APPENDIX D

SUPPORTING INFORMATION

Draft Preliminary Design Report

Weber County Emergency Watershed Protection – Ogden Bay Wildlife Management Area Structures Repair Project

PRELIMINARY DESIGN REPORT

(Draft)

Prepared for:

Weber County Engineering Department
2380 Washington Blvd. Suite 240
Ogden, Utah 84401

Prepared by:

Bowen, Collins & Associates
154 East 14000 South
Draper, UT 84020

Bowen Collins
& Associates, Inc.
CONSULTING ENGINEERS

July 2013

Weber County Emergency Watershed Protection – Ogden Bay Wildlife Management Area Structures Repair Project

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(DRAFT)

Prepared by:

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Draper, UT 84020

July 2013

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INTRODUCTION

This report provides a summary of the proposed design criteria and concepts for the recommended Weber County Emergency Watershed Protection (EWP) – Ogden Bay Waterfowl Management Area Structures Repair Project located within the State of Utah-owned Ogden Bay Waterfowl Management Area (WMA), Weber County, Utah. This report has been prepared to allow officials from the Natural Resource Conservation Service (NRCS), Weber County, the project sponsor, and other project stakeholders to review and approve the proposed design criteria and concepts before proceeding with final design.

BACKGROUND

The State of Utah – Department of Natural Resources (DNR) owns and operates the Ogden Bay WMA located along the Weber River in the west end of Weber County near the Great Salt Lake. The WMA includes over 38 miles of levee system that is used to water wetlands for waterfowl habitat. The DNR operates three main regulating structures at the WMA that control water releases from the Lower Weber River to the Great Salt Lake. These three structures are the South Run, Middle Run, and North Run regulating structures. In the spring of 2011, runoff from extreme rainfall and snowmelt events caused extensive erosion, flood damage, and sediment deposition in areas on and along the Lower Weber River in Weber County, Utah. During the 2011 flood, some people impacted by flooding believed that the levee and the three structures at Ogden Bay were restricting Weber River discharges into the Great Salt Lake and increasing flood levels in areas upstream of the levee. In an effort to mitigate these issues, WMA levees were breached in two locations: one near the Middle Run Structure, the other just downstream of the South Run structure. The resulting increased discharges through the WMA caused significant damage to the internal levee system and the associated water distribution ditches and regulating structures. The NRCS, DNR, and Weber County have worked together to identify the structural modifications that are the subject of this report to help mitigate the flooding and sedimentation problems experienced during the 2011 flood near the regulating structures and to protect existing Ogden Bay WMA facilities.

HYDRAULIC ANALYSIS

A hydraulic river model was developed of the Lower Weber River that extended from about a mile downstream of the WMA levee to about the 4700 West bridge. USGS flow records, field notes that included surveyed water surfaces near the South Run structure, photographs taken during the 2011 flood, and personal observations and reports from DNR and County staff were used to calibrate the model so that it accurately simulated the flood conditions that existed during the 2011 flood. Using model results, it was estimated that during the peak discharge of the 2011 flood event (about 5,000 cfs before the embankment failed at the Little Weber Overflow Channel), about 2700 cfs was being discharged through the South Run structure, about 2300 cfs was flowing over and through the North Run structure, and the levee near the Middle Run structure had about 6 inches of freeboard.

The flood frequency analysis that was performed for the current-effective FEMA Flood Insurance Study indicates that the magnitudes of the 1- and 2-percent annual chance floods (100-

and 5-year floods) are 6,200 cfs and 4,600 cfs, respectively at the USGS streamflow gage at Plain City. This means that the 2011 flood has about a 1.6 percent chance of occurring in any given year (a recurrence interval of about 63-years).

The calibrated model was revised to simulate structural repairs and modifications that could allow more water to be discharged through the North Run and South Run regulating structures and downstream channels. Increasing discharges through the Middle Run structure was not evaluated because increasing discharges through the manual levee breach in 2011 caused significant damage to the internal regulating structures and ditches in the WMA due to their limited hydraulic capacity. A summary of hydraulic model output for the 2011 event and alternatives that include modifications to the North Run and South Run structures are presented in Table 1.

Table 1
Estimated Impacts to Water Surface Elevations for Structural Repair Alternatives
For an Assumed 5,000 cfs Discharge Condition

	At South Run		At North Run		1 Mile Upstream of Middle Run	
Repair Alternative	Estimated Discharge (cfs)	Estimated Water Surface Elevation (ft)	Estimated Discharge (cfs)	Estimated Water Surface Elevation (ft)	Estimated Discharge (cfs)	Estimated Water Surface Elevation (ft)
2011 Flood	**2700**	**4211.5**	**2300**	**4212.7**	**5000**	**4214.8**
Add One 20' Gate to South Run Structure	2750	4210.8	2250	4212.65	5000	4214.8
Add Two Gates (40' Total Width) to South Run Structure	2770	4210.6	2230	4212.64	5000	4214.8
Increase Capacity of North Run Channel	2450	4211.1	2550	4212.42	5000	4214.8
Add Two Gates at (40' Total Width) at South Run AND Increase Capacity of North Run Channel	2510	4210.4	2490	4212.4	5000	4214.8

Note: The water surface elevations presented in this table are based on the assumption that the water level of the Great Salt Lake does not create backwater effects in the Lower Weber River.

The following conclusions can be made from evaluating the model results presented in Table 1:

1. Due to the mild slope and limited capacity of the channel along the Lower Weber River, repairs or modifications to the South Run Structure and North Run channel to increase

conveyance capacity will not significantly impact water surface elevations in the Weber River upstream of a point located about one mile upstream of the Middle Run Regulating Structure.

2. During the 2011 flood, the water surface upstream of the South Run structure was about 1.5 feet higher than the water surface downstream of the structure. Adding one gate with a width of 20 feet would decrease that difference in water surface elevations to about 0.7 feet with a total design discharge of 5000 cfs. Constructing two additional gates with a combined width of 40 feet would decrease the difference in water surface elevation to about 0.5 feet with a total design discharge of 5000 cfs.

3. Adding two gates with a combined with of 40 feet at the South Run structure would allow 3600 cfs to pass through the structure with an upstream water surface elevation of 4211.5 (an increase of about 33 percent over the 2011 estimated discharge).

4. The North Run regulating structure will overtop regardless of whether or not repairs are made to the South Run structure or the North Run channel and/or structure.

5. Due to the mild slope of the ground and channel below the North Run regulating structure, significantly increasing the size of the North Run channel below the regulating structure will not significantly increase the conveyance capacity of the channel.

6. The capacity of the natural channel between the 1200 South bridge and the WMA levee would have to be increased significantly by enlarging the channel cross section in order to significantly reduce the area of flood inundation associated with the 2011 flood.

NEED FOR THE PROJECT

Repairing deficiencies associated with the existing facilities near Ogden Bay WMA and adding a second regulating structure at the South Run site are needed to increase levee freeboard a WMA levee, increase the hydraulic capacity of the Weber River in this area, and to increase the sediment conveyance capacity of the River in the vicinity by lowering the invert of the structure. The new structure should have at least one radial gate that is at least 25 feet wide to help pass large trees and debris that tend to hang up at the existing structure during large runoff events.

It was noted during the 2011 flood that the upstream and downstream water surface elevations differed approximately 18 inches at the South Run structure. Implementing these mitigation measures will significantly reduce the head differential across the South Run structure and protect the existing internal WMA regulating structures and the WMA levee system during large flood events on the Weber River.

DESIRED OUTCOME

The proposed additional regulating structure adjacent to the existing South Run structure along with repairs to the existing Middle Run structure will help resolve hydraulic deficiencies around the WMA and help protect the WMA levees and internal water distribution facilities from damage when the river is at flood stages, without having to breach levees. It will also reduce maintenance and make it easier to pass more floating debris through the South Run regulating structure.

It was originally anticipated that increasing the capacity of the South Run structure would significantly reduce the area of flood inundation between the 1200 South bridge and the WMA. However, hydraulic river modeling results of this reach of river (summarized in Table 1) indicate that due to the limited capacity of the river channel through this area, repairs that only add capacity to the South Run structure will not significantly reduce the area inundated by flooding between the WMA levee and the 1200 South bridge during the 2011 flood.

PUBLIC BENEFIT

The Ogden Bay WMA includes approximately 20,000 acres of wetland habitat for waterfowl and birds. About 15,000 ducks are born at the WMA each year, with the most common species being cinnamon teal, gadwall, mallard, pintail, and northern shoveler. Hikers can access the dike roads all year round and the WMA is open to hunters during the hunting season. (http://www.publiclands.org/explore/site.php?id=1387) Implementing the mitigation methods described above will help protect public property and waterfowl habitat from damage associated with future flood events. It was hoped that increasing the capacity of the South Run Regulating Structure would significantly reduce the inundated flood area between the 1200 South bridge and the WMA. However, due the limited capacity of the river channel in this area, the hydraulic model of the river indicates that adding gates and capacity to the South Run Regulating Structure would result in only a minor reduction on inundated area.

RECOMMENDED PROJECT ELEMENTS

Weber County is proposing to complete the Ogden Bay Waterfowl Management Area Structures Repair Project to protect existing levee systems and waterfowl habitat at the WMA. The repair work that is proposed is generally shown on Figure 1 and is described below:

- Construction of a second regulating structure adjacent to the existing South Run regulating structure. The new structure should have one or two gate openings with a minimum of 40 feet total width. At least one of the gates should have a minimum width of 25 feet and the invert of floor elevation of the new structure should be 2 feet lower than that of the existing structure.
- Replace the side and bottom seals and the cable I-bolt connections on the existing South Run structure radial gates.
- Stabilize the 19-ft deep scour hole just downstream of the existing South Run structure that was discovered during recent field investigations by filling it with granular material and riprap.
- Install riprap bank stabilization on the upstream and downstream faces of the levee system around the South Run structures.
- Replace the wood bridge decking on the existing South Run structure to provide load capacity and area for construction vehicles to cross the structure.

- Construction of a new gated outfall structure to the west of the existing South Run Structure at the location of the 2011 levee breach.
- Remove and replace the existing radial gate at the Middle Run structure.
- Remove and replace the existing slide gates at the Middle Run structure.
- Remove and replace the existing (3) radial gates at the North Run Structure.
- Bring power to the South, Middle, and North Run structures, install electric actuators, and SCADA control systems.
- Install new open channel flow monitoring devices at the South Run, Middle Run, North Run and near the 1200 South bridge on the Weber River.
- Repair or replace (9) existing turnout structures within the Ogden Bay WMA.

Photographs of the sites are included in Appendix A for reference. Preliminary design drawings showing the conceptual repairs on the South Run and Middle Run structures are included in Appendix B for review. All proposed work associated with this project is located on property owned by the State of Utah.

GEOTECHNICAL ANALYSIS

A detailed geotechnical analysis has been performed on the soils and foundation for the additional regulating structure. That analysis evaluated slope stability analysis of the existing dike and structure, provide recommendation to stabilize the scour hole downstream of the existing structure, and provide recommendation for the foundation of the new structure. A draft of the geotechnical report is included in Appendix C.

EXISTING SOUTH RUN STRUCTURE BRIDGE MODIFICATIONS

The existing bridge over the South Run structure is composed of 5 steel girders (W12x26) and a 3x12 timber deck. The timber deck is placed perpendicular to the steel girders and 4 additional 3x12 planks are then placed parallel to the direction of travel (perpendicular to the deck members) at the likely wheel locations. The steel girders appear to be in fair condition but are fully covered with rust. There is no evidence that these steel members were ever coated with a protective coating (paint or galvanized). The beams are cross-braced with 2 lines of transverse channel bridging placed at 1/3 points of each span. The girders are simple-span between the supporting substructure elements.

Anticipated design loading for the bridge is considered to be an H20 truck. This truck weighs a total of 40,000 lbs and has 2 axles. The front axle carries 8,000 lbs and the back axle carries 32,000 lbs (single axle). This truck is an idealized vehicle for bridge design and covers many actual truck arrangements, including an 8-yard concrete ready mix truck carrying legal highway loads. Legal highway limits also reflect this truck. The applicable legal limits for Utah indicate a 20,000 lb front axle and a back <u>tandem</u> axle with 17,000 lbs on each axle of the dual, for a total back axle of 34,000 lbs. The tandem truck produces a slightly smaller design moment (150.33 k-ft/lane vs 172.00 k-ft/lane for the H20 truck) but its heavier front axle produces a shear at the end of the steel beams which is slightly larger than the H20 truck produces (37.81 k vs 35.00 k for the H20 truck).

The element of the existing bridge with the least capacity is the wood decking. The existing deck would be 50% overstressed under an H20 loading. Additionally, wood decks do not distribute loads well to the steel girders below. Because of this, the steel beams are 16% overstressed under an H20 loading. The bridge would be adequate for lesser trucks but in general, it should be limited to vehicles with a gross vehicle weight (GVW) of 10,000 lbs or an H10. Unfortunately, that rating will not allow construction vehicles to cross the bridge in order to construct the anticipated new facilities to the north.

In order to make it so that construction vehicles can safely cross over the South Run structure, the existing bridge structure will need to be replaced. Two alternatives were evaluated for this purpose and are summarized below.

Alternative 1 – Construct a Cast-in-Place Deck

This option would remove the wood deck and rusted steel girders and install new galvanized steel girders and a cast-in-place concrete deck. This option requires the addition of shear stud connectors to the beams and stay-in-place metal deck forms for casting the concrete slab. The new concrete deck greatly would increase the capacity of the bridge's steel girders in bending but it does not help much for shear since the web of the steel beams is still the limiting element. Nevertheless, this arrangement provides a structure capable of supporting the full H20 loading, including the 8-yd concrete truck with about 6 inches of clearance on each side. The estimated cost to implement this repair alternative is about $82,000.

Alternative 2 – Install Precast/Prestressed Concrete Slabs

This option involves removing the existing superstructure completely (both wood and steel) and replacing it with new precast/prestressed concrete slabs. After the slabs are placed, a 5-in thick cast-in-place concrete deck is placed composite with the precast slabs to tie the precast slabs together and force them to act as one element. This arrangement can easily support the anticipated loads and could readily be made to carry even greater loads with minimal additional expense. It would also allow for more clearance for construction vehicle passage. The estimated cost to implement this repair alternative is about $79,000.

Both of the above alternatives should also include a new bridge rail capable of resisting vehicular impact at low speeds. Generally, highway bridges include railings that have been crash tested at high speeds but the high-speed requirement does not seem necessary here. The removable pipe rails currently on the existing structure are not adequate for vehicular loads and probably do not meet the loading requirements for pedestrians either due to the condition of the base attachments. The bridge is intended for vehicular traffic, which means the rail height should be 2'-8". If the crossings are intended for pedestrians, then the rail would need to have a minimum height of 3'-6".

The rails can readily be attached to the sides of the precast slabs but they would need to be attached to the top of the new concrete slab with the steel option. Attaching the rails to the top surface reduces the clear width available for vehicles to a value less than 10 ft, which is not desirable.

It is recommended that the existing bridge structure be repaired by replacing it with the precast/prestressed slabs. Because everything is concrete, there would be no long term maintenance issues. It is the strongest of the two options, provides the most clear vehicular space, and is slightly cheaper. The recommended bridge reconstruction plan and alternate deck section are shown on Drawing S-5 of the drawings set. Detailed cost breakdowns for the two alternatives are provided in Appendix D.

MIDDLE RUN STRUCTURE REPAIRS

The existing invert elevation of the Middle Run regulating structure is approximately 1.1 feet higher than the invert of the existing South Run regulating structure. However, currently, the invert elevation of the channel downstream of the Middle Run structure is more than 3 feet higher than the Middle Run structure invert. In addition, the channel downstream of the Middle Run structure does not have a direct connection to convey releases to the Great Salt Lake. This structure is used to regulate irrigation flows to the WMA levee and wetland system. The needed releases through the structure can only be provided when the gates at the South Run structure are closed or partially closed to create needed backwater to overcome the elevation differences in the structures and channel inverts.

During the 2011 flood event, the existing radial gate on the Middle Run structure was manually opened and the additional discharge through the WMA system of levees and internal regulating structures caused extensive damage. A hydraulic river model was used to simulate the effects of breaching the levee in near the Middle Run regulating structure in 2011. The model indicated that between 300 and 350 cfs would have been released through the breach. However, it reportedly did not have a significant impact on the water surface upstream of the levee at either the South Run or North Run regulating Structures and it would not have had a significant impact on the water surface elevation one mile upstream of the Middle Run structure. The two slide gates have adequate capacity to provide needed irrigation flows to the internal WMA facilities. As mentioned previously, the existing 8’ x 10’ radial gate does not operate and needs to be manually opened with a backhoe or crane. This gate will be replaced with a new radial gate and downstream culverts will be repaired or replaced with larger culvert with headwalls and gates or stoplog to allow Ogden Bay WMA personnel to control water releases through the wetlands.

POWER AND SCADA CONTROLS

The existing power supply at the South Run Structure is single phase 120/240 Volts. The selected contractor will need to install conduit from the South Run Structure to the Middle and North Run Structures for both power and fiber optic cables. Rocky Mountain Power will provide and install their power cables and transformers. New transformers will be required at the Middle and North Run Structures. The actuators for the new radial gates and slide gates at the structures will need to be rated for 240 Volt single phase power.

Both Weber County and the DNR recommended that the new structures at the WMA be provided with automated electrical controls and Programmable Logic Controller (PLC) and

Supervisory Control and Data Acquisition (SCADA) programming for the operation, monitoring and control of ten gates that control flow from the South, Middle, and North Runs of the Weber River as it feeds to the Great Salt Lake. SCADA programming will include installation of separate electrical control panels at the South Run structure, the Middle Run structure, the North Run structure, and at the home/office sites. There will be one enclosure at the site of the three gates at the Middle Run structure, one enclosure at the site of the five gates at the South Run structure, one enclosure for the three gates at the North Run Structure, and one enclosure at the home/office site. It was assumed that all sites will communicate using wireless, unlicensed, spread-spectrum, frequency-hopping, Ethernet radios.

The South Run site enclosure will house the main Allen-Bradley (A-B) PLC and a touchscreen Human-Machine-Interface (HMI) for complete operator control of the entire SCADA system. This HMI will allow for adjustments to all seven radial gates at both the new and existing structures. It will also include the required radio and antenna equipment.

The Middle Run site enclosure will house the A-B Flex I/O equipment that communicates with the A-B PLC at the South Run site over buried fiber optic. There will be two local panel displays that will provide current positioning of the two gates at this site. The operator will only be able to locally control the two gates at this site while at this site. It will also include the required radio and antenna equipment to communicate with the South Run site.

The North Run site enclosure will house the A-B Flex I/O equipment that communicates with the A-B PLC at the South Run site over buried fiber optic. There will be three local panel displays that will provide current positioning of the three gates at this site. The operator will only be able to locally control the three gates at this site while at this site.

The home/office site enclosure(s) will house a remote HMI station that can be used by Weber County and DNR personnel to monitor and control all seven gates at both sites, as required. It will also include the required radio and antenna equipment. One DNR home/office site will communicate with the A-B PLC at the South Run site over the wireless radios. The Weber County home/office site can communicate through the DNR site via radio or over the internet. Operating and control can be provided to both DNR and the County. These issues will need to be worked out during the design process.

It is proposed to use A-B ControLogix PLC and Flex I/O to monitor the level and flow of the water and to control the positioning of the gates to meet the DNR/County's water control requirements. The gates will be equipped with automatic controls to allow the opening and closing based on the flow and/or level of the water at each site. Operators may manually override the automatic controls of the gates for maintenance and/or emergency situations at the sites. There will be analog (4-20mA) positioning and feedback that will tell the A-B PLC the current position of the valve(s) in a specified range. That range value can be in a percentage (%) or distance (feet or inches). A desired setpoint (water flow/level) will be entered into the controller and the gate(s) will modulate to maintain the given setpoint.

If additional controls requirements need to be considered in programming this SCADA system, BC&A will need to meet with DNR/County personnel to get all details of this project as intended.

SCADA System Equipment Summary for Regulating Gates

The equipment for South Run site will include the following equipment to enclose the controls equipment necessary:

- 48”x36”x16” stainless steel, NEMA 4X enclosure
- 15” HMI Touchscreen
- 14 – 3pos. switches for gate operations
- A-B ControLogix PLC w/ 17-slot rack, E-Net adapter, and all required I/O cards
- Ethernet switch
- 24VDC power supply
- Panel temperature control equipment
- UPS for power backup
- Radio, cables, connectors, antenna, mast and hardware

The equipment for Middle Run site will include the following equipment to enclose the controls equipment necessary:

- 36”x36”x12” stainless steel, NEMA 4X enclosure
- 2 – panel displays
- 4 – 3pos. switches for gate operations
- A-B Flex I/O Controller w/ E-Net adapter, and all required I/O cards
- Ethernet switch
- 24VDC power supply
- Panel temperature control equipment
- UPS for power backup

The equipment for North Run site will include the following equipment to enclose the controls equipment necessary:

- 36”x36”x12” stainless steel, NEMA 4X enclosure
- 3 – panel displays
- 6 – 3pos. switches for gate operations
- A-B Flex I/O Controller w/ E-Net adapter, and all required I/O cards
- Ethernet switch
- 24VDC power supply
- Panel temperature control equipment
- UPS for power backup

The equipment for Home/Office site(s) will include the following equipment to enclose the controls equipment necessary:

- 20”x20”x12” stainless steel, NEMA 4X enclosure
- 15” HMI Touchscreen

- Ethernet switch
- 24VDC power supply
- UPS for power backup
- Radio, cables, connectors, antenna, mast and hardware
- A relay will also be provided to the Weber County SCADA system from DNR to the County, or visa versa so that both agencies can have access to the monitoring and controls.

FLOW MONITORING DEVICES

Weber County has requested that flow monitoring structures and devices be constructed near the 1200 South Bridge and immediately downstream of the regulating structures at South Run, Middle Run, and North Run so that the County and DNR can use flow data from the USGS Plain City stream flow gate to properly monitor and regulate discharges at the various points in the Lower Weber River. For flow monitoring purposes, it is recommended that rated channel sections with stage recording devices be installed at the 1200 South bridge and below the South Run and North Run structures. However, before installing a device at the 1200 South bridge, more detailed analysis will need to be completed to determine if typical backwater effects from WMA operations would influence a typical rated section. It is also recommended that an ultrasonic velocity meter be installed at the Middle Run structure to measure discharges through that structure. Val Bachman/DNR recently stated that he is also working on installing flow metering gates at a couple of locations. After reviewing this report, Weber County and the DNR should coordinate goals and efforts for flow monitoring, automated reading, and data sharing to determine how to proceed during the design process. For preliminary budgetary purposes, a budget of $50,000 has been included in the preliminary cost estimate for flow metering devices and equipment.

ENVIRONMENTAL AND CULTURAL CLEARANCE STATUS

NRCS has conducted the environmental survey and cultural resources reports for this project.

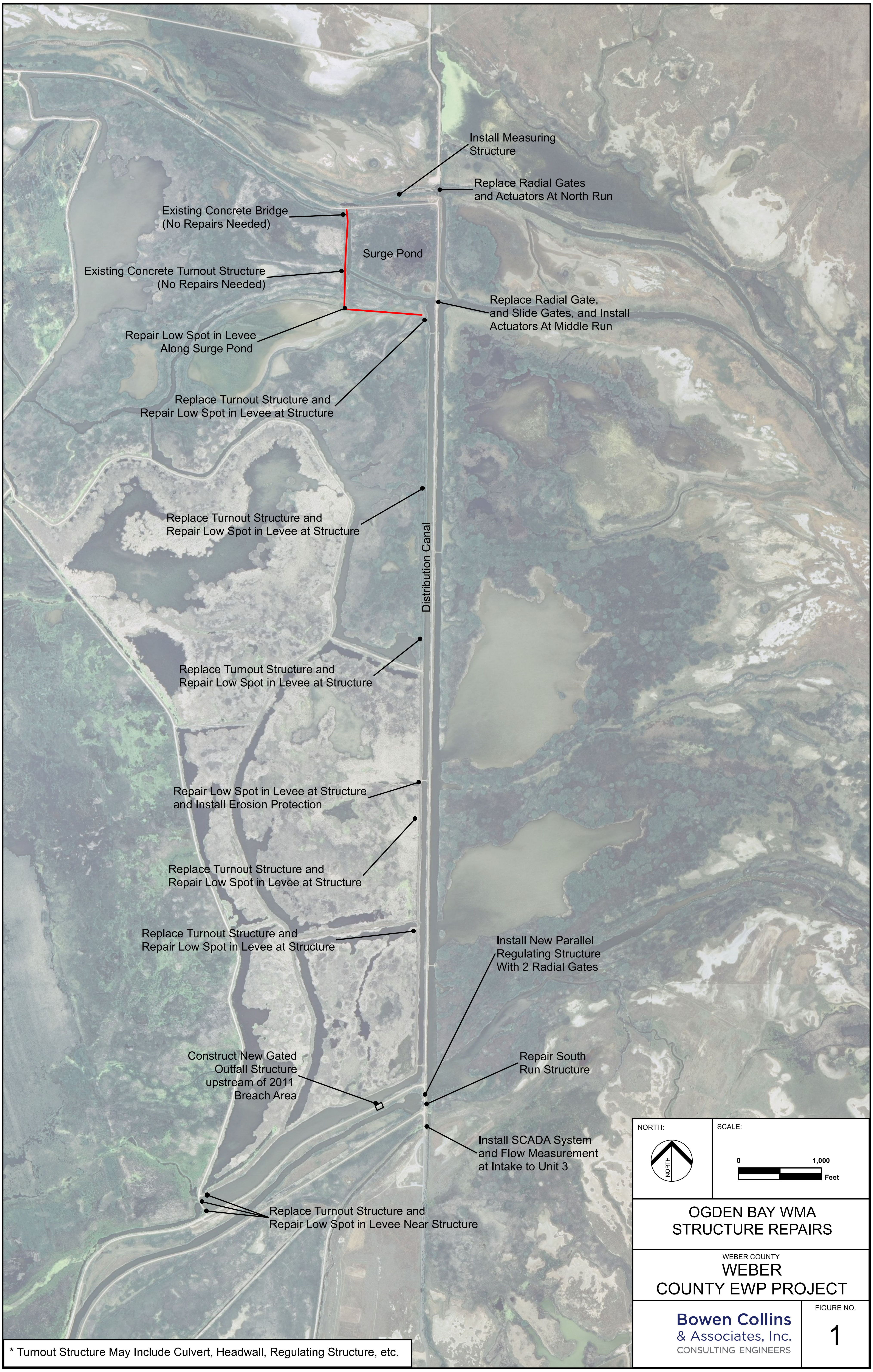
Stream Alteration Permit

The State of Utah stream alteration permit application and U.S. Army Corps of Engineers permit for work within the Weber River has already been submitted and has been approved by the permitting agencies.

CONSTRUCTION SCHEDULE

It is anticipated that the work associated with this project will be constructed between the fall of 2013 and spring of 2014.

FIGURES



* Turnout Structure May Include Culvert, Headwall, Regulating Structure, etc.

OGDEN BAY WMA
STRUCTURE REPAIRS

WEBER COUNTY
WEBER
COUNTY EWP PROJECT

Bowen Collins
& Associates, Inc.
CONSULTING ENGINEERS

FIGURE NO.
1

APPENDIX A

PHOTOGRAPHS

Weber EWP – Ogden Bay Wildlife Management Area Structure Repair Project

East side of existing South Run Structure

South Run Structure looking upstream (east)

Existing South Run Structure Radial Gates

Downstream face of existing Middle Run Structure

Existing South Run Structure Downstream Concrete Seal

Upstream Face of existing Middle Run Structure

South Run Structure looking downstream (west)

Existing South Run Structure deck

APPENDIX B

PRELIMINARY DESIGN DRAWINGS

DRAWINGS FOR CONSTRUCTION OF THE

OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

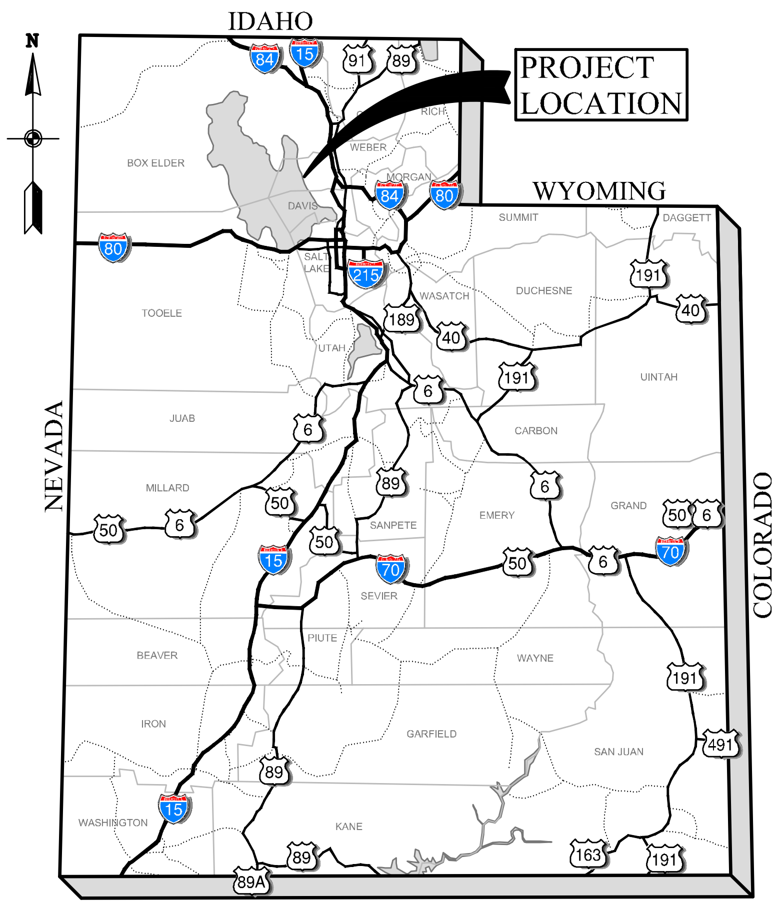
WEBER COUNTY, UTAH

DESIGNED BY BOWEN COLLINS & ASSOCIATES

FOR WEBER COUNTY IN COOPERATION WITH THE USDA-NRCS

WITH FUNDING FROM THE EMERGENCY WATERSHED PROTECTION PROGRAM

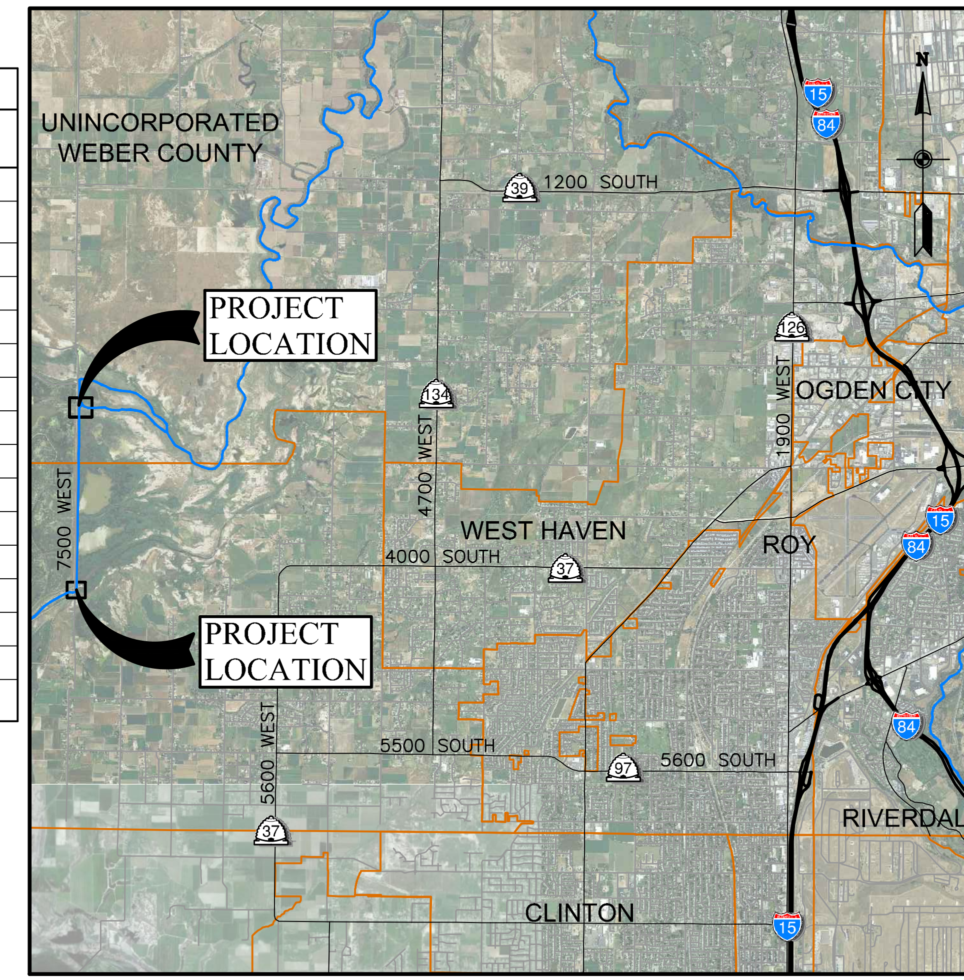
Weber County EWP



PROJECT LOCATION MAP

SHEET	DWG NO.	DRAWING TITLE	FILE
		GENERAL	
1	G−1	INDEX OF DRAWINGS, PROJECT LOCATION AND VICINITY MAPS	OB_BCA_3341201_G01.dwg
2	G−2	GENERAL NOTES ABBREVIATIONS AND SYMBOLS	OB_BCA_3341201_G02.dwg
3	G−3	KEY SHEET AND SURVEY CONTROL	OB_BCA_3341201_G03.dwg
		CIVIL	
4	C−1	MIDDLE RUN STRUCTURE DEMOLITION PLAN	OB_BCA_3341201_C01.dwg
5	C−2	SOUTH RUN STRUCTURE DEMOLITION PLAN	OB_BCA_3341201_C02.dwg
6	C−3	MIDDLE RUN STRUCTURE PLAN	OB_BCA_3341201_C03.dwg
7	C−4	SOUTH RUN STRUCTURE PLAN	OB_BCA_3341201_C04.dwg
8	C−5	SOUTH RUN STRUCTURE PROFILE	OB_BCA_3341201_C05.dwg
		STRUCTURAL	
9	S−1	MIDDLE RUN STRUCTURE	OB_BCA_3341201_S01.dwg
10	S−2	SOUTH RUN STRUCTURE	OB_BCA_3341201_S02.dwg
11	S−3	SOUTH RUN STRUCTURE SECTIONS − 1	OB_BCA_3341201_S03.dwg
12	S−4	SOUTH RUN STRUCTURE SECTIONS − 2	OB_BCA_3341201_S04.dwg
13	S−5	EXISTING SOUTH RUN STRUCTURE BRIDGE RECONSTRUCTION	OB_BCA_3341201_S05.dwg

NOTE: THESE DRAWINGS ARE PREPARED IN COLOR TO DEPICT DETAIL AND DESIGN INTENT. DO NOT RELY ON BLACK AND WHITE REPRODUCTION.



PROJECT VICINITY MAP

APPROVED FOR CONSTRUCTION

JARED ANDERSEN, P.E., WEBER COUNTY ENGINEER — DATE

TO THE BEST OF MY PROFESSIONAL KNOWLEDGE, JUDGEMENT AND BELIEF, THESE PLANS MEET APPLICABLE NRCS STANDARDS

CRAIG R. BAGLEY, P.E., PROJECT MANAGER — DATE

Bowen Collins & Associates, Inc. Consulting Engineers

PRELIMINARY

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

WEBER COUNTY
OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

DESIGN: T. OLSEN
DRAWN: B. ABEL
REVIEW
CHECKED: C. BAGLEY
APPROVED: C. BAGLEY

GENERAL
INDEX OF DRAWINGS, PROJECT LOCATION AND VICINITY MAPS

PROJECT NUMBER: 334−12−01
DATE: MAY 2013

DRAWING NO. G−1

SHEET 1 OF XX

P:\Weber County\2012 EWP\2.0 − Design Phase\2.10 Drawings\Ogden Bay\Sht\OB_BCA_3341201_G01.dwg Plotted: 5/9/2013 4:02 PM By: Bonnie Baucom

DISCIPLINE IDENTIFICATION

LETTER*	DISCIPLINE	NUMBER**
G	GENERAL	0000
A	ARCHITECTURAL	1000
C	CIVIL	2000
L	LANDSCAPE	2800
M	MECHANICAL	3000
H	HVAC	3600
P	PLUMBING	3800
S	STRUCTURAL	4000
E	ELECTRICAL	5000
I	INSTRUMENTATION	6000

DRAWING IDENTIFICATION

DRAWING NO. SHOWN IN TITLE BLOCK AND CALLOUTS AS:

S–2 — DRAWING NO.*** ; INDIVIDUAL NUMBER ; DISCIPLINE LETTER*

SECTION IDENTIFICATION

(1) SECTION CUT SHOWN ON DRAWING AS:

B / M–2 — SECTION *LETTER* ; DRAWING NO.*** WHERE THE SECTION IS SHOWN (SEE NOTE A)

(2) THIS SECTION IS IDENTIFIED AS:

SECTION B / M–1 — SCALE: (SEE NOTE B) — SECTION *LETTER* ; DRAWING NO.*** WHERE THE SECTION CUT IS SHOWN

DETAIL IDENTIFICATION

(1) DETAIL CALLOUT SHOWN ON DRAWING AS:

1 / M–3 — DETAIL *NUMBER* ; DRAWING NO.*** WHERE THE DETAIL IS SHOWN (SEE NOTE A)

(2) THIS DETAIL IS IDENTIFIED AS:

DETAIL 1 / M–1 — SCALE: (SEE NOTE B) — DETAIL *NUMBER* ; DRAWING NO.*** WHERE THE DETAIL CALLOUT IS SHOWN

NOTE:

A. IF SECTION CUT AND SECTION (OR DETAIL CALLOUT AND DETAIL) ARE SHOWN ON SAME DRAWING, THE DRAWING NO.*** IS REPLACED BY A HORIZONTAL LINE.

B. AS DESIGNATED. NTS = NOT TO SCALE. IF SECTION AND/OR DETAILS ARE THE SAME SCALE AND ON THE SAME DRAWING, SEE TITLE BLOCK AT "SCALE:"; THE SCALE TEXT AT CALLOUT SHALL BE OMITTED.

STANDARD DETAIL IDENTIFICATION

(1) STANDARD DETAIL CALLOUT SHOWN ON DRAWING AS:

C / 2000 — DISCIPLINE* ; STANDARD DETAIL NUMBER** (SEE NOTE)

(2) THIS DETAIL IS IDENTIFIED AS:

(DETAIL NAME) C / 2000 — DISCIPLINE* ; STANDARD DETAIL NUMBER** (SEE NOTE)

NOTE:
LOCATED ON DRAWINGS WHERE THE DETAIL IS TAKEN AND SHOWN (SEE INDEX OF DRAWINGS FOR LOCATION OF STANDARD DETAILS).

MISCELLANEOUS NOTES:

1. ELECTRICAL SYMBOLS SHOWN ON ELECTRICAL SHEETS FOR WELDING SYMBOLS USE AMERICAN WELDING SOCIETY STANDARD SYMBOLS. SEE AMERICAN INSTITUTE OF STEEL CONSTRUCTION MANUAL.

ABBREVIATIONS/ACRONYMS

@	AT	LF	LINEAR FEET
AB	ANCHOR BOLT	LG	LONG
ADD'L	ADDITIONAL	LT	LEFT
AL	ALUMINUM		
APPROX	APPROXIMATE	MATL	MATERIAL
ASSY	ASSEMBLY	MAX	MAXIMUM
BLDG	BUILDING	MFR	MANUFACTURER
BOT	BOTTOM	MH	MANHOLE
BTWN	BETWEEN	MIN	MINIMUM
		MISC	MISCELLANEOUS
C	CONDUIT		
CB	CATCH BASIN	N	NORTH
CFS	CUBIC FEET PER SECOND	NTS	NOT TO SCALE
CL	CENTERLINE		
CLR	CLEAR, CLEARANCE	OC	ON CENTER
CMP	CORRUGATED METAL PIPE	OPNG	OPENING
CONC	CONCRETE		
CONN	CONNECTION	PH	POTHOLE
CONST	CONSTRUCTION	PT	POINT
CONT	CONTINUOUS	PVC	POLYVINYL CHLORIDE
CPLG	COUPLING	PW	POTABLE WATER
CTRD	CENTERED		
CTR	CENTER	R	RADIUS
CU FT	CUBIC FOOT	RCP	REINFORCED CONCRTE PIPE
		RCB	REINFORCED BOX CULVERT
DEFL	DEFLECTION	RDCR	REDUCER
DI	DUCTILE IRON	REINF	REINFORCED, REINFORCING
DIA	DIAMETER	REQD	REQUIRED
DWG	DRAWING	ROW	RIGHT–OF–WAY
DWL	DOWEL	RT	RIGHT
		RW	RAW WATER
E	EAST		
EA	EACH	SCH	SCHEDULE
EF	EACH FACE	SD	STORM DRAIN
EL	ELEVATION	SEC	SECTION
ELB	ELBOW	SIM	SIMILAR
EQ	EQUAL	SLP	SLOPE
EQL SP	EQUALLY SPACED	SPEC	SPECIFICATION (S)
EQUIP	EQUIPMENT	SQ	SQUARE
EW	EACH WAY	SS	SANITARY SEWER
EXIST	EXISTING	STA	STATION
		STD	STANDARD
FG	FINISH GRADE	STL	STEEL
FL	FLOW LINE	STRL	STRUCTURAL
FLG	FLANGE	STRUCT	STRUCTURE
FLR	FLOOR		
FNSH	FINISH	T&B	TOP AND BOTTOM
FT	FEET OR FOOT	TBC	TOP BACK CURB
FTG	FOOTING	TDH	TOTAL DEPTH IN HEAD
		TEL	TELEPHONE
G	GAS	THK	THICK OR THICKNESS
GA	GAGE OR GAUGE	TOA	TOP OF ASPHALT
GALV	GALVANIZED	TOG	TOP OF GRATE
GE	GROOVED END	TOW	TOP OF WALL
GPM	GALLONS PER MINUTE	TYP	TYPICAL
GS	GAS SERVICE LATERAL		
		UDOT	UTAH DEPARTMENT OF TRANSPORTATION
HAFB	HILL AIR FORCE BASE		
HORIZ	HORIZONTAL	UTBC	UNTREATED BASE COURSE
HP	HORSE POWER		
HSS	HIGH STRENGTH STEEL	VCP	VENT PIPING
IE	INVERT ELEVATION	W	WATER OR WEST
INVT	INVERT	W/	WITH
IRR	IRRIGATION	W/O	WITHOUT
		WSTP	WATERSTOP
JT	JOINT	WS	WATER SERVICE LATERAL

GENERAL NOTES:

1. SYMBOLS FOR STRUCTURES, PIPE, ETC. USED FOR IDENTIFICATION ARE SHOWN IN LEGENDS AND SHALL BE FOLLOWED THROUGHOUT THE PLANS WHENEVER APPLICABLE. NOT ALL OF THE VARIOUS COMPONENTS SHOWN IN THESE LEGENDS ARE NECESSARILY USED IN THE PROJECT.
2. SCALES OF THE DRAWINGS AND DETAILS ARE SHOWN IN TITLE BLOCK OR DIRECTLY UNDER THE PLAN OR DETAIL. THE SIZE OF THE ORIGINAL PLOTTED DRAWINGS IS 22"X34". CARE SHOULD BE TAKEN TO REVIEW AND VERIFY SCALE BAR IN THE TITLE BLOCK AREA TO DETERMINE THE SCALE OF REDUCED REPRODUCTIONS.
3. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO PERFORM CONSTRUCTION ACTIVITIES IN ACCORDANCE WITH THE CONTRACT DOCUMENTS. ANY ADDITIONS, DELETIONS, OR MODIFICATIONS SHALL FIRST MEET WITH THE WRITTEN APPROVAL OF THE ENGINEER AND THE OWNER.
4. CONTRACTOR SHALL COMPLY WITH OWNER–OBTAINED PERMIT(S) AND COMPLY WITH ALL REQUIREMENTS OF GOVERNING AGENCIES.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR WETTING DOWN DRY MATERIAL AND CONTROLLING RUBBISH TO PREVENT BLOWING. DUST CONTROL REQUIREMENTS WILL BE IN ACCORDANCE TO THE GOVERNING AGENCY STANDARDS.
6. THE CONTRACTOR SHALL KEEP ALL CONSTRUCTION ACTIVITIES WITHIN THE ESTABLISHED RIGHT–OF–WAY AND CONSTRUCTION EASEMENTS AS SHOWN ON THE DRAWINGS. THIS SHALL INCLUDE BUT NOT BE LIMITED TO VEHICLES AND EQUIPMENT, LIMITS OF EXCAVATION, AND EXCAVATED MATERIAL AND BACKFILL STORAGE. IF THE CONTRACTOR REQUIRES ADDITIONAL WORK AREA TO FACILITATE CONSTRUCTION, IT SHALL BE SOLELY THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN SUCH EASEMENTS OR AGREEMENTS FROM INDIVIDUAL PROPERTY OWNERS.
7. EXISTING UTILITIES SHOWN ON DRAWINGS ARE BASED ON A RECORD SEARCH BY LOCAL CONTROLLING AGENCIES AND ARE APPROXIMATELY LOCATED. EXISTING UTILITIES ARE SHOWN FOR THE CONVENIENCE OF THE CONTRACTOR ONLY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE LOCATION OF AND PRESERVING ALL UTILITIES INCLUDING THOSE NOT SHOWN OR INCORRECTLY SHOWN ON THE DRAWINGS. CONTRACTOR SHALL NOTIFY UTILITY COMPANIES AT LEAST TWO (2) WEEKS IN ADVANCE OF UTILITY CONFLICTS REQUIRING RELOCATION OF MAIN LINES, AND AT LEAST ONE (1) WEEK IN ADVANCE OF CONFLICTS REQUIRING RELOCATION OF SERVICE LATERALS.
8. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING FACILITIES WHICH ARE TO REMAIN IN PLACE FROM DAMAGE, INCLUDING EXISTING ACCESS ROADS. ALL SUCH FACILITIES OR STRUCTURES DAMAGED BY THE CONTRACTORS OPERATIONS SHALL BE REPAIRED OR RECONSTRUCTED TO ORIGINAL OR BETTER CONDITION TO THE SATISFACTION OF THE OWNER AT THE EXPENSE OF THE CONTRACTOR.
9. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING AND PROTECTING SERVICE LINES FOR GAS, SEWER, WATER, AND OTHER UTILITIES AND REPAIRING DAMAGE TO SUCH LINES AS A RESULT OF THE CONTRACTOR'S OPERATIONS. IN GENERAL, SERVICE CONNECTIONS FOR UTILITIES ARE NOT SHOWN ON THE DRAWINGS.
10. CONTRACTOR SHALL PRESERVE ALL SURVEY MONUMENTS, CONTROL POINTS AND TEMPORARY BENCH MARKS. ANY MONUMENTS OR CONTROL POINTS DAMAGED BY THE CONTRACTOR SHALL BE REPLACED AT CONTRACTOR'S EXPENSE.
11. EXCAVATION LIMITS SHOWN ON THE DRAWINGS ARE GRAPHICAL REPRESENTATIONS ONLY, AND DO NOT REPRESENT ACTUAL EXCAVATION LIMITS REQUIRED TO DO COMPLETE THE WORK. CONTRACTOR IS SOLELY RESPONSIBLE FOR CONFORMANCE WITH LOCAL AND FEDERAL CODES GOVERNING EXCAVATIONS AND TRENCHES. CONTRACTOR IS RESPONSIBLE FOR THE SAFETY OF THE PUBLIC AND PROTECTION OF PERSONNEL AND WORKERS.
12. CONTRACTOR SHALL CONTACT BLUE STAKES AT 1–800–662–4111 FOR MARKING OF EXISTING UTILITIES PRIOR TO PERFORMING ANY EXCAVATION. CALL FOR UNDERGROUND LOCATING TWO WORKING DAYS PRIOR TO ANY EXCAVATION.
13. CONTRACTOR SHALL BE SOLELY RESPONSIBLE TO PROVIDE ALL TEMPORARY EROSION CONTROL AND MAINTENANCE AND SHALL PROVIDE EROSION AND SEDIMENT CONTROL PLANS TO WEBER COUNTY FOR REVIEW.
14. NO CHANGE IN DESIGN LOCATION OR GRADE SHALL BE MADE BY THE CONTRACTOR WITHOUT THE WRITTEN APPROVAL OF THE ENGINEER OR THEIR AUTHORIZED REPRESENTATIVE.
15. CONTRACTOR SHALL CONSTRUCT BERMS AND/OR DRAINAGE DITCHES AS NEEDED TO KEEP SURFACE WATER FROM ENTERING CONSTRUCTION EXCAVATIONS OR INTERFERING WITH CONSTRUCTION EFFORTS.
16. CONTRACTOR SHALL COORDINATE FINAL EXTENTS OF BANK STABILIZATION WITH ENGINEER PRIOR TO CONSTRUCTION.
17. TEMPORARY CHANNEL ACCESS, WITH APPROVAL OF THE ENGINEER, THE CONTRACTOR MAY CONSTRUCT TEMPORARY ACCESS POINTS TO THE WORK AREAS IN ADDITION TO THOSE SHOWN ON THE DRAWINGS TO FACILITATE CONSTRUCTION. DISTURBED AREAS SHALL BE RESTORED AND RESEEDED AFTER CONSTRUCTION. SEE SPECIFICATIONS FOR RESEEDING REQUIREMENTS.
18. THIS REACH OF THE WEBER RIVER CAN EXPERIENCE MOUNTAIN RUNOFF AND RUNOFF FROM URBAN DRAINAGE CONNECTIONS. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR DEWATERING AND WATER MANAGEMENT DURING THE CONSTRUCTION PERIOD.
19. PRIOR TO CONSTRUCTION, CONTRACTOR SHALL MEET WITH REPRESENTATIVES FROM THE WATER FOWL MANAGEMENT AREA AND DELINEATE THE EXTENTS OF THE TEMPORARY CONSTRUCTION AREA, AND DISCUSS SITE–SPECIFIC REQUIREMENTS.
20. STRUCTURE REPAIR WORK WILL BE PREFORMED WHEN WATER IS IN THE RIVER. WATER DEPTH AND VELOCITY MAY VARY DURING THE CONTRACT PERIOD.
21. CONTRACTOR SHALL CONSTRUCT COFFERDAMS OR OTHER MEANS TO CONTROL SURFACE AND GROUND WATER AS REQUIRED TO INSTALL OR CONSTRUCT REPAIRS.

SYMBOLS

EXISTING FEATURES ARE SHOWN SCREENED.

- COMM — COMMUNICATION LINE
- G — GAS
- P(oh) — POWER OVERHEAD
- E(ug) — POWER UNDERGROUND
- SS — SANITARY SEWER
- SD — STORM DRAIN
- T — TELEPHONE UNDERGROUND
- FO — FIBER OPTIC
- W — WATER
- IRR — IRRIGATION
- 4243 — CONTOUR LINE, 1 FT INTERVAL
- 4245 — CONTOUR LINE, 5 FT INTERVAL
- PROPERTY LINE OR EASEMENT
- FENCE
- STREET CENTERLINE
- TEMPORARY FENCE
- EXISTING AC PAVING (SCREENED)
- EDGE OF ASPHALT
- DITCH CENTERLINE WITH FLOW DIRECTION
- R/W — RIGHT OF WAY
- LIMIT OF GRADING OR EXISTING GRADE LINE
- POWER BOX
- POWER POLE
- LIGHT POLE
- EXISTING UTILITY OR TELEPHONE POLE
- 1 — COORDINATE IDENTIFIER
- POTHOLE LOCATION
- NEW STRUCTURE OR FACILITY
- EXISTING STRUCTURE OR FACILITY
- FUTURE STRUCTURE OR FACILITY
- SIGN
- STREET LAMPS
- 1 — SHEET NOTE, REFERED IN BUBBLE
- MH — EXISTING MANHOLE
- MH — NEW MANHOLE
- ROAD
- SIGN
- SPOT ELEVATION
- BENCH MARK
- TP–2 — TEST PIT LOCATION AND NUMBER
- BH–2 — BORING LOCATION AND NUMBER
- XXXXXX — TO BE REMOVED OR DEMOLISHED
- LIMITS OF GRAVEL SURFACE
- CONCRETE OR CONCRETE SURFACE
- GRANULAR BACKFILL
- EARTH
- BEDROCK
- CULVERT
- SLOPE WITH FLOW DIRECTION

Bowen Collins & Associates, Inc. Consulting Engineers

PRELIMINARY

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

VERIFY SCALE — BAR IS ONE INCH ON ORIGINAL DRAWING

WEBER COUNTY
OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

REVIEW — CHECKED C. BAGLEY — APPROVED C. BAGLEY

DESIGN — DESIGN T. OLSEN — DRAWN B. ABEL

GENERAL
GENERAL NOTES, ABBREVIATIONS, AND SYMBOLS

PROJECT NUMBER 334–12–01

DATE: MAY 2013

DRAWING NO. G–2

SHEET 2 OF XX

LEGEND:

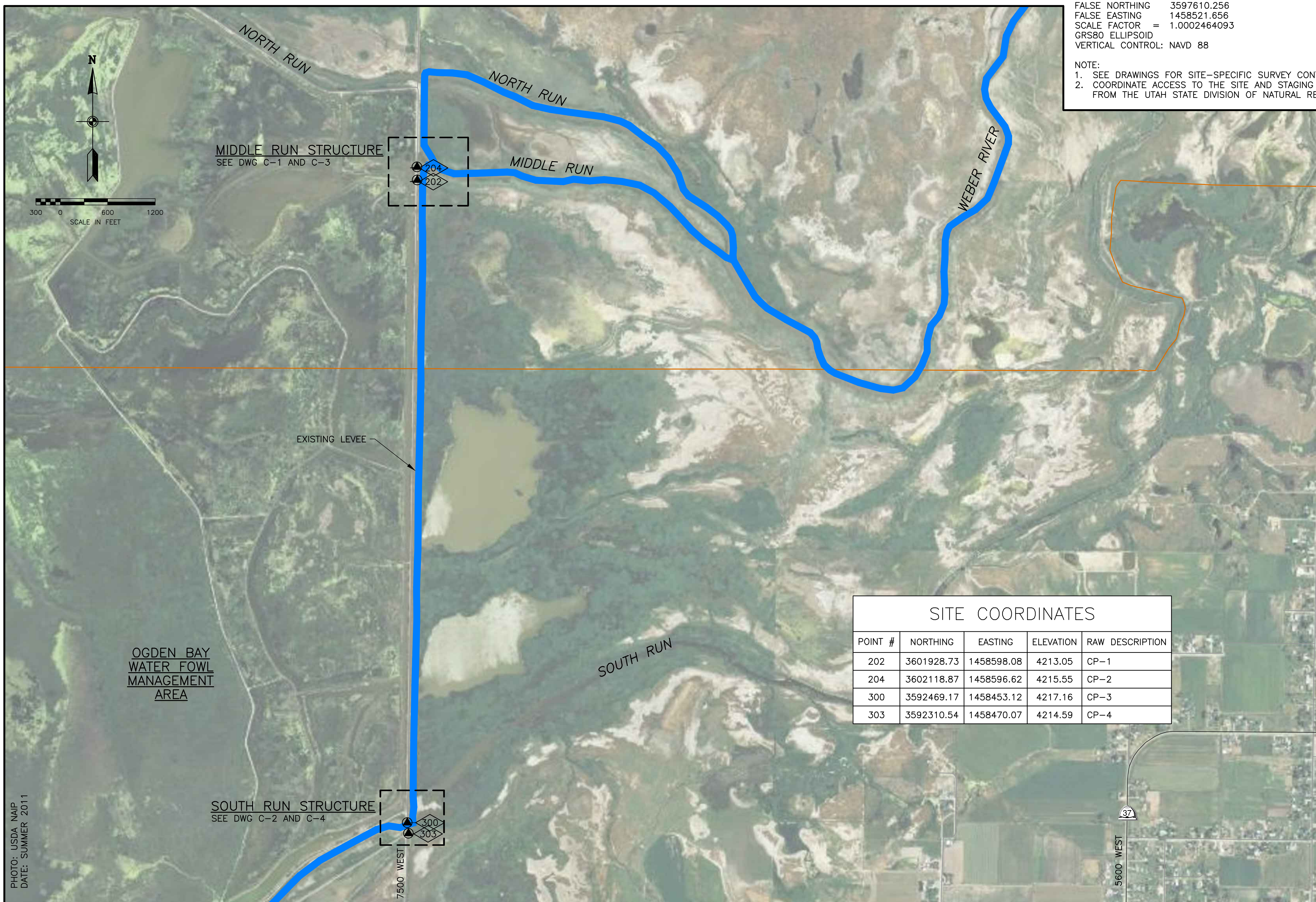
CORPORATE BOUNDARY

WEBER RIVER

PROJECT SURVEY CONTROL

HORIZONTAL CONTROL: MODIFIED STATE PLANE NAD83 US SURVEY FEET
ORIGIN LATITUDE N41°12'03.24"
ORIGIN LONGITUDE W112°02'39.62"
FALSE NORTHING 3597610.256
FALSE EASTING 1458521.656
SCALE FACTOR = 1.0002464093
GRS80 ELLIPSOID
VERTICAL CONTROL: NAVD 88

NOTE:
1. SEE DRAWINGS FOR SITE-SPECIFIC SURVEY CONTROL POINTS.
2. COORDINATE ACCESS TO THE SITE AND STAGING WITH PERSONELL FROM THE UTAH STATE DIVISION OF NATURAL RESOURCES.



SITE COORDINATES

POINT #	NORTHING	EASTING	ELEVATION	RAW DESCRIPTION
202	3601928.73	1458598.08	4213.05	CP-1
204	3602118.87	1458596.62	4215.55	CP-2
300	3592469.17	1458453.12	4217.16	CP-3
303	3592310.54	1458470.07	4214.59	CP-4

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REVISIONS

NO.	DATE	REV. BY	DESCRIPTION

WEBER COUNTY
OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

REVIEW
CHECKED C. BAGLEY
APPROVED C. BAGLEY

DESIGN
DESIGN T. OLSEN
DRAWN B. ABEL

GENERAL
KEY SHEET AND SURVEY CONTROL

PROJECT NUMBER 334-12-01
DATE: MAY 2013

DRAWING NO.
G-3
SHEET 3 OF XX

P:\Weber County\2012 EWP\2.0 - Design Phase\2.10 Drawings\Ogden Bay\Sht\OB_BCA_3341201_G03.dwg Plotted: 5/9/2013 4:09 PM By: Bonnie Baucom

NOTES:

1. FOR PROPOSED REPAIRS, SEE DRAWING NO. C-3
2. WORK WITHIN THE RIVER SHALL COMPLY WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL PERMITS. REFER TO SECTION 01450 FOR DETAILS.

MIDDLE RUN DIVERSION DEMOLITION 1/--

NTS

PHOTO: AGRC HRO 2006
CONTOUR INTERVAL: 2-FOOT

Bowen Collins & Associates, Inc. Consulting Engineers

PRELIMINARY

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

VERIFY SCALE — BAR IS ONE INCH ON ORIGINAL DRAWING

WEBER COUNTY
OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

DESIGN: DESIGN T. OLSEN; DRAWN B. ABEL
REVIEW: CHECKED C. BAGLEY; APPROVED C. BAGLEY

CIVIL
MIDDLE RUN STRUCTURE DEMOLITION PLAN
PROJECT NUMBER 334-12-01
DATE: MAY 2013

DRAWING NO. C-1
SHEET 4 OF XX

P:\Weber County\2012 EWP\2.0 – Design Phase\2.10 Drawings\Ogden Bay\Sht\OB_BCA_3341201_C01.dwg Plotted: 5/9/2013 4:09 PM By: Bonnie Baucom

NOTES:

1. FOR PROPOSED REPAIRS, SEE DRAWING NO. C-4
2. WORK WITHIN THE RIVER SHALL COMPLY WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL PERMITS. REFER TO SECTION 01450 FOR DETAILS.

SOUTH RUN DIVERSION DEMOLITION 2 --

NTS

PHOTO: AGRC HRO 2006

CONTOUR INTERVAL: 2-FOOT

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NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

WEBER COUNTY

OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING

DESIGN: DESIGN T. OLSEN; DRAWN B. ABEL

REVIEW: CHECKED C. BAGLEY; APPROVED C. BAGLEY

CIVIL

SOUTH RUN STRUCTURE DEMOLITION PLAN

DATE: MAY 2013

PROJECT NUMBER 334-12-01

DRAWING NO. C-2

SHEET 5 OF XX

NOTES:

1. FOR DEMOLITION, SEE DRAWING C-1.

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PRELIMINARY

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

WEBER COUNTY
OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

DESIGN
DESIGN T. OLSEN
DRAWN B. ABEL

REVIEW
CHECKED C. BAGLEY
APPROVED C. BAGLEY

CIVIL
MIDDLE RUN STRUCTURE PLAN

DATE: MAY 2013

PROJECT NUMBER 334-12-01

DRAWING NO.
C-3

SHEET 6 OF XX

P:\Weber County\2012 EWP\2.0 - Design Phase\2.10 Drawings\Ogden Bay\Sht\OB_BCA_3341201_C03.dwg Plotted: 7/1/2013 1:08 PM By: Bonnie Baucom

NOTES:

1. FOR DEMOLITION, SEE DRAWING C-2.

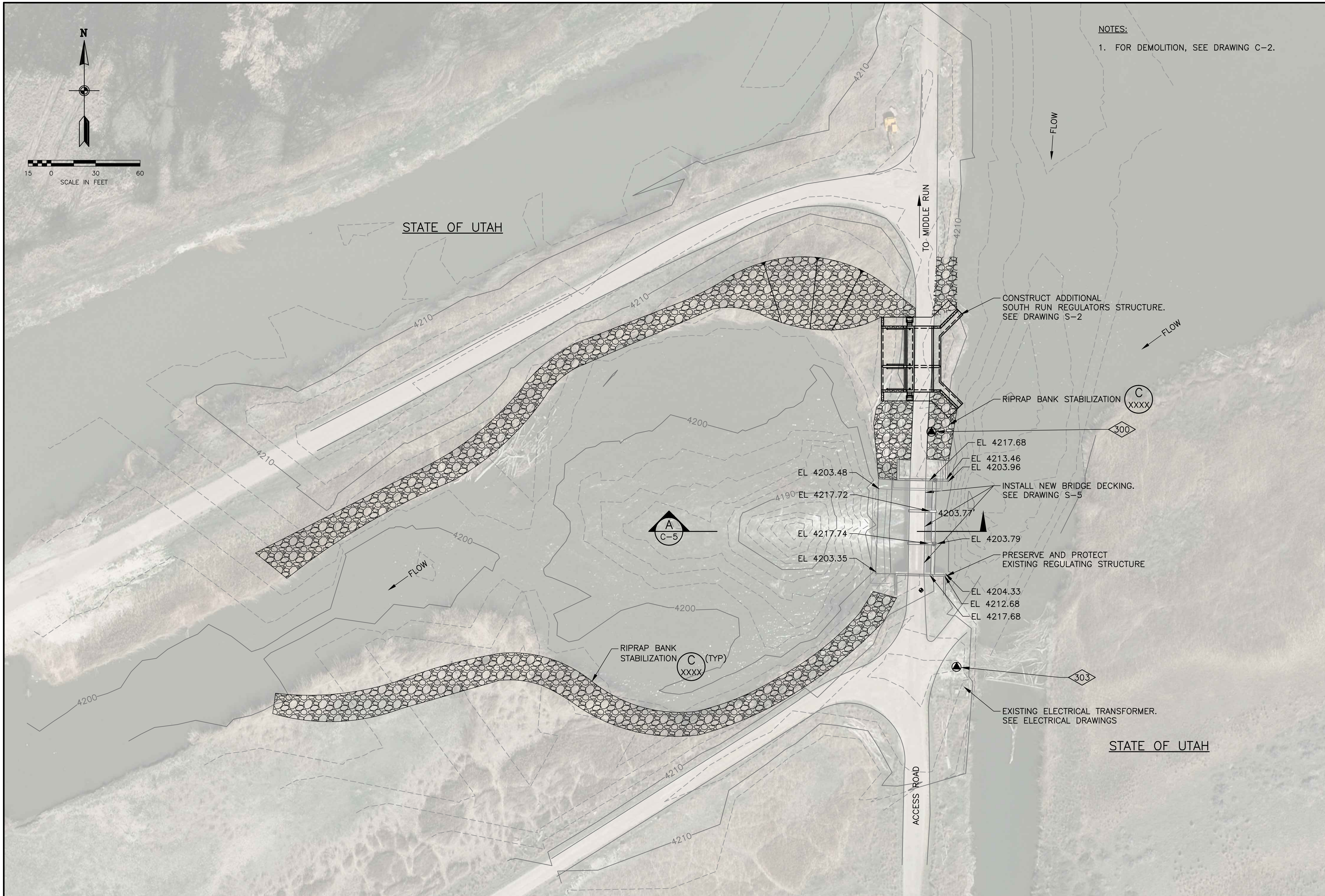

PHOTO: AGRC HRO 2006
CONTOUR INTERVAL: 2-FOOT

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NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

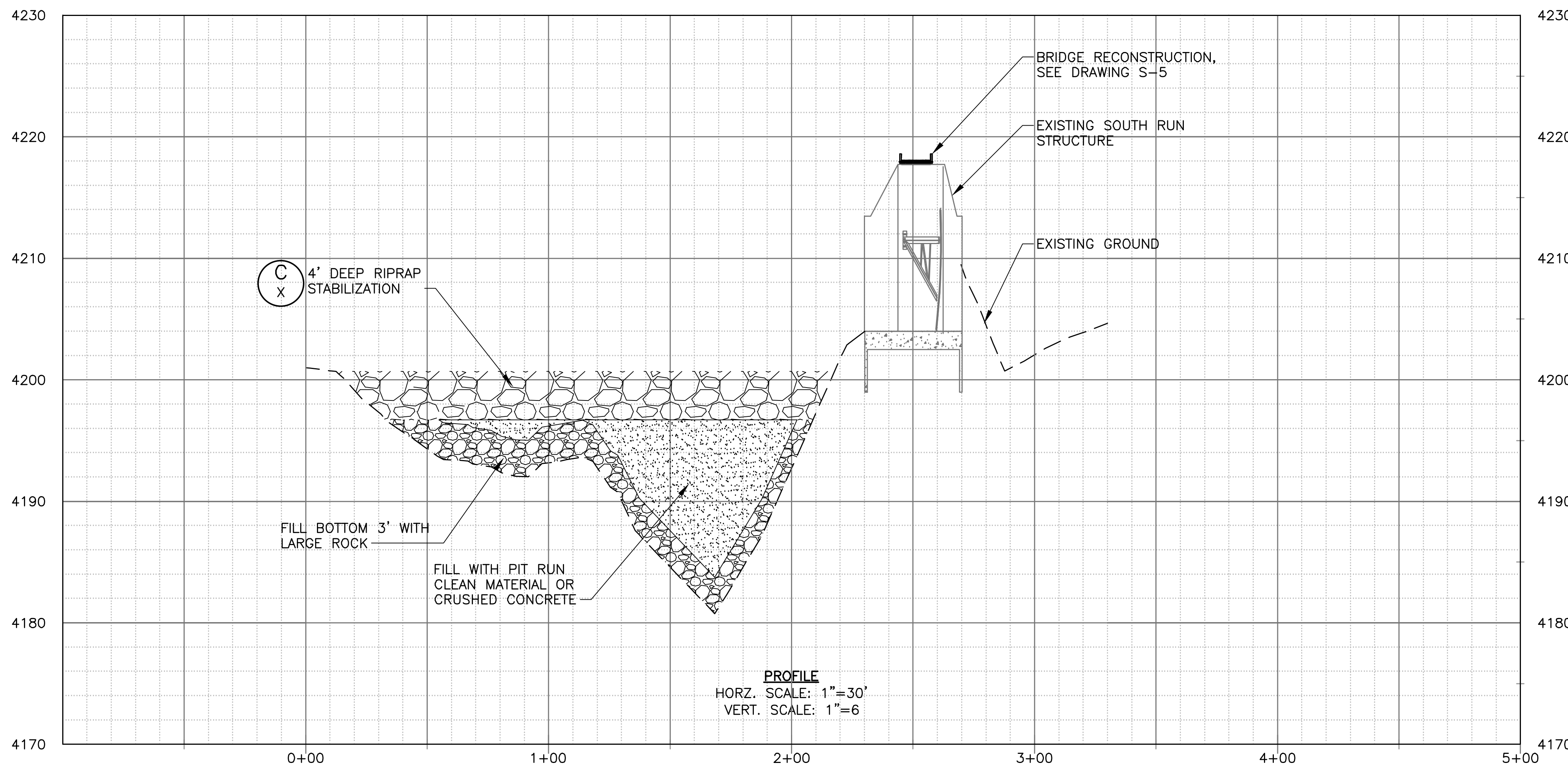
WEBER COUNTY
OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

DESIGN: DESIGN T. OLSEN; DRAWN B. ABEL
REVIEW: CHECKED C. BAGLEY; APPROVED C. BAGLEY

CIVIL
SOUTH RUN STRUCTURE PLAN
PROJECT NUMBER 334-12-01
DATE: MAY 2013

DRAWING NO. C-4
SHEET 7 OF XX



PROFILE
HORZ. SCALE: 1"=30'
VERT. SCALE: 1"=6

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PRELIMINARY

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

WEBER COUNTY
OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

DESIGN
DESIGN T. OLSEN
DRAWN B. ABEL

REVIEW
CHECKED C. BAGLEY
APPROVED C. BAGLEY

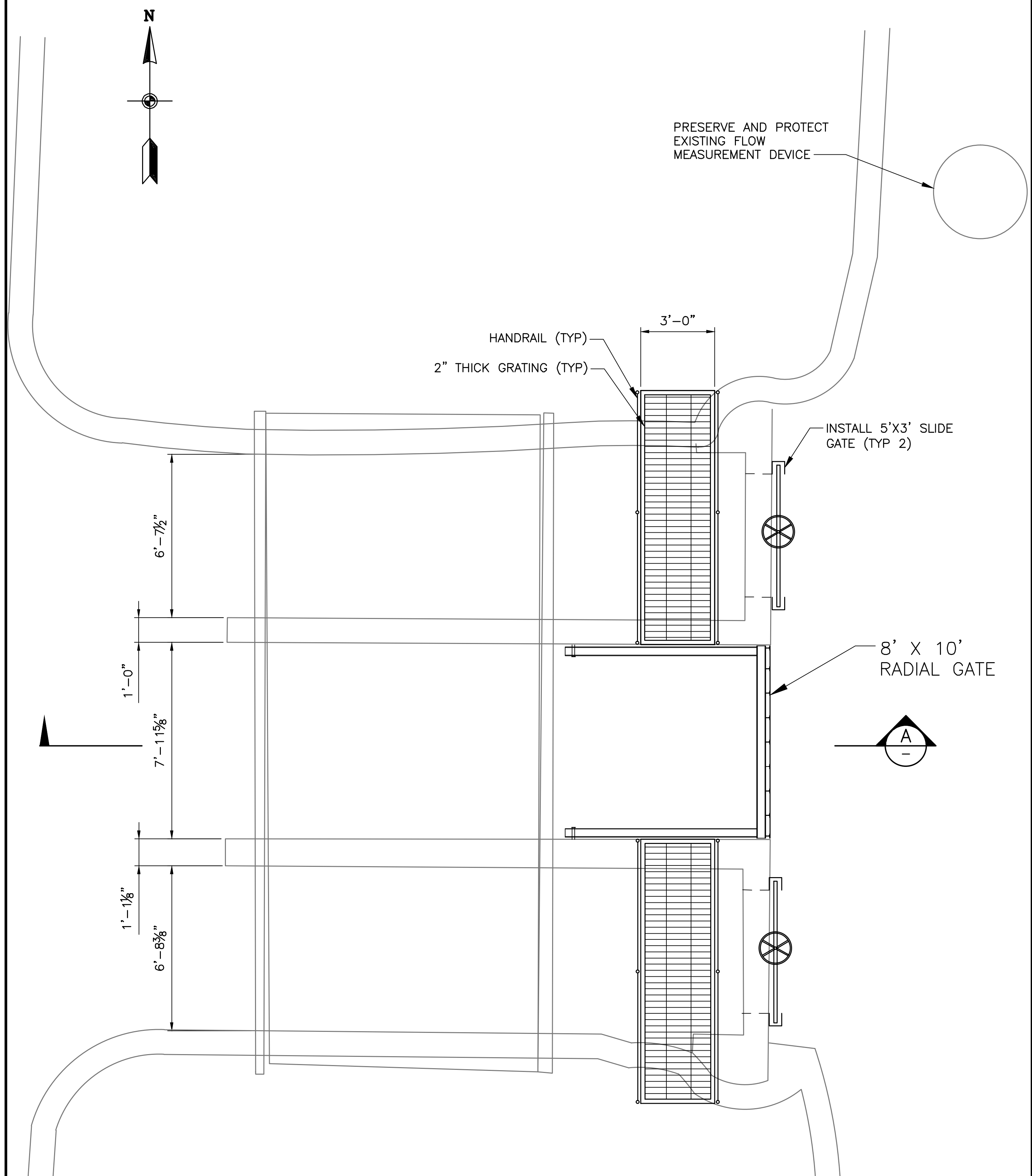
CIVIL
SOUTH RUN STRUCTURE PROFILE

PROJECT NUMBER 334-12-01

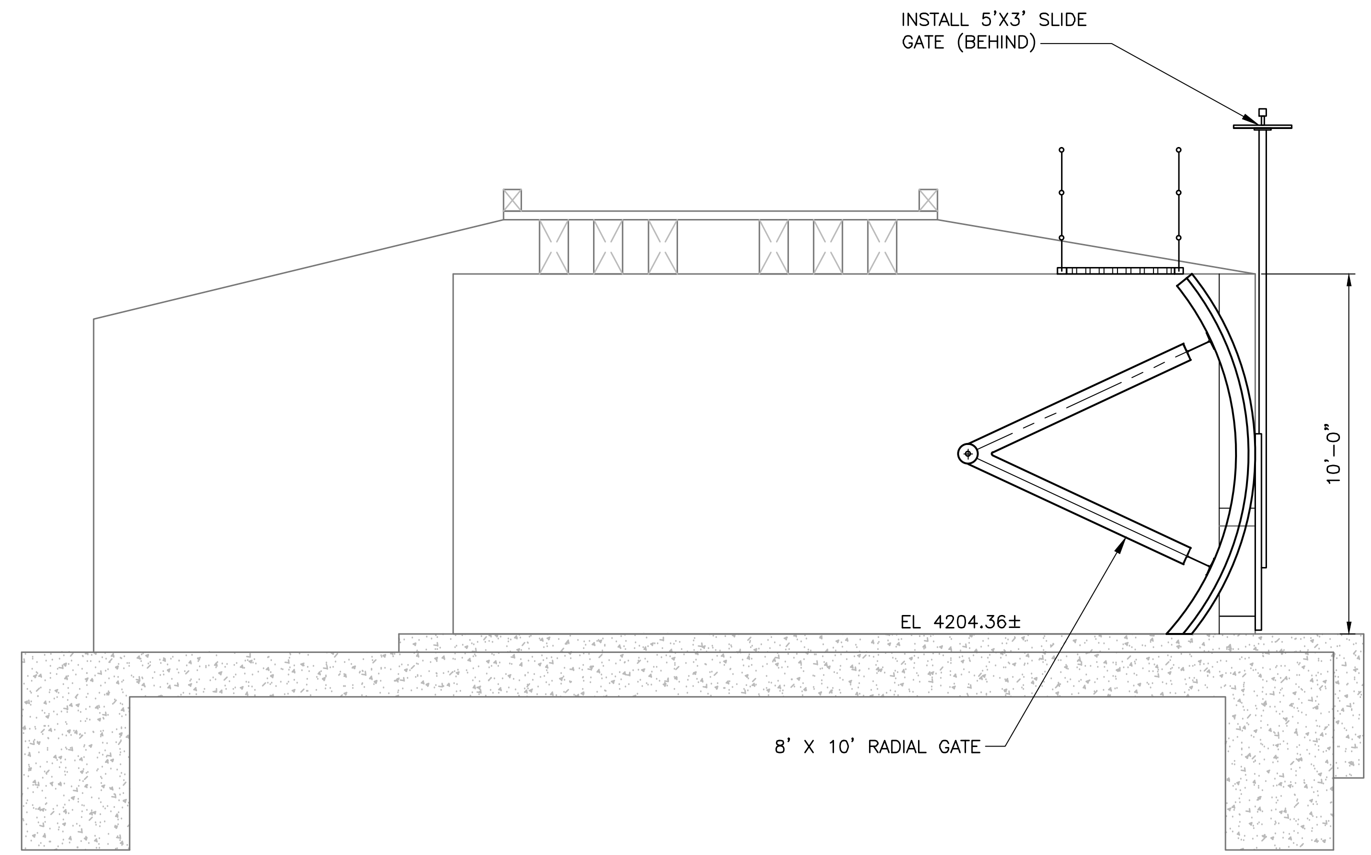
DATE: MAY 2013

DRAWING NO.
C-5

SHEET 8 OF XX



PLAN
3/8" = 1'-0"



SECTION A –
3/8" = 1'-0"

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Consulting Engineers

PRELIMINARY

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

WEBER COUNTY
OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

DESIGN
DESIGN R. DAVIS
DRAWN R. DAVIS

REVIEW
CHECKED T. OLSEN
APPROVED R. DAVIS

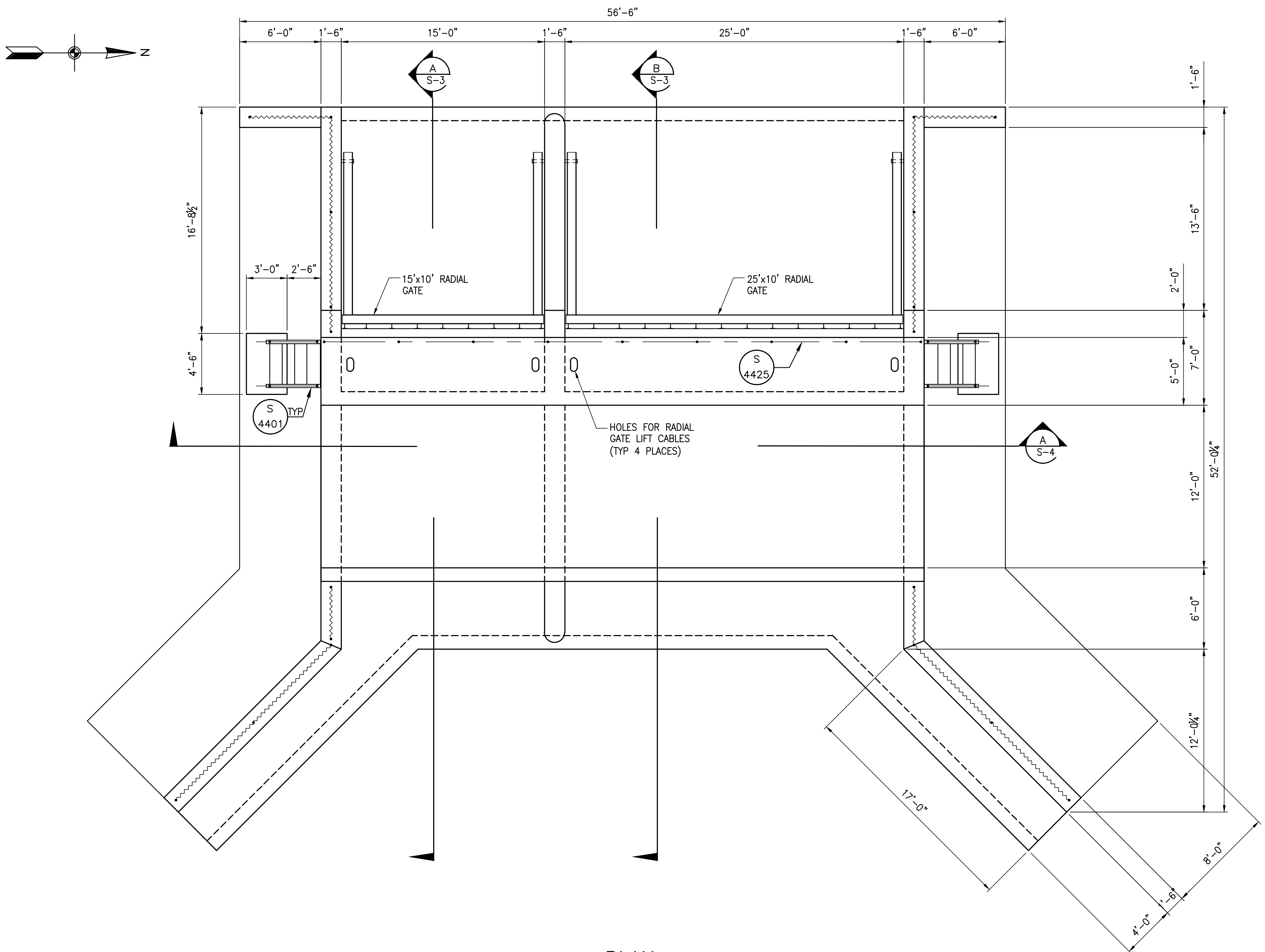
STRUCTURAL
MIDDLE RUN STRUCTURE

DATE: MAY 2013
PROJECT NUMBER 334-12-01

DRAWING NO.
S-1
SHEET 9 OF XX

NOTES:

1. GATE OPERATORS NOT SHOWN FOR CLARITY IN DEPICTING STRUCTURE.



PLAN

SCALE: 1/4"=1'-0"

PRELIMINARY

Bowen Collins & Associates, Inc. Consulting Engineers

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

WEBER COUNTY

OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING

DESIGN: DESIGN R. DAVIS; DRAWN R. DAVIS

REVIEW: CHECKED T. OLSEN; APPROVED R. DAVIS

STRUCTURAL

SOUTH RUN STRUCTURE

PROJECT NUMBER 334-12-01

DATE: MAY 2013

DRAWING NO. S-2

SHEET XX OF XX

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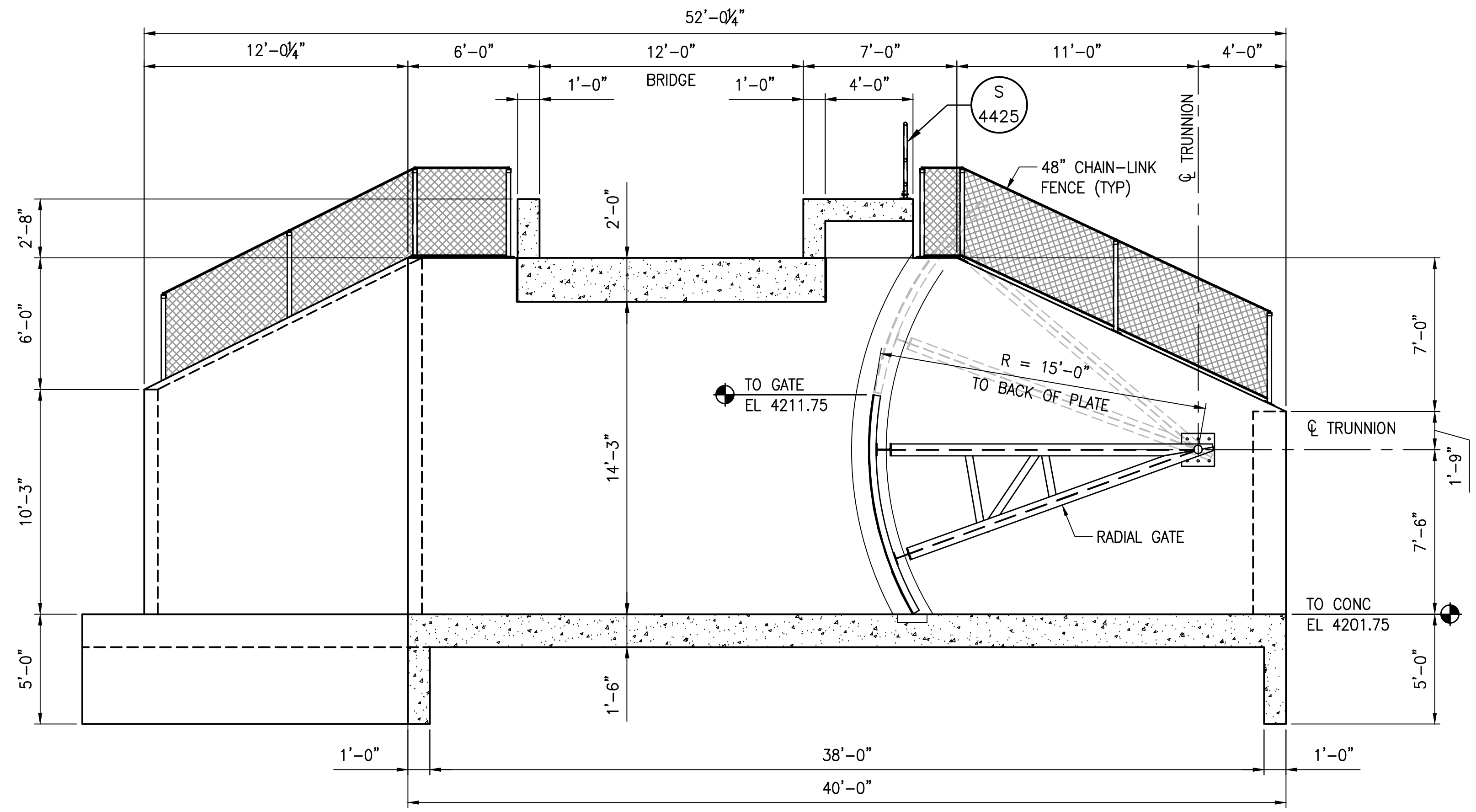
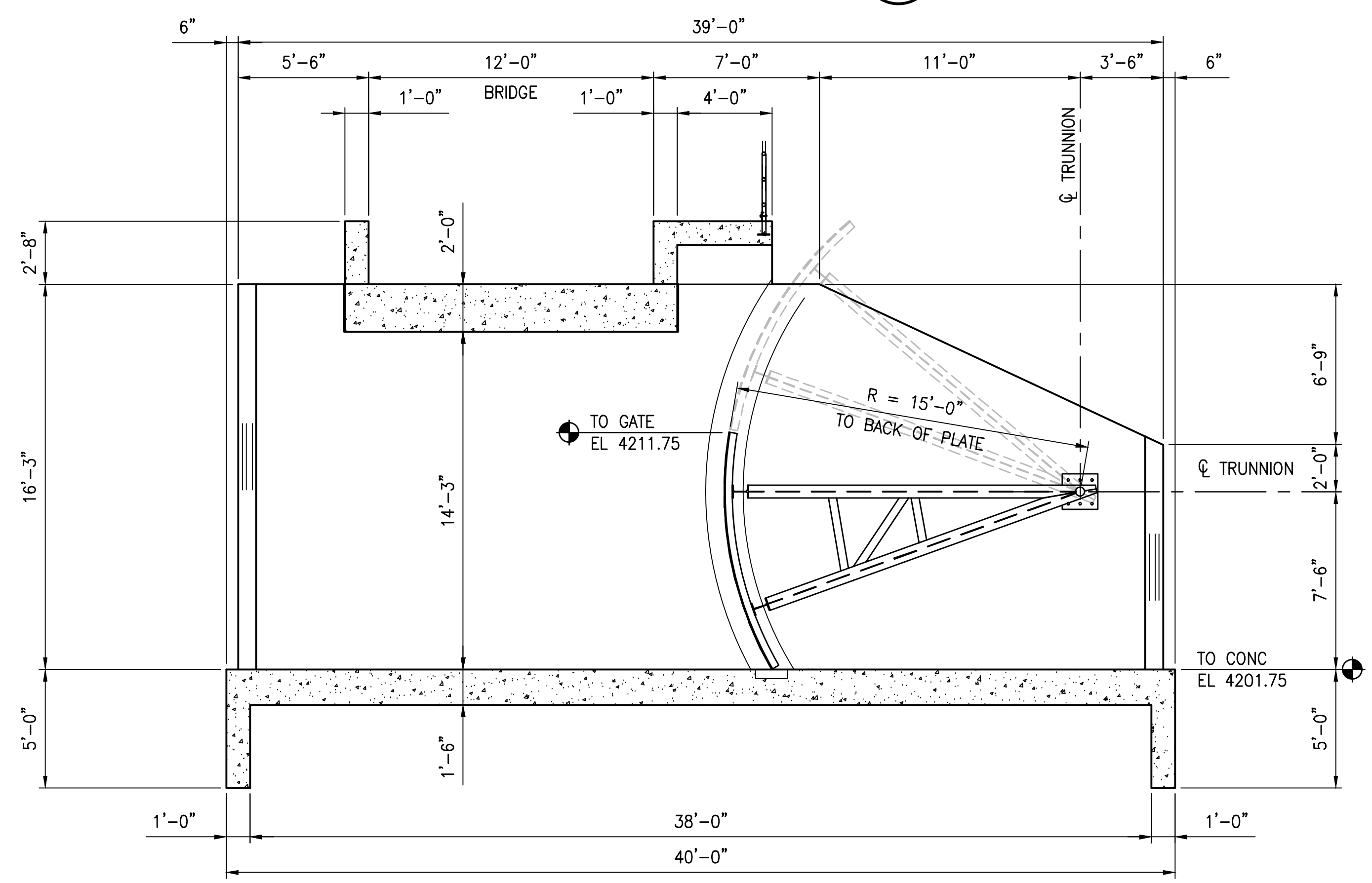


SECTION (A / S-2)
SCALE: 1/4"=1'-0"



SECTION (B / S-2)
SCALE: 1/4"=1'-0"

Bowen Collins & Associates, Inc.
Consulting Engineers

PRELIMINARY

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

WEBER COUNTY
OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

DESIGN
DESIGN R. DAVIS
DRAWN R. DAVIS

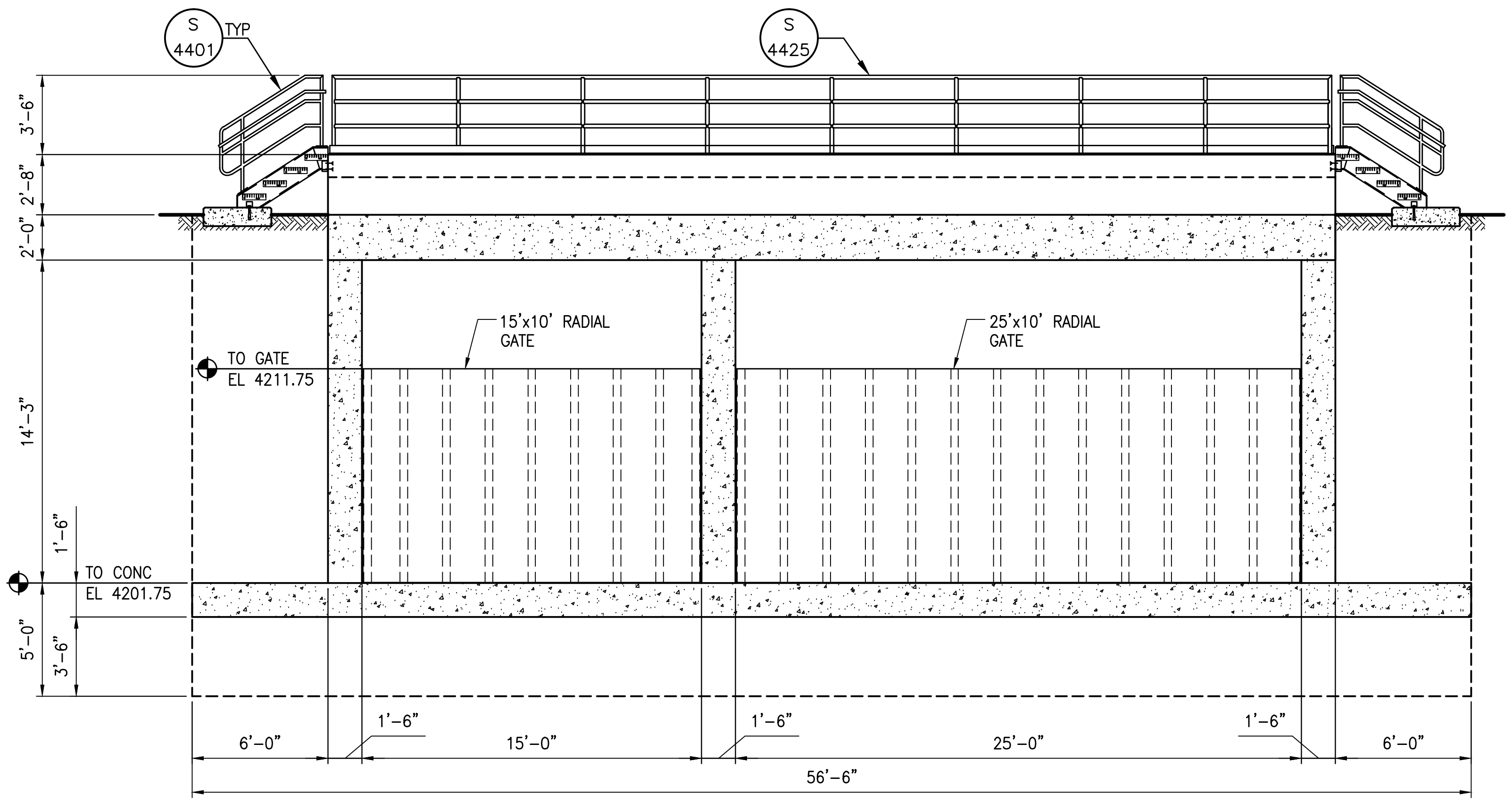
REVIEW
CHECKED T. OLSEN
APPROVED R. DAVIS

STRUCTURAL
SOUTH RUN STRUCTURE SECTIONS – 1

PROJECT NUMBER 334-12-01
DATE: MAY 2013

DRAWING NO.
S-3
SHEET XX OF XX

P:\Weber County\2012 EWP\2.0 – Design Phase\2.10 Drawings\Ogden Bay\Sht\OB_BCA_3341201_S03.dwg Plotted: 5/9/2013 4:15 PM By: Bonnie Baucom



SECTION A / S-2

SCALE: 1/4"=1'-0"

Bowen Collins & Associates, Inc. Consulting Engineers

PRELIMINARY

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

WEBER COUNTY

OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING

DESIGN

DESIGN R. DAVIS

DRAWN R. DAVIS

REVIEW

CHECKED T. OLSEN

APPROVED R. DAVIS

STRUCTURAL

SOUTH RUN STRUCTURE SECTIONS – 2

PROJECT NUMBER 334-12-01

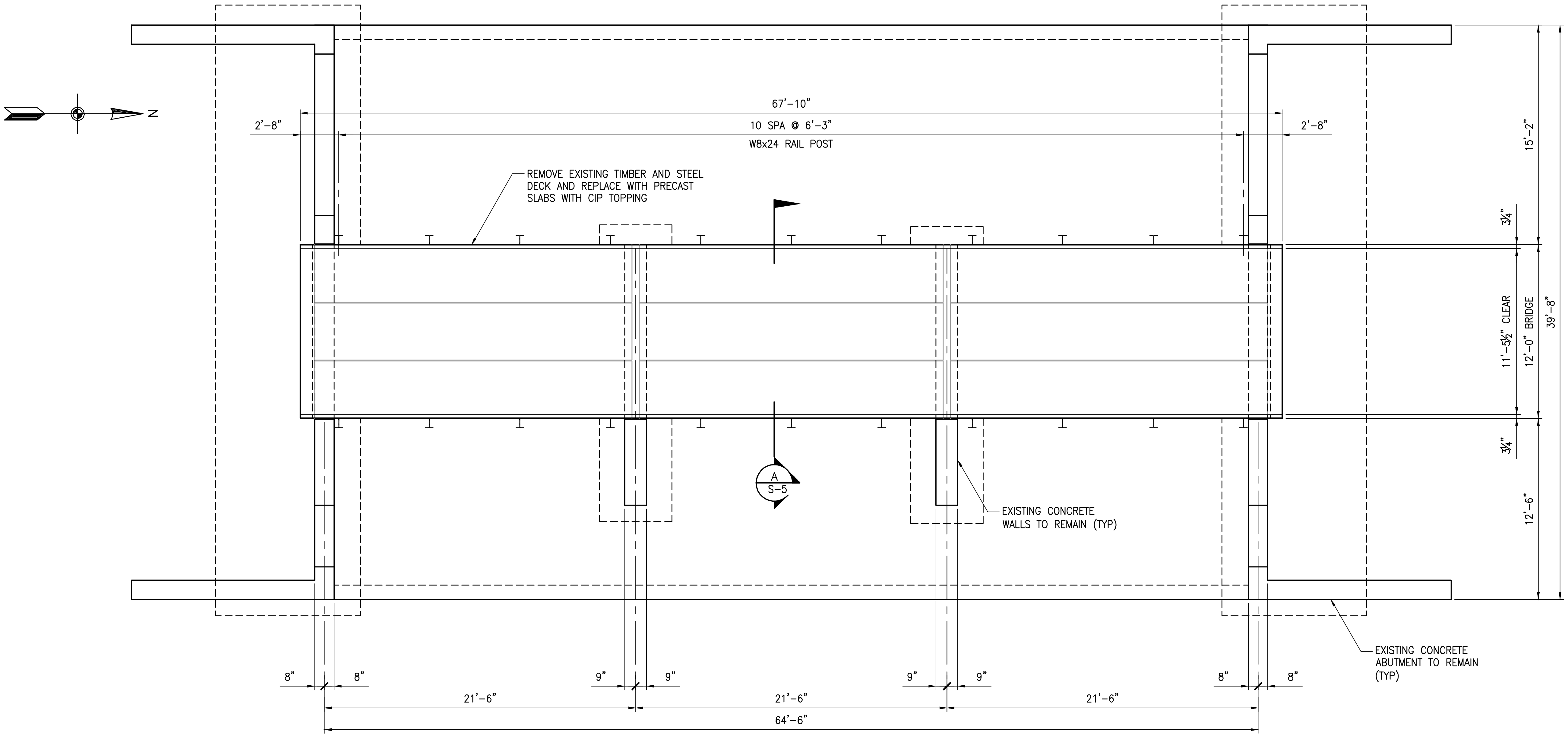
DATE: MAY 2013

DRAWING NO.

S-4

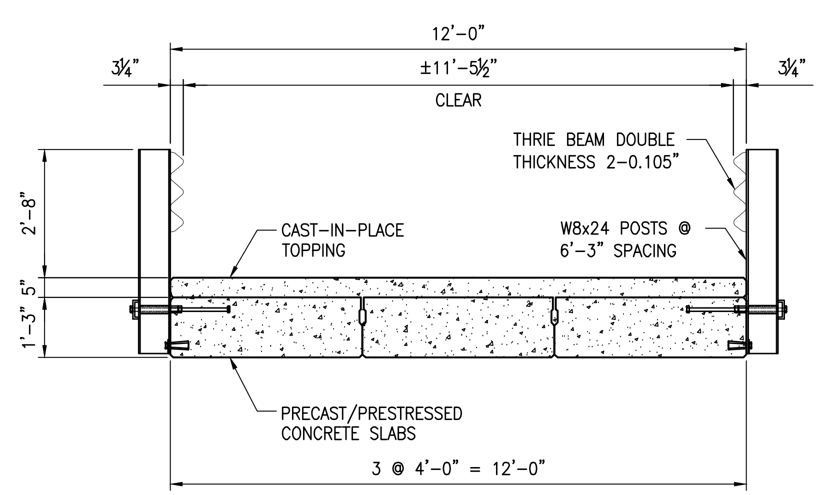
SHEET XX OF XX

P:\Weber County\2012 EWP\2.0 – Design Phase\2.10 Drawings\Ogden Bay\Sht\OB_BCA_3341201_S04.dwg Plotted: 5/9/2013 4:16 PM By: Bonnie Baucom



RECOMMENDED BRIDGE RECONSTRUCTION PLAN

SCALE: 1/4"=1'-0"



SECTION

SCALE: 1/2"=1'-0"

A
S-5

Bowen Collins & Associates, Inc. Consulting Engineers

PRELIMINARY

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS

WEBER COUNTY
OGDEN BAY WATERFOWL MANAGEMENT AREA STRUCTURE REPAIR PROJECT

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

REVIEW
CHECKED T. OLSEN
APPROVED R. DAVIS

DESIGN
DESIGN R. DAVIS
DRAWN R. DAVIS

STRUCTURAL
EXISTING SOUTH RUN STRUCTURE BRIDGE RECONSTRUCTION

PROJECT NUMBER 334-12-01

DATE: MAY 2013

DRAWING NO.
S-5

SHEET XX OF XX

APPENDIX C

GEOTECHNICAL DATA

Geotechnical Data Report
Weber County Watershed Protection

Prepared for
Bowen Collins & Associates, Inc.
May 2013

GERHART COLE INC.
GEOTECHNICAL ENGINEERS

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Acronyms and Abbreviations

BST	Borehole Shear Test
FEM	Finite Element Method
GCI	Gerhart Cole Inc.
GIS	Geographic Information System
HSA	Hollow-stem Auger
MSL	Mean Sea Level
N	Standard Penetration Resistance
SPT	Standard Penetration Test
St	Sensitivity
Su	Undrained shearing strength
TH	Test Hole
USCS	Unified Soil Classification System

1.1 PROJECT DESCRIPTION

The project is located at three sites along the Lower Weber River in Weber County, Utah. The first site (South Run) is located on the main levee of the Lower Weber River on 7500 West, which borders the east side of the main sections of the Ogden Bay Waterfowl Management Refuge. The second site is located at approximately 500 North 5100 West where the Little Weber River Diversion Channel crosses under 5100 West. The third site is located approximately 2,000 feet to the east of 5100 West at the divergence of the Little Weber River Diversion Channel from the Lower Weber River.

The project scope at Site 1 included evaluating the stability of the existing levee at the South Run gate structure, providing recommendations for backfilling the plunge pool on the downstream side of the existing diversion structure, and providing recommendations to aid in the design of a new diversion structure. Preliminary project plans were provided to us that show the dimensions of the proposed cast-in-place reinforced concrete structure, though no foundation loading conditions were provided. The project scope at Site 2 included providing recommendations for construction of 4’ x 12’ box culverts that will be installed under 5100 West. We understand the box culverts will be installed with approximately 8 to 12 inches of soil cover and with 3 inches of asphalt concrete pavement. Neither the total installed length of the box culverts nor the number of box culverts were provided. The project scope at Site 3 included providing recommendations for construction of a new diversion structure. We understand this diversion structure will be similar in design and construction to the proposed diversion structure at Site 1, though no project plans, design information or foundation loading conditions were provided.

1.2 BACKGROUND

Between April 2011 and June 2011, Weber County experienced flood levels along the Lower Weber River that caused moderate to severe damage to stream banks, irrigation structures and other public infrastructure. The majority of the damage occurred between the mouth of Weber Canyon in Uintah City and the Lower Weber River near the Great Salt Lake and on the Ogden Bay Bird Refuge.

The United States Department of Agriculture, Natural Resource Conservation Service (NRCS) has awarded Weber County a grant under their Emergency Watershed Protection (EWP) program to design and construct flood control improvements along the Weber River. Though numerous goals have been identified by Weber County for this project, our scope of work involved working towards completion of only two of the goals: 1) installation of protective measures to protect against recurrence of flooding by diverting water through the Ogden Bay Bird Refuge, and 2) installation of protective measures to protect against recurrence of flooding by diverting water from the river channel to the Little Weber Diversion Channel.

1.2.1 Design Documents and Drawings

Weber County and Bowen Collins & Associates (BCA) provided information to us to aid in our work which included:

- Request for Proposals for Consultant Services, Weber County Emergency Watershed Protection Project on the Weber River – Weber County
- Preliminary Drawings, South Run Structure - BCA
- Bathymetric Survey Points, South Run Structure - BCA

These design documents and drawings were evaluated and incorporated into this study to supplement our data, where appropriate. It should be noted, however, that no survey data or structural design information was available for the Little Weber Diversion Channel control structure.

1.3 SCOPE OF SERVICES

Based on our understanding of the project we completed the following tasks:

- Task 1.0 – Field Studies
- Task 2.0 – Laboratory Studies
- Task 3.0 – Geotechnical Analyses and Design
- Task 4.0 – Geotechnical Design Report

2.1 GENERAL

Field studies were completed for the proposed South Run gate structure located at the Ogden Bay Waterfowl Management Refuge and for the proposed box culverts located at approximately 500 North 5100 West on March 5, 2013. Field studies were completed for the proposed gate structure located at the divergence of the Little Weber River Diversion Channel from the Lower Weber River on April 22, 2013. The main objectives were to study and characterize existing soil conditions of levee and foundation materials and to obtain samples for laboratory testing. Field studies included using hollow-stem auger drilling techniques.

Test hole locations were mapped using a hand held Garmin GPS device; suggesting that the actual locations may vary up to 33 feet, according to the accuracy reported by the device manufacturers.

2.2 TEST HOLE DRILLING

Five (5) test holes were completed during these studies. Test holes were completed to approximate depths between 26.5 and 51.5 feet. Test hole data is summarized in Table 2-1, and project and test hole locations are plotted on Figures 2-1 through 2-3. Summary logs of the test holes are found in Figures 2-4 through 2-8; a legend of soil descriptions is included in Figure 2-9.

Test holes were logged and observed by a licensed engineer. Material descriptions were developed by observing samples retrieved, drilling behavior, and cuttings during the drilling process. Soils were classified following Unified Soil Classification System (USCS) and ASTM D-2488 procedures. Laboratory test results were used to supplement field descriptions and adjustments were made to field logs where appropriate.

Test holes were drilled using a truck mounted CME-75 drilling rig with 8-inch (outside diameter) hollow stem augers. The drill rig was supplied and operated by Bedke Geotechnical Field Services. All test holes were backfilled full using the auger cuttings.

2.3 SAMPLING

Drive samples were obtained at selected intervals using 1-3/8-inch (ID) Standard Penetration Test (SPT) samplers driven with an automatic trip hammer consisting of a 140 pound weight falling 30 inches. Penetration resistance was recorded as the number of blows (N) required to advance the sampler 12 inches. Undisturbed samples, for laboratory strength and consolidation testing, were obtained with thinned-walled Shelby tubes.

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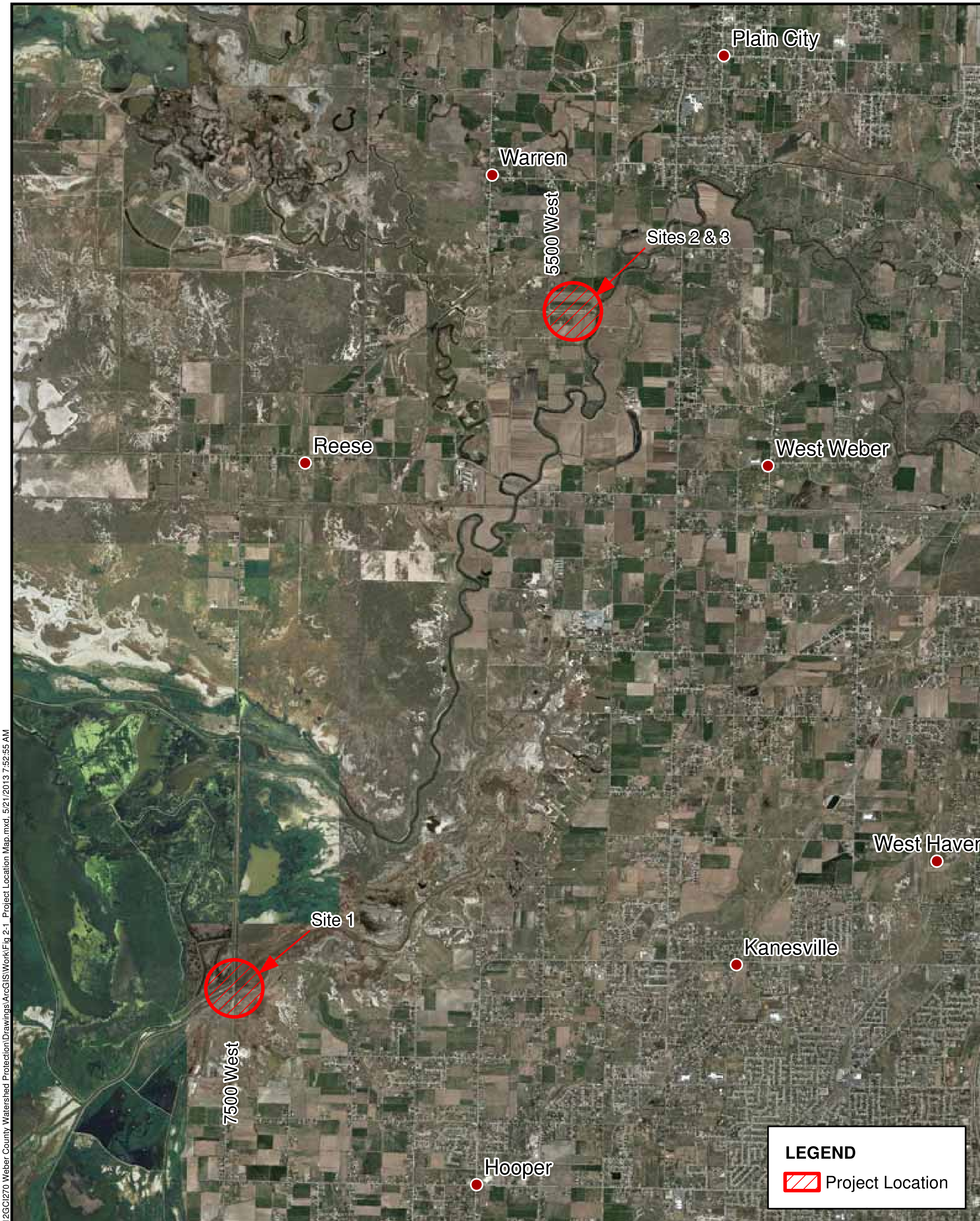
Table 2-1 Test Hole Data
Weber County Watershed Protection (12GCI270)

Test Hole	Date Drilled	Long.	Lat.	Elev. (ft) [a]	Total depth (ft)	Water depth[b] (ft)	Test Hole Type	Drilling Method	Comments
TH-01	3/5/13	-112.1611	41.1869	4217	51.5	9.0	8-in HSA; 4.25-in ID	Hollow Stem Auger	
TH-02	03/05/13	-112.1611	41.1868	4219	26.5	10.0	8-in HSA; 4.25-in ID	Hollow Stem Auger	
TH-03	03/05/13	-112.1130	41.2673	4227	26.5	6.0	8-in HSA; 4.25-in ID	Hollow Stem Auger	
TH-04	04/22/13	-112.1058	41.2676	4228	27.0	10.0	8-in HSA; 4.25-in ID	Hollow Stem Auger	
TH-05	04/22/13	-112.1059	41.2670	4228	32.0	11.0	8-in HSA; 4.25-in ID	Hollow Stem Auger	

Notes: a: Elevations collected using a hand held Garmin GPS device
b: Ground water depth estimated at time of drilling



J:\PROJECTS\2012\12GC270 Weber County Watershed Protection\Drawings\ArcGIS\Work\Fig 2-1 Project Location Map.mxd, 5/21/2013 7:52:55 AM

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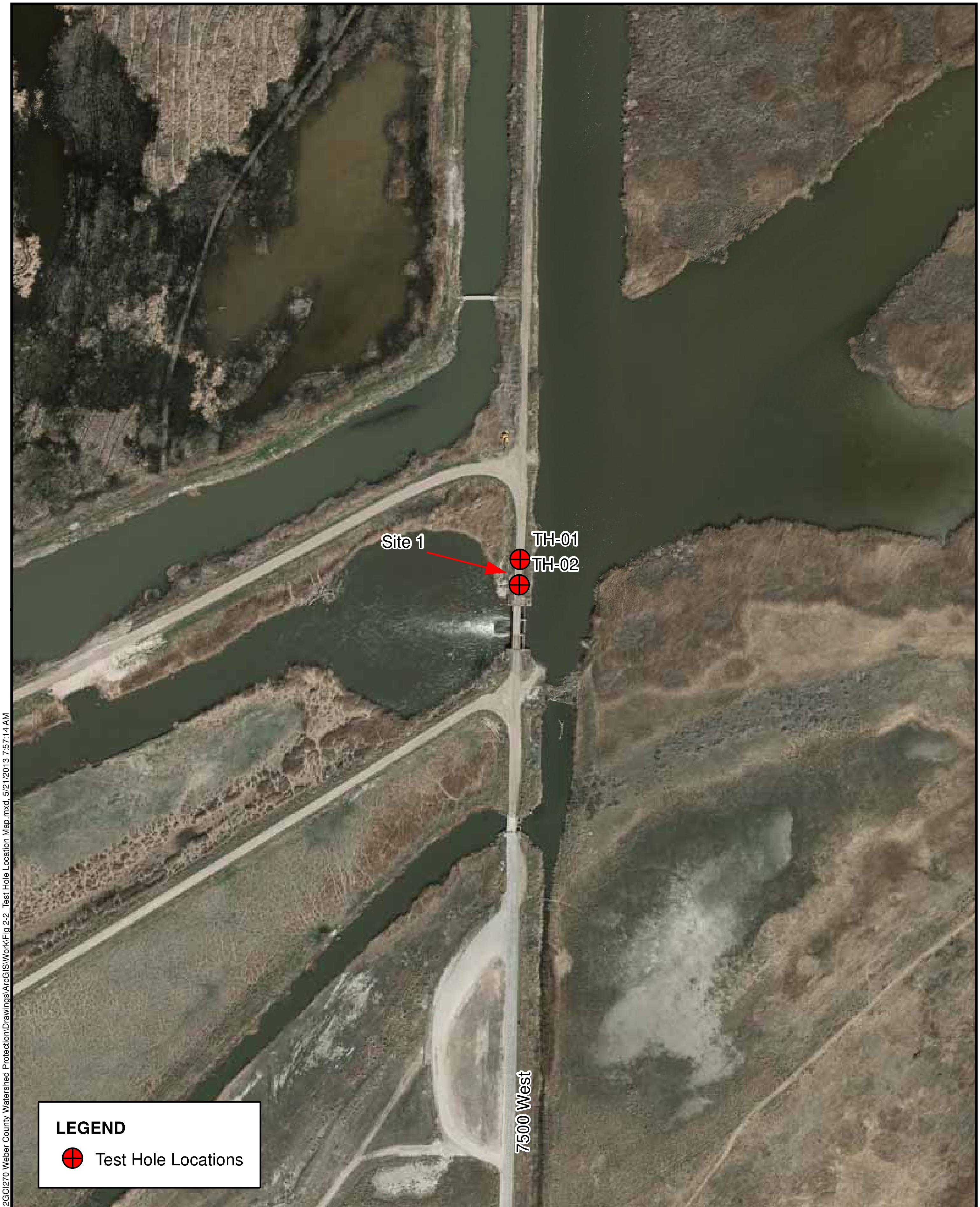
Weber County Watershed Protection

Project Location Map

Figure 2-1



J:\PROJECTS\2012\12GCI270 Weber County Watershed Protection\Drawings\ArcGIS\Work\Fig 2-2 Test Hole Location Map.mxd, 5/21/2013 7:57:14 AM

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Weber County Watershed Protection

Test Hole Location Map

Figure 2-2

GERHART COLE INC.
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Weber County Watershed Protection

Test Hole Location Map

N

0 125 250 500 Feet

Figure 2-3

J:\PROJECTS\2012\12GC1270 Weber County Watershed Protection\Drawings\ArcGIS\Work\Fig 2-3_Test Hole Location Map.mxd, 5/21/2013 10:08:06 AM

Project: Weber County Watershed Protection
Project Location: Ogden Bay Waterfowl Management Refuge
Project Number: 12GCI270

Log of Test Hole TH-01

Date(s) Drilled	**3/5/13**	Logged By	**B. Conder**	Checked By	**P. Gerhart**
Drilling Method	**HSA**	Drill Bit Size/Type	**8-in HSA; 4.25-in ID**	Total Depth Drilled (feet)	**51.5 feet**
Drill Rig Type	**CME 75**	Drilling Contractor	**Bedke Geotech. Field Services**	Hammer Weight/ Drop(lbs/in.)	**Automatic Trip Hammer**
Apparent Groundwater Depth	**9**			Ground Surface Elevation (feet)	**4217.0**
Comments		Test Hole Backfill	**Cuttings**	Elevation Datum	

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery, inches	Graphic Log	MATERIAL DESCRIPTION	FIELD NOTES
	0						GRAVEL, silty with sand, moist, brown, subrounded to subangular, (GM) FILL	
4215							CLAY, stiff, sandy with gravel, moist, olive brown to brown, mottled, (CL) FILL	
	5		1	3-4-4 [8]	14			
4210								
	9						∇ CLAY, soft, wet, gray, with frequent sand seams, (CH)	- Change in drilling at 9 ft
	10		2	0-0-3 [3]	14			
4205								
	15		3		20			- 350 psi down pressure
4200								
	20		4	1-1-3 [4]	16		CLAY, very soft to soft, wet, dark gray, with occasional sand seams, (CH)	
4195								
	25		5	0-0-1 [1]	18			
4190								
	30							

Figure 2-4

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Project: Weber County Watershed Protection
Project Location: Ogden Bay Waterfowl Management Refuge
Project Number: 12GCI270

Log of Test Hole TH-01

Depth, feet	Sample Number	Sampling Resistance	Recovery, inches	MATERIAL DESCRIPTION	FIELD NOTES
30	6	0-0-1-1 [1]	24		
35	7	0-0-1 [1]	18		
40	8		20	CLAY, stiff, wet, dark gray, with frequent sand seams, (CL)	- 500 psi down pressure
45	9	3-4-5 [9]	18		
50	10	3-4-4 [8]	18	SAND, very loose, wet, dark gray, fine grained, (SP)	- Auger sank 2" when rod and plug were pulled for sampling
				Bottom of Test Hole at 51.5 feet.	

Elevation, feet: 4185, 4180, 4175, 4170, 4165, 4160, 4155

Depth, feet: 30, 35, 40, 45, 50, 55, 60, 65

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Figure 2-4

Project: Weber County Watershed Protection Project Location: Ogden Bay Waterfowl Management Refuge Project Number: 12GCI270	# Log of Test Hole TH-02 Sheet 1 of 1

Date(s) Drilled	3/5/13	Logged By	B. Conder	Checked By	P. Gerhart
Drilling Method	HSA	Drill Bit Size/Type	8-in HSA; 4.25-in ID	Total Depth Drilled (feet)	26.5 feet
Drill Rig Type	CME 75	Drilling Contractor	Bedke Geotech. Field Services	Hammer Weight/ Drop(lbs/in.)	Automatic Trip Hammer
Apparent Groundwater Depth	10			Ground Surface Elevation (feet)	4219.0
Comments		Test Hole Backfill	Cuttings	Elevation Datum	

Elevation, feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Sampling Resistance	SAMPLES: Recovery, inches	Graphic Log	MATERIAL DESCRIPTION	FIELD NOTES
	0						GRAVEL, silty with sand, moist, brown, subrounded to subangular, (GM) FILL	
	2						CLAY, medium stiff, sandy, moist, light olive brown to brown, mottled, (CL) FILL	
4215								
	5		1	2-3-4 [7]	12			
4210								
	10		2	0-1-2 [3]	18		∇ CLAY, soft, wet, light olive gray, with rootlets, (CL)	
4205								
	15		3	0-1-2 [3]	18		- with iron oxide staining	
4200								
	20		4		20		CLAY, wet, dark gray, with frequent sand seams, (CH)	
4195								
	25		5	1-1-1 [2]	18		CLAY, soft, wet, brown, with occasional sand seams, with black mottling (CL)	
	26.5						Bottom of Test Hole at 26.5 feet.	
4190								
	30							

Figure 2-5

GERHART COLE INC.
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Project: Weber County Watershed Protection	Log of Test Hole TH-03
Project Location: 500 North 5500 West	Sheet 1 of 1
Project Number: 12GCI270	

Date(s) Drilled	**3/5/13**	Logged By	**B. Conder**	Checked By	**P. Gerhart**
Drilling Method	**HSA**	Drill Bit Size/Type	**8-in HSA; 4.25-in ID**	Total Depth Drilled (feet)	**26.5 feet**
Drill Rig Type	**CME 75**	Drilling Contractor	**Bedke Geotech. Field Services**	Hammer Weight/ Drop(lbs/in.)	**Automatic Trip Hammer**
Apparent Groundwater Depth	**6**			Ground Surface Elevation (feet)	**4227.0**
Comments		Test Hole Backfill	**Cuttings**	Elevation Datum	

Elevation, feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Sampling Resistance	SAMPLES: Recovery, inches	Graphic Log	MATERIAL DESCRIPTION	FIELD NOTES
	0						GRAVEL, clayey with sand, moist, brown, subrounded, (GC) FILL	
4225								
							GRAVEL, loose, clayey with sand, moist to wet, brown, subangular to angular, (GG) FILL	
	5	X	1	3-2-3 [5]	1		▽	
4220							SAND, loose to medium dense, silty, wet, brown, fine grained, (SM)	- Change in drilling at 7 ft
	10	X	2	2-4-5 [9]	18			- Flowing sands, water added
4215								
	15	X	3	5-9-12 [21]	18			- Flowing sands, water added
4210								
	20	X	4	4-9-9-6 [18]	24		SAND, medium dense, with gravel, wet, brown, fine to coarse grained, (SP)	
4205							CLAY, medium stiff to stiff, wet, dark gray, with occasional sand seams, (CL)	- Material change in SPT sampler
	25	X	5	3-4-1 [5]	18			
4200							Bottom of Test Hole at 26.5 feet.	
	30							

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Project: Weber County Watershed Protection
Project Location: 500 North 5500 West
Project Number: 12GCI270

Log of Test Hole TH-04

Date(s) Drilled	4/22/13	Logged By	B. Conder	Checked By	P. Gerhart
Drilling Method	HSA	Drill Bit Size/Type	8-in HSA; 4.25-in ID	Total Depth Drilled (feet)	27.0 feet
Drill Rig Type	CME 75	Drilling Contractor	Bedke Geotech. Field Services	Hammer Weight/ Drop(lbs/in.)	Automatic Trip Hammer
Apparent Groundwater Depth	10			Ground Surface Elevation (feet)	4228.0
Comments		Test Hole Backfill	Cuttings	Elevation Datum	

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery, inches	Graphic Log	MATERIAL DESCRIPTION	FIELD NOTES
	0						CLAY, sandy, moist, dark brown, topsoil, with rootlets, (CL)	
4225							CLAY, medium stiff, with sand, moist, brown, with organics, (CL)	
	5	X	1	4	14		SAND, very loose to loose, with silt, wet, brown, fine grained, (SP-SM)	- Material change in SPT sampler
4220								
	10	X	2	4	18		∇	
4215								
	15	X	3	1	18			- Water added
4210								
	20	X	4	4	12			- Flowing sands, water added
4205								
	25	X	5	3	20		CLAY, soft, with sand, wet, gray, (CL)	- Material change in SPT sampler
							Bottom of Test Hole at 27 feet.	
4200								
	30							

SOIL TEST HOLE 12GCI270_TH_LOGS_5500 WEST.GPJ GERHART.GDT 5/9/13

Project: Weber County Watershed Protection	**Log of Test Hole TH-05**
Project Location: 500 North 5500 West	Sheet 1 of 2
Project Number: 12GCI270	

Date(s) Drilled	**4/22/13**	Logged By	**B. Conder**	Checked By	**P. Gerhart**
Drilling Method	**HSA**	Drill Bit Size/Type	**8-in HSA; 4.25-in ID**	Total Depth Drilled (feet)	**32.0 feet**
Drill Rig Type	**CME 75**	Drilling Contractor	**Bedke Geotech. Field Services**	Hammer Weight/ Drop(lbs/in.)	**Automatic Trip Hammer**
Apparent Groundwater Depth	**11**			Ground Surface Elevation (feet)	**4228.0**
Comments		Test Hole Backfill	**Cuttings**	Elevation Datum	

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery, inches	Graphic Log	MATERIAL DESCRIPTION	FIELD NOTES
	0						SILT, soft to medium stiff, moist, brown, with sand lenses, with rootlets near surface from plowed field, (ML)	
4225								
	5	X	1	6	14			
4220								
	10	X	2	4	18		∇	- Material change in SPT sampler
							SAND, very loose to loose, wet, brown, fine grained, (SP)	
4215								
	15	X	3	5	12			- Flowing sands, water added
4210								
	20	X	4	2	6		- grades to gray, fine to medium grained	- Water added
4205								
	25	X	5	1	24		CLAY, very soft, wet, dark gray, (CL)	- Water added
4200								
	30							

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery, inches	Graphic Log	MATERIAL DESCRIPTION	FIELD NOTES
	30		6		24		- with sand seams	
							Bottom of Test Hole at 32 feet.	
4195								
	35							
4190								
	40							
4185								
	45							
4180								
	50							
4175								
	55							
4170								
	60							
4165								
	65							

Unified Soil Classification System (USCS)

Material Types	Major Soil Divisions		Group Symbol and Legend	Typical Names
COARSE-GRAINED SOILS >50% retained on No. 200 sieve	GRAVELS >50% of coarse fraction retained on No. 4 Sieve	Clean GRAVELS (little or no fines)	GW	Well-Graded GRAVEL, GRAVEL-sand mixtures, few fines
			GP	Poorly-Graded GRAVEL, GRAVEL-sand mixtures, few fines
		GRAVELS with fines (appreciable amount of fines)	GM	Silty GRAVEL, GRAVEL-sand silt mixtures
			GC	Clayey GRAVEL, GRAVEL-sand clay mixtures
	SANDS >50% of coarse fraction passing the No. 4 sieve	Clean SANDS (little or no fines)	SW	Well-Graded SAND, SAND-gravel mixtures, few fines
			SP	Poorly-Graded SAND, SAND-gravel mixtures, few fines
		SANDS with fines (appreciable amount of fines)	SM	Silty SAND, SAND-silt mixtures
			SC	Clayey SAND, SAND-clay mixtures
FINE-GRAINED SOILS >50% Passing No. 200 Sieve	SILTS and CLAYS liquid limit < 50	Inorganic 1) CF > 30%: + Sandy/Gravelly 2) CF = 15-30% + with sand/gravel	CL	Lean CLAY, Gravelly/Sandy CLAY, low to med. plasticity
			ML	SILT, Gravelly/Sandy SILT, no to slight plasticity
		Organic	OL	Organic CLAY or SILT
	SILTS and CLAYS liquid limit < 50	Inorganic 1) CF > 30%: + Sandy/Gravelly 2) CF = 15-30% + with sand/gravel	CH	Fat CLAY, Gravelly/Sandy Fat CLAY, high plasticity
			MH	Elastic SILT, Gravelly/Sandy Elastic SILT, low to high plasticity
		Organic	OH	Organic CLAY or SILT
Highly orgainc soils		Primarily Organic Matter; Organic Odor	PT	PEAT
Boulders / Cobbles		> 50% (by volume) particles > 3"	COBBLES BOULDERS	Boulders (>12"); Cobbles (>3" and <12")

Other Material Symbols

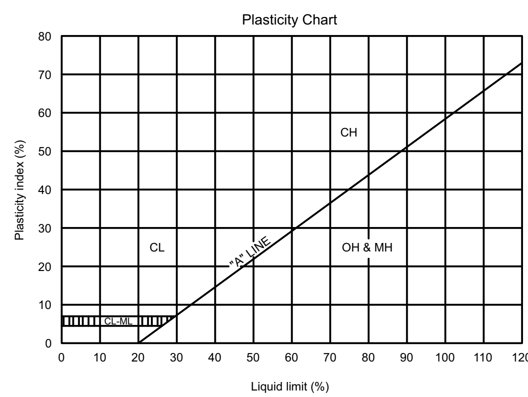
- Bedrock
- Asphalt
- Concrete
- Topsoil
- Fill

Sample Types

- Auger Cuttings
- Continuous sampler
- Grab Sample
- No Recovery
- Shelby Tube
- Standard Penetration Test (SPT)
- Cont. Sample
- California Sampler
- Rock Core
- Modified California Sampler
- Other (see remarks)
- Piston Sampler (Shelby Tube)
- Split Spoon
- Vane Shear

Apparent water level

Measured water level



Descriptors for Coarse Grained Soils

Apparent Density	Dr (%)	SPT	MC	CAL
very loose	0-15	<4	<6	<8
loose	15-35	4-10	6-15	8-20
med. dense	35-65	10-30	15-42	20-56
dense	65-85	30-50	42-72	56-96
very dense	85-100	>50	>72	>96

Descriptors for Fine Grained Soils

Consistency	Su (psf)	SPT	MC	CAL
very soft	< 250	<2	<2	<2
soft	250-500	2-4	2-4	2-5
med. stiff	500-1000	4-8	4-10	5-11
stiff	1000-2000	8-15	10-19	11-22
very stiff	2000-4000	15-30	19-37	22-45
hard	>4000	>30	>37	>45

SPT - Standard split spoon (SPT): 2" OD, 1.375" ID
MC - Modified California: 2.5" OD, 1.875" ID
CAL - California: 3" OD, 2.375" ID

Stratification

Description	Criteria
Seam	1/16" to 1/2"
Layer	1/2" to 12"
Occasional	<= 1 per ft. thickness
Frequent	> 1 per ft. thickness

Modifiers

Description	Est. (%)
Trace	<5
Some	5-12
With	>12

Descriptors for Moisture

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

Descriptors for Particle Size

Description	Criteria
Boulder	>12" : larger than a basketball
Cobble	3-12" : larger than a grapefruit
Coarse Gravel	3/4-3" : larger than a grape
Fine Gravel	No.4-3/4" : larger than a pea
Coarse Sand	No.10-4 : larger than rock salt grain
Medium Sand	No.40-4 : larger than window screen opening
Fine Sand	No.200-40 : larger than a sugar grain

Descriptios for Particle Angularity

Description	Criteria
Angular	Sharp edges, rel. plane sides, unpolished surface
Subangular	Similar to angular, but with rounded edges
Subrounded	Nearly plane sides, well-rounded corners & edges
Rounded	Smoothly curved sides and no edges

Abbreviated Soil Classification Symbols (after ASTM D2488 X.5)

Prefix	Suffix
s = sandy	s = with sand
g = gravelly	g = with gravel
	c = with cobbles
	b = with boulders

Abbreviated system for supplementary presentations when complete description is referenced. Examples:

Group Symbol and Full Name	Abbreviated
Sandy Lean CLAY (CL)	s(CL)
Poorly Graded SAND with silt and gravel	(SP-SM)g
Poorly Graded GRAVEL with sand, cobbles, and boulders (GP)	(GP)scb
Gravelly SILT with sand and cobbles (ML)	g(ML)sc

General Notes:
1) Strata graphic lines on the logs represent approximate boundaries.
2) No warranty is provided as to the continuity of soil conditions between points explored and sample locations.
3) Logs represent soil conditions observed at the point of exploration on the date indicated.
4) Visual methods were used to classify the materials in general accordance with the Unified Soils Classification Systems; actual designations based on laboratory methods may vary.

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Legend to Soil Descriptions

Figure 2-9

3.1 GENERAL

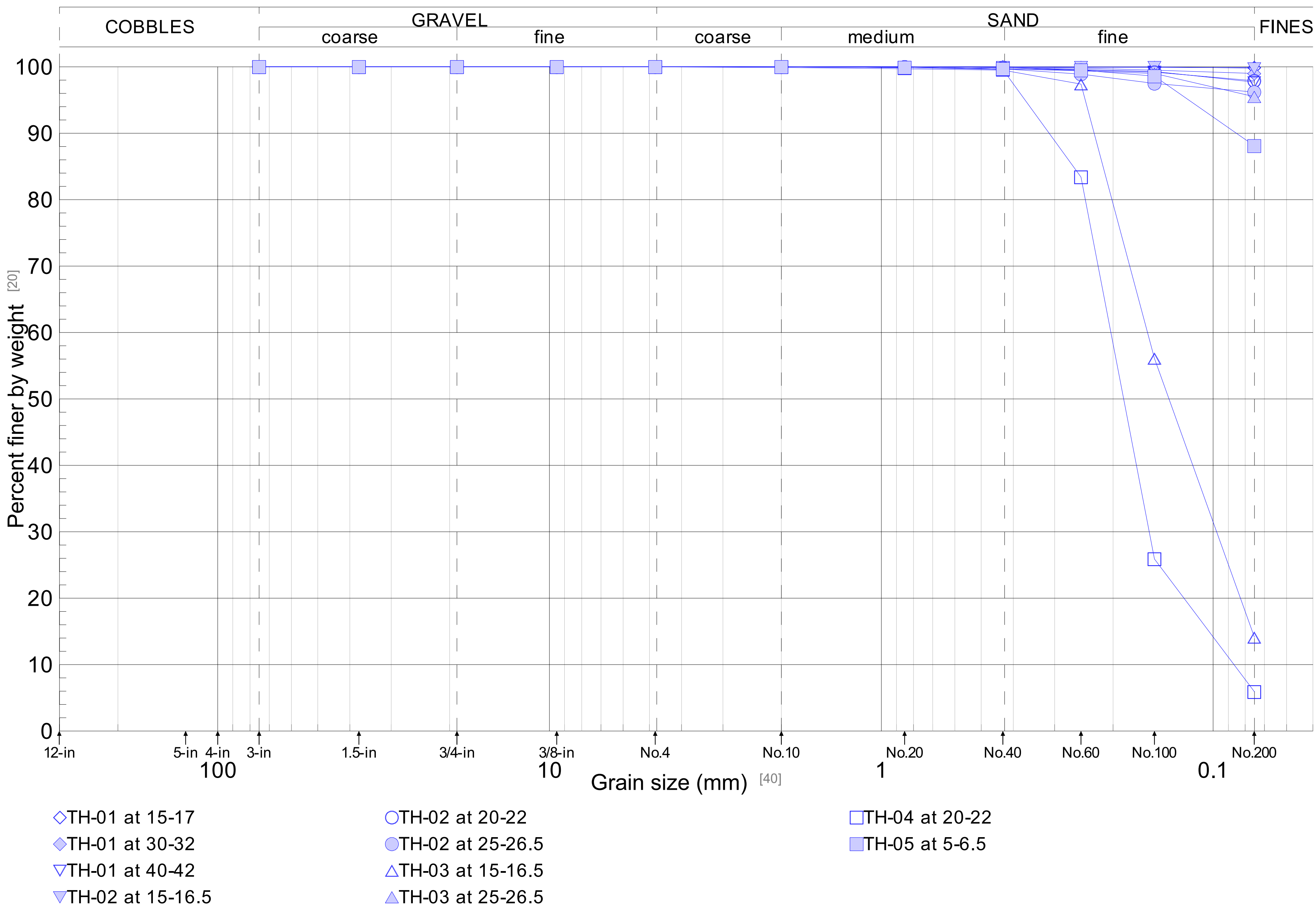
Selected samples obtained from test holes were tested in a geotechnical laboratory. In particular, the testing consisted of:

1. ASTM D422 *Test Method for Particle-Size Analysis of Soils.*
2. ASTM D2216 *Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures*
3. ASTM D2435 *Test Method for One-Dimensional Consolidation Properties of Soils Using Incremental Loading*
4. ASTM D4318 *Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*
5. ASTM D4767 *Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils*

Laboratory test results for the test holes are summarized on Table 3-1 and graphically in Figures 3-1 through 3-2. Sensitivity vs. Effective Stress Relationships developed from laboratory data are plotted on Figure 3-3.

Table 3-1 Summary of Laboratory Test Results

						Atterberg Limits [a]					Grain-Size								Grain-Size Analysis (Percent Finer)									
Test Hole	Depth (ft)	Avg. Depth (ft)	Moisture content (%)	Dry unit weight (pcf)	Moist / Sat. unit weight (pcf)	LL (%)	PL (%)	PI (%)	Cohesive Index, CI	Liquidity Index, LI	GRAVEL (No.4 - 3")	coarse GRAVEL (3/4-3")	fine GRAVEL (No.4-3/4")	SAND (No.200-No.4)	coarse SAND (No.10-No.4)	medium SAND (No.40-No.10)	fine SAND (No.200-No.40)	FINES (<No.200)	1.5-in (37.5 mm)	3/4-in (19 mm)	3/8-in (9.5 mm)	No.4 (4.75 mm)	No.10 (2 mm)	No.20 (0.85 mm)	No.40 (0.425 mm)	No.60 (0.25 mm)	No.100 (0.15 mm)	No.200 (0.075 mm)
TH-01	15-17	16	39			57	24	33	1.38	0.5	0	0	0	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100
TH-01	30-32	31	47			54	23	31	1.35	0.8	0	0	0	1	0	0	1	99	100	100	100	100	100	100	100	100	100	99
TH-01	40-42	41	28	92		37	21	16	0.76	0.5	0	0	0	2	0	0	2	98	100	100	100	100	100	100	100	100	99	98
TH-02	15-16.5	15.75	32			44	21	23	1.1	0.5	0	0	0	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100
TH-02	20-22	21	37	85		50	24	26	1.08	0.5	0	0	0	2	0	0	2	98	100	100	100	100	100	100	100	100	99	98
TH-02	25-26.5	25.75	37			48	23	25	1.09	0.6	0	0	0	4	0	0	4	96	100	100	100	100	100	100	100	99	98	96
TH-03	15-16.5	15.75	26								0	0	0	86	0	0	85	14	100	100	100	100	100	100	100	97	56	14
TH-03	25-26.5	25.75	32			34	23	11	0.48	0.8	0	0	0	4	0	0	4	96	100	100	100	100	100	100	100	99	99	96
TH-04	20-22	21	27								0	0	0	94	0	0	94	6	100	100	100	100	100	100	100	83	26	6
TH-05	5-6.5	5.75	8								0	0	0	12	0	0	12	88	100	100	100	100	100	100	100	100	99	88
TH-05	30-32	31	35	84																								



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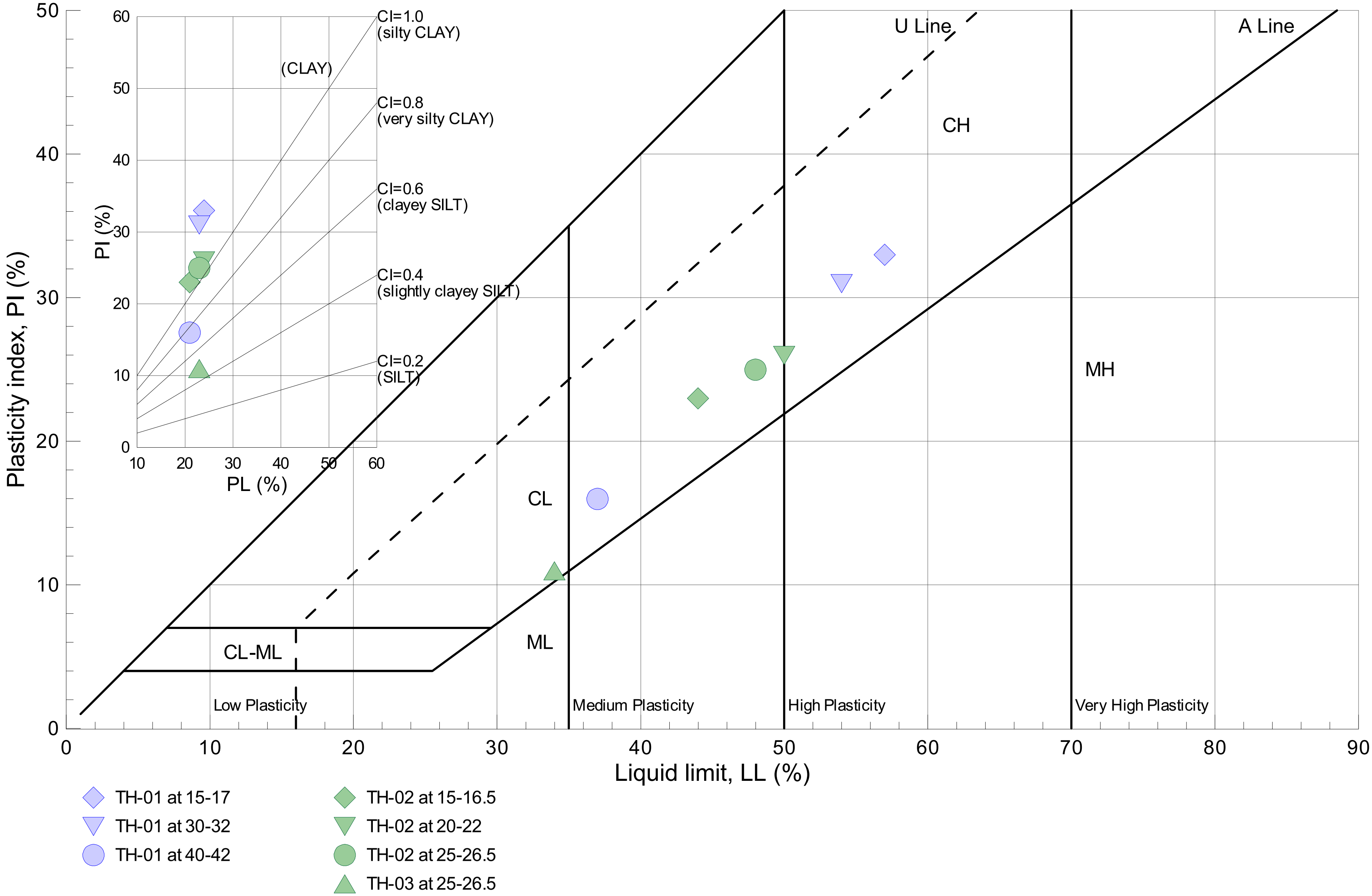
Grain-Size Analysis

Weber County Watershed Protection (12GCI270)

Figure 3-1



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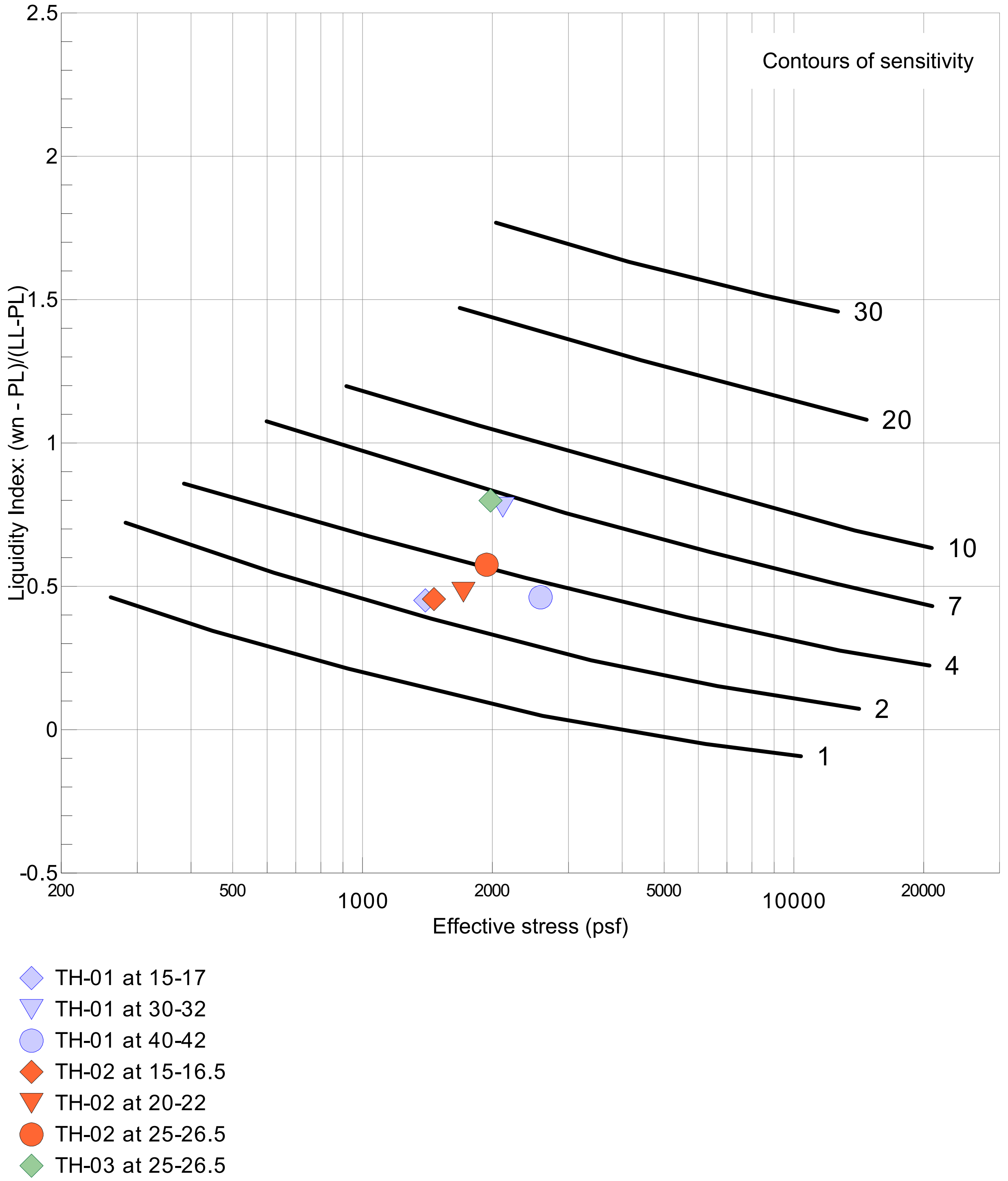
Casagrande's Plasticity Chart (Atterberg Limits)

Weber County Watershed Protection (12GCI270)

Figure 3-2



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Sensitivity, LI, and Effective Stress Relationships (Mitchell,1993)

Weber County Watershed Protection (12GCI270) | Figure 3-3

4.1 GENERAL

This section summarizes characterization of the levee and foundation materials at the three sites located along the Lower Weber River. Data was collected from five (5) test holes completed during our field studies. Field observations and measurements were coupled with laboratory testing to interpret existing site conditions.

As stated in Section 1.1, the project is located at three sites along the Lower Weber River in Weber County, Utah. Test holes TH-01 and TH-02 were completed at Site 1 which is located on the main levee of the Lower Weber River on 7500 West, bordering the east side of the main sections of the Ogden Bay Waterfowl Management Refuge. Test hole TH-03 was completed at Site 2 which is located at approximately 500 North 5100 West where the Little Weber River Diversion Channel crosses under 5100 West. Test holes TH-04 and TH-05 were completed at Site 3 which is located approximately 2,000 feet to the east of 5100 West at the divergence of the Little Weber River Diversion Channel from the Lower Weber River.

4.2 SITE 1 (SOUTH RUN DIVERSION STRUCTURE)

4.2.1 Levee Materials

Near-surface materials along the levee consist of approximately 9 inches of silty gravel fill used to construct the levee road. Underlying the silty gravel materials, to depths of about 9 to 10 feet, is a medium stiff to stiff sandy clay fill layer.

4.2.2 Foundation Materials

Foundation materials underlying the levee fills consist of clay deposits interbedded with occasional to frequent fine-grained sand seams to a depth of about 50 feet. Below 50 feet, fine-grained sand was found to the maximum depth explored of 51.5 feet. SPT blow-counts generally suggest very soft to stiff clay deposits and very loose sand deposits. Atterberg limits indicate the clay deposits are moderately to highly plastic with plasticity index values ranging from 16 to 33 (see Figure 3-2). A considerable portion of the clay material can be considered slightly sensitive to sensitive; with sensitivity values ranging from 2 to 7 (see Figure 3-3).

4.3 SITE 2 (5100 WEST BOX CULVERT)

4.3.1 Fill Materials

Near surface soils consist of clayey gravel fill materials to a depth of about 7 feet. The fill materials at the location of test hole TH-03 can be attributed to trench backfill for an existing corrugate metal pipe that runs parallel to the east side of 5100 West. SPT blow-counts generally suggest loose granular fill material.

4.3.2 Foundation Materials

Foundation materials underlying the roadway fills consist of sand and silty sand deposits to a depth of about 21.5 feet. Below 21.5 feet, extending the maximum depth explored of 26.5 feet, clay deposits interbedded with occasional fine-grained sand seams were found. SPT blow-counts generally suggest medium stiff to stiff clay deposits and loose to medium dense granular deposits. Atterberg limits indicate the clay deposits are slightly plastic with a plasticity index value of 11 (see Figure 3-2). A considerable portion of the clay material can be considered sensitive; with a sensitivity value of about 7 (see Figure 3-3).

4.4 SITE 3 (LITTLE WEBER DIVERSION STRUCTURE)

4.4.1 Near-Surface Materials

Near-surface materials vary between test holes TH-04 and TH-05. In TH-04 the near-surface materials consist of about 9 inches of sandy clay topsoil overlying clay to a depth of about 5.5 feet. In TH-05 the near-surface materials consist of silt with fine sand lenses to a depth of about 11 feet. SPT blow-counts generally suggest soft to medium stiff clay and silt deposits.

4.4.2 Foundation Materials

Foundation materials underlying the near-surface clay and silt deposits consist of fine-grained sands to depths of about 25 feet. Below 25 feet, clay deposits interbedded with fine-grained sand seams were found to the maximum depth explored of 32 feet. SPT blow-counts generally suggest very soft to stiff clay deposits and very loose to loose granular deposits.

4.5 GROUNDWATER

Groundwater was found in all test holes ranging in depths from 6 feet below the ground surface at test hole TH-03 to 11 feet at test hole TH-05. Heaving/flowing conditions were noted in all Test Holes except TH-02, as evidenced either by material flowing into the augers or by the augers sinking into the underlying material when rod and plug were pulled for sampling. Fluctuations in ground water levels should be anticipated due to surface infiltration or other environmental changes.

5.1 STABILITY ANALYSES – SITE 1 (SOUTH RUN DIVERSION STRUCTURE)

Levee / Embankment stability analyses were performed to assess the factor of safety under existing conditions at the gate structure at Site 1 (South Run Diversion Structure) and to assess the factor of safety during rapid drawdown of the plunge pool water level prior to backfilling. These analyses were performed using SLOPE/W and the Morgenstern-Price method, which considers both force and moment equilibrium issues as part of the analyses. Groundwater levels were estimated based on data collected during our field studies. Stability analyses were performed for the following cases:

1. Existing Conditions – These analyses were used to provide stability estimates of existing conditions.

2. Rapid Drawdown – These analyses were used to provide stability estimates of conditions immediately following pumping and removal of water from plunge pool in preparation for backfill placement.

Cross Sections utilized in the analyses were based on elevation contours shown on the Ogden Bay Wildlife Management Area Repair Project preliminary plan set, South Run Structure Plan, Drawing Number C-4; as well as survey data provided by BCA.

5.1.1 Material Properties

A summary of material properties included in the modeling are provided in Table 5-1. Effective stress values were selected for the analyses. Material properties were developed using soil classification characteristics, laboratory test data including triaxial test results, SPT blow counts, and correlation data.

5.1.2 Existing Conditions Analyses

These analyses evaluated the slope stability of the existing levee / embankment at Site 1, specifically at the location of the existing diversion structure. As discussed in Section 4.2, underlying the levee fills we identified interbedded clay deposits to a depth of about 50 feet. Below 50 feet, fine-grained sand was found to the maximum depth explored of 51.5 feet. Based on the provided survey data and our field observations, we assumed that the existing diversion structure is founded on the native clay deposits and not on levee fill materials. We assumed the phreatic surface on the upstream side of the diversion structure to be near the top of the radial gate at approximate elevation 4210, with the phreatic surface on the downstream side to be near the concrete floor of the diversion structure at approximate elevation 4203. Based on the data collected during our field studies and from the provided survey data, we arrived at the slope geometry shown on Figure 5-1.

Accordingly, we performed limit equilibrium slope stability analyses using the computer program SLOPE/W to assist us in quantifying the stability of the existing levee slopes. A computed factor of safety of approximately 15.8 suggests the current levee configuration to be stable with acceptable factors of safety. Stability results are summarized in Table 5-2 and shown on Figure 5-1a.

5.1.3 Rapid Drawdown Analyses

We understand current project plans call for the plunge pool to be backfilled to an approximate elevation of 4200 feet. This will require placement of approximately 19 feet of granular backfill. In order to begin placing backfill, however, the existing phreatic surface on the downstream side of the diversion structure must first be drawn down to at least the approximate elevation of the bottom of plunge pool at 4181 feet. Our analyses were performed assuming the water will be rapidly drawn down and the pore pressures will not dissipate prior to placing backfill. These analyses, shown on Figure 5-2, represent the most critical period during construction; which is to say the period between the end of rapid drawdown of the phreatic surface and the beginning of backfill placement.

Accordingly, we performed limit equilibrium slope stability analyses using the computer program SLOPE/W to assist us in quantifying the slope stability of the levee slopes immediately following rapid drawdown of the phreatic surface. A computed factor of safety of approximately 4.9 suggests the levee configuration, during construction, to be stable with acceptable factors of safety. Stability results are summarized in Table 5-2 and shown on Figure 5-2a.

Given the acceptable factors of safety for both the Rapid Drawdown and Existing Conditions Analyses, no analyses were completed for the period following construction once the backfill has been placed and the piezometric surfaces return to pre-construction levels, as we believe this condition will be more stable than existing conditions.

Table 5-1 Stability Analysis Parameters (Static Stability Analyses)

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Site 1 (South Run Diversion Structure) - Existing Conditions & Rapid Drawdown

Materials Names	GeoStudio Material Zone	GeoStudio Names	Unit Weight (pcf)	Effective Friction Angle, ϕ' (degrees)	Effective Cohesive Strength, c' (psf)	Data Source
Concrete	Zone 1	Concrete	150.0	--	--	GCI Evaluation
Clay	Zone 2	CH	92.0	20.0	1000	GCI Evaluation, laboratory testing
Clay	Zone 3	CH (2)	92.0	20.0	1000	GCI Evaluation, laboratory testing
Clay	Zone 4	CL	88.0	23.5	800	GCI Evaluation, laboratory testing
Sand	Zone 5	SP	116.0	32.0	0	GCI Evaluation

Table 5-2: Stability Analysis Summary

Site 1 (South Run Diversion Structure)

Static Stability Analysis Model	Computed Factor of Safety	Figures
Existing Conditions	15.847	5-1a
Rapid Drawdown	4.886	5-2a

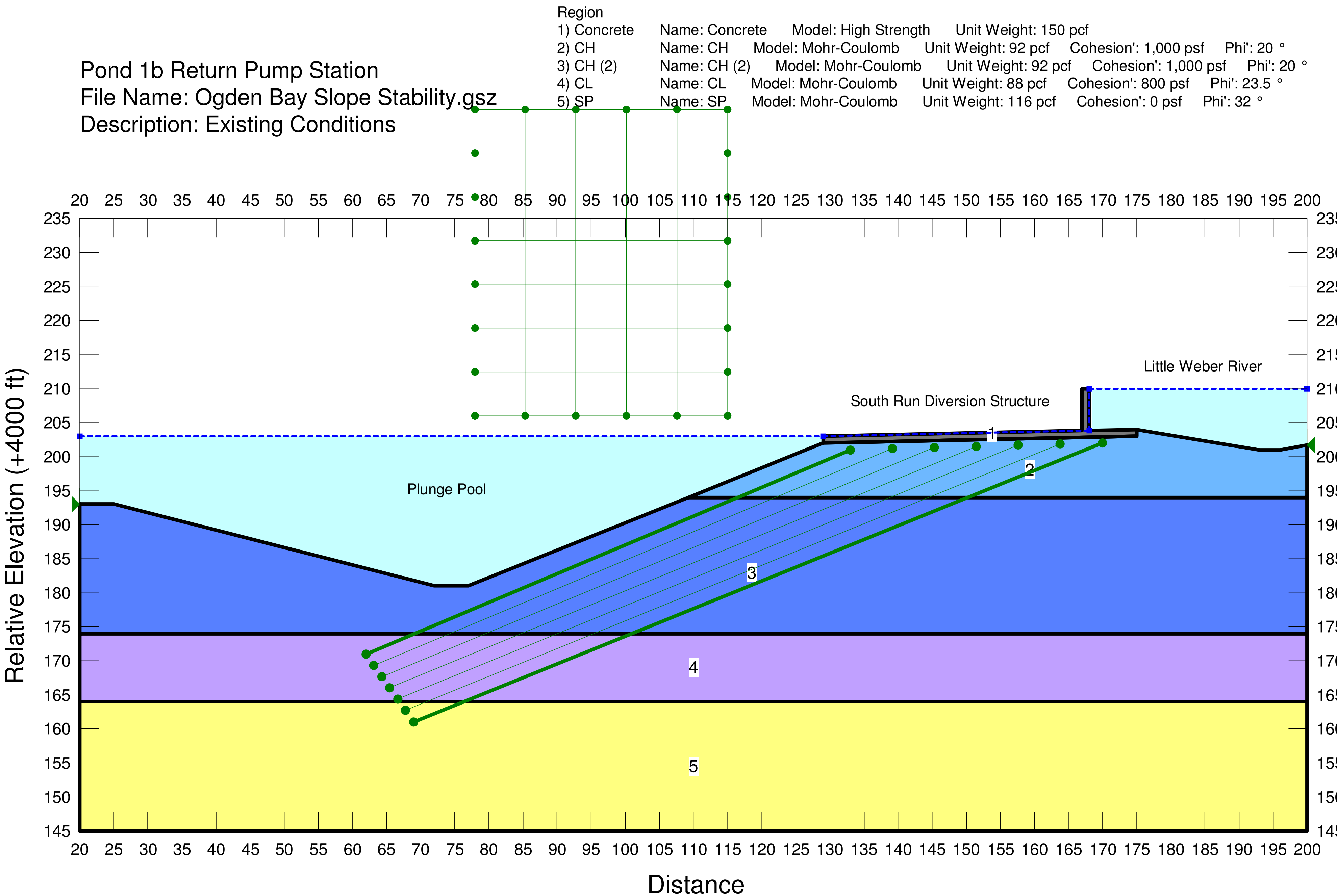
Pond 1b Return Pump Station
File Name: Ogden Bay Slope Stability.gsz
Description: Existing Conditions
Region
1) Concrete Name: Concrete Model: High Strength Unit Weight: 150 pcf
2) CH Name: CH Model: Mohr-Coulomb Unit Weight: 92 pcf Cohesion': 1,000 psf Phi': 20 °
3) CH (2) Name: CH (2) Model: Mohr-Coulomb Unit Weight: 92 pcf Cohesion': 1,000 psf Phi': 20 °
4) CL Name: CL Model: Mohr-Coulomb Unit Weight: 88 pcf Cohesion': 800 psf Phi': 23.5 °
5) SP Name: SP Model: Mohr-Coulomb Unit Weight: 116 pcf Cohesion': 0 psf Phi': 32 °
Little Weber River
South Run Diversion Structure
Plunge Pool
1
2
3
4
5
Relative Elevation (+4000 ft)
Distance

Figure 5-1

Pond 1b Return Pump Station
File Name: Ogden Bay Slope Stability.gsz
Description: Existing Conditions

Region	Name	Model	Unit Weight	Cohesion'	Phi'
1) Concrete	Name: Concrete	Model: High Strength	Unit Weight: 150 pcf		
2) CH	Name: CH	Model: Mohr-Coulomb	Unit Weight: 92 pcf	Cohesion': 1,000 psf	Phi': 20 °
3) CH (2)	Name: CH (2)	Model: Mohr-Coulomb	Unit Weight: 92 pcf	Cohesion': 1,000 psf	Phi': 20 °
4) CL	Name: CL	Model: Mohr-Coulomb	Unit Weight: 88 pcf	Cohesion': 800 psf	Phi': 23.5 °
5) SP	Name: SP	Model: Mohr-Coulomb	Unit Weight: 116 pcf	Cohesion': 0 psf	Phi': 32 °

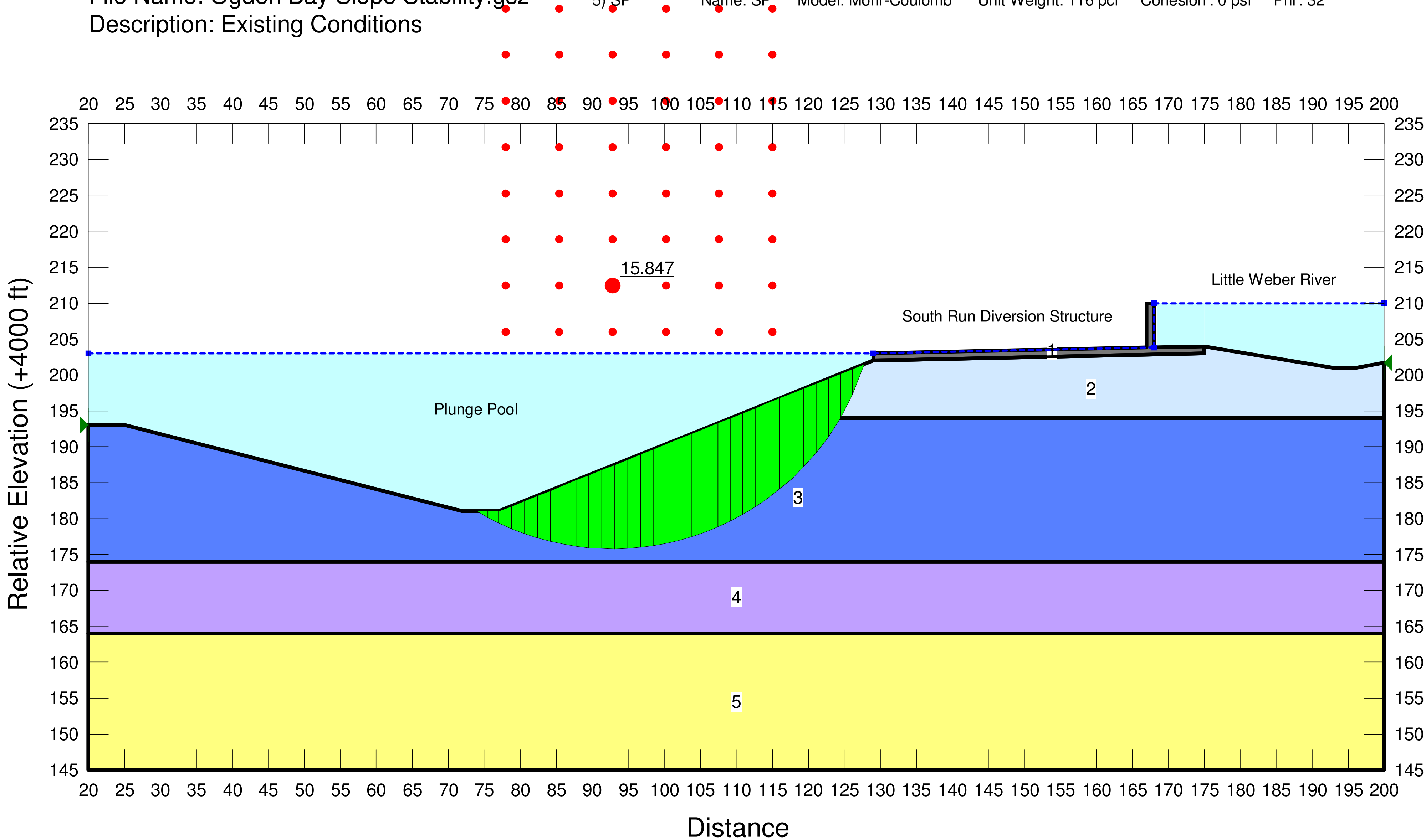

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Figure 5-1a

Pond 1b Return Pump Station
File Name: Ogden Bay Slope Stability.gsz
Description: Rapid Drawdown

Region	Name	Model	Unit Weight	Cohesion'	Phi'
1) Concrete	Name: Concrete	Model: High Strength	Unit Weight: 150 pcf		
2) CH	Name: CH	Model: Mohr-Coulomb	Unit Weight: 92 pcf	Cohesion': 1,000 psf	Phi': 20 °
3) CH (2)	Name: CH (2)	Model: Mohr-Coulomb	Unit Weight: 92 pcf	Cohesion': 1,000 psf	Phi': 20 °
4) CL	Name: CL	Model: Mohr-Coulomb	Unit Weight: 88 pcf	Cohesion': 800 psf	Phi': 23.5 °
5) SP	Name: SP	Model: Mohr-Coulomb	Unit Weight: 116 pcf	Cohesion': 0 psf	Phi': 32 °

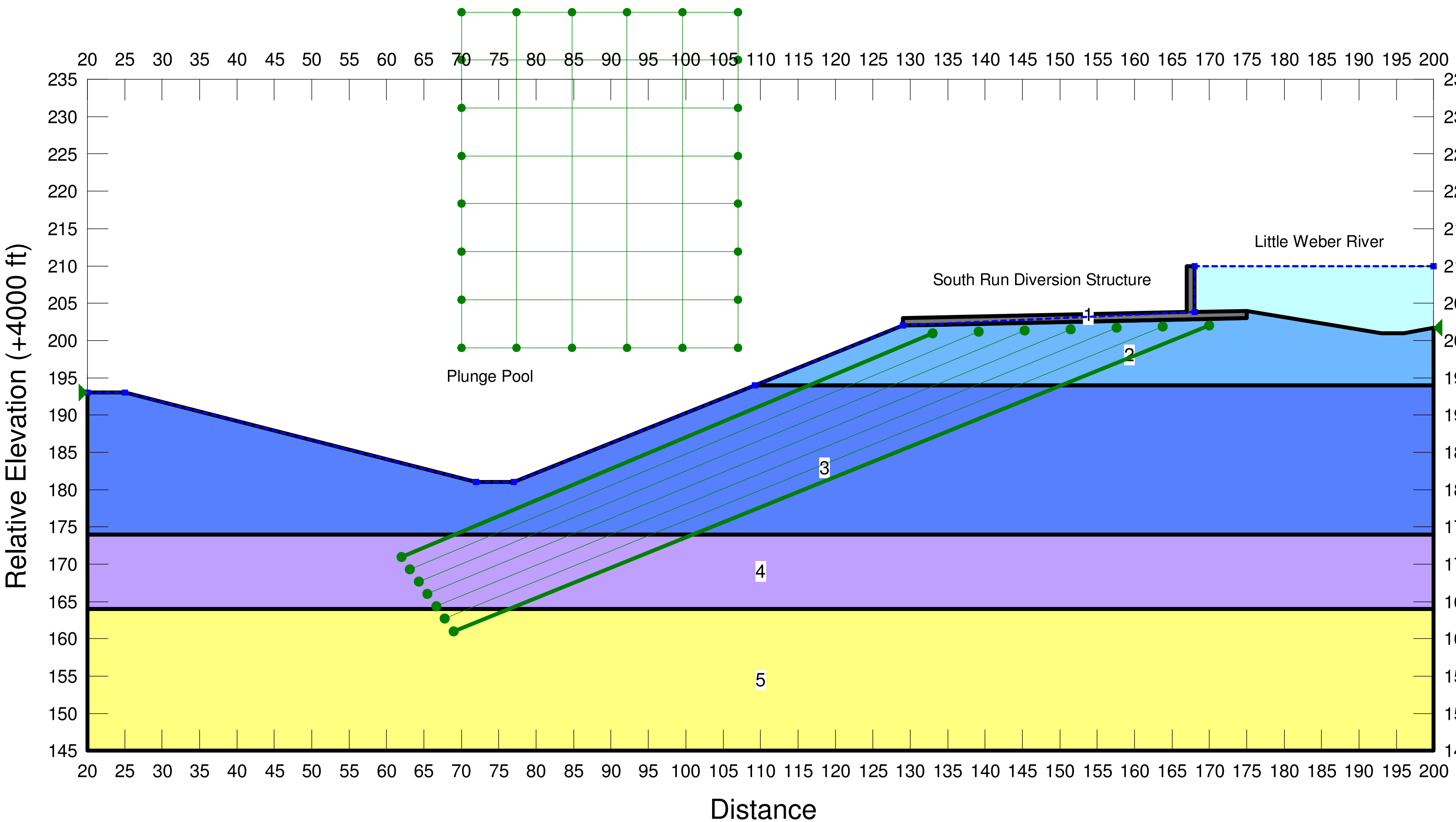

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Figure 5-2

Pond 1b Return Pump Station
File Name: Ogden Bay Slope Stability.gsz
Description: Rapid Drawdown

Region	Name	Model	Unit Weight	Cohesion'	Phi'
1) Concrete	Name: Concrete	Model: High Strength	Unit Weight: 150 pcf		
2) CH	Name: CH	Model: Mohr-Coulomb	Unit Weight: 92 pcf	Cohesion': 1,000 psf	Phi': 20 °
3) CH (2)	Name: CH (2)	Model: Mohr-Coulomb	Unit Weight: 92 pcf	Cohesion': 1,000 psf	Phi': 20 °
4) CL	Name: CL	Model: Mohr-Coulomb	Unit Weight: 88 pcf	Cohesion': 800 psf	Phi': 23.5 °
5) SP	Name: SP	Model: Mohr-Coulomb	Unit Weight: 116 pcf	Cohesion': 0 psf	Phi': 32 °

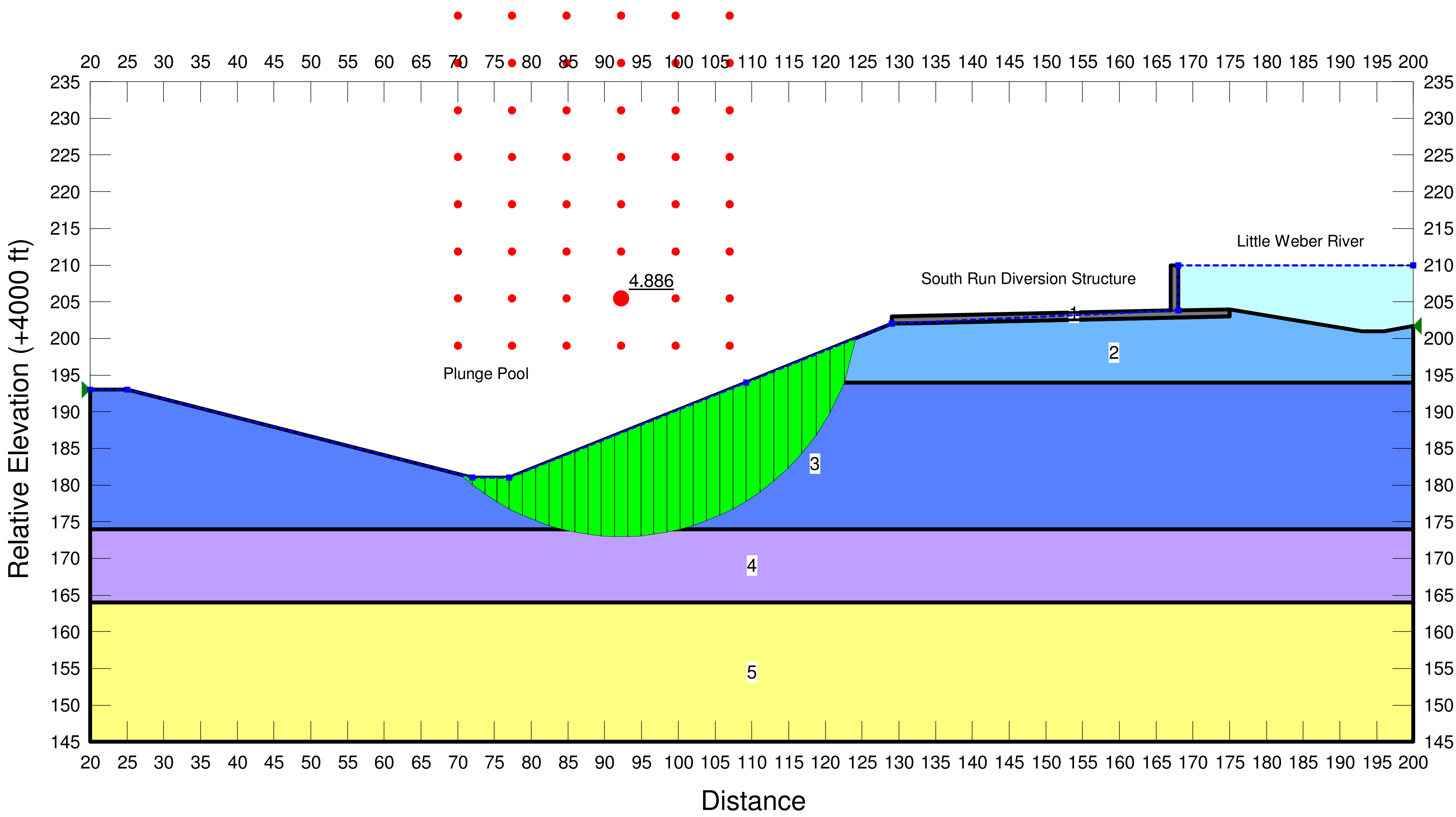

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Figure 5-2a

6.1 GENERAL

1. Stability modeling for Site 1 (South Run Diversion Structure) suggests the existing levee and embankments are stable in their existing configuration. During rapid drawdown of ponded water, as is anticipated during construction of the new diversion structure and during placement of fill in the plunge pool, stability modeling suggests the existing levee and embankments will remain stable.

2. We understand that current project plans for Site 1 call for backfill to be placed in the plunge pool to an approximate finished elevation of 4200 feet. Based on the results of our stability analyses, we conclude that backfill could be placed to a lower finished elevation while still maintaining long-term stability of the levee and thus provide a cost savings benefit to the project. However, we recommend that riprap and/or other erosion control measures be properly designed and constructed in the plunge pool to mitigate continued erosion and scour of the plunge pool, as continued uncontrolled erosion could lead to future instability of the levee.

6.2 GEOTECHNICAL DESIGN CRITERIA – SITE 1 (SOUTH RUN DIVERSION STRUCTURE)

6.2.1 Subgrade Preparation

All vegetation, topsoil, fill materials, debris, and other unsuitable materials should be removed prior to bringing the site to grade. Due to the presence of soft clays, additional subgrade preparation will be needed beneath structures. Native materials should be removed an additional 12 inches below final bottom grades. Exposed areas should then be proof-rolled with heavy rubber-tired equipment such as a loaded scraper or front-end loader. Any soft or loose areas identified during this process should be either, compacted, removed and replaced, or stabilized. Once subgrade preparation is complete, the site can be brought to final grade.

Within the plunge pool area, we anticipate the very soft to soft clay soils will limit the use of rubber-tired equipment until the subgrade is stabilized. Pit run material should be placed over the soft subgrade materials in maximum 12-inch lifts and statically rolled or compacted until a stable subgrade is constructed.

6.2.2 Structural Fill and Compaction

All fill placed for the support of structures or flatwork should consist of structural fill. Structural fill should consist of reasonably graded sand and gravels with a maximum size of 3-inches and fines content (minus No. 200 sieve size) less than 30 percent.

Structural fill should be placed in maximum 10-inch lifts (prior to compaction). Lift thickness should be decreased to 6-inches in areas where lighter compaction equipment is used. Soils in compacted fills beneath all footings and slabs-on-grade should be compacted to 100 percent maximum dry density (MDD) in accordance with ASTM D698 and at moisture contents near that considered optimum for compaction.

Backfill around foundation walls should be compacted to 95 percent MDD (ASTM D698). Small compaction equipment should be used near foundation walls to minimize the potential for wall damage and deflections; and to ensure that soil compaction around vertical walls, intended to impede subsurface water flows (i.e. cutoff walls), is adequately performed. Construction management personnel should be specifically instructed to carefully observe this work.

All fill placed to backfill the plunge pool area should consist of pit run material. Once the subgrade has been stabilized (see Section 6.3.1), the pit run material should be placed in maximum 12-inch lifts (prior to compaction). Pit run material should be placed to within 2 feet of finished grade to allow for placement of rip-rap material. Pit run material should be compacted by making four (4) to six (6) passes with a heavy dozer or other appropriate compaction equipment. Rip-rap material should be sized appropriately by the designer to mitigate future erosion of the plunge pool area.

6.2.3 Excavation and Dewatering

Our field studies revealed soft, saturated clay material near the elevation of the bottom of the proposed diversion structure. Furthermore, very soft to soft saturated clay material was found near the elevation of the existing bottom of the plunge pool. The contractor and designer should be aware that specialized excavation equipment may be needed for effective subgrade preparation and excavation.

Groundwater was found within planned excavation depths and will likely experience periodic fluctuations associated with precipitation and flows of the nearby canal and Lower Weber River. The contractor should be aware that dewatering will be needed during construction. We anticipate groundwater levels will need to be lowered on the order of 20 to 25 feet and a minimum of 2 feet below the base of excavations during construction. Dewatering systems should be designed to prevent migration of finer materials, quick conditions, and subgrade softening.

Temporary slopes and/or shoring will be needed for construction. Proper shoring and trench boxes should be used where appropriate. Shoring trench boxes should be designed to restrain lateral loads resulting from the soil mass, groundwater, surcharge from construction equipment and other applicable loads; and care should be taken to maintain stability of excavations during construction. Stockpile and excavated materials should be kept a minimum of 5 feet away from the top of shoring elements or temporary slopes.

Temporary slopes in sand/gravel materials less than 15 feet in depth may be constructed at 2.0 Horizontal to 1.0 Vertical (2.0H:1.0V) or flatter; temporary slopes in clays may be constructed at 1.5H:1.0V or flatter. *Groundwater levels should be maintained a minimum of 2 feet below the base of excavation while excavations are open.* Temporary shoring/trench boxes and/or significantly flatter slopes should be used when dewatering cannot achieve the 2 feet minimum. These areas should be evaluated on a case-by-case basis by a qualified geotechnical engineer during construction.

The contractor should rely upon his own methods to determine and maintain safe and stable slopes during construction subject to his particular construction procedures and to those subsurface conditions more fully exposed during construction. All excavations should comply at a minimum with the Occupational Safety and Health Administration's (OSHA) construction standards for excavations and any other applicable standards. All excavations should be observed by qualified personnel. The Contractor is ultimately responsible for trench and site safety.

6.2.4 Load Induced Settlement

Consolidation analyses performed for the South Run Diversion Structure suggests foundation clay materials are slightly over consolidated. Consolidation is a process where a soil decreases in volume as stresses are applied. For a saturated fine-grained (clay or silt) soil, excess pore water pressure is generated by applied stresses and begins to dissipate in a time dependent manner. Consolidation processes can take from several months to several years depending upon factors such as the thickness of fine-grained layers and values of hydraulic conductivity (k).

Settlement analyses were performed using the software program Settle3D v2.0 (RocScience, 2010). Generalized fill geometries based on project plans and survey data provided by BCA were used to assess settlement potential of the proposed diversion structure. We assessed settlement potential of the diversion structure using both flexible and rigid loading conditions. However, based on structural designs provided by BCA (which show the diversion structure to include an 18-inch thick reinforced concrete bottom slab, a bridge, 5 foot deep cutoff walls, and several vertical walls) we believe the diversion structure will act as a rigid structure. Our settlement estimates provided below are based on our assumption of using a rigid foundation. We estimated the total dead load from the diversion structure to be about 600 psf, which is the value used in our analyses. We also assumed the center of mass of the structure to be near the center of the embankment. *If actual structural loads are calculated to be greater than the values assumed for our analyses or if the structure will be eccentrically loaded, we recommend that additional settlement analyses be performed to re-evaluate post construction settlement and differential settlement and their associated risks*.

Based on the results of our analyses, we estimate post-construction structure settlement to be about 2.1 inches (± 0.5 inches) if the diversion structure is constructed directly on the native materials (i.e., no structural fill). In order to minimize the potential for post-construction settlement, we evaluated over-excavating and replacing the native materials with between 1 and 6 feet of structural fill beneath the diversion structure. Results of our settlement analyses are summarized on Table 6-1.

6.2.5 Lateral Earth Pressures

Lateral earth pressures on structures are influenced by many factors including the type and depth of the structure, soils and backfill adjacent to the structure, allowable structure movement, hydrostatic pressures and surcharge loads. Below grade elements, such as the planned diversion structure walls, are usually designed assuming soil stresses on them from adjacent soils and fill can be approximated by triangular soil stress distributions. We believe that approximation could be used for the planned facilities.

"At rest" lateral earth pressures are generally assumed for buried structural elements that are designed for little or no movement. Elements that can move or deflect sufficiently to develop the strength of the soils and backfill behind the wall can be designed assuming "active" lateral earth pressures for structures. A movement or rotation equal to about 0.1 percent of the buried depth of the element is usually considered to be required to develop lateral earth pressures adjacent to sands and gravels. Passive lateral earth pressures are generally assumed to resist structure movement. Structure movements of at least 2 percent of the buried depth of the structure element are generally required to develop full passive lateral earth pressures. Approximately 50 percent of full passive pressures are developed at movements corresponding to about 0.5 percent of the buried depths.

If backfill adjacent to buried structural members consists of reasonably well graded sands and gravels (structural fill materials), we suggest structures be designed assuming coefficients of static at-rest (k_0), active (k_a), passive (k_p) lateral earth pressures of 0.5, 0.3, and 3.3, respectively. We recommend assuming a moist backfill unit weight of 130 pcf and a coefficient of sliding friction of 0.5 be used for design purposes. Hydrostatic pressures and surcharge loads should be added to lateral earth pressures as applicable. Appropriate factors of safety should also be applied to lateral earth pressure designs.

6.3 GEOTECHNICAL DESIGN CRITERIA – SITE 2 (5100 WEST BOX CULVERT)

6.3.1 Subgrade Preparation

All vegetation, topsoil, asphalt pavement, fill materials, debris, and other unsuitable materials should be removed prior to bringing the site to grade. Due to the presence of loose sands, additional subgrade preparation will be needed beneath structures. Native materials should be excavated out an additional 12 inches below final bottom grades. Exposed areas should then be proof-rolled with heavy rubber-tired equipment such as a loaded scraper or front-end loader. Any soft or loose areas identified during this process should be either, compacted, removed and replaced, or stabilized. Once subgrade preparation is complete, the site can be brought to final grade.

6.3.2 Structural Fill and Compaction

All fill placed for the support of structures or flatwork should consist of structural fill. Structural fill should consist of reasonably graded sand and gravels with a maximum size of 3-inches and fines content (minus No. 200 sieve size) less than 25 percent.

Structural fill should be placed in maximum 10-inch lifts (prior to compaction). Lift thickness should be decreased to 6-inches in areas where lighter compaction equipment is used. Soils in compacted fills beneath all footings, box culverts and slabs-on-grade should be compacted to 100 percent maximum dry density (MDD) in accordance with ASTM D698 and at moisture contents near that considered optimum for compaction.

Backfill around foundation and box culvert walls should be compacted to 95 percent MDD (ASTM D698). Small compaction equipment should be used near foundation and box culvert walls to minimize the potential for wall damage and deflections.

6.3.3 Excavation and Dewatering

Our field studies revealed loose, saturated sand material near the elevation of the bottom of the proposed diversion structure. The contractor and designer should be aware that specialized excavation equipment may be needed for effective subgrade preparation and excavation.

Groundwater was found within planned excavation depths and will likely experience periodic fluctuations associated with precipitation and flows of the Little Weber Cutoff Channel and Lower Weber River. The contractor should be aware that dewatering will be needed during construction. We anticipate that dewatering will be required outside the excavation areas and that groundwater levels should be maintained a minimum of 2 feet below the base of excavations during construction. Furthermore, flowing sands were found at a depth of about 10 feet below the top of pavement elevation and should be anticipated in deeper excavations. Dewatering systems should be designed to prevent migration of finer materials, quick conditions, and subgrade softening.

Temporary slopes and/or shoring will be needed for construction. Proper shoring and trench boxes should be used where appropriate. Shoring trench boxes should be designed to restrain lateral loads resulting from the soil mass, groundwater, surcharge from construction equipment and other applicable loads; and care should be taken to maintain stability of excavations during construction. Stockpile and excavated materials should be kept a minimum of 5 feet away from the top of shoring elements or temporary slopes.

Temporary slopes in sand/gravel materials less than 10 feet in depth may be constructed at 2.0 Horizontal to 1.0 Vertical (2.0H:1.0V) or flatter; temporary slopes in clays may be constructed at 1.5H:1.0V or flatter. *Groundwater levels should be maintained a minimum of 2 feet below the base of excavation while excavation is open.*

Temporary shoring/trench boxes and/or significantly flatter slopes should be used when dewatering cannot achieve the 2 feet minimum or where flowing sands are encountered. These areas should be evaluated on a case-by-case basis by a qualified geotechnical engineer during construction.

The contractor should rely upon his own methods to determine and maintain safe and stable slopes during construction subject to his particular construction procedures and to those subsurface conditions more fully exposed during construction. All excavations should comply at a minimum with the Occupational Safety and Health Administration's (OSHA) construction standards for excavations and any other applicable standards. All excavations should be observed by qualified personnel. The Contractor is ultimately responsible for trench and site safety.

6.3.4 Load Induced Settlement

Settlement analyses were performed using the software program Settle3D v2.0 (RocScience, 2010). Based on information provided by BCA, we evaluated load induced settlement for 4'x12' box culverts installed at a depth of about 7.5 feet. Typical box culvert weights of about 5800 lbs/ft (obtained from manufacturer's data) were used in our analyses. Based on the results of our analyses, box culverts constructed using the recommendations contained in this report are expected to experience total settlements less than 1-inch and differential settlements less than ½-inch over a distance of 25 feet.

6.3.5 Lateral Earth Pressures

Lateral earth pressures on structures are influenced by many factors including the type and depth of the structure, soils and backfill adjacent to the structure, allowable structure movement, hydrostatic pressures and surcharge loads. Below grade elements, such as the planned box culvert walls, are usually designed assuming soil stresses on them from adjacent soils and fill can be approximated by triangular soil stress distributions. We believe that approximation could be used for the planned facilities.

"At rest" lateral earth pressures are generally assumed for buried structural elements that are designed for little or no movement. Elements that can move or deflect sufficiently to develop the strength of the soils and backfill behind the wall can be designed assuming "active" lateral earth pressures for structures. A movement or rotation equal to about 0.1 percent of the buried depth of the element is usually considered to be required to develop lateral earth pressures adjacent to sands and gravels. Passive lateral earth pressures are generally assumed to resist structure movement. Structure movements of at least 2 percent of the buried depth of the structure element are generally required to develop full passive lateral earth pressures. Approximately 50 percent of full passive pressures are developed at movements corresponding to about 0.5 percent of the buried depths.

If backfill adjacent to buried structural members consists of reasonably well graded sands and gravels (structural fill materials), we suggest structures be designed assuming coefficients of static at-rest (k_0), active (k_a), passive (k_p) lateral earth pressures of 0.5, 0.3, and 3.3, respectively. We recommend assuming a moist backfill unit weight of 130 pcf and a coefficient of sliding friction of 0.5 be used for design purposes. Hydrostatic pressures and surcharge loads should be added to lateral earth pressures as applicable. Appropriate factors of safety should also be applied to lateral earth pressure designs.

6.4 LIMITATIONS

Professional judgments on subsurface conditions and analysis conclusions are presented in this report. These are based partly on our evaluations of technical information, partly on geotechnical studies performed by us, and partly on our general experience with projects with similar subsurface conditions.

Gerhart Cole Inc. represents that our services are performed within the limitations prescribed by the Client in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances at the time this report was prepared. No other representation to the Client, is expressed or implied, and no warranty or guarantee is included or intended.

It is the Client's responsibility to see that all parties to the project including the designer, contractor, subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

Table 6-1 Settlement Analyses Summary

Site 1 (South Run Diversion Structure)

Structural Fill Thickness (feet)	Settlement (inches)
0.0	2.1 ± 0.5
1.0	1.8 ± 0.5
2.0	1.6 ± 0.5
3.0	1.4 ± 0.5
4.0	1.2 ± 0.5
5.0	1.1 ± 0.5
6.0	1.0 ± 0.5

GEO-SLOPE (2007). Seepage Modeling with SLOPE/W and Engineering Methodology, Geo-Slope International Ltd., 3rd Ed.

RocScience (2010). Settlement and Consolidation Analyses with Settle3D, RocScience Inc., Version 2.0.

Weber County (2012). Request for Proposals for Consultant Services, Weber County Emergency Watershed Protection Project on the Weber River.

APPENDIX A

WEBER COUNTY WATERSHED PROTECTION

LABORATORY DATA

GERHART COLE INC.
GEOTECHNICAL ENGINEERS

Triaxial Test - Isotropic Consolidated Sheared Undrained Measuring Pore Pressure (CIU-PP) - *After ASTM D4767 and USBR 5750*

GERHART COLE INC.

Project: Weber County Watershed Prot. **TH/TP/Sample:** TH-02
No: 12GCI270 **Depth:** 20-22 (20.5-20.9 portion)
Location: Weber County Sample descrition: (CL)
Date: 28-Feb-13 USCS classification: not requested
Tested by: db Sample type: Relative undisturbed Shelby Tube
Reduced by: rtc
Checked by: rtc

		Test Number	S1	45 psi	S2	20 psi
			Initial	Bef. Shr. MethodB [e]	Initial	Bef. Shr. MethodB [e]
Unit weight data	Sample ht., H (in)	0°	5.530		6.420	
		120°	5.540		6.416	
		240°	5.530		6.409	
	Avg. height, Havg (in)		5.533	5.393	6.415	6.384
	Avg. height, Havg (cm)		14.055	13.699	16.294	16.215
	ΔHsc (in) [a]			0.14		0.031
	Sample dia., D (in)	top	2.850		2.850	
		mid	2.840		2.850	
		bot	2.830		2.830	
	Avg. dia., Davg (in)		2.840	2.848	2.845	2.822
	Avg. dia., Davg (cm)		7.214	7.233	7.226	7.168
	Avg. area, Aavg (in^2)		6.335	6.368	6.357	6.255
	Avg. area, Aavg (cm^2)		40.869	41.086	41.013	40.355
	Wt. rings + wet soil (g)		1074.98	1051.47	1225.36	1211.93
	Wt. rings (g)		0.00	0.00	0.00	0.00
	Volume, Vo (in^3)		35.1	34.3	40.8	39.9
	Vo (cm^3)		574.4	562.8	668.3	654.3
	Vo (ft^3)		0.0203	0.0199	0.0236	0.0231
	ΔV Method A	ΔVs (cm^3) [b]				
		ΔVc (cm^3) [b]				
Moisture	Wet soil + tare (g)		373.42	1196.26	197.00	1361.35
	Dry soil + tare (g)		317.05	938.46	184.50	1060.60
	Tare (g)		145.28	145.31	144.50	150.63
	Moisture content, w (%)		32.8	32.5	31.3	33.1
Phase Relationships	Gs, assumed		2.70	2.70	2.70	2.70
	Mass total (g)		1075.0	1072.4	1225.4	1242.2
	Mass of solids (g)		809.4	809.4	933.6	933.6
	Volume (cm^3)		574.4	562.8	668.3	654.3
	Volume of water (cm^3)		265.6	263.1	291.8	308.6
	Volume of solids (cm^3)		299.8	299.8	345.8	345.8
	Volume of voids (cm^3)		274.6	263.1	322.5	308.6
	Volume of air (cm^3)		9.0	0.0	30.7	0.0
	Void ratio, e		0.916	0.878	0.933	0.892
	Porosity, n		0.478	0.467	0.483	0.472
	Volumetric moisture, T		0.462	0.467	0.437	0.472
	Saturation, S (%) [c]		96.71	100.00	90.47	100.00
	Dry density (gm/cm^3)		1.409	1.438	1.397	1.427
	Wet unit wt., gm (pcf)		116.8	119.0	114.5	118.5
	Dry unit wt., gd (pcf)		88.0	89.8	87.2	89.1

Notes:

[a] ΔHsc (in) = change in height during saturation and consolidation

[b] ΔVs = change in volume during saturation, ΔVc = change in volume during conso

[c] Saturation before shear set to 100% for phase calculations

[d] Before shear Aavg using method A; where Ac (Method A) = (Vo-DVs - DVc)/(Ho-

[e] Before shear Aavg using method B; where Ac (Method B) = (Vwf + Vs)/Hc

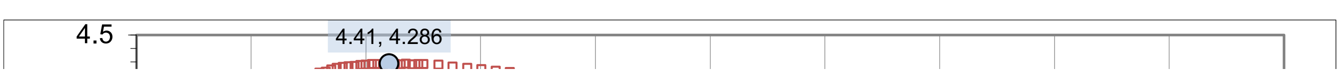
Triaxial Test - Isotropic Consolidated Sheared Undrained
Measuring Pore Pressure (CIU-PP) *- After ASTM D4767 and USBR 5750*

GERHART COLE INC.

Project:	**Weber County Watershed Prot.**	**TH/TP/Sample:**	**TH-02**
No:	**12GCI270**	**Depth:**	**20-22 (20.5-20.9 portion)**
Location:	Weber County	Sample descrition:	(CL)
Date:	28-Feb-13	USCS classification:	not requested
		Sample type:	Relative undisturbed Shelby Tul

Test Number		S1 at 45 psi	S2 at 20 psi
Test information	Total backpressure (psi)	45.0	50.0
	Skempton B	0.97	0.96
	t-90 (min)	67.5	105.3
	t-100 (min)	97.5	155.3
	t-50 (min)	15.8	24.6
	Strain rate (%/hr)	1.20	1.20
	Strain rate (%/min)	0.02	0.02
	Membrane correction	Yes	Yes
	Filter paper correction	No filter paper	No filter paper
Max principal stress ratio (s1/s3), failure criteria	Strain at failure, ef (%)	8.68	4.41
	Time to failure, tf (min)	434.2	220.4
	Obliquity, s'1/s'3	3.245	4.286
	Excess pore pressure, u (psi)	25.33	9.81
	q = q' = (s1+s3)/2 (psi)	20.59	13.99
	p' = (s'1+s'3)/2 (psi)	38.93	22.51
	p = (s1+s3)/2 (psi)	64.26	32.32
	Effective major principal stress, s'1 (psi)	59.52	36.50
	Effective minor principal stress, s'3 (psi)	18.34	8.52
	Total major pincipal stress, s1 (psi)	84.85	46.31
	Total minot pincipal stress, s3 (psi)	43.67	18.33
	Skemption A at failure, Af	0.62	0.35
	Secant friction angle, phi-s (deg)	31.9	38.4
		Effective stress	Total stress
	Friction angle, phi (deg)	23.7	11.9
	Cohesion intercept, c (psi)	5.4	7.5
Peak deviator stress (s1-s3), failure criteria	Strain at failure, ef (%)	7.41	7.52
	Time to failure, tf (min)	370.3	375.8
	Deviator stress, s1-s3 (psi)	41.31	29.06
	Excess pore pressure, u (psi)	25.13	9.15
	q = q' = (s1+s3)/2 (psi)	20.65	14.53
	p' = (s'1+s'3)/2 (psi)	39.08	23.72
	p = (s1+s3)/2 (psi)	64.21	32.86
	Effective major principal stress, s'1 (psi)	59.73	38.25
	Effective minor principal stress, s'3 (psi)	18.43	9.19
	Total major pincipal stress, s1 (psi)	84.86	47.39
	Total minot pincipal stress, s3 (psi)	43.56	18.33
	Skemption A at failure, Af	0.61	0.31
	Secant friction angle, phi-s (deg)	31.9	37.8
		Effective stress	Total stress
	Friction angle, phi (deg)	23.5	11.3
	Cohesion intercept, c (psi)	5.5	8.3

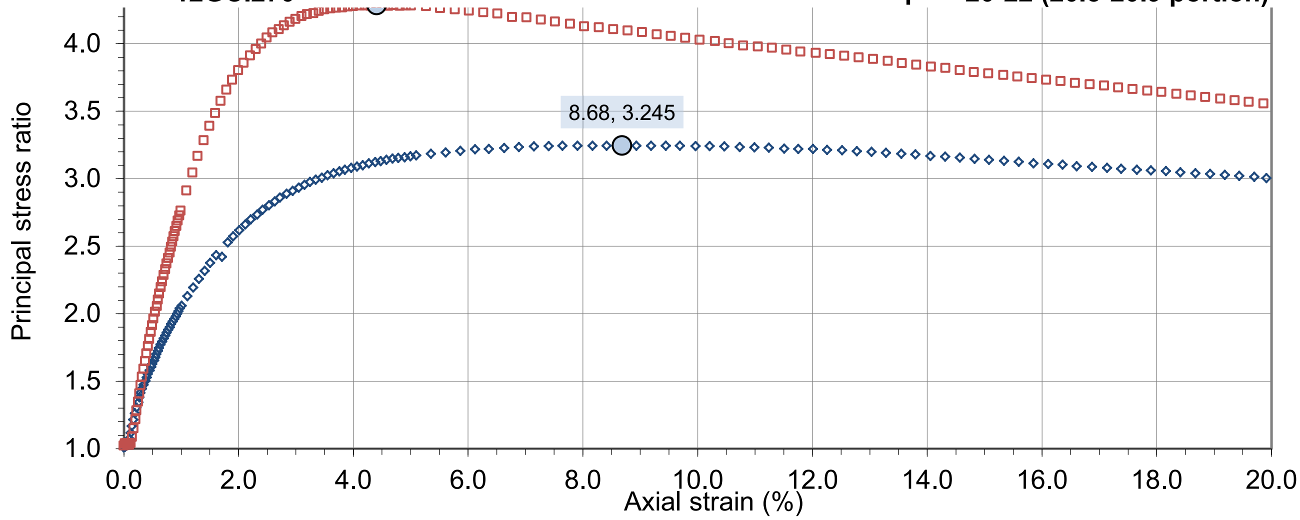
Comments:

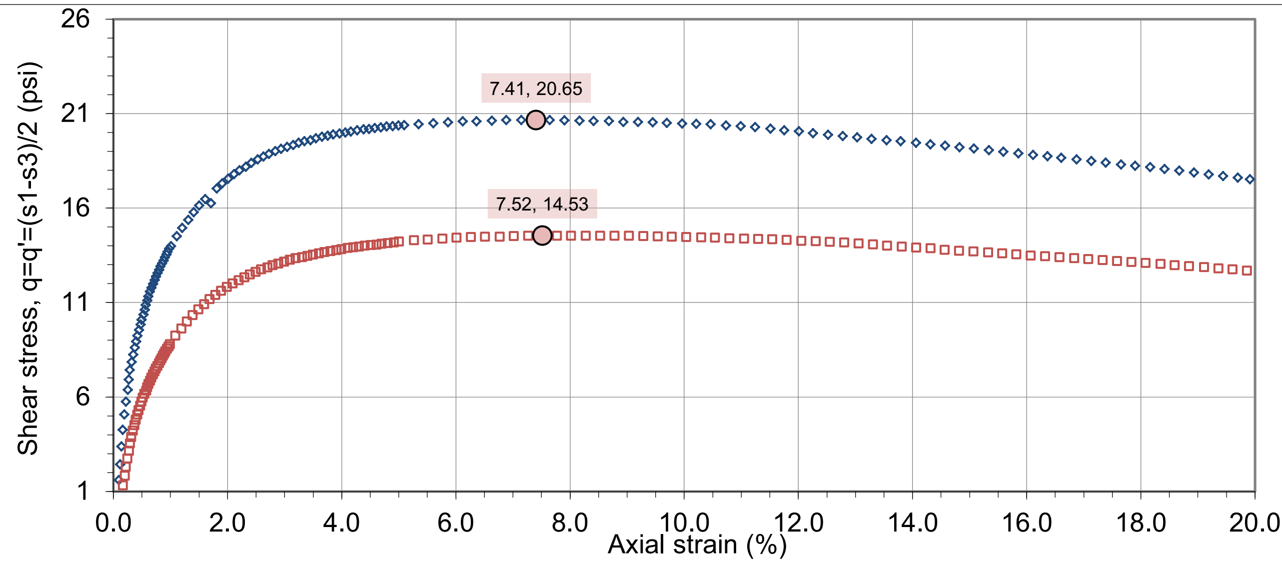


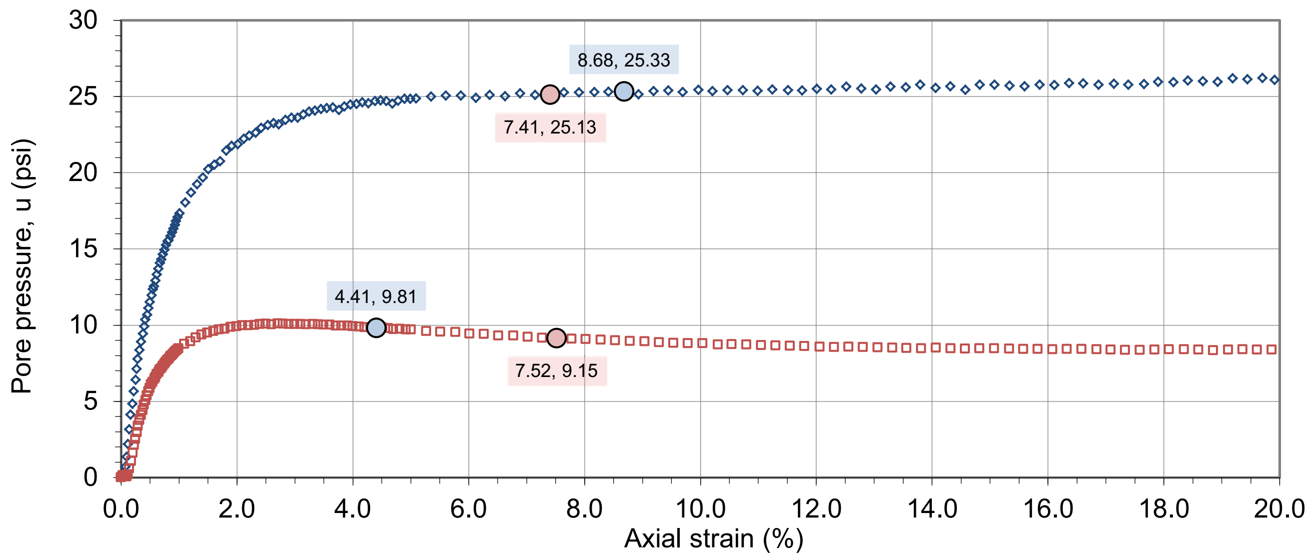
Triaxial Test - Isotropic Consolidated Sheared Undrained
Measuring Pore Pressure (CIU-PP) *- After ASTM D4767 and USBR 5750*

Project: Weber County Watershed Prot. **TH/TP/Sample: TH-02**

No: 12GCI270 **Depth: 20-22 (20.5-20.9 portion)**





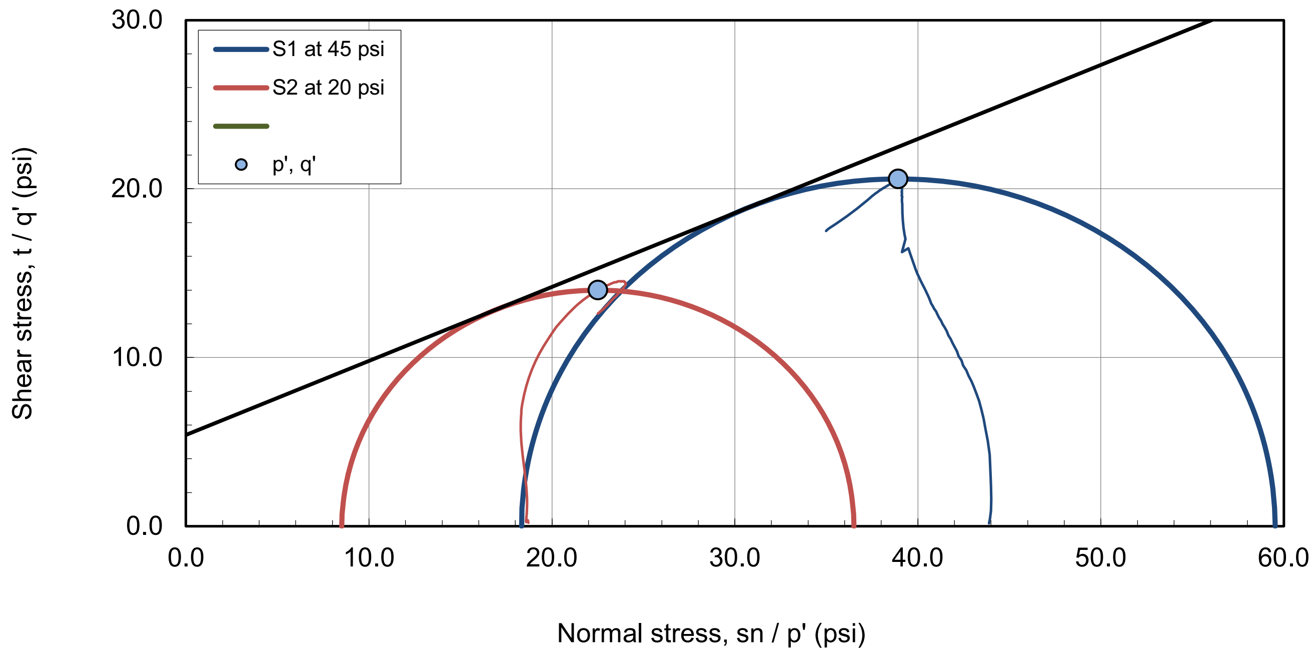


Triaxial Test - Isotropic Consolidated Sheared Undrained
Measuring Pore Pressure (CIU-PP) *- After ASTM D4767 and USBR 5750*

GERHART COLE INC.

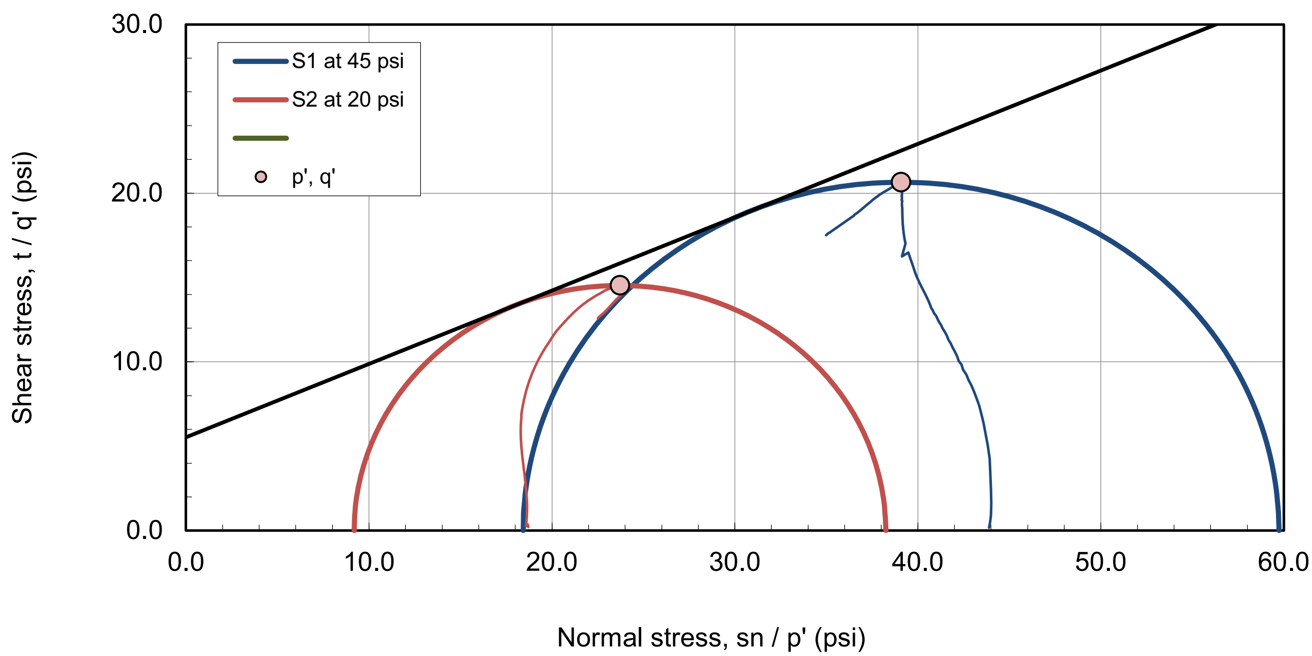
Project: **Weber County Watershed Prot.** **TH/TP/Sample:** **TH-02**
No: **12GCI270** **Depth:** **20-22 (20.5-20.9 portion)**

Effective stress results



Max principal stress ratio (s'1/s'3), failure criteria Mohr and p' - q' space plots

Effective stress results



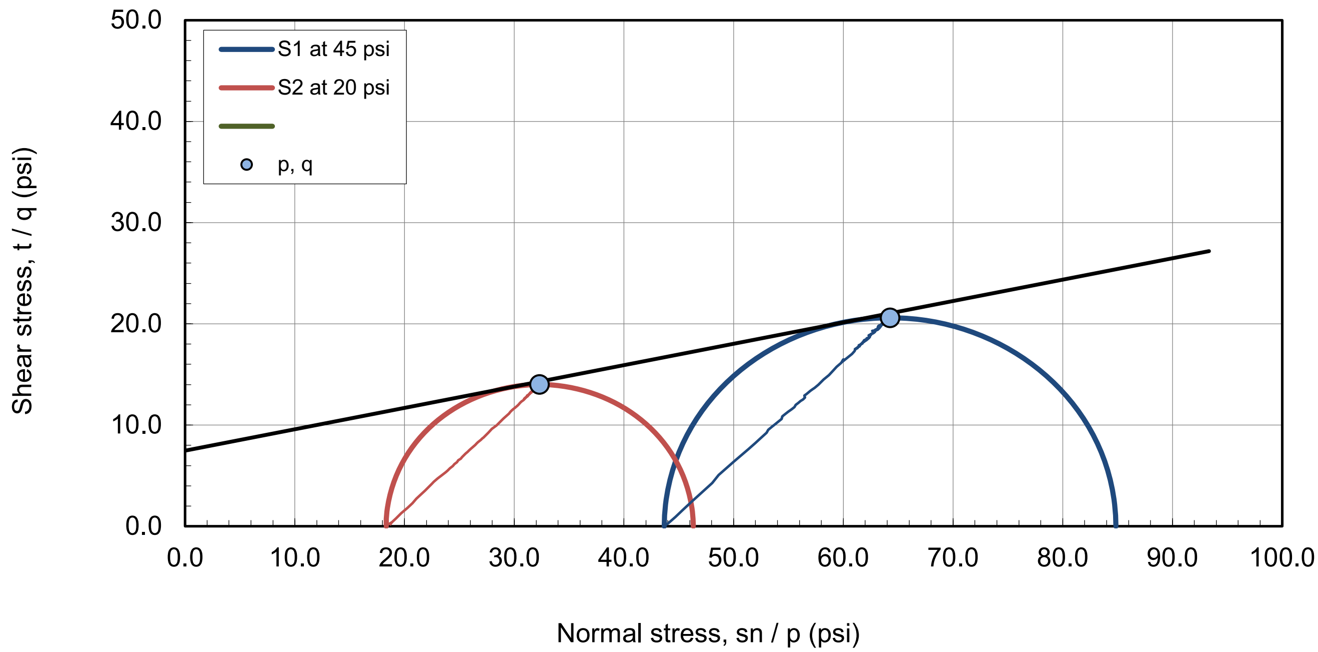
Peak deviator stress (s1-s3), failure criteria Mohr and p' - q' space plots

Triaxial Test - Isotropic Consolidated Sheared Undrained
Measuring Pore Pressure (CIU-PP) *- After ASTM D4767 and USBR 5750*

GERHART COLE INC.

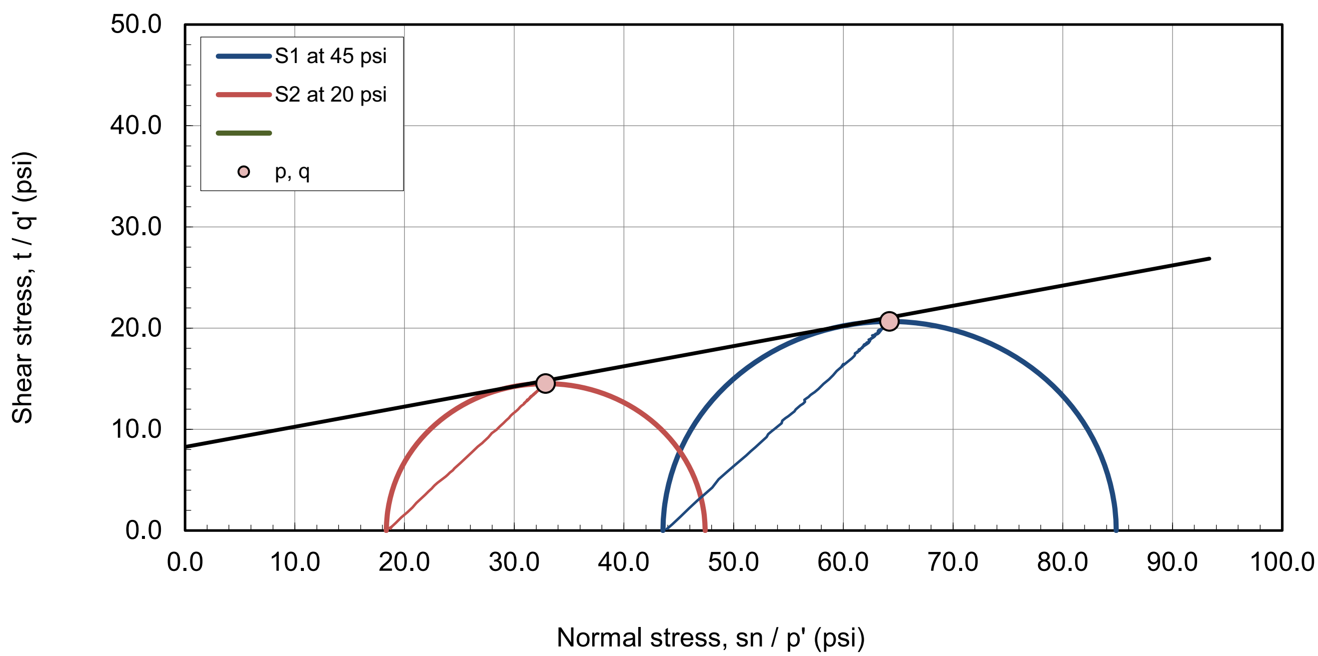
Project: **Weber County Watershed Prot.** **TH/TP/Sample:** **TH-02**
No: **12GCI270** **Depth:** **20-22 (20.5-20.9 portion)**

Total stress results



Max principal stress ratio (s1/s3), failure criteria Mohr and p - q space plots - effective stress results

Total stress results

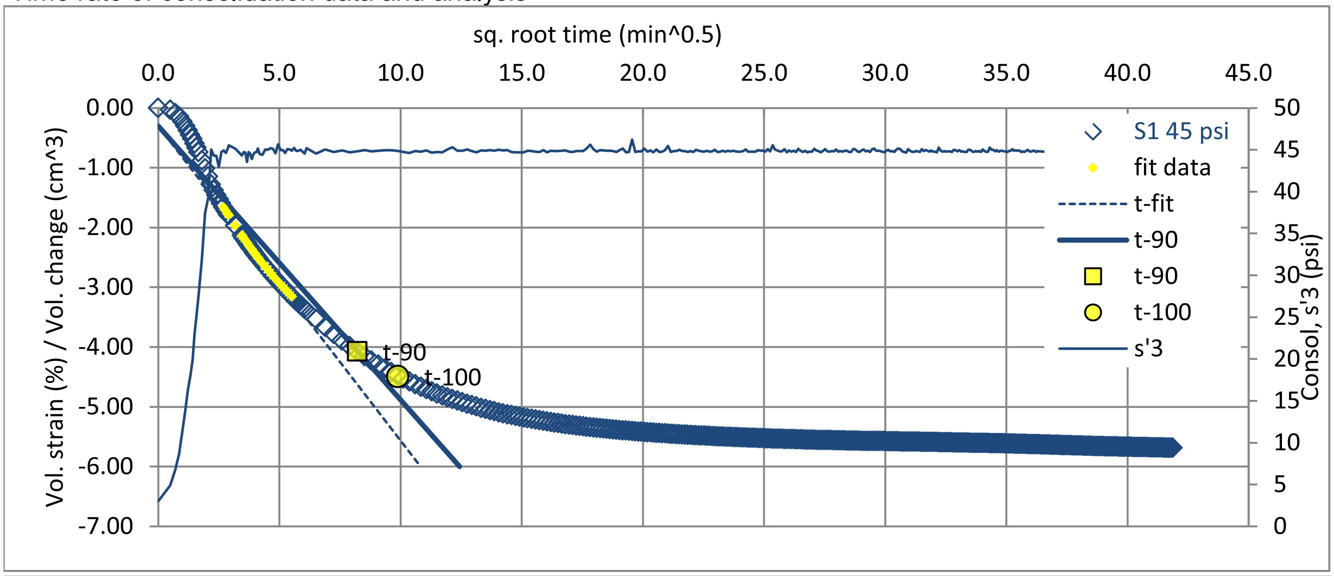


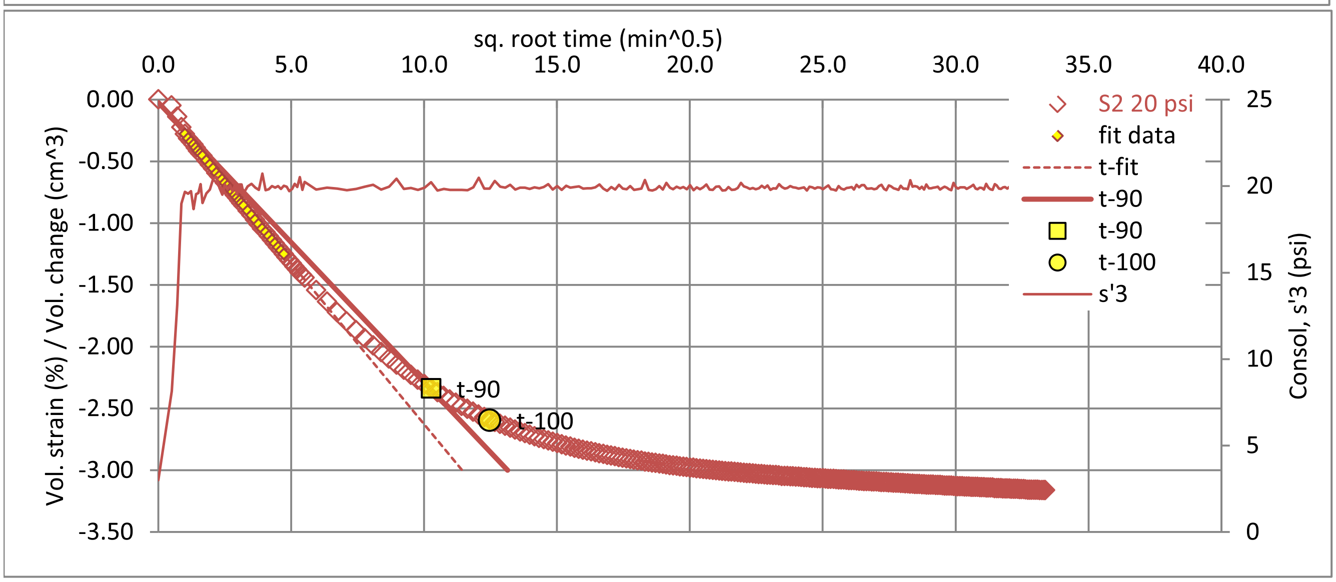
Peak deviator stress (s1-s3), failure criteria Mohr and p - q space plots

Triaxial Test - Isotropic Consolidated Sheared Undrained
Measuring Pore Pressure (CIU-PP) *- After ASTM D4767 and USBR 5750*

Project: **Weber County Watershed Prot.** **TH/TP/Sample:** **TH-02**
No: **12GCI270** **Depth:** **20-22 (20.5-20.9 portion)**

Time rate of consolidation data and analysis





APPENDIX D

DETAILED COST BREAKDOWN

PRELIMINARY ESTIMATE
NEW BRIDGE W/ PRECAST SLABS

ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
1	REMOVE EXISTING WOOD DECK	SQ FT	780	$ 2.00	$ 1,560.00
2	REMOVE STEEL BEAMS (W12X26)	LIN FT	325	$ 5.00	$ 1,625.00
3	SAW CUT BACKWALL	LIN FT	32	$ 39.00	$ 1,248.00
4	PRECAST/PRESTRESSED SLAB BEAMS	SQ FT	778	$ 70.00	$ 54,460.00
5	CONCRETE DECK	CU YD	13	$ 300.00	$ 3,900.00
6	REINFORCING STEEL (A615)	LB	2,100	$ 1.60	$ 3,360.00
7	BRIDGE RAILING (THRIE BEAM)	FT	176	$ 26.00	$ 4,576.00
8	BRIDGE RAILING POSTS (RIGID)	EA	30	$ 30.00	$ 900.00
			BRIDGE TOTAL		$ 71,629.00
			10% CONTINGENCY		$ 7,162.90
			ANTICIPATED BID PRICE		$ 78,791.90

PRELIMINARY ESTIMATE
NEW STEEL GIRDERS & NEW CONCRETE SLAB

ITEM	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
1	REMOVE EXISTING WOOD DECK	SQ FT	780	$ 2.00	$ 1,560.00
2	REMOVE STEEL BEAMS (W12X26)	LIN FT	325	$ 5.00	$ 1,625.00
3	SAW CUT BACKWALL	LIN FT	32	$ 39.00	$ 1,248.00
4	STEEL GIRDERS (W12x35) W/ STUD CONNECTORS	LB	11,200	$ 3.50	$ 39,200.00
5	STEEL BRIDGING (C8x13.75)	LB	852	$ 3.00	$ 2,556.00
3	STAY-IN-PLACE BRIDGE FORMS	SQ FT	1,000	$ 3.00	$ 3,000.00
6	CONCRETE DECK	CU YD	23	$ 400.00	$ 9,200.00
7	REINFORCING STEEL (A615)	LB	6,500	$ 1.60	$ 10,400.00
8	BRIDGE RAILING (THRIE BEAM)	FT	176	$ 26.00	$ 4,576.00
9	BRIDGE RAILING POSTS (RIGID)	EA	30	$ 30.00	$ 900.00
			BRIDGE TOTAL		$ 74,265.00
			10% CONTINGENCY		$ 7,426.50
			ANTICIPATED BID PRICE		$ 81,691.50