# Appendix A

SOUTHERN COMPANY

# LOG OF TEST BORING

**BORING BY-GSA-MW-01**
**PAGE 1 OF 2**
**ECS37275**

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

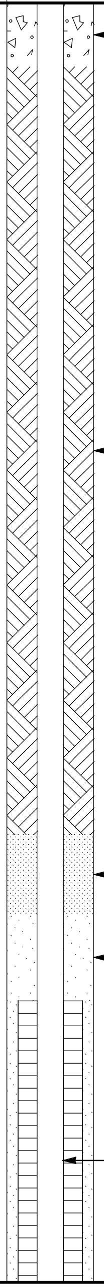
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/23/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 20.7 **COORDINATES:** N:362,038.24 E:1,808,279.56
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION<br>Weak Moderate Strong | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|---|
| | | **Silty Sand (SM)**<br>- light olive brown (2.5Y 5/4) alluvium moist, minimal clay, organic rich | | | |
| 5<br>10<br>15 | | **Silty Sand (SM)**<br>- white (7.5YR 8/1) alluvium wet, predominantly fine to medium grained, no gravel | | | |
| 20 | | **Silty Sand (SM)**<br>- white (10YR 8/1) alluvium wet, very wet | | | |
| | | **Clayey Sand (SC)**<br>- very pale brown / very pale orange (10YR 8/2) and gray (10YR 6/1) alluvium wet, medium, silty clay and sand interbedded, sand is medium to coarse grained | | | |
| 25 | | **Poorly-graded Sand (SP)**<br>- white (10YR 8/1) alluvium wet, medium to coarse grained, subrounded to subangular quartzite/chert gravel ~ 2-3 cm in size | | | |
| 30<br>35 | | **Silty Sand (SM)**<br>- white (10YR 8/1) alluvium wet, medium grained, no fines, no gravel, rare mica | | | |
| 40 | | **Poorly-graded Sand (SP)**<br>- very pale brown (10YR 8/3) alluvium wet, coarse grained with 10% gravel | | | |

WELL DATA

Completion:
Protective aluminum cover with bollards;
3-foot square concrete pad



Surface Seal:
Concrete

Annular Fill:
Portland Cement-Bentonite Grout - 12.9ppg (6 - 50lbs bags PC, 4.5 cups Gel, 35 gal. Water)

Annular Seal:
Pel-Plug 3/8 Bentonite Non-Coated Pellets (0.5 - 5gal buckets)

Filter:
Filter Media 1A Silica Sand (4 - 50 lbs bags)

**Standpipe:**
**2" OD PVC (SCH 40)**

Screen:
10 ft; 0.010" Slot Prepack

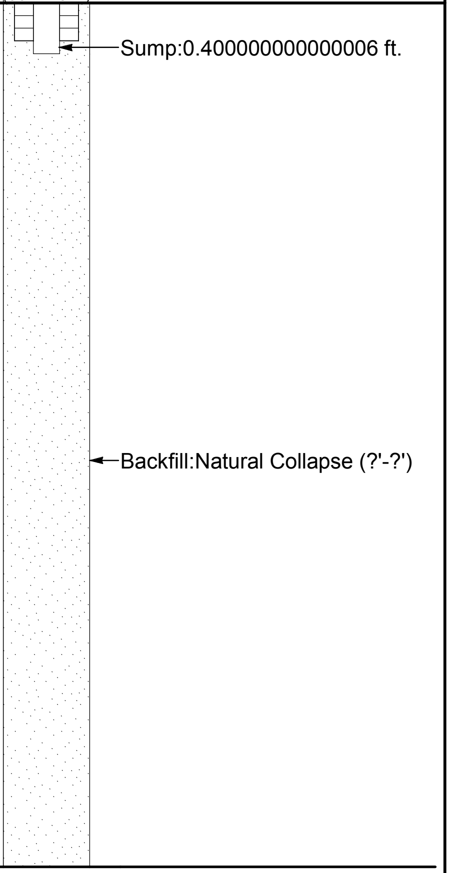
*(Continued Next Page)*

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS | WELL DATA Completion: Protective aluminum cover with bollards; 3-foot square concrete pad |
|---|---|---|---|---|---|---|
| | | **Poorly-graded Sand (SP)** *(Con't)* | | | | (CONTINUED) |
| 45 | | **Poorly-graded Sand (SP)**<br>- white (10YR 8/1) and pale yellow (2.5Y 7/4) alluvium wet, medium, medium to coarse grained sand, with subangular gravel, clay nodules present from 43 to 50 feet | | | | |
| 50 | | | | | | |
| 55 | | | | | | |
| 60 | | | | | | |
| 65 | | | | | | |
| | | Bottom of borehole at 67.0 feet. | | | | |
| 70 | | | | | | |
| 75 | | | | | | |
| 80 | | | | | | |
| 85 | | | | | | |



SOUTHERN COMPANY

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

# LOG OF TEST BORING

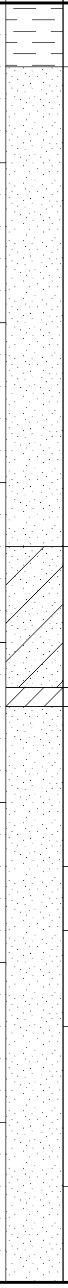
## BORING BY-GSA-MW-02

PAGE 1 OF 2
ECS37275

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

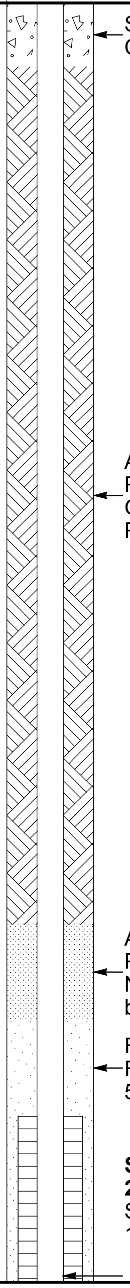
**DATE STARTED** 9/23/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 20.0 **COORDINATES:** N:361,968.69 E:1,807,662.77
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|
| | **Low Plastic Organic Silt or Clay (OL)**<br>- reddish yellow (7.5YR 7/8) alluvium wet, medium dense, organic rich | | | |
| 5<br>10<br>15 | **Poorly-graded Sand (SP)**<br>- white (10YR 8/1) and reddish yellow (7.5YR 7/8) alluvium moist, rare gravel, medium grained | | | |
| 20 | **Clayey Sand (SC)**<br>- white (10YR 8/1) alluvium moist, increasing clay content with depth, no organic material | | | |
| | **Lean Clay (CL)**<br>- white (10YR 8/1) alluvium | | | |
| 25 | **Poorly-graded Sand (SP)**<br>- white (7.5YR 8/1) alluvium micaceous, medium to coarse grained, subrounded gravel | | | |
| | **Poorly-graded Sand (SP)**<br>- yellow (10YR 7/6) alluvium wet, coarse to medium grained, pebbles are predominantly subangular | | | |
| 30 | **Poorly-graded Sand (SP)**<br>- very pale brown (10YR 7/3) alluvium wet, coarse to medium grained, pebbles are predominantly subangular | | | |
| 35 | **Poorly-graded Sand (SP)**<br>- very pale brown (10YR 8/3) alluvium wet, coarse to medium grained, pebbles are predominantly subangular | | | |
| 40 | **Poorly-graded Sand (SP)**<br>- very pale brown (10YR 7/3) alluvium wet, coarse to medium grained, pebbles are predominantly subangular | | | |



WELL DATA

Completion:
Protective aluminum cover with bollards;
3-foot square concrete pad



Surface Seal:
Concrete

Annular Fill:
Portland Cement-Bentonite Grout - 12.9ppg (6 - 50lbs bags PC, 4.5 cups Gel, 35 gal. Water)

Annular Seal:
Pel-Plug 3/8 Bentonite Non-Coated Pellets (0.5 - 5gal buckets)

Filter:
Filter Media 1A Silica Sand (4 - 50 lbs bags)

**Standpipe:**
**2" OD PVC (SCH 40)**
Screen:
10 ft; 0.010" Slot Prepack

(Continued Next Page)

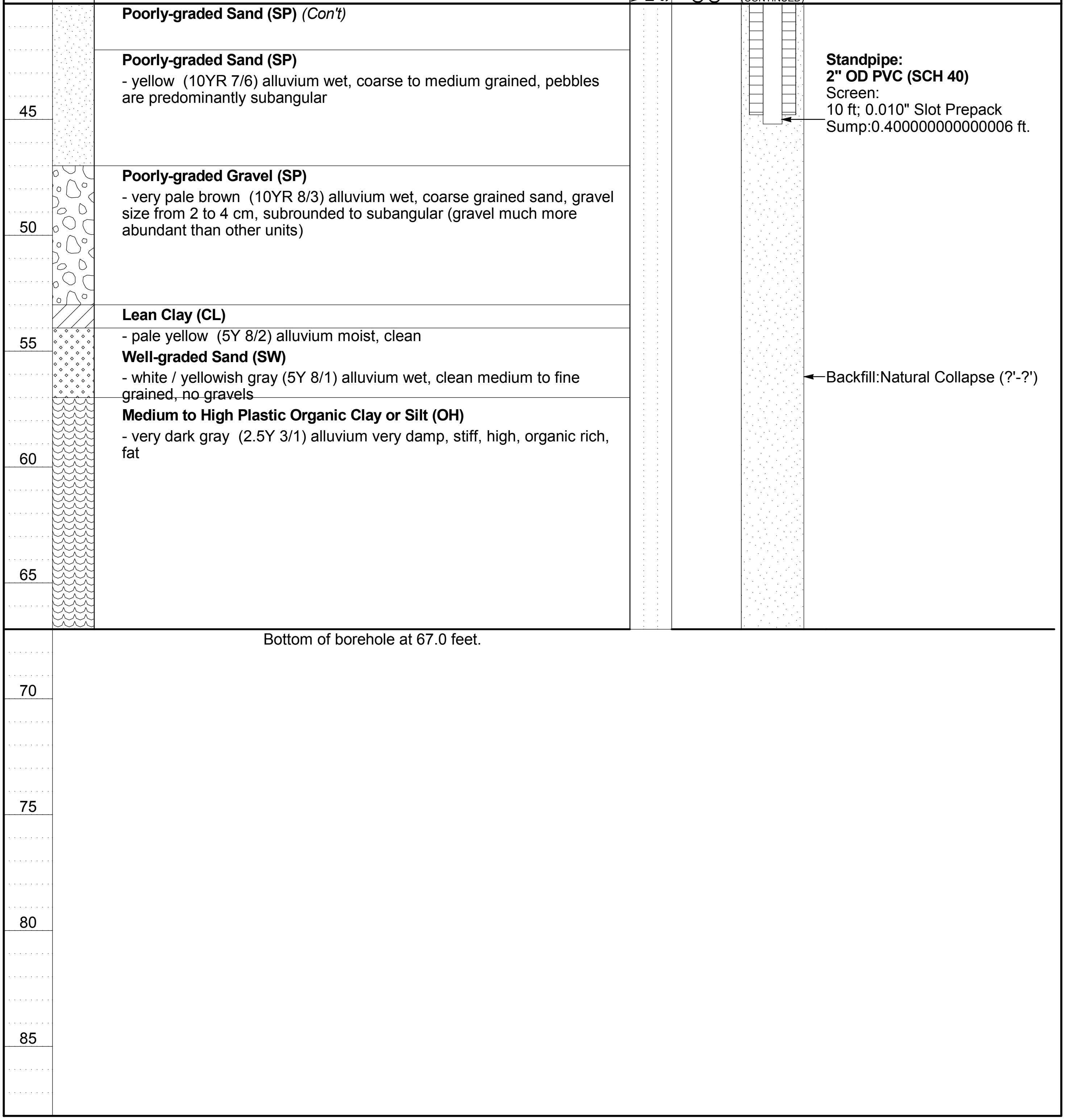
# LOG OF TEST BORING

**BORING BY-GSA-MW-02**
**PAGE 2 OF 2**
**ECS37275**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA<br>Completion:<br>Protective aluminum cover with bollards;<br>3-foot square concrete pad |
|---|---|---|---|---|---|---|

(CONTINUED)



**Poorly-graded Sand (SP)** *(Con't)*

**Poorly-graded Sand (SP)**
- yellow (10YR 7/6) alluvium wet, coarse to medium grained, pebbles are predominantly subangular

**Poorly-graded Gravel (SP)**
- very pale brown (10YR 8/3) alluvium wet, coarse grained sand, gravel size from 2 to 4 cm, subrounded to subangular (gravel much more abundant than other units)

**Lean Clay (CL)**
- pale yellow (5Y 8/2) alluvium moist, clean

**Well-graded Sand (SW)**
- white / yellowish gray (5Y 8/1) alluvium wet, clean medium to fine grained, no gravels

**Medium to High Plastic Organic Clay or Silt (OH)**
- very dark gray (2.5Y 3/1) alluvium very damp, stiff, high, organic rich, fat

Bottom of borehole at 67.0 feet.

**Standpipe:**
**2" OD PVC (SCH 40)**
Screen:
10 ft; 0.010" Slot Prepack
Sump:0.400000000000006 ft.

Backfill:Natural Collapse (?'-?')

**SOUTHERN COMPANY**

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

# LOG OF TEST BORING

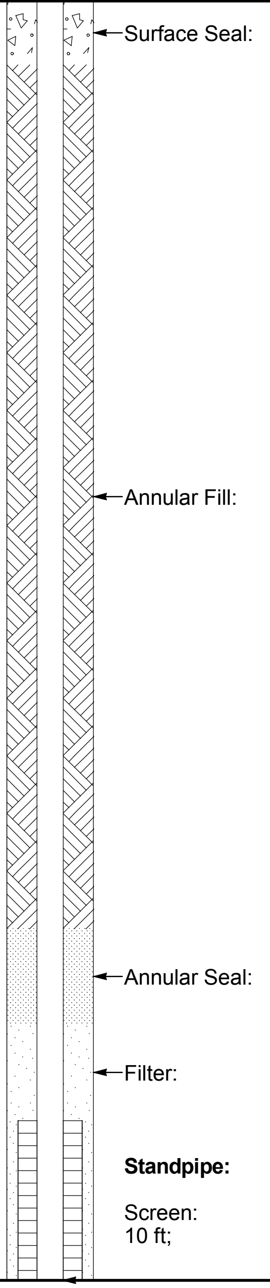
**BORING BY-GSA-MW-03**
**PAGE 1 OF 2**
**ECS37275**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/22/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 23.2 **COORDINATES:** N:361,627.64 E:1,807,366.92
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|---|
| | | **Silty Sand (SM)**<br>- very pale brown (10YR 8/4) alluvium damp, fine to medium grained | | | |
| 5 | | **Lean Clay (CL)**<br>- gray (5YR 5/1) alluvium damp, medium dense, low, fine sandy clay with sand lense ~4 inches at 6.0 feet. grades down from darker to ligher gray color | | | |
| 10 | | **Medium to High Plastic Organic Clay or Silt (OH)**<br>- brown (7.5YR 5/2) alluvium damp, high, orangic rich with possible charcoal or coal. | | | |
| 15<br>20 | | **Well-graded Sand (SW)**<br>- white (10YR 8/1) alluvium wet, fine to medium, clean | | | |
| | | **Elastic Silt (MH)**<br>- light gray (10YR 7/1) alluvium fine clayey-silty sand becomes more clayey with depth | | | |
| 25 | | **Well-graded Sand (SW)**<br>- white (10YR 8/1) alluvium wet, medium sand, clean | | | |
| 30<br>35 | | **Well-graded Gravelly Sand (SW)**<br>- yellow (10YR 7/6) alluvium wet, medium to coarse sand, some gravel | | | |
| 40 | | **Well-graded Sand (SW)**<br>- white (10YR 8/1) alluvium wet, medium sand grades down to coarse sand | | | |

WELL DATA



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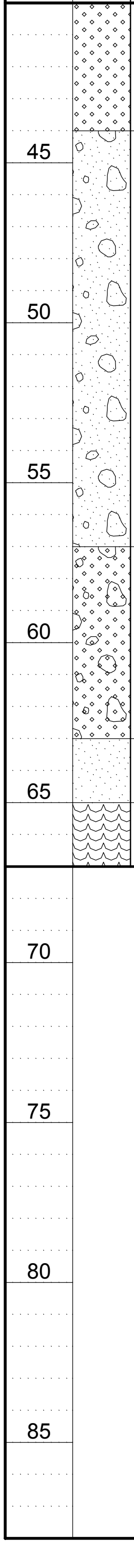
SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION (Weak Moderate Strong) | GROUNDWATER OBSERVATIONS | WELL DATA



**Well-graded Sand (SW)** *(Con't)*

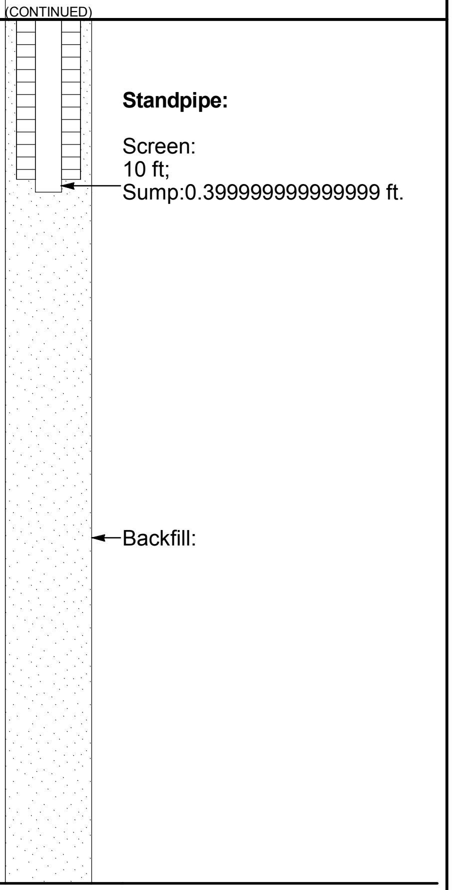
**Poorly-graded Gravelly Sand (SP)**
- yellow (10YR 7/8) alluvium wet, coarse sand with gravel

**Well-graded Gravelly Sand (SW)**
- white (10YR 8/1) alluvium wet, medium to coarse sand

**Poorly-graded Sand (SP)**
- yellow (10YR 7/8) alluvium wet, coarse sand with pea sized gravels

**Medium to High Plastic Organic Clay or Silt (OH)**
- very dark gray (10YR 3/1) alluvium stiff, high, organic rich, fat clay, very plastic

Bottom of borehole at 67.0 feet.



# BORING BY-GSA-MW-04 ( R )

PAGE 1 OF 2

ECS37275

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs

**LOCATION** Bucks, AL

**DATE STARTED** 10/12/2015 **COMPLETED** 10/13/2015 **SURF. ELEV.** 29.1 **COORDINATES:** N:361,932.31 E:1,806,927.51

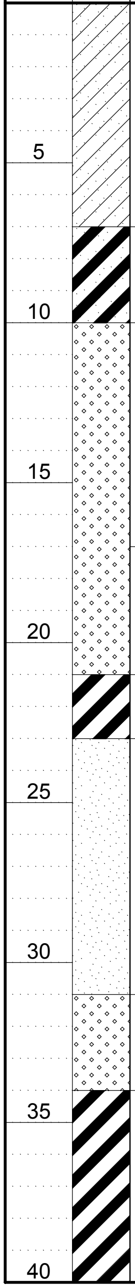
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic

**DRILLED BY** T. Ardito **LOGGED BY** S. Baxter **CHECKED BY** B. Coates **ANGLE** **BEARING**

**BORING DEPTH** 87 ft. **GROUND WATER DEPTH: DURING** 21 ft. **COMP.** 23.66 ft. **DELAYED** 23.59 ft. after 24 hrs.

**NOTES** No geophysical data collected Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|---|



**Sandy Lean Clay (CL)**
- mottled strong brown (7.5YR 4/6) and reddish yellow (7.5YR 6/8) fill moist, sandy, trace gravel

**Sandy Fat Clay (CH)**
- strong brown (7.5YR 5/6) alluvium moist, sandy

**Well-graded Sand (SW)**
- mottled reddish yellow (7.5YR 7/8) and reddish yellow (7.5YR 6/8) alluvium moist, coarse to fine grained, interbedded clay

**Well-graded Sand (SW)**
- mottled reddish yellow (7.5YR 7/8) and pinkish white (7.5YR 8/2) alluvium wet, coarse to very fine grained, increasing clay content with depth

▽

**Fat Clay (CH)**
- dark gray (7.5YR 4/1) alluvium wet, trace wood pulp

▼

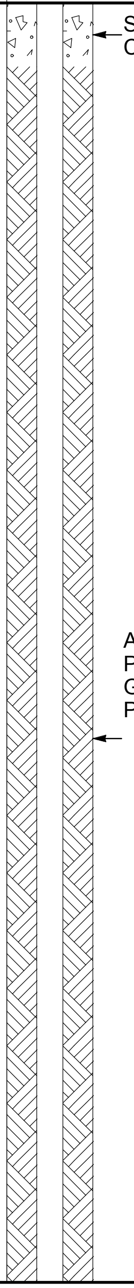
**Poorly-graded Sand (SP)**
- gray (7.5YR 6/1) alluvium wet, coarse grained with trace fines, trace gravel and clay

- SP: gray (7.5YR 6/1) alluvium wet, coarse grained with trace fines, trace gravel and clay

**Well-graded Sand (SW)**
- mottled reddish yellow (7.5YR 6/8) and yellow (10YR 8/8) alluvium wet, coarse to fine grained, clayey

**Fat Clay (CH)**
- dark gray (7.5YR 4/1) alluvium wet, trace wood pulp

Completion:
Protective aluminum cover with bollards;
3-foot square concrete pad



Surface Seal:
Concrete

Annular Fill:
Portland Cement-Bentonite Grout - 12.8ppg (6 - 50lbs bags PC, 3 cups Gel, 45 gal. Water)

*(Continued Next Page)*

**BORING BY-GSA-MW-04 ( R )**
**PAGE 2 OF 2**
**ECS37275**

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

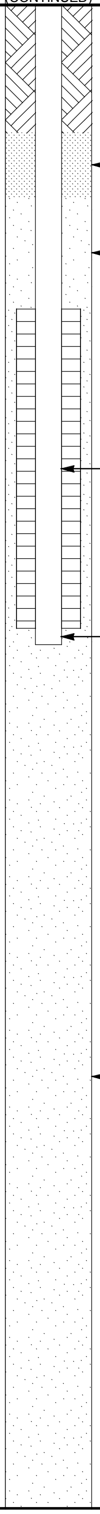
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|---|
| | | **Fat Clay (CH)** *(Con't)* | | | |
| 45 | | | | | |
| 50 | | **Poorly-graded Sand (SP)**<br>- reddish yellow (7.5YR 6/8) alluvium wet, coarse grained with trace fines, trace gravel and interbedded gravel | | | |
| 55 | | | | | |
| | | **Poorly-graded Sand (SP)**<br>- gray (7.5YR 6/1) alluvium wet, coarse grained with trace fines, trace gravel and interbedded clay | | | |
| 60 | | | | | |
| 65 | | | | | |
| | | - coarsening downward | | | |
| 70 | | | | | |
| 75 | | | | | |
| | | **Fat Clay (CH)**<br>- gray (7.5YR 6/1) alluvium wet, trace wood pulp | | | |
| 80 | | | | | |
| 85 | | | | | |
| | | Bottom of borehole at 87.0 feet. | | | |

WELL DATA

Completion:
Protective aluminum cover with bollards;
3-foot square concrete pad

(CONTINUED)



Annular Fill:
Portland Cement-Bentonite Grout - 12.8ppg (6 - 50lbs bags PC, 3 cups Gel, 45 gal. Water)

Annular Seal:
Pel-Plug 3/8 Bentonite Non-Coated Pellets (1 - 5gal buckets )

Filter:
Filter Media 1A Silica Sand (3.5 - 50 lbs bags)

**Standpipe:**
**2" OD PVC (SCH 40)**
Screen:
10 ft; 0.010" Slot Prepack

Sump:0.5 ft.

Backfill:Natural Collapse (60'-87')

# BORING BY-GSA-MW-05

PAGE 1 OF 2

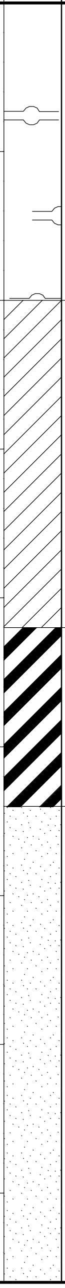
ECS37275

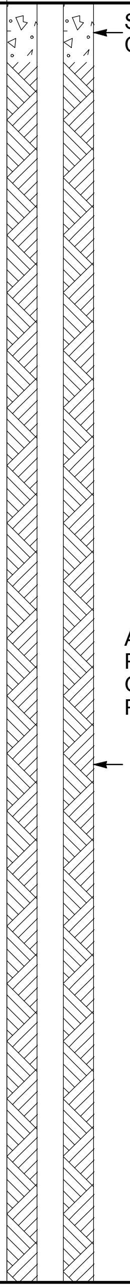
# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/30/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 34.3 **COORDINATES:** N:362,557.33 E:1,807,427.93
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** S. Baxter **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 89 ft. **GROUND WATER DEPTH: DURING** 25 ft. **COMP.** 29.5 ft. **DELAYED** 29.5 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.





| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS | WELL DATA<br>Completion:<br>Protective aluminum cover with bollards; 3-foot square concrete pad |
|---|---|---|---|---|---|
| | **Utility Clearance (HYDROEXCAVATION)** | | | | Surface Seal:<br>Concrete |
| 5 | | | | | |
| 10 | **Lean Clay (CL)**<br>- mottled reddish yellow (7.5YR 6/8) and gray (7.5YR 6/1) fill moist, sandy | | | | |
| 15 | | | | | |
| 20 | - 3.0" black contact | | | | |
| | **Fat Clay (CH)**<br>- gray (7.5YR 6/1) alluvium wet, trace silt, very clean | | | | Annular Fill:<br>Portland Cement-Bentonite Grout - 12.9ppg (9 - 50lbs bags PC, 7 cups Gel, 85 gal. Water) |
| 25 | ▽ | | | | |
| | **Poorly-graded Sand (SP)**<br>- mottled reddish yellow (7.5YR 6/8) and light brown (7.5YR 6/3) alluvium wet, coarse grained with trace fines, trace gravel | | | | |
| 30 | ▼ | | | | |
| 35 | | | | | |
| | - coarsens downward, more consistent color | | | | |
| 40 | | | | | |

(Continued Next Page)

SOUTHERN COMPANY

# LOG OF TEST BORING

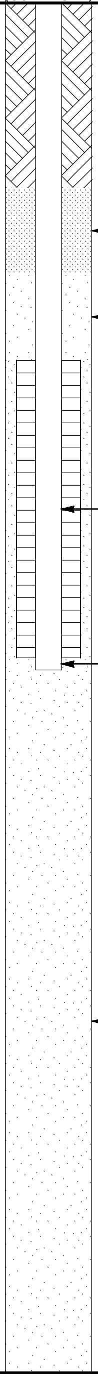
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

WELL DATA

Completion:
Protective aluminum cover with bollards; 3-foot square concrete pad

(CONTINUED)



| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|---|
| | | **Poorly-graded Sand (SP)** *(Con't)* | | | | |
| 45 | | | | | | Annular Fill:<br>Portland Cement-Bentonite Grout - 12.9ppg (9 - 50lbs bags PC, 7 cups Gel, 85 gal. Water) |
| 50 | | | | | | Annular Seal:<br>Pel-Plug 3/8 Bentonite Non-Coated Pellets (1 - 5gal buckets) |
| | | | | | | Filter:<br>Filter Media 1A Silica Sand (3.5 - 50 lbs bags) |
| 55 | | **Sandy Lean Clay (CL)**<br>- gray (7.5YR 6/1) alluvium wet, sandy | | | | |
| | | **Poorly-graded Sand (SP)**<br>- mottled reddish yellow (7.5YR 6/8) and light brown (7.5YR 6/3) alluvium wet, coarse grained with trace fines, trace gravel | | | | |
| 60 | | **Poorly-graded Sand (SP)**<br>- gray (7.5YR 6/1) alluvium wet, coarse grained with little to no fines, no gravel | | | | **Standpipe:**<br>**2" OD PVC (SCH 40)**<br>Screen:<br>10 ft; 0.010" Slot Prepack |
| 65 | | | | | | Sump:0.400000000000006 ft. |
| | | - SP: gray (7.5YR 6/1) alluvium wet, coarse grained with little to no fines, no gravel | | | | |
| 70 | | | | | | |
| 75 | | | | | | |
| | | - SP: gray (7.5YR 6/1) alluvium wet, coarse grained with little to no fines, no gravel | | | | Backfill:Natural Collapse (65'-89') |
| 80 | | | | | | |
| 85 | | | | | | |
| | | **Fat Clay (CH)**<br>- strong brown (7.5YR 5/6) alluvium wet, sandy, trace organic pulp | | | | |
| 90 | | Bottom of borehole at 89.0 feet. | | | | |

SOUTHERN COMPANY

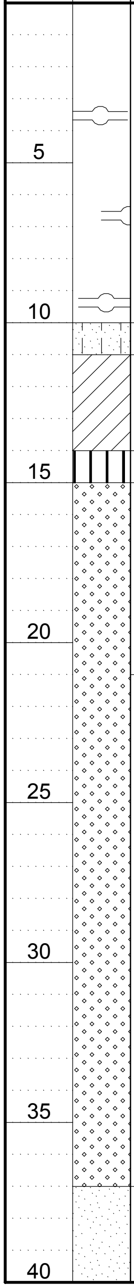
# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/28/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 21.7 **COORDINATES:** N:363,068.86 E:1,807,361.63
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|---|



**Utility Clearance (HYDROEXCAVATION)**

**Silty Sand (SM)**

- light gray (2.5Y 7/1) and yellow (2.5Y 7/6) alluvium moist, thinnly laminated, some organics

**Lean Clay (CL)**

- light brownish gray (2.5Y 6/2) alluvium soft, medium, laminated, concentrated organics

**Silt (ML)**

- light gray / yellowish gray (5Y 7/2) alluvium moist, fine grained sand

**Well-graded Sand (SW)**

- white / yellowish gray (5Y 8/1) alluvium wet, repeated fining upward sequences of coarse to medium sand, each sequence about 0.5 foot thick, rare pebble

**Well-graded Sand (SW)**

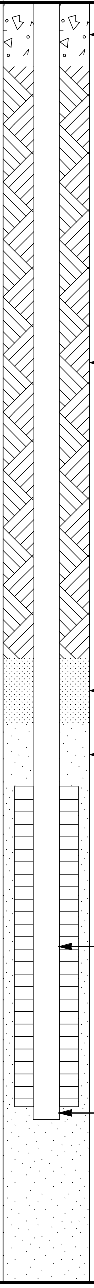
- reddish yellow (7.5YR 6/8), yellow / pale yellowish orange (10YR 8/6) and reddish yellow (7.5YR 7/6) alluvium wet, gravelly fining upward sequences about 1 foot thick, gravel base at each sequence, grades up to medium sand

**Poorly-graded Sand (SP)**

- pale yellow (2.5Y 7/4) alluvium wet, medium grained, clean, rare pebble

WELL DATA

Completion:
Protective aluminum cover with bollards;
3-foot square concrete pad



Surface Seal:
Concrete

Annular Fill:
Portland Cement-Bentonite Grout - 12.9ppg (6 - 50lbs bags PC, 4.5 cups Gel, 35 gal. Water)

Annular Seal:
Pel-Plug 3/8 Bentonite Non-Coated Pellets (0.5 - 5gal buckets)

Filter:
Filter Media 1A Silica Sand (3 - 50 lbs bags)

**Standpipe:**
**2" OD PVC (SCH 40)**
Screen:
10 ft; 0.010" Slot Prepack

Sump:0.399999999999999 ft.

Backfill:Natural Collapse (?'-?')

*(Continued Next Page)*

# BORING BY-GSA-MW-06

PAGE 2 OF 2

ECS37275

# LOG OF TEST BORING

SOUTHERN COMPANY

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs

**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION<br>Weak Moderate Strong | GROUNDWATER OBSERVATIONS | WELL DATA<br>Completion:<br>Protective aluminum cover with bollards;<br>3-foot square concrete pad<br>(CONTINUED) |
|---|---|---|---|---|---|---|
| | | **Well-graded Sand (SW)**<br>- yellow (10YR 7/8) and pale yellow (2.5Y 8/2) alluvium wet, medium to fine grained clean sand | | | | |
| 45 | | | | | | |
| | | **Clayey Sand (SC)**<br>- yellow (10YR 7/8) alluvium wet, medium, fine grained sand, most clay in top 4 inches | | | | |
| 50 | | | | | | |
| | | **Poorly-graded Sand (SP)**<br>- pale yellow (2.5Y 8/4) alluvium wet, coarse to medium grained sand, subangular gravel | | | | Backfill:Natural Collapse (?'-?') |
| 55 | | | | | | |
| | | **Well-graded Sand (SW)**<br>- pale yellow (2.5Y 8/2) alluvium wet, medium to coarse sand, no gravel | | | | |
| 60 | | | | | | |
| 65 | | | | | | |
| | | **Clayey Sand (SC)**<br>- gray (5Y 5/1) alluvium wet, fine grained sand with organic material present | | | | |
| | | Bottom of borehole at 67.0 feet. | | | | |
| 70 | | | | | | |
| 75 | | | | | | |
| 80 | | | | | | |
| 85 | | | | | | |

**SOUTHERN COMPANY**

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

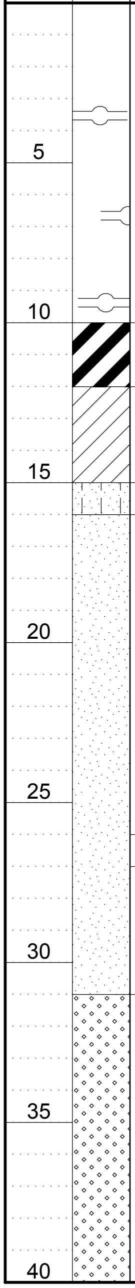
# LOG OF TEST BORING

**BORING BY-GSA-MW-07**
**PAGE 1 OF 2**
**ECS37275**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/28/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 20.6 **COORDINATES:** N:363,101.48 E:1,807,776.83
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|---|



**Utility Clearance (HYDROEXCAVATION)**

**Fat Clay (CH)**
- pinkish gray (7.5YR 6/2) alluvium moist, dense, medium, inorganic with thin <2mm interbeds of fine sand

**Lean Clay (CL)**
- light brownish gray / pale yellowish brown (10YR 6/2) and yellowish brown (10YR 5/8) alluvium damp, dense, medium, contains 2 colors, within yellowish brown inclusions are pebbles

**Silty Sand (SM)**
- light brownish gray / pale yellowish brown (10YR 6/2) alluvium wet, fine grained with trace clay

**Poorly-graded Sand (SP)**
- pale yellow (2.5Y 8/2) alluvium wet, repeating fining upward sequences of gravel to medium grained sand, each sequence ~1 foot thick, no clay

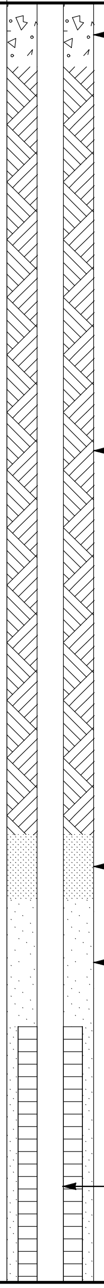
**Poorly-graded Sand (SP)**
- yellow (10YR 7/6) alluvium wet, medium to coarse grained, no gravel

**Poorly-graded Sand (SP)**
- yellow (10YR 7/6) and gray (7.5YR 6/1) alluvium wet, medium to coarse sand with 35% large clay nodules

**Well-graded Sand (SW)**
- reddish yellow (7.5YR 6/8) alluvium wet, coarse grained, gravelly sand, repeating fining upward sequences about 1.5 foot thick

WELL DATA

Completion:
Protective aluminum cover with bollards; 3-foot square concrete pad



Surface Seal:
Concrete

Annular Fill:
Portland Cement-Bentonite Grout - 12.9ppg (6 - 50lbs bags PC, 4.5 cups Gel, 35 gal. Water)

Annular Seal:
Pel-Plug 3/8 Bentonite Non-Coated Pellets (0.5 - 5gal buckets)

Filter:
Filter Media 1A Silica Sand (3.5 - 50 lbs bags)

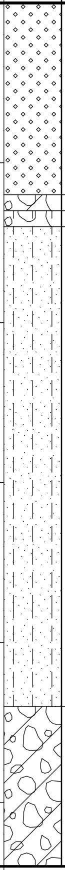
**Standpipe:**
**2" OD PVC (SCH 40)**
Screen:
10 ft; 0.010" Slot Prepack

*(Continued Next Page)*

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS | WELL DATA<br>Completion:<br>Protective aluminum cover with bollards; 3-foot square concrete pad |
|---|---|---|---|---|---|---|

(CONTINUED)



**Well-graded Sand (SW)** *(Con't)*

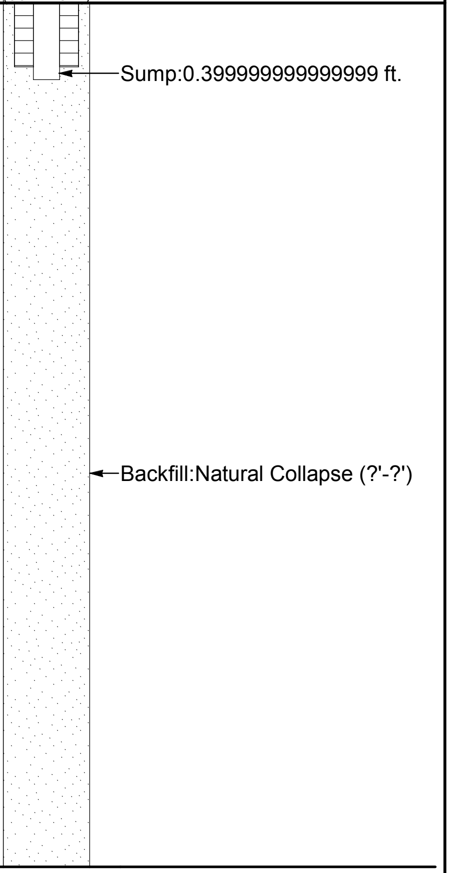
**Clayey Gravel (GC)**
- light gray (10YR 7/2) alluvium wet

**Silty Gravel (GM)**
- yellow (10YR 7/6) alluvium wet, fine grained sand

**Silty Sand (SM)**
- pale yellow (2.5Y 7/4) alluvium wet, clean, medium to fine grained, no clay, no gravel

**Clayey Gravel (GC)**
- yellow (10YR 7/6) alluvium wet, interbedded coarse sand and gravel with some clay, trace claystone clasts also present.

Bottom of borehole at 67.0 feet.



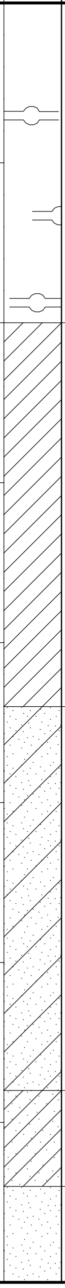
# BORING BY-GSA-MW-08
**PAGE 1 OF 2**
**ECS37275**

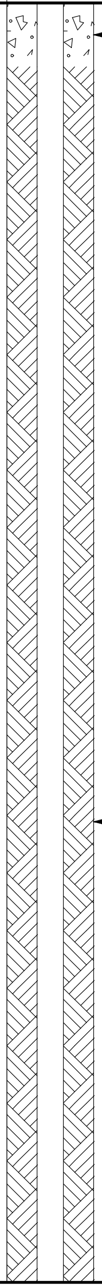
# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/29/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 34.4 **COORDINATES:** N:362,918.17 E:1,808,316.29
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** S. Baxter **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 87 ft. **GROUND WATER DEPTH: DURING** 25 ft. **COMP.** 27.8 ft. **DELAYED** 27.8 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.





| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION (Weak Moderate Strong) | GROUNDWATER OBSERVATIONS | WELL DATA<br>Completion:<br>Protective aluminum cover with bollards;<br>3-foot square concrete pad |
|---|---|---|---|---|---|
| 5<br>10 | **Utility Clearance (HYDROEXCAVATION)** | | | | Surface Seal:<br>Concrete |
| 15<br>20 | **Lean Clay (CL)**<br>- mottled strong brown (7.5YR 5/8) and gray (7.5YR 6/1) fill moist, sandy, trace orgainics<br>- CL: mottled strong brown (7.5YR 5/8) and gray (7.5YR 6/1) fill moist, sandy, trace orgainics | | | | Annular Fill:<br>Portland Cement-Bentonite Grout - 13.0ppg (9 - 50lbs bags PC, 6 cups Gel, 85 gal. Water) |
| 25<br>30 | **Clayey Sand (SC)**<br>- mottled reddish yellow (7.5YR 6/8) and gray (7.5YR 6/1) alluvium wet, clayey, coarse grained with trace fines, trace gravel<br>▼ - SP: mottled reddish yellow (7.5YR 6/8) and gray (7.5YR 6/1) alluvium wet, clayey, coarse grained with trace fines, trace gravel | | | ∇<br>▼ | |
| 35 | **Sandy Lean Clay (CL)**<br>- mottled gray (7.5YR 6/1) and reddish yellow (7.5YR 6/8) alluvium wet, sandy, trace fine gravel | | | | |
| 40 | **Poorly-graded Sand (SP)**<br>- mottled reddish yellow (7.5YR 6/8) and yellow (10YR 7/8) alluvium wet, coarse grained with trace fines, trace clay nodules, rounded river gravel | | | | |

*(Continued Next Page)*

SOUTHERN COMPANY

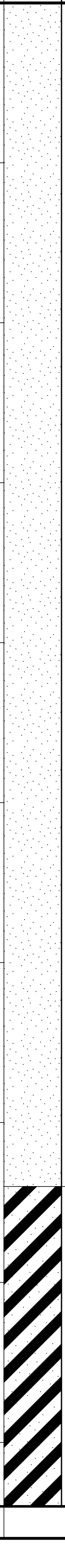
# LOG OF TEST BORING

**BORING BY-GSA-MW-08**
**PAGE 2 OF 2**
**ECS37275**

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|---|
| | | **Poorly-graded Sand (SP)** *(Con't)* | | | |
| 45 | | | | | |
| | | - SP: mottled reddish yellow (7.5YR 6/8) and yellow (10YR 7/8) alluvium wet, coarse grained with trace fines, trace clay nodules, rounded river gravel, coarsening downward | | | |
| 50 | | | | | |
| 55 | | | | | |
| | | - SP: dusky red (5R 3/4) alluvium wet, coarse grained with trace fines, trace clay nodules, rounded river gravel, coarsening downward | | | |
| 60 | | | | | |
| 65 | | | | | |
| 70 | | | | | |
| 75 | | | | | |
| | | **Sandy Fat Clay (CH)**<br>- gray (7.5YR 6/1) alluvium wet, sandy | | | |
| 80 | | | | | |
| 85 | | | | | |

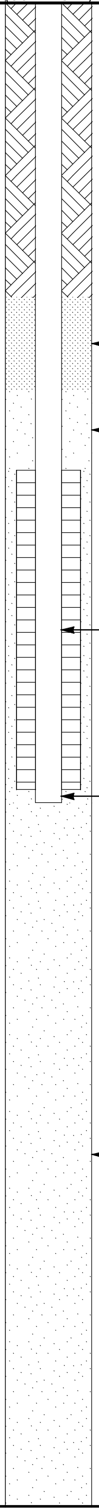


Bottom of borehole at 87.0 feet.

WELL DATA

Completion:
Protective aluminum cover with bollards;
3-foot square concrete pad

(CONTINUED)



Annular Fill:
Portland Cement-Bentonite Grout - 13.0ppg (9 - 50lbs bags PC, 6 cups Gel, 85 gal. Water)

Annular Seal:
Pel-Plug 3/8 Bentonite Non-Coated Pellets (1 - 5gal buckets)

Filter:
Filter Media 1A Silica Sand (2.5 - 50 lbs bags)

**Standpipe:**
**2" OD PVC (SCH 40)**

Screen:
9.99999999999999 ft; 0.010" Slot Prepack

Sump:0.400000000000006 ft.

Backfill:Natural Collapse (65'-87')

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 1/27/16 10:30 - C:\USERS\GBDYER\DOWNLOADS\PLANT BARRY CCR BORING LOGS.GPJ

SOUTHERN COMPANY

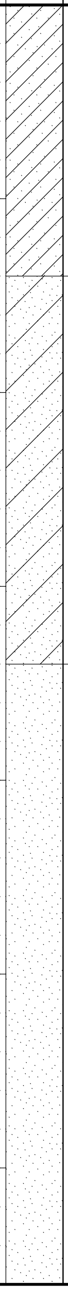
# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

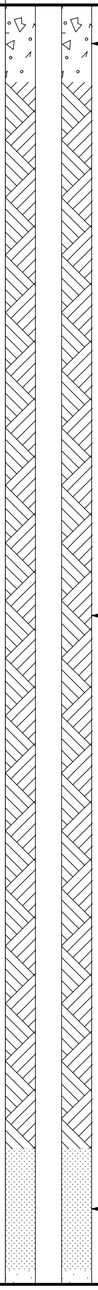
**DATE STARTED** 9/23/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 13.3 **COORDINATES:** N:362,799.55 E:1,808,595.91
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** J. Hall **LOGGED BY** S. Baxter **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** 15 ft. **COMP.** 13.8 ft. **DELAYED** 13.8 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|---|
| 0 | | **Sandy Lean Clay (CL)**<br>- mottled reddish yellow (7.5YR 6/8) and reddish yellow (7.5YR 7/8) fill moist, trace sand | | | |
| 5 | | | | | |
| 7 | | **Clayey Sand (SC)**<br>- mottled strong brown (7.5YR 5/8) and gray (7.5YR 6/1) fill moist, grades to unmottled | | | |
| 10 | | | | | |
| 14 | | | | | ▼ |
| 15 | | | | | ▽ |
| 17 | | **Poorly-graded Sand (SP)**<br>- reddish yellow (7.5YR 7/6) alluvium wet, coarse grained with trace fines, trace clay nodules and gravel | | | |
| 20 | | | | | |
| 25 | | | | | |
| 30 | | | | | |



**WELL DATA**

Completion:
Protective aluminum cover with bollards;
3-foot square concrete pad



Surface Seal:
Concrete

Annular Fill:
Portland Cement-Bentonite Grout - 12.7ppg (6 - 50lbs bags PC, 3.5 cups Gel, 50 gal. Water)

Annular Seal:
Pel-Plug 3/8 Bentonite Non-Coated Pellets (1 - 5gal buckets)

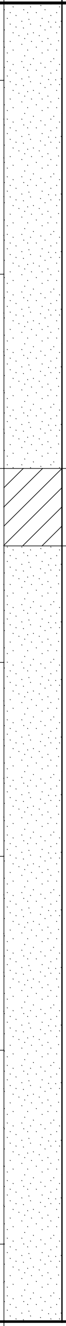
*(Continued Next Page)*

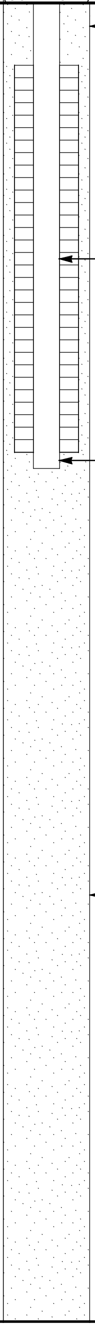
# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION<br>Weak<br>Moderate<br>Strong | GROUNDWATER OBSERVATIONS | WELL DATA<br>Completion:<br>Protective aluminum cover with bollards; 3-foot square concrete pad |
|---|---|---|---|---|---|---|
| 35 | | **Poorly-graded Sand (SP)** *(Con't)* | | | | (CONTINUED)<br>Filter:<br>Filter Media 1A Silica Sand (3 - 50 lbs bags) |
| 40 | | | | | | **Standpipe:**<br>**2" OD PVC (SCH 40)**<br>Screen:<br>10 ft; 0.010" Slot Prepack |
| 45 | | | | | | Sump:0.399999999999999 ft. |
| | | **Lean Clay (CL)**<br>- gray (7.5YR 6/1) alluvium wet, sandy, trace gravel | | | | |
| 50 | | **Poorly-graded Sand (SP)**<br>- mottled reddish yellow (7.5YR 6/8) and light gray (7.5YR 7/1) alluvium wet, coarse grained with trace fines, trace clay and gravel | | | | |
| 55 | | | | | | Backfill:Natural Collapse (45'-67') |
| 60 | | - SP: mottled reddish yellow (7.5YR 6/8) and light gray (7.5YR 7/1) alluvium wet, coarse grained with trace fines, trace clay and coarsening downward gravel | | | | |
| 65 | | | | | | |
| 70 | | Bottom of borehole at 67.0 feet. | | | | |





**BORING BY-GSA-MW-10**
**PAGE 1 OF 2**
**ECS37275**

SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

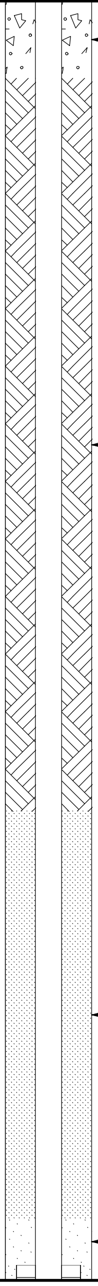
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/23/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 17.6 **COORDINATES:** N:362,441.66 E:1,808,600.05
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** J. Hall **LOGGED BY** S. Baxter **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** 20 ft. **COMP.** 14.4 ft. **DELAYED** 14.4 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION<br>Weak Moderate Strong | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|---|
| | | **Sandy Lean Clay (CL)**<br>- light brown (7.5YR 6/3) fill moist, sandy, trace roots | | | |
| 5 | | | | | |
| | | **Sandy Lean Clay (CL)**<br>- mottled light brown (7.5YR 6/4) and reddish yellow (7.5YR 6/8) fill moist, sandy, sand coarse to fine grained | | | |
| 10 | | | | | |
| 15 | ▼ | | | | |
| 20 | ▽ | | | | |
| 25 | | | | | |
| | | **Poorly-graded Sand (SP)**<br>- light gray (7.5YR 7/1) alluvium wet, coarse grained with trace fines, trace clay nodules<br>- SP: mottled light gray (7.5YR 7/1) and strong brown (7.5YR 5/8) alluvium wet, coarse grained with trace fines, trace clay nodules | | | |
| 30 | | | | | |

WELL DATA

Completion:
Protective aluminum cover with bollards;
3-foot square concrete pad



Surface Seal:
Concrete

Annular Fill:
Portland Cement-Bentonite Grout - 12.8ppg (5 - 50lbs bags PC, 3.5 cups Gel, 50 gal. Water)

Annular Seal:
Pel-Plug 3/8 Bentonite Non-Coated Pellets (1 - 5gal buckets)

Filter:
Filter Media 1A Silica Sand (4 - 50 lbs bags)

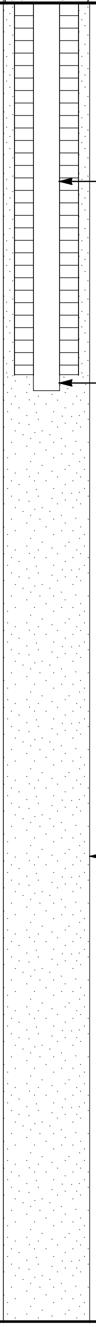
*(Continued Next Page)*

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS | WELL DATA Completion: Protective aluminum cover with bollards; 3-foot square concrete pad |
|---|---|---|---|---|---|---|
| 35 | | **Poorly-graded Sand (SP)** *(Con't)* | | | | (CONTINUED) |
| | | - SP: mottled light gray (7.5YR 7/1) and strong brown (7.5YR 5/8) alluvium wet, very coarse grained with trace fines, trace clay nodules | | | | |
| 40 | | | | | | |
| 45 | | | | | | |
| | | - SP: mottled light gray (7.5YR 7/1) and strong brown (7.5YR 5/8) alluvium wet, very coarse grained with trace fines, trace clay nodules | | | | |
| 50 | | | | | | |
| 55 | | | | | | |
| | | - SP: reddish yellow (7.5YR 6/8) alluvium wet, coarse grained with trace fines, trace rounded gravel | | | | |
| 60 | | | | | | |
| 65 | | **Fat Clay (CH)**<br>- mottled strong brown (7.5YR 4/6) and very dark gray (7.5YR 3/1) alluvium wet, trace peat | | | | |
| 70 | | Bottom of borehole at 67.0 feet. | | | | |



**Standpipe:**
**2" OD PVC (SCH 40)**
Screen:
10 ft; 0.010" Slot Prepack

Sump:0.399999999999999 ft.

Backfill:Natural Collapse
(43'-67')

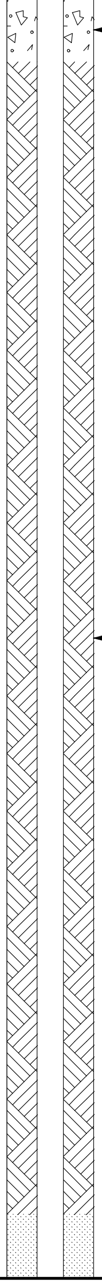
SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/25/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 25.9 **COORDINATES:** N:363,466.38 E:1,807,619.63
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** J. Hall **LOGGED BY** C. Stanford **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.



| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS | WELL DATA Completion: Protective aluminum cover with bollards; 3-foot square concrete pad |
|---|---|---|---|---|---|---|
| 5<br>10 | | **Utility Clearance (HYDROEXCAVATION)** | | | | Surface Seal: Concrete |
| | | **Lean Clay (CL)**<br>- light gray (5Y 7/1) and red (2.5YR 4/8) no, red inclusions, crumbley | | | | |
| 15<br>20 | | **Fat Clay (CH)**<br>- light olive gray (5Y 6/2) moist dense, medium | | | | Annular Fill: Portland Cement-Bentonite Grout - 12.9ppg (6 - 50lbs bags PC, 4.5 cups Gel, 35 gal. Water) |
| | | **Silty Sand (SM)**<br>- white / yellowish gray (5Y 8/1) moist fine grained sand with clay clasts near the base | | | | |
| | | **Clayey Sand (SC)**<br>- olive gray (5Y 4/2) moist dense, high, some fine sand | | | | |
| 25 | | **Poorly-graded Sand (SP)**<br>- white / yellowish gray (5Y 8/1) moist medium grained, micaceous, | | | | |
| 30<br>35 | | **Poorly-graded Gravel (SP)**<br>- yellow (10YR 7/8) and yellow / pale yellowish orange (10YR 8/6) wet coarse sand, subangular 0.5 to 1 cm gravels. limited recovery from 27-37. | | | | |
| 40 | | **Poorly-graded Gravel (SP)**<br>- white / yellowish gray (5Y 8/1) wet medium grained sand with some gravel in upper foot (37-38). coarsens upward | | | | |

*(Continued Next Page)*

# BORING BY-GSA-MW-11
**PAGE 2 OF 2**
**ECS37275**

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

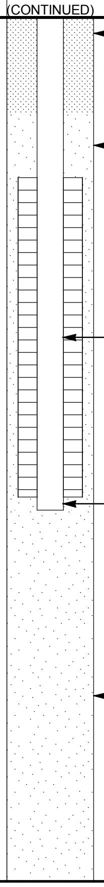
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|
| 45 | **Poorly-graded Gravel (SP)** *(Con't)* | | | |
| 50 | **Poorly-graded Gravel (SP)**<br>- yellow (5Y 8/8), white / yellowish gray (5Y 8/1) and yellow (5Y 7/8) wet coarse grained with subangular gravel and clay nodules. gravels larger near base - coarsens upward | | | |
| 55 | **Silty Sand (SM)**<br>- white (2.5Y 8/1) wet silty, interbedded fine to medium grained | | | |
| 60 | **Well-graded Sand (SW)**<br>- white / yellowish gray (5Y 8/1) wet coarse sand with subangular gravel and rare clay nodules. | | | |
| | **Silty Sand (SM)**<br>- very pale brown (10YR 7/3) wet fine to medium grained sand, no clay, no gravel | | | |
| 65 | **Lean Clay (CL)**<br>- very pale brown (10YR 8/4) wet dense, high, fine sand to silty clay | | | |
| | **Poorly-graded Sand (SP)**<br>- yellow (5Y 7/8) wet very coarse grained with some clay clasts | | | |
| | Bottom of borehole at 67.0 feet. | | | |
| 70 | | | | |
| 75 | | | | |
| 80 | | | | |
| 85 | | | | |

WELL DATA

Completion:
Protective aluminum cover with bollards; 3-foot square concrete pad

(CONTINUED)



Annular Seal:
Pel-Plug 3/8 Bentonite Non-Coated Pellets (1 - 5gal buckets)

Filter:
Filter Media 1A Silica Sand (3 - 50 lbs bags)

**Standpipe:**
**2" OD PVC (SCH 40)**

Screen:
10 ft; 0.010" Slot Prepack

Sump:0.399999999999999 ft.

Backfill:Natural Collapse (?'-?')

**SOUTHERN COMPANY**

# LOG OF TEST BORING

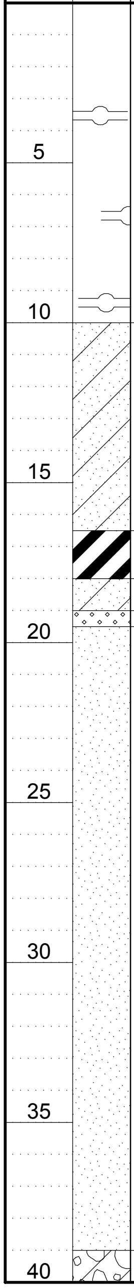
**BORING BY-GSA-MW-12**
**PAGE 1 OF 2**
**ECS37275**

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/29/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 17.4 **COORDINATES:** N:363,286.54 E:1,808,282.28
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.

DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION (Weak, Moderate, Strong) | GROUNDWATER OBSERVATIONS | WELL DATA



**Utility Clearance (HYDROEXCAVATION)**

**Clayey Sand (SC)**
- light gray (5Y 7/1), red (2.5YR 5/8) and brownish yellow (10YR 6/8) alluvium wet, predominantly fine sand with some coarse grained lenses

**Fat Clay (CH)**
- light brownish gray / pale yellowish brown (10YR 6/2) and brownish yellow (10YR 6/8) alluvium wet, dense, high, inorganic

**Clayey Sand (SC)**
- yellowish brown (10YR 5/8) alluvium wet, fine sand

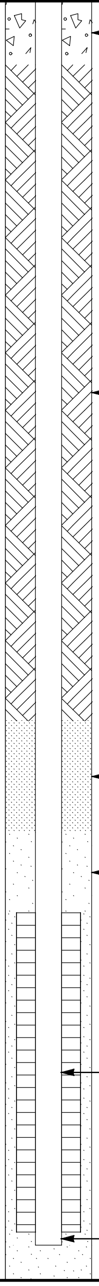
**Well-graded Sand (SW)**
- strong brown (7.5YR 5/8) alluvium wet, coarse sand, some subangular gravel

**Poorly-graded Sand (SP)**
- very pale brown / grayish orange (10YR 7/4) alluvium wet, repeating fining upward sequences of coarse, gravelly sand to medium sand. (each sequence about 1.5 feet thick)

**Clayey Gravel (GC)**

WELL DATA

Completion:
Protective aluminum cover with bollards; 3-foot square concrete pad



Surface Seal:
Concrete

Annular Fill:
Portland Cement-Bentonite Grout - 12.9ppg (5 - 50lbs bags PC, 4.5 cups Gel, 35 gal. Water)

Annular Seal:
Pel-Plug 3/8 Bentonite Non-Coated Pellets (1 - 5gal buckets)

Filter:
Filter Media 1A Silica Sand (3 - 50 lbs bags)

**Standpipe:**
**2" OD PVC (SCH 40)**
Screen:
10 ft; 0.010" Slot Prepack

Sump:0.399999999999999 ft.
Backfill:Natural Collapse (?'-?')

*(Continued Next Page)*

SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

WELL DATA

Completion:
Protective aluminum cover with bollards; 3-foot square concrete pad

(CONTINUED)

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | HCL REACTION Weak Moderate Strong | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|---|
| | | - very pale brown / grayish orange (10YR 7/4) alluvium wet, subrounded gravel with clay matrix<br>**Clayey Gravel (GC)** *(Con't)* | | | | |
| 45<br>50<br>55 | | **Well-graded Sand (SW)**<br>- pale yellow (2.5Y 7/4) alluvium wet, medium grained, clean, very little gravel, thin gravel lense at 48 feet. | | | | Backfill:Natural Collapse (?'-?') |
| | | **Poorly-graded Sand (SP)**<br>- reddish yellow (7.5YR 6/8) alluvium wet, subrounded to subangular gravel within coarse sand matrix | | | | |
| 60<br>65 | | **Medium to High Plastic Organic Clay or Silt (OH)**<br>- very dark gray (5Y 3/1) alluvium damp, medium stiff, high, highly organic, pieces of bark and stick. | | | | |
| 70<br>75<br>80<br>85 | | Bottom of borehole at 67.0 feet. | | | | |

# Appendix B

Appendix B

Summary of Groundwater Elevations

| Well ID | Top of Casing Elevation (feet MSL) | Groundwater Elevation (feet MSL) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 12/14/2015 | 2/22/2016 | 4/18/2016 | 6/7/2016 | 8/29/2016 | 1/30/2017 | 3/20/2017 | 5/1/2017 | 6/5/2017 | 9/12/2017 | 11/15/2017 | 1/22/2018 | 4/30/2018 | 8/27/2018 |
| BY-GSA-MW-1 | 20.66 | 6.17 | 7.726 | 7.916 | 5.806 | 5.126 | 6.936 | 5.416 | 5.506 | 6.636 | 5.446 | 5.426 | 4.746 | 6.826 | 5.216 |
| BY-GSA-MW-2 | 19.95 | 5.64 | 7.549 | 7.769 | 5.749 | 5.039 | 6.819 | 5.299 | 5.479 | 6.449 | 5.299 | 5.279 | 4.679 | 6.659 | 5.059 |
| BY-GSA-MW-3 | 23.24 | 6.32 | 8.191 | 8.451 | 6.521 | 5.781 | 7.551 | 6.041 | 6.161 | 7.391 | 6.161 | 6.081 | 5.461 | 7.191 | 5.761 |
| BY-GSA-MW-4 | 29.12 | 6.07 | 7.826 | 8.126 | 6.206 | 5.466 | 7.246 | 5.706 | 5.976 | 6.866 | 5.736 | 5.686 | 5.176 | 6.986 | 5.466 |
| BY-GSA-MW-5 | 34.31 | 5.29 | 7.081 | 7.411 | 5.281 | 4.611 | 6.521 | 4.781 | 5.171 | 5.771 | 8.591 | 4.671 | 4.181 | 6.421 | 4.611 |
| BY-GSA-MW-6 | 21.68 | 4.79 | 6.491 | 6.961 | 4.631 | 4.021 | 6.141 | 4.081 | 4.731 | 5.061 | 3.871 | 3.931 | 3.561 | 6.021 | 4.071 |
| BY-GSA-MW-7 | 20.60 | 4.81 | 6.575 | 6.975 | 4.635 | 4.025 | 6.165 | 4.105 | 4.645 | 5.085 | 3.805 | 3.925 | 3.475 | 6.005 | 3.995 |
| BY-GSA-MW-8 | 34.36 | 5.03 | 6.97 | 7.21 | 4.98 | 4.26 | 6.36 | 4.52 | 4.9 | 5.48 | 4.22 | 4.36 | 3.82 | 6.28 | 4.34 |
| BY-GSA-MW-9 | 13.32 | 4.83 | 6.677 | 7.017 | 4.807 | 4.137 | 6.227 | 4.367 | 4.747 | 5.477 | 4.167 | 4.247 | 3.717 | 6.097 | 4.257 |
| BY-GSA-MW-10 | 17.61 | 5.21 | 7.079 | 7.399 | 5.219 | 4.549 | 6.569 | 4.819 | 5.039 | 5.959 | 4.689 | 4.759 | 4.149 | 6.409 | 4.689 |
| BY-GSA-MW-11 | 25.92 | 4.46 | 6.198 | 6.708 | 4.298 | 3.628 | 5.948 | 3.708 | 4.418 | 4.738 | NM | 3.458 | 3.148 | 5.958 | 3.788 |
| BY-GSA-MW-12 | 17.44 | 4.87 | 6.685 | 7.085 | 4.745 | 4.055 | 6.295 | 4.195 | 4.715 | 5.205 | 3.825 | 3.975 | 3.525 | 6.185 | 4.125 |

# APPENDIX 4
# TOPOGRAPHIC MAPS, GRADING PLANS AND FINAL STACKING PLANS

DRAWING INDEX

PLANT BARRY UNIT 5 – FGD PROJECT – GYPSUM STORAGE AREA – CELL NO. 1

CIVIL DRAWINGS: INITIAL CONSTRUCTION DRAWINGS FOR CELL NO. 1 AND SEDIMENTATION POND

| | |
|---|---|
| E5C11030 – | CELL NO. 1 DRAWING INDEX, NOTES AND SPECIFICATIONS |
| E5C11031 – | CELL NO. 1 EXISTING TOPO–PRECONSTRUCTION |
| E5C11032 – | GENERAL ARRANGEMENT AND SITE PLAN–CELL NO. 1 THROUGH CELL NO. 3 |
| E5C11033 – | CELL NO. 1–CELL NO. 1–DETAIL PLAN FOR INITIAL DIKE CONSTRUCTION |
| E5C11034 – | CELL NO. 1–CELL NO. 1–SEDIMENTATION POND DETAIL FOR INITIAL DIKE CONST. |
| E5C11035 – | CELL NO. 1–TYPICAL DIKE SECTIONS |
| E5C11036 – | CELL NO. 1–SECTIONS AND DETAILS–RISER STRUCTURE AND DECANT PIPE |
| E5C11037 – | CELL NO. 1–SECTIONS AND DETAILS |
| E5C11038 – | CELL NO. 1–SECTIONS AND DETAILS |
| E5C11039 – | CELL NO. 1–SECTIONS AND DETAILS |
| E5C11040 – | CELL NO. 1–SECTIONS AND DETAILS |
| E5C11041 – | DETAIL PLANS A THROUGH E–CELL NO. 1 THROUGH CELL NO. 3 |
| E5C11042 – | CELL NO. 1–ENTRANCE ROAD PLAN 1 |
| E5C11043 – | CELL NO. 1–ENTRANCE ROAD PLAN 2 |
| E5C11044 – | CELL NO. 1–ENTRANCE ROAD DETAILS AND SECTIONS |
| E5C11045 – | CELL NO. 1–MISCELLANEOUS SECTIONS AND DETAILS |
| E5C11046 – | EMERGENCY POND–TYPICAL SECTIONS |

CIVIL DRAWINGS: SLUICING & STACKING – OPERATIONS AND CONSTRUCTION SEQUENCE DRAWINGS

| | |
|---|---|
| E5C11047 – | CELL NO. 1 OPERATIONS PLAN–PERIMETER DITCH CONSTRUCTION |
| E5C11048 – | CELL NO. 1 OPERATIONS PLAN–FINAL STACKING PLAN |
| E5C11049 – | CELL NO. 1 OPERATIONS PLAN–SECTION A–A AND SECTION B–B |
| E5C11050 – | CELL NO. 1 OPERATIONS PLAN–MISCELLANEOUS SECTIONS AND DETAILS |
| E5C11051 – | CELL NO. 1 OPERATIONS PLAN–SIPHON INSTALLATION AND OPERATION DETAILS |

ADDITIONAL CIVIL DRAWINGS: INITIAL CONSTRUCTION DRAWINGS FOR CELL NO. 1

| | |
|---|---|
| E5C11052 – | CELL NO. 1–SECTIONS AND DETAILS |
| E5C11053 – | CELL NO. 1–SECTIONS AND DETAILS |
| E5C11054 – | CELL NO. 1–GYPSUM LOADING AREA PLAN AND SECTIONS |

6 A

STRUCTURAL DRAWINGS:

| | |
|---|---|
| E5C12071 – | OUTDOOR CONCRETE, GYPSUM SURGE POND AREA PUMPS & ELECTRICAL BUILDING FOUNDATION PLAN |
| E5C12072 – | OUTDOOR CONCRETE, GYPSUM SURGE POND AREA SECTIONS AND DETAILS |
| E5C12073 – | OUTDOOR CONCRETE, GYPSUM SURGE POND AREA WASTE WATER PIPE SUPPORTS FOUNDATION PLAN |
| E5C12074 – | OUTDOOR CONCRETE, GYPSUM SURGE POND AREA WASTE WATER PIPE SUPPORTS SECTIONS AND DETAILS |
| E5C12075 – | OUTDOOR CONCRETE, EMERGENCY GYPSUM SLURRY POND SUMP FOUNDATION PLAN AND DETAILS |
| E5C12122 – | OUTLET STRUCTURE FOUNDATION PLAN AND DETAILS |
| E5C12124 – | OUTDOOR CONCRETE GYPSUM MARKET LAYDOWN AREA TIRE WASH FOUNDATION PLANS DETAILS |

MECHANICAL DRAWINGS:

SEE THE FOLLOWING DRAWINGS FOR REFERENCED MECHANICAL DRAWINGS. THIS LIST DOES NOT INCLUDE ALL MECHANICAL DRAWINGS PERTINENT TO THIS PROJECT.

| | |
|---|---|
| E5M21109 SHEET 1 – | EQUIPMENT LAYOUT GYPSUM SURGE POND WATER PUMPS |
| E5M22300 SHEET 1 – | PIPING LAYOUT GYPSUM SURGE POND WATER WASTE WATER RETURN |
| E5M22300 SHEET 2 – | PIPING PLAN WASTE WATER RETURN |
| E5M22300 SHEET 3 – | SECTIONS WASTE WATER RETURN |
| E5M22515 SHEET 9 AND 10 – | PIPING PLAN–GYPSUM DRAWOFF TO DWTR. CELL 1 & WASTE WTR. TO ASH POND PIPING |

ELECTRICAL DRAWINGS:

SEE THE FOLLOWING DRAWINGS FOR REFERENCED ELECTRICAL DRAWINGS. THIS LIST DOES NOT INCLUDE ALL ELECTRICAL DRAWINGS PERTINENT TO THIS PROJECT.

E5E30050 SHEET 3 – CELL NO. 1 ELECT. EQUIPMENT AND DUCT RUN

TECHNICAL SPECIFICATION REFERENCE

1. REFER TO TECHNICAL SPECIFICATION, SECTION 31 FOR CONSTRUCTION OF CELL 1 AND SEDIMENTATION POND OF THE GYPSUM STORAGE AREA.

STORM WATER POLLUTION PREVENTION PLAN (SWPP PLAN) REFERENCE

1. REFER TO THE STORM WATER POLLUTION PREVENTION PLAN (SWPP PLAN).

GENERAL CONSTRUCTION NOTES

1. THE CONTRACTOR SHALL OBTAIN FROM THE PURCHASER DESIGNATED ACCESS DIRECTIONS ACROSS THE PLANT PROPERTY.

2. EXISTING ACCESS AND PLANT ROADS SHALL BE MAINTAINED AND REPAIRED IF NECESSARY DURING CONSTRUCTION BY THE CONTRACTOR TO THE SATISFACTION OF THE PURCHASER'S PROJECT CONSTRUCTION MANAGER, PCM.

3. THE CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING HIS OWN STANDARD QUALITY CONTROL AND QUALITY ASSURANCE PROGRAM OR PRACTICES AND SHALL INSTITUTE ANY ADDITIONAL CONTROLS OR PROCEDURES IN ACCORDANCE WITH PROVEN INDUSTRY PRACTICE TO ASSUME COMPLIANCE WITH THESE DRAWINGS AND TECHNICAL SPECIFICATIONS.

4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PLANNING AND OPERATING ANY DEWATERING, SURFACE WATER RUNOFF CONTROL, AND PROVISIONS FOR DRAINAGE FOR EXCAVATIONS, AND FOR THE PLACEMENT OF MATERIALS. SUCH WORK SHALL BE AT NO ADDITIONAL EXPENSE TO THE PURCHASER.

5. THE CONTRACTOR SHALL STAY OUT OF DESIGNATED WETLANDS. THESE WETLANDS HAVE BEEN MARKED BY THE PURCHASER. SHOULD ANY OF THE MARKERS BE DISTURBED, THE CONTRACTOR SHALL NOTIFY THE PURCHASER IMMEDIATELY.

6. ALL GRADE ELEVATIONS SHOWN ON DRAWINGS ARE FINISH GRADE.

EROSION AND SEDIMENT CONTROL

1. THE CONTRACTOR SHALL ABIDE BY AND IMPLEMENT THE STORM WATER POLLUTION PREVENTION PLAN (SWPP PLAN).

2. PRIOR TO CONSTRUCTION, ANY NECESSARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE CONSTRUCTED AND PUT INTO PLACE, AND ANY REQUIRED DIVERSION BERMS, DITCHES AND OTHER STORM WATER MANAGEMENT STRUCTURES SHALL BE CONSTRUCTED AS NEEDED. THESE AND OTHER APPROPRIATE MEASURES SHALL BE MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD AS MAY BE REQUIRED BY THE SWPP PLAN.

3. ALL EROSION AND SEDIMENT CONTROL AT THE SITE SHALL BE PERFORMED IN ACCORDANCE WITH THE ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, LATEST EDITION.

4. AT LOCATIONS WHERE CLASS I RIPRAP IS USED FOR SLOPE PROTECTION, USE MIRAFI 180N OR APPROVED EQUAL FOR UNDERLYING FILTER FABRIC.

EARTHWORK AND CONSTRUCTED FILL

1. CELL DIKES, CELL ACCESS RAMPS, AND GENERAL FILL AREAS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS SECTION 31 FOR CONSTRUCTION OF CELL 1 OF THE GYPSUM STORAGE AREA.

2. EARTH FILL MATERIAL SHALL BE OBTAINED FROM APPROVED BORROW AREAS AS DESIGNATED OR APPROVED BY THE PURCHASER.

3. ALL EARTHWORK CONSTRUCTION SHALL BE DONE TO THE LINES, GRADES, AND CROSS SECTIONS SHOWN ON THE DRAWINGS. THE CONTRACTOR WILL ESTABLISH ALL NECESSARY BENCHMARKS AND BASE LINES REQUIRED FOR THE WORK.

HIGH DENSITY POLYETHYLENE (HDPE) LINER

1. THE BOTTOM AND INTERIOR SLOPE OF THE CELL AND PONDS SHALL BE LINED WITH A 60 MIL TEXTURED HDPE CARBON BLACK LINER AS SHOWN ON THE DRAWINGS AND AS DESCRIBED IN THE TECHNICAL SPECIFICATIONS.

2. THE HDPE LINER SHALL BE STORED, HANDLED AND INSTALLED ACCORDING TO THE TECHNICAL SPECIFICATIONS AND AS PER MANUFACTURERS GUIDE–LINES AND INSTRUCTIONS.

GEOCOMPOSITE DRAINAGE NET AND UNDERDRAIN COLLECTION SUMPS

1. A GEOCOMPOSITE DRAINAGE NET SHALL BE INSTALLED ABOVE THE HDPE LINER ACROSS THE BOTTOM AREA OF THE CELL AS SHOWN ON THE DRAWINGS AND AS DESCRIBED IN THE TECHNICAL SPECIFICATIONS.

2. THE GEOCOMPOSITE DRAINAGE NET SHALL CONSIST OF ONE LAYER OF HDPE DRAINAGE NET OVERLAIN BY ONE LAYER OF GEOTEXTILE TO CREATE A SINGLE SIDED GEOCOMPOSITE. THE DRAINAGE LAYER SHALL BE GSE FABRINET UF, SINGLE SIDED, WITH 10 OZ FABRIC OR APPPROVED EQUAL. THE GEOTEXTILE SHALL BE A NON–WOVEN PUNCHED POLYETHYLENE.

3. THE GEOCOMPOSITE DRAINAGE NET SHALL BE STORED, HANDLED AND INSTALLED ACCORDING TO THE TECHNICAL SPECIFICATIONS AND AS PER MANUFACTURER'S GUIDELINES AND INSTRUCTIONS.

4. WATER COLLECTED BY THE GEOCOMPOSITE DRAINAGE NET WILL BE COLLECTED IN TWO UNDERDRAIN COLLECTION SUMPS. THE UNDERDRAIN COLLECTION SUMPS SHALL BE LOCATED AND CONSTRUCTED AS SHOWN ON THE DRAWINGS.

CONCRETE

1. DESIGN MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE FOLLOWING LATEST STANDARDS AND SPECIFICATIONS UNLESS OTHERWISE MODIFIED ON THE DESIGN DRAWINGS.
   - –ACI–318 BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE.
   - –ACI–315 MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES.
   - –ACI–347R RECOMMENDED PRACTICE FOR CONCRETE FORMWORK.
   - –CRSI RECOMMENDED PRACTICE FOR PLACING REINFORCING STEEL.

2. ALL CAST IN PLACE CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI IN 28 DAYS, UNLESS OTHERWISE NOTED.

3. USE A TYPE I/II PORTLAND CEMENT AND A W/C RATION OF .45.

4. CONCRETE SHALL HAVE A FLY ASH CONTENT EQUAL TO 15–30% OF THE TOTAL CEMENTITIOUS MATERIAL, UNLESS OTHERWISE APPROVED BY THE DESIGNING ENGINEER. FLY ASH SHALL CONFORM TO REQUIREMENTS OF ASTM C618, CLASS F.

5. IF READY–MIX CONCRETE IS USED FROM AN APPROVED SUPPLIER, ALL CONCRETE SHALL BE PLACED WITHIN 1½ HOURS AFTER MIXING.

6. CONCRETE SLABS SHALL HAVE A STEEL TROWEL FINISH.

7. REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO AST A615, GRADE 60. WELDED STEEL WIRE FABRIC SHALL BE ASTM A185 PLAIN TYPE.

8. CHAMFER ALL EXPOSED EXTERNAL CORNERS OF CONCRETE WITH A 45 DEGREE CHAMFER, UNLESS OTHERWISE NOTED.

9. PROVIDE A MINIMUM COVER OF 3" FOR ALL REINFORCING STEEL.

10. EMBEDMENT AND SPLICE LENGTHS FOR REINFORCING STEEL SHALL CONFORM TO ACI–318, UNLESS OTHERWISE NOTED.

11. ALL REINFORCING BAR HOOKS SHOWN ON DRAWINGS SHALL BE ACI STANDARD 90 DEGREE HOOKS, UNLESS OTHERWISE NOTED.

12. REBAR FABRICATOR SHALL OBTAIN APPROVAL OF HIS DETAIL DRAWINGS BEFORE BEGINNING FABRICATION, UNLESS OTHERWISE NOTED IN PURCHASE ORDER.

CONCRETE AND METAL LINING SYSTEM

1. ALL CONCRETE AND METAL THAT WILL BE EXPOSED OR IN CONTACT WITH GYPSUM AND/OR GYPSUM SLURRY WATER, UNLESS OTHERWISE NOTED, SHALL BE COATED WITH CHEMPRUF 2410 LINING SYSTEM BY ATLAS MINERALS AND CHEMICALS, INC. OR APPROVED EQUAL. THIS WILL INCLUDE ALL CONCRETE COLLARS AROUND DITCH CULVERT DRAIN PIPES IN CELLS 1, 2, & 3, ALL CONCRETE COLLARS AROUND THE GYPSUM SLUICE PIPES AT THE GYPSUM COLLECTION BASINS, THE CONCRETE COLLAR AROUND THE PIPE FROM THE EMERGENCY GYPSUM SLURRY POND, CONCRETE SURFACES FOR HDPE CHANNEL EMBEDS AT RISER STRUCTURE AND ASSOCIATED DECANT PIPE, THE CONCRETE RISER STURCTURE, AND ALL CONCRETE FOUNDATIONS AND CONCRETE COLLARS WITHIN THE SEDIMENTATION POND,

2. THIS COATING WILL NOT BE APPLIED ON ROLLER COMPACTED (ZERO SLUMP) CONCRETE LOCATED IN THE GYPSUM COLLECTION BASINS, GYPSUM COLLECTION BASIN SPILLWAY CONCRETE, CONCRETE IN THE EMERGENCY GYPSUM SLURRY POND, OR ON REINFORCED CONCRETE PARAPETS IN THE GYPSUM SLURRY PIPE TRENCH

3. THE LINING SYSTEM MATERIALS SHALL BE STORED, HANDLED AND APPLIED AS PER MANUFACTURERS GUIDELINES AND INSTRUCTIONS.

4. THE LINING SYSTEM SHALL BE APPLIED BY A KNOWLEDGEABLE AND EXPERIENCED SPECIALTY CONTRACTOR.

FLOWABLE FILL

1. FOR FLOWABLE FILL BACKFILL, A FLY ASH/CEMENT FLOWABLE FILL 500 PSI MIX SHALL CONSIST OF THE FOLLOWING:
   - 250 LBS OF CLASS "F" FLY ASH
   - 200 LBS OF CEMENT 1
   - 2594 LBS OF CONCRETE SAND
   - 350 LBS OR 42 GALLONS OF WATER(POTABLE)
   - 8 OZ OF AEA

2. ALL FLOWABLE FILL TO SET 72 HOURS PRIOR TO PLACING COMPACTED SOIL BACKFILL ON FLOWABLE FILL.

3. TO PREVENT FLOTATION, HOLD DOWN STRAPS SHALL BE USED ON THE DISCHARGE PIPES PRIOR TO PLACING FLOWABLE FILL.

PERIMETER CHAIN LINK FENCE

1. A PERIMETER CHAIN LINK FENCE SHALL BE INSTALLED ONLY AROUND THE SEDIMENTATION POND AS SHOWN ON THE DRAWINGS AND AS SPECIFIED BY THE PURCHASER. THE FENCE SHALL EXTEND 7 FEET ABOVE THE GROUND AND 1 FOOT BELOW GROUND. A VEHICULAR GATE AS SPECIFIED BY THE PURCHASER SHALL BE INSTALLED WHERE REQUESTED BY THE PURCHASER AROUND THE SEDIMENTATION POND AND IN THE LOCATIONS SHOWN ON PLAN SHEETS E5C11033 AND E5C11034.

DECANT PIPE AND RISER STRUCTURE

1. THE HORIZONTAL DECANT PIPES FOR THE RISER STRUCTURE SHALL BE HANCOR BLUE SEAL OR ADS DUAL WALL/N–12 WT IB HDPE PIPE OR APPROVED EQUAL. THE PIPE SHALL HAVE A SMOOTH INTERIOR AND ANGULAR EXTERIOR CORRUGATIONS.

2. TO MINIMIZE JOINTS AND JOINT INSTALLATION, PIPE SHALL BE FURNISHED IN THE MAXIMUM NON–CUSTOM LENGTHS.

3. PIPE JOINTS SHALL BE WATERTIGHT ACCORDING TO THE MANUFACTURE'S GUIDELINES AND INSTRUCTIONS, AND SHALL CONTAIN A REINFORCED BELL.

4. THE RISER STRUCTURE WILL CONSIST OF A THREE SIDED CONCRETE BOX WITH A SERIES OF STOPLOGS TO BE ADDED AS NEEDED.

5. THE 6"X6" (ACTUALLY 5.5"X5.5") WOODEN STOPLOGS SHALL BE 3'–11" LONG AND SHALL BE GRADE 1 PRESSURE TREATED WOOD. THE TIMBER SHALL BE STRAIGHT, NON–WARPED, AND FREE OF MAJOR CRACKS.

OTHER PIPES AND LINES

1. PIPES FOR THE INTERIOR PERIMETER DITCH CULVERTS SHALL BE HANCOR BLUE SEAL OR ADS DUAL WALL/N–12 WT IB HDPE PIPE OR APPROVED EQUAL. THE PIPES SHALL HAVE A SMOOTH INTERIOR AND ANGULAR EXTERIOR CORRUGATIONS.

2. 12" ø COLLECTOR PIPES FOR THE UNDERDRAIN COLLECTION SUMP, ADJOINING TEES, AND PIPES LEADING FROM THE COLLECTOR PIPES TO THE SEDIMENTATION POND SHALL BE HANCOR BLUE SEAL OR ADS DUAL WALL/N–12 WT IB HDPE PIPE OR APPROVED EQUAL. THE PIPES SHALL HAVE A SMOOTH INTERIOR AND ANGULAR EXTERIOR CORRUGATIONS, ONLY THE COLLECTOR PIPES SHALL BE PERFORATED.

3. THE COLLECTION SUMP WHICH EXTENDS TO THE CENTER OF THE CELL SHALL ONTAIN TWO 6" NOMINAL ø HDPE COLLECTOR PIPES. THE PIPES SHALL HAVE A MINIMUM WALL THICKNESS OF 0.39 INCHES, MAXIMUM SDR–17 RATED. PERFORATIONS SHALL BE AASHTO CLASS I PERFORATIONS–3 ROWS OF PERFORATIONS REQ'D (A TOTAL OF 6 PER FT OF PIPE). EACH PERFORATION 0.4" ø CIRCULAR AT 60' OFF CENTERLINE OF BOTTOM OF PIPE.

4. THE RETURN WATER SUCTION LINES SHALL BE HDPE PER THE FOLLOWING SPECS: 3FX–11: WPR 160 PSI (SDR11), PE3408 POLYETHYLENE RESIN, ASTM D3350 CELL CLASSIFICATION 345464C IN ACCORDANCE WITH ASTM F714.

5. THE TWO LEVEL INSTRUMENT LINES ARE FRP MATERIAL PER THE FOLLOWING SPECS: 3LX–10: ASTM D2996, FILAMENT WOUND RTRP TYPE 1, GRADE 2, CLASS E, PLAIN END.

CONCRETE COVER ENCAPSULATION NOTES:

1. THE CELLS SHALL BE DEWATERED OF ANY STANDING WATER TO FACILITATE CONSTRUCTION AND ENCAPSULATION OF THE RISER ASSEMBLY AND DISCHARGE PIPE WITH CONCRETE.

2. TO ENSURE THAT THE FIRST RISER JOINT IS NOT COVERED BY CONCRETE, THE RISER EXTENSION MAY BE INSTALLED PRIOR TO PLACEMENT OF THE CONCRETE COVER. IF IT BECOMES EVIDENT THAT THE CONCRETE COVER WILL INTERFERE WITH THE FIRST RISER PIPE EXTENSION JOINT THE CONCRETE MAY BE BLOCKED OUT AROUND THE EXTENSION JOINT TO ALLOW INSTALLATION OF THE RISER EXTENSION.

3. THE RISER ASSEMBLY AND DISCHARGE PIPE SHALL BE ENCAPSULATED WITH A 4000 PSI @ 28–DAY CONCRETE MIX.

4. CONCRETE TO SET 72 HOURS PRIOR TO PLACING CELL IN OPERATION.

5. TO PREVENT FLOTATION AND TO ELIMINATE BOW IN THE PIPE HOLD DOWN STRAPS SHALL BE INSTALLED AS SHOWN ON DRAWING E5C11036 PRIOR TO ENCAPSULATION WITH CONCRETE.

6. ALL JOINTS AND ANY POINTS OF POSSIBLE LEAKAGE BETWEEN THE HDPE CUSTOM TEE AND THE NYLOPLAST DRAIN BASINS SHALL BE SEALED WITH BITUMINOUS MASTIC, SEALANT AND/OR TAPE PRIOR TO ENCAPSULATING WITH CONCRETE

7. TIE–DOWN STRAPS TO BE LOCATED AT APPROXIMATE 3' SPACING ALONG THE DISCHARGE PIPE. STRAPS TO BE LOCATED WITHIN CORRUGATIONS AND ON EITHER SIDE OF ANY PIPE JOINTS.

8. FORMS MAY BE LEFT IN PLACE.

GRASSING – PERMANENT/TEMPORARY SEEDING

1. ALL DISTURBED AND/OR EXPOSED AREAS THAT WILL REMAIN EXPOSED FOR MORE THAN THREE MONTHS SHALL BE SEEDED, MULCHED AND FERTILIZED UPON REACHING FINAL GRADES.

2. AREAS OF STRUCTURAL FILL SHALL BE GRASSED UPON REACHING FINAL GRADES.

3. TOPSOIL SHALL BE PLACED TO A FINAL COVER THICKNESS OF 4 INCHES TO 6 INCHES ON AREAS THAT ARE REQUIRED TO RECEIVE GRASSING.

4. THE FOLLOWING SCHEDULE INDICATES THE RECOMMENDED SPECIES, PLANTING DATES, AND SEEDING RATES. THE AREAS SHALL BE SEEDED ACCORDING TO THE BEST MIX FOR PLANT BARRY VICINITY DURING THE TIME OF YEAR SEEDING APPLICATION SHALL OCCUR. UNLESS OTHERWISE SPECIFIED THE CONTRACTOR SHALL SUBMIT A PROPOSED MIX TO THE PURCHASER FOR APPROVAL BEFORE GRASSING OPERATIONS.

   FOR PLANTING BETWEEN FEBRUARY 1 AND NOVEMBER 1, SEED SHALL BE COMPOSED OF THE COMBINATION SHOWN BELOW TO YIELD A STAND OF DEEP ROOT COASTAL BERMUDA OR OTHER SEED MIX APPROVED BY THE PURCHASER:

| VARIETY | SEED PER ACRE(LBS) | SEEDING DATES |
|---|---|---|
| PENSACOLA BAHIA GRASS | 40 | FEB. 1 – NOV. 1 |
| COMMON BERMUDA GRASS | 10 | MARCH 1 – JULY 15 |
| PENSACOLA BAHIA GRASS &<br>COMMON BERMUDA GRASS | 30<br>5 | MARCH 1 – JULY 15 |
| SERICEA | 40–60 | FEB. 15 – JULY 15 |
| SERICA &<br>COMMON BERMUDA GRASS | 40–60<br>10 | FEB. 15 – JULY 15 |

   IN THE ABSENCE OF SOIL TEST DATA, THE FOLLOWING FERTILIZATION RATES SHALL BE USED:

| VEGETATION | N–P–K | FERTILIZER RATES PER ACRE |
|---|---|---|
| GRASS ALONE | 8–24–24 | 400 LBS |
| GRASS–LEGUME MIXTURE | 8–24–24 | 400 LBS |
| LEGUME ALONE | 0–20–20 | 500 LBS |

5. AFTER SEEDING, AN EROSION CONTROL BIODEGRADABLE STRAW BLANKET SHALL BE INSTALLED ON THE EXTERIOR (3:1) SLOPES OF THE DIKES.

6. THIS MATERIAL SHALL BE A BIONET S150BN DOUBLE NET STRAW BLANKET BY NORTH AMERICAN GREEN, OR APPROVED EQUAL.

7. THE BLANKET SHALL BE INSTALLED PER MANUFACTURER'S ISNTALLATION INSTRUCTIONS. HOWEVER, THE BLANKET SHALL BE TACKED AS NECESSARY TO THE GROUND TO WITHSTAND THE UPDWARD GROWTH OF GRASS AND TO PERMIT THE ESTABLISHMENT OF GRASS THROUGH THE BLANKET. FAILURE TO ACCOMPLISH THIS WILL REQUIRE THAT THE AFFECTED AREA TO BE RE–GRASSED AND REDONE TO THE SATISFACTION OF THE PCM.

8. FLATTER AREAS WHICH HAVE SLOPES LESS THAN 3:1 SHALL BE MULCHED WITH BAHIA HAY MULCH OR WITH OTHER SUITABLE MATERIAL.

9. WATER REQUIRED TO PROMOTE A SATISFACTORY GROWTH SHALL BE FURNISHED BY THE PURCHASER AND APPLIED BY THE CONTRACTOR.

GRADED AGGREGATE BASE

1. MATERIALS SHALL BE PLACED PER ALDOT SPECIFICATIONS GRADED AGGREGATE BASE TYPE A

ADVANCED PRINT

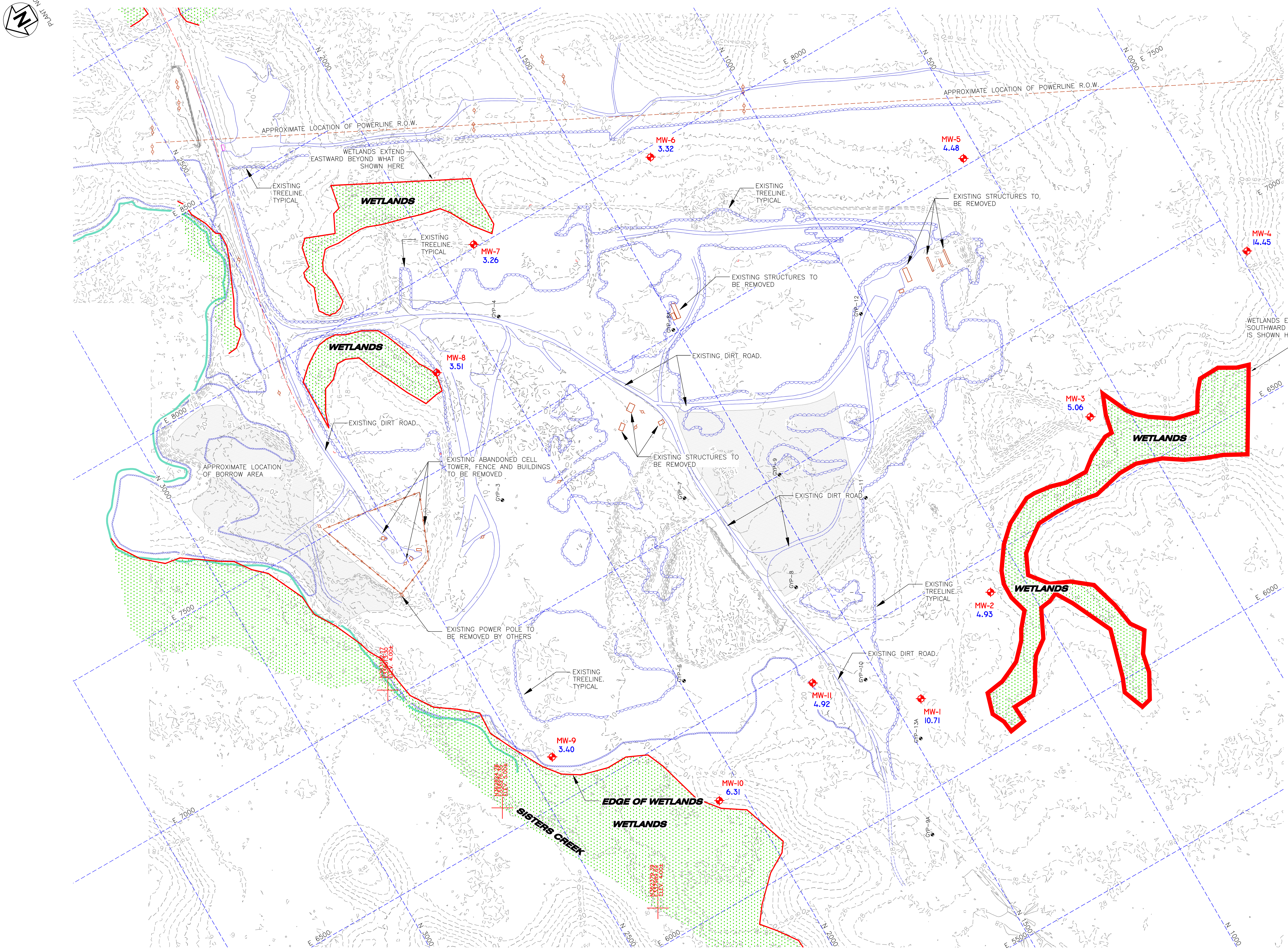
| REVISION | DATE | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 6 | 8–14–09 | A. F–8 ADDED SHEET E5C11054<br>EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 5 | 7–02–09 | A. F–8 ADDED SHEETS E5C11052 AND E5C11053<br>B. G–4 UPDATED NOTES FOR VEHICULAR SWING GATE<br>C. D–2 ADDED NOTE FOR GRADED AGGREGATE BASE<br>D. H–4 UPDATED FLOWABLE FILL SPECS<br>EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | 4–27–09 | A. G–8 CHANGED DRAWING E5C11036 TITLE<br>B. F–8 ADDED STRUCTURAL DRAWING E5C12122<br>C. C–6 CHANGED CONCRETE AND METAL LINING SYSTEM NOTE 1<br>D. G–3 CHANGED DECANT PIPE AND RISER STRUCTURE NOTES<br>EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 3–5–09 | A. G–8 UPDATED CIVIL DRAWING LIST<br>B. F–8 UPDATED MECHANICAL DRAWING LIST<br>C. E–8 ADDED ELECTRICAL DRAWING LIST<br>D. B–5 ADDED CONCRETE LINING SYSTEM NOTES<br>E. C–4 ADDED CONCRETE COVER ENCAPSULATION NOTES<br>F. F–6 REVISED NOTE 2 PERTAINING TO GEOCOMPOSITE DRAINAGE NET<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11–14–08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 04–11–08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12–3–07 | ISSUED FOR CONSTRUCTION | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

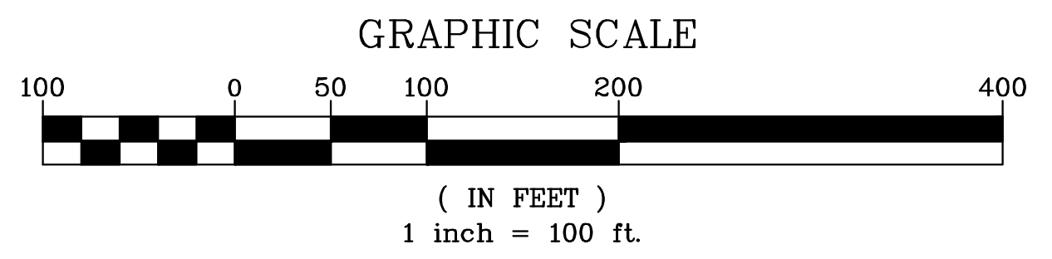
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1
DRAWING INDEX, NOTES AND SPECIFICATIONS

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N/A | | **E5C11030** | 1 | FINAL | 6 |

ANSI E: 44x34 Acad2004



# EXISTING TOPO-PRECONSTRUCTION



LEGEND:

- ● BORING LOCATIONS
- ● MW-1 10.71 MONITORING WELLS

NOTES:

1. GRIDLINES SHOWN ARE IN PLANT GRID.

| REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION 2 | DATE 11-14-08 | REVISION 1 | DATE 04-11-08 | REVISION 0 | DATE 12-3-07 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION<br>EWO 2161DE | | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION<br>EWO 2161DE | | ISSUED FOR CONSTRUCTION<br>EWO 2161DE | |

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1
EXISTING TOPO – PRECONSTRUCTION

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=100' | | **E5C11031** | 1 | FINAL | 2 |

ANSI E: 44x34 Acad2004

# GENERAL ARRANGEMENT AND SITE PLAN

NOTES:

1. GRID LINES AND COORDINATES SHOWN ARE IN PLANT GRID.

LEGEND:

| | |
|---|---|
| ⯁ MW-1 10.71 | MONITORING WELLS |

**ADVANCED PRINT**

| REVISION | DATE | | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| 5 | 08-14-09 | A. C-4 CHANGED GAB TO 12"<br>B. G-6 ADDED GYPSUM MARKDET LOADING AREA AND GYPSUM MARKET STACKING AREA | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | 07-02-09 | A. G-7 ADDED GYPSUM MARKET LOADING AREA<br>B. E-6 ADDED ALDOT STANDARD GUARDRAIL | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 03-05-09 | A. G-7 ADDED ELECTRICAL DUCT | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
GENERAL ARRANGEMENT AND SITE PLAN
CELL NO. 1 THROUGH CELL NO. 3

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=100' | | E5C11032 | 1 | FINAL | 5 |

ANSI E: 44x34 Acad2004

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

GRAPHIC SCALE
50 0 25 50 100 200
( IN FEET )
1 inch = 50 ft.

NOTES:

1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| 5 | 08-14-09 | A. A-7, E-8, H-8, ADDED SOUTH EVACUATION ROAD NOTE<br>B. H-8, CHANGED RADIUS<br>C. F-5 ADDED GYPSUM MARKET STACKING AREA<br>D. G-3, G-5 REVISED SPILLWAY COORDINATES AND ELEVATIONS | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | 07-02-09 | A. G-6, H-1 ADDED GYPSUM MARKET LOADING AREA<br>B. G-6, C-6, C-7 ADDED GUARDRAIL<br>C. G-5 CHANGED SPILLWAY LOCATION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 03-05-09 | A. D-6 ADDED PIPE SLEEVES AND PIPING<br>B. G-6 ADDED ELECT DUCT RUN<br>C. H-4 ADDED PIPES, CONCRETE PAD, AND GUARDPOSTS<br>D. B-6 ADDED ELECT DUCT RUN<br>E. C-6 ADDED PIPE SLEEVE AND PIPING | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 4-11-08 | ISSUED FOR CONSTRUCTION GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1–DETAIL PLAN FOR INITIAL
DIKE CONSTRUCTION

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=50' | | E5C11033 | 1 | FINAL | 5 |

ANSI E: 44x34 Acad2004

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

**ADVANCED PRINT**

NOTES:

1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

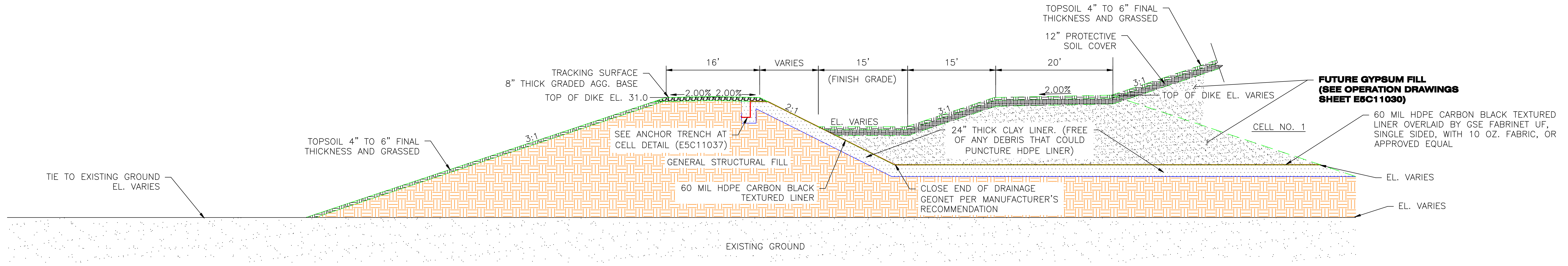
| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| 5 | 08-14-09 | A. B-2 CHANGED GAB TO 12"<br>B. C-3, E-6, F-8, ADDED SOUTH EVACUATION NOTE.<br>C. D-5, CHANGED SECTION C-C TO C'-C'<br>D. E-2, REVISED DISTANCE TO CL<br>E. H-7, ADDED GYPSUM MARKET STACKING AREA | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | 07-02-09 | A. C-4, F-7 ADDED GUARDRAIL AND SWING GATE | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 03-05-09 | A. G-7 ADDED PIPE SLEEVES AND PIPING<br>B. H-7 ADDED ELECT DUCT RUN<br>C. B-6 ADDED ELECT DUCT RUN<br>D. F-7 ADDED ELECT DUCT RUN AND EDITED NOTE<br>E. F-8 ADDED PIPE SLEEVE AND PIPING | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-03-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

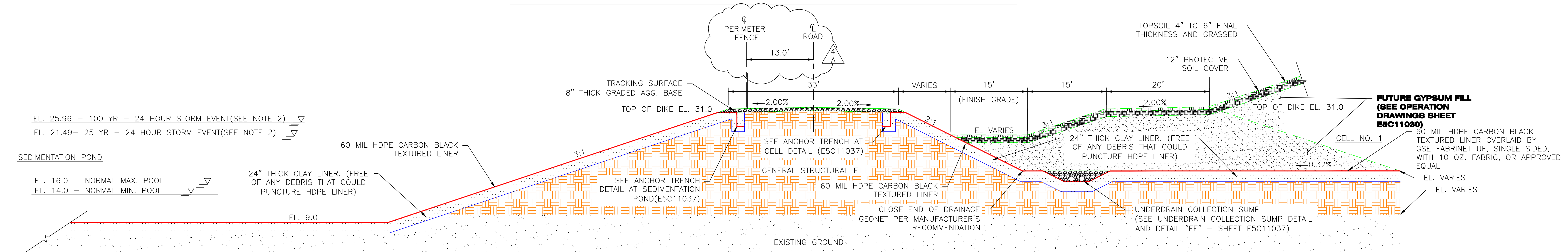
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1–SEDIMENTATION POND DETAIL PLAN
FOR INITIAL DIKE CONSTRUCTION

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=50' | | E5C11034 | 1 | FINAL | 5 |

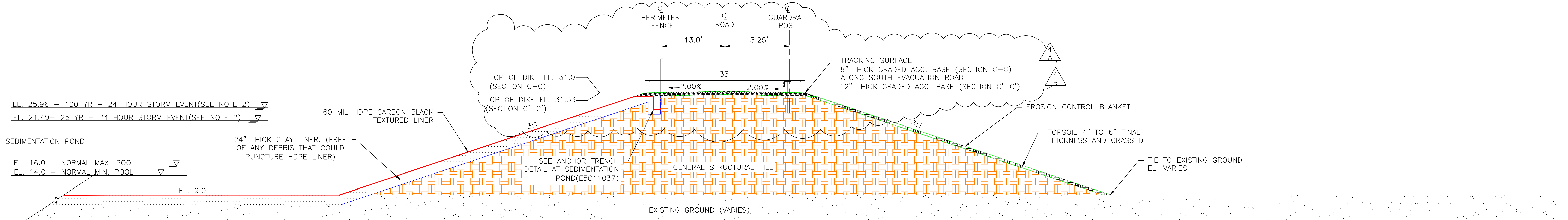
ANSI E: 44x34 Acad2004



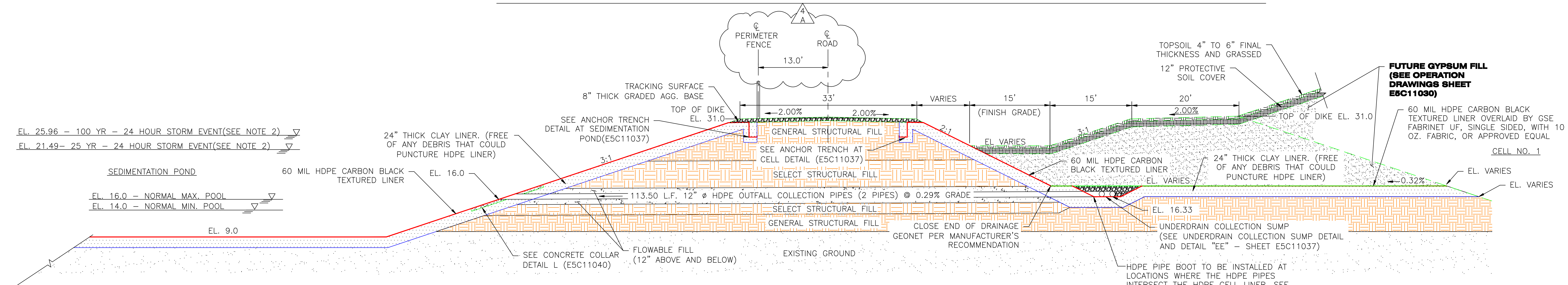
## SECTION A-A(E5C11033)
## TYPICAL DIKE SECTION THROUGH CELL



## SECTION B-B(E5C11033)
## TYPICAL DIKE SECTION THROUGH SEDIMENTATION POND



## SECTION C-C AND SECTION C'-C' (E5C11034)
## TYPICAL DIKE SECTION THROUGH SEDIMENTATION POND



## SECTION K-K(E5C11033 AND E5C11034)
## OUTFALL COLLECTION PIPES

NOTES:

1. FOR DESCRIPTION AND CLASSIFICATION OF GENERAL STRUCTURAL FILL, SELECT STRUCTURAL FILL AND CLAY LINER MATERIAL SEE TECHNICAL SPECIFICATIONS.
2. STORM WATER ELEVATION BASED ON COMBINED RUNOFF FROM CELLS 1 AND FUTURE CELL 2 AND 3, ASSUMING NO PUMP DISCHARGE.

REFERENCES:

1. FOR A COMPLETE DRAWING LIST SEE DRAWING E5C11030.
2. SEE TECHNICAL SPECIFICATION, SECTION 31 FOR CONSTRUCTION OF CELL 1, SEDIMENTATION POND OF THE GYPSUM STORAGE AREA AND EMERGENCY GYPSUM SLURRY POND.

ADVANCE PRINT

| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| REVISION | DATE | | | | | | | | | |
| REVISION | DATE | | | | | | | | | |
| REVISION | DATE | | | | | | | | | |
| REVISION 4 | 8-14-09 | A. C-5, E-4, F-4 ADDED FENCE AND GUARDRAIL WITH DIMENSIONS<br>B. E-4, ADDED SECTION C'-C' AND REVISED TOP OF DIKE ELEVATION. | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 3 | 3-5-09 | A. B-3 ADDED PIPE BOOT<br>B. C-8 , D-8, F-8 STORM EVENT ELEVATIONS ADJUSTED FOR INCREASED POND VOLUME | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| REVISION 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

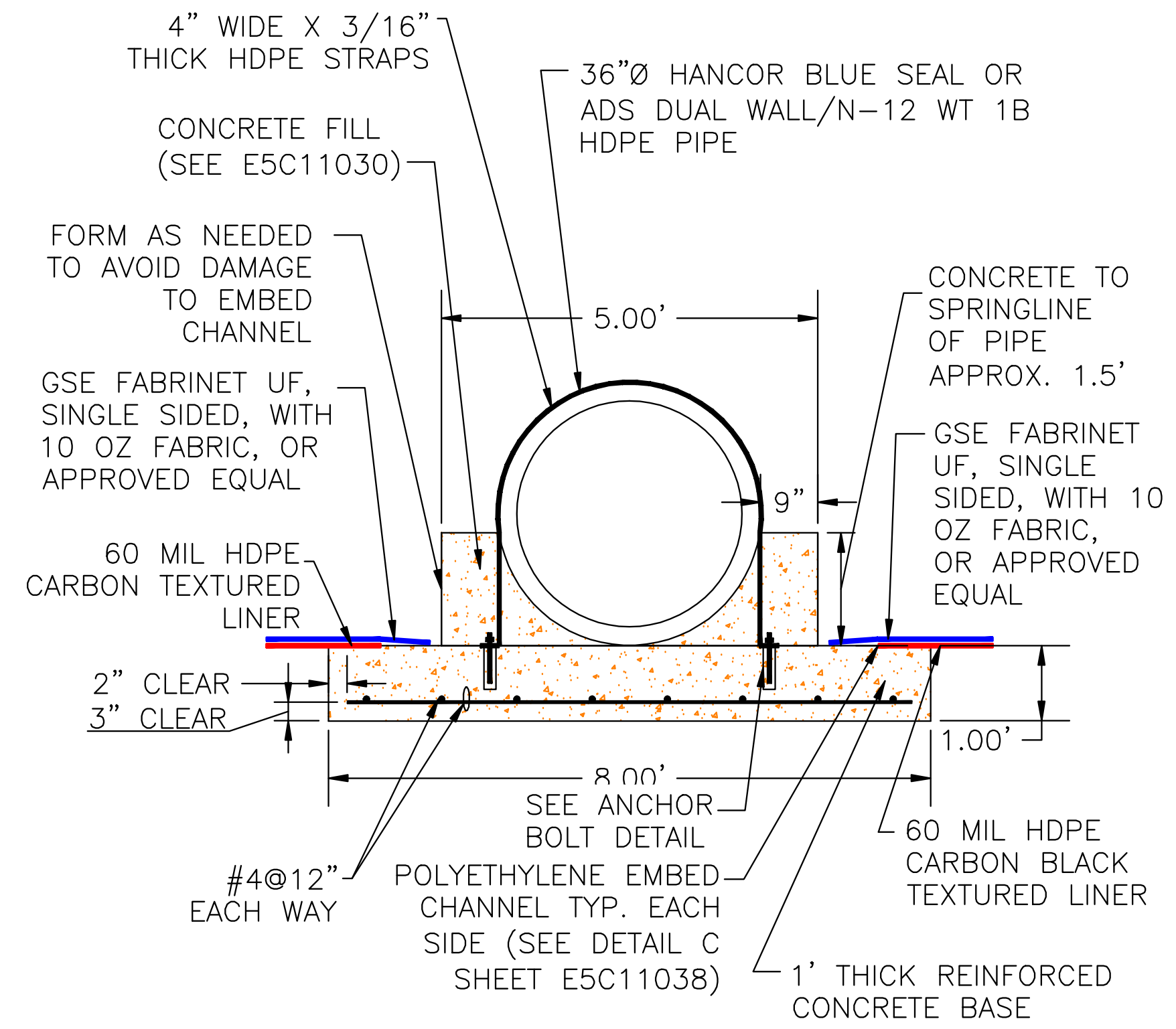
**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 – TYPICAL SECTIONS

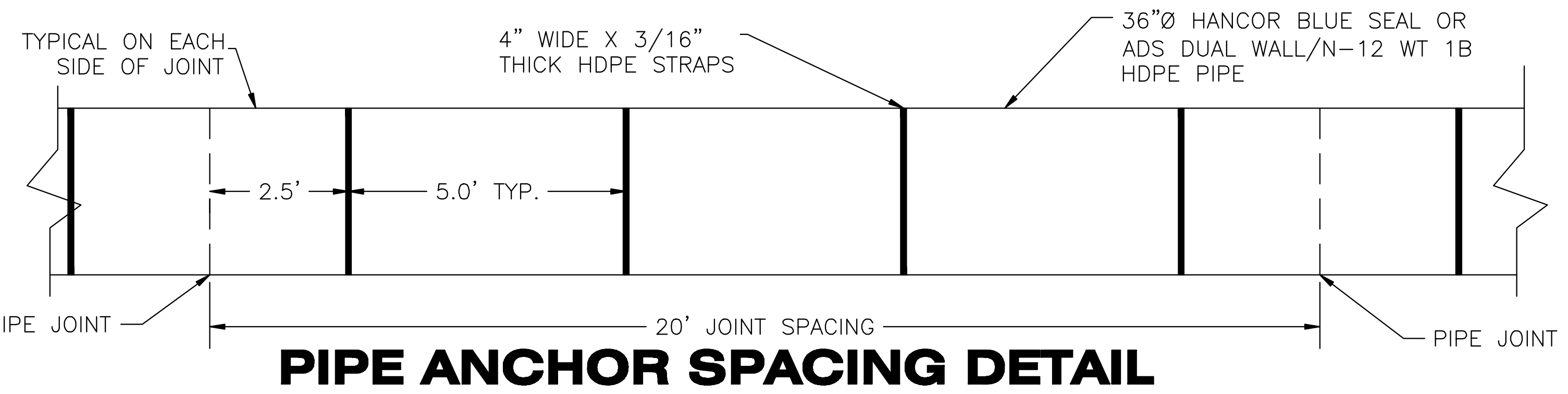
| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N.T.S. | | E5C11035 | 1 | FINAL | 4 |

ANSI E: 44x34 Acad2004

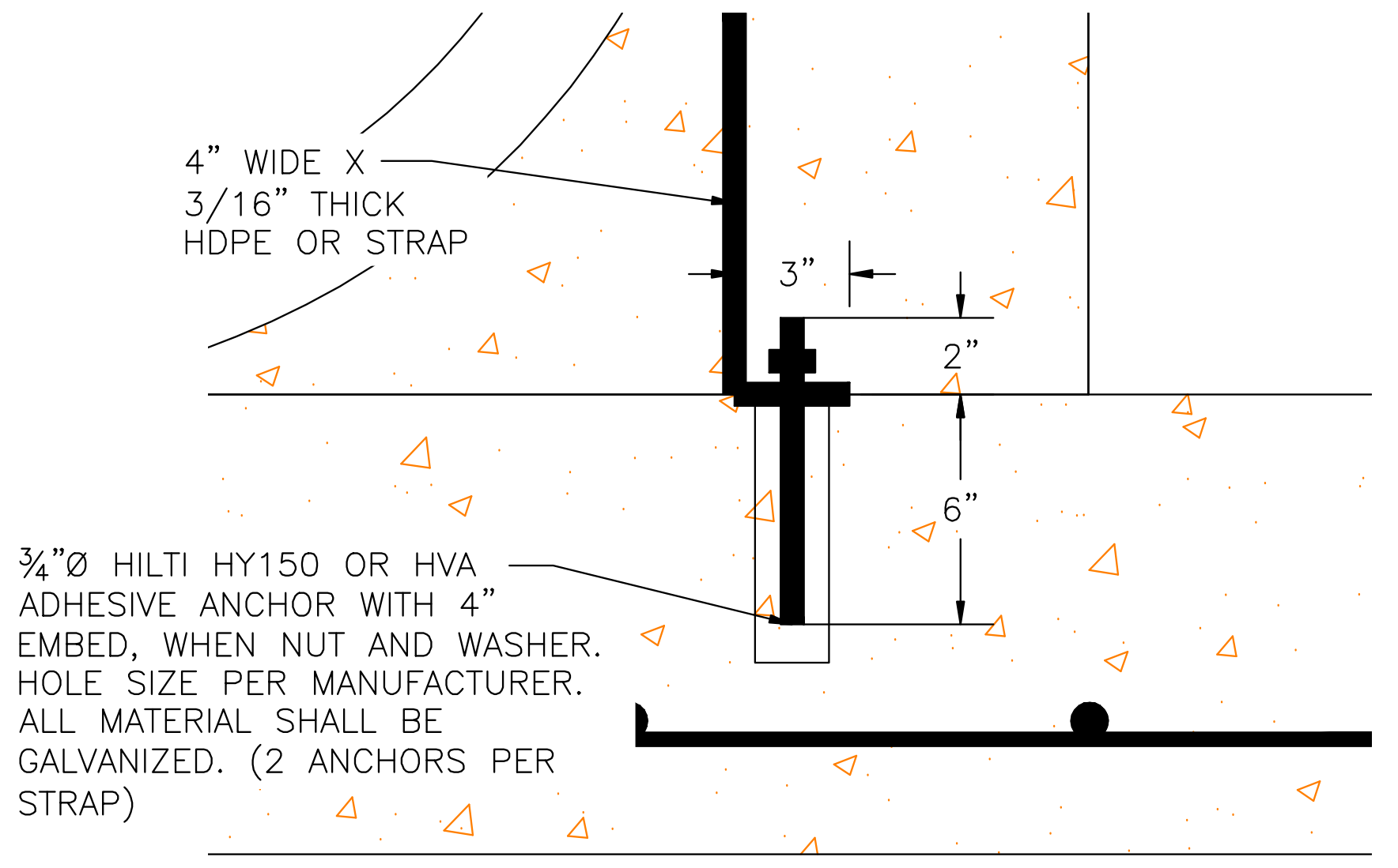
## SECTION E-E(E5C11033)
## CELL NO. 1 RISER STRUCTURE AND DECANT PIPE
## N.T.S.



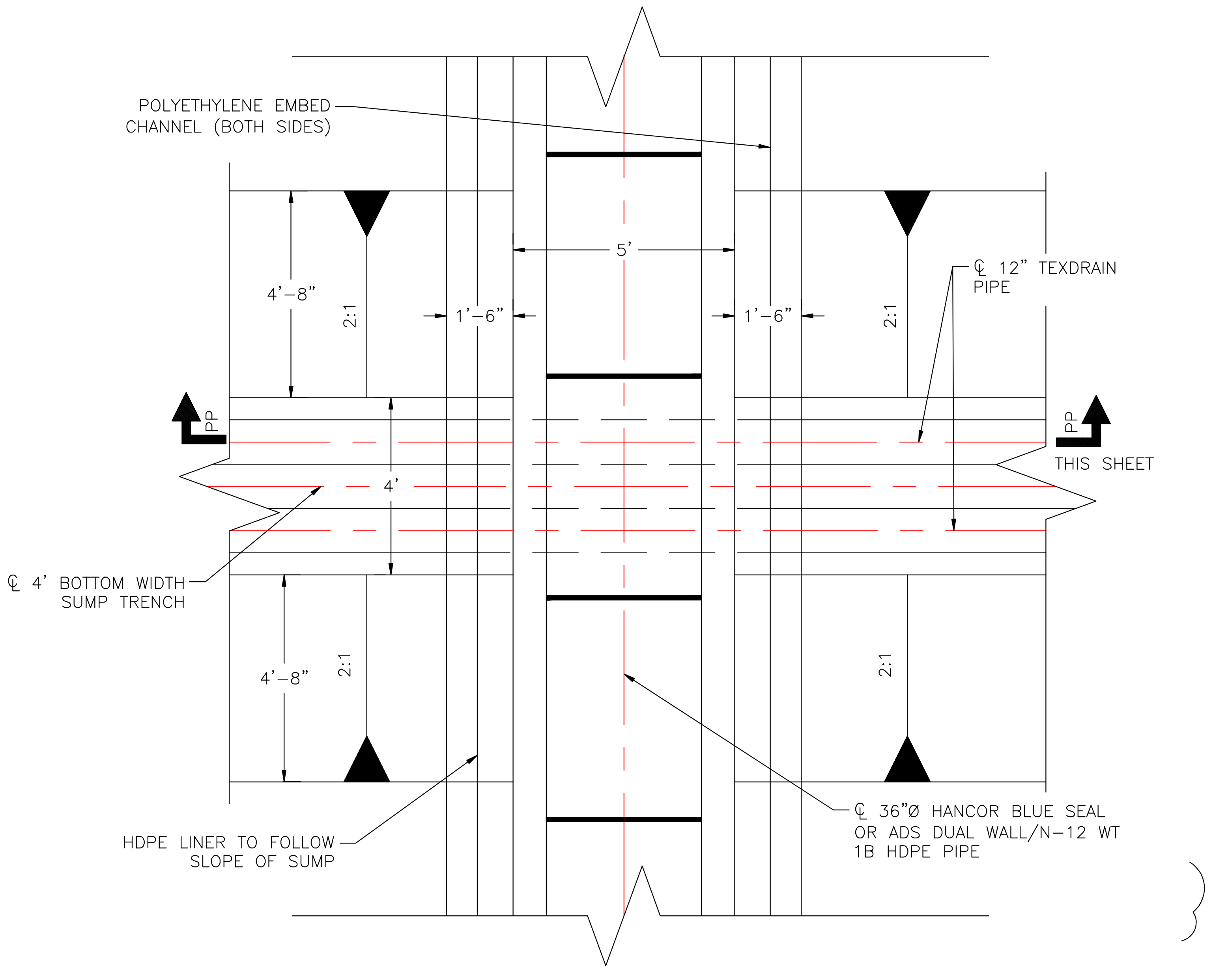
## DETAIL A
## PIPE ANCHOR DETAIL
## N.T.S.



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

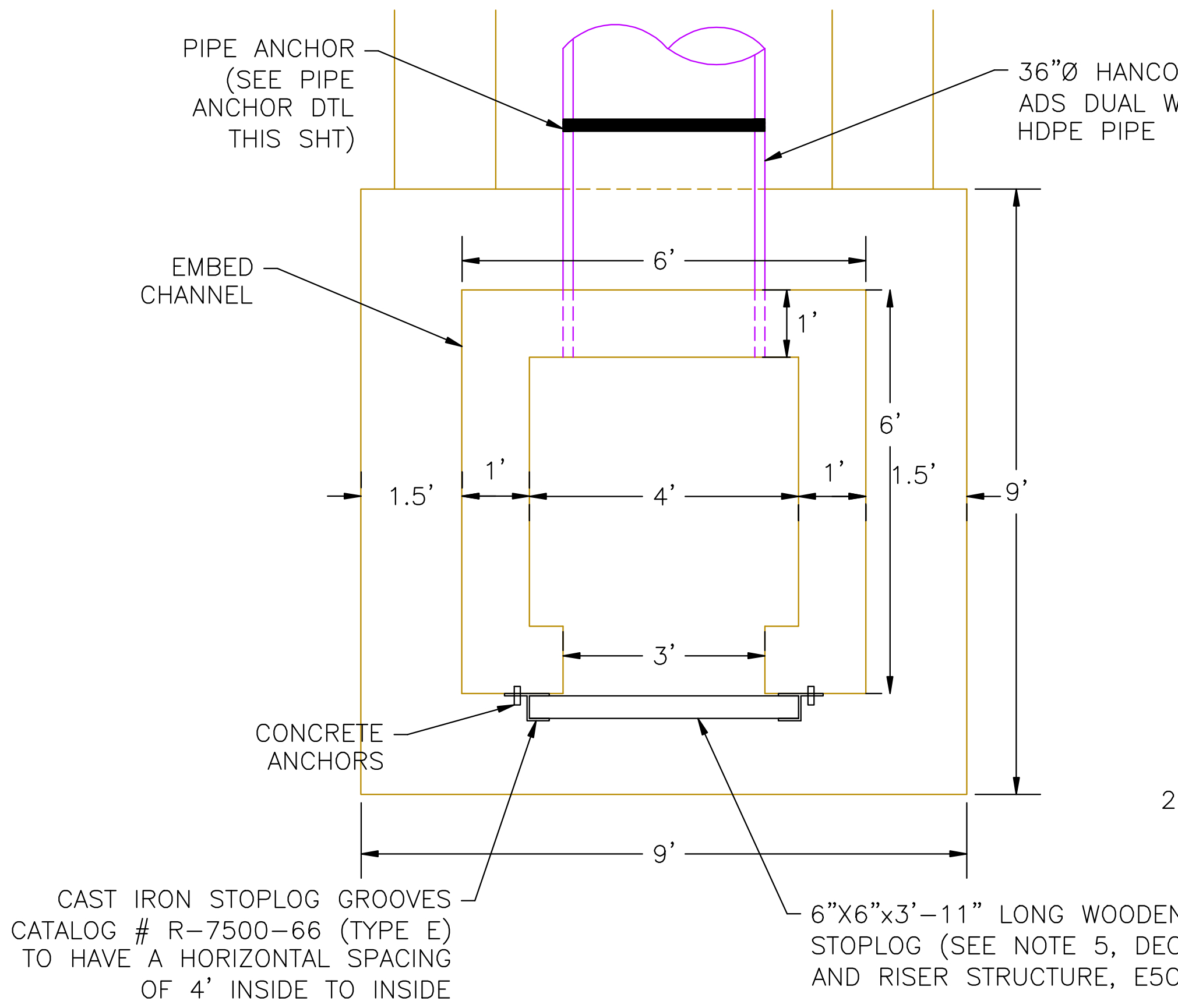


## ANCHOR BOLT DETAIL
## N.T.S.

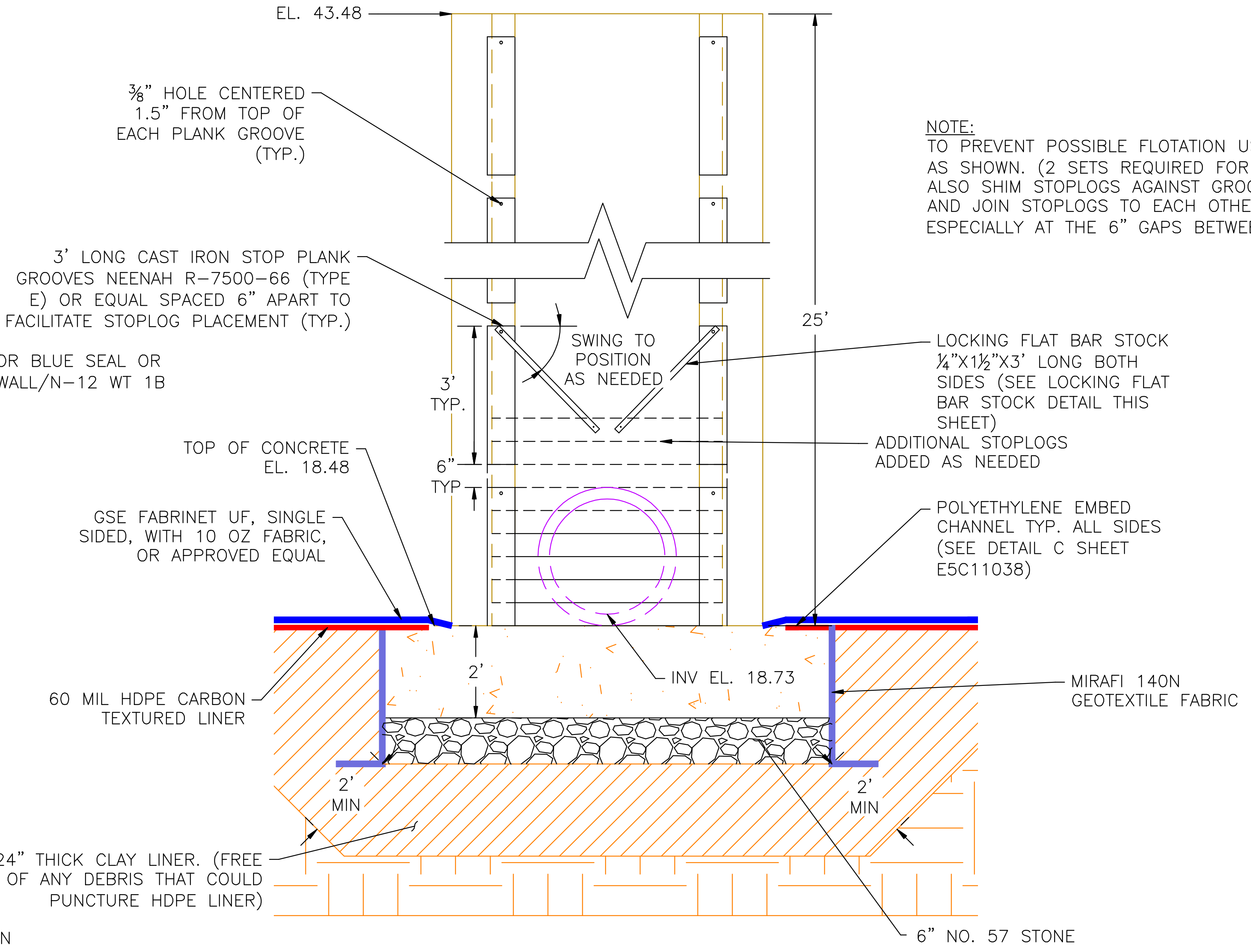


## SUMP/DECANT PIPE CROSSING PLAN VIEW
## N.T.S.

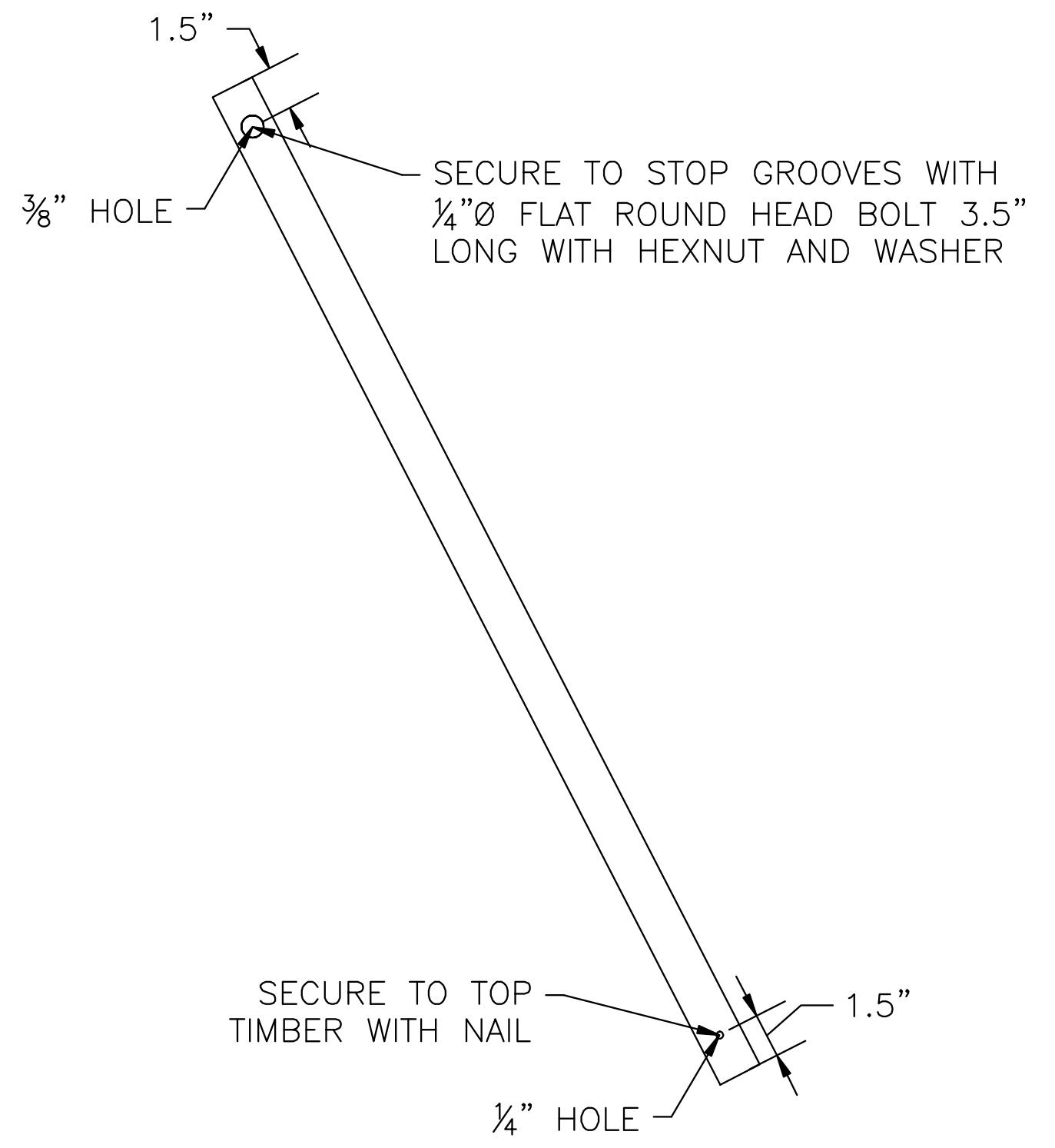
NOTE:
TO PREVENT POSSIBLE FLOTATION USE LOCKING FLAT BAR STOCK AS SHOWN. (2 SETS REQUIRED FOR ALTERNATING PLACEMENT), ALSO SHIM STOPLOGS AGAINST GROOVES TO PREVENT MOVEMENT AND JOIN STOPLOGS TO EACH OTHER WHERE NEEDED, ESPECIALLY AT THE 6" GAPS BETWEEN PLANK GROOVES



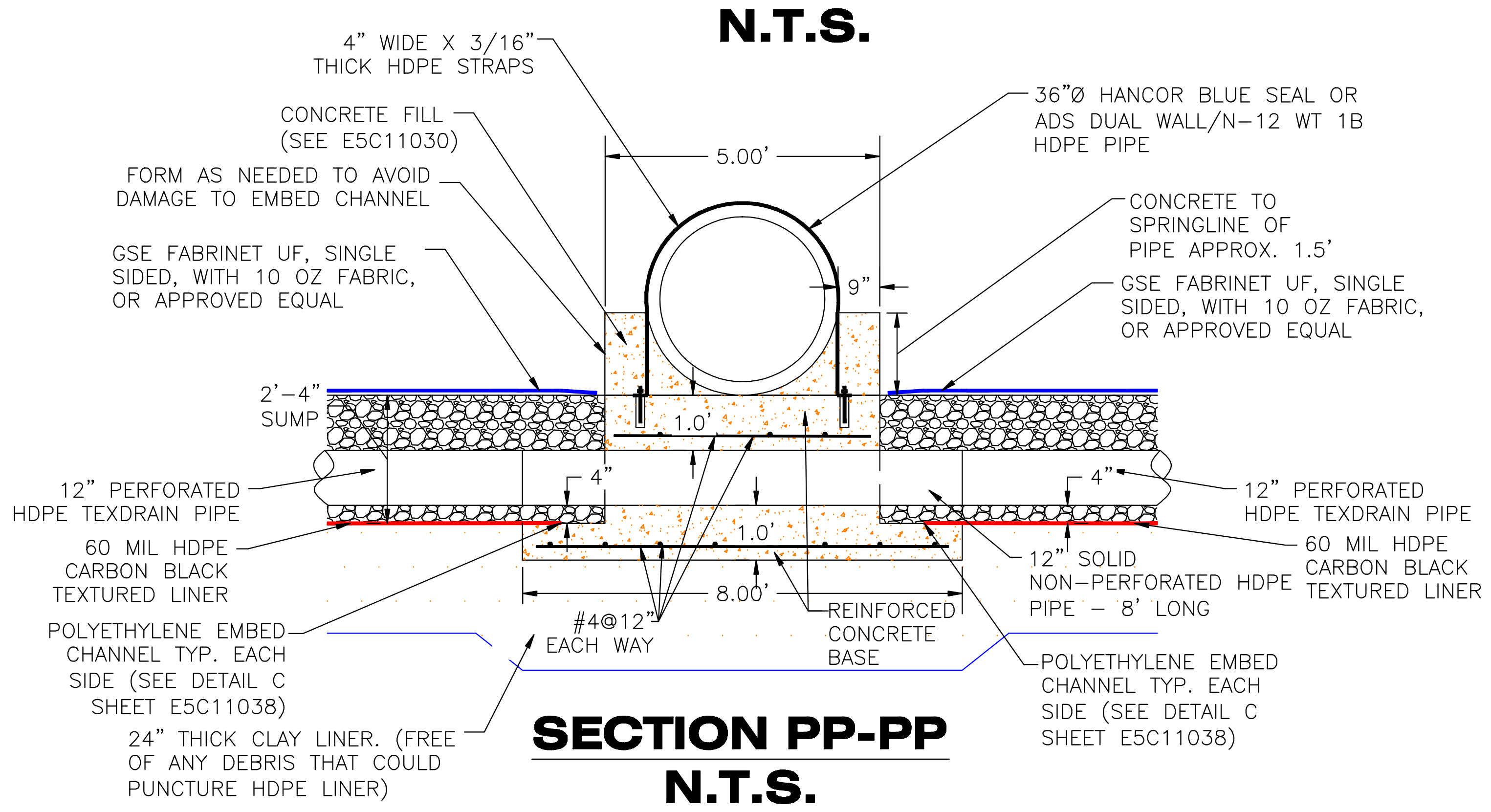
## RISER STRUCTURE PLAN
## N.T.S.



## RISER STRUCTURE SECTION
## N.T.S.



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



## SECTION PP-PP
## N.T.S.

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

**ADVANCED PRINT**

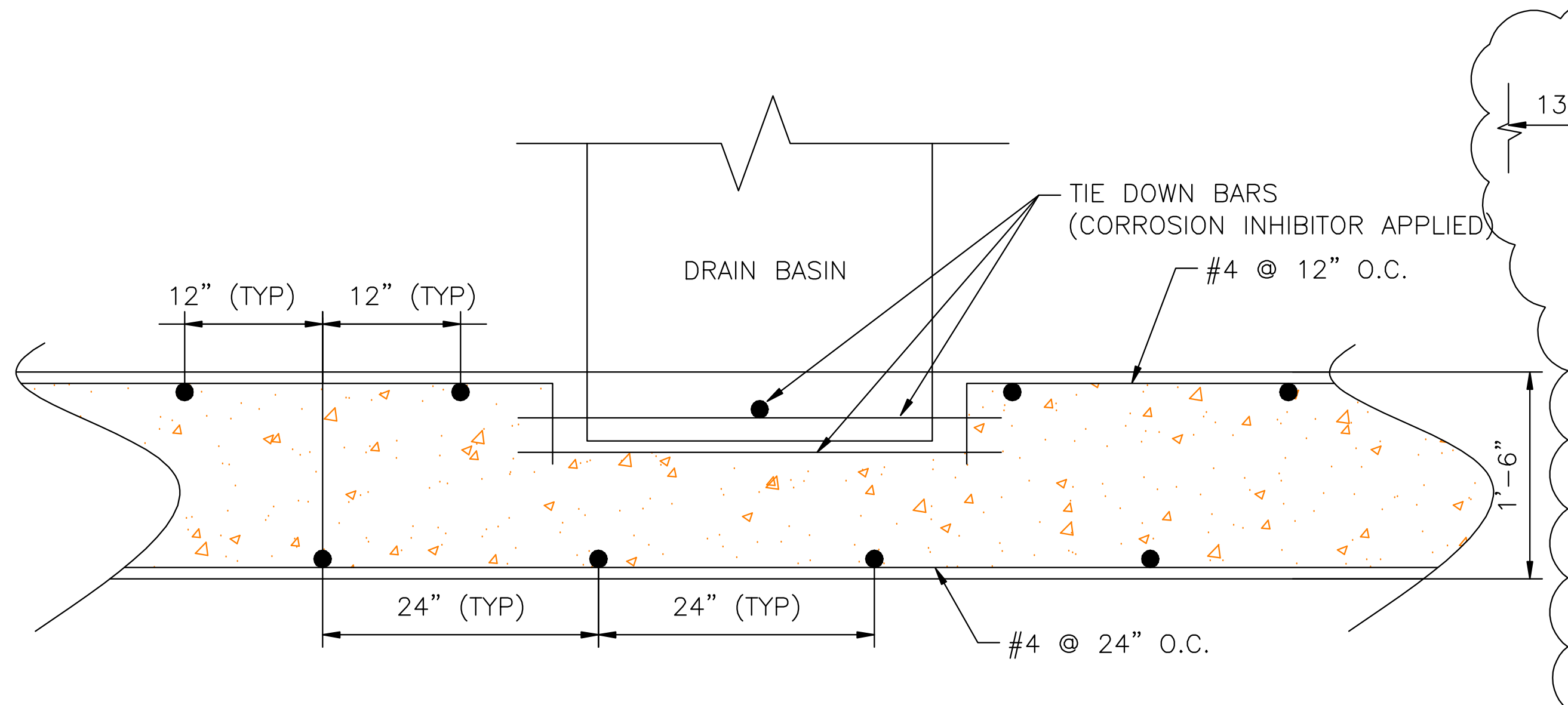
**Southern Company Generation Engineering and Construction Services**
FOR
**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 – SECTIONS AND DETAILS
RISER STRUCTURE AND DECANT PIPE

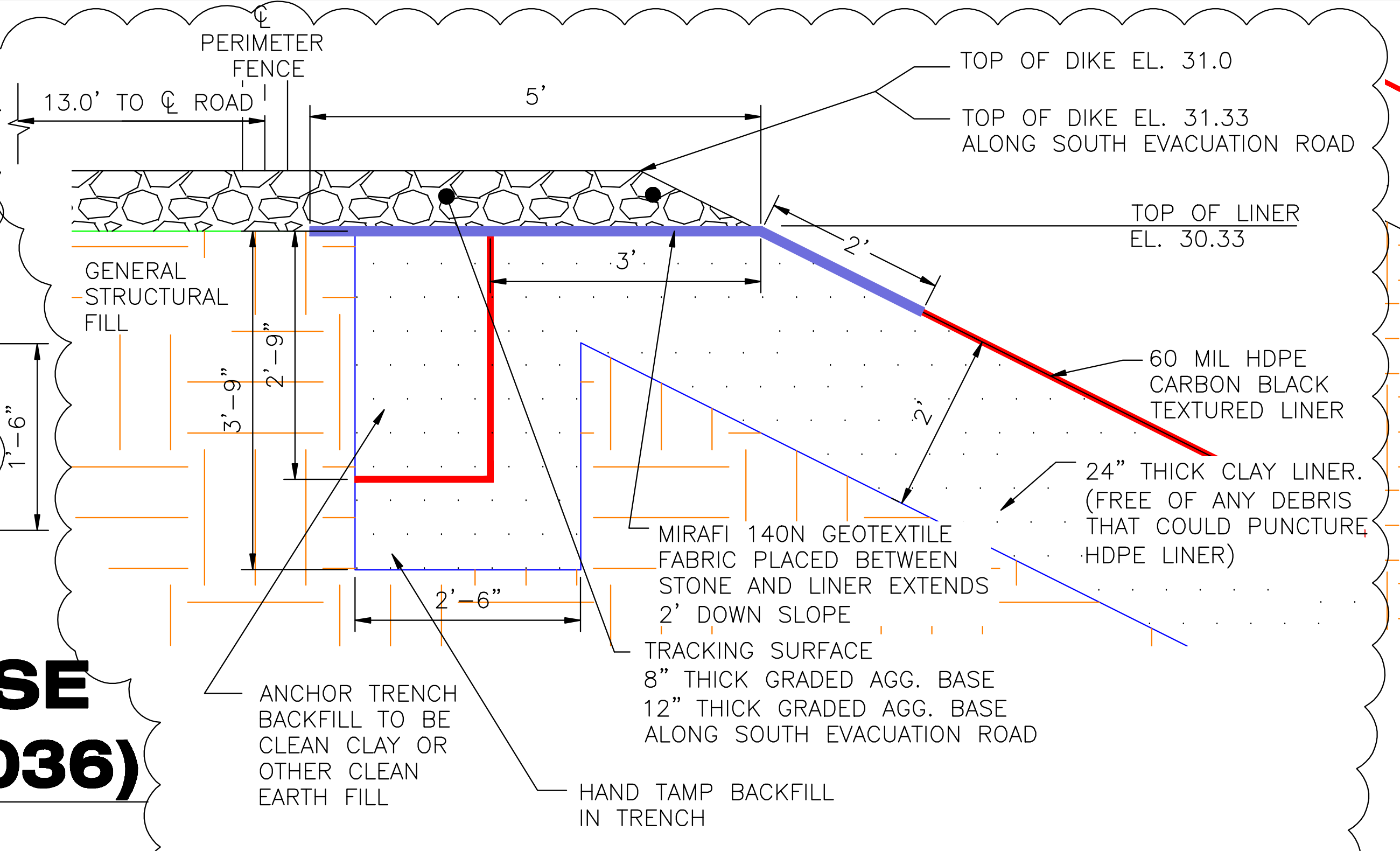
| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| 5 | 8-14-09 | A. H-3 ADDED PERIMETER FENCE | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | 4-27-09 | GENERAL REVISION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 03-05-09 | A. G-3 , F-7, F-8, E-5 REVISED SECTION D-D AND E-E TO SHOW CONCRETE COVER AND NOT FLOWABLE FILL ABOVE CUSTOM TEE, AND REVISED ELEVATIONS OF NYLOPLAST DRAIN BASINS TOPS AND PVC EXTENSIONS. ADDED COATING NOTE.<br>B. B-1 ADDED NOTE ON ANCHOR BOLT DETAIL<br>C. ADDED SECTION PP-PP AND SUMP/DECANT PIPE CROSSING PLAN VIEW | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N/A | | **E5C11036** | 1 | FINAL | 5 |

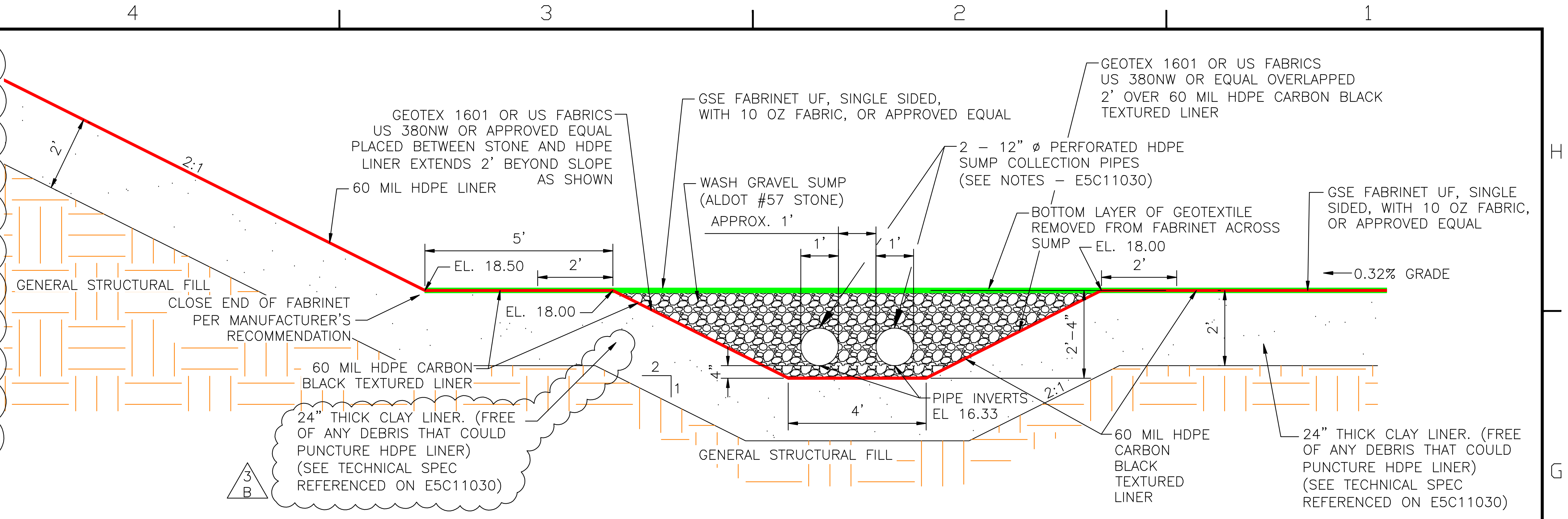
ANSI E: 44x34 Acad2004



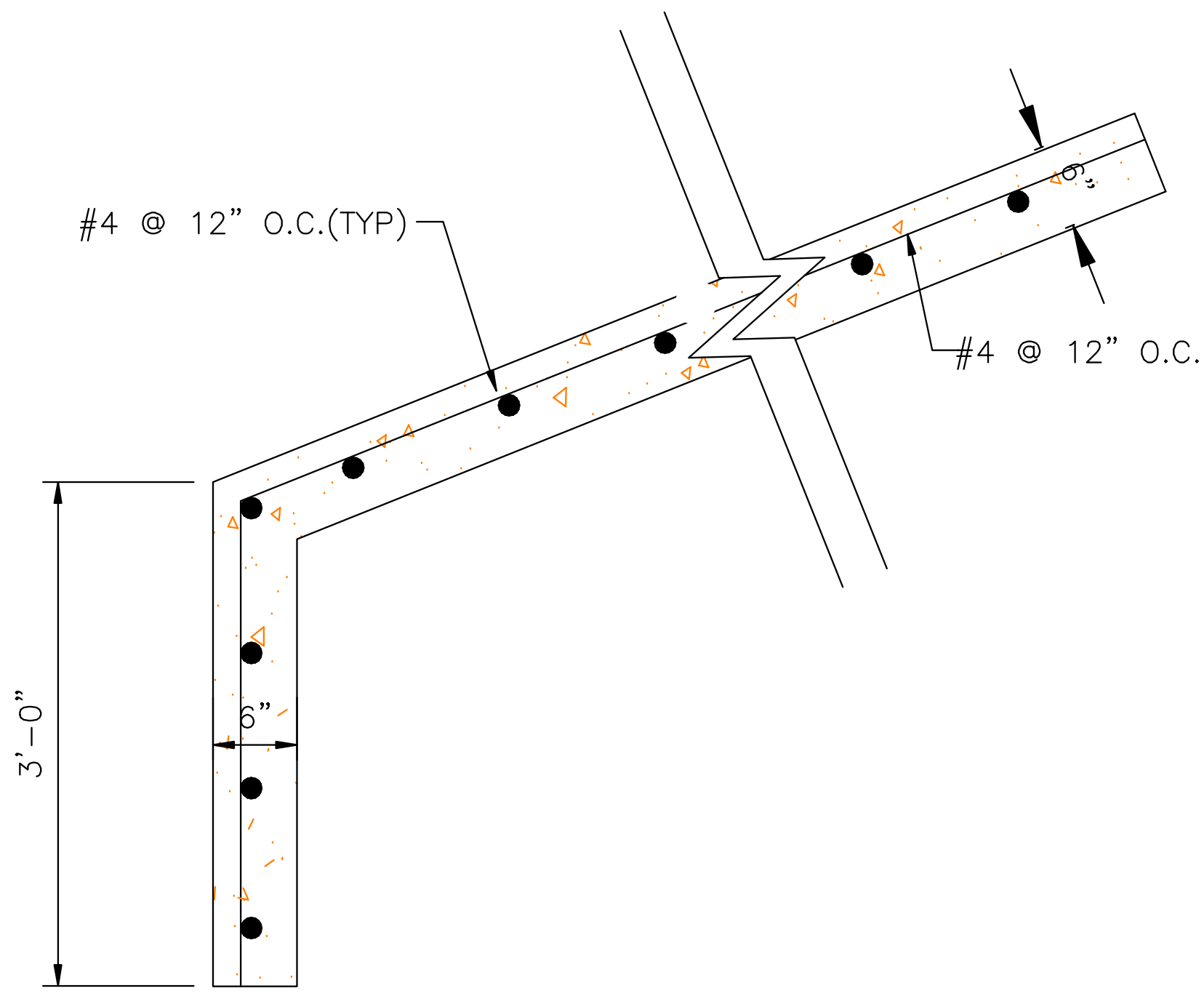
## RISER ASSEMBLY CONCRETE BASE TYP REINFORCING DETAIL (EC511036)



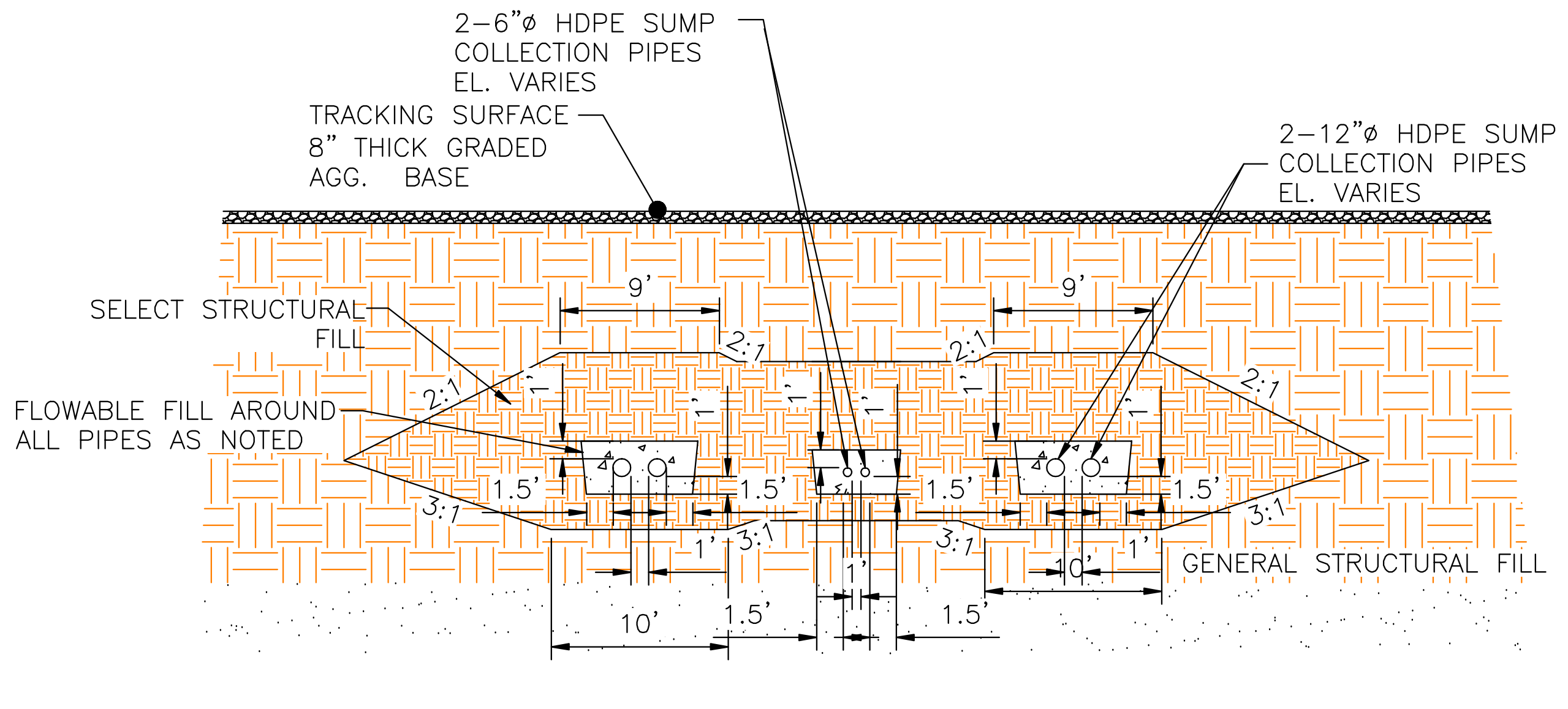
## ANCHOR TRENCH DETAIL AT SEDIMENTATION POND



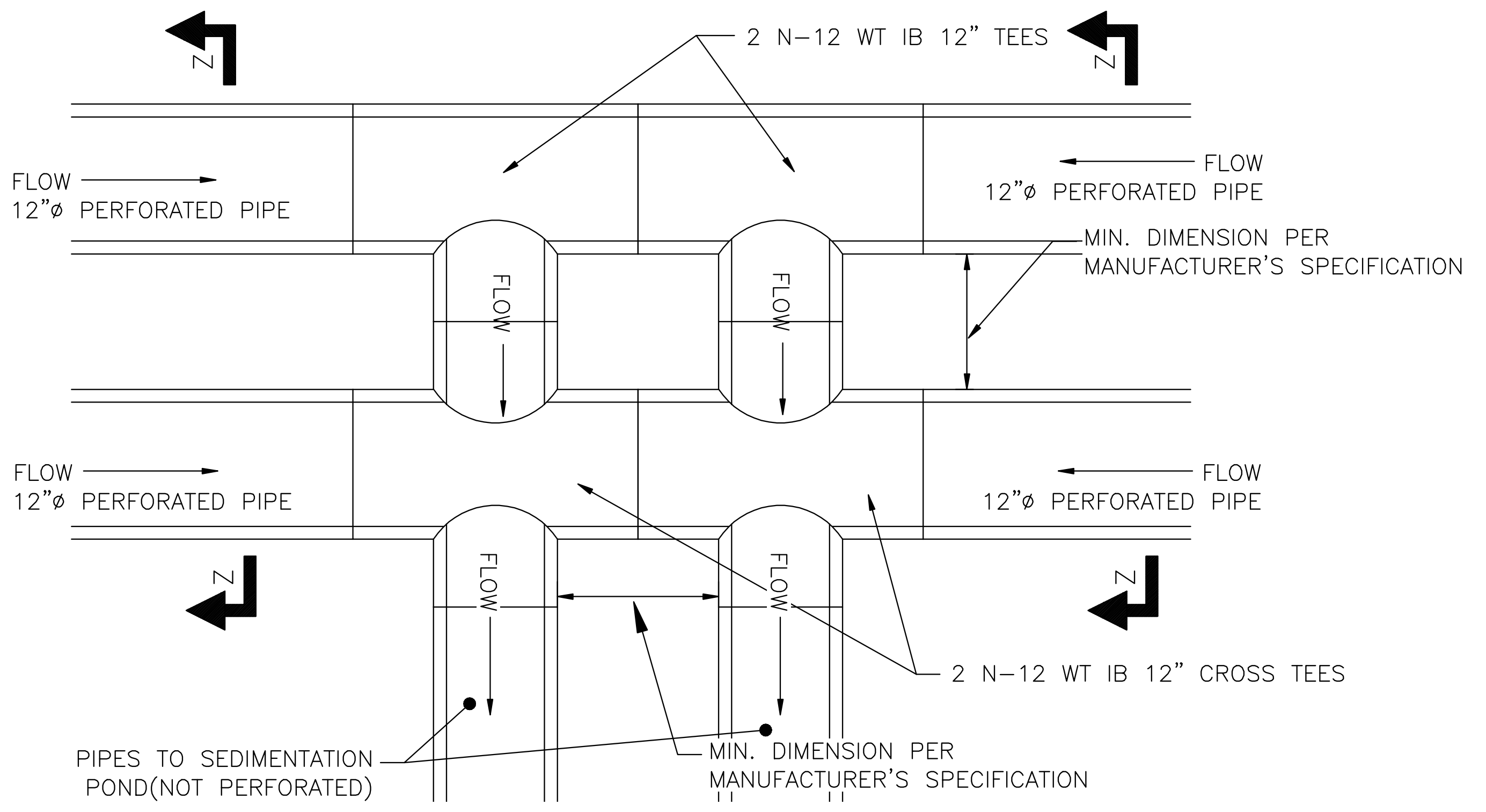
## UNDERDRAIN COLLECTION SUMP DETAIL



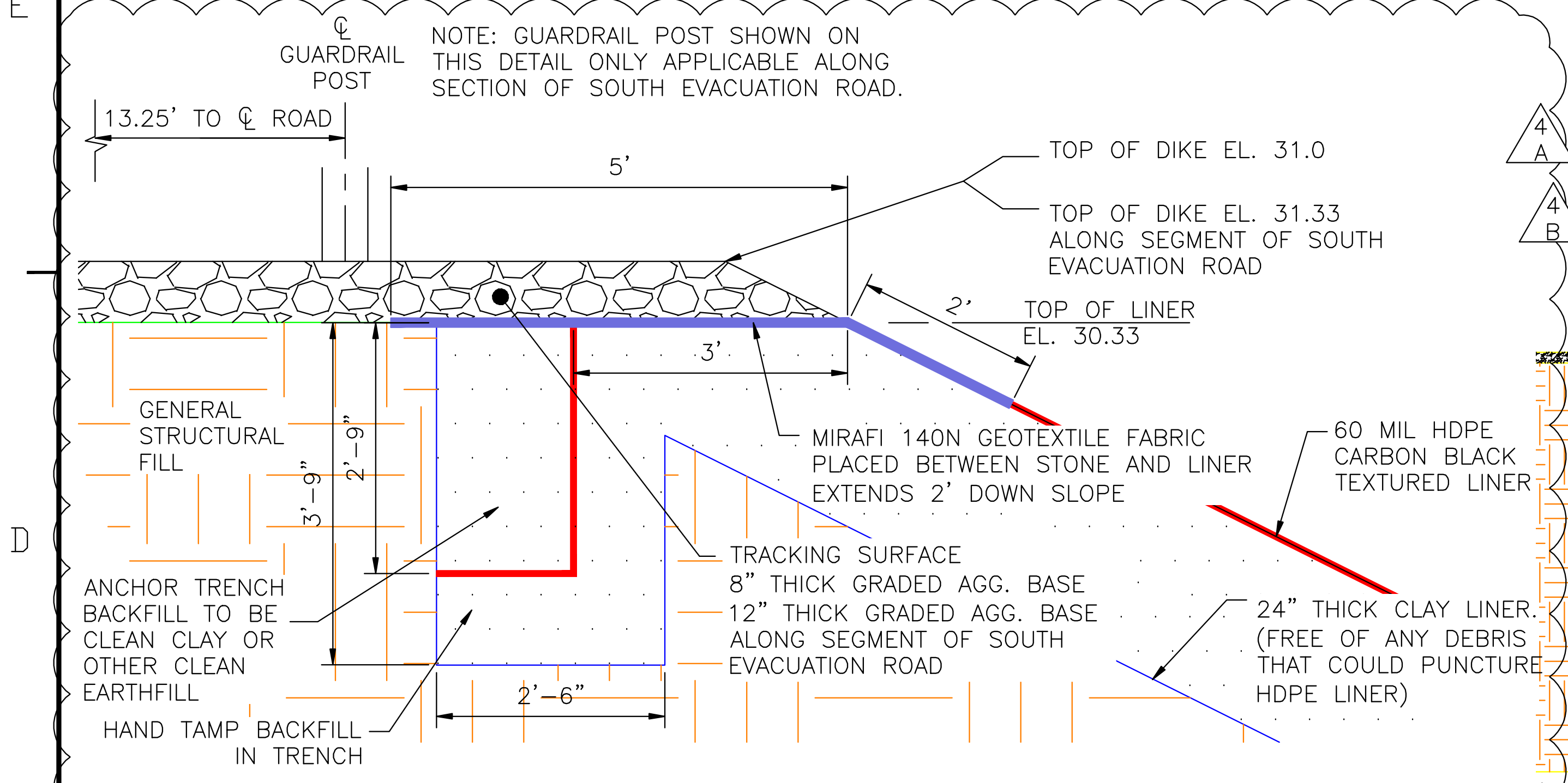
## CONCRETE HEADWALL/COLLAR TYP REINFORCING DETAIL (E5C11036)



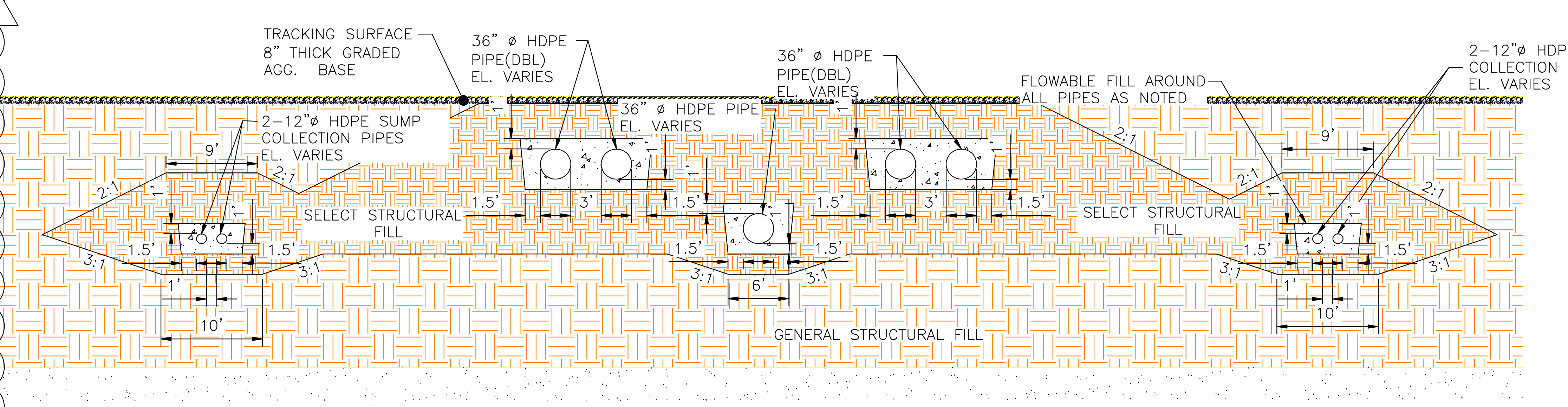
## SECTION H-H(E5C11033)
## OUTFALL COLLECTION PIPES



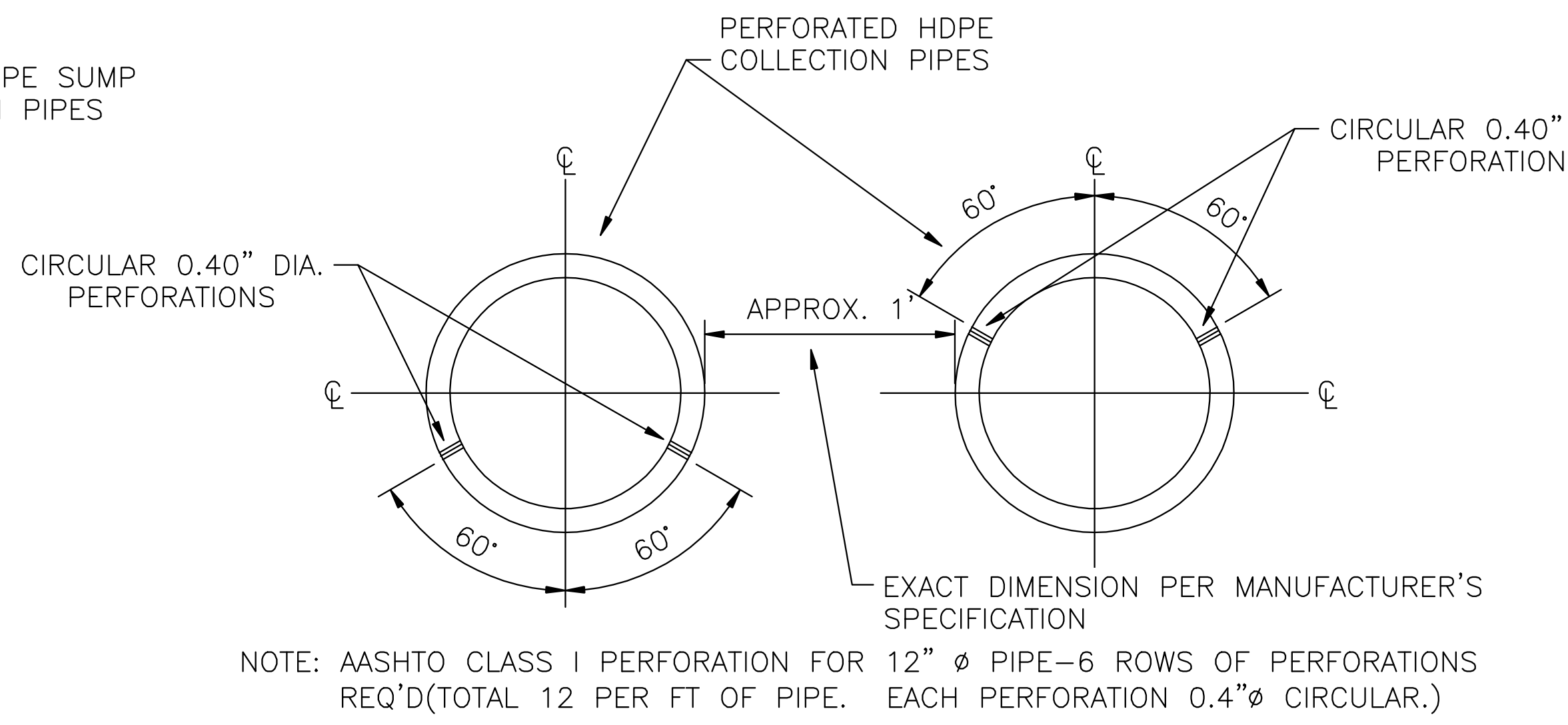
## DETAIL "EE"
## OUTFALL COLLECTOR PIPE JUNCTION DETAIL(4 PLACES)(E5C11033 AND E5C11035)



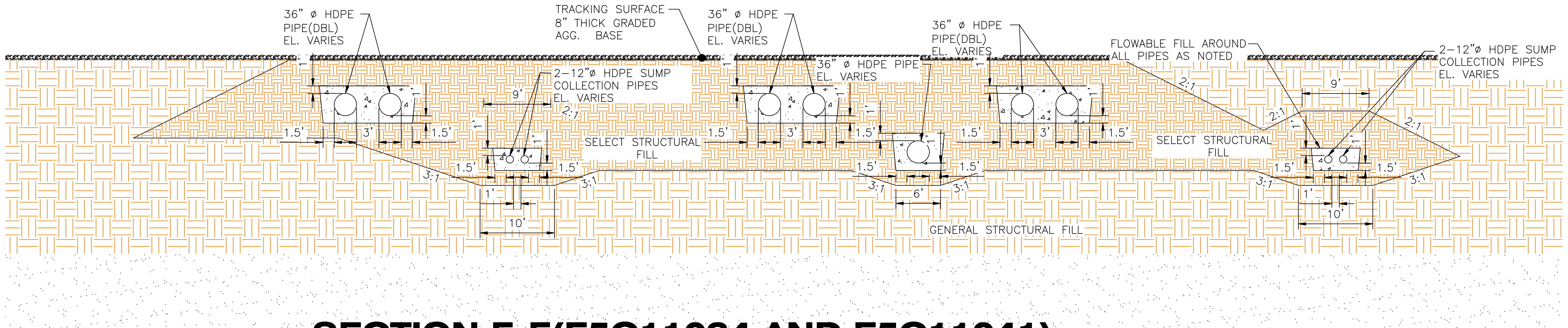
## ANCHOR TRENCH DETAIL AT CELL



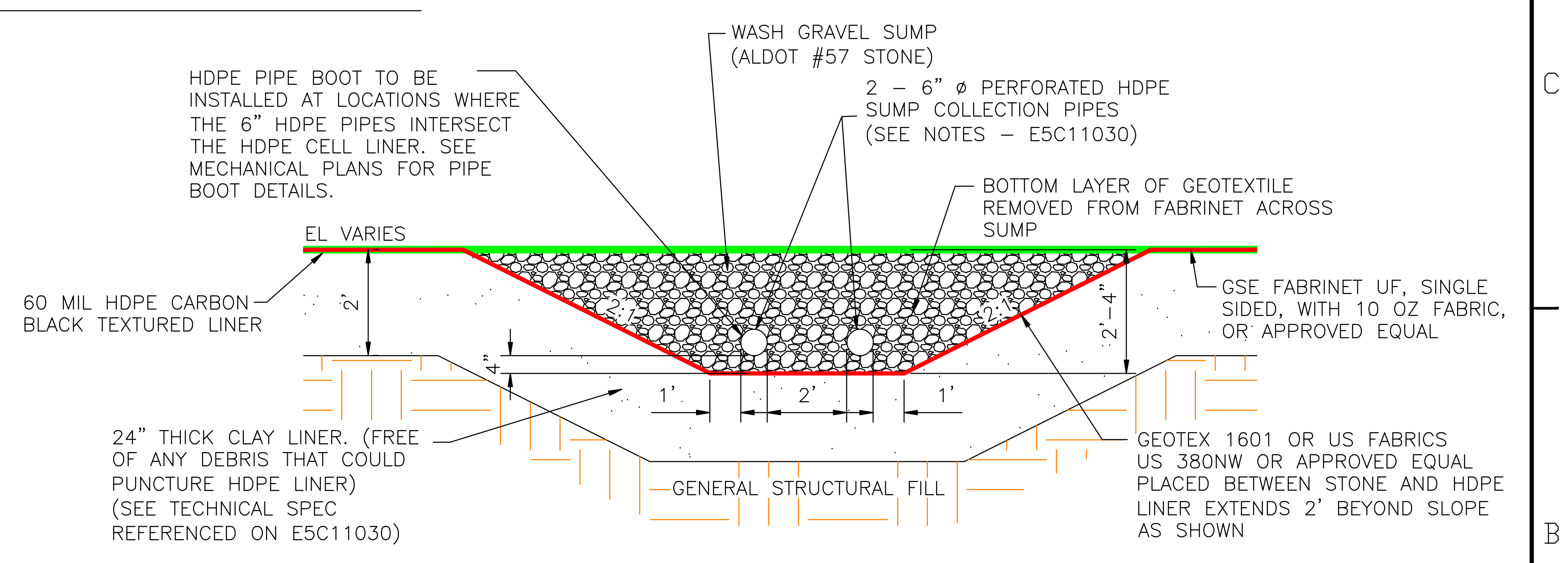
## SECTION V-V(E5C11041)
## OUTFALL COLLECTION PIPES, DECANT PIPES AND DITCH CULVERTS



## SECTION Z-Z(DETAIL "EE")
## PERFORATED PIPE DETAIL



## SECTION F-F(E5C11034 AND E5C11041)
## OUTFALL COLLECTION PIPES, DECANT PIPES AND DITCH CULVERTS



## SECTION KK-KK (E5C11033 & E2C11045)
## UNDERDRAIN COLLECTION SUMP DETAIL

**ADVANCE PRINT**

| REVISION 4 | DATE 8-14-09 | REVISION 3 | DATE 3-5-09 | REVISION 2 | DATE 11-14-08 | REVISION 1 | DATE 04-11-08 | REVISION 0 | DATE 12-3-07 |
|---|---|---|---|---|---|---|---|---|---|
| A. D-7, G-5 ADDED PERIMETER FENCE AND ADDED ELEVATIONS<br>B. D-7, G-5 ADDED TRACKING SURFACE CLARIFICATION | | A. G-5 CORRECTED ANCHOR TRENCH DETAIL AT SED. POND<br>B. G-1, G-3, B-3 ADDED NOTE FOR TECHNICAL SPEC. REFERENCE | | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | | ISSUED FOR CONSTRUCTION | |
| EWO 2161DE | | EWO 2161DE | | EWO 2161DE | | EWO 2161DE | | EWO 2161DE | |

| | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|
| REVISION 4 | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 3 | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 2 | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 1 | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| REVISION 0 | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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PLANT BARRY UNIT 5
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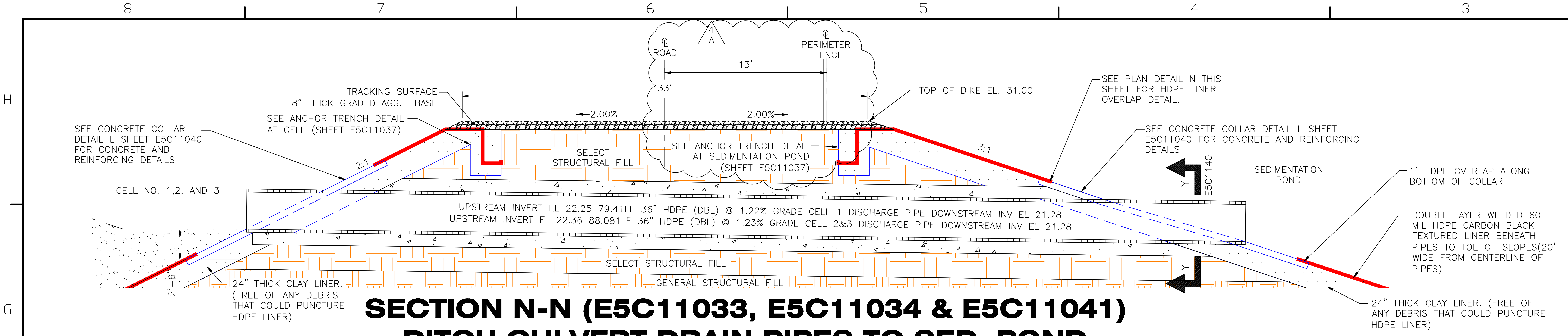
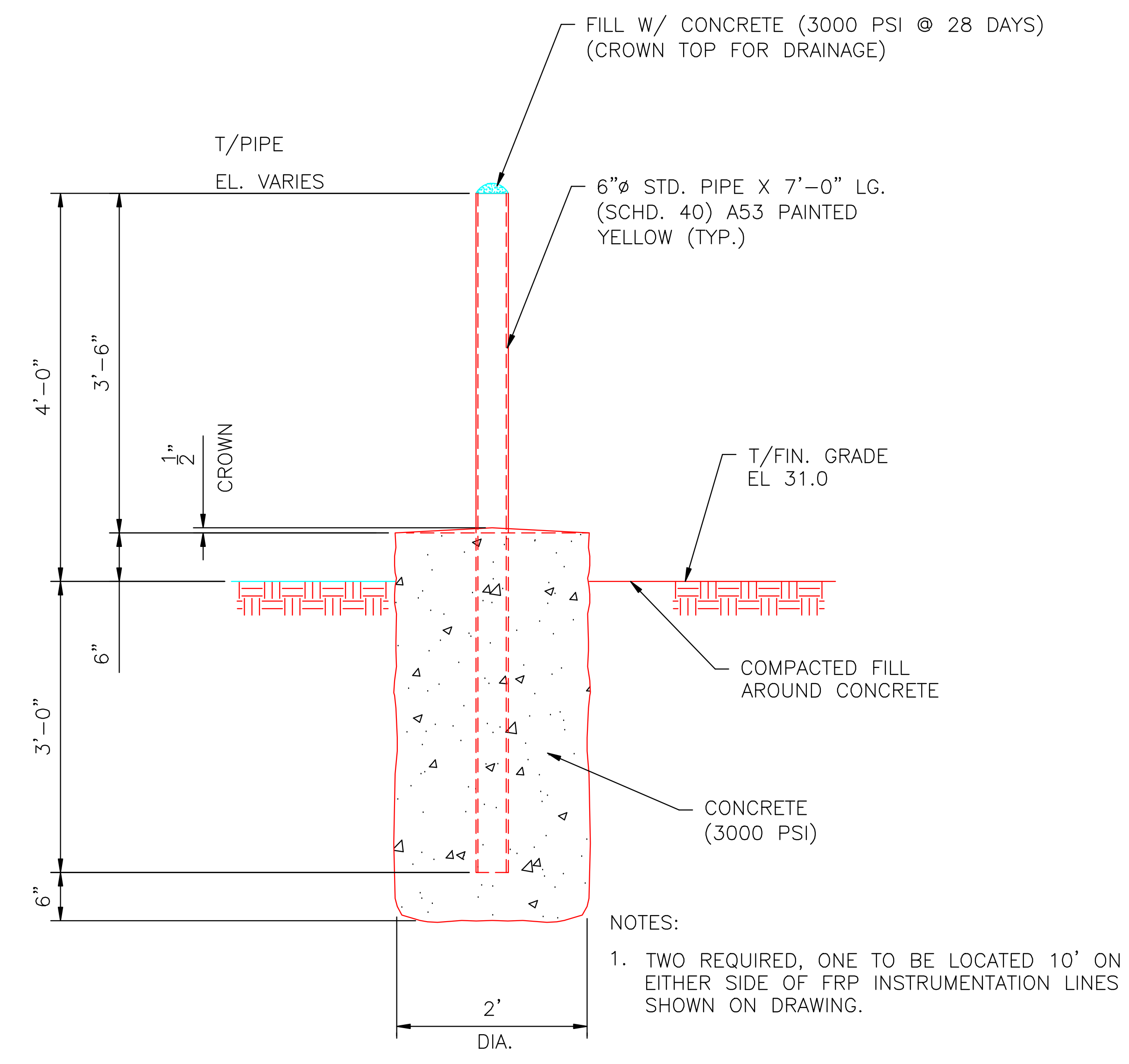
GYPSUM STORAGE AREA
CELL NO. 1 - SECTIONS AND DETAILS

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N/A | | E5C11037 | 1 | FINAL | 4 |

ANSI E: 44x34 Acad2004

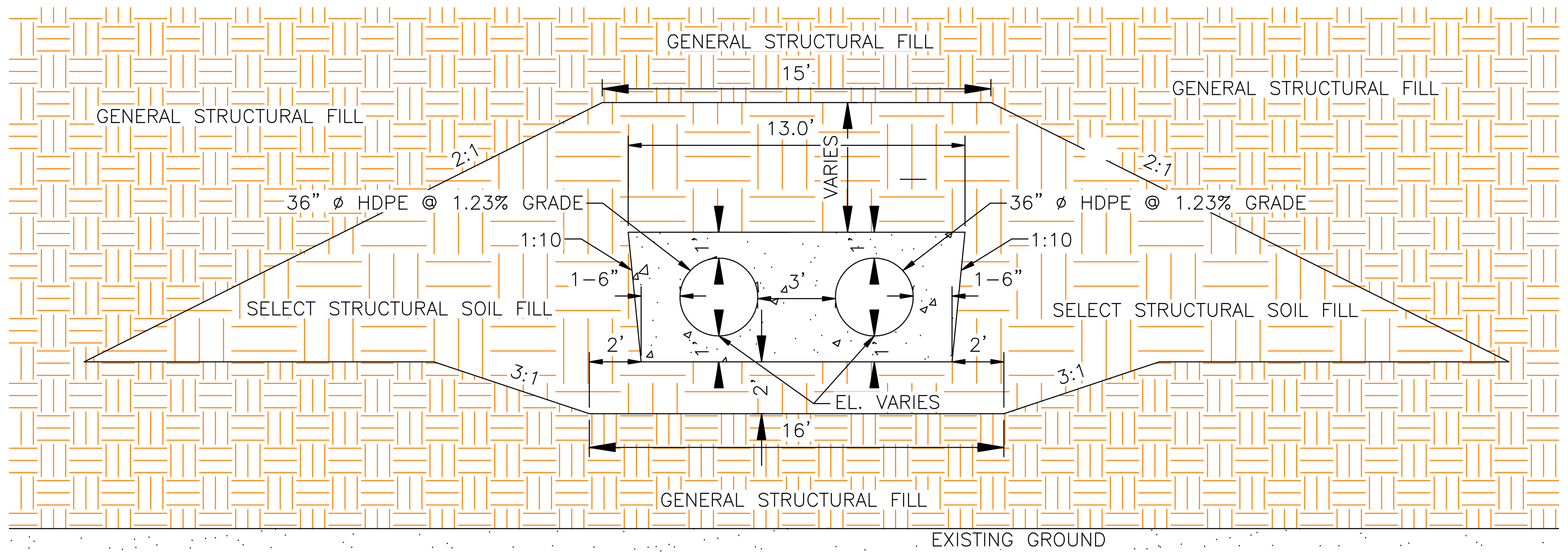


## SECTION N-N (E5C11033, E5C11034 & E5C11041)
## DITCH CULVERT DRAIN PIPES TO SED. POND

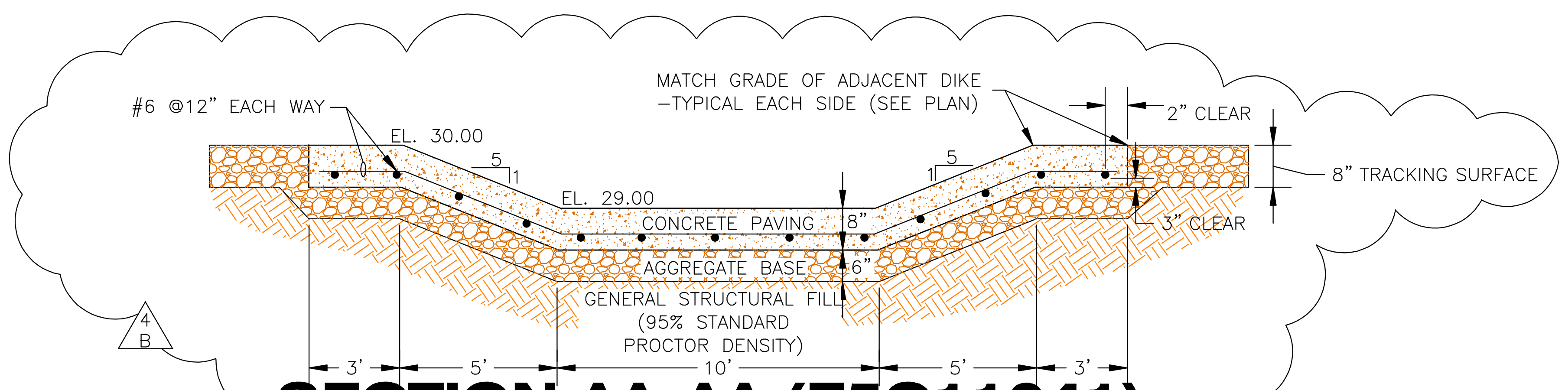


NOTES:
1. TWO REQUIRED, ONE TO BE LOCATED 10' ON EITHER SIDE OF FRP INSTRUMENTATION LINES AS SHOWN ON DRAWING.

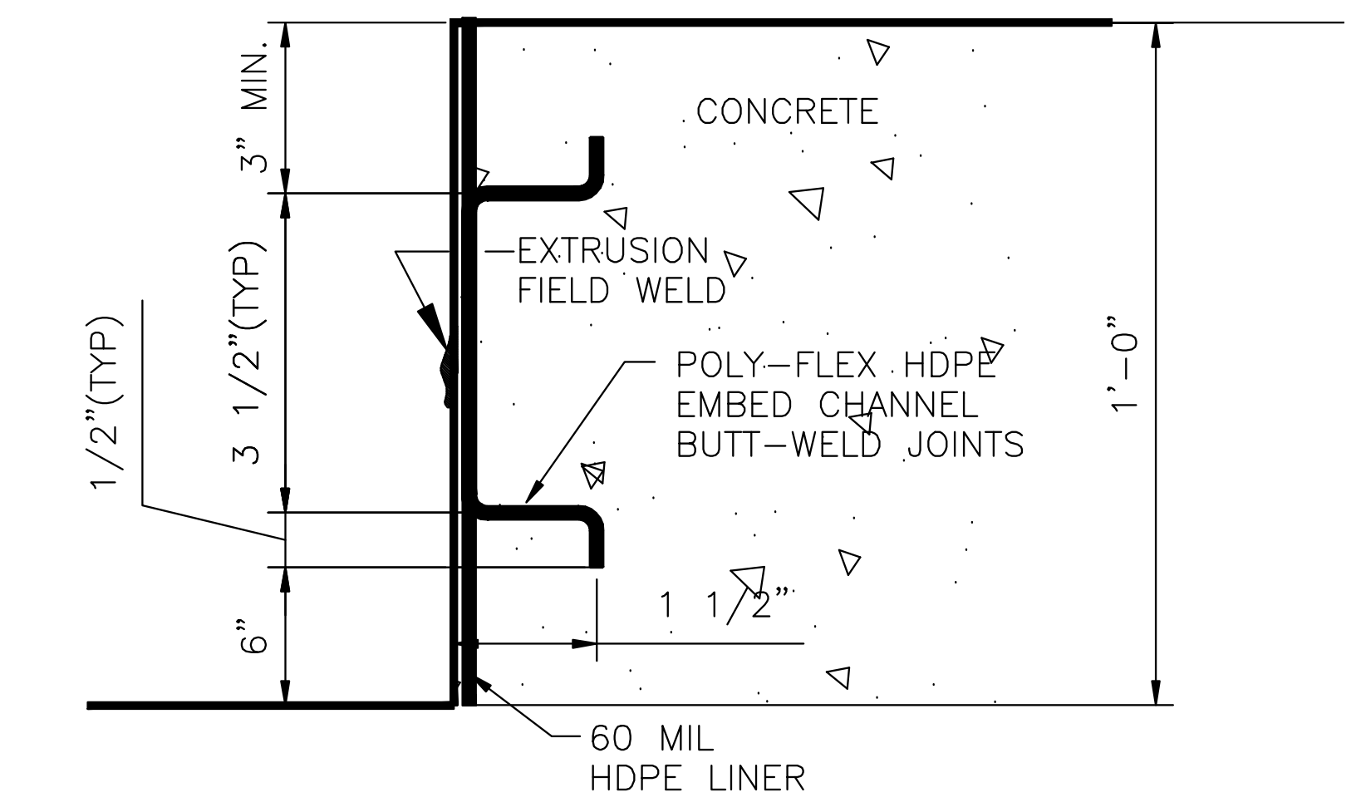
## TYP. GUARDPOST DETAIL



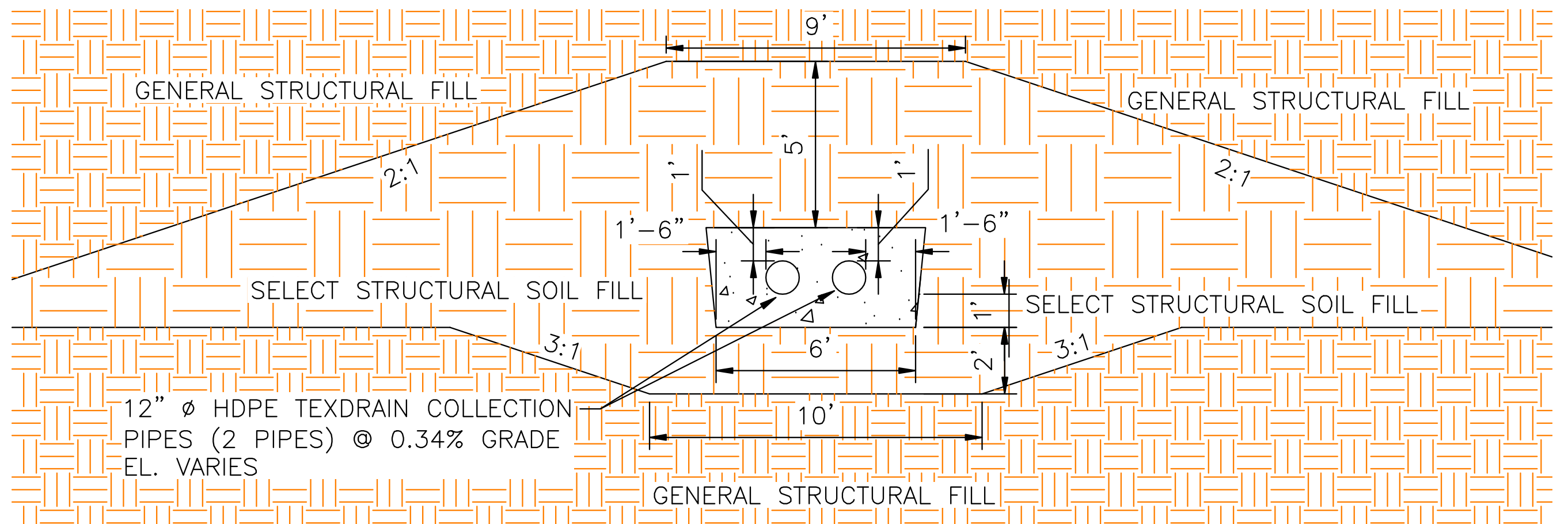
## SECTION P-P (E5C11034 & E5C11041)
## DITCH CULVERTS TO SEDIMENTATION POND



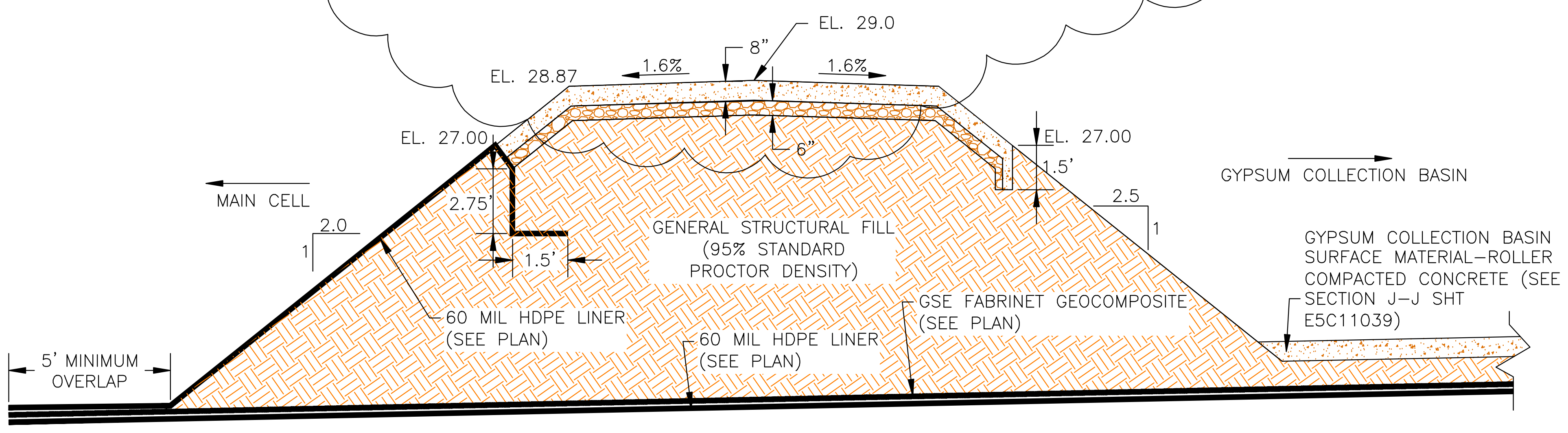
## SECTION AA-AA (E5C11041)



## DETAIL D POLYFLEX HDPE EMBED VERTICAL CHANNEL INSTALLATION

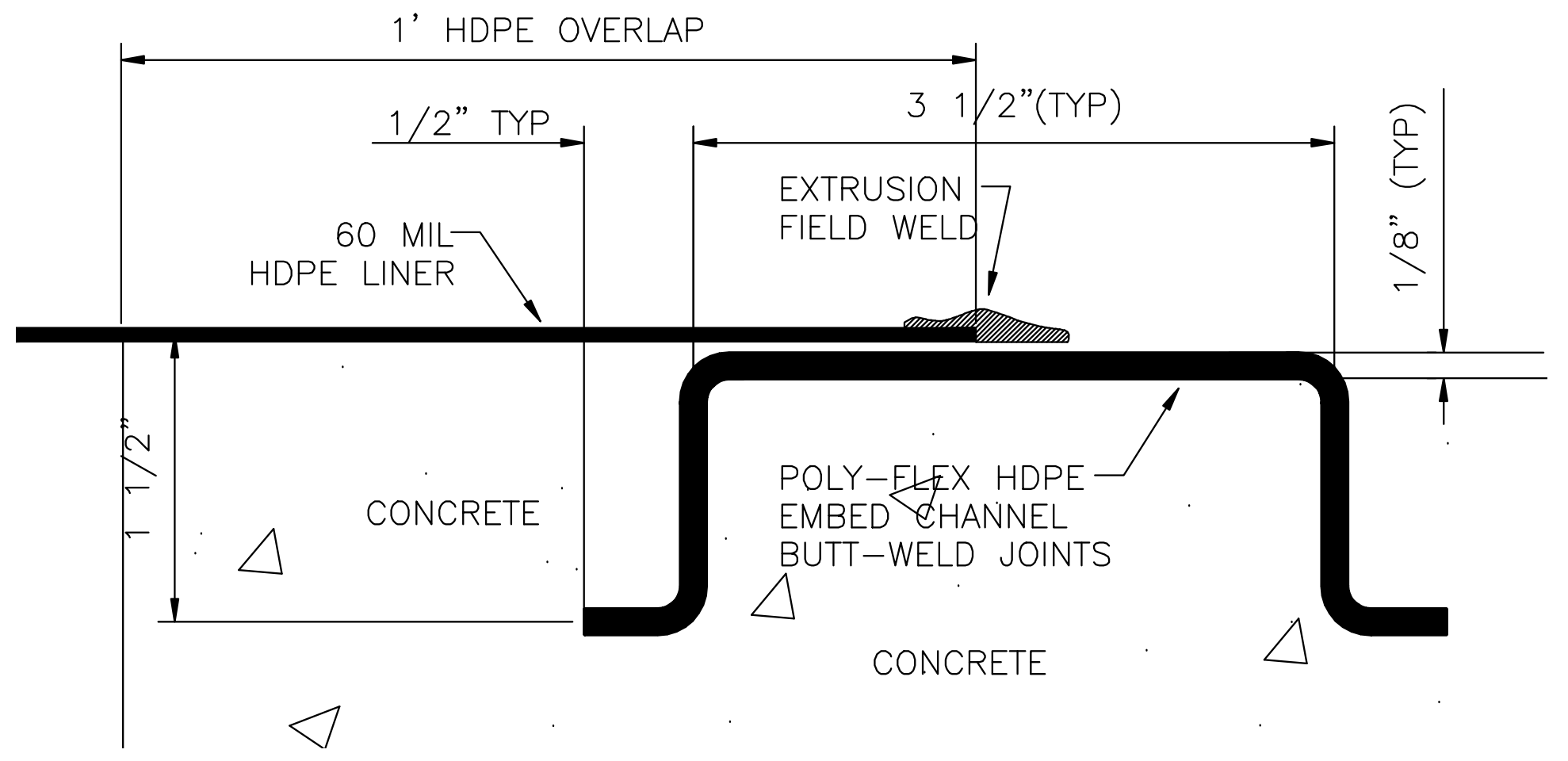


## SECTION H-H (E5C11033, E5C11034 & E5C11041)
## 12" Ø HDPE SUMP COLLECTION PIPES
## TO SEDIMENTATION POND

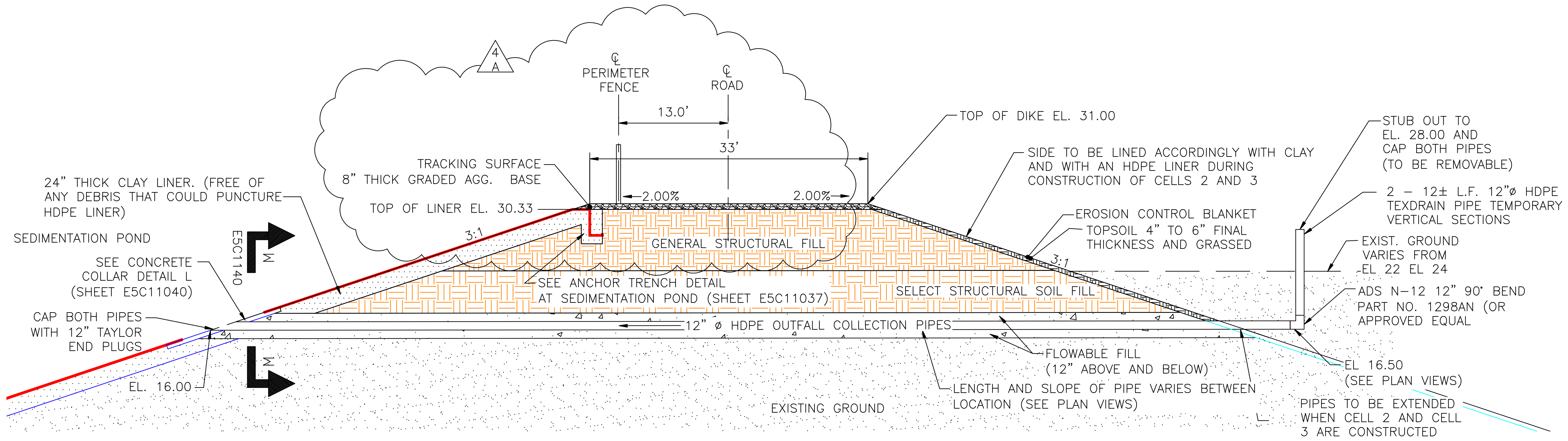


SPILLWAY NOTES:
1. FLUME LAYOUT TO BE AS SHOWN ON PLAN.
2. ELEVATIONS SHOWN ARE TO TOP OF FINISHED CONCRETE.
3. CONCRETE TO BE 4000 PSI.
4. AGGREGATE BASE TO BE TYPE "B" (COMPACTED TO 90% MODIFIED PROCTOR DENSITY OR AS APPROVED BY OWNER'S REPRESENTATIVE).
5. SURFACE TO BE BROOM FINISHED.
6. ALL REINFORCING SHALL HAVE 2" MINIMUM COVER OF CONCRETE WHERE FORMS ARE USED AND 3" MINIMUM COVER WHEN POURED AGAINST THE GROUND.
7. BEVEL EXPOSED EDGES OF CONC. 3/4".
8. ALL REINFORCING SHALL CONFORM TO ASTM SPEC. A615, GRADE 60.

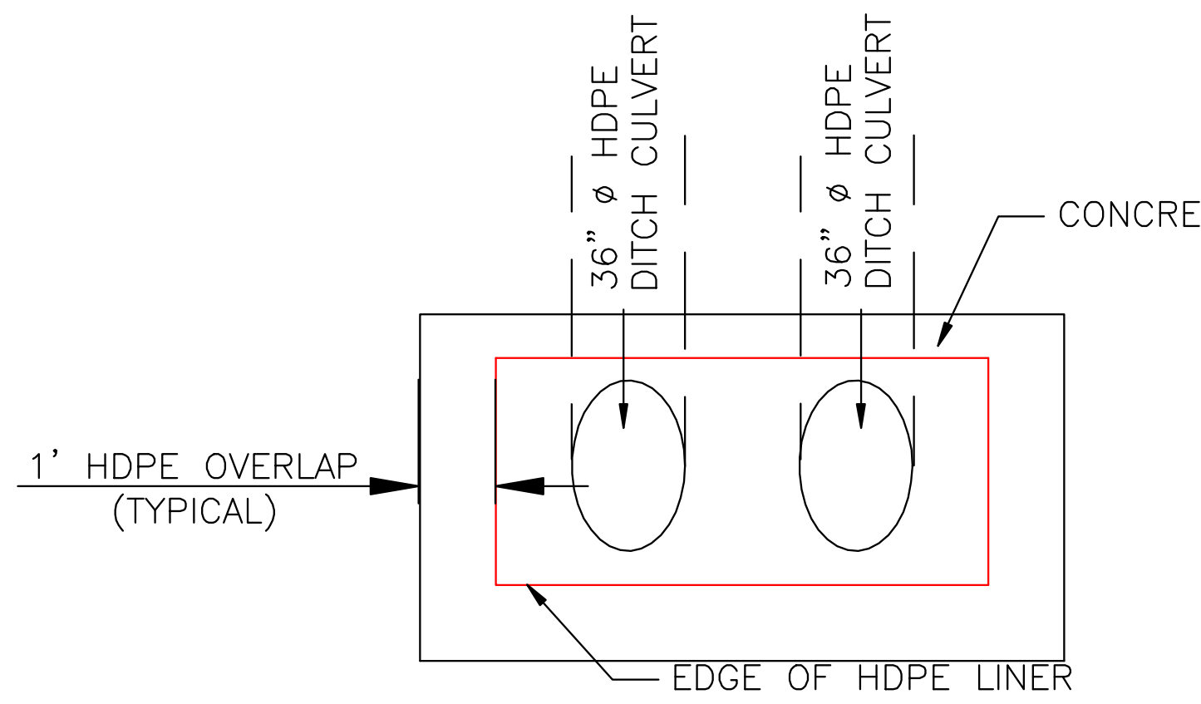
## SECTION BB-BB (E5C11041)
## GYPSUM COLLECTION BASIN SPILLWAY DETAIL
## N.T.S.



## DETAIL C POLYFLEX HDPE EMBED HORIZONTAL CHANNEL INSTALLATION



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



## PLAN DETAIL N(SECTION N-N)

ADVANCE PRINT

| REVISION 4 | DATE 8-14-09 | REVISION 3 | DATE 3-5-09 | REVISION 2 | DATE 11-14-08 | REVISION 1 | DATE 04-11-08 | REVISION 0 | DATE 12-3-07 |
|---|---|---|---|---|---|---|---|---|---|
| A. C-7 & H-6 ADDED PERIMETER FENCE AND DIMENSIONS<br>B. F-4 UPDATED ELEVATIONS<br>EWO 2161DE | | A. H-3 & H-8 CORRECTED CONCRETE COLLAR<br>EWO 2161DE | | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION<br>EWO 2161DE | | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION<br>EWO 2161DE | | ISSUED FOR CONSTRUCTION<br>EWO 2161DE | |

| | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|
| REVISION 4 | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 3 | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 2 | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 1 | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| REVISION 0 | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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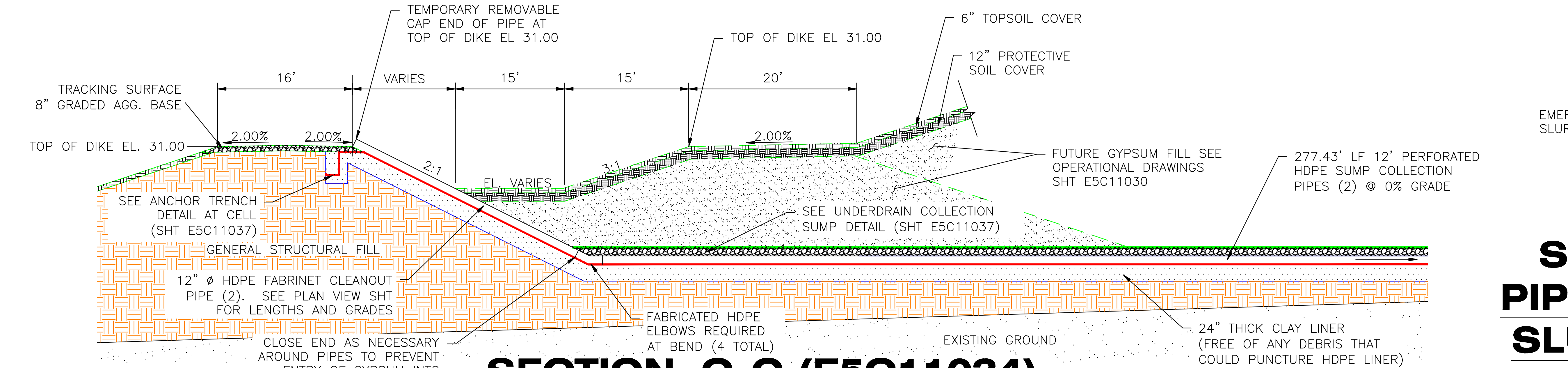
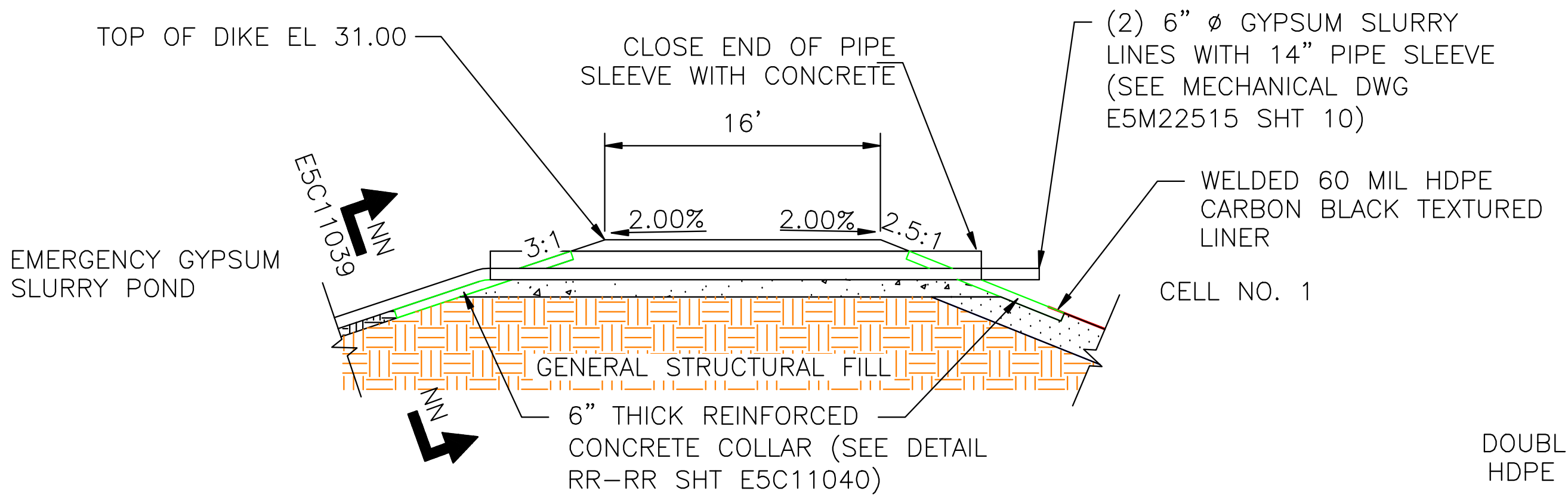
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 – SECTIONS AND DETAILS

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N/A | | E5C11038 | 1 | FINAL | 4 |

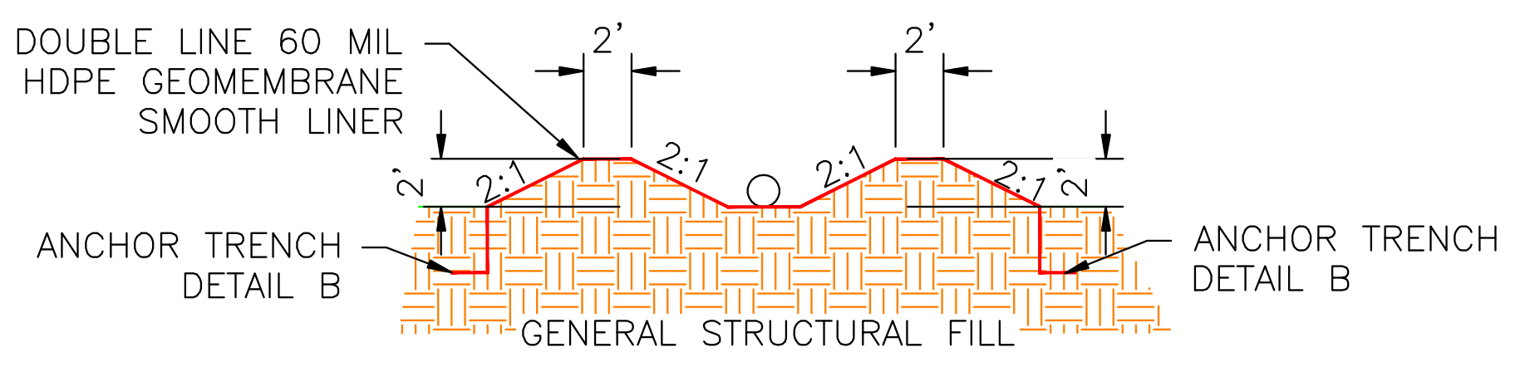
ANSI E: 44x34 Acad2004



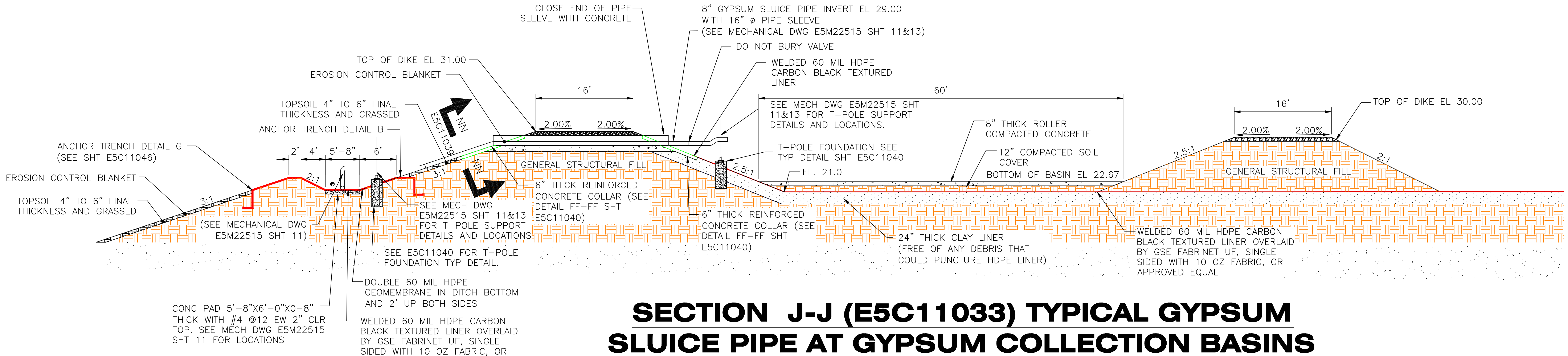
## SECTION G-G (E5C11034)
## TYPICAL CLEANOUT PIPE TO UDERDRAIN COLLECTION PIPES (TWO PLACES)



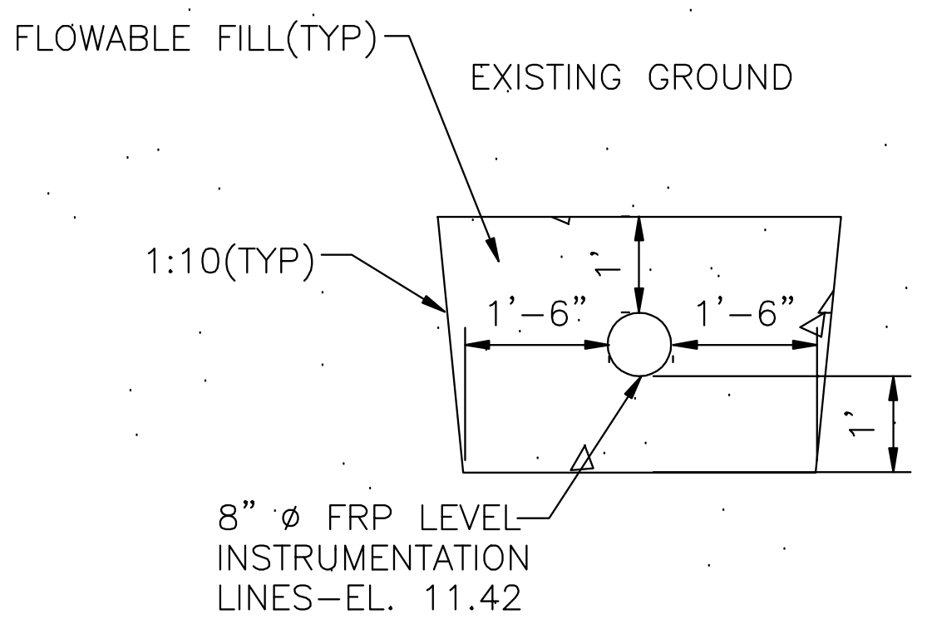
## SECTION MM-MM (E5C11033)
## PIPE FROM EMERGENCY GYPSUM SLURRY POND PUMPS TO CELL 1



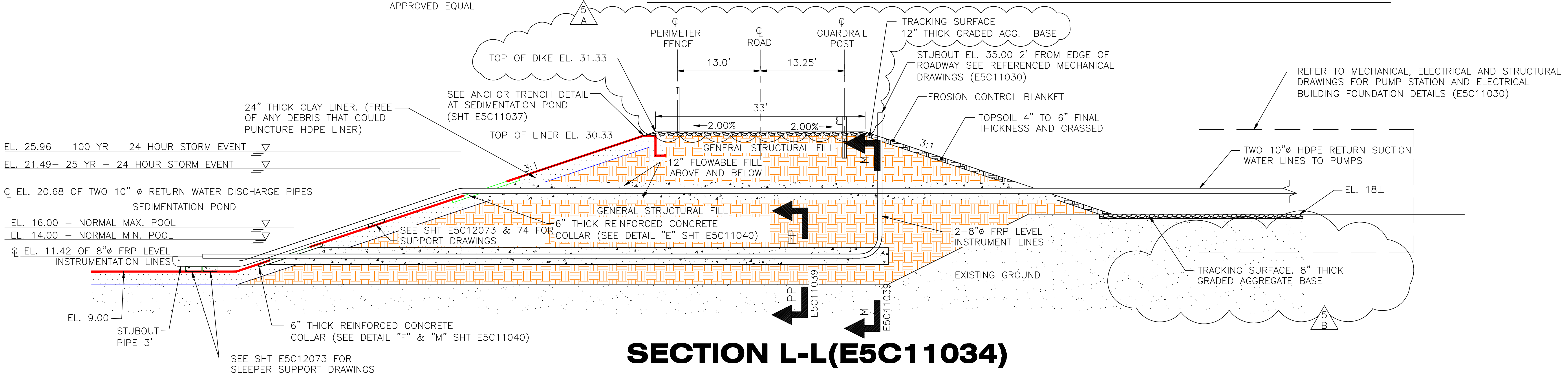
## SECTION NN-NN (E5C11033)
## SLUICE LINE TRENCH



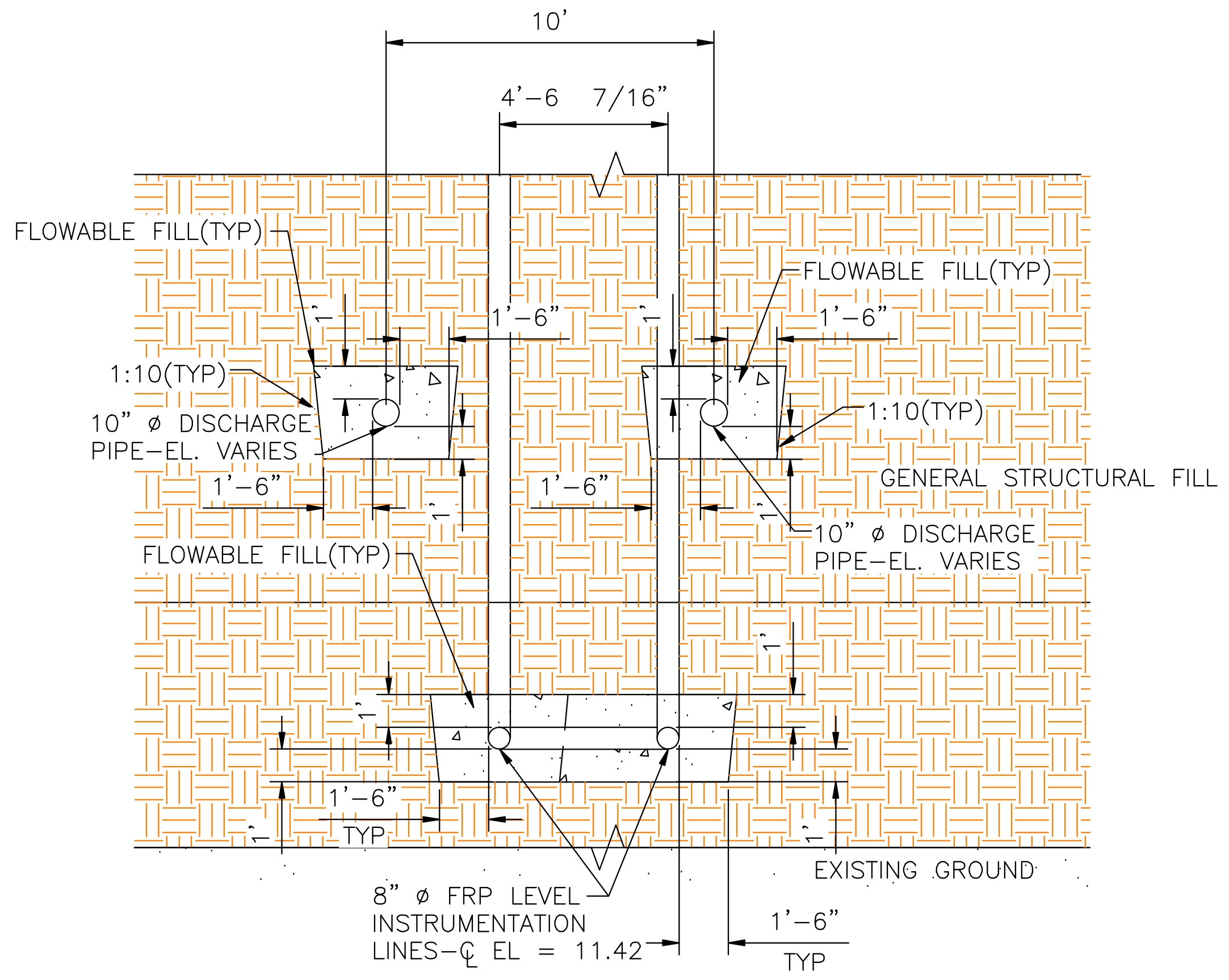
## SECTION J-J (E5C11033) TYPICAL GYPSUM SLUICE PIPE AT GYPSUM COLLECTION BASINS



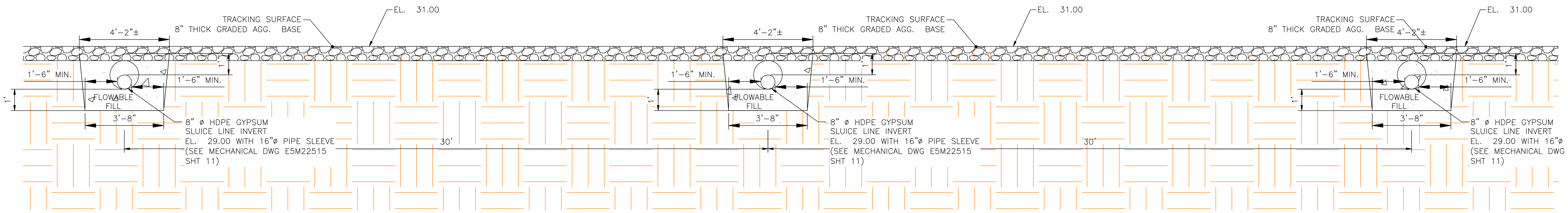
## SECTION PP-PP (E5C11039) FOR FRP LEVEL INSTRUMENTATION LINES



## SECTION L-L(E5C11034)
## TYPICAL OUTLET PIPES TO PUMP



## SECTION M-M
## (E5C11034 & E5C11039)



## SECTION T-T(E5C11033)
## THREE 8" Ø GYPSUM SLUICE LINES TO CELL NO. 1 (2 PLACES)

**ADVANCED PRINT**

| REVISION | DATE | | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| 5 | 8-14-09 | A. E-6 ADDED PERIMETER FENCE AND GUARDRAIL AND REVISED TOP OF LINER/DIKE ELEVATIONS<br>B. D-3 CALLED OUT GRADED AGG BASE | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | 7-14-09 | A. REVISED RETURN WATER LINE ELEVATION | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 3-5-09 | A. H-3 ADDED PIPE SLEEVE<br>B. F-7, F-6, F-5, AND C-7 ADDED PIPE SLEEVE, CONCRETE PAD, T-POLE FOUNDATION AND MECH DETAIL REFERENCE<br>C. B-7, B-4, AND B-2 ADDED PIPE SLEEVE AND SLUICELINE ELEV CALLED OUT AS INVERT<br>D. F-6 & H-3 CLOSE END OF PIPE SLEEVE WITH CONCRETE<br>E. D-8 STORM EVENT ELEVATIONS ADJUSTED FOR INCREASED POND VOLUMES | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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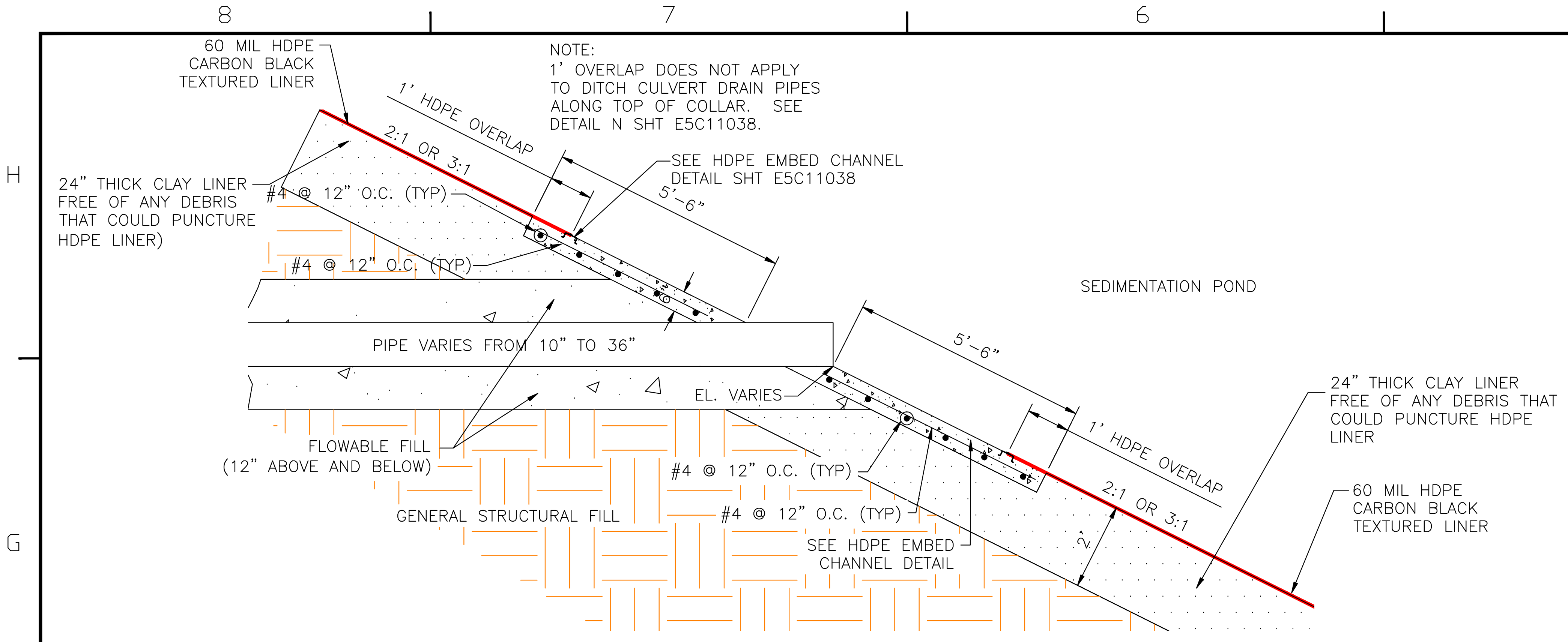
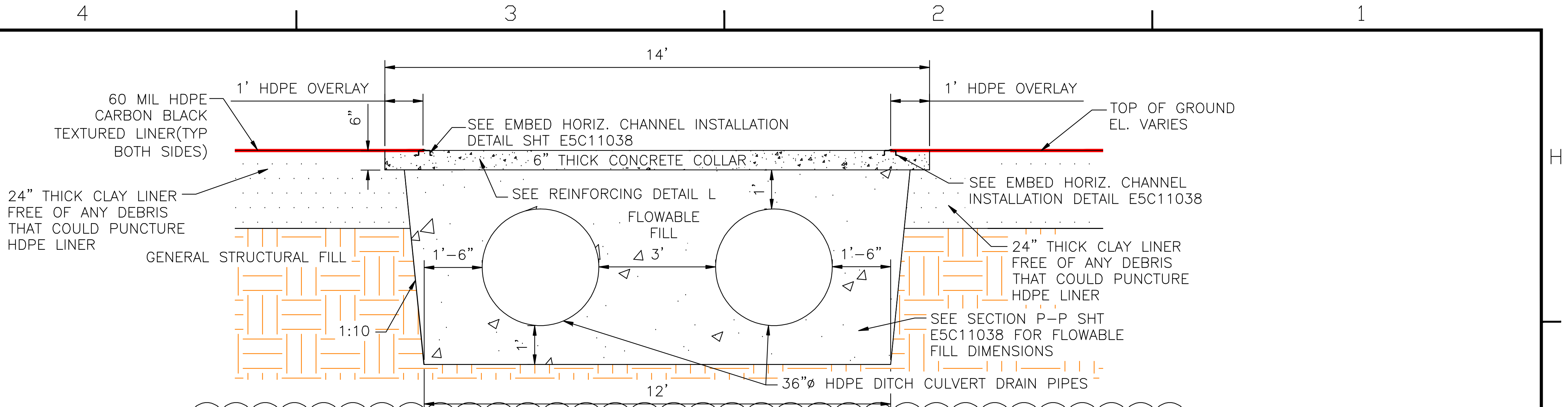
| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N/A | | E5C11039 | 1 | FINAL | 5 |

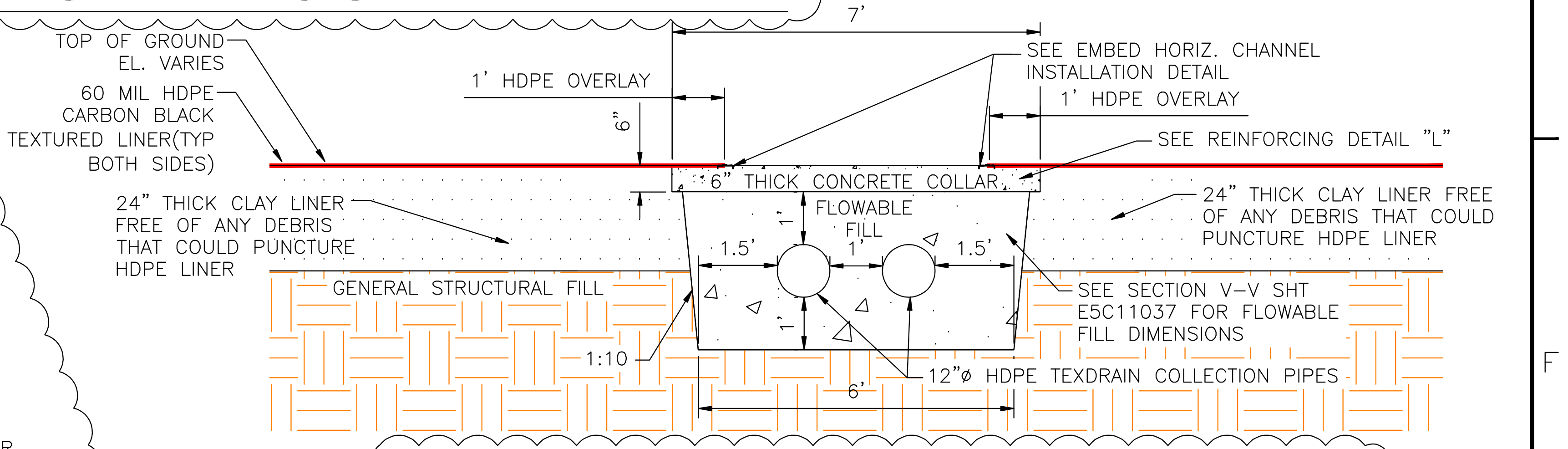
ANSI E: 44x34 Acad2004



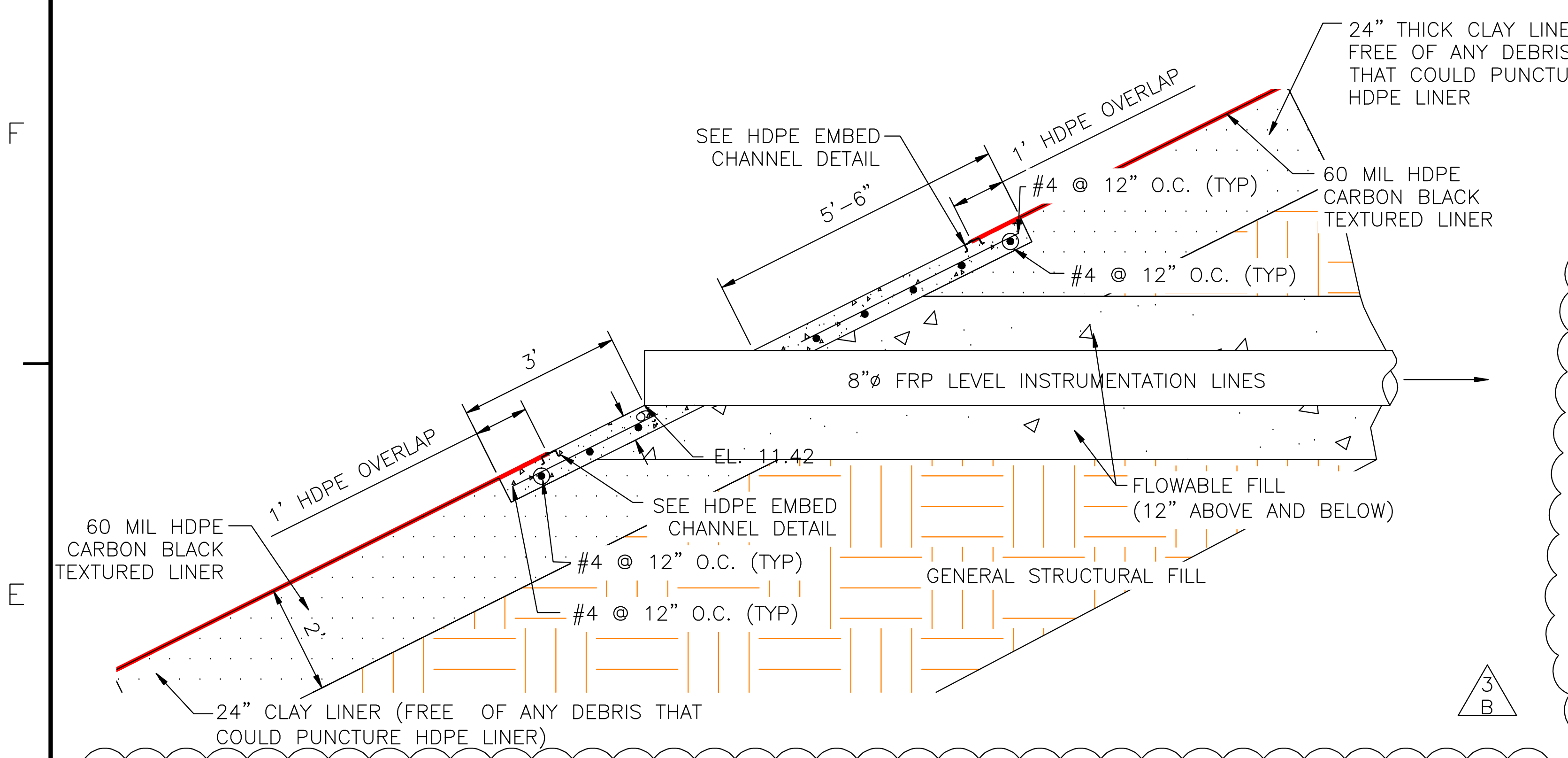
## CONCRETE COLLAR DETAIL "L"
## FOR DECANT PIPES, OUTFALL COLLECTION PIPES AND
## FOR SEDIMENTATION POND PUMP SUCTION



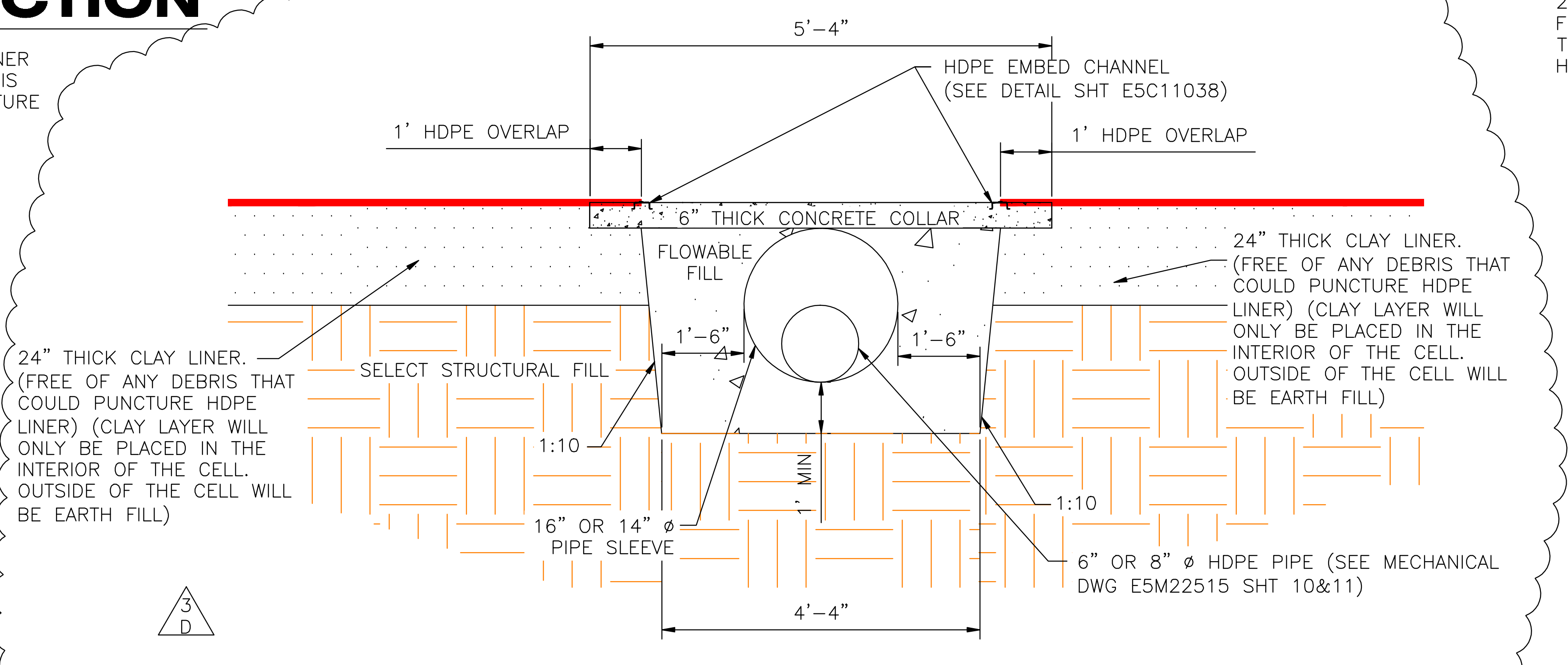
## SECTION Y-Y (E5C11033 & E5C11038)
## DITCH CULVERT DRAIN PIPES 3/E
## CONCRETE COLLAR DETAIL



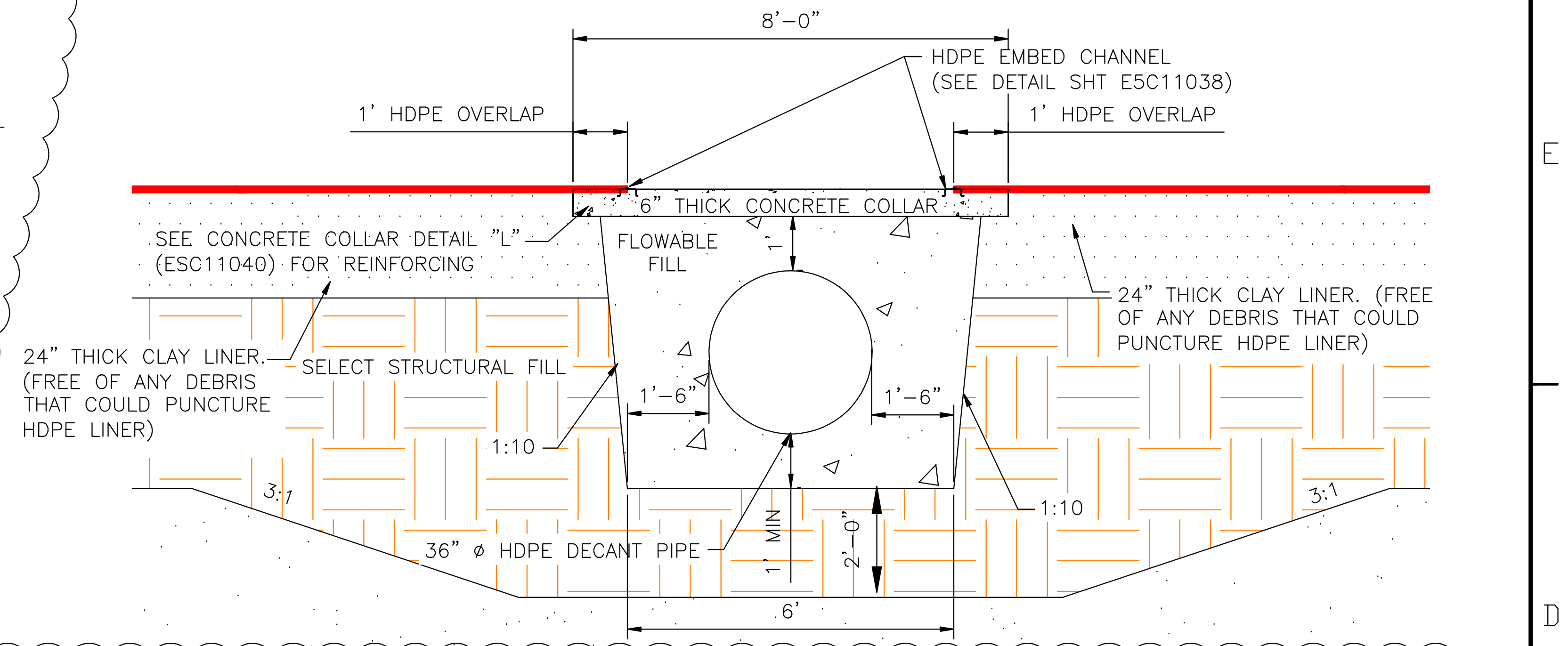
## SECTION W-W (E5C11038)
## 3/E OUTFALL COLLECTION
## CONCRETE COLLAR DETAIL



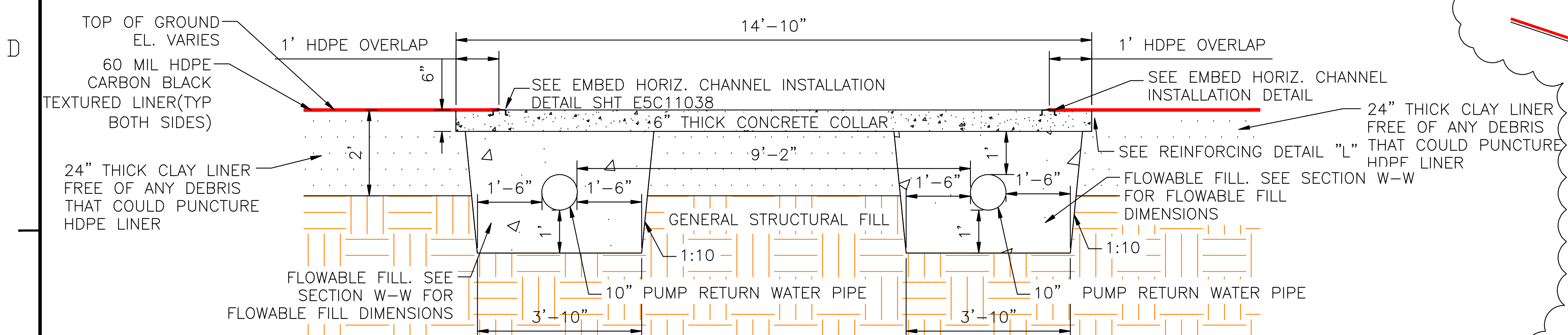
## CONCRETE COLLAR DETAIL "M" (E5C11039)
## FOR FRP LEVEL INSTRUMENTATION LINES



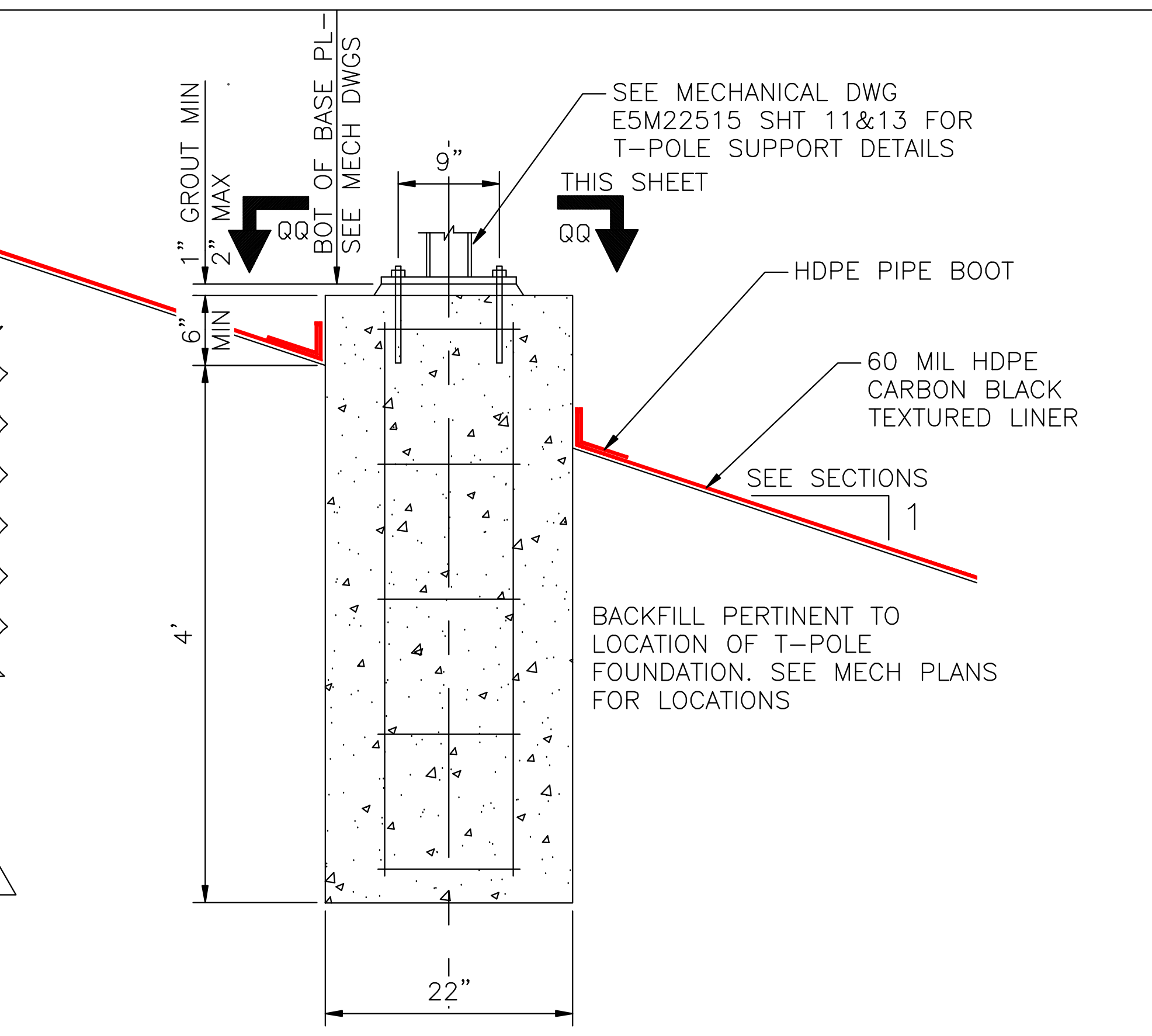
## SECTION RR-RR(E5C11039 & E5C11040)
## PIPE SLEEVE CONCRETE COLLAR DETAIL



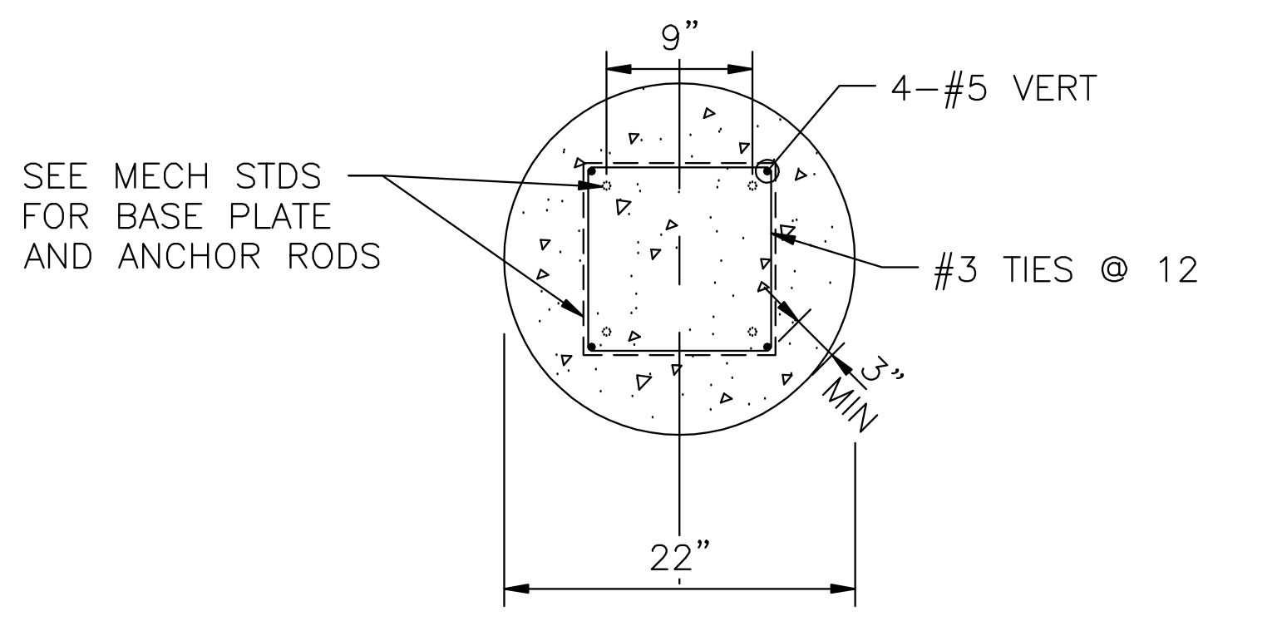
## 3/E SECTION S-S(E5C11036 & E5C11045)
## DECANT PIPE CONCRETE COLLAR DETAIL



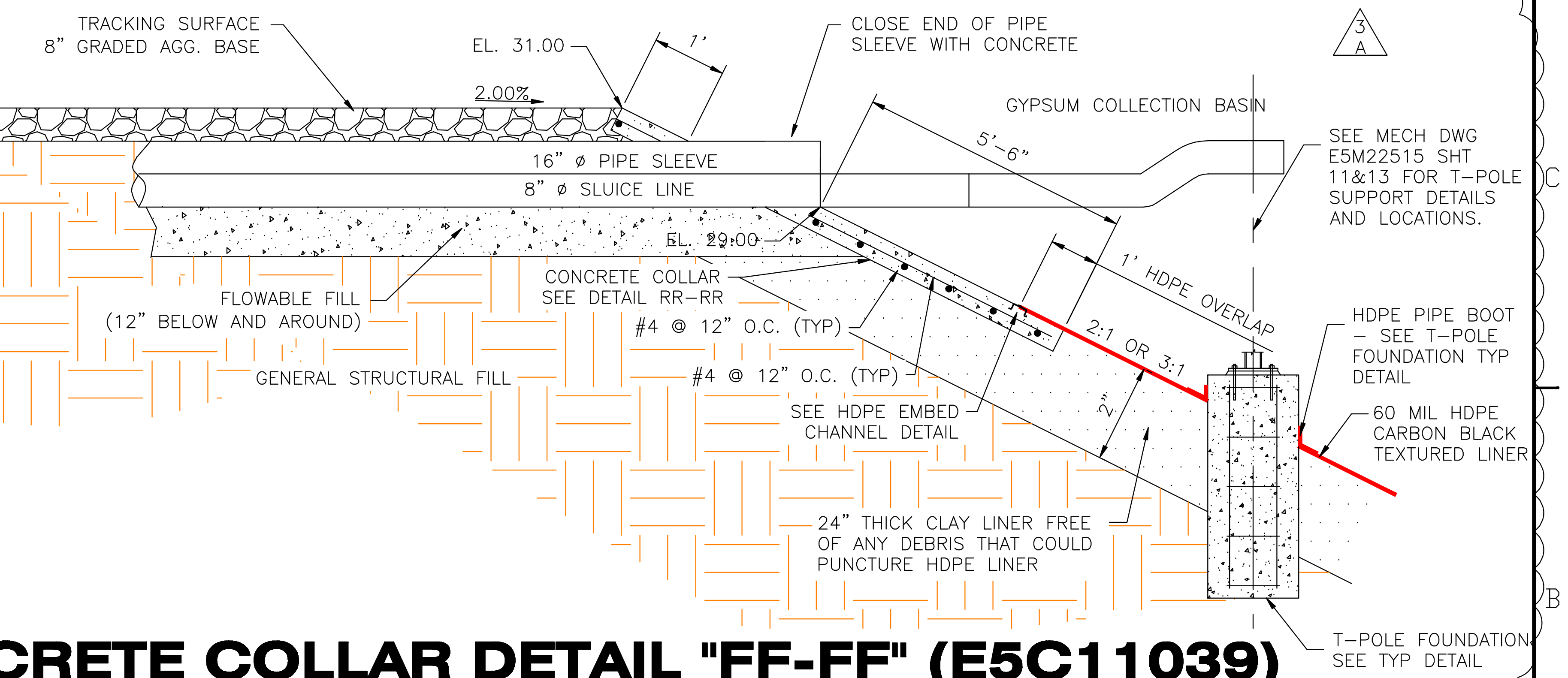
## CONCRETE COLLAR DETAIL "E" (E5C11039)



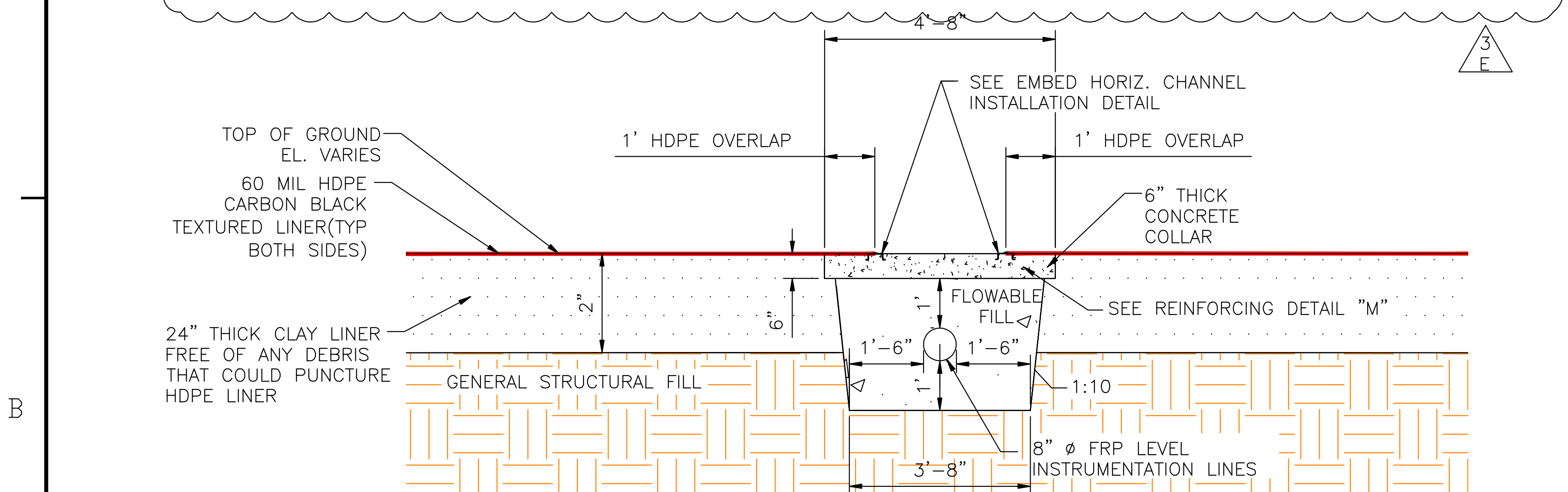
## T-POLE FOUNDATION TYP DETAIL



## SECTION QQ-QQ



## CONCRETE COLLAR DETAIL "FF-FF" (E5C11039)
## FOR GYPSUM SLUICE LINES



## CONCRETE COLLAR DETAIL "F" (E5C11039)

3/E

1. FOR THE ATTACHMENT OF THE HDPE LINER, ALL CONCRETE COLLARS SHALL CONTAIN HDPE EMBED CHANNELS AS SHOWN ON THE DETAILS AND SECTIONS. ALSO, SEE EMBED CHANNEL DETAILS FOR HORIZONTAL AND VERTICAL INSTALLATIONS ON SHT E5C11040.

**ADVANCED PRINT**

| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| REVISION | DATE | | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
| REVISION | DATE | | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
| REVISION | DATE | | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
| REVISION | DATE | | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
| REVISION 3 | 3-5-09 | A. C-3 AND E-6 ADDED DETAIL FF-FF AND<br>B. E-6 MODIFIED DETAIL "M" LABEL FOR RFP INSTRUMENTATION LINES ONLY<br>C. C-5 ADDED T-POLE FOUNDATION DETAIL AND SECTION<br>D. E-5 ADDED SECTION RR-RR<br>E. G-2, E-2, H-3, B-7, E-7, D-7 UPDATED CONCRETE COLLAR DIMENSIONS | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| REVISION 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

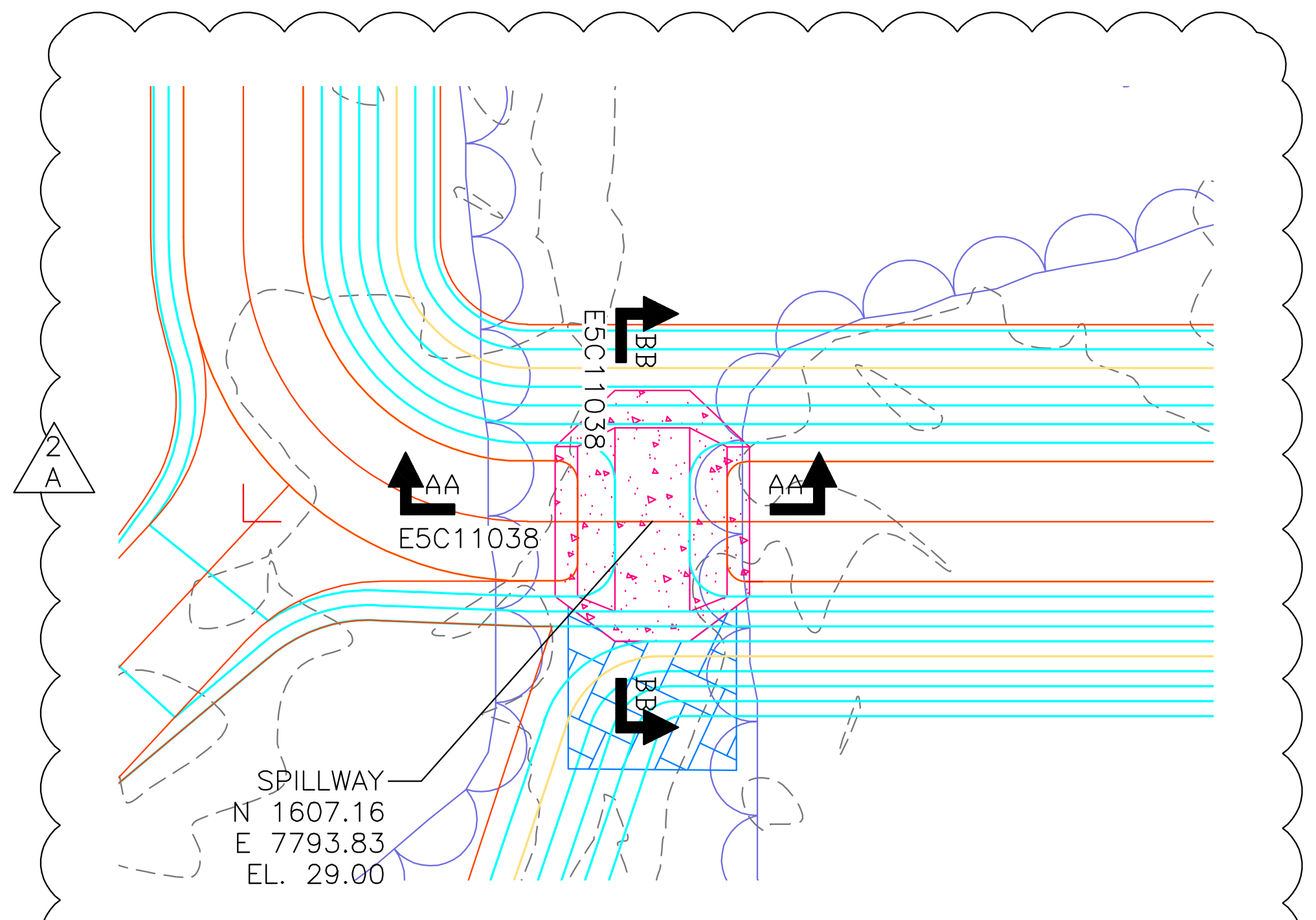
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

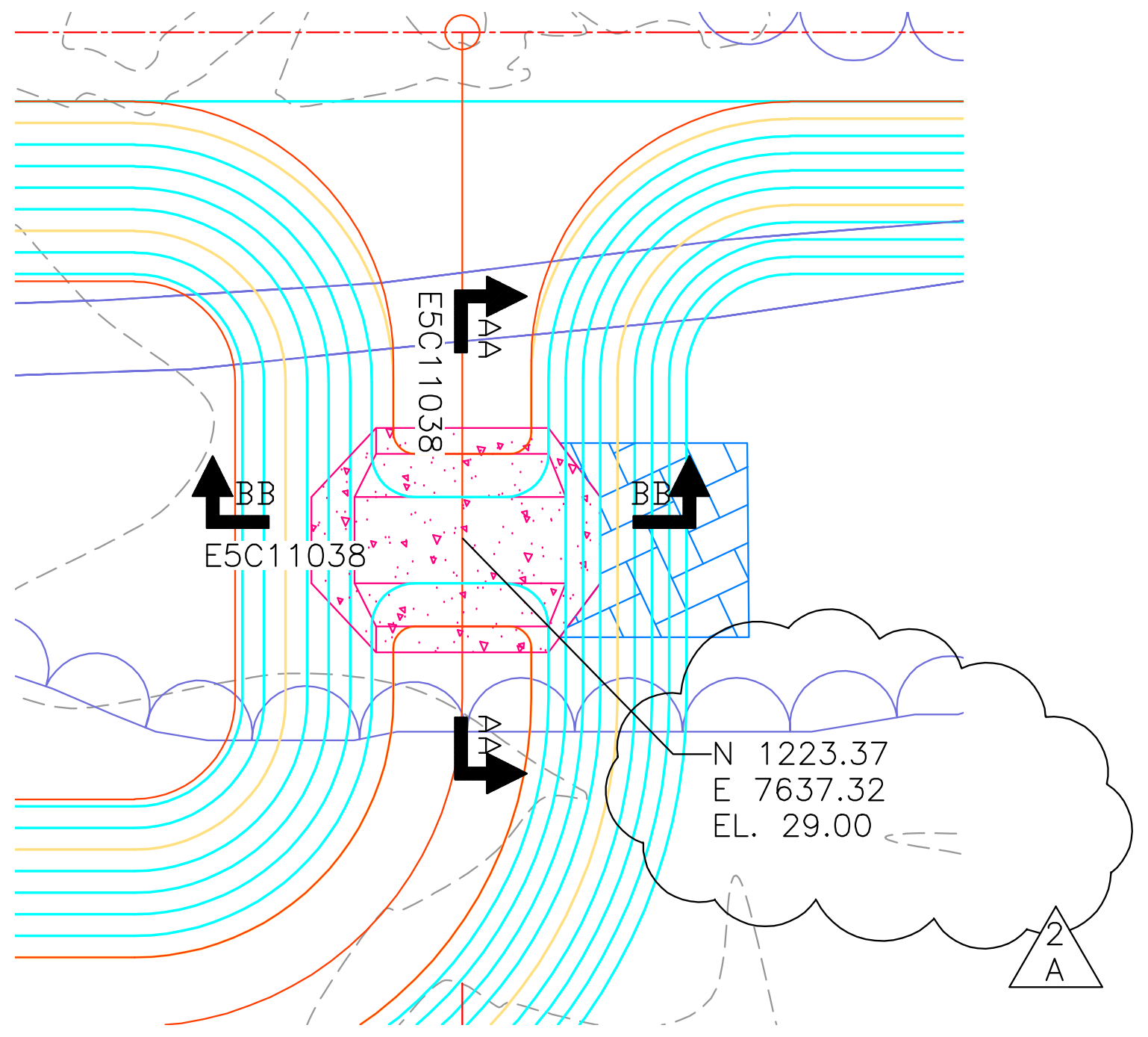
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 – SECTIONS AND DETAILS

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N/A | | E5C11040 | 1 | FINAL | 3 |

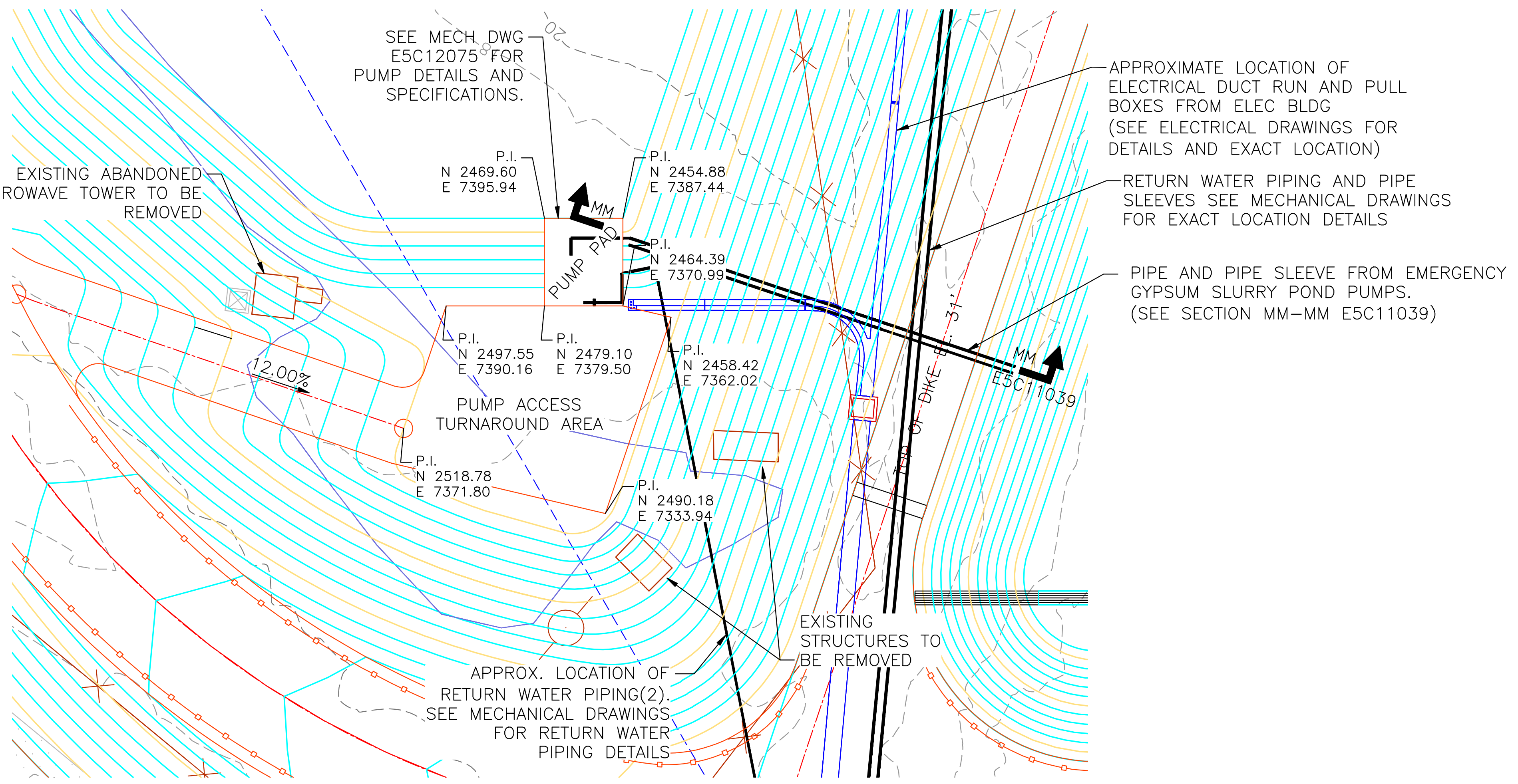
ANSI E: 44x34 Acad2004



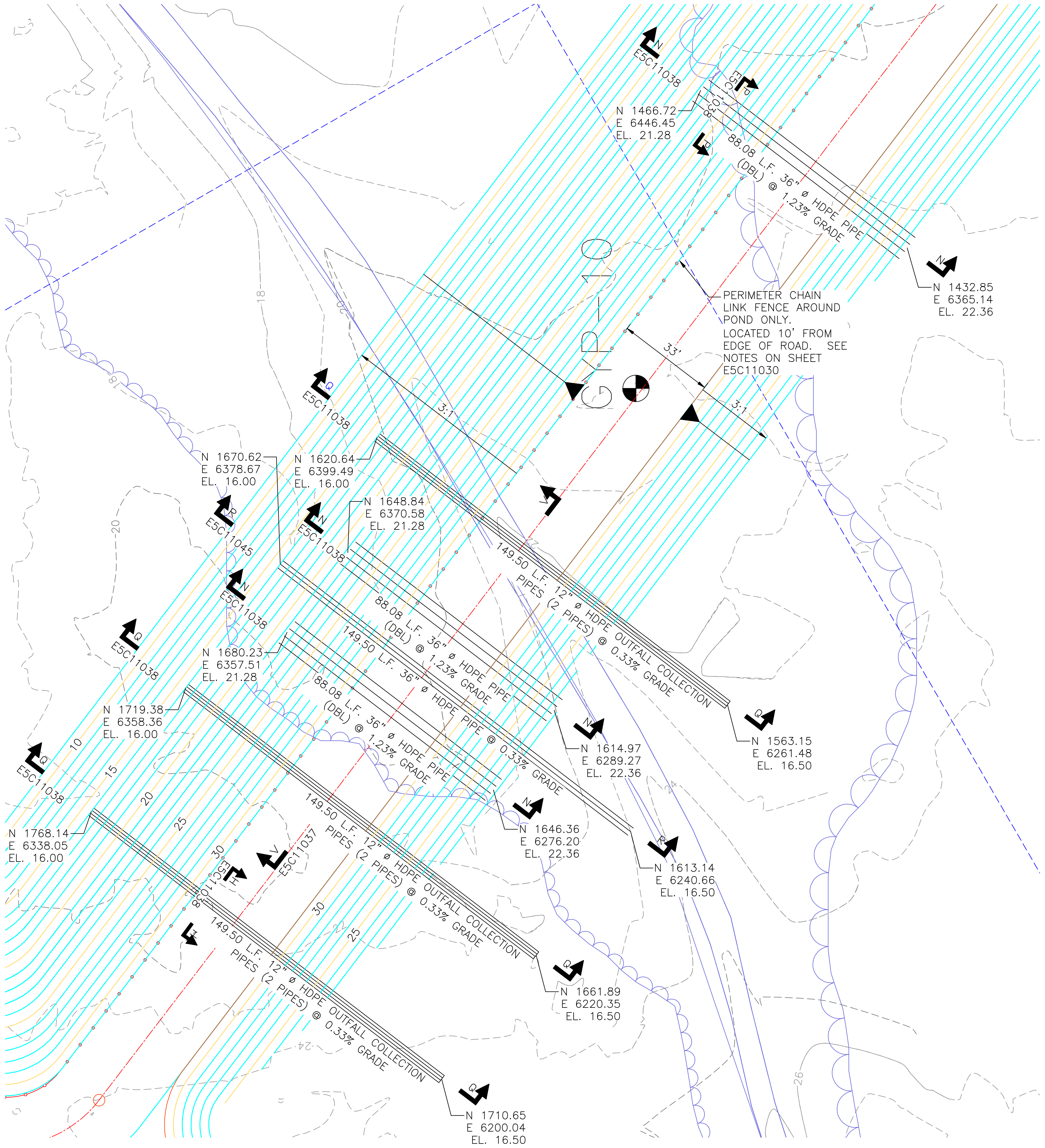
## DETAIL PLAN A
SCALE: 1"=20'



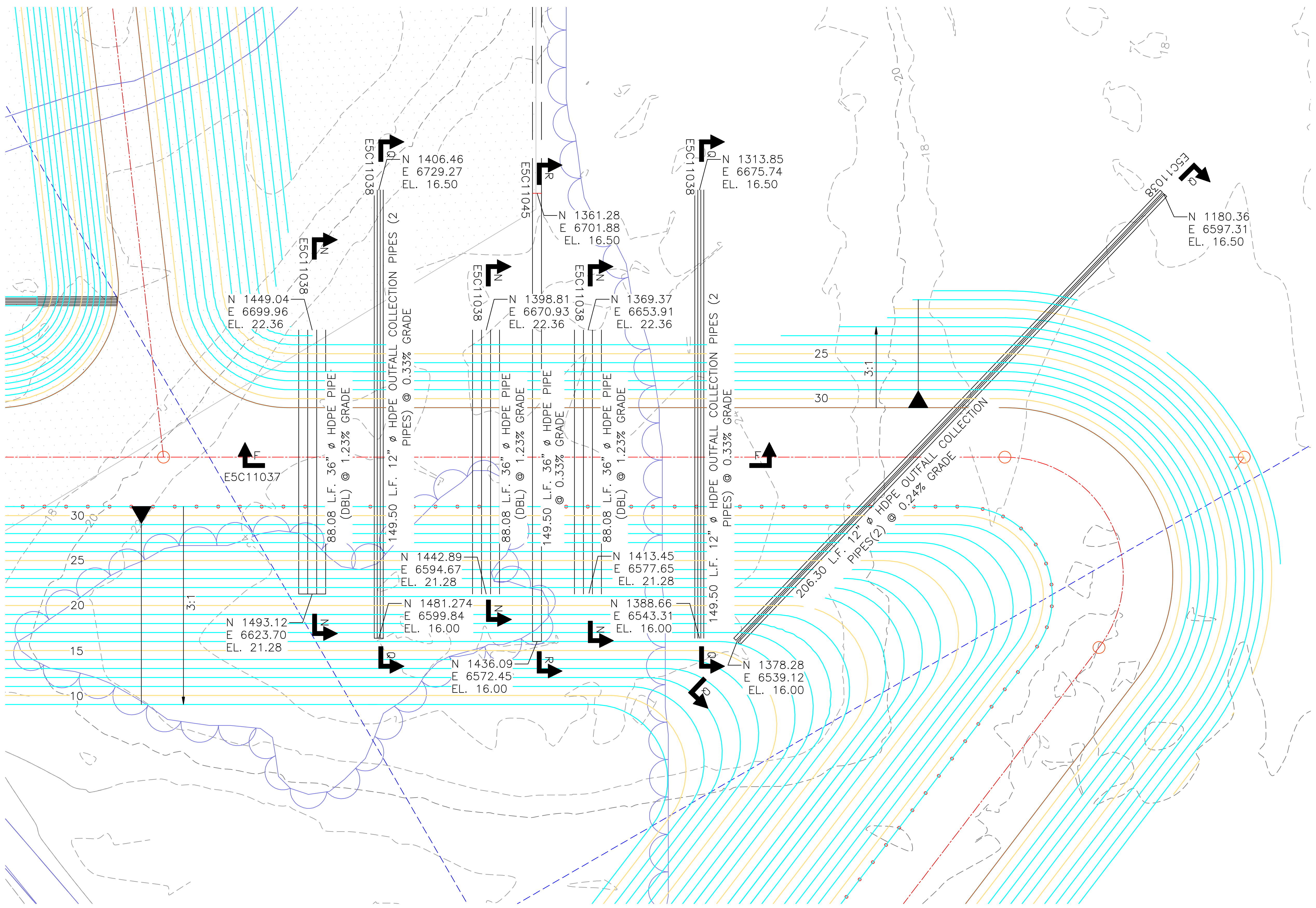
## DETAIL PLAN B
SCALE: 1"=20'



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



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



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

NOTES:

1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

**ADVANCED PRINT**

| REVISION | DATE | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|
| REVISION 3 | 8-14-09 | A. G-5, G-7 REVISED DETAIL PLAN A TO SHOW NEW LOCATION AND ELEVATIONS OF EMERGENCY SPILLWAYS<br>EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 2 | 7-2-09 | A. G-7 REVISED DETAIL PLAN A TO SHOW NEW LOCATION OF EMERGENCY SPILLWAY<br>B. C-7 UPDATED COORDINATES AND ADDED MECHANICAL REFERENCE<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 1 | 3-5-09 | A. G-3 REVISED DETAIL PLAN E TO SHOW MECHANICAL PIPE SLEEVES AND PIPES, AND ELECTRICAL DUCT RUN<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 0 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

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

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

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=20' | | E5C11041 | 1 | FINAL | 3 |

ANSI E: 44x34 Acad2004

| CL DITCH COORDINATES | | | |
|---|---|---|---|
| PI# | NORTHING | EASTING | ELEVATION |
| 1 | 2493.78 | 9994.72 | 18.00 |
| 2 | 2462.47 | 9916.30 | 17.23 |
| 3 | 2441.70 | 9866.00 | 16.74 |
| 4 | 2420.07 | 9810.99 | 16.14 |
| 5 | 2382.77 | 9714.20 | 15.10 |
| 6 | 2365.36 | 9663.24 | 14.56 |
| 7 | 2353.36 | 9621.51 | 14.52 |
| 8 | 2344.76 | 9589.45 | 14.49 |
| 9 | 2341.02 | 9572.64 | 14.47 |
| 10 | 2330.12 | 9523.88 | 14.42 |
| 11 | 2319.84 | 9441.07 | 14.34 |
| 12 | 2305.19 | 9173.36 | 14.09 |
| 13 | 2330.08 | 8778.06 | 13.71 |
| 14 | 2340.81 | 8723.19 | 13.65 |

## DETAIL AREA A

GRAPHIC SCALE
10 0 5 10 20 40
( IN FEET )
1 inch = 10 ft.

## GENERAL ARRANGEMENT AND SITE PLAN

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

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

**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL 1–ENTRANCE ROAD PLAN 1

| REVISION | DATE |
|---|---|
| REVISION 0 | 11-17-08 |
| ISSUED FOR CONSTRUCTION | |

EWO: 2161DE

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=30' | | **E5C11042** | 1 | FINAL | 0 |

ANSI E: 44x34 Acad2004

# GENERAL ARRANGEMENT AND SITE PLAN

ADVANCED PRINT

| CL DITCH COORDINATES | | | |
|---|---|---|---|
| PI# | NORTHING | EASTING | ELEVATION |
| 15 | 2351.81 | 8669.35 | 13.59 |
| 16 | 2363.92 | 8616.58 | 13.54 |
| 17 | 2376.37 | 8565.27 | 13.49 |
| 18 | 2392.56 | 8504.26 | 13.43 |
| 19 | 2447.48 | 8285.93 | 13.22 |
| 20 | 2509.08 | 8022.27 | 12.96 |
| 21 | 2519.25 | 7970.19 | 12.92 |
| 22 | 2526.85 | 7857.37 | 12.83 |
| 23 | 2525.27 | 7768.37 | 12.77 |
| 24 | 2527.75 | 7704.73 | 12.67 |
| 25 | 2517.28 | 7685.73 | 12.66 |
| 26 | 2443.64 | 7643.17 | 12.55 |
| 27 | 2464.42 | 7607.22 | 12.50 |

| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 3 | 8-14-09 | A. F-1 ADDED GYPSUM MARKET STACKING AREA | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 7-2-09 | A. E-4 ADDED GYPSUM MARKET LOADING AREA<br>B. H-6 REVISED SECTION AND GRADES | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 3-5-09 | A. E-2 ADDED ELECT DUCT RUN | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 0 | 11-14-08 | ISSUED FOR CONSTRUCTION | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |

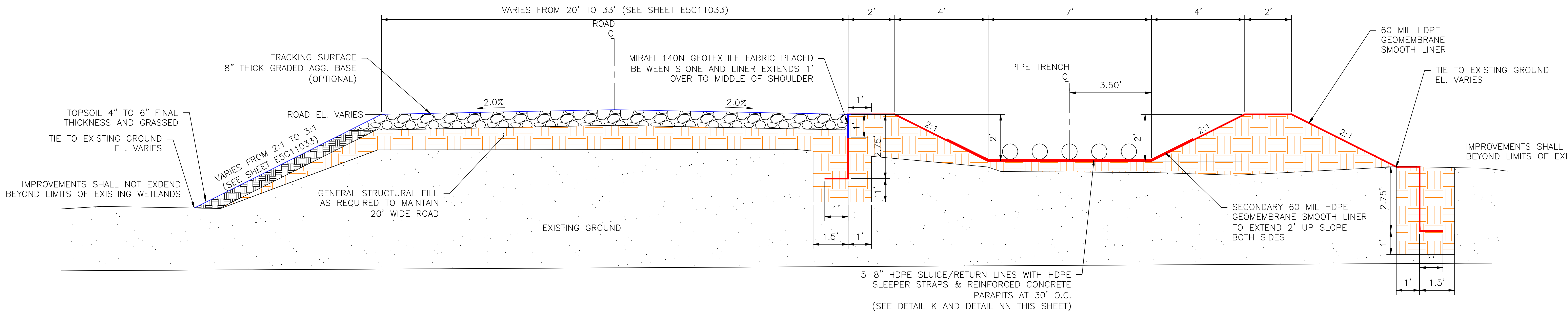
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

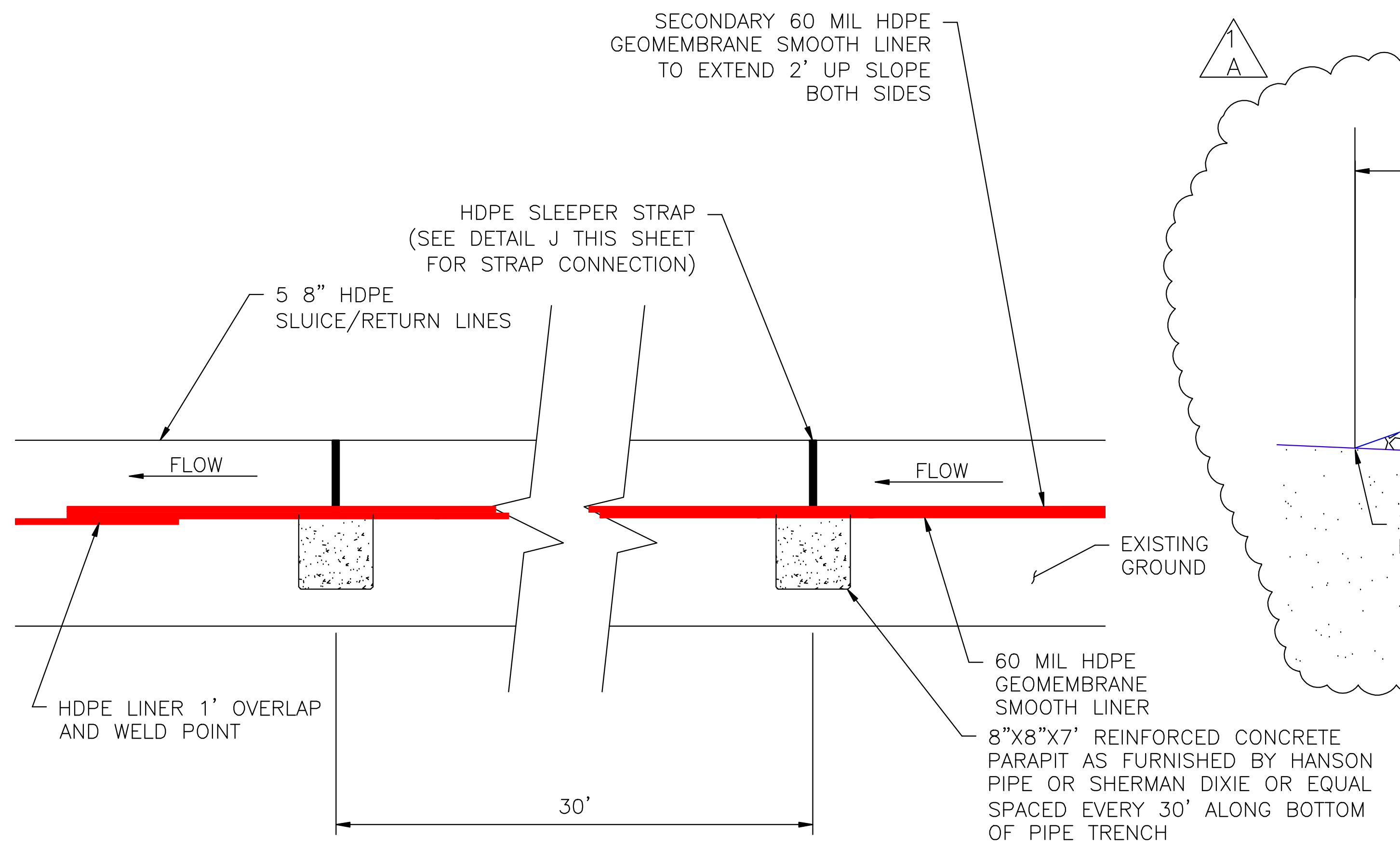
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 – ENTRANCE ROAD PLAN 2

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=100' | | **E5C11043** | 1 | FINAL | 3 |

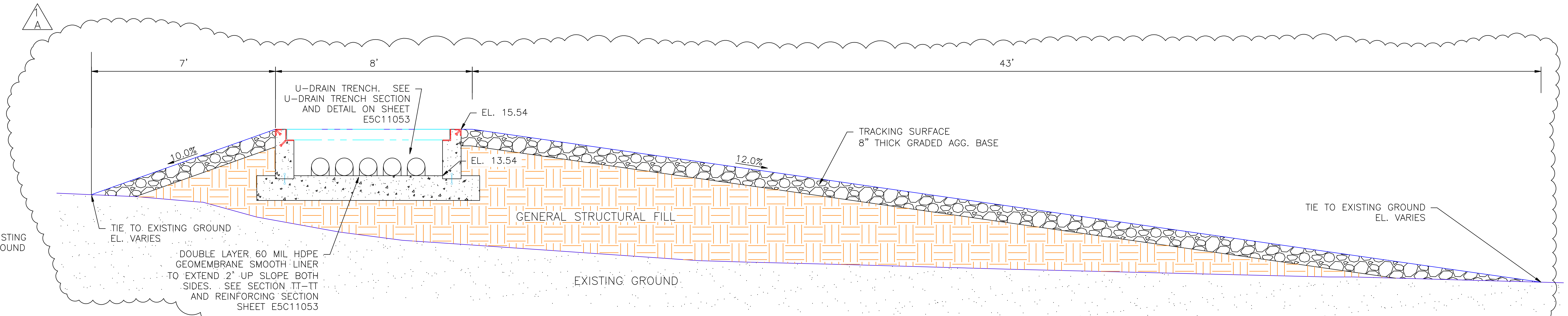
ANSI E: 44x34 Acad2004



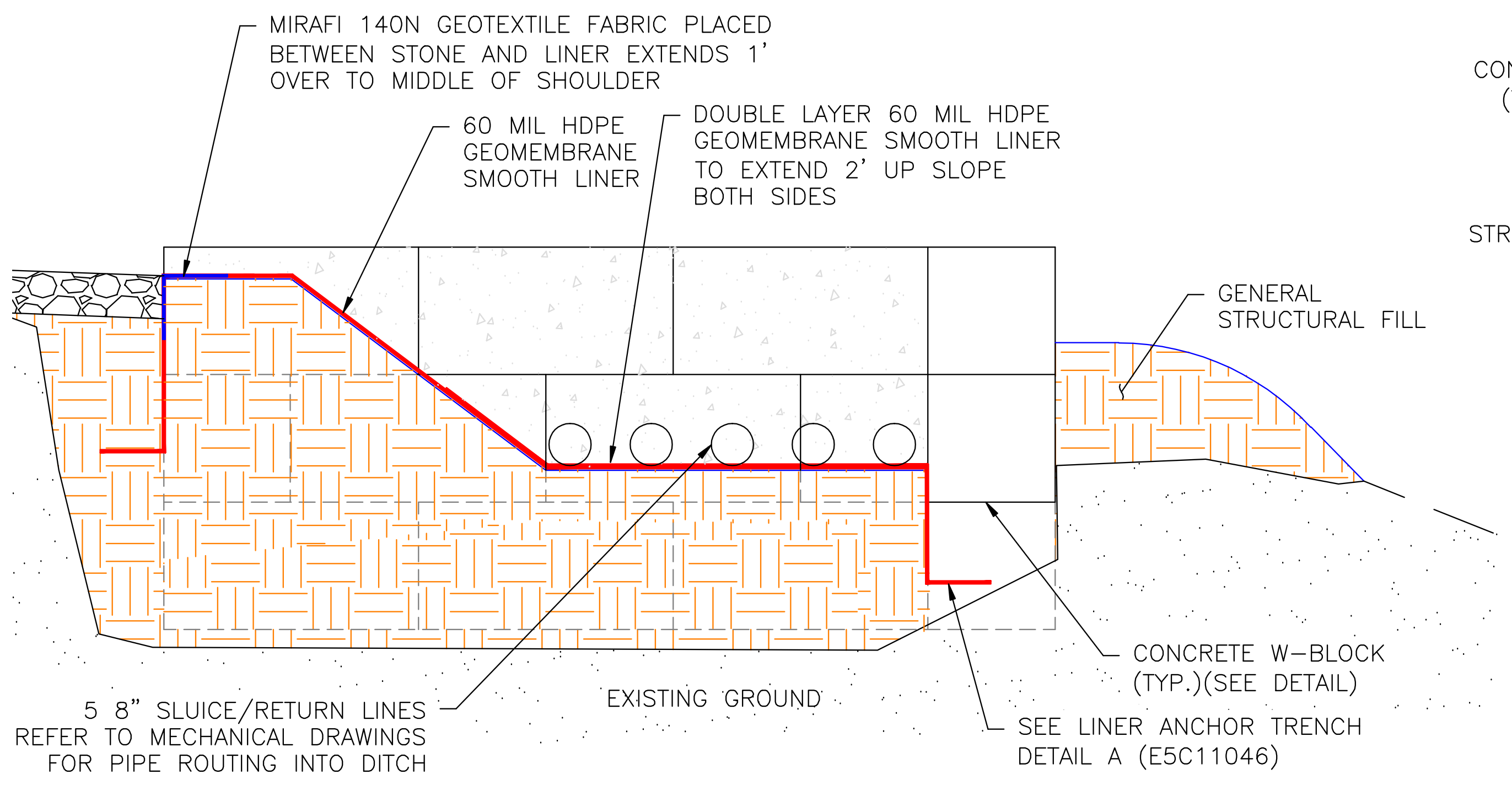
## SECTION FF-FF (E5C11042 & E5C11043)
## TYPICAL ACCESS ROAD AND PIPE TRENCH



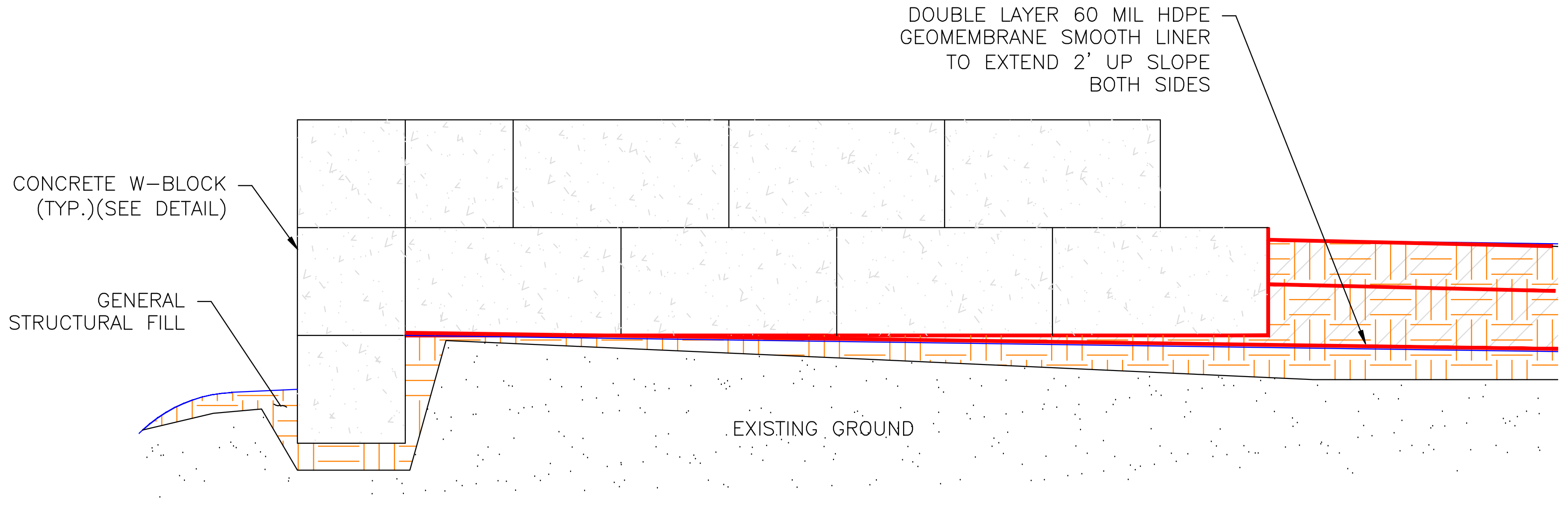
## DETAIL NN
## PRECAST PARAPIT SPACING



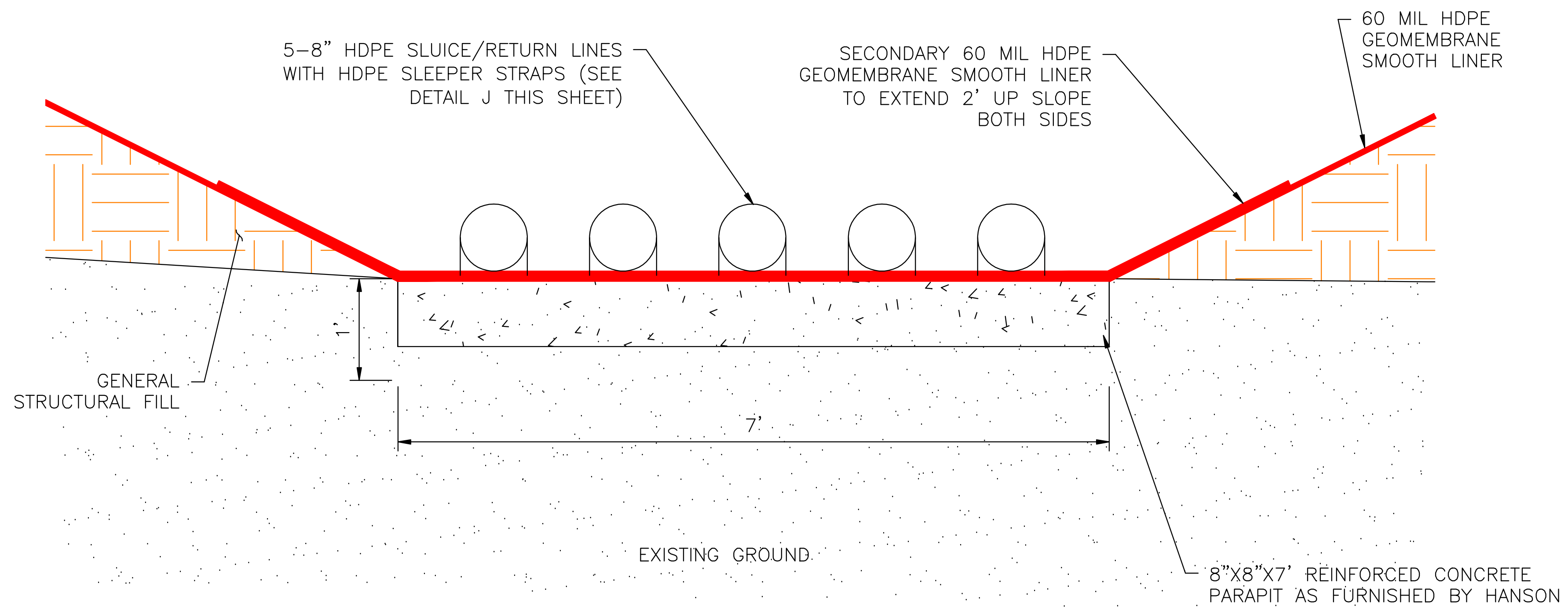
## SECTION LL-LL (E5C11043)
## TYPICAL ACCESS ROAD AND PIPE TRENCH



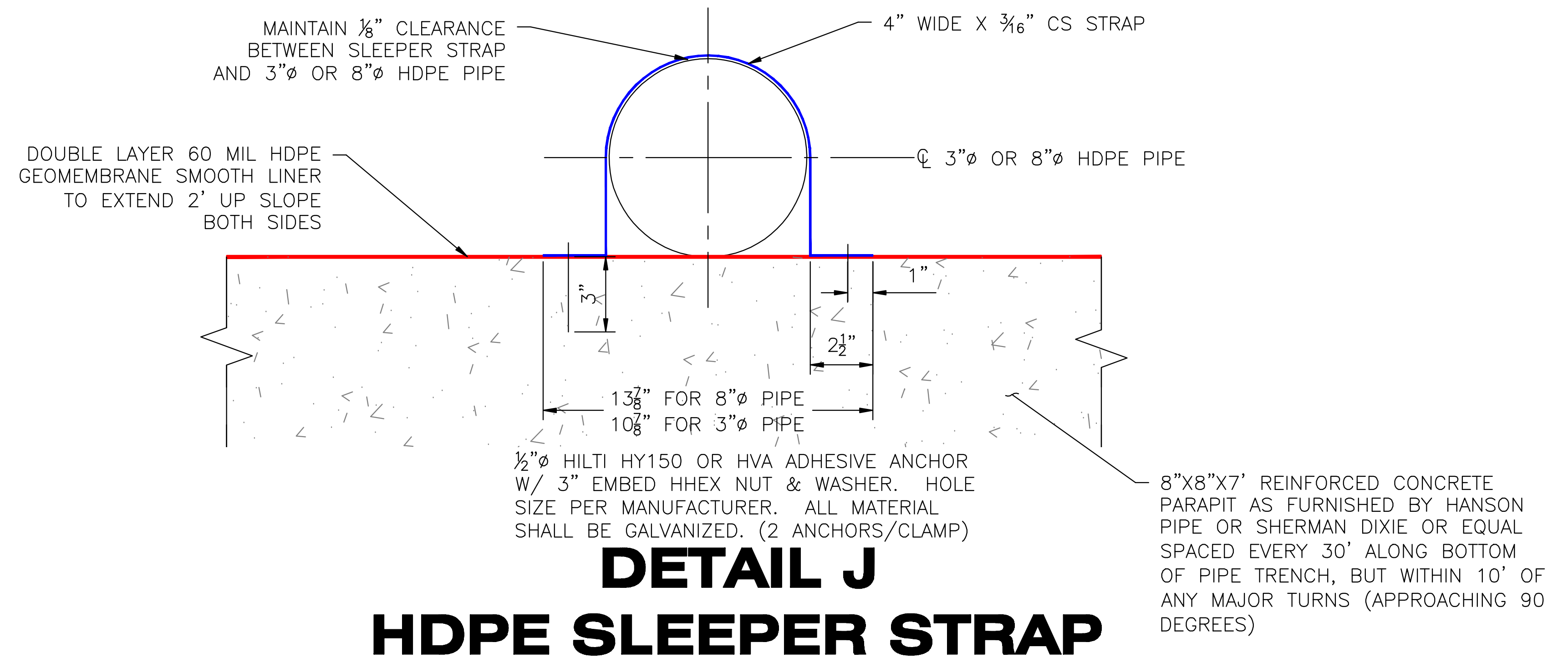
## SECTION HH-HH (E5C11042)
## TRENCH WALL



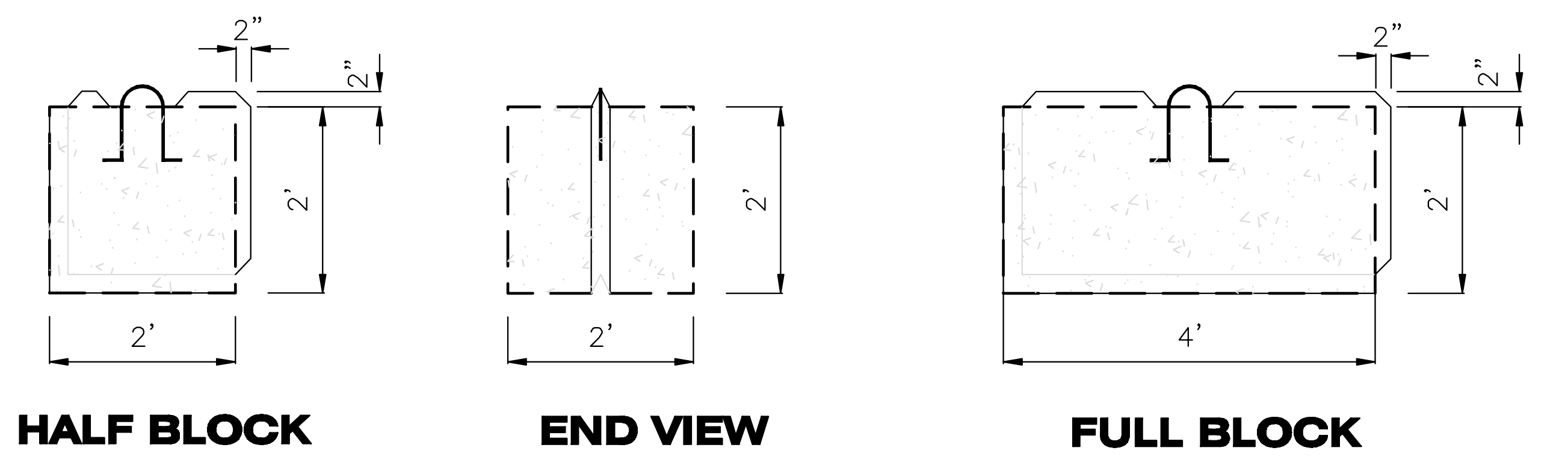
## SECTION GG-GG (E5C11042)
## TRENCH WALL



## DETAIL K
## PIPE TRENCH DETAIL



## DETAIL J
## HDPE SLEEPER STRAP



## DETAIL
## W-BLOCK

NOTE:
W-BLOCKS TO BE INSTALLED AS CLOSE AS POSSIBLE–MAX JT GAP ¼". JOINT SEALANT SHALL BE APPLIED TO INTERIOR JOINTS, AND SHALL BE A POLYSULFIDE RUBBER MATERIAL "THIOKOL 2235M" BY POLTSPEC (HOUSTON, TX. 281-397-0033) OR APPROVED EQUAL. INSTALLATION SHALL BE IN STRICT ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS.

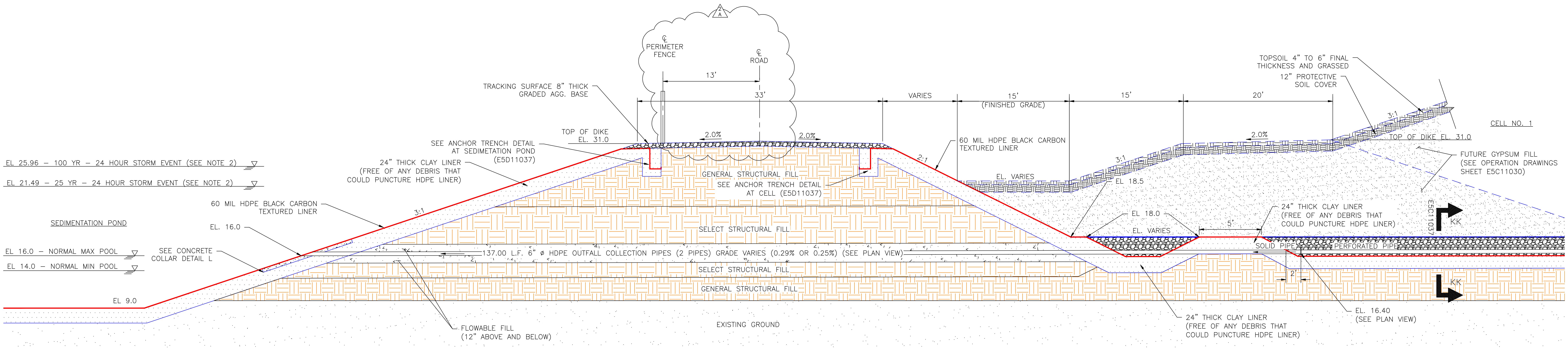
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1–ENTRANCE ROAD
DETAILS AND SECTIONS

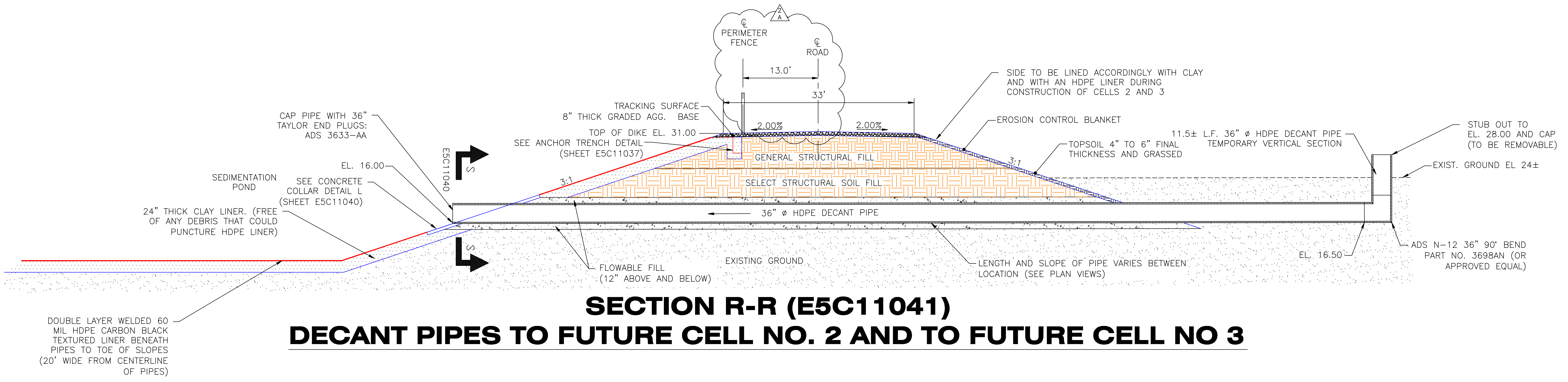
| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7-2-09 | A. CHANGED SECTION LL-LL BOX CULVERT TO U-DRAIN TRENCH | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | |
| 0 | 11-14-08 | ISSUED FOR CONSTRUCTION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N.T.S. | | E5C11044 | 1 | FINAL | 1 |

ANSI E: 44x34 Acad2004



## SECTION EE-EE (E5C11033 & E5C11034)
## OUTFALL COLLECTION PIPES



## SECTION R-R (E5C11041)
## DECANT PIPES TO FUTURE CELL NO. 2 AND TO FUTURE CELL NO 3

ADVANCED PRINT

| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 2 | 8-14-09 | A. D-5, G-5 ADDED PERIMETER FENCE AND DIMENSIONS | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 3-5-09 | A. F-8 STORM EVENT ELEVATIONS ADJUSTED FOR INCREASED POND VOLUME | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 0 | 11-14-08 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

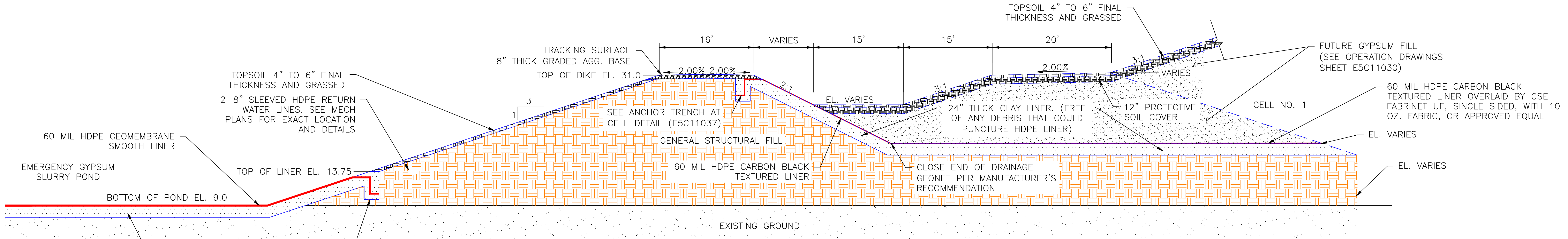
**Southern Company Generation
Engineering and Construction Services
FOR**

**Alabama Power Company**

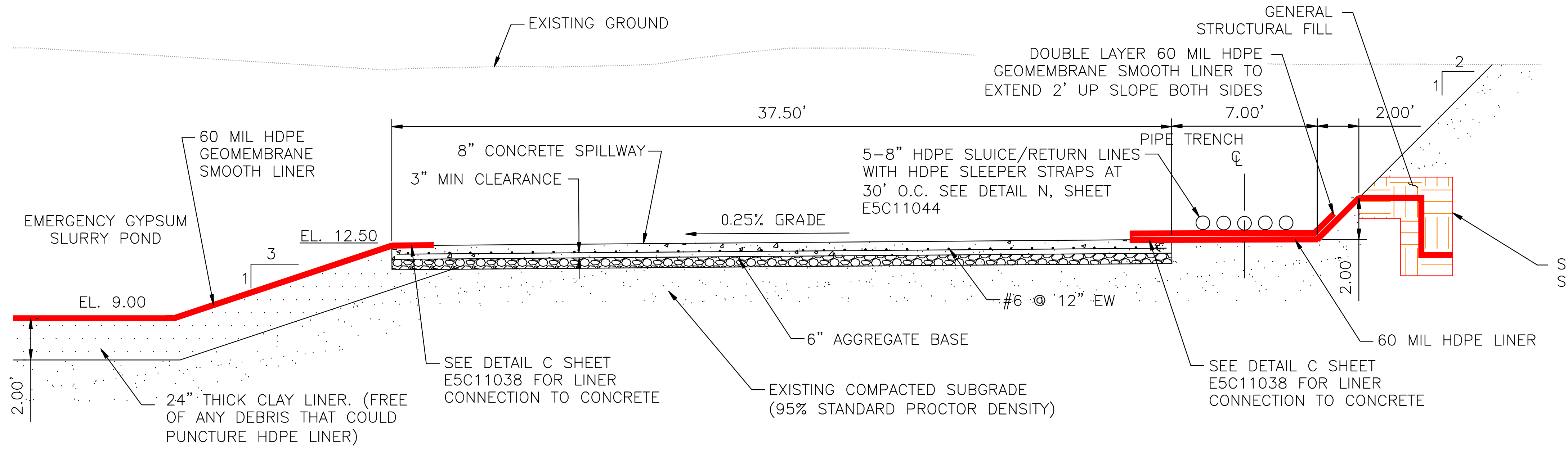
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1
MISCELLANEOUS SECTIONS AND DETAILS

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N.T.S. | | **E5C11045** | 1 | FINAL | 2 |

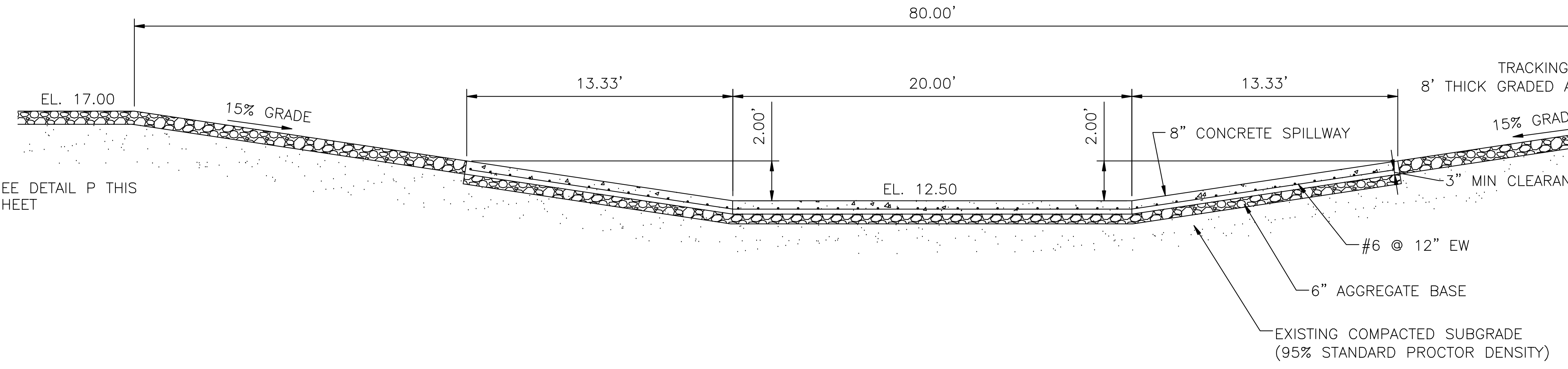
ANSI E: 44x34 Acad2004



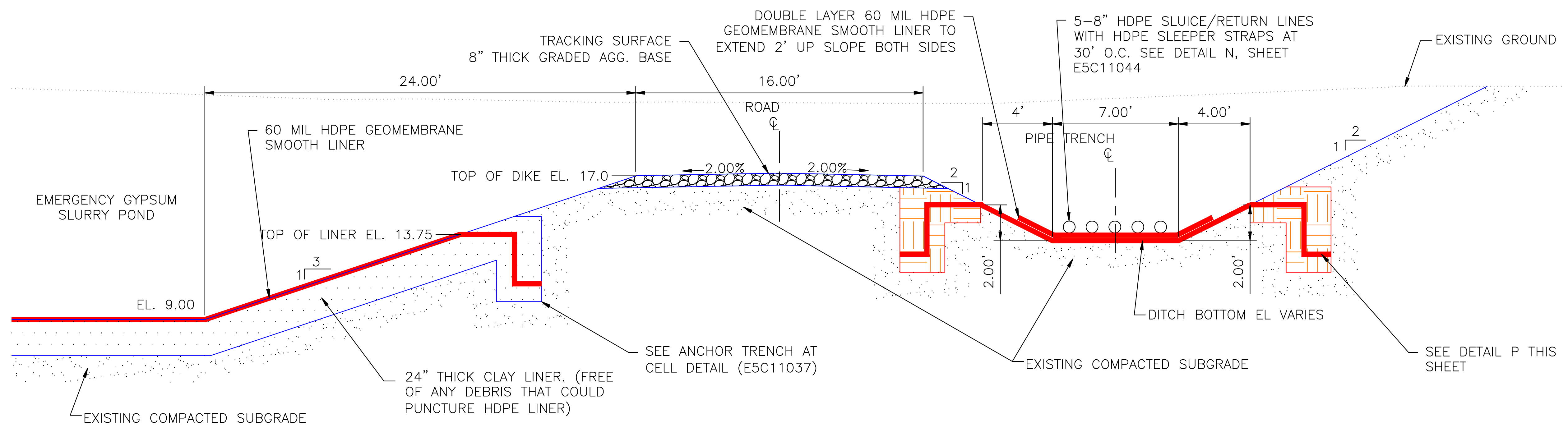
## SECTION RR-RR (E5C11033)
## TYPICAL DIKE SECTION THROUGH CELL



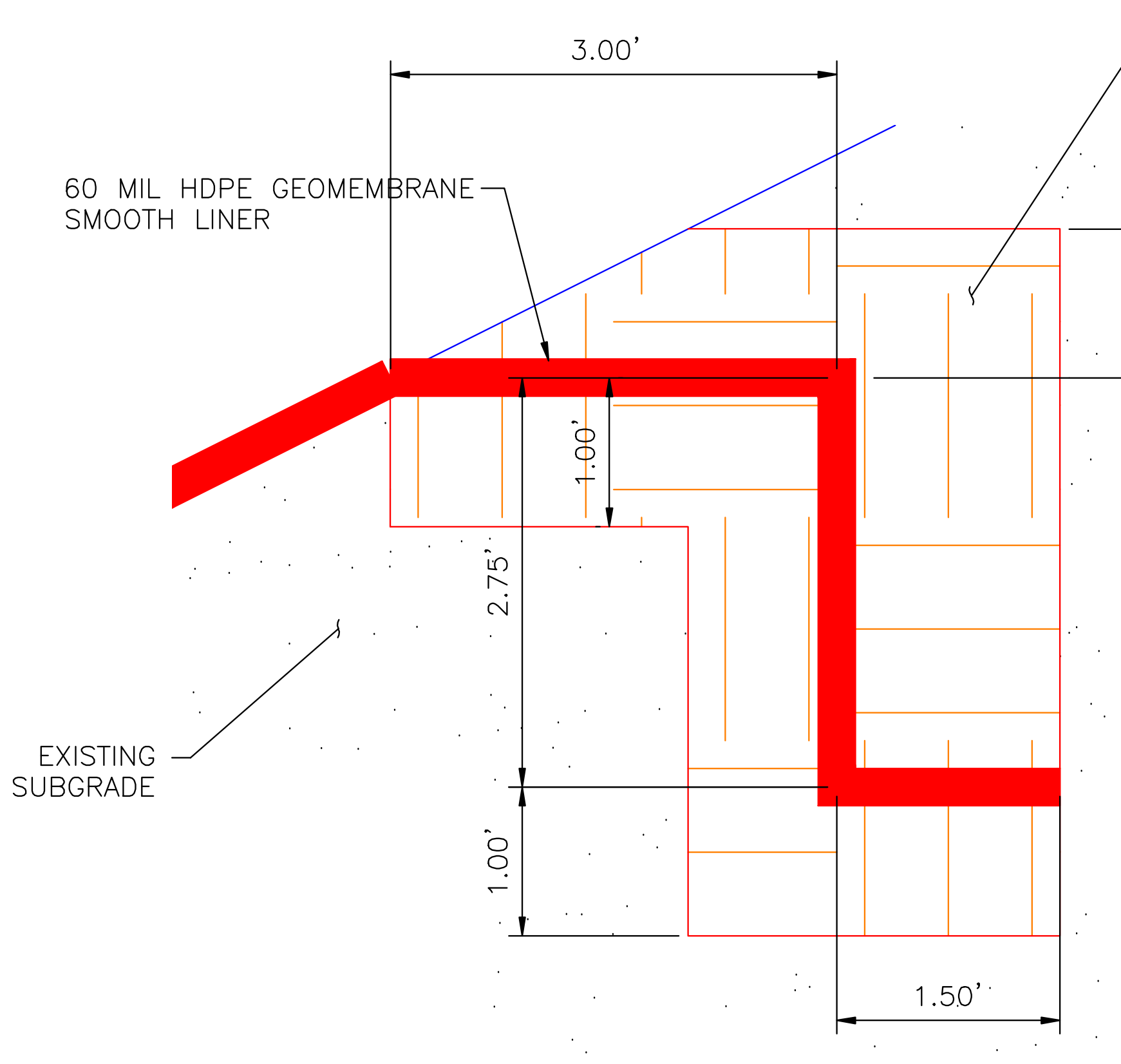
## SECTION X-X (E5C11033)
## EMERGENCY POND CONCRETE INLET STRUCTURE



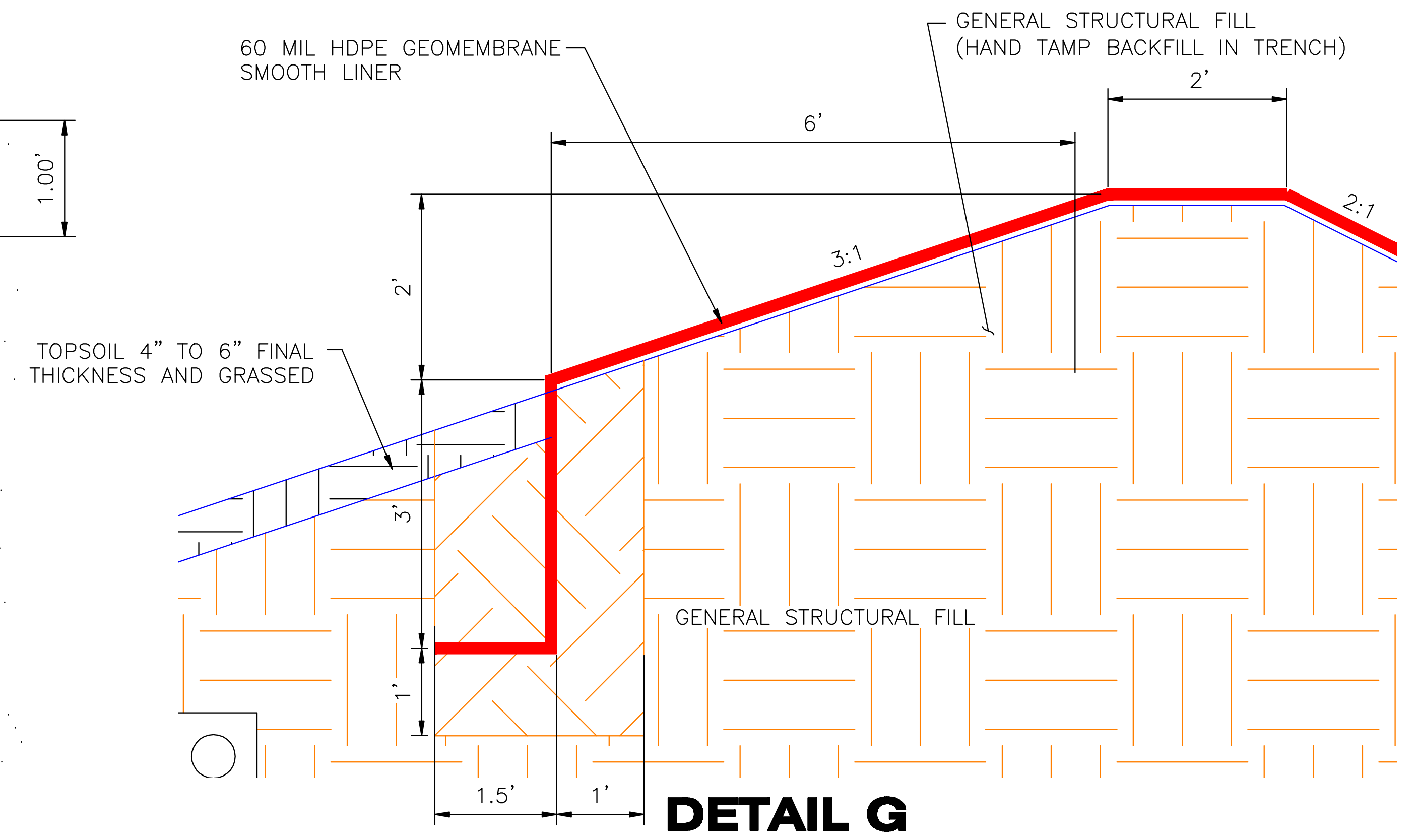
## SECTION JJ-JJ (E5C11033)
## EMERGENCY POND CONCRETE INLET STRUCTURE



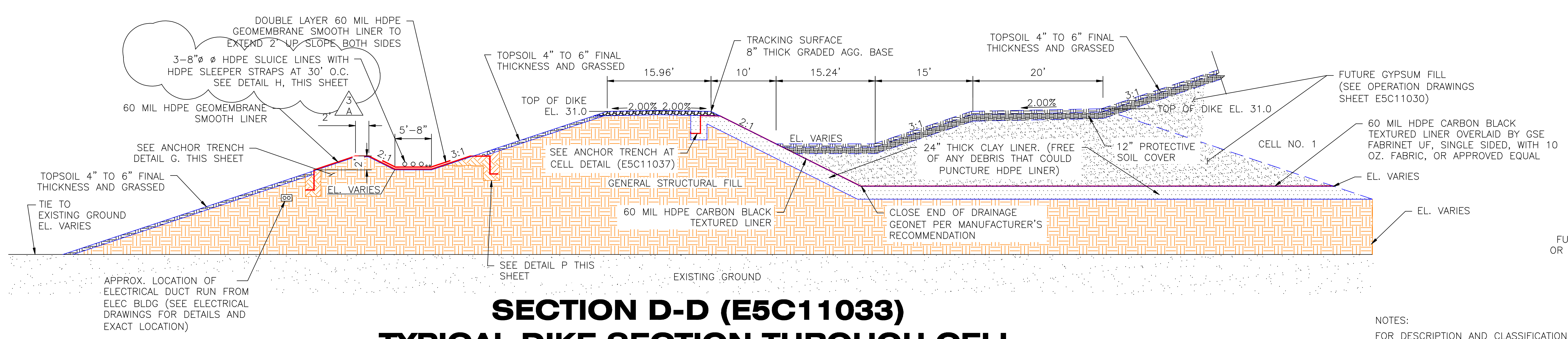
## SECTION CC-CC (E5C11033)
## TYPICAL SECTION THROUGH EMERGENCY POND



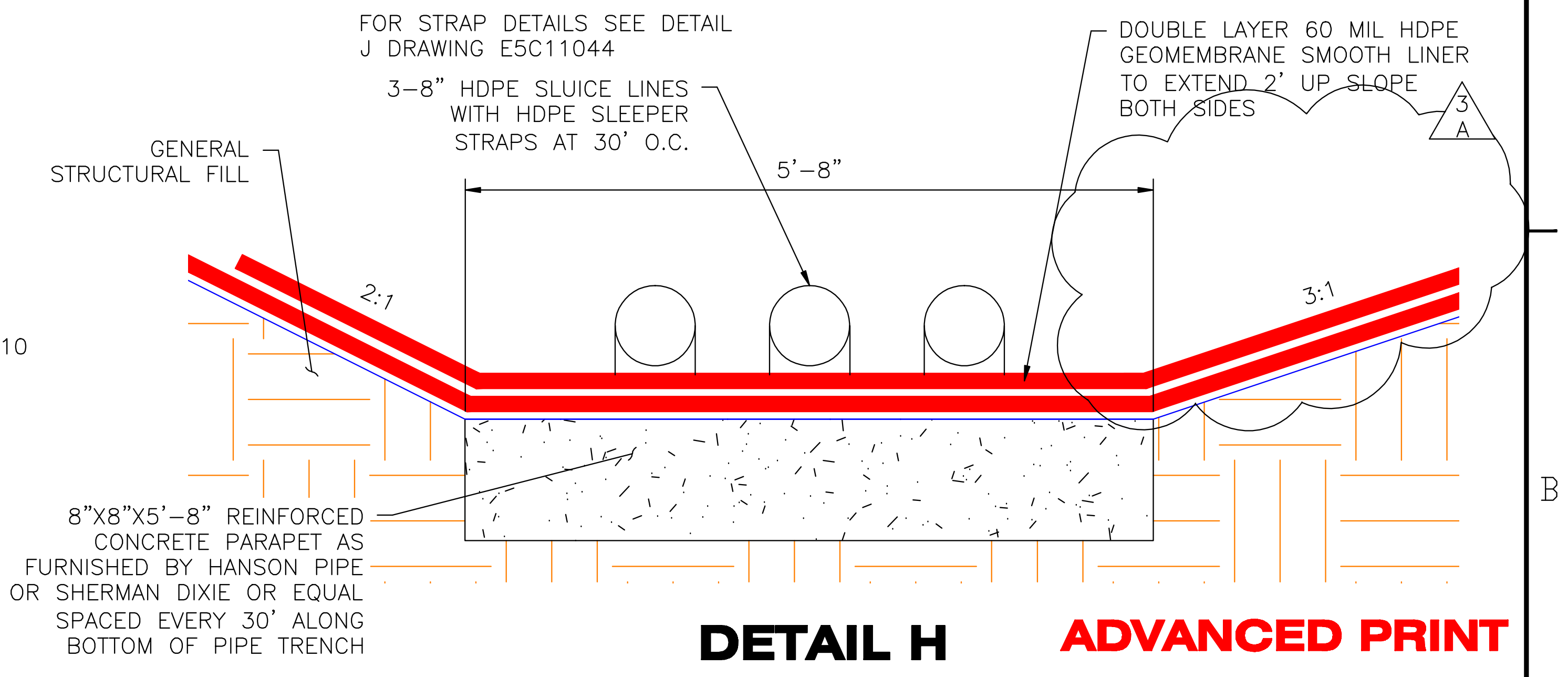
## DETAIL P
## LINER ANCHOR TRENCH



## DETAIL G
## LINER ANCHOR TRENCH



## SECTION D-D (E5C11033)
## TYPICAL DIKE SECTION THROUGH CELL



## DETAIL H

**ADVANCED PRINT**

## PRECAST CONCRETE SLAB W/SLEEPER STRAPS

NOTES:

FOR DESCRIPTION AND CLASSIFICATION OF GENERAL STRUCTURAL FILL, SELECT STRUCTURAL FILL AND CLAY LINER MATERIAL SEE TECHNICAL SPECIFICATIONS.

| REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION 3 | DATE 08-14-09 | REVISION 2 | DATE 07-01-09 | REVISION 1 | DATE 03-11-09 | REVISION 0 | DATE 11-14-08 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | A. B-1, B-7 DELETED 3"ø WATER LINES<br>EWO 2161DE | | A. B-1, B-7 ADDED 3"ø WATER LINES<br>EWO 2161DE | | A. D-7 ADDED APPROX LOCATION OF ELECTRICAL DUCT RUN<br>B. D-12 CHANGED CONCRETE PARAPET DIMENSION TO 8"X8"X5'-8"<br>EWO 2161DE | | ISSUED FOR CONSTRUCTION<br>EWO 2161DE | |

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

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

**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
EMERGENCY POND- TYPICAL SECTIONS

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N.T.S. | | E5C11046 | 1 | FINAL | 3 |

ANSI E: 44x34 Acad2004

OPERATIONS PLAN DRAWINGS
E5C11048 – CELL NO. 1 OPERATIONS PLAN–FINAL STACKING PLAN
E5C11049 – CELL NO. 1 OPERATIONS PLAN–SECTION A–A AND SECTION B–B
E5C11050 – CELL NO. 1 OPERATIONS PLAN–MISCELLANEOUS SECTIONS AND DETAILS
E5C11051 – CELL NO. 1 OPERATIONS PLAN–SIPHON INSTALLATION AND OPERATION DETAILS

REFERENCE DRAWINGS
SEE DRAWING INDEX E1C11030

# CELL NO. 1 - OPERATIONS AND CONSTRUCTION
# PERIMETER RIM DITCH PLAN

GRAPHIC SCALE
50 0 25 50 100 200
( IN FEET )
1 inch = 50 ft.

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

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 – OPERATIONS PLAN
PERIMETER RIM DITCH CONSTRUCTION

| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 09-04-09 | GENERAL REVISION | 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 0 | 12-31-08 | ISSUED FOR CONSTRUCTION | 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=50' | 210800 | **E5C11047** | 1 | FINAL | 1 |

ANSI E: 44x34 Acad2004

CELL 1–STORAGE CAPACITY AND STORAGE LIFE

DESIGN OF CELL BASED ON 0.6% SULFUR COAL
INCOMING FLOW RATE – 280,218 LBS/HR
GYPSUM PRODUCTION RATE = 26,462 LBS/HR = 231,807,120 LBS/YR

FINAL CELL 1 STACK (0.6% SULFUR)
STORAGE VOLUME CAPACITY – 730,458 CY = 19,722,366 C.F.
OR 1,380,565,620 LBS (ASSUMING 70 LBS/C.F.)
STORAGE LIFE – 5.96 YEARS

DESIGN OF CELL BASED ON 1.0% SULFUR COAL
INCOMING FLOW RATE – 288,718 LBS/HR
GYPSUM PRODUCTION RATE = 46,270 LBS/HR = 405,325,200 LBS/YR

FINAL CELL 1 STACK (1.0% SULFUR)
STORAGE VOLUME CAPACITY – 730,458 CY = 19,722,366 C.F.
OR 1,380,565,620 LBS (ASSUMING 70 LBS/C.F.)
STORAGE LIFE – 3.41 YEARS

DESIGN OF CELL BASED ON 2.5% SULFUR COAL
INCOMING FLOW RATE – 584,623 LBS/HR
GYPSUM PRODUCTION RATE = 111,909 LBS/HR = 980,322,840 LBS/YR

FINAL CELL 1 STACK (2.5% SULFUR)
STORAGE VOLUME CAPACITY – 730,458 CY = 19,722,366 C.F.
OR 1,380,565,620 LBS (ASSUMING 70 LBS/C.F.)
STORAGE LIFE – 1.41 YEARS

## CELL NO. 1 - OPERATIONS AND CONSTRUCTION FINAL STACKING PLAN

GRAPHIC SCALE
50 0 25 50 100 200
( IN FEET )
1 inch = 50 ft.

NOTES:

1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 09-04-09 | GENERAL REVISION | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 0 | 12-31-08 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

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

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1–OPERATIONS PLAN
FINAL STACKING PLAN

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
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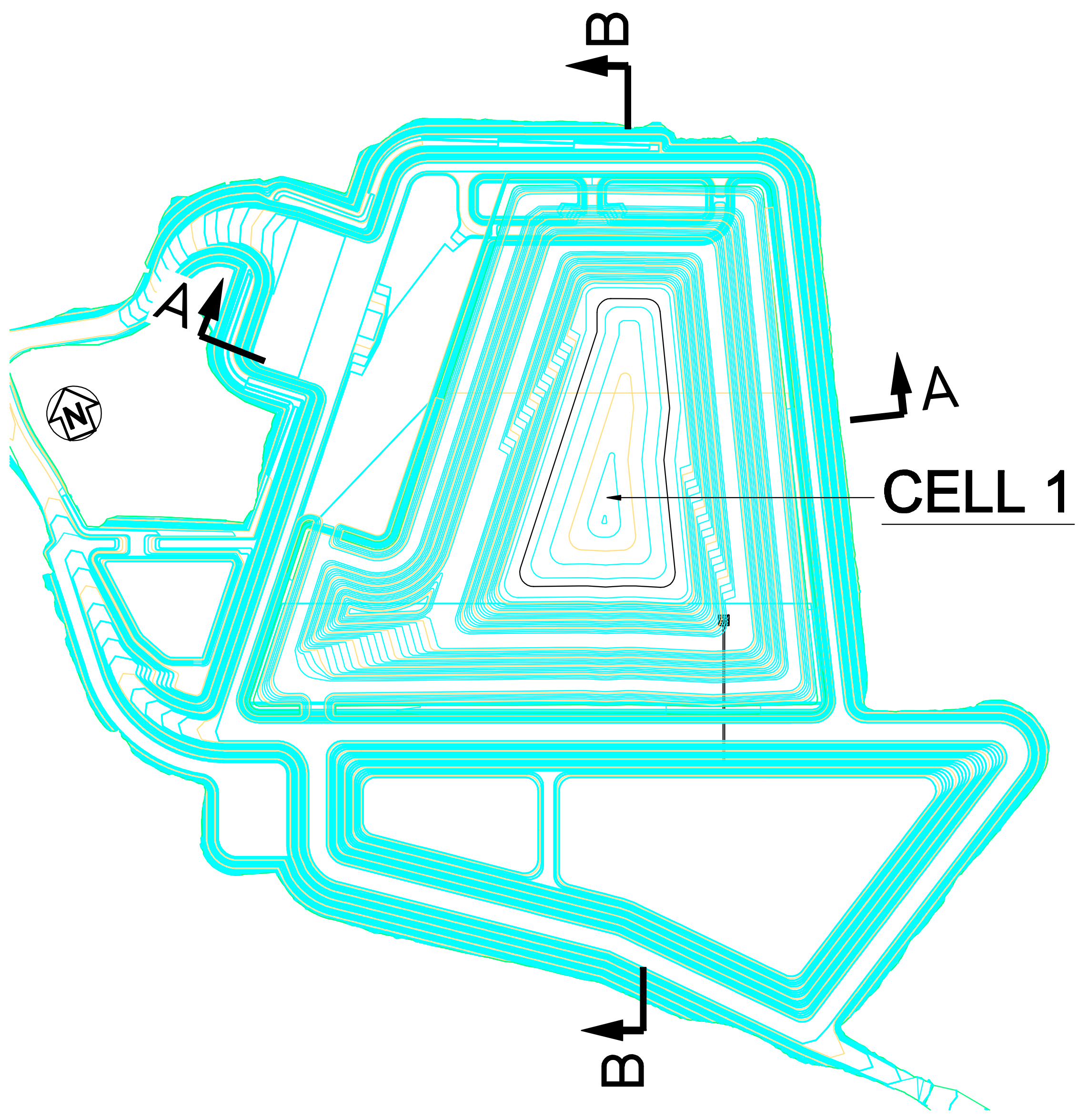
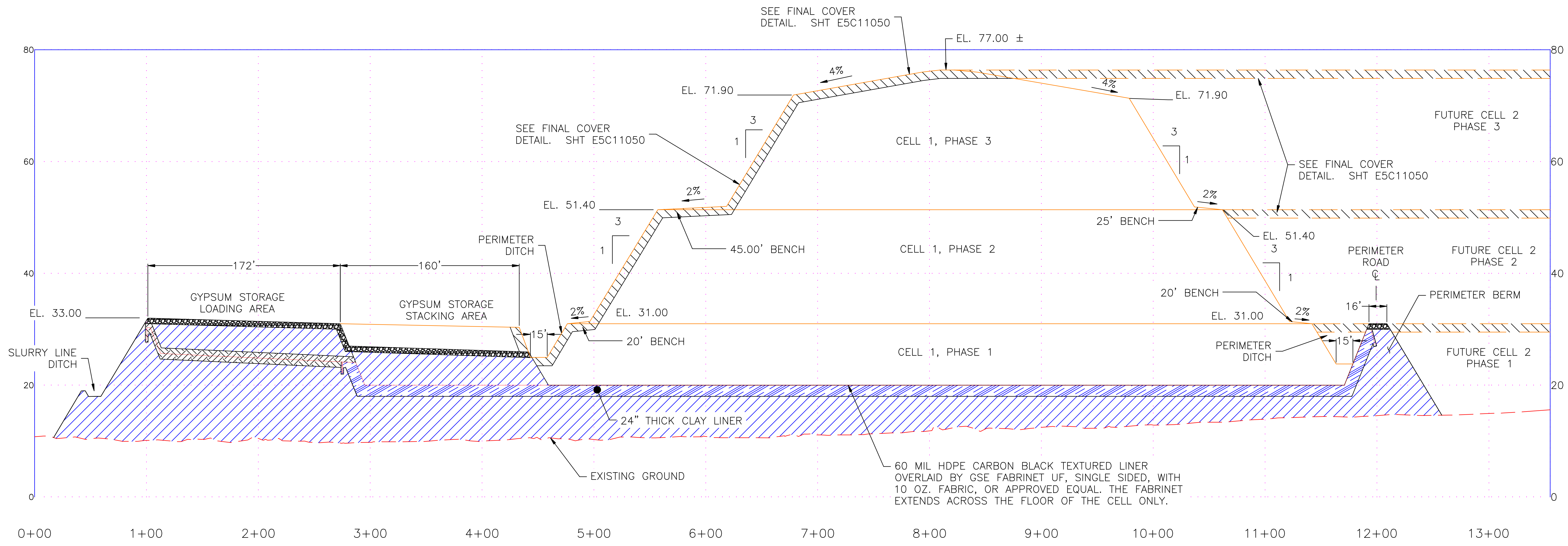
| 1"=50' | 210800 | **E5C11048** | 1 | FINAL | 1 |

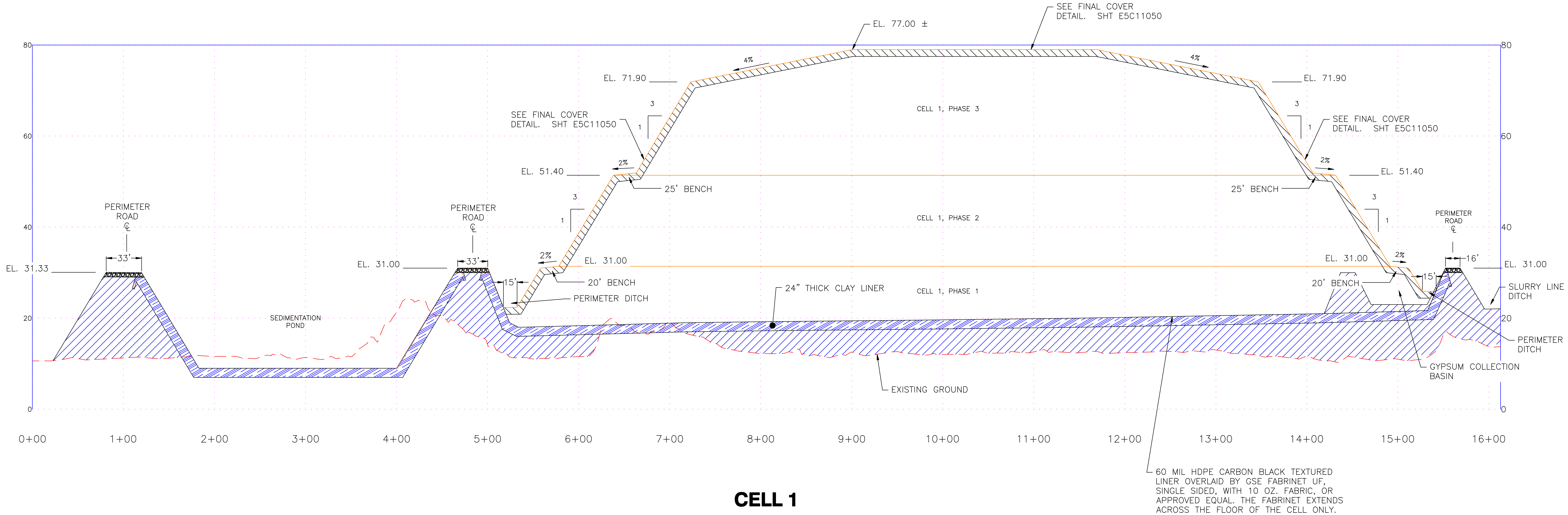
ANSI E: 44x34 Acad2004



## KEY PLAN
NOT TO SCALE



## CELL 1
## SECTION A-A
SCALE: H: 1"=50' V: 1"=10'



## CELL 1
## SECTION B-B
SCALE: H: 1"=50' V: 1"=10'

NOTES:

1. THE CAP AND CLOSURE SHOWN ON THIS SHEET IS INTENDED TO BE USED ONLY WHEN CELL 2 IS READY TO BE CLOSED AND CAPPED AND IS SHOWN HERE ONLY FOR CLARITY. FINAL STACK HEIGHT GRADES FOR CELL 1 WILL NEED TO ACCOUNT FOR THE 1.5 FEET OF CLOSURE CAP. CLOSURE AND CAPPING OF CELL 1 WILL NOT OCCUR UNTIL CELL 2 IS AT ITS FINAL STACK HEIGHT.

| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 09-04-09 | GENERAL REVISION | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 0 | 12-31-08 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

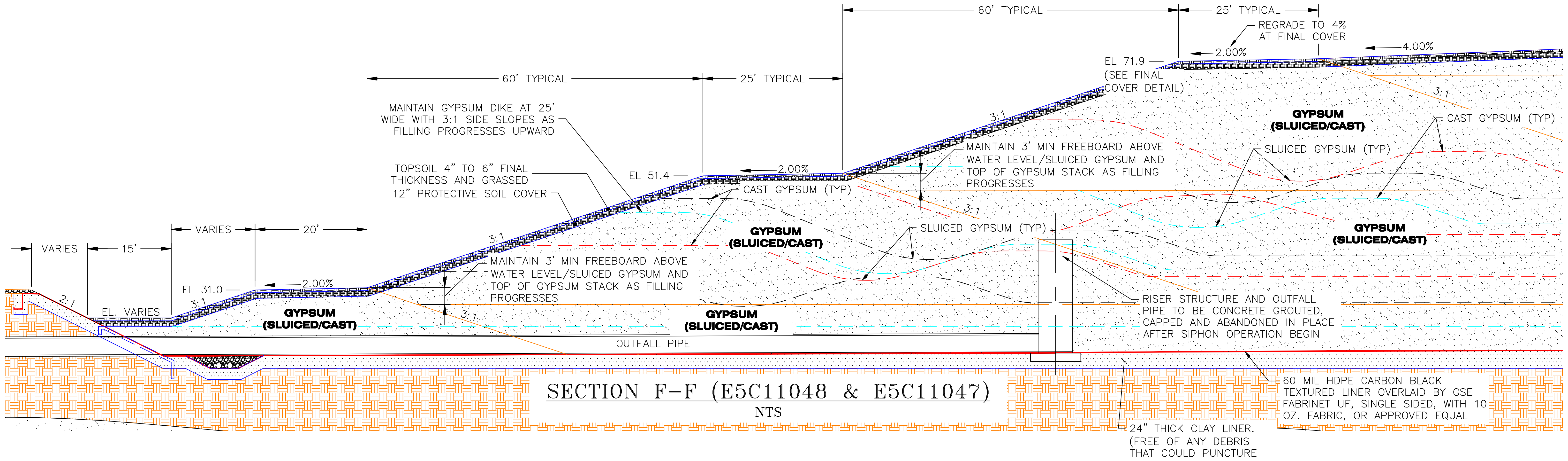
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

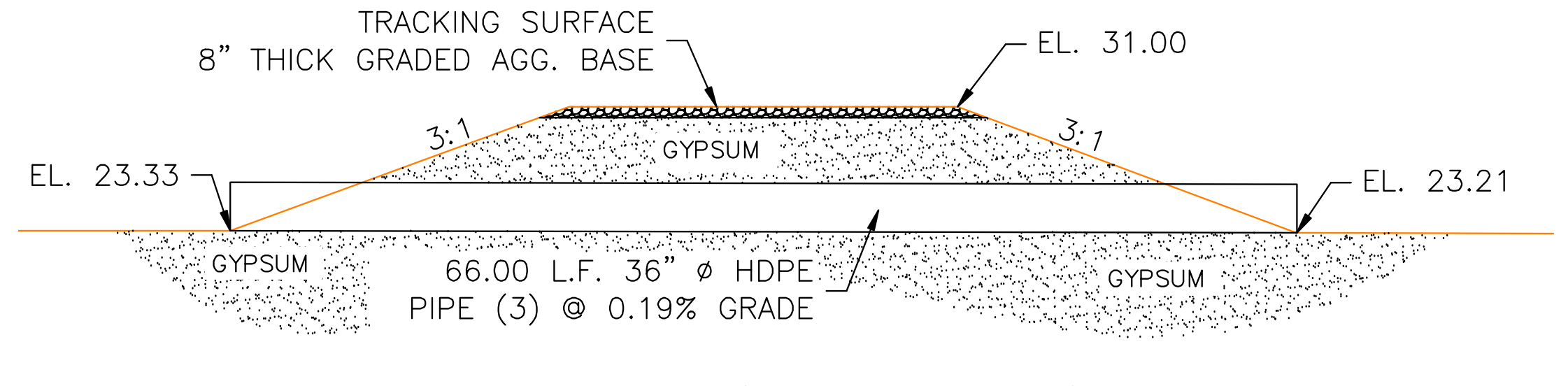
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 OPERATIONS PLAN
SECTION A-A & SECTION B-B

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| AS NOTED | 210800 | E5C11049 | 1 | FINAL | 1 |

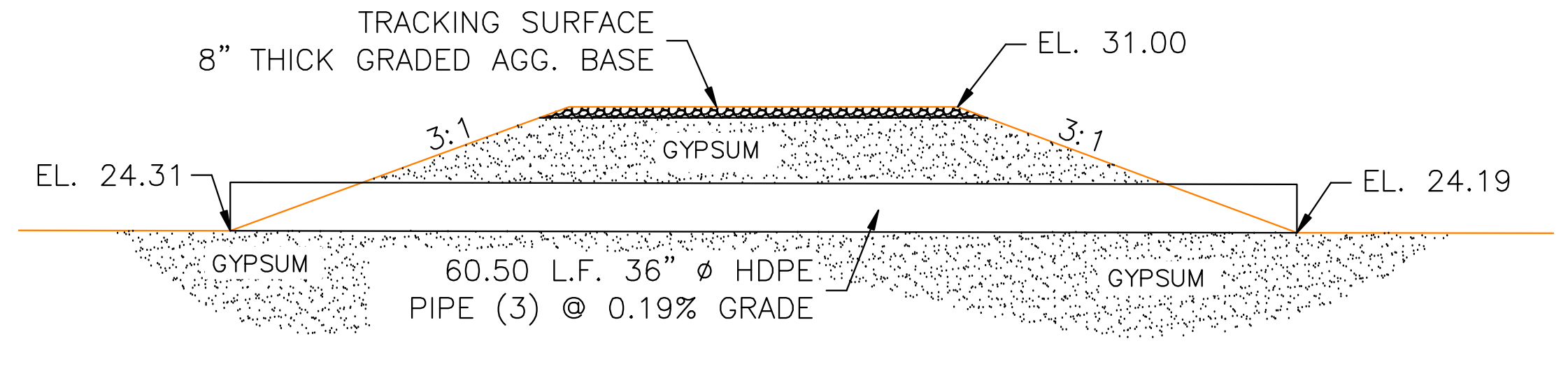
ANSI E: 44x34 Acad2004



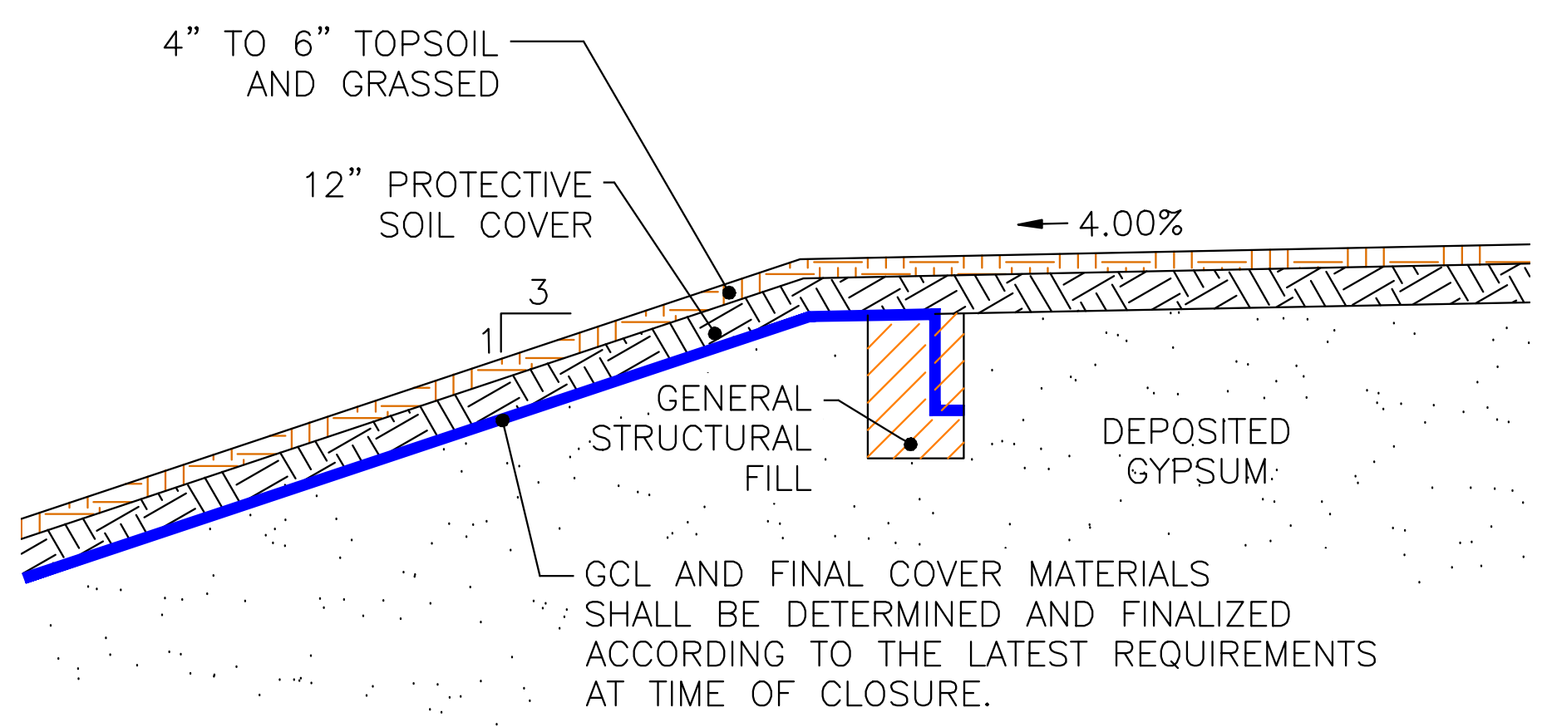
SECTION F-F (E5C11048 & E5C11047)
NTS



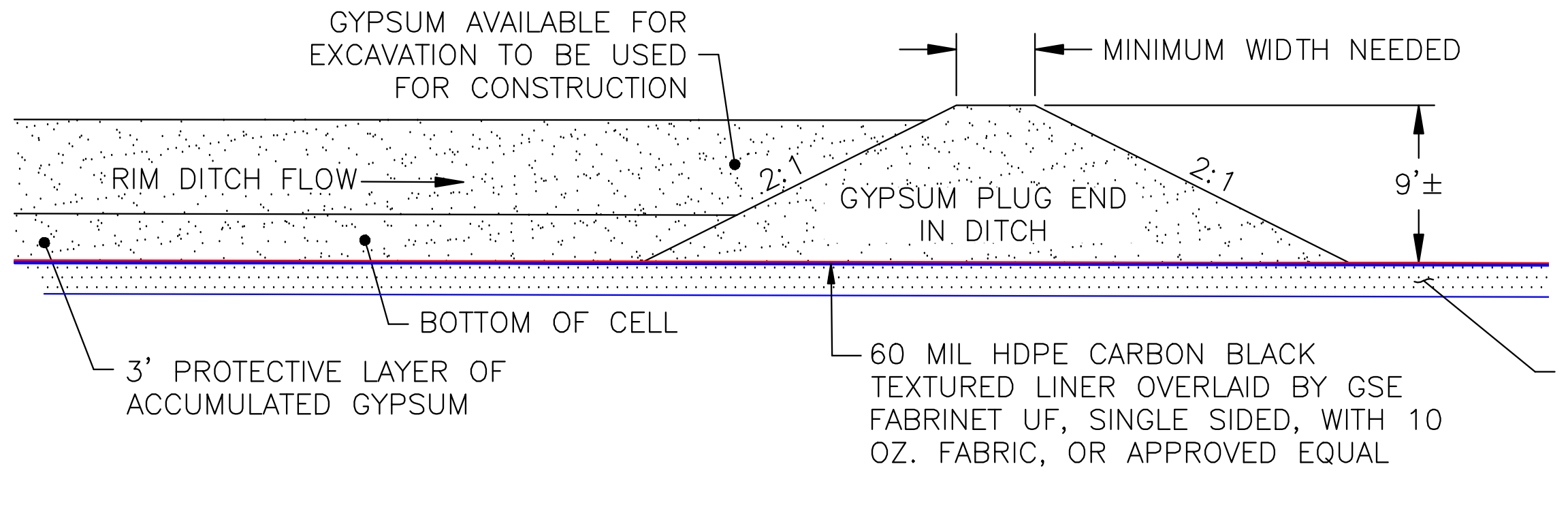
SECTION D-D (E5C11047)
NTS



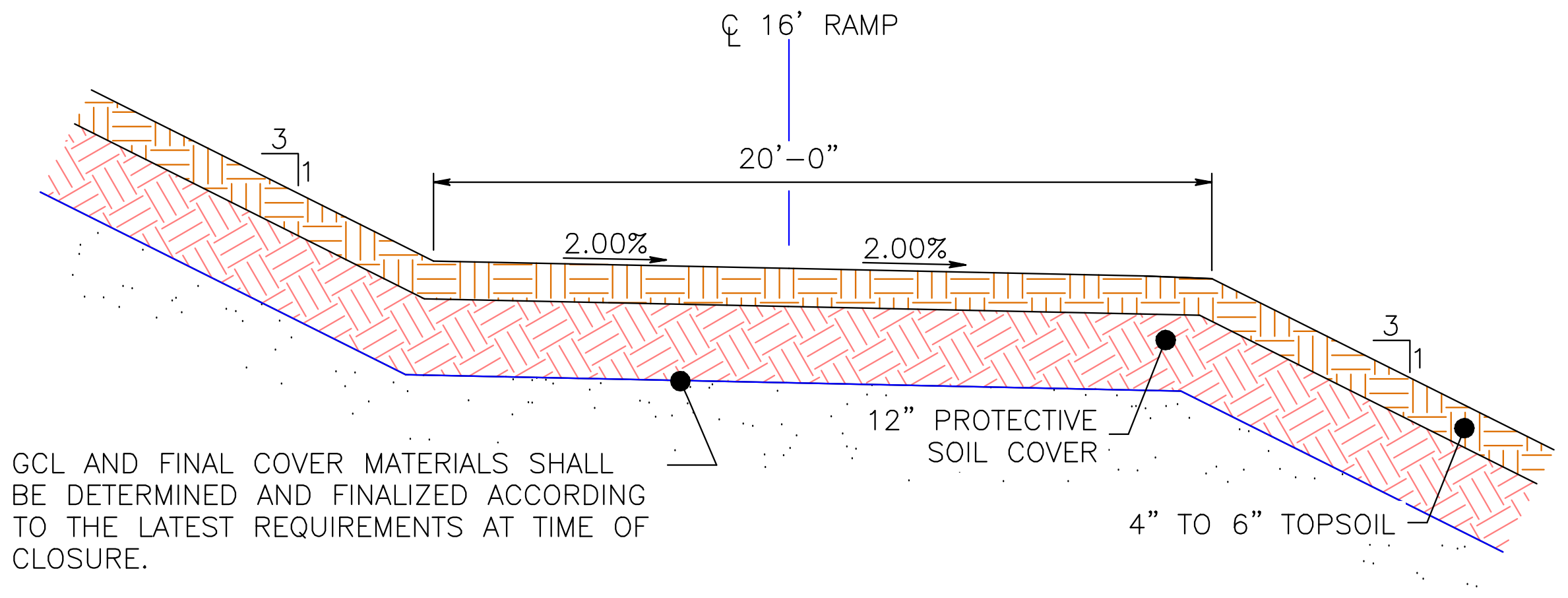
SECTION D'-D' (E5C11048)
NTS



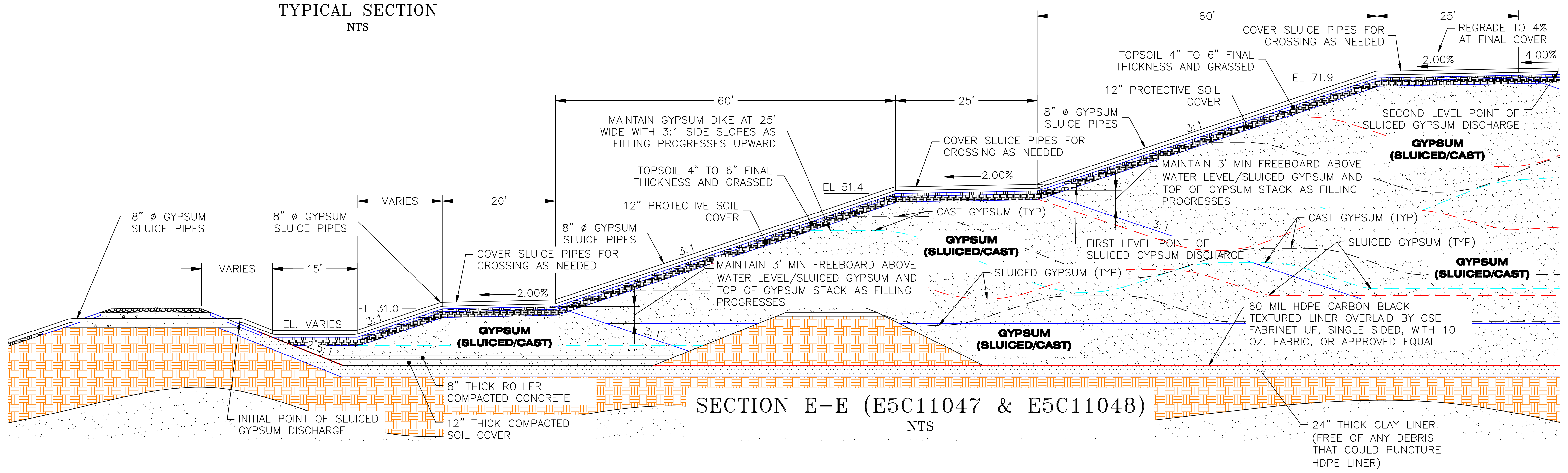
FINAL COVER DETAIL
NTS



END PLUG DETAIL
NTS



RAMP AT FINAL COVER
TYPICAL SECTION
NTS



SECTION E-E (E5C11047 & E5C11048)
NTS

NOTES

1. THE CAP AND CLOSURE DETAIL SHOWN ON THIS SHEET IS INTENDED TO BE USED ONLY WHEN CELL 2 IS READY TO BE CLOSED AND CAPPED AND IS SHOWN HERE ONLY FOR CLARITY. FINAL STACK HEIGHT GRADES FOR CELL 1 WILL NEED TO ACCOUNT FOR THE 1.5 FEET OF CLOSURE CAP. CLOSURE AND CAPPING OF CELL 1 WILL NOT OCCUR UNTIL CELL 2 IS AT ITS FINAL STACK HEIGHT.

PLAN OF OPERATION OF GYPSUM STORAGE AREA – CELL 1

1. THE OPERATION OF THE STORAGE FACILITY BEGINS WITH THE SLUICING OF GYPSUM INTO ONE OF THE GYPSUM COLLECTION BASINS. THE COLLECTION BASINS INCLUDE A PROTECTIVE COVERING OF SOIL AND ROLLER COMPACTED CONCRETE (RCC) THAT EXTENDS ACROSS THE BOTTOM OF THE BASINS ABOVE THE HDPE LINER. THESE BASINS PROVIDE AN INITIAL SOURCE OF GYPSUM MATERIAL WHICH CAN BE USED AS A CONSTRUCTION MATERIAL AND AN AREA TO PERMIT SAFE EXCAVATION. EXCAVATED GYPSUM FROM THESE AREAS WILL BE USED FOR THE INITIAL CONSTRUCTION OF THE PERIMETER RIM DITCHES AND GYPSUM BERMS.

2. AS THE BASIN FILLS WITH GYPSUM, SLUICE WATER WILL BE ALLOWED TO SPILL OVER A CONCRETE LINED SPILLWAY. ONCE THE BASIN IS COMPLETELY FILLED WITH GYPSUM, SLUICING WILL BE DIVERTED INTO THE OTHER BASIN, WHILE THE FIRST BASIN IS EXCAVATED. SLUICING AND EXCAVATION OPERATIONS WILL THEN ALTERNATE FROM ONE BASIN TO THE OTHER. AS THE RIM DITCHES ARE CONSTRUCTED, GYPSUM WILL ALSO BE ALLOWED TO SPILL THROUGH THE SPILLWAY FROM THE COLLECTIONS BASINS AND FLOW DOWN INTO THE RIM DITCHES.

3. THE RIM DITCHES SHALL BE CONSTRUCTED FROM EACH END OF THE BASINS AND WILL BE USED TO CONVEY GYPSUM ALONG THE INSIDE PERIMETER TO THE FAR DOWNSTREAM EXTENT OF THE CELL. OTHER ADJOINING LATERAL DITCHES WILL BE CONSTRUCTED INTO THE RIM DITCH AS NEEDED AND WHERE NEEDED TO CONVEY AND DEPOSIT GYPSUM THROUGHOUT THE CENTER OF THE CELL. THESE LATERAL DITCHES CAN BE CONSTRUCTED WHERE NEEDED BY CUTTING AN OPENING OUT OF THE RIM DITCH AND THEN TEMPORARILY PLUGGING THE RIM DITCH WITH GYPSUM AT THAT POINT.

4. WHEN GYPSUM ACCUMULATES IN THE RIM DITCH TO A SUFFICIENT DEPTH ABOVE THE HDPE LINER, AND ONLY AFTER THE EQUIPMENT OPERATOR GAINS EXPERIENCE WORKING WITH GYPSUM, THE GYPSUM CAN BE EXCAVATED FROM WITHIN THE RIM DITCH WITHOUT HAVING TO RETURN TO THE COLLECTION BASINS. A MINIMUM 3' PROTECTIVE LAYER OF ACCUMULATED GYPSUM IN THE RIM DITCH ABOVE THE LINER AND OTHER APPROPRIATE SAFEGUARDS (LIKE MARKING A BOOM) SHALL BE PUT IN PLACE TO PREVENT ACCIDENTAL DIGGING INTO THE DRAINAGE NET AND HDPE LINER. ONCE THERE IS A SUFFICIENT AMOUNT OF GYPSUM AVAILABLE FOR USE AS A CONSTRUCTION MATERIAL, THE GYPSUM COLLECTION BASINS WILL NO LONGER BE NEEDED. THE BASINS WILL EVENTUALLY BE ENGULFED BY THE STACK AND THE PERIMETER DITCH EXTENDED THROUGH THE AREA PREVIOUSLY OCCUPIED BY THE BASINS.

5. DURING FIRST LEVEL FILLING, SLUICE WATER WILL EXIT THE CELL THROUGH THE RISER ASSEMBLY STRUCTURE AND DECANT PIPE INTO THE SEDIMENTATION POND (SEE DRAWING E5C11036). INITIALLY TO FACILITATE CONSTRUCTION OF THE RIM DITCHES, THE WATER DEPTH IN THE CELL WILL BE SET AT 2 FT BY THE TWO 12 INCH DIA END PIPES LOCATED AT THE ENDS OF THE DRAIN BASINS OF THE RISER ASSEMBLY. AS FILLING PROGRESSES, THESE END PIPES WILL BE PLUGGED AND WATER WILL RISE AND OVERFLOW INTO THE TOP OF THE DRAIN BASINS. PVC RISER EXTENSIONS WILL BE ADDED WHEN NEEDED TO STAY ABOVE THE SETTLED GYPSUM ELEVATION. IDEALLY, TO FACILITATE CONSTRUCTION OF GYPSUM BERMS AND TO FACILITATE THE OPERATION OF CONSTRUCTION EQUIPMENT ON DRY GYPSUM MATERIAL, THE NORMAL OPERATING LEVEL IN THE POND SHOULD BE KEPT TO A MINIMUM. SPECIAL ATTENTION SHOULD BE EXERCISED TO ASSURE THAT GYPSUM STAYS WITHIN THE CELL AND DOES NOT ESCAPE THROUGH THE RISER ASSEMBLY DECANT PIPE.

6. IT SHOULD BE NOTED THAT IT WILL BE THE OPERATION CONTRACTOR'S OR MANAGER'S RESPONSIBILITY TO MAKE SURE THAT ALL EQUIPMENT OPERATORS ARE QUALIFIED AND UNDERSTAND THE CONDITIONS IN WHICH THEY ARE WORKING.

7. OPERATIONS WITHIN THE CELL MUST BE PERFORMED WITHOUT DAMAGING THE UNDERLYING DRAINAGE NET AND HDPE LINER FROM OPERATING EQUIPMENT. ANY DAMAGES CAUSED BY OPERATIONS, ANIMALS, OR ANY OTHER MEANS MUST BE REPORTED AND REPAIRED IMMEDIATELY.

8. WHEN CONSTRUCTING THE RIM DITCH BERMS, GYPSUM MATERIAL MUST BE PUSHED OUT TO A SUFFICIENT DEPTH ABOVE THE DRAINAGE NET AND LINER AHEAD OF CONSTRUCTION EQUIPMENT.

9. AFTER THE USEFUL LIFE OF THE RISER ASSEMBLY AND DECANT PIPE, A SIPHON SYSTEM WILL REPLACE THAT STRUCTURE FOR REMOVING WATER FROM THE CELL AT THE SUBSEQUENT LEVELS OF STORAGE. DURING CONSTRUCTION OF THE FIRST GYPSUM DIKE AND PRIOR TO THE DECOMMISSIONING OF THE RISER ASSEMBLY STRUCTURE AND DECANT PIPE, THE SIPHON WILL BE INSTALLED. THE INSTALLATION AND OPERATION PLAN, INCLUDING MAINTENANCE FOR THE SIPHON, IS CONTAINED ON DRAWING E5C11051. PRIOR TO CLOSING THE RISER ASSEMBLY AND DECANT PIPE (BY CAPPING AND CONCRETE GROUTING UP) THE SIPHON MUST BE CHECKED AND TESTED TO ASSURE THAT IT IS IN GOOD WORKING ORDER, AND THAT SIPHON OPERATORS HAVE A GOOD WORKING KNOWLEDGE OF IT'S OPERATION.

10. WHEN THE DIKE CONSTRUCTION FOR LEVEL 2 BEGINS, GYPSUM CONSTRUCTED COLLECTION BASINS CAN BE CONSTRUCTED IF DESIRED FOR LEVEL 2 AND 3 TO BE USED AS A SOURCE OF GYPSUM MATERIAL. A RIM DITCH WILL ALSO BE USED AS IN THE INITIAL LEVEL. THIS DITCH WILL ALSO BE CONSTRUCTED OUT OF GYPSUM AND USED IN THE SAME MANNER AS THE RIM DITCH FOR THE INITIAL LEVEL.

11. WHEN THE SIPHON IS MOVED TO CELL 2, THE CONCRETE THRUST BLOCKS AND CONCRETE ANCHORS SHALL BE REMOVED FROM THE SLOPE OF THE CELL.

12. FOR EACH SUBSEQUENT LEVEL OF GYPSUM SLUICING AND GYPSUM DIKE AND RIM DITCH CONSTRUCTION, THE SAME CONSTRUCTION TECHNIQUES AND OPERATIONS WILL APPLY. GYPSUM SLUICE LINES WILL BE PROGRESSIVELY EXTENDED UP THE SLOPE OF THE GYPSUM DIKES TO THE NEXT LEVEL AS FILLING PROCEEDS.

13. GYPSUM SLOPES SHALL BE MAINTAINED, AND GULLIES REPAIRED, AS NEEDED TO PREVENT EROSION UNTIL THE TIME OF FINAL COVER IS APPLIED.

14. AT CLOSURE, THE CELLS SHALL BE CLOSED ACCORDING TO LATEST REQUIREMENTS AT THAT TIME. THE GCL AND FINAL COVER MATERIALS WILL ALSO BE DETERMINED AND FINALIZED AT TIME OF CLOSURE.

15. INSPECTIONS OF THE EARTH DIKES AND GYPSUM FILL (STACKED) DIKES SHALL BE PERFORMED ON A ROUTINE BASIS, AS WELL AS AFTER ANY $\frac{1}{2}$ INCH OR GREATER RAINFALL EVENT.

16. MAINTENANCE AND REPAIR OF SLOPES SHALL BE PERFORMED AS NEEDED, AND SHALL INCLUDE THE MOWING OF GRASSED SLOPES TO FACILITATE INSPECTIONS AND TO PREVENT THE GROWTH OF TREES AND BUSHES.

PLACEMENT AND COMPACTION OF STACKED GYPSUM

1. PRIOR TO STACKING CAST GYPSUM, A TEST FILL PAD SHALL BE PREPARED ON DRY CAST GYPSUM, OR IN AN AREA OF SUITABLE FOUNDATION CONDITIONS, FOR DETERMINATION OF THE REQUIRED NUMBER OF EQUIPMENT PASSES TO ACHIEVE A MINIMUM OF 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY THE STANDARD PROCTOR METHOD, ASTM D698 (THE DRYING TEMPERATURE FOR ASTM D698 SHALL BE ADJUSTED TO 55°C, ± 5°C TO PREVENT DRYING OF CHEMICALLY BONDED WATER). FOR THE TEST PAD, GYPSUM SHALL BE PLACED IN LIFTS OF SIX TO EIGHT INCHES, NOMINAL LOOSE LIFT THICKNESS, AND COMPACTED WITH THE SELECTED COMPACTION EQUIPMENT. THE PLACEMENT MOISTURE CONTENT OF THE GYPSUM SHALL BE AT OPTIMUM MOISTURE CONTENT PLUS OR MINUS 2%. A MINIMUM OF THREE FIELD DENSITY TESTS, BY NUCLEAR METHODS OR SAND CONE DENSITY TESTING, SHALL BE PERFORMED AFTER TWO, FOUR, AND SIX PASSES OF THE COMPACTION EQUIPMENT. ADDITIONAL PASSES OF THE EQUIPMENT SHALL BE PERFORMED AS REQUIRED. THIS SAME PROCEDURE SHALL BE FOLLOWED UPON A CHANGE IN COMPACTION EQUIPMENT TO CONFIRM THE MINIMUM NUMBER OF PASSES. PRIOR TO COMPACTION, THE MOISTURE CONTENT OF THE GYPSUM SHALL BE DETERMINED AND ADJUSTED TO WITHIN PLUS OR MINUS 2% OF OPTIMUM, PER THE ABOVE MODIFIED PROCEDURES.

2. THE REQUIRED MINIMUM NUMBER OF PASSES FOR COMPACTION OF THE CAST/STACKED GYPSUM AT THE PLACEMENT MOISTURE CONTENT OF OPTIMUM PLUS OR MINUS 2% SHALL BE THE NUMBER OF PASSES WHERE THE 95% COMPACTION CRITERIA IS MET OR EXCEEDED, ALONG WITH A MAXIMUM LOOSE LIFT THICKNESS OF EIGHT INCHES.

3. TO ASSURE THAT THE PROCEDURE IS PRODUCING THE DENSITY AND STRENGTH OF MATERIAL REQUIRED FOR STABILITY, NUCLEAR METHODS OR SAND CONE DENSITY VERIFICATION TESTING SHALL BE PERFORMED AT RANDOM LOCATIONS ON AN AREA OF COMPACTED CAST GYPSUM ON A RANDOM BASIS TO BE DETERMINED BY THE PURCHASER'S REPRESENTATIVE. THE REQUIRED NUMBER OF PASSES SHALL BE VERIFIED BY ADDITIONAL, RANDOM FIELD DENSITY TESTING, AS SPECIFIED BY THE PURCHASER'S REPRESENTATIVE, AND UPON A CHANGE IN COMPACTION EQUIPMENT. A COPY OF ALL FIELD DENSITY TEST RESULTS SHALL BE PROVIDED TO THE PURCHASER'S REPRESENTATIVE AND THE PURCHASER'S GEOTECHNICAL ENGINEER.

4. IF THE SURFACE OF A GYPSUM LIFT IS EXPECTED TO BE EXPOSED FOR LONGER THAN 24 HOURS, THE SURFACE SHALL BE GRADED TO PREVENT PONDING OF PRECIPITATION AND ROLLED WITH A SMOOTH DRUM ROLLER TO SEAL THE SURFACE TO REDUCE INFILTRATION.

5. PRIOR TO PLACEMENT OF GYPSUM ON OR AGAINST THE SURFACE OF ANY PREVIOUSLY PLACED MATERIAL, ALL SOFT OR LOOSE MATERIAL AND ALL SURFACES CONTAINING CRACKS, GULLIES, OR EROSION FEATURES SHALL BE REMOVED OR REWORKED TO MEET A SATISFACTORILY DENSE FILL. THE PREVIOUSLY PLACED MATERIAL SHALL BE LOOSENED BY SCARIFYING, DISCING OR BLADING TO A MAXIMUM DEPTH OF 2 INCHES, AND THE MOISTURE CONTENT SHALL BE ADJUSTED TO MAXIMIZE THE COMPACTED DENSITY FOR THE GYPSUM MATERIAL.

**6. VIBRATORY ROLLERS ARE NOT ACCEPTABLE FOR COMPACTION OF THE GYPSUM.**

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

**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1–OPERATIONS PLAN
MISCELLANEOUS SECTIONS AND DETAILS

REVISION 1 DATE 09-04-09
GENERAL REVISION
EWO 2161DE

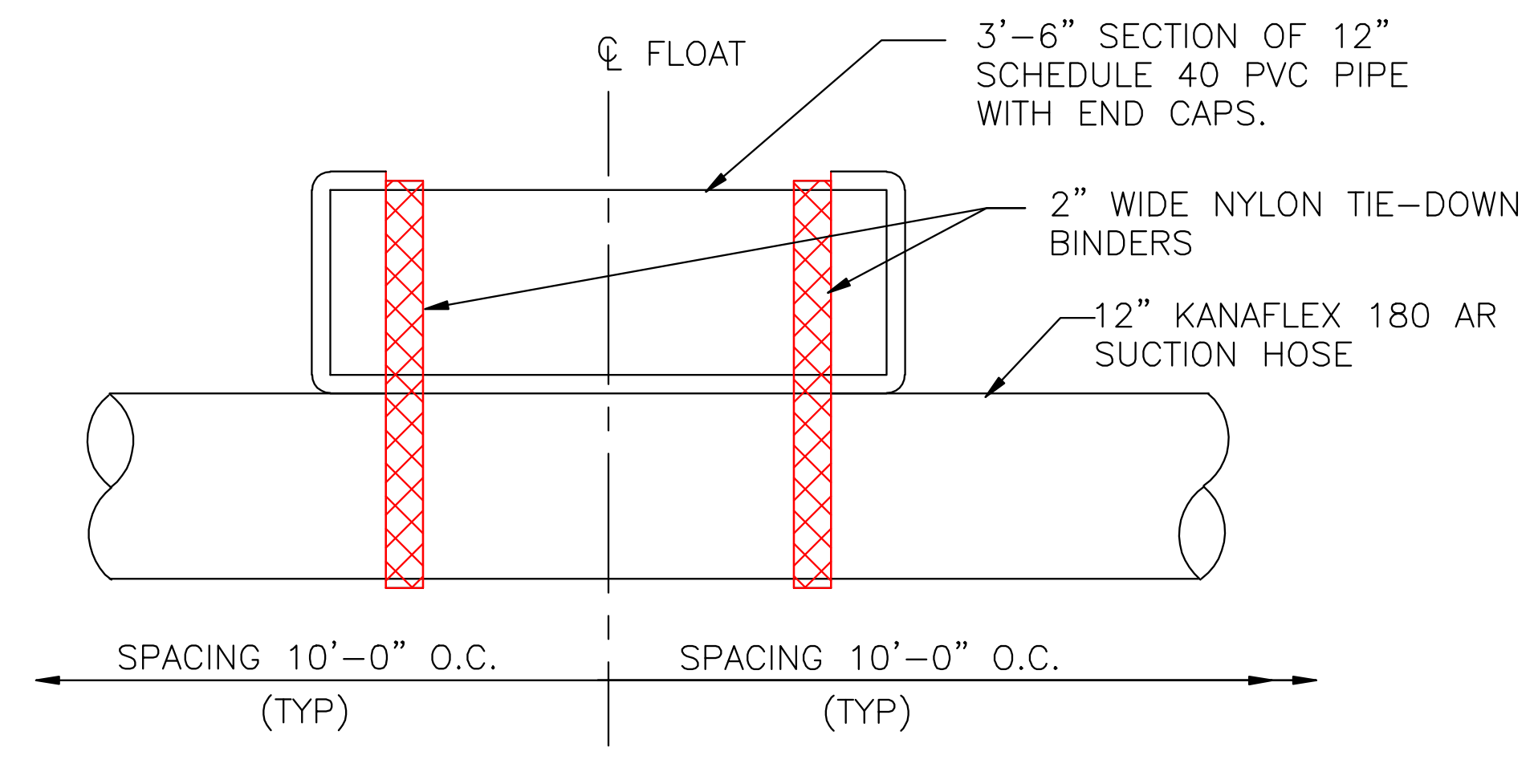
| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |

REVISION 0 DATE 12-31-08
ISSUED FOR CONSTRUCTION
EWO 2161DE

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

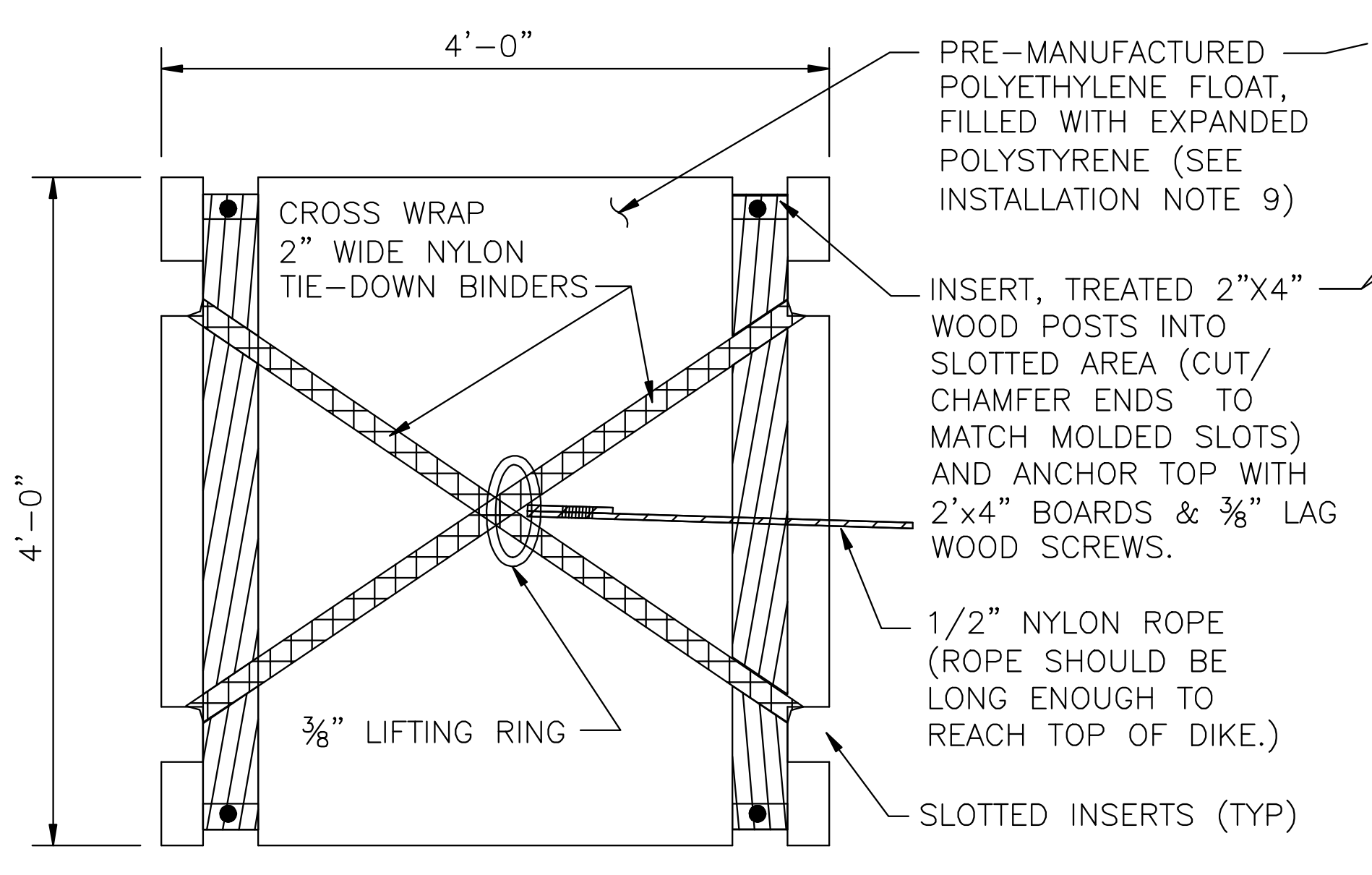
| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| AS NOTED | 210800 | **E5C11050** | 1 | FINAL | 1 |

ANSI E: 44x34 Acad2004

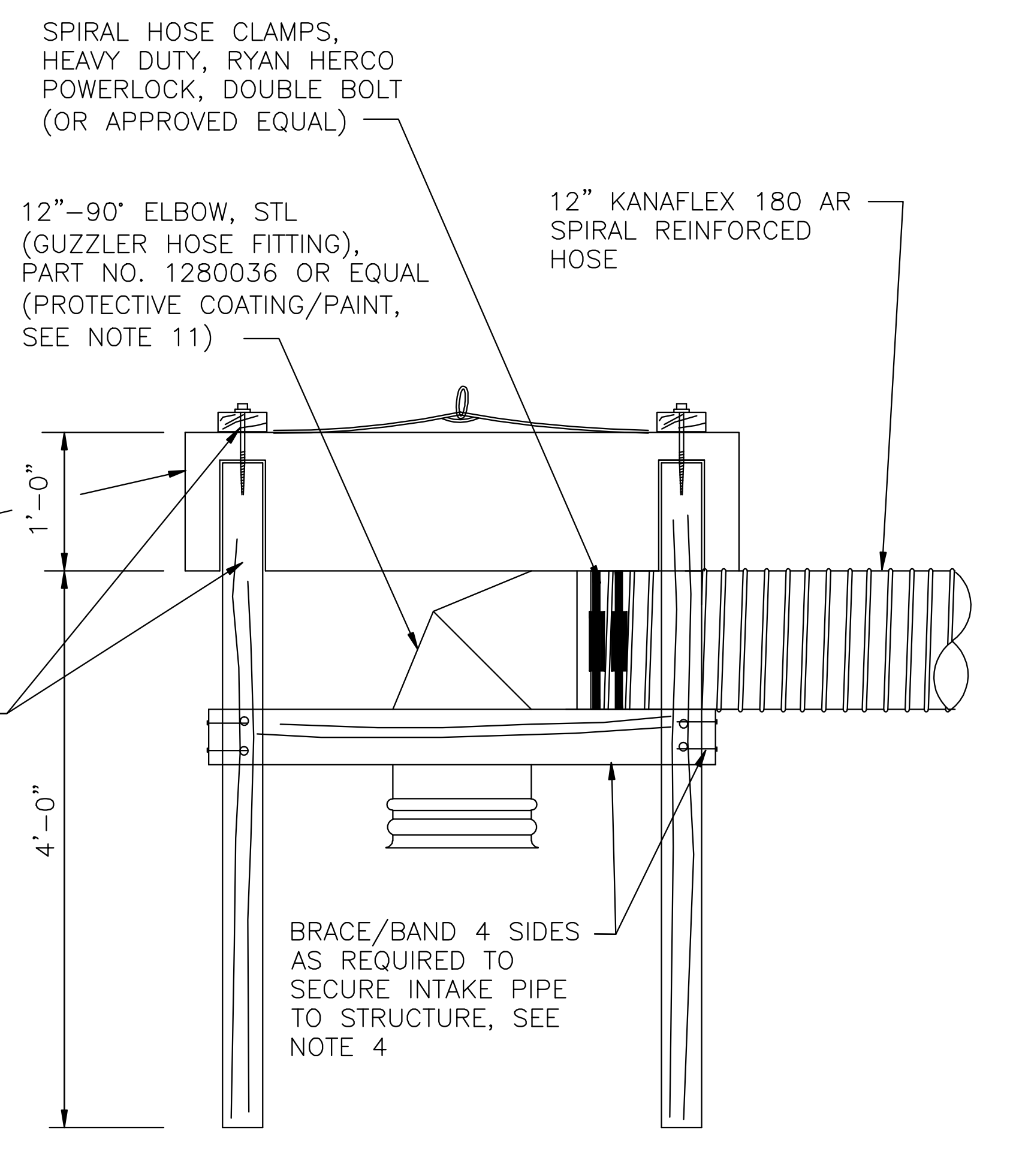


## SUCTION HOSE FLOAT

N.T.S.



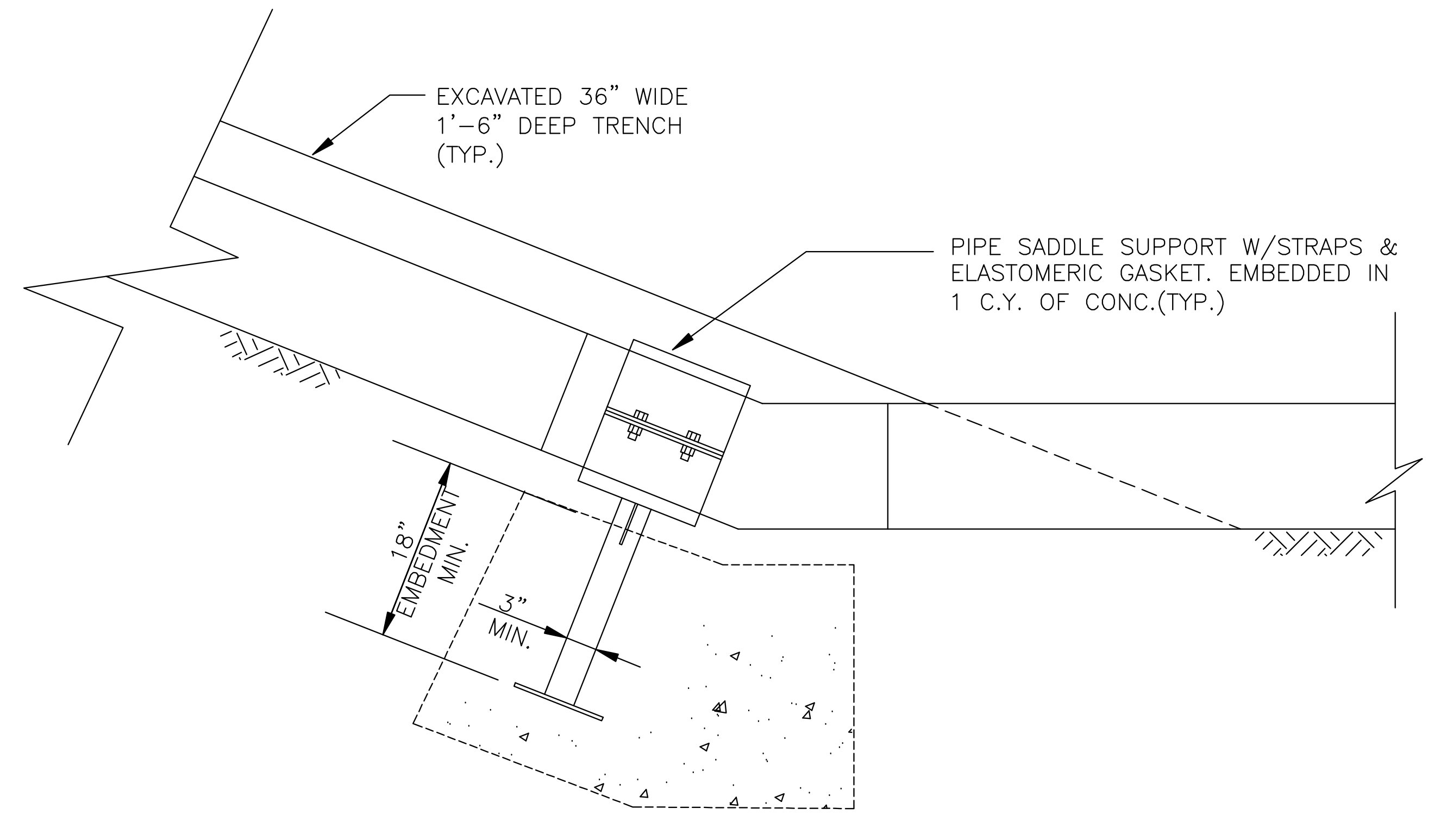
**TOP VIEW**



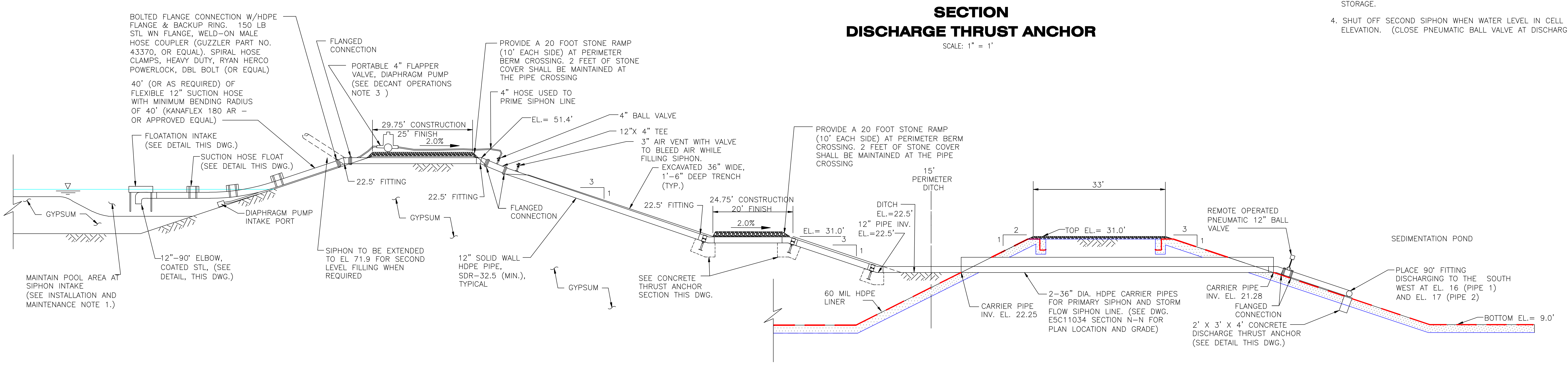
**END VIEW**

## POLYETHYLENE 4'X4'X1' FLOATATION INTAKE

N.T.S.



## SECTION
## THRUST ANCHOR



## SIPHON SECTION C - C (E5C11048)

SCALE: 1" = 10'

### METAL SURFACE COATINGS/PAINT:

1. ALL METAL SURFACES WHICH SHALL BE IN CONTACT WITH GYPSUM SLURRY OR DECANT OVER AN EXTENDED PERIOD OF TIME SHALL BE COATED BY THE MANUFACTURER WITH A CORROSION INHIBITIVE PAINT PROVEN EFFECTIVE AS A BARRIER TO THE GYPSUM PRODUCT (CALCIUM SULFATE DIHYDRATE) WITH THE EXCEPTION OF STAINLESS STEEL AND ALUMINUM WHICH DO NOT REQUIRE COATING. GALVANIZED STEEL SHOULD NOT BE SUBSTITUTED FOR MATERIAL SHOWN ON THE PLANS. GALVANIZED BOLTS, FITTINGS, ETC... WHERE INDICATED IN THE PLANS SHOULD NOT BE COATED.

2. PRODUCTS WITHOUT MANUFACTURER APPLIED PROTECTANT SHALL BE THOROUGHLY COATED AS DESCRIBED BELOW IN ACCORDANCE WITH SCS/ALABAMA POWER PAINT/COATING SPECIFICATIONS. PAINT COLOR SHALL BE AS DIRECTED BY ALABAMA POWER.

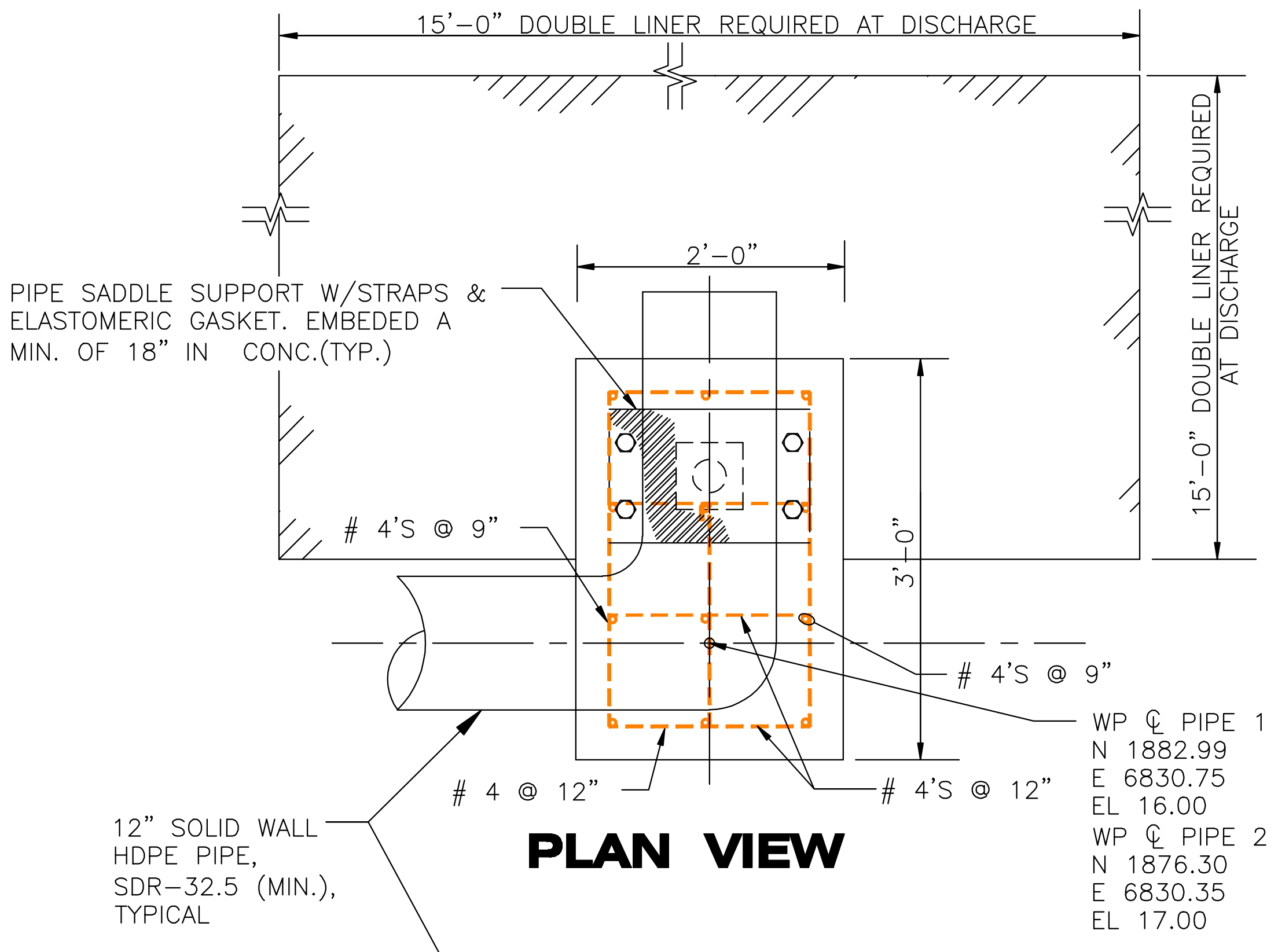
   –PRIME COAT: SHERWIN-WILLIAMS ZINC-CLAD II, ETHYL SILICATE, INORGANIC, ZINC-RICH COATING AT 2 TO 3 MILS DFT

   –MIDDLE COAT: SHERWIN-WILLIAMS MACROPOXY 646, EPOXY MASTIC AT 5 TO 7 MILS DFT

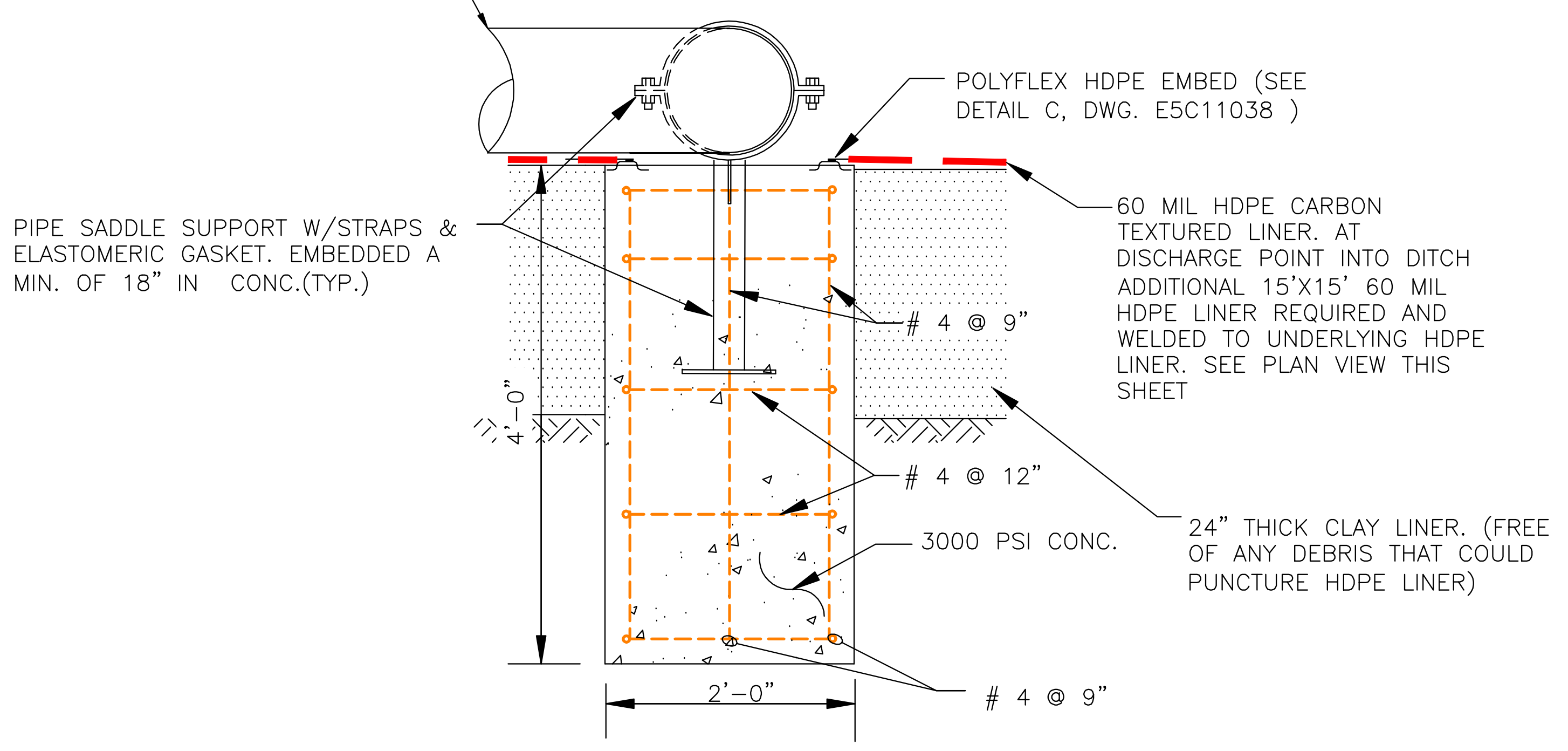
   –FINISH COAT: SHERWIN-WILLIAMS ACROLON 218 HS ACRYLIC POLYURETHANE, POLYURETHANE ENAMEL AT 2 MILS DFT

3. ALL SURFACES TO RECEIVE COATINGS SHALL BE THOROUGHLY PREPARED FOLLOWING MANUFACTURER'S GUIDELINES AND SCS/ALABAMA POWER SPECIFICATIONS. CONTRACTOR SHALL BE RESPONSIBLE FOR ADHERING TO ALL FEDERAL, STATE, AND LOCAL RULES AND REGULATIONS PERTAINING TO THE STORAGE/TRANSPORT AND APPLICATION OF PAINTS, COATINGS, SOLVENTS, ETC... INCLUDING THE DEPARTMENT OF LABOR'S OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION'S (OSHA'S) CURRENT REGULATIONS.

4. CONTRACTOR SHALL PROTECT VALVE STEMS AND OTHER SURFACES FROM OVERSPRAY.



**PLAN VIEW**



## SECTION
## DISCHARGE THRUST ANCHOR

SCALE: 1" = 1'

# SIPHON INSTALLATION AND OPERATION NOTES:

### INSTALLATION AND MAINTENANCE:

1. EXCAVATE GYPSUM TO MAINTAIN SUFFICIENT POOL AREA AT SIPHON INTAKE OF PPROPRIATE DEPTH DURING DECANT OPERATIONS OF CELL. 5' SUGGESTED, 3' MINIMUM DEPTH – WILL LOSE SIPHON AT 2' DEPTH).

2. SECOND SIPHON SHOULD BE CAREFULLY MAINTAINED, TESTED, AND SHOULD BE IN POSITION FOR USE AS REQUIRED DURING STORM EVENTS. INTAKE POINT OF THIS SIPHON SHOULD BE POSITIONED 50 FEET OR MORE FROM THE PRIMARY INTAKE SIPHON.

3. FLAG/PROTECT VALVES AND APPURTENANCES OF SIPHON TO PREVENT DAMAGE FROM TRAFFIC AT TOP OF DIKES.

4. SIPHON MUST BE MAINTAINED AIRTIGHT TO PREVENT LOSS OF SUCTION DURING OPERATIONS. FLEX HOSE OR HDPE SOLID WALL PIPE MUST NOT BE PIERCED BY ANY SUPPORTING SCREWS OR BOLTS WHEN ASSEMBLING APPARATUS.

5. WATER SUPPLY INTO SIPHON MAY BE PUMPED FROM CELL OR PLANT WATER.

6. UPPER SECTION OF SIPHON AT TOP-OF-DIKE SHOULD BE BURIED WITH A MINIMUM OF 2 FEET OF COMPACTED COVER ABOVE PIPE SUPPORTS. UPPER FOOT OF COVER SHOULD BE CRUSHED AGGREGATE BASE MATERIAL.

7. TO REMOVE ANY ACCUMULATED HARDENED GYPSUM FROM INSIDE SURFACE OF PIPE, OPERATOR MAY PERIODICALLY USE HAND-HELD RUBBER HAMMER STRIKING OUTSIDE SURFACE OF MAIN SIPHON LINE. CARE SHOULD BE TAKEN TO PREVENT DAMAGE TO SIPHON VALVES/APPURTENANCES. MOTOR OPERATED EQUIPMENT SHOULD NOT BE USED TO STRIKE SIPHON.

8. SIPHON OPERATIONS WILL BE LIMITED DUE TO AVAILABLE HEIGHT DIFFERENTIAL BETWEEN INTAKE IN GYPSUM CELL AND DISCHARGE OUTLET END OF SIPHON. SIPHON WILL ONLY WORK AT DIKE ELEVATION HEIGHTS: CELL#1 EL. 51.4 AND ABOVE.

9. A PRE-MANUFACTURED 4'X4'X12" POLYETHYLENE DOCK FLOAT SECTION WITH EXPANDED POLYSTYRENE FILL AS SHOWN IN DETAILS MAY BE ACQUIRED AT WWW.PROTATCH.COM OR AN APPROVED EQUAL MAY BE PROVIDED.

10. THE SIPHON PIPE RUNNING DOWN OUTER SLOPE OF STACKS SHOULD BE PLACED IN AN EXCAVATED TRENCH TO CONTROL MOVEMENT OF PIPE FROM EXPANSION/ CONTRACTION OF HDPE AND THRUST OF SIPHON DURING OPERATIONS. THIS TRENCH SHOULD NOT BE BACKFILLED AS THERE WILL BE A NEED TO REMOVE GYPSUM DEPOSITS ACCUMULATING ALONG THE LENGTH OF THE PIPE (SEE NOTE 8 ABOVE). THE PIPE SHOULD NOT BE ENCASED IN THE CONCRETE THRUST BLOCKS BUT SHOULD BE SECURELY ATTACHED TO THE CONCRETE USING PIPE SADDLE SUPPORTS W/STRAPS AND ELASTOMERIC GASKET.

11. ALL METAL SURFACES OF THE SIPHON ASSEMBLY ARE TO BE COATED AS OUTLINED IN METAL SURFACE COATINGS/PAINT NOTES ON THIS DRAWING.

### DECANT OPERATIONS:

1. SUBMERGE INTAKE OF PIPE BELOW POOL ELEVATION OF GYPSUM CELL. ALLOW FOR SUFFICIENT SUBMERGENCE TO PREVENT LOSS OF PRIME IN SIPHON IF AIR IS ALLOWED INTO INTAKE. A CLEAR POOL IN THE AREA OF THE INTAKE MUST BE MAINTAINED DURING COURSE OF CELL DECANTING.

2. CLOSE GATE VALVE AT PIPE DISCHARGE END. VALVE SHOULD BE A PNEUMATICALLY OPERATED BALL VALVE WHICH CAN BE OPERATED FROM THE TOP OF DIKE AREA TO FACILITATE SEQUENCE OF OPERATION/FILLING OF SIPHON.

3. OPEN AIR VENT VALVE AND OPEN WATER SUPPLY VALVE AT TOP OF SIPHON/DIKE AND FILL DISCHARGE PIPE FROM DOWNSTREAM BALL VALVE UNTIL WATER DISCHARGES FROM THE AIR VENT.

4. TURN OFF WATER SUPPLY WHEN DOWNSTREAM PIPE IS FILLED AND CLOSE AIR VENT VALVE.

5. OPEN DISCHARGE VALVE (PNEUMATIC BALL VALVE) TO START SIPHON.

6. REGULATE FLOW FROM CELL BY DISCHARGE VALVE.

7. FOR CONTINUOUS OPERATION, THE DISCHARGE VALVE WILL NEED TO BE CALIBRATED SUCH THAT THE OPERATOR WILL KNOW THE VALVE POSITION WHERE THE DISCHARGE EQUALS THAT OF THE SLURRY ENTERING THE STACK..I.E. THE PERMANENT POOL ELEVATION OF THE STACK IS CONSTANT. THIS VALVE MAY BE OPENED UP TO ALLOW FOR ADDITIONAL DISCHARGE FROM STORM EVENTS, HOWEVER A SECOND SIPHON WILL BE NEEDED FOR LARGER STORM FLOW DISCHARGE (SEE BELOW).

### STORM FLOW DISCHARGE OPERATIONS:

1. MAINTAIN DECANT SIPHON FLOW WITH DISCHARGE VALVE OPEN FOR FULL FLOW.

2. PRIME SECOND SIPHON USING PROCEDURES ABOVE AND SET DISCHARGE VALVE OPEN TO FULL FLOW.

3. MONITOR WATER LEVELS IN CELL ALONG WITH SEDIMENTATION AND RETURN WATER PONDS. INCREASE FLOW FROM SEDIMENTATION POND TO RETURN WATER POND VIA BALL VALVE AT SEDIMENTATION POND DISCHARGE TO INCREASE STORM WATER STORAGE.

4. SHUT OFF SECOND SIPHON WHEN WATER LEVEL IN CELL RETURNS TO PROCESS ELEVATION. (CLOSE PNEUMATIC BALL VALVE AT DISCHARGE OF SIPHON).

CAD DETAILS
AutoCad 2008 | DJH – 08

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

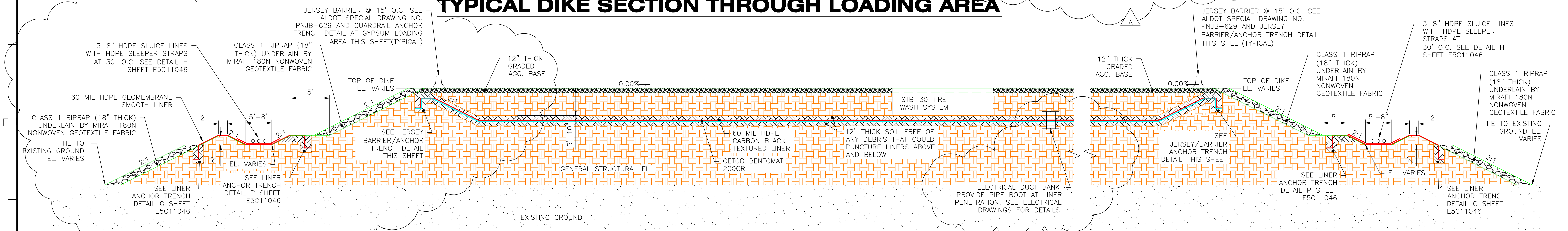
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 OPERATIONS PLAN
SIPHON INSTALLATION AND OPERATION DETAILS

| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 09-04-09 | GENERAL REVISION | EWO 2161DE | EEJ | MHL | BRH | JTM | KAH | TDJ | CKT |
| 0 | 12-31-08 | ISSUED FOR CONSTRUCTION | EWO 2161DE | DJH | MHL | BRH | JTM | KAH | TDJ | CKT |

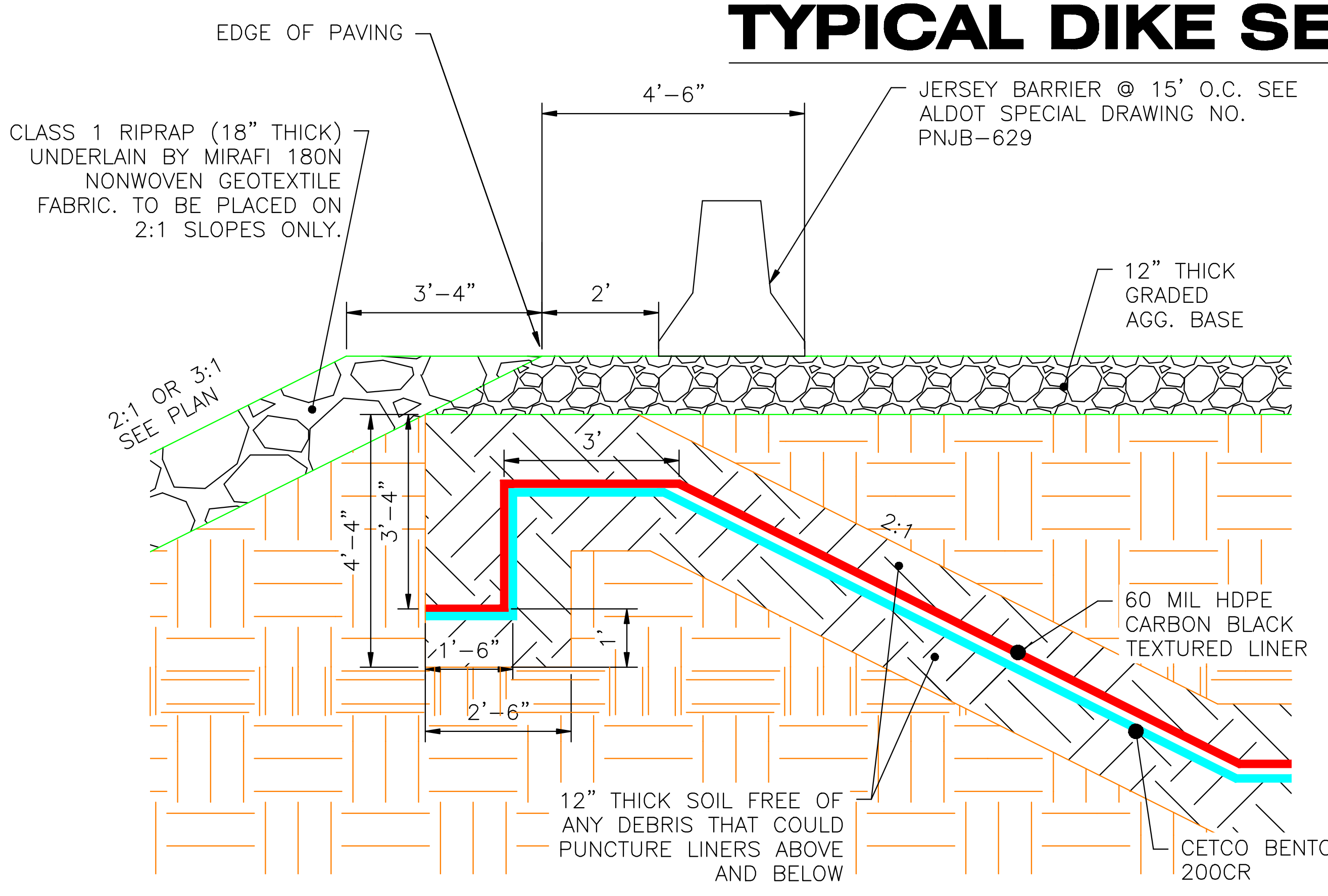
| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| AS NOTED | 210800 | **E5C11051** | 1 | FINAL | 1 |

ANSI E: 44x34 Acad2007

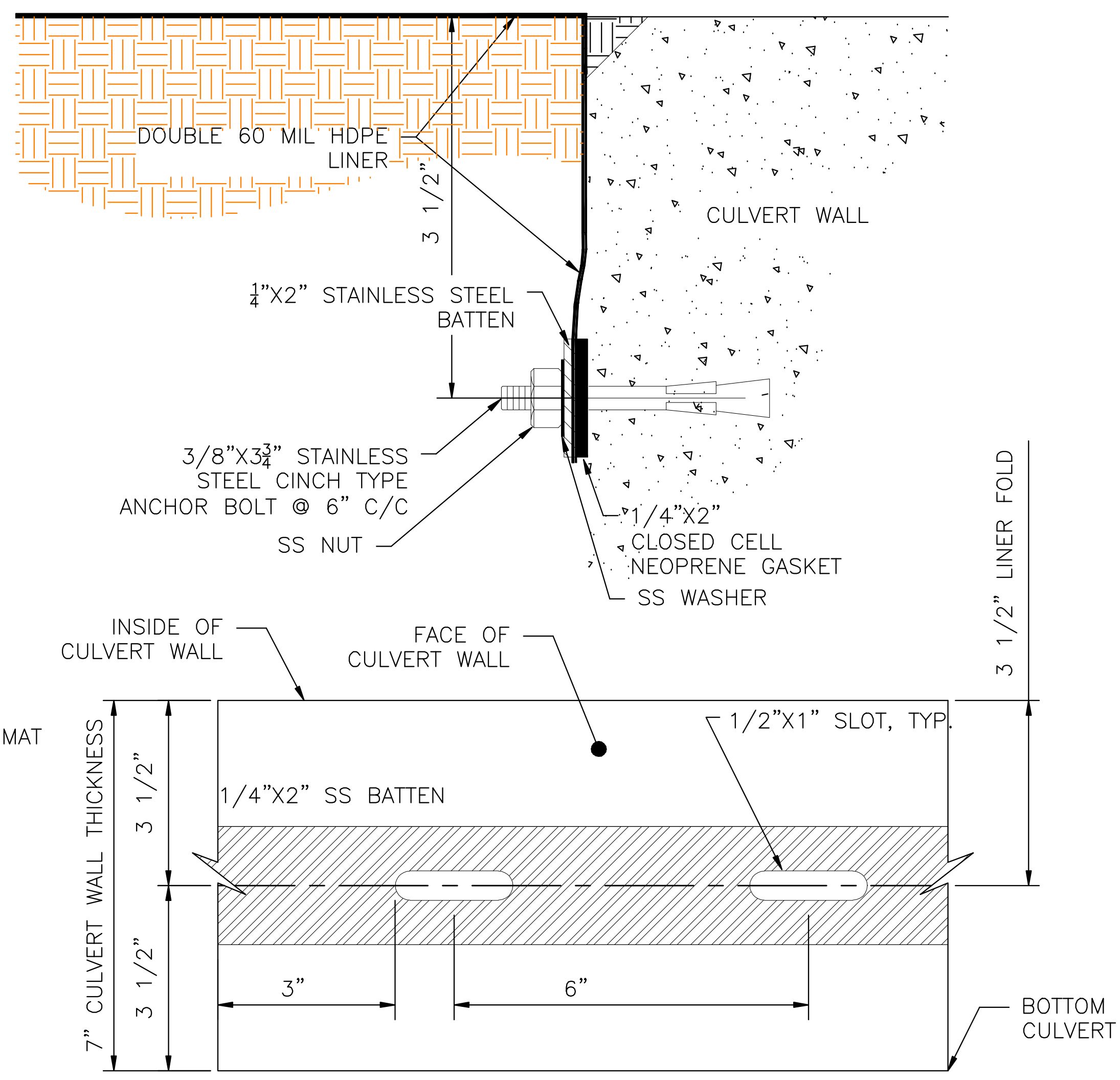
# SECTION V V-V V
# TYPICAL DIKE SECTION THROUGH LOADING AREA



# SECTION YY-YY(E5C11033)
# TYPICAL DIKE SECTION THROUGH LOADING AREA

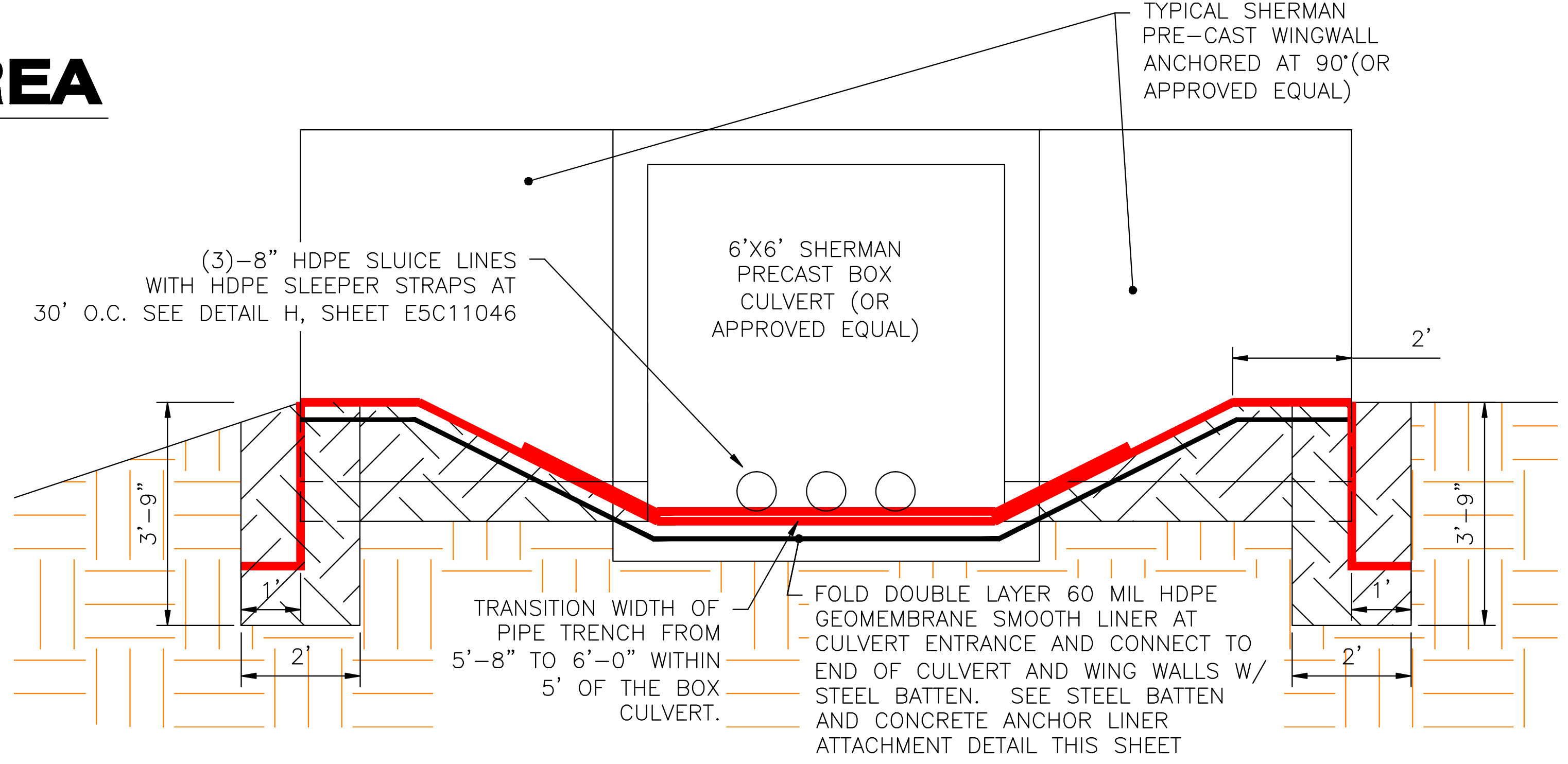


# JERSEY BARRIER/ANCHOR TRENCH DETAIL

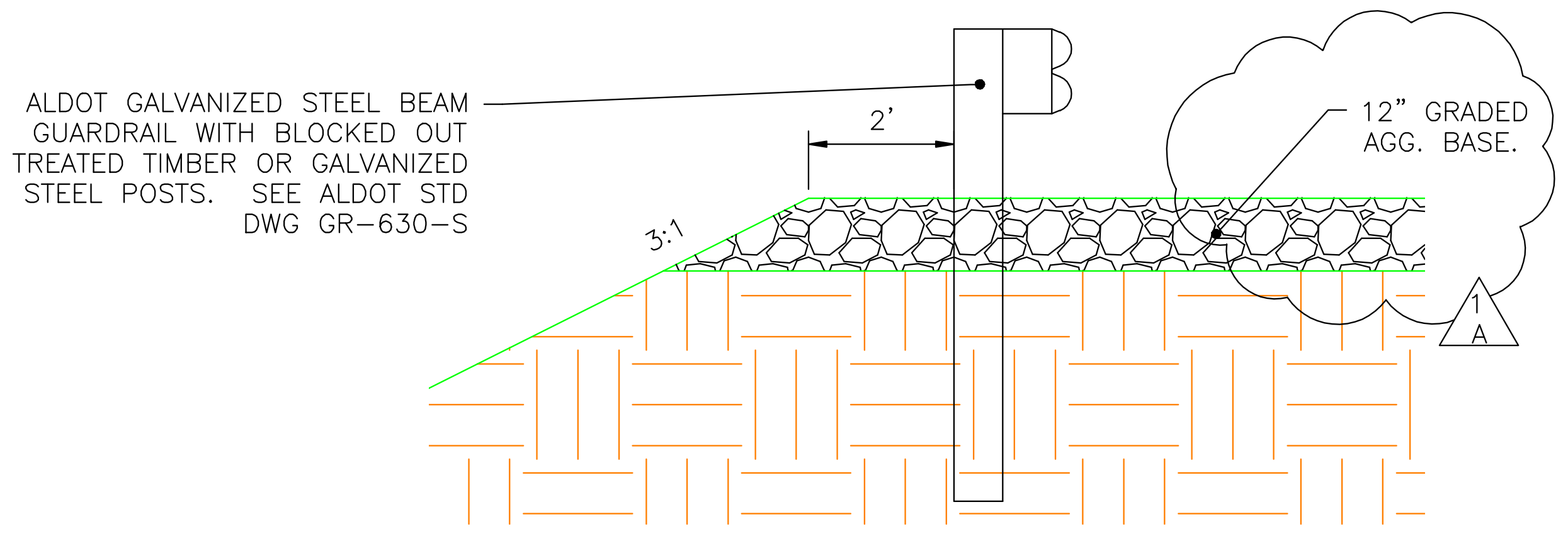


# STEEL BATTEN & CONCRETE ANCHOR LINER ATTACHMENT

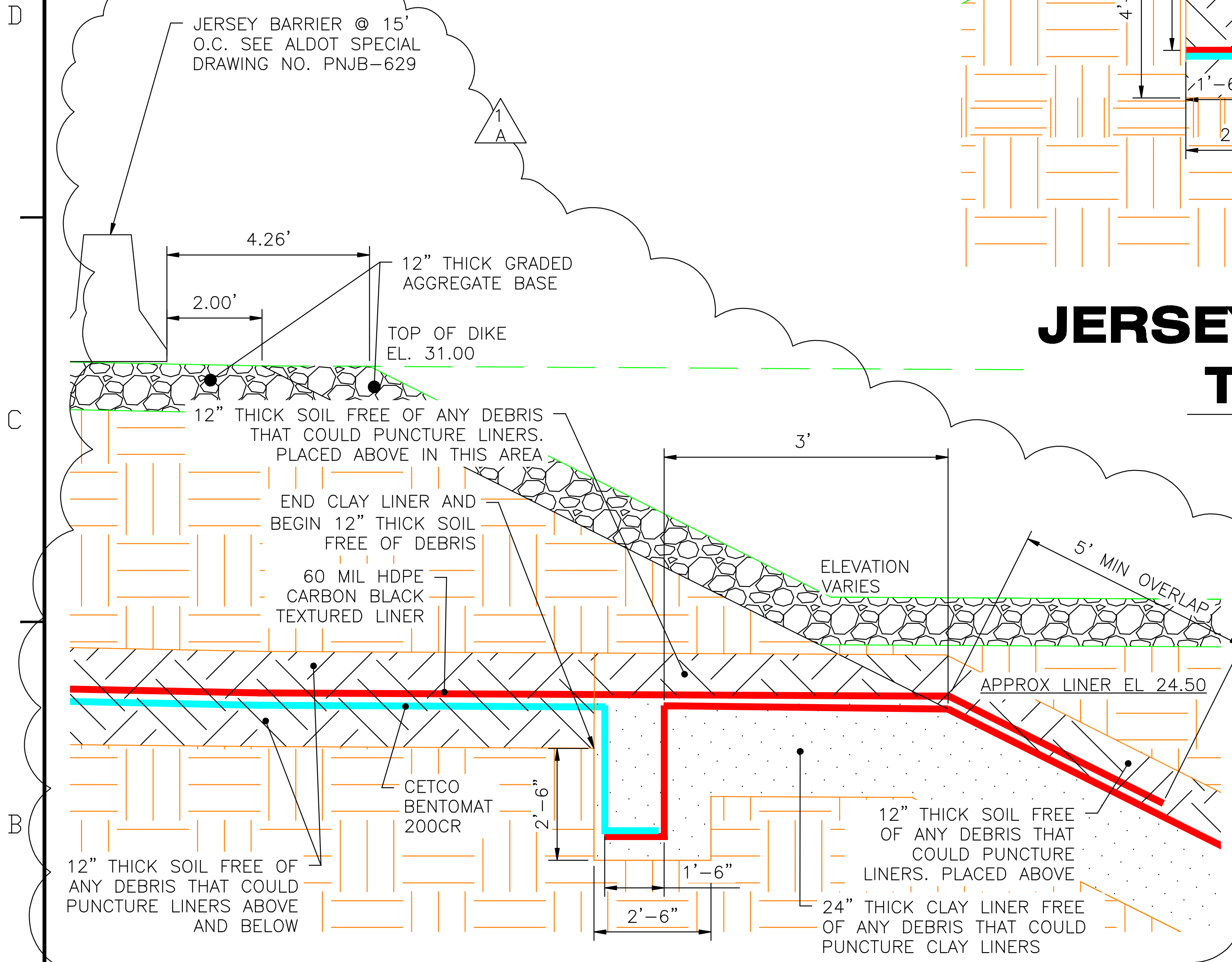
N.T.S.



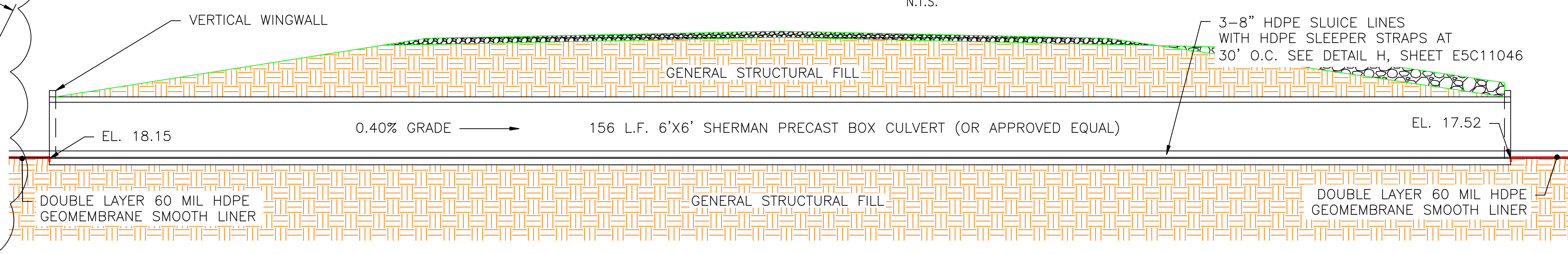
# LINER CONNECTION DETAIL AT CULVERT ENTRANCE



# TYPICAL GUARDRAIL DETAIL



# SOUTH LINER ANCHOR TRENCH DETAIL AT GYPSUM LOADING AREA



NOTE: SLEEPER STRAPS TO BE PLACED EVERY 30' OC THROUGHOUT THE 6'X6' PRECAST BOX CULVERT. SEE DTL J SHT E5C11044 FOR SLEEPER STRAP DETATIL.

# SECTION XX-XX (E5C11033)
# 6'X6' BOX CULVERT AT GYPSUM LOADING AREA ENTRANCE

GENERAL NOTES:

1. FOR DESCRIPTION AND CLASSIFICATION OF GENERAL STRUCTURAL FILL, SELECT STRUCTURAL FILL AND CLAY LINER MATERIAL SEE TECHNICAL SPECIFICATIONS.
2. PRECAST BOX CULVERT JOINTS SHALL BE WATERTIGHT.
3. PRECAST BOX CULVERT JOINTS SHALL BE FILLED USING 7/8" THICK STRIP OF PREMOLDED EXPANSION JOINT MEETING ASTM C990 (CS-102). NO NON-SHRINK GROUT.
4. FOR THE PRECAST BOX CULVERT, WRAP ALL EXTERNAL TOP, BOTTOM, AND SIDE JOINTS WITH CONWRAP CS-212, CLASS "C", SELF-ADHESIVE (POLYOLEFIN BACKED) SEALANT WRAP. PRIOR TO PLACEMENT OF THE CS-212, APPLY A SOLVENT BASE PRIMER (BUTYL) TO CONCRETE SURFACE. PLACE CS-212 SEALANT UNDER THE BOXES TO FACILITATE PLACEMENT OF THE JOINT WRAP ON THE SIDES AND TOP. JOINT WRAP TO BE CONTINUOUS AROUND EXTERNAL JOINTS, WITH A 2' MINIMUM LAP OVER JOINTS.

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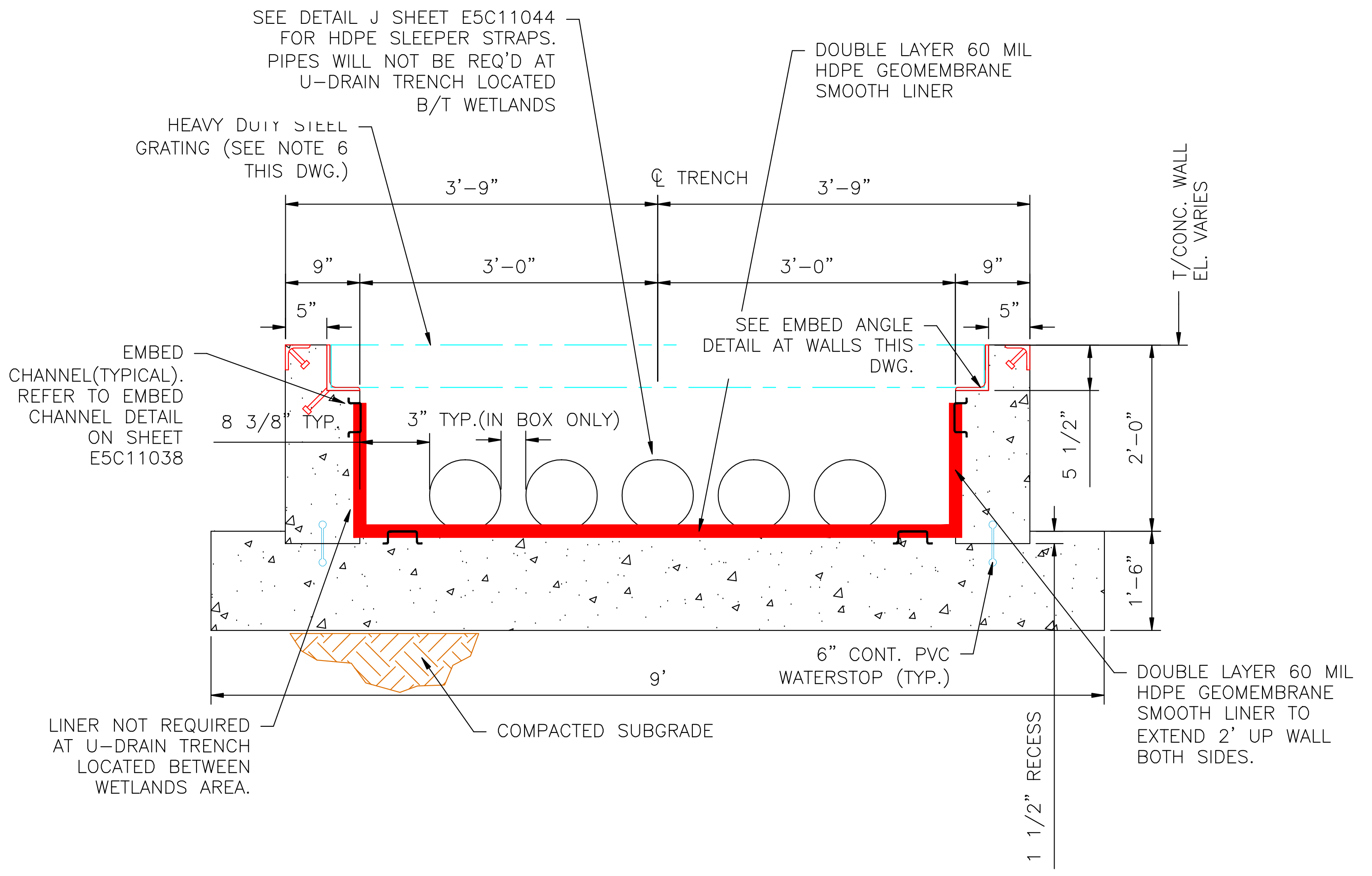
Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 - SECTIONS AND DETAILS

| REVISION | DATE | DESCRIPTION | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 7-2-09 | ISSUED FOR CONSTRUCTION<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 8-14-09 | A. F-3 ADDED ELECTRICAL DUCT BANK<br>B D-8,F-7 REMOVED WATER LINE INFORMATION AND CONCRETE SUPPORT DETAIL<br>C. C-1 REVISED TO SHOW 12" GAB<br>D. B-8, H-3 ADDED GYPSUM LOADING AREA AND DETAILS<br>EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |

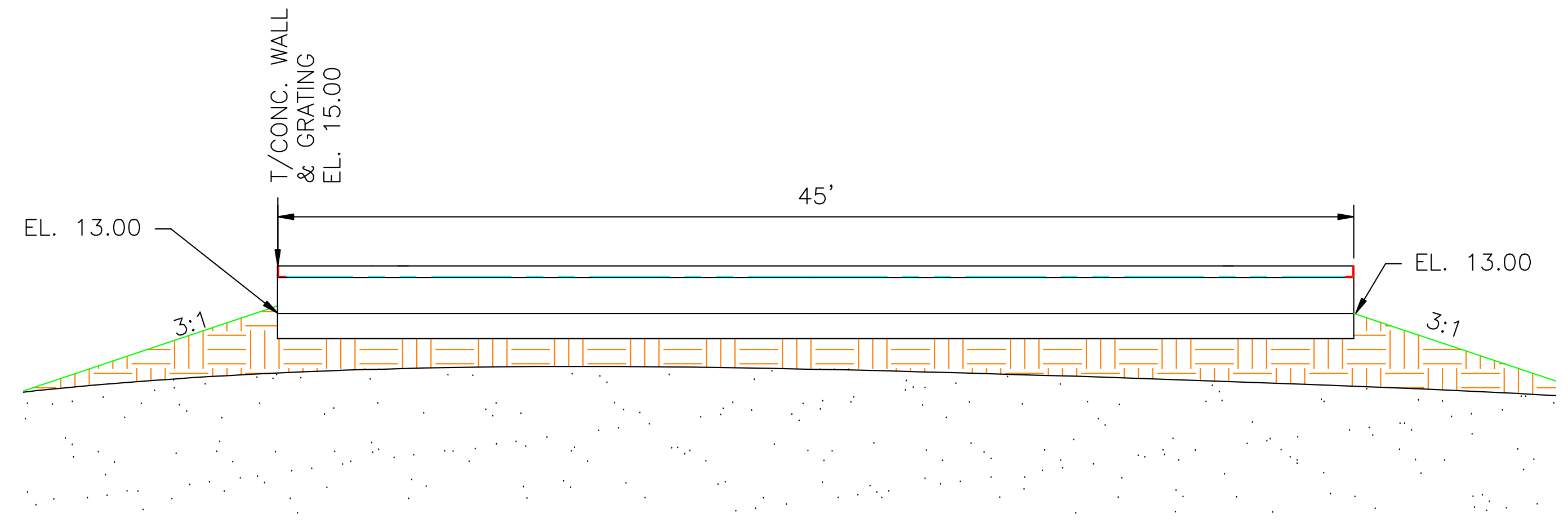
| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N.T.S. |  | E5C11052 | 1 | FINAL | 1 |

ANSI E: 44x34 Acad2004



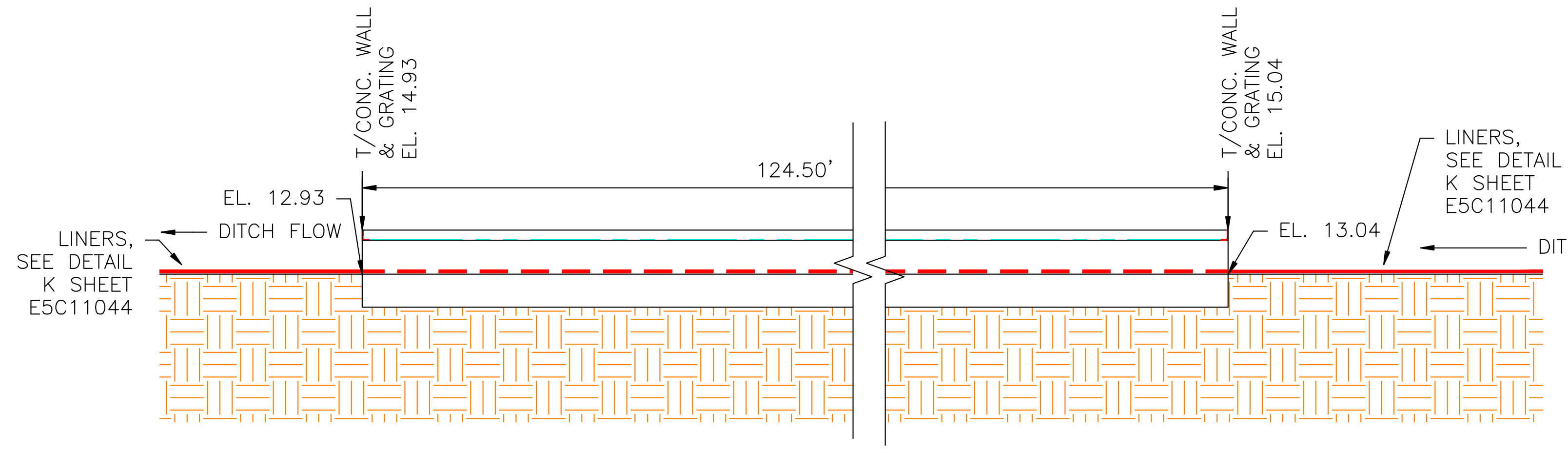
# SECTION TT-TT (E5C11033)
# U-DRAIN TRENCH

N.T.S



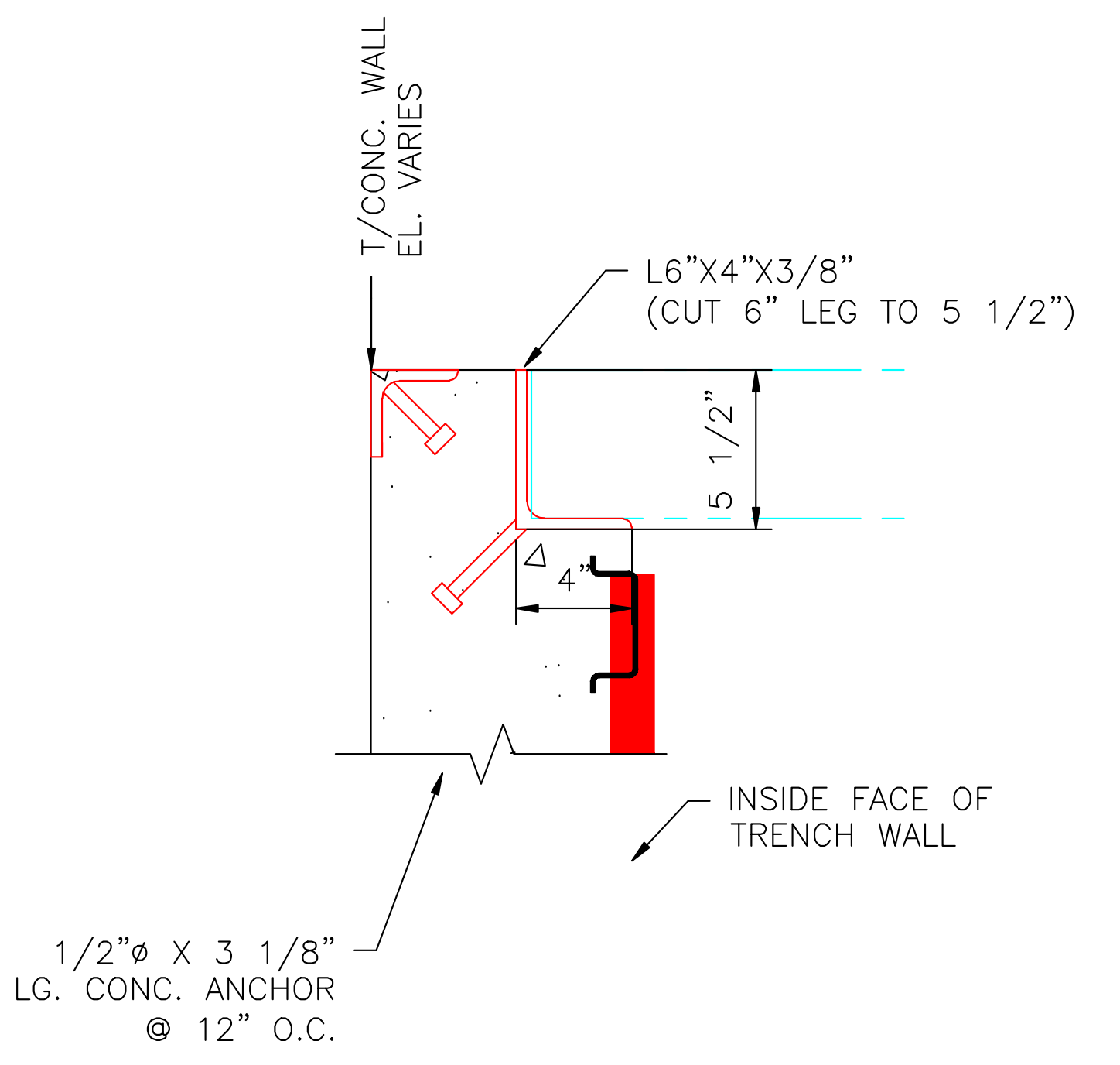
# SECTION UU-UU (E5C11033)
# U-DRAIN TRENCH AT WETLANDS

N.T.S



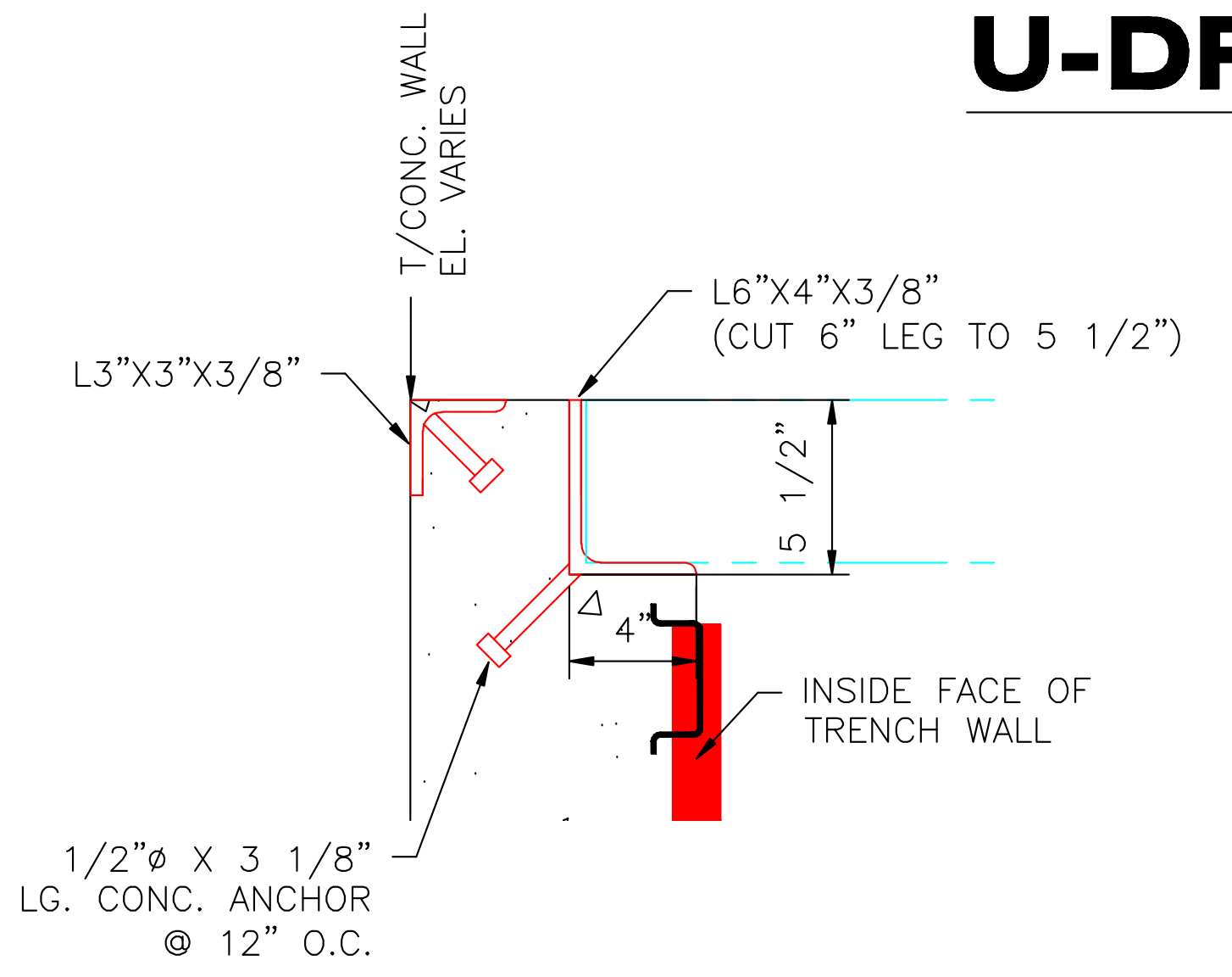
# SECTION SS-SS (E5C11033)
# U-DRAIN TRENCH AT LOADING ENTRANCE INTERSECTION

N.T.S



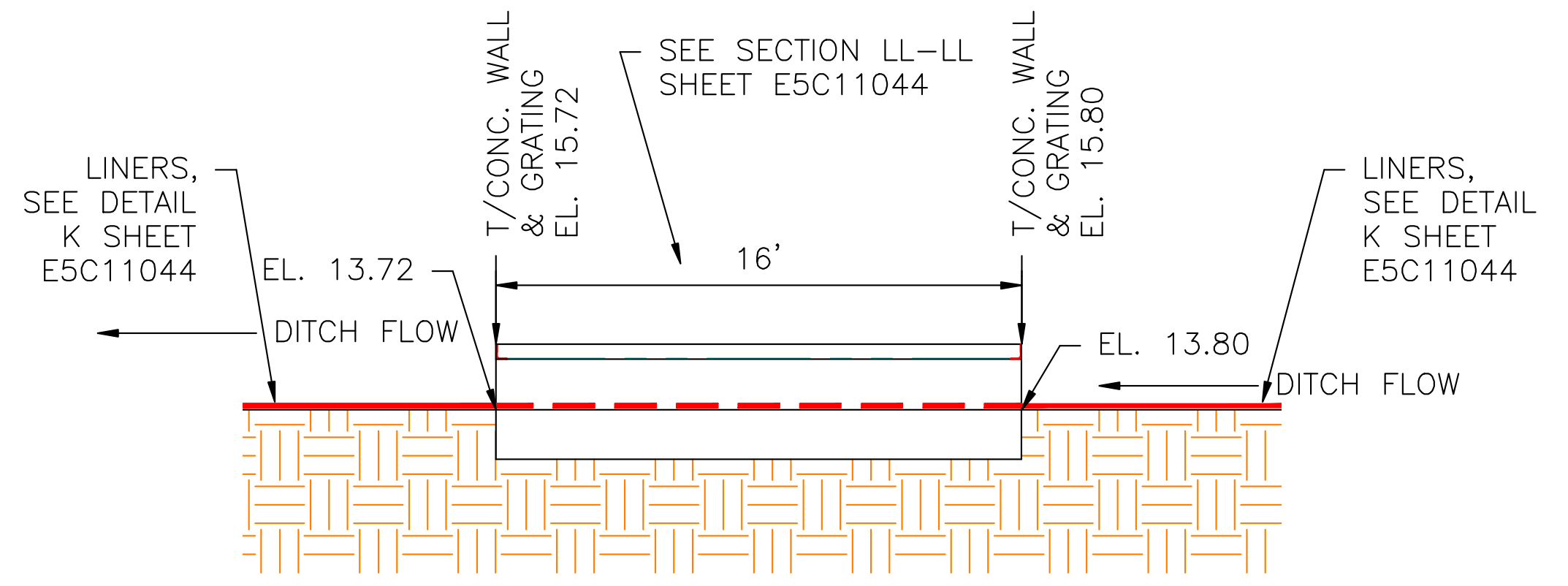
# U-DRAIN TRENCH
# EMBED ANGLE DETAIL
# @ GRATING

N.T.S



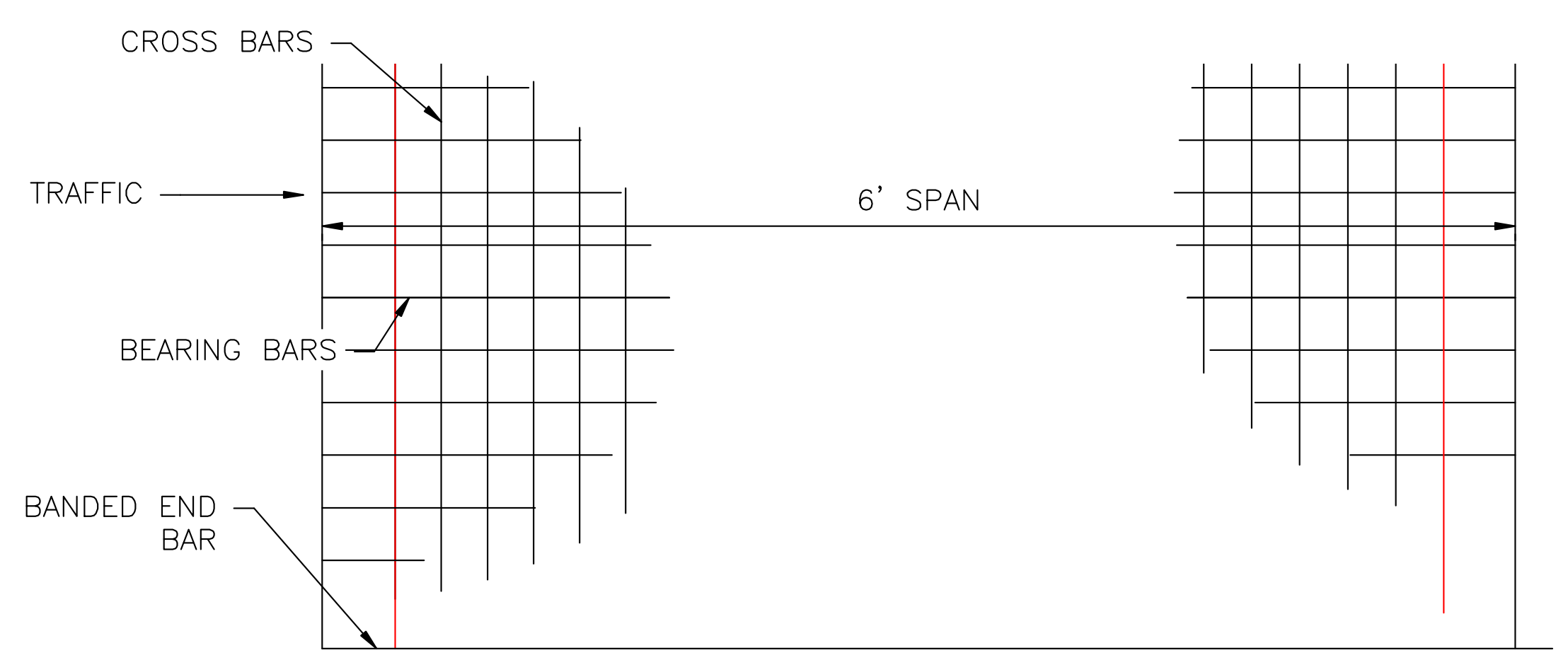
# U-DRAIN TRENCH
# EMBED ANGLE DETAIL
# @ WALL EDGES

N.T.S



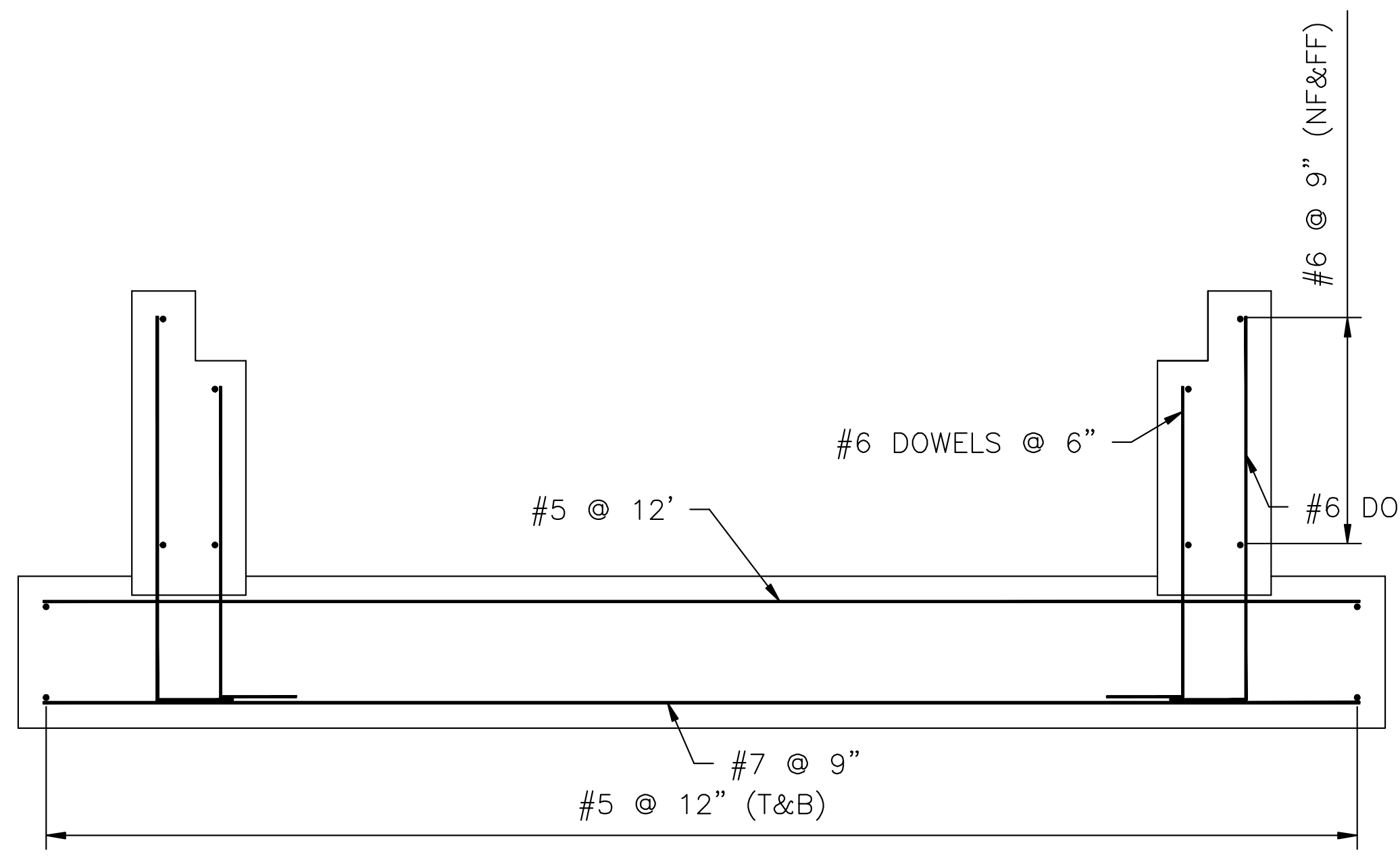
# SECTION ZZ-ZZ (E5C11043)
# U-DRAIN TRENCH AT MAINTENANCE ACCESS ROAD

N.T.S



# U-DRAIN TRENCH
# PLAN VIEW GRATING

N.T.S



# U-DRAIN TRENCH
# REINFORCING DETAL

N.T.S

## CONCRETE NOTES:

1. IF READY-MIX CONCRETE IS TO BE USED FROM AN APPROVED SUPPLIER, ALL CONC. SHALL BE IN PLACE WITHIN 1 1/2 HOURS AFTER MIXING, UNLESS LONGER TIME IS PERMITTED BY THE PURCHASER.
2. ALL CONCRETE SHOWN ON THIS DRAWING SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4,000 P.S.I. AT 28 DAYS.
3. ALL REINFORCING SHALL HAVE 2" MINIMUM COVER OF CONCRETE WHERE FORMS ARE USED AND 3" MINIMUM COVER WHEN POURED AGAINST THE GROUND.
4. CONCRETE SHALL BE FINISHED IN ACCORDANCE WITH THE FOLLOWING:

| | |
|---|---|
| BASE SLAB SURFACE – | SMOOTH FINISH |
| FORMED SURFACE – | SMOOTH FORM |

5. BEVEL EXPOSED EDGES OF CONC. 3/4", UNLESS NOTED.
6. ALL REINFORCING SHALL CONFORM TO ASTM SPEC. A615, GRADE 60.

## STRUCTURAL STEEL NOTES:

1. STRUCTURAL STEEL SHALL BE A.S.T.M. A36.
2. (a) DESIGN, FABRICATION AND ERECTION SHALL CONFORM TO THE A.I.S.C. SPECIFICATIONS, NINTH EDITION AND THE CODE OF STANDARD PRACTICE.
3. (a) STRUCTURAL STEEL SHALL BE CLEANED IN ACCORDANCE WITH SSPC SPECIFICATION SP6 AND SHOP COATED WITH AN INORGANIC ZINC PRIMER TO A MINIMUM DRY FILM THICKNESS OF 3 MILS.
   (b) PAINT SHALL BE SHERWIN WILLIAMS PRIME COAT AND FINISH COAT SYSTEM (OR EQUAL):
    1. PRIME COAT: 1 CT. ZINC-CLAD II HS ETHYL SILICATE @ 3 MILS DFT, MAX.
    2. FINISH COAT: 1 CT. COROTHANE II @ 2 – 4 MILS DFT COLOR – BLACK
4. THE STEEL FABRICATOR SHALL OBTAIN APPROVAL OF HIS DETAIL DRAWINGS PRIOR TO BEGINNNING OF FABRICATION OF DETAILED ITEMS.
5. STEEL GRATING SHALL BE IKG INDUSTRIES STYLE HW, TYPE P22C (GALV.) OR APPROVED EQUAL. THE GRATING MATERIAL SHALL CONFORM TO ASTM A36 STEEL SPECS. FOR THE MAIN BEARING BARS. MAIN BARS TO BE 5" DEEP BY $\frac{3}{8}$" THICK, SPACED AT 1$\frac{7}{8}$" CENTERS. THE CROSS BARS TO BE WELDED USING $\frac{1}{2}$" ROUND CROSS BAR, SPACED 4" ON CENTER. THE BANDED GRATING PANELS SHALL SPAN 76 INCHES MAXIMUM SPAN WITH A MAXIMUM WIDTH OF 48" AND SATISFY AASHTO LOADINGS FOR HS20. STEEL GRATING SHALL BE USED TO COVER ENTIRE LENGTH OF TRENCH.

## GENERAL NOTES:

1. FOR DESCRIPTION AND CLASSIFICATION OF GENERAL STRUCTURAL FILL, SELECT STRUCTURAL FILL AND CLAY LINER MATERIAL SEE TECHNICAL SPECIFICATIONS.

2. LINER SHALL BE TRANSITIONED FROM THE DITCH TO THE CONCRETE BOXES IN A MANNER THAT ENSURES THE DITCH AND BOX TO BE WATERTIGHT.

ADVANCED PRINT

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

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 – SECTIONS AND DETAILS

REVISION 0 DATE 7-2-09
ISSUED FOR CONSTRUCTION
EWO 2161DE

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR | SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JWM | PMG | BRH | JTM | KAH | TDJ | CKT | N.T.S. | | E5C11053 | 1 | FINAL | 0 |

ANSI E: 44x34 Acad2004

# APPENDIX 5

# INITIAL HAZARD POTENTIAL CLASSIFICATION
# &
# EMERGENCY ACTION PLAN

The Hazard Potential Classification and Emergency Action Plan for the Plant Barry Gypsum Pond were initially prepared to satisfy federal standards. They also satisfy 335-13-15-.04(4)(a)2., 335-13-15-.04(4)(a)3. and 335-13-15-.09(1)(a)6. and are included for that purpose.

# INITIAL HAZARD POTENTIAL ASSESSMENT
# PLANT BARRY GYPSUM POND
# ALABAMA POWER COMPANY

Section §257.73(a)(2) of EPA's regulations requires the owner or operator of an existing CCR surface impoundment to conduct periodic hazard potential classification assessments. The owner or operator must document the hazard potential of each surface impoundment as a high hazard potential CCR unit, a significant hazard potential CCR unit or a low hazard potential CCR unit.

The CCR surface impoundment located at Alabama Power Company's Plant Barry, also referred to as the Plant Barry Gypsum Pond, is located near Bucks, Alabama. The CCR surface impoundment is a lined facility formed by an engineered perimeter dike. The CCR unit is bounded on all sides by undeveloped plant property. In the unlikely event of an embankment failure, water and CCR would could potentially impact adjoining plant property and nearby wetlands.

Based on the potential impacts in the unlikely event of an embankment failure, a hazard potential classification of Significant Hazard Potential has been assigned to the Plant Barry Gypsum Pond, in that failure or mis-operation of the CCR unit would result in no probable loss of human life but could cause economic losses and environmental damage to adjoining plant property.

I hereby certify that the hazard potential classification was conducted in accordance with 40 C.F.R. Part 257.73 (a)(2).

10/17

James C. Pegues, P.E.
Licensed State of AL, PE No. 16516

16516
JAMES C. [illegible], JR.

# CCR SURFACE IMPOUNDMENT EMERGENCY ACTION PLAN

## Plant Barry Gypsum Pond

I hereby certify that this Emergency Action Plan has been prepared in accordance with the requirements of 40 C.F.R. Part 257.73.

James C. Pegues, P.E.
Licensed State of Alabama, P.E. No. 16516

16516
JAMES C. PEGUES, JR.

**ISSUE DATE:** April 17, 2017
**REVISION #:** **0**

# REVISION RECORD

In accordance with 40 C.F.R. Part 257.73, this Emergency Action Plan (EAP) must be amended whenever there is a change in conditions that would substantially affect the EAP in effect. Additionally, the EAP must be evaluated, at a minimum, every five years to ensure the information is accurate. As necessary, this EAP must be updated and a revised EAP placed in the facility's operating record as required by 40 C.F.R. Part 257.105(f)(6).

| Revision Number | Date | Sections Affected/Reason |
|---|---|---|
| 0 | 04/17/2017 | Creation of Initial EAP |

# TABLE OF CONTENTS

# APPENDICES

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ALDOT | Alabama Department of Transportation |
| AEMA | Alabama Emergency Management Agency |
| APC | Alabama Power Company |
| CCR | Coal Combustion Residuals |
| CFR | Code of Federal Regulations |
| E&CS | Engineering & Construction Services |
| EAP | Emergency Action Plan |
| EMA | Emergency Management Agency |
| EPA | Environmental Protection Agency |
| FERC | Federal Energy Regulatory Commission |
| H:V | Horizontal:Vertical |
| HDPE | High-Density Polyethylene |
| ID | Inside Diameter |
| SCS | Southern Company Services |

# DEFINITIONS

**Adverse Consequences.** Negative impacts that may result from the failure of a dam. The primary concerns are loss of life, economic loss (including property damage), lifeline disruption and environmental impact.

**Coal Combustion Residuals (CCR).** Fly , bottom , boiler slag, and flue gas desulfurization materials generated from burning coal for the purpose of generating electricity by electric utilities and independent power producers.

**CCR Surface Impoundment .** A natural topographic depression, man-made excavation, or diked area which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR.

**Dam/Dike/Embankment.** An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage.

**Dam Failure.** Catastrophic type of failure characterized by the sudden, rapid and uncontrolled release of impounded water or the likelihood of such an uncontrolled release. It is recognized that there are lesser degrees of failure and that any malfunction or abnormality outside the design assumptions and parameters that adversely affect a dam's primary function of impounding water is properly considered a failure. These lesser degrees of failure can progressively lead to or heighten the risk of catastrophic failure. They are, however, normally amenable to corrective action.

> **Imminent Failure (Condition A Emergency).** Failure of a dam/dike/embankment is imminent or has occurred.
>
> **Potential Failure (Condition B Emergency).** A potential failure condition of a dam/dike/embankment is a developing condition, but adequate time is available to properly evaluate the problem and implement corrective actions that may alleviate or prevent failure.
>
> **Non-Failure Condition.** A condition that will not, by itself, lead to a failure, but that requires investigation and notification of internal and/or external personnel.

**Emergency.** A condition that develops unexpectedly, endangers the structural integrity of the dam, and requires immediate action. An emergency can lead to Adverse Consequences in the event of Imminent Failure.

**Filter.** One or more layers of granular material graded so as to allow seepage through or within the layers while preventing the migration of material from adjacent zones.

**Inundation Map.** A graphic representation of the inundation zone that shows the potential impact area due to a breach of the Gypsum Pond. The inundation maps in this procedure are based on a specific computer-modeled dam breach scenario; therefore, the boundaries depicted are estimates for that particular model. *The models are considered conservative but larger floods could potentially occur.* Please refer to Appendix B.

**Inundation Zone.** Area subject to flooding in the event of increased flows due to a dam/dike/embankment failure.

**Piping.** The progressive development of internal erosion of the dam/dike/embankment or foundation material by seepage.

**Probable Maximum Flood.** The flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the drainage basin.

**Sunny Day Failure.** A night or day failure that occurs during fair weather or when weather-related flooding is not occurring.

# 1.0 STATEMENT OF PURPOSE

This Emergency Action Plan (EAP) has been prepared for the Plant Barry Gypsum Pond to meet the requirements of 40 C.F.R. Part 257.73(a)(3). The EAP identifies potential safety emergency conditions at the Plant Barry Gypsum Pond and specifies actions to be followed to minimize potential loss of life and property damage if such conditions exist.

This EAP will provide responding personnel with:

- Pertinent information and description related to Plant Barry Gypsum Pond;
- Definition of events or circumstances that represent a safety emergency;
- Procedures that will be followed to detect a safety emergency;
- Notification procedures in the event of a safety emergency;
- Information to assist in decision making;
- A list of responsible persons and their respective responsibilities;
- Provisions for an annual face-to-face meeting with local emergency responders;
- Contact information for emergency agencies and emergency responders
- A map that delineates the downstream area that could be affected in the event of a failure.

# 2.0 FACILITY DESCRIPTION

Plant Barry is a coal-fired power plant located near Bucks, Alabama. This EAP covers emergency response procedures for the Plant Barry Gypsum Pond (the Gypsum Pond), which is designed to receive and store gypsum produced during the electric generating process at Plant Barry. An overview of Plant Barry and the surrounding area is shown in Appendix A – Figure 1.

The Gypsum Pond is approximately 32 acres in size, including its sedimentation pond, and has a normal operating pool elevation of 23 feet (Appendix A – Figure 2 and Figure 3). The Gypsum Pond has earthen embankments (also referred to as dam/dike) with a maximum height of approximately 25 feet. The crest surface is composed of grass and a gravel access drive. The interior slopes of the pond are lined with a HDPE geomembrane. Downstream slopes are covered with grass.

The Gypsum Pond dam/dike has been assigned a Significant Hazard Potential classification under 40 C.F.R. Part 257.73 of the Environmental Protection Agency’s (EPA’s) Coal Combustion Residuals (CCR) Rule. This classification, by definition, indicates that there is no probable loss of human life in the event of a dam/dike failure or misoperation of the facility, but there is a potential for economic loss or environmental damage. There are no other dams located downstream that could be impacted by the failure of the Gypsum Pond dam/dike. The limits of potential flooding in the event of failure of the Gypsum Pond dam/dike can be seen on the Inundation Maps, which are included as Appendix B. The provided inundation maps were developed based on the results of routing the breach wave downstream using the computer software, HEC-RAS. HEC-RAS is a general application one-dimensional hydraulic model that can perform unsteady flow routing through an open channel system that may also include culverts, bridges, levees, tributaries, storage areas, and other dams. Unsteady flow analyses allow for flow conditions that vary temporally and spatially such as a dam breach simulation. Breach parameters such as failure time, breach width, and breach side slopes were selected from industry accepted empirical formulas. Water surface elevation data was extracted from the hydraulic model and plotted on best available LiDAR topographic information for the downstream areas.

Normal river/lake levels and the flow from simulated dam breaches were superimposed over topographical maps to identify areas subject to flooding. ***These flood extents are provided for planning purposes only; actual flooding can vary due to actual conditions present at the time of the failure.***

# 3.0 DETECTION, EVALUATION, AND CLASSIFICATION PROCEDURES FOR EMERGENCIES

## 3.1 Inspection Schedule and Condition Detection/Evaluation

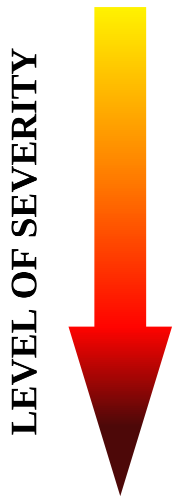
Trained personnel from Plant Barry inspect the Gypsum Pond dams/dike on a regular basis to pre-emptively detect conditions, in a timely manner, that could indicate a potential issue so that it can be addressed. Trained personnel from the Plant's Environmental Compliance group perform weekly inspections; and SCS E&CS Dam Safety personnel perform semi-annual inspections.

Plant personnel conducting inspections of the dams/dikes are trained on an annual basis by engineers from SCS E&CS Dam Safety on the appropriate surveillance and monitoring requirements.

Any issues discovered during an inspection are reported to SCS E&CS Dam Safety (Fossil Dam Safety) as prescribed in the Safety Procedure for Dams and Dikes at Fossil Generation Plants (GEN10004). The Fossil Dam Safety Engineer(s) working with plant personnel will recommend a corrective course of action, as needed.

## 3.2 Condition Severity Classifications

Gypsum Pond dam/dike conditions will be classified based on the type of event, severity of the situation, and the time required to take corrective measures. This procedure covers the following severity classifications:



**NON-FAILURE CONDITION (NFC)**

A situation that will not, by itself, lead to a failure and is not considered an emergency. However, an NFC does require investigation and notification of Fossil Dam Safety personnel and may require corrective action in order to prevent conditions that may lead to an emergency.

**POTENTIAL FAILURE – Condition B Emergency (B)**

A developing situation where failure of a dam/dike may occur but implementation of pre-planned actions may alleviate or prevent failure. In general, adequate time is considered available to properly evaluate and implement corrective actions. *Should conditions worsen, an Imminent Failure emergency may be declared.*

**IMMINENT FAILURE – Condition A Emergency (A)**

A situation where failure of the dam/dike is imminent or has already occurred.

## 3.3 Guidance for Determining the Emergency Level

The following table details potential situations that could occur at the Gypsum Pond dam/dike. *The Condition Level indicated in the right-most column corresponds with the Condition Severity Classifications in Section 3.2 above.*

| Event | Situation | Condition Level |
|---|---|---|
| Discharge Structure Flow | Spillway flow that could result in flooding of people downstream if the reservoir level continues to rise | B |
| | Spillway flow that is flooding people downstream | A |
| Embankment Overtopping | Reservoir level is 1 foot below the top of the dam/dike | B |
| | Water from the reservoir is flowing over the top of the dam/dike | A |
| Seepage | New seepage areas in or near the dam/dike | NFC |
| | New seepage areas with cloudy discharge or increasing flow rate | B |
| | Seepage with discharge greater than 10 gallons per minute | A |
| Dropouts | Observation of new sinkhole in reservoir area or on embankment | B |
| | Rapidly enlarging sinkhole | A |
| Embankment Cracking | New cracks in the embankment greater than ¼-inch wide without seepage | NFC |
| | Cracks in the embankment with seepage | B |
| Embankment Movement | Visual movement/slippage of the embankment slope | NFC |
| | Sudden or rapidly proceeding slides of the embankment slopes | A |
| Earthquake | Measurable earthquake felt or reported on or within 50 miles of the dam/dike | NFC |
| | Earthquake resulting in visible damage to the dam/dike or appurtenances | B |
| | Earthquake resulting in uncontrolled release of water from the dam/dike | A |
| Security Threat | Verified bomb threat that, if carried out, could result in damage to the dam/dike | B |
| | Detonated bomb that has resulted in damage to the dam/dike or appurtenances | A |
| Sabotage / Vandalism | Damage to dam/dike or appurtenances that could adversely impact the functioning of the dam/dike | NFC |
| | Modification to the dam/dike or appurtenances that could adversely impact the functioning of the dam/dike | NFC |
| | Damage to dam/dike or appurtenances that has resulted in seepage flow | B |
| | Damage to dam/dike or appurtenances that has resulted in uncontrolled water release | A |

# 4.0 INCIDENT RESPONSE

The following situations and conditions should be evaluated when performing condition severity detections and evaluations.

**Overtopping.** The Gypsum Pond reservoir has a relatively small watershed area compared to the overall size of the reservoir. The Gypsum Pond receives and/or contains rainfall/stormwater, water used for sluicing gypsum, and submerged CCR. The pond is designed to safely contain and pass the 1000 year storm event.

**Seepage.** Failures due to internal erosion and/or piping resulting from seepage would be detected in the early stages during the regular inspections conducted by plant personnel. Inspectors are trained to look for evidence of seepage. Therefore, the conditions that could lead to failures of this type would likely be discovered and corrected, making an actual failure a remote possibility.

**Slope Instability.** Slope instability would be demonstrated by sloughing of dam/dike slopes, which would be detected by security personnel in their daily observations, or by Environmental Compliance personnel in their weekly inspections. The conditions that could potentially lead to a failure of this type would also be detected in advance and corrected making an actual failure a remote possibility.

In the event that conditions are detected that could potentially lead to a dam/dike failure, the flowcharts in Appendices C (Incident Response) and D (Response Notification) will be used to respond to the situation and alert applicable personnel and emergency agencies. In that situation, local emergency management agencies (EMAs) would respond and begin warnings and evacuations as soon as possible following the declaration of a safety emergency.

## 4.1 Access to the Site

Figures 1 and 2 in Appendix A illustrate the location of the gypsum pond within Plant property.

## 4.2 Response during Periods of Darkness

Plant Barry is operational and/or manned 24 hours a day every day, and personnel and equipment are able to access the site at any time. Response times would not vary significantly from daylight conditions.

## 4.3 Response during Weekends and Holidays

Plant Barry is operational and manned 24 hours a day every day, and personnel and equipment will be able to access the site at any time.

## 4.4 Response during Adverse Weather

The dam/dike is accessed by paved and gravel-surfaced roads and is accessible during periods of adverse weather. If severe flooding causes road closures, response times may be adversely affected.

# 5.0 RESPONSIBLE PERSONS AND RESPONSIBILITIES

Designated personnel have been trained in the use of these response procedures and are aware of their responsibilities in making the procedures effective. The chain of command and the individual responsibilities for plant personnel, public officials, and agencies are outlined below.

## 5.1 Incident Commander

The Incident Commander is the 24-hour point of contact for all plant emergencies. The Primary Incident Commander is the Operations Team Leader on-shift . The Secondary Incident Commander is the Combined Cycle Operations Team Leader on-shift , and should be contacted if the Primary Incident Commander cannot be reached.

The Incident Commander is responsible for ensuring the following functions are addressed as required for emergency response situations:

1. Verifying that an emergency condition exists.

2. Assessing and declaring the emergency condition.

3. Ensuring that Compliance consults with Fossil Dam Safety to evaluate conditions and determine remediation actions.

4. Emergency Actions
    a. If necessary, implement actions to lower the water level in the impoundment in consultation with Fossil Dam Safety.
    b. Call-out of personnel necessary to perform the work required on plant site during the emergency.

5. Ensure the notification process as outlined in the Response Notification Flowchart (Appendix D) is completed in an expedient manner.

6. Other responsibilities include:
    a. Establishing lines of communication from the plant to the local and state EMAs.
    b. Ensuring emergency sources of power are available for the operation of essential equipment such as emergency lighting.
    c. Ensuring the availability of heavy equipment and trained operators to aid in the mitigation effort.

## 5.2 Emergency Response Team Leader

The Incident Commander shall assign an Emergency Response Team Leader as appropriate for the type of emergency incident. Duties include reporting matters relating to potential emergency action directly to the Incident Commander, accounting for his/her crew personnel and directing their actions.

## 5.3 Plant Security Department

The Plant Security Department is responsible for securing company property and controlling access to company facilities. The Plant Security Department will relay information to the Incident Commander. The Incident Commander will determine the appropriate people and agencies to notify. The Plant Security Department will perform emergency notifications to Plant departments as appropriate.

## 5.4 Plant Environmental Compliance

Environmental Compliance personnel are responsible for assessing conditions, contacting the Plant Manager, obtaining assistance from Fossil Dam Safety, and for providing technical updates to the Incident Commander. Compliance personnel can also request assistance from APC Environmental Affairs, if conditions warrant.

## 5.5 Alabama Control Center

The Alabama Control Center contacts the National Weather Service to inform them of conditions at the plant that may lead to potential flooding downstream.

## 5.6 SCS Fossil Dam Safety

SCS Fossil Dam Safety is responsible for coordinating and providing the technical support necessary to mitigate the emergency condition and for notifying APC Corporate Communications of the emergency condition. The Fossil Dam Safety Manager shall notify the APC Supply Chain Management as shown on the Response Notification Flowchart (Appendix D).

## 5.7 APC Personnel

### Environmental Affairs

APC Environmental Affairs is responsible for coordinating long-term environmental response (after the initial response) and to remediate environmental issues and provide the technical support necessary for any remediation needs. Environmental Affairs is also responsible for all communications with environmental regulatory agencies for appropriate reporting of releases to the environment and for securing variances to existing permits, if needed.

If necessary, Environmental Affairs will also help secure approved remediation contractors for the specific emergency condition that may exist. They will also provide additional support, such as emergency manpower, material, equipment, and expertise to assist in mitigation efforts, if needed.

### Corporate Communications

APC Corporate Communications is responsible for coordinating the APC media response and will schedule news briefings and prepare news releases, as required. APC Corporate Communications will also work with local and State Public Information Officers to ensure that timely, accurate, and consistent information is made available to media outlets.

**Corporate Security**
APC Corporate Security is responsible for supporting Plant Security personnel and contracting with local law enforcement for additional security personnel as needed.

**Supply Chain Management**
Supply Chain Management is responsible for obtaining additional equipment and materials necessary to mitigate the emergency condition and begin the recovery process.

## 5.8 Emergency Agencies

Local EMAs are responsible for planning and implementing evacuation and sheltering plans as well as directing search, rescue, and recovery efforts. If additional resources are required, the local agencies can contact the Alabama Emergency Management Agency (Alabama EMA) for assistance.

The local EMAs are the point of contact between plant personnel and local jurisdictions. The EMAs are responsible for the direction and control of emergency operations at the local level and keeping local government officials informed of the status of emergency operations.

Alabama EMA generally becomes involved in an emergency situation if the local agencies are not capable of handling the situation or if assistance is requested by a local agency or by the Governor. Refer to the "Alabama Emergency Operations Plan" (AEOP) for an explanation of specific functions. Alabama EMA has responsibilities similar to the local EMAs but is also responsible for mobilizing state military support as well as State Disaster Center operations.

## 5.9 Law Enforcement

Local Law Enforcement agencies are notified by the appropriate EMA. Alabama EMA notifies the State Patrol as well as the Alabama Department of Transportation (ALDOT). Law Enforcement is responsible for traffic control and can assist with evacuation, mitigation, and rescue activities.

## 6.0 NOTIFICATION PROCEDURES

Communication during an emergency event will primarily be by company phone. In the event of system failure, Southern Linc radios and cell phones would be utilized as an alternate method of communication. These numbers are listed on the Response Notification Flowchart located in Appendix D.

Local and state EMA will be notified in the event of an emergency, and these agencies will be responsible for notifying the public. In the event of an imminent failure, local and state EMA's will be notified to immediately begin evacuation procedures. APC Corporate Communications will provide information for media outlets and will be responsible for communicating relevant information to the public.

### 6.1 Incident Response Flowchart for Imminent Failure and Potential Failure Emergencies

Personnel responsible for executing mitigation and/or emergency actions shall be thoroughly familiar with their responsibilities under this EAP.

A. When a Condition B or Condition A situation is detected, notify plant personnel in accordance with the Incident Response Flowchart (below and in Appendix C). Plant Environmental Compliance should contact Fossil Dam Safety immediately for technical consultation. Fossil Dam Safety will provide the evaluation of the conditions and provide a determination if there is an immediate threat to the dam/dike. If there is an immediate threat of dam/dike or dike failure, declare an **Imminent Failure Emergency** and proceed to Step I.

B. If no immediate threat is detected, determine if the problem detected could possibly lead to failure of the dam/dike. If there is a potential for failure but corrective measures may be taken to moderate or alleviate failure, declare a **Potential Failure Emergency (Condition B)** and proceed to Step C.

C. If a **Potential Failure Emergency** has been declared, notify personnel and agencies listed on the Response Notification Flowchart (Appendix D). Document all communications using the appropriate forms contained in Appendix E. Once outside agencies have been notified of an issue or potential problem, plant management is responsible for keeping local EMAs informed of any change in conditions.

D. Begin corrective measures to attempt to alleviate or prevent failure.

E. Evaluate the effectiveness of the corrective measures. If the corrective actions are successful, update all personnel/agencies previously contacted of the status of the improved conditions and document relevant communications using the forms provided in Appendix E. At this time, the Incident Commander will end the emergency condition. Fossil Dam Safety will be responsible for preparing the after-action report.

F. If the corrective measures are not effective, Fossil Dam Safety will determine if there is time to take additional corrective measures.

G. If there is not time to take additional corrective measures and failure is imminent, declare an **Imminent Failure Emergency** and proceed to Step J.

H. If there is time to implement additional corrective measures, return to Step E. Additional support can be requested from Civil Field Services or outside contractors, as needed.

I. If an **Imminent Failure Emergency** has been declared by the Incident Commander or his designee, ensure that all personnel have been moved to a safe area and perform notifications per the Response Notification Flowchart (Appendix D). Document all communications using the appropriate forms contained in Appendix E. Once outside agencies have been notified of a problem or potential problem, the Incident Commander or his designee is responsible for keeping local EMAs informed of any change in conditions. Fossil Dam Safety will be responsible for preparing the after-action report.

## 6.2 Additional Considerations

All communication shall be documented using the *Data Recording Sheet* located in Appendix E.

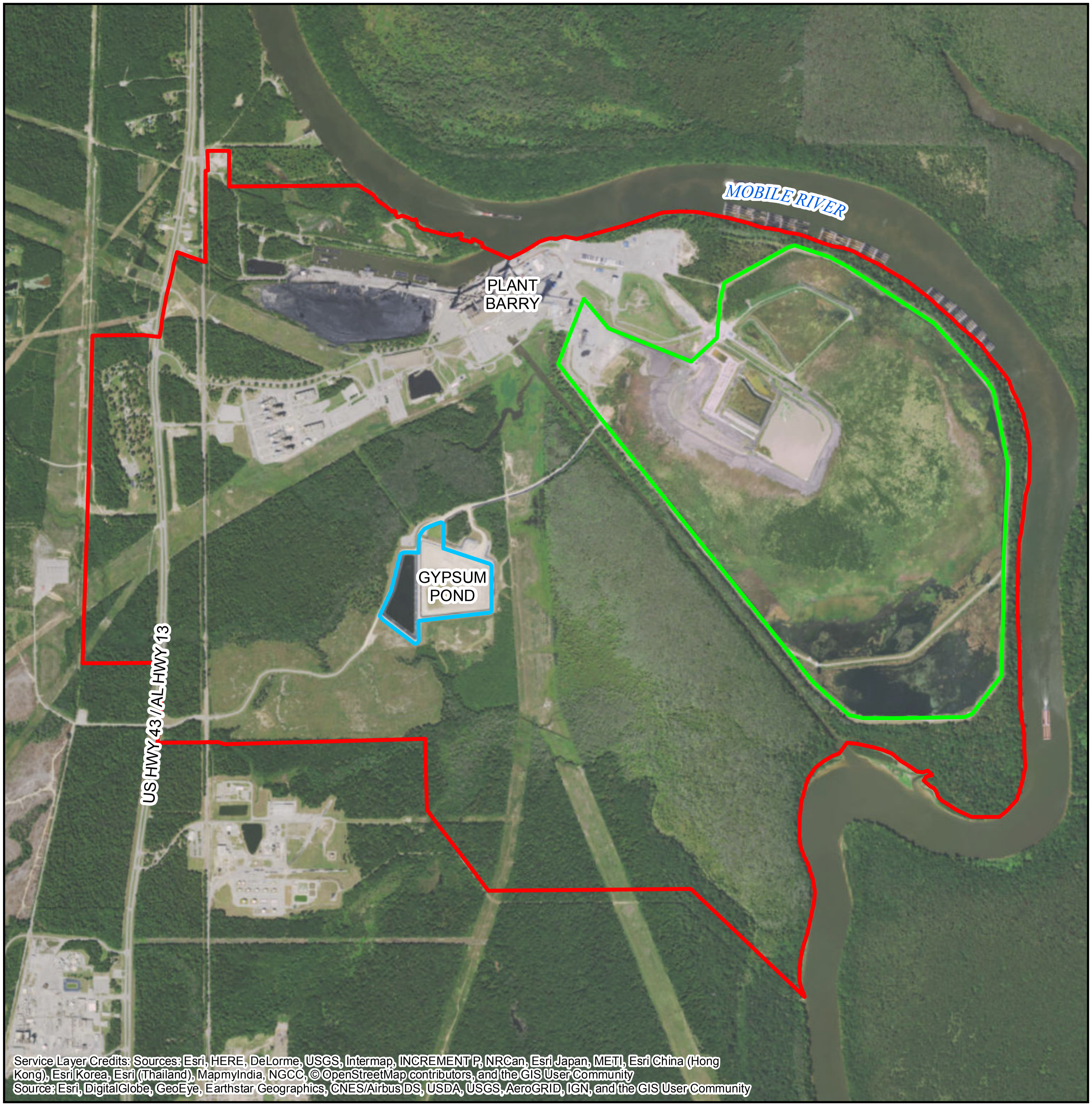
# 7.0 PROVISIONS FOR ANNUAL COORDINATION MEETING

An annual face-to-face meeting will be held with representatives of Plant Barry, APC, and local emergency responders. The representatives may include:

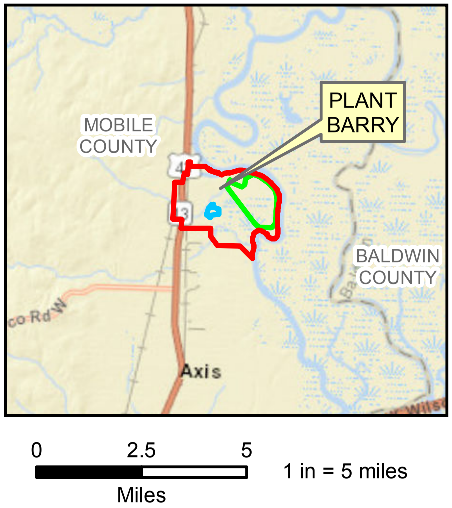
- Plant Barry Plant Manager and Team Leaders
- Plant Barry Emergency Response Team
- Southern Company Services Fossil Dam Safety
- APC Environmental Affairs
- APC Corporate Communications
- Local Emergency Responders

# APPENDIX A

## Plant Barry Location Map – Figure 1
## Gypsum Pond Overview – Figure 2



Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



LEGEND

- 🟦 Gypsum Pond Boundary
- 🟩 Ash Pond Boundary
- 🟥 Plant Boundary

N

0 1,000 2,000 4,000
Feet

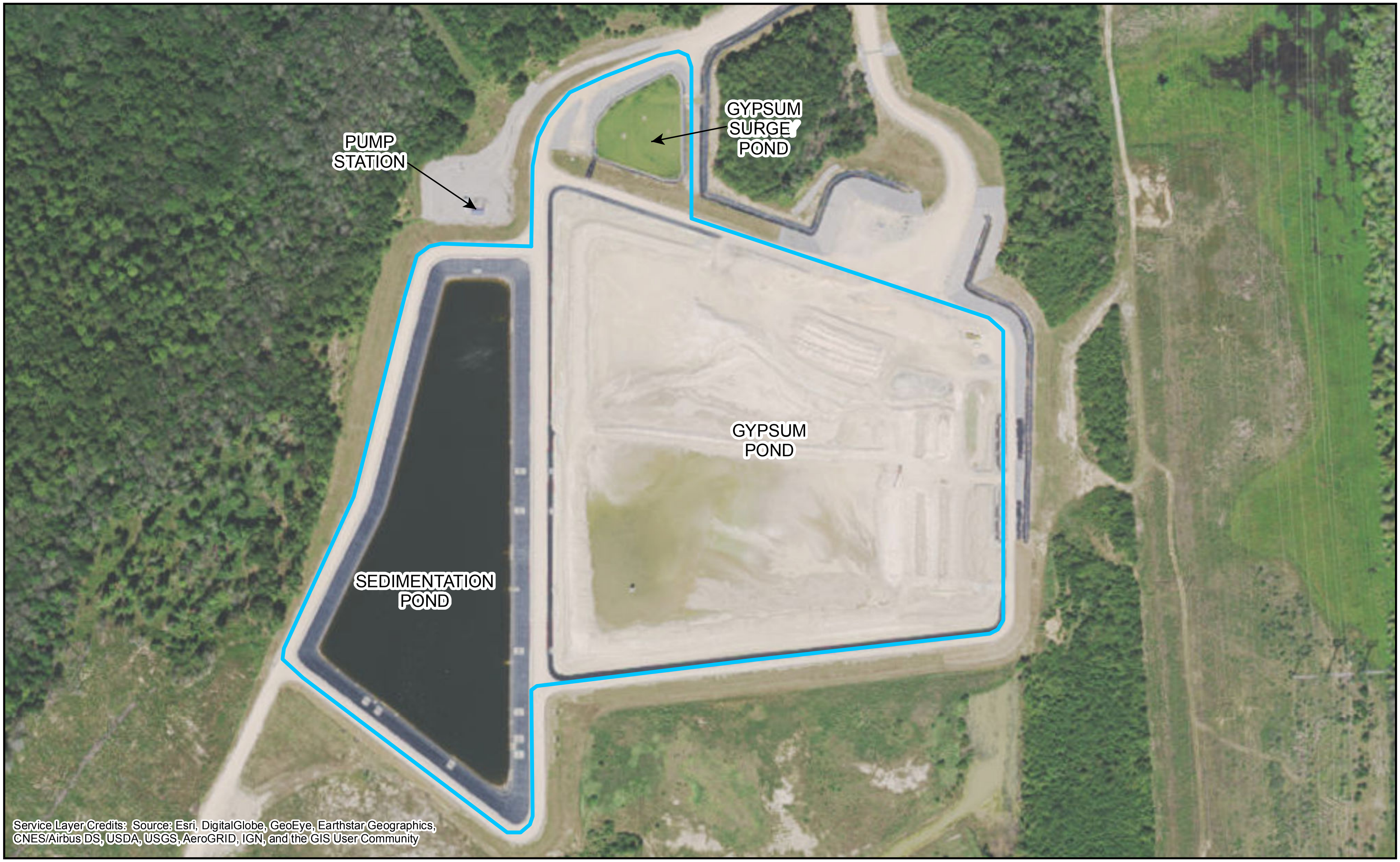
1 inch = 2,000 feet

NOTE: Right-of-way boundaries are included within plant boundary for clarity.

FIGURE 1
PLANT BARRY LOCATION MAP
MOBILE COUNTY, ALABAMA

**Southern Company Services**
**FOR**

# Alabama Power Company



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

▭ Gypsum Pond Boundary

N

0 150 300 600

Feet

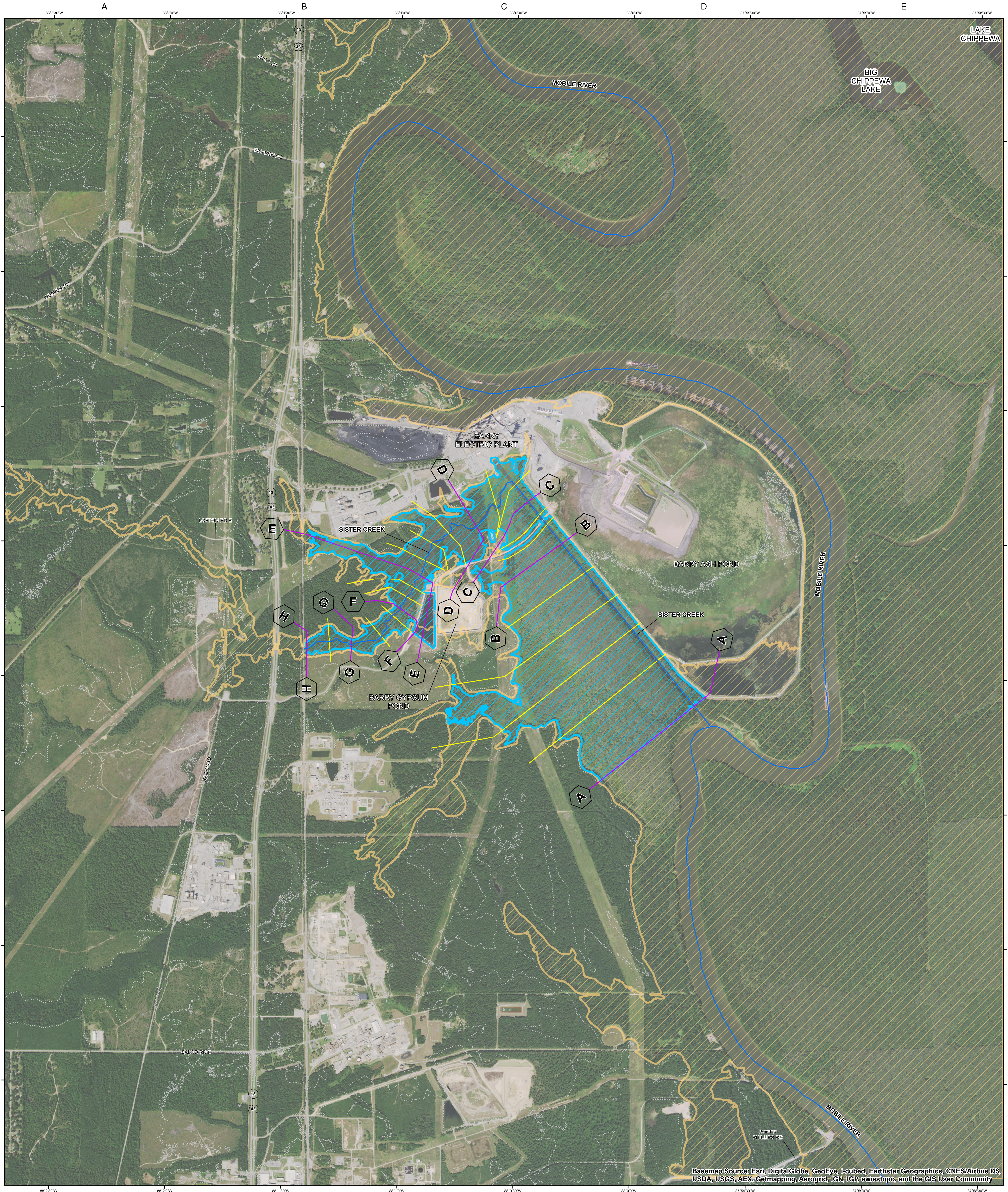
1 inch = 300 feet

FIGURE 2
GYPSUM POND OVERVIEW
PLANT BARRY
MOBILE COUNTY, ALABAMA

**Southern Company Services**
**FOR**
**Alabama Power Company**

# APPENDIX B

## Inundation Maps



| Top of Dam Breach | | | | | | |
|---|---|---|---|---|---|---|
| Cross-Section Label | Distance from Dam (miles) | Time to Initial Wave (hours) | Time to Max Wave (hours) | Non-Breach[4] WSEL (NAVD, feet) | Max Breach WSEL (NAVD, feet) | Elevation Increase[3] (feet) |
| A | 2.06[2] | 0.50 | 3.27 | 6.47 | 6.88 | 0.41 |
| B | 1.17[2] | 0.17 | 1.27 | 6.84 | 7.37 | 0.53 |
| C | 0.94[2] | 0.08 | 0.93 | 7.81 | 9.07 | 1.26 |
| D | 0.55[2] | 0.08 | 0.83 | 7.99 | 9.36 | 1.37 |
| E | 0.14[2] | 0.00 | 0.57 | 8.29 | 10.46 | 2.17 |
| F | 0.04[1] | 0.00 | 0.47 | 8.99 | 12.81 | 3.82 |
| G | 0.35[1] | 0.08 | 0.50 | 11.88 | 13.24 | 1.36 |
| H | 0.57[1] | 0.17 | 0.62 | 15.97 | 16.01 | 0.04 |

[1] Cross-sections upstream of the dam breach location

[2] Cross-sections downstream of the dam breach location

[3] Comparison to the non-breach condition

[4] The non-breach water-surface elevations simulate a 10-year event

SOUTHERN COMPANY

Projection
State Plane Alabama West FIPS 0102

N
W E
S

**Issue Date: January 31, 2017**

Page 1 of 1

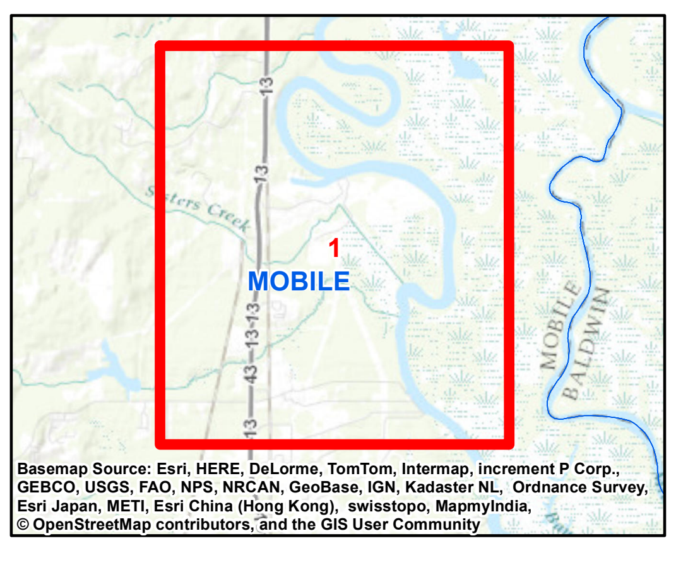
# Plant Barry

## Gypsum Pond Dam Inundation Analysis

### Mobile County

0 500 1,000 2,000 3,000 4,000 Feet

1 inch = 1,000 feet



Basemap Source: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

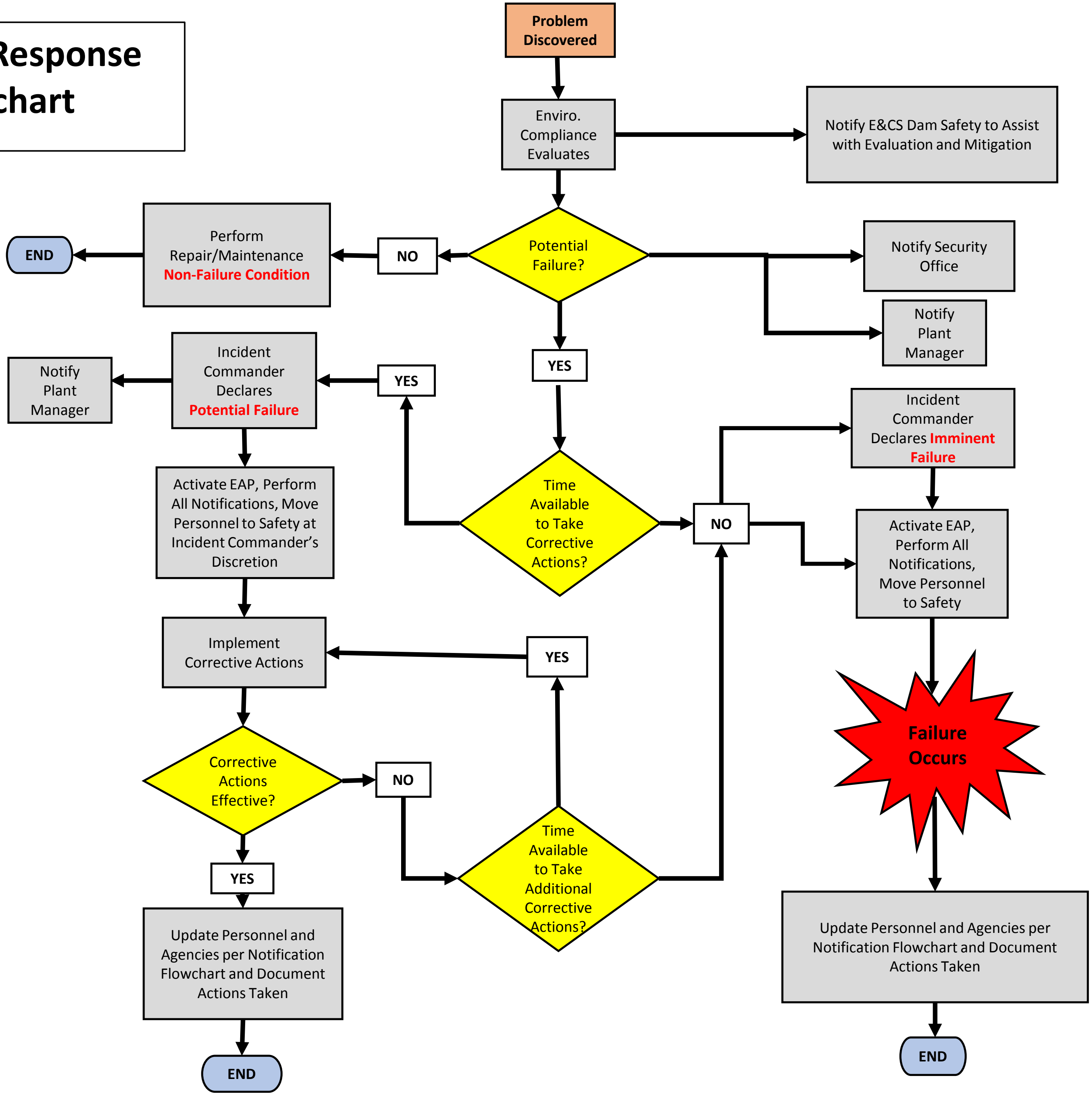
| | |
|---|---|
| ∼ | Stream/River Centerline |
| — | Lettered Cross Section |
| — | Model Cross Section |
| ▨ | Design Storm Breach Floodplain |
| ▨ | Effective 100-year Floodplain |
| - - - | 20-ft Contours |

Note:
1. The information contained in this map is prepared for use in notification of downstream property owners by emergency management personnel.
2. Mapping of flooded areas and floodwave travel times are approximate. Timing and extent of actual indundation may differ from information presented on this map.
3. It is prudent to assume that areas outside, but adjacent to, the inundation limits shown could also be flooded.
4. The contours shown on this map were generated from the LiDAR Digital Elevation Model (DEM) for Mobile County.

# APPENDIX C

## Incident Response Flowchart

# Incident Response Flowchart

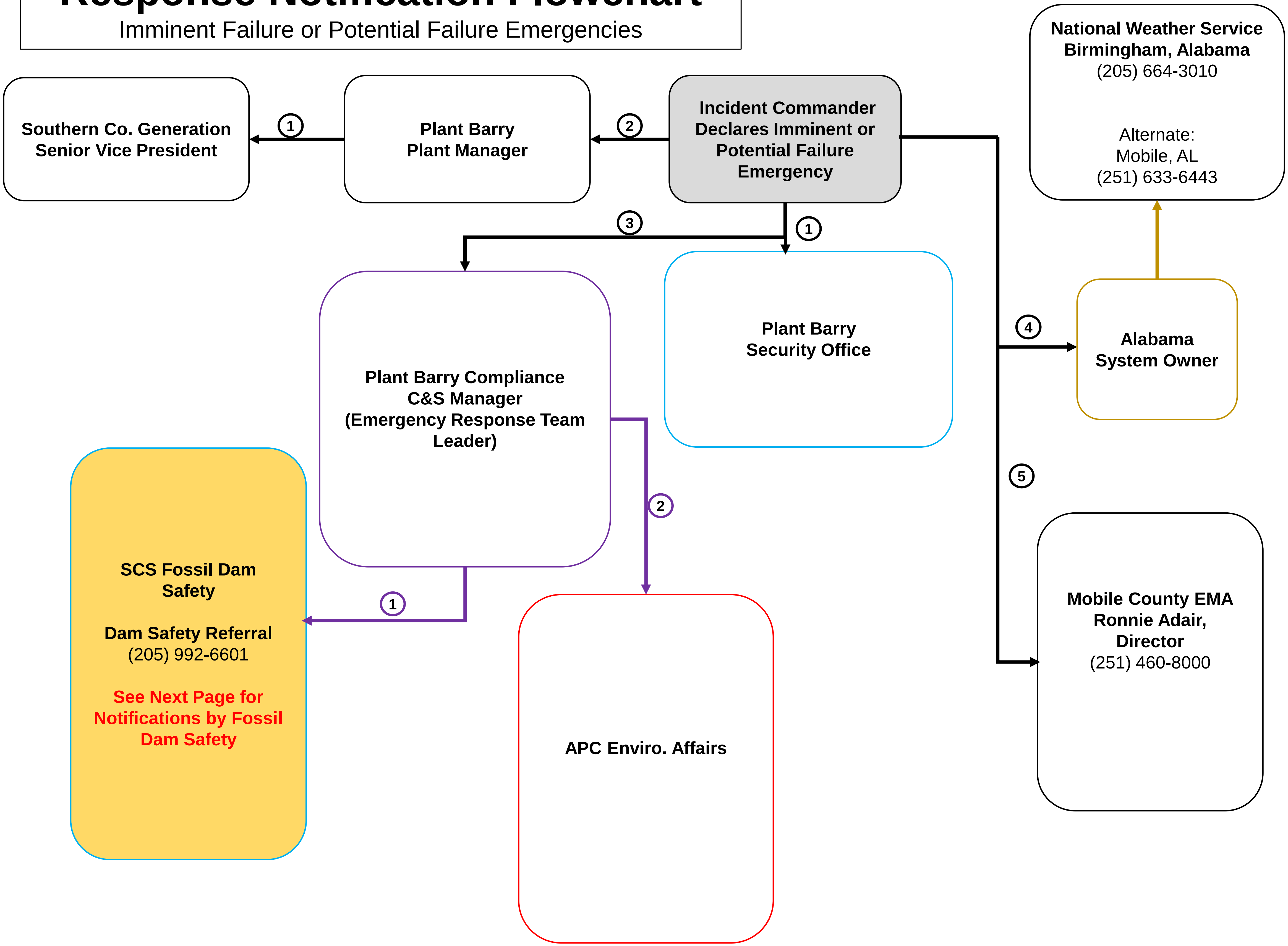


# APPENDIX D

## Response Notification Flowchart

# Response Notification Flowchart

Imminent Failure or Potential Failure Emergencies



**Incident Commander Declares Imminent or Potential Failure Emergency**

**Plant Barry Plant Manager**

**Southern Co. Generation Senior Vice President**

**National Weather Service Birmingham, Alabama**
(205) 664-3010

Alternate:
Mobile, AL
(251) 633-6443

**Plant Barry Security Office**

**Plant Barry Compliance C&S Manager (Emergency Response Team Leader)**

**Alabama System Owner**

**SCS Fossil Dam Safety**

**Dam Safety Referral**
(205) 992-6601

**See Next Page for Notifications by Fossil Dam Safety**

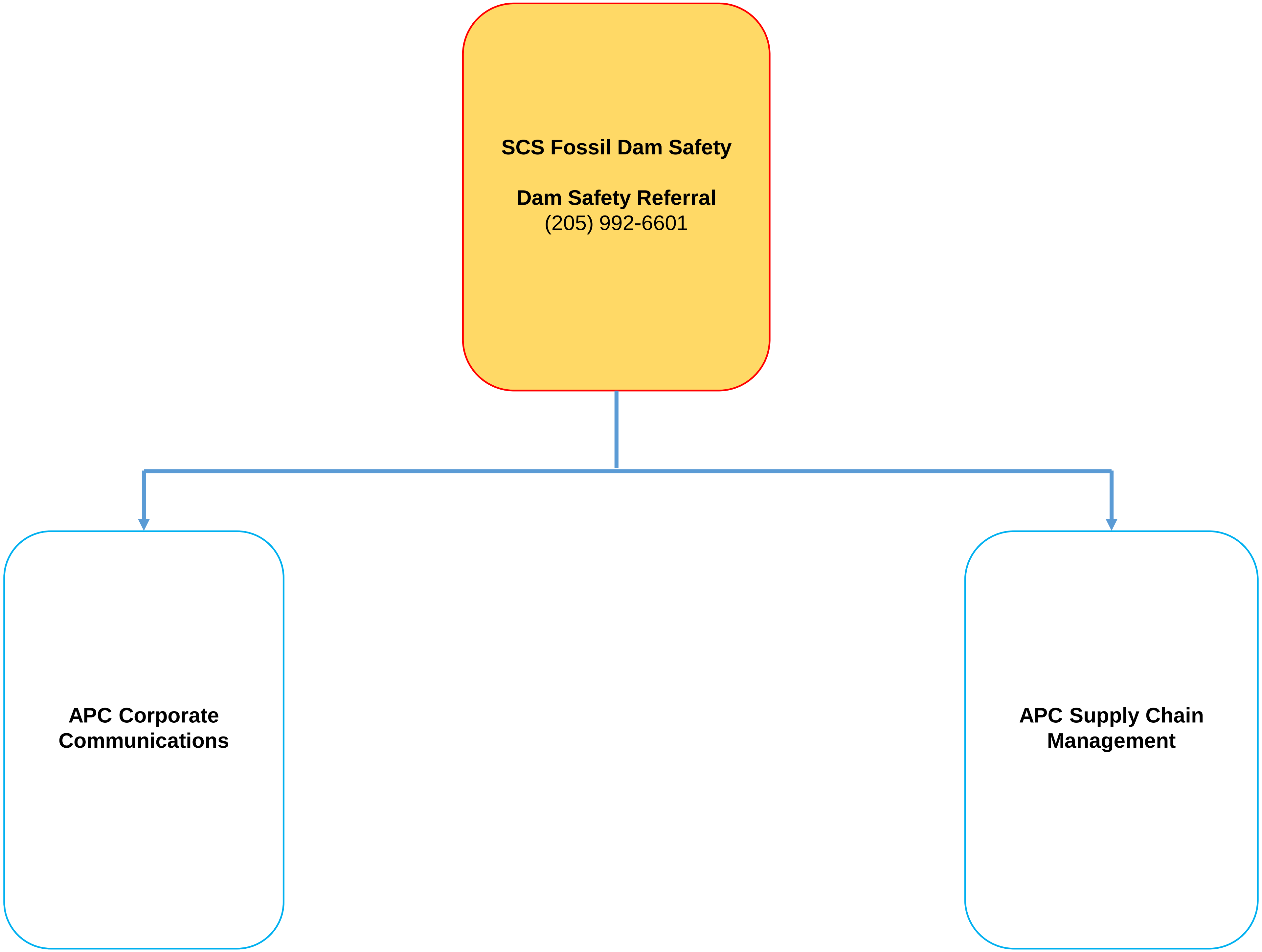
**APC Enviro. Affairs**

**Mobile County EMA Ronnie Adair, Director**
(251) 460-8000

# Response Notification Flowchart

Imminent Failure or Potential Failure Emergencies

*Fossil Dam Safety Notifications*



**SCS Fossil Dam Safety**

**Dam Safety Referral**
(205) 992-6601

**APC Corporate Communications**

**APC Supply Chain Management**

# Emergency Responders Contact Information

***If a Condition A Emergency has occurred call 911***

1) Mobile County Sheriff's Office – 1-251-574-2423
2) Mobile County Emergency Management Agency – 1-251-460-8000
3) Alabama Emergency Management Agency – 1-205-280-2200
4) National Weather Service
    a. Birmingham Office – 1-205-664-3010
    b. Mobile Office – 1-251-633-6443

# APPENDIX E

## Data Recording Sheet

# EMERGENCY ACTION PLAN
## DATA RECORDING SHEET

The Data Recording Sheet will be used to record important information relating to dam safety emergency.

**Team Member(s):** ______________________________

**Date of Incident:** ______________________________

**Time of Incident:** ______________________________

**Type of Emergency:** ______________________________

**Emergency Coordinator:** ______________________________

**Description of Events:*** ______________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

**What is Being Done:*** ______________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

*Attach additional pages as necessary.

**For incoming questions, refer all calls to:**

| | |
|---|---|
| Media Inquiries: | Alabama Power Company Corporate Communications |
| EMA Inquiries: | Plant Manager/Incident Commander |
| Environmental Agency Inquiries: | APC Environmental Affairs |

Page 1 of _____

# APPENDIX F

## Instructions for the Construction of an Emergency Reverse Filter

# EMERGENCY REVERSE FILTER CONSTRUCTION

The purpose of the reverse filter is to slow down the flow of water in order to reduce the ability of the water to carry soil particles. The size of the soil particle that a flow of water can carry is a function of the 3rd power of the velocity of the flow. The slower the velocity, the less soil the water can carry. The other function of the filter is to trap soil particles before they exit.

The usual components of a reverse filter are as follows:

- #100 concrete sand
- # 89 stone
- # 57 stone
- ALDOT Class 1 - Class 3 riprap (not required, utilize if available)

These materials should be stockpiled in a location where they can easily and quickly be moved to the seepage site. Two truckloads of each type of material should be stored in a convenient location that is out of the way. It is best if they are located so that a backhoe or front end loader can pick them up and transfer them directly to the seepage site. Transport schemes that require multiple vehicles and multiple operators are usually impossible to implement at night or on weekends. The stockpiles should be labeled "Emergency Filter Stockpile – Emergency Use Only" to keep them from being appropriated for other purposes by those unaware of their purpose.

To build a reverse filter over a boil or area of concentrated seepage, follow the directions below. A cross section of the reverse filter construction is provided on the next page.

1) Clear loose material from around the site.

2) Place 6" of #10 washed sand over the area of concern, and extend it for at least 12" beyond the seepage limits.

3) Place 6" of #89 stone over the sand, and extend it for at least 6" beyond the sand.

4) Place 6" of #57 stone over the sand, and extend it for at least 6" beyond the #89 stone.

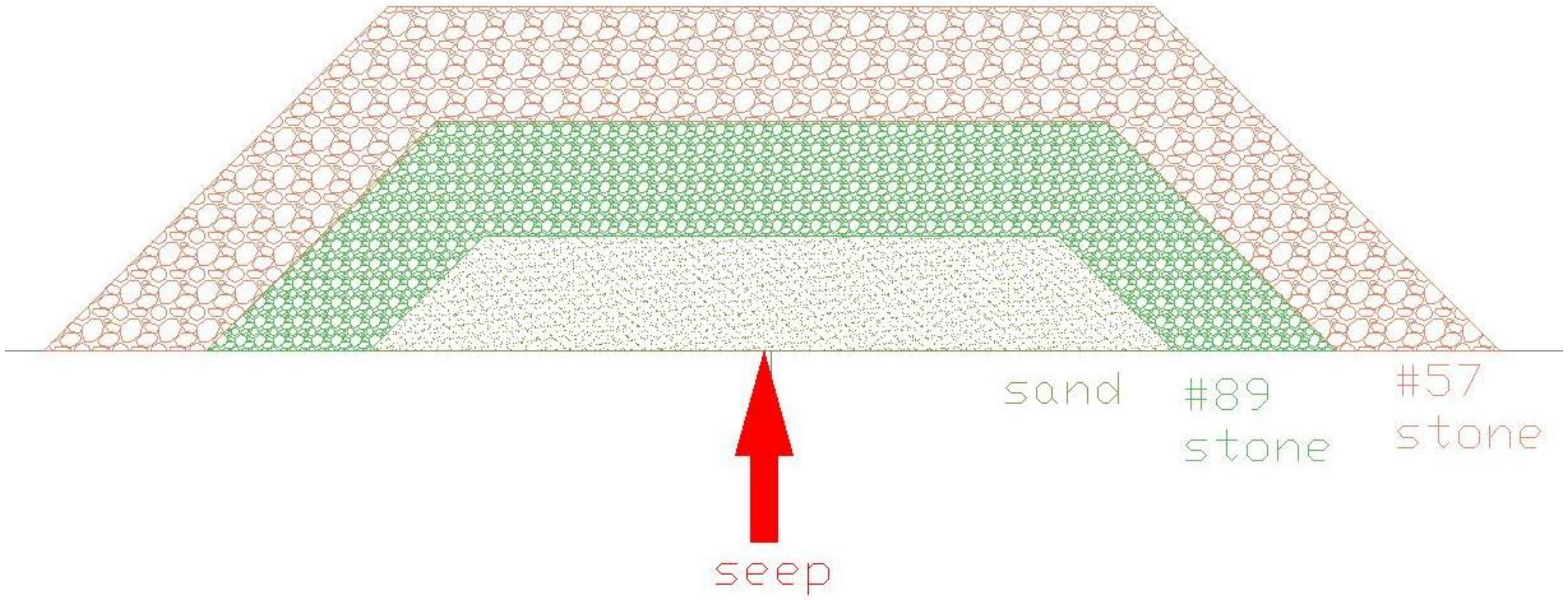
5) If necessary to stabilize the #57 stone, place rip rap on top of the #57 stone. Conditions that may make the rip rap necessary are anticipated surface flows that might wash away the filter or increasing seepage flows that may try to shift the lighter filter materials.

If the flow is too fast for the sand to remain in place, a layer of #57 stone or ALDOT Class 1 - Class 3 riprap may be placed over the boil to slow the flow down. This is followed by a layer of #89 stone, then the sand, and then the #89, #57 and riprap in succession.

Sometimes a seep will pop out on the edge of a newly applied filter. In this case, it is generally necessary to apply the granular filter as a blanket to the general area rather than as a spot treatment. The layers are as described above but will cover a larger area.

**Filter fabric or geotextile is not acceptable as a substitute for the sand. The fabric tends to smear and clog if applied in a wet situation.**

# CROSS SECTION OF A REVERSE FILTER OVER A SEEP OR BOIL



# APPENDIX 6
# HISTORY OF CONSTRUCTION

# HISTORY OF CONSTRUCTION FOR EXISTING CCR SURFACE IMPOUNDMENT
# PLANT BARRY GYPSUM POND

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

| | |
|---|---|
| Site Name: | James M. Barry Electric Generating Plant |
| Site Location: | Bucks, Alabama |
| Site Address: | 15300 U.S Highway 43 North<br>Bucks, Alabama 36512 |
| Owner: | Alabama Power Company |
| Owner Address: | 600 North 18th Street; Birmingham, AL 35203 |

| | |
|---|---|
| CCR Impoundment Name: | Plant Barry Gypsum Pond |
| NID ID: | NA |

ADEM's Rules governing coal combustion residuals require the owner or operator of an existing CCR surface impoundment to complie a history of construction. *See* ADEM Admin. Code r. 335-13-15-.04(4)(c)1. To the extent feasible, the following information is provided:

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

30.995992, -88.014690
See Location Map in the Appendix

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

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

## *(iv) Watershed Description:*

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

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

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

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

The Plant Barry Gypsum Pond was designed and constructed between 2007 and 2010 and consists of a 21.3-acre gypsum storage cell and a 10.4-acre sedimentation pond. The Gypsum Pond dikes were constructed using clayey sands, sandy silts, and silty sand compacted to a minimum 95% maximum dry density. The bottom of the pond is lined with 2 feet of compacted clay having a maximum in-place permeability of $1x10^{-7}$ cm/s overlain by a manufactured 60-mil HDPE geomembrane.

### *(vii) Engineering Diagram:*

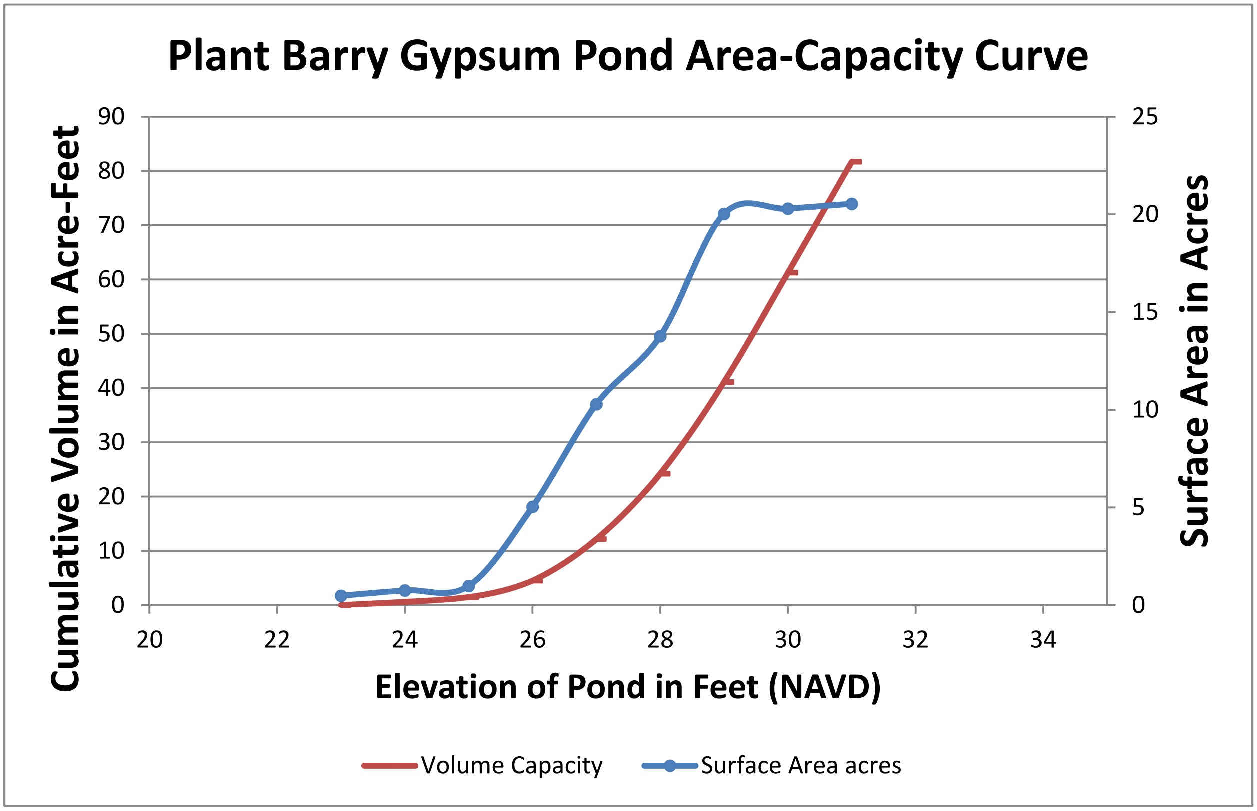
The following drawings reflecting the construction of the Plant Barry Gypsum Pond can be found in the Appendix:

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

### *(viii) Description of Instrumentation:*

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

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



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

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

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

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

***Construction specifications:***

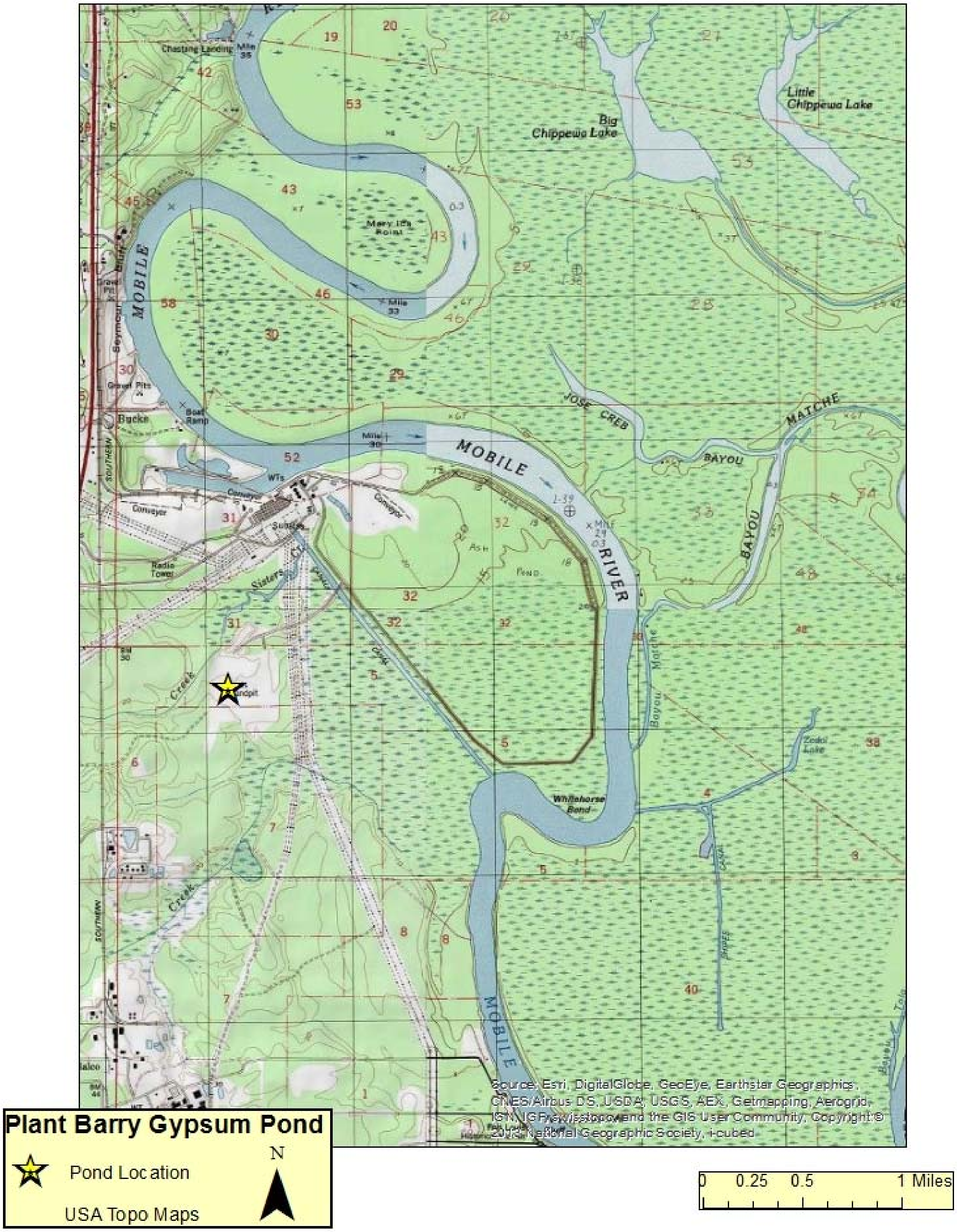
The following specifications relevant to the construction of the Plant Barry Gypsum Pond can be found in the Appendix:

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

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

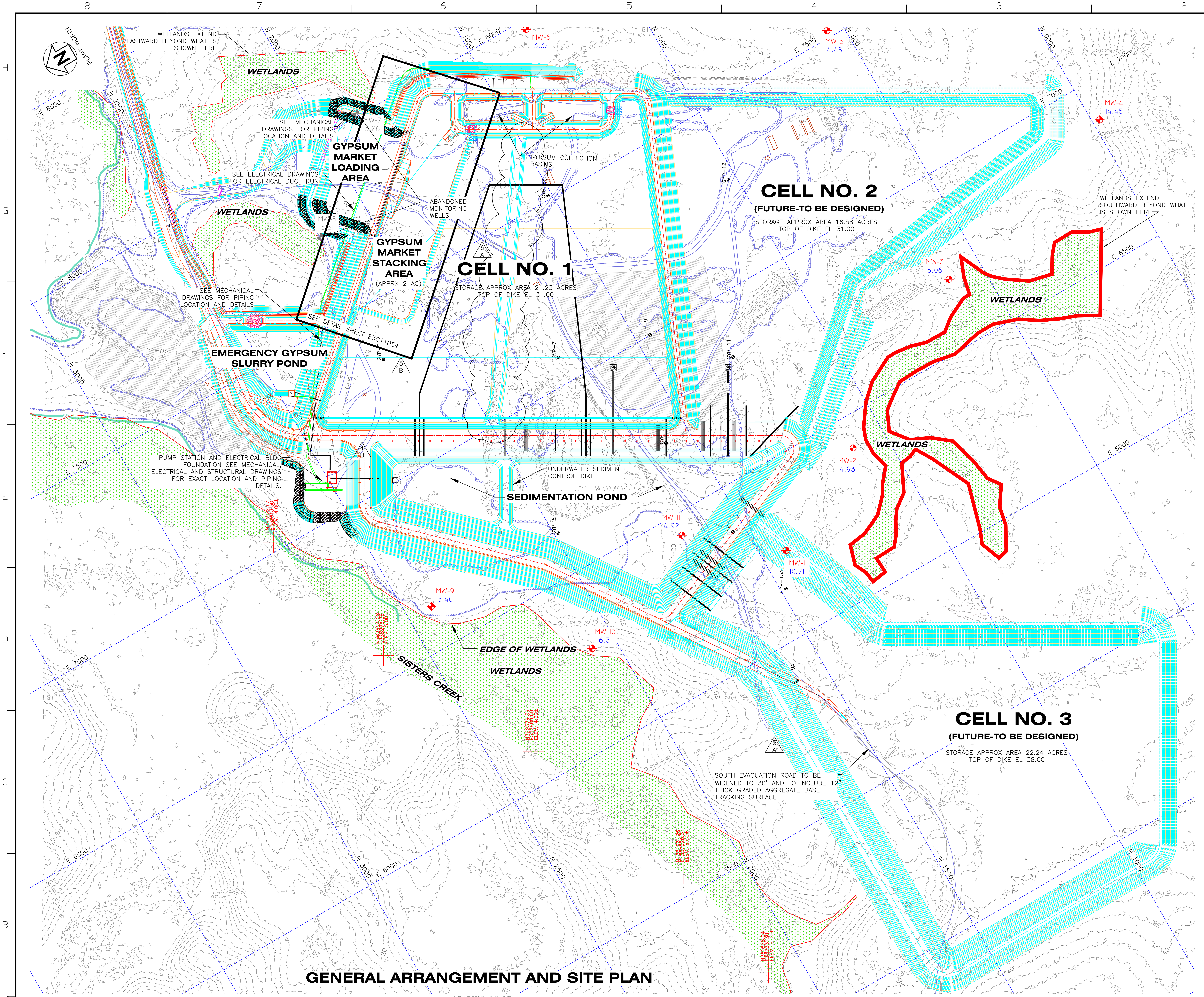
There are no known instances of structural instability at the CCR unit.

# Appendix



**Plant Barry Gypsum Pond**

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Copyright © 2013 National Geographic Society, i-cubed



# GENERAL ARRANGEMENT AND SITE PLAN

NOTES:

1. GRID LINES AND COORDINATES SHOWN ARE IN PLANT GRID.

LEGEND:

| | |
|---|---|
| MW-1 10.71 | MONITORING WELLS |

| REVISION | DATE | REVISION 6 | DATE 12-19-11 | REVISION 5 | DATE 08-14-09 | REVISION 4 | DATE 07-02-09 |
|---|---|---|---|---|---|---|---|
| | | A. ADDED AS-BUILT CONDITIONS<br>ECS5517 | | A. C-4 CHANGED GAB TO 12"<br>B. G-6 ADDED GYPSUM MARKDET LOADING AREA AND GYPSUM MARKET STACKING AREA<br>EWO 2161DE | | A. G-7 ADDED GYPSUM MARKET LOADING AREA<br>B. E-6 ADDED ALDOT STANDARD GUARDRAIL<br>EWO 2161DE | |

| REVISION 3 | DATE 03-05-09 | REVISION 2 | DATE 11-14-08 | REVISION 1 | DATE 04-11-08 | REVISION 0 | DATE 12-3-07 |
|---|---|---|---|---|---|---|---|
| A. G-7 ADDED ELECTRICAL DUCT<br>EWO 2161DE | | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION<br>EWO 2161DE | | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION<br>EWO 2161DE | | ISSUED FOR CONSTRUCTION<br>EWO 2161DE | |

| Revision | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 6 | CSM | DPK | JBS | ☒ | ☒ | ☒ | ☒ |
| 5 | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
GENERAL ARRANGEMENT AND SITE PLAN
CELL NO. 1 THROUGH CELL NO. 3

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=100' | | E5C11032 | 1 | FINAL | 6 |

ANSI E: 44x34 Acad2004

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

GRAPHIC SCALE

50 0 25 50 100 200

( IN FEET )
1 inch = 50 ft.

NOTES:

1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

| REVISION | DATE | | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| 6 | 12-19-11 | A. ADDED AS-BUILT CONDITIONS | ECS5517 | CSM | DPK | JBS | | | | |
| 5 | 08-14-09 | A. A–7, E–8, H–8, ADDED SOUTH EVACUATION ROAD NOTE<br>B. H–8, CHANGED RADIUS<br>C. F–5 ADDED GYPSUM MARKET STACKING AREA<br>D. G–3, G–5 REVISED SPILLWAY COORDINATES AND ELEVATIONS | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | 07-02-09 | A. G–6, H–1 ADDED GYPSUM MARKET LOADING AREA<br>B. G–6, C–6, C–7 ADDED GUARDRAIL<br>C. G–5 CHANGED SPILLWAY LOCATION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 03-05-09 | A. D–6 ADDED PIPE SLEEVES AND PIPING<br>B. G–6 ADDED ELECT DUCT RUN<br>C. H–4 ADDED PIPES, CONCRETE PAD, AND GUARDPOSTS<br>D. B–6 ADDED ELECT DUCT RUN<br>E. C–6 ADDED PIPE SLEEVE AND PIPING | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 4-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1–DETAIL PLAN FOR INITIAL
DIKE CONSTRUCTION

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=50' | | E5C11033 | 1 | FINAL | 6 |

ANSI E: 44x34 Acad2004

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

NOTES:

1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

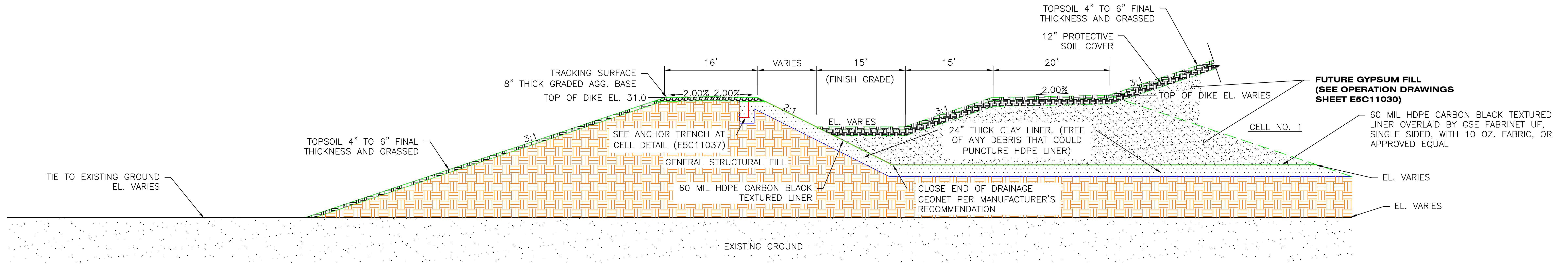
| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  |  |  |  |
| 6 | 12-19-11 | A. ADDED AS-BUILT CONDITIONS | ECS5517 | CSM | DPK | JBS |  |  |  |  |
| 5 | 08-14-09 | A. B-2 CHANGED GAB TO 12"<br>B. C-3, E-6, F-8, ADDED SOUTH EVACUATION NOTE.<br>C. D-5, CHANGED SECTION C-C TO C'-C'<br>D. E-2, REVISED DISTANCE TO CL<br>E. H-7, ADDED GYPSUM MARKET STACKING AREA | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | 07-02-09 | A. C-4, F-7 ADDED GUARDRAIL AND SWING GATE | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 03-05-09 | A. G-7 ADDED PIPE SLEEVES AND PIPING<br>B. H-7 ADDED ELECT DUCT RUN<br>C. B-6 ADDED ELECT DUCT RUN<br>D. F-7 ADDED ELECT DUCT RUN AND EDITED NOTE<br>E. F-8 ADDED PIPE SLEEVE AND PIPING | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-03-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

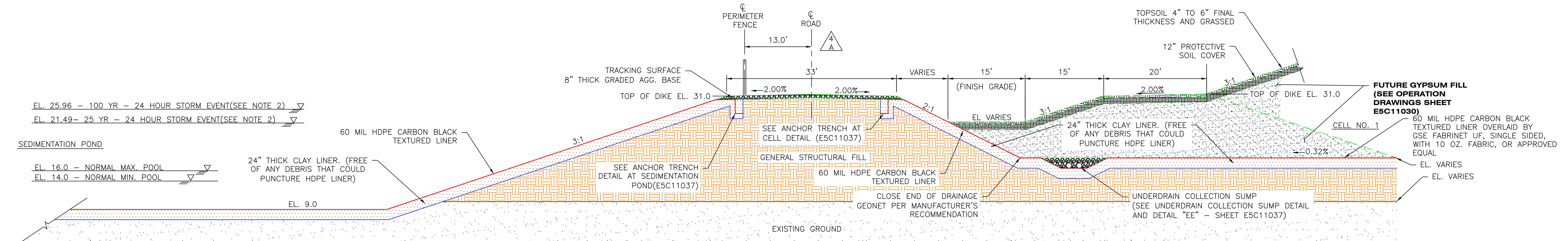
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1-SEDIMENTATION POND DETAIL PLAN
FOR INITIAL DIKE CONSTRUCTION

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=50' |  | E5C11034 | 1 | FINAL | 6 |

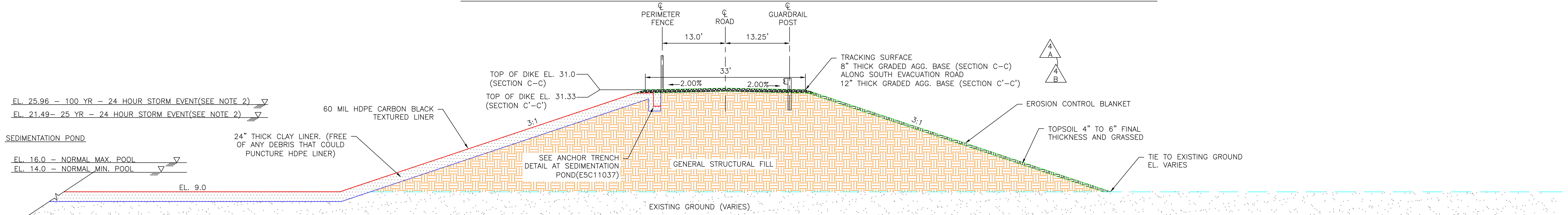
ANSI E: 44x34 Acad2004



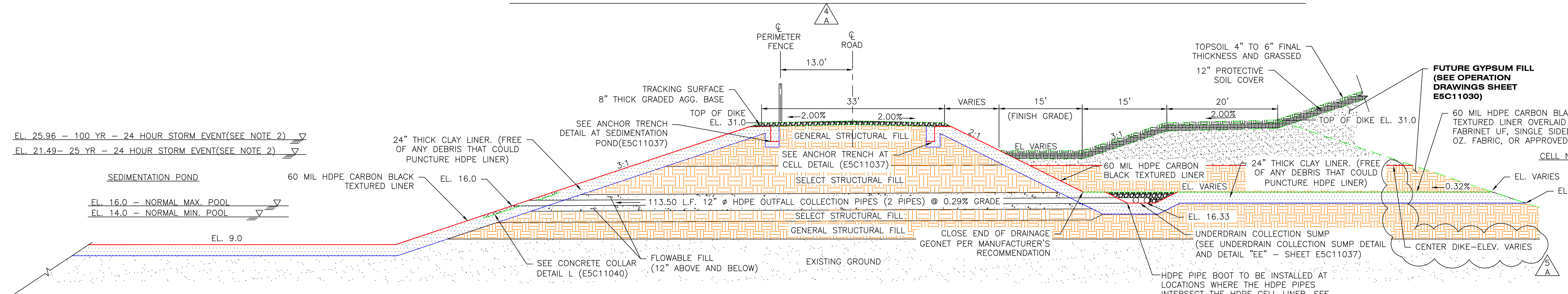
## SECTION A-A(E5C11033)
## TYPICAL DIKE SECTION THROUGH CELL



## SECTION B-B(E5C11033)
## TYPICAL DIKE SECTION THROUGH SEDIMENTATION POND



## SECTION C-C AND SECTION C'-C' (E5C11034)
## TYPICAL DIKE SECTION THROUGH SEDIMENTATION POND



## SECTION K-K(E5C11033 AND E5C11034)
## OUTFALL COLLECTION PIPES

NOTES:

1. FOR DESCRIPTION AND CLASSIFICATION OF GENERAL STRUCTURAL FILL, SELECT STRUCTURAL FILL AND CLAY LINER MATERIAL SEE TECHNICAL SPECIFICATIONS.
2. STORM WATER ELEVATION BASED ON COMBINED RUNOFF FROM CELLS 1 AND FUTURE CELL 2 AND 3, ASSUMING NO PUMP DISCHARGE.

REFERENCES:

1. FOR A COMPLETE DRAWING LIST SEE DRAWING E5C11030.
2. SEE TECHNICAL SPECIFICATION, SECTION 31 FOR CONSTRUCTION OF CELL 1, SEDIMENTATION POND OF THE GYPSUM STORAGE AREA AND EMERGENCY GYPSUM SLURRY POND.

| REVISION | DATE | DESCRIPTION | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| 5 | 12-19-11 | A. ADDED AS-BUILT CONDITIONS | ECS5517 | CSM | DPK | JBS | ☒ | ☒ | ☒ | ☒ |
| 4 | 8-14-09 | A. C-5, E-4, F-4 ADDED FENCE AND GUARDRAIL WITH DIMENSIONS<br>B. E-4, ADDED SECTION C'-C' AND REVISED TOP OF DIKE ELEVATION. | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 3-5-09 | A. B-3 ADDED PIPE BOOT<br>B. C-8 , D-8, F-8 STORM EVENT ELEVATIONS ADJUSTED FOR INCREASED POND VOLUME | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

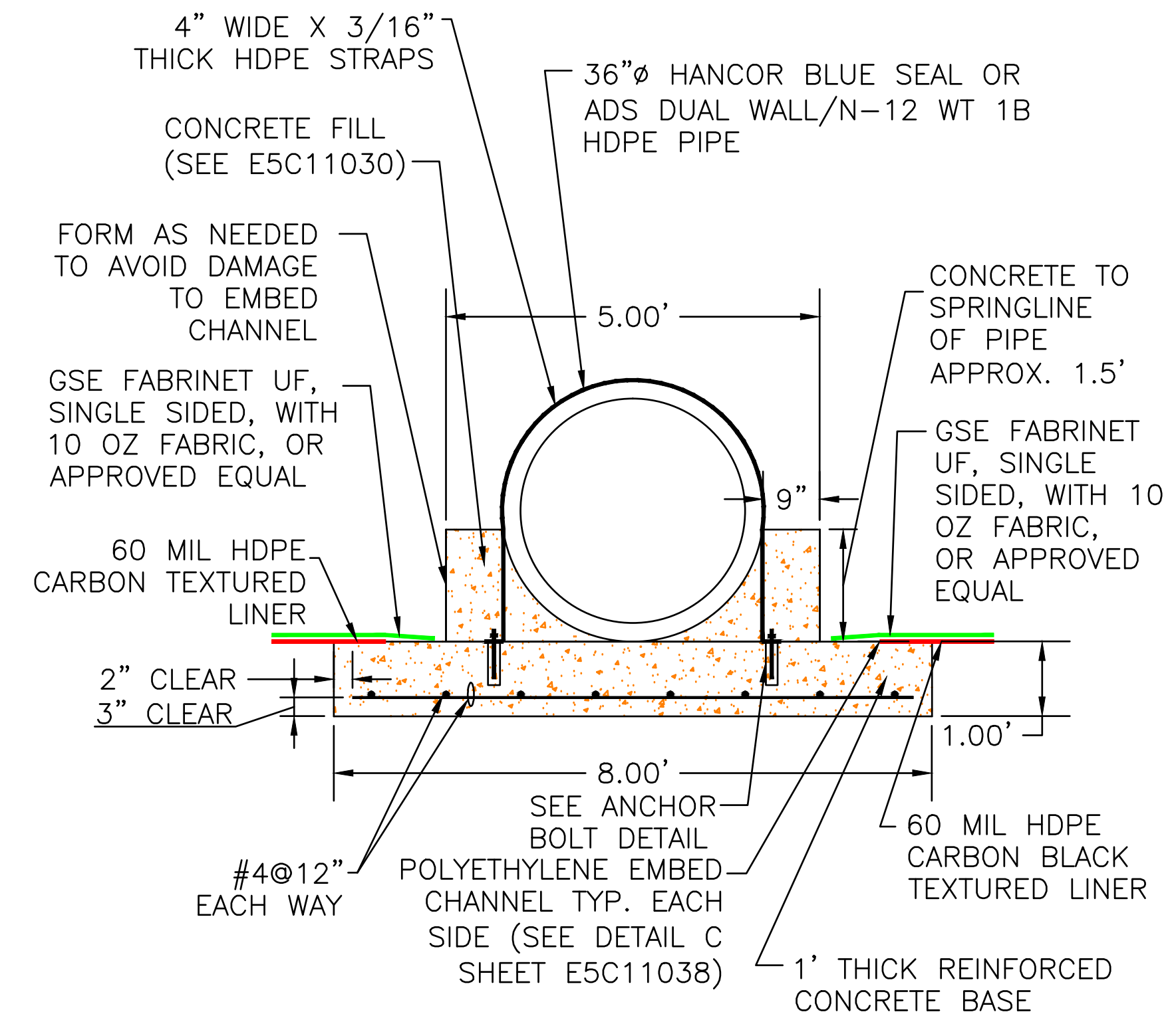
**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 – TYPICAL SECTIONS

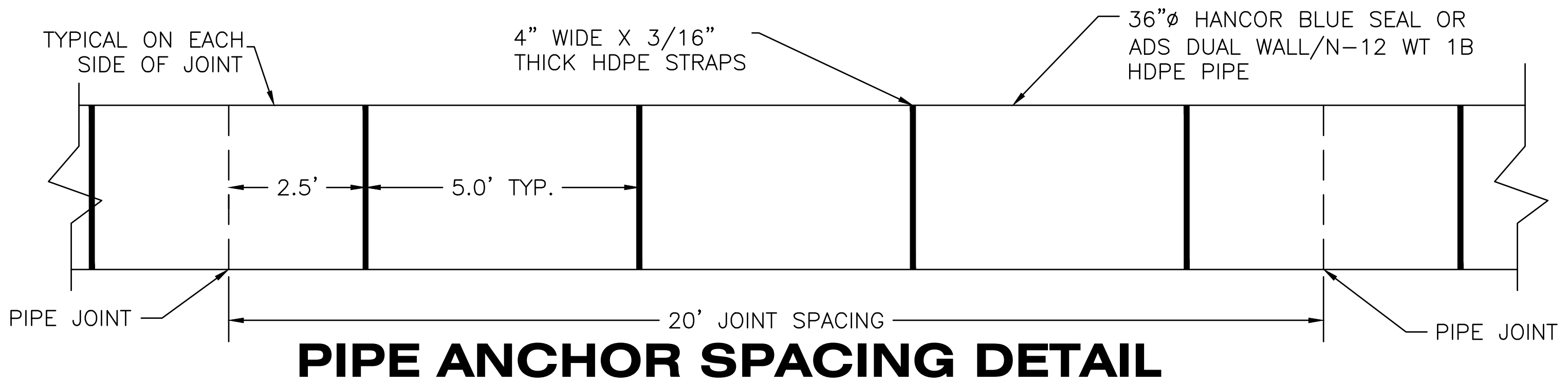
| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N.T.S. | | E5C11035 | 1 | FINAL | 5 |

ANSI E: 44x34 Acad2004

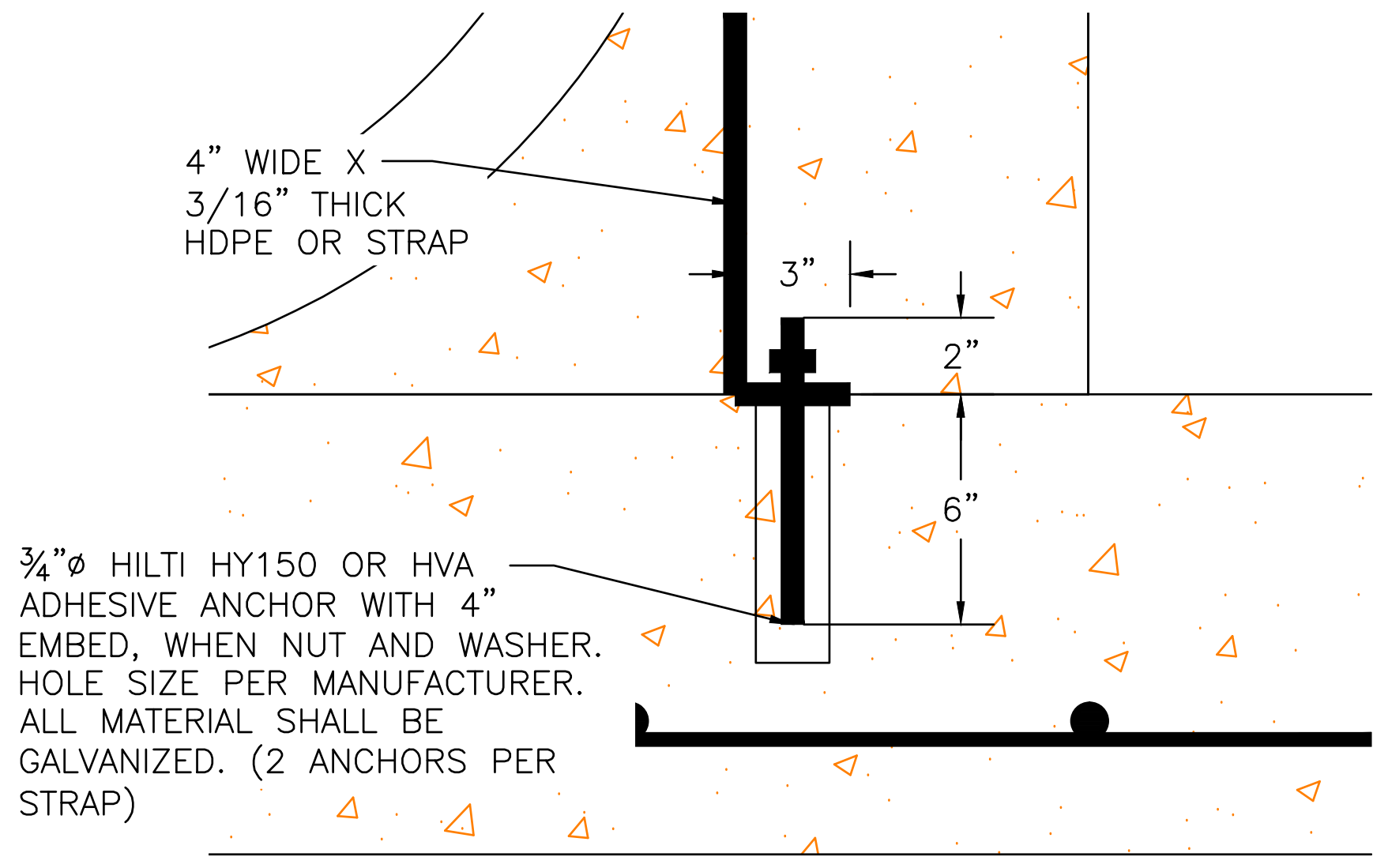
## SECTION E-E(E5C11033)
## CELL NO. 1 RISER STRUCTURE AND DECANT PIPE
## N.T.S.



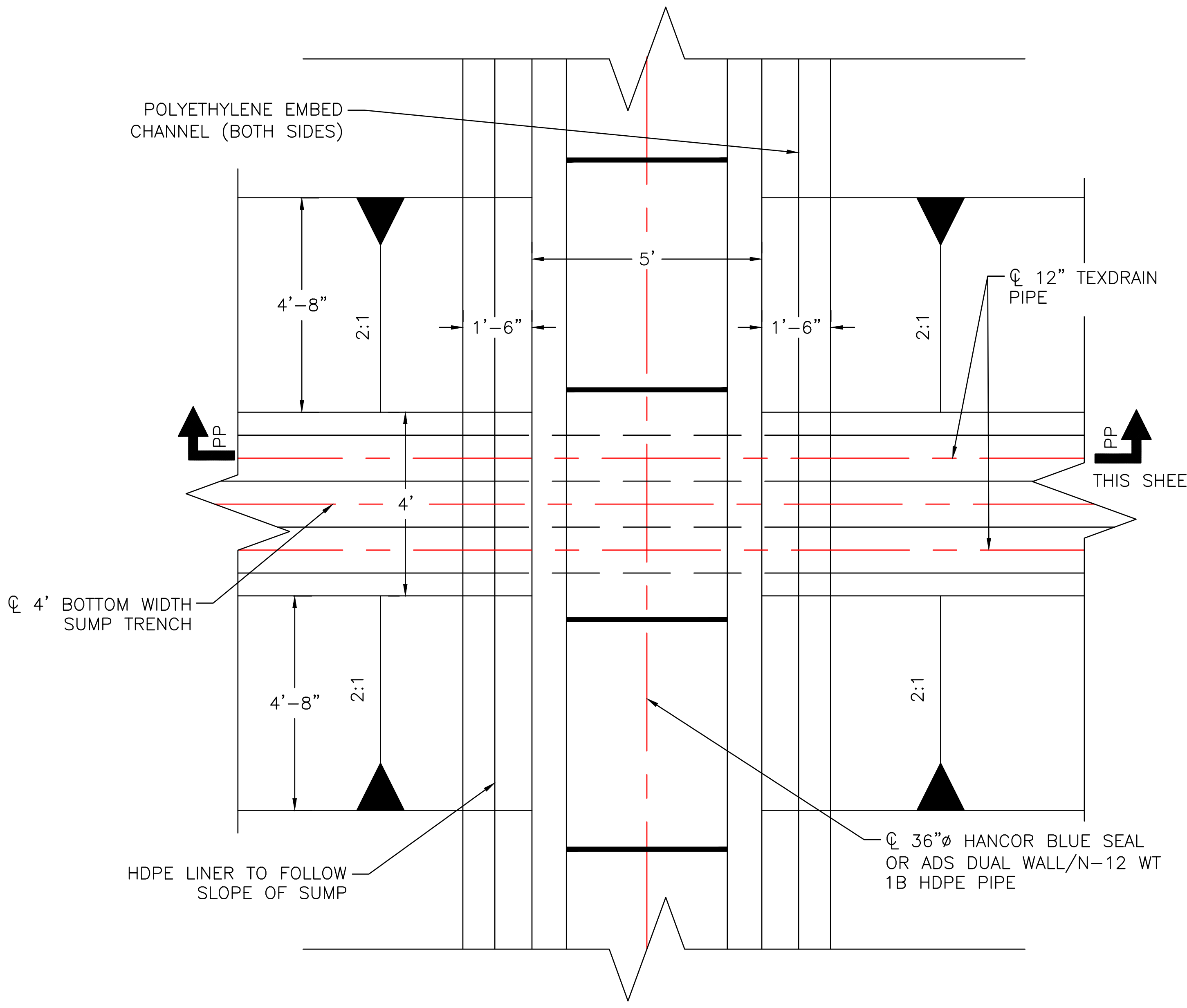
## DETAIL A
## PIPE ANCHOR DETAIL
## N.T.S.



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

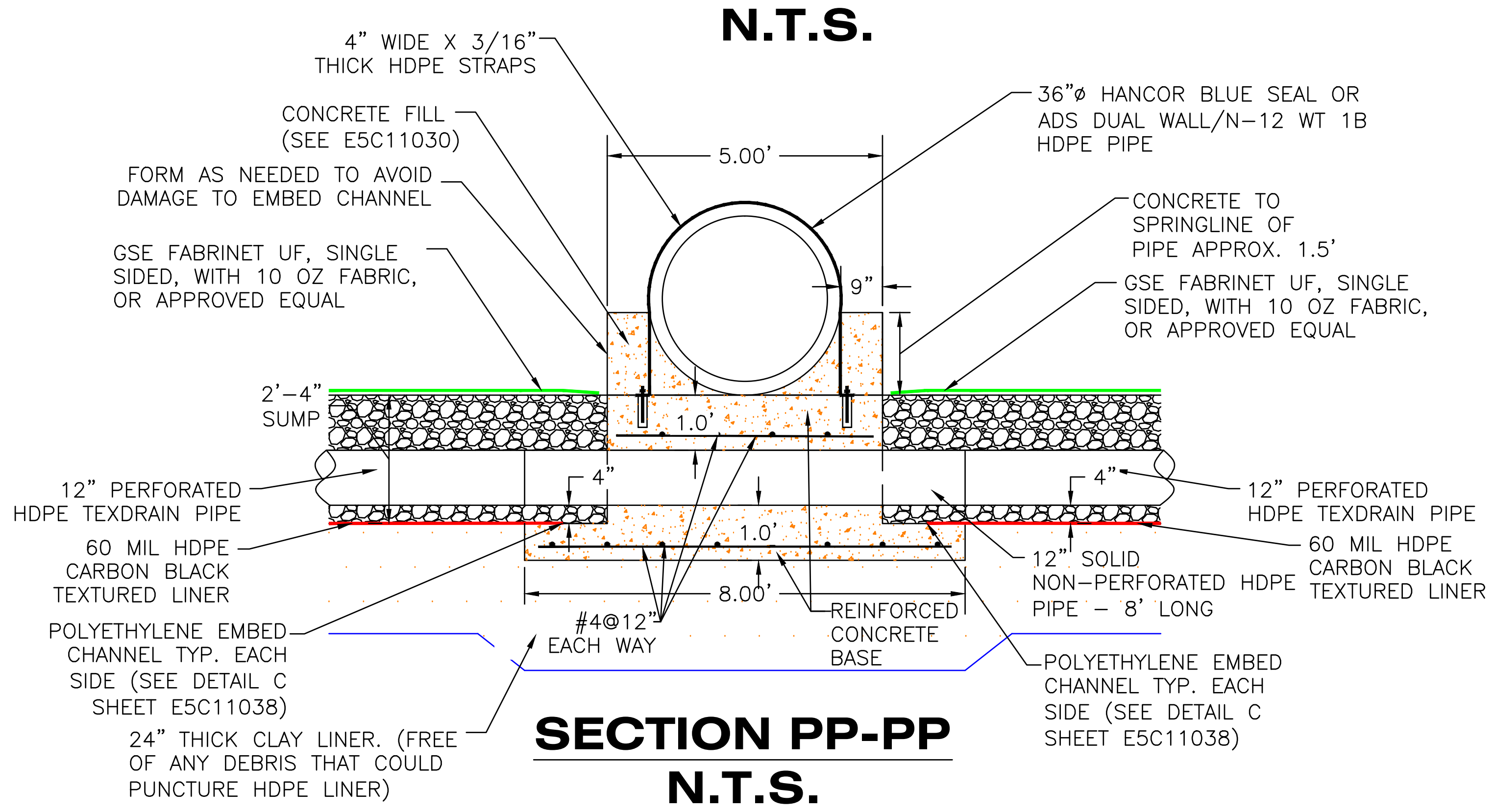


## ANCHOR BOLT DETAIL
## N.T.S.

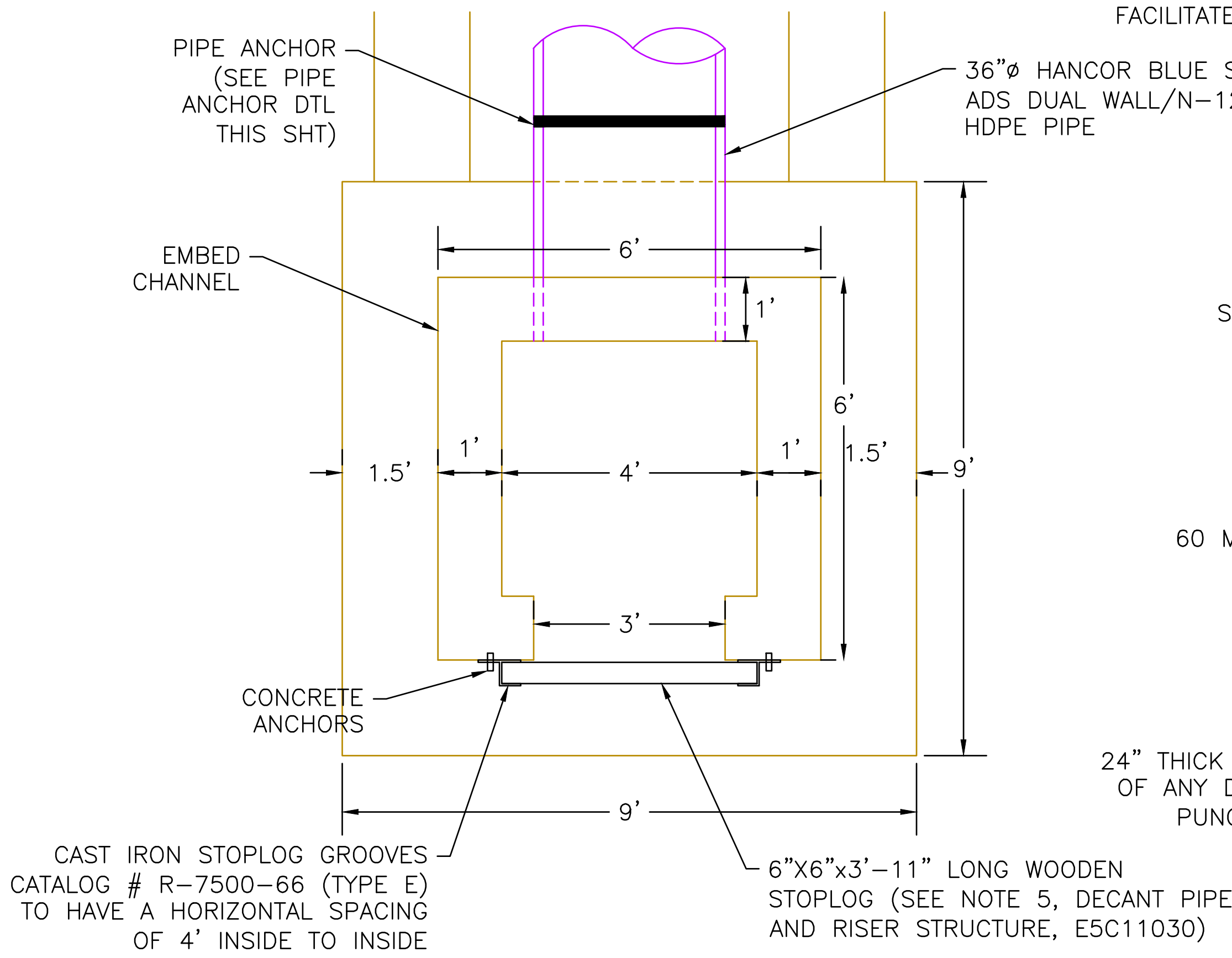


## SUMP/DECANT PIPE CROSSING PLAN VIEW
## N.T.S.

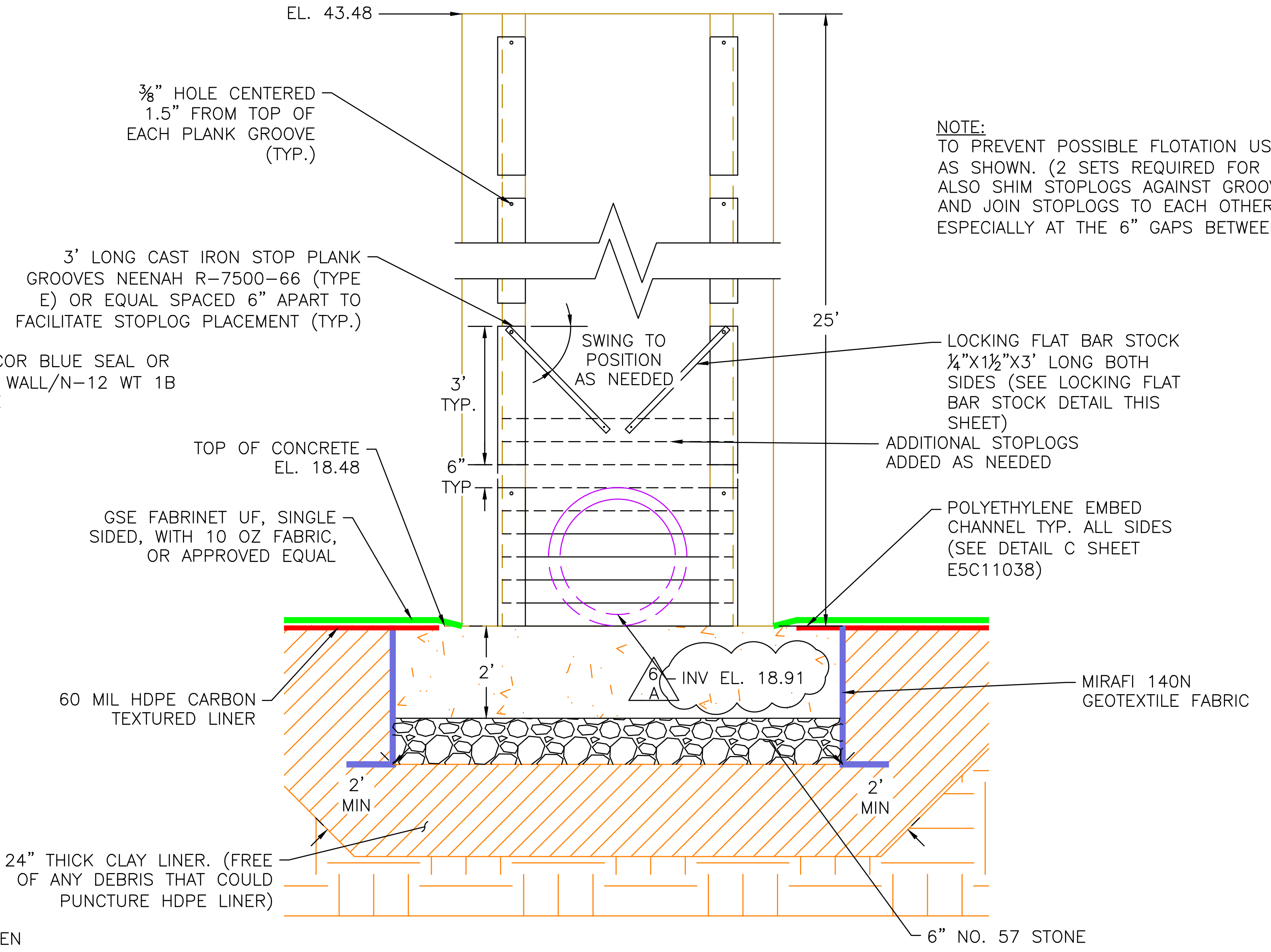
NOTE:
TO PREVENT POSSIBLE FLOTATION USE LOCKING FLAT BAR STOCK AS SHOWN. (2 SETS REQUIRED FOR ALTERNATING PLACEMENT). ALSO SHIM STOPLOGS AGAINST GROOVES TO PREVENT MOVEMENT AND JOIN STOPLOGS TO EACH OTHER WHERE NEEDED, ESPECIALLY AT THE 6" GAPS BETWEEN PLANK GROOVES



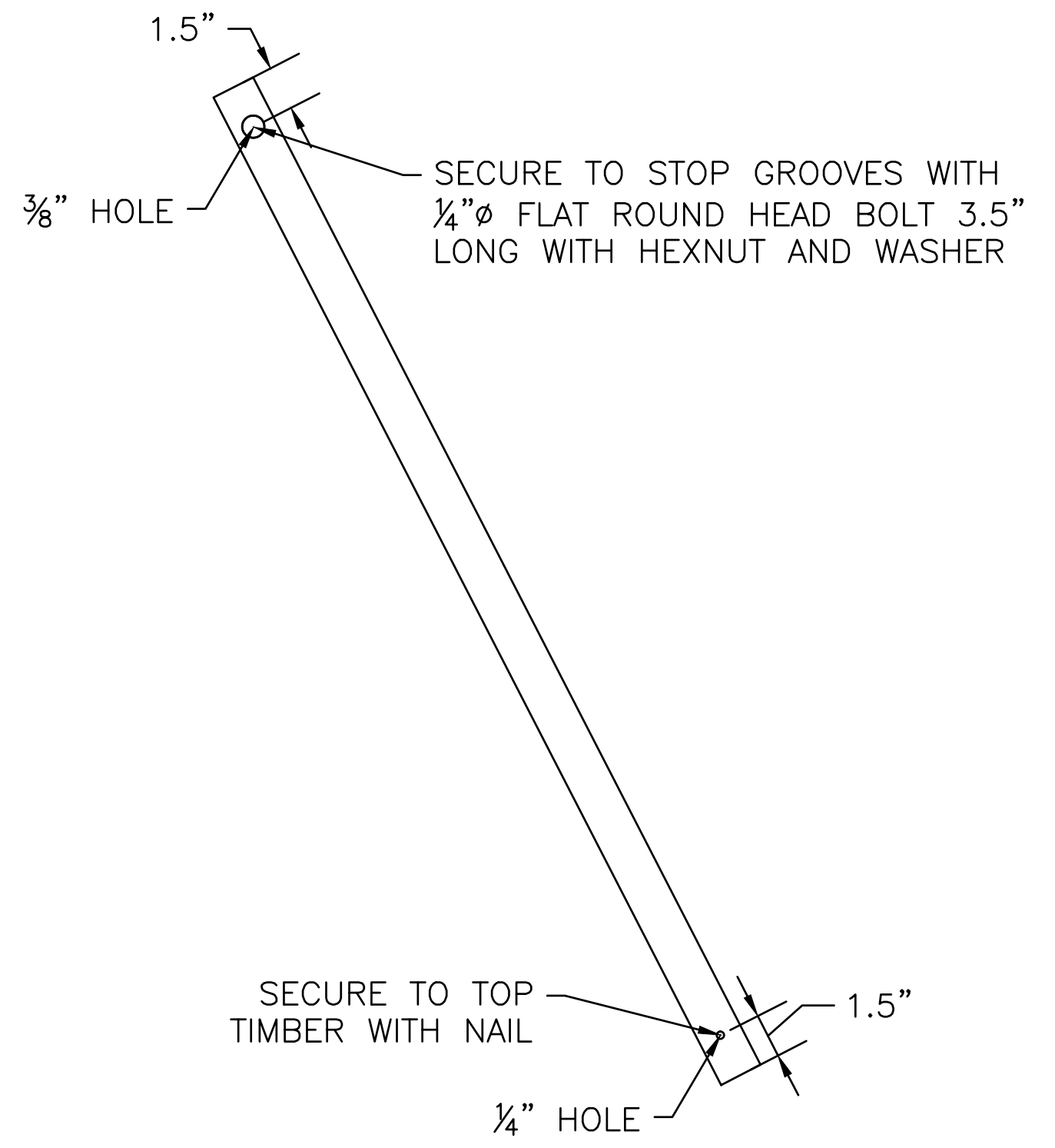
## SECTION PP-PP
## N.T.S.



## RISER STRUCTURE PLAN
## N.T.S.



## RISER STRUCTURE SECTION
## N.T.S.



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

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

| REVISION | DATE | DESCRIPTION | EWO | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| 6 | 12-19-11 | A. ADDED AS-BUILT CONDITIONS | ECS5517 | CSM | DPK | JBS | ☒ | ☒ | ☒ | ☒ |
| 5 | 8-14-09 | A. H-3 ADDED PERIMETER FENCE | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | 4-27-09 | GENERAL REVISION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 03-05-09 | A. G-3 , F-7, F-8, E-5 REVISED SECTION D-D AND E-E TO SHOW CONCRETE COVER AND NOT FLOWABLE FILL ABOVE CUSTOM TEE, AND REVISED ELEVATIONS OF NYLOPLAST DRAIN BASINS TOPS AND PVC EXTENSIONS. ADDED COATING NOTE.<br>B. B-1 ADDED NOTE ON ANCHOR BOLT DETAIL<br>C. ADDED SECTION PP-PP AND SUMP/DECANT PIPE CROSSING PLAN VIEW | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

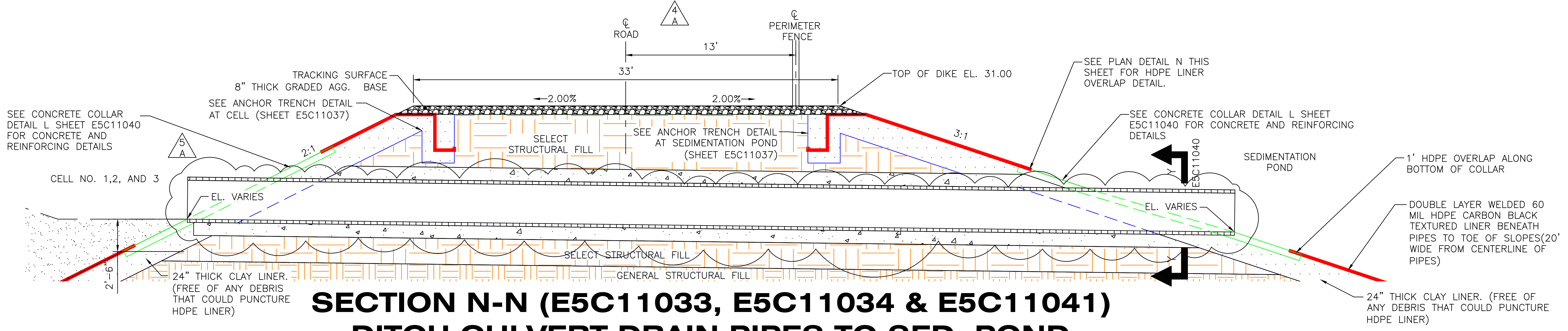
**Southern Company Generation Engineering and Construction Services**
**FOR**

**Alabama Power Company**

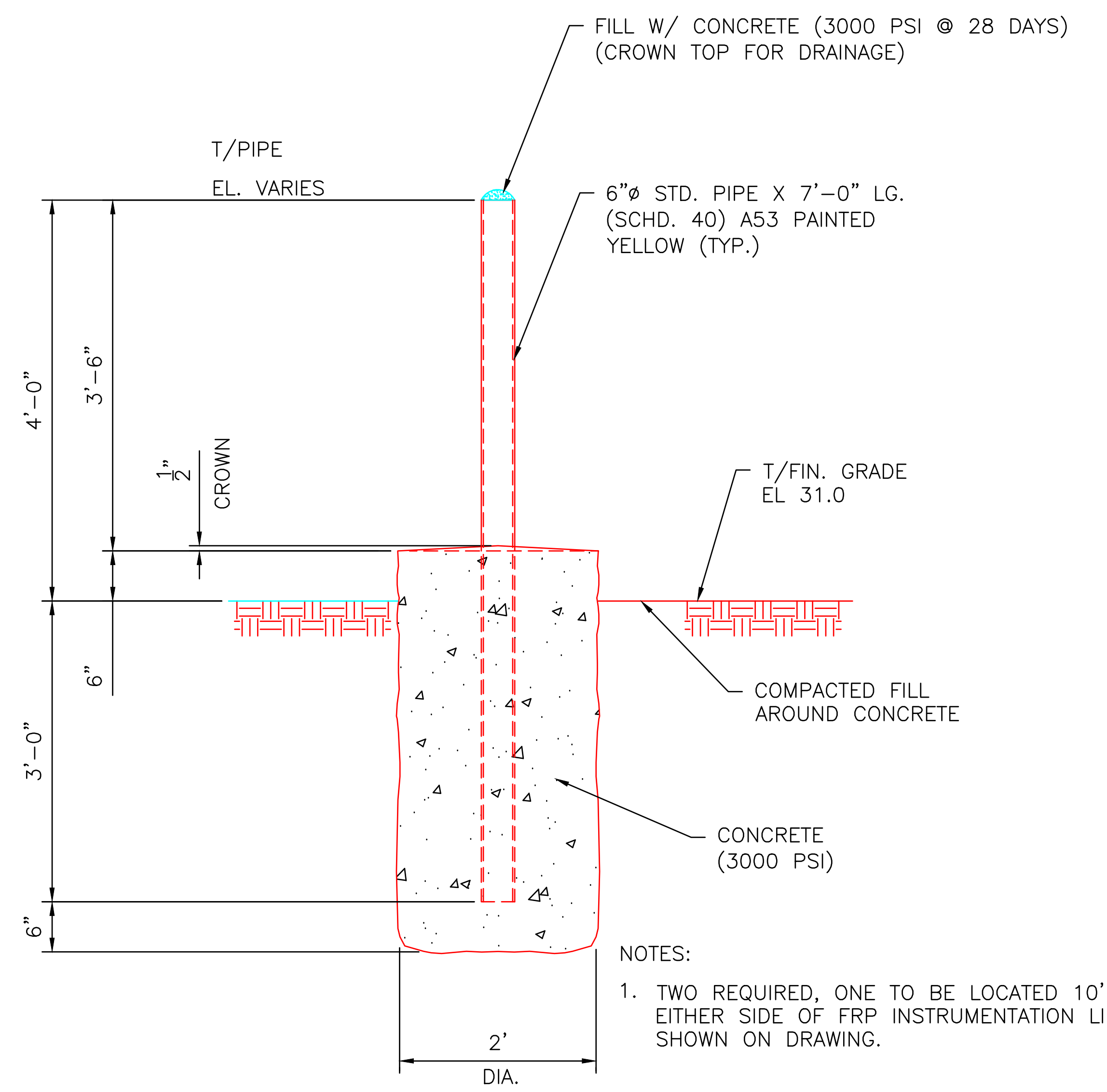
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 – SECTIONS AND DETAILS
RISER STRUCTURE AND DECANT PIPE

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N/A | | E5C11036 | 1 | FINAL | 6 |

ANSI E: 44x34 Acad2004

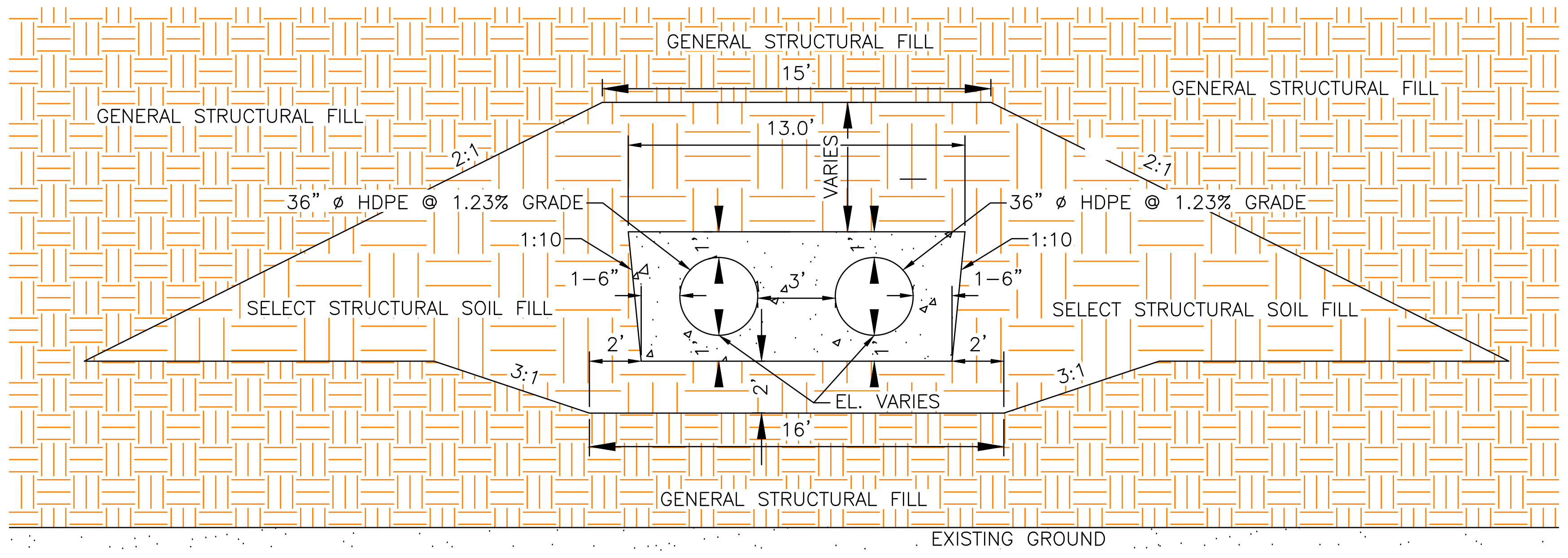


## SECTION N-N (E5C11033, E5C11034 & E5C11041)
## DITCH CULVERT DRAIN PIPES TO SED. POND

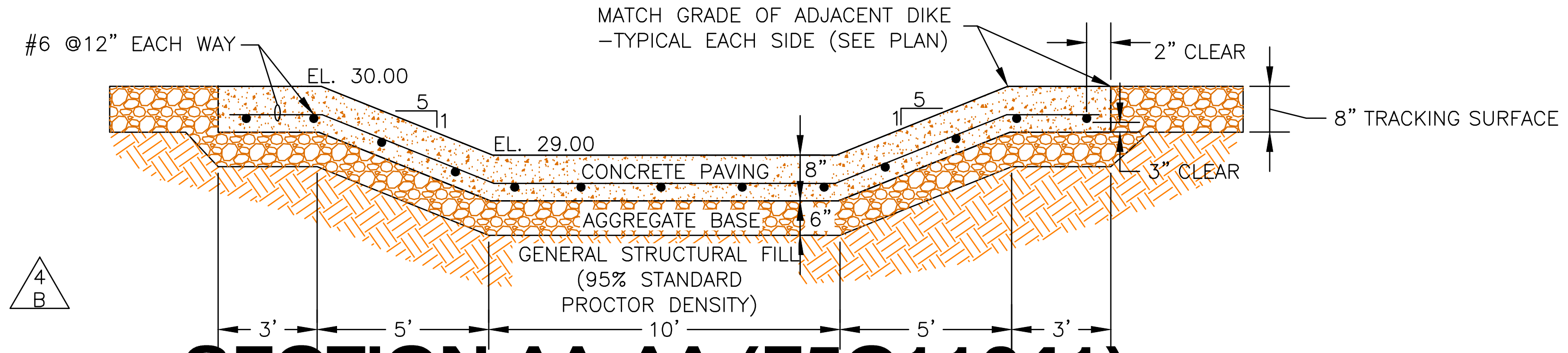


NOTES:
1. TWO REQUIRED, ONE TO BE LOCATED 10' ON EITHER SIDE OF FRP INSTRUMENTATION LINES AS SHOWN ON DRAWING.

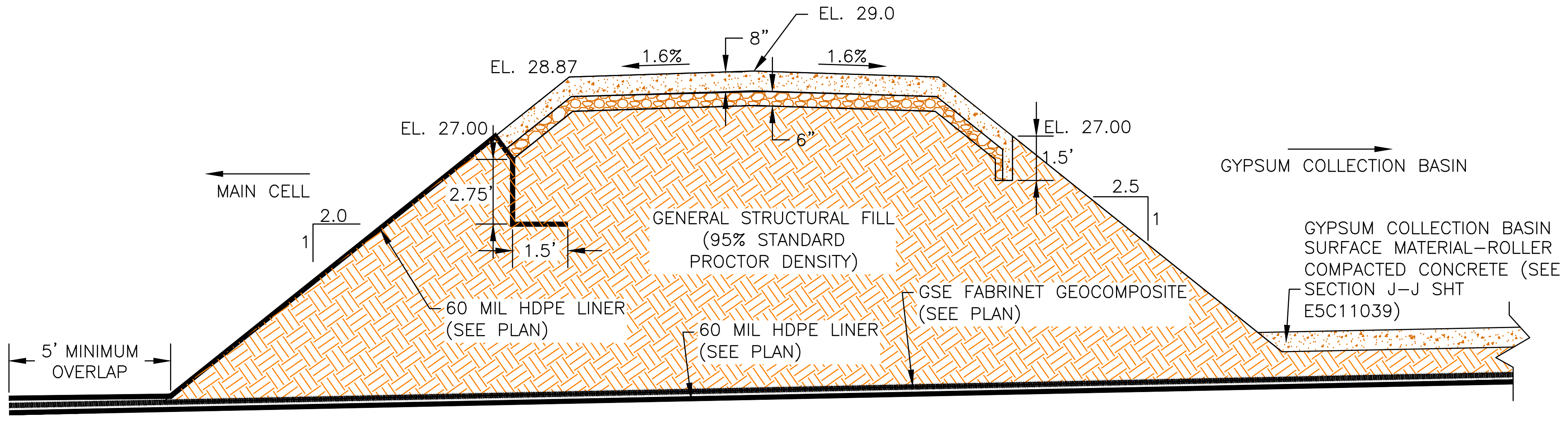
## TYP. GUARDPOST DETAIL



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

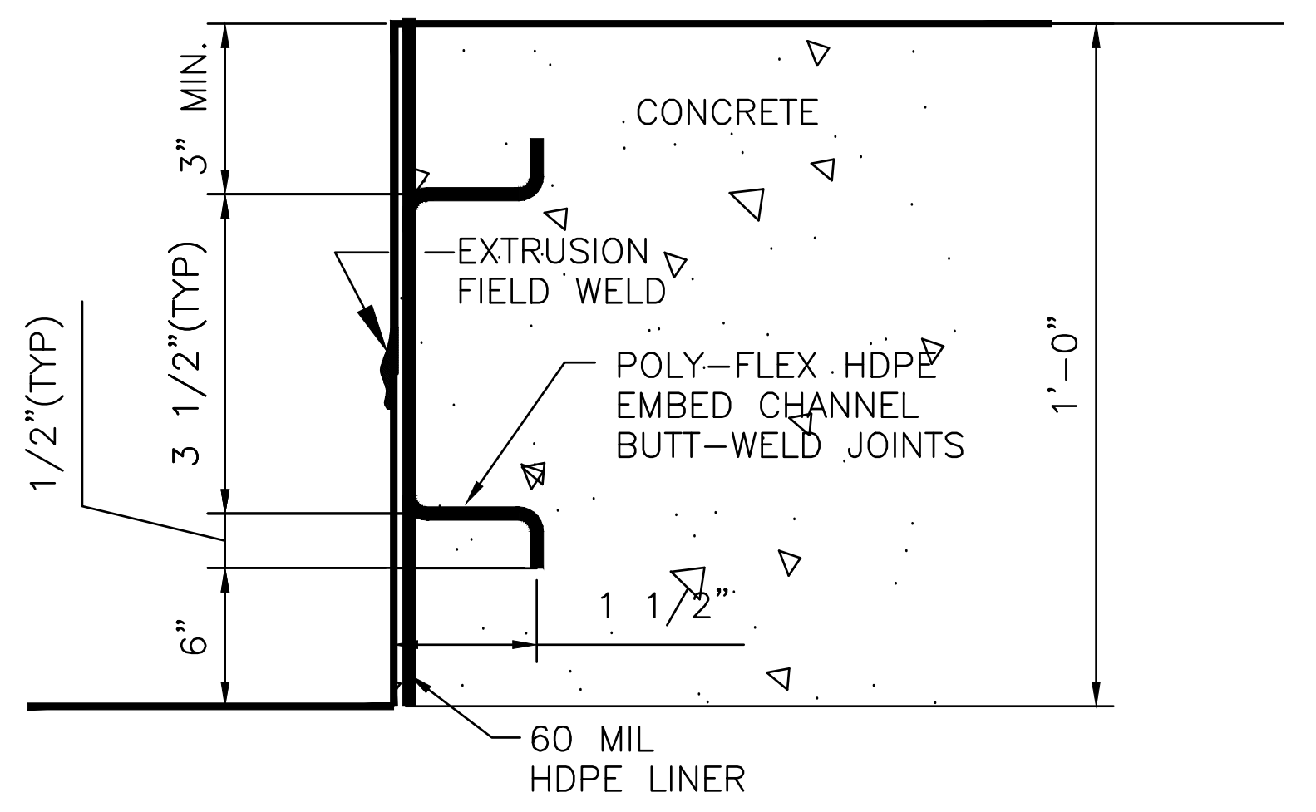


## SECTION AA-AA (E5C11041)

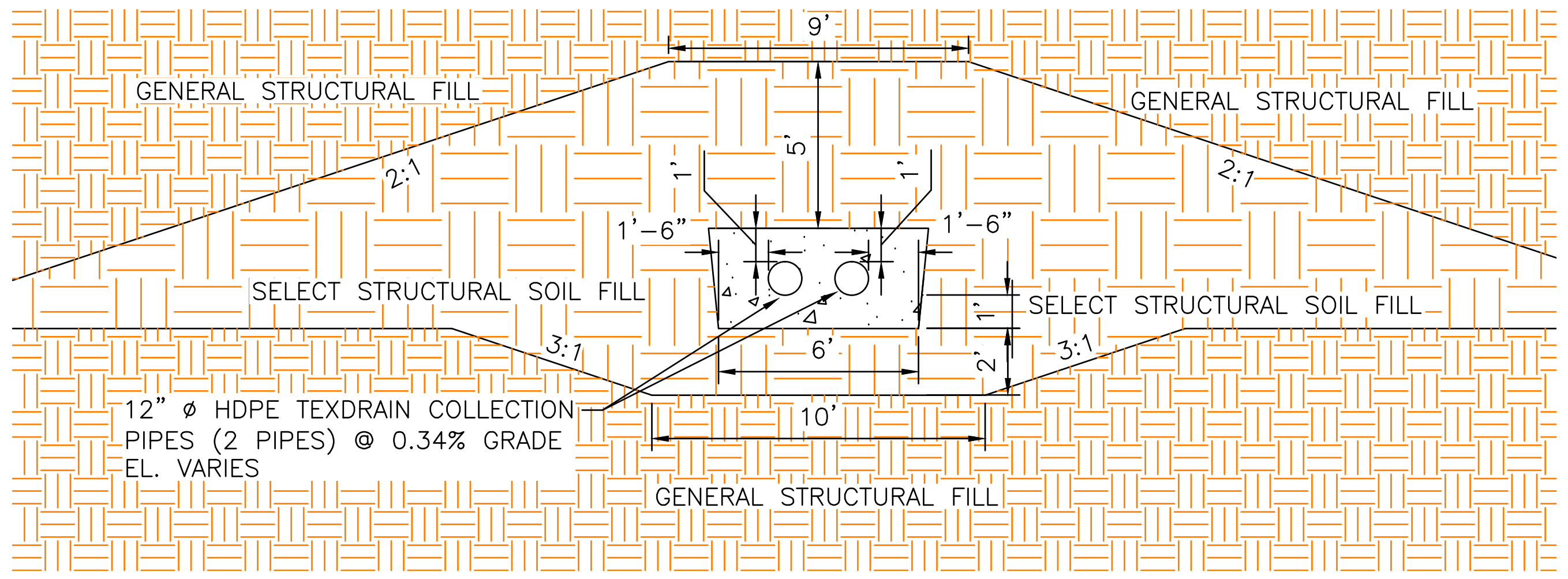


SPILLWAY NOTES:
1. FLUME LAYOUT TO BE AS SHOWN ON PLAN.
2. ELEVATIONS SHOWN ARE TO TOP OF FINISHED CONCRETE.
3. CONCRETE TO BE 4000 PSI.
4. AGGREGATE BASE TO BE TYPE "B" (COMPACTED TO 90% MODIFIED PROCTOR DENSITY OR AS APPROVED BY OWNER'S REPRESENTATIVE).
5. SURFACE TO BE BROOM FINISHED.
6. ALL REINFORCING SHALL HAVE 2" MINIMUM COVER OF CONCRETE WHERE FORMS ARE USED AND 3" MINIMUM COVER WHEN POURED AGAINST THE GROUND.
7. BEVEL EXPOSED EDGES OF CONC. 3/4".
8. ALL REINFORCING SHALL CONFORM TO ASTM SPEC. A615, GRADE 60.

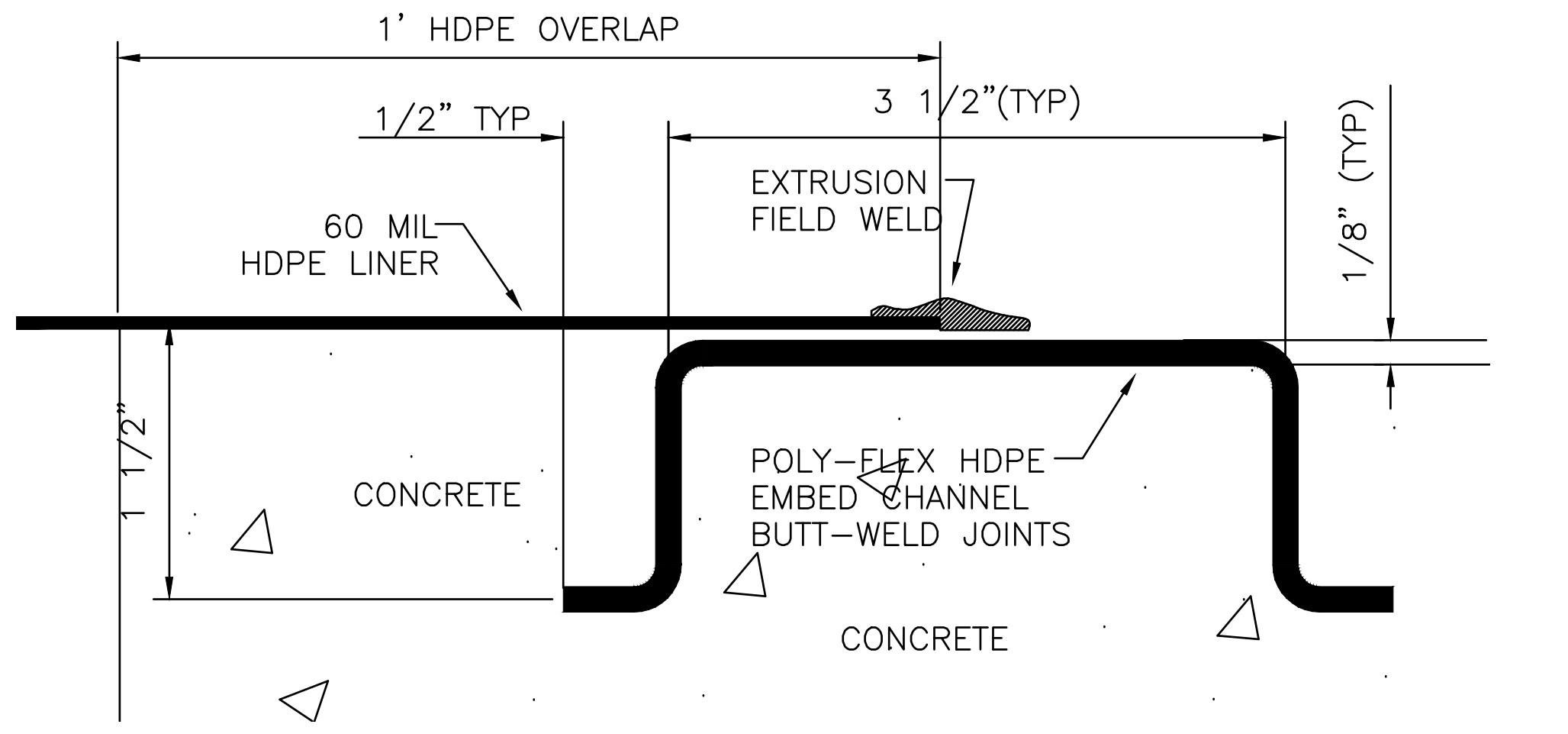
## SECTION BB-BB (E5C11041)
## GYPSUM COLLECTION BASIN SPILLWAY DETAIL
## N.T.S.



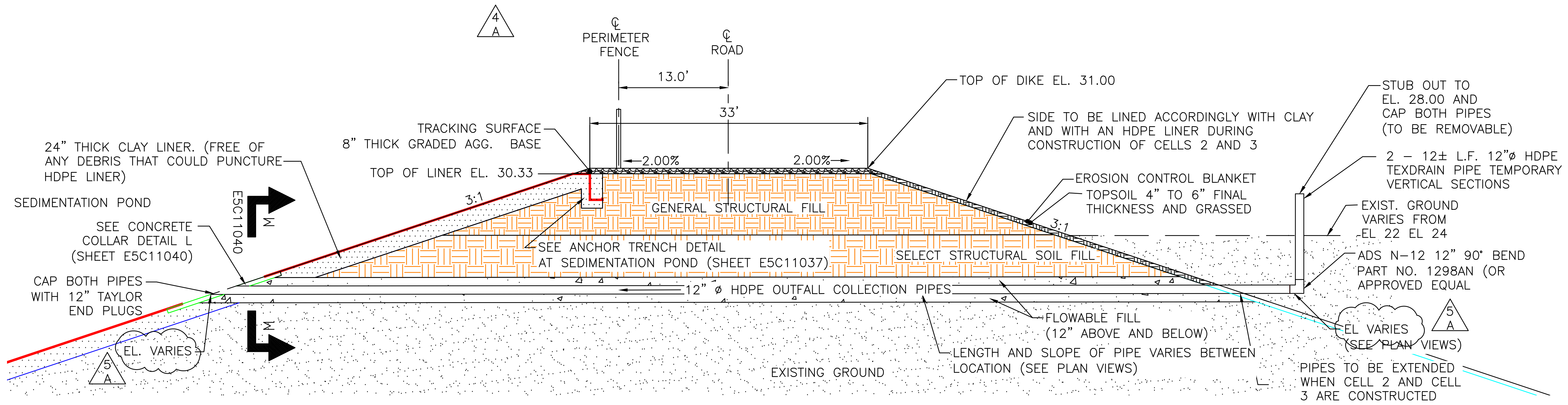
## DETAIL D POLYFLEX HDPE EMBED VERTICAL CHANNEL INSTALLATION



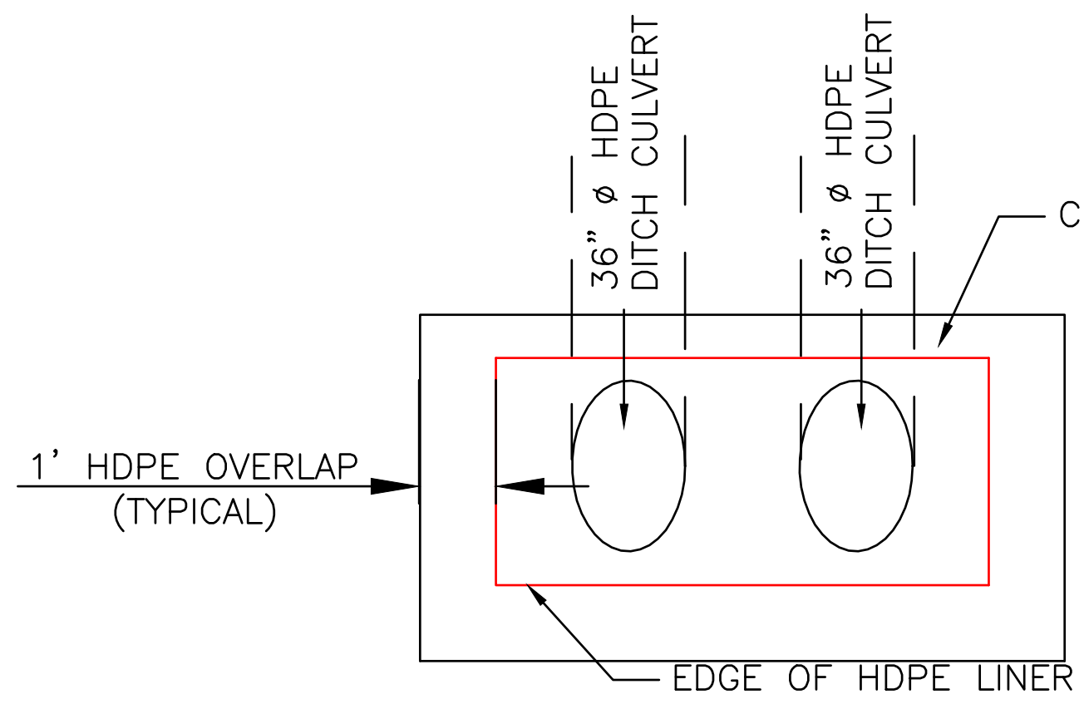
## SECTION H-H (E5C11033, E5C11034 & E5C11041)
## 12" Ø HDPE SUMP COLLECTION PIPES TO SEDIMENTATION POND



## DETAIL C POLYFLEX HDPE EMBED HORIZONTAL CHANNEL INSTALLATION



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



## PLAN DETAIL N(SECTION N-N)

| REVISION | DATE | | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| 5 | 12-19-11 | A. ADDED AS-BUILT CONDITIONS | ECS5517 | CSM | DPK | JBS | X | X | X | X |
| 4 | 8-14-09 | A. C-7 & H-6 ADDED PERIMETER FENCE AND DIMENSIONS<br>B. F-4 UPDATED ELEVATIONS | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 3-5-09 | A. H-3 & H-8 CORRECTED CONCRETE COLLAR | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

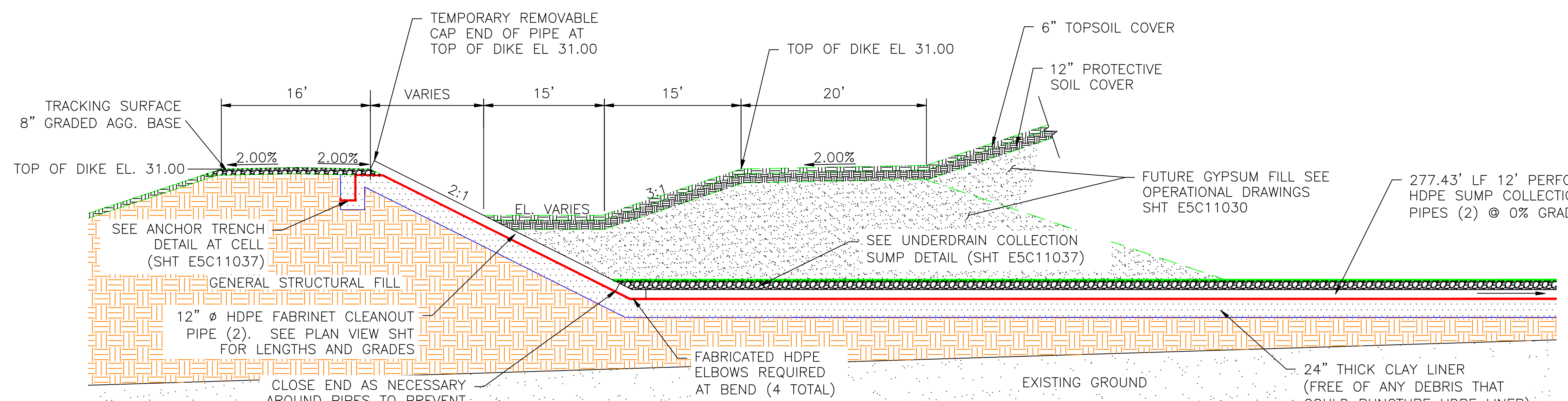
**Southern Company Generation Engineering and Construction Services**
**FOR**

**Alabama Power Company**

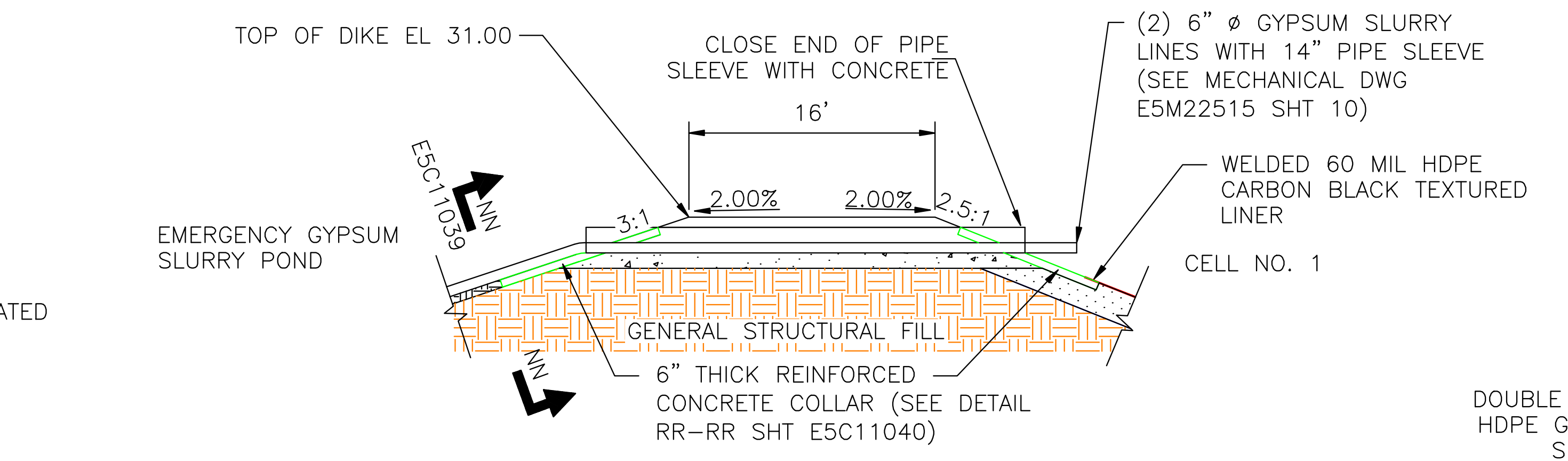
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 - SECTIONS AND DETAILS

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N/A | | E5C11038 | 1 | FINAL | 5 |

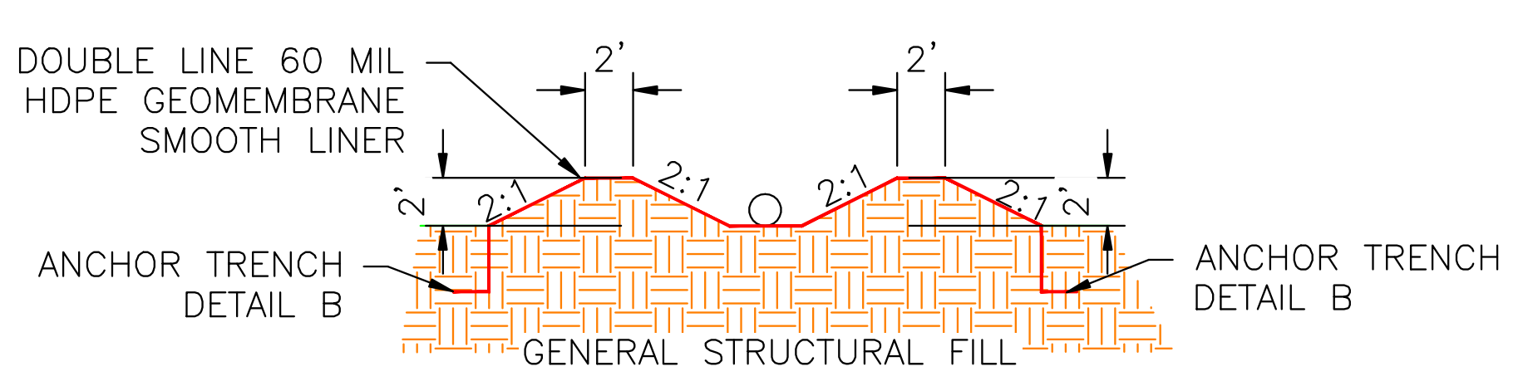
ANSI E: 44x34 Acad2004



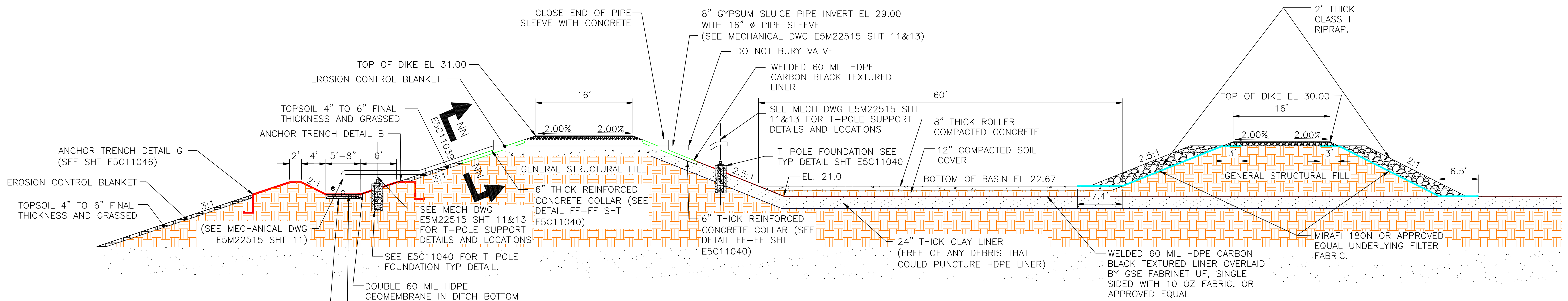
## SECTION G-G (E5C11034)
## TYPICAL CLEANOUT PIPE TO UDERDRAIN COLLECTION PIPES (TWO PLACES)



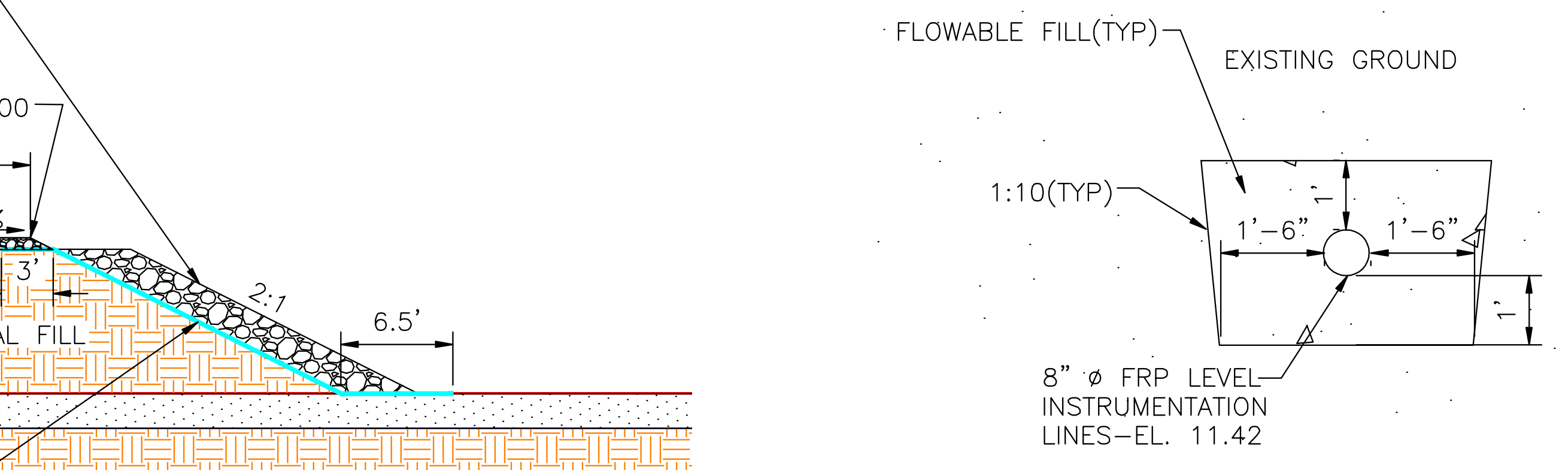
## SECTION MM-MM (E5C11033)
## PIPE FROM EMERGENCY GYPSUM SLURRY POND PUMPS TO CELL 1



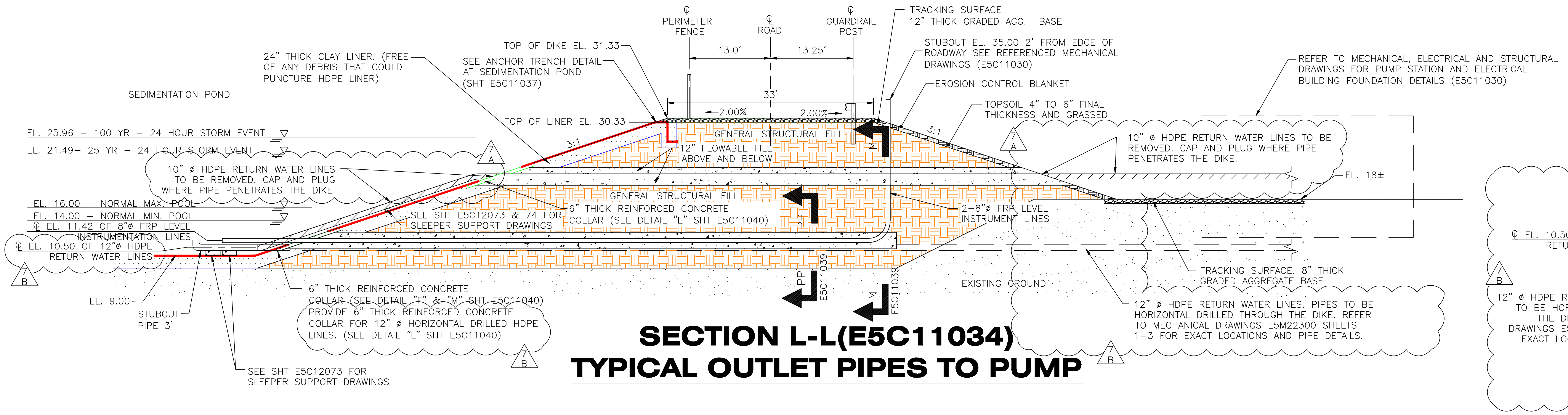
## SECTION NN-NN (E5C11033)
## SLUICE LINE TRENCH



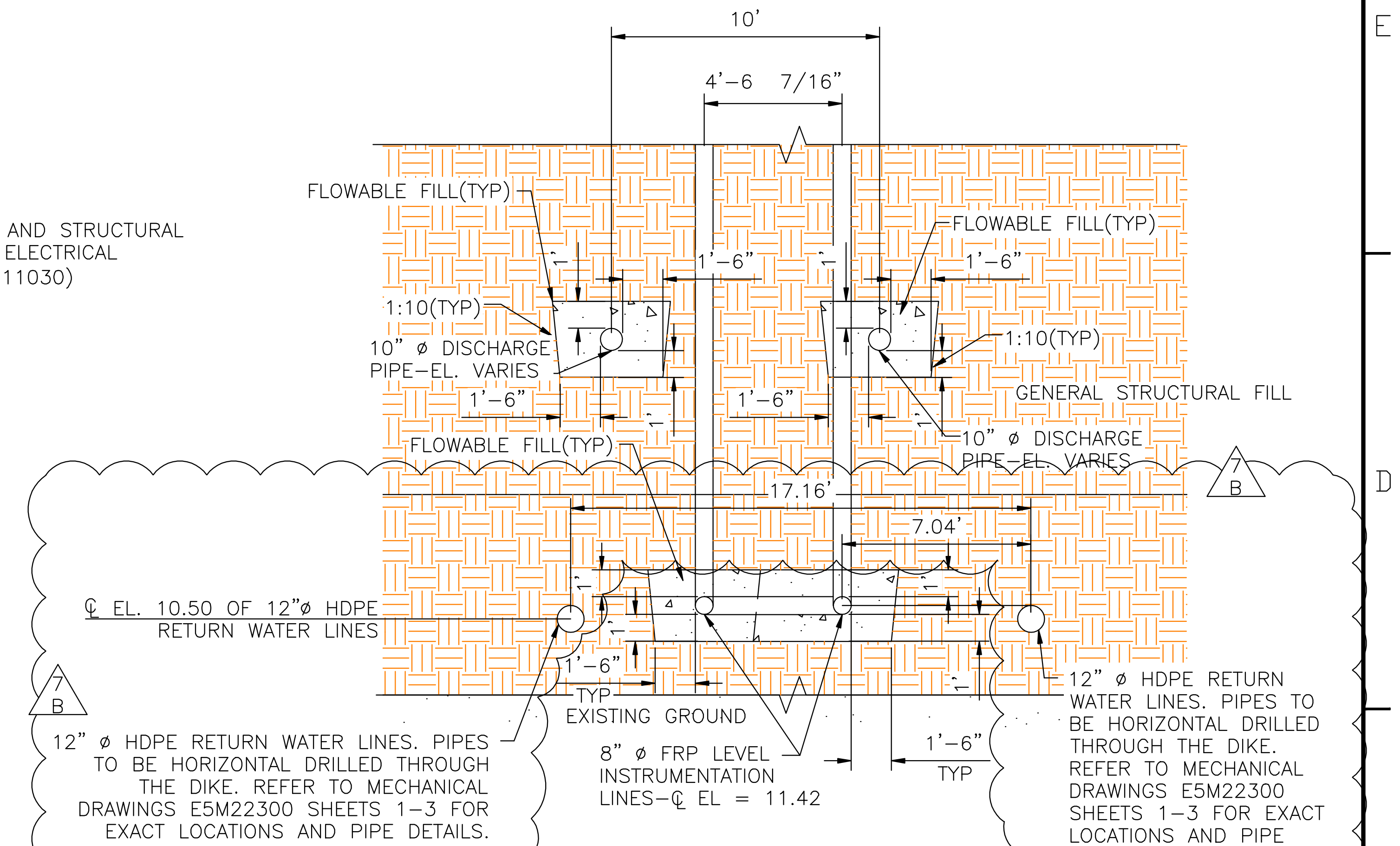
## SECTION J-J (E5C11033) TYPICAL GYPSUM SLUICE PIPE AT GYPSUM COLLECTION BASINS



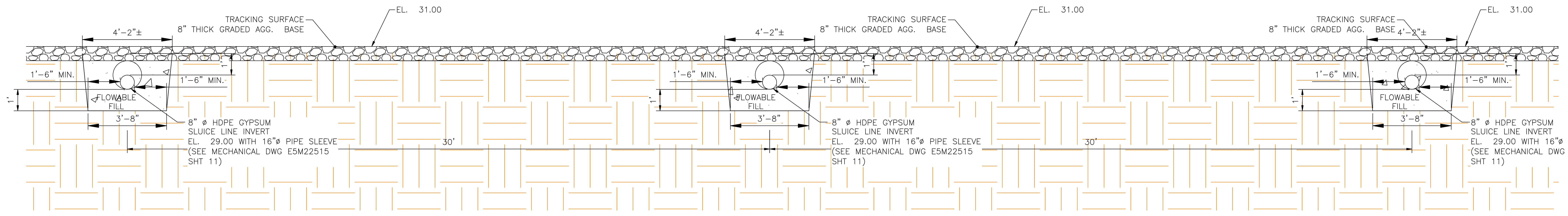
## SECTION PP-PP (E5C11039)
## FOR FRP LEVEL
## INSTRUMENTATION LINES



## SECTION L-L(E5C11034)
## TYPICAL OUTLET PIPES TO PUMP



## SECTION M-M
## (E5C11034 & E5C11039)



## SECTION T-T(E5C11033)
## THREE 8" Ø GYPSUM SLUICE LINES TO CELL NO. 1 (2 PLACES)

| REVISION | DATE | | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| REVISION 7 | 8-6-10 | A. REMOVED 10" ø HDPE RETURN WATER LINES.<br>B. ADDED 12" ø HORIZONTAL DRILLED HDPE RETURN WATER LINES AND CONCRETE COLLAR NOTE. | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | RL |
| REVISION 6 | 5-25-10 | A. F-3 ADDED RIPRAP SLOPE PROTECTION AND MIRIFI FILTER FABRIC | EWO 2161DE | EEJ | PMG | BRH | | | | RL |
| REVISION 5 | 8-14-09 | A. E-6 ADDED PERIMETER FENCE AND GUARDRAIL AND REVISED TOP OF LINER/DIKE ELEVATIONS<br>B. D-3 CALLED OUT GRADED AGG BASE | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 4 | 7-14-09 | A. REVISED RETURN WATER LINE ELEVATION | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 3 | 3-5-09 | A. H-3 ADDED PIPE SLEEVE<br>B. F-7, F-6, F-5, AND C-7 ADDED PIPE SLEEVE, CONCRETE PAD, T-POLE FOUNDATION AND MECH DETAIL REFERENCE<br>C. B-7, B-4, AND B-2 ADDED PIPE SLEEVE AND SLUICELINE ELEV CALLED OUT AS INVERT<br>D. F-6 & H-3 CLOSE END OF PIPE SLEEVE WITH CONCRETE<br>E. D-8 STORM EVENT ELEVATIONS ADJUSTED FOR INCREASED POND VOLUMES | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | ECO | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| REVISION 0 | 12-3-07 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

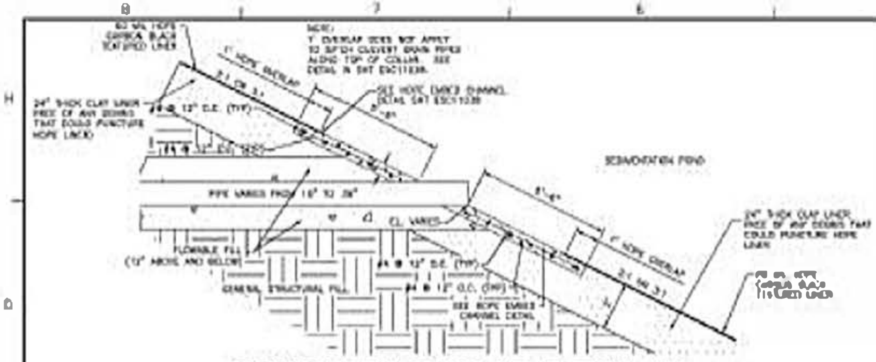
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

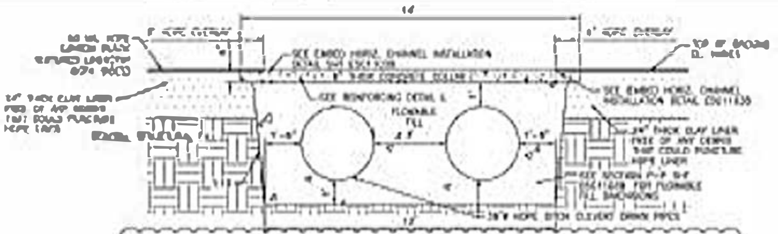
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1 – SECTIONS AND DETAILS

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N/A | | E5C11039 | 1 | FINAL | 7 |

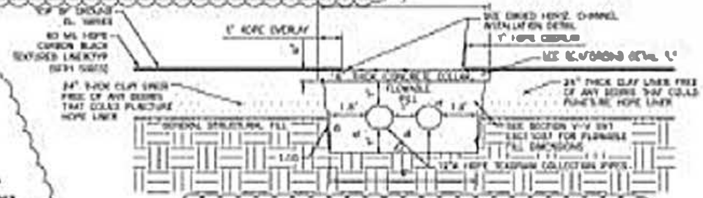
ANSI E: 44x34 Acad2004



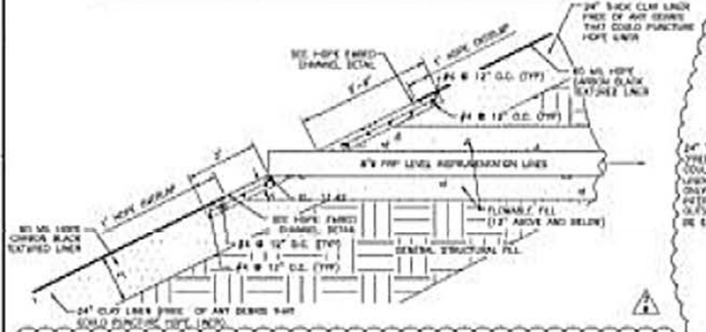
## CONCRETE COLLAR DETAIL "L" FOR DECANT PIPES, OUTFALL COLLECTION PIPES AND FOR SEDIMENTATION POND PUMP SUCTION



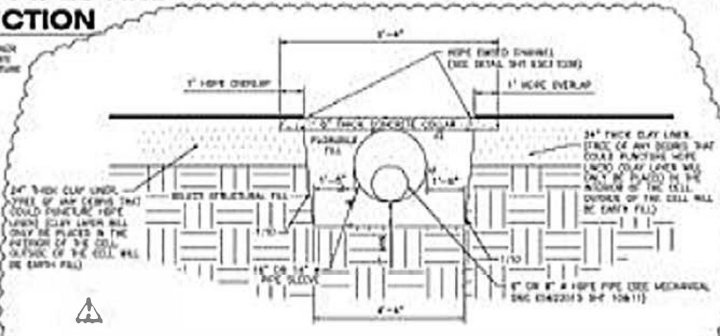
## SECTION Y-Y (E5C11033 & E5C11038) DITCH CULVERT DRAIN PIPES CONCRETE COLLAR DETAIL



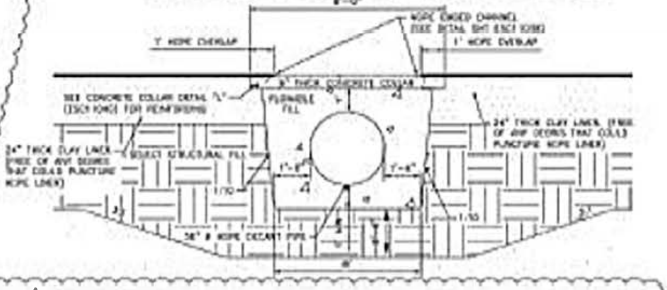
## SECTION W-W (E5C11038) OUTFALL COLLECTION CONCRETE COLLAR DETAIL



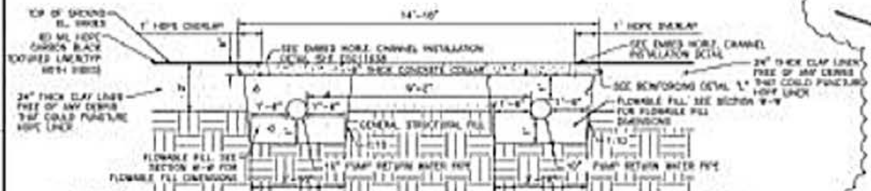
## CONCRETE COLLAR DETAIL "M" (E5C11039) FOR FRP LEVEL INSTRUMENTATION LINES



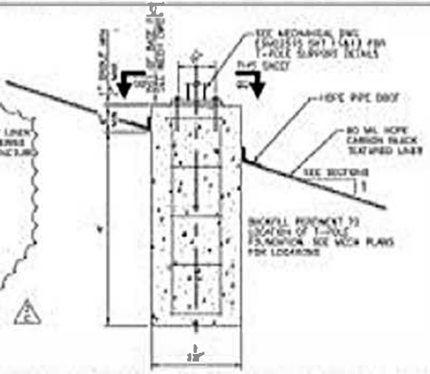
## SECTION RR-RR(E5C11039 & E5C11040) PIPE SLEEVE CONCRETE COLLAR DETAIL



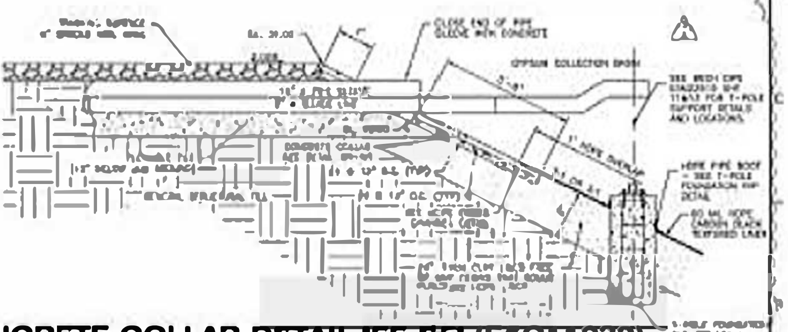
## SECTION S-S(E5C11036 & E5C11045) DECANT PIPE CONCRETE COLLAR DETAIL



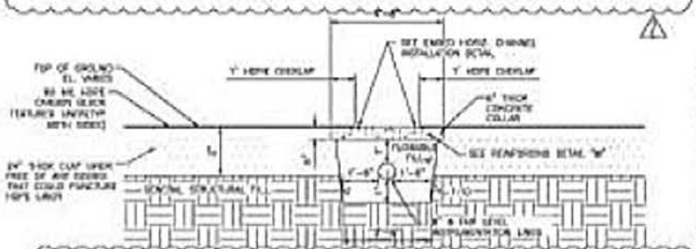
## CONCRETE COLLAR DETAIL "E" (E5C11039)



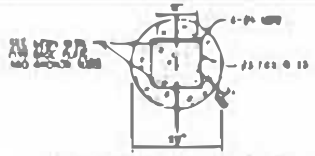
## T-POLE FOUNDATION TYP DETAIL



## CONCRETE COLLAR DETAIL "FF-FF" (E5C11039) FOR GYPSUM SLUICE LINES



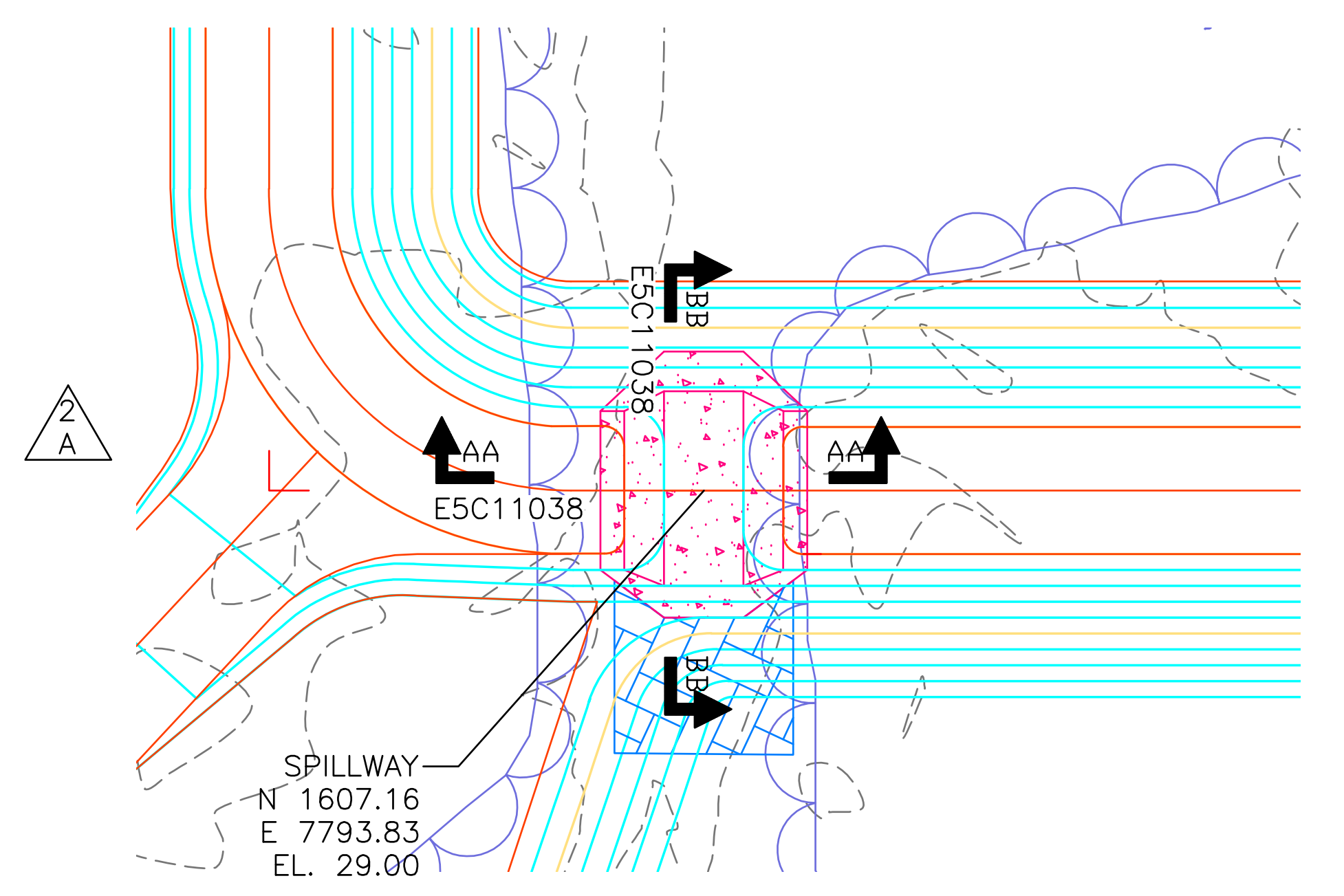
## CONCRETE COLLAR DETAIL "F" (E5C11039)



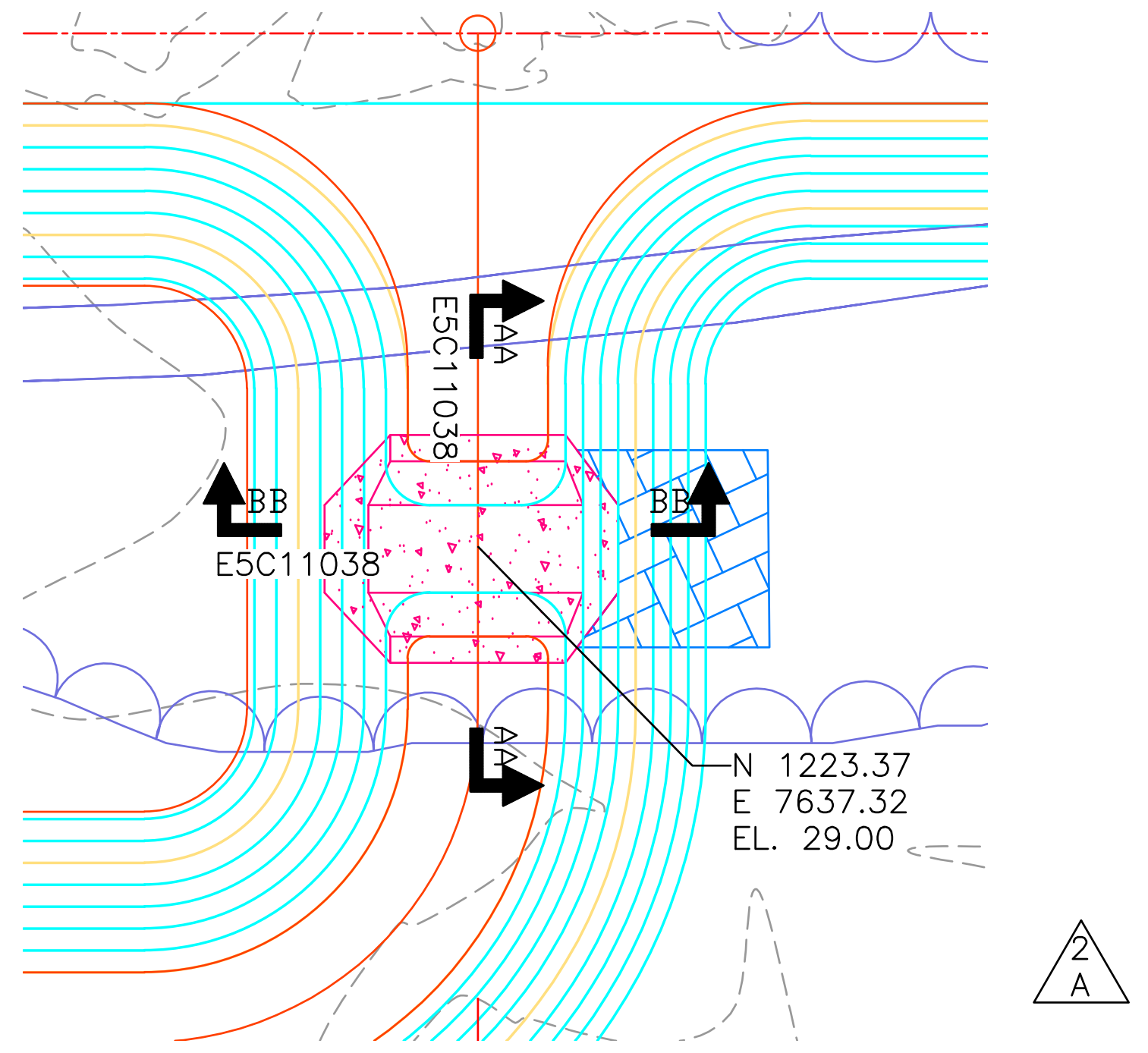
## SECTION QQ-QQ

CELL NO. 1 – SECTIONS AND DETAILS

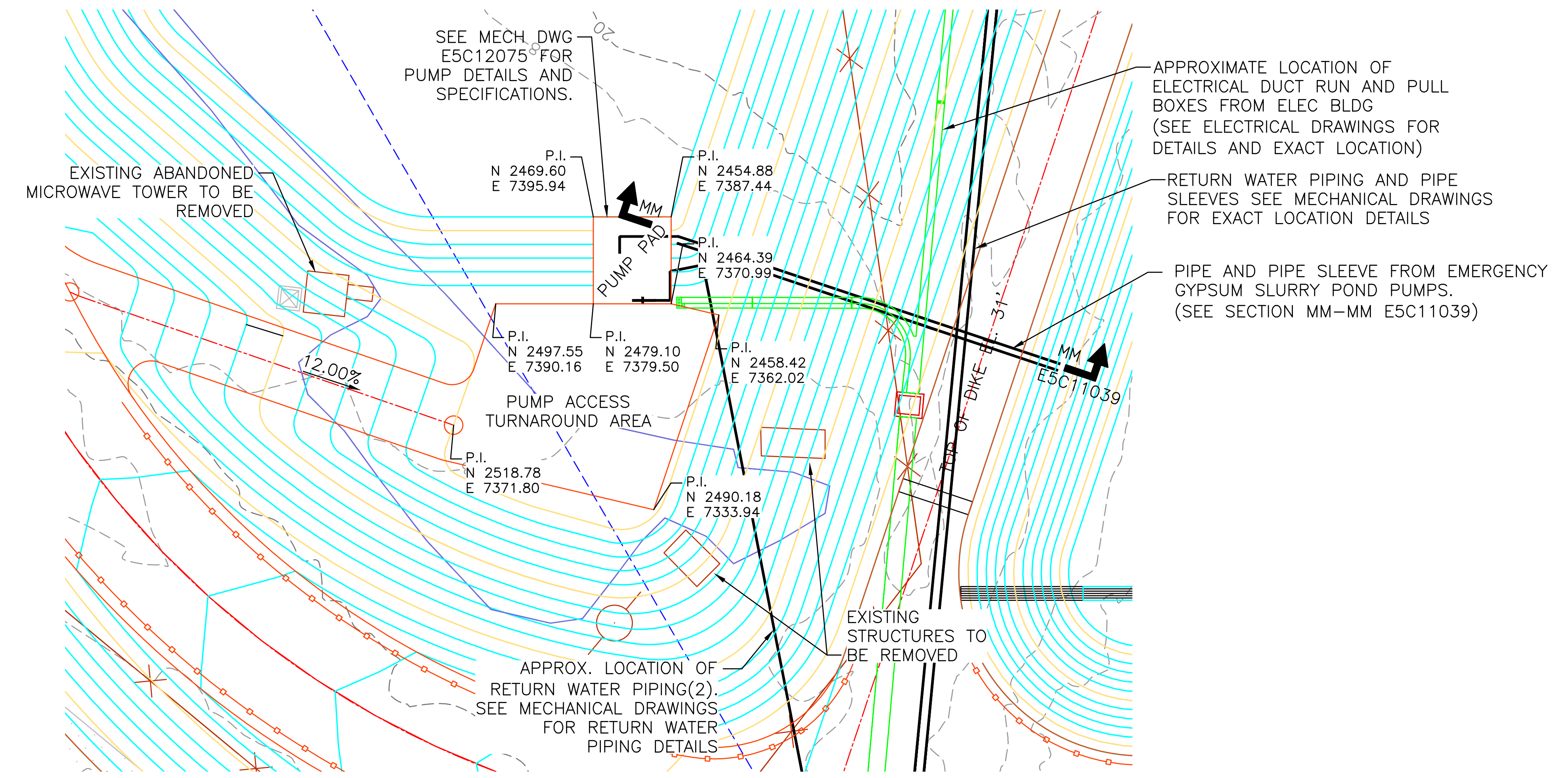
E5C11040



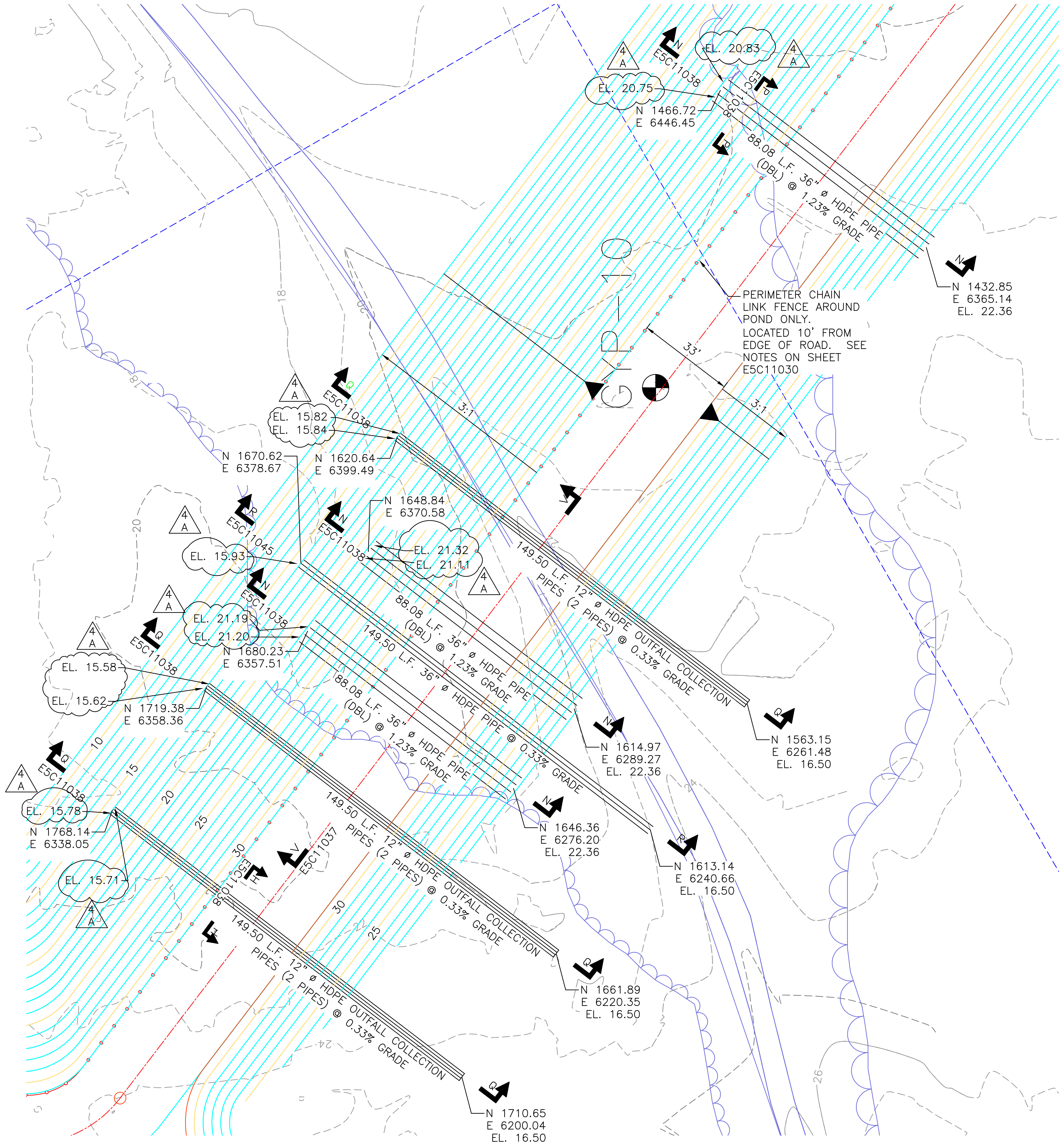
## DETAIL PLAN A
SCALE: 1"=20'



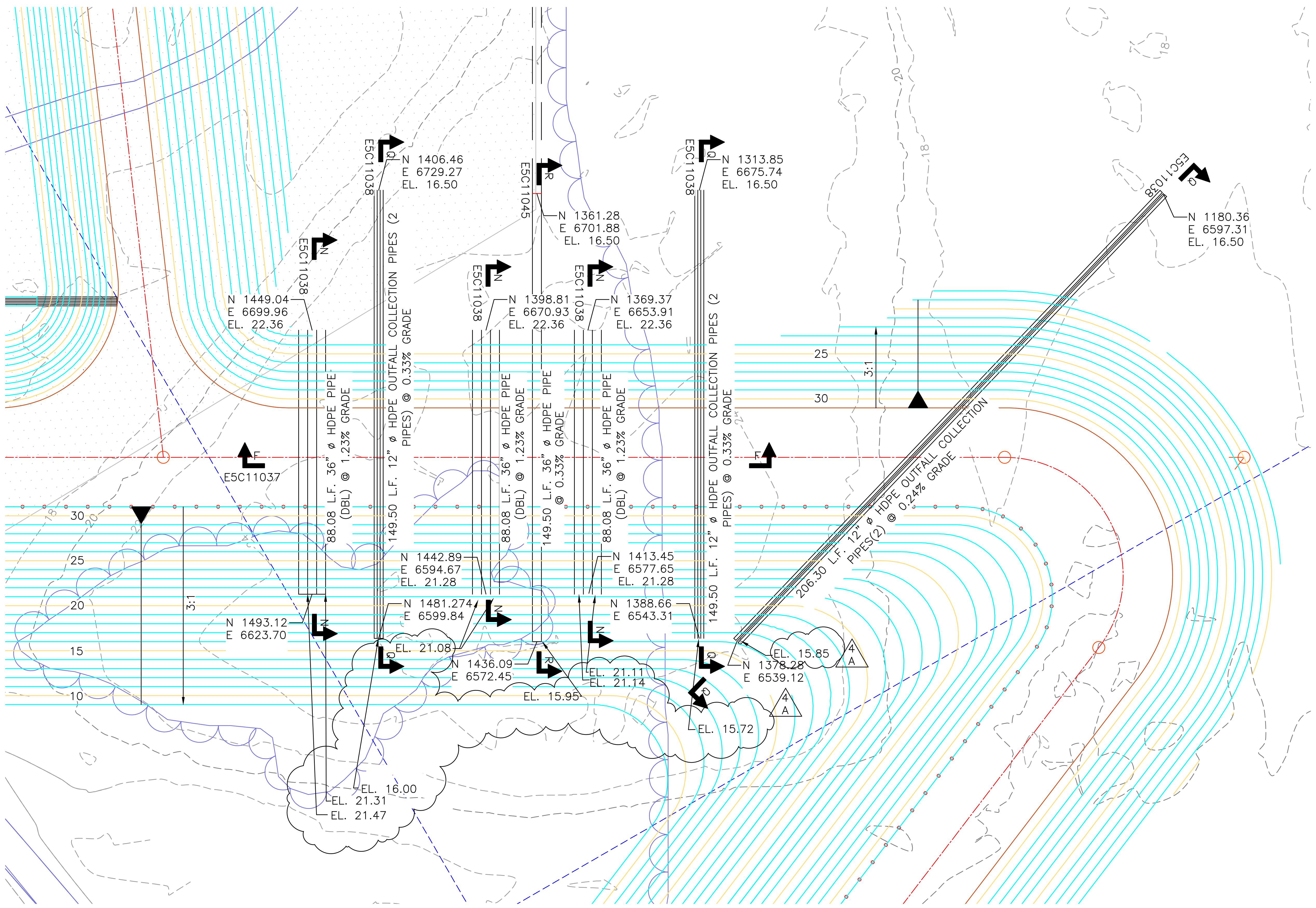
## DETAIL PLAN B
SCALE: 1"=20'



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



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



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

NOTES:

1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

| REVISION 4 | DATE 12-19-11 |
|---|---|
| A. ADDED AS-BUILT CONDITIONS<br>ECS5517 | |

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| CSM | DPK | JBS | ☒ | ☒ | ☒ | ☒ |

| REVISION 3 | DATE 8-14-09 |
|---|---|
| A. G-5, G-7 REVISED DETAIL PLAN A TO SHOW NEW LOCATION AND ELEVATIONS OF EMERGENCY SPILLWAYS<br>EWO 2161DE | |

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |

| REVISION 2 | DATE 7-2-09 |
|---|---|
| A. G-7 REVISED DETAIL PLAN A TO SHOW NEW LOCATION OF EMERGENCY SPILLWAY<br>B. C-7 UPDATED COORDINATES AND ADDED MECHANICAL REFERENCE<br>EWO 2161DE | |

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

| REVISION 1 | DATE 3-5-09 |
|---|---|
| A. G-3 REVISED DETAIL PLAN E TO SHOW MECHANICAL PIPE SLEEVES AND PIPES, AND ELECTRICAL DUCT RUN<br>EWO 2161DE | |

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

| REVISION 0 | DATE 11-14-08 |
|---|---|
| ISSUED FOR CONSTRUCTION<br>EWO 2161DE | |

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

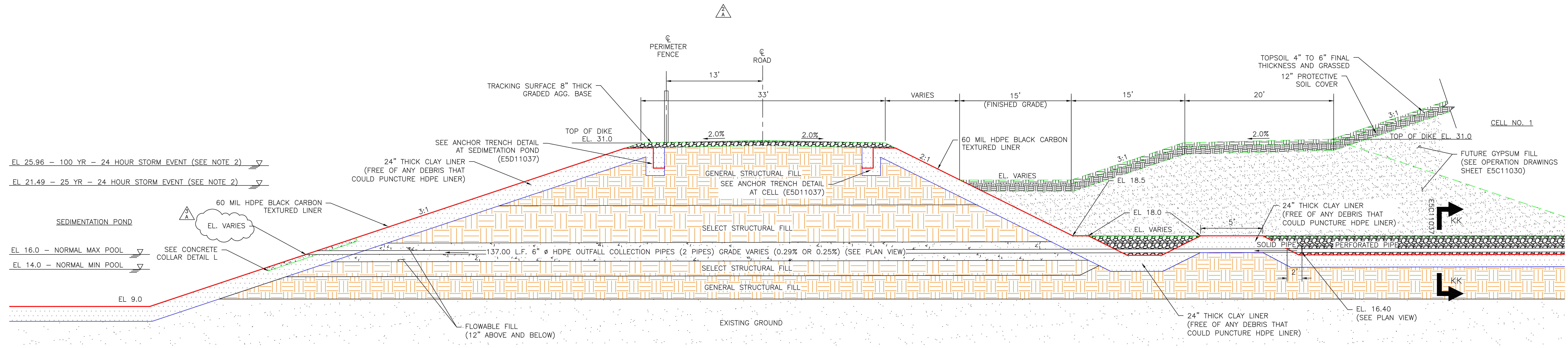
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

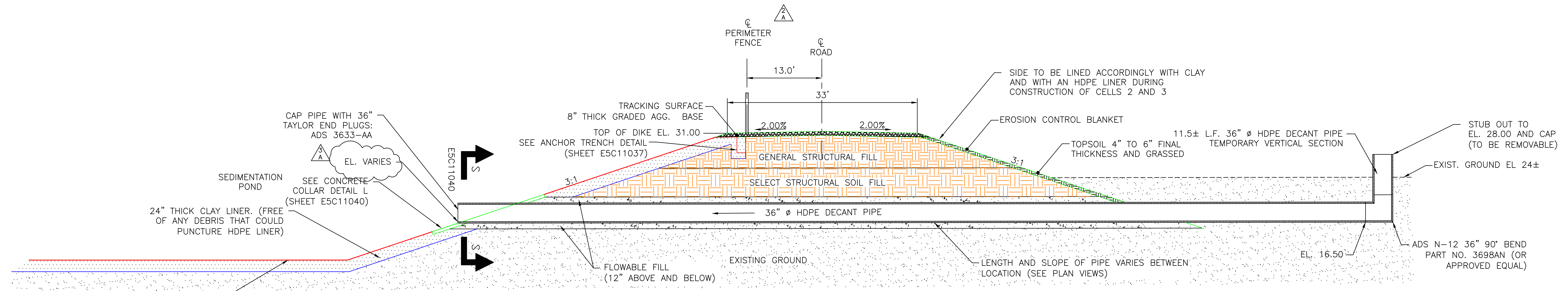
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
DETAIL PLANS A THROUGH E
CELL NO. 1 THROUGH CELL NO. 3

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=20' | | E5C11041 | 1 | FINAL | 4 |

ANSI E: 44x34 Acad2004



## SECTION EE-EE (E5C11033 & E5C11034)
## OUTFALL COLLECTION PIPES



## SECTION R-R (E5C11041)
## DECANT PIPES TO FUTURE CELL NO. 2 AND TO FUTURE CELL NO 3

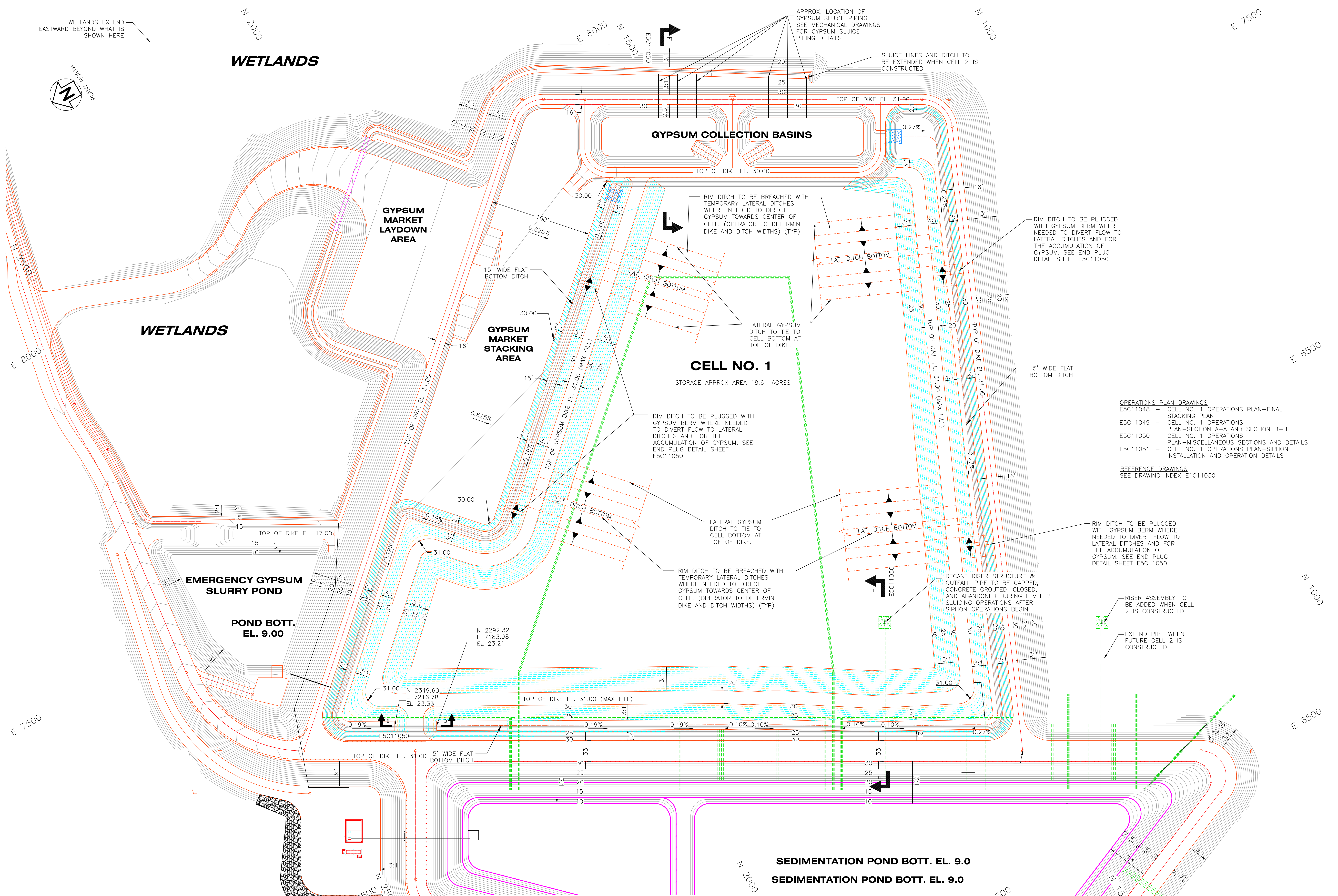
| REVISION | DATE | DESCRIPTION | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|---|
| REVISION 3 | 12-19-11 | A. ADDED AS-BUILT CONDITIONS | ECS5517 | CSM | DPK | JBS | ☒ | ☒ | ☒ | ☒ |
| REVISION 2 | 8-14-09 | A. D-5, G-5 ADDED PERIMETER FENCE AND DIMENSIONS | EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 1 | 3-5-09 | A. F-8 STORM EVENT ELEVATIONS ADJUSTED FOR INCREASED POND VOLUME | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| REVISION 0 | 11-14-08 | ISSUED FOR CONSTRUCTION | EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

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

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1
MISCELLANEOUS SECTIONS AND DETAILS

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| N.T.S. | | E5C11045 | 1 | FINAL | 3 |

ANSI E: 44x34 Acad2004



OPERATIONS PLAN DRAWINGS
E5C11048 – CELL NO. 1 OPERATIONS PLAN–FINAL STACKING PLAN
E5C11049 – CELL NO. 1 OPERATIONS PLAN–SECTION A–A AND SECTION B–B
E5C11050 – CELL NO. 1 OPERATIONS PLAN–MISCELLANEOUS SECTIONS AND DETAILS
E5C11051 – CELL NO. 1 OPERATIONS PLAN–SIPHON INSTALLATION AND OPERATION DETAILS

REFERENCE DRAWINGS
SEE DRAWING INDEX E1C11030

# CELL NO. 1 - OPERATIONS AND CONSTRUCTION PERIMETER RIM DITCH PLAN

GRAPHIC SCALE
50 0 25 50 100 200
( IN FEET )
1 inch = 50 ft.

| | | | | |
|---|---|---|---|---|
| 1 | GENERAL REVISION | 09-04-09 | EWO 2161DE | EEJ PMG BRH JTM KAH TDJ CKT |
| 0 | ISSUED FOR CONSTRUCTION | 12-31-08 | EWO 2161DE | EEJ PMG BRH JTM KAH TDJ CKT |

REVISION DATE BY CHK'D CIVIL APPR ELECT APPR I/C APPR MECH APPR DISC MGR

E5C11047

# INQUIRY NUMBER 000082099

# SOUTHERN COMPANY GENERATION
# ENGINEERING AND CONSTRUCTION SERVICES

# TECHNICAL SPECIFICATION SECTION 31

FOR THE

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

OF THE

# GYPSUM STORAGE AREA

AT

# PLANT BARRY

# ALABAMA POWER COMPANY

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

Reviewed By:

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

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

REVISIONS

| NO. | DESCRIPTION | BY | REVIEWED | APPROVED | DATE |
|---|---|---|---|---|---|
| 0 | Issued for Construction | THH | JCP/PMG | TMU | 12/03/2007 |
| 1 | Issued for Construction | THH | JCP/PMG | TMU | 1/04/2008 |
| 2 | Issued for Construction | THH | JCP/PMG | TMU | 4/11/2008 |
| 3 | Issued for Construction-General Revision | THH | JCP/PMG | TMU | 11/14/2008 |
| 4 | Added RCC Section | THH | JCP/PMG | JBS | 4/7/2009 |
| 5 | Added GCL Section | THH | JCP/PMG | JBS | 7/10/2009 |

# TABLE OF CONTENTS

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

## 1.0 GENERAL

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

### 1.1 GENERAL INFORMATION

1.1.1 These Specifications, all related attachments and associated documents cover the furnishing of all materials (unless otherwise noted), labor, supervision, equipment, and tools required for the construction of the Gypsum Storage Cell 1 at Plant Barry. The technical and construction requirements, including notes, Specifications, and design data continue on the Drawings. The Drawings and Notes are an integral part of these Specifications.

1.1.2 The provisions of these Specifications shall govern unless otherwise specified in the contract documents. In case of conflicting requirements, the contract documents shall govern. Discrepancies between the Drawings and the Specifications shall be brought to the attention of the Purchaser for resolution before the performance of the work. In the case of discrepancies between the scale dimensions on the Drawings and the dimensions the written dimensions shall govern.

1.1.3 The Contractor shall ensure that all work is performed in accordance with the Occupational Safety and Health Act of 1970 and other Standards and Codes listed herein (latest revision).

1.1.4 The Contractor shall receive, unload, haul to site, handle, store, place, and secure all materials and equipment. Any security measures taken for the protection of the Contractor's equipment shall be at his expense.

1.1.5 The Contractor shall furnish and keep in good working condition at all times sufficient equipment of the proper design and capacity to do all work described under these Specifications and in accordance with the established schedule.

1.1.6 The Contractor shall furnish appropriate equipment for minimizing fugitive dust.

1.1.7 The Contractor shall comply with all applicable state and county regulations concerning hazardous material disposal and burning operations, if allowed by the Purchaser. The Contractor shall have the responsibility for obtaining any necessary permits for these activities.

1.1.8 All earthwork, including ramps and access roads, done for the convenience of the Contractor shall be done at his expense. Such work will be restored to its original elevation at the Contractor's expense if the Purchaser so desires.

1.1.9 The Contractor shall install, at his expense, any drainage piping required because of the Contractor's mode of operation including his ramps and roads.

1.1.10 The Contractor shall provide traffic control during roadway related construction activities and material deliveries. This shall be coordinated with other activities ongoing at the plant. If within active and congested areas around the plant, traffic control shall include flag persons, barriers, and other control aids to provide for the safe routing of traffic in the affected area.

1.1.11 The Contractor shall inform the Purchaser of any existing wells encountered within the footprint of the construction that have not been previously abandoned. If present, these wells shall be abandoned by the Purchaser. Monitoring wells located outside the footprint of the cell shall not be damaged or destroyed by construction activities. Any monitoring well damaged or destroyed by the Contractor and his activities shall be replaced at no cost to the Purchaser.

## 1.2 APPLICABLE DOCUMENTS

1.2.1 Drawings – Reference Inquiry Package for Drawing List.

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

Occupational Safety and Health Administration

- Occupational Safety and Health Act of 1970

American Society for Testing and Materials (ASTM)

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

- ASTM D 792 – Standard Test Methods for Density and Specific Gravity (relative density) and Density of Plastics by Displacement

- ASTM D 1004 - Standard Test Method for Tear Resistance of Plastic Film and Sheeting

- ASTM D 1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

- ASTM D 1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique

- ASTM D 1603 - Standard Test Method for Carbon Black in Olefin Plastics

- ASTM D 3895 - Standard Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry

- ASTM D 4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique

- ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products

- ASTM D 5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics

- ASTM D 5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test

- ASTM D 5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

- ASTM D 5721 - Standard Practice for Air-Oven Aging of Polyolefin Geomembranes

- ASTM D 5885 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry

- ASTM D 5994 - Standard Test Method for Measuring Core Thickness of Textured Geomembranes

- ASTM D 6392 – Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

- ASTM D 6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

- ASTM C 33 - Standard Specification for Concrete Aggregates

- ASTM C 138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

- ASTM C 150 - Standard Specification for Portland Cement

- ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete

- ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

- ASTM C 1040 - Standard Test Methods for In-Place Density of Unhardened and Hardened Concrete, Including Roller Compacted Concrete, By Nuclear Methods

- ASTM D 5890 – Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners

- ASTM D 5891 – Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners

- ASTM D 5993 – Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners

- ASTM D 6768 – Standard Test Method for Tensile Strength of Geosynthetic Clay Liners

- ASTM D 5887 – Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter

- ASTM D 5321 – Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

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

Geosynthetic Research Institute GRI Standards

- GM 10 - The Stress Crack Resistance of HDPE Geomembrane Sheet

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

- GM 12 - Asperity Measurement of Textured Geomembranes Using a Depth Gage

- GM 13 - Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Geomembranes

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

Codes specific to the local county

Alabama Department of Environmental Management regulations

Environmental Protection Agency (EPA) regulations

# 2.0 EARTHWORK

## 2.1 SITE CONDITIONS

2.1.1 The Contractor shall visit the site and acquaint himself with site conditions, utility locations, and the proposed scope of work.

2.1.2 Soil borings have been performed at the gypsum disposal site. The locations of these borings are shown on the Drawings. The boring logs for the borings are available to the Contractor.

2.1.3 Test pit excavations and bulk samples obtained have been performed in the borrow area. The general areas of the locations of the test pits are available for inspection by the Contractor. The results of soil laboratory testing on bulk samples from the borrow area are also available to the Contractor.

2.1.4 The field testing, measurements, and associated laboratory testing performed by the Purchaser have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions. The Purchaser assumes no responsibility for the accuracy of the investigations, the resulting data, or the interpretation; nor does the Purchaser guarantee that the materials and conditions will not vary from those indicated by the investigations.  In addition, the Purchaser will not be responsible for any deduction, interpretation, or conclusion drawn by the Contractor.

## 2.2 LINES AND GRADES

2.2.1 The project shall be constructed to the elevations, lines, grades and cross sections shown on applicable Drawings.  The Purchaser reserves the right to increase the foundation widths, change the embankment slopes, and to make such other changes in the embankment sections as conditions indicate are necessary for the construction of a safe and permanent structure.  The Contractor shall be compensated for changes in plan and/or sections resulting in changes of quantities of materials.

2.2.2 The soil that has been placed in the proposed dike footprint shall be removed down to base grade.  The soil may be used for dike construction material if it meets the specifications of Section 2.5.  The Contractor should expect to encounter some unsuitable material for dike construction when removing this soil.

## 2.3 CLEARING, GRUBBING, AND STRIPPING

2.3.1 Clearing, grubbing and stripping will be required to prepare the work area for construction.

2.3.2 Vegetated areas within the construction footprint shall be cleared, grubbed, and stripped of any vegetation, organic matter and/or any other debris.  Stripped topsoil shall be stockpiled at a location on the site to be designated by the Project Construction Manager.

2.3.3 The grubbed area shall be harrowed and raked with a tractor-mounted root rake to collect all small material previously overlooked.  The tractor shall be of adequate size to achieve a minimum of 4 inches penetration of the root rake teeth.  The root rake teeth shall not be more than 12 inches apart.

2.3.4 Trees, stumps, and brush cleared from the above areas shall be disposed of by burning, if allowed by the Purchaser, by mulching, or by removal from the site. All burning shall be performed in accordance with state and local regulations. Burn pits shall be located outside of the construction area, borrow area, outside of future cell construction, and off right-of-ways.

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

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

## 2.4 SUBGRADE PREPARATION

2.4.1 Proof-roll the entire cell subgrade utilizing loaded, off-road trucks with a gross machine weight, including payload of 40 tons of soil, that will impart approximately 7600 psf subgrade loading over a minimum tire width of 2 feet. Prior to receiving earth fill, the foundation area shall be scarified by harrowing or other suitable means.

2.4.2 Any areas failing proof roll shall be undercut and replaced with structural soil fill and re-rolled.

2.4.3 No fill shall be placed on any part of the subgrade until such areas have been proof rolled and approved by the Purchaser.

2.4.4 Work flow shall be planned such that the first fill lift is placed soon after subgrade compaction to minimize subgrade exposure to inclement weather.

2.4.5 The Contractor shall be required to prepare the base and interior dike slopes, including the sedimentation ponds, for installation of the HDPE liner surface as shown on the Drawings. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than ½-inch in diameter, or debris of any kind. These surfaces shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade.

## 2.5 STRUCTURAL EARTH FILL

2.5.1 Compacted dike material shall consist of the clayey sands (SC), sandy silts (ML), and silty sands (SM) from the excavation of the borrow area and shall be placed and compacted in accordance with these Specifications and Drawings.

2.5.2 Pipe penetrations shall be encapsulated in flowable fill then surrounded with select structural soil fill as shown on the Drawings. The select structural fill material shall have a plasticity index (PI) of greater than 12, a minimum of 35% by weight passing the #200 sieve (per ASTM D-422), and a Unified Soil Classification System (USCS) designation of SC, CL, ML, or CH. The fill shall be tested using appropriate ASTM methods and be approved by the Project Construction Manager.

2.5.3 No particle greater in size than 3 inches shall be used as dike fill.

2.5.4 Fill materials from other places other than the borrow area may be used if they meet the requirements named in this section or if approved by the Project Construction Manager. The spoil material located within the footprint of the gypsum cell or previously stockpiled near the site by others may be used as dike material if the total organic carbon (TOC) content is less than 5% and if approved by the Project Construction Manager. If the TOC results are greater than 5%, the material may be used as fill material in the interior of the cell. Material with greater than 5% TOC may not be used under the footprint of the dike or as structural dike fill. The contractor must provide laboratory analysis for approval by the Project Construction Manager.

2.5.5 Material from the spoil area or stockpile containing greater than 5% TOC may be used as structural dike fill if it is blended with other soil to fulfill the TOC requirement.

2.5.6 No earth fill shall be placed on any part of the dike foundation until such areas have been inspected and approved by the Project Construction Manager.

2.5.7 Earth fill shall be placed in uniform layers of 8 to 10 inches, nominal thickness, loose measurement. The fill material shall be placed one foot beyond the full width of the dike on each side. Each layer shall be kept level with the necessary grading equipment. Upon completion of compaction, fill slopes shall be cut back to the final slope. Particular care must be used to obtain the required compaction along the edges of the dike.

2.5.8 Quality control testing shall be performed on all earth fill in accordance with Section 2.8 of this Specification. No earth fill layer may be placed until the

Project Construction Manager has verified that the underlying layer has met the compaction and/or moisture requirements.

2.5.9 If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or as directed by the Project Construction Manger, before the succeeding layer is placed.

2.5.10 During the dumping and spreading processes, the Contractor shall maintain at all times a force of men adequate for removal of roots and debris from all earth fill materials and all stones greater than 3-inch maximum dimension.

2.5.11 Earth fill material for the dike shall be compacted to a minimum 95% maximum dry density, as determined by the Standard Proctor compaction test (ASTM D698). The moisture content of the earth fill at the time of placement shall be between -1% and +2% of the optimum moisture obtained by Standard Proctor compaction test. The Contractor shall strive to place the earth fill material on the wet side of optimum.

2.5.12 When moisture content is too low, the moisture content shall be adjusted to within the above specification prior to compaction. Moisture adjustment shall be by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and disking of the layer shall be done after deposition, but before compaction.

2.5.13 If the moisture content is too high, the Contractor will be permitted to stockpile and disk the earth fill material to promote drying to bring it back within the allowable moisture range. This drying must be done prior to placement.

2.5.14 Earth fill which cannot be compacted with roller equipment because of inadequate clearances shall be spread in 4-inch layers and compacted with power tampers to the extent required by the specifications for embankment material.

2.5.15 The Contractor will be required to remove any compacted material that does not comply with the compaction and/or moisture requirements and replace the compacted earth fill to comply with these Specifications at his own expense.

2.5.16 Excavations required for density and moisture tests shall be repaired by scarifying the walls of the excavation, backfilling, and compacting the fill material to the criteria specified in this Section.

2.5.17 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to insure that the correct reference Proctor curves are being used for compaction check.

2.5.18 If the construction of the dike is interrupted, the Contractor shall be required to shape and smooth the last layer of earth fill material placed on the fill to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the Contractor shall be required to level, scarify and compact the last layer of earth fill material before placing additional layers.

2.5.19 Dike slopes shall be grassed upon reaching final grade in accordance with the Vegetation Schedule.

## 2.6 COMPACTED CLAY LINER

2.6.1 A compacted clay liner shall be installed as the upper two feet of earth fill underlying the HDPE liner. The clay liner shall be placed and compacted in accordance with these Specifications and Drawings.

2.6.2 Compacted clay liner material shall have a in-place permeability equal to or less than 1 x $10^{-7}$ cm/sec, shall contain a minimum of 20% material passing the #200 sieve, shall have a plasticity index (PI) of between 10 and 30, shall have a maximum clod size of 2 inches, and shall be free of organics or other debris.

2.6.3 Prior to placement of the clay liner, the borrow material shall be sampled to verify the soil characteristics. A minimum of three soil samples of clay shall be obtained for laboratory testing from the borrow area actively being utilized for the clay liner placement. Laboratory testing on the soil samples shall include the Standard Proctor density (ASTM D 698), permeability by constant head (ASTM D 2434) or falling head test, grain size distribution and hydrometer analysis (ASTM D 422), Atterberg Limits (ASTM D 4318) and in-place moisture (ASTM D 2216). The density and in-place moisture data should be used to make adjustments in the moisture level of the clay prior to and during placement of the material

2.6.4 Clay liner material shall be placed in uniform layers of 8 inches, nominal thickness, loose measurement. Each layer shall be kept level with the necessary grading equipment. Upon completion of compaction, fill slopes shall be cut back to the final slope.

2.6.5 Quality control testing shall be performed on the liner in accordance with Section 2.8 of this Specification. No clay liner layer may be placed until the Project Construction Manager has verified that the underlying layer has met the compaction, permeability, and/or moisture requirements.

2.6.6 If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or as directed by the Project Construction Manger, before the succeeding layer is placed.

2.6.7 Clay liner material shall be compacted to a minimum 95% maximum dry density, as determined by the Standard Proctor compaction test (ASTM D 698), or to the percent compaction required to achieve the specified permeability, whichever is greater. The moisture content of the clay liner at the time of placement shall be wet of optimum as determined by the Standard Proctor compaction test.

2.6.8 When moisture content is too low, the moisture content shall be adjusted to within the above specification prior to compaction. Moisture adjustment shall be by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and disking of the layer shall be done after deposition, but before compaction.

2.6.9 If the moisture content is too high, the Contractor will be permitted to stockpile and disk the liner material to promote drying to bring it back within the allowable moisture range. This drying must be done prior to placement.

2.6.10 Liner material which cannot be compacted with roller equipment because of inadequate clearances shall be spread in 4-inch layers and compacted with power tampers to the extent required by the specifications in this Section.

2.6.11 The Contractor will be required to remove any compacted material that does not comply with the compaction, moisture, and/or permeability requirements and replace the compacted earth fill to comply with these Specifications at his own expense.

2.6.12 Excavations required for density and moisture tests shall be repaired by scarifying the walls of the excavation, backfilling, and compacting the fill material to the criteria specified in this Section.

2.6.13 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to insure that the correct reference Proctor curves are being used for compaction check.

2.6.14 If the construction of the soil liner is interrupted, the Contractor shall be required to shape and smooth the last layer of earth fill material placed on the fill to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the Contractor shall be required to level, scarify and compact the last layer of liner material before placing additional layers.

2.6.15 The Contractor shall be required to repair erosion features, desiccation cracks, and other defects in the clay liner. All soils and sediments that have been transported onto the active clay liner placement areas from storm runoff shall be removed or graded away from the clay liner. All repairs to the liner shall be completed prior to the subsequent lift of clay material placed.

## 2.7 EARTHWORK EQUIPMENT

### 2.7.1 General

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

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

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

### 2.7.2 Tamping Roller

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

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

### 2.7.3 Pneumatic Rubber-Tired Roller

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

### 2.7.4 Tamping Compactors

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

### 2.7.5 Vibratory Rollers

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

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

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

## 2.8 QUALITY CONTROL TESTING

2.8.1 Field density and moisture content testing shall be performed by the Purchaser's Representative to verify that compaction requirements have been achieved. In-place field density testing of the compacted soil shall be preformed in accordance with the procedure ASTM D 1556-00, the sand cone method. Test results reports should include both the moisture content and dry density, along with other data such as location, elevation, Proctor curve used for comparison, etc.

2.8.2 Testing procedures of in-place density and moisture content by nuclear methods is described in ASTM D 6938. The procedure may be used provided: 1) acceptable correlation with sand cone density test results can be obtained according to the guidelines of Section 7, "Calibration", of ASTM D 6938, and 2) the initial correlation results are reviewed and use of the nuclear device is approved by the Project Construction Manager. In addition, it shall be required that the testing agency or representative have the necessary licenses to operate a nuclear energy source, and to take all safety precautions per Section 6 of ASTM D 6938.

2.8.3 In the event of repeated failures, or water content and density test values plotting far from the Proctor curves used for comparison in computing percent compaction, it shall be the option of the Project Construction Manager to require one or two point Proctor checks (on the dry side of optimum) to verify that the proper Proctor curve is being referenced. If not, a new Proctor curve determined by a five-point test shall be required. The Contractor shall sample and perform the five-point testing, all at the Contractor's expense.

2.8.4 If the compaction requirements for a lift have not been achieved, the Purchaser's Representative shall direct the Contractor to either rework the lift to obtain the compaction requirements or remove and replace with a new lift for compaction, all at the Contractor's expense.

2.8.5 The in-place density testing frequency for the soil shall be one test for each 20,000 square feet of lift area or portion thereof for each lift, with a minimum of one test performed for each 200 lineal feet of dike per lift as measured parallel to the dike axis.

2.8.6 Laboratory confirmation testing for the compacted embankment fill shall be performed to record the in-place shear strength properties of the fill and to verify that the permeability of the compacted fill surrounding the flowable fill is equal to or less than that specified in these Specifications. The confirmation testing shall consist of obtaining duplicate, undisturbed samples of the compacted fill for laboratory confirmation of field density, moisture content, shear strength (by consolidated-undrained triaxial method with pore-pressure measurements) and hydraulic conductivity of field compacted material. The undisturbed samples shall be obtained by pushing a thin walled drive cylinder into the compacted fill at a frequency of one (1) tube per 400 lineal feet of dike for every 10 vertical feet of fill.

2.8.7 Laboratory confirmation testing for the compacted clay liner material placed in the upper two (2) feet below the final grade shall be performed to verify that the permeability of the compacted liner is equal to or less than $1 \times 10^{-7}$ cm/sec using either the falling head or back pressure permeability test. The confirmation testing shall consist of obtaining undisturbed samples of the compacted fill for laboratory confirmation of field density, moisture content, and hydraulic conductivity of field compacted material. The undisturbed samples shall be obtained by pushing a thin walled drive cylinder into the compacted liner at a frequency of one (1) tube per 8,000 cu. yd. of liner material or one (1) tube per 2 ft. lift per acre and one (1) tube per lift per 800 linear feet of side slope.

2.8.8 The drive tubes used to collect the undisturbed samples shall be cleaned and paraffin sealed to preserve the moisture content and delivered to the independent soil testing laboratory. The location, lift, and depth below the surface should be recorded with each sample. The undisturbed samples shall be stored and handled in such a manner as to prevent damage to the sample from freezing, transporting or other means. After the undisturbed samples are taken, the holes shall be filled with bentonite (powder, chips, or pellets) to maintain the integrity of the fill.

2.8.9 The results of all permeability tests by the testing laboratory shall be reported to the Owner’s Engineer. If any permeability test result is higher than the minimum required value of $1 \times 10^{-7}$ cm/sec, the Contractor shall rework or replace a section or entire lift of the clay layer being constructed, at the Contractor’s expense. All reworked or replaced sections of clay liner shall be retested and meet the minimum permeability requirements.

# 3.0 DRAINAGE DITCHES, CHANNELS AND SLOPES

## 3.1 GENERAL

3.1.1 The gypsum slurry pipe containment ditch and all drainage channels and perimeter drainage ditches shall be excavated to the lines, grades, cross-sections, and elevations indicated on the Drawings. The waterways shall be free of bank projections or other irregularities which will impede normal flow.

3.1.2 All earth removed and not used in construction shall be disposed of so that it will not interfere with the functioning of the waterway.

3.1.3 The perimeter drainage ditch for the future gypsum raise located on the inside crest of the dike shall be lined with a 60 mil high density polyethylene (HDPE) liner as shown on the Drawings.

3.1.4 The gypsum slurry pipe containment ditch located from the canal bridge to the emergency gypsum slurry pond shall be lined with a 60 mil, smooth, high density polyethylene (HDPE) liner as shown on the drawings.

3.1.5 The gypsum slurry pipe containment ditch shall be constructed using select structural fill as specified in Section 2.5.2. The fill shall be placed and compacted as specified in Section 2.5. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than ½-inch in diameter, or debris of any kind.

# 4.0 HDPE LINER

## 4.1 QUALIFICATIONS OF CONTRACTOR WORK ACTIVITIES

4.1.1 The manufacturer shall have at least 5 years continuous experience in manufacturing polyethylene geomembrane and/or experience totaling 10,000,000 square feet of manufactured polyethylene geomembrane.

4.1.2 The installation contractor shall be the manufacturer or a dealer trained to install the manufacturer's geomembrane. Installation shall be performed under the constant direction of a field installation supervisor who shall remain on site and be responsible, throughout the liner installation, for liner layout, seaming, testing, repairs, and all other activities by the Installer. The field installation supervisor shall have installed or supervised the installation of a minimum of 2,000,000 square feet of polyethylene geomembrane. Seaming shall be performed under the direction of a master seamer (who may also be the field installation supervisor) who has seamed a minimum of 2,000,000 square feet of polyethylene geomembrane, using the same type of seaming apparatus specified for this project. The field installation supervisor and/or master seamer shall be present whenever seaming is performed.

## 4.2 MATERIALS

4.2.1 The geomembrane used for Cell 1 and the ponds shall be 60 mil thick, textured, high density polyethylene (HDPE), a minimum 22.5 feet seamless width, as manufactured by the Gundle/SLT (GSE) or Poly-America companies, or an approved equal. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.

4.2.2 The geomembrane used for the gypsum slurry containment ditch shall be 60 mil thick, smooth, HDPE, as manufactured by the Gundle/SLT (GSE) or Poly-America companies, or an approved equal. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.

4.2.3 The Contractor shall provide QC certificates for both the liner and the welding rods.

4.2.4 The surface of the geomembrane shall not have striations, roughness, pinholes, or bubbles and shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter except that if in the opinion of the Purchaser the blemish will not adversely affect properties and use of the liner, the Inspector may accept the liner after sufficient laboratory test data are provided to support such acceptance, and further provided all such testing is done at the sole expense of the Contractor.

4.2.5 The geomembrane shall be supplied in rolls. Labels on each roll shall identify the thickness of the material, the length and width of the roll, batch and roll numbers, and the name of the manufacturer.

4.2.6 Gasket material shall be neoprene, closed cell medium, ¼-inch thick, 2 inches wide, 50 foot lengths with adhesive on one side.

4.2.7 Metal battens or straps and hardware shall be ASTM A-276 Grade 316 or 317 stainless steel. Water cut-off mastic shall be a Neoprene Flashing Cement.

4.2.8 Sealant shall be General Electric Silicone, RTV 103, or approved equal.

## 4.3 GEOMEMBRANE RAW MATERIALS

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

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

## 4.4 ROLLS

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

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

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

## 4.5 GEOMEMBRANE INSTALLATION

4.5.1 The geomembrane shall be packaged and shipped by appropriate means to ensure that no damage is incurred. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. The rolls shall be stored on a prepared smooth surface (not wooden pallets) and shall not be stacked.

4.5.2 Off-loading and storage of the materials shall be the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Purchaser. No off-loading shall be done unless monitored by the Purchaser. Damage occurring during off-loading shall be documented by the Purchaser and the Contractor. The Purchaser shall be the final authority on determination of damage.

4.5.3 The Contractor shall inspect the subgrade preparation prior to liner installation. The subgrade shall be compacted in accordance with the project specifications. Weak or compressible areas which cannot be satisfactorily compacted should be removed and replaced with properly compacted fill. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, or debris of any kind. The subgrade shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. Standing water or excessive moisture shall not be allowed.

4.5.4 The Contractor, on a daily basis, shall approve the surface on which the geomembrane will be installed. After the supporting surface has been approved, it shall be the Contractor's responsibility to indicate to the Purchaser any changes to its condition that may require repair work.

4.5.5 The Contractor shall certify in writing that the subgrade on which the geomembrane is to be installed is acceptable. This shall be done prior to commencing work.

4.5.6 The installation of the geomembrane shall be in accordance with the manufacturer's recommendations. The Contractor shall submit a panel layout drawing and a detailed, written procedure for the Purchaser's review.

4.5.7 All seams and non-seam areas of the geomembrane shall be inspected by the inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

4.5.8 The anchor trench shall be excavated to the line, grade, and width shown on the project construction drawings, prior to liner system placement. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the geomembrane.

4.5.9 The Contractor is responsible for ensuring that the geomembrane is handled and installed in such a manner that it is not damaged.

4.5.10 The rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the Purchaser. The installer shall be responsible for the following:

- Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

- Personnel working on the geomembrane shall not smoke or wear damaging shoes.

- The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil.

- Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

- Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F. Placement can proceed below 32° F only after it has been verified by the inspector that the material can be seamed according to the specification. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the installation supervisor.

## 4.6 FIELD SEAMING

4.6.1 Field seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit the proposed seaming procedures for the Purchaser's review.

4.6.2 Approved seaming processes are fusion and extrusion welding. On side slopes, seams shall be oriented in the general direction of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized.

4.6.3 No base T-seam shall be closer than 5 feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a fishmouth or wrinkle is found, it shall be relieved and cap-stripped.

4.6.4 Geomembrane panels must have a finished minimum overlap of 4 inches for fusion welding and 6 inches for extrusion welding.

4.6.5 Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

## 4.7 FIELD TEST SEAMS

4.7.1 Field test seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit the proposed testing procedures for the Purchaser's review.

4.7.2 Field test seams shall be conducted on the liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each seaming period and at least once every 4 hours, for each seaming apparatus and personnel used that day.

4.7.3 All test seams shall be made in contact with the subgrade. Welding rod used for extrusion welding shall have the same properties as the resin used to manufacture the geomembrane. The Contractor shall provide QC certificates for the welding rods.

4.7.4 The Installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing or Air Pressure Testing (for double fusion seams only).

## 4.8 DESTRUCTIVE SEAM TESTING

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

4.8.2 Sampling Procedure

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

4.8.3 Size and Disposition of Samples

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

### 4.8.4 Field Laboratory Testing

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

### 4.8.5 Independent Laboratory Testing

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

### 4.8.6 Procedures for Destructive Test Failure

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

- The Installer shall cap strip the seam between the failed location and any passed test locations.
- The Installer can retrace the welding path to an intermediate location (usually 10 feet from the location of the failed test), and take a sample for an additional field test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, then the process is repeated.
- Over the length of seam failure, the Installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip.

4.8.7 Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the inspector. Each location that fails the non-destructive testing shall be marked by the Inspector, and repaired accordingly.

### 4.8.8 Repair Procedures

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

- Patches shall be completed by extrusion welding. The weld area shall be ground no more than 10 minutes prior to welding. No more than 10% of the thickness shall be removed by grinding. Welding shall commence where the grinding started and must overlap the previous seam by at least 2 inches. Reseaming over an existing seam without regrinding shall not be permitted. The welding shall restart by grinding the existing seam and rewelding a new seam.

- Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of defects.

4.8.9 Verification of Repairs

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

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

## 4.9 BACKFILLING OF ANCHOR TRENCH

4.9.1 The anchor trench shall be backfilled by the Contractor. Trench backfill material shall be placed in accordance with the Manufacturer’s recommendations.

4.9.2 Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. If damage occurs, it shall be repaired prior to backfilling.

## 4.10 GEOMEMBRANE ACCEPTANCE

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

- Installation is finished

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

# 5.0 GEOCOMPOSITE DRAINAGE

## 5.1 MATERIAL

5.1.1 The geocomposite shall consist of one layer of HDPE drainage net overlain by one layer of geotextile to create a single sided geocomposite. The drainage layer shall be GSE Fabrinet UF, single sided, with 10 oz. fabric, or approved equal.

5.1.2 The drainage net manufacturer shall have successfully manufactured 5,000,000 square feet of polyethylene drainage net. The drainage net shall be manufactured of polyethylene resin in the United States by extruding two sets of polyethylene strands to form a three dimensional structure to provide planar flow and shall be compounded and manufactured specifically for the intended application.

5.1.3 The geotextile shall be a non-woven needle punched polyethylene manufactured in the United States specifically for the intended application.

5.1.4 The minimum average properties of the drainage layer shall be as follows:

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

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

## 5.2 INSTALLATION

5.2.1 The material shall be deployed in such a manner as to continually keep the geocomposite sheet in sufficient tension to reduce folds and wrinkles.

5.2.2 In the presence of high wind, all material shall be weighted with sandbags or the equivalent.

5.2.3 The geocomposite shall be cut using a hook blade. If the material is being cut in place, special care must be taken to protect the underlying HDPE liner.

5.2.4 The material shall be connected to all drainage pipes as shown on the Drawings.

5.2.5 Care shall be taken not to entrap stones or excessive dust that could damage the geocomposite, or generate clogging of the drains or filters.

5.2.6 The material may be seamed by overlapping and tying the geonet with ties and overlapping the geotextile by either thermal bonding or sewing.

5.2.7 When overlapping the rolls side to side, the geonet shall be overlapped a minimum of 4 inches and tied. Tying shall be every 5 feet to 10 feet across the bottom of the panel and every 5 feet along the length of the geonet panel. The geocomposite in the drainage ditch shall be tied at one foot intervals.

5.2.8 When connecting geocomposite rolls end to end, the geonet shall be overlapped a minimum of one foot and tied every 12 inches across the roll. The geotextiles shall be overlapped and thermal bonded or sewn.

5.2.9 Tying of the geonet will be with plastic fasteners as recommended by the Manufacturer. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed.

5.2.10 If the geocomposite is damaged and the tear or hole is less than 3 feet by 3 feet, the roll shall be cut and a butt joint placed. If the geonet is undamaged and the geotextile is damaged, a patch of geotextile shall be placed and shall be thermally bonded a minimum of 12 inches in all directions.

# 6.0 ROLLER COMPACTED (ZERO SLUMP) CONCRETE

## 6.1 MATERIAL

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

6.1.2 Cementitious Materials

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

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

### 6.1.3 Water

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

### 6.1.4 Fine Aggregate

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

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

6.1.4.3 Gradation of the fine aggregate shall be as follows:

**Gradation Requirements**
**RCC Fine Aggregate**

| Sieve Size | Percent Passing by Weight |
|---|---|
| 3/8-in | 100 |
| No. 4 | 95 – 100 |
| No. 8 | 75 – 95 |
| No. 16 | 55 – 80 |
| No. 30 | 35 – 60 |
| No. 50 | 24 – 40 |
| No. 100 | 12 – 28 |
| No. 200 | 8 - 18 |

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

### 6.1.5 Coarse Aggregate

6.1.5.1 Coarse aggregate shall consist of crushed stone.

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

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

### 6.1.6 Admixtures

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

6.1.6.2 Admixtures for air-entrainment shall not be used.

## 6.2 INSTALLATION

### 6.2.1 Placement

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

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

### 6.2.2 Compaction

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

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

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

### 6.3 TESTING

6.3.1 Field density testing shall be performed to verify that compaction requirements have been achieved. In-place field density testing of the compacted RCC shall be performed in accordance with the procedures of ASTM C 1040. Test results reported should include test method used (direct transmission or backscatter), density values, and other requirements of the ASTM standard. The testing equipment shall be calibrated as per the standard.

6.3.2 The Contractor shall provide a third party inspector to ensure quality control plans, programs, and practices are followed, and shall institute any additional controls or procedures in accordance with proven industry practice to assure compliance with the Special Conditions, Scope of Work, Technical Specifications, and Drawings.

6.3.3 The in-place density testing frequency for the RCC shall be one test for each 2,500 square feet of lift area or portion thereof for each lift, with a minimum of five tests per lift.

## 7.0 GEOSYNTHETIC CLAY LINER (GCL)

### 7.1 GENERAL

7.1.1 A geosynthetic clay liner (GCL), overlying the six (6)-inch compacted clay/silt layer, shall be used as part of the composite liner system for the site. The GCL shall be placed underlying the HDPE in the area of the gypsum loading area, as shown on the Drawings.

7.1.2 The GCL shall be placed in accordance with these Specifications, the manufacturer’s recommendations, and the details indicated on drawings.

7.1.3 The Contractor shall provide panel placement and GCL connection details to the Purchaser fourteen (14) days prior to the start of GCL installation.

7.1.4 The Contractor shall furnish the GCL Manufacturer’s Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the product’s specifications.

### 7.2 MATERIAL

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

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

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

**Notes**

1 Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.

2 Bentonite mass/area reported at 0 percent moisture content.

3 All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using four (4) inch grips.

4 Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of $5x10^{-9}$ cm/sec for typical GCL thickness. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.

5 Peak values measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

## 7.3 LABELING AND PACKAGING

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

7.3.2 The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

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

## 7.4 SHIPPING, HANDLING, AND STORAGE

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

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

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

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

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

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

## 7.5 SURFACE PREPARATION

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

7.5.2 The Contractor, on a daily basis, shall approve the surface on which the GCL will be installed. After the supporting soil surface has been approved, it shall be the Contractor’s responsibility to indicate to the Purchaser any changes to its condition that may require repair work.

7.5.3 The Contractor shall certify in writing that the subgrade on which the GCL is to be installed is acceptable. This shall be done prior to commencing work. It shall be the Contractor’s responsibility thereafter to indicate to the Purchaser any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in this Section.

7.5.4 Immediately prior to GCL deployment, the subgrade shall be finish-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than one-half inch (12 mm) from the surface shall be either removed, crushed or pushed into the surface with a smooth-drum compactor.

7.5.5 The Contractor shall submit certificates of subgrade acceptance, signed by the Contractor and the Purchaser’s Representative, for each area prepared for GCL placement.

7.5.6 At the top of sloped areas of the job site, an anchor trench for the GCL, HDPE, and geocomposite shall be excavated. The trench shall be excavated and approved by the Purchaser’s Representative prior to GCL placement. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist anywhere within the trench.

## 7.6 GCL PLACEMENT

7.6.1 The GCL shall be placed in accordance with guidelines and specifications provided by the manufacturer of the material.

7.6.2 GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL.

7.6.3 Equipment which could damage the GCL shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

7.6.4 Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL.

7.6.5 The GCL panels shall be placed parallel to the direction of the slope. All GCL panels should lie flat on the underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.

7.6.6 Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The Purchaser's Representative and GCL supplier should be consulted for specific guidance if premature hydration occurs.

7.6.7 As directed by the project drawings and specifications, the end of the GCL roll shall be placed in an anchor trench at the top of the slope. When utilizing an anchor trench design, the front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench. The GCL should cover the entire trench floor and the rear trench wall.

## 7.7 SEAMING

7.7.1 The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is required for reinforced GCL.

7.7.2 The minimum dimension of the longitudinal overlap should be six (6) inches. End-of-roll overlapped seams should be similarly constructed, but the minimum overlap should measure 24 inches.

7.7.3 Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.

7.7.4 Unless the GCL contains bentonite grooves to facilitate seaming without additional bentonite, bentonite-enhanced seams are constructed between the overlapping adjacent panels described above. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the six (6)-inch line. A similar bead of granular sodium bentonite is applied at the end-of-roll overlap. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.4 kg/m).

7.7.5 The granular bentonite sealing clay used for overlap seaming, penetration sealing, and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer.

### 7.8 DAMAGE REPAIR

7.8.1 Any GCL that is damaged during delivery or handling operations and cannot be used in the liner installation shall be replaced by the Contractor at no additional cost to the Purchaser.

7.8.2 If any GCL is damaged during installation, to include placement of the overlying HDPE liner and placement and compaction of the protection soil cover and topsoil, and the Purchaser determines the GCL will not perform for the liner system, then the affected installed GCL shall be replaced by the Contractor at no additional cost to the Purchaser.

7.8.3 If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 inches is achieved around all of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.

## 8.0 RISERS AND DISCHARGE PIPES

### 8.1 GENERAL

8.1.1 Riser and discharge pipes shall be of size and specifications as indicated in the Drawings.

8.1.2 Discharge pipes shall be placed on a concrete base and encased with concrete up to the springline as shown on the Drawings. Hold down straps shall be attached to the base.

8.1.3 All pipes penetrating the dike structure shall be encased in a minimum of 12 inches of flowable fill above and below and 18 inches of flowable fill on the sides. Flowable fill shall meet the specifications shown on the Drawings.

8.1.4 Hold down straps shall be used on the pipe while placing the concrete.

8.1.5 The compacted fill material shall meet the requirements of Section 2.5.2 of this Specification and shall be placed in accordance with the same. It shall be clean soil, free of roots, vegetation, rocks greater than 3 inches maximum dimension, or other objectionable material. If machine placement and compaction is not feasible, the fill material shall be placed in 4-inch lifts and hand compacted under and around the pipe to at least the same density as the adjacent fill material.

# 9.0 VEGETATION

## 9.1 GENERAL

9.1.1 A layer of topsoil 4-inches to 6-inches in final thickness shall be placed on all areas to be grassed. All disturbed areas not covered with liner material, as shown on the Drawings, shall be grassed. Topsoil shall be free of subsoil, clay, weeds, roots, and impurities. Hydroseeding methods may be used.

9.1.2 The Contractor shall produce a satisfactory stand of perennial grass in accordance with the vegetation schedule below. If it is necessary to repeat any or all the work, including plowing, fertilizing, watering, mulching and seeding, the Contractor shall repeat these operations until a satisfactory stand is obtained at no additional cost to the Purchaser.

9.1.3 Final stabilization shall be defined as follows: all soil disturbing activities at the site have been completed, and that for unpaved areas and areas not covered by permanent structures, 100% of the soil surface is uniformly covered in permanent vegetation with a density of 70% or greater, or equivalent permanent stabilization measures (such as the use of rip rap, gabions, permanent mulches or geotextiles) have been employed.

9.1.4 After placement of the topsoil, the area to be vegetated shall be fertilized and limed, then seeded with a perennial grass as indicated in the vegetation schedule shown below:

Vegetation Schedule

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

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

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

9.1.5 Measures shall be taken to prevent erosion of the topsoil layer and vegetation until a full vegetative growth has been obtained. The Contractor shall make daily inspections of the seeded areas and repair all eroded areas to the satisfaction of the Purchaser.

9.1.6 After seeding, an erosion control biodegradable straw blanket shall be installed on the exterior slopes of the dikes and any areas that have slopes of 3:1 or greater. This material shall be a BioNet S150BN Double Net Straw Blanket by North American Green, or approved equal. The blanket shall be installed per manufacturer's installation instructions. However, the blanket shall be tacked as necessary to the ground to withstand the upward growth of grass and to permit the establishment of grass through the blanket. Failure to accomplish this will require that the effected area be re-grassed and redone to the satisfaction of the Project Construction Manager.

9.1.7 Graded areas that are to be grassed, which have slopes less than 3:1, shall be mulched with straw or other suitable material.

9.1.8 Water required to promote a satisfactory growth shall be furnished by the Purchaser and applied by the Contractor.

## 10.0 RECORDS

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

# APPENDIX 7

# STRUCTURAL STABILITY ASSESSMENT
# &
# FACTOR OF SAFETY CALCULATIONS

The Initial Structural Stability Assessment was initially prepared to satisfy federal standards. It also satisfies 335-13-15-.04(4)(d) and 335-13-15-.09(1)(a)7.(ii) and is included for that purpose. Likewise, the Initial Factor of Safety Calculation was initially prepared to satisfy federal standards. It also satisfies 335-13-15-.04(4)(e) and 335-13-15-.09(1)(a)7.(iii) and is included for that purpose.

# INITIAL STRUCTURAL STABILITY ASSESSMENT
# PLANT BARRY GYPSUM POND
# ALABAMA POWER COMPANY

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities Final Rule (40 C.F.R. Part 257 and Part 261) section §257.73(d) requires the owner or operator of an existing CCR surface impoundment to conduct periodic structural stability assessments. The owner or operator must document whether the design, construction, operation and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein.

The CCR surface impoundment located at Alabama Power Company's Plant Barry that is also referred to as the Plant Barry Gypsum Pond, is located on Plant Barry property, near Bucks, Alabama. The lined CCR surface impoundment is formed by an engineered perimeter embankment. The foundations generally consist of stable and competent medium stiff to stiff clays and medium dense clayey sands.

Slope protection against surface erosion consists of HDPE liner on the interior of the surface impoundment, and grassy vegetation on the exterior slopes. Wave action is not a concern at this site due to the presence of the HDPE liner. The pond is not operated in such a manner as to normally be subjected to rapid drawdown conditions, and the presence of the liner prevents adverse effects from a potential rapid drawdown condition.

The perimeter embankments have been properly constructed using mechanical stabilization, compacted to a density sufficient to withstand the range of loading conditions.

Vegetated slopes of the dike are properly maintained to a manageable height to allow for periodic inspection.

The primary spillway is constructed of a 36-in diameter HDPE outlet pipe leading from a concrete riser structure. The spillway is designed, constructed operated and maintained to adequately manage flow during and following the peak discharge from the 1,000-yr storm.

The primary spillway discharge structure passes through the base of the embankment. The pipe is constructed of HDPE and is free of deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the structure.

The downstream slopes of the embankment are not subject to inundation from adjacent water bodies.

I hereby certify that the structural stability assessment was conducted in accordance with 40 C.F.R. Part 257.73(d).

10/14/16

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

16516
JAMES C. PEGUES, JR.

# INITIAL SAFETY FACTOR ASSESSMENT
# PLANT BARRY GYPSUM STORAGE FACILITY
# ALABAMA POWER COMPANY

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities" Final Rule (40 C.F.R. Part 257 and Part 261), §257.73(e), requires the owner or operator of an existing CCR surface impoundment to conduct periodic safety factor assessments. The owner or operator must document that the minimum safety factors outlined in §257.73(e)(1)(i) through (iv) for the critical embankment section are achieved.

The CCR surface impoundment located at Alabama Power Company's Plant Barry also referred to as the Plant Barry Gypsum Storage Facility is located on Plant Barry property, near Bucks, Alabama. The lined CCR surface impoundment is formed by an engineered perimeter embankment. The critical section of this CCR unit has been determined to be located on the west side of the unit.

The analyses used to determine the minimum safety factor for the critical section resulted in the following minimum safety factors:

| Loading Condition | Minimum Calculated Safety Factor | Minimum Required Safety Factor |
|---|---|---|
| Long-term Maximum Storage Pool (Static) | 1.8 | 1.5 |
| Maximum Surcharge Pool (Static) | 1.7 | 1.4 |
| Seismic | 1.7 | 1.0 |

The embankments are constructed of well compacted clayey sands that are not susceptible to liquefaction. Therefore, a minimum liquefaction safety factor determination was not required.

I hereby certify that the safety factor assessment was conducted in accordance with 40 C.F.R. Part 257.73 (e)(1).

10/7/16

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

16516
JAMES C. PEGUES, JR.

SOUTHERN COMPANY

## Engineering and Construction Services Calculation

**Calculation Number:**
**TV-BA-APC387586-591-002**

| | | |
|---|---|---|
| **Project/Plant:**<br>Plant Barry Gypsum Storage Facility | **Unit(s):**<br>Units 1-5 | **Discipline/Area:**<br>ES&FS |
| **Title/Subject:**<br>Factor of Safety Assessment for CCR Rule | | |
| **Purpose/Objective:**<br>Analyze slope stability of Gypsum Storage Facility | | |
| **System or Equipment Tag Numbers:**<br>NA | **Originator:**<br>Rajendra S. Gondhalekar | |

### Contents

| Topic | Page | Attachments<br>(Computer Printouts, Tech. Papers, Sketches, Correspondence) | # of Pages |
|---|---|---|---|
| Purpose of Calculation | 2 | Attachment A – Cell 1 Construction Drawings | 2 |
| Methodology | 2 | Attachment B – Analysis Section Location | 1 |
| Criteria and Assumptions | 3 | | |
| Summary of Conclusions | 4 | | |
| Design Inputs/References | 5 | | |
| Body of Calculation | 5-8 | | |
| | | | |
| Total # of pages including cover sheet & attachments: | 13 | | |

### Revision Record

| Rev. No. | Description | Originator Initial / Date | Reviewer Initial / Date | Approver Initial / Date |
|---|---|---|---|---|
| 0 | Issued for Information | RSG/10-04-16 | JAL/10-04-16 | JCP/10-04-16 |
| | | | | |
| | | | | |
| | | | | |

**Notes:**

## Purpose of Calculation

Barry Steam Plant is owned and operated by Alabama Power Company and located 30 miles north of Mobile, Alabama, off of Hwy 43 near Bucks, Alabama. Plant Barry is a seven unit generating facility, including two natural gas fired combined cycle units and five coal fired units. Plant Barry is in the process has installed a flue gas desulfurization system (scrubber) on Unit 5. This process produces gypsum as a by-product. The FGD gypsum is sluiced to a lined facility for final storage or disposal.

The gypsum storage facility will be constructed in a four cell arrangement with construction of Cell 1 currently completed. Additional cells will be completed as capacity demands dictate. Construction of the Cell 1 involved grading of the existing ground surface and the constructing of a perimeter dike out of compacted fill. The inside of Cell 1 was be lined with a high-density polyethylene (HDPE) liner to prevent infiltration of decant water into the subsurface. A drainage system utilizing a layer of geogrid sandwiched between layers of geofabric (i.e. TexDrain) carries decant water from the bottom of the cell to collection pipes which discharge into a sediment basin. A plan view of the Cell 1 design is shown in the Attachments.

The perimeter dike has been constructed using compacted fill from a nearby borrow area. This fill consists of silty and clayey sands. The dike averages approximately 20 feet in height and will varies in top width from 16 to 32 feet. The top of the dike at the critical section is at approximately elevation EL31 based on the latest topographic map. The exterior slope of the dikes is at 3H:1V and the interior slope of dikes within Cell 1 is at 2H:1V.

During operation, gypsum slurry is sluiced into the cell and allowed to decant through the drainage system. The dry gypsum that remains is used to create perimeter dikes, allowing the sluiced gypsum to be raised in levels to a final height of approximately 77 feet. A 3H:1V exterior slope will be maintained for the gypsum, and a 16 foot set-back will be constructed between the gypsum levels. Cross-sections showing the levels of gypsum placement in Cell 1 are shown in the Attachments.

The purpose of this calculation is to evaluate the stability of Plant Barry's gypsum storage facility and dike at the critical analysis section located on the after the final level of gypsum placement in Cell 1.

## Methodology

The calculation was performed using the following methods and software:

GeoStudio 2012 (Version 8.15, Build 11777), Copyright 1991-2016, GEO-SLOPE International, Ltd.

Strata (Version alpha, Revision 0.2.0), Geotechnical Engineering Center, Department of Civil, Architectural, and Environmental Engineering, University of Texas.

Morgenstern-Price analytical method was run and reported.

## Criteria and Assumptions

The slope stability models were run using the following assumptions and design criteria:

- Seismic site response was determined using a one-dimensional equivalent linear site response analysis. The analysis was performed using Strata, utilizing random vibration theory. The input motion consisted of the USGS published 2008 Uniform Hazard Response Spectrum (UHRS) for Site Class B/C at a 2% Probability of Exceedance in 50 years. The UHRS was converted to a Fourier Amplitude Spectrum, and propagated through a representative one dimensional soil column using linear wave propagation with strain-dependent dynamic soil properties. The input soil properties and layer thickness were randomized based on defined statistical distributions to perform Monte Carlo simulations for 100 realizations, which were used to generate a median estimate of the surface ground motions.
- The median surface ground motions were then used to calculate a pseudostatic seismic coefficient for utilization in the stability analysis using the approach suggested by Bray and Tavasarou (2009). The procedure calculates the seismic coefficient for an allowable seismic displacement and a probability exceedance of the displacement. For this analysis, an allowable displacement of 0.5 ft, and a probability of exceedance of 16% were conservatively selected, providing a seismic coefficient of 0.008g for use as a horizontal acceleration in the stability analysis.
- The current required minimum criteria (factors of safety) were taken from the Structural Integrity Criteria for existing CCR surface impoundment from 40 CFR 257.73, published April 17, 2015.
- The soil properties of unit weight, phi angle, and cohesion were obtained from historical laboratory and in-situ test results.
- Soil stratigraphy and piezometric data was estimated from the historical boring logs.
- The properties of unit weight, phi angle, and cohesion for the gypsum were derived from laboratory test data from Plant Scholz gypsum samples including the following: sedimented – consolidation samples, cast and sedimented triaxial samples, cast gypsum samples, and in-situ tests on sedimented gypsum
- The COE EM 1110-2-1902, October 2003, allows the use of the phreatic surface established for the maximum storage condition (normal pool) in the analysis for the maximum surcharge loading condition. This is based on the short term duration of the surcharge loading relative to the permeability of the embankment and the foundation materials. This method is used in the analysis for the impoundments at this facility with surcharge loading.

The Cross-Section and materials used in this survey calculation were generally gathered from historical slope stability analyses for the gypsum storage facility. The critical section for the storage facility was identified to be located along the west side of Cell 1.

### Input Data

The following soil properties were used in the analyses.

| Soil Type | Unit Weight, pcf | Cohesion, psf | Phi Angle, deg |
|---|---|---|---|
| Gypsum | 85 | 0 | 30 |
| Dike Fill | 122 | 500 | 26 |
| Base Soil | 110 | 300 | 20 |

### Hydrologic Considerations

Since the analysis condition consists of the gypsum stack being at a significantly higher elevation than the perimeter dikes and drainage channels, the gypsum will not receive any runoff from the surrounding areas. For the purpose of the analyses, the hydrologic conditions in the gypsum stack were conservatively assumed to be at the operating pool elevation for the previous level for the long term maximum storage condition, and at the surface of the gypsum top deck for the maximum surcharge condition.

### Load Conditions

The stability of the Plant Barry gypsum storage facility was evaluated for the load conditions indicated in the following table. When appropriate, cases were run both in the gypsum and the dike.

## Summary of Conclusions

The following table lists the factors of safety for various slope stability failure conditions. All conditions are steady state except where noted. Construction cases were not considered. Based on the results of these analyses all structures are stable.

| **North East Main Dike** | | |
|---|---|---|
| **Case** | **Computed Factor of Safety** | **Typical Minimum Factor of Safety** |
| Long-term Maximum Storage Pool (Static) | 1.8 | 1.5 |
| Maximum Surcharge Pool (Static) | 1.7 | 1.4 |
| Seismic | 1.7 | 1.0 |

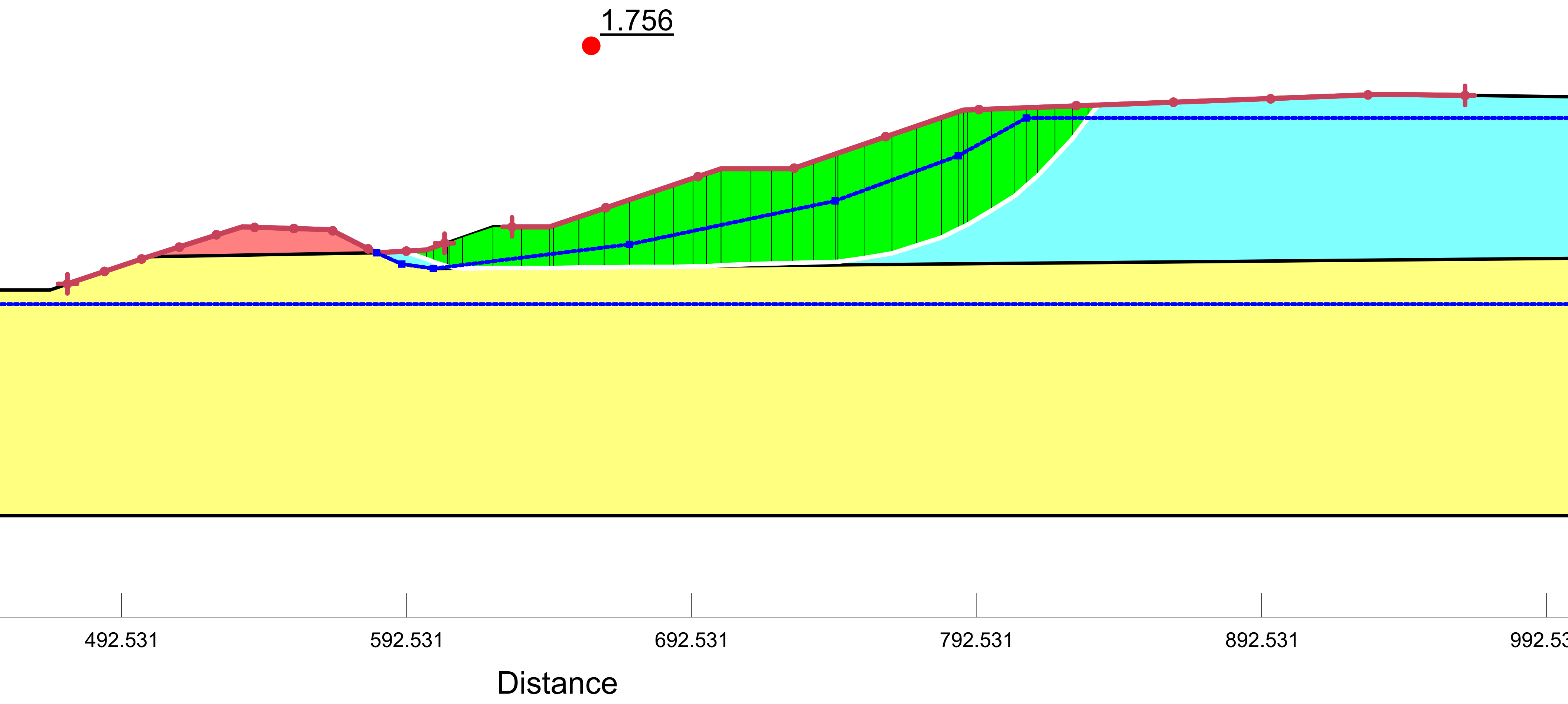
The analyses indicate that in all cases, the factors of safety are above the required minimums.

## Design Inputs/References

- USGS Earthquake Hazards website, http://www.usgs.gov/hazards/earthquakes/.
- US Corps of Engineers Manual EM 1110-2-1902, October 2003
- Bray, J. D. and Travasarou, T., *Pseudostatic Coefficient for Use in Simplified Seismic Slope Stability Evaluation*, Journal of Geotechnical and Environmental Engineering, American Society of Civil Engineers, September 2009

## Body of Calculation

Calculation consists of Slope-W modeling attached.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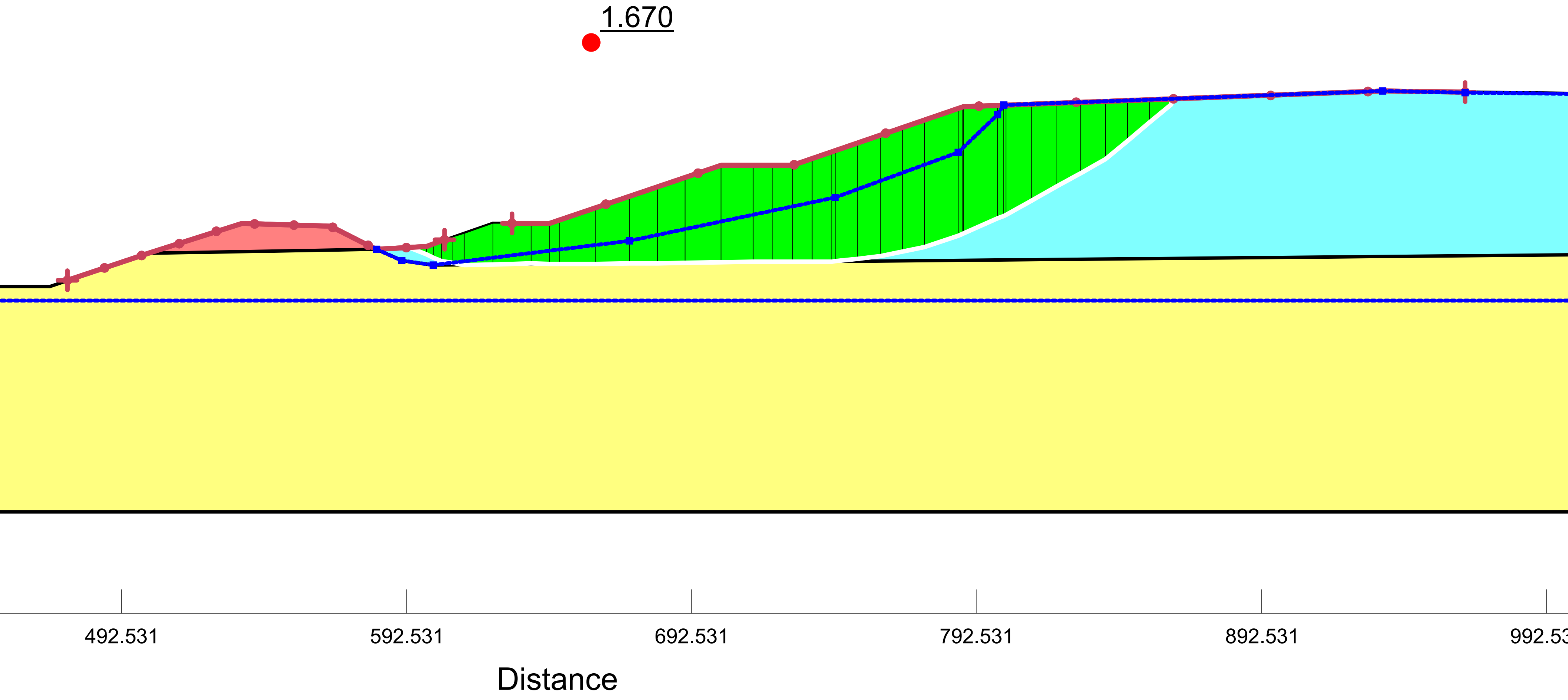
692.531
792.531
892.531
992.53
Distance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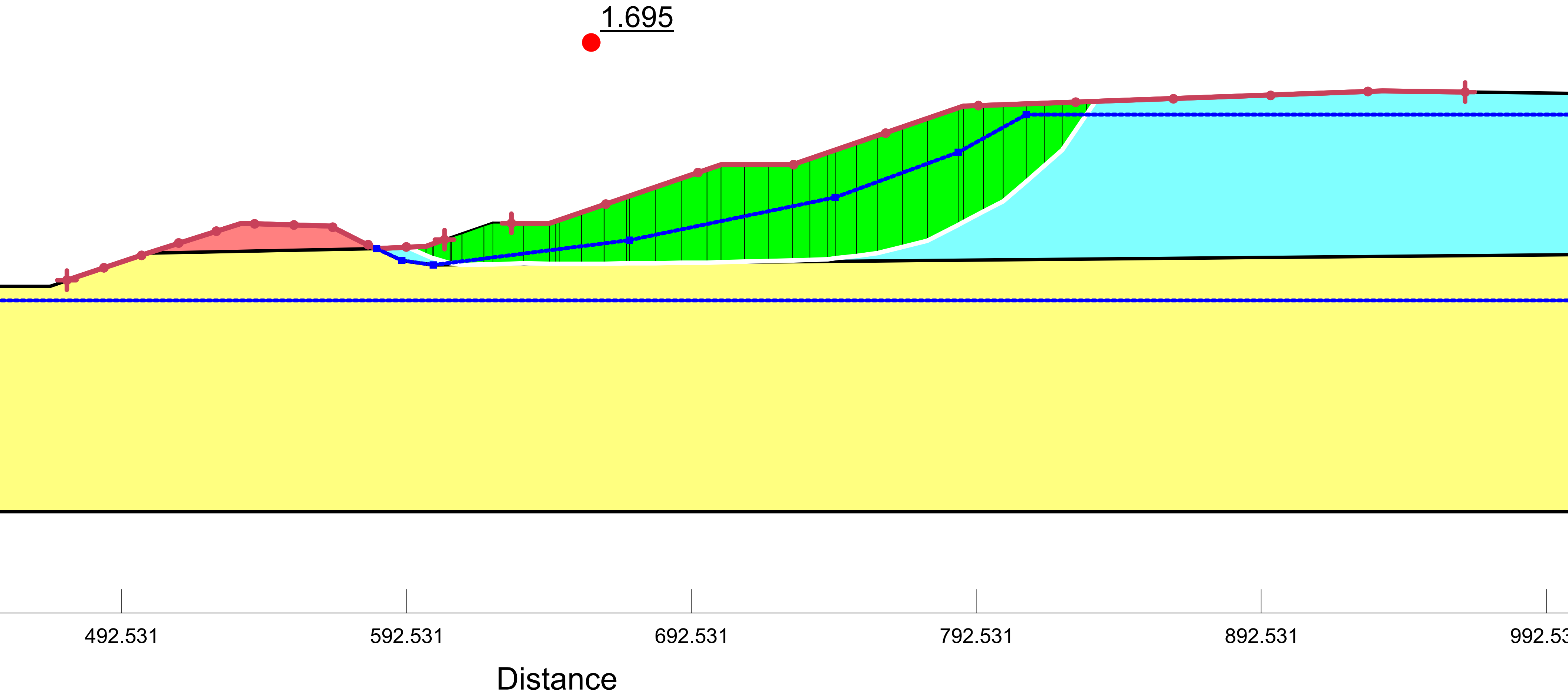
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Distance

# Attachment A

Figure – Cell 1 Construction Drawings

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

NOTES:

1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

GRAPHIC SCALE

50 0 25 50 100 200

( IN FEET )
1 inch = 50 ft.

| REVISION | DATE | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 6 | 12-19-11 | A. ADDED AS-BUILT CONDITIONS<br>ECS5517 | CSM | DPK | JBS | | | | |
| 5 | 08-14-09 | A. B-2 CHANGED GAB TO 12"<br>B. C-3, E-6, F-8, ADDED SOUTH EVACUATION NOTE.<br>C. D-5, CHANGED SECTION C-C TO C'-C'<br>D. E-2, REVISED DISTANCE TO CL<br>E. H-7, ADDED GYPSUM MARKET STACKING AREA<br>EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 4 | 07-02-09 | A. C-4, F-7 ADDED GUARDRAIL AND SWING GATE<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 3 | 03-05-09 | A. G-7 ADDED PIPE SLEEVES AND PIPING<br>B. H-7 ADDED ELECT DUCT RUN<br>C. B-6 ADDED ELECT DUCT RUN<br>D. F-7 ADDED ELECT DUCT RUN AND EDITED NOTE<br>E. F-8 ADDED PIPE SLEEVE AND PIPING<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 2 | 11-14-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |
| 1 | 04-11-08 | ISSUED FOR CONSTRUCTION<br>GENERAL REVISION<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |
| 0 | 12-03-07 | ISSUED FOR CONSTRUCTION<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | RAM | CKT |

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

**Alabama Power Company**

PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1-SEDIMENTATION POND DETAIL PLAN
FOR INITIAL DIKE CONSTRUCTION

Quality Record

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=50' | | E5C11034 | 1 | FINAL | 6 |

ANSI E: 44x34 Acad2004

CELL 1–STORAGE CAPACITY AND STORAGE LIFE

DESIGN OF CELL BASED ON 0.6% SULFUR COAL
INCOMING FLOW RATE – 280,218 LBS/HR
GYPSUM PRODUCTION RATE = 26,462 LBS/HR = 231,807,120 LBS/YR

FINAL CELL 1 STACK (0.6% SULFUR)
STORAGE VOLUME CAPACITY – 730,458 CY = 19,722,366 C.F.
OR 1,380,565,620 LBS (ASSUMING 70 LBS/C.F.)
STORAGE LIFE – 5.96 YEARS

DESIGN OF CELL BASED ON 1.0% SULFUR COAL
INCOMING FLOW RATE – 288,718 LBS/HR
GYPSUM PRODUCTION RATE = 46,270 LBS/HR = 405,325,200 LBS/YR

FINAL CELL 1 STACK (1.0% SULFUR)
STORAGE VOLUME CAPACITY – 730,458 CY = 19,722,366 C.F.
OR 1,380,565,620 LBS (ASSUMING 70 LBS/C.F.)
STORAGE LIFE – 3.41 YEARS

DESIGN OF CELL BASED ON 2.5% SULFUR COAL
INCOMING FLOW RATE – 584,623 LBS/HR
GYPSUM PRODUCTION RATE = 111,909 LBS/HR = 980,322,840 LBS/YR

FINAL CELL 1 STACK (2.5% SULFUR)
STORAGE VOLUME CAPACITY – 730,458 CY = 19,722,366 C.F.
OR 1,380,565,620 LBS (ASSUMING 70 LBS/C.F.)
STORAGE LIFE – 1.41 YEARS

# CELL NO. 1 - OPERATIONS AND CONSTRUCTION FINAL STACKING PLAN

GRAPHIC SCALE

50 0 25 50 100 200

( IN FEET )
1 inch = 50 ft.

NOTES:

1. GRIDLINES AND COORDINATES SHOWN ARE IN PLANT GRID.

| REVISION | DATE | | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 1 | 09-04-09 | GENERAL REVISION<br>EWO 2161DE | EEJ | PMG | BRH | JTM | KAH | TDJ | CKT |
| 0 | 12-31-08 | ISSUED FOR CONSTRUCTION<br>EWO 2161DE | JWM | PMG | BRH | JTM | KAH | TDJ | CKT |

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

**Alabama Power Company**

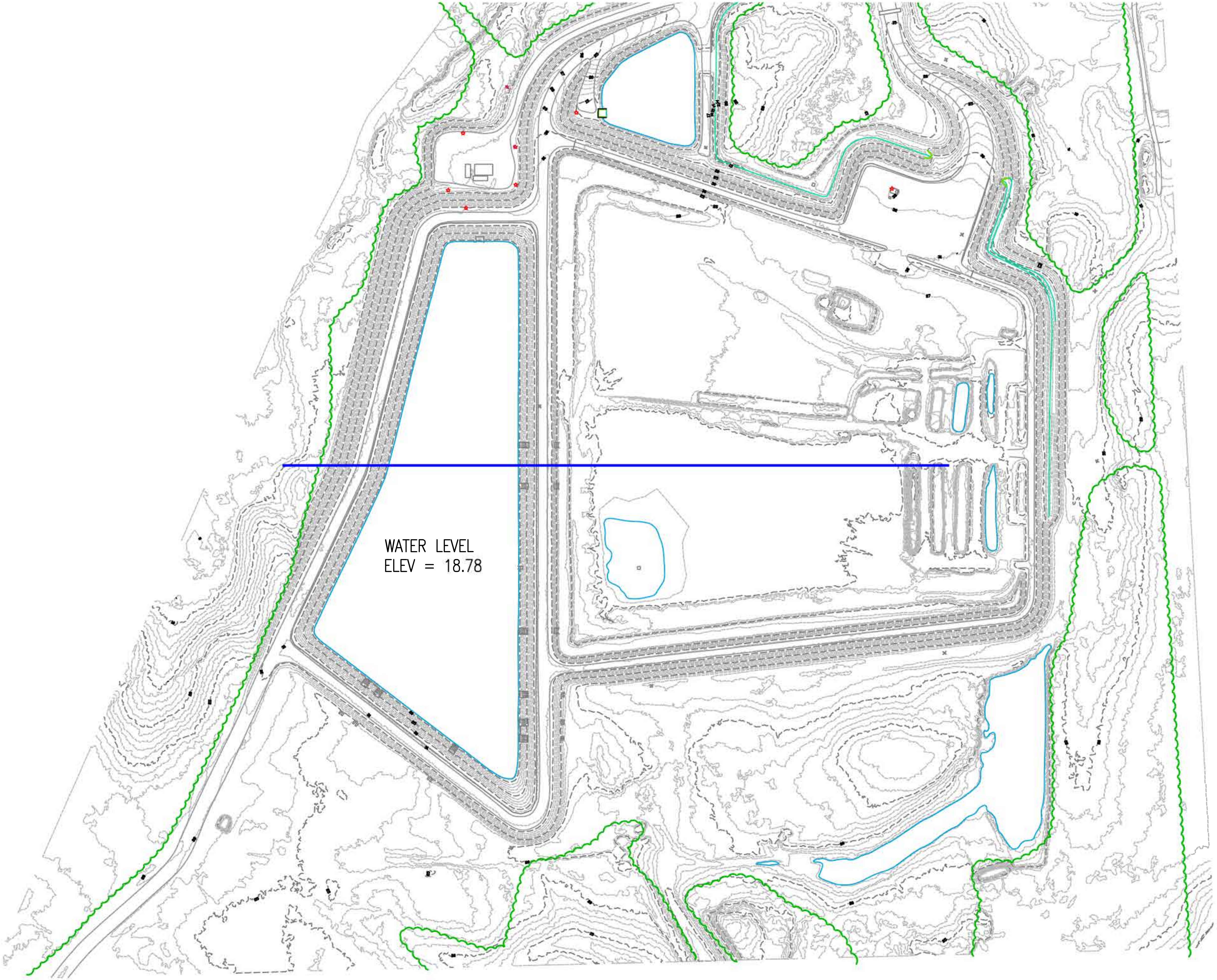
PLANT BARRY UNIT 5
FGD PROJECT
GYPSUM STORAGE AREA
CELL NO. 1–OPERATIONS PLAN
FINAL STACKING PLAN

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| 1"=50' | 210800 | E5C11048 | 1 | FINAL | 1 |

ANSI E: 44x34 Acad2004

# Attachment B

Figure – Analysis Section Location


WATER LEVEL
ELEV = 18.78

# APPENDIX 8
# TECHNICAL SPECIFICATIONS

# SOUTHERN COMPANY GENERATION
# ENGINEERING AND CONSTRUCTION SERVICES

# TECHNICAL SPECIFICATIONS
# SECTION 312300

# FOR

# EARTHWORK AND FINAL COVER INSTALLATION
# FOR
# CLOSURE OF GYPSUM POND

# FOR

# PLANT BARRY

# ALABAMA POWER COMPANY

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# TECHNICAL SPECIFICATIONS
# EARTHWORK AND FINAL COVER INSTALLATION
# FOR
# CLOSURE OF GYPSUM POND

## 1.0 GENERAL

1.1 These technical specifications will pertain to the closure of the Gypsum Pond located at Plant Barry in Bucks, Mobile County, Alabama. The gypsum pond will be closed under the applicable requirements of ADEM Admin. Code 335-13-15, known hereafter as the “ADEM Solid Waste Regulations.” The pond will be closed with the gypsum in place.

1.1 These Specifications, and all related attachments and associated documents, cover the furnishing of all materials (unless otherwise noted), labor, and supervision required for the in-place closure of the ash pond, including installation of a final cover system for the ash pond as described herein and presented on the Closure Drawings, and the technical and construction requirements, including notes, specifications, and design data contained in the Drawings. The Drawings and Notes are an integral part of these Specifications.

1.2 The following terms shall apply to these Technical Specifications ("Specifications"):

a) The term "Purchaser" means Alabama Power Company (APC).

b) The term “Contractor” means the entity awarded the contract to furnish the materials and perform the work as described herein, and to construct the final cover system as specified in the contract documents.

c) The term “Construction Site Manager” (CSM) means the on-site manager of the project or his designated representative. He is the authorized representative at the site for the Purchaser.

d) The term "Purchaser's Representative" means the representative designated by the CSM to perform certain activities under these Specifications.

e) The terms “Accepted, Acceptable, or Approved” denotes that of which must be acceptable, accepted or approved by the CSM or his authorized representative.

f) The terms “CQC Firm”, “CQC Inspector”, and “CQC Professional Engineer” refer to the Contractor’s third-party firm responsible for construction quality control monitoring, testing and documentation for all work performed during the construction of the facility.

1.3 Any discrepancies between the Drawings noted in Section 3.1 and the provisions of the Specifications shall be brought to the attention of the Purchaser for resolution before the performance of the work. In the case of discrepancies between the scale dimensions on the Drawings and the written dimensions, the written dimensions shall govern.

1.4 The Contractor shall ensure that all work is performed in accordance with the

Occupational Safety and Health Act of 1970 and other standards and codes listed herein (latest revision).

1.5 As necessary, the Purchaser will file for a National Pollutant Discharge Elimination System (NPDES) Construction General Permit for storm water discharge under ALR100000 (discharges from construction activities that result in a total land disturbance of one acre or greater and sites less than one acre but are part of a common plan of development or sale) from the Alabama Department of Environmental Management (ADEM). The Contractor shall be responsible for obtaining any other necessary permits for conducting the work covered by these Specifications.

1.4 All land disturbing activities shall be consistent with the minimum standards in the *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas,* latest revision.

1.5 Installation and maintenance of erosion and sediment control measures (e.g. “BMPs”) and monitoring of surface waters during construction, if required, shall be performed by the Contractor in accordance with the NPDES Construction General Permit (Permit Number ALR100000) and the Construction Best Management Practices Plan (CBMPP), respectively.

1.6 The Contractor shall provide methods, means, and facilities to prevent contamination of the soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by the construction activities. Toxic liquids, chemicals, fuels, and lubricants shall be deposited into containers for subsequent removal offsite in accordance with all applicable federal, state, and local codes and standards.

1.7 The Contractor shall furnish and keep in good working condition at all times sufficient equipment of the proper design and capacity to do all work described under these Specifications and in accordance with the established schedule. The Purchaser’s acceptance of the Contractor’s list of equipment shall not be construed to mean that the listed equipment is adequate or sufficient to perform the work or that additional equipment shall not be required to maintain the schedule or perform the work specified herein.

1.8 The Contractor shall furnish appropriate equipment for minimizing fugitive dust. The Contractor shall continually take steps necessary to minimize dust created by all equipment, vehicles, work activities, or storage areas. These steps shall include, but not be limited to, watering roads and work areas. Open-bodied trucks handling sand, stone, gravel, or earth shall be covered if the truck is traveling off site. The Contractor shall not deposit dirt, mud, or debris on public roads, plant roads, or adjacent properties.

1.9 The Contractor is responsible for the unloading, handling, and storage of all materials supplied by him and shall ensure that all materials are handled and stored so as to prevent any damage. Materials damaged during handling, shipping, or storage shall be replaced at no cost to the Purchaser. The Contractor shall store materials only in areas as directed by the Purchaser. Any security measures taken for the protection of the Contractor's equipment shall be at the Contractor's expense.

1.10 Construction activities, except as shown on the Drawings, will not be performed within the areas designated as the Buffer Zone. This Buffer Zone is indicated on the Drawings. The Buffer Zone will be flagged and marked by the Contractor prior to construction.

1.11 The Contractor shall have the responsibility for obtaining third party QC testing for all work performed during the construction of the facility.

1.12 All earthwork, including ramps and access roads, done for the convenience of the Contractor, shall be done at his expense unless instructed to be completed by the purchaser. Such work will be restored to its original elevation at the Contractor's expense if the Purchaser so desires.

1.13 The Contractor shall install, at his expense unless expected to be completed by the purchaser, any drainage piping required because of the Contractor's mode of operation including ramps and roads.

1.14 Plant Barry is an active power generation site. The Contractor and the PCM, or his representative, shall mutually determine a designated path for vehicles that are used by the Contractor or that haul material to and within the site for the Contractor. The Contractor's vehicles outside the designated traffic path must not obstruct or hinder traffic flow on the site. The Contractor shall provide traffic control during roadway related construction activities and material deliveries. This shall be coordinated with other activities ongoing at the plant. If within active and congested areas around the plant, traffic control shall include flag persons, barriers, and other control aids to provide for the safe routing of traffic in the affected area.

1.15 At all times, the Contractor shall provide protection to prevent damage to existing facilities, roads, underground pipes, and other Purchaser's equipment and property that may be on site. The Contractor will be liable for any damages to MPC property caused by the Contractor.

1.16 The Purchaser shall have the right to inspect the Contractor's work as deemed necessary. The Purchaser shall have the right to inspect the Contractor's work locations, to inspect the materials in use, to meet and discuss with the Contractor the progress of the work and the manner in which it is being done. The Purchaser shall have the authority to reject materials or suspend any work not performed in accordance with these Specifications. The Contractor shall be responsible for performing the work in strict accordance with these Specifications, and the presence of the Purchaser's Representative shall not relieve the Contractor and his subcontractors of that responsibility.

1.17 Piezometers and Groundwater Monitoring Wells located in the site area shall not be damaged or destroyed by construction activities. The Contractor shall provide Purchaser approved measures to protect the piezometers and wells in the site area. Any monitoring well(s) damaged or destroyed by the Contractor and/or his activities shall be replaced at no cost to the Purchaser.

1.18 Priority pollutant testing shall be performed of any off-site borrow materials or topsoil material. The Contractor shall provide the Purchaser notice at least three weeks before hauling begins so that the Purchaser can schedule a time for collecting soil samples for chemical analyses. No off-site borrow material may be brought onto the site until the Purchaser has reviewed the analytical results and approved the borrow source.

# 2.0 COVER SYSTEMS AND CERTIFICATION

## 2.1 Cover Systems

2.1.1 Closure of the Gypsum Pond shall be accomplished by the installation of a final cover system designed to minimize infiltration and erosion. Two alternate final cover systems are presented:

a) Final Cover System, Alternative 1, will consist of the ClosureTurf™ system as manufactured by Agru America. This system consists of an Agru 50 mil linear low density polyethylene (LLDPE) SuperGripnet® geomembrane, Engineered Turf, and sand ballast.

b) Final Cover System, Alternative 2, a composite cover system consisting of a 40 mil linear low density polyethylene (LLDPE) textured geomembrane overlain by a geocomposite drainage material, a minimum 18 inches of protective cover soil, and a minimum 6 inches of topsoil.

## 2.2 Certification

The installation of the final cover system for the Gypsum Pond shall be certified as being constructed in accordance with the applicable ADEM Solid Waste Regulations. This certification shall be performed by a professional engineer registered to practice in the State of Alabama and placed in the Gypsum Pond operating record within 60 days of the completion of all construction activities. This Certification will be provided by the Purchaser or the Purchaser’s Representative.

# 3.0 APPLICABLE DOCUMENTS

## 3.1 Drawings

The Drawing List is contained on the Drawings.

## 3.2 Codes and Standards

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

If codes or standards are found to conflict with each other, it should be brought to the attention of the Purchaser to determine which is most applicable.

<u>Occupational Safety and Health Administration</u>

- Occupational Safety and Health Act of 1970

<u>ASTM International (ASTM)</u>

- ASTM C 117 - Standard Test Method for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C 136 – Standard Test Method for Sieve Analysis of fine and Coarse Aggregates
- ASTM D 422 – Standard Test Method for Particle-Size Analysis of Soils
- ASTM D 698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft$^3$ (600 kN-m/m$^3$))
- ASTM D 792 – Standard Test Methods for Density and Specific Gravity (relative density) and Density of Plastics by Displacement
- ASTM D 1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
- ASTM D 1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- ASTM D 1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique
- ASTM D 1603 - Standard Test Method for Carbon Black in Olefin Plastics
- ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil In - Place by the Sand Cone Method
- ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m$^3$))
- ASTM D 1587 - Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
- ASTM D 2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D 2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
- ASTM D 2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D 2488 - Description and Identification of Soils (Visual-Manual Procedure)
- ASTM D 2937 - Standard Test Method for Density of Soil In Place by the Drive Cylinder Method
- ASTM D 3017 – Standard Test Method for Water Content of Soil and Rock In

Place Nuclear Methods (Shallow Depth)

- ASTM D 3895 - Standard Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry
- ASTM D 4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D 4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
- ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- ASTM D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
- ASTM D 4716 - Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
- ASTM D 4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile
- ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
- ASTM D 4959 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method
- ASTM D 5035 - Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
- ASTM D 5084 - Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
- ASTM D 5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- ASTM D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles

- ASTM D 5321 - Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
- ASTM D 5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- ASTM D 5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- ASTM D 5721 - Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
- ASTM D 5885 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
- ASTM D 5994 - Standard Test Method for Measuring Core Thickness of Textured Geomembranes
- ASTM D 6392 – Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- ASTM D 6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- ASTM D 6938 Rev B - Standard Test Method for In-Place Density and Water Content of Soil and Soil – Aggregate In Place by Nuclear Methods (Shallow Depth)
- ASTM D 7005 - Determining the Bond Strength (Ply Adhesion) of Geocomposites
- ASTM D1204 -Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
- ASTM D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- ASTM D1907 - Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method
- ASTM D2256 -Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method
- ASTM D3218 -Standard Specification for Polyolefin Monofilaments
- ASTM D5323 – Standard Test Method for Determination of 2% Secant Modulus for Polyethylene Geomembranes

- ASTM D5617 – Standard Test Method for Multi-Axial Tension Test for Geosynthetics
- ASTM D6913 -Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- ASTM D7007 – Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials

Geosynthetic Research Institute GRI Standards

- GM 10 - The Stress Crack Resistance of HDPE Geomembrane Sheet
- GM 11 - Accelerated Weathering of Geomembranes using a Fluorescent UVA Device
- GM 12 - Asperity Measurement of Textured Geomembranes Using a Depth Gage
- GM 13 - Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Geomembranes
- GM 19 – Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes
- GRI-GM17 – Test Methods, Test Properties, and Testing Frequency and for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes

United States Environmental Protection Guidance

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

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

Alabama Department of Environmental Management (ADEM) regulations

Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas

## 4.0 SITE CONDITIONS

4.1 The Contractor shall visit the site and acquaint himself with site conditions, utility locations, and the proposed scope of work.

4.2 The Contractor is responsible for acquiring and maintaining a dig permit per Alabama state law.

4.3 Vibratory equipment shall have vibratory devices mechanically disengaged and rendered inoperable while operating on dikes or the gypsum pond.

## 5.0 THIRD PARTY QUALITY CONTROL

5.1 The Contractor shall provide to the Purchaser, for the Purchaser's acceptance and approval, the following documentation indicating that the Contractor's Third Party Quality Control firm and personnel that will participate on this Project meets the minimum experience and qualifications indicated herein.

5.2 The Contractor shall provide to the Purchaser the qualifications of a third-party CQC Inspector for construction quality control (CQC) for the placement and compaction of the compacted structural fill.

5.3 The Contractor shall provide to the Purchaser the qualifications of a third-party CQC Inspector for construction quality control (CQC) of the ClosureTurf™ Final Cover System installation documenting the minimum requirements of Section 11.3.5 of these Specifications.

5.4 The Contractor shall provide to the Purchaser a statement of qualifications of a third-party CQC Inspector for construction quality control (CQC) of the geomembrane liner and drainage geocomposite installation documenting the minimum requirements of Section 12.3.3 of these Specifications.

5.5 The Contractor shall provide to the Purchaser the qualifications of the third party's soil testing laboratory contracted to perform the CQC testing for the structural earth fill.

## 6.0 LINES AND GRADES

The project shall be constructed to the elevations, lines, grades and cross sections shown on applicable Drawings. The Purchaser reserves the right to increase the foundation widths, change the embankment slopes, and to make such other changes in the embankment sections as conditions indicate are necessary for the construction of a safe and permanent structure. The Contractor shall be compensated for the changes in plan and/or sections resulting in changes in quantities of materials.

## 7.0 CLEAR, GRUBBING, AND STRIPPING

7.1 Prior to any clearing or grubbing operations, initial BMPs shall be installed. Erosion control measures and best management practices shown in the Storm Water Pollution Prevention Plan (SWPPP) shall be followed.

7.2 The footprint of the gypsum pond shall be cleared of any woody vegetation prior to excavation and/or fill operations. Grassy vegetation and grass mats are not required to be removed.

7.3 Trees, stumps, and brush cleared from the above areas shall be disposed of outside the closure areas by mulching or burning, if allowed by Purchaser. Mulch may be used as a temporary perimeter BMP, but shall ultimately be disposed of off-site.

7.4 Spoil material shall be disposed of outside the closure areas only in areas to be designated by the Purchaser. The Contractor shall slope the spoil area for drainage and provide silt fences and a perennial stand of vegetation per the SWPPP.

7.5 Gypsum laden roots on grubbed and stripped material may be cleaned as much as practical by screening and washing processes, or other approved methods, prior to leaving the site for disposal. Usable material, as approved by the Purchaser, may be stockpiled for future use at Purchaser designated locations.

7.6 Adequate erosion control measures shall be installed around the spoil and stockpile areas in accordance with details shown on the construction and erosion control drawings (SWPPP).

7.7 Burning of brush and debris will not be allowed.

## 8.0 FOUNDATION AND SUBGRADE PREPARATION

### 8.1 Areas to Receive Fill

8.1.1 The Contractor shall prepare, install and maintain erosion and sediment control measures, as required by the SWPPP. If measures beyond those in the SWPPP are deemed necessary, contact the PCM to have those reviewed & approved by the SWPPP engineer and the SWPPP updated PRIOR to the measures being installed.

8.1.2 Material suitable for topsoil, material to be used for the eighteen (18) inch protective soil layer, and the material to be used as structural earth fill shall be stockpiled separately in a location specified by the Purchaser’s Representative.

8.1.3 Proof-roll the entire subgrade utilizing loaded, off-road trucks with a gross machine weight, including payload of 40 tons of soil. Any areas failing proof-roll shall be undercut and replaced with structural soil fill and re-rolled, or modified through the use of bridging layer as described in section 9.0.

8.1.4 Prior to receiving structural earth fill, the foundation areas shall be scarified by harrowing or other suitable means. The moisture content of the roughened surface shall be adjusted to within the limits provided in section 10.1.9. No fill shall be placed on any part of the subgrade until such areas have been conditioned, proof-rolled, inspected, and approved in writing by the Contractor’s QC Inspector and the Purchaser.

8.1.5 Work flow shall be planned such that the first embankment fill lift is placed soon after subgrade compaction to minimize subgrade exposure to inclement weather.

### 8.2 Geomembrane

8.2.1 The Contractor shall maintain the subgrade suitability and integrity until the geomembrane installation is completed and accepted.

8.2.2 The Contractor shall repair rough areas and any damage to the subgrade caused by installation of the geomembrane.

8.2.3 Subgrade shall be smooth, uniform, firm and free from rocks or other debris. For deployment over soil subgrade, no rocks or protrusions greater than 1/2-inch in diameter shall be exposed at the subgrade surface.

8.2.4 The Contractor shall verify that the surface on which the geomembrane will be installed is acceptable. In so doing the Contractor shall assume full liability for the accepted surface.

8.2.5 The Contractor shall submit written certificates of subgrade acceptance, signed by the Contractor, CQC Inspector, and the Purchaser’s Representative, for each area prepared for geomembrane placement.

8.2.6 The beginning of installation means acceptance of existing conditions. The Contractor shall be responsible for maintenance of the geomembrane covered subgrade once installation of geomembrane begins.

## 9.0 BRIDGING LAYER

9.1 Where it can be demonstrated that it is impracticable to proof-roll the subgrade as specified in section 8.1 or achieve the degree of compaction specified in section 10.1, a bridging layer may be placed.

9.2 The bridging layer shall be of sufficient thickness to allow the passage of earthmoving equipment with minimal surface heaving, but no more than four feet in thickness

9.3 The bridging layer shall be end-dumped and spread in a single layer. The compaction requirements of Section 10.1 will not apply to the bridging layer.

9.4 Acceptable materials for the construction of the bridging layer include structural earth fill as defined in Section 10.1, gypsum fill, sand, and rock fill materials.

9.5 Any gypsum fill used in the bridging lift must have been excavated from the gypsum pond and not at any point been transported out of the pond.

9.6 Geogrid reinforcement may be used as part of the bridging layer. All geogrid should be placed in accordance with the manufacturer's recommendations.

## 10.0 STRUCTURAL EARTH FILL AND ASH FILL

### 10.1 Structural Earth and Gypsum Fill

10.1.1 The Contractor shall provide third party CQC testing for all earth work performed for the closure of the Gypsum Pond.

10.1.2 Compacted earth fill should generally consist of sandy clays (CL), clayey silts (ML), clayey sands (SC), and clayey to silty sands (SC/SM) from a Purchaser approved borrow area.

10.1.3 No earth fill or gypsum shall be placed on any part of the foundation until such areas have proof-rolled, inspected, and approved in writing by the soils CQC Inspector and the Purchaser's Representative.

10.1.4 Fill materials shall be placed in uniform layers of eight inches, nominal thickness, loose measurement, for one foot beyond the full width of the fill on each side. The thickness of each layer shall be kept uniform with the necessary grading equipment. Upon completion of compaction, the slopes shall be cut back to the final slope. Particular care must be used to obtain the required compaction along the edges of the fill slopes.

10.1.5 Vibratory compaction equipment is not permitted to operate on the dike or gypsum pond. Equipment that has vibratory capability must have the vibratory component mechanically disengaged and rendered inoperable while operating on the dike or gypsum pond.

10.1.6 If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or as directed by the Purchaser's Representative, before the succeeding layer is placed.

10.1.7 During the dumping and spreading processes, the Contractor shall maintain at all times a force of men adequate for removal of roots and debris from all structural earth fill materials and all stones and clay clods greater than three inch maximum. Clay clod size may be reduced in size to meet this Specification by disking, tilling or other means. The distribution of materials throughout the structural fill shall be essentially uniform and free of any lenses, pockets, streaks, or layers of materials differing substantially in texture, moisture content, or gradation from the surrounding material.

10.1.8 The compacted structural fill and gypsum subgrade beneath the LLDPE component of the final cover shall be free of roots, debris, and all stones and clay clods greater than one-half ($^1/_2$) inch maximum. Clay clod size may be reduced in size to meet this Specification by disking, tilling or other means.

10.1.9 Structural earth fill and gypsum material shall be compacted to a minimum of 95% of the relative maximum dry density as determined by the standard Proctor compaction test (ASTM D 698). The moisture content of the earth fill at the time of placement shall be within -2% and +2% of the optimum moisture obtained by standard Proctor compaction test.

10.1.10 When moisture content is too low, the moisture content shall be adjusted to within the above limits prior to compaction. Moisture adjustment shall be achieved by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and harrowing of the layer shall be done after deposition, but before compaction.

10.1.11 If the moisture content is too high, the Contractor will be permitted to disk in place or stockpile and disk the earth fill material to promote drying to bring it back within the allowable moisture range.

10.1.12 The Contractor will be required to remove any compacted material that does not comply with the compaction requirements and replace the compacted earth fill to comply with this Specification at his own expense.

10.1.13 Structural earth fill or gypsum which cannot be compacted with roller equipment because of inadequate clearances shall be spread in four-inch layers and compacted with hand-guided power tampers to the extent required by these Specifications. Rocks two inches and greater, in any dimension, roots, and debris shall be removed from the fill and disposed of in an approved manner.

10.1.14 Field density and moisture content tests shall be performed daily in all types of material being placed. At a minimum, one in place density test shall be performed for each lift for each day fill material is placed.

10.1.15 For earth fill and gypsum material, at least one field moisture content and density test shall be performed for every 1,000 cy of fill (one per acre of lift area) or more often if deemed necessary in the opinion of the Purchaser's Representative.

10.1.16 If an in-place density or moisture test fails to meet the requirements for compaction and/or moisture, the area shall be reworked and then retested. If, however, the second test fails to meet the criteria, the area failing the criteria shall be delineated, and reworked or removed, and then retested. The areas requiring reworking/recompacting shall be noted on record drawings and reported.

10.1.17 In the event of repeated failures, or water content and density test values plotting far from the Proctor curves used for comparison in computing percent compaction, it shall be the option of the Purchaser's Representative, to require one or two-point Proctor checks to verify that the proper Proctor curve is being referenced. If not, a new Proctor curve determined by a five-point test shall be required.

10.1.18 The surveyed location, lift designation, and elevation or depth of the field density and moisture tests (passing, failing, and retests) shall be recorded and noted on the respective test records. The locations of these tests shall be shown on a figure or drawing.

10.1.19 Excavations required for density and moisture tests shall be repaired by scarifying the walls of the excavation, backfilling, and compacting the fill material to the criteria specified above.

10.1.20 If the construction of the embankment is interrupted, the Contractor shall be required to shape and smooth the last layer of earth fill material placed on the fill to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the Contractor shall be required to level, scarify and compact the last layer of earth fill material before placing additional layers.

10.1.21 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to ensure that the correct reference Proctor curves are being used for compaction check.

10.1.22 Earth fill areas, ditches, and other disturbed areas outside the cover area shall be grassed upon reaching final grade in accordance with these Specifications, the SWPPP and the Vegetation Schedule shown on the Drawings.

## 11.0 GEOMEMBRANE LINER, ENGINEERED TURF & SAND BALLAST (CLOSURE TURF™ COVER SYSTTEM)

### 11.1 General

11.1.1 ArmorFill™ E, a specialty component of the ClosureTurf® system, is a proprietary polymer-based product developed by Watershed Geosynthetics specifically to bind the ASTM-C33 sand infill component of the ClosureTurf® system for long-term performance applications.

11.1.2 HydroBinder™, a specialized component of the ClosureTurf® system, is a proprietary cementitious product used as an infill component of the ClosureTurf® system for high-velocity applications in swales and drainage channels.

11.1.3 HydroBinder™ shall be used for the slope drainage system at locations shown on the drawings.

11.1.4 ArmorFill™ E shall be used at transitions between Closure Turf® and HydroBinder™ as specified on the drawings.

11.1.5 The structured geomembrane shall be comprised of 50 mil linear low density polyethylene (LLDPE) Super Gripnet® structured geomembrane material as manufactured by Agru America. Product properties are listed in Section 11.4, Table 1.

11.1.6 The Engineered Turf layer consists of two polypropylene woven geotextiles tufted with polyethylene yarns overlying the 50 mil LLDPE structured geomembrane. Product properties are listed in Section 11.4, Table 2.

11.1.7 Color of the Engineered Turf layer shall be of standard color (100% green), or enhanced color (75% green + 25% tan).

11.1.8 The structured geomembrane and the engineered turf must be purchased as a system from the same supplier to ensure desired performance.

11.1.9 The sand infill for the Engineered Turf ballast shall consist of grain size distributions meeting ASTM C-33 specifications shown in Section 12.4, Table 3. All infill material shall meet ASTM C33 specifications unless otherwise approved by the Purchaser.

11.1.10 ArmorFill™ E shall consist of the proprietary polymer emulsion component and be mixed according to the requirements shown in Section 11.4, Table 4.

11.1.11 The HydroBinder$^{TM}$ infill for the Engineered Turf ballast shall consist of the proprietary cementitious product and meet the requirements as shown in Section 11.4, Table 5. All cementitious infill mix design shall meet ASTM C387 specifications for high strength mortars as described in Table 5 unless otherwise approved by the Purchaser.

11.1.12 A Manufacturer's Representative shall be on site during the initial phase of the ClosureTurf® installation and ArmorFill™ E/HydroBinder$^{TM}$ application to provide assistance to the Contractor.

11.1.13 At the request of the Purchaser or the Purchaser's Representative, representative product samples of the materials used on this project shall be provided for the Purchaser's use in confirmation testing for material properties.

## 11.2 Submittals

11.2.1 The ClosureTurf® installation contractor shall be an experienced and trained ClosureTurf® installer and be able to provide documentation that they have manufacturer's approval status. The ClosureTurf® installation contractor shall also utilize a licensed installer for the sand infill installation and ArmorFill™E/HydroBinder$^{TM}$ application of ClosureTurf® if not licensed to install the infill themselves. A Copy of Installer's Letter of Approval or License issued by the Manufacturer shall be provided to the Purchaser.

11.2.2 The Contractor shall provide to the Purchaser qualification statements from the geomembrane Installation Contractor, and a Statement of Qualifications for the CQC Inspector and laboratory documenting the minimum requirements of Section 11.3 of these Specifications.

11.2.3 The Contractor shall provide the manufacturer product data sheets for all material to be provided for the project.

11.2.4 The Contractor shall provide to the Purchaser the Manufacturer's Quality Control (CQC) Program, including tests, test procedures, and frequencies, for manufacture of all materials for this project.

11.2.5 A copy of the manufacturer's quality control results shall be submitted to the Purchaser's Representative a minimum of seven calendar days prior to geomembrane shipment to the site. Quality control testing shall be performed by the manufacturer in accordance with the test procedures, and frequency listed in the Quality Control Program and as approved by the Purchaser's Representative. Prior to delivery, the following shall be submitted to the Owner's Representative for Review:

11.2.6 Certification stating all geomembrane rolls are furnished by one manufacturer, and all rolls are manufactured from one resin type.

11.2.7 Copies of quality control certificates issued by the Manufacturer. The quality control certificates shall include:

11.2.8 Roll numbers and identification;

11.2.9 Sampling procedures; and

11.2.10 Results of quality control tests, including descriptions of the test methods used.

11.2.11 The results of the manufacturing quality control tests shall meet or exceed the property values listed in Section 11.4.

11.2.12 Geomembrane delivery, storage, handling and installation instructions.

11.2.13 Extrudate Beads and/or Welding Rods:

11.2.14 Statement of production dates.

11.2.15 Certification stating all extrudate is from one manufacturer and is the same resin type as the resin used to manufacture the geomembrane rolls.

11.2.16 Copies of quality control certificates issued by the Manufacturer.

11.2.17 The Engineered Turf manufacturer shall provide inspection records of the tufting procedures for the Turf material. These will include visual inspection records of the following properties every 150,000 sq. ft:

11.2.18 Tufting Gauge

11.2.19 Pile height

11.2.20 Roll Length and roll numbers.

11.2.21 The Manufacturer shall also provide documentation on the geotextile product and yarn manufacturer minimum properties for the Engineered Turf.

11.2.22 The Engineered Turf manufacturer shall provide pantone color codes available for Engineered Turf component.

11.2.23 Prior to mobilization of the Installer to the site, Contractor shall submit shop drawings indicating panel layout and field seams 14 calendar days prior to installation of geomembrane.

11.2.24 The Contractor shall furnish the Purchaser upon completion of the project:

11.2.25 A 1-year warranty provided by the Geosynthetics Installer against defects in workmanship. Warranty conditions concerning limits of liability will be evaluated and must be acceptable to the Owner.

11.2.26 As-built Geomembrane Panel Drawings. As-built Drawings shall include panel locations, panel identification numbers, geomembrane roll numbers for each panel, seam caps, destructive sample locations, and repairs.

11.2.27 The Contractor shall submit a certification from the manufacturer of the geomembrane that the raw materials, and finished geomembrane rolls, meet the physical property requirements indicated in these Specifications.

11.2.28 After installation, the Contractor shall submit a certification, signed by the Contractor and signed and sealed by the CQC Firm's Professional Engineer, that the geomembrane and ClosureTurf® cover system was placed in accordance with these Specifications.

## 11.3 Installation Contractor Qualifications

11.3.1 The Superintendent shall have supervised the installation of a minimum of 2,000,000 square feet of polyethylene geomembrane and 500,000 square feet of geotextile.

11.3.2 The master seamer shall have experience seaming a minimum of 1,000,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site.

11.3.3 All other seaming personnel shall have seamed at least 100,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Personnel who have seamed less than 100,000 square feet of polyethylene geomembrane shall be allowed to seam only under the direct supervision of the master seamer or Superintendent.

11.3.4 The installation Contractor shall attend the manufacturer's course on installation procedures for the ClosureTurf® system. Certificates of course completion shall be submitted by the Contractor.

11.3.5 The Contractor shall provide a third-party inspector for construction quality control (CQC) of the LLDPE installation. The LLDPE inspector shall be an individual or company who is independent from the geomembrane manufacturer and installer, who shall be responsible for monitoring and documenting activities related to the CQC of the LLDPE throughout installation. The inspector who is on site monitoring the installation activities every day that they are taking place, shall have provided CQC services for the installation of the proposed or similar products for at least five completed projects totaling not less than 1,000,000 square feet. The inspector should be an engineer registered to practice in the state of Alabama or a geosynthetics installation technician certified through the Inspector Certification Program (ICP) administered by the Geosynthetics Certification Institute (GCI). The Contractor shall provide the Purchaser with a statement of qualifications (SOQ) for the LLDPE inspector prior to starting work.

## 11.4 Materials, Delivery and Storage

11.4.1 The structured geomembrane shall be comprised of 50 mil linear low density polyethylene (LLDPE) Super Gripnet® structured geomembrane material as manufactured by Agru America, with a minimum 23-foot seamless width. There shall be no factory seams. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.

11.4.2 The geomembrane shall be manufactured of polyethylene resins and shall be compounded and manufactured specifically for the intended purpose. The Contractor shall submit a certification from the manufacturer of the geomembrane that the raw materials meet the physical property requirements indicated in the following table.

11.4.3 The surface of the geomembrane shall not have striations, roughness, pinholes, or bubbles and shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter except that, if in the opinion of the Purchaser's Representative, the blemish will not adversely affect properties and use of the liner.

11.4.4 The geomembrane shall be supplied in rolls; folds will not be permitted. Identify each roll with labels indicating lot number, roll number, thickness, length, width, manufacturer, and plant location.

11.4.5 Resin shall be LLDPE, new, first quality, compounded and manufactured specifically for producing LLDPE geomembrane.

11.4.6 Extrudate Rod or Bead shall be made from same resin as the geomembrane. Additives shall be thoroughly dispersed. The rods or beads shall be free of contamination by moisture or foreign matter.

11.4.7 All rolls of Engineered Turf delivered to the site shall be inspected for the following:

11.4.8 The Engineered Turf is wrapped in rolls with protective covering.

11.4.9 The rolls are not damaged during unloading.

11.4.10 Protect the Engineered Turf from mud, soil, dirt, dust, debris, cutting, or impact forces.

11.4.11 Each roll must be marked or tagged with proper, original, manufacturer - applied identification.

11.4.12 Separate damaged rolls from undamaged rolls and store at locations designated by the Purchaser until proper disposition of material is determined by the Purchaser.

11.4.13 The Purchaser will be the final authority regarding damage.

11.4.14 Separate rolls without proper documentation and store until the Purchaser's Representative approval is received.

11.4.15 The materials shall be stored in space allocated by the Purchaser.

11.4.16 The materials shall be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

11.4.17 The materials shall be stored on level prepared surface (not on wooden pallets).

11.4.18 The materials shall be stacked per Manufacturer's recommendation but no more than three rolls high for geomembrane and geocomposite, and no more than five rolls for ClosureTurf®. Other height restrictions may apply based on site specific safety requirements.

11.4.19 Appropriate handling equipment shall be used to load, move or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader and roll bars for deployment. Dragging panels on ground surface will not be permitted.

11.4.20 The Installer is responsible for storage, and transporting material from storage area to installation area.

11.4.21 Damaged geomembrane will be documented by the Purchaser's Representative.

11.4.22 Damaged geomembrane may be repaired, if approved by the Purchaser's Representative, in accordance with these Specifications or shall be replaced at no additional cost to the Owner.

**TABLE 1 - STRUCTURED LLDPE GEOMEMBRANE - 50 MIL Super GripNet by Agru America**

| Property | Frequency | Test Method | Minimum Average Value |
|---|---|---|---|
| Raw Materials: | | | |
| Density | Once per 200,000 lbs of resin | ASTM D 1505<br>ASTM D 792 | Max. 0.939 g/cc |
| Melt Index | Once per 200,000 lbs resin | ASTM D 1238,190˚C, 2.16kg | ≤ 1.0 g/10 min. |
| Oxidative Induction Time (OIT) | Once per 200,000 lbs resin | | |
| Standard OIT | | ASTM D 3895 | 100 min. (min. avg.) |
| Or | | | |
| High Pressure OIT | | ASTM D 5885 | 400 min. (min. avg.) |
| Thickness | per roll | ASTM D 5994 | |
| Minimum Average | | | 50 mils |
| Lowest individual of 8 of 10 readings | | | 45 mils |
| Drainage Stud Height (min. avg) | Every Second Roll | ASTM D7466[2] | 130 mil |
| Friction Spike Height (min. avg) | Every Second Roll | ASTM D7466[2] | 175 mil |
| Density | Once per 200,000 lbs of resin | ASTM D 792B | Max. 0.939 g/cc |
| Tensile Properties (avg. both directions) (min. avg) | 20,000 lbs. | ASTM D 6693, Type IV | |
| Yield Strength | | 2 in/min | N/A |
| Break Strength | | | 105 lb/in |
| Yield Elongation | | | N/A |
| Break Elongation | | | 300 % |
| Tear Resistance | 45,000 lbs | ASTM D 1004 | 30 lb (min. avg.) |
| Puncture Resistance | 45,000 lbs | ASTM D 4833 | 55 lb (min. avg.) |
| 2% Modulus lb/in (max) | Per formulation | D5323 | 3000 (max) |
| Axi-Symmetric Break Resistance Strain - % (min.) | Per formulation | D5617 | 30 |
| Carbon Black Content | 20,000 lbs. | ASTM D 4218 | 2.0 % - 3.0 % |
| Carbon Black Dispersion | 45,000 lbs. | ASTM D 5596 | Only near spherical agglomerates:<br>10 views Cat. 1 or 2 No more than one (1) view from Category 3. |
| Oxidative Induction Time (OIT)<br>Standard OIT, minutes | 200,000 lbs | ASTM D 3895, 200˚C, 1 atm $0_2$ | ≥140 min. |
| Oven Aging @ 85ºC<br>High Pressure OIT (min. avg.) - % retained after 90 days | Per Each Formulation | ASTM D5721<br>ASTM D5885, 150˚C, 500psi $0_2$ | 60% |
| UV Resistance<br>High Pressure OIT - % retained after 1600 hours | Per Each Formulation | ASTM D7238<br>ASTM D5885, 150˚C, 500psi $0_2$ | (20hr. cycle @ 75˚C/4hr. condensation @60˚)<br>35% |

1. Reference GRI GM17 & LLDPE Super Gripnet Liner Product Data Sheet, Agru America.
2. Even though ASTM D7466 is specific to textured geomembrane, this method is still applicable for SuperGrip materials.

| **TABLE 2 - ENGINEERED TURF COMPONENT** | | | |
|---|---|---|---|
| Property | Frequency | Test Method | Minimum Average Value |
| CBR Puncture | Once per 150,000 sf | ASTM D 6241 | 800 lbs (MARV) |
| Tensile Product (MD/XD) | Once per 150,000 sf | ASTM D 4595 | 1000 lb/ft min. (MARV) |
| Rainfall Induced Erosion | N/A | ASTM D 6459 | <0.45% Infill Loss 6 in/hr |
| Aerodynamic Evaluation | N/A | GTRI Wind Tunnel | 120 mph with max. uplift of 0.12 psf |
| Turf Fiber UV Stability | N/A | ASTM G147 | >60% retained tensile strength @ 100 yrs (projected) |
| Backing system UV Stability (Exposed) | N/A | ASTM G154 Modified Cycle 1, UVA340 | 110 lb/ft retained tensile strength @ 6500 hrs (projected) |
| Steady State Hydraulic Overtopping (ClosureTurf® with HydroBinder$^{TM}$) | N/A | ASTM D7277<br>ASTM D7276 | 5 ft overtopping resulting in 29 fps velocity & 8.8 psf shear stress for Manning N Value of 0.02 |
| Full Scale Wave Overtopping Test – Cumulative Volume (ClosureTurf® with HydroBinder™) | N/A | CSU Wave Simulator | 165,000 ft$^3$/ft |
| Full Scale Wave Overtopping Test – Max. Avg. Wave Overtopping Discharge (ClosureTurf® w/ HydroBinderTM) | | CSU Wave Simulator | 4.0 ft$^3$/s/ft |
| Transmissivity w/ underlying structured geomembrane, Normal Stress @ 50 psf & 0.33m$^2$/sec | NA | ASTM D4716 | 2.5 x 10$^{-3}$ m$^2$/sec, min. |
| Internal Friction of combined components | N/A | ASTM D5321 | 35˚, min. |
| | | | |

| **TABLE 3 - ENGINEERED TURF INFILL & BALLAST SAND** | |
|---|---|
| ASTM C33 | |
| Sieve | Percent Passing |
| 3/8 in. (9.5mm) | 100 |
| No. 4 (4.75 mm) | 95 – 100 |
| No. 8 (2.36 mm) | 80 – 100 |
| No. 16 (1.18 mm) | 50 – 85 |
| No. 30 (600 µm) | 25 – 60 |
| No. 50 (300 µm) | 5 – 30 |
| No. 100 (150 µm) | 0 - 10 |

| TABLE 4 – ArmorFill$^{TM}$ POLYMER EMULSION | |
|---|---|
| Product | Full Strength Emulsion (260-gallon tote typical) |
| Mix | 6 parts water to 1 part ArmorFill Polymer Emulsion |

| TABLE 5 – ENGINEERED TURF HydroBinder$^{TM}$ INFILL & BALLAST | |
|---|---|
| Product | 80 lb. bags or 3000 lb. bulk super sacks |
| Cement | Portland Cement Brand meeting ASTM C150, Type I or II. Only one brand used throughout project. |
| Cementitious Infill Mix | ASTM C387 for high strength mortars. Min. 28 day compressive strength of 5000 psi for the batched material as supplied (see Spec Section 12.17.16 for testing requirements) |

## 11.5 Equipment

11.5.1 Heavy vehicles shall not be permitted to operate directly on the liner material. Rubber-tired ATV's and flat-track skid steers are acceptable if wheel contact (ground pressure) is less than 6 psi.

11.5.2 In areas of heavy traffic, the geomembrane shall be protected by placing protective cover, with a minimum thickness of 3 feet, over the geomembrane.

11.5.3 If the geomembrane is damaged by vehicular traffic, it shall be replaced at the Contractor's expense.

11.5.4 Equipment on the geomembrane shall meet the specifications of Table 6 contained in Section 11.13.

## 11.6 Geomembrane Installation

11.6.1 The geomembrane shall be packaged and shipped by appropriate means to ensure that no damage is incurred. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, solvents, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. Stacking of the rolls is allowed following manufacturer's recommendations.

11.6.2 The manufacturer assumes responsibility for initial loading the geomembrane. Off-loading and storage of the materials shall be the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Purchaser. No off-loading shall be done unless monitored by the Purchaser's Representative. Damage occurring during off-loading shall be documented by the Purchaser and the Contractor. The Purchaser shall be the final authority on determination of damage.

11.6.3 The installation of the geomembrane shall be in accordance with the manufacturer's recommendations and these Specifications. The Contractor shall submit a panel layout drawing and a detailed, written installation procedure for the Purchaser's review fourteen days prior to installation.

11.6.4 All seam and non-seam areas of the geomembrane shall be inspected by the CQC Inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

11.6.5 The anchor trench shall be excavated to the lines, grades, and widths shown on the project construction drawings, prior to liner system placement. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the geomembrane.

11.6.6 The Contractor is responsible for ensuring that the geomembrane is handled and installed in such a manner that it is not damaged.

11.6.7 The geomembrane shall not be deployed during precipitation, in the presence of excessive moisture, in areas of ponded water, in the presence of excessive winds, or in excessive heat or cold.

11.6.8 Each panel shall be marked with an "identification code" (number or letter) consistent with the layout plan. The identification code shall be simple and logical. Markings shall not be used that permanently alter the line, such as stampings, weld marks, hydrocarbon marks, etc. The number of panels deployed in one day shall be limited by the number of panels which can be seamed on the same day. All deployed panels shall be seamed to adjacent panels by the end of each day.

11.6.9 The rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the Purchaser's Representative. The equipment shall not damage the geomembrane by handling, trafficking, leakage of hydrocarbons, deployment or other means. The placement shall be observed by the CQC Inspector and the Purchaser's Representative.

11.6.10 The Contractor shall inspect the subgrade preparation prior to liner installation. The subgrade shall be compacted in accordance with the Specifications. Weak or compressible areas which cannot be satisfactorily compacted should be removed and replaced with appropriate and properly compacted material. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than one-half inch in diameter, or debris of any kind. The subgrade shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. The surface shall contain no rutting, cracks or tire tracks exceeding ¼ inch in depth. Standing water or excessive moisture shall not be allowed.

11.6.11 The Contractor, on a daily basis, shall approve the surface on which the geomembrane will be installed. After the supporting soil surface has been approved, it shall be the Contractor's responsibility to indicate to the Purchaser any changes to its condition that may require repair work.

11.6.12 The Contractor shall submit written Certificates of Subgrade Acceptance, signed by the Contractor, CQC Inspector, and Purchaser's Representative, for each area prepared for geomembrane installation. This shall be done prior to commencing work.

11.6.13 Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

11.6.14 Personnel working on the geomembrane shall not smoke or wear damaging shoes.

11.6.15 The method used to unroll the panels shall not cause scratches, crimps, or creases in the geomembrane.

11.6.16 Unroll panels with the spike down and the stud side up for the structured geomembrane to assure that the deployment method protects the geomembrane from scratches and crimps and protects soil surface.

11.6.17 Unroll panels with adequate tension to prevent undulations or wrinkles when placed on the ground. The spike side down prevents easy movement of the panel. Individual panels placed with more than 5 undulations greater than 2 inches in height shall be deployed again.

11.6.18 Use a method to minimize wrinkles, especially differential wrinkles between adjacent panels.

11.6.19 Place adequate hold-downs to prevent uplift by wind. Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

11.6.20 Protect geomembrane in heavy traffic areas by geotextile, extra geomembrane or other suitable materials.

11.6.21 Do not allow vehicular traffic on unprotected geomembrane surface.

11.6.22 Panels deployed on grades steeper than 12% shall extend a minimum of 5 feet beyond the crest or toe of that grade with no cross seams. Cross seams may be allowed by following the guidelines in Section 11.7.3.

11.6.23 Visually inspect sheet surface during unrolling of geomembrane and mark faulty or suspect areas for repair or test. Replace faulty (requires more than one patch per 200 square feet) geomembrane stock at no additional cost to the Owner.

11.6.24 Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F. Placement can proceed below 32° F only after it has been verified by the CQC Inspector that the material can be seamed according to the Specification. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the installation supervisor.

11.6.25 After panel deployment and before welding, any horizontal wrinkles must be walked down or wiggled down the slope to minimize wrinkles after welding.

11.6.26 Limit maximum wrinkle height to 4 inches during warmer ambient temperatures and 2 to 3 inches in cooler temperatures.

11.6.27 Geomembrane wrinkles shall not be folded over.

11.6.28 After each panel welding, the sheet should be hand pulled in order to avoid the formation of ridging along the seams (snapping).

11.6.29 Physically remove wrinkles by walking them or by pretension pulling on the sheet after welding each panel.

## 11.7 Geomembrane Field Seaming

11.7.1 Field seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit a copy of the proposed seaming procedures (both fusion and extrusion welding, including preparation procedures), prior to commencement of seaming, for the Purchaser's review and approval.

11.7.2 Remove studs and spikes from the structured geomembrane at butt weld locations. During the stud/spike removal operation, do not reduce the thickness of the barrier section of the geomembrane to less than the minimum thickness listed in Section 11.4.

11.7.3 The only approved seaming processes are fusion and extrusion welding. On side slopes, seams shall be oriented in the general direction of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized. Cross seams will be allowed on slopes provided that cross seams are cut at 45º and adjacent cross seams are staggered. Cross seams shall be kept to the lower half of the slope. No more than one cross seam will be allowed per panel slope length.

11.7.4 No seam of any kind shall be closer than 5 feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a fishmouth or wrinkle is found, it shall be relieved and cap-stripped.

11.7.5 Geomembrane panels must have a finished minimum overlap of 4 inches for fusion welding and 6 inches for extrusion welding.

11.7.6 Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

11.7.7 Generators used to power welding/grinding apparatus shall be placed on a rub sheet and/or in a HDPE tub to prevent damages caused by vibrations/equipment leaks and to protect the liner during refueling of these generators.

11.7.8 The Installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing for extrusion welds or Air Pressure Testing for double fusion seams. In areas where vacuum box testing is not applicable, spark testing shall be used (i.e. around pipes).

11.7.9 Where flumes exit down the slope, provide a full panel width parallel to the flow line, avoiding seams along the bottom of the flume. If flume width is too wide for a full panel, seams shall be placed on the interior flume slope, above the flow line.

## 11.8 Geomembrane Field Trial Seams

11.8.1 Field trial seams shall be made in accordance with the manufacturer's recommendations and these Specifications. The Contractor shall submit a copy of the proposed testing procedures for the Purchaser's review and approval.

11.8.2 Field trial seams shall be conducted, per seaming apparatus and per seamer, on the liner to verify that seaming conditions are satisfactory. Trial seams shall be conducted at the beginning of each seaming period, at least once every four hours for each seaming apparatus and personnel used that day. Additional field trial seams may be requested by and at the discretion of the Purchaser's Representative.

11.8.3 All trial seams shall be made in contact with the subgrade. Welding rod used for extrusion welding shall have the same properties as the resin used to manufacture the geomembrane.

11.8.4 Field trial seaming shall be conducted under the same ambient temperature and preheating conditions as the production seams.

11.8.5 Field trial seams shall be destructively tested in accordance with section 11.9.

## 11.9 Geomembrane Destructive Seam Testing for Fusion and Extrusion Seaming

11.9.1 Destructive seam testing should be minimized to preserve the integrity of the liner. The Contractor shall take one (1) destructive test sample once per 500 cumulative feet of seam length, per fusion welding device, from a location specified by the CQC Inspector. This frequency applies to extrusion seams as well. If the amount of extrusion seaming is < 500 feet then a minimum of one (1) extrusion destructive test shall be performed.

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

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

11.9.4 The Installer shall test ten one-inch wide specimens from his sample; five specimens for shear strength and five for peel strength. The CQC Inspector shall submit samples to an independent laboratory for confirmation testing. Seam test results shall be evaluated using the current GRI Test Method GM19 which allows for four of five specimens meeting the required seam strength and the fifth specimen meeting 80% of the required strength. Additionally, peel separation shall not exceed 25%.

11.9.5 Seams shall be tested according to the following methodology:

| **Property** | **Test Method** | **Minimum Average Value** |
|---|---|---|
| Seam Properties | ASTM D 6392 | |
| 1. Shear Strength | GM19 | 75 lb/in |
| 2. Peel Strength | | |
| • Hot Wedge | | 63 lb/in |
| • Extrusion Fillet | | 57 lb/in |

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

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

a) The installer shall cap strip the seam between the failed location and any passed test locations.

b) The installer shall retrace the welding path to a location (initially a minimum of 10 feet on each side of the failed seam location) to identify and isolate the failed seam in both previous and next direction of failed destructive, by taking two new samples, one from each direction. If these tests pass, then the seam shall be cap stripped between the passing tests. If the test fails, then the process is repeated.

c) Over the length of seam failure, the installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip.

d) All seams and non-seam areas of the geomembrane shall be inspected by the inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

e) Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the inspector. Each location that fails the non-destructive testing shall be marked by the inspector and repaired accordingly.

## 11.10 Geomembrane Repair Procedures

11.10.1 The geomembrane will be inspected before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be swept or washed by the Installer if surface contamination inhibits inspection. The Installer shall ensure that an inspection of the geomembrane precedes any seaming of that section.

11.10.2 Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

11.10.3 Repair, removal and replacement shall be at the Installers expense if the damage results from the Installer’s activities.

11.10.4 Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. The Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the Purchaser’s Representative and the Installer.

11.10.5 The following repair procedures shall apply:

a) Defective seams shall be cap stripped or replaced.

b) All holes of any size shall be patched.

c) Tears shall be repaired by patching. If the tear is on a slope or an area susceptible to stress and has a sharp end it must be rounded prior to patching.

d) Blisters, large cuts and undispersed raw materials shall be repaired by patches.

e) Patches shall be completed by extrusion welding. The weld area shall be ground no more than 10 minutes prior to welding. No more than 10% of the thickness shall be removed by grinding. Welding shall commence where the grinding started and must overlap the previous seam by at least two inches.

Reseaming over an existing seam without regrinding shall not be permitted. The welding shall restart by grinding the existing seam and rewelding a new seam.

f) Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of six (6) inches beyond the edge of defects.

g) All T's and intersections shall be patched. Welding the excess overlap is not permitted.

h) Geomembrane surfaces to be repaired shall be abraded (extrusion welds only) no more than 1/2 hour prior to the repair.

i) All geomembrane surfaces shall be clean and dry at the time of repair.

j) The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the Owner's Representative.

k) Extend patches or caps at least 6 inches beyond the edge of the defect, i.e., be a minimum of 12 inches in diameter, and round all corners of material to be patched.

l) Bevel the edge of the patch and do not cut patch with repair sheet in contact with geomembrane. Temporarily bond the patch to the geomembrane with an approved method, extrusion weld the patch and then vacuum test the repair.

## 11.11 Verification of Repairs

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

11.11.2 The inspector shall keep daily documentation of all non-destructive and destructive testing. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested. (i.e., Test 1 followed by Test 1R1).

## 11.12 Engineered Turf Deployment

11.12.1 After geomembrane installation, including required documentation, has been completed, the geomembrane surface shall be cleared of all significant deposits of stones, soil and debris that could damage the geomembrane or impede the hydraulic function between the stud side of the structured geomembrane and the Engineered Turf component. Any soil or debris washed down to the toe of slope during cleaning procedures shall be physically removed from the geomembrane surface without damage to the geomembrane. No turf shall be deployed until the geomembrane has been inspected and approved in writing by the Contractor's QC Inspector and the Purchaser.

11.12.2 The Engineered Turf shall be deployed without damage to the geotextile component and minimal loss of the synthetic grass component. Deployment equipment shall not damage the Engineered Turf geotextile, cause synthetic grass loss, or damage underlying geomembrane by handling, trafficking, leakage of hydrocarbons, or by other means.

11.12.3 The Engineered Turf shall be deployed smooth and free of tension, stress, folds, wrinkles, creases, and free of contaminants such as soil, grease, fuel, etc.

11.12.4 The Engineered Turf shall be deployed with the synthetic grass blades pointing towards the top of the slope on sideslopes greater than 12%. In ditches, the orientation requirement of the grass blades shall not apply.

11.12.5 Engineered Turf shall be secured with sand bag anchoring at the top of the slope and then rolled down the slope.

11.12.6 Seaming operations shall be performed using a 4-inch overlap and fastened with heavy-duty textile stitching machine. A prayer type seam is to be constructed using a Nulong sewing machine or equivalent. Stitching operations shall be performed such that the woven geotextiles are not exposed. Sewing shall occur between the 1st and 2nd row of stiches to avoid exposure of the black geotextile after flipping the panel.

11.12.7 After seaming operations, the ends of the Engineered Turf panels shall be permanently anchored in the perimeter and bench roadways.

11.12.8 Construction equipment on the deployed Engineered Turf shall be minimized to reduce the potential for geosynthetic material puncture. Equipment travel on exposed structured geomembrane is prohibited. Small equipment such as generators shall be placed on scrap geomembrane material (rub sheets) above geosynthetic materials in the ClosureTurf® Final Cover System.

11.12.9 Seams shall be at least 5 feet away from stress points such as the crest of slopes greater than 12%. Where possible, seams shall be made only across ditch and swale cross-sections with minimal seam intersections. When seams are necessary along flow lines, a full panel width shall be placed along the bottom of the ditch with seams above the flow line., avoiding seams along the bottom of the ditch. If ditch width is too wide for a full panel, seams shall be placed in the interior ditch slope above the flow line.

11.12.10 Engineering turf shall be protected against dust and dirt accumulation prior to infill placement. Contractor shall ensure clean engineering turf prior to installation of infill. No infill materials shall be deployed until the engineered turf has been inspected and approved in writing by the Contractor's QC Inspector and the Purchaser.

## 11.13 Equipment on Engineered Turf

11.13.1 Equipment utilized for ballast sand and ArmorFill™/HydroBinder™ applications on top of the engineered turf alone and slopes flatter than 15% shall be limited to light rubber-tired, flat-track skid steer or padded track equipment with a maximum ground pressure less than 6 psi. No equipment at all is allowed on top of the engineered turf alone with slopes exceeding 15%.

11.13.2 Post sand ballast and ArmorFill™/HydroBinder™ deployment, drivability ground pressures for the top deck and/or slopes less than 15% shall be limited to 15 psi. Post sand ballast and ArmorFill™/HydroBinder™ deployment drivability ground pressures for slopes greater than 15% shall be limited to 6 psi. Post sand ballast is defined as a sand infill of a minimum of ½ inches in thickness. A ground pressure of 35 psi is acceptable only for stationary type equipment such as the CAS AT7 sand/rock slinger to be used for deployment of sand ballast/ArmorFill™/HydroBinder™ on the top deck as well as on slopes. If this or similar equipment is used, it shall be moved unloaded. A minimum of 2 inches of additional ballast sand is required under the stationary equipment to protect the underlying engineered turf. The table below includes all acceptable equipment, ground pressures, and tire pressures.

11.13.3 It is preferable to deploy the sand and/or ArmorFill$^{TM}$/HydroBinder$^{TM}$ horizontal to the slope and not straight up and down. In cases where the equipment is required to go up and down the slope, it shall traverse the slope at a 45 degree angle.

11.13.4 No equipment will be left running and unattended over the constructed geosynthetics. For areas of frequent or heavy traffic, thicker infill may be required as specified on the drawings or as directed by Purchaser’s Representative.

11.13.5 Equipment operators shall inspect equipment rubber tires or tracks for sharp protrusions from foreign matter or tire/track damage, embedded rocks, or other foreign materials protruding from tires/track and remove such protrusions and foreign matter prior to driving on the geomembrane or Engineered Turf. Equipment travel paths driven on geomembrane and Engineered Turf shall be as straight as possible with no sharp turns, sudden stops or quick starts.

11.13.6 Table 6 below includes all acceptable equipment, tire pressures, and ground pressures. The Contractor shall provide to Purchaser a list of all proposed equipment with determined ground pressures and tire pressures 14 days prior to the start of engineered turf installation.

## TABLE 6 – ALLOWABLE EQUIPMENT, GROUND PRESSURES AND TIRE PRESSURES FOR OPERATION ON INSTALLED ClosureTurf® COMPONENTS

| **Component** | **Allowable Equipment** | **Allowable Ground Pressure (PSI)** | **Allowable Tire Pressure (PSI)** | **Remarks** |
|---|---|---|---|---|
| LLDPE (All Locations) | Light Rubber tired ATV’s, flat-track skid steer | < 6 psi | NA | No sharp turns or sudden stops. Maintain slower speeds. |
| Turf only (slopes exceeding 15%) | No equipment | - | - | - |
| Turf only (slopes flatter than 15%) | Light Rubber tired ATV’s, flat-track skid steer or padded tracked equipment (continuous flat surface) | < 6 psi | < 30 psi | No sharp turns or sudden stops. Maintain slower speeds. |
| Turf with min. sand infill requirement (1/2”) (post construction) (slopes flatter than 15%) | Light Rubber tired ATV’s, rubber tired tractors, skid steer | <15 psi | 30 to 60 psi based on slope angle, up to 80 psi based on subgrade and Eng. of Record approval | No sharp turns or sudden stops. Maintain slower speeds. |
| Turf with min. sand infill requirement (1/2”) (post construction) (slopes exceeding 15%) | Light Rubber tired ATV’s or skid steer | < 6 psi | 30 to 60 psi based on slope angle, up to 80 psi based on subgrade and Eng. of Record approval | Deployment shall be horizontal to the slope and not straight up and down. In cases where equipment shall traverse the slope, they shall travel at a 45 degree angle. No sharp turns or sudden stops. Maintain slower speeds. |
| Turf with min. sand infill requirement (1/2”) (post construction) (slopes flatter than 15%) | CAS AT7 sand/rock slinger (or equivalent type) | <35 psi | 30 to 60 psi, preferably on the lower side while stationary | Equipment shall be stationary and additional sand ballast (2-inch min.) shall be built up under the equipment to provide additional protection to the underlying liner. Equipment is intended to be stationary. Upon relocating equipment, it shall be moved unloaded. |

## 11.14 Engineered Turf Repair Procedure

11.14.1 All Turf repairs will be completed by using a heat bonded seam. This can be accomplished by using a hand held leister or a Varimat V2 leistering machine.

11.14.2 All seams with considerable length should use the Varimat V2 leistering machine. This gives consistent pressure (77 lbs) throughout the seam. Seam strength is a combination between weight and temperature. The temperature of the Varimat V2 leistering machine should be discussed prior to use because temperature control is a variable that can be increased/decreased depending on weather conditions.

11.14.3 A hand held leister should be used in smaller/concentrated areas. This may include areas around well heads or patches where Turf was cut.

## 11.15 Sand Ballast Infill

11.15.1 The sand layer will be a minimum ½-inch thick, but not greater than ¾-inches thick, and shall be worked into the Engineered Turf layer as in-fill between the synthetic yarn blades. The physical characteristics of the sand layer will be evaluated through visual observation (and laboratory testing if deemed necessary by the CQC Inspector) before construction and visual observation during construction. Additional testing during construction will be at the discretion of the CQC Inspector.

11.15.2 The sand may be spread using low ground pressure equipment and a pull-behind spreader bar following guidelines provided in Section 11.13. Rotary brush equipment may be used to evenly distribute the sand infill into the synthetic grass matrix. The sand spreading operation shall be done in front of deployment equipment travel to improve the bearing capacity of the cover system below. Use of rotary brush equipment shall be performed in a manner that does not result in removal of the synthetic grass blades from the underlying woven geotextile.

11.15.3 Conveyor systems and or blower equipment may be used to spread and place the sand in-fill on slopes too steep for equipment contact. These deployment systems shall not be used during wind speed conditions higher than 15 miles per hour. Dust generation may be mitigated by maintaining the sand infill at a moisture content sufficient to control dust but not impede the placement operation.

11.15.4 Contractor shall explain in detail in the pre-construction meeting the method of sand deployment to be used. The method shall be approved by the Purchaser. For slopes steeper than 3H:1V the sand infill shall be placed using long reach conveyors belts or using water or air express blower methods. The sand layer may be placed using any appropriate equipment capable of completing the work and should only receive minimal compaction required for stability.

11.15.5 Sand ballast infill shall completely cover the double-layer woven geotextile of the Engineered Turf component. Areas of exposed geotextile or thin layering of sand ballast unsatisfactory to the requirements of Section 11.4, Table 3, shall receive additional sand ballast. If the cause of poor sand ballast placement and resulting geotextile exposure is wrinkles in the underlying structure geomembrane, the Engineered Turf component shall be pulled back from the geomembrane component, the geomembrane wrinkle removed and the geomembrane shall repaired per the requirements in these specifications. The Engineered Turf shall be re-deployed and ballasted with sand infill satisfactory to the requirements of this section and Section 11.4, Table 3.

11.15.6 The CQC Inspector shall verify that a minimum thickness of ½ inch of sand is placed on the Turf. Frequency will be 20 measurements per acre of final cover installed.

11.15.7 The Contractor shall provide to the Purchaser the grain size distribution, from the source of the sand infill/ballast, for every 250 cy of material or more frequent if requested by the purchaser.

## 11.16 ArmorFill™ Application

11.16.1 ArmorFill™ is a proprietary polymer-based product developed by Watershed Geosynthetics specifically to bind the ASTM-C33 sand infill component of the ClosureTurf® system for long-term performance applications.

11.16.2 Application of ArmorFill™ will be performed by an installer certified by Watershed Geosynthetics.

11.16.3 To obtain the proper ratio, mix ArmorFill™ at a rate of 6 parts water to 1 part ArmorFill™ by volume (Section 11.4, Table 4).

11.16.4 Apply ArmorFill™ under dry weather conditions and when precipitation is not expected for at least 24 hours after installation.

11.16.5 Apply ArmorFill™ on a previously installed ClosureTurf® system that is free of leaves and other material that may inhibit the penetration of the ArmorFill™ into the sand component.

11.16.6 Apply ArmorFill™ only after approval of the finished ClosureTurf® product installation.

11.16.7 Mix in a hydraulic conveyance system such as a hydro seeding device that contains a mechanical agitator/auger type mixer that is sized appropriately for the project. (Example: Finn T-Series Hydro Seeder or equivalent).

11.16.8 Place water into tank before mixing ArmorFill™ .

11.16.9 Fully agitate the ArmorFill™ throughout the application process.

11.16.10 ArmorFill™ application equipment will have a 2-inch diameter hose with a spray adjustment nozzle and cut off function in the nozzle head.

11.16.11 Reduce the number of equipment set-ups required and take care with the application hose so as previously applied ArmorFill™ is not displaced by dragging.

11.16.12 Spray product evenly.

11.16.13 Apply ArmorFill™ at a rate of approximately 2,600 gallons of the mix per acre.

11.16.14 All waste products will be disposed of in accordance with site regulations and as approved by Purchaser.

11.16.15 Do not apply ArmorFill™ in inclement weather or in freezing temperatures. Inclement weather shall mean the existence of rain or lightening, or abnormal climatic conditions (whether they be those of hail, snow, cold, high wind, extreme high temperature or the like or any combination thereof) by virtue of which it is either not reasonable or not safe for employees exposed to continue working.

11.16.16 Avoid unnecessary foot traffic on the applied product for 24 hours.

11.16.17 No vehicle traffic is allowed on the applied product for 7 calendar days.

## 11.17 HydroBinder$^{TM}$ Infill Installation

11.17.1 Installation of the HydroBinder$^{TM}$ infill for the engineered turf shall be performed by a licensed installer.

11.17.2 The HydroBinder$^{TM}$ infill layer shall be have a minimum thickness of ¾ inch, but not greater than 1 inch, in dry thickness. The desired thickness will be achieved prior to the hydration process. At grade breaks and drainage benches, the thickness of the HydroBinder$^{TM}$ shall be increased as specified on the drawings or as directed by Purchaser's Representative.

11.17.3 Weep holes may be required at downchutes and other locations for draining the internal drainage layer through the engineered turf. Remove the HydroBinder$^{TM}$ in the areas of the weep holes prior to hydration or block the weep hole locations prior to infilling. Blocks may consist of pipe, dowels, etc. If weep holes are required, weep hole diameters shall be 1 inch and be installed along the toe of the slope at intervals designated by the Purchaser. In addition, drainage relief may be required in perimeter ditch locations utilizing drainage windows. At specified intervals and locations, the engineered turf will be shingled in the direction of flow with a small section of the HydroBinder$^{TM}$ removed therefore draining the internal drainage layer through the engineered turf. The Purchaser and/or Purchaser's Representative will provide weep hole and drainage window locations and details based on the manufacturer's recommendations.

11.17.4 The HydroBinder$^{TM}$ infill shall be installed into the engineered turf while it is in a dry state. The engineered turf shall be dry. If the engineered turf is wet from rain or dew, the installer shall wait until it is dry. The installer may attempt to speed up the drying process by using a blower. In addition, the infill shall not be installed in inclement, wet or rainy weather, or the threat of inclement weather. Also, the infill shall not be installed in freezing temperatures. If HydroBinder$^{TM}$ is exposed to construction traffic or inclement weather within 48 hours, those areas shall be inspected by Contractor's QC and Purchaser, and if evaluated to be damaged shall be replaced.

11.17.5 The infill shall be worked into the engineered turf layer between the synthetic yarn blades so that the tuffs are in an upright position. The physical characteristics of the infill layer will be evaluated through visual observation before construction and visual observation during construction. Additional testing during construction will be at the discretion of the CQC Inspector.

11.17.6 The hydration process must occur the day of the infill placement.

11.17.7 Personnel access on the engineered turf shall be prohibited for 48 hours following the hydration of the HydroBinder$^{TM}$.

11.17.8 The infill shall be thoroughly hydrated; however, care must be taken to avoid displacement of the non-hydrated infill. The Installer shall not overhydrate the infill so that water begins to run-off and cause erosion of the cement infill. The objective is to soak the area to start the hydration process but not to inundate with water beyond saturation.

11.17.9 Once hydration is completed as described, backfill and compaction of the anchor trenches should take place.

11.17.10 The HydroBinder$^{TM}$ infill may be spread using low ground pressure equipment and a pull-behind spreader bar. Rotary brush equipment may be used to evenly distribute the infill into the synthetic grass matrix. The infill spreading operation shall be done in front of deployment equipment travel to improve the bearing capacity of the cover system below. Use of rotary brush equipment shall be performed in a manner that does not result in removal of the synthetic grass blades from the underlying woven geotextile. In addition, hand spreading and rakes maybe be used to spread the infill material. If rakes are used, only plastic rakes or flexible, pronged metal rakes shall be allowed.

11.17.11 Conveyor systems and or blower equipment may be used to spread and place the infill on slopes too steep for equipment contact. These deployment systems shall not be used during wind speed conditions higher than 15 miles per hour. Dust generation may be mitigated by maintaining the infill at a moisture content sufficient to control dust but not impede the placement operation.

11.17.12 Contractor shall explain in detail in the pre-construction meeting the method of infill deployment to be used. The method shall be approved by the Purchaser. For slopes steeper than 3H:1V the infill shall be placed using long reach conveyors belts or using water or air express blower methods. The infill layer may be placed using any appropriate equipment capable of completing the work and should only receive minimal compaction required for stability.

11.17.13 HydroBinder$^{TM}$ infill shall completely cover the double-layer woven geotextile of the engineered turf component. Areas of exposed geotextile or thin layering of infill unsatisfactory to the requirements of this Section shall receive additional infill. If the cause of poor infill placement and resulting geotextile exposure is wrinkles in the underlying structure geomembrane, the engineered turf component shall be pulled back from the geomembrane component, the geomembrane wrinkle removed and the geomembrane repaired per the requirements of Section 12.10. The Engineered Turf shall be re-deployed and ballasted with infill satisfactory to the requirements of this Section and Section 11.4, Table 5.

11.17.14 For areas with exposed geotextile due to wrinkles and isolated small voids, a UV resistant coating shall be applied to the exposed area and additional infill material shall be applied immediately to the coating and hydrated. The UV coating product shall be manufactured by Quikrete (product #8640), Sakrete product (#60205006), or approved equivalent.

11.17.15 The QC Inspector shall verify that a minimum thickness of ¾ inch of infill (dry) is placed on the synthetic turf. Frequency shall be 1 test per 100 linear feet of ditch and 20 measurements per acre of final cover installed. Thickness measurements shall be taken using a caliper or equivalent device. CQC shall also inspect to confirm full hydration by excavating with a small tool into the infill.

The Contractor shall provide to the Purchaser the manufacturers certifications for the HydroBinder$^{TM}$ infill properties listed in Section 11.4, Table 5. One certification of compressive strength is required per batch of material.

## 11.18 HydroBinder$^{TM}$ Repair Procedures

11.18.1 Areas where the HydroBinder$^{TM}$ has cracked, crushed, or has voids shall be repaired according to the manufacturers specifications.

11.18.2 Affected areas shall be cleaned by removing the loose infill. Confirm that the Engineering Turf and underlying components are not damaged. If damage is observed, repair procedures for the specific component shall be followed as per Sections 11.10 and/or 11.17. The owner shall be notified of any damage prior to repair.

11.18.3 Cracks in the HydroBinder$^{TM}$ shall be sealed by applying concrete crack sealants such as Quikrete product #8640, Sakrete Product #60205006, or an approved equivalent.

11.18.4 For areas of concern that are larger than cracks, new HydroBinder$^{TM}$ infill shall be applied to the affected area. The infill material shall be applied dry to a minimum thickness of ¾ inch, or thicker for grade breaks, drainage benches, and traffic ways, and shall match the thickness of the intact HydroBinder$^{TM}$. Installation of the infill shall follow guidelines set forth in Section 11.17.

11.18.5 The area shall be raked or broomed to pull the engineered turf fibers up through the dry infill mix without causing damage to the existing geomembrane and Turf components, following guidelines in Section 11.17.10.

11.18.6 The CQC inspector shall keep daily documentation of all repairs. This documentation shall identify all repairs, areas, size, location, and procedures and include before and after photographs.

## 11.19 Anchor Trench

11.19.1 Avoid backfilling the anchor trenches until the synthetic grass and sand infill placement of the CLOSURETURF™ component has been completed. This will allow corrections in the field during the deployment of both the geomembrane and the synthetic grass component. Note that wrinkles will travel down the slopes and cannot be redistributed up slopes, so is important that both top and bottom anchor trenches remain open so that pulling adjustments can be made.

11.19.2 The geomembrane anchor trench shall be left open until seaming is completed.

11.19.3 Expansion and contraction of the geomembrane should be accounted for in the geomembrane placement. Prior to backfilling, the depth of penetration of the geomembrane into the anchor trench will be verified by the CQC Inspector at a minimum of 100 foot spacing along the anchor trench. The anchor trench should be filled in the morning when temperatures are coolest to reduce bridging of the geomembrane.

11.19.4 General fill material placed in anchor trenches will be placed in uniform lifts, which do not exceed 12 inches in loose thickness and are compacted. In-place moisture/density tests may be taken at the discretion of the CQC Inspector to evaluate the quality of the backfill. The test results will not be required as part of the final documentation. Slightly rounded corners will be provided in anchor trenches where the geomembrane enters the trench so as to avoid sharp bends in the geomembrane. No loose soil (e.g., excessive water content) will be allowed to underlie the anchored components of CLOSURE TURF™ Final Cover System.

11.19.5 The geomembrane and the Engineered Turf should cover the entire trench floor.

11.19.6 The anchor trench shall be backfilled with soil meeting the requirements of Structural fill as described in section 10.0 with the exception that the maximum particle size shall be limited to one - half (1/2) inch in the largest dimension.

11.19.7 Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane or Engineered Turf. If damage occurs, it shall be repaired prior to backfilling and at the Contractor's expense.

### 11.20 Geomembrane Acceptance

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

a) Installation is finished;
b) All submittals completed;
c) Verification of the adequacy of all field seams and repairs, including associated testing, is complete;
d) Receipt of approved, final panel layout drawing (as-builts);
e) Construction area cleaned;
f) Final field inspection completed (all punch list items from previous inspections shall be complete);
g) Sign-off of acceptance of the geomembrane has been made by the Purchaser;
h) Warranty signed over to Purchaser.

## 12.0 COMPOSITE COVER SYSTEM

### 12.1 General

12.1.1 For the Alternative 1 Final Cover System, the final gypsum subgrade of the Gypsum Pond shall be covered with a 40 mil textured LLDPE geomembrane overlain by a double sided geocomposite drainage layer with a minimum 18-inch protective soil cover. An erosion control layer consisting of a minimum of six inches of topsoil that will support vegetative growth shall be placed over the soil cover.

12.1.2 The LLDPE and drainage material shall be placed in accordance with these Specifications, the manufacturer's recommendations, and the details indicated on the Drawings.

### 12.2 Submittals

12.2.1 The Contractor shall provide to the Purchaser the Manufacturer's Quality Control

(CQC) Program and Manual, or descriptive documentation for manufacture of the geomembrane and geocomposite from the manufacturer.

12.2.2 The Contractor shall provide to the Purchaser, for review and approval, qualification statements from the GCL and geocomposite manufacturer, certified installer, and CQC Inspector documenting the minimum requirements of sections 12.3 and 12.11 of these Specifications.

12.2.3 The Contractor shall provide to Purchaser placement procedures and a panel layout for placement of the geomembrane and geocomposite panels over the area of installation fourteen days prior to the start of liner installation.

12.2.4 Upon each shipment, the Contractor shall furnish the geomembrane and geocomposite manufacturer's Quality Assurance/Quality Control (QA/QC) roll certifications, signed by a responsible party employed by the manufacturer, to verify that the materials supplied for the project are in accordance with the requirements of sections 12.4 and 12.13 this Specification. The certifications shall reference the lot and roll number as well as the manufacturer’s name and address.

12.2.5 As installation proceeds, the Contractor shall submit certificates of subgrade acceptance, signed by the Contractor, the CQC Inspector, and the Purchaser’s Representative for each area that is covered by the geomembrane.

12.2.6 After installation, the Contractor shall submit a certification, signed by the Contractor and signed and sealed by the CQC Firm’s Professional Engineer, that the geomembrane and geocomposite was placed in accordance with these Specifications.

12.2.7 The Contractor shall provide certification that all resin used in the manufacture of the geocomposite drainage geonet for this job meets the Specifications and provide a copy of the quality control certificates issued by the resin supplier.

## 12.3 Geomembrane Contractor Qualifications

12.3.1 The manufacturer of the geomembrane (LLDPE) must have produced at least ten million square feet of product, with at least eight million square feet installed.

12.3.2 The geomembrane installer must either have installed at least one million square feet of product or must provide to Alabama Power satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the geomembrane will be installed in a competent, professional manner.

12.3.3 The Contractor shall provide, a third-party inspector for construction quality control (CQC) of the geomembrane installation. The inspector shall be an individual or company who is independent from the manufacturer and installer and shall be responsible for monitoring and documenting activities related to the CQA of the geomembrane throughout installation. The inspector shall have provided CQC services for the installation of the proposed or similar products for at least five completed projects totaling not less than one million square feet. The inspector should be an engineer registered to practice in the State of Alabama or a geosynthetics installation technician certified through the Inspector Certification Program (ICP) administered by the Geosynthetics Certification Institute (GCI). The Contractor shall provide the Purchaser with a statement of the inspector's qualifications with the bid.

12.3.4 A Manufacturer’s Representative shall be on site during the initial phase of the geomembrane installation to provide assistance to the Contractor.

## 12.4 Geomembrane Material

12.4.1 The geomembrane shall be a 40 mil textured linear low density polyethylene (LLDPE) with a minimum 23 feet seamless width. There shall be no factory seams. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.
12.4.2 The geomembrane shall be manufactured of polyethylene resins and shall be compounded and manufactured specifically for the intended purpose. The Contractor shall submit a certification from the manufacturer of the geomembrane that the raw materials meet the physical property requirements indicated in the following table.
12.4.3 The surface of the geomembrane shall not have striations, roughness, pinholes, or bubbles and shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter except that, if in the opinion of the Purchaser’s Representative, the blemish will not adversely affect properties and use of the liner.
12.4.4 The geomembrane shall be supplied in rolls; folds will not be permitted. Identify each roll with labels indicating lot number, roll number, thickness, length, width, manufacturer, and plant location.
12.4.5 Resin shall be LLDPE, new, first quality, compounded and manufactured specifically for producing LLDPE geomembrane.
12.4.6 Extrudate Rod or Bead shall be made from same resin as the geomembrane. Additives shall be thoroughly dispersed. The rods or beads shall be free of contamination by moisture or foreign matter.
12.4.7 The materials shall be stored in space allocated by the Purchaser.
12.4.8 The materials shall be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.
12.4.9 The materials shall be stored on level prepared surface (not on wooden pallets).
12.4.10 The materials shall be stacked per Manufacturer's recommendation but no more than three rolls high.
12.4.11 Appropriate handling equipment shall be used to load, move or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader and roll bars for deployment. Dragging panels on ground surface will not be permitted.
12.4.12 The Installer is responsible for storage, and transporting material from storage area to installation area.
12.4.13 Damaged geomembrane will be documented by the Purchaser’s Representative.
12.4.14 Damaged geomembrane may be repaired, if approved by the Purchaser’s Representative, in accordance with these Specifications or shall be replaced at no additional cost to the Owner.
12.4.15 The geomembrane shall have the following properties:

| TEXTURED LLDPE GEOMEMBRANE - 40 MIL | | | |
|---|---|---|---|
| Property | Frequency | Test Method | Minimum Average Value |
| Density | Once per 200,000 lbs of resin | ASTM D 792 | Max. 0.939 g/cc |
| Melt Index | Once per 200,000 lbs of resin | ASTM D 1238,190˚C, 2.16kg | ≤ 1.0 g/10 min. |
| Oxidative Induction Time (OIT)<br>Standard OIT<br>Or<br>High Pressure OIT | Once per 200,000 lbs resin | ASTM D 3895<br>ASTM D 5885 | 100 min. (min. avg.)<br>400 min. (min. avg.) |
| Thickness:<br>Nominal<br>Minimum Average<br>Minimum 8 of 10<br>Lowest individual | per roll | ASTM D 5994 | <br>40 mil<br>38 mil<br>36 mil<br>34 mil |
| Asperity Height | Every 2nd Roll | ASTM D 7466<br>GRI GM12 | 20 mil |
| Tensile Properties (avg. both directions) (min. avg)<br>Break Strength<br>Break Elongation | 20,000 lbs. | ASTM D 6693, Type IV | <br>112 lb/in<br>400 % |
| Tear Resistance | 45,000 lbs | ASTM D 1004 | 25 lb (min. avg.) |
| Puncture Resistance | 45,000 lbs | ASTM D 4833 | 50 lb (min. avg.) |
| 2% Modulus lb/in (max) | Per formulation | D5323 | 3000 (max) |
| Axi-Symmetric Break Resistance Strain - % (min.) | Per formulation | D5617 | 30 |
| Carbon Black Content | 20,000 lbs. | ASTM D 4218 | 2.0 % - 3.0 % |
| Carbon Black Dispersion[1] | 45,000 lbs. | ASTM D 5596 | See Note (1) |
| Oxidative Induction Time (OIT) Standard OIT, minutes | 200,000 lbs | ASTM D 3895, 200˚C, 1 atm $0_2$ | ≥140 min. |

**Notes:**

(1) Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than one (1) view from Category 3.

## 12.5 Equipment

12.5.1 Heavy vehicles shall not be permitted to operate directly on the liner material. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than six (6) psi.

12.5.2 In areas of heavy traffic, the geomembrane shall be protected by placing protective cover, with a minimum thickness of three (3) feet, over the geomembrane.

12.5.3 If the geomembrane is damaged by vehicular traffic, it shall be replaced at the Contractor's expense.

## 12.6 Geomembrane Installation

12.6.1 The geomembrane shall be packaged and shipped by appropriate means to ensure that no damage is incurred. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, solvents, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. Stacking of the rolls is allowed following manufacturer's recommendations.

12.6.2 The manufacturer assumes responsibility for initial loading the geomembrane. Off-loading and storage of the materials shall be the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Purchaser. No off-loading shall be done unless monitored by the Purchaser's Representative. Damage occurring during off-loading shall be documented by the Purchaser and the Contractor. The Purchaser shall be the final authority on determination of damage.

12.6.3 The installation of the geomembrane shall be in accordance with the manufacturer's recommendations and these Specifications. The Contractor shall submit a panel layout drawing and a detailed, written installation procedure for the Purchaser's review fourteen days prior to installation.

12.6.4 All seam and non-seam areas of the geomembrane shall be inspected by the CQC Inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

12.6.5 The anchor trench shall be excavated to the lines, grades, and widths shown on the project construction drawings, prior to liner system placement. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the geomembrane.

12.6.6 The Contractor is responsible for ensuring that the geomembrane is handled and installed in such a manner that it is not damaged.

12.6.7 The geomembrane shall not be deployed during precipitation, in the presence of excessive moisture, in areas of ponded water, in the presence of excessive winds, or in excessive heat or cold.

12.6.8 Each panel shall be marked with an "identification code" (number or letter) consistent with the layout plan. The identification code shall be simple and logical. Markings shall not be used that permanently alter the line, such as stampings, weld marks, hydrocarbon marks, etc. The number of panels deployed in one day shall be limited by the number of panels which can be seamed on the same day. All deployed panels shall be seamed to adjacent panels by the end of each day.

12.6.9 The rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the Purchaser's Representative. The equipment shall not damage the geomembrane by handling, trafficking, leakage of hydrocarbons, deployment or other means. The placement shall be observed by the CQC Inspector and the Purchaser's Representative.

12.6.10 The Contractor shall inspect the subgrade preparation prior to liner installation. The subgrade shall be compacted in accordance with the project specifications. Weak or compressible areas which cannot be satisfactorily compacted should be removed and replaced with properly compacted clay liner material. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than one-half inch in diameter, or debris of any kind. The subgrade shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. The surface shall contain no rutting, cracks or tire tracks. Standing water or excessive moisture shall not be allowed.

12.6.11 The Contractor, on a daily basis, shall approve the surface on which the geomembrane will be installed. After the supporting soil surface has been approved, it shall be the Contractor’s responsibility to indicate to the Purchaser any changes to its condition that may require repair work.

12.6.12 The Contractor shall submit written Certificates of Subgrade Acceptance, signed by the Contractor, CQC Inspector, and Purchaser’s Representative, for each area prepared for geomembrane installation. This shall be done prior to commencing work.

12.6.13 Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

12.6.14 Personnel working on the geomembrane shall not smoke or wear damaging shoes.

12.6.15 The method used to unroll the panels shall not cause scratches, crimps, or creases in the geomembrane.

12.6.16 Unroll panels with the spike down and the stud side up for the structured geomembrane to assure that the deployment method protects the geomembrane from scratches and crimps and protects soil surface.

12.6.17 Unroll panels with adequate tension to prevent undulations or wrinkles when placed on the ground. The spike side down prevents easy movement of the panel. Individual panels placed with more than 5 undulations greater than 2-inches in height shall be deployed again.

12.6.18 Use a method to minimize wrinkles, especially differential wrinkles between adjacent panels.

12.6.19 Place adequate hold-downs to prevent uplift by wind. Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

12.6.20 Protect geomembrane in heavy traffic areas by geotextile, extra geomembrane or other suitable materials.

12.6.21 Do not allow vehicular traffic on unprotected geomembrane surface.

12.6.22 Panels deployed on grades steeper than 12% shall extend a minimum of 3 feet beyond the crest or toe of that grade with no cross seams.

12.6.23 Visually inspect sheet surface during unrolling of geomembrane and mark faulty or suspect areas for repair or test. Replace faulty (requires more than one patch per 200 square feet) geomembrane stock at no additional cost to the Owner.

12.6.24 Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F measured 6 inches above the membrane surface. Placement can proceed below 32° F only after it has been verified by the CQC Inspector that the material can be seamed according to the Specification. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the installation supervisor.

12.6.25 After panel deployment and before welding, any horizontal wrinkles must be walked down or wiggled down the slope to minimize wrinkles after welding.

12.6.26 Limit maximum wrinkle height to 4 inches during warmer ambient temperatures and 2 to 3 inches in cooler temperatures.

12.6.27 Geomembrane wrinkles shall not be folded over.

12.6.28 After each panel welding, the sheet should be hand pulled in order to avoid the formation of ridging along the seams (snapping).

12.6.29 Physically remove wrinkles by walking them or by pretension pulling on the sheet after welding each panel.

## 12.7 Geomembrane Field Seaming

12.7.1 Field seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit a copy of the proposed seaming procedures (both fusion and extrusion welding, including preparation procedures), prior to commencement of seaming, for the Purchaser's review and approval.

12.7.2 Remove studs and spikes from the structured geomembrane at butt weld locations. During the stud/spike removal operation, do not reduce the thickness of the barrier section of the geomembrane to less than the minimum thickness listed in section 12.4.

12.7.3 The only approved seaming processes are fusion and extrusion welding. On side slopes, seams shall be oriented in the general direction of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized. Cross seams will be allowed on slopes provided that cross seams are cut at 45° and adjacent cross seams are staggered. Cross seams shall be kept to the lower half of the slope. No more than one cross seam will be allowed per panel slope length.

12.7.4 No seam of any kind shall be closer than five feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a fishmouth or wrinkle is found, it shall be relieved and cap-stripped.

12.7.5 Geomembrane panels must have a finished minimum overlap of four inches for fusion welding and six inches for extrusion welding.

12.7.6 Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

12.7.7 Generators used to power welding/grinding apparatus shall be placed on a rub sheet and/or on a HDPE tub to prevent damages caused by vibrations/equipment leaks and to protect the liner during refueling of these generators.

12.7.8 The Installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing for extrusion welds or Air Pressure Testing for double fusion seams.

## 12.8 Geomembrane Field Trial Seams

12.8.1 Field trial seams shall be made in accordance with the manufacturer's recommendations and these Specifications. The Contractor shall submit a copy of the proposed testing procedures for the Purchaser's review and approval.

12.8.2 Field trial seams shall be conducted, per seaming apparatus and per seamer, on the liner to verify that seaming conditions are satisfactory. Trial seams shall be conducted at the beginning of each seaming period, at least once every four hours for each seaming apparatus and personnel used that day. Additional field trial seams may be requested by and at the discretion of the Purchaser's Representative.

12.8.3 All trial seams shall be made in contact with the subgrade. Welding rod used for extrusion welding shall have the same properties as the resin used to manufacture the geomembrane.

12.8.4 Field trial seaming shall be conducted under the same ambient temperature and preheating conditions as the production seams.

12.8.5 Field trial seams shall be destructively tested in accordance with section 12.9.

## 12.9 Geomembrane Destructive Seam Testing for Fusion and Extrusion Seaming

12.9.1 Destructive seam testing should be minimized to preserve the integrity of the liner. The Contractor shall take one (1) destructive test sample once per 500 cumulative feet of seam length, per fusion welding device, from a location specified by the CQC Inspector. This frequency applies to extrusion seams as well. If the amount of extrusion seaming is < 500 feet then a minimum of one (1) extrusion destructive test shall be performed.

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

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

12.9.4 The Installer shall test ten one-inch wide specimens from his sample; five specimens for shear strength and five for peel strength. The CQC Inspector shall submit samples to an independent laboratory for confirmation testing. Seam test results shall be evaluated using the current GRI Test Method GM19 which allows for four of five specimens meeting the required seam strength and the fifth specimen meeting 80% of the required strength. Additionally, peel separation shall not exceed 25%.

12.9.5 Seams shall be tested according to the following methodology:

| Property | Test Method | Minimum Average Value |
|---|---|---|
| Seam Properties | ASTM D 6392 | |
| 3. Shear Strength | GM19 | 75 lb/in |
| 4. Peel Strength | | |
| • Hot Wedge | | 63 lb/in |
| • Extrusion Fillet | | 57 lb/in |

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

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

a) The installer shall cap strip the seam between the failed location and any passed test locations.

b) The installer shall retrace the welding path to a location (initially a minimum of 10 feet on each side of the failed seam location) to identify and isolate the failed seam in both previous and next direction of failed destructive, by taking two new samples, one from each direction. If these tests pass, then the seam shall be cap stripped between the passing tests. If the test fails, then the process is repeated.

c) Over the length of seam failure, the installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip.

d) All seams and non-seam areas of the geomembrane shall be inspected by the inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

e) Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the inspector. Each location that fails the non-destructive testing shall be marked by the inspector and repaired accordingly.

## 12.10 Geomembrane Repair Procedures

12.10.1 The geomembrane will be inspected before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be swept or washed by the Installer if surface contamination inhibits inspection. The Installer shall ensure that an inspection of the geomembrane precedes any seaming of that section.

12.10.2 Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

12.10.3 Repair, removal and replacement shall be at the Installers expense if the damage results from the Installer's activities.

12.10.4 Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. The Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the Purchaser's Representative and the Installer.

12.10.5 The following repair procedures shall apply:

a) Defective seams shall be cap stripped or replaced.

b) All holes of any size shall be patched.

c) Tears shall be repaired by patching. If the tear is on a slope or an area susceptible to stress and has a sharp end it must be rounded prior to patching.

d) Blisters, large cuts and undispersed raw materials shall be repaired by patches.

e) Patches shall be completed by extrusion welding. The weld area shall be ground no more than 10 minutes prior to welding. No more than 10% of the thickness shall be removed by grinding. Welding shall commence where the grinding started and must overlap the previous seam by at least two inches. Reseaming over an existing seam without regrinding shall not be permitted. The welding shall restart by grinding the existing seam and rewelding a new seam.

f) Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of six (6) inches beyond the edge of defects.
g) All T's and intersections shall be patched. Welding the excess overlap is not permitted.
h) Geomembrane surfaces to be repaired shall be abraded (extrusion welds only) no more than 1/2 hour prior to the repair.
i) All geomembrane surfaces shall be clean and dry at the time of repair.
j) The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the Owner's Representative.
k) Extend patches or caps at least 6 inches beyond the edge of the defect, i.e., be a minimum of 12 inches in diameter, and round all corners of material to be patched.
l) Bevel the edge of the patch and do not cut patch with repair sheet in contact with geomembrane. Temporarily bond the patch to the geomembrane with an approved method, extrusion weld the patch and then vacuum test the repair.

## 12.11 Verification of Repairs

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

12.11.2 The inspector shall keep daily documentation of all non-destructive and destructive testing. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested. (i.e., Test 1 followed by Test 1R1).

## 12.12 Geocomposite Contractor Qualifications

12.12.1 The drainage material manufacturer shall have successfully manufactured five (5) million square feet of polyethylene drainage material.

12.12.2 Installation of the drainage material shall be performed by the manufacturer or be a manufacturer-approved dealer/installer. The drainage material installer must either have installed at least one (1) million square feet of product, or must provide to the Purchaser satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the respective geosynthetic will be installed in a competent, professional manner.

12.12.3 The installation supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the contract documents.

12.12.4 The Contractor shall provide a third-party inspector for CQC of the geocomposite installation. The inspector shall be an individual or company who is independent from the manufacturer and installer and shall be responsible for monitoring and documenting activities related to the CQC of the geocomposite throughout installation. The inspector who is on site monitoring the installation activities every day that they are taking place, shall have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The inspector should be an engineer registered to practice in the State of Georgia or a geosynthetics installation technician certified through the Inspector Certification Program (ICP) administered by the Geosynthetics Certification Institute (GCI). The Contractor shall provide the Purchaser with a statement of the inspector's qualifications prior to starting installation of the geocomposite.

12.12.5 A Manufacturer’s Representative may be on site during the initial phase of the geocomposite installation to provide assistance to the Contractor.

## 12.13 Geocomposite Labeling, Delivery, Storage, and Handling Requirements

12.13.1 Each roll of material delivered to the site shall be wrapped and labeled by the manufacturer. The label shall contain the following information:

a) manufacturer’s name
b) product identification
c) length and width
d) roll number

12.13.2 The material shall be stored as specified by the manufacturer in an area specified by the Purchaser. The storage will be free of materials capable of damaging the material.

12.13.3 Unloading of the drainage material from the delivery trucks will be performed by the Contractor. Unloading of the materials will be performed as directed by the manufacturer.

12.13.4 The rolls must be adequate for safe transportation to the point of delivery, offloading and storage. Storage measures will be taken as specifically stated by the manufacturer.

## 12.14 Geocomposite Material Properties

12.14.1 The geocomposite shall consist of one (1) layer of HDPE drainage net (geonet) connected between two (2) layers of non-woven geotextile to create a double-sided geocomposite.

12.14.2 The drainage net shall be manufactured of new first quality polyethylene resin and shall be compounded and manufactured specifically for the intended application.

12.14.3 The Contractor shall provide written certification from the manufacturer that all resin used in the manufacture of the drainage net for this job meets the Specifications which shall include a copy of the quality control certificates issued by the resin supplier.

12.14.4 The Contractor shall provide written certification from the manufacturer that the material was manufactured in accordance with this Specification, together with a report of test results, prior to material shipment.

12.14.5 The minimum average properties of the geocomposite shall be as follows:

| DOUBLE-SIDED DRAINAGE GEOCOMPOSITE | | | | |
|---|---|---|---|---|
| **Tested Property** | **Test Method** | **Frequency** | **Value[(1)]** | **Units** |
| **Geonet Core [(2)]** | | | | |
| Raw Materials:<br>Density<br><br>Melt Index | <br>ASTM D792, B<br>ASTM D1505<br>ASTM D1238 | <br>Per lot<br><br>Per lot | <br>0.94<br><br>≤ 1.0 | <br>g/cc<br><br>g/ 10 min. |
| Thickness | ASTM D 5199 | 1/50,000 $ft^2$ | 250 | mil |
| Density | ASTM D 1505 | 1/50,000 $ft^2$ | 0.94 | g/cc |
| Carbon Black Content | ASTM D 4218 | 1/50,000 $ft^2$ | 2.0 – 3.0 | % |
| Tensile Strength | ASTM D 5035 | 1/50,000 $ft^2$ | 55 | lbs/inch |
| Transmissivity[(3)] | ASTM D 4716 | 1/50,000 $ft^2$ | $3 \times 10^{-3}$ | $m^2$/sec |
| **Geotextile (prior to lamination)[4]** | | | | |
| Mass per Unit Area | ASTM D 5261 | 1/100,000 $ft^2$ | 6.0 | oz/$yd^2$ |
| Grab Tensile | ASTM D 4632 | 1/100,000 $ft^2$ | 170 | lbs |
| Flow Rate | ASTM D 4491 | 1/100,000 $ft^2$ | 125 | gpm/ $ft^2$ |
| Puncture Strength | ASTM D 4833 | 1/100,000 $ft^2$ | 95 | lbs |
| Permittivity | ASTM D 4491 | 1/100,000 $ft^2$ | 1.6 | $Sec^{-1}$ |
| AOS | ASTM D 4751 | 1/100,000 $ft^2$ | 70 sieve | US Sieve |
| UV Resistance | ASTM D 4355 | once per formulation | 70 | % retained |
| **Geocomposite** | | | | |
| Transmissivity[(3)] | ASTM D 4716 | 1/500,000 $ft^2$ | $3.5 \times 10^{-4}$ | $m^2$/sec |
| Peel Adhesion | ASTM D 7005 | 1/50,000 $ft^2$ | 1.0 | lbs/in |

Notes

1. These are minimum average roll values (MARV values) and are based on the cumulative results of specimens tested. AOS in mm units is a maximum average roll value.
2. Component properties prior to lamination.
3. Gradient of 0.1, normal load of 10,000 psf, water at 70° F, between stainless steel plates for 15 minutes
4. Refer to geotextile product data sheet for additional specifications.

## 12.15 Geocomposite Placement

12.15.1 The geocomposite roll shall be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the Purchaser's Representative.

12.15.2 In the presence of wind, all geocomposites shall be weighted down with sandbags or the equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.

12.15.3 Each component of the geocomposite will be secured or seamed to the like component at overlaps. Adjacent edges of the geonet along the length of the roll shall be placed with the edges of each geonet butted against each other. The overlaps shall be joined by tying the geonet structure with plastic cable ties spaced every five (5) feet along the roll length, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

12.15.4 Adjoining geocomposite rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite a minimum of twelve (12) inches across the roll width. The overlaps shall be joined by tying the geonet structure with plastic cable ties spaced every twelve (12) inches along the roll width, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

12.15.5 The geonet portion shall be tied every six (6) inches in the anchor trench, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

12.15.6 Prior to covering the deployed geocomposite, each roll shall be inspected for damage resulting from construction.

12.15.7 Any rips, tears or damaged areas on the deployed geocomposite shall be removed and patched. The patch shall be secured to the original geonet by tying every six (6) inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be joined in accordance with sections 12.14.3 and 12.14.4 above.

12.15.8 All geocomposite geotextile overlaps shall be sewn at the seams.

## 12.16 Anchor Trenches

12.16.1 As directed by the project Drawings and Specifications, the end of the geomembrane and geocomposite rolls shall be placed in an anchor trench. The front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench.

12.16.2 The geomembrane and geocomposite should cover the entire trench floor.

12.16.3 The anchor trench shall be backfilled by the earthwork contractor. Trench backfill material shall be well compacted by approved methods to minimize water intrusion or material pull-out.

12.16.4 The anchor trench shall be backfilled with soil meeting the requirements of Structural Fill as described in section 10.0 with the exception that the maximum particle size shall be limited to one (1) inch in the largest dimension.

12.16.5 Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane or geocomposite. If damage occurs, it shall be repaired prior to backfilling and at the Contractor's expense.

## 12.17 Protective Cover Soils

12.17.1 The protective soil cover material shall be free of angular stones, particles in excess of 1 inch in maximum diameter, or other foreign matter that could damage the geocomposite and the geomembrane.

12.17.2 In applying the protective cover material, no equipment shall drive directly across the geocomposite. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.

12.17.3 The protective soil cover shall be placed on the geocomposite in a manner that prevents damage to the geocomposite.

12.17.4 Soil cover should be placed in a manner that prevents the soil from entering the geocomposite overlap zones. Soil cover shall be pushed from the toe of slopes up, not from top of slopes down, to minimize tensile forces on the geocomposite and geomembrane.

12.17.5 The protective cover shall be placed over the geocomposite using low contact pressure, wide-tracked construction equipment that minimizes stresses on the geocomposite. The cover shall be placed and spread by making a minimum of four complete passes with the tracks of the equipment. Special care and attention shall be made by the Contractor to ensure that the underlying geocomposite is not damaged.

12.17.6 The protective cover soil shall be a minimum eighteen (18) inches thick. This thickness does not apply to frequently trafficked areas or roadways, for which a minimum thickness of three feet is required.

### 12.18 Topsoil

12.18.1 Topsoil material is generally defined as the upper surface of dark fertile soil, which contains decaying matter and roots. Topsoil shall be free of subsoil, clay, weeds, large roots, or foreign material that would interfere with seeding or maintenance.

12.18.2 Testing of samples of topsoil may be required to determine if any nutrients should be added to the soil in addition to the application of fertilizer and lime.

12.18.3 The topsoil cover shall be placed in a minimum loose lift thickness of six inches and then grassed. If erosion occurs before grassing operations, the area shall be repaired to the satisfaction of the PCM.

## 13.0 SEDIMENT AND EROSION CONTROL

13.1 Minimum sediment and erosion control measures are shown on the Drawings and in the Storm Water Pollution Prevention Plan (SWPPP) for the Plant Barry Gypsum Pond Closure. Additional measures shall be taken as required or as directed by the Purchaser to minimize erosion of soil.

13.2 During the course of this project, the Contractor shall plan and coordinate his work to minimize the amount of suspended soil particles entering rivers and streams or leaving the general work area and being deposited in undesirable places. Any property damage or fines resulting from the Contractor’s negligence shall be borne by the Contractor.

10.2 The Contractor shall not excavate, uncover or denude areas of work until adequate erosion and sediment control measures are installed. The Contractor’s earthmoving operations shall at all times be in full compliance with the requirements of the Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas.

13.3 The Purchaser will inspect the sediment and erosion control practices (e.g. “BMPs”) employed to evaluate their effectiveness. Any deficiencies shall be immediately corrected by the Contractor at no cost to the Purchaser.

13.4 Erosion and sediment control measures shall be utilized and maintained as indicated in the Plans.

## 14.0 VEGETATION

14.1 A minimum six-inch layer of topsoil shall be placed on all areas to be grassed.

14.2 Earth fill areas and other disturbed areas shall be grassed. Hydroseeding methods may be used.

14.3 The Contractor shall produce a satisfactory stand of perennial grass in accordance with the Vegetation Schedule as shown on the Drawings. If it is necessary to repeat any or all the work, including plowing, fertilizing, watering, mulching and seeding, the Contractor shall repeat these operations until a satisfactory stand is obtained.

14.4 A satisfactory stand of grass is defined as 100% of soil surface being uniformly covered in permanent vegetation with a density of 70% or greater, or landscaped according to the Plan (uniformly covered with landscaping materials in planned landscaped areas), or equivalent permanent stabilization measures as defined in the Handbook (excluding a crop of annual vegetation and a seeding of target crop perennials appropriate for the region).

14.5 Measures shall be taken to prevent erosion of the topsoil layer and vegetation until a full vegetative growth has been obtained. After seeding, an erosion control biodegradable straw blanket shall be installed on any slopes equal to or steeper than 3H:1V. This material shall be as indicated on the Drawings. The blanket shall be installed per manufacturer’s installation instructions. However, the blanket shall be tacked as necessary to the ground to withstand the upward growth of grass and to permit the establishment of grass through the blanket. Failure to accomplish this will require that the affected area be re-grassed.

14.6 Water required to promote a satisfactory growth shall be furnished and applied by the Contractor as often as necessary to achieve the results outlined above.

14.7 The Contractor shall make daily inspections of the seeded areas and repair all eroded areas to the satisfaction of the Purchaser.

## 15.0 RECORDS

### 15.1 Quality Control Records

15.1.1 The quality control records of inspection and field quality control records shall be compiled by the Contractor’s CQC Inspector and provided to the Purchaser on an on-going basis or as directed. The final records will provide the background data necessary for the certification of the final cover construction. All records shall be forwarded to the Plant’s permanent file to be retained as a permanent record of the project.

15.1.2 At the completion of the construction of the final cover, a Construction Quality

Assurance Report (Construction Certification), prepared by the Purchaser, shall be submitted along with a registered engineer's certification that the final cover was constructed in accordance with the approved Closure/Post Closure drawings and the ADEM Solid Waste Regulations. The Contractor shall provide, at a minimum, the following information for preparation of the Certification Report:

a) Elevation Contour Drawings of the subgrade on a maximum 100ft. by 100ft. grid. Drawings to be signed and sealed by a land surveyor registered to practice in the State of Alabama.

b) For the Composite Cover System:
   1. Final geomembrane panel layout
   2. Final geocomposite panel layout
   3. Elevation Contour Drawings of the top surface of the 18 inch Protective Soil Layer on a maximum 100ft. by 100ft. grid (as used for the subgrade). Protective Soil Cover thickness relative to the subgrade shall be indicated at the grid points. Drawings to be signed and sealed by a land surveyor registered to practice in the State of Alabama.
   4. Finished Grade - elevation contour drawings with thickness of topsoil indicated on the same maximum 100 ft. x 100 ft. grid as the Protective Cover Soil Elevation Contour Drawing. Drawings to be signed and sealed by a land surveyor registered to practice in the State of Alabama.

c) For the ClosureTurf cover system:
   1. As-built drawings indicating panel locations, panel identification numbers, geomembrane roll numbers for each panel, seam caps, destructive sample locations, and repair locations.
   2. Finished Grade - elevation contour drawings on the same maximum 100 ft. x 100 ft. grid as the Subgrade Elevation Contour Drawing. Drawings to be signed and sealed by a land surveyor registered to practice in the State of Alabama.

d) All survey shots shall be "stacked" in order to properly verify the given layer's thickness. The use of interpolation or other computer generated methods to achieve point stacking are not acceptable.

e) Thickness determinations obtained at grid points on slopes shall be made normal to the slopes.

f) All survey and topographic information shall be submitted in both pdf and dwg file formats which are compatible with AutoCAD 2010.

g) A summary of major construction activities which shall include a description of the activity and schedule dates. This summary shall be based on daily logs provided by the on-site inspector. This shall also serve to document the presence of a qualified member of the inspection team during any construction activity involving structural fill or any component of the liner.

h) Project CQC summary reports including all field testing and inspection results. This summary shall be inclusive of all passing tests as well as failing tests and retests. This shall include at a minimum, all field moisture content and density tests, Proctor curves, Atterberg limits, particle size distribution, CQC resumes, CQC welding rod certificates, subgrade acceptance forms, LLDPE panel deployment logs, fusion and extrusion trial seam logs, fusion and extrusion seam logs, LLDPE repair logs, pressure and vacuum test logs, fusion and extrusion destructive test logs, concrete cylinder break reports, concrete pour cards, concrete tickets, rebar mill certification reports, and all daily field reports.

i) Copies of all field CQC reports for structural fill, gypsum fill, and geosynthetic installation.

### 15.2 Record Topographic Survey

A record topographic survey will be performed by the Purchaser to fully document the lateral and vertical extent of the developed area. This survey will be maintained as part of the permanent record. Drawings to be signed and sealed by a land surveyor registered to practice in the State of Alabama.

# APPENDIX 9
# OPERATIONS PLAN

# OPERATION PLAN
# PLANT BARRY GYPSUM STORAGE FACILITY
# ALABAMA POWER COMPANY
# BUCKS, ALABAMA

This document serves as an operation plan for the Plant Barry Gypsum Storage Facility. The Gypsum Storage Facility, located at Plant Barry near Bucks, Alabama, is owned and operated by Alabama Power Company. This Operation Plan includes a Fugitive Dust control plan, and Inflow Design Flood control plan, a Groundwater Monitoring plan and procedures regarding Recordkeeping and Notification Compliance Procedures. Also included are procedures for updating the plans and assessments required by the Alabama Department of Environmental Management (Department) regulations.

## Fugitive Dust Control Plan

The Fugitive Dust Control Plan prepared for the Plant Barry Gypsum Storage Facility can be found in Appendix A of this Operation Plan.

## Inflow Design Flood Control Plan

The Inflow Design Flood Control Plan prepared for the Plant Barry Gypsum Storage Facility can be found in Appendix B of this Operation Plan.

## Groundwater Monitoring Plan

The groundwater monitoring plan for the Plant Barry Gypsum Storage Facility can be found in Appendix C of this Operation Plan.

## Recordkeeping and Notification Compliance Procedures

As outlined in 335-13-15-.08(1), each Owner or Operator of a CCR unit subject to the Department regulations must maintain files of certain information in an operating record at the facility. Each file is to be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record or study. Electronic storage of the records is acceptable. These records are to be made available to the Department upon request.

Certain notifications are to be made in accordance with the requirements of 335-13-15-.08(2). In many instances, such notifications are to be placed in the facility's Operating Record. In certain instances, further notifications are to be made to the Department Directory within 30 days of placement of a notification into the Operating Records. Furthermore, a publicly accessible internet site must be established for posting of certain notifications and compliance information within 30 days of it being placed in the Operating Record.

Alabama Power and Plant Barry maintain an electronic Operating Record for the facility. In addition, a publicly accessible internet site has already been established for compliance with EPA's CCR Rule. Required notifications and compliance data, as outlined in 335-13-15-.08 and as applicable to the Plant Barry Gypsum Storage Facility, will be maintained in the electronic Operating Record, and as required, made available on the publicly accessible internet site within 30 days of placement in the Operating Record. Furthermore, required notifications will be made to the Department Director within 30 days of placement in the Operating Record.

## Procedures for Updating Plans and Assessments

Certain plans and assessments are required to be updated at specified intervals and/or upon modification of certain components of the facility. If and when applicable, updates will be made to the respective plans and assessments, and notifications placed in the Operating Record, posted to the publicly accessible internet site, and communicated in writing to the Department Director in accordance with the Department rules.

# OPERATION PLAN
## APPENDIX A
## FUGITIVE DUST CONTROL PLAN

The Fugitive Dust Plan for Plant Barry was initially prepared to satisfy federal standards. It also satisfies 335-13-15-.05(1) and 335-13-15-.09(1)(a)11.(i) and is included for that purpose.

# COAL COMBUSTION RESIDUAL (CCR)
# FUGITIVE DUST CONTROL PLAN

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## Plant Barry
## October 2015

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Professional Engineer Certification:

Based upon my knowledge, information, and belief that the content in the attached Fugitive Dust Control Plan is accurate, I hereby certify that this Fugitive Dust Control Plan meets the requirements of 40 CFR § 257.80(b)(1)-(7) (Coal Combustion Residuals Rule).

Wyman Turner, PE No. 30102, 12-31-15 Date: 10-08-15

*Name, P.E. License No., Expiration Date*

Wyman Turner

*Signature*

ALABAMA
LICENSED
No. 30102
PROFESSIONAL
ENGINEER
WYMAN D. TURNER

## AMENDMENT SUMMARY

| Date | Amendment # | Comments / Notes |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

## 1.0 PURPOSE

The purpose of this guideline is to demonstrate compliance with the fugitive dust requirements in 40 CFR § 257.80 (b)(1) through (7).

## 2.0 SCOPE

This fugitive dust plan identifies and describes the Coal Combustion Residuals (CCR) fugitive dust control measures that Plant Barry will use to minimize CCR from becoming airborne at the facility, including CCR fugitive dust originating from CCR units, roads, and other CCR management and material handling activities. Coal combustion residuals are generated from the burning of coal to produce electricity and are defined as fly ash, bottom ash, boiler slag, and flue gas desulfurization (FGD) materials.

## 3.0 REFERENCES

40 CFR §§ 257.53, 257.80, 257.105(g)(2)

## 4.0 GENERAL INFORMATION

EPA defines “fugitive dust” as “solid airborne particulate matter that contains or is derived from CCR, emitted from any source other than through a stack, or chimney.” 40 CFR § 257.53.

## 5.0 PROCESSES

1) Identify the CCR units on plant site that are subject to the requirements in §257.80 to minimize CCR from becoming airborne.

    - Ash Pond
    - Gypsum Pond

2) Identify and describe the fugitive dust control measures that are applicable and appropriate to minimize CCR from becoming airborne at the units listed in Section 5.0 (1) of this plan.

Ash Pond

Fugitive dust control measures in the ash pond area include the following:

1. Spraying dewatered ash with water using a water truck as needed to promote the formation of a surface “crust” and minimize the potential for fugitive dust generation.
2. Access to the CCR unit is minimized, allowing only necessary personnel to conduct operations, maintenance and inspections.
3. Plant personnel conduct routine inspections for fugitive dust; plant CCR personnel are notified if fugitive dust generation is observed and action is taken.
4. Areas with observed fugitive dust are sprayed with water using water truck or other means.
5. Vehicle speed is limited. A speed limit sign is posted at each access road entrance to the CCR unit.
6. Areas in the wet portion of the pond include vegetation to control erosion and minimize dust.

Gypsum Pond

Fugitive dust control measures in the gypsum pond area include the following steps:

1. Access to the CCR unit is minimized, allowing only necessary personnel and equipment to conduct operations, maintenance and inspection.
2. Operations include routine inspections for fugitive dust.
3. Areas with observed fugitive dust are watered using a water truck or other methods.
4. Vehicle speed is limited. A speed limit sign is posted at each access road entrance to the CCR unit.
5. Trucks carrying gypsum are covered prior to leaving the CCR unit.

3) Explain how the control measures described in Section 5.0 (2) of this plan are applicable and appropriate for each CCR unit.

The fugitive dust control measures identified and described in this plan were adopted and implemented based upon an evaluation of site-specific conditions, engineering site visits, and subject matter expert input. Minimizing access to dust areas, regular watering of roads in CCR handling areas, using water to create a crust on top of dewatered ash, reducing vehicle speeds, including routine inspections, responding to fugitive dust concerns and using covered trucks for off-site hauling in the manner discussed in Section 5.0 (2) are determined to be applicable and appropriate dust control measures for the listed CCR units. The evaluation included assessing the effectiveness of the fugitive dust control measures for each CCR unit over time. Consideration was given to various factors such as site conditions, weather conditions, moisture content and physical condition of the CCR (ash and gypsum), as well as operating conditions within the CCR units.

4) Describe the process to emplace CCR as conditioned CCR for any CCR landfill listed in Section 5.0 (1) of this plan.

The plant does not operate any dry CCR landfills. Measures to address dry areas within the pond are described in Section 5.0 (2).

5) Describe the fugitive dust control measures to minimize CCR from becoming airborne on roads and at other CCR management and material handling activities.

Any accumulation of CCR material or dust generation within the CCR units, production areas, and along CCR transport routes is promptly addressed to control fugitive dust by wetting using a water truck or other methods as needed. CCR materials may also be flushed to wet sumps or transported directly to the settling ponds to prevent releases of fugitive dust.

See discussion of CCR units in Section 5.0 (2) of this plan.

6) Describe the process to periodically assess the effectiveness of the fugitive dust control measures described in this plan.

Plant personnel perform routine CCR fugitive dust inspections and ensure the operation of the water spray trucks or other dust suppression activities as necessary. Plant personnel understand the importance of minimizing CCR fugitive dust generation and the requirement that any CCR fugitive dust observations should be promptly addressed.

7) Describe the process to log citizen complaints received involving CCR fugitive dust events at the facility.

When a complaint is received regarding a CCR fugitive dust event at the facility, the complaint is documented and investigated. Appropriate steps are taken, including any appropriate action, if needed.

# OPERATION PLAN
## APPENDIX B
## INFLOW DESIGN FLOOD CONTROL PLAN

The Inflow Design Flood Control Plan for the Plant Barry Gypsum Pond was initially prepared to satisfy federal standards. It also satisfies 335-13-15-.05(3) and 335-13-15-.09(1)(a)11.(ii) and is included for that purpose.

# INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
# PLANT BARRY GYPSUM POND
# ALABAMA POWER COMPANY

Section 257.82 of EPA's regulations requires the owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment to design, construct, operate and maintain an inflow design flood control system capable of safely managing flow during and following the peak discharge of the specified inflow design flood. The owner or operator also has to prepare a written plan documenting how the inflow flood control system has been designed and constructed to meet the requirements of this section of the rule.

The existing CCR surface impoundment referred to as the Plant Barry Gypsum Pond is located at Alabama Power Company's Plant Barry. The facility consists of a CCR storage area and a sedimentation pond. The inflow design flood consists solely of the rainfall that falls within the limits of the surface impoundment (process flows into the pond were determined to be negligible during the design storm). Stormwater is temporarily stored within the limits of the surface impoundment and discharged through a 6-foot square concrete riser connected to a 36" HDPE pipe that discharges into the sedimentation pond.

The inflow design flood has been calculated using the Natural Resources Conservation Service method (also known as the Soil Conservation Service (SCS) method) using the 1,000-yr storm event required for a Significant hazard potential facility. Runoff curve number data was determined using Table 2-2A from the Urban Hydrology for Small Watersheds (TR-55). Appendix A and B from the TR-55 were used to determine the rainfall distribution methodology. Precipitation values were determined from NOAA's Precipitation Frequency Data Server (Atlas-14).

The NRCS provided information on the soil characteristics and hydrologic groups present at the site. It was determined that the hydrological groups "C" and "D" should be used to best reflect the characteristics of the soils on site in order to determine curve number values. This information was placed into Hydraflow Hydrographs and used to generate appropriate precipitation curves, storm basin routing information, and resulting rating curves to evaluate surface impoundment capacity.

Calculations indicate the unit can safely store and pass the inflow design storm.

The facility is operated subject to and in accordance with § 257.3-3 of EPA's regulations.

I hereby certify that the inflow design flood control system plan meets the requirements of 40 C.F.R. Part 257.82.

10/17/16

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

16516
JAMES C. PEGUES, JR.

# Inflow Design Control System Plan: Hydrologic and Hydraulic Calculation Summary

for

***Plant Barry Gypsum Pond***

Prepared by:

Southern Company Services
Technical Services

Originator: ______________________ 10/6/16
Jeff Harper Date

Reviewer: ______________________ 10/11/16
Jason S. Wilson Date

Approval: ______________________ 10/12/16
James C. Pegues Date

## 1.0 Purpose of Calculation

The purpose of this report is to demonstrate the hydraulic capacity of the subject CCR impoundment in order to prepare an inflow design flood control plan as required by the United States Environmental Protection Agency's (EPA) final rule for Disposal of CCR from Electric Utilities (EPA 40 CFR 257).

## 2.0 Summary of Conclusions

A hydrologic and hydraulic model was developed for the Plant Barry Gypsum Pond to determine the hydraulic capacity of the impoundment. The design storm for the Plant Barry Gypsum Pond is a 1000-year rainfall event. Southern Company has selected a storm length of 24-hours for all inflow design flood control plans. The results of routing a 1000-year, 24-hour rainfall event through the impoundment are presented in Table 1 below:

Table 1-Flood Routing Results for Plant Barry Gypsum Pond

| Plant Barry | Normal Pool El (ft) | Top of embankment El (ft) | Emergency Spillway Crest El (ft) | Peak Water Surface Elevation (ft | Freeboard* (ft) | Peak Inflow (cfs) | Peak Outflow (cfs) |
|---|---|---|---|---|---|---|---|
| Gypsum Pond | 22.36 | 30.00 | N/A | 27.20 | 2.80 | 400.85 | 298.39 |

*Freeboard is measured from the top of embankment to the peak water surface elevation

## 3.0 Methodology

### 3.1 HYDROLOGIC ANALYSES

The Plant Barry Gypsum Pond is classified as a significant hazard structure. The design storm for a significant hazard structure is a 1000-year rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Table 2.

Table 2. Plant Barry Gypsum Pond Storm Distribution

| Hazard Classification | Return Frequency (years) | Storm Duration (hours) | Rainfall Total (Inches) | Rainfall Source | Storm Distribution |
|---|---|---|---|---|---|
| Significant | 1000 | 24 | 21.6 | NOAA Atlas 14 | SCS Type III |

The drainage area for the Plant Barry Gypsum Pond was delineated based on LiDAR data acquired for the Plant in 2016. Runoff characteristics were developed based on the Soil Conservation Service (SCS) methodologies as outlined in TR-55. An SCS curve number of 86 was used as the pond maintains a low water level, has a covering of gypsum, and no vegetation. The time of concentration assumed for the basin was 10 minutes. A TR-55 gives a Tc of 13.6 minutes.

A table of the pertinent basin characteristics of the Gypsum Pond is provided below in Table 3.

Table 3—Gypsum Pond Hydrologic Information

| | |
|---|---|
| Drainage Basin Area (acres) | 31.7 |
| Hydrologic Curve Number, CN | 86 |
| Hydrologic Methodology | SCS Method |
| Time of Concentration (minutes) | 10 |
| Hydrologic Software | Hydraflow Hydrographs |
| | |

Runoff values were determined by importing the characteristics developed above into a hydrologic model using Hydraflow Hydrographs for Civil 3D.

Process flows from Plant Barry were not considered in the analysis given that the plant would not be likely to discharge gypsum slurry into the pond during a 1000-year rainfall event.

## 3.2 HYDRAULIC ANALYSES

Storage values for the Gypsum Pond were determined by developing a stage-storage relationship utilizing contour data. The pond discharges directly through 6 - 36” diameter pipes into a sedimentation basin that is design to fully contain a 100-year, 24-hour storm event. Clear water from this pond is then pumped back to the plant for reuse.

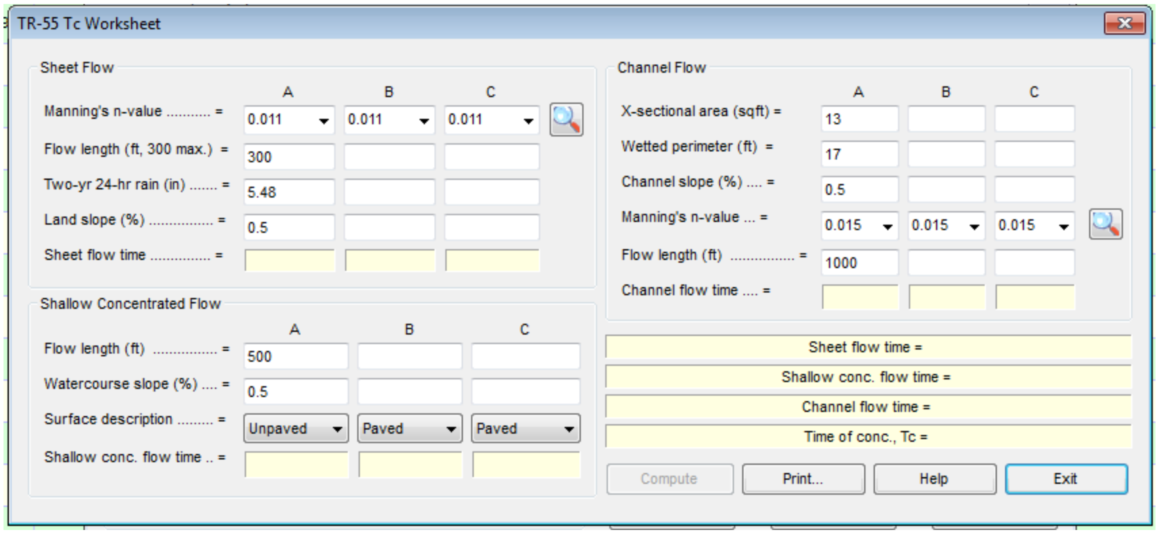
Table 4—Spillway Attribute Table

| Spillway Component | US Invert El (feet) | DS Invert El (feet) | Dimension | Grade (%) | Length (ft) | Capacity (cfs) |
|---|---|---|---|---|---|---|
| 36” Pipes | 23 | 22.56 | 6 - 36” Diameter | 0.5 | 88 | 282 |

## 4.0 SUPPORTING INFORMATION

DRAINAGE BASIN

# TIME OF CONCENTRATION



TR-55 Tc Worksheet

Sheet Flow

| | A | B | C |
|---|---|---|---|
| Manning's n-value .......... = | 0.011 | 0.011 | 0.011 |
| Flow length (ft, 300 max.) = | 300 | | |
| Two-yr 24-hr rain (in) ....... = | 5.48 | | |
| Land slope (%) ............... = | 0.5 | | |
| Sheet flow time .............. = | | | |

Shallow Concentrated Flow

| | A | B | C |
|---|---|---|---|
| Flow length (ft) ............... = | 500 | | |
| Watercourse slope (%) .... = | 0.5 | | |
| Surface description ........ = | Unpaved | Paved | Paved |
| Shallow conc. flow time .. = | | | |

Channel Flow

| | A | B | C |
|---|---|---|---|
| X-sectional area (sqft) = | 13 | | |
| Wetted perimeter (ft) = | 17 | | |
| Channel slope (%) .... = | 0.5 | | |
| Manning's n-value ... = | 0.015 | 0.015 | 0.015 |
| Flow length (ft) ............... = | 1000 | | |
| Channel flow time .... = | | | |

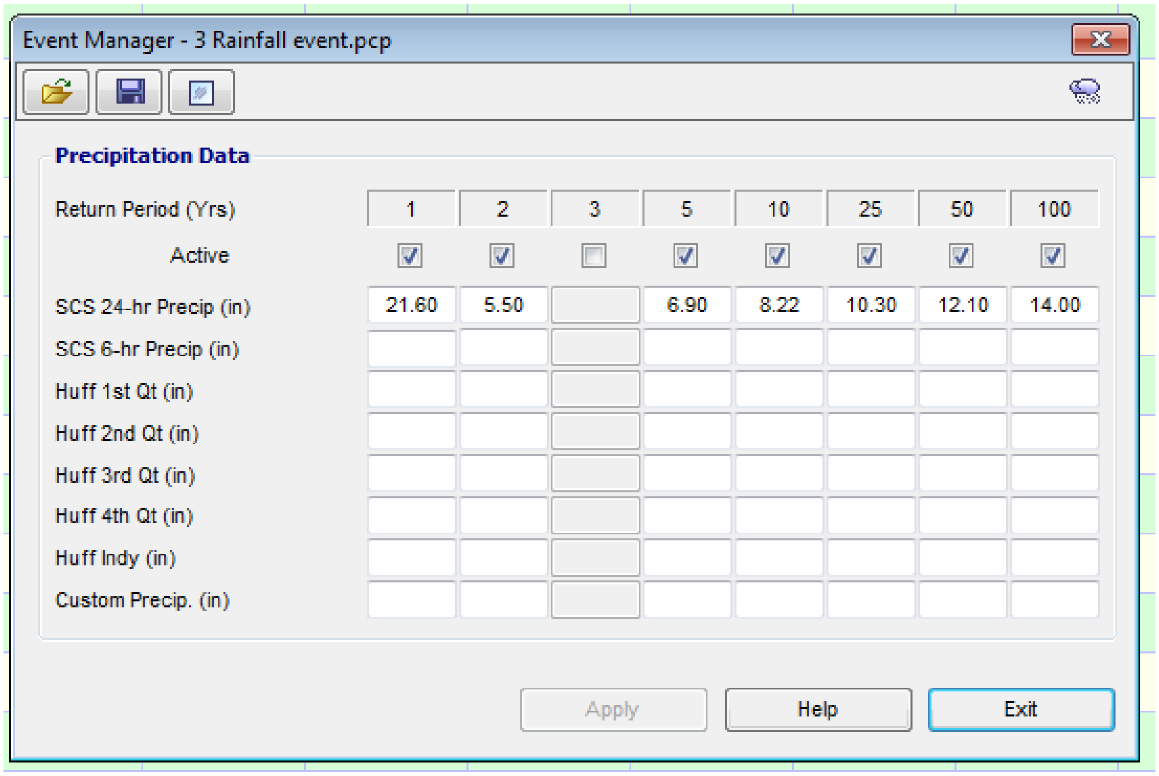
Sheet flow time =

Shallow conc. flow time =

Channel flow time =

Time of conc., Tc =

# RAINFALL DATA



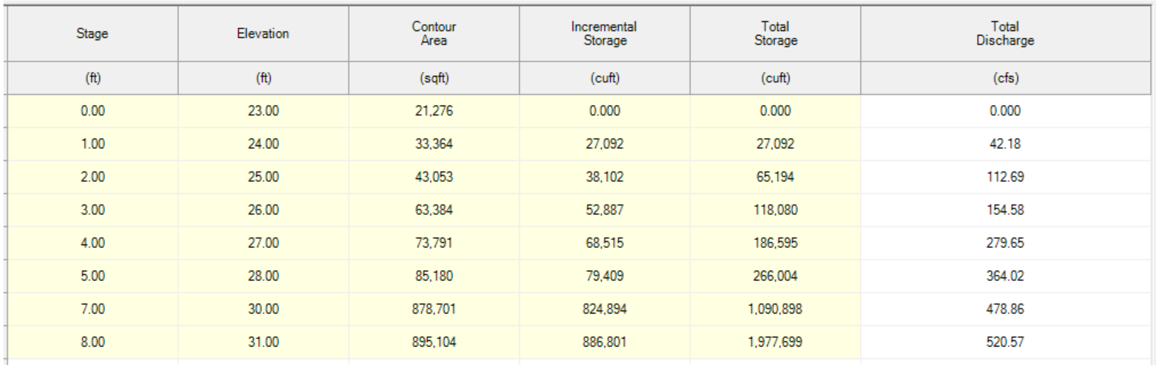
Event Manager - 3 Rainfall event.pcp

**Precipitation Data**

| Return Period (Yrs) | 1 | 2 | 3 | 5 | 10 | 25 | 50 | 100 |
|---|---|---|---|---|---|---|---|---|
| Active | ☑ | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ |
| SCS 24-hr Precip (in) | 21.60 | 5.50 | | 6.90 | 8.22 | 10.30 | 12.10 | 14.00 |
| SCS 6-hr Precip (in) | | | | | | | | |
| Huff 1st Qt (in) | | | | | | | | |
| Huff 2nd Qt (in) | | | | | | | | |
| Huff 3rd Qt (in) | | | | | | | | |
| Huff 4th Qt (in) | | | | | | | | |
| Huff Indy (in) | | | | | | | | |
| Custom Precip. (in) | | | | | | | | |

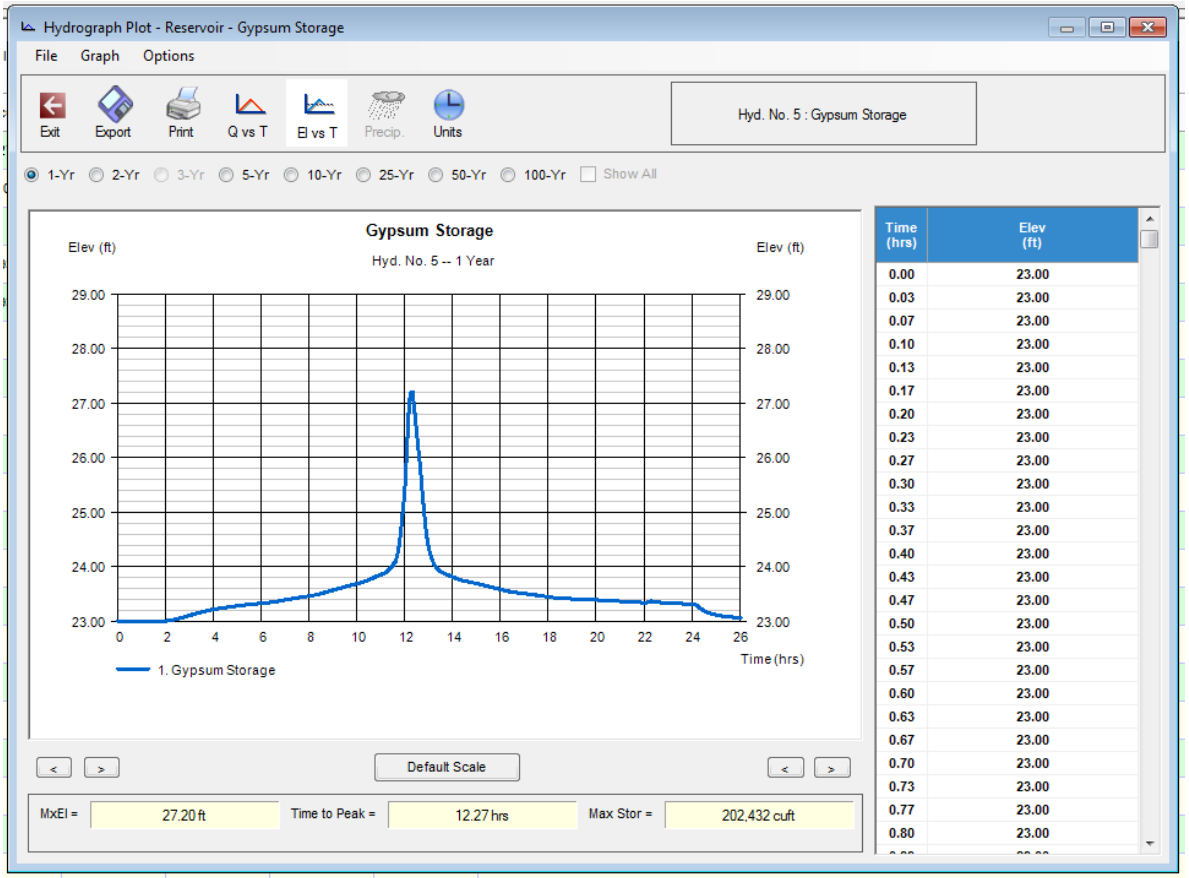
## 4.2 POND PERFORMANCE

### STAGE/STORAGE/DISCHARGE



| Stage | Elevation | Contour Area | Incremental Storage | Total Storage | Total Discharge |
|---|---|---|---|---|---|
| (ft) | (ft) | (sqft) | (cuft) | (cuft) | (cfs) |
| 0.00 | 23.00 | 21,276 | 0.000 | 0.000 | 0.000 |
| 1.00 | 24.00 | 33,364 | 27,092 | 27,092 | 42.18 |
| 2.00 | 25.00 | 43,053 | 38,102 | 65,194 | 112.69 |
| 3.00 | 26.00 | 63,384 | 52,887 | 118,080 | 154.58 |
| 4.00 | 27.00 | 73,791 | 68,515 | 186,595 | 279.65 |
| 5.00 | 28.00 | 85,180 | 79,409 | 266,004 | 364.02 |
| 7.00 | 30.00 | 878,701 | 824,894 | 1,090,898 | 478.86 |
| 8.00 | 31.00 | 895,104 | 886,801 | 1,977,699 | 520.57 |

### ELEVATION/TIME



Hyd. No. 5 : Gypsum Storage

● 1-Yr ○ 2-Yr ○ 3-Yr ○ 5-Yr ○ 10-Yr ○ 25-Yr ○ 50-Yr ○ 100-Yr ☐ Show All

MxEl = 27.20 ft

Time to Peak = 12.27 hrs

Max Stor = 202,432 cuft

| Time (hrs) | Elev (ft) |
|---|---|
| 0.00 | 23.00 |
| 0.03 | 23.00 |
| 0.07 | 23.00 |
| 0.10 | 23.00 |
| 0.13 | 23.00 |
| 0.17 | 23.00 |
| 0.20 | 23.00 |
| 0.23 | 23.00 |
| 0.27 | 23.00 |
| 0.30 | 23.00 |
| 0.33 | 23.00 |
| 0.37 | 23.00 |
| 0.40 | 23.00 |
| 0.43 | 23.00 |
| 0.47 | 23.00 |
| 0.50 | 23.00 |
| 0.53 | 23.00 |
| 0.57 | 23.00 |
| 0.60 | 23.00 |
| 0.63 | 23.00 |
| 0.67 | 23.00 |
| 0.70 | 23.00 |
| 0.73 | 23.00 |
| 0.77 | 23.00 |
| 0.80 | 23.00 |

# OPERATION PLAN
## APPENDIX C
## GROUNDWATER MONITORING PLAN

Alabama Power

**Dustin G. Brooks**
**Environmental Affairs Supervisor**
**Environmental Compliance**

600 North 18th Street
Post Office Box 2641
12N-0830
Birmingham, Alabama 35291

Tel 205.257.4194
Fax 205.257.4349
dgbrooks@southernco.com

August 24, 2020

Received: 8/24/20

Via email to sss@adem.alabama.gov

Mr. S. Scott Story, Chief
Solid Waste Branch
Land Division
Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2400

Re: Response to ADEM Letter of August 14, 2020 -- Groundwater Monitoring Plan Comments

Dear Mr. Story:

The following provides responses to comments received in a letter received from the Alabama Department of Environmental Management (ADEM or Department) Land Division dated August 14, 2020. The following presents the full text of the letter provided by ADEM followed by our response in italics.

## General Comments

1) Additional information is requested to be included as part of the pending Assessment of Corrective Measures Plan to thoroughly characterize site conditions. The information should include the following:
   a) Additional historical potentiometric figures. This is requested to aid in the assessment of the groundwater flow at the site.
   b) Additional detailed geologic cross sections. Cross sections aid the hydrogeologic interpretation of groundwater flow direction and are crucial for assessing the monitoring well network.
   c) A table of all historical groundwater, pore water, and surface water data is needed to aid in the review of statistical background. In addition to the GWMP, a historical groundwater data table should be included in all groundwater monitoring repo1ts.
   d) Please provide the data associated with the advanced geophysical methods that were used for the Plant Gaston Ash Pond Monitoring Wells.

*This information will be provided for each plant in the subsequent Delineation Reports to be submitted to the Department on or before September 30, 2020.*

2) Section 4.5 of the Groundwater Monitoring Plan (GWMP) states "If an upgradient well is abandoned due to pond closure activities or by an unforeseen circumstance, the historical data from that well will remain in the upgradient data pool and, therefore, the well remains part of the upgradient network by legacy." Data from a background well that is abandoned may remain relevant for use as statistical background. However, it is recommended that background data for each background well proposed for abandonment be evaluated and included in statistical background upon Department approval prior to submiss ion of the monitoring well abandonment plan.

*This has been addressed by modifications to Section 2.2.2 of the SAP and Section 4.5 of the monitoring plans consistent with this request. Background data for each upgradient well proposed for abandonment (or otherwise removed from the background network) will be statistically evaluated with respect to the background data pool. Based on the evaluation, a proposal will be submitted to the Department for approval detailing the evaluation of the data and proposing the continued use (or disuse) of the data in the background data set. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

3) Section 2.2.2 of the Statistical Analysis Plan (SAP) should clearly specify how background will be evaluated, and eliminated or included. lt is recommended that Section 2.2.2 of the SAP indicate that modifications to background will occur with Department approval.

*This has been addressed by modifications to Section 2.2.2 of the SAP. Language has been added to Sections 1.0, 2.0, and 2.2 that clearly state that any changes to the statistical analysis plan (including background wells and the background data set) require Department approval. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

4) Section 6.3 of the GWMP states that the analytical "method used will be able to reach a suitable practical quantification limit to detect natural background conditions at the facility." It is recommended that the GWMP be revised to reflect the requirements of ADEM Admin. Code r. 335-13-15-.06(4)(g)5.

*Section 6.3 of the GWMPs have been modified consistent with this request using language consistent with ADEM Admin. Code r. 335-13-15-.06(4)(g)5. The plans clearly state "that any practical quantitation limit that is used will be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility." See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

5) The GWMPs for Plant Barry, Plant Gadsden, Plant Greene, and Plant Miller describe a process for using intrawell analysis. Because no compliance monitoring wells were installed prior to the placement of waste at the facility, it does not appear that intrawell analysis will accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit as require d by ADEM Admin. code r. 335-13-15-.06(2)(a)1. Intrawell analysis procedures should be removed from all Ash Pond GWMPs and SAPs. Intrawell analysis may be justifiable for the lined Barry Gypsum and Gaston Gypsum ponds.

*Intrawell analysis has been used on a very limited basis for select few parameters during detection monitoring. Each of these sites is in assessment monitoring and proceeding with groundwater remedy selection. Nonetheless, intrawell statistical analysis of Appendix III detection constituents will be discontinued. Section 8.1 of the GWMPs for Plant Barry, Plant Gadsden, Plant Greene, and Plant Miller have been amended to remove the option of intrawell statistical analysis for Appendix III detection monitoring constituents. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

6) The proposed use of tolerance intervals to set Groundwater Protection Standard s (GWPSs) using pooled data from multiple wells screened in different hydrostratigraphic positions, without explicit checks for spatial variation, does not comply with requirements listed in Section 17.2 .1 of the March 2009 Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance (Unified Guidance) to set adequate tolerance limits. It is recommended that the GWMP comply with recommendations stated in the Unified Guidance.

*Section 5.2 of the SAP has been modified to address this request. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

7) Sections 7.5 and 21.0 of the Unified Guidance present GWPS testing as an either/or decision using either a multi-sample approach (using detection monitoring tests listed in Part III of the Unified Guidance), or a single-sample approach (using assessment and corrective action tests listed in Part IV of the Unified Guidance). The GWMP includes a combined approach using both tolerance limits to set an elevated GWPS and confidence intervals that require the entire interval to exceed the GWPS before corrective action is indicated. Section 7.5 and Example 7-1 of the Unified Guidance couch multi-sample tests to provide a reasonable GWPS for concentrations of constituents that "are occasionally found at uncontaminated background well concentrations exceeding the irrespective MCLs. The regulations then provide that a GWPS based on background levels is appropriate. "It appears that the multi- sample approach should only be applied to constituents with observed concentrations that

occasionally exceed relative MCLs and health-based standards in uncontaminated background rather than applied universally to all Appendix IV constituents.

*Section 5.2 of the SAP has been modified to address this request. Additional documentation provided by Dr. Kirk Cameron, primary author of the Unified Guidance, explains the intended use of interwell tolerance limits (a detection monitoring test) when applied to Assessment Monitoring programs to establish an alternate GWPS when concentrations upgradient naturally exceed MCLs. The documentation supports the use of parametric and nonparametric tolerance limits (depending on the distribution of a given constituent) using pooled upgradient well data regardless of the presence of spatial variation. The resulting statistical limit establishes the threshold of all anticipated unimpacted average concentrations at downgradient wells when compared to a GWPS through the use of confidence intervals. Parametric tolerance limits will be used with Department approval when data sets follow a normal distribution. In the event that a data transformation or high degree of variability establishes a background limit that is less than conservative from a regulatory perspective, a nonparametric tolerance limit will be constructed. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

8) Section 4.1 of the SAP indicates that parametric confidence intervals will be constructed at the 99% confidence level, which is the highest confidence level in the guidance. Because statistical confidence is not the same as power, Section 7.4.1 of " the Unified Guidance recommends reversing the usual sequence: first select the desired level of power for the test, (I-B), and then compute the associated (maximum) false positive rate (a). In this way a pre-specified power can be maintained even if the sample size is too low to simultaneously minimize the risks of both Type I and Type II errors (i.e., false positives and false negatives)." Section 7.4.1 of the Unified Guidance indicates "statistical confidence is not the same as power. The confidence level merely indicates how often - in repeated applications - the population will contain the true population parameter (0); not how often the test will indicate an exceedance of a fixed standard. "It appears that parametric confidence intervals should be constructed at a confidence level based on power to minimize the risk of missing contamination above the GWPS. Justification for the use of confidence intervals set at the 99% confidence level should include calculations demonstrating that the true population coefficient of variation is no greater than 0.5.

*Section 4.1 of the SAP has been modified to address this request. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

9) Section 4.2 of the SAP states that "In Corrective Action, a well/parameter pair is declared to no longer be an SSI over the GWPS when the entire interval falls below a specified limit (i.e., the Upper Confidence Limit [UCL] falls below the limit), or when the LCL of the Append ix IV parameters does not exceed the GWPS for a period of three consecutive years." Section 7.5 of the Unified Guidance indicates that the proposed combined single-sample and multi-sample approach "based on both background sample size and sample variability is recommended for identifying the background GWPS at a suitably high enough level above current background to allow for reversal of the test hypotheses. ... a GWPS based on this method allows for a variety of confidence interval tests (e.g., a one-way normal mean confidence interval identified in [7.3] and [7.4])." The statistical methods referenced in ADEM Adm in. code r. 335-13- l 5-.06(9)(d)2 are applicable to detection monitoring tests referenced in ADEM Adm in. code r. 335-13- 15-.06(4)(f) and (g). Confidence intervals require justification for use under ADEM Admin. code r. 335- 13-15-.06(4)(f)5. Hypothesis test structures using confidence intervals should be consistent with equations [7.1] and [7.2] of the Unified Guidance when us in g the proposed method. It is recommended that the portion of the GWMP stating "or when the LCL of the Appendix IV parameters does not exceed the GWPS for a period of three consecutive years." be removed.

*Section 4.2 of the SAP has been modified to address this request by striking the phrase "or when the LCL of the Appendix IV parameters does not exceed the GWPS for a period of three consecutive years." The removed language does not appear in the GWMPs. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

10) The term "statistical limit " appears to be used twice in Section 5.2 of the SAP to describe the GWPS in assessment monitoring comparisons described in ADEM Admin. Code r. 335-13-15-.06(e), (f), and (g). It is recommended that the terminology used in the SAP be consistent with terminology used in Solid Waste regulations.

*We presume that the intended reference in this comment was to* ADEM Admin. Code r. 335-13-15-.06(6)(e), (f), and (g). *Section 5.2 of the SAP has been modified to address this request by using terminology consistent with Solid Waste regulations (i.e. groundwater protection standard or GWPS). See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

## **Individual CCR Unit Comments**

### Plant Barry Ash Pond

1) Table 2 provides a comparison of constituents between background and downgradient wells to demonstrate that proposed background wells are not impacted. Boron is listed as ND, however time series graphs included in the background update indicate that there are detections (not J values for boron) in proposed background monitoring wells at the Plant Barry Ash Pond. The footnote indicates that the detection was below the MDL, and thus considered ND. However, Table 3 shows the RL for boron as 0.05 mg/L, the detections are at minimum greater than 0.1 mg/L. Time series graphs are not included for other key indicator parameters (time series graphs were not constructed for this purpose, but they provide the only reference to historical data in the GWMP). It is recommended that the GWMP be revise d to accurately represent monitoring data.

*Table 2 has been updated to use average boron concentrations, using ½ the reporting limit where not detected. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

### Plant Barry Gypsum Pond

1) Table 2 provides a comparison of constituents between background and downgradient wells to demonstrate that proposed background wells are not impacted. Boron is listed as ND, however time series graphs included in the background update indicate that there are detections (not J values for boron) in proposed background monitoring wells at the Plant Barry Gypsum Pond. The footnote indicates that the detection was below the MDL, and thus considered ND. However, Table 3 shows the RL for boron as 0.05 mg/L, the detections are at minimum greater than 0.1 mg/L. Time series graphs are not included for other key indicator parameters (time series graphs were not constructed for this purpose, but they provide the only reference to historical data in the GWMP). It is recommended that the GWMP be revise d to accurately represent monitoring data.

*Table 2 has been updated to use average boron concentrations, using ½ the reporting limit where not detected. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

### Plant Gadsden Ash Pond

1) The Table of contents in the SAP indicates that Appendix A is "Background Screening and Compliance Evaluation" however no such document is attached, as was provided for the other CCR units. Please provide this in formation.

*Appendix A was inadvertently omitted from the SAP and is now included. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

**Plant Miller Ash Pond**

1) Section 5 .2 of the GWMP states that " Screen length will not exceed 10 feet without justification as to why a longer screen is necessary (e.g. significant variation in groundwater level)." Table 1 indicates that monitoring wells GS-AP-MW-8, GS-AP-MW-13, GS-AP-MW- 17V, MR-AP-MW- 19 HA, MR-AP-M W-28H, MR-AP-MW-30H, MR-AP-MW-31H, MR-AP-MW-33H, MR-AP- MW -36 H, and MR-AP-MW-2V were installed with 20 feet of well screen. It is recommended that the GWMP include information to explain the reason these wells were installed with longer screens.

*Section 5.2 of the GWMPs for Plants Miller and Gorgas have been modified to explain the reasoning for installing certain wells with screen lengths greater than 10 feet. As previously discussed with the Department, because of the nature of the geology at Plants Miller and Gorgas locating water-bearing fractures and zones is difficult, as evidenced by numerous dry holes drilled at the site. Additional well screen length is often necessary at fractured rock sites such as Plant Miller and Gorgas: groundwater yield is so low that wells are not able to be developed or sampled using conventional methods. The additional footage of well screen assists well development and sampling by providing a greater volume of groundwater and can provide more fracture and groundwater flow zone intersection. See the updated Groundwater Monitoring Plan submitted to the Department on August 24, 2020.*

2) Monitoring wells MR-AP-MW-21 and MR-AP-MW-23 are screened 95 feet in elevation apart. Groundwater elevations appear to indicate that these wells are screened in an unconfined aquifer. Additional information should be provided to identify the geology at MR-AP-MW-23 and provide rationale for installing the well screens such a distance apart. Figure 6C should identify the aquifer in which these wells are screened.

*A revised Figure 6C including the requested information has been included in the updated Groundwater Monitoring Plan submitted to the Department on August 21, 2020. Additional geologic information will be submitted in the upcoming Plant Miller groundwater delineation report due on or before September 30th, 2020.*

*At Plant Miller compliance wells vary in depth from approximately 40 feet below ground surface (ft BGS) to 291 ft BGS and are screened across multiple discrete flow zones. This variability in well screen depth and flow zone(s) can lead to natural variability in groundwater quality. These proposed upgradient locations were chosen based upon similar position on the Sequatchie Anticline and APC land ownership. These locations sit on the opposite limb of the Sequatchie Anticline, but at similar elevation, structural, and stratigraphic setting. Staggered depth* *intervals are an attempt to capture depth dependent variation in groundwater quality which can differ based upon age of groundwater and groundwater-rock interactions along heterogenous Pottsville Strata.*

3) The boring log for monitoring well MR-AP-MW-21 indicates that at 175 feet BGS the "Driller lost all water circulation at the beginning of Run 19 and never got it back. Mud tub drained out." It appears that the drilling fluid may have been los t down the borehole. Please clarify what occurred during the installation of proposed background monitoring well MR-AP-MW-21.

*As evidenced by the caliper log provided in the GWMP, the bore intersected a fracture between 174.5 ft BGS and 175.3 ft BGS. The loss of water circulation occurred across this interval indicating relatively high permeability and ability for the fracture to take drilling water. The use of the description "Mud tub" was not meant to imply that drilling mud was utilized in the boring advancement process. Sonic drilling relies on water as drilling lubricant and only water was utilized at this location. Groundwater quality samples collected from this location do not exhibit unusual physical appearance or a geochemical signature indicating drilling-induced bias.*

4) The monitoring well installation process described in Section 5.2 of the GWMP does not adequately describe the process indicated on provided boring logs. In many cases monitoring wells constructed at the site were installed after boring hundreds of feet to bedrock, conducting geophysical methods on the borehole, and abandoning the boring below the interval selected for monitoring with bentonite chips. The process of inserting bentonite chips into the borehole requires a specific process to ensure that bridging does not occur, resulting in an inadequate seal. It is recommended that the process used to install monitoring wells above abandoned bore holes be thoroughly described in the GWMP.

*Section 5.2 of the revised GWMP has been updated to include the requested information, including the use of bentonite and the process used to install monitoring wells over abandoned boreholes. See the updated Groundwater Monitoring Plan submitted to the Department on August 24, 2020.*

5) The elevation of the screened interval for monito ring well MR-AP-PZ-5 is incorrectly listed in Table 1. It is recommended that the table be corrected.

*Table 1 has been corrected and included in the updated Groundwater Monitoring Plan submitted to the Department on August 24, 2020.*

We appreciate the opportunity to provide these clarifications.  I will be pleased to discuss these items if that is helpful to you. If you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,

Dustin Brooks

Dustin G. Brooks
Environmental Affairs Supervisor

cc: Eric Wallis – Southern Company Services

# PLANT BARRY GYPSUM POND
# GROUNDWATER MONITORING PLAN

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## REVISED August 21, 2020

**PREPARED FOR:**

Alabama Power

Southern Company Services
Earth Sciences and Environmental Engineering

# REVISED GROUNDWATER MONITORING PLAN

# ALABAMA POWER COMPANY - PLANT BARRY

This *Revised Groundwater Monitoring Plan, Alabama Power Company - Plant Barry Gypsum Pond*, has been prepared to document that the Site groundwater monitoring network and monitoring plan meets the requirements described by ADEM Admin Code r. 335-13-15-.06(2). It has been completed under the supervision of a licensed Professional Geologist with Southern Company Services.

**Report Prepared by:**

Lauren Parker
8/21/2020

Lauren Parker
Geologist

Date

Gregory B. Dyer
8/21/2020

Gregory B. Dyer, P.G.
Alabama Professional Geologist No. 1471

Date

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# 1. INTRODUCTION

The Plant Barry Gypsum Pond Groundwater Monitoring Plan (GMP) has been updated to include additional information regarding the hydrogeological evaluation for the Site, the background groundwater monitoring network, procedures for updating the background data set, expansion of the groundwater monitoring network, and statistical methods used to evaluate groundwater quality data.

Groundwater monitoring at the Plant Barry Gypsum Pond is required by the Alabama Department of Environmental Management (ADEM or the Department), ADEM Admin Code r. 335-13-15-.06, to detect potential downgradient changes in groundwater quality. This GMP meets the requirements set forth for groundwater monitoring networks as described by ADEM Admin Code r. 335-13-15-.06(2). This plan describes the groundwater monitoring program for the Site, including the following key components: description of subsurface hydrogeology and uppermost aquifer, monitoring well network design, sampling and analyses program, and statistical analyses program.

Groundwater monitoring has occurred since 2016 and results reported to ADEM. Upon initiating detection groundwater monitoring at the Site in 2017 statistically significant increases (SSIs) of monitoring parameters were detected above background levels. Pursuant to State and Federal regulations assessment monitoring was implemented. During assessment monitoring, no Appendix IV monitoring parameters were detected at statistically significant levels (SSLs) above groundwater protection standards. The Site remains in semi-annual assessment monitoring.

The purpose of this plan is to present the groundwater monitoring network, field and lab procedures, and site-specific statistical analysis plan for Departmental review and approval. This plan also seeks to establish procedures or mechanisms for managing changes to the monitoring network and statistical analyses.

# 2. SITE LOCATION AND DESCRIPTION

Alabama Power Company's Plant James M. Barry Electric Generating Plant (Plant Barry) is in northeastern Mobile County, Alabama, approximately 23 miles north of Mobile, AL and 1 mile east of the city of Bucks, AL. The physical address is 15300 U.S. Highway 43 North, Bucks, Alabama 36512. Plant Barry lies in Section 36 of Township 1 North, Range 1 West, Sections 31 and 32 of Township 1 North, Range 1 East, Section 1 of Township 1 South, Range 1 West, and Sections 5 and 6 of Township 1 South, Range 1 East. Section/Township/Range data are based on visual inspection of USGS topographic quadrangle maps and GIS maps (USGS, 1980, 1982a, 1982b, 1983). The Gypsum Storage Pond is located south-southwest of the main plant and in between Sister's Creek to the north, Cold Creek to the south, and the plant's discharge canal to the east. **Figure 1, Site Location Map**, depicts the location of the Plant and Gypsum Pond with respect to the surrounding area.

The Gypsum Pond was constructed between 2007 and 2010 and consists of a 21.3-acre gypsum storage cell and a 10.4-acre sedimentation pond. F**igure 2, Site Plan Map**, depicts the general configuration of the coal combustion residual (CCR) unit and the site monitoring well network. **Figure 3, Site Topographic Map**, depicts the topography of the Site.

# 3. GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

The geology of the Site is characterized by sedimentary deposits ranging in age from Tertiary to Quaternary. The Pliocene age Citronelle formation, while present regionally, was not encountered at the Site. Sedimentary alluvial and terrace deposits of the Quaternary Period overlie largely unconsolidated Tertiary deposits in and adjacent to the flood plains of the Mobile River. At the site, Holocene age alluvial and low terrace deposits overlie undifferentiated Miocene Series sediments. Miocene Series sediments were primarily deposited in a regressive marine depositional environment. The Miocene Series is comprised of fine to very coarse-grained sand with interbedded sandy clays, silts, and shell fragments (Walter and Kidd, 1979). Siliciclastic sediments of the Miocene Series are often micaceous and pyritic, and contain wood fragments, shell debris, and heavy minerals (Chandler et al., 1985). Alluvial, low terrace, and coastal deposits reflect estuarine, deltaic, lagoonal, and shoreface deposition in lowland areas from late Pleistocene to Holocene time.

These deposits consist of fine to coarse sand, which can be rich in heavy detrital minerals (Hsu, 1960), silt, sandy clay, clay, and shell fragments (Chandler et al., 1985). **Figure 4, Site Geologic Map**, illustrates the surface geology at the site and neighboring areas. Generalized near-surface stratigraphy of the Site, in descending order, consists of (1) lean to flat clay down to an elevation of 10 feet MSL, (2) a poorly to well sorted sand with lenses of clay down to elevations between -45 and -50 feet MSL, and (3) a basal clay layer. Stratigraphy of the Site is shown **on Figure 5A, Geologic Cross-Section A-A'** and **Figure 5B, Geologic Cross-Section B-B'**. As shown on **Figure 5B**, groundwater monitoring wells are interpreted to be installed in the same Unit 3 sands that exist beneath the ash pond to the east. These units are considered part of the Pleistocene to Holocene age alluvial, low terrace, and coastal deposits described above. The uppermost clay interval is described as a gray to brown to reddish-yellow, sandy lean clay that occasionally grades into an organic rich fat clay near the base of the unit. Some spatial heterogeneity is observed, as the clay is not present at boring location MW-1 and found to be much thicker at boring location MW-10. Portions of this clay rich interval are likely inclusive of fill materials placed during construction of the Gypsum Pond.

Underlying the clay, an interval consisting largely of coarse sediments and includes zones of clayey sand, well-sorted sand, poorly-sorted sand, and gravelly, sand to gravel. The vertical and horizontal heterogeneity of these sands are not uncommon as sand beds deposited in stream or creek valleys are very lenticular and generally, can be traced over only short distances (Davis, 1987). Clay stringers or clay rich intervals are also encountered but are not prevalent. These clays represent low energy deposition, whereas sands and gravels represent higher energy environments. Gravel or sandy gravel intervals might be representative of buried creek beds. Beneath the sandy layer, a mottled gray to brown fat clay with trace wood fragments and sand to medium to high plasticity organic clay is encountered. At some locations (MW-6 and MW-7), the upper surface of this unit has also been described as a clayey sand or clayey gravel. Borings conducted at the site, largely, did not penetrate the vertical extent of this clay unit;

however, limited data suggests this unit to be 10 feet in thickness or greater beneath the site. The two major aquifers in northern Mobile County are the Miocene-Pliocene Aquifer and the Watercourse Aquifer. The thickness of the Miocene-Pliocene Aquifer, which consists of the Miocene Series undifferentiated and the Pliocene-age Citronelle Formation, is about 3,400 feet in coastal areas to the south, but it is thinner in northern Mobile County. This aquifer consists of beds of sand, gravel and clay, where groundwater flows through sand and gravel beds that are irregular in thickness and of limited lateral extent. Clay intervals between the sand units are not laterally extensive enough to prevent downward movement of ground water, but they do provide semi-confinement in some areas. Correlation of one sand unit to another is difficult, due to the discontinuous nature of these deposits. In Northern Mobile County, the principal water-bearing sands in the aquifer are at the base of the Miocene- Pliocene sequence (Gillett et al., 2000). The Watercourse Aquifer is comprised of Quaternary alluvial and low terrace deposits consisting of interbedded sand, gravel, and clay. Buried sand and gravel channels, which yield large amounts of water, are surrounded by silty and clayey sediments that do not yield significant amounts of water but allow infiltration of water to recharge the sand and gravel beds (Gillett et al., 2000). Boring and well construction logs are presented in **Appendix A, Well Installation and Field Logs.**

The uppermost aquifer beneath the site corresponds to alluvial, low terrace, and coastal deposit sands, which are part of the Watercourse Aquifer system. At the site, the Watercourse Aquifer consists of medium to coarse sands with discrete gravelly, sand and gravel. Clay nodules, lenses, and stringers are present, but are not prevalent. Depth to the top of the Watercourse Aquifer generally ranges between 15 and 25 feet below ground surface (BGS) and appears to extend down to approximately 65 to 70 feet BGS, where clays are encountered. Groundwater recharge to the Watercourse Aquifer is largely accomplished via infiltration of precipitation and subsequent percolation down to the water table. Temporary recharge to the aquifer might occur during high stage or flood events of the Mobile River where surface water could infiltrate via hydraulically connected sand beds or infiltration of flooded water. The latter would occur in areas where land has been inundated by flood waters. The Gypsum Pond is located above the 100 year storm stage. Regionally, the Watercourse and Miocene-Pliocene Aquifers are considered to be hydraulically connected due to the discontinuous nature of clay aquitards. However, locally semiconfined to confined conditions might be present when a sufficient aquitard separates the aquifers or sand units.

Site groundwater has a flow pattern that is a subdued replica of the natural topography and has gravity as the dominant force driving its flow. Groundwater flows from higher topographic elevations south of the Gypsum Pond to lower topographic elevations to the north. East of the Gypsum Pond, groundwater flow bends towards the northeast. Groundwater flow is through porous sands of the Watercourse Aquifer (rates can be estimated using Darcy's flow-equations). The potentiometric surface presented in **Figure 6, Potentiometric Surface Map (October 2, 2019)**, indicate that groundwater flow direction is consistent despite seasonal fluctuations.

# 4. SELECTION OF WELL LOCATIONS

According to ADEM Admin Code r. 335-13-15-.06(2)(a), the groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

1. Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit; and
2. Accurately represent the quality of groundwater passing the waste boundary of the CCR unit.

ADEM Admin Code r. 335-13-15-.06(2)(b) states that the number, spacing, and depths of groundwater monitoring system wells must be determined based upon Site-specific technical information that must include a characterization of:

1. Aquifer thickness, groundwater flow rate, groundwater flow direction, including seasonal and temporal fluctuations in groundwater flow; and
2. Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

ADEM Admin Code r. 335-13-15-.06(2)(c) requires the groundwater monitoring system to include the number of monitoring wells necessary to meet the performance standard set forth in the rules. The monitoring system must contain a minimum of one upgradient and three downgradient monitoring wells but consist of additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit. Boring logs and well construction data for each compliance and delineation well are presented in **Appendix A, Well Installation and Field Logs.**

## 4.1 Compliance Monitoring Network

Groundwater monitoring wells comprising the compliance monitoring network are installed to monitor the uppermost occurrence of groundwater beneath the Site and accurately represent the quality of groundwater passing the waste boundary of the CCR unit. Locations were selected based on facility layout and Site geologic and hydrogeologic considerations. The groundwater monitoring network at Plant Barry Gypsum Pond is subdivided into upgradient background and compliance locations based upon potentiometric contours and interpretation of groundwater flow direction.

Compliance wells are screened within the uppermost aquifer and are used to assess potential impacts to the first “aquifer” in the event of a release. Groundwater monitoring wells are designed and constructed using "Design and Installation of Groundwater Monitoring Wells in Aquifers", ASTM Subcommittee D18.21 on Groundwater Monitoring, as a guide. **Table 1, Groundwater Monitoring Well Network Details,** and **Figure 7, Monitoring Well Location Map**, present the designed purpose and locations of monitoring wells with respect to the facility. Monitoring wells will generally be installed within Unit 3 sands.

Two piezometers have been utilized historically for purposes of better defining groundwater flow direction at the Site (BY-GSA-PZ-11 and BY-GSA-PZ-12). At the request of the Department, BY-GSA-PZ-11, will be converted to downgradient monitoring wells during the first semi-annual monitoring event of 2020.

## 4.2 Background Monitoring Wells

Background groundwater is the baseline quality of groundwater that is representative of the aquifer being monitored, and that has not been affected by the CCR unit. A background groundwater monitoring network has been identified at the Site based on groundwater flow conditions, groundwater quality, and statistical screening of the data in accordance with the Unified Guidance (*Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance*, March 2009, USEPA 530/R-09-007). The following describes the selected background network based on these criteria.

As presented on **Table 1 and Figure 7**, 4 monitoring wells (BY-GSA-MW-1 through 4) located upgradient of the Gypsum Storage Area (GSA) serve as background monitoring wells for the site. The following provides a Site-specific evaluation of the background network using these criteria.

### 4.2.1 Groundwater Elevations and Flow

Groundwater elevations and potentiometric surfaces constructed for the Site depict a definitive groundwater flow direction and establish areas hydraulically upgradient of the Gypsum Pond. As shown on **Figure 6**, groundwater generally flows from southwest to northeast across the Gypsum Pond towards the Plant Barry Ash Pond and Mobile River. This groundwater flow direction supports an upgradient designation for wells BY-GSA-MW-1 through BY-GSA-MW-4 which are generally located to the south and southwest of the Gypsum Pond. As shown on **Figure 5B**, these background wells are screened in the same hydrostratigraphic unit (Unit 3 sand) as downgradient wells and provide representative groundwater quality for comparison with downgradient wells.

### 4.2.2 Groundwater Geochemistry

In addition to analyzing groundwater flow at the Site, a review of groundwater geochemistry and field parameters were conducted as a part of upgradient well screening. As presented in **Table 2, Upgradient Comparisons – Key Indicator Parameters**, concentrations of key gypsum ($CaSO_4$-$2H_20$) indicator parameters such as calcium and sulfate are low and not indicative of gypsum leachate. Similarly, other potential indicators such as boron, arsenic, and lithium are not detected. Field parameters revealed no anomalies and were generally similar across the Site, which is consistent with a lined facility and wells installed in the same hydrostratigraphic unit. This geochemical evaluation provided no indication of a CCR impact and support an upgradient designation for monitoring wells BY-GSA-MW-1, BY-GSA-MW-2, BY-GSA-MW-3, and BY-GSA-MW-4.

### 4.2.3 Statistical Screening

Details regarding screening of the background is presented in **Appendix B, Statistical Analysis Plan**. Groundwater quality was determined to be representative of a statistical background following screening in accordance with the Unified Guidance (Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance, March 2009, USEPA 530/R-09-007).

## 4.3 Downgradient Compliance Wells

Adequately locating and screening downgradient monitoring wells are essential to being able to detect potential impacts to groundwater from the CCR Unit. A tightly, spaced (350 – 500 ft) downgradient monitoring well network (BY-GSA-MW-5 through BY-GSA-MW-10) was installed along the Gypsum Pond boundary to the west, north, and south. Additionally, piezometer BY-GSA-PZ-11 is being converted to a downgradient monitoring well and will be sampled semi-annually beginning with the first semi-annual sampling event in 2020. These wells were appropriately located and screened to represent groundwater quality passing the waste boundary and detect potential gypsum leachate impacts to groundwater.

## 4.4 Delineation Well Network

Pursuant to ADEM Admin. Code r. 335-13-15-.06(6)(g)2., if assessment monitoring is implemented and exceedances of GWPS are observed, wells may be required to delineate the nature and extent of exceedances. A site-specific well delineation plan will be submitted to the Department for approval. Any newly-installed delineation well will be sampled for Appendix III and IV constituents as part of the assessment groundwater monitoring program until the Department approves a change to the monitoring program.

Delineation wells, when installed, will be sampled initially after development and following this initial sampling event, sampling of delineation wells will be transitioned to the semi-annual compliance sampling event schedule. Occasionally, due to the remote nature or location along surface water bodies, delineation wells may not be accessible due to unavoidable circumstances (flooding, impassable access, etc). In this event, delineation wells will be sampled at a later date or during the next scheduled semi-annual sampling event.

### 4.5 Updating the Background Well Network

The intention of this groundwater monitoring plan is to present the final groundwater monitoring network and designation of monitoring wells for permitting. However, in the future and over time the upgradient or background well network may be updated by adding or removing wells, updating background periods, re-designating existing wells, or modifying the background data set.

Changes to the background well network and data set will be made only after receipt of Departmental approval.

If an update or modification to the permitted background network is recommended in the future, APC will complete the following:

- A notice will be submitted to the Department describing the proposed change(s) and the rationale for the change. The notice will contain statistical screening of the background data set and include sufficient information to evaluate and approve the request.
- Upon approval by the Department, the background network and data set will be adjusted pursuant to the proposal and used for future analyses.
- A revised groundwater monitoring plan and minor modification will be submitted to the Department.

The Statistical Analysis Plan in **Appendix B** provides details regarding requesting Department approval for updates and changes to the background well network and data set.

When well re-designations are approved by the Department, new statistical limits will be calculated based upon the resulting monitoring well network. When background is updated, historical reports and exceedance lists will not be updated unless approved by the Department. In general, changes will apply to future analysis unless an immediate change is warranted. If delineation or groundwater corrective action is underway, the new background data will be applied to those actions as appropriate with Department approval.

When background data is updated changes will apply to future analysis unless an immediate change is warranted. If delineation or groundwater corrective action is underway, the new background will be applied to those actions as appropriate with Department approval.

# 5. MONITORING WELL DRILLING, CONSTRUCTION, ABANDONMENT & REPORTING

The following describes monitoring system performance standards that have been applied to monitoring well activities subsequent to this monitoring plan and that will be applicable to all work performed in the future.

## 5.1 DRILLING

Drilling methodology may include hollow stem augers, direct push, air rotary, mud rotary, or rotosonic techniques. The drilling method will minimize the disturbance of subsurface materials and will not cause impact to the groundwater. Borings will be advanced using an appropriate drilling technology capable of drilling and installing a well in Site-specific geology. Drilling equipment will be decontaminated before use and between borehole locations using the procedures described in the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Field Equipment Cleaning and Decontamination as a guide.

Sampling or coring may be used to help determine the stratigraphy and geology. Samples will be logged by a qualified groundwater scientist. Screen depths will be chosen based on the depth of the uppermost aquifer. Logging will be performed by a geologist or geotechnical engineer registered in the State of Alabama or working under the direction of a geologist or engineer registered in Alabama.

## 5.2 DESIGN AND CONSTRUCTION

Well construction materials will be sufficiently durable to resist chemical and physical degradation and will not interfere with the quality of groundwater samples. Groundwater monitoring wells are designed and constructed in accordance with ADEM Admin Code r. 335-13-15-.06(2)(e) using "Design and Installation of Groundwater Monitoring Wells in Aquifers", ASTM Subcommittee D18.21 on Groundwater Monitoring as a guide. Well installations will generally follow the procedures outlined below.

Soil borings will be advanced from the land surface to the desired depth by utilizing conventional drilling methods, such as hollow-stem augers, rotary wash, rotosonic, or direct push technology. Only potable water will be used; drilling muds and air systems will be avoided to the extent possible.

The minimum soil boring diameter will be four inches larger than the outside diameter of the well casing, and a minimum well casing diameter of two inches will be used. Up to ten feet of ASTM NSF-rated Schedule 40 PVC with 0.010- in. slots will be set at an approximate depth of 10-20 ft below the typical water table depth. ASTM NSF-rated Schedule 40 PVC flush-threaded riser casing with will be used to finish the well approximately 3 feet of above-ground surface. A filter pack consisting of well-rounded and chemically inert materials (e.g., clean quartz) will be packed around the screen from the bottom of the borehole to 2 feet above the top of the screen. Sodium bentonite pellets will be placed to create a seal above the screen in the annulus for a minimum of 2-ft above the filter pack by dropping or washing down with potable water, or by tremie method. The annular space above the seal will be filled via tremie injection with a high-solids bentonite slurry, neat cement, or cement-bentonite grout mixture to the ground surface.

The design and construction of the intake of the groundwater wells will: (1) allow sufficient groundwater flow to the well for sampling; (2) minimize the passage of formation materials (turbidity) into the well; and (3) ensure sufficient structural integrity to prevent the collapse of the intake structure.

Each groundwater monitoring well will include a well screen designed to limit the amount of formation material passing into the well when it is purged and sampled. Screens with 0.010-inch slots have proven effective for the earth materials at the Site and will be used unless geologic conditions discovered at the time of installation dictate a different size. Screen length will not exceed 10 feet without justification as to why a longer screen is necessary (e.g. significant variation in groundwater level). If the above prove ineffective for developing a well with sufficient yield or acceptable turbidity, further steps will be taken to assure that the well screen is appropriately sized for the formation material. This may include performing sieve analysis of the formation material and determining well screen slot size based on the grain size distribution.

Pre-packed dual-wall well screens may be used for well construction. Pre-packed well screens combine a centralized inner well screen, a developed filter sand pack, and an outer conductor screen in one integrated unit composed of inert materials. Pre-packed well screens will be installed following general industry standards and using the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Design and Installation of Monitoring Wells as a general guide. If the dual-wall pre-packed-screened wells do not yield sufficient water or are excessively turbid after development, further steps will be taken to assure that the well screen is appropriately sized for the formation material. This may include performing sieve analysis of the formation material and determining well screen slot size based on the grain size distribution.

The monitoring wells will be completed with concrete pads approximately 6-inches thick extending approximately 3 feet around the well and sloping away from the well. Each well will be capped and enclosed in a lockable above-ground protective cover with weep holes to prevent build-up of water within the protective casing. Wells located in areas with potential traffic will require a minimum of three surface protection bumper guards (bollards). All wells will have proper identification including the well identification number, total depth, and installation date.

## 5.3 Wells with Inconsistent Water Levels

The following procedures should be followed when field observations suggest that saturated conditions may exist at the target borehole depth at temporary and permanent well locations, but only minor amounts of free water (i.e., water capable of being sampled from a well casing) are observed in the well boreholes during drilling. These procedures should not be followed when "dry" (i.e., no free water) conditions are observed in the well boreholes at the target borehole depth. The field geologist will communicate with the project manager to determine if the boring should then be properly abandoned.

The decision to install a permanent well will be based on measurement of a target water column length. The target water column length for permanent wells is five (5) feet based on placement of the pump intake at least one (1) foot above the base of the screen and the well yielding sufficient sample volume to collect a complete sample set with quality assurance/quality control samples within one (1) day.

The following summarizes the procedure that will be followed:

- Prepare a workplan describing, at a minimum, well location(s), purpose, drilling method, target depth, and water level performance standards outlined below and submit to the Department per ADEM Admin Code r. 35-13-15-.06(2)(e).
- Drill the monitoring well borehole to the target depth.
- If sonic or core drilling, and a significant volume of drilling lubricant (drilling water) is used in tight formations (low permeability), the purging of 1 borehole volume and subsequent monitoring of water level recovery may be utilized to evaluate recharge rate.
- If the target water column length is not observed in the borehole after drilling, allow the water level in the borehole to equilibrate for 24 hours. The area around the borehole will be prepared to prevent surface water infiltration into the borehole.
- If a minimum of 5 feet of water is present in the borehole (or 4 feet of water will be present above the planned pump intake depth) after 24 hours, install the monitoring well at the target depth.
- If the above water column criteria are not present in the borehole after 24 hours, then terminate drilling at the location and grout the borehole following the appropriate Department standards.
- If a well is not installed, the Department will be notified, and an alternative well installation plan developed if necessary, to meet Department requirements.

## 5.4 WELL DEVELOPMENT

Upon completion of well construction, the monitoring wells will be developed using a combination of surging and purging to remove excess fines and sediments and to promote good hydraulic communication with the aquifer. Development will continue until the purged water is free of visible fines, and water quality field parameters (turbidity, pH, temperature, and conductivity) have stabilized. In cases of slow recharge and slow turbidity reduction, potable water may be injected and purged as needed to remove fines. If this approach is used, a minimum of three times the volume of water introduced must be purged from the well.

## 5.5 ABANDONMENT

If a permitted monitoring well should be abandoned, procedures will be followed in accordance with ADEM Admin Code r. 335-13-15-.06(2)(g). If practical, the entire well casing and screen will be removed. Removal can be accomplished by over-drilling the well with hollow stem augers and removing the grout and filter pack material from the well, followed by removal of the casing and the well screen. The clean borehole will then be backfilled with neat Portland cement from bottom to top by pressure grouting using the positive displacement (tremie) method. If the casing cannot be removed the well will be tremie grouted from the bottom of the well upwards with a neat cement. Additionally, a concrete seal will be placed at the ground surface. In either case, the top two feet of the borehole will be poured with concrete to insure a secure surface seal (plug).

Records of well abandonment activities will be kept for each well abandoned. The records will include the depth of emplacement and volume of all abandonment materials, methods of casing removal, and depth to water and well bottom prior to abandonment. A copy of these records will be provided to ADEM and a copy placed in the operating record.

If a replacement well is required, a plan and justification will be submitted to support replacement location(s) and screened intervals along with the proposal to abandon wells.

## 5.6 DOCUMENTATION

Pursuant to ADEM Admin. Code r. 335-13-15-.06(2)(e)4., APC will document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. The name of the drilling contractor and type of drill rig will also be documented.

# 6. GROUNDWATER SAMPLING AND ANALYSIS PLAN

Pursuant to ADEM Admin. Code r. 335-13-15-.06(4), the following section describes groundwater sampling requirements with respect to parameters for analysis, sampling frequency, sample preservation and shipment, analytical methods, chain of custody control, and quality assurance and quality control. Groundwater samples used to provide compliance monitoring data will not be filtered prior to collection.

## 6.1 SAMPLE COLLECTION

Groundwater samples will be collected from the monitoring well network as part of the Detection Monitoring Program, and potentially as part of the Assessment Monitoring Program, in accordance with the APC Low-Flow Groundwater Sampling Technical Standard Operating Procedures (TSOP) included as **Appendix C**. Samples will be collected using low-volume purge, or “low-flow” sampling methods with peristaltic or bladder pumps. Depth to water readings at each well location will be taken prior to sampling. Water quality parameters (pH, redox potential, conductivity, etc.) will be measured during purging and recorded on a field sampling form. Samples will be collected after field parameter stabilization criteria are met.

Low-flow (minimal drawdown) groundwater sampling procedures will be used for purging and sampling monitoring wells that will sustain a pumping rate of at least 100 milliliters per minute (mL/min) without significant water-level drawdown. Flow rates should not exceed 500 mL/min. Field water quality parameters recorded during purging will be used as criteria to determine when purging has been completed.

Where non-dedicated pumps are used, the sampling equipment must be slowly lowered into the well so as to avoid agitation of the water column. Sampling equipment and pump intakes must not extend below the midpoint of any well screen unless the well is known to drawdown and is a threat to go dry even with low flow rates or the water level in the well does not extend above the screened interval.

Most wells are screened with the top-of-screen below the static water level in the well. In these wells (1) the water level in the well must not be drawn down below the top of screen, and (2) stabilization of the water column will be considered achieved when three consecutive water level measurements vary by 0.33 feet or less at a pumping rate of no less than 100 mL/min.

If the static (pre-pumping) water level is below the top-of-screen, the water level must not be drawn down below the top of pump where it can be accurately measured.

Field water quality parameters (temperature, pH, turbidity, conductivity, dissolved oxygen and oxidation-reduction potential) will be measured but not all will be used for determining stabilization. Stabilization will be considered achieved and purging will be considered complete when three consecutive measurements of each field parameter vary within the following limits:

- 0.2 standard units for pH,
- 5% for specific conductance,
- 0.2 mg/L or 10% for DO > 0.5 mg/L (whichever is greater),
- IF DO < 0.5 mg/L there is no stabilization criteria for DO,
- Turbidity (see the following section for more detail), and
- Temperature and ORP – record only, no stabilization criteria.

The goal when sampling is to attain a turbidity of less than 5 nephelometric turbidity units (NTU); however, samples may be collected where turbidity is less than 10 NTU and the stabilization criteria described above are met. If sample turbidity is greater than 10 NTU and all other stabilization criteria have been met, samplers must take reasonable steps (i.e., Additional purging) to reduce the turbidity to 10 NTU or less.

- If turbidity is less than 10 NTU, and all other parameters are stabilized, the well should be sampled.
- Where turbidity remains above 10 NTU and turbidity has stabilized within 10% for 3 consecutive readings, the well has been pumped for at least 2 hours and the water quality indicator parameters have stabilized, a complete sample set using the appropriate, pre-preserved containers will be collected followed by an additional sample set using unpreserved containers to be lab filtered and analyzed for the dissolved portion of target constituents.

Samplers must check the “Lab FILTERED” box on the chain-of-custody form and properly note on the sample label.

If necessary, and pursuant to industry-accepted guidance, stabilization criteria may be adjusted to accommodate Site-specific or well-specific conditions (USEPA, 1996).

## 6.2 SAMPLE PRESERVATION AND SHIPMENT

Groundwater samples will be collected in the designated size and type of containers required for specific parameters and laboratory methods. Sample bottles will be pre-preserved and do not require field preservation. Where temperature control is required, field personnel will place samples in a cooler with ice immediately after sample collection. Dry ice, blue ice, and other cooling packs may not be used. Samples will be cooled to less than 6°C and maintained until receipt by the analytical laboratory.

Samples will be delivered to the APC General Testing Laboratory within 48 hours of collection following appropriate temperature control and chain-of-custody procedures. At no time will samples be analyzed after the method-prescribed hold time has expired. If using commercial shipping methods and relinquishing control of the samples to a third-party courier, the shipping cooler will be sealed using a custody seal to identify samples which may have been tampered with during transport to the laboratory.

The seal must be labeled with instructions for the laboratory to notify the shipper if the seal is broken when the samples arrive at the laboratory.

## 6.3 ANALYTICAL METHODS

As shown on **Table 3, Analytical Methods and Project Reporting Limits**, the groundwater samples will be analyzed using methods specified in USEPA Manual SW-846, EPA 600/4-79-020, Standard Methods for the Examination of Water and Wastewater (SM18-20), USEPA Methods for the Chemical Analysis of Water and Wastes (MCAWW), American Society for Testing and Materials (ASTM), or other suitable analytical methods approved by ADEM. Any practical quantitation limit (reporting limit) that is used will be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility. Field instruments used to measure pH must be accurate and reproducible to within 0.2 Standard Units (S.U.).

## 6.4 CHAIN OF CUSTODY CONTROL

The COC record is required for tracing sample possession from time of collection to time of receipt at the laboratory. The National Enforcement Investigations Center (NEIC) of USEPA considers a sample to be in custody under any of the following conditions:

- It is in the individual’s possession
- It is in the individual’s view after being in his/her possession
- It was in the individual’s possession and (s)he locked it up (e.g. locked in a vehicle)
- It is in a designated secure area

All samples will be handled under COC procedures beginning in the field. The field team leader will be the field sample custodian and will be responsible for ensuring that COC procedures are followed. The use of electronic COCs are encouraged and utilized by APC Water Field Services. The record will contain the following information:

- Sample destination and transporter
- Sample identification numbers
- Signature of collector
- Date and time of collection
- Sample type
- Identification of monitoring well
- Number of sample containers
- Parameters requested for analysis
- Signature of person(s) involved in the chain of possession
- Inclusive dates of possession

The samples must be in the custody of assigned personnel, an assigned agent, or the laboratory. If the samples are transferred to other employees for delivery or transport, the sampler or possessor must relinquish possession and the samples must be received by the new owner.

If the samples are being shipped, a hard copy COC must be signed and enclosed within the shipping container in a watertight bag. Shipping agents such as Federal Express do not sign the chain-of-custody form. The shipping receipt must be retained by the samplers as part of the record documenting sample transfer.

## 6.5 SAMPLING PARAMETERS AND FREQUENCY

**Table 4, Groundwater Monitoring Parameters and Frequency** presents the groundwater monitoring parameters and sampling frequency. A minimum of eight independent samples from each groundwater well will be collected and analyzed for 40 CFR 257, Subpart D, Appendix III and Appendix IV test parameters to establish a background statistical dataset.

DETECTION MONITORING

After background has been established, detection monitoring will be performed in accordance with ADEM Admin. Code r. 335-13-15-.06(5)(b). The detection monitoring frequency for the Appendix III parameters will be at least semi-annual during the active life of the facility and the post-closure care period.

ASSESSMENT MONITORING

If required, assessment monitoring will be performed per ADEM Admin. Code r. 335-13-15-.06(6). Assessment monitoring is required whenever a statistically significant increase (SSI) over background levels has been detected for one or more of the constituents listed in 40 CFR 257, Subpart D, Appendix III test parameters.

For assessment sampling at the Site, two semi-annual sampling events will be performed. As shown on **Table 4**, the full suite of Appendix III and IV constituents will be sampled and statistically analyzed semiannually at all compliance monitoring wells during assessment monitroing.

A proposal may be made to the Department to modify the subset of delineation wells sampled during assessment monitoring or the sampling frequency. Proposed changes will be implemented following Department approval.

## 6.6 QUALITY ASSURANCE AND QUALITY CONTROL

All field quality control samples will be prepared the same as compliance samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected during each sampling event.

FIELD EQUIPMENT RINSATE BLANKS

In cases where sampling equipment is not new or dedicated, an equipment rinsate blank will be collected at a rate of one blank per 10 samples. The equipment rinsate blanks are prepared in the field using the same distilled or deionized water used for decontamination. The water is poured over and through each type of sampling equipment and submitted to the laboratory for analysis of target constituents. If the equipment is dedicated or new for each monitoring well, equipment rinsate blanks will be collected at a rate of 1 blank per CCR unit. If a plant has multiple CCR storage units, an equipment rinsate blank should be collected at each unit (e.g. ash pond, gypsum storage, etc.)

FIELD DUPLICATES

Field duplicates are collected by filling additional containers at the same location, and the field duplicate is assigned a unique sample identification number. One field duplicate will be collected for every group of 10 samples.

FIELD BLANKS

Field blanks are collected in the field using the same distilled or deionized water source that is used for decontamination. The water is poured directly into the supplied sample containers in the field and submitted to the laboratory for analysis of target constituents. One field blank will be collected for every group of 10 samples.

The groundwater samples will be analyzed by licensed and accredited laboratories through the National Environmental Laboratory Accreditation Program (NELAP). Lab data reports will include the records of standard laboratory QA/QC reports.

# 7. REPORTING RESULTS

The following subsections outline reportable results and delivery.

## 7.1 14-Day Notification

Pursuant to ADEM Admin. Code r. 335-13-15-.06(4)(h)3., the Department will be notified of any new statistical exceedances identified during detection or assessment monitoring within 14 days. Since the exceedance will also be described in subsequent monitoring reports and addressed pursuant to the rules, the initial notification will not be repeated for the same exceedance in subsequent monitoring events.

## 7.2 Semi-Annual Groundwater Monitoring Reports

Pursuant to ADEM Admin. Code R. 335-13-15-.06(1)(f), an annual groundwater monitoring and corrective action report documenting the results of sampling and analysis will be submitted to ADEM by January 31st of each year. Pursuant to ADEM Admin. Code r. 335-13-15-.06(5)(g), a semi-annual report to coincide with the semi-annual groundwater sampling will also be submitted. The semi-annual report will be submitted to ADEM by July 31st of each year. At a minimum, semi-annual and annual reports will include:

1. A narrative describing sampling activities and findings including a summary of the number of samples collected, the dates the samples were collected and whether the samples were required by the detection or assessment monitoring programs.
2. A brief overview of purging/sampling methodologies.
3. If applicable, analytical results for samples collected from each delineation well during the semi-annual period.
4. Discussion of results.
5. Recommendations for future monitoring consistent with ADEM's CCR rules.
6. Potentiometric surface contour map for the aquifer(s) being monitored, signed and sealed by an Alabama-registered P.G. or P.E.
7. Table of as-built information for groundwater monitoring wells including top of casing elevations, ground elevations, screened elevations, current groundwater elevations and depth to water measurements.
8. Groundwater flow rate and direction calculations.
9. Identification of any groundwater wells that were installed or decommissioned during the preceding year, along with a narrative description of why these actions were taken.

10. A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels.

11. If applicable, assessment monitoring results.

12. Any alternate source demonstration completed during the previous monitoring period, if applicable.

13. Laboratory Reports and COC documentation.

14. Field sampling logs including field instrument calibration, indicator parameters and parameter stabilization data.

15. Documentation of non-functioning wells, dry surface water and underdrain sampling locations.

16. Table of current analytical results for each well, highlighting statistically significant increases and concentrations above maximum contaminant level (MCL).

17. Statistical analyses.

18. Certification by a qualified groundwater scientist.

# 8. STATISTICAL ANALYSIS

Groundwater quality data from each sampling event will be statistically evaluated to determine if there has been a statistically significant change in groundwater chemistry. Historical background data will be used to determine statistical limits. According to ADEM Admin. Code r. 335-13-15-.06(4)(f), which incorporates the statistical analysis requirements of 40 CFR 257.93, the Site must specify in the operating record the statistical methods to be used in evaluating groundwater monitoring data for each constituent.

A Site-specific statistical analysis plan that provides details regarding the statistical methods to be used will be placed in the Site's operating record pursuant to ADEM Admin Code r. 335-13-15-.06(4)(f). **Appendix B, Statistical Analysis Plan**, provides the Site-specific plan.

The Sanitas Groundwater statistical software is used to perform the statistical analyses. Sanitas is a decision support software package that incorporates the statistical tests required of RCRA Subtitle C and D facilities by EPA regulations. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities as well as with the USEPA Unified Guidance (2009). The following subsections provide a high-level summary of the statistical analyses plan as broken down by monitoring program status.

## 8.1 Detection Monitoring

As discussed in **Appendix B**, Intrawell prediction limits, combined with a 1-of-2 verification strategy, are used for chloride and sulfate to determine whether there has been a SSI over background groundwater quality. Interwell prediction limits, combined with a 1-of-2 verification strategy, are used to evaluate boron, calcium, fluoride, pH, and TDS. Intrawell prediction limits use screened historical data within a given well to establish limits for parameters at that well. The most recent sample from the same well is compared to its respective background to identify SSIs over background. Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent. The most recent sample from each downgradient well is compared to the background limit to identify SSIs.

Groundwater Stats Consulting demonstrated that these test methods were appropriate in the attached Statistical Analysis Plan, which was updated in October 2019 with additional data screening and evaluation. Time series plots were used to screen proposed background data for suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective. Suspected outliers at all wells for Appendix III parameters are formally tested using Tukey's box plot method and, when identified, flagged in the computer database.

The following adjustments are also applicable to the statistical analysis per the Unified Guidance:

- No statistical analyses are required on wells and analytes containing 100% non-detects (EPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in the background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for non-detects is the practical quantitation limit (PQL) as reported by the laboratory.
- When data contain between 15-50% non-detects the Kaplan-Meier non-detect adjustment is applied to the background data.
- Non-parametric prediction limits are used on data containing greater than 50% non-detects.

## 8.2 Assessment Monitoring

When in assessment monitoring, Appendix IV constituent concentrations are compared to a GWPS. Appendix IV analysis uses the pooled results from the individual downgradient well to develop a well-specific Confidence Interval that is compared to the statistical limit (GWPS). The statistical limit is either the Inter-well Tolerance Limit (i.e. background) calculated using the pool of all available upgradient well data (see Chapter 7 of the Unified Guidance), or an applicable GWPS published in the regulations such as the Maximum Contaminant Level (MCL). As discussed in the Statistical Analysis Plan, Appendix IV background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Interwell Tolerance Limits (background) were calculated using pooled upgradient well data for Appendix IV parameters. When the Lower Confidence Limit (LCL), or the entire interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSL.

As described in 40 CFR § 257.95(h)(1)-(3) and specified by ADEM Variance dated April 15, 2019, the GWPS is:

(1) The maximum contaminant level (MCL) established under 40 CFR §141.62 and 141.66.
(2) Where an MCL has not been established:
    (i) Cobalt 0.006 mg/L;
    (ii) Lead 0.015 mg/L;
    (iii) Lithium 0.040 mg/L; and
    (iv) Molybdenum 0.100 mg/L.
(3) Background levels for constituents where the background level is higher than the MCL or rule-specified GWPS.

Details regarding the statistical analysis of assessment monitoring results are included in the Statistical Analysis Plan in **Appendix B**.

### 8.2.1 Delineation Wells

During assessment monitoring, and if delineation wells are required, any newly-installed delineation well will be sampled for Appendix III and IV constituents on the same schedule as the compliance monitoring well network.  A proposal may be made to the Department to modify the subset of delineation wells sampled during assessment monitoring, or the sampling frequency.  Data obtained from delineation wells will be compared to the GWPS numerically until sufficient data is obtained to prepare well-specific Confidence Intervals.

# 9. REFERENCES

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# Tables

## Table 1.
## Groundwater Monitoring Well Network Details

| Well Name | Purpose | Installation Date | Northing [1] | Easting [1] | Ground Elevation [2] | Top of Casing Elevation [2] | Well Depth (ft.) Below Top of Casing | Top of Screen Elevation [2,4] | Bottom of Screen Elevation [2,4] | Screen Length (ft.) |
|---|---|---|---|---|---|---|---|---|---|---|
| BY-GSA-MW-1 | Upgradient | 10/7/2015 | 362040.419 | 1808280.793 | 17.49 | 20.66 | 43.83 | -15.94 | -5.94 | 10 |
| BY-GSA-MW-2 | Upgradient | 10/7/2015 | 361970.572 | 1807662.482 | 17.00 | 19.95 | 47.58 | -20.18 | -10.18 | 10 |
| BY-GSA-MW-3 | Upgradient | 10/7/2015 | 361628.894 | 1807368.366 | 20.15 | 23.24 | 48.53 | -17.98 | -7.98 | 10 |
| BY-GSA-MW-4 | Upgradient | 10/13/2015 | 361930.406 | 1806925.713 | 26.16 | 29.12 | 64.06 | -27.50 | -17.50 | 10 |
| BY-GSA-MW-5 | Downgradient | 10/8/2015 | 362556.147 | 1807430.006 | 31.21 | 34.31 | 69.12 | -27.51 | -17.51 | 10 |
| BY-GSA-MW-6 | Downgradient | 10/8/2015 | 363069.127 | 1807359.035 | 18.60 | 21.68 | 37.88 | -8.88 | 1.12 | 10 |
| BY-GSA-MW-7 | Downgradient | 10/8/2015 | 363103.505 | 1807778.082 | 17.46 | 20.59 | 45.53 | -17.67 | -7.67 | 10 |
| BY-GSA-MW-8 | Downgradient | 10/8/2015 | 362919.540 | 1808314.524 | 31.51 | 34.36 | 68.84 | -26.93 | -16.93 | 10 |
| BY-GSA-MW-9 | Downgradient | 10/8/2015 | 362798.723 | 1808598.555 | 10.44 | 13.32 | 46.14 | -25.30 | -15.30 | 10 |
| BY-GSA-MW-10 | Downgradient | 10/8/2015 | 362443.556 | 1808600.090 | 14.65 | 17.61 | 44.69 | -19.64 | -9.64 | 10 |
| BY-GSA-PZ-11 [3] | Downgradient | 10/8/2015 | 363464.097 | 1807619.818 | 23.56 | 25.92 | 57.92 | -23.96 | -13.96 | 10 |
| BY-GSA-PZ-12 [3] | Piezometer | 10/8/2015 | 363285.151 | 1808280.669 | 14.14 | 17.43 | 43.48 | -18.94 | -8.94 | 10 |

Notes:

1. Northing and easting are in feet relative to the State Plane Alabama West North America Datum of 1983.
2. Elevations are in feet relative to the North American vertical Datum of 1988.
3. Piezometers are utilized for water level readings except for PZ-11 which is being converted to a downgradient monitoring well.
4. Top of screen and bottom of screen depths are calculated relative Top of Casing elevation and less the well sump length of 0.4’.

## Table 2. Plant Barry GP Upgradient Comparisons – Key Indicator Parameters

| | **Well Designation** | **DO** (mg/L) | **pH** (SU) | **ORP** (mV) | **Conductivity** (uS/cm) | **Boron** (mg/L) | **Calcium** (mg/L) | **Sulfate** (mg/L) | **Chloride** (mg/L) | **Arsenic** (mg/L) | **Cobalt** (mg/L) | **Lithium** (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BY-GSA-MW-1** | Upgradient | 0.37 | 4.69 | 176.6 | 57.0 | 0.041 | 1.32 | 11.16 | 4.25 | 0.0005 [3] | 0.0062 | 0.005 [3] |
| **BY-GSA-MW-2** | Upgradient | 6.89 | 4.71 | 251.0 | 54.6 | 0.014 [3] | 1.32 | 6.13 | 3.90 | 0.0005 [3] | 0.0014 | 0.005 [3] |
| **BY-GSA-MW-3** | Upgradient | 5.93 | 4.89 | 246.1 | 46.8 | 0.011 [3] | 1.68 | 7.47 | 3.77 | 0.0005 [3] | 0.001 [3] | 0.005 [3] |
| **BY-GSA-MW-4** | Upgradient | 6.70 | 4.83 | 233.8 | 44.0 | 0.013 [3] | 1.40 | 6.65 | 3.74 | 0.0005 [3] | 0.001 [3] | 0.005 [3] |
| | | | | | | | | | | | | |
| Compliance [2] | Average Concentrations from Wells | 3.93 | 4.81 | 321.63 | 55.7 | 0.088 | 2.63 | 9.53 | 4.67 | 0.0005 [3] | 0.001 [3] | 0.0005 [3] |

Notes:

1. Fifty percent (50%) of the MDL was utilized in averaging when concentration was non-detect
2. Currently no SSLs in downgradient well network
3. Greater than 75% non-detect in population
4. Date range includes background sampling period through 2019

# Table 3.
# Analytical Methods and Project Reporting Limits

| Appendix III Parameters | | |
|---|---|---|
| **Parameter** | **Analytical Method** | **Reporting Limit (mg/L) [1]** |
| Boron | EPA 200.7/200.8 | 0.05 |
| Calcium | EPA 200.7/200.8 | 0.25 |
| Chloride | EPA 300.0 | 2 |
| Fluoride | EPA 300.0 | 0.1 |
| pH | None | None |
| Sulfate | EPA 300.0 | 5 |
| Total Dissolved Solids (TDS) | SM 2540C | 5 |
| **Appendix IV Parameters** | | |
| **Parameter** | **Analytical Method** | **Reporting Limit (mg/L)** |
| Antimony | EPA 200.7/200.8 | 0.0025 |
| Arsenic | EPA 200.7/200.8 | 0.00125 |
| Barium | EPA 200.7/200.8 | 0.0025 |
| Beryllium | EPA 200.7/200.8 | 0.0025 |
| Cadmium | EPA 200.7/200.8 | 0.0025 |
| Chromium | EPA 200.7/200.8 | 0.0025 |
| Cobalt | EPA 200.7/200.8 | 0.0025 |
| Fluoride | EPA 300.0 | 0.1 |
| Lead | EPA 200.7/200.8 | 0.00125 |
| Lithium | EPA 200.7/200.8 | 0.0025 |
| Mercury | EPA 7470A | 0.0002 |
| Molybdenum | EPA 200.7/200.8 | 0.015 |
| Selenium | EPA 200.7/200.8 | 0.00125 |
| Thallium | EPA 200.7/200.8 | 0.0005 |
| Radium 226 & 228 combined [2] | EPA 9315/9320 | 1 pCi/L |

Notes:

1. mg/L - Milligrams per liter

2. Combined Radium 226 + 228 reported in pCi/L - Picocuries per liter

# Table 4.
# Groundwater Monitoring Parameters and Frequency

| Monitoring Parameters | | Groundwater Sampling Schedule | |
|---|---|---|---|
| | | Semi-Annual Event 1 | Semi-Annual Event 2 |
| | | (Jan-June) | (July-Dec) |
| **Field Parameters** | Temperature | X | X |
| | pH | X | X |
| | Specific Conductance | X | X |
| | Oxidation Reduction Potential | X | X |
| | Turbidity | X | X |
| | Dissolved Oxygen | X | X |
| **Appendix III** | Boron | X | X |
| | Calcium | X | X |
| | Chloride | X | X |
| | Fluoride | X | X |
| | pH | X | X |
| | Sulfate | X | X |
| | Total Dissolved Solids | X | X |
| **Appendix IV** | Antimony | X | X |
| | Arsenic | X | X |
| | Barium | X | X |
| | Beryllium | X | X |
| | Cadmium | X | X |
| | Chromium | X | X |
| | Cobalt | X | X |
| | Fluoride | X | X |
| | Lead | X | X |
| | Lithium | X | X |
| | Mercury | X | X |
| | Molybdenum | X | X |
| | Selenium | X | X |
| | Thallium | X | X |
| | Radium 226 & 228 | X | X |

# Figures

**Legend**

🟥 Property Boundary (Approximate)

🟦 Gypsum Pond Boundary

N

0 1,000 2,000 4,000 6,000 8,000 Feet

SCALE 1:24000

DATE 2/25/2020

DRAWN BY KWR

CHECKED BY GBD

DRAWING TITLE

SITE LOCATION MAP
PLANT BARRY GYPSUM POND

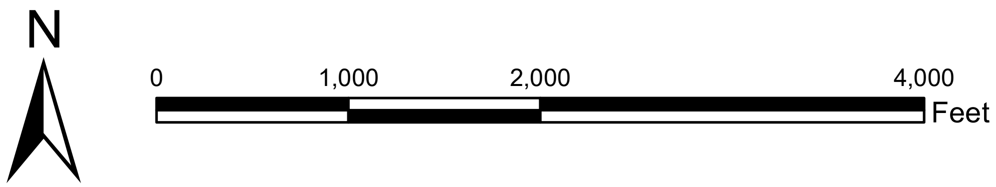
FIGURE NO

**FIGURE 1**

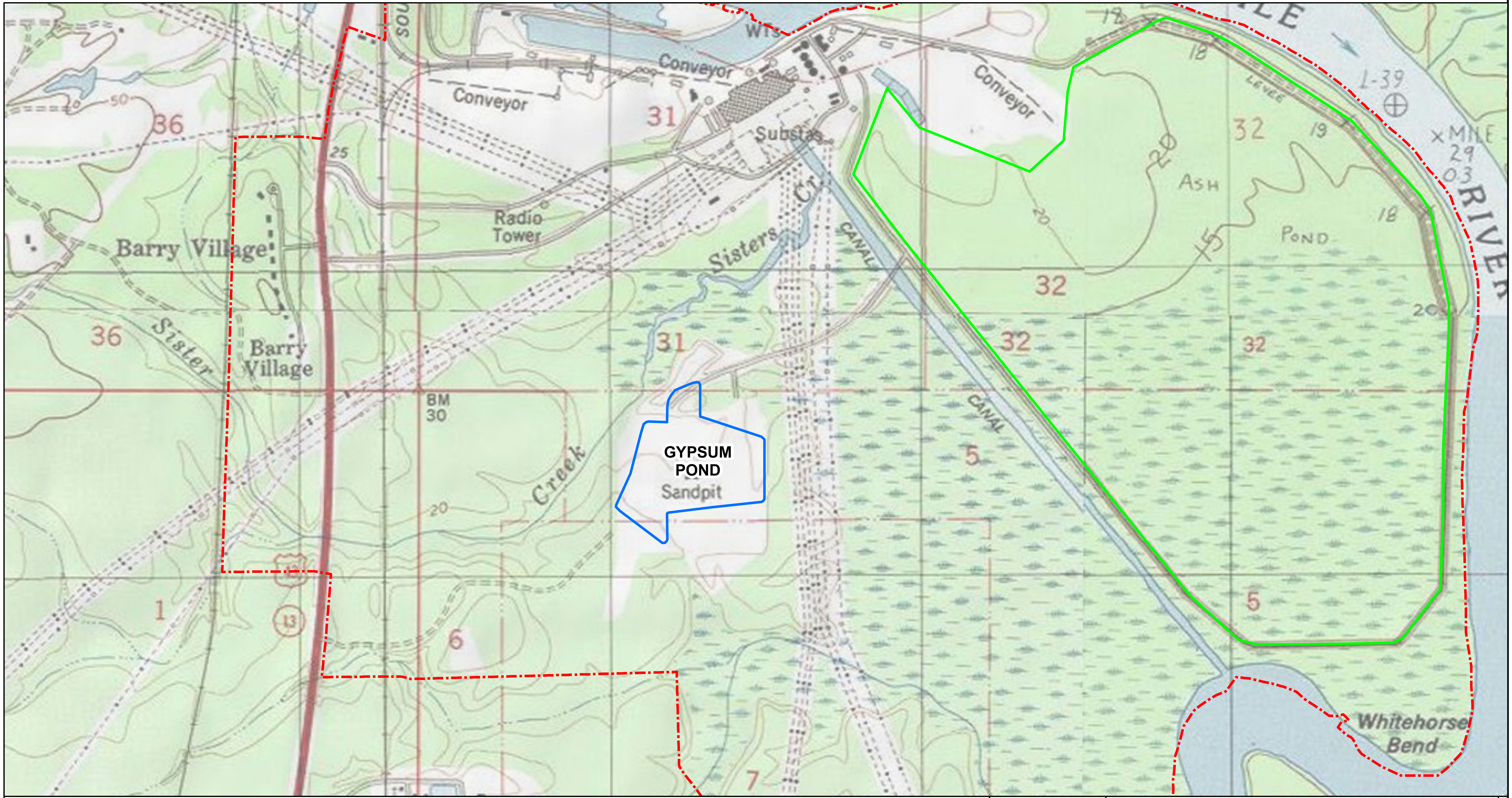
Southern Company

**Legend**

- 🟥 Property Boundary (Approximate)
- 🟩 Ash Pond Boundary
- 🟦 Gypsum Storage Area Boundary
- ⁀ 5-foot Topographic Contour
- ⊕ Downgradient Monitoring Well
- ✚ Upgradient Monitoring Well
- ⊖ Piezometer



| | |
|---|---|
| SCALE 1:12000 | DRAWING TITLE<br>SITE PLAN MAP<br>PLANT BARRY GYPSUM POND |
| DATE 4/14/2020 | |
| DRAWN BY KWR | FIGURE NO<br>**FIGURE 2** |
| CHECKED BY GBD | Southern Company |



**Legend**

🟥 Property Boundary (Approximate)
🟩 Ash Pond Boundary
🟦 Gypsum Storage Area Boundary

N

0 1,000 2,000 4,000 Feet

SCALE 1:12000
DATE 2/25/2020
DRAWN BY KWR
CHECKED BY GBD

DRAWING TITLE
SITE TOPOGRAPHIC MAP
PLANT BARRY GYPSUM POND

FIGURE NO
**FIGURE 3**

Southern Company

**Legend**

☐ Gypsum Pond

┅ Property Boundary (Approximate)

**Geologic Units**

▭ Alluvial, coastal, and low terrace deposits (Qalt)

▭ Miocene Series undifferentiated (Tm)

N

0 1,000 2,000 4,000 6,000 Feet

SCALE 1:20000

DATE 2/25/2020

DRAWN BY KWR

CHECKED BY GBD

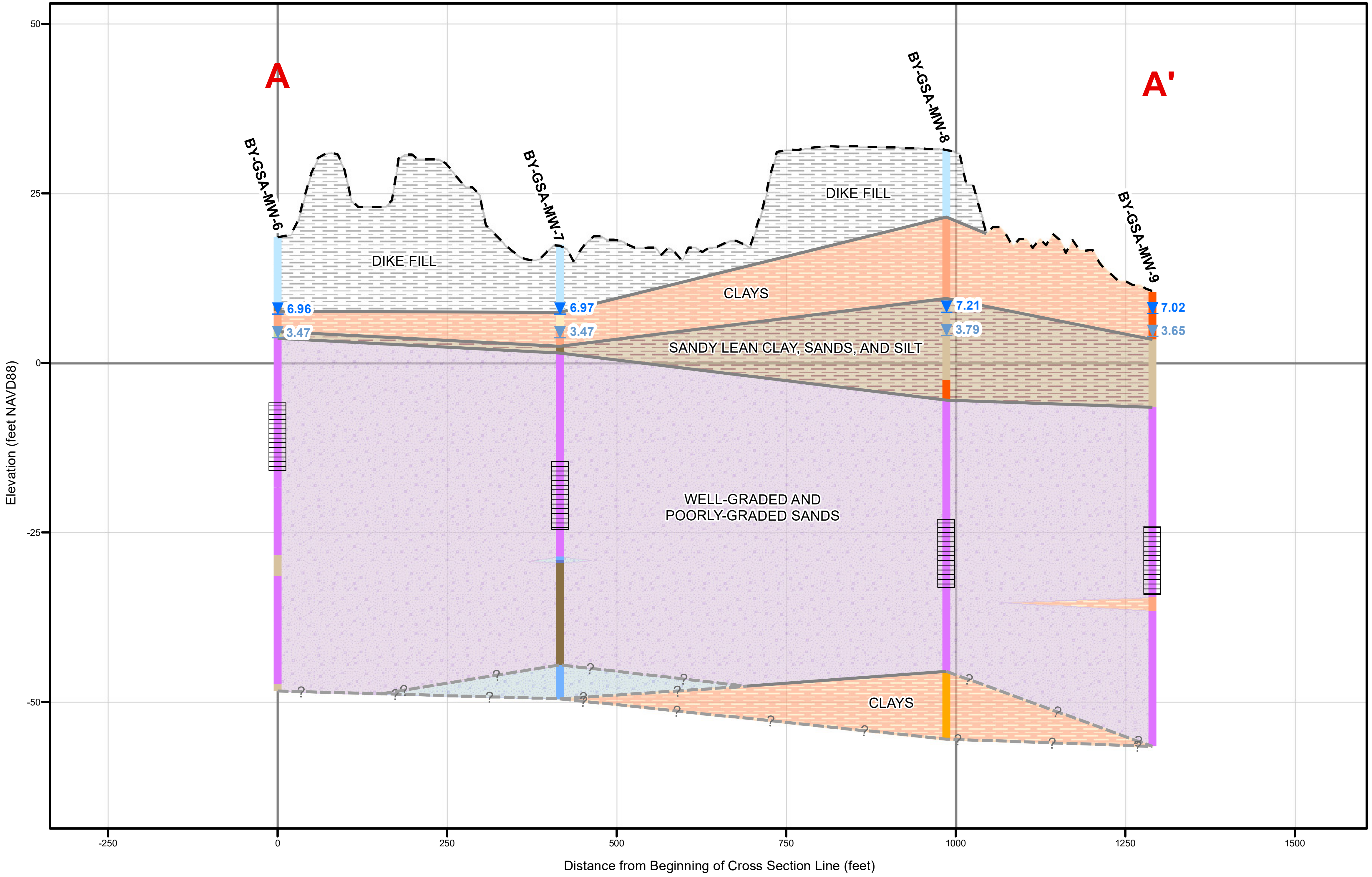
DRAWING TITLE

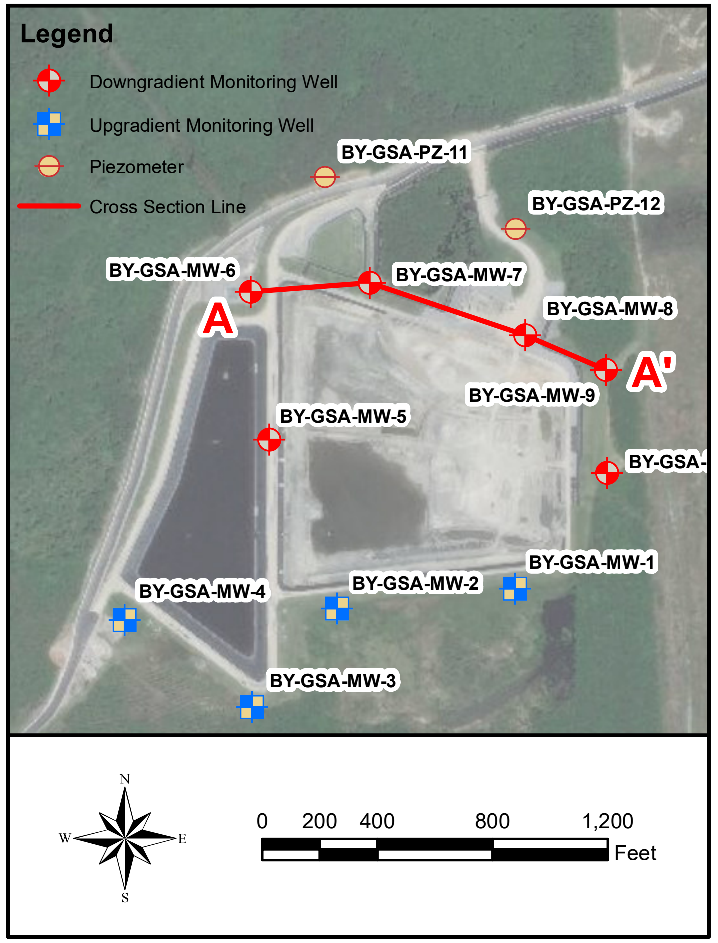
## SITE GEOLOGIC MAP
## PLANT BARRY GYPSUM POND

FIGURE NO

**FIGURE 4**

Southern Company





Notes: 1. Source of ground surface elevation data: Lidar
2. NAVD88 indicates North American Vertical Datum of 1988.
3. Maximum and minimum groundwater elevation data were derived from the highest and lowest groundwater elevation values measured during events spanning December 14, 2015 to October 2, 2019.
4. Vertical exaggeration: 25x.

**Legend**

- ▼ Maximum Groundwater Elevation
- ▽ Minimum Groundwater Elevation
- ╱╲╱ Ground Surface Elevation
- ▤ Screened Interval
- ╱?╱ Unit Boundary (inferred)
- ╱╲╱ Unit Boundary

Borehole Description

- Hydroexcavation
- Fat Clay
- Lean Clay
- Sandy Fat Clay
- Sandy Lean Clay
- Silt
- Clayey Sand
- Silty Sand
- Well-graded and Poorly-graded Sand
- Clayey Gravel
- Silty Gravel

Geologic Unit

- Fill
- Clays
- Sandy Lean Clay, Sands, and Silt
- Sands
- Gravels

SCALE
As Shown

DATE
4/14/2020

DRAWN BY
KWR

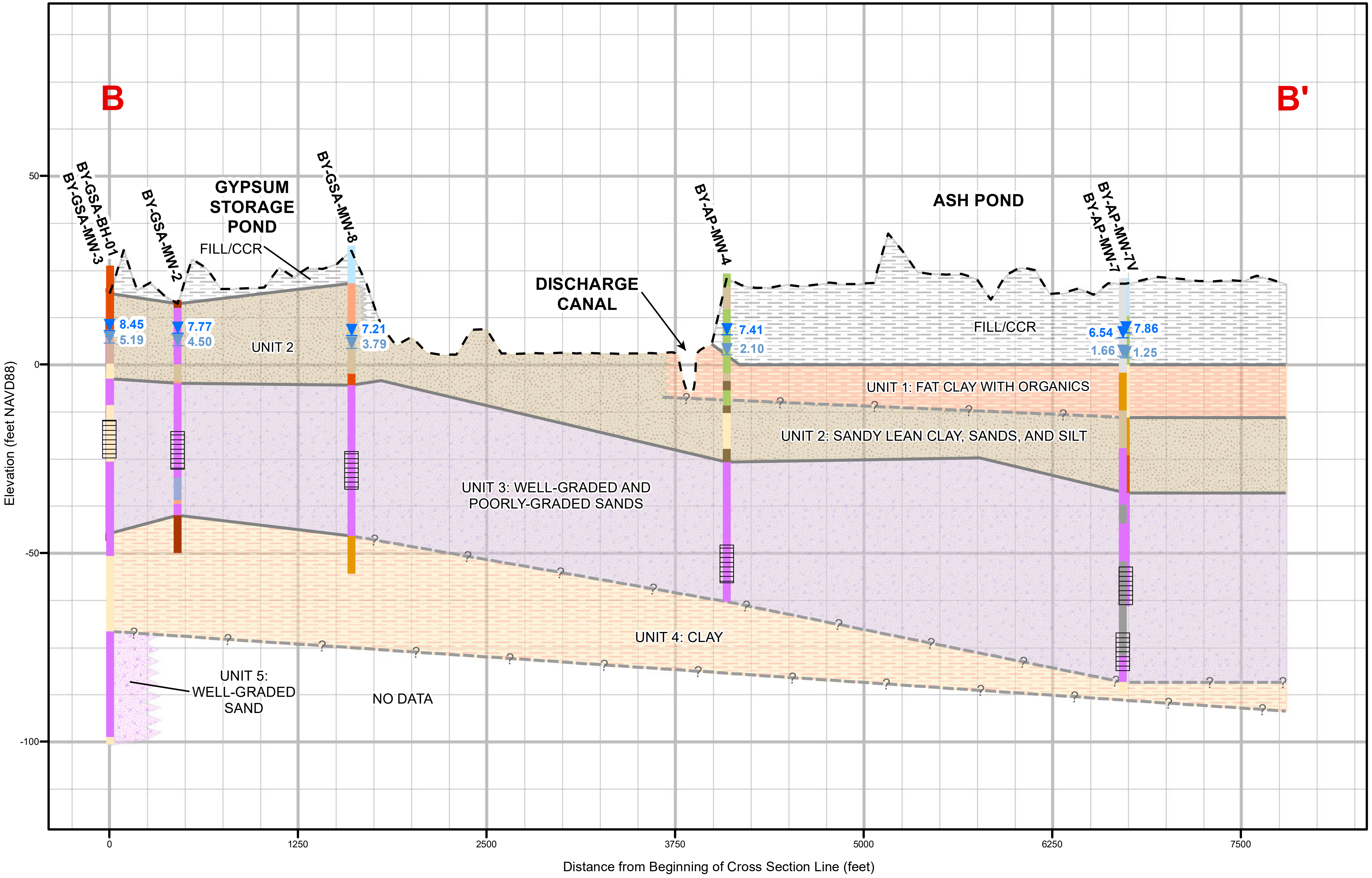
CHECKED BY
GBD

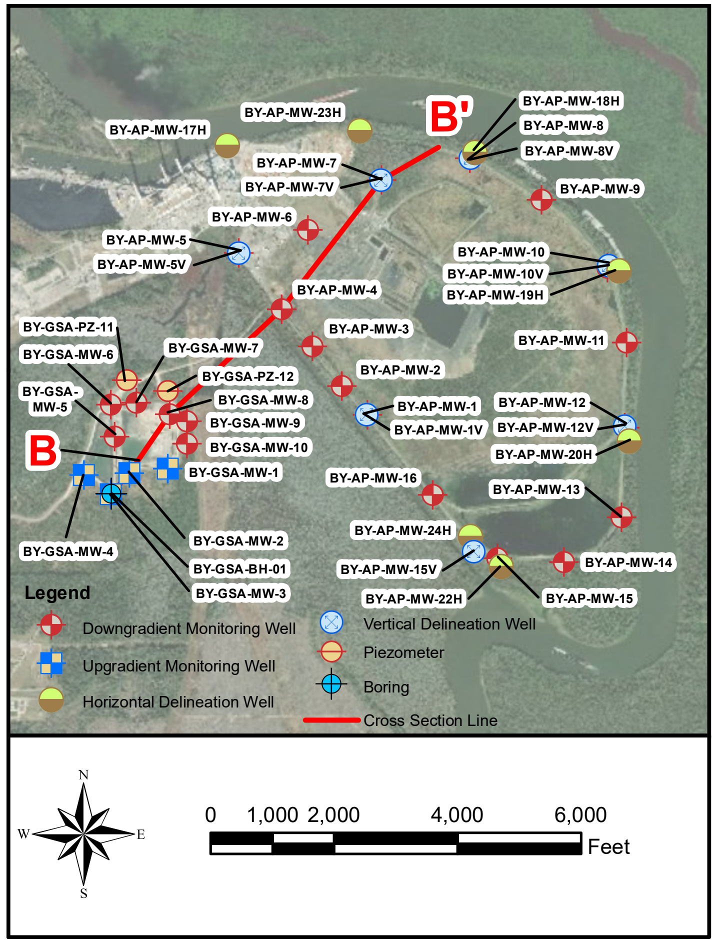
DRAWING TITLE

# GEOLOGIC CROSS SECTION A - A'
# PLANT BARRY GYPSUM POND

FIGURE NO
**FIGURE 5a**

Southern Company





Notes:
1. Source of ground surface elevation data: Lidar
2. Source of Discharge Canal depth: Bathymetry
3. NAVD88 indicates North American Vertical Datum of 1988.
4. Maximum and minimum groundwater elevation data were derived from the highest and lowest groundwater elevation values measured during events spanning December 14, 2015 to October 2, 2019.
5. Vertical exaggeration: 25x.

**Legend**

- ▼ Maximum Groundwater Elevation
- ▼ Minimum Groundwater Elevation
- ╱╲╱ Ground Surface Elevation
- ▤ Screen Interval
- ╱?╲ Unit Boundary (inferred)
- ╱╲ Unit Boundary

**Borehole Description**

- ■ Hydroexcavation
- ■ Fill
- ■ No Recovery
- ■ Fat Clay
- ■ Lean Clay
- ■ Sandy Fat Clay
- ■ Sandy Lean Clay
- ■ Organic Silt or Clay
- ■ Silt
- ■ Clayey Sand
- ■ Clayey Silty Sand
- ■ Silty Sand
- ■ Well-graded and Poorly-graded Sands
- ■ Well-graded and Poorly-graded Gravels

**Geologic Unit**

- ▤ Fill
- ▨ Unit 1: Fat Clay with Organics
- ▨ Unit 2: Sandy Lean Clay, Sands, and Silts
- ▨ Unit 3: Well-graded and Poorly-graded Sands
- ▨ Unit 4: Clay
- ▨ Unit 5: Well-Graded Sand

SCALE
As Shown

DATE
4/14/2020

DRAWN BY
KWR

CHECKED BY
GBD

DRAWING TITLE

# GEOLOGIC CROSS SECTION B - B'
# PLANT BARRY GYPSUM POND

FIGURE NO
**FIGURE 5b**

Southern Company

**Legend**

- 🔴 Downgradient Monitoring Well
- 🟦 Upgradient Monitoring Well
- 🟠 Piezometer
- ⌒ Potentiometric Surface Contour (ft NAVD)
- ↗ Groundwater Flow Direction
- ▭ Gypsum Pond

N

0 250 500 1,000 Feet

| | |
|---|---|
| SCALE | 1:3000 |
| DATE | 4/7/2020 |
| DRAWN BY | KWR |
| CHECKED BY | GBD |

DRAWING TITLE

# POTENTIOMETRIC SURFACE CONTOUR MAP
MAY 28, 2019
PLANT BARRY GYPSUM POND

FIGURE NO

**FIGURE 6A**

Southern Company

**Legend**

| | |
|---|---|
| ⊕ Downgradient Monitoring Well | ⌒ Potentiometric Surface Contour (ft NAVD) |
| ▦ Upgradient Monitoring Well | ↗ Groundwater Flow Direction |
| ⊖ Piezometer | ▭ Gypsum Pond |

N

0 250 500 1,000 Feet

| | |
|---|---|
| SCALE | 1:3000 |
| DATE | 4/7/2020 |
| DRAWN BY | KAR |
| CHECKED BY | GBD |

DRAWING TITLE

POTENTIOMETRIC SURFACE CONTOUR MAP
OCTOBER 2, 2019
PLANT BARRY GYPSUM POND

FIGURE NO

**FIGURE 6B**

Southern Company

**Legend**

⊕ Downgradient Monitoring Well
▦ Upgradient Monitoring Well
⊖ Piezometer
▭ Gypsum Pond

N

0 250 500 1,000 Feet

SCALE 1:3000

DATE 4/7/2020

DRAWN BY KAR

CHECKED BY GBD

DRAWING TITLE

## MONITORING WELL LOCATION MAP
## PLANT BARRY GYPSUM POND

FIGURE NO

**FIGURE 7**

Southern Company

# Appendix A

# Appendix A

# BORING LOG

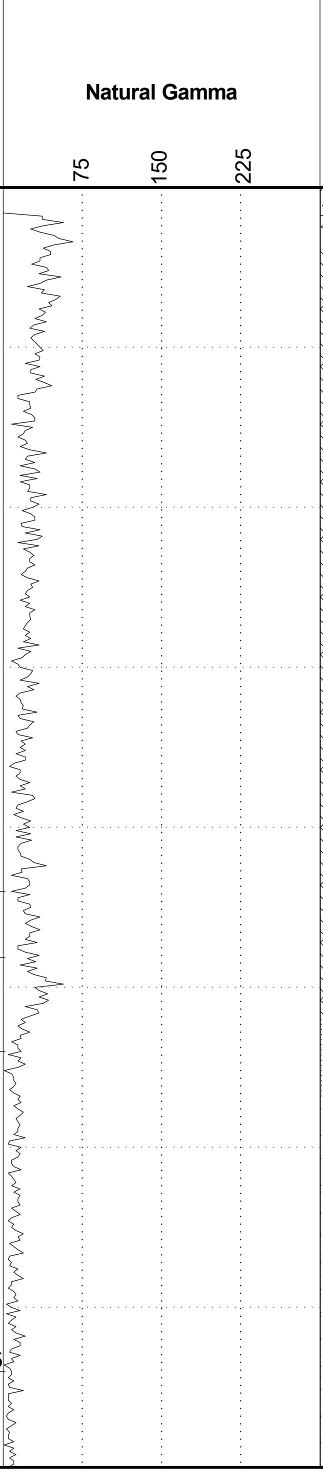
**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

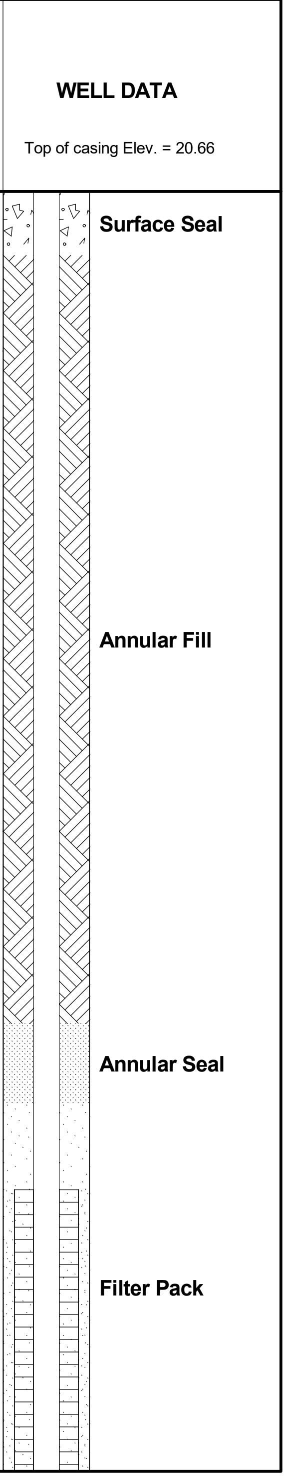
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/23/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 17.5 **COORDINATES:** N:362,038.24 E:1,808,279.56
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| MATERIAL DESCRIPTION | ELEVATION |
|---|---|
| | 17.5 |
| **Silty Sand (SM)**<br>light olive brown (2.5Y 5/4) alluvium moist, minimal clay, organic rich<br>white (7.5YR 8/1) alluvium wet, predominantly fine to medium grained, no gravel<br>white (10YR 8/1) alluvium wet, very wet | -4.5 |
| **Clayey Sand (SC)**<br>very pale brown / very pale orange (10YR 8/2) and gray (10YR 6/1) alluvium wet, medium, silty clay and sand interbedded, sand is medium to coarse grained | -6.5 |
| **Poorly-graded Sand (SP)**<br>white (10YR 8/1) alluvium wet, medium to coarse grained, subrounded to subangular quartzite/chert gravel ~ 2-3 cm in size | -9.5 |
| **Silty Sand (SM)**<br>white (10YR 8/1) alluvium wet, medium grained, no fines, no gravel, rare mica | -19.5 |
| **Poorly-graded Sand (SP)**<br>very pale brown (10YR 8/3) alluvium wet, coarse grained with 10% gravel | |

DEPTH (ft): 5, 10, 15, 20, 25, 30, 35, 40





(Continued Next Page)

# BORING BY-GSA-MW-01

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ECS37275

# BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

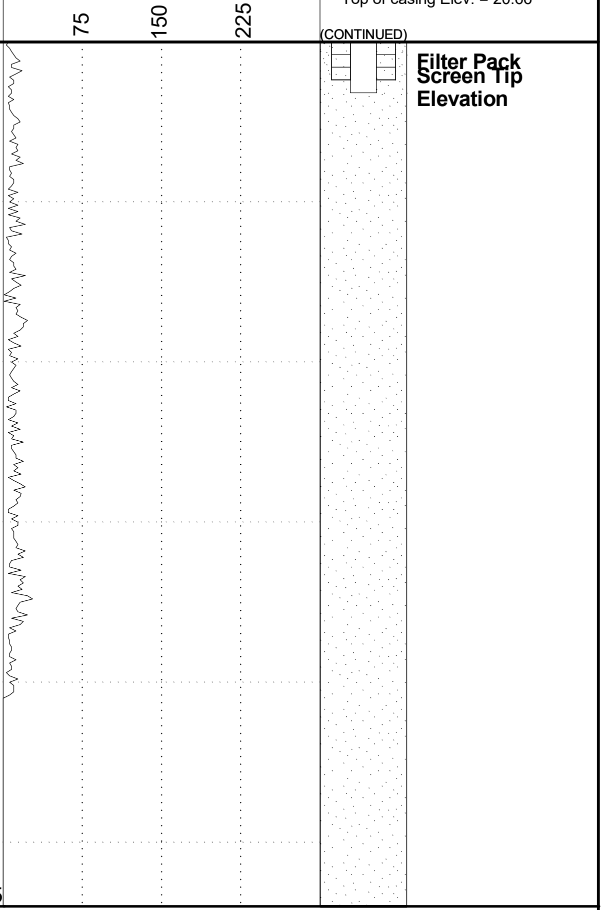
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|---|
| | | **Poorly-graded Sand (SP)**<br>very pale brown (10YR 8/3) alluvium wet, coarse grained with 10% gravel*(Con't)* | 17.5 |
| 45 | | white (10YR 8/1) and pale yellow (2.5Y 7/4) alluvium wet, medium, medium to coarse grained sand, with subangular gravel, clay nodules present from 43 to 50 feet | |
| 50 | | | |
| 55 | | | |
| 60 | | | |
| 65 | | | -49.5 |

**Natural Gamma**

**WELL DATA**

Top of casing Elev. = 20.66



Bottom of borehole at 67.0 feet.

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/11/17 11:26 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC ATTORNEY CLIENT PRIVILEGED\PLANT BARRY\ACES2520 BARRY AP CHARACTERIZATION REPORT\

# BORING BY-GSA-MW-02
PAGE 1 OF 2
ECS37275

# BORING LOG

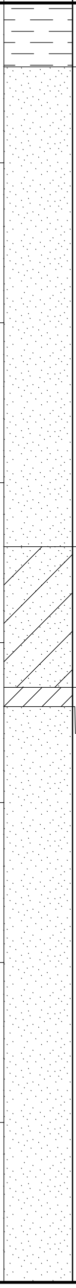
**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

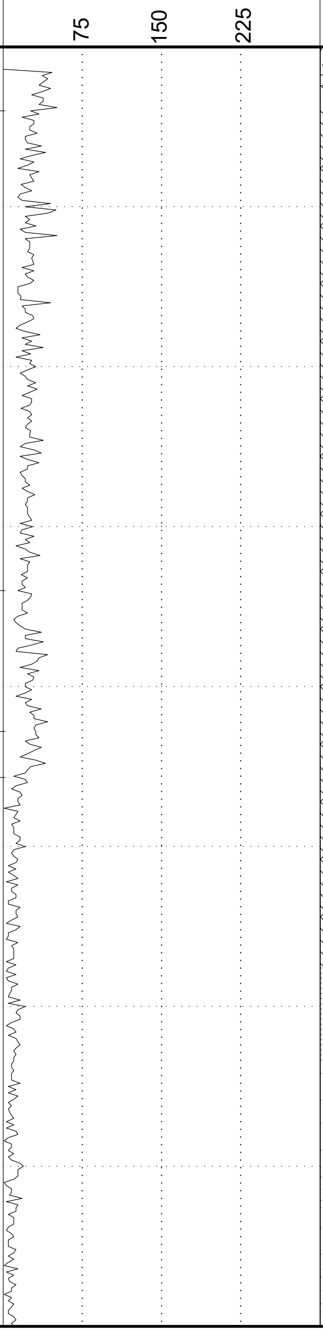
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/23/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 17.0 **COORDINATES:** N:361,968.69 E:1,807,662.77
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|
| | | 17.0 |
| | **Low Plastic Organic Silt or Clay (OL)**<br>reddish yellow (7.5YR 7/8) alluvium wet, medium dense, organic rich | |
| | | 15.0 |
| | **Poorly-graded Sand (SP)**<br>white (10YR 8/1) and reddish yellow (7.5YR 7/8) alluvium moist, rare gravel, medium grained | |
| 5 | | |
| 10 | | |
| 15 | | |
| | | 0.0 |
| | **Clayey Sand (SC)**<br>white (10YR 8/1) alluvium moist, increasing clay content with depth, no organic material | |
| 20 | | |
| | | -4.4 |
| | **Lean Clay (CL)**<br>white (10YR 8/1) alluvium | -5.0 |
| | **Poorly-graded Sand (SP)**<br>white (7.5YR 8/1) alluvium micaceous, medium to coarse grained, subrounded gravel | |
| 25 | | |
| | yellow (10YR 7/6) alluvium wet, coarse to medium grained, pebbles are predominantly subangular | |
| 30 | very pale brown (10YR 7/3) alluvium wet, coarse to medium grained, pebbles are predominantly subangular | |
| | very pale brown (10YR 8/3) alluvium wet, coarse to medium grained, pebbles are predominantly subangular | |
| 35 | | |
| | very pale brown (10YR 7/3) alluvium wet, coarse to medium grained, pebbles are predominantly subangular | |
| 40 | | |

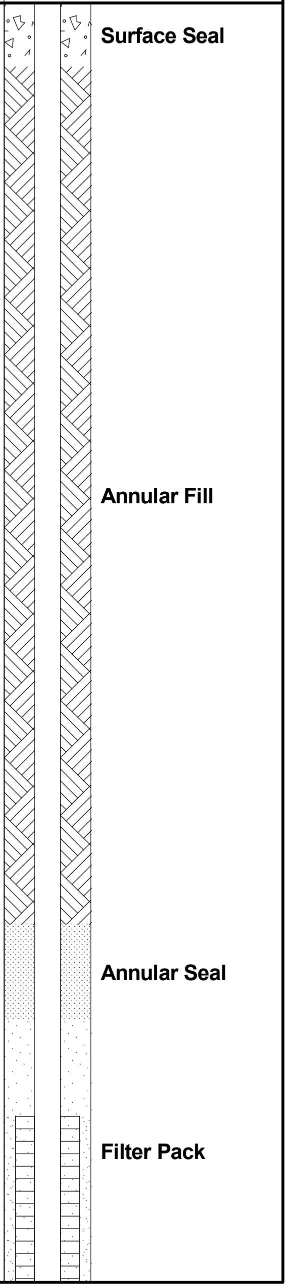
GRAPHIC LOG





**WELL DATA**

Top of casing Elev. = 19.95



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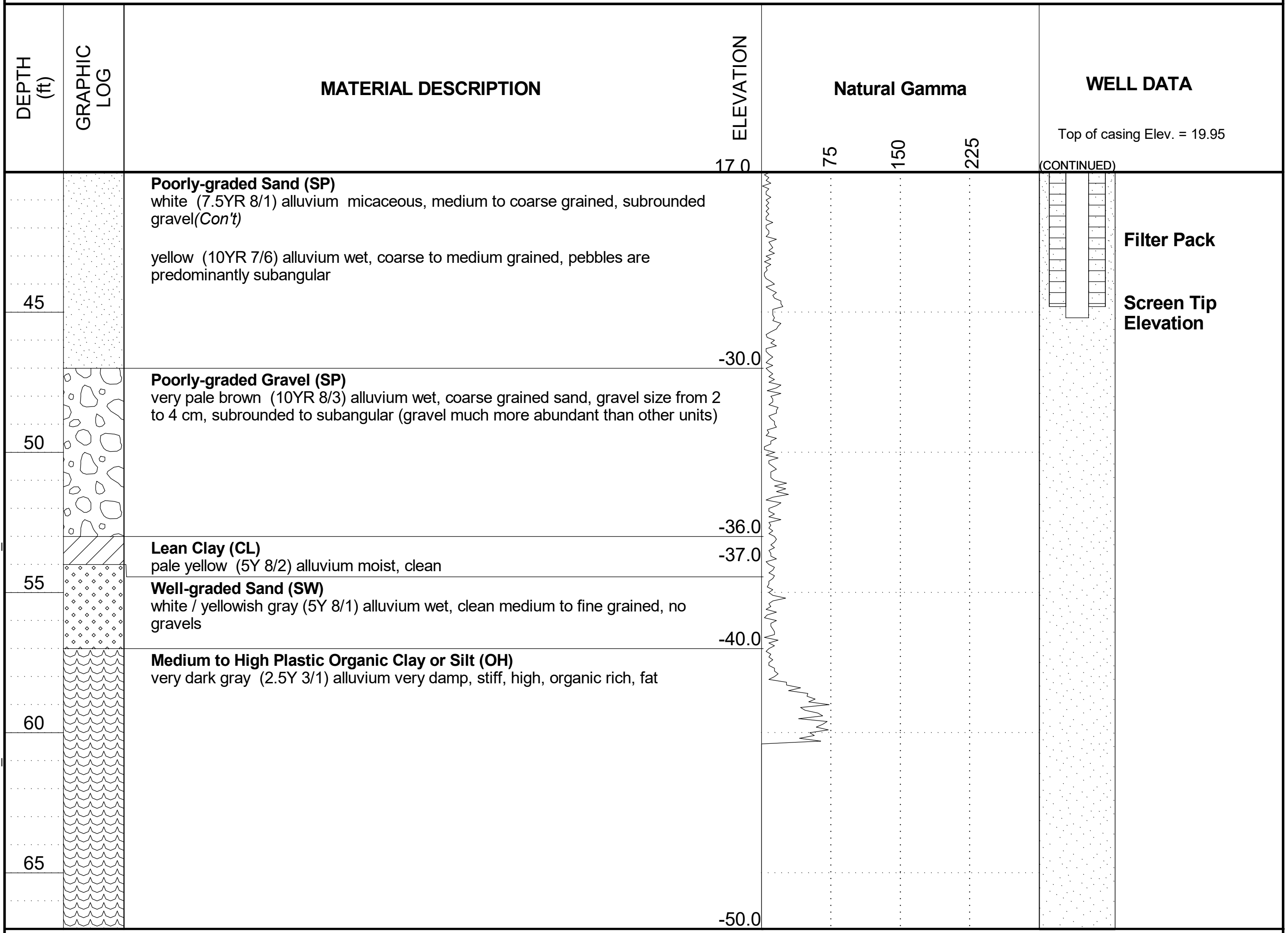
**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

# BORING LOG

## BORING BY-GSA-MW-02
**PAGE 2 OF 2**
**ECS37275**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL



**Poorly-graded Sand (SP)**
white (7.5YR 8/1) alluvium micaceous, medium to coarse grained, subrounded gravel*(Con't)*

yellow (10YR 7/6) alluvium wet, coarse to medium grained, pebbles are predominantly subangular

**Poorly-graded Gravel (SP)**
very pale brown (10YR 8/3) alluvium wet, coarse grained sand, gravel size from 2 to 4 cm, subrounded to subangular (gravel much more abundant than other units)

**Lean Clay (CL)**
pale yellow (5Y 8/2) alluvium moist, clean

**Well-graded Sand (SW)**
white / yellowish gray (5Y 8/1) alluvium wet, clean medium to fine grained, no gravels

**Medium to High Plastic Organic Clay or Silt (OH)**
very dark gray (2.5Y 3/1) alluvium very damp, stiff, high, organic rich, fat

Bottom of borehole at 67.0 feet.

**SOUTHERN COMPANY**

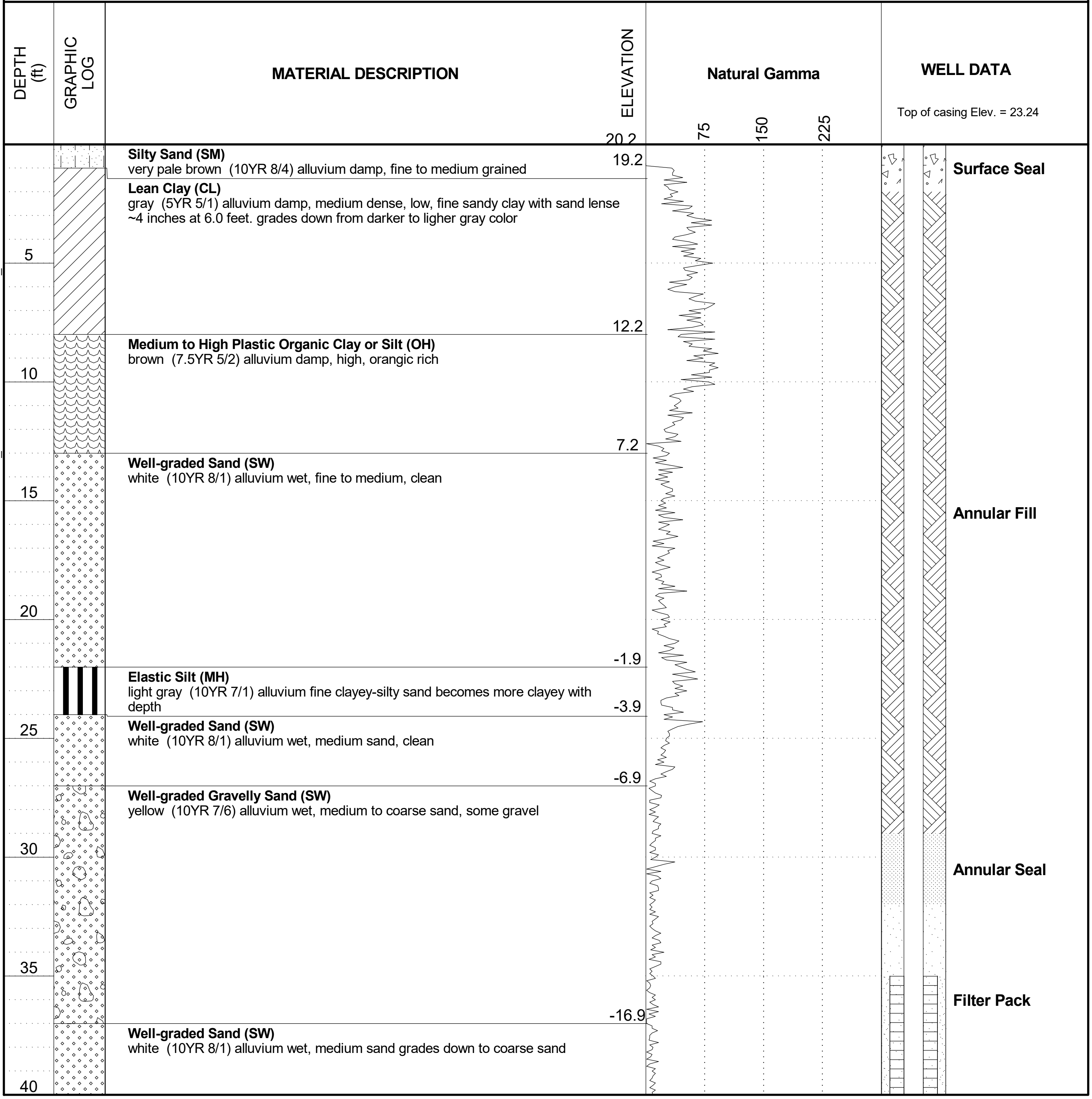
# BORING LOG

## BORING BY-GSA-MW-03
**PAGE 1 OF 2**
**ECS37275**

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/22/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 20.2 **COORDINATES:** N:361,627.64 E:1,807,366.92
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.



| MATERIAL DESCRIPTION | ELEVATION |
|---|---|
| | 20.2 |
| **Silty Sand (SM)**<br>very pale brown (10YR 8/4) alluvium damp, fine to medium grained | 19.2 |
| **Lean Clay (CL)**<br>gray (5YR 5/1) alluvium damp, medium dense, low, fine sandy clay with sand lense ~4 inches at 6.0 feet. grades down from darker to ligher gray color | 12.2 |
| **Medium to High Plastic Organic Clay or Silt (OH)**<br>brown (7.5YR 5/2) alluvium damp, high, orangic rich | 7.2 |
| **Well-graded Sand (SW)**<br>white (10YR 8/1) alluvium wet, fine to medium, clean | -1.9 |
| **Elastic Silt (MH)**<br>light gray (10YR 7/1) alluvium fine clayey-silty sand becomes more clayey with depth | -3.9 |
| **Well-graded Sand (SW)**<br>white (10YR 8/1) alluvium wet, medium sand, clean | -6.9 |
| **Well-graded Gravelly Sand (SW)**<br>yellow (10YR 7/6) alluvium wet, medium to coarse sand, some gravel | -16.9 |
| **Well-graded Sand (SW)**<br>white (10YR 8/1) alluvium wet, medium sand grades down to coarse sand | |

*(Continued Next Page)*

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/11/17 11:26 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC ATTORNEY CLIENT PRIVILEGED\PLANT BARRY\ACES2520 BARRY AP CHARACTERIZATION REPORT\

# BORING BY-GSA-MW-03

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ECS37275

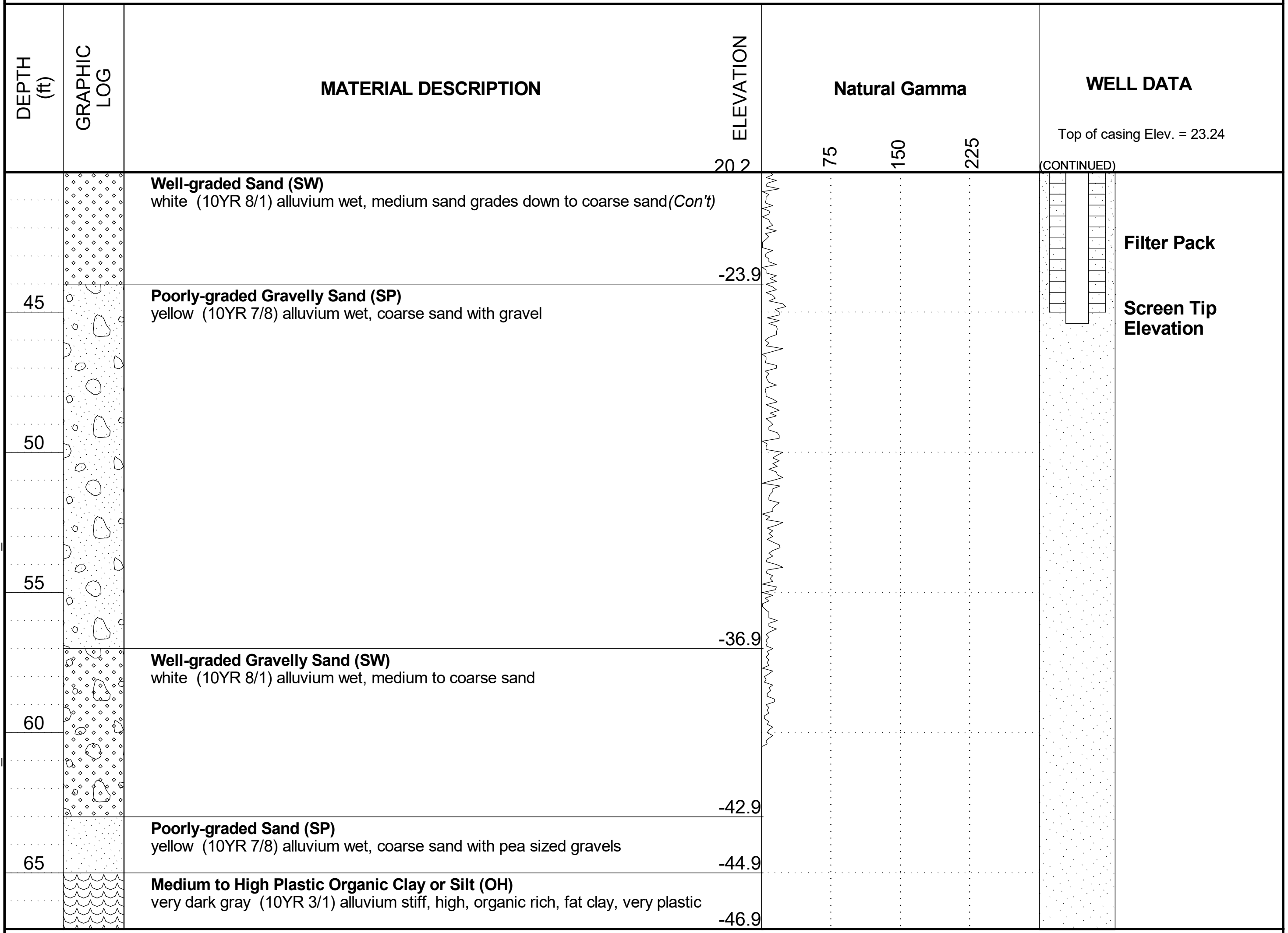
SOUTHERN COMPANY

# BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs

**LOCATION** Bucks, AL



| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|
| | | 20.2 |
| | **Well-graded Sand (SW)**<br>white (10YR 8/1) alluvium wet, medium sand grades down to coarse sand *(Con't)* | -23.9 |
| 45 | **Poorly-graded Gravelly Sand (SP)**<br>yellow (10YR 7/8) alluvium wet, coarse sand with gravel | -36.9 |
| 60 | **Well-graded Gravelly Sand (SW)**<br>white (10YR 8/1) alluvium wet, medium to coarse sand | -42.9 |
| | **Poorly-graded Sand (SP)**<br>yellow (10YR 7/8) alluvium wet, coarse sand with pea sized gravels | -44.9 |
| 65 | **Medium to High Plastic Organic Clay or Silt (OH)**<br>very dark gray (10YR 3/1) alluvium stiff, high, organic rich, fat clay, very plastic | -46.9 |

Bottom of borehole at 67.0 feet.

# BORING BY-GSA-MW-04
PAGE 1 OF 2
ECS37275

SOUTHERN COMPANY

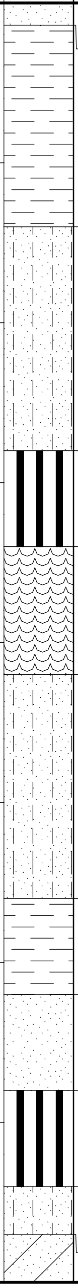
# BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

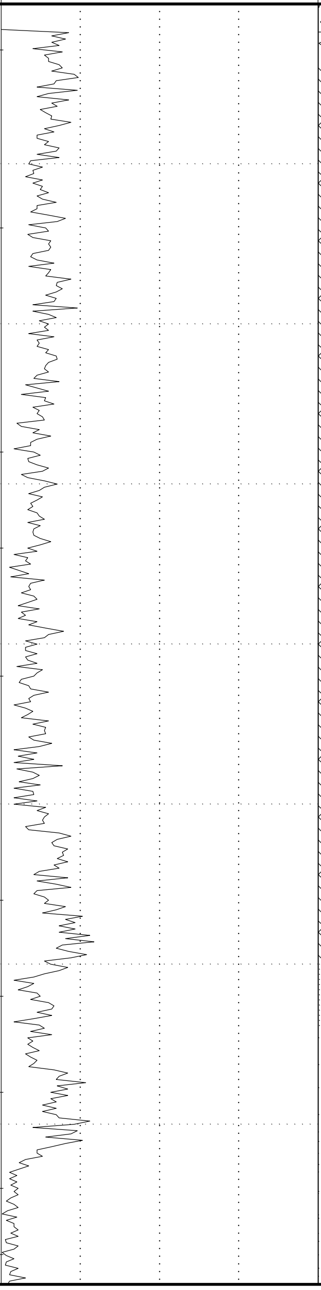
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

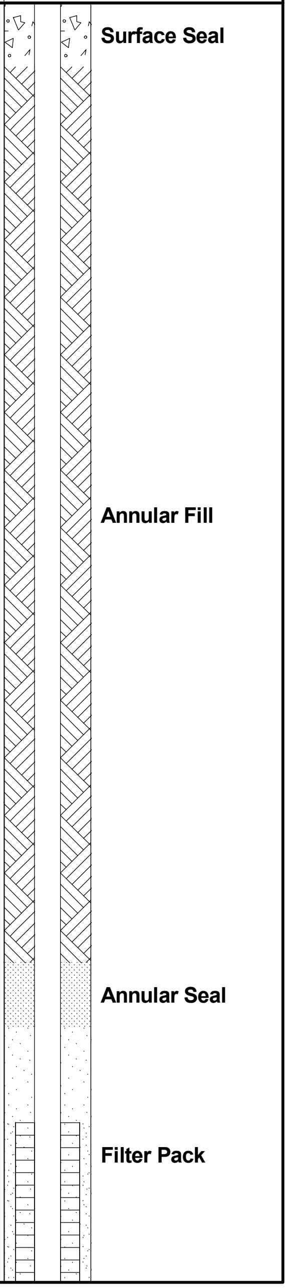
**DATE STARTED** 9/18/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 26.2 **COORDINATES:**
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** M. Tanner **CHECKED BY** B. Coates
**BORING DEPTH** 87 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION | Natural Gamma | WELL DATA |
|---|---|---|---|---|---|
| | | | 26.2 | 75 150 225 | Top of casing Elev. = 29.12 |



| MATERIAL DESCRIPTION | ELEVATION |
|---|---|
| **Poorly-graded Sand (SP)**<br>very pale brown / grayish orange (10YR 7/4) fill moist, fine to medium grained, silty | 25.5 |
| **Low Plastic Organic Silt or Clay (OL)**<br>brownish yellow / dark yellowish orange (10YR 6/6) fill moist, some (<10%) fine sand and crushed limestone from 4.0-4.5 feet<br>black (10YR 2/1) and very dark gray (10YR 3/1) fill moist | 19.2 |
| **Silty Sand (SM)**<br>brownish yellow (10YR 6/8) fill moist, fine to medium grained, some silt | 12.2 |
| **Elastic Silt (MH)**<br>light brownish gray / pale yellowish brown (10YR 6/2) alluvium stiff, medium | 9.2 |
| **Medium to High Plastic Organic Clay or Silt (OH)**<br>dark gray (2.5Y 4/1) alluvium woody material also present | 5.2 |
| **Silty Sand (SM)**<br>light gray (10YR 7/1), brownish yellow (10YR 6/8) and pink (5YR 7/3) alluvium wet, fine to medium grained, grades to pink color | -1.8 |
| **Low Plastic Organic Silt or Clay (OL)**<br>light brownish gray (2.5Y 6/2) and light gray (2.5Y 7/1) alluvium wet, medium, with thin interbeds of fine silty sand | -4.8 |
| **Poorly-graded Sand (SP)**<br>light gray (2.5Y 7/1) alluvium wet, predominately medium grained, slightly silty | -7.8 |
| **Elastic Silt (MH)**<br>dark gray (2.5Y 4/1) alluvium medium | -10.8 |
| **Silty Sand (SM)**<br>pale yellow (5Y 7/3) alluvium wet, fine to medium grained with very little silt, micaceous | -12.3 |
| **Clayey Sand (SC)** | -13.8 |





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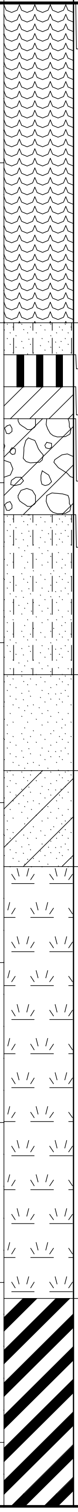
SOUTHERN COMPANY

# BORING LOG

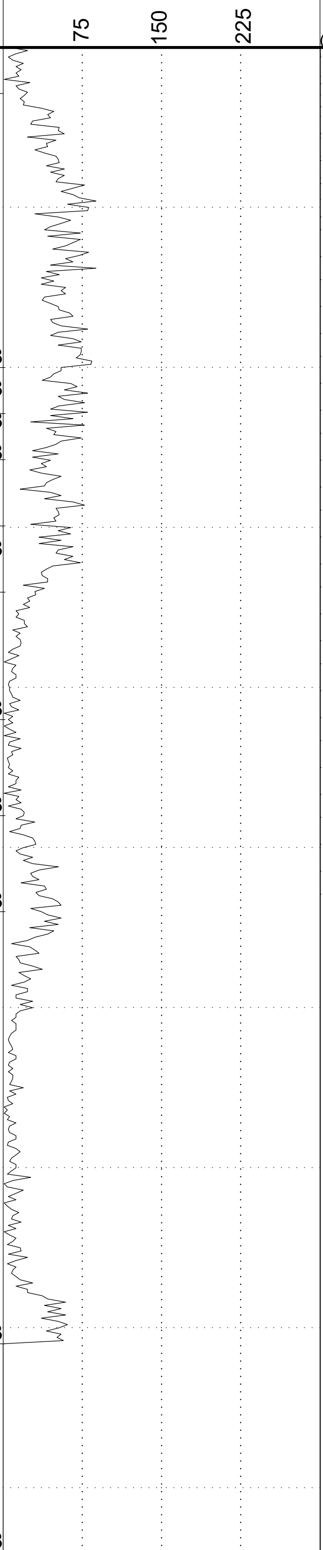
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

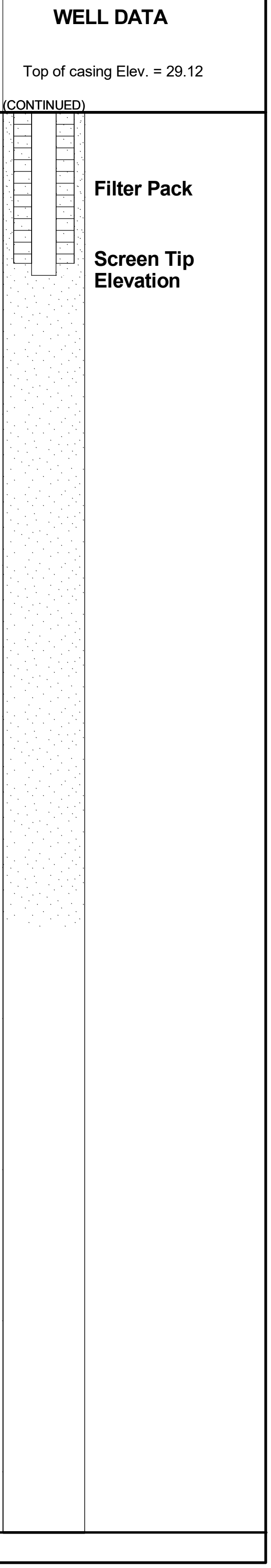
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL



| MATERIAL DESCRIPTION | ELEVATION |
|---|---|
| | 26.2 |
| gray (5Y 5/1) and dark gray / olive gray (5Y 4/1) alluvium fine-grained, organic rich, muscovite | |
| **Medium to High Plastic Organic Clay or Silt (OH)**<br>mottled dark gray / olive gray (5Y 4/1) and pale olive / dusky yellow (5Y 6/4) alluvium stiff, high, organic leaf and sticks, very thin (<2mm) sand lenses | -23.8 |
| **Silty Sand (SM)**<br>light gray (5Y 7/1) alluvium wet, fine to very fine, trace mica. | -24.8 |
| **Elastic Silt (MH)**<br>dark gray / olive gray (5Y 4/1) alluvium stiff, medium, silty and sandy. no organics | -25.8 |
| **Lean Clay (CL)**<br>mottled strong brown (7.5YR 5/8) and gray (7.5YR 5/1) alluvium wet, thin fine-grained sand interbedded | -26.8 |
| **Clayey Gravel (GC)**<br>yellow (10YR 7/8) alluvium wet, round to subrounded gravel with thin (<4mm) clay lenses. | -29.8 |
| **Silty Sand (SM)**<br>pale yellow (5Y 8/2) alluvium wet, fine-grained with minor silty clay | -34.8 |
| **Poorly-graded Sand (SP)**<br>pale yellow (5Y 8/2) alluvium wet, with fine-grained, clean sand | -37.8 |
| **Clayey Sand (SC)**<br>pale yellow (5Y 8/2) alluvium sandy, fine-grained, clean, no gravel | -40.8 |
| **Peat (PT)**<br>black (5Y 2.5/1) alluvium stiff, high, peat-like, bark and tree-material, plastic | -54.3 |
| **Fat Clay (CH)**<br>black (N1) alluvium stiff, high, decreasing organics with depth | -60.8 |

Bottom of borehole at 87.0 feet.





# BORING BY-GSA-MW-04 ( R )

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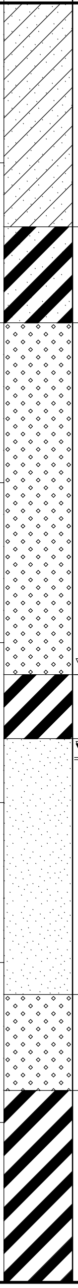
# BORING LOG

**SOUTHERN COMPANY**

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 10/12/2015 **COMPLETED** 10/13/2015 **SURF. ELEV.** 26.2 **COORDINATES:** N:361,932.31 E:1,806,927.51
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
**BORING DEPTH** 87 ft. **GROUND WATER DEPTH: DURING** 21 ft. **COMP.** 23.66 ft. **DELAYED** 23.59 ft. after 24 hrs.
**NOTES** No geophysical data collected Well installed. Refer to well data sheet.



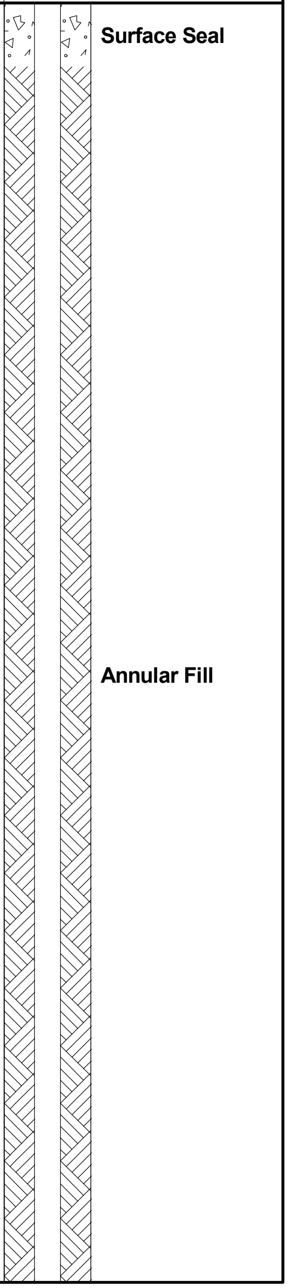
| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|
| | | 26.2 |
| | **Sandy Lean Clay (CL)**<br>mottled strong brown (7.5YR 4/6) and reddish yellow (7.5YR 6/8) fill moist, sandy, trace gravel | |
| 5 | | |
| | | 19.2 |
| | **Sandy Fat Clay (CH)**<br>strong brown (7.5YR 5/6) alluvium moist, sandy | |
| 10 | | 16.2 |
| | **Well-graded Sand (SW)**<br>mottled reddish yellow (7.5YR 7/8) and reddish yellow (7.5YR 6/8) alluvium moist, coarse to fine grained, interbedded clay | |
| 15 | | |
| | mottled reddish yellow (7.5YR 7/8) and pinkish white (7.5YR 8/2) alluvium wet, coarse to very fine grained, increasing clay content with depth | |
| 20 | | |
| | ▽ | 5.2 |
| | **Fat Clay (CH)**<br>dark gray (7.5YR 4/1) alluvium wet, trace wood pulp | |
| | | 3.2 |
| | ▼ **Poorly-graded Sand (SP)**<br>gray (7.5YR 6/1) alluvium wet, coarse grained with trace fines, trace gravel and clay | |
| 25 | | |
| | gray (7.5YR 6/1) alluvium wet, coarse grained with trace fines, trace gravel and clay | |
| 30 | | |
| | | -4.8 |
| | **Well-graded Sand (SW)**<br>mottled reddish yellow (7.5YR 6/8) and yellow (10YR 8/8) alluvium wet, coarse to fine grained, clayey | |
| | | -7.8 |
| 35 | **Fat Clay (CH)**<br>dark gray (7.5YR 4/1) alluvium wet, trace wood pulp | |
| 40 | | |

**Natural Gamma**

75 150 225

**WELL DATA**

Top of casing Elev. = 29.12



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# BORING BY-GSA-MW-04 ( R )

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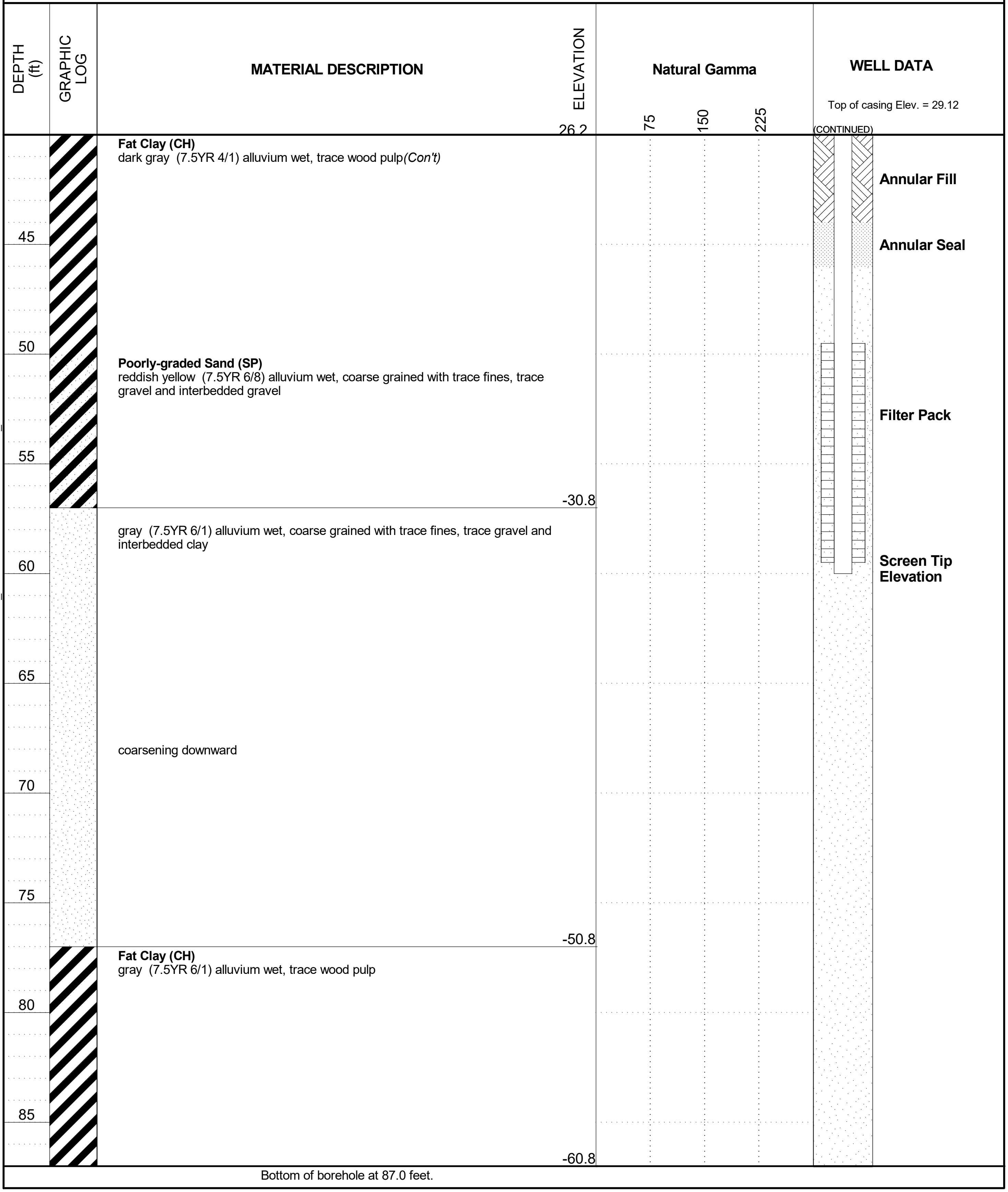
# BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs

**LOCATION** Bucks, AL



| MATERIAL DESCRIPTION | ELEVATION |
|---|---|
| **Fat Clay (CH)**<br>dark gray (7.5YR 4/1) alluvium wet, trace wood pulp*(Con't)* | 26.2 |
| **Poorly-graded Sand (SP)**<br>reddish yellow (7.5YR 6/8) alluvium wet, coarse grained with trace fines, trace gravel and interbedded gravel | -30.8 |
| gray (7.5YR 6/1) alluvium wet, coarse grained with trace fines, trace gravel and interbedded clay<br>coarsening downward | -50.8 |
| **Fat Clay (CH)**<br>gray (7.5YR 6/1) alluvium wet, trace wood pulp | -60.8 |

Bottom of borehole at 87.0 feet.

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/11/17 11:26 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC ATTORNEY CLIENT PRIVILEGED\PLANT BARRY\ACES2520 BARRY AP CHARACTERIZATION REPORT\

**SOUTHERN COMPANY**

# BORING LOG

## BORING BY-GSA-MW-05
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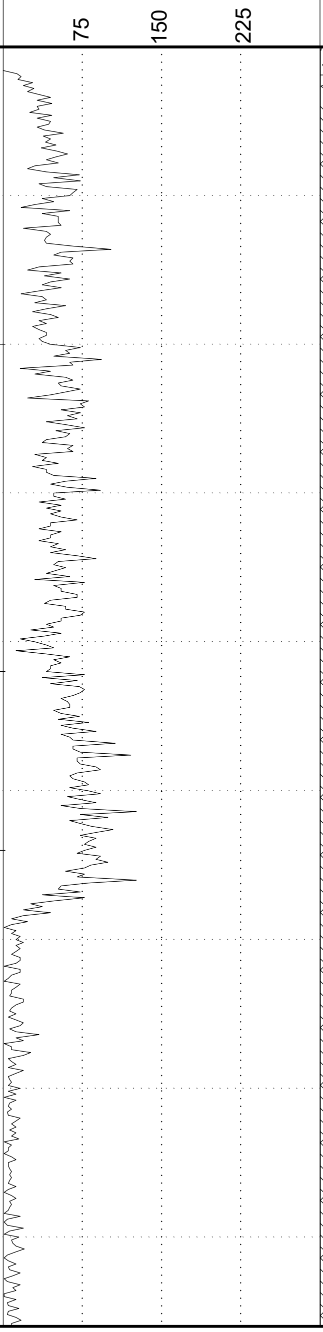
**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/30/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 31.2 **COORDINATES:** N:362,557.33 E:1,807,427.93
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
**BORING DEPTH** 89 ft. **GROUND WATER DEPTH: DURING** 25 ft. **COMP.** 29.5 ft. **DELAYED** 29.5 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.

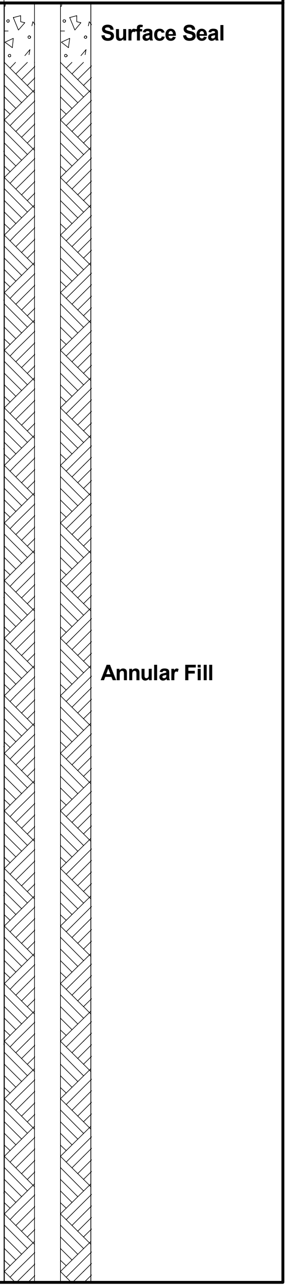
| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|---|
| | | | 31.2 |
| 5<br>10 | | **Utility Clearance (HYDROEXCAVATION)** | 21.2 |
| 15<br>20 | | **Lean Clay (CL)**<br>mottled reddish yellow (7.5YR 6/8) and gray (7.5YR 6/1) fill moist, sandy | 10.2 |
| 25 | ▽ | **Fat Clay (CH)**<br>gray (7.5YR 6/1) alluvium wet, trace silt, very clean | 4.2 |
| 30<br>35<br>40 | ▼ | **Poorly-graded Sand (SP)**<br>mottled reddish yellow (7.5YR 6/8) and light brown (7.5YR 6/3) alluvium wet, coarse grained with trace fines, trace gravel<br>coarsens downward, more consistent color | |

**Natural Gamma**



**WELL DATA**

Top of casing Elev. = 34.31



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SOUTHERN COMPANY

# BORING LOG

## BORING BY-GSA-MW-05
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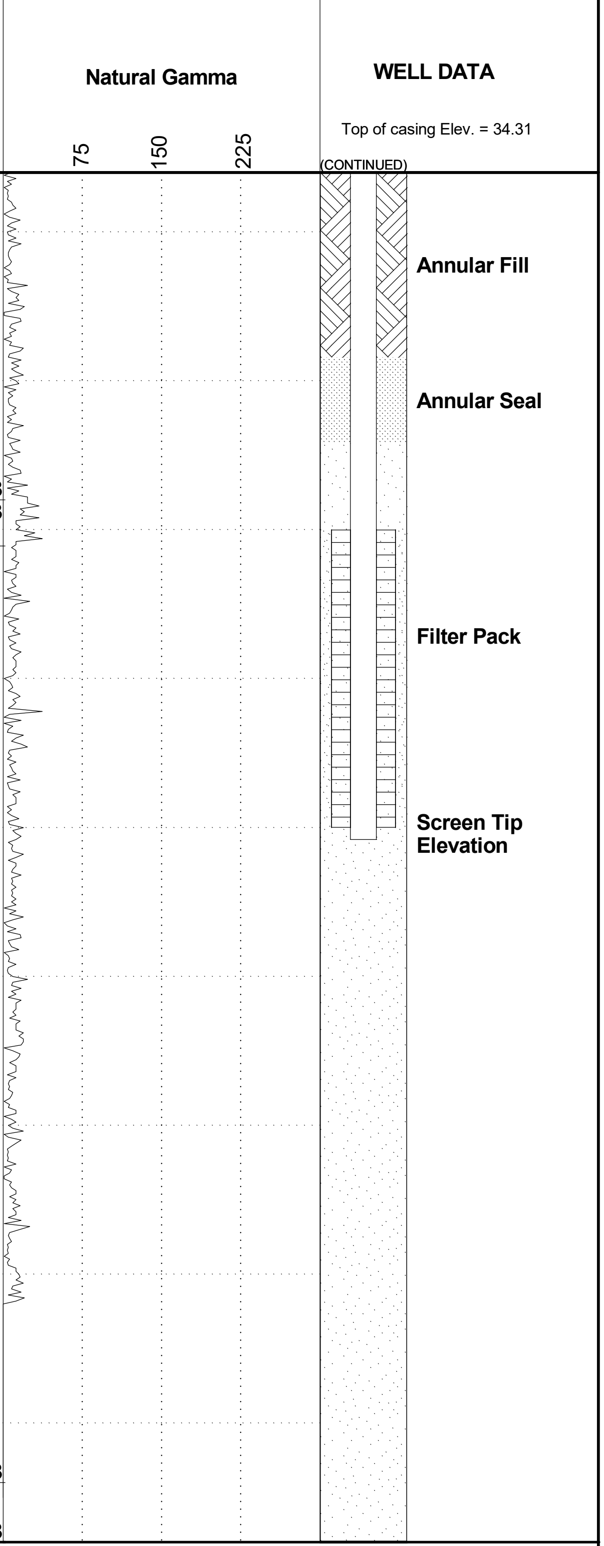
ECS37275

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|
| | | 31.2 |
| | **Poorly-graded Sand (SP)**<br>mottled reddish yellow (7.5YR 6/8) and light brown (7.5YR 6/3) alluvium wet, coarse grained with trace fines, trace gravel*(Con't)* | |
| 45 | | |
| 50 | | |
| | | -22.8 |
| 55 | **Sandy Lean Clay (CL)**<br>gray (7.5YR 6/1) alluvium wet, sandy | -23.3 |
| | **Poorly-graded Sand (SP)**<br>mottled reddish yellow (7.5YR 6/8) and light brown (7.5YR 6/3) alluvium wet, coarse grained with trace fines, trace gravel<br>gray (7.5YR 6/1) alluvium wet, coarse grained with little to no fines, no gravel | |
| 60 | | |
| 65 | | |
| | gray (7.5YR 6/1) alluvium wet, coarse grained with little to no fines, no gravel | |
| 70 | | |
| 75 | | |
| | gray (7.5YR 6/1) alluvium wet, coarse grained with little to no fines, no gravel | |
| 80 | | |
| 85 | | |
| | | -55.8 |
| | **Fat Clay (CH)**<br>strong brown (7.5YR 5/6) alluvium wet, sandy, trace organic pulp | |
| | | -57.8 |



Bottom of borehole at 89.0 feet.

# BORING BY-GSA-MW-06
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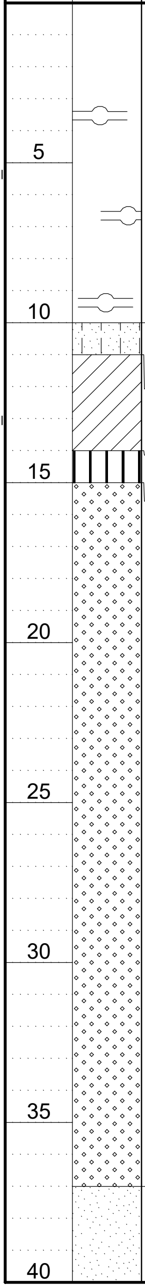
ECS37275

# BORING LOG

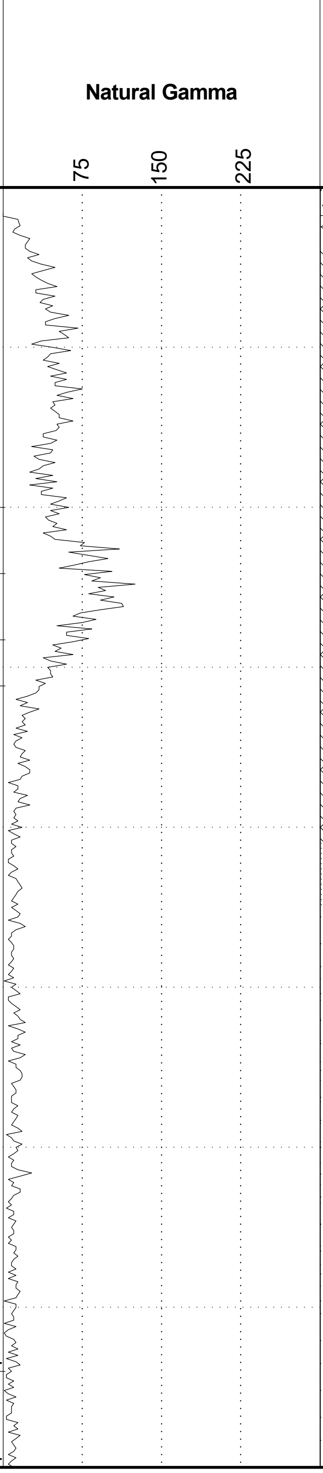
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

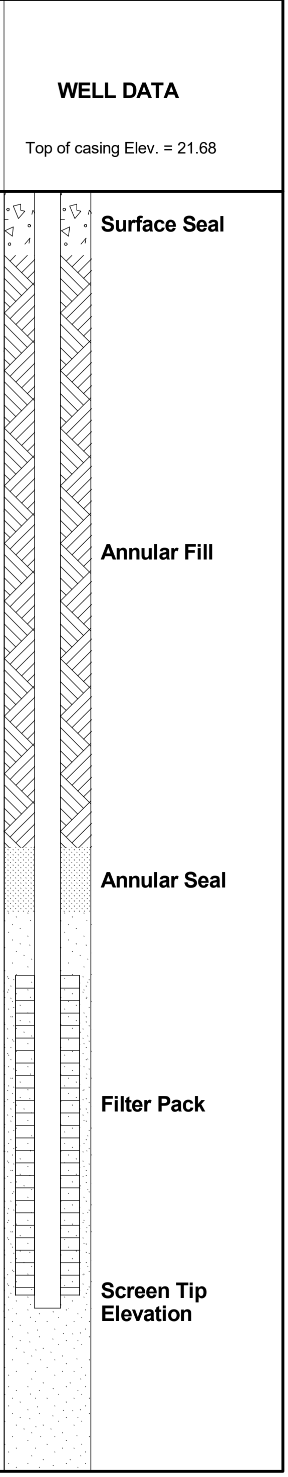
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/28/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 18.6 **COORDINATES:** N:363,068.86 E:1,807,361.63
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.



| MATERIAL DESCRIPTION | ELEVATION |
|---|---|
| | 18.6 |
| **Utility Clearance (HYDROEXCAVATION)** | 8.6 |
| **Silty Sand (SM)**<br>light gray (2.5Y 7/1) and yellow (2.5Y 7/6) alluvium moist, thinnly laminated, some organics | 7.6 |
| **Lean Clay (CL)**<br>light brownish gray (2.5Y 6/2) alluvium soft, medium, laminated, concentrated organics | 4.6 |
| **Silt (ML)**<br>light gray / yellowish gray (5Y 7/2) alluvium moist, fine grained sand | 3.6 |
| **Well-graded Sand (SW)**<br>white / yellowish gray (5Y 8/1) alluvium wet, repeated fining upward sequences of coarse to medium sand, each sequence about 0.5 foot thick, rare pebble<br>reddish yellow (7.5YR 6/8), yellow / pale yellowish orange (10YR 8/6) and reddish yellow (7.5YR 7/6) alluvium wet, gravelly fining upward sequences about 1 foot thick, gravel base at each sequence, grades up to medium sand | -18.4 |
| **Poorly-graded Sand (SP)**<br>pale yellow (2.5Y 7/4) alluvium wet, medium grained, clean, rare pebble | -21.4 |





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# BORING LOG

SOUTHERN COMPANY

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

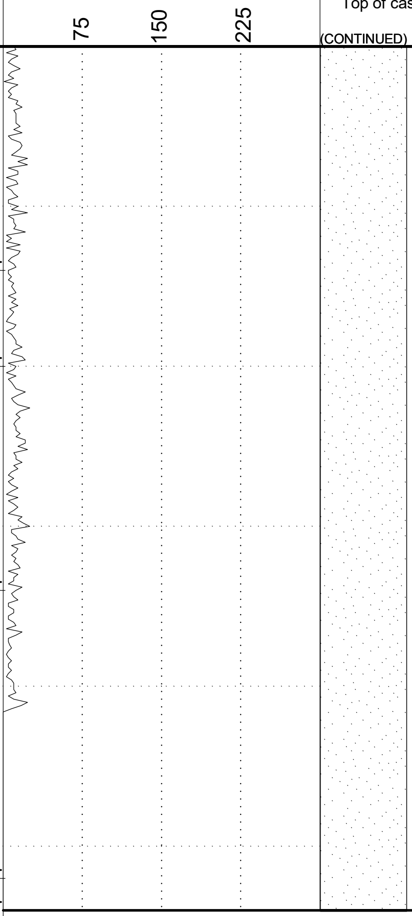
| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|---|
| | | | 18.6 |
| 45 | | **Well-graded Sand (SW)**<br>yellow (10YR 7/8) and pale yellow (2.5Y 8/2) alluvium wet, medium to fine grained clean sand | -28.4 |
| 50 | | **Clayey Sand (SC)**<br>yellow (10YR 7/8) alluvium wet, medium, fine grained sand, most clay in top 4 inches | -31.4 |
| 55 | | **Poorly-graded Sand (SP)**<br>pale yellow (2.5Y 8/4) alluvium wet, coarse to medium grained sand, subangular gravel | -38.4 |
| 60<br>65 | | **Well-graded Sand (SW)**<br>pale yellow (2.5Y 8/2) alluvium wet, medium to coarse sand, no gravel | -47.4 |
| | | **Clayey Sand (SC)**<br>gray (5Y 5/1) alluvium wet, fine grained sand with organic material present | -48.4 |

Bottom of borehole at 67.0 feet.

**Natural Gamma**

**WELL DATA**

Top of casing Elev. = 21.68



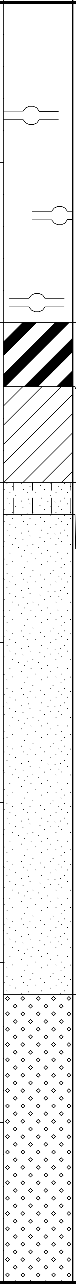
**BORING BY-GSA-MW-07**
**PAGE 1 OF 2**
**ECS37275**

# BORING LOG

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

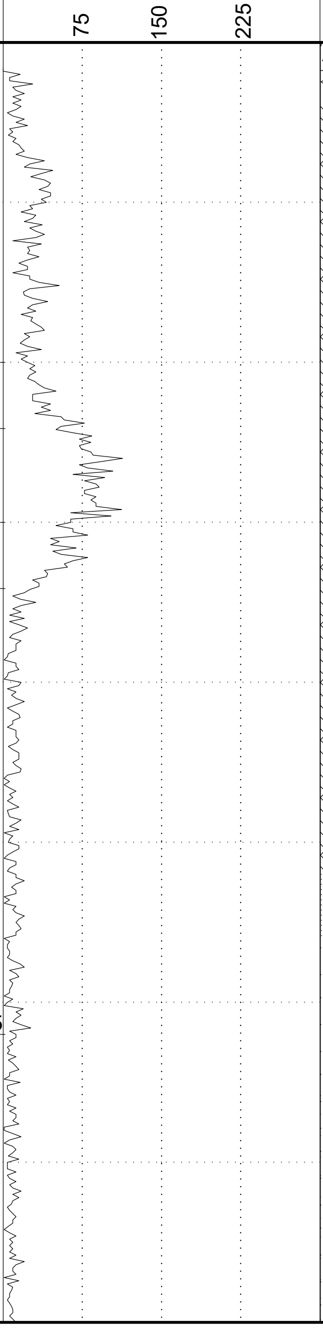
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/28/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 17.5 **COORDINATES:** N:363,101.48 E:1,807,776.83
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.



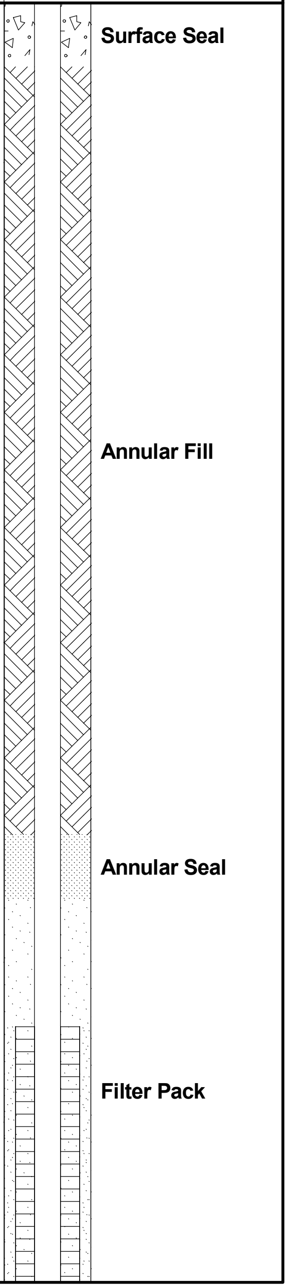
| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|
| | | 17.5 |
| 5<br>10 | **Utility Clearance (HYDROEXCAVATION)** | 7.5 |
| | **Fat Clay (CH)**<br>pinkish gray (7.5YR 6/2) alluvium moist, dense, medium, inorganic with thin <2mm interbeds of fine sand | 5.5 |
| 15 | **Lean Clay (CL)**<br>light brownish gray / pale yellowish brown (10YR 6/2) and yellowish brown (10YR 5/8) alluvium damp, dense, medium, contains 2 colors, within yellowish brown inclusions are pebbles | 2.5 |
| | **Silty Sand (SM)**<br>light brownish gray / pale yellowish brown (10YR 6/2) alluvium wet, fine grained with trace clay | 1.5 |
| 20<br>25<br>30 | **Poorly-graded Sand (SP)**<br>pale yellow (2.5Y 8/2) alluvium wet, repeating fining upward sequences of gravel to medium grained sand, each sequence ~1 foot thick, no clay<br>yellow (10YR 7/6) alluvium wet, medium to coarse grained, no gravel<br>yellow (10YR 7/6) and gray (7.5YR 6/1) alluvium wet, medium to coarse sand with 35% large clay nodules | -13.5 |
| 35<br>40 | **Well-graded Sand (SW)**<br>reddish yellow (7.5YR 6/8) alluvium wet, coarse grained, gravelly sand, repeating fining upward sequences about 1.5 foot thick | |

**Natural Gamma**



**WELL DATA**

Top of casing Elev. = 17.46



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# BORING BY-GSA-MW-07

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# BORING LOG

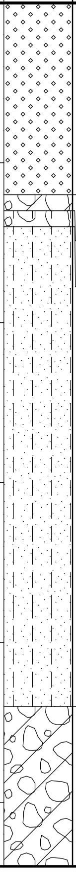
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs

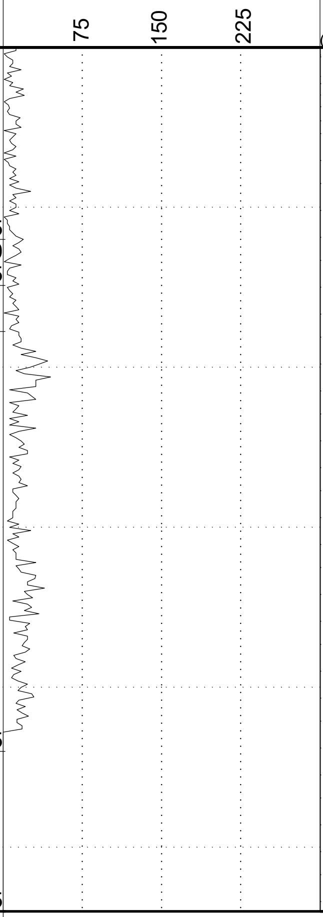
**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|---|
| | | | 17.5 |
| 45 | | **Well-graded Sand (SW)**<br>reddish yellow (7.5YR 6/8) alluvium wet, coarse grained, gravelly sand, repeating fining upward sequences about 1.5 foot thick*(Con't)* | -28.5 |
| | | **Clayey Gravel (GC)**<br>light gray (10YR 7/2) alluvium wet | -29.0 |
| | | **Silty Gravel (GM)**<br>yellow (10YR 7/6) alluvium wet, fine grained sand | -29.5 |
| 50<br>55<br>60 | | **Silty Sand (SM)**<br>pale yellow (2.5Y 7/4) alluvium wet, clean, medium to fine grained, no clay, no gravel | -44.5 |
| 65 | | **Clayey Gravel (GC)**<br>yellow (10YR 7/6) alluvium wet, interbedded coarse sand and gravel with some clay, trace claystone clasts also present. | -49.5 |

Bottom of borehole at 67.0 feet.

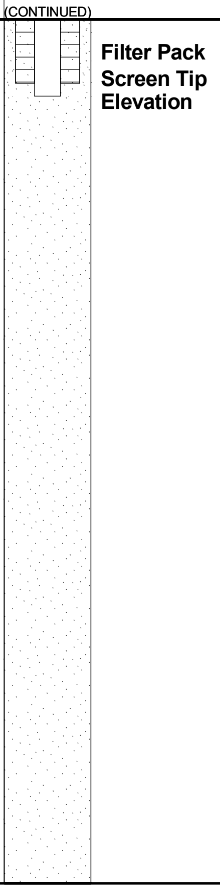


**Natural Gamma**



**WELL DATA**

Top of casing Elev. = 17.46



# BORING BY-GSA-MW-08

PAGE 1 OF 2
ECS37275

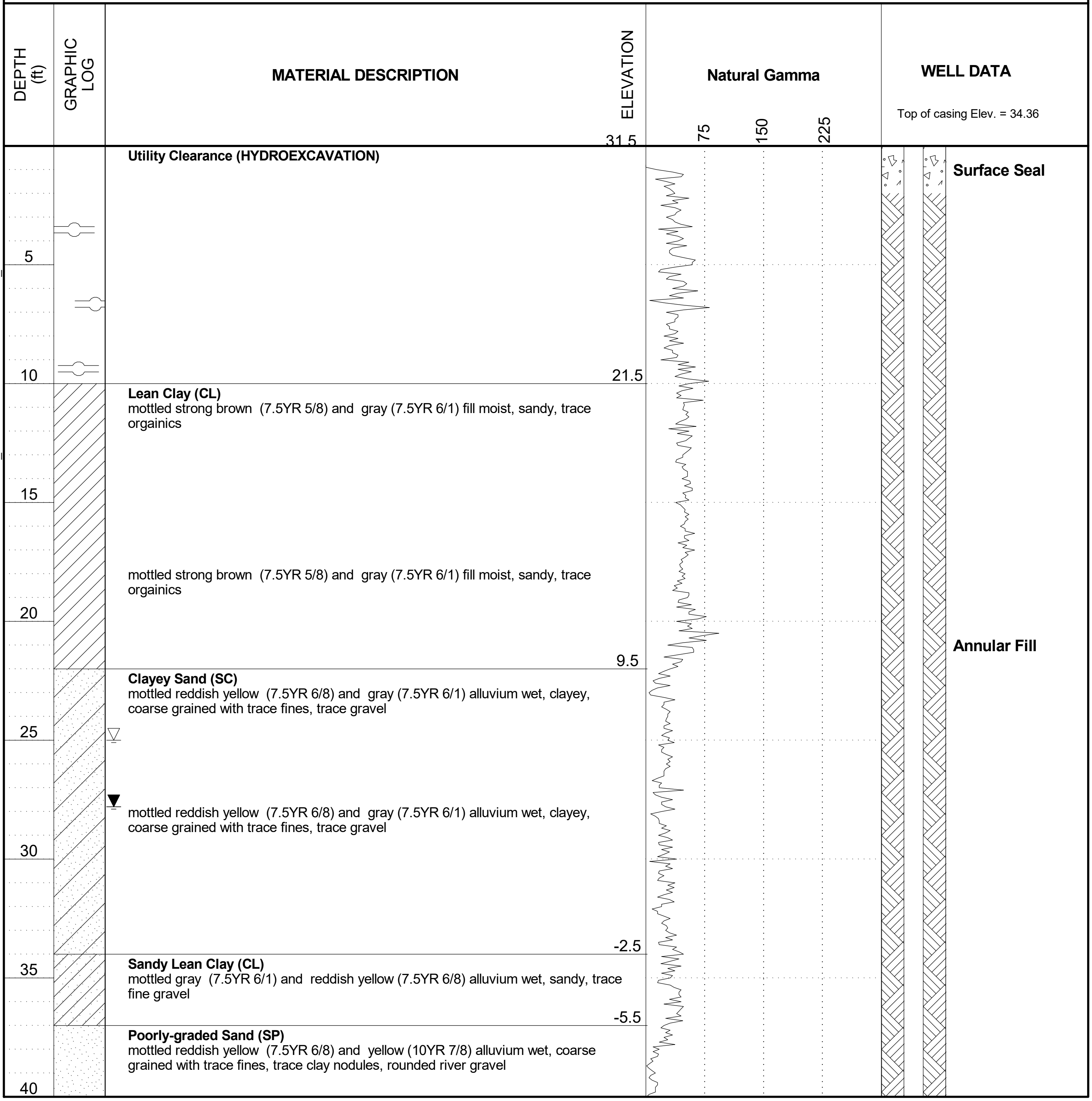
SOUTHERN COMPANY

# BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/29/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 31.5 **COORDINATES:** N:362,918.17 E:1,808,316.29
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
**BORING DEPTH** 87 ft. **GROUND WATER DEPTH: DURING** 25 ft. **COMP.** 27.8 ft. **DELAYED** 27.8 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.



**MATERIAL DESCRIPTION**

31.5

**Utility Clearance (HYDROEXCAVATION)**

21.5

**Lean Clay (CL)**
mottled strong brown (7.5YR 5/8) and gray (7.5YR 6/1) fill moist, sandy, trace orgainics

mottled strong brown (7.5YR 5/8) and gray (7.5YR 6/1) fill moist, sandy, trace orgainics

9.5

**Clayey Sand (SC)**
mottled reddish yellow (7.5YR 6/8) and gray (7.5YR 6/1) alluvium wet, clayey, coarse grained with trace fines, trace gravel

mottled reddish yellow (7.5YR 6/8) and gray (7.5YR 6/1) alluvium wet, clayey, coarse grained with trace fines, trace gravel

-2.5

**Sandy Lean Clay (CL)**
mottled gray (7.5YR 6/1) and reddish yellow (7.5YR 6/8) alluvium wet, sandy, trace fine gravel

-5.5

**Poorly-graded Sand (SP)**
mottled reddish yellow (7.5YR 6/8) and yellow (10YR 7/8) alluvium wet, coarse grained with trace fines, trace clay nodules, rounded river gravel

*(Continued Next Page)*

# BORING BY-GSA-MW-08

PAGE 2 OF 2

ECS37275

# BORING LOG

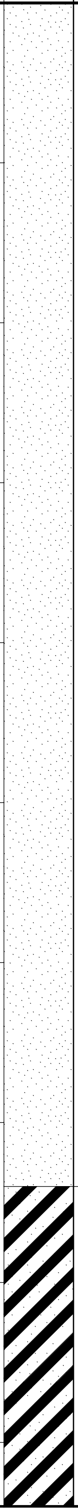
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs

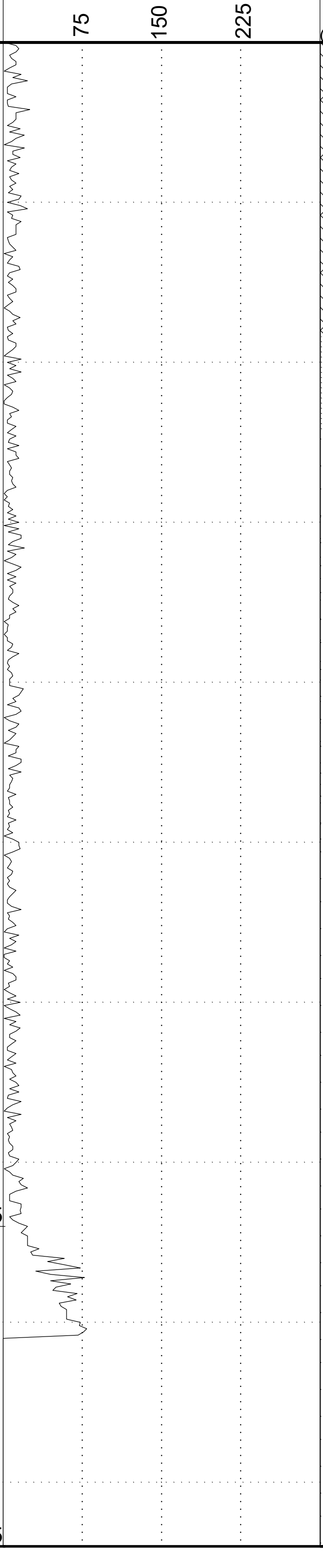
**LOCATION** Bucks, AL

| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|
| | **Poorly-graded Sand (SP)**<br>mottled reddish yellow (7.5YR 6/8) and yellow (10YR 7/8) alluvium wet, coarse grained with trace fines, trace clay nodules, rounded river gravel*(Con't)* | 31.5 |
| 45 | | |
| | mottled reddish yellow (7.5YR 6/8) and yellow (10YR 7/8) alluvium wet, coarse grained with trace fines, trace clay nodules, rounded river gravel, coarsening downward | |
| 50 | | |
| 55 | | |
| | dusky red (5R 3/4) alluvium wet, coarse grained with trace fines, trace clay nodules, rounded river gravel, coarsening downward | |
| 60 | | |
| 65 | | |
| 70 | | |
| 75 | | |
| | **Sandy Fat Clay (CH)**<br>gray (7.5YR 6/1) alluvium wet, sandy | -45.5 |
| 80 | | |
| 85 | | |
| | | -55.5 |

GRAPHIC LOG

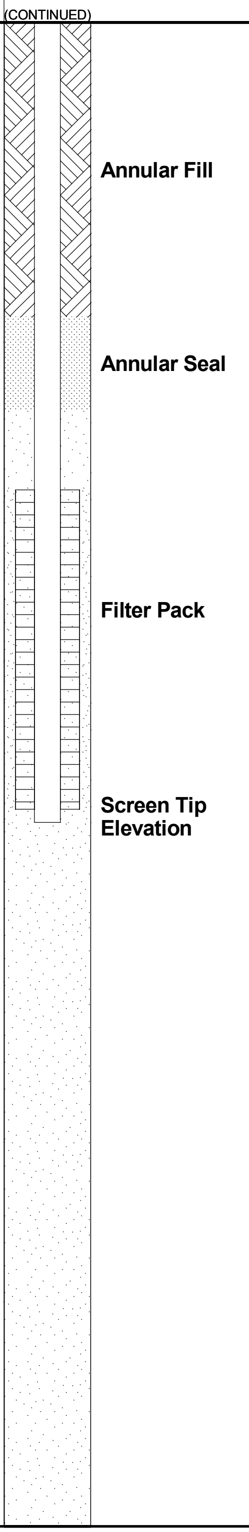


**Natural Gamma**



**WELL DATA**

Top of casing Elev. = 34.36



Bottom of borehole at 87.0 feet.

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/11/17 11:26 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC ATTORNEY CLIENT PRIVILEGED\PLANT BARRY\ACES2520 BARRY AP CHARACTERIZATION REPORT\

# BORING BY-GSA-MW-09

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# BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs

**LOCATION** Bucks, AL

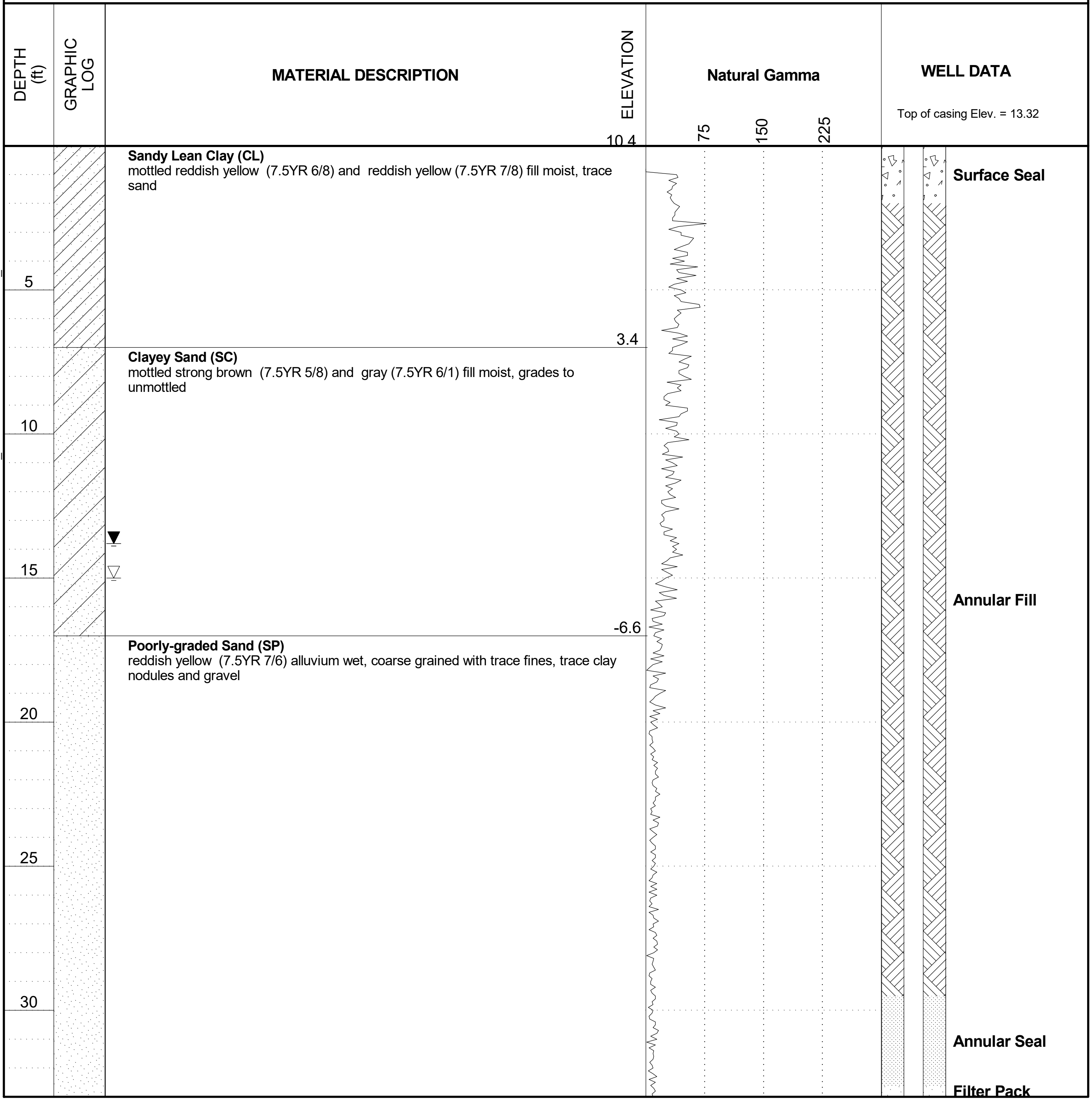
**DATE STARTED** 9/23/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 10.4 **COORDINATES:** N:362,799.55 E:1,808,595.91

**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic

**DRILLED BY** J. Hall **LOGGED BY** S. Baxter **CHECKED BY** B. Coates

**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** 15 ft. **COMP.** 13.8 ft. **DELAYED** 13.8 ft. after 48 hrs.

**NOTES** Well installed. Refer to well data sheet.



**MATERIAL DESCRIPTION**

**Sandy Lean Clay (CL)**
mottled reddish yellow (7.5YR 6/8) and reddish yellow (7.5YR 7/8) fill moist, trace sand

**Clayey Sand (SC)**
mottled strong brown (7.5YR 5/8) and gray (7.5YR 6/1) fill moist, grades to unmottled

**Poorly-graded Sand (SP)**
reddish yellow (7.5YR 7/6) alluvium wet, coarse grained with trace fines, trace clay nodules and gravel

*(Continued Next Page)*

**SOUTHERN COMPANY**

# BORING LOG

## BORING BY-GSA-MW-09

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**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

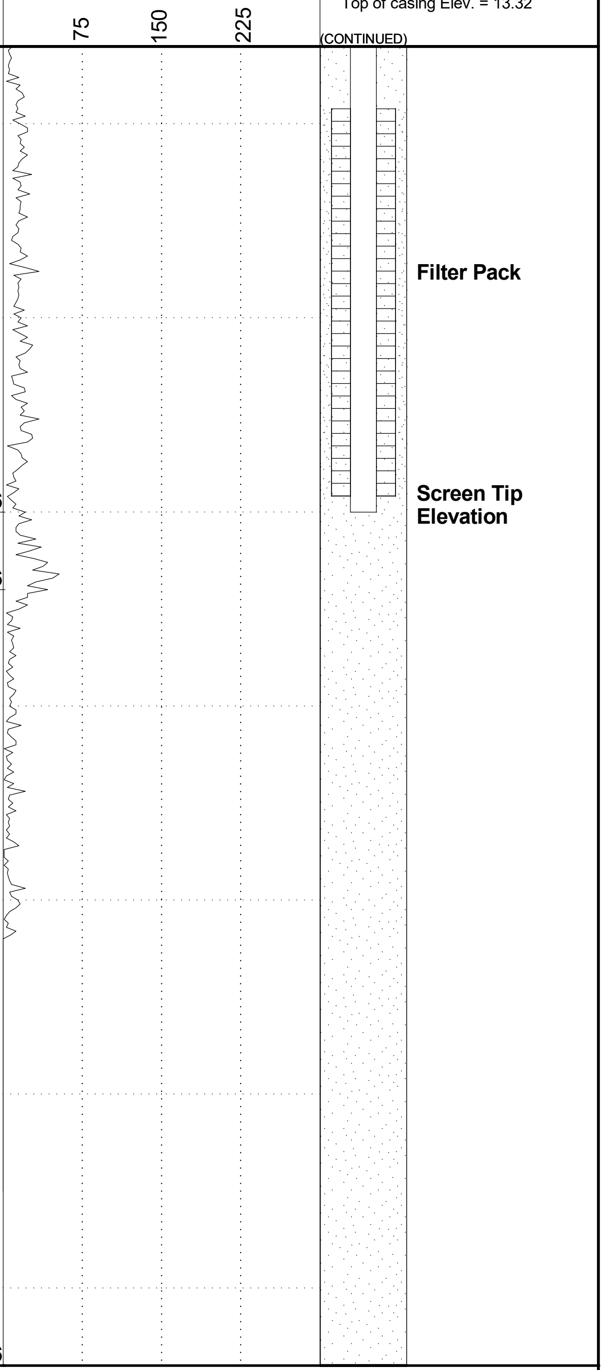
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|---|
| | | | 10.4 |
| 35 | | **Poorly-graded Sand (SP)**<br>reddish yellow (7.5YR 7/6) alluvium wet, coarse grained with trace fines, trace clay nodules and gravel*(Con't)* | |
| 40 | | | |
| 45 | | | -34.6 |
| | | **Lean Clay (CL)**<br>gray (7.5YR 6/1) alluvium wet, sandy, trace gravel | -36.6 |
| 50 | | **Poorly-graded Sand (SP)**<br>mottled reddish yellow (7.5YR 6/8) and light gray (7.5YR 7/1) alluvium wet, coarse grained with trace fines, trace clay and gravel | |
| 55 | | | |
| 60 | | mottled reddish yellow (7.5YR 6/8) and light gray (7.5YR 7/1) alluvium wet, coarse grained with trace fines, trace clay and coarsening downward gravel | |
| 65 | | | -56.6 |

**Natural Gamma**

**WELL DATA**

Top of casing Elev. = 13.32



Bottom of borehole at 67.0 feet.

**SOUTHERN COMPANY**

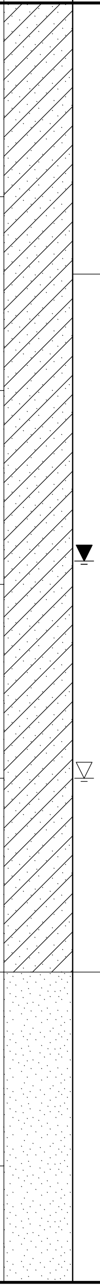
# BORING LOG

## BORING BY-GSA-MW-10
PAGE 1 OF 2
ECS37275

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

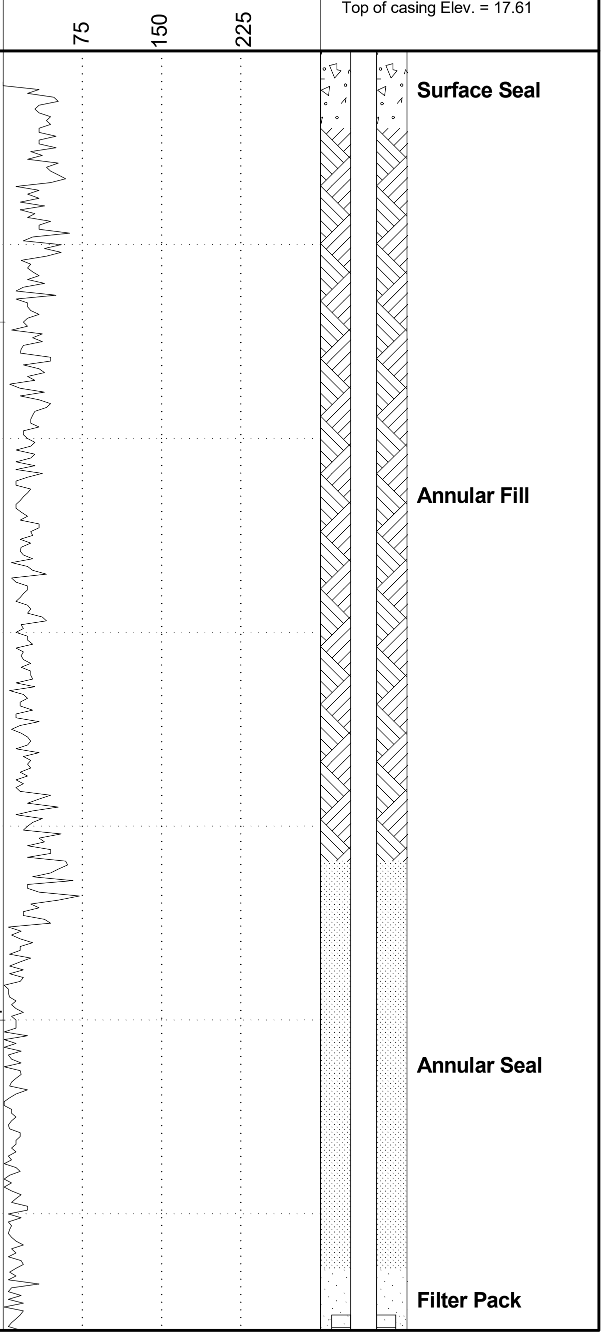
**DATE STARTED** 9/23/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 14.7 **COORDINATES:** N:362,441.66 E:1,808,600.05
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** J. Hall **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** 20 ft. **COMP.** 14.4 ft. **DELAYED** 14.4 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.



| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|
| | | 14.7 |
| | **Sandy Lean Clay (CL)**<br>light brown (7.5YR 6/3) fill moist, sandy, trace roots | |
| 5 | | |
| | | 7.7 |
| | **Sandy Lean Clay (CL)**<br>mottled light brown (7.5YR 6/4) and reddish yellow (7.5YR 6/8) fill moist, sandy, sand coarse to fine grained | |
| 10 | | |
| 15 | | |
| 20 | | |
| 25 | | -10.4 |
| | **Poorly-graded Sand (SP)**<br>light gray (7.5YR 7/1) alluvium wet, coarse grained with trace fines, trace clay nodules | |
| | mottled light gray (7.5YR 7/1) and strong brown (7.5YR 5/8) alluvium wet, coarse grained with trace fines, trace clay nodules | |
| 30 | | |

**Natural Gamma** | **WELL DATA**

Top of casing Elev. = 17.61



*(Continued Next Page)*

DEPTH (ft) | GRAPHIC LOG | **MATERIAL DESCRIPTION** | ELEVATION | **Natural Gamma** | **WELL DATA**

Top of casing Elev. = 17.61

14.7

**Poorly-graded Sand (SP)**
light gray (7.5YR 7/1) alluvium wet, coarse grained with trace fines, trace clay nodules*(Con't)*

35

mottled light gray (7.5YR 7/1) and strong brown (7.5YR 5/8) alluvium wet, very coarse grained with trace fines, trace clay nodules

40

45

mottled light gray (7.5YR 7/1) and strong brown (7.5YR 5/8) alluvium wet, very coarse grained with trace fines, trace clay nodules

50

55

reddish yellow (7.5YR 6/8) alluvium wet, coarse grained with trace fines, trace rounded gravel

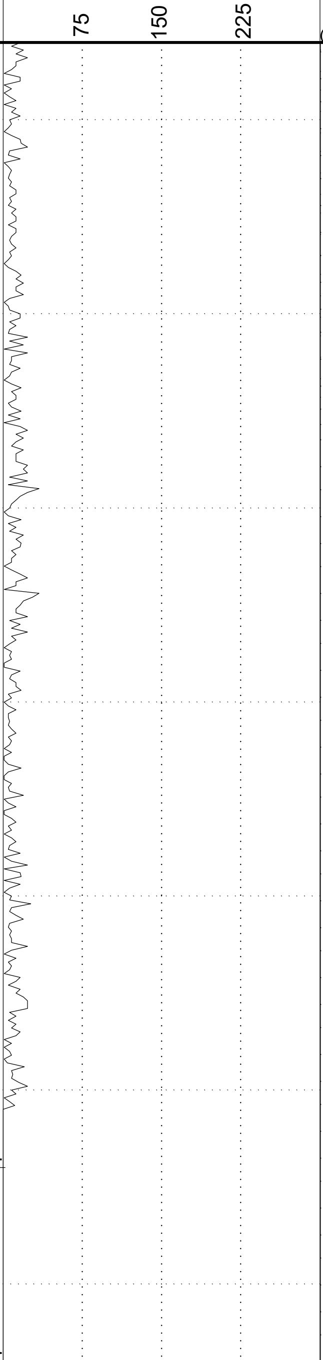
60

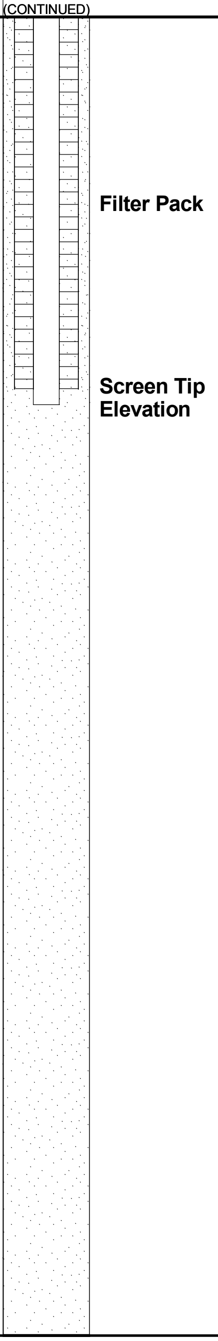
-47.4

**Fat Clay (CH)**
mottled strong brown (7.5YR 4/6) and very dark gray (7.5YR 3/1) alluvium wet, trace peat

65

-52.4





Bottom of borehole at 67.0 feet.

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/11/17 11:26 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC ATTORNEY CLIENT PRIVILEGED\PLANT BARRY\ACES2520 BARRY AP CHARACTERIZATION REPORT\

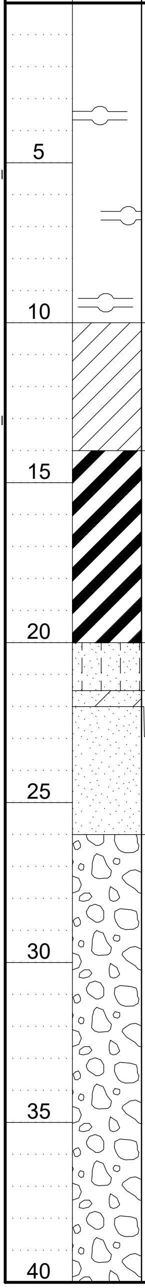
# BORING BY-GSA-PZ-11
PAGE 1 OF 2
ECS37275

# BORING LOG

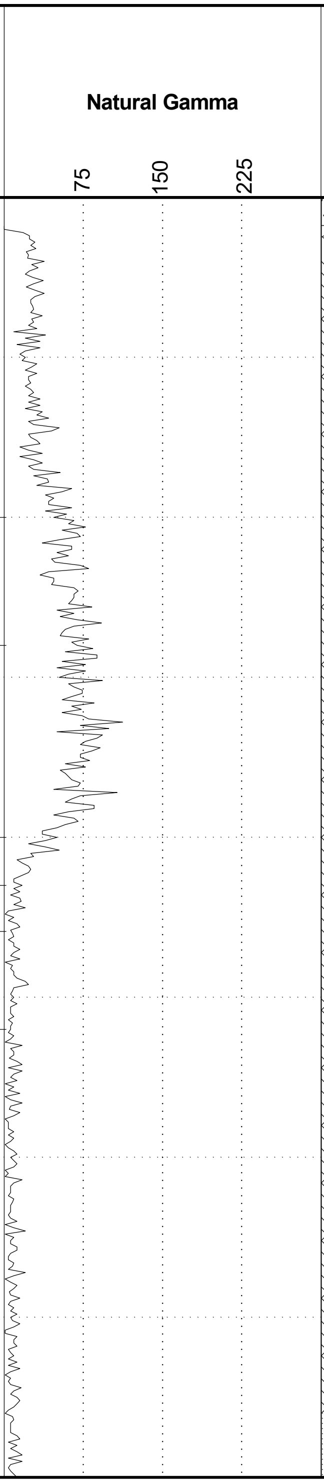
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

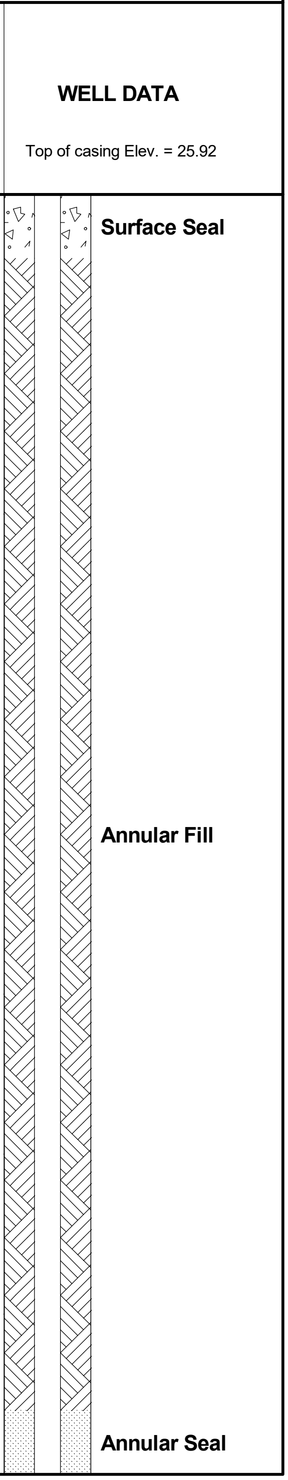
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/25/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 23.6 **COORDINATES:** N:363,466.38 E:1,807,619.63
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** J. Hall **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.



| MATERIAL DESCRIPTION | ELEVATION |
|---|---|
| | 23.6 |
| **Utility Clearance (HYDROEXCAVATION)** | 13.6 |
| **Lean Clay (CL)**<br>light gray (5Y 7/1) and red (2.5YR 4/8) no, red inclusions, crumbley | 9.6 |
| **Fat Clay (CH)**<br>light olive gray (5Y 6/2) moist dense, medium | 3.6 |
| **Silty Sand (SM)**<br>white / yellowish gray (5Y 8/1) moist fine grained sand with clay clasts near the base | 2.1 |
| **Clayey Sand (SC)**<br>olive gray (5Y 4/2) moist dense, high, some fine sand | 1.6 |
| **Poorly-graded Sand (SP)**<br>white / yellowish gray (5Y 8/1) moist medium grained, micaceous | -2.4 |
| **Poorly-graded Gravel (SP)**<br>yellow (10YR 7/8) and yellow / pale yellowish orange (10YR 8/6) wet coarse sand, subangular 0.5 to 1 cm gravels. limited recovery from 27-37.<br>white / yellowish gray (5Y 8/1) wet medium grained sand with some gravel in upper foot (37-38). coarsens upward | |





Top of casing Elev. = 25.92

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# BORING BY-GSA-PZ-11
PAGE 2 OF 2
ECS37275

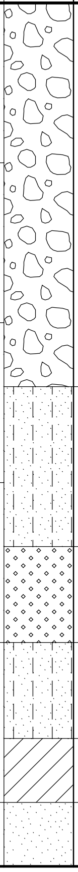
# BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

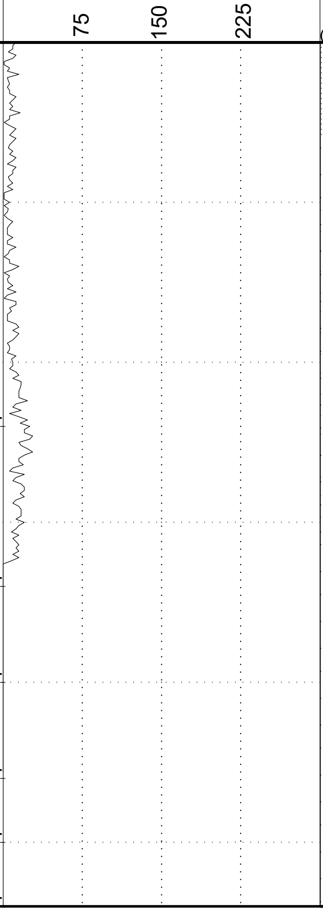
**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

| DEPTH (ft) | MATERIAL DESCRIPTION | ELEVATION |
|---|---|---|
| | | 23.6 |
| | **Poorly-graded Gravel (SP)**<br>yellow (10YR 7/8) and yellow / pale yellowish orange (10YR 8/6) wet coarse sand, subangular 0.5 to 1 cm gravels. limited recovery from 27-37. *(Con't)* | |
| 45 | yellow (5Y 8/8), white / yellowish gray (5Y 8/1) and yellow (5Y 7/8) wet coarse grained with subangular gravel and clay nodules. gravels larger near base - coarsens upward | |
| 50 | | -28.4 |
| | **Silty Sand (SM)**<br>white (2.5Y 8/1) wet silty, interbedded fine to medium grained | |
| 55 | | -33.4 |
| | **Well-graded Sand (SW)**<br>white / yellowish gray (5Y 8/1) wet coarse sand with subangular gravel and rare clay nodules. | |
| 60 | | -36.4 |
| | **Silty Sand (SM)**<br>very pale brown (10YR 7/3) wet fine to medium grained sand, no clay, no gravel | -39.4 |
| | **Lean Clay (CL)**<br>very pale brown (10YR 8/4) wet dense, high, fine sand to silty clay | |
| 65 | | -41.4 |
| | **Poorly-graded Sand (SP)**<br>yellow (5Y 7/8) wet very coarse grained with some clay clasts | -43.4 |

GRAPHIC LOG

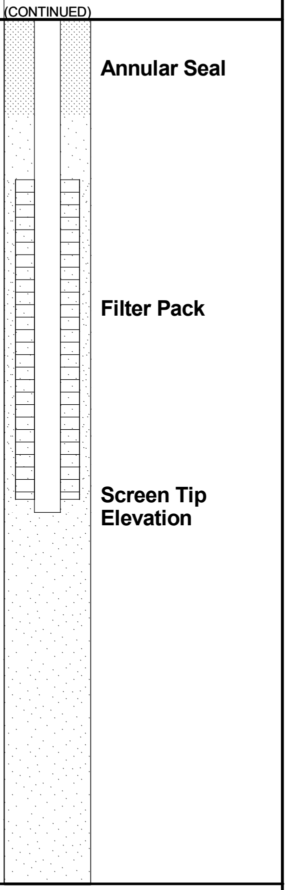


**Natural Gamma**



**WELL DATA**

Top of casing Elev. = 25.92



Bottom of borehole at 67.0 feet.

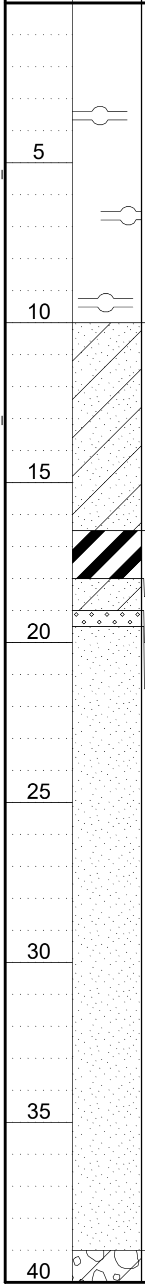
SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/11/17 11:26 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFTAPC ATTORNEY CLIENT PRIVILEGEDPLANT BARRYACES2520 BARRY AP CHARACTERIZATION REPORT

# BORING LOG

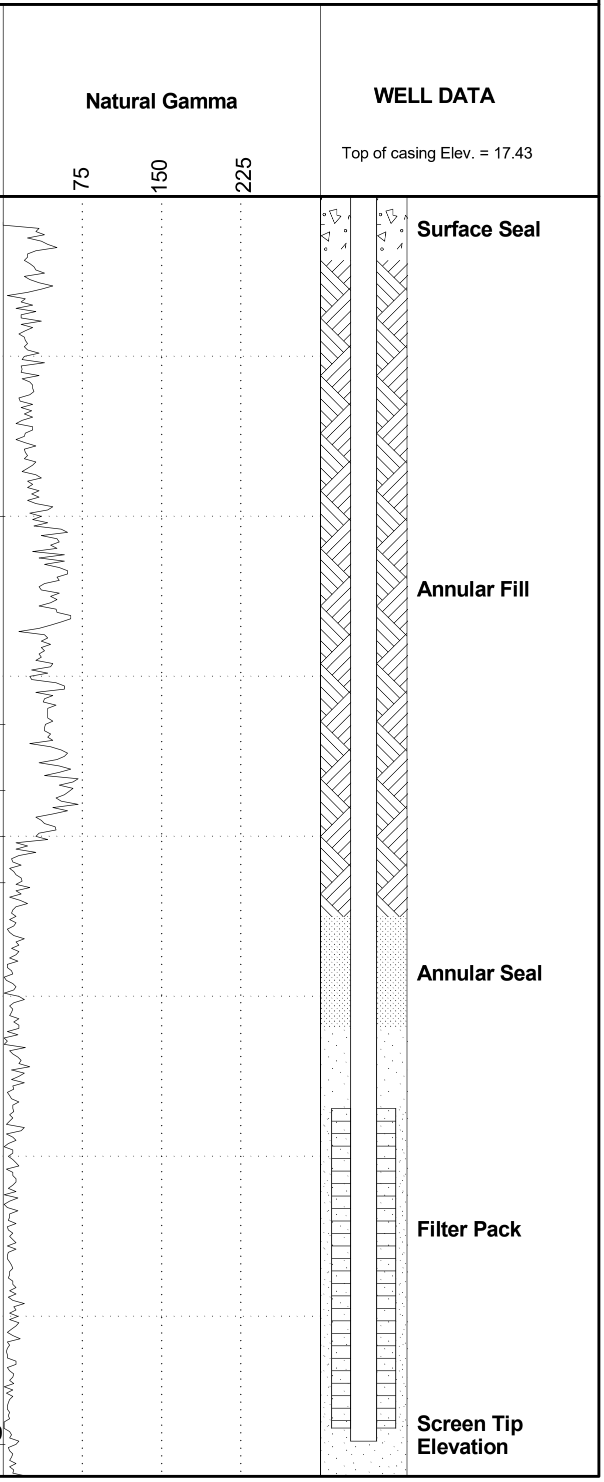
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/29/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 14.1 **COORDINATES:** N:363,286.54 E:1,808,282.28
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.



| MATERIAL DESCRIPTION | ELEVATION |
|---|---|
| | 14.1 |
| **Utility Clearance (HYDROEXCAVATION)** | 4.1 |
| **Clayey Sand (SC)**<br>light gray (5Y 7/1), red (2.5YR 5/8) and brownish yellow (10YR 6/8) alluvium wet, predominantly fine sand with some coarse grained lenses | -2.4 |
| **Fat Clay (CH)**<br>light brownish gray / pale yellowish brown (10YR 6/2) and brownish yellow (10YR 6/8) alluvium wet, dense, high, inorganic | -3.9 |
| **Clayey Sand (SC)**<br>yellowish brown (10YR 5/8) alluvium wet, fine sand | -4.9<br>-5.4 |
| **Well-graded Sand (SW)**<br>strong brown (7.5YR 5/8) alluvium wet, coarse sand, some subangular gravel | |
| **Poorly-graded Sand (SP)**<br>very pale brown / grayish orange (10YR 7/4) alluvium wet, repeating fining upward sequences of coarse, gravelly sand to medium sand. (each sequence about 1.5 feet thick) | -24.9 |



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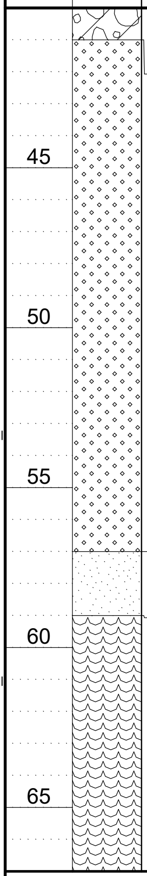
**SOUTHERN COMPANY**

# BORING LOG

**BORING BY-GSA-PZ-12**
**PAGE 2 OF 2**
**ECS37275**

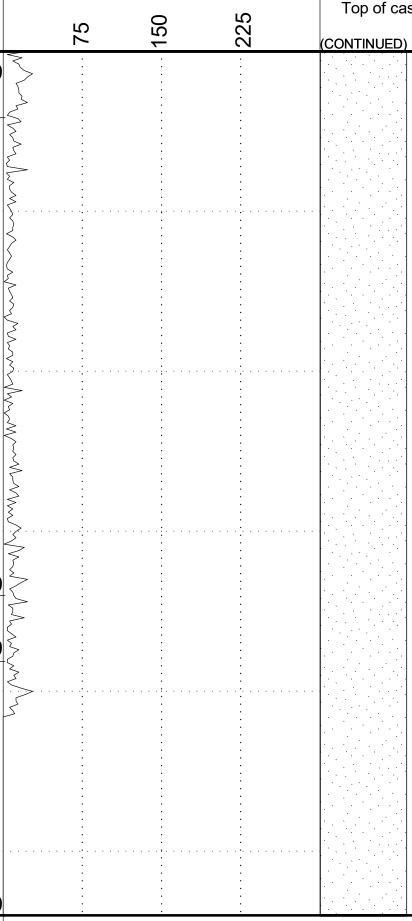
**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL



| MATERIAL DESCRIPTION | ELEVATION |
|---|---|
| | 14.1 |
| **Clayey Gravel (GC)**<br>very pale brown / grayish orange (10YR 7/4) alluvium wet, subrounded gravel with clay matrix*(Con't)* | -26.9 |
| **Well-graded Sand (SW)**<br>pale yellow (2.5Y 7/4) alluvium wet, medium grained, clean, very little gravel, thin gravel lense at 48 feet. | -42.9 |
| **Poorly-graded Sand (SP)**<br>reddish yellow (7.5YR 6/8) alluvium wet, subrounded to subangular gravel within coarse sand matrix | -44.9 |
| **Medium to High Plastic Organic Clay or Silt (OH)**<br>very dark gray (5Y 3/1) alluvium damp, medium stiff, high, highly organic, pieces of bark and stick. | -52.9 |

Bottom of borehole at 67.0 feet.



**SOUTHERN COMPANY**

# LOG OF WELL INSTALLATION

## BORING BY-GSA-MW-01

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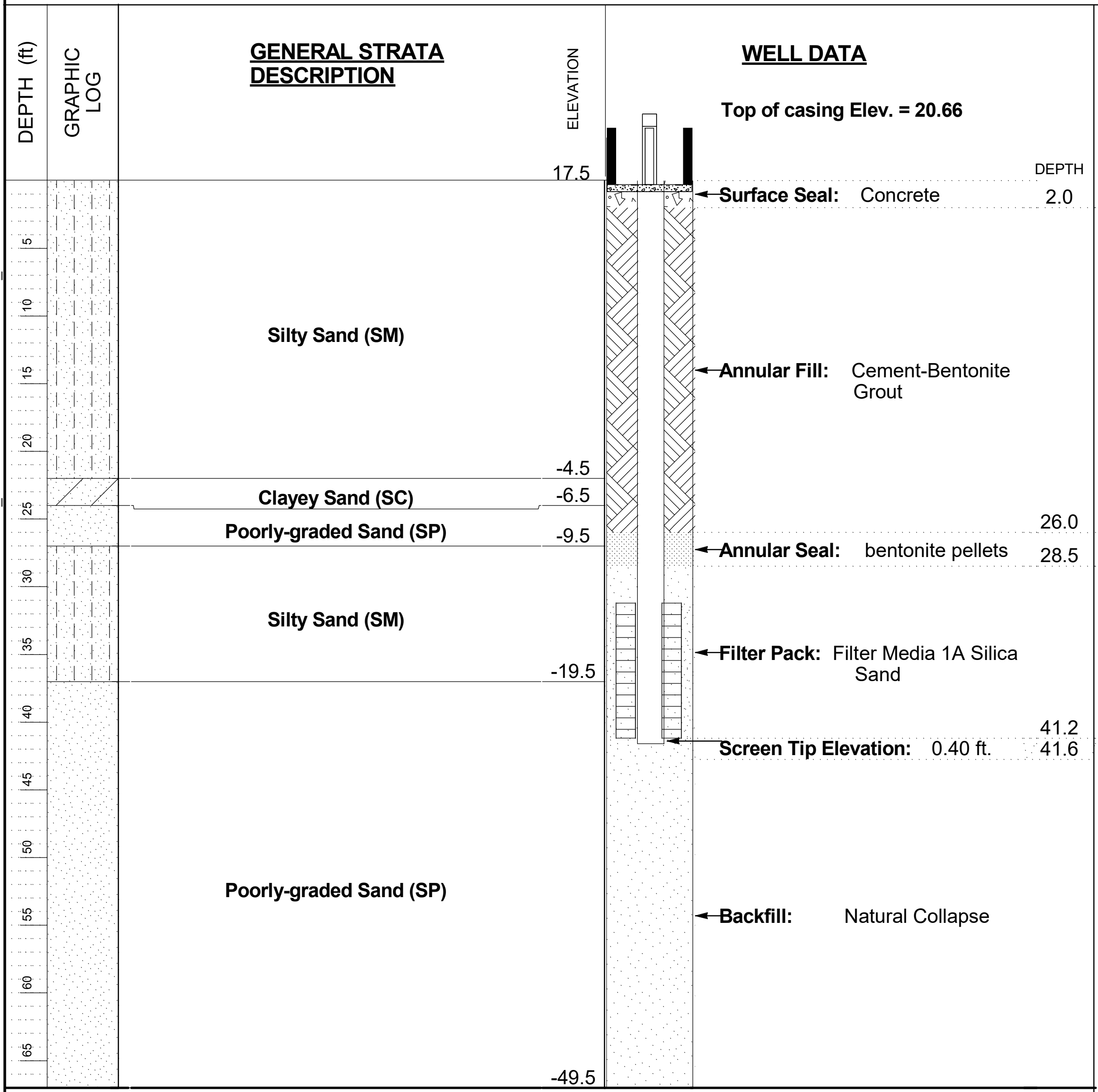
ECS37275

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/23/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 17.5 **COORDINATES:** N:362,038.24 E:1,808,279.56
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.



| GENERAL STRATA DESCRIPTION | ELEVATION |
|---|---|
| | 17.5 |
| **Silty Sand (SM)** | -4.5 |
| **Clayey Sand (SC)** | -6.5 |
| **Poorly-graded Sand (SP)** | -9.5 |
| **Silty Sand (SM)** | -19.5 |
| **Poorly-graded Sand (SP)** | -49.5 |

**Bottom of borehole at 67.0 feet.**

**WELL DATA**

**Top of casing Elev. = 20.66**

| | DEPTH |
|---|---|
| **Surface Seal:** Concrete | 2.0 |
| **Annular Fill:** Cement-Bentonite Grout | 26.0 |
| **Annular Seal:** bentonite pellets | 28.5 |
| **Filter Pack:** Filter Media 1A Silica Sand | 41.2 |
| **Screen Tip Elevation:** 0.40 ft. | 41.6 |
| **Backfill:** Natural Collapse | |

**NOTES:**

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches **Screen Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
**Casing Length:** 70.17 feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

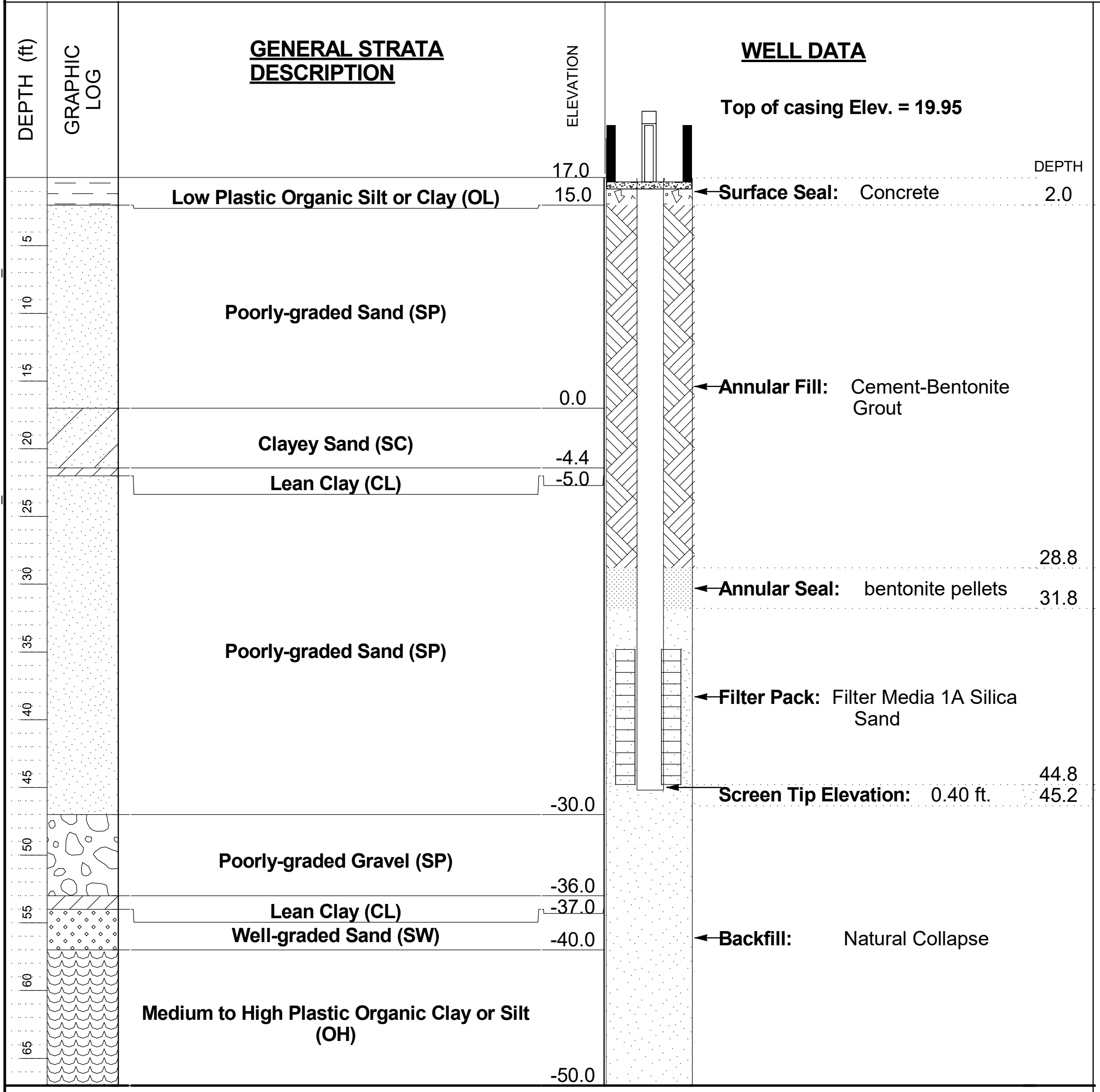
SOUTHERN COMPANY

# LOG OF WELL INSTALLATION

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/23/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 17.0 **COORDINATES:** N:361,968.69 E:1,807,662.77
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.



| **GENERAL STRATA DESCRIPTION** | **ELEVATION** |
|---|---|
| | 17.0 |
| **Low Plastic Organic Silt or Clay (OL)** | 15.0 |
| **Poorly-graded Sand (SP)** | 0.0 |
| **Clayey Sand (SC)** | -4.4 |
| **Lean Clay (CL)** | -5.0 |
| **Poorly-graded Sand (SP)** | -30.0 |
| **Poorly-graded Gravel (SP)** | -36.0 |
| **Lean Clay (CL)** | -37.0 |
| **Well-graded Sand (SW)** | -40.0 |
| **Medium to High Plastic Organic Clay or Silt (OH)** | -50.0 |

**Bottom of borehole at 67.0 feet.**

## WELL DATA

**Top of casing Elev. = 19.95**

| | | DEPTH |
|---|---|---|
| **Surface Seal:** | Concrete | 2.0 |
| **Annular Fill:** | Cement-Bentonite Grout | 28.8 |
| **Annular Seal:** | bentonite pellets | 31.8 |
| **Filter Pack:** | Filter Media 1A Silica Sand | 44.8 |
| **Screen Tip Elevation:** | 0.40 ft. | 45.2 |
| **Backfill:** | Natural Collapse | |

**NOTES:**

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC
**Casing Length:** 69.95 feet
**Screen Diameter:** 2 inches
**Screen Length:** 10 feet
**Screen Mesh:** 0.010
**Screen Material:** PVC
**PrePack Screen:** Yes

# BORING BY-GSA-MW-03

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# LOG OF WELL INSTALLATION

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs

**LOCATION** Bucks, AL

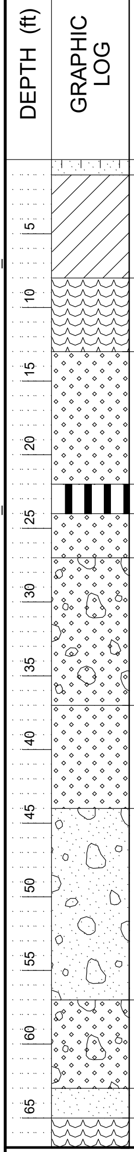
**DATE STARTED** 9/22/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 20.2 **COORDINATES:** N:361,627.64 E:1,807,366.92

**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic

**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates

**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**

**NOTES** Well installed. Refer to well data sheet.

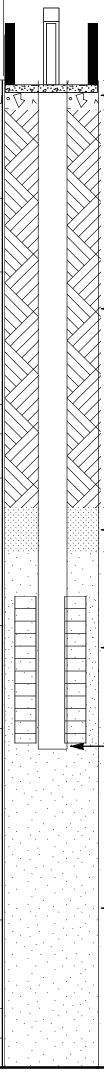


| GENERAL STRATA DESCRIPTION | ELEVATION |
|---|---|
| | 20.2 |
| Silty Sand (SM) | 19.2 |
| Lean Clay (CL) | 12.2 |
| Medium to High Plastic Organic Clay or Silt (OH) | 7.2 |
| Well-graded Sand (SW) | -1.9 |
| Elastic Silt (MH) | -3.9 |
| Well-graded Sand (SW) | -6.9 |
| Well-graded Gravelly Sand (SW) | -16.9 |
| Well-graded Sand (SW) | -23.9 |
| Poorly-graded Gravelly Sand (SP) | -36.9 |
| Well-graded Gravelly Sand (SW) | -42.9 |
| Poorly-graded Sand (SP) | -44.9 |
| Medium to High Plastic Organic Clay or Silt (OH) | -46.9 |

Bottom of borehole at 67.0 feet.

## WELL DATA

**Top of casing Elev. = 23.24**



| WELL DATA | DEPTH |
|---|---|
| **Surface Seal:** Concrete | 2.0 |
| **Annular Fill:** Cement-Bentonite Grout | 29.0 |
| **Annular Seal:** bentonite pellets | 32.0 |
| **Filter Pack:** Filter Media 1A Silica Sand | 45.0 |
| **Screen Tip Elevation:** 0.40 ft. | 45.4 |
| **Backfill:** Natural Collapse | |

**NOTES:**

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC
**Casing Length:** 70.09 feet
**Screen Diameter:** 2 inches
**Screen Length:** 10 feet
**Screen Mesh:** 0.010
**Screen Material:** PVC
**PrePack Screen:** Yes

**BORING BY-GSA-MW-04**
**PAGE 1 OF 1**
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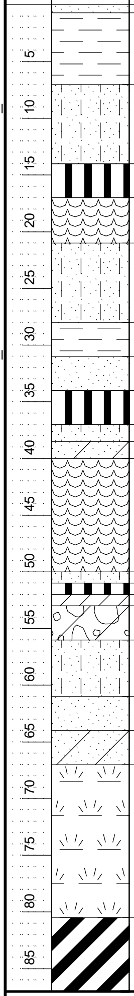
# LOG OF WELL INSTALLATION

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/18/2015 **COMPLETED** 10/7/2015 **SURF. ELEV.** 26.2 **COORDINATES:**
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** M. Tanner **CHECKED BY** B. Coates
**BORING DEPTH** 87 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

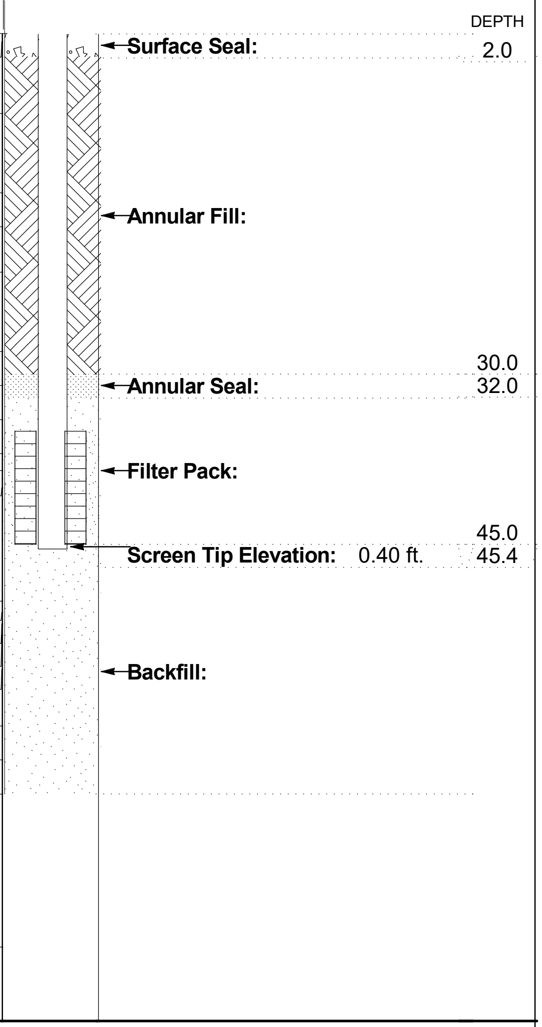


| GENERAL STRATA DESCRIPTION | ELEVATION |
|---|---|
| | 26.2 |
| Poorly-graded Sand (SP) | 25.5 |
| Low Plastic Organic Silt or Clay (OL) | 19.2 |
| Silty Sand (SM) | 12.2 |
| Elastic Silt (MH) | 9.2 |
| Medium to High Plastic Organic Clay or Silt (OH) | 5.2 |
| Silty Sand (SM) | -1.8 |
| Low Plastic Organic Silt or Clay (OL) | -4.8 |
| Poorly-graded Sand (SP) | -7.8 |
| Elastic Silt (MH) | -10.8 |
| Silty Sand (SM) | -12.3 |
| Clayey Sand (SC) | -13.8 |
| Medium to High Plastic Organic Clay or Silt (OH) | -23.8 |
| Silty Sand (SM) | -24.8 |
| Elastic Silt (MH) | -25.8 |
| Lean Clay (CL) | -26.8 |
| Clayey Gravel (GC) | -29.8 |
| Silty Sand (SM) | -34.8 |
| Poorly-graded Sand (SP) | -37.8 |
| Clayey Sand (SC) | -40.8 |
| Peat (PT) | -54.3 |
| Fat Clay (CH) | -60.8 |

Bottom of borehole at 87.0 feet.

## WELL DATA

**Top of casing Elev. = 29.12**



| | DEPTH |
|---|---|
| Surface Seal: | 2.0 |
| Annular Fill: | 30.0 |
| Annular Seal: | 32.0 |
| Filter Pack: | 45.0 |
| Screen Tip Elevation: 0.40 ft. | 45.4 |
| Backfill: | |

**NOTES:**

## WELL SPECIFICATIONS

**Casing Diameter:** inches **Screen Diameter:** inches
**Casing Material:** **Screen Length:** feet **Screen Material:**
**Casing Length:** feet **Screen Mesh:** **PrePack Screen:**

**BORING BY-GSA-MW-04 ( R )**
**PAGE 1 OF 1**
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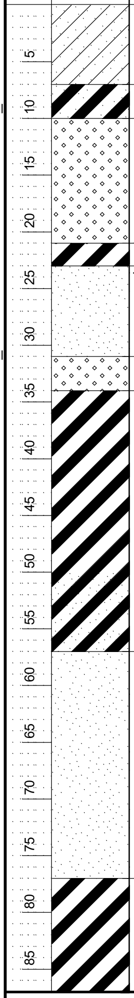
SOUTHERN COMPANY

# LOG OF WELL INSTALLATION

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 10/12/2015 **COMPLETED** 10/13/2015 **SURF. ELEV.** 26.2 **COORDINATES:** N:361,932.31 E:1,806,927.51
**CONTRACTOR** Cascade Drilling **EQUIPMENT** ____ **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
**BORING DEPTH** 87 ft. **GROUND WATER DEPTH: DURING** 21 ft. **COMP.** 23.66 ft. **DELAYED** 23.59 ft. after 24 hrs.
**NOTES** No geophysical data collected Well installed. Refer to well data sheet.

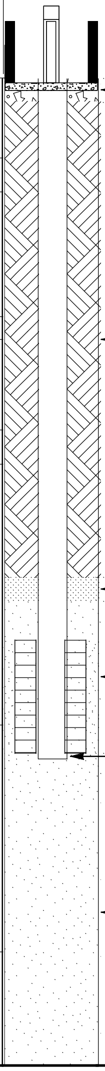


| GENERAL STRATA DESCRIPTION | ELEVATION |
|---|---|
| | 26.2 |
| **Sandy Lean Clay (CL)** | 19.2 |
| **Sandy Fat Clay (CH)** | 16.2 |
| **Well-graded Sand (SW)** | 5.2 |
| **Fat Clay (CH)** | 3.2 |
| **Poorly-graded Sand (SP)** | -4.8 |
| **Well-graded Sand (SW)** | -7.8 |
| **Fat Clay (CH)** | -30.8 |
| **Poorly-graded Sand (SP)** | -50.8 |
| **Fat Clay (CH)** | -60.8 |

**Bottom of borehole at 87.0 feet.**

**WELL DATA**

**Top of casing Elev. = 29.12**



| | | DEPTH |
|---|---|---|
| **Surface Seal:** | Concrete | 2.0 |
| **Annular Fill:** | Cement-Bentonite Grout | |
| | | 44.0 |
| **Annular Seal:** | bentonite pellets | 46.0 |
| **Filter Pack:** | Filter Media 1A Silica Sand | |
| | | 59.5 |
| **Screen Tip Elevation:** | 0.50 ft. | 60.0 |
| **Backfill:** | Natural Collapse | |

**NOTES:**

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches **Screen Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
**Casing Length:** 89.96 feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/11/17 11:24 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC ATTORNEY CLIENT PRIVILEGED\PLANT BARRY\ACES2520 BARRY AP CHARACTERIZATION REF

**SOUTHERN COMPANY**

# LOG OF WELL INSTALLATION

## BORING BY-GSA-MW-05
PAGE 1 OF 1
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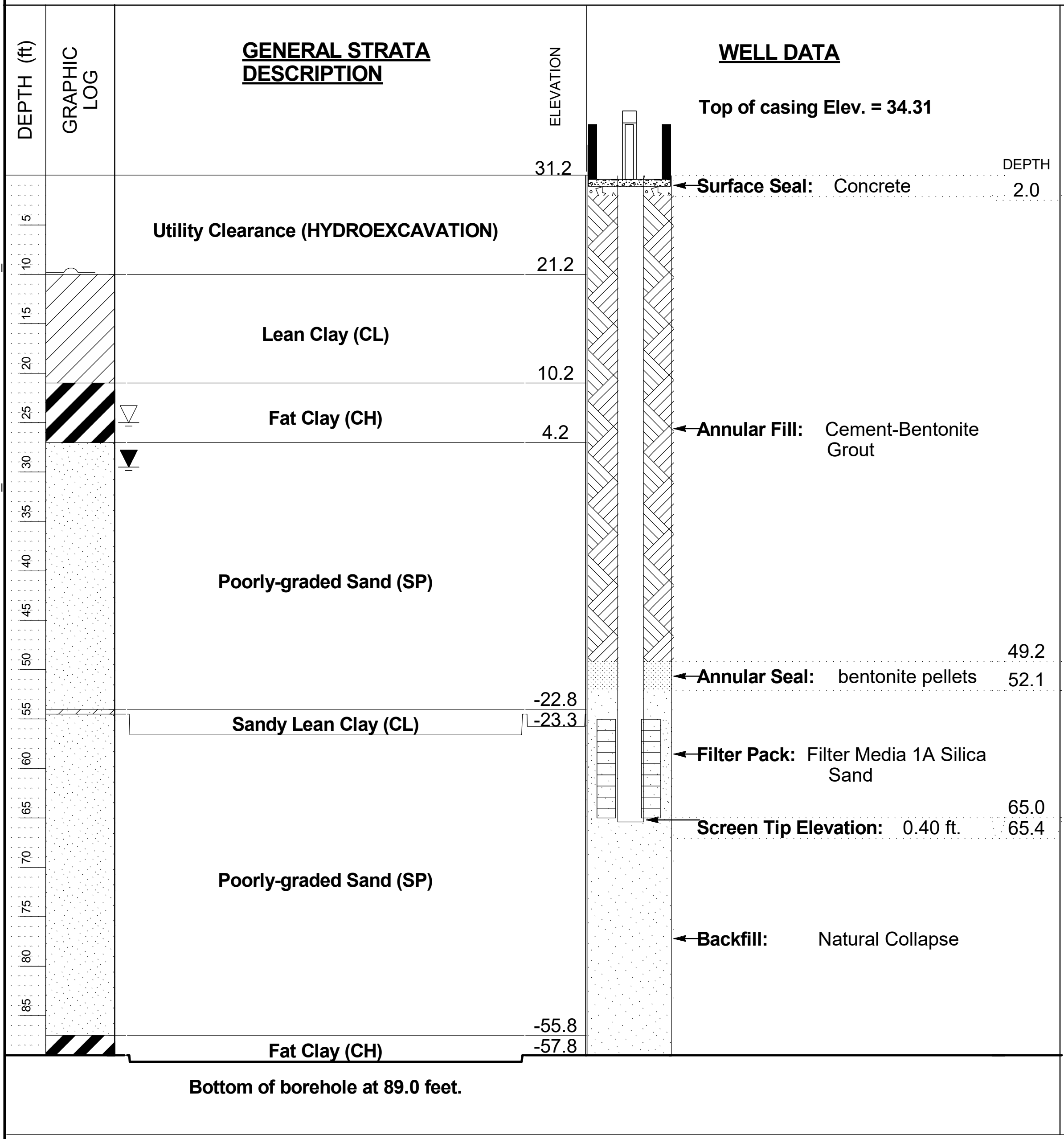
**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/30/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 31.2 **COORDINATES:** N:362,557.33 E:1,807,427.93
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
**BORING DEPTH** 89 ft. **GROUND WATER DEPTH: DURING** 25 ft. **COMP.** 29.5 ft. **DELAYED** 29.5 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.



| GENERAL STRATA DESCRIPTION | ELEVATION |
|---|---|
| | 31.2 |
| Utility Clearance (HYDROEXCAVATION) | 21.2 |
| Lean Clay (CL) | 10.2 |
| Fat Clay (CH) | 4.2 |
| Poorly-graded Sand (SP) | -22.8 |
| Sandy Lean Clay (CL) | -23.3 |
| Poorly-graded Sand (SP) | -55.8 |
| Fat Clay (CH) | -57.8 |

Bottom of borehole at 89.0 feet.

| WELL DATA | | DEPTH |
|---|---|---|
| **Surface Seal:** | Concrete | 2.0 |
| **Annular Fill:** | Cement-Bentonite Grout | 49.2 |
| **Annular Seal:** | bentonite pellets | 52.1 |
| **Filter Pack:** | Filter Media 1A Silica Sand | 65.0 |
| **Screen Tip Elevation:** | 0.40 ft. | 65.4 |
| **Backfill:** | Natural Collapse | |

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches **Screen Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
**Casing Length:** 92.1 feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

# BORING BY-GSA-MW-06
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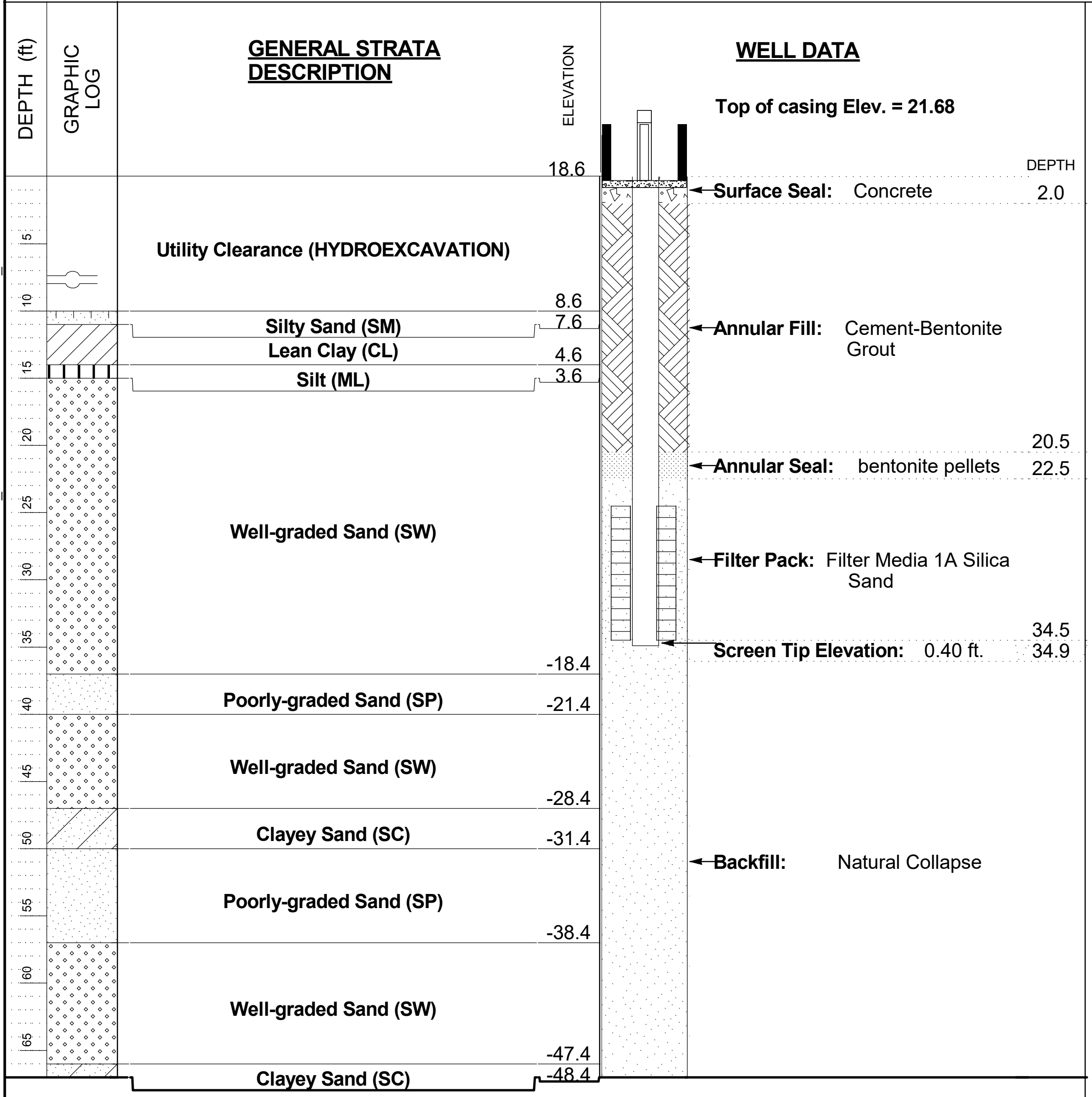
# LOG OF WELL INSTALLATION

SOUTHERN COMPANY

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/28/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 18.6 **COORDINATES:** N:363,068.86 E:1,807,361.63
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.



| DEPTH (ft) | GENERAL STRATA DESCRIPTION | ELEVATION |
|---|---|---|
| | | 18.6 |
| | **Utility Clearance (HYDROEXCAVATION)** | 8.6 |
| | **Silty Sand (SM)** | 7.6 |
| | **Lean Clay (CL)** | 4.6 |
| | **Silt (ML)** | 3.6 |
| | **Well-graded Sand (SW)** | -18.4 |
| | **Poorly-graded Sand (SP)** | -21.4 |
| | **Well-graded Sand (SW)** | -28.4 |
| | **Clayey Sand (SC)** | -31.4 |
| | **Poorly-graded Sand (SP)** | -38.4 |
| | **Well-graded Sand (SW)** | -47.4 |
| | **Clayey Sand (SC)** | -48.4 |

**Bottom of borehole at 67.0 feet.**

## WELL DATA

**Top of casing Elev. = 21.68**

| | | DEPTH |
|---|---|---|
| **Surface Seal:** | Concrete | 2.0 |
| **Annular Fill:** | Cement-Bentonite Grout | 20.5 |
| **Annular Seal:** | bentonite pellets | 22.5 |
| **Filter Pack:** | Filter Media 1A Silica Sand | 34.5 |
| **Screen Tip Elevation:** | 0.40 ft. | 34.9 |
| **Backfill:** | Natural Collapse | |

**NOTES:**

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC
**Casing Length:** 70.08 feet
**Screen Diameter:** 2 inches
**Screen Length:** 10 feet
**Screen Mesh:** 0.010
**Screen Material:** PVC
**PrePack Screen:** Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/11/17 11:24 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC ATTORNEY CLIENT PRIVILEGED\PLANT BARRY\ACES2520 BARRY AP CHARACTERIZATION REF

**SOUTHERN COMPANY**

# LOG OF WELL INSTALLATION

## BORING BY-GSA-MW-07

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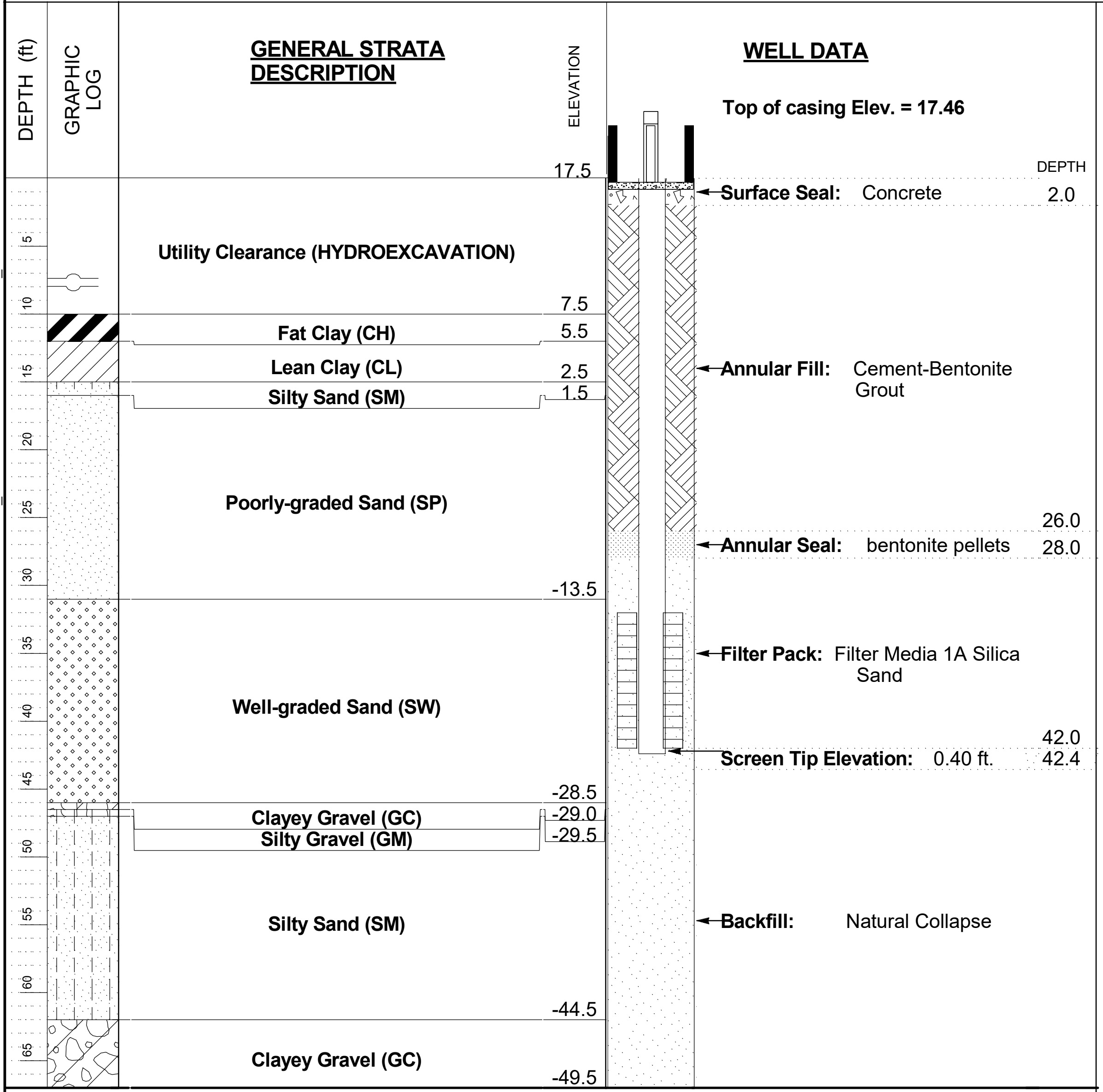
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/28/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 17.5 **COORDINATES:** N:363,101.48 E:1,807,776.83
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.



| GENERAL STRATA DESCRIPTION | ELEVATION |
|---|---|
| | 17.5 |
| Utility Clearance (HYDROEXCAVATION) | 7.5 |
| Fat Clay (CH) | 5.5 |
| Lean Clay (CL) | 2.5 |
| Silty Sand (SM) | 1.5 |
| Poorly-graded Sand (SP) | -13.5 |
| Well-graded Sand (SW) | -28.5 |
| Clayey Gravel (GC) | -29.0 |
| Silty Gravel (GM) | -29.5 |
| Silty Sand (SM) | -44.5 |
| Clayey Gravel (GC) | -49.5 |

Bottom of borehole at 67.0 feet.

**WELL DATA**

**Top of casing Elev. = 17.46**

| WELL DATA | DEPTH |
|---|---|
| **Surface Seal:** Concrete | 2.0 |
| **Annular Fill:** Cement-Bentonite Grout | 26.0 |
| **Annular Seal:** bentonite pellets | 28.0 |
| **Filter Pack:** Filter Media 1A Silica Sand | 42.0 |
| **Screen Tip Elevation:** 0.40 ft. | 42.4 |
| **Backfill:** Natural Collapse | |

**NOTES:**

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches **Screen Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
**Casing Length:** 70.13 feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

**SOUTHERN COMPANY**

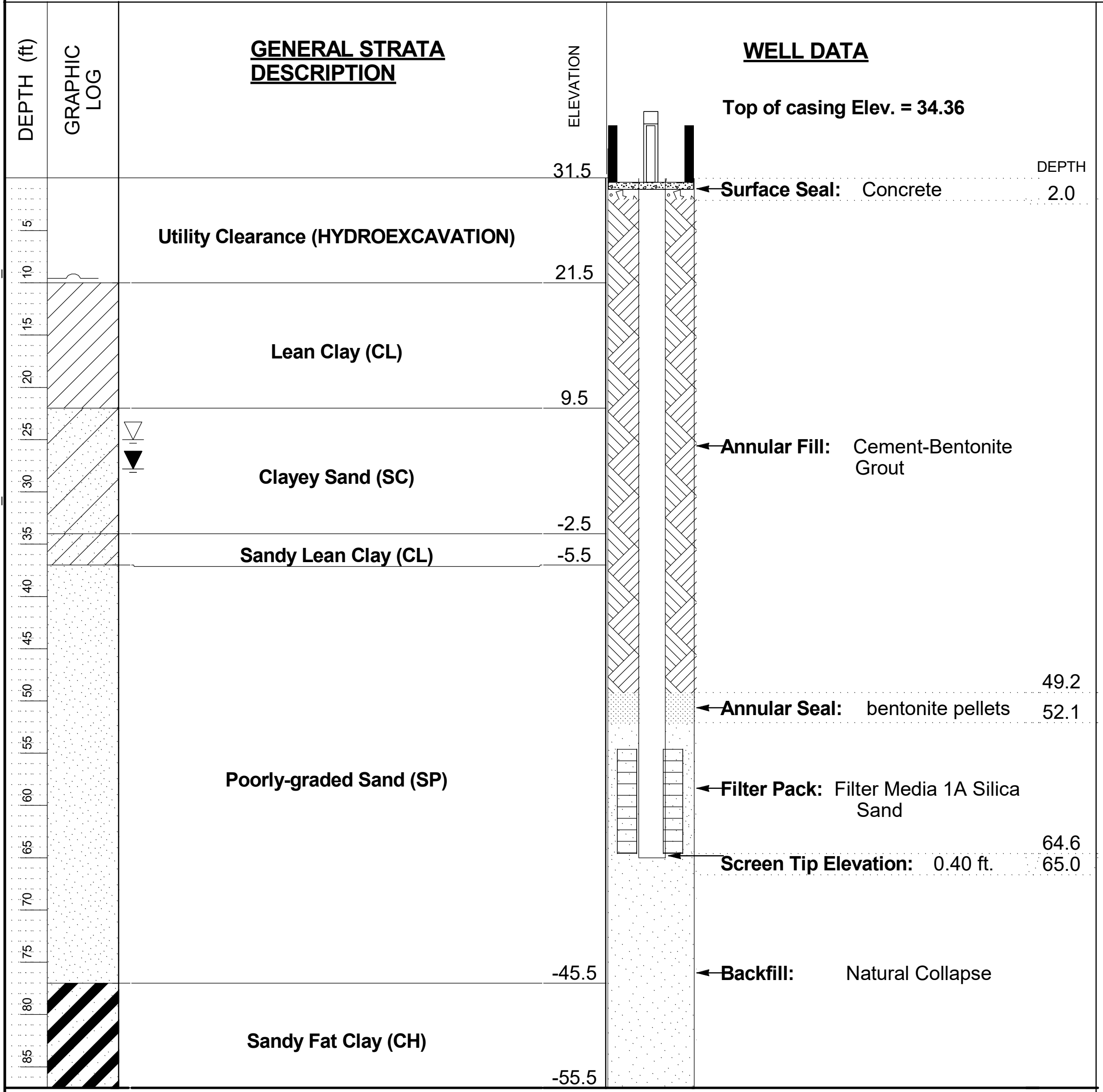
# LOG OF WELL INSTALLATION

**BORING BY-GSA-MW-08**
**PAGE 1 OF 1**
**ECS37275**

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/29/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 31.5 **COORDINATES:** N:362,918.17 E:1,808,316.29
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
**BORING DEPTH** 87 ft. **GROUND WATER DEPTH: DURING** 25 ft. **COMP.** 27.8 ft. **DELAYED** 27.8 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.



| ELEVATION | GENERAL STRATA DESCRIPTION |
|---|---|
| 31.5 | |
| 21.5 | Utility Clearance (HYDROEXCAVATION) |
| 9.5 | Lean Clay (CL) |
| -2.5 | Clayey Sand (SC) |
| -5.5 | Sandy Lean Clay (CL) |
| -45.5 | Poorly-graded Sand (SP) |
| -55.5 | Sandy Fat Clay (CH) |

Bottom of borehole at 87.0 feet.

**WELL DATA**

**Top of casing Elev. = 34.36**

| | DEPTH |
|---|---|
| **Surface Seal:** Concrete | 2.0 |
| **Annular Fill:** Cement-Bentonite Grout | |
| | 49.2 |
| **Annular Seal:** bentonite pellets | 52.1 |
| **Filter Pack:** Filter Media 1A Silica Sand | |
| | 64.6 |
| **Screen Tip Elevation:** 0.40 ft. | 65.0 |
| **Backfill:** Natural Collapse | |

**NOTES:**

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches **Screen Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
**Casing Length:** 89.85 feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/11/17 11:24 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC ATTORNEY CLIENT PRIVILEGED\PLANT BARRY\ACES2520 BARRY AP CHARACTERIZATION REF

SOUTHERN COMPANY

# LOG OF WELL INSTALLATION

## BORING BY-GSA-MW-09

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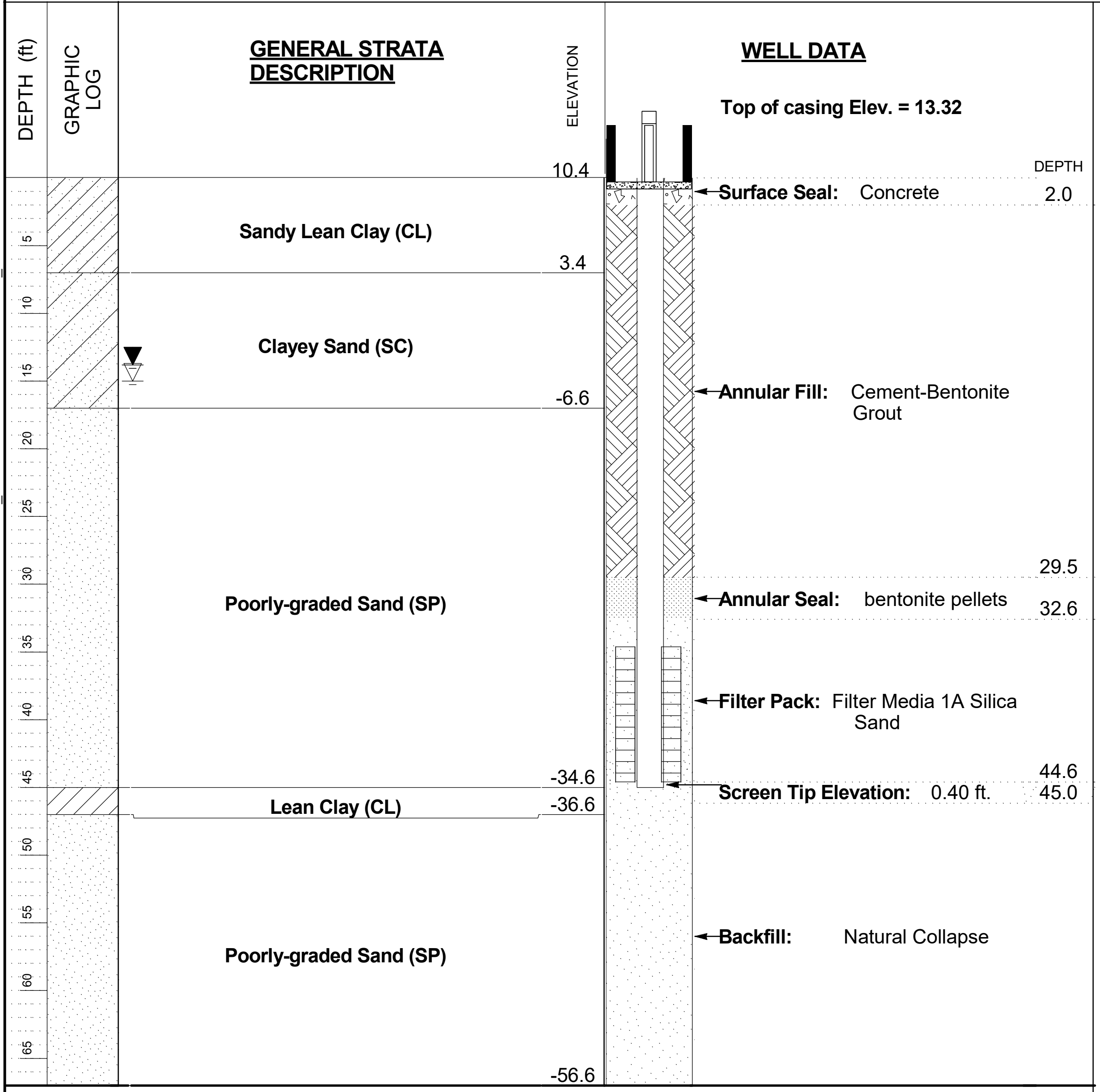
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/23/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 10.4 **COORDINATES:** N:362,799.55 E:1,808,595.91
**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** J. Hall **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** 15 ft. **COMP.** 13.8 ft. **DELAYED** 13.8 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.



**NOTES:**

Bottom of borehole at 67.0 feet.

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC
**Casing Length:** 69.88 feet
**Screen Diameter:** 2 inches
**Screen Length:** 10 feet
**Screen Mesh:** 0.010
**Screen Material:** PVC
**PrePack Screen:** Yes

# BORING BY-GSA-MW-10

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# LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs

**LOCATION** Bucks, AL

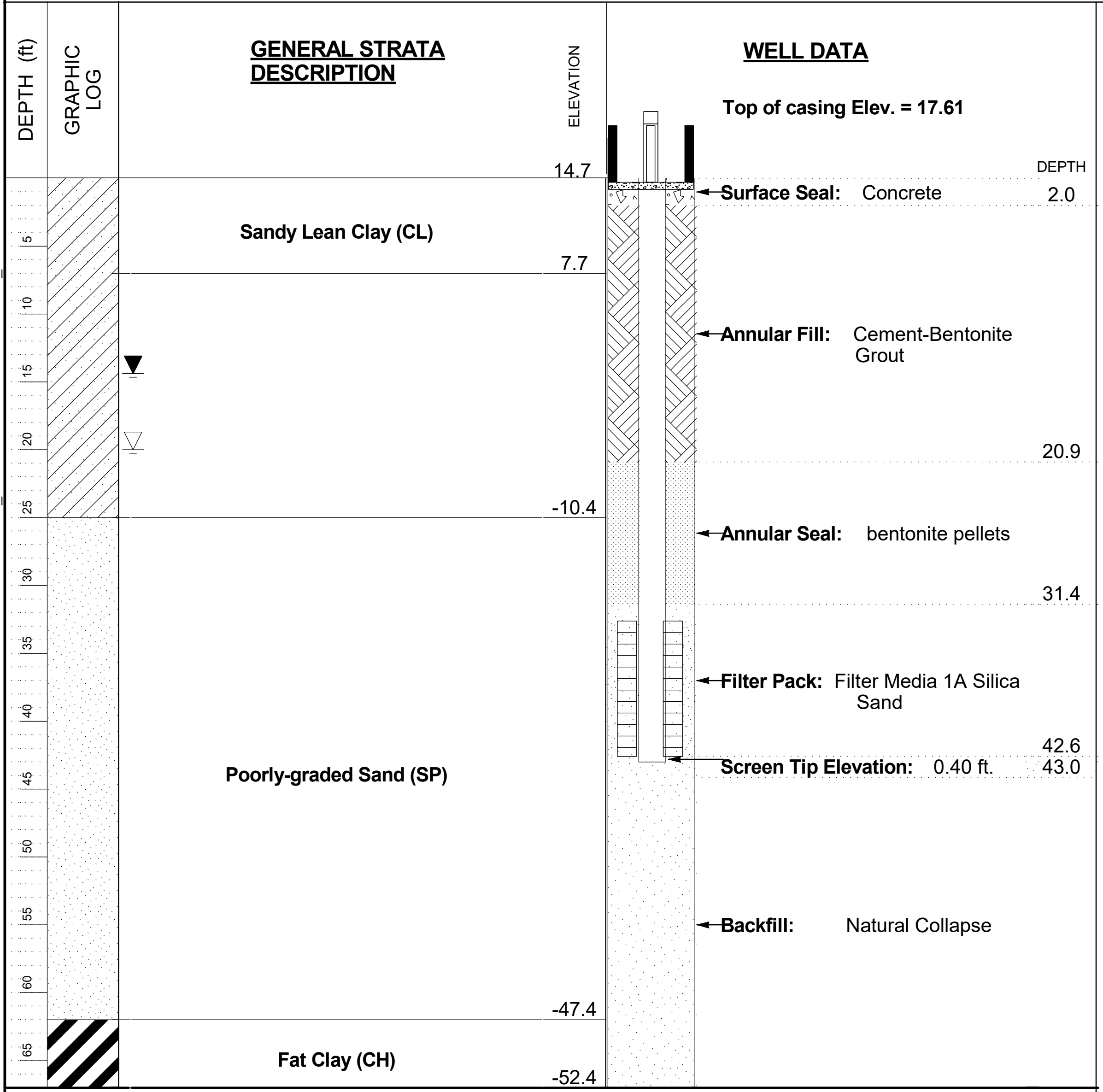
**DATE STARTED** 9/23/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 14.7 **COORDINATES:** N:362,441.66 E:1,808,600.05

**CONTRACTOR** Cascade Drilling **EQUIPMENT** **METHOD** Sonic

**DRILLED BY** J. Hall **LOGGED BY** S. Baxter **CHECKED BY** B. Coates

**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** 20 ft. **COMP.** 14.4 ft. **DELAYED** 14.4 ft. after 48 hrs.

**NOTES** Well installed. Refer to well data sheet.



| GENERAL STRATA DESCRIPTION | ELEVATION |
|---|---|
| | 14.7 |
| Sandy Lean Clay (CL) | 7.7 |
| | -10.4 |
| Poorly-graded Sand (SP) | -47.4 |
| Fat Clay (CH) | -52.4 |

Bottom of borehole at 67.0 feet.

**WELL DATA**

**Top of casing Elev. = 17.61**

| | | DEPTH |
|---|---|---|
| **Surface Seal:** | Concrete | 2.0 |
| **Annular Fill:** | Cement-Bentonite Grout | 20.9 |
| **Annular Seal:** | bentonite pellets | 31.4 |
| **Filter Pack:** | Filter Media 1A Silica Sand | 42.6 |
| **Screen Tip Elevation:** | 0.40 ft. | 43.0 |
| **Backfill:** | Natural Collapse | |

**NOTES:**

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches **Screen Diameter:** 2 inches

**Casing Material:** Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC

**Casing Length:** 69.96 feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

# BORING BY-GSA-PZ-11
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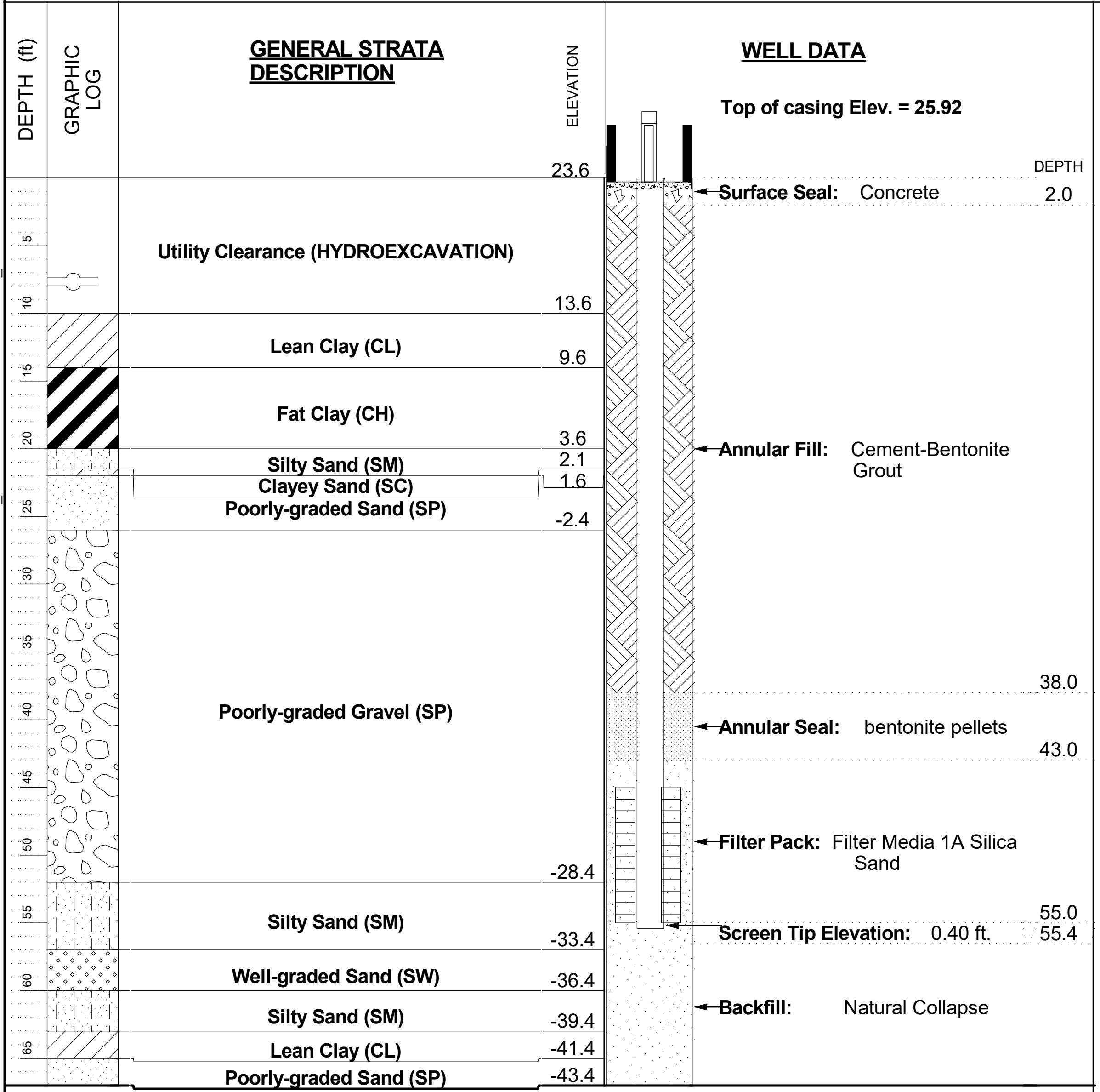
# LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/25/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 23.6 **COORDINATES:** N:363,466.38 E:1,807,619.63
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** J. Hall **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.



| GENERAL STRATA DESCRIPTION | ELEVATION |
|---|---|
| | 23.6 |
| Utility Clearance (HYDROEXCAVATION) | 13.6 |
| Lean Clay (CL) | 9.6 |
| Fat Clay (CH) | 3.6 |
| Silty Sand (SM) | 2.1 |
| Clayey Sand (SC) | 1.6 |
| Poorly-graded Sand (SP) | -2.4 |
| Poorly-graded Gravel (SP) | -28.4 |
| Silty Sand (SM) | -33.4 |
| Well-graded Sand (SW) | -36.4 |
| Silty Sand (SM) | -39.4 |
| Lean Clay (CL) | -41.4 |
| Poorly-graded Sand (SP) | -43.4 |

**WELL DATA**

**Top of casing Elev. = 25.92**

| | | DEPTH |
|---|---|---|
| **Surface Seal:** | Concrete | 2.0 |
| **Annular Fill:** | Cement-Bentonite Grout | 38.0 |
| **Annular Seal:** | bentonite pellets | 43.0 |
| **Filter Pack:** | Filter Media 1A Silica Sand | 55.0 |
| **Screen Tip Elevation:** | 0.40 ft. | 55.4 |
| **Backfill:** | Natural Collapse | |

Bottom of borehole at 67.0 feet.

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches **Screen Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
**Casing Length:** 69.36 feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

**SOUTHERN COMPANY**

# LOG OF WELL INSTALLATION

## BORING BY-GSA-PZ-12

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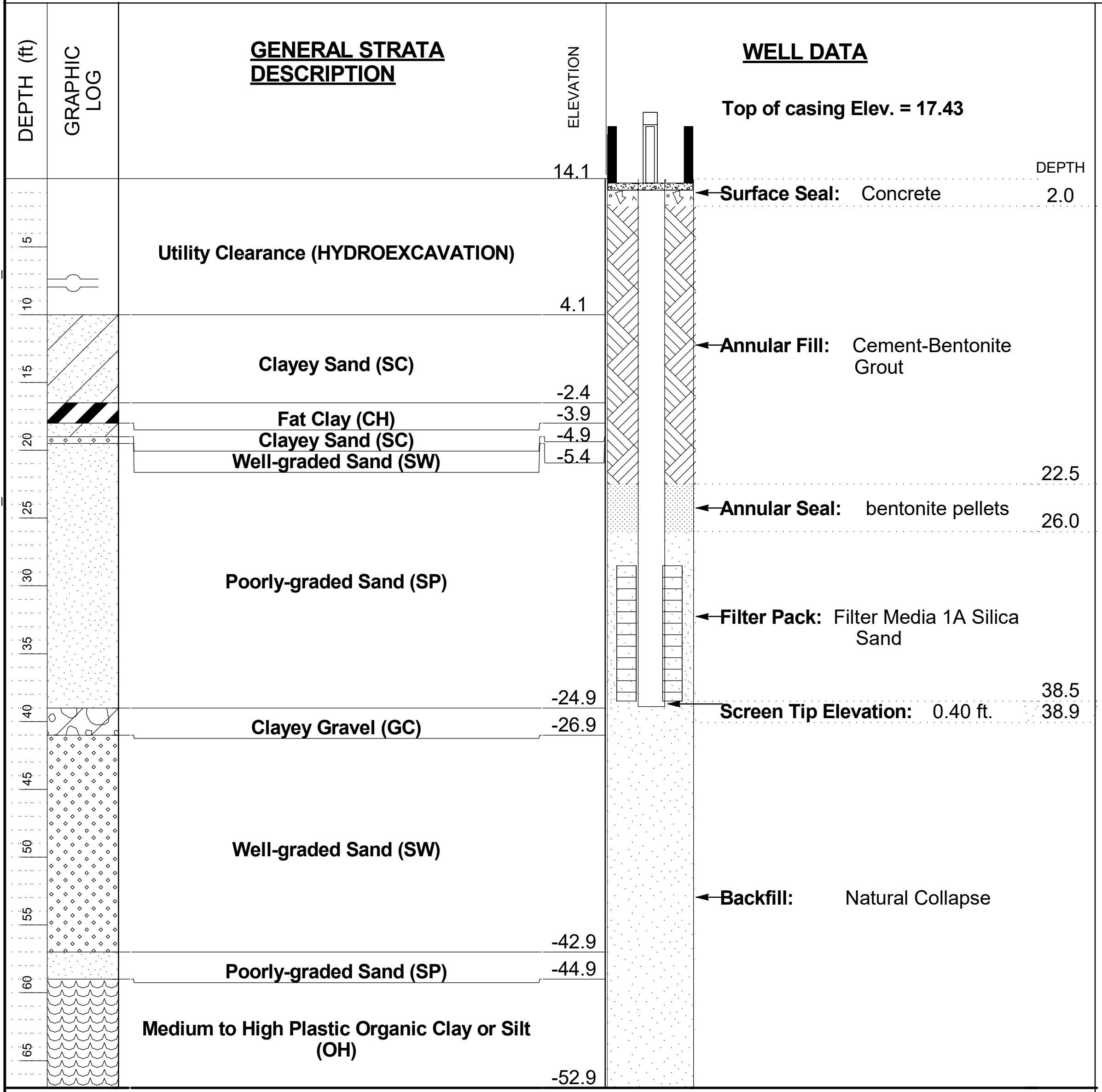
ECS37275

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Barry CCR Boring Logs
**LOCATION** Bucks, AL

**DATE STARTED** 9/29/2015 **COMPLETED** 10/8/2015 **SURF. ELEV.** 14.1 **COORDINATES:** N:363,286.54 E:1,808,282.28
**CONTRACTOR** Cascade Drilling, LP **EQUIPMENT** **METHOD** Sonic
**DRILLED BY** T. Ardito **LOGGED BY** C. Stanford **CHECKED BY** B. Coates
**BORING DEPTH** 67 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
**NOTES** Hydrovac excavation from 0-10 feet Well installed. Refer to well data sheet.



**GENERAL STRATA DESCRIPTION**

| | |
|---|---|
| | 14.1 |
| Utility Clearance (HYDROEXCAVATION) | 4.1 |
| Clayey Sand (SC) | -2.4 |
| Fat Clay (CH) | -3.9 |
| Clayey Sand (SC) | -4.9 |
| Well-graded Sand (SW) | -5.4 |
| Poorly-graded Sand (SP) | -24.9 |
| Clayey Gravel (GC) | -26.9 |
| Well-graded Sand (SW) | -42.9 |
| Poorly-graded Sand (SP) | -44.9 |
| Medium to High Plastic Organic Clay or Silt (OH) | -52.9 |

Bottom of borehole at 67.0 feet.

**WELL DATA**

**Top of casing Elev. = 17.43**

| | |
|---|---|
| **Surface Seal:** Concrete | 2.0 |
| **Annular Fill:** Cement-Bentonite Grout | 22.5 |
| **Annular Seal:** bentonite pellets | 26.0 |
| **Filter Pack:** Filter Media 1A Silica Sand | 38.5 |
| **Screen Tip Elevation:** 0.40 ft. | 38.9 |
| **Backfill:** Natural Collapse | |

**NOTES:**

## WELL SPECIFICATIONS

**Casing Diameter:** 2 inches
**Casing Material:** Schedule 40 PVC
**Casing Length:** 70.29 feet
**Screen Diameter:** 2 inches
**Screen Length:** 10 feet
**Screen Mesh:** 0.010
**Screen Material:** PVC
**PrePack Screen:** Yes

# Appendix B

# ALABAMA POWER COMPANY
# PLANT BARRY
# GYPSUM POND
# STATISTICAL ANALYSIS PLAN

Prepared for

Alabama Power Company
Birmingham, Alabama

Prepared by

Groundwater Stats Consulting
Mobile, Alabama

Revised August 2020

# ALABAMA POWER COMPANY
# PLANT BARRY
# GYPSUM POND
# STATISTICAL ANALYSIS PLAN

Kristina L. Rayner
Groundwater Stats Consulting, LLC
Originator

Gregory T. Whetstone, P.E.
Southern Company Services, Inc.
Reviewer

## TABLE OF CONTENTS

## APPENDICES

## 1.0 INTRODUCTION

This updated Statistical Analysis Plan (SAP) describes the site-specific statistical analysis approach that will be used to evaluate groundwater at Alabama Power Company's Plant Barry Gypsum Pond pursuant to ADEM Admin. Code r. 335-13-15-.06 and 40 CFR Part 257. 90 through 95 under detection and assessment monitoring programs.

A compliance groundwater monitoring well system was installed pursuant to requirements of 40 CFR 257.91(e)(1). A background well network is installed upgradient of the CCR unit. Downgradient monitoring wells were installed along the downgradient waste boundary pursuant to 40 CFR 257.91(a)(2). The compliance monitoring well network is described in the site-specific groundwater monitoring plan and summarized in the attached Table 1.

Alabama Power Company conducted 8 background monitoring sample events beginning in 2016. Samples were collected from the compliance monitoring wells and analyzed for CCR Appendix III and IV parameters pursuant to 40 CFR 257.91 Appendix III and IV parameters are as follows:

1) Appendix III (Detection Monitoring) - boron, calcium, chloride, fluoride, pH, sulfate, and TDS
2) Appendix IV (Assessment Monitoring) – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

This updated SAP has been developed based upon the characteristics of the groundwater quality data collected since groundwater monitoring was implemented in 2016 following the requirements in 40 CFR 257.91[1], and the United States Environmental Protection Agency (USEPA) Unified Guidance (March 2009)[2]. The plan describes:

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[1] Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities, 2015.

[2] U.S. EPA, March 2009. *Unified Guidance*, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

1) Background data collection, management, and updates;
2) Statistical concepts applicable to detection and assessment monitoring programs;
3) Site-specific statistical analysis methods for Detection Monitoring; and
4) Statistical approach for Assessment Monitoring and Corrective Action.

As part of ongoing site activities, installation of additional wells may be necessary to characterize site conditions or supplement the assessment monitoring well network. The disposition of these additional wells will be described in the site groundwater monitoring plan. Procedures for statistically evaluating additional wells are described in this SAP.

Any change to the statistical analysis plan (e.g. statistical analysis method, background period, background data set, well network, screening method, etc.) will only be implemented upon receipt of approval from the Alabama Department of Environmental Management (Department).

## 2.0 BACKGROUND

This section describes the establishment, screening, update, and management of the background data sets used for detection, assessment and corrective action phases of groundwater monitoring. Included are descriptions of the tests that are used to determine whether the potential background data represent site-specific conditions and the procedures used to update (expand or truncate) the background data set. Also described are procedures that will be used to update the data set with more current monitoring data or as new background monitoring wells are installed.

Changes or updates to background updates will only be made after Department approval.

### 2.1 Background Screening

Background is determined based on site-specific conditions such upgradient wells, wells not in the groundwater flow path of the unit, or wells determined to not be affected by the disposal unit. Once background wells are selected based on site-specific conditions, the data are screened as follows:

### 2.1.1 Outlier Testing

An outlier is defined as an observation that is unlikely to have come from the same distribution as the rest of the data. A statistical outlier test, such as the 1989 EPA Outlier Test [3]or Tukey's Outlier Test as discussed in the USEPA Guidance, will be performed on the monitoring well data when time series plots or box and whiskers plots indicate the presence of extreme observations relative to other observations. The outlier test will serve as a data quality check to help identify errors from data entry and other sources.

Statistical outliers in the background data will be deselected unless it can be proven that the data point is not an anomalous value and does represent naturally occurring variation. This is conservative from a regulatory perspective in that it ensures that the background limits are not artificially elevated. When outliers are identified, they are flagged in the data set and the values excluded from background limit calculations. Re-testing for outliers will be performed when background updates are proposed.

### 2.1.2 Testing and Adjusting for Seasonal Effects

Testing and adjusting data for seasonal factors ensures that seasonal effects will not affect the test results. When seasonal effects are suspected, the Kruskal-Wallis seasonality test will be used to determine whether the seasonal effects are statistically significant when there are sufficient data to test for seasonality. When seasonal effects are confirmed, the data will be de-seasonalized prior to calculating a statistical limit. Data are de-seasonalized by subtracting the seasonal mean and adding back the grand mean to each observation. Background data will be re-tested when there are at least four new values available and a background update is proposed.

### 2.1.3 Temporal Trend Testing

The Sen's Slope/Mann-Kendall statistical analysis will be performed on all well/constituent pairs to evaluate concentrations over time. The Sen's Slope Estimator will be used to estimate the rate of change (increasing, no change, or decreasing) for each constituent at each well. The Mann Kendall statistic will be used to determine whether each of those trends is statistically significant. The Sen's Slope/Mann Kendall analysis requires at least five observations.

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[3] 1953, "Processing data for outliers", *Biometrics*, Vol. 9, pp.74-89.

When a significant trend is present, older historical values may be deselected from the background data prior to computing background limits in cases where groundwater is presumed not to be impacted by the unit. The resulting limits will reflect more current conditions and will not be influenced by older, historical conditions that are no longer relevant. If upgradient concentration levels are changing over time (i.e. trending upward or downward), the prospective background data set may need to be truncated, removing older data to ensure that the resulting limits continue to represent current natural conditions.

For instance, when background concentration levels are increasing over time due to upgradient water quality changes, if the background data sets are not adjusted, the established PLs could result in increased false positive or false negative risk. In some cases, including older historical data in the background data set may result in overly sensitive limits and an increased chance of false positive readings. In other cases, using all background data when there are temporal changes in background levels may artificially elevate limits. This scenario may occur even when there is a decreasing trend in background concentration levels. An elevated limit under these circumstances is a direct result of an inflated standard deviation that is used in the computation of the parametric limit, which in turn will increase the risk of false negative test outcomes.

Well/constituent pairs that have increasing or decreasing concentration levels over time will be evaluated to determine if earlier data are no longer representative of present-day groundwater quality. In those cases, earlier data may be deselected prior to construction of limits to reduce variation as well as to provide limits that are conservative from a regulatory perspective that will detect future changes in groundwater quality.

Background limits also need to allow for random variation in groundwater concentration levels that are naturally present at a site. The availability of multiple background wells can give an indication of the natural variability in groundwater constituent levels across a site.

### *2.1.4 Sample Size*

While a parametric prediction limit may be constructed with as little as four samples per well, the CCR Rule and the EPA Unified Guidance recommend that a minimum of at least 8 independent background observations be collected for constructing statistical limits. The reliability of the statistical results is greatly enhanced by increasing the sample size to eight or more. An increased sample size tends to more accurately characterize the variation and typically reduce the probability of erroneous conclusions. Furthermore, if a nonparametric prediction limit is required, the confidence level associated with the test will be dependent on the number of background data available as well as the number of comparisons to the statistical limit.

### *2.1.5 Non-Detect Data*

When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit (RL) utilized for nondetects is the practical quantification limit (PQL) used by the laboratory.

When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit. Trace (or estimated) values which are reported above the method detection limit (MDL) and below the PQL/RL are used in the statistical analysis as reported by the laboratory. These values are flagged with "J" to distinguish between estimated values and values reported above the PQL.

If detection limits change over a period of analysis, then a statistically significant trend could be the result of increasing or decreasing laboratory precision and not an actual change in water quality. Under those circumstances, an appropriate substitution of the detection limit will be considered, such as the median or most recent detection limit.

## 2.2 Updating Interwell Background

The following describes the process that will be used to update interwell background data sets. Background updates described below will only be performed after Department approval.

Interwell statistical methods are constructed by pooling upgradient well data from 2 or more upgradient wells. For the Detection Monitoring program, background-derived Prediction Limits will be updated during each semi-annual event by incorporating the most recent sampling results from the existing background well network into the background data set. New background data will be screened for any new outliers as described above.

For the Assessment and Corrective Action program, background-derived tolerance limits are used to construct background limits using pooled upgradient well data for comparison against established standards. The tolerance limits will be updated every 2 years after screening as described above.

Once background has been established, the background well network may be updated by (1) adding wells to the background well network, or (2) removing wells and data from the background well network. The following describes the additional statistical screening steps that will be taken to update the background after a site-specific determination is made that the wells meet the hydraulic and geochemical requirements of a background location.

### *2.2.1 Adding to the Background Well Network*

The background data set may be updated or adjusted by incorporating new wells into the network or installing new background monitoring wells. When new wells are installed, the following process will be used to statistically evaluate the results and incorporate them into the background data set upon receipt of ADEM approval.

Prior to incorporating new upgradient well data for construction of statistical limits, Tukey's outlier test and visual screening are used to evaluate data. Any confirmed outliers are flagged as such in the database and deselected prior to construction of interwell prediction limits. Any flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. A summary of Tukey's test results and flagged values will be provided with the report.

Upgradient well data will be further tested for trends as described earlier. When no statistically significant trends are identified, all new well data will be incorporated into the background. Any records with trending data will be evaluated on a case by case basis, and records may require deselection if historical data are no longer representative of present-day groundwater quality conditions. Interwell prediction limits using all upgradient well data are re-calculated as a result of this screening.

### *2.2.2 Removing Wells and Data from Background*

As additional background data are collected, or site conditions change, a recommendation may be made to remove a well from the background network for any number of reasons (e.g. removal, change in groundwater flow conditions, change in chemistry, vandalism, etc.). If an upgradient well will no longer be part of the background network, the historical data from that well will no longer be included in the construction of interwell limits (which pool upgradient well data) without Department approval.

When wells are proposed for removal from the network, a site-specific statistical and geochemical evaluation will be made to identify the population(s) of data that may not represent background conditions. A proposal will be submitted to the Department for approval identifying the recommended use or disuse of historical data from the well(s) proposed for removal. The proposal will include statistical data screening and will explain the rationale for the proposed use of the data.

In the case where an upgradient well is no longer sampled (i.e. due to well damage, etc.), but historical data are still representative of upgradient water quality, an evaluation will be conducted as described below to determine whether data are still representative of background and should continue to be included in the background data set. When demonstration shows that groundwater quality from a well is still representative of naturally occurring groundwater quality upgradient of the facility, this data will be used in construction of statistical limits with ADEM approval. In cases where data from upgradient wells removed from the network do not represent upgradient groundwater quality, a proposal will be made for ADEM approval whereby interwell prediction limits will be re-calculated using data from only those upgradient wells in the network.

When preparing a background data evaluation for Department approval, the statistical portion of the evaluation will be accomplished by:

i. Using the ANOVA to determine whether significant variation exists among upgradient wells which would prevent the well's data from being included in construction of interwell prediction limits;
ii. Visual screening using Time Series and Box Plots to determine whether measurements are similar to neighboring upgradient wells;
iii. Screening the background data set for outliers as described above; and

iv. Performing trend tests to identify statistically significant increasing or decreasing trends which may require adjustment of the record to eliminate trending data and reduce variation.

## 2.3 Updating Intrawell Background

Intrawell statistical methods may be used at well locations that have not been impacted by a release from the unit being monitored. When using intrawell methods, once the background limits are established, data will not be evaluated again for updating until a minimum of 4 new samples are available, or every 2 years[4]. Data will be screened for outliers and trends as described above.

When updating an intra-well background, data are tested for suitability of updating by consolidating new sampling observations with the screened background data. Before updating the data for intrawell testing, it is necessary to verify that the most recent observations represent an unimpacted state as compared with the existing background. Data are first screened for outliers and, when confirmed, flagged as such in the database and deselected prior to constructing statistical limits. This step results in statistical limits that are conservative from a regulatory perspective.

The Mann-Whitney (Wilcoxon Rank Sum) two-sample test is then used to compare the median of the first group of background observations to the median of the more recent 4 or more observations. If the most recent data group is not found to be statistically different than the older data, the background data set may be updated and the prediction limits will be reconstructed to include the more recent background samples. When statistical differences are identified by the Mann Whitney test, statistical limits may not be eligible for updating. When more samples are available, data will be tested again for suitability of updating background data sets. In the event it is determined that the historical data are no longer representative of present-day groundwater quality in the absence of suspected impacts, only the more recent 8 or more measurements will be used to update the prediction limits.

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[4] US EPA Unified Guidance, March 2009. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities – Section 5.3*. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

## 3.0 STATISTICAL APPROACH FOR DETECTION MONITORING

The following sections describe the concepts related to developing a site-specific SAP for detection monitoring. The statistical evaluation includes screening upgradient well data to characterize groundwater upgradient of the facility and determine whether intrawell or interwell methods are recommended as the most appropriate statistical method for each Appendix III constituent.

### 3.1 Statistical Method

When data from multiple upgradient wells are available, a determination will be made as to whether the upgradient well data appear to come from the same population or whether there is evidence of spatial variation upgradient of the facility. Data for each constituent are plotted using box and whisker plots to assist in making this determination, providing visual representation of concentrations within and across wells. Analysis of Variance (ANOVA) may be used initially to statistically evaluate whether significant spatial variation exists at each unit.

Interwell prediction limits (PLs) pool upgradient well data to construct statistical limits which are used to evaluate data at downgradient wells. These tests are appropriate when the ANOVA determines that no significant spatial variation exists among the background wells.

In the event the ANOVA determines:

1) evidence of significant spatial variation upgradient of the facility, or
2) that there are insufficient upgradient well data, or
3) that interwell methods will not adequately address the question of a change in groundwater quality at any of the downgradient wells,

the USEPA Unified Guidance recommends switching from interwell methods to intrawell methods when it can be reasonably demonstrated that no impact from the CCR unit is present for well/constituent pairs in detection monitoring.

Intrawell PLs, which compare the most recent sample from a given well to statistical limits constructed from historical measurements at the same well, are extremely useful for rapidly detecting changes over time at a given location. Intrawell methods remove the influence of on-site spatial variation in well-to-well concentration levels. Site monitoring data are evaluated for the appropriateness of intrawell methods, including screening of background data from within each well for trends, seasonality when sufficient data are available, and outliers.

## 3.2 Prediction Limits

The use of PL tests is restricted to Appendix III parameters recently sampled at groundwater monitoring wells to represent *current* conditions. Background stability will be tested using temporal and seasonal trend tests, utilizing de-seasonalizing adjustments when seasonal trends are present. Moreover, statistical conditions including background sample size requirements as specified in USEPA guidance and regulations will be verified prior to the use of each statistical approach.

## 3.3 Criteria for Using the Interwell Statistical Methodology

There are a number of conditions that need to be met before an interwell statistical analysis can be considered appropriate for a specific site. These conditions are described in this section.

1. Ensuring that the aquifer underlying the site is continuous and that all monitoring wells are screened in the same level;
2. Ensuring that limits will be adequately sensitive in detecting a facility release;
3. Ensuring that limits reflect current background conditions; and
4. Ensuring that confounding factors will not confuse the results.

### *3.3.1 Aquifer Designation and Monitoring Wells*

Where the uppermost aquifer underlying a site is discontinuous, where downgradient monitoring wells are screened in differing levels, or where the upgradient monitoring well network is limited, EPA recommends performing intrawell analyses, to avoid confusing an impact caused by a release from the facility with a difference between wells caused by heterogeneous hydrogeology.

The statistical approach for constituents of concern will be based on interwell or intrawell PLs, and in some cases a combination of both methods, as a result of evaluation of spatial variation at the site. Box and whisker plots may be provided to demonstrate concentration levels within each well and across wells. When significant differences exist in concentration levels, particularly between upgradient wells, this indicates spatial variation in the groundwater quality. Spatial variation and/or limited upgradient well data would tend to create statistical limits that are:

1) not conservative from a regulatory perspective; or
2) not representative of background water quality.

## 3.4 Criteria for Using an Intrawell Statistical Methodology

The following is a description of the criteria that a site must meet to use an intrawell statistical methodology if it is determined that interwell methods are not appropriate.

### *3.4.1 Screening of Prospective Historical Background Data*

Prior to using an intrawell analysis, it will be necessary to demonstrate that there have been no potential prior impacts at downgradient wells on the prospective historical background data as a result of the current practices at the Site. In addition to an independent investigation for prior impacts, prospective background data for intrawell tests will be screened for trends, seasonality and outliers as described above. If intrawell analyses are not feasible due to elevated concentrations in downgradient wells relative to concentrations upgradient of the facility, as determined during the screening process, interwell analyses will initially be utilized until further evidence supports the use of intrawell testing.

### *3.4.2 Stable Naturally Occurring Concentrations*

The background data screening procedure described here is designed to check for stable background conditions, and account for existing groundwater quality from past or present activities in the area. While having pre-waste data is ideal for characterization of groundwater quality prior to waste placement, these facilities do not have pre-waste data.

The Sen's Slope/Mann-Kendall test for increasing or decreasing temporal trends will be used to test prospective background data when time series plots indicate the possibility of either increasing or decreasing trends over time. In the case where significant trends are found, unrepresentative values will be deselected only when it is clear that the trend is not the result of contamination. Assuming no alternative source, if similar trends and/or concentration levels are noted upgradient of the unit for the same parameters, it will be assumed that concentration levels represent natural variation in groundwater, and thus, earlier data will be removed so that compliance limits reflect current groundwater conditions upgradient of the unit.

## 3.5 Site-Wide False Positive Rates (SWFPR) and Statistical Power

The USEPA Unified Guidance recommends an annual site-wide false positive rate of 10%, which is distributed equally among the total number of sampling events. A site-wide false positive rate of 5% is targeted for each semi-annual sampling event. USEPA also requires demonstration that the statistical methodology selected for a facility will provide adequate statistical power, as discussed in Section 3.7 to detect a release, should one occur.

## 3.6 Determination of Future Compliance Observations Falling Within Background Limits

Intrawell or interwell upper PL are constructed with a test-specific alpha based on the overall site-wide false positive rate (SWFPR) of 5% for each sampling event. Any compliance observation that exceeds the background prediction limit will be followed with one or two independent resamples, depending on the resample plan, to determine whether the initial exceedance is verified.

The following pretests are used to ensure that the statistical test criteria are met:

1) *Data Distribution*. The distribution of the data will be tested using either the Shapiro-Wilk test (for background sample sizes of 50 or less) or the Shapiro-Francia test (for background sample sizes greater than 50). Non-normally distributed data will be transformed using the ladder of powers[5] to normalize the data prior to construction of background limits. When background data cannot be normalized, nonparametric PL will be calculated.

2) *Handling Non-Detects*. Simple substitution per USEPA Guidance[6] will be used when non-detects comprise less than or equal to 15% of the individual well data. Simple substitution refers to the practice of substituting one-half the reporting or

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[5] 1992, *Statistical Methods In Water Resources,* Elsevier, Helsel, D. R., & Hirsch, R. M.

[6] June 1992, *Addendum to Interim Final Guidance, Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities.* Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

detection limit for non-detects. When the proportion of non-detects (NDs) in background falls between 16 and 50%, a non-detect adjustment such as the Kaplan-Meier or Regression on Order Statistics (ROS) method for adjustment of the mean and standard deviation will be used prior to constructing a parametric prediction limit. When the proportion of non-detects exceeds 50%, or when the data cannot be normalized, a nonparametric prediction limit will be used.

## 3.7 Statistical Power

The USEPA Unified Guidance also requires that facilities achieve adequate statistical power to detect a release, even if only at one facility well and involving a single constituent. More specifically, EPA recommends power of approximately 55% when concentration levels are 3 standard deviations above the background mean, or approximately 80% power at 4 standard deviations above the background mean.

The performance of a given testing strategy is displayed in Power Curves which are based on the particular statistical method chosen combined with the resampling plan, the false positive rate associated with the statistical test, as well as the number of background samples available and the size and configuration of the monitoring network.

Power Curves for the PLs following this report demonstrate that the specified plan has the power to detect a release in downgradient wells and meet or exceed at least one of the power recommendations. As more data are collected during routine semi-annual sampling events and the background sets are expanded, the power requirements will exceed recommended power requirements.

## 4.0 STATISTICAL APPROACH FOR ASSESSMENT MONITORING & CORRECTIVE ACTION

The following describes the general statistical procedures that will be used if a facility enters Assessment or Corrective Action monitoring because of SSIs in the Detection monitoring program. Site-specific and event-specific SAPs may be developed at that time according to permit or regulatory requirements.

## 4.1 Assessment Monitoring

Assessment Monitoring may be initiated when there is a confirmed SSI over background in one or more wells for any of the Appendix III parameters. Wells are sampled for Appendix IV parameters semiannually concurrent with Appendix III constituents.

When in assessment monitoring, Appendix IV constituent concentrations are compared to Groundwater Protection Standards (GWPS), or other applicable standards, using Confidence Intervals. Upgradient well data are screened for outliers and trends as described above and tolerance limits are used to develop background limits. GWPS may be based on background limits when background concentrations are higher than the established Maximum Contaminant Levels (MCLs) or other rule-specified GWPS.

Parametric confidence intervals around the population mean will be constructed at the 99% confidence level when data follow a normal distribution, and around the geometric mean (or population median) when data follow a transformed-normal distribution.

Non-parametric confidence intervals will be constructed when data do not pass a normality test and cannot be normalized via a transformation. The confidence level associated with the non-parametric tests is dependent on the number of values used to construct the interval. Confidence intervals require a minimum of four samples; however, a minimum of eight samples are recommended. When non-parametric confidence intervals are constructed, a maximum of eight of the most recent samples will be used in the comparison. When a well/constituent pair does not have the minimum sample requirement, the well/constituent pair will continue to be reported and tracked using time series plots and/or trend tests until such time that enough data are available.

In Assessment Monitoring, when the Lower Confidence Limit (LCL), or the entire interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSI.

## 4.2 Corrective Action

If groundwater corrective action is triggered, semi-annual sampling of the assessment monitoring wells will continue and Confidence Intervals will monitor the progress of remediation efforts. Confidence Intervals are compared to GWPS and the entire interval must fall below a specified limit (i.e. the Upper Confidence Limit [UCL] must be below the limit) to demonstrate compliance. A site-specific monitoring program will be developed based on the final corrective action plan and points-of-compliance.

## 5.0 SITE-SPECIFIC STATISTICAL ANALYSIS METHODS

A site-specific statistical analysis approach was developed after applying the screening criteria described previously. Results of the site-specific screening are presented in Appendix A, Background Screening and Compliance Evaluation. The following is a detailed description of the statistical analysis methodology that will be used for groundwater quality analysis at the site when monitored constituents are present in any of the downgradient wells.

Background sampling began in February 2016. The monitoring well network is described on Table 1.

For the statistical analysis of analytical results obtained from the existing monitoring well network, (1) the number of samples collected will be consistent with the appropriate statistical procedures as recommended by the CCR Rule and the USEPA Unified Guidance; (2) the statistical method will comply with the EPA-recommended performance standards; and (3) determination of whether or not there is a statistically significant increase (SSI) over background values in the future will be completed per the above-mentioned regulations.

### 5.1 Detection Monitoring Program

Groundwater quality data will be evaluated through use of interwell prediction limits, combined with a 1-of-2 resampling strategy for boron, calcium, fluoride, pH and TDS. Intrawell prediction limits, combined with a 1-of-2 resampling approach, will be used to evaluate chloride and sulfate. If a statistical exceedance is found, one independent resample will be collected to determine whether the initial exceedance is verified.

If the initial finding is not verified by resampling, the resampled value will replace the initial finding. When the resample confirms the initial finding, the exceedance will be reported. The Sen’s Slope/Mann Kendall trend test will be used, in addition to PL, to statistically evaluate concentration levels over time and determine whether concentrations are increasing, decreasing, or stabilizing.

The chance of false positive results increases with increasing numbers of statistical tests. The total number of statistical tests for a facility is the number of parameters tested multiplied by the number of monitoring wells. In an effort to reduce the overall number of statistical tests performed at each semi-annual sampling event, thereby lowering the chance of a false exceedance while maintaining a high degree of statistical confidence that a release will be detected, Plant Barry Gypsum Pond will:

1) Monitor constituents in wells with detections (i.e. excluding well/constituent pairs with 100% nondetects); and
2) Incorporate a 1-of-2 retesting strategy

The following statistical methods will be used:

### *5.1.1 Parametric Prediction Limits*

These limits will be computed per USEPA Unified Guidance when data can be normalized, possibly via transformation. The test alpha will be calculated based on the following configuration:

Annual SWFPR = 0.10
1-of-2 resampling plan with a minimum of 8 background samples for interwell tests
1-of-2 resampling plan with a minimum of 8 background samples for intrawell tests
w= 6 (number of compliance wells)
c= 7 constituents

### *5.1.2 Nonparametric Prediction Limits*

The highest background value will be used to set the upper nonparametric prediction limit. The associated confidence level takes into account the prospect of additional future compliance values (retests) when there is an initial exceedance. The achieved confidence level is determined based on the background sample size, the number of monitoring wells in the network, and the number of proposed retests, using tables provided in the USEPA Unified Guidance[7].

### *5.1.3 Retesting Strategy*

When the prediction limit analyses indicate initial exceedances, discrete verification resamples from the indicating well(s) will be collected within 90 days and prior to the next regularly scheduled sampling event. If the initial exceedance is verified, a confirmed SSI will be reported. For the test to be valid, the resample needs to be statistically independent which requires that sufficient time elapse between the initial sample and resample. A minimum time interval between samples will be established to ensure that separate volumes of groundwater are being sampled.

### *5.1.4 Background Data Set*

Interwell tests, which compare downgradient well data to statistical limits constructed from all pooled upgradient well data after careful screening, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter. Because upgradient well data represent natural groundwater quality upgradient of the facility, intrawell prediction limits are also constructed on these wells. A minimum of 8 background samples are required for both interwell and intrawell tests.

The background data set will be managed, screened and updated as described previously after receipt of Department approval.

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[7] USEPA Unified Guidance, March 2009. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities*. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

## 5.2 Assessment Monitoring Program

Assessment monitoring will be performed following the procedures described in Section 4.0. When assessment monitoring is initiated, Appendix IV constituents are sampled semi-annually, and concentrations in downgradient wells are statistically compared as described below to GWPS. Following the Unified Guidance, the Maximum Contaminant Level (MCL) is used as the GWPS. When reported concentrations in upgradient wells are higher than the established MCLs, background limits may be developed as described below from an interwell tolerance limit using the pool of all approved upgradient well data (see Chapter 7 of the Unified Guidance).

Parametric tolerance limits, which are used when pooled upgradient well data follow a normal or transformed-normal distribution, may be constructed on upgradient well or wells with the highest average concentrations with Department approval. This step serves to reduce the effect of spatial variation on the standard deviation in the parametric case when calculating a GWPS. Non-parametric tolerance limits will be constructed when data do not follow a normal or transformed-normal distribution or when a parametric tolerance limit is not approved.

For constituents without established MCLs, the CCR-rule specified limits will be used as the GWPS unless Department-approved background is higher as calculated from interwell tolerance limit as described above. Appendix IV background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Confidence Intervals are then constructed using a maximum of 8 of the most recent assessment measurements from a given downgradient well for comparison to the GWPS to determine compliance.

Parametric tolerance limits (i.e. UTLs) are calculated when data follow a normal or transformed-normal distribution using pooled upgradient well data as described above for Appendix IV parameters with a target of 95% confidence and 95% coverage. When data sets contain greater than 50% nondetects or do not follow a normal or transformed-normal distribution, the confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. The UTLs are then used as background levels for establishing the GWPS under case 3 below.

As described in 40 CFR § 257.95(h)(1)-(3) the GWPS is:

1. The maximum contaminant level (MCL) established under 40 CFR § 141.62 and 141.66.
2. Where an MCL has not been established:
    (i) Cobalt 0.006 mg/L;
    (ii) Lead 0.015 mg/L;
    (iii) Lithium 0.040 mg/L; and
    (iv) Molybdenum 0.100 mg/L.
3. Background levels for constituents where the background level is higher than the MCL or rule-specified GWPS.

In assessment monitoring, when the Lower Confidence Limit (LCL), or the entire confidence interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSL.

With Department approval, the background limits will be updated and compared to the MCLs and CCR-rule specified limits for Appendix IV constituents every two years to determine whether the established limit or background will be used as the GWPS in the confidence interval comparisons, as discussed above.

### 5.3 Corrective Action Monitoring Program

When implemented, groundwater corrective action will include a remedy monitoring program. The remedy monitoring program will be prepared under separate cover and include details regarding statistical analysis of results.

## 6.0 BIBLIOGRAPHY

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Zar, Jerrold H., 1996. *Biostatistical Analysis*. 3rd edition (p112) Prentice Hall

# Figures

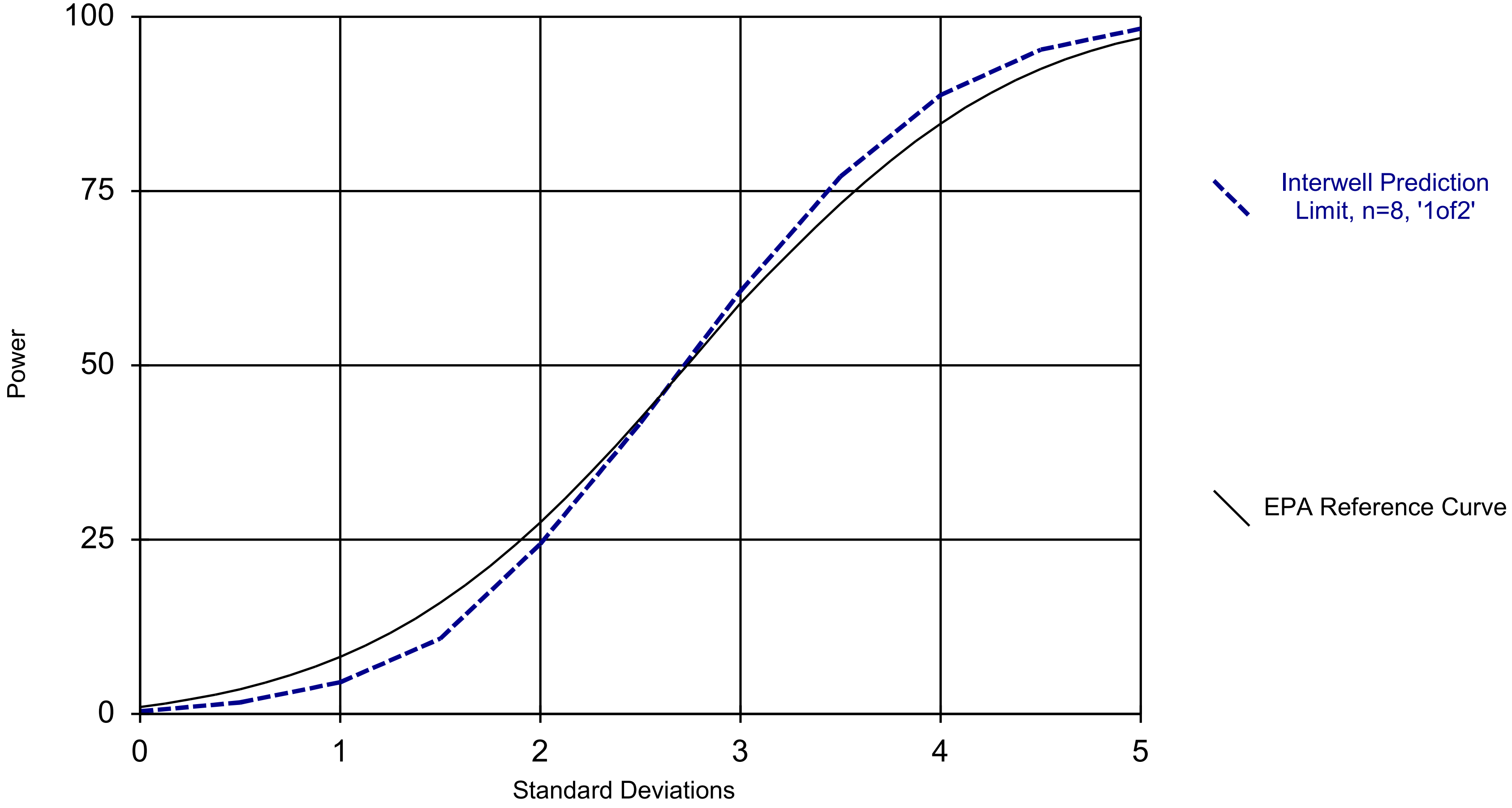
# Table 1.
# Groundwater Monitoring Well Network Details

| Well Name | Purpose | Installation Date | Northing | Easting | Ground Elevation | Top of Casing Elevation | Well Depth (ft.) Below Top of Casing | Top of Screen Elevation (feet MSL) | Bottom of Screen Elevation (feet MSL) | Screen Length |
|---|---|---|---|---|---|---|---|---|---|---|
| BY-GSA-MW-1 | Upgradient | 10/7/2015 | 362040.419 | 1808280.793 | 17.49 | 20.66 | 43.83 | -15.94 | -5.94 | 10 |
| BY-GSA-MW-2 | Upgradient | 10/7/2015 | 361970.572 | 1807662.482 | 17.00 | 19.95 | 47.58 | -20.18 | -10.18 | 10 |
| BY-GSA-MW-3 | Upgradient | 10/7/2015 | 361628.894 | 1807368.366 | 20.15 | 23.24 | 48.53 | -17.98 | -7.98 | 10 |
| BY-GSA-MW-4 | Upgradient | 10/13/2015 | 361930.406 | 1806925.713 | 26.16 | 29.12 | 64.06 | -27.50 | -17.50 | 10 |
| BY-GSA-MW-5 | Downgradient | 10/8/2015 | 362556.147 | 1807430.006 | 31.21 | 34.31 | 69.12 | -27.51 | -17.51 | 10 |
| BY-GSA-MW-6 | Downgradient | 10/8/2015 | 363069.127 | 1807359.035 | 18.60 | 21.68 | 37.88 | -8.88 | 1.12 | 10 |
| BY-GSA-MW-7 | Downgradient | 10/8/2015 | 363103.505 | 1807778.082 | 17.46 | 20.59 | 45.53 | -17.67 | -7.67 | 10 |
| BY-GSA-MW-8 | Downgradient | 10/8/2015 | 362919.540 | 1808314.524 | 31.51 | 34.36 | 68.84 | -26.93 | -16.93 | 10 |
| BY-GSA-MW-9 | Downgradient | 10/8/2015 | 362798.723 | 1808598.555 | 10.44 | 13.32 | 46.14 | -25.30 | -15.30 | 10 |
| BY-GSA-MW-10 | Downgradient | 10/8/2015 | 362443.556 | 1808600.090 | 14.65 | 17.61 | 44.69 | -19.64 | -9.64 | 10 |
| BY-GSA-PZ-11 | Downgradient | 10/8/2015 | 363464.097 | 1807619.818 | 23.56 | 25.92 | 57.92 | -23.96 | -13.96 | 10 |
| BY-GSA-PZ-12* | Piezometer | 10/8/2015 | 363285.151 | 1808280.669 | 14.14 | 17.43 | 43.48 | -18.94 | -8.94 | 10 |

Notes:

1. Northing and easting are in feet relative to the State Plane Alabama West North America Datum of 1983.
2. Elevations are in feet relative to the North American vertical Datum of 1988.
3. *Piezometers are utilized for water level readings only.
4. Top of screen and bottom of screen depths are calculated relative Top of Casing elevation and less the well sump length of 0.4’.
5. MSL - Mean Sea Level

# Power Curve

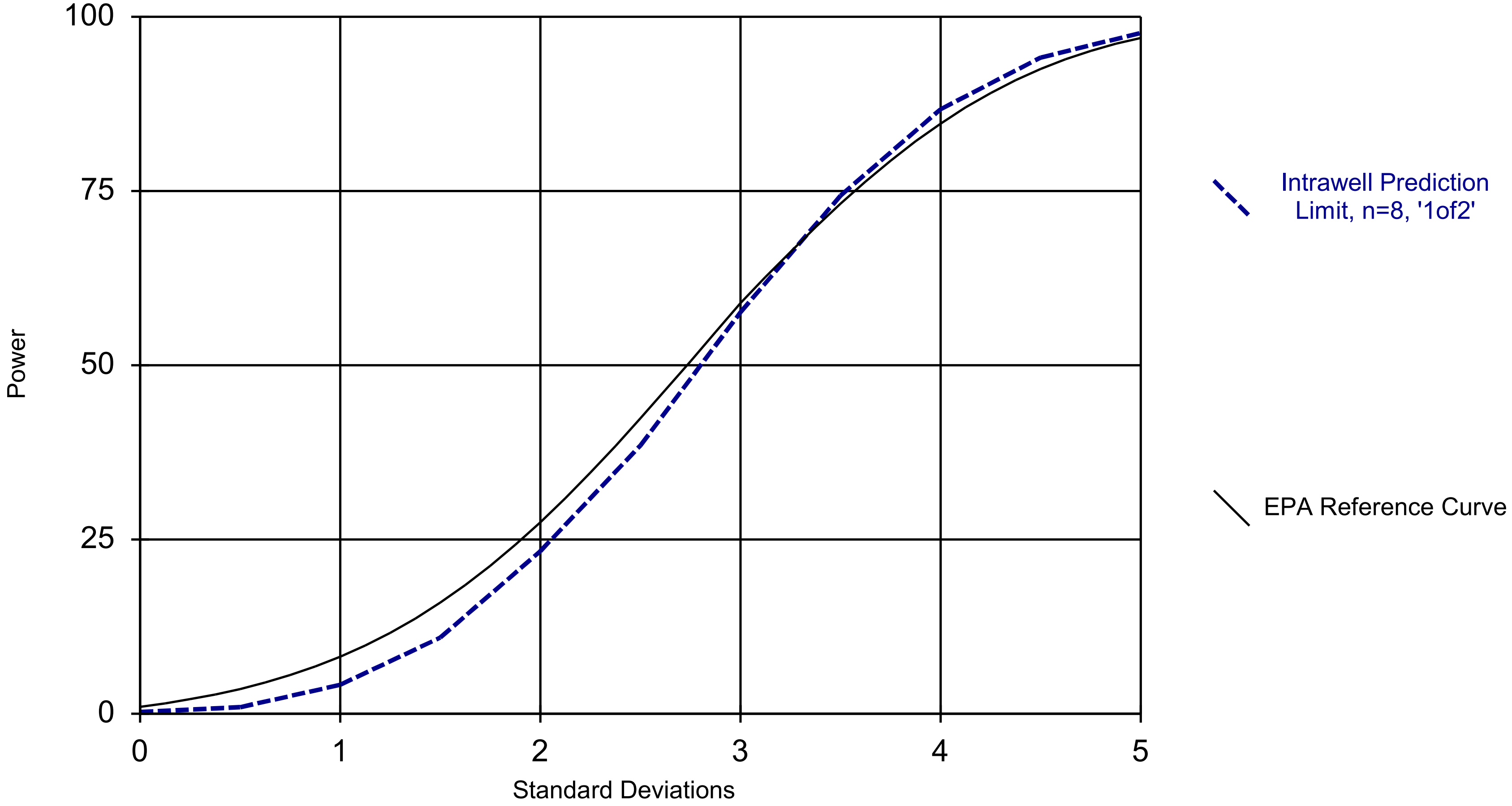


Kappa = 2.742, based on 6 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/9/2020 2:47 PM

Plant Barry Client: Southern Company Data: Barry GSA

# Power Curve



Kappa = 2.831, based on 6 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/9/2020 2:46 PM

Plant Barry Client: Southern Company Data: Barry GSA

# Appendix A

## Background Screening and Compliance Evaluation

GROUNDWATER STATS
CONSULTING

September 16, 2019

Southern Company Services
Attn: Mr. Greg Dyer
3535 Colonnade Parkway
Birmingham, AL 35243

Re: Plant Barry Gypsum Pond
Background Update - 2019

Dear Mr. Dyer,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening for the proposed background update of the prediction limits with data through May 2019 for Alabama Power Company's Plant Barry Gypsum Pond. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at site for the CCR program in 2016. The monitoring well network, as provided by Southern Company Services, consists of the following:

- **Upgradient wells:** BY-GSA-MW-1, BY-GSA-MW-2, BY-GSA-MW-3, BY-GSA-MW-4;
- **Downgradient wells:** BY-GSA-MW-5, BY-GSA-MW-6, BY-GSA-MW-7, BY-GSA-MW-8, BY-GSA-MW-9, and BY-GSA-MW-10.

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was prepared according to the Statistical Analysis Plan approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting. The analysis was reviewed by Dr. Jim Loftis, Civil & Environmental Engineering professor emeritus at Colorado State University and Senior Advisor to Groundwater Stats Consulting.

The following CCR Detection Monitoring parameters are evaluated in this report:

- **Appendix III** (Detection Monitoring) - boron, calcium, chloride, fluoride, pH, sulfate, and TDS

Time series and box plots for these parameters are provided for all wells and constituents, and are used to evaluate concentrations over the entire record for the purpose of updating statistical limits (Figures A and B, respectively). Values in background which have been flagged as outliers may be seen in a lighter font and as a disconnected symbol on the graphs.

## Background Update Summary

Intrawell prediction limits, which compare the most recent compliance sample from a given well to historical data from the same well, are updated by testing for the appropriateness of consolidating new sampling observations with the screened background data. This process is described below and requires a minimum of four new data points. Historical data were evaluated for updating with newer data through May 2019 through the use of time series graphs to identify potential outliers when necessary, as well as with the Mann Whitney test for equality of medians. As discussed in the Statistical Analysis Plan (October 2018), intrawell prediction limits are used to evaluate chloride and sulfate at all wells due to natural spatial variation for these parameters.

Interwell prediction limits, which compare the most recent sample from each downgradient well to statistical limits constructed from pooled upgradient well data, are updated during each sample event. Data from upgradient wells are periodically re-screened for newly developing trends, which may require adjustment of the background period to eliminate the trend, as well as for outliers over the entire record. Interwell prediction limits are used to evaluate boron, calcium, fluoride, pH and TDS.

Prior to performing prediction limits, proposed background data through May 2019 were reviewed to identify any newly suspected outliers at all wells for chloride and sulfate, and at upgradient wells for boron, calcium, fluoride, pH, and TDS (Figure C). Both Tukey’s Test and visual screening are used to identify potential outliers. When identified, values were flagged with “o” and excluded to reduce variation, better represent background conditions, and provide limits that are conservative from a regulatory perspective. Potential outliers that are identified by Tukey’s test but are not greatly different from the rest of the data are not flagged. Also, outliers that are not identified as important by Tukey’s test may be identified visually. As mentioned above, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. Summaries of both Tukey's test results and of flagged values follow this letter.

For constituents requiring intrawell prediction limits, the Mann Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through June 2017 to compliance data through May 2019 to evaluate whether the groups are statistically similar at the 99% confidence level, in which case background data may be updated with compliance data (Figure D). The Mann Whitney test found no statistically significant differences between the two groups. Therefore, all wells were updated with data through May 2019 for construction of intrawell prediction limits for chloride and sulfate.

When the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background are not updated to include the newer data, but will be reconsidered in the future. A summary of these results follows this letter and the test results are included with the Mann Whitney test section at the end of this report.

The Sen's Slope/Mann Kendall trend test was used to evaluate the entire record of data from upgradient wells for parameters utilizing interwell prediction limits (Figure E). When statistically significant increasing trends are identified in upgradient wells, the earlier portion of data is deselected prior to construction of interwell statistical limits if the trending data would result in statistical limits that are not conservative from a regulatory perspective. Statistically significant trends were noted in upgradient wells and may be seen on the Trend Test Summary Table. These trends required no adjustments at this time, however, because the period of record is short and/or the magnitudes of the trends were low relative to the average concentrations in background.

## Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 verification strategy were constructed for boron, calcium, fluoride, pH, and TDS; while intrawell prediction limits combined with a 1-of-2 verification strategy were constructed for chloride and sulfate. Future samples will be compared against these prediction limits (Figures F and G, respectively). In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified, and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result; therefore, no further action is necessary. A summary of the updated prediction limits follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for Barry Gypsum Pond. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

ACollins

Andrew T. Collins
Groundwater Analyst

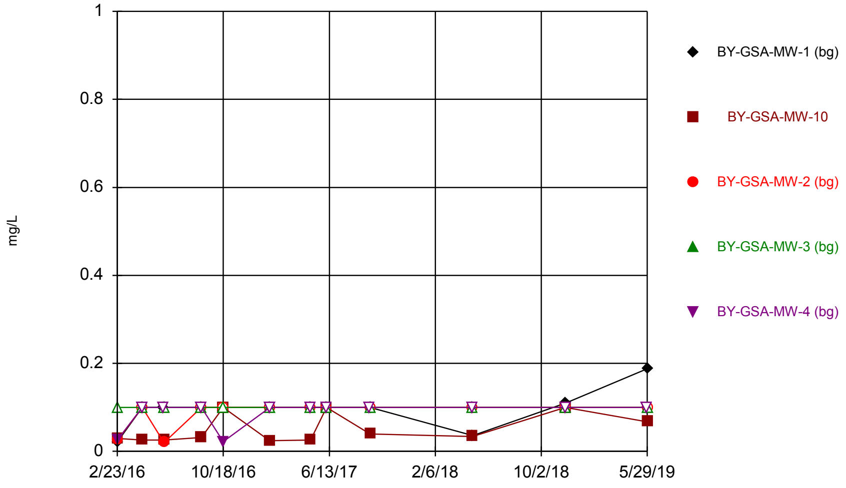
Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

# FIGURE A.

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

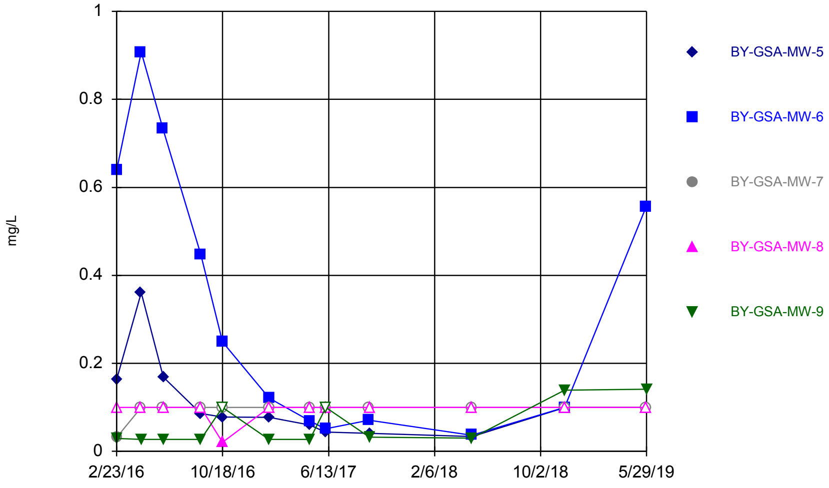
Time Series



Constituent: Boron    Analysis Run 9/12/2019 1:11 PM
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

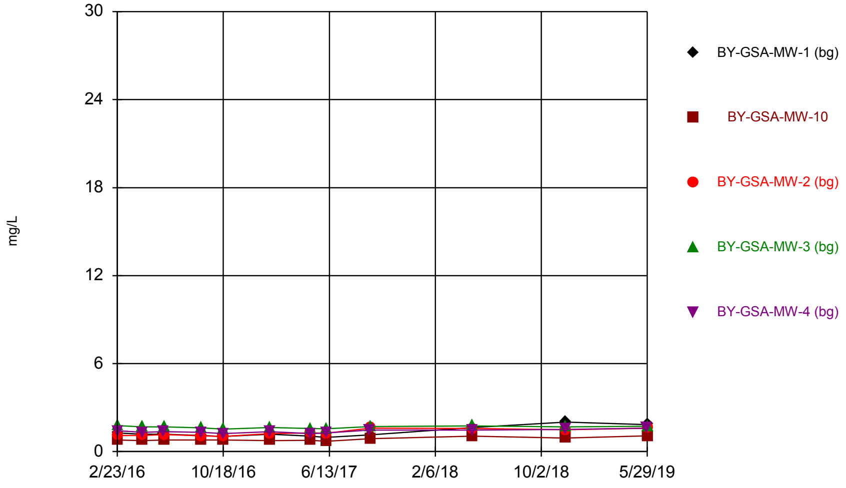
Time Series



Constituent: Boron    Analysis Run 9/12/2019 1:11 PM
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

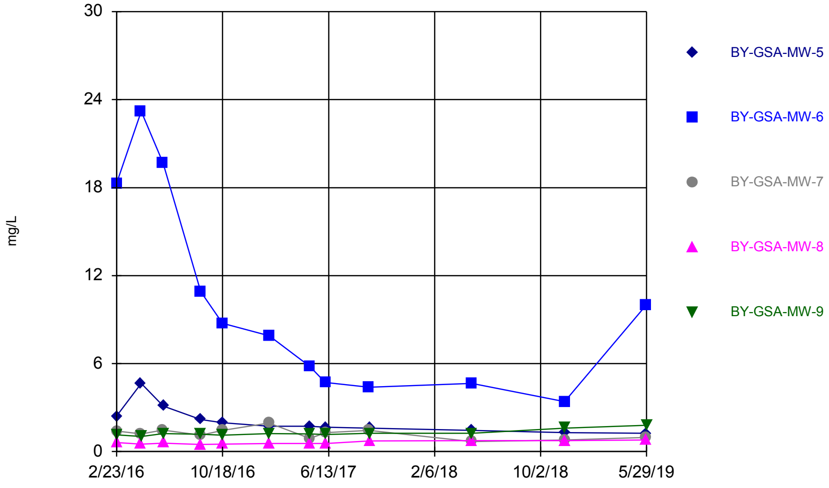
Time Series



Constituent: Calcium    Analysis Run 9/12/2019 1:11 PM
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Time Series



Constituent: Calcium    Analysis Run 9/12/2019 1:11 PM
Plant Barry    Client: Southern Company    Data: Barry GSA

# Time Series

Constituent: Boron (mg/L)  Analysis Run 9/12/2019 1:11 PM

Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-1 (bg) | BY-GSA-MW-10 | BY-GSA-MW-2 (bg) | BY-GSA-MW-3 (bg) | BY-GSA-MW-4 (bg) |
|---|---|---|---|---|---|
| 2/23/2016 | 0.0212 (J) | 0.0294 (J) | 0.0252 (J) | <0.1 | 0.0257 (J) |
| 4/19/2016 | <0.1 | 0.0257 (J) | <0.1 | <0.1 | <0.1 |
| 6/6/2016 | <0.1 | | | | <0.1 |
| 6/7/2016 | | 0.0257 (J) | 0.0202 (J) | <0.1 | |
| 8/30/2016 | <0.1 | 0.0317 (J) | <0.1 | <0.1 | <0.1 |
| 10/18/2016 | <0.1 | <0.1 | <0.1 | <0.1 | 0.022 (J) |
| 1/30/2017 | | 0.0243 (J) | | | |
| 1/31/2017 | <0.1 | | <0.1 | <0.1 | <0.1 |
| 5/2/2017 | <0.1 | 0.0259 (J) | <0.1 | <0.1 | <0.1 |
| 6/6/2017 | <0.1 | | <0.1 | <0.1 | <0.1 |
| 6/7/2017 | | <0.1 | | | |
| 9/12/2017 | | | | | <0.1 |
| 9/13/2017 | <0.1 | 0.0394 (J) | <0.1 | <0.1 | |
| 5/1/2018 | | 0.0338 (J) | <0.1 | <0.1 | <0.1 |
| 5/2/2018 | 0.0362 (J) | | | | |
| 11/26/2018 | | <0.1 (J) | | | <0.1 |
| 11/27/2018 | 0.11 | | <0.1 (J) | <0.1 | |
| 5/28/2019 | | | | | <0.1 |
| 5/29/2019 | 0.188 | 0.0669 (J) | <0.1 | <0.1 | |

# Time Series

Constituent: Boron (mg/L)  Analysis Run 9/12/2019 1:11 PM

Plant Barry  Client: Southern Company  Data: Barry GSA

|  | BY-GSA-MW-5 | BY-GSA-MW-6 | BY-GSA-MW-7 | BY-GSA-MW-8 | BY-GSA-MW-9 |
|---|---|---|---|---|---|
| 2/23/2016 | 0.163 | 0.638 | 0.0314 (J) | <0.1 | 0.0297 (J) |
| 4/18/2016 | 0.361 | 0.908 | <0.1 | <0.1 |  |
| 4/19/2016 |  |  |  |  | 0.0269 (J) |
| 6/6/2016 |  | 0.733 | <0.1 |  |  |
| 6/7/2016 | 0.169 |  |  | <0.1 | 0.0271 (J) |
| 8/30/2016 | 0.0858 (J) | 0.448 | <0.1 | <0.1 | 0.0272 (J) |
| 10/18/2016 | 0.0778 (J) | 0.249 | <0.1 | 0.0207 (J) | <0.1 |
| 1/30/2017 |  |  | <0.1 |  | 0.0269 (J) |
| 1/31/2017 | 0.077 (J) | 0.121 |  | <0.1 |  |
| 5/2/2017 | 0.0602 (J) | 0.0695 (J) | <0.1 | <0.1 | 0.027 (J) |
| 6/6/2017 | 0.0442 (J) | 0.0509 (J) |  |  |  |
| 6/7/2017 |  |  | <0.1 | <0.1 | <0.1 |
| 9/12/2017 |  | 0.0709 (J) | <0.1 |  |  |
| 9/13/2017 | 0.0411 (J) |  |  | <0.1 | 0.032 (J) |
| 5/1/2018 |  | 0.0365 (J) | <0.1 |  | 0.0302 (J) |
| 5/2/2018 | 0.0334 (J) |  |  | <0.1 |  |
| 11/26/2018 |  | <0.1 (J) |  |  | 0.139 |
| 11/27/2018 | <0.1 (J) |  | <0.1 | <0.1 |  |
| 5/28/2019 | <0.1 | 0.556 | <0.1 | <0.1 |  |
| 5/29/2019 |  |  |  |  | 0.141 |

# Time Series

Constituent: Calcium (mg/L)    Analysis Run 9/12/2019 1:11 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

| | BY-GSA-MW-1 (bg) | BY-GSA-MW-10 | BY-GSA-MW-2 (bg) | BY-GSA-MW-3 (bg) | BY-GSA-MW-4 (bg) |
|---|---|---|---|---|---|
| 2/23/2016 | 1.28 | 0.795 | 1.11 | 1.77 | 1.42 |
| 4/19/2016 | 1.19 | 0.761 | 1.09 | 1.68 | 1.31 |
| 6/6/2016 | 1.19 | | | | 1.35 |
| 6/7/2016 | | 0.799 | 1.16 | 1.68 | |
| 8/30/2016 | 1.11 | 0.788 | 1.08 | 1.62 | 1.31 |
| 10/18/2016 | 1.04 | 0.788 | 1.03 | 1.53 | 1.22 |
| 1/30/2017 | | 0.755 | | | |
| 1/31/2017 | 1.19 | | 1.23 | 1.65 | 1.36 |
| 5/2/2017 | 1.05 | 0.763 | 1.28 | 1.58 | 1.24 |
| 6/6/2017 | 0.978 | | 1.25 | 1.55 | 1.28 |
| 6/7/2017 | | 0.706 | | | |
| 9/12/2017 | | | | | 1.47 |
| 9/13/2017 | 1.14 | 0.873 | 1.6 | 1.71 | |
| 5/1/2018 | | 1.05 | 1.58 | 1.76 | 1.47 |
| 5/2/2018 | 1.64 | | | | |
| 11/26/2018 | | 0.922 | | | 1.52 |
| 11/27/2018 | 2.01 | | 1.49 | 1.69 | |
| 5/28/2019 | | | | | 1.6 |
| 5/29/2019 | 1.85 | 1.07 | 1.59 | 1.74 | |

# Time Series

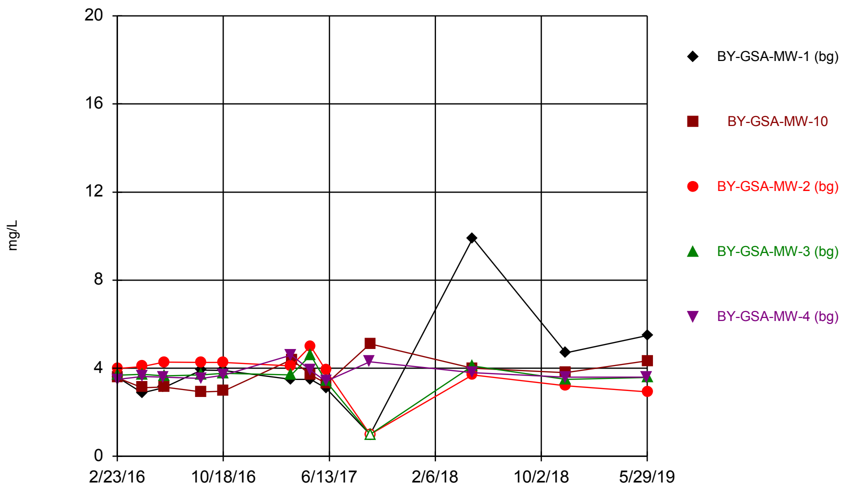
Constituent: Calcium (mg/L)    Analysis Run 9/12/2019 1:11 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

| | BY-GSA-MW-5 | BY-GSA-MW-6 | BY-GSA-MW-7 | BY-GSA-MW-8 | BY-GSA-MW-9 |
|---|---|---|---|---|---|
| 2/23/2016 | 2.42 | 18.3 | 1.4 | 0.618 | 1.15 |
| 4/18/2016 | 4.65 | 23.2 | 1.2 | 0.505 | |
| 4/19/2016 | | | | | 1.04 |
| 6/6/2016 | | 19.7 | 1.48 | | |
| 6/7/2016 | 3.1 | | | 0.587 | 1.22 |
| 8/30/2016 | 2.19 | 10.9 | 1.13 | 0.495 (J) | 1.18 |
| 10/18/2016 | 1.97 | 8.74 | 1.45 | 0.503 | 1.12 |
| 1/30/2017 | | | 1.95 | | 1.23 |
| 1/31/2017 | 1.73 | 7.89 | | 0.554 | |
| 5/2/2017 | 1.74 | 5.81 | 0.908 | 0.548 | 1.2 |
| 6/6/2017 | 1.66 | 4.72 | | | |
| 6/7/2017 | | | 1.29 | 0.545 | 1.17 |
| 9/12/2017 | | 4.39 | 1.44 | | |
| 9/13/2017 | 1.61 | | | 0.723 | 1.25 |
| 5/1/2018 | | 4.66 | 0.695 | | 1.25 |
| 5/2/2018 | 1.44 | | | 0.751 | |
| 11/26/2018 | | 3.41 | | | 1.61 |
| 11/27/2018 | 1.3 | | 0.798 | 0.743 | |
| 5/28/2019 | 1.25 | 10 | 0.972 | 0.789 | |
| 5/29/2019 | | | | | 1.8 |

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

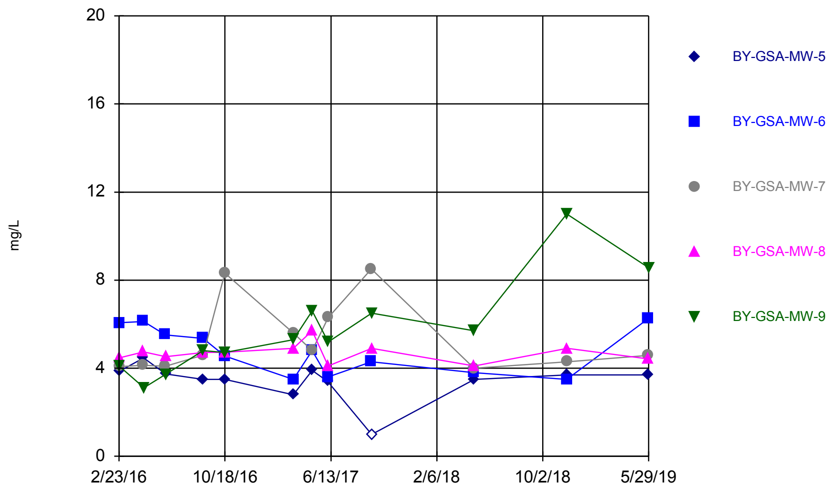
Time Series



Constituent: Chloride Analysis Run 9/12/2019 1:11 PM
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

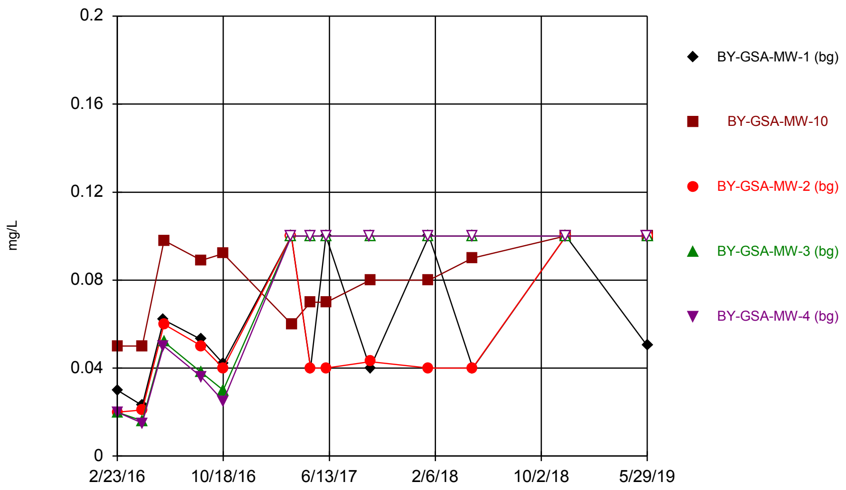
Time Series



Constituent: Chloride Analysis Run 9/12/2019 1:11 PM
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

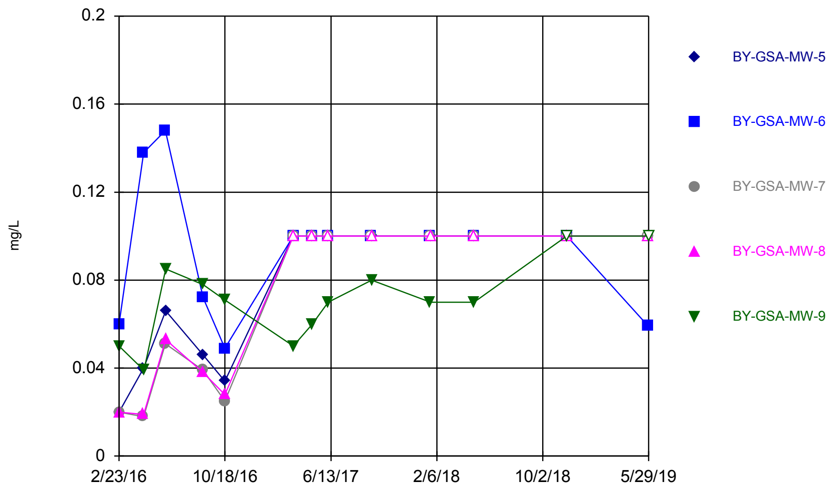
Time Series



Constituent: Fluoride Analysis Run 9/12/2019 1:11 PM
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Fluoride Analysis Run 9/12/2019 1:11 PM
Plant Barry Client: Southern Company Data: Barry GSA

# Time Series

Constituent: Chloride (mg/L)    Analysis Run 9/12/2019 1:11 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

| | BY-GSA-MW-1 (bg) | BY-GSA-MW-10 | BY-GSA-MW-2 (bg) | BY-GSA-MW-3 (bg) | BY-GSA-MW-4 (bg) |
|---|---|---|---|---|---|
| 2/23/2016 | 3.59 | 3.57 | 3.99 | 3.68 | 3.5 |
| 4/19/2016 | 2.89 | 3.12 | 4.08 | 3.72 | 3.63 |
| 6/6/2016 | 3.12 | | | | 3.6 |
| 6/7/2016 | | 3.14 | 4.28 | 3.66 | |
| 8/30/2016 | 3.91 | 2.93 | 4.26 | 3.7 | 3.54 |
| 10/18/2016 | 3.9 | 2.96 | 4.26 | 3.77 | 3.68 |
| 3/20/2017 | 3.5 | | 4.1 | 3.7 | 4.6 |
| 3/21/2017 | | 4.4 | | | |
| 5/2/2017 | 3.5 | 3.7 | 5 | 4.6 | 3.9 |
| 6/6/2017 | 3.1 | | 3.9 | 3.4 | 3.4 |
| 6/7/2017 | | 3.3 | | | |
| 9/12/2017 | | | | | 4.3 |
| 9/13/2017 | <2 (U*) | 5.1 | <2 (U*) | <2 (U*) | |
| 5/1/2018 | | 4 | 3.7 | 4.1 | 3.8 |
| 5/2/2018 | 9.9 | | | | |
| 11/26/2018 | | 3.8 | | | 3.6 |
| 11/27/2018 | 4.7 | | 3.2 | 3.5 | |
| 5/28/2019 | | | | | 3.6 |
| 5/29/2019 | 5.48 | 4.34 | 2.93 | 3.58 | |

# Time Series

Constituent: Chloride (mg/L)  Analysis Run 9/12/2019 1:11 PM

Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-5 | BY-GSA-MW-6 | BY-GSA-MW-7 | BY-GSA-MW-8 | BY-GSA-MW-9 |
|---|---|---|---|---|---|
| 2/23/2016 | 3.86 | 6.06 | 4.08 | 4.47 | 4.1 |
| 4/18/2016 | 4.46 | 6.13 | 4.14 | 4.74 | |
| 4/19/2016 | | | | | 3.11 |
| 6/6/2016 | | 5.52 | 4.09 | | |
| 6/7/2016 | 3.74 | | | 4.52 | 3.72 |
| 8/30/2016 | 3.5 | 5.35 | 4.6 | 4.71 | 4.8 |
| 10/18/2016 | 3.5 | 4.55 | 8.32 | 4.73 | 4.71 |
| 3/21/2017 | 2.8 | 3.5 | 5.6 | 4.9 | 5.3 |
| 5/2/2017 | 3.9 | 4.8 | 4.8 | 5.7 | 6.6 |
| 6/6/2017 | 3.4 | 3.6 | | | |
| 6/7/2017 | | | 6.3 | 4.1 | 5.2 |
| 9/12/2017 | | 4.3 | 8.5 | | |
| 9/13/2017 | <2 (U*) | | | 4.9 | 6.5 |
| 5/1/2018 | | 3.8 | 4 | | 5.7 |
| 5/2/2018 | 3.5 | | | 4.1 | |
| 11/26/2018 | | 3.5 | | | 11 |
| 11/27/2018 | 3.7 | | 4.3 | 4.9 | |
| 5/28/2019 | 3.69 | 6.26 | 4.59 | 4.43 | |
| 5/29/2019 | | | | | 8.56 |

# Time Series

Constituent: Fluoride (mg/L)  Analysis Run 9/12/2019 1:11 PM

Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-1 (bg) | BY-GSA-MW-10 | BY-GSA-MW-2 (bg) | BY-GSA-MW-3 (bg) | BY-GSA-MW-4 (bg) |
|---|---|---|---|---|---|
| 2/23/2016 | 0.03 (J) | 0.05 (J) | 0.02 (J) | 0.02 (J) | 0.02 (J) |
| 4/19/2016 | 0.023 (J) | 0.05 (J) | 0.021 (J) | 0.016 (J) | 0.015 (J) |
| 6/6/2016 | 0.062 (J) | | | | 0.05 (J) |
| 6/7/2016 | | 0.098 (J) | 0.06 (J) | 0.052 (J) | |
| 8/30/2016 | 0.053 (J) | 0.089 (J) | 0.05 (J) | 0.038 (J) | 0.036 (J) |
| 10/18/2016 | 0.042 (J) | 0.092 (J) | 0.04 (J) | 0.03 (J) | 0.025 (J) |
| 3/20/2017 | <0.1 | | <0.1 | <0.1 | <0.1 |
| 3/21/2017 | | 0.06 (J) | | | |
| 5/2/2017 | 0.04 (J) | 0.07 (J) | 0.04 (J) | <0.1 | <0.1 |
| 6/6/2017 | <0.1 | | 0.04 (J) | <0.1 | <0.1 |
| 6/7/2017 | | 0.07 (J) | | | |
| 9/12/2017 | | | | | <0.1 |
| 9/13/2017 | 0.04 (J) | 0.08 (J) | 0.043 (J) | <0.1 | |
| 1/23/2018 | <0.1 | 0.08 (J) | 0.04 (J) | <0.1 | <0.1 |
| 5/1/2018 | | 0.09 (J) | 0.04 (J) | <0.1 | <0.1 |
| 5/2/2018 | 0.04 (J) | | | | |
| 11/26/2018 | | <0.1 (J) | | | <0.1 |
| 11/27/2018 | <0.1 | | <0.1 | <0.1 | |
| 5/28/2019 | | | | | <0.1 |
| 5/29/2019 | 0.0502 (J) | <0.1 | <0.1 | <0.1 | |

# Time Series

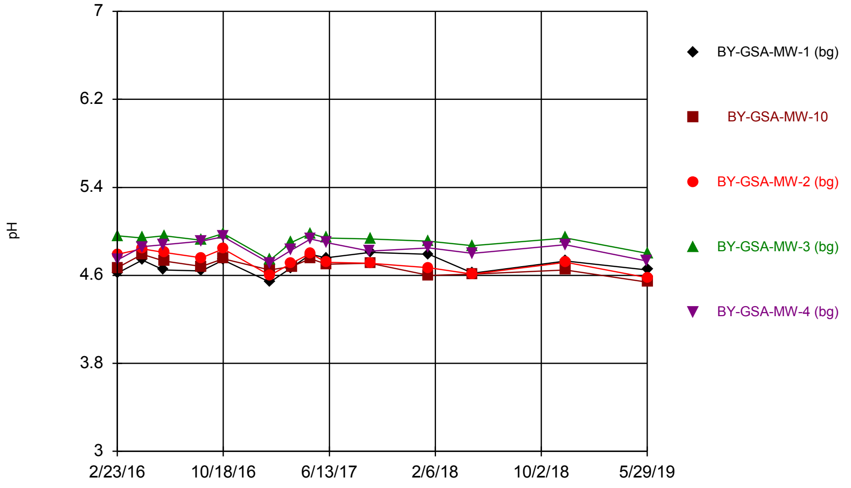
Constituent: Fluoride (mg/L)    Analysis Run 9/12/2019 1:11 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

| | BY-GSA-MW-5 | BY-GSA-MW-6 | BY-GSA-MW-7 | BY-GSA-MW-8 | BY-GSA-MW-9 |
|---|---|---|---|---|---|
| 2/23/2016 | 0.02 (J) | 0.06 (J) | 0.02 (J) | 0.02 (J) | 0.05 (J) |
| 4/18/2016 | 0.04 (J) | 0.138 (J) | 0.018 (J) | 0.019 (J) | |
| 4/19/2016 | | | | | 0.039 (J) |
| 6/6/2016 | | 0.148 (J) | 0.051 (J) | | |
| 6/7/2016 | 0.066 (J) | | | 0.053 (J) | 0.085 (J) |
| 8/30/2016 | 0.046 (J) | 0.072 (J) | 0.039 (J) | 0.038 (J) | 0.078 (J) |
| 10/18/2016 | 0.034 (J) | 0.049 (J) | 0.025 (J) | 0.028 (J) | 0.071 (J) |
| 3/21/2017 | <0.1 | <0.1 | <0.1 | <0.1 | 0.05 (J) |
| 5/2/2017 | <0.1 | <0.1 | <0.1 | <0.1 | 0.06 (J) |
| 6/6/2017 | <0.1 | <0.1 | | | |
| 6/7/2017 | | | <0.1 | <0.1 | 0.07 (J) |
| 9/12/2017 | | <0.1 | <0.1 | | |
| 9/13/2017 | <0.1 | | | <0.1 | 0.08 (J) |
| 1/22/2018 | | <0.1 | <0.1 | | |
| 1/23/2018 | | | | | 0.07 (J) |
| 1/24/2018 | <0.1 | | | <0.1 | |
| 5/1/2018 | | <0.1 | <0.1 | | 0.07 (J) |
| 5/2/2018 | <0.1 | | | <0.1 | |
| 11/26/2018 | | <0.1 | | | <0.1 (J) |
| 11/27/2018 | <0.1 | | <0.1 | <0.1 | |
| 5/28/2019 | <0.1 | 0.0591 (J) | <0.1 | <0.1 | |
| 5/29/2019 | | | | | <0.1 |

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Time Series

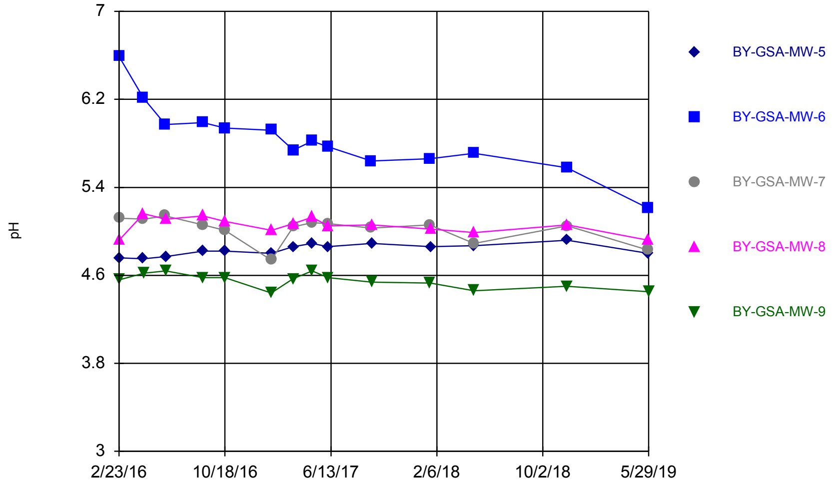


Constituent: pH Analysis Run 9/12/2019 1:11 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Time Series

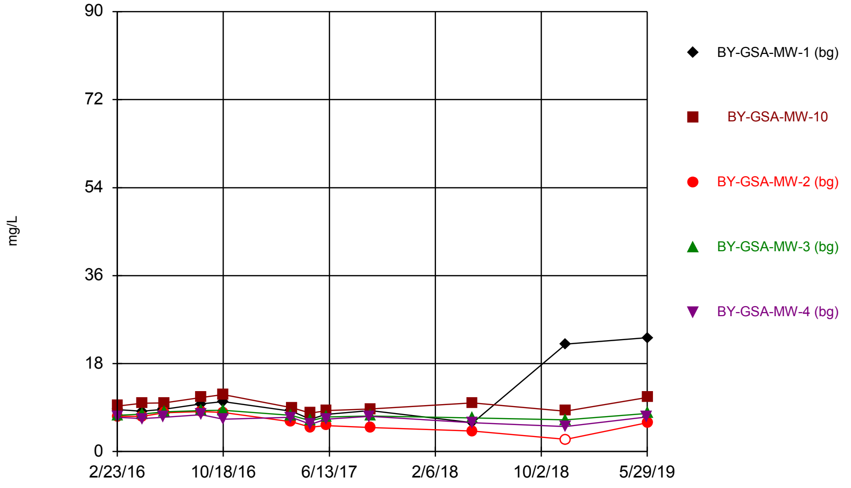


Constituent: pH Analysis Run 9/12/2019 1:11 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series

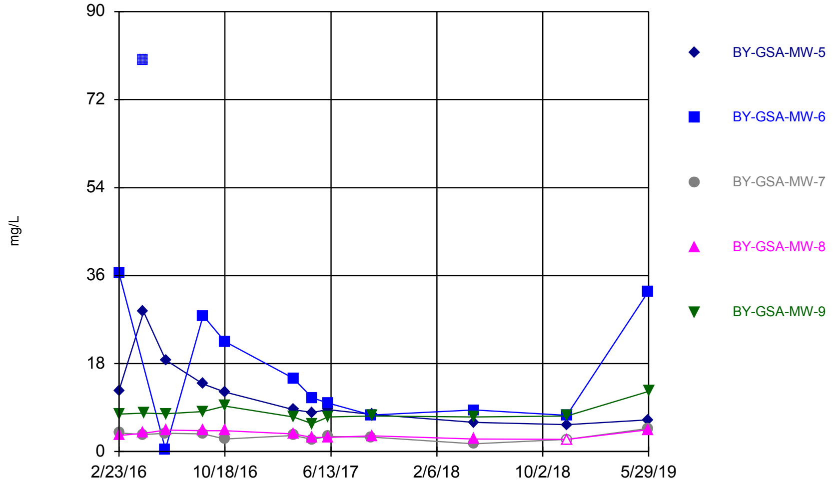


Constituent: Sulfate Analysis Run 9/12/2019 1:11 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Sulfate Analysis Run 9/12/2019 1:11 PM

Plant Barry Client: Southern Company Data: Barry GSA

# Time Series

Constituent: pH (pH)  Analysis Run 9/12/2019 1:11 PM

Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-1 (bg) | BY-GSA-MW-10 | BY-GSA-MW-2 (bg) | BY-GSA-MW-3 (bg) | BY-GSA-MW-4 (bg) |
|---|---|---|---|---|---|
| 2/23/2016 | 4.62 | 4.67 | 4.79 | 4.96 | 4.74 |
| 4/19/2016 | 4.74 | 4.79 | 4.84 | 4.94 | 4.86 |
| 6/6/2016 | 4.65 | | | | 4.88 |
| 6/7/2016 | | 4.73 | 4.81 | 4.96 | |
| 8/30/2016 | 4.64 | 4.68 | 4.76 | 4.92 | 4.91 |
| 10/18/2016 | 4.74 | 4.75 | 4.84 | 4.98 | 4.95 |
| 1/30/2017 | | 4.65 | | | |
| 1/31/2017 | 4.54 | | 4.6 | 4.74 | 4.71 |
| 3/20/2017 | 4.67 | | 4.71 | 4.9 | 4.83 |
| 3/21/2017 | | 4.68 | | | |
| 5/2/2017 | 4.79 | 4.75 | 4.8 | 4.98 | 4.93 |
| 6/6/2017 | 4.76 | | 4.72 | 4.94 | 4.9 |
| 6/7/2017 | | 4.7 | | | |
| 9/12/2017 | | | | | 4.82 |
| 9/13/2017 | 4.81 | 4.71 | 4.71 | 4.93 | |
| 1/23/2018 | 4.79 | 4.6 | 4.67 | 4.91 | 4.85 |
| 5/1/2018 | | 4.61 | 4.61 | 4.87 | 4.8 |
| 5/2/2018 | 4.62 | | | | |
| 11/26/2018 | | 4.65 | | | 4.88 |
| 11/27/2018 | 4.73 | | 4.72 | 4.94 | |
| 5/28/2019 | | | | | 4.73 |
| 5/29/2019 | 4.65 | 4.54 | 4.58 | 4.8 | |

# Time Series

Constituent: pH (pH)  Analysis Run 9/12/2019 1:11 PM

Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-5 | BY-GSA-MW-6 | BY-GSA-MW-7 | BY-GSA-MW-8 | BY-GSA-MW-9 |
|---|---|---|---|---|---|
| 2/23/2016 | 4.76 | 6.59 | 5.12 | 4.92 | 4.56 |
| 4/18/2016 | 4.75 | 6.21 | 5.11 | 5.16 | |
| 4/19/2016 | | | | | 4.62 |
| 6/6/2016 | | 5.97 | 5.14 | | |
| 6/7/2016 | 4.77 | | | 5.11 | 4.64 |
| 8/30/2016 | 4.82 | 5.99 | 5.06 | 5.14 | 4.58 |
| 10/18/2016 | 4.82 | 5.94 | 5.01 | 5.09 | 4.58 |
| 1/30/2017 | | | 4.74 | | 4.44 |
| 1/31/2017 | 4.8 | 5.92 | | 5.01 | |
| 3/21/2017 | 4.86 | 5.74 | 5.04 | 5.07 | 4.57 |
| 5/2/2017 | 4.89 | 5.82 | 5.08 | 5.13 | 4.64 |
| 6/6/2017 | 4.86 | 5.77 | | | |
| 6/7/2017 | | | 5.07 | 5.05 | 4.58 |
| 9/12/2017 | | 5.64 | 5.03 | | |
| 9/13/2017 | 4.89 | | | 5.06 | 4.54 |
| 1/22/2018 | | 5.66 | 5.06 | | |
| 1/23/2018 | | | | | 4.53 |
| 1/24/2018 | 4.86 | | | 5.02 | |
| 5/1/2018 | | 5.71 | 4.89 | | 4.46 |
| 5/2/2018 | 4.87 | | | 4.99 | |
| 11/26/2018 | | 5.58 | | | 4.5 |
| 11/27/2018 | 4.92 | | 5.05 | 5.06 | |
| 5/28/2019 | 4.8 | 5.21 | 4.83 | 4.92 | |
| 5/29/2019 | | | | | 4.45 |

# Time Series

Constituent: Sulfate (mg/L)    Analysis Run 9/12/2019 1:11 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

| | BY-GSA-MW-1 (bg) | BY-GSA-MW-10 | BY-GSA-MW-2 (bg) | BY-GSA-MW-3 (bg) | BY-GSA-MW-4 (bg) |
|---|---|---|---|---|---|
| 2/23/2016 | 8.59 | 9.29 | 7.2 | 7.44 | 7.04 |
| 4/19/2016 | 8.27 | 9.92 | 7.22 | 7.66 | 6.74 |
| 6/6/2016 | 8.66 | | | | 7.04 |
| 6/7/2016 | | 10 | 7.92 | 8.16 | |
| 8/30/2016 | 9.74 | 11.1 | 8.17 | 8.43 | 7.57 |
| 10/18/2016 | 10.2 | 11.7 | 7.99 | 8.47 | 6.62 |
| 3/20/2017 | 8.3 | | 6.1 | 7.4 | 7 |
| 3/21/2017 | | 9 | | | |
| 5/2/2017 | 6.6 | 7.9 | 5 | 6.3 | 5.6 |
| 6/6/2017 | 7.6 | | 5.3 | 7.1 | 6.6 |
| 6/7/2017 | | 8.4 | | | |
| 9/12/2017 | | | | | 7.2 |
| 9/13/2017 | 8.4 | 8.7 | 4.9 (J) | 7.3 | |
| 5/1/2018 | | 10 | 4.2 (J) | 6.9 | 5.9 |
| 5/2/2018 | 5.9 | | | | |
| 11/26/2018 | | 8.3 | | | 5.1 |
| 11/27/2018 | 22 | | <5 (J) | 6.5 | |
| 5/28/2019 | | | | | 7.1 |
| 5/29/2019 | 23.3 | 11.1 | 5.94 | 7.81 | |

# Time Series

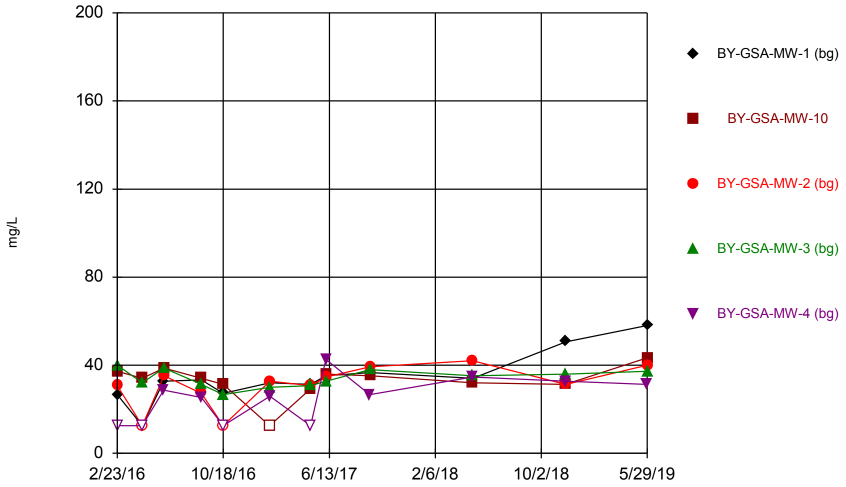
Constituent: Sulfate (mg/L)  Analysis Run 9/12/2019 1:11 PM

Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-5 | BY-GSA-MW-6 | BY-GSA-MW-7 | BY-GSA-MW-8 | BY-GSA-MW-9 |
|---|---|---|---|---|---|
| 2/23/2016 | 12.5 | 36.5 | 3.82 | 3.33 | 7.71 |
| 4/18/2016 | 28.6 | 80.2 (o) | 3.48 | 3.78 | |
| 4/19/2016 | | | | | 7.85 |
| 6/6/2016 | | 0.498 (J) | 3.76 | | |
| 6/7/2016 | 18.7 | | | 4.44 | 7.76 |
| 8/30/2016 | 13.8 | 27.8 | 3.62 | 4.29 | 8.22 |
| 10/18/2016 | 12.2 | 22.5 | 2.58 | 4.27 | 9.29 |
| 3/21/2017 | 8.6 | 15 | 3.3 (J) | 3.6 (J) | 7.1 |
| 5/2/2017 | 8 | 11 | 2.5 (J) | 2.9 (J) | 5.7 |
| 6/6/2017 | 8.6 | 10 | | | |
| 6/7/2017 | | | 3.1 (J) | 2.9 (J) | 7.1 |
| 9/12/2017 | | 7.5 | 3 (J) | | |
| 9/13/2017 | 7.6 | | | 3.2 (J) | 7.3 |
| 5/1/2018 | | 8.5 | 1.6 (J) | | 7.1 |
| 5/2/2018 | 6 | | | 2.6 (J) | |
| 11/26/2018 | | 7.4 | | | 7.3 |
| 11/27/2018 | 5.5 | | <5 (J) | <5 (J) | |
| 5/28/2019 | 6.5 | 32.7 | 4.74 | 4.46 | |
| 5/29/2019 | | | | | 12.3 |

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

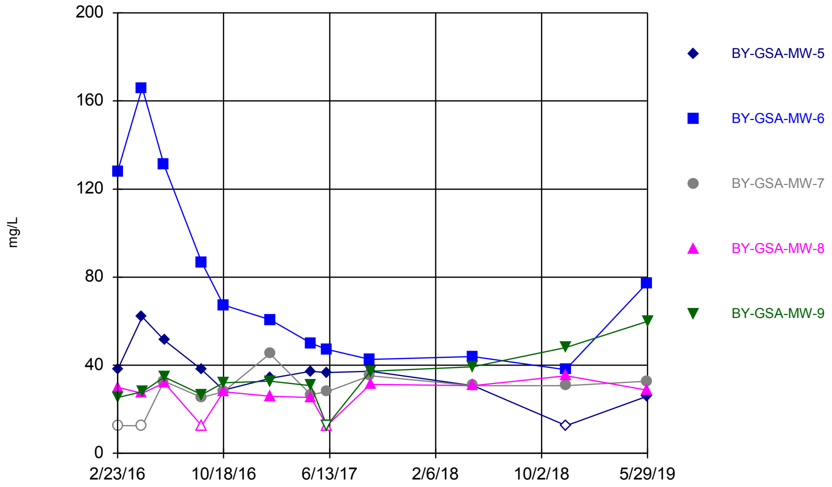
Time Series



Constituent: TDS Analysis Run 9/12/2019 1:11 PM
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: TDS Analysis Run 9/12/2019 1:11 PM
Plant Barry Client: Southern Company Data: Barry GSA

# Time Series

Constituent: TDS (mg/L) Analysis Run 9/12/2019 1:11 PM

Plant Barry Client: Southern Company Data: Barry GSA

| | BY-GSA-MW-1 (bg) | BY-GSA-MW-10 | BY-GSA-MW-2 (bg) | BY-GSA-MW-3 (bg) | BY-GSA-MW-4 (bg) |
|---|---|---|---|---|---|
| 2/23/2016 | 26.7 | 37.3 | 30.7 | 40 | <25 |
| 4/19/2016 | <25 | 34 | <25 | 32 | <25 |
| 6/6/2016 | 32.7 | | | | 28.7 |
| 6/7/2016 | | 38.7 | 35.3 | 38.7 | |
| 8/30/2016 | 33.3 | 34 | 27.3 | 31.3 | 25.3 |
| 10/18/2016 | 27.3 | 31.3 | <25 | 26.7 | <25 |
| 1/30/2017 | | <25 | | | |
| 1/31/2017 | 32 | | 32.7 | 30 | 26 |
| 5/2/2017 | 31.3 | 29.3 | 30.7 | 30.7 | <25 |
| 6/6/2017 | 35.3 | | 34.7 | 32.7 | 42.7 |
| 6/7/2017 | | 36 | | | |
| 9/12/2017 | | | | | 26.7 |
| 9/13/2017 | 36.7 | 35.3 | 39.3 | 38 | |
| 5/1/2018 | | 32 | 42 | 35.3 | 34.7 |
| 5/2/2018 | 34 | | | | |
| 11/26/2018 | | 31.3 | | | 32.7 |
| 11/27/2018 | 50.7 | | 31.3 | 36 | |
| 5/28/2019 | | | | | 31.3 |
| 5/29/2019 | 58 | 43.3 | 40 | 37.3 | |

# Time Series

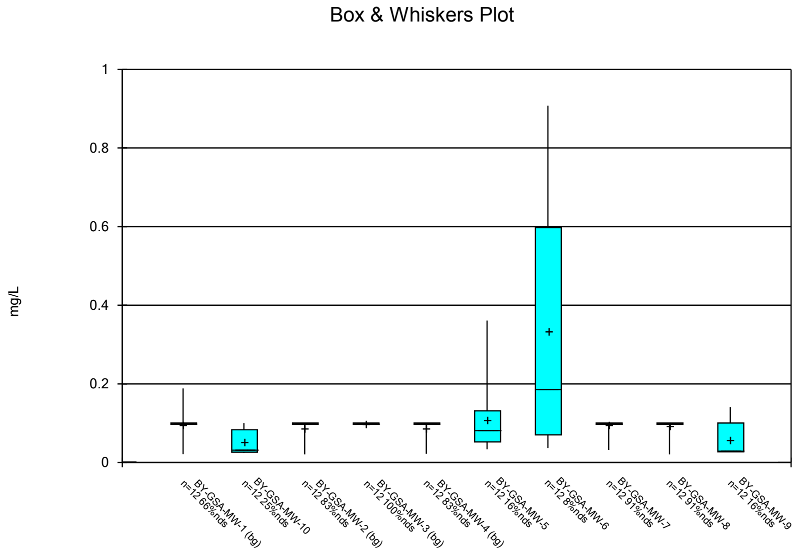
Constituent: TDS (mg/L)    Analysis Run 9/12/2019 1:11 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

| | BY-GSA-MW-5 | BY-GSA-MW-6 | BY-GSA-MW-7 | BY-GSA-MW-8 | BY-GSA-MW-9 |
|---|---|---|---|---|---|
| 2/23/2016 | 38 | 128 | <25 | 30 | 25.3 |
| 4/18/2016 | 62 | 166 | <25 | 27.3 | |
| 4/19/2016 | | | | | 28 |
| 6/6/2016 | | 131 | 32.7 | | |
| 6/7/2016 | 51.3 | | | 32 | 34.7 |
| 8/30/2016 | 38 | 86.7 | 25.3 | <25 | 26.7 |
| 10/18/2016 | 28.7 | 67.3 | 28 | 28 | 32 |
| 1/30/2017 | | | 45.3 | | 32.7 |
| 1/31/2017 | 34 | 60.7 | | 26 | |
| 5/2/2017 | 37.3 | 50 | 26.7 | 25.3 | 30.7 |
| 6/6/2017 | 36.7 | 47.3 | | | |
| 6/7/2017 | | | 28 | <25 | <25 |
| 9/12/2017 | | 42.7 | 35.3 | | |
| 9/13/2017 | 37.3 | | | 31.3 | 37.3 |
| 5/1/2018 | | 44 | 30.7 | | 39.3 |
| 5/2/2018 | 30.7 | | | 30.7 | |
| 11/26/2018 | | 38 | | | 48 |
| 11/27/2018 | <25 | | 30.7 | 35.3 | |
| 5/28/2019 | 26 | 77.3 | 32.7 | 28.7 | |
| 5/29/2019 | | | | | 60 |

# FIGURE B.

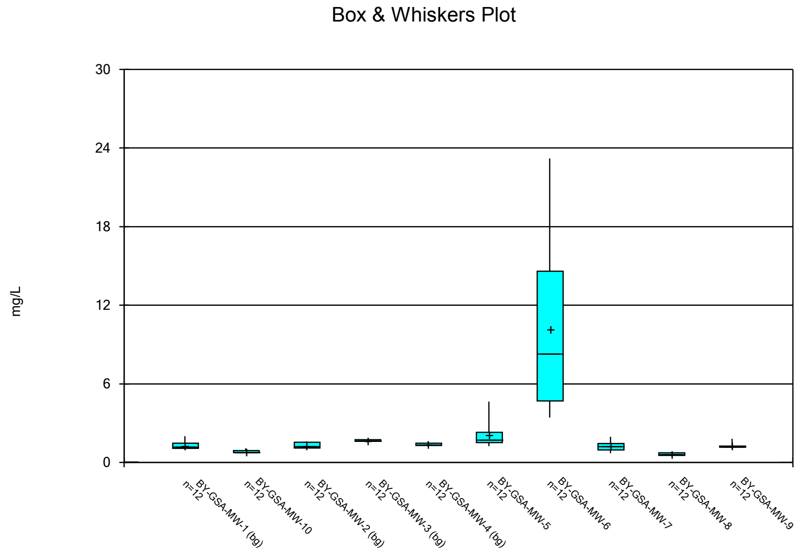
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Boron Analysis Run 9/12/2019 1:11 PM

Plant Barry Client: Southern Company Data: Barry GSA

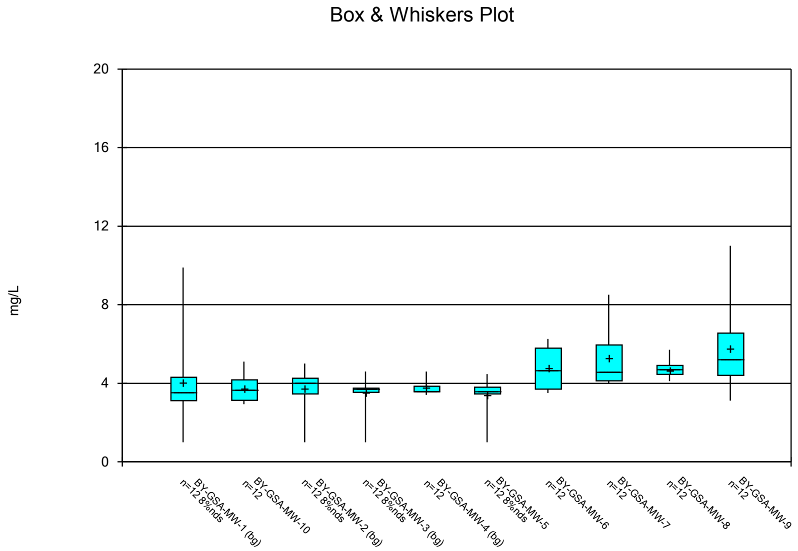
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Calcium Analysis Run 9/12/2019 1:11 PM

Plant Barry Client: Southern Company Data: Barry GSA

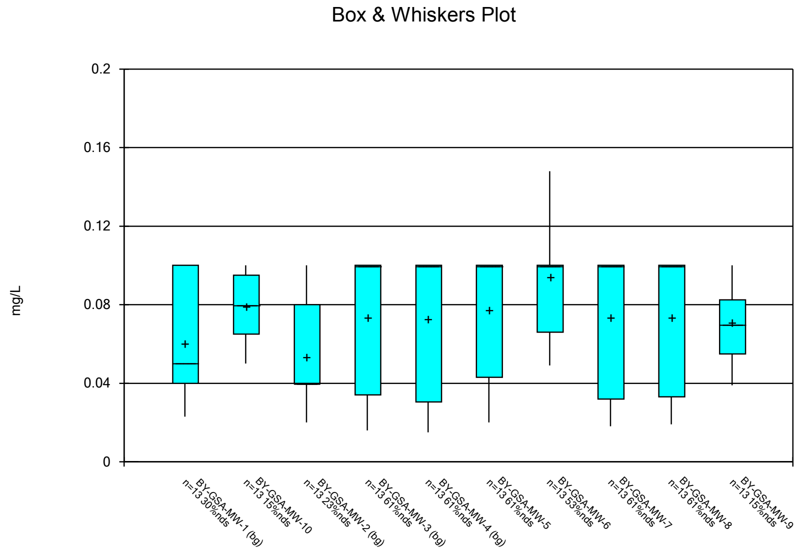
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Chloride Analysis Run 9/12/2019 1:11 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

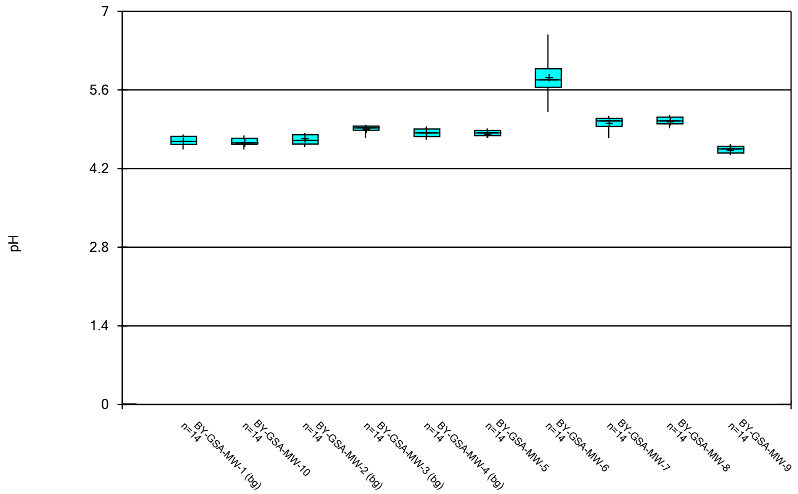


Constituent: Fluoride Analysis Run 9/12/2019 1:11 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

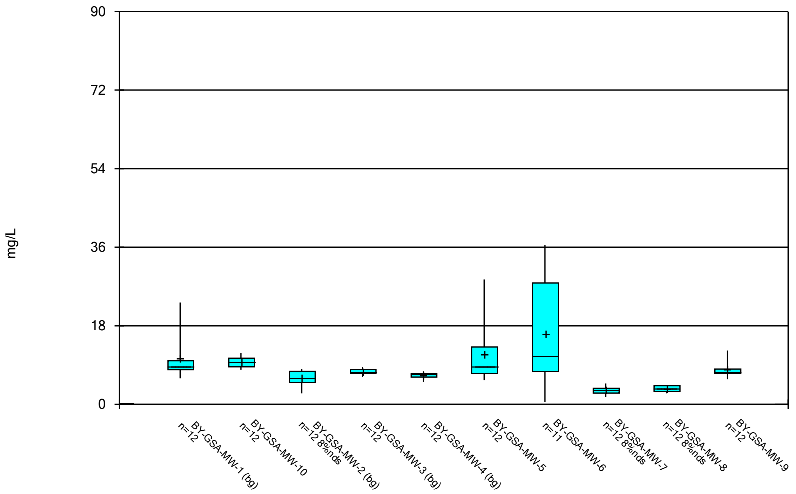


Constituent: pH    Analysis Run 9/12/2019 1:11 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

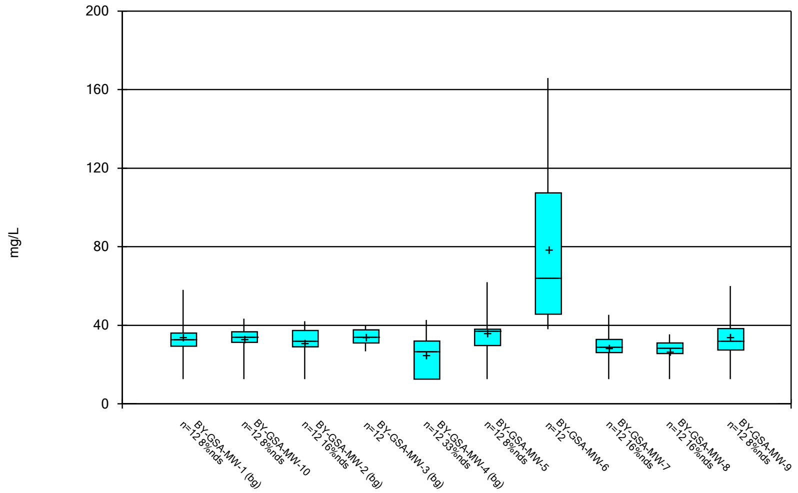


Constituent: Sulfate    Analysis Run 9/12/2019 1:12 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: TDS    Analysis Run 9/12/2019 1:12 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

# FIGURE C.

# Outlier Summary

Plant Barry Client: Southern Company Data: Barry GSA Printed 9/12/2019, 1:10 PM

|  | BY-GSA-MW-6 Sulfate (mg/L) |
|---|---|
| 4/18/2016 | 80.2 (o) |

# Outlier Analysis - Significant Results

Plant Barry Client: Southern Company Data: Barry GSA Printed 9/12/2019, 1:17 PM

| Constituent | Well | Outlier | Value(s) | Date(s) | Method | Alpha | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Calcium (mg/L)** | **BY-GSA-MW-9** | **Yes** | **1.61,1.8** | **11/26/2018,5/29/2019** | **NP** | **NaN** | **12** | **1.268** | **0.2162** | **ln(x)** | **ShapiroWilk** |
| **Chloride (mg/L)** | **BY-GSA-MW-1 (bg)** | **Yes** | **9.9** | **5/2/2018** | **NP** | **NaN** | **12** | **4.049** | **2.131** | **x^(1/3)** | **ShapiroWilk** |
| **Chloride (mg/L)** | **BY-GSA-MW-3 (bg)** | **Yes** | **4.6,1** | **5/2/2017,9/13/2017** | **NP** | **NaN** | **12** | **3.534** | **0.8571** | **x^3** | **ShapiroWilk** |
| **Sulfate (mg/L)** | **BY-GSA-MW-1 (bg)** | **Yes** | **22,23.3** | **11/27/2018,5/29/2019** | **NP** | **NaN** | **12** | **10.63** | **5.741** | **ln(x)** | **ShapiroWilk** |
| **Sulfate (mg/L)** | **BY-GSA-MW-9** | **Yes** | **12.3** | **5/29/2019** | **NP** | **NaN** | **12** | **7.894** | **1.622** | **ln(x)** | **ShapiroWilk** |
| **TDS (mg/L)** | **BY-GSA-MW-1 (bg)** | **Yes** | **12.5** | **4/19/2016** | **NP** | **NaN** | **12** | **34.21** | **11.43** | **sqrt(x)** | **ShapiroWilk** |

# Outlier Analysis - All Results

Plant Barry Client: Southern Company Data: Barry GSA Printed 9/12/2019, 1:17 PM

| Constituent | Well | Outlier | Value(s) | Date(s) | Method | Alpha | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Boron (mg/L) | BY-GSA-MW-1 (bg) | n/a | n/a | n/a | NP | NaN | 12 | 0.09628 | 0.0404 | unknown | ShapiroWilk |
| Boron (mg/L) | BY-GSA-MW-10 | No | n/a | n/a | NP | NaN | 12 | 0.05023 | 0.03211 | ln(x) | ShapiroWilk |
| Boron (mg/L) | BY-GSA-MW-2 (bg) | n/a | n/a | n/a | NP | NaN | 12 | 0.08712 | 0.03011 | unknown | ShapiroWilk |
| Boron (mg/L) | BY-GSA-MW-3 (bg) | n/a | n/a | n/a | NP | NaN | 12 | 0.1 | 0 | unknown | ShapiroWilk |
| Boron (mg/L) | BY-GSA-MW-4 (bg) | n/a | n/a | n/a | NP | NaN | 12 | 0.08731 | 0.02965 | unknown | ShapiroWilk |
| Boron (mg/L) | BY-GSA-MW-5 | No | n/a | n/a | NP | NaN | 12 | 0.1094 | 0.09026 | ln(x) | ShapiroWilk |
| Boron (mg/L) | BY-GSA-MW-6 | No | n/a | n/a | NP | NaN | 12 | 0.3317 | 0.3102 | ln(x) | ShapiroWilk |
| Boron (mg/L) | BY-GSA-MW-7 | n/a | n/a | n/a | NP | NaN | 12 | 0.09428 | 0.0198 | unknown | ShapiroWilk |
| Boron (mg/L) | BY-GSA-MW-8 | n/a | n/a | n/a | NP | NaN | 12 | 0.09339 | 0.02289 | unknown | ShapiroWilk |
| Boron (mg/L) | BY-GSA-MW-9 | No | n/a | n/a | NP | NaN | 12 | 0.05892 | 0.04673 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | BY-GSA-MW-1 (bg) | No | n/a | n/a | NP | NaN | 12 | 1.306 | 0.3376 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | BY-GSA-MW-10 | No | n/a | n/a | NP | NaN | 12 | 0.8392 | 0.1173 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | BY-GSA-MW-2 (bg) | No | n/a | n/a | NP | NaN | 12 | 1.291 | 0.2167 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | BY-GSA-MW-3 (bg) | No | n/a | n/a | NP | NaN | 12 | 1.663 | 0.07958 | x^6 | ShapiroWilk |
| Calcium (mg/L) | BY-GSA-MW-4 (bg) | No | n/a | n/a | NP | NaN | 12 | 1.379 | 0.1176 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | BY-GSA-MW-5 | No | n/a | n/a | NP | NaN | 12 | 2.088 | 0.9595 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | BY-GSA-MW-6 | No | n/a | n/a | NP | NaN | 12 | 10.14 | 6.692 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | BY-GSA-MW-7 | No | n/a | n/a | NP | NaN | 12 | 1.226 | 0.3516 | sqrt(x) | ShapiroWilk |
| Calcium (mg/L) | BY-GSA-MW-8 | No | n/a | n/a | NP | NaN | 12 | 0.6134 | 0.1086 | ln(x) | ShapiroWilk |
| **Calcium (mg/L)** | **BY-GSA-MW-9** | **Yes** | **1.61,1.8** | **11/26/2018,5/29/2019** | **NP** | **NaN** | **12** | **1.268** | **0.2162** | **ln(x)** | **ShapiroWilk** |
| **Chloride (mg/L)** | **BY-GSA-MW-1 (bg)** | **Yes** | **9.9** | **5/2/2018** | **NP** | **NaN** | **12** | **4.049** | **2.131** | **x^(1/3)** | **ShapiroWilk** |
| Chloride (mg/L) | BY-GSA-MW-10 | No | n/a | n/a | NP | NaN | 12 | 3.697 | 0.6693 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | BY-GSA-MW-2 (bg) | No | n/a | n/a | NP | NaN | 12 | 3.725 | 1.009 | x^3 | ShapiroWilk |
| **Chloride (mg/L)** | **BY-GSA-MW-3 (bg)** | **Yes** | **4.6,1** | **5/2/2017,9/13/2017** | **NP** | **NaN** | **12** | **3.534** | **0.8571** | **x^3** | **ShapiroWilk** |
| Chloride (mg/L) | BY-GSA-MW-4 (bg) | No | n/a | n/a | NP | NaN | 12 | 3.763 | 0.3521 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | BY-GSA-MW-5 | No | n/a | n/a | NP | NaN | 12 | 3.421 | 0.8539 | x^3 | ShapiroWilk |
| Chloride (mg/L) | BY-GSA-MW-6 | No | n/a | n/a | NP | NaN | 12 | 4.781 | 1.063 | sqrt(x) | ShapiroWilk |
| Chloride (mg/L) | BY-GSA-MW-7 | No | n/a | n/a | NP | NaN | 12 | 5.277 | 1.615 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | BY-GSA-MW-8 | No | n/a | n/a | NP | NaN | 12 | 4.683 | 0.4261 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | BY-GSA-MW-9 | No | n/a | n/a | NP | NaN | 12 | 5.775 | 2.196 | ln(x) | ShapiroWilk |
| Fluoride (mg/L) | BY-GSA-MW-1 (bg) | No | n/a | n/a | NP | NaN | 13 | 0.06002 | 0.02936 | ln(x) | ShapiroWilk |
| Fluoride (mg/L) | BY-GSA-MW-10 | No | n/a | n/a | NP | NaN | 13 | 0.07915 | 0.01789 | x^3 | ShapiroWilk |
| Fluoride (mg/L) | BY-GSA-MW-2 (bg) | No | n/a | n/a | NP | NaN | 13 | 0.05338 | 0.02849 | ln(x) | ShapiroWilk |
| Fluoride (mg/L) | BY-GSA-MW-3 (bg) | No | n/a | n/a | NP | NaN | 13 | 0.07354 | 0.03583 | ln(x) | ShapiroWilk |
| Fluoride (mg/L) | BY-GSA-MW-4 (bg) | No | n/a | n/a | NP | NaN | 13 | 0.07277 | 0.03675 | ln(x) | ShapiroWilk |
| Fluoride (mg/L) | BY-GSA-MW-5 | No | n/a | n/a | NP | NaN | 13 | 0.07738 | 0.03133 | x^(1/3) | ShapiroWilk |
| Fluoride (mg/L) | BY-GSA-MW-6 | No | n/a | n/a | NP | NaN | 13 | 0.09432 | 0.02885 | sqrt(x) | ShapiroWilk |
| Fluoride (mg/L) | BY-GSA-MW-7 | No | n/a | n/a | NP | NaN | 13 | 0.07331 | 0.03607 | ln(x) | ShapiroWilk |
| Fluoride (mg/L) | BY-GSA-MW-8 | No | n/a | n/a | NP | NaN | 13 | 0.07369 | 0.03559 | ln(x) | ShapiroWilk |
| Fluoride (mg/L) | BY-GSA-MW-9 | No | n/a | n/a | NP | NaN | 13 | 0.071 | 0.01834 | normal | ShapiroWilk |
| pH (pH) | BY-GSA-MW-1 (bg) | No | n/a | n/a | NP | NaN | 14 | 4.696 | 0.08025 | x^6 | ShapiroWilk |
| pH (pH) | BY-GSA-MW-10 | No | n/a | n/a | NP | NaN | 14 | 4.679 | 0.06708 | x^6 | ShapiroWilk |
| pH (pH) | BY-GSA-MW-2 (bg) | No | n/a | n/a | NP | NaN | 14 | 4.726 | 0.08689 | x^6 | ShapiroWilk |
| pH (pH) | BY-GSA-MW-3 (bg) | No | n/a | n/a | NP | NaN | 14 | 4.912 | 0.0683 | x^6 | ShapiroWilk |
| pH (pH) | BY-GSA-MW-4 (bg) | No | n/a | n/a | NP | NaN | 14 | 4.842 | 0.07516 | x^6 | ShapiroWilk |
| pH (pH) | BY-GSA-MW-5 | No | n/a | n/a | NP | NaN | 14 | 4.834 | 0.05286 | x^6 | ShapiroWilk |
| pH (pH) | BY-GSA-MW-6 | No | n/a | n/a | NP | NaN | 14 | 5.839 | 0.3192 | ln(x) | ShapiroWilk |
| pH (pH) | BY-GSA-MW-7 | No | n/a | n/a | NP | NaN | 14 | 5.016 | 0.1159 | x^6 | ShapiroWilk |
| pH (pH) | BY-GSA-MW-8 | No | n/a | n/a | NP | NaN | 14 | 5.052 | 0.07454 | x^6 | ShapiroWilk |
| pH (pH) | BY-GSA-MW-9 | No | n/a | n/a | NP | NaN | 14 | 4.549 | 0.0665 | x^6 | ShapiroWilk |
| **Sulfate (mg/L)** | **BY-GSA-MW-1 (bg)** | **Yes** | **22,23.3** | **11/27/2018,5/29/2019** | **NP** | **NaN** | **12** | **10.63** | **5.741** | **ln(x)** | **ShapiroWilk** |
| Sulfate (mg/L) | BY-GSA-MW-10 | No | n/a | n/a | NP | NaN | 12 | 9.618 | 1.229 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | BY-GSA-MW-2 (bg) | No | n/a | n/a | NP | NaN | 12 | 6.037 | 1.744 | x^2 | ShapiroWilk |
| Sulfate (mg/L) | BY-GSA-MW-3 (bg) | No | n/a | n/a | NP | NaN | 12 | 7.456 | 0.6976 | normal | ShapiroWilk |
| Sulfate (mg/L) | BY-GSA-MW-4 (bg) | No | n/a | n/a | NP | NaN | 12 | 6.626 | 0.7293 | x^6 | ShapiroWilk |

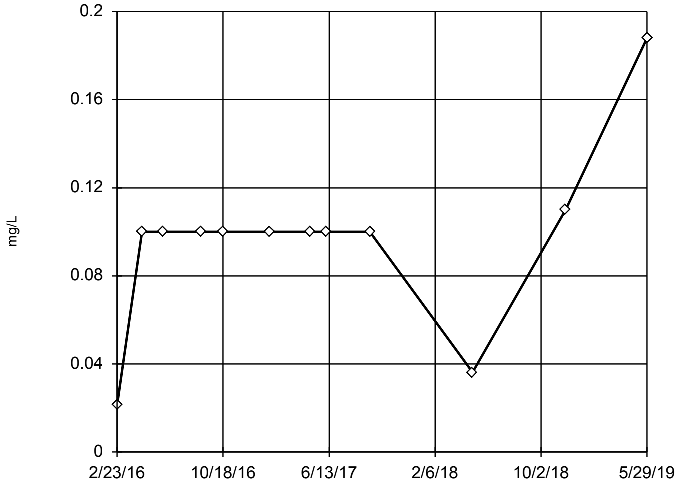
# Outlier Analysis - All Results

Plant Barry     Client: Southern Company     Data: Barry GSA     Printed 9/12/2019, 1:17 PM

| Constituent | Well | Outlier | Value(s) | Date(s) | Method | Alpha | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sulfate (mg/L) | BY-GSA-MW-5 | No | n/a | n/a | NP | NaN | 12 | 11.38 | 6.65 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | BY-GSA-MW-6 | No | n/a | n/a | NP | NaN | 12 | 21.63 | 21.59 | x^(1/3) | ShapiroWilk |
| Sulfate (mg/L) | BY-GSA-MW-7 | No | n/a | n/a | NP | NaN | 12 | 3.167 | 0.8144 | normal | ShapiroWilk |
| Sulfate (mg/L) | BY-GSA-MW-8 | No | n/a | n/a | NP | NaN | 12 | 3.523 | 0.7232 | ln(x) | ShapiroWilk |
| **Sulfate (mg/L)** | **BY-GSA-MW-9** | **Yes** | **12.3** | **5/29/2019** | **NP** | **NaN** | **12** | **7.894** | **1.622** | **ln(x)** | **ShapiroWilk** |
| **TDS (mg/L)** | **BY-GSA-MW-1 (bg)** | **Yes** | **12.5** | **4/19/2016** | **NP** | **NaN** | **12** | **34.21** | **11.43** | **sqrt(x)** | **ShapiroWilk** |
| TDS (mg/L) | BY-GSA-MW-10 | No | n/a | n/a | NP | NaN | 12 | 32.92 | 7.471 | x^3 | ShapiroWilk |
| TDS (mg/L) | BY-GSA-MW-2 (bg) | No | n/a | n/a | NP | NaN | 12 | 30.75 | 9.552 | x^3 | ShapiroWilk |
| TDS (mg/L) | BY-GSA-MW-3 (bg) | No | n/a | n/a | NP | NaN | 12 | 34.06 | 4.088 | x^2 | ShapiroWilk |
| TDS (mg/L) | BY-GSA-MW-4 (bg) | No | n/a | n/a | NP | NaN | 12 | 24.84 | 10.22 | x^2 | ShapiroWilk |
| TDS (mg/L) | BY-GSA-MW-5 | No | n/a | n/a | NP | NaN | 12 | 36.04 | 12.28 | normal | ShapiroWilk |
| TDS (mg/L) | BY-GSA-MW-6 | No | n/a | n/a | NP | NaN | 12 | 78.25 | 41.86 | ln(x) | ShapiroWilk |
| TDS (mg/L) | BY-GSA-MW-7 | No | n/a | n/a | NP | NaN | 12 | 28.37 | 9.041 | x^2 | ShapiroWilk |
| TDS (mg/L) | BY-GSA-MW-8 | No | n/a | n/a | NP | NaN | 12 | 26.63 | 7.147 | x^4 | ShapiroWilk |
| TDS (mg/L) | BY-GSA-MW-9 | No | n/a | n/a | NP | NaN | 12 | 33.93 | 11.89 | sqrt(x) | ShapiroWilk |

## Tukey's Outlier Screening

BY-GSA-MW-1 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Boron    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

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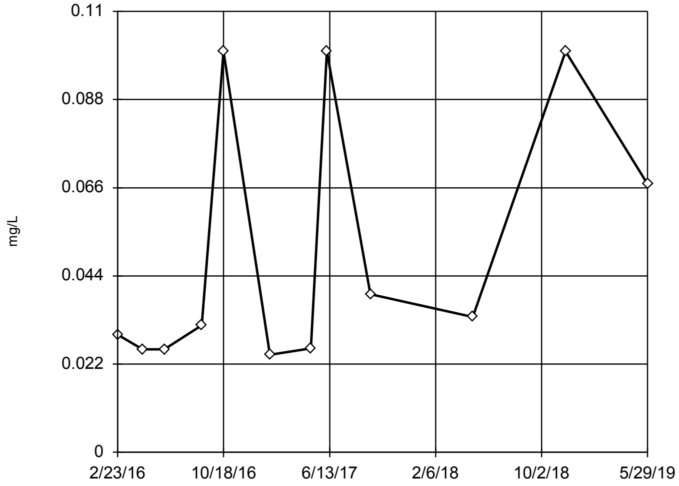
## Tukey's Outlier Screening

BY-GSA-MW-10



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2.606, low cutoff = 0.0008097, based on IQR multiplier of 3.

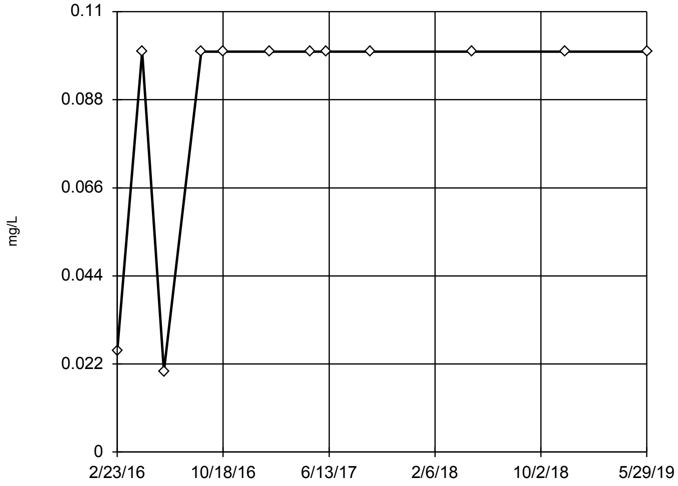
Constituent: Boron    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

---

## Tukey's Outlier Screening

BY-GSA-MW-2 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Boron    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

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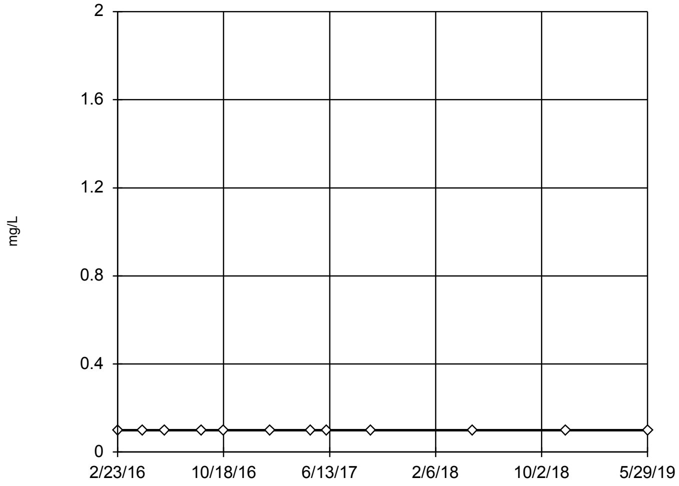
## Tukey's Outlier Screening

BY-GSA-MW-3 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

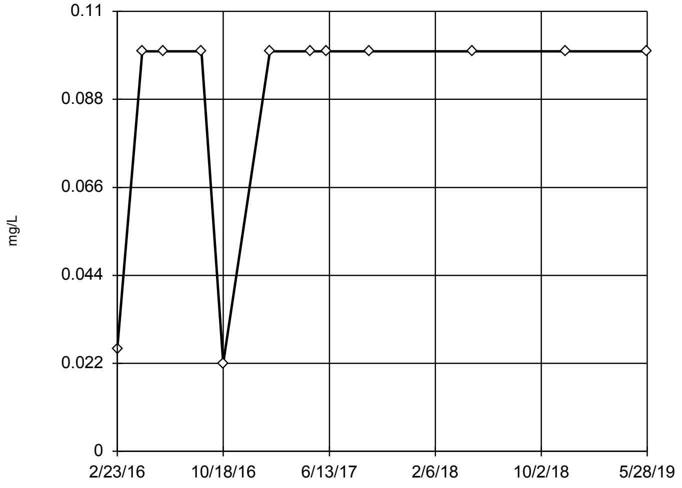
Constituent: Boron    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### BY-GSA-MW-4 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Boron    Analysis Run 9/12/2019 1:15 PM

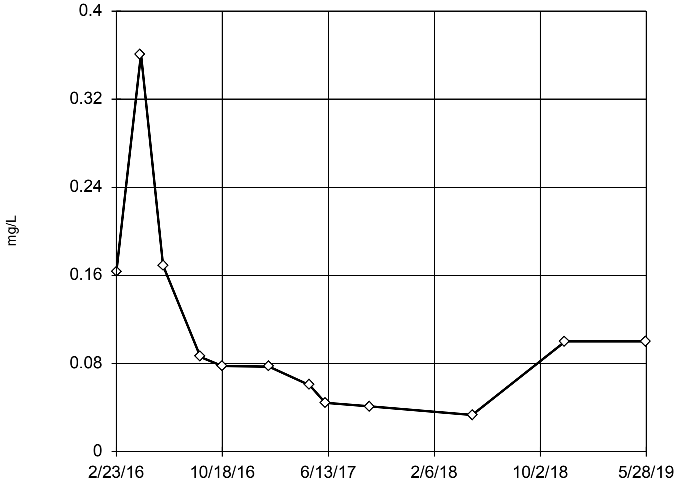
Plant Barry    Client: Southern Company    Data: Barry GSA

---

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### BY-GSA-MW-5



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.936, low cutoff = 0.003402, based on IQR multiplier of 3.

Constituent: Boron    Analysis Run 9/12/2019 1:15 PM

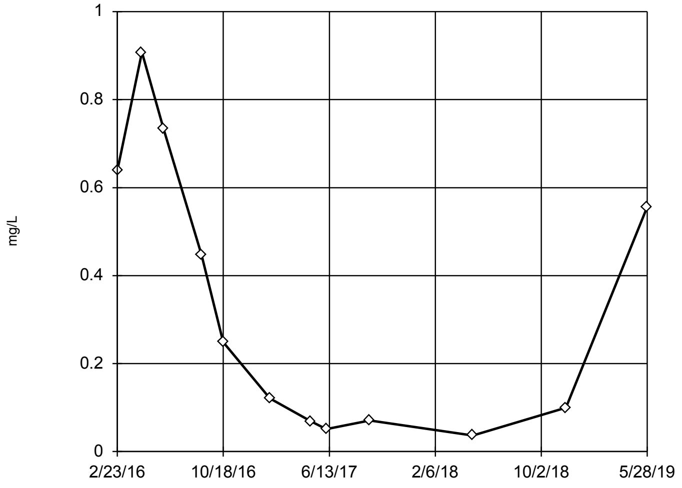
Plant Barry    Client: Southern Company    Data: Barry GSA

---

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### BY-GSA-MW-6



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 363.8, low cutoff = 0.0001149, based on IQR multiplier of 3.

Constituent: Boron    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

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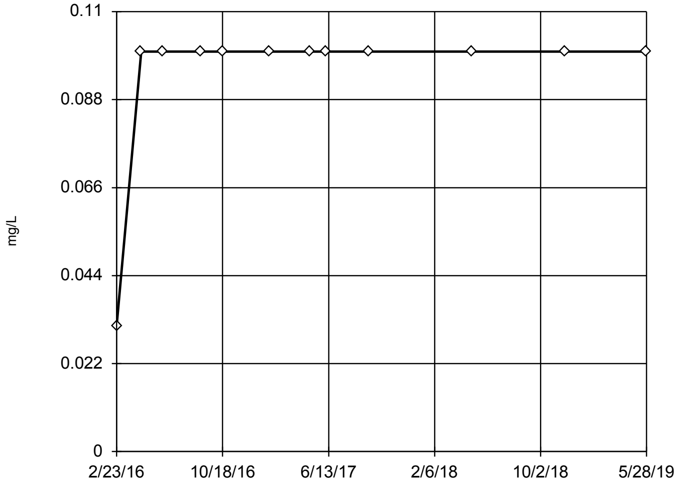
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### BY-GSA-MW-7



n = 12

No outliers found. Tukey's method selected by user.

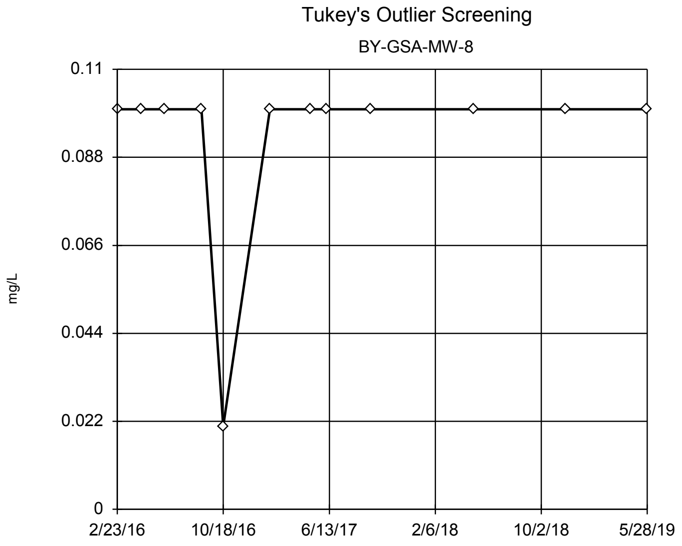
Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Boron    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

No outliers found. Tukey's method selected by user.

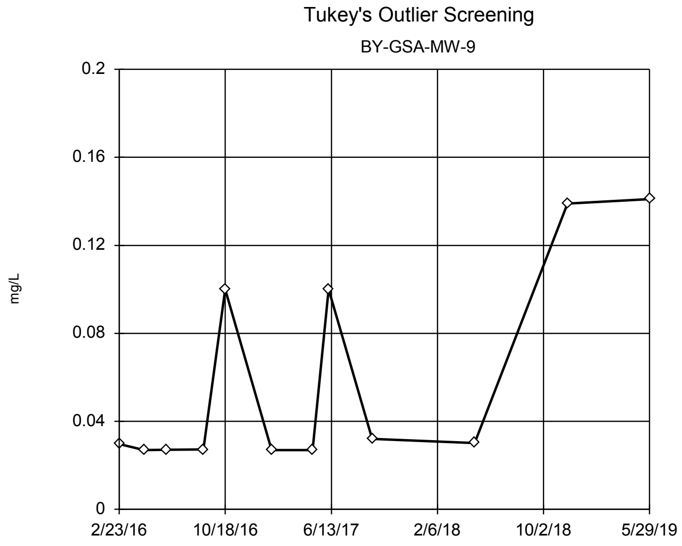
Ladder of Powers transformations did not improve normality; analysis run on raw data.

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Boron Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

No outliers found. Tukey's method selected by user.

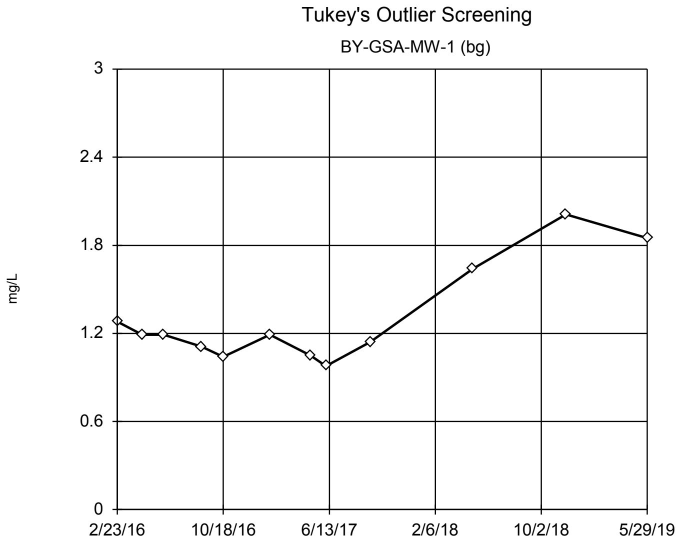
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.052, low cutoff = 0.0005354, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

No outliers found. Tukey's method selected by user.

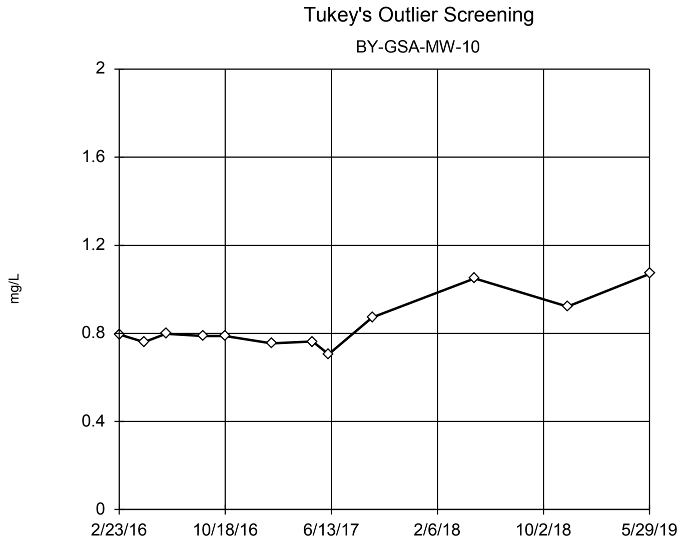
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3.502, low cutoff = 0.4466, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.464, low cutoff = 0.4669, based on IQR multiplier of 3.

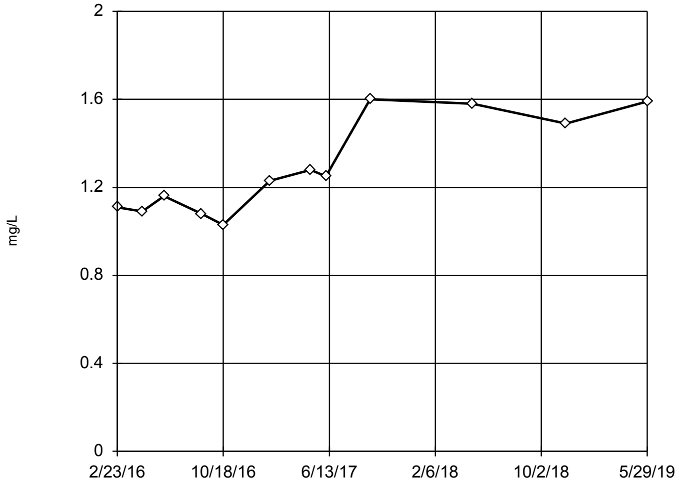
Constituent: Calcium Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-2 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 4.164, low cutoff = 0.4053, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

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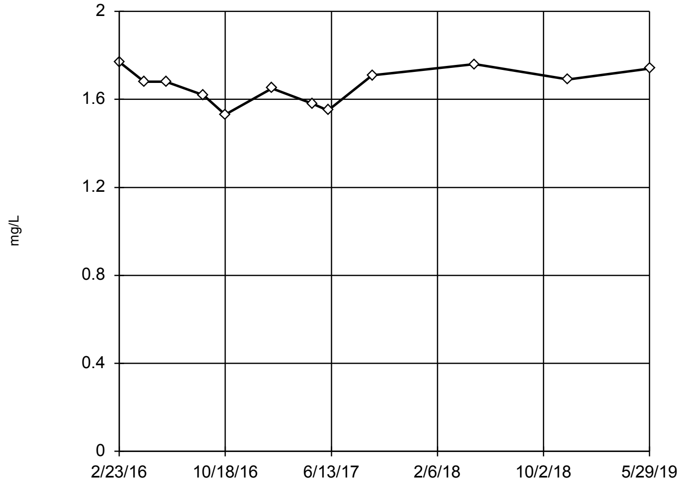
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-3 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.95, low cutoff = -1.51, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

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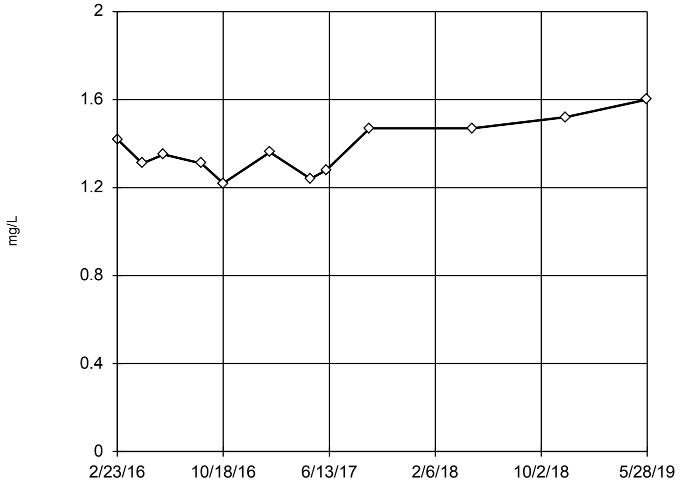
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-4 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2.151, low cutoff = 0.8851, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

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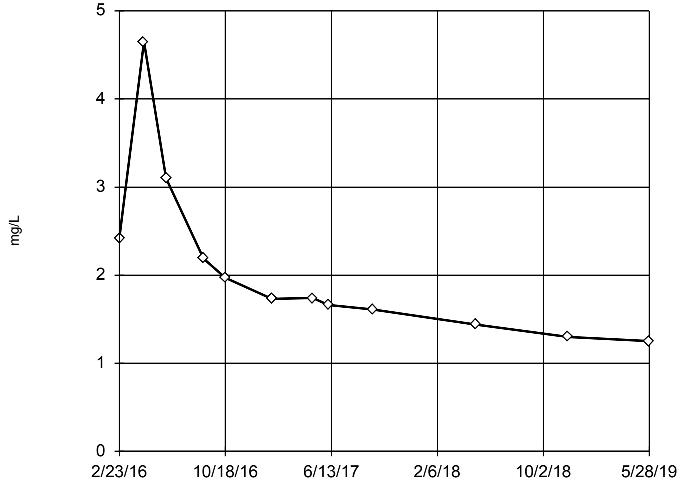
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-5



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 7.957, low cutoff = 0.4405, based on IQR multiplier of 3.

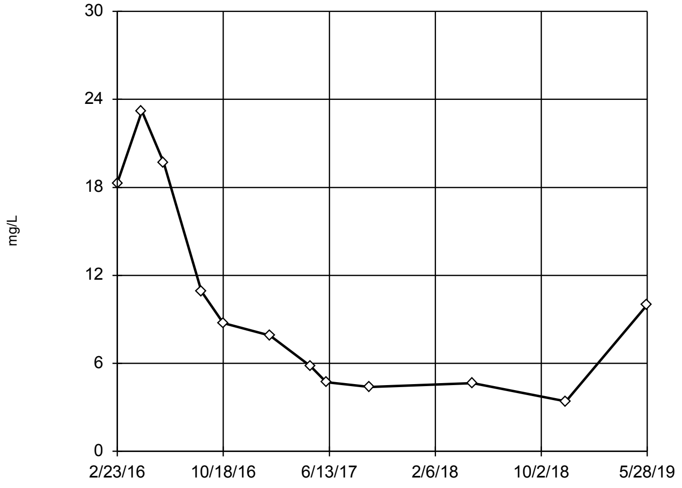
Constituent: Calcium Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-6



n = 12

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

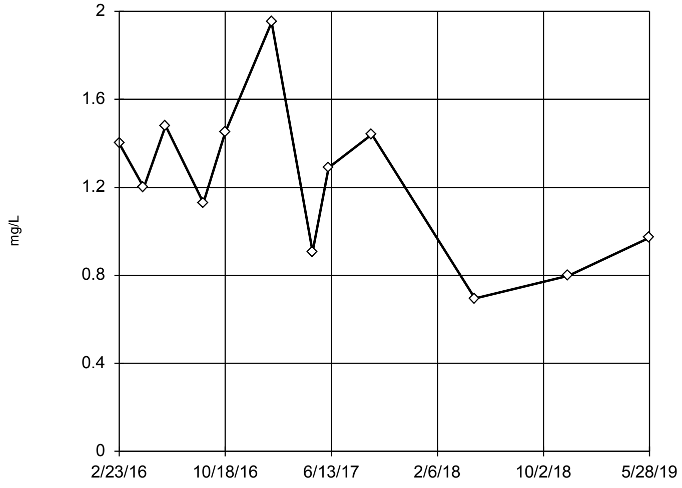
High cutoff = 385.7, low cutoff = 0.1717, based on IQR multiplier of 3.

Constituent: Calcium   Analysis Run 9/12/2019 1:15 PM
Plant Barry   Client: Southern Company   Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-7



n = 12

No outliers found.
Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

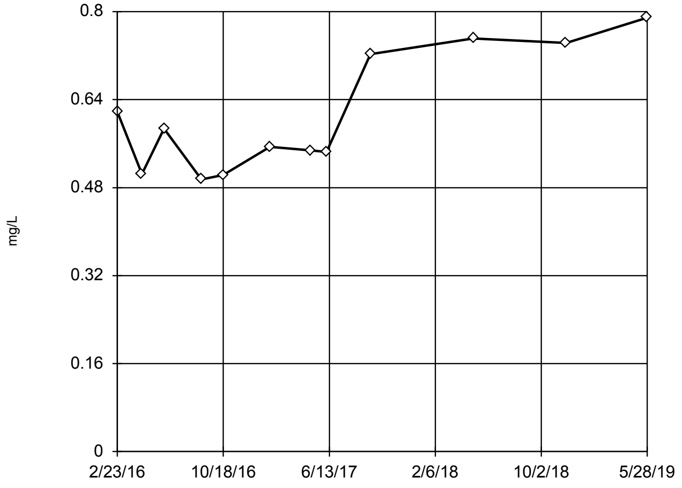
High cutoff = 3.611, low cutoff = 0.07363, based on IQR multiplier of 3.

Constituent: Calcium   Analysis Run 9/12/2019 1:15 PM
Plant Barry   Client: Southern Company   Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-8



n = 12

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

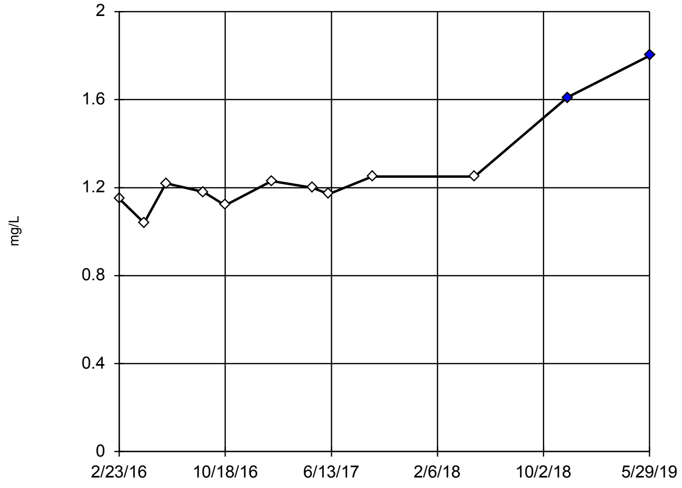
High cutoff = 1.999, low cutoff = 0.1924, based on IQR multiplier of 3.

Constituent: Calcium   Analysis Run 9/12/2019 1:15 PM
Plant Barry   Client: Southern Company   Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-9



n = 12

Outliers are drawn as solid.
Tukey's method selected by user.

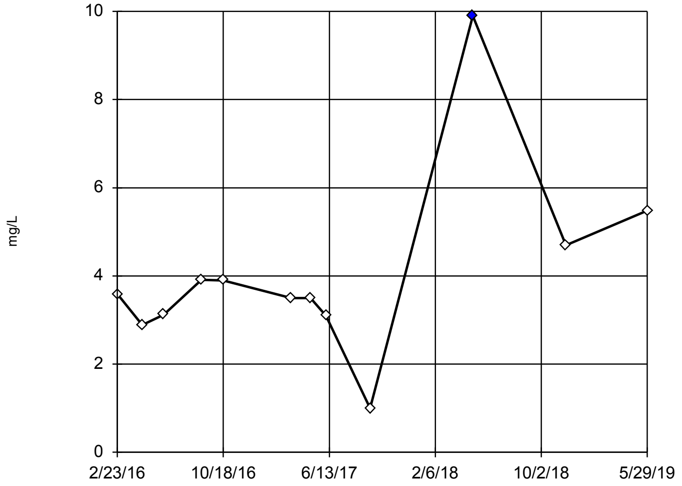
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.564, low cutoff = 0.9269, based on IQR multiplier of 3.

Constituent: Calcium   Analysis Run 9/12/2019 1:15 PM
Plant Barry   Client: Southern Company   Data: Barry GSA

## Tukey's Outlier Screening

BY-GSA-MW-1 (bg)



n = 12

Outlier is drawn as solid. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 9.555, low cutoff = 0.8929, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

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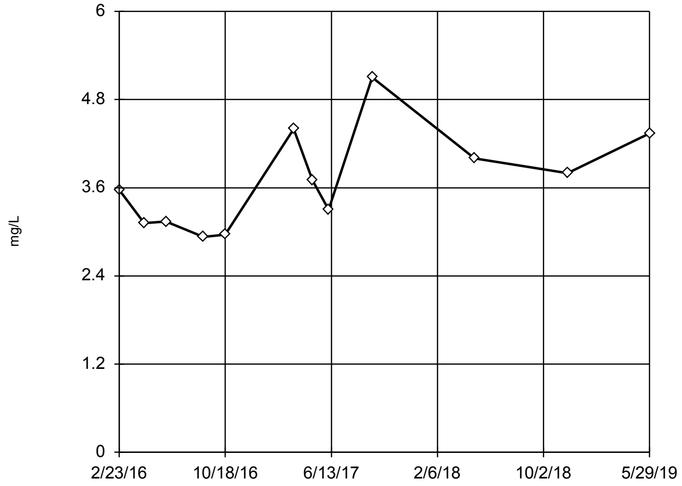
## Tukey's Outlier Screening

BY-GSA-MW-10



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 9.828, low cutoff = 1.327, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

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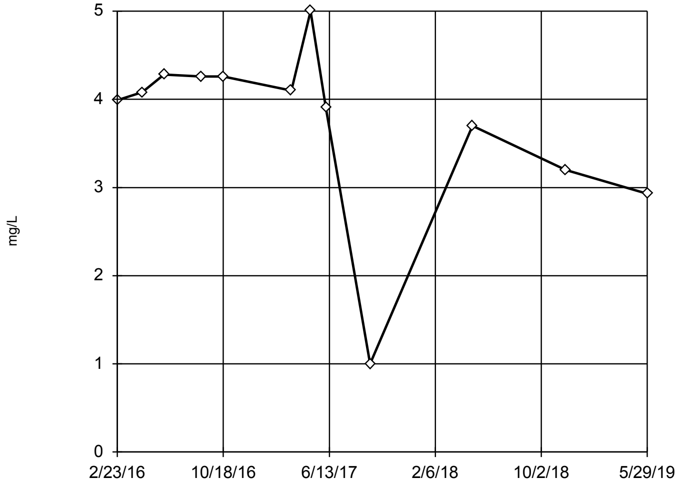
## Tukey's Outlier Screening

BY-GSA-MW-2 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.689, low cutoff = -4.022, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

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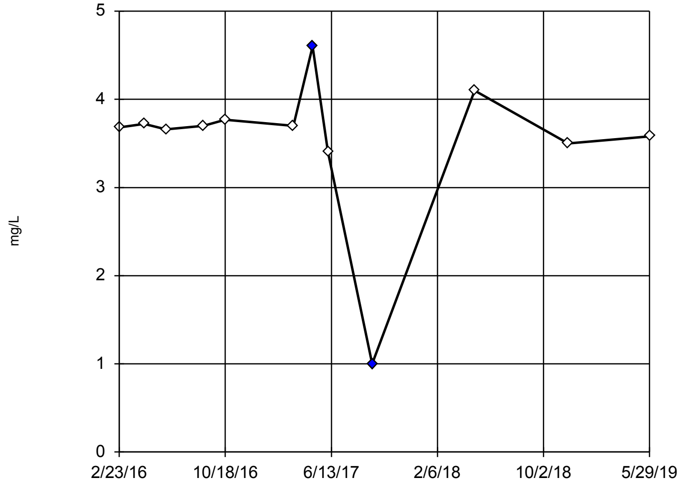
## Tukey's Outlier Screening

BY-GSA-MW-3 (bg)



n = 12

Outliers are drawn as solid. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 4.254, low cutoff = 2.711, based on IQR multiplier of 3.

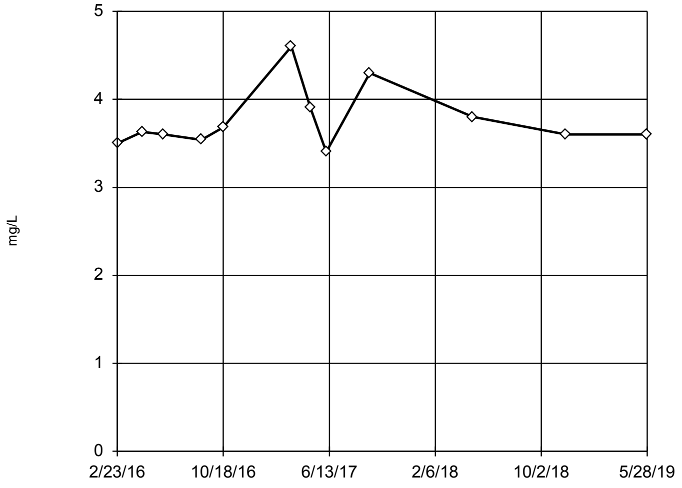
Constituent: Chloride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-4 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 4.828, low cutoff = 2.847, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

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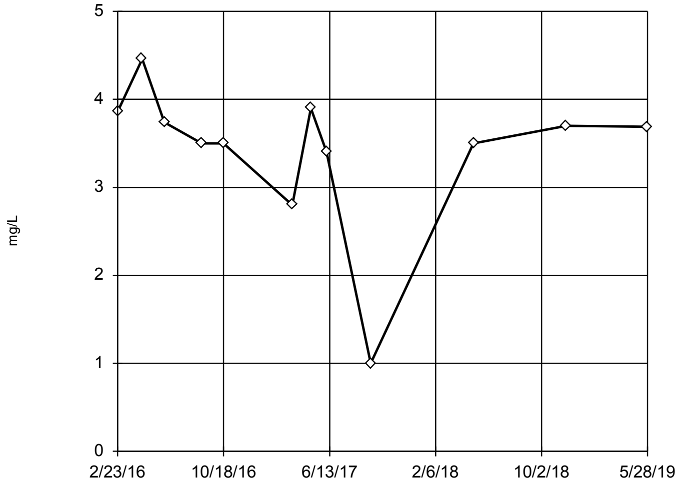
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-5



n = 12

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 4.585, low cutoff = -0.725, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

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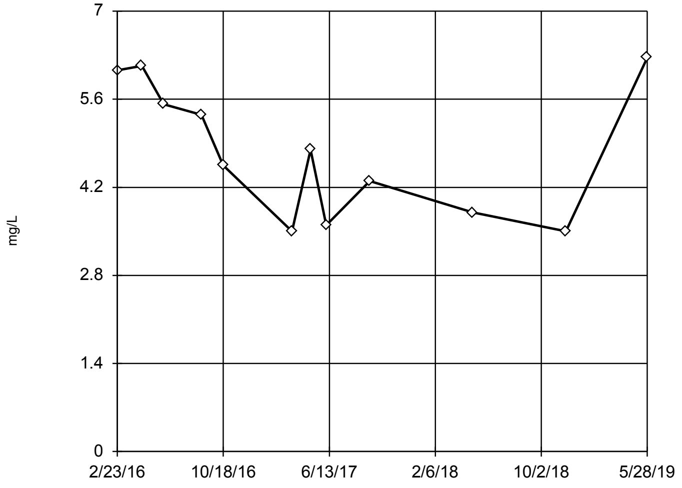
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-6



n = 12

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 14.84, low cutoff = 0.2272, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

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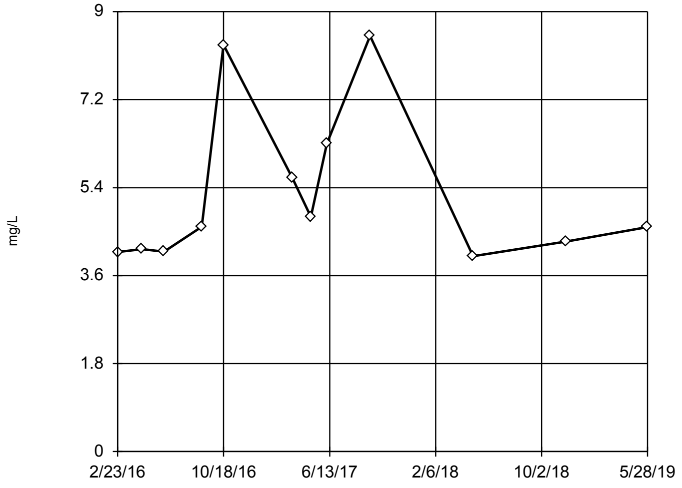
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-7



n = 12

No outliers found. Tukey's method selected by user.

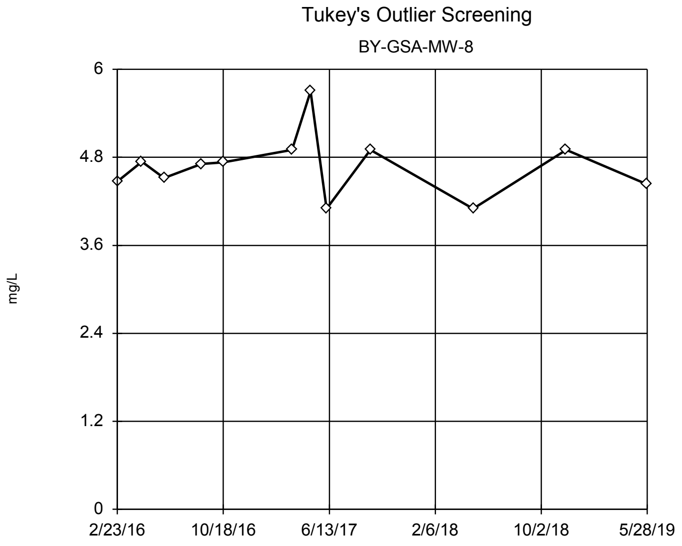
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 17.86, low cutoff = 1.368, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

No outliers found. Tukey's method selected by user.

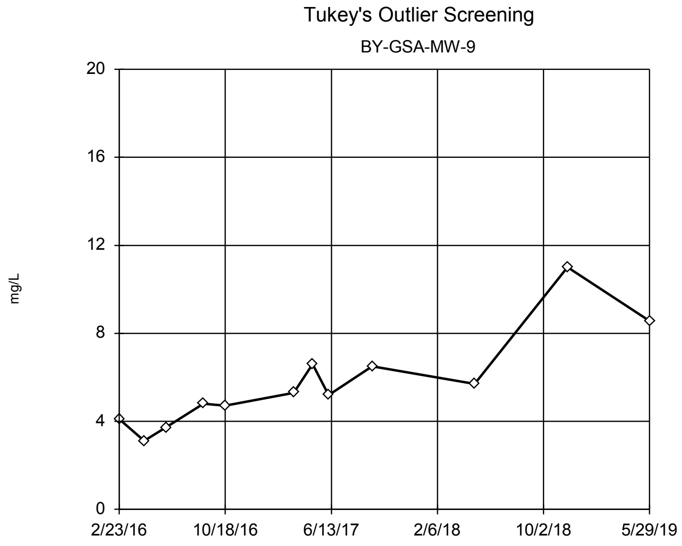
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 6.542, low cutoff = 3.333, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

No outliers found. Tukey's method selected by user.

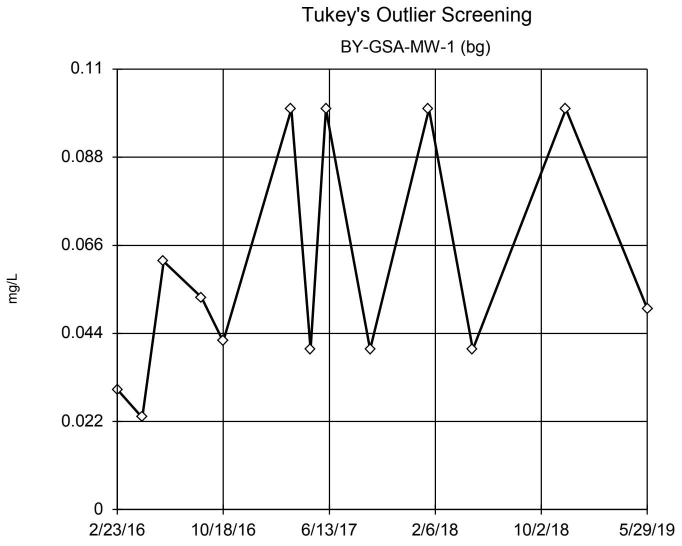
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 21.69, low cutoff = 1.327, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

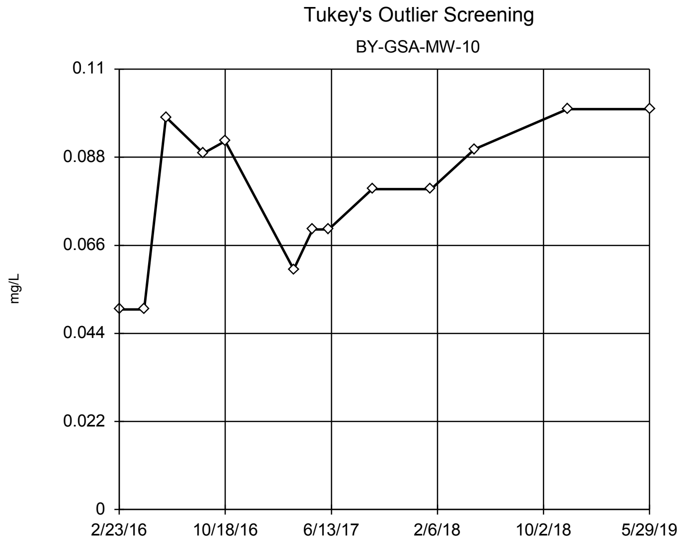
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.563, low cutoff = 0.00256, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

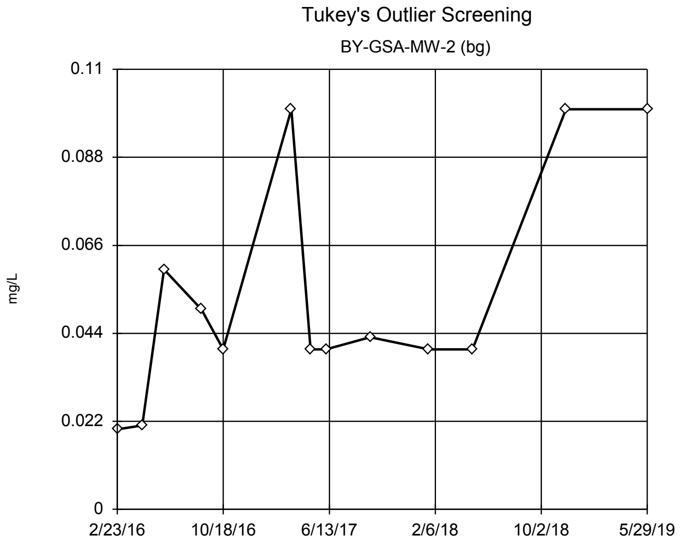
Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1375, low cutoff = -0.1135, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

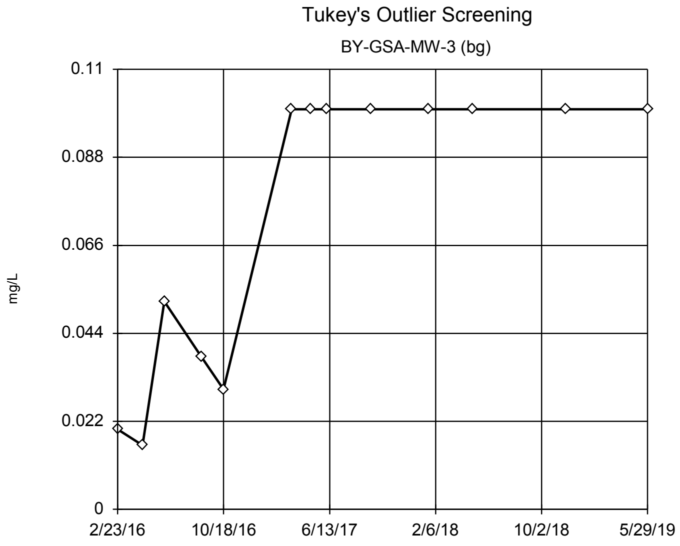
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.5625, low cutoff = 0.005508, based on IQR multiplier of 3.

Constituent: Fluoride    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

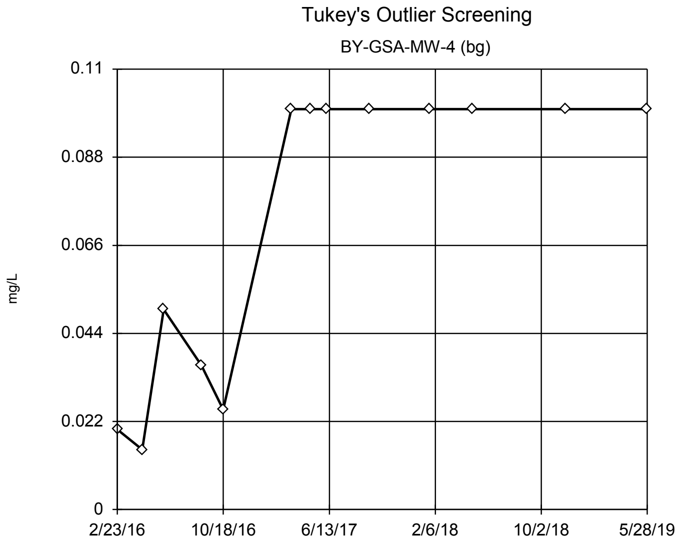
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2.598, low cutoff = 0.0013, based on IQR multiplier of 3.

Constituent: Fluoride    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

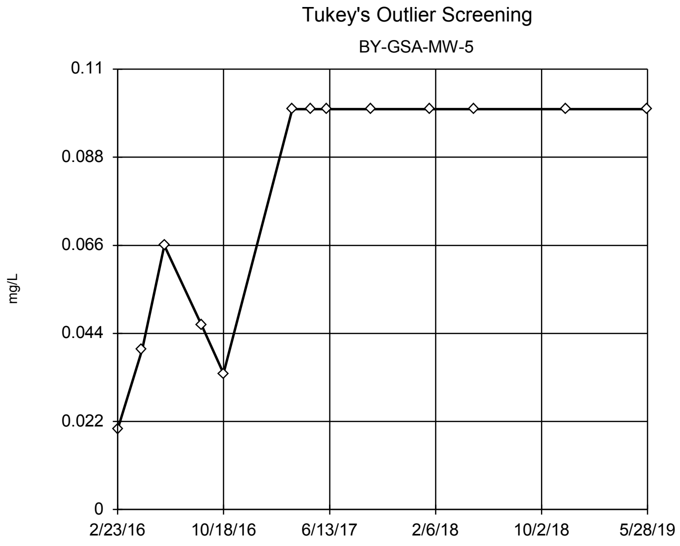
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3.704, low cutoff = 0.00081, based on IQR multiplier of 3.

Constituent: Fluoride    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

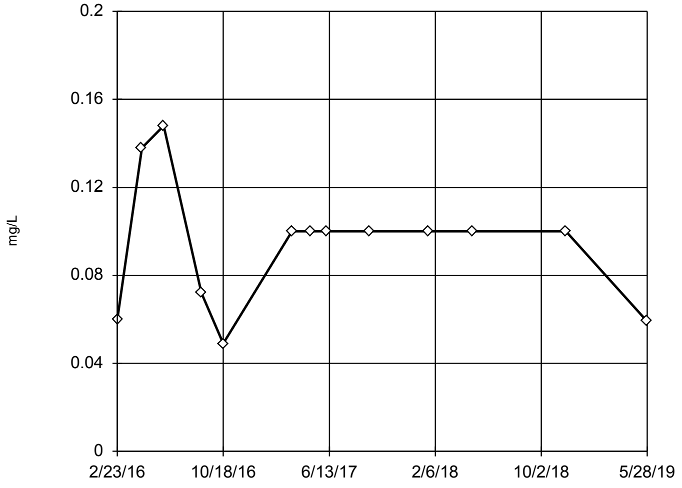
High cutoff = 0.524, low cutoff = 5.4e-7, based on IQR multiplier of 3.

Constituent: Fluoride    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

## Tukey's Outlier Screening

BY-GSA-MW-6



n = 13

No outliers found.
Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

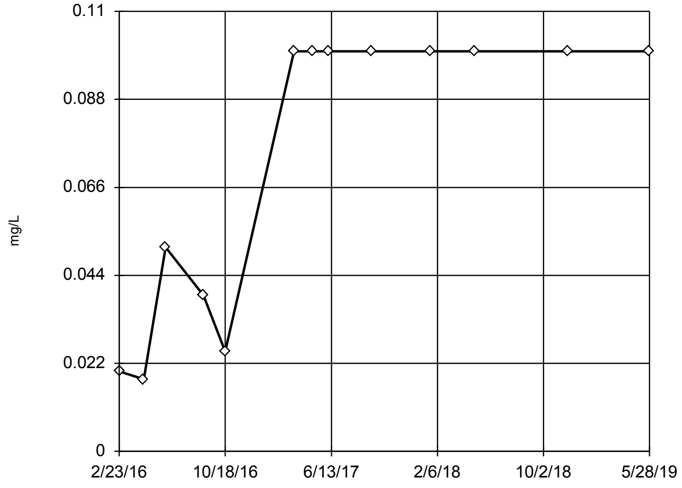
High cutoff = 0.245, low cutoff = 0.006064, based on IQR multiplier of 3.

Constituent: Fluoride    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

## Tukey's Outlier Screening

BY-GSA-MW-7



n = 13

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

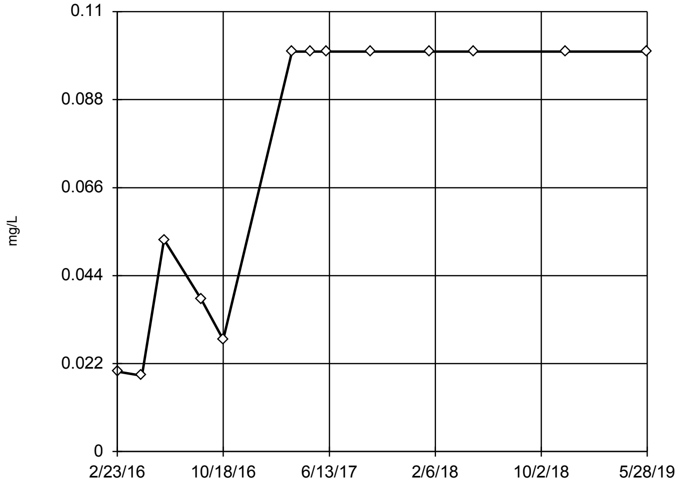
High cutoff = 3.285, low cutoff = 0.0009506, based on IQR multiplier of 3.

Constituent: Fluoride    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

## Tukey's Outlier Screening

BY-GSA-MW-8



n = 13

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

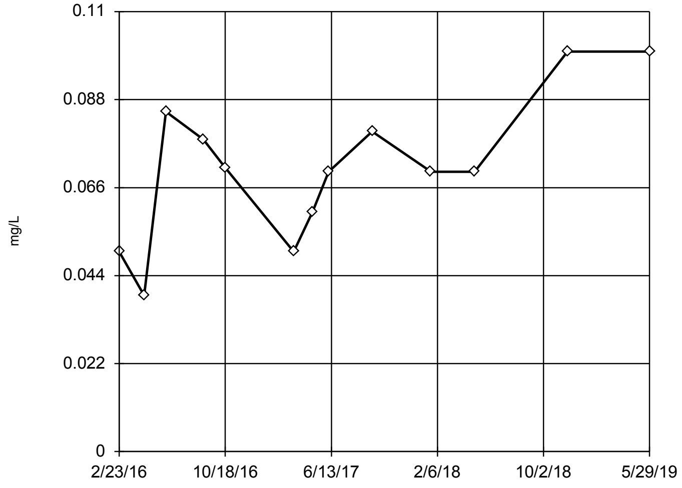
High cutoff = 2.881, low cutoff = 0.001132, based on IQR multiplier of 3.

Constituent: Fluoride    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

## Tukey's Outlier Screening

BY-GSA-MW-9



n = 13

No outliers found.
Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.165, low cutoff = -0.0275, based on IQR multiplier of 3.

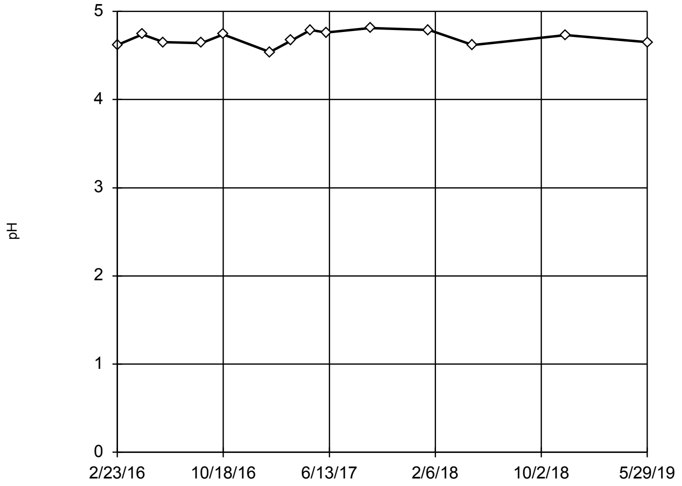
Constituent: Fluoride    Analysis Run 9/12/2019 1:15 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-1 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.113, low cutoff = 3.958, based on IQR multiplier of 3.

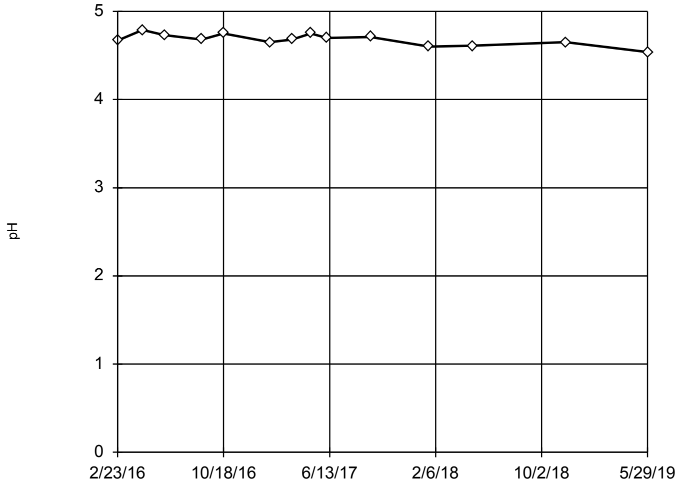
Constituent: pH Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-10



n = 14

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.01, low cutoff = 4.187, based on IQR multiplier of 3.

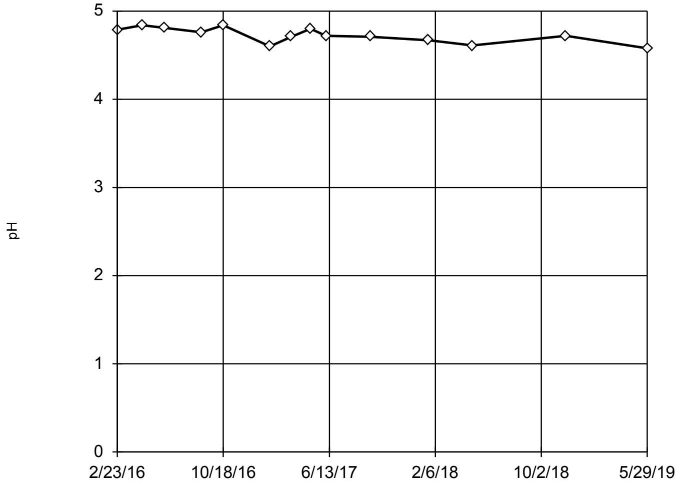
Constituent: pH Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-2 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.178, low cutoff = 3.802, based on IQR multiplier of 3.

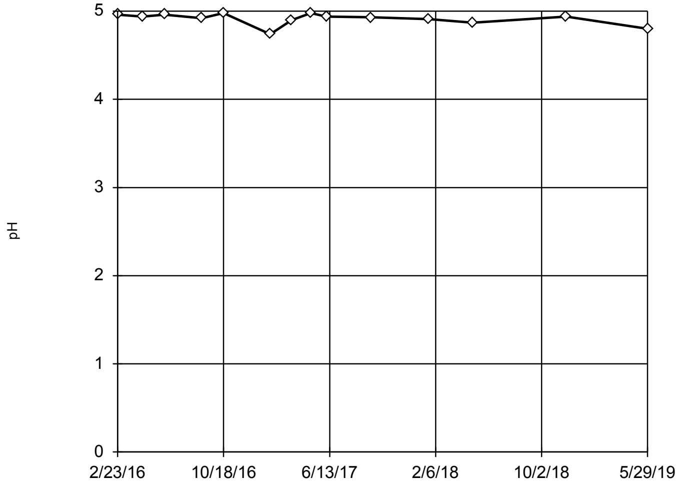
Constituent: pH Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-3 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.156, low cutoff = 4.618, based on IQR multiplier of 3.

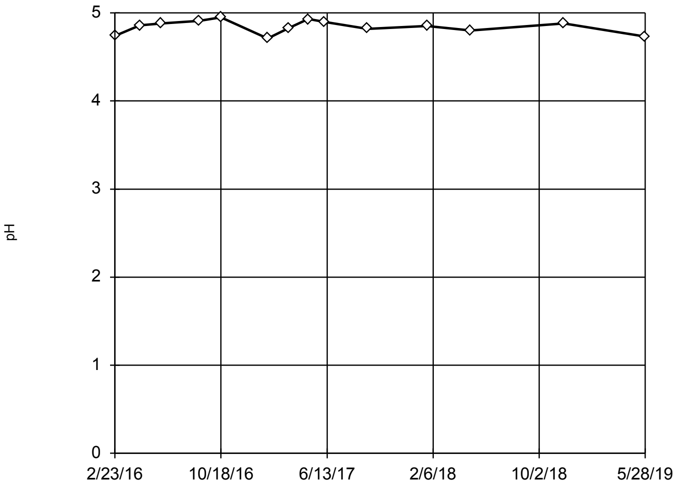
Constituent: pH Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-4 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.225, low cutoff = 4.184, based on IQR multiplier of 3.

Constituent: pH Analysis Run 9/12/2019 1:15 PM

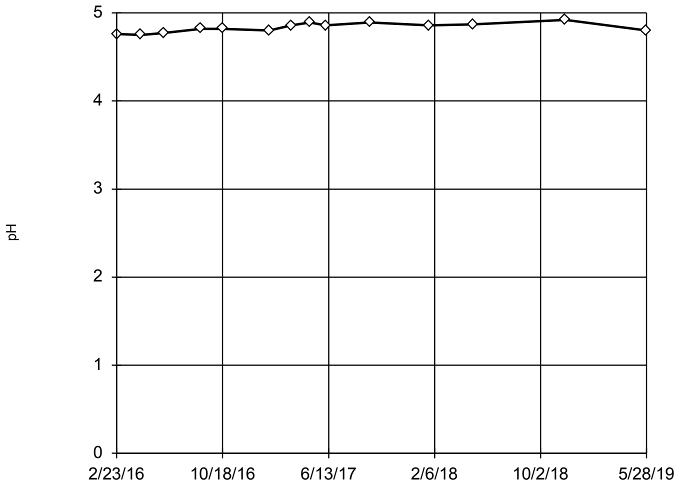
Plant Barry Client: Southern Company Data: Barry GSA

---

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-5



n = 14

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.12, low cutoff = 4.424, based on IQR multiplier of 3.

Constituent: pH Analysis Run 9/12/2019 1:15 PM

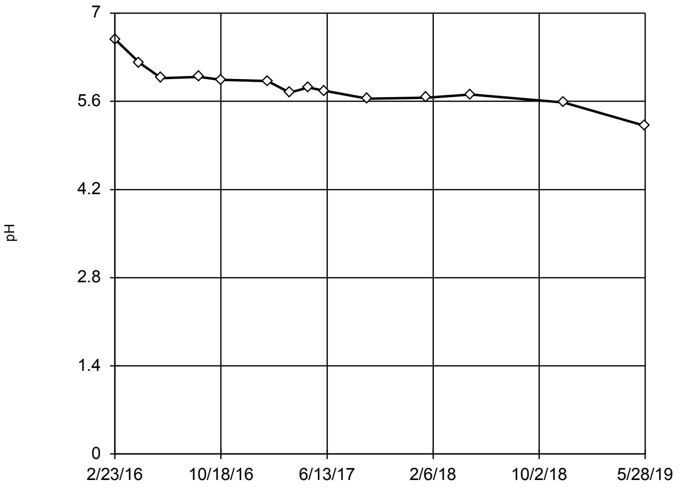
Plant Barry Client: Southern Company Data: Barry GSA

---

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-6



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 7.09, low cutoff = 4.765, based on IQR multiplier of 3.

Constituent: pH Analysis Run 9/12/2019 1:15 PM

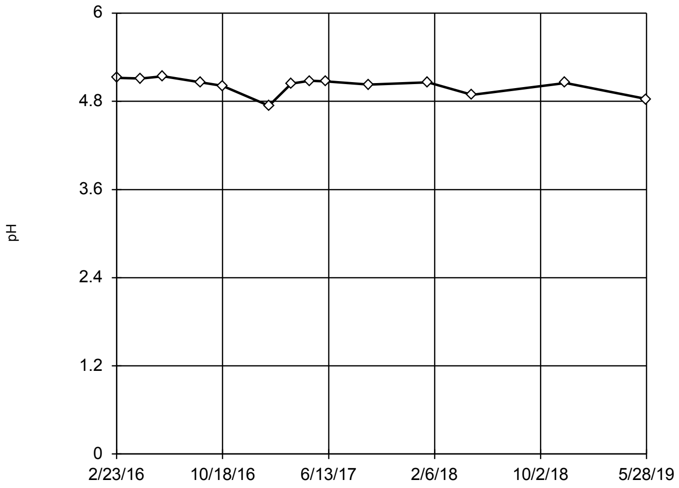
Plant Barry Client: Southern Company Data: Barry GSA

---

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-7



n = 14

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.434, low cutoff = 4.318, based on IQR multiplier of 3.

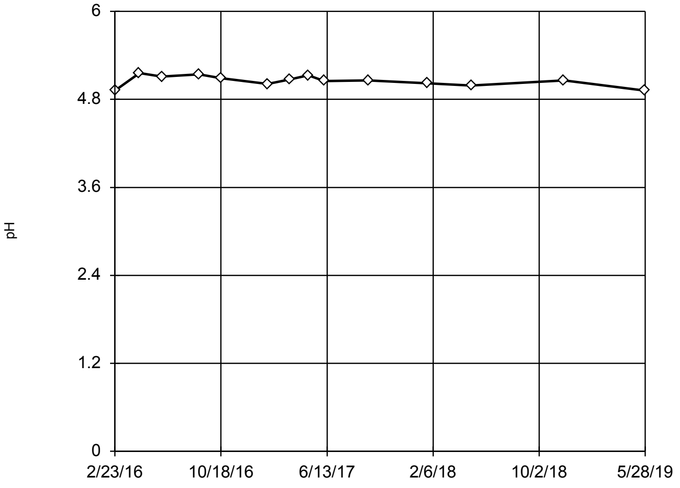
Constituent: pH Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-8



n = 14

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.414, low cutoff = 4.514, based on IQR multiplier of 3.

Constituent: pH Analysis Run 9/12/2019 1:15 PM

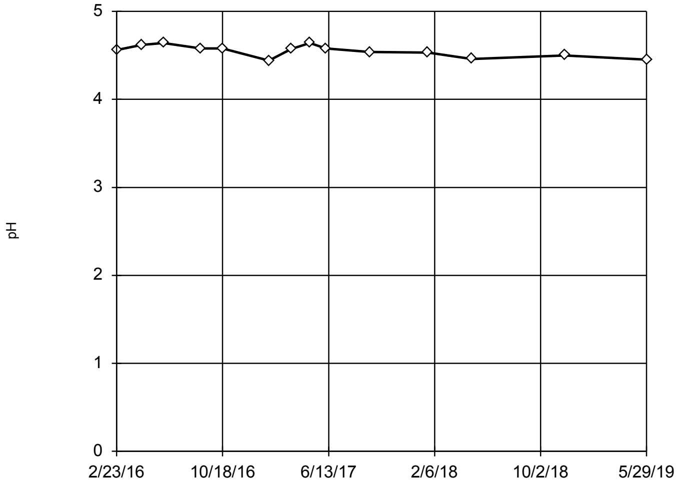
Plant Barry Client: Southern Company Data: Barry GSA

---

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-9



n = 14

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 4.888, low cutoff = 3.97, based on IQR multiplier of 3.

Constituent: pH Analysis Run 9/12/2019 1:15 PM

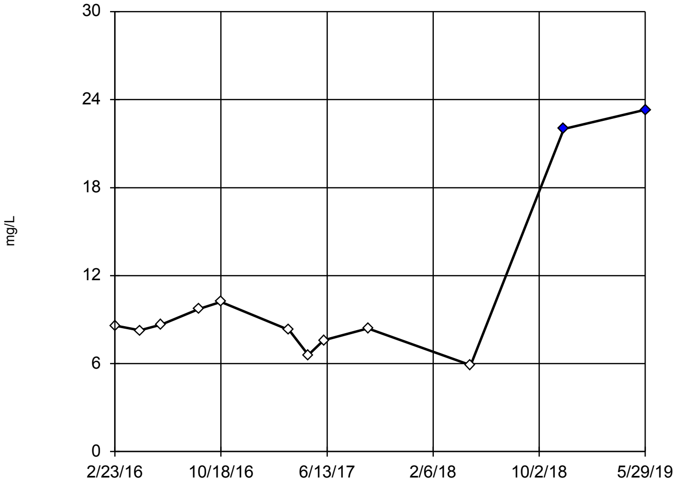
Plant Barry Client: Southern Company Data: Barry GSA

---

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-1 (bg)



n = 12

Outliers are drawn as solid.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 19.81, low cutoff = 3.989, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 9/12/2019 1:15 PM

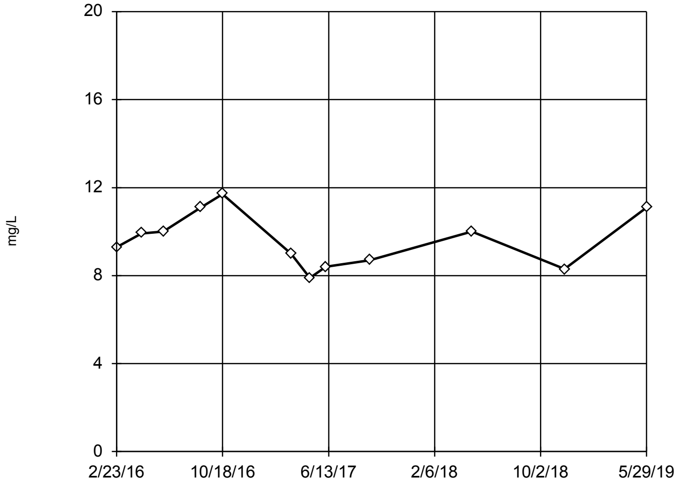
Plant Barry Client: Southern Company Data: Barry GSA

---

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-10



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 19.72, low cutoff = 4.567, based on IQR multiplier of 3.

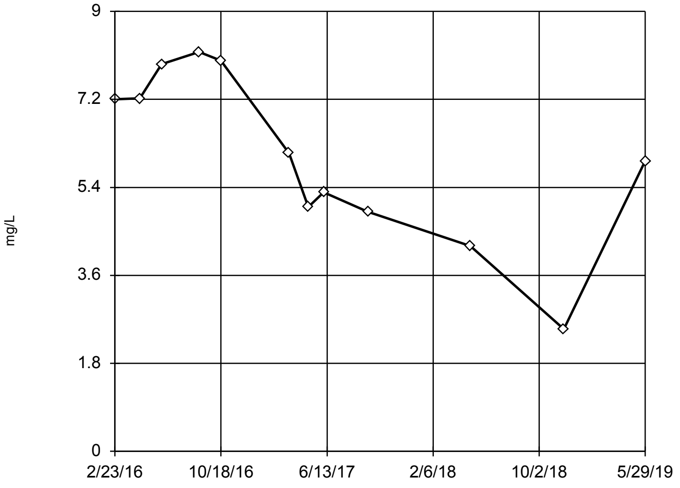
Constituent: Sulfate Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-2 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 12.5, low cutoff = -8.618, based on IQR multiplier of 3.

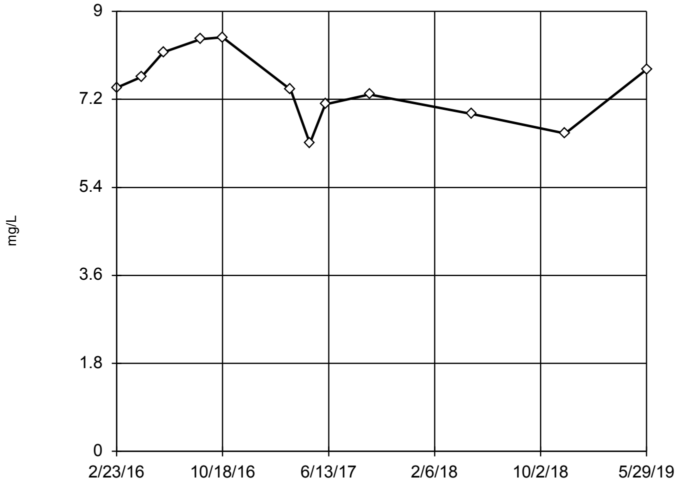
Constituent: Sulfate     Analysis Run 9/12/2019 1:15 PM

Plant Barry     Client: Southern Company     Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-3 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 10.94, low cutoff = 4.045, based on IQR multiplier of 3.

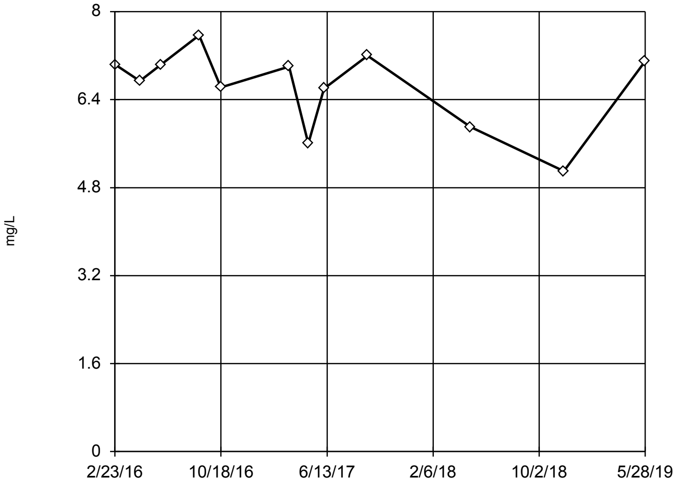
Constituent: Sulfate     Analysis Run 9/12/2019 1:15 PM

Plant Barry     Client: Southern Company     Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-4 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 8.237, low cutoff = -7.072, based on IQR multiplier of 3.

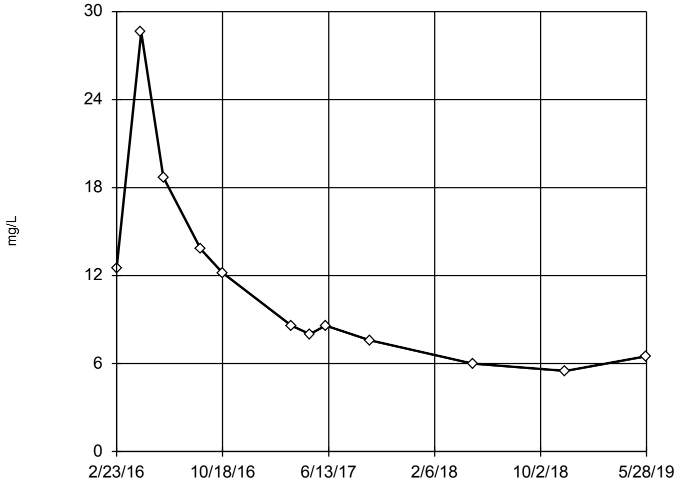
Constituent: Sulfate     Analysis Run 9/12/2019 1:15 PM

Plant Barry     Client: Southern Company     Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-5



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 85.7, low cutoff = 1.077, based on IQR multiplier of 3.

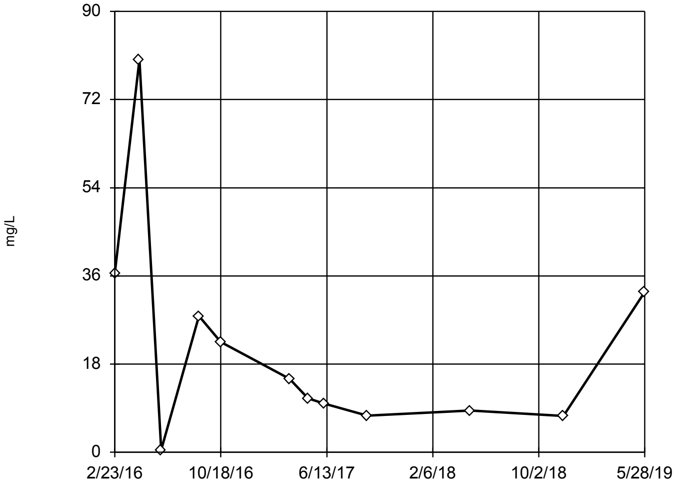
Constituent: Sulfate     Analysis Run 9/12/2019 1:15 PM

Plant Barry     Client: Southern Company     Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### BY-GSA-MW-6



n = 12

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 269.2, low cutoff = -2.429, based on IQR multiplier of 3.

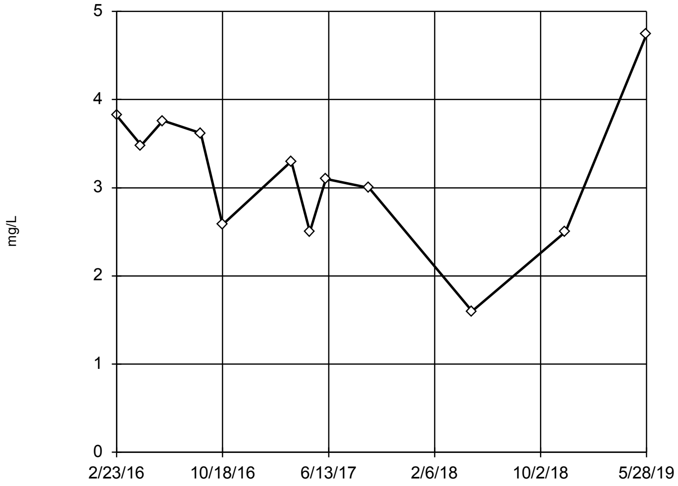
Constituent: Sulfate Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### BY-GSA-MW-7



n = 12

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 7.14, low cutoff = -0.91, based on IQR multiplier of 3.

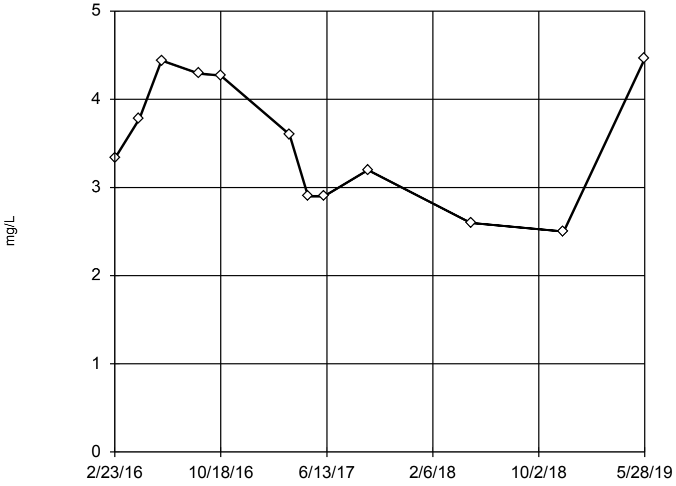
Constituent: Sulfate Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### BY-GSA-MW-8



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 13.76, low cutoff = 0.9021, based on IQR multiplier of 3.

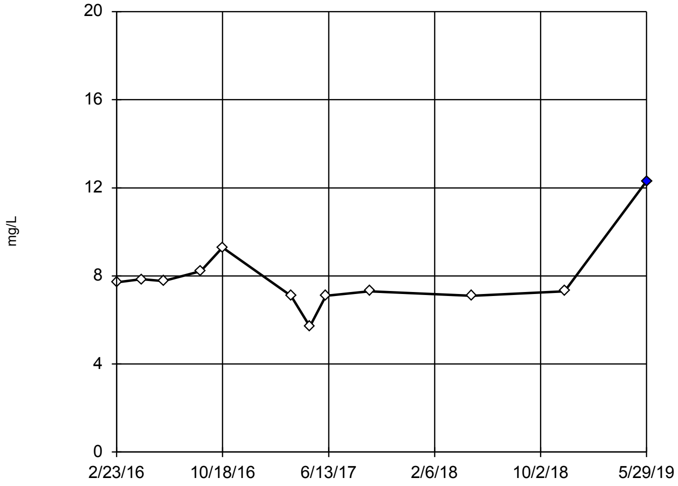
Constituent: Sulfate Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### BY-GSA-MW-9



n = 12

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 11.63, low cutoff = 4.903, based on IQR multiplier of 3.

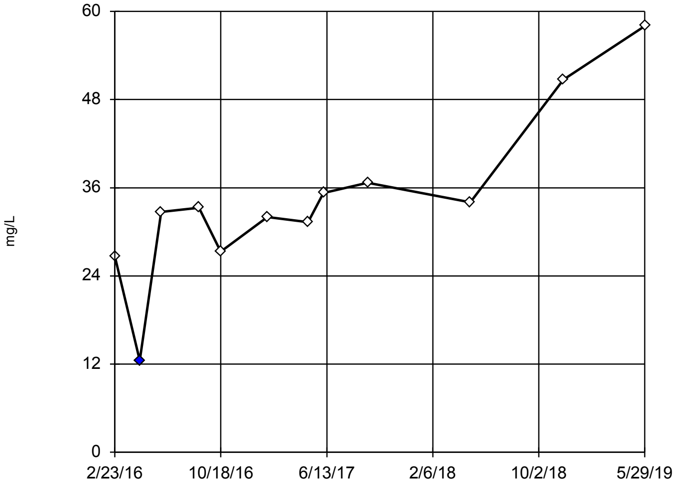
Constituent: Sulfate Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-1 (bg)



n = 12

Outlier is drawn as solid. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 60.37, low cutoff = 13.25, based on IQR multiplier of 3.

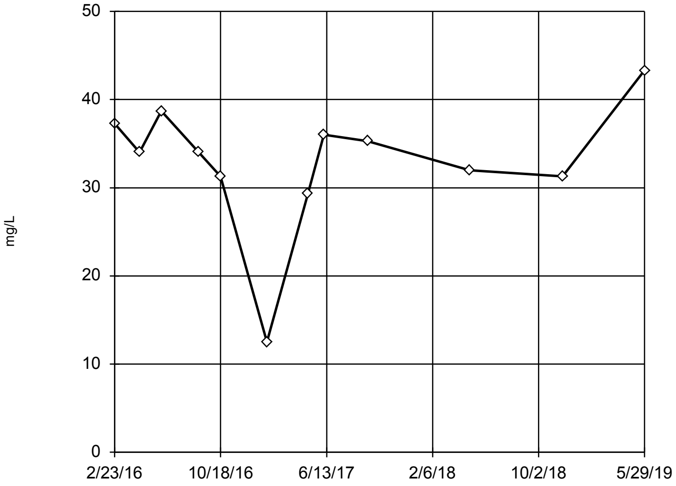
Constituent: TDS Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-10



n = 12

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 47.19, low cutoff = -29.31, based on IQR multiplier of 3.

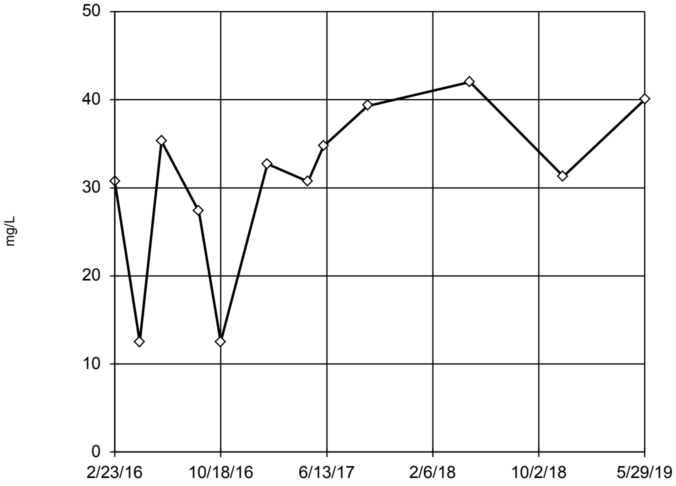
Constituent: TDS Analysis Run 9/12/2019 1:15 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-2 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 51.36, low cutoff = -38.81, based on IQR multiplier of 3.

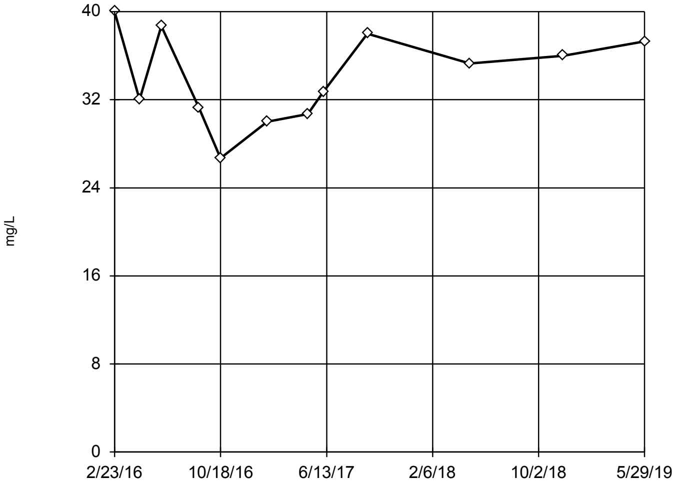
Constituent: TDS Analysis Run 9/12/2019 1:16 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

BY-GSA-MW-3 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 52.79, low cutoff = -20.21, based on IQR multiplier of 3.

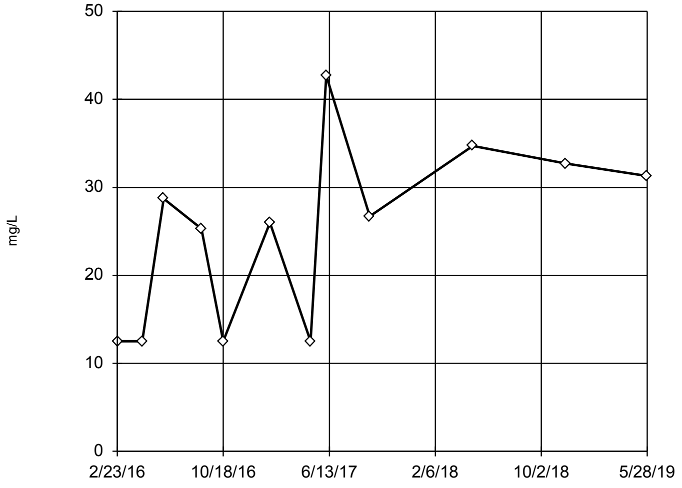
Constituent: TDS Analysis Run 9/12/2019 1:16 PM

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BY-GSA-MW-4 (bg)



n = 12

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 60.24, low cutoff = -49.48, based on IQR multiplier of 3.

Constituent: TDS    Analysis Run 9/12/2019 1:16 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

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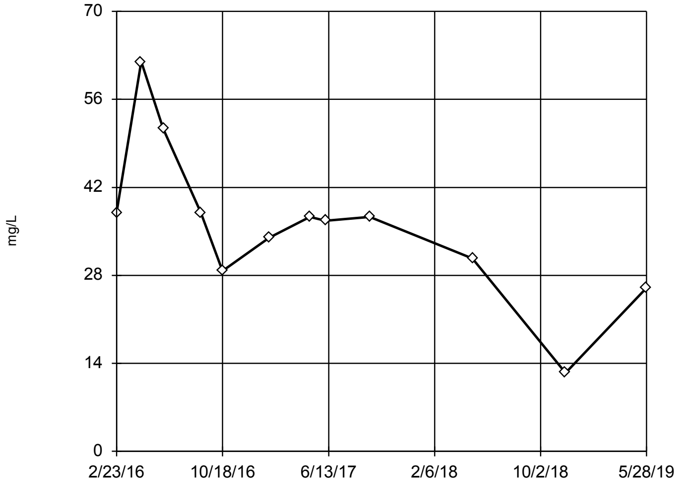
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BY-GSA-MW-5



n = 12

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 62.9, low cutoff = 4.8, based on IQR multiplier of 3.

Constituent: TDS    Analysis Run 9/12/2019 1:16 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

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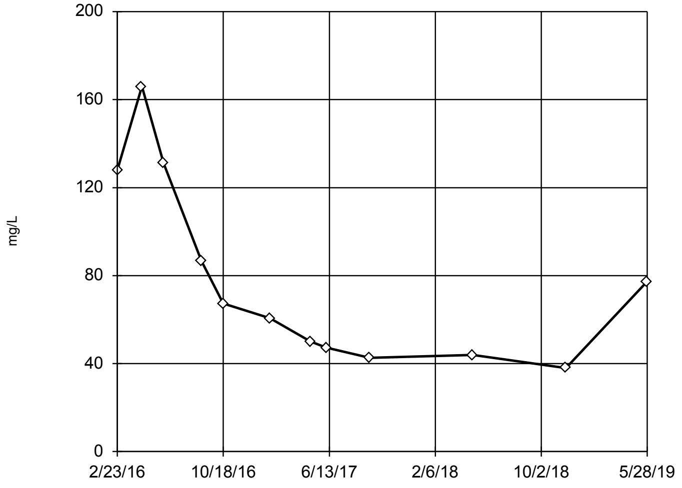
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BY-GSA-MW-6



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1297, low cutoff = 3.705, based on IQR multiplier of 3.

Constituent: TDS    Analysis Run 9/12/2019 1:16 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

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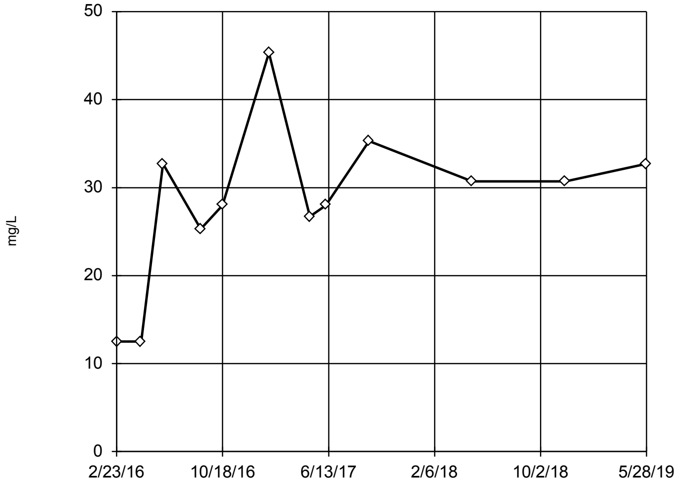
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BY-GSA-MW-7



n = 12

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 47.41, low cutoff = -22.4, based on IQR multiplier of 3.

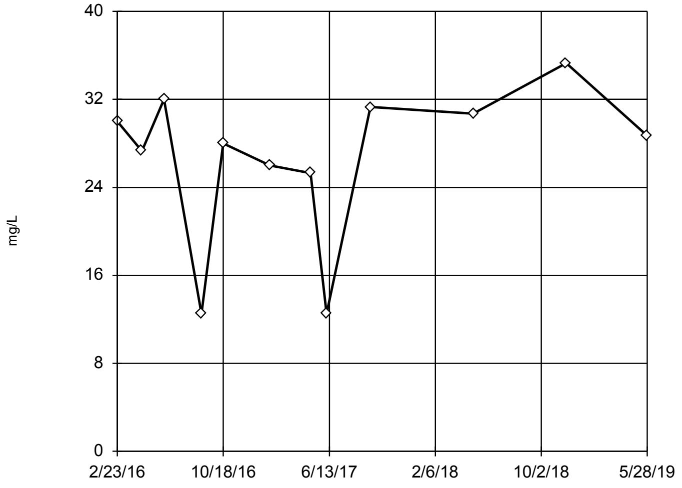
Constituent: TDS    Analysis Run 9/12/2019 1:16 PM

Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### BY-GSA-MW-8



n = 12

No outliers found. Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 39.34, low cutoff = -31.92, based on IQR multiplier of 3.

Constituent: TDS Analysis Run 9/12/2019 1:16 PM

Plant Barry Client: Southern Company Data: Barry GSA

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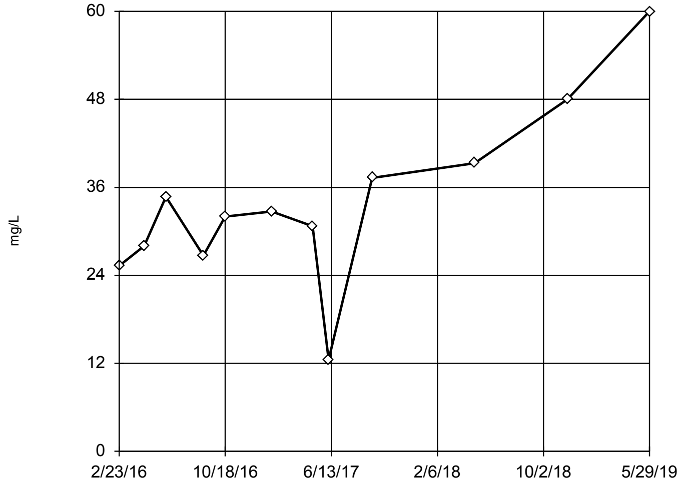
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### BY-GSA-MW-9



n = 12

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 82.17, low cutoff = 5.536, based on IQR multiplier of 3.

Constituent: TDS Analysis Run 9/12/2019 1:16 PM

Plant Barry Client: Southern Company Data: Barry GSA

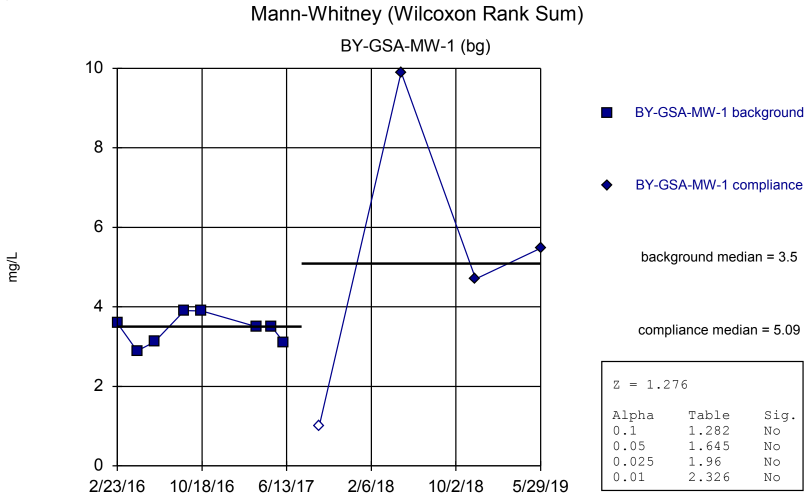
# FIGURE D.

# Welch's t-test/Mann-Whitney - All Results

Plant Barry Client: Southern Company Data: Barry GSA Printed 9/12/2019, 1:22 PM

| Constituent | Well | Calc. | 0.01 | Method |
|---|---|---|---|---|
| Chloride (mg/L) | BY-GSA-MW-1 (bg) | 1.276 | No | Mann-W |
| Chloride (mg/L) | BY-GSA-MW-10 | 2.123 | No | Mann-W |
| Chloride (mg/L) | BY-GSA-MW-2 (bg) | -2.807 | No | Mann-W |
| Chloride (mg/L) | BY-GSA-MW-3 (bg) | -1.276 | No | Mann-W |
| Chloride (mg/L) | BY-GSA-MW-4 (bg) | 0.5986 | No | Mann-W |
| Chloride (mg/L) | BY-GSA-MW-5 | -0.9407 | No | Mann-W |
| Chloride (mg/L) | BY-GSA-MW-6 | -0.6806 | No | Mann-W |
| Chloride (mg/L) | BY-GSA-MW-7 | -0.4246 | No | Mann-W |
| Chloride (mg/L) | BY-GSA-MW-8 | -0.3427 | No | Mann-W |
| Chloride (mg/L) | BY-GSA-MW-9 | 2.293 | No | Mann-W |
| Sulfate (mg/L) | BY-GSA-MW-1 (bg) | 0.5944 | No | Mann-W |
| Sulfate (mg/L) | BY-GSA-MW-10 | -0.2557 | No | Mann-W |
| Sulfate (mg/L) | BY-GSA-MW-2 (bg) | -2.463 | No | Mann-W |
| Sulfate (mg/L) | BY-GSA-MW-3 (bg) | -1.274 | No | Mann-W |
| Sulfate (mg/L) | BY-GSA-MW-4 (bg) | -0.2552 | No | Mann-W |
| Sulfate (mg/L) | BY-GSA-MW-5 | -2.807 | No | Mann-W |
| Sulfate (mg/L) | BY-GSA-MW-6 | -1.039 | No | Mann-W |
| Sulfate (mg/L) | BY-GSA-MW-7 | -1.021 | No | Mann-W |
| Sulfate (mg/L) | BY-GSA-MW-8 | -1.106 | No | Mann-W |
| Sulfate (mg/L) | BY-GSA-MW-9 | -0.08567 | No | Mann-W |

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

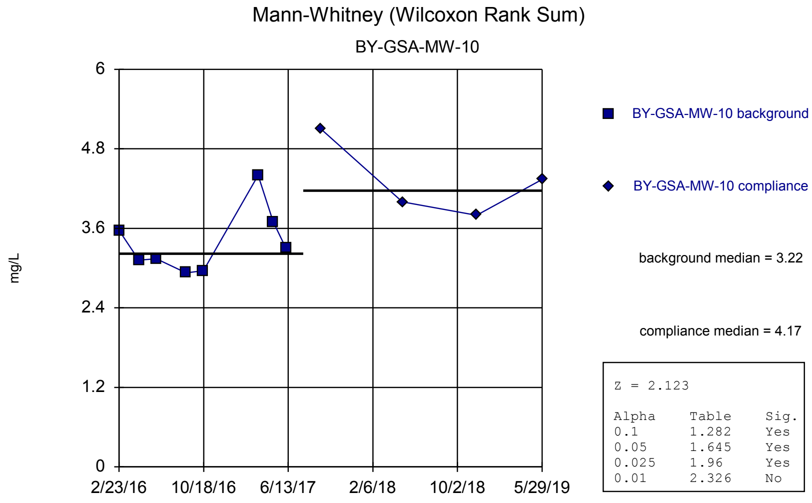


Z = 1.276

| Alpha | Table | Sig. |
|---|---|---|
| 0.1 | 1.282 | No |
| 0.05 | 1.645 | No |
| 0.025 | 1.96 | No |
| 0.01 | 2.326 | No |

Constituent: Chloride    Analysis Run 9/12/2019 1:21 PM    View: Mann Whitney
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

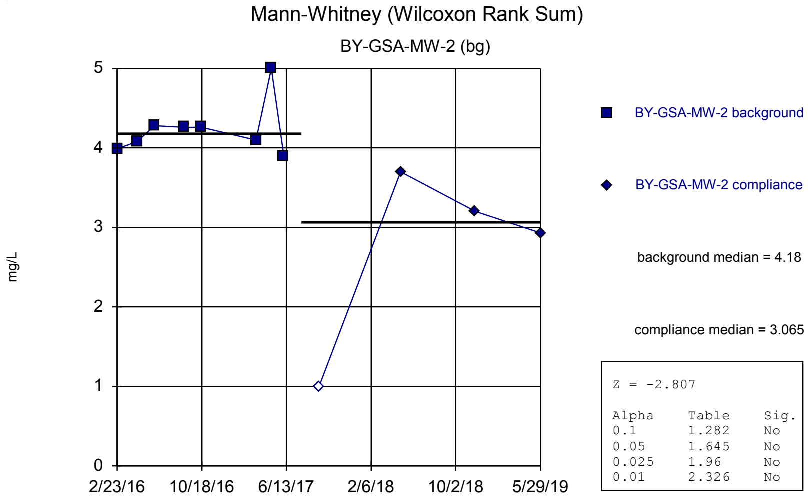


Z = 2.123

| Alpha | Table | Sig. |
|---|---|---|
| 0.1 | 1.282 | Yes |
| 0.05 | 1.645 | Yes |
| 0.025 | 1.96 | Yes |
| 0.01 | 2.326 | No |

Constituent: Chloride    Analysis Run 9/12/2019 1:21 PM    View: Mann Whitney
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

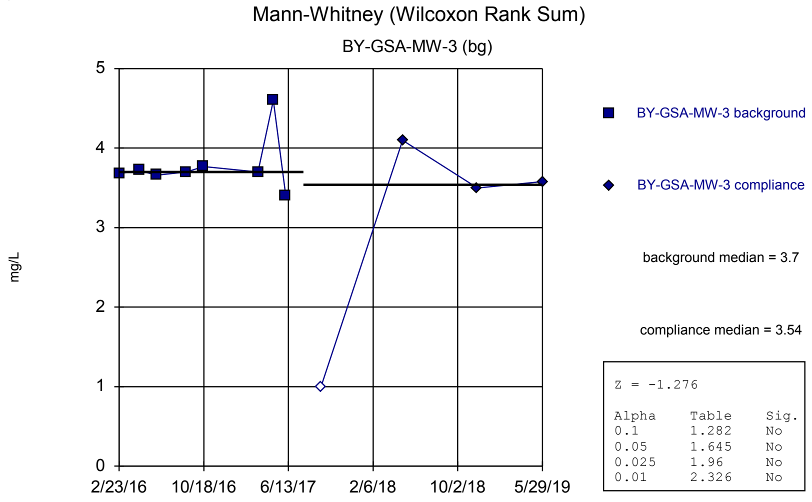


Z = -2.807

| Alpha | Table | Sig. |
|---|---|---|
| 0.1 | 1.282 | No |
| 0.05 | 1.645 | No |
| 0.025 | 1.96 | No |
| 0.01 | 2.326 | No |

Constituent: Chloride    Analysis Run 9/12/2019 1:21 PM    View: Mann Whitney
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

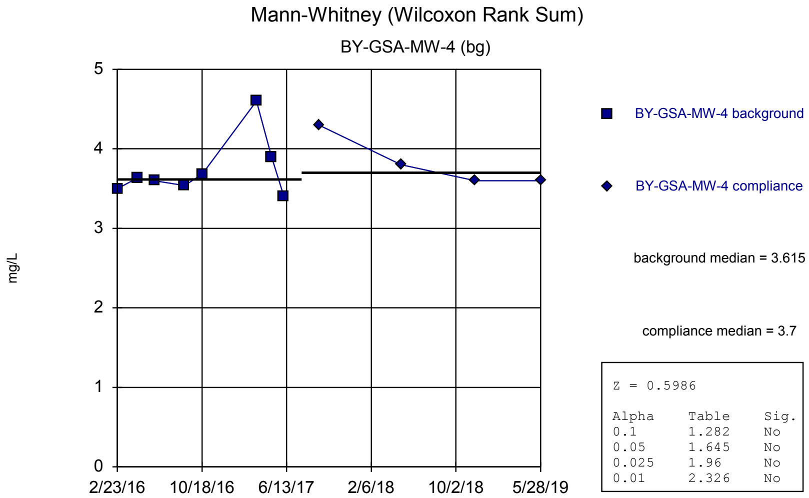


Z = -1.276

| Alpha | Table | Sig. |
|---|---|---|
| 0.1 | 1.282 | No |
| 0.05 | 1.645 | No |
| 0.025 | 1.96 | No |
| 0.01 | 2.326 | No |

Constituent: Chloride    Analysis Run 9/12/2019 1:21 PM    View: Mann Whitney
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

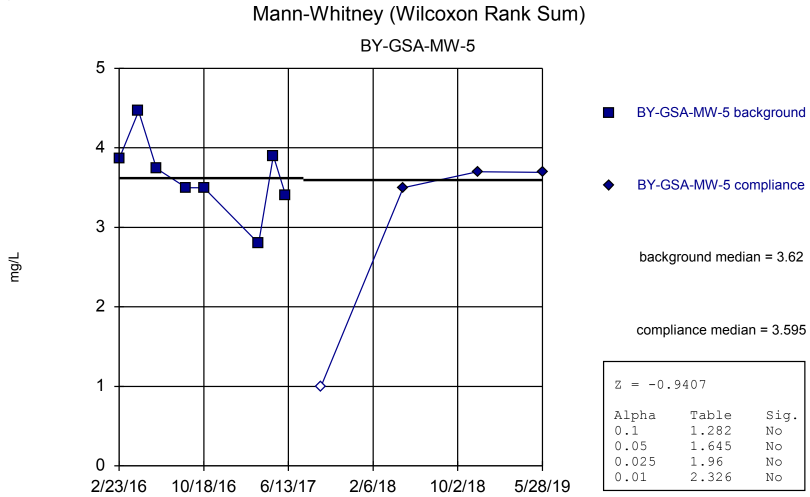


Constituent: Chloride Analysis Run 9/12/2019 1:21 PM View: Mann Whitney

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

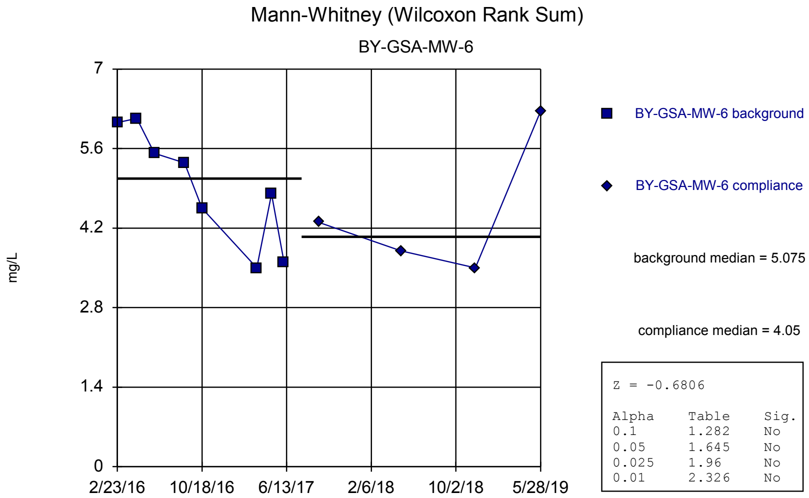
Hollow symbols indicate censored values.



Constituent: Chloride Analysis Run 9/12/2019 1:21 PM View: Mann Whitney

Plant Barry Client: Southern Company Data: Barry GSA

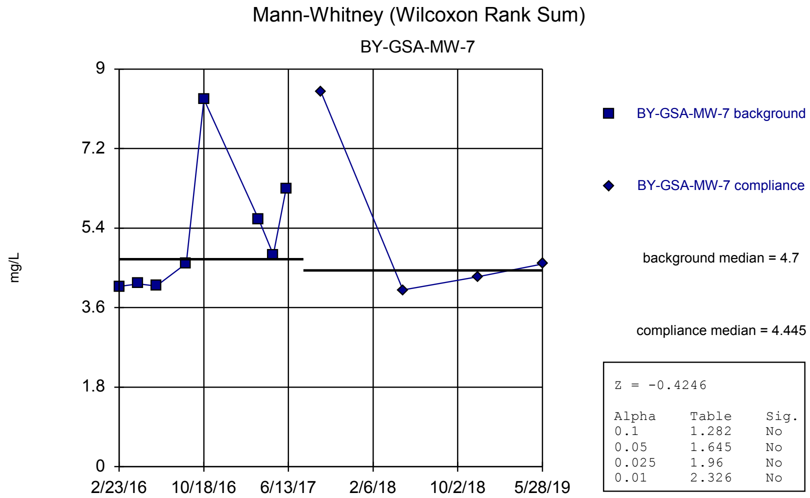
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Chloride Analysis Run 9/12/2019 1:21 PM View: Mann Whitney

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



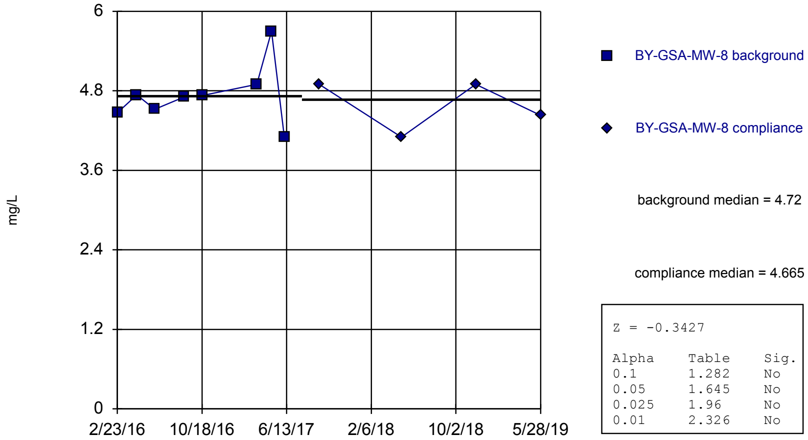
Constituent: Chloride Analysis Run 9/12/2019 1:21 PM View: Mann Whitney

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

### Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-8



Z = -0.3427

| Alpha | Table | Sig. |
|---|---|---|
| 0.1 | 1.282 | No |
| 0.05 | 1.645 | No |
| 0.025 | 1.96 | No |
| 0.01 | 2.326 | No |

Constituent: Chloride Analysis Run 9/12/2019 1:21 PM View: Mann Whitney
Plant Barry Client: Southern Company Data: Barry GSA

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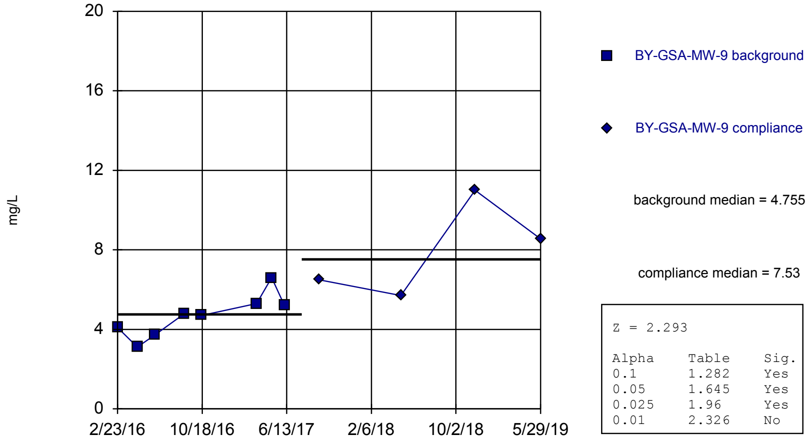
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

### Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-9



Z = 2.293

| Alpha | Table | Sig. |
|---|---|---|
| 0.1 | 1.282 | Yes |
| 0.05 | 1.645 | Yes |
| 0.025 | 1.96 | Yes |
| 0.01 | 2.326 | No |

Constituent: Chloride Analysis Run 9/12/2019 1:21 PM View: Mann Whitney
Plant Barry Client: Southern Company Data: Barry GSA

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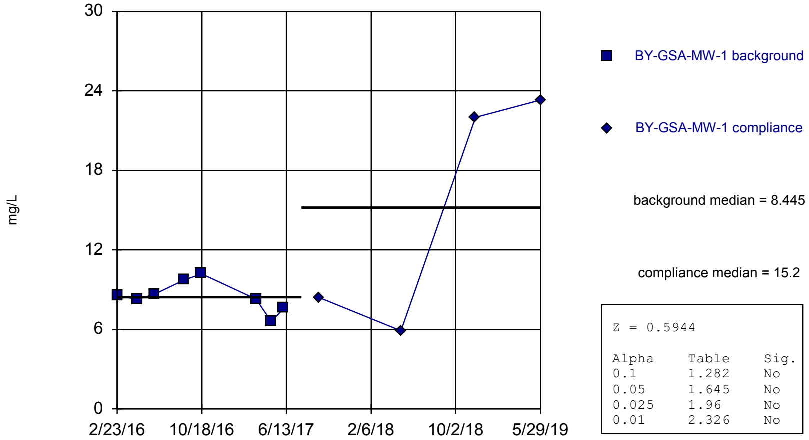
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

### Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-1 (bg)



Z = 0.5944

| Alpha | Table | Sig. |
|---|---|---|
| 0.1 | 1.282 | No |
| 0.05 | 1.645 | No |
| 0.025 | 1.96 | No |
| 0.01 | 2.326 | No |

Constituent: Sulfate Analysis Run 9/12/2019 1:21 PM View: Mann Whitney
Plant Barry Client: Southern Company Data: Barry GSA

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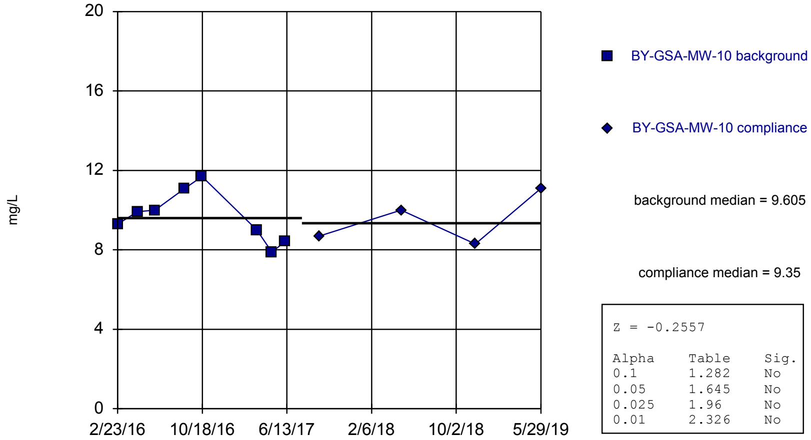
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

### Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-10



Z = -0.2557

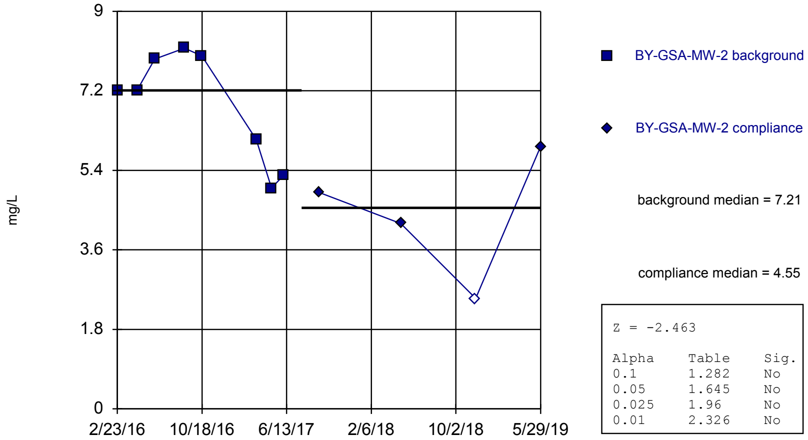
| Alpha | Table | Sig. |
|---|---|---|
| 0.1 | 1.282 | No |
| 0.05 | 1.645 | No |
| 0.025 | 1.96 | No |
| 0.01 | 2.326 | No |

Constituent: Sulfate Analysis Run 9/12/2019 1:21 PM View: Mann Whitney
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-2 (bg)



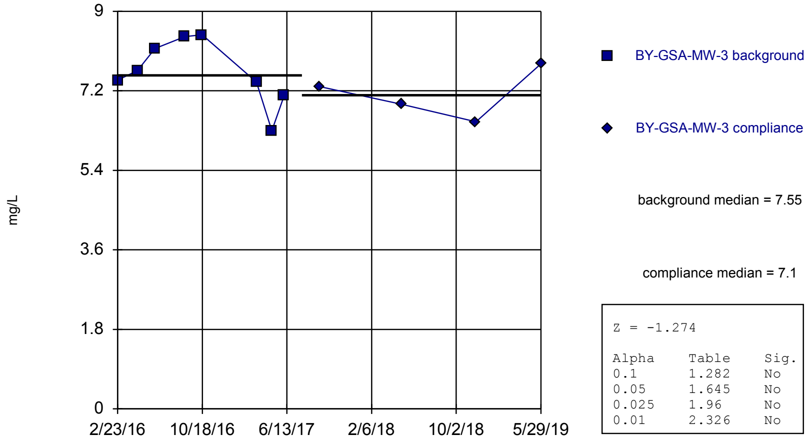
```
Z = -2.463

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Sulfate   Analysis Run 9/12/2019 1:21 PM   View: Mann Whitney
Plant Barry   Client: Southern Company   Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-3 (bg)



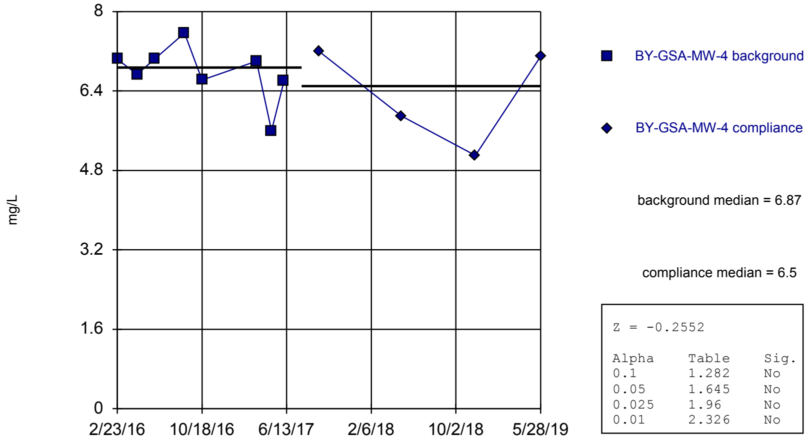
```
Z = -1.274

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Sulfate   Analysis Run 9/12/2019 1:21 PM   View: Mann Whitney
Plant Barry   Client: Southern Company   Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-4 (bg)



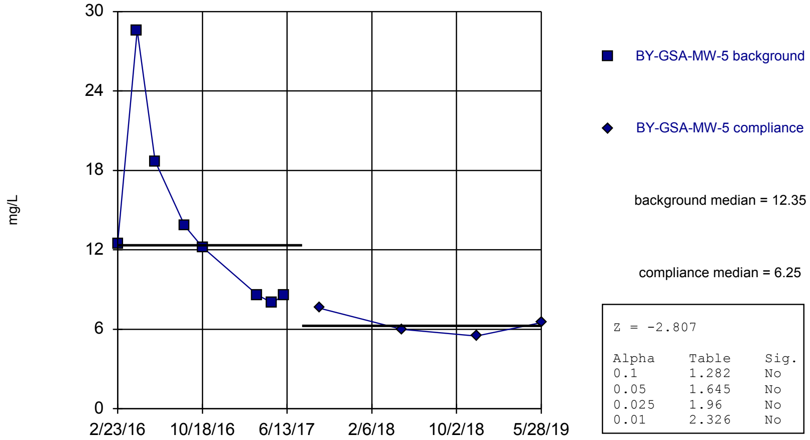
```
Z = -0.2552

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Sulfate   Analysis Run 9/12/2019 1:21 PM   View: Mann Whitney
Plant Barry   Client: Southern Company   Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-5



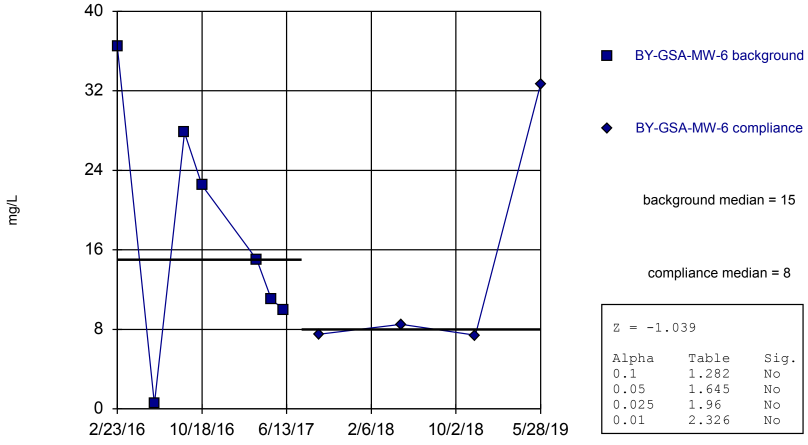
```
Z = -2.807

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Sulfate   Analysis Run 9/12/2019 1:21 PM   View: Mann Whitney
Plant Barry   Client: Southern Company   Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-6



```
Z = -1.039

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

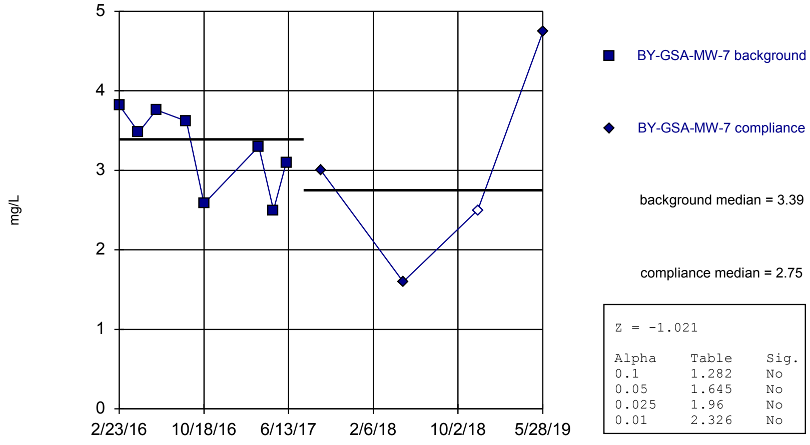
Constituent: Sulfate Analysis Run 9/12/2019 1:21 PM View: Mann Whitney
Plant Barry Client: Southern Company Data: Barry GSA

---

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-7



```
Z = -1.021

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

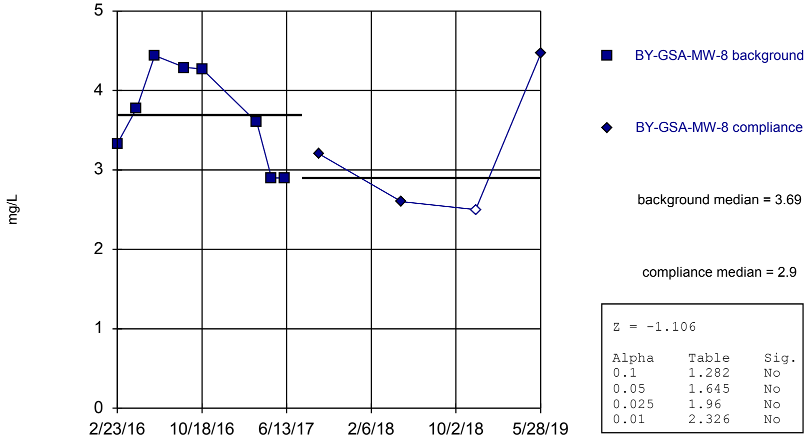
Constituent: Sulfate Analysis Run 9/12/2019 1:21 PM View: Mann Whitney
Plant Barry Client: Southern Company Data: Barry GSA

---

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-8



```
Z = -1.106

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Sulfate Analysis Run 9/12/2019 1:21 PM View: Mann Whitney
Plant Barry Client: Southern Company Data: Barry GSA

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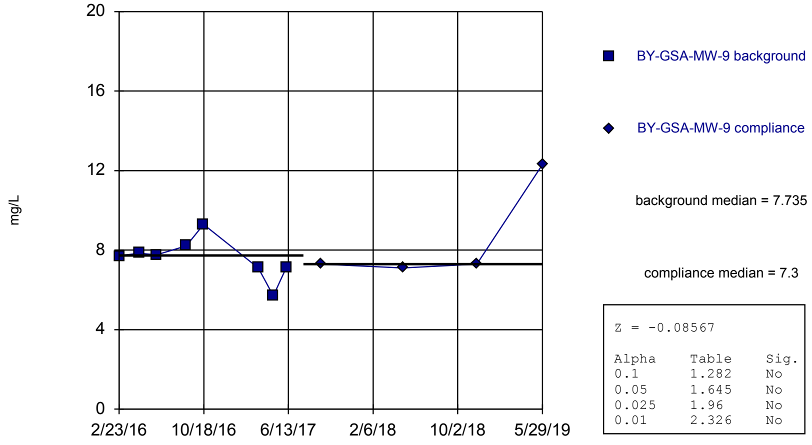
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Mann-Whitney (Wilcoxon Rank Sum)

BY-GSA-MW-9



```
Z = -0.08567

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Sulfate Analysis Run 9/12/2019 1:21 PM View: Mann Whitney
Plant Barry Client: Southern Company Data: Barry GSA

# FIGURE E.

# Trend Tests Summary Table - Significant Results

Plant Barry     Client: Southern Company     Data: Barry GSA     Printed 9/12/2019, 1:25 PM

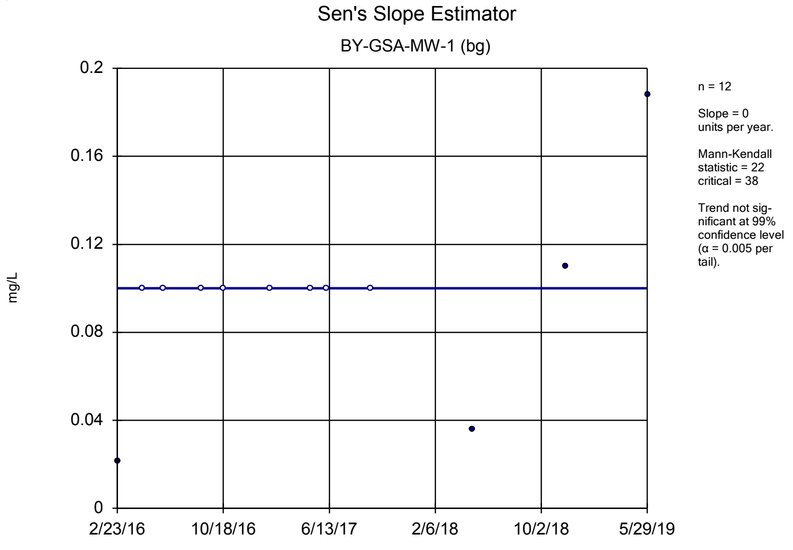
| Constituent | Well | Slope | Calc. | Critical | Sig. | N | %NDs | Normality | Xform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Calcium (mg/L)** | **BY-GSA-MW-2 (bg)** | **0.1672** | **40** | **38** | **Yes** | **12** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| **TDS (mg/L)** | **BY-GSA-MW-1 (bg)** | **8.844** | **46** | **38** | **Yes** | **12** | **8.333** | **n/a** | **n/a** | **0.01** | **NP** |

# Trend Tests Summary Table - All Results

Plant Barry Client: Southern Company Data: Barry GSA Printed 9/12/2019, 1:25 PM

| Constituent | Well | Slope | Calc. | Critical | Sig. | N | %NDs | Normality | Xform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Boron (mg/L) | BY-GSA-MW-1 (bg) | 0 | 22 | 38 | No | 12 | 66.67 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | BY-GSA-MW-2 (bg) | 0 | 17 | 38 | No | 12 | 83.33 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | BY-GSA-MW-3 (bg) | 0 | 0 | 38 | No | 12 | 100 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | BY-GSA-MW-4 (bg) | 0 | 13 | 38 | No | 12 | 83.33 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | BY-GSA-MW-1 (bg) | 0.1375 | 9 | 38 | No | 12 | 0 | n/a | n/a | 0.01 | NP |
| **Calcium (mg/L)** | **BY-GSA-MW-2 (bg)** | **0.1672** | **40** | **38** | **Yes** | **12** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| Calcium (mg/L) | BY-GSA-MW-3 (bg) | 0.01081 | 5 | 38 | No | 12 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | BY-GSA-MW-4 (bg) | 0.07965 | 26 | 38 | No | 12 | 0 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | BY-GSA-MW-1 (bg) | 0.006308 | 19 | 43 | No | 13 | 30.77 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | BY-GSA-MW-2 (bg) | 0.0106 | 25 | 43 | No | 13 | 23.08 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | BY-GSA-MW-3 (bg) | 0.02691 | 42 | 43 | No | 13 | 61.54 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | BY-GSA-MW-4 (bg) | 0.02683 | 42 | 43 | No | 13 | 61.54 | n/a | n/a | 0.01 | NP |
| pH (pH) | BY-GSA-MW-1 (bg) | 0.0316 | 17 | 48 | No | 14 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | BY-GSA-MW-2 (bg) | -0.0669 | -48 | -48 | No | 14 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | BY-GSA-MW-3 (bg) | -0.0269 | -30 | -48 | No | 14 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | BY-GSA-MW-4 (bg) | -0.01837 | -12 | -48 | No | 14 | 0 | n/a | n/a | 0.01 | NP |
| **TDS (mg/L)** | **BY-GSA-MW-1 (bg)** | **8.844** | **46** | **38** | **Yes** | **12** | **8.333** | **n/a** | **n/a** | **0.01** | **NP** |
| TDS (mg/L) | BY-GSA-MW-2 (bg) | 4.846 | 32 | 38 | No | 12 | 16.67 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | BY-GSA-MW-3 (bg) | 1.578 | 6 | 38 | No | 12 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | BY-GSA-MW-4 (bg) | 5.306 | 30 | 38 | No | 12 | 33.33 | n/a | n/a | 0.01 | NP |

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



n = 12

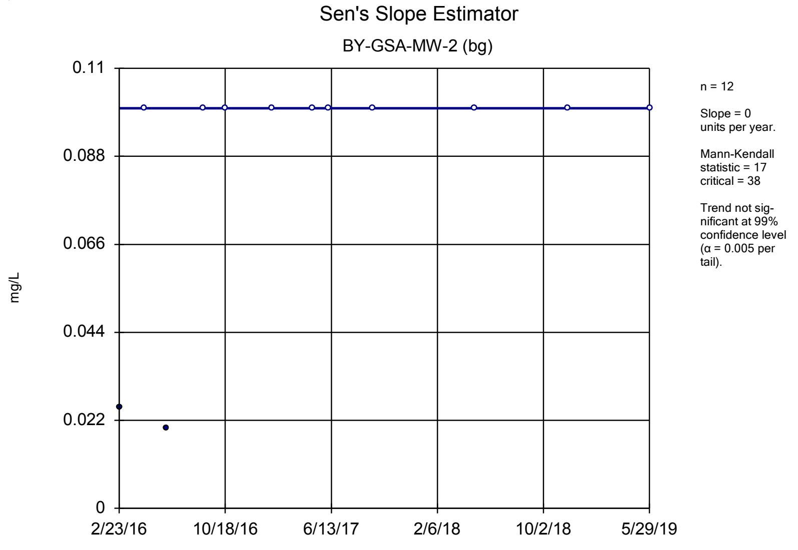
Slope = 0
units per year.

Mann-Kendall
statistic = 22
critical = 38

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



n = 12

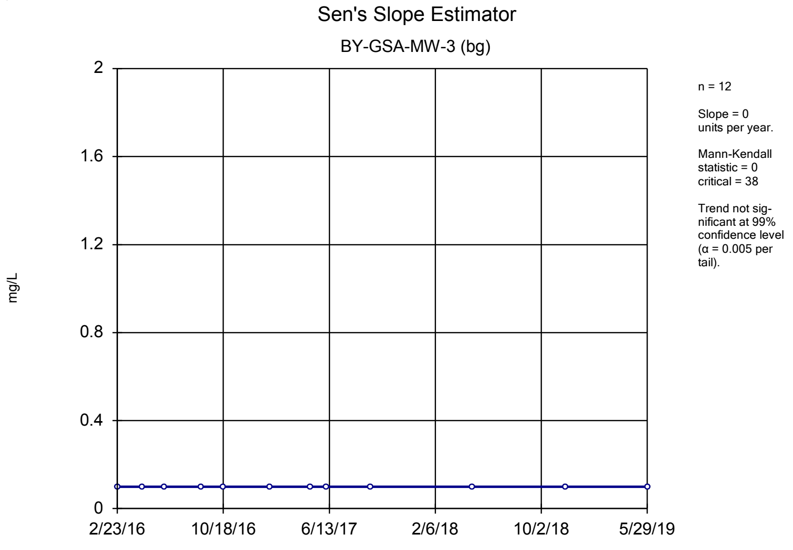
Slope = 0
units per year.

Mann-Kendall
statistic = 17
critical = 38

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



n = 12

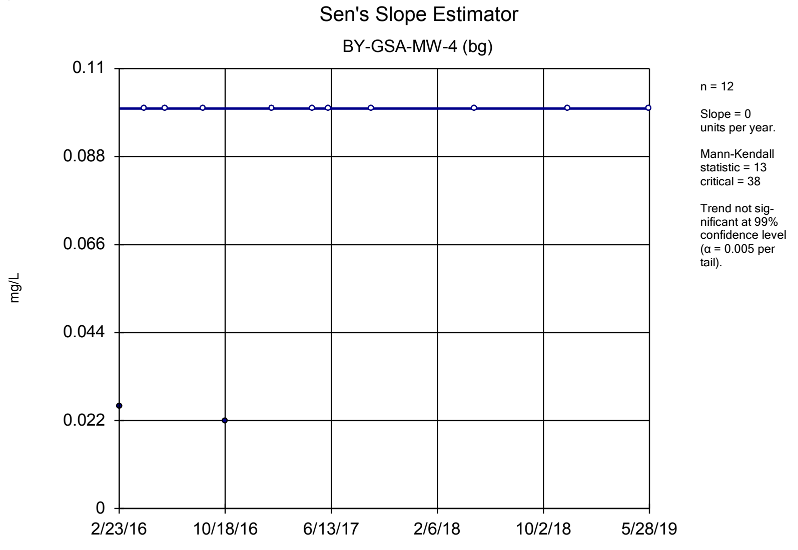
Slope = 0
units per year.

Mann-Kendall
statistic = 0
critical = 38

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



n = 12

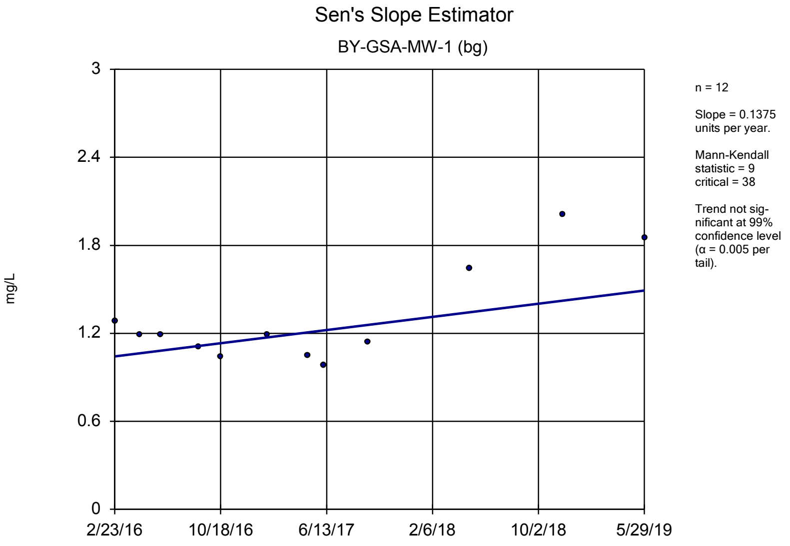
Slope = 0
units per year.

Mann-Kendall
statistic = 13
critical = 38

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG


Sen's Slope Estimator

BY-GSA-MW-1 (bg)

n = 12

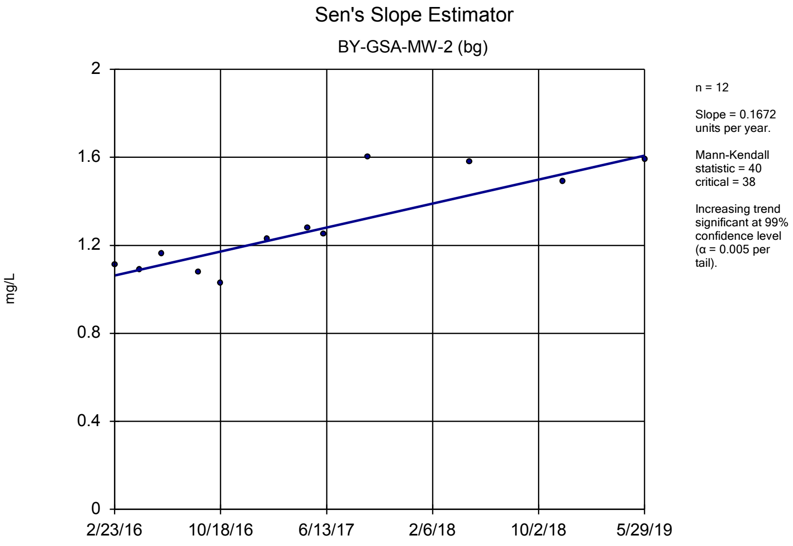
Slope = 0.1375
units per year.

Mann-Kendall
statistic = 9
critical = 38

Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Calcium    Analysis Run 9/12/2019 1:24 PM    View: Trend Tests
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG


Sen's Slope Estimator

BY-GSA-MW-2 (bg)

n = 12

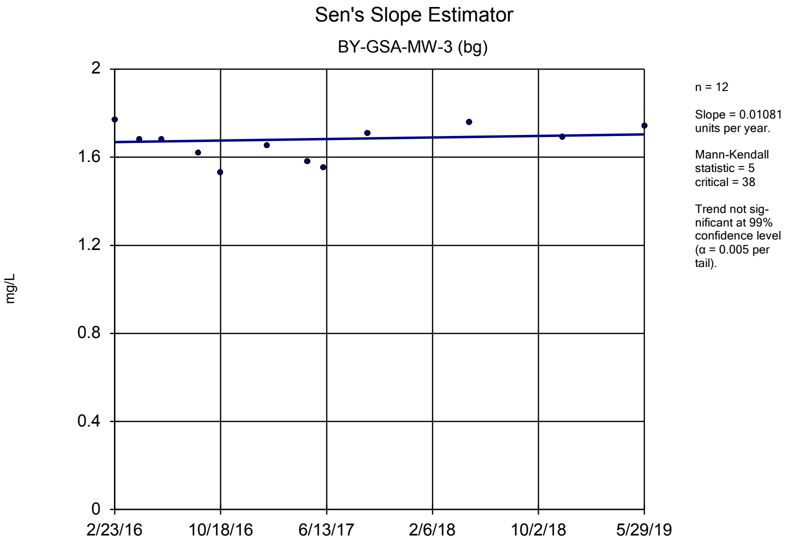
Slope = 0.1672
units per year.

Mann-Kendall
statistic = 40
critical = 38

Increasing trend
significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Calcium    Analysis Run 9/12/2019 1:24 PM    View: Trend Tests
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG


Sen's Slope Estimator

BY-GSA-MW-3 (bg)

n = 12

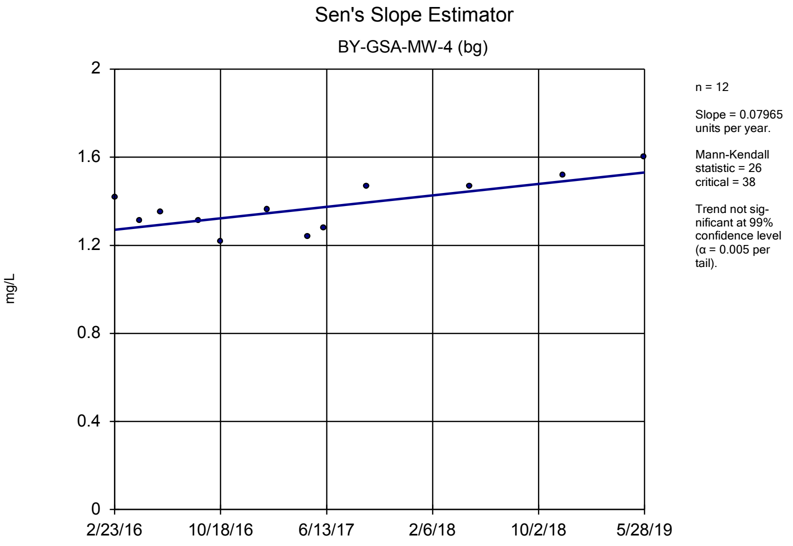
Slope = 0.01081
units per year.

Mann-Kendall
statistic = 5
critical = 38

Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Calcium    Analysis Run 9/12/2019 1:24 PM    View: Trend Tests
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG


Sen's Slope Estimator

BY-GSA-MW-4 (bg)

n = 12

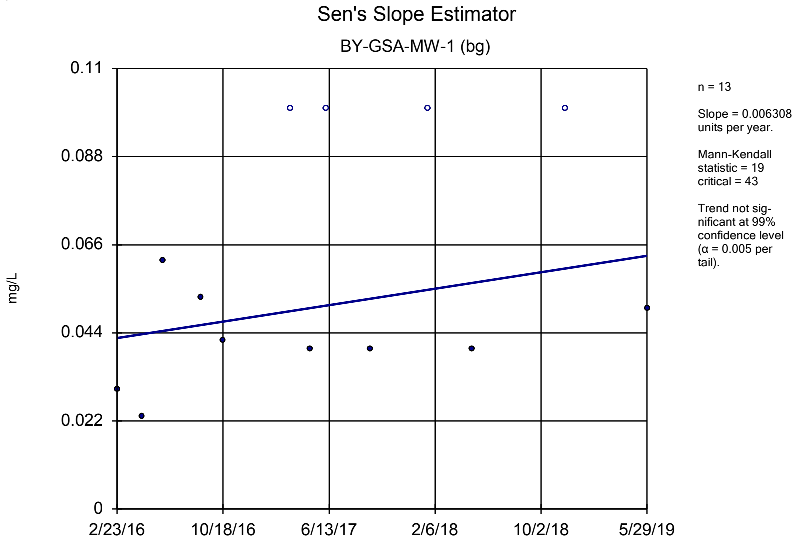
Slope = 0.07965
units per year.

Mann-Kendall
statistic = 26
critical = 38

Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

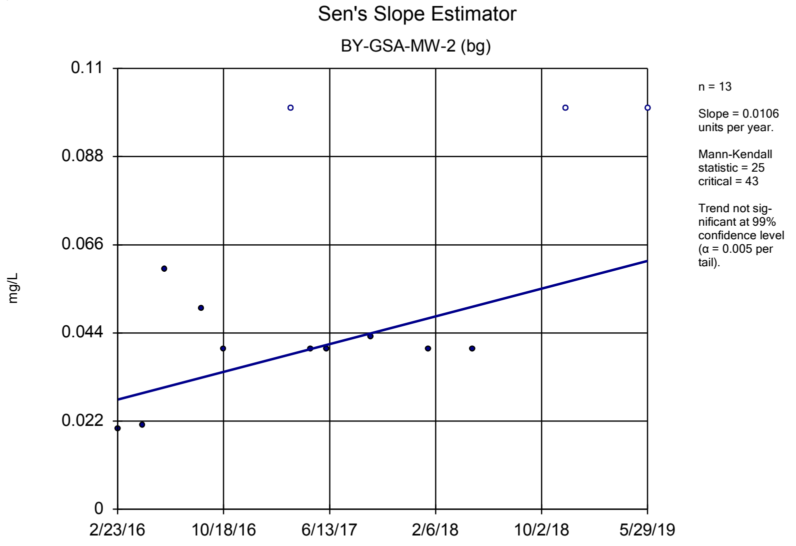
Constituent: Calcium    Analysis Run 9/12/2019 1:24 PM    View: Trend Tests
Plant Barry    Client: Southern Company    Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



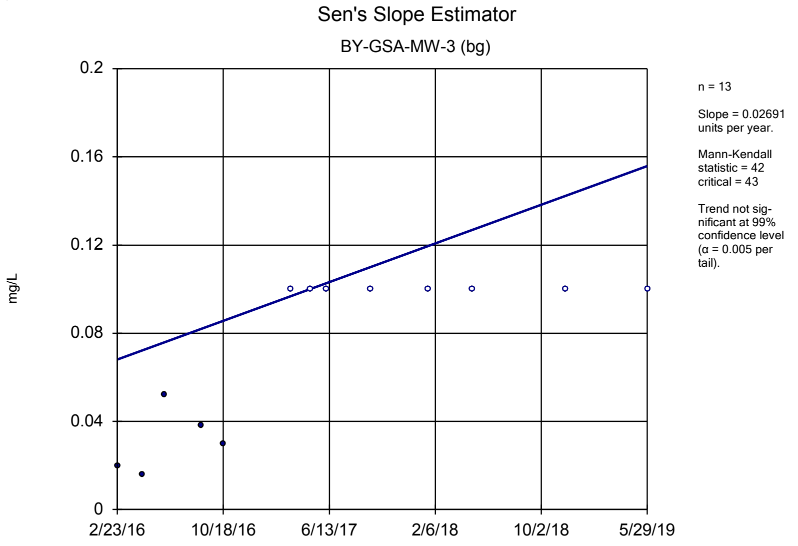
Constituent: Fluoride Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



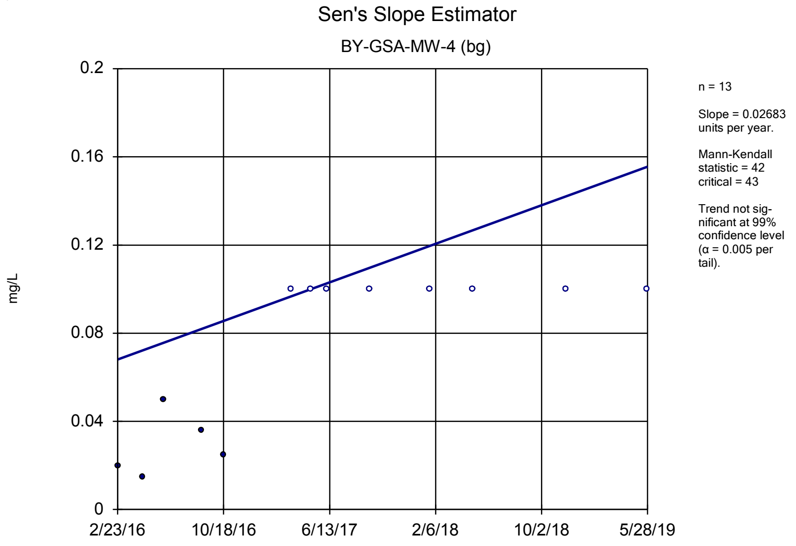
Constituent: Fluoride Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Fluoride Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

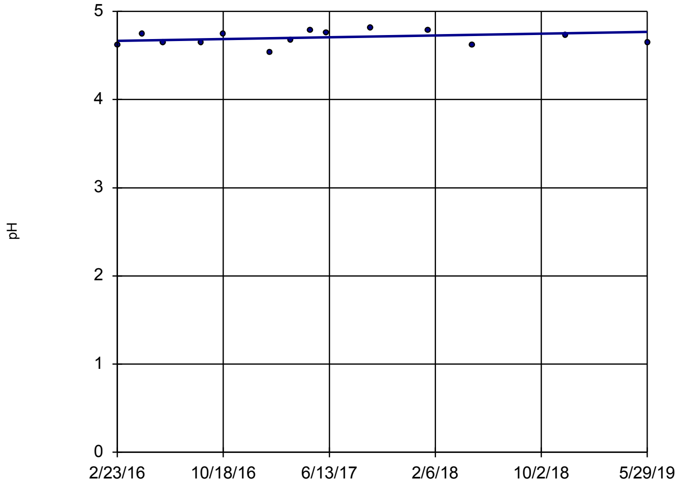


Constituent: Fluoride Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

BY-GSA-MW-1 (bg)



n = 14

Slope = 0.0316 units per year.

Mann-Kendall statistic = 17 critical = 48

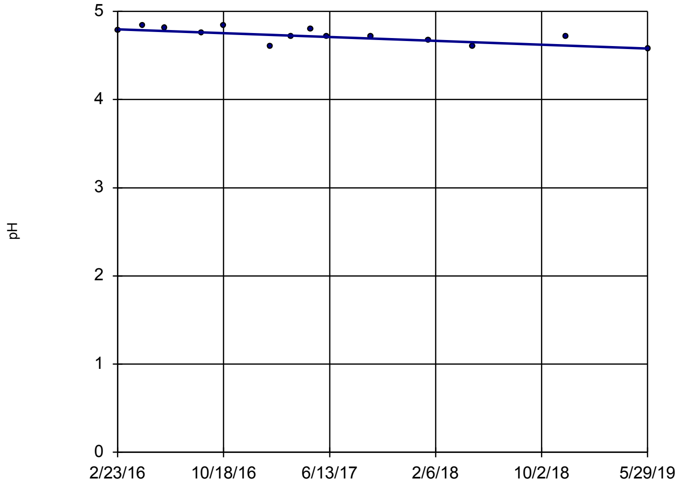
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

BY-GSA-MW-2 (bg)



n = 14

Slope = -0.0669 units per year.

Mann-Kendall statistic = -48 critical = -48

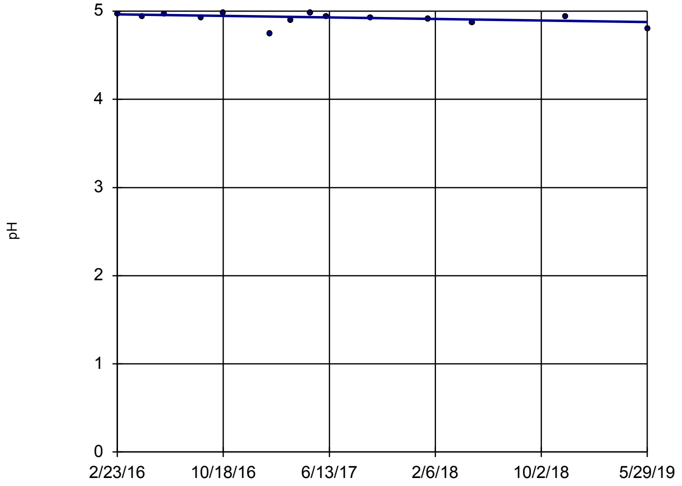
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

BY-GSA-MW-3 (bg)



n = 14

Slope = -0.0269 units per year.

Mann-Kendall statistic = -30 critical = -48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

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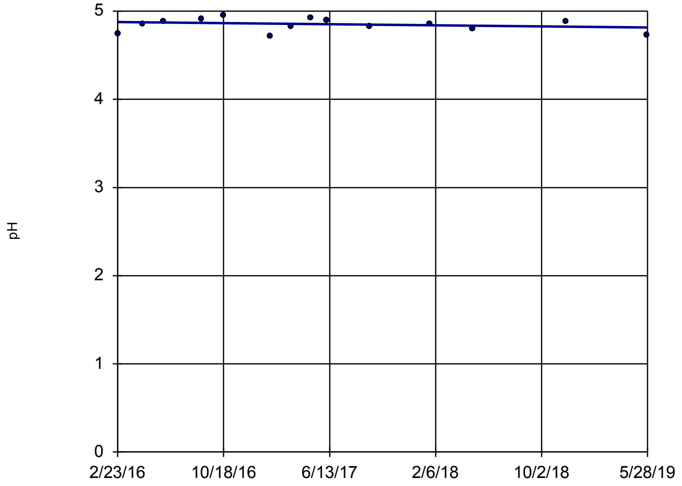
Sen's Slope Estimator

BY-GSA-MW-4 (bg)



n = 14

Slope = -0.01837 units per year.

Mann-Kendall statistic = -12 critical = -48

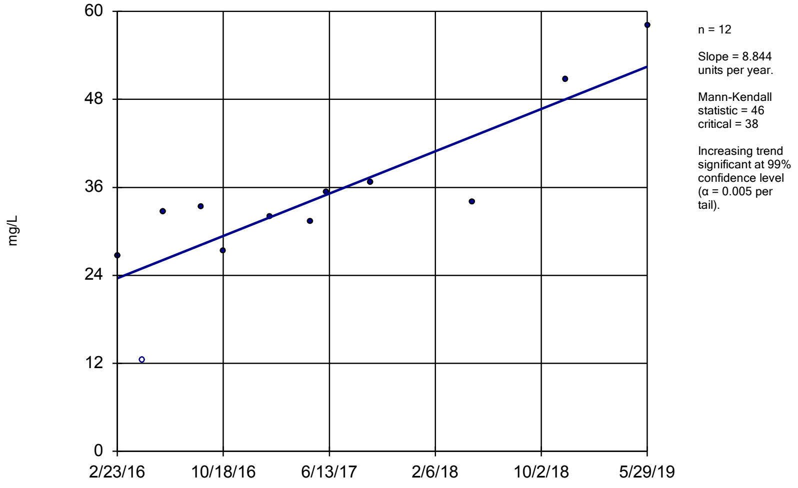
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

BY-GSA-MW-1 (bg)

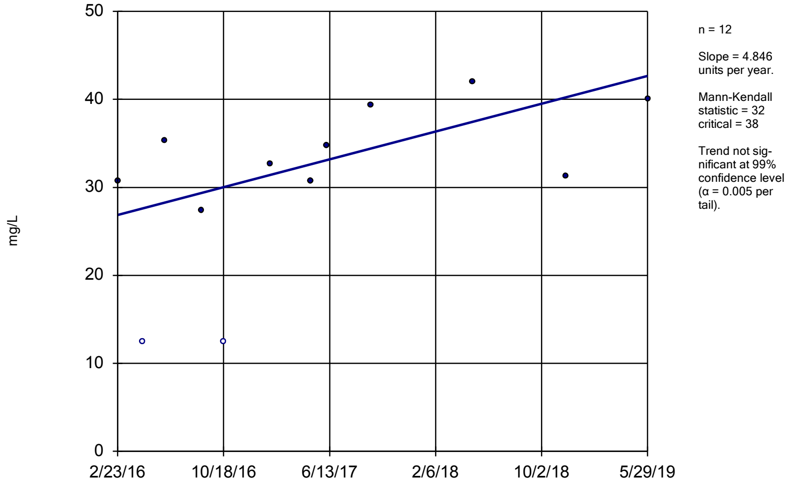


Constituent: TDS Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

BY-GSA-MW-2 (bg)

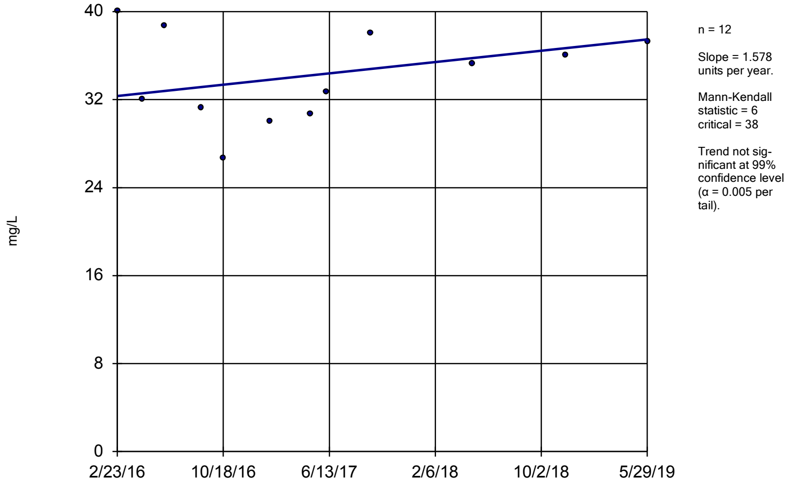


Constituent: TDS Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

BY-GSA-MW-3 (bg)

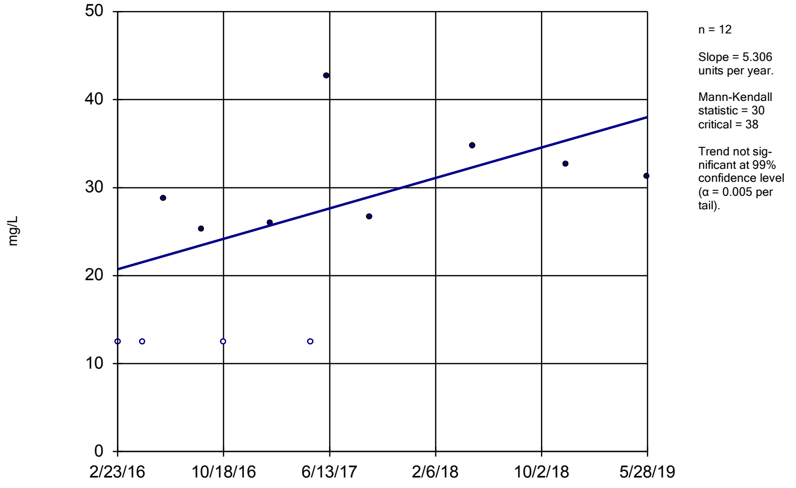


Constituent: TDS Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

BY-GSA-MW-4 (bg)



Constituent: TDS Analysis Run 9/12/2019 1:24 PM View: Trend Tests
Plant Barry Client: Southern Company Data: Barry GSA

# FIGURE F.

# Interwell Prediction Limit Summary Table - All Results

Plant Barry Client: Southern Company Data: Barry GSA Printed 9/13/2019, 9:41 AM

| Constituent | Well | Upper Lim. | Lower Lim. | Date | Observ. | Sig. | Bg N | Bg Mean | Std. Dev. | %NDs | ND Adj. | Transform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boron (mg/L) | n/a | 0.188 | n/a | n/a | 6 future | n/a | 48 | n/a | n/a | 83.33 | n/a | n/a | 0.000818 | NP Inter (NDs) 1 of 2 |
| Calcium (mg/L) | n/a | 1.898 | n/a | n/a | 6 future | n/a | 48 | 1.41 | 0.2558 | 0 | None | No | 0.001254 | Param Inter 1 of 2 |
| Fluoride (mg/L) | n/a | 0.1 | n/a | n/a | 6 future | n/a | 52 | n/a | n/a | 44.23 | n/a | n/a | 0.0006966 | NP Inter (normality) 1 of 2 |
| pH (pH) | n/a | 5.014 | 4.575 | n/a | 6 future | n/a | 56 | 4.794 | 0.1162 | 0 | None | No | 0.0006268 | Param Inter 1 of 2 |
| TDS (mg/L) | n/a | 58 | n/a | n/a | 6 future | n/a | 48 | n/a | n/a | 14.58 | n/a | n/a | 0.000818 | NP Inter (normality) 1 of 2 |

# FIGURE G.

# Intrawell Prediction Limit Summary Table - All Results

Plant Barry     Client: Southern Company     Data: Barry GSA     Printed 9/13/2019, 10:46 AM

| Constituent | Well | Upper Lim. | Date | Observ. | Sig. | Bg N | Bg Mean | Std. Dev. | %NDs | ND Adj. | Transform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloride (mg/L) | BY-GSA-MW-1 | 9.822 | n/a | 1 future | n/a | 12 | 1.956 | 0.4939 | 8.333 | None | sqrt(x) | 0.001254 | Param Intra 1 of 2 |
| Chloride (mg/L) | BY-GSA-MW-10 | 5.293 | n/a | 1 future | n/a | 12 | 3.697 | 0.6693 | 0 | None | No | 0.001254 | Param Intra 1 of 2 |
| Chloride (mg/L) | BY-GSA-MW-2 | 5.401 | n/a | 1 future | n/a | 12 | 14.81 | 6.021 | 8.333 | None | x^2 | 0.001254 | Param Intra 1 of 2 |
| Chloride (mg/L) | BY-GSA-MW-3 | 4.671 | n/a | 1 future | n/a | 12 | 50.05 | 21.74 | 8.333 | None | x^3 | 0.001254 | Param Intra 1 of 2 |
| Chloride (mg/L) | BY-GSA-MW-4 | 4.615 | n/a | 1 future | n/a | 12 | 1.938 | 0.08822 | 0 | None | sqrt(x) | 0.001254 | Param Intra 1 of 2 |
| Chloride (mg/L) | BY-GSA-MW-5 | 4.818 | n/a | 1 future | n/a | 12 | 12.37 | 4.547 | 8.333 | None | x^2 | 0.001254 | Param Intra 1 of 2 |
| Chloride (mg/L) | BY-GSA-MW-6 | 7.317 | n/a | 1 future | n/a | 12 | 4.781 | 1.063 | 0 | None | No | 0.001254 | Param Intra 1 of 2 |
| Chloride (mg/L) | BY-GSA-MW-7 | 9.716 | n/a | 1 future | n/a | 12 | 1.627 | 0.2713 | 0 | None | ln(x) | 0.001254 | Param Intra 1 of 2 |
| Chloride (mg/L) | BY-GSA-MW-8 | 5.7 | n/a | 1 future | n/a | 12 | 4.683 | 0.4261 | 0 | None | No | 0.001254 | Param Intra 1 of 2 |
| Chloride (mg/L) | BY-GSA-MW-9 | 11.01 | n/a | 1 future | n/a | 12 | 5.775 | 2.196 | 0 | None | No | 0.001254 | Param Intra 1 of 2 |
| Sulfate (mg/L) | BY-GSA-MW-1 | 23.3 | n/a | 1 future | n/a | 12 | n/a | n/a | 0 | n/a | n/a | 0.01077 | NP Intra (normality) 1 of 2 |
| Sulfate (mg/L) | BY-GSA-MW-10 | 12.55 | n/a | 1 future | n/a | 12 | 9.618 | 1.229 | 0 | None | No | 0.001254 | Param Intra 1 of 2 |
| Sulfate (mg/L) | BY-GSA-MW-2 | 10.2 | n/a | 1 future | n/a | 12 | 6.037 | 1.744 | 8.333 | None | No | 0.001254 | Param Intra 1 of 2 |
| Sulfate (mg/L) | BY-GSA-MW-3 | 9.12 | n/a | 1 future | n/a | 12 | 7.456 | 0.6976 | 0 | None | No | 0.001254 | Param Intra 1 of 2 |
| Sulfate (mg/L) | BY-GSA-MW-4 | 8.365 | n/a | 1 future | n/a | 12 | 6.626 | 0.7293 | 0 | None | No | 0.001254 | Param Intra 1 of 2 |
| Sulfate (mg/L) | BY-GSA-MW-5 | 28.75 | n/a | 1 future | n/a | 12 | 3.268 | 0.8781 | 0 | None | sqrt(x) | 0.001254 | Param Intra 1 of 2 |
| Sulfate (mg/L) | BY-GSA-MW-6 | 45.34 | n/a | 1 future | n/a | 11 | 16.31 | 11.77 | 0 | None | No | 0.001254 | Param Intra 1 of 2 |
| Sulfate (mg/L) | BY-GSA-MW-7 | 5.109 | n/a | 1 future | n/a | 12 | 3.167 | 0.8144 | 8.333 | None | No | 0.001254 | Param Intra 1 of 2 |
| Sulfate (mg/L) | BY-GSA-MW-8 | 5.248 | n/a | 1 future | n/a | 12 | 3.523 | 0.7232 | 8.333 | None | No | 0.001254 | Param Intra 1 of 2 |
| Sulfate (mg/L) | BY-GSA-MW-9 | 11.87 | n/a | 1 future | n/a | 12 | 2.798 | 0.2716 | 0 | None | sqrt(x) | 0.001254 | Param Intra 1 of 2 |

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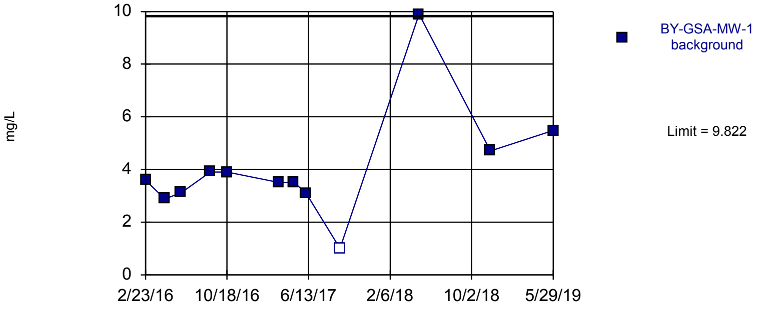
Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Parametric, BY-GSA-MW-1 (bg)



Background Data Summary (based on square root transformation): Mean=1.956, Std. Dev.=0.4939, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8699, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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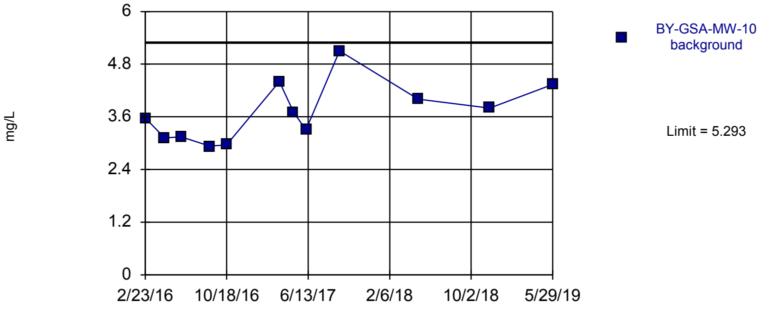
## Prediction Limit

Intrawell Parametric, BY-GSA-MW-10



Background Data Summary: Mean=3.697, Std. Dev.=0.6693, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9292, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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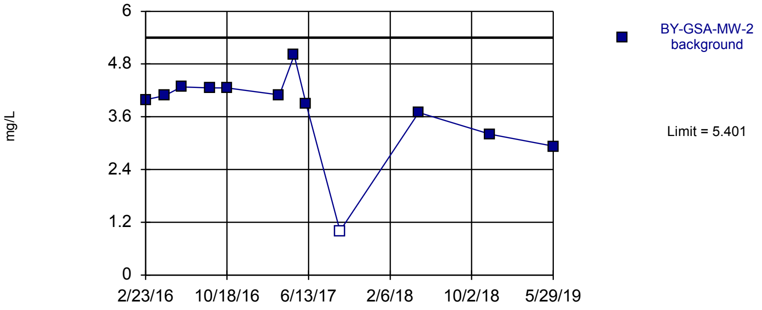
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Parametric, BY-GSA-MW-2 (bg)



Background Data Summary (based on square transformation): Mean=14.81, Std. Dev.=6.021, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9156, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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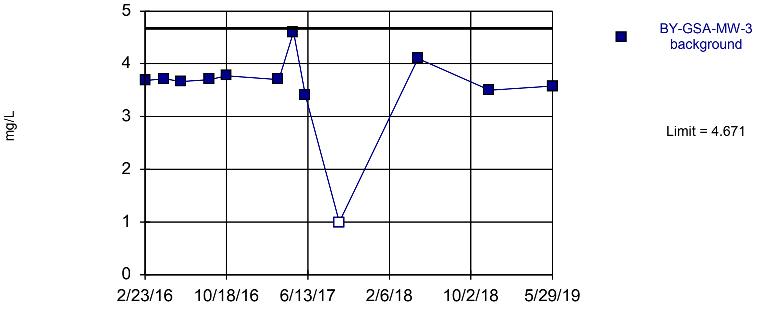
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Parametric, BY-GSA-MW-3 (bg)



Background Data Summary (based on cube transformation): Mean=50.05, Std. Dev.=21.74, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8422, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

# Prediction Limit

Constituent: Chloride (mg/L)  Analysis Run 9/13/2019 10:47 AM  View: Intrawell PLs

Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-1 |
|---|---|
| 2/23/2016 | 3.59 |
| 4/19/2016 | 2.89 |
| 6/6/2016 | 3.12 |
| 8/30/2016 | 3.91 |
| 10/18/2016 | 3.9 |
| 3/20/2017 | 3.5 |
| 5/2/2017 | 3.5 |
| 6/6/2017 | 3.1 |
| 9/13/2017 | <2 (U*) |
| 5/2/2018 | 9.9 |
| 11/27/2018 | 4.7 |
| 5/29/2019 | 5.48 |

# Prediction Limit

Constituent: Chloride (mg/L)　Analysis Run 9/13/2019 10:47 AM　View: Intrawell PLs

Plant Barry　Client: Southern Company　Data: Barry GSA

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| | BY-GSA-MW-10 |
|---|---|
| 2/23/2016 | 3.57 |
| 4/19/2016 | 3.12 |
| 6/7/2016 | 3.14 |
| 8/30/2016 | 2.93 |
| 10/18/2016 | 2.96 |
| 3/21/2017 | 4.4 |
| 5/2/2017 | 3.7 |
| 6/7/2017 | 3.3 |
| 9/13/2017 | 5.1 |
| 5/1/2018 | 4 |
| 11/26/2018 | 3.8 |
| 5/29/2019 | 4.34 |

# Prediction Limit

Constituent: Chloride (mg/L)    Analysis Run 9/13/2019 10:47 AM    View: Intrawell PLs
Plant Barry    Client: Southern Company    Data: Barry GSA

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| | BY-GSA-MW-2 |
|---|---|
| 2/23/2016 | 3.99 |
| 4/19/2016 | 4.08 |
| 6/7/2016 | 4.28 |
| 8/30/2016 | 4.26 |
| 10/18/2016 | 4.26 |
| 3/20/2017 | 4.1 |
| 5/2/2017 | 5 |
| 6/6/2017 | 3.9 |
| 9/13/2017 | <2 (U*) |
| 5/1/2018 | 3.7 |
| 11/27/2018 | 3.2 |
| 5/29/2019 | 2.93 |

# Prediction Limit

Constituent: Chloride (mg/L)  Analysis Run 9/13/2019 10:47 AM  View: Intrawell PLs

Plant Barry  Client: Southern Company  Data: Barry GSA

|  | BY-GSA-MW-3 |
|---|---|
| 2/23/2016 | 3.68 |
| 4/19/2016 | 3.72 |
| 6/7/2016 | 3.66 |
| 8/30/2016 | 3.7 |
| 10/18/2016 | 3.77 |
| 3/20/2017 | 3.7 |
| 5/2/2017 | 4.6 |
| 6/6/2017 | 3.4 |
| 9/13/2017 | <2 (U*) |
| 5/1/2018 | 4.1 |
| 11/27/2018 | 3.5 |
| 5/29/2019 | 3.58 |

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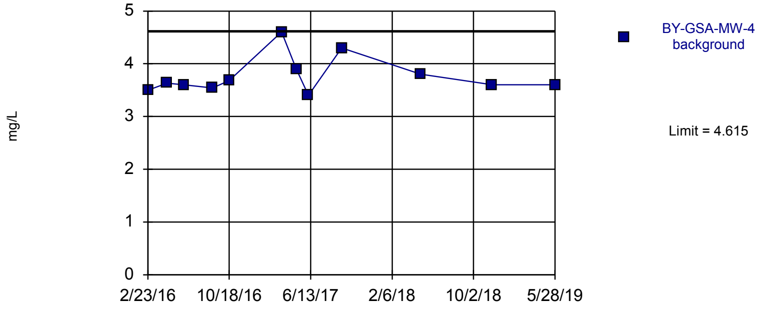
## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-4 (bg)



Background Data Summary (based on square root transformation): Mean=1.938, Std. Dev.=0.08822, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8171, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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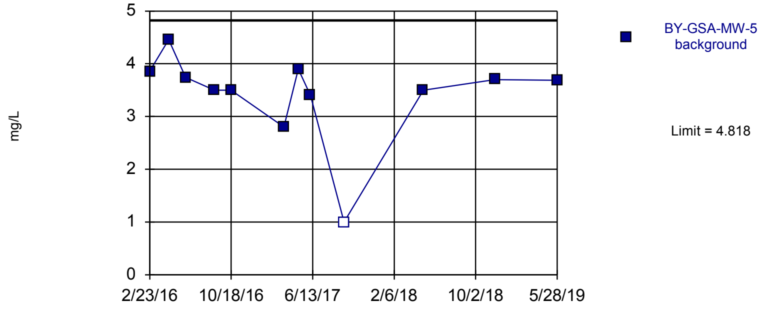
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-5



Background Data Summary (based on square transformation): Mean=12.37, Std. Dev.=4.547, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8651, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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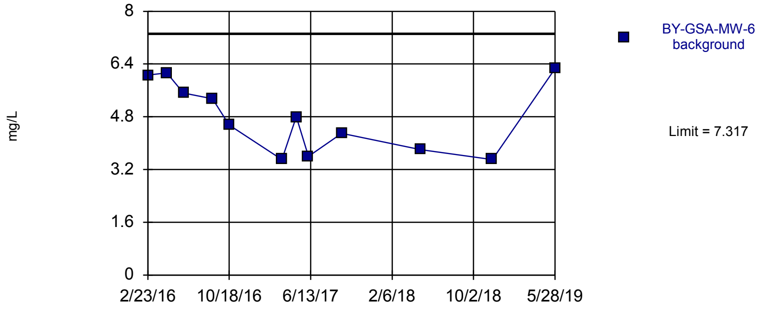
## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-6



Background Data Summary: Mean=4.781, Std. Dev.=1.063, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.897, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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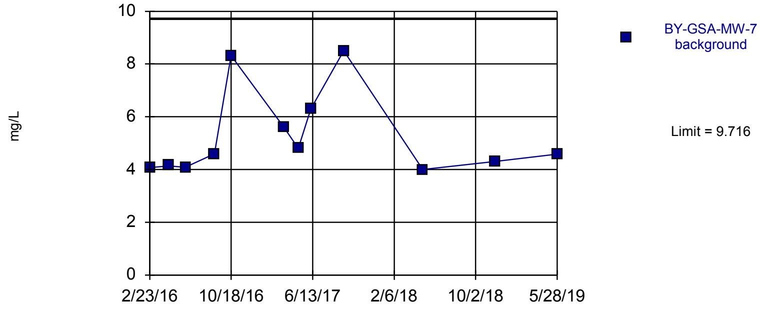
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-7



Background Data Summary (based on natural log transformation): Mean=1.627, Std. Dev.=0.2713, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8089, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

# Prediction Limit

Constituent: Chloride (mg/L)  Analysis Run 9/13/2019 10:47 AM  View: Intrawell PLs
Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-4 |
|---|---|
| 2/23/2016 | 3.5 |
| 4/19/2016 | 3.63 |
| 6/6/2016 | 3.6 |
| 8/30/2016 | 3.54 |
| 10/18/2016 | 3.68 |
| 3/20/2017 | 4.6 |
| 5/2/2017 | 3.9 |
| 6/6/2017 | 3.4 |
| 9/12/2017 | 4.3 |
| 5/1/2018 | 3.8 |
| 11/26/2018 | 3.6 |
| 5/28/2019 | 3.6 |

# Prediction Limit

Constituent: Chloride (mg/L)    Analysis Run 9/13/2019 10:47 AM    View: Intrawell PLs

Plant Barry    Client: Southern Company    Data: Barry GSA

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|  | BY-GSA-MW-5 |
|---|---|
| 2/23/2016 | 3.86 |
| 4/18/2016 | 4.46 |
| 6/7/2016 | 3.74 |
| 8/30/2016 | 3.5 |
| 10/18/2016 | 3.5 |
| 3/21/2017 | 2.8 |
| 5/2/2017 | 3.9 |
| 6/6/2017 | 3.4 |
| 9/13/2017 | <2 (U*) |
| 5/2/2018 | 3.5 |
| 11/27/2018 | 3.7 |
| 5/28/2019 | 3.69 |

# Prediction Limit

Constituent: Chloride (mg/L)    Analysis Run 9/13/2019 10:47 AM    View: Intrawell PLs

Plant Barry    Client: Southern Company    Data: Barry GSA

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| | BY-GSA-MW-6 |
|---|---|
| 2/23/2016 | 6.06 |
| 4/18/2016 | 6.13 |
| 6/6/2016 | 5.52 |
| 8/30/2016 | 5.35 |
| 10/18/2016 | 4.55 |
| 3/21/2017 | 3.5 |
| 5/2/2017 | 4.8 |
| 6/6/2017 | 3.6 |
| 9/12/2017 | 4.3 |
| 5/1/2018 | 3.8 |
| 11/26/2018 | 3.5 |
| 5/28/2019 | 6.26 |

# Prediction Limit

Constituent: Chloride (mg/L)  Analysis Run 9/13/2019 10:47 AM  View: Intrawell PLs
Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-7 |
|---|---|
| 2/23/2016 | 4.08 |
| 4/18/2016 | 4.14 |
| 6/6/2016 | 4.09 |
| 8/30/2016 | 4.6 |
| 10/18/2016 | 8.32 |
| 3/21/2017 | 5.6 |
| 5/2/2017 | 4.8 |
| 6/7/2017 | 6.3 |
| 9/12/2017 | 8.5 |
| 5/1/2018 | 4 |
| 11/27/2018 | 4.3 |
| 5/28/2019 | 4.59 |

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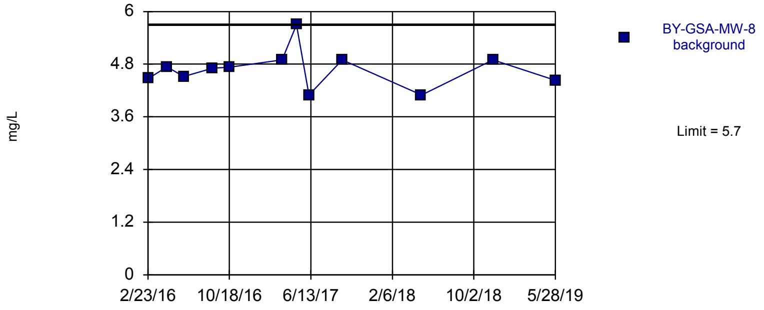
## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-8



Background Data Summary: Mean=4.683, Std. Dev.=0.4261, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9008, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

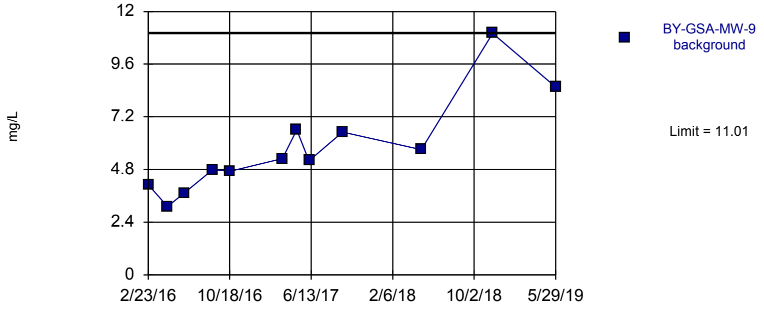
Constituent: Chloride Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-9



Background Data Summary: Mean=5.775, Std. Dev.=2.196, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8939, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

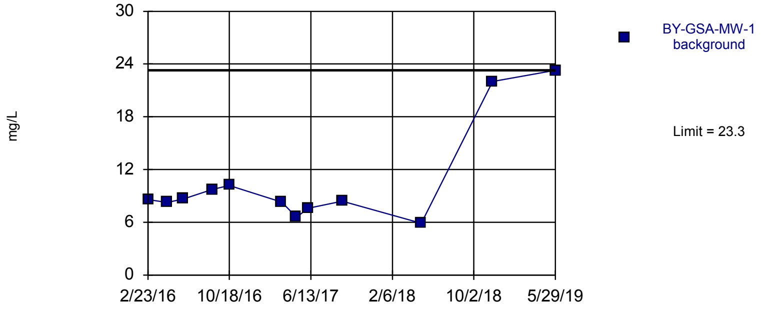
Constituent: Chloride Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs

Plant Barry Client: Southern Company Data: Barry GSA

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Prediction Limit

### Intrawell Non-parametric, BY-GSA-MW-1 (bg)



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/13/2019 10:45 AM View: Intrawell PLs

Plant Barry Client: Southern Company Data: Barry GSA

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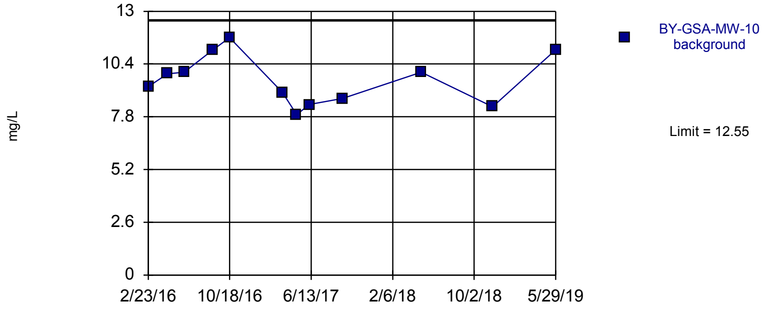
## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-10



Background Data Summary: Mean=9.618, Std. Dev.=1.229, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9451, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/13/2019 10:46 AM View: Intrawell PLs

Plant Barry Client: Southern Company Data: Barry GSA

# Prediction Limit

Constituent: Chloride (mg/L)  Analysis Run 9/13/2019 10:47 AM  View: Intrawell PLs

Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-8 |
|---|---|
| 2/23/2016 | 4.47 |
| 4/18/2016 | 4.74 |
| 6/7/2016 | 4.52 |
| 8/30/2016 | 4.71 |
| 10/18/2016 | 4.73 |
| 3/21/2017 | 4.9 |
| 5/2/2017 | 5.7 |
| 6/7/2017 | 4.1 |
| 9/13/2017 | 4.9 |
| 5/2/2018 | 4.1 |
| 11/27/2018 | 4.9 |
| 5/28/2019 | 4.43 |

# Prediction Limit

Constituent: Chloride (mg/L) Analysis Run 9/13/2019 10:47 AM View: Intrawell PLs

Plant Barry Client: Southern Company Data: Barry GSA

| | BY-GSA-MW-9 |
|---|---|
| 2/23/2016 | 4.1 |
| 4/19/2016 | 3.11 |
| 6/7/2016 | 3.72 |
| 8/30/2016 | 4.8 |
| 10/18/2016 | 4.71 |
| 3/21/2017 | 5.3 |
| 5/2/2017 | 6.6 |
| 6/7/2017 | 5.2 |
| 9/13/2017 | 6.5 |
| 5/1/2018 | 5.7 |
| 11/26/2018 | 11 |
| 5/29/2019 | 8.56 |

# Prediction Limit

Constituent: Sulfate (mg/L) Analysis Run 9/13/2019 10:47 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

| | BY-GSA-MW-1 |
|---|---|
| 2/23/2016 | 8.59 |
| 4/19/2016 | 8.27 |
| 6/6/2016 | 8.66 |
| 8/30/2016 | 9.74 |
| 10/18/2016 | 10.2 |
| 3/20/2017 | 8.3 |
| 5/2/2017 | 6.6 |
| 6/6/2017 | 7.6 |
| 9/13/2017 | 8.4 |
| 5/2/2018 | 5.9 |
| 11/27/2018 | 22 |
| 5/29/2019 | 23.3 |

# Prediction Limit

Constituent: Sulfate (mg/L) Analysis Run 9/13/2019 10:47 AM View: Intrawell PLs

Plant Barry Client: Southern Company Data: Barry GSA

|  | BY-GSA-MW-10 |
|---|---|
| 2/23/2016 | 9.29 |
| 4/19/2016 | 9.92 |
| 6/7/2016 | 10 |
| 8/30/2016 | 11.1 |
| 10/18/2016 | 11.7 |
| 3/21/2017 | 9 |
| 5/2/2017 | 7.9 |
| 6/7/2017 | 8.4 |
| 9/13/2017 | 8.7 |
| 5/1/2018 | 10 |
| 11/26/2018 | 8.3 |
| 5/29/2019 | 11.1 |

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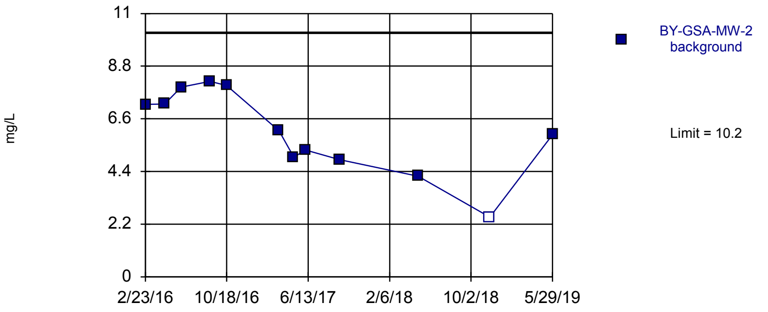
Hollow symbols indicate censored values.

## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-2 (bg)



Background Data Summary: Mean=6.037, Std. Dev.=1.744, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9387, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/13/2019 10:46 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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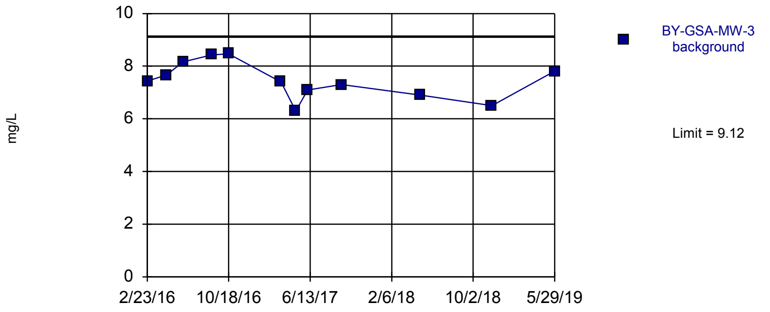
## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-3 (bg)



Background Data Summary: Mean=7.456, Std. Dev.=0.6976, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9647, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/13/2019 10:46 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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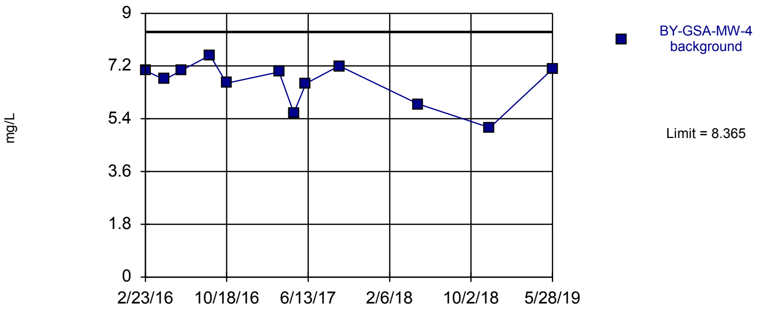
## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-4 (bg)



Background Data Summary: Mean=6.626, Std. Dev.=0.7293, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8904, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/13/2019 10:46 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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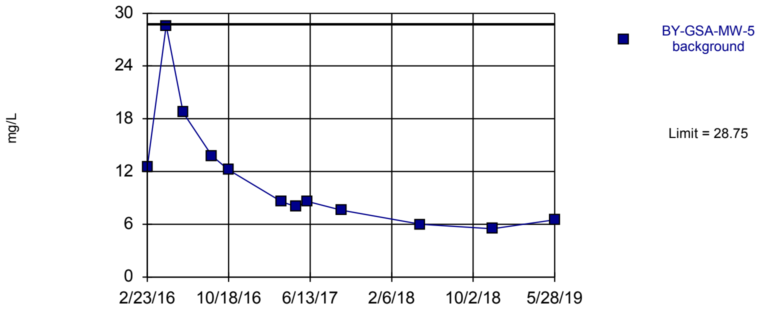
## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-5



Background Data Summary (based on square root transformation): Mean=3.268, Std. Dev.=0.8781, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.876, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/13/2019 10:46 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

# Prediction Limit

Constituent: Sulfate (mg/L)    Analysis Run 9/13/2019 10:47 AM    View: Intrawell PLs

Plant Barry    Client: Southern Company    Data: Barry GSA

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| | BY-GSA-MW-2 |
|---|---|
| 2/23/2016 | 7.2 |
| 4/19/2016 | 7.22 |
| 6/7/2016 | 7.92 |
| 8/30/2016 | 8.17 |
| 10/18/2016 | 7.99 |
| 3/20/2017 | 6.1 |
| 5/2/2017 | 5 |
| 6/6/2017 | 5.3 |
| 9/13/2017 | 4.9 (J) |
| 5/1/2018 | 4.2 (J) |
| 11/27/2018 | <5 (J) |
| 5/29/2019 | 5.94 |

# Prediction Limit

Constituent: Sulfate (mg/L)    Analysis Run 9/13/2019 10:47 AM    View: Intrawell PLs
Plant Barry    Client: Southern Company    Data: Barry GSA

|  | BY-GSA-MW-3 |
|---|---|
| 2/23/2016 | 7.44 |
| 4/19/2016 | 7.66 |
| 6/7/2016 | 8.16 |
| 8/30/2016 | 8.43 |
| 10/18/2016 | 8.47 |
| 3/20/2017 | 7.4 |
| 5/2/2017 | 6.3 |
| 6/6/2017 | 7.1 |
| 9/13/2017 | 7.3 |
| 5/1/2018 | 6.9 |
| 11/27/2018 | 6.5 |
| 5/29/2019 | 7.81 |

# Prediction Limit

Constituent: Sulfate (mg/L)  Analysis Run 9/13/2019 10:47 AM  View: Intrawell PLs
Plant Barry  Client: Southern Company  Data: Barry GSA

|  | BY-GSA-MW-4 |
|---|---|
| 2/23/2016 | 7.04 |
| 4/19/2016 | 6.74 |
| 6/6/2016 | 7.04 |
| 8/30/2016 | 7.57 |
| 10/18/2016 | 6.62 |
| 3/20/2017 | 7 |
| 5/2/2017 | 5.6 |
| 6/6/2017 | 6.6 |
| 9/12/2017 | 7.2 |
| 5/1/2018 | 5.9 |
| 11/26/2018 | 5.1 |
| 5/28/2019 | 7.1 |

# Prediction Limit

Constituent: Sulfate (mg/L)    Analysis Run 9/13/2019 10:47 AM    View: Intrawell PLs

Plant Barry    Client: Southern Company    Data: Barry GSA

| | BY-GSA-MW-5 |
|---|---|
| 2/23/2016 | 12.5 |
| 4/18/2016 | 28.6 |
| 6/7/2016 | 18.7 |
| 8/30/2016 | 13.8 |
| 10/18/2016 | 12.2 |
| 3/21/2017 | 8.6 |
| 5/2/2017 | 8 |
| 6/6/2017 | 8.6 |
| 9/13/2017 | 7.6 |
| 5/2/2018 | 6 |
| 11/27/2018 | 5.5 |
| 5/28/2019 | 6.5 |

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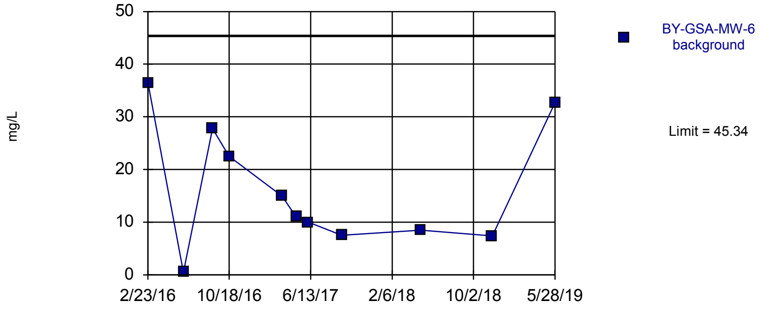
## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-6



Background Data Summary: Mean=16.31, Std. Dev.=11.77, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9097, critical = 0.792. Kappa = 2.467 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/13/2019 10:46 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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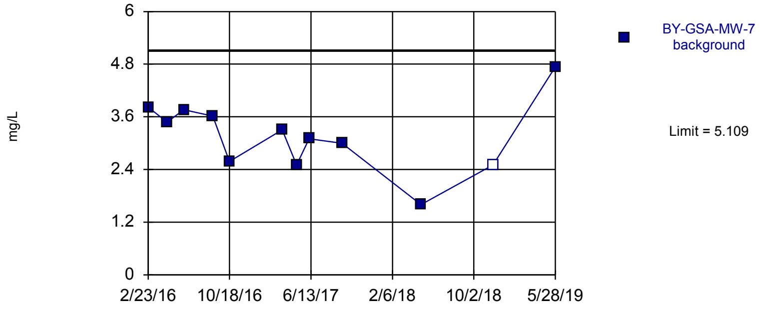
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-7



Background Data Summary: Mean=3.167, Std. Dev.=0.8144, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9765, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/13/2019 10:46 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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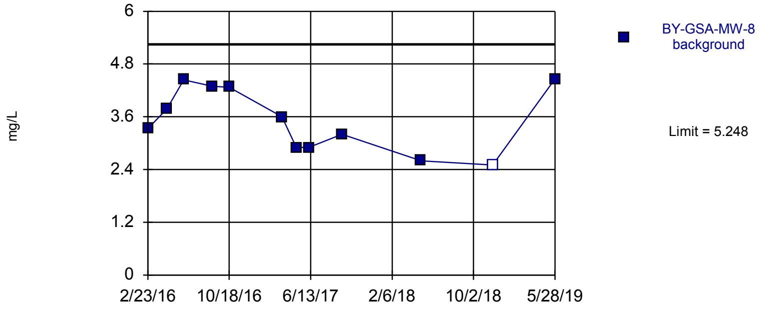
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-8



Background Data Summary: Mean=3.523, Std. Dev.=0.7232, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9115, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/13/2019 10:46 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

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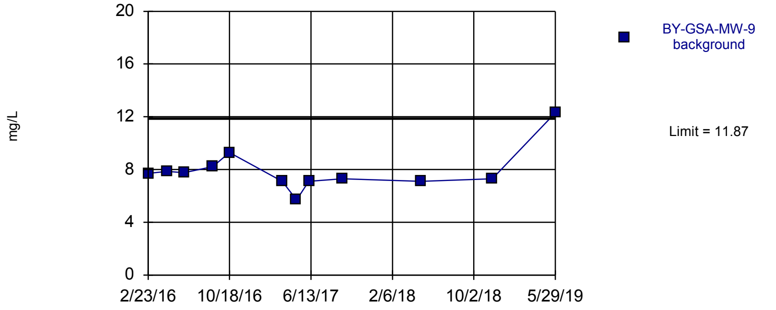
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

## Prediction Limit

### Intrawell Parametric, BY-GSA-MW-9



Background Data Summary (based on square root transformation): Mean=2.798, Std. Dev.=0.2716, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8285, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/13/2019 10:46 AM View: Intrawell PLs
Plant Barry Client: Southern Company Data: Barry GSA

# Prediction Limit

Constituent: Sulfate (mg/L)    Analysis Run 9/13/2019 10:47 AM    View: Intrawell PLs
Plant Barry    Client: Southern Company    Data: Barry GSA

| | BY-GSA-MW-6 |
|---|---|
| 2/23/2016 | 36.5 |
| 4/18/2016 | 80.2 (o) |
| 6/6/2016 | 0.498 (J) |
| 8/30/2016 | 27.8 |
| 10/18/2016 | 22.5 |
| 3/21/2017 | 15 |
| 5/2/2017 | 11 |
| 6/6/2017 | 10 |
| 9/12/2017 | 7.5 |
| 5/1/2018 | 8.5 |
| 11/26/2018 | 7.4 |
| 5/28/2019 | 32.7 |

# Prediction Limit

Constituent: Sulfate (mg/L)    Analysis Run 9/13/2019 10:47 AM    View: Intrawell PLs

Plant Barry    Client: Southern Company    Data: Barry GSA

| | BY-GSA-MW-7 |
|---|---|
| 2/23/2016 | 3.82 |
| 4/18/2016 | 3.48 |
| 6/6/2016 | 3.76 |
| 8/30/2016 | 3.62 |
| 10/18/2016 | 2.58 |
| 3/21/2017 | 3.3 (J) |
| 5/2/2017 | 2.5 (J) |
| 6/7/2017 | 3.1 (J) |
| 9/12/2017 | 3 (J) |
| 5/1/2018 | 1.6 (J) |
| 11/27/2018 | <5 (J) |
| 5/28/2019 | 4.74 |

# Prediction Limit

Constituent: Sulfate (mg/L)  Analysis Run 9/13/2019 10:47 AM  View: Intrawell PLs
Plant Barry  Client: Southern Company  Data: Barry GSA

| | BY-GSA-MW-8 |
|---|---|
| 2/23/2016 | 3.33 |
| 4/18/2016 | 3.78 |
| 6/7/2016 | 4.44 |
| 8/30/2016 | 4.29 |
| 10/18/2016 | 4.27 |
| 3/21/2017 | 3.6 (J) |
| 5/2/2017 | 2.9 (J) |
| 6/7/2017 | 2.9 (J) |
| 9/13/2017 | 3.2 (J) |
| 5/2/2018 | 2.6 (J) |
| 11/27/2018 | <5 (J) |
| 5/28/2019 | 4.46 |

# Prediction Limit

Constituent: Sulfate (mg/L)  Analysis Run 9/13/2019 10:47 AM  View: Intrawell PLs

Plant Barry  Client: Southern Company  Data: Barry GSA

|  | BY-GSA-MW-9 |
|---|---|
| 2/23/2016 | 7.71 |
| 4/19/2016 | 7.85 |
| 6/7/2016 | 7.76 |
| 8/30/2016 | 8.22 |
| 10/18/2016 | 9.29 |
| 3/21/2017 | 7.1 |
| 5/2/2017 | 5.7 |
| 6/7/2017 | 7.1 |
| 9/13/2017 | 7.3 |
| 5/1/2018 | 7.1 |
| 11/26/2018 | 7.3 |
| 5/29/2019 | 12.3 |

# Appendix C

| | |
|---|---|
| Procedure Number | 7839 |
| Revision Number | 4 |
| Effective Date | 03/23/2020 |
| Page Number | 1 of 16 |

# WFG Low-Flow Groundwater Sampling TSOP

## 1. Purpose

1.1. The purpose of this Technical SOP (TSOP) is to discuss the process and requirements associated with conducting Low-Flow groundwater sampling.

1.2. This TSOP specifically describes using bladder pumps and peristaltic pumps to obtain groundwater samples collected for laboratory analysis by the Alabama Power Company (APC) Environmental Affairs (EA), Water Field Group (WFG).

## 2. Scope

2.1. This procedure is to be used by field personnel when collecting and handling groundwater samples using the Low-Flow groundwater collection method in the field.

2.2. The sampling equipment covered in this TSOP may be portable (well-to-well) or well-dedicated.

2.3. The sampling of SVOCs and VOCs should not be collected with the use of peristaltic pumps unless prior written customer approval is attained.

2.4. The procedure is designed to ensure that the samples collected are representative of the aquifer or target formation and that sample cross-contamination is eliminated during the sampling and handling process.

2.5. This procedure cannot replace education and experience. Professional judgment should be used in conjunction with this procedure.

## 3. Definitions/Abbreviations

3.1. Low-Flow (or micropurge) - Refers to the velocity with which water is withdrawn from the well. The objective of low-flow sampling is to extract fresh samples of the ambient groundwater from within the screened interval of the well with minimal impact to the zone of influence of the well.

3.2. Drawdown - Lowering of the water column within a well due to pumping. Typically associated with high-flow purging of a well for water sampling.

3.3. DI water – De-ionized water. Water that has been passed through a standard deionizing resin column. Water used for decontamination of field equipment.

3.4. Ultra-pure DI water- Water that is filtered and treated to the highest levels of purity. This water is used for the filling of blanks.

3.5. Phosphate-free soap or cleaner – A cleaner which contains, by weight, 0.5% or less of phosphates or derivatives of phosphates (Liquinox® or Luminox®).

3.6. Potable water- Water that is safe to consume. Can be used in detergent solution and first rinse during decontamination. Can be replaced by DI water.

3.7. PPE - Personal Protective Equipment.

3.8. NTU - Nephelometeric Turbidity Units. The unit of measure used when measuring the turbidity of water.

3.9. COC - Chain of Custody. A controlled document used to record sample information and transfer the samples to the laboratory after collection.

3.10. SVOCs and VOCs- Semi-volatile organic compounds and volatile organic compounds.

3.11. DO - Dissolved Oxygen

3.12. ORP - Oxidation Reduction Potential

3.13. SAP - Sampling and Analysis Plan

3.14. EDAS- Environmental Data Acquisition System

3.15. Artesian well- A well in which water rises under pressure from a permeable stratum overlaid by impermeable rock.

## 4. References

4.1. Internal Documents

4.1.1. WFG Groundwater Equipment Decontamination TSOP
4.1.2. WFG Groundwater Water Level and Total Depth Measurements TSOP
4.1.3. WFG General Water Sampling and Field Measurement TSOP
4.1.4. WFG Deployment and Maintenance of Dedicated Groundwater Equipment TSOP
4.1.5. WFG Turbidity TSOP
4.1.6. WFG Temperature TSOP
4.1.7. WFG Conductivity TSOP
4.1.8. WFG Luminescent Dissolved Oxygen (LDO) TSOP
4.1.9. WFG Oxidation-Reduction Potential (ORP) TSOP
4.1.10. WFG pH (TSOP-SM-4500H) TSOP
4.1.11. WFG Electronic Calibration Form
4.1.12. Groundwater Electronic Chain of Custody

4.1.13. Site specific SAP

4.2. External Documents

4.2.1. United States Environmental Protection Agency (U.S. EPA). Region 4, Groundwater Sampling. Document # SESDPROC-301-R4.
4.2.2. Florida Department of Environmental Protection (DEP). FS 2200 Groundwater Sampling. Document # DEP-SOP-001/01.
4.2.3. United States Environmental Protection Agency (U.S. EPA). Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. Document # EPA/540/S-95/504.
4.2.4. ASTM Standard D6771-18- Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations

## 5. Method Overview

5.1. Low flow sampling of groundwater from within the screened interval is accomplished by maintaining a low pump rate that minimizes drawdown of the water column while leaving the more stagnant water above the screened interval undisturbed.

5.2. Indicator parameters and water levels are measured at the beginning of and while micro-purging the well. Stabilization acceptance criteria for turbidity, pH, specific conductance and DO are found in the site specific SAP. Stabilization of these parameters indicates that the water is representative of ambient conditions and sample collection can begin. ORP and temperature measurements should also be collected but will not be used as indicators of stability.

5.3. Non-dedicated sampling equipment must be decontaminated prior to next use in a well to avoid cross contamination. Refer to and understand the Groundwater Equipment Decontamination TSOP prior to performing groundwater sampling.

## 6. Detection Limit

6.1. Some of the indicator parameter methods used to show equilibrium of the well water have minimum detection limits or other quality control requirements. Refer to the latest version of the TSOPs associated with these procedures (turbidity, pH, specific conductance, and DO).

6.2. Users of this procedure must study and be familiar with the applicable data acceptance criteria and required field measurements. Refer to the SAP for information on these parameters and other information.

## 7. Safety

7.1. Appropriate PPE should be worn and utilized when sampling groundwater wells in accordance with APC policies. Generally this includes safety glasses, hard hats, gloves and safety-toed boots. Plant-specific requirements may also apply and should be determined/known prior to arriving at the work location.

7.2. Refer to the WFG General Water Sampling and Field Measurement TSOP procedure for general safety requirements.

7.3. If using compressed Nitrogen gas for deep wells, always secure tanks when transporting and ensure protective cap is secured over valve. Take care to avoid exceeding the max pressure rating of the controller, air hose and pump.

## 8. Equipment and Materials

The following is a basic listing of the necessary reusable and expendable items that are required to complete this procedure.

8.1. Reusable Items

8.1.1. Field Book
8.1.2. Appropriate installation diagram and/or well construction data
8.1.3. Keys for well locks
8.1.4. Water level meter
8.1.5. Pump with parts (tubing grab plates, bladders, O-rings, etc.)
8.1.6. Pump controller
8.1.7. Peristaltic pump
8.1.8. Flow-through cell
8.1.9. iPad
8.1.10. InSitu™ multi-parameter probe
8.1.11. Handheld turbidity meter
8.1.12. Generator (min. 2,000 kW)
8.1.13. Air compressor and hose
8.1.14. Graduated cylinder
8.1.15. Tubing Weight (for peristaltic application)
8.1.16. Tubing caddy with counter unit or other measurement device
8.1.17. Decon/wash containers w/ lids (3)
8.1.18. Coolers for samples
8.1.19. Procedures & SAPs

8.2. Consumable/Disposable Items

8.2.1. Tubing (estimated for number of wells x well depths with extra)
8.2.2. Silicone tubing for peristaltic pump head
8.2.3. COCs (if electronic format is not suitable)
8.2.4. Plastic sheeting
8.2.5. Gasoline (in approved container)
8.2.6. Ice for samples
8.2.7. Sample Bottles
8.2.8. DI water (For decon)
8.2.9. Ultra-Pure DI water (For blanks collection)
8.2.10. Potable water (for decon)
8.2.11. Phosphate free detergent (e.g. Liquinox or Luminox®)
8.2.12. Support rope or coated safety cable
8.2.13. Calibration Standards
8.2.14. Disposal sample bags & trash bags
8.2.15. Paper towels

## 9. Reagents & Standards

9.1. This document describes the Low-Flow purging and sampling procedure and does not include method calibration procedures. Calibration procedures may be found in the associated method TSOP on the APC Qualtrax site. The instrument(s) used to measure indicator parameters must be verified daily using the below appropriate calibration standards (or equivalent).

9.1.1. ORP- ZoBell's ORP Solution
9.1.2. pH- 3-point calibration

  9.1.2.1. 2.00 buffer standard for pH
  9.1.2.2. 4.00 buffer standard for pH
  9.1.2.3. 7.00 buffer standard for pH
  9.1.2.4. 10.00 buffer standard for pH
  9.1.2.5. 12.00 buffer standard for pH

9.1.3. DO - NA
9.1.4. Specific Conductance - 1,412 µS/cm, or appropriate conductivity standard
9.1.5. Turbidity – Zeroed with 0.00 standard and calibrated with 10.00 NTU standard

## 10. Calibration

10.1. Calibration and/or verification of water quality measurement equipment shall be performed at the start of each day and should be specific to the manufacturer's calibration instructions. A verification check of the instrument calibration will be performed after the calibration and at the end of each day with a standard of the same value but different lot number or manufacturer.

10.2. All calibration data, and initial and final LCS data, should be recorded electronically in the calibration log on EDAS.

10.3. Refer to the APC TSOP for each method to complete the instrument calibration (TSOPs: turbidity, pH, temperature, specific conductance, DO and ORP).

## 11. Procedure

### General Note

At the start of each sampling event, a round of water levels from each well should be collected for use in generating a potentiometric surface map. This should be completed on the first day of the sampling event. Refer to the Groundwater Water Level and Total Depth Measurement TSOP for guidance.

11.1. Well lock keys are maintained by the plant compliance contact and must be obtained from the compliance office, if not already assigned a key, prior to beginning work

11.2. Inspect the well for any damage or tampering. If there is evidence of damage or tampering, immediately notify the Technical Manager or the Water Field Services Supervisor. Take photos of the site as documentation and make sure not to disturb the well. The damage/tampering and any discussions about a response should also be documented in the field logbook or electronically in the iPad.

11.3. If the well is in good condition, open the well head and if the well is non-dedicated and non-vented, remove the inner casing cap to allow for atmospheric equilibration. Begin setting up to sample by arranging/organizing the work zone.

11.4. Designate a clean work space or work surface used to provide a contaminant-free area to place sampling equipment during assembly.

11.5. Calibrate or verify all field parameter measurement equipment at the start of each day (this typically includes an InSitu multi-meter probe and a handheld turbidity meter if an inline turbidity sensor is not used). Refer to the appropriate method TSOP and calibration procedure for each instrument used.

11.6. All non-dedicated equipment that will, or could come into contact with groundwater (e.g. pump and water level meter) in the well must be decontaminated prior to each use. Refer to the Groundwater Equipment Decontamination TSOP for more details.

11.7. Using a properly functioning water level indicator, lower the probe into the well and obtain an initial water level measurement for the well (Refer to WFG Groundwater Water Level and Total Depth Measurements TSOP).

11.8. Measure and record all water levels to the nearest hundredth (0.01) foot at the reference point or survey mark on the well casing.

11.9. Refer to the WFG Deployment and Maintenance of Dedicated Groundwater Equipment TSOP for initial or re-deployment of dedicated pumps and for performing maintenance activities.

11.10. Dedicated Low-Flow – Bladder Pump

11.10.1. Connect the external compressor hose to the pump controller intake port using the quick-connect.

11.10.2. Connect the pump air supply line to the “Air Out” quick connect on the control box. Connect the other end of the air supply line to the air connection on the dedicated well cap.

11.10.3. Connect a short piece of tubing to the existing sample line on the dedicated well cap and then connect to the bottom of the flow-through cell for the InSitu multi-probe. Use care to ensure proper connection of the tubing.

11.10.4. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth. Ensure that the dedicated pump is still located below the water table, and at a suitable sampling depth.

11.10.5. Insert the InSitu multi-parameter probe into the flow-through cell and press the power button

11.10.6. Turn on the iPad and open the InSitu Low-Flow application (iSitu® or VuSitu® app). Enter the initial data needed to initiate the program or if a template is available, open the well specific template. Refer to the manufacturer’s instructions for a step-by-step explanation of the Low-Flow app and the data input required.

11.10.7. Continue to fill in all appropriate information in the InSitu program using the parameter stabilization criteria set forth in the site-specific SAP. Always confirm with the Technical Manager that the current SAP is being used.

11.10.8. Place the generator as far away as possible from the well, preferable downwind. Start the generator and the air compressor to begin pumping. If the well is too deep for a traditional air compressor, use of compressed Nitrogen gas, high pressure controller and pressure regulator may be required.

11.10.9. Monitor the water level and adjust the flow rate on the pump controller to provide a constant water level in the well. Pump rates should not exceed three tenths of a foot (0.3) water level drawdown when sampling. During initial pump start-up, drawdown may exceed three tenths of a foot (0.3) while flow rate adjustments are being made or while water level stabilization occurs.

11.10.10. Use a graduated cylinder (or similar) to measure the flow rate in milliliters per minute (ml/min). Purge rates must fall between 100 and 500 ml/min or meet the specific requirements provided in the project SAP. If the minimum flow rate requirement of 100 ml/min cannot be achieved without water level drawdown exceeding three tenths of a foot (0.3), refer to section 16.1.

11.10.10.1. If the well has been previously purged and sampled, refer back to the most recent well record and make an effort to target that purge rate for consistency.

11.10.11. When a stable purge rate is attained, enter that flow rate in the InSitu program and set the measurement frequency to every 5 minutes. The Low-Flow application (iSitu® or VuSitu® app) will now be used to determine when groundwater samples can be taken. The Low-Flow app uses the previously entered SAP acceptance criteria and applies them to each measurement. When the criteria are met, the indicator parameter will be highlighted in green on the iPad screen, indicating equilibration.

11.10.12. Note the start time and other well information in the field log book and start the program.

11.10.13. Turbidity measurements may be taken with an inline turbidity sensor or with an external handheld unit. If using an external turbidity meter, readings must collected as close as possible to the time as the readings acquired from the InSitu meter.

11.10.14. Continue to measure water level and turbidity at the same measurement frequency as the indicator parameters, entering the values in the iPad InSitu application.

11.10.15. Once the water level and all field parameters have stabilized and turbidity is less than 10 NTU according to the criteria in the SAP, the well is considered equilibrated and sampling may take place. Refer to the site-specific SAP and Sections 16.2 and 16.3 of this procedure for direction on wells where 10 NTU are unattainable.

11.10.16. Tap the "**Finish Test**" button on the iPad and enter any relevant notes such as time sampled in the comment section. Email the data file to a secure company email address for storage and use. In the event that there is no data service to email the file and the iPad is damaged or lost before the field report can be sent, the well will be re-sampled.
11.10.17. **DO NOT** turn off the pump. Complete the labeling for all sample bottles and also record the same information for each sample in the field log book, and all electronic forms.
11.10.18. Put on nitrile or latex gloves and make sure that all bottles are preserved with the appropriate acid.
11.10.19. Carefully remove the sample line from the bottom of the flow-through cell. Cut the end off of the sample tubing and begin filling up the sample containers.
11.10.20. Do not adjust the flow rate when sampling.
11.10.21. Fill up the containers by placing the tubing in the mouth of the bottle, using care not to touch the mouth or sides of the container. Do not overfill sample bottles. Bottle should be filled to the top leaving a small amount of headspace, unless otherwise directed by the customer or lab.
11.10.22. Upon filling and capping all sample containers, place the samples in the sample cooler and ensure that the samples with temperature requirements are placed on ice.
11.10.23. Turn off the controller, air compressor and generator.
11.10.24. Remove the water level indicator from the well, making sure to decontaminate the wetted tape and probe portion.
11.10.25. Disconnect the airline tubing from the controller and make sure the sample line tubing is disconnected. Secure the dedicated tubing within the wellhead in such manner that the tubing stays clean and does not fall into the well. Close and secure the well.

11.11. Non- Dedicated Low Flow- Bladder Pump

11.11.1. Complete Steps 11.1 – 11.9 from the above procedure.
11.11.2. Assemble a clean pump system with a bladder, and connect the support rope or cable, sample line, and air line to the top of the pump assembly. Use care to ensure proper connection and positioning. Never lower a pump in a well without a support rope attached.
11.11.3. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth.

11.11.4. Slowly lower the pump assembly into the well, using care to minimize disturbance once the groundwater interface is reached. The tubing counter or other depth measurement devices can be used to aid in determining appropriate depth.
11.11.5. Recharge characteristics may dictate the need to place the pump intake slightly lower than the mid-screen depth if drawdown historically is unavoidable.
11.11.6. With the pump intake lowered to approximately mid-screen depth, secure the support rope or cable so that the pump is fixed and stationary in the well.
11.11.7. Cut the air line to an appropriate length and attach to the air hose on the pump controller. Next, cut the water line to an appropriate length and attach to the bottom of the flow-through cell.
11.11.8. Re-lower the water level meter into the well.
11.11.9. Follow above Steps 11.10.5 – 11.10.23.
11.11.10. Remove the pump and tubing from the well. Discard the used tubing and pump bladder. Never re-use disposable sampling equipment or tubing.
11.11.11. Place the well cap back on the well and close and lock the well lid.

11.12. Low Flow –Peristaltic Pumps

11.12.1. Complete steps 11.1 – 11.9 from the above procedures.
11.12.2. Peristaltic- Dedicated Well Tubing

11.12.2.1. Prepare an adequate length of clean silicon tubing that has the correct outside and inside dimensions to allow proper fit in the pump head. Insert into the pump head rollers and secure (refer to pump user manual for additional information).
11.12.2.2. Connect the vacuum end of the silicone tubing to the barb fitting on the dedicated well cap.
11.12.2.3. Attach the discharge end of the silicone tubing to the bottom of the flow through cell.

11.12.3. Peristaltic- Non-Dedicated Well Tubing

11.12.3.1. Attach the tubing weight to the end of clean polyethylene tubing.
11.12.3.2. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth.

11.12.3.3. Using the tubing caddy or another tubing depth measurement device, slowly lower the tubing and weight to the mid-screen depth.

11.12.3.4. Once the tubing intake is at the correct depth, allow for excess tubing at the surface and insert into the pump head rollers and secure.

11.12.3.5. Allow for a short section (one to three feet) of tubing from the discharge side of the pump head. This may be used for both the purge discharge and to fill sample bottles upon stabilization.

11.12.3.6. Attach the discharge tubing to the intake (lower) port of the flow-through cell.

11.12.4. Insert the InSitu multi-parameter probe into the flow-through cell and press the power button on the battery pack.

11.12.5. Turn on the iPad and open the InSitu Low-Flow application (iSitu® or VuSitu® app). Enter the initial data needed to initiate the program or if a template is available, open the well-specific template. Refer to the manufacturer's instructions for a step-by-step explanation of the Low-Flow app and the data input required.

11.12.6. Make the necessary preparations to provide power to the pump. Turn on the peristaltic pump to produce a vacuum on the well side of the pump head and begin purging. Observe pump direction to ensure that the pump operation is applying a vacuum to the sample line (down-hole) tubing.

11.12.7. Monitor the water level and adjust the flow rate to provide a constant water level in the well. The pump rate will initially require adjustment based on the site and well properties. Pump rates should not exceed three tenths of a foot (0.3) water level drawdown when sampling. During initial pump start-up, drawdown may exceed three tenths of a foot (0.3) while flow rate adjustments are being made or while water level stabilization occurs. If the minimum flow rate requirement of 100 ml/min cannot be achieved without water level drawdown exceeding three tenths of a foot (0.3), refer to section 16.1.

11.12.8. Continue to fill in all appropriate information in the InSitu program using the parameter stabilization criteria set forth in the site-specific SAP. Always confirm with the Technical Manager that the current SAP data are being used.

11.12.9. Use a graduated cylinder (or similar) to measure the flow rate in milliliters per minute (ml/min). Purge rates must fall between 100 and 500 ml/min or meet the specific requirements provided in the project SAP.

11.12.9.1. If the well has been previously purged and sampled, refer back to the most recent well record and make an effort to match the purge rate for consistency.

11.12.10. When a stable purge rate is attained, enter that flow rate in the InSitu program and set the measurement frequency to 5 minutes. The Low-Flow application (iSitu® or VuSitu® app) will now be used to determine when groundwater samples can be taken. The Low-Flow app uses the previously entered SAP acceptance criteria and compares them to each measurement. When the criteria are met, the indicator parameter will be highlighted in green on the iPad screen, indicating equilibration.

11.12.11. Note the start time and other well information in the field log book and start the program.

11.12.12. Turbidity measurements may be taken with an inline turbidity sensor or with an external handheld unit. If using an external turbidity meter, readings must be collected as close as possible to the time as the readings acquired from the InSitu meter.

11.12.13. Continue to measure water level and turbidity at the same measurement frequency as the indicator parameters, entering the values in the iPad SmarTROLL™ application.

11.12.14. Once the water level and all field parameters have stabilized and turbidity is less than 10 NTU according to the criteria in the SAP, the well is considered equilibrated and sampling may take place. Refer to the site-specific SAP and Sections 16.2 and 16.3 of this procedure for wells where 10 NTU is unattainable.

11.12.15. Tap the “**Finish Test**” button on the iPad and enter any relevant notes such as time sampled in the comment section. Email the data file to a secure company email address for storage and use. In the event that there is no data service to email the file and the iPad is damaged or lost before the field report can be sent, the well will be re-sampled.

11.12.16. **DO NOT** turn off the pump. Complete the labeling for all sample bottles and also record the same information for each sample in the field log book and associated electronic forms.

11.12.17. Make sure that all bottles are preserved with the appropriate acid.

11.12.18. Carefully remove the sample line from the bottom of the flow-through cell. Cut the end off of the sample tubing and begin filling up the sample containers.

11.12.19. Do not adjust the flow rate when sampling.

11.12.20. Fill up the containers by placing the tubing in the mouth of the bottle, using care not to touch the mouth or sides of the container. Do not overfill sample bottles. Bottles should be filled to the top leaving a small amount of headspace unless otherwise directed by the customer or lab.

11.12.21. Upon filling and capping all sample containers, place the samples in the sample cooler and ensure that the samples with temperature requirements are placed on ice.

11.12.22. Stop the pump and reverse the flow direction so that the sample line is emptied of water.

11.12.23. Turn off the peristaltic pump and generator.

11.12.24. Remove the water level indicator from the well, making sure to decontaminate the wetted tape and probe.

11.12.25. For dedicated tubing, disconnect the silicone tubing piece from the pump and dedicated well cap and throw away. Close and secure the well. For non-dedicated tubing, disconnect the tubing from the pump and throw away.

11.13. Decontamination and Clean-Up – For all Reusable Components

11.13.1. Decontamination of any reusable components can be completed as a separate task at a later time but must not be re-used until decontaminated according to the WFG Groundwater Equipment Decontamination TSOP.

11.13.2. Do not re-use any disposable sampling equipment and throw away all non-dedicated tubing and bladders after use.

11.13.3. Pack up and secure all equipment and complete all sample information on the COC.

11.13.4. Reattach well cap (as appropriate) and close and lock the wellhead.

## 12. Calculations and Reports

12.1. Sample reports should be emailed in the field using the InSitu iPad application to a secure company email address.

## 13. Data Interpretation, Recording and Reporting

13.1. Data interpretation and reporting will be completed by personnel with Southern Company Services (SCS) and will subsequently be used to produce the compliance report per the Coal Combustion Residuals Rule [80 FR 21301] and respective state agency requirements.

13.2. Recording of field data used to support the interpretation and reporting process will be completed using field log books and/or sample reports that will be filled out each time groundwater monitoring activities are conducted. The field log book or sample report should contain the following information:

- 13.2.1. Well identification number
- 13.2.2. Well depth
- 13.2.3. Static water level depth, date & time
- 13.2.4. Pumping rate, drawdown, indicator parameter values, time at five minute intervals; calculated or measured total volume pumped
- 13.2.5. Time of sample collection
- 13.2.6. Field observations
- 13.2.7. Name of sample collectors
- 13.2.8. Weather conditions
- 13.2.9. QA/QC data for blanks (sample time and location)

13.3. Information on sample times, dates, analytical methods, personnel, etc. should be filled out on the COC for each sample and turned in with the samples to the proper lab.

## 14. Quality Control Acceptance Criteria and Corrective Actions for Failed QC

14.1. Any deviations or issues related to the well sampling process should be documented in the field log book or sample report.

14.2. One sample duplicate and one field blank shall be collected per every group of 10 wells sampled as specified in the SAP. An equipment rinsate blank should also be collected at a rate of 1 per every CCR storage unit. Refer to the site specific SAP for guidance. Ultra-pure DI water shall be used as the control water for all blanks.

14.3. Calibration acceptance criteria for field parameters may be found in the individual TSOP documents. Refer to individual TSOPs for guidance on initial and final LCS failures.

## 15. Diagrams

15.1. Well construction logs are maintained by SCS Earth Sciences and may be consulted to confirm total well depth and screened interval.

## 16. Deviations/Exceptions

16.1. The low-flow sampling method is not always feasible in some wells due to very slow recharge rates. Depending on the geology and conditions of water bearing zones, water levels may decline at rates greater than the accepted minimum drawdown limit of three tenths of a foot (0.3 ft) even with minimal flow rates. If this is the case, and the well has a dedicated pump, minimum purge sampling may be necessary. Follow the below steps for minimum purge sampling:

16.1.1. Calculate the total system volume (bladder, tubing & flow through cell) by inputting the necessary information in the InSitu program.
16.1.2. Purge 1-3 times the system volume, depending on the volume of the overhead water column.
16.1.3. Purge rates should occur at rates less than 100 ml/min.
16.1.4. Collect field readings after at least 1 system volume has been purged.
16.1.5. Commence sampling once system volume(s) have been purged.
16.1.6. Document field methodology, data, calculations and observations.

16.2. The target for monitoring turbidity is readings less than or equal to 5 NTUs, however this value is not mandatory (EPA, July 1996). In some instances, turbidity levels may exceed the recommended turbidity level due to natural aquifer conditions, changes in aquifer recharge, or other well characteristics. When these conditions are encountered, the following guidelines shall be considered:

16.2.1. If turbidity readings are greater than 5 NTU but less than 10 NTU and all other parameter criteria has been met, sampling can commence.
16.2.2. If turbidity readings are slightly above 10 NTU, but are trending downward, purging and monitoring shall continue.
16.2.3. If turbidity readings are greater than 10 NTUs and are stable within 10% for the final 3 consecutive readings and pumping has occurred for at least 2 hours, well sampling shall be based upon stabilization of critical indicator parameters (pH, Specific Conductance and DO).

16.2.3.1. In situations described in the above section, first collect a preserved sample set followed by an additional preserved sample set to be field filtered.
16.2.3.2. After the first sample set is collected, attach a 0.45 micron field filter to the end of the sample line. Allow for about 300 ml of sample water to pass through the filter prior to sample collection. Once filtered bottles have been filled, dispose of the filter. Ensure that the filtered sample set is properly denoted on the label.

16.3. Artesian Wells

16.3.1. For wells that are artesian, water may free flow out of the well casing before it reaches equilibrium. In such cases, a dedicated pump is not required. It is acceptable to collect the sample using traditional low flow criteria utilizing a special well cap fitted with control valve routed directly to the flow through cell. A minimum of 1 well volume should be purged before sample collection.

## 17. Client-Defined Specifications/Observations/Specialized Analysis

17.1. A project SAP is required on a groundwater sampling project and is available for review in the groundwater folder on EDAS. This document provides project-specific information regarding regulatory, sampling, containerization, chemical analysis, and data acceptance criteria requirements.

*****END OF DOCUMENT*****

# APPENDIX 10
# WRITTEN CLOSURE AND POST-CLOSURE CARE PLAN

# CLOSURE PLAN FOR EXISTING CCR SURFACE IMPOUNDMENT
# PLANT BARRY GYPSUM POND
# ADEM ADMIN. CODE r. 335-13-15-.07(3)

## SITE INFORMATION

**Site Name / Address**
Plant Barry
15300 Highway 43 North
Bucks, Alabama 36512

**Owner Name / Address**
Alabama Power Company
600 North 18th Street
Birmingham, AL 35203

**CCR Unit**

Plant Barry Gypsum Pond

**Closure Method**

Close In-Place

## CLOSURE PLAN DESCRIPTION

### r. 335-13-15-.07(3)(b)(1)(i) – Narrative description of how the CCR unit will be closed.

The Plant Barry Gypsum Pond will be closed by leaving CCR in place. The written closure plan will be amended if there is a change in operation that would substantially affect the written closure plan in effect and/or if there are unanticipated events that necessitate a revision of the closure plan.

### r. 335-13-15-.07(3)(b)(1)(iii) –Closure of the CCR unit by leaving CCR in place

The Barry Gypsum Pond was designed and constructed with a 60-mil HDPE liner overlying 2 feet of compacted clay having a permeability of $1 \times 10^{-7}$ cm/s. The pond will be dewatered sufficiently to remove the free liquids and to an extent to provide a stable base for the construction of the final cover system.

The gypsum subgrade for the final cover of the Gypsum Pond will be graded to create a stable subgrade for the final cover system. The final cover will be constructed to control, minimize or eliminate, to the maximum extent feasible, post closure infiltration of liquids into the waste and potential releases of CCR from the unit. This will be prevented by providing sufficient grades and slopes to; 1) preclude the probability of future impoundment of water, slurry, or sediment; 2) ensure slope and cover system stability; 3) minimize the need for further maintenance; and, 4) be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.

# CLOSURE PLAN FOR EXISTING CCR SURFACE IMPOUNDMENT
# PLANT BARRY GYPSUM POND
# ADEM ADMIN. CODE r. 335-13-15-.07(3)

## Description of Final Cover System

The final cover system will be designed to minimize infiltration and erosion. The final cover system is currently expected to consist of a 60 mil HDPE geomembrane overlain by a drainage geocomposite, which will then be covered with a minimum 18-inch protective soil layer and a minimum 6-inch topsoil layer capable of sustaining vegetative growth. This final cover system will minimize infiltration and erosion and meets or exceeds the requirements of r. 335-13-15-.07(3) in that the permeability of the final cover system will be less than or equal to the permeability of the bottom liner system. Final design will ensure the disruption of the integrity of the final cover system is minimized through a design that accommodates settlement and subsidence, in addition to providing an erosion layer for protection from wind or water erosion.

## r. 335-13-15-.07(3)(b)(1)(iv) – Estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit

The Plant Barry Gypsum Pond was designed for a maximum capacity of 650,000 cubic yards of CCR. Future use of the unit will not substantially affect the written closure plan.

## r. 335-13-15-.07(3)(b)(1)(v) – Estimate of the largest area of the CCR unit ever requiring a final cover

The Barry Gypsum Pond has an approximate storage area of about 19 acres. The final cover will be applied to the 19-acre footprint of the CCR unit.

## r. 335-13-15-.07(3)(b)(1)(vi) – Closure Schedule

The milestones and the associated timeframes are initial estimates. Some of the activities associated with the milestones will overlap. Milestones reflect approximate time to implement closure instead of dates since there is no specific date to initiate closure. The facility is still operational, and serves not only as a disposal area but a reclaim area for beneficial reuse of gypsum. Date to initiate closure has not yet been established; therefore, a reasonable estimate of the year of completing closure is not yet available. However, once closure is initiated it will take an estimated 18 months to complete all closure activities.

**Milestones**
Regulatory Interface – 6 months
Dewatering – 3 months
Grading and stabilization – 3 months
Installation of final cover – 6 months
Estimate of Year in which all closure activities will be completed – Approximately 18 months after initiation of closure

# CLOSURE PLAN FOR EXISTING CCR SURFACE IMPOUNDMENT
# PLANT BARRY GYPSUM STORAGE FACILITY
# ADEM ADMIN. CODE r. 335-13-15-.07(3)

## Certification Statement

## Initial Written Closure Plan for a CCR Surface Impoundment or Landfill

**Site Name / Address**

Plant Barry
15300 Highway 43 North
Bucks, Alabama 36512

**Owner Name / Address**

Alabama Power Company
600 North 18th Street
Birmingham, AL 35203

**CCR Unit**

Plant Barry Gypsum Storage Facility

I hereby certify that the written closure plan was prepared in accordance with the requirements of ADEM ADMIN. CODE r. 335-13-15-.07(3), and that the final cover system will meet the requirements of r. 335-13-15-.07(3).

12/3/18

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

16516
JAMES C. PEGUES, JR.

# INITIAL POST-CLOSURE CARE PLAN
# PLANT BARRY GYPSUM POND
# ALABAMA POWER COMPANY

ADEM Administrative Code r. 335-13-15-.07(5) requires the owner or operator of an existing CCR surface impoundment that is closed in place to provide for post-closure care of the unit for a period of at least 30 years. Post-closure care includes maintenance of the facility, as well as groundwater monitoring in accordance with r. 335-13-15-.06(1) through 335-13-15-.06(9).

The CCR surface impoundment located at Alabama Power Company's Plant Barry that is also referred to as the Plant Barry Gypsum Pond, is currently expected to be closed in place under the provisions of r. 335-13-15-.07(3). Following closure, maintenance will be provided on the final cover system for the required post-closure care period so that the integrity and effectiveness of the final cover system will be maintained. Maintenance activities will include, as needed, repairs to the final cover to correct any effects related to settlement, subsidence, erosion or other events, and will be performed to prevent run-on or run-off from eroding or otherwise damaging the final cover. Maintenance tasks could include, but not be limited to, repair of erosion features, replacement of eroded cover soils and re-establishment of vegetation, where applicable. Maintenance will be performed on a semi-annual schedule, or more frequently if needed.

The groundwater monitoring system will be maintained throughout the required post-closure care period. Groundwater monitoring, as needed, will be performed on a semiannual basis during the required post-closure care period as well.

The following office(s) can be contacted about the facility during the post-closure care period.
Barry Steam Plant
Environmental Manager
15300 Highway 43 North, Bucks, AL 36512-0070
1-251-829-2600
G2CCRPostBAR@southernco.com

At the present time, there is no planned use of the facility after closure. If current planning changes, such changes will be noted in an amendment to this post-closure care plan. Any future use of the property after closure will not disturb the integrity of the final cover, liner or any other component of the containment system. Furthermore, the functionality of the groundwater monitoring system will be maintained.

No later than 60 days following completion of the post-closure care period of 30 years, Alabama Power Company will prepare a notification verifying completion of the post-closure care.

I hereby certify that this post-closure care plan has been prepared in accordance with the requirements of ADEM Admin. Code r. 335-13-15-.07(5).

12/13/18

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

16516
JAMES C. PEGUES, JR.

# APPENDIX 11
# ADJACENT PROPERTY OWNERS

No other landowners adjoin the surveyed facility boundary for this CCR Unit.