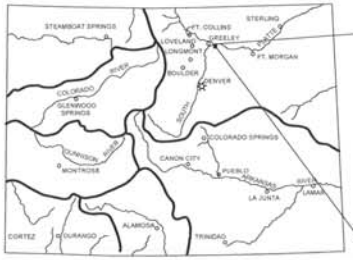
CONSTRUCTION PLANS FOR

DELTA WATER STORAGE

PREPARED FOR:

OWNER: FORT MORGAN FARMS LLC
5821 WEST CR 54E
BELLVUE, CO 80512

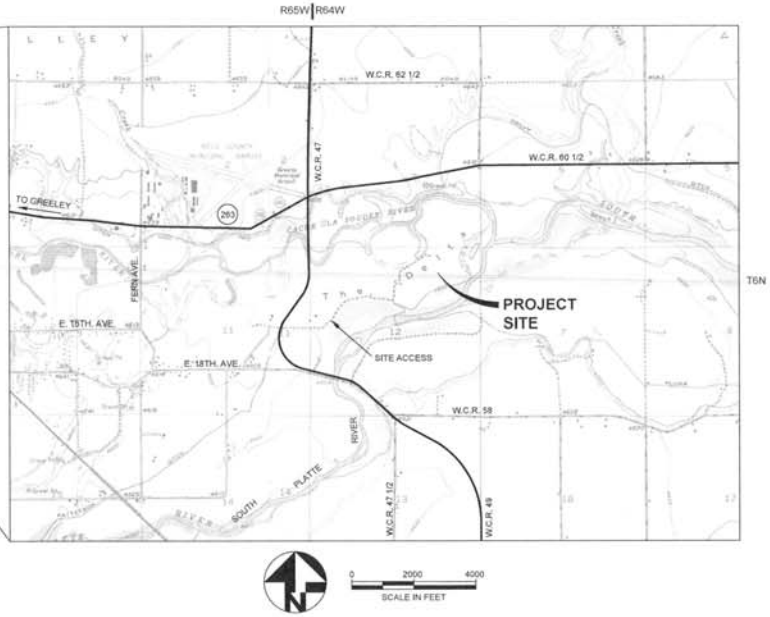
CONTRACTOR: FORGEN LLC
6025 S QUEBEC ST SUITE 300
CENTENNIAL, CO 80111



STATE OF COLORADO
PROJECT LOCATION MAP

NORTH

SCALE: NONE



SHEET INDEX:

NOTES:

DEERE AND AULT CONSULTANTS, INC. IS NOT A GUARANTOR OF THE PERFORMANCE OF THE WORK.

DEERE AND AULT CONSULTANTS, INC. IS NOT RESPONSIBLE FOR SAFETY, IN, ON, OR ABOUT THE PROJECT SITE, NOR FOR COMPLIANCE BY THE APPROPRIATE PARTY WITH ANY REGULATIONS RELATED THERETO.

DEERE AND AULT CONSULTANTS, INC. EXERCISES NO CONTROL OVER THE SAFETY OR ADEQUACY OF ANY EQUIPMENT, BUILDING COMPONENTS, FORMS, OR OTHER WORK AIDS USED IN OR ABOUT THE PROJECT, OR OVER THE SUPERINTENDING OF THE SAME.

WRITTEN SCALES ON PLAN ARE FOR FULL SIZED 22" x 34" PLANS AND DO NOT APPLY TO REDUCED PLAN SETS.

811 Know what's below. Call before you dig.

CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES

DEERE & AULT CONSULTANTS, INC. ASSUMES NO RESPONSIBILITY FOR EXISTING UTILITY LOCATIONS (HORIZONTAL AND VERTICAL). THE EXISTING UTILITIES SHOWN ON THIS DRAWING HAVE BEEN PLOTTED FROM THE BEST AVAILABLE INFORMATION. IT IS, HOWEVER, THE RESPONSIBILITY OF THE CONTRACTOR TO FIELD VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION ACTIVITIES.

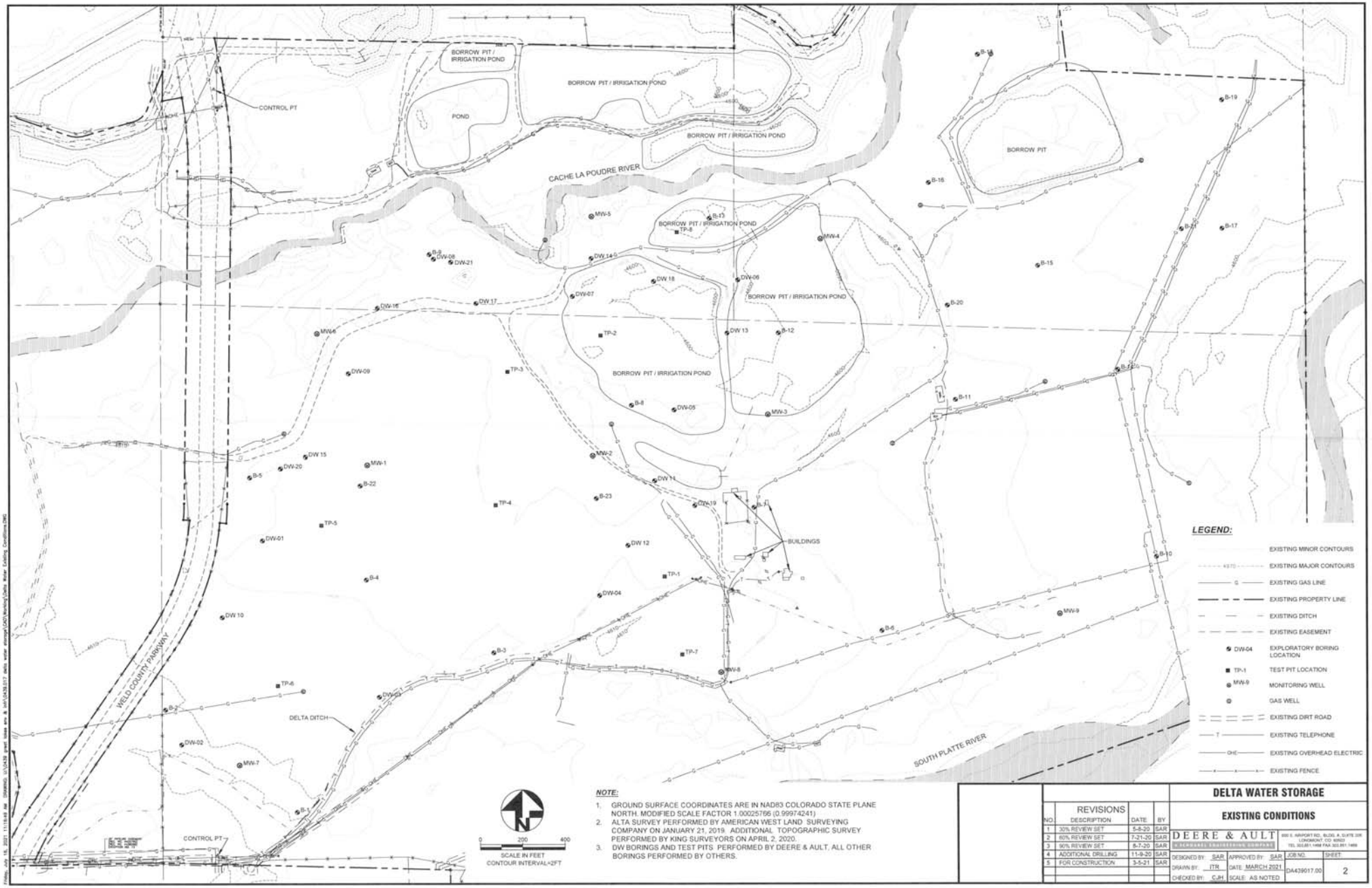
NO.	REVISIONS DESCRIPTION	DATE	BY
1	30% REVIEW SET	5-8-20	SAR
2	60% REVIEW SET	7-21-20	SAR
3	90% REVIEW SET	8-7-20	SAR
4	ADDITIONAL DRILLING	11-9-20	SAR
5	FOR CONSTRUCTION	3-5-21	SAR

DELTA WATER STORAGE

COVER SHEET & VICINITY MAP

DEERE & AULT
ENGINEERING CONSULTANTS
500 S. AIRPORT RD., BLDG. A, SUITE 205
LONGMONT, CO 80503
TEL 303.651.1466 FAX 303.651.1466

DESIGNED BY: SAR | APPROVED BY: SAR | JOB NO.: | SHEET:
DRAWN BY: ITR | DATE: MARCH 2021 | 0A439017.00 | 1
CHECKED BY: CJH | SCALE: AS NOTED



NOTE:

1. GROUND SURFACE COORDINATES ARE IN NAD83 COLORADO STATE PLANE NORTH. MODIFIED SCALE FACTOR 1.00025765 (0.99974241)
2. ALTA SURVEY PERFORMED BY AMERICAN WEST LAND SURVEYING COMPANY ON JANUARY 21, 2019. ADDITIONAL TOPOGRAPHIC SURVEY PERFORMED BY KING SURVEYORS ON APRIL 2, 2020.
3. DW BORINGS AND TEST PITS PERFORMED BY DEERE & AULT. ALL OTHER BORINGS PERFORMED BY OTHERS.

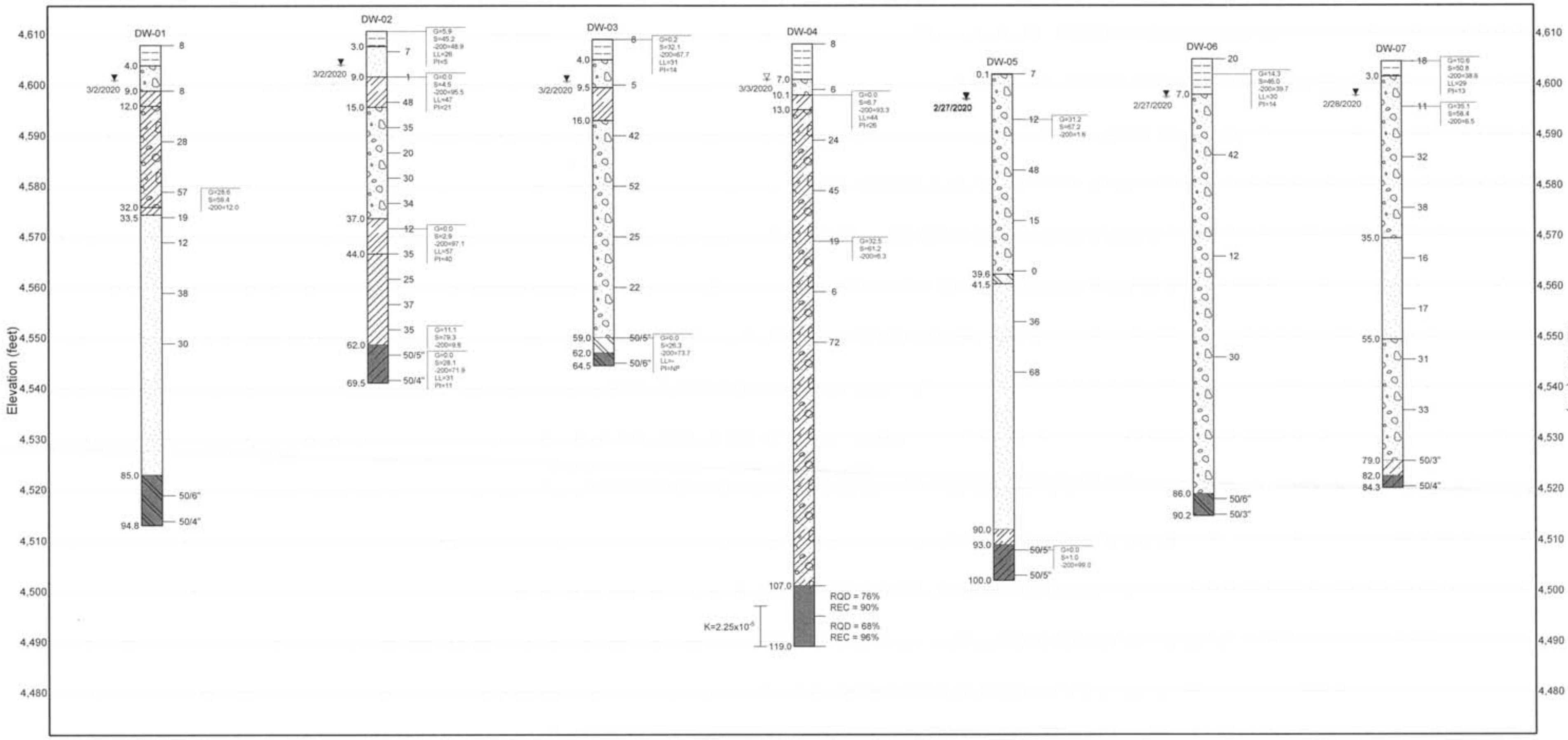
NO.	REVISIONS DESCRIPTION	DATE	BY
1	30% REVIEW SET	5-8-20	SAR
2	60% REVIEW SET	7-21-20	SAR
3	90% REVIEW SET	8-7-20	SAR
4	ADDITIONAL DRILLING	11-9-20	SAR
5	FOR CONSTRUCTION	3-5-21	SAR

DELTA WATER STORAGE

EXISTING CONDITIONS

DEERE & AULT
A RAMAKER ENGINEERING COMPANY
600 E. AIRPORT RD., BLDG. A, SUITE 205
LONGMONT, CO. 80503
TEL 303.651.1488 FAX 303.651.1489

DESIGNED BY: SAR | APPROVED BY: SAR | JOB NO. | SHEET:
DRAWN BY: ITR | DATE: MARCH 2021 | DA439017.00 | 2
CHECKED BY: CJH | SCALE: AS NOTED



SCALE IN FEET

BORING LOG LEGEND - LITHOLOGY

SYMBOLOGY

- Overburden Soils: Clayey Sand/Sandy Clay locally with gravel, loose to medium dense, medium stiff to stiff, dry to slightly moist, low to non plastic, brown (SC, SM, CL)
- Clay: stiff to very stiff, moist, grey to tan/orange, very high to low plasticity, locally interbedded with fine sand (CH, CL)
- Clayey to Silty Sand: loose to medium dense, moist, tan/orange or brown, non to medium plastic, locally with gravel (SC, SM)
- Clayey Sand/Sandy Clay with Gravel: generally poorly graded, medium dense to dense, stiff to hard, wet, tan, non plastic, fine gravel up to ~4 cm (SC, SP-SC)
- Sand: poorly graded, with local gravel, loose to dense, moist to wet, tan to grey, (SP)
- Sand with Gravel: poorly graded, loose to dense, wet, tan, locally with clay (SP)
- Silty Sand: poorly graded, fine grained, medium dense, wet, non plastic (SM)
- Claystone-Weathered: dense, slightly moist, yellowish grey, plastic (CH)
- Sandy Claystone-Fresh: hard, slightly moist, dark grey, plastic (CL, CL-ML)
- Sandstone-Weathered: poorly graded, dense to very dense, moist to wet, tan/brown with orange, non plastic, fine to medium grained (SP, SC, SM)
- Siltstone-Weathered: dense/hard, slightly moist to moist, orange with grey, low to non plastic
- Claystone-Fresh: very dense, slightly moist, grey to dark grey, plastic, local sandstone concretions (CH, CL)
- Sandstone-Fresh: poorly graded, dense to very dense, slightly moist to moist, grey to dark grey, non plastic, fine to medium grained (SP, SC, SM)
- Sandy Claystone-Fresh: Dense to very dense, slightly moist, dark grey, plastic (CL, CL-ML)
- Cemented Sandstone-Weathered: hard (very strong), slightly moist, grey, non plastic, bioturbated to laminated, bivalve fossils present, fine to medium grained (SP)
- Siltstone-Fresh: very dense/hard, slightly moist to moist, light grey to dark grey, low to moderate plasticity, with local clay (ML)

NOTES:

1. EXPLORATORY BORINGS WERE DRILLED ON 2/27/20 THROUGH 3/3/20, AND 5/4/20 THROUGH 5/8/20 USING A TRUCK-MOUNTED CME 75 DRILL RIG WITH A 4.25-INCH I.D. HOLLOW STEM AUGER. EXPORITORY BORINGS DRILLED ON 9/21/20 THROUGH 9/23/20 (DW-19, DW-20 & DW-21) WERE DONE USING HQ SOLID CASING. NO SAMPLES WERE TAKEN BEFORE A DEPTH OF 69 FT. HQ CORING TECHNIQUES WERE USED FOR THE BOTTOM 10 FT OF DW-04 & DW-08.
2. LINES BETWEEN MATERIALS REPRESENT APPROXIMATE BOUNDARIES BETWEEN TYPES AND TRANSITIONS MAY BE GRADUAL.
3. GROUND WATER LEVELS WERE MEASURED AT THE TIME OF DRILLING OR JUST AFTER COMPLETION ON THE DATE INDICATED. GROUNDWATER LEVELS MAY FLUCTUATE SEASONALLY.

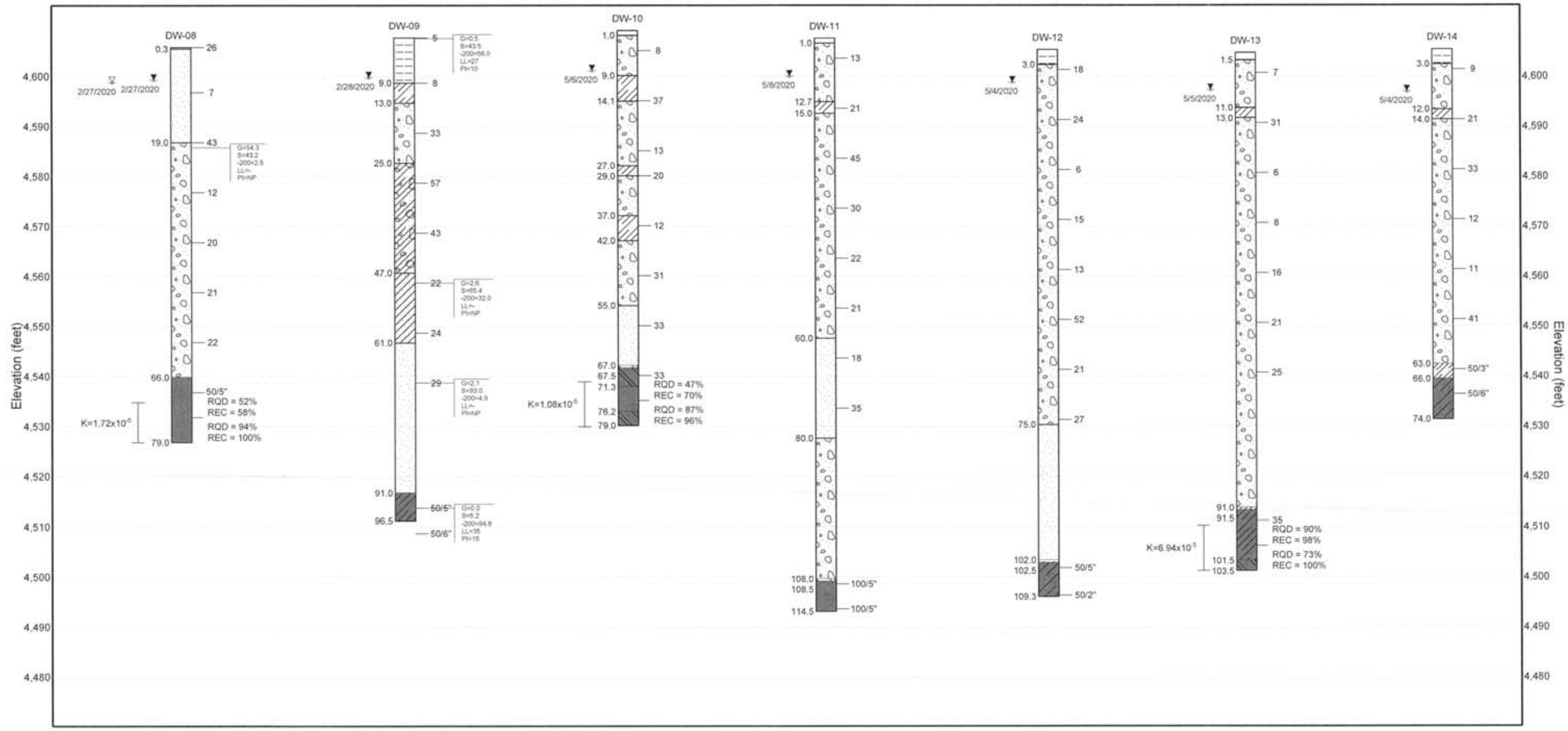
REVISIONS			
NO.	DESCRIPTION	DATE	BY
1	30% REVIEW SET	5-8-20	SAR
2	60% REVIEW SET	7-21-20	SAR
3	90% REVIEW SET	8-7-20	SAR
4	ADDITIONAL DRILLING	11-9-20	SAR
5	FOR CONSTRUCTION	3-5-21	SAR

DELTA WATER STORAGE

SUMMARY LOGS OF EXPLORATORY BORINGS DW-01 THROUGH DW-07

DEERE & AULT

DESIGNED BY: SAR | APPROVED BY: SAR | JOB NO. DA439017.00 | SHEET: 3
DRAWN BY: ITR | DATE: MARCH 2021
CHECKED BY: CJH | SCALE: AS NOTED



0 10' 20'
SCALE IN FEET

BORING LOG LEGEND - LITHOLOGY

SYMBOLOGY

- Overburden Soils: Clayey Sand/Sandy Clay locally with gravel, loose to medium dense, medium stiff to stiff, dry to slightly moist, low to non plastic, brown (SC, SM, CL)
- Clay: stiff to very stiff, moist, grey to tan/orange, very high to low plasticity, locally interbedded with fine sand (CH, CL)
- Clayey to Silty Sand: loose to medium dense, moist, tan/orange or brown, non to medium plastic, locally with gravel (SC, SM)
- Clayey Sand/Sandy Clay with Gravel: generally poorly graded, medium dense to dense, stiff to hard, wet, tan, non plastic, fine gravel up to ~4 cm (SC, SP-SC)
- Sand: poorly graded, with local gravel, loose to dense, moist to wet, tan to grey, (SP)
- Sand with Gravel: poorly graded, loose to dense, wet, tan, locally with clay (SP)
- Silty Sand: poorly graded, fine grained, medium dense, wet, non plastic (SM)
- Claystone-Weathered: dense, slightly moist, yellowish grey, plastic (CH)
- Sandy Claystone-Fresh: hard, slightly moist, dark grey, plastic (CL, CL-ML)
- Sandstone-Weathered: poorly graded, dense to very dense, moist to wet, tan/brown with orange, non plastic, fine to medium grained (SP, SC, SM)
- Siltstone-Weathered: dense/hard, slightly moist to moist, orange with grey, low to non plastic
- Claystone-Fresh: very dense, slightly moist, grey to dark grey, plastic, local sandstone concretions (CH, CL)
- Sandstone-Fresh: poorly graded, dense to very dense, slightly moist to moist, grey to dark grey, non plastic, fine to medium grained (SP, SC, SM)
- Sandy Claystone-Fresh: Dense to very dense, slightly moist, dark grey, plastic (CL, CL-ML)
- Cemented Sandstone-Weathered: hard (very strong), slightly moist, grey, non plastic, bioturbated to laminated, bivalve fossils present, fine to medium grained (SP)
- Siltstone-Fresh: very dense/hard, slightly moist to moist, light grey to dark grey, low to moderate plasticity, with local clay (ML)

NOTES:

1. EXPLORATORY BORINGS WERE DRILLED ON 2/27/20 THROUGH 3/3/20, AND 5/4/20 THROUGH 5/8/20 USING A TRUCK-MOUNTED CME 75 DRILL RIG WITH A 4.25-INCH I.D. HOLLOW STEM AUGER. EXPORITORY BORINGS DRILLED ON 9/21/20 THROUGH 9/23/20 (DW-19, DW-20 & DW-21) WERE DONE USING HQ SOLID CASING. NO SAMPLES WERE TAKEN BEFORE A DEPTH OF 69 FT. HQ CORING TECHNIQUES WERE USED FOR THE BOTTOM 10 FT OF DW-04 & DW-08.
2. LINES BETWEEN MATERIALS REPRESENT APPROXIMATE BOUNDARIES BETWEEN TYPES AND TRANSITIONS MAY BE GRADUAL.
3. GROUND WATER LEVELS WERE MEASURED AT THE TIME OF DRILLING OR JUST AFTER COMPLETION ON THE DATE INDICATED. GROUNDWATER LEVELS MAY FLUCTUATE SEASONALLY.

DELTA WATER STORAGE

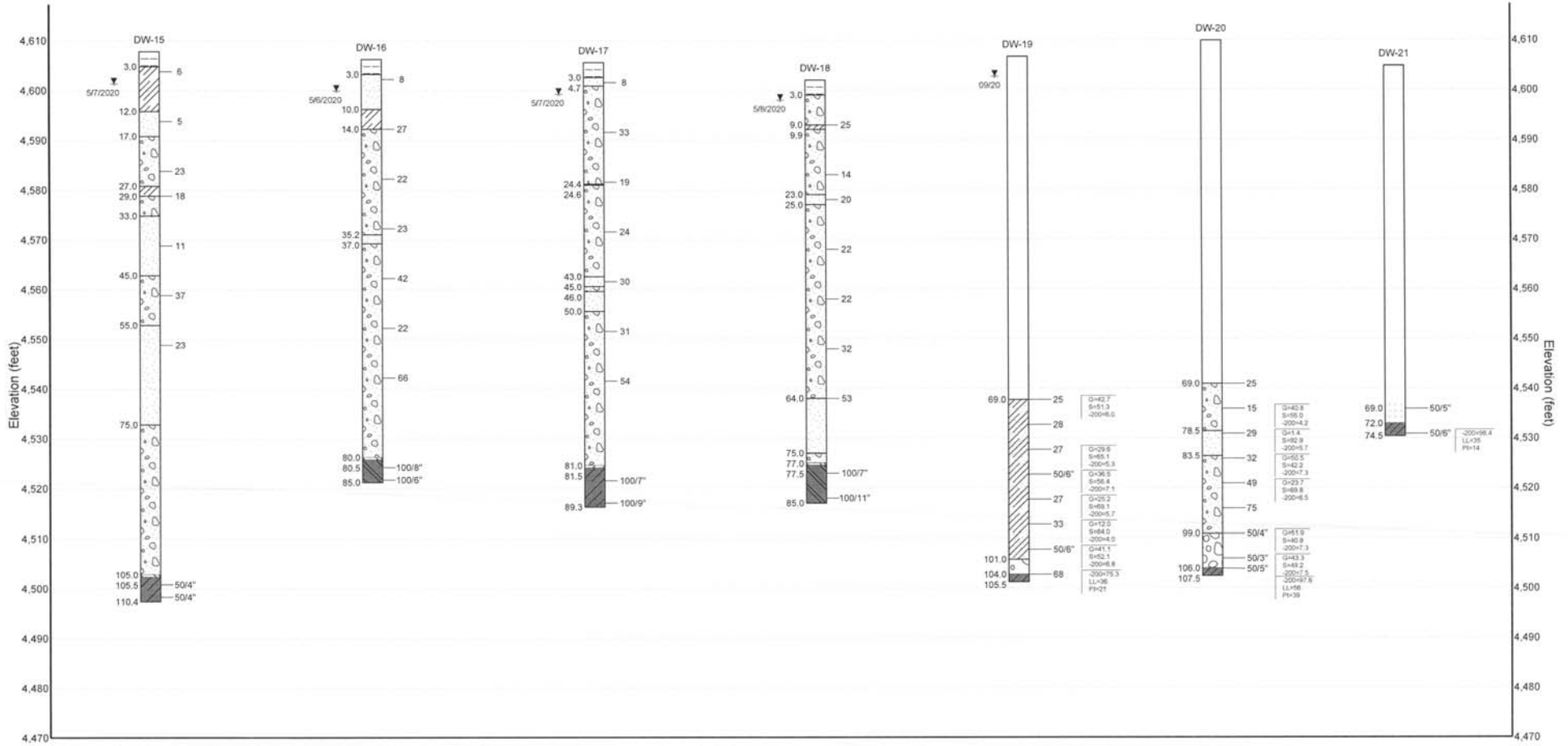
SUMMARY LOGS OF EXPLORATORY BORINGS DW-08 THROUGH DW-14

REVISIONS

NO.	DESCRIPTION	DATE	BY
1	30% REVIEW SET	5-8-20	SAR
2	60% REVIEW SET	7-21-20	SAR
3	90% REVIEW SET	8-7-20	SAR
4	ADDITIONAL DRILLING	11-9-20	SAR
5	FOR CONSTRUCTION	3-5-21	SAR

DEERE & AULT

DESIGNED BY: SAR | APPROVED BY: SAR | JOB NO.: DA439017.00 | SHEET: 4
DRAWN BY: ITR | DATE: MARCH 2021
CHECKED BY: CJH | SCALE: AS NOTED



0 10' 20'
SCALE IN FEET

BORING LOG LEGEND - LITHOLOGY

SYMBOLOGY

- Overburden Soils: Clayey Sand/Sandy Clay locally with gravel, loose to medium dense, medium stiff to stiff, dry to slightly moist, low to non plastic, brown (SC, SM, CL)
- Clay: stiff to very stiff, moist, grey to tan/orange, very high to low plasticity, locally interbedded with fine sand (CH, CL)
- Clayey to Silty Sand: loose to medium dense, moist, tan/orange or brown, non to medium plastic, locally with gravel (SC, SM)
- Clayey Sand/Sandy Clay with Gravel: generally poorly graded, medium dense to dense, stiff to hard, wet, tan, non plastic, fine gravel up to ~4 cm (SC, SP-SC)
- Sand: poorly graded, with local gravel, loose to dense, moist to wet, tan to grey, (SP)
- Sand with Gravel: poorly graded, loose to dense, wet, tan, locally with clay (SP)
- Silty Sand: poorly graded, fine grained, medium dense, wet, non plastic (SM)
- Claystone-Weathered: dense, slightly moist, yellowish grey, plastic (CH)
- Sandy Claystone-Fresh: hard, slightly moist, dark grey, plastic (CL, CL-ML)
- Sandstone-Weathered: poorly graded, dense to very dense, moist to wet, tan/brown with orange, non plastic, fine to medium grained (SP, SC, SM)
- Siltstone-Weathered: dense/hard, slightly moist to moist, orange with grey, low to non plastic
- Claystone-Fresh: very dense, slightly moist, grey to dark grey, plastic, local sandstone concretions (CH, CL)
- Sandstone-Fresh: poorly graded, dense to very dense, slightly moist to moist, grey to dark grey, non plastic, fine to medium grained (SP, SC, SM)
- Sandy Claystone-Fresh: Dense to very dense, slightly moist, dark grey, plastic (CL, CL-ML)
- Cemented Sandstone-Weathered: hard (very strong), slightly moist, grey, non plastic, bioturbated to laminated, bivalve fossils present, fine to medium grained (SP)
- Siltstone-Fresh: very dense/hard, slightly moist to moist, light grey to dark grey, low to moderate plasticity, with local clay (ML)

NOTES:

1. EXPLORATORY BORINGS WERE DRILLED ON 2/27/20 THROUGH 3/3/20, AND 5/4/20 THROUGH 5/8/20 USING A TRUCK-MOUNTED CME 75 DRILL RIG WITH A 4.25-INCH I.D. HOLLOW STEM AUGER. EXPORITORY BORINGS DRILLED ON 9/21/20 THROUGH 9/23/20 (DW-19, DW-20 & DW-21) WERE DONE USING HQ SOLID CASING. NO SAMPLES WERE TAKEN BEFORE A DEPTH OF 69 FT. HQ CORING TECHNIQUES WERE USED FOR THE BOTTOM 10 FT OF DW-04 & DW-08.
2. LINES BETWEEN MATERIALS REPRESENT APPROXIMATE BOUNDARIES BETWEEN TYPES AND TRANSITIONS MAY BE GRADUAL.
3. GROUND WATER LEVELS WERE MEASURED AT THE TIME OF DRILLING OR JUST AFTER COMPLETION ON THE DATE INDICATED. GROUNDWATER LEVELS MAY FLUCTUATE SEASONALLY.

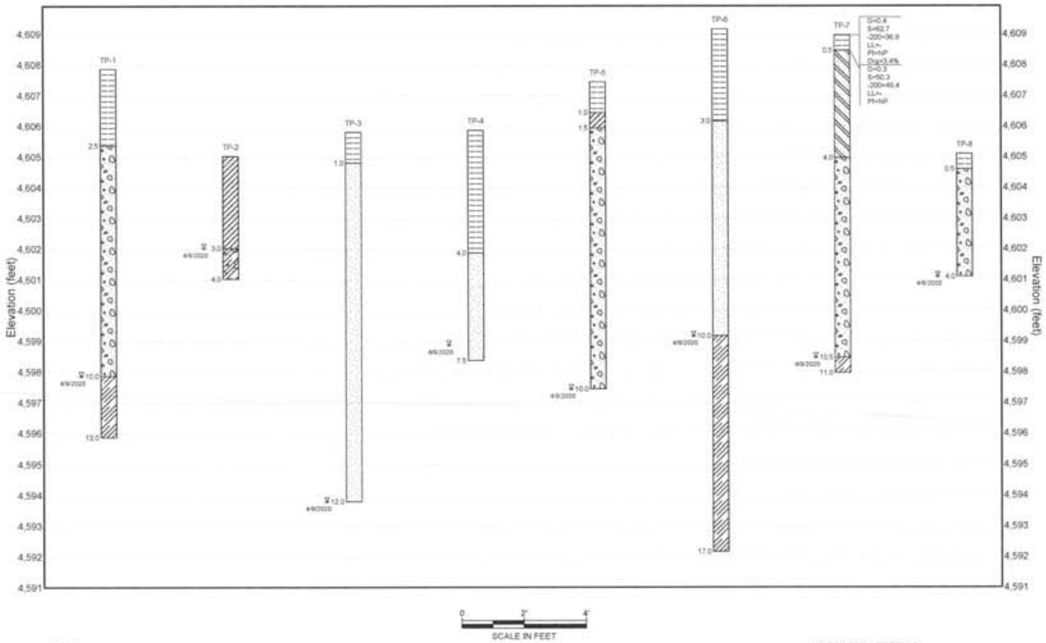
REVISIONS			
NO.	DESCRIPTION	DATE	BY
1	30% REVIEW SET	5-8-20	SAR
2	60% REVIEW SET	7-21-20	SAR
3	90% REVIEW SET	8-7-20	SAR
4	ADDITIONAL DRILLING	11-9-20	SAR
5	FOR CONSTRUCTION	3-5-21	SAR

DELTA WATER STORAGE

SUMMARY LOGS OF EXPLORATORY BORINGS DW-15 THROUGH DW-21

DEERE & AULT
A SUMMARY ENGINEERING COMPANY
600 S. AIRPORT RD., BLDG. A, SUITE 205
LONGMONT, CO. 80503
TEL 303.651.1466 FAX 303.651.1466

DESIGNED BY: SAR | APPROVED BY: SAR | JOB NO. DA439017.00 | SHEET: 5
DRAWN BY: ITR | DATE: MARCH 2021
CHECKED BY: CJH | SCALE: AS NOTED



NOTES

1. EXPLORATORY TEST PITS WERE EXCAVATED ON 4/6/20 AND ON 4/9/20 USING A CASE 580N RUBBER TIRED HOE.
2. ALL BORINGS WERE LOCATED USING THE ARCGIS COLLECTOR CELL PHONE APPLICATION ON 4/6/20 AND 4/9/20. ALL POINTS ARE RECORD IN NAD 1983 COLORADO STATE PLANE NORTH.
3. LINES BETWEEN MATERIALS REPRESENT APPROXIMATE BOUNDARIES BETWEEN TYPES AND TRANSITIONS MAY BE GRADUAL.
4. GROUND WATER LEVELS WERE MEASURED AT THE TIME OF EXCAVATION. GROUNDWATER LEVELS MAY FLUCTUATE SEASONALLY.

LABORATORY TESTING

MC =	Moisture Content
DD =	Dry Density
G =	% Gravel By Weight
S =	% Sand By Weight
-200 =	% By Weight Passing the #200 Sieve (Fines)
LL =	Liquid Limit
PI =	Plasticity Index, "NP" = Nonplastic Material
(Other) =	Any Other Tests Performed on the Material

BORING LOG LEGEND - LITHOLOGY

SYMBOLOGY

- Overburden Soils: Clayey Sand/Sandy Clay locally with gravel, loose to medium dense, medium stiff to stiff, dry to slightly moist, low to non plastic, brown (SC, SM, CL)
- Clay: stiff to very stiff, moist, grey to tan/orange, very high to low plasticity, locally interbedded with fine sand (CH, CL)
- Clayey to Silty Sand: loose to medium dense, moist, tan/orange or brown, non to medium plastic, locally with gravel (SC, SM)
- Clayey Sand/Sandy Clay with Gravel: generally poorly graded, medium dense to dense, stiff to hard, wet, tan, non plastic, fine gravel up to ~4 cm (SC, SP-SC)
- Sand: poorly graded, with local gravel, loose to dense, moist to wet, tan to grey, (SP)
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- Claystone-Weathered: dense, slightly moist, yellowish grey, plastic (CH)
- Sandy Claystone-Fresh: hard, slightly moist, dark grey, plastic (CL, CL-ML)
- Sandstone-Weathered: poorly graded, dense to very dense, moist to wet, tan/brown with orange, non plastic, fine to medium grained (SP, SC, SM)
- Siltstone-Weathered: dense/hard, slightly moist to moist, orange with grey, low to non plastic
- Claystone-Fresh: very dense, slightly moist, grey to dark grey, plastic, local sandstone concretions (CH, CL)
- Sandstone-Fresh: poorly graded, dense to very dense, slightly moist to moist, grey to dark grey, non plastic, fine to medium grained (SP, SC, SM)
- Sandy Claystone-Fresh: Dense to very dense, slightly moist, dark grey, plastic (CL, CL-ML)
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- Siltstone-Fresh: very dense/hard, slightly moist to moist, light grey to dark grey, low to moderate plasticity, with local clay (ML)

REVISIONS

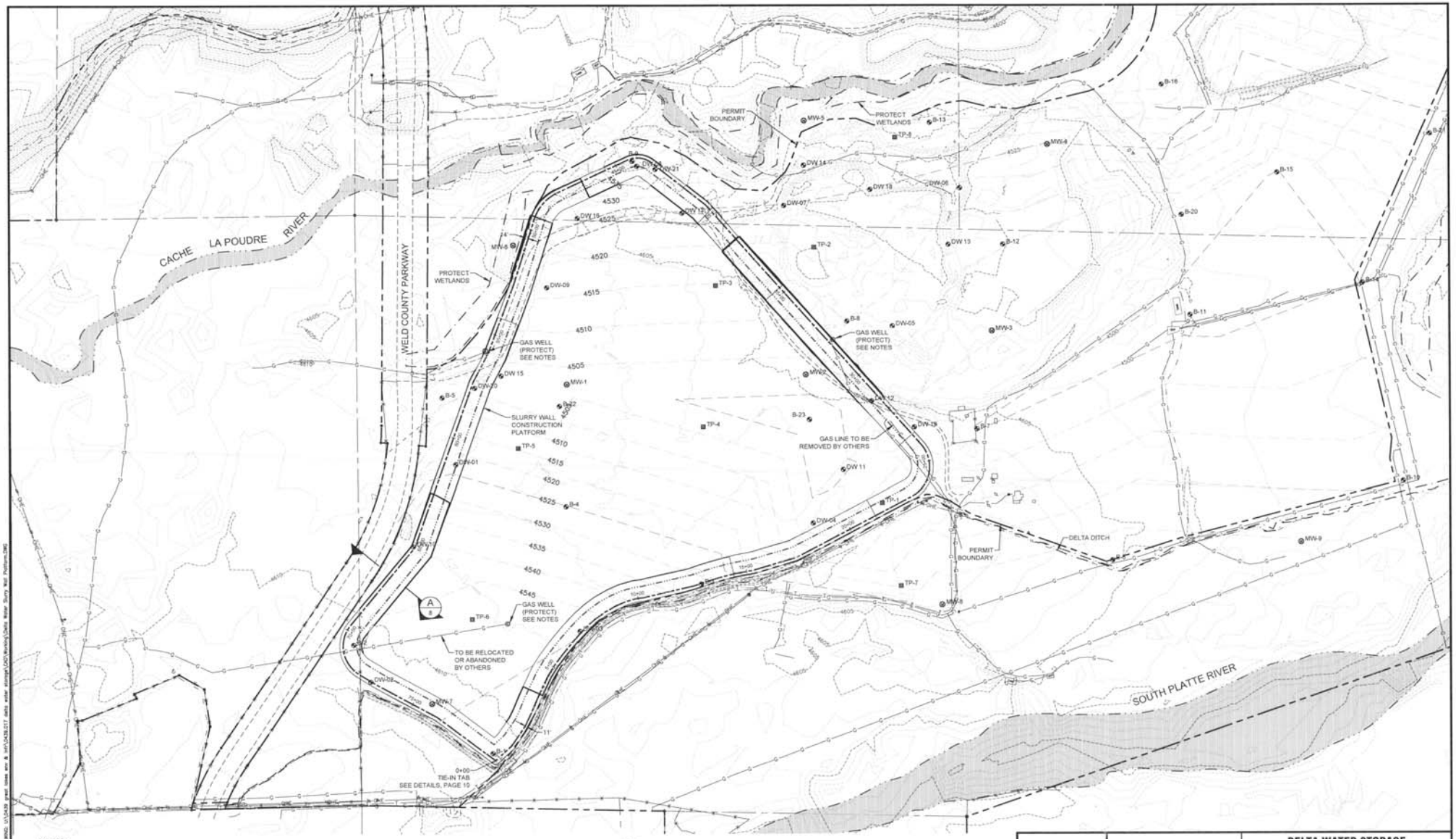
NO.	DESCRIPTION	DATE	BY
1	30% REVIEW SET	5-8-20	SAR
2	60% REVIEW SET	7-21-20	SAR
3	90% REVIEW SET	8-7-20	SAR
4	ADDITIONAL DRILLING	11-9-20	SAR
5	FOR CONSTRUCTION	3-5-21	SAR

DELTA WATER STORAGE

SUMMARY LOGS OF EXPLORATORY TEST PITS

DEERE & AULT

DESIGNED BY: SAR	APPROVED BY: SAR	JOB NO.	SHEET:
DRAWN BY: ITR	DATE: MARCH 2021	DA439017.00	6
CHECKED BY: CJH	SCALE: AS NOTED		



NOTES:

1. DW SERIES EXPLORATORY BORINGS AND TEST PITS DONE BY DEERE & AULT BETWEEN FEBRUARY AND MAY 2020.
2. B SERIES BORINGS DONE BY CESARE INC. FOR J-T CONSULTING JANUARY 2019.
3. MW MONITORING WELLS INSTALLED BY J-2 CONTRACTING CO., APRIL 2019.
4. GAS WELL CUT AND CAPPED BELOW GRADE. MAINTAIN 15 FT OFFSET AS DIRECTED BY FORT MORGAN FARMS.

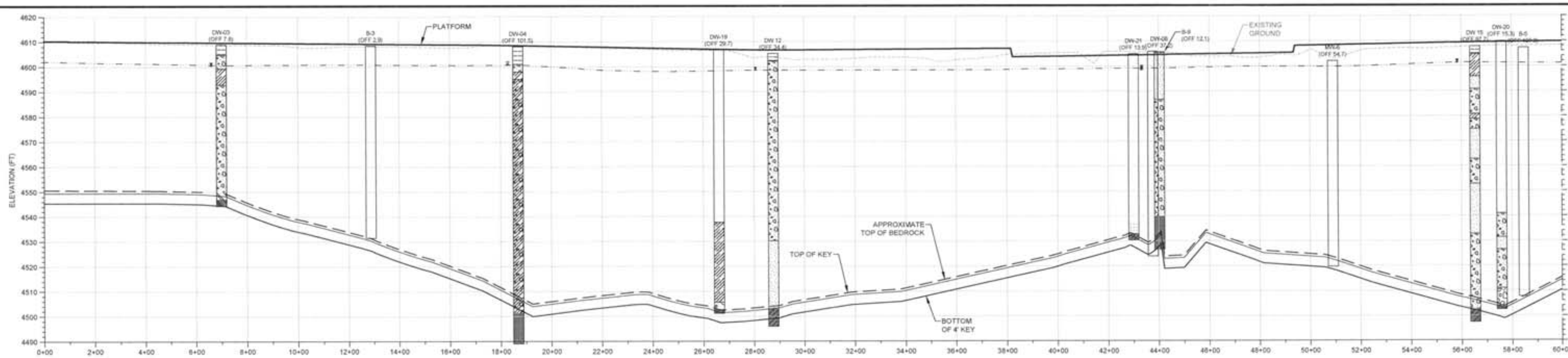
REVISIONS			
NO.	DESCRIPTION	DATE	BY
1	30% REVIEW SET	5-8-20	SAR
2	60% REVIEW SET	7-21-20	SAR
3	90% REVIEW SET	8-7-20	SAR
4	ADDITIONAL DRILLING	11-9-20	SAR
5	FOR CONSTRUCTION	3-5-21	SAR

DELTA WATER STORAGE

SLURRY WALL ALIGNMENT PLAN

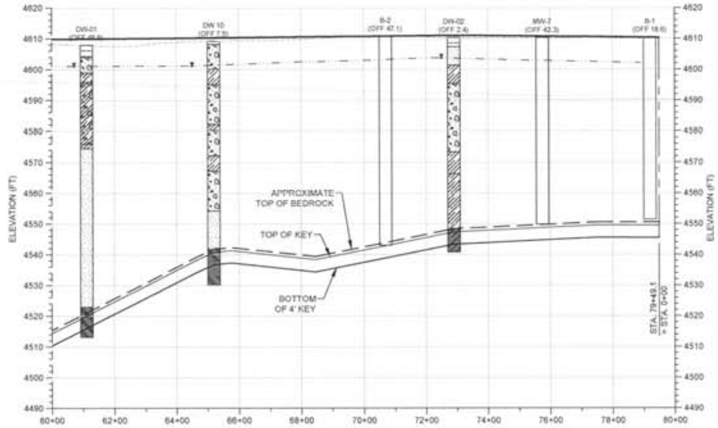
DEERE & AULT
CONSULTANTS IN WATER RESOURCES
600 S. AIRPORT RD., BLDG. A, SUITE 205
LONGMONT, CO 80503
TEL 303.651.1466 FAX 303.651.1469

DESIGNED BY: SAR | APPROVED BY: SAR | JOB NO.: | SHEET:
DRAWN BY: ITR | DATE: MARCH 2021 | DA439017.00 | 7
CHECKED BY: CJH | SCALE: AS NOTED



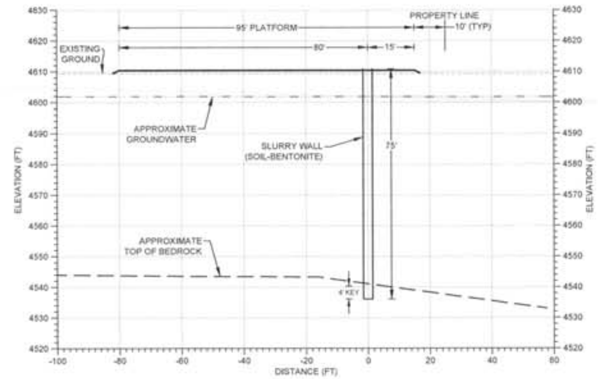
SLURRY WALL PROFILE

Vertical Scale (FT) 0 20 40
Horizontal Scale (FT) 0 200 400



SLURRY WALL PROFILE

Vertical Scale (FT) 0 20 40
Horizontal Scale (FT) 0 200 400



A/7 **TYPICAL SLURRY WALL PLATFORM SECTION**

0 20 40
SCALE IN FEET

NOTES:

1. DW SERIES EXPLORATORY BORINGS AND TEST PITS DONE BY DEERE & AULT BETWEEN FEBRUARY AND MAY 2020.
2. B SERIES BORINGS DONE BY CESARE INC. FOR J-T CONSULTING JANUARY 2019.
3. MW MONITORING WELLS INSTALLED BY J-2 CONTRACTING CO., MAY 2019. DEPTH OF BEDROCK ESTIMATED OFF SEO WELL COMPLETION REPORTS.

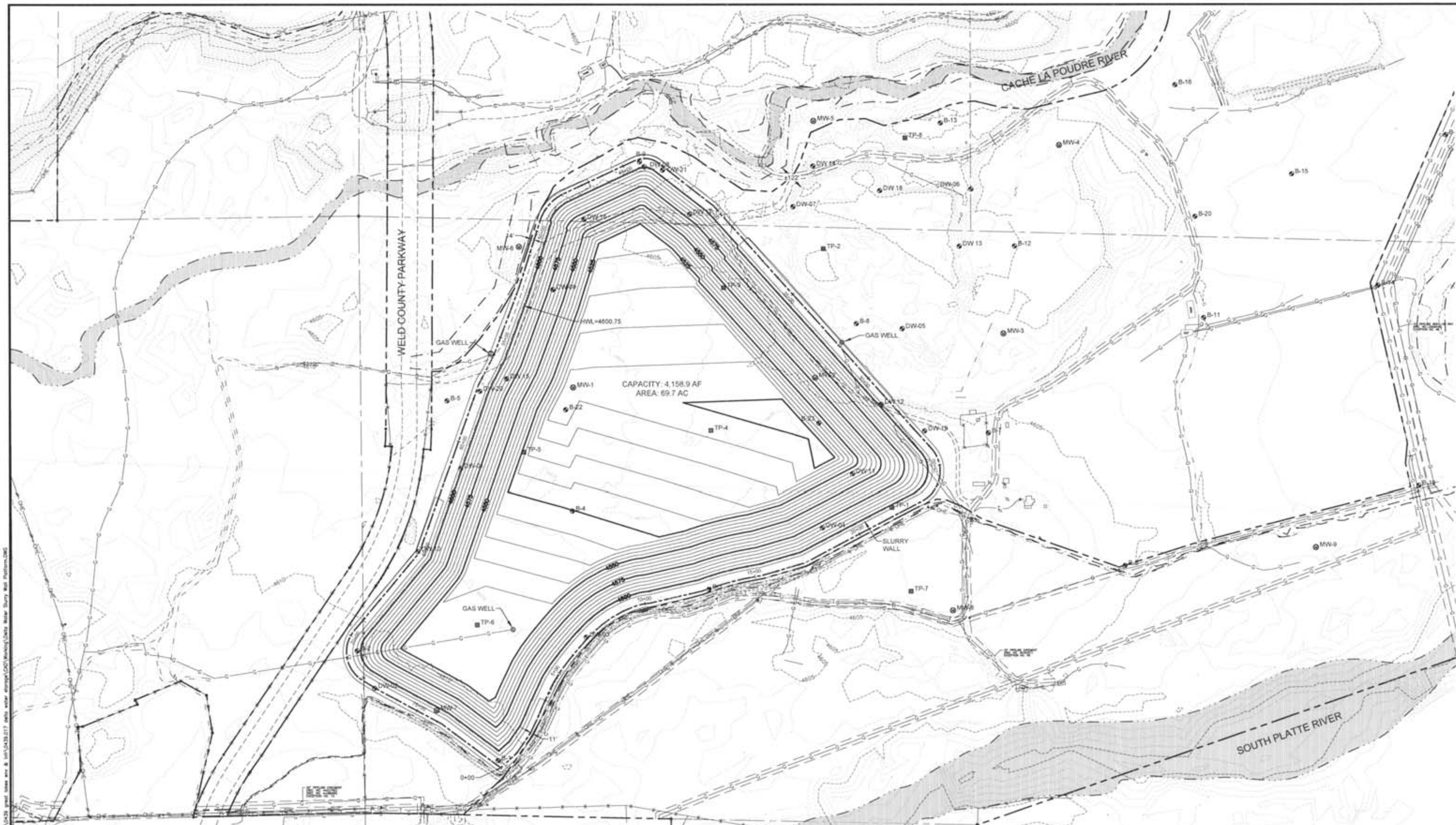
NO.	REVISIONS DESCRIPTION	DATE	BY
1	30% REVIEW SET	5-8-20	SAR
2	60% REVIEW SET	7-21-20	SAR
3	90% REVIEW SET	8-7-20	SAR
4	ADDITIONAL DRILLING	11-9-20	SAR
5	FOR CONSTRUCTION	3-5-21	SAR

DELTA WATER STORAGE

SLURRY WALL PROFILE

DEERE & AULT

DESIGNED BY: SAR | APPROVED BY: SAR | JOB NO. DA439017.00 | SHEET 8
DRAWN BY: ITR | DATE: MARCH 2021
CHECKED BY: CJH | SCALE: AS NOTED



NOTES:

1. DW SERIES EXPLORATORY BORINGS AND TEST PITS DONE BY DEERE & AULT BETWEEN FEBRUARY AND MAY 2020.
2. B SERIES BORINGS DONE BY CESARE INC. FOR J-T CONSULTING JANUARY 2019.
3. MW MONITORING WELLS INSTALLED BY J-2 CONTRACTING CO., MAY 2019.

0 200 400
SCALE IN FEET
EXISTING CONTOUR INTERVAL=1FT
PROPOSED CONTOUR INTERVAL=5FT

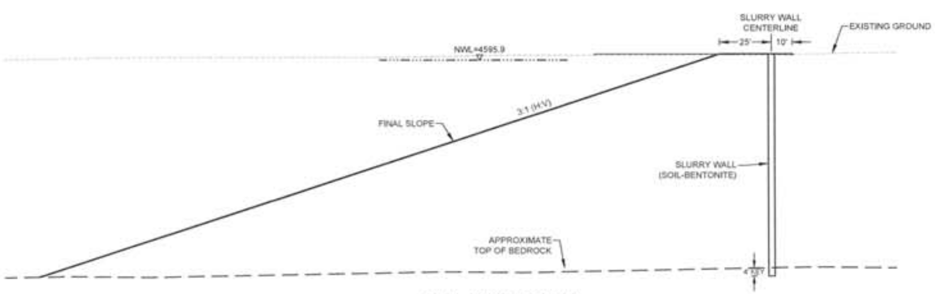
DELTA WATER STORAGE

RECLAMATION PLAN

REVISIONS			
NO.	DESCRIPTION	DATE	BY
1	30% REVIEW SET	5-8-20	SAR
2	60% REVIEW SET	7-21-20	SAR
3	90% REVIEW SET	8-7-20	SAR
4	ADDITIONAL DRILLING	11-9-20	SAR
5	FOR CONSTRUCTION	3-5-21	SAR

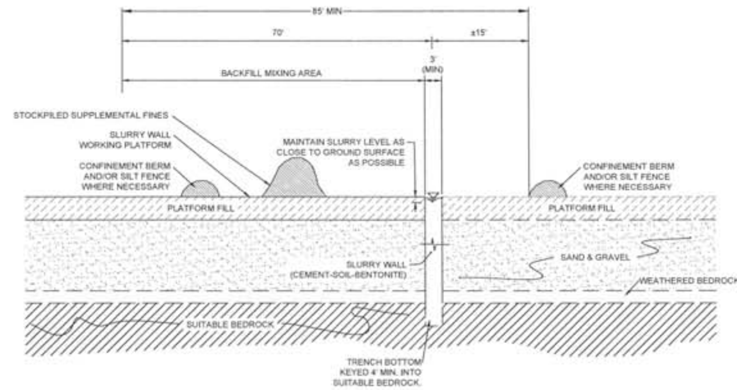
DEERE & AULT
A GEOSYNTEC CONSULTANTS COMPANY
LONGMONT, CO

DESIGNED BY: SAR	APPROVED BY: SAR	JOB NO.	SHEET
DRAWN BY: ITR	DATE: MARCH 2021	DA439017.00	9
CHECKED BY: CJH	SCALE: AS NOTED		



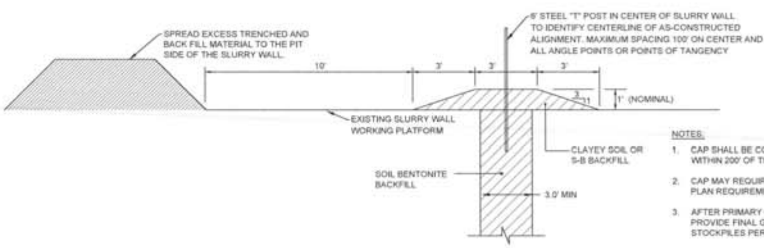
FINAL SLOPE DETAIL

0 30' 60'
SCALE IN FEET



TYPICAL SLURRY WALL DETAIL

NOT TO SCALE

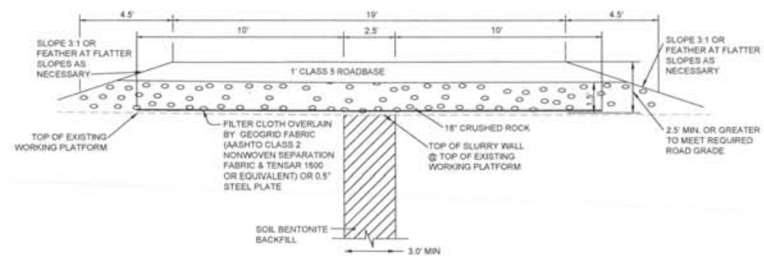


NOTES:

1. CAP SHALL BE CONSTRUCTED, WITH 'T' POST INSTALLED AS REQUIRED WITHIN 200' OF THE ACTIVE BACKFILL MIXING AREA.
2. CAP MAY REQUIRE LOCAL FIELD ADJUSTMENT TO MEET FINAL GRADING PLAN REQUIREMENTS, AS NECESSARY, TO MEET PROJECT INTENT.
3. AFTER PRIMARY CONSOLIDATION OF THE SLURRY WALL, OWNER SHALL PROVIDE FINAL GRADING OF CAP MATERIAL AND EXCESS MATERIAL STOCKPILES PER RECLAMATION PLAN.

SLURRY WALL TRENCH CAP DETAIL

NOT TO SCALE



PERMANENT ROAD CROSSING DETAIL

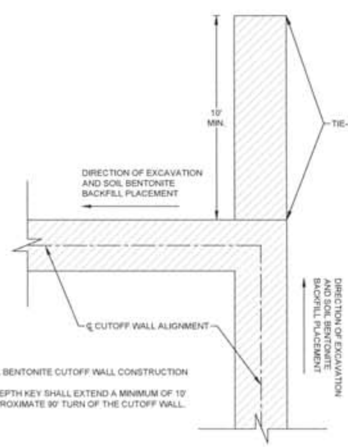
NOT TO SCALE

NOTES:

1. PERMANENT ROAD CROSSING TO BE LOCATED AT OWNER'S DIRECTION.

Start Station	End Station	Cast Out %	Supplemental Fines (CY/LF)	Dry Bentonite Application Rate (lbs/LF)	Spacing Between Bags (3000lb bag) Feet
0+00	8+00	10	1	288.12	13
8+10	14+90	30	2.75	295.3	10
15+00	37+50	45	5.2	374.2	8
37+60	47+90	45	4	266.7	11
48+00	63+00	30	3.3	369.2	8
63+10	72+00	30	2.5	243.44	12
72+00	78+90	10	1	288.12	13

1. TABLE BASED ON SUPPLEMENTAL FINES WITH AN AVERAGE OF 60% PASSING THE #200 SIEVE.
2. RATES SHOWN ARE FOR A MINIMUM OF 30% PASSING #200 SIEVE FOR S-B BACKFILL AND MAY REQUIRE ADJUSTMENT.
3. BAG SPACING BASED ON A DRY BENTONITE APPLICATION RATE OF 1% AND MAY BE ADJUSTED BASED ON THE FINAL MIX DESIGN AND THE MINIMUM OF FINES PASSING #200 SIEVE AS APPROVED BY DESIGN ENGINEER.



NOTES:

1. TIE-IN TAB SHALL BE USED FOR SOIL BENTONITE CUTOFF WALL CONSTRUCTION AT STA. 0+00
2. CONTINUOUS TRENCH WITH FULL DEPTH KEY SHALL EXTEND A MINIMUM OF 10' BEYOND THE INTERSECTION OF APPROXIMATE 90' TURN OF THE CUTOFF WALL.

SLURRY WALL TIE-IN TAB

NOT TO SCALE

NO.	REVISIONS DESCRIPTION	DATE	BY
1	30% REVIEW SET	5-8-20	SAR
2	60% REVIEW SET	7-21-20	SAR
3	90% REVIEW SET	8-7-20	SAR
4	ADDITIONAL DRILLING	11-9-20	SAR
5	FOR CONSTRUCTION	3-5-21	SAR

DELTA WATER STORAGE

DETAILS

DEERE & AULT

DESIGNED BY: SAR APPROVED BY: SAR
DRAWN BY: ITR DATE: MARCH 2021
CHECKED BY: CJH SCALE: AS NOTED
JOB NO. DA439017.00
SHEET: 10

TECHNICAL SPECIFICATIONS

FOR THE

DELTA WATER STORAGE RESERVOIR

Prepared for:

OWNER:
FORT MORGAN FARMS LLC.
5821 WEST CR.54E
BELLVUE, COLORADO 80512

CONTRACTOR:
FORGEN, LLC.
6025 SOUTH QUEBEC ST, STE. 300
CENTENNIAL, COLORADO 80111

D&A JOB NO. DA439017.00

MARCH 2021

DEERE & AULT
A SCHNABEL ENGINEERING COMPANY
600 South Airport Road, Suite A-205
Longmont, CO 80503
(303) 651-1468 • Fax (303) 651-1469

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PROJECT TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 11 00

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general information on Work.

B. Related Sections:

1. SECTION 01 14 13 – ACCESS TO SITE.

1.2 SEQUENCING AND SCHEDULING

A. Work covered by Contract Documents:

1. Provide all labor, materials, and equipment for the construction of the Delta Water Storage Reservoir Low Permeability Cutoff Wall, including the following major components:
   a. Site mobilization and demobilization
   b. Platform grading
   c. Erosion and sediment control
   d. Dewatering and water management
   e. Material handling and supplemental fines placement
   f. Construction of low permeability cutoff wall
   g. Site restoration and clean up

B. Access to the site:

1. The Project site is located near Greeley, Colorado.

2. The Project site is permitted as part of an active gravel mine to be operated by J-2 Contracting Co. Mining may or may not be occurring during the Work. Site access will be in accordance with site specific and/or MSHA requirements.

3. See additional requirements in SECTION 01 14 13 – ACCESS TO SITE.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Keep construction areas clean and orderly.

B. Stockpile material in a manner that will cause the least damage to adjacent ditches and grassed areas, agricultural crops, general vegetation, driveways, and fences regardless of whether on private property, the Site, or public right-of-way.

C. Give unpaved streets, roads, detours or haul roads used in the Work area a dust-prevention treatment approved by the OWNER or periodically water to prevent dust. Follow applicable environmental regulations for dust prevention.

D. Comply with the requirements of right-of-way permits.

E. Clean any dirt, gravel or other foreign material caused by the Work operations from public roadways.

END OF SECTION

SECTION 01 14 13

ACCESS TO SITE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general information and execution for access to secure site.

B. Related Sections:

1. SECTION 01 50 00 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
2. SECTION 01 60 00 – PRODUCTS, MATERIALS, AND EQUIPMENT

1.2 DEFINITIONS

A. Secure Site: Active gravel mine and other areas designated by the OWNER.

B. CONTRACTOR Personnel: CONTRACTOR employees, subcontractors, suppliers, manufacturers, and other personnel designated by the CONTRACTOR performing the Work.

C. MSHA: Mine Safety and Health Administration

1.3 COORDINATION

A. Escort:

1. General escort requirements: Any person not having MSHA Part 46/48 training
2. Storage and staging area requirements: As specified in SECTION 01 50 00 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS AND SECTION 01 60 00 - PRODUCTS, MATERIALS, AND EQUIPMENT.
3. Truck loading and unloading: The Contactor will designate an area for general loading and unloading of supplies, materials, and equipment for on-going deliveries. Personnel associated with the delivery must sign in and follow general site safety regulations, but need not to be MSHA Part 46/48 certified. If loading or unloading must occur outside of the normal delivery area, trucking personnel must be escorted by MSHA trained personnel. Any additional safety measures required for these circumstances are at the discretion of the CONTRACTOR.

1.4 SEQUENCING AND SCHEDULING

A. Comply with site security policies of the OWNER and/or Mine Site Operator.

B. Secure sites are considered restricted areas and are subject to additional site-specific procedures:

1. Provide a site sign-in/sign-out log to track on-site personnel
2. CONTRACTOR personnel entering the site are required to sign-in at the property entrance.
3. Media representatives are not allowed on sites without prior written approval by the OWNER. Site visits shall be coordinated with the OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 -EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Section includes general information for payment procedures.

1.2 PRICE AND PAYMENT PROCEDURES

A. Payment:

1. Progress payments will be made in accordance with the Contract Documents.
2. Payment for all Lump Sum and Unit Price Work shown or specified in the Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each lump sum item and actual work completed for unit price items of the accepted Bid Form.
3. Payment for Lump Sum work cover all Work required by the Contract Documents.

B. Non-Payment for Rejected or Unused Products:

1. Payment will not be made for:
   a. Loading, hauling, and disposing of rejected material.
   b. Quantities of material wasted or disposed of in a manner not called for under the Contract Documents.
   c. Rejected loads of material, including material rejected after it has been placed for failure to conform to provisions of the Contract Documents.
   d. Material not unloaded from the transporting vehicle.
   e. Defective work not accepted by the OWNER.
   f. Materials remaining on hand after completion of the Work.

C. Partial Payment for Stored Materials and Equipment:

1. Partial payment will be made for materials and equipment delivered or stored only if materials are accepted and the Contract Document requirements are met.
2. Final payment will be made only for materials incorporated in the Work; remaining materials, or which partial payments have been made, shall revert to the CONTRACTOR and partial payments made for those items will be deducted from the final payment.

1.3 DEFINITIONS

A. Construction Schedule of Values: Allocates values for the various parts of the Work (activities, or groups of activities/categories) used as the basis for submitting and reviewing progress payments.

1.4 SUBMITTALS

A. Schedule of Estimated Progress Payments (Cashflow Projections):

1. Submit with the CLS.
2. Submit adjustments with Applications for Payment.

B. Construction Schedule of Values:

1. Prepare and Construction Schedule for Values for Work under the Agreement in the Contract Documents.

2. The total of the Construction Schedule of Values shall equal the Contract Price.

3. Description of items: The Construction Schedule of Values indicates major categories of Work for the purpose of comparative proposal analysis, the payment breakdown for monthly progress payments, and additions or deductions. Items are not intended to be inclusive descriptions of Work categories.
   a. Groundwater cutoff wall and interim stabilizing slopes design:
      1) This item consists of geotechnical investigations and design of the groundwater cutoff wall and interim slopes.
      2) Measurement: Lump sum.
   b. Engineer of Record services during construction:
      1) This item consists of design services during construction.
      2) Measurement: Lump sum.
   c. Soil-bentonite cutoff wall construction, 4-feet into suitable bedrock:
      1) This item consists of construction of the groundwater cutoff wall.
      2) Measurement: Square feet.
   d. Interim stabilizing slopes construction:
      1) This item consists of construction of the interim stabilizing slopes.
      2) Measurement: Lump sum.
   e. Site restoration:
      1) This item consists of site restoration, including seeding and restoration of the reservoir rim road.
      2) Measurement: Lump sum.
   f. Remove and stockpile overburden piles along groundwater cutoff wall alignment that are not designated as sight berms:
      1) This item consists of loading, hauling, and stockpiling of overburden piles.
      2) Measurement: Cubic yard.
   g. Mobilization (not to exceed 10% of Total Bid):
      1) Perform operations in connection with preparatory work for the execution of Contract Work.
      2) Payment will be based on a lump sum price bid not to exceed the value stated on the Bid Form.
      3) Progress payments for mobilization will be made as work progresses as follows:
         a) When 10% of the Contract amount is earned, 25% of the mobilization bid item will be paid.
         b) When 25% of the Contract amount is earned, 50% of the mobilization bid item less previous payments will be paid.
         c) When 50% of the Contract amount is earned, 75% of the mobilization bid item less previous payments will be paid.
         d) When 75% of the Contract amount is earned, 100% of the mobilization bid item less previous payments will be paid
      4) Retainage as described in the Agreement also applies to progress payments for mobilization.

C. Application for Payment:

1. Submit monthly by using the approved Application for Payment Form.

2. Submit on the date stated in the Contract Documents and include the accepted Construction Schedule of Values.

3. Submit an updated CLS in accordance with the Contract Documents with each monthly Application for Payment.

4. Preparation:

a. Round values to the nearest cent.
b. List each Change Order and Written Amendment executed prior to the date of submission as a separate line item.
c. Execute certification by the authorized officer of the CONTRACTOR.

D. Final Application for Payment: Submit in accordance with Final Payment Release.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Section includes general information and execution for project management and coordination.

1.2 COORDINATION

A. Separate Contracts:

1. Coordinate with CONTRACTOR's work with separate contractors.
2. Coordinate with the OWNER and ENGINEER to avoid delays to separate contracts.

B. Coordinate with the OWNER's normal activities on or near the site to:

1. Maintain roads so that they are fully operational during the Work.
2. Allow access by the OWNER's personnel to the Work area as required to maintain operations.

1.3 MEETINGS

A. General:

1. Make arrangement for meetings throughout the progress of Work.
2. Prepare a meeting agenda and distribute the agenda with notice of each meeting.
3. Preside at the meetings, record the minutes of proceedings and decisions, and reproduce and distribute copies of the minutes to participants and parties affected by meeting decisions within 5 days after each meeting.

B. Pre-Construction Meeting:

1. Review and discussion the following subjects at a minimum:
   a. Required schedules.
   b. Groundwater control.
   c. Erosion/sediment control.
   d. Sequencing of critical path Work items.
   e. Work changes and clarification procedures.
   f. Use of site, access, office and storage areas, security and temporary facilities.
   g. Major product deliveries and priorities.
   h. CONTRACTOR's safety plan.
   i. Progress payment procedures.
2. Minimum attendance:
   a. The OWNER's representatives.
   b. The ENGINEER's project manager.
   c. The CONTRACTOR's project manager.
   d. The CONTRACTOR's superintendent.
   e. The CONTRACTOR's quality control representative.
   f. Any Subcontractors involved in Work.
   g. Others as appropriate to the agenda.

C. Progress Meetings:

1. Schedule weekly progress meetings at the site to review Work progress.

2. Minimum attendance:
   a. The OWNER's representative.
   b. The ENGINEER's project manager.
   c. The CONTRACTOR's superintendent.
   d. The CONTRACTOR's quality control representative.
   e. Any Subcontractors involved in Work.
   f. Others as appropriate to the agenda.

D. Special Meetings:

1. Should issues arise that are not address in the pre-construction or progress meetings a special meeting may be held.

2. Any involved party may request a special Meeting be held. Or the OWNER may request certain parties have a special meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general information for submittal procedures.

B. Related Sections:

1. SECTION 01 77 00 – CONTRACT CLOSEOUT

1.2 COORDINATION

A. Submittal Procedures:

1. Schedule and make submissions in accordance with the requirements of individual Specification sections and in such a sequence as to cause no delay in the Work.

2. Identification of Submittals:
   a. Complete, sign, and transmit with each submittal package one Submittal Transmittal and Response Form.
   b. Identify each submittal with the following numbering system:
      1) Sequentially number each submittal.
      2) Number resubmittals with the original number and an alphabetic suffix; maintain the numbering sequence throughout for each submittal package.
   c. Format submittals in an orderly manner, indexed with labeled tab dividers.
   d. Show the date of submission.
   e. Show the project title and the OWNER's contact identification and contract number.
   f. Show the names of the CONTRACTOR, subcontractor, or supplier, and the manufacturer, as appropriate.
   g. Identify the Contract Document section and the paragraph to which the submittal applies.
   h. Identify the submittal type; submit only one type in each submittal package.
   i. A single Submittal Transmittal Form shall be used for each Specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple Specification sections will not be acceptable, unless the primary section references other sections for components.

3. Certify (by checkbox and name) that:
   a. The submittal was reviewed.
   b. Products, field dimensions, and adjacent construction have been verified.
   c. Information has been coordinated with the requirements of the Work and the Contract Documents.

4. Revise and resubmit the submittal in its entirety when required; identify the changes made since the previous submittal. When requested, submit additional information.

5. Submittals that do not clearly bear the CONTRACTOR's specific written indication of the CONTRACTOR review and approval of the submittal or that are transmitted with an unsigned or uncertified submission form will be returned to the CONTRACTOR without being reviewed.

6. Submissions that are not required in the Contract Documents will be returned to the CONTRACTOR without review.

7. Review times, completeness, and resubmittals:

a. For each submittal, allow 20 days for the ENGINEER's review, excluding delivery time to and from the CONTRACTOR unless otherwise specified in the individual Specification sections.
b. If drawings, product submittals, samples, mock-ups or other required submissions are incomplete or are not properly submitted, the ENGINEER will not review the submittal and will immediately return the submittal to the CONTRACTOR.
c. Complete resubmittals in the same review period as designated for the original submittal.

8. Schedule delays:
   a. The adjustment of Contract Time or Price due to the ENGINEER's review of submittals will only be allowed if the following criteria are met:
      1) The CONTRACTOR has notified the ENGINEER in writing that the timely review of the submittal in question is critical to the progress of Work and has received the ENGINEER's written acceptance to reflect such. Written agreement by the ENGINEER to reduce the submittal review time will be made only for unusual and CONTRACTOR-justified reasons. Acceptance of a CLS containing submittal review times less than specified or less than agreed to, in writing, by the ENGINEER will not constitute the ENGINEER's acceptance of review times.
      2) The ENGINEER has failed to review and return the first submission of the submittal within the agreed time shown on the current accepted schedule of submissions; or, if no time is shown thereon within 20 days after receipt.
      3) The CONTRACTOR demonstrates that the delay in the progress of the Work is directly attributable to the ENGINEER's failure to return the submittal within the time shown and accepted by the ENGINEER.
   b. No adjustment to the Contract Time or Price will be allowed due to delays in progress of the Work caused by rejection and subsequent resubmission of submittals, including multiple resubmissions.

B. Disposition:

1. Distribution of reviewed submittals:
   a. One copy to the OWNER and/or OWNER's representative.
   b. Remaining copies returned to the CONTRACTOR.

2. The ENGINEER will review, mark, and stamp as appropriate and distribute marked-up copies as noted:
   a. Final for Construction (for incorporation in Work): Begin to implement activities to incorporate specific products or work covered by the submittal.
   b. Final for Construction, as Corrected (for incorporation in the Work): Begin to implement activities to incorporate products for work covered by the submittal in accordance with notations.
   c. For Correction and Resubmittal:
      1) Submittal is not approved.
      2) Make corrections or develop a replacement and resubmit in the same manner and quantity as specified for the original submission.
   d. Rejected - Resubmit:
      1) Submittal is not approved.
      2) Complete and resubmit or submit missing portions.

1.3 SUBMITTALS

A. Product Data:

1. Clearly mark each copy to identify pertinent products or models and show performance characteristics and capacities, the dimensions and clearances required, wiring or piping diagrams and controls, and external connections, anchorages, and supports required.

2. Supplement the Manufacturer's standard data to provide information unique to this Work.

B. Shop Drawings:

1. Submit Shop Drawings and samples to the ENGINEER as specified in individual Specification sections.

2. Present a clear and thorough manner and in sufficient detail to show the kind, size, arrangement, and function of components, materials, and devices and compliance with the Contract Documents.

3. Identify:
   a. Pertinent drawing sheets and detail numbers, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Critical field dimensions and relationships to other critical features of the Work.
   c. Each deviation or variation from the Contract Documents.
   d. Manufacturer's standard schematic drawings and diagrams:
      1) Delete information that is not acceptable to the Work.
      2) Supplement standard information to provide information specifically applicable to the Work.

4. Design data: Show calculations, dimensions, assumptions, referenced standards, and codes upon which the design is based.

5. Foreign Manufacturers:
   a. The names and addresses of at least two companies closest to the Work that maintain technical service representatives.
   b. A complete inventory of spare parts and accessories for each piece of equipment.

C. Samples:

1. Submit samples to the ENGINEER as specified in individual Specification sections.

2. Present in a clear and thorough manner and in sufficient detail to show the kind, size, arrangement, and function of components, materials, and devices, and compliance with the Contract Documents.

3. Identify:
   a. Pertinent drawing sheets and detail numbers, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Critical field dimensions and relationships to other critical features of the Work.
   c. Samples: Source, location, date taken, and by whom.
   d. Each deviation or variation from the Contract Documents.
   e. Manufacturer's standard schematic drawings and diagrams:
      1) Delete information that is not applicable to the Work.
      2) Supplement standard information to provide information specifically applicable to the Work.

4. Foreign Manufacturers:
   a. The names and addresses of at least two companies closest to the Work that maintain technical service representatives.
   b. A complete inventory of spare parts and accessories for each piece of equipment.

D. Quality Control Submittals:

1. Certificates:
   a. Manufacturer's Certificate of Compliance:
      1) Submit prior to the shipment of the product or material to the Work site.
      2) Ensure that the certificate is signed by the product manufacturer certifying that the materials, manufacturer, and product conforms to or exceeds specified requirements and is appropriate for the intended use.
      3) Submit supporting reference data, test results, affidavits, and certifications, as appropriate.

b. Certificates of successful testing or inspection: Submit when testing or inspection is required by laws and regulations, governing agencies, or specified in individual Specification sections.

E. Closeout Submittals: As specified in SECTION 01 77 00 - CONTRACT CLOSEOUT.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 13

ABBREVIATIONS AND ACRONYMS

PART 1 - GENERAL

1.1 ABBREVIATIONS AND ACRONYMS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used. Additional abbreviations and acronyms are defined in the Contract Drawings.

1.	AASHTO	American Association of State Highway and Transportation Officials
2.	ACI	American Concrete Institute
3.	ANSI	American National Standards Institute
4.	API	American Petroleum Institute
5.	ASR	Alkali-Silica Reaction
6.	ASTM	ASTM International, formerly known as American Society for Testing and Materials
7.	AWS	American Welding Society
8.	AWWA	American Water Works Association
9.	BH	Borehole
10.	BM	Benchmark
11.	CDOT	Colorado Department of Transportation
12.	CDPHE	Colorado Department of Public Health and Environment
13.	CLS	Cost Loaded Schedule
14.	CP	Control Point
15.	CRSI	Concrete Reinforcing Steel Institute
16.	DRMS	Division of Reclamation, Mining and Safety
17.	EPA	Environmental Protection Agency
18.	F	Fahrenheit
19.	IBC	International Building Code
20.	ICC	International Code Council
21.	ICC/ES	International Code Council Evaluation Service
22.	KSI	Kips-Force per Square Inch
23.	LL	Liquid Limit
24.	MDO	Medium Density Overlay
25.	MSHA	Mine Safety and Health Administration
26.	MUTCD	Manual of Uniform Traffic Control Devices
27.	NAVD	North American Vertical Datum
28.	NPDES	National Pollutant Discharge Elimination System
29.	OW	Observation Well
30.	PI	Plastic Index
31.	PJF	Pre-formed Joint Filler
32.	PL	Plastic Limit
33.	PSI	Pounds per Square Inch
34.	PVC	Polyvinyl Chloride
35.	QA	Quality Assurance
36.	QC	Quality Control
37.	ROW	Right-of-Way
38.	RPM	Revolutions per Minute

39.	RQD	Rock Quality Designation
40.	SWMP	Storm Water Management Plan
41.	TP	Test Pit
42.	UBC	Uniform Building Code
43.	UDFCD	Urban Drainage and Flood Control District
44.	UNCC	Utility Notification Center of Colorado
45.	USCS	Unified Soil Classification System
46.	USGS	United States Geological Survey
47.	WCR	Weld County Road
48.	WWF	Welded Wire Fabric

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 16

MATERIALS TESTING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Section includes general information for materials testing.

1.2 REFERENCES

A. American Petroleum Institute (API):

1. 13A - Specification for Drilling Fluids Materials
2. 13B - Recommended Practice for Field Testing Water-based Drilling Fluids

B. ASTM International (ASTM):

1. D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400-ft-lbf/ft3 (600 kN-m/m3))
2. D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
3. D 2216 - Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
4. D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
5. D 4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
6. D 4254 - Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
7. D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
8. D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating
9. D 5084 - Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Parameter
10. D 6913 - Standard Test Method for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
11. D 6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. American Association of State Highway and Transportation Officials (AASHTO):

1. T272 - Standard Method of Test for Family of Curves - One Point Method.

D. Table 1 – Delta Water Storage Reservoir Low Permeability Cutoff Wall Construction Quality Control Program

1.3 DEFINITIONS

A. OWNER: Fort Morgan Farms, LLC

B. CONTRACTOR: Forgen

C. ENGINEER: Deere and Ault Consultants, Inc.

1.4 COORDINATION

A. Provide all testing and reporting required to satisfy the performance of the Work.

B. Assist and cooperate with the ENGINEER and/or OWNER'S REPRESENTATIVE for access to the Work in order to perform testing.

C. Provide timely access to areas for testing and a smooth and level surface for testing.

D. Backfill test pits to original fill placement requirements.

E. Provide adequate lighting for performing tests under low light conditions.

1.5 SUBMITTALS

A. Inspection and/or Testing Laboratory:

1. Name, address, and qualifications of the inspection and/or testing laboratory

B. CONTRACTOR's QC Report:

1. Certified test results documenting conformance with all Specification requirements for:
   a. Quality control test results for imported materials.
   b. Site QC test results for in-place fill with interpretations of passing, failing, or in the event of a failed test, retest results after corrective measures.

1.6 QUALITY CONTROL

A. Soil-Bentonite Cutoff Wall:

1. Perform the Work as described in SECTION 31 56 13.13 - LOW PERMEABILITY CUTTOFF WALL.

2. CONTRACTOR QC testing:
   a. Quality control field and laboratory testing shall be performed as specified in this Section See Table 1 for specification limits.
   b. CONTRACTOR QC to test the following material properties at the minimum frequencies listed below:
      1) Water sampled prior to introduction into slurry mixing plant
         a) pH: One times per source or as changes occur
         b) Hardness: One time per source or as changes occur
      2) Supplemental Fines: Per borrow source or as changes occur
      3) Bentonite Slurry: Fresh sampled from the point of introduction into the trench
         a) Unit Weight in accordance with API RP 13B: Two times per shift
         b) Viscosity in accordance with API RP 13B: Two times per shift
         c) pH in accordance with API RP 13B: once per shift
         d) Filtrate Loss in accordance with API RP 13B: Once per shift for the first 3 passing samples, once per week there after
      4) Bentonite Slurry: In-trench samples from the bottom 25% of the trench
         a) Unit Weight in accordance with API RP 13B: Two times per shift
         b) Viscosity in accordance with API RP 13B: Two times per shift
         c) Filtrate loss in accordance with API RP 13B: Two times per shift
         d) Sand Content in accordance with API RP 13B: Two times per shift
      5) Soil-Bentonite Backfill samples from the point of introduction into the trench

a) Unit Weight in accordance with API RP 13B: Two times per shift
b) Slump in accordance with ASTM C 143: Two times per shift
c) Gradation in accordance with ASTM D 6913: One time per shift
d) Triaxial Permeability in accordance with ASTM D 5084: One per 1,500 lineal feet. The sample taken for permeability test shall be split and a gradation test shall be performed on the same sample. Test shall be performed with an effective confining pressure based on the estimated vertical pressure at 2/3 the average wall height of the cutoff wall. Soil-bentonite backfill shall be placed into the flexible wall permeameter at the slump measured in the field without compactive effort.
e) The s-b backfill shall have a minimum fines content (soil passing the No. 200 sieve) of 30% of the dry unit weight. If gradation testing determines the fines content is less than 30% additional fine grained soil will be added to the s-b backfill. If the fines content is less than 25%, s-b backfill operations will immediately stop until gradation testing determines that the minimum fines content of the s-b backfill ready for placement in the trench is above the minimum specification limit.

3. Test Standards:
   a. Bentonite slurry and soil-bentonite backfill quality control testing:
      1) Bentonite: In accordance with API 13A
      2) Bentonite Slurry: Marsh Funnel and mud balance in accordance with API RP 13B
      3) Bentonite Slurry: Filtrate Loss in accordance with API RP 13B
      4) Slump: In accordance with ASTM C 143
      5) Unit Weight/Density: In accordance with ASTM D 698
      6) Grain Size Distribution: In accordance with ASTM D 6913
      7) Permeability: In accordance with ASTM D 5084

TABLE 1
Delta Water Storage Reservoir Low Permeability Cutoff Wall Construction Quality Control Program

Subject		Standard	Type of Test	Minimum Frequency	Specified Values
Trench Bottom Soundings		---	• Key trench depth soundings	• Per 10 lineal feet	• Greater of design depth or 4' key
Bottom Key Bedrock Samples		---	• Construction documentation	• Per cut	• Less weathered bedrock by observation
Backfill Profile Soundings		---	• Backfill profile soundings	• Beginning and end of each shift	• Consistent measurements with no indications of sloughing or caving
Materials	Water	---	• pH • Total Hardness	• Per water source or as changes occur	• pH between 6.0 & 10.5 • Hardness less than or equal to 200 ppm
	Additives	---	• Manufacturers certificate of compliance with stated characteristics	• One time	• As approved by Engineer
	Bentonite	API Std 13A	• Manufacturers certificate of compliance	• Each supplier	• Premium grade sodium cation montomorillonite
	Supplemental Fines	---	• Selected soils obtained from a borrow area as approved by the Engineer	• Per borrow source or as changes occur	• ≥ 60% passing #200 • Roll to 1/8" thread
Slurry	Prepared for placement into the trench	API Std 13B-1	• Unit Weight • Viscosity • pH • Filtrate Loss (min. 3 passing)	• Twice per shift • Twice per shift • Once per shift • Once per week	• Unit weight ≥ 1.03 gm/cc (64.27 pcf) • ≥ 40 sec-Marsh @ 68°F • ≥ 7 & < 11 • Loss ≤ 20 cc in 30 min. @ 100 psi
	In Trench	API Std 13B-1	• Unit Weight • Viscosity • Filtrate Loss • Sand Content	• Twice per shift • Twice per shift • Twice per shift • Twice per shift	• 1.03 - 1.40 gm/cc (64.27 – 87.36 pcf) • ≥ 40 sec-Marsh @ 68° • Loss ≤ 30 cc in 30 min. @ 100 psi • Sand content ≤ 20% by volume
Soil-Bentonite	At Trench	ASTM C 143 ASTM D 6913	• Unit Weight • Slump • Gradation • Moisture Content • Dry Bentonite Application • Triaxial Permeability Test	• Twice per shift • Twice per shift • Once per shift • Once per shift • Continuous • Once per 1,500 lf	• ≥ Slurry in trench plus 15 pcf • 2" to 6" • 65 to 100% passing 3/8" • 40 to 85% passing #20 • ≥ 30% passing #200 • None • 1% • ≤ 1×10^{-7} cm/sec

NOTES:
1. Supplemental fines will be stockpiled in a windrow along the construction platform. The volume of supplemental fines stockpiles at each station shall be based on the design amount required to provide backfill having ≥ 30% passing the No. 200 sieve.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 00

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general information, products and execution for construction facilities and temporary controls.

B. Protect all existing utilities and improvements not designated for removal and restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation.

C. Related Sections:

1. SECTION 01 14 13 – ACCESS TO SITE
2. SECTION 01 60 00 – PRODUCTS, MATERIAL AND EQUIPMENT
3. SECTION 31 25 00 – SEDIMENTATION AND EROSION CONTROL

1.2 REFERENCES

A. Environmental Protection Agency (EPA):

1. Federal Clean Water Act Section 402 – National Pollutant Discharge Elimination System (NPDES)

B. Urban Drainage and Flood Control District (UDFCD):

1. Drainage Criteria Manual, Volume 3

C. U.S. Department of Transportation, Federal Highway Administration:

1. Manual on Uniform Traffic Control Devices (MUTCD)

D. MSHA

1. Comply with MSHA Part 46 Surface Miner Training

1.3 COORDINATION

A. Safety Procedures:

1. Comply with the OWNER's safety rules
2. Comply with the Site rules as outlined in SECTION 01 14 13 - ACCESS TO SITE
3. Notify the OWNER immediately and follow-up in writing of serious accidents on site and any related claims.
4. Comply with MSHA regulations and mine operator's safety rules.

B. Rights-of-Way:

1. The CONTRACTOR shall not do any work that would affect any oil, gas, sewer, or water pipeline; any telephone, or electric transmission line; any roadway, any fence; or any other structure, nor shall the CONTRACTOR enter upon the rights-of-way involved until authorization is received from the proper party.

2. Requirements for work near high voltage overhead power transmission lines are the responsibility of the CONTRACTOR. CONTRACTOR shall be responsible for taking all necessary precautions and complying with these clearance requirements.

C. Traffic Control:

1. As required by the jurisdiction issuing permits.

1.4 SEQUENCING AND SCHEDULING

A. Mobilization:

1. Mobilization includes at a minimum:
   a. Obtaining required permits.
   b. Moving the CONTRACTOR's equipment required for operations onto the site.
   c. Installing temporary construction power.
   d. Providing on-site sanitary facilities and potable water as specified and required by laws, regulations and governing agencies.
   e. Arranging for and erecting the CONTRACTOR's work and storage yard.
   f. Posting OSHA required notices and establishing safety programs and procedures.
   g. Providing the CONTRACTOR, ENGINEER, OWNER, and OWNER's representative with necessary field facilities (i.e. office, laboratory).
2. Use the area(s) designated for the CONTRACTOR's temporary facilities as shown on the Drawings.

1.5 SUBMITTALS

A. Administrative Submittals:

1. Copies of permit and approvals for construction as required by law, regulations, governing agencies and the Contract Documents.

B. Temporary Construction Submittals:

1. A plan for silt fence, straw bale installation and any other erosion control measures as outlined in SECTION 31 25 00 - SEDIMENTATION AND EROSION CONTROL.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish an office and/or laboratory space as well as necessary utilities for the functionality of said space.

PART 3 - EXECUTION

3.1 GENERAL

A. Storage Yards and Buildings:

1. As specified in SECTION 01 60 00 - PRODUCTS, MATERIALS, AND EQUIPMENT.
2. Items stored on site are at risk of damage due to weather, animals and other natural causes.
3. Temporary storage yards: Construct temporary storage yards for the storage of products not subject to damage by weather.
4. Temporary storage buildings: Store products subject to damage by weather in temporary structures.
5. Security fencing:

a. If desired, construct temporary security fence for the protection of materials, tools and equipment.
b. Maintain the fence during the construction period.
c. Upon completion of Work, remove the security fence and restore the site.

B. Parking:

1. Control parking to avoid interference with traffic, access by emergency vehicles, other Site operations or construction operations.

2. Provide parking facilities for personnel working on the Site.

3.2 PROTECTION

A. Do not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization.

B. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed shall be accurately restored after construction is complete.

C. CONTRACTOR is responsible for the cleanliness and safety of all roadways adjacent to the construction site. If at any time, these roadways are found to be dangerous or not passable due to debris or mud, local jurisdictions may shut down the project until necessary clean-up is carried out by the CONTRACTOR at his expense. If clean-up is deemed to be unsatisfactory or If the local jurisdiction chooses, the local jurisdiction may carry out required clean-up and bill the OWNER or CONTRACTOR. The CONTRACTOR is required to incur the cost of all such clean-up.

D. Protect underground utilities and other improvements which may be impaired during construction operations, regardless of whether or not the utilities are indicated on the Drawings. Take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

3.3 EXISTING UTILITIES

A. Except where the Drawings indicate utilities have been field located during design or certain utility locations will be exposed as part of the Work, make exploratory excavations as deemed necessary to determine the exact locations and depths of utilities which may interfere with the Work. All such exploratory excavations shall be performed within a sufficient time in advance of construction to avoid possible delays. Notify the ENGINEER if such exploratory excavations show the noted utility locations to be in error.

B. Contact and coordinate with utility companies regarding protection of existing utilities and special requirements at utility crossing locations and other conditions where the Work is nearby existing utilities. CONTRACTOR shall be responsible for all costs of coordination with utilities including but not limited to outages, protection or support and any fees for costs from the utility. Furnish copies of all written agreements obtained by CONTRACTOR to the ENGINEER.

C. Utilities to be Relocated: If necessary to relocate any utility on or near the property, coordinate with the utility owner to relocate said utility.

END OF SECTION

SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. CONTRACTOR shall provide environmental controls consistent with regulatory requirements throughout the duration of the Project.

B. Full compensation for required compliance and cooperation is considered subsidiary to other items of Work, and no additional compensation will be allowed.

1.2 SUBMITTALS

A. Dust control agents other than water must be approved by ENGINEER prior to use.

B. Plan for water control, if requested, prior to beginning any Work.

C. Stormwater quality management measures, Stormwater Management Plan (SWMP) and methods proposed by CONTRACTOR must be in conformance with all applicable permits and approved by ENGINEER prior to installation and prior to moving onto the construction site.

1. Submit the initial phase SWMP at the preconstruction conference. Submit plans for future phases of construction a minimum of 28 days before start of that construction phase to allow review and resubmittal, if necessary.

D. Prepare schedules to implement stormwater management features, including but not limited to erosion and sediment control Work, and submit for acceptance at preconstruction conference.

1. Schedules shall incorporate construction activities, haul roads, borrow pits, storage and plant sites, and the plan for disposal of waste material.

2. Work shall not start until the ENGINEER has approved these schedules.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 DUST CONTROL

A. CONTRACTOR shall minimize dust from construction operations.

B. During the performance of the Work whether on right-of-way provided by OWNER or elsewhere, CONTRACTOR shall furnish labor, equipment, and materials to control dust at all times, including evenings, holidays, and weekends.

C. CONTRACTOR shall be liable for any damage resulting from dust originating from CONTRACTOR's operations.

3.2 HOUSEKEEPING

A. CONTRACTOR shall keep the Project neat, orderly, and in a safe condition at all times, and shall store and use equipment, tools, and materials in a manner that does not present a hazard.

B. CONTRACTOR shall provide on-site containers for collection of rubbish and construction waste and dispose of it at frequent intervals during the progress of Work, and whenever directed by ENGINEER.

C. CONTRACTOR shall be responsible for conforming will all elements of the SWMP and other CDPHE permits, including any requirements addressing storage and disposal of potential stormwater pollutants.

3.3 DISPOSAL

A. CONTRACTOR shall legally dispose of waste materials and materials determined by ENGINEER to be waste in an approved disposal site in a manner meeting all federal, state, local, and Project regulations.

B. CONTRACTOR shall not bury waste unless authorized by the OWNER and the ENGINEER.

C. All costs related to disposal, including but not limited to dump fees, permits, etc., will be the responsibility of CONTRACTOR.

D. Excess excavation shall become the property of CONTRACTOR (unless otherwise specified) and be legally disposed of by CONTRACTOR outside the limits of construction in an approved disposal site.

E. Excess excavated material suitable for backfill shall not be disposed of until all backfill operations are complete.

F. CONTRACTOR shall immediately inform ENGINEER of any hazardous materials encountered during construction and legally dispose of such hazardous materials at an approved disposal site.

G. Burning will not be permitted.

3.4 WATER CONTROL

A. Periodic Flooding:

1. The Project may be subject to periodic flooding as a result of rainfall and snowmelt, reservoir or pond releases, flows from adjacent developed areas and stormwater pipes, and groundwater flows from saturated soils or other groundwater sources.

B. Until final acceptance of the Project by OWNER, CONTRACTOR shall have the charge and care thereof and shall take every precaution against injury or damage to any part thereof from any cause, including surface and subsurface water, whether arising from the execution or from non-execution of the Work.

C. CONTRACTOR shall rebuild, repair, restore, and make good injuries or damages to any portion of the Work because of causes beyond the control of and without the fault of negligence of CONTRACTOR, including but not restricted to high water, floods, or acts of God, of the public enemy, or of governmental authorities.

D. CONTRACTOR shall be responsible for the Project and shall take such precautions as may be necessary to construct the Project in a dry condition and provide for drainage, dewatering, and control of surface and subsurface water and shall erect any necessary temporary structures or other facilities at CONTRACTOR's expense.

E. CONTRACTOR is advised that the Work may occur in a river or drainage channel subject to intermittent and extensive runoff conditions such that, unless the construction area is properly protected, localized flooding and extensive soil erosion may occur.

F. OWNER, at OWNER's option, may require CONTRACTOR to update the water control plan.

G. CONTRACTOR, at CONTRACTOR's expense, shall furnish necessary equipment and materials required to control surface and subsurface water in all areas from start of Work through the completion of the Project. Applicable permits related to specific controls shall be obtained by CONTRACTOR and all associated fees shall be borne by the CONTRACTOR.

H. CONTRACTOR is responsible for furnishing; transporting; and installing all materials and equipment, well points, pumping, channelization, diversion, damming, or other means of controlling surface water, groundwater, runoff from other drainage tributaries, and pipe effluent as necessary to complete all of the Work in accordance with the Contract Documents.

3.5 WATER QUALITY CONTROL

A. CONTRACTOR shall comply with the "Colorado Water Quality Control Act", the "Protection of Fishing Streams", the "Clean Water Act", regulations promulgated, certifications issued, and the construction requirements listed below.

1. In the event of conflicts between Federal and State water quality control laws, rules, or regulations, the more restrictive laws, rules, or regulations shall apply.

B. This Work shall consist of measures needed for the purpose of minimizing water pollution, erosion, and sedimentation during the length of the construction activity.

C. This Specifications shall be followed to minimize the pollution of any watercourse, wetland, or water impoundment area.

D. Stormwater Management Plan (SWMP):

1. If a SWMP is provided in the Drawings and Specifications, it shall be used by CONTRACTOR as a guideline only. The CONTRACTOR shall be responsible for the development and implementation of the SWMP.

2. CONTRACTOR shall submit SWMP for review by OWNER in accordance with the submittal requirements defined in these Specifications. Adjustments to the approved plan may be required by OWNER based on actual construction operations. Changes to the plan shall only be made with the written approval of the OWNER.

3. The SWMP may include measures for the control of erosion and sedimentation, and measures for stormwater quality management.

4. CONTRACTOR shall take the necessary steps to comply with the intent of OWNER's SWMP guidance, if it is provided in the Drawings and Specifications, and other applicable standards, permit conditions, and regulations of appropriate agencies.

E. CONTRACTOR shall construct, operate, maintain, and remove in a safe manner temporary erosion and sediment control features described in OWNER's SWMP guidance, if it is provided in the Drawings and Specifications.

F. CONTRACTOR shall conduct the Work in such a manner to prevent contamination of adjacent watercourses, wetlands, or water impoundment areas.

G. Diversion or Bypass around Erosion Control Facilities:

1. Any diversion from, or bypass of water around facilities necessary to maintain compliance with the terms and conditions contained in SWMP is prohibited except:
   a. Where unavoidable to prevent loss of life or severe property damage.
   b. Where excessive storm drainage or runoff would damage the facilities.

2. If diversion or bypass of water around the facilities occurs, CONTRACTOR shall immediately notify OWNER of the occurrence.

3. CONTRACTOR, at CONTRACTOR's expense, shall repair the breached or bypassed facilities and shall be responsible for the restoration of site drainage to conform to the requirements of the approved SWMP.

H. If CONTRACTOR installs a portable concrete or asphalt plant, it is CONTRACTOR's responsibility to obtain stormwater discharge and other required permits for such plants.

I. CONTRACTOR shall provide design and implementation methods for overall site stormwater quality management to prevent contaminated surface runoff from entering the waters of the State and of erosion and sediment control measures for the purpose of correcting conditions unforeseen during the design of the Project, or for emergency situations that develop during construction.

1. Applicable erosion and sediment control measures can be found in the UDFCD *Urban Storm Drainage Criteria Manual, Volume 3 - Best Management Practices*.

J. CONTRACTOR shall include temporary erosion and sediment control features for construction Work outside the right-of-way that is necessary for borrow pits, haul roads, and equipment and material storage sites.

1. Should the inclusion of these additional Work areas cause the Project to be subject to Stormwater Discharge Permit(s), it shall be CONTRACTOR's responsibility to obtain the necessary permit(s).

K. CONTRACTOR shall continuously maintain stormwater management features from start of Work through the completion of the Project, ensuring proper functionality.

L. CONTRACTOR is responsible for the removal and storage and/or disposal of accumulated sediment.

M. Any construction waste or salvageable material, excavation excess material, fill material, construction equipment, toxins, fuels, lubricants, and other petroleum distillates shall not be stored or stockpiled within fifty (50) feet of the ordinary high water line of any watercourse, wetland, or water impoundment area or other sensitive areas as identified by the ENGINEER.

N. Equipment servicing shall occur within ENGINEER approved designated areas.

O. Spill prevention and containment measures as proposed by CONTRACTOR and approved by ENGINEER shall be used at all storage sites.

3.6 NOISE CONTROL

A. Mechanical equipment shall be equipped with the best available mufflers to reduce noise.

3.7 CONTRACTOR shall be responsible for obtaining any necessary permits and shall limit noise to the levels established in the permit and in local jurisdiction noise control ordinances, if applicable.

A. CONTRACTOR shall perform noise level monitoring as necessary, or as requested by the OWNER, to show that permitted noise levels are not exceeded.

B. During the performance of the Work, whether on right-of-way provided by OWNER or elsewhere, CONTRACTOR shall furnish all the labor, equipment, and materials required to reduce the noise nuisance.

END OF SECTION

SECTION 01 60 00

PRODUCTS, MATERIALS, AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general information, products, and execution for materials and equipment.

B. Related Sections:

1. SECTION 01 33 00 – SUBMITTAL PROCEDURES
2. SECTION 01 50 00 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1.2 DEFINITIONS

A. Products is defined to include purchased items for incorporation into Work, regardless of whether specifically purchased for the project or taken from CONTRACTOR's stock of previously purchased products.

B. Materials is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to Work.

C. Equipment is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items).

D. Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties", "systems", "structure", finishes", "accessories", "furnishings", "special conditions", and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

E. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying, and installation of Work.

1.3 SELECTION

A. Source Limitations: To the greatest extent possible for each unit of Work, product products, materials, and equipment of a single kind from a single source.

B. Compatibility of Options: Where more than once choice is available as options for CONTRACTOR's selection of a product, materials or equipment, select an option which is compatible with other products, materials or equipment. Compatibility is a basic general requirement of product, materials, and equipment selections.

1.4 TRANSPORTATION AND DELIVERY

A. Transport products by methods designed to avoid damage and delivery in undamaged condition in Manufacturer's unopened containers and packaging.

B. Provide equipment and personnel to handle products, materials and equipment, including those furnished by OWNER, if any, by methods designed to prevent soiling and damage.

C. Provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

D. Control delivery schedules to minimize long-term storage of products at the site and overcrowding of construction spaces. In particular, CONTRACTOR shall coordinate to minimize holding of storage times for flammable, hazardous, easily damaged, or materials sensitive to deterioration, theft, and other sources of loss.

1.5 STORAGE AND PROTECTION

A. Store work by methods and means that will prevent damage, deterioration, and loss, including theft. Store products in accordance with Manufacturer's written instructions and with seals and labels intact and legible. Store sensitive products in weather-tight climate-controlled enclosures; maintain temperature and humidity ranges within tolerances required by Manufacturer's recommendations.

B. For exterior storage of fabricated products, store products on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering and provide ventilation to avoid condensation.

C. Store loose granular materials on solid flat surfaces in a well-drained area; prevent mixing with foreign matter.

D. Storing shall be arranged to provide access for inspection.

1.6 MAINTENANCE OF PRODUCTS IN STORAGE

A. Periodically inspect stored products on a scheduled basis to assure products are undamaged and are maintained under required conditions. Maintain a log of inspections and make the log available to the Project Manager on request.

B. Surfaces of products exposed to the elements shall not be adversely affected and weathering of finished shall not occur.

C. Service products on a regularly scheduled basis. Maintain and submit a log of services as a record document prior to final acceptance in accordance with the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 71 23

CONSTRUCTION SURVEYING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general information and execution for construction surveying.

B. Related Sections:

1. SECTION 01 33 00 – SUBMITTAL PROCEDURES

1.2 COORDINATION

A. Survey:

1. The CONTRACTOR will establish or identify existing horizontal and vertical survey control for the Work in accordance with the Contract Documents. The survey control shall be performed by a licensed professional surveyor.

2. Perform surveys necessary to layout the Work including but not limited to alignments, grades, and elevations from the established control points.

3. The ENGINEER may review and/or verify the CONTRACTOR-established lines, grades, and elevations by surveys.

4. Notify ENGINEER, OWNER, and property and utility owners, as appropriate, a minimum of 5 days prior to the anticipated commencement of site conditions surveys in any one area and 24 hours in advance of actual start.

5. Review of surveys performed or requested by the ENGINEER shall not relieve the CONTRACTOR's responsibility for correct lines, grades, elevations, and structure layout.

B. Construction Layout:

1. Perform construction layout using qualified, competent personnel.

2. Stake alignment and platform at 25-foot intervals, grade changes, and beginning and end of all curves.

3. Make survey data available for review throughout the construction time period.

4. Enter survey notes and construction stakeout notes into a hard cover field book.

5. By the Substantial Completion date, submit data developed by surveys.

1.3 REFERENCE AND COORDINATE POINTS

A. Protect and preserve reference points and benchmarks.

B. Report damage or destroyed reference points and benchmarks to the ENGINEER.

1. The CONTRACTOR will hire a surveyor to re-establish damaged, moved, altered, or destroyed reference benchmarks and coordinate points.

2. If damaged, moved, altered, or destroyed by the CONTRACTOR, the cost of re-establishing such points shall be borne by the CONTRACTOR.

3. The ENGINEER is not responsible for increased cost or delays to the CONTRACTOR relating to reference points or benchmarks that are damaged, moved, altered, or destroyed by the CONTRACTOR or its Subcontractors, suppliers, agents, or employees or other contractors working on-site.

C. Report potential errors in reference points or benchmarks to the ENGINEER.

1. Discontinue the use of reference points or benchmarks alleged to be in error until the accuracy of such points can be verified.

2. Claims for extra compensation for the alteration or reconstruction allegedly due to errors in reference points or benchmarks is not allowed unless original reference points and benchmarks still exist or substantiating evidence proving the error is furnished by the CONTRACTOR, and unless the CONTRACTOR has reported such errors to the ENGINEER as specified herein.

D. Use of control monuments for construction surveying, other than those shown on the Drawings or furnished by or approved by the ENGINEER, is prohibited.

E. Range Points:

1. Protect existing range points and section monuments as described below:
   a. Range points and section monuments disturbed during construction shall be resurveyed and restored by the OWNER and paid for by the CONTRACTOR in accordance with the local jurisdiction guidelines and requirements for range points.
   b. Prior to disturbing a range point or section monument, the CONTRACTOR shall notify the OWNER that the information required to reset the monument has been prepared, stamped, and signed by a Professional Land Surveyor registered in the State of Colorado.
   c. The OWNER will withhold resurveying the restoration services, offered above, for circumstances related to the CONTRACTOR's neglect to provide adequate notification; the responsibility and cost for surveying and restoration shall become the CONTRACTOR's.
   d. The OWNER will collect information to resurvey and restore range points and section monuments prior to the beginning of Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION LINES AND GRADES

A. CONTRACTOR:

1. Make and maintain points and lines in connection with the surveys required.

2. Preserve line and grade stakes and markers set by the ENGINEER until otherwise authorized.

END OF SECTION

SECTION 01 77 00

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general information and execution for contract closeout.

1.2 SUBMITTALS

A. Quality Control Submittals: Written procedures for maintaining and markup of Record Documents.

B. Contract Closeout Submittals: Submit in accordance with the General Conditions and as specified in individual Specification sections:

1. Record Documents.
2. Warranties, bonds, and service agreements.
3. Consent of Surety to Final Payment.
4. Releases or Waivers of Liens and Claims.
5. Releases from Agreements.
6. Final Application for Payment.

C. Upon completion of closeout activities, submit an Application for Final Payment and a completed Final Payment Release Form as provided in the General Conditions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CLEANING

A. At completion of the Work and prior to the Substantial Completion date, remove tools, equipment, surplus materials, debris, and temporary construction facilities and controls from the premises.

B. Leave Work and adjacent areas in a clean condition.

C. Remove grease, dirt, dust, paint, stains, and other foreign materials resulting from Work from street surfaces and surrounding areas.

D. Repair damage to any surface or substrate caused by the improper use of techniques or materials.

E. Repair, patch, and touch up marred surfaces to match adjacent surfaces.

F. Broom clean paved surfaces.

G. Leave watercourses, gutters, and ditches open and clean.

H. Leave the site free of debris or excess materials of any sort.

I. Haul waste from the job site to an approved disposal area.

J. Retuned grassed areas disturbed by Work to original grade and re-seed or re-sod.

K. If the CONTRACTOR fails to perform cleanup, it may be performed by the OWNER and the CONTRACTOR's expense.

END OF SECTION

DIVISION 02 – SITE WORK

SECTION 02 24 19

SELECTIVE DEMOLITION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Section includes general information and execution for selective demolition.

1.2 DEFINITIONS

A. Demolish, Demolition, or Remove: Remove and properly dispose of designated existing equipment, materials, and ancillary features and components.

B. Relocate: Remove and relocate existing equipment, materials, and ancillary features and components.

C. Retain and Protect: Leave designated existing equipment, materials, and ancillary features and components in place and protect them from damage.

1.3 COORDINATION

A. Coordinate demolition with the OWNER and the ENGINEER.

B. Obtain any necessary permits before beginning demolition work.

1.4 SUBMITTALS

A. Quality Control Submittals:

1. Proposed methods of demolition and equipment to be used.
2. Copies of authorizations and permits required to perform demolition work.
3. Plan showing location and type of construction barricades and/or fences to be used.

1.5 SITE CONDITIONS

A. Information contained in the Contract Documents showing the scope of demolition is based on available Record Drawings:

1. Inspect facilities and verify the nature and location of the Work.
2. Differences between the Contract Documents and actual facilities does not constitute grounds for a time extension or Contract modifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Notify the ENGINEER in writing a minimum of 7 days prior to beginning demolition work.

B. Provide temporary barricades and other protection as required.

C. Cover and protect existing facilities, structures, equipment, and fixtures to be retained.

D. Provide required shoring, bracing, and supports.

E. Materials Designated for Reuse:

1. Do not remove additional materials without the approval of the ENGINEER.
2. Store and maintain equipment and materials in the same condition as when removed.
3. The CONTRACTOR and the ENGINEER will document and record the condition of equipment and materials prior to removal.

F. Demolition:

1. Conduct demolition operations and debris removal in a manner ensuring minimum interference with roads, streets, and other adjacent occupied facilities currently in use.
2. Drawings to define the extent of demolition. Only make rough cuts and breaks that exceed the limits of the demolition shown on the Drawings if approved by the ENGINEER.
3. Remove materials in order to conform to new elevations, profiles, and sizes. Comply with specified tolerances and finishes.
4. Saw cut or otherwise isolate materials to be removed to minimize damage to adjacent surfaces.
5. Remove concrete and asphalt in workable sections.
6. Protect materials and equipment that are designated for reuse.
7. Remove items to be demolished to the limits shown on the Drawings.
8. Protect existing structures, components, and surfaces from damage.
9. Use water sprinkling and other methods to limit dust.
10. Reinforcing steel:
    a. Cut back reinforcing steel and the embedded material exposed by demolition to a minimum of 1 inch below the concrete face.

G. Backfilling:

1. Do not use demolition debris as backfill material.

H. Disposal:

1. Equipment and materials shown on the Drawings to be removed shall be properly disposed of by the CONTRACTOR.
2. Dispose of demolished materials offsite in accordance with applicable laws, ordinances, rules, and regulations.

3.2 DEMOLITION SCHEDULE

A. Demolish:

1. Trees and shrubs within 50 feet of the groundwater cutoff wall.

B. Remove and Reinstall:

1. All existing fence that conflicts with construction operations shall be removed and immediately reinstalled after cutoff wall construction is completed in the area. Provide temporary fencing as necessary to ensure the site is continuously secure.

END OF SECTION

DIVISION 31 – EARTHWORK

SECTION 31 11 00

SITE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. In the initial move onto the Site, the CONTRACTOR shall protect existing fences, irrigation structures and associated improvements, streets, and utilities within and around the construction areas from damage due to boulders, trees, or other objects dislodged during the construction process and clear, grub, strip, and re-grade certain areas in preparation with commencing Work, in accordance with the Contract Documents. The CONTRACTOR shall stay within the limits of construction as identified on the drawings. Construction fencing shall be used to delineate areas that shall not be disturbed by the Work.

B. RELATED SECTIONS

1. SECTION 01 14 13 – ACCESS TO SITE

1.2 SITE INSPECTION

A. Prior to moving onto the Site, the CONTRACTOR shall inspect the site conditions and review maps of the onsite pipelines, utilities, and existing facilities along with property and right-of-way lines.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRIMARY ACCESS

A. The CONTRACTOR shall utilize existing, and improve as directed in the Contract Documents, access to the Site as shown, including access barriers to prohibit entry of unauthorized persons.

B. Utility Interference: Where existing utilities interfere with the Work, notify the utility owner and the ENGINEER before proceeding in accordance with the General Conditions.

3.2 CLEARING, GRUBBING, AND STRIPPING

A. Construction areas and stockpiles shall be cleared of grass, weeds and organic matter to at least a depth of 2-in or until no organic matter is present. The site shall be cleared of structures, pavement, sidewalks, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, or impair the subsequent usefulness of the Work, or obstruct its operation. Loose stones and boulders within 10-ft of the top of cut lines shall be removed from the Site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction.

B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove stumps, roots, and buried logs larger than 1-in diameter and other objectionable material. Underground structures, debris or waste shall be removed if found on the Site. Objectionable material from the clearing and grubbing process shall be removed from the Site and wasted in approved off Site locations.

C. Areas on the Drawings that are not identified for clearing and grubbing shall be left untouched by the CONTRACTOR.

D. Unless otherwise indicated, native vegetation larger than 3-inches in diameter at the base shall not be removed without the ENGINEER's approval. The removal of any trees, shrubs, fences, or other improvements outside of the construction limits, if necessary, for the CONTRACTOR's choice of means and methods, shall be first discussed with the ENGINEER before being arranged with the owner of the property, and shall be removed and replaced, as part of the Work.

E. Debris from clearing and grubbing shall be stockpiled as directed by the OWNER. Burning or burying of debris is not permitted on Site.

END OF SECTION

SECTION 31 25 00

SEDIMENTATION AND EROSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment and incidentals required and perform all installation, maintenance, removal, and area cleanup related to erosion and sedimentation control work as shown on the Drawings and as specified herein. The work shall include, but not necessarily be limited to; installation of temporary access ways and staging areas, silt fences, stone filter boxes, stone filter berms, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, excelsior matting installation and final cleanup.

B. RELATED SECTIONS

1. SECTION 01 33 00 – SUBMITTAL PROCEDURES
2. SECTION 31 11 00 – SITE PREPARATION
3. SECTION 31 56 13.13 – LOW PERMEABILITY CUTTOFF WALL

1.2 SUBMITTALS

A. Submit, in accordance with SECTION 01 33 00 - SUBMITTALS, technical product literature for all commercial products, including seed mix, fertilizer, erosion control blankets, sediment control logs, and straw mulch tackifier, to be used for erosion and sedimentation control.

B. Submit an Erosion Control Plan.

1.3 QUALITY ASSURANCE

A. Be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the Construction Site to offsite areas or into the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Drawings necessary to prevent the movement of sediment offsite shall be installed, maintained, removed, and cleaned up at the expense of the CONTRACTOR. The CONTRACTOR shall obtain a General Stormwater Discharge Permit as required by the Colorado Department of Health and Environment for Stormwater Discharges Associated with Construction Activity.

B. Sedimentation and erosion control measures shall conform to the requirements of the Colorado Department of Public Health and Environment, Town of Greeley standard specifications, and Weld County. If conflict between standards occurs, CONTRACTOR is to use most strict description.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Crushed stone for sediment filtration devices, access ways and staging areas shall conform to specified material as describe in specific section of technical specification and/or as called out on the Construction Drawings.

B. Silt Fence shall be a prefabricated commercial product made of a woven, polypropylene, ultraviolet resistant material such as "Envirofence" by Mirafi Inc., Charlotte, NC or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Silt Fence: Install all materials per guidance by material manufacturer.

3.2 MAINTENANCE AND INSPECTIONS

A. Inspections

1. Make a visual inspection of all erosion and sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to off Site areas, promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.

B. Device Maintenance (installed prior to commencement of work)

1. Silt Fences
   a. Remove accumulated sediment once it builds up to 1/2 of the height of the fabric.
   b. Replace damaged fabric, or patch with a 2-ft minimum overlap.
   c. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.

2. Sediment Logs
   a. Repair logs and remove sediments when 1/2 of log is buried.

3. Vehicle Tracking Pad and Concrete Washout
   a. Muck out trapped debris and dewatering pit trench when it has built up to within 6-in of the top of the berm.
   b. Replace crushed stone filter when saturated with silt and pore space is less than 1/4 of original installation.

4. Add crushed stone to access ways and staging area as necessary to maintain a firm surface free of ruts and mud holes.

3.3 REMOVAL AND FINAL CLEANUP

A. Remove temporary erosion and sedimentation control measures as installed by CONTRACTOR and/or others, and legally dispose of them within 30 days after final site stabilization is achieved, after erosion and sedimentation control measures are no longer required, or as directed by the ENGINEER.

B. Perform the removal of erosion and sedimentation control measures in a manner as to prevent damage to completed Work and re-vegetated areas.

C. Repair and stabilize damaged areas to prevent erosion and sedimentation from occurring.

D. The ENGINEER may direct the CONTRACTOR to leave all or a portion of temporary erosion and sedimentation control measures in place until Final Completion date.

E. After review and acceptance of the Work, the OWNER shall accept responsibility for subject measures.

END OF SECTION

SECTION 31 56 13.13

LOW PERMEABILITY CUTOFF WALL

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Section includes general information, products, and execution for low permeability cutoff walls.

B. Related Sections:

1. SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION
2. SECTION 01 45 16 – MATERIALS TESTING

1.2 DEFINITIONS

A. Excavation Refusal: The inability to achieve the full depth (typically 4 feet key in suitable bedrock) across the bottom trench length of that "set" (usually 30 to 40 feet) at a depth of 80 feet or less, with a V-shaped rock ripping bucket and the excavator in proper and effective operating condition, after 2 hours of excavation effort with little to no progress in depth. Upon excavation refusal; excavation effort will continue for a period of 30 minutes. If the excavation has not progressed 1-foot in depth or achieved the full key depth, in the 30-minute period the bottom of the trench shall be cleaned and excavation of that set considered complete. If a minimum of 1-foot of depth is achieved within 30 minutes excavation refusal has not occurred and normal trench excavation shall continue. Excavation refusal shall be determined with mutual agreement of the CONTRACTOR, and ENGINEER.

B. Highly Weathered Bedrock: Iron stained, moist to wet, silty claystone bedrock

C. Less Weathered Bedrock: Hard (weak rock), blocky, grey to dark grey, dry to slightly moist claystone bedrock with local areas of very hard siltstone.

D. Suitable Bedrock: Less weathered bedrock as approved by visual inspection by the ENGINEER

E. Obstructions:

1. Expect to excavate cobbles and boulders up to 24 inches in diameter.
2. Part of the low permeability cutoff wall may extend through overburden materials that may contain objects such as pipes, construction debris, and large boulders amongst others. Such objects, when encountered during excavation of the low permeability cutoff wall, will be defined as obstructions when the following conditions are met:
   a. The object encountered is an overburden soils (i.e., above top of geological bedrock) that causes a definite and measurable slow-down in the rate of excavation.
   b. The object encountered is greater in size than 4 feet by 2 feet by 2 feet or the object encountered is linear (such as a section of pipe) that does not meet the size requirements stated above, but is located at depths greater than 8 feet and is oriented at an angle to the low permeability cutoff wall alignment that caused a definite and measurable slow-down in the rate of excavation.
3. Naturally occurring material such as cobbles and boulders smaller than 4 feet by 2 feet by 2 feet shall not be considered obstructions. ENGINEER shall be the sole judge of whether an obstruction has been encountered.

F. Top of Suitable Bedrock: The depth of the top of bedrock shall be identified by the ENGINEER during excavation. The top of identified bedrock shall be measured from the construction platform.

1.3 REFERENCES

A. American Petroleum Institute (API):

1. API 13A - Specification for Drilling Fluid Materials
2. API 13B - Recommended Practice for Field Testing Water-Based Drilling Fluids

1.4 SUBMITTALS

A. Work Plan:

1. Low permeability cutoff work plan. Proposed equipment and methods of construction, including the following:
   a. Method for bentonite slurry preparation, distribution, and disposal
   b. Layout, locations, dimensions, and methods to prepare:
   c. Bentonite slurry preparation areas
   d. Low permeability backfill mixing area
   e. Method to excavate the cutoff wall trench and clean the bottom of the trench
   f. Method of monitoring and maintaining the bentonite slurry level in the cutoff wall trench when the trench is left open overnight, between one and three days, or over a three-day period of time.
   g. Methods of maintaining the stability of the cutoff wall trench and continuity and quality of backfill in case of sudden loss or drop in bentonite slurry wall of 2 feet below the slurry trench construction platform.
   h. Method to maintain stability of the trench when bentonite slurry cannot be maintained at least 2 feet above the level of groundwater.
   i. Methods to maintain the stability of the cutoff wall trench and the continuity and quality of the backfill when the top width of the trench expands to more than the allowed width, or more than 10 linear feet or cracks develop. Corrective action by CONTRACTOR must occur if trench width increases to 10 or more feet wide at the surface.
   j. Equipment and methods to:
      1) Measure and verify the depth to the bottom of the cutoff wall trench excavation at any time during excavation
      2) Check and prove the cleanliness of the bottom the trench, including the depth of sediment accumulation on the bottom of the trench
      3) Verify the required minimum penetration into the underlying bedrock before backfilling the trench with low permeability backfill
   k. Methods of mixing, transporting, handling, and placing low permeability backfill.
   l. Methods for segregating and removing bedrock, oversize materials and any other materials undesirable in the low permeability backfill.
   m. Methods to perform construction in areas considered by the CONTRACTOR to require remote mixing and methods for transporting and placing low permeability backfill.
   n. Methods and procedures to construct the cutoff wall in corners, turns in alignment, and restricted areas to ensure continuity of the cutoff wall.
   o. Method of keying together two adjoining sections of cutoff wall if constructed is interrupted.
   p. Method of disposing excess bentonite slurry at the completion of construction of the cutoff wall.
   q. Locations where excavation of the cutoff wall trench will begin and end, and procedures to begin and end the trench, including excavation slopes, backfill placement, and slurry removal.

r. Sampling tool to obtain relatively undisturbed samples of bedrock at the bottom of the trench excavation.
s. Sampling tool to collect samples of in-trench slurry from the bottom 25% of the trench.
t. Method to verify vertically of the trench.

2. Proposed shut downs and methods to protect cut off wall from cave-ins, or other similar issues.

B. Quality Control:

1. Certificate of Compliance and test reports from the bentonite manufacturer from each supplier of bentonite shipped to the site. The certificate shall state that the bentonite complies with all applicable API standards. Test reports shall include, but not be limited to, filtrate loss, density, polymer and chemical additive content, viscosity, moisture content, and yield. No bentonite shall be used before acceptance by ENGINEER.

2. Proposed procedures for sampling, preparing laboratory test specimens, and laboratory testing program before beginning the bentonite slurry and low permeability backfill mix design and laboratory testing program.

1.5 WARRANTY

A. Warranty for one year from Substantial Completion date, for the satisfactory performance and installation of the low permeability cutoff wall system and associated appurtenances.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bentonite:

1. Bentonite shall consist of 90 yield (90 barrels of bentonite slurry per ton of bentonite) natural Wyoming sodium bentonite power, ground to pass a No. 200 sieve, and in accordance with API 13A, Section 9.

B. Water:

1. Water for construction of the low permeability cutoff wall will be available from on-site sources. CONTRACTOR shall confirm that necessary permits and a sufficient water supply are in place to complete the Work.

2. The pH of the water used for bentonite slurry shall be between 6.0 and 9.0.

3. Total hardness less than or equal to 200 ppm.

C. Bentonite Water Slurry:

1. By definition, the slurry is a stable, fully hydrated, colloidal suspension of powered bentonite and water.

2. Mixed in a mixer that can completely disperse the bentonite particles and produce a stable colloidal suspension. No slurry shall be mixed by hand or in the trench. Mixing of bentonite and water shall continue until the bentonite particles are fully hydrated and the bentonite slurry is homogeneous. The bentonite slurry wall be periodically mixed or recirculated to keep it homogenous.

3. Provide all necessary storage, sumps, pumps, valves, and hose, supply lines, and other equipment required to supply a continuous quantity of fully hydrated bentonite slurry to the trench.

4. Additives normally used for control of oil-well drilling fluid may be used provided they meet the requirements of this section, are suitable to maintain slurry characteristics that are compatible with the soil and groundwater characteristics in the trench, and are acceptable by ENGINEER. No additives shall be used before acceptance by ENGINEER.

5. Perform tests and demonstrate compliance with the following requirements. Testing procedures shall be in accordance with API 13B.
   a. Viscosity:
      1) Fresh bentonite slurry (at the point of introduction to the trench) shall have a minimum viscosity of 40 seconds as measured by the Marsh Funnel testing method.
   b. Density of the bentonite slurry in the trench shall be such that adequate trench support is provided, and, that the slurry wall will be readily displaced by the low permeability backfill mixture. The density of the bentonite slurry in the trench shall be at least 15 pounds per cubic foot less than the wet density of the low permeability backfill, when the backfill is placed in the trench and not more than 87.36 pounds per cubic foot.
   c. Filtrate Loss:
      1) Fresh bentonite slurry prior to the introduction into the trench shall have a filtrate loss less than or equal to 20 cubic centimeters in 30 minutes, using a filter press at 100 pounds per square inch pressure.
      2) Bentonite slurry in the trench shall have a filtrate loss less than or equal to 30 cubic centimeters in 30 minutes, using a filter press at 100 pounds per square inch pressure.

D. Slurry Mixing and Cleaning Equipment:

1. The slurry mixing plant shall use a high-speed/high-shear, colloidal mixer or a high-velocity pressure venture jet mixer used in conjunction with a high-speed/high-shear centrifugal pump. The plant shall be equipped with a mechanically or hydraulically agitated sump and shall include pumps, valves, hoses, supply lines, tools, and other equipment and materials required to prepare the slurry and deliver it in a continuous supply from the hydration pond of tanks to the slurry trench. Mixers shall be capable of achieving complete dispersion of bentonite and additives, and shall be capable of continually mixing the slurry to provide and maintain a uniform blended slurry. Provide sufficient ponds or tanks for storage of hydrated bentonite slurry. Slurry cleaning equipment shall be available to reduce sand, sediment, or other solids as necessary to maintain the sand content or density requirements of the slurry in the trench. Slurry cleaning equipment may include, but not be limited to, vibratory shaker screens, centrifugal sand separators, or stilling ponds.

E. Soil-Bentonite Backfill:

1. The soil-bentonite cutoff wall shall be formed by a homogeneous mixture of soil, bentonite and water (soil-bentonite backfill) that completely displaces the bentonite slurry in the excavated cutoff wall trench.

2. Supplemental fines with a minimum percent passing the No. 200 sieve specified on Table 1 in SECTION 01 45 16 – MATERIALS TESTING, and plasticity that allow the soil to roll into a 1/8-inch thread shall be added to the soil-bentonite backfill mixture.

3. The soil-bentonite backfill shall have a leakage rate not greater than (1x10-7 cm/sec) with the requirements of this section and shall have a dry bentonite addition percentage (dry weight of bentonite to dry weight of soil in addition of bentonite derived from slurry) sufficient to reduce the leakage rate, and meet the gradation requirements on Table 1 in SECTION 01 45 16 – MATERIALS TESTING.

4. Bentonite shall be powered bentonite conforming to the requirements of this section. Additives may be used provided they meet the requirements of this section and are suitable for the intended use. No additives shall be used before acceptance by ENGINEER.

5. Soil for the soil-bentonite backfill shall consist of overburden soils, excavated bedrock, and/or imported material which generally consist of sand, gravel, clay, and silt; with a clay content necessary to meet the requirements of this section and Table 1 in SECTION 01 45 16 – MATERIALS TESTING. The soils shall be thoroughly mixed so that they become relatively homogeneous and lumps or clods are eliminated in the prepared soil-bentonite backfill. The soil shall contain no particles or clumps larger than 3 inches in diameter. A significant portion of excavated materials may not be suitable for backfill and will be cast out during excavation. The suitability of the soil is subject to acceptance by ENGINEER.

6. Thoroughly mix the materials so that they become well graded so that lumps or clods are eliminated in the prepared soil-bentonite backfill.

7. Soil-bentonite backfill, as it is being placed in the excavated cutoff wall trench, shall have a wet density of at least 15 pounds per cubic foot greater than that of the bentonite slurry in the trench, and a slump of 2 to 6 inches. The soil-bentonite backfill shall be thoroughly mixed, homogenous, and have a consistency that does not allow segregation.

PART 3 - EXECUTION

3.1 GENERAL

A. Construction shall be performed with the continuous trench excavator dig method.

B. The low permeability cutoff wall shall be formed by a homogeneous mixture of soil, bentonite, and water backfill that displaces the bentonite slurry in the excavated cutoff wall trench and has a permeability of 1x10-7 cm/sec or less. The low permeability backfill shall be at least 3.0 feet wide when measured perpendicular to the excavated cutoff wall trench. The nominal width of the cutoff wall shall be based on the width of the backhoe bucket used to excavate the cutoff wall trench.

C. The intent is to construct a continuous low permeability cutoff wall with a leakage rate not greater than the "design standard" leakage rate in the State Engineer Guidelines for Lining Criteria for Gravel Pits, August 1999.

D. Before performing any Work covered by this section, become thoroughly familiar with the site, site conditions, site utilities (above and below ground), subsurface conditions, lines and limits of site disturbances, and all other portions of the Work.

E. Maintain the stability of the excavated trench.

F. Prevent damage to existing facilities, slopes, or improvements that are to remain in-place.

G. Construct the low permeability cutoff wall at the locations and to the depths shown on the Drawings after preparation of necessary construction staging and Work area.

H. Low permeability cutoff wall shall be homogenous and continuous and shall not contain voids, windows, cracks, or any areas that do not achieve the specified maximum hydraulic conductivity.

I. Employ construction methods that completely prevent leakage or spillage of excavated soils, bentonite slurry, or low permeability backfill into the reservoir, wetlands, or other areas outside of the existing property and or mine limits.

J. Provide and maintain sufficient personnel, and equipment, and materials on-site to raise the bentonite slurry level in the excavation, maintain sufficient capacity to immediately raise the bentonite slurry level in case of sudden loss of bentonite slurry from the cutoff wall trench.

3.2 PREPARATION

A. Prepare necessary construction staging and Work areas, construction platforms, bentonite slurry preparation areas, and low permeability backfill mixing areas as required to construct the cutoff wall.

B. Excess soils excavated from the cutoff wall trench shall be cast down the face of the existing mine in a manner that shall not interfere with mine operations or water quality.

3.3 INSTALLATION

A. Equipment:

1. Use equipment to excavate the cutoff wall trench that has the capacity to remove overburden soils, sandstone, siltstone, claystone bedrock, and obstructions from the trench. The equipment shall have the capacity and capability to excavate to depth of at least 10 feet deeper than the bottom of the cutoff wall shown on the Drawings.

2. The equipment shall be arranged to permit free vertical passage of bentonite slurry within the trench and prevent the development of suction pressures. The equipment shall be such that raveling of the sides of the trench is minimized and the width of the trench is maintained. The equipment shall be capable of excavating the cutoff wall trench to the minimum required width with one pass of the excavator bucket.

3. Use equipment accepted by ENGINEER for final cleaning of the bottom of the trench before placing low permeability backfill.

4. Use devices accepted by ENGINEER to demonstrate that the trench is excavated to the required depth, width, and vertical tolerance shown on the Drawings.

5. Use equipment for mixing bentonite slurry that produces a stable, fully hydrated, colloidal suspension of bentonite and water. Transport the bentonite slurry by means of temporary pipeline or other methods approved by ENGINEER.

6. Use suitable equipment and/or practices that remove detrimental quantities of excavated material and other foreign material (detritus) from the slurry.

7. Use mixing equipment that produces a thoroughly mixed, homogenous backfill mixture that has a consistency that does not allow segregation, or unmixed pockets of low permeability backfill.

B. Excavation of Low Permeability Cutoff Wall:

1. Excavation of the cutoff wall trench includes, but is not limited to, excavating from the prepared surface of the construction platform, through overburden soils and into bedrock.

2. Excavation shall extend vertically from the prepared surface of the construction platform to the depths shown on the Drawings, or as required by ENGINEER. The depth of the cutoff wall trench may be modified by ENGINEER.

3. The excavation shall be completed with a maximum allowable deviation from vertical of 1% (1:100). Make and provide to ENGINEER measurements every 200 feet along the excavated cutoff wall trench that can confirm that the excavation is within this vertical tolerance. Additional measurements shall be made by CONTRACTOR as requested by ENGINEER.

4. Maintain the stability of the excavated cutoff wall trench at all times for its full depth. Excavate in a manner that does not cause movement or loss of ground. The following conditions shall be met:
   a. Excavation shall extend to the required depth at the location where the excavation is started. The full depth of the excavation shall be carried along the alignment of the cutoff wall as a continuous process.
   b. The toe of the cutoff wall trench excavation shall not precede the toe of the low permeability backfill slope by more than 30 feet. At the start of each set excavate the toe of the low permeability backfill slope.
   c. The low permeability cutoff wall shall be constructed without undue interruption until it is complete. Should the construction be delayed by more than 4 days, re-excavation of some of the previously constructed cutoff wall will be required. Re-excavation shall consist of removal of at least a 5-foot thickness of soil-bentonite backfill (measured perpendicular to the slope of the backfill) for the full depth of trench.
   d. Should construction be temporarily stopped and the cutoff wall trench backfilled to the limit of excavation, the portions of the cutoff wall before and after the interruption shall be keyed together in accordance with this section.
   e. The portions of the cutoff wall trench that have not been backfilled will be monitored for build-up of sediment on the bottom of the trench.
5. Show to the satisfaction of the ENGINEER, that the required bottom depth of the cutoff wall trench has been achieved, that the bottom depth is uniform as required (no scallops) for the length of the set and from one set to the next, and that the bottom of the trench has been cleaned of sand, gravel, sediment, or other material that may have fallen or settled to the bottom. Obtain a sample of bedrock material at approximately 30-foot intervals along the trench bottom using a sampling tool acceptable to ENGINEER. Obtain additional bottom samples as requested by ENGINEER at intermediate locations.
6. Clean the trench bottom and toe of the backfill at the start of each day.
7. The excavated cutoff wall trench shall be filled and maintained at all times with a stable suspension of bentonite slurry or low permeability backfill. The following conditions shall be met:
   a. Bentonite slurry shall be added to the excavation cutoff wall trench as necessary to maintain the slurry level within 2 feet of the construction platform and at least 2 feet above the local groundwater level.
   b. Provide protection against rainfall and concentrated flow from ditches and dewatering pipes from entering the excavated cutoff wall trench by constructing berms and diversions as necessary. The addition of water to the bentonite slurry in the trench will not be permitted.
8. Locate equipment and material stockpiles so they do not jeopardize the stability of the excavated cutoff wall trench or place a surcharge on the trench.
9. Properly dispose of all excess bentonite materials.
10. If cracks develop in the construction platform along and adjacent to the cutoff wall excavation perform the following:
    a. Notify the ENGINEER.
    b. Notify OWNER'S REPRESENTATIVE
    c. Survey the limits of the crack.

C. Removal of Obstructions During Excavation:

1. Remove obstructions as necessary during excavation of the slurry trench for the low permeability cutoff wall. Notify ENGINEER if obstruction removal would result in wider cutoff wall width or deviation of the cutoff wall alignment.

2. Complete construction of the low permeability cutoff wall such that there are no pervious voids or "windows" at the locations from where obstructions were removed.

D. Mixing and Placing Low Permeability Backfill:

1. Bedrock and soil that is not readily disaggregated to meet the maximum particle size shall not be incorporated into the backfill shall be removed and disposed of in the permanent stockpile for excavated cutoff wall material.

2. The low permeability backfill mixture shall be thoroughly mixed in a homogenous mass, free from large lumps, clods, or pockets of fines, sand, gravel, or frozen materials. Thoroughly mix the excavated soils with dry bentonite and/or bentonite slurry as required.

3. The bentonite slurry used for the low permeability backfill may be fresh or from the excavated cutoff wall trench. Mixing of the low permeability backfill with water will not be permitted.,

4. Place the low permeability backfill so that no pockets of bentonite slurry are in the completed cutoff trench.

5. Unmixed low permeability backfill materials shall not be allowed to fall into the trench.

6. Free dropping of the backfill through the bentonite slurry in the excavated trench will not be permitted.

7. Initial backfill shall be placed by tremmie methods to the bottom of the trench by lowering it to the bottom of the trench with a crane or clamshell bucket, by use of a lead-in trench, or by other methods approved by ENGINEER. Backfill shall be placed by these methods approved by ENGINEER. Backfill shall be placed by these methods until the surface of the backfill rises above the construction platform at the end of the cutoff wall trench. If a lead-in trench is used, it shall have a slope of 1H:1V or flatter.

8. CONTRACTOR shall receive no compensation for excavation associated with construction of a lead-in trench.

9. Once backfill rises to ground surface, place backfill by backhoe, bulldozer, or other approved method, such that the backfill enters the trench by sliding down the forward face of the previously placed backfill. The backfill shall not be dropped or deposited in any other manner.

10. Backfill continuously from beginning of the excavated cutoff wall trench, in the direction of the excavation to the end of the trench.

11. If test results indicate that the hydraulic conductivity, bentonite content, or density requirements are not met, representative portions of the low permeability backfill shall be removed from the cutoff wall trench and the proportions of the low permeability backfill shall be adjusted to meet the requirements of this section and Table 1 in SECTION 01 45 16 – MATERIALS TESTING.

12. Low permeability backfill placement operations shall proceed so that the top of the backfill below the surface of the bentonite slurry follows a reasonably smooth grade and has no hollows that may trap pockets of bentonite slurry during subsequent backfilling.

13. Frozen low permeability backfill shall not be placed in the trench and soil containing frozen lumps shall not be used to mix low permeability backfill.

14. Place curing cap on top of the low permeability backfill concurrent with low permeability backfilling. The material used to construct the curing cap shall meet the requirements of this section and Table 1 in SECTION 01 45 16 – MATERIALS TESTING.

15. The curing cap shall remain in-place a minimum of 4 months. Removal of the curing cap is not required unless the OWNER specifically directs the CONTRACTOR to do so. Construction of road crossings over the cutoff wall within the minimum 4 month curing

period can occur with the ENGINEER's approval or direction. Road crossings must be constructed according to the plans.

16. If the cutoff wall cap settles below the lowest elevation of the top of the cutoff wall, typically a settlement of more than 1-foot, the low area shall be refilled to at least the minimum top of cutoff wall elevation with soil-bentonite backfill or clayey soils.

3.4 QUALITY CONTROL

A. Quality Control testing shall be as specified in SECTION 01 45 16 - MATERIALS TESTING.

B. Tolerances:

1. The cutoff wall shall be essentially vertical as specified in this section, and shall be laterally and longitudinally continuous.
2. The cutoff wall excavation depth shall be measured every 10 linear feet, at the beginning and end of each shift, and periodically as required to confirm cutoff wall construction.
3. The depth of the cutoff wall shall be within 6-inches of the depth determined in the field by the ENGINEER.
4. The cutoff wall shall be excavated within 3 feet of the centerline of the design alignment. Deviations from the alignment by more than 3 feet must be approved by the ENGINEER prior to the start of excavation of the set.
5. Construction will not be permitted if the ambient air temperature is below 20° F, when severe weather conditions could compromise the quality of Work, in the opinion of the ENGINEER, or when low permeability backfill is freezing.
6. The bottom of the cutoff wall excavation will be sloped to match changes in top of bedrock elevation.
   a. When the top of bedrock elevation decreases, the excavation shall be sloped down at a 1H:1V slope to maintain the required excavation depth into bedrock.
   b. When the top of bedrock elevation increases, the excavation shall be sloped up at a 3H:1V slope to maintain the minimum required excavation depth into bedrock.
7. Excavation and backfill shall stop if bentonite water slurry or low permeability backfill do not meet the requirements of the Contract Documents. Excavation shall not resume until bentonite water slurry or low permeability backfill properties meet the requirements of the Contract Documents.

END OF SECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Section includes general information, products, and execution for aggregate base course.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses.

B. ASTM International (ASTM):

1. D 75 - Standard Practice for Sampling Aggregates.
2. D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbs/ft3 (600 kN-M/M3)).

C. Colorado Department of Transportation (CDOT):

1. Standard Specification for Road and Bridge Construction.

1.3 SUBMITTALS

A. Samples: size in accordance with D 75.

B. Quality Control Submittals: Laboratory tests.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregates:

1. Aggregates for bases shall be crushed stone, crushed slag, crushed concrete, crushed gravel, or natural gravel in accordance with AASHTO M 147.
2. The plasticity index (PI) shall be 6 or less, and the liquid limit (LL) shall be less than 30 for Class 5 and 6.
3. In accordance with the Standard Specification for Road and Bridge Construction.

B. Gradations:

TABLE 1
Percentage by Weight Passing Square Mesh Sieves

Sieve Designation	Material			
	Class 5	Recycled Class 6	No. 4	No. 467
2-inch	-	-	100	100
1 1/2-inch	100	-	90 to 100	90 to 100
1-inch	95 to 100	100	20 to 55	-
3/4-inch	-	95 to 100	0 to15	30 to 70
3/8-inch	-	-	0 to 5	10 to 30
No. 4	30 to 70	30 to 65	-	0 to 5
No. 8	-	25 to 55	-	-
No. 200	3 to 15	3 to 12	-	-

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade:

1. The subgrade shall be considered to be the finished earth, subbase course, or base course upon which any subbase, base, or surface course is to be constructed.
2. Preparation shall consist of the Work necessary to restore, correct, strengthen, or prepare the subgrade to a condition suitable for applying and supporting the intended course.
3. Aggregate base course for roads, parking areas, sidewalks, and slabs on grade:
   a. The top 6 inches of topsoil shall be stripped within the area to be aggregate surfaced.
   b. Following the stripping of the topsoil, the upper 12 inches of subgrade shall be scarified, moisture condition within 2 percent of optimum moisture content and compacted to a minimum of 95% compaction in accordance with ASTM D 698.
   c. Fill shall be placed within 2% of optimum moisture content and compacted to a minimum of 95% compaction in accordance with ASTM D 698.
4. The subgrade shall be prepared and constructed to have a uniform density. It shall be brought to the required alignment and cross-section with equipment and methods adapted for that purpose. Upon completion of shaping and compacting operations, the subgrade shall be smooth, at the required density, and at the proper elevation and contour to receive aggregate base course.
5. Holes, ruts, and other depressions in the subgrade shall be filled with materials similar to those existing in the subgrade. High places shall be excavated and removed to the required line, grade, and section.
6. Areas of yielding or unstable material shall be excavated and backfilled with stabilization rock as determined by the ENGINEER. Base course material shall not be placed on a subgrade that is soft, spongy, or covered by ice or snow. Base course shall not be placed on a dry or dusty subgrade where the existing condition would cause rapid dissipation of moisture from the base course material and hinder or preclude its proper compaction. Apply water to dry subgrades and rework and compact as necessary.

7. The ENGINEER will direct the CONTRACTOR to make minor adjustments in the finish grade from that shown on the Drawings as may be necessary or desirable to maintain the characteristics of a stabilized subgrade by minimizing the amount of cutting into or filling.

B. Earth subgrade:

1. When the subgrade is an earth subgrade, it shall be prepared by removing vegetation, excavating and removing materials, filling depressions, scarifying, shaping, moisture content, and smoothing and compacting to meet the required grade, section, moisture content, and density.

2. Stones greater than 3 inches shall be removed.

3. Subgrade shall proofrolled as requested by the Engineer prior to placement of any soils.

3.2 INSTALLATION

A. Aggregate base course shall be constructed to the width and section shown on the Drawings.

B. The maximum compacted thickness of a layer shall not exceed 8 inches.

C. Each layer shall be constructed as far in advance of the successive layer as directed by the ENGINEER. The Work shall proceed from the point nearest the point of supply of aggregate so that hauling equipment travels over the previously placed material. Hauling equipment shall be routed as uniformly as possible over portions of the previously constructed courses or layers of the base course.

D. The material shall be deposited on the soil subgrade or on the previously placed layer in a manner that minimized segregation and facilitates spreading to a uniform layer of the required section. In the event that blending of materials is necessary to provide the required gradation and properties of the material, and is done in the roadway, the same shall be accomplished by mixing aggregate and blending material by means of blade graders, discs, harrows, or other equipment to affect a uniform distribution and gradation throughout the finished mixture. Excessive mixing and grading that causes segregation between the course and fine materials is prohibited.

E. Equipment:

1. Equipment shall be capable of performing the Work required by this section. Inadequate equipment shall be replaced or supplemented.

2. Improperly used equipment shall be cause for rejection of Work if, in the opinion of the ENGINEER, the Work fails to meet the requirements of this section.

3. Equipment used for compaction shall be the rolling type, the vibratory type, or a combination thereof and be of sufficient capacity to meet the compaction requirements herein.

F. Compaction:

1. After a layer of course is placed and spread to the required thickness, width, and contour, it shall be compacted. If the material is too dry to readily attain the required density, it shall be moistened to the degree necessary for proper compaction.

2. Compaction of each layer shall continue until the required density of a minimum of 95 percent density per ASTM D-698 is reached. The surface of each layer shall be maintained during compaction operations in such a manner that a uniform texture is produced and aggregates are firmly keyed.

3. In areas where proper compaction is not obtainable due to segregation of materials, excess fines, or other deficiencies in aggregate, it shall be reworked as necessary or the material shall be removed and replaced with aggregates as specified in this section.

4. The surface of each layer shall be kept true and smooth.

END OF SECTION