

APPENDIX D
SUPPORTING INFORMATION

Draft Conceptual Design Technical Memorandum



TECHNICAL MEMORANDUM

TO: Jared Andersen, Weber County

FROM: Craig Bagley P.E., and Kameron Ballentine P.E.
Bowen Collins and Associates
154 East 14000 South
Draper, UT 84020

DATE: July 9, 2013

SUBJECT: Little Weber Creek Channel Restoration

Draft

INTRODUCTION

During the 2011 flood event a section of earthen embankment that separated the Weber River from Little Weber Creek failed. Little Weber Creek is also known as the Little Weber Overflow Channel and the Little Weber Cutoff Channel. The embankment failure in 2011 allowed an estimated peak discharge of 1,000 cfs to exit the Weber River and flow into Little Weber Creek and the adjacent floodplain, causing flooding over a large area for an extended period of time. This Technical Memorandum has been prepared to summarize the work performed to identify existing capacity restrictions along Little Weber Creek and to identify the work that was performed to evaluate and identify means that will restore conveyance capacity to the historic drainage and reduce flood damage during the next large runoff event.

Little Weber Creek Characteristics

Little Weber Creek has historically served as a natural drain for shallow ground water and irrigation tail water as well as a means to convey runoff discharged into the west floodplain of the Lower Weber River to the Great Salt Lake. Most of the culverts and structures that have been constructed across the channel are sized to convey only small discharges from ground water and irrigation return flows, not large discharges from the Weber River. Figure 1 shows the location of Little Weber Creek and identifies the existing sizes and estimated capacities of the existing culvert crossings.

The land on the west side of Lower Weber River, between 900 North and 1100 South, slopes to the west, away from the Weber River. When flood water from the Weber River gets onto the west overbank it flows away from the Weber River into the Little Weber Creek, as is generally shown in Figure 2. It is also important to note that the original Lower Weber River channel has about 3,500 cfs capacity between Plain City and 1150 South. Berms have been constructed on the river banks to increase the bank-full capacity to about 5,000 cfs in the same reach. Because

GSL

GSL Minerals

Plain City

ID	Location/Description	Culvert Size	Estimated Capacity (cfs) ¹
5	Culvert in 5500 West	36" CMP	40
6	Culvert in 700 North	42" CMP	60
7	Culverts in 6700 West	(2) 30" CMP	56
8	Culvert in the Private Road West of 6700 West	42" CMP	60
9	Fill at approximately 7500 West and 1400 North	< 36" CMP	40
10	Fill at approximately 7900 West and 2000 North	< 36" CMP	40
11	Rainbow Dike	3' X 6' Conc, (2) 24" CMP, 48" CMP	205
12	Culverts at GSL Minerals Railroad	(5) 36" CMP	210
13	GSL Minerals Fresh Water Canal	Opening in the Canal	Unknown
14	Culvert at GSL Minerals Earthen Dam	< 30" Steel Pipe Culvert	38
15	GSL Minerals Fresh Water Canal	-	Unknown

¹ Assuming Inlet Control With 1 Foot of Head Above Top of Pipe

LEGEND

- Existing Flow Restriction
- Weber River
- Little Weber Creek

NORTH: 

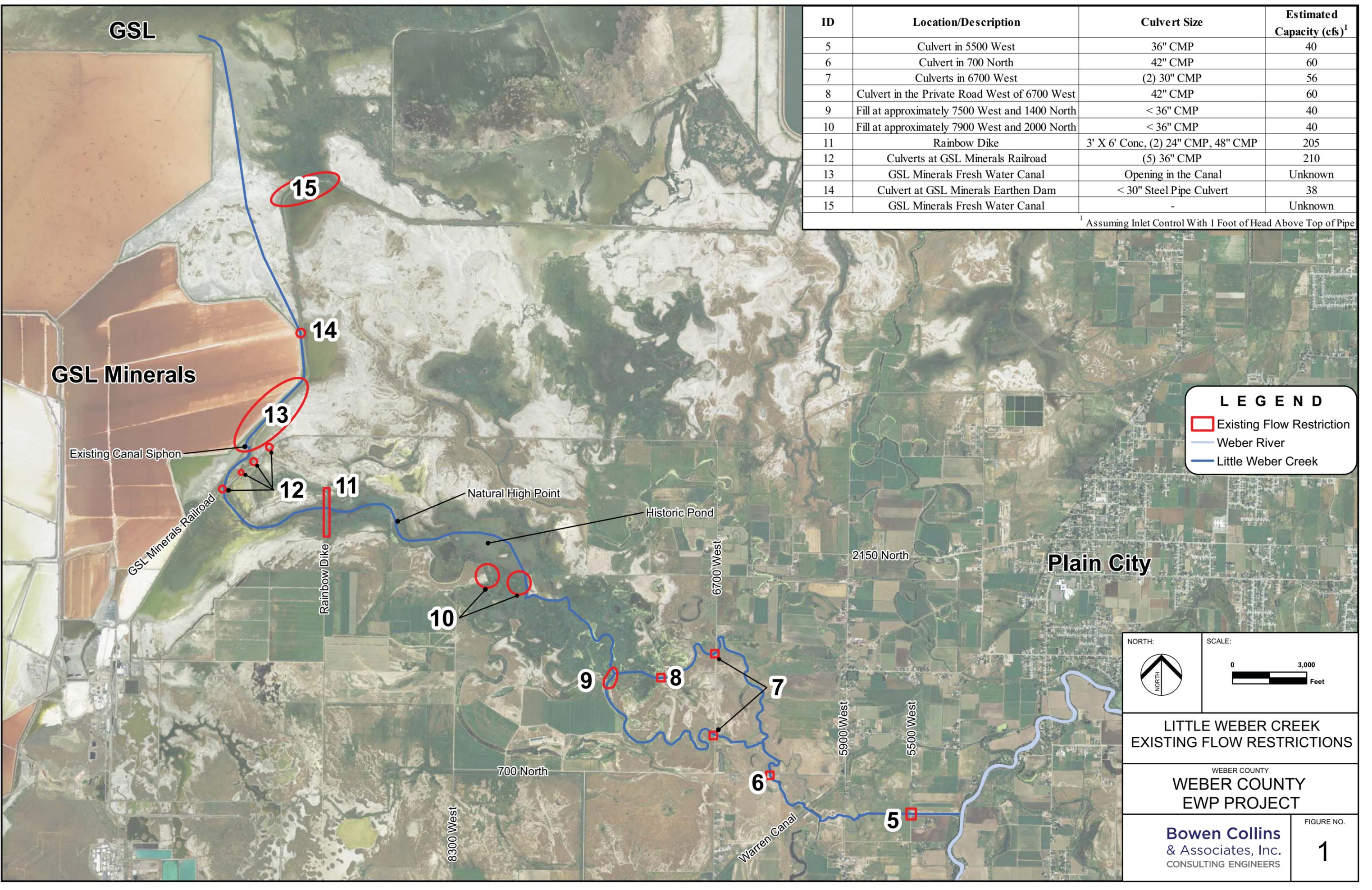
SCALE: 

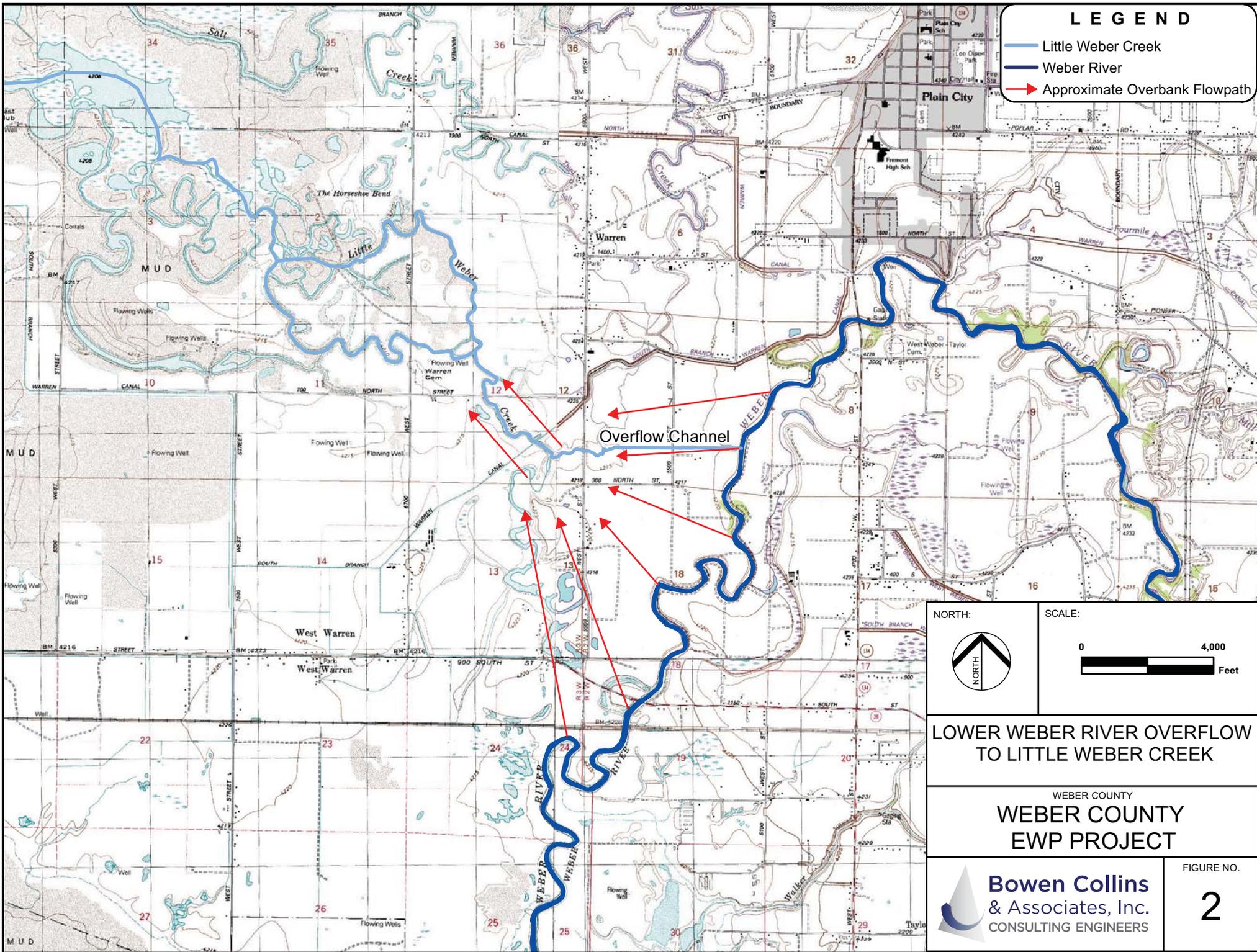
LITTLE WEBER CREEK EXISTING FLOW RESTRICTIONS

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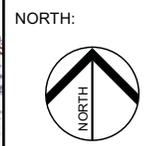
FIGURE NO. **1**





LEGEND

- Little Weber Creek
- Weber River
- ▶ Approximate Overbank Flowpath



LOWER WEBER RIVER OVERFLOW TO LITTLE WEBER CREEK

WEBER COUNTY
**WEBER COUNTY
 EWP PROJECT**

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of the natural topography of the area and the limited capacity of the Lower Weber River, Little Weber Creek receives significant runoff from the Weber River during major flood events, as evidenced during the 2011 flood event. Historic aerial photographs from the 1930's and 1940's confirm the historic nature and function of Little Weber Creek (see Appendix A).

There is very little gradient to Little Weber Creek, particularly west of about 6000 West. There is less than 12 feet of elevation drop in channel invert in the 58,000 feet between the Warren Canal crossing, near 6000 West, and the point where the channel turns to the northwest at on the east side of the GSL Minerals dike, as shown in Figures 1 and 3. This mild gradient and the fact that the Little Weber Creek channel is fairly small, result in a fairly wide floodplain during large runoff events. The current effective FEMA regulatory floodplain (also contained in Appendix A) identifies the approximate boundaries of the floodplain associated with a flood event that has a one percent chance of occurring in any given year.

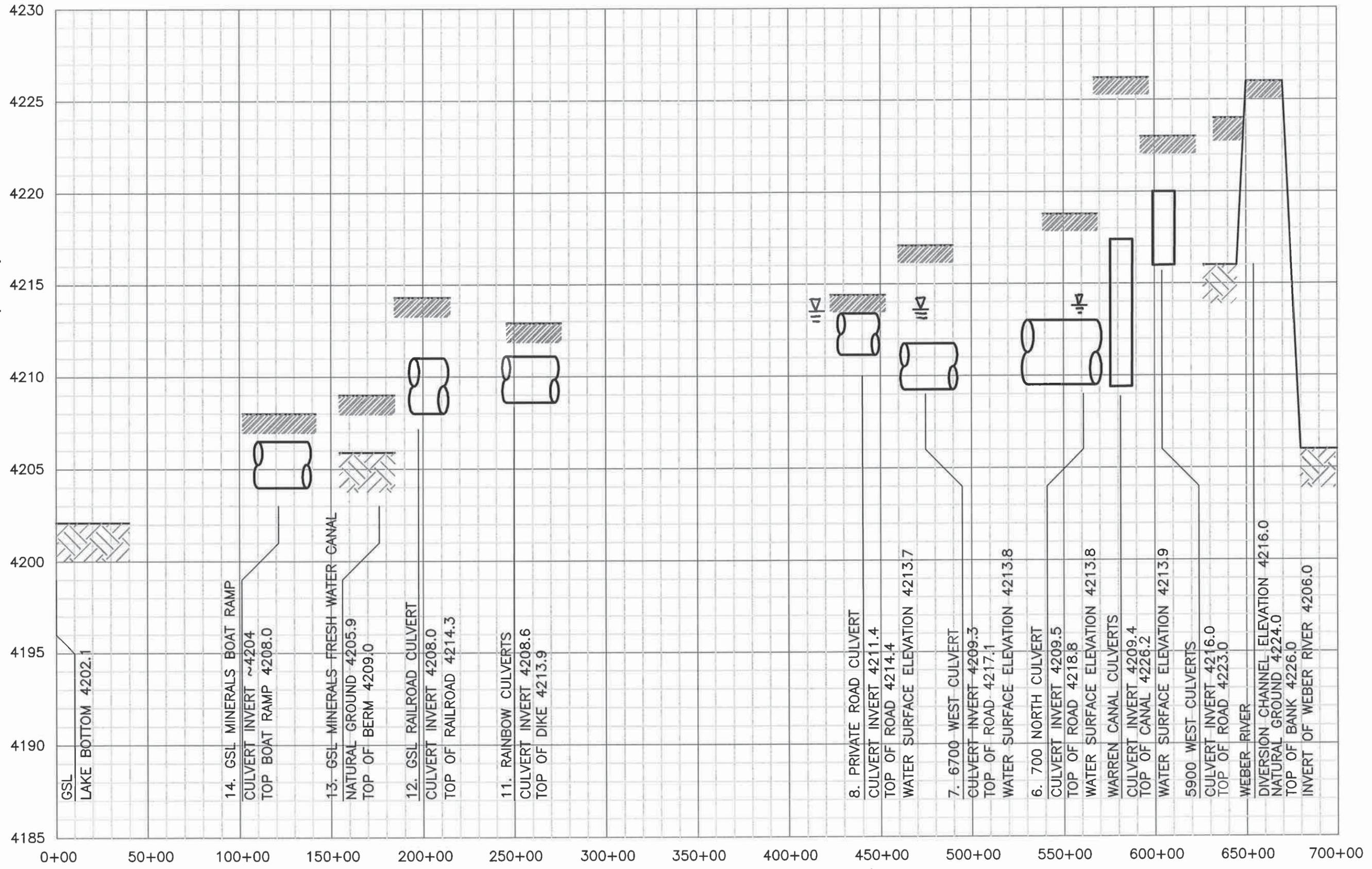
Since the 1940s, the Little Weber Creek drainage has been significantly modified by the construction of elevated roads, railroads, development, and GSL Minerals, etc. Those modifications have created a number of localized capacity restrictions along Little Weber Creek. Those restrictions in conveyance capacity have left areas along the Little Weber Creek drainage susceptible to flooding during large runoff events on the Weber River, as was experienced in 1952, 1983 and 2011. During those flood events, there was extensive flooding including standing water in farm fields and ranches, flooding on private property, and general inundation as shown in the photos in Appendix B. The inundated area during those flood events was similar to the floodplain boundaries on the existing floodplain map included in Appendix A. It is interesting to note that during the 1952, 1983 and 2011 flood events, means to temporarily mitigate the capacity restrictions created by the undersized culverts were implemented by Weber County and land owners to reduce flood damage along Little Weber Creek. Road, railroad, and canal embankments with undersized culverts were breached to allow the floodwaters to more easily flow to the Great Salt Lake.

A review of the historic aerial photographs included in Appendix A also reveals two things. First, there is a historic natural depression that creates a shallow lake along the creek alignment between about 8000 West and 8300 West. Second, phragmites and other invasive plants have become established in much of the section of Little Weber Creek located between 6700 West and the railroad east of GSL Minerals. This invasive vegetation has also had some effect in reducing the flood conveyance capacity of the Little Weber Creek channel.

A field survey of existing major culvert crossings was performed and Bowen, Collins & Associate (BC&A) staff completed multiple field visits and had conversations with private land owners in an effort to identify the locations of the existing capacity restrictions along Little Weber Creek. Figure 1 summarizes the major capacity restrictions found during the field visits. The culvert inverts from the field survey are illustrated in Figure 3. Photographs of each of the major restrictions are included in Appendix C.

One of the property owners (Randy Marriott) met with BC&A staff on-site and showed them two restrictions in the channel (Numbers 9 and 10 on Figure 1). Mr. Marriott uses those restrictions to store water on his property for irrigation purposes. He has requested that any restoration

ELEVATION IN FEET (NAVD)



LITTLE WEBER CREEK STATION (FEET)
MEASURED FROM NORTH END OF GSL MINERALS



NO.	DATE	REV. BY	DESCRIPTION

WEBER COUNTY
LITTLE WEBER CREEK

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

LITTLE WEBER CREEK
PROFILE

DATE: MAY 2013
PROJECT NUMBER 334-12-01

FIGURE NO.
3

projects on his property allow him to continue to store water for irrigation purposes. Research indicates that he does have a water right to store water in this area (Water Right Number 35-8083).

The Rainbow Dike (Number 11 on Figure 1) is a restriction with culverts and stop logs to backup and store water in the Little Weber Creek. The stop logs and culverts are operated and maintained by the Department of Natural Resources (DNR). Val Bachman, a representative of the DNR, has requested that the restoration project associated with the Rainbow Dike allow them to continue to store water at that location. The DNR also has a water right to store water (Water Right Number 35-10772).

The GSL Minerals Fresh Water Canal (Number 13 on Figure 1) has berms about 2 feet high on either side, which restricts flow over the canal. A siphon has been installed through a short section of the canal to allow water to flow from one side of the canal to the other. Local property owners indicated that the cut section of canal was a restriction during the 2011 flood event.

Mitigation Alternatives to Remove Capacity Restrictions

Three alternatives were considered to mitigate the capacity restrictions along Little Weber Creek. The first alternative is to enlarge the capacity of the existing channel from 5500 West to the Great Salt Lake, construct a new regulating structure that would allow regulated releases from the Weber River into Little Weber Creek during periods of high discharge, and replace the undersized culverts. The second and third alternatives include constructing a new regulating structure and replacing the undersized culverts, but not enlarging the capacity of the channel. Because of likely impacts to wetlands and permitting requirements, and due to the lack of significant gradient between the Warren Canal crossing and the GSL, the first alternative was eliminated from further consideration. The second and third alternatives include the following key features, as illustrated on Figures 4-a, 4-b and 5:

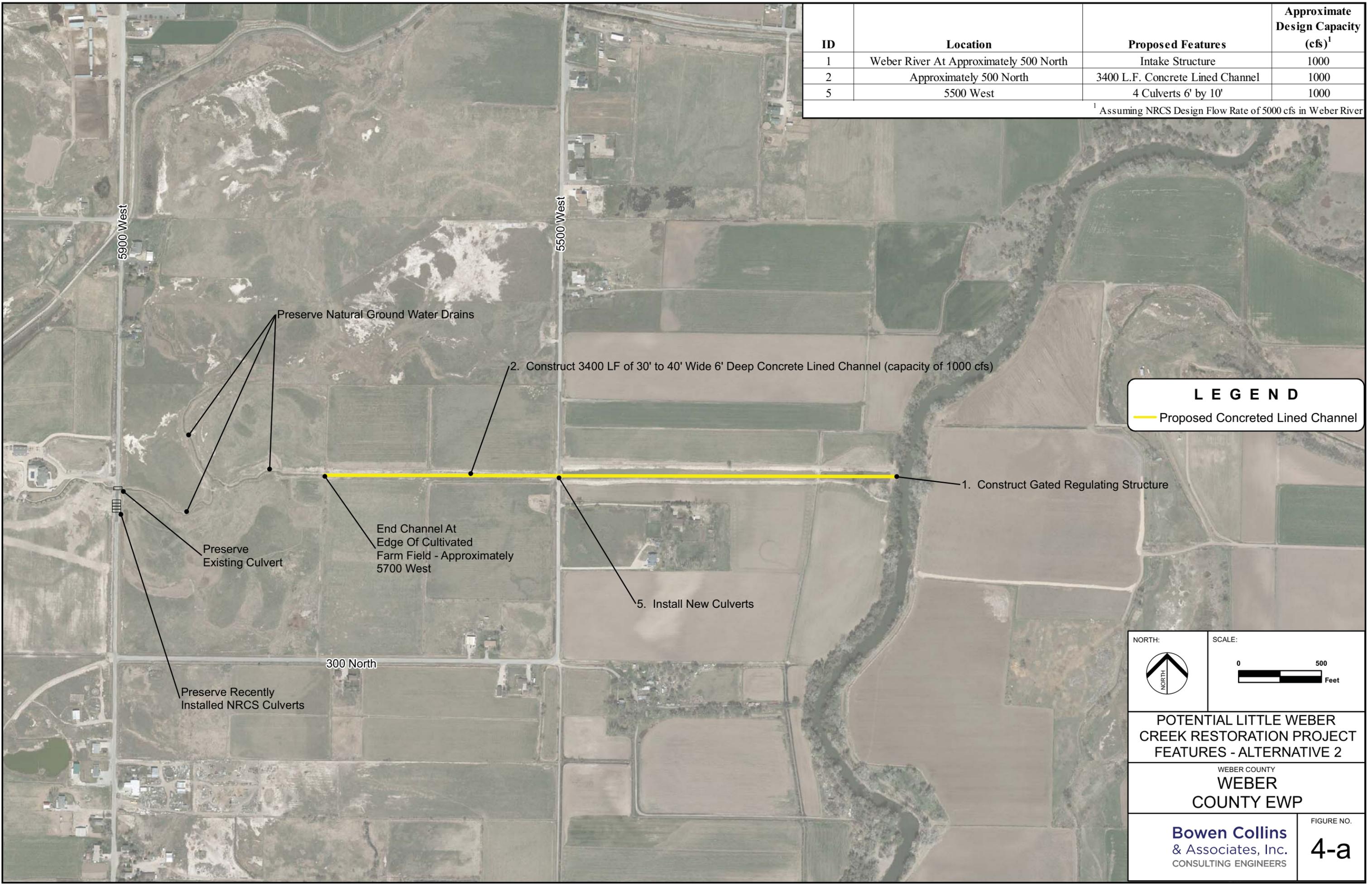
Alternative 2

Alternative 2 includes the following features, as shown on Figure 4-a:

- **Construct Intake Structure on Weber River (ID 1)** – Construct a concrete regulating structure on the west bank of the Lower Weber River. The regulating structure would allow water to be released from the Weber River during flood events to reduce flooding potential on the Lower Weber River below 4700 West to protect the existing embankments along the river by providing more freeboard. The flow rate in the Weber River at which the intake structure will be activated will be decided during the pre-design or design process. For conceptual purposes it is assumed that the structure will be activated once the flow in Weber River reaches approximately 3,000-4,000 cfs. Note, the capacity of the Lower Weber River is approximately 3,500 cfs before water is impounded on the embankments. The structure will be designed to discharge approximately 1,000 cfs from the Weber River into Little Weber Creek when the Weber River is running at bank full capacity below 4700 West (about 5000 cfs). A regulating structure with two 20-foot by 8-foot radial gates would be sufficient to allow 1,000 cfs to be released from

ID	Location	Proposed Features	Approximate Design Capacity (cfs) ¹
1	Weber River At Approximately 500 North	Intake Structure	1000
2	Approximately 500 North	3400 L.F. Concrete Lined Channel	1000
5	5500 West	4 Culverts 6' by 10'	1000

¹ Assuming NRCS Design Flow Rate of 5000 cfs in Weber River



LEGEND

— Proposed Concreted Lined Channel

Preserve Natural Ground Water Drains

2. Construct 3400 LF of 30' to 40' Wide 6' Deep Concrete Lined Channel (capacity of 1000 cfs)

1. Construct Gated Regulating Structure

Preserve Existing Culvert

End Channel At Edge Of Cultivated Farm Field - Approximately 5700 West

5. Install New Culverts

Preserve Recently Installed NRCS Culverts

300 North

NORTH: 

SCALE: 

POTENTIAL LITTLE WEBER CREEK RESTORATION PROJECT FEATURES - ALTERNATIVE 2

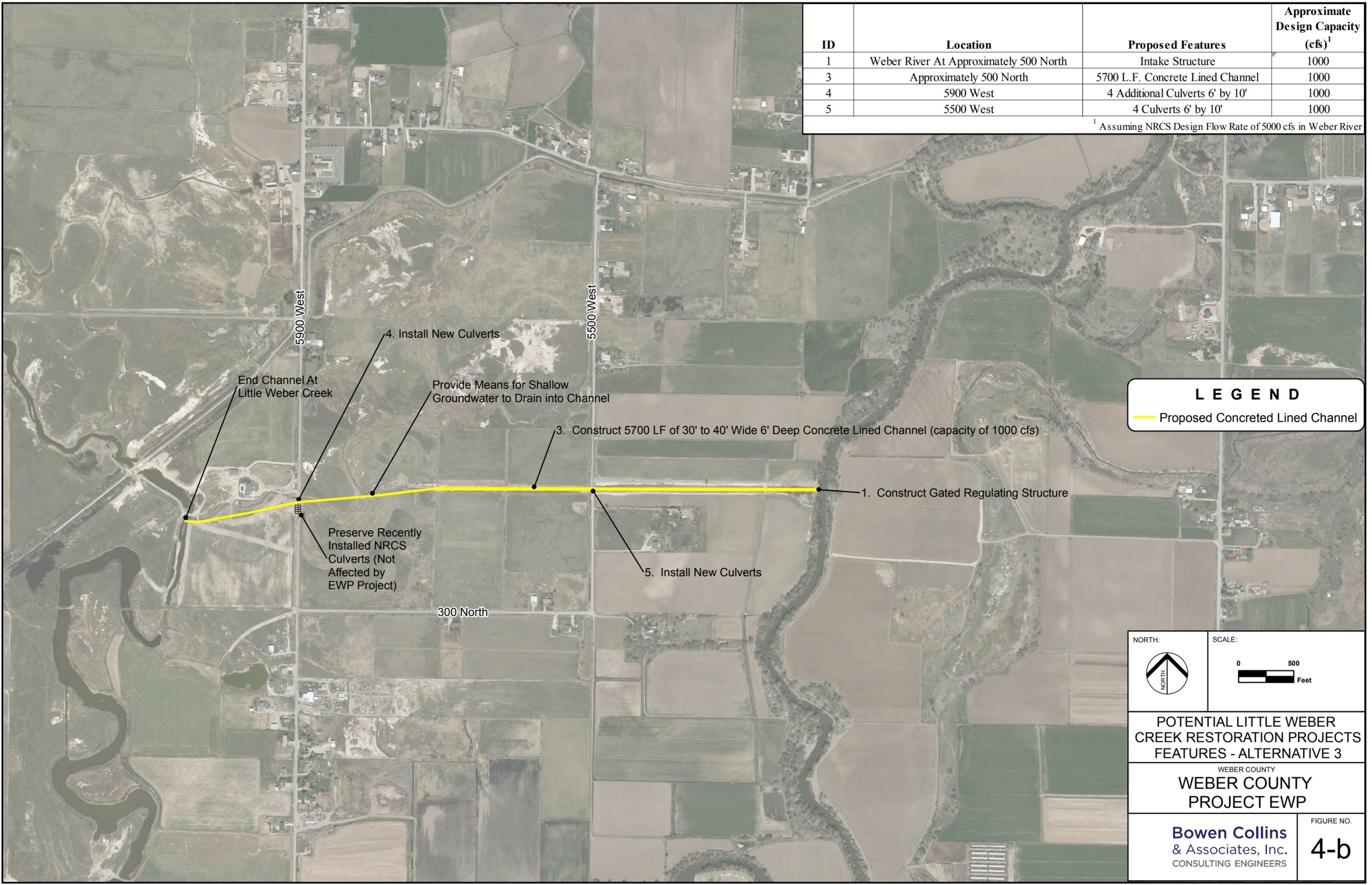
WEBER COUNTY
WEBER COUNTY EWP

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FIGURE NO.
4-a

ID	Location	Proposed Features	Approximate Design Capacity (cfs) ¹
1	Weber River At Approximately 500 North	Intake Structure	1000
3	Approximately 500 North	5700 L.F. Concrete Lined Channel	1000
4	5900 West	4 Additional Culverts 6' by 10'	1000
5	5500 West	4 Culverts 6' by 10'	1000

¹ Assuming NRCS Design Flow Rate of 5000 cfs in Weber River



LEGEND

— Proposed Concreted Lined Channel

NORTH: 

SCALE:  500 Feet

POTENTIAL LITTLE WEBER CREEK RESTORATION PROJECTS FEATURES - ALTERNATIVE 3

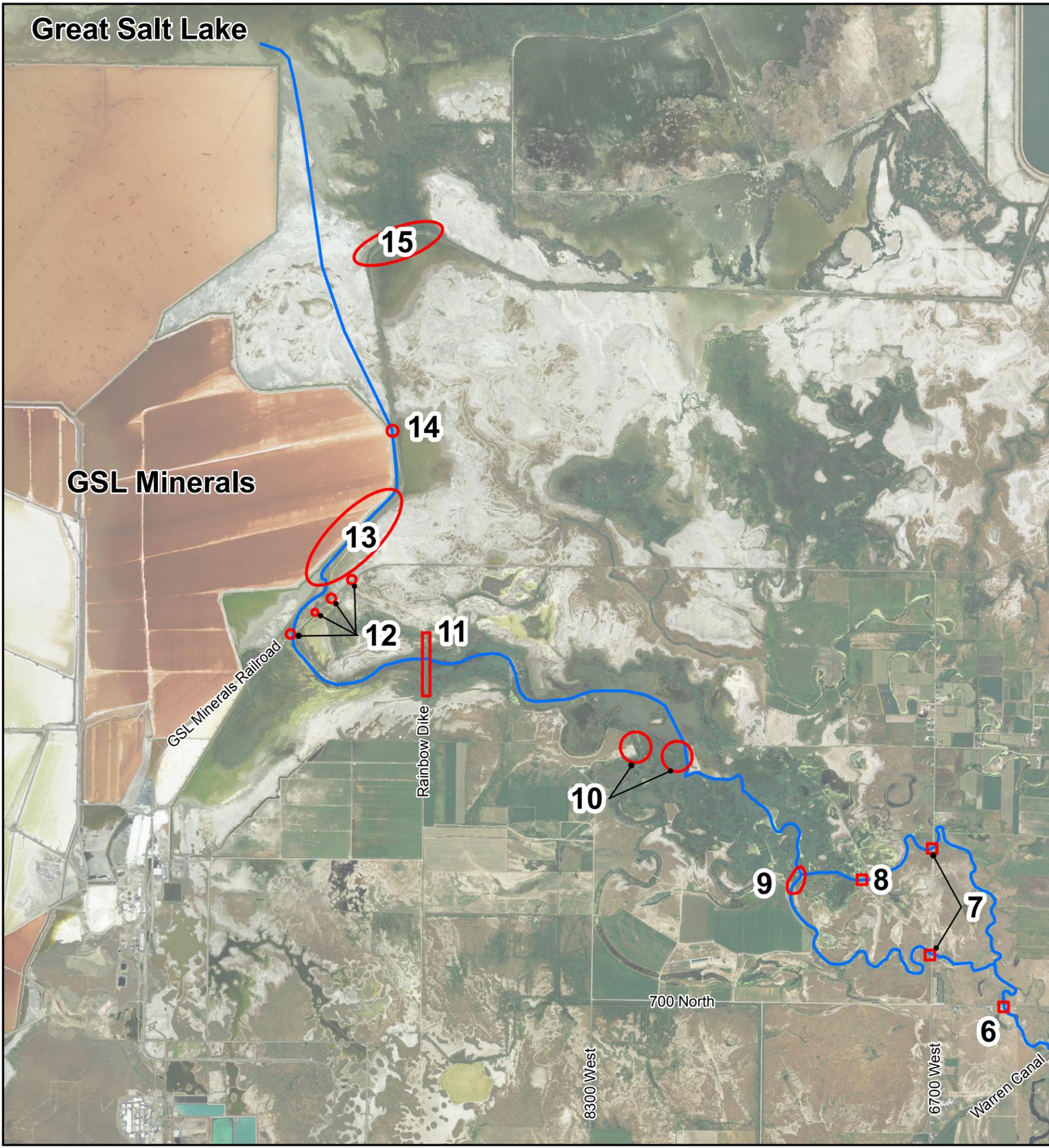
WEBER COUNTY
WEBER COUNTY PROJECT EWP

<p>Bowen Collins & Associates, Inc. CONSULTING ENGINEERS</p>	<p>FIGURE NO. 4-b</p>
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Great Salt Lake

GSL Minerals

Plain City



ID	Location	Proposed Feature	Approximate Design Capacity (cfs) ¹
6	700 North	(5) 12' X 4' Concrete Box Culverts	1000 ¹
7	6700 West	(6) 10' X 4' Concrete Box Culverts	1000 ¹
8	Private Road West of 6700 West	(4) 10' X 4' Concrete Box Culverts	520 ¹
9	Fill at approximately 7500 West and 1400 North	Remove Berms - Possibly Install Regulating Structure	-
10	Fill at approximately 7900 West and 2000 North	Remove Berms - Possibly Install Regulating Structure	-
11	Rainbow Dike	(4) 12' X 4' Concrete Box Culverts and Install Regulating Structure(s)	1000 ²
12	GSL Minerals Railroad	(10) 12' X 4' Concrete Box Culverts	1000 ⁵
13	GSL Minerals Fresh Water Canal	Enclose Canal for 150'	900 ⁴
14	GSL Minerals Earthen Dam	(7) 12' X 4' Concrete Box Culverts	1000 ¹
15	GSL Minerals Fresh Water Canal	Enclose Canal for 30'	180 ⁴

¹ Assumes Inlet Control with Culvert Flowing Full

² Assumes Inlet Control with Culvert Flowing Full and Diversion has Capacity to Pass 400 cfs

³ Assumes Inlet Control with 1 Foot of Head Over Top of Pipe

⁴ Assumes 2 Feet of Water Flowing Over Top of Enclosure at 3 ft/s

⁵ Assumes 2 Feet of Water Flowing in the Culverts

LEGEND

- Restoration Project
- Weber River
- Little Weber Creek

NORTH:

SCALE:

PROPOSED LITTLE WEBER CREEK RESTORATION PROJECT FEATURES ALTERNATIVES 2 AND 3

WEBER COUNTY
WEBER COUNTY EWP

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FIGURE NO.
5

the Weber River during major flood events. For conceptual purposes it is assumed that Weber County would operate the intake structure. The County would need to monitor the water level and freeboard in the Lower Weber River during major flood events and open the gates only in an effort to maintain freeboard on the embankments to reduce flooding potential. An initial estimate of the recommended minimum allowable freeboard in the Lower Weber River is 2 feet. An operating plan will need be developed with the interested parties that defines when the gates would be opened and to document other operational parameters of the intake structure.

- **Construct a Channel from the Weber River to 5700 West (ID 2)** – Construct a rectangular concrete-lined channel from the Weber River to approximately 5700 West (approximately 3,400 linear feet). The channel will be designed to convey releases from the Weber River up to 1,000 cfs and would discharge into the historic drainage and floodplain at about 5700 West. The channel cross section is rectangular and would need to be 30 feet to 40 feet wide and 6 feet deep to convey the design flow. Appendix D contains a concept drawing of a rectangular channel that could be used for this project. A trapezoidal cross section was also considered. However, land owners have expressed desires to minimize the channel footprint and impact to properties. A rectangular cross section would minimize the property impacts.

The concrete channel for this alternative would terminate at approximately 5700 West where the topography prevents the construction of a channel that is 6 feet deep. The water table is very close to the ground surface west of 5700 West and extending the channel west of 5700 West has the potential to lower the water table in the area. The natural floodplain west of 5700 West of the Warren Canal would not be affected by the concrete channel. It is important to note that if 1000 cfs is flowing in the Little Weber Creek, alternatives 2 or 3 would not prevent flooding 1000 to 2000 feet west of the Warren Canal due to back water created from the lack of capacity of the Little Weber Creek channel.

- **Install culverts at 5500 West (ID 5)** – Install four 10-foot by 6-foot culverts under 5500 West. The culverts would continue the channel proposed in alternatives 2 or 3.

Alternative 3

Alternative 3 includes the intake structure (ID 1) and the culverts at 5500 West (ID 5) presented in Alternative 2. Alternative 3 also includes following features, as shown on Figure 4-b:

- **Construct a Channel from the Weber River to the Warren Canal (ID 3)** – Construct a concrete-lined channel from the Weber River to the Warren Canal (approximately 5,700 linear feet). The channel would be designed to convey releases from the Weber River of up to 1,000 cfs and would connect to the natural open channel east of the Warren Canal. The channel cross section is rectangular and would need to be 30 feet to 40 feet wide and 6 feet deep for the same reasons discussed in ID 2.

Because the groundwater west of 5700 West is close to the ground surface, the concrete lined channel would need to allow the groundwater to flow into or out of the channel.

There are also natural ground water drainages that would need to be collected in the concrete channel.

A conceptual hydraulic computer HEC-RAS model was developed of the concrete-lined channel for Alternative 3. Figures 6 and 7 illustrate the profile of the Little Weber Creek from the computer model, with 500 cfs and 1000 cfs. As can be seen from Figure 6, a flow rate of 500 cfs would be contained in the concrete-lined channel. However, as shown on Figure 7, the concrete-lined channel could not contain 1000 cfs near the Warren Canal. As stated previously, the Little Weber Creek downstream of the Warren Canal does not have capacity to convey 1000 cfs, and would cause backwater approximately 1000 to 2000 feet upstream of the Warren Cannel. The backwater would cause flooding outside of the concrete lined channel.

- **Install culverts at 5900 West (ID 4)** – Install four 10-foot by 6-foot culverts under 5700 West adjacent to the existing culverts recently installed by the NRCS. The proposed culverts would need to be installed about 2.5 feet lower than the existing NRCS culverts. The NRCS culverts would not need to be disturbed by this proposed EWP project.

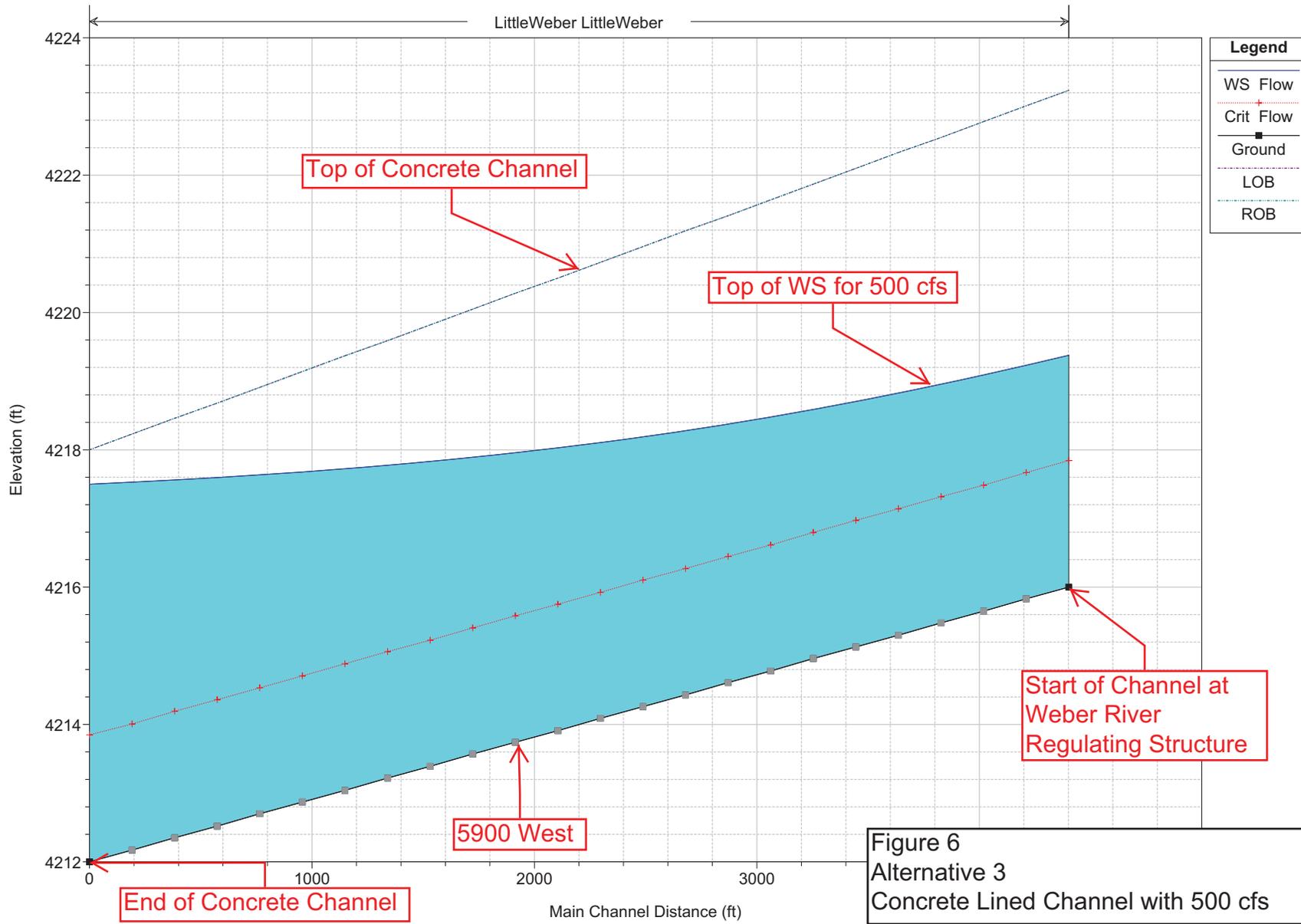
Alternatives 2 and 3

Both alternatives 2 and 3 include the following projects as shown on Figure 5:

- **Install Culverts at 700 North (ID 6)** – Remove the existing 42 inch CMP culvert. Install 5 concrete culverts each 12 feet wide by 4 feet high under 700 North.
- **Install Culverts at 6700 West (ID 7)** - Remove the existing 30 inch CMP culverts. Install 6 concrete culverts each 10 feet wide by 4 feet high under 6700 West. Between 700 North and 6700 West, Little Weber Creek splits into two branches. Both branches cross 6700 West, with about 0.6 miles between them. Based on aerial photographs and survey data, each branch receives about half of the total flow. Therefore, it is recommended that three culverts be installed at both road crossings.
- **Install Culverts at Private Road West of 6700 West (ID 8)** - Remove the existing 42 inch CMP culvert. Install 4 concrete culverts each 10 feet wide by 4 feet high under the Private Road West of 6700 West. It is important to remember that only half of the flooding is anticipated to be in this branch of the Little Weber Creek.
- **Remove Fill in Little Weber Creek at approximately 7500 West and 1400 North (ID 9)** – The fill in the channel and associated culvert(s) will need to be removed at approximately 7500 West and 1400 North. As mentioned previously, Randy Marriott has requested that a structure be installed that would allow him to store water on his property. Culverts with a slotted head wall for stop logs would be a feasible option to meet his needs. During our discussions, he indicated that he has water rights that allow him to store water on his property.
- **Remove Fill in Little Weber Creek at approximately 7900 West and 2000 North (ID 10)** - The fill in the channel at approximately 7900 West and 2000 North and associated culvert(s) will need to be removed. Based on conversations with Randy Marriott, there are two locations where the majority of the flow passes during major flood events. As

Weber River Lower Plan: LW - 35 ft 7/9/2013

LittleWeber LittleWeber



Weber River Lower Plan: LW - 35 ft 7/9/2013

LittleWeber LittleWeber

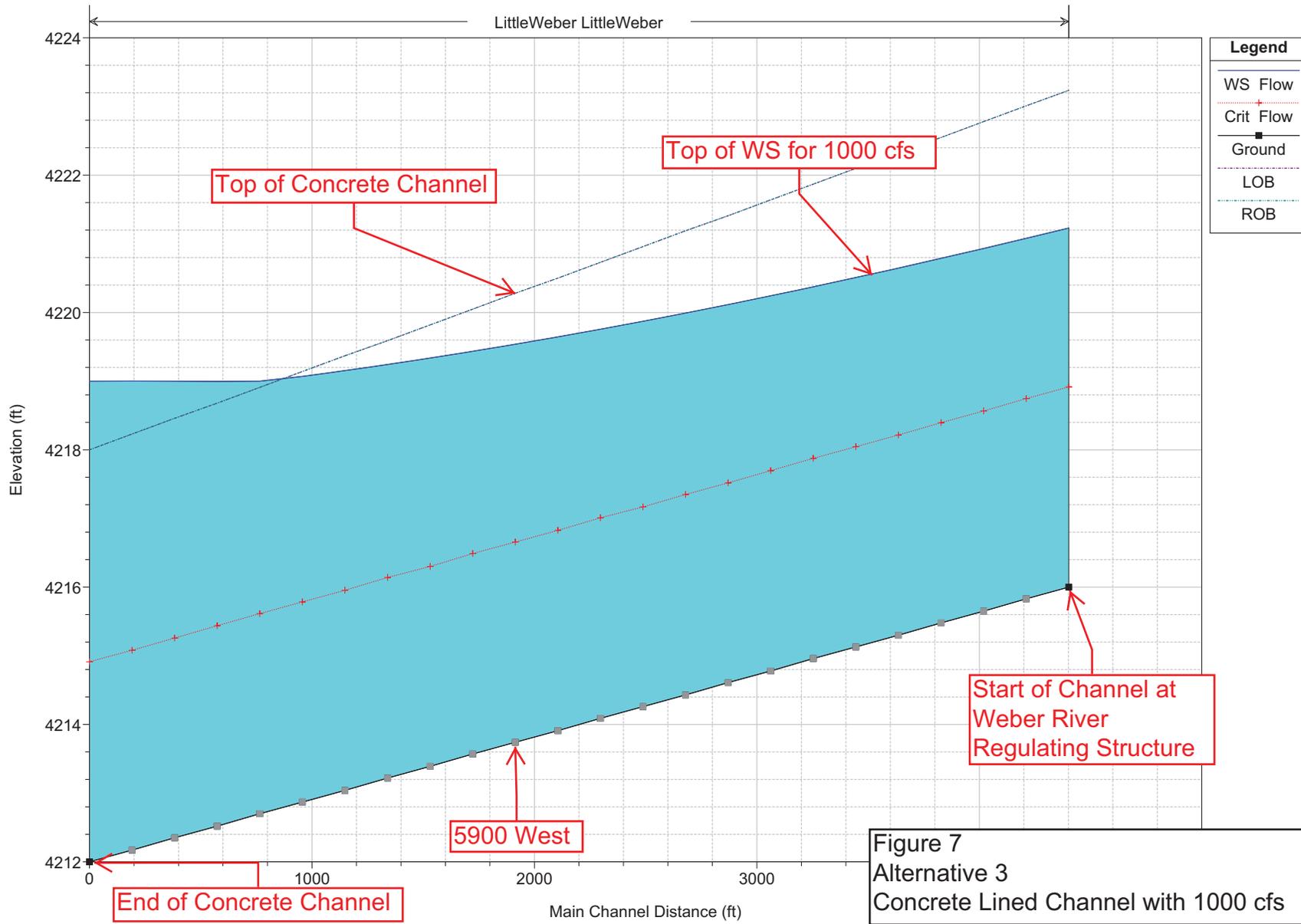


Figure 7
Alternative 3
Concrete Lined Channel with 1000 cfs

with the previously mentioned project, culverts with a slotted head wall for stop logs may be appropriate.

- **Install Culverts at Rainbow Dike (ID 11)** - Remove the existing 30-inch CMP culverts, 48 inch CMP culvert, and concrete box culvert. Replace both of the 30-inch culverts with 2 concrete culverts each 12 feet wide by 4 feet high. Replace the 48-inch culvert with 2 concrete culverts each 12 feet wide by 4 feet high, and replace the 3-foot by 6-foot culvert with a regulating structure. The proposed culverts would be constructed in the same location as the existing culverts. As mentioned previously, Val Bachman has requested that the DNR be allowed to continue to store water at Rainbow Pond. Culverts with a slotted head wall for stop logs may be appropriate on the Rainbow Dike, depending on the water rights owned by the DNR.
- **Install Culverts under GSL Minerals Railroad (ID 12)** - Remove the 5 existing 36-inch CMP culverts and replace each of them with 2 concrete culverts that are 12 feet wide by 4 feet high. The proposed culverts could be constructed in the same location as the existing culverts, to improve hydraulic conditions of the floodplain. A second option for the location of the culverts could be to install at one location to improve constructability, and to decrease construction time. The location of the culverts would need to be discussed with GSL minerals. It is important to note that the Little Weber Creek channel is not well defined downstream of the Rainbow Dike. It is less than a foot deep in some areas. Because the channel in this area is not well defined, and the ground surface is so flat near the GSL Minerals, the flooding tends to be wide and shallow. During flood events, it would be difficult to back-up water along the railroad deeper than two feet. The culverts are recommended to be at least 4 feet tall for maintenance and to allow for additional capacity if they collect sediment.
- **Enclose GSL Minerals Fresh Water Canal - 150 foot section (ID 13)** – To convey flood flows across the GSL Minerals Fresh Water Canal, the canal would need to be enclosed in a box culvert for approximately 150 feet. The top of the enclosure would not be higher than the natural ground surface. The berms on either side of the canal would also need to be removed along the canal enclosure. This would allow the flood flows to pass over the enclosed canal, while maintaining the canal operation.
- **Install Culverts at GSL Minerals Earthen Dam (ID 14)** - Remove the existing steel pipe culvert. Install 7 concrete culverts each 12 feet wide by 4 feet high in the boat ramp. The earthen dam is used as a boat ramp, and is not used to back-up and store water for GSL Minerals. Flood mitigation measures in the earthen dam may not be required if the earthen dam is a non-essential facility and GSL Minerals agrees to remove it. This would save costs on unnecessary flood mitigation measures. This issue should be discussed with GSL Minerals.
- **Enclose GSL Minerals Fresh Water Canal – Approximately 30 foot section (ID 15)** – The topography of the area around GSL minerals slopes north and west, as well as being very flat. As a result, when the floodplain becomes very wide, it will not be possible to direct all the flooding through the opening created by the 150-foot canal enclosure. If flooding bypasses the 150-foot canal enclosure, it will follow the canal north until the canal curves at the natural low point in the ground surface (as experienced during the 2011 flood). Similar to the previous proposed project, it is recommended that about 30

feet of the canal be enclosed, with the berms removed, to allow the flood water to flow cross the Fresh Water Canal at the natural low point.

Conclusions

In conclusion, the following observations from the Little Weber Creek analysis are listed below:

- **Overflow:** The Little Weber Creek is the historic overflow for flooding from the Lower Weber River, as shown during the major flood events of the 1950's, 1980's and 2011.
- **Restrictions:** There are major restrictions that inhibit drainage and augment flooding in the Little Weber Creek.
- **Mitigate Flooding** – To partially mitigate future flooding it is recommended that the restrictions in the Little Weber Creek be repaired or removed. Channelizing the Little Weber Creek is not a feasible option, due to the lack of slope in the channel, high ground water, and the extensive wetlands surrounding the channel.
- **Future Channel Capacity** - Removing the restrictions will not give the channel 1,000 cfs capacity downstream of 5700 West, nor will it prevent all future flooding, but will allow the Little Weber Creek to drain more quickly and limit inundation during floods.

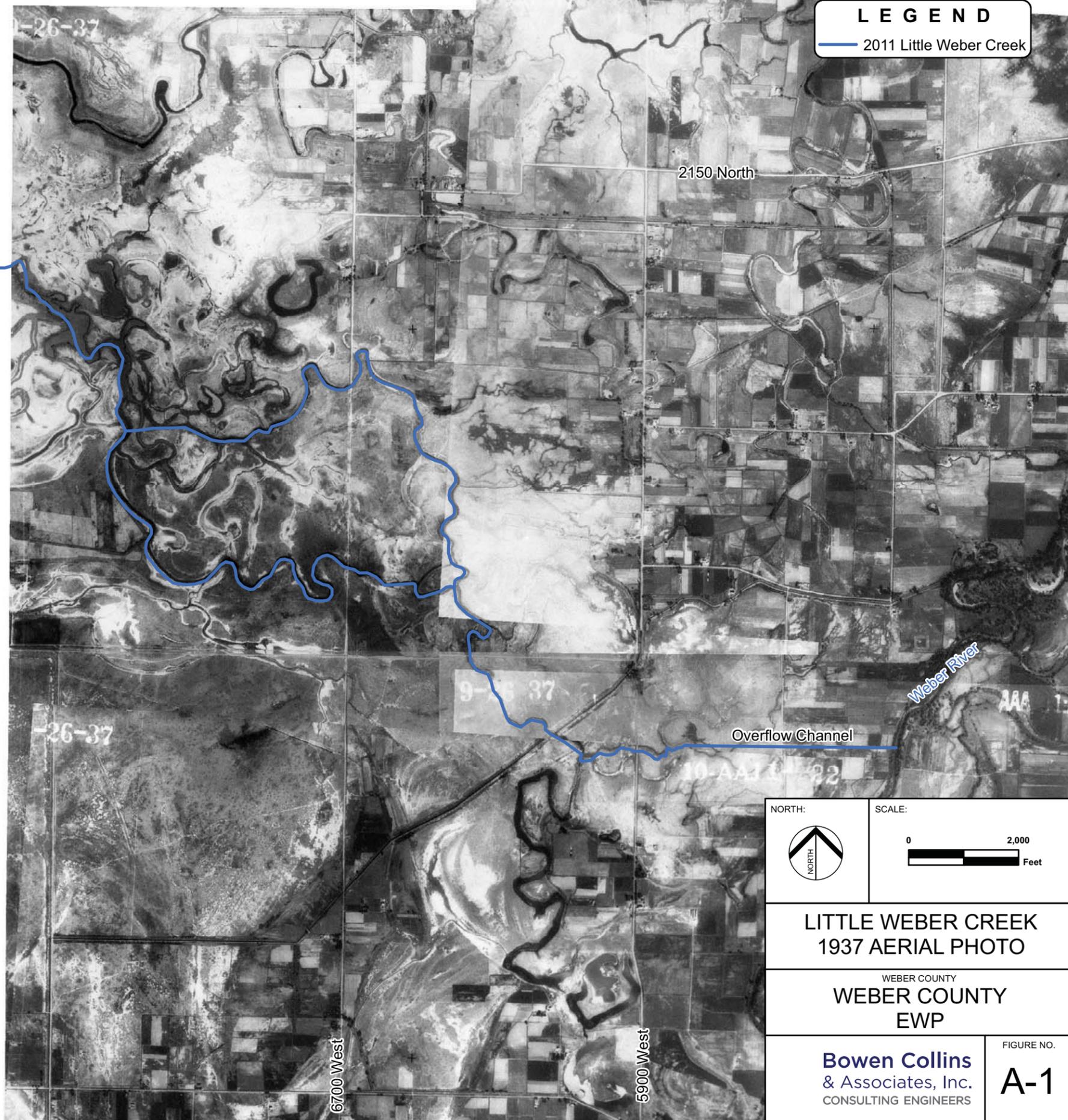
Coordination

The following issues will need to be addressed during the design process:

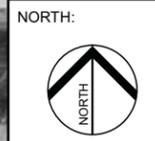
- **Weber River Regulating Structure** – An operating plan for the regulating structure that would discharge flood water from the Weber River into the Little Weber River will need to be discussed with the interested parties. The flow rate at which the intake structure would be activated will need to be decided.
- **Water Rights** – Randy Marriott and Val Bachman have both requested that the culverts or structures on their properties allow them to store water from the Little Weber Creek. Both parties have indicated that they have the appropriate water storage right. After preliminary research of the water rights on the DWR website, the DNR have the right to store water upstream of the Rainbow Dike. Randy Marriott also has a water right that allows him to store water on his property, on the west side of ID 9 (see Figure 5). However, it appears that Mr. Marriott does not have any additional storage rights for the remainder of the proposed projects on his property (See Appendix E for Water Right Data). Though BC&A has performed a preliminary search of water rights, further research is needed to understand of the water rights of both Randy Marriott and the DNR to determine if the structures should be constructed with the ability to store water
- **GSL Minerals** – Coordination with GSL Minerals needs to occur regarding the projects that will directly impact their facilities (railroad, canal, boat ramp, etc.). The canal enclosure and culvert crossing under the railroad will need to be discussed with them. Also, the decision to install culverts or remove the earthen dam during flood events will need to be coordinated.

APPENDIX A
1930'S, 1940'S AND 2011 AERIAL PHOTOS
AND CURRENT FEMA FLOODPLAIN MAP

Blank Area Indicates
1937 Aerial Photo
Not Available



LEGEND
— 2011 Little Weber Creek

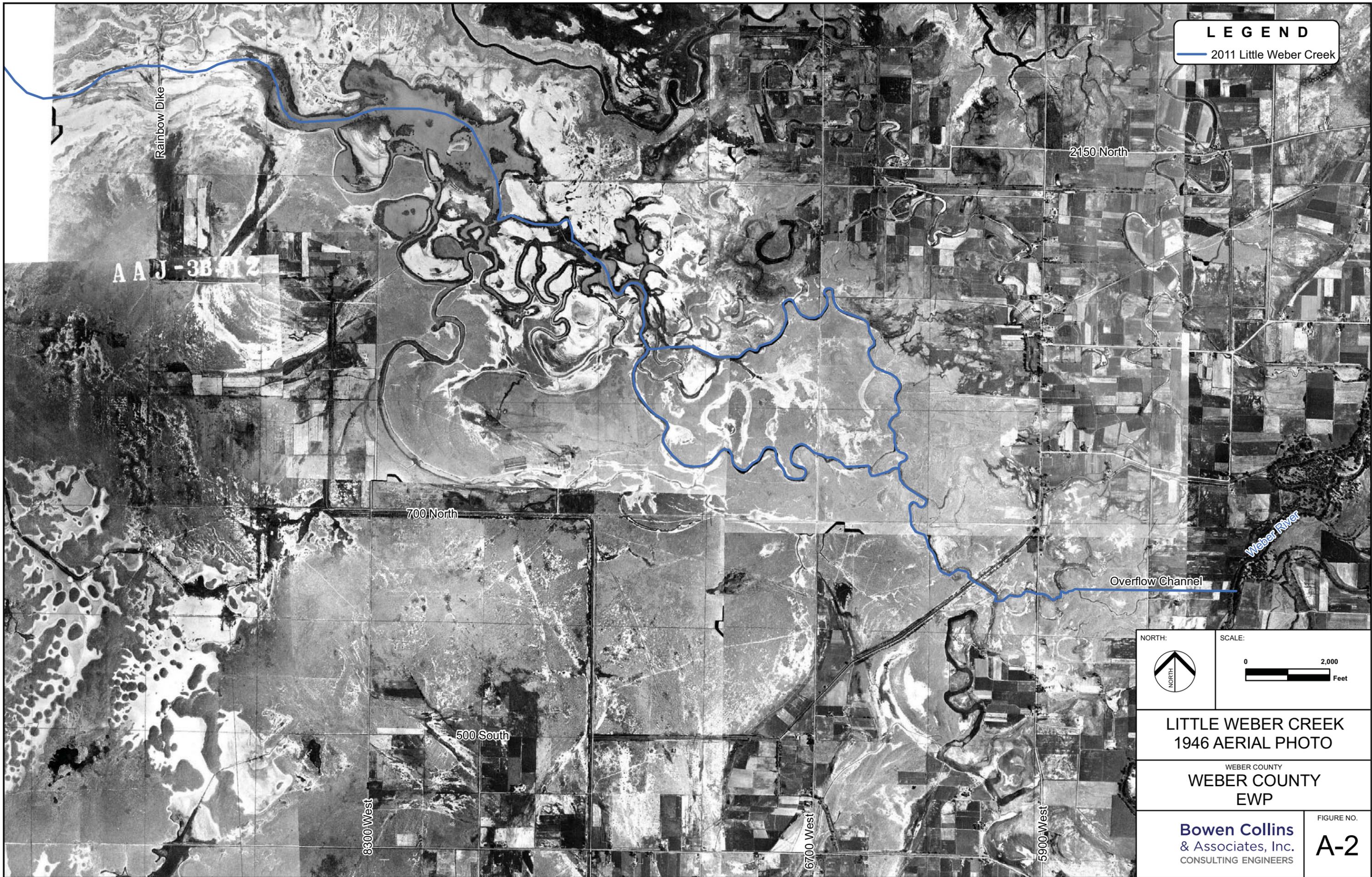


**LITTLE WEBER CREEK
1937 AERIAL PHOTO**

WEBER COUNTY
**WEBER COUNTY
EWP**

**Bowen Collins
& Associates, Inc.**
CONSULTING ENGINEERS

FIGURE NO.
A-1



LEGEND
 — 2011 Little Weber Creek



**LITTLE WEBER CREEK
 1946 AERIAL PHOTO**

WEBER COUNTY
**WEBER COUNTY
 EWP**

**Bowen Collins
 & Associates, Inc.**
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FIGURE NO.
A-2



LEGEND
 — 2011 Little Weber Creek



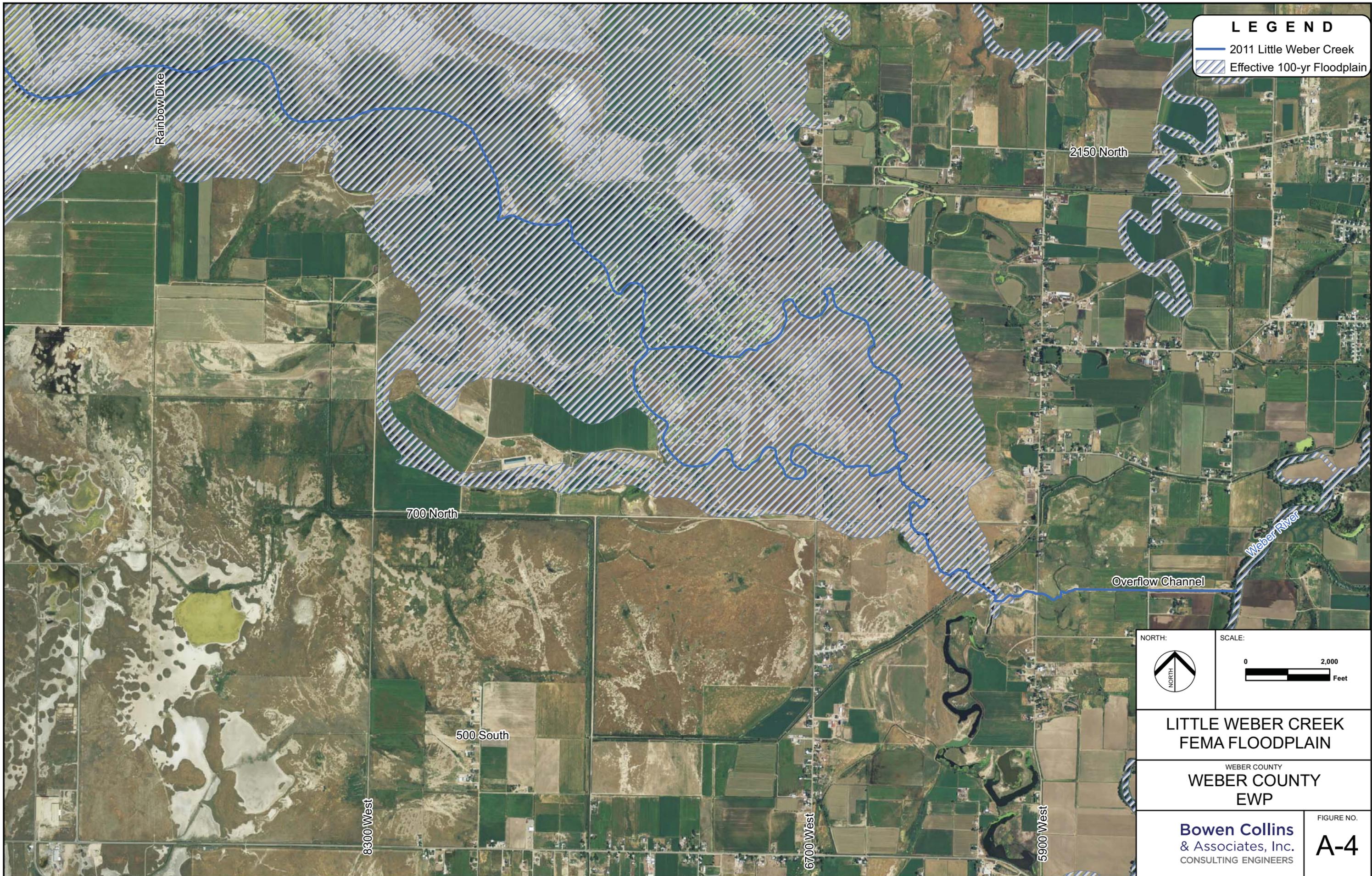
SCALE:
 0 2,000
 Feet

**LITTLE WEBER CREEK
 2011 AERIAL PHOTO**

WEBER COUNTY
**WEBER COUNTY
 EWP**

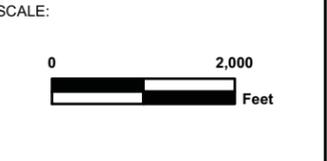
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 & Associates, Inc.**
 CONSULTING ENGINEERS

FIGURE NO.
A-3



LEGEND

- 2011 Little Weber Creek
- ▨ Effective 100-yr Floodplain



**LITTLE WEBER CREEK
FEMA FLOODPLAIN**

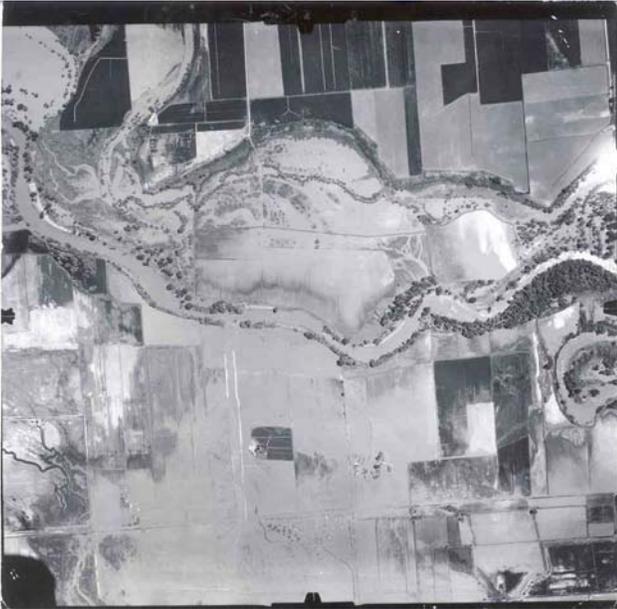
WEBER COUNTY
**WEBER COUNTY
EWP**

**Bowen Collins
& Associates, Inc.**
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FIGURE NO.
A-4

APPENDIX B
AERIAL PHOTOS OF HISTORIC FLOOD EVENTS

Flooding in 1952



Weber River Break – Little Weber Diversion Channel



Weber River Flooding at Approximately 400 South

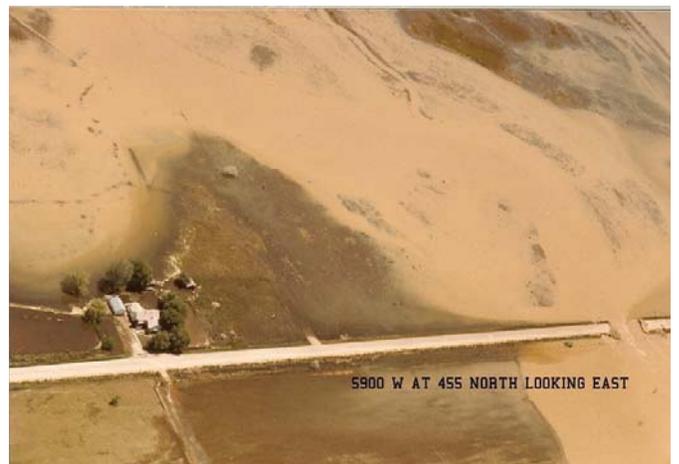


Little Weber Creek Flooding at Warren Canal and
6700 West



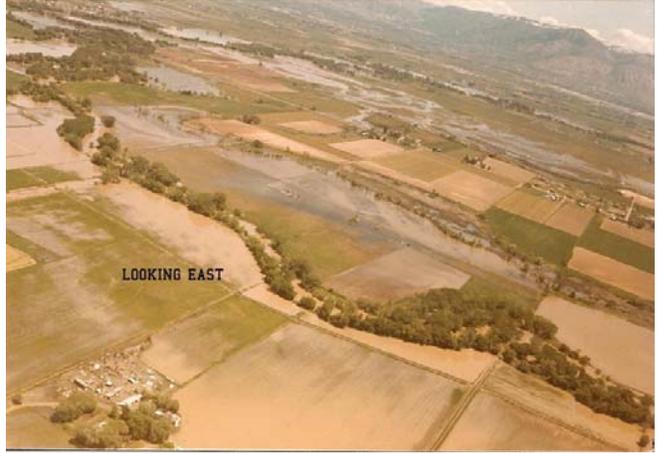
Little Weber Creek Flooding at Approximately 6700
West and 1500 North

Flooding in 1983

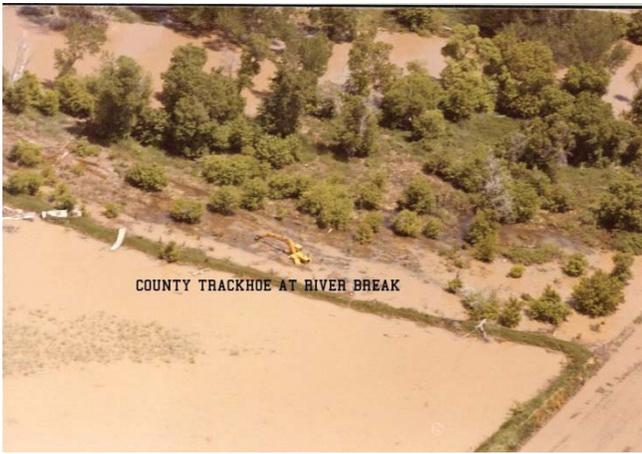




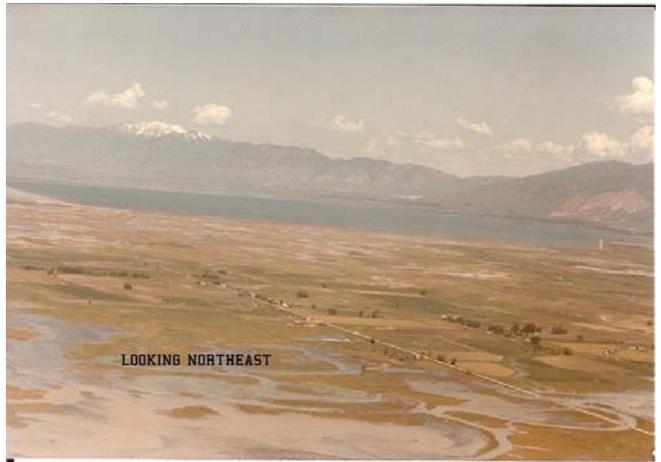
6700 W. ROAD BREACH LOOKING EAST



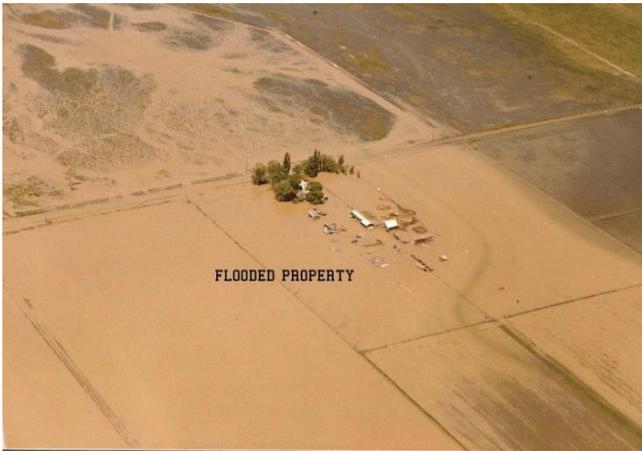
LOOKING EAST



COUNTY TRACKHOE AT RIVER BREAK



LOOKING NORTHEAST



FLOODED PROPERTY



WARREN CANAL BREACH #2 LOOKING EAST

2011 Flooding



Neilson House Flooding



Breach at 5900 West



Breach at 5900 West



Neilson House Flooding



Breach at 5900 West



Breach at 6700 West



Weber River Break



Breach at 5500 West



Weber River Break

APPENDIX C
FIELD PHOTOS OF RESTRICTIONS

Sites 2, 3 and 4



Site 2



Site 2



Site 2



Site 3



Site 2



Site 4

Sites 4 and 5



Site 4



Site 5 - North Site



Site 4



Site 5 - North Site



Site 2 - North Site



Site 5 - South Site

Sites 5 and 6



Site 5 – North Site



Site 6



Site 5 – North Site



Site 6



Site 6

Sites 7 and 8



Site 7



Site 8



Site 7



Site 8



Site 8

Sites 9 and 10



Site 9



Site 10



Site 9



Site 10



Site 9



Site 10

Sites 10 and 12



Site 10



Site 10



Site 10



Site 12

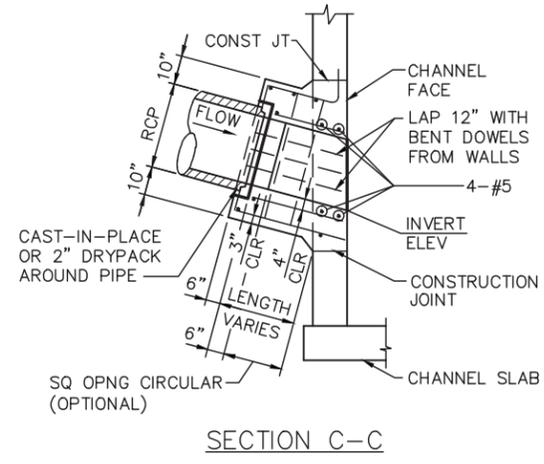


Site 10

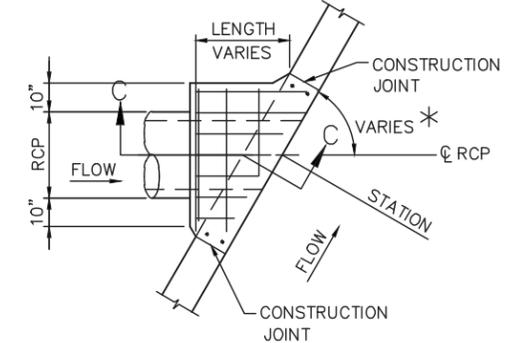


Site 12

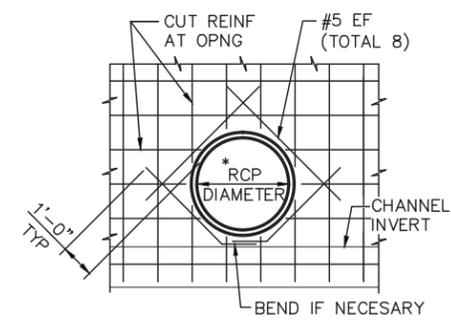
APPENDIX D
CONCEPT DRAWING OF CONCRETE CHANNEL



SECTION C-C

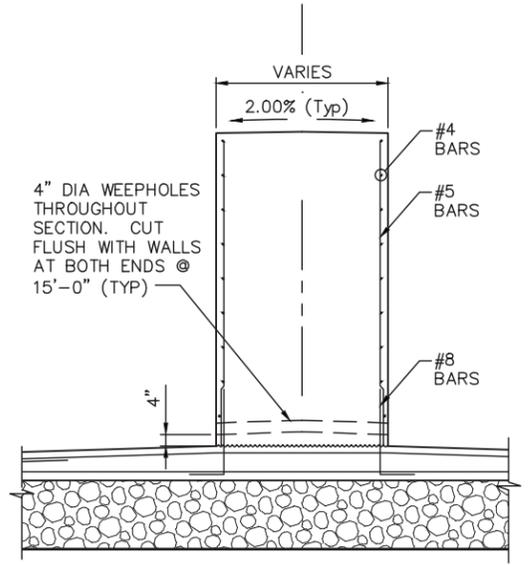


PLAN

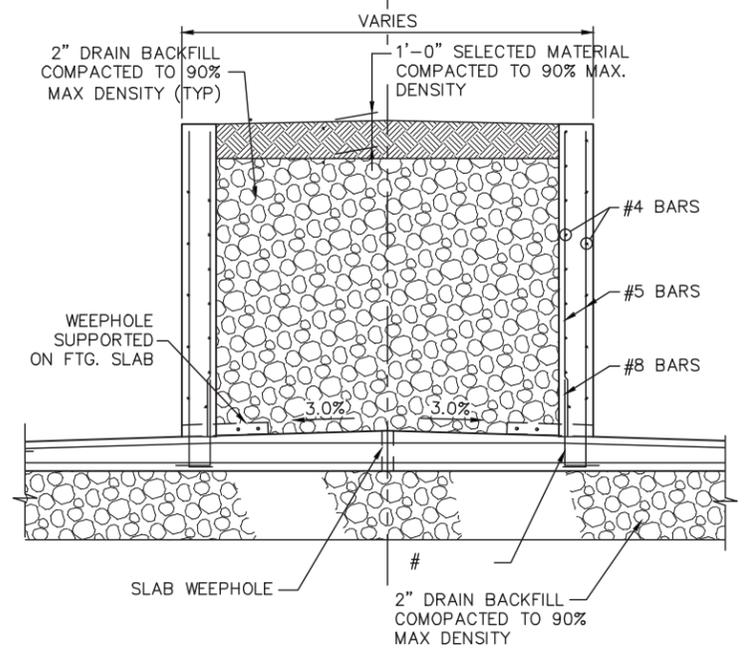


WALL OPENING DETAIL

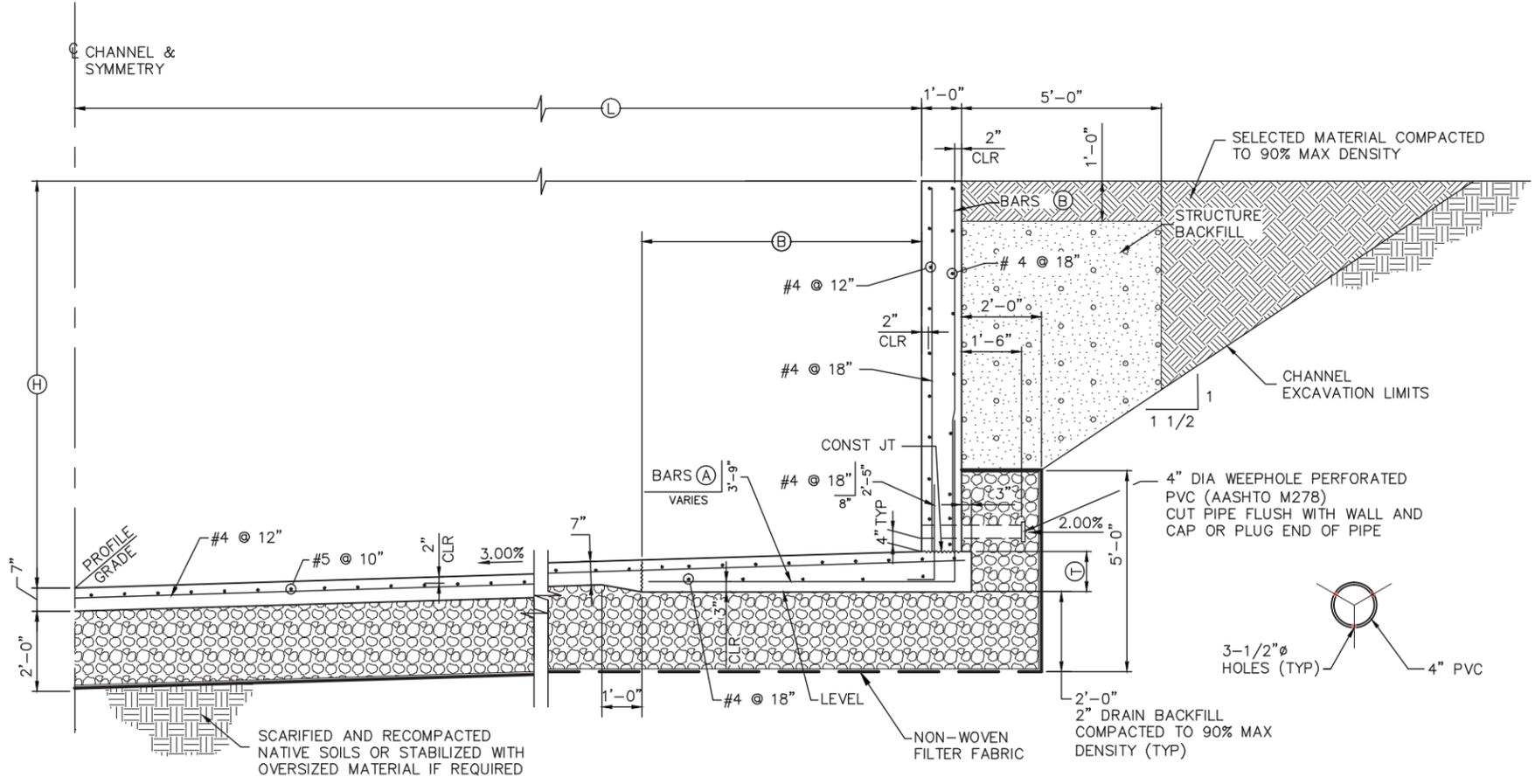
- NOTES:
1. OPENINGS IN CHANNEL WALL SHALL BE CHAMFERED 3/4-INCH UNLESS OTHERWISE NOTED.
 2. CUT REINFORCEMENT 2-INCHES FROM OPENING IN CHANNEL WALL EXCEPT WHEN HOOK OR BEND IS REQUIRED.
 3. "T" WALL THICKNESS OF PIPE.
 4. ALL REINFORCEMENT SHALL HAVE A MINIMUM OF 2-INCHES CLEARANCE UNLESS OTHERWISE NOTED.



SECTION B-B



SECTION A-A



TYPICAL CHANNEL SECTION

NO.	DATE	REV. BY	DESCRIPTION

<p>VERIFY SCALE BAR IS ONE INCH ON ORIGINAL DRAWING</p>	<p>REVIEW CHECKED X.XXXXXX APPROVED X.XXXXXX</p>
<p>DESIGN DESIGN X.XXXXXX DRAWN X.XXXXXX</p>	<p>DESIGN CHECKED X.XXXXXX APPROVED X.XXXXXX</p>

<p>DISCIPLINE LITTLE WEBER CANAL CONCEPT</p>	<p>WEBER COUNTY WEBER RIVER BANK PROTECTION PROJECT</p>
<p>DATE: FEBRUARY 2013</p>	<p>PROJECT NUMBER 334-12-01</p>

<p>DRAWING NO. X-XX</p>
<p>SHEET XX OF XX</p>

APPENDIX E
WATER RIGHTS

Search

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 07/09/2013

WATER RIGHT: **35-8083** APPLICATION/CLAIM NO.: **A7954** CERT. NO.: 1317

=====

OWNERSHIP*****

=====

NAME: Western Basin Land and Livestock, LLC
 ADDR: 1896 North 3450 West
 Ogden, UT 84404
 INTEREST: 100%

=====

DATES, ETC.*****

=====

LAND OWNED BY APPLICANT? Yes COUNTY TAX ID#:

FILED: [PRIORITY: 01/10/1919]PUB BEGAN: [PUB ENDED: [NEWSPAPER:

ProtestEnd: [PROTESTED: [No]]HEARNG HLD: [SE ACTION: [Approved] ActionDate: [PROOF DUE:

EXTENSION: [ELEC/PROOF:[]]ELEC/PROOF: [CERT/WUC: [LAP, ETC: [LAPS LETTER:

RUSH LETTR: [RENOVATE: [RECON REQ: [TYPE: []]

PD BOOK: [35-]]MAP: []]PUB DATE:

***TYPE -- DOCUMENT -- STATUS--**

Type of Right: Application to Appropriate Source of Info: Certificate Status: Certificate

=====

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)*****MAP VIEWER**GOOGLE VIEW***

=====

FLOW: 4.0 cfs AND 300.0 acre-feet
 SOURCE: Little Weber River
 COUNTY: Weber COMMON DESCRIPTION:

POINT OF DIVERSION -- SURFACE:
(1) S 100 ft E 1350 ft from NW cor, Sec 03, T 6N, R 3W, SLBM
 Diverting Works: Pump and ditch

Source: Little Weber River

Stream Alt Required?: No

POINT OF REDIVERSION:
(1) N 1985 ft W 3705 ft from E4 cor, Sec 11, T 6N, R 3W, SLBM
 Diverting Works:

Source:

=====

USES OF WATER RIGHT*** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ***** EDU -- Equivalent Domestic Unit or 1 Family**

=====

SUPPLEMENTAL GROUP NO.: 208908.

.....

IRRIGATION: 182.72 acres PERIOD OF USE: 04/01 TO 10/01

Purpose of Use: Sto.Irr. 300 ac.ft. diverted from Little Weber River. Stored , SLB&M.

.....

###PLACE OF USE:

	-----NORTH WEST QUARTER-----				*-----NORTH EAST QUARTER-----*				*-----SOUTH WEST QUARTER-----*				*-----SOUTH EAST QUARTER-----*			
	NW	NE	SW	SE												
Sec 03 T 6N R 3W SLBM	*				*				*				*			
Sec 10 T 6N R 3W SLBM	X	X			X	X			*				*			
Sec 11 T 6N R 3W SLBM	X	X			*				*				*			

GROUP

=====

OTHER COMMENTS*****

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Weber River Decree No. 83
 Proposed Determination No. 675 a,b. Pg. 224
 Said water to be stored in a natural channel of Little Weber River by means of
 a dam the center of which is to be at a point 1350 ft E. and 100 ft. S of the
 NW cor. of Sec. 3 T6N R3W thereby flooding during said period of storage the
 SW4 Sec. 1,S2 Sec. 2, N2 and SE4, Sec. 3. N2 Sec. 11, NW4 Sec.12 T6N R3W SLB&M

*****END OF DATA*****