.53	618.51	618.51	4.7	S09	15700.00	352.42	589.30	589.31	3.2						
S1101	15500.00	866.30	588.81	588.90	3.2	S10	15800.00	352.42	590.10	590.20	3.3						
S1102	15500.00	918.28	603.66	603.72	3.2	S11	15900.00	352.42	590.91	591.03	3.1						
S1103	15500.00	970.21	618.50	618.50	4.7	S12	16000.00	352.42	591.72	591.88	3.2						
S1201	15400.00	853.27	587.98	588.12	3.2	S13	16100.00	352.42	592.53	592.72	3.5						
S1202	15400.00	915.68	603.24	603.30	3.3	S14	16200.00	352.42	593.34	593.59	3.4						
S1203	15400.00	969.10	618.50	618.51	4.8	S15	16300.00	352.42	594.15	594.46	3.1						
S1301	15300.00	858.25	587.15	587.19	3.3	S16	16400.00	352.42	594.96	595.33	3.2						
S1302	15300.00	913.11	602.83	602.89	3.3	S17	16500.00	352.42	595.77	596.14	3.0						
S1303	15300.00	967.98	618.50	618.51	4.7	S18	16600.00	352.42	596.58	597.05	3.1						
S1401	15200.00	854.22	586.32	586.41	3.2	S19	16700.00	352.42	597.39	597.86	3.1						
S1402	15200.00	910.54	602.41	602.41	3.1	S20	16800.00	352.42	598.20	598.67	3.2						
S1501	15100.00	850.19	585.49	585.59	3.2	S21	16900.00	352.42	599.01	599.48	3.2						
S1502	15100.00	907.97	601.99	602.01	3.2	S22	17000.00	352.42	599.82	600.29	3.3						
S1503	15100.00	965.78	618.50	618.52	4.8	S23	17100.00	352.42	600.63	601.10	3.5						
S1601	15000.00	846.17	584.65	584.73	3.2	S24	17200.00	352.42	601.44	601.91	3.2						
S1602	15000.00	903.57	601.31	601.31	3.1	S25	17300.00	352.42	602.25	602.72	3.3						
S1603	15000.00	964.83	618.50	618.57	4.8	S26	17400.00	352.42	603.06	603.53	3.4						
S1701	14900.00	842.14	583.82	584.08	3.3	S27	17500.00	352.42	603.87	604.34	3.1						
S1702	14900.00	903.35	601.31	601.39	3.2	S28	17600.00	352.42	604.68	605.15	3.2						
S1703	14900.00	963.57	618.50	618.57	4.7	S29	17700.00	352.42	605.49	605.96	3.3						
S1801	14813.86	838.67	583.11	583.51	3.5	S30	17800.00	352.42	606.30	606.77	3.3						
S1802	14782.32	869.87	592.12	592.16	3.1	S31	17900.00	352.42	607.11	607.58	3.3						
S1803	14781.09	962.19	618.50	618.54	4.6	S32	18000.00	352.42	607.92	608.39	3.4						
S1901	14813.86	838.67	583.11	583.51	3.5	S33	18100.00	352.42	608.73	609.20	3.2						
S1902	14782.32	869.87	592.12	592.16	3.1	S34	18200.00	352.42	609.54	610.01	3.2						
S1903	14781.09	962.19	618.50	618.54	4.6	S35	18300.00	352.42	610.35	610.82	3.3						
S2001	14814.62	800.00	582.89	582.98	3.1	S01	14900.00	200.00	583.73	583.84	3.4						
S2002	14782.16	800.00	600.75	600.75	3.2	S02	15000.00	200.00	584.54	584.64	3.4						
S2003	14689.97	800.00	618.50	618.58	4.7	S03	15100.00	200.00	585.35	585.42	3.3						
S2101	14816.61	700.00	582.31	582.51	3.2	SG04	15200.00	200.00	586.15	586.21	3.2						
S2102	14782.08	700.00	600.75	600.80	3.2	SG05	15300.00	200.00	586.96	587.04	3.1						
S2103	14689.98	700.00	618.50	618.58	4.6	SG06	15400.00	200.00	587.77	587.81	3.1						
S2201	14815.61	600.00	582.56	582.75	3.3	SG07	15500.00	200.00	588.58	588.65	3.3						
S2202	14782.06	600.00	600.75	600.76	3.3	SG08	15600.00	200.00	589.39	589.43	3.3						
S2203	14689.93	600.00	618.50	618.50	4.7	SG09	15700.00	200.00	590.20	590.26	3.1						
S2301	14814.16	500.00	583.00	583.15	3.3	SG10	15800.00	200.00	591.01	591.07	3.2						
S2302	14782.04	500.00	600.75	600.75	3.4	SG11	15900.00	200.00	591.82	591.88	3.4						
S2303	14689.91	500.00	618.50	618.52	4.9	SG12	16000.00	200.00	592.63	592.69	3.3						
S2401	14816.11	400.00	582.44	582.87	3.6	SG13	16100.00	200.00	593.44	593.51	3.2						
S2402	14782.01	400.00	600.75	600.77	3.3	SG14	16200.00	200.00	594.25	594.32	3.4						
S2403	14689.88	400.00	618.50	618.51	4.8	SG15	16300.00	200.00	595.06	595.13	3.2						
S2501	14815.99	300.00	582.46	582.58	3.2	SG16	16400.00	200.00	595.87	595.97	3.1						
S2502	14781.99	300.00	600.75	600.78	3.3	SG17											

01 - ON 30'vd
2010-08-10

CONTROL POINT NUMBER	GRID COORDINATES (NORTHING EASTING)	DESIGN RECORD	THICKNESS	CONTROL POINT NUMBER	GRID COORDINATES (NORTHING EASTING)	DESIGN RECORD	THICKNESS	CONTROL POINT NUMBER	GRID COORDINATES (NORTHING EASTING)	DESIGN RECORD	THICKNESS
D001	16093.86 600.00	595.92 596.32	1.0	D401	16000.00 131.44	596.02 596.39	1.0	D61	14900.00 700.00	583.99 584.10	1.1
D002	16131.65 600.00	606.71 606.86	1.1	D402	16000.00 68.28	596.70 596.83	1.0	D62	15000.00 700.00	594.79 594.85	1.1
D003	16172.91 600.00	618.50 618.67	1.0	D403	16000.00 52.75	618.50 618.59	1.0	D63	15100.00 700.00	585.60 585.77	1.1
D004	16092.87 700.00	595.62 596.04	1.0	D404	16084.54 130.16	596.71 597.11	1.0	D64	15200.00 700.00	586.41 586.61	1.2
D005	16131.66 700.00	606.71 606.86	1.1	D405	16085.04 93.19	607.27 607.46	1.0	D65	15300.00 700.00	587.22 587.41	1.2
D006	16172.91 700.00	618.50 618.70	1.1	D406	16085.54 56.89	618.50 618.59	1.0	D66	15400.00 700.00	588.03 588.19	1.1
D007	16095.02 800.00	596.23 596.74	1.0	D407	16096.99 142.27	596.74 597.31	1.1	D67	15500.00 700.00	588.83 589.00	1.1
D008	16132.36 800.00	606.90 607.10	1.1	D408	16133.47 142.28	607.27 607.50	1.0	D68	15600.00 700.00	589.64 590.73	1.0
D009	16172.97 800.00	618.50 618.71	1.1	D409	16172.77 142.25	618.50 618.78	1.1	D69	15700.00 700.00	592.45 592.57	1.1
D010	16094.47 900.00	596.71 597.34	1.1	D410	16096.39 200.00	596.74 597.34	1.1	D70	15800.00 700.00	593.26 593.42	1.1
D011	16133.70 900.00	607.27 607.31	1.1	D411	16132.59 200.00	607.27 607.27	1.1	D71	15900.00 700.00	594.06 594.22	1.1
D012	16173.00 900.00	618.50 618.72	1.0	D412	16172.79 200.00	618.50 618.67	1.1	D72	16000.00 700.00	594.87 595.07	1.0
D013	16094.47 1000.00	596.82 597.11	1.1	D413	16172.82 200.00	597.34 597.41	1.1	D73	16100.00 700.00	595.67 595.74	1.1
D014	16134.00 1000.00	607.27 607.40	1.1	D414	16172.82 300.00	606.71 606.93	1.1	D74	16200.00 800.00	585.38 585.57	1.1
D015	16173.00 1000.00	618.50 618.69	1.0	D415	16172.82 300.00	618.50 618.73	1.1	D75	16300.00 800.00	586.19 586.39	1.2
D016	16095.02 1100.00	596.23 596.18	1.1	D416	16172.82 400.00	596.75 596.06	1.1	D76	16400.00 800.00	587.00 587.08	1.1
D017	16133.00 1100.00	606.90 606.84	1.2	D417	16172.82 400.00	606.71 606.88	1.0	D77	16500.00 800.00	587.81 587.98	1.2
D018	16172.97 1100.00	618.50 618.72	1.1	D418	16172.82 500.00	618.50 618.72	1.1	D78	16600.00 800.00	588.61 588.73	1.0
D019	16095.02 1200.00	596.23 596.48	1.1	D419	16172.82 500.00	596.36 596.65	1.1	D79	16700.00 800.00	589.42 589.59	1.1
D020	16133.00 1200.00	606.90 606.84	1.1	D420	16172.82 600.00	606.71 606.88	1.0	D80	16800.00 800.00	590.23 590.40	1.1
D021	16172.97 1200.00	618.50 618.56	1.0	D421	16172.82 700.00	618.50 618.65	1.1	D81	16900.00 800.00	591.04 591.17	1.1
D022	16095.02 1300.00	596.23 596.55	1.1	D422	16172.82 800.00	596.74 596.81	1.1	D82	17000.00 800.00	591.85 592.02	1.1
D023	16133.00 1300.00	606.90 606.84	1.1	D423	16172.82 900.00	606.71 606.88	1.0	D83	17100.00 800.00	592.66 592.83	1.1
D024	16172.97 1300.00	618.50 618.61	1.1	D424	16172.82 1000.00	618.50 618.61	1.1	D84	17200.00 800.00	593.47 593.64	1.1
D025	16095.02 1400.00	596.23 596.55	1.1	D425	16172.82 1100.00	596.74 596.81	1.1	D85	17300.00 800.00	594.28 594.45	1.1
D026	16133.00 1400.00	606.90 606.84	1.1	D426	16172.82 1200.00	606.71 606.88	1.0	D86	17400.00 800.00	595.09 595.26	1.1
D027	16172.97 1400.00	618.50 618.56	1.0	D427	16172.82 1300.00	618.50 618.61	1.1	D87	17500.00 800.00	595.90 596.07	1.1
D028	16095.02 1500.00	596.23 596.55	1.1	D428	16172.82 1400.00	596.74 596.81	1.1	D88	17600.00 800.00	596.71 596.88	1.1
D029	16133.00 1500.00	606.90 606.84	1.1	D429	16172.82 1500.00	606.71 606.88	1.0	D89	17700.00 800.00	597.52 597.69	1.1
D030	16172.97 1500.00	618.50 618.56	1.0	D430	16172.82 1600.00	618.50 618.61	1.1	D90	17800.00 800.00	598.33 598.50	1.1
D031	16095.02 1600.00	596.23 596.55	1.1	D431	16172.82 1700.00	596.74 596.81	1.1	D91	17900.00 800.00	599.14 599.31	1.1
D032	16133.00 1600.00	606.90 606.84	1.1	D432	16172.82 1800.00	606.71 606.88	1.0	D92	18000.00 800.00	599.95 600.12	1.1
D033	16172.97 1600.00	618.50 618.56	1.0	D433	16172.82 1900.00	618.50 618.61	1.1	D93	18100.00 800.00	600.76 600.93	1.1
D034	16095.02 1700.00	596.23 596.55	1.1	D434	16172.82 2000.00	596.74 596.81	1.1	D94	18200.00 800.00	601.57 601.74	1.1
D035	16133.00 1700.00	606.90 606.84	1.1	D435	16172.82 2100.00	606.71 606.88	1.0	D95	18300.00 800.00	602.38 602.55	1.1
D036	16172.97 1700.00	618.50 618.56	1.0	D436	16172.82 2200.00	618.50 618.61	1.1	D96	18400.00 800.00	603.19 603.36	1.1
D037	16095.02 1800.00	596.23 596.55	1.1	D437	16172.82 2300.00	596.74 596.81	1.1	D97	18500.00 800.00	604.00 604.17	1.1
D038	16133.00 1800.00	606.90 606.84	1.1	D438	16172.82 2400.00	606.71 606.88	1.0	D98	18600.00 800.00	604.81 604.98	1.1
D039	16172.97 1800.00	618.50 618.56	1.0	D439	16172.82 2500.00	618.50 618.61	1.1	D99	18700.00 800.00	605.62 605.79	1.1
D040	16095.02 1900.00	596.23 596.55	1.1	D440	16172.82 2600.00	596.74 596.81	1.1	D100	18800.00 800.00	606.43 606.60	1.1

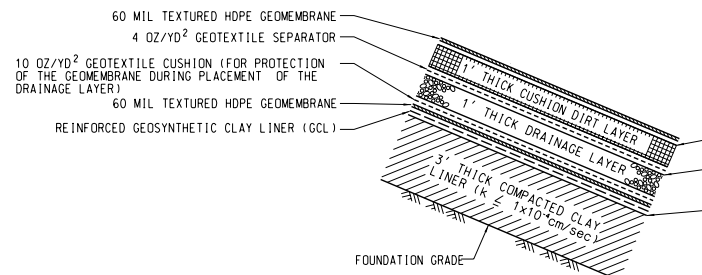


GEONET COORDINATES (AS SURVEYED BY MAURER-STUTZ, INC. OCT. 16, 2008 THRU NOV. 09, 2008)

MSI Point #	Northing	Eastng	Elevation	MSI Point #	Northing	Eastng	Elevation	MSI Point #	Northing	Eastng	Elevation	MSI Point #	Northing	Eastng	Elevation
GN10 NW	16031.54	247.52	594.68	GN10 SW	15820.24	592.11	592.92	GN19 SE	15838.81	598.82	592.99	GN28 SW	15820.81	592.02	586.50
GN11 NW	16031.29	244.17	594.67	GN11 SW	15722.77	594.71	592.16	GN20 SE	15829.70	595.63	592.99	GN29 SW	15829.70	768.16	586.87
GN12 NW	16029.87	247.92	593.88	GN12 SW	15722.88	591.21	592.17	GN21 SE	15817.61	434.87	590.48	GN30 SW	15829.70	764.66	586.88
GN13 NW	16028.44	244.04	593.94	GN13 SW	15721.75	591.69	591.11	GN22 SE	15817.61	431.59	590.41	GN31 SW	15829.70	761.69	586.47
GN14 NW	16027.01	240.25	593.88	GN14 SW	15724.23	591.29	592.13	GN23 SE	15810.69	434.02	588.54	GN32 SW	15829.70	753.68	586.43
GN15 NW	16025.58	236.46	593.93	GN15 SW	15720.65	590.65	590.65	GN24 SE	15811.01	431.12	588.61	GN33 SW	15829.70	745.67	587.69
GN16 NW	16024.15	232.67	593.98	GN16 SW	15718.17	589.77	589.77	GN25 SE	15811.01	427.14	588.61	GN34 SW	15829.70	737.66	587.69
GN17 NW	16022.72	228.88	594.04	GN17 SW	15715.69	588.89	588.89	GN26 SE	15811.01	423.16	588.61	GN35 SW	15829.70	729.65	587.69
GN18 NW	16021.29	225.09	594.10	GN18 SW	15713.21	588.01	588.01	GN27 SE	15811.01	419.18	588.61	GN36 SW	15829.70	721.64	587.69
GN19 NW	16019.86	221.30	594.16	GN19 SW	15710.73	587.13	587.13	GN28 SE	15811.01	415.20	588.61	GN37 SW	15829.70	713.63	587.69
GN20 NW	16018.43	217.51	594.22	GN20 SW	15708.25	586.25	586.25	GN29 SE	15811.01	411.22	588.61	GN38 SW	15829.70	705.62	587.69
GN21 NW	16017.00	213.72	594.28	GN21 SW	15705.77	585.37	585.37	GN30 SE	15811.01	407.24	588.61	GN39 SW	15829.70	697.61	587.69
GN22 NW	16015.57	209.93	594.34	GN22 SW	15703.29	584.49	584.49	GN31 SE	15811.01	403.26	588.61	GN40 SW	15829.70	689.60	587.69
GN23 NW	16014.14	206.14	594.40	GN23 SW	15700.81	583.61	583.61	GN32 SE	15811.01	399.28	588.61	GN41 SW	15829.70	681.59	587.69
GN24 NW	16012.71	202.35	594.46	GN24 SW	15698.33	582.73	582.73	GN33 SE	15811.01	395.30	588.61	GN42 SW	15829.70	673.58	587.69
GN25 NW	16011.28	198.56	594.52	GN25 SW	15695.85	581.85	581.85	GN34 SE	15811.01	391.32	588.61	GN43 SW	15829.70	665.57	587.69
GN26 NW	16009.85	194.77	594.58	GN26 SW	15693.37	580.97	580.97	GN35 SE	15811.01	387.34	588.61	GN44 SW	15829.70	657.56	587.69
GN27 NW	16008.42	190.98	594.64	GN27 SW	15690.89	580.10	580.10	GN36 SE	15811.01	383.36	588.61	GN45 SW	15829.70	649.55	587.69
GN28 NW	16006.99	187.19	594.70	GN28 SW	15688.41	579.22	579.22	GN37 SE	15811.01	379.38	588.61	GN46 SW	15829.70	641.54	587.69
GN29 NW	16005.56	183.40	594.76	GN29 SW	15685.93	578.34	578.34	GN38 SE	15811.01	375.40	588.61	GN47 SW	15829.70	633.53	587.69
GN30 NW	16004.13	179.61	594.82	GN30 SW	15683.45	577.46	577.46	GN39 SE	15811.01	371.42	588.61	GN48 SW	15829.70	625.52	587.69
GN31 NW	16002.70	175.82	594.88	GN31 SW	15680.97	576.58	576.58	GN40 SE	15811.01	367.44	588.61	GN49 SW	15829.70	617.51	587.69
GN32 NW	16001.27	172.03	594.94	GN32 SW	15678.49	575.70	575.70	GN41 SE	15811.01	363.46	588.61	GN50 SW	15829.70	609.50	587.69
GN33															

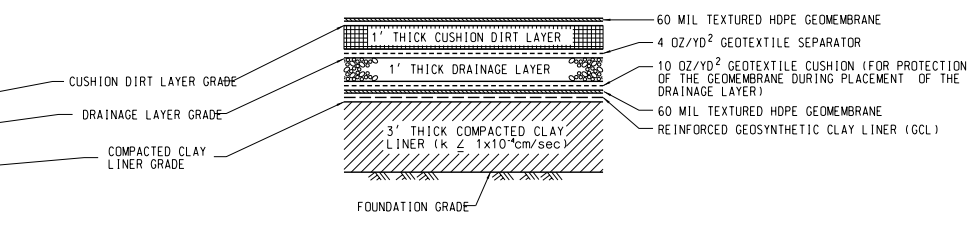
11-0810
C180-C102

CONTROL POINT NUMBER	GRID COORDINATES	TOP OF CUSHION DIRT RECORD	CUSHION DIRT	CONTROL POINT NUMBER	GRID COORDINATES	TOP OF CUSHION DIRT RECORD	CUSHION DIRT	CONTROL POINT NUMBER	GRID COORDINATES	TOP OF CUSHION DIRT RECORD	CUSHION DIRT
C0101	16093.12	600.00	597.30	C3002	15000.00	67.45	61.53	C0115	15100.00	300.00	586.75
C0102	16144.88	600.00	611.53	C3003	15000.00	62.45	61.40	C0116	15000.00	300.00	587.57
C0103	16144.88	600.00	611.53	C3004	15000.00	62.45	61.40	C0117	15000.00	300.00	587.57
C0104	16165.63	600.00	597.30	C3005	15000.00	62.45	61.40	C0118	15000.00	300.00	587.57
C0201	16092.72	700.00	597.10	C3102	15100.00	68.79	61.53	C0119	15000.00	300.00	589.99
C0202	16144.81	700.00	611.53	C3103	15100.00	63.79	61.40	C0220	15000.00	300.00	591.80
C0203	16144.81	700.00	611.53	C3104	15100.00	63.79	61.40	C0221	15000.00	300.00	591.80
C0204	16165.66	700.00	597.10	C3201	15200.00	150.93	588.44	C0222	15000.00	300.00	594.41
C0301	16094.87	800.00	597.23	C3202	15200.00	70.12	61.53	C0223	15000.00	300.00	595.22
C0302	16144.81	800.00	611.53	C3203	15200.00	65.12	61.40	C0224	15000.00	300.00	595.22
C0303	16144.81	800.00	611.53	C3204	15200.00	65.12	61.40	C0225	14900.00	400.00	585.11
C0304	16165.69	800.00	597.23	C3301	15300.00	149.41	589.61	C0226	15000.00	400.00	585.92
C0401	16096.68	884.70	597.74	C3302	15300.00	71.45	61.53	C0227	15100.00	400.00	586.73
C0402	16144.81	884.70	611.53	C3303	15300.00	66.45	61.40	C0228	15100.00	400.00	586.73
C0403	16144.81	884.70	611.53	C3304	15300.00	66.45	61.40	C0229	15300.00	400.00	588.58
C0404	16165.72	884.69	597.74	C3401	15400.00	147.88	590.08	C0230	15400.00	400.00	589.15
C0501	16094.87	900.00	597.71	C3402	15400.00	72.72	61.53	C0231	15400.00	400.00	589.15
C0502	16093.93	945.11	611.53	C3403	15400.00	67.79	61.40	C0232	15000.00	400.00	591.77
C0503	16093.93	945.11	611.53	C3404	15400.00	67.79	61.40	C0233	15700.00	400.00	593.58
C0504	16093.93	945.11	611.53	C3501	15500.00	146.38	589.61	C0234	15800.00	400.00	594.38
C0505	16093.93	945.11	611.53	C3502	15500.00	71.45	61.53	C0235	15900.00	400.00	595.19
C0506	16093.93	945.11	611.53	C3503	15500.00	69.12	61.40	C0236	16000.00	400.00	596.00
C0507	16093.93	945.11	611.53	C3504	15500.00	69.12	61.40	C0237	14900.00	400.00	596.80
C0508	16093.93	945.11	611.53	C3601	15600.00	141.26	592.73	C0238	15000.00	500.00	596.61
C0509	16093.93	945.11	611.53	C3602	15600.00	75.45	61.53	C0239	15100.00	500.00	597.32
C0510	16093.93	945.11	611.53	C3603	15600.00	75.45	61.53	C0240	15200.00	500.00	598.13
C0511	16093.93	945.11	611.53	C3604	15600.00	75.45	61.53	C0241	15300.00	500.00	598.94
C0512	16093.93	945.11	611.53	C3701	15700.00	136.18	594.81	C0242	15400.00	500.00	599.74
C0513	16093.93	945.11	611.53	C3702	15700.00	76.79	61.53	C0243	15500.00	500.00	600.55
C0514	16093.93	945.11	611.53	C3703	15700.00	76.79	61.53	C0244	15600.00	500.00	601.35
C0515	16093.93	945.11	611.53	C3704	15700.00	76.79	61.53	C0245	15700.00	500.00	602.16
C0516	16093.93	945.11	611.53	C3801	15800.00	134.63	595.65	C0246	15800.00	500.00	602.96
C0517	16093.93	945.11	611.53	C3802	15800.00	78.12	61.53	C0247	15900.00	500.00	603.77
C0518	16093.93	945.11	611.53	C3803	15800.00	78.12	61.53	C0248	16000.00	500.00	604.57
C0519	16093.93	945.11	611.53	C3804	15800.00	78.12	61.53	C0249	16100.00	500.00	605.38
C0520	16093.93	945.11	611.53	C3901	15900.00	133.11	596.20	C0250	16200.00	500.00	606.18
C0521	16093.93	945.11	611.53	C3902	15900.00	74.45	61.40	C0251	16300.00	500.00	606.99
C0522	16093.93	945.11	611.53	C3903	15900.00	74.45	61.40	C0252	16400.00	500.00	607.79
C0523	16093.93	945.11	611.53	C3904	15900.00	74.45	61.40	C0253	16500.00	500.00	608.60
C0524	16093.93	945.11	611.53	C4001	16000.00	131.58	597.02	C0254	16600.00	500.00	609.40
C0525	16093.93	945.11	611.53	C4002	16000.00	75.79	61.40	C0255	16700.00	500.00	610.21
C0526	16093.93	945.11	611.53	C4003	16000.00	75.79	61.40	C0256	16800.00	500.00	611.01
C0527	16093.93	945.11	611.53	C4004	16000.00	75.79	61.40	C0257	16900.00	500.00	611.82
C0528	16093.93	945.11	611.53	C4101	16100.00	130.31	597.53	C0258	17000.00	500.00	612.62
C0529	16093.93	945.11	611.53	C4102	16100.00	75.79	61.40	C0259	17100.00	500.00	613.43
C0530	16093.93	945.11	611.53	C4103	16100.00	75.79	61.40	C0260	17200.00	500.00	614.23
C0531	16093.93	945.11	611.53	C4104	16100.00	75.79	61.40	C0261	17300.00	500.00	615.04
C0532	16093.93	945.11	611.53	C4201	16200.00	142.27	597.74	C0262	17400.00	500.00	615.84
C0533	16093.93	945.11	611.53	C4202	16200.00	76.79	61.53	C0263	17500.00	500.00	616.65
C0534	16093.93	945.11	611.53	C4203	16200.00	76.79	61.53	C0264	17600.00	500.00	617.45
C0535	16093.93	945.11	611.53	C4204	16200.00	76.79	61.53	C0265	17700.00	500.00	618.26
C0536	16093.93	945.11	611.53	C4301	16300.00	200.00	597.30	C0266	17800.00	500.00	619.06
C0537	16093.93	945.11	611.53	C4302	16300.00	76.79	61.53	C0267	17900.00	500.00	619.87
C0538	16093.93	945.11	611.53	C4303	16300.00	76.79	61.53	C0268	18000.00	500.00	620.67
C0539	16093.93	945.11	611.53	C4304	16300.00	76.79	61.53	C0269	18100.00	500.00	621.48
C0540	16093.93	945.11	611.53	C4401	16400.00	142.26	597.02	C0270	18200.00	500.00	622.28
C0541	16093.93	945.11	611.53	C4402	16400.00	76.79	61.53	C0271	18300.00	500.00	623.09
C0542	16093.93	945.11	611.53	C4403	16400.00	76.79	61.53	C0272	18400.00	500.00	623.89
C0543	16093.93	945.11	611.53	C4404	16400.00	76.79	61.53	C0273	18500.00	500.00	624.70
C0544	16093.93	945.11	611.53	C4501	16500.00	200.00	597.30	C0274	18600.00	500.00	625.50
C0545	16093.93	945.11	611.53	C4502	16500.00	76.79	61.53	C0275	18700.00	500.00	626.31
C0546	16093.93	945.11	611.53	C4503	16500.00	76.79	61.53	C0276	18800.00	500.00	627.11
C0547	16093.93	945.11	611.53	C4504	16500.00	76.79	61.53	C0277	18900.00	500.00	627.92
C0548	16093.93	945.11	611.53	C4601	16600.00	142.26	597.02	C0278	19000.00	500.00	628.72
C0549	16093.93	945.11	611.53	C4602	16600.00	76.79	61.53	C0279	19100.00	500.00	629.53
C0550	16093.93	945.11	611.53	C4603	16600.00	76.79	61.53	C0280	19200.00	500.00	630.33
C0551	16093.93	945.11	611.53	C4604	16600.00	76.79	61.53	C0281	19300.00	500.00	631.14
C0552	16093.93	945.11	611.53	C4701	16700.00	142.26	597.02	C0282	19400.00	500.00	631.94
C0553	16093.93	945.11	611.53	C4702	16700.00	76.79	61.53	C0283	19500.00	500.00	632.75
C0554	16093.93	945.11	611.53	C4703	16700.00	76.79	61.53	C0284	19600.00	500.00	633.55
C0555	16093.93	945.11	611.53	C4704	16700.00	76.79	61.53	C0285	19700.00	500.00	634.36
C0556	16093.93	945.11	611.53	C4801	16800.00	200.00	597.30	C0286	19800.00	500.00	635.16
C0557	16093.93	945.11	611.53	C4802	16800.00	76.79	61.53	C0287	19900.00	500.00	635.97
C0558	16093.93	945.11	611.53	C4803	16800.00	76.79	61.53	C0288	20000.00	500.00	636.77
C0559	16093.93	945.11	611.53	C4804	16800.00	76.79	61.53	C0289	20100.00	500.00	637.58
C0560	16093.93	945.11	611.53	C4901	16900.00	142.26	597.02	C0290	20200.00	500.00	638.38
C0561	16093.93	945.11	611.53	C4902	16900.00	76.79	61.53	C0291	20300.00	500.00	639.19
C0562	16093.93	945.11	611.53	C4903	16900.00	76.79	61.53	C0292	20400.00	500.00	640.00
C0563	16093.93	945.11	611.53	C4904	16900.00	76.79	61.53	C0293	20500.00	500.00	640.80
C0564	16093.93	945.11	611.53	C5001	17000.00	142.26	597.02	C0294	20600.00	500.00	641.61
C0565	16093.93	945.11	611.53	C5002	17000.00	76.79	61.53	C0295	20700.00	500.00	642.41
C0566	16093.93	945.11	6								



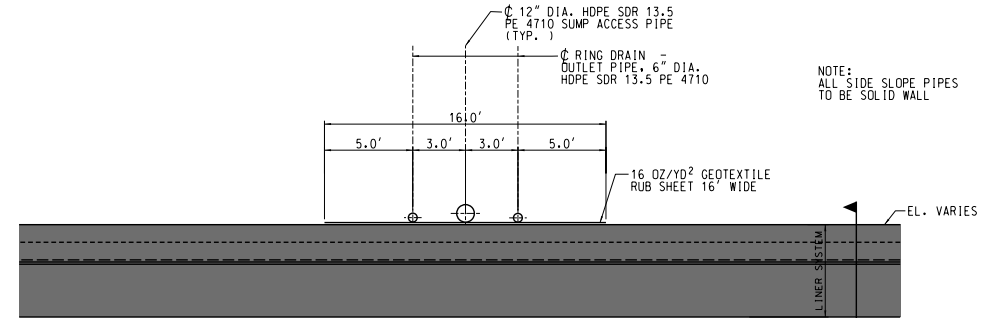
1 SIDE SLOPE LINER SYSTEM
NTS

NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN



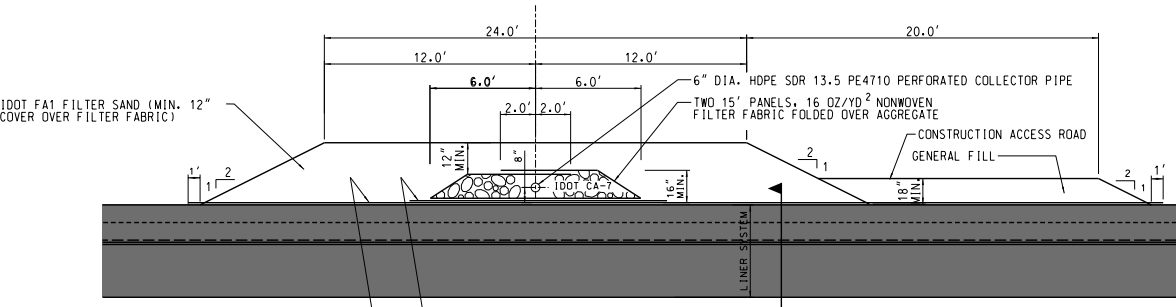
2 BOTTOM LINER SYSTEM
NTS

NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN



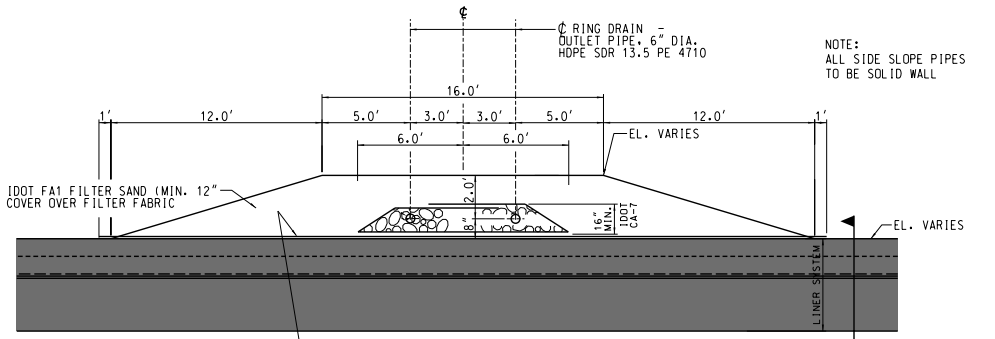
3 RING DRAIN RISER CROSS SECTION (3-PIPES) FOR PROCESS WATER RECOVERY SYSTEM

SCALE: 1" = 4'
NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN



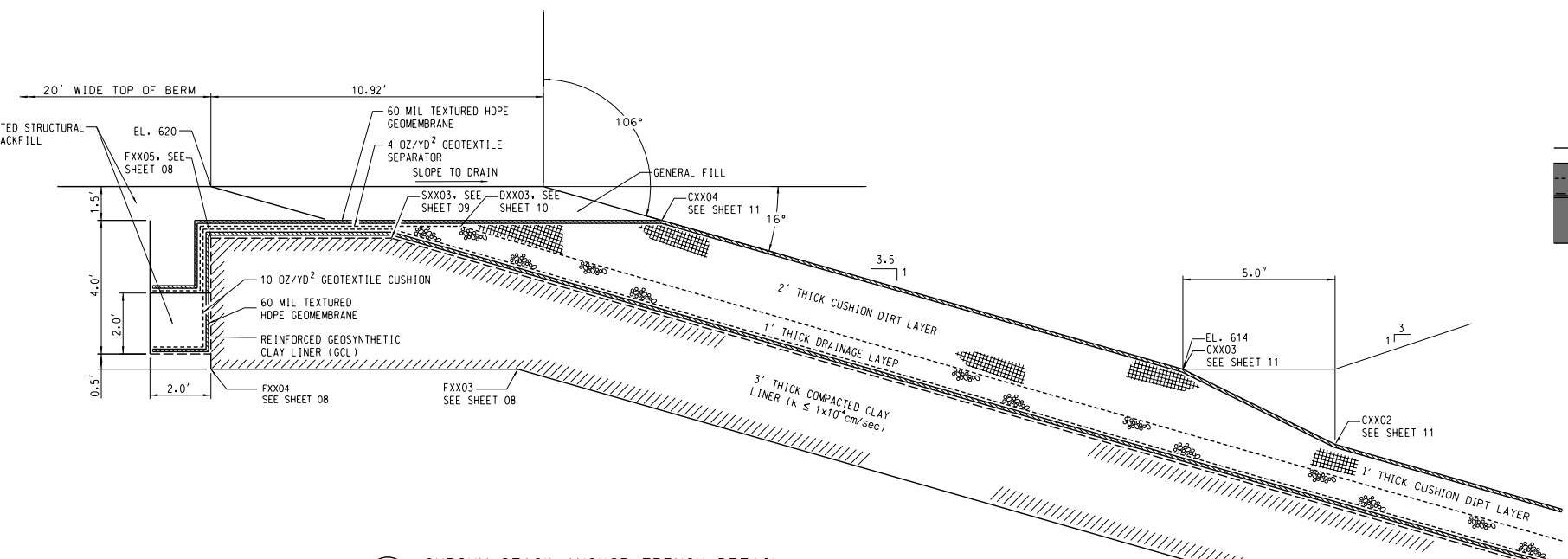
4 RING DRAIN COLLECTOR CROSS SECTION FOR PROCESS WATER RECOVERY SYSTEM

SCALE: 1" = 4'
NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN



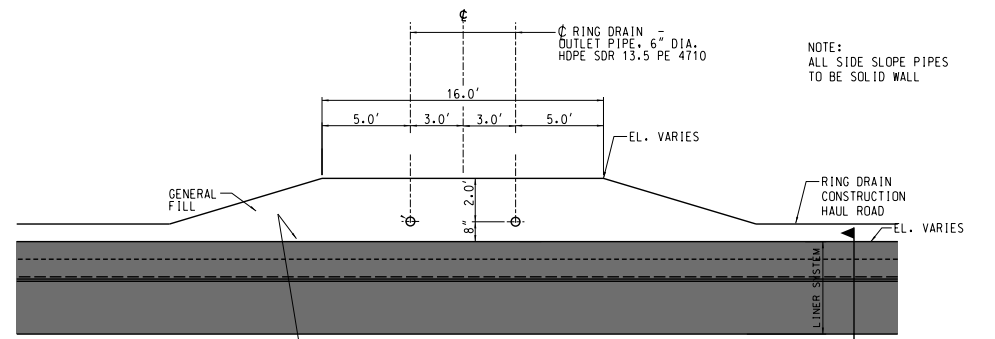
OUTLETS 1 & 5

ADDITIONAL 10 OZ/YD² NONWOVEN POLYESTER OR POLYPROPYLENE FILTER FABRIC RUB SHEET.



5 GYPSUM STACK ANCHOR TRENCH DETAIL
NTS

NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN



OUTLETS 2, 3 & 4

ADDITIONAL 16 OZ/YD² NONWOVEN POLYESTER OR POLYPROPYLENE FILTER FABRIC RUB SHEET.

6 PIPES BETWEEN RING DRAIN AND RISERS FOR PROCESS WATER RECOVERY SYSTEM

SCALE: 1" = 4'
NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN

AEG CAD GENERATED
DO NOT REVISE MANUALLY

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION	REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION						
1	03-05-08	SKB	SMB	SMB	REVISED DETAIL 5 - ISSUED FOR BIDDING - NOT FOR CONSTRUCTION						
2	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION						
3	09-19-08	TCJ	RWH	RWH	ADDED LEACHATE COLLECTION NOTE TO ALL DETAILS						
4	02-12-09	SKB	SMB	SMB	REVISED DETAIL 6						
5	03-05-09	SKB	JMM	-	ISSUED FOR RECORD DRAWING BY HANSON						



RECORD DRAWING FILE NO. -C180-C102-I2.dgn

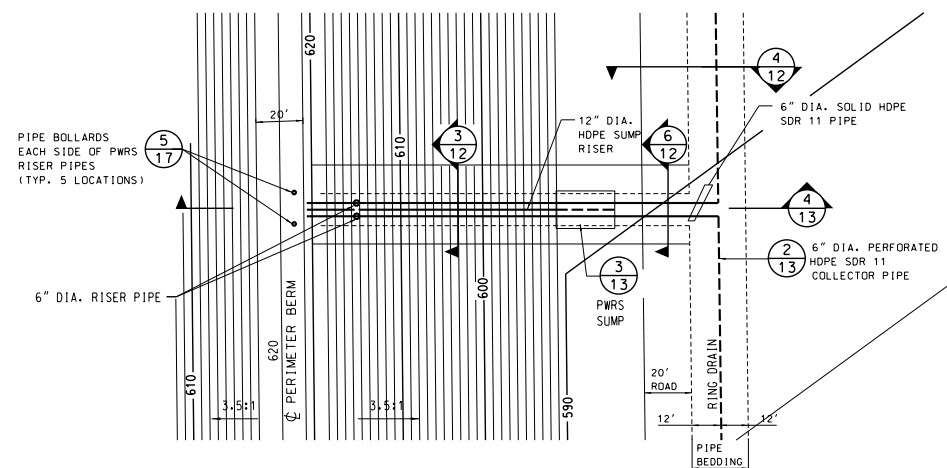
DRAWING TITLE
PWRS - RING DRAIN DETAILS

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

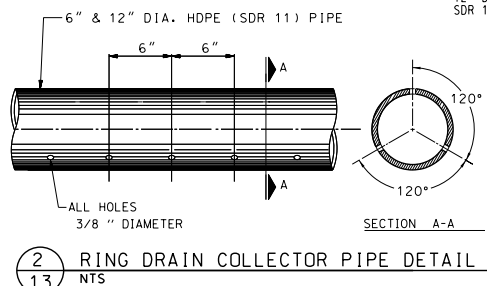


DRAWING NUMBER	REV.
C180-C102	5
SHEET NO. 12	OF 33

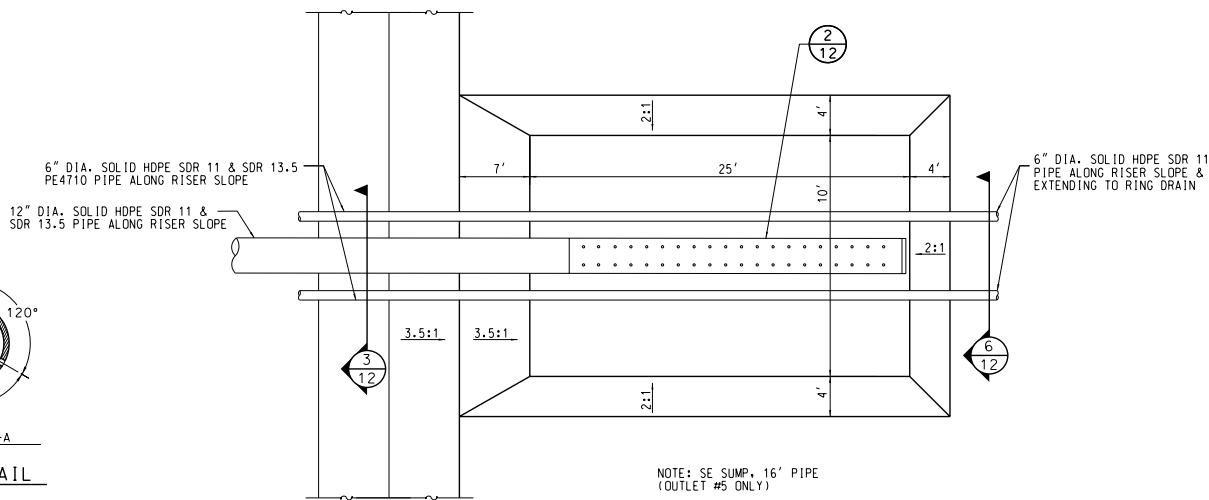
PERFORATED PIPE
SOLID PIPE



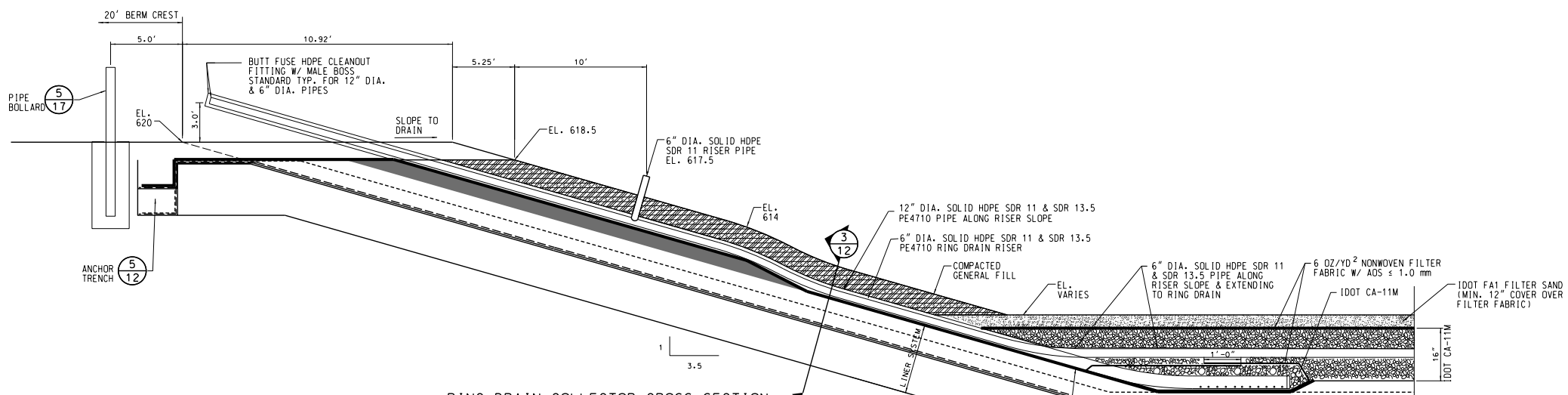
1
13
PROCESS WATER RECOVERY SYSTEM - PARTIAL PLAN (TYP. 5 LOCATIONS)
SCALE: 1"=30'



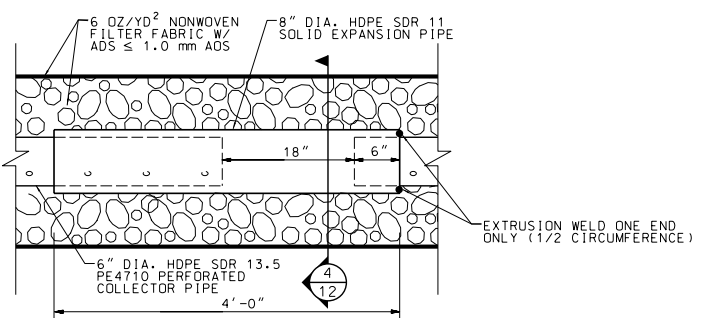
2
13
RING DRAIN COLLECTOR PIPE DETAIL
NTS



3
13
PWRs SUMP PLAN
NTS



4
13
RING DRAIN COLLECTOR CROSS SECTION FOR PROCESS WATER RECOVERY SYSTEM
NTS



5
13
RING DRAIN COLLECTOR PIPE EXPANSION UNION
NTS

NOTE:
INSTALL EXPANSION UNION EVERY 100 FT OF 6" DIA. PERFORATED COLLECTOR PIPE

NOTE:
RING DRAIN COLLECTOR PIPES ARE PERFORATED.
RING DRAIN RISER PIPES ARE NOT PERFORATED.

Brans00939
05/14/2009
R03 Job: 03:5000\pwr. StackCAD\Drawings\C180-C102-13.dgn

AEC CAD GENERATED
DO NOT REVISE MANUALLY

DRAWING RECORD					DRAWING RECORD						
REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION	REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION						
1	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION						
2		SKB	JDM		ISSUED FOR RECORD DRAWING						



RECORD DRAWING FILE NO. C180-C102-13.dgn

DRAWING TITLE
PWRs - RING DRAIN DETAILS

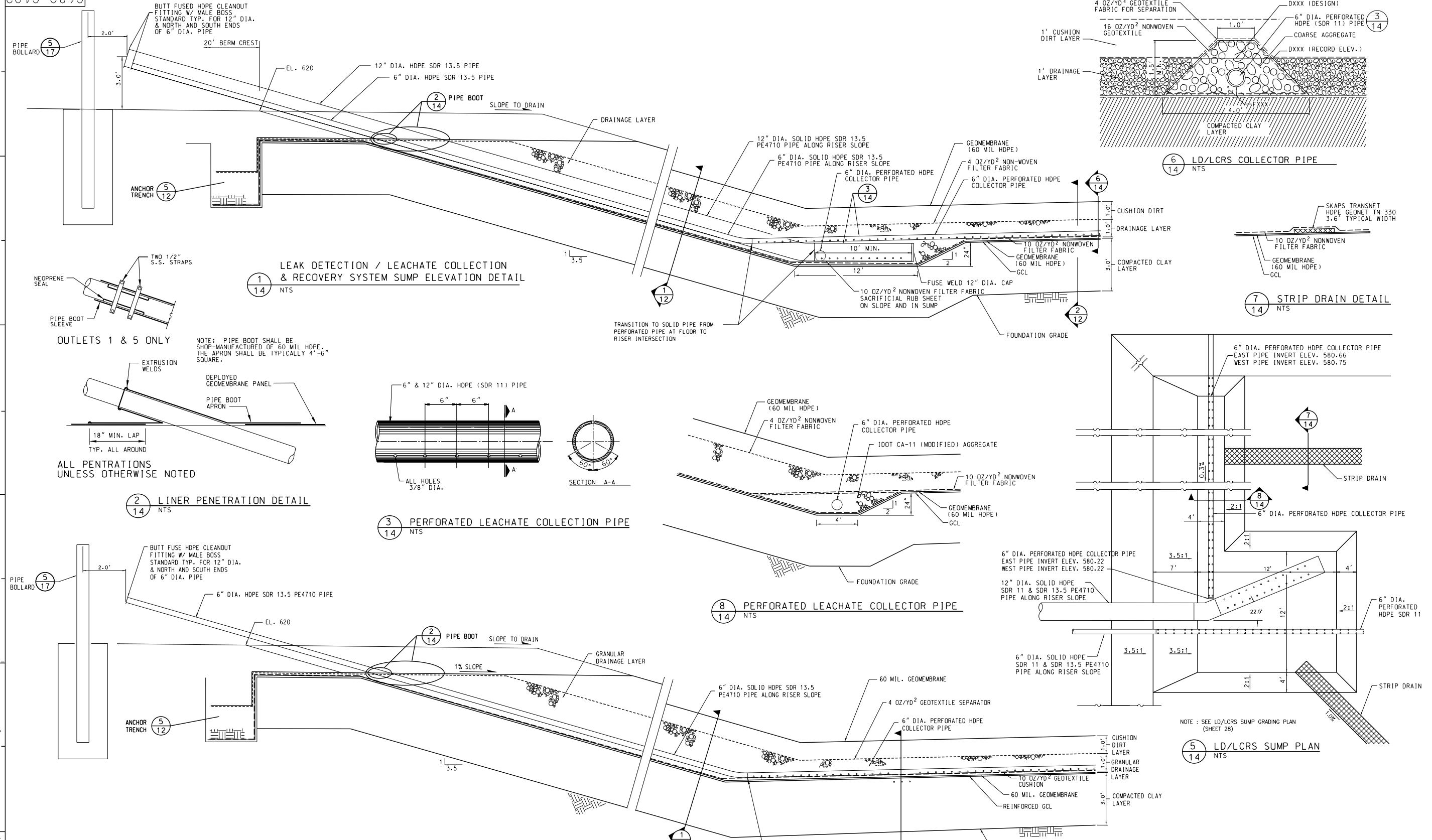
GYPSSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. _____

DRAWING NUMBER
C180-C102
SHEET NO. 13 OF 33



SCALE
DRAFTER
DATE
03-26-09

REV.
2



RECORD DRAWING FILE NO. -C180-C102-I4.dgn

REC CAD GENERATED
DO NOT REVISE MANUALLY

DRAWING RECORD					DRAWING RECORD						
REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION	REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION						
1	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION						
2	10-10-08	TCJ	DBH	SMB	MODIFIED LD/LCRS SUMP PLAN						
3	03-05-09	SKB	JMM		ISSUED FOR RECORD DRAWING BY HANSON						



LD/LCRS SECTIONS & DETAILS

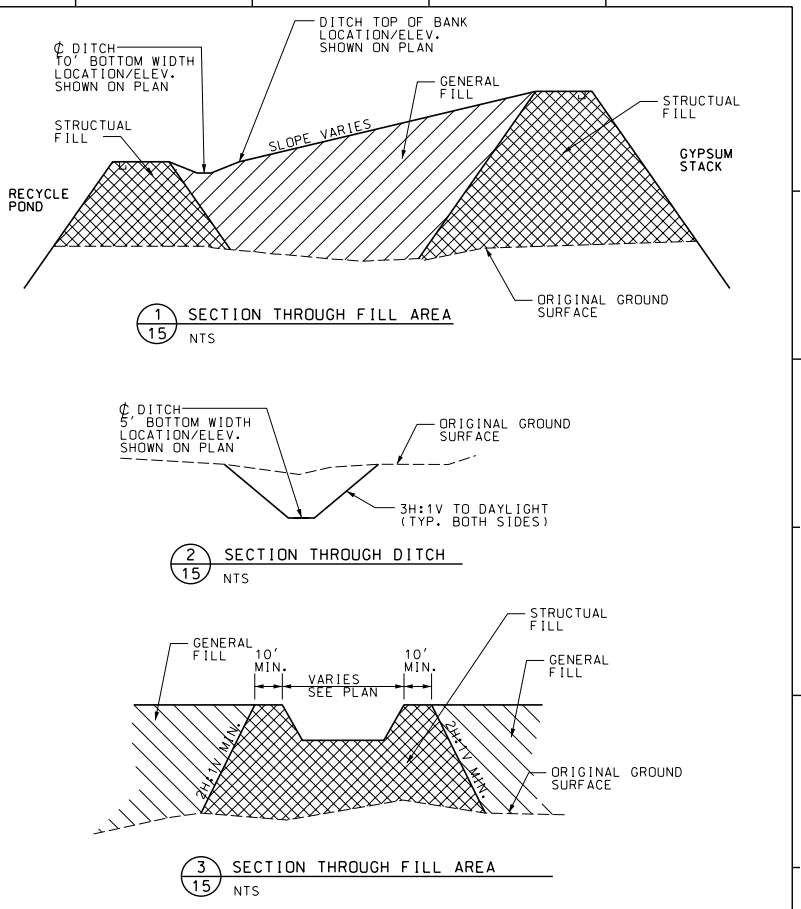
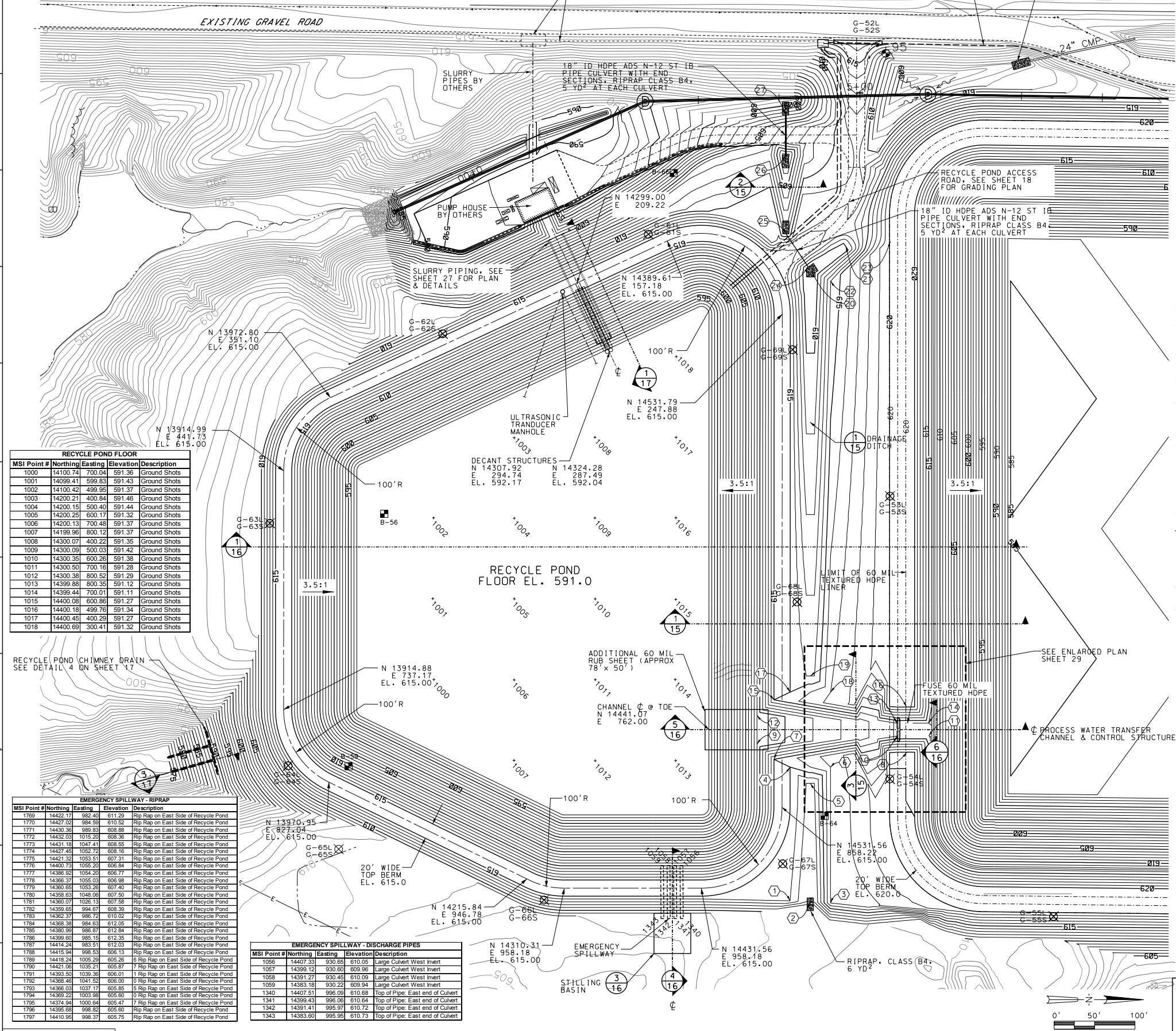
GYPNUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. _____

Ameren Energy
Resources Generating

DRAWING NUMBER: **C180-C102**
REV. **3**

SHEET NO. 14 OF 33

Brans00939
 05/14/2009
 R03 Job: 03:5000\9\p\p\m Stack/CADD/Sheets/C180-C102-I4.dgn
 LAYOUT: KMK 05-15-09
 DRAWN: SKB 04-16-09
 REVIEWED:



MSI Point #	Northing	Eastng	Elevation	Description
1000	14100.74	700.04	591.36	Ground Shots
1001	14099.41	599.83	591.43	Ground Shots
1002	14100.42	499.95	591.37	Ground Shots
1003	14200.21	400.84	591.46	Ground Shots
1004	14200.15	500.40	591.44	Ground Shots
1005	14200.25	600.17	591.32	Ground Shots
1006	14200.13	700.48	591.37	Ground Shots
1007	14199.96	800.12	591.37	Ground Shots
1008	14300.07	400.22	591.35	Ground Shots
1009	14300.09	500.03	591.42	Ground Shots
1010	14300.35	600.26	591.38	Ground Shots
1011	14300.50	700.16	591.28	Ground Shots
1012	14300.38	800.52	591.29	Ground Shots
1013	14399.88	800.35	591.12	Ground Shots
1014	14399.44	700.01	591.11	Ground Shots
1015	14400.08	600.36	591.27	Ground Shots
1016	14400.18	499.78	591.34	Ground Shots
1017	14400.45	400.29	591.27	Ground Shots
1018	14400.69	300.41	591.32	Ground Shots

MSI Point #	Northing	Eastng	Elevation	Description
1769	14422.17	982.40	611.29	Rip Rap on East Side of Recycle Pond
1770	14427.02	984.29	610.52	Rip Rap on East Side of Recycle Pond
1771	14431.76	989.63	608.88	Rip Rap on East Side of Recycle Pond
1772	14432.03	1015.20	608.36	Rip Rap on East Side of Recycle Pond
1773	14431.18	1047.41	608.55	Rip Rap on East Side of Recycle Pond
1774	14427.45	1052.72	608.16	Rip Rap on East Side of Recycle Pond
1775	14421.02	1053.51	607.31	Rip Rap on East Side of Recycle Pond
1776	14400.73	1055.20	606.84	Rip Rap on East Side of Recycle Pond
1777	14388.92	1054.20	606.77	Rip Rap on East Side of Recycle Pond
1778	14386.37	1055.03	606.98	Rip Rap on East Side of Recycle Pond
1779	14380.05	1053.63	607.49	Rip Rap on East Side of Recycle Pond
1780	14358.63	1048.06	607.50	Rip Rap on East Side of Recycle Pond
1781	14360.07	1028.13	607.58	Rip Rap on East Side of Recycle Pond
1782	14359.65	994.67	608.39	Rip Rap on East Side of Recycle Pond
1783	14362.37	958.22	610.02	Rip Rap on East Side of Recycle Pond
1784	14368.38	984.63	612.05	Rip Rap on East Side of Recycle Pond
1785	14380.99	998.87	612.84	Rip Rap on East Side of Recycle Pond
1786	14389.93	985.15	612.35	Rip Rap on East Side of Recycle Pond
1787	14414.24	983.51	612.03	Rip Rap on East Side of Recycle Pond
1788	14415.94	998.53	608.13	Rip Rap on East Side of Recycle Pond
1789	14418.24	1005.29	605.26	Rip Rap on East Side of Recycle Pond
1790	14427.06	1032.21	605.67	Rip Rap on East Side of Recycle Pond
1791	14381.50	1038.36	606.01	Rip Rap on East Side of Recycle Pond
1792	14388.46	1041.52	606.00	Rip Rap on East Side of Recycle Pond
1793	14386.03	1037.17	605.85	Rip Rap on East Side of Recycle Pond
1794	14389.52	1003.98	605.69	Rip Rap on East Side of Recycle Pond
1795	14374.94	1000.64	605.47	Rip Rap on East Side of Recycle Pond
1796	14395.68	998.82	605.60	Rip Rap on East Side of Recycle Pond
1797	14410.95	998.37	605.75	Rip Rap on East Side of Recycle Pond

MSI Point #	Northing	Eastng	Elevation	Description
1056	14407.33	930.65	610.05	Large Culvert West Invert
1057	14399.12	930.60	609.96	Large Culvert West Invert
1058	14391.27	930.45	610.09	Large Culvert West Invert
1059	14383.18	930.22	609.94	Large Culvert West Invert
1340	14407.51	996.09	610.68	Top of Pipe, East end of Culvert
1341	14399.43	996.00	610.64	Top of Pipe, East end of Culvert
1342	14391.41	995.97	610.72	Top of Pipe, East end of Culvert
1343	14383.60	995.95	610.73	Top of Pipe, East end of Culvert

STANDARD LEGEND
(ALL SYMBOLS MAY NOT BE USED ON EACH PLAN)

- ORIGINAL CONTOURS
- FENCELINE
- TRANSMISSION TOWER
- OVERHEAD ELECTRIC
- LIMITS OF VEGETATION
- GRAVEL ROAD
- RAILROAD
- STORM SEWER
- CONTROL POINT
- NEW CONTOURS
- LD/LCRS COLLECTION PIPE
- GEONET
- MONITORING WELL
- BORING
- FUTURE GROUNDWATER MONITORING WELL
- 4" DIA. PERFORATED DRAINAGE PIPING
- 6" DIA. OUTFALL PIPING
-

POINT NUMBER	GRADING TABLE			ELEVATION OR INVERT
	NORTHING	EASTING	ELEVATION	
1	14541.49	873.84	614.00	
2	14566.48	976.25	612.00	
3	14591.49	976.56	617.00	
4	14541.55	808.45	615.00	
5	14566.54	828.46	613.00	
6	14591.55	808.47	617.00	
7	14521.55	788.85	615.00	
8	14585.65	790.09	620.00	
9	14500.57	780.02	609.00	
10	14573.64	770.09	614.00	
11	14572.87	770.10	614.00	
12	14500.57	744.02	609.00	
13	14573.64	754.09	614.00	
14	14572.86	754.10	614.00	
15	14521.59	725.21	615.00	
16	14585.63	734.09	620.00	
17	14541.59	715.67	615.00	
18	14591.59	716.69	617.00	
19	14566.59	695.68	614.00	
20	14566.79	193.68	609.00	
21	14570.57	184.41	610.00	
22	14591.79	207.04	614.00	
23	14566.51	157.75	620.00	
24	14564.00	189.52	609.00	
25	14536.22	147.95	608.90	
26	14536.22	51.05	602.50	
27	14536.22	1.05	602.30	

NOTES:
1. CONTOURS SHOWN IN RECYCLE POND REPRESENT TOP OF LINER.
2. THE PROPERTY IS LOCATED IN SECTION 18, TOWNSHIP 6 NORTH, RANGE 5 EAST, 4TH P.M., FULTON COUNTY, ILLINOIS.

REC CAD GENERATED
DO NOT REVISE MANUALLY

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
1	03-05-08	SKB	SMB	SMB	ADDED SLURRY PIPING - ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
2	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION
3	09-29-08	DBH	SMB	SMB	REVISED COORDINATES FOR PROCESS WATER CONTROL STRUCTURE
4	12-19-08	TCJ			REVISED CHIMNEY DRAIN
5	03-05-09	SKB	JMM		ISSUED FOR RECORD DRAWING BY HANSON

HANSON
Hanson Professional Services Inc.
1525 South Sixth Street
Springfield, Illinois 62703-2886
Phone: (217) 788-2450 Fax: (217) 788-2503
1111 North Commercial Professional Service
Corporation #184-001084
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DRAWING TITLE
RECYCLE POND PLAN
GYPNUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. _____
DRAWING NUMBER
C180-C102
SHEET NO. 15 OF 33
REV. 5
Amen Energy
Resources Generating

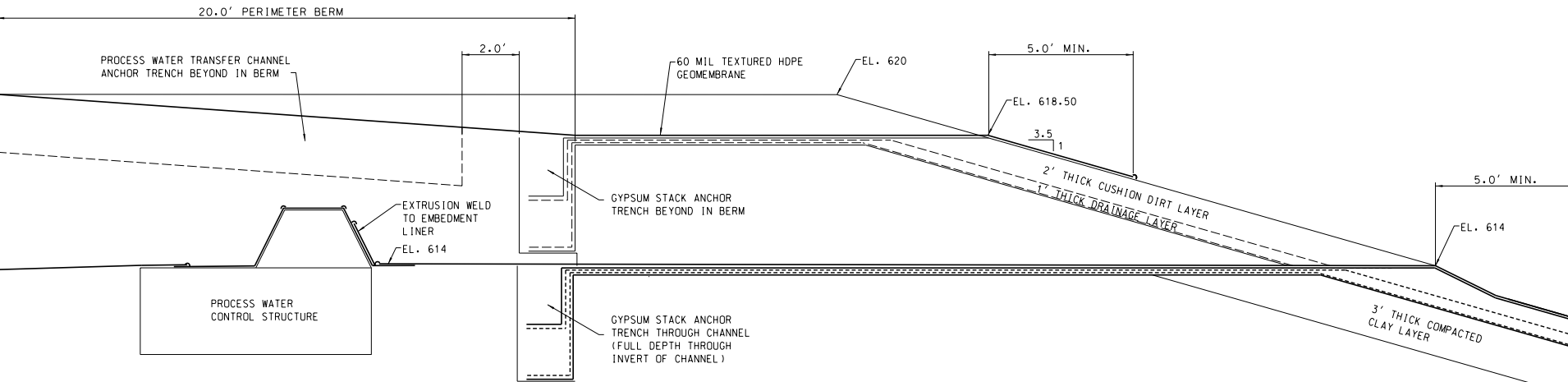
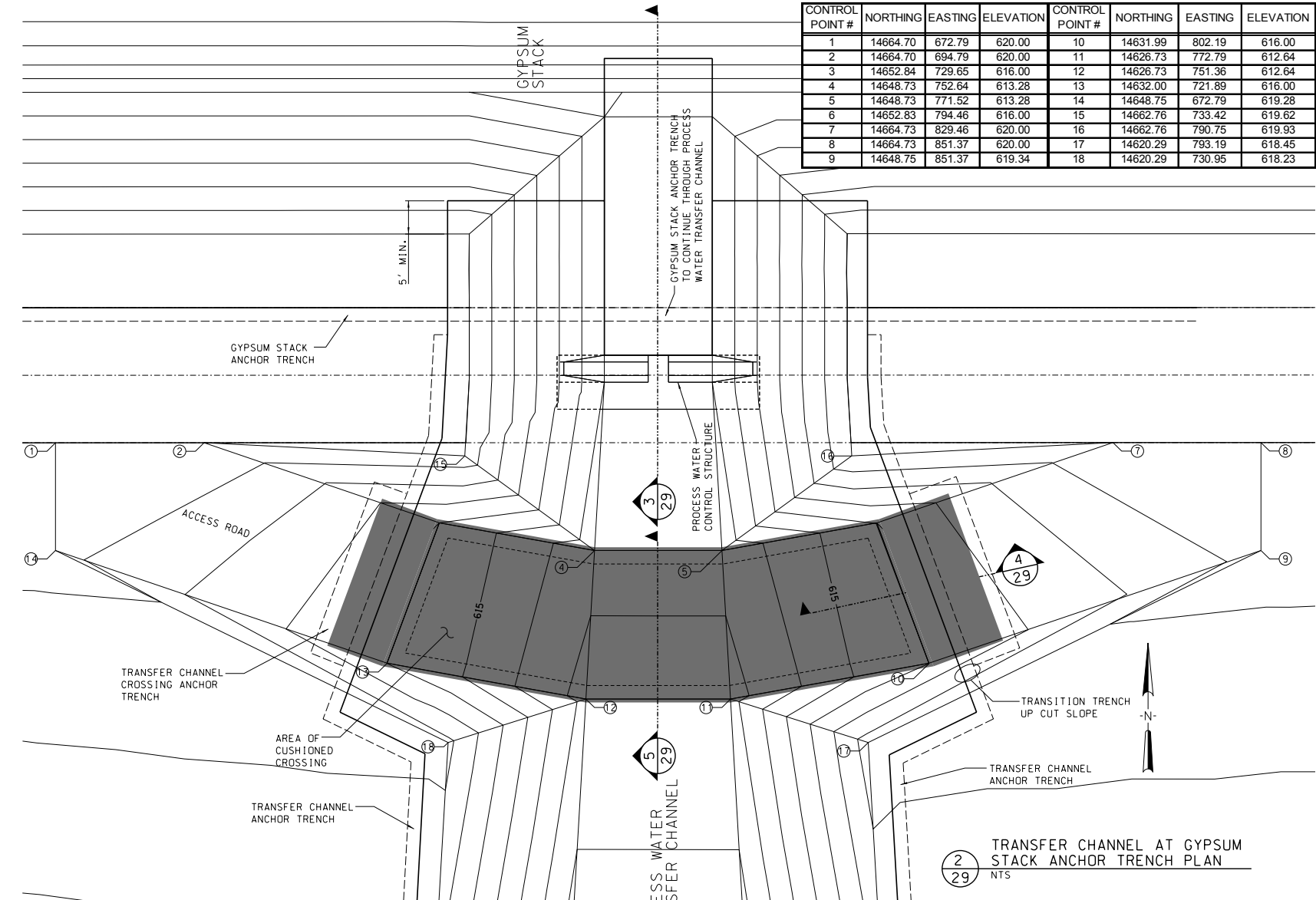
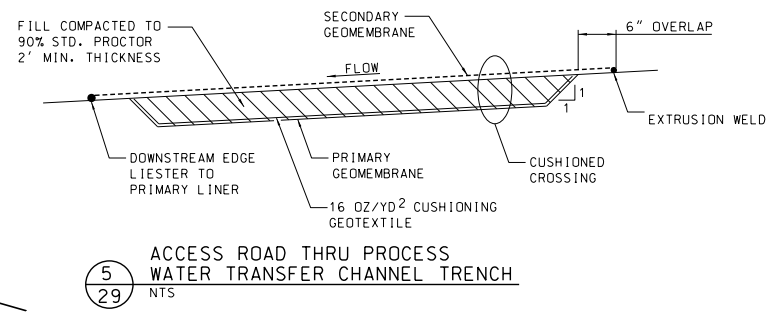
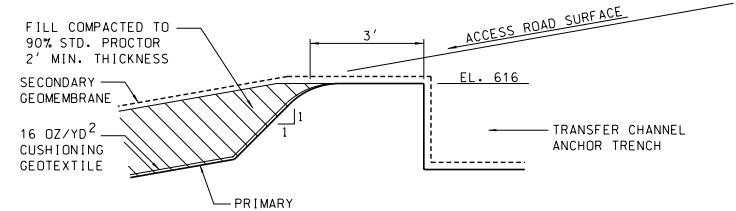
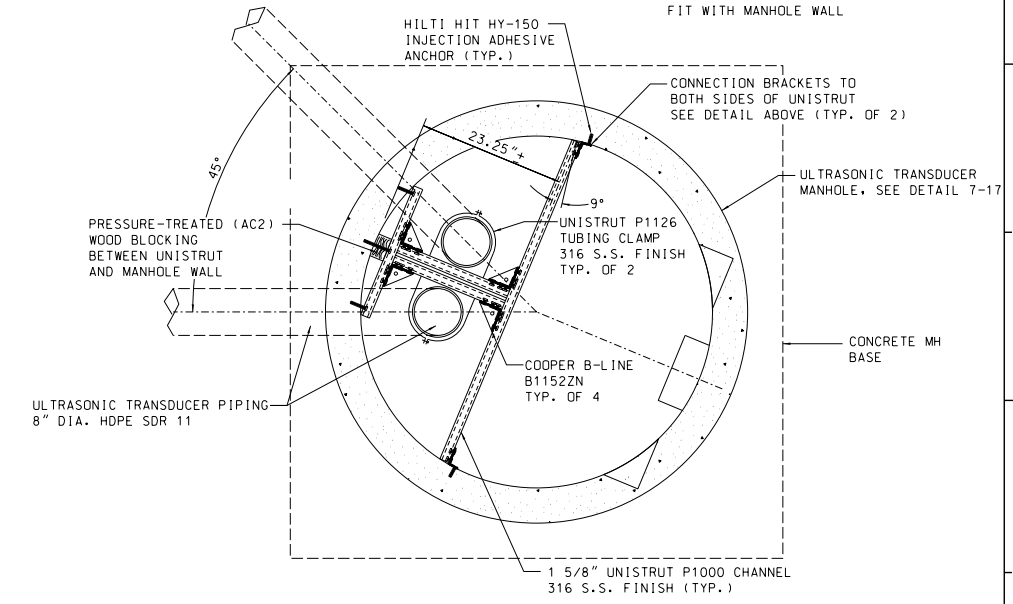
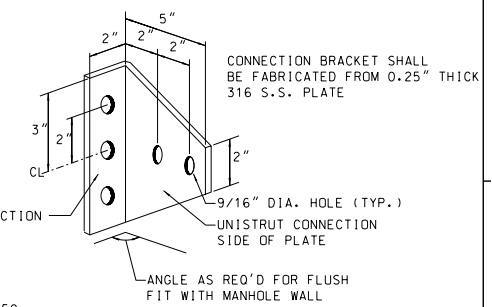
GRADING TABLE

CONTROL POINT #	NORTHING	EASTING	ELEVATION	CONTROL POINT #	NORTHING	EASTING	ELEVATION
1	14664.70	672.79	620.00	10	14631.99	802.19	616.00
2	14664.70	694.79	620.00	11	14626.73	772.79	612.64
3	14652.84	729.65	616.00	12	14626.73	751.36	612.64
4	14648.73	752.64	613.28	13	14632.00	721.89	616.00
5	14648.73	771.52	613.28	14	14648.75	672.79	619.28
6	14652.83	794.46	616.00	15	14662.76	733.42	619.62
7	14664.73	829.46	620.00	16	14662.76	790.75	619.93
8	14664.73	851.37	620.00	17	14620.29	793.19	618.45
9	14648.75	851.37	619.34	18	14620.29	730.95	618.23

NOTE:

ALL ANCHORS IN MANHOLE WALLS SHALL BE HILTI HIT HY-150 MAX. INJECTION ADHESIVE ANCHORS SET TO A DEPTH OF 3".

ALL FASTENER HARDWARE AND UNISTRUT CHANNEL NUTS (PART P1010) SHALL BE 316 S.S. WITH 1/2"x13 BOLT SIZE



AWING FILE NO. -C180-C102-29.dgn

DRAWING TITLE

MISCELLANEOUS DETAILS

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. _____

SCALE

DRAFTER

DATE 03-26-09

Ameren Energy Resources Generating

DRAWING NUMBER
C180-C102

REV.
2

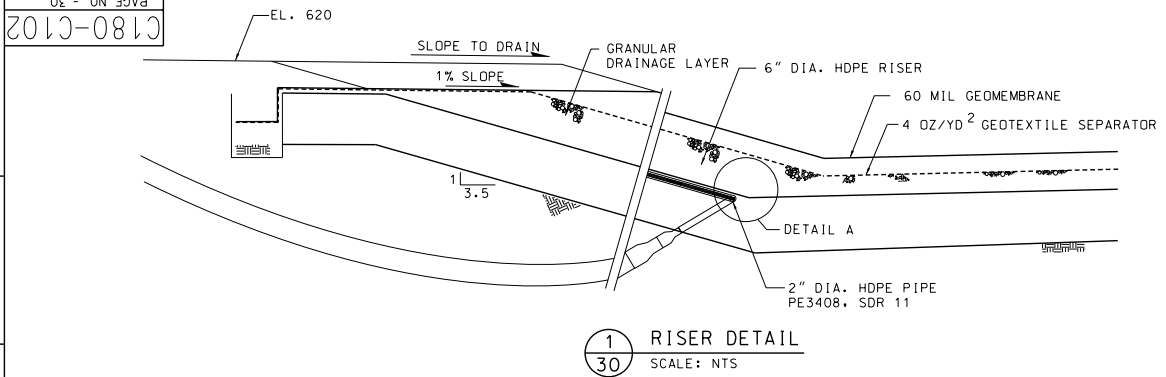
SHEET NO. 29 OF 33

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0	11-07-08	TCJ	DBH	SMB						ISSUED FOR CONSTRUCTION
1	01-08-09	TCJ	DBH	DBH						ADDED ACCESS ROAD CROSSING AND DETAILS
2	03-05-09	SKB	JMM	-						ISSUED FOR RECORD DRAWING

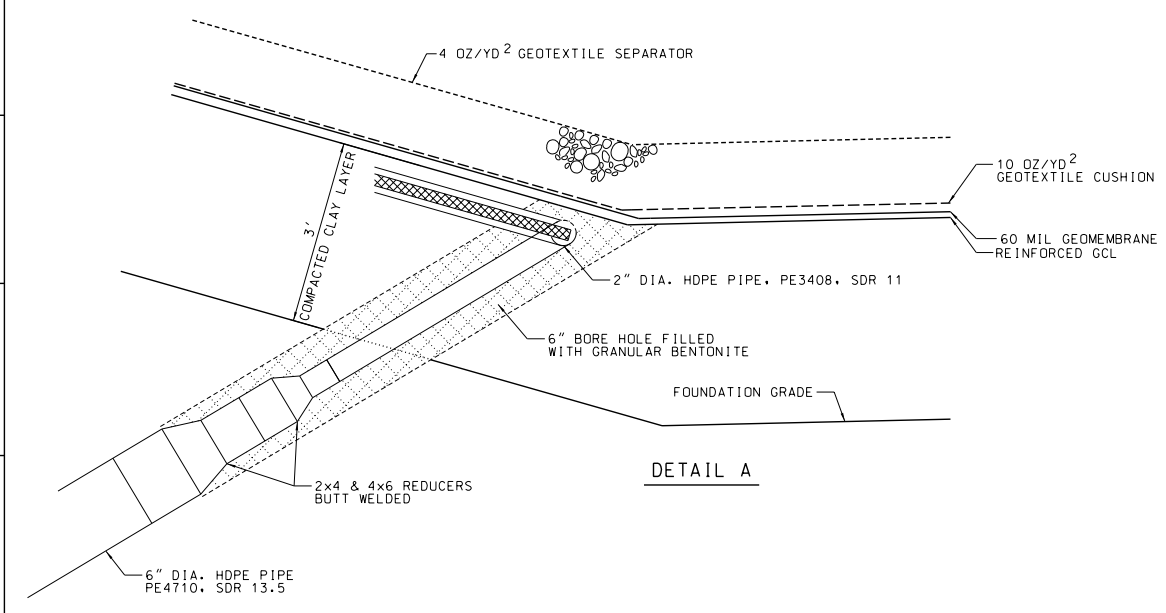
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Brans00939
 03/15/2009
 R03 Job:03:5000 Gypsum Stack CAD Sheets V080-C102-29.dgn

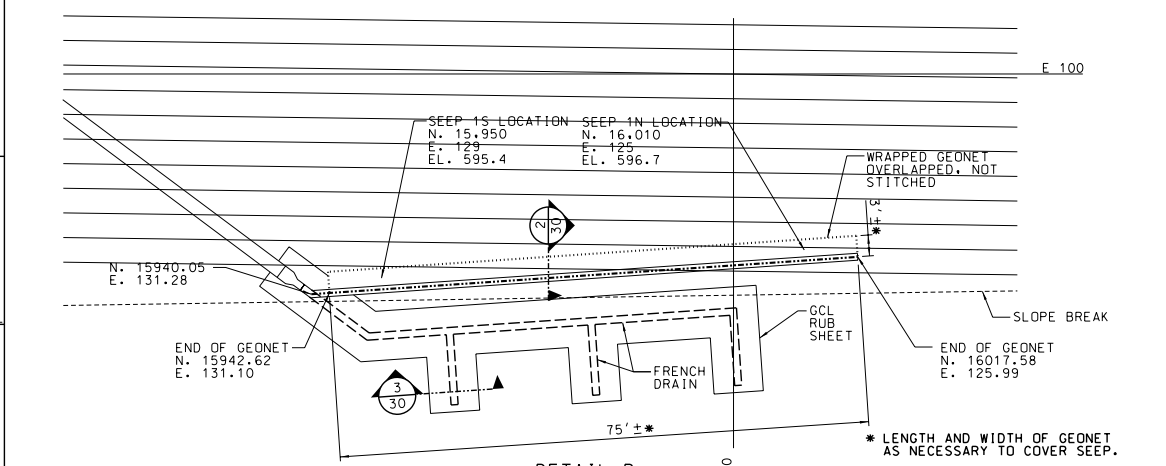
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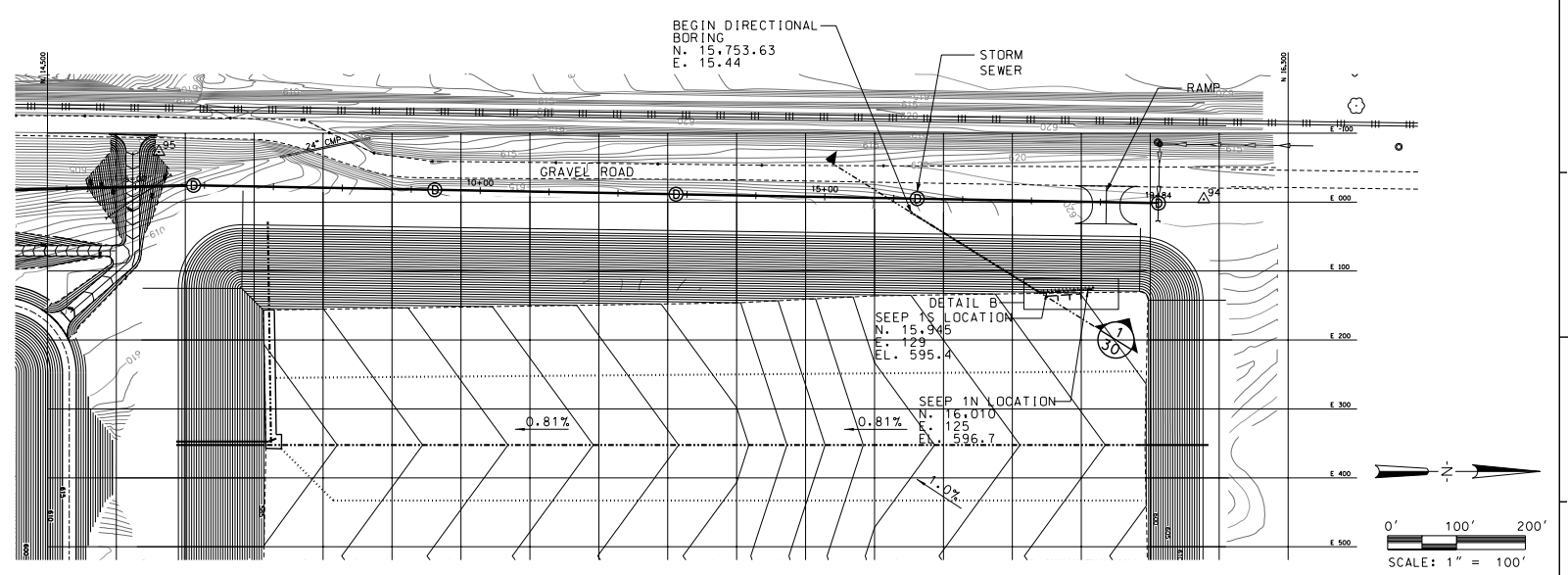
1 RISER DETAIL
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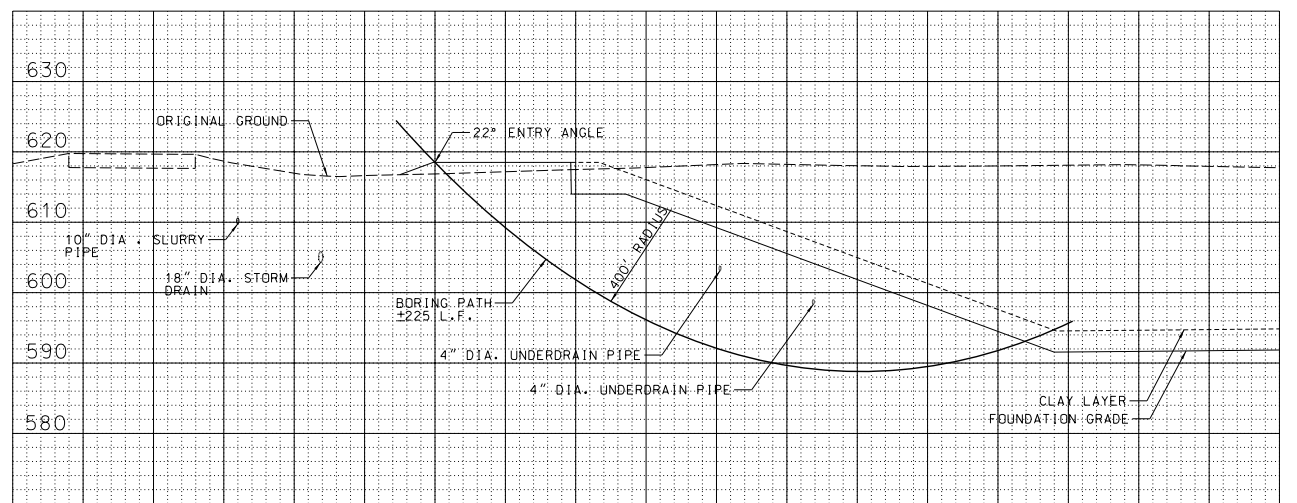
DETAIL A



2 GEONET DETAIL
SCALE: NTS

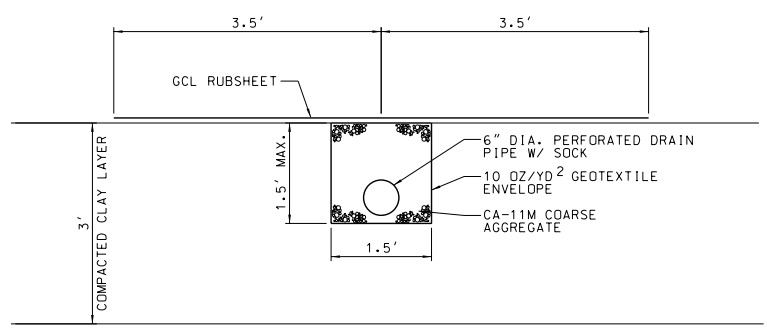


SCALE: 1" = 100'



BORING PROFILE

STATION	CLAY LAYER ELEVATION	BORING PATH ELEVATION
0+00	618.50	618.50
0+10	618.50	614.57
0+20	618.50	610.94
0+30	618.50	607.62
0+40	618.50	604.58
0+50	618.50	601.82
0+60	618.26	599.34
0+70	616.79	597.14
0+80	615.31	595.19
0+90	613.84	593.51
1+00	612.36	592.09
1+10	610.89	590.83
1+20	609.41	590.02
1+30	607.94	589.36
1+40	606.46	588.95
1+50	604.98	588.80
1+60	603.51	588.89
1+70	602.03	589.23
1+80	600.56	589.83
1+90	599.08	590.67
2+00	597.61	591.77
2+10	596.13	593.13
2+20	594.66	594.74



3 FRENCH DRAIN DETAIL
SCALE: NTS

NOTE:
SEE OTHER PLAN SHEETS FOR STANDARD LEGEND.



RECORD DRAWING FILE NO. -C180-C102-30-SEEP1.dgn

DRAWING TITLE
LD/LCRS UNDERDRAIN DEWATERING SYSTEM-SEEP 1
GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. _____

DRAWING NUMBER
C180-C102

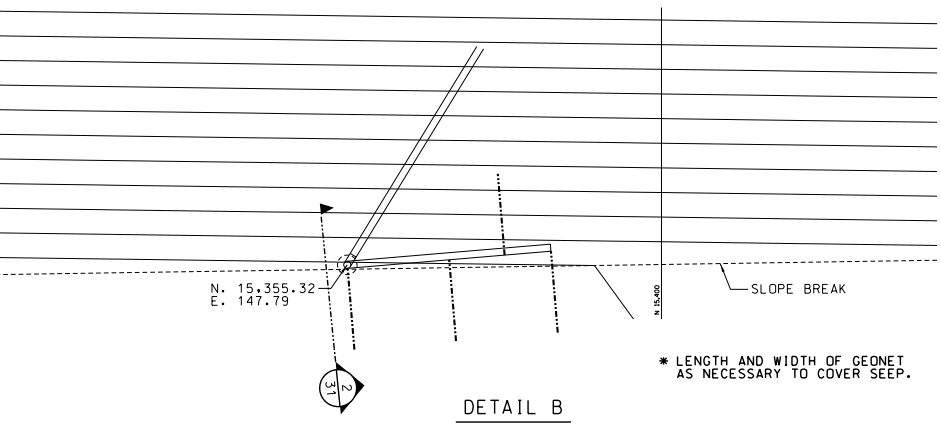
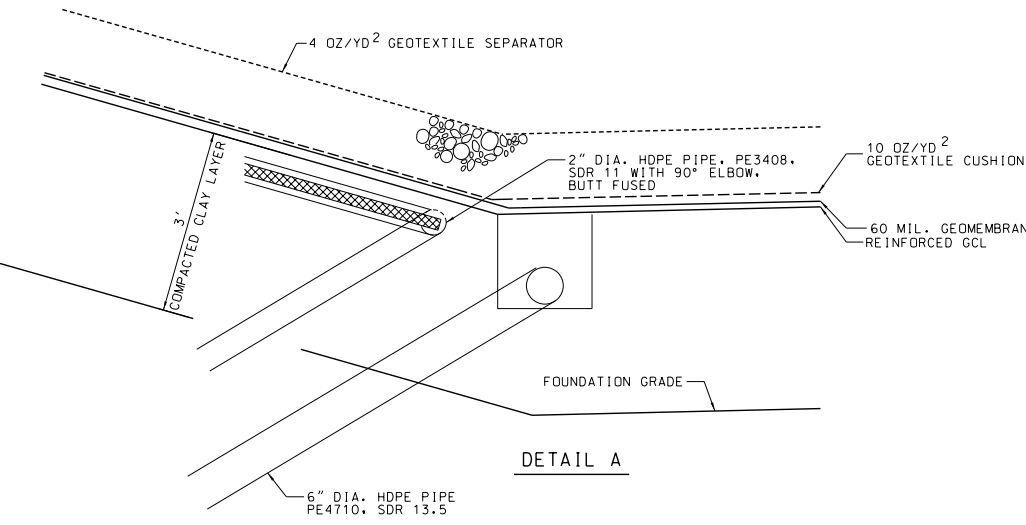
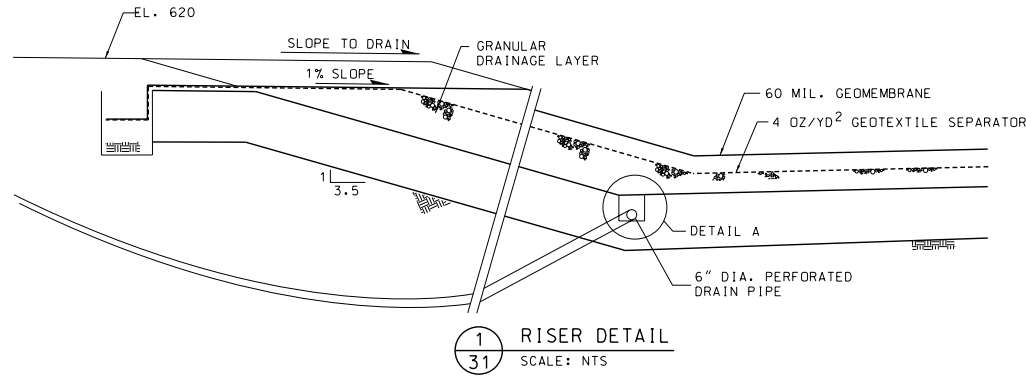
REV. 2

SHEET NO. 30 OF 33

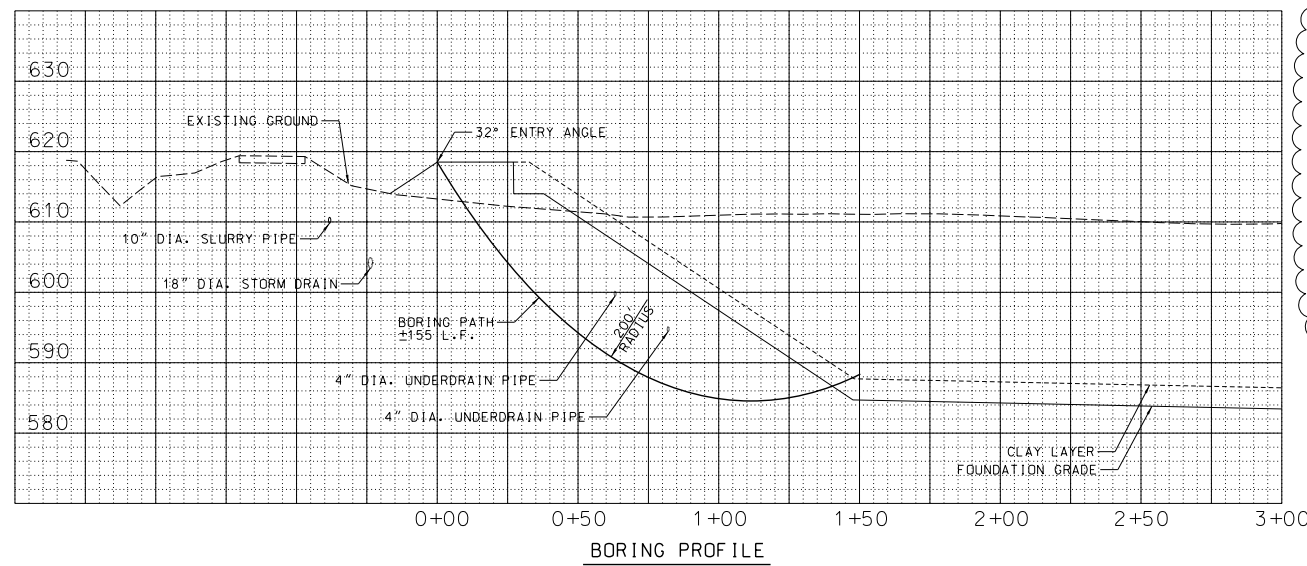
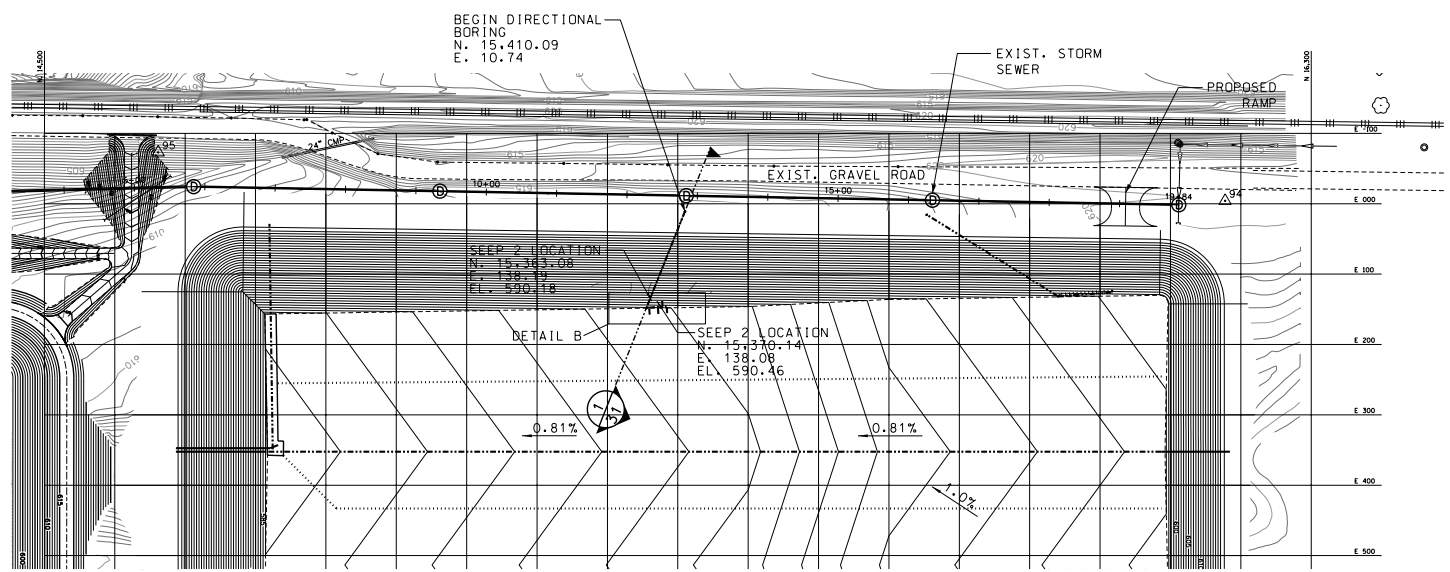
Ameren Energy Resources Generating

REC CAD GENERATED
DO NOT REVISE MANUALLY

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0	11-07-08	TCJ	RWH	DBH	ISSUED FOR CONSTRUCTION				
1	11-14-08	TCJ			REVISED BORING PATH AND ENTRY POINT - ISSUED FOR CONSTRUCTION				
2	03-05-09	SKB	JMM		ISSUED FOR RECORD DRAWING BY HANSON				



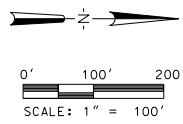
2
31 GEONET DETAIL
SCALE: NTS



STATION	CLAY LAYER ELEVATION	BORING PATH ELEVATION
0+00	618.50	618.50
0+10	618.50	612.21
0+20	618.50	606.70
0+30	618.50	601.90
0+40	616.55	597.77
0+50	613.88	594.24
0+60	611.21	591.30
0+70	608.55	588.91
0+80	605.88	587.05
0+90	603.21	585.72
1+00	600.54	584.89
1+10	597.88	584.57
1+20	595.21	584.75
1+30	592.54	585.43
1+40	589.88	586.61

STANDARD LEGEND
(ALL SYMBOLS MAY NOT BE USED ON EACH PLAN)

	ORIGINAL CONTOURS		NEW CONTOURS
	FENCE LINE		LD/LCRS COLLECTION PIPE
	TRANSMISSION TOWER		GEONET
	OVERHEAD ELECTRIC		MONITORING WELL
	LIMITS OF VEGETATION		BORING
	GRAVEL ROAD		FUTURE GROUNDWATER MONITORING WELL
	RAILROAD		4" DIA. PERFORATED DRAINAGE PIPING
	STORM SEWER		6" DIA. OUTFALL PIPING
	CONTROL POINT		



RECORD DRAWING FILE NO. -C180-C102-31-SEEP2.dgn



DRAWING TITLE
**LD/LCRS UNDERDRAIN
DEWATERING SYSTEM-SEEP 2**
GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. _____



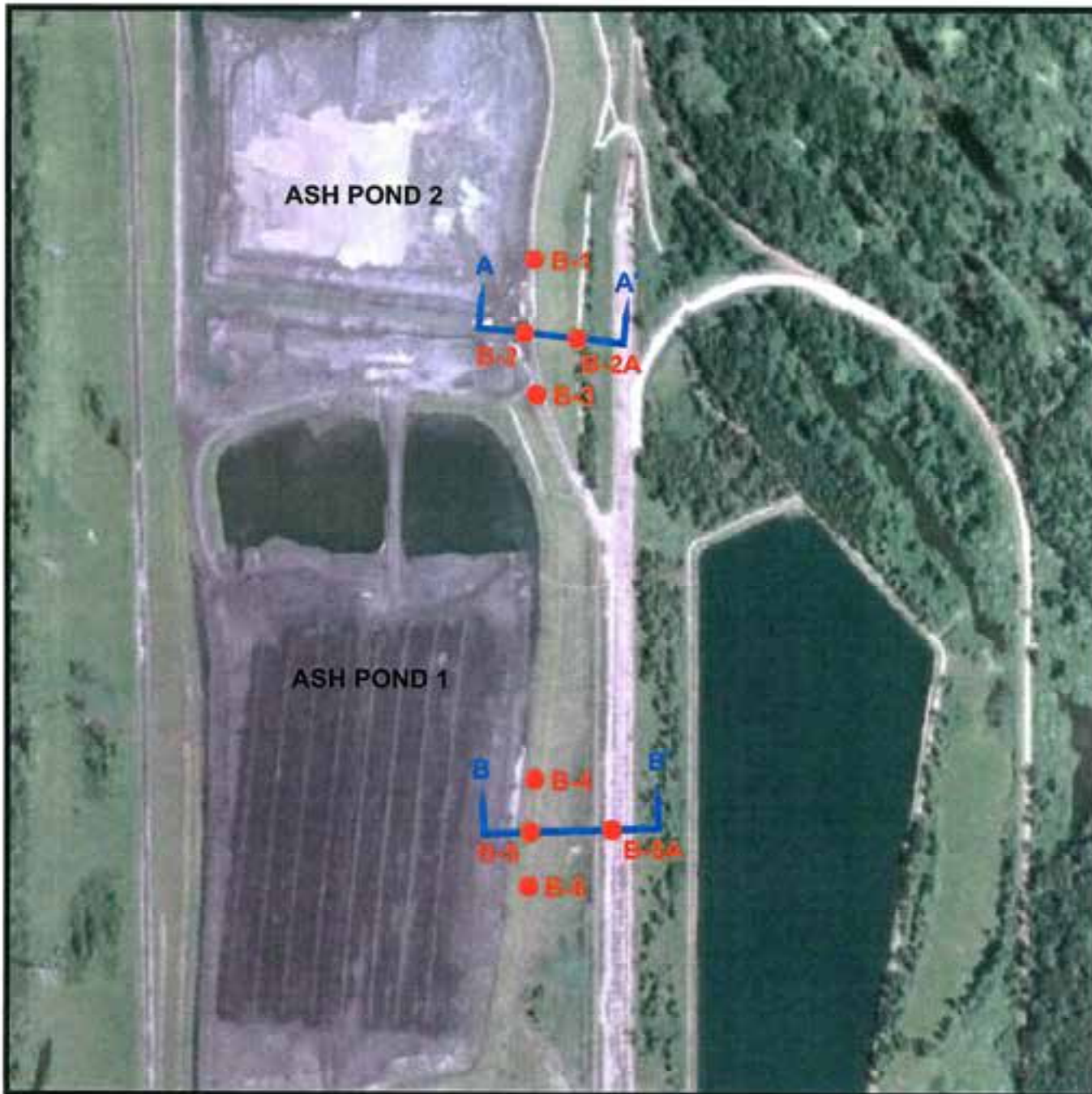
DRAWING NUMBER
C180-C102
SHEET NO. 31 OF 33

AEG CAD GENERATED
DO NOT REVISE MANUALLY

REVISIONS					DRAWING RECORD				
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1	11-24-08	TCJ	RWH	DBH					
2	03-05-09	TCJ	JMM						
DESCRIPTION					DESCRIPTION				
ISSUED FOR CONSTRUCTION									
ISSUED FOR CONSTRUCTION REVISED PENETRATION LOCATION									
ISSUED FOR RECORD DRAWING BY HANSON									



Appendix C: Duck Creek Power Station Boring and Piezometer Locations

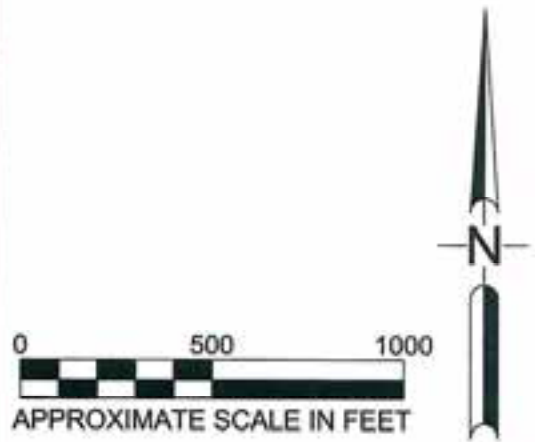


NOTES

1. Plan adapted from an aerial photograph courtesy of Google Earth.

LEGEND

- Boring Location
- Slope Stability Cross Section



Drawn By: SLC	Ck'd By: <i>SLC</i>	App'vd By: <i>DJN</i>
Date: 11-03-10	Date: <i>12/4/10</i>	Date: <i>1/11/11</i>



Duck Creek Power Station
Canton, Illinois

**AERIAL PHOTOGRAPH OF SITE
AND BORING LOCATIONS**

Project Number J017150.01	PLATE 2
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Figure C.1. Piezometer locations for Ash Pond No. 1 and Ash Pond No. 2.



Appendix D: Project Manual; Specification No's.: C180-C102 (excerpt)

**PROJECT MANUAL
GYPSUM STACK AND RECYCLE POND AND CCB LANDFILL CONSTRUCTION
GYPSUM MANAGEMENT FACILITY AND CCB LANDFILL
DUCK CREEK POWER STATION
FULTON COUNTY, ILLINOIS**

SPECIFICATION NO'S.: C180-C102

Prepared For:

AMEREN ENERGY RESOURCES GENERATING COMPANY

Prepared By:

HANSON PROFESSIONAL SERVICES INC.
1525 South Sixth Street
Springfield, Illinois 62703

Specifications for Construction

April 11, 2008

BIDDING CLARIFICATIONS FOR AMEREN CONTRACT DOCUMENTS
AMEREN ENERGY RESOURCES GENERATING COMPANY
GYPSUM MANAGEMENT FACILITY AND CCB LANDFILL
PROJECT SPECIFICATIONS NO. C180-C102
ADDENDUM #2

Prepared March 24, 2008
By Hanson Professional Services, Inc.
Preparer: DBH

Hanson Professional Services is please to provide the following clarifications to outstanding questions regarding the contract documents:

- 1) *Please clarify again Bid Form page BF-A-5 the 146,740 cy is the amount excavated and stockpiled. In addition in that price we include 146,740 cy going back in place?*

Answer: The Estimated Quantity of 146,740 C.Y. shown on Bid Forms A and B is our estimated TOTAL excavation needed for the Over-excavation of Soil and Sand from NE & SW Corners of Gypsum Stack Area. The excavation shall be backfilled with suitable structural backfill after the unsuitable sand lens material has been removed and stockpiled. Our estimate for unsuitable sand material is the 17,600 C.Y. shown in the same section of the Bid Forms.

- 2) *What is the status of design on slurry piping plan and details? Currently sheet C102-27 does not provide sufficient information.*

Answer: An updated sheet will be issued with Addendum #2.

- 3) *Per sheet C102-05, "All under drain pipes installed under the excavation contract C180-C101 shall remain in place. Subsurface drainage piping shall be sealed with bentonite slurry in accordance with project specifications upon completion of the liner system". Please provide specifications.*

Answer: Sealing of the subsurface drainage system is specified in Section 02141 - Surface Water Management, paragraph 3.06.

- 4) *Is dwg. format available with Landfill, Gypsum and Recycle Pond area merged to one drawing. We specifically need existing and proposed contours for both projects consolidated as one design and existing layer. The lins provided are for the Gypsum Pond only, would appreciate fill for Landfill if drawings can not be merged. Will Hanson be able to provide design contours for cushion dirt layer? Currently available drawings provide points only from sheet C102-11.*

Answer: We will be issuing updated tin & dwg files for the Gypsum Stack Recycle Pond that reflects the work completed under Contract C180-C101 with Addendum #2. Tin & DWG files for the CCB Landfill will be issued later in the week, as it is currently being surveyed and verified.

- 5) *The granular materials for the drainage layer and separation berm shall provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-3} . Is there a specific material anticipated for the completion of this work?*

Answer: The granular materials required for the drainage layer and separation berm are adequately specified in the Project Specifications. The Contractor shall be responsible for determining availability and sourcing for these materials.

Addendum #2-1

6) *Is a construction joint allowed in the Process Water Control Structure.*

Answer: A Bonded Construction Joint will be allowed for this structure, provided that it is constructed in accordance with article 503.09 of the Illinois Department of Transportation "Standard Specifications for Road and Bridge Construction" Adopted January 1, 2007.

7) *What if anything is required on the low water crossing on sheet 16 of the CCB Landfill?*

Answer: No special materials are required in this area, the invert of the existing spillway channel shall be maintained and crossed by the proposed haul road.

8) *Is the Coarse Aggregate for the Leachate collection pipe also the IDOT CA-7 Per Article 1004.1 of IDOT Specs.*

Answer: The Coarse Aggregate for the Leachate Collection Pipe shall be a gradation as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-3} cm/sec. We will issue a correction to the specifications with Addendum #2.

9) *Detail 7/17 for the Ultrasonic Transducer from your web site is different than your handout at the pre-bid meeting is the web site detail the one we are to provide?*

Answer: The latest detail on the web site is the latest one, however a revision to that detail will be issued with Addendum #2.

10) *Bid Form page A-3 Riprap Class B4, the unit of measure is LF, should that be TONS or S.Y.?*

Answer: The correct unit should be S.Y.

11) *In an effort to utilize local aggregate sources, can we use "Special Provision Rock" as specified by IDOT for Contracts 68206 & 68205 for the aggregate base and surface course?*

Answer: All aggregates shall be supplied as specified in Section 02315 Granular Materials.

12) *Can we substitute a butt fusion reducer in lieu of the 50% welded extrusion joints" as shown in detail 5/13?*

Answer: A butt fusion reducer would be acceptable in that location (Detail 5/13 - Plans C180-C102)

13) *Page 27, slurry piping- Is this the sluice piping from section 2640? There is no size listed on the plans. The plan shows dashed and solid lines, what do they represent. Section 2640 calls for valves in the sluice piping, are these the valves shown on sheet 27?*

Answer: A revised sheet C180-102-27 and a new sheet C180-102-28 are included in Addendum #2.

14) *The specs say all underdrain within lined areas of cell is to be grouted. Is the recycle pond lined?*

Answer: The subdrainage outfall piping beneath the recycle pond is to be grouted.

Addendum #2-2

15) *We are trying to figure out what gradation of rock is required for detail 6/14 on the gypsum stack and also for detail 1/12 and 2/12 on the CCB Landfill. Section 2315 Part 2 does not have the gradation language we are used to looking at for the CCB Landfill Course Aggregate.*

Answer: The Coarse Aggregate material called out in these details is the same as is specified in Section 02315 - Part 2.01-B-2 for CCB Landfill Coarse Aggregate. A revised specification will be included in this Addendum.

Addendum #2-3

BIDDING CLARIFICATIONS FOR AMEREN CONTRACT DOCUMENTS
AMEREN ENERGY RESOURCES GENERATING COMPANY
GYPHUM MANAGEMENT FACILITY AND CCB LANDFILL
PROJECT SPECIFICATIONS NO. C180-C102

ADDENDUM #3

Prepared March 27, 2008
By Hanson Professional Services, Inc.
Preparer: DBH

Hanson Professional Services is pleased to provide the following clarifications to outstanding questions regarding the contract documents:

Question: One GCL manufacturer produces a double nonwoven, needlepunch reinforced geosynthetic clay liner that will meet or exceed the project requirements and the GRI-GCL-3 specification, with only two clarifications:

Footnote #2 in Table 1 of the GRI-GCL-3 specification states that for nonwoven reinforced GCLs, one of the Geotextiles must contain a scrim component of mass > 2.9 oz/yd² for dimensional stability. An exception to the scrim reinforcement requirement has been requested.

Table 1 of the GRI-GCL-3 specification states that nonwoven reinforced GCLs should be manufactured with minimum 5.9 and 5.8 oz/yd² Geotextiles. Our product is manufactured with minimum 6.0 and 2.7 oz/yd² nonwoven Geotextiles and it will still meet the peel and tensile strength requirements in the specifications. Accordingly, an exception to the minimum geotextile weights has been requested.

Answer: We will allow these exceptions, provided that all of the other requirements of the specifications are met by the GCL being submitted for bid.

Question: Aggregate suppliers cannot perform the testing required to qualify that their materials will meet the project specifications in the time allotted for bidding. What can the aggregate suppliers do to provide a reasonable quote for the aggregate materials within the Gypsum Stack and CCB Landfill footprints.

Answer: Adequate bidding time was allotted for relatively quick permeability and gradation testing, and these test results should be available. However, based on the time allotted for bidding and the turn-around time needed to complete the longer tests necessary to certify project specification compliance, we will allow aggregate suppliers to certify a unit price for these materials based on the contingency that they will meet the following required specifications:

ASTM D3042-03 Standard Test Method for Insoluble Residue in Carbonate Aggregates (15% loss Max.)

Addendum #3-1

**Na₂SO₄ Soundness 5 Cycle, Illinois Modified AASHTO T 104 {15% Loss Max.}
ASTM C 1260 Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method) (Less than 0.10% internal expansions at 16 days after casting)**

Additional question related to the overexcavation and replacement of materials in the NE and SW corners of the gypsum stack area:

Please clarify "The excavation shall be backfilled with suitable structural backfill". How and where will that backfill be paid for?

Answer: Please note that the bid form section for additional items to be paid on a unit cost or time and material basis provides estimated quantities only. The bid form allows for separate pricing for unsuitable sand soils that will need to be excavated from the NE and SW corners of the gypsum stack areas and transported to stockpiles (estimated at 17,600 cy) and for excavation and recompaction of soil material suitable for reuse (estimated at 146,740 cy). Based on these ESTIMATED volumes, the total ESTIMATED volume to be over-excavated from the NE and SW corners of the gypsum stack excavation is 164,340 cy {17,600 cy of which is estimated to be unsuitable sand that needs to be transported out of the excavation and stockpiled}. Note again that we will be removing an unknown amount of sand from the excavation. Shrinkage as a result of the compaction process may also be a factor. Any shortage of suitable backfill shall be obtained from the subsoil stockpiles. Backfilling the excavation with Structural Fill to be obtained from stockpiles will be paid for at Time and Material or by the unit cost included on the bid form for "Backfill w/Structural Fill from Stockpile."

Question: Can the test pad for the clay liner be constructed outside the footprint of the cell?

Answer: The test soil liner must be constructed within the footprint of the cell.

What end treatment is to be applied to the upstream ends of the 6" and 12" perforated laterals shown on Sheet C180-C110-09 and detailed on sheet C180-C110-12 for the CCB Landfill?

Answer: Cleanouts with threaded caps shall be installed at the termination points for the 6" and 12" perforated laterals. Revised drawing #C180-C110-09 is attached indicating this detail.

Question: The new details for vaults on the slurry lines show 8" FRP being bolted into 8" Valves, then a 10" HDPE pipes. The bolt patterns on the 10" pipe and 8" valve are not compatible. Please clarify.

Answer: An FRP spindle needs to be provided to go from the 8" valve to the 10" HDPE pipe. Revised drawing #C180-C102-28 is attached to show this configuration.

FINAL NOTE: THE BIDS ARE DUE MONDAY, 3/31/08. NO MORE QUESTIONS WILL BE ACCEPTED PRIOR TO BIDDING. PLEASE INCLUDE ANY ADDITIONAL ASSUMPTIONS AND CLARIFICATIONS WITH YOUR BIDS.

Addendum #3-2

GYPSUM STACK AND RECYCLE POND AND CCB LANDFILL CONSTRUCTION
 GYPSUM MANAGEMENT FACILITY AND CCB LANDFILL
 DUCK CREEK POWER STATION
 FULTON COUNTY, ILLINOIS

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01356 - Storm Water Pollution Prevention Measures	01356-1 to 01356-3
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02100 - Site Preparation	02100-1 to 02100-2
02140 – Surface Water Management	02140-1 to 02140-4
02200 - Earthwork	02200-1 to 02200-13
02275 - Riprap	02275-1 to 02275-2
02315 - Granular Drainage Materials	02315-1 to 02315-9
02373 - Geotextiles	02373-1 to 02373-8
02376 - Geosynthetic Clay Liner	02376-1 to 02376-8
Attachment 1 – GRI-GCL3 Specification	End of Section
02640 - HDPE Piping	02640-1 to 02640-4
02700 – Storm Drainage	02700-1 to 02700-2

02800 - HDPE Geomembrane	02800-1 to 02800-15
Attachment 1 – GR1-GM13 Specification	End of Section
02936 – Topsoil Seeding and Mulching	02936-1 to 02936-3
03100 – Concrete Formwork	03100-1 to 03100-5
03200 – Concrete Reinforcement	03200-1 to 03200-3
03300 – Cast-In-Place Concrete	03300-1 to 03300-6
03400 – Concrete Embedment Liner	03400-1 to 03400-4

Appendix 1 – Field Change Order Process

Appendix 2 – Construction Quality Assurance (CQA) Plan

Appendix 3 – Geotechnical Data

Appendix 4 – Construction Field Office

DIVISION 1 - GENERAL REQUIREMENTS
Section 01010 - Summary of Work
ADDENDUM #1

PART 1. GENERAL

1.0 INTRODUCTION

A. Gypsum Management Facility

The intent of this contract is to provide the services of a General Contractor to construct Gypsum Management Facility, consisting of a lined Gypsum Stack and Recycle Pond for the disposal of gypsum at Ameren Energy Resources Generating Company (AERG) Duck Creek Power Station's Gypsum Management Facility located near Canton, Illinois.

Excavation to approximately 5.4 ft. above foundation grade, partial construction of Recycle Pond perimeter berm, installation of a temporary stormwater outlet ditch, a temporary subsurface drainage system and the Recycle Pond pump station pad with access road were completed under a prior contract as outlined in the plans. Excavated material was stockpiled north and east of the excavation for use in this contract.

B. CCB Landfill

The intent of this contract is to provide the services of a General Contractor to construct a CCB Landfill, consisting a base 3 ft. thick Compacted Clay Liner, Geosynthetic Clay Liner (GCL), High Density Polyethylene (HDPE) Geomembrane, Geotextile Cushion Fabric and Leachate Collection System for the permanent disposal of coal combustion by-products (CCB) at the Ameren Energy Resources Generating Company (AERG) Duck Creek Power Station CCB Landfill located near Canton, Illinois.

Excavation to approximately 6 in. above foundation grade, construction of perimeter berm, installation of a permanent berm ditch outlet structure and a temporary subsurface drainage system were completed under prior contract. Excavated material was visually segregated during excavation and stockpiled east of the excavation for use in this contract.

2.0 DESCRIPTION OF WORK

2.01 Gypsum Management Facility

The scope of work shall consist of furnishing all materials, equipment, tools, labor, and incidentals necessary to perform the work as described below:

A. Gypsum Stack - Foundation Preparation

1. Excavate areas indicated on the plans to remove areas of underground sand seams and backfill with structural soil backfill.
2. Locally excavate to the foundation grade as indicated on the plans and finish grade the portion of the cell to be covered by Compacted Clay Liner.
3. Proof roll to identify unsuitable foundation soil materials.
4. As directed by the Owner's Representative, Excavate and replace unsuitable foundation materials consisting of unknown pockets of peat, sand, muck or other unsuitable materials with suitable structural backfill. Installation of geotextile fabric for ground stabilization, as deemed necessary by the owner's Representative, will be installed on a time and materials basis.

B. Gypsum Stack - Compacted Clay Liner

1. Construct Test Soil Liner, as outlined Section 5.0 of the project Construction Quality Assurance (CQA) Plan, included in Appendix 2, to demonstrate construction procedures and equipment that will produce the specified permeability.
2. Obtain Foundation Grade Verification by Amerens Field Surveyor prior to constructing areas requiring Compacted Clay Liner, as outlined in Section 6.2.1a of the project Construction Quality Assurance Plan.
3. Install Compacted Clay Liner in accordance with the project specifications using the compactive means demonstrated by the Test Soil Liner.

C. Gypsum Stack - Excavation and Backfill of Anchor Trench

1. Excavate anchor trench.
2. Place initial trench backfill after installation of Geosynthetic Clay Liner (GCL) and High Density Polyethylene (HDPE) Geomembrane by geosynthetic liner Contractor.
3. Complete trench backfill after installation of separation geotextile.

D. Gypsum Stack - Geosynthetic Clay Liner (GCL)

1. The Geosynthetics Installer's Representative shall jointly inspect the surface of the Compacted Clay Liner with the Owner's Representative

before commencing daily work. The Geosynthetics Installer's Representative shall continuously observe the condition of the Compacted Clay Liner during GCL placement and submit a Certificate of Acceptance in the daily report that no GCL was placed over visibly defective Compacted Clay Liner.

2. Furnish and install GCL on accepted Compacted Clay Liner. Provide reinforced GCL on the sideslopes and bottom of Gypsum Stack. Protect GCL per the Manufacturer's recommendations until it is covered by HDPE Geomembrane

E. Gypsum Stack High Density Polyethylene (HDPE) Geomembrane (Lower Layer)

1. The Geosynthetics Installer's Representative shall jointly inspect the GCL with the Owner's Representative; continuously observe the condition of the GCL during HDPE Geomembrane placement; and submit a Certificate of Acceptance in the daily report that no HDPE Geomembrane was placed over visibly defective GCL.
2. Furnish and install HDPE geomembrane on accepted GCL. Provide textured HDPE liner on the side slopes and bottom of the Gypsum Stack. Protect HDPE liner until it is covered by geotextile cushion fabric.
3. The Geosynthetics Installer shall perform non-destructive seam testing at frequencies specified in Section 6.3.2 of the Construction Quality Assurance Plan. Provide samples for destructive seam testing by the Owner's testing consultant, and repair sampled locations.

F. Gypsum Stack - Geotextile Cushion Fabric

1. The Geosynthetics Installer's Representative shall jointly inspect the HDPE Geomembrane with the Owner's Representative; continuously observe the condition of the HDPE Geomembrane during placement of the geotextile cushion fabric; and submit a Certificate of Acceptance in the daily report that no geotextile fabric was placed over visibly defective HDPE Geomembrane.
2. Furnish and install geotextile cushion on accepted Geomembrane.
3. Furnish and install drainage layer material for ballast.

G. Gypsum Stack - HDPE Leachate Collection Piping

1. Furnish and install geotextile fabric for coarse aggregate envelope.
2. Furnish and install initial lift of coarse aggregate.
3. Furnish and install leachate collection piping as shown on the plans.
4. Furnish and install coarse aggregate along the pipe to provide lateral stability.
5. The piping installer shall obtain concurrence with the Owner's Representative that the piping installation meets the intended design

requirements before placing remainder of coarse aggregate and geotextile envelope.

H. Gypsum Stack - Drainage Layer

1. Furnish and install granular material for drainage layer in accordance with the project plans and specifications.
2. Obtain verification by the Owner's Field Surveyor that the minimum required Drainage Layer thickness has been achieved.

I. Gypsum Stack - Separation Fabric

1. The Geosynthetics Installer's Representative shall jointly inspect the Drainage Layer with the Owner's Representative; continuously observing the condition of the surface of the Drainage Layer during placement of the Geotextile Separation Fabric; and submit a Certificate of Acceptance in the daily report that no geotextile fabric was placed over visibly defective Drainage Layer surface.
2. Furnish and install geotextile fabric on accepted Drainage Layer and anchor geotextile fabric in anchor trench.

J. Gypsum Stack - Cushion Dirt

1. Place Cushion Dirt to facilitate installation of the second HDPE Geomembrane. The Contractor shall protect the underlying Separation Fabric per the project specifications.
2. Obtain verification by the Owner's Field Surveyor that the minimum required Cushion Dirt thickness has been achieved.

K. Gypsum Stack High Density Polyethylene (HDPE) Geomembrane (Upper Layer)

1. The Geosynthetics Installer's Representative shall jointly inspect the surface of the Cushion Dirt with the Owner's Representative before commencing daily work. The Geosynthetics Installer's Representative shall continuously observe the condition of the Cushion Dirt during HDPE Geomembrane placement and submit a Certificate of Acceptance in the daily report that no HDPE Geomembrane was placed over visibly defective Cushion Dirt.
2. Furnish and install HDPE Geomembrane on approved Cushion Dirt. Provide textured HDPE Geomembrane on cell side slopes and bottom of cell. Protect HDPE Geomembrane until it is initially covered by gypsum waste material.
3. The Geosynthetics Installer shall perform non-destructive seam testing at frequencies specified in Section 6.3.2 of the Construction Quality Assurance Plan. Provide samples for destructive seam testing by the Owner's testing consultant, and repair sampled locations.

- L. Gypsum Stack - HDPE Process Water Recovery System
1. Furnish and install HDPE Process Water Collection System, as shown on the plans.
 2. The piping installer shall obtain concurrence with the Owner's Representative that the piping installation meets the intended design requirements before covering the piping with aggregate and filter fabric as shown on the plan.
- M. Gypsum Stack - Miscellaneous Earthwork
1. Provide access ramp to perimeter berm of cell.
- N. Gypsum Sluice Piping
1. Connect to existing piping and install new Gypsum Sluice Piping, fittings and valves for the Gypsum Stack.
- O. Gypsum Stack - Subdrainage System
1. Abandon existing subdrainage system, and remove vent pipes, vertical drains and inlet structures as specified in Section 02140 – Surface Water Management.
- P. Gypsum Stack - Erosion Control
2. Maintain previously installed temporary erosion control systems during the life of the contract.
 3. Seed and mulch all exposed soil surfaces.
- Q. Recycle Pond - Earthwork
1. Strip topsoil from areas of the proposed excavation and proposed compacted berms.
 2. Excavate the recycle pond to the lines and grades shown on the plans.
 3. Proof roll stripped/excavated areas to expose unsuitable materials.
 4. Remove and replace unsuitable foundation material and/or install geotextile fabric for ground stabilization as directed by the Owner's Representative. Work required to correct unsuitable foundation material will be paid by the Owner on a Time and Materials Basis.
 5. Construct Recycle Pond Embankments, Process Water Transfer Channel and Emergency Spillway to the line and grades shown on the plans.

R. Recycle Pond – Toe Drain

1. Furnish and install aggregate materials and filter fabric at the outside toe of the recycle pond dam as shown on the plans.

S. Recycle Pond - Excavation and Backfill of Anchor Trench

1. Excavate anchor trench.
2. Backfill trench after installation of High Density Polyethylene (HDPE) Geomembrane by Geosynthetics Installer.

T. Recycle Pond - HDPE Geomembrane

1. The Geosynthetics Installer's Representative shall jointly inspect the surface of the recycle pond foundation soils with the Owner's Representative before commencing daily work. The Geosynthetics Installer's Representative shall continuously observe the condition of the foundation soils during HDPE Geomembrance placement and submit a Certificate of Acceptance in the daily report that no HDPE Geomembrane was placed over visibly defective foundation soil.
2. Furnish and install HDPE Geomembrane on approved foundation soil. Provide textured HDPE Geomembrane on recycle pond side slopes and bottom. Anchor in the excavated anchor trench and backfill in accordance with the project specifications.
3. The Geosynthetics Installer shall perform non-destructive seam testing at frequencies specified in Section 6.3.2 of the Construction Quality Assurance Plan. Provide samples for destructive seam testing by the Owner's testing consultant, and repair sampled locations.

U. Recycle Pond - Water Transfer Structures

1. Furnish, fabricate, and install all materials and aggregate necessary to construct the Process Water Control Structure, Process Water Transfer Channel, Recycle Pond Emergency Spillway/Riprap Stilling Basin, and Side Slope Decant Pipe/Riprap Basin as shown on the plans.

~~V. Construction Field Office~~

~~The Contractor shall furnish and install a Construction Field Office for the Owner's use in accordance with the Specifications of Appendix 4 of these Specifications.~~

2.02 CCB Landfill

A. Foundation Preparation:

1. Remove top 6" of soil from the existing excavation and stockpile in an area designated on the Plans.
2. Finish grade the portion of the cell to be covered by Compacted Clay Liner.
3. Proof roll to expose any unsuitable foundation materials.
4. Remove and replace unsuitable foundation material and/or install geotextile fabric for ground stabilization as directed by the Owner's Representative.

B. Compacted Clay Liner

1. Construct Test Soil Liner, as outlined Section 5.0 of the project Construction Quality Assurance (CQA) Plan, included in Appendix 2, to demonstrate construction procedures and equipment that will produce the specified permeability.
2. Obtain Foundation Grade Verification by Amerens Field Surveyor prior to constructing areas requiring Compacted Clay Liner, as outlined in Section 6.2.1a of the project Construction Quality Assurance Plan.
3. Install Compacted Clay Liner in accordance with the project specifications using the compactive means demonstrated by the Test Soil Liner.

C. Excavation and Backfill of Anchor Trench:

1. Excavate anchor trench.
2. Place initial trench backfill after installation of GCL and HDPE geomembrane by geosynthetic liner contractor.
3. Complete trench backfill after installation of separation geotextile.

D. Geosynthetic Clay Liner (GCL)

1. The Geosynthetics Installer's Representative shall jointly inspect the surface of the Compacted Clay Liner with the Owner's Representative before commencing daily work. The Geosynthetics Installer's Representative shall continuously observe the condition of the Compacted Clay Liner during GCL placement and submit a Certificate of Acceptance in the daily report that no GCL was placed over visibly defective Compacted Clay Liner.
2. Furnish and install GCL on accepted Compacted Clay Liner. Provide reinforced GCL on the sideslopes and bottom of the cell. Protect GCL per the Manufacturer's recommendations until it is covered by HDPE Geomembrane

E. High Density Polyethylene (HDPE) Geomembrane (Lower Layer)

1. The Geosynthetics Installer's Representative shall jointly inspect the GCL with the Owner's Representative; continuously observe the condition of the GCL during HDPE Geomembrane placement; and submit a Certificate of Acceptance in the daily report that no HDPE Geomembrane was placed over visibly defective GCL.
2. Furnish and install HDPE Geomembrane on accepted GCL. Provide textured HDPE Geomembrane on cell side slopes and smooth HDPE Geomembrane on bottom of the cell. Protect HDPE liner until it is covered by geotextile cushion fabric.
3. The Geosynthetics Installer shall perform non-destructive seam testing at frequencies specified in Section 6.3.2 of the Construction Quality Assurance Plan. Provide samples for destructive seam testing by the Owner's testing consultant, and repair sampled locations.

F. Geotextile Cushion Fabric:

1. The Geosynthetics Installer's Representative shall jointly inspect the HDPE Geomembrane with the Owner's Representative; continuously observe the condition of the HDPE Geomembrane during placement of the geotextile cushion fabric; and submit a Certificate of Acceptance in the daily report that no geotextile fabric was placed over visibly defective HDPE Geomembrane.
2. Install geotextile cushion on accepted Geomembrane.
3. Install drainage layer material for ballast.

G. HDPE Leachate Collection Piping:

1. Place geotextile fabric for coarse aggregate envelope.
2. Place initial lift of Coarse Aggregate Bedding.
3. Furnish and install HDPE Leachate Collection Piping on Coarse Aggregate bedding.
4. Place coarse aggregate along the pipe to provide lateral stability.
5. The piping installer shall obtain concurrence with the Owner's Representative that the piping installation meets the intended design requirements before covering the piping with remainder of coarse aggregate and geotextile envelope as shown on the plans.

H. Drainage Layer and Separation Berm:

1. Place granular material for separation berm and drainage layer.

- I. Separation Fabric:
 - 1. Install geotextile fabric on accepted drainage layer and anchor geotextile fabric in anchor trench.
- J. Haul Roads
 - 1. Finish materials and construct Haul Road to the top of the CCB Landfill.
- K. Miscellaneous Earthwork:
 - 1. Provide construction access ramp to bottom of cell.
 - 2. Place general fill to form in-board side of berm ditch.
- L. Construct and maintain temporary erosion control systems during the life of the contract. Remove and dispose of temporary erosion control items when no longer required. Seed and mulch all remaining disturbed soil surfaces.

3.0 OWNER AND MANUFACTURER'S DRAWINGS

3.1 Provided By Ameren Energy Resources Generating

A. Hard-Copy Drawings

The following drawings are intended to indicate the scope of the work to be done and details necessary for the installation of items set forth in this specification, and are part of this specification. These drawings in general are to scale, but dimensions shall always be followed and drawings are not to be scaled. In case of errors or discrepancies, the Owner's Representative shall be consulted for the adjustment of all complications arising therefrom. The Owner's Representative's decisions shall be final.

<u>AERG</u>	<u>SHEET TITLE</u>
<u>DRAWING NO.</u>	
C180-C102-01	Title & Index
C180-C102-02	General Notes
C180-C102-03	Site Plan
C180-C102-04	Existing Site Conditions
C180-C102-04A	Existing Subsurface Drainage Profiles
C180-C102-05	Existing Subsurface & Vertical Drain Details
C180-C102-06	Existing Subsurface Drainage Details
C180-C102-07	Existing Grading Plan
C180-C102-08	Gypsum Stack-Foundation Grade
C180-C102-09	Gypsum Stack-Top of Clay Layer
C180-C102-10	Gypsum Stack- Leak Detection/Leachate Collection

AERG
DRAWING NO.

SHEET TITLE

C180-C102-11	Recovery System (LD/LCRS) Drainage Layer Grade Process Water Recovery System (PWRS) - Ring Drain System Cushion Dirt Layer Grade
C180-C102-12	PWRS-Ring Drain Details
C180-C102-13	PWRS-Ring Drain Details
C180-C102-14	LD/LCRS Sections & Details
C180-C102-15	Recycle Pond Plan
C180-C102-16	Recycle Pond Details
C180-C102-17	Recycle Pond Details
C180-C102-18	Access Road and Pump Station Site Plan
C180-C102-19	Access Road Vertical Alignments
C180-C102-20	Erosion Control Plan
C180-C102-21	Erosion Control Details
C180-C102-22	Groundwater Monitoring & Boring Plan
C180-C102-23	Geological Cross Sections
C180-C102-24	Geological Cross Sections
C180-C102-25	Geological Cross Sections
C180-C102-26	Geological Cross Sections

AERG
DRAWING NO.

SHEET TITLE

C180-C110-01	Title and Index
C180-C110-02	General Notes
C180-C110-03	Site Plan
C180-C110-04	Foundation Grade Plan
C180-C110-05	Foundation Grade Control Data
C180-C110-06	Base Grade Plan
C180-C110-07	Base Grade Control Data
C180-C110-08	Geomembrane Panel Layout
C180-C110-09	Drainage Layer Grade Plan & Leachate Collection Piping
C180-C110-10	Drainage Grade Control Data
C180-C110-11	Typical Sections and Details
C180-C110-12	Leachate Collection Details
C180-C110-13	Typical Cross Sections
C180-C110-14	Separation Berm Details
C180-C110-15	Exist. Sub-Drain Plan & Details
C180-C110-16	Haul Road / Construction Water Access Road Plan <u>Landfill Haul Road</u>
C180-C110-17	Construction Water Access Road
C180-C110-17	Boring Well and Section Locations

<u>AERG</u> <u>DRAWING NO.</u>	<u>SHEET TITLE</u>
C180-C110-18	Geologic Cross Sections A and B
C180-C110-19	Geologic Cross Sections C, D, and E
C180-C110-20	Geologic Cross Sections F to K

B. **Electronic Files**

The following electronic files are provided solely for the convenience of the bidder and/or Contractor and are subject to the terms and conditions stipulated in the Disclaimer text included with the electronic files.

1. Drawings listed above in PDF format.
2. TIN files of the existing and proposed ground surfaces.
3. Bid Forms.
4. Disclaimer text.

In the event of a conflict between the hard-copy documents and the electronic files, the hard-copy documents shall govern.

3.2 **Provided by the Contractor**

The Contractor shall submit to the Owner's Representative, with such promptness as to cause no delay in the performance of the work, four copies of shop drawings, product data sheets, etc., as required by these specifications. No purchasing, fabrication, erection, processing, or shipping of the aforementioned materials may begin until the required documentation has been reviewed by the Owner.

Three copies of data required to be submitted to the Owner's Representative shall be forwarded to each of the following:

Ameren Energy Resources Generating
 Dave Boyce
 Duck Creek Power Station
 17751 North CILCO Road
 Canton, Illinois 61520

Hanson Professional Services Inc.
 Steven Bishoff
 1525 South Sixth Street
 Springfield, Illinois 62703-2886

Data sheets and shop drawings shall be reviewed and returned to the Contractor within ten (10) working days after receipt. Approval is for general design features only and will not relieve the Contractor of responsibility for proper quantities, adequacy of details, and

coordination with other trades. Deviation from Contract Documents are not approved unless specifically requested in writing by the Contractor and approved in writing by the Owner.

Should field changes be required, such changes shall be promptly documented by the Contractor and submitted to the Owner in the form of as-built drawings. The field change order process is included in Appendix I.

4.0 MATERIALS AND EQUIPMENT SUPPLIED BY THE OWNER

The materials and equipment that are to be furnished by the Owner are listed in the schedule below:

<u>ITEM</u>	<u>SHIPPING DATE</u>	<u>LOCATION</u>
Drainage Layer Material (Gypsum Stack & CCB Landfill)	Prior to Start of Construction	Stockpile
Coarse Aggregate Encasement for Ring Drain Piping (DOT CA 7) (Gypsum Stack)	Prior to Start of Construction	Stockpile
Filter Sand for Protection of Ring Drain Piping (DOT CA 1) (Gypsum Stack)	Prior to Start of Construction	Stockpile
Coarse Aggregate Course Encasement For Leachate Collection Piping (CCB Landfill)	Prior to Start of Construction	Stockpile

Note: Per Addendum #1, none of the above listed aggregates will be supplied by the owner

5.0 MATERIALS AND EQUIPMENT FURNISHED BY THE CONTRACTOR

All materials, equipment, tools, and any incidental items necessary to complete each portion of the work described herein and/or shown on the drawings shall be furnished by the Contractor.

6.0 UTILITIES, FACILITIES, AND MISCELLANEOUS

The following utilities, facilities, etc., shall be provided as indicated.

	<u>Item</u>	<u>Provided By</u>
A.	Telephone Service for Use of Construction Forces	Contractor
B.	Sanitary Facilities	Contractor
C.	Drinking Water	Contractor
D.	Construction Water	Contractor
E.	Electric Service for Contractor's Use	Contractor
F.	Construction Office and Storage Facilities for Contractor's Use	Contractor
G.	Construction of Gravel Haul Roads and Parking Area for Construction Forces	Contractor

Submit with the bid documents a general layout of temporary facilities required for the Contractor's operations, such as haul roads, parking areas, temporary drainage facilities, Contractor's construction field office and storage facilities, electric service, telephone service, staging and laydown areas, etc.

7.0 SCHEDULE

The Contractor shall be required to furnish the Owner's Representative with a complete schedule of the Work to be performed under this contract broken down by major activity.

The schedule shall include the Contractor's estimate of man-days required for each activity, and shall show precedent relationships between activities. The schedule shall be included as part of the bid package presented by the Contractor. The schedule shall comply with the dates and guidelines listed below:

- A. The required start date of this contract is upon receipt of Purchase Order. The Purchase Order is expected to be issued within two (2) weeks of the bid due date.
- B. The required finish date of this for the Gypsum Management Facility Contract is September 30, 2008. The required finish date for the CCB Landfill Contract is December 31, 2008 for the Scope of Work included in Bid Forms A & C.

- C. The level of detail in each schedule shall be sufficient to permit the Owner to monitor the Contractor's performance relative to the specified guidelines. The required level of detail will be discussed at the pre-bid meeting.
- D. The Contractor shall submit a daily construction report and shall furnish schedule status reports at weekly progress meetings until the work is completed. The schedule status reports shall indicate by activity the scheduled percent of completion as shown on the original schedule, the actual percent completion as of the date of the report, and the number of man-days expended on the project to date.

If at any time during this Contract, when the Contractor's actual progress, in the opinion of the Owner, is such that the completion dates of the work will not be met, the Contractor shall participate in a re-evaluation of the remaining work.

If, as a result of this re-evaluation of the remaining work, it is determined by the Owner that the completion date will not be met, the Owner retains the right to direct the Contractor to accelerate the construction program. It shall be the responsibility of the Contractor to initiate and comply with such corrective action as required or directed.

At the time of the award of this contract, scheduling requirements will be discussed in detail by all interested parties.

8.0 CONSTRUCTION QUALITY CONTROL ASSURANCE

A. Construction Quality Assurance Plan

A Construction Quality Assurance (CQA) Plan has been developed for this project to ensure compliance with the all applicable permit requirements. A copy of this plan is included in Appendix 2. The testing requirements and frequency of this plan will govern in instances which there may be discrepancies between the CQA Plan and these specifications.

B. Testing and Inspections:

1. The Contractor is responsible for construction quality control testing, sampling, and inspections to ensure that the materials and workmanship comply with the plans and specifications. The Contractor shall submit results of construction quality control testing. The Contractor shall visually inspect underlying surfaces on a continuous basis immediately ahead of placement of geosynthetics and geotextile and shall certify in the daily report that no material was placed over visibly defective substrate.
2. The Contractor is responsible for non-destructive testing of all Geomembrane seams and for providing samples for prequalification material testing and destructive seam testing as directed by the Owner's

Representative. The minimum sampling frequencies are specified in Appendix 2.

3. Except as specified above, Construction Quality Assurance (CQA) testing, sampling, and inspections to verify compliance with the plans and specifications are the responsibility of the Owner. The CQA sampling and testing requirements are summarized in Appendix 2. The Contractor shall coordinate and cooperate with the Owner's materials testing consultant to provide samples and accommodate testing activities at no additional cost to the Owner.

C. Construction Surveying

Construction surveying for layout and grading control shall be the responsibility of the Contractor. Finished grades will be surveyed by the Owner's surveyor to verify that the finished grade is within 0.1 ft. of plan grade.

- D. CQA Surveys to certify material thickness, leachate piping and ditch grades are the responsibility of the Owner. CQA Surveying requirements are summarized in Appendix 2.

9.0 COORDINATION WITH OTHERS

This Contractor will work in close harmony with other Contractors or AERG personnel who may be employed at this site. In the event of differences of opinion regarding scheduling of work, the decision of the Owner will be final and binding.

The following construction activities are anticipated within the landfill facility boundary during this contract:

- A. Loading and Hauling of coal combustion by-product to the site by AERG personnel or Contractor.
- B. Loading and Hauling of water for dust control operations on AERG property.
- C. Loading and hauling stockpiled excavated material from the stockpile south of East McKinley Road by Fulton County Highway Department Contractor and by Ameren personnel or contractor.
- D. Monitoring, removing, and disposing of leachate by Ameren's CCB disposal facility operator.

10.0 SAFETY AND SITE SECURITY

The Contractor will comply with safety and security requirements stipulated in the General Conditions and Supplemental General Conditions.

- A. Although the Ameren Energy Resources Generating property is generally fenced and patrolled by Ameren Energy Resources Generating security, the site should not be considered secure.
 1. A Security Check-In Station will be provided by AERG for the duration of the construction project at the entrance on McKinley Road.
- B. Contractor personnel will be required to attend a 2-hour site-specific safety orientation conducted by the Owner.
- C. Contractor personnel will be required to submit to a ten (10) panel drug test to be performed and provided by AERG.
- D. A copy of the Contractor's Field Construction Safety Program shall be submitted with the Contractor's bid package.
- E. The Contractor shall have a designated Safety Supervisor on site whenever construction work is being performed.

11.0 DUST CONTROL

The Contractor shall be responsible for controlling dust and air-borne dirt generated by construction activities. Dust shall be controlled by applying water to exposed surfaces, particularly surfaces on which construction vehicles travel. Water from the Duck Creek Reservoir is unsuitable. A pond north and east of the proposed CCB Landfill is designated as the only water source available for use by the Contractor.

No chemical dust suppressants shall be permitted unless approved in writing by the Owner's Representative. Dust control measures shall be readily available for implementation whenever the Contractor or the Owner's Representative deems that dust control is needed. The cost of dust control shall be included in the contract lump sum price.

PART 2. PRODUCTS

No products used.

PART 3. EXECUTION

- 1.0 The Contractor shall be responsible for inspecting the site to note any and all conditions that may affect the work under the contract. The Contractor shall satisfy himself as to the nature, extent and location of the work; the configuration of the ground; the equipment and facilities needed for construction; the general and local conditions of the area; and all other factors and conditions which can, in any way, affect the work under the contract. Any failure by the Contractor to do so will not relieve him from responsibility for successfully performing the work without additional expense to the Owner.

- 2.0 The Contractor is specifically advised of the presence of overhead power lines that traverse the project work area.

END OF SECTION 01010

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DIVISION 1—GENERAL REQUIREMENTS
Section 01356 – Storm Water Pollution Prevention
Measures

PART 1. GENERAL

1.01 DESCRIPTION

- A. This section pertains to the construction and maintenance of existing and proposed temporary erosion control systems to control erosion and sediment damage to adjacent properties and water resources.

1.02 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

02936 - Topsoil, Seeding, and Mulching.

1.03 REFERENCES

The following reference, or cited portions thereof, governs the work:

Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.

1.04 SUBMITTALS

- A. Submittals shall follow the provisions of Section 01010.
- B. Preconstruction Submittals: A storm water best management practices (BMP) plan shall be submitted that includes the following items:
1. Inspection and record-keeping procedures; and
 2. Maintenance procedures for erosion controls.

PART 2. PRODUCTS

2.01 EROSION CONTROL SYSTEMS

Materials for erosion control systems shall be in accordance with Article 280.02 of the IDOT Standard Specifications.

PART 3. EXECUTION

3.01 EXAMINATION

The site shall be examined to determine the condition existing temporary erosion controls systems installed under a prior contract and the extent of new work required.

3.02 PRECONSTRUCTION JOBSITE INSPECTION

- A. The person who shall be at the jobsite during construction and who shall be responsible for insuring that erosion control work is completed in a timely manner shall be identified at the preconstruction meeting.
- B. A jobsite inspection shall be conducted with the Owner's Representative to review and designate the locations and types of erosion protection to be placed. The inspection shall be scheduled at the preconstruction conference and carried out on the job site before beginning any work that will disturb existing drainage or potentially create erodible conditions.

3.03 CONSTRUCTION

- A. Temporary erosion control systems shall be constructed in accordance with IDOT Standard 280001 and Article 280.04 of the Standard Specifications and as directed by the Owner's Representative. Erosion control devices shall be in place and approved by the Owner's Representative prior to beginning other work.
- B. Incorporate permanent erosion control features into the project at the earliest practicable time to minimize the need for temporary erosion controls.

3.04 MAINTENANCE

- A. Temporary erosion control systems shall be maintained in accordance with Article 280.05 of the Standard Specifications, except that measurement and payment provisions shall not apply.
- B. Temporary erosion control systems for unprotected disturbed areas shall be cleaned of trapped sediment and repaired immediately prior to project close out.
- C. Temporary seeding shall be applied to all disturbed areas except the gypsum stack excavation and the future fill and topsoil stockpiles.

3.05 REMOVAL AND DISPOSAL

All temporary erosion control system shall be left in place by the Contractor for future construction operations at both facilities.

END OF SECTION 01356

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PART 1. GENERAL

1.01 DESCRIPTION

Logs of borings and laboratory soil test data.

PART 2. PRODUCTS

No products used.

PART 3. EXECUTION

3.01 TEST BORINGS

- A. Test borings were taken at the locations shown on the drawings. Copies of boring logs, along with soil test data on soil samples recovered from the borings are included in Appendix 3.
- B. Data on indicated subsurface conditions are not intended as representations or warrants of continuity of such conditions between soil borings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. Data are made available for the convenience of the Contractor.
- C. Additional test borings and other exploratory operations may be made by the Contractor at no additional cost to the Owner, provided such operations are approved by the Owner's Representative.

3.02 SITE OBSERVATIONS

- B. Gypsum Management Facility (Gypsum Stack & Recycle Pond)
 - 1. The Gypsum Stack has been excavated to foundation grade on the sideslopes, and to within approximately 5.4 of foundation grade at the bottom of the cell. The remaining 5.4 feet of material will be utilized to construct the 3 foot thick clay layer. A drainage channel was cut from the southwest floor of the excavation to allow adequate surface water drainage. During the pre-bid meeting, Contractors will be given opportunity to view the excavation and resulting stockpiles, and to observe the in-situ conditions at the time of the meeting.

2. The earthwork for the recycle pond pump station pad and access road, as well as sections of the recycle pond perimeter berm have been constructed to finish grade. During the pre-bid meeting, Contractors will be given the opportunity to view the in-situ conditions at the time of the meeting.

A. CCB Landfill

1. The CCB Landfill has been excavated to within 6 in. of foundation grade. During the pre-bid meeting, Contractors will be given opportunity to view the excavation and observe the in-situ conditions near foundation grade at the time of the meeting.

END OF SECTION 02010

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PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to stripping of topsoil and vegetation from areas of the site that are to be excavated.

1.02 RELATED SECTIONS

No related sections.

PART 2. PRODUCTS

No products used.

PART 3. EXECUTION

3.01 EXAMINATION

The Contractor shall examine the site to determine the extent of work required, as well as the extent of previously stripped topsoil completed under a previous contract.

3.02 SITE PREPARATION - STRIPPING

- A. The Gypsum Stack and portions of the Recycle Pond grading limits have been previously stripped under a separate contract as shown on the plans. Any remaining vegetation and topsoil encountered within the Gypsum Stack and Recycle Pond grading limits required to complete the work in this contract shall be stripped. ~~Topsoil shall be kept clean and free of all foreign material, and stored in separate stockpiles from vegetation and common excavations. Stockpiles shall be located as indicated on the drawings or as directed by the Owner's Representative.~~ Topsoil removed by stripping shall not be stockpiled, and shall be deposited completely as described in section 3.02-C of this specification.
- B. The top 6" of the existing excavation area of the CCB Landfill-Cell 1 within the CCB Landfill shall be removed and stockpiled per Specification Section 02200 Earthwork.
- C. Stripped Topsoil shall be used to fill depressions east of the Gypsum Management Facility as shown in the Plans.

3.03 DISPOSAL

- A. All materials resulting from site preparation operations shall be stockpiled in the designated spoil area. Contractor shall obey all laws and regulations when disposing of the materials.

END OF SECTION 02100

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DIVISION 2 - SITE WORK

Section 02140 – Surface Water Management

PART 1. GENERAL

1.01 DESCRIPTION OF WORK

Control of surface water caused by precipitation and abandonment of existing subsurface drainage facilities within the construction limits of the Gypsum Management CCB Landfill shall be considered as part of the work under this specification.

- A. The work to be completed by the Contractor includes, but is not necessarily limited to, the following:
 - 1. Maintenance of existing Erosion and Sedimentation Control Measures according to Section 01356; and
 - 2. Dewatering excavations from water caused by precipitation.
 - 3. Abandonment of the existing subdrainage systems.
- B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control and abandonment of the existing subsurface dewatering systems at the end of the Contract.

1.02 EXISTING FACILITIES

- A. Gypsum Management Facility
 - 1. An existing ditch at the south end of the existing excavation provides gravity outlet for the excavation to 5.4 feet above the foundation grade.
 - 2. An existing subdrainage system provides limited control of groundwater migration into the excavation. The subdrainage system outlets by gravity flow to an existing ditch approximately 0.3 mile south of the existing excavation.
- B. CCB Landfill Facility
 - 1. An existing ditch at the southeast corner of the existing excavation provides gravity outlet for the excavation to foundation grade.
 - 2. An existing subdrainage system provides limited control of groundwater migration into the excavation. The subdrainage system outlets by gravity flow to an existing channel approximately 0.2 mile east of the existing excavation.

1.03 REQUIREMENTS

- B. The General Contractor shall employ standard surface water management practices to prevent the ponding of stormwater runoff and/or erosion of existing and proposed earth surfaces, as required to complete the work.

1.04 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

1. 01356 – Storm Water Pollution Prevention Measures
2. 02010 - Subsurface Investigation
3. 02200 - Earthwork

PART 2. PRODUCTS

2.01 MATERIALS

- A. Materials and equipment for surface water management shall be reviewed by the Owner's Representative for compatibility with future construction and operation of the facility.

PART 3. EXECUTION

3.01 SURFACE WATER MANAGEMENT

- A. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water caused by precipitation from all construction work areas and excavations.
- B. Drainage features shall have sufficient capacity to avoid flooding of work areas.
- C. Drainage features shall be so arranged and altered, as required to avoid degradation of the final excavated surface(s).
- D. The Contractor shall utilize all necessary erosion and sediment control measures according to Section 01356 to avoid construction-related sedimentation of existing and proposed facilities.

3.02 WATER DISPOSAL

- A. Dispose of water removed from the excavations in such a manner as:
 1. Will not endanger portions of work under construction or completed.
 2. Will cause no inconvenience to Owner or to others working near site.
 3. Will comply with the stipulations of Section 01356.

4. Will control runoff. The Contractor shall be responsible for control of runoff in all work areas, including, but not limited to: excavations, access roads, parking areas, stockpile, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with Section 01356.

- B. Existing site drainage features or proposed subdrainage system may be used for water disposal.

3.03 DAMAGES

- A. Immediately repair damages to adjacent facilities caused by the surface water management facilities, as constructed by the Contractor.

3.04 REMOVAL OF STORMWATER MANAGEMENT SYSTEMS INSTALLED BY CONTRACTOR

- A. Remove and backfill temporary sumps, ditches, trenches, etc. according to Section 02300, as required by the Owner.

3.05 CORRECTIVE ACTION

Work shall be performed as necessary for reinstatement of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor to control surface water, at no additional cost to Owner.

3.06 ABANDONMENT OF EXISTING SUBDRAINAGE SYSTEMS

Concurrence shall be obtained from Owner before discontinuing operation of subdrainage system.

The General Contractor shall maintain the existing subdrainage systems during construction of the Gypsum Management and CCB Landfill Facilities.

Prior to construction of the Compacted Clay Liner at the Gypsum Management Facility, all vertical drains consisting of a geotextile fabric encased pea gravel envelope shall be removed. The pea gravel shall be stockpiled and the geotextile fabric shall be removed and disposed of in a legal manner. Subdrainage piping damaged during removal of the vertical drains shall be repaired with equal material incidental to the work. An existing drainage structure consisting of 24" diameter reinforced concrete pipes with a ditch grate shall be removed. The concrete pipes shall be disposed of in a legal manner and the ditch grate shall be salvaged per the direction of Owner's Representative

Upon completion of the construction of either facility, that facility's existing subdrainage system within the lined portion of the cell shall be abandoned as follows:

1. At each subdrainage vent pipe riser location, a mixture of high solids bentonite grout shall be pumped into the subdrainage piping to completely seal the system. The high solids bentonite grout shall be CETCO Volclay Grout or an approved equal that is NSF/ANSI Standard 60 certified. The grout shall be mixed according to the manufacturer's specifications for this application to provide a low permeability seal less than 1×10^{-7} cm/sec.
2. Cut the vent pipe risers 36 inches below with the ground surface. Fill the remaining vent piping with concrete as shown on the plans.
3. Remove completely the existing concrete inlet at the southeast quadrant of the gypsum stack excavation and dispose of in a legal manner. The grate will be salvaged and stored at the direction of the owner.
4. Remove completely the vent pipe protective bollards and dispose of in a legal manner.

END OF SECTION 02140

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DIVISION 2 – SITEWORK
Section 02200 – Earthwork
ADDENDUM #1

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to excavation, fill, and backfill required for foundation preparation, construction of Compacted Clay Liners, anchor trench construction, miscellaneous site grading, berm construction.

1.02 RELATED SECTIONS

- A. The following sections contain items which are related to the work in this section:
1. 01356 – Storm Water Pollution Prevention Measures
 2. 02100 - Site Preparation
 3. 02140 – Surface Water Management
 4. 02373 – Geotextiles
 3. 02936 - Topsoil, Seeding, and Mulching

1.03 REFERENCES

The following references, or cited portions thereof, govern the work:

1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007
2. Department of Sustainable Natural Resources, Soil Survey Standard Test Method, Unified Soil Classification System: Field Method (USCS).

1.04 MEASUREMENT AND PAYMENT

- A. The Contractor shall be responsible for estimating the extent of excavation and fill required to complete the work, including, but not limited to, excavation to required elevations; loading, transporting, placing, and compacting the Compacted Clay Liners; excavation and backfill of anchor trench; and miscellaneous site grading, including berm construction. The Contractor shall include the dollar amount associated with all earthwork in his Lump Sum Bid amount.
- B. Removal and replacement of unsuitable foundation material (including underground sand channel materials) and subgrade stabilization measures directed by the Owner's Representative will be paid for on a time and material basis. Payment quantities will be based volume of excavation, determined from field surveys by the Owner's Field Surveyor.

1.05 EARTHWORK COMPLETED UNDER PRIOR CONTRACT

A. Gypsum Management Facility

1. The gypsum stack has been excavated to approximately 5.4 ft. above foundation grade across the bottom of the cell.
2. Excavated subsoil material was stockpiled north and east into short term and long term subsoil stockpiles as shown on the plans. Stripped Topsoil was stockpiled separately.
3. The ~~75,000~~ yard subsoil stockpile east of the Gypsum Stack shall be completely depleted under this contract. Schedule and timing shall be determined by the Contractor.

B. CCB Landfill

1. The cell has been excavated to approximately 6 in. above foundation grade and the perimeter berm has been completed, except for an existing construction access ramp on the east side of the cell near Sta. 205+00.
2. Excavated material was stockpiled in locations east of the excavation. The intended use and location for each stockpile is shown on the plans

1.06 COORDINATION

Existing utilities or other plant facilities shall not be interrupted, except when permitted in writing by the Owner's Representative and then only after acceptable temporary services have been provided. A minimum 48-hour notice shall be provided prior to proceeding with an approved temporary interruption.

1.07 SURFACE WATER MANAGEMENT

Control of surface water caused by precipitation necessary for completion of the work under this contract according to Section 02140 is the responsibility of the Contractor and shall be included in the contract lump sum price.

1.08 SUBMITTALS

A. Materials Handling Plan.

A materials handling plan shall be submitted for construction and protection of the Compacted Clay Liner. The plan shall describe the following:

1. Processing and placement of the Compacted Clay Liner: type, model number, weight, and critical dimensions of equipment to be used for soil processing, compaction, scarification, and smooth rolling;

2. Method of protecting the Compacted Clay Liner from changes in moisture content and freezing after placement.

PART 2. PRODUCTS

2.01 MATERIALS

A. Earth Fill Material

Earth Fill Material shall consist of a mixture of clay, silt, sand, and gravel-sized particles obtained from previously constructed subsoil stockpiles. These materials can be used separately or mixed as required for best results. These materials shall be free of ice, snow, organic matter, rubbish, and debris. Coarse-grained particles shall be well dispersed to prevent the development of segregated pockets or zones with insufficient fine material to fill the interstices.

B. Compacted Clay Liners

1. Gypsum Management Facility

The Compacted Clay Liner for the Gypsum Management Facility shall be soil materials obtained from the approximately 5.4 ft. of material remaining above the foundation grade that was left in-place under the previous excavation contract. The material shall be free of ice, snow, organic matter, rubbish, and debris, and shall have a maximum clod size no greater than the length of the compactor foot for the compaction equipment proposed by the Contractor. When compacted, the material shall have a vertical hydraulic conductivity of less than 1×10^{-4} cm/sec.

2. CCB Landfill

The Compacted Clay Liner for the CCB Landfill shall be soil materials obtained from on-site excavations and materials stockpiled east of the cell. The material shall be free of ice, snow, organic matter, rubbish, and debris, and shall have a maximum clod size no greater than the length of the compactor foot for the compaction equipment proposed by the Contractor. When compacted, the material shall have a vertical hydraulic conductivity of less than 1×10^{-6} cm/sec.

C. Soil Stabilizers and Moisture Conditioning Agents

Additives to accelerate drying or to improve stability and workability of soil shall not be permitted unless approved in writing by the Owner's Representative.

2.02 EQUIPMENT

A. Compaction Equipment

1. Tamping foot rollers

Compaction equipment shall consist of tamping foot rollers which have a minimum weight of 40,000 pounds. At least one tamping foot shall be provided for each 110 square in. of drum surface. The length of each tamping foot, measured from the outside surface of the drum, shall be at least 1 in. longer than the loose lift thickness.

2. Steel-Wheeled Rollers

Equipment used to produce a smooth compacted surface shall be a smooth, non-vibratory steel wheeled roller weighing not less than 1,000 lb. per lineal ft.

B. Scarification Equipment

Discs, rotor tillers, or other equipment used to scarify the surface shall be capable of uniformly disturbing at least the upper 6 in. of surface to provide good bonding between lifts.

C. Mixing and Spreading Equipment

Discs, harrows, and motor graders or other similar equipment shall be available at the site for use in spreading, mixing, and drying Compacted Subsoil Stockpile Material.

PART 3. EXECUTION

3.01 PREPARATION

A. Control of Work

Benchmarks, monuments, and other reference points shall be maintained throughout the work area.

B. Utility Location

Before starting excavation, the location and extent of underground utilities in the work area shall be established.

3.02 EXCAVATION

A. General

Excavation consists of removal and redistribution of material encountered when establishing required grade and subgrade elevations. The Contractor shall be responsible for dewatering, protection, shoring, and disposal of excavated materials as necessary to complete the excavation.

B. Procedures

Excavation may be accomplished by any method and by use of any equipment that is suitable to the work, except that blasting will not be permitted. Based on previous construction experience at the site, it is recommended that excavation to the foundation grade be completed as far in advance of the Compacted Clay Liner placement as possible to allow the foundation surface to dry and form a "crust" capable of sustaining compactive effort.

C. Overexcavation

Overexcavation shall be performed to the lines and grades indicated on the plans. Additional overexcavation required to remove unsuitable materials as requested by the Owner's Representative shall be paid for by the Owner for at the Unit Price for Excavation. Any overexcavation or excess excavation not requested by the Owner's Representative shall be at the expense of the Contractor.

D. Disposal of Excavated Materials

Contractor shall stockpile excess excavated subsoil or topsoil materials in their corresponding stockpile for future use.

3.03 SUBGRADE PREPARATION

A. Areas to receive fill shall be proof rolled under the observation of the Owner's Representative. Soft, loose, weak, or wet materials shall be removed and replaced with compacted fill or stabilized with geotechnical fabric or geogrid as directed by the Owner's Representative and paid on a time and materials basis. Joints, fractures, and moisture seeps shall be repaired, and local sand deposits, if present at foundation grade, shall be removed and backfilled with compacted fill material as directed by the Owner's Representative.

B. The Owner's Representative may recommend additional drying time for soft, wet subgrade that has not been exposed long enough to permit "crust" formation. If approved by the Owner's Representative, the Contractor may install, at his own expense, geotechnical fabric to stabilize the wet subgrade and expedite construction.

- C. Following the excavation for the Compacted Clay Liner, the CQA Officer shall direct the Owner's Field Surveyor to verify that actual depths and grades of the foundation are in accordance with the plans and specifications. Elevations shall be surveyed on a 100 ft. grid pattern for the bottom of the cell. The points surveyed for side slopes will be at the top, midpoint, and toe. In addition, all breaks in grade will be surveyed. Foundation excavation grading shall meet a control tolerance requirement of 0 ft to -0.4 ft. The measured depths and grades shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor agency. The CQA Officer shall review the survey data for conformance to requirements and, if found in agreement with requirements, provide certification for the work in accordance with CQA Plan Procedures.
- C. The Contractor shall not place fill until the subgrade has been examined jointly with the Owner's Representative and a certificate of approval for the subgrade has been submitted to the Owner's Representative.

3.04 STRUCTURAL FILL

A. Placement

1. Unless otherwise indicated on the plans, all Fill shall be composed of Earth Fill Material.
2. Fill materials used in embankment construction shall normally be placed in lanes parallel to the embankment axis and shall be placed in conformance with the lines, grades, and slopes as indicated on the plans. Placement of fill materials in lanes which are not parallel to the embankment will be allowed only where working room is too restricted for normal placement as determined by the Owner's Representative.
3. Fill shall be spread in approximately flat layers in such a manner as to obtain lifts of relatively uniform thickness without spaces between successively deposited loads. Segregation shall be prevented during placing and spreading. Hauling equipment shall be routed across the fill in such a way as to promote uniform compaction and to prevent the formation of ruts.
4. The maximum compacted thickness of each lift shall not exceed 8 in. where heavy compaction equipment will be used. The maximum compacted thickness shall not exceed 3 in. where power tampers or similar smaller equipment will be used. It may be necessary to reduce the thickness of lifts in order to obtain the required minimum density.
5. Where compacted Fill is to be placed against existing slopes, each lift shall be keyed into existing slope by removing existing slope material in steps as each new lift is placed.
6. The surface of the fill shall be kept reasonably smooth. The fill surface shall be sloped transverse to the axis of the embankments to allow drainage. If the compacted surface is, in the opinion of the Owner's Representative, too smooth or too dry to bond properly with the succeeding lift, it shall be roughened by scarifying, light discing, or other acceptable means, and it shall be sprinkled with water before the

- succeeding lift is placed thereon. If the surface becomes rutted or uneven subsequent to compaction, it shall be flattened and leveled before placing the next lift. This extra work shall be at the Contractor's expense.
7. Fill operations shall be suspended during periods of extended wet weather. Upon resuming operations, all fill materials that are excessively wet or soft shall be reprocessed in place or removed and stockpiled for reprocessing. The removal of soft material shall be carried to such depth as is necessary to expose firm materials. Fill shall not be placed on frozen surfaces.
 8. When filling operations at any section will be suspended for any period in excess of 12 hours or in wet weather, the surface of the fill shall be rolled smooth to seal it against excessive absorption of moisture and to facilitate runoff. Prior to resuming fill placement and compaction, the fill surface shall be scarified and/or disced and moisture conditioned as required.
 9. The Contractor will receive no additional compensation for any removal, reprocessing, stockpiling, recompaction, wasting, or similar operation related to suspensions or conditions due to weather or other causes unless caused by the Owner.
 10. Earth fill access ramps shall not be constructed within the limits of the compacted embankments without the approval of the Owner's Representative. When such ramps are approved, they shall be constructed of Compacted Clay Liner material (in-board of the perimeter berm) or compacted Fill (out-board of the perimeter berm).

B. Compaction -

1. Fill materials shall be compacted to a dry density equal to or greater than the following:
 - a. The Gypsum Management Facility: 95 percent of the maximum dry density obtained from the Standard Proctor Test, ASTM D698.
 - b. The CCB Landfill: 90 percent of the maximum dry density obtained from the Standard Proctor Test, ASTM D698.

In order to insure uniform coverage and to facilitate construction inspection and control, the compaction of each layer shall proceed in a systematic, orderly, and continuous manner. Rolling shall be parallel to the embankment axis, except where there is insufficient working room for such operations.

2. The moisture content of all earth fill materials shall be as uniform as practicable throughout each lift. Fill shall be compacted at a moisture content that is no more than 2 percent below and no more than 2 percent above optimum moisture content.
3. Moisture conditioning of fill materials shall be performed by discing, harrowing, plowing, blading, or other suitable means prior to excavation. Moisture conditioning where the fill is placed shall be limited to minor adjustments prior to compaction. Addition of moisture shall be by using a

pressure spray bar mounted in front of or to one side of a water tanker so that water will not collect in the tracks of the truck.

4. Any materials that are placed but not compacted prior to drying out or becoming too wet shall be removed and replaced or reprocessed at the Contractor's expense.
5. No admixtures as drying agents or to improve the workability of the soil will be allowed.

3.05 GENERAL FILL

General Fill materials shall be placed to the specifications for Structural Fill, except it shall be compacted to a dry density equal to or greater than 92 percent of the maximum dry density obtained from the Standard Proctor Test, ASTM D698

3.06 COMPACTED CLAY LINERS

A. Sources

The Compacted Clay Liners for both the Gypsum Management Facility and the CCB Landfill shall be constructed from Compacted Clay Liner material as described in paragraph 2.01(B) above.

B. Test Soil Liner

A Test Soil Liner of the actual full scale liner shall be constructed in accordance with the following requirements:

1. Test liner will be constructed from the same soil material sources, to the same design specifications, and with similar equipment and procedures as are proposed for the full scale liner.
2. Test liner will be at least four times the width of the widest piece of equipment to be used.
3. Test liner will be no less than 100 ft long to allow equipment to reach normal operating speed before reaching a central 40-ft test area.
4. Test liner will be constructed with maximum 8-in. compacted lifts for a total liner thickness of 3 ft.
5. Test liner will be tested by the Owner's Testing Firm in accordance with the project Construction Quality Assurance (CQA) Plan, included in Appendix 2, summarized below for each of the following physical properties:
 - a. Multiple two-stage Bouwwell permeameter tests will be used on the test liner to determine the hydraulic conductivity. The two-stage field hydraulic conductivity test is a falling head infiltration test conducted in a cased borehole, typically 4 in. in diameter. The test is cited in the U.S. EPA Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities, September 1993 (EPA/600/R-93/182).

- b. Undisturbed samples (Shelby tubes) will be tested in the laboratory for hydraulic conductivity to determine if there is a statistical correlation to the field testing results.
 - c. Other engineering parameters including, but not limited to, particle size analysis, liquid limits, plasticity, water content, and in-place density that are needed to evaluate the full scale liner will be determined.
6. Additional test fills will be constructed for each new soil type or for each change in equipment or procedures.

C. Full Scale Liner Construction:

1. Full scale liner construction shall not be commenced until the results of the in-place compaction testing and Bouwmeester permeameter tests on the test liner confirm that the construction procedures and specified compaction requirements produce in-situ hydraulic conductivities as specified in Section 2.01(B) above.
2. The liner shall be constructed according to the placement and compaction requirements for general fill, except the material shall be compacted to a density of no less than 95 percent of maximum dry density as determined by the Standard Proctor Test (ASTM D 698) at the following moisture contents:
 - a. Gypsum Stack Compacted Clay Liner shall be compacted at a moisture content between 100 percent and 105 percent of optimum.
 - b. CCB Landfill Compacted Clay Liner shall be compacted at a moisture content determined by the "acceptable zone" criteria as outlined in the project CQA Plan.

The same compaction procedures, such as number of passes, speed, and compaction equipment used on construction of the test liner shall be used. Grade stakes shall not be driven into the clay liner.

3. Moisture/density, hydraulic conductivity, and strength testing of the Compacted Clay Liner shall be conducted by the soil testing agency under the requirements and frequencies specified in the project CQA Plan to verify that ongoing liner placement meets the criteria developed by the Test Soil Liner.
4. The completed liner shall be smooth rolled to limit moisture loss and promote run-off of surface water. Moisture content shall be maintained within the specified range and erosion or other damage that occurs in the soil liner shall be repaired as directed by the Owner's Representative until the geosynthetic liner is placed.

5. Voids created in the Compacted Clay Liner during construction (including, but not limited to, penetrations for test samples, and other penetrations necessary for construction) shall be repaired by removing material that does not meet the requirements for Compacted Clay Liner material, backfill with Compacted Clay Liner material, granular or pelletized bentonite, or a mixture of bentonite and Compacted Clay Liner material in lifts no thicker than 2 in. and tamping each lift with a steel rod. Each lift shall be tamped a minimum of 25 times altering the location of the rod within the void for each blow. Other ruts and depressions in the surface of the lifts shall be scarified, filled, and then compacted to grade.

3.07 CUSHION DIRT (Gypsum Management Facility Only)

Cushion Dirt to be placed beneath the upper High Density Polyethylene (HDPE) Geomembrane is to be placed to the specifications for General Fill in Section 3.04 above, except fill materials for Cushion Dirt shall be compacted to a dry density equal to or greater than 90 percent of the maximum dry density obtained from the Standard Proctor Test, ASTM D698.

3.08 ANCHOR TRENCH CONSTRUCTION

A. Gypsum Management Facility – Gypsum Stack

1. The anchor trench shall be excavated to the depth and width shown on the anchor trench details. The front edge of the trench shall be rounded to eliminate any sharp corners that could cause excessive stress to the geosynthetic liners. Loose soil shall be removed or compacted into the floor of the trench.
2. Subsequent to Geosynthetic Clay Liner (GCL), Bottom HDPE Geomembrane and Geotextile Cushion installation, the liners shall be placed in the trench to fully cover the entire trench floor, but do not extend up the back of the trench wall. After the liner installation, the trench shall be backfilled with 1 ft. of Compacted Clay Liner material. The backfill shall be deposited and compacted according to the requirements for general fill in such a manner as to prevent damage to the GCL and liner materials.
3. Subsequent to installation of separation geotextile on top of drainage layer, it shall be verified that the fabric extends across the top of the initial 1 ft layer of trench backfill, but does not extend up the back of the trench wall. After the separation geotextile has been installed in, the trench shall be backfilled with 2 ft of Compacted Clay Liner material. The backfill shall be deposited and compacted according to the requirements for general fill in such a manner as to prevent damage to the separation geotextile.

4. Subsequent to installation of the upper HDPE Geomembrane, the liner shall be installed into the trench and extend across the top of the initial 1 ft layer of trench backfill, but not extend up the back of the trench wall. After the liner installation in the trench has been inspected jointly with the Owner's Representative, and the Geosynthetics Installer's Representative has submitted a certificate of approval that the HDPE Geomembrane was installed in the anchor trench in accordance with the plans and specifications, the Contractor may backfill the remainder of the trench to the top of the Compacted Clay Liner. Deposit and compact the backfill according to the requirements for general fill in such a manner as to prevent damage to the HDPE Geomembrane.

B. Gypsum Management Facility – Recycle Pond

1. The anchor trench shall be excavated to the depth and width shown on the anchor trench details. The front edge of the trench shall be rounded to eliminate any sharp corners that could cause excessive stress to the geosynthetic liners. Loose soil shall be removed or compacted into the floor of the trench.
2. Subsequent to HDPE Geomembrane installation, it shall be verified that the liner covers the entire trench floor, but does not extend up the back of the trench wall. After the liner installation in the trench has been inspected jointly with the Owner's Representative, and the Geosynthetics Installer's Representative has submitted a certificate of approval that the HDPE Geomembrane was installed in the anchor trench in accordance with the plans and specifications, the Contractor may backfill the remainder of the trench to the top of the Recycle Pond berm. The backfill shall be deposited and compacted according to the requirements for general fill in such a manner as to prevent damage to the liner material.

C. CCB Landfill

1. Excavate a ledge at bottom of anchor trench elevation and place and compact Compacted Clay Liner material on the ledge as shown on the anchor trench details in the plans.
2. Excavate the anchor trench to the depth and width shown on the anchor trench details. Round the front edge of the trench to eliminate any sharp corners that could cause excessive stress to the geosynthetic liners. Remove loose soil or compact it into the floor of the trench.
3. Subsequent to GCL and HDPE geomembrane installation by the geosynthetic liner contractor, verify that the liners cover the entire trench floor, but do not extend up the back of the trench wall. After the liner installation in the trench has been inspected jointly with the Owner's Representative, and the Geosynthetics Installer's Representative has submitted a certificate of approval that the HDPE Geomembrane was

installed in the anchor trench in accordance with the plans and specifications, the Contractor may backfill the remainder of the trench to the top of the Compacted Clay Liner. Deposit and compact the backfill according to the requirements for general fill in such a manner as to prevent damage to the GCL and HDPE geomembrane.

4. Subsequent to installation of separation geotextile on top of drainage layer, verify that the fabric extends across the top of the initial 1 ft layer of trench backfill, but does not extend up the back of the trench wall. After the fabric installation in the trench has been inspected and approved by the Owner's Representative, backfill the remainder of the trench to the top of the Compacted Clay Liner. Deposit and compact the backfill according to the requirements for general fill in such a manner as to prevent damage to the geotextile fabric.

3.09 TESTING

- A. Construction Quality Assurance (CQA) compaction and permeability tests will be made by the Owner's Testing Consultant during the progress of the work as indicated in the Construction Quality Assurance Plan, included in Appendix 2. The Contractor shall cooperate with the Testing Consultant and allow such tests to be performed.
- B. If tests indicate that an area of fill or Compacted Clay Liner does not meet the specified requirements, additional tests shall be performed to determine the extent of non-compliance. The Contractor shall moisture condition and recompact that area until a passing test result is obtained.
- C. Moisture/density testing by nuclear methods will be conducted by the Owner's Testing Firm at a minimum frequency as outlined in the Construction Quality Assurance (CQA) Plan. The range of moisture content will be determined in accordance with the "acceptable zone" method which is also outlined in the Project CQA Manual. A moisture test will be considered failed if the result indicates that the moisture content does not lie within the "acceptable zone." Material that fails will be dried or wetted until satisfactory moisture content is achieved. A density test will be considered failed if the result indicates a dry density outside the "acceptable zone." The material will be compacted until a passing test is achieved.

To ensure accuracy and reproducibility of testing of the soil liner for compaction and moisture content, all density gauges shall be certified by annual calibration.

3.10 FINISH GRADING

All excavated and filled areas shall be fine graded and leveled to provide a smooth finish free of debris, foreign matter, objectionable stones, clods, lumps, pockets, or high spots, properly drained and true to indicated elevations. Finish grading shall be only near completion of work or when requested. Any portions

of the berm damaged by construction shall be restored. The berm ditch shall be finished to design grade, and the ditch side slopes shaped and trimmed to provide a uniform ditch cross section.

3.11 CONSTRUCTION TOLERANCES

- A. Elevations will be surveyed at breaks in slopes and on a 100 ft. grid pattern on the base before and after liner construction to verify liner thickness and to verify that proper drainage slopes to leachate collection piping are maintained. To verify material thickness, all horizontal survey coordinates will be the same for the bottom and the top of the material that is placed. Side slope thicknesses will be verified using crest (top), midpoint, and toe documentation points. A test will be considered failed if it does not meet the minimum design requirements. To obtain the specified design thickness, additional soil material will be placed and compacted in failing areas where the as-built thickness is less than the design thickness. Surveying required for verification of final construction tolerances will be performed by the Owner's Land Surveyor.

- B. The minimum specified design thickness of all Compacted Clay Liners shall be 3.00 ft.

END OF SECTION 02200

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PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to the placement of riprap for erosion control.

1.02 RELATED SECTIONS

The following section contains items which are related to the work in this section:

02200 - Earthwork

1.03 REFERENCES

Specified references or cited portions thereof, current at date of bidding documents unless otherwise specified, govern the work.

- A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.

1.04 SUBMITTALS

Product Data: Provide quarry name and material type prior to delivery.

PART 2. PRODUCTS

2.01 MATERIALS

- A. Stone Riprap and Bedding materials according to Article 1005.01 of the Illinois Standard Specifications for Road and Bridge Construction.
- B. Filter Fabric material, where required by IDOT specifications for Stone Riprap, shall furnished according to Article 1080.03, with an AOS (Apparent Opening Size) as indicated on the plans.
- C. Riprap Source shall be listed on the current IDOT Approved Aggregate Source List.
- D. Gradation as indicated in the drawings. Quality shall be Class A.

PART 3. EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

- A. Stone Riprap and Bedding shall be installed in accordance with Section 281 of the Illinois Standard Specifications for Road and Bridge Construction for the placement of Stone Riprap. Measurement and payment provisions of Section 281 shall not apply.
- B. Filter Fabric for Stone Riprap shall be installed in accordance with Section 282 of the Illinois Standard Specifications for Road and Bridge Construction.
- C. The Owner's Representative shall be allowed to visually inspect Riprap for compliance with specifications prior to placement.

END OF SECTION 02275

DIVISION 2 – SITEWORK
Section 02315 – Granular Materials
ADDENDUM #2

PART 1. GENERAL

1.01 DESCRIPTION

A. Gypsum Management Facility

This section pertains to the following:

1. Furnishing and placing granular drainage materials for the drainage layer and Leachate Collection System piping.
2. Furnishing and placing coarse aggregate for encasement of the Process Water Recovery System piping.
3. Furnishing and installing Filter Sand for the protection of the Process Water Recovery System piping.
4. Furnishing and installing materials for roadbed construction related to the Gypsum Management Facility access roads.
5. Recycle Pond Drain.
6. Furnishing and installing materials for roadbed construction related to maintaining McKinley Road on AERG property.
- 7. Furnishing and installing materials for roadbed construction related to the Landfill Haul Road.**

B. CCB Landfill

This section pertains to the following:

1. Placing granular material for Drainage Layer.
2. Placing granular material for Separation Berm.
3. Placing Coarse Aggregate for encasement of leachate collection piping.
4. Furnishing and installing materials for roadbed construction related to the landfill access road.

1.02 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

1. 02300 - Earthwork
2. 02373 - Geotextiles
3. 02640 - Leachate Collection Piping

1.03 REFERENCES

The following references, or cited portions thereof, govern the work:

1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.
2. American Society for Testing and Materials (ASTM):
 - a. ASTM D 75 (2003) Practice for Sampling Aggregates.
 - b. ASTM D 422 (1963; R 2002) Test Method for Particle-Size Analysis of Soils.
 - c. ASTM D 2434 (1968, R 2000) Test Method for Permeability of Granular Soils (Constant Head).
 - d. ASTM D 3042 (2003) Test Method for Insoluble Residue in Carbonate Aggregates.
 - e. ASTM C 1260 (2005) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
3. American Geological Institute (AGI). Geoscience Handbook AGI Data Sheets, 4th Edition.

1.04 MEASUREMENT AND PAYMENT

The Contractor shall be responsible for estimating the extent of granular materials required to complete the work including, but not limited to, construction of drainage layer, encasement of leachate collection piping, and road-bed construction. The Contractor shall include the dollar amount associated with furnishing and placing all granular materials in his Lump Sum Bid amount.

1.05 COORDINATION

- A. The geosynthetic liner shall be covered with granular materials as soon as practicable after a section of liner has been approved by the Owner's Representative.

1.06 SUBMITTALS

- A. Product Data:
 1. Aggregate source list: Submit a list of proposed aggregate sources.
 2. Shipping Tickets: Submit shipping tickets for the granular materials delivered to the site. Shipping tickets shall be according to paragraph 1004.011 of the IDOT Standard Specifications.

B. Test Reports,

1. Submit results of grain size analysis (ASTM D422) and hydraulic conductivity testing (ASTM D2434) for gradations established by the Contractor that provide the specified hydraulic conductivity. Test results are required for each proposed source and gradation. Submit test results for each source demonstrating compliance with reactivity, soundness, and abrasion requirements specified herein.

C. Samples:

1. Submit one sample per source for each gradation proposed for use on the project. Samples shall be at least one pound and shall be obtained and shipped according to ASTM D75. Submit samples at least 15 days prior to starting construction of the drainage layer and coarse aggregate encasement for leachate piping.

1.07 STORAGE AND HANDLING

- A. Storage and handling of granular materials shall be according to paragraph 1004.01e of the IDOT Standard Specifications.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Coarse Granular materials shall meet the Description of Gravel, as described in Section 1004.01(a)(1) of the IDOT Standard Specifications, and shall be spherical to sub-discoidal, sub-rounded to well rounded particles as defined by AGI Data Sheet, 4th Edition, Sheet 8.4 – Comparison Charts for Estimating Roundness and Sphericity.
2. Granular materials shall experience no more than 15 percent carbonate loss per ASTM D3042.
3. Granular materials shall be free of deleterious material, and shall meet the Na₂SO₄ soundness and Los Angeles Abrasion Specifications for Class B quality aggregate per paragraph 1004.01 of the IDOT Standard Specifications.
4. All material shall pass the 2 in. sieve, and no greater than 5 percent shall be retained on the No. 200 sieve.
5. Granular materials shall be innocuous to alkali-silica reactivity, and shall exhibit internal expansions of less than 0.10 percent at 16 days after casting as determined by ASTM C 1260.

B. Gypsum Management Facility Granular Materials

1. Granular Materials for Drainage Layer

Gradation for granular material for Drainage Layer shall be as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-3} cm/sec.

2. Coarse Aggregate around Ring Drain Collection Piping

Coarse Aggregate used to encase the ring drain collection piping shall be IDOT Gradation CA 7 material as outlined in Article 1004.01 of the IDOT Standard Specifications for Road and Bridge Construction.

3. Filter Sand

Filter Sand used for protective cover over the ring drain collection system shall be IDOT Gradation FA 1, Class B or better according to Article 1003 of the IDOT Standard Specifications for Road and Bridge Construction.

4. Aggregate Base Course, Type B

Aggregate Base Course, Type B used for base material for all new access roads and the Landfill Haul Road shall be IDOT Gradation CA 2, in accordance with Section 1004.04 of the IDOT Standard Specifications for Road and Bridge Construction. The requirements from Section 2.01A of this specification shall not apply.

5. Aggregate Surface Course, Type B

Aggregate Surface Course, Type B used for surface material for all new access roads and the Landfill Haul Road ~~McKinley Road relocation~~ shall be IDOT Gradation CA 6, in accordance with Section 1004.04 of the IDOT Standard Specifications for Road and Bridge Construction. The material shall originate from an IDOT approved source. The requirements from Section 2.01A of this specification shall not apply.

6. Coarse Aggregate for Leachate Collection/Leachate Detection Piping

Gradation for coarse aggregate encasement around Leachate Collection/Leachate Detection Laterals shall be as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-1} cm/sec.

B. CCB Landfill Granular Materials

1. Granular Materials for Drainage Layer and Separation Berm.

Gradation for granular material for drainage layer and separation berm shall be as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-3} cm/sec.

2. Coarse Aggregate.

Gradation for coarse aggregate shall be as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-1} cm/sec.

2.02 EQUIPMENT

Equipment for spreading and compacting granular materials shall be low ground pressure equipment to prevent damage to the underlying geosynthetic liners.

PART 3. EXECUTION

3.01 PROTECTION OF GEOSYNTHETICS

- A. Protection of the geosynthetic liners is critically important. Approved geosynthetic liner shall be covered by granular material as soon as practicable. Granular material shall be placed to a minimum thickness of 1 ft before any heavy equipment or loaded trucks are allowed on the lined area.
- B. No vehicular traffic shall travel directly on the geosynthetic liner other than an approved low ground pressure All Terrain Vehicle or equivalent.
- C. Any damage to the geosynthetic liner system shall be repaired, as directed by the Owner's Representative, at the expense of the Contractor.

3.02 DRAINAGE LAYER (GYPSUM STACK)

A. Placement on Cell Floor

- 1. The granular material shall be back-dumped on the geotextile cushion fabric in a sequence of operations beginning at the perimeter of the liner on the cell floor.
- 2. Placement of material on the fabric shall be accomplished by spreading dumped material off of previously placed material with a bulldozer blade or endloader, in such a manner as to prevent tearing or shoving of the cloth. Dumping of material directly on the fabric will only be permitted to establish an initial working platform. No vehicles or construction

equipment shall be allowed on the fabric prior to placement of the granular blanket to a minimum thickness of 1 ft.

B. Placement on Cell Side Slopes

1. Placement of granular material on cell side slopes shall be accomplished using methods and equipment similar to that specified for placement of material on cell floor.
2. The Contractor may place earth fill material underlain with separation geotextile fabric to buttress the granular material on the slope:
 - a. The Construction Quality Assurance (CQA) survey to certify thickness of drainage material shall be completed within the footprint of the gypsum stack before it is covered with separation geotextile fabric.
 - b. Separation geotextile fabric shall extend beyond the toe of gypsum buttress a sufficient distance to prevent contamination of the granular drainage layer. See Sections 02373 and 02320 for construction of separation geotextile fabric.

3.03 DRAINAGE LAYER (CCB LANDFILL)

A. Placement on Cell Floor.

1. The granular material shall be back-dumped on the geotextile cushion fabric in a sequence of operations beginning at the perimeter of the liner on the cell floor.
2. Placement of material on the fabric shall be accomplished by spreading dumped material off of previously placed material with a bulldozer blade or endloader, in such a manner as to prevent tearing or shoving of the cloth. Dumping of material directly on the fabric will only be permitted to establish an initial working platform. No vehicles or construction equipment shall be allowed on the fabric prior to placement of the granular blanket to a minimum thickness of 1 ft.

B. Placement on Cell Side Slopes.

1. Placement of granular material on cell side slopes shall be accomplished using methods and equipment similar to that specified for placement of material on cell floor.
2. The Contractor may place CCB underlain with separation geotextile fabric to buttress the granular material on the slope:
 - a. The Construction Quality Assurance (CQA) survey to certify thickness of drainage material shall be completed within the footprint of the CCB before CCB placement.

- b. Separation geotextile fabric shall extend beyond the toe of CCB buttress a sufficient distance to prevent contamination of the granular drainage layer. See Sections 02373 and 02320 for construction of separation geotextile fabric and CCB, respectively.
- C. Placement in Separation Berm.
 - I. Granular material for the separation berm shall be placed and spread in uniform lifts not to exceed 1 ft. The initial lift shall be placed according to paragraph A. The separation berm shall be constructed across the floor of the cell to at least the level of the top of drainage layer before any CCB is placed within the cell, and the top of berm shall be maintained at or above the level of adjacent CCB as CCB placement progresses.

3.04 COARSE AGGREGATE FOR ENCASEMENT OF RING DRAIN COLLECTION PIPING (GYPSUM MANAGEMENT FACILITY)

- A. The geotextile filter fabric for encasement of leachate collection piping shall be placed on the approved cushion geotextile fabric according to Section 02373 – Geotextiles.
- B. The coarse aggregate shall be placed and consolidated with a vibratory plate compactor on the encasement fabric to the width shown on the plans to the level of the bottom of the ring drain collection piping.
- C. Course aggregate shall be placed and consolidated with a vibratory plate compactor along the pipe during pipe installation. The coarse aggregate shall be placed longitudinally along the pipe in lifts not to exceed 8 in. thick to a height of at least the center of the pipe. The aggregate shall be maintained at equal elevation on each side of the pipe, and the first lift of material shall be mechanically tamped to ensure that the space under the pipe is completely filled. The top of pipe shall not be covered until the CQA survey certifies leachate piping grade has been completed.
- D. After the CQA survey has been completed, coarse aggregate material shall continue to be placed in lifts not to exceed 8 in. thick, as specified in the previous paragraph until the minimum cover height shown in the plans is attained.
- E. The running of trucks or heavy equipment over leachate piping shall be avoided until there is at least a 12 in. cover of Filter Sand over the completed geotextile envelope.

3.05 COARSE AGGREGATE FOR ENCASEMENT OF LEACHATE COLLECTION PIPING (CCB LANDFILL)

- A. Place geotextile fabric for encasement of leachate collection piping on the approved cushion geotextile fabric according to Section 02373 – Geotextiles.
- B. Place and consolidate coarse aggregate with a vibratory plate compactor on the encasement fabric to the width shown on the plans to the level of the bottom of the leachate piping.
- C. Place and consolidate coarse aggregate along the pipe during pipe installation. Place coarse aggregate longitudinally along the pipe in lifts not to exceed 8 in. thick to a height of at least the center of the pipe. Maintain the aggregate at equal elevation on each side of the pipe, and mechanically tamp the first lift of material to ensure that the space under the pipe is completely filled. Do not cover the top of pipe until the CQA survey to certify leachate piping grade has been completed.
- C. After the CQA survey has been completed, continue placing coarse aggregate material in lifts not to exceed 8 in. thick, as specified in the previous paragraph until the minimum cover height shown in the plans is attained.
- D. Avoid running trucks or heavy equipment over leachate piping until there is at least 12 in. cover over the completed geotextile envelope. Provide temporary ramps no steeper than 10H:1V transverse to the piping for temporary equipment crossings until the first lift of CCB is placed.

3.06 ROADWAY CONSTRUCTION

- A. Prepare the roadway subgrade as shown on the plans, in accordance with Section 02200 – Earthwork.
- B. Furnish Geotechnical Fabric for Ground Stabilization in accordance with Section 02373 – Geotextiles.
- C. Furnish Aggregate Base Course, Type B in accordance with Article 351 of the IDOT Standard Specifications for Road and Bridge Construction.
- D. Furnish Aggregate Surface Course, Type B in accordance with Article 402 of the IDOT Standard Specifications for Road and Bridge Construction.

3.07 TESTING

- A. Independent gradation and permeability tests will be made by the Owner's Testing Lab during the progress of the work at frequencies as required in the project Construction Quality Assurance (CQA) Plan, included in Appendix 2.

The Contractor shall cooperate with the Testing Lab and allow such tests to be performed.

- B. If tests indicate that an area of granular material or coarse aggregate does not meet the specified requirements of the project CQA Plan, then the Contractor shall remove the material and replace it with suitable material.

3.05 FINISH GRADING

The granular drainage layer shall be fine graded, but not compacted, to provide a smooth finish before a CQA survey of the completed portion of the drainage layer is requested. The CQA Officer shall direct the survey agency to determine elevations at the top of the final constructed surface of the Drainage Layer using a 100 ft. grid pattern (and the break points in slope) to verify attainment of the plan grades and elevations. To verify thickness, all horizontal survey coordinates shall be the same for the top of the cushion, and final constructed surface. Side slope thicknesses will be verified using crest (top), midpoint, and toe documentation points. In no instance shall the field determined thickness be less than 1.0 ft. The measured depths and grades shall be documented on "as built" drawings furnished to the CQA Officer by the survey agency. Ruts or erosion damage shall be repaired before placement of the separation geotextile fabric.

END OF SECTION 02315

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to furnishing and installing geotextile fabrics on prepared surfaces.

1.02 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

1. 02300 - Earthwork
2. 02315 - Granular Materials
3. 02800 – HDPE Geomembrane

1.03 REFERENCES

The following references, or cited portions thereof, govern the work:

1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.
2. American Society for Testing and Materials (ASTM):
 - a. ASTM 3776 (1996; R 2002) Standard Test Method for Mass per Unit Area (Weight) of Fabric;
 - b. ASTM D 3786 (2001) Test Method for Hydraulic Bursting Strength of Textile Fabrics -- Diaphragm Bursting Strength Tester Method;
 - c. ASTM D 4533 (2004) Test Method for Trapezoid Tearing Strength of Geotextiles;
 - d. ASTM D 4632 (1991; R 2003) Test Method for Grab Breaking Load and Elongation of Geotextiles;
 - e. ASTM D 4751 (2004) Test Method for Determining Apparent Opening Size of Geotextile;
 - f. ASTM D 4833 (2000) Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products;
 - g. ASTM D 4873 (2002) Guide for Identification, Storage, and Handling of Geosynthetic Rolls;
 - h. ASTM D 4884 (1996; R 2003) Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles;
 - i. ASTM D5261-92(2003) Standard Test Method for Measuring Mass per Unit Area of Geotextiles

- j. ASTM D6241-04 Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

1.04 MEASUREMENT AND PAYMENT

- A. The Contractor shall be responsible for estimating the extent of geotextile fabric required to complete the work including fabric for laps, anchorage, repairs, and samples for Construction Quality Assurance (CQA) testing. The Contractor shall include the dollar amount associated with all geotextile construction in his Lump Sum Bid amount, except as specified in paragraph B.
- B. Geotextile Fabric for Ground Stabilization, when directed by the Owner's Representative for stabilization of foundation soils, will be paid for on a time and materials basis.
- C. No additional payment will be made for geotextile fabric for ground stabilization installed at the Contractor's discretion.

1.05 SUBMITTALS

- A. Product Data
 - 1. The manufacturer's list of guaranteed properties for each geotextile fabric proposed for use on the project shall be submitted.
 - 2. The manufacturer's installation guidelines shall be submitted.
- B. Samples

Samples of geotextile fabrics shall be submitted for CQA prequalification testing. Sample size and sampling frequency are specified in Appendix 2.
- C. Inventory

A copy of the roll inventory that identifies, as a minimum, manufacturer or supplier, product or style number, roll number, width, and length of roll as identified on the roll label shall be submitted.

1.06 STORAGE AND HANDLING

Geotextiles shall be stored and handled according to ASTM D4873.

PART 2. PRODUCTS

2.01 MATERIALS

A. Geotextile Fabric for Liner System

Geotextile fabrics for use in the cell liner system shall consist of non-woven filaments of polypropylene, polyester, or polyethylene. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Non-woven fabric may be needle-punched, heat-bonded, or a combination thereof. The filaments shall be dimensionally stable (i.e., filaments shall maintain their relative position with respect to each other) and resistant to delamination. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile. The filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permeability.

Fabric shall have the following physical properties:

Physical Properties⁽¹⁾	4 oz. (Separation)	6 oz. (PWRS)	16 oz. (CA Envelope & Rub Sheet)
Mass/Unit Area (oz./yd ²) ASTM D5261	4.0	6.0	16.0
Grab Tensile Strength (lb.) ASTM D4632	115	160	380
Grab Elongation (%) ASTM D4632	50	50	50
Puncture Strength (lb.) ASTM D4833	65	85	240
Puncture (CBR) Strength (lb.) ASTM D6241	310	410	1025
Mullen Burst Strength (psi) ASTM D3786	210	280	750
Trapezoidal Tear Strength (lb.) ASTM D4533	50	60	150
Width (ft.)	15	15	15
Apparent Opening Size (AOS) Max. US Std. Sieve No. ASTM D4751	70	70	100
UV Resistance ⁽²⁾ (%) ASTM D4355	70	70	70
Roll Width (ft.)	15	15	15

Notes

- (1) All values listed are Minimum Average Roll Values (MARV) unless otherwise noted, calculated as the typical minus two standard deviations.

- (2) UV Resistance is a minimum value and not a MARV. Evaluation to be on 2.0 inch strip tensile specimens after 500 hours exposure.

B. Geotextile Cushion

Fabric for Geotextile Cushion shall consist of non-woven filaments of polypropylene, polyester, or polyethylene. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Non-woven fabric may be needle-punched, heat-bonded, or a combination thereof. The filaments shall be dimensionally stable (i.e., filaments shall maintain their relative position with respect to each other) and resistant to delamination. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile. The filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permeability.

Fabric shall have the following physical properties:

Physical Properties⁽¹⁾	10 oz. (Geotextile Cushion)
Mass per unit area (oz/yd ²) ASTM D5261	10
Grab Tensile Strength (lb.) ASTM D4632	230
Grab Tensile Elongation (%) ASTM D4632	50
Trapezoidal Tear Strength (lb.) ASTM D4533	95
Puncture (CBR) Strength (lb.) ASTM D6241	700
Puncture (CBR) Elongation (in.) ASTM D6241	1.5
UV Resistance ⁽²⁾ (%) ASTM D4355	70
Apparent Opening Size (Max.) (AOS) Sieve No. - ASTM D4751	---
Roll Width (ft.)	15

Notes:

- (1) All Values listed are Minimum Average Roll Values (MARV). Unless otherwise noted, calculated as the typical minus two standard deviations.
- (2) UV Resistance is a minimum value and not a MARV. Evaluation to be on 2.0 inch strip tensile specimens after 500 hours exposure.

C. Geotechnical Fabric for Ground Stabilization

Geotechnical fabric for ground stabilization shall conform to Article 1080.02 of the IDOT Standard Specifications for Road and Bridge Construction.

D. Thread for Seams

High strength thread should be used such that seam test should conform to ASTM D4884. The thread shall meet the chemical, ultraviolet, and physical requirements of the geotextile, and the color shall be different from that of the geotextile.

E. Securing Devices

Pins, staples, and other devices that project through the geotextile fabric are not permitted for fabrics installed above the geomembrane. Sandbags, stone, or other appropriate means approved by the Owner's Representative shall be used to prevent movement of the geotextile.

2.02 EQUIPMENT

- A. Equipment for spreading and compacting granular materials shall be low ground pressure equipment to prevent damage to the underlying geosynthetic liners.

PART 3. EXECUTION

3.01 SAMPLES FOR CQA TESTING

- A. Geotextile fabric samples shall be obtained, identified and packaged from rolls designated by the Owner's Representative according to ASTM D4873.
- B. Samples shall be 3 ft. wide by the full roll width.

3.02 BASE PREPARATION

- A. Surface on which the geotextile will be placed shall be prepared to a relatively smooth surface condition, and shall be free from obstruction, debris, depressions, erosion features, or any irregularities that would prevent continuous, intimate contact of the geotextile with the entire surface. Rills, gullies, and ruts must be graded out of the surface before geotextile placement. Areas on which geotextile are to be placed shall be graded and/or dressed in accordance with Section 02200 – Earthwork and Section 02315 – Granular Materials. Prior to daily placement, the Installer shall provide the CQA Officer daily "certificates of acceptance" which document the Installer's inspection and acceptance of the underlying surface as being suitable for the geotextile installation.
- B. Geotextile cushion fabric will be installed directly on the geosynthetic liner. Jointly inspect the liner with the Owner's Representative before commencing fabric installation each day. Notify the Owner's Representative promptly of any damage or defects observed in the liner as fabric installation progresses. Do not place fabric in the damaged or defective area until the liner has been repaired and

approved by the Owner's Representative. Submit a daily inspection report identifying the area of fabric placement and certifying that there were no visible defects in the area of fabric placement.

- C. Do not run heavy vehicle traffic directly on the geosynthetic liner or cushion geotextile. Use vehicles and equipment as specified in paragraph 2.02 to transport and deploy fabric on the liner. Operate the equipment with care, and place protective cover over the geomembrane, if necessary, to avoid damaging the liner. Route traffic and personnel over installed cushion fabric and use the installed fabric as a working platform to the greatest extent possible.

3.03 INSTALLATION

A. General Requirements:

- 1. Geotextile fabric shall be unrolled and laid out following these requirements to the greatest extent practical:
 - a. Orient panels with the longest dimension parallel to the slope.
 - b. Minimize the number of seams in corners and odd-shaped areas.
 - c. Extend panels on slopes a minimum of 5 ft onto a horizontal surface.

Geotextile panels shall be unrolled using methods that will not damage the fabric and will protect underlying surface from damage. While unrolling, the geotextile fabric shall be visually inspected for imperfections and faulty or suspect areas marked. Ballast shall be placed on fabric to prevent wind uplift. Expansion and contraction should be allowed for by leaving slack.

Heavy vehicle traffic shall not be run directly on geotextile fabric. Fabric in areas of heavy traffic shall be protected with protective cover over the fabric.

2. Laps

Individual panels of geotextile fabric shall be lapped according to manufacturer's instructions and as specified herein. Provide a minimum overlap of 3 in. unless otherwise specified herein or in the plans. Shingle overlaps so that water or other material cannot run down the slope between the two layers of fabric.

3. Field Seams

Continuously sew all laps on slopes steeper than 10H:1V. This requirement does not apply to the heavy geotextile fabric for envelopment of coarse aggregate around leachate piping.

4. Defects and Repairs

Examine the installed geotextile fabric for defects, holes discontinuous seams, puckered or separated laps, etc. Repair defective laps and seams. Patch holes and defects according to manufacturer's recommendations and as directed by the Owner's Representative. Do not cover suspect or patched areas until they have been inspected and approved by the Owner's Representative.

B. Geotextile Fabric for Separation

1. Use low ground pressure equipment to avoid rutting the granular material.
2. Horizontal seams (parallel to top of slope) will be permitted on cell side slopes to facilitate staged construction of the drainage layer on the side slope.
3. Extend separation geotextile fabric into and across the bottom of the anchor trench and complete backfill of the trench according to Section 02200.

C. Geotextile Fabric for Coarse Aggregate Envelope

1. Geotextile for coarse aggregate envelope will be installed directly on the cushion fabric. Remove any foreign materials from the cushion fabric within the footprint of the coarse aggregate leachate piping encasement before installing the geotextile envelope. Place sufficient width to completely envelop the coarse aggregate and provide a longitudinal lap of at least 6 in.
2. After the coarse aggregate encasement has been completed, according to Section 02315, wrap the geotextile around the mounded aggregate, and cover the lap with at least 6 in. of material before permitting vehicle or equipment on the fabric.
3. Any ballast material other than coarse aggregate, according to Section 02315, that is placed within the envelope will require removal during coarse aggregate construction.

D. Geotechnical Fabric for Ground Stabilization

1. Install Geotechnical Fabric for Ground Stabilization in accordance with Section 210 of the IDOT Standard Specifications for Road and Bridge Construction.

2. If approved by the Owner's Representative, the Contractor may, at his own expense, install geotextile or geogrid for ground stabilization outside the limits designated by the Owner's Representative.
3. Submit as-built drawings that clearly delineate limits and type of ground stabilization.

3.04 PROTECTION

- A. Protect installed fabric until it is covered by at least 1 ft. of overlying material.
- B. Any damage to the geotextile during its installation or during placement of overlying materials shall be replaced by the Contractor at no cost to the Owner. Unless otherwise noted, the work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 14 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage prior to and during the placement of overlying materials. Before placement of overlying materials, the Contractor shall demonstrate that the placement technique will not cause damage to the geotextile.

3.05 TESTING AND INSPECTION

A. Prequalification Testing

Geotextiles are subject to CQA testing by the Owner's Testing Consultant to verify conformance with the manufacturer's list of guaranteed properties according to the project Construction Quality Assurance Plan, included in Appendix 2. The Contractor shall provide samples as specified herein. Any fabric that does not conform to the list of guaranteed properties shall be removed from the site.

- B. Installed fabric shall be inspected by the Owner's Representative. No material shall be placed on the fabric, other than ballast, until the installation has been approved by the Owner's Representative. Ballast shall not obscure seams or significant length of unseamed laps. The Owner's Representative may require removal of ballast to inspect suspect areas.
- C. If the Owner's Representative suspects that completed work has been damaged by construction methods that do not conform to the specifications, he may require removal of completed work to verify the integrity of the underlying materials. The Contractor shall bear the cost of removal and subsequent repair as directed by the Owner's Representative, if the integrity of the underlying materials was damaged. If no damage was found, the Owner will pay the Contractor for the investigation work on a time and materials basis.

END OF SECTION 02373

DIVISION 2 - SITEWORK

Section 02376 – Geosynthetic Clay Liner

PART 1. GENERAL

1.01 DESCRIPTION

- A. This section covers furnishing and installation of a reinforced needlepunched Geosynthetic Clay Liner (GCL) at the Gypsum Management Facility and the CCB Landfill.
- B. The work includes furnishing all equipment and materials, providing all labor, supervision, administration and management necessary to perform the work as specified herein and as shown on the plans.

1.02 RELATED SECTIONS

None.

1.03 REFERENCES

The following references, or cited portions thereof, govern the work

1. Geosynthetic Institute
 - a. GRI-GCL3, Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs).
2. American Society for Testing and Materials (ASTM):
 - a. ASTM D 4632 (1991; R 2003), Standard Test Method for Grab Breaking Load and Elongation of Geotextiles;
 - b. ASTM D 4643 (2000), Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method;
 - c. ASTM D 5084 (2003), Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter;
 - d. ASTM D 5261 (1992; R 2003), Test Method for Measuring Mass Per Unit Area of Geotextiles;
 - e. ASTM D 5321 (2002), Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method;

- f. ASTM D 5887 (2004). Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter;
- g. ASTM D 5888 (1995; R 2002). Practice for Storage and Handling of Geosynthetic Clay Liners;
- h. ASTM D 5889 (1997; R 2003). Practice for Quality Control of Geosynthetic Clay Liners;
- i. ASTM D 5890 (2002). Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners;
- j. ASTM D 5891 (2002). Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners.

1.04 SUBMITTALS

- A. With the bid, the Contractor shall furnish the following information:
 - 1. Conceptual description of the proposed plan for placement of the GCL panels over the areas of installation.
 - 2. GCL Manufacturer's Quality Control (MQC) Plan for documenting compliance with Sections 2.01 and 2.02 of these specifications.
 - 3. GCL manufacturer's historical data for reinforced GCL of a) 10,000-hour creep shear testing per Section 2.01 D. and b) seam flow data at 2 psi confining pressure per Section 2.01 E.
 - 4. A copy of GCL manufacturer's International Standards Organization (ISO) Quality Certificate of Registration.
 - 5. Statement of experience from the proposed GCL supplier.
 - 6. Statement of experience from the proposed GCL installer.
- B. At the Owner Representative's or Owner's request, the Contractor shall furnish:
 - 1. A representative sample of the GCLs.
 - 2. A project reference list for the GCL(s) consisting of the principal details of at least ten projects totaling at least 10 million sq. ft (100,000 sq. meters) in size.
- C. Upon shipment, the Contractor shall furnish:
 - 1. The GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this specification.
 - 2. Inventory of materials received.
- D. As installation proceeds, the Geosynthetics Installer's Representative shall submit certificates of subgrade acceptance, signed by the Contractor and Construction Quality Assurance (CQA) Inspector (see Sections 1.06 and 3.03) for each area that is covered by the GCL.

E. Warranty

After construction, the contractor shall submit material and installation warranty certificates.

1.05 QUALIFICATIONS

- A. GCL Manufacturer must have produced at least 10 million sq. ft. (1 million sq. meters) of GCL, with at least 8 million sq. ft. (800,000 sq. meters) installed.
- B. The GCL Installer must either have installed at least 1 million sq. ft. (100,000 sq. meters) of GCL, or must provide to the Engineer satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the GCL will be installed in a competent, professional manner.

1.06 CONSTRUCTION QUALITY ASSURANCE (CQA)

- A. Construction Quality Assurance of the GCL installation shall be performed as outlined in the project Construction Quality Assurance Plan, included in Appendix 2 of these Specifications.
- B. The GCL Installer shall provide his own CQA inspector. The Owner shall provide a third-party inspector for CQA monitoring of the GCL installation. The inspector shall be an individual or company who is independent from the manufacturer and installer and who shall be responsible for monitoring and documenting activities, related to the CQA of the GCL throughout installation.
- C. Testing of the GCL as necessary to support the CQA effort shall be performed by a third party laboratory retained by the Owner and independent from the GCL manufacturer and installer.

WARRANTY

The geomembrane material shall be warranted, on a pro-rata basis against manufacturer's defects for a period of five (5) years from the date of liner installation. The installation shall be warranted against defects in workmanship for a period of (1) year from the date of liner completion.

PART 2. PRODUCTS

2.01 MATERIALS

- A. The GCL shall be manufactured as a hydraulic barrier consisting of clay bonded between two layers of nonwoven geotextile by needle punching.

- B. The GCL shall be manufactured to conform with the test methods, required properties, and testing frequencies of the GRI-GCL3 specification for Reinforced, Geotextile Related GCL.
- C. In addition to the minimum properties given in Table 1(a) of GRI-GCL3, the GCL shall conform to the following specifications.

Test Method	Minimum Value
Bentonite Mass/Area (ASTM D 5993)	0.75 lb./ft ²
GCL Grab Tensile Strength (ASTM D 4632)	90 lb.
GCL Peel Strength (ASTM D 4632)	15 lb.

- D. The reinforced GCL shall have seam test data from an independent laboratory showing that the seam flow with a grooved cut in one of the nonwoven geotextiles is less than $1 \times 10^{-8} \text{ m}^3/\text{m}^2/\text{s}$ at 2 psi hydraulic pressure.
- E. The minimum acceptable dimensions of full-size GCL panels shall be 150 ft. (45.7 m) in length. Short rolls [(those manufactured to a length greater than 70 ft. (21 meters) but less than a full-length roll)] may be supplied at a rate no greater than three (3) per truckload or three (3) rolls every 36,000 sq. ft. (3,500 sq. meters) of GCL, whichever is less.

2.02 PRODUCT QUALITY DOCUMENTATION

The GCL manufacturer shall provide the Contractor or other designated party with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the GCL manufacturer and shall include:

- A. The Manufacturer's Certification that the material was manufactured and tested in accordance with GRI-GCL3 specifications, together with a report of the test results, shall be furnished at the time of shipment.
- B. The manufacturers recommended seaming method with seam test data from an independent laboratory showing that the seam flow is less than $1 \times 10^{-8} \text{ m}^3/\text{m}^2/\text{s}$ at 2 psi hydraulic pressure.
- C. GCL lot and roll numbers supplied for the project (with corresponding shipping information).

2.03 PRODUCT LABELING

- A. Prior to shipment, the GCL manufacturer shall label each roll, identifying:
 - I. Product identification information (Manufacturer's name and address, brand product code).

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

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2.04 PACKAGING

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

2.05 ACCESSORY BENTONITE

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

PART 3. EXECUTION

3.01 SHIPPING AND HANDLING

- A. The rolls of GCL shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading.
- B. The Installation Supervisor shall be present during delivery and unloading of the GCL. 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. The Installation Supervisor shall prepare and submit an inventory that includes lot and roll number for materials received.
- C. The Installer is responsible for unloading the GCL. The Installer should contact the Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

3.02 STORAGE

- A. Storage of the GCL rolls and accessory bentonite shall be the responsibility of the Installer.
- B. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

- C. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.
- D. The integrity and legibility of the labels shall be preserved during storage.

3.03 EARTHWORK

- A. The compacted clay liner upon which the GCL is installed shall be prepared and compacted prior to installation. The surface shall be smooth, firm, and unyielding, and free of:
 - 1. Vegetation.
 - 2. Construction debris.
 - 3. Sticks.
 - 4. Sharp rocks.
 - 5. Void spaces.
 - 6. Ice.
 - 7. Abrupt elevation changes.
 - 8. Standing water.
 - 9. Cracks larger than 0.25 in. (6 mm) in width.
 - 10. Any other foreign matter that could contact the GCL.
- B. Immediately prior to GCL deployment, the compacted clay liner shall be final-graded by the contractor 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 0.5 in. (12 mm) from the surface shall either be removed, crushed or pushed into the surface with a smooth-drum compactor.
- C. Prior to daily GCL placement, the installer shall provide to the CQA Officer daily "certificates of acceptance" which document the Installer's inspection and acceptance of the underlying surface as being suitable for GCL installation.
- D. It shall be the Installer's responsibility thereafter to indicate to the Owner's Representative any change in the condition of the compacted clay liner that could cause the subgrade to be out of compliance with any of the requirements listed in this Section. The Installation Supervisor shall certify in the daily report that no GCL was placed over visibly defective low permeability soil surface.
- E. At the top of sloped areas of the job site, an anchor trench for the GCL shall be excavated by the contractor in accordance with the project plans. The trench shall be excavated and approved by the CQA Inspector 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.

3.04 GCL PLACEMENT

- A. GCL rolls shall be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging shall be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) shall be in accordance with the Owner Representative's recommendations.
- B. Equipment which could damage the GCL, shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.
- C. Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.
- D. The GCL panels shall be placed parallel to the direction of the slope.
- E. All GCL panels shall lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels.
- F. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, the Installer shall remove and replace the hydrated material as directed by the Owner Representative.

3.05 ANCHORAGE

- A. 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. The front edge of the trench shall be rounded so as to eliminate any sharp corners. Loose soil shall be removed from the floor of the trench. The GCL shall cover the entire trench floor, but shall not extend up the rear trench wall.

3.06 SEAMING

- A. The GCL seams shall be constructed by overlapping their adjacent edges according to the manufacturer's recommendations. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris.
- B. End-of-roll overlapped seams shall be constructed with a minimum overlap of 24 in. (600 mm). 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. End-of-roll overlapped seams for all reinforced GCL seams require bentonite-enhanced seams as described below.

- C. Bentonite-enhanced seams shall be constructed between the overlapping adjacent panels as follows. 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 6-inch (150 mm) line. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal ft. (0.4 kg/m). A similar bead of granular sodium bentonite is applied at the end-of-roll overlap.

3.07 DETAIL WORK

- A. There shall be no penetrations through the GCL.
- B. Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process.

3.08 DAMAGE REPAIR

- A. If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible, if approved by the Owner's Representative, 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 in. (300 mm) is achieved around all of the damaged area. Granular bentonite or bentonite mastic shall 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. Patching shall be certified by the Installer's CQA Inspector and observed by the Owner's Representative.

PART 4. GRI-GCL3 SPECIFICATIONS

Geosynthetics Research Institute (GRI) GRI-GCL3, "Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs).", Dated -- May 16, 2005.

END OF SECTION 02376

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Original - May 16, 2005

GRI-GCL3*

Standard Specification for

"Test Methods, Required Properties, and Testing Frequencies of
Geosynthetic Clay Liners (GCLs)"

This specification was developed by the Geosynthetic Research Institute (GRI), with the cooperation of the member organizations for general use by the public. It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part. Neither GRI, the Geosynthetic Institute, nor any of its related institutes, warrant or indemnifies any materials produced according to this specification either at this time or in the future.

1. Scope

- 1.1 This specification covers the manufacturing quality control (MQC) of geosynthetic clay liners (GCLs), describing types of tests, the proper test methods, minimum and sometimes maximum values, and the minimum testing frequencies.

Note 1: Geosynthetic Clay Liners (GCLs) are also called Clay Geosynthetic Barriers (GBR-Cs).

- 1.2 There are two general categories of GCLs covered in this specification: reinforced and nonreinforced. Within each category there are geotextile, polymer coated geotextiles, and geomembrane/geofilm related types.
- 1.3 This specification is intended to aid manufacturers, suppliers, purchasers and users of GCLs in establishing an acceptable level of effort for manufacturing quality control.

*This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective version.

- 1.4 This specification does not address manufacturing quality assurance (MQA), product acceptance testing, or conformance testing. These are independent activities taken by organizations other than the GCL manufacturer.
- 1.5 The values stated in SI (metric) units are to be regarded as the standard. The U.S. (English) units are calculated values using a "soft" conversion accuracy.
- 1.6 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards

- D 638 Test Method for Tensile Properties of Plastics
- D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D 882 Test Method for Tensile Properties of Thin Plastic Sheeting
- D 1141 Practice for Preparation of Substitute Ocean Water
- D 1505 Test Method for Density of Plastics by the Density-Gradient Method
- D 4354 Practice for Sampling of Geosynthetics for Testing
- D 4439 Terminology for Geosynthetics
- D 4632 Test Method for Grab Breaking Load and Elongation of Geotextiles
- D 4759 Practice for Determining the Specification Conformance of Geosynthetics
- D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
- D 5261 Test Method for Measuring Mass per Unit Area of Geotextiles
- D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes
- D 5887 Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using Flexible Wall Permeameter
- D 5888 Practice for Storage and Handling of Geosynthetic Clay Liners
- D 5889 Practice for Quality Control of Geosynthetic Clay Liners
- D 5890 Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
- D 5891 Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
- D 5993 Test Method for Measuring the Mass Per Unit Area of Geosynthetic Clay Liners
- D 5994 Test Method for Measuring the Core Thickness of Textured Geomembrane
- D 6102 Guide for Installation of Geosynthetic Clay Liners
- D 6141 Guide for Screening the Clay Portion of a GCL for Chemical Compatibility to Liquids

- D 6243 Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method
- D 6495 Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners
- D 6496 Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners
- D 6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- D 6766 Test Method for Evaluation of Hydraulic Properties of Geosynthetic Clay Liners Permeated with Potentially Incompatible Liquids
- D 6768 Test Method for Tensile Strength of Geosynthetic Clay Liners

2.2 GRI Standards

- GM13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
- GM17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes
- GM18 Test Properties, Testing Frequency and Recommended Warranty for Flexible Polypropylene (FPP and FPP-R) Nonreinforced and Reinforced Geomembranes (Presently suspended as of May 3, 2004)

2.3 Government Document:

U.S. Environmental Protection Agency Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities," EPA/600/R-93/182. September 1993. 305 pgs.

3. Terminology

3.1 Definition

3.1.1 Geosynthetic Definitions:

- 3.1.1.1 geotextile, n a permeability geosynthetic comprised solely of textiles. (ASTM D 4439)
- 3.1.1.2 geomembrane, n—an essentially impermeable geosynthetic barrier composed of one or more synthetic sheets. (ASTM D 4439)
- 3.1.1.3 geofilm, n—a thin polymeric film which is essentially impermeable having a thickness no greater than 0.25 mm (10 mils).
- 3.1.1.4 geotextile-polymer, n -a geotextile which has been coated with, or impregnated by, a polymer such as polypropylene

3.1.1.5 geosynthetic clay liner, n—a manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetic materials. (ASTM D 4439)

Note 1: Geotextile Related GCL is one in which two geotextiles are used respectively as cap and carrier to the bentonite. Cap and carrier designations in this standard refer to respective orientations during manufacturing. This may or may not be the as-placed orientation in the field. It can be internally reinforced by needle punching or stitching, or be nonreinforced.

Geotextile Polymer Coated GCL is one in which two geotextiles are used respectively as cap and carrier to the encased bentonite, however, one of the geotextiles has been polymer coated in a manner that the permeability and flux are decreased. Cap and carrier designations refer to the as manufactured product and not necessarily to the as-placed orientation. It can be internally reinforced by needle punching or stitching, or be nonreinforced.

Geomembrane/Geofilm Related GCL is one in which a geomembrane or geofilm is included in the cross section either above or below the cap geotextile. It can be internally reinforced by needle punching or be nonreinforced. Also in the nonreinforced category is bentonite adhesively bonded to a geomembrane.

3.1.2 Material Definitions

3.1.2.1 bentonite—a distinct type of fine-grained clay soil typically containing not less than 80% montmorillonite clay, usually characterized by high swelling upon wetting.

3.1.2.2 Formulation, n - The mixture of a unique combination of ingredients identified by type, properties and quantity. For geosynthetic materials, a formulation refers to the exact percentages of resin, additives, carbon black and/or other additives. It does not necessarily refer to individual suppliers of each ingredient. The individual suppliers must meet the manufacturer's internal quality control specification.

3.1.3 Organizational Definitions:

3.1.3.1 installer, n—the party who installs, or facilitates installation of, any materials purchased from manufacturers or suppliers.

3.1.3.2 manufacturer, n—the group, corporation, partnership, or individual that manufactures a product.

3.1.3.3 purchaser, n—the person, company, or organization that purchases any materials or work to be performed.

3.1.3.4 supplier, n the party who supplies material or services.

3.1.4 Quality Definitions:

- 3.1.4.1 Manufacturing Quality Control (MQC) - A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications. ref. EPA/600/R-93/182
- 3.1.4.2 Manufacturing Quality Assurance (MQA) - A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections, verifications, audits and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project. ref. EPA/600/R-93/182
- 3.1.4.3 Construction Quality Control (CQC) - A planned system of inspections that are used to directly monitor and control the quality of a construction project. Construction quality control is normally performed by the geosynthetics manufacturer or installer, or for natural soil materials by the earthwork contractor, and is necessary to achieve quality in the constructed or installed system. Construction quality control (CQC) refers to measures taken by the installer or contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project. ref. EPA/600/R-93/182
- 3.1.4.4 Construction Quality Assurance (CQA) - A planned system of activities that provide assurance that the facility was constructed as specified in the design. Construction quality assurance includes inspections, verification, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance (CQA) refers to measures taken by the CQA organization to assess if the installer or contractor is in compliance with the plans and specifications for a project. ref. EPA.600/R-93/182

4. Significance and Use

- 4.1 GCLs must be properly manufactured in a manner consistent with a minimum level of quality control as determined by in-house testing of the final product. This specification presents the types of tests, standard methods of the testing, required (usually minimum) test values, and minimum testing frequencies which should be embodied in the manufacturer's quality control documents. The quoted tests, test methods and test values in Table I must appear in the MQC plan and the MQC report.
- 4.2 It should be clearly recognized that manufacturers may perform additional tests or at greater frequency than required in this specification, or both. In this case, the manufacturer's quality control plan will then take precedence over this specification.
- 4.3 It should also be recognized that purchasers and installers of GCLs may require additional tests or at a great frequency than called for in this specification, or both. The organization(s) producing such project specific specification or quality assurance plan should recognize that such requirements are beyond the current state-of-the-practice. If such a request is made by purchasers or installers, they should clearly communicate the requirements to the manufacturer or supplier during the contract decisions in order that disputes do not arise at a subsequent time.

5. Procedure

- 5.1 The procedures embodied in this specification are contained in the respective test methods given in Table I.
 - 5.1.1 The minimum recommended quality control tests for the manufacture of GCLs are given in Table I. Specific tests are performed on the bentonite, the geosynthetic component materials, and the finished GCL. Table I(a) is in S.I. (Metric) units and Table I(b) is in U.S. (English) units.

Note 2: The conversion from S.I. units into U.S. units is soft.
 - 5.1.2 The individual properties in Table I are minimum values; except fluid loss, moisture content, and permeability (or flux). They are maximum values. The manner of taking specimens is described in the appropriate test method. When an average value is indicated, it is listed in the table as "min. ave.", or "max. ave.".
- 5.2 Bentonite (as received)
Two tests are required; swell index and fluid loss. The latter is a maximum value. These tests should be performed on the bentonite prior to fabrication into a GCL.

or on bentonite taken from the manufactured product if the bentonite is modified in any way during manufacturing, e.g., if an adhesive is added.

5.3 Geotextile (as received)

Mass per unit area is required on the as-manufactured cap and carrier fabrics, with different values depending on the fabric being nonwoven or woven.

Note 3: These tests are to be performed on the geotextiles before manufacturing into the final GCL. Removal of the geotextiles from the manufactured product and subsequent testing will give erroneous values and is not an acceptable practice. The exception is polymer coated GCLs where the geotextile must be removed to determine its mass per unit area.

5.4 Geomembrane/Geofilm (as received)

The following tests are required; thickness, density, and tensile strength at break. All are minimum required values. Tensile strength at break is the lowest of machine direction and cross machine direction.

Note 4: These tests are to be performed on the geomembrane or geofilm before manufacturing into the final GCL. Removal of the geomembrane or geofilm from the manufactured product and subsequent testing will give erroneous values and is not an accepted practice.

5.5 GCL (as manufactured)

Six tests are required on the as-manufactured GCL, with one having an alternative, i.e., hydraulic conductivity or flux. All are minimum values, with the exception of moisture content and hydraulic conductivity or flux.

5.6 GCL (long-term)

The purpose of these long-term or endurance tests is to provide confidence in the continuing acceptable performance of the bentonite and geosynthetic components of the installed GCL.

5.6.1 The durability of the bentonite is evaluated using a permeant consisting of 0.1 M calcium chloride solution. See ASTM D 6141 which is a guide for this particular aspect of the specification. The GCL is to be hydrated with distilled dionized water prior to conducting the tests with the calcium chloride solution. In this regard, ASTM D6766 Scenario I and Method C is the procedure to be used. Furthermore, this test is conducted twice at two different normal pressures, i.e., 35 and 500 kPa. The maximum allowable values are listed in Table 1.

5.6.2 The geotextiles in their as-received condition are evaluated by incubation in a forced air oven per ASTM D5721 set at 60°C for 50 days. The

minimum percent in tensile strength retained at break, as measured by ASTM D6768, is 65%. If individual yarns are used in reinforcing GCLs, they must also meet this same endurance criterion.

5.6.3 The geomembrane in its as-received condition is evaluated for durability via the appropriate GRI Specification. For high density polyethylene (HDPE), the specification is GRI GM13. For linear low density polyethylene (LLDPE), the specification is GRI GM17. For flexible polypropylene (fPP), the specification is GRI GM18.

5.6.4 The geofilm in its as-received condition is evaluated by incubation in a forced air oven per ASTM D5721 set at 60°C for 50 days. The minimum percent tensile strength retained at break for either MD or XMD, as measured by ASTM D882, is reported accordingly and must meet or exceed the specification value.

Note 5: It should be recognized that the above durability criterion for geofilms is not as stringent as the criteria for geomembranes stated in Section 5.6.3.

6. Workmanship and Appearance

6.1 Waterproof ink overlap lines should be printed on both edges of one of the surfaces (geotextile or geomembrane) of the manufactured GCL.

Note 6: The overlap lines are minimally 150 mm (6.0 in.) from the edges of the GCL. Other design-related situations may require greater overlap distances to be printed on the GCLs, e.g., when not backfilled in a timely manner.

6.2 Needle punched and stitch bonded GCLs shall be essentially free of broken needles and fragments of needles that would negatively effect the performance of the final product. There must be continuous needle detection and removal devices, e.g., metal detectors and magnets, used during manufacture of GCL products.

6.3 The manufactured GCL shall have good appearance qualities. It shall be free from such defects that would affect the specified properties and integrity of the product.

6.4 General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents. ASTM D5888 and D5889 should be followed in this regard.

7. MQC Sampling

- 7.1 Sampling shall be in accordance with the specific test methods listed in Table 1. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire roll width, see ASTM D 4354.
- 7.2 The number of tests shall be in accordance with the appropriate test methods listed in Table 1.
- 7.3 The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are the minimum average values and are designated as "min. ave.". When the property is a maximum value, the designation is "max. ave.".

8. MQC Retest and Rejection

- 8.1 If the results of any test do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

9. Packaging and Marking

- 9.1 The GCL shall be rolled, clearly labeled, and onto a substantial core, encased in a waterproof wrapper. Packaging must be adequate for safe transportation to the point of delivery.
- 9.2 The label should include manufacturer, style, lot and/or roll number, weight, length and width.

10. Conformance and Certification

- 10.1 Conformance of the manufactured GCL to this specification, or agreed-upon variation thereof, shall be performed by the MQA organization or designated by the purchaser/owner. ASTM D 4759 can be used as a general guide, but individual test methods must be clearly stipulated and communicated to the parties involved.
- 10.2 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

Table 1(a) – Specification for Geosynthetic Clay Liners (GCLs)

Property	ASTM Test Method	Reinforced GCL		Non-Reinforced GCL		Testing Frequency
		GT-Related	GT Polymer Coated	GT-Related	GT Polymer Coated	
Clay (as received)						
swell index (ml/2g)	D5890	24	24	24	24	50 tonnes
fluid loss (ml/h)	D5891	18	18	18	18	50 tonnes
Geotextiles (as received)						
cap fabric (nonwoven) - mass/unit area (g/m ²) ⁽²⁾	D5261	200	200	70	100	20,000 m ²
cap fabric (woven) - mass/unit area (g/m ²)	D5261	100	100	-	-	20,000 m ²
carrier fabric (nonwoven composite) - mass (g/m ²) ⁽²⁾	D5261	240	240	90	100	20,000 m ²
carrier fabric (woven) - mass/unit area (g/m ²)	D5261	100	100	-	-	20,000 m ²
coating - mass/unit area (g/m ²) ⁽³⁾	D5261	n/a	100	n/a	100	4,000 m ²
Geomembrane/Geofilm (as received)						
thickness ⁽⁴⁾ (mm)	D5199/D5994	n/a	n/a	0.40/0.50/0.10	n/a	0.40/0.75/0.10
density (g/cc)	D1505/D792	n/a	n/a	0.92	n/a	0.92
break tensile strength, MD&XMD (kN/m)	D6693	n/a	n/a	n/a	n/a	6.0
break tensile strength, MD (kN/m)	D882	n/a	n/a	n/a	n/a	2.5
GCL (as manufactured)						
mass of GCL (g/m ²) ⁽⁵⁾	D5993	4000	4050	4000	4050	4,000 m ²
mass of bentonite (g/m ²) ⁽⁶⁾	D5993	3700	3700	3700	3700	4,000 m ²
moisture content ⁽⁷⁾ (%)	D5993	(4)	(4)	(4)	(4)	(4)
tensile str., MB) (kN/m)	D6768	4.0	4.0	4.0	4.0	20,000 m ²
peel strength (N/m)	D6496	360	360	n/a	n/a	4,000 m ²
permeability ⁽⁸⁾ (m/sec), "or"	D5887	5 x 10 ⁻¹¹	5 x 10 ⁻¹²	5 x 10 ⁻¹¹	5 x 10 ⁻¹²	25,000 m ²
flux ⁽⁹⁾ (m ³ /sec-m ²)	D5887	1 x 10 ⁻⁸	1 x 10 ⁻⁹	1 x 10 ⁻⁸	1 x 10 ⁻⁹	25,000 m ²
GCL permeability ⁽¹⁰⁾ (m/sec) (max. at 35 kPa)	D6766	1 x 10 ⁻⁸	1 x 10 ⁻⁹	1 x 10 ⁻⁸	1 x 10 ⁻⁹	yearly
GCL permeability ⁽¹⁰⁾ (m/sec) (max. at 500 kPa)	D6766 mod.	5 x 10 ⁻¹⁰	5 x 10 ⁻¹¹	5 x 10 ⁻¹⁰	5 x 10 ⁻¹¹	yearly
Component Durability:						
geotextile and reinforcing yarns ⁽⁸⁾ (% strength retained)	See § 5.6.2	65	65	65	65	yearly
geomembrane	See § 5.6.3	n/a	n/a	n/a	n/a	yearly
geofilm/polymer treated ⁽⁸⁾ (% strength retained)	See § 5.6.4	n/a	85	n/a	85	yearly

n/a = not applicable with respect to this property

- These values are maximum (all others are minimum)
- For both cap and carrier fabrics for nonwoven reinforced GCLs, one, or the other, must contain a scrim component of mass ≥ 100 g/m² for dimensional stability
- Calculated value obtained from difference of coated fabric to as-received fabric
- Value is both site-specific and product-specific and is currently being evaluated
- First value is for smooth geomembrane; second for textured geomembrane; third for geofilm
- Mass of the GCL and bentonite is measured after oven drying per the stated test method
- Value represents GCL permeability after permeation with a 0.1 M calcium chloride solution (11.1 g CaCl₂ in 1-liter water)
- Value represents the minimum percent strength retained from the as-manufactured value after oven aging at 60°C for 50 days
- Durability criteria should follow the appropriate specification for the geomembrane type used, i.e. GRI GM-13 for HDPE, GRI GM-17 for LLDPE or GRI GM-18 for FFP

Table 1(b) – Specification for Geosynthetic Clay Liners (GCLs)

Property	ASTM Test Method	Reinforced GCL		Non-Reinforced GCL		Testing Frequency
		G.T. Related	G.T. Polymer Coated	GM-GF Related	G.T. Polymer Coated	
Clay (as received)						
swell index (ml/2g)	D5890	24	24	24	24	50 tonnes
fluid loss (ml) ⁽¹⁾	D5891	18	18	18	18	50 tonnes
Geotextiles (as received)						
cap fabric (nonwoven) - mass/unit area (oz/yd ²) ⁽²⁾	D5261	5.8	5.8	5.8	2.9	n/a/2.1
cap fabric (woven) - mass/unit area (oz/yd ²)	D5261	3.0	3.0	3.0	-	-
carrier fabric (nonwoven composite) - mass/(oz/yd ²) ⁽²⁾	D5261	5.9	5.9	5.9	2.9	n/a/2.7
carrier fabric (woven) - mass/unit area (oz/yd ²)	D5261	3.0	3.0	3.0	-	-
coating - mass/unit area (oz/yd ²) ⁽³⁾	D5261	n/a	2.9	n/a	2.9	n/a
Geomembrane/film (as received)						
thickness ⁽⁴⁾ (mils)	D5199/D5994	n/a	n/a	15/20/4	n/a	15/30/4
density (g/cc)	D1505/D792	n/a	n/a	0.92	n/a	0.92
break tensile strength, MD&XMD (lb/in.)	D6693	n/a	n/a	n/a	n/a	34
break tensile strength, MD & XMD (lb/in.) (GCL - as manufactured)	D882	n/a	n/a	14	n/a	14
mass of GCL (lb-ft ²) ⁽⁵⁾	D5993	0.82	0.83	0.84	0.83	0.84
mass of bentonite (lb-ft ²) ⁽⁶⁾	D5993	0.75	0.75	0.75	0.75	0.75
moisture content ⁽⁷⁾ (%)	D5993	(4)	(4)	(4)	(4)	(4)
tensile str., MD (lb/in.)	D6768	23	23	23	23	25
peel strength (lb/in.)	D6496	2.1	2.1	2.1	n/a	n/a
permeability ⁽⁸⁾ (cm ³ /sec-cm ³) "or"	D5887	5 x 10 ⁻⁹	5 x 10 ⁻¹⁰	n/a	5 x 10 ⁻⁹	n/a
flux ⁽⁹⁾ (cm ³ /sec-cm ³)	D5887	1 x 10 ⁻⁹	1 x 10 ⁻⁷	n/a	1 x 10 ⁻⁶	n/a
GCL permeability ⁽¹⁰⁾⁽¹¹⁾ (cm ³ /sec) (max. at 5 lb/in. ²)	D6766	1 x 10 ⁻⁶	1 x 10 ⁻⁶	1 x 10 ⁻⁷	1 x 10 ⁻⁷	1 x 10 ⁻⁶
GCL permeability ⁽¹⁰⁾⁽¹¹⁾ (cm ³ /sec) (max. at 70 lb/in. ²)	D6766 mod.	5 x 10 ⁻⁶	5 x 10 ⁻⁶	5 x 10 ⁻⁹	5 x 10 ⁻⁹	5 x 10 ⁻⁶
Component Durability						
geotextile and reinforcing yarns ⁽⁸⁾ (% strength retained)	See § 5.6.2	65	65	n/a	65	n/a
geomembrane	See § 5.6.3	n/a	n/a	GM Spec ⁽¹¹⁾	n/a	GM Spec ⁽¹¹⁾
geofilm/polymer treated ⁽⁸⁾ (% strength retained)	See § 5.6.4	n/a	85	80	85	80

n/a = not applicable with respect to this property ;

- (1) These values are maximum (all others are minimum)
- (2) For both cap and carrier fabrics for nonwoven reinforced GCLs; one, or the other, must contain a serum component of mass > 2.9 mg/d² for dimensional stability
- (3) Calculated value obtained from difference of coated fabric to as-received fabric
- (4) Value is both site-specific and product-specific and is currently being evaluated
- (5) First value is for smooth geomembrane; second for textured geomembrane; third for geofilm
- (6) Mass of the GCL and bentonite is measured after oven drying per the stated test method
- (7) Value represents GCL permeability after permeation with a 0.1 M calcium chloride solution (11.1 g CaCl₂ in 1-liter water)
- (8) Value represents the minimum percent strength retained from the as-manufactured value after oven aging at 60°C for 50 days
- (9) Durability criteria should follow the appropriate specification for the geomembrane used; i.e., GRI GM-13 for HDPE, GRI GM-17 for LLDPE or GRI GM-18 for PP

DIVISION 2 - SITE WORK
Section 02640 – HDPE Piping
ADDENDUM #2

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to construction of the HDPE (High Density Polyethylene) Piping for the Leachate Collection System, Process Water Recovery System, ~~the Slurry Piping and Valves~~, and Recycle Pond Decant System at the Gypsum Management Facility and the Leachate Collection System for the CCB Landfill.

1.02 RELATED SECTIONS

None.

1.03 REFERENCES

The following references, or cited portions thereof, govern the work

A. American Society of Testing and Materials:

1. ASTM D 2683 (2004); Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
2. ASTM D 3261 (2003); Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
3. ASTM D 3350 (2005); Specification for Polyethylene Plastics Pipe and Fittings Materials.
4. ASTM F 412 (2001a); Terminology Relating to Plastic Piping System.
5. ASTM F 1055 (1998); Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
6. ASTM F 1056 (2004); Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings.
7. ASTM F714-06a Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
8. ASTM F2164-02 Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure

1.04 SUBMITTALS

A. Qualifications

Submit qualifications of the Welding Supervisor who will be responsible for construction quality control of the pipe joining process.

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B. Material Certifications

Submit manufacturer certifications that the pipe provided complies with the requirements herein.

C. Product Data

1. Submit product data and operating instructions for pipe joining equipment.
2. Submit pipe manufacturer's recommended procedures for storing, handling, and installing pipe and fittings.

1.05 QUALIFICATIONS

- A. The Contractor or Subcontractor performing the work under this section shall have in his employ a Welding Supervisor who has completed a minimum of 10,000 ft of pipe joining work using the type of equipment proposed for use in this work. The Welding Supervisor shall be on site at all times during pipe line installation, and shall provide direct supervision over other employees.

1.06 WARRANTY

- A. The pipe and fittings shall be warranted, on a pro-rata basis, against manufacturer's defects for a period of five (5) years from the date of pipe installation. The installation shall be warranted against defects in workmanship for a period of one (1) year from the date of completion.

PART 2. PRODUCTS

2.01 MATERIALS

A. Leachate and Process Water Collection Piping

1. Pipe material shall be High Density Polyethylene (HDPE) PE 3408, according to ASTM F412, with minimum cell classification values of 345464C, according to ASTM D3350. Iron pipe size (IPS) and standard dimension ratio (SDR) shall be as indicated in the plans.
2. Size and spacing of holes in perforated pipe shall be as indicated in the plans.

~~B. Slurry Sluice Piping~~

~~Pipe for HDPE Sluice Liner shall be manufactured from a PE 3408 resin. The resin material shall meet the specifications of ASTM D3350 02 with a minimum cell~~

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~~classification of PE345464C. Pipe O.D. sizes 4" to 54" shall be available in steel pipe sizes (IPS). Pipe shall have a manufacturing standard of ASTM D3035 and be manufactured by an ISO 9001 certified manufacturer. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.~~

~~Pipe shall be manufactured from a pipe resin which meets ASTM D 3350-05 with a minimum cell classification of 445474C. Pipe shall be manufactured to the dimensions of ASTM F-714. The service factor to determine the pressure rating shall be 0.63. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.~~

C. Fittings (Leachate and Process Water Collection Piping)

1. Fittings shall be made of the same material and size as the HDPE piping, and shall have a pressure rating no less than 160 psi.
2. **Butt Fusion Fittings**

Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings are to be manufactured using a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records.

3. **Electrofusion Fittings** - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99. Electrofusion Fittings shall have a manufacturing standard of ASTM F-1055. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans.
4. **Flanged and Mechanical Joint Adapters** - Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D-3350. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D-3261. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Flanged and Mechanical Joint Adapters are to be used for Sluice Piping only.

~~D. Valves and Valve Piping for Sluice Slurry Piping~~

~~Valves used for Sluice Piping shall be ITT Fabri Valve XS150-ULV-Urethane~~

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Lined Knife Gate Valves. Valve Material: Yet to Be Determined

~~Valves used for the Slurry Piping System shall be Clarkson KGF Knife Gate Valve with ductile iron housing high tear strength gum rubber sleeves, C276 gate rated at 300 psig, with manual handwheel actuation.~~

~~Fittings and piping at valve stations shall be SILVER STREAK model fiberglass reinforced plastic (FRP) as manufactured by Fiber Glass Systems. Flanges shall have ANSI B16.5 Class 150 bolt hole patterns. Flanged connections to valves shall have ANSI B16.5 Class 300 bolt hole patterns. ASTM A307, Grade B, hex head bolts shall be supplied. Washers shall be supplied on all nuts and bolts. Gaskets shall be 1/8" thick, 60-70 durometer full-face type suitable for the service shown on the drawings and as recommended in the manufacturer's standard installation procedures. Pipe shall be installed as specified and indicated on the drawings.~~

E. Fittings for HDPE Slurry Piping

1. ~~Butt Fusion Fittings - Fittings Pipe shall be manufactured from a pipe resin which meets ASTM D 3350-05 with a minimum cell classification of 445474C. Pipe shall be manufactured to the dimensions of ASTM F-714. The service factor to determine the pressure rating shall be 0.63. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.~~
2. ~~Molded Butt Fusion Fittings shall have a manufacturing standard of ASTM D-3261. Molded & fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings must have the same pressure rating as the pipe; a DR less than the pipe shall be used. Fabricated fittings are to be manufactured using a Data Logger to record temperature, fusion pressure, and a graphic representation of the fusion cycle shall be part of the Quality Control records.~~
3. ~~Electrofusion Fittings - Fittings shall be made from resin or pipe meeting ASTM D 3350-05 with a minimum cell classification of 445474C; Electrofusion Fittings shall meet the manufacturing standard of ASTM F-1055. Fittings shall have the same pressure rating as the pipe or higher unless otherwise specified on the plans.~~
4. ~~Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be made from materials containing resin that meets ASTM D 3350-05 with a minimum cell classification of 445474C.~~

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2.02 EQUIPMENT

- A. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All field welds shall be made with fusion equipment equipped with a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records.
- B. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.
- C. Mechanical joining will be used where the butt fusion method can not be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a Ductile Iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring.
- D. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

PART 3. EXECUTION

3.01 MATERIAL DELIVERY, STORAGE, AND HANDLING

- A. HDPE pipe and fittings shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading. The Owner will provide an on-site storage site. Storage site requirements (size and preferred location) shall be submitted with the bid documents.
- B. Storage and handling shall be according to manufacturer's recommendations.

3.02 BASE PREPARATION

HDPE Piping for leachate and process water collection shall be installed on a layer of coarse aggregate placed by the Contractor in accordance with the plans. The grade of the coarse aggregate base shall be verified before installing the piping.

3.03 TRENCH INSTALLATION

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Excavation, Foundation, Bedding and Haunching for the underground installation of HDPE Sluice Piping shall be in accordance with Section 20-2.20 of the "Standard Specifications for Water and Sewer Main Construction in Illinois". The trench shall be backfilled with excavated material to the top of trench surface. Excavations in areas of Structural Fill shall be backfill with and compacted to the specifications of Section 02200-Earthwork for Structural Fill. All other areas shall be backfilled to 92% of the dry density, as determined by the Standard Proctor Test ASTM D698.

3.03 INSTALLATION

All pipe and fittings shall be installed according to the manufacturer's recommendations. Removal of weld beads is not required. Contractor shall place coarse aggregate along the pipe to provide lateral stability. Welds shall not be obscured until they have been approved by the Owner's Representative, the top of pipe shall not be covered until the Construction Quality Assurance (CQA) survey has been completed to verify conformance with specified tolerances.

3.04 INSPECTIONS

- A. The Owner's Representative shall visually inspect pipe materials to verify that each pipe material is properly stamped (by the manufacturer) for ASTM acceptance before installation. Defective or damaged materials shall be removed from the site.
- B. Each weld and connection shall be visually inspected by the Owner's Representative. Defective welds shall be repaired as directed by the Owner's Representative and according to manufacturer's recommendations. Welds and connections shall not be covered until they have been approved by the Owner's Representative.

3.05 TOLERANCES

- A. HDPE piping shall be located within 0.5 ft. of plan location, and elevation shall be within 0.1 ft. of plan elevation with no adverse slopes.

~~3.06 TESTING~~

- ~~A. All Slurry Piping shall be Hydrostatic Tested in accordance with ASTM F 2164, using a Design Pressure of 270 PSIG.~~

END OF SECTION 02936

DIVISION 2 - SITEWORK
Section 02700-Storm Drainage
ADDENDUM #1

PART 1. GENERAL

1.01 DESCRIPTION

- A. This section includes installing pipe culverts and end sections for pipe culverts.
- B. Storm Drainage installation shall include incidental related work such as topsoil removal, trench excavation, backfill, compaction, tie-in of existing system, etc.,

1.02 RELATED SECTIONS

- A. The following sections contain items which are related to the work in this section:
 - 1. 02200 - Earthwork

1.03 REFERENCES

- A. The following reference, or cited portions thereof, governs the work:
 - 1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007. Payment provisions shall not apply.

PART 2. PRODUCTS

2.01 PIPE CULVERTS

- A. HDPE Pipe Culverts shall be installed in accordance with Article 542 of the Standard Specifications. All piping shall be Corrugated PE (Polyethylene) with a Smooth Interior, in accordance with AASHTO M 294, Type S.

2.02 METAL END SECTIONS

- A. Metal End Sections shall be either aluminum or steel in accordance with Article 542.07(c) of the Standard Specifications.

2.03 REINFORCED CONCRETE CULVERT PIPE

- A. Reinforced Concrete Culvert Pipe shall be furnished in accordance with Article 1042.06(a) of the Standard Specifications.

2.03 PRECAST REINFORCED CONCRETE FLARED END SECTIONS

- A. Precast Reinforced Concrete Flared End Sections shall be furnished in accordance with Article 1042.07(a) of the Standard Specifications.**

PART 3. EXECUTION

3.01 STORM DRAINAGE PIPING INSTALLATION

- A. Construct pipe culverts in accordance with the Article 542 of the Standard Specifications. Bedding and Haunching shall be IDOT CA-6 Gradation. Trench excavations are to be backfilled with on-site clayey materials instead of sand. Compact backfill to 95 percent of the maximum dry density as determined by the Standard Proctor test – ASTM D-698.

3.02 ~~METAL~~ END SECTION INSTALLATION

- A. End Treatments shall be installed according to Article 542.07 of the Standard Specifications.

END OF SECTION 02700

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PART 1. GENERAL

1.01 DESCRIPTION

- A. This section includes manufacturing, furnishing, and installing High Density Polyethylene (HDPE) Geomembranes for the Gypsum Management Facility and the CCB Landfill.
- B. The work includes furnishing all equipment and materials and providing all labor, supervision, administration and management necessary to perform the work as shown on the plans.

1.02 RELATED SECTIONS

- A. The following sections contain items which are related to the work in this section:
 - 1. 02373 – Geotextiles
 - 2. 02376 – Geosynthetic Clay Liner

1.03 REFERENCES

- A. The following references, or cited portions thereof, govern the work:
 - 1. American Society for Testing and Materials (ASTM):
 - a. D 638, Standard Test Method for Tensile Properties of Plastics.
 - b. D 751, Standard Test Methods for Coated Fabrics.
 - c. D 792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
 - d. D 1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
 - e. D 1204, Standard Test Method for Linear Dimensional Changes of Non Rigid Thermoplastic Sheeting or Film at Elevated Temperature.
 - f. D 1238, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
 - g. D 1505, Standard Test Method for Density of Plastics by Density-Gradient Technique.
 - h. D 1603, Standard Test Method for Carbon Black in Olefin Plastics.
 - i. D 3895, Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.

- j. D 4218, Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
- k. D 4437, Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
- l. D 4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
- m. D 5199, Standard Test Method for Measuring Nominal Thickness of Smooth Geomembranes.
- n. D 5397, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefins using Notched Constant Tensile Load Test.
- o. D 5596, Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.
- p. D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
- q. D 5721, Practice for Air-Oven Aging of Polyolefin Geomembranes.
- r. D 5820, Test Method for Air Testing.
- s. D 5885, Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.
- t. D 5994, Standard Test Method for Measuring Nominal Thickness of Textured Geomembranes
- u. D 6365, Standard Practice for the Nondestructive Testing of Geomembrane Seams using The Spark Test

2. Geosynthetic Research Institute (GRI):

- a. GRI GM 6, Pressurized Air Channel Test for Dual Seamed Geomembranes
- b. GRI GM 9, Cold Weather Seaming of Geomembranes
- c. GRI GM 10, Specification for Stress Crack Resistance of HDPE Geomembrane Sheet
- d. GRI GM 13, Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
- e. GRI GM 14, Test Frequencies for Destructive Seam Testing

1.04 SUBMITTALS

- A. Submit the following to the Engineer or Owner, for review and approval, within a reasonable time so as to expedite shipment or installation of the Geomembrane:
 - 1. Documentation of manufacturer's qualifications as specified in subsection 1.05A of this Section.
 - 2. Manufacturer's Quality Control program manual or descriptive documentation.

3. A material properties sheet, including at a minimum all properties specified in GRI GM 13, including test methods used.
4. Sample of the material.
5. Documentation of Installer's qualifications, as specified below and in subsection 1.05B of this Section.
 - a. Submit a list of at least ten completed facilities. For each name and type of facility; its location; the date of installation; phone number of contact at the facility; type and thickness of geomembrane and; surface area of the installed geomembrane.
 - b. Submit resumes or qualifications of the Installation Supervisor, Master Seamer and Technicians to be assigned to this project.
 - c. Quality Control Program.
6. Example Material Warranty and Liner Installation Warranty complying with subsections 1.07 and 1.08 of this Section.
7. Resin Supplier's name, resin production plant identification, resin brand name and number, production date of the resin, resin Manufacturer's quality control certificates, and certification that the properties of the resin meet the requirements of these specifications.

B. Shop Drawings

1. Submit copies of shop drawings for engineer's approval within a reasonable time so as not to delay the start of geomembrane installation. Shop drawings shall show the proposed panel layout identifying seams and details. Seams should generally follow direction of the slope. Butt seams or roll-end seams should not occur on a slope unless approved by the Owner's Representative. Butt seams on a slope, if allowed, should be staggered.
2. Placement of geomembrane will not be allowed to proceed until Owner's Representative has received and approved the shop drawings.

C. Additional Submittals (In-Progress and at Completion)

1. Manufacturer's warranty (refer to subsection 1.08).
2. Geomembrane installation warranty (refer to subsection 1.09).
3. Daily written acceptance of subgrade surface (refer to subsection 3.01.C).
4. Low-temperature seaming procedures if applicable (refer to subsection 3.03.A)
5. Prequalification test seam samples (refer to subsection 3.05.A.6).
6. Field seam non-destructive test results (refer to subsection 3.05.B.1).
7. Field seam destructive test results (refer to subsection 3.05.C.6).
8. Daily field installation reports (refer to subsection 3.05.G).

9. Installation record drawing, as discussed in subsection 3.05.G).

1.05 QUALITY CONTROL

A. Manufacturer's Qualifications:

The manufacturer of geomembrane of the type specified or similar product shall have at least five years experience in the manufacture of such geomembrane. In addition, the geomembrane manufacturer shall have manufactured at least 10,000,000 sq. ft. of the specified type of geomembrane or similar product during the last five years.

B. Installer's Qualifications:

- 1 The Geomembrane Installer shall be the Manufacturer, approved Manufacturer's Installer or a contractor approved by the Owner's Representative to install the geomembrane.
- 2 The Geomembrane Installer shall have at least three years experience in the installation of the specified geomembrane or similar. The Geomembrane Installer shall have installed at least 10 projects involving a total of 5,000,000 sq. ft. of the specified type of geomembrane or similar during the last three years.
- 3 Installation shall be performed under the direction of a field Installation Supervisor who shall be responsible throughout the geomembrane installation, for geomembrane panel layout, seaming, patching, testing, repairs, and all other activities of the Geomembrane Installer. The Field Installation Supervisor shall have installed or supervised the installation and seaming of a minimum of 10 projects involving a total of 5,000,000 sq. ft. of geomembrane of the type specified or similar product.
- 4 Seaming shall be performed under the direction of a Master Seamer (who may also be the Field Installation Supervisor or Crew Foreman) who has seamed a minimum of 3,000,000 sq. ft. of geomembrane of the type specified or similar product, using the same type of seaming apparatus to be used in the current project. The Field Installation Supervisor and/or Master Seamer shall be present whenever seaming, patching, other welding operations, and testing is performed.
- 5 All seaming, patching, other welding operations, and testing shall be performed by qualified technicians employed by the Geomembrane Installer.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall be firmly affixed and shall clearly state the manufacturer's name, product identification, material thickness, roll number, roll dimensions and roll weight.
- B. Geomembrane shall be protected from mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

- C. Rolls shall be stored away from high traffic areas. Continuously and uniformly support rolls on a smooth, level prepared surface.
- D. Rolls shall not be stacked more than three high.

1.07 PROJECT CONDITIONS

Geomembrane shall not be installed in the presence of standing water, while precipitation is occurring, during excessive winds, or when material temperatures are outside the limits specified in Section 3.03.

1.08 MATERIAL WARRANTY

As required by specification, or as required in GRI GM 13 (attachment A)

1.09 GEOMEMBRANE INSTALLATION WARRANTY

The Geomembrane Installer shall guarantee the geomembrane installation against defects in the installation and workmanship for 1 year commencing with the date of final acceptance.

1.10 GEOMEMBRANE PRE-CONSTRUCTION MEETING

- A. Geomembrane Pre-Construction Meeting shall be held at the site prior to installation of the geomembrane. At a minimum, the meeting shall be attended by the Geomembrane Installer, Owner, Owner's representative (Engineer and/or CQA Firm), and the General Contractor.
- B. Topics for this meeting shall include:
 - 1. Responsibilities of each party.
 - 2. Lines of authority and communication. Resolution of any project document ambiguity.
 - 3. Methods for documenting, reporting and distributing documents and reports.
 - 4. Procedures for packaging and storing archive samples.
 - 5. Review of time schedule for all installation and testing.
 - 6. Review of panel layout and numbering systems for panels and seams including details for marking on geomembrane.
 - 7. Procedures and responsibilities for preparation and submission of as-built panel and seam drawings.
 - 8. Temperature and weather limitations. Installation procedures for adverse weather conditions. Defining acceptable subgrade, geomembrane, or ambient moisture and temperature conditions for working during liner installation.
 - 9. Subgrade conditions, dewatering responsibilities and subgrade maintenance plan.
 - 10. Deployment techniques including allowable subgrade for the geomembrane.
 - 11. Plan for controlling expansion/contraction and wrinkling of the

- geomembrane.
 - 12. Covering of the geomembrane and cover soil placement.
 - 13. Measurement and payment schedules.
 - 14. Health and safety.
- C. The meeting shall be documented by the Owner's Representative and minutes shall be transmitted to all parties.

PART 2. PRODUCTS

2.01 SOURCE QUALITY CONTROL

Manufacturing Quality Control

- A. The test methods and frequencies used by the manufacturer for quality control/quality assurance of the above geomembrane prior to delivery, shall be in accordance with GRI GM13, or modified as required for project specific conditions.
- B. The manufacturer's geomembrane quality control certifications, including results of quality control testing of the products, as specified in subsection 2.01.C of this Section, must be supplied to the Owner's Representative. The certification shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or Technical Services Manager. Certifications shall include lot and roll numbers and corresponding shipping information.
- C. The Manufacturer will provide Certification that the geomembrane and welding rod supplied for the project have the same base resin and material properties.

2.02 GEOMEMBRANE

- A. The geomembrane shall consist of new, first quality products designed and manufactured specifically for the purpose of this work which shall have been satisfactorily demonstrated by prior testing to be suitable and durable for such purposes. The geomembrane rolls shall be seamless, high density polyethylene (HDPE- Density >0.94g/cm) containing no plasticizers, fillers or extenders and shall be free of holes, blisters or contaminants, and leak free verified by 100% in line spark or equivalent testing. The geomembrane shall be supplied as a continuous sheet with no factory seams in rolls. Smooth Geomembrane shall meet the property requirements shown in Table 1(a) of the GRI GM13 Specifications included at the end of this Section. Textured Geomembrane shall meet the property requirements shown in Table 2(a) of the GRI GM13 Specifications included at the end of this Section.
- B. Material shall be reviewed for conformance to the project specifications by the Owner's Representative.

PART 3. EXECUTION

3.01 SUBGRADE PREPARATION

- A. Geomembrane installed over geosynthetic clay liner (GCL) (Gypsum Stack and CCB Landfill).

The area of GCL to be covered with geomembrane shall be jointly inspected by the Geosynthetics Installer's CQA Representative daily with the Owner's Representative before commencing geomembrane installation for the day, and the condition of the GCL shall be continuously observed as geomembrane installation progresses. Rocks, stones, sticks, sharp objects and debris of any kind shall be removed from the surface of the GCL. The Owner's Representative shall be notified of any discontinuities, premature hydration, or otherwise defective GCL. Geomembrane shall not be placed over suspect areas until they have been repaired to the satisfaction of the Owner's Representative. The Geosynthetics Installer's CQA Representative shall submit a certificate of acceptance to the Owner's Representative daily, stating that the GCL surface was acceptable at the time of geomembrane installation.

- B. Geomembrane installed over cushion dirt.(Gypsum Stack only) **or Earth Fill Material (Recycle Pond only)**

The area of cushion dirt to be covered with geomembrane shall be prepared in accordance with the Section 02200 – Earthwork. The surface shall be smooth and free of ruts and holes, rocks, stones, sticks, sharp objects and debris of any kind.

- C. The Geomembrane installer shall provide daily, a certificate of acceptance for the surface to be covered by the geomembrane in that day's operations. The surface shall be maintained in a manner, during geomembrane installation, to ensure subgrade suitability.
- D. All subgrade damaged by construction equipment and deemed unsuitable by the Owner's Representative for geomembrane deployment shall be repaired prior to placement of the geomembrane. All repairs shall be reviewed by the Owner's Representative and approved by the Geomembrane Installer. This damage, repair, and the responsibilities of the contractor and Geomembrane Installer shall be defined in the preconstruction meeting.

3.02 GEOMEMBRANE PLACEMENT

- A. No geomembrane shall be deployed until the applicable certifications and quality control certificates listed in subsection 1.04 of this Section are submitted to and approved by the Owner's Representative. Should geomembrane material be deployed prior to approval by the Owner's Representative it will be at the sole risk of the Geomembrane Installer and/or Contractor. If the material does not meet project specifications it shall be removed from the work area at no cost to the

owner.

- B. The geomembrane shall be installed to the limits shown on the project drawings and essentially as shown on approved panel layout drawings.
- C. No geomembrane material shall be unrolled and deployed if the material temperatures are lower than 0 degrees C (32 degrees F). Temperature limitations should be defined in the preconstruction meeting. Typically, only the quantity of geomembrane that will be anchored and seamed together in one day should be deployed.
- D. No vehicular traffic shall travel on the geomembrane other than an approved low ground pressure All Terrain Vehicle or equivalent.
- E. Sand bags or equivalent ballast shall be used as necessary to temporarily hold the geomembrane material in position under the foreseeable and reasonably - expected wind conditions. Sand bag material shall be sufficiently close-knit to prevent soil fines from working through the bags and discharging on the geomembrane.
- F. Geomembrane placement shall not be done if moisture prevents proper subgrade preparation, panel placement, or panel seaming. Moisture limitations will be defined in the preconstruction meeting.
- G. Damaged panels or portions of the damaged panels which have been rejected shall be marked and their removal from the work area recorded.
- H. The geomembrane shall not be allowed to "bridge over" voids or low areas in the subgrade. In these areas, the subgrade shall be prepared to allow the geomembrane to rest in intimate contact with the subgrade.
- I. Wrinkles caused by panel placement or thermal expansion should be minimized in accordance with section 1.10 B11.
- J. Considerations on Site Geometry: In general, seams shall be oriented parallel to the line of the maximum slope. In corners and odd shaped geometric locations, the total length of field seams shall be minimized. Seams shall not be located at low points in the subgrade.
- K. Overlapping: The panels shall be overlapped prior to seaming to whatever extent is necessary to effect a good weld and allow for proper testing. In no case shall this overlap be less than 75mm (3 in.).

3.03 SEAMING PROCEDURES

- A. No geomembrane material shall be seamed when liner temperatures are less than 0 degrees C (32 degrees F).
- B. No geomembrane material shall be seamed when the sheet temperature is above 75 degrees C (170 degrees F) as measured by an infrared thermometer or surface thermocouple.
- C. Seaming shall primarily be performed using automatic fusion welding equipment and techniques. Extrusion welding shall be used where fusion welding is not possible such as at pipe penetrations, patches, repairs and short (less than a roll width) runs of seams.
- D. Fishmouths or excessive wrinkles at the seam overlaps, shall be minimized and when necessary cut along the ridge of the wrinkles back into the panel so as to

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effect a flat overlap. The cut shall be terminated with a keyhole cut (nominal 10 mm (1/2 in) diameter hole) so as to minimize crack/tear propagation. The overlay shall subsequently be seamed. The key hole cut shall be patched with an oval or round patch of the same base geomembrane material extending a minimum of 150 mm (6 in.) beyond the cut in all directions.

3.04 PIPE AND STRUCTURE PENETRATION SEALING SYSTEM

- A. Provide penetration sealing system as shown in the Project Drawings.
- B. Penetrations shall be constructed from the base geomembrane material, flat stock, prefabricated boots and accessories as shown on the Project Drawings. The prefabricated or field fabricated assembly shall be field welded to the geomembrane as shown on the Project Drawings so as to prevent leakage. This assembly shall be tested as outlined in section 3.05.B. Alternatively, where field non destructive testing can not be performed, attachments will be field spark tested by standard holiday leak detectors in accordance with ASTM 6365. Spark testing should be done in areas where both air pressure testing and vacuum testing are not possible.
 - 1. Equipment for Spark testing shall be comprised of but not limited to: A hand held holiday spark tester and conductive wand that generates a high voltage.
 - 2. The testing activities shall be performed by the Geomembrane Installer by placing an electrically conductive tape or wire beneath the seam prior to welding. A trial seam containing a non welded segment shall be subject to a calibration test to ensure that such a defect (non welded segment) will be identified under the planned machine settings and procedures. Upon completion of the weld, enable the spark tester and hold approximately 25mm (1 in) above the weld moving slowly over the entire length of the weld in accordance with ASTM 6365. If there is no spark the weld is considered to be leak free.
 - 3. A spark indicates a hole in the seam. The faulty area shall be located, repaired and retested by the Geomembrane Installer.
 - 4. Care should be taken if flammable gases are present in the area to be tested.

3.05 FIELD QUALITY CONTROL

The Owner's Representative shall be notified prior to all pre qualification and production welding and testing, or as agreed upon in the pre construction meeting.

- A. Prequalification Test Seams
 - 1. Test seams shall be prepared and tested by the Geomembrane Installer to verify that seaming parameters (speed, temperature and pressure of welding equipment) are adequate.
 - 2. Test seams shall be made by each welding technician and tested in accordance with ASTM D 4437 at the beginning of each seaming period. Test seaming shall be performed under the same conditions and with the same equipment and operator combination as production seaming. The

test seam shall be approximately 3.3 meters (10 feet) long for fusion welding and 1 meter (3 feet) long for extrusion welding with the seam centered lengthwise. At a minimum, tests seams should be made by each technician 1 time every 4–6 hours; additional tests may be required with changes in environmental conditions.

3. Two 25 mm (1 in) wide specimens shall be die-cut by the Geomembrane Installer from each end of the test seam. These specimens shall be tested by the Geomembrane Installer using a field tensiometer testing both tracks for peel strength and also for shear strength. Each specimen shall fail in the parent material and not in the weld, "Film Tear Bond"(F.T.D. failure). Seam separation equal to or greater than 10% of the track width shall be considered a failing test.
4. The minimum acceptable seam strength values to be obtained for all specimens tested are listed in Subsection 3.05.C.4 of this Section. All four specimens shall pass for the test seam to be a passing seam.
5. If a test seam fails, an additional test seam shall be immediately conducted. If the additional test seam fails, the seaming apparatus shall be rejected and not used for production seaming until the deficiencies are corrected and a successful test seam can be produced.
6. A sample from each test seam shall be labeled. The label shall indicate the date, geomembrane temperature, number of the seaming unit, technician performing the test seam and pass or fail description. The sample shall then be given to the Owner's Representative for archiving.

B. Field Seam Non-destructive Testing

1. All field seams shall be non-destructively tested by the Geomembrane Installer over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of tester and outcome of all non-destructive testing shall be recorded and submitted to the Owner's Representative.
2. Testing should be done as the seaming work progresses, not at the completion of all field seaming. All defects found during testing shall be numbered and marked immediately after detection. All defects found should be repaired, retested and remarked to indicate acceptable completion of the repair.
3. Non-destructive testing shall be performed using vacuum box, air pressure or spark testing equipment.
4. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods. The Geomembrane Installer shall demonstrate to the Owner's Representative all test methods to verify the test procedures are valid.
5. Extrusion seams shall be vacuum box tested by the Geomembrane Installer in accordance with ASTM D 4437 and ASTM D 5641 with the following equipment and procedures:
 - a. Equipment for testing extrusion seams shall be comprised of but not limited to: a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket

- attached to the base, port hole or valve assembly and a vacuum gauge; a vacuum pump assembly equipped with a pressure controller and pipe connections; a rubber pressure/vacuum hose with fittings and connections; a plastic bucket; wide paint brush or mop; and a soapy solution.
- b. The vacuum pump shall be charged and the tank pressure adjusted to approximately 35 kPa (5 psig).
 - c. The Geomembrane Installer shall create a leak tight seal between the gasket and geomembrane interface by wetting a strip of geomembrane approximately 0.3m (12 in) by 1.2m (48 in) (length and width of box) with a soapy solution, placing the box over the wetted area, and then compressing the box against the geomembrane. The Geomembrane Installer shall then close the bleed valve, open the vacuum valve, maintain initial pressure of approximately 35 kPa (5 psig) for approximately 5 seconds. The geomembrane should be continuously examined through the viewing window for the presence of soap bubbles, indicating a leak. If no bubbles appear after 5 seconds, the area shall be considered leak free. The box shall be depressurized and moved over the next adjoining area with an appropriate overlap and the process repeated.
 - d. All areas where soap bubbles appear shall be marked, repaired and then retested.
 - e. At locations where seams cannot be non destructively tested, such as pipe penetrations, alternate nondestructive spark testing (as outlined in section 3.04.B) or equivalent should be substituted.
 - f. All seams that are vacuum tested shall be marked with the date tested, the name of the technician performing the test and the results of the test.
6. Double Fusion seams with an enclosed channel shall be air pressure tested by the Geomembrane Installer in accordance with ASTM D 5820 and ASTM D 4437 and the following equipment and procedures:
- a. Equipment for testing double fusion seams shall be comprised of but not limited to: an air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 210 kPa (30 psig), mounted on a cushion to protect the geomembrane; and a manometer equipped with a sharp hollow needle or other approved pressure feed device.
 - b. The Testing activities shall be performed by the Geomembrane Installer. Both ends of the seam to be tested shall be sealed and a needle or other approved pressure feed device inserted into the tunnel created by the double wedge fusion weld. The air pump shall be adjusted to a pressure of 210 kPa (30 psig), and the valve closed,. Allow 2 minutes for the injected air to come to equilibrium in the channel, and sustain pressure for 5 minutes. If pressure loss does not exceed 28 kPa (4 psig) after this five minute period the seam shall be considered leak tight. Release pressure from the opposite end verifying pressure drop on needle to ensure testing of

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the entire seam. The needle or other approved pressure feed device shall be removed and the feed hole sealed.

- c. If loss of pressure exceeds 28 kPa (4 psig) during the testing period or pressure does not stabilize, the faulty area shall be located, repaired and retested by the Geomembrane Installer.
- d. Results of the pressure testing shall be recorded on the liner at the seam tested and on a pressure testing record.

C. Destructive Field Seam Testing

1. One destructive test sample per 150 linear m (500 linear ft) seam length or another predetermined length in accordance with GRI GM 14 shall be taken by the Geomembrane Installer from a location specified by the Owner's Representative. The Geomembrane Installer shall not be informed in advance of the sample location. In order to obtain test results prior to completion of geomembrane installation, samples shall be cut by the Geomembrane Installer as directed by the Owner's Representative as seaming progresses.
2. All field samples shall be marked with their sample number and seam number. The sample number, date, time, location, and seam number shall be recorded. The Geomembrane Installer shall repair all holes in the geomembrane resulting from obtaining the seam samples. All patches shall be vacuum box tested or spark tested. If a patch cannot be permanently installed over the test location the same day of sample collection, a temporary patch shall be tack welded or hot air welded over the opening until a permanent patch can be affixed.
3. The destructive sample size shall be 300 mm (12 in) wide by 1 m (36 in) long with the seam centered lengthwise. The sample shall be cut into three equal sections and distributed as follows: one section given to the Owner's Representative as an archive sample; one section given to the Owner's Representative for laboratory testing as specified in paragraph 5 below; and one section retained by the Geomembrane Installer for field testing as specified in paragraph 4 below.
4. For field testing, the Geomembrane Installer shall cut 10 identical 25 mm (1 in) wide replicate specimens from his sample. The Geomembrane Installer shall test five specimens for seam shear strength and five for peel strength. Peel tests will be performed on both inside and outside weld tracks. To be acceptable, 4 of 5 test specimens must pass the stated criteria in section 2.02 with less than 10% separation. If 4 of 5 specimens pass, the sample qualifies for testing by the testing laboratory if required.
5. If independent seam testing is required by the specifications it shall be conducted in accordance with ASTM 5820 or ASTM D4437 or GRI GM 6.
6. Reports of the results of examinations and testing shall be prepared and submitted to the Owner's Representative.
7. For field seams, if a laboratory test fails, that shall be considered as an indicator of the possible inadequacy of the entire seamed length corresponding to the test sample. Additional destructive test portions shall

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then be taken by the Geomembrane Installer at locations indicated by the Engineer, typically 3 m (10 ft) on either side of the failed sample and laboratory seam tests shall be performed. Passing tests shall be an indicator of adequate seams. Failing tests shall be an indicator of non-adequate seams and all seams represented by the destructive test location shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be non-destructively vacuum box tested until adequacy of the seams is achieved. Cap strip seams exceeding 50 M in length (150 FT) shall be destructively tested.

D. Identification of Defects

1. Panels and seams shall be inspected by the Installer and Owner's Representative during and after panel deployment to identify all defects, including holes, blisters, undispersed raw materials and signs of contamination by foreign matter.

E. Evaluation of Defects: Each suspect location on the liner (both in geomembrane seam and non-seam areas) shall be non-destructively tested using one of the methods described in Section 3.05.B. Each location which fails non-destructive testing shall be marked, numbered, measured and posted on the daily "installation" drawings and subsequently repaired.

1. If a destructive sample fails the field or laboratory test, the Geomembrane Installer shall repair the seam between the two nearest passed locations on both sides of the failed destructive sample location.
2. Defective seams, tears or holes shall be repaired by reseaming or applying a extrusion welded cap strip.
3. Reseaming may consist of either:
 - a. Removing the defective weld area and rewelding the parent material using the original welding equipment; or
 - b. Reseaming by extrusion welding along the overlap at the outside seam edge left by the fusion welding process.
4. Blisters, larger holes, and contamination by foreign matter shall be repaired by patches and/or extrusion weld beads as required. Each patch shall extend a minimum of 150 mm (6 in) beyond all edges of the defects.
5. All repairs shall be measured, located and recorded.

F. Verification of Repairs on Seams: Each repair shall be non-destructively tested using either vacuum box or spark testing methods. Tests which pass the non-destructive test shall be taken as an indication of a successful repair. Failed tests shall be reseamed and retested until a passing test results. The number, date, location, technician and test outcome of each patch shall be recorded.

G. Daily Field Installation Reports: At the beginning of each day's work, the Installer shall provide the Engineer with daily reports for all work accomplished on the previous work day. Reports shall include the following:

1. Total amount and location of geomembrane placed;

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2. Total length and location of seams completed, name of technicians doing seaming and welding unit numbers;
 3. Drawings of the previous day's installed geomembrane showing panel numbers, seam numbers and locations of non-destructive and destructive testing;
 4. Results of pre-qualification test seams;
 5. Results of non-destructive testing; and
 6. Results of vacuum testing of repairs.
- H. Destructive test results shall be reported prior to covering of liner or within 48 hours.

3.06 LINER ACCEPTANCE

- A. Geomembrane liner will be accepted by the Owner's Representative when:
1. The entire installation is finished or an agreed upon subsection of the installation is finished;
 2. All Installer's QC documentation is completed and submitted to the owner
 3. Verification of the adequacy of all field seams and repairs and associated geomembrane testing is complete.

3.07 ANCHOR TRENCH

- A. Construct as specified on the project drawings.

3.08 DISPOSAL OF SCRAP MATERIALS

- A. On completion of installation, the Geomembrane Installer shall dispose of all trash and scrap material in a location designated by the Owner's Representative, remove equipment used in connection with the work herein, and shall leave the premises in a neat acceptable manner. Scrap sections larger than 5 feet on each edge shall be segregated from smaller scraps and retained by the Owner. No scrap material shall be allowed to remain on the geomembrane surface.

PART 4. GRI GM13 SPECIFICATIONS

Geosynthetics Research Institute (GRI) Test Method GM13 – "Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes", Revision 8, Dated July 10, 2006.

ATTACHMENT A:

Minimum Average Weld Properties for Smooth and Textured HDPE Geomembranes (English units)								
Property	Test Method	30 mil	40 mil	50 mil	60 mil	80 mil	100 mil	120 mil
Peel strength (fusion & extrusion) lb/in.	ASTM 4437	39	52	65	78	104	130	156
Shear strength (fusion & extrusion) lb/in.	ASTM 4437	60	80	100	120	160	200	239

END OF SECTION 02800

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Revision 8: July 10, 2006
Revision schedule on pg. 11

GRI Test Method GM13*

Standard Specification for

“Test Methods, Test Properties and Testing Frequency for
High Density Polyethylene (HDPE) Smooth and Textured Geomembranes”

This specification was developed by the Geosynthetic Research Institute (GRI), with the cooperation of the member organizations for general use by the public. It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part. Neither GRI, the Geosynthetic Institute, nor any of its related institutes, warrant or indemnifies any materials produced according to this specification either at this time or in the future.

1. Scope

- 1.1 This specification covers high density polyethylene (HDPE) geomembranes with a formulated sheet density of 0.940 g/ml, or higher, in the thickness range of 0.75 mm (30 mils) to 3.0 mm (120 mils). Both smooth and textured geomembrane surfaces are included.
- 1.2 This specification sets forth a set of minimum, physical, mechanical and chemical properties that must be met, or exceeded by the geomembrane being manufactured. In a few cases a range is specified.
- 1.3 In the context of quality systems and management, this specification represents manufacturing quality control (MQC).

Note 1: Manufacturing quality control represents those actions taken by a manufacturer to ensure that the product represents the stated objective and properties set forth in this specification.

- 1.4 This standard specification is intended to ensure good quality and performance of HDPE geomembranes in general applications, but is possibly not adequate for the complete specification in a specific situation. Additional tests, or more restrictive

*This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective version.

values for test indicated, may be necessary under conditions of a particular application.

Note 2: For information on installation techniques, users of this standard are referred to the geosynthetics literature, which is abundant on the subject.

2. Referenced Documents

2.1 ASTM Standards

- D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement
- D 1004 Test Method for Initial Tear Resistance of Plastics Film and Sheeting
- D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
- D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
- D 1603 Test Method for Carbon Black in Olefin Plastics
- D 3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis
- D 4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
- D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
- D 5397 Procedure to Perform a Single Point Notched Constant Tensile Load – (SP-NCTL) Test: Appendix
- D 5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes
- D 5885 Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
- D 5994 Test Method for Measuring the Core Thickness of Textured Geomembranes
- D 6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

2.2 GRI Standards

- GM10 Specification for the Stress Crack Resistance of Geomembrane Sheet
- GM 11 Accelerated Weathering of Geomembranes using a Fluorescent UVA-Condensation Exposure Device
- GM 12 Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage

- 2.3 U. S. Environmental Protection Agency Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities." EPA/600/R-93/182, September 1993, 305 pgs.

3. Definitions

Manufacturing Quality Control (MQC) - A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications.

ref. EPA/600/R-93/182

Manufacturing Quality Assurance (MQA) - A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections, verifications, audits and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project.

ref. EPA/600/R-93/182

Formulation, n - The mixture of a unique combination of ingredients identified by type, properties and quantity. For HDPE polyethylene geomembranes, a formulation is defined as the exact percentages and types of resin(s), additives and carbon black.

4. Material Classification and Formulation

- 4.1 This specification covers high density polyethylene geomembranes with a formulated sheet density of 0.940 g/ml, or higher. Density can be measured by ASTM D1505 or ASTM D792. If the latter, Method B is recommended.
- 4.2 The polyethylene resin from which the geomembrane is made will generally be in the density range of 0.932 g/ml or higher, and have a melt index value per ASTM D1238 of less than 1.0 g/10 min.
- 4.3 The resin shall be virgin material with no more than 10% rework. If rework is used, it must be a similar HDPE as the parent material.
- 4.4 No post consumer resin (PCR) of any type shall be added to the formulation.

5. Physical, Mechanical and Chemical Property Requirements

5.1 The geomembrane shall conform to the test property requirements prescribed in Tables 1 and 2. Table 1 is for smooth HDPE geomembranes and Table 2 is for single and double sided textured HDPE geomembranes. Each of the tables are given in English and SI (metric) units. The conversion from English to SI (metric) is soft.

Note 3: The tensile strength properties in this specification were originally based on ASTM D 638 which uses a laboratory testing temperature of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Since ASTM Committee D35 on Geosynthetics adopted ASTM D 6693 (in place of D 638), this GRI Specification followed accordingly. The difference is that D 6693 uses a testing temperature of $21^{\circ}\text{C} \pm 2^{\circ}\text{C}$. The numeric values of strength and elongation were not changed in this specification. If a dispute arises in this regard, the original temperature of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ should be utilized for testing purposes.

Note 4: There are several tests often included in other HDPE specifications which are omitted from this standard because they are outdated, irrelevant or generate information that is not necessary to evaluate on a routine MQC basis. The following tests have been purposely omitted:

- Volatile Loss
- Dimensional Stability
- Coeff. of Linear Expansion
- Resistance to Soil Burial
- Low Temperature Impact
- ESCR Test (D 1693)
- Wide Width Tensile
- Water Vapor Transmission
- Water Absorption
- Ozone Resistance
- Modulus of Elasticity
- Hydrostatic Resistance
- Tensile Impact
- Field Seam Strength
- Multi-Axial Burst
- Various Toxicity Tests

Note 5: There are several tests which are included in this standard (that are not customarily required in other HDPE specifications) because they are relevant and important in the context of current manufacturing processes. The following tests have been purposely added:

- Oxidative Induction Time
- Oven Aging
- Ultraviolet Resistance
- Asperity Height of Textured Sheet (see Note 6)

Note 6: The minimum average value of asperity height does not represent an expected value of interface shear strength. Shear strength

associated with geomembranes is both site-specific and product-specific and should be determined by direct shear testing using ASTM D5321/ASTM D6243 as prescribed. This testing should be included in the particular site's CQA conformance testing protocol for the geosynthetic materials involved, or formally waived by the Design Engineer, with concurrence from the Owner prior to the deployment of the geosynthetic materials.

Note 7: There are other tests in this standard, focused on a particular property, which are updated to current standards. The following are in this category:

- Thickness of Textured Sheet
- Puncture Resistance
- Stress Crack Resistance
- Carbon Black Dispersion (In the viewing and subsequent quantitative interpretation of ASTM D 5596 only near spherical agglomerates shall be included in the assessment).

Note 8: There are several GRI tests currently included in this standard. Since these topics are not covered in ASTM standards, this is necessary. They are the following:

- UV Fluorescent Light Exposure
- Asperity Height Measurement

5.2 The values listed in the tables of this specification are to be interpreted according to the designated test method. In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV).

5.3 The properties of the HDPE geomembrane shall be tested at the minimum frequencies shown in Tables 1 and 2. If the specific manufacturer's quality control guide is more stringent and is certified accordingly, it must be followed in like manner.

Note 9: This specification is focused on manufacturing quality control (MQC). Conformance testing and manufacturing quality assurance (MQA) testing are at the discretion of the purchaser and/or quality assurance engineer, respectively.

6. Workmanship and Appearance

6.1 Smooth geomembrane shall have good appearance qualities. It shall be free from such defects that would affect the specified properties of the geomembrane.

6.2 Textured geomembrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and such defects that would affect the specified properties of the geomembrane.

6.3 General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.

7. MQC Sampling

7.1 Sampling shall be in accordance with the specific test methods listed in Tables 1 and 2. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire roll width.

7.2 The number of tests shall be in accordance with the appropriate test methods listed in Tables 1 and 2.

7.3 The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are the minimum average values and are designated as "min. ave."

8. MQC Retest and Rejection

8.1 If the results of any test do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

9. Packaging and Marketing

9.1 The geomembrane shall be rolled onto a substantial core or core segments and held firm by dedicated straps/slings, or other suitable means. The rolls must be adequate for safe transportation to the point of delivery, unless otherwise specified in the contract or order.

10. Certification

10.1 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

Table 1(a) – High Density Polyethylene (HDPE) Geomembrane -Smooth

Properties	Test Method	Test Value					Testing Frequency (minimum)	
		30 mils	40 mils	50 mils	60 mils	80 mils		100 mils
Thickness (min. ave.)	D 5199	nom.	nom.	nom.	nom.	nom.	nom.	nom.
• lowest individual of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%
Density mg./l (min.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc
Tensile Properties (1) (min. ave.)	D 6693	63 lb/in.	84 lb/in.	105 lb/in.	126 lb/in.	168 lb/in.	210 lb/in.	252 lb/in.
• yield strength	Type IV	114 lb/in.	152 lb/in.	190 lb/in.	228 lb/in.	304 lb/in.	380 lb/in.	456 lb/in.
• break strength		12%	12%	12%	12%	12%	12%	12%
• yield elongation		700%	700%	700%	700%	700%	700%	700%
• break elongation								
Tear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb
Puncture Resistance (min. ave.)	D 4833	54 lb	72 lb	90 lb	108 lb	144 lb	180 lb	216 lb
Stress Crack Resistance (2)	D 5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.
Carbon Black Content (range)	D 1603 (3)	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%
Carbon Black Dispersion	D 5596	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)
Oxidative Induction Time (OIT) (min. ave.) (5)								
(a) Standard OIT	D 3895	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.
— or —								
(b) High Pressure OIT	D 5885	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.
Oxon Aging at 85°C (5), (6)	D 5721							
(a) Standard OIT (min. ave.) - % retained after 90 days	D 3895	55%	55%	55%	55%	55%	55%	55%
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	80%	80%	80%	80%	80%	80%	80%
UV Resistance (7)	GM II							
(a) Standard OIT (min. ave.)	D 3895	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)
— or —								
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs. (9)	D 5885	50%	50%	50%	50%	50%	50%	50%

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.

Yield elongation is calculated using a gage length of 1.5 inches

Break elongation is calculated using a gage length of 2.0 in.

(2) The yield stress used to calculate the applied load for the SP-NCTI test should be the manufacturer's mean value via MQC testing.

(3) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(4) Carbon black dispersion (only neat spherical agglomerates) for 10 different views:

9 in Categories 1 or 2 and 1 in Category 3

(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(9) UV resistance is based on percent retained value regardless of the original IIP-OIT value.

Table 1(b) – High Density Polyethylene (HDPE) Geomembrane - Smooth

Properties	Test Method	Test Value										Testing Frequency (minimum)
		0.75 mm nom. (mil) -10%	1.00 mm nom. (mil) -10%	1.25 mm nom. (mil) -10%	1.50 mm nom. (mil) -10%	2.00 mm nom. (mil) -10%	2.50 mm nom. (mil) -10%	3.00 mm nom. (mil) -10%				
Thickness - mils (min. ave.) • lowest individual of 10 values	D 5199	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	90,000 kg
Density (min.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	90,000 kg
Tensile Properties (1) (min. ave.) • yield strength • break strength • yield elongation • break elongation	D 6693 Type IV	11 kN/m 20 kN/m 12% 700%	15 kN/m 27 kN/m 12% 700%	18 kN/m 33 kN/m 12% 700%	22 kN/m 40 kN/m 12% 700%	29 kN/m 53 kN/m 12% 700%	37 kN/m 67 kN/m 12% 700%	44 kN/m 80 kN/m 12% 700%	44 kN/m 80 kN/m 12% 700%	44 kN/m 80 kN/m 12% 700%	44 kN/m 80 kN/m 12% 700%	9,000 kg
Tear Resistance (min. ave.)	D 1004	93 N	125 N	156 N	187 N	249 N	311 N	374 N	374 N	374 N	20,000 kg	
Puncture Resistance (min. ave.)	D 4833	240 N	320 N	400 N	480 N	640 N	800 N	960 N	960 N	960 N	20,000 kg	
Stress Crack Resistance (2)	D 5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	per GRI GYM-10	
Carbon Black Content - %	D 1603 (3)	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	9,000 kg	
Carbon Black Dispersion	D 5596	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	20,000 kg	
Oxidative Induction Time (OIT) (min. ave.) (5) (a) Standard OIT — or — (b) High Pressure OIT	D 3895	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	9,000 kg	
Oven Aging at 85°C (5), (6) (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	per each formulation	
UV Resistance (7) (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs (9)	D 5721 D 3895	55%	55%	55%	55%	55%	55%	55%	55%	55%	per each formulation	
	D 5885	80%	80%	80%	80%	80%	80%	80%	80%	80%	per each formulation	
	D 3895	N. R. (8)	N. R. (8)	N. R. (8)	N. R. (8)	N. R. (8)	N. R. (8)	N. R. (8)	N. R. (8)	N. R. (8)	per each formulation	
	D 5885	50%	50%	50%	50%	50%	50%	50%	50%	50%	per each formulation	

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction
Yield elongation is calculated using a gage length of 33 mm
Break elongation is calculated using a gage length of 50 mm
(2) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
(3) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.
(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3
(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(9) UV resistance is based on percent retained value regardless of the original EP-OIT value.

Table 2(a) – High Density Polyethylene (HDPE) Geomembrane - Textured

Properties	Test Method	Test Value						Testing Frequency (minimum) per roll
		30 mils nom (+5%) -10% -15%	40 mils nom (+5%) -10% -15%	50 mils nom (+5%) -10% -15%	60 mils nom (+5%) -10% -15%	80 mils nom (+5%) -10% -15%	100 mils nom (+5%) -10% -15%	
Thickness mils (min. ave.)	D 5994	30 mils nom (+5%) -10% -15%	40 mils nom (+5%) -10% -15%	50 mils nom (+5%) -10% -15%	60 mils nom (+5%) -10% -15%	80 mils nom (+5%) -10% -15%	100 mils nom (+5%) -10% -15%	120 mils nom (+5%) -10% -15%
Asperity Height mils (min. ave. (1))	GM 12	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil
Density (min. ave.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc
Tensile Properties (min. ave.) (2)	D 6693	63 lb/in	84 lb/in	105 lb/in	126 lb/in	168 lb/in	210 lb/in	252 lb/in
• yield strength	Type IV	45 lb/in	60 lb/in	75 lb/in	90 lb/in	120 lb/in	150 lb/in	180 lb/in
• break strength		12%	12%	12%	12%	12%	12%	12%
• yield elongation		100%	100%	100%	100%	100%	100%	100%
• break elongation								
Tear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb
Puncture Resistance (min. ave.)	D 4833	45 lb	60 lb	75 lb	90 lb	120 lb	150 lb	180 lb
Stress Crack Resistance (4)	D 5307 (Ages 1)	300 hr	300 hr	300 hr	300 hr	300 hr	300 hr	300 hr
Carbon Black Content (range)	D 1603 (5)	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%
Carbon Black Dispersion	D 5596	note (6)	note (6)	note (6)	note (6)	note (6)	note (6)	note (6)
Oxidative Induction Time (OIT) (min. ave.) (7)								
(a) Standard OIT	D 3895	100 min	100 min	100 min	100 min	100 min	100 min	100 min
or								
(b) High Pressure OIT	D 5885	400 min	400 min	400 min	400 min	400 min	400 min	400 min
Oven Aging at 85°C (7) (8)	D 5721	55%	55%	55%	55%	55%	55%	55%
(a) Standard OIT (min. ave.) - % retained after 90 days	D 3895	55%	55%	55%	55%	55%	55%	55%
or								
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	80%	80%	80%	80%	80%	80%	80%
UV Resistance (9)	GM 11							
(a) Standard OIT (min. ave.)	D 3895	N.R. (10)	N.R. (10)	N.R. (10)	N.R. (10)	N.R. (10)	N.R. (10)	N.R. (10)
or								
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs (11)	D 5885	50%	50%	50%	50%	50%	50%	50%

(1) OIT (1) readings, 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils, also see Note 6

(2) Allocate the measurement side for double sided textured sheet

(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 3 test specimens each direction

(4) Yield elongation is calculated using a gage length of 1.3 inches

(5) Break elongation is calculated using a gage length of 2.0 inches

(6) P-NCTE test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials

(7) The yield stress used to calculate the applied load for the SP-NCTE test should be the manufacturer's mean value via MQC testing

(8) Other methods such as D 4218 (infrared furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (infrared furnace) can be established

(9) Carbon black dispersion (only near spherical agglomerates) for 10 different views

(10) in Categories 1 or 2 and 1 in Category 3

(11) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane

(12) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response

(13) The condition of the test should be 20 hr UV cycle at 75°C followed by 4 hr condensation at 60°C

(14) Not recommended since the high temperature of the SCL-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples

(15) UV resistance is based on percent retained value regardless of the original HQ-G11 value

Table 2(b) – High Density Polyethylene (HDPE) Geomembrane – Textured

Properties	Test Method	Test Value							Testing Frequency (minimum) per roll
		0.75 mm	1.00 mm	1.25 mm	1.50 mm	2.00 mm	2.50 mm	3.00 mm	
Thickness min (min. ave.)	D 5994	nom (-5%) -10% -15%	nom (-5%) -10% -15%	nom (-5%) -10% -15%	nom (-5%) -10% -15%	nom (-5%) -10% -15%	nom (-5%) -10% -15%	nom (-5%) -10% -15%	per roll
• lowest individual for 8 out of 10 values									
• lowest individual for any of the 10 values									
Asperity Height (min. ave. / ft)	GM 12	0.25 mm	0.25 mm	0.25 mm	0.25 mm	0.25 mm	0.25 mm	0.25 mm	every 2 nd roll / 2)
Density (min. ave.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	90,000 kg
Tensile Properties (min. ave.) (3)	D 6693								9,000 kg
• yield strength	Type IV	15 kN/m	18 kN/m	22 kN/m	27 kN/m	29 kN/m	37 kN/m	44 kN/m	
• break strength		10 kN/m	13 kN/m	16 kN/m	20 kN/m	21 kN/m	26 kN/m	32 kN/m	
• yield elongation		12%	12%	12%	12%	12%	12%	12%	
• break elongation		100%	100%	100%	100%	100%	100%	100%	
Tear Resistance (min. ave.)	D 2004	93 N	125 N	156 N	187 N	240 N	311 N	374 N	20,000 kg
Puncture Resistance (min. ave.)	D 4813	200N	267 N	333 N	400 N	534 N	667 N	800 N	20,000 kg
Stress Crack Resistance (4)	D 5397	300 hr	300 hr	300 hr	300 hr	360 hr	300 hr	300 hr	per GRI GM70
Carbon Black Content (range)	(A) App 1								
Carbon Black Dispersion	D 1603 (5)	note (6)	note (6)	note (6)	note (6)	note (6)	note (6)	note (6)	
Oxidative Induction Time (OIT) (min. ave.) (7)	D 5396	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	9,000 kg
(a) Standard OIT		note (6)	note (6)	note (6)	note (6)	note (6)	note (6)	note (6)	20,000 kg
— or —									90,000 kg
(b) High Pressure OIT	D 3895	100 min	100 min	100 min	100 min	100 min	100 min	100 min	
(c) High Pressure OIT	D 5885	400 min	400 min	400 min	400 min	400 min	400 min	400 min	
Oven Aging at 85°C (7), (8)	D 5721								
(a) Standard OIT (min. ave.) - % retained after 90 days	D 3895	55%	55%	55%	55%	55%	55%	55%	per each formulation
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	80%	80%	80%	80%	80%	80%	80%	
UV Resistance (9)	GM 11								
(a) Standard OIT (min. ave.)	D 3895	N.R. (10)	N.R. (10)	N.R. (10)	N.R. (10)	N.R. (10)	N.R. (10)	N.R. (10)	per each formulation
— or —									
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs (11)	D 5885	50%	50%	50%	50%	50%	50%	50%	

(1) Of 10 readings, 8 out of 10 must be ≥ 0.18 mm, and lowest individual reading must be ≥ 0.13 mm, also see Note 6.

(2) Alternate the measurement side for double sided textured sheet

(3) Machine direction (MD) and cross machine direction (CMD) average values should be on the basis of 5 test specimens each direction

Yield elongation is calculated using a gage length of 33 mm

Break elongation is calculated using a gage length of 30 mm

(4) The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth sheets or on smooth sheets made from the same formulation as being used for the textured sheet materials

(5) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MOC testing

Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established

(6) Carbon black dispersion (only near spherical agglomerates) for 10 different views

9 in Categories 1 or 2 and 1 in Category 3

(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane

It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response

(8) The condition of the test should be 20 hr UV cycle at 75°C followed by 4 hr condensation at 60°C

(9) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples

(10) UV resistance is based on percent retained value regardless of the original FIP-OIT value

Adoption and Revision Schedule

for

HDPE Specification per GRI-GM13

**"Test Methods, Test Properties, Testing Frequency for
High Density Polyethylene (HDPE) Smooth and Textured Geomembranes"**

- Adopted:** June 17, 1997
- Revision 1:** November 20, 1998: changed CB dispersion from allowing 2 views to be in Category 3 to requiring all 10 views to be in Category 1 or 2. Also reduced UV percent retained from 60% to 50%.
- Revision 2:** April 29, 1999: added to Note 5 after the listing of Carbon Black Dispersion the following: "(In the viewing and subsequent quantitative interpretation of ASTM D5596 only near spherical agglomerates shall be included in the assessment)" and to Note (4) in the property tables.
- Revision 3:** June 28, 2000: added a new Section 5.2 that the numeric table values are neither MARV or MaxARV. They are to be interpreted per the the designated test method.
- Revision 4:** December 13, 2000: added one Category 3 is allowed for carbon black dispersion. Also, unified terminology to "strength" and "elongation".
- Revision 5:** May 15, 2003: Increased minimum acceptable stress crack resistance time from 200 hrs to 300 hrs.
- Revision 6:** June 23, 2003: Adopted ASTM D 6693, in place of ASTM D 638, for tensile strength testing. Also, added Note 2.
- Revision 7:** February 20, 2006: Added Note 6 on Asperity Height clarification with respect to shear strength.
- Revision 8:** Removed recommended warranty from specification.

DIVISION 2 - SITE WORK

Section 02936 - Topsoil, Seeding, and Mulching

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to seeding and placing mulch or erosion control blanket over seeded areas.

1.02 RELATED SECTIONS

A. Specified elsewhere:

1. 02200 - Earthwork

1.03 REFERENCES

The following reference or cited portions thereof, current at date of bidding documents unless otherwise specified, governs the work.

A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.

1.04 SPECIFICATIONS

A. Work shall conform to the applicable requirements of Sections 250 and 251 of Standard Specifications for Road and Bridge Construction and to the requirements hereinafter specified.

B. Exceptions: All references in the IDOT specifications to methods of measurement and payment shall not apply.

1.05 WARRANTY

A. Warranty for one (1) year plus one growing season from date of substantial completion shall be provided.

PART 2. PRODUCTS

2.01 MATERIALS

A. Seed: Seed shall conform to Article 1081.04 of the IDOT Standard Specifications where IDOT seed mixtures are specified. In areas where Ameren Energy

02936-1

Generating hay seeding mix is specified, it shall be composed as follows:

<u>Seed Type</u>	<u>Pounds/Acre</u>
Vernal Alfalfa	12
Wrangler Alfalfa	8
Medium Red Clover	6
Timothy	4

- B. Mulch Material and Erosion Control Blanket: Mulch material shall conform to Article 1081.06 and the excelsior blanket/knitted straw mat shall conform to Article 1081.10 of the IDOT Standard Specifications.
- C. Fertilizer and agricultural ground limestone will not be permitted.

PART 3. EXECUTION

3.01 CONSTRUCTION

- A. Seed bed preparation and seeding methods shall conform to Section 250 of the IDOT Specifications. Seeding of areas disturbed by construction activities after September 30, 2008 may be deferred until Spring 2009 at no additional cost to the Owner.
- B. Seed shall be applied to the perimeter berm ditch, to disturbed portions of the perimeter berm, and to all disturbed earth surfaces outside of the existing perimeter berm. IDOT seeding mixture 7 shall be used on stockpiles. IDOT seeding mixture 1A shall be used on the gypsum stack perimeter earthen berm, the recycle pond dam embankment and on slopes that are 4H:1V or steeper. The Ameren hay seed mix shall be used on slopes flatter than 4H:1V.
- C. Application rates for IDOT seed mixtures shall be as specified in Section 250 of the IDOT Specifications. The application rate for the Ameren Energy Resources Generating's seed mix shall be as specified in the Ameren Energy Resources Generating's hay seeding mix.
- D. Seeded areas shall be mulched in accordance with Article 251.03. The Contractor may use either Method 2 or Method 3.

3.02 MAINTENANCE OF COMPLETED WORK

- A. All areas seeded by the Contractor shall be maintained by the Contractor during the period between completion of such work and final completion and acceptance of the Contractor's work by the Owner. This maintenance shall be such that the completed work, at time of acceptance, complies in all respects with the requirements herein

specified.

- B. The areas seeded will be required to germinate. If the seed does not germinate, the Contractor will be required to regrade and reseed at no additional cost to the Owner.

END OF SECTION 02936

02936-3

DIVISION 3 - CONCRETE
Section 03100 - Concrete Formwork

PART 1. GENERAL

1.01 WORK INCLUDES

- A. The complete installation of the formwork for cast-in-place concrete, with shoring, bracing and anchorage, openings for other work, form accessories, form stripping.

1.02 RELATED SECTIONS

- A. Section 03200 - Concrete Reinforcement.
- B. Section 03300 - Cast-In-Place Concrete.
- C. Section 03400 – Concrete Embedment Liner.

1.03 REFERENCES

- A. ACI 347 - Recommended Practice For Concrete Formwork.
- B. ACI 301 - Specifications For Structural Concrete For Buildings.

1.04 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 347 and 301.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for design, fabrication, erection and removal of formwork.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.08 COORDINATION

- A. Coordinate this Section with other Sections of work which require attachment of components of formwork.
- B. If formwork is placed which results in insufficient concrete cover over reinforcement, request instructions from Owner's Representative before proceeding.

PART 2. PRODUCTS

2.01 WOOD FORM MATERIALS

- A. Softwood Plywood: 3/4 in. PS 1-83 "B-B" (concrete form) plywood, Class I, exterior grade or better, mill-oiled and edge sealed with each piece bearing legible inspection trademark.
- B. Architectural Plywood: 3/4 in. PS 1-83 "B-B" plyform, Class I, with High Density smooth overlay, 1 surface, edge sealed with each piece bearing legible inspection trademark.

2.02 MANUFACTURERS - PREFABRICATED FORMS

- A. Weyerhaeuser Concrete Form.
- B. Georgia Pacific, G-P Exterior Soft Wood Plywood Product.
- C. Plywood and Door Corporation's Finn-Form.

2.03 PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

2.04 FORMWORK ACCESSORIES

- A. Form Ties: Snap-off type, galvanized metal, adjustable length, 1 in. back break dimension, free of defects that could leave holes larger than 1 in. in concrete surface; Dayton-Sure Grip snap-in-form ties, as manufactured by Dayton Superior

Corp., Symons Ties as manufactured by Symons Corporation, Snap-Tys as manufactured by Richmond Corporation. Ties shall be removed after forms are removed, and holes filled with mortar that matches the adjacent surfaces.

- B. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture; by Magic Kote manufactured by Symons Manufacturing Co., Form Coat manufactured by Concrete Services Co., Formcel manufactured by Lambert Corp.
- C. Corners: Chamfered, wood strip type; 3/4 x 3/4 in. size on all exterior corners, 3 x 3 in. size where shown on the drawings; maximum possible lengths.
- D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- E. Concrete Embedment Liner, where required, shall be installed in accordance with Section 03400 – Concrete Embedment Liner.

PART 3. EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

- A. Earth forms are not permitted, except for footings.

3.03 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301. Metal forms shall be installed in strict accordance with manufacturer's directions and specifications.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members which are not indicated on drawings.

3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in or passing through concrete work.
- B. Locate and set in place items which will be cast directly into concrete.
- C. Coordinate work of other Sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts.
- D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 FORM CLEANING

- A. Clean and remove foreign matter within forms as erection proceeds.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts or water to clean out forms. Use compressed air or other means to remove foreign matter.

3.07 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

3.08 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- B. Do not reuse wood formwork more than three times for concrete surfaces to be exposed to view. Do no patch formwork.

3.09 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finished concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

END OF SECTION 03100

DIVISION 3 - CONCRETE
Section 03200 - Concrete Reinforcement

PART 1. GENERAL

1.01 WORK INCLUDES

- A. The complete installation of the reinforcing steel bars and accessories for cast-in-place concrete.

1.02 RELATED SECTIONS

- A. Section 03100 - Concrete Formwork.
- B. Section 03300 - Cast-in-Place Concrete.

1.03 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 318 - Building Code Requirements For Reinforced Concrete.
- C. ACI SP-66 - American Concrete Institute - Detailing Manual.
- D. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- E. CRSI - Concrete Reinforcing Steel Institute Manual of Practice.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01010.
- B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel, and bending and cutting schedules. Contract drawings shall not be reproduced as the basis for shop drawings.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with CRSI Manual of Standard Practice.
- B. Submit certified copies of mill test report of reinforcement materials analysis.

03200-1

1.06 COORDINATION

- A. Coordinate with placement of formwork, formed openings and other work.

PART 2. PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars.

2.02 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage, annealed steel wire, epoxy coated when used with epoxy-coated reinforcement.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.
- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.

2.03 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI Manual of Standard Practice and ACI SP-66.
- B. Splice reinforcement on at locations indicated on drawings. Indicate location of splices on shop drawings.

PART 3. EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Clean reinforcement of foreign particles or coatings.
- B. Accommodate placement of formed openings.
- C. Conform to ACI 318 code for concrete cover over reinforcement.

3.02 FIELD QUALITY CONTROL

- A. Contractor shall notify the Owner's Representative at least 24 hrs. in advance of concrete placement. Placement of reinforcing shall occur in such sequence that the Owner's Representative has sufficient time to inspect the correctness of the reinforcing within the placement area. The Owner's Representative retains the right to require necessary revisions be made before concrete is placed.

END OF SECTION 03200

DIVISION 3 - CONCRETE
Section 03300 - Cast-In-Place Concrete

PART 1. GENERAL

1.01 WORK INCLUDES

- A. The complete installation of cast-in-place concrete structures, including joint sealants.

1.02 RELATED SECTIONS

- A. Section 03100 - Concrete Formwork: Formwork and accessories.
- B. Section 03200 - Concrete Reinforcement.
- C. Section 03400 - Concrete Embedment Liner

1.03 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 302 - Guide for Concrete Floor and Slab Construction.
- C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- D. ACI 305R - Hot Weather Concreting.
- E. ACI 306R - Cold Weather Concreting.
- F. ACI 308 - Standard Practice for Curing Concrete.
- G. ACI 318 - Building Code Requirements for Reinforced Concrete.
- H. ASTM C31 - Concrete Test Specimens.
- I. ASTM C33 - Concrete Aggregates.
- J. ASTM C94 - Ready-Mixed Concrete.
- K. ASTM C150 - Portland Cement.
- L. ASTM C260 - Air Entraining Admixtures for Concrete.

M. ASTM C494 - Chemical Admixtures for Concrete.

1.04 SUBMITTALS

A. Product Data: Provide data on joint devices, attachment accessories, admixtures.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Acquire cement and aggregate from same source for all work.

C. Conform to ACI 305R when concreting during hot weather.

D. Conform to ACI 306R when concreting during cold weather.

1.06 COORDINATION

A. Coordinate this Section with other Sections which require embedment of components in cast-in-place concrete.

1.07 PRODUCT DATA

A. Submit proposed mix design to Owner's Representative for review prior to commencement of work. Identify source and provide material certificates for cement, fine and coarse aggregates. Provide recent laboratory gradation for fine and coarse aggregates and mix design information in accordance with ACI 301.

B. Submit Construction joint plan.

PART 2. PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal Portland Type, Gray Color.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: Potable.

2.02 ADMIXTURES

A. Air Entrainment: ASTM C260.

B. Chemical: ASTM C494. Maximum 0.05% Chloride Ion Contents.

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- C. The use of calcium chloride in any concrete is not permitted.

2.03 ACCESSORIES

- A. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.
- B. Curing Compound: Dress and Seal No. 18 by L&M Construction Chemicals, MB-429 by Master Builders, or Sikagard Cure/Hard by the Sika Corporation.
- C. Epoxy Grouted Adhesive Anchors: Hilti, Red Head, Simpson, or Rawl.

2.04 CONCRETE MIX

- A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.
- B. Select proportions for normal weight concrete in accordance with ACI 301.
- C. Provide normal weight concrete of the following characteristics:
 - 1. Compressive strength at 28 days: 4,000 psi.
 - 2. Slump: 4 in. - A tolerance of up to 1 in. above the maximum shall be allowed for one batch in any five consecutive batches tested.
 - 3. Water/cement ratios: 0.4 (max).
- D. Use accelerating admixtures in cold weather only when approved by Owner's Representative. Use of admixtures will not relax cold weather placement requirements.
- E. Use set-retarding admixtures during hot weather only when approved by Owner's Representative.
- F. Water-reducing admixtures may be used in all concrete except footings and in strict compliance with the manufacturer's directions.
- G. Add air-entraining agent to concrete mix for air content of 6% (\pm 1%).

PART 3. EXECUTION

3.01 EXAMINATION

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.02 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.
- B. Notify Owner's Representative minimum of 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, and embedded parts are not disturbed during concrete placement.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Place concrete continuously between predetermined expansion, control, and construction joints.
- F. When air temperature is between 80°F and 90°F, reduce the mixing and delivery time specified in ASTM C94 from 1-1/2 hours to 75 minutes. When the air temperature is above 90°F, reduce the mixing and delivery time to 60 minutes.
- G. Cold weather concreting. Comply with ACI 306 except as follows:
 - 1. In freezing weather, provide suitable means for maintaining concrete temperature at a minimum of 70°F for three days, or 50°F for five days after placing.
 - 2. Cooling of concrete to outside temperature: Not faster than 1° per hour for first day and 2° per hour thereafter until outside temperature is reached.
 - 3. Maximum temperature of concrete produced with heated aggregated, heated water, or both, at any time during its production or transportation: 90°F.
 - 4. Do not mix chemicals or other foreign materials in concrete to prevent freezing or to accelerate hardening of concrete, unless approved in writing by Owner's Representative.
- H. Hot weather concreting. Comply with ACI 305R.
 - 1. ACI recommendations shall be observed when any combination of high air

temperature, low relative humidity and wind velocity tend to impair the quality of fresh or hardened concrete.

2. Retarding and water reducing admixtures shall be approved in writing for each concrete mix design prior to placement.

3.03 CONCRETE FINISHING

- A. Provide exterior concrete formed surfaces to be left exposed with smooth rubbed finish in accord with ACI 301. All other formed surfaces shall have fins, projections and offsets removed.
- B. Provide Class A tolerances to exterior concrete slabs according to ACI 301.
 1. Broom finish all exterior slabs. Broom out all tool marks.
- C. Pitch slabs to drain.

3.04 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for a period necessary for hydration of cement and hardening of concrete in accordance with ACI 308.
- C. Cure and protect finished concrete slabs in accordance with ACI 308.

3.05 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01010, paragraph 8.0.
- B. Testing firm will take cylinders, perform slump and air entrainment tests in accordance with ACI 301.
- C. Provide free access to Work and cooperate with appointed firm.
- D. Submit proposed concrete mix design to Owner's Representative firm for review 14 days prior to commencement of Work.
- E. Testing frequency shall be as specified in Section 01010, paragraph 8, except that one additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

3.06 PATCHING

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Owner's Representative and performed by the Contractor at no additional cost to the project.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Owner's Representative for each individual area.

END OF SECTION 03300

- B. Included with the shipment of liner, submit certified test reports that the liner and material are manufactured in accordance with standards specified herein.

1.05 QUALIFICATIONS

- A. The HDPE liner specified in this section shall be furnished by a manufacturer who is fully experienced, reputable and qualified in the manufacturing of the materials. The manufacturer must at least 10 years of manufacturing experience.
- B. Locking devices must be extruded to the sheet as a one step process.
- C. Liner shall be GSE StudLiner as manufactured by GSE Lining Technology, Inc.
- D. Liner shall be 8 feet in width.
- E. Liner shall demonstrate a minimum pull-out strength of 14,000 psf.

1.06 COORDINATION

- A. Coordinate with placement of formwork, formed openings and other work.

PART 2. PRODUCTS

2.01 ROLL DIMENSIONS

- A. Embedment sheets shall be produced in rolls that are 8.0 ft (2.4 m) in width and a thickness range of 80 mils (2.0 mm) to 200 mils (5.0 mm) in thickness. Roll lengths vary according to thickness.
- B. Locking studs of the same material as that of the liner shall be integrally extruded with the sheet. Stud spacing shall be on approximate 1.25 in (30 mm) centers, such that there are approximately 110 studs per square foot (1200 per square meter).

2.02 MATERIAL PROPERTIES

- A. The material used in the embedment liner and in all welding strips shall be made from 97-98% virgin high density polyethylene and 1.5-3% carbon black or pigmentation for the purpose of an otherwise specified color.
- B. Plasticizer shall not be added to the resin formulation.
- C. Embedment sheet and welding strips shall be free of holes, pinholes, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.

- D. The HDPE cap strips shall be made from HDPE, have good impact resistance and have an elongation sufficient to bridge up to 1/4 inch settling cracks.
- E. Cap strips shall be approximately 4 inches wide or greater and shall be equivalent to that of the liner.
- F. Material shall maintain a repairable state through it's lifecycle by methods approved and recommended by the manufacturer.
- G. Embedment sheets shall have the following physical properties when tested in accordance with Table 1.
- H. Raw resin shall have the following properties when tested in accordance with Table 2.

Table 1: Material Properties

Property	Test Method	Nominal Value				Testing Frequency
Thickness, mm (mil)	ASTM D 5199	2.00 (80)	3.00 (120)	4.00 (160)	5.00 (200)	Every 5 th roll
Density, g/cm ³	ASTM D 1505	0.94	0.94	0.94	0.94	1/100,000 ft ²
Tensile Properties Strength@Yield, lb/in ² (MPa) Elongation @ Break, %	ASTM D 6693 Type IV, Dumbbell G.L. = 2.0in.	2,200 (14.5) 500	2,200 (14.5) 500	2,200 (14.5) 500	2,200 (14.5) 500	1/100,000 ft ²
Stud Pull-Out Strength ¹ , lb/ft ² (kN/m ²)		>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	1/ product
Carbon Black Content/ Pigment Content, % Black Liner Gray Liner	ASTM D 1603, mod. ASTM D 5630, mod.	2-3 1.5 – 2.5	2-3 1.5 – 2.5	2-3 1.5 – 2.5	2-3 1.5 – 2.5	1/100,000 ft ²
Carbon Black Dispersion ²	ASTM D 5596	Note 2	Note 2	Note 2	Note 2	1/100,000 ft ²
Notched Constant Tensile Load, hours	ASTM D 5397	400	400	400	400	1/ formulation
Coefficient of Linear Thermal Expansion, per °C	ASTM D 696	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1/ product
Low Temperature Brittleness, °C	ASTM D 746	-77	-77	-77	-77	1/ product
Dimensional Stability, % (each direction)	ASTM D 1204	± 1.0	± 1.0	± 1.0	± 1.0	1/ product
Water Absorption, %	ASTM D 570	0.1	0.1	0.1	0.1	1/ product
Water Vapor Transmission, (g/m ² /day)	ASTM E 96	<0.01	<0.01	<0.01	<0.01	1/ product

¹Note: Concrete must have a compressive strength of at least 5,000 lb/in² (34,540 kPa).

²Note: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view for category 3.

Table 2: Raw Material Properties

Property	Test Method	Value	Testing Frequency
Density, g/cm ³	ASTM D 1505	0.932	1/ resin lot
Melt Flow, g/10 min	ASTM D 1238 (190/2.16)	≤ 1.0	1/ resin lot
OIT, minutes	ASTM D 3895 (1atm/200°C)	100	1/ formulation

2.03 MATERIAL SUPPLY

- A. Embedment sheets shall be supplied in roll form, sheets, pre-fabricated tubes or panels.
- B. Cap strips shall be supplied in 4 inch widths or greater.

PART 3. EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Clean reinforcement of foreign particles or coatings.
- B. Accommodate placement of formed openings.
- C. Conform to ACI 318 code for concrete cover over reinforcement.

3.02 FIELD QUALITY CONTROL

- A. Contractor shall notify the Owner's Representative at least 24 hrs. in advance of concrete placement. Placement of the Concrete Embedment Liner shall occur in such sequence that the Owner's Representative has sufficient time to inspect the correctness of the placement within the concrete formwork area. The Owner's Representative retains the right to require necessary revisions be made before concrete is placed.

END OF SECTION 03200

APPENDIX 2

CONSTRUCTION QUALITY ASSURANCE PLAN

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FIGURES

Figure 2.1 Project Organization Chart

End of Text

Figure 11.1 Control of CQA Documents and Samples

End of Text

APPENDICES

A – Table A.1 Material Testing & Frequency

B – Procedure for Determining Soil Liner Acceptable Zone for Compaction and Moisture Content

C – Forms CQAP-2.1, CQAP-4.1, CQAP-8.1, CQAP-8.2 & CQAP-10.1

1.0 INTRODUCTION

This Plan describes the Construction Quality Assurance (CQA) program for the proposed Gypsum Management and CCB Landfill Facilities at the Ameren Duck Creek Power Plant in Fulton County, Illinois. The plan has been developed in accordance with the requirements of 35 IAC Part 811, Subpart E entitled *Construction Quality Assurance Programs*.

The Plan requires a scheduled program of CQA monitoring, inspection, sampling and testing to verify compliance with project plans and specifications. The Plan also addresses the testing requirements for test soil liners that will be constructed to verify materials and construction methods for the full-scale liners. The goal of this program is to achieve a reasonable degree of certainty that the construction of the facilities meets the specified designs.

Appendix A lists the testing methods, acceptance requirements and testing frequencies that shall guide the implementation of this plan. Also listed is the party responsible for conducting the testing for each of the constructed components of the landfill. The plan requires oversight by the CQA Officer for all testing carried out by the geosynthetic installers.

The CQA Plan also requires preparation by the CQA Officer of a final report at the end of construction that provides all inspection and testing documentation and certifies that the facilities have been constructed in accordance with the engineering design.

This Plan is intended to supplement the project plans and specifications. Where a conflict exists, the approved CQA Plan will govern.

2.0 RESPONSIBILITY AND AUTHORITY OF PROJECT PERSONNEL

The project participants involved in the construction and quality assurance oversight of the construction are shown in Figure 2.1 *Project Organization Chart*. The Owner is the Ameren Energy Resources Generating Company (AERG or Ameren) who will retain a General Contractor to construct the facilities and a CQA Officer to provide the quality assurance oversight services. The following list the responsibilities and authority of each of the participants shown in Figure 2.1.

2.1 Owner

Ameren Energy Resources Generating Company (Ameren) is responsible for obtaining all necessary permits for construction and operation of the facilities. Ameren retains under contract all parties for the construction including the General Contractor, the Design Engineer (Hanson Professional Services Inc.), the CQA Officer, and the CQA testing and monitoring firms.

The Ameren Construction Manager will be in charge of coordinating overall construction activities and will act as Ameren's primary interface with the General Contractor. The Construction Manager coordinates all matters involving contract issues with the Ameren Project Manager including approving field changes to the project plans and specifications.

2.2 Design Engineer

The Design Engineer (Hanson Professional Services Inc.) is responsible for development of plans and specifications that fulfill the needs of the Owner and meet the requirements of the regulatory agencies. The Design Engineer is also responsible for responding to Contractor requests for information (RFIs) during the construction process as may be required to clarify the plans and specifications or to address identified conflicts in the documents. The Design Engineer is further responsible for developing any modifications to the plans and specifications as may be required to address changed field conditions, field cost savings, design improvements or other necessary or desired modifications as approved by the Owner.

2.3 CQA Personnel

2.3.1 Key Personnel (Owner's Representative)

Ameren will retain a CQA Officer for the project who will report directly to Ameren's Construction Manager (see Figure 2.1 *Organization Chart*). The CQA Officer shall be a professional engineer registered in the State of Illinois, who is a person other than the operator or an employee of the operator, and who will supervise and be responsible for all inspection, testing, and other activities required to be implemented as part of the CQA program. The CQA Officer will also be responsible for, and will provide direct supervision to, the testing and monitoring firms shown in Figure 2.1 who will perform the monitoring, testing, sampling, and inspections required by the CQA program as described more specifically in Section 6.0. The CQA Officer will be present at the outset of major undertakings and at critical times during the construction. The time that the CQA Officer must be at the project site will be dependent upon the type of construction being conducted. The CQA Officer will exercise his/her own professional judgment to be present at the project site as required to assume full responsibility for the inspection and testing performed by those persons under his/her direct supervision. The CQA Officer shall have sufficient on-site full-time staff to adequately carry out the quality assurance activities specified herein.

If the CQA Officer is unable to be present to perform duties as outlined, then the CQA Officer will provide, in writing, reasons for his/her absence including designation of the person who will exercise professional judgment in carrying out the duties of a CQA Officer as the designated CQA Officer-in-absentia. A signed statement shall be provided and recorded that the CQA Officer assumes full responsibility for all inspections performed and reports prepared by the designated CQA Officer-in-absentia during any absence of the CQA Officer.

It is required that the CQA Officer (or his designated representative), with on-site support personnel as required, provide oversight of the monitoring, inspection, testing and/or sampling of the following construction activities for the facilities:

- Test Liner,
- Excavation, grading, and preparation of the subgrade and foundation,
- Placement of the compacted soil liner,
- Placement of geosynthetic components,

- Installation of the leachate drainage and collection systems.
- Construction of surface water ditches, channels, berms, and drainage structures, and
- Placement of concrete structures.

The CQA Officer (or his designated representative) must certify that the sampling, inspection and test results for the major elements of the construction are in compliance with established design requirements before subsequent sequential items of the construction can be initiated. The major elements of Work requiring compliance certification include:

- Subgrade prior to placement of soil test liner (CCB landfill facility only).
- Soil test liner prior to placement of the low permeability soil liner.
- Subgrade prior to placement of the low permeability soil liner (CCB landfill facility only),
- Low permeability soil liner prior to placement of the geosynthetic clay liner (GCL),
- GCL liner prior to placement of the geomembrane.
- Geomembrane prior to placement of the geotextile cushion,
- Geotextile cushion prior to placement of the drainage layer,
- Piping installation prior to completed placement of the drainage layer,
- Drainage layer prior to placement of geotextile fabric.
- Cushion Dirt prior to placement of the geomembrane (gypsum facility only), and
- Geosynthetic installations in anchor trenches prior to backfilling.

Certification will require a through review of all inspection, sampling and testing completed for the work item to ensure that all design requirements have been met, a visual inspection of the work item, and the completion and signing of form CQAP 2.1 *CQA Certification* by the CQA Officer. The Contractor or Installer for the immediately following item of work shall not be allowed to initiate work until completion of the signed form by the CQA Officer.

The completed and signed forms CQAP-2.1 shall be filed as a project records in accordance with the provisions of Section 11.0

2.3.2 Document Controller

The staff of the CQA Officer shall include a Document Controller who will be responsible for: (1) control of the CQA Plan to ensure that only current documents are being employed by the CQA staff and (2) filing of all CQA records related to the monitoring, sampling, inspecting and testing specified in the CQA Plan.

Requirements for control of the CQA Plan and for filing of project records are presented in Section 11.0.

2.4 Testing and Monitoring Firms

The testing and monitoring firms, under the direction of the CQA Officer (see Figure 2.1), shall be responsible for conducting the quality assurance sampling, inspection and testing required by Section 6.0 of the CQA Plan except that only monitoring and limited (independent) sampling and testing shall be required for the geosynthetics (i.e., geomembranes, geosynthetic clay liners and

geotextiles). The suppliers and installers shall be responsible for all the sampling and testing required by Section 6.0 for the geosynthetics (see Section 2.6).

2.4.1 Soil/Concrete Testing (Lab and Field)

One or more soil/concrete testing firms that has been qualified by the Illinois Department of Transportation (IDOT) will be retained to perform the field and laboratory sampling and testing required by the CQA Plan. Materials sampled and tested will include fine-grained soils, coarse grained soils, aggregates, rip rap and concrete.

Each firm shall be required to provide "certificates of calibration" (or other proof of calibration) to the CQA Officer for each of the measuring and/or test equipment used in the laboratory or field; except that such certificates are not required for commercial grade equipment such as rulers, tape measures or other devices that provide adequate accuracy for their intended purpose.

All field and laboratory forms proposed for collection of data shall be subject to review by Ameren prior to use. Forms deemed to be incomplete or otherwise shall be modified to meet the intent of the CQA Plan.

2.4.2 Surveyor

One or more surveyors will be retained to verify attainment of specified elevations, slopes and grades within the tolerances required by the CQA Plan. The firm(s) selected shall have the capacity to complete all work by or under the supervision of an Illinois Professional Land Surveyor.

Each surveyor will be required to provide "certificates of calibration" (or other proof of calibration) to the CQA Officer for each surveying device used; except that such certificates are not required for commercial grade equipment such as rulers, tape measures or other devices that provide adequate accuracy for their intended purpose.

All field forms proposed for collection of data shall be subject to review by Ameren prior to use. Forms deemed to be incomplete or otherwise unacceptable shall be modified to meet the intent of the CQA Plan.

2.4.3 Geosynthetics Monitor and Geosynthetics Testing Laboratory

A geosynthetics monitoring firm will be retained to conduct oversight of the quality assurance inspections, testing and sampling carried out in the field by the suppliers and installers for the geosynthetics (see Section 2.5) to ensure that the requirements of the CQA Plan are met including directing additional inspection, sampling and testing as may be deemed necessary by the monitoring firm. The monitoring firm will also collect its own representative samples of the geosynthetics for independent testing by a geosynthetics testing laboratory. The monitoring firm shall have previous experience in installation oversight of at least 10,000,000 sq. ft. of similar geosynthetic materials.

The laboratory will be independent of both the manufacturer and the installer of the geosynthetics and will be required to have its own QA plan for the project work. The QA Plan shall be subject to review by Ameren prior to start of services.

All field and laboratory forms proposed for collection of data shall be subject to review by Ameren prior to use. Forms deemed to be incomplete or otherwise unacceptable shall be modified to meet the intent of the CQA Plan.

2.5 Contractors, Suppliers and Installers

The contractor, subcontractors, suppliers and installers are responsible for completing their portions of the work within specified schedules and in accordance with the requirements of the plans and specifications. They additionally shall accommodate the monitoring, sampling, inspections and testing that are the responsibility of the CQA Officer under the QCA Plan.

The geosynthetic Suppliers and Installers shall provide the quality assurance inspection, sampling and testing as required by Section 6.0 of the CQA Plan. Additionally, the geosynthetic suppliers shall be required to submit "certificates of acceptance" for certain items of work that precede their construction activities. The "certificates" are more specifically discussed in Section 4.0.

3.0 PROJECT MEETINGS

Periodic meetings will be held during the life of the project to enhance coordination among the various parties involved. Meetings will include preconstruction meetings, routine progress meetings and, as needed, problem or work deficiency meetings.

3.1 Preconstruction Meetings

Preconstruction meetings shall be held at the site for the major earthwork items and geosynthetic installations. At a minimum, the Ameren Construction Manager, the CQA Officer, representatives of the testing firms, and the earthwork contractor or geosynthetic installer should attend. In addition to the topics for discussion as listed in the project specifications, the following CQA items will be covered:

- Discuss the established protocol for inspections, tests and sampling including use of form CQAP 8.1 *Daily Inspection Report* (see Section 8.0).
- Discuss items of work requiring CQA Officer certification or Installer acceptance before subsequent work items can be initiated (see Section 4.0), and
- Discuss the established protocol for handling construction deficiencies, corrective measures, and retesting (see Section 7.0).

The meeting shall be conducted by the Ameren Construction Manager or CQA Officer and will be documented by CQA personnel with distribution to all attendees. Meeting minutes will be filed as project records in accordance with Section 11.0.

3.2 Progress Meetings

At the discretion of the Ameren Construction Manager or the CQA Officer, brief progress meetings will be scheduled to discuss on-going and up-coming construction activities. The meeting will be attended by the Ameren Construction manager, the CQA Officer, and the appropriate site foreman (i.e. when earthwork is being performed, the earthwork foreman will be present; when geosynthetics are being installed, the installer foreman will be present, etc.). In addition to the CQA Officer topics of discussion regarding progress, the following CQA items should be reviewed:

- Discuss the established protocol for inspections, tests and sampling including use of form CQAP 8.1 *Daily Inspection Report* (see Section 8.0).
- Discuss items of work requiring CQA Officer certification or Installer acceptance before new work items can be initiated (see Section 4.0), and
- Discuss the established protocol for handling construction deficiencies, corrective measures, and retesting (see Section 7.0).

These meetings will be documented by the CQA Officer with distribution to all attendees including the Ameren Project Manager. Meeting minutes will be filed as project records in accordance with Section 11.0.

3.3 Problem or Work Deficiency Meetings

Special meetings will be approved by the CQA Officer when a problem or work deficiency is present (or is likely to occur) that is (or could be) of a serious nature. At a minimum, the meeting should be attended by the Ameren Construction Manager, earthwork or installer foremen as appropriate, and the CQA Officer. The Ameren Project Manager should attend those meetings that include discussions of severe and/or recurring problems or deficiencies. The purpose of these meetings is to define and resolve the problem or work deficiency in the following manner:

- Define the problem or deficiency and its probable causes,
- Discuss alternative actions to address the problem or deficiency ,
- Implement the selected action to resolve the problem or deficiency, and
- Verify that the implemented action has been effective.

The meeting will be documented by the CQA Officer with distribution to all attendees including the Ameren Project Manager. Meeting minutes will be filed as project records in accordance with Section 11.0.

4.0 IN-PROGRESS ACCEPTANCE OF WORK

4.1 Introduction

It is very important during placement of the geosynthetics not to entrap fugitive clay, stones, sand, etc. that could damage the geosynthetic, cause clogging of drains or filters, or hamper seaming of the geosynthetic. The geosynthetic installers shall accept responsibility for inspecting

the substrate (on a daily basis) to ensure such entrapments are not present within the substrate area to be covered each day. When found acceptable, the installer shall complete and sign form CQAP-4.1 *Installer Certificate of Acceptance* that documents (on a daily basis) acceptance of the substrate for geosynthetic placement. The installer shall provide the original signed document to the CQA Officer for his signature of receipt.

Completed and signed forms CQAP-4.1 shall be filed as project records in accordance with the provisions of Section 11.0.

4.2 Elements of Work Requiring Prior Acceptance

The following table cites the elements of work that shall require daily "certificates of acceptance" for the substrate including the installer responsible for providing the certification. Any other areas of geosynthetic installation not included in the table shall still be subject to the requirements of this section.

Table 4.1 Installer Certifications for Acceptance of Work

Substrate to Be Accepted by Installer	Installer
1. Surface of Low Permeability Soil Liner	Geosynthetic Clay Liner (GCL) Installer
2. Surface of Geosynthetic Clay Liner (GCL)	Geomembrane Installer
3. Surface of Geomembrane	Geotextile Cushion Installer
4. Surface of Drainage Layer	Geotextile Filter Installer
5. Surface of Cushion Dirt	Geomembrane Installer

5.0 TEST SOIL LINER

5.1 Introduction

A compacted low permeability soil test liner shall be constructed within the footprint of the proposed soil liner prior to any work being initiated on the full scale construction. The purpose of the test liner is to verify that the materials and methods of construction proposed for the full scale liner will provide the quality of construction required by the CQA Plan. Additional soil test liners shall be constructed for each time the material properties from a new borrow source are found to be significantly different or there is a significant change in the methods of construction and/or equipment.

The test liner will be constructed on a competent foundation from the same prequalified soil material sources, to the same design specifications, and with similar equipment and procedures as are proposed by the contractor for the full scale liner. The foundation (subgrade) for the soil test liner shall be subject to the requirements of Section 6.2.1 and sampling/testing for material prequalification and placement shall be that provided in Section 6.2.2 except that:

1. The survey grid for foundation grade verification and for liner thickness verification shall be as established by the CQA Officer.
2. The frequencies for placement testing shall be as established by the CQA Officer.
3. The testing for hydraulic conductivity shall be as provided in Section 5.2.

5.2 Sampling and Testing Program

The soil test liner shall be sampled and tested under the direction of the CQA officer as described below for each of the physical properties listed.

1. At least five (5) two-stage field tests (ASTM designation D 6391-06) shall be used on the test liner to determine the hydraulic conductivity. Both the vertical hydraulic conductivity (k_1) and the horizontal hydraulic conductivity (k_2) shall be calculated.
2. Undisturbed samples (Shelby tubes) will be tested in the laboratory for vertical hydraulic conductivity to determine if there is a statistical correlation to the field testing results. At least two (2) samples should be tested.
3. The determination of other engineering parameters including, but not limited to, particle size analysis, liquid limits, plastic limits, water contents, and unconfined compressive strengths that are needed to evaluate the full scale liner shall be as directed by the CQA Officer.

5.3 Requirements for CQA Certification of Test Soil Liner for Landfill Construction

1. At least four of the five field hydraulic conductivity tests shall result in a measured vertical hydraulic conductivity of 5.0×10^{-7} cm/sec or less. No test shall have a hydraulic conductivity greater than 1.0×10^{-6} cm/sec.
2. The laboratory hydraulic conductivity tests shall indicate a measured vertical hydraulic conductivity of 1.0×10^{-6} or less.

5.4 Requirements for CQA Certification of Test Soil Liner for Gypsum Stack

1. At least four of the five field hydraulic conductivity tests shall result in a measured vertical hydraulic conductivity of 5.0×10^{-5} cm/sec or less. No test shall have a hydraulic conductivity greater than 1.0×10^{-3} cm/sec.
3. The laboratory hydraulic conductivity tests shall indicate a measured vertical hydraulic conductivity of 1.0×10^{-4} or less.

5.5 Report of Results and Certification

The CQA Officer shall prepare reports describing the test programs carried out and the results obtained. The reports shall be filed as project records in accordance with Section 11.0.

The CQA Officer shall review the sampling and test results for the test soil liners and, if found in agreement with requirements, provide certification for the work using form CQAP 2.1.

6.0 SAMPLING AND TESTING REQUIREMENTS

6.1 Introduction

Prequalification and placement sampling/testing requirements for the various materials and construction activities are as summarized in Table A.1. Frequencies for material placement testing listed in Table A.1 are based on the volume of material used in construction and are to be considered minimums. The CQA Officer shall select the specific locations for testing on a random basis exercising professional judgment to ensure that testing and sampling fairly represent the construction.

The testing firms under the direction of the CQA Officer shall be responsible for the sampling and testing listed in Table A.1 for: (1) the Soils Prequalification and Placement Testing, (2) the Drainage Media Prequalification and Placement Testing, and (3) the Other Material Placement Testing. The geosynthetic installers shall be responsible for the sampling and testing listed in Table A.1 for the Geosynthetics Prequalification and Placement Testing with daily overview (and some independent laboratory testing) by the geosynthetic firms and the CQA Officer.

The results of the sampling and testing shall be documented on a daily basis by each agency or installer providing the quality assurance activities and the originals of the sampling and testing results provided to the CQA Officer. The CQA officer shall complete form CQAP 8.1 *Daily Inspection Report* (see Section 8.0) for each of the testing firms or installer providing results and attach the results to the form. The completed form CQAP 8.1 and attached results shall be incorporated into the *Daily Summary Report* (see Section 8.0).

6.2 Soils

6.2.1 Foundation (Subgrade) – Low Permeability Soil Liner

6.2.1a. Foundation Grade Verification

Following excavation for the low permeability soil liner, the CQA Officer shall direct the surveyor to verify that actual depths and grades of the foundation (subgrade) are in accordance with the plans and specifications. Elevations shall be surveyed on a 100 ft grid pattern for the bottom of the cell. The points surveyed for side slopes will be at the top, midpoint, and toe. In addition, all breaks in grade will be surveyed. Foundation excavation grading shall meet a control tolerance requirement of 0 ft to -0.4 ft. The measured depths and grades shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor.

The CQA Officer shall review the survey data for conformance to requirements and, if found in agreement with requirements, provide certification for the work using form CQAP 2.1.

6.2.1b. Foundation Fill

Foundation (subgrade) materials not meeting the requirements of the plans and specifications are required to be excavated and replaced with suitable foundation fill to develop a stable foundation for the landfill. The CQA Officer shall make a foundation inspection with the soil testing firm and direct any sampling and testing necessary to identify areas requiring removal and replacement. The CQA Officer shall inform the earthwork contractor of unsuitable areas requiring removal and replacement.

Foundation fill used by the contractor for replacement shall be sampled and tested by the soil testing firm to check compliance with the prequalification and placement requirements listed in Table A-1. The CQA Officer shall direct the surveying firm to determine the locations and extent of all removal and replacement activity and to document all such information on "as built" drawings to be furnished to the CQA Officer.

The CQA Officer shall review the sampling and test results for the foundation fill and, if found in agreement with the prequalification and placement requirements, provide certification for the work using form CQAP 2.1. The certification for foundation fill may be provided on the same form providing the certification for foundation grade.

6.2.2 Low Permeability Soil Liner

6.2.2a. Prequalification Testing

Table I.1 requires that prequalification testing for each soil type being used for liner construction at the landfill include the development of an "acceptable zone" of moisture-density for the compacted soil that will result in a liner with a minimum hydraulic conductivity of 1.0×10^{-6} cm/sec. The resulting "acceptable zone" then serves as the major control for material placement during construction.

The CQA officer shall direct the soil testing agency to determine the "acceptable zone" for each soil type to be used for landfill liner construction and provide the results in a written report to be available for comparisons with the material placement testing results. The determination of the "acceptable zone" shall be in accordance with Appendix B or other published methodology used in the profession. The report will be filed as a project record in accordance with Section 11.0.

There is no prequalification testing required for the soil materials to be used for the gypsum stack liner construction except that the materials selected shall have sufficient fines to achieve the in-place hydraulic conductivity specified in Section 5.4.

6.2.2b. Material Thickness Testing

The CQA Officer shall direct the survey agency to determine elevations at the foundation of the soil liner and at the final constructed surface using a 100 ft grid pattern (and the break points in slope) to verify attainment of the plan grades and elevations. To verify liner thickness, all horizontal survey coordinates shall be the same for the foundation and final constructed surface. Side slope thicknesses will be verified using crest (top), midpoint, and toe documentation points.

The measured depths and grades shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor agency.

6.2.2c. Moisture/Density Testing

Moisture/density testing of the compacted soil liner shall be conducted by the soil testing agency under the requirements and at the frequencies specified in Table A.1. During construction of the soil liner the CQA Officer shall confirm the following:

- Use of the same construction equipment as used in the test soil liner.
- Use of same procedures, such as number of passes and speed,
- Uniformity of coverage by compaction equipment,
- Consistent achievement of density, water content and permeability of each successive lift.
- Use of methods to bond successive lifts together.
- Achievement of liner strengths on sidewalls,
- Contemporaneous placement of protective covering to prevent drying and desiccation, where necessary,
- Prevention of placement of frozen material or the placement of material on frozen ground,
- Prevention of damage to completed liner sections, and
- That construction proceeds only during favorable climatic conditions.

6.2.2d. Hydraulic Conductivity Testing

Samples of the in-place liner shall be obtained and tested for hydraulic conductivity under the requirements and at the minimum frequency as specified in Table A.1. Multiple samples may be collected at a given test location for the purpose of retesting in the event of unacceptable hydraulic conductivity results from the initial sample.

Boreholes, excavations or other disturbances to the soil liner resulting from the obtainment of samples shall be backfilled as directed by the CQA Officer.

6.2.2e. Certification of Work

The CQA Officer shall review the sampling and test results for the low permeability soil liner and, if found in agreement with the prequalification and placement requirements, provide certification for the work using form CQAP 2.1.

6.2.3 Berms

6.2.3a. Landfill Containment Berms

The CQA Officer shall direct verification of excavated foundation (subgrade) depths and grades as specified in Section 6.2.1a except that the foundation grid shall be as directed by the CQA Officer. Foundation fills shall be as specified in Section 6.2.1b.

Prequalification testing for material sources shall meet the requirements in Table A.1.

The CQA Officer shall direct the soil agency to conduct the following inspection activities during berm construction:

- Observation of fill material characteristics.
- Observation of loose lift thickness.
- Observation of clod size reduction and material homogenization, and
- Placement testing as specified in Table A.1.

Documentation of construction on "as-built" plans shall be as specified in Section 6.5.2.

The CQA Officer shall review the sampling and test results for the landfill containment berms and, if found in agreement with the prequalification and placement requirements, provide certification for the work using form CQAP 2.1.

6.2.3b Temporary Cell Separation Berms

The CQA Officer shall direct verification of excavated foundation (subgrade) depths and grades as specified in Section 6.2.1a except that the foundation grid shall be as directed by the CQA Officer. Foundation fills shall be as specified in Section 6.2.1b.

Prequalification testing for material sources shall meet the requirements in Table A.1.

The CQA Officer shall direct the soil agency to conduct the following inspection activities during berm construction:

- Observation of fill material characteristics.
- Observation of loose lift thickness.
- Observation of clod size reduction and material homogenization.
- Placement testing as specified in Table A.1, and
- Measurements of berm slopes.

6.3 Geosynthetics

6.3.1 Geosynthetic Clay Liner (GCL)

6.3.1a. Prequalification Testing

The geosynthetic clay liner (GCL) installer shall provide to the CQA Officer the test results from a qualified laboratory for the type and frequency of prequalification testing listed in Table A.1. The submittal shall include certification from the laboratory that the test results verify the manufacturer's guaranteed properties.

The CQA Officer shall direct the geosynthetics QA monitor firm to select a representative number of additional samples of the GCL for submittal to the monitor's geosynthetic laboratory for independent verification of the manufacturer's guaranteed properties.

The results of laboratory testing shall meet the GCL manufacturer's specifications as shown in the following table.

GCL Laboratory Testing Methods/Minimum Values Required	
Test Method	Minimum Value
Bentonite Mass/Area (ASTM D5993)	0.75 lb./ft ²
GCL Grab Tensile Strength (ASTM D4632)	90 lb.
GCL Peel Strength (ASTM D4632)	15 lb.

The installer shall direct the test laboratory to submit the results of all laboratory test results and certification to the Document Controller for filing as project records in accordance with Section 11.0.

6.3.1b. Installer Certification of Placement Surface

Prior to daily clay liner placement, the installer shall provide to the CQA Officer daily "certificates of acceptance" (form CQAP-4.1) which document the installer's inspection and acceptance of the underlying surface as being suitable for the GCL installation (see Section 4.0).

All daily "certificates of acceptance" (form CQAP-4.1) shall be filed as project records in accordance with Section 11.0.

6.3.1c Deployment

The CQA Officer shall direct the geosynthetic QA monitor firm to oversee activities of the installer during placement and field testing of the GCL.

Incoming rolls of GCL shall be inventoried and inspected by the installer. Manufacturer's certifications will be inspected for conformance with the requirements of this plan. Holes or other visible defects shall be recorded in the CQA Officer's daily report and clearly marked on the GCL roll for identification of necessary repairs or rejection of the roll.

GCL shall be placed such that all seams run parallel to the slope. GCL should be dry when installed. Wet or hydrated GCL shall not be used. GCL panels shall be laid with a minimum 6 in. overlap on longitudinal seams and a minimum 12 in. overlap on panel end seams. Seam overlaps shall be placed such that the direction of flow is from the top panel to the underlying panel to form a shingle effect. Direct contact with GCL shall be minimized.

6.3.1d. Seaming

The GCL shall be sealed in accordance with the recommendations of the GCL manufacturer. Dry bentonite having the same chemical and material properties as the GCL shall be evenly dispersed from the panel edge to the lap line continuously along the seam or overlap areas. All dirt, gravel, or other debris shall be removed from the seam or overlap areas.

Prior to covering the GCL, the installer shall verify all exposed seams or overlaps and examine the GCL for any defects. At the judgment of the installer, a panel or section that becomes seriously damaged or hydrated shall be replaced. All repairs shall be made by placement of a

patch of the same material over the damaged area at least 1 ft beyond the repair area. The GCL will be immediately covered and protected from precipitation by the overlaying geomembrane.

6.3.1e. Shear Strength Conformance Testing

Shear strength conformance tests shall be performed on the GCL to verify the interface shear strengths of the GCL with the appropriate material (HDPE geomembrane or compacted clay). The results of the shear strength conformance tests will be used to confirm that the actual interface shear strengths are equal to or greater than the interface shear strengths used in the stability analyses. Shear strength conformance tests on subsequent phases and/or cell development need not be performed if the same manufacturer and materials are used in the construction of the subsequent phase and/or cell. Conformance testing shall be in accordance with ASTM D 5321 or other suitable method.

6.3.2 Geomembrane

6.3.2a. Prequalification Testing

The geomembrane installer shall provide to the CQA Officer the test results from a qualified laboratory for the type and frequency of prequalification testing listed in Table A.1. The submittal shall include certification from the laboratory that the test results verify the manufacturer's guaranteed properties.

The CQA Officer shall direct the geosynthetics QA monitor firm to select a representative number of additional samples of the geomembrane for submittal to the monitor's geosynthetic laboratory for independent verification of the manufacturer's guaranteed properties.

The installer shall direct the test laboratory to submit the results of all laboratory results and certification to the Document Controller for filing as project records in accordance with Section 11.0.

6.3.2b. Installer Certification of Placement Surface

Prior to daily geomembrane placement, the installer shall provide to the CQA Officer daily "certificates of acceptance" (form CQAP-4.1) which document the installer's inspection and acceptance of the underlying surface as being suitable for the geomembrane installation (see Section 4.0).

All daily "certificates of acceptance" (form CQAP-4.1) shall be filed as project records in accordance with Section 11.0.

6.3.2c. Placement Testing for Seam Overlap

The contractor and installer shall arrange geomembrane sections such that the use of field seams is minimized and that horizontal seams are not used on side slopes. Seam overlaps shall be field measured by the installer to verify the requirement in Table A.1 is met for all seams within the geomembrane footprint. The CQA Officer shall direct the geosynthetics QA monitor firm to

make independent measurements of a representative number of seam overlaps for additional verification of the requirement in Table A.1.

At completion of geomembrane placement, the installer shall provide the CQA Officer with "as-built" drawings of the geomembrane installation showing all seam locations and seam measurement locations.

6.3.2d. Placement Non-Destructive Testing

The installer shall conduct non-destructive testing of seams at the frequency specified in Table A.1. All seams shall be nondestructively tested over their full-length using a vacuum test unit, air pressure test or other method approved by the CQA Officer. Continuity testing will be completed as the seaming progresses.

The CQA Officer shall direct the geosynthetics QA monitor firm to monitor all non-destructive testing carried out by the installer.

The installer shall submit all non-destructive field testing results to the CQA Officer for filing as project records in accordance with Section 11.0.

Vacuum testing and air pressure testing procedures shall be as given in the following sections.

Vacuum Testing (Extruded Welds)

The following procedures are applicable to those processes which produce an extruded weld.

Equipment

The following equipment shall be used when conducting vacuum tests:

- A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, a port hole or valve assembly, and a vacuum gauge,
- A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections,
- A rubber pressure/vacuum hose with fittings and connections,
- A bucket, and
- A soapy solution.

Procedures

The following procedures will be followed:

1. Energize the vacuum pump and reduce the tank pressure to approximately minus 5 psi (10 in. of Hg) gauge.
2. Wet a strip of geomembrane approximately 12 in. wide by 48 in. long (an area larger than the coverage size of the vacuum box) with the soapy solution.
3. Place the box over the wetted area.
4. Close the bleed valve and open the vacuum valve.
5. Verify that a leak tight seal is created.

6. For a period of not less than 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
7. If no bubble appears after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area, repeat the process.
8. All areas where soap bubbles appear will be marked and repaired and then retested until passing test results are obtained.

Air Pressure Testing (For Double Fusion Seam Only)

The following procedures are applicable to those processes which produce a double seam with an enclosed space.

Equipment

The equipment will be comprised of the following:

- An air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining a pressure between 25 psi to 30 psi and mounted on a cushion to protect the geomembrane.
- A rubber hose with fittings and connections, and
- A sharp hollow needle, or other approved pressure feed device.

Procedures

The following procedures will be observed:

1. Both ends of the seam to be tested will be sealed.
2. A needle or other approved pressure feed device will be inserted into the tunnel created by the fusion weld.
3. A protective cushion will be inserted between the air pump and the geomembrane.
4. The air pump will be energized to a pressure between 25 psi and 30 psi. The valve will be closed, and the pressure will be sustained for approximately 5 minutes.
5. If loss of pressure exceeds 3 psi or does not stabilize, the faulty area will be located, then repaired and retested until passing test results are obtained.
6. At the conclusion of a passing air pressure test, the opposite end of the seam will be slit and subsequent drop in pressure will be monitored. This will ensure that the entire seam was completely tested.
7. Remove needle or other approved pressure feed device and seal.

6.3.2e. Placement Destructive Testing

General

Destructive seam tests shall be performed at randomly selected geomembrane locations. The purpose of these tests is to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

The CQA Officer shall direct the geosynthetics QA monitor firm to monitor all destructive testing carried out by the installer.

The installer shall submit the results of all destructive testing to the CQA Officer for filing as project records in accordance with Section 11.0.

Location and Frequency

The installer shall select locations where seam samples will be cut out for testing. Those locations shall be established as follows:

1. Selection will be at a minimum frequency of one test location per 500 ft of seam length. This minimum frequency is to be determined as an average taken throughout the entire area of placement.
2. Test locations will be determined during seaming at the installer's discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of imperfect welding.

The CQA Officer shall direct the geosynthetics QA monitor firm to select and cut out a representative number of additional samples for independent laboratory testing.

Sampling Procedure

Samples will be cut as the seaming progresses in order to have laboratory test results before the geomembrane is covered by another material. The installer shall:

- Assign a number to each sample, and mark it accordingly.
- Record sample location on layout ("as-built") drawing, and
- Record reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the geomembrane).

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired. The continuity of the new seams in the repaired area shall be vacuum tested.

Field Testing

The installer shall test in the field, by tensiometer, two 1 in. wide sample strips from the samples identified for destructive testing; one for peel and one for shear. This testing shall include the independent samples obtained by the geosynthetics QA monitor firm. Field testing will prequalify samples for laboratory testing. The requirements and frequency for field testing shall be as provided in the table at the end of this section.

The installer shall conduct all field tests and mark all samples and portions with their number. The installer shall also log the date, time, ambient temperature, number of seaming unit, name of seamer, welding apparatus temperatures and pressures, and pass or fail description, and attach a copy to each sample portion.

Geosynthetic Quality Assurance Laboratory Testing

Prequalifying field tests shall identify samples for laboratory testing. The installer's quality assurance laboratory shall be as selected by the installer with concurrence of the CQA Officer.

Testing shall include shear strength and peel adhesion. At least five specimens shall be tested by the installer's laboratory for each method. Specimens shall be selected alternately by test from the samples (i.e., peel, shear). All laboratory testing shall be accordance with ASTM D 4437.

The CQA Officer shall direct the geosynthetic QA monitor firm to have additional samples tested for peel and strength by the monitor's independent geosynthetics laboratory as deemed necessary.

Procedures for Destructive Test Failure

The following procedures will apply whenever a sample fails a destructive test, whether the test was conducted in the laboratory or by field tensiometer. The installer has two options:

1. The installer may reconstruct the seam between any two passed test locations.
2. The installer may trace the welding path to an intermediate location at least 10 ft from the point of the failed test in each direction, and take a small sample for an additional field test at each location. If these additional samples pass the tests, then full laboratory samples are taken. If these laboratory samples pass the tests, then the seam is reconstructed between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed.

All acceptable seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 ft of reconstructed seam, a sample taken from the zone in which the seam has been reconstructed must pass destructive testing.

The installer will document all actions taken in conjunction with destructive test failures.

Geomembrane Destructive Seam Tests and Frequency					
Property	Test Method	60-mil HDPE	40-mil HDPE	40-mil LLDPE	Frequency
Seam Shear Strength	ASTM D 4437	120 ppi	80 ppi	44 ppi	See Note 1
Seam Peel Strength (hot wedge fusion)	ASTM D 4437	78 ppi	52 ppi	40 ppi	See Note 1
Seam Peel Strength (fillet extrusion)	ASTM D 4437	72 ppi	45 ppi	40 ppi	See Note 1
Notes:					
1. Destructive testing of seams shall occur at a minimum frequency of once per 500 ft of seam length.					
2. Values apply for both smooth and textured geomembranes.					

6.3.3 Geotextile

6.3.3a. Prequalification Testing

The geotextile installer shall provide to the CQA Officer the test results from a qualified laboratory for the type and frequency of prequalification testing listed in Table A.1. The submittal

shall include certification from the laboratory that the test results verify the manufacturer's guaranteed properties.

The CQA Officer shall direct the geosynthetics QA monitor firm to select a representative number of additional samples of the geomembrane for submittal to the monitor's geosynthetic laboratory for independent verification of the manufacturer's guaranteed properties.

The installer shall submit the results of all laboratory results and certification to the CQA Officer for filing as project records in accordance with Section 11.0.

6.3.3b. Installer Certification of Placement Surface

Prior to daily geotextile placement, the installer shall provide to the CQA Officer daily "certificates of acceptance" (form CQAP-4.1) which document the installer's inspection and acceptance of the underlying surface as being suitable for the geotextile installation (see Section 4.0).

All daily "certificates of acceptance" (form CQAP-4.1) shall be filed as project records in accordance with Section 11.0.

6.3.3c. Deployment

Incoming rolls of geotextile shall be inventoried and inspected by the installer. Manufacturer's certifications will be inspected for conformance with the requirements of this plan. Holes, tears, or other visible defects will be recorded in the CQA Officer's daily report and clearly marked on the synthetic for identification of necessary repairs.

The installer shall check that the geosynthetic installation conforms to the construction requirements and manufacturer's recommendations. The CQA Officer shall direct the geosynthetics QA monitor firm to oversee the inspections by the installer.

On slopes steeper than 10H:1V, all geotextiles shall be continuously sewn. Geotextiles shall be overlapped a minimum of 3 in. prior to seaming. This requirement does not apply to the leachate system filter fabric. All sewing shall be done using thread with physical, chemical, and ultraviolet high resistance properties equal to or exceeding those of the geotextile. The CQA Officer shall direct the geosynthetics QA monitor firm to make independent measurements of a representative number of seam overlaps for additional verification of the requirement in Table A.1.

The 10-oz. cushion geotextile (immediately above the geomembrane liner and beneath the drainage layer) shall be placed with vertical seams running up the slopes and into the anchor trench. Horizontal seams (perpendicular to the slope) shall be allowed on side slopes for the 4-oz. filter geotextile overlaying the drainage layer to facilitate staged construction of the drainage layer going up the slope. All overlaps shall be "shingled" so that water or other material can not run down the slope between the geotextile seams.

6.4 Drainage Media

6.4.1 Granular Drainage Layer

6.4.1a. Prequalification Testing

Each source of material for the drainage layer shall be tested for hydraulic conductivity and grain size analyses in accordance with Table A.1 to determine suitability of the source.

6.4.1b. Material Thickness Testing During Placement

The CQA Officer shall direct the survey firm to determine elevations at the top of the geotextile cushion and at the final constructed surface of the granular drainage layer using a 100 ft grid pattern (and the break points in slope) to verify attainment of the plan grades and elevations. To verify liner thickness, all horizontal survey coordinates shall be the same for the top of the cushion and final constructed surface. Side slope thicknesses will be verified using crest (top), midpoint, and toe documentation points.

The CQA officer may approve the use of thickness plates as an alternative method to surveying.

In no instance shall the field determined thickness be less than 1.0 ft. The measured depths and grades shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor.

6.4.1c. Gradation and Hydraulic Conductivity Testing During Placement

The CQA officer shall direct the soil test firm to take an initial sample of the granular drainage layer within the first 100 cu. yds. of material placement and test for hydraulic conductivity and grain size to confirm suitability of the source. Continuing sampling and testing shall be completed at the frequencies specified in Table A.1.

Compaction of the drainage layer shall not be allowed during placement to avoid breakdown of materials

Gradation tests may be considered passing provided the hydraulic conductivity requirements are met and the specified percentage of fines is not exceeded.

6.4.1d. Certification of Work

The CQA Officer shall review the sampling and test results for the granular drainage layer and, if found in agreement with the prequalification and placement requirements, provide certification for the work using form CQAP 2.1.

6.4.2 Coarse Aggregate

6.4.2a. Prequalification Testing

Each source of material for the coarse aggregate shall be tested for hydraulic conductivity and grain size analyses in accordance with Table A.1 to determine suitability of the source.

6.4.2b. Material Placement

The CQA Officer shall direct that inspection of piping as provided in Section 6.5.1 be completed prior to placement of coarse aggregate around the piping. Compaction of the coarse aggregate shall not be allowed during placement to avoid breakdown of materials.

The CQA officer shall direct the soil test firm to take an initial sample of the coarse aggregate within the first 100 cu. yds. of material placement and test for hydraulic conductivity and grain size to confirm suitability of the source. Continuing sampling and testing shall be completed at the frequencies specified in Table A.1.

Gradation tests may be considered passing provided the hydraulic conductivity requirements are met and the specified percentage of fines is not exceeded.

6.4.2c. Certification of Work

The CQA Officer shall review the sampling and test results for the coarse aggregate and, if found in agreement with the prequalification and placement requirements, provide certification for the work using form CQAP 2.1.

6.5 Other Material Placement Testing

6.5.1 Placement testing of Leachate Piping System

The CQA Officer shall direct the surveyor to check the invert elevations and plan coordinates for the constructed piping system at the locations and frequencies specified in Table A.1.

The CQA Officer or other CQA staff shall inspect pipe size, materials and connections including all components of the leachate collection and management systems to verify compliance with plan and specification requirements.

The measured grades and coordinates shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor.

The CQA Officer shall review the survey results for the leachate piping system and management systems and, if found in agreement with the placement requirements, provide certification for the work using form CQAP 2.1.

6.5.2 Placement Testing of Surface Water Management System

The CQA Officer shall direct the survey agency to determine the elevations and grades of the constructed berms and channels in accordance with the requirements and frequency specified in Table A.1.

The measured elevations and grades shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor.

6.5.3 Placement Testing of Concrete

The CQA Officer shall direct the soil test firm to carry out placement testing for concrete in accordance with the requirements and frequency specified in Table A.1.

The contractor shall submit proposed concrete mix designs to the CQA Officer for review prior to ordering of concrete.

The CQA Officer shall review the concrete testing results and, if found in agreement with the placement requirements, provide certification for the work using form CQAP 2.1.

7.0 CORRECTIVE MEASURES

The CQA Officer shall reject and require replacement of all materials for which sampling, testing or inspection results show that prequalification requirements are not met. The CQA Officer shall also reject workmanship (and require corrective rework) for which sampling, testing or inspection results show that material placement requirements are not met. The lateral and/or vertical extent of corrective measures for rework shall be based on the frequency of testing and judgment of the CQA Officer.

The CQA Officer may neglect the occasional occurrence of failed moisture/density tests or laboratory hydraulic conductivity tests carried out for the low permeability soil liner provided the failed tests can be shown to be outliers and are not concentrated in one area or lift. The CQA officer shall provide written justification in the Daily Summary Report for assignment of failed tests as outliers.

8.0 DOCUMENTATION OF SAMPLING AND TESTING

8.1 Daily Summary Reports

A daily summary report shall be prepared by the CQA Officer, or under the direct supervision of the CQA Officer, during each day of activity. Form CQAP 8.1 *Daily Summary Report* shall serve as the base document to which the daily inspection reports (see Section 8.2) are to be attached.

Each report shall be signed and dated by the CQA Officer and CQA Officer-in-absentia. The original report (and attachments) shall be submitted to the Document Controller and filed as a project record in accordance with Section 11.0.

8.2 Daily Inspection Reports

A daily inspection report shall be prepared by the CQA Officer, or under the direct supervision of the CQA Officer, for each day that materials, or placement of materials, are being inspected, sampled or tested. Form CQAP 8.2 *Daily Inspection Report* shall serve as the base document to which the test data, photographic records, test results, etc. are to be attached.

Each report shall be signed and dated by the CQA Officer or CQA Officer-in-absentia. The original report (and attachments) shall be submitted to the CQA Officer who shall incorporate the report into the daily summary report.

8.3 Photographs

Photographs may be incorporated into the daily inspection report or daily summary report to provide a visual record of work progress, inspection/testing activity, construction work, or other items considered important to the report. The photographs, at a minimum, shall be furnished with the following information:

- The location, date and time of the photograph,
- A description of the item photographed including direction of view (N,S,E or W),
- Personnel, testing agencies, installers or contractors present, and
- Name of photographer.

9.0 FINAL CERTIFICATION REPORT

Upon completion of the construction contract (but before the landfill or gypsum stack is placed into service), the CQA Officer shall submit an acceptance report to the Illinois Environmental Protection Agency. The acceptance report shall contain the following:

- A certification by the CQA officer that the construction has been prepared and constructed in accordance with the engineering design.
- As-built drawings as specified herein, and
- All daily summary reports.

10.0 CONSTRUCTION MANAGEMENT ACTIVITIES

10.1 Requests for Information (RFIs)

The general contractor or installer may, after exercising due diligence to locate required information, request from the CQA Officer clarification or interpretation of the contract documents. The general contractor or installer shall make specific reference to the contract drawing(s) or specification(s) in question and include estimates of any cost or schedule impacts that could possibly be associated with the requested clarification or interpretation.

The general contractor or installer shall initiate the RFI in a timely manner using form CQAP-10.1 *Request for Information*. The CQA Officer shall, with reasonable promptness, respond to the RFI on the same form CQAP-10.1 and return a copy of the completed form to the party making the request as final disposition of the matter.

Additional copies of the completed form shall be distributed as directed by the CQA Officer. All RFI's shall be filed as project records in accordance with Section 11.0.

10.2 Review of Contractor Submittals

The Contractor shall submit shop drawings, product data and samples to the CQA Officer in accordance with the requirements of the project specifications and with such promptness as to cause no delay of the work. The Contractor shall not authorize purchase, fabrication, erection, processing or shipping of any items associated with the submittal until review of the shop drawings, product data or samples has been completed by the CQA Officer and no resubmittals are required by the CQA Officer.

All submittals from subcontractors shall be reviewed first by the Contractor to satisfy the contractor's responsibilities for lengths, dimensions, quantities, means and methods, and other such items.

The CQA Officer and/or Design Engineer shall review the submittals for conformance with design concepts and conformance with the information shown in the contract documents. Upon completion of review, the CQA Officer shall return the submittal to the Contractor with one of the following notations for each item in the submittal:

- No exceptions taken.
- Furnish as corrected,
- Revise and resubmit.
- Submit specified item, or
- Rejected.

The Contractor shall resubmit corrected shop drawings, product data or samples for those items noted as requiring revision or submission or noted as rejected.

The CQA Officer shall maintain copies of all submittals and a log documenting submittal descriptions, dates of receipt, dates of return, review personnel, and actions taken on the submittals. Copies of submittals and the log shall be filed as project records in accordance with Section 11.0.

10.3 Field Change Order Process

The Contractor shall be responsible for preparing requests for field change order (FCO) in accordance with AREG procedures and submitting the FCO requests on the appropriate AREG FCO form to the CQA Officer.

The CQA Officer shall be responsible for reviewing the FCO with the Design Engineer, determining agreement or non-agreement with the requested change, and submitting the documented decision to the Contractor on the appropriate AREG FCO form with copies to the Ameren Project Manager. Agreement to the FCO shall require signature approval of the Ameren Project Manager.

The CQA Officer shall maintain an on-going log of authorized FCOs and running balance of project costs. Copies of the FCOs and log of authorized FCOs shall be retained as project records in accordance with Section 11.0.

11.0 DOCUMENT CONTROL AND PROJECT RECORDS

11.1 CQA Plan

The CQA officer shall control the preparation, issue and revisions of the CQA Plan so that correct documents are being employed by the project participants. The CQA Plan, including all changes thereto, shall be reviewed for adequacy and approved for release by the CQA Officer and Ameren Project Manager.

The Document Controller shall issue controlled copies of the CQA Plan and maintain all records associated with its preparation, issue and revisions.

11.2 Project Records

The maintenance of project records during construction of the landfill shall be the responsibility of the Document Controller and shall be protected against damage, deterioration, and loss. Records shall be maintained in a manner as to be readily identifiable and retrievable.

Control of CQA documents and samples during the construction process shall be as shown in Figure 11.1. All original CQA documents from both the field and laboratories shall be ultimately furnished to the Document Controller for filing and maintenance. Samples may be discarded after testing and documentation of results is complete.

Project records shall be made available to the Ameren Project Manager as requested during construction and, when requested, shall be turned over to AERG at completion of the construction contract.

Records shall include, but not be limited to, the following:

- CQA Plan (all revision levels),
- CQA Plan documentation (reviews, issuance and revisions),
- Meeting minutes,
- Daily inspection reports (form CQAP 8.1),
- Daily summary reports (form CQAP 8.2),
- Certificates of acceptance by geosynthetic installers,
- CQA certifications (form CQAP 2.1),
- Certificates of calibration for inspection, measuring and test equipment,
- Report for test soil liner,
- Report for compacted soil liner "acceptable zone",
- "As-built" drawings,
- Laboratory test results for soils, drainage media, and concrete,
- Laboratory test results for geosynthetics,
- Laboratory certifications of manufacturer's guaranteed properties for geosynthetics,
- Contractor Requests for Field Change Order (AERG FCO form),

- Log of Authorized Field Change Orders,
- Shop drawing submittals,
- Log of shop drawing submittals,
- Requests for information from contractor/installers,
- Responses to requests for information, and
- Final certification report.

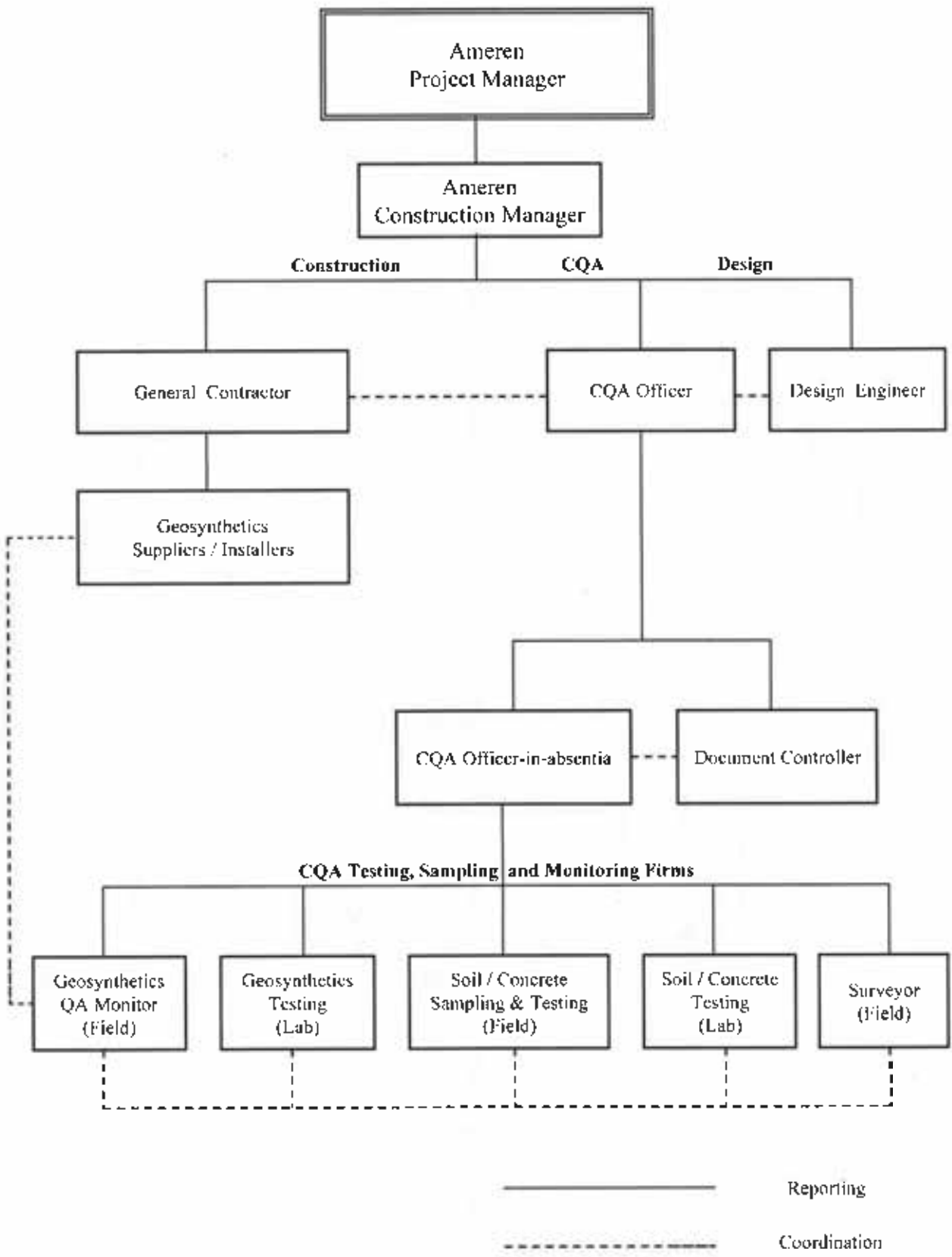


Figure 2.1 Project Organization Chart

Appendix A

Material Testing and Frequency

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirement/Specification	Frequency	Responsibility
SOILS - PREQUALIFICATION TESTING			
FOUNDATION FILL & BERMS			
Standard Proctor Curve - ASTM D698	PL < 5, LL < 20% 200 Sieve > 47% See Note 1	Per soil type (See Note 2)	CQA Officer
Amerberg Limits - ASTM D418		Per soil type	
Grain Size Analysis - ASTM D422		Per soil type	
Hydraulic Conductivity - ASTM D5334		Per soil type	
SOIL LINER			
Standard Proctor Curve - ASTM D698	*Acceptable Zone* see Appendix B USCS Classification USCS Classification 1.0 x 10 ⁻⁶ cm/sec *Acceptable Zone* see Appendix B	Per soil type	CQA Officer
Amerberg Limits - ASTM D418		Per soil type	
Grain Size Analysis - ASTM D422		Per soil type	
Hydraulic Conductivity - ASTM D5334		Per soil type	
Develop *Acceptable Zone*			
3 PROTECTIVE FINAL SOIL COVER			
Standard Proctor Curve - ASTM D698*	*Acceptable Zone* see Appendix B USCS Classification USCS Classification See Note 1 *Acceptable Zone* see Appendix B Visual Appearance	Per soil type*	Not Applicable to this Contract
Amerberg Limits - ASTM D418*		Per soil type*	
Grain Size Analysis - ASTM D422*		Per soil type*	
Hydraulic Conductivity - ASTM D5334		Per soil type*	
Develop *Acceptable Zone*			

* On the first two feet of the protective layer only. (The third foot is topsoil.)

Note 1: There is no specific requirement for hydraulic conductivity for the foundation, berms and final cover soils as they are not part of the liner system. However, insitu materials on the site generally exhibit hydraulic conductivities in the range of 1 x 10⁻⁶ to 1 x 10⁻⁷ cm/sec. The construction contractor will attempt to utilize the most impermeable materials available (as identified visually) when constructing foundation fill and berms. For purposes of a complete construct on record, hydraulic conductivity of placed foundation fill and soil berms will be field tested at a rate of 1 test per each 10,000 cubic yards of material placed, although no specific threshold values are required.

Note 2: "Soil Type" refers to differences in soil color and/or textural composition that would be indicative of differences in soil characteristics.

Note for Geomembranes: See Section 6.0 of the CQA Plan for additional GCL and geomembrane testing requirements.

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirement/Specification	Frequency	Responsibility
SOILS - MATERIAL PLACEMENT TESTING			
FOUNDATION Soil test	0 to 0.2 feet Design Grade	100-foot grid	CQA Officer
FOUNDATION FILL & BERMS			
Density/Moisture - ASTM D2922 & D3017	99% Standard Proctor Density and ±1% to Optimum Moisture Content	1 per 10,000 cubic yards (minimum) 1 per compacted lift	CQA Officer
Strength	0.5 ft (hand-held penetrometer)	1 per 10,000 cubic yards (minimum) 1 per compacted lift	
Hydraulic Conductivity - ASTM D5084	See Note 1	1 per 10,000 cubic yards	
Sieve and Hydrometer Analysis of Soils - ASTM D422 Liquid Limit, Plastic Limit and Plasticity Index Gatenberg Limit - ASTM D4318	200 Sieve > 50% PI > 5, LL > 20	Per Soil Type Per Soil Type	
SOIL LINER			
Thickness	5 foot minimum thickness (base), 1 foot minimum thickness (cover), and maintain design grade	100-foot grid	CQA Officer
Density/Moisture - ASTM D2922 & D3017	95% Standard Proctor Density and Optimum to ±5% Moisture Content in accordance with Acceptable Zone (see Note 3)	1 per acre per lift or 1 per 1,000 cubic yards	
Strength	0.5 ft (hand-held penetrometer) See Note 4	1 per acre per lift or 1 per 1,000 cubic yards 1 per 10,000 cubic yards	
HYDRAULIC FINAL SOIL COVER			
Thickness	5 foot minimum field thickness including 1 foot of gravel - maintain design grade	100-foot grid	Not Applicable to this Contract
Density/Moisture - ASTM D2922 & D3017	90% Standard Proctor Density and ±3% to Optimum Moisture Content	1 per 10,000 cubic yards (minimum) 1 per compacted lift	
Strength*	0.5 ft (hand-held penetrometer)	1 per 10,000 cubic yards (minimum) 1 per compacted lift	

* On the first two feet of the protective layer only (The third foot is optional)

Note 1: There is no specific requirement for hydraulic conductivity for the foundation, berms and final cover soils as they are not part of the liner system. However, initial materials on the site generally exhibit hydraulic conductivities in the range of 1×10^{-7} cm/sec to 1×10^{-6} cm/sec. The construction contractor will attempt to utilize the most permeable materials available (as identified visually) when constructing foundation fill and berms. For purposes of a complete construction record, hydraulic conductivity of placed foundation fill and side berms will be field tested at a rate of 1 test per each 10,000 cubic yards of material placed, although no specific threshold values are required.

Note 3: Acceptable Zone* restriction applies only to the soil liner for the landfill. The gypsum stock soil liner shall only be required to meet the construction and moisture content specification

Note 4: The hydraulic conductivity for the landfill soil liners is 1.0×10^{-7} cm/sec (maximum) and for the gypsum stock soil liner is 1.0×10^{-7} cm/sec (maximum)

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirement/Specification	Frequency	Responsibility
GEOSYNTHETICS - PREQUALIFICATION TESTING			
GEOMEMBRANE (60 mil smooth 50 mil reinforced, 40 mil reinforced)			
Raw Material	Manufacturer's List of Guaranteed Properties	All rolls	
Geometric Properties	Manufacturer's List of Guaranteed Properties	All rolls	
Puncture Resistance - ASTM D4891	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per row material batch, whichever is greater. Sample 3 feet wide by the full roll width.	Installer
Tear Resistance - ASTM D1104	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per row material batch, whichever is greater. Sample 3 feet wide by the full roll width.	
Thickness - ASTM D1535/D1544	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per row material batch, whichever is greater. Sample 3 feet wide by the full roll width.	
Tensile Strength and Elongation - ASTM D638 (Modified) or D6611	Manufacturer's List of Guaranteed Properties	1 per 10,000 square feet or per row material batch, whichever is greater. Sample 3 feet wide by the full roll width.	
GEOTEXTILES (Non-Woven, 4 ounce, 16 ounce, 16 ounce)			
Geosilt Properties	Manufacturer's List of Guaranteed Properties	All rolls	
Mass per Cu. Yd. Area - ASTM D3776	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width.	
Grab Tensile Strength - ASTM D4532	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width.	
Trapezoidal Tear Strength - ASTM D4533	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width.	
Apparent Opening Size - ASTM D4751	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width.	
Puncture Resistance - ASTM D3787	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width.	
Permeability - ASTM D4491	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width.	

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirement/Specification	Frequency	Responsibility
GEOSYNTHETICS - PREQUALIFICATION TESTING			
GEOSYNTHETIC CLAY LINER (GCL) GCL Properties	Manufacturer's List of Guaranteed Properties	All rolls 1 per 100,000 square feet or per row material batch, whichever is greater. Sample 3 feet wide by the full roll width	Installer
Benotone Mass/Area - ASTM D4945	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per row material batch, whichever is greater. Sample 3 feet wide by the full roll width	Installer
Grab Tensile Strength - ASTM D4632	Manufacturer's List of Guaranteed Properties	1 per 50,000 square feet or per row material batch, whichever is greater. Sample 3 feet wide by the full roll width	Installer
Peel Strength - ASTM D4632	Manufacturer's List of Guaranteed Properties	1 per 50,000 square feet or per row material batch, whichever is greater. Sample 3 feet wide by the full roll width	Installer
GEOSYNTHETICS - MATERIAL PLACEMENT TESTING			
GEOSYNTHETICS (see roll smooth, cut and installed, 48 mil thickness)			
Seam Overlay	3" to 4"	All Seams	Installer
Non-Destructive Testing	As per Section 6.1.16 of CQA Plan	All Seams	
Destructive Testing	As per Section 6.1.2 of CQA Plan	Minimum One Every 500 Feet	
GEOTEXTILES (Non-Wovens, 4 mm, 10 mils, 36 mm)			
Seam Overlay	3" to 4"	All Seams	Installer
Installation	Physical Installation per Section 6.1.3 of CQA Plan	None	
GEOSYNTHETIC CLAY LINER (GCL)			
Seam Overlay	As per Section 6.1.14 of CQA Plan	All Seams	Installer
Installation	Physical Installation per Section 6.1.3 of CQA Plan	None	

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirements/Specification	Frequency	Responsibility
DRAINAGE MEDIA - PREQUALIFICATION TESTING			
GRANULAR DRAINAGE LAYER Hydraulic Conductivity - ASTM D2434 Grain Size Analysis - ASTM D422	1.0 x 10 ³ cm/sec (Minimum) Field Established Based on Hydraulic Conductivity (Fines Passing #200 < 5%)	One Test per Source One Test per Source	COA Officer
COARSE AGGREGATE Hydraulic Conductivity - ASTM D2434 Grain Size Analysis - ASTM D422	1.0 x 10 ³ cm/sec (Minimum) Field Established Based on Hydraulic Conductivity (Fines Passing #200 < 5%)	One Test per Source One Test per Source	COA Officer
DRAINAGE MEDIA - MATERIAL PLACEMENT TESTING			
GRANULAR DRAINAGE LAYER Thickness	One Foot Minimum Thickness	100 Foot Grid	COA Officer
Gradation - ASTM D422 Hydraulic Conductivity - ASTM D2434	Field Established Based on Hydraulic Conductivity (Fines Passing #200 < 5%) 1.0 x 10 ³ cm/sec (Minimum)	1 per 3,000 cubic yards 1 per 10,000 cubic yards	
COARSE AGGREGATE Gradation - ASTM D422 Hydraulic Conductivity - ASTM D2434	Field Established Based on Hydraulic Conductivity (Fines Passing #200 < 5%) 1.0 x 10 ³ cm/sec (Minimum)	1 per 3,000 cubic yards 1 per 10,000 cubic yards	COA Officer

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirements/Specification	Frequency	Responsibility
OTHER MATERIAL PLACEMENT TESTING REQUIREMENTS			
LEACHATE PIPING SYSTEM ELEVATIONS & LOCATIONS Survey Wells and Connections	Elevation +/- 0.1 feet with no adverse slopes. Plan location +/- 0.5 feet. Visual Inspection	Every 100 feet and connections Each connection	CQA Officer
SURFACE WATER MANAGEMENT SYSTEM Survey	Ficht established for positive drainage (+/- 0.4 feet)	Inlet and Outlet and every 100 linear feet along ditch channel	CQA Officer
CONCRETE			
Slump - ASTM C143	2" to 4" at time of placement	1 per 25 cubic yards or minimum 1 per day	CQA Officer
Air Entrainment - ASTM C201	5% to 7% at time of placement	1 per 100 cubic yards or minimum 1 per day	
Compressive Strength - ASTM C31 and C39	3,500 psi at 28 days	2 cylinders per 50 cubic yards or minimum 2 cylinders per day	
Delivery Time - ASTM C94	Total Mixing and Delivery Time less than 1.5 Hours	Each Delivery	

Appendix B

Acceptable Zone Procedure

PROCEDURE FOR DETERMINATION OF SOIL LINER ACCEPTABLE ZONE OF COMPACTION AND MOISTURE CONTENT

INTRODUCTION

One of the most significant factors affecting the performance of compacted soil liners is the adequate control of water content and dry unit weight during construction. A carefully written compaction specification will result in a compacted soil liner achieving the required hydraulic conductivity while also satisfying other factors affecting performance such as strength, compressibility, and resistance to desiccation. Because a soil liner is meant to be a hydraulic barrier, hydraulic conductivity requirements are the primary factor affecting the criteria of a compaction specification. The specification should be then tightened as necessary to meet other performance standards.

For this project, the specification will require that the soil be compacted to at least 95 percent maximum dry density as obtained from the Standard Proctor test per ASTM D 698, with a moisture range of optimum to 5 percentage points wet of optimum. Testing of the proposed liner soils will be performed to determine its acceptable density and moisture content zone for a maximum hydraulic conductivity of 1.0×10^{-6} cm/sec for the final cover and base liner. Research work performed by Benson and Daniel (1990) shows that the acceptable zone can be expected to parallel a "line of optimums." This procedure should be run when a new source of soil is selected for liner construction or when the Proctor density changes by 10 pcf or more.

PROCEDURE

The following steps will be performed during prequalification of a soil source for liner construction. The source investigation will identify consistency of the soil and have completed soil index tests including grain size distribution and Atterberg Limit determinations. Once the initial index testing is complete, a proper value for Proctor density can be selected, and then the following steps can be followed.

- Compact three samples at a controlled moisture of ± 1 percent of optimum moisture at approximately 97 percent to 93 percent of standard Proctor maximum dry density. These samples should be tested for hydraulic conductivity using ASTM D 5084. If all samples pass, it can be assumed as confirmation that the specified 95 percent of maximum dry density is an appropriate lower density range.
- If all three initial hydraulic conductivity test results are $\leq 1.0 \times 10^{-6}$ cm/sec for the base liner and the final cover, then three more samples shall be prepared to confirm the moisture content range. Using approximately 93 percent to 95 percent dry density, prepare one sample at -1 points (dry of optimum), one at +3 points and one at +8 points of optimum moisture content. Test these new samples for hydraulic conductivity using ASTM D 5084. If all samples pass, it can be assumed as confirmation that the optimum to +5 percentage points is an appropriate moisture content range.

- If the first two steps do not confirm the permeability window, the CQA Officer will determine if the soil will be used for construction. If it will be used, then further testing can be performed to define a smaller acceptable zone.
- In some cases, the borrow sources may be so variable that composting of the soil will be required for testing. In these cases, three or four Proctor tests should be performed to determine the range of maximum dry density. If the range of maximum dry densities is less than 10 pcf, a composite can be tested as outlined above. If the range of maximum dry densities is greater, the highest and lowest soil values should be tested to determine an acceptable range.

Selection of density value shall be based on inspector's identification of soil percentages. Prequalification testing will assure the conformance of permeability.

USE OF THE ACCEPTABLE RANGE

During construction, the acceptable window will be verified by the specified interval of construction sample testing. Each sample will be tested for density, moisture, grain size, and Atterberg Limits when submitted for hydraulic conductivity testing. The results can then be compared to prequalification testing to verify soil consistency and passing hydraulic conductivity. These tests can also be plotted on the Proctor curve as documentation of acceptable zone or as a demonstration that the zone can be enlarged.



Appendix E: Operation and Maintenance Manual, Duck Creek Energy Center, Gypsum Management Facility

Operation and Maintenance Manual
Illinois Power Resources Generating, LLC
Duck Creek Energy Center
Gypsum Management Facility
Fulton County, Illinois

Prepared For:

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Revised August 2014

**OPERATION AND MAINTENANCE MANUAL
DUCK CREEK ENERGY CENTER
GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS**

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SECTION 1.0 **GENERAL**

This operation and maintenance (O&M) manual outlines objectives, proposed policies, responsibilities, and procedures for Illinois Power Resources Generating, LLC (IPRG) and Contractor personnel who are responsible for the management of the Duck Creek Energy Center Gypsum Management Facility (GMF). The GMF incorporates two reservoirs, the Gypsum Stack and the Recycle Pond, for processing and storing gypsum.

1.1 REASONS FOR DEVELOPMENT OF THE O&M MANUAL

In addition to providing guidance to the IPRG and Contractor personnel who are responsible for the operations and maintenance of Duck Creek GMF, this manual has been prepared in accordance with state regulations. The State of Illinois Rivers, Lakes and Streams Act, (615 ILCS 5) Paragraph 23a includes the statement "The Department is authorized to carry out inspections of any dam within the State, and to establish standards and issue permits for the safe construction of new dams and the reconstruction, repair, operation and maintenance of all existing dams." (emphasis added).

Part 3702 of the 17 Illinois Administrative Code, Chapter I entitled the "Construction and Maintenance of Dams" details the requirements to obtain a permit for the construction, operation, and maintenance of a dam. Section 3702.40 b) includes the following statement:

"5) As a condition of each permit, the dam owner shall submit a maintenance plan detailing the procedures and schedules to be followed to maintain the dam and its appurtenances in a reasonable state of repair."

Thus it is a requirement of all dam owners who have dams which fall under the jurisdiction of the Illinois Department of Natural Resources to operate and maintain them safely.

As a dam owner, IPRG is responsible for the safety of the public and for maintaining the structures at the facility for both safety and economy. The overall public interest is served by providing a document to serve as a basis for the safe and economical operation and maintenance of the dam during both emergency and day-to-day conditions.

1.2 GENERAL RESPONSIBILITIES CONCERNING DAMS

IPRG is responsible for the operation and maintenance of the Gypsum Stack Dam and the Recycle Pond Dam. These responsibilities include general maintenance (mowing, removing debris from decants, placing riprap where needed, etc.), operation, inspection and emergency action decisions. IPRG plans to enter into an agreement with an independent contractor to perform certain aspects of the operation and maintenance of the GMF.

SECTION 2.0 DEFINITIONS

Abutment - That part of the valley side or concrete walls against which the dam is constructed. Right and left abutments are those on respective sides of an observer when viewed looking downstream.

Appurtenant Works - The structures or machinery auxiliary to dams which are built to operate and maintain dams; such as outlet works, spillways, gates, valves, channels, etc.

Boil - A stream of water discharging from the ground surface downstream of the dam carrying with it a volume of soil which is distributed around the hole formed by the discharging water.

Berm - A horizontal step or bench in the sloping profile of an embankment dam.

Breach - A break, gap, or opening (failure) in a dam which releases impoundment water.

Dam - A barrier built for impounding or diverting the flow of water.

Dike (Levee) - An embankment, usually applied to embankments or structures built to protect land from flooding.

Drain, Layer or Blanket - A layer of pervious material in a dam to facilitate the drainage of the embankment including such items as a toe drain, a weephole, and a chimney drain.

Drawdown - The resultant lowering of the water surface level due to the release of water from the impoundment.

Duck Creek Plant Datum - the Duck Creek Station horizontal and vertical coordinate system ("Plant System") on which the design and construction survey information, and elevations used in this document is based. Reference the control points shown on the construction drawings (Drawing C180-C102-04, Rev 3, or later) for horizontal and vertical control information.

Embankment - Fill material, usually rock or earth, placed with sloping sides.

Earthen Dam - Any dam constructed of excavated natural materials.

Failure - An incident resulting in the uncontrolled release of water from the dam.

Freeboard - The vertical distance between a stated water level and the top of the dam.

Gate or Valve - In general, a device in which a leaf or member is moved across the waterway to control or stop the flow.

Groin - The junction of the upstream or downstream face of the dam with the valley wall.

Maintenance - The upkeep, involving labor and materials, necessary for efficient operation of dams and their appurtenant works.

Operation - The administration, management, and performance needed to operate the dam and appurtenant works.

Operation and Maintenance Inspection - Inspections conducted by the dam Operator. These inspections are frequent visual "Walk-around" inspections of the dam surface and appurtenant works.

Outlet - An opening through which water can freely discharge for a particular purpose from an impoundment.

Phreatic Surface - The upper surface of saturation in an embankment.

Piping - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam, discharging water that contains soil particles.

Riprap - A layer of large stones, broken rock or precast blocks placed in a random fashion usually on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against wave and ice action.

Silt/Sediment - Soil particles and debris in an impoundment.

Slump/Slide Area - A portion of earth embankment which moves downslope, sometimes suddenly, often with cracks developing.

Spillway System - A structure or structures over or through which flows are discharged. If the flow is controlled by gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control of the flows, it is considered an uncontrolled spillway.

Emergency Spillway - A spillway designed to operate very infrequently, only during exceptionally large floods, usually constructed of materials expected to erode slowly.

Principal Spillway - The main spillway which controls both normal and flood flows and is usually constructed of non-erodable materials.

Auxiliary Spillway - A spillway which works in conjunction with the principal spillway to control flood flows and is usually constructed of non-erodable materials.

Stilling Basin - A basin constructed to dissipate the energy of fast flowing water, such as from a spillway, and to protect the streambed from erosion.

Toe of Embankment - The junction of the face of the dam with the ground surface in the floodplain upstream or downstream of the dam.

SECTION 3.0 **INFORMATION ABOUT THE DAMS**

3.1 LOCATION

The Gypsum Stack and Recycle Pond Dams are located in the NW 1/4 of Section 18, Township 6 North, Range 5 East of the Forth Principal Meridian in Fulton County, Illinois. More specifically, the dams are located east of Bethel Cemetery Road approximately 2 miles southeast of Canton, Illinois. A map showing the location of the dams is included in Appendix A.

3.2 DESCRIPTION OF DAM AND APPURTENANCES

The gypsum stack dam has a maximum earthen embankment height of 32 ft and a maximum impounding capacity of 773 acre-ft, measured at the top of the earthen dam elevation of 620 ft per Duck Creek Plant Datum (EL 620). However, due to the “stacking” of gypsum above the top of the earthen dam, the total volume within the completed gypsum stack will be approximately 2256 acre-ft. The recycle pond dam has a maximum embankment height of 41 ft and a maximum impounding capacity of 150 acre-ft (measured at the top of dam elevation of 615 ft).

The gypsum stack dam has a single high density polyethylene (HDPE) lined spillway (transfer channel) which discharges to the recycle pond. The transfer channel is a trapezoidal channel with 3H:1V side slopes. The transfer channel transitions from a 16-ft bottom width at an invert elevation of 614.0 ft at the upstream end, to a 35-ft bottom width at an invert elevation of 609.0 ft at the downstream end. A 2-ft tall HDPE covered concrete weir, located near the upstream end of the transfer channel, is fitted with stop logs capable of raising the discharge control elevation to 616.0 ft. To protect the HDPE liner from abrasion during flows, the transfer channel and a portion of the recycle pond dam incorporate an additional sacrificial layer of HDPE at the location where the transfer channel discharges to the recycle pond.

The emergency spillway for the recycle pond consists of four 42-inch diameter HDPE pipes which discharge into a riprap lined plunge pool. The upstream inverts of the pipes are at EL 610.0 and the downstream inverts are at EL 607.0. The emergency spillway has been provided in the event of an accidental overflowing of the recycle pond or catastrophic rainfall only. It is not expected to be activated during the life of the facility.

Pertinent data about the dams, appurtenant works, and reservoirs are presented in Appendix B.

3.3 SIZE CLASSIFICATION

The gypsum stack earthen dam has a maximum embankment height of 32 ft and a maximum impounding capacity of 773 acre-ft (measured at the top of dam elevation of 620 ft). Based on IDNR criteria, the gypsum stack earthen dam is classified as a small-size dam. However, since the gypsum stack is planned to ultimately meet or exceed 100 ft in height, the gypsum stack will eventually be classified as a large-size dam.

The recycle pond dam has a maximum embankment height of 41 ft and a maximum impounding capacity of 150 acre-ft (measured at the top of dam elevation 615 ft). Since the recycle pond dam embankment exceeds 40 ft in height, it is classified as an intermediate-size dam.

3.4 HAZARD CLASSIFICATION

The breach wave resulting from a failure of either dam is expected to be contained within the Duck Creek Reservoir located immediately downstream. Considering the low probability for causing loss of life or economic loss to adjacent landowners, both dams are classified as CLASS III, LOW HAZARD POTENTIAL dams.

SECTION 4.0 **OPERATIONS ACTIVITIES**

The operations plan describes the proposed operation of the Duck Creek Gypsum Management Facility (GMF) which includes the gypsum stack and the recycle pond.

4.1 SITE OPERATIONS

The GMF will receive flue gas desulfurization sludge (gypsum) from the Duck Creek Energy Center (the Plant). Gypsum will be transported to the GMF in slurry form (approximately 20 percent solids) and allowed to settle. Clarified process water will then be siphoned or decanted to the recycle pond and returned to the Plant for reuse via pipeline.

The GMF will potentially receive gypsum slurry 24 hours per day, seven days per week. Routine operation and maintenance activities are expected to be conducted during day shift hours. The filling times and staging chronology included in this document are calculated from gypsum production rates estimated at 23,500 tons per month, which is based on the plant burning high sulfur coal (6.8 lbs of SO₂ per million BTU) at a 90% capacity factor. The sluice and process water return rates referenced in this document are per the Hitachi Power Systems America, Ltd. MATERIAL BALANCE Case Study: 4,131 mmBtu/hr Drawing No. 0013-361-110-0381 Rev. B dated 3-19-07. Variations in these parameters would result in variations in the estimated chronology and flow rates.

The Plant is a restricted access location. A series of fences and gates exist to prevent unauthorized access to the property. The proposed GMF is located within the restricted plant confines, and is, therefore, not accessible to the general public.

4.2 PERSONNEL

The proposed GMF will be owned and operated by IPRG. Corporate offices are located in Houston, Texas. IPRG plans to enter into an agreement with an independent Contractor to perform certain aspects of the operation and maintenance of the GMF. The contractual operator (Operator) of the gypsum stack will be responsible for daily operation and maintenance of the gypsum stack, recycle pond and peripheral areas.

4.3 OPERATION OF VAULTS AND VALVES

IPRG personnel will be responsible for the operation of the valves which control the flow of slurry and water between the Plant, recycle pond and gypsum stack to the first valve vault located at the recycle pond entrance road. Beyond that point, the Operator will be responsible for distribution of gypsum slurry to various areas of the gypsum stack (this includes the valve vaults on the mid-western side of the gypsum stack and the north side of the gypsum stack). Two redundant pipes will carry the gypsum slurry from the plant. Although only one pipe will be in use at any time, conditions at the plant may result in a discharge pipe switch at any time. **BOTH PIPES MUST BE AVAILABLE TO DISCHARGE GYPSUM AT ALL TIMES WHEN**

THE PLANT IS OPERATING. Valves to both pipes must be open, and the ends of both pipes must be positioned so that there would be no restrictions to gypsum discharge at any time.

4.4 GYPSUM MANAGEMENT FACILITY STARTUP

The major components of the GMF consist of:

- The gypsum stack;
- The recycle pond;
- The HDPE-lined earthen transfer channel that connects the two structures, and through which clarified process water will be decanted from the gypsum stack into the recycle pond; and
- The recycle pond decant system and pump-house, through which process water will be returned to the Plant for reuse.

Upon completion of the recycle pond construction, the recycle pond will be partially filled with water pumped from the Plant or from Duck Creek Reservoir. The recycle pond pumps will be commissioned and then shut off pending the introduction of slurry into the gypsum stack. Procedures for these operations are discussed in the following sections.

4.4.1 Siphon Installation and Operation

The bottom of the gypsum stack is approximately 29 ft below the transfer channel invert elevation of 614 ft. During the period when the gypsum sluicing and stacking operations are conducted below the transfer channel elevation, clarified water must be siphoned from the gypsum stack to the recycle pond. Based on a slurry discharge rate of 653 gal/minute (gpm), and an average reclaim water return rate of 626 gpm, a minimum of two redundant (2) 10-inch diameter HDPE siphons should be primed and operable at all times. Installation of the siphon pipes and valves is included in the original GMF construction.

Each of the siphon pipes will pass through the transfer channel and the outlet end of the siphon pipes shall be laid on the bottom of the recycle pond at elevation 590 ft. Ballast will be required at the outlet of the pipe to prevent the pipes from potentially floating to the surface and breaking the siphon. Ballast or other means of restraint may also be required in the transfer channel to hold the pipes in place. For a 300 ft long, 10-inch diameter HDPE siphon, the water level in the gypsum stack will need to be approximately 4.5 ft higher than the water level in the recycle pond in order to pass the equilibrium process water return rates discussed above.

4.4.2 Initial Filling of Recycle Pond With Water

The recycle pond will initially be partially filled with water pumped from Duck Creek Reservoir or the plant. The recycle pond will be filled to a water surface elevation of 598 ft in order to accommodate proper pump functioning during commissioning and startup of the slurry discharge to the gypsum stack. Duck Creek plant personnel will monitor and regulate the water level in the recycle pond.

4.4.3 Commissioning the Pumps and Siphons

Once the recycle pond and gypsum stack have operational levels of water, the siphons, the recirculation pump system (recycle pond to gypsum stack), and the recycle pump system (recycle pond to plant) will be primed and tested. IPRG will be responsible for operation and maintenance of the recycle / recirculation pumps.

4.5 GYPSUM MANAGEMENT FACILITY OPERATION

The gypsum slurry (approximately 20 percent solids) will be pumped from the Plant to the gypsum stack via piping. Piping will be HDPE with a pressure rating for the design hydraulic and static head. The HDPE pipe will discharge the slurry into the gypsum stack, and the gypsum will settle by gravity.

The water level in the recycle pond should be maintained at a minimum elevation of 598 ft in order to insure uninterrupted pumping of water back to the plant. However, at times, there will be intermittent outages at the plant. During an outage, bottom drains in the gypsum stack will continue to discharge water to the recycle pond and the recycle pumps will continue to recirculate water from the recycle pond to the gypsum stack. The recirculation of water is required during outages in order to utilize the water storage capacity of the gypsum to help maintain sufficient storage capacity in the recycle pond to accommodate all precipitation runoff from the entire gypsum stack/recycle pond area during an expected maximum 12-week maintenance outage at the Plant.

At a placement rate of 23,500 tons per month, it will take approximately 3 years to fill the gypsum stack with gypsum to the invert of the HDPE-lined transfer channel at EL 614. Until that time, clarified return water will be siphoned into the recycle pond using one of two redundant 10-inch diameter siphon pipelines. Water that flows from the gypsum stack to the recycle pond will be pumped back to the Plant for reuse, or recirculated to the top of the gypsum stack during periods when the plant is shutdown.

In order to stack the gypsum material with the required factors of safety for slope stability, a system of strategically placed perimeter ditches and dikes must be constructed. Interior dikes will also need to be constructed to accommodate the installation of ring drains and the development of cells located within the gypsum stack. Key components of the gypsum stacking process are described in the following sections to highlight the effort required to successfully stack gypsum with the required factors of safety against slope failure.

4.5.1 Initial Filling With Gypsum Slurry

There are two redundant gypsum slurry pipelines which will be capable of discharging midway along the north side or west side of the of the gypsum stack at a maximum rate of 1.5 cfs (675 gal/min). The initial construction of the GMF includes a ring drain system on the HDPE liner on the bottom of the gypsum stack. When gypsum slurry is initially discharged into the gypsum stack, **extreme care must be taken to prevent any erosion of the sand layer over the ring drain. Any displacement of sand may impair the function of the ring drain.** If necessary, the sand layer may be protected with a layer of larger aggregate or temporarily

covered with an approved geotextile wherever necessary to prevent erosion of the sand layer. It may be preferable to use a flange-connected pipe extension to extend the slurry discharge line to the interior side of the ring drain so that the bottom troughs will collect the water and prevent erosion of the sand layer. The pipe extension can be removed when the ring drains are covered and protected by settled gypsum. If any ring drain sand is displaced, the Operator shall immediately notify Ameren so that an appropriate response and repair method can be determined. Please see Figure A for details and a general depiction of the ring drain assembly.

Settled gypsum will gradually create a plane of material (gypsum beach) sloping gently towards the south end of the gypsum stack. Please see Figure B for a depiction of the gypsum beach. Clarified water will collect in the south end of the gypsum stack and will be siphoned into the recycle pond when it reaches EL 602.5, the level necessary to provide the head to siphon the process water at the system equilibrium rates. The GMF Operator will be responsible for operation and maintenance of the siphons. At the design flow rates, it will take approximately 95 days of operation in order for the water in the gypsum stack to reach this level.

4.5.2 Gypsum Dike and Cell Construction

The bottom slope of the gypsum stack liner, and the siphoning of water from the gypsum stack to the recycle pond, will partially drain the gypsum to allow for “early stacking” of material below the crest of the earthen dam. This is advantageous for several reasons. One reason is that the construction of compacted dikes at a lower elevation may improve foundation conditions for the remainder of the stack. Employing stacking procedures at a lower elevation also affords the opportunity for the Operator to become familiar with the material and develop confidence in a construction routine which will maximize stability when stacking the material above the top of the earthen embankment. Early stacking also allows Ameren the opportunity to complete preliminary testing on proposed piezometer locations for development of a piezometer installation and monitoring plan, as discussed in Section 4.5.8, which will be refined prior to stacking above the top of the earthen embankment.

The procedures for controlling the deposition of gypsum will begin once the gypsum beach at the north end of the gypsum stack reaches an elevation of approximately 605 ft, NGVD, which is 10 ft above the HDPE liner (7.5 ft above the top of the ring drain assemblies). Based on an assumed deposited gypsum slope of 0.3%, and a water level of 602.5 ft, the gypsum beach which will be visible above water is predicted to span half the length of the gypsum stack (reference Figure B). At full production (16.7 acre-ft deposited per month), the time required for the gypsum beach to reach this configuration is estimated at five to six months. .

The first procedural steps in controlling the deposition of (stacking) gypsum are the construction of a perimeter ditch, a perimeter dike, a rim ditch, and a rim dike. The perimeter ditch is the ditch which will be formed between the earthen embankment and the gypsum. The perimeter dike is the gypsum dike on the interior side of the perimeter ditch. The rim ditch is a ditch which will be formed on the interior side of the perimeter dike. The rim dike is a gypsum dike which will be formed on the interior side of the rim ditch. These basic components of the gypsum stack are illustrated in Figure C. Specific details pertaining to the ditches are provided in Sections 4.5.3 and 4.5.4.

During the initial stages of stacking, the perimeter ditch, perimeter dike, rim ditch and rim dike will be constructed simultaneously. They will be constructed by building two elevated dikes on the gypsum beach beginning at the middle of the north side and proceeding both clockwise and counterclockwise around the perimeter of the gypsum beach (see Figure D). Access to the beach will be provided by carefully pushing an approved fill material onto the beach from the crest of the earthen embankment to create an access pad. The thickness of the fill layer will need to be at least 24-inches over the geomembrane liner to avoid damage to the liner, and will need to be at least 36-inches over the gypsum beach. Once the fill material has been placed far enough out onto the beach to allow excavation of the gypsum without damaging the liner, the access pad can be completed using gypsum excavated from the beach (see Figure E).

Gypsum excavated from the beach is expected to be soft and saturated and must be windrowed and allowed to dewater before it can be spread and compacted to form the roadway. The gypsum is expected to dewater sufficiently in 24 hours to allow spreading and compacting. Adequate compaction is expected to be achieved by tracking with a D-6 dozer or similar equipment.

After construction of the dikes and ditches has begun, the slurry discharge lines should be relocated to discharge to the rim ditch. This will allow the rim ditch to be refilled each day to provide gypsum for raising the roadway as the excavator retreats from the most recently placed windrow. The rim ditch will also serve as the primary means of diverting slurry around the stack to the location where deposition is desired.

When the initial perimeter dike is completed, the top of the perimeter dike should be at least 30 ft wide, at least 10 ft above the beach and the side slopes graded to be 3.0H:1.0V (see Detail A on Figure B). The top of the initial rim dike should be at least 3.5 ft above the beach. Additional interior dikes may also be constructed as needed to create cells which facilitate the settling process. The exterior side slope of the rim dike shall be 3.0H:1.0V. The interior side slope of the rim dike and the side slopes on any interior dikes may be allowed to form at the angle of repose for the gypsum material. **A minimum freeboard of 3.5 ft must be maintained between the slurry level in the rim ditch and the crest of the perimeter dike. Subsequently, the perimeter dike must always be maintained at an elevation at least 3.5 ft higher than the rim dike or any other interior dike.**

The rim and perimeter dikes should be raised in lift increments of approximately 1 foot and may be moved laterally each lift as needed to maintain the required design slopes of 3.0H:1.0V on the perimeter dike. The slopes can be graded with a smooth-edged excavator bucket, e.g., a finish or cleanup bucket. **Under no circumstances should the slopes of the gypsum stack be graded using a toothed excavator bucket.**

Clarified water will be transferred from the rim ditch to the perimeter ditch where it will be carried to the transfer channel for discharge to the recycle pond. The GMF construction included installation of a stop log system for the transfer channel. The stop logs may be used for **temporary** reductions in flow to the Recycle Pond and increases in water levels in the gypsum stack for water balance purposes during operation. During the initial stacking process, when a siphon must be used to transfer water to the recycle pond, the transfer of water from the rim ditch

to the perimeter ditch may be achieved with an open cut through the perimeter dike. However, once the perimeter dike rises above elevation 614 ft (the invert of the transfer channel), decants, stilling wells and splash pads (see Sections 4.5.5 and 4.5.7) are required for the purpose of transferring clarified water from the rim ditch to the perimeter ditch.

4.5.3 Perimeter Ditch

Throughout the stacking operations, a perimeter ditch must be constructed and maintained around the toe of the gypsum stack. The perimeter ditch will be located between the perimeter dike (outer gypsum slope) and the HDPE lined earthen embankment. This ditch will collect water from the ring drains, decants and rainfall runoff, and convey it to the transfer channel where it will be discharged to the recycle pond. The perimeter ditch shall be constructed by covering the HDPE liner with a 2 ft thick protective layer of gypsum and shaping the channel to the required dimensions. The perimeter ditch is required to have a maximum invert elevation of 614 ft (6 ft below the top of the earthen perimeter dam) and a bottom width of at least 5 ft. A larger ditch bottom width may be utilized to reduce the frequency of any dredging necessary to maintain the minimum required dimensions.

4.5.4 Rim Ditch

The rim ditch will be the primary means of diverting slurry from the slurry discharge pipes to the desired deposition area. The rim ditch will also transport clarified water to the decant structures so the water can be discharged to the perimeter ditch. Consequently, the width of the rim ditch will vary according to the needs at any particular location on the gypsum stack. There may also be cases where blocking the rim ditch is desirable to divert water into a particular cell. There are only two primary constraints on the construction of the rim ditch: (1) the outer slope shall not be steeper than 3.0H:1.0V (this is the inner slope of the perimeter dike); and (2) the normal operating water level shall be at least 3.5 ft below the top of the perimeter dike.

4.5.5 Installation and Operation of Decants and Stilling Wells

The progressive stacking of gypsum will require the installation of at least four (4) decant structures (2 redundant sets of 2) in the rim ditch to convey water to the lower perimeter ditch without eroding the gypsum stack slopes. A minimum of two (2) decant structures are required in order to maintain the water level in the rim ditch and provide adequate discharge capacity for design precipitation events. An additional redundant set of two (2) decant structures will also be required to be installed. The decant structures will consist of 16-inch diameter solid wall HDPE IPS DR 11 pipe sections with 12-inch diameter screw-capped tees installed at 6 ft intervals along the length of the pipe. (When installed on a 3H:1V slope, the tees at 6 ft intervals will translate to 2 ft elevation intervals.) The decant structures will each discharge to a stilling well located in the perimeter ditch at the toe of the outer gypsum stack slope.

During construction of the first gypsum dike above elevation 614 ft (the invert elevation of the perimeter ditch and transfer channel), a 16-inch diameter solid wall HDPE IPS DR11 pipe will be installed as shown in Figure **FError! Reference source not found.** The horizontal portion of the pipe will be approximately 80 ft long with an invert at EL 614. The inlet end of the horizontal pipe will be attached to the first decant pipe section with an 18.4 degree angle

fitting. Prior to backfilling over the horizontal portion of the pipe, a 20 ft wide geogrid must be installed over the entire horizontal portion of the pipe, to prevent the pipe from potentially floating out of the saturated gypsum layer during the initial stages of the stacking operation.

The outlet end of the decant pipe will be welded to, and discharge into, a 48-inch diameter HDPE stand pipe with a 1-inch thick HDPE plate welded to the bottom. The stand pipe will have a top elevation of 618 ft and a bottom elevation of 611 ft. The stand pipe will be filled with concrete ballast to EL 614 (see Detail A on Figure F). Additionally, a 4-inch diameter low flow drain will be installed in the stand pipe at elevation 614 ft in order to allow for the cleanout of any gypsum which might accumulate in the stand pipe. In order to allow for proper function of the stilling well, the low flow drain pipe should not be installed in line with the 16-inch decant pipe, but rather offset to one side.

Each time the perimeter gypsum dike is raised, a new decant pipe section will be butt welded to the decant structure. The decant pipe section will be supported by the interior 3H:1V slope of the rim ditch. The water level in the rim ditch will be progressively raised through the stacking operation by capping the appropriate tees in the decant pipe sections. As previously stated, the normal water level shall be at least 3.5 ft below the crest of the perimeter gypsum dike.

4.5.6 Installation of Upper Ring Drains

Upon completion of the first gypsum dike above elevation 614 ft, and prior to construction of the next progressively stacked dike, two interior ring drains must be installed concurrent with development and operation of the interior gypsum cells. Additional ring drains will be required as the height of the gypsum stack increases. Final details and specifications for the upper ring drains will be provided by the design engineer at the time of installation. The upper ring drains are required to control the phreatic surface which will develop within the stack. A preliminary design for the upper ring drains is as follows, as shown on Figure C: A 3 ft tall gypsum dike will be constructed along the centerline of the proposed ring drain using the same techniques as for gypsum dike construction. After construction of the dike, a 4 ft deep channel with a 4 ft bottom width will be excavated along the center of the dike. Side slopes on the cut should be no steeper than 1:1. The bottom and sides of the cut should be filled with IDOT FA1 gradation sand to form a layer which is 1 ft thick. After the sand is placed, the channel will then be lined with non-woven geotextile to be specified by the design engineer. The geotextile will be covered with coarse granular material (to be specified) 2 ft wide by 2 ft deep, with a perforated HDPE pipe imbedded in the center. The fabric will then be wrapped over the top of the coarse granular material and covered with an additional 1 ft thick layer of FA1 gradation sand. The gypsum must not be in direct contact with the non-woven geotextile. The upper ring drains will discharge to the perimeter ditch via solid-wall HDPE pipe.

4.5.7 Splash Pads at Ring Drain & Decant Discharge Locations

At each location where a ring drain and/or a decant structure discharges to the perimeter ditch, the ditch shall be lined with a material capable of resisting the erosive velocities. Materials such as concrete, cable stayed concrete blocks or a geogrid backfilled with washed

aggregate may be acceptable. Operator-proposed methods shall be submitted to Ameren for approval prior to placement. The splash pads shall be installed concurrently with or immediately after construction of the perimeter ditch, ring drain outlets and decant stilling wells.

4.5.8 Piezometer Installation and Monitoring

The side slopes of the gypsum stack will be constructed with 3.0H:1.0V side slopes. (After consolidation of the settled gypsum over time, the final slopes are expected to approach 3.75H:1.0V.) The stability of the gypsum stack slopes is critically dependent on the location of the phreatic surface which will develop within the gypsum stack. Proper installation and functioning of the ring drains will ensure that the phreatic surface is located an adequate distance from the surface of the slope as necessary to maintain a stable slope. In order to monitor the phreatic surface within the gypsum stack, piezometers will be installed on each side of the gypsum stack. A preliminary piezometer detail is included on Figure C. The location and depth of each piezometer will be determined by the design engineer prior to installation, and an installation and monitoring plan will be developed based on information obtained during the initial gypsum stacking operations below the level of the earthen berm. “Critical elevations” corresponding to the anticipated readings at various stages during the progressive raising of the gypsum stack will be established for each piezometer. The water level in each piezometer will be read and recorded in accordance with a specified schedule. If at any time a reading is recorded higher than the “critical elevation” for that stage of operation, Ameren and the design engineer must be contacted immediately for evaluation of the reading. It is imperative that the piezometers are installed and monitored in accordance with the plan and the design engineer’s specifications. Depending on the piezometer readings, it may also be necessary to install additional seepage collection drains to maintain the phreatic surface at or below the critical level within the gypsum stack.

Figure A – Bottom Ring Drain Assembly

Figure B - Initial Gypsum Dike Construction

Figure C - Components of Gypsum Stack

Figure D - Progression of Ditch and Dike Construction

Figure E - Access Pad Extension onto Gypsum Beach

Figure F - Decant Pipe and Stilling Well Details

SECTION 5.0 DAM INSPECTIONS

The inspection program includes two types of dam inspections which are required to be performed in accordance with IDNR/OWR's Rules for Construction and Maintenance of Dams. The first type of inspection is regularly conducted by the dam Operator and is referred to as an Operation and Maintenance Inspection. The second type of inspection, referred to as the Engineering Inspection, is conducted by a qualified engineer approved by Ameren.

Inspections shall be conducted throughout the operating life of the structures. The "operating life of the structure" will be considered to cease upon receipt of written affirmation from IDNR/OWR indicating that the structure is no longer considered a dam. Copies of all inspection reports shall be maintained at the Plant for the operating life of the structures.

5.1 OPERATION AND MAINTENANCE INSPECTION

"Walk-around" inspections of the dams and appurtenant works are to be made by the dam Operator. During these inspections, a checklist of items to be maintained and items to be observed should be recorded. The checklist provided in Appendix B shall be utilized for these inspections. **If any of the following items are found to be unusual or are cause for concern, the Ameren Shift Supervisor should be immediately notified.**

Frequency: Weekly. Also, during and after unusual events such as heavy rainfall or after an earthquake.

Inspection Items: During each inspection the following items should be noted in particular.

1. Water Level - Maximum levels as a result of heavy rainfall should be recorded.
2. Earth Embankment - Walk the crest, side slopes and downstream toe of the dam concentrating on surface erosion, seepage, cracks, settlement, slumps, slides, and animal burrows. These are described as follows:
 - Surface Erosion - Removal of vegetative cover by water action or pedestrian or vehicle usage forming deep ruts or gullies.
 - Seepage - The passage of water through and/or underneath the earth embankment abutment and natural groundline or at the contact between the embankment and outlet works. It can be indicated by cattails or other wet environmental vegetation, erosion, channelization, or slumping on the embankment face.
 - Cracks - Deep cracks usually indicate the movement of the dam and/or the foundation and can be in either the longitudinal (along the length of the dam) or transverse (across the dam) directions. Cracking can be an indicator of the

beginning of slumps. Shallow cracks may develop during the summer when the surface soils of the embankment become severely dried and are usually of no concern in regard to the safety of the dam.

- Settlement - Settlement is indicated by depressions or low spots and can be signs of consolidation of the dam or foundation or the loss of material beneath the settlement area.
 - Slumps/Slides - A slow or sudden movement of the earth embankment slope on either face toward the toe of the dam.
 - If seepage indicates the presence of soil particles, or if deep cracks, settlement, slumps, or slides are noticed, a qualified engineer should be contacted immediately for consultation.
 - Animal Burrows - Animal burrows result in a loss of earth embankment material and can provide seepage paths for water through the embankment.
3. Gypsum Embankment - Walk the crest, side slopes and downstream toe of the dam concentrating on surface erosion, seepage, cracks, settlement, slumps, slides and animal burrows. The descriptions for these are the same as for earth embankment.
 4. Vegetation - Grass should be a thick vigorous growth to stabilize the earth embankment soils and prevent erosion from occurring. Note the height of the grass; if greater than 1 foot a mowing of the area should be scheduled before the next inspection. There should be NO trees on the earth embankment and NONE within a minimum of 20 ft of the embankment toes or other structures. The gypsum embankment will not be seeded and is not expected to have any vegetation.
 5. Gypsum Stack piezometers should be inspected for any damage or loss of function. Damaged piezometers must be promptly repaired or replaced since their function is critical to ensuring stability of the gypsum stack.
 6. The water level in each Gypsum Stack piezometer must be measured and recorded. If the water level in any piezometer is above the “critical elevation” as discussed in Section 4.5.8, Ameren should be notified and the **design engineer should be immediately consulted for guidance on an appropriate course of action.**
 7. Gypsum Stack LD/LCRS Drains - The change in location or amount of flows discharging from the Leak Detection/Leachate Collection Recovery System (LD/LCRS) should be recorded. If a significant change has occurred, a qualified engineer should be contacted for consultation.
 8. Gypsum Stack Ring Drains - The change in location or amount of flows discharging from the Ring Drains should be recorded. If a significant change has occurred, a qualified engineer should be contacted for consultation.

9. Gypsum Stack Fixed Decant – Check the alignment and supports for the pipe. Record the amount of flows discharging from the pipe and any erosion or scour around the discharge point.
10. Gypsum Stack Perimeter Ditch – The perimeter ditch should have a consistent prismatic shape for the entire length. Inspect the perimeter ditch for evidence of erosion, sediment deposition and irregularity in channel geometry, especially in the vicinity of siphon, decant or ring drain outfall structures. If irregularities are noted, repairs should be scheduled and completed.
11. Stop Logs - Check to make sure that the stop logs in the transfer ditch are undamaged, and, if installed, are operating well and allowing for the free flow of water over them.
12. Transfer Channel - Check for any debris or other obstructions which may block or restrict the free flow of water. Check for any pools or undulation of the floor of the channel.
13. Recycle Pond Decant - Check for any debris or other obstructions around the Recycle Pond decant which may block or restrict the free flow of water. The emergency dewatering valve should be lubricated. If there is no return water in the pipe, the emergency dewatering valve should be exercised. Record the physical and operating conditions of the system.
14. Recycle Pond Drop Inlet Spillways - Check for any debris or other obstructions around the inlet crest and at the bottom of the drop inlet which may block or restrict the free flow of water. Check for the development of any rusty areas on the concrete, and seepage, cracking, breaking, or spalling of the concrete. Check for settlement or cracking of the crest. Check for any debris in the pipes which may restrict the flow of water. Check for any tears or leaks in the HDPE liner covering the concrete.
15. Recycle Pond Rip Rap Basin - Check for any debris or other obstructions in the riprap basin which may block or restrict the free flow of water. Check to make sure that the rip rap is remaining in a uniform position. Freeze/thaw action or flow over the rip rap may tend to lift or fracture, thus requiring replacement or leveling to maintain the necessary level of protection. NO trees or woody vegetation should be growing through the rip rap.
16. Fences - Check for damage, accumulated debris, operation of gates and locks, and adequacy of locations (this may change with time as people access the area or development occurs in the area).
17. Perimeter - Check the perimeter of the dams for a distance of at least 100 ft beyond the toe for signs of seepage or boils.

18. HDPE Liner – Wherever exposed, the HDPE Liner should be inspected for tears, gouges, protrusions under the liner and abrasion.

Records: Log books of activities occurring at the dam is to be kept current by the dam Operator. The log books shall be made available for review by the inspecting engineer during the Engineering Inspection. The log books should contain at the least the following documentation:

1. Completed operation and maintenance inspection checklists
2. Readings from all piezometers on the Gypsum Stack
3. Additional visual observations
4. A list of maintenance performed
5. A list of any unusual occurrences at the dam
6. A copy of the engineering inspection reports

5.2 ENGINEERING INSPECTION

The engineering inspection is to be conducted by a qualified engineer approved by IPRG. The inspection will provide a thorough evaluation of the dam and appurtenant structures. The forms provided in Appendix C shall be utilized for these inspections.

Frequency: The Gypsum Stack Dam and Recycle Pond Dam are classified as CLASS III, LOW HAZARD POTENTIAL dams. Class III dams are to be inspected at least once every five years.

Inspection Items: The engineer will thoroughly inspect all of the items noted under Operation and Maintenance Inspection.

Records: The Dam Inspection Report form, Appendix C, will be completed by the inspecting engineer and will be signed and sealed by an Illinois Registered Professional Engineer. This report will document any deficiencies; recommend remedial actions; and establish time requirements for addressing the deficiencies. The original report will be retained in Ameren's file and a copy of the report will be submitted to the Illinois Department of Natural Resources, Office of Water Resources.

SECTION 6.0
MAINTENANCE ACTIVITIES

Timely repairs are a must after problem areas have been identified. The dam Operator is to perform the work required to correct items noted in the operation and maintenance and engineering inspections. Such items include mowing, seeding, tree and brush removal, replacing rip rap, repairing fences and locks, clearing debris, etc. The maintenance activities specified in the following sections are minimum requirements. NOTE: NO alterations or repairs to structural elements should be made without the assistance of a qualified engineer and the concurrence of the Illinois Department of Natural Resources, Office of Water Resources.

6.1 ROUTINE MAINTENANCE

Debris: Remove all trash, logs and other debris which may obstruct flow into the principal spillway pipes and drop inlets, or block passage from their discharge channels.

Rip Rap: Replace rip rap as needed to provide adequate protection against erosion.

Vegetation Control:

1. Maintain a good grass cover on the embankment by seeding, fertilizing and mulching areas which are refilled, barren, or thinly vegetated. Seeding mixtures used for maintenance reseeding shall result in a cover compatible with adjacent cover. The seeding mixture specified at the time of the dam's construction was IDOT Standard Specifications Class 1A (Salt Tolerant Lawn Mixture) as follows:

IDOT Class 1A Salt Tolerant Lawn Mixture

Bluegrass	60 lb/acre
Perennial Ryegrass	20 lb/acre
Dawsons Red Fescue.....	20 lb/acre
Scaldis Hard Fescue	20 lb/acre
Fults Salt Grass	60 lb/acre

2. Grassed areas such as the embankment and the areas beyond the embankment toes for a distance of at least 20 ft should be mowed at least twice annually or at any time the height of the grass exceeds 1 foot.
3. All erosion areas will be filled and compacted, reseeded, fertilized and mulched to establish a thick erosion resistant cover.
4. Remove all trees and brush growing on the dam embankment to prevent development of a root system which could provide seepage paths. Herbicides utilized for tree and brush control are discussed in Appendix D.
5. Keep the riprap basin clear of weeds, brush, and trees.

6. Remove all trees and brush growing on the dam embankment to prevent development of a root system which could provide seepage paths. Herbicides utilized for tree and brush control are discussed in Appendix D.
7. Clear all brush and trees to a distance of approximately 20 ft beyond both toes of the dam.

Animal Damage: Fill rodent holes and other animal burrows with compacted clayey dirt and reseed. If rodents become a nuisance, an effective rodent control program as approved by the Illinois Department of Natural Resources District Wildlife Biologist should be implemented.

Signs: All warning signs shall be maintained (repaired, painted, or replaced) as needed.

6.2 EROSION AND DUST CONTROL

As stacking operations commence, the dewatered gypsum is expected to form a thin layer of “crust” which will resist erosion and prevent the migration of fugitive dust from the gypsum stack. (This expectation is based on a case study of flue-gas desulfurization by-product (gypsum) stacking by the Electric Power Research Institute entitled Evaluation of Chiyoda Thoroughbred 121 FGD Process and Gypsum Stacking, Volume 3 Addendum, dated March 1981.) Should a protective layer of crust fail to form or fail to provide adequate erosion and dust control, appropriate measures for addressing these concerns will be implemented.

APPENDIX A
LOCATION MAP

APPENDIX B
PERTINENT DATA ABOUT THE DAMS

Gypsum Stack Dam

DAM		
Top of Dam Elevation	620	ft
Invert of Reservoir Elevation	585	ft
Reservoir Area at Invert	0.7	acres
Reservoir Area at Top of Dam	31.6	acres
Total Reservoir Volume	773.2	acre-ft
Total Watershed Area	31.6	acres

TRANSFER CHANNEL		
Bottom Width	16.00	ft
Top Width	16.00	ft
Depth	6.00	ft
Upstream Invert	614.00	ft
Downstream Invert	609.00	ft
Weir Elevation	616.00	ft
Weir Length	16.00	ft

0.5 PMF STORM EVENT		
Critical Storm Duration	24	hours
Peak Inflow	374.7	cfs
Peak Outflow	190	cfs
Total Inflow	54.88	acre-ft
Total Outflow	54.91	acre-ft
Peak Storage	9.46	acre-ft
Peak WSEL (HEC-HMS)	618.5	ft
Peak WSEL (HEC-RAS)	618.31	ft
Freeboard over Max WSEL	1.5	ft
Wave Runup/Wind Setup	1.48	ft

PERIMETER DITCH		
Bottom Width	5.00	ft
Top Width	44.00	ft
Depth	6.00	ft
Outer Side Slope	3.5:1	H:V
Inner Side Slope	3:1	H:V
Upstream Invert	615.16	ft
Downstream Invert	614.00	ft
Ditch slope	0.00050	ft/ft
Bank Full Cross-sectional Area	147.00	sf
Length of Each Ditch (Centerline)	2322.00	ft
Bank Full Volume of Each Ditch	7.84	acre-ft
Total Ditch length (Centerline)	4644.00	ft
Total Ditch Bank Full Volume	15.67	acre-ft

100-YR STORM EVENT		
Critical Storm Duration	0.5	hours
Peak Inflow	274.7	cfs
Peak Outflow	91.4	cfs
Total Inflow	21.08	acre-ft
Total Outflow	21.12	acre-ft
Peak Storage	6.31	acre-ft
Computed WSEL (HEC-HMS)	617.54	ft
Computed WSEL (HEC-RAS)	617.66	ft
Freeboard over Max WSEL	2.34	ft
Wave Runup/Wind Setup	1.48	ft

Recycle Pond Dam

DAM		
Top of Dam Elevation	615	ft
Invert of Reservoir Elevation	592	ft
Reservoir Area at Invert	4.87	acres
Reservoir Area at Top of Dam	8.21	acres
Total Reservoir Volume	150.4	acre-ft
Total Watershed Area	39.81	acres

SPILLWAY			
Pipe Length	60	ft	
Pipe Diameter (Inside)	42	inch	
Number of Pipes	4		
Pipe Slope	0.03333	Ft/ft	
Upstream Invert	610	ft	
Downstream Invert	607	ft	
Entrance Loss Coefficient	0.9		

0.5 PMF Storm Event - Starting WSEL @ 610		
Critical Storm Duration	24	hours
Peak Inflow	252.4	cfs
Peak Outflow	123.6	cfs
Total Inflow	65.96	acre-ft
Total Outflow	62.88	acre-ft
Peak Storage	135.79	acre-ft
Peak WSEL (HEC-HMS)	612.99	ft
Peak WSEL (HEC-RAS)	613.00	ft
Freeboard over Peak WSEL	2.01	ft
Wave Runup/Wind Setup	1.77	ft
Peak Spillway Outlet Velocity	12.73	fps

100-yr Storm Event - Starting WSEL @ 610			
Critical Storm Duration	2	hours	
Peak Inflow	107.1	cfs	
Peak Outflow	29.5	cfs	
Total Inflow	27.22	acre-ft	
Total Outflow	24.15	acre-ft	
Peak Storage	125.25	acre-ft	
Peak WSEL (HEC-HMS)	611.37	ft	
Computed WSEL (HEC-RAS)	611.37	ft	
Freeboard over Peak WSEL	3.63	ft	
Wave Runup/Wind Setup	1.77	ft	
Peak Spillway Outlet Velocity	9.92	fps	

0.5 PMF Storm Event - Starting WSEL @ 599.5		
Critical Storm Duration	24	hours
Peak Inflow	252.1	cfs
Peak Outflow	0	cfs
Total Inflow	65.96	acre-ft
Total Outflow	0	acre-ft
Peak Storage	114.47	acre-ft
Peak WSEL (HEC-HMS)	609.70	ft
Freeboard over Peak WSEL	5.3	ft
Wave Runup/Wind Setup	1.77	ft

100-yr Storm Event - Starting WSEL @ 604			
Critical Storm Duration	24	hours	
Peak Inflow	32.3	cfs	
Peak Outflow	0	cfs	
Total Inflow	36.46	acre-ft	
Total Outflow	0	acre-ft	
Peak Storage	114.07	acre-ft	
Peak WSEL (HEC-HMS)	609.64	ft	
Freeboard over Peak WSEL	5.36	ft	
Wave Runup/Wind Setup	1.77	ft	

APPENDIX C
OPERATION AND MAINTENANCE INSPECTION CHECKLIST

OPERATION AND MAINTENANCE INSPECTION CHECKLIST

Dam Name (circle one): Gypsum Stack Dam Recycle Pond Dam

Date: _____ Time: _____

Name of Inspector: _____

Reservoir Elevation: _____ ft

<u>ITEM</u>	<u>NO</u>	<u>YES</u>	<u>IF YES</u>
Record Piezometer Readings for Gypsum Stack. Are any readings above the critical level? (see section 4.8.2 of O&M)			Contact Engineering Manager and notify Hanson Professional Services
Note the condition of the Piezometers on the Gypsum Stack. Any damage?			Contact Engineering Manager
Deep Surface Cracks			Contact Engineering Manager
Slump or Slide on the upstream or downstream face			Contact Engineering Manager
Erosion from runoff, wave action or traffic			Repair and stabilize
Wet areas on the gypsum or earthen embankment indicating seepage			Contact Engineering Manager
Flows of cloudy water from seepage areas on the gypsum or earthen embankment			Contact Engineering Manager
Uneven settlement			Contact Engineering Manager
Trees, brush or burrow holes on the embankment or in the riprap basin			Remove trees and brush, fill holes
Transfer channel or Spillway pipes blocked			Clear immediately
Damage to stop logs			Repair or replace
Tear in Liner			Repair and schedule engineer inspection
Settlement or displacement of Gypsum Stack siphon decant pipes or outlets			Schedule engineer inspection
Settlement or displacement of Gypsum Stack fixed decant pipes or outlets			Schedule engineer inspection
Discharge from Gypsum Stack LD/LCRS Drains?			Record discharge rate for each outlet (time to fill bucket)
Discharge from Gypsum Stack Ring Drains?			Record discharge rate for each outlet (time to fill bucket)
Gypsum Stack Perimeter Ditch erosion			Schedule repair
Problems with Recycle Pond decant			Contact Engineering Manager
Height of grass (inches		inches	If more than 1 foot, schedule mowing

APPENDIX D
ENGINEERING INSPECTION FORM

Dam Inspection Report

Name of Dam IPRG Duck Creek Gypsum Stack & Recycle Pond Dams Dam ID No. IL50573 & IL50574

Permit Number DS2007125 Class of Dam III

Location NW 1/4 Section 18 Township 6N Range 5E 4th P.M.

Owner _____
Name Telephone Number (Day)

Street _____
Telephone Number (Night)

County Fulton

City _____ Zip Code _____

Type of Dam Homogeneous earthen embankment (gypsum stack is homogeneous gypsum embankment)

Type of Spillway _____

Date(s) Inspected _____

Weather When Inspected _____

Temperature When Inspected _____

Pool Elevation When Inspected _____

Tailwater Elevation When Inspected _____

Inspection Personnel:

Name Title

Name Title

Name Title

Name Title

Professional Engineer's Seal

The Department of Natural Resources is requesting information that is necessary to accomplish the statutory purpose as outlined under the River, Lakes and Streams Act, 615 ILCS 5 (1994 State Bar Edition). Submittal of this information is REQUIRED. Failure to provide the required information could result in the initiation of non-compliance procedures as outlined in Section 702.160 of the "Rules for Construction and Maintenance of Dams". This form has been approved by the State Forms Management Center.

CONDITION CODES

<u>EC</u>	:	<u>Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; such as, pool draw down, work stoppage, plant stoppage.</u>
<u>NE</u>	:	<u>No evidence of a problem</u>
<u>GC</u>	:	<u>Good condition</u>
<u>MM</u>	:	<u>Item needing minor maintenance and/or repairs within the year, the safety or integrity of the item is not yet imperiled</u>
<u>IM</u>	:	<u>Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.</u>
<u>EC</u>	:	<u>Emergency condition which if not immediately repaired or other appropriate measures taken could lead to failure of the dam</u>
<u>OB</u>	:	<u>Condition requires regular observation to ensure that the condition does not become worse</u>
<u>NA</u>	:	<u>Not applicable to this dam</u>
<u>NI</u>	:	<u>Not inspected - list the reason for non-inspection under deficiencies</u>
<u>EC</u>	:	<u>Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; such as, pool draw down, work stoppage, plant stoppage.</u>

GYP SUM STACK - EARTH EMBANKMENT

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Surface Cracks			
Vertical and Horizontal Alignment of Crest			
Unusual movement or Cracking at or Beyond Toe			
Sloughing or Erosion of Outer Embankment Slopes			
Upstream Face Slope Protection (HDPE Liner)			
Seepage			
Animal Damage			

GYP SUM STACK - EARTH EMBANKMENT

(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Vegetative Cover			

GYPSUM STACK - GYPSUM EMBANKMENT

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Surface Cracks			
Vertical and Horizontal Alignment of Crest			
Unusual movement or Cracking at or Beyond Toe			
Sloughing or Erosion of Outside Embankment Slopes			
Sloughing or Erosion of Inside Embankment Slopes			
Seepage			
Animal Damage			

GYPSUM STACK - GYPSUM EMBANKMENT

(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Condition of Piezometers on Gypsum Stack			
Piezometer Readings on Gypsum Stack Above Critical Level?			

GYPSUM STACK – PERIMETER DITCH

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Ditch Geometry (15 ft bottom width, 3:1 slopes, 8-9 ft depth)			
Concrete Apron at ring drain outlets			
Ring Drain Discharge Pipes			
Stilling Wells for Fixed Decants			

TRANSFER CHANNEL - (between gypsum stack and recycle pond)

Drop Inlet Structure

Overflow Spillway Structure

Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Debris			
Side Slope Stability			
HPDE Liner			
HDPE Liner Welds			
Stop Logs			
Differential Settlement			

RECYCLE POND - EMBANKMENT

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Surface Cracks			
Vertical and Horizontal Alignment of Crest			
Unusual movement or Cracking at or Beyond Toe			
Sloughing or Erosion of Outer Embankment Slopes			
Upstream Face Slope Protection (HDPE Liner)			
Seepage			
Animal Damage			

RECYCLE POND - EMBANKMENT

(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Vegetative Cover			

RECYCLE POND - PRINCIPAL SPILLWAY (Left, Looking Downstream)

Drop Inlet Structure

Overflow Spillway Structure

Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment of Structure Walls			
Construction Joints			
Differential Settlement			
Erosion, Spalling, Cavitation			
Joint Separation			
Seepage Around or into Conduit			
Surface Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Left, Looking Downstream)

(Continued)

Drop Inlet Structure

Overflow Spillway Structure

Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Structural Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Center)

Drop Inlet Structure

Overflow Spillway Structure

Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment of Structure Walls			
Construction Joints			
Differential Settlement			
Erosion, Spalling, Cavitation			
Joint Separation			
Seepage Around or into Conduit			
Surface Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Right, Looking Downstream)

Drop Inlet Structure

Overflow Spillway Structure

Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment of Structure Walls			
Construction Joints			
Differential Settlement			
Erosion, Spalling, Cavitation			
Joint Separation			
Seepage Around or into Conduit			
Surface Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Right, Looking Downstream)

(Continued)

Drop Inlet Structure

Overflow Spillway Structure

Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Structural Cracks			

RECYCLE POND - ENERGY DISSIPATOR

Principal Spillway

Outlet Works

Type:

Riprap Basin

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Riprap			
Outlet Channel			
Debris			

RECYCLE POND - DECANT STRUCTURE

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment			
Connection to Bollard			
Debris in Inlets			
Condition of Pipe			
Condition of Liner Beneath Pipe			
Connection to Ballast			
Connection of Pipe Boot to Liner			

RECYCLE POND - DECANT STRUCTURE

(continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Seepage Around or into Conduit			

APPENDIX E
HERBICIDES

HERBICIDES

Site personnel should check with the Illinois Department of Natural Resources, Regional Fisheries Biologist and the Regional Wildlife Biologist before using any herbicide. Read the product label prior to use and follow the use directions and precautions accordingly.

On March 1, 1979 the U.S. Environmental Protection Agency (U.S.E.P.A.) halted the use of the herbicide 2, 4, 5-T in parks and recreation areas. The use of silvex (2, 4, 5-TP) around water has also been banned.

The Agronomy Department at the University of Illinois and the Aquatic Biology Section of the Department of Natural Resources, Office of Scientific Research and Analysis indicate that the herbicides containing the 2, 4-D or 2, 4-DP are legal for use in parks and recreation areas and effective for controlling brush and woody growth. Some examples of approved herbicides are:

1. Tordon RTU by DOW Chemical. (Can be obtained with blue dye.)
2. WEEDONE 170 by Union Carbide
3. WEEDONE, 2, 4-DP by Union Carbide
4. A 1% to 2% solution of ROUNDUP
5. Garlon by DOW Chemical
6. Banvel by Sandoz

Your distributor may carry brand name herbicides other than those listed above. Be certain that the product does not contain the ingredients 2, 4, 5-T or 2, 4, 5-TP. An example of an unacceptable product is ESTERON 2, 4, 5 by DOW Chemical.