**REPORT**

# Annual Inspection

*Coal Creek Station - Upstream Raise 92 CCR Surface Impoundment*

Submitted to:

**Great River Energy**
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Submitted by:

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## FIGURES



## APPENDICES

# 1.0 INTRODUCTION

As part of 40 CFR Part 257 of the Subtitle D solid waste provisions under the Resource Conservation and Recovery Act (RCRA), utilities are required to complete annual inspections for surface impoundments and landfills containing Coal Combustion Residuals (CCR). This report has been prepared by Golder Associates Inc. (Golder) for Great River Energy (GRE) to satisfy the annual inspection requirements for CCR surface impoundments under 40 CFR Part 257.83.

Coal Creek Station (CCS) is located in McLean County, approximately 10 miles northwest of Washburn, North Dakota. There are four facilities located at CCS that fall under the CCR rule requirements (Figure 1):

- Drains Pond System CCR Surface Impoundment (Drains Pond System)
- Upstream Raise 91 CCR Surface Impoundment (Upstream Raise 91)
- Upstream Raise 92 CCR Surface Impoundment (Upstream Raise 92)
- Southeast Section 16 CCR Landfill (Southeast 16)

Upstream Raise 91 and Upstream Raise 92 both operate as impoundments and will be closed with CCR in-place. The Drains Pond System is currently being used to dewater bottom ash and as a process water impoundment to return conveyance water back to the plant. The Southeast 16 landfill operates as a landfill and is used as a storage/disposal facility for CCRs that do not contain free liquid. This report presents a review of available facility information and findings of the inspection of Upstream Raise 92 at CCS performed September 24, 2019.

# 2.0 REVIEW OF EXISTING INFORMATION

## 2.1 Geological Conditions

Upstream Raise 92 is generally constructed over a glacial till layer consisting of sandy and silty-clay soils. The glacial till varies in thickness from 20 feet to several hundred feet in the area of CCS. Silty-sand and sand lenses are present throughout the glacial till formation, which is underlain by poorly consolidated siltstone/sandstone bedrock (Barr Engineering 1982; CPA and UPA 1989).

## 2.2 Facility Location and Operation

Upstream Raise 92 (Figure 2) is located in Section 16, Township 145N, Range 82W and covers approximately 110 acres. The facility is used as a combined dewatering and storage facility for CCRs including fly ash, bottom ash, and flue gas desulfurization (FGD) material. FGD material and hydraulic conveyance water enter Upstream Raise 92 through a high-density polyethylene (HDPE) pipe from the plant to the northwest corner of the facility. The pipe runs above ground from the northwest corner of the facility to the final discharge location. The on-grade HDPE pipe is periodically moved to different areas of Upstream Raise 92 to achieve an even distribution of FGD material in the facility. Bottom ash and fly ash are hauled to the facility using heavy construction equipment, such as Caterpillar 777 haul trucks. The facility is dewatered using gravity-driven drainage pipes that extend from the west side of Upstream Raise 92 to the east side of Upstream Raise 91. Upstream Raise 92 is approximately 300 feet south of Lower Samuelson Slough and 100 feet north of the rail lines. Upstream Raise 91 is adjacent to the west end of the facility and the plant dry CCR landfill (Southeast 16) is adjacent to the east side of the facility. Upstream Raise 92 was constructed within the boundaries of the historic Ash Pond 92 (west side of Upstream Raise 92) and the Southwest Section 16 Landfill (east side of Upstream Raise 92).

## 2.3 Site History and Liner Systems

Ash Pond 92 was originally part of the South Ash Pond. The South Ash Pond was constructed with a clay core dike around the perimeter and a soil liner. A new clay liner was installed over the South Ash Pond in 1982 and the facility remained in operation until 1987 when in-place CCRs were excavated from the South Ash Pond and transported to the Section 5 dry CCR landfill (Eugene A. Hickok & Associates 1986; Foth & Van Dyke 1988). The South Ash Pond was then divided into Ash Pond 91 and Ash Pond 92. Ash Pond 92 was deepened and a new composite liner consisting of a 2-foot thick clay and 40-mil HDPE liner was completed in 1989. The liner is overlain with 1 foot of sand, 1 foot of Pit Run gravel, and a drainage system with collection pipes that slope to the north side of the facility. Ash Pond 92 was modified in 2002 to allow for “vertical” placement of CCRs. Since September of 2002, the facility has been constructed with an interior area of FGD material, a drainage layer of bottom ash, and an outer shell of fly ash (Figure 3).

The Southwest Section 16 Landfill was originally part of the East Ash Pond and was constructed with a natural clay liner. In 1989, the facility was reclassified as a solid waste disposal area and CCRs from the other parts of the East Ash Pond were excavated and placed in the Southwest Section 16 Landfill. The Southwest Section 16 Landfill was re-graded and a new composite liner consisting of a 1-foot thick clay and 60-mil LLDPE liner was installed over the previously placed CCR in three phases between 2005 and 2008. The liner is overlain with a “liner head reduction system” consisting of 18 inches of granular material and drainage pipes overlain by a 1-foot clay liner. The Southwest Section 16 Landfill was re-graded and relined to allow for “vertical” placement of CCRs and has been connected with the “vertical” placement of CCRs occurring in Ash Pond 92. An additional 7 acres of composite liner was installed in the southeast corner of Upstream Raise 91 and in the area between Upstream Raise 91 and Upstream Raise 92 in 2016. The liner completes a continuous composite-lined area between Upstream Raise 91 and Upstream Raise 92. The composite liner system installed in 2016 consists of (from bottom to top): Geosynthetic Clay Liner (GCL) and 60-mil HDPE liner.

Appendix A contains additional information regarding the design of Upstream Raise 92.

## 2.4 Site Geometry

The design crest of the original soil perimeter berms surrounding Upstream Raise 92 are at approximate elevations between 1900 feet above mean sea level (amsl) and 1920 feet amsl. This berm surrounding the facility has a gravel surfaced roadway supporting both light passenger vehicles and heavy construction equipment, such as Caterpillar 777 haul trucks. Based on existing topography, original berm downstream slopes generally have 3:1 or 2.5:1 slopes down to perimeter drainage ditches with elevations between approximately 1880 feet amsl and 1900 feet amsl. The original soil perimeter berm upstream slopes have an approximate 3:1 slope from this original soil perimeter berm to the base of the facility between 1892 feet amsl and 1910 feet amsl.

An expansion berm on the east half of the facility built with soil and CCRs extends from the original soil perimeter berms to an elevation of 1950 feet amsl at 3.5:1 to 4:1 slopes. The entire facility is designed with 4:1 final CCR slopes from the perimeter berms to elevation 1974 feet amsl, 15% final CCR grades between elevations 1974 feet amsl and 2004 feet amsl, and a 5% crown to achieve a final CCR elevation of approximately 2022 feet amsl (Figure 3).

## 2.5 Changes in Geometry

No significant changes to geometry were noted other than the continued placement of CCRs to the design grades. Between January and December of 2019, the bottom ash/fly ash has increased in elevation from

approximately 1995 feet amsl to 1998 feet amsl and the FGD material has increased in elevation from approximately 1982 feet amsl to 1988 feet amsl.

## 2.6 Storage Capacity and Volumes

Based on a comparison between the approximate grades as of the fall of 2019 and the final permitted grades of Upstream Raise 92, the facility has a remaining CCR capacity of approximately 700,000 cubic yards (CY). The approximate total CCR capacity of Upstream Raise 92 is 12,920,000 CY. Therefore, the amount of CCR contained in the facility at the time of the inspection is estimated to be approximately 12,220,000 CY.

## 2.7 Impounded Water

The depth of impounded water in Upstream Raise 92 varies with time as more CCRs are deposited and as operational variables change (such as gravity drainage pipe elevations). At the time of the inspection, the depth of impounded water at Upstream Raise 92 varied from zero feet on the east side of the facility (FGD material deposition location) to approximately two feet on the west side of the facility. It is estimated that approximately 5,600,000 gallons (17.2 acre-feet) of water was impounded at the time of inspection.

## 2.8 Permits

Upstream Raise 92 is currently permitted with the North Dakota Department of Environmental Quality (NDDEQ) under Permit Number 0033. Previous permit modification documents describe additional historical information about the design of the facility (CPA 1997, CPA and UPA 1989, GRE 2003, GRE 2012).

## 2.9 Summary of 2019 Weekly Inspections

Routine weekly inspections of Upstream Raise 92 facility were performed throughout 2019 as a part of the final CCR Rule. Based on a review of the available inspection forms, the following items were noted:

- Generally good site maintenance.
- No signs of significant settlement or cracking of the berm downstream slopes.
- Cracks in bottom ash and fly ash crests and side slopes continued to be noted and are expected to continue during placement of CCRs. These cracks have been discussed between onsite staff and design engineers, and are attributed to consolidation of interior FGD materials.
- Seepage was noted at an isolated location on the south downstream slope near the toe. GRE personnel discussed the observations with the design engineers in September at approximately the same time as the annual professional engineer inspection. The area of seepage was monitored due to significant rains in the fall of 2019 and was noted to dissipate after initial observations.
- Fugitive dust is actively controlled using a water truck (as required).

## 2.10 Summary of Previous Inspection

The most recent annual professional engineer inspection of Upstream Raise 92 was performed by Golder in the fall of 2018 (Golder 2019) and a summary of the observations of that inspection are as follows:

- Generally good vegetation and site maintenance.

- No signs of significant or unexpected seepage, settlement, or cracking of the berm downstream slopes, although the surface water drainage at the toe along the south side of Upstream Raise 92 had some standing water and marshy vegetation due to recent grading activities.
- Cracks in the bottom ash and fly ash CCR crests were noted and were attributed to consolidation of interior FGD materials. These cracks were expected to continue during placement of CCRs.
- Minor erosion of the fly ash "shell" (within the lined footprint of the facility) and accumulation of sediment in perimeter contact water channels.
- Several small animal burrows, but none that were anticipated to cause areas of structural weakness.
- Portions of the final cover seeded in the past three years have fair to good native grass vegetative growth.

# 3.0 2019 ANNUAL INSPECTION

On September 24, 2019, Kayla Moden, Todd Stong, Paul Schlicht, and Craig Schuettpelz of Golder performed a visual inspection of Upstream Raise 92 per USEPA Regulation 40 CFR Part 257.83(b) requirements. The inspection consisted of visual observations while walking around the facility traversing up and down the perimeter berm and CCR placement areas. An annual inspection checklist used during the inspection is presented in Appendix B. Photographs were taken and are presented in Appendix C. The following presents a summary of the observations made during the 2019 annual inspection.

## 3.1 Hydraulic Structures

Upstream Raise 92 has an inflow pipe for depositing FGD material. The on-grade HDPE pipe is 8 inches in diameter and is periodically moved to different areas of Upstream Raise 92 (or Upstream Raise 91) to achieve an even distribution of FGD material in the facilities.

The outflows from Upstream Raise 92 consist of a series of gravity drainage pipes and culverts that transfer CCR conveyance water from the facility to the adjacent Upstream Raise 91. Over time, the gravity drainage pipes can become clogged with material and new pipes are installed to convey water between the facilities. At the time of the inspection, gravity drainage pipes appeared to be in good condition and were located above the impounded water within Upstream Raise 92 in preparation for drainage to start at a specified level. The culvert connecting the drainage ditch on the northwest side of Upstream Raise 92 to Upstream Raise 91 was in fair condition, as sediment had accumulated in this perimeter channel and at the culvert inlet.

The inflow and outflow systems appear to be in fair to good condition with no sign of settlement, cracking, or corrosion.

## 3.2 Perimeter Berm

### 3.2.1 Berm Upstream Slope

The berm upstream slopes are mostly covered by CCR deposition and/or final cover. A small amount of the berm upstream slope from elevation 1917 to 1920 was visible on the north side of the facility. The observed slope appeared to match the design slopes of 3:1 and are being protected from erosion with a cemented fly ash layer. The berm upstream slopes appeared to be competent with no signs of significant distress.

### 3.2.2 Berm Crest

The berm crest along the north and south sides of Upstream Raise 92 is surfaced with gravel and used for both light vehicle and heavy construction equipment traffic. The berm crest on the west side of Upstream Raise 92 was

not visible since Upstream Raise 92 is connected with Upstream Raise 91 via a geomembrane liner. The crest of the original perimeter soil berm on the north and south sides of the facility (elevation 1900 feet amsl to 1920 feet amsl) is a gravel surfaced road that appeared to be in good condition with minor rutting, likely a result of recent significant rains. The roads were well-compacted and the north side experiences frequent heavy traffic. The visual inspections did not reveal signs of cracking, erosion, or settlement.

### 3.2.3 Berm Downstream Slope

The berm downstream slopes of Upstream Raise 92 below the original and expansion berms are heavily vegetated with native grasses. Occasional animal burrows up to approximately six inches in diameter were observed on the north and south berm downstream slopes. There is no noticeable significant erosion, cracks, or scarps on these grassy slopes and they appear to be in good condition.

A seep was noted on the south berm downstream slope of Upstream Raise 92 approximately 10 feet from the toe of the slope. The seep was located at the approximate historic location of the toe drain that was a part of the original design of the impoundment berms prior to geomembrane liner construction (see Section 2.3). The localized wet area was approximately 10 feet wide and 20 feet long and generally had a zone of saturated soft clay at the surface (uppermost 3 to 4 inches) underlain with a layer of gravel/cobbles intermixed with clay. Continued monitoring of the seep following the annual inspection indicated that the seep location had moved down the slope after several days and was not visible after approximately 10 days. These observations appear to support that the seep was likely a result of recent significant rainfall infiltrating the perimeter berm. The area will continue to be monitored as a part of the weekly inspections of the facility.

## 3.3 Toe

The toe of the slopes on the north and south sides of Upstream Raise 92 are mostly covered with tall grass. A few small animal burrows were noted during the inspection, but there were no noticeable signs of seepage, cracks, or settlement.

The surface water drainage at the toe of the slope on the south side of Upstream Raise 92 had some marshy vegetation and standing water. The surface water drainage ditch in this area was recently modified to promote flow toward site surface water drainages and therefore portions of this ditch were not yet well-vegetated. The presence of some standing water in this surface water drainage ditch was noted due to the low average slope of this ditch and the fact that it is near typical groundwater levels. Side slopes of this drainage ditch are also relatively steep near the toe, but did not show signs of movement. The toe may need to be regraded and reseeded in the future to limit erosion. In addition, the downchute channels should be extended and hydraulic jump basins constructed on the south side of the facility to limit erosion when final cover is constructed over the entirety of Upstream Raise 92.

## 3.4 CCR Placement

### 3.4.1 CCR Upstream Slope

The CCR upstream slope is defined as the slope that toes out into the raise pool. The CCR upstream slope of Upstream Raise 92 is constantly changing as bottom ash and FGD material are deposited. Therefore, the CCR upstream slopes are temporary and dependent on the angle of repose of the bottom ash material. The vertical distance from the top of the bottom ash CCR upstream slope to the water/FGD material mixture is approximately 9 to 12 feet in most locations. The CCR upstream slopes appear to be in good condition with no signs of structural weakness.

### 3.4.2 CCR Crest

The CCR crest along the top of the facility is constructed mainly of bottom ash. The CCR crest is bordered on the outsides of the facility by a fly ash “shell” primarily for erosion protection and as a trafficking surface. Bottom ash on the CCR crest of the facility is in good condition and is continually worked and compacted with heavy equipment. During the inspection, cracks were noted on the surface of the CCR downstream slopes and the CCR crest (between elevations 1974 feet amsl and 1995 feet amsl) within the lined footprint of the facility. In each case, the cracks were between approximately 1 and 18 inches wide, up to several feet deep, and up to several hundred feet long. The cracks are expected and can be attributed to consolidation of FGD material on the interior of the facility and the relatively rigid bottom ash and fly ash exterior of the facility. These cracks are continually observed and evaluated by onsite operations personnel for changes to the shape, offset, or length of the features, and the installed instrumentation (inclinometers and piezometers) provides additional information regarding the performance of the facility with respect to the design.

### 3.4.3 CCR Downstream Slope (no Cover)

The area above the original and expansion berm downstream slopes surrounding the west and east sides, and a portion of the north and south sides of Upstream Raise 92 had an exposed fly ash “shell” at the time of the inspections (CCR downstream slope). The fly ash CCR downstream slope is in good condition and there was no noticeable seepage, sloughing, or abnormally thriving vegetation during the inspections; however, there were cracks noted on the surface of the CCR downstream slopes as described in Section 3.4.2 of this report as well as some minor erosion of the fly ash shell. The eroded fly ash is collected within the lined footprint in a perimeter ditch and must be periodically cleaned out as required.

### 3.4.4 CCR Downstream Slope (with Cover)

Portions of CCR downstream slopes on the north side of Upstream Raise 92 have temporary cover. These areas were well vegetated with grass and weeds but had experienced some minor erosion. The CCR downstream slopes with temporary cover appeared to be in generally good condition to aid in controlling erosion of the outer fly ash “shell” and limit wind-blown fugitive dust.

The south CCR downstream slope of Upstream Raise 92 has final cover on the side slopes to an elevation of 1974 feet amsl with terraces approximately every 20 vertical feet and downchute drainage channels along the side slopes. Final cover seeded in the past four years has fair to good native grass vegetative growth. These areas should continue to be monitored and should be re-seeded to promote growth of native grass species, as required. Other areas of the CCR downstream slope with final cover constructed more than four years ago show good native grass vegetative growth. Wormwood growth was noted on the final cover in addition to the native grass. Wormwood is a noxious woody weed that should be mitigated when growing on final or temporary cover slopes. Occasional small burrows up to four inches in diameter were also noted on final covered slopes. Minor cracks were noted near the top of final covered slopes (contact water separation berm) on the south side of the facility. There is no noticeable significant erosion, scarps, or settlement on these grassy slopes and they appear to be in good condition.

## 3.5 Instrumentation

Water levels in Upstream Raise 92 are monitored monthly using 15 piezometers located within the placed CCR slopes of the facility. In addition, two inclinometers were installed in the CCR slopes of the facility to monitor slope movements associated with ongoing consolidation of FGD material in the facility. The plan view location of each piezometer and inclinometer is shown in Figure 4.

Piezometer measurements for the past year are included in Appendix D-1. Piezometers PZ-1 through PZ-12 were constructed near the perimeter bottom ash seepage piping and have historically fluctuated by less than approximately 3 feet as the facility height has increased. Piezometers PZ-13 (D and S) and PZ-14 (D and S) were constructed along the side slopes of the facility and show greater variability since installation as they are nearer to the FGD material pool in the center of the facility.

In 2016, water levels within piezometer PZ-13D rose approximately 15 feet abruptly. This piezometer was evaluated with a downhole camera on July 23, 2019 and was determined to be damaged approximately 53 feet from the top of the piezometer (broken casing). As such, this piezometer was removed from future monitoring. Appendix D-2 contains photographs from the field investigation that show damage to Piezometer PZ-13D.

Inclinometer measurements taken since 2014 are shown in Appendix D-3. Inclinometer measurements show a general trend that supports the consolidation of the FGD material in the middle of the facility. Consolidation of thicker zones of FGD material in the middle of the facility is greater than consolidation of FGD material zones near the perimeter. Therefore, the inclinometers show a trend of the rigid fly ash and bottom ash material settling toward the center of the facility. Inclinometers appear to show that movement is slowing as a majority of the loading of the facility moves inward, further from the inclinometers.

## 3.6 Signs of Structural Weakness or Other Observations that Could Affect Stability

No signs of structural weakness or other observations that could affect the stability of Upstream Raise 92 were observed during the site inspection in September 2019.

# 4.0 SUMMARY AND CONCLUSIONS

An annual visual inspection was performed for Upstream Raise 92 at Coal Creek Station on September 24, 2019. The inspection met the requirements for CCR surface impoundments under 40 CFR Part 257.83. Golder observed good vegetation and site maintenance and did not identify significant structural deficiencies such as settlement, or unexpected cracking during visual observations of Upstream Raise 92. A seep was noted on the south berm downstream slope of Upstream Raise 92. The seep appears to have been a result of significant rain events and has since receded and not been visible on the slope surface. The temporary seepage is not expected to impact overall structural stability. Site personnel will continue to monitor the seep location for any changes. Overall, the facility appeared to be in good condition at the time of the visual evaluation.

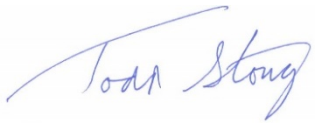
In addition to annual inspections by the Professional Engineer, trained and qualified site personnel continue to perform the required weekly facility inspections to look for signs of potential structural weaknesses. Instrumentation (inclinometers and piezometers) will be monitored regularly to ensure proper operation of the equipment and to evaluate the overall structural stability of the facility.

Minor maintenance items that may need to be continually addressed include monitoring the size and shape of cracks in CCR downstream slope and CCR crest of the facility, repairing large animal burrows as they appear, monitoring erosion and vegetative success of the re-configured surface water channel along the south toe of the facility (including construction to complete downchute channels and hydraulic jump basins prior to final cover of the entirety of Upstream Raise 92), clean-out of collected material in the perimeter channels and maintaining gravity and culvert piping between Upstream Raise 91 and Upstream Raise 92, re-seeding of CCR downstream slopes with final cover, and removal of any woody vegetation growing on the berm downstream slopes. In

addition, the inflow and outflow piping should be monitored regularly to ensure proper conveyance of water to and from the facility.

**Golder Associates Inc.**

Craig Schuettpelz
*Senior Engineer*



Todd Stong
*Senior Consultant and Associate*

TJS/CCS/af



https://golderassociates.sharepoint.com/sites/102406/technical work/a - ccr support/a5 - ccr rule/ccr annual inspections/_final rpts/ur92/19115185_ur92_ccrinspreport_fnl_27jan20.docx

# 5.0 REFERENCES

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Great River Energy – Coal Creek Station. GRE 2012. Permit Modification Document, Permit No. SP-033. Original Permit Modification dated December 12, 2012.

# Figures


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**NOTE(S)**

1. AERIAL IMAGE FROM UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURE AERIAL IMAGERY PROGRAM, TAKEN IN 2018.

**GREAT RIVER ENERGY - COAL CREEK STATION**
**2019 ANNUAL CCR FACILITY INSPECTION REPORT**
**SITE OVERVIEW**

**FIGURE 1**

Path: \\Denver\acad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\19115185\Annual Inspection\ | File Name: Fig2 - UR92 Site Overview.dwg

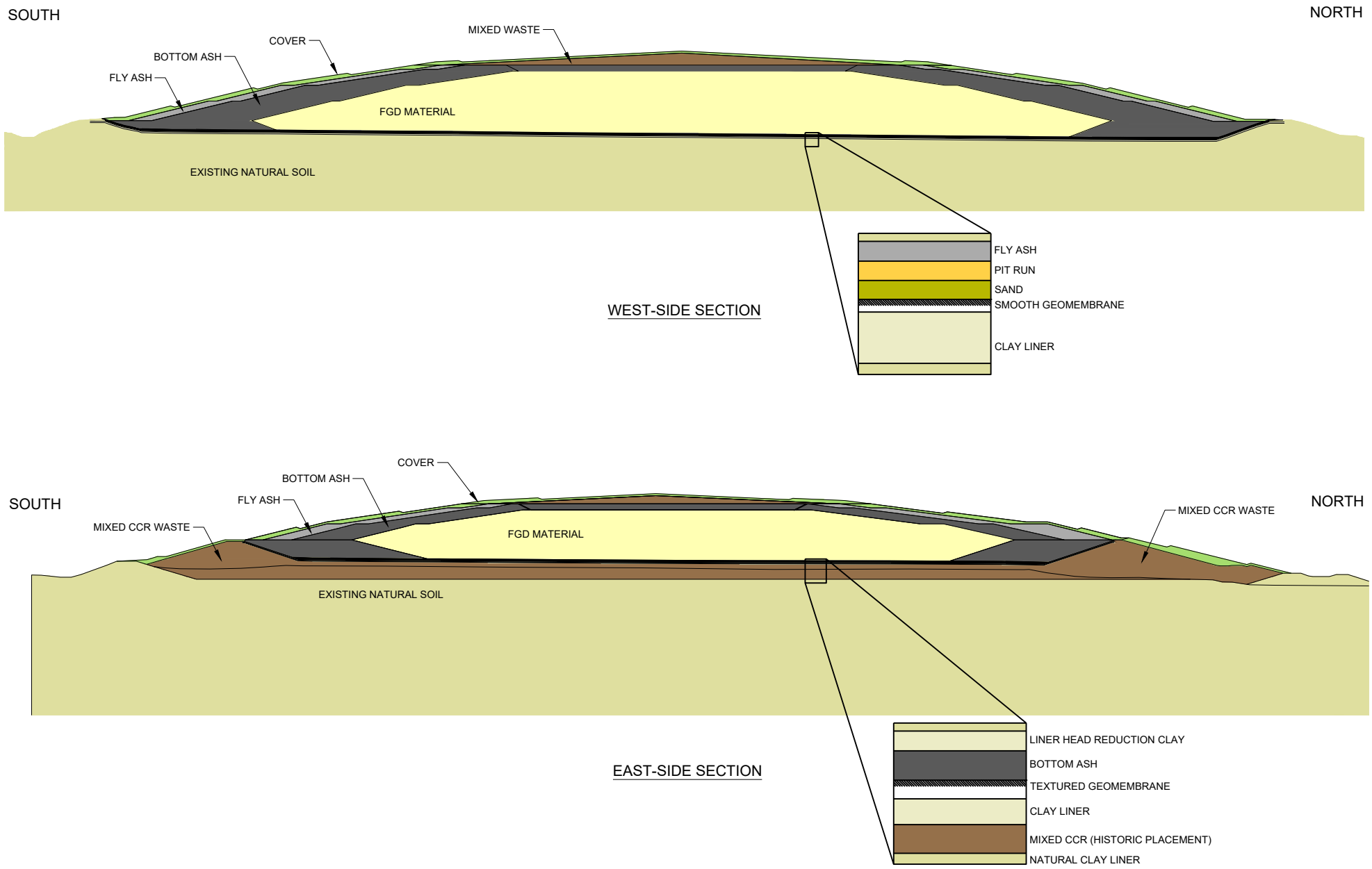

GOLDER

**REFERENCE(S)**

1. FOREGROUND AERIAL IMAGES FROM GREAT RIVER ENERGY PHOTOGRAPHS TAKEN IN 2019.
2. BACKGROUND AERIAL IMAGE FROM THE UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURE AERIAL IMAGERY PROGRAM, TAKEN IN 2018.

**GREAT RIVER ENERGY - COAL CREEK STATION**
**2019 ANNUAL CCR FACILITY INSPECTION REPORT**
**UPSTREAM RAISE 92 - SITE OVERVIEW**

**FIGURE 2**

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**GREAT RIVER ENERGY - COAL CREEK STATION**
**2019 ANNUAL CCR FACILITY INSPECTION REPORT**
**UPSTREAM RAISE 92 - CROSS SECTIONS**

**FIGURE 3**

Path: \\Denver\acad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\19115185\Annual Inspection\ | File Name: Fig4 - UR91 and UR92 Instrumentation Overview_UPDATED.dwg


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**GREAT RIVER ENERGY - COAL CREEK STATION**
**2019 ANNUAL CCR FACILITY INSPECTION REPORT**
**UPSTREAM RAISE 92 INSTRUMENTATION OVERVIEW**

**FIGURE 4**

APPENDIX A

# Selected Construction Drawings and Permit Drawings

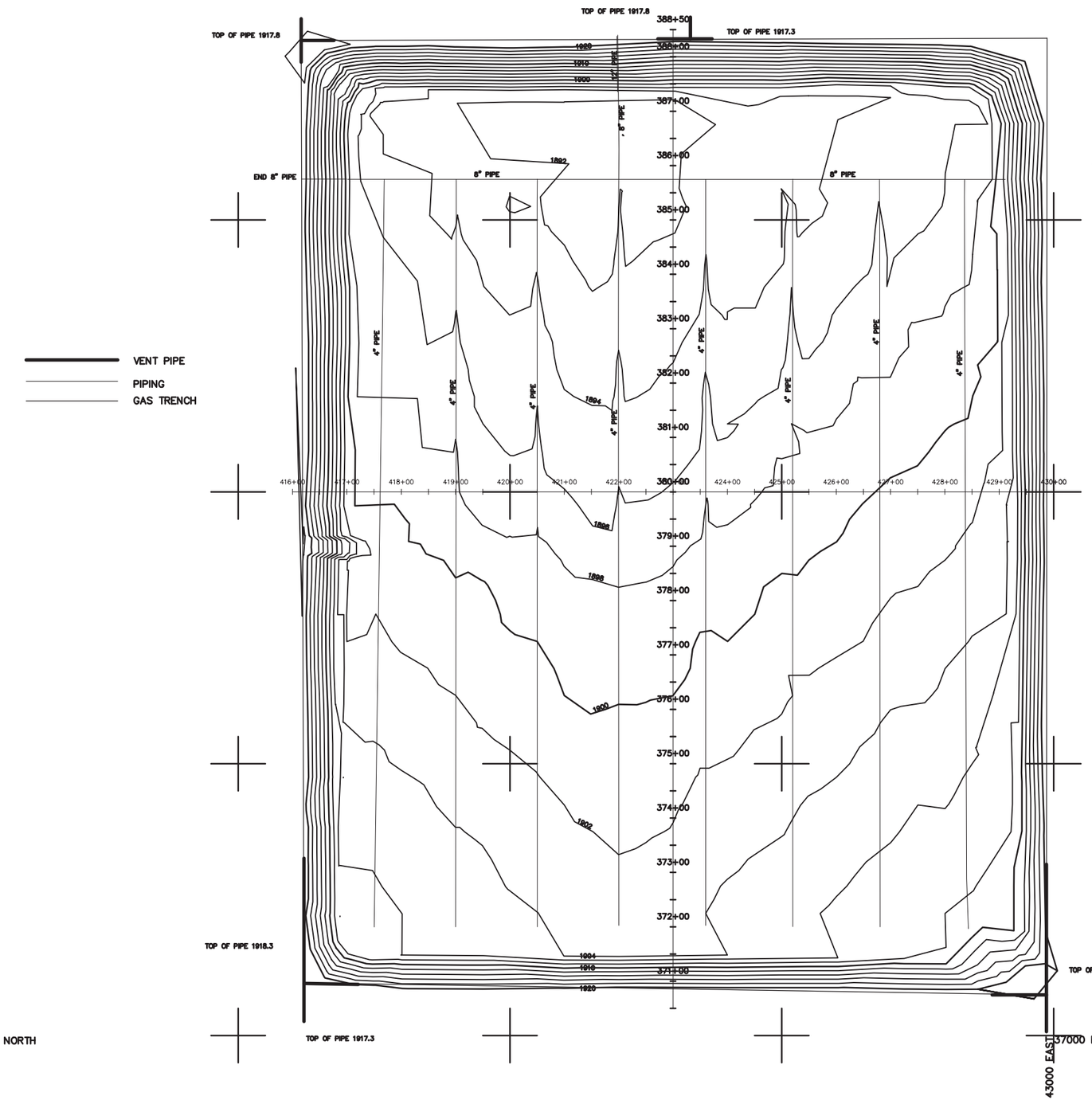
# COAL CREEK STATION

## *EAST HALF SOUTH ASH POND*

## FINISHED GRADES

AND PIPING

## UNDERWOOD, NORTH DAKOTA




VENT PIPE
PIPING
GAS TRENCH

GRAPHIC SCALE

100 0 50 100 200 400

( IN FEET )
1 inch = 100 ft.

THIS DRAWING PREPARED JANUARY 26, 1990
FROM INFORMATION COMPLETED ON DECEMBER 20, 1989

NOTES
1. SITE LOCATION SW 1/4 SECTION 16 T. 145 N., R. 82 W., McLEAN COUNTY, NORTH DAKOTA.
2. TOPOGRAPHY IS BASED ON AN ACTUAL SURVEY OF THE GROUNDS.
3. ELEVATIONS ARE BASED ON SEA LEVEL DATUM.
4. HORIZONTAL DATUM IS BASED ON NORTH DAKOTA STATE PLANE COORDINATES SYSTEM AS FOLLOWS:
   SITE GRID NORTH = NORTH STATE PLANE COORDINATES MINUS 1000,000.
   SITE GRID EAST = EAST STATE PLANE COORDINATES MINUS 1,800,000.

SURVEYOR'S CERTIFICATE

I, LARRY J. SMITH, A REGISTERED LAND SURVEYOR IN THE STATE OF NORTH DAKOTA, HEREBY CERTIFY THAT THE ANNEXED PLAT IS A TRUE COPY OF THE NOTES OF SURVEY COMPLETED ON DECEMBER 20, 1989 AND IS A TRUE REPRESENTATION OF THE AS-BUILT CONDITION.

LARRY J. SMITH
NORTH DAKOTA REGISTRATION
NO. 2363


CIVIL ENGINEERING LAND PLANNING LAND SURVEYING
SWENSON, HAGEN & CO. P.C.
CONSULTING ENGINEERS
P.O. BOX 1135, 909 BASIN AVENUE
BISMARCK, NORTH DAKOTA 58502
701-223-2800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Foth & Van Dyke

SCALE

SCOPE ID.

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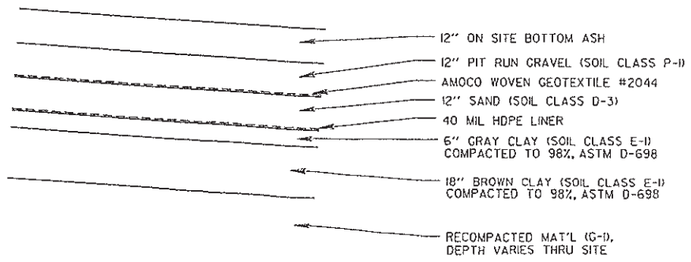
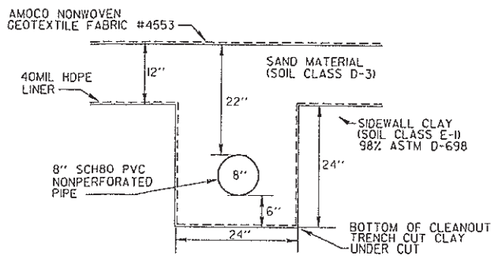
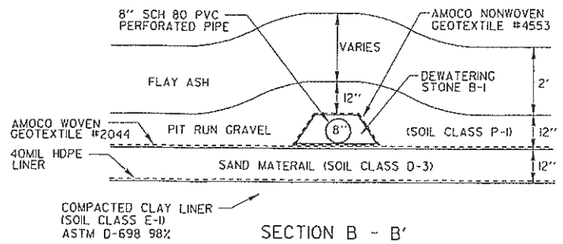



1/11 TYPICAL FLEXIBLE MEMBRANE LINER (FML) DETAIL

NOT TO SCALE




SECTION A - A'

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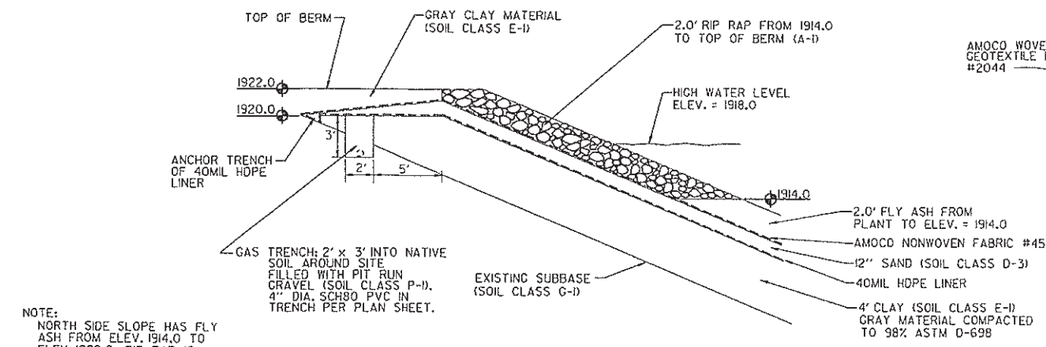
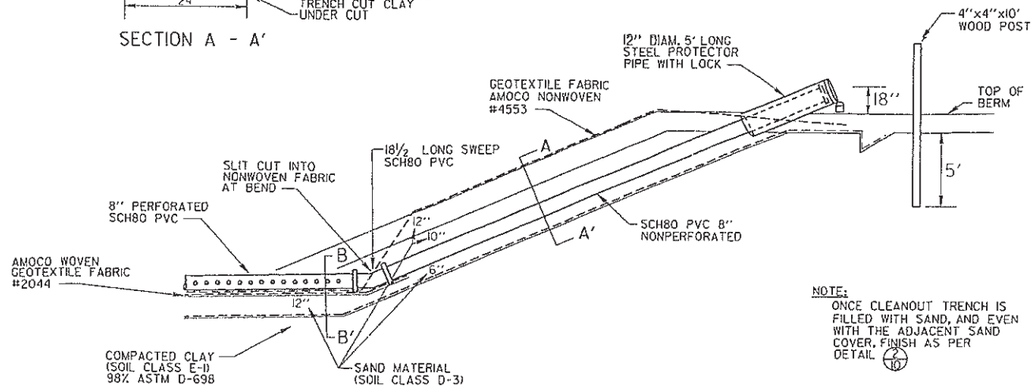



NOTE:
NORTH SIDE SLOPE HAS FLY ASH FROM ELEV. 1914.0 TO ELEV. 1922.0. RIP RAP IS REPLACED WITH FLYASH.

2/11 TYPICAL SIDE WALL DETAIL OF SOUTH, EAST AND WEST SLOPES

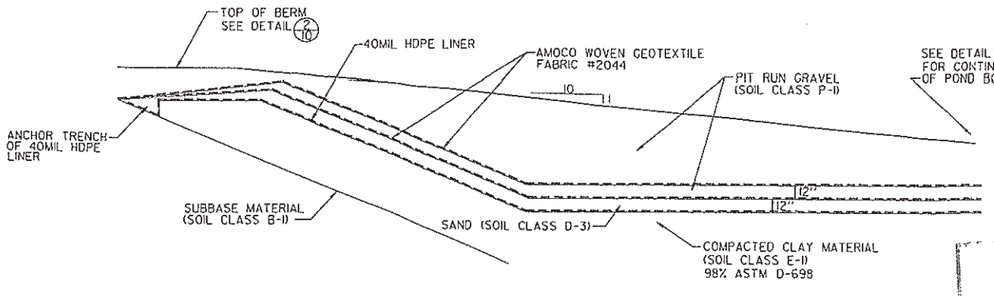
NOT TO SCALE




NOTE:
ONCE CLEANOUT TRENCH IS FILLED WITH SAND, AND EVEN WITH THE ADJACENT SAND COVER, FINISH AS PER DETAIL 6/10

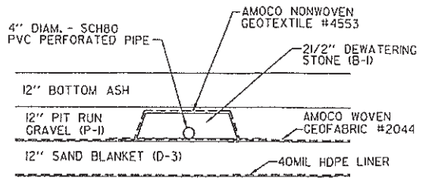
4/11 TYPICAL CLEAN-OUT RISERS EAST AND WEST SLOPES

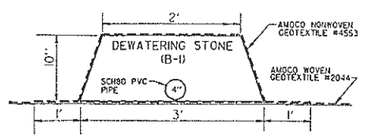
NOT TO SCALE




3/11 PERMANENT HEAVY EQUIPMENT ENTRANCE RAMP DETAIL (SOUTHEAST CORNER OF POND)

NOT TO SCALE




TYPICAL DEWATERING STONE DETAIL

5/11 TYPICAL DEWATERING AND HEADER TRENCH DETAIL WITH DETAIL OF THE BEDDING AROUND THE PERFORATED PIPE

NOT TO SCALE





CADD PROJ CODE: SCOO | PRF NAME: SCOODET
DRAWN BY: DP | DATE: 1/25/90
SURVEYED BY: LS | DATE: 9/8/89
SURVEY DATA:

RECORD DRAWINGS OF COMPLETED CONSTRUCTION BASED ON CONTRACTORS AND/OR OWNERS RECORDS DURING CONSTRUCTION.
BY [illegible] DATE 2-6-90

REVISIONS / REMARKS

| NO. | BY | DATE |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |

APPROVED BY: [illegible] DATE: 2-6-90
REVIEWED BY: [illegible] DATE: 2-6-90
PREPARED BY: [illegible] DATE: 2-6-90

Foth & Van Dyke

COOPERATIVE POWER
EDEN PRAIRIE, MINN.
AND
UNITED POWER
ELK RIVER, MINN.

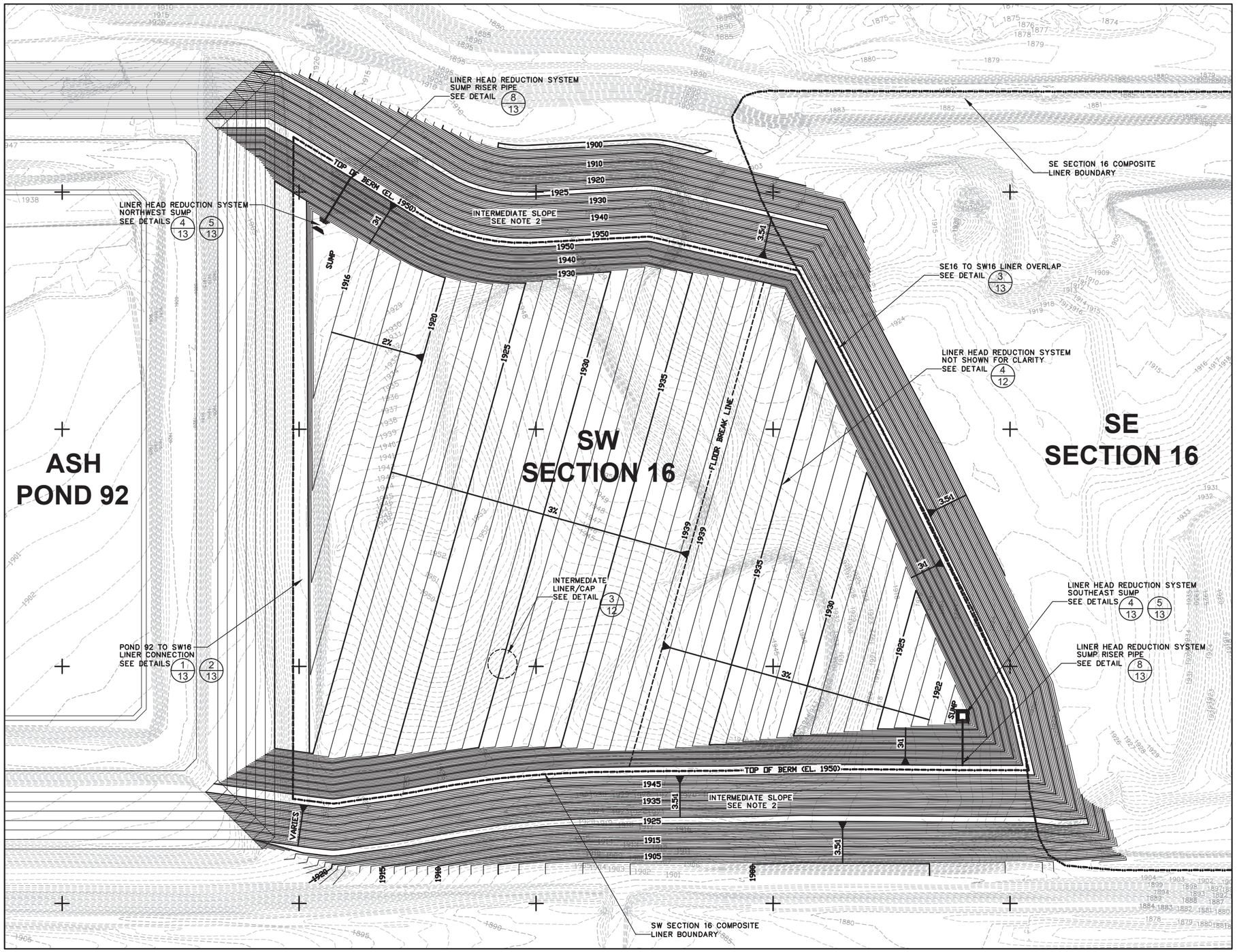
DOCUMENTATION DRAWINGS
COAL CREEK STATION
EAST HALF OF SOUTH ASH POND

DETAILS

SCALE NOT TO SCALE

SCOPE ID 89C16

DRAWING NO. 11




## LEGEND

- EXISTING GROUND TOPOGRAPHY (SEE REFERENCES)
- PREVIOUS PHASE PROPOSED TOPOGRAPHY
- PROPOSED CONSTRUCTION TOPOGRAPHY
- SW SECTION 16 COMPOSITE LINER BOUNDARY
- SE SECTION 16 COMPOSITE LINER BOUNDARY

## NOTES

1. SW SECTION 16 GRADES REPRESENT TOP OF CLAY LINER/SOIL DIKE.
2. SW SECTION 16 CONTAINMENT DIKE SLOPES ARE INTERMEDIATE SLOPES AT 3.5H:1V. FINAL CLOSURE SLOPES WILL BE GRADED TO 4H:1V.

## REGULATORY DESIGN BASIS

1. CONTROL OF RUN-ON AND RUN-OFF DURING OPERATIONS FROM A TWENTY-FIVE-YEAR, TWENTY-FOUR-HOUR STORM EVENT (3.75"), PER SUBDIVISION A OF SUBSECTION 3 OF NDAC SECTION 33-20-04.1-09.
2. OPERATE THE UPSTREAM RAISE (SURFACE IMPOUNDMENT) TO HAVE A FREEBOARD OF AT LEAST TWO FEET, PER SUBDIVISION D OF SUBSECTION 2 OF NDAC SECTION 33-20-08.1-01.
3. MINIMIZE EROSION OF FINAL COVER, PER SUBDIVISION B3 OF SUBSECTION 4 OF NDAC SECTION 33-20-04.1-09.
4. MAXIMUM FINAL SLOPES NOT LESS THAN THREE PERCENT, NOR MORE THAN TWENTY-FIVE PERCENT, PER SUBDIVISION B3 OF SUBSECTION 4 OF NDAC SECTION 33-20-04.1-09.
5. EVALUATE SLOPES STEEPER THAN FIFTEEN PERCENT TO ENSURE STABILITY, PER SUBDIVISION B3 OF SUBSECTION 4 OF NDAC SECTION 33-20-04.1-09.
6. CONTROL OF SURFACE WATER DRAINAGE FROM FINAL SLOPES, PER SUBDIVISIONS B2-B4 OF SUBSECTION 4 OF NDAC SECTION 33-20-04.1-09.
7. COMPOSITE LINER, PER SUBDIVISION B OF SUBSECTION 2 OF NDAC SECTION 33-20-08.1-01.
8. APPROPRIATE ENGINEERED FINAL COVER DESIGN, PER NDAC SECTION 33-20-07.1-02.
9. ALL OTHER APPLICABLE RULES FROM NDCC CHAPTER 23-29 AND NDAC ARTICLE 33-20.

## REFERENCES

1. SITE LOCATION: SECTION 16, T145N, R82W, MCLEAN COUNTY, NORTH DAKOTA.
2. EXISTING GROUND TOPOGRAPHY PROVIDED BY GREAT RIVER ENERGY. PERFORMED BY INTERSTATE ENGINEERING AND KADRMAS, LEE & JACKSON BETWEEN 1996 AND 2003.
3. ELEVATIONS BASED ON MEAN SEA LEVEL DATUM, CONTOUR INTERVAL IS ONE FOOT.
4. HORIZONTAL DATUM BASED ON NORTH DAKOTA STATE PLANE COORDINATE SYSTEM AS FOLLOWS:

   SITE GRID N = N STATE PLANE COORDINATE MINUS 100,000
   SITE GRID E = E STATE PLANE COORDINATE MINUS 1,800,000

5. ALL PROPERTY SHOWN ON THIS MAP IS OPERATED BY GREAT RIVER ENERGY.

DRAFT

100 0 100
1" = 100 FEET

ENGINEER'S STAMP

REFERENCE DRAWINGS

| NO. | REVISION DESCRIPTION (THIS DRAWING IS NOT APPROVED UNLESS LAST REVISION IS HAND WRITTEN) | DATE | BY | CHKD | AP'VD |
|---|---|---|---|---|---|
| C | ISSUED FOR DRAFT REVISED PERMIT MODIFICATION | 07/09/04 | | | |
| B | ISSUED FOR PERMIT MODIFICATION | 09/24/03 | TJS | RRJ | RRJ |
| A | ISSUED FOR CLIENT REVIEW | 06/04/03 | TJS | – | RRJ |

PRINT ISSUE RECORD

| | |
|---|---|
| DATE | |
| FOR | |
| REVISED | |
| CLIENT | |
| FIELD | |

PROJECT
GREAT RIVER ENERGY
COAL CREEK STATION
PERMIT NO. SP-033 PERMIT MODIFICATION

TITLE
# PHASE 2: SW SECTION 16 INTERMEDIATE LINER/CAP

Golder Associates
Denver, Colorado

| | | | | | |
|---|---|---|---|---|---|
| PROJECT No. | 023-2411 | | FILE No. | 0232411A020 | |
| DESIGN | TJS | 05/01/03 | SCALE | AS SHOWN | REV. C |
| CADD | TJS | 05/01/03 | 5 | | |
| CHECK | RRJ | 06/02/03 | | | |
| REVIEW | RRJ | 06/02/03 | | | |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Last Plot: Sep 27, 2010 15:28
Machine: NOT SET
By: Cschuettpelz
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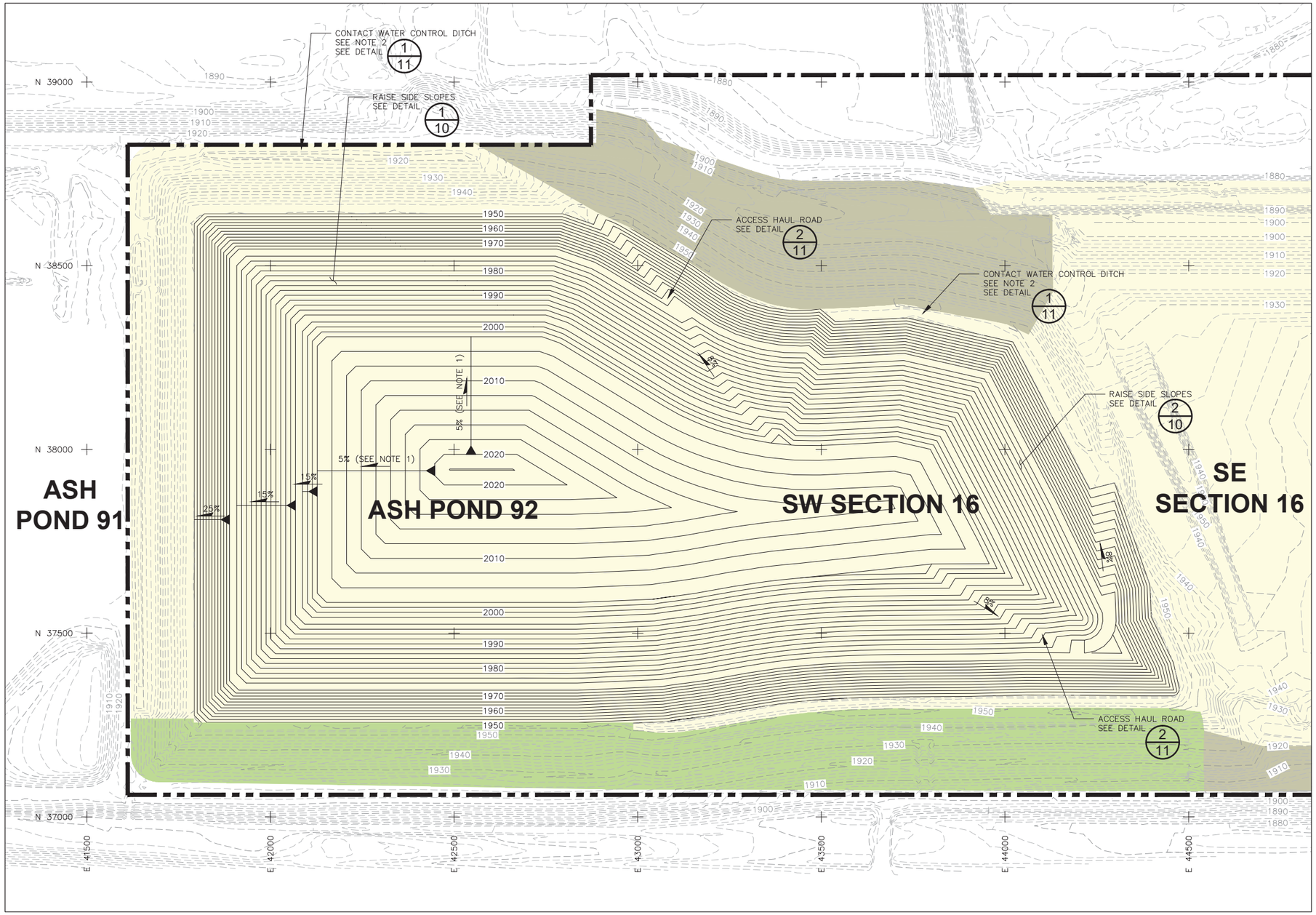
By: Cschuettpelz




## LEGEND

- EXISTING GROUND TOPOGRAPHY (1880)
- PROPOSED TOP OF CCP TOPOGRAPHY (1980)
- AREA OF ACTIVE CCP PLACEMENT
- TEMPORARY COVER PLACED
- FINAL COVER PLACED
- PERMITTED LIMIT OF CCP PLACEMENT

## NOTES

1. CCP GRADES OF THE CROWN OF THE FACILITY ARE SHOWN AT 5%, BUT MAY BE CONSTRUCTED BETWEEN 3% AND 5%.
2. CONTACT WATER IS COLLECTED IN THE DITCH AROUND ASH POND 92 AND SW SECTION 16. WATER IS DIRECTED THROUGH CULVERTS TO ASH POND 91 OR DOWNWARD INTO THE UPSTREAM RAISE.

## REFERENCES

1. SITE LOCATION: SECTION 16, T145N, R82W, MCLEAN COUNTY, NORTH DAKOTA.
2. EXISTING GROUND TOPOGRAPHY PROVIDED BY GREAT RIVER ENERGY. PERFORMED BETWEEN 1996 AND 2011.
3. COORDINATES BASED ON PLANT GRID SYSTEM.
4. CONTOUR INTERVAL IS TWO FEET.
5. ALL PROPERTY SHOWN ON THIS MAP IS OWNED BY GREAT RIVER ENERGY.

150 0 150
SCALE FEET

**DRAFT**

ENGINEER'S STAMP

ORIGINAL DRAWING STAMPED BY TODD STONG, REGISTERED PROFESSIONAL ENGINEER IN THE STATE OF NORTH DAKOTA (PE #6144), IS ON FILE AT GOLDER ASSOCIATES' LAKEWOOD, COLORADO, OFFICE.

| NO. | REVISION DESCRIPTION | DATE | DESIGN | CADD | CHECK | REVIEW |
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| B | ISSUED FOR PERMIT MODIFICATION | 11/30/12 | CCS | CCS | TJS | RRJ |
| A | ISSUED FOR CLIENT REVIEW | 10/24/12 | CCS | CCS | TJS | RRJ |

PROJECT
GREAT RIVER ENERGY
COAL CREEK STATION
PERMIT NO. SP-033 PERMIT MODIFICATION

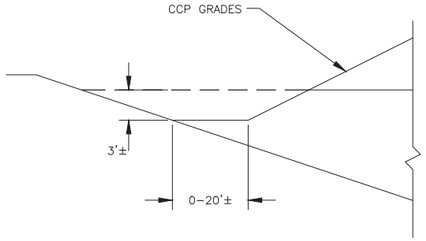
TITLE
# PHASES 3 AND 4: ASH POND 92 & SW SECTION 16 RAISE VERTICAL EXPANSION

Golder Associates

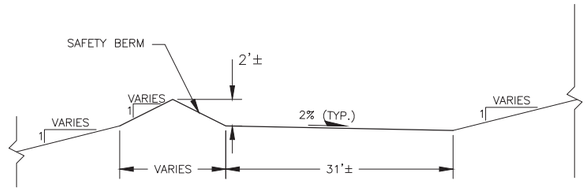
GREAT RIVER ENERGY

FILE No. 11381519A006
PROJECT No. 113-81519

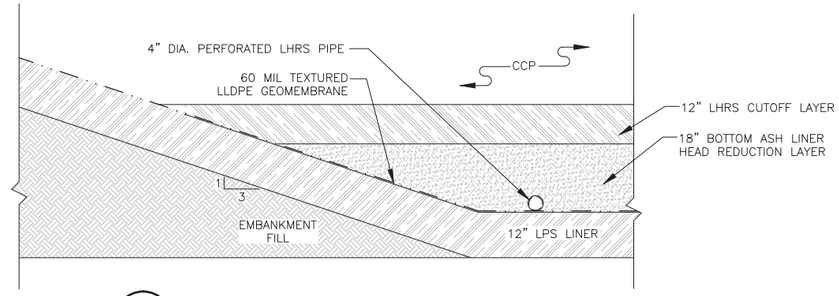
5



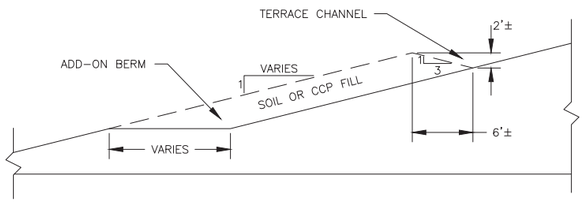

1/11 **CONTACT WATER CONTROL DITCH**
NOT TO SCALE



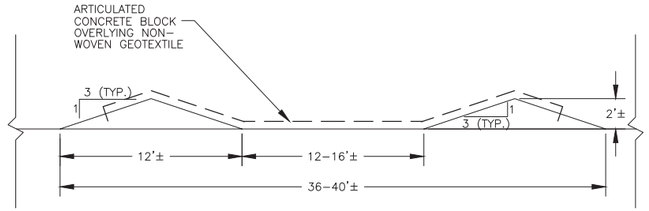

2/11 **ACCESS HAUL ROAD**
NOT TO SCALE



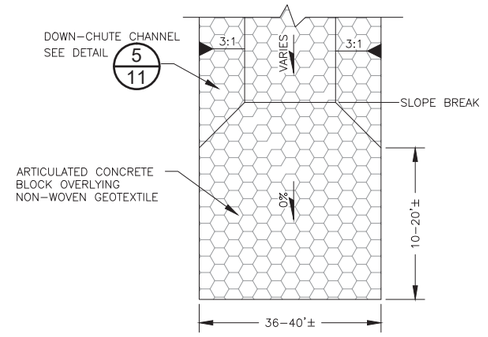

3/11 **SW 16 INTERMEDIATE LINER/CAP AND LHRS DETAIL**
NOT TO SCALE




4/11 **TERRACE CHANNEL DETAIL**
NOT TO SCALE




5/11 **TYPICAL DOWN-CHUTE CHANNEL**
NOT TO SCALE




6/11 **HYDRAULIC JUMP BASIN**
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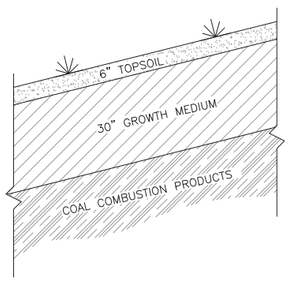
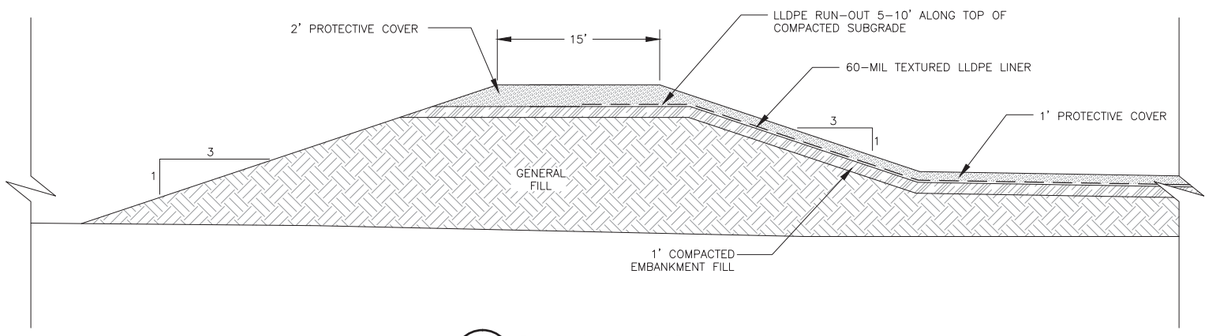



7/11 **FINAL COVER DETAIL**
NOT TO SCALE




8/11 **SUMP EXTENSION DETAIL**
NOT TO SCALE

**DRAFT**

ENGINEER'S STAMP

ORIGINAL DRAWING STAMPED BY TODD STONG, REGISTERED PROFESSIONAL ENGINEER IN THE STATE OF NORTH DAKOTA (PE #6144), IS ON FILE AT GOLDER ASSOCIATES' LAKEWOOD, COLORADO, OFFICE.

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| B | ISSUED FOR PERMIT MODIFICATION | 11/30/12 | CCS | CCS | TJS | RRJ |
| A | ISSUED FOR CLIENT REVIEW | 10/24/12 | CCS | CCS | TJS | RRJ |

PROJECT
GREAT RIVER ENERGY
COAL CREEK STATION
PERMIT NO. SP-033 PERMIT MODIFICATION

TITLE
**DETAIL SHEET 2**

Golder Associates

GREAT RIVER ENERGY

FILE No. 11381519A012
PROJECT No. 113–81519

**11**

**APPENDIX B**

# Visual Observation Checklist

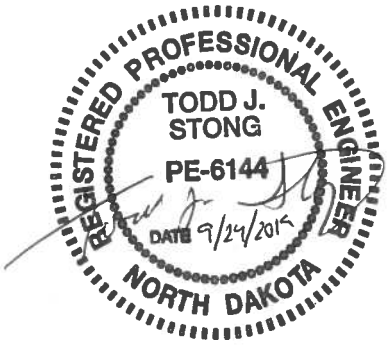
# INSPECTION CHECKLIST

**Facility Name:** Upstream Raise 92
**Owner and Address**: Great River Energy – Coal Creek Station
**Purpose of Facility:** CCR Containment
**Legal:** Sections 16&17 **Township:**145N **Range:** 82W
**County:** McLean
**Inspected By:** Todd Stong/Craig Schuettpelz/Paul Schlicht/ Kayla Moden **Inspection Date:** September 24, 2019
**Weather:** Mostly cloudy, windy 55ºF, no precipitation

| ITEM | Y | N | N/A | REMARKS |
|---|---|---|---|---|
| **1. Water levels** | | | | |
| a. High water mark | | | X | |
| b. Current water level | X | | | Elevation: 1988ft |
| **2. Inflow structure** (*Flue gas desulfurization piping)* | | | | |
| a. Settlement | | X | | |
| b. Cracking | | X | | |
| c. Corrosion | | X | | |
| d. Obstacles in inlet | | X | | |
| e. Riprap/erosion control | | | X | |
| **3. Outflow structure** (*Drains to Upstream Raise 91)* | | | | |
| a. Settlement | | X | | |
| b. Cracking | | X | | |
| c. Corrosion | | X | | |
| d. Obstacles in outlet | | X | | |
| e. Riprap/erosion control | | | X | |
| **4. CCR placement areas** | | | | |
| a. CCR upstream slope erosion | | X | | |
| b. CCR upstream slope cracks/settlement | | X | | |
| c. CCR crest exposed to heavy traffic | X | | | Cat 777 |
| d. CCR crest damage from vehicles/machinery | | X | | |
| e. CCR crest cracks/settlement | X | | | Settlement of fly ash over FGD material. |
| f. CCR downstream slope erosion | X | | | Minor erosion of fly ash. |
| g. Downstream slope seepage/sloughs/cracks/settlement | X | | | Settlement and cracking of fly ash over FGD material. |
| **5. Covered downstream slopes** | | | | |
| a. Downstream Slope erosion | X | | | Minor erosion of temporary cover. |
| b. Downstream Slope rodent burrows | X | | | South side |
| c. Downstream Slope vegetation | X | | | Less vegetation above el. 1950 ft and on temporary cover; healthy vegetation below el. 1950 ft. Woody vegetation present on final cover slopes. |
| d. Downstream Slope seepage/sloughs/cracks/settlement | X | | | Cracks due to settlement of fly ash over FGD material at el. 1974 ft. No cracks noted below el. 1974 ft on covered downstream slopes. |
| **6. Perimeter berm** | | | | |
| a. Upstream Slope erosion (exposed liner) | | X | | |
| b. Upstream Slope rodent burrows | | X | | |
| c. Upstream Slope vegetation | | X | | |
| d. Upstream Slope cracks/settlement | | X | | |
| e. Upstream Slope riprap/other erosion protection | X | | | Fly ash protective cover in perimeter ditches. |
| f. Crest exposed to heavy traffic | X | | | North side haul road (CAT 777) |
| g. Crest damage from vehicles/machinery | | X | | |
| h. Crest comparable to design width | X | | | |
| i. Crest rodent burrows | | X | | |
| j. Downstream Slope erosion | X | | | Minor erosion on south side. |
| k. Downstream Slope rodent burrows | X | | | Several small burrows on south side. |
| l. Downstream Slope vegetation | X | | | Healthy grass and reeds, some sparse vegetation near toe of slope where it is over steepened due to regrading of the south drainage channel. |
| m. Downstream Slope seepage/sloughing/cracks/settlement | X | | | Seepage was noted on the south berm downstream slope approximately 10 feet from the toe of the slope. |
| **7. Toe** | | | | |
| a. Vegetation | X | | | Healthy grass and reeds. |
| b. Rodent burrows | X | | | Small burrows on south side. |
| c. Seepage/sloughs/cracks/settlement | | X | | |
| d. Drainage conditions | X | | | Some standing water. |

***General Remarks:*** Seepage was noted on the south downstream perimeter berm slope. The location of the seep should be monitored as a part of the weekly inspections of the facility. Cracking of fly ash within the facility was noted and should be expected due to settlement of the FGD material. Minor maintenance includes addressing small burrows, maintaining fly ash protective cover, maintaining inflow and outflow piping, and addressing vegetative success of the cover and erosion as observed.

***Name of Engineer (Engineer Firm):***
Todd Stong, PE (Golder Associates, Inc.)
***Date:*** 9/24/2015
***Signature:*** Todd J. Stong



**APPENDIX C**

# Photographs

Path: \\Denver\acad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\19115185\Annual Inspection\ | File Name: PhotoLog - UR92 Locations.dwg


**LEGEND**

1 PHOTOGRAPH ID AND LOCATION

**NOTE(S)**

1. FOREGROUND AERIAL IMAGES FROM GREAT RIVER ENERGY PHOTOGRAPHS TAKEN IN 2019.
2. BACKGROUND AERIAL IMAGE FROM THE UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURE AERIAL IMAGERY PROGRAM, TAKEN IN 2018.

GOLDER

**GREAT RIVER ENERGY - COAL CREEK STATION**
**2019 ANNUAL CCR FACILITY INSPECTION REPORT**
**UPSTREAM RAISE 92 - PHOTOGRAPH LOCATIONS**

**FIGURE 1**

**Upstream Raise 92**

Photograph 1 (North CCR downstream slope (no cover))
Crack in fly ash near piezometers (IMGP6856.JPG)

Photograph 2 (North CCR downstream slope)
Temporary cover on north CCR slope (IMGP6859.JPG)

**Upstream Raise 92**

Photograph 3 (Northwest CCR crest and upstream slope)
Bottom ash berm crest and upstream slope on northwest Flue Gas Desulfurization (FGD) Pool corner (IMGP6862.JPG)

Photograph 4 (West CCR downstream slope (no cover))
Minor fly ash erosion on west downstream slope (IMGP6865.JPG)

**Upstream Raise 92**

Photograph 5 (South CCR downstream slope (no cover))
Cracking along south side within the contact water control ditch (IMGP6874.JPG)

Photograph 6 (South CCR downstream slope (no cover))
Cracking and erosion of fly ash around piezometers (IMGP6876.JPG)

**Upstream Raise 92**

Photograph 7 (East side FGD Pool)
Hydraulic deposition of FGD material on east side of Upstream Raise 92 (IMGP6889.JPG)

Photograph 8 (East CCR downstream slope (no cover))
Contact water ditch at elevation 1950 feet on east downstream slope (IMGP6892.JPG)

**Upstream Raise 92**

Photograph 9 (East haul ramp)
Safety berm along portion of east ramp (IMGP6894.JPG)

Photograph 10 (North CCR downstream slope)
Contact water control ditch and temporary cover below elevation 1950 feet (IMGP6896.JPG)

**Upstream Raise 92**


Photograph 11 (North CCR downstream slope)
Perimeter contact water control ditch and partially plugged HDPE culvert directing contact water to Upstream Raise 91 (PDS UR92 (5).JPG)


Photograph 12 (West CCR downstream slope (no cover))
Gravity drains between Upstream Raise 92 and Upstream Raise 91 (PDS UR92 (8).JPG)

## Upstream Raise 92


Photograph 13 (Southwest downstream downchute channel)
Articulated Concrete Block (ACB) downchute channel with established vegetation (PDS UR92 (10).JPG)

Photograph 14 (North haul ramp)
Minor erosion of fly ash along inside of ramp (north side) (DSCF0414.JPG)

**Upstream Raise 92**

Photograph 15 (North haul ramp)
Ramp had been temporarily steepened on north side for added width (DSCF0420.JPG)

Photograph 16 (North berm downstream slope)
Animal burrow, approximately 6 inches in diameter (DSCF0421.JPG)

**Upstream Raise 92**

Photograph 17 (South berm downstream slope and toe)
Oversteepened toe of slope area (DSCF0439.JPG)

Photograph 18 (South berm downstream slope)
Extents of seep area on berm downstream slope of Upstream Raise 92 (DSCF0443.JPG)

**Upstream Raise 92**

Photograph 19 (South berm downstream slope)
Seep on downstream slope with upper 3-4 inches of soft clay underlain by cobble/gravel and clay (DSCF0445.JPG)

Photograph 20 (South berm downstream slope)
Irregular-shaped downstream slope, well-vegetated (DSCF0449.JPG)

**Upstream Raise 92**

Photograph 21 (South berm downstream slope and toe)
ACB completed to the toe of the berm downstream slope instead of across the south drainage channel, minor woody vegetation (DSCF0452.JPG)

Photograph 22 (Southeast CCR downstream slope (covered))
Standing water at southeast toe of CCR downstream slope (covered) above perimeter road (DSCF0457.JPG)

## Upstream Raise 92

Photograph 23 (North berm downstream slope)
Culvert outlet conveying contact water from Upstream Raise 92 to Southeast 16 contact water channel (DSCF0461.JPG)

Photograph 24 (North berm downstream slope and haul road to Southeast 16)
Haul road and contact water control channel (DSCF0466.JPG)

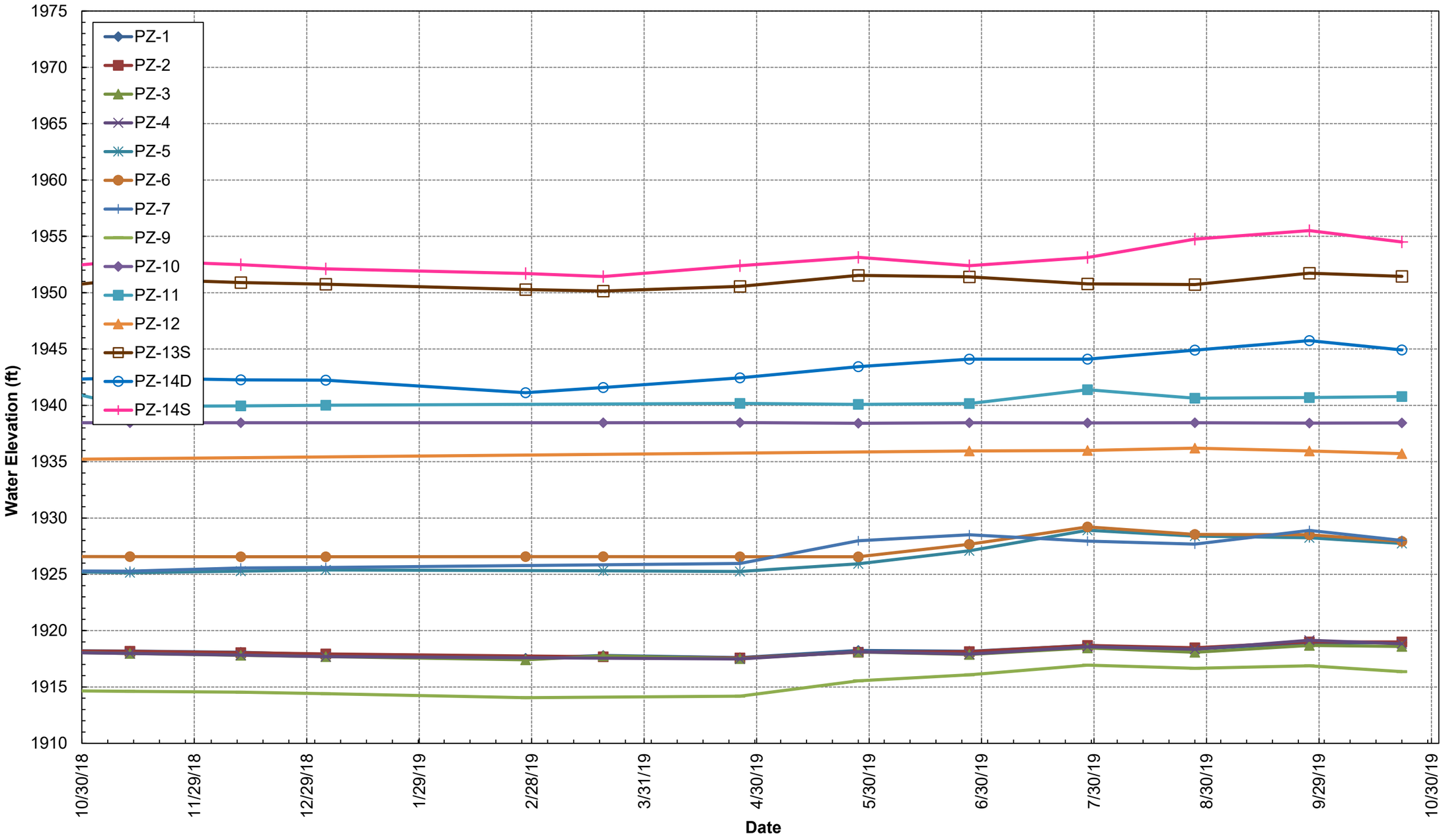
APPENDIX D

# Instrumentation Results

**APPENDIX D-1**

# Piezometer Information

# Upstream Raise 92 Piezometer Elevations



**APPENDIX D-2**

# Piezometer PZ-13D Damage Photographs

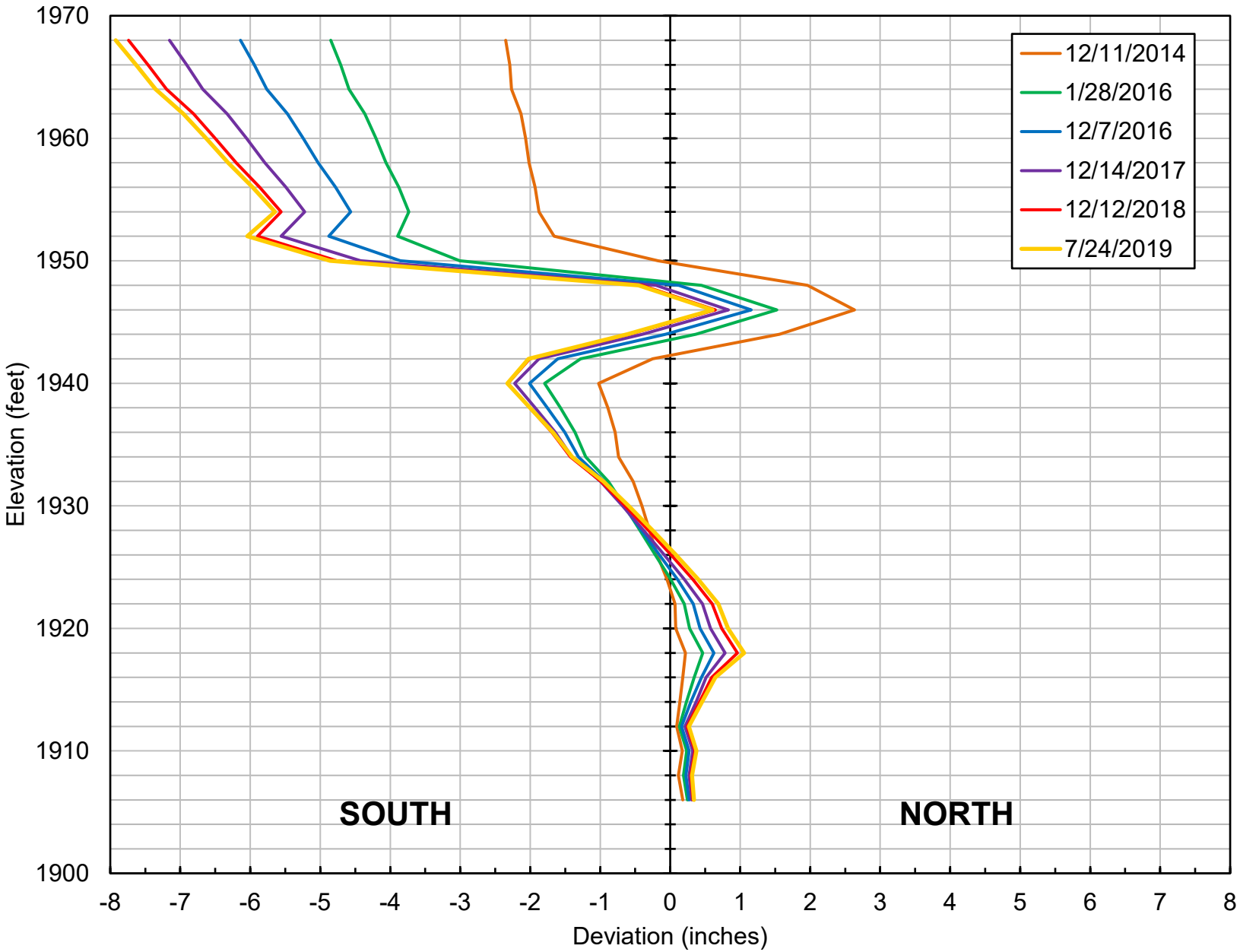
**Upstream Raise 92**
**PZ-13D Damage**
**Photograph 1**

**Upstream Raise 92**
**PZ-13D Damage**
**Photograph 2**

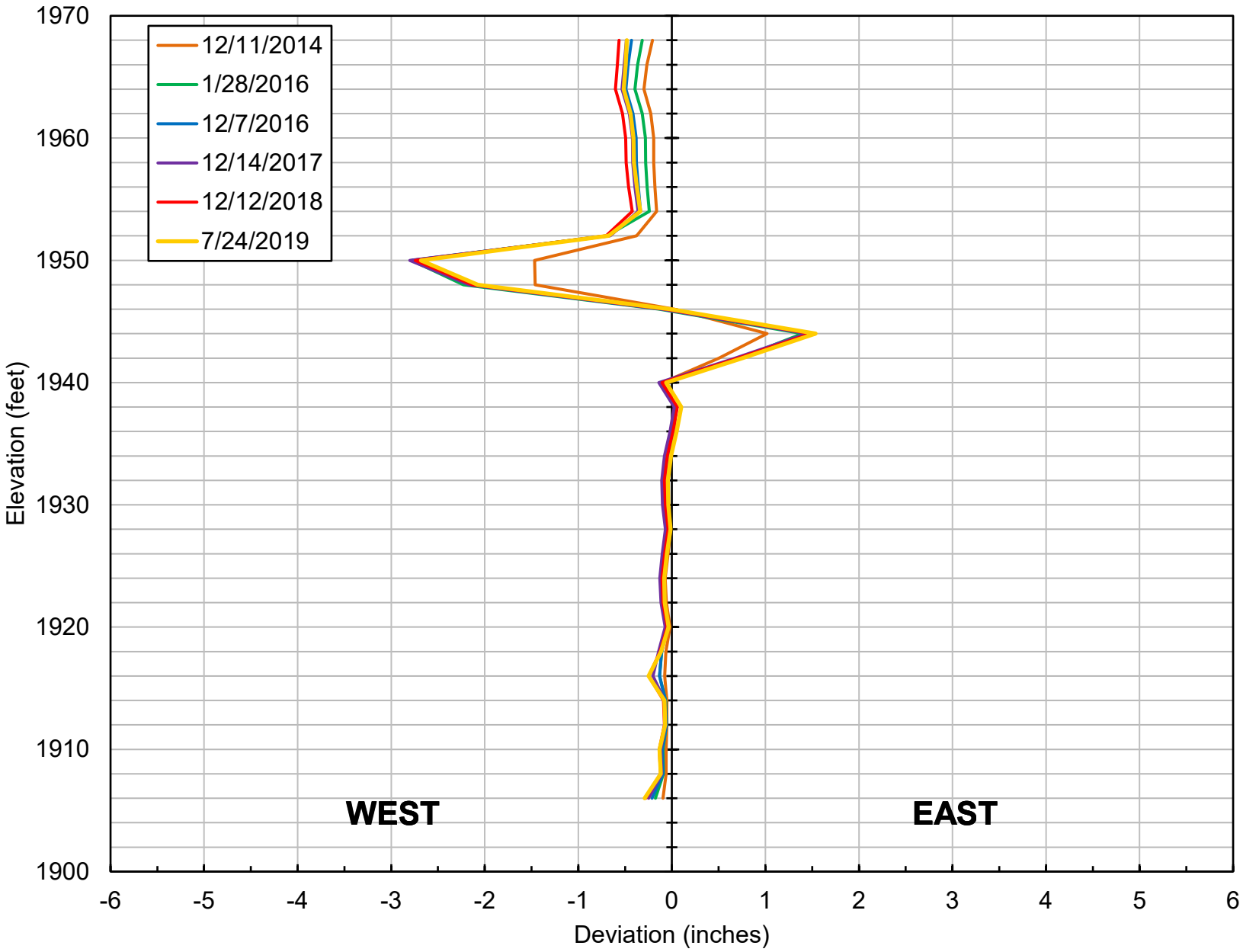
**APPENDIX D-3**

# Inclinometer Information

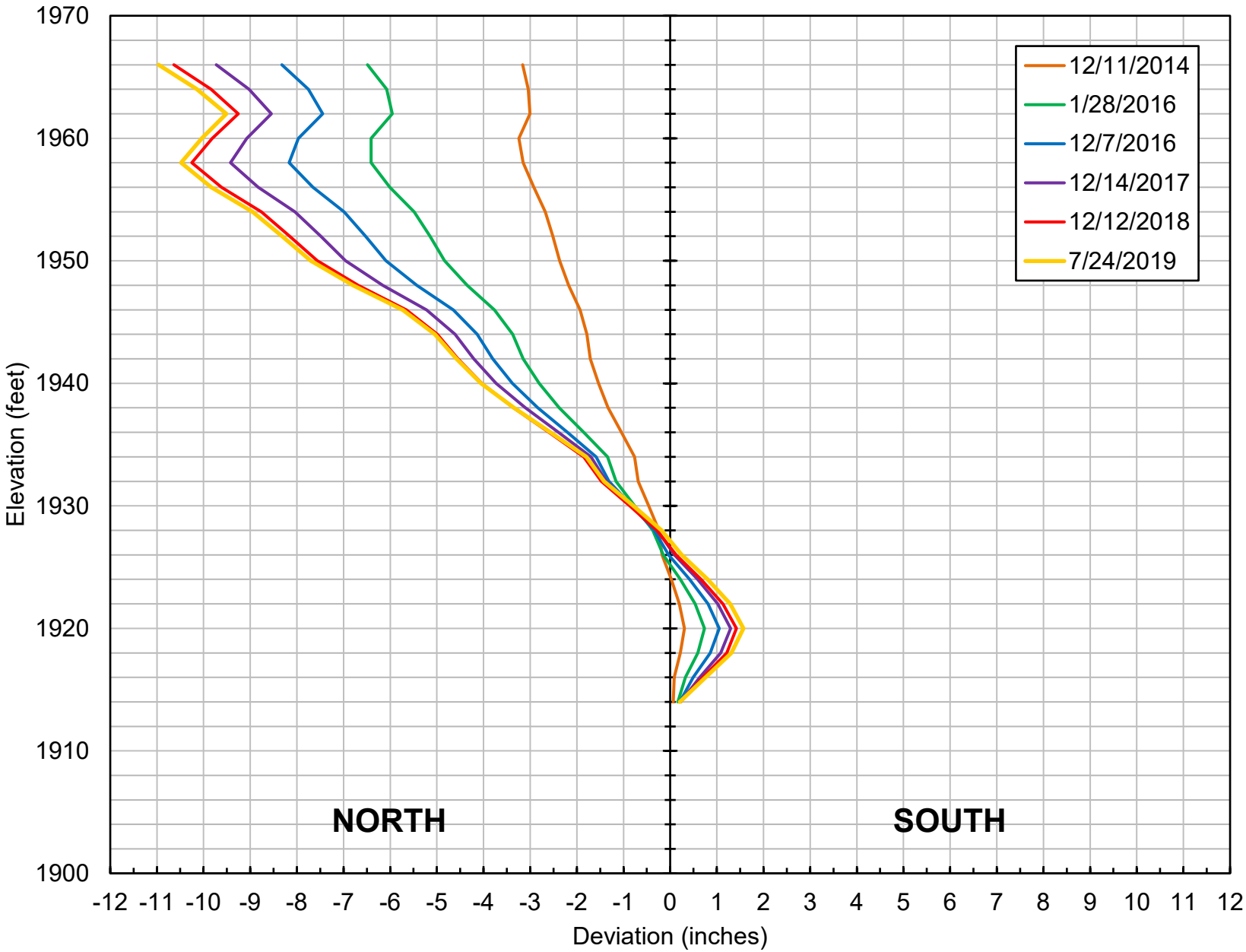
**Upstream Raise 92**
**Inclinometer IN-3 Summary**



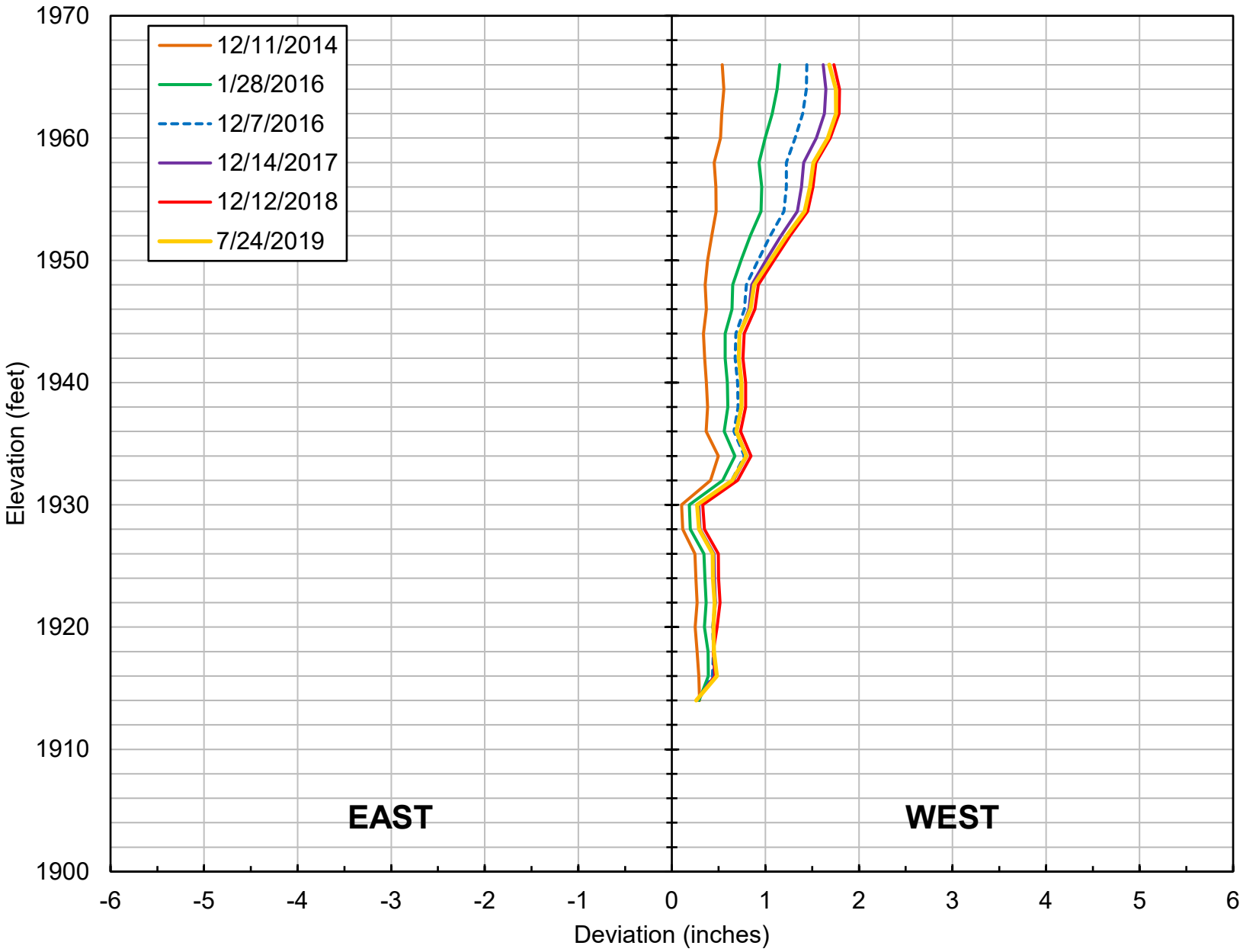
**Upstream Raise 92**
**Inclinometer IN-3 Summary**



**Upstream Raise 92**
**Inclinometer IN-4 Summary**



**Upstream Raise 92**
**Inclinometer IN-4 Summary**

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