

# POST CLOSURE PLAN

**CFR 257.104(d)**

Fly Ash Reservoir 1 Landfill  
Cardinal Plant  
Brilliant, Ohio

September, 2016

Prepared for: Cardinal Operating Company - Cardinal Plant  
Brilliant, Ohio

Prepared by: Geotechnical Engineering Services  
American Electric Power Service Corporation  
1 Riverside Plaza  
Columbus, OH 43215

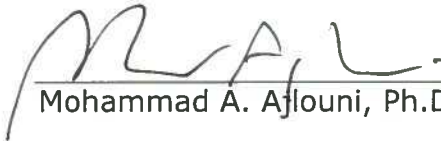


GERS-16-065

POST CLOSURE PLAN  
CFR 257.104(d)  
FLY ASH RESERVOIR FAR1 LANDFILL  
CARDINAL PLANT

GERS-16-065

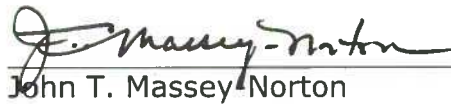
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DATE

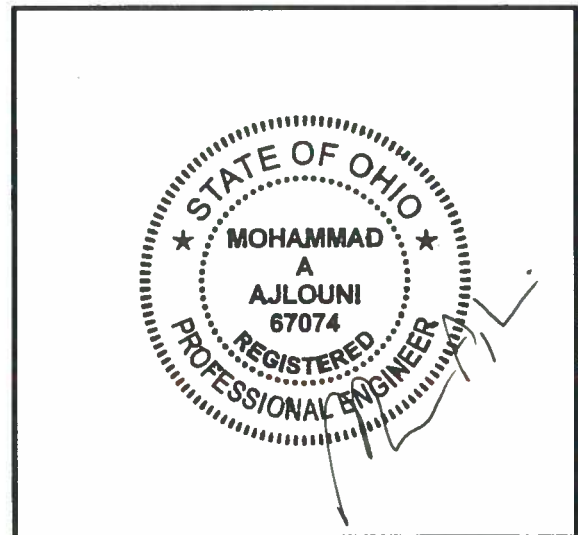
Sept. 9, 2016

APPROVED BY

  
Gary F. Zych, P.E.  
Manager - AEP Geotechnical Engineering

DATE

9/12/2016



I certify to the best of my knowledge, information, and belief that the information contained in this post closure plan meets the requirements of 40 CFR § 257.104

# TABLE OF CONTENTS

<b>1.0 OBJECTIVE</b> .....	1
<b>2.0 DESCRIPTION OF THE CCR UNIT</b> .....	1
<b>3.0 DESCRIPTION OF POST CLOSURE PLAN 257.104(d)(1)(i)</b> .....	1
3.1 Section 257.104(b)(1).....	1
3.2 Section 257.104(b)(3).....	3
<b>4.0 POST-CLOSURE CONTACT 257.104 (d)(1)(ii)</b> .....	3
<b>5.0 POST-CLOSURE PLANNED USE 257.104 (d)(1)(iii)</b> .....	3

## **Attachment A: Post Closure Care Plan from approved landfill permit**

## **1.0 OBJECTIVE**

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.104(d) for Post Closure Plans of CCR units.

## **2.0 DESCRIPTION OF THE CCR UNIT**

The Cardinal Fly Ash Reservoir 1 (FAR1) Residual Solid Waste Landfill is located in Jefferson County, Brilliant, Ohio. The landfill is owned by Buckeye Power and AEP Generation Resources (GENCO) a unit of American Electric Power. The landfill is operated by Cardinal Operating Company-Cardinal Plant. Cardinal Landfill is being constructed under Permit To Install (PTI) No. 06-07993, issued on May 11, 2007. The Cardinal Power Plant in Wells Township, Jefferson County, near the town of Brilliant in eastern Ohio.

The 127 acre landfill consists of two phases and six cells. Phase 1 overlies the bench area between the FAR 1 impoundment and the highwall and consists of Cells 1 and 2 in addition to Cell 3. Phase 2 will be developed over the FAR 1 impoundment (except for Cell 3) and consists of Cells 4 – 6.

The FAR I landfill receive gypsum from the plant via trucks.

## **3.0 DESCRIPTION OF POST CLOSURE PLAN 257.104(d)(1)(i)**

***[A description of the monitoring and maintenance activities required in paragraph (b) of this section for the CCR unit, and the frequency at which these activities will be performed.]***

The FAR 1 Landfill will be closed by closure in place. The FAR 1 Landfill will be closed periodically during the life of the facility. The closure activities are further discussed in the OEPA-approved Closure Plan in Attachment A. This Plan in Attachment A contains all of the pertinent information and requirements of Section 257.102 (b), however, the post closure care period will be 30 years not 15 years as indicated in the attachment.

### **3.1 SECTION 257.104(b)(1)**

***[Maintaining the integrity and effectiveness of the final cover system including making repairs to the final cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover.]***

Inspections are performed for the items noted below. The inspection frequencies are scheduled to properly detect any issues so that repairs can be performed before significant harm occurs.

- **Embankment**: The entire waste embankment, including top surface and side-slopes, will be inspected for slides, settlement, subsidence, displacement, and cover condition (see below).
- **Soil Dike**: The soil dike will be inspected for slides, displacement, and erosion.
- **Cover**: The final cover will be inspected for erosion and for the condition of the vegetated cover, i.e., gaps in vegetation or presence of undesirable trees or brush. The integrity of the cover drainage system will also be inspected.
- **Final Cover Surface**: The Final Cover surface will be inspected for any ponding of water or flat areas.

- Surface Drainage System: The surface drainage system, including channels, culverts, slope drains, etc., will be inspected for erosion, integrity of channel lining, ponding, and accumulated sediment.
- Leachate Collection Piping: The discharge pipes of the Leachate Collection System at the Leachate Collection Pond will be inspected for clogging or damage. Other exposed portions of the Leachate Collection System including cleanouts will be inspected for damage. Similarly, the Leachate Collection Pond will be inspected for general damage to the pond and perimeter berms, and for accumulation of sediment in the pond.

Maintenance during the post-closure care period will be performed as discussed below, based upon the facility inspections described above.

- Security Control Devices: Any portions of the roadway barricades which might be damaged will be repaired or replaced as necessary.
- Erosion Damage Repair: Any areas exhibiting erosion will be repaired by replacing and compacting the material in-kind to design grade/specifications, and reseeding the area to the specifications. Applications of additional fertilizer, selective herbicides, rodent control measures, etc. will be implemented as necessary. In the selection of fertilizers and herbicides, ensure their use will not impact the groundwater negatively. Follow-up monitoring of the repaired area will be conducted to ascertain the integrity of the repair.
- Settlement, Subsidence, Displacement: Any areas at the closed site exhibiting evidence of settlement, subsidence, or displacement will be examined to determine the cause of the movement. If backfilling or placing additional fill material is needed to maintain the integrity of the closed structure, it will be performed in accordance with the site/closure specifications, including seeding. If the condition reoccurs or persists, or if the severity of the condition initially is judged to warrant it, a detailed investigation of the cause will be performed and remedial action will be performed. Similarly, any areas of the soil dike exhibiting sliding, displacement, or seepage will be investigated. Repairs will be made as necessary. Follow-up monitoring of the area will be performed to ascertain that the problem has been corrected.
- Closure Cap Surface: Any areas that show signs of ponding water or flat contours will be examined and rectified.
- Surface Water Drainage System: The channel linings are designed to withstand the design velocities. Maintenance of the surface water drainage system will consist of removing sediment and/or undesirable vegetation from the surface water runoff control system (channels and culverts) as required. Eroded areas will be repaired by back-filling and reseeding according to the specifications. Damage to culverts will be repaired; structure replacement will be performed if needed.
- Leachate Collection System: Maintenance of the leachate collection system, collection sump, and leachate pumps will consist of repairing and/or replacing in-kind any damaged or eroded portions of the system and pond, cleaning pipes, and removing leachate and sediment from the collection sump and the Leachate Collection Pond, as needed.

### **3.2 SECTION 257.104(b)(3)**

***[Maintaining the groundwater monitoring system and monitoring the groundwater in accordance with the requirements of §§257.90 through 257.98.]***

The groundwater monitoring system will be inspected for the general integrity of the wells, well casings and well protective casings. Any damaged portions of the monitoring wells and/or their protective casings will be replaced in-kind.

Monitoring the groundwater will be in accordance with the groundwater monitoring plan for this facility and in accordance with the requirements of §§257.90 through 257.98.

### **4.0 POST-CLOSURE CONTACT 257.104 (d)(1)(ii)**

***[The name, address, telephone number and email address of the person or office to contact about the facility during the post-closure care period.]***

The name, address, and telephone number of the person to contact about the Facility during the post-closure period shall be provided upon notice of closure.

### **5.0 POST-CLOSURE PLANNED USE 257.104 (d)(1)(iii)**

***[A description of the planned uses of the property during the post-closure period. Post-closure use of the property shall not disturb the integrity of the final cover, liner(s), or any other component of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in this subpart...]***

The post-closure use of the property will be undisturbed vacant land space. The only activities occurring on the closed CCR unit will be related to the Post-Closure care activities.

**ATTACHMENT A**

**Post Closure Care Plan from approved landfill permit**

**Final Closure/Post-Closure Plan**

OAC 3745-30-05 (C)(9)(d)/OAC 3745-30-09

**PERMIT-TO-INSTALL APPLICATION  
CARDINAL FAR 1 RESIDUAL WASTE LANDFILL FACILITY**

**VOLUME 5**

*Submitted to*

**Ohio Environmental Protection Agency**

*Submitted and Owned by*

**Cardinal Operating Company**  
Brilliant, Ohio

*Prepared by*

**American Electric Power Service Corporation**  
1 Riverside Plaza, Columbus Ohio 43215

*and*

**GeoSyntec Consultants**  
55 West Wacker Drive, Suite 1100  
Chicago, Illinois 60601

May 2006



**TABLE OF CONTENTS**

**1. INTRODUCTION..... 1**

**2. FACILITY LOCATION..... 2**

**3. VARIANCES/EXEMPTIONS..... 3**

**4. FACILITY CONTACTS..... 4**

**5. PLANS AND DETAIL DRAWINGS ..... 5**

**6. STATIC AND SEISMIC STABILITY ANALYSIS ..... 6**

**7. GROUNDWATER MONITORING PLAN ..... 7**

**8. FINANCIAL ASSURANCE..... 8**

**9. CLAY RESOURCES..... 9**

**10. QUALITY ASSURANCE/QUALITY CONTROL PLAN..... 10**

**11. EROSION CONTROL..... 11**

**12. MANDATORY CLOSURE/NOTIFICATIONS..... 12**

**13. FINAL CLOSURE ACTIVITIES ..... 13**

**14. POST-CLOSURE CARE ACTIVITIES..... 15**

## **LIST OF TABLES**

Table 1	Closure Costs Summary
Table 2	Post-Closure Care Costs Summary

## **LIST OF APPENDICES**

Appendix A	Supporting Closure and Post-Closure Care Cost Calculations
Appendix B	Draft Financial Insurance Instrument

## **LIST OF ACRONYMS**

BAT	Best Available Technology
EPA	Environmental Protection Agency
FAD	Fly Ash Dam
FAR	Fly Ash Reservoir
FGD	Flue Gas Desulfurization
HDPE	High Density Polyethylene
OAC	Ohio Administrative Code
QA/QC	Quality Assurance/Quality Control
RSB	Recompacted Soil Barrier
RSL	Recompacted Soil Liner
RWL	Residual Waste Landfill

## **1. INTRODUCTION**

This residual waste facility Final Closure/Post-Closure Plan presents information for the closure and post-closure operations of the Cardinal Operating Company's Fly Ash Reservoir 1 (FAR 1) Residual Waste Landfill (RWL) Facility pursuant to Ohio Administrative Code (OAC) 3745-30-09 and OAC 3745-30-10. Drawings referenced herein are presented in the accompanying Permit-to-Install (PTI) drawing set.

## **2. FACILITY LOCATION**

The Cardinal FAR 1 Residual Waste Landfill (RWL) is located approximately 1.5 miles north of the Cardinal Plant electrical generating facility located near the town of Brilliant in Wells Township, Jefferson County, Ohio. More specifically, the RWL is located approximately 6,500 feet northeast of the intersection of Riddles Run Road (Township Road 163) and Township Road 164.

### **3. VARIANCES/EXEMPTIONS**

At this time Cardinal Operating Company has not requested any variance or exemptions to the requirements specified in OAC 3745-30-09 or OAC 3745-30-10, for residual waste landfills.

#### **4. FACILITY CONTACTS**

Any questions regarding the FAR 1 RWL during the final closure and post-closure care period should be directed to:

American Electric Power  
Waste Management and Mitigation Services Manager  
1 Riverside Plaza  
Columbus, Ohio 43215  
Ph. (614) 716-1266

or

Cardinal FAR 1  
Landfill Manager  
306 County Road 7E  
Brilliant, Ohio 43913  
Ph. (740) 598-6540

## **5. PLANS AND DETAIL DRAWINGS**

The plans showing the horizontal limits and top elevations of the waste, the cover system, and the surface water control structures are shown on Drawings 4K, 4M and 4N, respectively. Drawing 4N, the stormwater management plan, shows the permanent stormwater run-on and run-off controls and as well as FAR 2 (which receives treated leachate, as necessary, and non-contact stormwater from the FAR 1 RWL). Detail drawings of the RWL stormwater controls are included on Drawings 7D and 7E. The detail drawings of the cover system are included on Drawing 7F.

## **6. STATIC AND SEISMIC STABILITY ANALYSIS**

The static and seismic stability analyses for the proposed completed landfill are provided in the *Stability Analysis Report* (Volume 3).

All factor of safety values calculated exceed the required minimum values of 1.50 for static conditions and 1.00 for seismic conditions, which are provided in OAC 3745-30-07(C)(11)(c) and OAC 3745-30-07(C)(11)(d) respectively, indicating that the proposed RWL is stable with respect to static and seismic conditions.



## **7. GROUNDWATER MONITORING PLAN**

The *Groundwater Monitoring Plan* is included in Volume 1.

## **8. FINANCIAL ASSURANCE**

Cardinal Operating Company will annually review, adjust and submit final closure and post-closure care cost estimates for the Cardinal FAR 1 RWL in accordance with OAC 3745-30-14(E)(14). The corporate guarantee will be used annually to demonstrate financial assurance for final closure and post-closure care. A draft copy of the financial assurance instrument is included in Appendix B.

The placement of final cover soils constitutes the most significant portion of final closure costs. Although the 127 acre footprint RWL will eventually be closed, the closure costs, as presented in this document, are based on the cost of closing the site at the time the largest area would require closure. The largest closure area would be approximately 53 acres and would occur after the completion of Phase 1 (Cells 1 and 2). The primary RWL closure components include placement and testing of the recompacted soil barrier (RSB), placement of the vegetative layer and establishing a vegetative cover, installing stormwater controls and implementing erosion control measures. As summarized in Table 1, the final closure costs for the Cardinal FAR 1 RWL are estimated to be \$8,172,280. Supporting cost estimate calculations are included in Appendix A.

Post-closure care activities will begin following closure certification and will continue for 15 years. Post-closure care components will consist primarily of monitoring (groundwater, surface water and leachate) and maintenance (cover system, leachate and surface water control systems, monitoring wells and access controls). As summarized in Table 2, the total post-closure care costs for the FAR 1 RWL are estimated to be \$4,353,120. Supporting cost estimate calculations are included in Appendix A.

## **9. CLAY RESOURCES**

The clay resources for the Cardinal FAR 1 RWL will be supplied from company owned borrow areas within a ten-mile radius of the landfill facility. It is anticipated that adequate resources will be available to satisfy the needs of the RWL through final closure and the post-closure care period. It is estimated that 489,961 cubic yards of RSB material and 604,370 cubic yards of cover soil would be required to construct a final cover system of the residual waste landfill over 165 acres of sloped and unsloped surfaces, including the extended cap over FAR 1 areas not within the limits of waste.

## **10. QUALITY ASSURANCE/QUALITY CONTROL PLAN**

The *Quality Assurance and Quality Control Plan* is included in Volume 5. Section 5.7 of the *Quality Assurance and Quality Control Plan* addresses the material qualification, test pad construction, and material placement specifications to ensure that the cover system is constructed in a manner consistent with the performance standards established in OAC 3745-30.

## **11. EROSION CONTROL**

Erosion and sediment control procedures are detailed on Drawings 7D, 7E and 7F. As indicated on Drawing 7E, soil erosion and sediment control practices will be implemented pursuant to the Ohio Rainwater and Land Development Manual and erosion and sediment controls will be maintained until construction is completed and/or the area is stabilized (i.e. vegetation is established). Supporting stormwater/surface water calculations are included in Volume 4.

## **12. MANDATORY CLOSURE CONDITIONS/NOTIFICATIONS**

Final Closure will be completed in a manner that minimizes the need for maintenance activities. Final Closure will be initiated when one of the following conditions have occurred:

1. Cardinal Operating Company declares that no more residual waste will be accepted at the facility;
2. The facility's solid waste license has expired and another license has not been applied for;
3. All approved limits of waste placement have been reached;
4. The facility's solid waste license has expired and another license has been applied for and denied as a final action;
5. The facility's solid waste license has been revoked as a final action; or
6. The facility's solid waste license has been suspended as a final action.

Cardinal Operating Company will provide written notice by certified mail to Ohio EPA, the Jefferson County General Health District and the Belmont/Jefferson Regional Solid Waste Authority at least ninety (90) days in advance of commencing final closure if initiated by condition numbers 1, 2, or 3 above. Any changes to the information that identifies the facility's contact person will be provided to the Ohio EPA in writing by certified mail at least thirty (30) days prior to commencing final closure. Within seven (7) days of the date that the facility actually ceases to accept waste, written notice by certified mail will be provided to the Ohio EPA and the Jefferson County General Health District, informing the agency of the actual date.

### 13. FINAL CLOSURE ACTIVITIES

Final closure activities will begin within seven days of the date that the facility has ceased to accept waste. Final closure activities include:

1. Constructing the final cover system;
2. Establishing vegetative cover;
3. Constructing and maintaining drainage and erosion/sediment controls;
4. Operating and maintaining treatment and monitoring systems;
5. Securing the facility; and
6. Closure certification and deed notation.

The primary closure activity is the placement of the cover system that will consist of a minimum two (2) foot thick low permeable RSB and thirty (30) inches of soil to protect the RSB from freeze/thaw cycles and support a vegetative cover. The material used to construct the RSB will be qualified, placed and tested in accordance with the approved *Quality Assurance/Quality Control Plan* (Volume 5). The final grades of the completed cover system are shown on Drawing 4M. With the exception of the benches the cover system will have minimum slopes of five (5) percent and maximum slopes of thirty-three (33) percent to minimize the potential for standing water.

The final cover system will be constructed in a progressive manner with additional areas being completed in most years. As outer slopes reach final waste grades, the final cover system will be constructed on these areas during the summer/early fall months and seeded.

Benches, ditches and culverts will be constructed and maintained to efficiently collect and convey surface water run-off to FAR 2. Temporary sediment and erosion control measures will be installed, as necessary, until a dense vegetative cover is established. Surface water control structures will be inspected routinely to monitor erosion or blockage of flow.

The RWL's security will be maintained during the closure and post-closure period unless the facility is to be used for other purposes as deemed acceptable by the Ohio EPA. Access will be maintained to all active monitoring sites throughout the post-closure care period.

All final closure activities will be completed with one (1) year of the date that the facility ceased accepting waste unless an alternative schedule has been approved by the Ohio EPA. Within ninety (90) days of completing final closure activities, the final closure certification report will be submitted to the Ohio EPA and will include:

1. Documentation on the construction of the final cover system;
2. A topographic map of the closed facility showing the information specified in OAC 3745-30-09(H)(1);
3. Documentation on the groundwater monitoring system;
4. A copy of the plat and deed notation filed with the County Recorder; and

5. Documentation that the facility is protected from unauthorized access.



## **14. POST-CLOSURE CARE ACTIVITIES**

Post-closure care activities will begin upon submittal of the final closure certification and will continue for a period of fifteen (15) years unless shortened or extended in accordance with OAC 3745-30-10(B). Post-closure care activities will include:

1. Continued operation and maintenance of the leachate management system, the stormwater/surface water management system and the groundwater monitoring program;
2. Maintenance of the final cover system;
3. Monitoring for leachate outbreaks and implementing remedial actions as necessary;
4. Fulfilling all inspection, monitoring, and reporting requirements; and
5. Submitting a post-closure care certification

Inspections of the closed RWL facility will be conducted quarterly throughout the post-closure care period. A written summary of the inspection will be submitted to the Ohio EPA within fifteen (15) days of conducting the inspection. The inspection report will document the nature and extent of any problem areas identified, as well as provide an estimated starting and completion date for required corrective measures to be taken.

The leachate and stormwater/surface water management systems, including piping, ditches, berms, and culverts, will be inspected for erosion, ponding, blockage of flow, sediment accumulation, and other evidence of improper performance. Discharge structures associated with FAR 2 will also be inspected to ensure operational performance.

Groundwater monitoring well locks, casing protectors and surface seals will be visually inspected during each sampling event and any unusual operational problems will be described in the groundwater reports submitted to the Ohio EPA.

The final cover system will be inspected for evidence of ponding, settlement and erosion, as well as damage caused by burrowing animals. Any damaged areas will be repaired by replacing the materials and restoring the site to final grade. If a condition reoccurs or persists, an investigation will be conducted to determine if a more permanent solution is warranted. Any permanent corrective measures that involve revisions to the facility's authorizing documents will be submitted to the Ohio EPA for review.

The condition of the vegetative cover will be evaluated (i.e. thickness, bare spots, invasive woody species) during each inspection. Corrective actions such as reseeding, fertilizing and selective herbicide applications will be implemented as necessary. Maintenance mowing will be conducted as necessary to discourage woody plant growth and to maintain the appearance and health of the vegetation.

In addition to the quarterly inspection reports, the facility will continue to monitor and report stormwater/surface water discharges during the post-closure care period in accordance with the facility's NPDES permit. It is anticipated that groundwater monitoring and reporting will continue on a semiannual basis. An annual report will be submitted containing a summary of the quantity of leachate generated, characteristics of the leachate and treatment received. The annual report will also update post-closure cost estimates.

Upon completion of the post-closure care period, a written certification will be prepared and submitted to the Ohio EPA with supporting documentation that all post-closure care activities have been completed in accordance with OAC 3745-30-10(D). The certification will be signed and sealed by a professional engineer registered in Ohio.

**Table 1**  
**Closure Cost Summary**

Final Closure/Post-Closure Plan  
Permit-to-Install Application  
Cardinal FAR 1 Residual Waste Landfill Facility

Closure Component	Cost
Cap System Components	\$ 6,146,300
Permanent Surface Water Structures	\$ 255,600
Site Access Control	\$ 257,000
Engineering (QA/QC)	\$ 130,500
<b>Subtotal of Closure Costs</b>	<b>\$ 6,789,400</b>
Administration	10 % of subtotal: \$ 678,940
Certification of Closure	\$ 25,000
Contingency	10 % of subtotal: \$ 678,940
<b>TOTAL COST OF CLOSURE</b>	<b>\$ 8,172,280</b>

NA = Not Applicable

**Table 2**  
**Post-Closure Care Cost Summary**

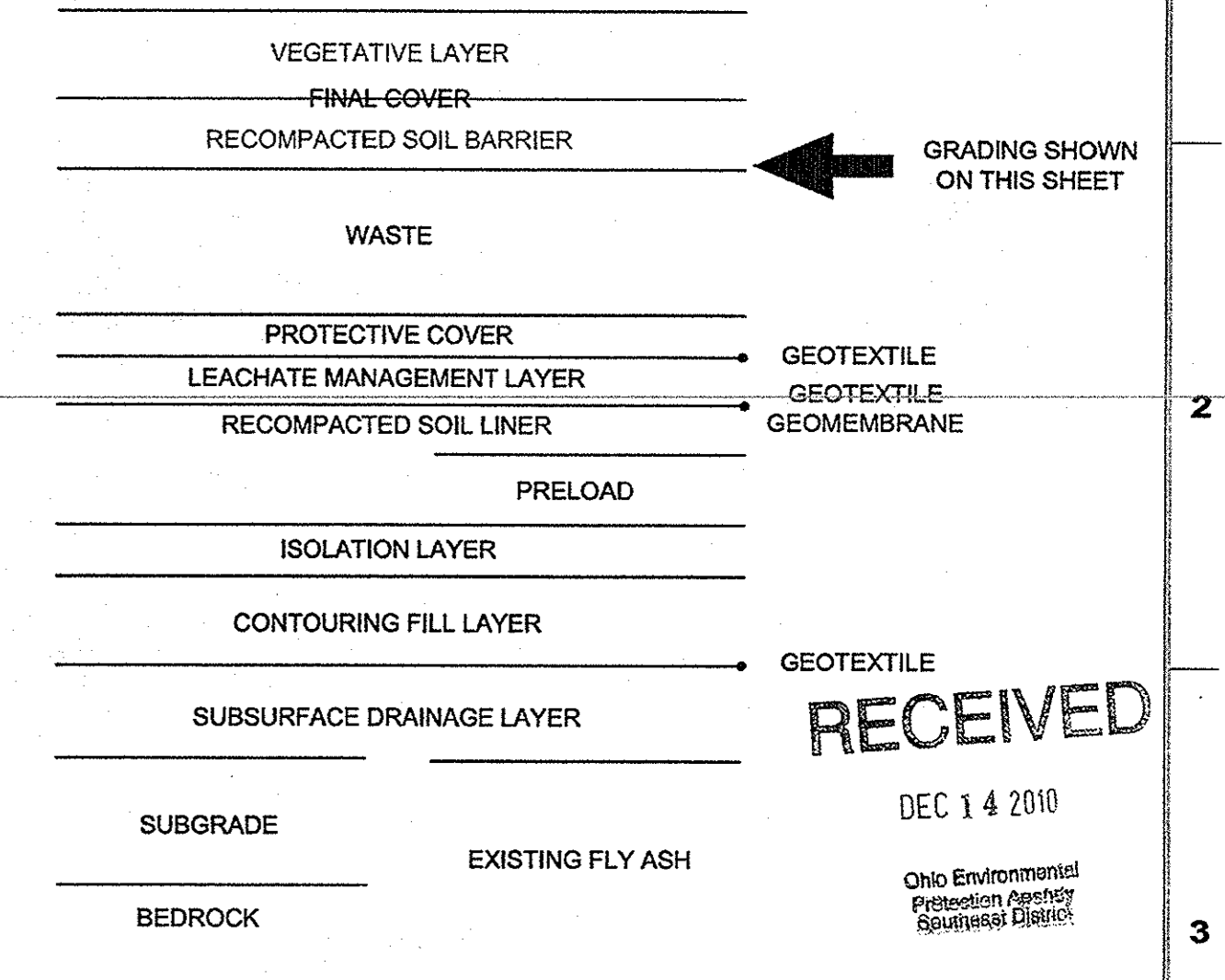
Final Closure/Post-Closure Plan  
Permit-to-Install Application  
Cardinal FAR 1 Residual Waste Landfill Facility

<b>Post-Closure Care Component</b>	<b>Cost</b>
Ground Water Monitoring	\$ 42,920
Leachate Monitoring	\$ 365
Surface Water Monitoring	\$ 365
Operation and Maintenance of Leachate Collection / Treatment Systems	\$ 10,000
Operation, Maintenance and Abandonment of Ground Water Monitoring Wells	\$ 11,433
Maintenance of Cover System	\$ 90,750
Operation and Maintenance of Surface Water Management System	\$ 18,000
Operation and Maintenance of Access Control Structures	\$ 57,000
<b>Subtotal of Annual Post-Closure Care Costs</b>	\$ 230,833
<b>Subtotal of 15 Years of Post-Closure Care Costs</b>	\$ 3,462,495
Administration 10 % of subtotal:	\$ 346,250
Final Certification Upon Completion of Post-Closure Care Period	\$ 25,000
Remedial Costs 15 % of subtotal:	\$ 519,375
<b>TOTAL COST OF POST CLOSURE CARE</b>	\$ 4,353,120

NA = Not Applicable



- FINAL WASTE ELEVATION GRADING PLAN NOTES:**
1. PLACE WASTE IN LANDFILL CELLS AS DEPICTED BY STAGING SHEETS 6A THROUGH 6G.
  2. GRADE THE WASTE SURFACE TO ACCOUNT FOR THE CONSTRUCTION OF THE LANDFILL ACCESS ROAD.
  3. THE EXISTING ROAD TO BE IMPROVED AND LANDFILL ACCESS ROAD TO BE CONSTRUCTED ARE SHOWN ON SHEET 4L AND DETAILS OF THE ROADS SHOWN ON SHEETS 7G AND 7H.



**LEGEND**

- 1020 — TOP OF WASTE ELEVATION (5'-ft INTERVAL)
- 1030 — EXISTING GROUND SURFACE ELEVATION (5'-ft INTERVAL)
- ===== LIMITS OF WASTE
- ==== ROAD TO BE IMPROVED AND ACCESS ROAD
- ==== EXISTING ROAD
- ===== BENCH
- BLOCKHOUSE RUN CENTER LINE
- ===== DENSE WOODS
- ===== TREES, BRUSH
- ⊕ TOWER
- W.E. 836.6 EXISTING WATER ELEVATION
- ===== PROPERTY LINE

**SOLID WASTE APPROVED**  
OHIO ENVIRONMENTAL PROTECTION AGENCY  
AUG 10 2011  
AS EVIDENCED BY COPY OF LETTER OF APPROVAL HERETO ATTACHED

DATE	NO.	DESCRIPTION	APPROV.
REVISIONS			
DEC 1 2010	C	PTI MODIFICATION NO. 1	MAA
MAY 25 2009	B	REVISED - MOD 1 RESPONSE	DBR
OCT 24 2008	A	ISSUED FOR PERMIT	DBR

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CARDINAL OPERATING COMPANY  
**CARDINAL PLANT**  
BRILLIANT OHIO  
TITLE: CARDINAL FAR 1 RESIDUAL WASTE LANDFILL FINAL WASTE ELEVATION GRADING PLAN  
DWG. NO. 13-30100-4K-C

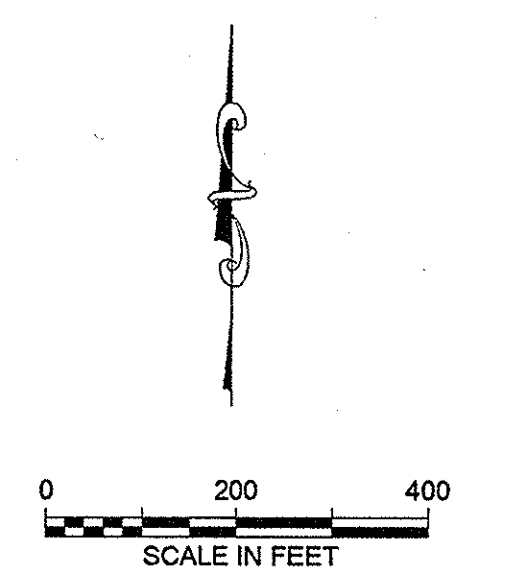
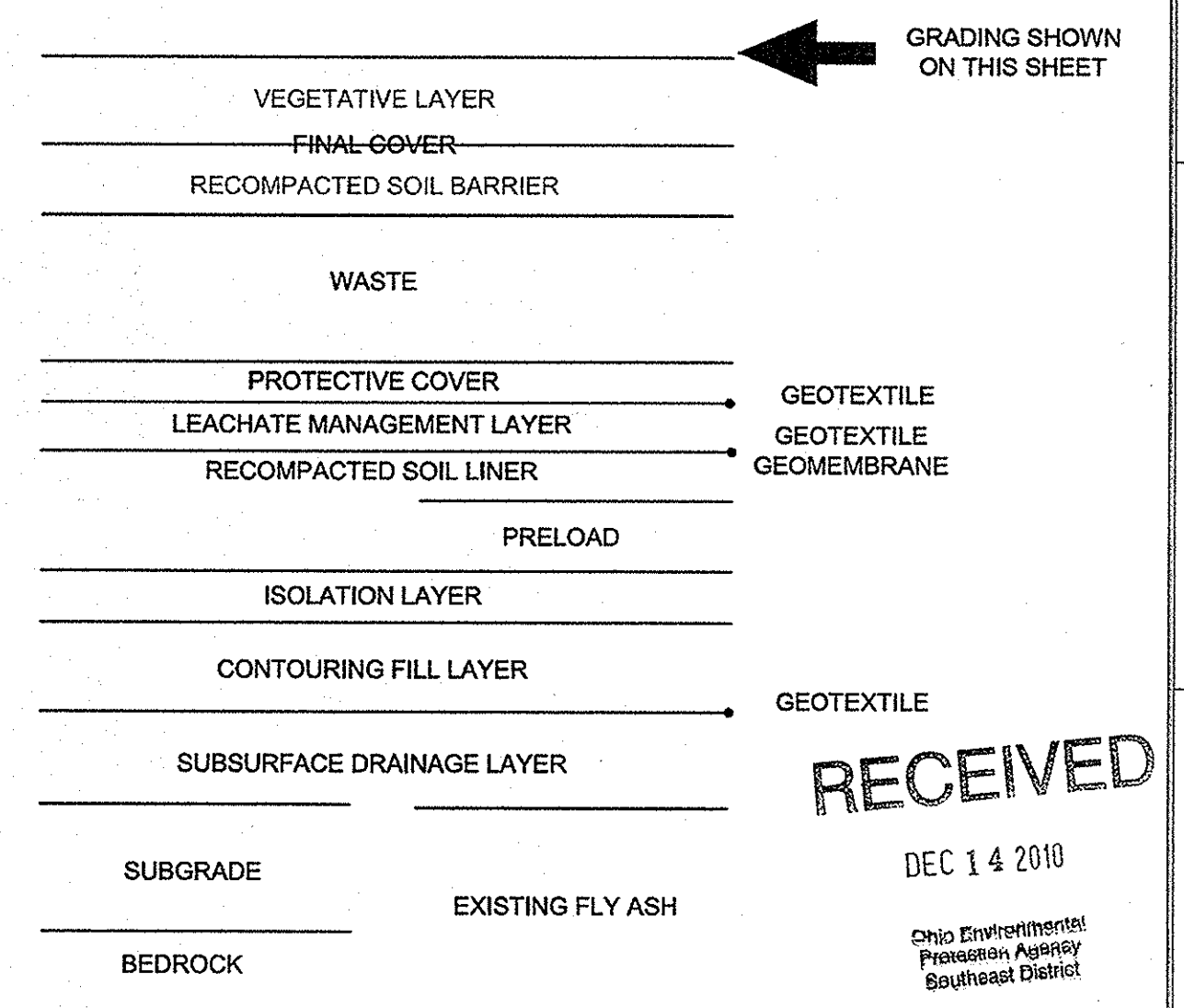
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DR: [Signature]  
OIL: [Signature]  
ENGR: [Signature]  
PROJ. ENGR. [Signature]  
DATE: 12-01-2010

**O.E.P.A. DRAWING NO. 4K**  
DRAWING 4K OF 39

1 RIVERSIDE PLAZA  
COLUMBUS, OH 43215



- FINAL COVER GRADING PLAN NOTES:**
1. PLACE MINIMUM 2.5 FEET VEGETATIVE LAYER OVER RECOMPACTED SOIL BARRIER LAYER.
  2. BEYOND THE LIMITS OF WASTE EXTENDING TO THE LIMITS OF FAR 1, 12 INCHES OF VEGETATIVE COVER WILL BE PLACED OVER THE EXTENDED RECOMPACTED SOIL BARRIER. SEE SHEET 7B.
  3. DETAILS OF THE EXISTING ROAD TO BE IMPROVED ARE LAID OUT ON SHEET 7G AND 7H.
  4. CONSTRUCT LANDFILL ACCESS ROAD ON TOP OF FINAL COVER.



**LEGEND**

	TOP OF FINAL COVER ELEVATION (5'-ft INTERVAL)
	EXISTING GROUND SURFACE ELEVATION (5'-ft INTERVAL)
	LIMITS OF WASTE
	LIMITS OF FAR 1
	ROAD TO BE IMPROVED AND ACCESS ROAD
	EXISTING ROAD
	BENCH
	BLOCKHOUSE RUN CENTER LINE
	DENSE WOODS
	TREES, BRUSH
	TRANSMISSION TOWER
	EXISTING WATER ELEVATION
	PROPERTY LINE

**SOLID WASTE APPROVED**  
OHIO ENVIRONMENTAL PROTECTION AGENCY  
AUG 10 2011  
AS EVIDENCED BY COPY OF LETTER OF APPROVAL HERETO ATTACHED.

DATE	NO.	DESCRIPTION	APPROV.
DEC 1 2010	C	PT1 MODIFICATION NO. 1	MSA
MAY 25 2009	B	REVISED - NO 1 RESPONSE	DOB
OCT 24 2005	A	ISSUED FOR PERMIT	DOB

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CARDINAL OPERATING COMPANY  
**CARDINAL PLANT**  
BRILLIANT OHIO

TITLE: CARDINAL FAR 1 RESIDUAL WASTE LANDFILL FINAL COVER GRADING PLAN

DWG. NO. 13-30100-4M-C  
SCALE: CIVIL ENGINEERING DIVISION

STATE OF OHIO  
REGISTERED PROFESSIONAL ENGINEER  
MOHAMMAD A. ALJOUNI  
07074  
SIGNATURE  
12-01-2010  
DATE

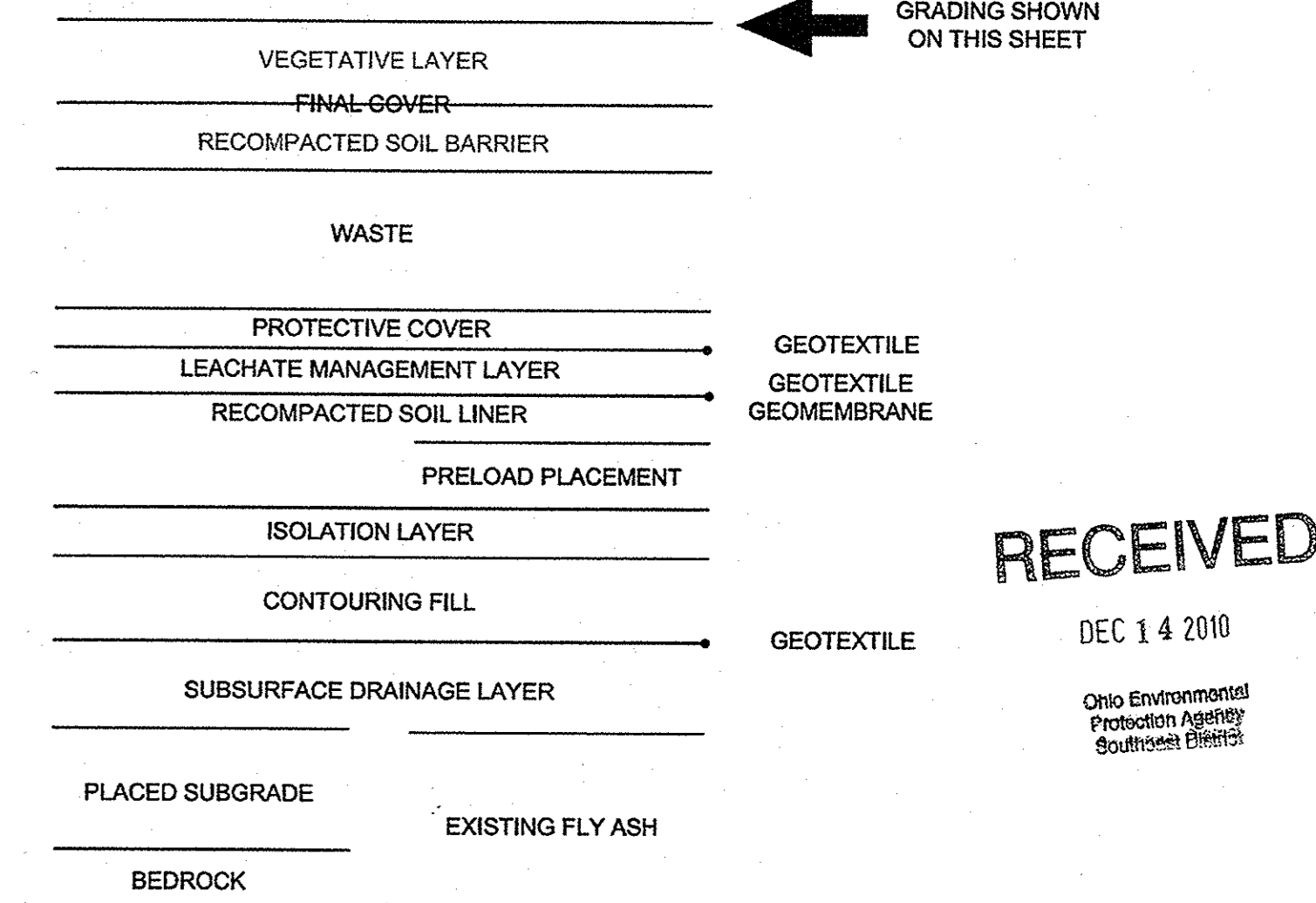
O.E.P.A. DRAWING NO. 4M

DRAWING 4M OF 39

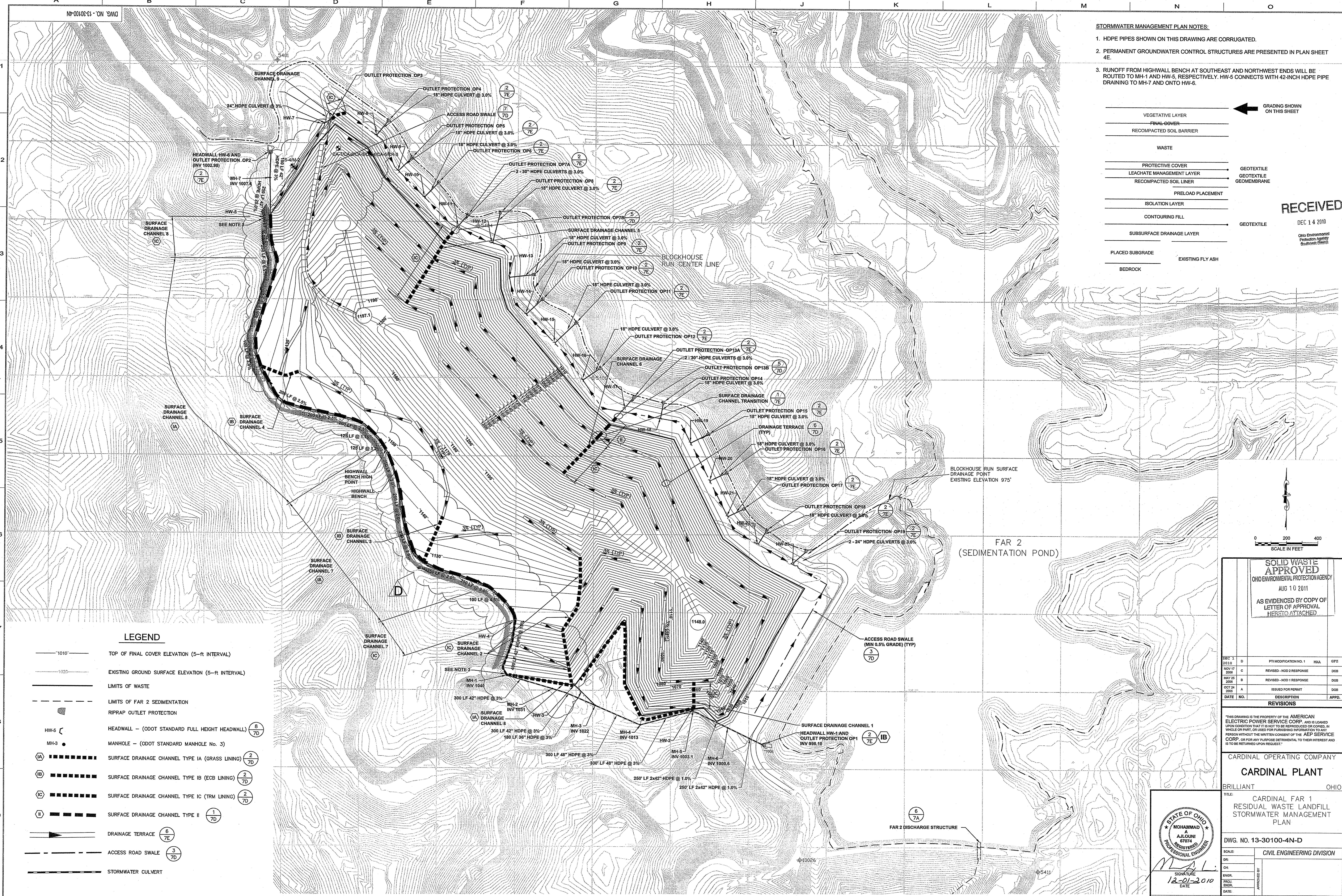
AEP AMERICAN ELECTRIC POWER  
1 RIVERSIDE PLAZA  
COLUMBUS, OH 43215

**STORMWATER MANAGEMENT PLAN NOTES:**

1. HDPE PIPES SHOWN ON THIS DRAWING ARE CORRUGATED.
2. PERMANENT GROUNDWATER CONTROL STRUCTURES ARE PRESENTED IN PLAN SHEET 4E.
3. RUNOFF FROM HIGHWALL BENCH AT SOUTHEAST AND NORTHWEST ENDS WILL BE ROUTED TO MH-1 AND HW-5, RESPECTIVELY. HW-5 CONNECTS WITH 42-INCH HDPE PIPE DRAINING TO MH-7 AND ONTO HW-6.

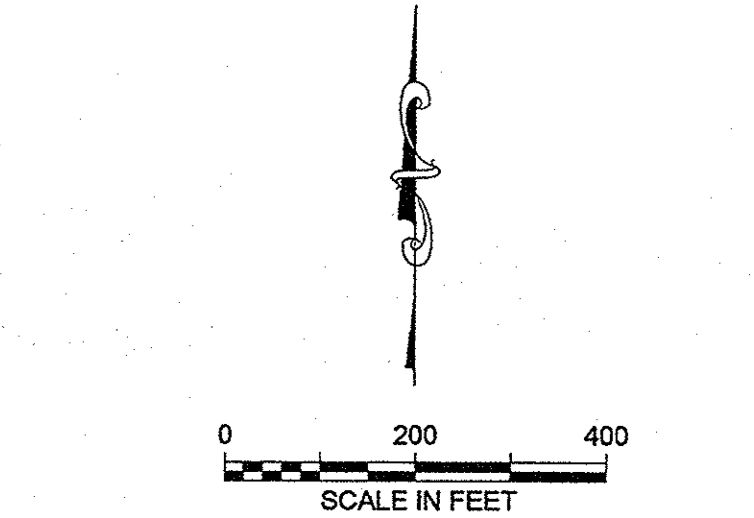


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DEC 14 2010  
Ohio Environmental Protection Agency  
Southwest District



**LEGEND**

- 1010' — TOP OF FINAL COVER ELEVATION (5-ft INTERVAL)
- 1020' — EXISTING GROUND SURFACE ELEVATION (5-ft INTERVAL)
- LIMITS OF WASTE
- LIMITS OF FAR 2 SEDIMENTATION
- ▨ RIPRAP OUTLET PROTECTION
- HW-5 HEADWALL - (ODOT STANDARD FULL HEIGHT HEADWALL) (8/7D)
- MH-3 MANHOLE - (ODOT STANDARD MANHOLE No. 3)
- (IA) SURFACE DRAINAGE CHANNEL TYPE IA (GRASS LINING) (2/7D)
- (IB) SURFACE DRAINAGE CHANNEL TYPE IB (ECB LINING) (2/7D)
- (IC) SURFACE DRAINAGE CHANNEL TYPE IC (TRM LINING) (2/7D)
- (II) SURFACE DRAINAGE CHANNEL TYPE II (1/7D)
- ▬ DRAINAGE TERRACE (6/7E)
- ACCESS ROAD SWALE (3/7D)
- STORMWATER CULVERT



**SOLID WASTE APPROVED**  
OHIO ENVIRONMENTAL PROTECTION AGENCY  
AUG 10 2011  
AS EVIDENCED BY COPY OF LETTER OF APPROVAL HERETO ATTACHED

REV. NO.	DATE	DESCRIPTION	APPROVED
2010	D	PTI MODIFICATION NO. 1	NAA, GPZ
NOV 17 2009	C	REVISED - NOD 2 RESPONSE	DOB
MAY 25 2009	B	REVISED - NOD 1 RESPONSE	DOB
OCT 24 2008	A	ISSUED FOR PERMIT	DOB

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CARDINAL OPERATING COMPANY  
**CARDINAL PLANT**  
BRILLIANT OHIO

TITLE: **CARDINAL FAR 1 RESIDUAL WASTE LANDFILL STORMWATER MANAGEMENT PLAN**

DWG. NO. 13-30100-4N-D

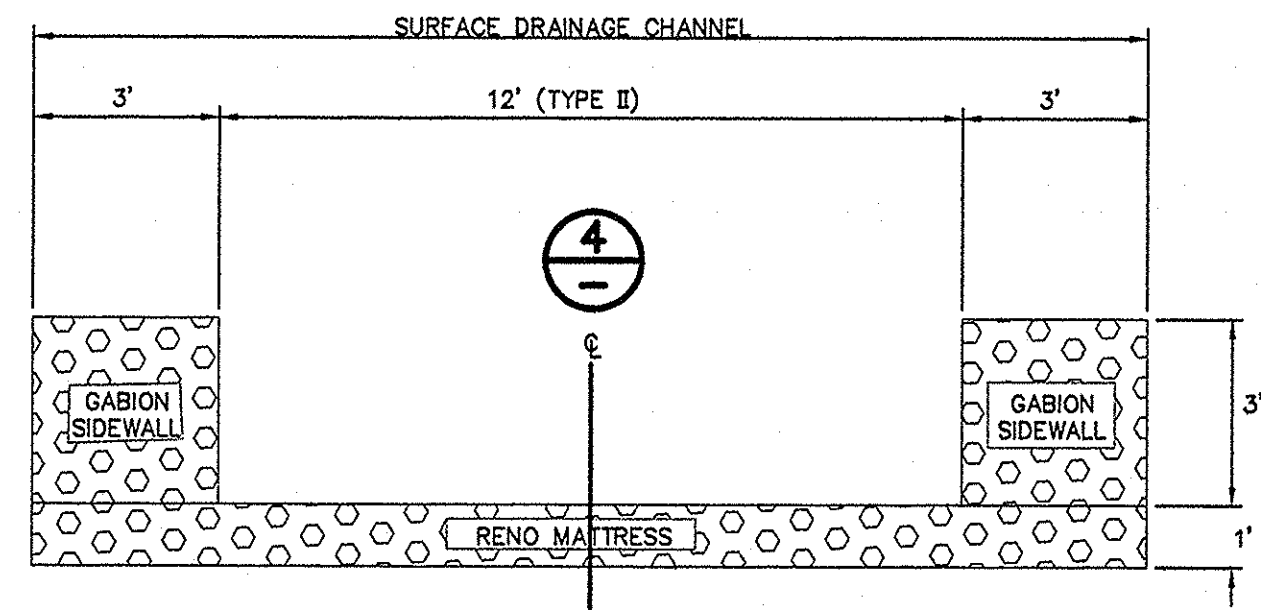
SCALE: CIVIL ENGINEERING DIVISION  
APPROVED BY: [Signature]  
DATE: 12-01-2010

STATE OF OHIO  
MOHAMMAD A. AJLOUNI  
REGISTERED PROFESSIONAL ENGINEER  
No. 67074

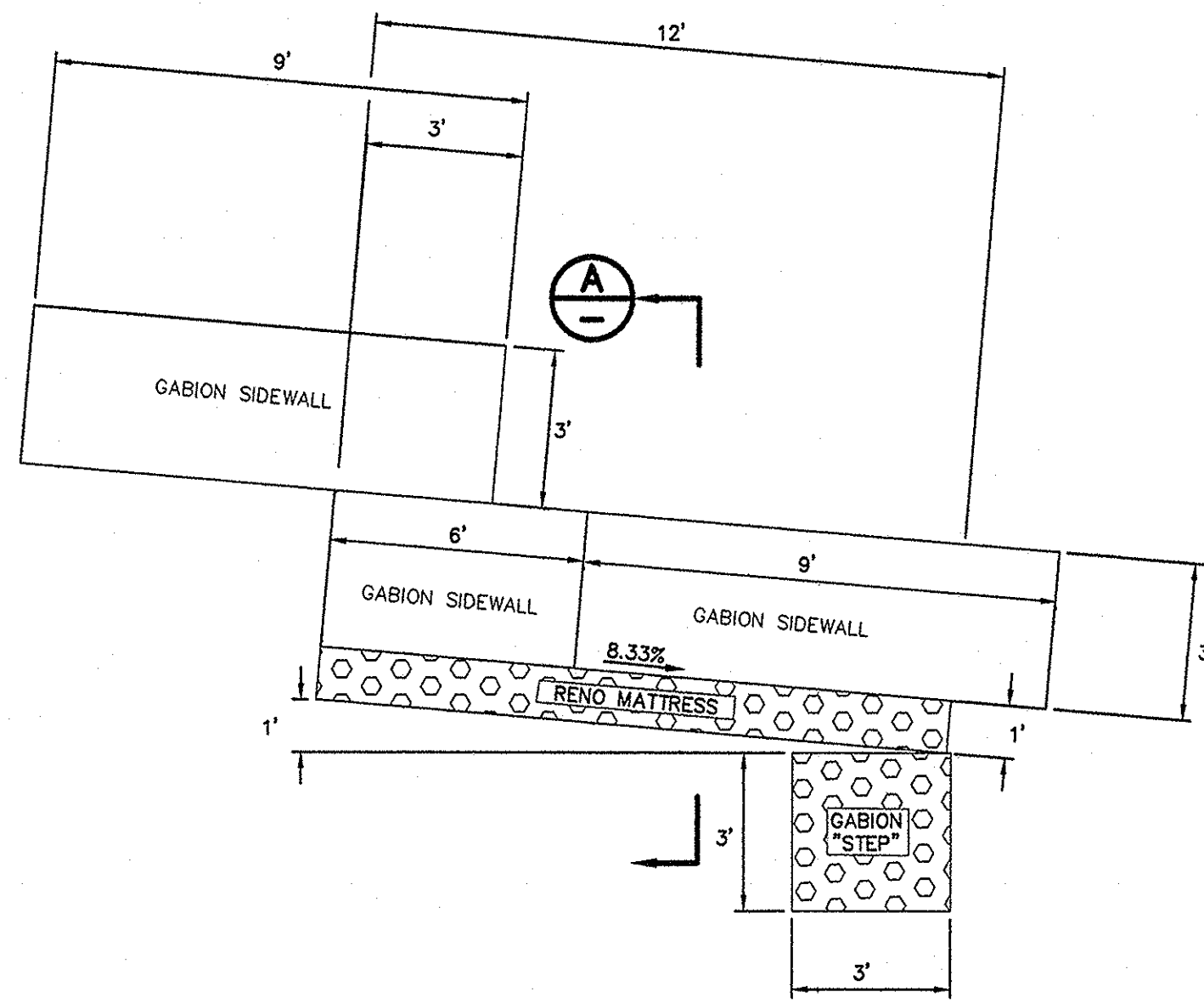
O.E.P.A. DRAWING NO. 4N

DRAWING 4N OF 39  
AEP AMERICAN ELECTRIC POWER  
1 RIVERSIDE PLAZA COLUMBUS, OH 43216

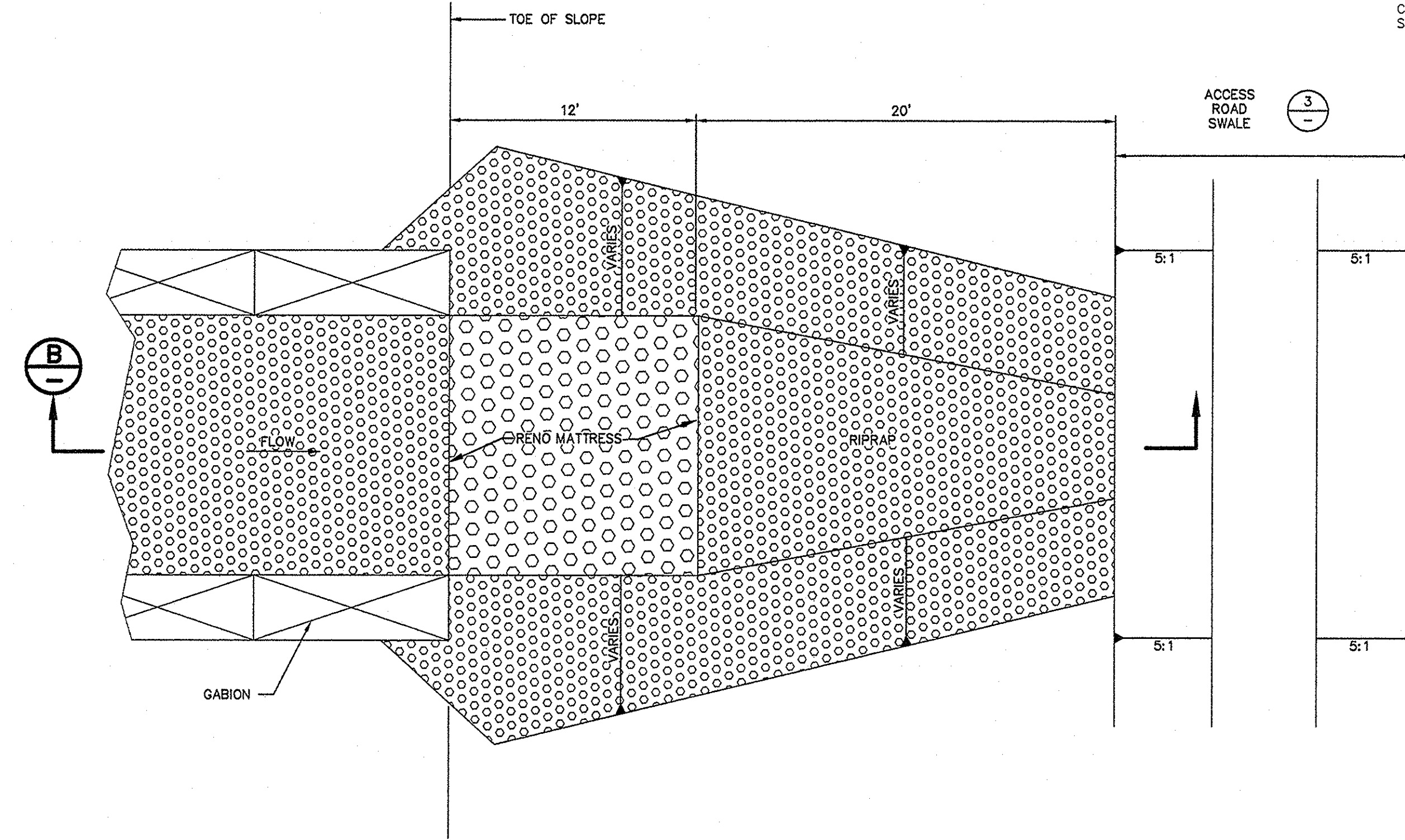
- NOTES:
- GABION BASKETS AND RENO MATTRESSES SHALL CONFORM TO ASTM A-975, STYLE
  - EROSION CONTROL BLANKET (ECB) SHALL BE NORTH AMERICAN GREEN S150, CURLEX 8 STITCHED, OR APPROVED EQUIVALENT. TURF REINFORCEMENT MAT (TRM) SHALL BE NORTH AMERICAN GREEN P-350, LANDLOK TDM 450, OR APPROVED EQUAL



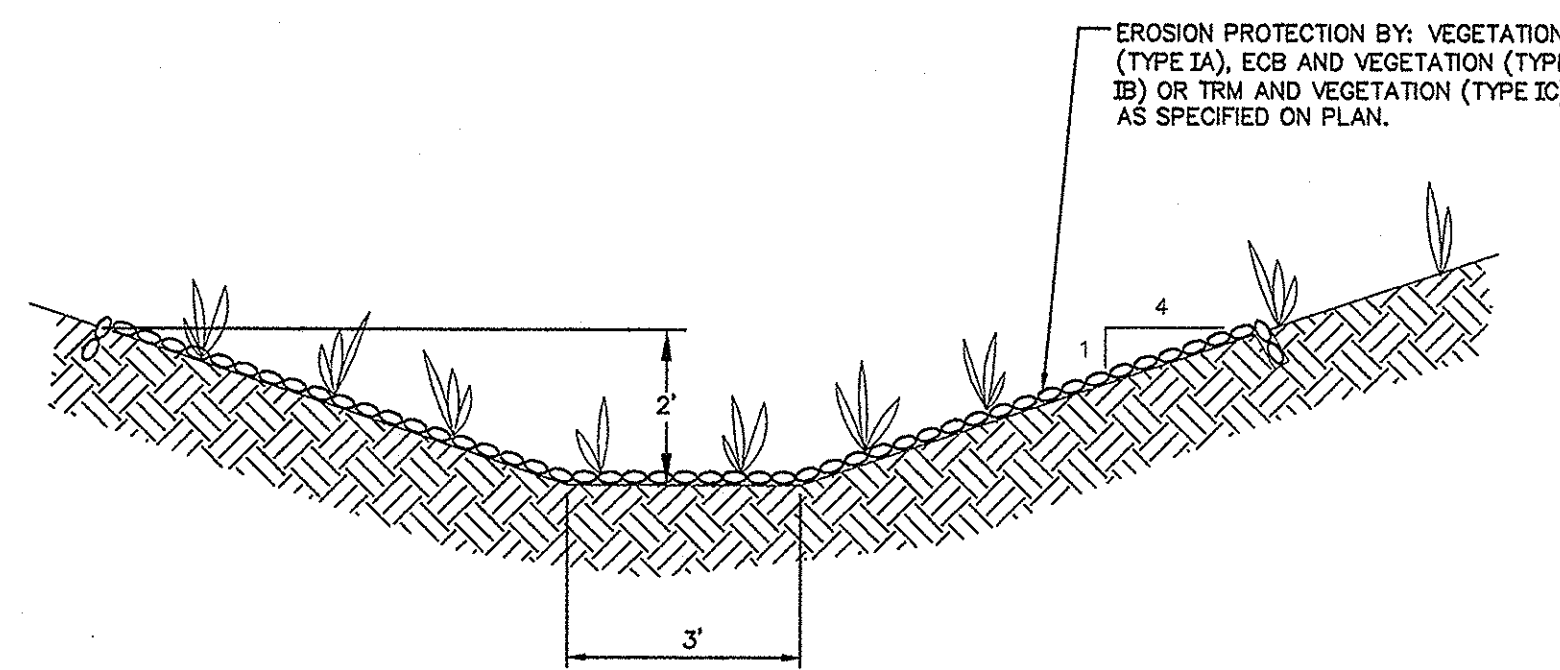
**1**  
**4N** DETAIL  
SURFACE DRAINAGE CHANNEL TYPE II  
SCALE: NTS  
(SEE NOTE 1 AND DETAIL 4 ON THIS SHEET)



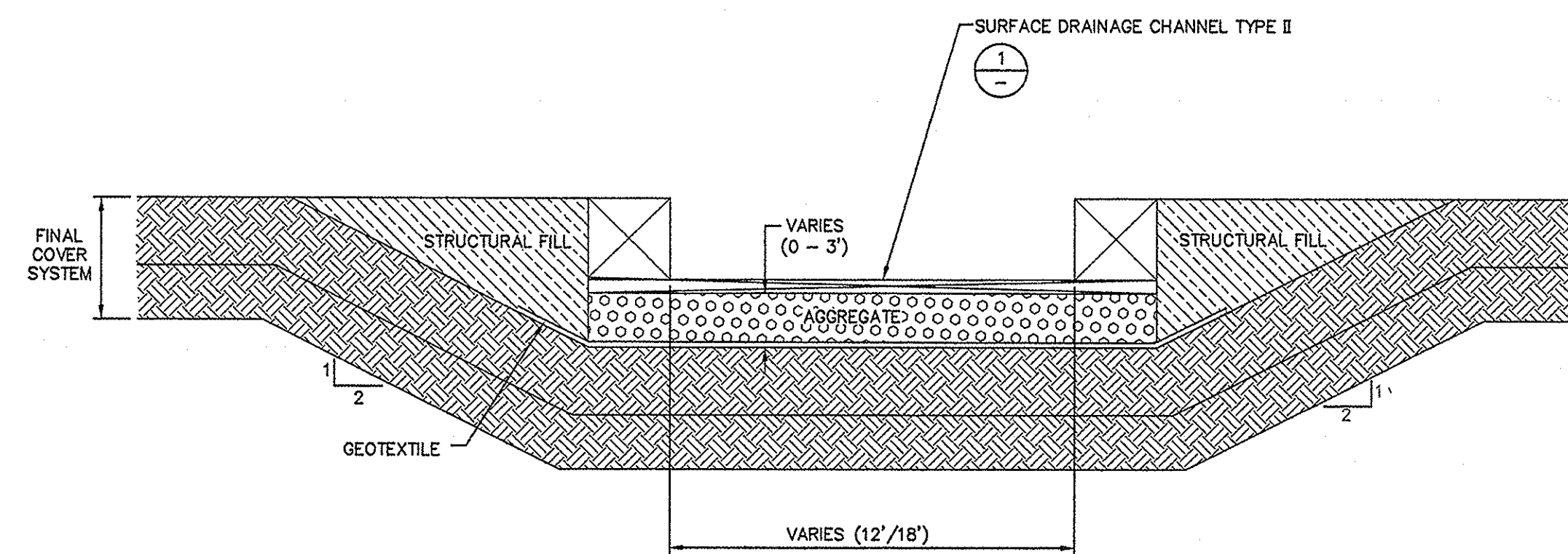
**4**  
**4N** PROFILE  
SURFACE DRAINAGE CHANNEL  
SCALE: NTS  
(SEE NOTE 1)



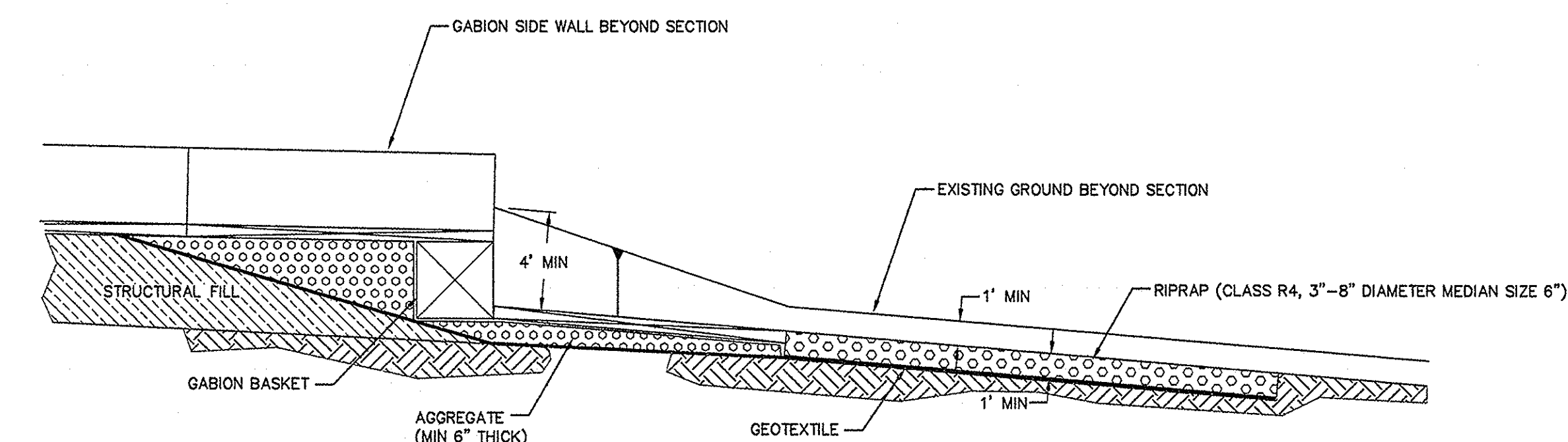
**5**  
**4N** PLAN  
OUTLET PROTECTION  
SCALE: NTS  
(SEE NOTE 1)



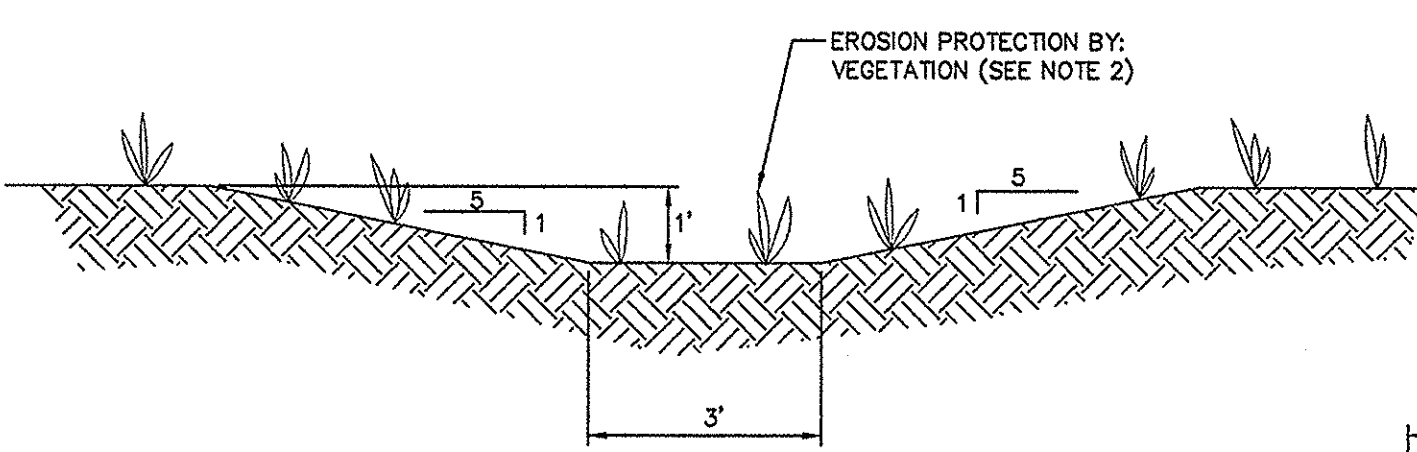
**2**  
**4N** DETAIL (TYP)  
SURFACE DRAINAGE CHANNEL TYPE IA/IB/IC  
SCALE: NTS  
(SEE NOTE 2)



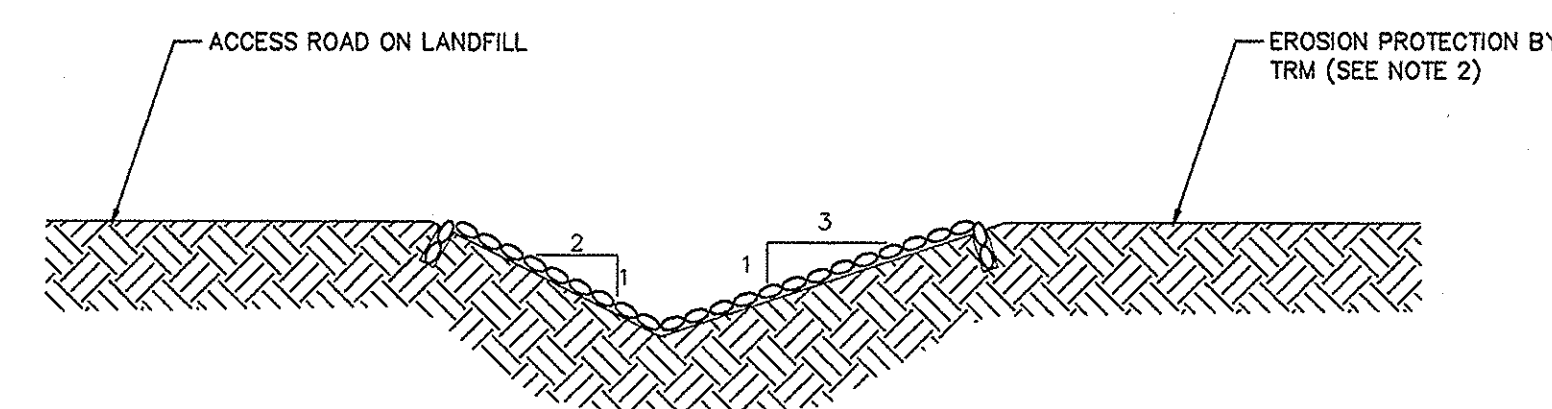
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**4N** SECTION  
SURFACE DRAINAGE CHANNEL TYPE II  
SCALE: NTS  
(SEE NOTE 1)



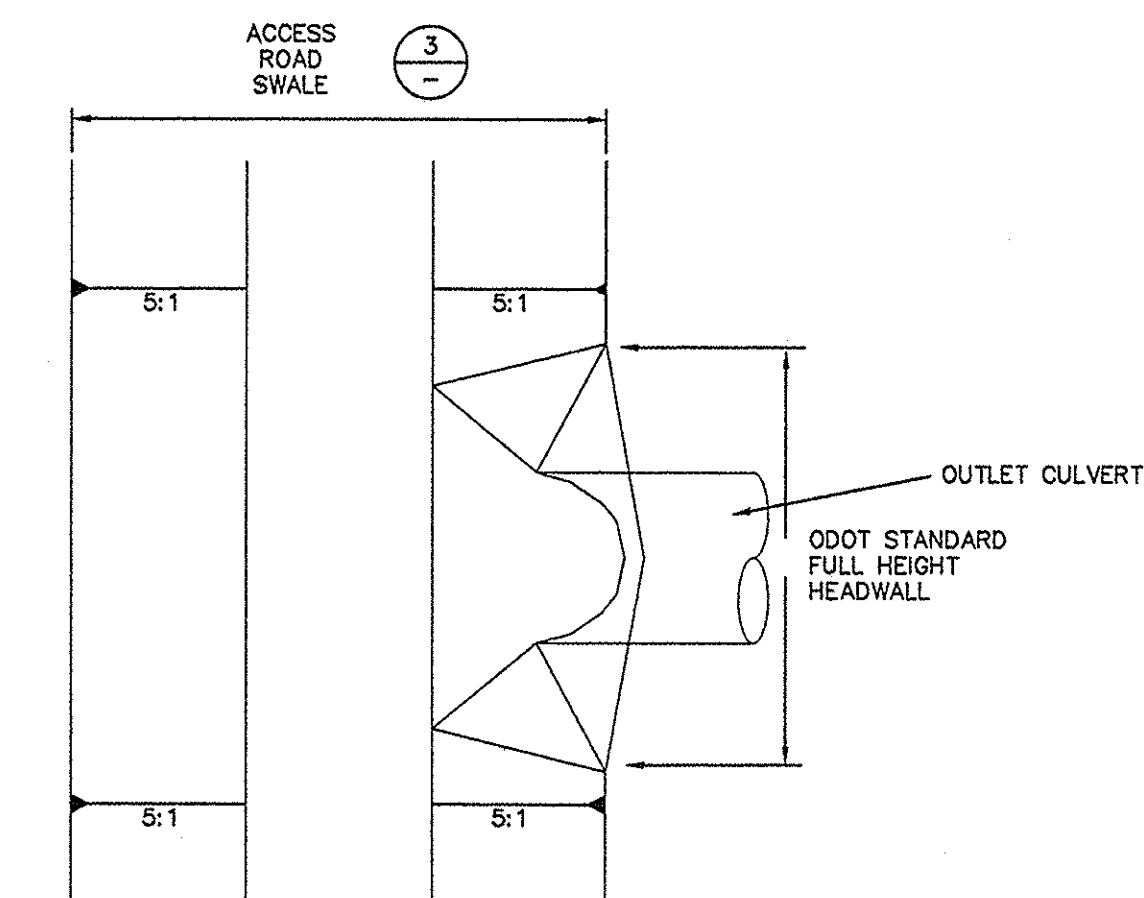
**B**  
**4N** SECTION  
TRANSITION  
SCALE: NTS  
(SEE NOTE 1)



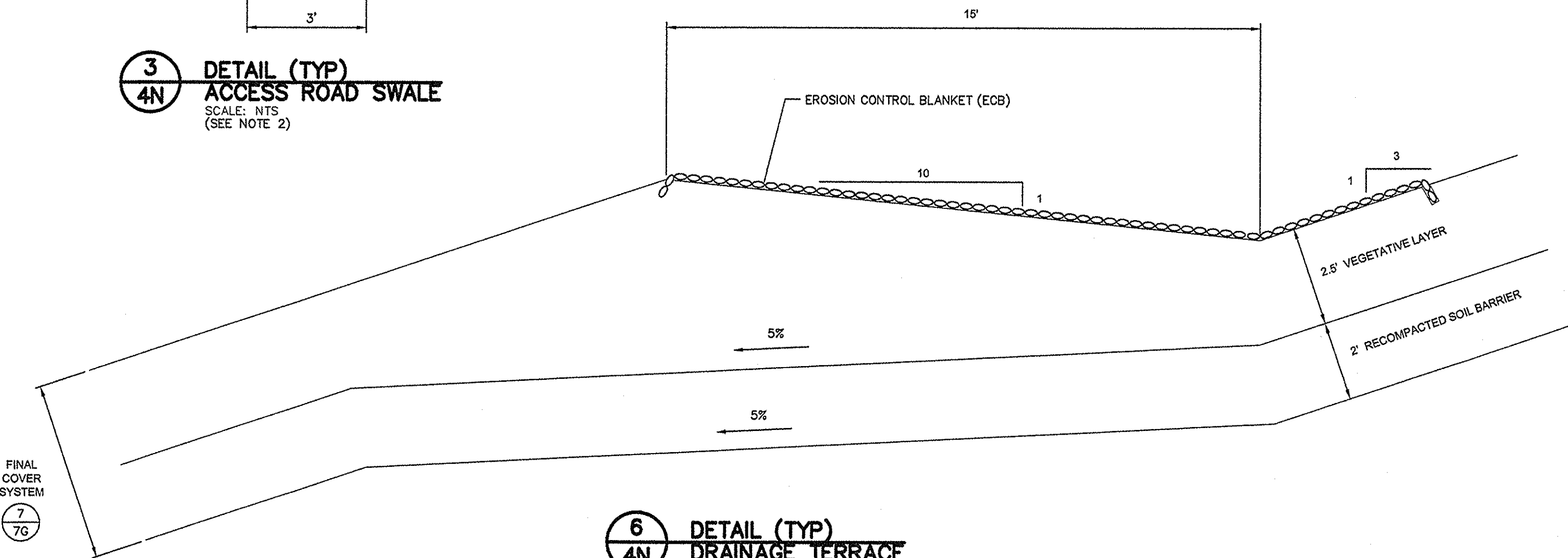
**3**  
**4N** DETAIL (TYP)  
ACCESS ROAD SWALE  
SCALE: NTS  
(SEE NOTE 2)



**7**  
**4N** DETAIL (TYP)  
ACCESS ROAD SWALE  
SCALE: NTS  
(SEE NOTE 2)



**8**  
**4N** PLAN (TYP)  
ACCESS ROAD SWALE CULVERT  
SCALE: NTS



**6**  
**4N** DETAIL (TYP)  
DRAINAGE TERRACE  
SCALE: NTS  
(SEE NOTE 2)

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OHIO ENVIRONMENTAL PROTECTION AGENCY  
MAY 11 2007  
AS EVIDENCED BY COPY OF LETTER OF APPROVAL HERETO ATTACHED

<b>RECEIVED</b>			
MAY 11 2007			
Ohio Environmental Protection Agency Southeast District			
MAY 29 2005	B	REVISED - NOD 1 RESPONSE	DGB
OCT 24 2005	A	ISSUED FOR PERMIT	DGB
DATE	NO.	DESCRIPTION	APPD.
REVISIONS			

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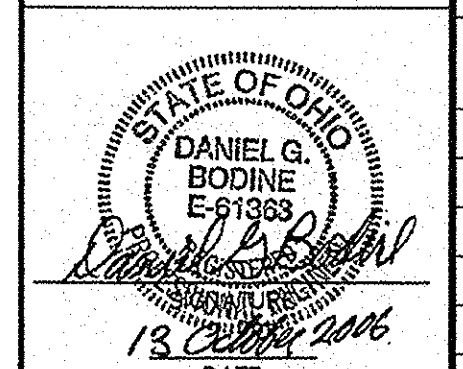
CARDINAL OPERATING COMPANY  
**CARDINAL PLANT**  
BRILLIANT OHIO

TITLE  
CARDINAL FAR 1  
RESIDUAL WASTE LANDFILL  
EROSION AND SEDIMENT  
CONTROL /STORMWATER  
CONTROL ELEMENTS I

DWG. NO. 13-30100-7D-B

SCALE: CIVIL ENGINEERING DIVISION

DR: [Signature]  
CR: [Signature]  
ENGR: [Signature]  
PROJ. ENGR: [Signature]  
DATE: [Signature]



PROJECT NO. 0169122  
FILE NO. [Blank]  
DRAWING 7D OF 39

O.E.P.A. DRAWING NO. 7D

1 RIVERSIDE PLAZA  
COLUMBUS, OH 43215

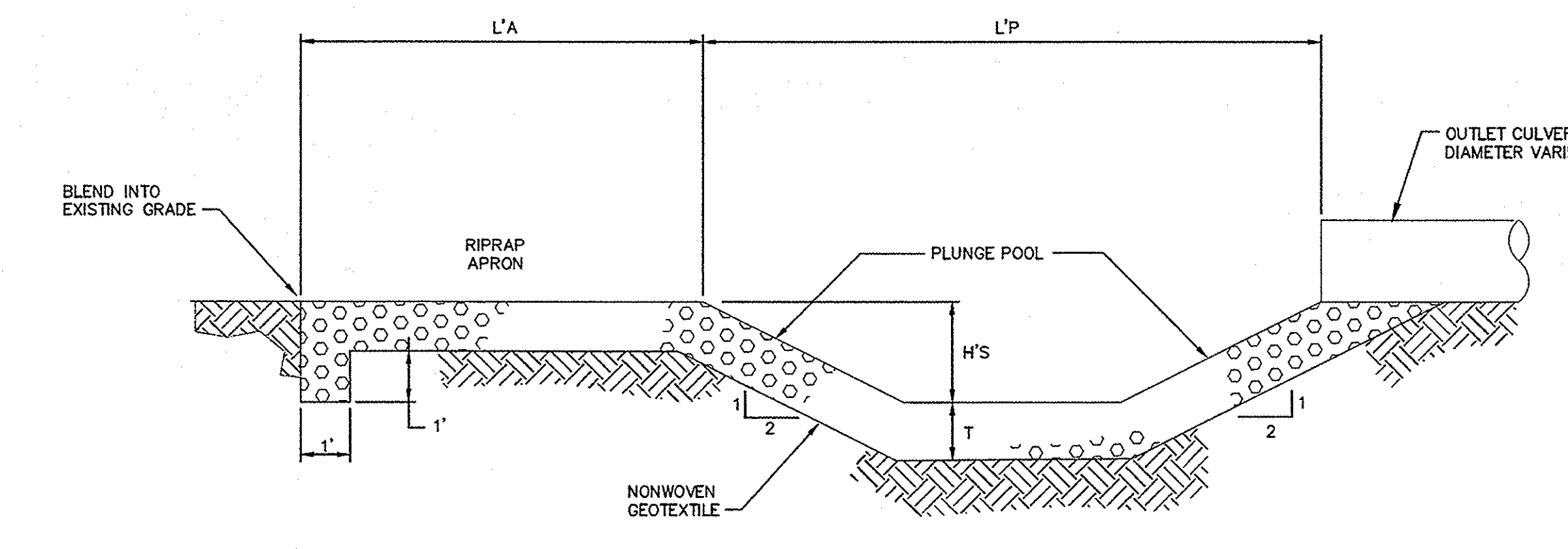
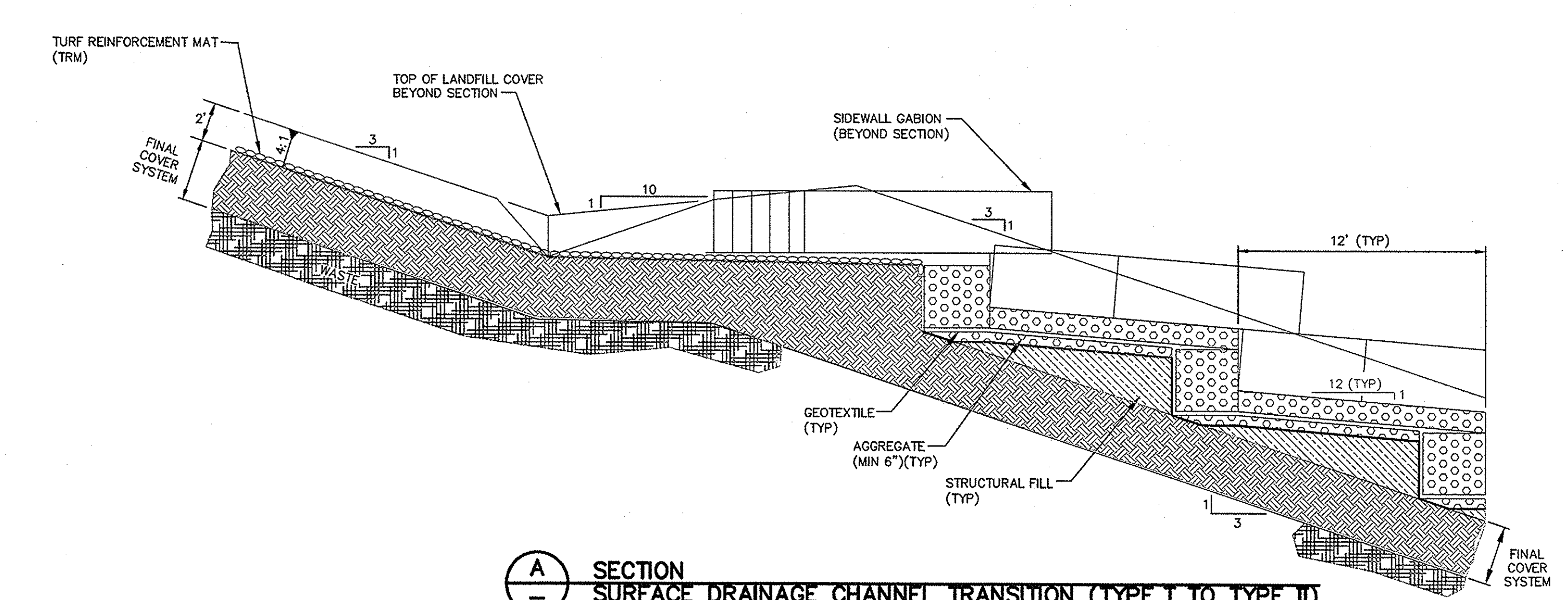
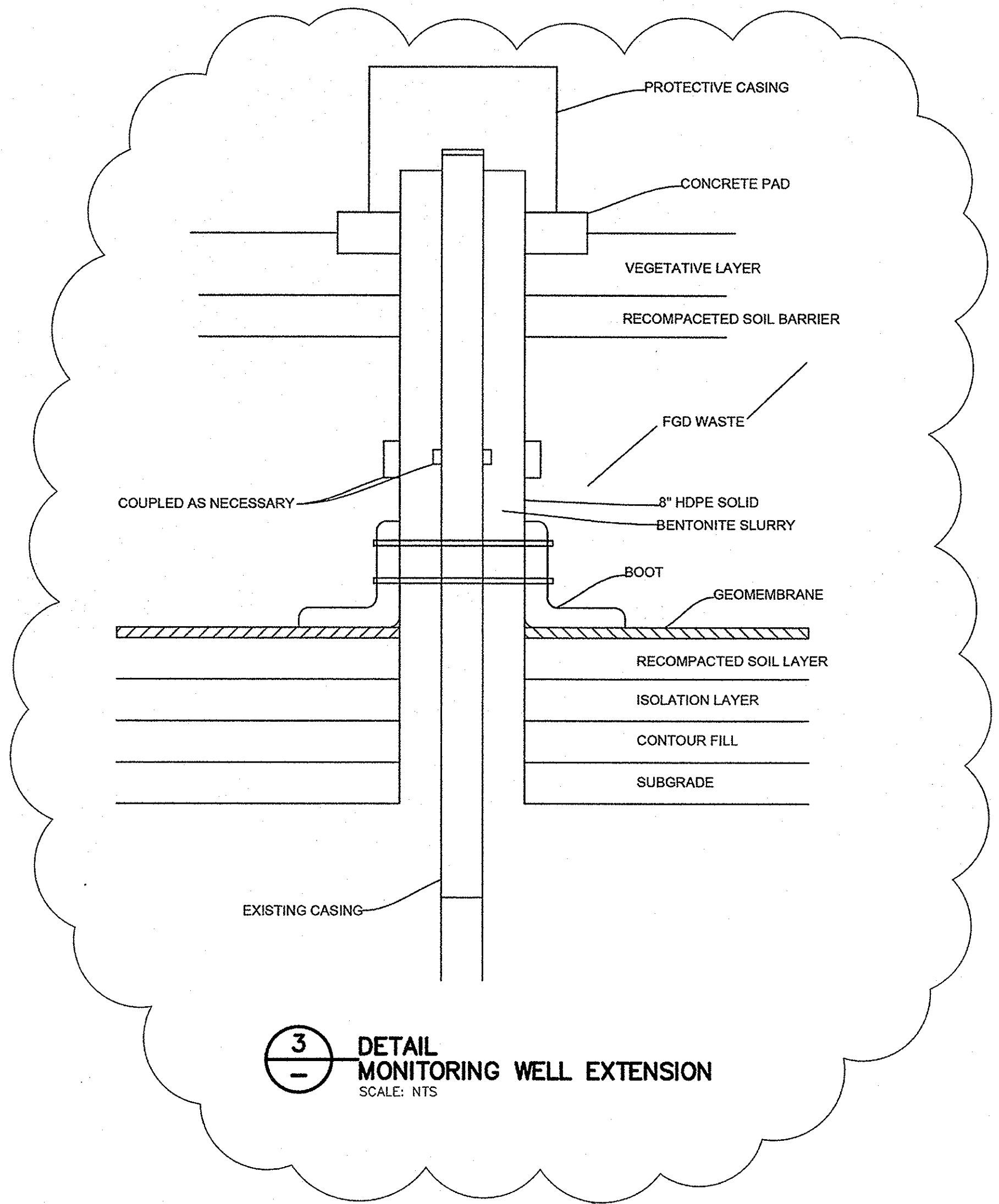
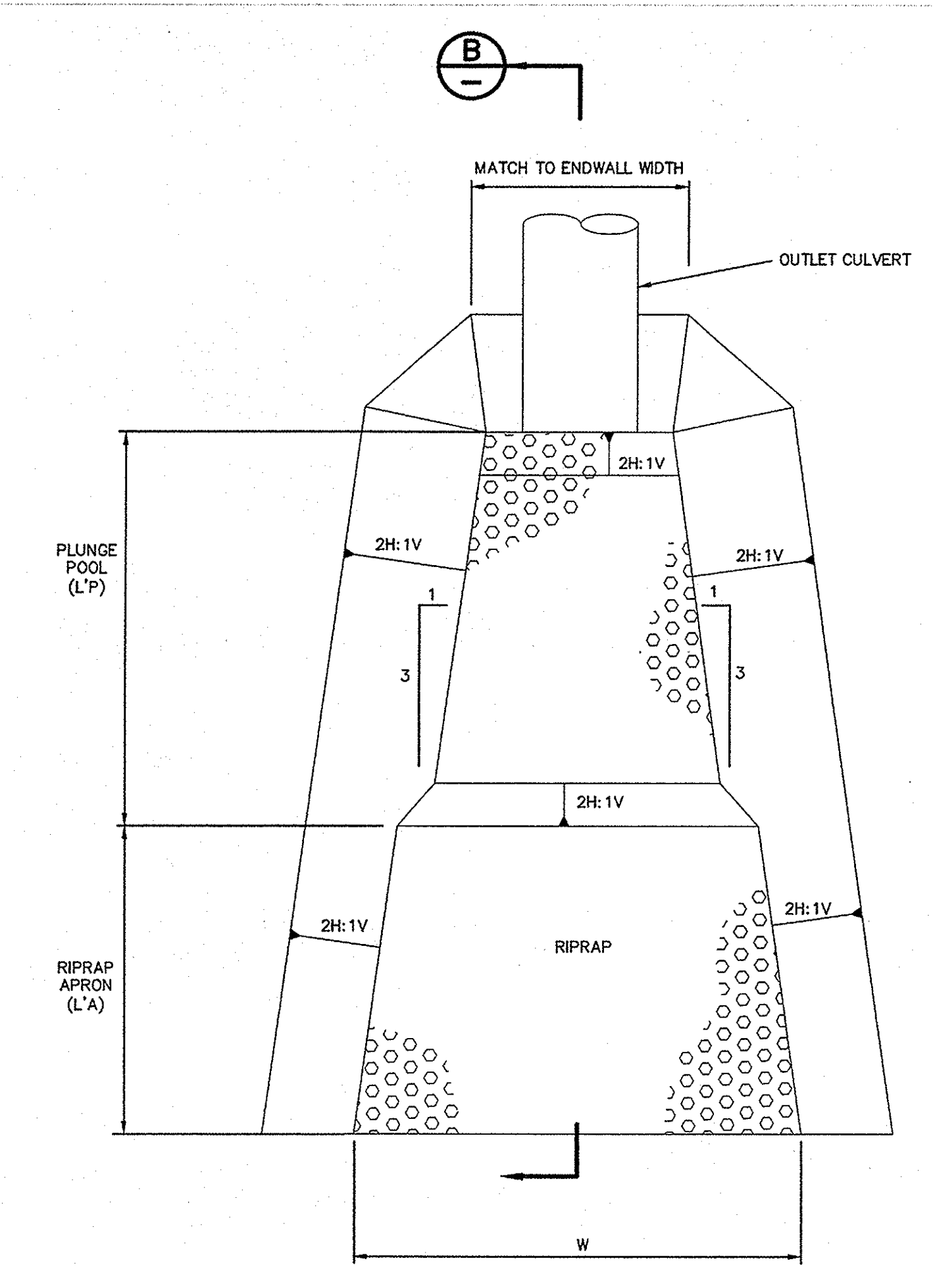
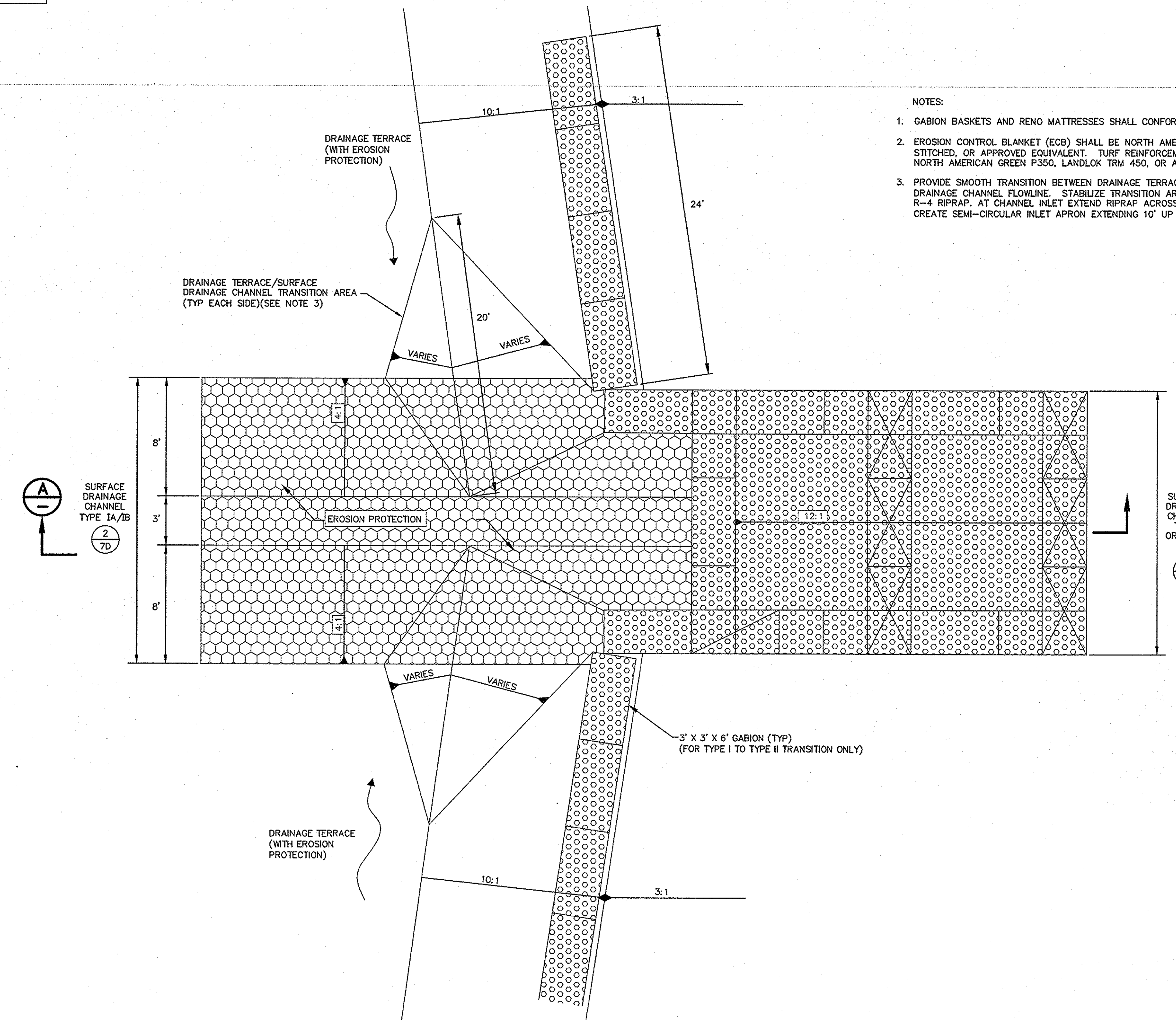


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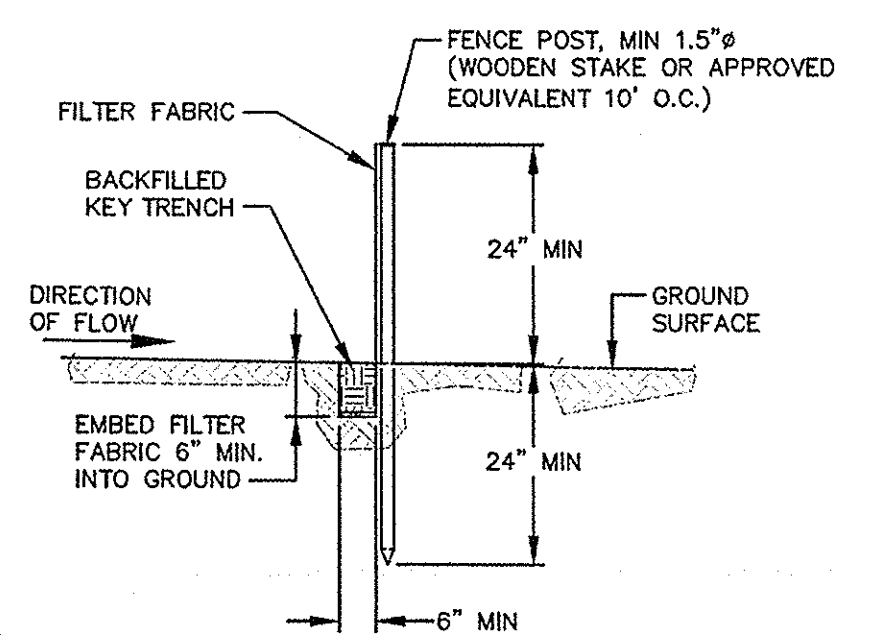
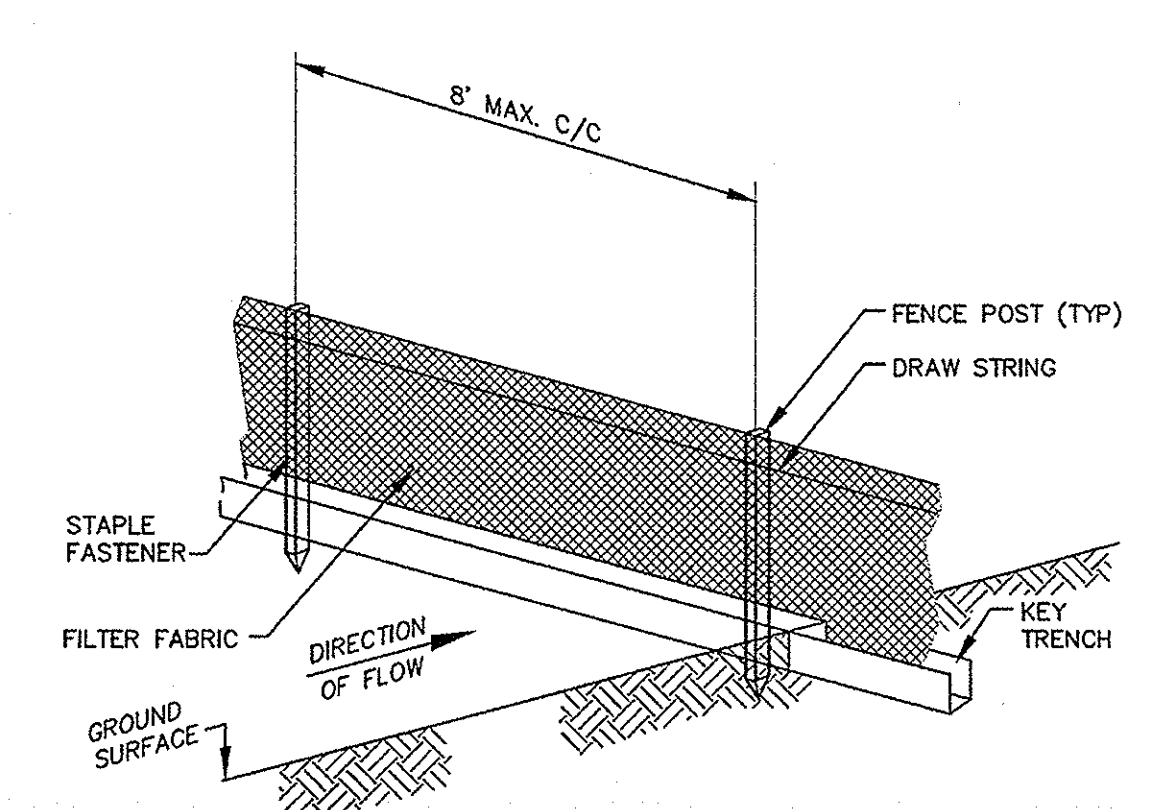
DEC 14 2010

Ohio Environmental Protection Agency  
Southwest District

- NOTES:
- GABION BASKETS AND RENO MATTRESSES SHALL CONFORM TO ASTM A-975, STYLE 1.
  - EROSION CONTROL BLANKET (ECB) SHALL BE NORTH AMERICAN GREEN S150, CURLX II STITCHED, OR APPROVED EQUIVALENT. TURF REINFORCEMENT MAT (TRM) SHALL BE NORTH AMERICAN GREEN P350, LANDLOK TRM 450, OR APPROVED EQUAL.
  - PROVIDE SMOOTH TRANSITION BETWEEN DRAINAGE TERRACE FLOWLINE AND SURFACE DRAINAGE CHANNEL FLOWLINE. STABILIZE TRANSITION AREA USING 12" THICK LAYER OF R-4 RIPRAP. AT CHANNEL INLET EXTEND RIPRAP ACROSS ENTIRE CHANNEL WIDTH AND CREATE SEMI-CIRCULAR INLET APRON EXTENDING 10' UP GRADIENT.



STRUCTURE	RIPRAP		DIMENSION (FEET)			
	NATIONAL STONE ASSN. CLASSIFICATION	INSTALLATION THICKNESS (T)	L'P	L'A	W	H'S
OP 1,2	R6 (7"-20" DIAMETER, MEDIAN SIZE 12")	24"	18	9	40	2
OP 3	R6 (7"-20" DIAMETER, MEDIAN SIZE 12")	24"	10	5	20	1
OP 4 TO 19	R5 (5"-16" DIAMETER, MEDIAN SIZE 8")	18"	14	8	22	1.5



SOLID WASTE APPROVED  
OHIO ENVIRONMENTAL PROTECTION AGENCY  
AUG 10 2011  
AS EVIDENCED BY COPY OF LETTER OF APPROVAL  
FIGURE ATTACHED

DATE	NO.	DESCRIPTION	APPROVED

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CARDINAL OPERATING COMPANY  
CARDINAL PLANT  
BRILLIANT OHIO  
SITE: CARDINAL FAR 1  
RESIDUAL WASTE LANDFILL  
EROSION AND SEDIMENT  
CONTROL / STORMWATER  
CONTROL ELEMENTS II

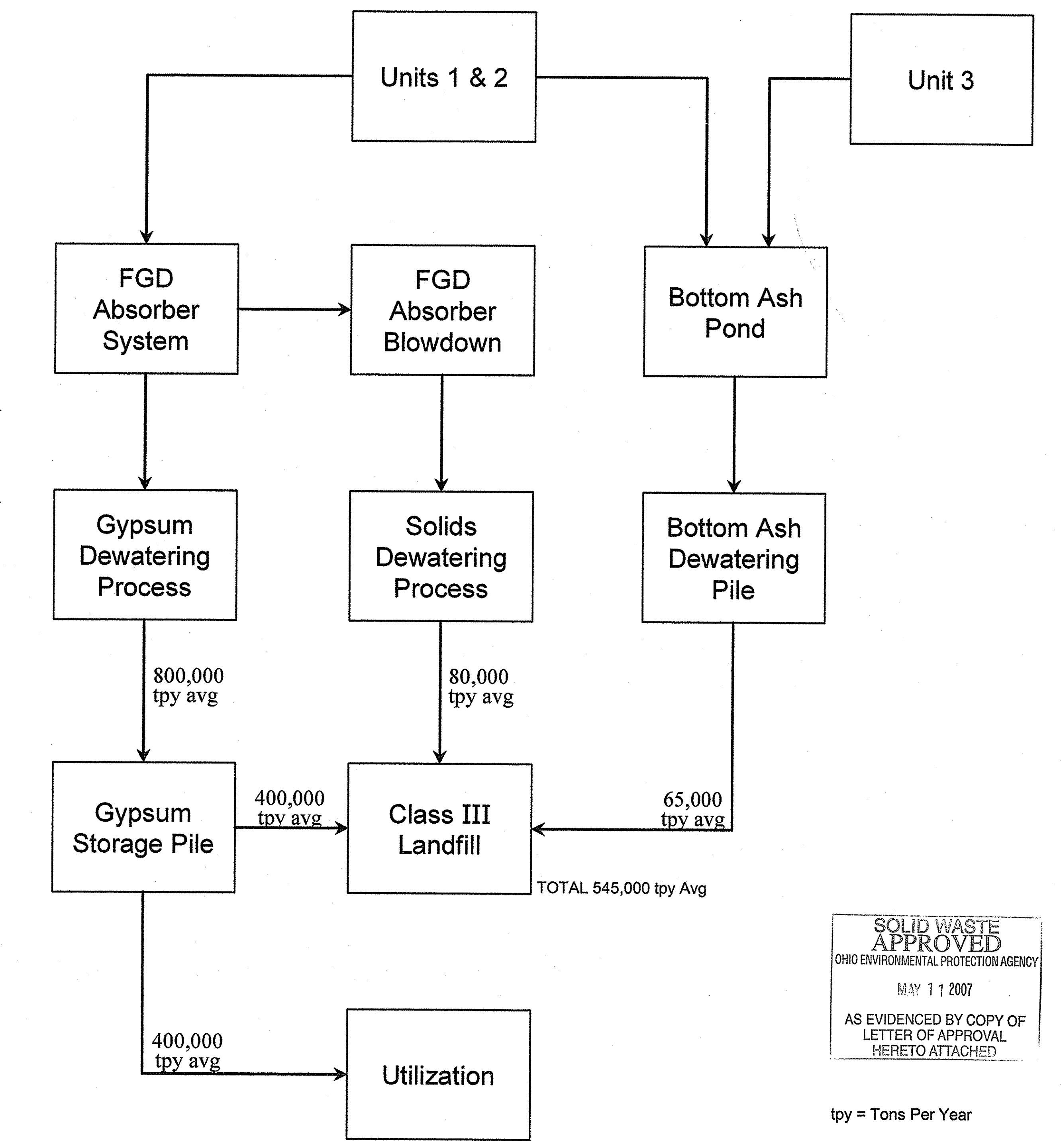
STATE OF OHIO  
MOHAMMAD A. ALLOUNI  
REGISTERED PROFESSIONAL ENGINEER  
12-01-2010

O.E.P.A. DRAWING NO. 7E

DRAWING 7E OF 39

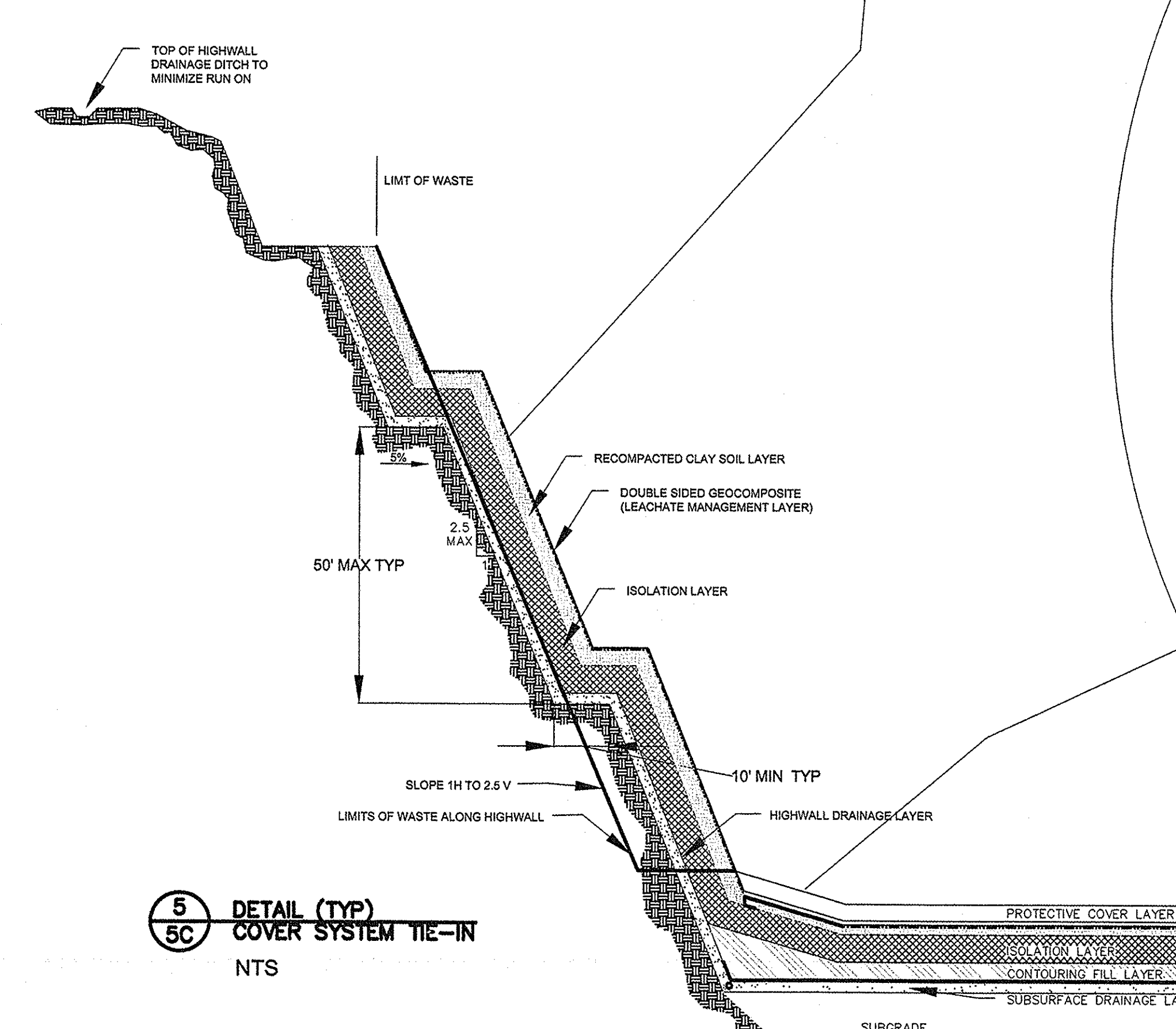
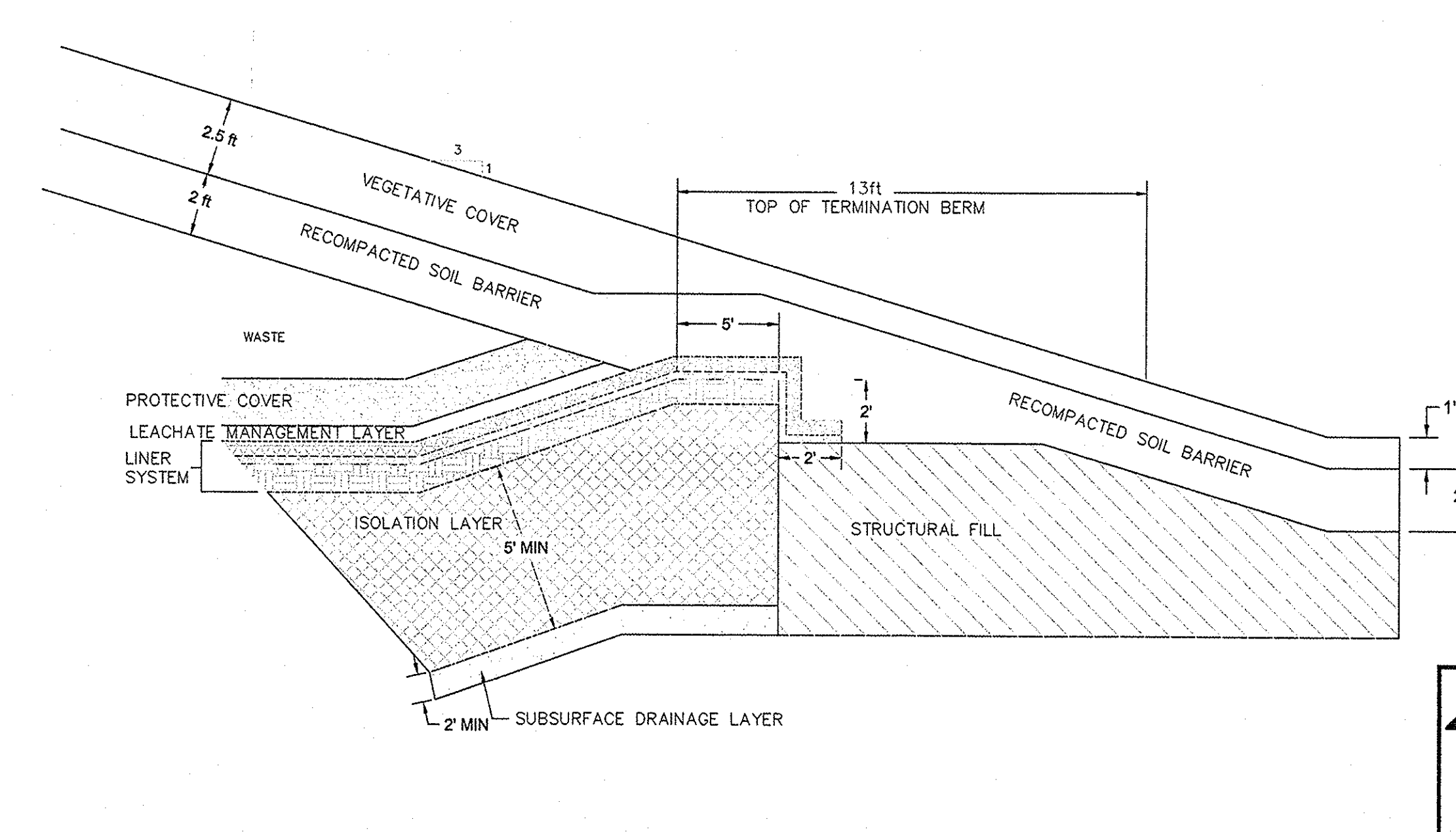
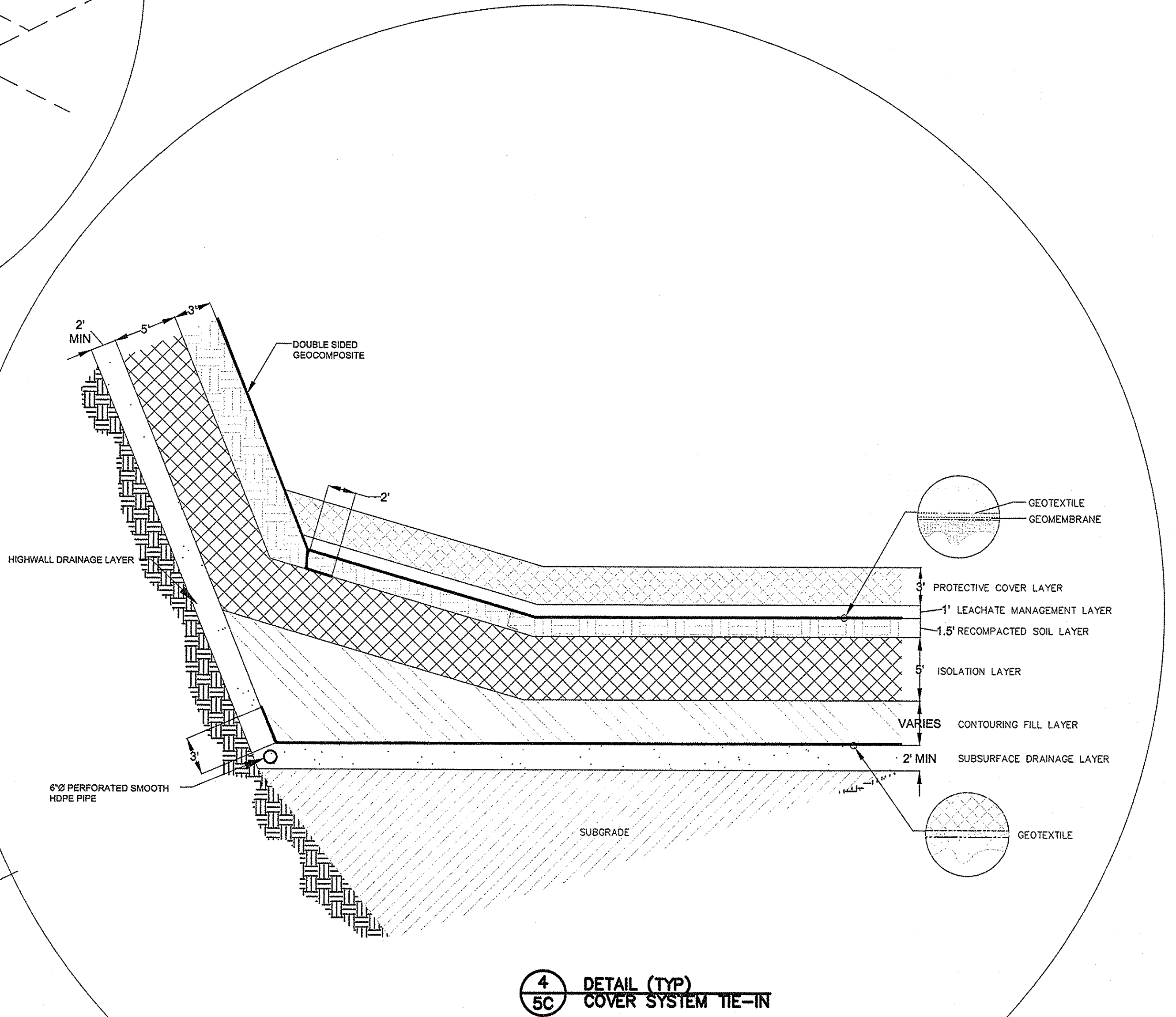
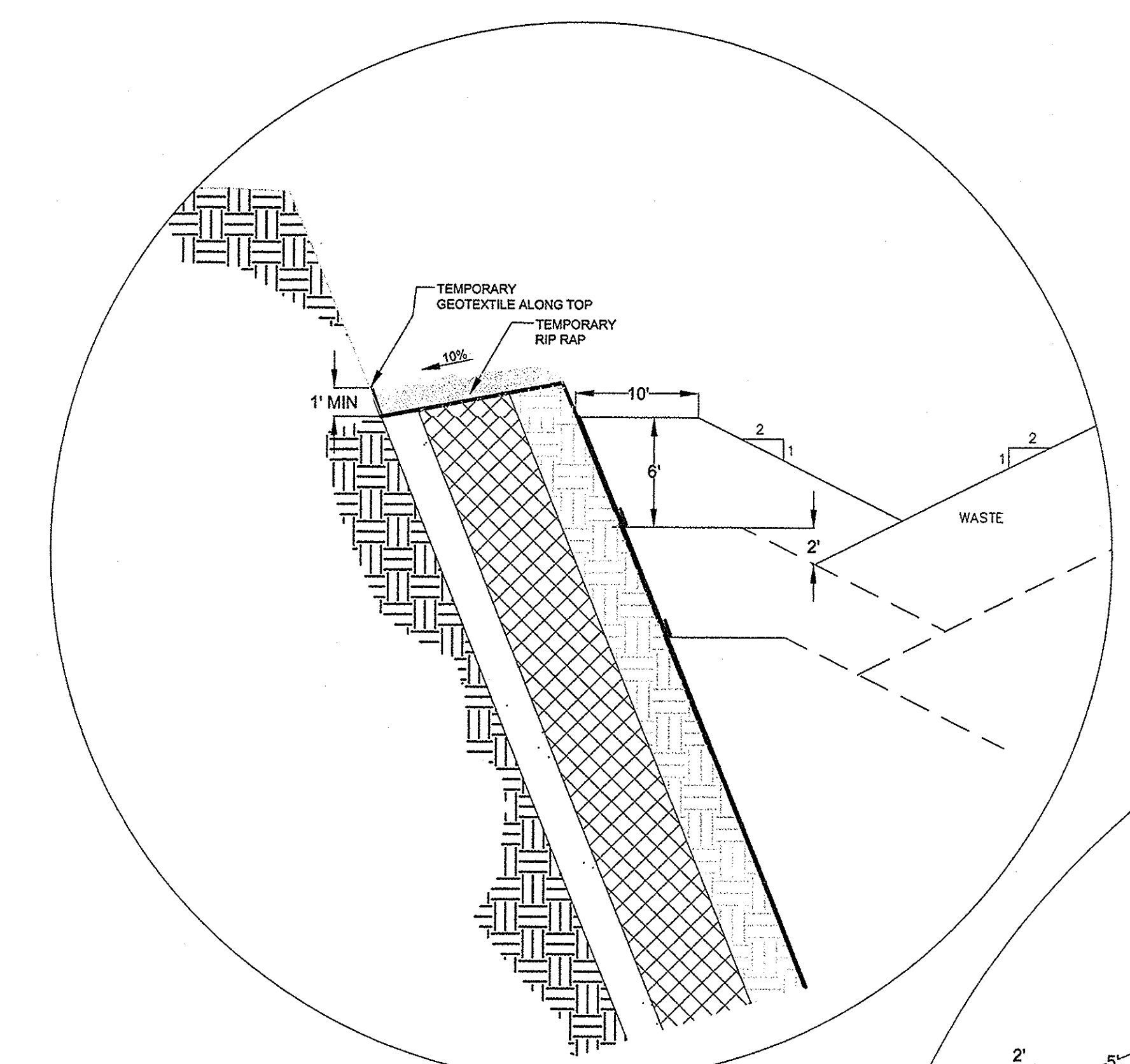
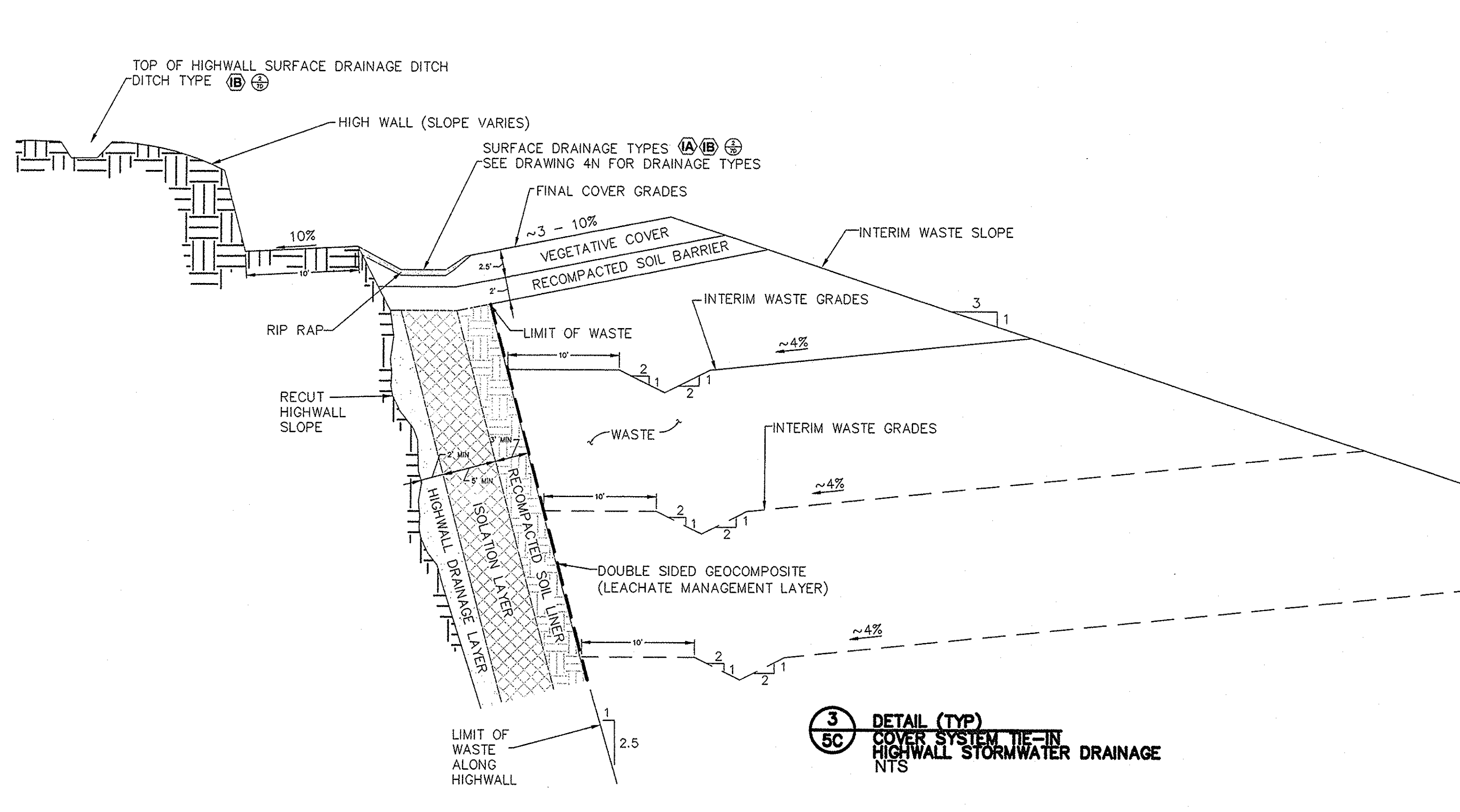
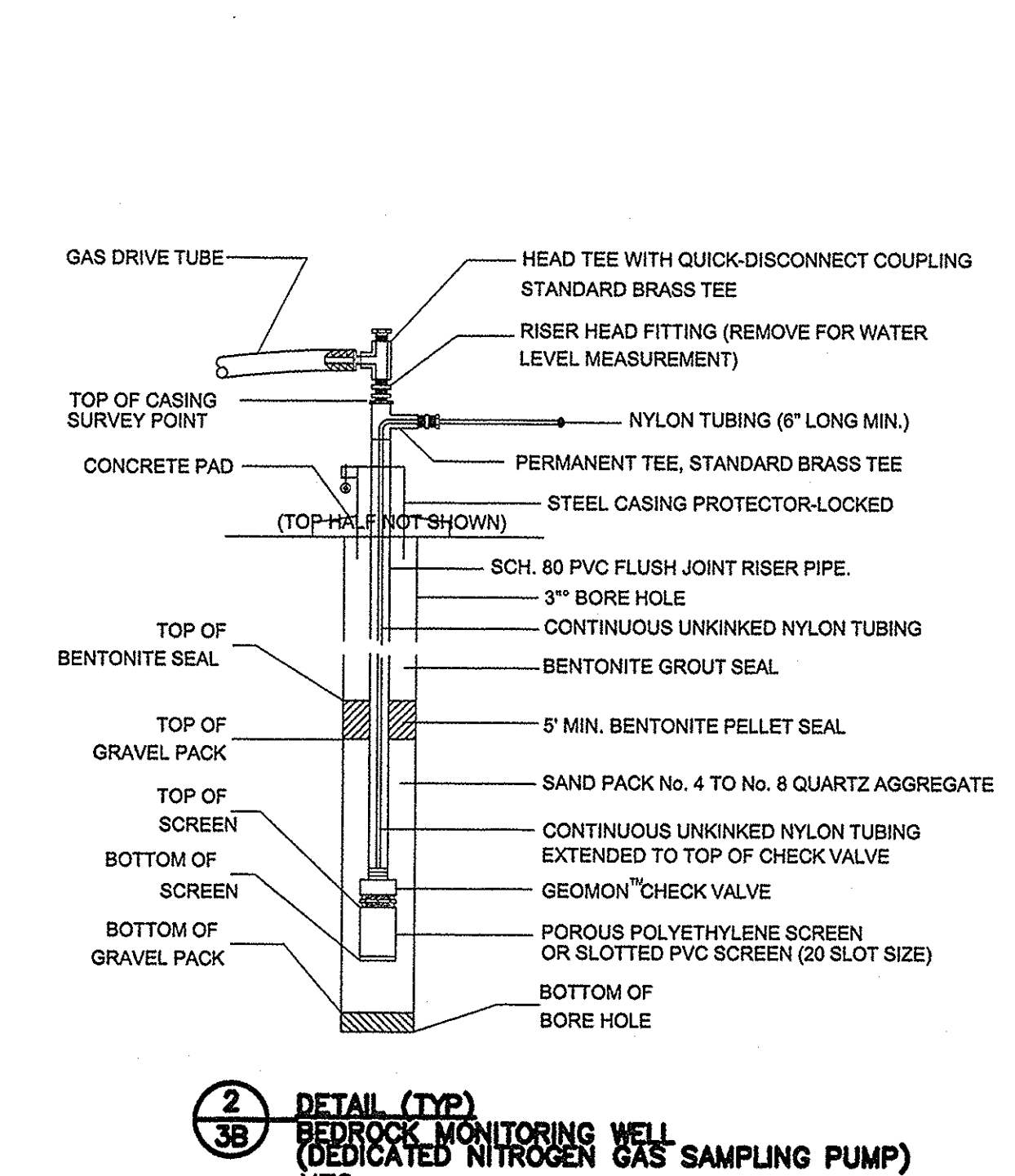
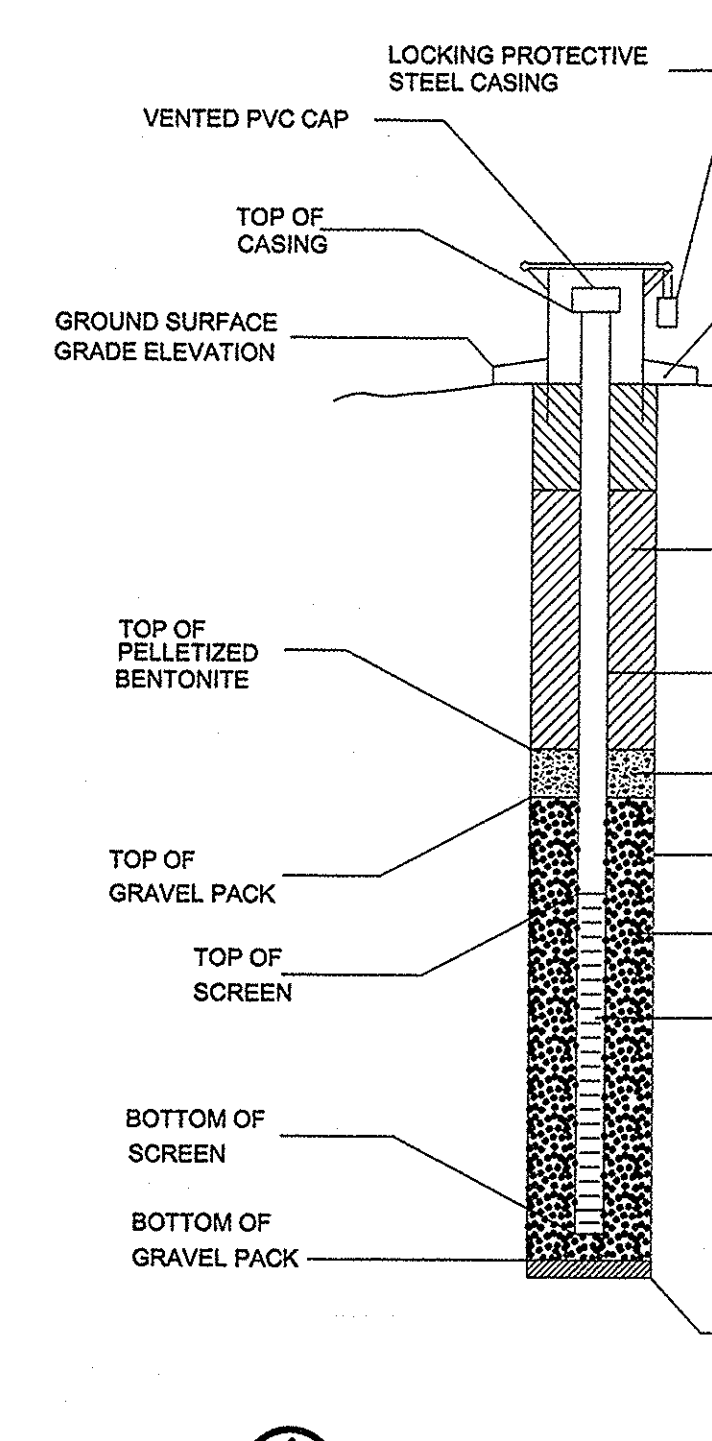
1 RIVERSIDE PLAZA  
COLUMBUS, OH 43215

GENERAL PROCESS FLOW DIAGRAM



**SOLID WASTE APPROVED**  
OHIO ENVIRONMENTAL PROTECTION AGENCY  
MAY 11 2007  
AS EVIDENCED BY COPY OF LETTER OF APPROVAL HERETO ATTACHED

tpy = Tons Per Year



**RECEIVED**  
MAY 02 2007  
Ohio Environmental Protection Agency  
Southwest District

DATE	NO.	DESCRIPTION	APPD.
JAN 25 2007	D	REVISED NOD 2 SUPPLEMENTAL RESPONSE	DGB
MAY 17 2007	C	REVISED - NOD 2 RESPONSE	DGB
MAY 25 2007	B	REVISED - NOD 1 RESPONSE	DGB
OCT 24 2006	A	ISSUED FOR PERMIT	DGB

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CARDINAL OPERATING COMPANY  
**CARDINAL PLANT**  
BRILLIANT OHIO

TITLE: **CARDINAL FAR 1 RESIDUAL WASTE LANDFILL COVER SYSTEM AND OTHER DETAILS**

DWG. NO. 13-30100-7F-D  
SCALE: **CIVIL ENGINEERING DIVISION**

PROJECT NO. CHER126  
FILE NO. **7E** OF 39  
DATE: **25 Jan 2007**

1 RIVERSIDE PLAZA  
COLUMBUS, OH 43215