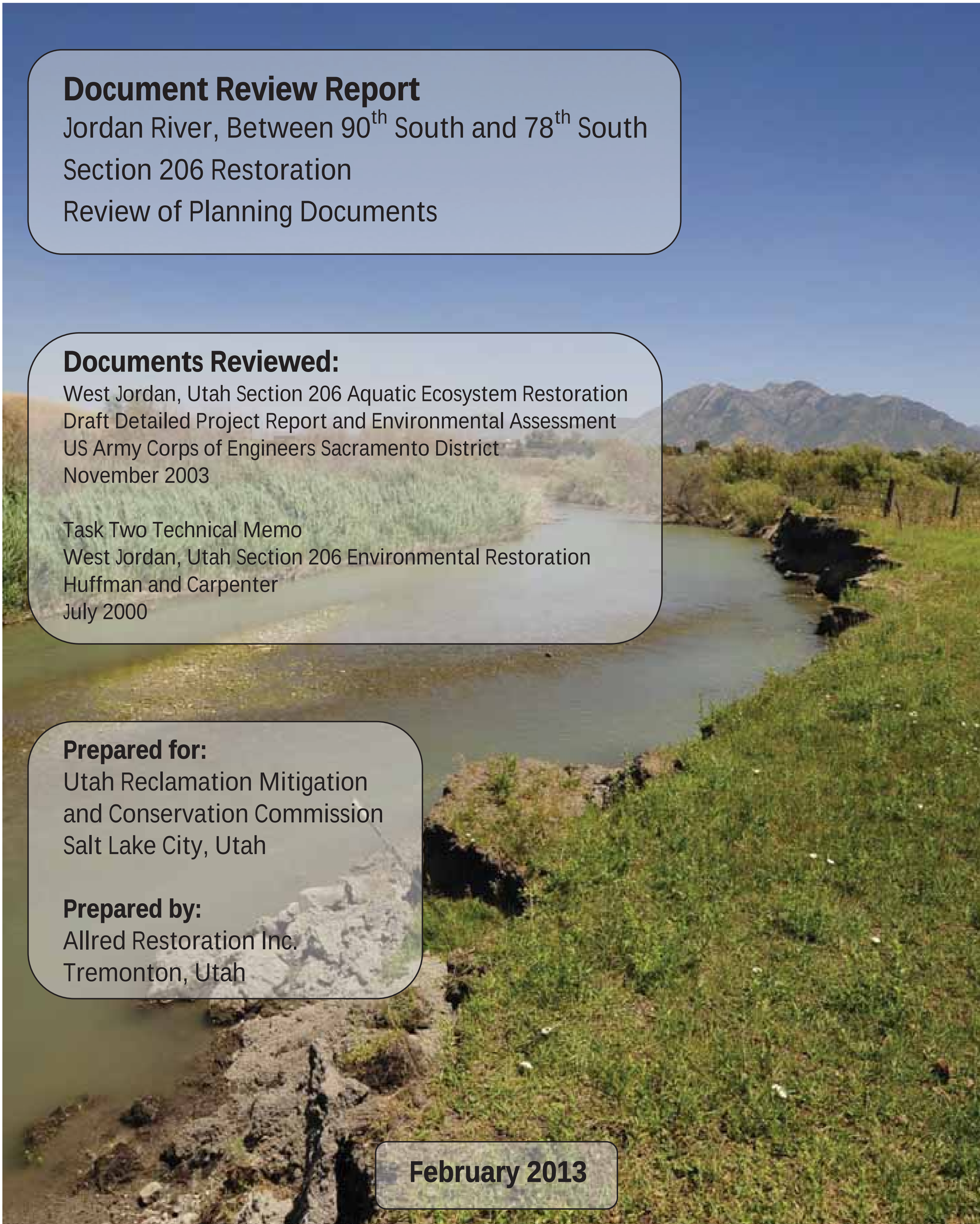


Document Review Report

Jordan River, Between 90th South and 78th South
Section 206 Restoration
Review of Planning Documents

Documents Reviewed:

West Jordan, Utah Section 206 Aquatic Ecosystem Restoration
Draft Detailed Project Report and Environmental Assessment
US Army Corps of Engineers Sacramento District
November 2003

Task Two Technical Memo
West Jordan, Utah Section 206 Environmental Restoration
Huffman and Carpenter
July 2000

Prepared for:
Utah Reclamation Mitigation
and Conservation Commission
Salt Lake City, Utah

Prepared by:
Allred Restoration Inc.
Tremonton, Utah

February 2013

Table of Contents

List of Figures

List of Tables

Background

The Utah Reclamation Mitigation and Conservation Commission (Commission) is responsible for mitigating the impacts to fish and wildlife that resulted from construction of the Central Utah Project and other federal Reclamation projects in Utah. As part of its mitigation program the Commission has developed numerous mitigation and conservation projects. These projects encompass several watersheds within the central and northern part of the State. Restoration of riverine, riparian and related wetlands features is a key component of many of the Commission's projects.

As part of its mitigation program the Commission is authorized to acquire and rehabilitate riverine and riparian habitats along Jordan River. The Mitigation Commission has been involved in planning a cooperative river/wetland restoration project along the Jordan River in conjunction with local municipal entities that was funded by other federal agencies. The project objective is the restoration of functional aquatic, riparian and wetland habitats within the project reach of the Jordan River corridor. The project is expected to result in a variety of positive environmental outcomes including restoration of riparian and wetland habitats and associated wetland values. An additional project objective is the maintenance of existing flood conveyance capacity of the Jordan River reach.

A considerable amount of work was completed many years ago which culminated in a Draft Detailed Project Report (DDPR) which is dated November 2003. Given the considerable time that has elapsed since it was written, the Commission determined that a thorough review and assessment of the DDPR and supporting documents should be completed prior to moving forward with the project. The Commission contracted with Allred Restoration to review and comment on the completeness and adequacy of the DDPR and supporting documentation.

The specific documents reviewed were:

1) West Jordan Utah, Section 206, Aquatic Ecosystem Restoration, Draft Detailed Project Report, November 2003. (**DDPR**)
   a) A draft Environmental Assessment (Appendix A. 97 pages, including attachments; November 2003 version, this has been updated with a draft 2011 version.
   b) Engineering Appendix (Appendix B; 44 pages + 42 plates dated November 2003, electronic version-Basis of Design, Revegetation and Geotechnical Reports);
   c) Real Estate Appendix (17 pages, land ownership and utility easements)
   d) Cost Effectiveness Evaluation (Appendix D; 12 pages with plates) and Habitat Evaluation Procedure Report (5 pages plus figures)
   e) Pertinent Correspondence (Environmental Assessment correspondence 38 pages)
2) Task Two Technical Memo West Jordan Utah; Section 206 Environmental Restoration. Huffman and Carpenter, Inc., July 2000. (**Tech Memo**)

Document Description and Purpose

This document provides a summary of the document review process that was completed by Allred Restoration. Given the volume of information in the DDPR and Tech Memo (over 600 pages), review and comment is necessarily limited to issues that were identified by Allred Restoration as important and relevant: specifically, those issues that need to be directly addressed if work on the project moves forward.

General Comments on the DDPR and Technical Memo

The Tech Memo and DDPR represent a considerable investment of money, time, and effort, to identify and address the important issues associated with any project of this magnitude being considered in an area surrounded by anthropogenic development. Although the project alternatives themselves are not complex, the proximity of project features to people and infrastructure warrant attention to every conceivable outcome. The Tech Memo and DDPR were apparently written to address every issue that was identified during the alternatives identification process. The included alternatives demonstrate a willingness to consider a range of possible solutions, and the overall work represents a high standard of excellence and attention to detail. Many of the problems identified during this review process are not a function of inadequate expertise, lack of understanding, or technical errors. While there were some instances of such problems, they were rare. Rather, most identified problems stem from the considerable span of time since the Technical Memo and DDPR were completed. For example… since the DDPR was completed in 2003, substantial changes have occurred to portions of the river channel, including channel widening and bank erosion. The high sustained flows during 2011 are likely responsible for many of the changes that have occurred. Of course, these recent events were not a part of the assessments in the 2003 DDPR. However, they should be addressed as the project moves forward. These issues and others identified during the review process are addressed individually in the sections that follow.

Technical Memo and DDPR - Specific Issues

Alternatives Assessment – Viability of Proposed Alternatives

The major issue identified during the review process involves the current lack of viability of at least two alternatives that were identified in the 2003 DDPR, including the preferred alternative. The DDPR includes evaluation and assessment of five alternatives, as follows:

1. No Action,
2. Benched Option without Off-Channel Wetlands,
3. Benched Option with Off-Channel Wetlands,
4. Meander Option without Off-Channel Wetlands,
5. Meander Option with Off-Channel Wetlands.

Note: Attachment 1 includes Plates 1 through 9 from the 2003 DDPR, showing site maps as well as plan views and cross sections of the alternatives. These are included for reference.

Alternatives 3 and 5 in the DDPR included off-channel wetlands that were to be constructed on the southern portion of a parcel of land known as the Beckstead Property, as shown in Attachment 1, Plates 2, 5, and 7. The Beckstead property was never purchased for the project, and the proposed wetlands on the Beckstead Site have now been removed from further consideration as a project alternative. As such, the list of viable proposed alternatives has been reduced from five to three, including the "No Action" alternative (Alternative 1).

To further complicate the Alternatives Assessment, the city of West Jordan is now considering the addition of a large urban fishing pond within the project boundaries. Figure 1 shows a concept drawing of one possible pond location. Although early in the design phase, the City has suggested that they wish to include the pond within the project boundaries. If this pond is included in plans for the property, Alternatives 2 and 4 are no longer viable as proposed: leaving only the "No Action" alternative from the 2003 DDPR. Addition of the pond basically invalidates the alternatives assessment portion of the DDPR and essentially begins the entire process anew. These changes in land availability and project goals present the most pressing problem identified in the review process.

Geomorphic Assessment

Channel Instability in Recent Years

The Task Two Technical Memo (completed in 2000 by Huffman and Carpenter) included an extensive geomorphic assessment of the history of the Jordan River channel in the project area based largely on historic aerial imagery, computational methods, and conclusions from other published sources. Using methods that included a Unit Hydraulic Geometry approach, a Geomorphic Stability Assessment, and professional judgment, they concluded that the channel was "stable in its present location" between 1991 and 1999. However, they qualify that conclusion by pointing out that the assessment period did not include substantial episodes of high flow. They further suggest that inclusion of high flows might lead to "modified conclusions". They also suggest that "the river's current stability is probably dependant on dredging and channelization activities". These conclusions, while factually correct for the time period of the assessment, are not particularly helpful today. Due to the irregular conditions encountered during the assessment period, the conclusions may not represent the actual form and process acting in the channel and the likely future condition of the channel under more typical high flow conditions.

Since completion of their assessment, considerable bank erosion and channel widening has occurred in portions of the Big Bend area. Figure 2 shows a section of the Jordan River within the project area, located just south of the Sharon Steel Tailings Cap, in which there has been substantial erosion, deposition, and channel widening. Nearly all of the erosion has occurred since completion of the 2000 Technical Memo. Further analyses demonstrated that the majority of the erosion occurred between 2009 and 2012 (Figure 3), probably driven primarily by the sustained high flows of 2011, which started in February and continued throughout the year, due to high snowpack and high water levels in Utah Lake. Streamflow in the Jordan River remained at levels that are geomorphically effective for nearly a full year, and large scale erosion occurred in areas that had been stable during the DDPR planning period.

Future Channel Function

The expected channel function, with respect to migration, following project implementation was not well addressed in the DDPR and the Tech Memo. The documents report that lack of channel migration due to bank hardening has caused episodic downcutting within the channel, which in turn has created conditions where the high flows cannot access the floodplain. These statements might suggest that channel migration would be a goal of the project, and might be allowed or even encouraged within the project boundaries, but that is never discussed explicitly.

In section 3.1, the planning objectives are outlined: they include

- Restoration of wetlands geomorphic/hydraulic function:
    1. Restore dynamic flood plain processes,
    2. Restore in-channel processes,
    3. Improve bank stabilization,
    4. Prevent further downcutting.

These objectives would seem to suggest that natural channel function would be desirable, but no real discussion is included that specifies which processes are desired (i.e. erosion, deposition, migration, etc.). Also, as mentioned earlier, improvements in bank stabilization could cause downcutting if not implemented carefully, particularly if that stabilization is accomplished using large rock riprap. Given the presence of the Sharon Steel cleanup site, the power station, the fur-breeders facility, and area homes, channel migration is only possible in a short section of the Big Bend area. No limits of migration were defined in the document. The expected form and process of the restored channel should be identified and the limits of natural function should be explicit in the document.

Hydrology

The 2000 Technical Memo hydrologic analyses included flood frequency estimates for the 90th South section of the Jordan River. These flood peak estimates were computed using various methods because the gage record for the Jordan River at 90th South was relatively short. Salt Lake County now uses FEMA flood frequency data (Federal Emergency Management Agency, Flood Insurance Study, Salt Lake County, Utah, 2009) that is to be used for projects on the Jordan River. The FEMA values are substantially different than those computed in the 2000 Technical Memo. Table 1 summarizes the differences in flood magnitude and frequency between these two documents.

Table 1. Flood Magnitude and Frequency Estimates

Recurrence Interval	Huffman and Carpenter - 2000	Salt Lake County - Current
10-year Peak Discharge	1,448 cfs	1,170 cfs
50-year Peak Discharge	2,100 cfs	2,230 cfs
100-year Peak Discharge	2,380 cfs	2,790 cfs

These differences in flood magnitude and frequency are substantial considering the roughly 15% increase in the 100-year peak discharge. Project managers will need to incorporate the new flood estimates into planning and design efforts. It is worth noting that the values computed in the 2000 study were done correctly using appropriate methods, but they are no longer valid. The current estimates will need to be used to meet county flood control guidelines.

In addition to changes in flood magnitude and frequency, other hydrologic issues of concern were not addressed in the DDPR or the Tech Memo. One major area of concern for the Jordan River is the episodic rising and lowering of flow levels within the river. These events occur because changes to streamflow are controlled by gates at the outlet of Utah Lake. These gates are often adjusted rapidly, causing rapid fluctuations in flow levels. These rapid changes are problematic from a restoration standpoint, because they often initiate rapid erosion. Of particularly concern are rapid decreases in flow levels, which leave saturated banks that fail under gravity due to the weight of saturated soils. These types of failures are common along the Jordan River.

Topography

The Technical Memo and DDPR used topography based on ground surveys and aerial photogrammetry. These were the best data sources available at that time. More recently, LIDAR data have become available for the project site. These LIDAR data provide a high level of accuracy and resolution for design work and alternatives assessment. The LIDAR data are shown in Figure 4.

The vertical datum used for the LIDAR data is the North American Vertical Datum of 1988 (NAVD88). This datum is different than that used for the work in the Technical Memo and the DDPR, which was apparently based on the National Geodetic Vertical Datum of 1929 (NGVD29), although the datum is not referenced in the document. NAVD88 differs from NGVD29 by roughly 3 feet in the project area. When the DDPR data are adjusted by 3 feet, the elevations align reasonably well. It is important to note that the differences between these two datums vary from location to location, so a 3-foot adjustment is only useful for a rough estimate in the project area. Care should be taken to ensure that current planning efforts based on the LIDAR data account for these differences.

HEC-RAS Modeling

Assessment of the HEC-RAS modeling efforts for the 2000 Technical Memo and the 2003 DDPR proved challenging. The original models that were provided to Allred Restoration were for alternatives not included in the Tech Memo and DDPR. Additional searching eventually produced the HEC-RAS models used for assessment of existing conditions as well as the range of alternatives.

The HEC-RAS models provided to Allred Restoration included an “Existing Conditions” model. Although this model may have accurately described site conditions at the time of the Tech Memo, it clearly does not describe the current conditions. As described earlier in this document, apparent channel changes have occurred in some areas that can be easily identified in aerial imagery, including erosion of banks, deposition of new point bars, and channel widening. Vertical changes in the bed profile may also have occurred, but these cannot be verified directly from aerial images without surveys. These changes in channel form probably justify a new RAS model to describe current conditions.

Note: The United States Geological Survey (USGS) recently completed a 2-D flow modeling effort for a section of the Jordan River, including the project area (Kenney and Freeman, 2011: Two-Dimensional Streamflow Simulations of the Jordan River, Midvale and West Jordan, Utah: USGS Scientific Investigations Report 2011-5043). Review of this paper was beyond the scope of this contract, but a brief review was completed. They surveyed new cross sections throughout the study area and their model could potentially be used to document the new channel conditions. However, this report was published in 2011 and may not capture much of the erosion that occurred during that year.

The 2000 Tech Memo included a comparison of RAS models from 1991 and 1999. This comparison again led to the conclusion that the channel was relatively stable during that time period: a period when no high flows occurred. They concluded as well that channel capacity had remained essentially unchanged over that span of time. However, the conclusion is again based on channel conditions that include frequent human intervention including dredging and bank stabilization. As such, no real process or function of the river is determined. Rather, they are simply demonstrating that the river doesn't change much when people prevent it from moving and dredge out accumulated sediments. Again, these conclusions are correct, but not particularly helpful.

Sediment Transport

The sediment transport analyses presented in the DDPR and Tech Memo are problematic at best. Most of the input estimates that are made rely on hydraulics from three cross sections that were modeled upstream of the bridge at 90th South. These three cross sections are located immediately upstream of the bridge and do not represent the sediment input conditions very well. Using them to estimate sediment delivery into the reach is probably not justified. The DDPR correctly notes that the North Jordan Diversion Structure, located 0.75 miles upstream of the project area, likely reduces the flow of sediment into the project area much of the time. And that periodic flushing of the stored sediment upstream of the structure sends pulses of sediment into the reach. However, they assume that the reach is sediment starved, which is by no means certain. In fact, the need to dredge sediment from the channel bed suggests otherwise. Also, their computed sediment loads are very large at over 300,000 tons in the Big Bend reach, which is not consistent with a sediment starved condition.

Other problems are apparent in the sediment transport calculations. For example, the DDPR describes the application of Shields Stress to determine the flow levels required to begin movement of sediment. It concluded that a discharge of roughly 240 cfs was required to initiate motion of sediment in Subreach 2. This finding suggests that essentially no sediment is in motion at discharges less than 240 cfs. However, later in the document, when calculating sediment loads, it states that the computed sediment load is 50 tons per day at a discharge of 60 cfs. These two findings are in opposition to each other, but no discussion or possible explanations are offered. Given the low slope it seems unlikely that transport of bed material is substantial at low discharges.

The DDPR also draws conclusions about the likelihood of downcutting or of aggradation under a range of flows. These conclusions are based on the hydraulic geometry analyses and are unsupported by any real transport data. The tendency of any particular section of the river to downcut or aggrade is far more complex than the methods that were applied can adequately predict.

Proposed Drain

The DDPR includes plans for a proposed semi-permeable riprap levee (Figure 5) that would allow water to drain from the new meander channel back into the old channel to maintain the riparian vegetation and to supply water for the Sharon Steel Wetland. This drain is likely not needed because the groundwater in the area will remain quite high and should keep the old channel filled with water at all times. Recent groundwater studies of the Jordan River suggest that this reach is a gaining reach, meaning that groundwater levels slope toward the river channel. The proposed design appears to be adequate but has a 2-to-1 slope on the downstream side. Steep slopes like this one are far less stable than more gradual slopes which occur over longer distances. I recommend that the slope be reduced to 6-to-1 or more on the back side of the levee, if it is deemed to be needed. In addition, high flows should be allowed to overtop this levee, whenever they occur. During periods of extremely high flow, the entire floodplain will be inundated. It would be better to allow the water to overtop the levee and flow down the old channel rather than trying to prevent it from overtopping. Given the extremely low slope in the area, water will likely be ponded against the back side of the levee before it overtops. The high water on the back side of the levee helps limit any tendency to headcut as water flows over the top, especially if the slope on the back side is shallow.

Costs

Selective Review of Costs Explained

The DDPR included both detailed cost sheets and overall cost summary tables. The costs were spread over a wide range of categories and areas of expertise. Although a review of all the individual line items is possible, it would require a team of individuals from a wide range of disciplines, and an extended effort to identify all the aspects of the project that may have changed in the nearly 10 years since the DDPR was issued. A complete review of all costs is beyond the scope of services of this review, but a thorough present-day cost estimate should be included in future planning activities, as the project moves forward.

For this report, Allred Restoration was asked by the URMCC to examine only those costs directly tied to the earth-moving activities associated with the project and oversight of those activities. These costs are addressed individually in the sections that follow.

Costs - Sitework Category

The detailed cost category of "Sitework" includes the following line items:

- Clear and Grub — $195,000 — (same for Options 2 & 4)
- Earthworks – Bulk Excavation — $1,440,000 — (same for Options 2 & 4)
- Earthworks – Grading and Replace Topsoil — $113,100 — (same for Options 2 & 4)

The "Sitework" category represents the single largest cost associated with the proposed restoration alternatives. The costs for this category are high because of the quantity of excavated material. Examination of the HEC-RAS models used to evaluate the alternatives shows that enormous volumes of floodplain material will need to be removed to lower the floodplain to an elevation where overbank flooding can occur: a primary goal of the project (Figures 6 and 7). Much of the floodplain will need to be lowered by 4 to 5 feet in order to be accessible to the river during frequent flood events.

The 2003 DDPR calls for 240,000 cubic yards of excavated material, for both Alternatives 2 and 4, at a unit cost of $5 per cubic yard, plus a 20% contingency. A unit cost of $5 per cubic yard is applicable today, thus the "Sitework" portion of the cost estimate is still reasonable in 2013 dollars, but **only** if the spoil material does not need to be trucked off-site at the project's expense (discussed at length in subsequent paragraphs). The wording in the DDPR is far too broad, explaining: *"Top soils would be excavated and stored on-site. Additionally, soils capable of supporting wetland vegetation would be stockpiled and reused. The remaining excess spoil material will be sold to offset excavation and transportation costs. If a buyer cannot be located, the excess spoil will be dumped at a site designated by the City of West Jordan within 20 miles of the construction site."*

Although the DDPR identified the correct excavation volumes and unit costs for the "Sitework" category, it neglected to illuminate the large differences in cost between selling the material and trucking it off-site. The estimated costs were apparently intended to cover either of these options. Given the large volumes of material, the cost of transporting the excavated material off-site may nearly double the overall project cost. The scenarios below are included to further describe the important differences between these options.

Scenario Assumptions

1) Assuming that topsoil would be stockpiled on-site and applied to the newly-recontoured surfaces at a depth of 6 inches, the topsoil volume would be roughly 40,000 cubic yards. Given the total excavation volume of 240,000 cubic yards, this leaves 200,000 cubic yards of material to truck off-site.
2) Assuming that side dump trucks were used, to transport the excess spoil off-site, that could carry 16 cubic yards per round trip, 12,500 round trips would be required to transport the spoil material off-site.

Scenario 1 – Nearby Location, within 5 road miles - 30 Minute Round Trip

- Assuming that the excess material could be trucked off-site to a **nearby** location, requiring only a 30-minute round trip (including loading time), transporting the excess spoil would require 6,250 hours of rental time for the dump trucks, at an assumed rate of $180 per hour. A fuel surcharge is also likely, at a rate of 10%.
- Assuming 20 trucks were run continuously for eight hours per day, each making 16 round trips per day, the spoil could be transported off-site in roughly 40 working days, or 2 months. This time estimate assumes no delays of any kind, which is somewhat unlikely.
- With the same 20% contingency used elsewhere in the DDPR, the cost of trucking the excess spoil to a nearby location is roughly $1,485,000.00.

Scenario 2 – Distant Location, within 20 road miles – 2 Hour Round Trip

- Assuming that the excess material must be trucked off-site to a distant location, requiring a longer 2-hour round trip, transporting the excess spoil would require 25,000 hours of rental time for the dump trucks, at an assumed rate of $180 per hour. A fuel surcharge is also likely, at a rate of 10%.
- Assuming 20 trucks were run continuously for eight hours per day, each making 4 round trips per day, the spoil could be transported off-site in roughly 160 working days, or roughly 8 months. This time estimate assumes essentially no delays of any kind, which is unlikely.
- With the same 20% contingency used elsewhere in the DDPR, the cost of trucking to a nearby location is $5,940,000.00.

Note: *These scenarios include only direct costs of trucking. Other costs, including flagmen, road cleanup, etc., would also be required if trucking the spoil off-site.*

As the above scenarios demonstrate, the cost of trucking the excess material off-site is extremely high. The previous costs estimates included in the DDPR did not directly take these costs into account. These trucking costs would be in addition to those already included in the "Sitework" category. Project managers should be aware of these high costs and consider them when evaluating options for construction. If the spoil could be sold and trucked off-site by others, the savings would be great. If not, other options would need to be explored.

If no buyer can be found, other arrangements might be made to waste the material somewhere nearby that did not require over-the-road trucking. If this could be arranged, considerable savings could be realized. The sheer volume of excess spoil material prohibits wasting it directly anywhere on the project property. However, project managers may want to pursue the option of wasting material on nearby properties, including the Sharon Steel cleanup site. The Sharon Steel project essentially involved burying contaminated soils under a cap of clean soils. It is possible that the excess spoil from the Jordan River project could be used to enhance the safety of the cleanup site by adding additional layers of clean soil over the existing soil cap. This option is offered as a possible approach, but the details of such an agreement, if feasible, are beyond the scope of this document.

Costs - Planning, Engineering and Design Category

This category accounts for roughly $356,000 of the total cost for Options 2 and 4. Although specific comments on these costs are not possible, general comments are applicable. The following sections will describe two possible approaches for planning, engineering and design of the project, and then offer some considerations and possible cost savings that could be achieved by selecting one approach over the other.

Two Approaches for Planning, Engineering and Design

Two major approaches are available to managers for a project like the proposed restoration: (1) detailed plans and specs approach, or (2) design/build approach. These two approaches can have very different up-front costs and each is suited best to particular types of projects. They are described in the following paragraphs.

Detailed Plans and Specs Approach

The detailed plans and specs approach involves producing detailed plans and specifications for every aspect of a construction project. Engineering and planning costs for this approach are often very high, due to the need for accurate description of every project detail. This method is frequently employed when contractors are used for the construction effort, and exact descriptions of every aspect of the construction are required in order for contractors to prepare bids. The problem with this approach for restoration projects is that it is difficult to foresee every eventuality that may occur during construction, often resulting in a large number of change orders which can greatly affect the final cost of a project. Each time something new is encountered, a new change order is required. While the detailed plans and specs approach works well for structures and other projects where all the details are known in advance, it is less well-suited to restoration projects, which are more likely to encounter unforeseen obstacles as well as great unforeseen opportunities.

Design/Build Approach

The design/build approach for project planning and construction offers a flexible way to plan for complex restoration projects. This method requires less up-front design cost because plans are prepared at a lower level of detail, relying on a set of “typical” treatments that will be used for an array of conditions that might be encountered during construction. Experience has demonstrated that this type of flexible design/build approach works extremely well for riverine ecosystem restoration, since flexibility allows designs to be adjusted to take advantage of conditions encountered as work progresses, thus improving upon initial designs.

The design/build method is particularly useful when state or federal agency crews are used for the construction effort. These agency crews normally work on a “time and materials” basis, thus reducing the need for change orders when adjustments to the original design are deemed to be beneficial for the project, thereby reducing costs while improving the final outcome. The design/build approach requires a good working relationship between restoration designers and construction crew foremen because minor adjustments to the design are a daily part of the construction process, and designers must be able to communicate well with construction personnel.

Recommended Approach for Planning, Engineering and Design

Although each of the approaches outlined above can be used for construction projects, only the design/build approach is recommended by Allred Restoration for river restoration projects like the Jordan River Project. The design/build method allows greater flexibility to adapt and include new opportunities that emerge during the construction phase. Previous river restoration projects have benefitted greatly by incorporating the design/build approach, and this project is likely to benefit as well.

Some cost savings could also be realized by using the design/build approach for the Jordan River Project. Allred Restoration estimates that the up-front costs for the Planning, Engineering, and Design category could be reduced by 40% if detailed plans and specs are not required. Additionally, the construction costs may be reduced by using agency crews to accomplish the work.

Costs - Construction Management Category

In the 2003 DDPR, the construction management category is responsible for over $327,600 of the overall project cost for Option 2, and $321,000 of the overall project cost for Option 4. These costs estimates appear to be valid in 2013 dollars, even assuming that the design/build approach is incorporated for planning, engineering and design. The design/build approach requires project designers to maintain a presence on-site during much of the construction phase, to allow for adjustments to be made quickly and efficiently. The cost estimate includes sufficient dollars for designers to oversee the work as it progresses, and for project updates and other interactions with agency personnel. This cost estimate will likely need little adjustment as the project moves forward.

Other Costs

It is important to note that the costs reviewed in the previous sections account for roughly 48% of the total projected cost for Alternatives 2 and 4. Other cost categories that were not reviewed for this report may have line items where costs can be reduced, but review of those items will need to be accomplished as planning for this project progresses.

Selected Plan – Based on Incremental Cost and Effectiveness Analysis

The DDPR included an Incremental Cost and Effectiveness Analysis (ICEA) based on a Habitat Evaluation Procedure (HEP). The HEP model is used to provide output results of various existing and future conditions. Output unit from the HEP model is termed an Average Annual Habitat Unit (AAHU). A detailed review of the procedure is not needed in this document, but it is important to note that the ICEA method was used along with HEP to select the best alternative. The result is a cost per AAHU for each alternative (Table 2). The effectiveness of the benched options (Alternatives 2 and 3) was demonstrated to be less than meander restoration options (Alternatives 4 and 5), and Alternative 5 was selected as the most cost-effective alternative. Remember that Alternatives 3 and 5 are no longer viable (gray in Table 4), thus, the conclusion drawn from the ICEA is no longer valid. Additionally, if changes are made to Alternative 4, such as the addition of a large fishing pond, the ICEA for that alternative is no longer correct. Whatever the design of a new alternative, it would need to have new cost/benefit analyses completed to verify its effectiveness, prior to being selected as the preferred alternative.

Table 2. Comparison of Selected Criteria for Each Alternative (Table 12 from DDPR)

Alternative	Completeness	Effectiveness (Increase in AAHUs)	Efficiency ($1,000s/AAHU)	Acceptability
1 – No Action	Incomplete -Does not address planning objectives	N/A	N/A	Does not meet restoration goals of non-Federal sponsor and others
2 – Benched Restoration without Off-Channel Wetlands	Complete if obtain Big Bend area only -28.6 acres of self-sustaining wetland -38.3 acres of irrigated wetland	31 AAHUs -Restores flood plain process to left hand side bank only	Least efficient $163K/AAHU	Low
3 – Benched Restoration with Off-Channel Wetlands	Complete for both Big Bend & Beckstead props -56.4 acres of self- sustaining wetland -28.7 acres of irrigated wetland	41.4 AAHUs -Restores flood plain process to left hand side bank only	Efficient $136K/AAHU	Moderate
4 – Meander Restoration without Off-Channel Wetlands	Complete if obtain Big Bend area only -67 acres of self -sustaining wetland -0 acres of irrigated wetland	33.2 AAHUs -Restores flood plain process to both banks -Guaranteed riffle pool sequence	Less efficient $141K/AAHU	Moderate
5 – Meander Restoration with Off-Channel Wetlands	Complete for both Big Bend and Beckstead props -67 acres of self-sustaining wetland -18.1 acres of irrigated wetland	43.3 AAHUs -Restores flood plain process to both banks -Guaranteed riffle pool sequence	Most efficient $120/AAHU	High NER Alternative (also Sponsor's preferred Alternative)

Summary

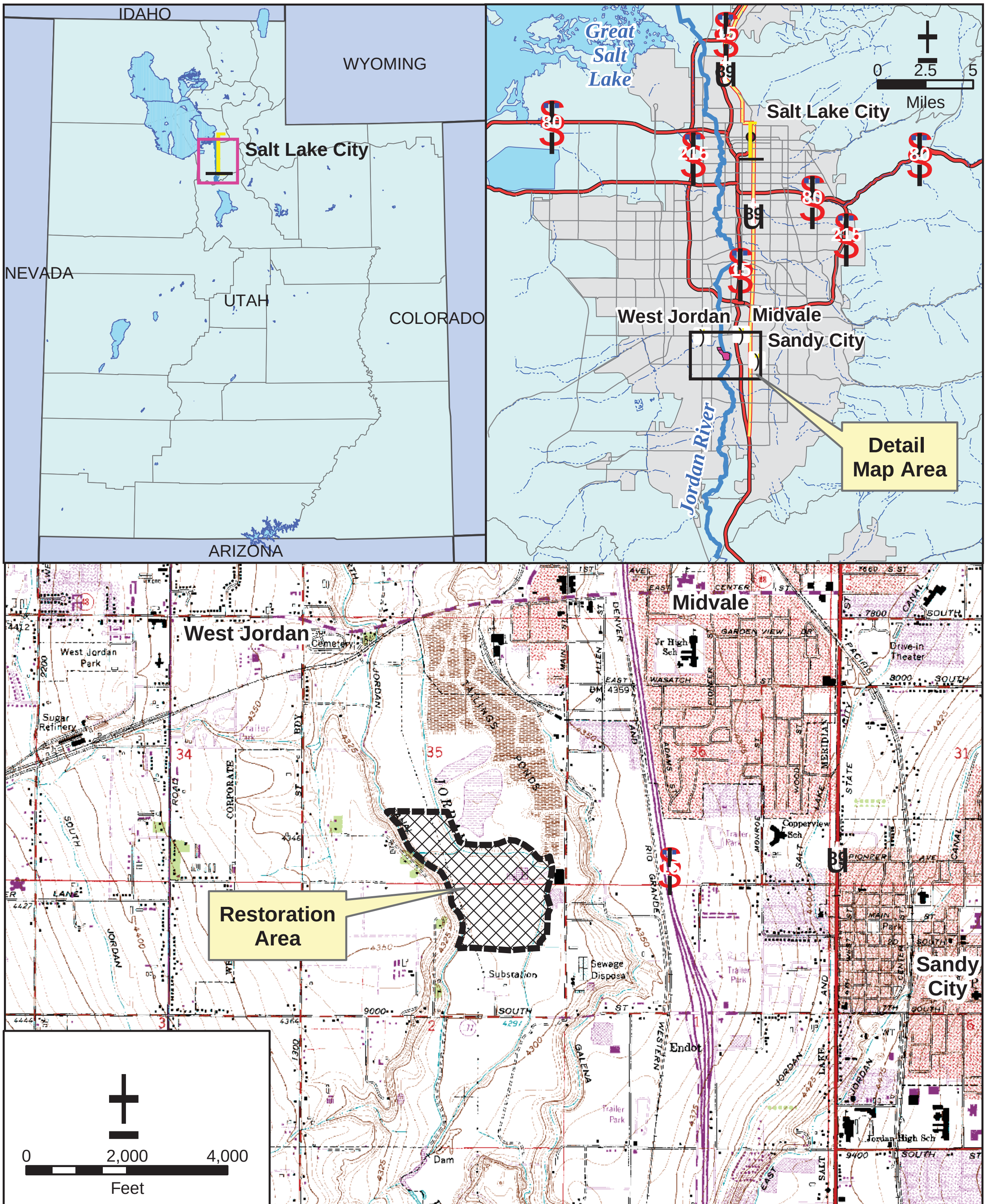
These documents offer a great deal of information about the history of the Jordan River and the analyses that were completed ten years ago. Despite the generally thorough nature of the documents that were reviewed, substantial change has occurred to both the project alternatives and the physical environment within the project area, since they were completed. As such, many of the analyses presented no longer apply directly or are subject to considerable uncertainty. When project managers are ready to move forward, many of the analyses will need to be revisited. Some of the analyses are not particularly useful, but others are imperative. This report has attempted to identify those issues that should be of utmost concern.

Perhaps the most disconcerting issue is the apparent lack of remaining alternatives that are viable. The proposed large pond, being considered by the City of West Jordan, probably amounts to a new alternative if included in the proposed design, but its inclusion is not a given at this point. At the very least, the cost/benefit analyses that were completed and used to help select a recommended alternative in the DDPR would likely need to be revised if the pond becomes part of the project. It is possible that the pond could be carefully incorporated into a new design in a way that meets the previous goals and wetland functions, and that does not substantially change the outcome of the cost/benefit analyses, but that is beyond the scope of this review document.

Although much has changed since these documents were prepared, the most important driving issues have not: specifically, the environmental degradation of the river and floodplain is ongoing, and the need for restoration still exists. This project is still viable. It still has the potential to provide meaningful environmental benefits if it is completed, and the costs are similar to those proposed many years ago, assuming that the spoil can be disposed of without excessive expenditures. The designs of the alternatives, as proposed in the DDPR, are probably not adequate for the current situation, and should be redone. But designers would not be starting from scratch. The best elements of the existing designs could be incorporated into new designs that better capture the current desires for the project area.

Attachment 1

Plates Copied Directly from the DDPR



Huffman & Carpenter, Inc.
Hydrologic & Wetland Regulatory Consultants

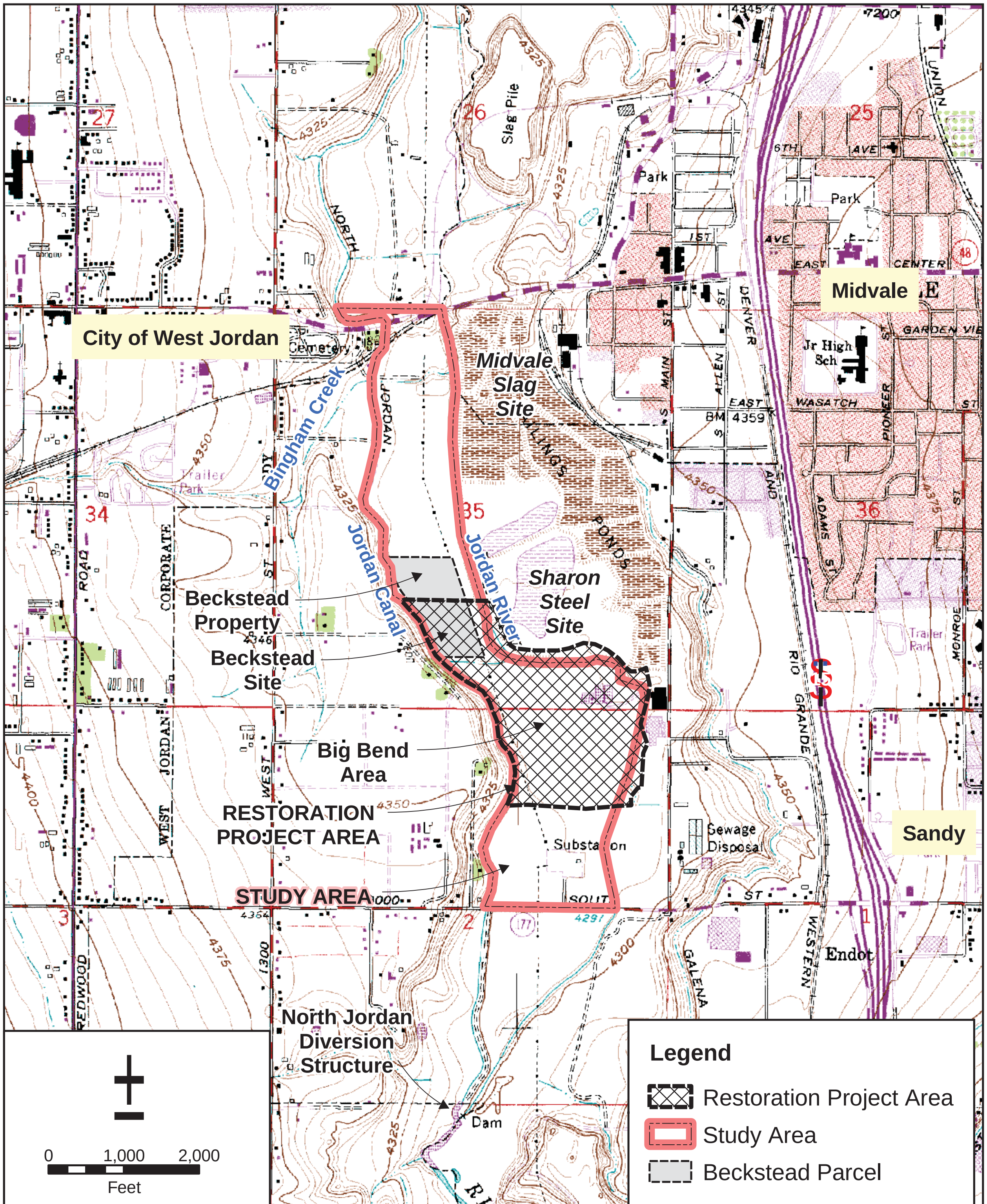
nvwetlands.com 775.828.1991
700 Smithridge Dr. Suite 102A Reno, Nevada

West Jordan, Utah
Section 206
Equatic Ecosystem Restoration

Plate 1

Vicinity Map

I:\Projects\100-Army Corp\100-188-Jordan\Mapping\ArcView\dpr-ea_plate1_vicinity_map.mxd 6/17/2003



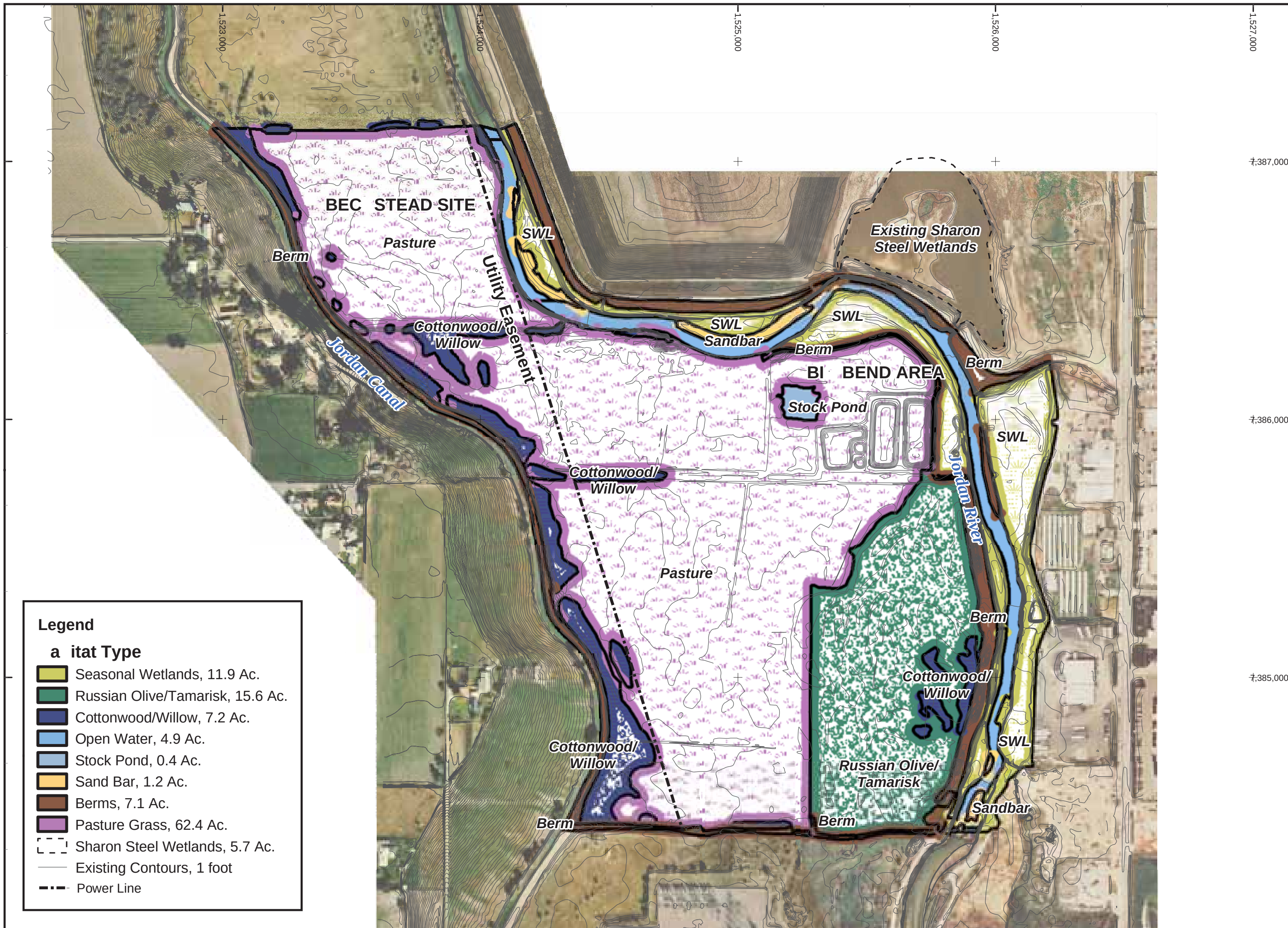
Huffman & Carpenter, Inc.
Hydrologic & Wetland Regulatory Consultants
nvwetlands.com 775.828.1991
700 Smithridge Dr. Suite 102A Reno, Nevada

West Jordan, Utah
Section 206
Equatic Ecosystem Restoration

Plate 2

Site Map

I:\Projects\100-Army Corp\100-188-Jordan\Mapping\ArcView\dpr-ea_plate2_site_map.mxd 6/17/2003



Huffman & Carpenter, Inc.
Hydrologic & Wetland Regulatory Consultants
www.nvwetlands.com 775.828.1991
700 Smithridge Dr. Suite 102A Reno, NV 89502

Ê

Scale 1" = 400'

0 200 400 600

Feet

Utah State Plane Coordinate System, Central Zone, NAD83, Feet

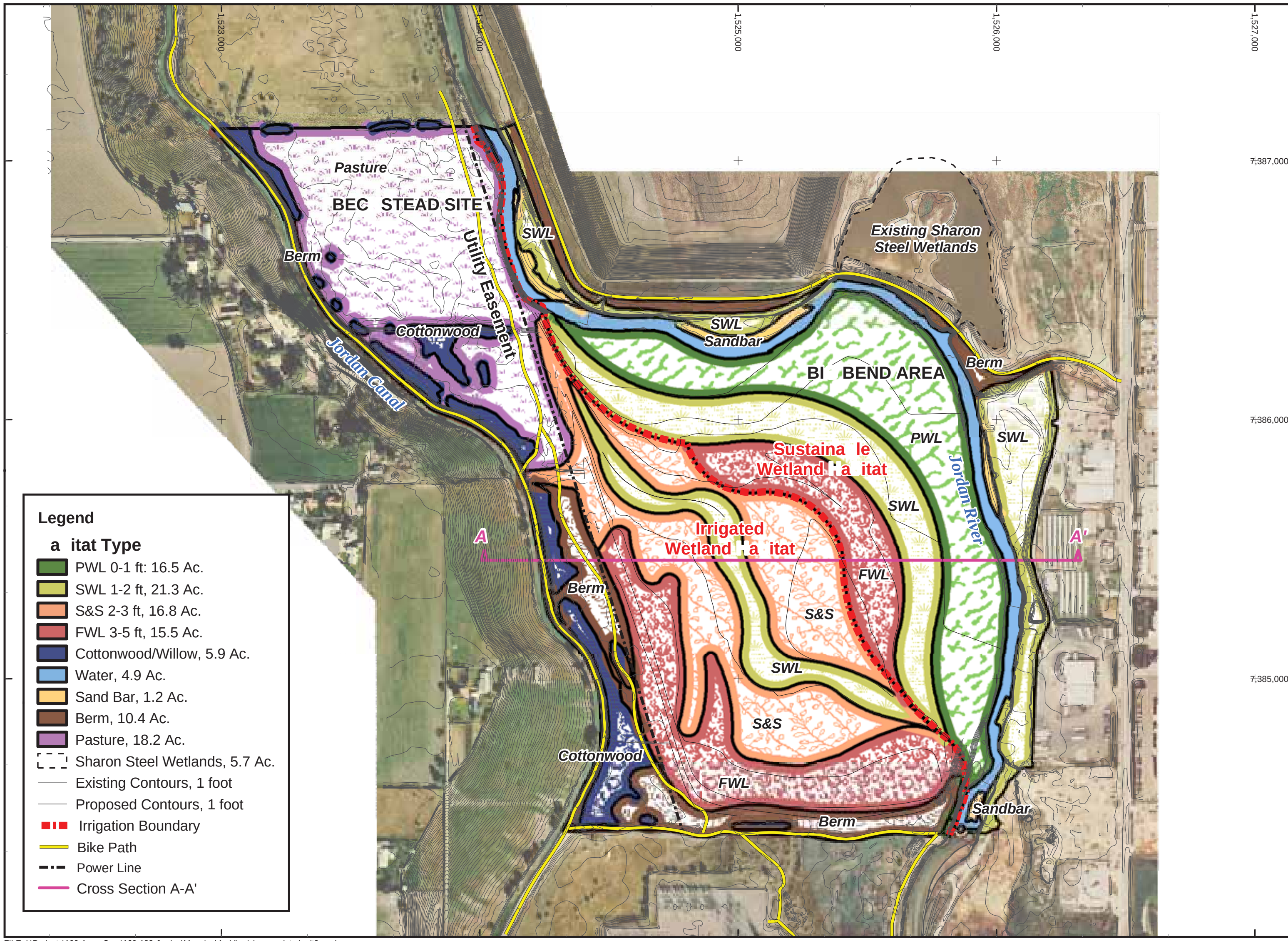
West Jordan, Utah
Section 206
Aquatic Ecosystem Restoration

Plate 3

Alternative 1
E isting a itats

FILE: I:\Projects\100-Army Corp\100-188-Jordan\Mapping\ArcView\dpr-ea_plate3_alt1.mxd

4/22/2003 GSH



Huffman & Carpenter, Inc.
Hydrologic & Wetland Regulatory Consultants
www.nvwetlands.com 775.828.1991
700 Smithridge Dr. Suite 102A Reno, NV 89502

Scale 1" = 400'
0 200 400 600
Feet
Utah State Plane Coordinate System, Central Zone, NAD83, Feet

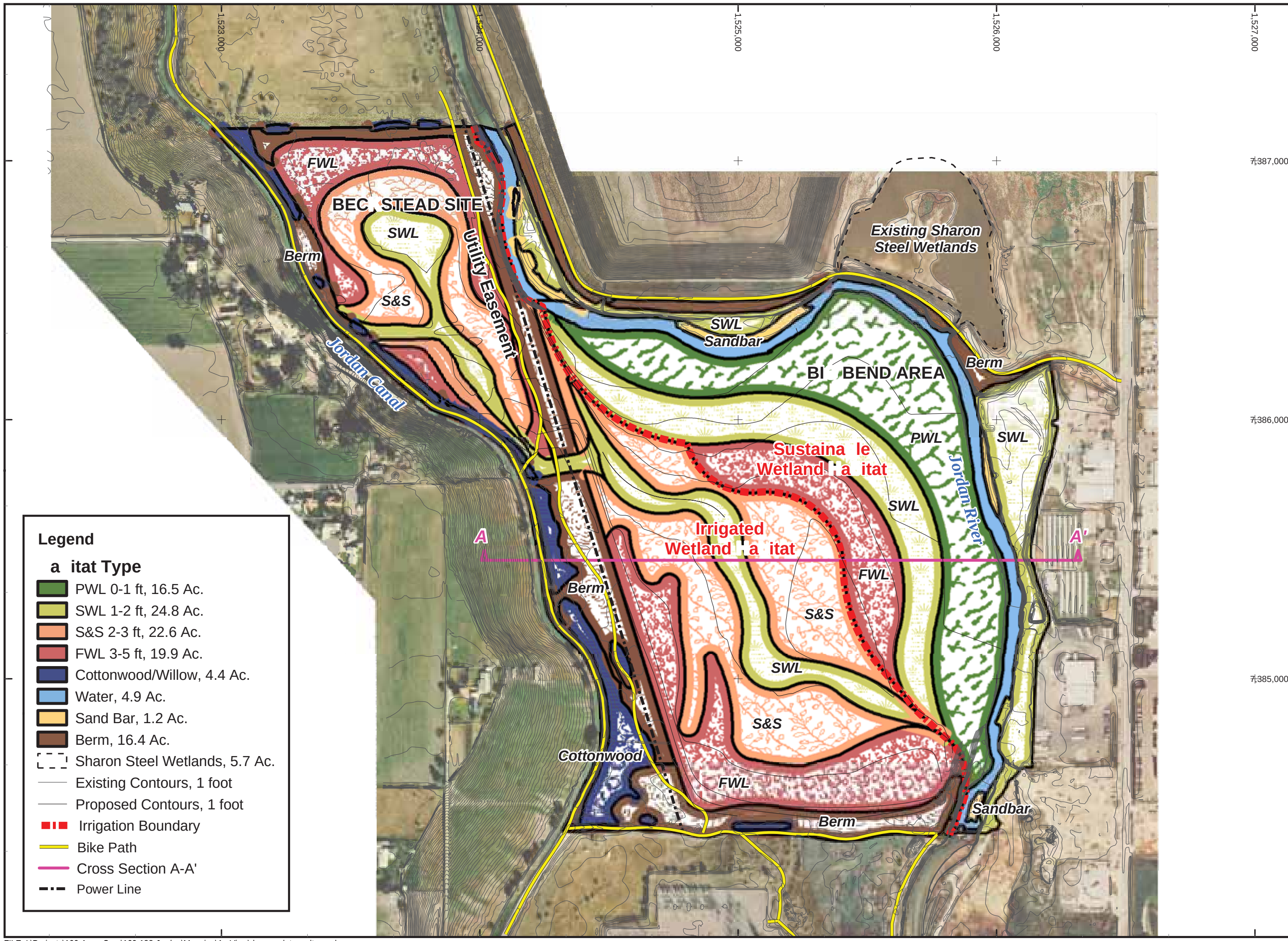
West Jordan, Utah
Section 206
Aquatic Ecosystem Restoration

Plate 4

Alternative 2
Benched Restoration
Without Off channel Wetlands

FILE: I:\Projects\100-Army Corp\100-188-Jordan\Mapping\ArcView\dpr-ea_plate4_alt2.mxd

4/22/2003 GSH



Huffman & Carpenter, Inc.
Hydrologic & Wetland Regulatory Consultants
www.nvwetlands.com 775.828.1991
700 Smithridge Dr. Suite 102A Reno, NV 89502

Scale 1" = 400'
0 200 400 600
Feet
Utah State Plane Coordinate System, Central Zone, NAD83, Feet

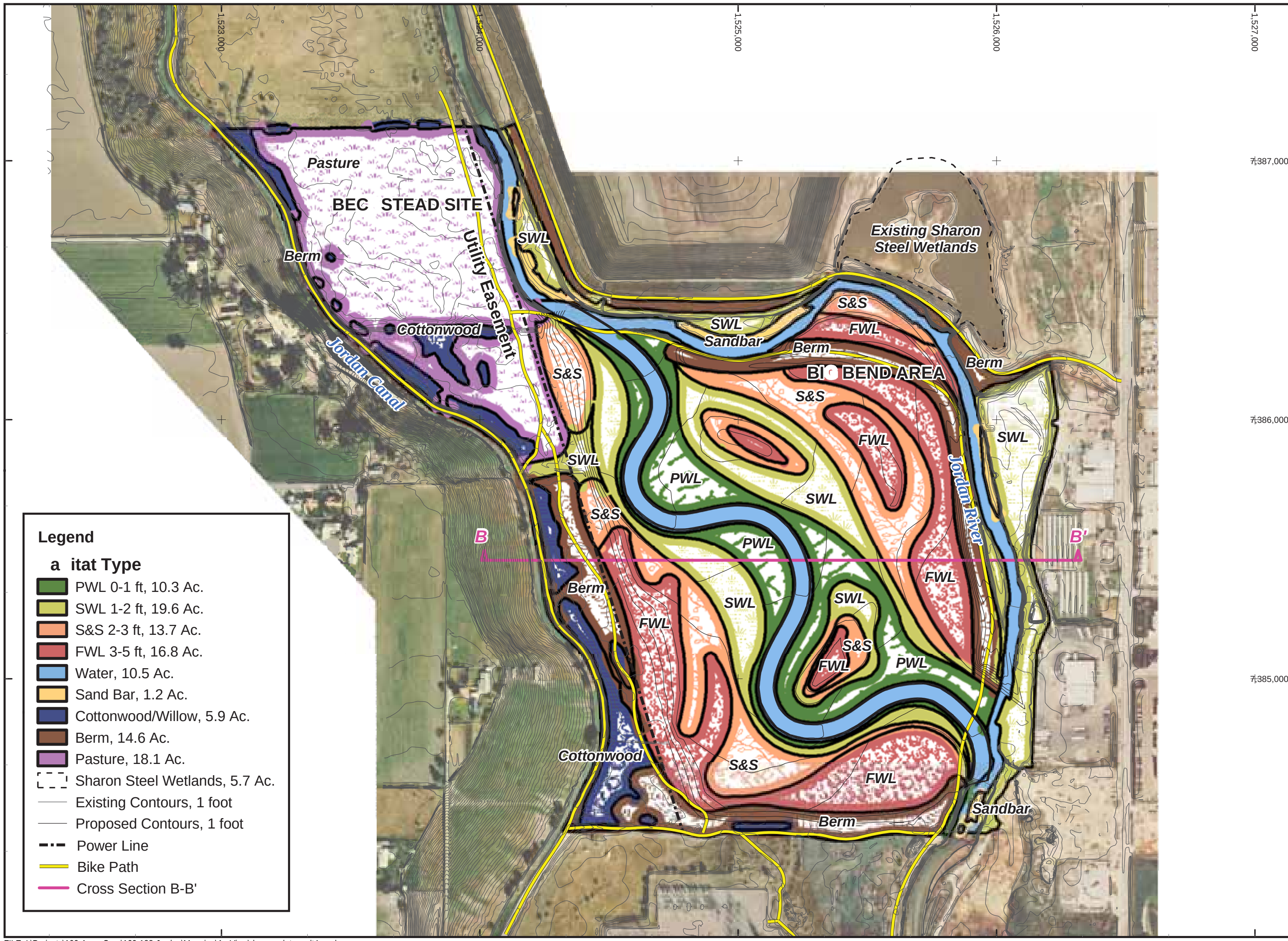
West Jordan, Utah
Section 206
Aquatic Ecosystem Restoration

Plate 5

Alternative
Benched Restoration
With Off Channel Wetlands

FILE: I:\Projects\100-Army Corp\100-188-Jordan\Mapping\ArcView\dpr-ea_plate _alt .mxd

4/22/2003 GSH



Huffman & Carpenter, Inc.
Hydrologic & Wetland Regulatory Consultants

www.nvwetlands.com 775.828.1991
700 Smithridge Dr. Suite 102A Reno, NV 89502

Scale 1" = 400'
0 200 400 600
Feet
Utah State Plane Coordinate System, Central Zone, NAD83, Feet

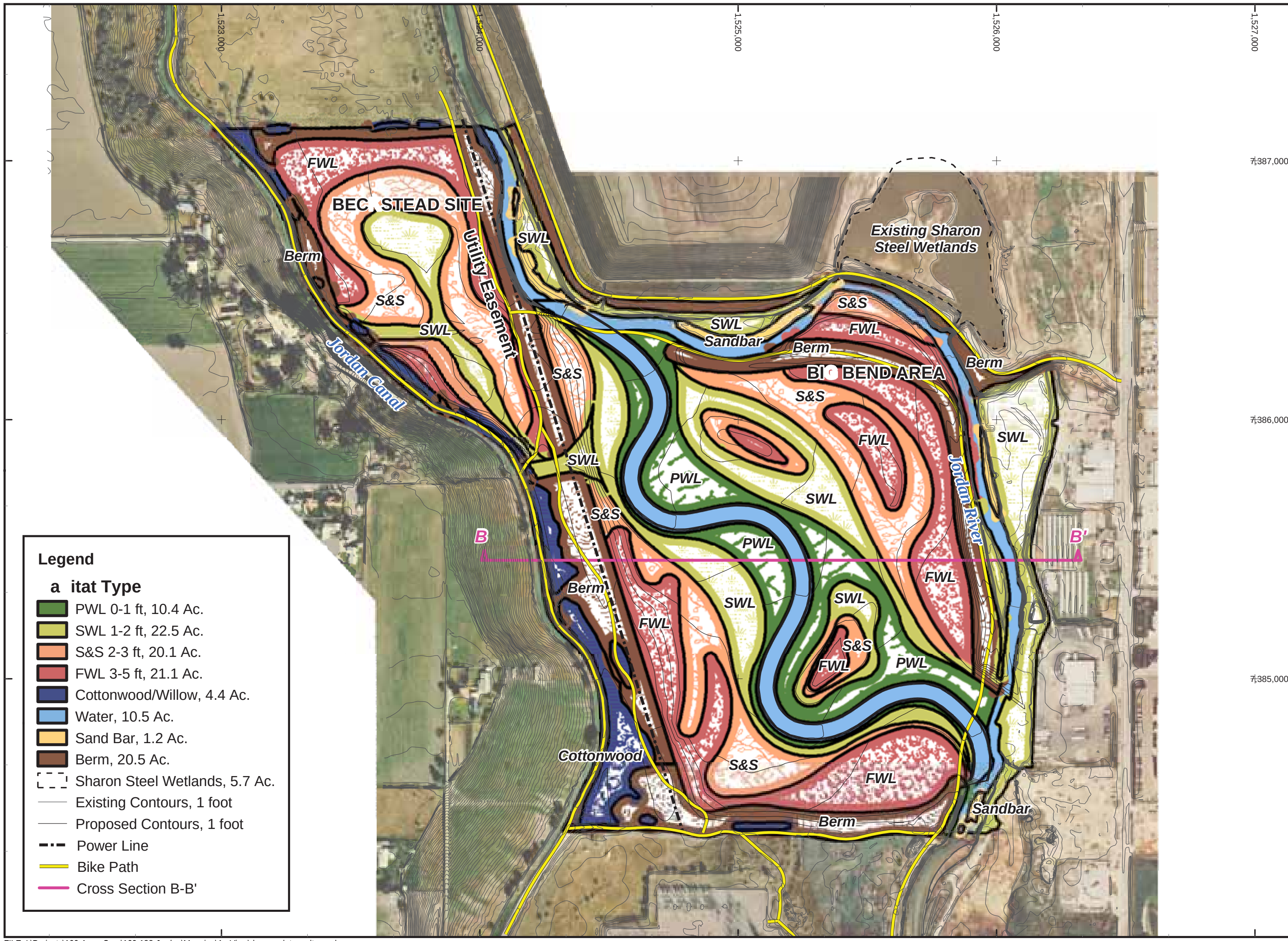
West Jordan, Utah
Section 206
Aquatic Ecosystem Restoration

Plate 6

Alternative
Meander Restoration
Without Off channel Wetlands

FILE: I:\Projects\100-Army Corp\100-188-Jordan\Mapping\ArcView\dpr-ea_plate _alt4.mxd

4/22/2003 GSH



Huffman & Carpenter, Inc.
Hydrologic & Wetland Regulatory Consultants
www.nvwetlands.com 775.828.1991
700 Smithridge Dr. Suite 102A Reno, NV 89502

Ê

Scale 1" = 400'

0 200 400 600

Feet

Utah State Plane Coordinate System, Central Zone, NAD83, Feet

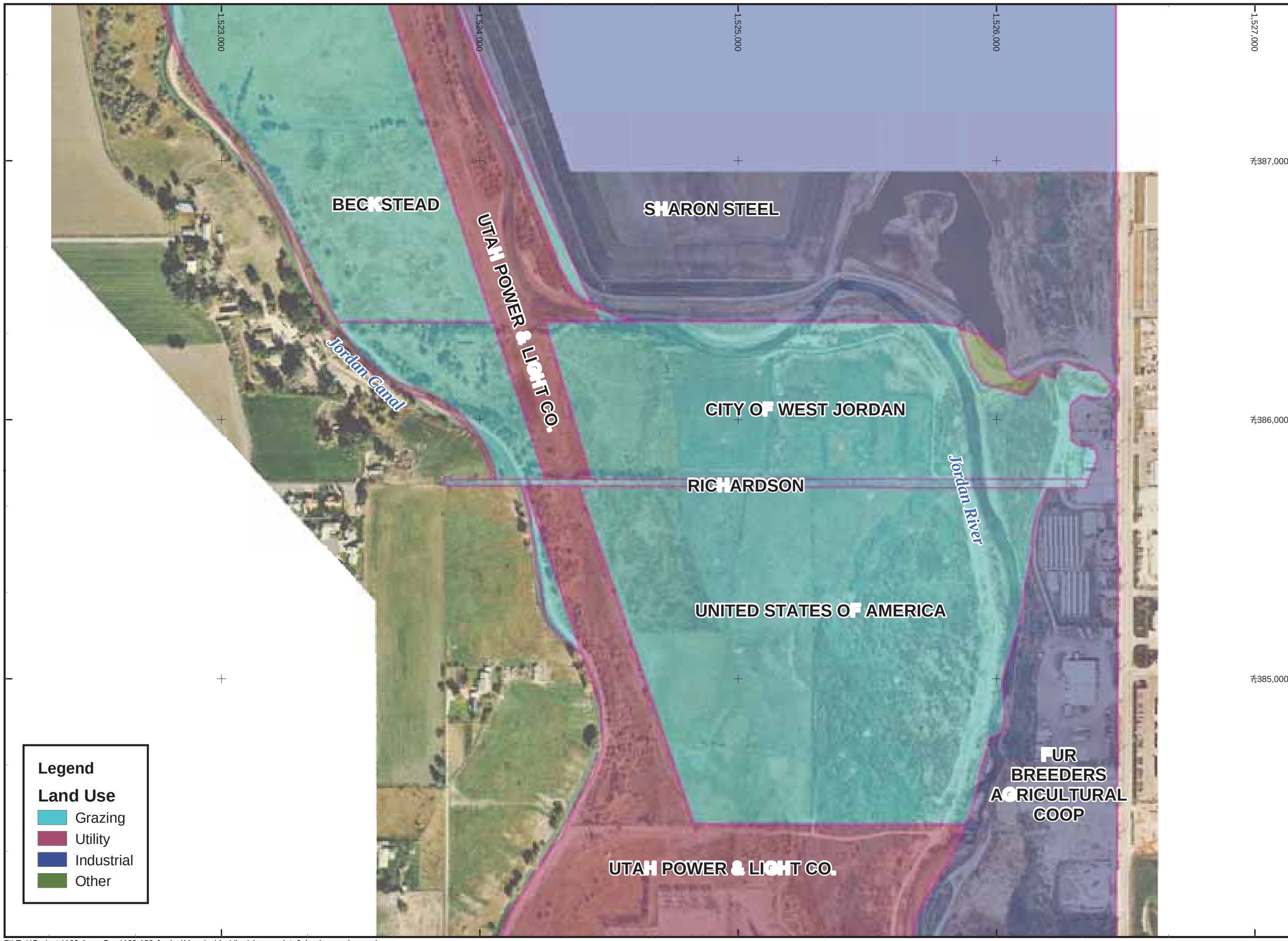
West Jordan, Utah
Section 206
Aquatic Ecosystem Restoration

Plate 7

Alternative 5
Meander Restoration
With Off channel Wetlands

FILE: I:\Projects\100-Army Corp\100-188-Jordan\Mapping\ArcView\dpr-ea_plate _alt .mxd

4/22/2003 GSH



Huffman & Carpenter, Inc.
Hydrologic & Wetland Regulatory Consultants
www.nvwetlands.com 775.828.1991
700 Smithridge Dr. Suite 102A · Reno, NV 89502

Scale 1" = 400'
0 200 400 600
Feet
Utah State Plane Coordinate System, Central Zone, NAD83, Feet

West Jordan, Utah
Section 206
Aquatic Ecosystem Restoration

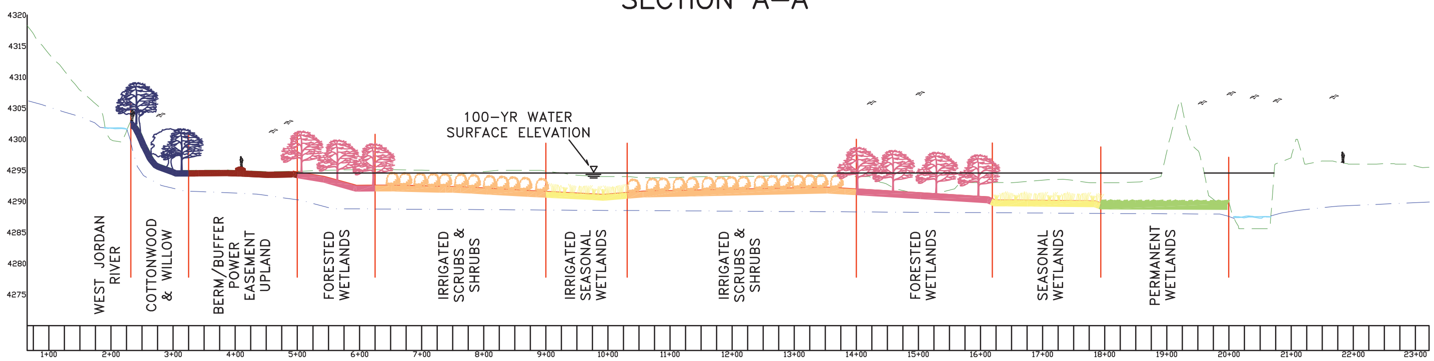
Plate 8

Land Use Plan

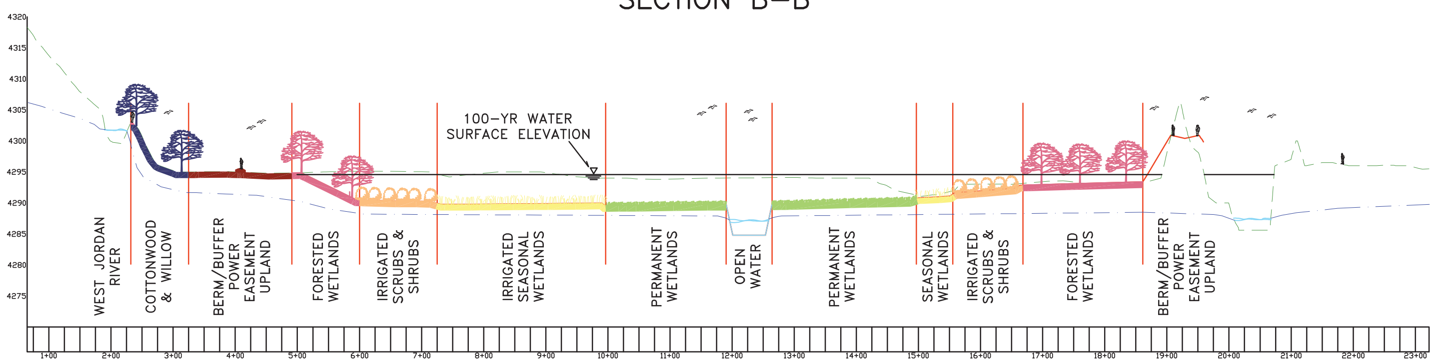
FILE: I:\Projects\100-Army Corp\100-188-Jordan\Mapping\ArcView\dpr-ea_plate8_land_ se_plan.mxd

6/9/2003 GSH

BENCHED RESTORATION
SECTION A–A'



MEANDER RESTORATION
SECTION B–B'



Huffman & Carpenter, Inc.
Hydrologic & Wetland Regulatory Consultants
www.nvwetlands.com 775.828.1991
700 Smithridge Dr. - Suite 102A - Reno, NV 89502

LEGEND

- EXISTING GROUND SURFACE
- PROPOSED GROUND SURFACE
- ANTICIPATED WATER TABLE
- 100–YEAR WATER SURFACE ELEVATION

SCALE
HORIZONTAL: 1" = 200'
VERTICAL: 1" = 20'

West Jordan, Utah
Section 206
Aquatic Ecosystem Restoration

PLATE 9

TYPICAL CROSS SECTIONS
Section A–A' & B–B'

I:\Projects\100–Army Corp\100–188–Jordan\Mapping\AutoCad\dwg\final\dpr–ea_plate9_cross–sections.dwg

JRC/GSH 6/17/03

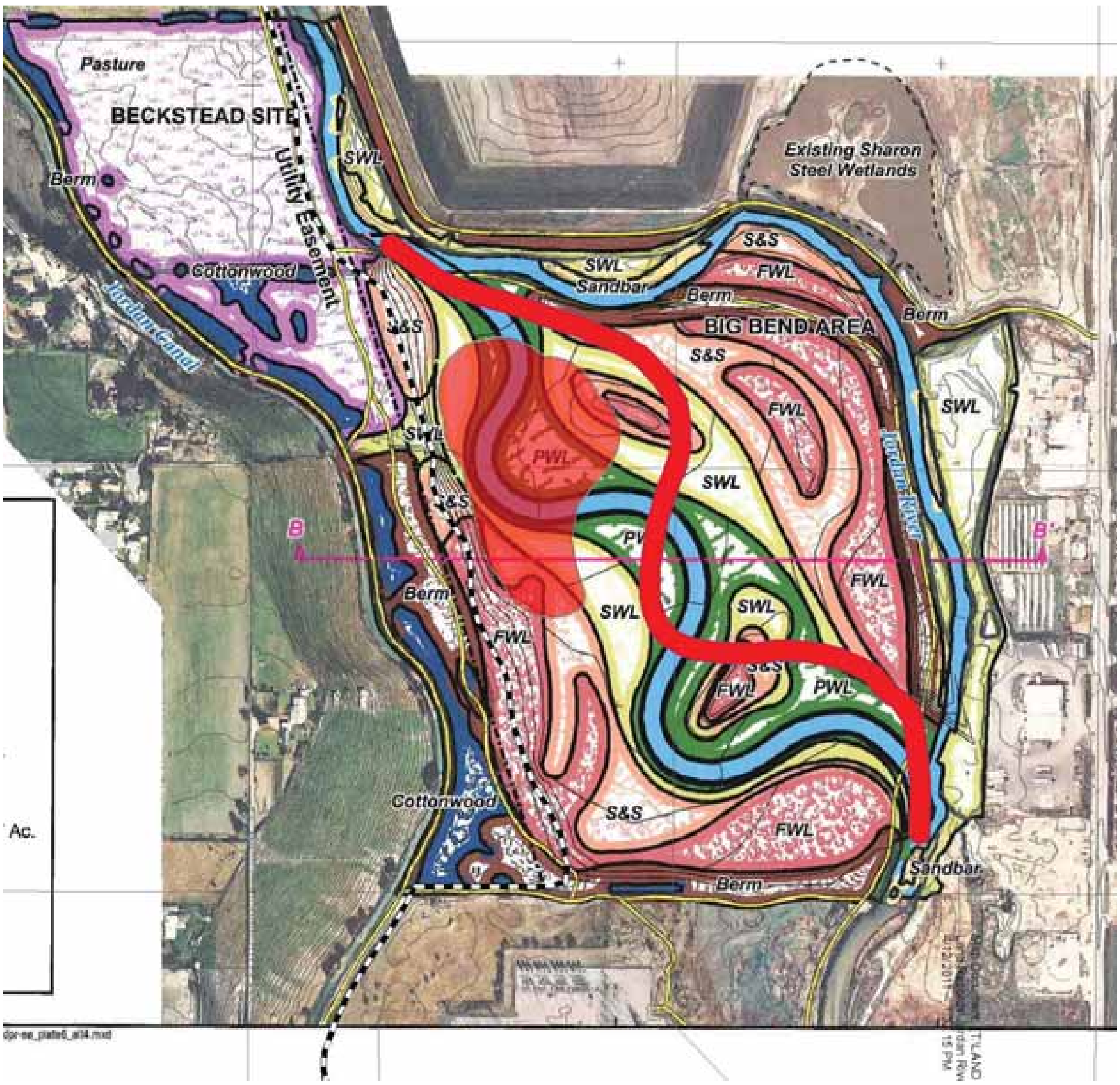


Figure 1. Conceptual drawing of one possible fishing pond design.

Figure 2. Channel erosion in the Big Bend area, south of the Sharon Steel cleanup site. The top image shows the channel as pictured in the 1990's Ortho Maps, including a trace of the southern edge of the active channel (yellow line). The middle and bottom images show the same area in 2003 and 2012, respectively. Note the bank erosion and channel widening that has occurred, mostly after the 2003 DDPR was completed.

Figure 3. Aerial imagery from 2009 (top) and 2012 (bottom) showing the erosion that occurred during the sustained high flows of 2011.

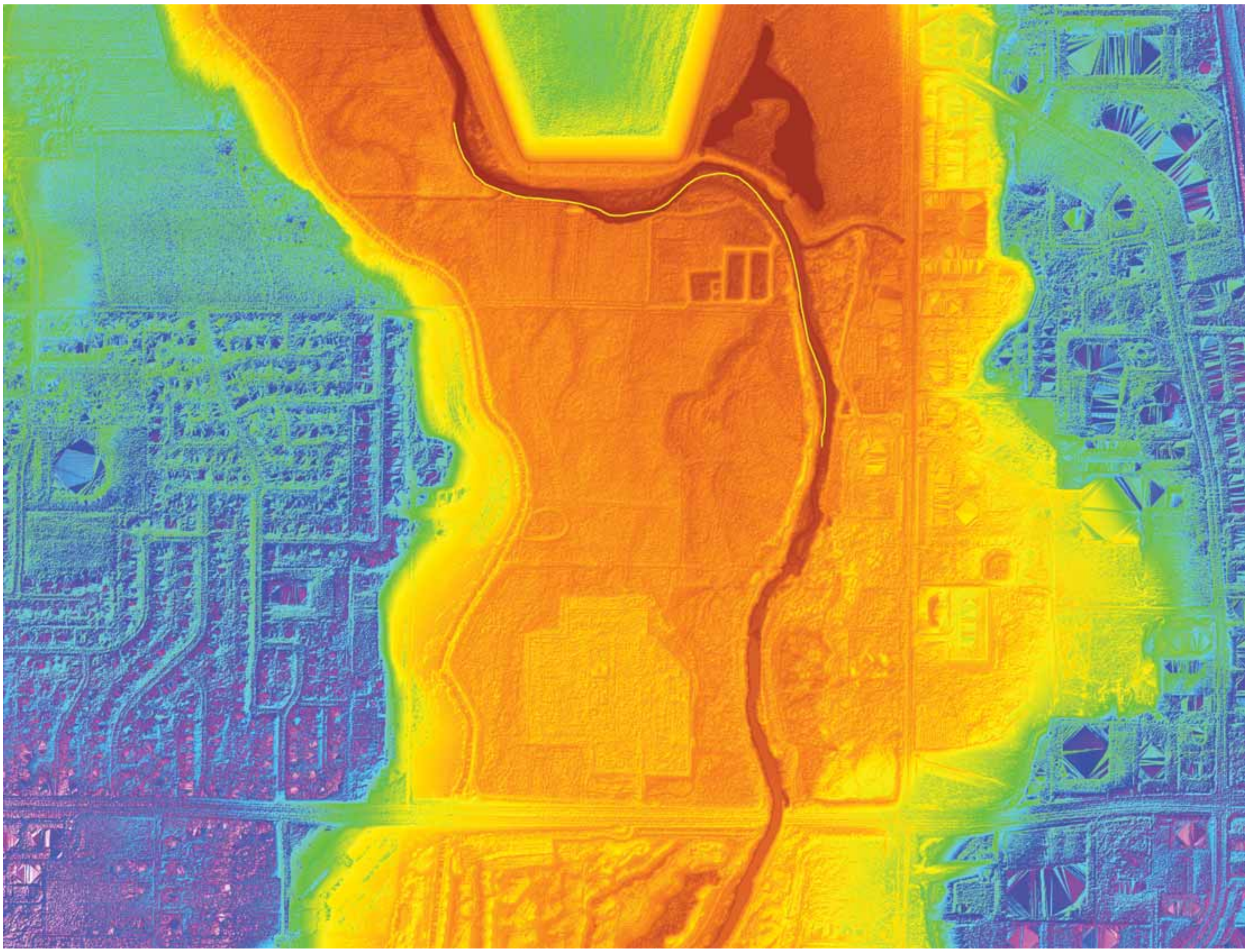


Figure 4. LIDAR data for the project area.

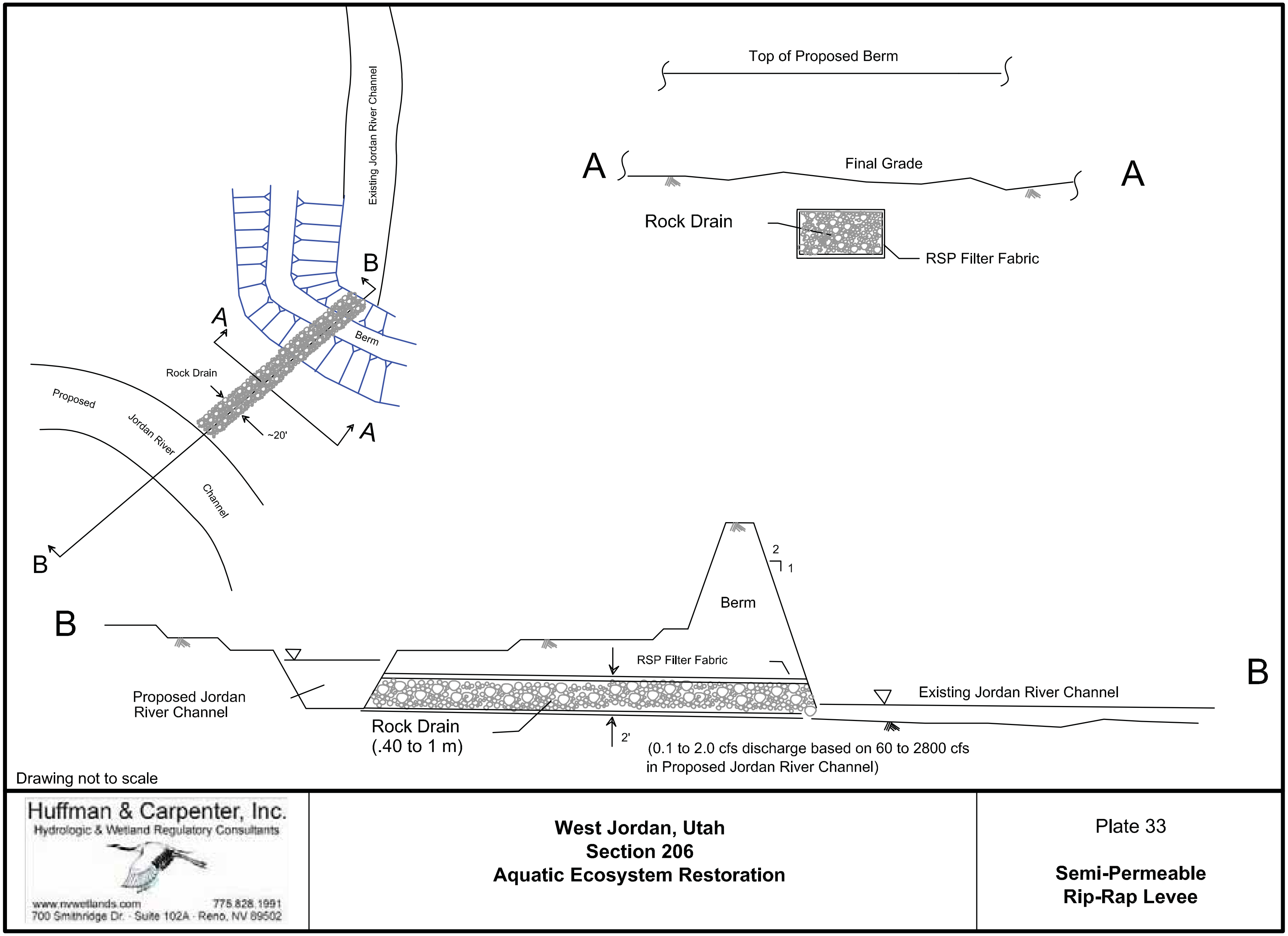


Figure 5. Proposed semi-permeable rip-rap levee.

Figure 6. Aerial image showing the location of HEC-RAS cross sections for Alternatives 4 and 5. The cross section location highlighted in red was used to generate the cross section plot shown in Figure 7.

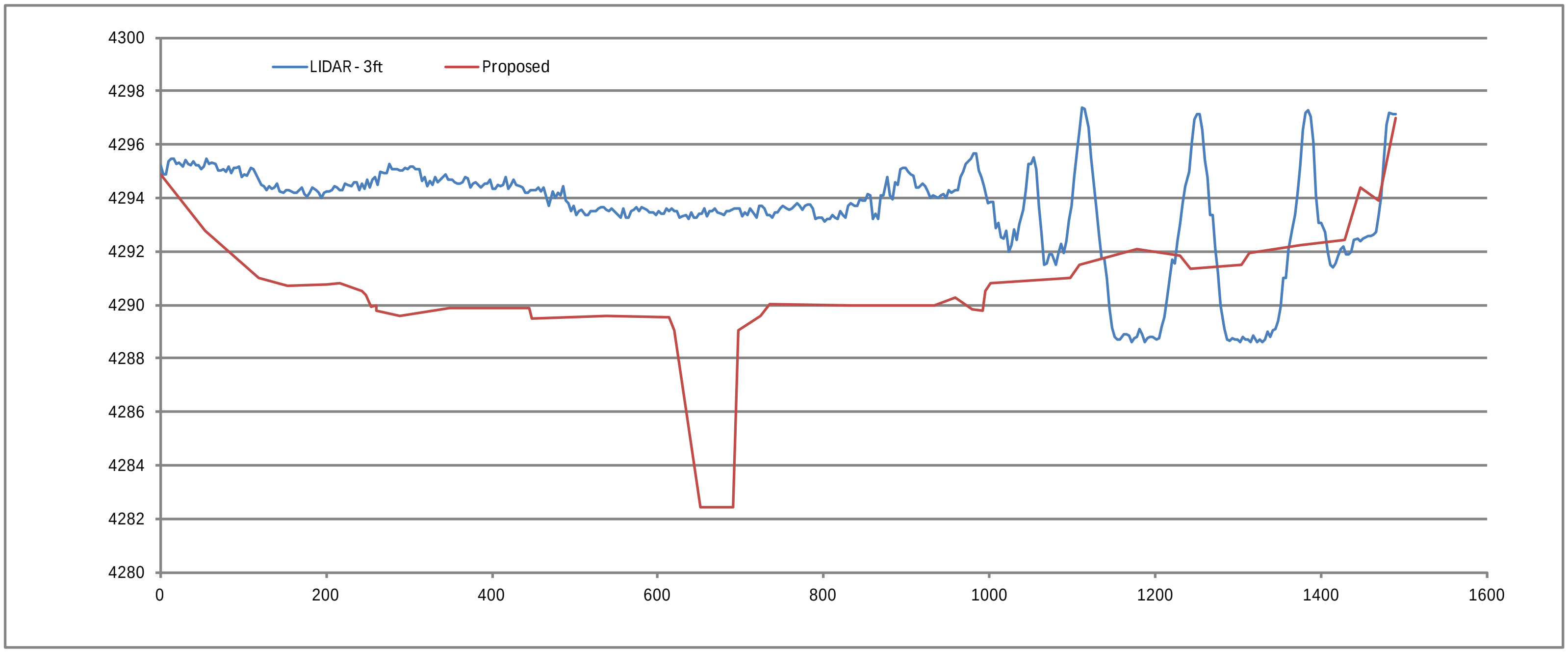


Figure 7. Plot of cross section from Figure 6, showing the existing ground surface from adjusted LIDAR data (blue line) and the proposed ground surface (red line). Note that much of the proposed surface requires between 4-5 feet of excavation and lowering of the existing ground surface.