DRAFT

ENVIRONMENTAL ASSESSMENT
AQUATIC HABITAT RESTORATION IN THE RIO GRANDE CANALIZATION PROJECT
SIERRA AND DOÑA ANA COUNTIES, NEW MEXICO AND EL PASO COUNTY, TEXAS

Prepared For:

United States Section International Boundary and Water Commission
4171 N. Mesa, Suite C-100
El Paso, Texas 79902

Prepared By:

Gulf South Research Corporation
8081 Innovation Park Drive
Baton Rouge, LA 70820
Contract Number: IBM15D0005
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COVER SHEET

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Lead Agency: United States Section, International Boundary and Water Commission (USIBWC)

Proposed Action: Develop and evaluate alternatives for aquatic habitat restoration in the Rio Grande Canalization Project (RGCP) and select alternatives for implementation and construction that meet the restoration requirements of the USIBWC Record of Decision (2009) for long-term management of the RGCP.

Abstract: The USIBWC is considering implementing aquatic habitat restoration projects to meet the restoration requirements of the USIBWC Record of Decision (ROD) (2009). The preferred alternatives would restore aquatic and/or riparian habitat within the RGCP. The Environmental Assessment assesses potential environmental impacts of the No Action Alternative and seven action alternatives. The action alternatives include:

- Alternative B - Yeso Arroyo: This alternative would create 6.9 acres of aquatic restoration features.
- Alternative C - Angostura Arroyo: This alternative would create 7.5 acres of aquatic restoration features.
- Alternative D - Broad Canyon Arroyo: This alternative would create 0.2 acre of aquatic restoration features.
- Alternative E - Selden Point Bar: This alternative would create 0.8 acre of aquatic restoration features.
- Alternative F - Las Cruces Effluent: This alternative would create 0.9 acres of aquatic restoration features.
- Alternative G - Mesilla Valley Bosque State Park: This alternative would create 15.8 acres of aquatic restoration features.
- Alternative H - Downstream of Courchesne Gage: This alternative would create 1.4 acres of aquatic restoration features.

Potential impacts on natural, cultural, and other resources were evaluated in the Environmental assessment. Based on the review of facts and analyses contained in the Environmental Assessment, a Finding of No Significant Impact is recommended. Four preferred alternatives are selected in the Finding of No Significant Impact: Alternative D - Broad Canyon Arroyo, Alternative E - Selden Point Bar, Alternative F - Las Cruces Effluent, and Alternative H - Downstream of Courchesne Gage.

U.S. INTERNTIONAL BOUNDARY AND WATER COMMISSION EL PASO, TEXAS
DRAFT FINDING OF NO SIGNIFICANT IMPACT
AQUATIC HABITAT RESTORATION IN THE
RIO GRANDE CANALIZATION PROJECT
SIERRA AND DOÑA ANA COUNTIES, NEW MEXICO
AND EL PASO COUNTY, TEXAS

LEAD AGENCY

United States Section, International Boundary and Water Commission, United States and Mexico (USIBWC)

OVERVIEW

The USIBWC prepared a Draft Environmental Assessment (EA) to analyze the potential impact of seven action alternatives and a No Action Alternative to implement aquatic habitat within the Rio Grande Canalization Project (RGCP). Based on a review of the facts and analyses contained in the Draft Environmental Assessment, four alternatives, Alternative D - Broad Canyon Arroyo, Alternative E - Selden Point Bar, Alternative F - Las Cruces Effluent, and Alternative H - Downstream of Courchesne Bridge, are selected as the preferred alternatives, and a Finding of No Significant Impact is recommended.

PUBLIC INVOLVEMENT

Pursuant to the National Environmental Policy Act (NEPA) guidance (40 Code of Federal Regulation (CFR) 1506.6), the USIBWC anticipates releasing for public review the Draft EA on June 4, 2019. Notice of the document will be published in the Federal Register and made available on the USIBWC website: http://www.ibwc.gov/EMD/EIS_EA_Public _Comment.html. Notice of Availability will be sent to a distribution list which includes local newspaper and media. In addition, the USIBWC held a Stakeholder meeting on November 9, 2018, to solicit early comments and views on the preliminary alternatives. In addition, the USIBWC will hold a public hearing during the public review period. The Public review of the Draft EA will be completed following a 30-day review period.

ALTERNATIVE ACTIONS EVALUATED

The No Action Alternative and seven action alternatives were evaluated in the Draft EA. Under the No Action Alternative, none of the restoration alternatives evaluated in the EA would be implemented. The USIBWC would not meet the restoration requirements of the 2009 *USIBWC Record of Decision for River Management Alternatives for the Rio Grande Canalization Project*. As part of the planning process, conceptual designs were developed for the seven action alternatives. The alternatives included the following:

- Alternative B - Yeso Arroyo: This alternative would create 6.9 acres of aquatic restoration features.

- Alternative C - Angostura Arroyo: This alternative would create 7.5 acres of aquatic restoration features.
- Alternative D - Broad Canyon Arroyo: This alternative would create 0.2 acre of aquatic restoration features.
- Alternative E - Selden Point Bar: This alternative would create 0.8 acre of aquatic restoration features.
- Alternative F - Las Cruces Effluent: This alternative would create 0.9 acres of aquatic restoration features.
- Alternative G - Mesilla Valley Bosque State Park: This alternative would create 15.8 acres of aquatic restoration features.
- Alternative H - Downstream of Courchesne Bridge: This alternative would create 1.4 acres of aquatic restoration features.

PREFERRED ALTERNATIVES

Alternative D – Broad Canyon Arroyo, Alternative E – Selden Point Bar, Alternative F – Las Cruces Effluent, and Alternative H – Downstream of Courchesne Bridge: Following the public comment period on the Draft EA, the USIBWC will either select the Preferred Alternatives, modify the Preferred Alternatives, or select one of the other action alternatives based on Public comments. Two alternatives (Alternative F - Las Cruces Effluent and Alternative H - Below Courchesne Bridge) will move forward with the construction design phase, while the other two smaller projects (Alternative D - Broad Canyon Arroyo and Alternative E - Selden Point Bar) will be implemented with conceptual plans.

SUMMARY OF FINDINGS

The USIBWC prepared the Draft EA pursuant to NEPA guidance (40 CFR 1500-1508) and the President's Council on Environmental Quality regulations for NEPA implementation, which include provisions for both the content and procedural aspects of the required EA.

NO ACTION ALTERNATIVE

Under the No Action Alternative, USIBWC would not implement any of the aquatic habitat restoration alternatives analyzed in the EA. The USIBWC would not meet the restoration commitments for aquatic habitat under the 2009 *USIBWC Record of Decision for River Management Alternatives for the Rio Grande Canalization Project*.

AFFECTS OF THE PREFERRED ALTERNATIVES

Biological Resources

Alternative D – Broad Canyon Arroyo: This alternative would enhance the backwater function and habitat diversity by creating a series of embayments supplemented with diverse riparian-wetland revegetation. These restoration features would provide diverse habitat that could support several fish species and macroinvertebrates. The addition of native herbaceous species may support small mammals or herpetofauna. As a result of removing non-native vegetation and

establishing native riparian and wetland herbaceous vegetation, this alternative would have a long-term, localized beneficial impact on vegetation and wildlife. Alternative D - Broad Canyon Arroyo would have a long-term, localized beneficial impact on aquatic species as a result to of creating aquatic habitat features. Riparian vegetation planted as part of this alternative would have a long-term, localized beneficial impact on southwestern willow flycatcher (*Empidonax traillii extimus*) and Yellow-billed cuckoo (*Coccyzus americanus*).

Alternative E – Selden Point Bar: This alternative would create a high-flow channel and a backwater channel supplemented by revegetation of approximately 20-acres with native riparian plant species (cottonwood [*Populus deltoides*] and coyote willow [*Salix exigua*]). This additional area of native riparian species would be able to support a wide range of taxa, including migratory or breeding birds, mammals, or herpetofauna. Construction of a flowing side channel, at least during irrigation season, provides addition habitat diversity for fish and aquatic species. The backwaters add another structural element. As a result of removing non-native vegetation and establishing native riparian vegetation, Alternative E - Selden Point Bar would have a long-term, localized beneficial impact on vegetation and wildlife. This alternative would have a long-term, moderate beneficial impact on wildlife and aquatic species as a result to of creating aquatic habitat features. Restored riparian habitat (cottonwood and willow) could provide potential nesting, roosting or foraging habitat for southwestern flycatcher and Yellow-billed cuckoo. Alternative E - Selden Point Bar would have a long-term, moderate impact on threatened and endangered species.

Alternative F – Las Cruces Effluent: This alternative would replace the straight concrete lined channel on the east side of the Rio Grande currently used to convey treated wastewater with a meandering channel that contains diverse aquatic habitat features. These aquatic habitats would be enhanced by planting aquatic vegetation within backwaters, and native riparian vegetation along the channel margins. The channel habitat would emphasize variable conditions to support a diversity of native fish species. This alternative has a high potential for restoration of regionally extirpated fish species. As a result establishing native riparian and herbaceous wetland vegetation, the Alternative F - Las Cruces Effluent would have a long-term localized beneficial impact on vegetation and wildlife, and a long-term moderate beneficial impact on aquatic species as a result of creating aquatic habitat features. The establishment of riparian vegetation would have a long-term, localized beneficial impact on threatened and endangered species.

Alternative H – Downstream of Courchesne Bridge: Under this alternative, a meandering channel that routes stormwater from below Highway 85 to the Rio Grande would be created. Benches, embayments, and pools would be included within the channel. This site differs from the others in that the riparian vegetation to be planted would be native herbaceous plantings rather than tree plantings. However, native herbaceous species may still accommodate numerous wildlife species, including small mammals or herpetofauna. During periods of elevated flow when wetland and terrestrial vegetation is flooded, fish species that occur in the Rio Grande would move onto the wetted terrace. Alternative H - Downstream of Courchesne Bridge would have a long-term, localized beneficial impact on vegetation, wildlife, and aquatic species. This alternative would not have an adverse or beneficial impact on threatened and endangered species.

Water Resources

Alternative D – Broad Canyon Arroyo: Spoil from the construction of embayments would be deposited on-site in barren areas. The embayments would replace the floodwater retaining capacity of the barren areas. Alternative D – Broad Canyon Arroyo is not anticipated to have an effect on flood control. Construction of backwater embayments would have a temporary, localized adverse impact on water quality. Sedimentation and introduction of contaminants would be reduced or eliminated by the incorporation of Best Management Practices (BMP) (e.g., Stormwater Pollution Prevention Plan [SWPPP]). This alternative would have a long-term negligible beneficial impact on water consumption as a result of reducing evapotranspiration by 0.9 acre-feet per year. Implementation of this alternative would impact approximately 0.01 acre of wetlands. The proposed restoration work would be implemented under a Nationwide Permit 27. Alternative D – Broad Canyon Arroyo would have a temporary negligible adverse impact on potential jurisdictional wetlands. However, this alternative would result in a long-term, localized beneficial impact on wetlands.

Alternative E – Selden Point Bar: This alternative would have a long-term, negligible beneficial impact on flood control if sediment deposition is maintained. Construction of a flow through channel and two backwater habitat areas would create additional storage for floodwater. Construction of a flow through channel and backwater features would have a temporary, localized adverse impact on water quality. Sedimentation and introduction of contaminants would be reduced or eliminated by the incorporation of Best Management Practices (BMP) (e.g., Stormwater Pollution Prevention Plan [SWPPP]). This alternative would have a long-term, moderate beneficial impact on water consumption as a result of reducing evapotranspiration by 13.9 acre-feet per year. Alternative E – Selden Point Bar would impact approximately 0.75 acres of wetlands. Impacted wetlands would be mitigated as part of the U.S. Army Corps of Engineers permitting process, thus this alternative would have a temporary, negligible impact on wetlands. However, the creation of wetlands would have a long-term, localized beneficial impact on wetlands.

Alternative F – Las Cruces Effluent: Riparian planting in the floodway could reduce water conveyance as the trees mature. However, the riparian area at this site is only 4 acres and represents a very small portion of the floodway. It is anticipated that this alternative would have a long-term, localized adverse impact on flood control. Construction of a meandering channel would have a temporary, localized adverse impact on water quality. Sedimentation and introduction of contaminants would be reduced or eliminated by the incorporation of BMPs (e.g., SWPPP). This alternative would increase evapotranspiration by 6.5 acre-feet per year. The USIBWC would need to obtain water rights to offset this water loss. This alternative can only be implemented if USIBWC can offset the water rights. USIBWC use of groundwater is subject to review by the Department of Justice, and USIBWC use of surface water is subject to approval from the irrigation district. This alternative would have a long-term, localized adverse impact on water consumption. This alternative is expected to have long-term, localized beneficial impacts on wetlands as a result of creating wetlands along the meandering channel.

Alternative H – Downstream of Courchesne Bridge: Herbaceous wetland vegetation is the primary focus of the conceptual with low density woody vegetation planted along the channel margins. It is not anticipated that the low density planting of woody vegetation would increase

the potential for fouling floodgates downstream. Alternative H – Downstream of Courchesne Bridge would have a long-term, localized adverseimpact on flood control. Construction of a meandering channel would have a temporary, localized adverse impact on water quality. Sedimentation and introduction of contaminants would be reduced or eliminated by the incorporation of Best Management Practices (BMP) (e.g., Stormwater Pollution Prevention Plan [SWPPP]). This alternative would have a long-term, moderate beneficial impact on water consumption as a result of reducing evapotranspiration of 24.5 acre-feet per year. Implementation of this alternative would impact approximately 0.02 acre of wetlands. A USACE permit would be obtained prior to construction. This alternative would have a temporary negligible adverse impact on potential jurisdictional wetlands. However, this alternative would result in a long-term, localized beneficial impact on wetlands.

Cultural Resources

Alternative D – Broad Canyon Arroyo: This site has only partially been surveyed for cultural resources, and the site contains previously recorded cultural resources recommended eligible and of undetermined eligibility for listing on the NRHP. All excavations would occur on USIBWC property and the project would be consulted with the New Mexico State Historic Preservation Officer (NMSHPO) per the Programmatic Agreement between USIBWC and NMSHPO.

Alternative E – Selden Point Bar: USIBWC property has been surveyed for cultural resources and the project would only occur on USIBWC property (Appendix A, Figure A-31). No cultural resources were recorded as part of the survey; therefore this alternative would not impact any cultural resources.

Alternative F – Las Cruces Effluent: This alternative site has been previously surveyed for cultural resources. No cultural resources have been previously recorded within the footprint of the alternative. Implementation of this alternative would have no adverse impact on cultural resources.

Alternative H – Downstream of Courchesne Bridge: This alternative site has been previously surveyed for cultural resources, and is located within the boundary of a New Mexico State Register property. Given that the proposed actions for this alternative include ground disturbing activities such as clearing and grubbing vegetation, constructing a meandering channel, and depositing spoil material in open barren areas, there is potential to disturb previously recorded cultural resources. Implementation of this alternative could result in adverse impact on cultural resources.

Soils

Alternative D – Broad Canyon Arroyo: Soils disturbance could increase soil erosion during and after construction; however USIBWC employs BMPs under all construction contract to eliminate or reduce impacts from temporary soil impacts. A SWPPP would be prepared prior to construction, and BMPs (e.g, silt fence) outlined in the SWPPP would be implemented during construction. Approximately 0.5 acre would experience long-term, localized adverse impacts as a result of excavation and shaping, and approximately 1 acre would experience temporary, negligible adverse impacts as a result of planting riparian vegetation.

Alternative E – Selden Point Bar: Soils disturbance could increase soil erosion during and after construction; however USIBWC employs BMPs under all construction contract to eliminate or reduce impacts from temporary soil impacts. A SWPPP would be prepared prior to construction, and BMPs (e.g, silt fence) outlined in the SWPPP would be implemented during construction. Approximately 0.75 acre would experience long-term, localized adverse impacts as a result of excavation and shaping, and approximately 8 acres would experience temporary, negligible adverse impacts as a result of planting riparian vegetation.

Alternative F – Las Cruces Effluent: Soils disturbance could increase soil erosion during and after construction; however USIBWC employs BMPs under all construction contract to eliminate or reduce impacts from temporary soil impacts. A SWPPP would be prepared prior to construction, and BMPs (e.g, silt fence) outlined in the SWPPP would be implemented during construction. Approximately 0.75 acre would experience long-term, localized adverse impacts as a result of excavating and terracing, and approximately 3 acres would experience temporary, negligible impacts as a result of planting riparian vegetation.

Alternative H – Downstream of Courchesne Bridge: Soils disturbance could increase soil erosion during and after construction; however USIBWC employs BMPs under all construction contract to eliminate or reduce impacts from temporary soil impacts. A SWPPP would be prepared prior to construction, and BMPs (e.g, silt fence) outlined in the SWPPP would be implemented during construction. Approximately 1 acre would experience long-term, localized adverse impacts as a result of excavation and shaping, and approximately 7.7 acre would experience temporary, negligible adverse impacts as a result of planting riparian vegetation.

Community Resources

Alternative D – Broad Canyon: Temporary adverse impacts on recreational opportunities are anticipated under Alternative D - Broad Canyon arroyo. Broad Canyon Arroyo is occasionally used for fishing and camping on BLM land, so these recreational activities may be limited during implementation of this alternative. A potential benefit of embayment construction and revegetation of riparian zones with native plants within the Broad Canyon Arroyo is enhancement of riparian and aquatic habitat, which could provide opportunities for bird watchers and nature enthusiasts.

Alternative E – Selden Point Bar: No negative impacts on recreational opportunities are anticipated under this alternative. The USIBWC owns the property and does not authorize unaffiliated persons on the premises.

Alternative F – Las Cruces Effluent: Temporary adverse impacts on recreational opportunities are anticipated under this alternative. Construction of a meandering clearwater side channel and two backwater habitat areas may temporarily impede access to the recreational trail adjacent to site. However, creating a meandering channel with a pedestrian bridge should add recreational value to this location, and enhance the City of Las Cruces' lease for the existing recreation trail. Construction of backwater habitat areas, as well as replacing non-native vegetation with native species, would enhance riparian habitat and could attract bird watchers and nature enthusiasts.

Alternative H – Downstream of Courchesne Bridge: No negative impacts on recreational opportunities are anticipated under this alternative. The USIBWC owns the property and does not authorize unaffiliated persons on the premises.

Cumulative Impacts and Unavoidable Impacts

A number of environmental impacts have occurred in the riparian areas of the Rio Grande associated with changes in the water regime and the large-scale invasion by saltcedar. These past impacts have largely stabilized and can be considered baselines against which impacts of the proposed action may be compared. The restoration of native aquatic habitats would be a step in mitigating these past impacts. A number of other habitat restoration projects have or are being implemented along the RGCP. The completion of each additional project, such as the preferred alternatives, would help to leverage the positive cumulative impact of these efforts.

Mitigation

Impacts to jurisdictional wetlands resulting from the proposed aquatic restoration projects will be permitted through the U.S. Army Corps of Engineers permitting process and mitigation will be provided per the permit conditions. The remaining unsurveyed portion of the Selden Point Bar site would be surveyed for cultural resources to ensure adverse impacts are avoided during construction.

DECISION

Based on the review of the facts and analysis contained in the Draft EA, I conclude the implementation of the four alternatives (Alternative D - Broad Canyon Arroyo, Alternative E - Selden Point Bar, Alternative F - Las Cruces Effluent, and Alternative H - Downstream of Courchesne Bridge) does not constitute a major action significantly affecting the quality of the human environment under the meaning of Section 102 (2) of the NEPA of 1969, as amended. Accordingly, requirements of the NEPA and regulations promulgated by the Council on Environmental Quality are fulfilled and an Environmental Impact Statement is not required.

_____ _____

Jayne Harkins, P.E. Date
Commissioner
International Boundary and Water
Commission, United States Section

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ACRONYMS AND ABBREVIATIONS

Ac-ft/year	Acre Feet Per Year
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARMS	State of New Mexico Archaeological Records Repository
BMP	Best Management Practices
BLM	Bureau of Land Management
BP	Before Present
CFR	Code of Federal Regulation
cfs	Cubic Feet Per Second
dB	Decibel
dBA	A-weighted Decibel
EA	Environmental Assessment
EBID	Elephant Butte Irrigation District
ET	Evapotranspiration
ESA	Endangered Species Act
FR	Federal Register
GSA	GeoSystems Analysis
LiDAR	Light Detection and Ranging
MBTA	Migratory Bird Treaty Act
MVBSP	Mesilla Valley Bosque State Park
NAAQS	National Ambient Air Quality Standards
NAF	Northern Aplomado Falcon
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMCRIS	New Mexico Cultural Resources Information System
NMED	New Mexico Environmental Department
NMDGF	New Mexico Department of Game and Fish
NMSHPO	New Mexico State Historic Preservation Office
NMSP	New Mexico State Park
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
PA	Programmatic Agreement
PM_{10}	Particulate Matter 10 Microns or Less
Reclamation	U.S. Bureau of Reclamation
RGCP	Rio Grande Canalization Project
RM	River Mile
ROD	Record of Decision
ROI	Region of Influence
SNM	State of New Mexico
SPCCP	Spill Prevention, Control, and Countermeasure Plan
SWEC	Southwest Environmental Center
SWFL	Southwestern Willow Flycatcher
SWPPP	Stormwater Pollution Prevention Plan

TCEQ	Texas Commission on Environmental Quality
TMDL	Total Maximum Daily Loads
TXDOT	Texas Department of Transportation
TXSHPO	Texas State Historic Preservation Officer
U.S.	United States
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USIBWC	U.S. International Boundary and Water Commission
WOUS	Waters of the United States
WSA	William Self and Associates
YBCU	Yellow-billed Cuckoo

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1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

Historically, the floodplain of the Rio Grande through southern New Mexico supported a wide mosaic of riparian plant communities and wetlands. In the 1940's, the United States (U.S.) Section International Boundary and Water Commission (USIBWC) constructed the Rio Grande Canalization Project (RGCP) to facilitate compliance with equitable allocation of water between the U.S. and Mexico under the U.S.-Mexico Convention of 1906 (Act of June 4, 1936, 49 Stat. 1463). USIBWC was granted the authority to construct, operate, and maintain the project through the Act of June 4, 1936, 49 Stat. 1463, Public Law No. 648. The RGCP, spanning an approximately 105-mile reach of the Rio Grande from Percha Diversion Dam, Sierra County, New Mexico to American Dam in El Paso, El Paso County, Texas, straightened and channelized the river, armored the riverbanks, constructed levees, and cleared the floodplain (Appendix A – Figure A-1). The RGCP provides flood protection against a 100-year flood and assures releases of water to U.S. and Mexico water users from upstream reservoirs in accordance with the 1906 Convention between the U.S. and Mexico. The construction and subsequent floodplain and channel maintenance of the RGCP have significantly reduced the occurrence and extent of aquatic, riparian, and wetland habitat.

On June 4, 2009, the USIBWC issued a Record of Decision (ROD) on long-term management of the RGCP (USIBWC 2009). The ROD authorized restoration of aquatic habitat and a mosaic of native riparian plant communities at 30 sites totaling 553 acres over 10 years (through 2019) (USIBWC 2016).

The Albuquerque District of the U.S. Army Corps of Engineers (USACE) prepared a Conceptual Restoration Plan (Conceptual Plan) to guide restoration of the 30 sites (USACE 2009). Three aquatic habitat restoration sites (Angostura Arroyo, Yeso Arroyo, and Placitas Arroyo) are proposed in the Conceptual Plan but aquatic habitat restoration projects have not been constructed yet. Each of the three conceptual aquatic habitat restoration sites is situated on the opposite side of the Rio Grande active channel from a major arroyo confluence, and the conceptual design involves destabilizing the riverbanks to encourage river migration into the abandoned floodplain terrace. However, USIBWC and project stakeholders are concerned that (if constructed) these projects may adversely impact RGCP levees and increase flood risk for neighboring communities. Due to these concerns, USIBWC is currently evaluating the aquatic habitat restoration sites recommended in the USACE Conceptual Plan against other potential aquatic restoration locations.

USIBWC has been reviewing possibilities for aquatic habitat restoration over the years and has been involved with stakeholder discussions for several possible restoration sites. The Paso del Norte Watershed Council and its participants funded a fish study, and final report, which was completed in September 2018 included several suggested additional locations to evaluate for possible aquatic restoration.

1.2 PURPOSE AND NEED

The purpose of this project is to develop and evaluate alternatives for aquatic habitat restoration in the RGCP and select projects for implementation and construction that meet the restoration requirement of the 2009 ROD (USIBWC 2009).

To date, 22 (approximately 508 acres) out of the 30 restoration sites (553 acres) identified in the 2009 ROD have been developed. Restoration of aquatic sites authorized in the 2009 ROD has to be initiated in 2019. The USACE Conceptual Plan (USACE 2009) estimated approximately 50 acres would be created at the arroyo sites; although, less than 50 acres would be created if these sites were implemented. Currently, approximately 45 acres of aquatic habitat restoration remains to be completed based on the ROD restoration acreage (USIBWC 2009). However, the objective is to identify the best and most feasible sites for aquatic habitat, and not necessarily to meet the ROD restoration acreage. This project is needed to identify, develop, and design aquatic restoration projects to satisfy the commitment to implement aquatic habitat, wetland, and riparian habitat restoration to fulfill USIBWC's commitments in the 2009 ROD. Restoration actions could include vegetation removal, disposal of wood debris, native vegetation planting, overbank lowering, bank cuts, natural levee breaches, secondary channels, bank destabilization, channel widening, arroyo mouth management, construction of inset floodplains, and use of supplemental water for on-site irrigation.

Per the USACE Conceptual Plan (USACE 2009) and USIBWC Rio Grande Canalization Project, River Management Plan (USIBWC 2016), the principle objectives for the overall habitat restoration projects in the RGCP include:

reduction of exotic vegetation,
enhancement of river floodplain hydraulic connectivity,
enhancement of aquatic diversity,
restoration of riparian function and enhancement of natural riverine processes,
improvement of terrestrial wildlife habitat,
restoration of endangered species habitat, and
restoration of riparian habitat.

The objectives of the site implementation plan are to produce enhanced cover and in-channel aquatic diversity, restore healthy riparian function, and enhance natural riverine processes. Aquatic habitat includes many types of habitats that serve multiple aquatic functions. These habitats can include wetlands, open water, ponds, riffles/runs, etc, and these various aquatic habitats target a variety of aquatic fauna, including fish, benthic macroinvertebrates, amphibians, reptiles, and shore birds. The purpose of this project is to create or improve aquatic habitat, and USIBWC does not have objectives that target specific types of aquatic habitat or species.

1.3 SCOPE OF THE ENVIRONMENTAL REVIEW

Federal agencies are required to take into consideration the environmental consequences of proposed and alternative actions in the decision-making process under the National Environmental Policy Act (NEPA) of 1969, as amended. The USIBWC regulations for

implementing NEPA are specified in Operational Procedures for Implementing Section 102 of the NEPA, Other Laws Pertaining to Specifics Aspects of the Environment and Applicable Executive Orders (46 Federal Register [FR] 44083, September 2, 1981). These federal regulations establish both the administrative process and substantive scope of the environmental impact evaluation designed to ensure that deciding authorities have a proper understanding of the potential environmental consequences of a contemplated course of action (USIBWC 2014).

This environmental assessment (EA) identifies and evaluates the potential environmental consequences that may result from implementation of eight alternatives, the No Action and seven different aquatic habitat sites, discussed in Section 2.

The following resource areas are analyzed for potential environmental consequences:

- biological resources (vegetation and habitat; wildlife, and threatened and endangered species),
- cultural resources,
- water resources (water quality, groundwater, and waters of the U.S.)
- community resources (recreation), and

During the stakeholder meeting and early coordination, stakeholders expressed the need to specifically address the following issues (Appendix C):

- conveyance capacity of the river,
- water depletion and water rights, and
- use of project water for aquatic habitat restoration.

USIBWC determined that the following resources areas would not require analysis: land use, environmental health issues (air quality, noise), and environmental justice. For all projects, the proposed wetlands will not impact the flood control project and the land use would change from non-aquatic habitat to aquatic habitat/riparian habitat. The construction of the projects could cause temporary but minor environmental health issues such as air quality and noise pollution; however, BMPs would be implemented during construction to eliminate or reduce minor and temporary impacts during construction. The proposed restoration site are located in rural or industrial settings and would not target or disproportionately affect minority and/or low income persons.

Analyses of environmental resources for the affected environment and environmental consequences are based on the potential impact at each alternative site. Analyses of the environmental consequences also include potential impacts on the RGCP and the region, depending on the resource and its relationship to the action alternatives and No Action Alternative.

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2.0 DESCRIPTION OF PROPOSED ALTERNATIVES

2.1 SUMMARY OF ALTERNATIVES EVALUATED

As part of the project team, GeoSystems Analysis, Inc. (GSA) prepared a habitat restoration site alternatives and conceptual design report (GSA 2019a) (Appendix B). The report considered a total of 10 alternatives (sites) as potential restoration sites to be included in the EA (Appendix A, Figure A-2). A total of seven alternative sites are selected in the report to be analyzed in this EA.

This EA evaluates eight alternatives, which are discussed below and summarized in Table 2-1.

1. Alternative A - No Action
2. Alternative B - Yeso Arroyo
3. Alternative C - Angostura Arroyo
4. Alternative D - Broad Canyon Arroyo
5. Alternative E - Selden Point Bar
6. Alternative F - Las Cruces Effluent
7. Alternative G - Mesilla Valley Bosque State Park
8. Alternative H - Downstream of Courchesne Bridge

2.2 ALTERNATIVE A: NO ACTION

Under Alternative A, none of the proposed action alternatives would be implemented within the RGCP.

2.3 ALTERNATIVE B: YESO ARROYO

The Yeso Arroyo site is approximately 14 acres and is located near river mile (RM) 94 (Appendix a, Figure A-2). The property is owned by USIBWC. The site is characterized by an elevated floodplain terrace located immediately across the arroyo confluence with the Rio Grande (Appendix A, Figure A-3). Yeso Arroyo is free flowing and contains no sediment control dams or lesser retention structures. The bankline across from the confluence is very steep, and USIBWC has historically placed large rip-rap along the toe of the bankline to minimize the potential for channel migration towards a non-engineered levee on the northeast side of the river. USIBWC has also historically dredged the river channel at this location to maintain channel conveyance capacity and gradient (Appendix B).

The Yeso Arroyo site was one of three aquatic restoration sites (along with Angostura Arroyo and Placitas Arroyo) proposed in the USACE Conceptual Plan (USACE 2009). The original design in that report proposed destabilizing the bankline across from the arroyo mouth by removing the riprap and vegetation from the bankline toe so that channel forming discharge in the Rio Grande could gradually erode the bank, increase channel sinuosity, and improve habitat complexity for native fish (Photograph 2-1). The riprap removed from the bankline would be used to reinforce the levee along the edge of the elevated floodplain terrace (Appendix B). The

design phase would have to evaluate whether the levee would require additional protection to prevent undermining.

Photograph 2-1. Riprap along the toe of the bank at Yeso Arroyo Alternative site.

The new conceptual design for the Yeso Arroyo site would create 6.9 acres of aquatic habitat by modifying the slope of the existing steep bankline terrace to create a series of nested terraced benches capable of experiencing overbank flood inundation at a range of low to moderate discharge levels (e.g., 800 to 2,500 cubic feet per second [cfs]). The terrace benches would be planted with native riparian vegetation that could provide nesting, roosting, and feeding substrate for bird species and, when inundated, habitat for native fishes. Lower bench surfaces would be planted with a diverse assemblage of herbaceous wetland plants (Appendix B).

The conceptual design under Alternative B - Yeso Arroyo includes the following features:

- clear and grub the excavation footprint,
- remove saltcedar (*Tamarix chinensis*) and other non-native vegetation,
- remove riprap from the bankline toe and deposit off-site,
- construct muti-stepped bankline terrace benches using three- to four-nested terrace benches stabilized by planting native riparian vegetation on the upper bench (Exhibit 2-1 and Appendix A, Figure A-4),
- plant cottonwood (*Populus deltoides*) and willow (*Salix* spp.) in surrounding riparian enhancement area,
- plant native herbaceous wetland vegetation on the lower terrace bench,
- trench coyote willow (*Salix exigua*) throughout highest terrace bench, and
- discontinue channel dredging in this reach segment to encourage channel mobility.

Table 2-1. Summary of Alternatives Evaluated in this EA

Name	Rive Mile and Bank	Location	Total Acres	Ownership	Benefits	Constraints	Evapotranspiration Difference (ac-ft/yr)	Estimated Restoration Cost	Created Aquatic Restoration Feature (Acre)
Alternative A: No Action	Not Applicable	Not Applicable							
Alternative B: Yeso Arroyo	94E	Hatch, New Mexico (32.737614, -107.28354)	14.3	USIBWC	• Improve channel and off channel aquatic habitat with a nested geomorphic floodplain (e.g., terrace benches) • Enhance riparian habitat • Direct benefits for SWFL[3] and YBCU[3] • Enhance riparian area • USIBWC owns property	• Levee protection • Significant earthwork	18.3	$836,900	6.9
Alternative C: Angostura Arroyo	80E	Hatch, New Mexico (32.65736, -107.095225)	14.9	USIBWC	• Improve channel and off channel aquatic habitat with a nested geomorphic floodplain (e.g., terrace benches) • Enhance riparian habitat • Direct benefits for SWFL and YBCU • Enhance riparian area • USIBWC owns property • Channel habitat heterogeneity near restoration site	• Levee protection • Significant earthwork	19.5	$690,800	7.5
Alternative D: Broad Canyon Arroyo	68W	Radium Springs, New Mexico (32.53325, -106.98412)	2.1	USIBWCIBWC, USFWS, State of New Mexico, BLM	• USIBWC no mow zone • Create backwater aquatic habitat • Create deep water, structurally diverse habitat (embayments) • Direct benefits for SWFL and YBCU • Channel habitat heterogeneity near restoration site • Enhance riparian – wetland vegetation	• Multiple owners • Regular sediment monitoring • Periodic maintenance (sediment removal)	-0.9	$37,665	0.2
Alternative E: Selden Point Bar	66E	Radium Springs, New Mexico (32.518509, -106.968552)	8.8	USIBWC	• Channel habitat heterogeneity near restoration site (less than upstream sites) • Perennial flows (most years) • Create high flow channel and backwater channel • Direct benefits for SWFL and YBCU • Enhance riparian habitat	• Access (equipment would have to be walked across active channel) • Ownership • Regular sediment monitoring • Periodic maintenance (sediment removal)	-13.9	$146,550	0.8
Alternative F:Las Cruces Effluent	44E	Las Cruces, New Mexico (32.293155, -106.82351)	4.5	USIBWC	• Create diverse aquatic habitat (long meandering channel) • Plant aquatic vegetation in backwater areas • Establish riparian vegetation • USIBWC owns property • Direct benefits for SWFL and • Create a diversity of habitats	• Cessation of mowing • Water rights • Labor intensive (fish structure)	6.5	$199,300	0.9

Table 2-1, continued

Name	Rive Mile and Bank	Location	Total Acres	Ownership	Benefits	Constraints	Evapotranspiration Difference (ac-ft/yr)	Estimated Restoration Cost	Created Aquatic Restoration Feature (Acre)
Alternative G: Mesilla Valley Bosque State Park	41W	Mesilla, New Mexico (32.24301, -106.81606)	31.3	USIBWC, EBID[2], New Mexico State Parks (NMSP), Private	• Enhance aquatic and riparian habitat • Create a diversity of habitats • Improve wetland and riparian habitat • Direct benefits to SWFL and YBCU • Potential to create interior floodplain and side channel habitats	• Potential land transfer between New Mexico State Parks and New Mexico Department of Game and Fish • Picacho Drain must be maintained for irrigation return flow and floodwater protection	-19.2	$657,700	15.8
Alternative H: Downstream of Courchesne Bridge	1E	El Paso, Texas (31.80262, -106.54139)	12.9	USIBWC	• Increase native wetland vegetation • Enhance aquatic habitat • Improve wetland habitat • Direct Benefits to SWFL and YBCU	• Buried utility infrastructure • Unknown status of future floodwall or levee construction • Unknown status of future TXDOT[4] drainage solutions	-24.5	$101,600	1.4

GSA 2019a
[1]Excludes riparian enhancements
[2]Elephant Butte Irrigation District
[3]Southwestern Willow Flycatcher (SWF, *Empidonax traillii extimus*) and Yellow-billed cuckoo (YBCU, *Coccyzus americanus*)
[4]Texas Department of Transportation (TXDOT)

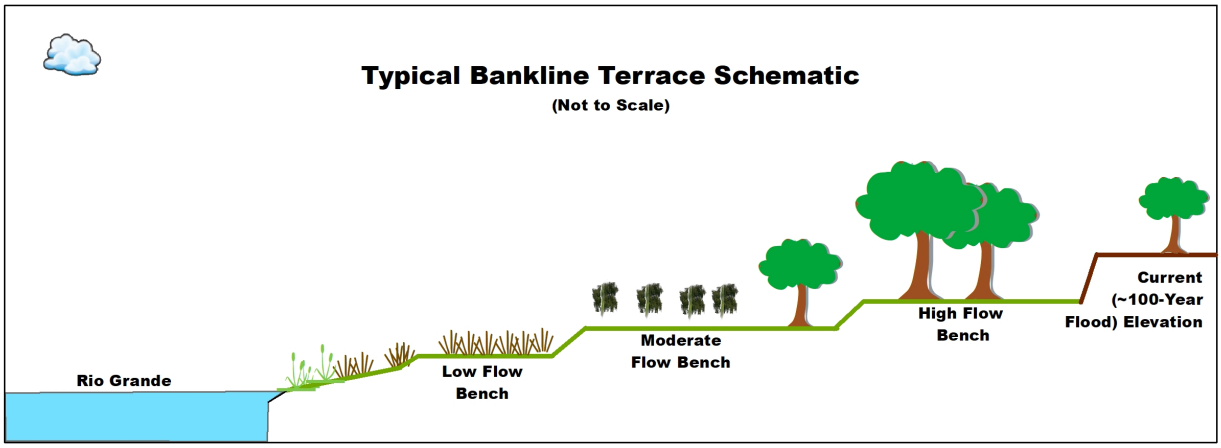

Exhibit 2-1. Cross-section of terraced bankline conceptual design of the Yeso Arroyo Alternative Site

Opportunities and Constraints

Compared to the sandy, homogenous channel conditions throughout most of the RGCP, the rocky channel substrate found at the Yeso Arroyo site has potential to provide relatively heterogenous aquatic habitat structure, including riffles, runs, and pool habitats. These complex channel conditions, particularly in combination with the previously constructed (by USIBWC) Yeso West wetland restoration site immediately downstream, form a potentially valuable and unique suite of aquatic habitat features in this segment of the Rio Grande. Furthermore, flow in this segment of the Rio Grande appears to be persistent (possibly perennial), even outside the irrigation delivery season, which further supports the potential for aquatic habitat enhancements through restoration.

The primary constraint at this site is to provide assurances to protect levee integrity. Additionally, lowering the floodplain terrace to desired discharges would require significant earthwork and costs. The opportunities and constraints at this site are discussed in detail in GSA's alternatives site and conceptual design report (Appendix B).

2.4 ALTERNATIVE C: ANGOSTURA ARROYO

The Angostura Arroyo site is an approximately 15-acre site located on USIBWC lands. Angostura Arroyo enters the Rio Grande from the south side of the river in a channel bend near RM 80 (Appendix A, Figure A-2 and Appendix A, Figure A-5). This site was included as an aquatic restoration site in the USACE Conceptual Plan (USACE 2009). The project site is located on USIBWC lands. The original design in the USACE Conceptual Plan (USACE 2009) is similar to Yeso Arroyo and includes saltcedar removal and bankline destabilization to facilitate river migration into the site. Both the arroyo mouth and the bankline are densely vegetated with willow. Arroyo discharge is funneled into a box culvert structure below Highway 185 and another road just west of the confluence with the Rio Grande. Rocky, volcanic derived alluvium is more common above the box culverts and arroyo substrate becomes more sand dominated below the culverts. Large rock and gravel bars have formed in the Rio Grande channel near the arroyo mouth, increasing the diversity of substrate and flow conditions in the channel in and around the confluence (Photograph 2-2). USIBWC has also historically dredged

the river channel at this location to maintain channel conveyance capacity and gradient. Flow in the Rio Grande appear to be persistent (possibly perennial) at this site, even outside the irrigation delivery season (Appendix A).

Photograph 2-2. Rio Grande Channel adjacent to the Yeso Arroyo Alternative site.

The new conceptual design for the Angostura Arroyo Alternative site is very similar to the Yeso Arroyo Alternative conceptual design and would create 7.5 acres of aquatic habitat. This alternative would include modifying the steep bankline slope by creating a series of terraced benches capable of experiencing overbank flood inundation at a range of low to moderate discharge levels (e.g., 800-2,500 cfs) (see Exhibit 2-1 and Alternative A, Figure A-6). Restoration consists primarily of lowering banks to provide a wetted low profile terrace when local discharge exceeds 800 cfs. The terrace benches would be planted with native riparian vegetation that would provide nesting substrate for bird species and potential nursery habitat for native fishes. Lower terrace surfaces would be revegetated with a diverse mix of wetland herbs while woody vegetation (cottonwood willow plus potted shrubs) planting is recommended on upper benches (Appendix B).

The conceptual design under the Alternative C - Angostura Arroyo includes the following features:

- clear and grub excavation footprint,
- remove saltcedar and other non-native vegetation,
- remove riprap from the bankline toe and deposit off-site,
- construct muti-stepped bankline terrace benches using three- to four-nested terrace benches stabilized by planting native riparian vegetation on the upper bench (see Exhibit 2-1 and Appendix A, Figure A-6),

- plant cottonwood and willow in surrounding riparian enhancement area,
- plant native herbaceous wetland vegetation on the lower terrace bench,
- trench coyote willow throughout highest terrace bench, and
- discontinue channel dredging in this reach segment to encourage channel mobility.

Opportunities and Constraints

This site has potential to improve in-channel and off-channel aquatic habitats with a nested geomorphic floodplain (e.g. terraced approach). Design discharges are intended to achieve a lowflow bench at approximately 800 cfs, moderate flow bench at approximately 1,400 cfs, a high flow bench at approximately 2,500 cfs, with the remainder of the terrace remaining protected at the 100-year flood elevation. Over time, this design alternative has potential to encourage natural recruitment of native vegetation. Deposition of large bed material from the arroyo contributes to increased habitat heterogeneity in the vicinity of the restoration area.

The primary constraint at this site is to provide assurances to protect levee integrity. Additionally, lowering the floodplain terrace to desired discharges would require significant earthwork and costs. The opportunities and constraints at this site are discussed in detail in GSA's habitat restoration alternatives site and conceptual design report (Appendix B).

2.5 ALTERNATIVE D: BROAD CANYON ARROYO

Broad Canyon Arroyo is a tributary to the Rio Grande that enters from the west side of the river near RM 68 (Appendix A, Figure A-2 and Figure A-7). The Broad Canyon Arroyo site is an approximately 2-acre site, and the site has been the focus of previous riparian habitat enhancement projects by U.S. Fish & Wildlife Service, (USFWS), New Mexico State Parks (NMSP), and others. These projects have mostly emphasized planting riparian vegetation, although success has been mixed. Currently, Gooding's willow (*Salix gooddingii*), cottonwood, and coyote willow pole plantings are flourishing near the mouth of Broad Canyon Arroyo and along the arroyo bottom (GSA 2019a). Conversely, coyote willow plantings on higher terraces further from the arroyo mouth have experienced high mortality. Probst and Bixby (2018) proposed multiple potential options for improving fish habitat at the site including 1) enhancing backwater habitat at the arroyo mouth and 2) establishing two alternative paths for carrying Rio Grande water via a new point of diversion to create a manmade spring in the arroyo. The site is described in detail in GSA's habitat restoration alternatives site and conceptual design report (Appendix B).

The conceptual restoration design for the Broad Canyon Arroyo site would create 0.2 acre of aquatic habitat by enhancing the backwater function and habitat diversity as a result of creating a series of embayments supplemented with diverse riparian-wetland revegetation. Excavated embayments provide an opportunity to diversify off channel aquatic habitat plus enhance existing restoration projects already located at the site. The embayments are designed with a target elevation approximately 1-foot higher than the primary arroyo flow path and predicted to begin inundating when localized discharge in the Rio Grande reaches approximately 400 cfs. Embayments nearest the Rio Grande would inundate first. At approximately 1,500 cfs (in the Rio Grande), backwater conditions are predicted to back far enough up the arroyo that each of the embayments would be entirely inundated. Manipulating topography in the arroyo mouth is

expected to diversify emergent wetland vegetation and provide backwater aquatic habitat for fish and other aquatic species.

The conceptual design under the Alternative D - Broad Canyon includes the following features:

- clear and grub vegetation in the excavation footprint,
- ensure protection of existing plantings and marsh habitats during excavation,
- construct backwater embayments adjacent to the primary flow path in Broad Canyon Arroyo at an average depth of 2 feet (Exhibit 2-2 and Appendix A, Figure A-8),
- target Bermuda grass (*Cynodon dactylon*) dominated locations when siting embayments,
- plant cottonwood and willow in surrounding riparian enhancement areas,
- plant native herbaceous wetland vegetation in excavated embayments,
- deposit spoil in open/barren areas (Appendix B), and
- seed spoil area with a diverse, site appropriate mixture of native grasses and forbs.

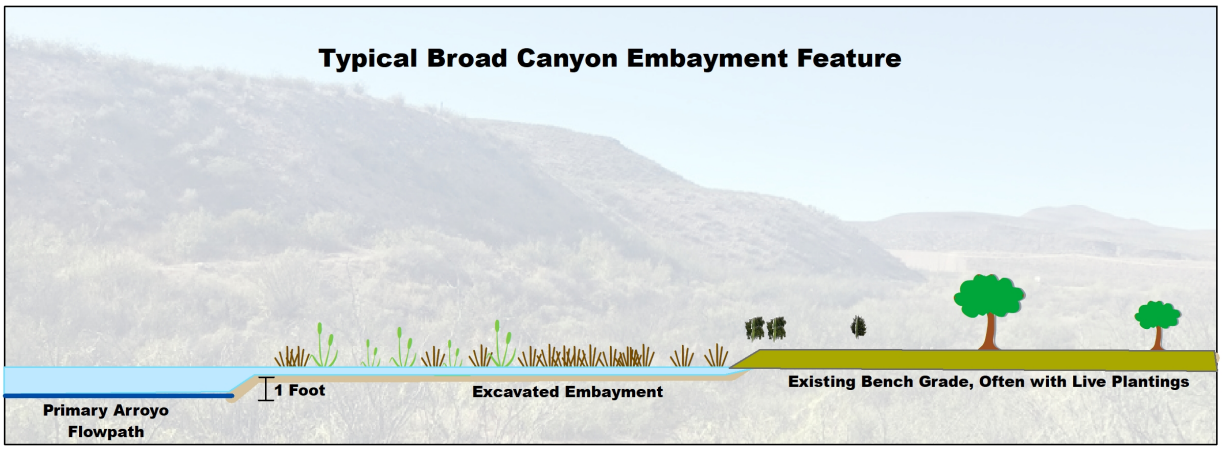

Exhibit 2-2. Cross-section of embayment design concept within the Broad Canyon Arroyo immediately upstream from its confluence with the Rio Grande.

This project would require coordination with multiple agencies because there are multiple owners. USIBWC owns the north bank while the State of New Mexico (SNM) owns portions of the south bank. Excavation would occur on USIBWC property only. Continuous sedimentation would need to be monitored and sediment would likely need to be periodically removed from the arroyo mouth to maintain the hydraulic connection with the Rio Grande.

In addition to enhancements within the arroyo bottom, as described in the GSA's alternative sites analysis and conceptual design report (Appendix B), Probst and Bixby (2018) also consider construction of a temporary, artificial spring with two alternative piping routes. The artificial spring concept is complicated due to clear creation of a new point of diversion and effects on the Rio Grande Compact deliveries. GSA reviewed existing hydraulic models along with Light Detection and Ranging (LiDAR) data to assess the feasibility of constructing an artificial spring as described in that report (Probst and Bixby 2018). An artificial spring is not included in this alternative and justification is provided in Appendix B. The opportunities and constraints at this site are discussed in detail in GSA's alternative sites analysis and conceptual design report (Appendix B).

2.6 ALTERNATIVE E: SELDEN POINT BAR

The Selden Point Bar site is a vegetated, bank-attached (point) bar located on the east side of the Rio Grande near RM 66 (Appendix A, Figure A-2 and Figure 2-9). The site is owned by USIBWC and is approximately 9 acres in size. Selden Canyon arroyo enters the Rio Grande just downstream of the site. A 2008 report (Parametrix 2008) indicates that this location (referred to as the "Martinez Property" in that report) contained dense saltcedar. Saltcedar was removed from the site in recent years and the native herbaceous community has colonized portions of the site. Several barren areas with cottonwood/willow poles appear to have been planted near the southern end of the site with mixed success, and along the bank with high mortality. Restoration efforts are being implemented by USFWS through an interagency agreement with USIBWC. A detailed description of the site is provided in Appendix B.

Flows at this location may be perennial in most years, but discharge was visibly lower in this river segment compared to near Broad Canyon during GSA's January site visit. Deposition of rock into the Rio Grande channel from the arroyo contributes to channel habitat heterogeneity in the vicinity of the restoration area but there is visibly less coarse substrate in the channel compared to the sites upstream (Appendix B).

The proposed conceptual restoration design for the Selden Point Bar site is designed to create a high-flow channel and a backwater channel supplemented by revegetation with native riparian and wetland plant species. The conceptual design for the Selden Point Bar site would create 0.8 acre of aquatic habitat. As illustrated in Exhibit 2-3 and Appendix A, Figure A-10, a side channel is proposed on the upstream end of the point-bar while two backwaters would be constructed on the downstream end (Exhibit 2-4). The channel is designed to begin inundating at 500 cfs and flow through by 1,000 cfs. The backwater features are designed to begin inundating at 500 cfs and would fill with water by 800 cfs. Within the vicinity of this site, riverine habitat is near monotonous and when wetted, consists almost entirely of a channel wide, sand-bottomed run except for rock immediately near the arroyo mouth. Construction of a flowing side channel, at least during irrigation season, provides addition habitat diversity. The backwaters add another structural element to the restoration feature (Appendix B).

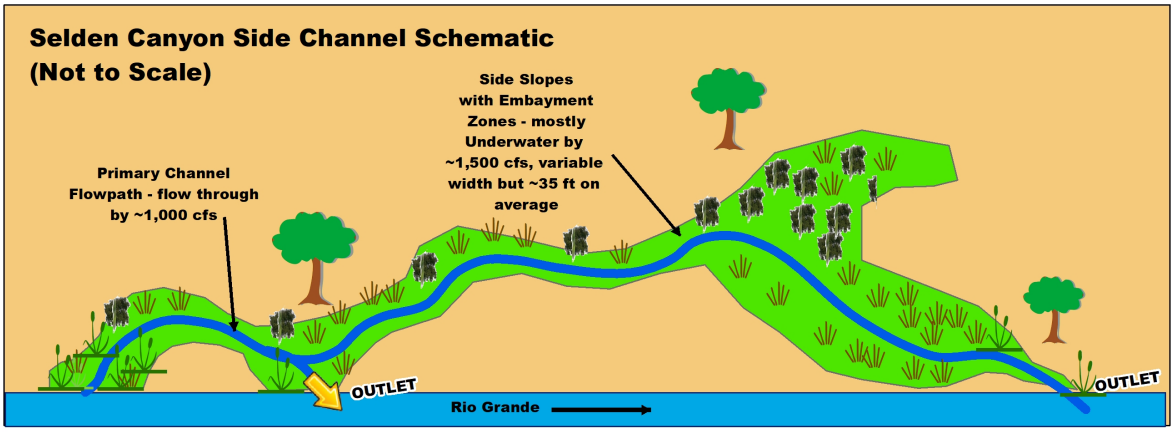

Exhibit 2-3. Illustration of a side channel design concept for Selden Point Bar.

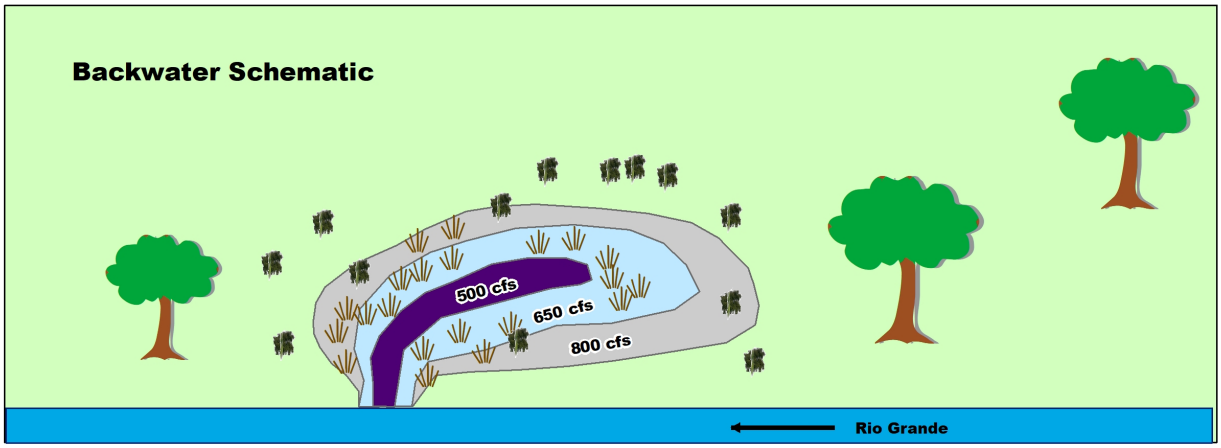

Exhibit 2-4. Illustration of a backwater with flow targets that could be used at Selden Point Bar.

The proposed conceptual design under Alternative E – Selden Point Bar includes the following features:

- retreat saltcedar throughout the site,
- clear and grub excavation footprint,
- construct a flow through channel within barren areas and areas of high concentrations of visible surface salts (Exhibit 2-3 and Appendix A, Figure A-10),
- construct two backwater habitat areas (avoiding live plantings and target weedy areas) (Exhibit 2-4 and Appendix A, Figure A-10),
- plant cottonwood and willow in surrounding riparian enhancement areas, and
- plant native wetland plant plugs in excavated areas.

Opportunities and Constraints

In addition to potential benefits for fish species, riparian plantings adjacent to the excavations would diversify the vegetation complexity at the site and improve habitat quality for the SWFL and YBCU. During moderate to high flows (e.g. 2,500+ cfs), it's also likely that the proposed aquatic features will promote (groundwater and surface water) inundation beyond the excavated footprints, likely flushing salts from the site.

The greatest constraint would be construction access. Heavy equipment would need to cross the active channel of the Rio Grande to access the site. It may be necessary to construct a temporary ramp from the opposite side of the river. Regular sedimentation monitoring would be necessary to validate that the sites continue to function as designed and/or mature on a desirable trajectory. Sediment cleanout would be highly likely on a periodic basis.

2.7 ALTERNATIVE F: LAS CRUCES EFFLUENT

The Las Cruces Effluent site is an approximately 4-acre site located on the east side of the Rio Grande near RM 44. Interstate 10 crosses the Rio Grande near the site (Appendix A, Figure A-2 and Figure 2-11) and the Las Cruces wastewater treatment plant is located east of the project site. USIBWC owns the project lands within the floodplain. The wastewater facility discharges

approximately 8 million gallons of treated water per day (constant discharge of approximately 5 cfs) and effluent travels directly to the river via a concrete-lined channel (Photograph 2-3). Effluent creates perennial flow in this segment of the Rio Grande that often extends for 2 to 3 river-miles through Mesilla Valley Bosque State Park (MVBSP) before completely seeping into the riverbed. The site is near La Llarona Park and paved walking trails support regular recreation (Appendix B). Probst and Bixby (2018) provide multiple habitat restoration design alternatives that include using effluent discharge to create a new channel or oxbow lake east of the concrete-lined effluent channel. The Pobst and Bixby proposal included a fish passage structure

Photograph 2-3. Las Cruces concrete-lined effluent channel.

The New Mexico State Engineer considers treated wastewater effluent discharge to the river channel as an offset for groundwater pumping by the treatment facility, and under the current permit, discharge volume must reach the river. Habitat restoration, therefore, must minimize evapotranspiration (ET) losses at the site and any proposed design would need to off-set any water depletions.

Under Alterative F - Las Cruces Effluent, the proposed design concept is to replace the straight concrete-lined channel currently used to convey treated wastewater to the Rio Grande with a relatively long, meandering channel with diverse aquatic habitat features (Appendix A, Figure A-12 and Exhibit 2-5). The conceptual design for the Las Cruces Effluent site would create 0.9 acre of aquatic habitat. A check structure would be constructed off the concrete-lined channel to reroute water into the constructed channel. The aquatic habitats would be enhanced by planting aquatic vegetation within backwaters, and riparian vegetation (cottonwood and willow) along the channel margins. The channel habitat would emphasize variable conditions to support a

diversity of native fish species. Probst and Bixby (2018) proposed a fish passage structure for the conceptual design. The purpose of the fish passage structure is to preclude noxious non-native fish species from entering into the constructed channel. The fish structure would need to be operated for several weeks after flows reach the Las Cruces reach in early irrigation season. The fish structure is labor intensive and would require manpower to sort and remove noxious non-native fish species. USIBWC is considering the fish passage structure as on option under this alternative and the final decision will be determined during the construction design phase.

Exhibit 2-5. Illustration of meandering channel at the Las Cruces Effluent Site.

The proposed conceptual design under Alternative F – Las Cruces Effluent includes the following features:

- create a meandering clearwater side channel with variable substrate and flow characteristics,
- install a fish passage structure (optional),
- install a check structure to control inflows into the constructed side channel,

- install flow-volume monitoring equipment at the side channel inlet and outlet structures to monitor and quantify water loss,
- install a pedestrian bridge over the channel,
- plant cottonwood and willow in surrounding riparian enhancement area, and
- plant native wetland plant plugs in the clearwater channel.

Opportunities and Constraints

Because of the proposed complexity, Alternative F – Las Cruces Effluent has the potential to provide habitat for a comparatively large diversity of fish species, and has the greatest potential for restoration of regionally extirpated fish species. If the mix of habitats includes a spring head and pool-run-riffle sequences with substrates ranging from sand through gravel and cobble, as many as eight locally extant species and two locally extirpated species might inhabit the constructed channel.

One major constraint at this site is the use of effluent water, which is not USIBWC water. Water rights would need to be obtained because the City of Las Cruces' groundwater permit uses the surface water discharge as offset. Per comments at the project scoping meeting, the City of Las Cruces supports the idea of using effluent to create wetland features. The City has tentatively offered water rights to offset potential evapotranspiration (ET) losses in the channel (Verdecchia 2019b). There is also a potential to transfer USIBWC groundwater rights for beneficial use with the New Mexico State Engineers Office, which would require construction of a groundwater well. USIBWC use of groundwater in the RGCP is subject to review and approval of the Department of Justice. Another possibility is to expand the site northward to create a connection to EBID's Mesilla Lateral Wasteway 11 and use surface water for the riparian habitat. Coordination would be required with EBID for the use of surface water in accordance with their policy.

The fish passage structure (optional) would require individuals to sort and remove noxious non-native fish species for several weeks once flows reach the Las Cruces reach during the irrigation season. Operation would be labor intensive and USIBWC does not have the available staff to operate the fish passage structure. An agreement with a third party would need to be developed for the fish passage structure to be feasible.

Coordination would also be required with the City of Las Cruces to incorporate the wetland into their lease for the walking path. Maintenance of this site could be included in the lease, and it could be incorporated into the recreation path with interpretive signs for pedestrians.

A local citizens group has proposed a wetland at this site in honor of the late author Charles Bowden. During the November 2018 scoping meeting, environmental groups expressed support for this alternative because of the consistent and perpetual water source.

2.8 ALTERNATIVE G: MESILLA VALLEY BOSQUE STATE PARK

MVBSP is located near RM 41 and was established in 2005 (Blue Earth 2008) (Appendix A, Figure A-2). The Park is located on the west side of the Rio Grande near the Town of Mesilla, New Mexico and has been the focal point of other restoration efforts over the past two decades

(Appendix A, Figure A-13). The Picacho Wetland project was constructed by Southwestern Environmental Center (SWEC), City of Las Cruces, and Elephant Butte Irrigation District (EBID) between 2002 and 2005 on a 55-acre tract of land within the Park managed by New Mexico Department of Game and Fish (NMDGF). It involved the construction of two ponds to create aquatic/wetland habitat near Picacho Drain. The MVBSP site is approximately 28 acres in size. A detailed description of MVBSP, past restoration efforts, and current restoration efforts is provided in Appendix B.

Several entities own property within and immediately adjacent to this site, including USIBWC, USFWS, EBID, NMSP, NMDGF, and private owners. There is a current ownership dispute between NMDGF and NMSP regarding MVBSP. Picacho Drain is near the entrance from the visitor center and is owned by the EBID. The EBID right of way includes a 50-foot buffer in each direction from the center of the drain (GSA 2019a) (Photograph 2-4). USIBWC owns most of segment between Picacho Drain and the Rio Grande except for isolated private land inholdings. NMSP/NMDGF owns the segment from Picacho Drain to the upland transition (away from the river).

Photograph 2-4. Overview of Picacho drain.

Multiple restoration options for this site were proposed by Probst and Bixby (2018), and by an older Resource Management Plan (RMP) (Blue Earth 2008). Potential alternatives presented in those reports include deepening existing resaca pool habitats, creating a side channel, excavating backwater, and modifying Picacho Drain. Additional design concepts were shared by EBID and USIBWC during a February 2019 site visit.

EBID rarely maintains Picacho Drain. It is currently overgrown with cattail (*Typhus* spp.) and beaver (*Castor canadensis*) dams frequently interrupt its conveyance efficiency. There is a potential for aquatic/riparian/wetland habitat creation; however, it is crucial that the drain continues to convey irrigation return flows and stormwater back to the river. River flows are perennial through most of the state park due to effluent released from the Las Cruces wastewater treatment facility. Even when the Rio Grande dries, groundwater often surfaces in the drain. The proposed conceptual design under the Alternative G - MVBSP includes a diversity of habitat features. First, a channel would be excavated between the Rio Grande and the Picacho Drain to enhance both riparian and aquatic habitat (Appendix A, Figure A-14 and Exhibit 6). Several shallow depressions (swales) would be excavated along the length of this channel and densely planted with coyote willow, cottonwood and Gooding's willow. The channel would be designed to provide water to new and existing riparian plantings as well as inundate an existing wetland mitigation site. Aquatic habitat in Picacho Drain would be enhanced by controlling cattails that currently dominate the drain and constructing a series of stepped terraces along the eastern edge of the drain that would be inundated under a range of discharges (Appendix A, Figure A-14 and Exhibit 2-7). The water in Picacho Drain would be from two principal sources, high-flows from the Rio Grande and stormwater during summer monsoon flows. The restoration designs emphasize habitat features for a wide-variety of native fish species.

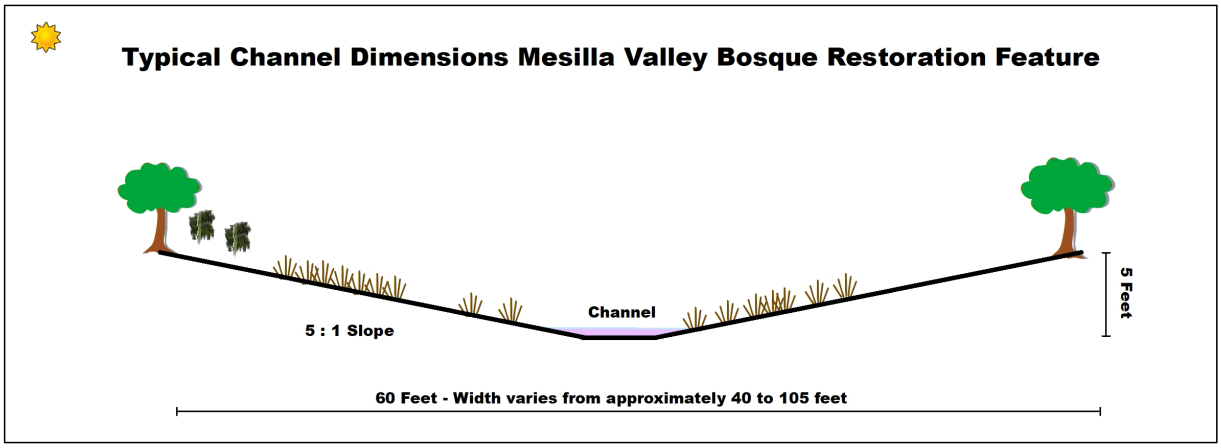

Exhibit 2-6. Cross-section of conceptual restoration design for the constructed channel at Mesilla Valley Bosque State Park.

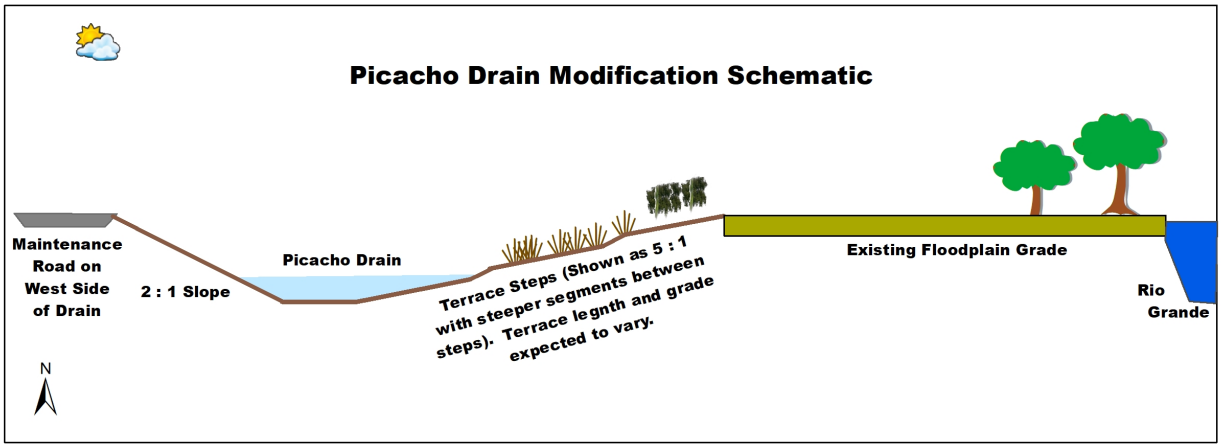

Exhibit 2-7. Cross-section showing conceptual design for habitat enhancements along Picacho Drain.

The proposed conceptual design under Alternative G - MVBSP includes the following features:

- remove all exotic vegetation from floodplain interior,
- clear and grub excavation footprint,
- construct a high flow channel that conveys water from Rio Grande to Picacho Drain (see Exhibit 2-6),
- excavate swales that integrate with the channel and plant willow whips and cottonwood within the swales,
- widen Picacho Drain (see Exhibit 2-7)
- construct multiple stepped bankline terraces on the east side of Picacho Drain (see Exhibit 2-7),
- remove cattail in Picacho Drain and the resaca ponds,
- install a new irrigation check structure in Picacho Drain to control inflow above the terraced section,
- plant cottonwood and willow in surrounding riparian enhancement area, and
- plant native wetland plant plugs in constructed channel and Picacho Drain terrace.

<u>Opportunities and Constraints</u>
Like the Las Cruces Effluent site, this proposed project will provide a diverse mix of habitats and consequently would be able to support a higher diversity of fish species. Groundwater seepage maintains near permanent surface water in portions of Picacho Drain.

Alternative G - MVBSP has the potential to create interior floodplain and side channel habitats that are rare to nonexistent in the RGCP. It is anticipated these features could become refuge habitats for numerous fish species. Proposed elements also integrate with previous restoration actions at the Park plus assist with controlling sediment deposition from tributary arroyos in the Park to prevent sedimentation of aquatic and wetland habitats while maintaining delivery of precipitation runoff to the Park and the Rio Grande. Habitat for native wetland- and riparian-dependent wildlife, including SWFL and YBCU will be improved.

One of the major constraints of this alternative is the proposed land transfer of MVBSP from NMSP to NMDGF. If the land transfer is litigated, the proposed project may not be initiated for several years until a settlement is decided. This alternative would require a large quantity of excavation which makes this alternative extremely expensive. Implementation of this alterantive would require a diversion of water which would have be approved by EBID. Impacts to wetlands would require permitting through the USACE which could be cumbersome since there are multiple landowners, including private landowners. Picacho Drain must be maintained for agricultural return flow and floodwater protection, thus, proposed designs must ensure the facility is accessible for periodic maintenance and comply with EBID policy.

2.9 ALTERNATIVE H: DOWNSTREAM OF COURCHESNE BRIDGE

The Downstream of Courchesne Bridge site is an approximately 13-acre site located near RM 1 in El Paso, TX (Appendix A, Figure A-2 and Appendix A, Figure A-15). This alternative site is owned by USIBWC and USIBWC is considering using a portion of the site for wetland mitigation for levee construction. TXDOT recently reconstructed Highway 85 near this location and the original highway design included a floodwall or levee along the highway; however, that feature may no longer be required. Stormwater runoff enters the site below the highway via two 8-foot by 8-foot box culverts; however, the outlets do not effectively convey water across the site (Photograph 2-5). At the current invert elevation, culverts from below the highway provide supplemental water and promote wetland expansion. A trench was excavated between the January and March 2019 site visits to improve stormwater drainage through the site and to return stormwater to the Rio Grande more efficiently. National Wetlands Inventory data indicates that the site supported jurisdictional wetland conditions prior to recent modifications of the highway (GSA 2019a). This site is discussed in detail in Appendix B.

Photograph 2-5. Overview of the Downstream of Corchesne Bridge site.

The conceptual design at this site focuses primarily on creating a meandering channel that routes stormwater from below the highway, through the site, and into the Rio Grande (Exhibit 2-7 and Appendix A, Figure A-16). Design elements would include benches, embayments, and pools within the channel and the along the margins. Supplemental herbaceous wetland plug plantings and low density, overhanging woody vegetation will increase native wetland species diversity and aquatic habitat complexity at this site.

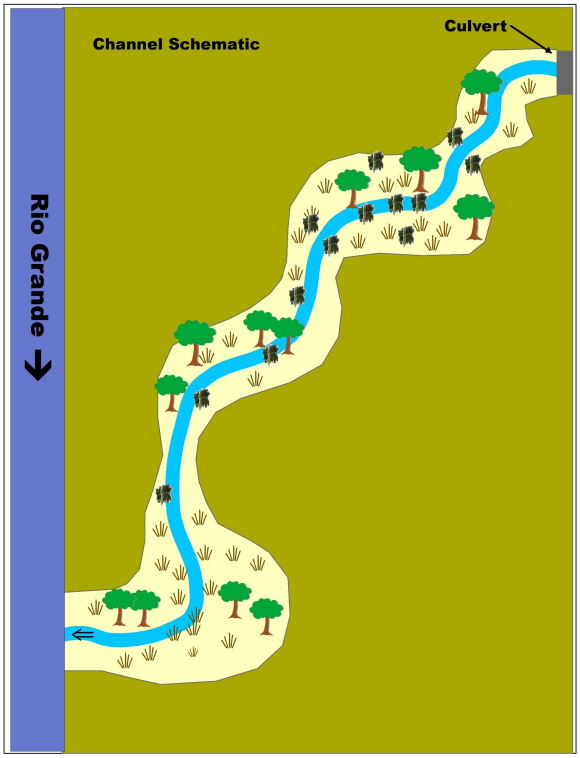

Exhibit 2-5. Conceptual meandering channel at Downstream of Courchesne Bridge site.

The proposed conceptual design under Alternative H – Downstream of Courchesne Bridge includes the following features:

- treat saltcedar and perennial pepperweed throughout the site,
- clear and grub vegetation in excavation footprint,
- conserve existing unique, herbaceous wetlands on-site,
- construct a meandering side channel with an average channel depth of 3 feet that carries stormwater from below the highway to the Rio Grande (Appendix A, Figure A-16, Exhibit 2-7),
- conserve existing unique, herbaceous wetlands onsite;
- plant native wetland plant plugs in excavated embayments and on channel side slopes,
- excavate floodplain terraces along the active Rio Grande channel,
- plant low density woody vegetation along constructed channel margin,
- deposit excavated spoil material in open/barren areas near former staging area or use as part of levee construction if applicable, and
- seed spoil area with a diverse, site appropriate mixture of grasses and forbs

Benefits and Constraints
Constraints at this site include buried utilities, future floodwall or levee construction, and uncertainty surrounding how TXDOT may respond to drainage challenges below the highway. Future restoration activities would need to be coordinated with TXDOT, as there is potential to integrate stormwater outfall improvements with habitat restoration. Recent trenching of new drainages through the site could potentially impact existing wetlands, thus conserving the high-quality wetlands that currently inhabit the site should be considered high importance.

2.10 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER CONSIDERATION

A total of six other potential alternatives sites were considered but eliminated from further consideration due to various uncertainties (e.g., land ownership). These sites are described in the GSA habitat restoration site alternatives and conceptual design report (Appendix B). The sites and the reasons for their elimination from further consideration are discussed in the following subsections and summarized in Table 2-2.

2.10.1 NeMexas Siphon Site

NeMexas Siphon site is near RM 7 (Appendix A, Figure A-2). A spur dyke parallels the Rio Grande and a large cattail marsh has formed behind the dyke in a previously excavated wetland (part of the EBID Dias Lagos project). Managing agencies are currently considering whether levee reconstruction is required, and if that happens, it would cause expansion of the levee footprint into adjacent riparian habitats. A siphon under the levee carries stormwater to the Rio Grande. While this location has potential for integrating stormwater retention, wetland construction, and habitat restoration, numerous potential obstacles exist relating to land ownership and possible levee reconstruction. The property is currently in an ownership dispute between Sunland Park, New Mexico and the Boy Scouts of America and litigation may be required. Due to these uncertainties, this site was removed from the restoration alternatives considered and no conceptual restoration design was developed (Table 2-2). An assessment for the site is provided in GSA's (2019a) habitat restoration alternatives site and conceptual design report in Appendix B.

Riverside portions of the site contain dense saltcedar and wetlands that have formed in excavated borrow pits within the riparian vegetation. A portion of the site has recently burned (Photograph 2-6). Soil and groundwater conditions appear to support a restoration approach that includes Goodding's willow forests, herbaceous wetlands, aquatic habitats, and excavated backwaters, that in combination, would be highly beneficial for SWFL and YBCU. The Rio Grande riverbed was entirely dry at this location during the November 2018 and January 2019 site visits.

2.10.2 Montoya Intercepting Drain Site

The Montoya Drain site is an EBID-owned irrigation facility near RM 3 (Appendix A, Figure A-2). The drain does not appear to be actively maintained and is currently overgrown with cattail(Photograph 2-7). Depending on EBID's long-term plan for this facility, the site has potential for aquatic habitat creation in the drain, possibly integrated with water conveyance requirements. Groundwater is shallow in the vicinity and standing water was observed in the

Table 2-2. Summary of Eliminated Alternatives

Name	Location	Ownership	Benefits	Constraints	Reasons Eliminated
Ne Mexas Siphon	Appendix A, Figure A-2	Disputed (City of Sunland Park, New Mexico and Boy Scouts of America	• Direct benefits for SWFL and YBCU • Enhance riparian habitat • Create wetland habitat • Integrate storm water retention • Shallow groundwater	• Property dispute • Potential levee construction	• Property Dispute and unknown potential levee alignment
Montoya Intercepting Drain	Appendix A, Figure A-2	EBID	• Create aquatic habitat • Shallow groundwater • USIBWC does not have a ROW	• Not owned by USIBWC	• Sites with better habitat creation potential on USIBWC lands
El Paso Electric/Montoya Drain Site	Appendix A, Figure A-2	Multiple owners	• Create aquatic habitat • Create wetland habitat • Integrate stromwater runoff	• Not owned by USIBWC • USIBWC has limited ROW • Uncertain plans for future projects • Land owner complexitie • Multiple jurisdictions	• Complexity of ownership • Limited USIBWC ROW
Placitas Arroyo Site	Appendix A, Figure A-2	USIBWC	• Improve channel and off channel aquatic habitat with a nested geomorphic floodplain (e.g., terrace benches) • Enhance riparian habitat • Direct benefits for SWFL3 and YBCU3 • Enhance riparian area • USIBWC owns property	• Proposed sediment retention facility	• Proposed sediment retention facility would reduce flow velocities
Trujillo site	Appendix A, Figure A-2	EBID		• Alternative introduced late in the design process	• Not considered because conceptual design process was too far along
Las Cruces Effluent Subterranean Pipe	Appendix A, Figure A-2		• Enhance aquatic and riparian habitat • Create a diversity of habitats • Improve wetland and riparian habitat • Direct benefits to SWFL and YBCU • Potential to create interior floodplain and side channel habitats	• Design is beyond Scope of Work for the project	• Design is beyond Scope of Work for the project

facility during the November 2018 and January 2019 site visits. This site was eliminated from further consideration because other sites with higher aquatic habitat restoration potential were identified (see Table 2-2). The site is owned by multiple jurisdictions, and USIBWC currently does not have a righ-of-way for the site. An assessment for the site is provided in GSA's (2019a) alternatives site and conceptual design report in Appendix B.

Photograph 2-6. Overview of burned area at the NeMexas Siphon Site.

Photograph 2-7. Representative photograph of the Montoya Drain Site

2.10.3 El Paso Electric/Montoya Drain Site

The El Paso Electric/Montoya Drain site is adjacent to the El Paso Electric power generation facility near RM 2 (Appendix A, Figure A-2 and Photograph 2-8). Numerous potential restoration approaches have been presented by USIBWC, project partners, and other entities. These projects have proposed the excavation of wetland features along the river near the Montoya Drain outlet, integrating stormwater runoff with new wetland creation, and modifying the drain outlet to improve aquatic habitat quality. El Paso Water Utility and El Paso Electric are considering new stormwater catchments in a large open area on the northwest side of Montoya Drain. However, due to land ownership complexities and uncertain plans for future projects, this alternative was eliminated from further consideration (see Table 2-2). However, El Paso Electric and El Paso Water Utilities could collaborate with a third-party proponent (e.g. non-profit organization), possibly USIBWC, in the future.

Photograph 2-8. Representative photograph of the El Paso Electric/Montoya Drain Site.

2.10.4 Placitas Arroyo Site

Placitas Arroyo is an aquatic habitat restoration site recommended in the USACE Conceptual Plan (Appendix A, Figure A-2) (USACE 2009). The proposed design in that report includes removal of the existing riprap toe protection plus bankline destabilization across from the arroyo confluence and cessation of future dredging (USACE 2009). The USACE Conceptual Plan (USACE 2009) suggests that the proposed design would facilitate natural channel migration, contribute to reduced channel conveyance capacity, and result in more frequent overbank flooding in locations immediately upstream of the arroyo mouth. Currently, there are plans to create a sediment retention facility in Placitas Arroyo above the confluence with the Rio Grande. Since a sediment dam would reduce flow velocity and sediment-laden tributary flows, this site was removed from further consideration (see Table 2-2).

2.10.5 Trujillo Canyon Site

Trujillo canyon enters the Rio Grande from the west side of the river just below Percha Dam (Appendix A, Figure A-2). EBID expressed interest in exploring habitat restoration potential at this site in the future. The site was not evaluated in GSA's (2019a) habitat restoration site and conceptual design report because the site was introduced late in the conceptual design process (see Table 2-2).

2.10.6 Las Cruces Effluent Subterranean Pipe

EBID expressed interest in piping effluent discharged from the Las Cruces wastewater treatment plant below the Rio Grande and into Picacho Drain on the opposite side of the river. This action may benefit the habitat improvements recommended at MVBSP, however, designing this type of structure is beyond the scope of this report (see Table 2-2). Additionally, project engineers tasked with designing later phases of this project do not recommend this type of active hydraulic control or mechanism in river restoration.

2.11 COMPARISON OF ALTERNATIVES

The benefits and constraints of each alternative and the feasibility to construct each alternative is provided in Table 2-3.

2.12 SUMMARY OF ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

Environmental impacts are discussed in detail in Section 3. Table 2-4 summarizes potential environmental consequences of the Alternatives evaluated.

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Table 2-3. Summary of Alternatives Evaluated in this EA

Name	Created Aquatic Restoration Feature (Acre)	Benefits	Constraints	Decision
Alternative A: No Action				
Alternative B: Yeso Arroyo	6.9	• Improve channel and off channel aquatic habitat with a nested geomorphic floodplain (e.g., terrace benches) • Enhance riparian habitat • Direct benefits for SWFL[3] and YBCU[3] • Enhance riparian area • USIBWC owns property	• Levee protection • Significant earthwork • Evapotranspiration increase of 18.3 ac-ft/yr • High total cost • High quantity of excavation • Potential to degrade levee interity	This alternative is less feasible to construct based on high total cost, high quantity of excavation, a moderate evapotranspiration increase, and the potential for levee degradation.
Alternative C: Angostura Arroyo	7.5	• Improve channel and off channel aquatic habitat with a nested geomorphic floodplain (e.g., terrace benches) • Enhance riparian habitat • Direct benefits for SWFL and YBCU • Enhance riparian area • USIBWC owns property • Channel habitat heterogeneity near restoration site	• Levee protection • Significant earthwork • Evapotranspiration increase of 19.5 ac-ft/yr • High total cost • High quantity of excavation • Potential to degrade levee interity	This alternative is less feasible to construct based on high total cost, high quantity of excavation, a moderate evapotranspiration increase, and the potential for levee degradation
Alternative D: Broad Canyon Arroyo	0.2	• USIBWC no mow zone • Create backwater aquatic habitat • Create deep water, structurally diverse habitat (embayments) • Direct benefits for SWFL and YBCU • Channel habitat heterogeneity near restoration site • Enhance riparian – wetland vegetation • Evapotranspiration decrease of 0.9 ac-ft/yr • Low total cost • Excavations would occur on USIBWC property • Does not require construction design to build	• Multiple owners • Regular sediment monitoring • Periodic maintenance (sediment removal)	This alternative is feasible to implement due to low construction cost, negligible decrease in evapotranspiration, benefits to SWFL and YBCU,does not require construction design, and excavations would occur on USIBWC property.
Alternative E: Selden Point Bar	0.8	• Channel habitat heterogeneity near restoration site (less than upstream sites) • Perennial flows (most years) • Create high flow channel and backwater channel • Direct benefits for SWFL and YBCU • Enhance riparian habitat • Evapotranspiration decrease of 13.9 ac-ft/yr • Moderate total cost • USIBWC owns property	• Access (equipment would have to be walked across active channel) • Regular sediment monitoring • Periodic maintenance (sediment removal)	This alternative is feasible to implement due to moderate construction cost, moderate decrease in evapotranspiration, does not require construction design, benefits to SWFL and YBCU, and excavations would occur on USIBWC property.
Alternative F:Las Cruces Effluent	0.9	• Create diverse aquatic habitat (long meandering channel) • Plant aquatic vegetation in backwater areas • Establish riparian vegetation • USIBWC owns property • Moderate total cost • Direct benefits for SWFL and • Create a diversity of habitats • Perennial water flowr • Potential to provide habitat for a variety of fish species due to complex design • Greatest potential to recover regionally extirpated fish species	• Cessation of mowing • Water rights • Labor intensive (fish structure) - optional • Potential water well installation • Evapotranspiration increase of 6.5 ac-ft/yr	This alternative is feasible to construct due to moderate total construction costs, perennial water flow, USIBWC ownership, potential to provide a diversity of aquatic habitat, potential to provide habitat for a variety of fish species, potential to recover regionally extirpated specie, and support by the City of Las Cruces and other stakeholderss.

Table 2-3, continued

Name	Created Aquatic Restoration Feature (Acre)	Benefits	Constraints	Decision
Alternative G: Mesilla Valley Bosque State Park	15.8	• Enhance aquatic and riparian habitat • Create a diversity of habitats • Improve wetland and riparian habitat • Direct benefits to SWFL and YBCU • Potential to create interior floodplain and side channel habitats • Evapotranspiration decrease of 19.2 ac-ft/yr	• Potential land transfer between New Mexico State Parks and New Mexico Department of Game and Fish • Picacho Drain must be maintained for irrigation return flow and floodwater protection • High total cost • High quantity of excavation • Multiple property owners • Wetland permitting on non-USIBWC lands	This alternative is less feasible to construct due to high total cost, high quantity of excavation, multiple landowners, unknown status of land transfer, and potential wetland permitting issues associated with multiple landowners
Alternative H: Downstream of Courchesne Bridge	1.4	• Increase native wetland vegetation • Enhance aquatic habitat • Improve wetland habitat • Direct Benefits to SWFL and YBCU • Evapotranspiration decrease of 24.5 ac-ft/yr • Moderate total cost • USIBWC owns property • High water table	• Buried utility infrastructure • Unknown status of future floodwall or levee construction • Unknown status of future TXDOT4 drainage solutions	This alternative is feasible to construct due to USIBWC owns the property, moderate decrease in evapotranspiration, moderate total cost, enhancement of aquatic habitat, improvement of wetland habitat, moderate total costs, and a high water table.

Table 2-4. Summary of Environmental Resources Affected by Alternatives

Environmental Resources	Effects of Alternatives							
	Alternative A	**Alternative B**	**Alternative C**	**Alternative D**	**Alternative E**	**Alternative F**	**Alternative G**	**Alternative H**
Biological Resources **A. Vegetation**	No Effect	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, moderate: beneficial	Long-term, localized beneficial
B. Wildlife (Terrestrial and Aquatic)	No Effect	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, moderate beneficial	Long-term, moderate beneficial	Long-term localized beneficial (terrestrial) and Long-term, moderate beneficial (aquatic species)	Long-term, moderate beneficial	Long-term, localized beneficial
C. Threatened and Endangered Species	No Effect	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, moderate beneficial	Long-term, localized beneficial	Long-term moderate: beneficial	No Effect
Water Resources **A. Flood Control**	No Effect	Long-term, moderate adverse	Long-term, moderate adverse	Long-term, no effect	Long-term negligible beneficial	Long-term, localized adverse	Long-term, localized beneficial	Long-term, localized adverse
B. Water Quality	No Effect	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, localized beneficial	Long-term, localized beneficial
C. Water Consumption	No Effect	Long-term, moderate adverse	Long-term, moderate adverse	Long-term, negligible beneficial	Long-term, moderate beneficial	Long-term, localized adverse	Long-term, moderate beneficial	Long-term, moderate: beneficial
D. Waters of the U.S.	No Effect	Temporary, negligible averse and long-term, localized beneficial	Temporary, negligible adverse and long-term, localized beneficial	Temporary, negligible adverse and long-term, localized beneficial	Temporary, negligible adverse and long-term, localized beneficial	Long-term, localized beneficial	Temporary, negligible adverse (mitigated) and long-term moderate beneficial	Temporary, negligible adverse and long-term, localized beneficial
Cultural Resources	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	Potential Adverse	Potential Adverse
Soils	No Effect	Long-term localized adverse and Temporary negligible adverse	Long-term, localized adverse and Temporary negligible adverse	Long-term, localized adverse and Temporary negligible adverse	Long-term, localized adverse and Temporary negligible adverse	Long-term, localized adverse and Temporary negligible adverse	Long-term, localized adverse and Temporary negligible adverse	Long-term, localized adverse and Temporary negligible adverse
Community Resources **Recreation**	No Effect	No Effect	No Effect	No Effect	No Effect	Temporary, negligible adverse and long-term, localized beneficial	Temporary, negligible adverse and long-term localized beneficial	No Effect

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3.0 AFFECTED ENVIRONMENT AND CONSEQUENCES

3.1 BIOLOGICAL RESOURCES

3.1.1 Vegetation

The RGCP is located in the northern Trans-Pecos region of the Chihuahuan Desert. This region historically was a mosaic of grasslands and desert shrublands (McMahan et al. 1984). Climatic conditions throughout the study area are classified as semi-arid continental, characterized by fairly hot summers, mild winters, and short temperate spring and fall seasons; with an average of 7.7 inches of precipitation per year (Parsons 2001). Detailed descriptions of the vegetation and habitat types occurring at each site are described below.

Alternative B – Yeso Arroyo

Three vegetation types at this site; include jimmyweed shrubland, saltcedar-coyote willow shrubland, and saltcedar-honey mesquite shrubland. Non-native saltcedar (*Tamarix chinensis)* dominates the vegetation along the banks with honey mesquite (*Prosopis glandulosa*) occurring in the southern segment and coyote willow in the northern segment of the site (GSA 2019a) (Appendix A, Figure A-17). Additional plant species growing along the bankline slope includes seep willow (*Baccharis salicina*), fourwing saltbush (*Atriplex canescens*), cottonwood, Torrey wolfberry (*Lycium torreyi*), whitethorn acacia (*Vachellia constricta*), prickly pear (*Opuntia* spp.), arrowweed (*Pluchea serecia*), feather plume (*Dalea formosa*), scratchgrass (*Muhlenbergia asperifolia*), Russian thistle (*Salsola tragus*), and velvetweed (*Oenothera curtiflora*) (GSA 2019a).

The elevated floodplain terrace above the bankline slope is currently dominated by Jimmyweed (*Isocoma pluriflora*), a native shrub. Other woody species documented on the floodplain terrace include saltcedar, honey mesquite, arrowweed, prickly pear, fourwing saltbush, whitethorn acacia, indigobush (*Amorpha fruticosa*), and longleaf jointfir (*Ephedra trifurca*).

Alternative C – Angostura Arroyo

Two vegetation types are described at this site; saltcedar-coyote willow shrubland and an open/barren area (Appendix A, Figure A-18). Saltcedar-coyote willow shrubland inhabits the bankline slope (GSA 2019a). Other woody species observed on the bankline include arrowweed, screwbean mesquite (*Prosopis pubescens*), seep willow (*Baccharis salicifolia* and *salicina*), honey mesquite, fourwing saltbush, wolfberry, and skunkbush sumac (*Rhus trilobata*). The floodplain terrace is actively mowed by USIBWC so woody vegetation is mostly absent and the area is considered open/barren. However, Russian thistle, jimmyweed, spiny chloracantha (*Chloracantha spinosa*), and fourwing saltbush stems occur in this area.

Alternative D – Broad Canyon Arroyo

Seven different vegetation types were described for this site (GSA 2019a). Most of the bankline habitats are a mix of shrublands (coyote willow, arrowweed, and honey mesquite shrublands), with an open/barren area adjacent to the west, a strip of wet meadow, and burrobrush and honey mesquite-ephedra shrubland furthest from the bankline (Appendix A, Figure A-19).
The open/barren area is dominated by Russian thistle, with patches of saltcedar, honey mesquite, and Mojave seablite (*Suaeda nigra*), and numerous piles of discarded concrete and rubble. The

wet meadow habitat at this site consists of a mix of cattail marsh, coyote willow, Gooding's willow, cottonwood, and Bermuda grass. The upland portions of the site include honey mesquite shrublands, burrobrush shrublands, and portions where jointfir co-dominates with honey mesquite. Russian thistle, sand dropseed, sacred datura (*Datura wrightii*), wolfberry, fringed twinevine, broom snakeweed (*Gutierrezia sarothrae*), giant sacaton (*Sporobolus giganticus*) are the primary herbaceous constituents.

Alternative E – Selden Point Bar
The bankline is dominated by saltcedar or a mix of shrublands (coyote willow, arrowweed-saltcedar, or coyote willow-baccharis) (Appendix A, Figure A-20). Immediately behind these shrublands lies an open/barren area which is dominated by non-native kochia (*Bassia scoparia*) and Russian thistle, and alkaliweed (*Cressa truxillensis*). Between this barren area and the railroad tracks is a large cattail marsh in what appears to be a former borrow pit. Adjacent to and downstream of the marsh is a wet meadow area with honey mesquite, seep willow, saltcedar, and wolfberry.

Alternative F – Las Cruces Effluent Site
Three vegetation types are described for this site; open/barren, wet meadow, and coyote-willow shrubland (GSA 2019a). The eastern side of the bank is dominated by a Bermuda grass meadow with occasional planted cottonwood situated between the levee and the recreational trail adjacent to the bankline (Appendix A, Figure A-21). A small portion of this area is mostly barren but supports patches of kochia and sand dropseed (*Sporobolus cryptandrus*). The bankline upstream from the effluent channel is a narrow coyote willow shrubland with some scratchgrass in the herbaceous layer. Downstream of the effluent discharge channel, the bankline is a mix of coyote willow interspersed with cattail, Johnsongrass (*Sorghum halapense*), an occasional saltcedar, spiny chlorocantha, and Bermuda grass.

The western side of the site is also dominated by a Bermuda grass meadow, but with more alkali sacaton than the eastern side. Occasional saltcedar, Lehman's lovegrass (*Eragrostis lehmanniana*), and kochia also occur. From north to south along the bankline, a Bermuda grass and spiny chlorocantha habitat becomes a healthy coyote willow shrubland with Bermuda grass along the ground.

Alternative G – Mesilla Valley Bosque State Park
Twelve different vegetation types are described for this site. North of the visitor's center the vegetation is dominated by grasslands/wet meadow habitat (Appendix A, Figure A-22) (GSA 2019a). The grassland, on the eastern side, is dominated by alkali sacaton with some Jimmyweed and wolfberry. The wet meadow habitat, on the western side, is dominated by saltgrass while other plants include alkali sacaton, globebmallow (*Sphaeracea* spp.), yerba mansa (*Anemopsis californica*), honey mesquite, screwbean mesquite, saltbush, wolfberry, and an occasional saltcedar. A narrow band of saltcedar with an occasional seep willow line the Picacho Drain west of the saltgrass meadow.

South of the visitor center is a diverse mosaic of different vegetation types. A narrow band of coyote willow shrubland lines the bank line and occasionally also includes saltcedar. Patches of previous wetland mitigation areas are now a wet meadow with scratchgrass, common

threesquare (*Schoenoplectus pungents*), arctic rush (*Juncus arcticus*), cattail, and yerba mansa. There are also large pools of open water that dry out periodically. In between these ponds and mitigation areas are saltgrass meadows and areas with kochi. As elevation increases north of the ponds, the habitat transitions to areas with arrowweed, wolfberry, honey mesquite, and skunkbush sumac. South of the ponds, the habitat contains a large coyote willow stand, followed by a mix of saltcedar, wolfberry, and arrowweed with some Gooding's willow, honey mesquite and screwbean mesquite south of where the Picacho Drain confluences with the river.

Alternative H – Downstream of Courchesne Bridge

Five vegetation types were identified at this site, but nearly the entire site is dominated by a saltgrass/scratchgrass wet meadow, with varying degrees of overstory cover (Appendix A, Figure A, Figure A-23) (GSA 2019a). Open/barren areas dominated by kochia and Mojave seablite are found adjacent to the road in locations that appear to have been used for staging equipment during recent construction on the adjacent highway. A small marsh area is dominated by a mix of cattail and hardstem bulrush and occurs immediately downstream of the northern drainage trench. Other species in this habitat include common reed (*Phragmites australis*), pepperweed (*Lepidium latifolium*), sedge (*Carex* sp.), wild licorice (*Glycyrrhiza lepidota*), Indianhemp (*Apocynum cannabinum*), Canada wild rye (*Elymus canadensis*), and dock (*Rumex* sp.).

The southern end of the site is significantly drier and becomes a honey mesquite-seep willow shrubland. Saltcedar nearly disappears in this zone while saltgrass/scratchgrass remain dominant in the herbaceous layer. In the downstream-most end, screwbean mesquite becomes more dominant, but with a diverse mix of other woody species like seep willow, honey mesquite, Jimmyweed, and Jerusalem thorn (*Parkinsonia aculeata*).

3.1.2 Wildlife

Several mammal, bird, and reptile species inhabit the RGCP within the project area. Potential mammal species include coyote (*Canis latrans*), kit fox (*Vulpes macrotis)*, Western spotted skunk (*Spilogale gracilis)*, raccoon (*Procyon lotor)*, white-footed mouse (*Peromyscus leucopus*), western harvest mouse (*Reithrodontomys megalotis*), house mouse (*Mus musculus*), rock squirrel (*Otospermophilus variegatus)*, southern pocket gopher (*Thomomys umbrinus*), desert cottontail (*Sylvilagus audubonii)*, and black-tailed jackrabbit (*Lepus californicus)* (Hink and Ohmart 1984). Common reptile and amphibian species include New Mexican whiptail (*Aspidoscelis neomexicana*) and southwestern woodhouse toad (*Anaxyrus woodhousii australis)* (Hink and Ohmart 1984).

Habitat in the RGCP is used by numerous migratory birds (Yong and Finch 1996, Finch and Yong 2000, USIBWC 2004). The Rio Grande is a major migratory flyway for numerous bird species, particularly waterfowl, shorebirds, and those associated with riparian habitats. USIBWC must comply with the Migratory Bird Treaty Act (MBTA) which protects migratory birds, their parts, nests, and eggs thereof during the nesting season. The USFWS has determined that the nesting season for the region including the RGCP is March 1 to August 31.

Bird species occupying the area include American kestrel (*Falco sparverius*), ash-throated flycatcher (*Myiarchus cinerascens*), black-chinned hummingbird (*Archilochus alexandri*),

Gambel's quail (*Callipepla gambeii*), great blue heron (*Ardea herodias*), inca dove (*Columbina inca*), killdeer (*Charadrius vociferous*), northern harrier (*Circus hudsonius*), red-tailed hawk (*Buteo jamaicensis*), snowy egret (*Egretta thula*), and yellow warbler (*Setophaga petechia*). Across all taxa, higher densities and diversity of species have been found within the Rio Grande in mature cottonwood or Russian olive stands, and in dense, intermediately aged cottonwood-coyote willow stands as compared to stands of non-native saltcedar (Hink and Ohmart 1984).

Historically, the Rio Grande was home to approximately 22 native fish species, and minnow species including the Rio Grande silvery minnow (*Hybognathus amarus)*, Red shiner (*Cyprinella lutrensis*), fathead minnow (*Pimephales promelas*), flathead chub (*Platygobio gracilis*), and longnose dace (*Rhinichthys cataractae*) were the main assemblage to dominate the Rio Grande (NMDGF 2015, Probst and Bixby 2018, Sallenave et al. 2018). Today there are approximately 15 native species along with numerous introduced species. Between Elephant Butte Reservoir and the city of El Paso, Texas, 20 total fish species, including nine native species, were found in the associated canals and ditches along the Rio Grande (Sallenave et al. 2018). The diversity of fish species was found to be highest at drainage locations closest to the river, and decreased farther away. Fishes found in drainage canals included several non-native sunfish species including green sunfish (*Lepomis cyanellus*), longear sunfish (*L. megalotis*), and largemouth bass (*Micropterus salmoides*), common carp (*Cyprinus carpio*), and yellow bullhead (*Ameiurus natalis*). The majority of fish species found in the drainage canals are non-native predatory fish species, although the native mosquitofish (*Gambusia affinis*) was also found.

Environmental Consequences

Alternative A – No Action

Under Alternative A - No Action, no aquatic habitat restoration projects included as part of this project would be implemented. The vegetation would largely remain the same, and would not be restored to aquatic species. No nesting, roosting, or foraging habitat would be created for aquatic species, reptiles, amphibians, or birds. No positive impacts are anticipated, as no restoration activities would be implemented under this alternative.

Alternative B – Yeso Arroyo

The restoration design for the Yeso Arroyo site includes modifying the slope of the existing steep bankline terrace by creating a series of terraced benches capable of experiencing overbank flood inundation at a range of low to moderate discharge levels (e.g., 800-2,000 cfs). The terrace benches would be planted with native riparian vegetation, including cottonwood and coyote willow, which could provide nesting, roosting, or feeding habitat for numerous species of small mammals, herpetofauna, and birds (GSA 2019a). As a result of removing non-native vegetation and establishing native riparian vegetation, Alternative B – Yeso Arroyo would have a long-term, localized beneficial impact on vegetation and wildlife.

When inundated, the terrace benches could provide habitat for native fishes. Bankline terracing would provide wetted, low-velocity habitat when local Rio Grande discharge exceeds 800 cfs. The most likely users of such a habitat would be red shiner and fathead minnow. Their primary use would be feeding on small aquatic macroinvertebrates. If water velocities were slow to moderate, western mosquitofish (*Gamusia affinis*) might also feed and potentially spawn.

Channel catfish (*Ictalurus punctatus*) might move through in search of macroinvertebrate and fish prey. Pulsing flows over the lowered terrace would transport organic debris into the river channel thereby increasing its nutrient base. Alternative B – Yeso Arroyo would have a long-term, localized beneficial impact on aquatic species as a result to of creating aquatic habitat.

Alternative C – Angostura Arroyo

The restoration design at this site is very similar to Alternative B - Yeso Arroyo in that it would involve altering the steep bankline slope by creating a series of terraced benches capable of experiencing overbank flood inundation at a range of low to moderate discharge levels (e.g., 800-2,000 cfs) (GSA 2019a).

The terrace benches would be planted with native cottonwood and coyote willow that could provide nesting, roosting, or foraging habitat for a wide range of taxa. When wetted sufficiently, it could also potentially provide habitat for native fishes. Of these, the most likely are red shiner, fathead minnow, and western mosquitofish. Fathead minnow and western mosquitofish favor low-velocity habitats with abundant aquatic vascular plants. Red shiner generally prefers moderate-velocity habitats, such as the inundated, upstream arroyo delta, but would use flooded areas such as the terrace for foraging. Female fathead minnows deposit their eggs on submerged organic matter and live-bearing western mosquitofish need zero or low-velocity habitats to avoid current entrainment of their young. Red shiner would spawn in the higher gradient portions of the upstream arroyo delta, but their young, upon emergence, would use the low velocity habitats of the terrace. The wetted terrace would likely support a variety of aquatic insects that would be consumed by fishes. A fourth species, channel catfish, might forage for insects and fishes on the terrace. As a result of removing non-native vegetation and establishing native riparian vegetation, Alternative C – Angostura Arroyo would have a long-term, localized beneficial impact on vegetation and wildlife. This alternative would have a long-term, localized beneficial impact on aquatic species as a result to of creating aquatic habitat.

Alternative D – Broad Canyon Arroyo

The restoration design for the Broad Canyon Arroyo site emphasizes enhancing the backwater function and habitat diversity by creating a series of embayments supplemented with diverse riparian-wetland revegetation (GSA 2019a). By approximately 1,500 cfs (in the Rio Grande), backwater conditions are predicted to back far enough up the arroyo that each of the embayments would be entirely underwater. Manipulating topography in the arroyo mouth is expected to diversify emergent wetland vegetation and provide backwater aquatic habitat for fish and other aquatic species. The addition of embayments to the Broad Canyon backwater would provide deep water, structurally diverse habitats that are not otherwise available in the existing channel. In addition to providing habitat for fathead minnow and western mosquitofish, the habitat features could potentially provide habitat for several large-bodied fish species. Of these, channel catfish and bluegill (*Lepomis macrochirus*) are the most likely beneficiaries. Gizzard shad (*Dorosoma sp*.) might forage for zooplankton in the still water habitat of the backwater. Less likely but still potential users of the improved backwater are red shiner, river carpsucker (*Carpiodes carpio*), and flathead catfish (*Pylodictis olivaris*). While restoration efforts at this site would focus on creating embayments adjacent to the Arroyo, revegetation would occur in the surrounding riparian area, with a focus on native herbaceous species and riparian enhancement. The addition of native herbaceous species may support small mammals or herpetofauna. As a

result of removing non-native vegetation and establishing native riparian and wetland herbaceous vegetation, Alternative D – Broad Canyon Arroyo would have a long-term, localized beneficial impact on vegetation and wildlife. This alternative would have a long-term, localized beneficial impact on aquatic species as a result to of creating aquatic habitat features.

Alternative E – Selden Point Bar

The restoration design for this site would involve creating a high-flow channel and a backwater channel supplemented by revegetation of nearly 20-acres with native riparian plant species (cottonwood and coyote willow) (GSA 2019a). This additional area of native riparian species would be able to support a wide range of taxa, including migratory or breeding birds, mammals, or herpetofauna. Construction of a flowing side channel, at least during irrigation season, provides additional habitat diversity. The backwaters add another structural element. Red shiner would be the most likely small-bodied user of the side channel, both for foraging (it is an insectivore) and potentially spawning (eggs deposited amongst pea gravel in flowing water). Depending on its depth, large-bodied channel catfish, flathead catfish and river carpsucker might also use it for feeding. The backwater portions of this site would most likely be used by fathead minnow and western mosquitofish. If sufficiently deep, gizzard shad might feed in the backwaters. As a result of removing non-native vegetation and establishing native riparian vegetation, Alternative E – Selden Point Bar would have a long-term, localized beneficial impact on vegetation. This alternative would have a long-term, moderate beneficial impact on wildlife as a result to of creating aquatic habitat features.

Alternative F – Las Cruces Effluent

The habitat creation concept for this site is to replace the straight concrete lined channel on the east side of the Rio Grande currently used to convey treated wastewater with a meandering channel that contains diverse aquatic habitat features (GSA 2019a). These aquatic habitats would be enhanced by planting aquatic vegetation within backwaters, and native riparian vegetation along the channel margins. Numerous wildlife species could benefit from the planting of cottonwood and willow along the meandering channel including migratory birds, small mammals, or herpetofauna. As a result of removing non-native vegetation and establishing native riparian and herbaceous wetland vegetation, Alternative F would have a long-term, localized beneficial impact on vegetation and wildlife.

The channel habitat would emphasize variable conditions to support a diversity of native fish species. Alternative F has the greatest potential for restoration of regionally extirpated species (GSA 2019a). Springhead habitat at the channel source could provide habitat for the regionally extirpated Mexican tetra (*Astyanax mexicanus*). Large, deep, and structurally complex pools would potentially support large-bodied species such as gizzard shad, bluegill, and largemouth bass. Both bluegills and largemouth bass construct shallow-depression nests in clean substrates near shore in moderately deep water. The primary small-bodied species occupying pool habitats would be fathead minnow and western mosquitofish. With moving water in close proximity to root mass pools, it might be possible to establish a small population of another regionally extirpated species, Rio Grande chub (*Gila pandora*). Small-bodied fishes and aquatic macroinvertebrates would provide forage for large-bodied occupants of pools. Riffles and runs would provide habitat for red shiner and longnose dace. Although recently documented in the region, longnose dace is extremely rare. Channel catfish would mainly inhabit moderate

velocity runs but would move into riffles and pools to feed. Rio Grande chub need rapid velocity riffles with gravel substrates for spawning. Insectivorous longnose dace would occur mainly in riffles but occasionally move into slower-velocity runs. Alternative F – Las Cruces Effluent would have a long-term, moderate beneficial impact on aquatic species as a result of creating aquatic habitat features.

Alternative G – Mesilla Valley Bosque State Park Alternative

The restoration design for this site includes a diversity of habitat features. Excavating a channel between the Rio Grande and the Picacho Drain would enhance both riparian and aquatic habitat (GSA 2019a). Several shallow depressions (swales) would be excavated along the length of this channel and densely planted with coyote willow, cottonwood, and Gooding's willow. Numerous wildlife species, including migratory birds, small mammals, and herpetofauna, could benefit from the additional native riparian vegetation. As a result of removing non-native vegetation and establishing native riparian and herbaceous wetland vegetation, Alternative G would have a long-term, moderate beneficial impact on vegetation and wildlife.

The channel would be intentionally situated to water new and existing riparian plantings plus inundate an existing wetland mitigation site. Aquatic habitat in Picacho Drain would be enhanced by controlling cattails that currently dominate the drain and constructed a series of stepped terraces along the eastern edge of the drain that would be inundated under a range of discharges. Among large-bodied fishes, longnose gar (*Lepisosteus osseus*; regionally extirpated), river carpsucker, and channel catfish could potentially persist in constructed channel/enhanced drain habitats. In addition, bluegill and largemouth bass currently occupy the Resaca and would benefit from habitat improvements. Longnose gar inhabits low-velocity rivers and oxbow lakes and prey on co-occurring fishes while river carpsucker is generally more common in water of somewhat greater velocity where it moves about feeding on bottom organic matter. Western mosquitofish and fathead minnow would occur in both drain and constructed channel habitats. Red shiner would mainly occur in the constructed channel when it had water. Alternative G _ MVBSP would have a long-term, moderate beneficial impact on aquatic species as a result to of creating aquatic habitat features.

Alternative H – Downstream of Courchesne Bridge

The conceptual restoration design at this site focuses primarily on creating a meandering channel that routes stormwater from below Highway 85 to the Rio Grande. Benches, embayments, and pools would be included within the channel. This site differs from the others in that the riparian vegetation to be planted would be native herbaceous plantings rather than tree plantings. However, native herbaceous species may still accommodate numerous wildlife species, including small mammals or herpetofauna. During periods of elevated flow when wetland and terrestrial vegetation is flooded, fish species that occur in the Rio Grande would move onto the wetted terrace. The most likely river occupants that would move onto the wetted terrace would be western mosquitofish and red shiner. If the terrace was wetted for a sufficient duration both species might spawn on it. Alternative H – Downstream of Courchesne Bridge would have a long-term, localized beneficial impact on vegetation, wildlife, and aquatic species.

3.1.3 Threatened and Endangered Species

The Endangered Species Act (ESA) was enacted to provide a program for the preservation of endangered and threatened species and to provide protection for the ecosystems upon which these species depend for their survival. All Federal agencies are required to implement protective measures for designated species and to use their authorities to further the purposes of the ESA (USFWS 2018).

An endangered species is a species officially recognized by USFWS as being in danger of extinction throughout all or a significant portion of its range. A threatened species is a species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

USFWS has also identified species that are candidates for listing as a result of identified threats to their continued existence. The ESA also calls for the conservation of what is termed critical habitat, the areas of land, water, and air space that an endangered species needs for survival.

There are a total of five federally listed species known to occur within Doña Ana County in New Mexico or El Paso County, Texas (USFWS 2019). Of these, four have been documented or have the potential to occur in the RGCP and are listed in Table 3-1, along with a brief descritption of their habitat. For more detailed description, please see the Biological Assessment (SWCA 2011, IDEALS-AGEISS 2017) and Biological Opinion (USFWS 2012, USFWS 2017) for the RGCP . One species, the Sneed pincushion cactus (*Escobaria sneedii)*, is federally listed as endangered, but is not included in the table; the cactus is found on exposed areas of steep, sloping limestone in grasslands or shrublands in the Chihuahuan desert and is therefore not likely to be in the project area. There is no designated critical habitat for any federally protected species within the project area. The three remaining species with a potential to occur in the project area are the northern Aplomado falcon (USFS 2014a), southwestern willow flycatcher (USFWS 2012, and Yellow-billed cuckoo.

Environmental Consequences

Alternative A – No Action

Under Alternative A – No Action, no restoration of terrestrial vegetation would occur. The vegetation along the Rio Grande would remain unchanged under this alternative, and no habitat for SWFL or YBCU would be created; therefore no impact to either species.

Alternative B – Yeso Arroyo

Under the Alternative B - Yeso Arroyo, up to 2.4 acres of saltcedar and other non-native vegetation would be removed from the site and be replaced with native cottonwood and willow vegetation. Although this area is too small to support breeding YBCU, it may provide potential roosting or foraging habitat for migrating YBCU. SWFL can utilize non-native and native vegetation similarly. Cottonwood and willow plantings on the higher terraces may provide potential nesting, roosting, or foraging habitat for SWFL and YBCU as the trees mature. Alternative B – Yeso Arroyo would have a long-term, localized beneficial impact on SWFL.

Table 3-1. Federally Listed Species with the Potential to Occur in the RGCP.

Common Name	Federal Status	Habitat	Potential to Occur at Sites	Potential Timeframe for Occurrence
BIRDS				
Southwestern Willow Flycatcher (*Empidonax traillii extimus*)	E	Inhabits dense riparian habitats along streams, reservoirs, or other wetlands containing tree and shrub species such as willow (*Salix* spp.), baccharis (*Baccharis* spp.), boxelder (*Acer negundo*), stinging nettle (*Urtica dioca*), blackberry (*Rubu*s spp.), cottonwood (*Populus* spp.), arrowweed (*Pluchea sericea*), saltcedar (*Tamarix s*pp.), and Russian olive (*Elaeagnus angustifolia*).	Yes, could use riparian vegetation along the Rio Grande for nesting and foraging habitat.	Spring and fall migration
Northern Aplomado Falcon (*Falco femoralis septentrionalis*)	EXPN	Open country, especially savannah and open woodlands, sometimes barren areas; grassy plains and valleys with scattered mesquite, yucca, or cactus.	Yes. Documented at Mesilla Valley Bosque State Park in winter 2010.	Year-round
Least tern (*Sterna antillarum*)	E	Nesting habitat is bare or sparsely vegetated sand, shell, or gravel beaches, sandbars, islands, or salt flats associated with rivers or reservoirs. Has been documented at MVBSP.	Not likely. No recent records along the Rio Grande.	N/A
Yellow-billed Cuckoo (*Coccyzus americanus*)	T	Associated with large tracts of deciduous, broad-leafed woodland with thick, scrubby undergrowth usually along water courses, as well as dense riparian thickets, marshes, and stands of successional hardwood forest. In the west it will also utilize mesquite scrubland adjacent to riparian woodlands.	Yes, could use riparian vegetation along the Rio Grande for nesting and foraging habitat. Documented at Mesilla Valley Bosque State Park and scattered records elsewhere along the Rio Grande between Hatch, NM and El Paso, TX.	Spring, summer, and fall

Source: USFWS 2019.
E – endangered, T – threatened, EXPN - experimental population, non-essential

Alternative C – Angostura Arroyo
Under Alternative C – Angostura Arroyo, saltcedar and other non-native vegetation would be removed from the site and be replaced with native cottonwood and willow vegetation. Although this area is too small to support breeding YBCU, it may provide potential roosting or foraging habitat for migrating YBCU. The SWFL can utilize non-native and native vegetation similarly, and the addition of native riparian vegetation on the higher terraces may provide potential nesting, roosting, or foraging habitat for the SWFL. This alternative would have a long-term, localized beneficial impact on SWFL and YBCU.

Alternative D – Broad Canyon Arroyo
Under Alternative D – Broad Canyon Arroyo, the majority of the restoration activities would focus on creating embayments adjacent to Broad Canyon Arroyo. The surrounding riparian area would be enhanced with vegetation including cottonwood and willow; however, the restoration would focus on native herbaceous species. This would enhance USIBWC's existing restoration efforts and plantings at the Broad Canyon Arroyo Restoration Site. The planting of cottonwood and willow in the riparian enhancement area could have a long-term, localized beneficial impact on SWFL or YBCU.

Alternative E – Selden Point Bar
Under Alternative E - Selden Point Bar, approximately 7 acres of saltcedar would be retreated and replanted with native cottonwood and willow adjacent to the river channel. This area is large enough to potentially support breeding SWFL or YBCU, and may provide potential nesting, roosting, or foraging habitat for either species. USIBWC's current efforts for restoration at the Selden Point Bar are focused on SWFL. This alternative would have a long-term moderate beneficial impact on SWFL and YBCU.

Alternative F – Las Cruces Effluent Site
Under Alternative F - Las Cruces Effluent Site, approximately 5-acres would be revegetated with native riparian species including cottonwood and willow. This area is too small to support breeding YBCU or SWFL, and it is highly used by recreationalist through the pedestrian trail. , it may provide potential roosting or foraging habitat for migrating YBCU. This alternative would have impacts on SWFL and YBCU.

Alternative G – Mesilla Valley Bosque State Park
Habitat enhancement would occur south of the visitor's center at the state park and would include removing saltcedar vegetation and replacing it with a mix of cottonwood, coyote willow, and Gooding's willow. The native riparian vegetation enhancement would have a positive impact on SWFL and YBCU by providing additional nesting, roosting, or foraging habitat. To limit adverse impacts on threatened and endangered species at this site, habitat enhancement activities should be limited to the non-breeding season. Alternative G - MVBSP would have a long-term, moderate beneficial impact on SWFL and YBCU.

Alternative H – Downstream of Courchesne Bridge
Under Alterntive H - Downstream of Courchesne Bridge, no adverse impacts to T & E species are anticipated. Small areas of saltcedar and pepperweed would be treated and native vegetation

enhancement would focus primarily on herbaceous wetland vegetation rather than cottonwood or willow. This alternative would not have an adverse or beneficial impact on SWFL or YBCU.

3.2 WATER REOURCES

3.2.1 Flood Control

A total of 131 miles of flood control levee is installed along the RGCP – 74 miles on the east and 57 on the west – to protect against overflow during storm events. Levees range in height from approximately 3 to 8 feet, and they have maintained gravel roads on top of them. On average, levees north of Mesilla Dam are approximately 750 to 800 feet apart, while levees south of Mesilla Dam are approximately 600 feet apart. The RGCP flood control system is built to withstand a 100-year storm event. Most of the floodplain is occupied by low vegetation, including grasses and shrubs, with the occasional tree. Areas within the RGCP that do not have flood control levees have natural protection from canyons and elevated bluffs. RGCP elevated many of the levees after a levee evaluation in 2007 (USIBWC 2007).

Environmental Consequences

Alternative A – No Action

No impacts are anticipated, because the integrity of the levee system would be maintained. Under Alternative A – No Action, none of the action alternatives would be implemented and conditions within the floodway would remain status quo. This alternative would have no impact on flood control.

Alternative B – Yeso Arroyo

Possible impacts could be anticipated from terracing the steep bankline of the Rio Grande, and a potential constraint of this alternative is that levee integrity may be jeopardized when the bank across from the mouth of the Yeso Arroyo is destabilized and the channel migrates within the floodplain. However, terracing and planting the terraced bank with riparian vegetation would help stabilize the bank and reduce bank erosion. This alternative could have a long-term, moderate adverse impact as a result of the potential loss of levee integrity.

Alternative C – Angostura Arroyo

Possible impacts could be anticipated from terracing the steep bankline of the Rio Grande, and a potential constraint of this alternative is that levee integrity may be jeopardized when the bank across from the mouth of the Angostura Arroyo is destabilized and the channel migrates within the floodplain. However, terracing and planting the terraced bank with riparian vegetation would help stabilize the bank and prevent bank erosion. Alternative C – Angostura Arroyo could have a long-term, moderate adverse impact as a result of the potential loss of levee integrity.

Alternative D – Broad Canyon Arroyo

Spoil from the construction of embayments would be deposited on-site in barren areas. The embayments would replace the floodwater retaining capacity of the barren areas. Alternative D – Broad Canyon Arroyo is not anticipated to have an effect on flood control.

Alternative E – Selden Point Bar
Beneficial impacts are anticipated from this alternative. Construction of a flow through channel and two backwater habitat areas would provide additional storage for floodwater. The channel would be designed to begin inundating at 500 cfs and flow through by 1,000 cfs (GSA 2009a). The backwater features would begin inundating at 500 cfs and would fill with water by 800 cfs. Alternative E – Selden Point Bar could have a negligible beneficial impact on flood control as a result of creating additional water storage capacity if sediment deposition is maintained.

Alternative F – Las Cruces Effluent
Riparian planting in the floodway could reduce water conveyance as the trees mature. Riparian vegetation increases the roughness coefficients and typically decrease flood storage capacity. However, the restoration site is only 4 acres and represents a very small portion of the floodway. It is anticipated that Alternative F – Las Cruces Effluent would have a long-term, localized adverse impact on flood control.

Alternative G – Mesilla Valley Bosque State Park
Beneficial impacts are anticipated from this alternative. Construction of a high flow channel between the Rio Grande and the Picacho Drain would provide additional storage for floodwater. In addition, shallow swales would be constructed along the high flow channel enabling local inundation during high-flow periods. The Picacho Drain banks would be widened and terraced, which would improve through flow during high-flows in the Rio Grande as well as improve stormwater conveyance. Alternative G – MVBSP would have a long-term localized, beneficial impact on flood control if sediment deposition is maintained.

Alternative H – Downstream of Courchesne Bridge
No negative impacts are anticipated from this alternative. Construction of a meandering channel in the floodplain is not expected to adversely impact flood control. Terracing and planting the Rio Grande bank with herbaceous vegetation would help stabilize the bank and prevent bank erosion. Herbaceous wetland vegetation is the primary focus of the conceptual with low density woody vegetation planted along the channel margins. The low density planting of woody vegetation could increase the potential for fouling floodgates downstream. Alternative H Downstream of Courchesne Bridge could have a long-term, localized adverse impact on flood control.

3.2.2 Water Quality
New Mexico and Texas send the United States Environmental Protection Agency (USEPA) surface water quality reports each year, as required by Section 303(b) of the Clean Water Act. Reports summarize the water quality for each individual river reach sampled, the use attainment, and address any concerns with the quality of the water sampled.

The section of the RGCP that flows through New Mexico falls inside Water Quality Standard Assessment Unit 20.6.4.101, which is a 107 mile reach extending from Percha Dam to the border of Texas. In 2007, the USEPA approved a TMDL for Bacteria in the Rio Grande between the international border and Elephant Butte Dam. Designated uses for this stretch of the RGCP include irrigation, marginal warmwater aquatic life, wildlife habitat, secondary contact, and livestock watering (NMED 2013; NMAC 2013). However, during the 2012-2014 assessment of

the surface water quality from Rio Grande Assessment Unit NW-2101, it was determined bacteria concentrations exceeded standards spanning from the international boundary to 1 mile below the Percha Dam which led to the area being labeled as "Not Supporting" primary contact (NMED 2013).

The section of the RGCP in Texas falls within Segment 2314 of the Rio Grande Basin and extends 21 miles from the International Dam to the New Mexico state boundary. In 2018, Segment 2314 was listed as impaired. Impairment description reads "bacteria (Recreational Use)" category 5c (TCEQ 2018). Designated uses for this stretch of the RGCP include contact recreation, fish consumption, public water supply, and high aquatic life.

Environmental Consequences

Alternative A – No Action
Under Alternative A - No Action Alternative, none of the action alternatives would be implemented and water quality would remain status quo. This alternative would have no impact on water quality.

Alternative B – Yeso Arroyo
Excavation of terraces would increase the potential for erosion and sedimentation in the Rio Grande. However, contractors would be held accountable for developing a Stormwater Pollution Prevention Plan (SWPPP) and a Spill Prevention, Control, and Countermeasure Plan (SPCCP) as well as acquiring all the necessary permits to comply with state and Federal regulations. Specific permits would include, but are not limited to, a stormwater protection permit and a water quality certification which is issued from the Environmental Protection Agency (EPA)/ New Mexico Environmental Department (NMED). Sedimentation and introduction of contaminants would be reduced or eliminated by using Best Management Practices (BMPs) and SWPPP and SPCCP measures. Planting of native riparian and wetland vegetation would help to stabilize banks, which would alleviate down-stream sedimentation, and improve water quality by sequestering contaminants (Miller 1990). Under Alternative B – Yeso Arroyo, long-term, localized beneficial impacts are anticipated on water quality.

Alternative C – Angostura Arroyo
This alternative would be expected to have impacts on water quality similar to those described for Alternative B - Yeso Arroyo.

Alternative D – Broad Canyon Arroyo
This alternative would be expected to have impacts on water quality similar to those described for Alternative B - Yeso Arroyo.

Alternative E – Selden Point Bar
This alternative would be expected to have impacts on water quality similar to those described for Alternative B – Yeso Arroyo.

Alternative F – Las Cruces Effluent Site
This alternative would be expected to have impacts on water quality similar to those described for Alternative B – Yeso Arroyo.

Alternative G – Mesilla Valley Bosque State Park
This alternative would be expected to have impacts on water quality similar to those described for Alternative B – Yeso Arroyo.

Alternative H – Downstream of Courchesne Bridge
This alternative would be expected to have impacts on water quality similar to those described for Alternative B – Yeso Arroyo.

3.2.3 Water Consumption

The groundwater found within the Project Area is located in the Mesilla Basin. The quality of the water found in the shallower portions of the aquifer is largely dependent on the quality of the water in the Rio Grande. The aquifer supports freshwater at depths from 150 feet to as far as 1,400 feet below ground. Shallower portions of the aquifer tend to have a higher proportion of minerals relative to deeper portions of the aquifer. The aquifer receives water from the following sources: the Rio Grande, canals, excess irrigation water, ephemeral streams, and the margin of basins (USIBWC 2013). Shallow groundwater levels vary about 3 to 14 feet below ground, according to USIBWC monitoring that took place from 2013 to 2017.

The Rio Grande Compact limits the amount of surface water that can be depleted (utilized for all purposes) annually in the Middle Rio Grande based on the flow of the river as measured at the Otowi Gage near Los Alamos. Additionally, the New Mexico State Engineer has determined that the Rio Grande is fully appropriated. As a result, increase in water use by one user must be offset by a reduction by another use or user, so that senior water rights and New Mexico's ability to meet its downstream delivery obligations are not impaired. Therefore, the New Mexico State Water Quality Plan requires that habitat restoration projects do not result in increased net water depletions, or that any increases are offset by purchased or leased water rights (USIBWC 2017).

Under the 2009 ROD, the USIBWC developed and implemented an Environmental Water Transaction Program in order for the USIBWC to acquire or lease water rights to offset increased evapotranspiration consumption from the implementation of habitat restoration sites, or for supplemental irrigation of sites. USIBWC may have some groundwater rights that could be transferred to offset increases in water consumption. NMOSE requires drilling a well or otherwise physically applying the groundwater to prove beneficial use (as opposed to offset only), and USIBWC's use of groundwater is subject to review by the Department of Justice. Surface water consumption of aquatic habitat could be offset by acquiring or leasing EBID-administered surface water rights; however, this would require a policy change by EBID. EBID's current policy does not allow the use of Project water for aquaculture or exposed groundwater restoration actions (EBID 2013). Surface water consumption of riparian areas could be offset by EBID-administered surface water rights under the current policy.

Environmental Consequences

Alternative A – No Action
Under this alternative, no habitat restoration projects would be implemented and water usage would remain *status quo*.

Alternative B – Yeso Arroyo
Negative impacts on water consumption are anticipated from creating a terraced bank along the Rio Grande. After restoration activities are complete, an additional 18.3 acre-feet per year (ac-ft/yr) of water is expected to be lost from the site each year as a result of evapotranspiration (ET) (Table 3-2). Overall, annual water consumption at the Yeso Arroyo site is predicted to increase 45 percent as a result of implementing Alternative B – Yeso Arroyo. Alternative B – Yeso Arroyo would have a long-term, moderate adverse impact on water consumption.

Table 3-2. Consumptive Water Use by Alternative.

Alternative	Pre-Restoration (ac-ft/yr)	Post-Restoration (ac-ft/yr)	Difference (ac-ft/yr)
Yeso Arroyo	40.7	59.0	18.3
Angostura Arroyo	42.5	62.0	19.5
Broad Canyon	9.1	8.1	-0.9
Selden Point Bar	45.5	31.6	-13.9
Las Cruces Effluent	10.7	17.2	6.5
MVBSP	154.5	135.3	-19.2
Downstream of Courchesne Bridge	59.9	35.4	-24.5

GSA 2019a

Alternative C – Angostura Arroyo
Negative impacts on water consumption are anticipated from creating a terraced bank along the Rio Grande. After restoration activities are complete, an additional 19.5 ac-ft/yr of water is expected to be lost from the site each year as a result of ET (see Table 3-2). Overall, annual water consumption at the Angostura Arroyo is predicted to increase approximately 46 percent as a result of implementing this alternative. Groundwater rights and surface water rights may be available as discussed previously. Alternative C – Angostura Arroyo would have a long-term, moderate adverse impact on water consumption.

Alternative D – Broad Canyon Arroyo
Beneficial impacts on water consumption anticipated from creating backwater embayments adjacent to a flow path at Broad Canyon Arroyo. When embayments are full, local groundwater levels may rise slightly. After restoration activities are complete, water loss associated with ET is expected to decrease 0.9 ac-ft/yr (see Table 3-2). This alternative would have a long-term, negligible beneficial impact on water consumption.

Alternative E – Selden Point Bar Beneficial impacts on groundwater are anticipated from creating a flow through channel and two backwater habitat areas at Selden Point Bar. Implementation of Alternative E would result in a decrease in water loss of 13.9 ac-ft/yr from ET (see Table 3-2). Overall, annual water consumption at the Selden Point Bar is predicted to

decrease 30 percent as a result of implementing this alternative. Alternative E would have a long-term, moderate beneficial impact on water consumption.

Alternative F – Las Cruces Effluent

Negative impacts on water consumption are anticipated from creating a meandering clearwater channel at Las Cruces Effluent Site. An additional 6.5 ac-ft/yr of water is expected to be lost from the site each year as a result of ET (see Table 3-2). Overall, annual losses of groundwater at the Las Cruces Effluent Site are predicted to increase approximately 54 percent as a result of implementing Alternative F. USIBWC may have some groundwater rights that could be transferred to offset increases in groundwater consumption. Additionally, the City of Las Cruces may be able to transfer water rights to offset increases in water consumption. This alternative would have a long-term, localized adverse impact on water consumption.

Alternative G – Mesilla Valley Bosque State Park

Beneficial impacts on water consumption are anticipated from creating a high-flow channel between Picacho Drain and the Rio Grande, widening and terracing Picacho Drain, and constructing swales along the high-flow channel. Implementation of Alternative G would result in a decrease in water loss of 19.2 ac-ft/yr from ET (see Table 3-2). Overall, annual losses of groundwater at MVBSP are predicted to decrease approximately 12 percent as a result of implementing Alternative G - MVBSP. This alternative would have a long-term, moderate beneficial impact on water consumption.

Alternative H – Downstream of Courchesne Bridge

Beneficial impacts on water consumption are anticipated from terracing the Rio Grande bankline in this area. Implementation of Alternative H would result in a decrease in water loss of 24.5 ac-ft/yr from ET (see Table 3-2). Overall, annual losses of groundwater at the site are predicted to decrease approximately 41 percent as a result of this alternative. Alternative H – Downstream of Courchesne Bridge would have a long-term, moderate beneficial impact on water consumption.

3.2.4 Waters of the United States

The USACE and USEPA require mitigation for impacts on waters of the United States (WOUS), including wetlands under 33 Code of Federal Regulation (CFR) and 40 CFR 230. Wetland delineations were conducted by GeoSystems Analysis, Inc. between March 5 through March 8, 2019 (GSA 2019b) at four sites, which include Broad Canyon, Selden Point Bar, MVBSP, and Downstream of Courchesne Bridge. The formal delineation only focused on portions of the site located with proposed excavation features, beyond those boundaries, wetland presence is surmised from aerial photography and coarser level field observations.

Alternative D – Broad Canyon Arroyo

A total of 0.49 acre of potentially jurisdictional wetland was delineated at Broad Canyon Arroyo (Appendix A, Figure A-24) (GSA 2019b). Wetland BC-WL1 is a small depressional wetland consisting primarily of cattails and is approximately 0.15 acre. BC-WL1 lies between the arroyo bank and is surrounded by hillside slopes. Wetland BC-WL2 is approximately 0.34 acre consisting of an emergent cattail wetlands within the arroyo channel, with occasional adjacent coyote willow patches.

Alternative E – Selden Point Bar
One potential jurisdictional wetland (SC-WL1) is located at Selden Point Bar (Appendix A, Figure A-25) (GSA 2010b). The entire wetland site consists of a large saltgrass meadow, an emergent cattail meadow, a willow bankline, and intermittent stands of arrowweed and saltcedar, totaling approximately 14 acres.

Alternative G – Mesilla Valley Bosque State Park
Six potential jurisdictional wetlands, totaling 23 acres, were identified near or overlapping the excavation features at MVSP (Appendix A, Figure A-26) (GSA 2019b). Both constructed wetland Resaca ponds (MVSP-WL1), and the entirety of the Picacho Drain (MVSP-WL6), where cattail maintenance is proposed, were potentially jurisdictional. A large emergent wetland (MVSP-WL2) slightly overlaps portions of the proposed side channel. MVSP-WL2 is extensive and includes the mitigation site, plus potentially the BEMP site, as well.

A smaller emergent wetland was identified in-between sand deposits that appear to be excavated material from Picacho Drain. This wetland overlaps with proposed willow swale excavations and partially within a segment of the proposed channel (MVSP-WL3). A third emergent wetland was identified within a portion of the proposed drain terracing across the Picacho Drain from the southern Resaca pond (MVSP-WL4). An additional riverine wetland was identified in the willow bankline (MVSP-WL5) and mapped adjacent to the proposed channel inlet, though the footprint did not overlap. Two other wetlands that fell outside of the excavation footprints were documented, but not recorded (sample locations MVSP-S11 & MVSP-S19).

The Resaca ponds (MVSP-WL1), treated here as a single wetland separated by a narrow berm, span approximately 4.25 acres (GSA 2019b). The Picacho Drain (MVSP-WL6) consists of approximately 1 acre (within our assessment area). Both features consist almost entirely of emergent cattail, sometimes with common threesquare and coyote willow along the edges. Bare soil and standing water occur in the deeper portions of the southern Resaca pond. Muck and redox features were found in the soil samples. These wetlands are sustained by supplemental water in the Picacho Drain plus shallow groundwater.

MVSP-WL2 (16.5 acres) and MVSP-WL3 (0.25 acre) are wetland meadows under a stand of saltcedar, dominated mostly by scratchgrass, a hydrophytic species, with yerba mansa, and arctic rush in depressional pockets (GSA 2019b). These two wetlands appear unnaturally separated by sand spoiled from Picacho Drain maintenance. The wetland is bound by the berm along Picacho Drain on the west, sand deposits to the south, and a slight elevational gradient on the east, possibly a historic farming terrace. This is where the wetland transitions to an upland as the dominant vegetation changes from scratchgrass (hydrophytic) to Bermudagrass (non-hydrophytic) and hydric soil indicators are no longer present. The north boundary was not delineated, as it was far from the proposed excavation features.

MVSP-WL4 (0.8 acre) is similar to the above wetlands, but with the addition of coyote willow. Additionally, a break in the berm hydrologically connects this portion to the Picacho Drain, providing an influx of surface water when the drain flows. Drainage patterns were observed within the wetland. The wetland is bound by sand deposits and the transition was noted with elevational gradients and an increase in saltcedar and coyote willow decadence.

MVSP-WL5 is a narrow willow bankline along the river, consisting of approximately 0.22 Acre (GSA 2019b). It consists entirely of coyote willow, with some scratchgrass cover in the herbaceous layer. Hydrologic indicators were observed on the river side of the bankline but were not at the appropriate depths on the inland side, due to the slope of the bankline, limiting this wetland to the lower portions of the slope.

Alternative H – Downstream of Courchesne Bridge
Two wetlands were identified at the Downstream of Courchesne Bridge site (Appendix A, Figure A-27) (GSA 2019b). DSC-WL1 is an approximately 0.33-acre emergent wetland dominated by common threesquare, with some saltgrass and scratchgrass intruding from the adjacent meadow area, and small patches of common reed (*Phragmites australis*) are present. The wetlands are located in a depressional area lower in elevation than the surrounding saltgrass meadow. The hydrologic conditions in this wetland are strongly correlated with water released from a box culvert, adjacent to where a new trench to the river was recently dug. Ponded water was present in this wetland during site visits conducted prior to recent drainage modifications.

DSC-WL2 is a narrow cattail-dominated bankline feature situated approximately 4-feet lower than the wetland meadow that dominates most of the site, and approximately 2-feet above the bed of the river channel. Some common threesquare was also present with a few other incidental species. This wetland is situated within the northern proposed bankline terrace. It consists of only 0.08 acre.

Environmental Consequences

Alternative A – No Action Alternative
No impacts are anticipated from Alternative A - No Action Alternative because there would be no development on or near WOUS, including wetlands.

Alternative B – Yeso Arroyo

The Rio Grande, which is a WOUS, would be impacted by excavation and shaping activities associated with terrace construction along the bankline. USIBWC would coordinate with the USACE and obtain all necessary permits and implement necessary mitigation prior to construction. However, this alternative would result in a long-term, localized beneficial impact on wetlands.

Alternative C – Angostura Arroyo
Under this alternative, impacts would be the same as those described for Alternative B – Yeso Arroyo.

Alternative D – Broad Canyon Arroyo
Under Alternative D, approximately 0.01 acre of wetlands would be impacted as a result of implementing Alternative D (Appendix A, Figure A-24) (GSA 2019b) . Approximately 0.01 acre of wetland BC-WL2 overlaps with the proposed excavations. Excavation sites were intentionally chosen to exclude potential wetlands. Restoration activities at the Broad Canyon Arroyo site would qualify under Nationwide Permit 27. Implementation of this alternative

would improve the heterogeneity and structural diversity of existing wetland habitats. Alternative D – Broad Canyon Arroyo would have a temporary negligible adverse impact on potential jurisdictional wetlands. However, this alternative would result in a long-term, localized beneficial impact on wetlands.

Alternative E – Selden Point Bar

Wetland SC-WL1 envelops almost all of the proposed excavation features at Selden Point Bar, and approximately 0.75 acre of wetlands would be impacted by the implementation of Alternative E. Immediate impacts would consist of soil and vegetation disturbance, and sedimentation monitoring may be necessary to evaluate the long term impacts of the proposed excavations. However, revegetation of the excavation areas with native riparian species should reduce sediment depositions in SC-WL1. The creation of two backwater habitat areas would increase the extent of aquatic habitats, while the replacement of saltcedar for native riparian vegetation in the excavation areas is likely to enhance existing wetlands. A USACE permit would be obtained prior to construction. Implementation of this alternative would have a temporary negligible impact on wetlands; however, implementation of the restoration project would result in a long-term, localized beneficial impact on wetlands.

Alternative F – Las Cruces Effluent

Based on USFWS National Wetland Inventory maps no wetlands are present at the Las Cruces Effluent site. Implementation of this alternative is not expected to adversely impact any WOUS, including wetlands. However, long-term, localized beneficial impacts are expected from the creation of wetlands along the meandering channel.

Alternative G – Mesilla Valley Bosque State Park

Approximately 7.4 acres of wetlands would be impacted by proposed restoration activities (Appendix A, Figure A-26) (GSA 2019b). Most (4.7 acres) of the proposed excavation features in potentially jurisdictional wetlands lie within the proposed cattail maintenance zones. MVSP-WL3 is entirely within the proposed channel and swale features. Only 1.6 acres of the 16.5-acre MVSP-WL2 wetland overlaps with proposed swale, channel and drain terracing features. Design alteration could avoid these two wetlands if that becomes necessary during later project stages. MVSP-WL4 mostly lies in the proposed drain terracing area, with slight overlap into the proposed cattail maintenance portion of Picacho Drain. These overlapping segments within the proposed excavation footprints total 0.81 acre. MVSP-WL5 only abuts to but does not overlap with the channel inlet. Channel and swale excavations would increase the total wetland area, increase the likelihood of inundation, and create aquatic habitat heterogeneity. Widening and terracing the banks of the Picacho Drain would further increase the extent of aquatic habitats in this area. A USACE permit would need to be obtained prior to construction, and any mitigation identified in the permit would be implemented to compensate for the loss of wetlands. Permitting will likely be difficult because the property is not USIBWC property. Implementation of this alternative would have a temporary, negligible adverse impact on wetlands; however, implementation of the restoration project would result in a long-term, moderate beneficial impact on wetlands.

Alternative H – Downstream of Courchesne Bridge
Approximately 0.02 acre of wetlands would be impacted by this restoration along with additional impacts to the Rio Grande during widening and terracing (Appendix A, Figure A-27). Of the two delineated wetlands at the Downstream of Courchesne Bridge site, only 0.02 acre of DSC-WL1 overlaps with the proposed Rio Grande bankline terrace feature. However, with recent drainage improvements on-site it is likely that the current hydrology will not be able to sustain the wetland. The proposed construction of multiple terraces along the Rio Grande would improve the extent of aquatic habitat, while the planting of native riparian vegetation along lower terraces would create desirable habitat diversity. A USACE permit would be obtained prior to construction. Implementation of this alternative would have a temporary, negligible adverse impact on wetlands; however, implementation of the restoration project would result in a long-term, localized beneficial impact on wetlands.

3.3 CULTURAL RESOURCES

Cultural resources can include prehistoric or historic buildings, sites, districts, objects, or structures evaluated as significant (36 CFR 60; see also National Park Service [NPS] 1990:53). Also included in the definition are significant properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization (36 CFR 800 16[l][1]). This section describes the state of knowledge pertaining to cultural resources, including previously reported archaeological sites and historic resources, as well as previously conducted research in the Area of Potential Effect of the RGCP proposed alternatives.

3.3.1 Regulatory Requirements
The National Historic Preservation Act (NHPA) establishes the Federal government's policy to provide leadership in the preservation of historic properties and to administer Federally owned or controlled historic properties in a spirit of stewardship. The NHPA further instituted Section 106 which requires Federal agencies to take into account the effects of their undertakings on historic properties. The NHPA established the Advisory Council on Historic Preservation to advocate full consideration of historic values in Federal decision making; review Federal programs and policies to promote effectiveness, coordination, and consistency with National preservation policies; and recommend administrative and legislative improvements for protecting our Nation's heritage with due recognition of other national needs and priorities. The NHPA also established State Historic Preservation Offices to administer National historic preservation programs on the state level and THPO programs on tribal lands, where appropriate. The NHPA also establishes the National Register of Historic Places (NRHP). The NRHP is the Nation's official list of cultural resources worthy of preservation and protection. Properties listed in the NRHP include districts, sites, buildings, structures and objects that are significant in U.S. history, architecture, archaeology, engineering, and culture. The NPS administers the NRHP (16 U.S.C. § 470).

3.3.2 Affected Environment
The area encompassing the proposed project alternatives has had a long and varied human past extending to the earliest known inhabitants of North America during the Paleoindian Period some 11,500 years before present (BP) to the present. An in-depth discussion focusing on the various cultural manifestations that have occurred over this extensive time period is beyond the

scope of this EA section. Table 3-2 provides a summary with references for further information for interested readers.

Table 3-3. Cultural Chronology of South Central NewMexico.

Period	Phase	Culture(s)	Years B.P./A.D.	
Historic	American		1847 - Present A.D.	Sanchez 1992; Roberts and Roberts 1988; Pittman 2011
	Mexican		1821 - 1847 A.D.	
	Spanish		1598 - 1821 A.D.	
Protohistoric		Chinarra, Concho, Jano, Jocome, Manso, Suma, Apache, and Navajo	1400s – 1500s A.D.	Vierra 1992; Sanchez 1992; Hester 1999
Formative	El Paso	Jornada Mogollon	1200 to 1450 A.D.	Simmons et al. 1989; Kurota and Chapman 2007; Whalen 1978; Beck 1985; Thompson et al. 2005; Wiseman et al. 2001
	Doña Ana	Jornada Mogollon	1000 – 1200 A.D.	
	Mesilla	Jornada Mogollon	200 – 1000 A.D.	
Archaic	Hueco	Hueco	2,900 - 1750 B.P.	Simmons et al. 1989; MacNeish and Beckett 1987
	Fresnal	Fresnal	4,500 - 2900 B.P.	
	Keystone	Keystone	6,000 - 4,500 B.P.	
	Gardner Springs	Gardner Springs	8,000 - 6,000 B.P.	
Paleoindian			11,500 to 7,500 B.P.	Simmons et al. 1989; Huckell 1972

3.3.3 Previous Investigations

Records of previous investigations in the proximity are on file with the USIBWC and at the State of New Mexico archaeological records repository (ARMS) and can be accessed via the New Mexico Cultural Resource Information System (NMCRIS). Numerous previous investigations have been conducted within 1.0 mile of the proposed project alternatives, but for the sake of brevity, only those investigations occurring within the footprint of project alternatives will be discussed here. Additionally, three of the project alternatives overlap the boundaries of previously recorded cultural resources, but as a public document the exact locations and details of those resources will not be disclosed under 43 CFR 7.18 Confidentiality of Archaeological Resource Information.

Two investigations specifically targeted the Rio Grande River floodplain as part of the RGCP. In 2009, William Self and Associates (WSA) conducted a cultural resources investigation on behalf of CH2M HILL, Inc. and USIBWC (Stinchcomb et al. 2009). The WSA investigation is not on file with NMCRIS. The WSA investigation included a 100-percent archaeological survey with subsurface testing survey of 7.3 miles of proposed floodwall and levee construction in El Paso County, TX and a 100-percent archaeological survey with subsurface testing of 34 high-probability areas identified by USIBWC within El Paso County, TX and Doña Ana County, NM. One area in particular overlapped the current Downstream of Courchesne Bridge site by 100 percent (Appendix A, Figure A-28). The WSA archaeological survey included pedestrian survey along with shovel test excavations (Stinchcomb et al. 2009). The WSA investigation recorded no cultural resources within the area surveyed that now includes the proposed Downstream of

Courchesne Bridge site (Stinchcomb et al. 2009). None of the other WSA survey areas corresponds with the current proposed project alternatives.

The second RGCP investigation that overlapped the current propose project alternative locations was conducted by TRC between 2010 and 2011 and consisted of a cultural resources pedestrian survey and architectural survey of 26 restoration areas and geoarchaeological evaluation of four restoration areas along the Rio Grande (Komulainen-Dillenburg et al. 2011). The TRC investigation is not on file with NMCRIS. Five of the restoration areas surveyed by TRC overlap portions of the current proposed alternatives including Alternative B - Yeso Arroyo Arroyo, Alternative C - Angostura Arroyo, Alternative D - Broad Canyon Arroyo, Alternative E - Selden Point Bar, and Alternative G - MVBSP (Appendix A, Figures A-28 through to A-33) No cultural resources were recorded in any of the TRC survey areas that overlap the current proposed project alternative areas. Although five of the TRC survey areas overlap the current proposed project alternative sites, none provided complete survey coverage leaving portions of the current proposed project alternative sites unsurveyed.

Four additional surveys unrelated to the RGCP also overlap project alternative locations. In 2002, Taschek Environmental Consulting (TEC) performed a linear survey along New Mexico Route 185, overlapping the west side of proposed Project Alternative D (Broad Canyon Arroyo) location (NMCRIS Activity 138526) (Appendix A, Figure A-30). The Taschek Environmental Consulting investigation included a pedestrian survey and recorded no cultural resources (Raymond and Sullins 2002).

In 2006, Advanced Archaeological Solutions conducted a cultural resources survey of a 1.25-mile section along the Rio Grande in Las Cruces, New Mexico (NMCRIS Activity 98715). The survey area entirely overlaps the proposed Project Alternative F (Las Cruces Effluent) location (Figure 3-18). The survey consisted of a pedestrian survey and no cultural resources were recorded (Stowe 2006).

In 2005, Human Systems Research Inc. conducted an archaeological survey of 307 acres for the proposed location of the Mesilla Valley Bosque State Park (NMCRIS Activity 94004). The survey area completely overlaps the proposed Project Alternative G (Mesilla Valley Bosque State Park) location (Appendix A, Figure A-33). The survey consisted of pedestrian survey and cultural resources were recorded (Kirkpatrick 2005).

In 1999, Parsons, Brinckerhoff conducted a cultural resources survey for a fiber optic cable line crossing the Rio Grande (NMCRIS Activity 64087). The survey consisted of a pedestrian survey and crossed a portion of the Downstream of Courchesne Bridge site (Appendix A, Figure A-32). The investigation recorded no cultural resources (Arms and Kovacik 1999).

Despite some overlapping survey coverage of the previous investigations, some portions of the proposed project alternative sites remain unsurveyed for cultural resources. Portions of the Alternative B (Yeso Arroyo), Alternative C (Angostura Arroyo), Alternative D (Broad Canyon Arroyo), and Alternative E (Seldon Canyon Point Bar) proposed project alternatives have not previously been surveyed for cultural resources. The proposed project alternative locations that

have been previously surveyed completely for cultural resources are the Alternatives F, G, and H.

Two of the proposed project alternative locations contain previously recorded cultural resources including Alternatives D, and G. Resources at Alternatives D and G are recommended eligible or are of undetermined eligibility for listing on the NRHP. Alternative H is included within the boundary of a State Register property, though it is unclear whether anything within the proposed alternative area is contributing to that resource.

In December 2017, the USIBWC entered into a Programmatic Agreement (PA) with New Mexico State Historic Preservation Officer (NMSHPO) for evaluating undertakings that could impact cultural resources and establishing procedures for consultations under specific types of actions in the RGCP. The USIBWC also has a similar PA with the Texas State Historic Preservation Officer (TXSHPO) for flood control projects in Texas from 2013.

There is a low potential for archaeological site to occur within the floodplain and near arroyo mouths. The selected restoration sites would be consulted with NMSHPO or TXSHPO under the PA prior to construction.

USIBWC construction specifications and River Management Plan include best management practices for procedures upon discovery of cultural resources during ground disturbing activities. The USIBWC Cultural Resources Specialist would consult with NMSHPO or TXSHPO under the appropriate PA, as determined necessary for each action. Before ground-disturbing maintenance work, a conference would be held with maintenance crews to inform them of the potential for disturbing subsurface cultural resources, and the procedures involved in the event that this occurs. Precautions would be taken to ensure that archaeological assistance is promptly available in case of a discovery. In addition, at all spoil sites, crews would be on the lookout for possible cultural resources, they would stop work immediately if any cultural resource is found and would notify the USIBWC Environmental Management Division promptly. The USIBWC Cultural Resources Specialist would conduct surveys of any incompletely surveyed areas.

Environmental Consequences

Alternative A – No Action
Under this alternative, no habitat restoration projects would be implemented and as a result, would have no adverse impact on cultural resources.

Alternative B – Yeso Arroyo
The Yeso Arroyo site has only partially been surveyed for cultural resources (Appendix A, Figure A-28). Within the portion of the site that has been previously surveyed, no cultural resources were recorded. Given that the proposed actions for Alternative B, include ground disturbing activities such as clearing and grubbing vegetation, constructing bankline terrace benches, and planting trees, there is potential to disturb previously unrecorded cultural resources outside previously surveyed areas, which may result in an Adverse Effect to cultural resources. If the remaining previously unsurveyed portion of the Yeso Arroyo site is investigated for cultural resources in accordance with Section 106 of the NHPA, it would be possible to evaluate

the effects of the undertaking on cultural resources so that there would be no adverse impact on cultural resources.

Alternative C – Angostura Arroyo
The Angostura Arroyo site has only partially been surveyed for cultural resources (Appendix A, Figure A-29). Within the portion of the site that has been previously surveyed, no cultural resources were recorded. Given that the proposed actions for Alternative C, include ground disturbing activities such as clearing and grubbing vegetation, constructing bankline terrace benches, and planting trees, there is potential to disturb previously unrecorded cultural resources outside previously surveyed areas, which may result in an Adverse Effect to cultural resources. If the remaining previously unsurveyed portion of the Angostura Arroyo site is investigated for cultural resources in accordance with Section 106 of the NHPA, it would be possible to evaluate the effects of the undertaking on cultural resources so that there would be no adverse impact on cultural resources.

Alternative D – Broad Canyon Arroyo
The portion of the Broad Canyon site owned by USIBWC has been surveyed for cultural resources (Appendix A, Figure A-30) and all excavations would occur on USIBWC property. The site contains previously recorded cultural resources recommended eligible and of undetermined eligibility for listing on the NRHP. Given that the proposed actions for Alternative D – Broad Canyon Arroyo include ground disturbing activities such as clearing and grubbing vegetation, constructing backwater embayments, and planting trees, there is potential to disturb previously recorded cultural resources as well as any unrecorded cultural resources outside previously surveyed areas, which would result in an adverse impact on cultural resources.

Alternative E – Selden Point Bar
USIBWC property has been surveyed for cultural resources and the project would only occur on USIBWC property (Appendix A, Figure A-31). No cultural resources were recorded as part of the survey; therefore this alternative would not impact any cultural resources.

Alternative F - Las Cruces Effluent
The Las Cruces Effluent site has been previously surveyed for cultural resources (Appendix A, Figure A-32). No cultural resources have been previously recorded within the Alternative F footprint. Implementation of Alternative F would have no adverse impact on cultural resources.

Alternative G – Mesilla Valley Bosque State Park
The MVBSP site has been completely surveyed for cultural resources (Appendix A, Figure A-33). There are multiple cultural resources within the footprint of Alternative G including one recommended for NRHP eligibility and one of undetermined eligibility. Given that the proposed actions under Alternative G - MVBSP include ground disturbing activities such as clearing and grubbing vegetation, constructing a high flow channel, constructing swales that integrate with channel, widening Picacho Drain and planting trees, there is potential to disturb previously recorded cultural resources that would result in adverse impacts on cultural resources.

Alternative H – Downstream of Courchesne Bridge
Alternative H has been previously surveyed for cultural resources (Appendix A, Figure A-34). Alternative H is within the boundary of a State Register property. Given that the proposed actions for Alternative H include ground disturbing activities such as clearing and grubbing vegetation, constructing a meandering channel, and depositing spoil material in open barren areas, there is potential to disturb previously recorded cultural resources. Implementation of Alternative H could result in adverse impact on cultural resources.

3.4 SOILS

According to the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey 24 soils are found at the 7 alternative sites (USDA 2019). The soil type found at each site alternative site is provided in Table 3-3.

Table 3-4. Soil types located in the project area.

Alternative	Soil Type
Alternative B – Yeso Arroyo	Anthony-Vinton fine sandy loam
Alternative B – Yeso Arroyo	Brazito loamy fine sand, 0 to 1 percent slope
Alternative B – Yeso Arroyo	Harkey loam
Alternative B – Yeso Arroyo	Riverwash
Alternative C – Angostura Arroyo	Agua silt loam, 0 to 2 percent slopes
Alternative C – Angostura Arroyo	Agua clay loam MLRA 42
Alternative C – Angostura Arroyo	Brazito loamy fine sand, 0 to 1 percent slopes
Alternative C – Angostura Arroyo	Brazito very fine sandy loam, thick surface
Alternative C – Angostura Arroyo	Glendale loam
Alternative C – Angostura Arroyo	Riverwash
Alternative D – Broad Canyon Arroyo	Agua variant soils, moderately wet
Alternative D – Broad Canyon Arroyo	Agua variant and Belen variant soils
Alternative D – Broad Canyon Arroyo	Belen variant soils
Alternative D – Broad Canyon Arroyo	Bluepoint-Caliza-Yturbide complex
Alternative D – Broad Canyon Arroyo	Canutio and Arizo gravelly sandy loams MLRA 42
Alternative D – Broad Canyon Arroyo	Pajarito fine sandy loam
Alternative D – Broad Canyon Arroyo	Riverwash
Alternative E – Selden Point Bar	Agua variant and Belen variant soils
Alternative E – Selden Point Bar	Bluepoint-Caliza-Yturbide complex
Alternative E – Selden Point Bar	Riverwash
Alternative F – Las Cruces Effluent	Brazito loamy fine sand, 0 to 1 percent slope
Alternative F – Las Cruces Effluent	Brazito very fine sandy loam, thick surface
Alternative F – Las Cruces Effluent	Riverwash
Alternative G – MVBSP	Anapra clay loam
Alternative G – MVBSP	Anthony-Vinto loams, 0 to 1 percent slopes

Table 3-4, continued

Alternative	Soil Type
Alternative G – MVBSP	Belen clay
Alternative G – MVBSP Alternative G – MVBSP Alternative G – MVBSP Alternative G – MVBSP Alternative G – MVBSP Alternative G – MVBSP	Bluepoint-Caliza-Yturbide complex
	Brazito loamy fine sandy loam, 0 to 1 percent slope
	Brazito very fine sandy loam, thick surface
	Glendale loam
	Harkey loam
	Riverwash
Alternative H – Downstream of Courchesne Bridge Alternative H – Downstream of Courchesne Bridge	Made land, Gila soil material
	Riverwash

Source: USDA, NRCS, Web Soil Survey 2019

Environmental Consequences

Alternative A – No Action
Under this alternative, none of the aquatic habitat restoration projects would be implemented, therefore, Alternative A - No Action would not impact soils at any of the alternative sites.

Alternative B – Yeso Arroyo
Under Alternative B – Yeso Arroyo, approximately 13 acres of Brazito loamy fine sand, 0 to 1 percent slopes soils would be impacted. Approximately 6 acres would experience long-term, localized adverse impacts as a result of excavating and terracing, and approximately 7 acres would experience temporary, negligible adverse impacts as a result of planting riparian vegetation. Soils disturbance could increase soil erosion during and after construction; however USIBWC employs BMPs under all construction contract to eliminate or reduce impacts from temporary soil impacts. A SWPPP would be prepared prior to construction, and BMPs (e.g, silt fence) outlined in the SWPPP would be implemented during construction.

Alternative C – Angostura Arroyo
Under Alternative C – Angostura Arroyo, approximately 0.01 acre of Agua silt loam, 0.4 acre Agua clay loam MLRA 42, 4.25 acres of Brazito loamy fine sand, 0 to 1 percent slopes, 1.7 acres of Brazito very fine sandy loam, thick surface, and 0.1 acre of Rivewash soils would be impacted. Approximately 1 acre would experience long-term, localized adverse impacts as a result of excavating and terracing, and approximately 5 acres would experience temporary, negligible adverse impacts as a result of planting riparian vegetation. Impacts associated with soil erosion would be similar to those described under Alternative B – Yeso Arroyo.

Alternative D – Broad Canyon Arroyo
Under Alternative D – Broad Canyon Arroyo, approximately 1.7 acres of Canutio and Arizo gravelly sandy loams MLRA 42 soils and less than 0.1 acre of Bluepoint-Caliza-Yturbide complex and Riverwash soils each would be impacted as a result of the project. Approximately 0.5 acre would experience long-term, localized adverse impacts as a result of excavation and shaping, and approximately 1 acre would experience temporary, negligible adverse impacts as a

result of planting riparian vegetation. Impacts associated with soil erosion would be similar to those described under Alternative B – Yeso Arroyo.

Alternative E – Selden Point Bar
Under Alternative E – Selden Point Bar, approximately 4.5 acres of Agua variant and Belen variant soils, 3.0 acres of Bluepoint-Xaliza-Yturbide complex, and 1 acre of Riverwash soils would be impacted as a result of project implementation. Approximately 0.75 acre would experience long-term, localized adverse impacts as a result of excavation and shaping, and approximately 8 acres would experience temporary, negligible adverse impacts as a result of planting riparian vegetation. Impacts associated with soil erosion would be similar to those described under Alternative B – Yeso Arroyo.

Alternative F – Las Cruces Effluent
Under this alternative, approximately 2.6 acres of Brazito very fine sandy loam, thick surface, and 0.2 acres of Riverwash soils would be impacted as a result of project implementation. Approximately 1 acre would experience long-term, localized adverse impacts as a result of excavation and shaping, and approximately 2 acres would experience temporary, negligible adverse impacts as a result of planting riparian vegetation. Impacts associated with soil erosion would be similar to those described under Alternative B – Yeso Arroyo.

Alternative G – Mesilla Valley Bosque State Park
Under this alternative, approximately 9 acres of Belen clay, 0.1 acre of Brazito loamy fine sand, 0 to 1 percent slope, 2.7 acres of Brazito very fine sandy loam, thick surface soils would be impacted. Approximately 5 acres would experience long-term, localized adverse impacts as a result of excavation and shaping, and approximately 7 acres would experience temporary, negligible adverse impacts as a result of planting riparian vegetation. Impacts associated with soil erosion would be similar to those described under Alternative B – Yeso Arroyo.

Alternative H – Downstream of Courchesne Bridge
Under this alternative, approximately 8.7 acres of Made land, Gila soil material, and 0.1 acre of Riverwash soils would be impacted. Approximately 1 acre would experience long-term, localized adverse impacts as a result of excavation and shaping, and approximately 7.7 acre would experience temporary, negligible adverse impacts as a result of planting riparian vegetation. Impacts associated with soil erosion would be similar to those described under Alternative B – Yeso Arroyo.

3.5 COMMUNITY RESOURCES

3.5.1 Recreation
An important consideration when weighing alternative actions is to determine the degree and extent in which they influence the local community. Some of the proposed alternative sites provide recreational opportunities in the forms of hunting/fishing, nature watching, jogging, etc. Evaluating how recreational opportunities will improve or decline as a result of the proposed alternative actions is integral in the site selection process.

Environmental Consequences

Alternative A – No Action
No impacts are anticipated. Under Alternative A – No Action, there would be no changes to the current land use, so there would be no impact on recreational opportunities.

Alternative B – Yeso Arroyo
No negative impacts on recreational opportunities are anticipated under this alternative. Terracing the Rio Grande and replacing non-native vegetation with native species would enhance riparian habitat and could attract bird watchers and nature enthusiasts.

Alternative C – Angostura Arroyo
No negative impacts on recreational opportunities are anticipated under this alternative. Terracing the Rio Grande and replacing non-native vegetation with native species would enhance riparian habitat and could attract bird watchers and nature enthusiasts.

Alternative D – Broad Canyon Arroyo
Temporary adverse impacts on recreational opportunities are anticipated under this altrnative. Broad Canyon Arroyo is occasionally used for fishing and camping on BLM land, so these recreational activities may be limited during implementation of Alternative D - Broad Canyon Arroyo. A potential benefit of embayment construction and revegetation of riparian zones with native plants within the Broad Canyon Arroyo is enhancement of riparian and aquatic habitat, which could attract bird watchers and nature enthusiasts. However, the USIBWC owns the property and does not authorize unaffiliated persons on the premises.

Alternative E – Selden Point Bar
No negative impacts on recreational opportunities are anticipated under this alternative. Construction of a flow through channel and two backwater habitat areas, in addition to replacing non-native vegetation with native species, would enhance riparian habitat and could attract bird watchers and nature enthusiasts. However, the USIBWC owns the property and does not authorize unaffiliated persons on the premises.

Alternative F – Las Cruces Effluent
Temporary adverse impacts on recreational opportunities are anticipated under this alternative. Construction of a meandering clearwater side channel and two backwater habitat areas may temporarily impede access to the recreational trail adjacent to site. However, creating a meandering channel with a pedestrian bridge should add recreational value to this location, and enhance the City of Las Cruces' lease for the existing recreation trail. Construction of backwater habitat areas, as well as replacing non-native vegetation with native species, would enhance riparian habitat and could attract bird watchers and nature enthusiasts.

Alternative G – Mesilla Valley Bosque State Park
Temporary negative impacts on recreation are anticipated under this alternative. Construction of a high flow channel between the Rio Grande and the Picacho Drain, along with widening and terracing the Picacho Drain, may temporarily impede access to recreational opportunities within MVBSP. However, construction of depressional wetlands along the Picacho Drain, as well as

replacing non-native vegetation with native species, would enhance riparian habitat and could attract bird watchers and nature enthusiasts. The proposed restoration project would enhance the MVBSP lease for the existing state park and trails.

Alternative H – Downstream of Courchesne Bridge
No negative impacts on recreational opportunities are anticipated under this alternative. Construction a channel and replacing non-native vegetation with native species, would enhance riparian habitat and could attract bird watchers and nature enthusiasts.

3.8 UNAVOIDABLE ADVERSE IMPACTS, AND IRREVERSIBLE AND IRRETRIEBABLE COMMITMENT OF RESOURCES

A commitment of resources is irreversible when its direct or indirect impacts limit the future availability of a resource. An irretrievable commitment refers to the use of consumption or resources that is neither renewable nor recoverable for later use by future generations. The commitment of resources refers primarily to the use of nonrenewable resources such as fossil fuels, water, labor, and electricity.

Any of the action alternatives would use fuels during construction, labor, and alter the restoration sites to aquatic, wetland, or riparian habitat. Unavoidable adverse impacts include the minimal noise and air quality pollution that would be generated during the construction of any of the action alternatives. None of the action alternatives pose substantial unavoidable adverse impacts or irretrievable commitments of resources.

3.9 CUMULATIVE IMPACTS

Cumulative impacts result from the direct and indirect impacts of implementing a proposed action, in addition to past, present, and foreseeable future actions by the USIBWC or other entities in the area. A number of environmental impacts have occurred in the riparian areas of the Rio Grande associated with changes in the water regime and the large-scale invasion by saltcedar. These past impacts have largely stabilized and can be considered baselines against which impacts of the proposed action can be compared. The restoration of native aquatic habitats would be a step in mitigating these past impacts. A number of other revegetation projects are being implemented along the Rio Grande. The completion of each additional project such as this would help to leverage the positive cumulative impact of these efforts.

The USIBWC and other agencies have implemented habitat restoration projects in the RGCP and will continue to do so in the future. The following is a description of other projects in the RGCP.

The USIBWC is participating in a collaborative effort with project stakeholder (EBID, USFWS, Reclamation, and others to implement environmental enhancements. Several projects have been implemented following the issuance of the 2009 ROD for the RGCP (USIBWC 2009). The ROD requires the agency to implement a variety of approaches to land management. These approaches include cessation of mowing in designated areas, elimination of grazing leases throughout the project, and habitat restoration activities such as saltcedar extraction, chemical treatment of saltcedar, installation of groundwater monitoring wells, possible construction of

irrigation infrastructure, planting of native trees, channel maintenance, and possible construction of sediment control infrastructure. Twenty-two of the 30 sites identified in the 2009 ROD have been implemented to date. The proposed action analyzed in this EA are a part of this effort.

The USIBWC is completing construction of levee rehabilitation throughout the RGCP (USIBWC 2007). Several projects for levee floodwalls and levees are still in the design phase; these remaining areas are in Canutillo, Texas, Sunland Park, New Mexico and El Paso, Texas above American Dam. All these areas are within the Region of Influence (ROI) of the proposed project.

EBID has implemented several restoration projects and proposes to implement additional projects in the RGCP as part of their WHEN: Water Habitat Energy Nexus project. Habitat restoration efforts include creating 21.2 acres of diverse habitat, 4.5 acres of suitable SWFL habitat, and not disturbing existing habitat (EBID 2018).

SWEC constructed the La Mancha Wetland project on 6 acres of land adjacent to the Rio Grande near the Town of Mesilla. The project is located on lands owned by SWEC and USIBWC and includes a pond, connection to the Rio Grande, native vegetation plantings. The purpose of the project is to restore spawning and nursery habitat for native fish.

In 2013, the State of Texas sued the states of New Mexico and Colorado alleging that by allowing farmers in southern New Mexico to pump from groundwater wells near the Rio Grande, New Mexico has failed to provide its legal share of water downstream. The U.S. Supreme Court issued an opinion that allows the United States to intervene on the Rio Grande water case and pursue claims under the Rio Grande Compact. It is currently unknown how water rights in New Mexico or Texas could be affected.

The South Central New Mexico Stormwater Management Coalition, composed of nine local agencies with stormwater management responsibilities, has developed a working group to address issues in the Rincon Arroyo Watershed. The working group is looking at initiating riparian restoration efforts as part of its Rincon Arroyo Watershed Project.

The proposed project would not result in any adverse cumulative impacts. Implementation of the proposed project would result in cumulative beneficial impacts on biological resources, threatened and endangered species, and water resources. The proposed project would restore aquatic habitat within the RGCP in compliance with the 2009 ROD.

Under the proposed Aquatic Habitat Restoration Project in the RGCP multiple restoration alternatives could be implemented. Implementation would of these project would result in cumulative temporary, negligible or localized impacts on resources such as soils during construction. However, the cumulative impact of implementing multiple aquatic restoration projects in the RGCP would be beneficial for resources such as wetlands, wildlife, and vegetation.

4.0 MITIGATION MEASURES

Impacts to jurisdictional wetlands resulting from the proposed aquatic restoration projects will be permitted through the USACE permitting process and mitigation will be provided per the permit conditions.

USIBWC would implement BMPs that are standard for USIBWC construction projects to minimize impacts to soil, water, wildlife, and other resources. BMPs are documented in USIBWC's River Management Plan and include, but are not limited to: dust abatement during construction, work during daytime hours, doing construction work only during dry or low flow conditions, avoiding impacts to nesting birds, servicing of heavy machinery outside of the floodplain, and reporting unearthed cultural resources and other natural resources during construction.

Archaeological surveys would be conducted at the preferred alternative sites if 100 percent of the site has not been surveyed. USIBWC would complete Section 106 consultation for the preferred alternatives.

USIBWC would consult with NMSHPO and/or TXSHPO under the 2017 and 2013 PAs, respectively prior to implementation of the alternatives.

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5.0 LIST OF PREPARERS AND REVIEWERS

Name	Title	Degree	Years Experience	Contribution
Elizabeth Verdecchia	USIBWC, Project Manager	M.A.G., Applied Geography, B.A., Environmental Science & Engineering	18	Review
Kelley Blough	USIBWC, Environmental Protection Specialist	B.A., Geology	28	Reviewer
Howard Nass	GSRC, Senior Project Manager	B.S., Forestry and Wildlife Management	29	Principal Author and Soils, Land Use, and Environmental Health Sections
Dennis Peters	GSRC, Senior Supervisor	M.S., Bio-Environmental Oceanography B.S., Biology	35	Review
Dr. Sandra Villarreal	Staff Ecologist	Ph.D., Ecology and Evolutionary Biology B.S., Environmental Science	10	Review
Logan Mccardle	Staff Biologist	M.S., Biology B.S., Ecology, Environmental Science, and Evolutionary Biology	10	Review
Lauren Solomon	Jr. Biologist	M.S., Biology B.S., Zoology	10	Biological Resources Section
Beau Rapier	Jr. Biologist	M.S., Science in Biology B.A., Forestry/Wildlife Management and Habitat Conservation	5	Water Resources and Community Resources Sections
Dr. Bretton Somers, PhD	Principal Investigator	Ph.D. Geography M.A., Geography B.A., Communications	18	Cultural Resources
Christy Guempel	GIS Analyst	B.S., Geography	11	GIS analysis and map production

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6.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS ON DISTRIBUTION LIST

List of key stakeholders	
Organizations & Other Entities	Elephant Butte Irrigation District (EBID) Southwest Environmental Center (SWEC) Audubon New Mexico Paso del Norte Watershed Council (Chair Conrad Keyes) El Paso County Water Improvement District #1 (EPCWID#1) Southcentral New Mexico Stormwater Coalition Local Congressional representatives Joan Hirschman Woodward USIBWC Upper Rio Grande Citizens Forum Board Sierra County Soil and Water Conservation District Doña Ana County Soil and Water Conservation District Doña Ana Mutual Domestic Water Southcentral New Mexico Stormwater Coalition Southern Group, Rio Grande Chapter of the Sierra Club (Dr. Kurt Warner) New Mexico Trail Commission Las Cruces Audubon (Sidney Webb) Rio Grande Compact Commission (Chris Stageman)
Federal Govt	U.S. Bureau of Reclamation (Reclamation) U.S. Bureau of Land Management (BLM) U.S. Fish and Wildlife Service (USFWS), San Andres NWF and Albuquerque U.S. Army Corps of Engineers (USACE), Albuquerque District USFWS San Andres National Wildlife Refuge Federal workgroup (USACE, BLM, USBR, USFS, USDA/NRCS, USFWS, USGS) U.S. Geological Survey (USGS) U.S. Environmental Protection Agency (USEPA)
State/Local Govt	Local municipalities New Mexico Depart of Agriculture (New Mexico State University Office) New Mexico Office of the State Engineer New Mexico State Parks (NMSP) City of Las Cruces City of Sunland Park Village of Hatch City of El Paso El Paso Water Utilities New Mexico Department of Game and Fish Mesilla Valley Bosque State Park

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APPENDIX A
FIGURES

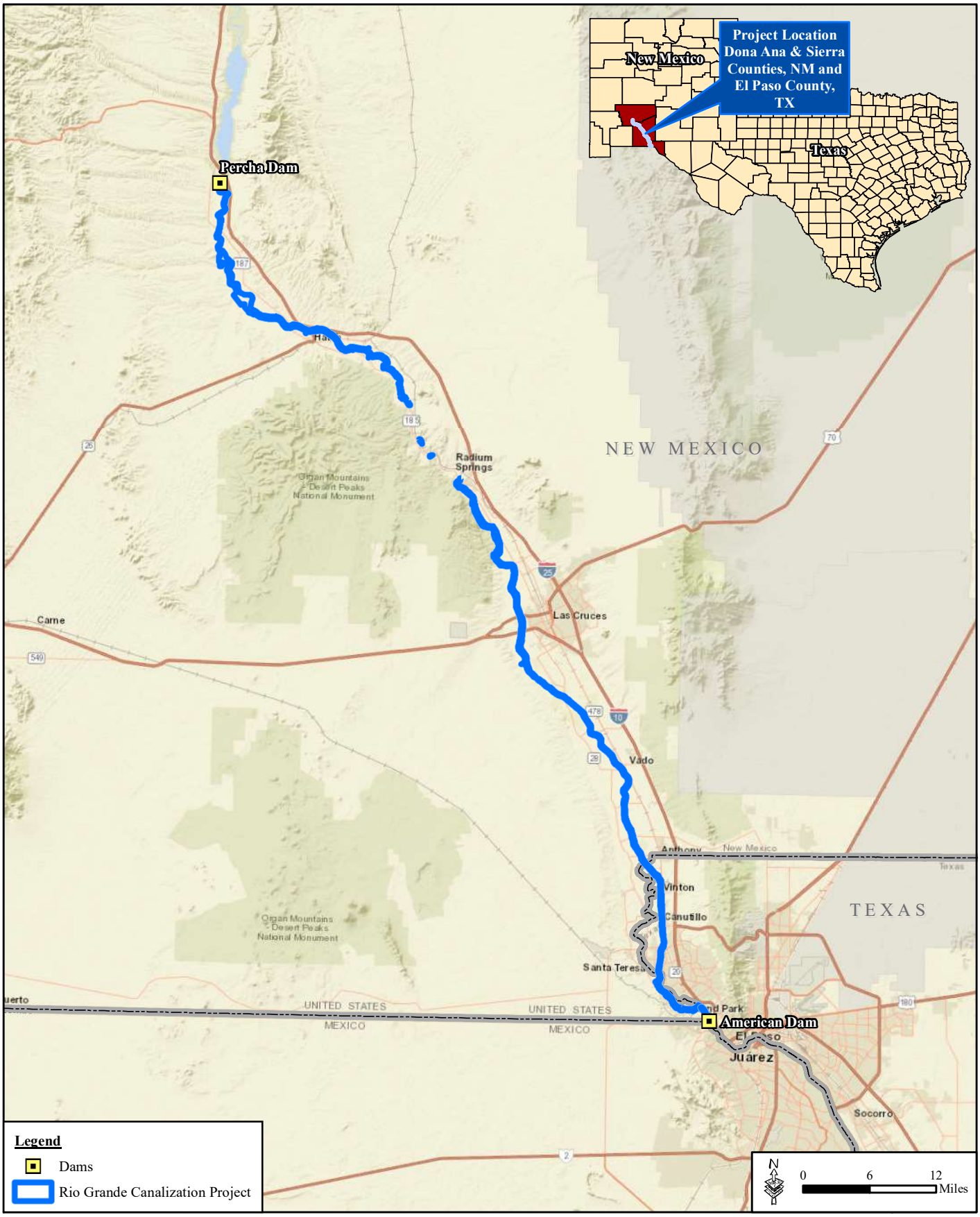

Figure A-1. Rio Grande Canalization Project

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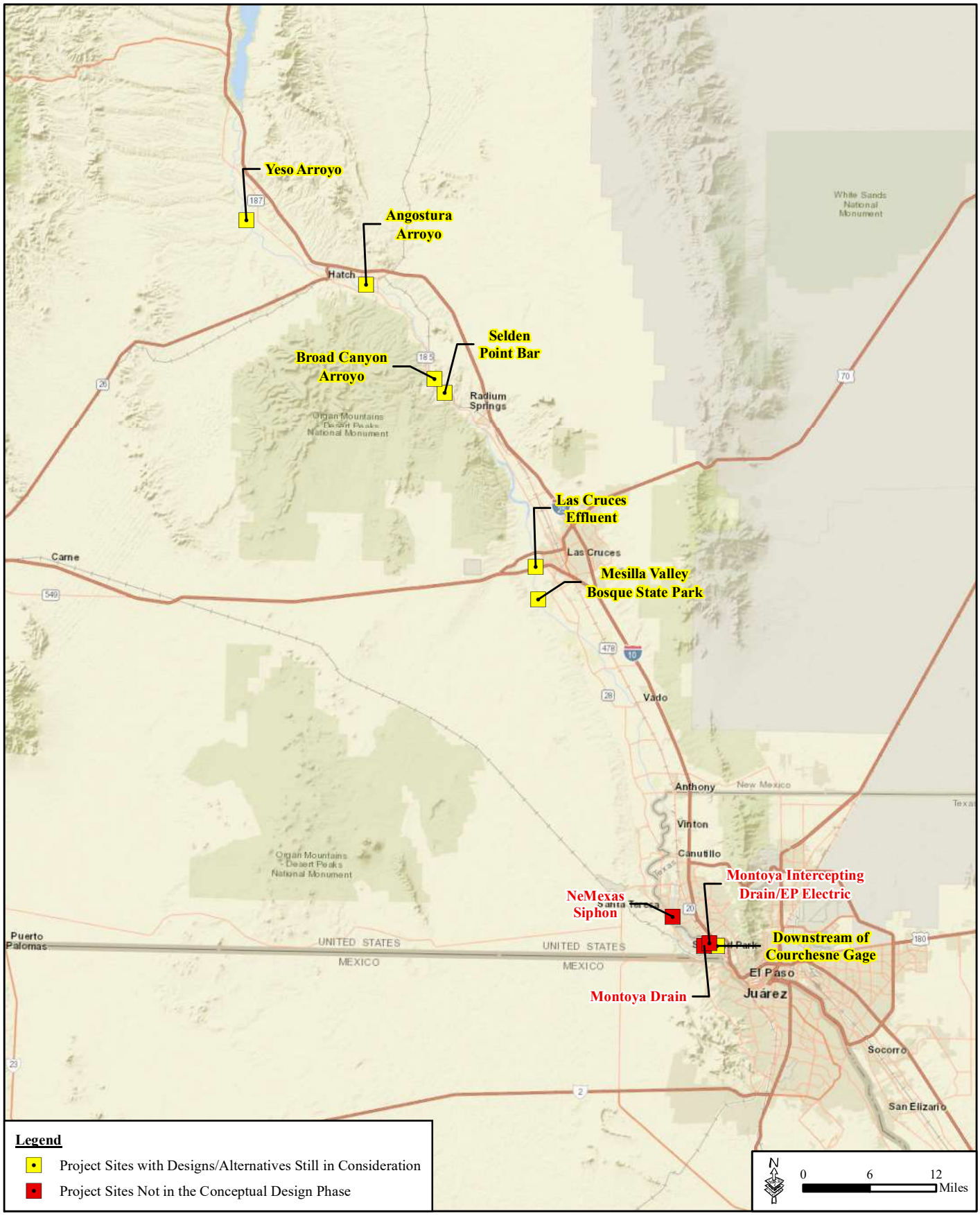

Figure A-2. Project Area Map Showing the Location of Project Sites Under Construction

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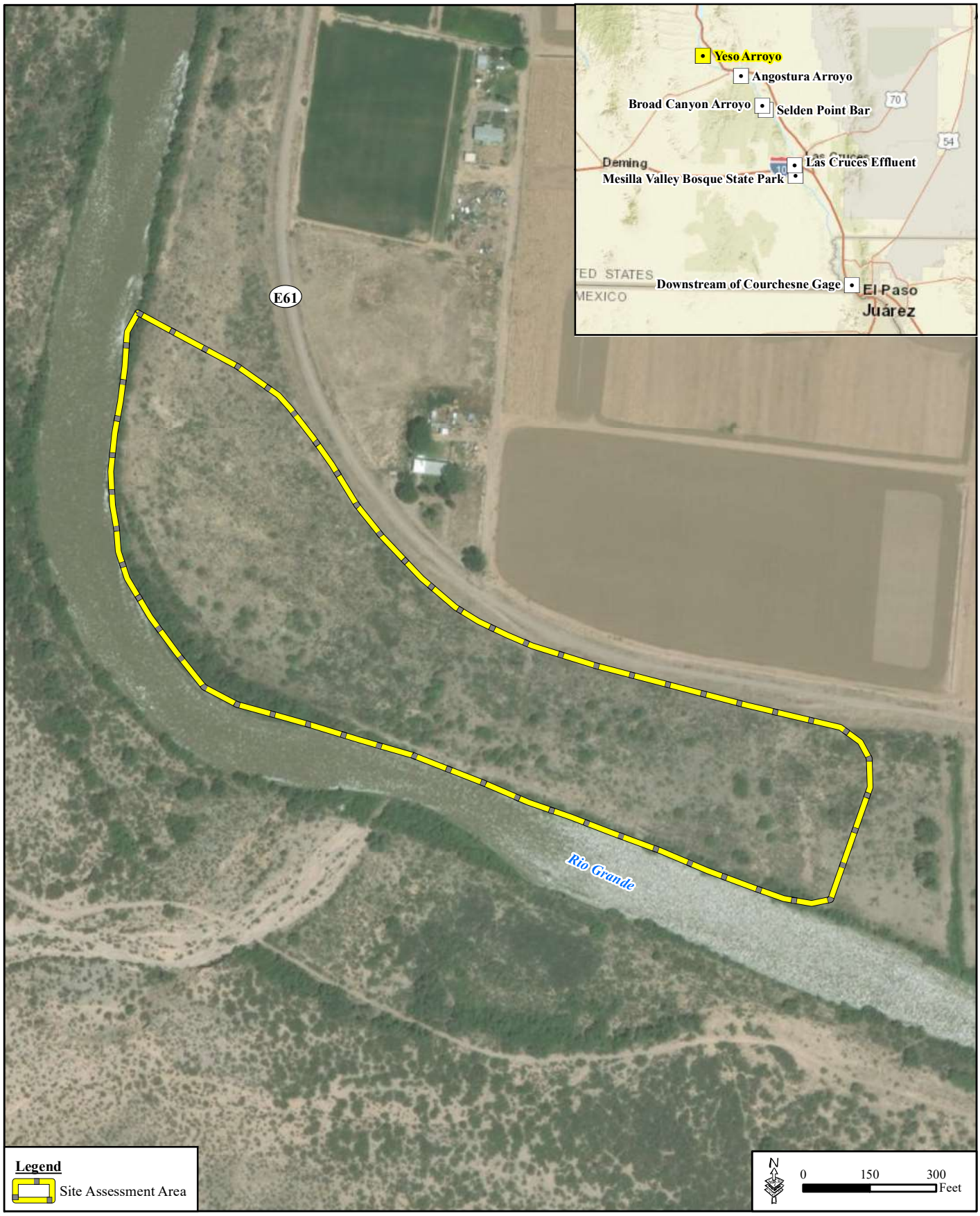

Figure A-3. Yeso Arroyo Alternative Site

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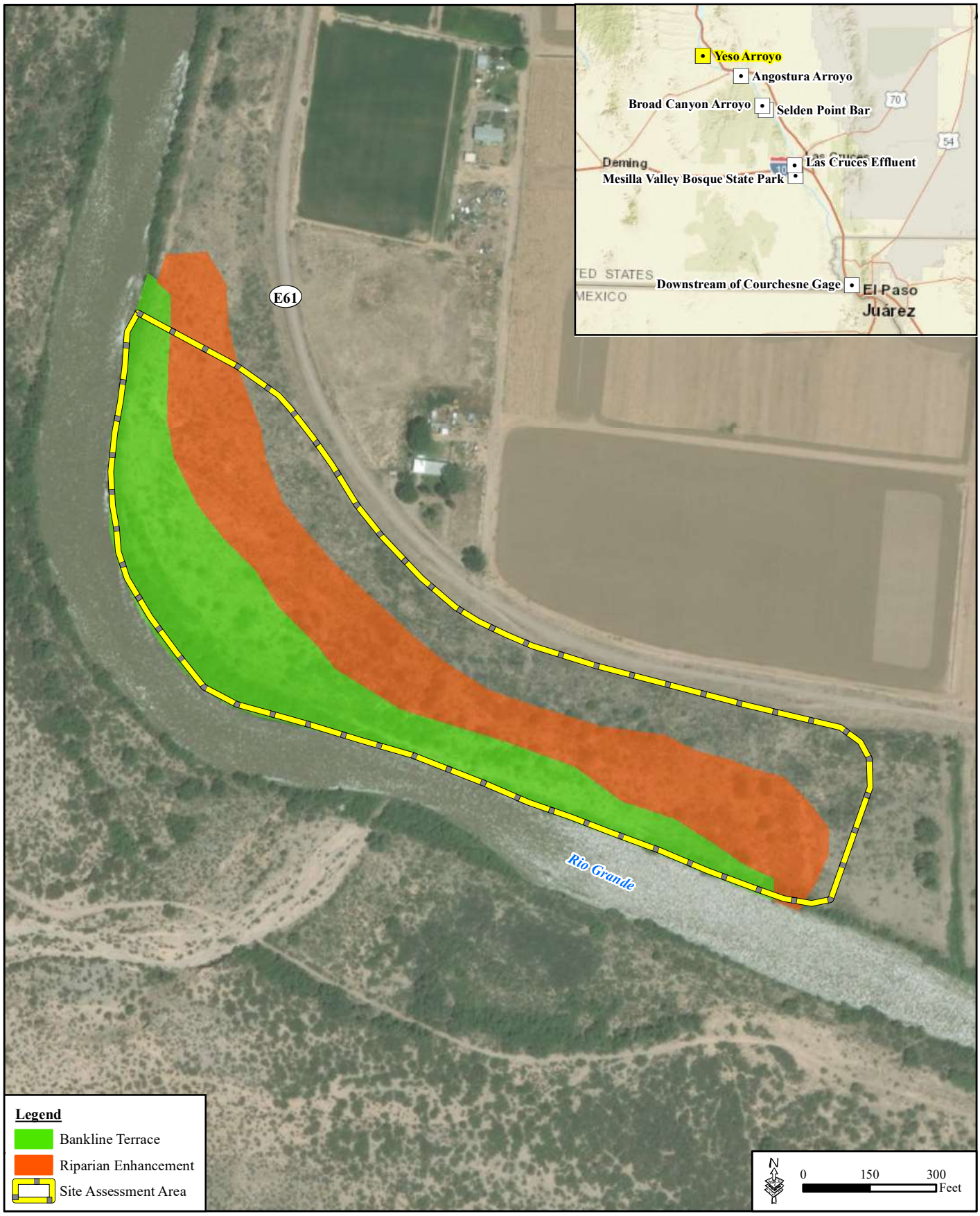

Figure A-4. Yeso Arroyo Alternative Site Conceptual Restoration Design

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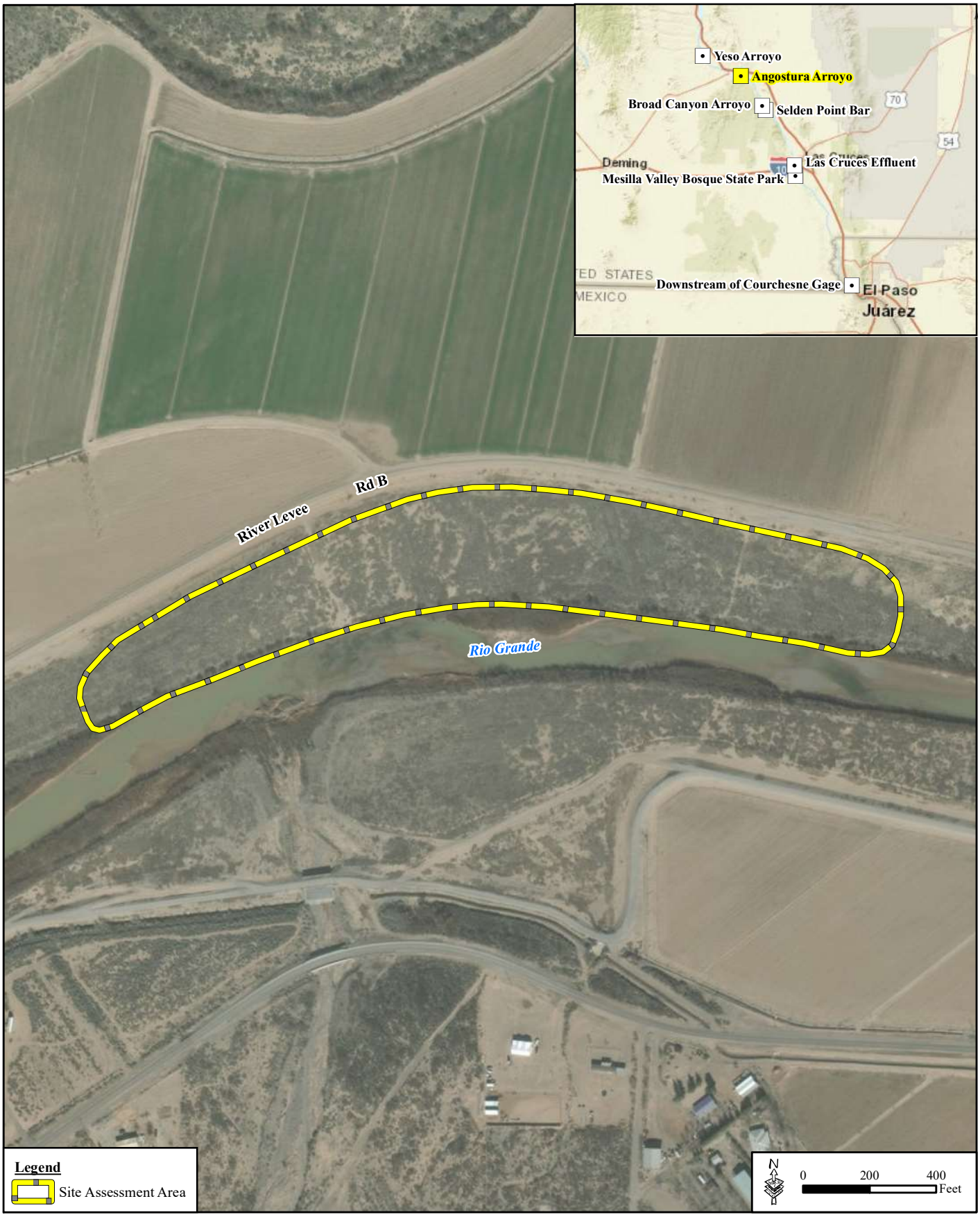

Figure A-5. Angostura Arroyo Alternative Site

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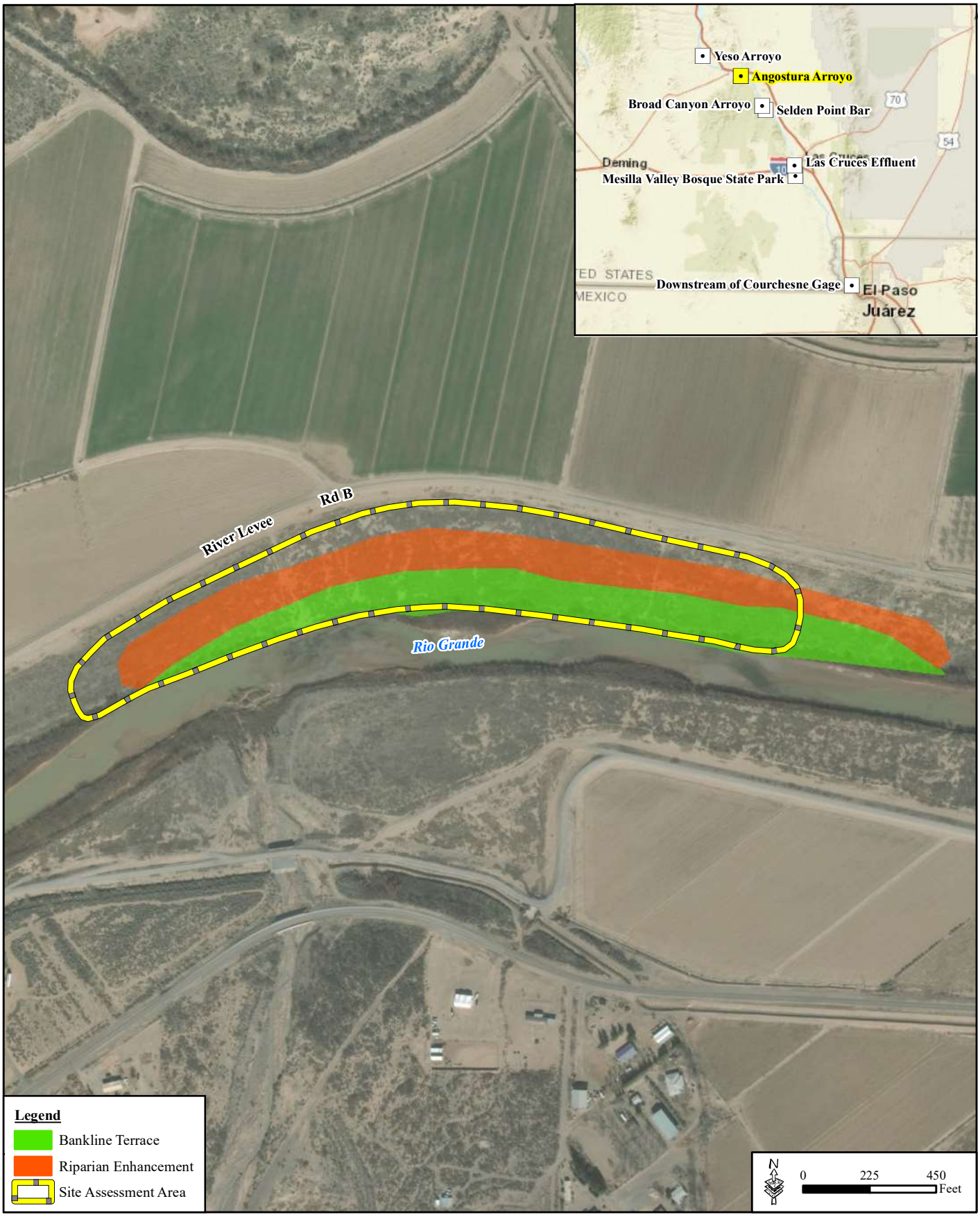

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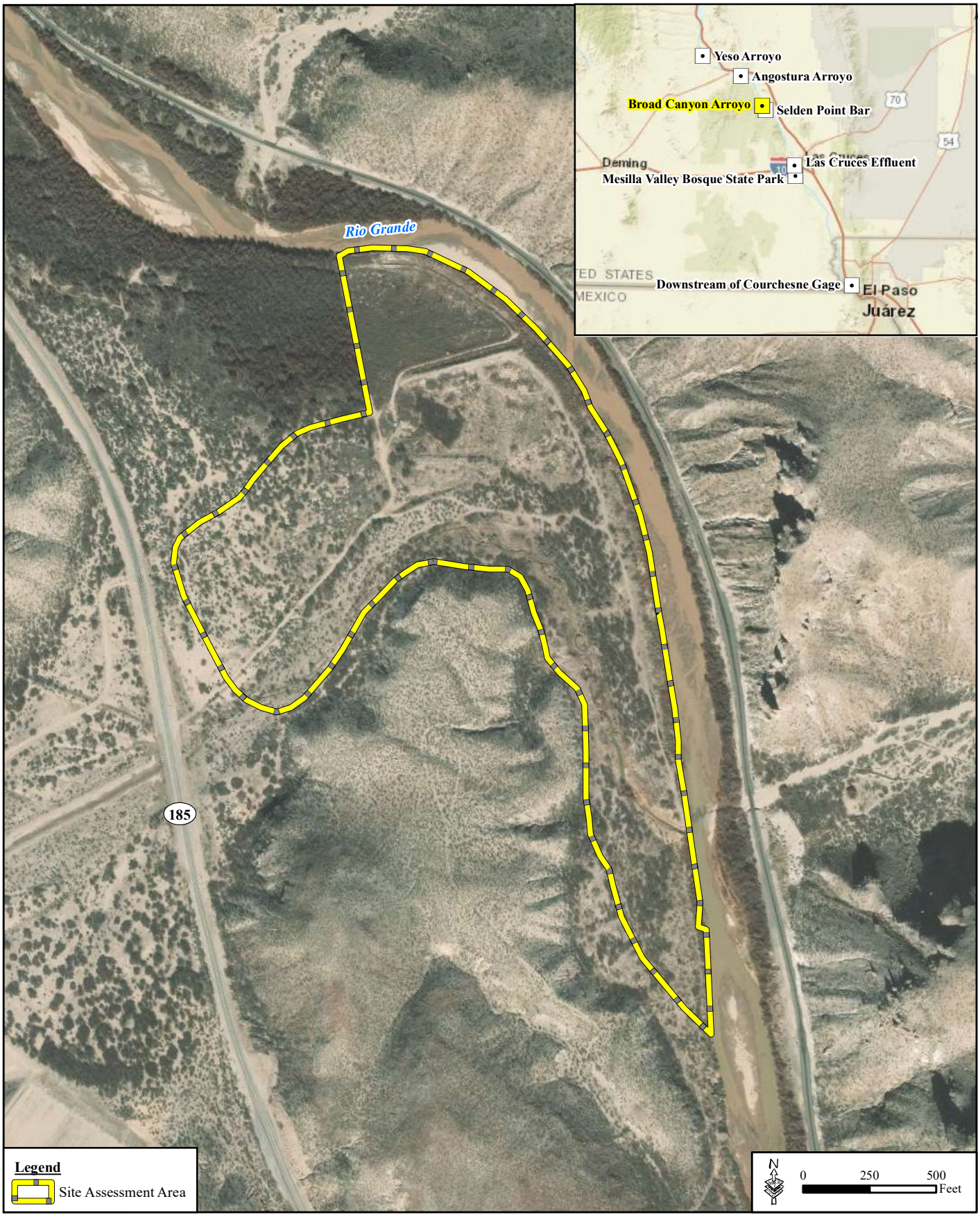

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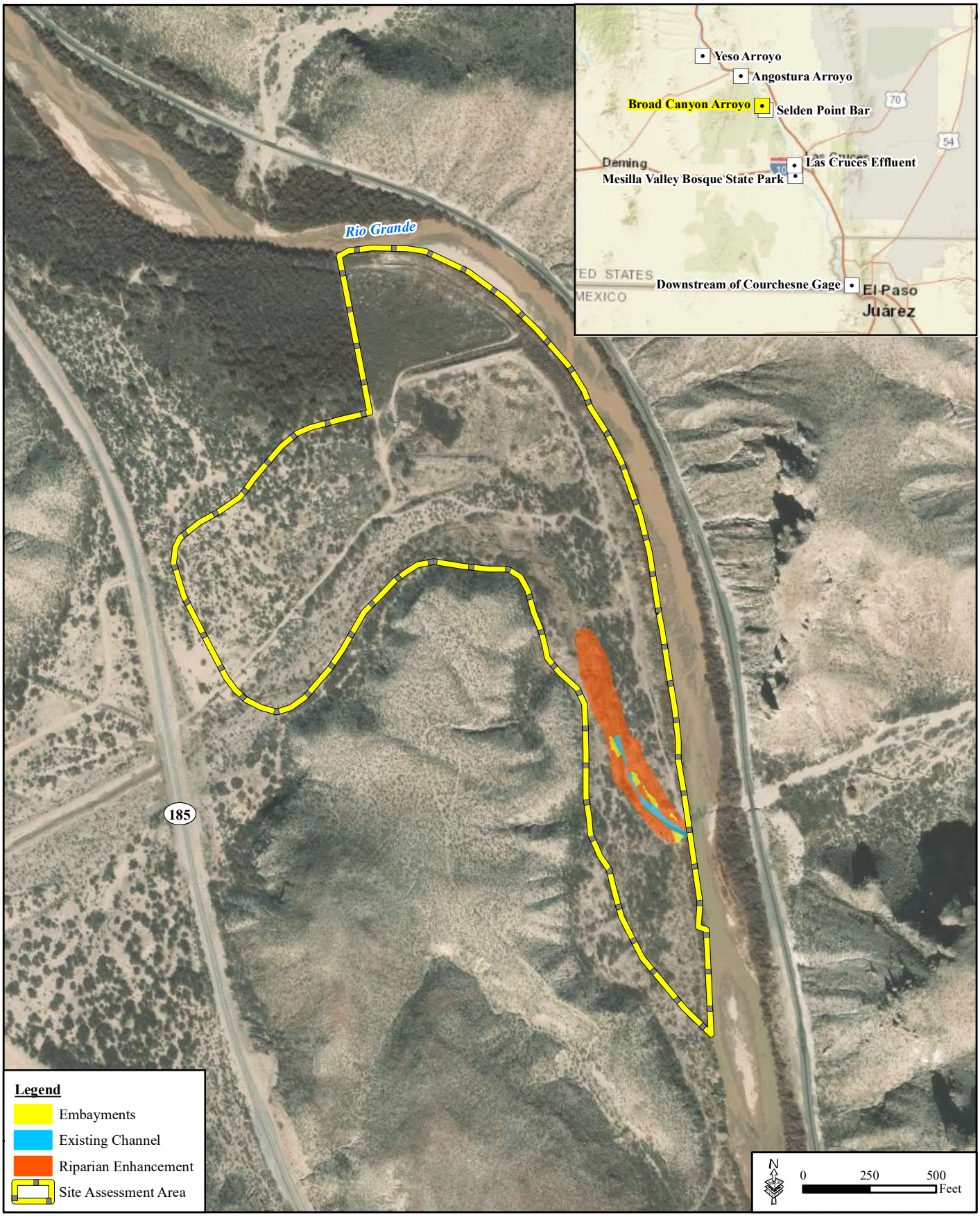

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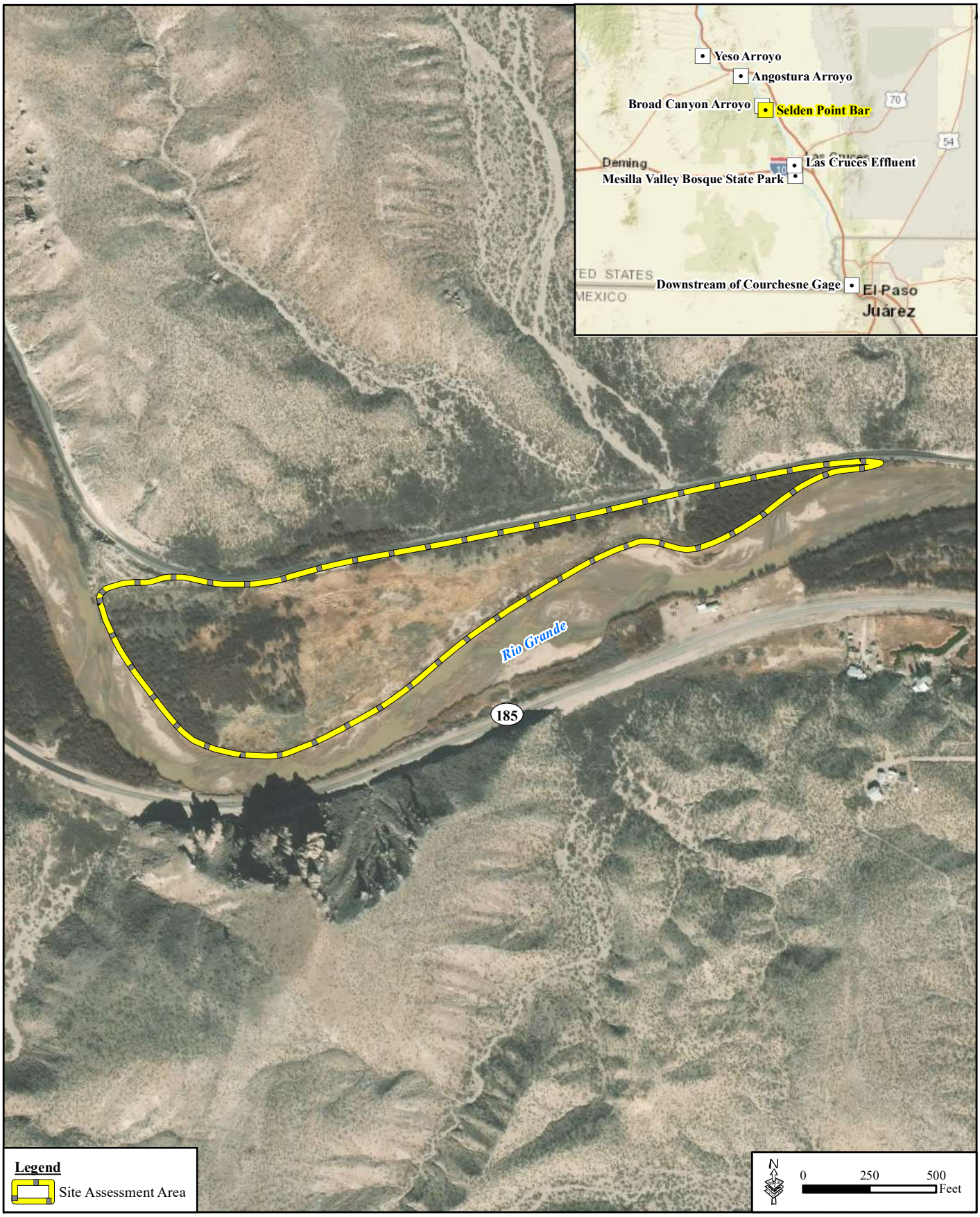

Figure A-9. Selden Point Bar Alternative Site

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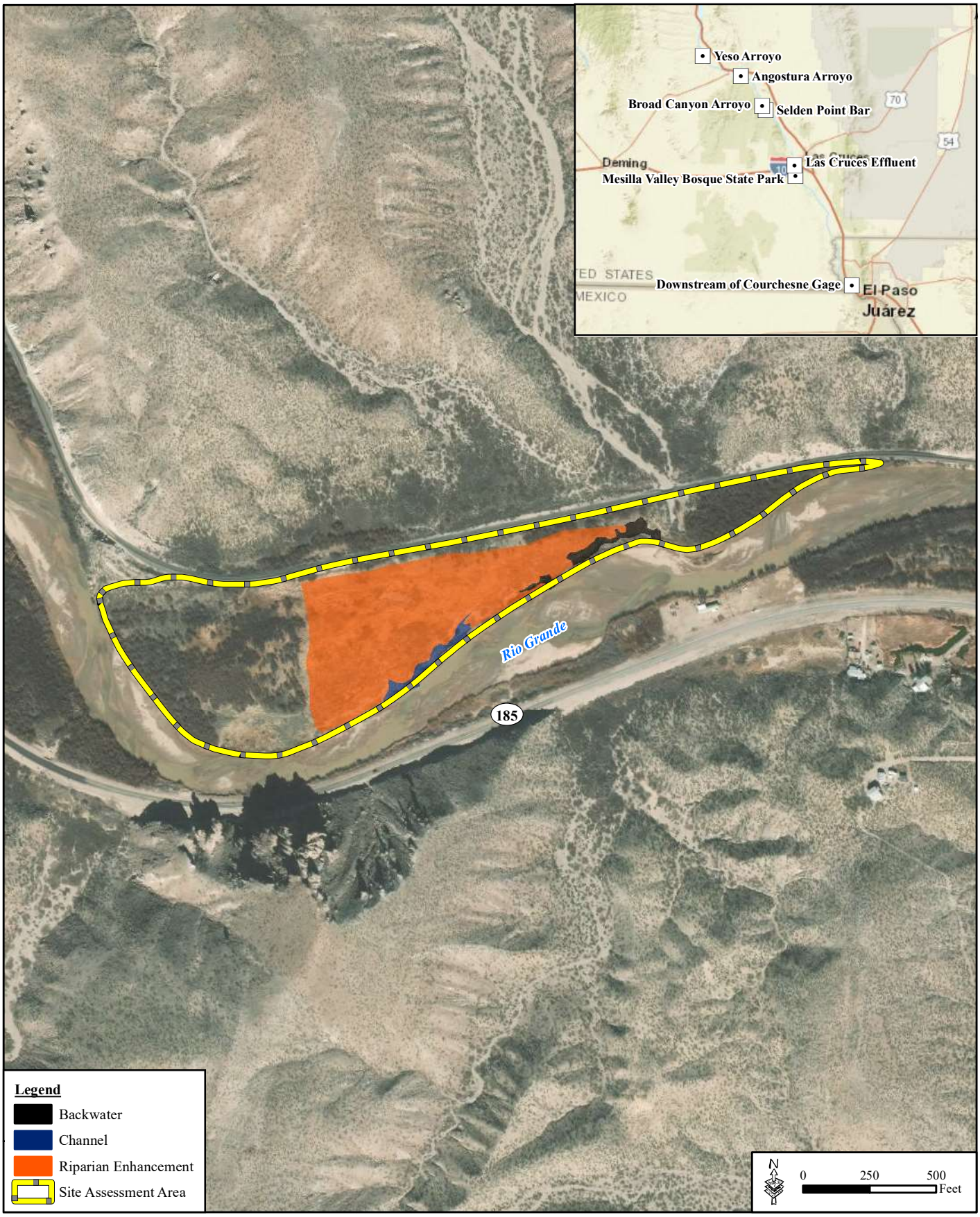

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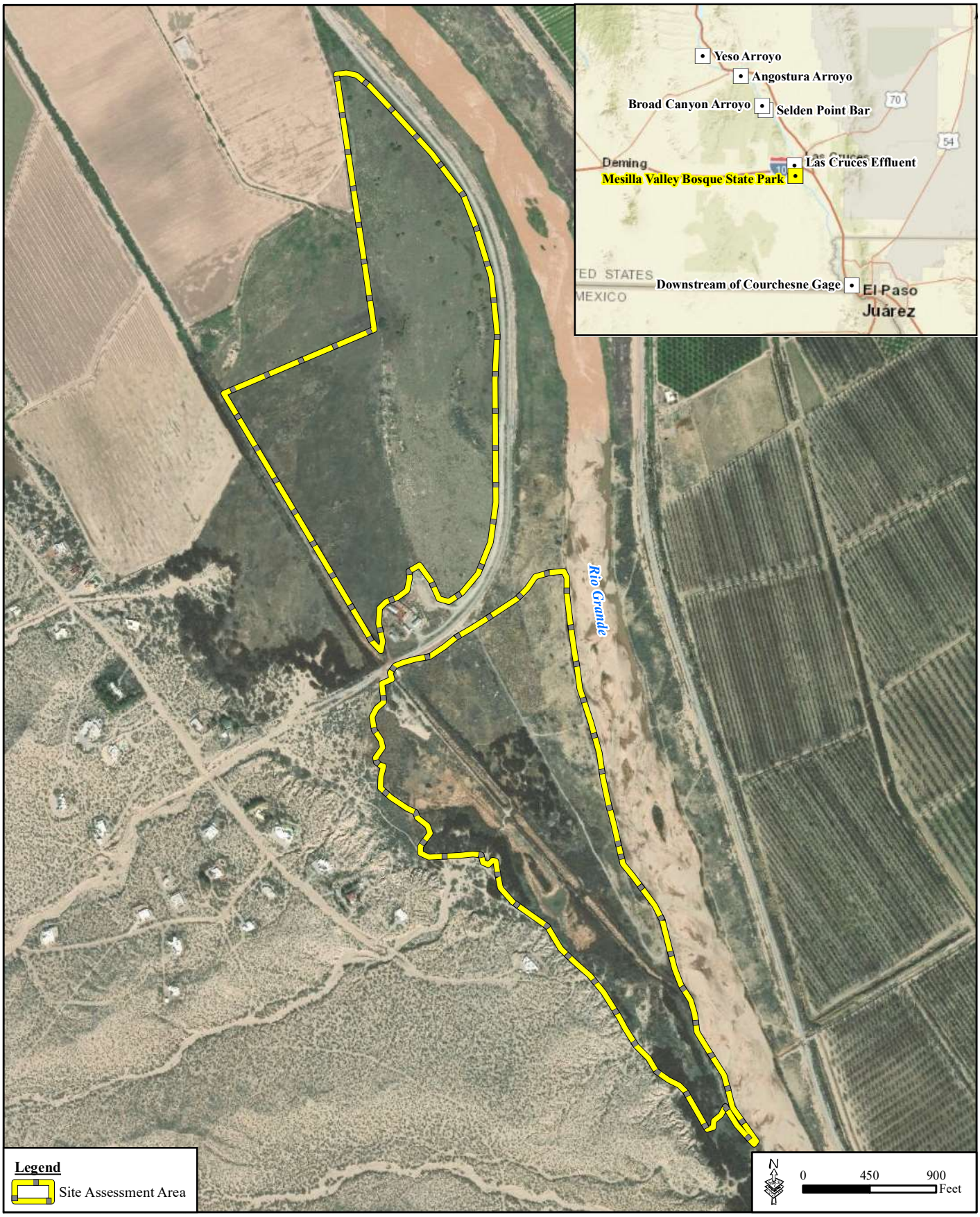

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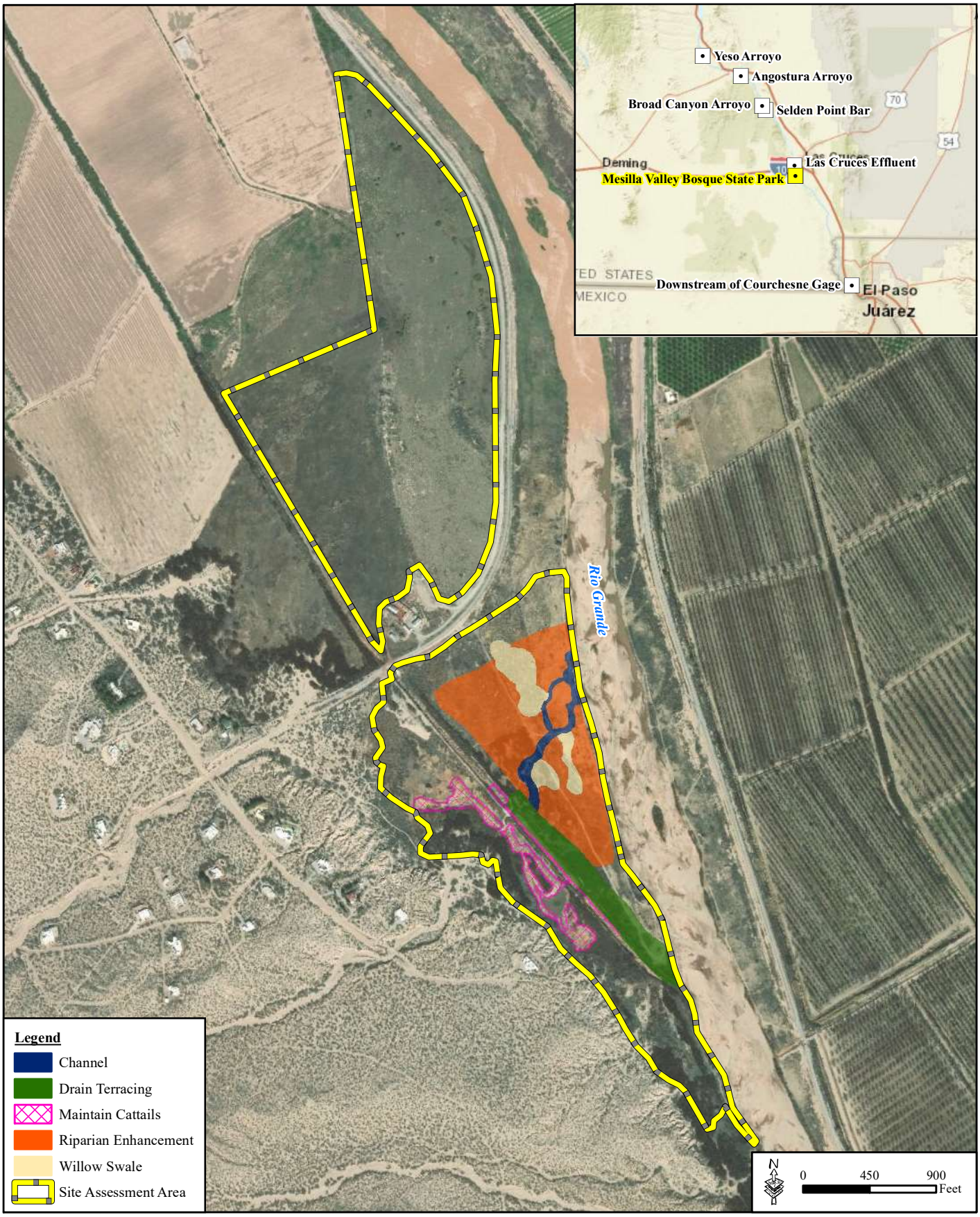

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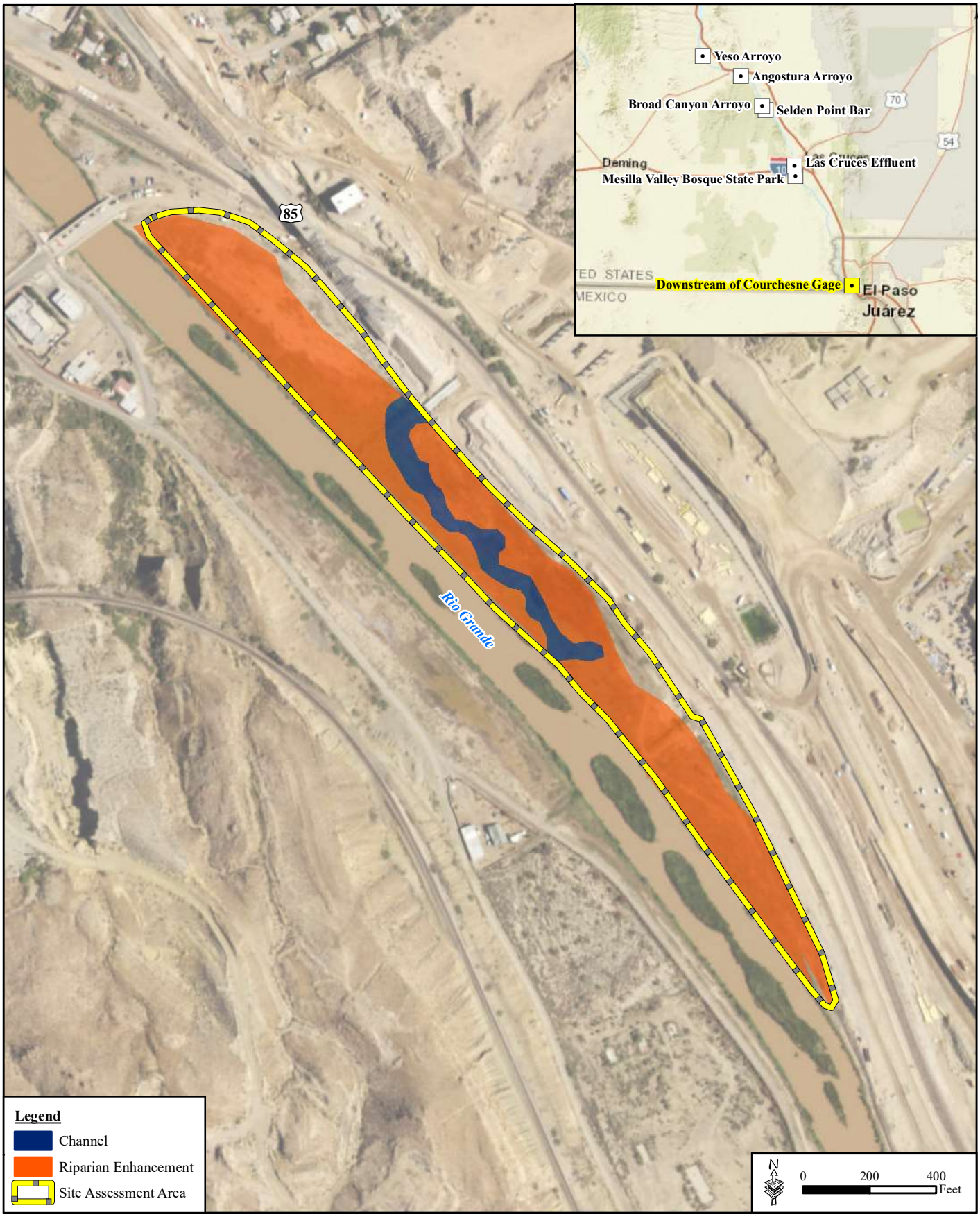

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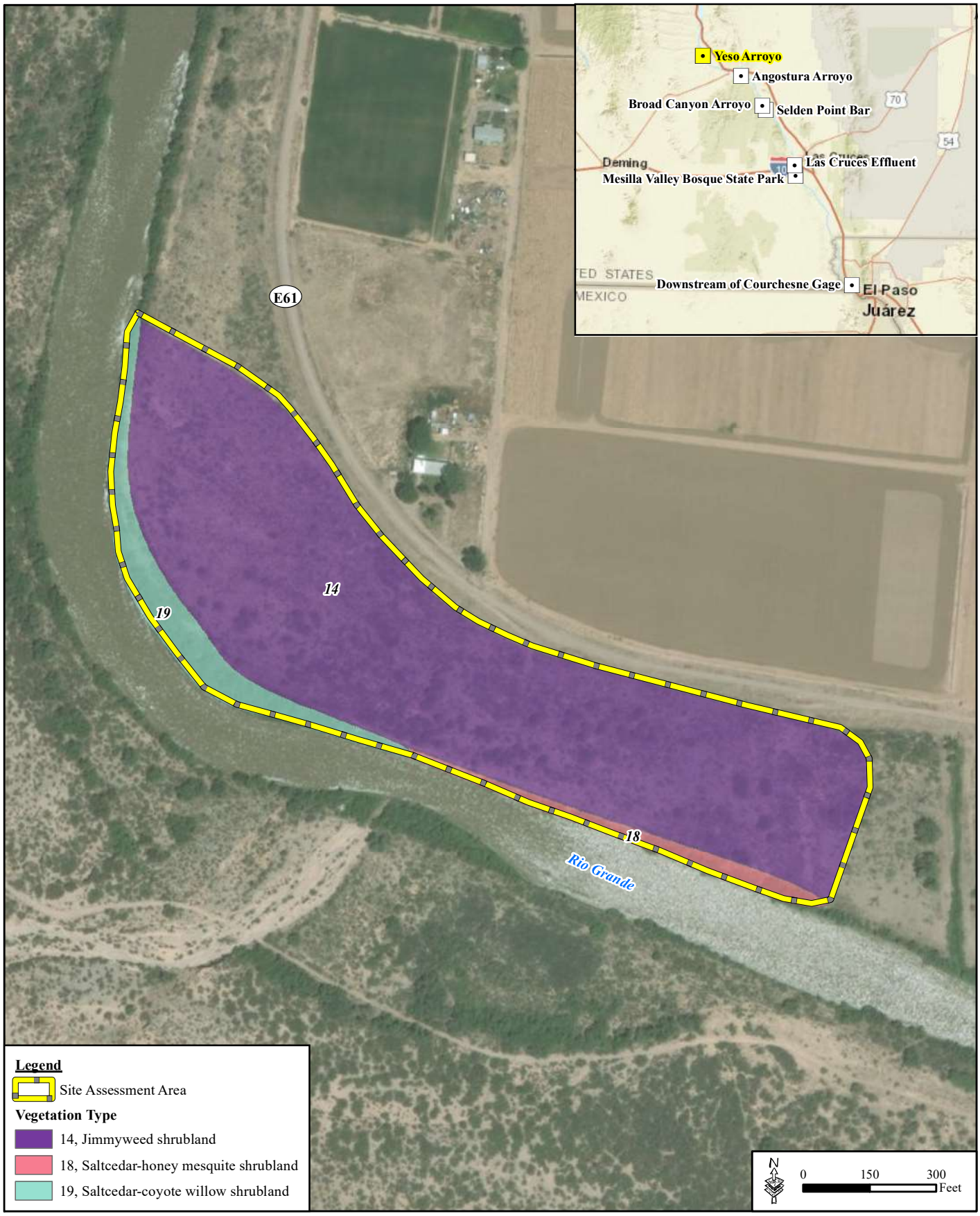

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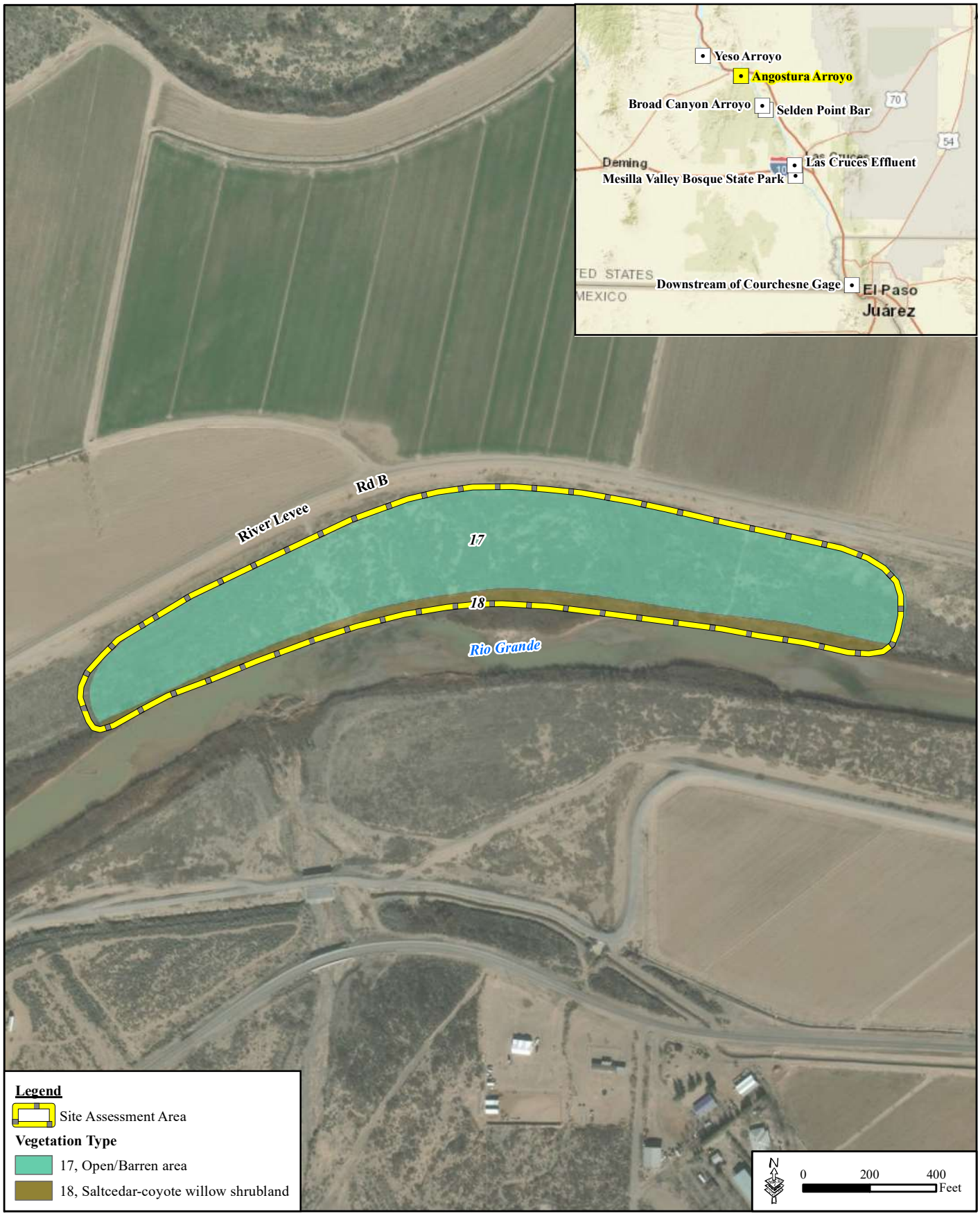

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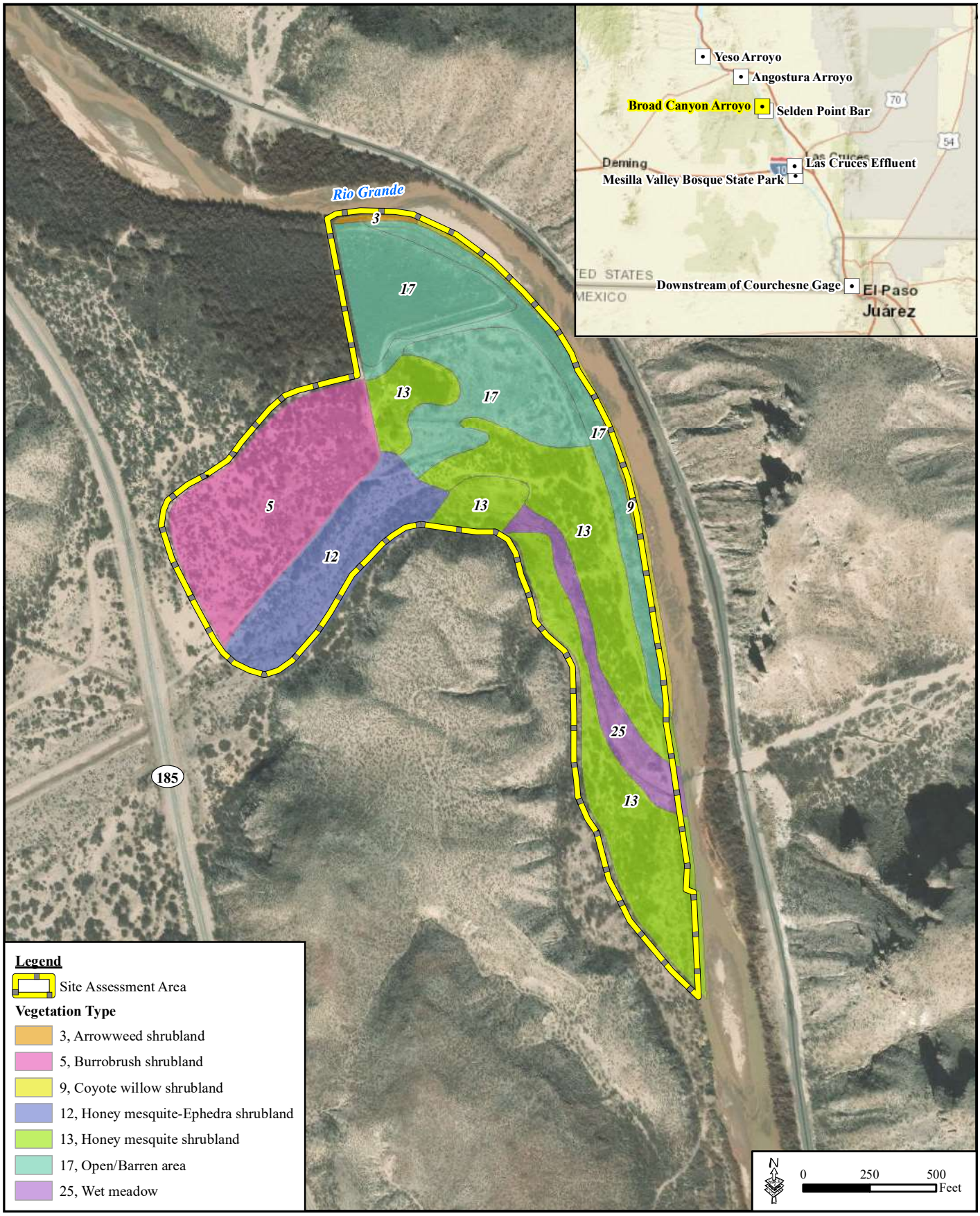

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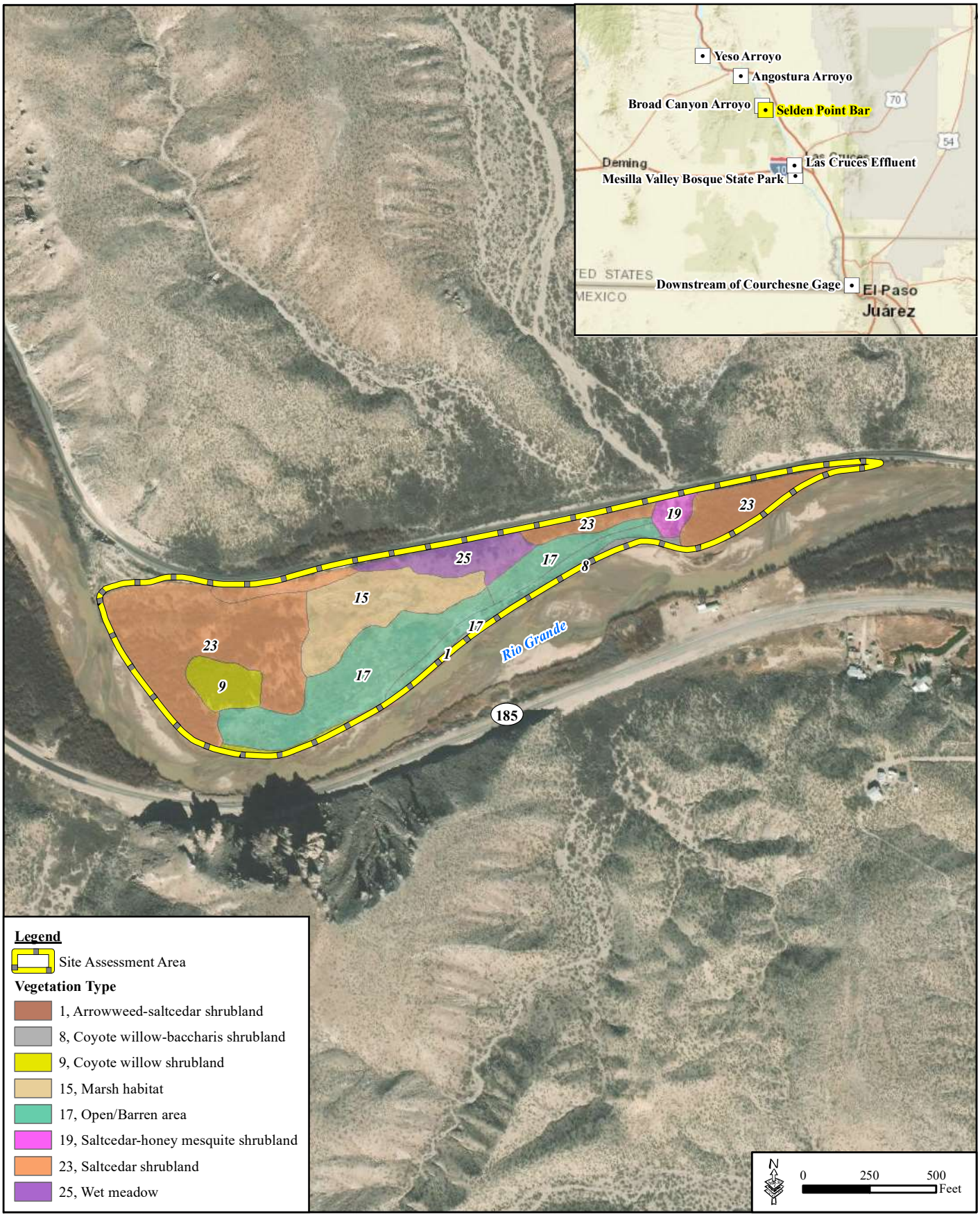

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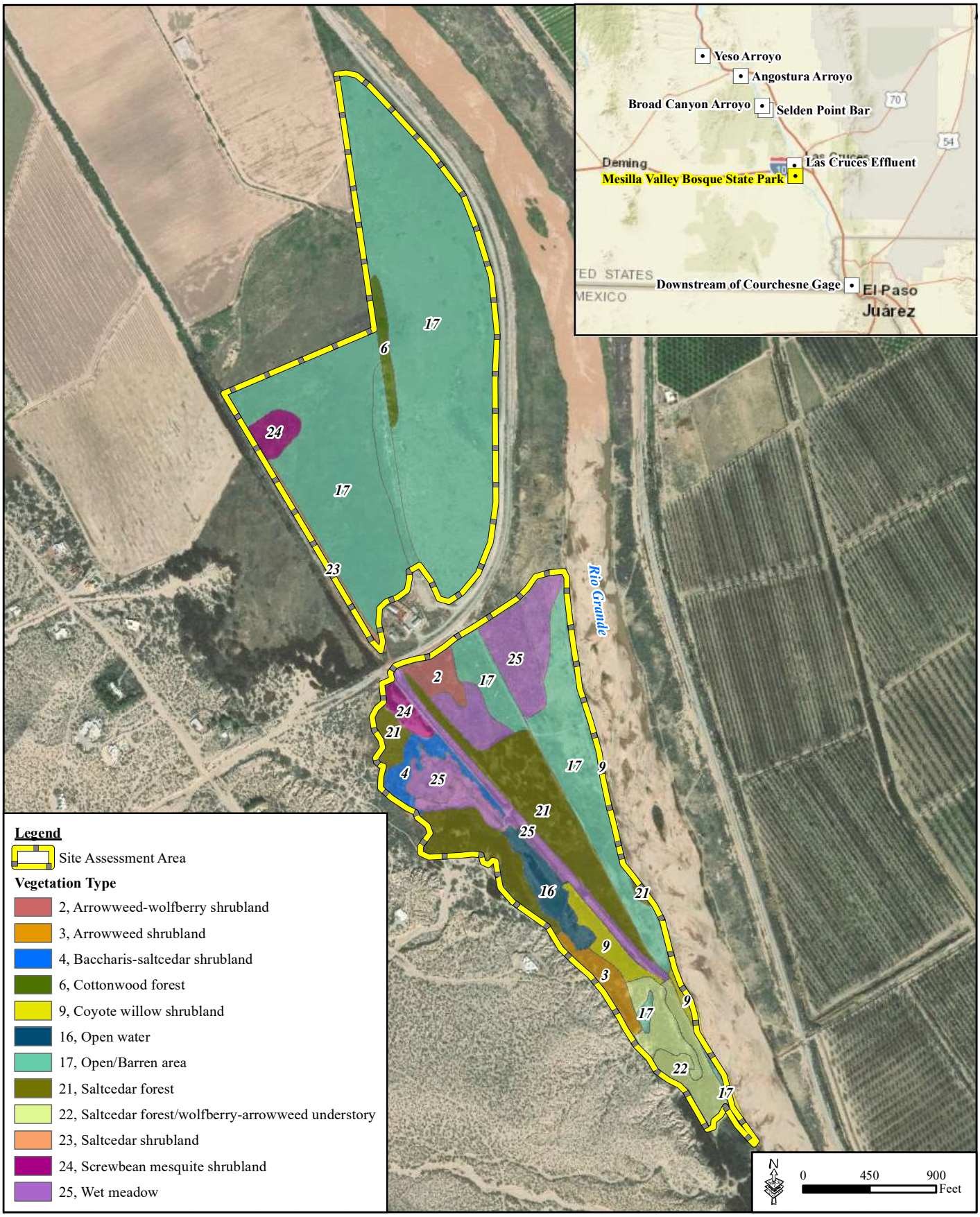

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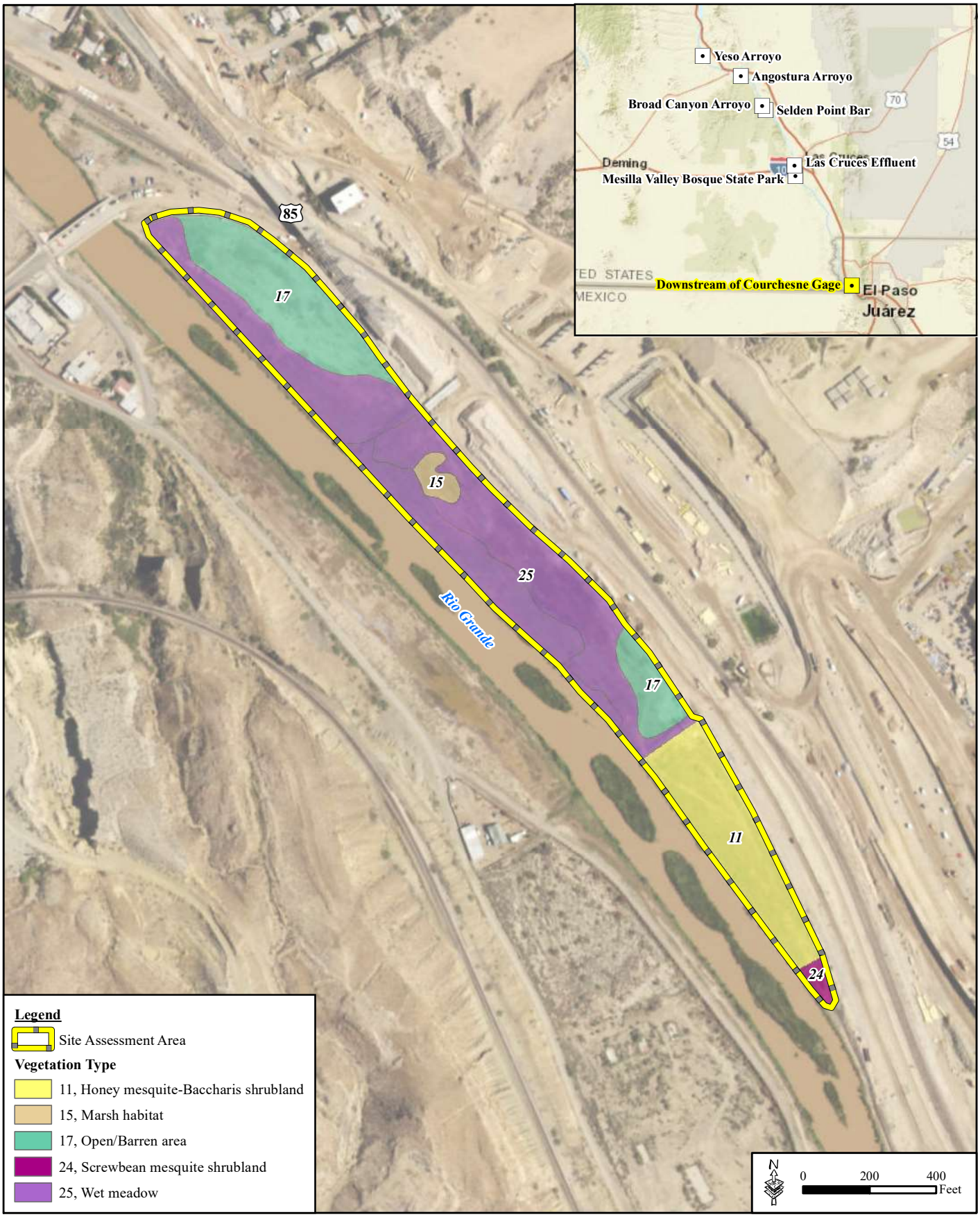

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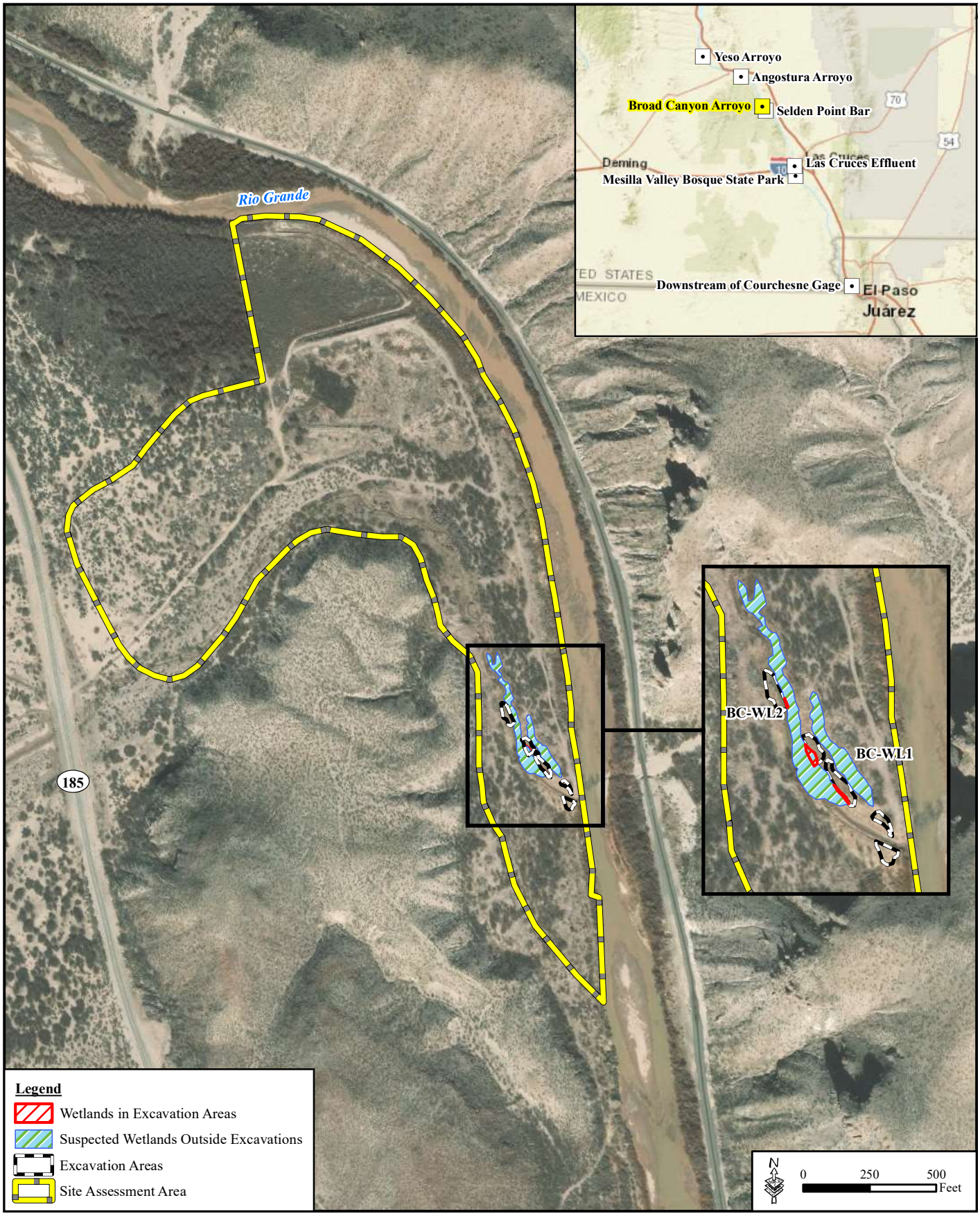

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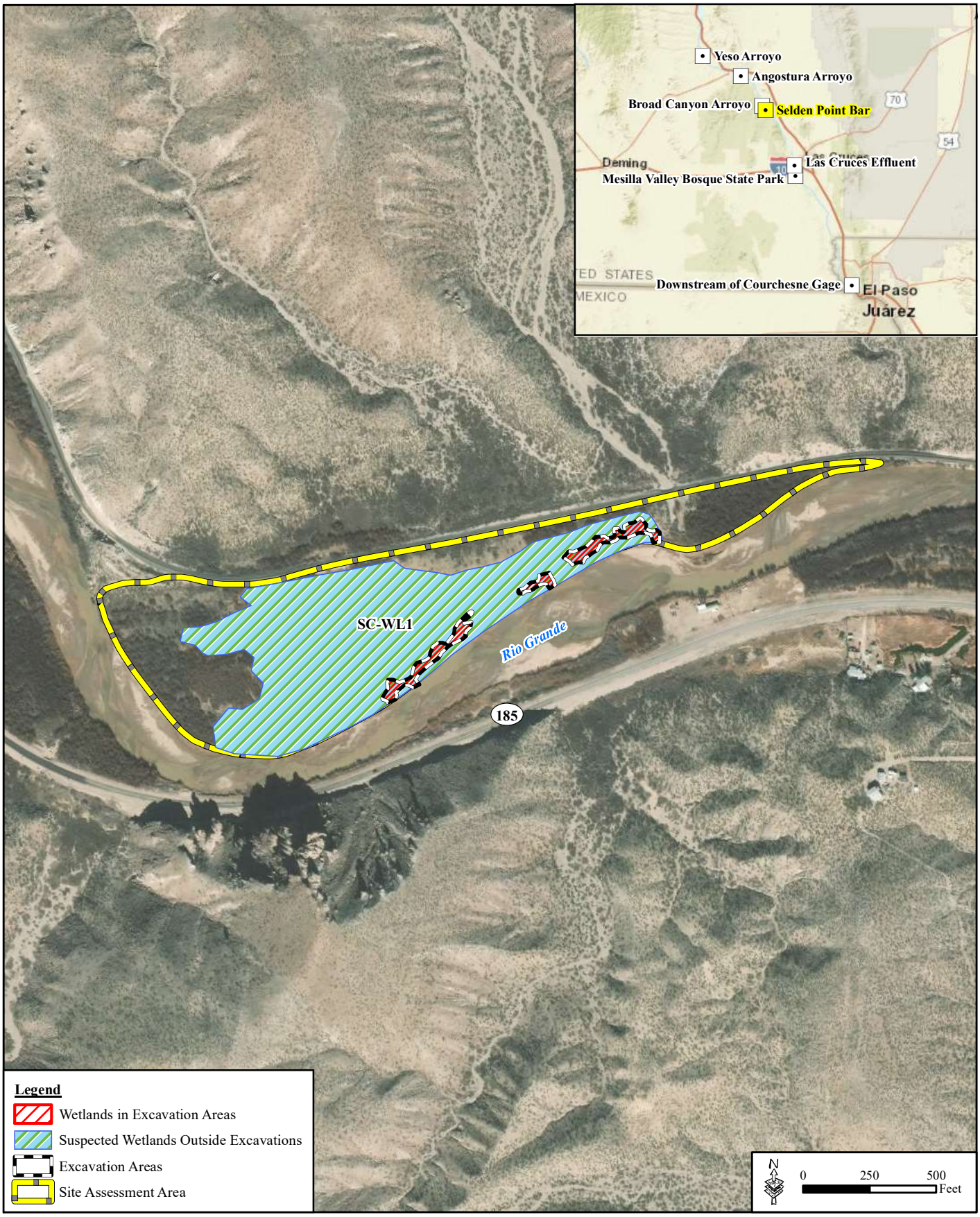

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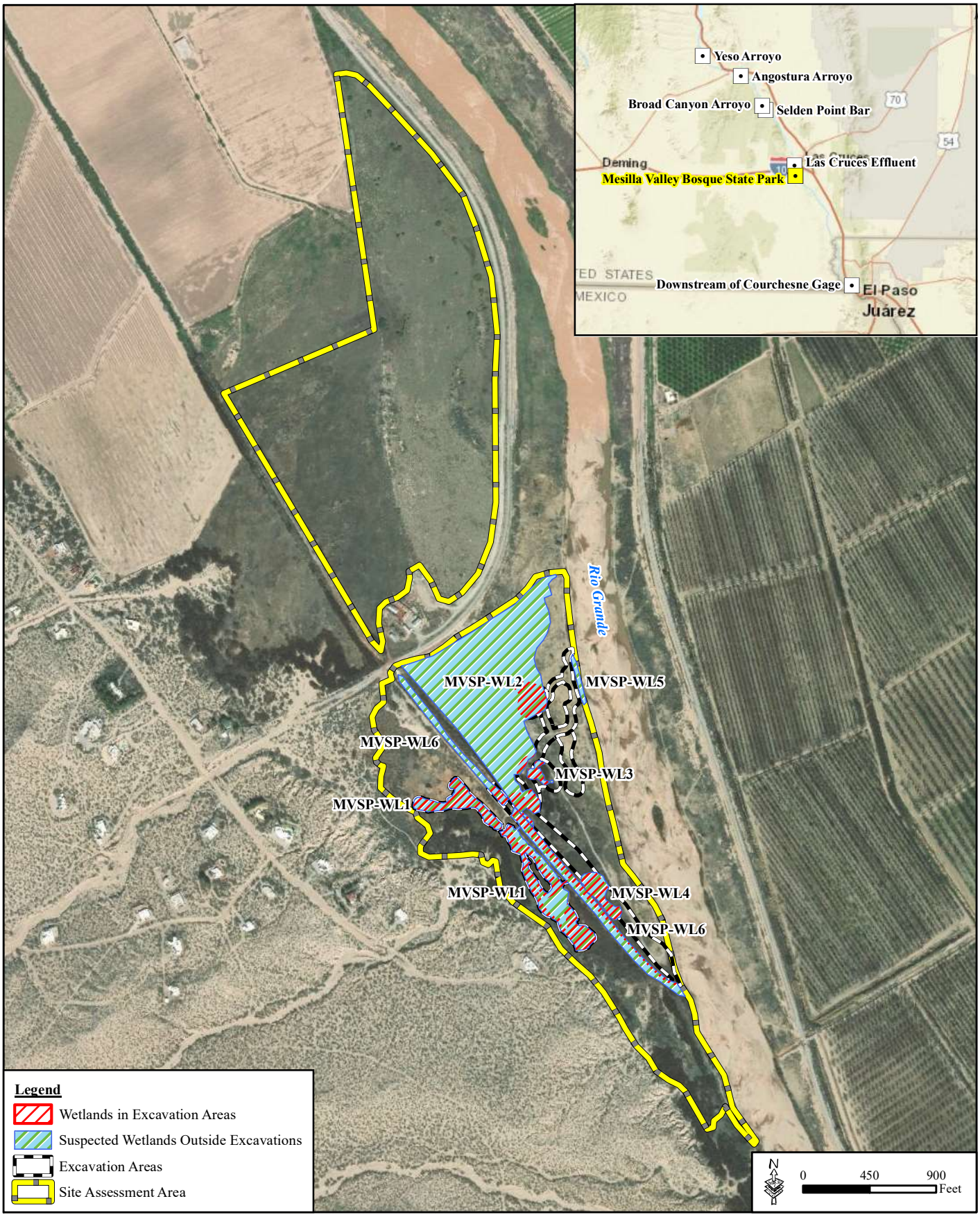

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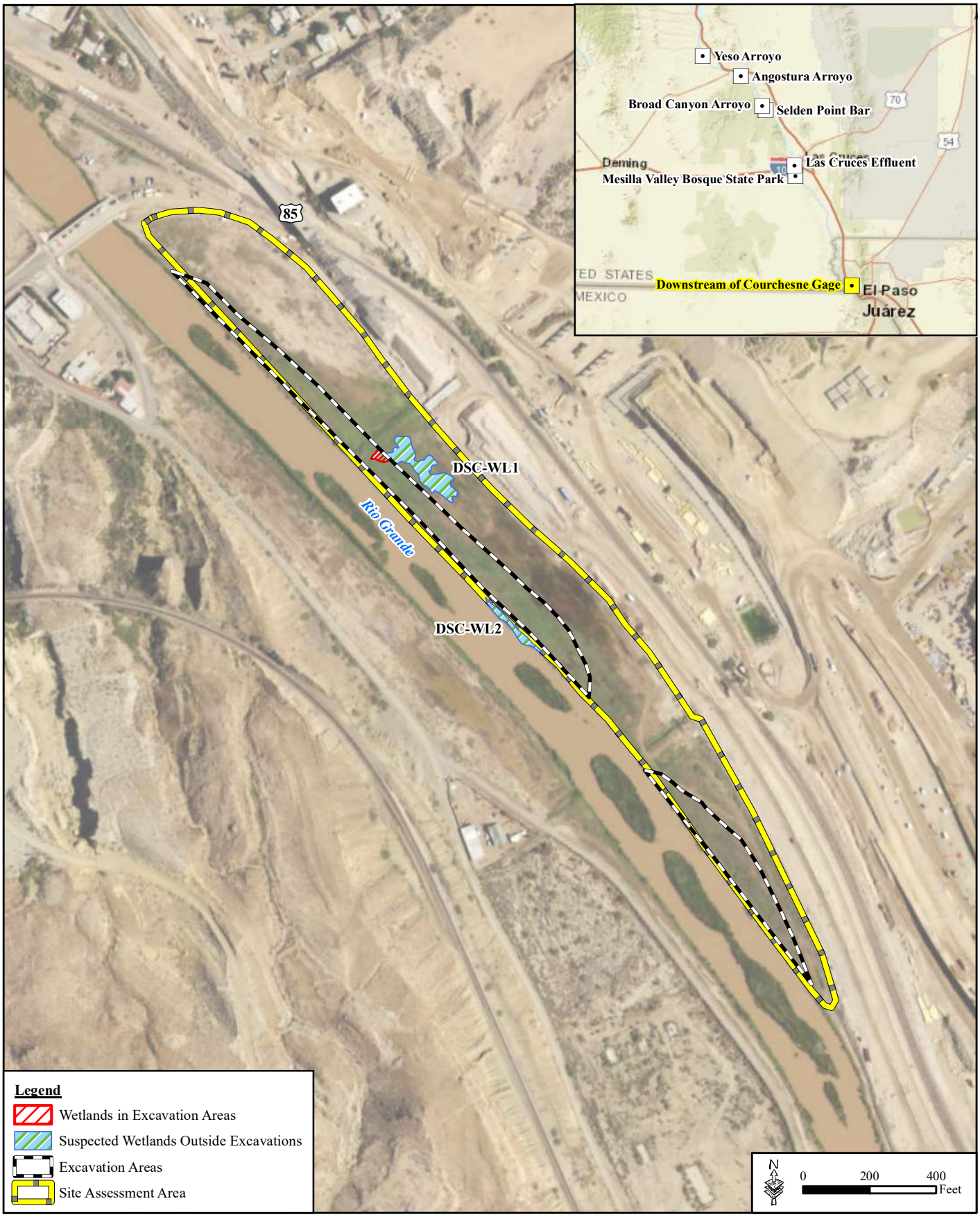

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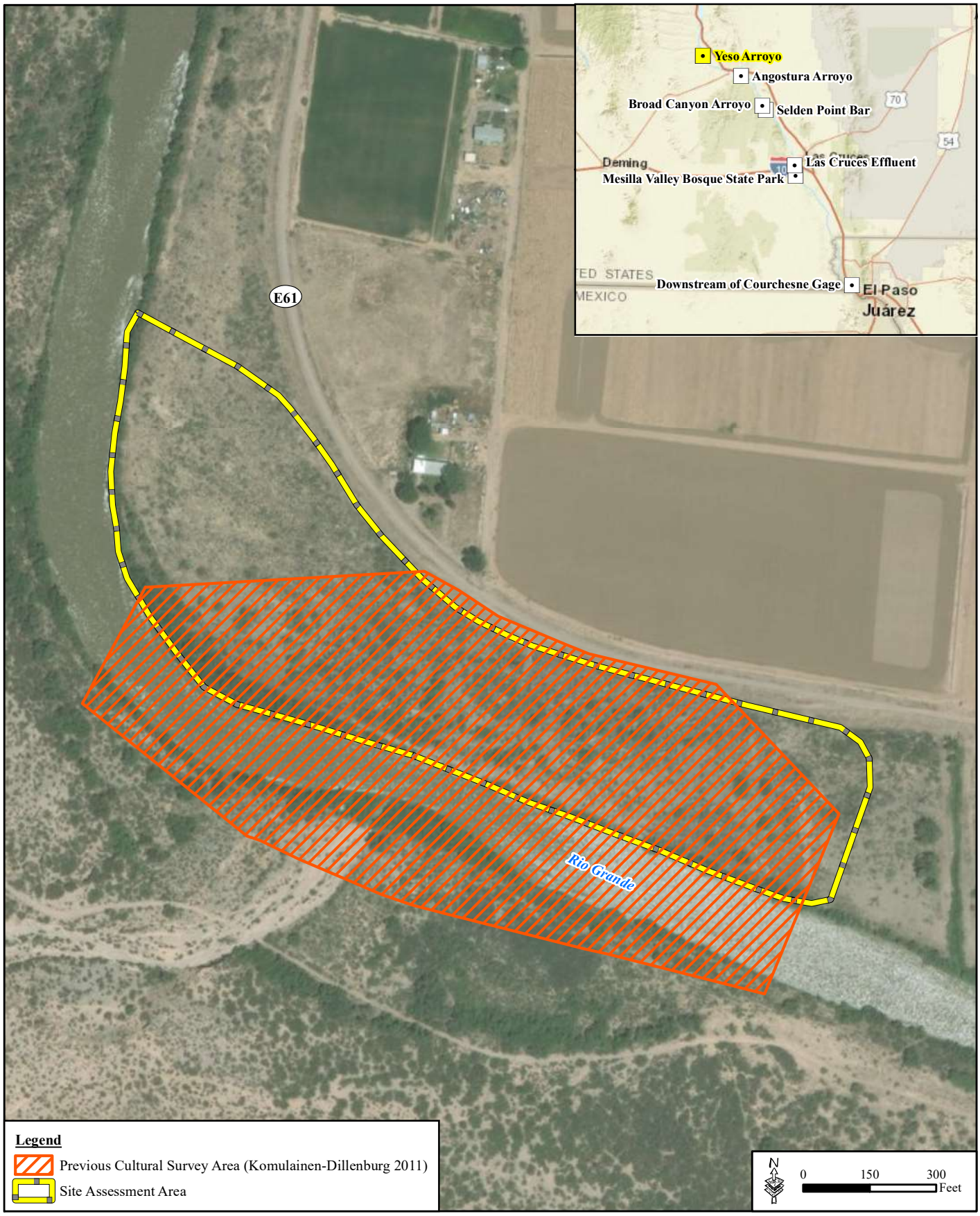

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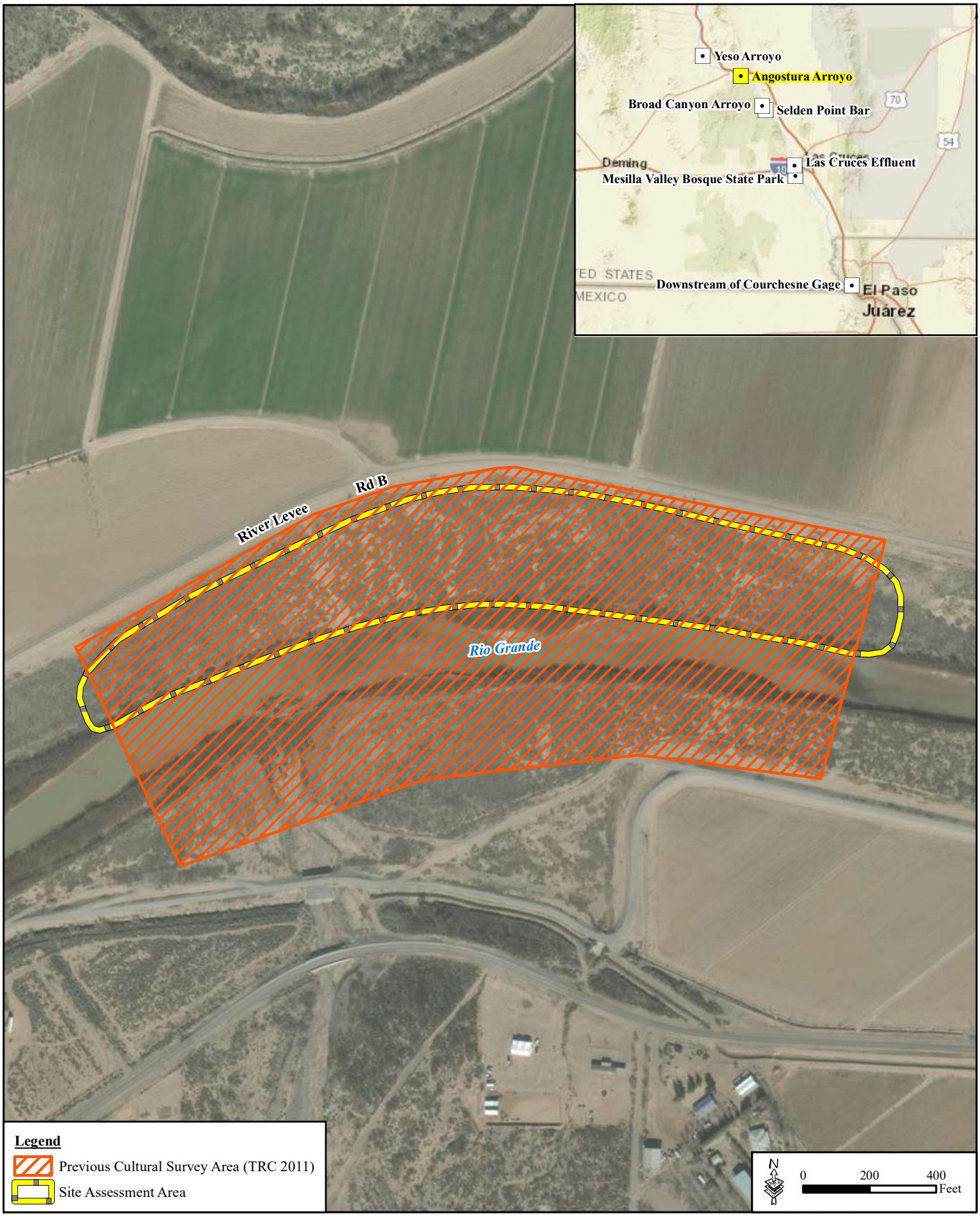

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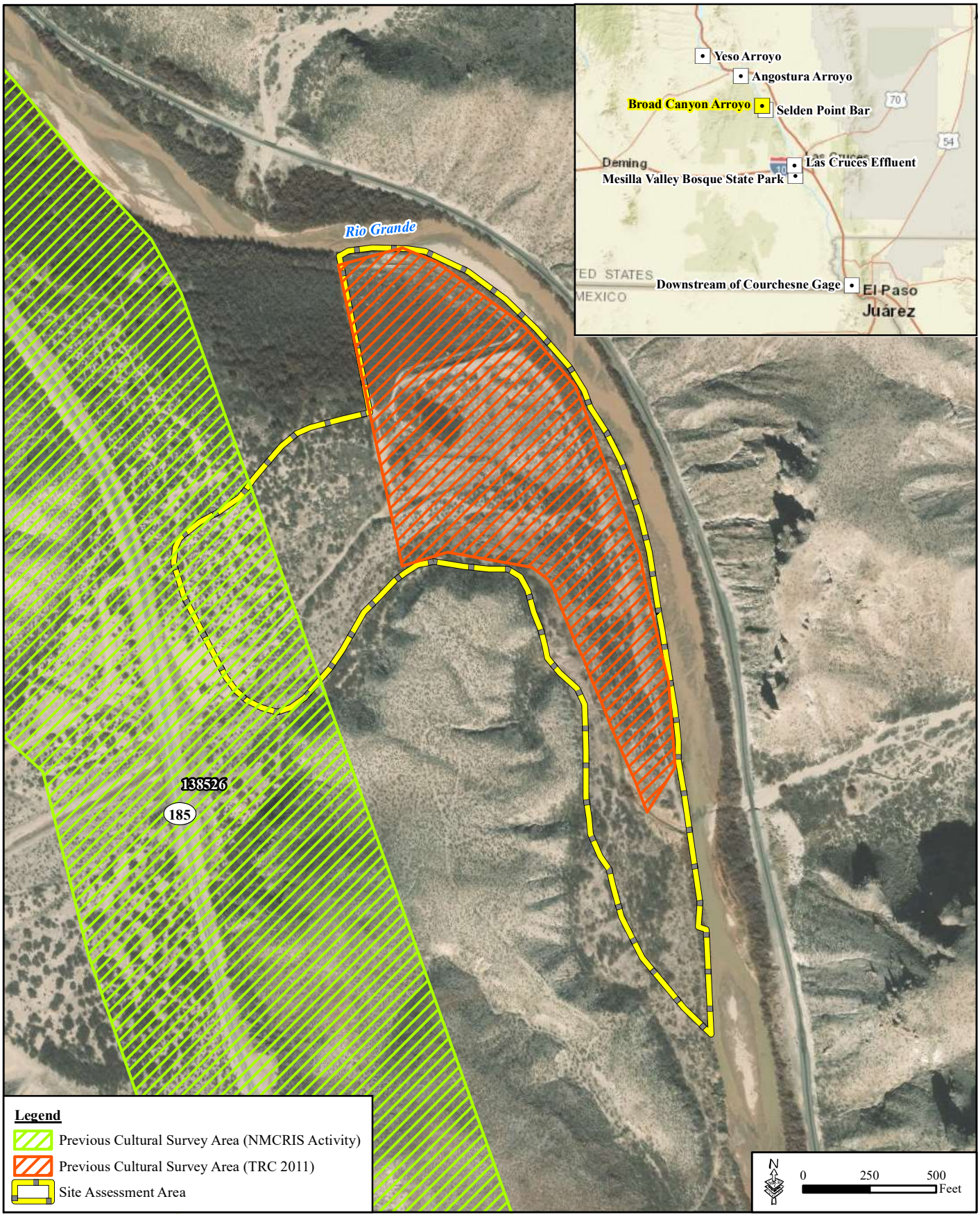

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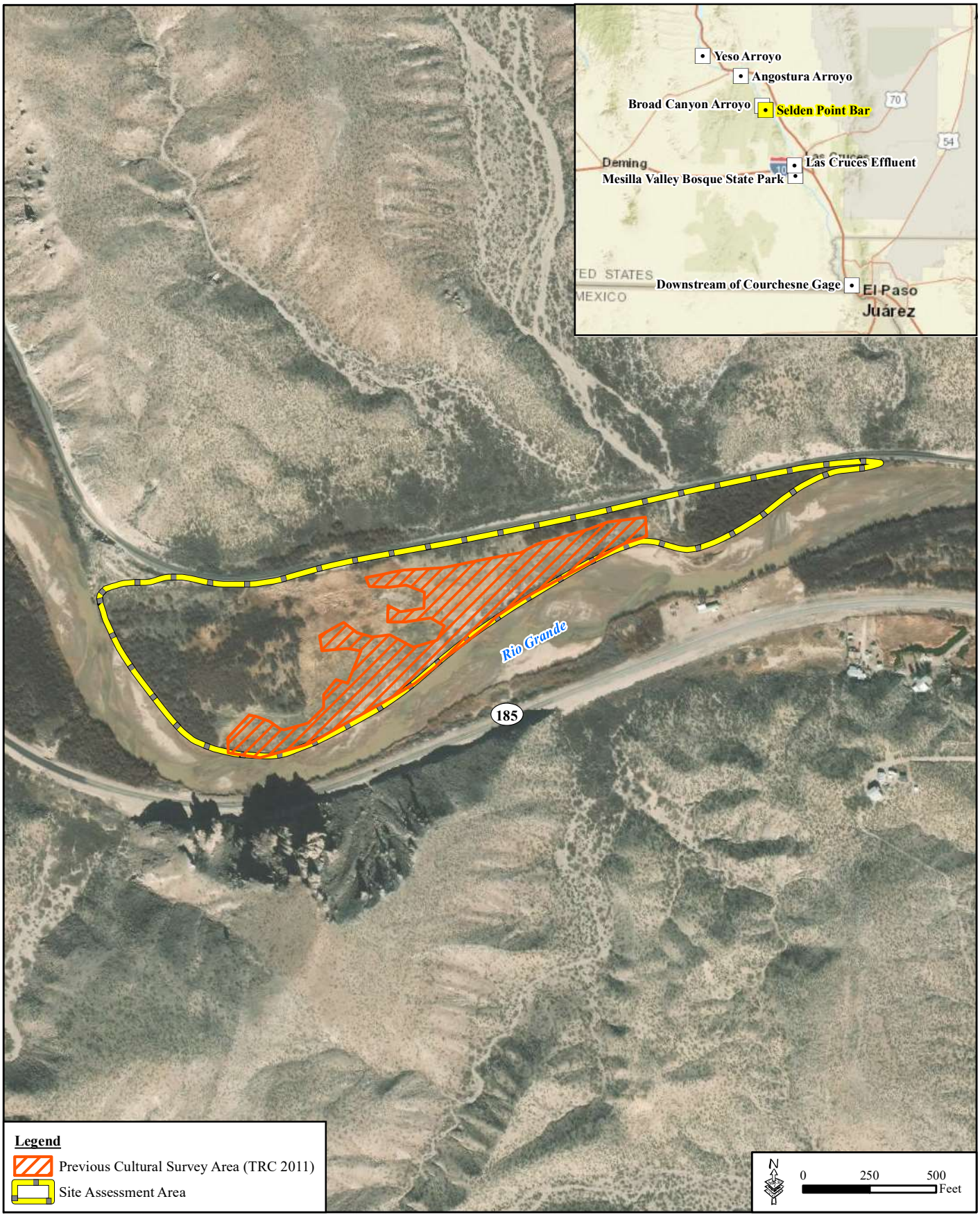

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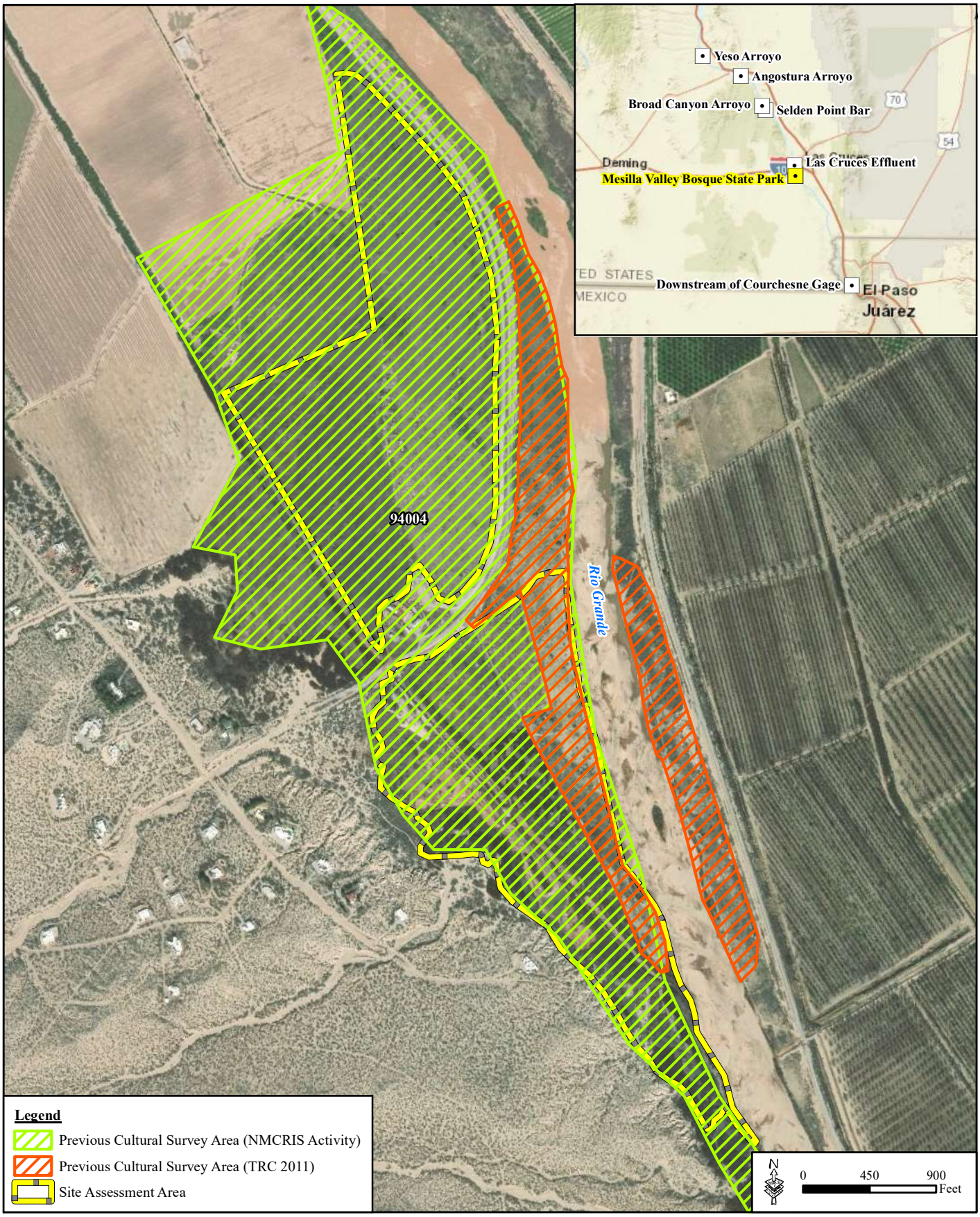

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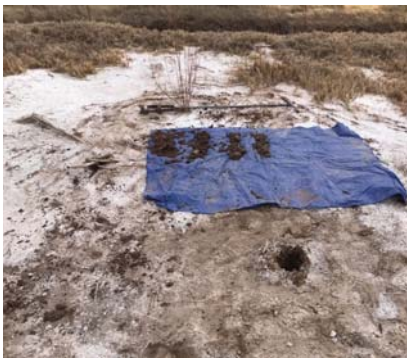

Rio Grande Canalization Project Aquatic Habitat Restoration Site Alternatives and Conceptual Designs

Prepared for:
United States Section
International Boundary &
Water Commission and Gulf
South Research Corporation

Prepared by:
GeoSystems Analysis
3150 Carlisle Blvd. NE,
Albuquerque, NM 87110
www.gsanalysis.com

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Name	Affiliation	Role
Chad McKenna	GeoSystems Analysis, Inc.	Ecologist/Geographic Information System (GIS) Analyst
Todd Caplan	GeoSystems Analysis, Inc.	Sr. Restoration Ecologist
David Propst	Consultant	Fisheries Scientist
Aayush Piya	GeoSystems Analysis, Inc,	Hydrologist
William Widener	GeoSystems Analysis, Inc,	Botanist
Howard Nass	Gulf South Research Corporation (GSRC)	Review
Elizabeth Verdecchia	United States International Boundary & Water Commission (USIBWC)	Review
Lee Forbes	SWCA	Review
Crystal Young	SWCA	Review

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1.0 INTRODUCTION AND BACKGROUND

Numerous modifications to optimize the Rio Grande in southern New Mexico (NM) and west Texas (TX) for irrigation delivery and to protect human life and property from catastrophic flooding have eroded the ecological integrity in the watershed. Elephant Butte Dam was completed in 1916. Then in the 1940's, the United States Section of the International Boundary and Water Commission (USIBWC) built the 105-mile-long Rio Grande Canalization Project (RGCP) from Percha Diversion Dam, Sierra County, NM through Dona Ana County, NM to American Dam in El Paso, El Paso County, TX. The RGCP facilitated "compliance with equitable allocation of water between the U.S. and Mexico under the U.S.-Mexico Convention of 1906 (Act of June 4, 1936, 49 Stat. 1463)" (USIBWC 2016).

The RGCP protects against a 100-year flood and assures water delivery to Mexico and U.S. users from Elephant Butte and Caballo Reservoirs upstream in NM. USIBWC was granted authority to construct, operate, and maintain the RGCP which straightened and entrenched the Rio Grande active channel, armored riverbanks, built flood-protection levees, removed floodplain vegetation, and has led to widespread river dewatering. These actions have ensured more consistent and predictable water delivery to Mexico and irrigators in the US, protected infrastructure from catastrophic flooding, and supported creation of a vast, diverse agricultural economy in southern NM and west TX; however, RGCP activities caused environmental and ecological damage.

Since construction, the RGCP has greatly reduced the distribution, frequency, and extent of valuable aquatic, riparian and wetland habitat, as well as, to federally-listed species including the Southwestern willow flycatcher (*Empidonax traillii extimus*), the yellow-billed cuckoo (*Coccyzus americanus*), and numerous aquatic species. A recent study estimates that one-half to two-thirds of native fish species diversity has been lost, virtually all the pre-dam aquatic habitat diversity destroyed, and native riparian forests are almost eliminated (Propst and Bixby 2018).

Historically, twenty-four fish species were potential inhabitants of this reach of the Rio Grande. Some were year-round residents while others occurred seasonally or when migrating up- or downstream. Based on surveys since the mid-1980s, 11 native species still occur there (Propst and Bixby 2018). Persistence of fishes in this reach is challenging because most of the river channel is seasonally dry. Those species that still occur do so because individuals find refuge by moving upstream to perennial river segments. Because of these extreme swings in habitat availability, quantity, and quality, the pool of potential colonizers of restored habitats is limited numerically and taxonomically. Potential colonizers are typically habitat "generalists" with broad environmental tolerances.

Environmental impacts were assessed in a 2009 USIBWC (2009) Environmental Impact Statement (EIS). The RGCP EIS evaluated four long-term Rio Grande management alternatives including: a) No Action, b) Flood Control Improvement, c) Integrated Land Management, and d) Targeted River Restoration. The EIS process strove to maintain flood control, water delivery, and operation and maintenance activities in a manner that could also benefit the river ecosystem. Following an 8-year EIS evaluation and stakeholder consultation process, USIBWC ultimately selected the Integrated Land Management Alternative and the Record of Decision (ROD) committed USIBWC to implement the selected alternative during the next 10 years (ending in 2019). The ROD also required that

USIBWC implement 30 conceptual restoration projects (which total about 550 acres) identified by the U.S. Army Corp of Engineers (USACE 2009) during this same 10-year time period (USIBWC 2016).

The ROD specifically authorized:

- Conversion of 1,983 acres to managed native grasslands;
- 553 acres of native riparian vegetation enhancement.
- Establishment of a minimum of 53 acres targeted for flycatcher habitat (dense riparian shrub habitat) by 2017 and up to 119 acres by 2019.

The first ROD implementation phase (2009 to 2014) included reach evaluations, pilot projects, and creation of an environmental water rights transaction framework. The second phase (2014 to 2019 focused on habitat restoration project design and construction (USIBWC 2016).

The Conceptual Restoration Plan and Cumulative Effects Analysis, Rio Grande—Caballo Dam to American Dam, New Mexico and Texas (”Conceptual Plan”) published by USACE (2009) via technical support contracts with Mussetter Engineering and Riada Engineering, identifies 30 potential habitat restoration project sites, recommends specific restoration techniques, and estimate project construction costs. Thus far, USIBWC has enhanced native riparian vegetation at a total of 22 sites spanning approximately 506 acres (E. Verdecchia, USIBWC, personal communication). Three aquatic habitat restoration sites (Angostura Arroyo, Yeso Arroyo, and Placitas Arroyo) are proposed in the Conceptual Plan but aquatic habitat restoration projects have not been constructed yet. Each of the three proposed aquatic habitat restoration sites is situated on the opposite side of the Rio Grande active channel from a major arroyo confluence and the conceptual design involves destabilizing the river banks to encourage river migration into the abandoned floodplain terrace. However, USIBWC and project stakeholders are concerned that (if constructed) these projects may adversely impact RGCP levees and increase flood risk for neighboring communities. Due to these concerns, USIBWC is currently evaluating the aquatic habitat restoration sites recommended in the Conceptual Plan against other potential aquatic restoration locations.

1.1 Scope of this Report

Under this project, GeoSystems Analysis, Inc. (GSA) was contracted as part of a Gulf South Research Corporation (GSRC)-led team to identify up to six aquatic habitat restoration project sites, develop conceptual designs, and provide key information that will enable GSRC to evaluate restoration site alternatives in an Environmental Assessment (EA). This report precedes the EA, which also evaluates a no action alternative. Of the six restoration sites identified through this process, USIBWC intends to select two projects for formal engineering design and construction during a later phase in this project.

The principle objectives for USIBWC-led habitat restoration projects in the canalization reach as stated in USIBWC 2016 and USACE 2009 include:

1) Reduce exotic vegetation,
2) enhance river-floodplain hydraulic connectivity,
3) enhance aquatic diversity,
4) restore riparian function and enhance natural riverine processes,
5) improve terrestrial wildlife habitat,

6) restore endangered species habitat, and
7) reestablish riparian habitat.

Per the project scope of work, USIBWC recommended the following restoration project site alternatives:

1) Las Cruces Effluent Site: wetland creation, fish passage structure, constructed channel and/or oxbow
2) Mesilla Valley Bosque State Park: deepen previously constructed oxbow pond (resaca) habitats, Picacho Drain modification, other excavated habitat features such as side channels
3) Broad Canyon Arroyo: enhancement of arroyo mouth
4) Conceptual Restoration Plan (USACE 2009) Arroyo Sites: bank destabilization at Yeso, Angostura, Placitas Arroyos
5) Plus, two additional sites to be determined by contractor.

A map showing the location of these project sites is presented in Figure 1.

Figure 1. Project area map showing locations of project sites under consideration.

* Red stars indicate sites removed during the conceptual design phase but evaluated in the field, green stars indicate sites with designs/alternatives still in consideration, blue stars mark sites discussed but not evaluated.

2.0 METHODS

Following a November 2018 site reconnaissance with USIBWC staff and stakeholders, and a November 9, 2018 scoping meeting with USIBWC, key stakeholders, other interested parties, and project consultants; GSA scientists completed site assessments at ten sites between January 6 and January 10, 2019. The specific sites assessed during this effort are presented in Table 1. Detailed descriptions of the assessment methodologies and results are described in the following subsections.

Table 1. Sites assessed in the field by GSA staff during January 2019.

Site	Location	Soils	Vegetation
Yeso Arroyo (Conceptual Plan Site)	Hatch, NM (32.737614, -107.28354)		X
Angostura Arroyo (Conceptual Plan Site)	Hatch, NM (32.65736, -107.095225)		X
Broad Canyon Arroyo	Radium Springs, NM (32.53325, -106.98412)	X	X
Selden Point Bar	Radium Springs, NM (32.518509, -106.968552)	X	X
Las Cruces Effluent Site	Las Cruces, NM (32.293155, -106.82351)	X	X
Mesilla Valley Bosque State Park	Mesilla, NM (32.24301, -106.81606)	X	X
NeMexas Siphon	Santa Teresa, NM (31.837603, -106.606335)	X	X
Montoya Intercepting Drain/EP Electric	El Paso, TX (31.803177, -106.549088)	X	X
Montoya Intercepting Drain	El Paso, TX (31.79963, -106.55679)		X
Downstream of Courchesne Gage	El Paso, TX (31.80262, -106.54139)	X	X

2.1 Vegetation Mapping

During fieldwork, GSA scientists divided potential habitat restoration sites into discreet “map units” and assigned representative vegetation types to each using a modified Hink and Ohmart (H&O) classification system (H & O 1984). H & O vegetation types are named based on dominant woody plant species in different canopy layers (i.e., “overstory” canopy exceeds 20 ft; “understory” canopy is less than 20 ft). When total canopy cover exceeds 25 percent in a canopy layer, the most dominant species (one or more) comprising that layer are used to name the vegetation type. Plant species names are abbreviated using letter codes, and the letter codes for dominant overstory and understory species are combined with a numerical code associated with the canopy structure (Figure 2).

The modified Hink and Ohmart classification system also provides suffix categories for describing non-woody vegetation types. For example, open water habitats, marsh habitats, and wet meadows are labeled as “OW”, “MH”, and “WM”, respectively. Open, barren areas that are sparsely vegetated by woody plants, lack an abundance of perennial grasses, and lack wetland herbaceous species are described as type “OP”, while grasslands are labeled as “G”.

Vegetation Community Naming Convention

OVERSTORY LAYER SPECIES	/	*UNDERSTORY LAYER SPECIES*	STRUCTURE TYPE
SPECIES(>=25%) - SPECIES(>=25%)	/	SPECIES(>=25%) - SPECIES(>=25%)	1-6

**Species in each layer listed in descending order of dominance

Plant Species Codes

Code	Common Name
ATX	Fourwing saltbush
AW	Arrowweed
B	Baccharis
BB	Burrobrush
C	Rio Grande cottonwood
CW	Coyote willow
EP	Ephedra/jointfir
HM	Honey mesquite
JW	Jimmyweed
SBM	Screwbean mesquite
SC	Saltcedar
WB	Wolfberry

Structure Types

Woody

Structure Type	Overstory Cover	Overstory Height	Understory Cover	Understory Height	Description
1	**>25%**	>40 feet	**>25%**	6-20 feet	Tall trees with dense understory
2	**>25%**	>40 feet	*<25%*	NA	Tall trees with sparse understory
3	**>25%**	20-40 feet	**>25%**	6-20 feet	Intermediate-sized trees with dense understory
4	**>25%**	20-40 feet	*<25%*	NA	Intermediate-sized trees with sparse understory
5	*<25%*	NA	**>25%**	6-20 feet	Dense shrubs
6	*<25%*	NA	**>25%**	<6 feet	Sparse shrubs

Non-Woody

G	Grassland
WM	Wet Meadow
MH	Marsh
OP	Open Area (often weedy)

Figure 2. Hink and Ohmart vegetation naming conventions applied to this project.

For the purpose of presenting data in this report, H&O vegetation communities were simplified into more general vegetation types, but electronic Geographic Information System (GIS) data delivered during this project, indicate the actual H&O type assigned at each map unit. In addition to ascribing a H&O vegetation type, the project botanist listed dominant herbaceous species as well as noxious weeds observed in each map unit. A list of all species observed during our site assessments is provided in Appendix C. In some instances where the conceptual design was expected to target very specific field locations (like the resaca ponds at Mesilla Valley State Park, barren patches at Selden Point Bar, and the mouth of Broad Canyon arroyo) due to degradation or another unique circumstance, sub-meter GPS was utilized to delineate a location with high accuracy.

2.2 Soil Assessment

Soil texture data were collected during January 2019 from numerous sampling locations strategically targeted within potential aquatic habitat restoration sites. The goal was to assess soil texture similarities and differences across a range of vegetation and other site conditions to aid future site restoration and revegetation planning efforts. The number of samples varied by site depending on vegetation diversity, design concept under consideration, and other factors including field efficiency. At each sampling location, representative photographs were recorded and then a hand auger was used to bore a hole to the alluvial groundwater table (except where buried rock prevented the auger

from reaching the water table). Soil cores were extracted from the auger hole in 1-foot increments and placed on a tarp. Each 1-foot increment was subdivided on the tarp based upon differences in textural characteristics. Soil textures were assessed using the "hand-feel" method described in Brady (2008). Soil textures were recorded for each discreet soil layer using the following USDA soil texture classes (Brady 2008):

- Sand (Sa)
- Loamy sand (LS)
- Sandy loam (SaL)
- Silt loam (SiL)
- Loam (L)
- Sandy clay loam (SaCL)
- Silty clay loam (SiCL)
- Clay loam (CL)
- Sandy clay (SaC)
- Silty clay (SiC)
- Clay (C)

Additional information recorded at each bore hole included notes regarding notable changes with depth in soil moisture, presence of visible salt concentrations, iron reduction-oxidation observations ("mottling"), and gleying. Bore hole observations are presented in the Results section of this report.

2.3 Hydraulic Modeling and River Flow Assessment

GSA obtained and ran simulation results produced by calibrated and validated hydraulic models (HEC-RAS) developed in support of a 2014 RGCP channel seepage and water budget study (Tetra Tech 2014). The steady state HEC-RAS model had been calibrated by Tetra Tech to align with 2011 Light Detection and Ranging (LiDAR) topographic data and adjusted in channel segments that were underwater when the LiDAR topography data were originally captured. Modeled discharges range from 10 to 6,000 cfs, 100-year discharge, plus ineffective flow areas (see Tetra Tech 2014 for more specific information regarding the hydraulic model). HEC-RAS simulation results were extrapolated to predict water surface elevations (WSE) from a variety of discharges contained in the steady state iteration of the 2014 model and used to determine excavation targets for conceptual designs and earthwork quantities published in this report.

Streamflow information was obtained at the Rio Grande below Leasburg Dam, Rio Grande at Hayner's Bridge, and Rio Grande at Mesilla Dam sites from USIBWC published datasets which include provisional data (https://waterdata.ibwc.gov/). These three gages were selected due to their proximity to the study sites. Published streamflow data from the USIBWC website date back to 2003 at Hayner's Bridge and 2011 at Leasburg Dam and Mesilla Dam while historical data are also available for many of the gages. As requested during the project scoping meeting, we compared flow duration for two periods (2003 to 2009 and 2010 to 2018) at the Hayner's Bridge site to ensure conceptual designs account for drought conditions over the past decade (Figure 3). A flow duration curve (Figure 4) was also developed for the entire period of record available at the Leasburg Dam and Mesilla Dam sites (2011 to 2018) via data downloaded from the USIBWC streamflow website.

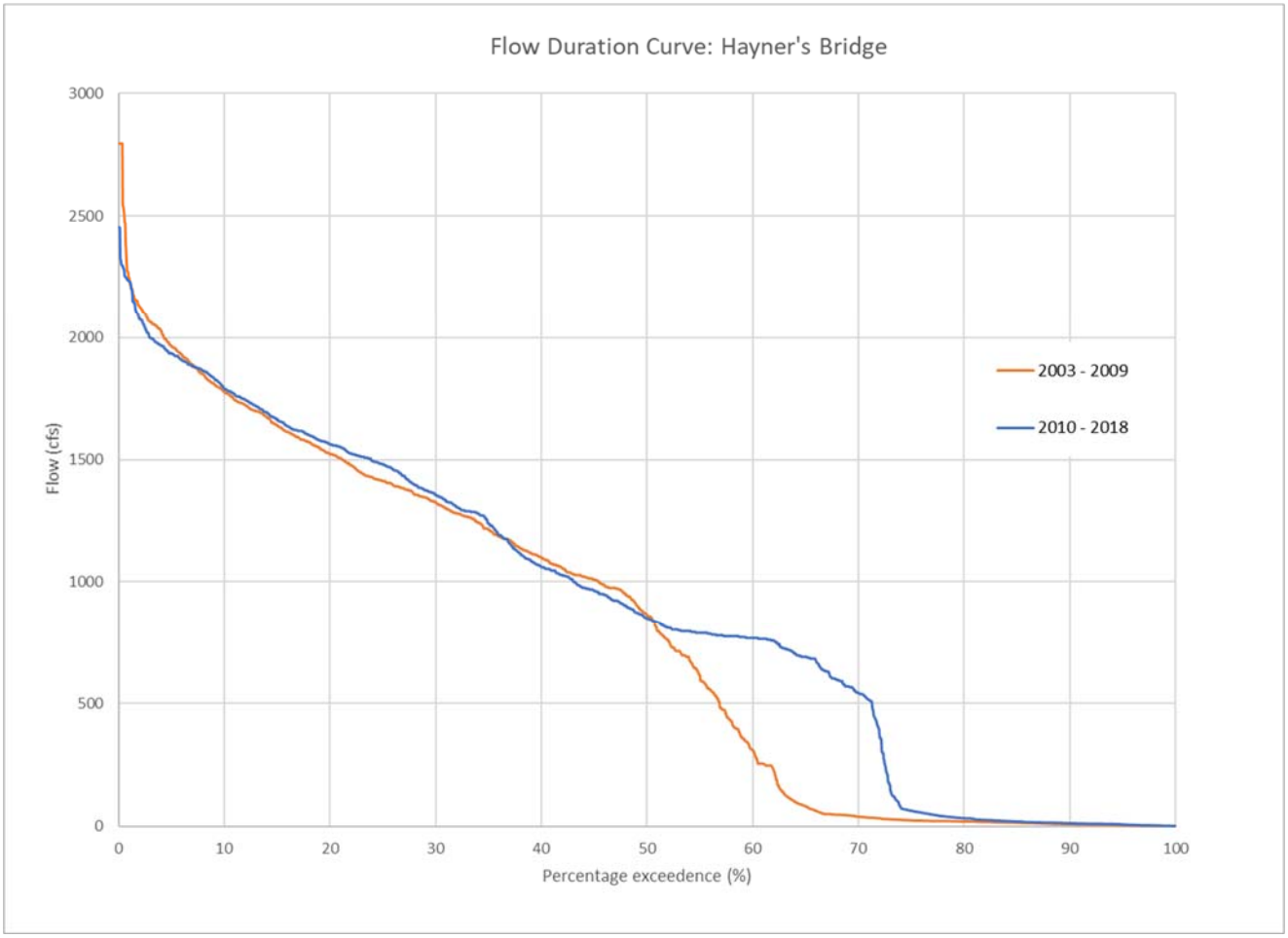


Figure 3. Flow duration curves at Hayner's Bridge Gage for two periods: 2003 to 2009 and 2010 to 2018.

Analysis at Hayner's Bridge (about 10 miles south of Hatch, NM) revealed that streamflow was very similar for 50% of the year during the past decade compared to the decade prior (Figure 3). However, at 60% exceedance, discharge increased by 150% during 2010-2018 compared to 2003-2009 (Table 2). Flows continued to be substantially higher at 75% and 90% exceedance since 2010. Comparably, between 2011-2018, the 50% exceedance discharge was 618 cubic feet per second (cfs) at Leasburg Dam (near Radium Springs, NM) while 60% exceedance was 320 cfs (Figure 4). Downstream at the Mesilla Dam gage, which lies below the Las Cruces sites, 50% exceedance discharge was 388 cfs while 60% exceedance was 196 cfs (Figure 5).

Table 2. Comparison of the discharge (cfs) relative to percent exceedance at the Hayner's Bridge Gage for two periods: 2003 to 2009 and 2010 to 2018.

	Percent Exceedance				
	25%	**50%**	**60%**	**75%**	**90%**
Period	**Discharge (cfs)**				
2003 to 2009	1,413	862	307	24	8
2010 to 2018	1,480	848	766	63	12
Percent Difference	5%	-2%	150%	163%	55%

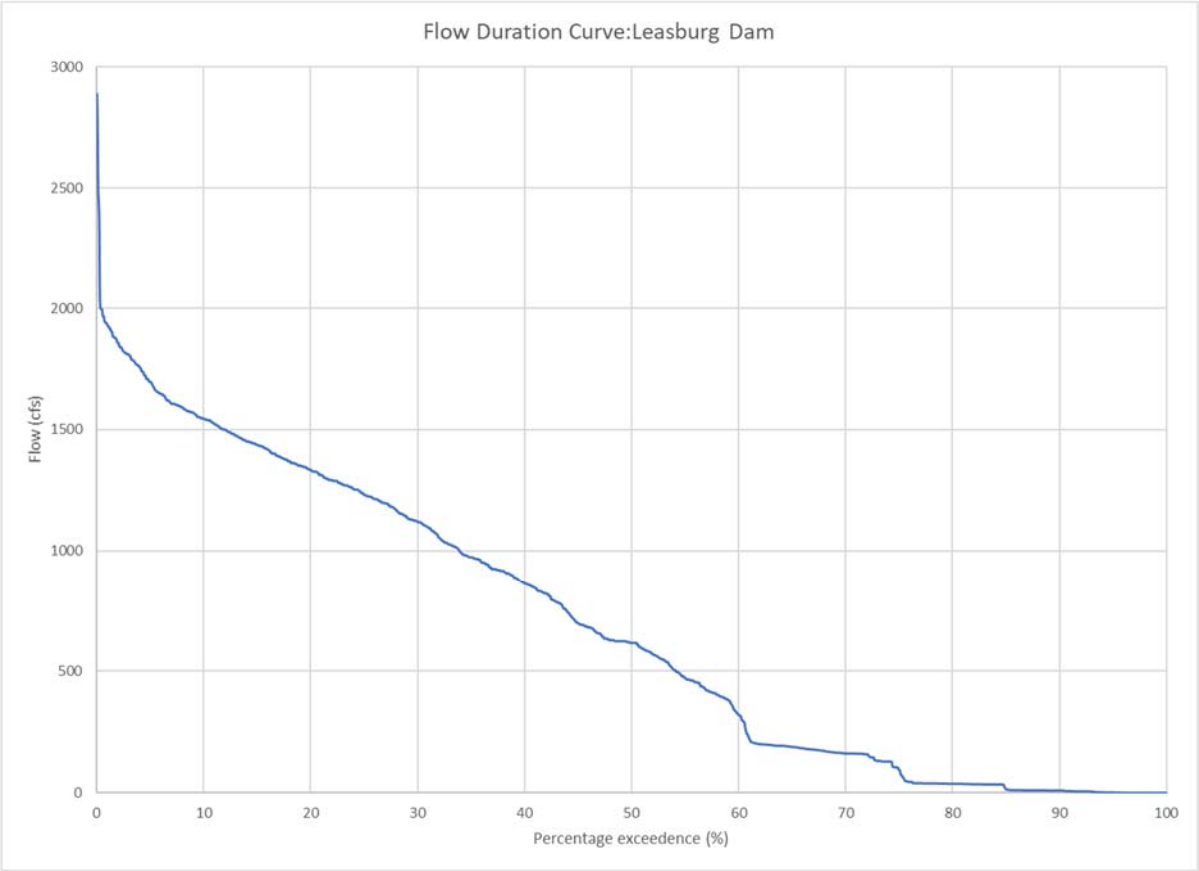


Figure 4. Flow duration curve at the Leasburg Dam Gage from 2011 to 2018.

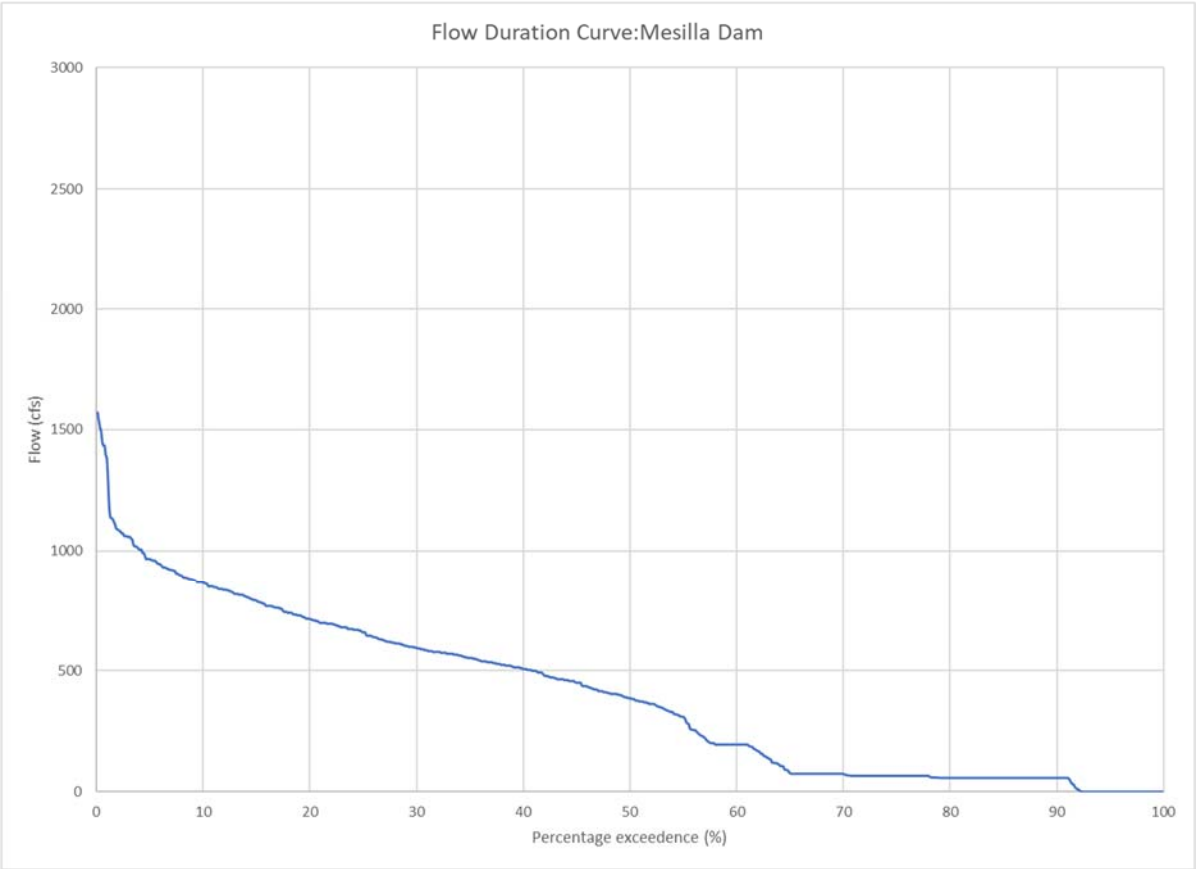


Figure 5. Flow duration curve at the Mesilla Dam gage from 2011 to 2018.

2.4 LiDAR Processing

GSA staff mosaicked individual 2011 LiDAR tiles (provided by USIBWC) into a single grid using Blue Marble Geographics Global Mapper software. The mosaicked 2011 LiDAR grid was then used as a basis for characterizing floodplain topography. Fluctuations in floodplain terrain were calculated by differencing the ground elevation in the floodplain from what appeared to be dry segments of the channel bed with a combination of analysis techniques that include virtual cross section draping, interpolation, and raster algebra. The resulting topographic grid predicts the height above or below the adjacent riverbed (in perpendicular cross section) for each grid cell in the floodplain. This process is particularly useful for extracting relatively low versus high spots in the floodplain from a LiDAR dataset that can otherwise be difficult to display or interpret (Appendix B). The results were also used to stage various restoration features recommended in this report and predict project excavation quantities.

2.5 Evapotranspiration Evaluation

Evapotranspiration (ET) is a process that accounts for movement of water from the land surface to the air via evaporation off standing water and soil plus transpiration by plants. GSA determined the net change in annual water depletion at each restoration site alternative following a similar method as the Conceptual Plan (USACE 2009). Estimates of consumptive use for various vegetation

communities published in USACE (2009) were supplemented with ET rates contained in other regional riparian/wetland planning documents (e.g. Multi-Species Conservation Plan [MSCP] 2004) when current or predicted future plant communities were not published in the Conceptual Plan.

ET rates used during this process include (adapted from USACE 2009 and MSCP 2004):

- Dense shrubs: 4.9 ft/yr
- Riparian forest: 4.8 ft/yr
- Riparian woodland: 3.4 ft/yr
- Grassland (including saltgrass meadows): 2.4 ft/yr
- Marsh: 5.8 ft/yr

We differenced existing ET rate for pre-restoration plant communities (per current vegetation mapping unless saltcedar removal previously occurred) and predicted optimal restored habitat type to calculate the predicted change in consumptive use attributed to habitat restoration activities. Net depletion volume for each site was then calculated in GIS software by multiplying ft/yr by the total acreage of each map unit. Several sites contained dense saltcedar prior to implementing previous exotic species management projects. At these locations (Broad Canyon, Selden Canyon, Mesilla Valley, and Downstream of Courchesne), a dense saltcedar shrubland was used as the baseline (pre-restoration) condition and we assume that dense saltcedar recolonization will be prevented during ongoing maintenance. Results are included in Table 11.

3.0 SITE CHARACTERIZATION AND CONCEPTUAL DESIGNS

The vegetation, soils, topography and hydrology evaluations described above were combined with restoration recommendations developed by others (USACE 2009, Propst and Bixby 2018, etc.) to develop conceptual restoration designs. The following subsections discuss results and recommendations using these combined sources.

3.1 Yeso Arroyo

The Yeso Arroyo project site is located near river mile (RM) 94 and is the northernmost site alternative addressed in this report. The Yeso Arroyo site is characterized by an elevated floodplain terrace located immediately across the arroyo confluence with the Rio Grande (Figure 6). Yeso arroyo is free flowing and contains no sediment control dams or lesser retention structures. The bankline across from the confluence is very steep, and USIBWC had historically placed large rip-rap along the toe of the bankline to minimize potential for channel migration towards a non-engineered levee on the northeast side of the river. USIBWC has also historically dredged the river channel in this location to maintain channel conveyance capacity and gradient. Rio Grande flows appear persistent, possibly perennial in this reach.

This site was one of three aquatic restoration sites (along with Angostura Arroyo and Placitas Arroyo) proposed in the Conceptual Plan (USACE 2009). The design in that report proposed destabilizing the bankline across from the arroyo mouth by removing the riprap and vegetation from the bankline toe so that channel forming discharge in the Rio Grande could gradually erode the bank, increase channel sinuosity and improve habitat complexity for native fish. The riprap removed

from the bankline would be used to reinforce the levee along the edge of the elevated floodplain terrace.

Site Assessment

Three vegetation map units were documented at the site (Figure 6). Non-native saltcedar (*Tamarix chinensis*) dominates the length of the bankline slope throughout the site. Honey mesquite (*Prosopis glandulosa*) is a co-dominant with saltcedar along the bankline in southern (downstream) segment of the site, while coyote willow (*Salix exigua*) is a co-dominant with saltcedar in the upstream segment. Additional woody plant species growing along the bankline slope includes willow baccharis (*Baccharis salicina*), fourwing saltbush (*Atriplex canescens*), Rio Grande cottonwood (*Populus deltoides*), wolfberry (*Lycium torreyi*), whitethorn acacia (*Acacia constricta*), prickly pear (*Opuntia phaeacantha*), arrowweed (*Pluchea serecia*), and feather plume (*Dalea formosa*). Scratchgrass (*Muhlenbergia asperifolia*) was the most common grass species observed on the bankline. Other grasses observed included Canada wildrye (*Elymus canadensis*), spike dropseed (*Sporobolus contractus*), sideoats grama (*Bouteloua curtipendula*), Bermuda grass (*Cynodon dactylon*), and bromes (*Bromus* sp.). Dominant forbs along the bankline slope included Russian thistle (*Salsola tragus*), velvetweed (*Oenothera curtiflora*), *Mentzelia* sp., globemallow (*Sphaeralcea* sp.), and fringed twinevine (*Funastrum cynachoides*). Two giant cane (*Arundo donax*) tussocks, a Class C noxious weed in NM (NMDA 2016), colonized the sloped bankline.

The elevated floodplain terrace above the bankline slope is currently dominated by Jimmyweed (*Isocoma pluriflora*), a native shrub (Figure 7). Other woody species documented on the floodplain terrace include saltcedar, honey mesquite, arrowweed, prickly pear, fourwing saltbush, whitethorn acacia, indigobush (*Psorothanmus scoparius*), and longleaf jointfir (*Ephedra trifurca*). The herbaceous layer is dominated by spike dropseed with interstices filled by winter annuals including redstem filaree (Erodium cicutarium), tansymustard (*Descuriania pinnata*), and annual Townsend daisy (*Townsendia annua*). Desert marigold (*Baileya multiradiata*), tansyaster (*Machaeranthera tanacetifolia*) globemallow, spectacle pod (*Dimorphocarpa wislizeni*), (*Schismus* sp.), silverleaf nightshade (*Solanum elaeagnifolium*), Lehmann lovegrass (*Eragrostis lehmanniana*) Russian thistle, bush muhly (*Muhlenbergia porteri*), twinpod (*Physaria* sp), needle grama (*Bouteloua aristidoides*) and woollygrass (*Dasyochloa pulchella*).

Field observations from the January 2019 site assessment found the riverbed contains a large quantity of 3- to 6-inch rock deposited immediately downstream of the Yeso Arroyo confluence, with some rocks as large as 12 to 18 inches. Yeso Arroyo was approximately 50 feet wide near the mouth and was also dominated by coarse substrate. Hydraulic modeling indicates that flows on the order of 6,000 cubic feet per second (cfs) would be required to crest surface of the elevated floodplain terrace. Under current conditions, therefore, river flows would only wet the floodplain terrace at the 100-year peak discharge (Figure 8). LiDAR data indicate that most of the floodplain terrace at the site is elevated 8 to 11 feet higher than the adjacent riverbed. Accordingly, no soil augering was performed during the recent site assessment.

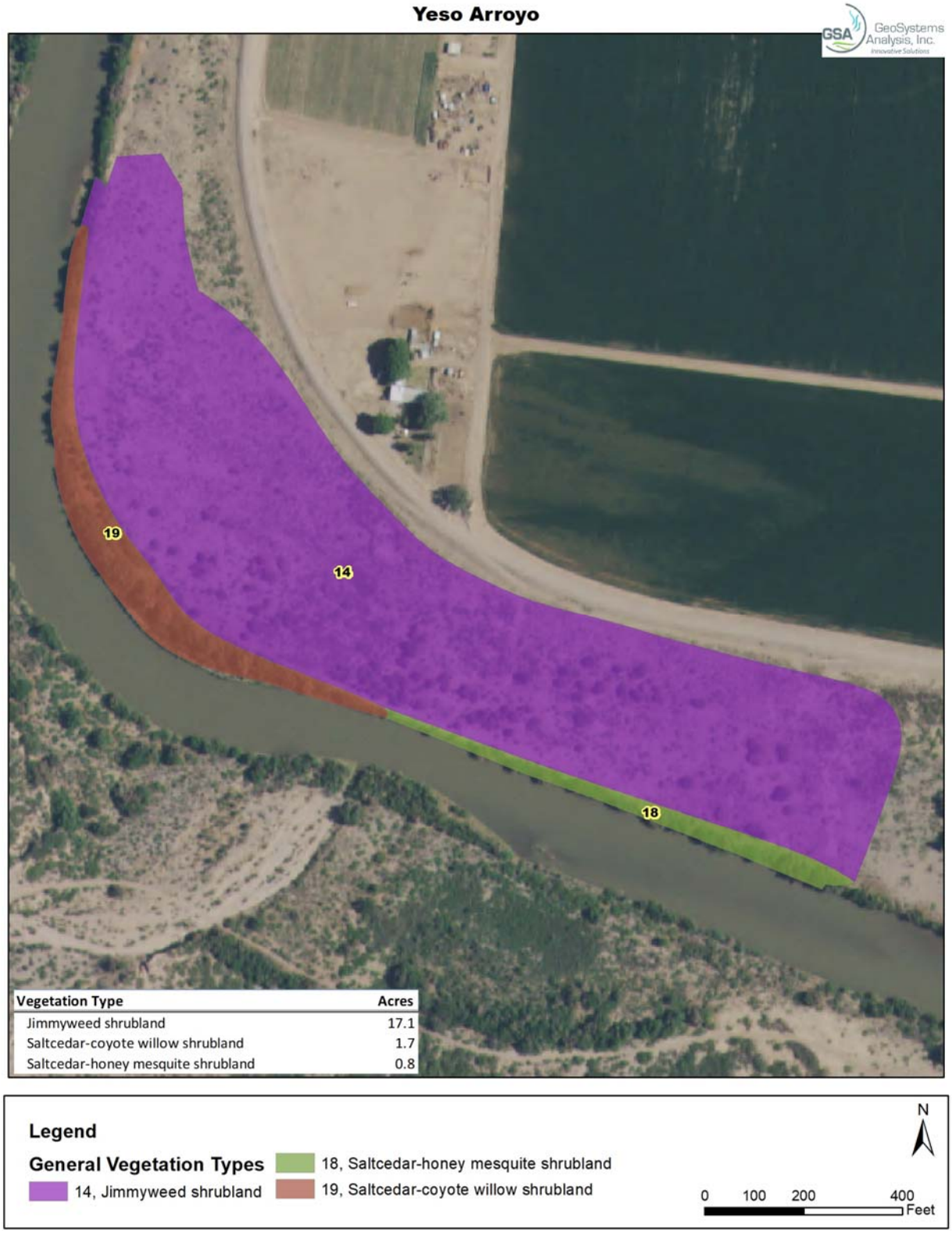


Figure 6. Yeso Arroyo vegetation map

Figure 7. Representative photos of the Yeso Arroyo site. Top photo: typical vegetation conditions on the elevated floodplain terrace. Bottom left: riprap on toe of bank. Bottom right: bed conditions in the Rio Grande near the site.

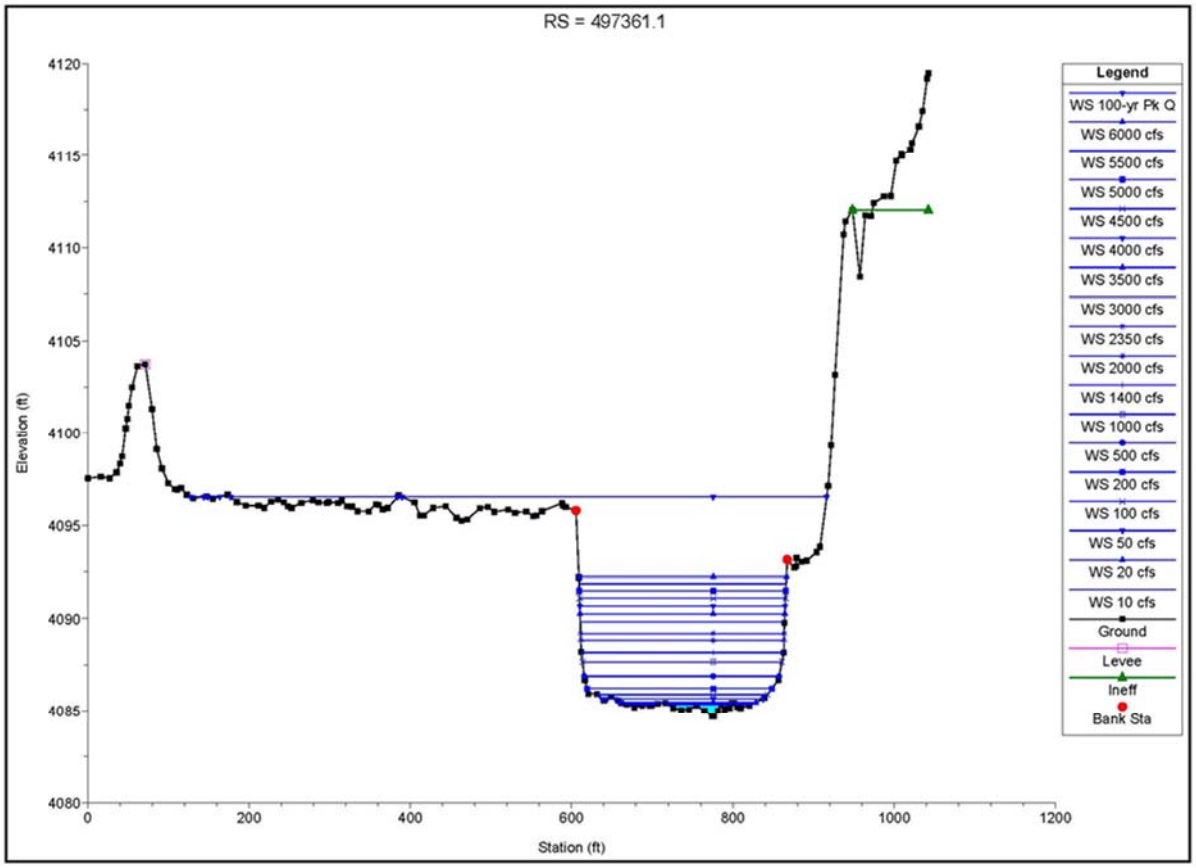


Figure 8. Representative channel cross-section of Rio Grande at Yeso Arroyo site showing predicted surface-water elevations under a range of discharges.

Conceptual Design

The conceptual design in this report for the Yeso Arroyo site (Figure 9 & Figure 11) includes modifying the slope of the existing steep bankline terrace by creating a series of terraced benches capable of experiencing overbank flood inundation at a range of low to moderate discharge levels (e.g., 800-2,500 cfs). The terrace benches would be planted with native riparian vegetation that could provide nesting, roosting and feeding substrate for bird species and, when inundated, habitat for native fishes. Lower bench surfaces should be actively revegetated with a diverse assemblage of wetland herbs while upper terrace surfaces should be targeted for revegetation with native woody plant species.

Bankline terracing will provide wetted, variable and sometimes low-velocity habitat when local Rio Grande discharge exceeds 800 cfs. The most likely users of such a habitat are red shiner (*Cyprinella lutrensis*) and fathead minnow (*Pimephales promelas*). Their primary use would be feeding on small aquatic macroinvertebrates. If water velocities were slow to moderate, western mosquitofish

(*Gambusia affinis*) might also feed and potentially spawn. Channel catfish (*Ictalurus punctatus*) might move through it in search of macroinvertebrate and fish prey. Pulsing flows over the lowered terrace would transport organic debris into the river channel thereby increasing its nutrient base.

The conceptual design elements include:

- Removing saltcedar and other non-native vegetation,
- Removing riprap from the bankline toe and placing along the base of the levee,
- Reduce the bankline slope gradient by creating three- to four- nested terrace benches stabilized by planting native riparian vegetation on the upper bench,
- Install herbaceous wetland vegetation on the lower bench surfaces and woody vegetation on the higher terraces,
- Discontinue channel dredging in this reach segment (as also recommended for the site in USACE 2009) to encourage channel mobility.

Opportunities and Constraints

Compared to the sandy, homogenous channel conditions through most of the RGCP, the rocky channel substrate found at the Yeso Arroyo site has potential to provide relatively heterogenous aquatic habitat structure, including riffles, runs, and pool habitats. These complex channel conditions, particularly in combination with the previously constructed (by USIBWC) Yeso West wetland restoration site immediately downstream, form a potentially valuable and unique suite of aquatic habitat features in this segment of the Rio Grande. Furthermore, flows in this segment of the Rio Grande appears to be persistent (possibly perennial), even outside the irrigation delivery season, which further supports the potential for aquatic habitat enhancements through restoration.

This site has excellent potential to improve in-channel and off channel aquatic habitats with a nested geomorphic floodplain (e.g. terraced approach). Design would incorporate (at minimum) a low-flow bench inundated at approximately 800 cfs, a moderate-flow bench inundated at approximately 1,400 cfs, a high-flow bench inundated at approximately 2,500 cfs, with the remainder of the terrace remaining protected at the 100-year flood elevation. To ensure optimal functionality, design elevations recommended in Figure 10 should be thoroughly evaluated in the engineering design phase. Over time, this design alternative has potential to encourage natural recruitment of native vegetation. Cottonwood/willow planting on the higher terrace sections would provide benefits to southwestern willow flycatcher and yellow-billed cuckoo as the trees mature.

The property is owned by USIBWC. The primary constraint at this site is to provide assurances to protect levee integrity. Scour analysis is recommended during the engineering phase of this project. Additionally, lowering the floodplain terrace to desired discharges would require significant earthwork (and cost). Ongoing maintenance will be required to periodically remove sediment (which often forms bankline berms in this design alternative) to ensure long-term functionality.

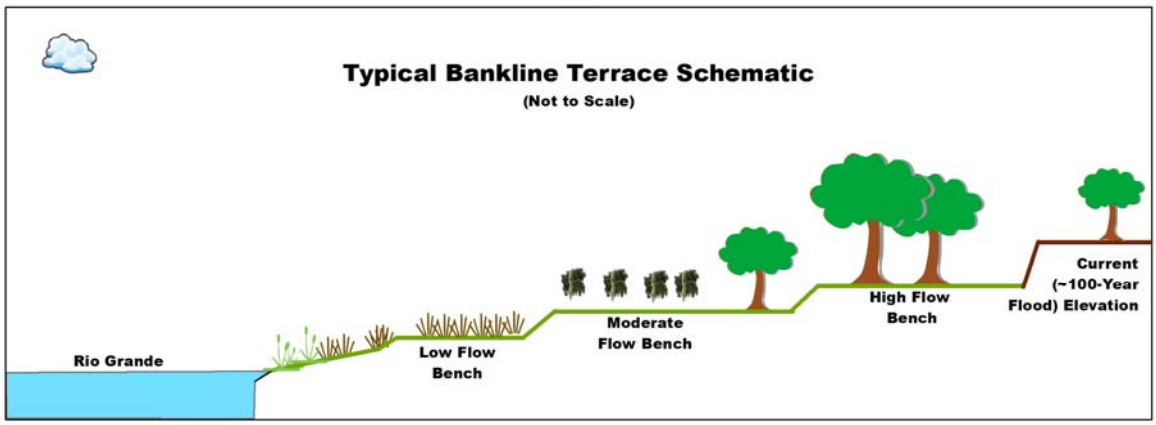


Figure 9. Cross-section of terraced bankline conceptual design at the Yeso Arroyo site.

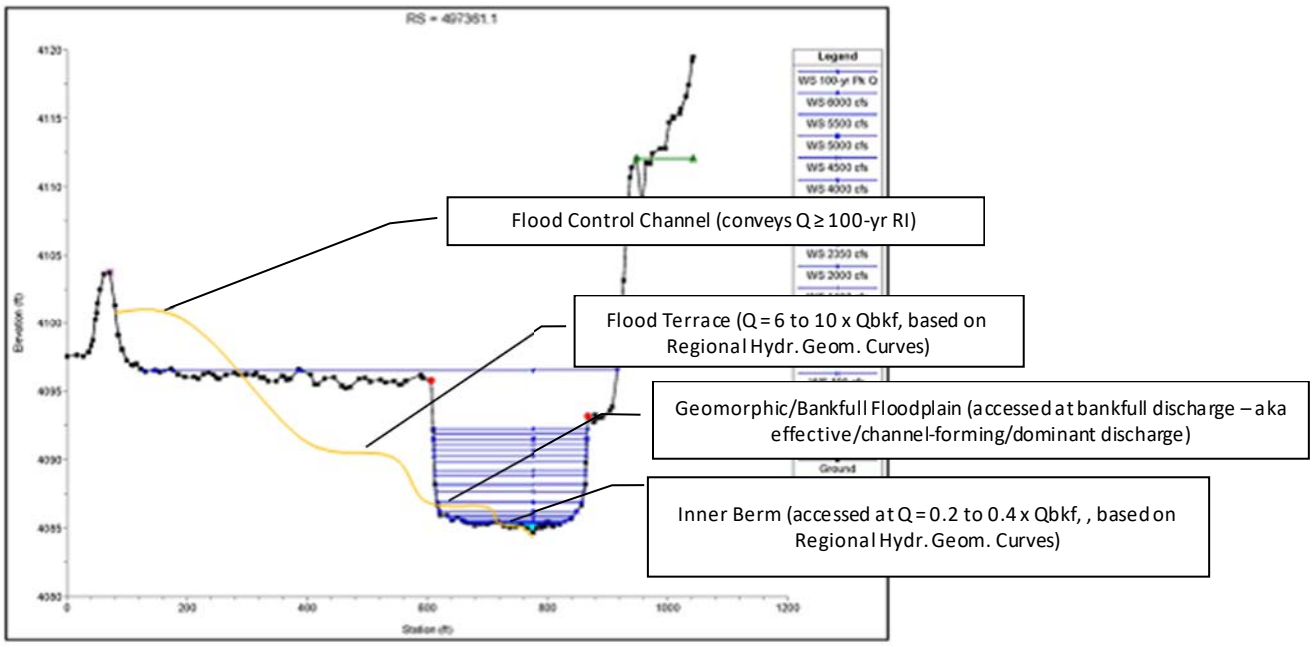


Figure 10. Geomorphic surfaces targeted in the nested terrace design. Lower terrace and bank full elevations and their associated terraces are representative of the secondary and overbank (i.e. effective/channel forming/dominant) discharges.

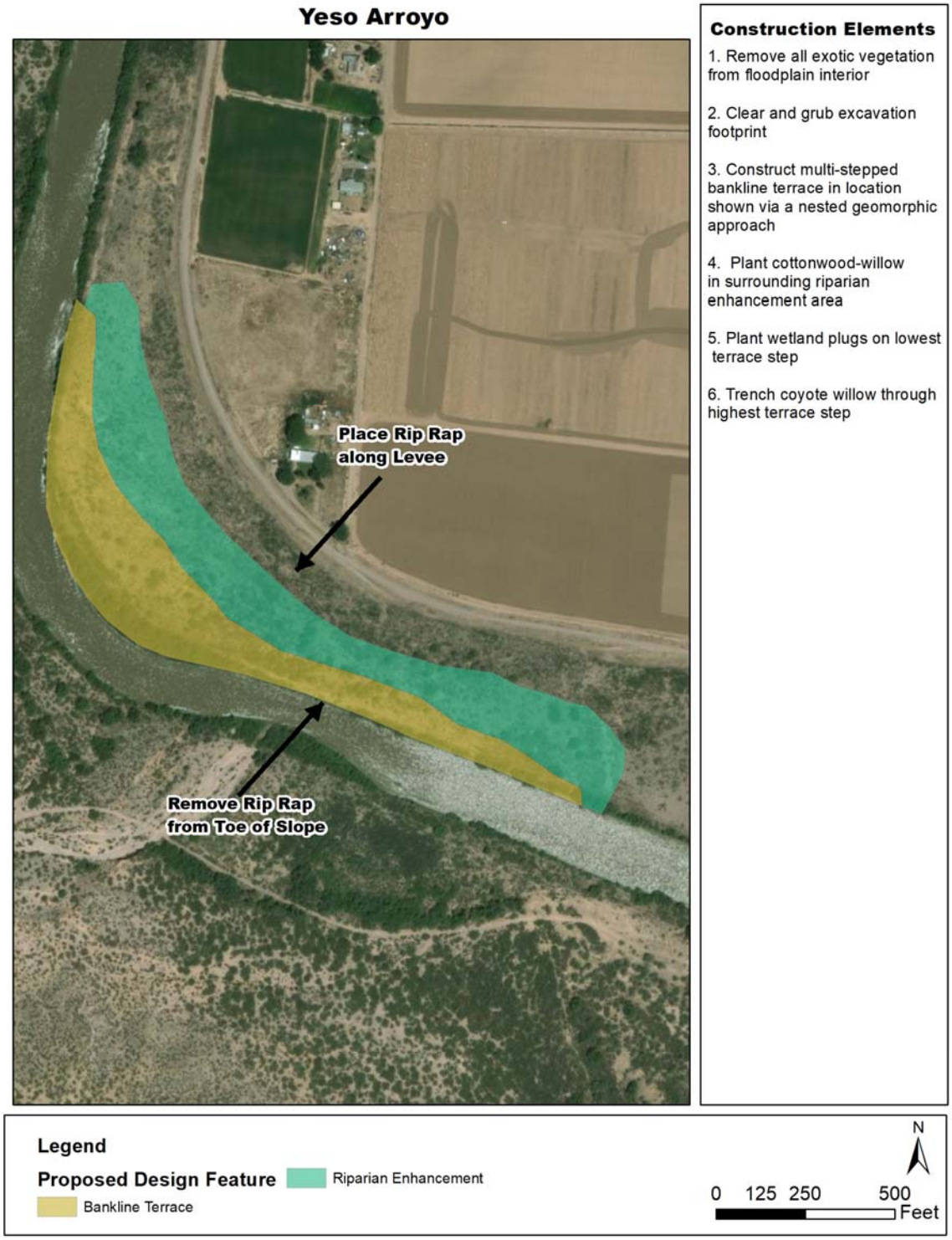


Figure 11. Plan-view conceptual restoration design map for the Yeso Arroyo project site.

3.2 Angostura Arroyo

Angostura Arroyo enters the Rio Grande from the south side of the river in a channel bend near RM 80. This site was included as an aquatic restoration site in the Conceptual Plan (USACE 2009). The design in that report is like Yeso Arroyo and includes saltcedar removal and bankline destabilization to facilitate river migration into the site. Both the arroyo mouth and the bankline are densely vegetated with willow. Arroyo discharge is funneled into a box culvert structure below highway 185 and another road just west of the confluence with the Rio Grande. Rocky, volcanic derived alluvium is more common above the box culverts and arroyo substrate becomes more sand dominated below the culverts. Large rock and gravel bars have formed in the Rio Grande channel near the arroyo mouth, increasing the diversity of substrate and flow conditions in the channel in and around the confluence. USIBWC has also historically dredged the river channel in this location to maintain channel conveyance capacity and gradient.

Flows in the Rio Grande appear to be persistent (possibly perennial) at this site, even outside the irrigation delivery season. LiDAR data indicates that much of the floodplain terrace is approximately 10 feet above the riverbed at this site (Appendix B) and hydraulic model results show that the site does not inundate until flows approach the 100-year discharge event (Figure 12). GSA scientists did not auger holes at this site, however, soils at the site are very coarse grained on the surface. The east bank of the river has large rock (likely riprap) along the toe.

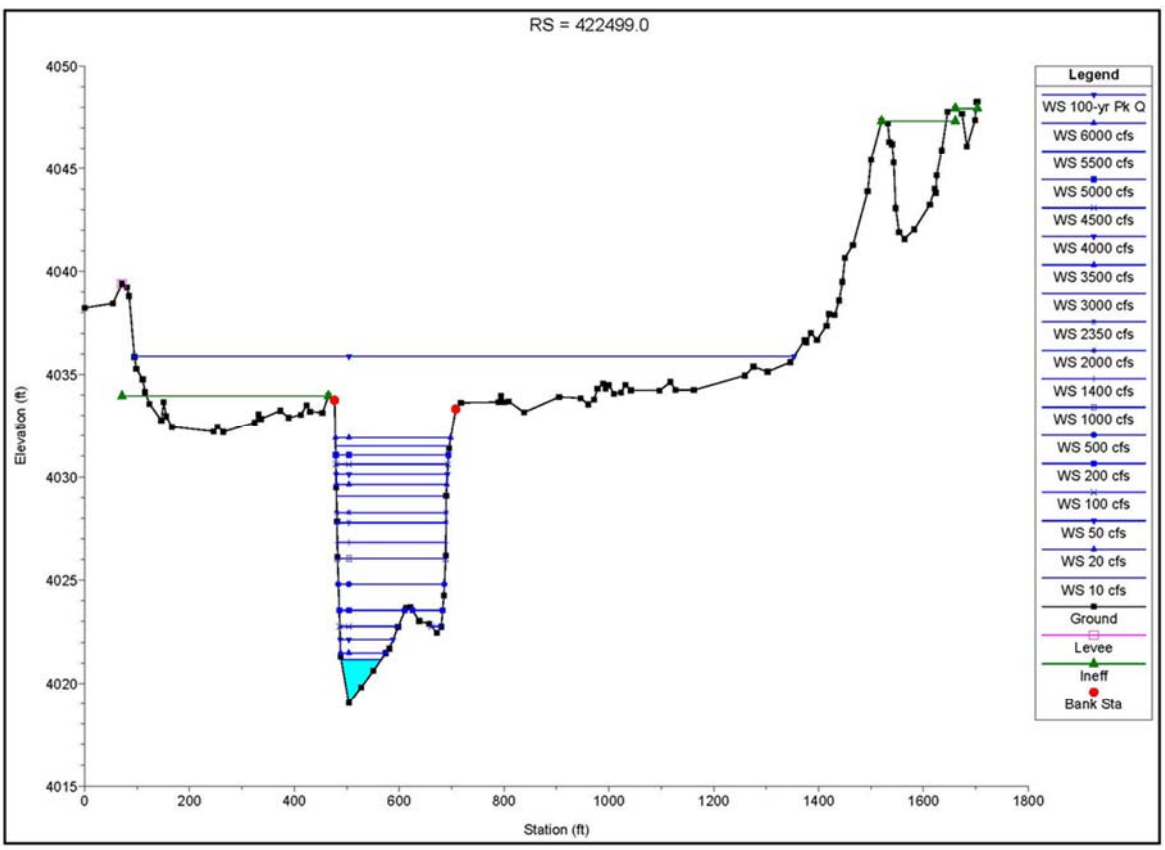


Figure 12. Representative channel cross-section of Rio Grande at Angostura Arroyo site showing predicted surface-water elevations under a range of discharges.

Site Assessment

Two vegetation types were identified at the proposed Angostura Arroyo restoration site (Figure 13). A saltcedar-coyote willow shrubland inhabits the bankline slope. Other woody species observed on the bankline include saltcedar, arrowweed, screwbean mesquite (*Prosopis pubescens*), Baccharis (*Baccharis salicifolia* and *salicina*), honey mesquite, fourwing saltbush, wolfberry, and skunkbush sumac (*Rhus trilobata*). Saltcedar is more prevalent on top of slope while coyote willow and *Baccharis* spp. are more common on lower portions of the slope. Spiny chloracantha (*Chloracantha spinosa*) bands inhabit the slope/terrace transition. A bench of cattail (*Typha domingensis*) and bulrush (*Schoenoplectus* sp.) occurs at the bottom of the bank. Bermudagrass, alkali sacaton (*Sporobolus airoides*), and bearded sprangletop (*Leptochloa fusca*) are the most abundant graminoids on the bankline slope.

The floodplain terrace is actively mowed by USIBWC so woody vegetation is mostly absent (Figure 14). The terrace is characterized as an open/barren area and Russian thistle is the most abundant species. Mowed saltcedar and arrowweed stems are patchy while Jimmyweed, spiny chloracantha, and fourwing saltbush stems are evenly distributed. Mowed whitethorn acacia, wolfberry, fourwing saltbush, and screwbean mesquite individuals are occasional. Alkali sacaton is the most abundant graminoid while bermudagrass, scratchgrass, needle grama, spike dropseed, Mediterranean (*Schismus* sp), feathertop (*Chloris virgata*), and mesa dropseed (*Sporobolus flexulosus*). Other annual weeds like kochia (*Bassia scoparia*) and amaranth (*Amaranthus* sp.) scorpionweed (*Phacelia* sp.), London rocket (*Sisimbrium irio*), and western tansymustard occur but at lower frequency than expected given the high degree of site disturbance.

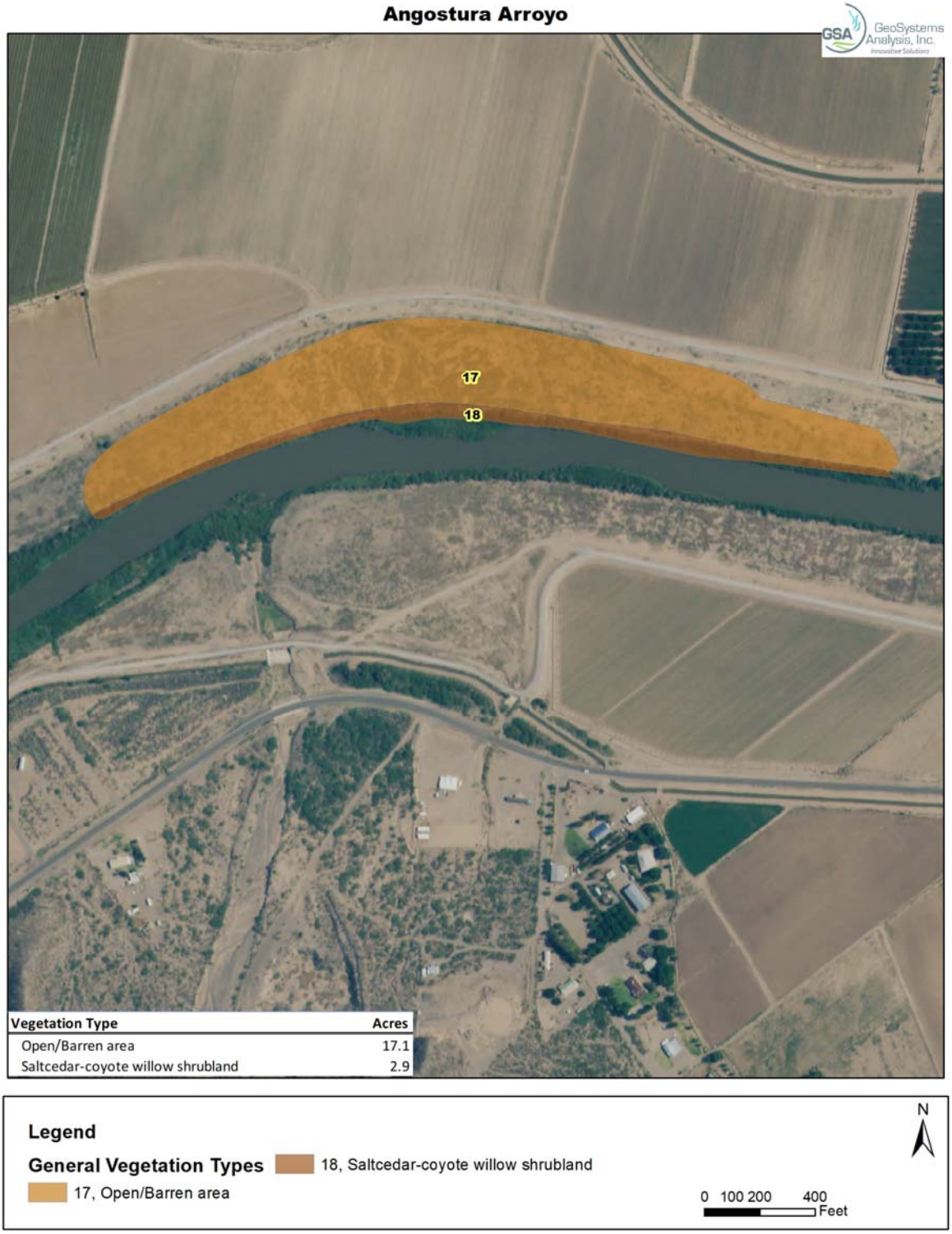


Figure 13. Angostura Arroyo vegetation map

Figure 14. Representative photos from the Angostura Arroyo site. Top photo: typical conditions on the elevated floodplain terrace. Bottom left and right, Rio Grande channel adjacent to the site.

Conceptual Design

The conceptual design at this site (Figure 17) is very similar to Yeso Arroyo in that it would involve modifying the steep bankline slope by creating a series of terraced benches (see Figure 9) capable of experiencing overbank flood inundation at a range of low to moderate discharge levels (e.g., 800-2,500 cfs). The terrace benches would be planted with native riparian vegetation that could provide nesting substrate for bird species and potential nursery habitat for native fishes. Lower terrace surfaces should be revegetated with a diverse mix of wetland herbs while woody vegetation (cottonwood-willow plus potted shrubs) planting is recommended on upper benches.

Restoration consists primarily of lowering banks to provide a wetted low-profile terrace when local discharge exceeds 800 cfs. When wetted sufficiently, several small-bodied, short-lived fish species may use the terrace. Of these, the most likely are red shiner, fathead minnow, and western mosquitofish. Fathead minnow and western mosquitofish favor low-velocity habitats with abundant aquatic vascular plants. Red shiner generally prefers moderate-velocity habitats, such as the inundated, upstream arroyo delta, but will use flooded areas such as the terrace for foraging. Female fathead minnows deposit their eggs on submerged organic matter and live-bearing western mosquitofish need zero or low-velocity habitats to avoid current entrainment of their young. Red shiner would spawn in the higher gradient portions of the upstream arroyo delta, but their young, upon emergence would use the low velocity habitats of the terrace. The wetted terrace would likely support a variety of aquatic insects that would be consumed by fishes. A fourth species, channel catfish, might forage for insects and fishes on the terrace. Pulsing flows over the lowered terrace would transport organic debris into the river channel thereby increasing its nutrient base.

The conceptual design elements include:

- Removing saltcedar and other non-native vegetation,
- Removing riprap from the bankline toe and placing along the base of the levee,
- Reduce the bankline slope gradient by creating three- to four-bankline terrace benches stabilized by planting native riparian vegetation on the upper bench,
- Install herbaceous wetland plant species on the lower benches and woody riparian species on the higher benches,
- Discontinue channel dredging in this reach segment (as recommended in USACE 2009) to encourage channel mobility.

<u>Opportunities and Constraints</u>

This site has potential to improve in-channel and off channel aquatic habitats with a nested geomorphic floodplain (e.g. terraced approach). Design discharges are intended to achieve a low-flow bench at approximately 800 cfs, moderate flow bench at approximately 1,400 cfs, a high flow bench at approximately 2,500 cfs, with the remainder of the terrace remaining protected at the 100-year flood elevation. Over time, this design alternative has potential to encourage natural recruitment of native vegetation recruitment. Cottonwood/willow planting on the higher terrace sections would provide benefits to southwestern willow flycatcher and yellow-billed cuckoo as the trees mature. Deposition of large bed material from the arroyo contributes to increased habitat heterogeneity in the vicinity of the restoration area.

The property is owned by USIBWC. The primary constraint at this site is to provide assurances to protect levee integrity. Supplemental flood scour evaluations are recommended during the engineering phase to ensure that project construction does not affect levee integrity. Additionally, lowering the floodplain terrace to desired discharges would require significant earthwork (and cost). Ongoing maintenance will be required to periodically remove sediment (which often forms bankline berms in this design alternative) to ensure long-term functionality.

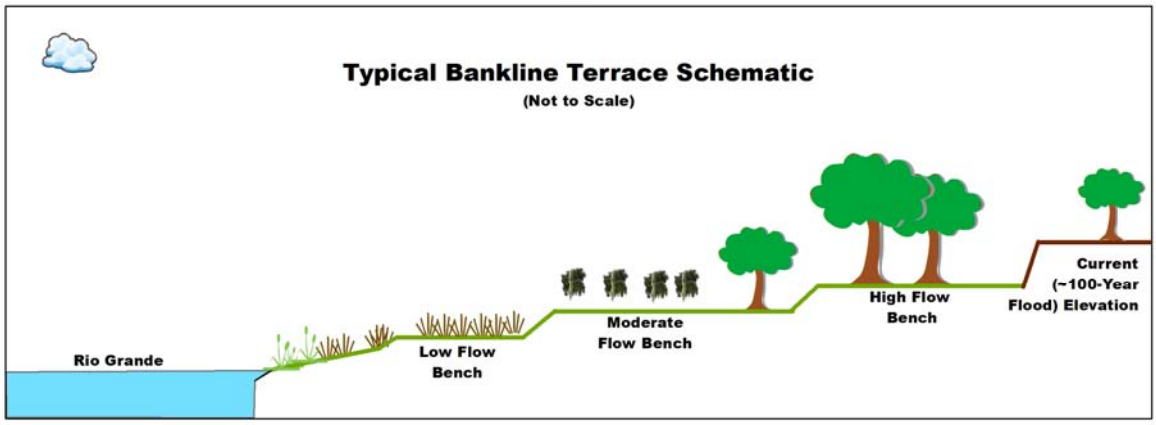


Figure 15. Cross-section of terraced bankline conceptual design at Angostura Arroyo site.

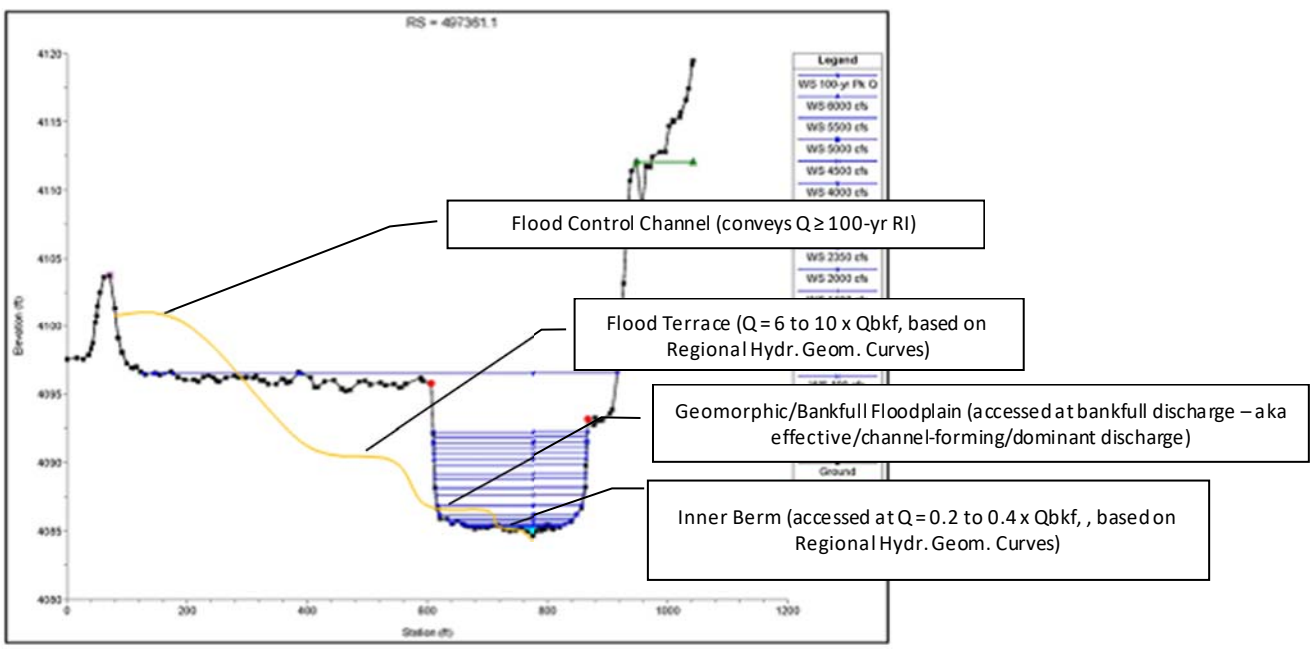


Figure 16. Example geomorphic surfaces targeted in the nested terrace design. Lower terrace and bank full elevations and their associated terraces are representative of the secondary and overbank (i.e. effective/channel forming/dominant) discharges.

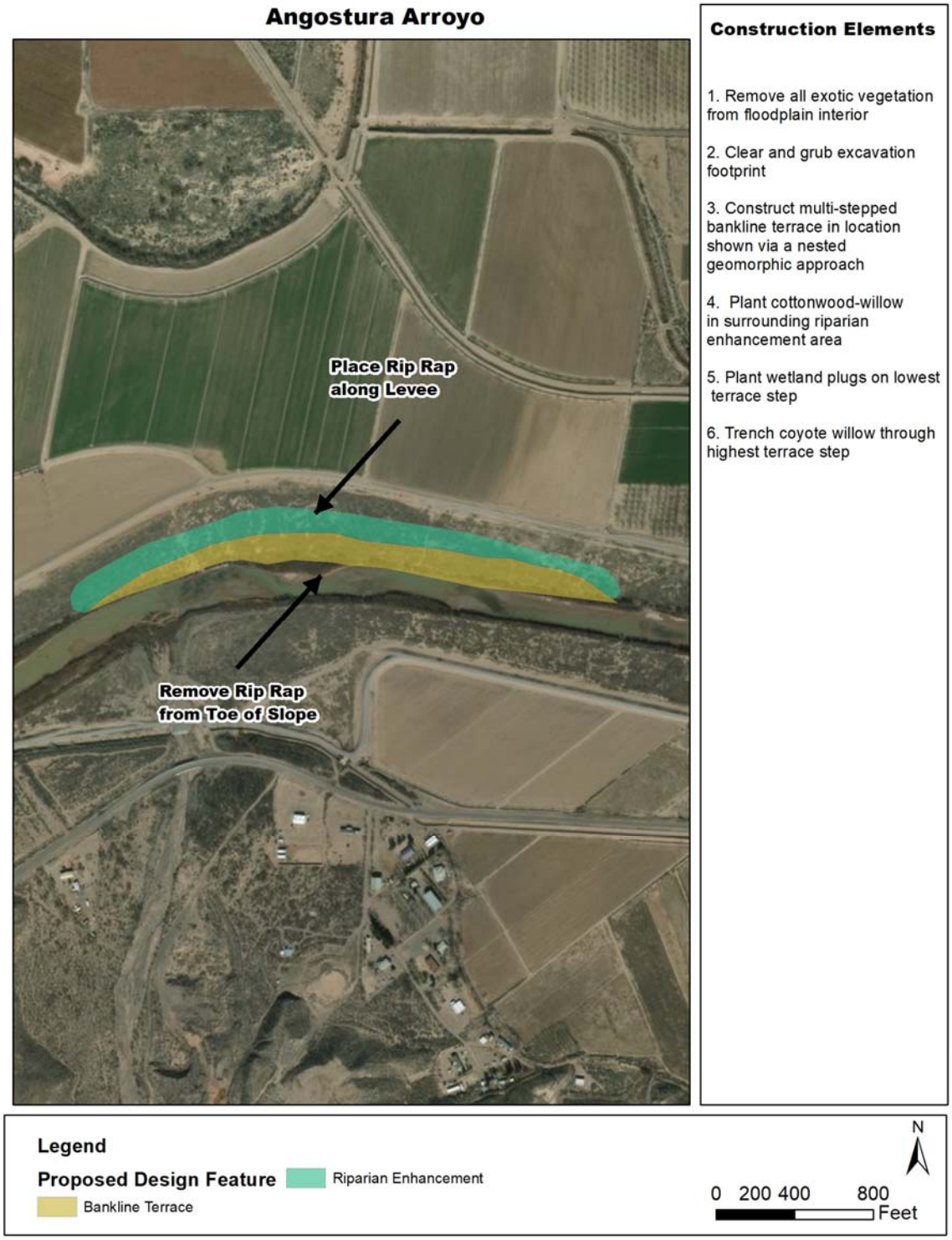


Figure 17. Angostura Arroyo conceptual restoration design map

3.3 Broad Canyon Arroyo

Broad Canyon Arroyo is a tributary to the Rio Grande that enters from the west side of the river near RM 68. The site has been the focus of previous riparian habitat enhancement by U.S. Fish & Wildlife Service (USFWS) for USIBWC. These projects have mostly emphasized planting riparian vegetation, although success has been mixed. Gooding's willow (*Salix gooddingii*), cottonwood and coyote willow pole plantings are flourishing near the mouth of Broad Canyon Arroyo and along the arroyo bottom. Conversely, coyote willow and cottonwood/willow tree plantings on higher terraces further from the arroyo mouth experienced high mortality. It's likely that soil salinity has negatively affected planting survival on the higher terraces. Propst and Bixby (2018) proposed multiple potential options for improving fish habitat at the site including 1) enhancing backwater habitat at the arroyo mouth and 2) establishing two alternative paths for carrying Rio Grande water via a new point of diversion to create a manmade spring in the arroyo

Buckle Bar Canyon joins the Rio Grande opposite (east) of Broad Canyon Arroyo. The substrate periodically delivered to the Rio Grande channel from both arroyos contributes to channel structural diversity and a substrate for benthic invertebrates. The Rio Grande channel contains short riffle, run and pool habitats, and the channel habitat complexity along the site is further enhanced by existing vegetated islands and point-bars. A backwater forms up Broad Canyon Arroyo during low to moderate flows. Hydraulic models indicate that a backwater begins to form when flows reach approximately 100 cfs (Figure 18) and inundation expands up the arroyo with increasing discharge. LiDAR data indicates that the arroyo bottom is approximately 2 feet above the riverbed at the confluence (Appendix B). Surface flow in the Rio Grande appears persistent, possibly perennial even outside the irrigation delivery season. This site lies in an USIBWC no-mow zone.

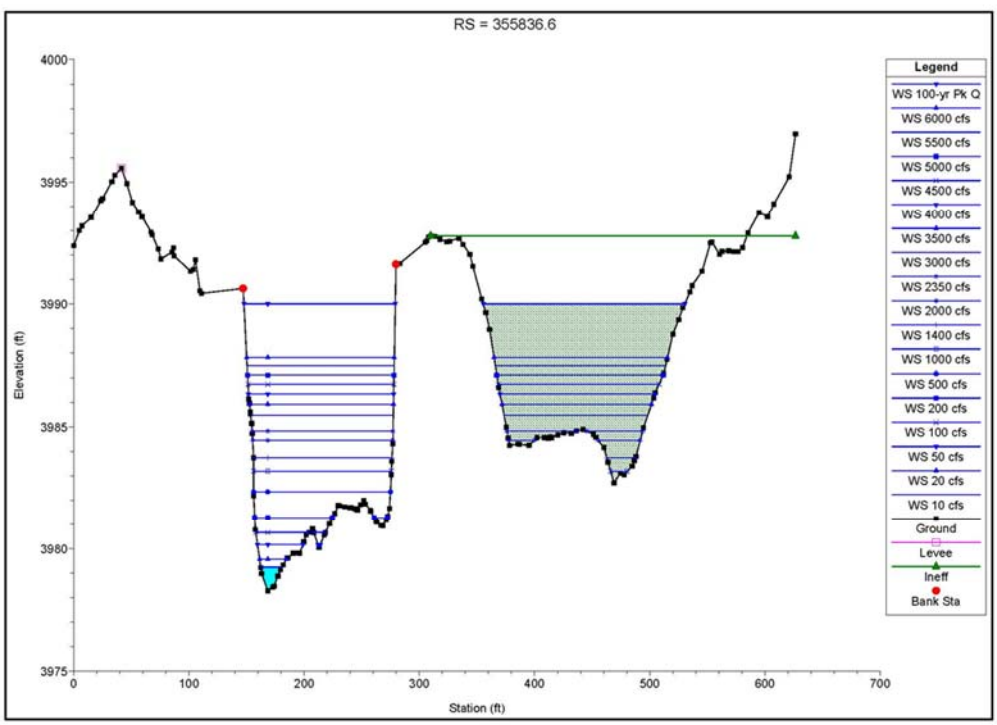


Figure 18. Representative channel cross-section of Rio Grande at the Broad Canyon Arroyo site showing predicted surface-water elevations under a range of discharges. Green-highlighted area shows predicted surface water elevations at the mouth of Broad Canyon Arroyo.

Site Assessment

Seven different vegetation types were described for the site as indicated in Figure 19. Most of the bankline is a coyote willow shrubland with occasional Baccharis, wolfberry, cottonwood, honey mesquite, arrowweed, and netleaf hackberry (*Celtis laevigata* var. *reticulata*). A short segment of bankline is mapped as an arrowweed shrubland near the north end of the assessment area. Alkali sacaton is the most abundant herbaceous plant along the bankline.

A long berm parallels the channel near the upstream-most edge, where it separates two distinct open/barren areas. The southern open/barren area is dominated with Russian thistle, with patches of saltcedar and honey mesquite, and numerous piles of discarded concrete and rubble. The open/barren area on the north side of the berm was cleared and planted with cottonwood, seep willow, Gooding's willow, wolfberry and possibly other species but survival appears low. That open/barren site is now dominated by Russian thistle and Mojave seablite (*Suaeda nigra*). The top of the berm is mostly bare and appears driven on occasionally (by railroad contractors and others). Honey mesquite shrublands with a mix of grasses, predominantly spike dropseed and woollygrass inhabit the berm edges. The riverside slope and the area between the berm and the willow bankline is weedy and diverse, with a portion that previously burned, possibly during prescriptive burning of debris piles. The riverside edge of the berm is predominantly Russian thistle, with scattered wolfberry and honey mesquite, and fringed twinevine growing throughout. The inland side of the berm is predominantly honey mesquite entangled with fringed twinevine and bristlegrass (*Setaria* sp.), amaranth, Russian thistle along with other weedy annuals dominating the herbaceous layer.

More upland portions of the site include honey mesquite shrublands, open/barren areas, burrobrush shrublands, and portions where jointfir (*Ephedra*) co-dominates with honey mesquite. Russian thistle, sand dropseed, sacred datura (*Datura wrightii*), wolfberry, fringed twinevine, broom snakeweed (*Gutierrezia sarothrae*), giant sacaton (*Sporobolus giganticus*) are the primary herbaceous constituents.

While the arroyo floodplain is mapped as a wet meadow at the scale shown in our report, the arroyo bottom is highly diverse with numerous small-scale wetland and aquatic features (Figure 20). The terrace above the active flow path is predominantly a bermudagrass meadow with small patches of saltgrass, common threesquare (*Schoenoplectus pungens*) and spike rush (*Eleocharis* sp.) dispersed throughout. Vigorous Gooding's willow and seep willow plantings are prominent near the confluence of the river, as well as a band of planted coyote willow, with high survival that will likely begin to spread via rhizome. Previous plantings near the confluence reportedly had high mortality, suspectedly due to salinity or prolonged inundation (USIBWC personal communication).

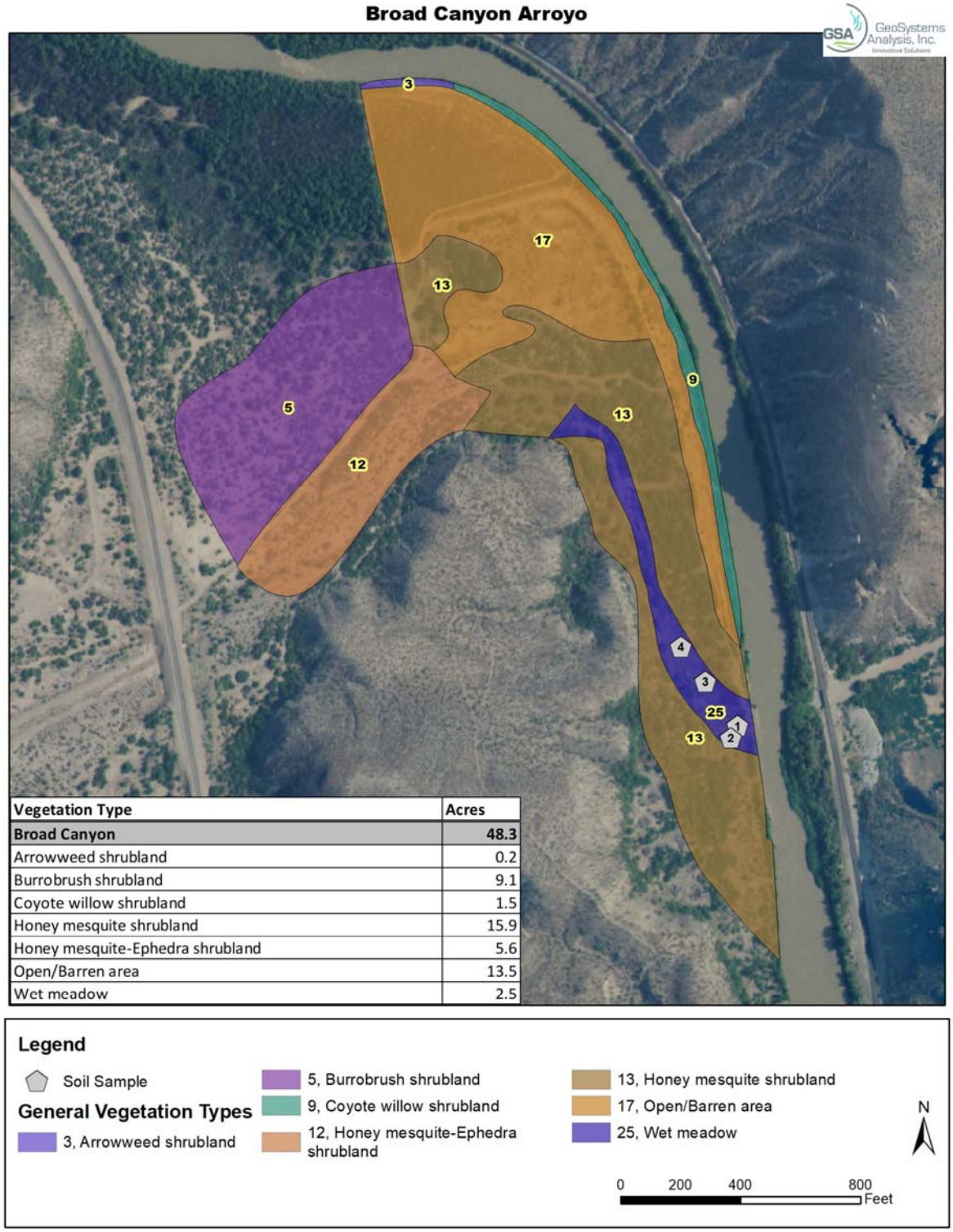
The arroyo flow path is bare from the river confluence to about 200 feet upstream, where a mosaic of cattail marsh areas, coyote willow patches, and small wet meadows begins. Beyond that point, extending about 900 feet upstream are smaller Gooding's willow and cottonwood plantings in the bermudagrass meadow intermixed with cattail marsh and coyote willow patches in and adjacent to the arroyo bottom. By about 1,100 feet above the confluence, rush patches diminish and the bermudagrass becomes mixed with kochia. Coyote and Gooding's willow patches discontinue near this location and the arroyo bank line has lower woody species cover - honey mesquite with an occasional planted cottonwood trench, and netleaf hackberry. Jungle rice (*Echinochloa colona*) and feather fingergrass become the dominant herbaceous species as the arroyo becomes drier, with

occasional giant sacaton (*Sporobolus wrightii*), globe mallow and silverleaf nightshade. By approximately 2,000 feet above the confluence, arroyo vegetation becomes more arid and blends with upland types that inhabit the sides of the canyon which are dominated by honey mesquite and longleaf jointfir and spike dropseed with woollygrass being the dominant herbaceous species.

Soils were augered at four locations as shown in Figure 19 and Table 3. Unfortunately, buried rock and gravel prevented penetration to groundwater at three of the bore holes augered on benches immediately above the primary flow path of Broad Canyon Arroyo. One bore hole in the primary flow path revealed clay soils down to 38 inches. After leaving the hole open for a few minutes, upwelling groundwater filled to 22 inches. Bore hole 3 was augered in a location with high coyote willow planting mortality. Salt crystals were abundant in the clay loam found in the top 13 inches. Salts were less apparent in the other auger locations, some of which included higher planting success.

Table 3. Soil texture and depth to groundwater observed at Broad Canyon Arroyo soil bore hole locations.

Bore Hole	Depth	Texture	Soil Moisture	Notes
1	0 to 4	C	Dry	Dry clay plates. Hole in unvegetated segment of arroyo, near mouth.
	4 to 11	C	Wet	
	11 to 38	C	Very Moist	
	22	GW		After sitting open, hole filled with water at 22".
2	0 to 8	CL	Slightly moist	Bermuda grass, Gooding's willow bench.
	0 to 30	C	Slightly moist	Hit a rock, groundwater likely ~5 feet.
3	0 to 13	CL		Visible salts concentrated in top layer. Hole in center of dead coyote willow plantings.
	13 to 24 +			Could not penetrate with auger. Gravelly coarse sand
4	0 to 10	CL	Moist	
	10+	Sa	Moist	Gravelly coarse sand. Could not penetrate. Less salt visible than hole 3. Salt crystals only apparent at transition point between clay and sand. Hole in Bermuda grass with live plantings.



Vegetation Type	Acres
Broad Canyon	**48.3**
Arrowweed shrubland	0.2
Burrobrush shrubland	9.1
Coyote willow shrubland	1.5
Honey mesquite shrubland	15.9
Honey mesquite-Ephedra shrubland	5.6
Open/Barren area	13.5
Wet meadow	2.5

Figure 19. Broad Canyon Arroyo vegetation map and soil sampling locations.

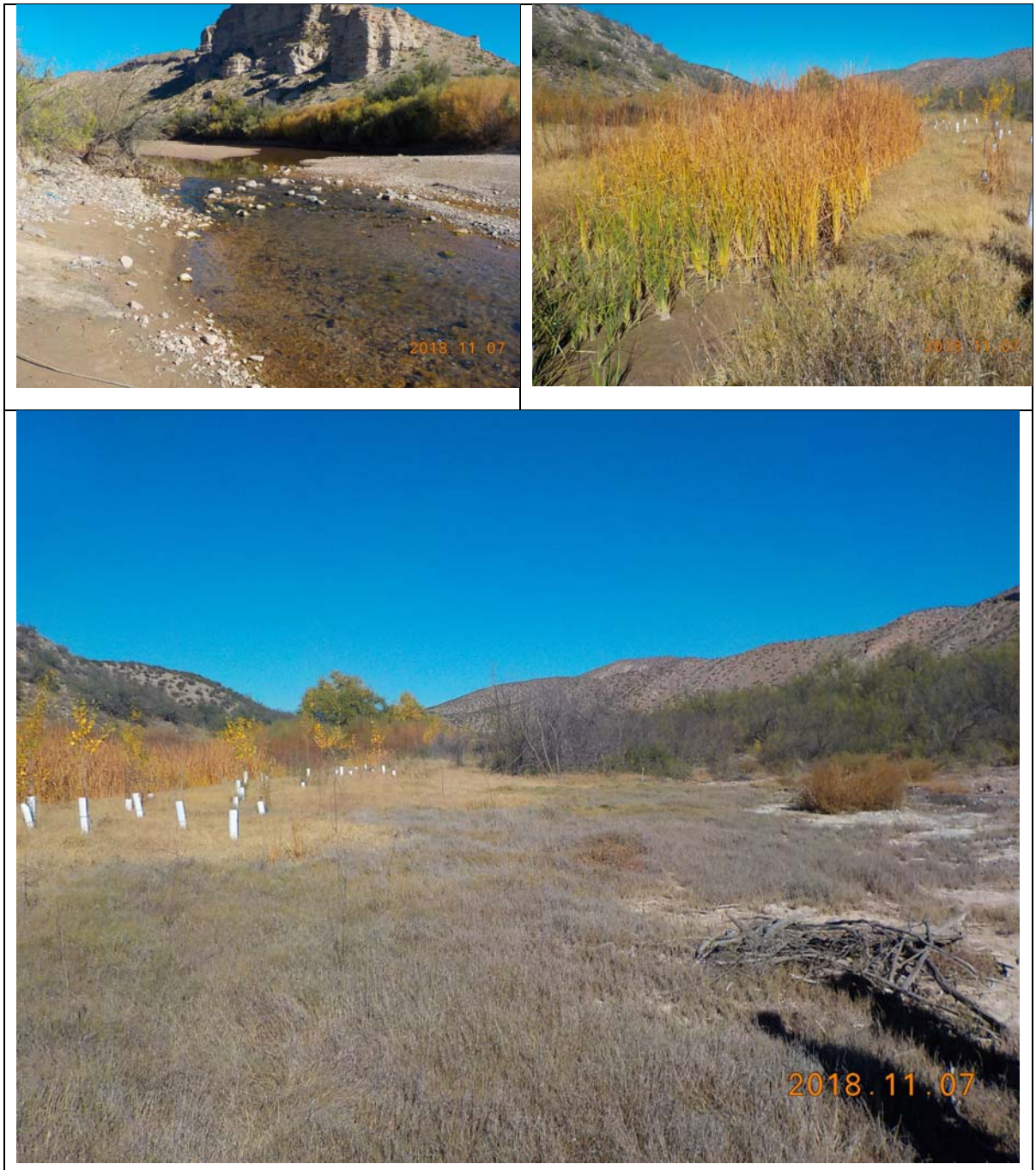


Figure 20. Representative photos of the Broad Canyon Arroyo site. Top left: Rio Grande near the arroyo confluence. Top right: marsh habitat in the arroyo bottom. Bottom photo: typical bench targeted for embayment excavation with nearby plantings.

Conceptual Design

The conceptual restoration design recommendation for the Broad Canyon Arroyo site emphasizes enhancing the backwater function and habitat diversity by creating a series of embayments supplemented with diverse riparian-wetland revegetation (Figure 21 & Figure 22). Excavated embayments provide an opportunity to diversify off channel aquatic habitat plus enhance existing restoration projects already located at the site. The embayments are designed with a target elevation approximately 1 foot higher than the primary arroyo flow path and predicted to begin inundating when localized discharge in the Rio Grande reaches approximately 400 cfs. Embayments nearest the Rio Grande would inundate first. By approximately 1,500 cfs (in the Rio Grande), backwater conditions are predicted to back far enough up the arroyo that each of the embayments would be entirely underwater. Manipulating topography in the arroyo mouth is expected to diversify emergent wetland vegetation and provide backwater aquatic habitat for fish and other aquatic species.

Addition of embayments to the Broad Canyon backwater will provide deep water, structurally diverse habitats that are not otherwise available in the existing channel. In addition to providing habitat for fathead minnow and western mosquitofish, the constructed deep-water features would potentially provide habitat for several large-bodied fish species. Of these, channel catfish and bluegill (*Lepomis macrochirus*) are the most likely beneficiaries. While channel catfish would be more likely to inhabit the Rio Grande when flowing, it would also forage in the backwater for macroinvertebrates and fish. Bluegill, however, would be more likely to inhabit the backwater, especially with addition of deep pool habitats. It is more common in deeper zero- and low-velocity structurally diverse habitats with vascular aquatic plants where it feeds on macroinvertebrates and small fishes. Gizzard shad (*Dorosoma sp*.) might forage for zooplankton in the still water habitat of the backwater. Less likely, but still potential users of the improved backwater are red shiner, river carpsucker, and flathead catfish (*Pylodictis olivaris*). Red shiner generally does not occur in zero-velocity habitats. Both large-bodied river carpsucker and flathead catfish might occasionally feed in the backwater; carpsucker on organic-rich sediments and flathead catfish on fishes and macroinvertebrates.

The conceptual design elements for this project site includes:

- Excavating strategically placed (to avoid live plantings and target Bermuda grass dominated locations) embayments adjacent to the primary flow path in Broad Canyon Arroyo,
- Revegetation with native riparian-wetland species, with emphasis on native herbaceous species.

<u>Opportunities and Constraints</u>

This project will require coordination with multiple agencies because there are multiple owners. USIBWC owns the north bank while USFWS and State of NM own portions of the south bank. Bureau of Land Management also owns a small portion of land near the site. Continuous sedimentation will need to be monitored and sediment will likely need to be periodically removed from the arroyo mouth to maintain the hydraulic connection with the Rio Grande.

In addition to enhancements within the arroyo bottom, as described in our conceptual design, Probst and Bixby (2018) also considers construction of temporary, artificial spring with two

alternative piping routes. That idea is complicated due to clear creation of a new point of diversion and effects on Rio Grande Compact deliveries. Regardless, the team reviewed existing hydraulic models along with the LiDAR data to assess the feasibility of constructing an artificial spring as described in that report (Propst and Bixby 2018). The team located the approximate field location and marked a Global Positioning System (GPS) location during the site visit. LiDAR data indicate that the ground elevation at that location is approximately 3,993 feet. A HEC-RAS cross section located near the proposed point of diversion shows that the water surface elevation does not rise to 3993 feet until river discharge nears 10,000 cfs. Hydraulic models indicate that by that discharge, a well-formed backwater migrates up the arroyo without support from an artificial spring. Thus, pumping would be required. Because the physical conditions do not readily support creation of an artificial spring, in addition to the predictably intensive maintenance associated with cleaning the polyvinyl chloride (PVC) pipe, removing debris from screens, servicing pumps, and permitting a new point of diversion, our design does not recommend creation of an artificial spring.

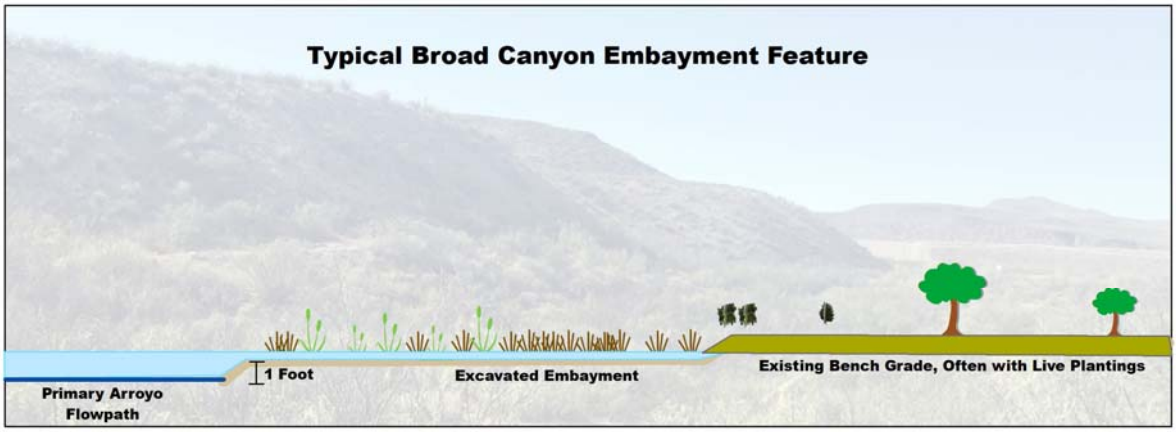


Figure 21. Cross-section of embayment design concept within the Broad Canyon Arroyo immediately upstream from its confluence with the Rio Grande.

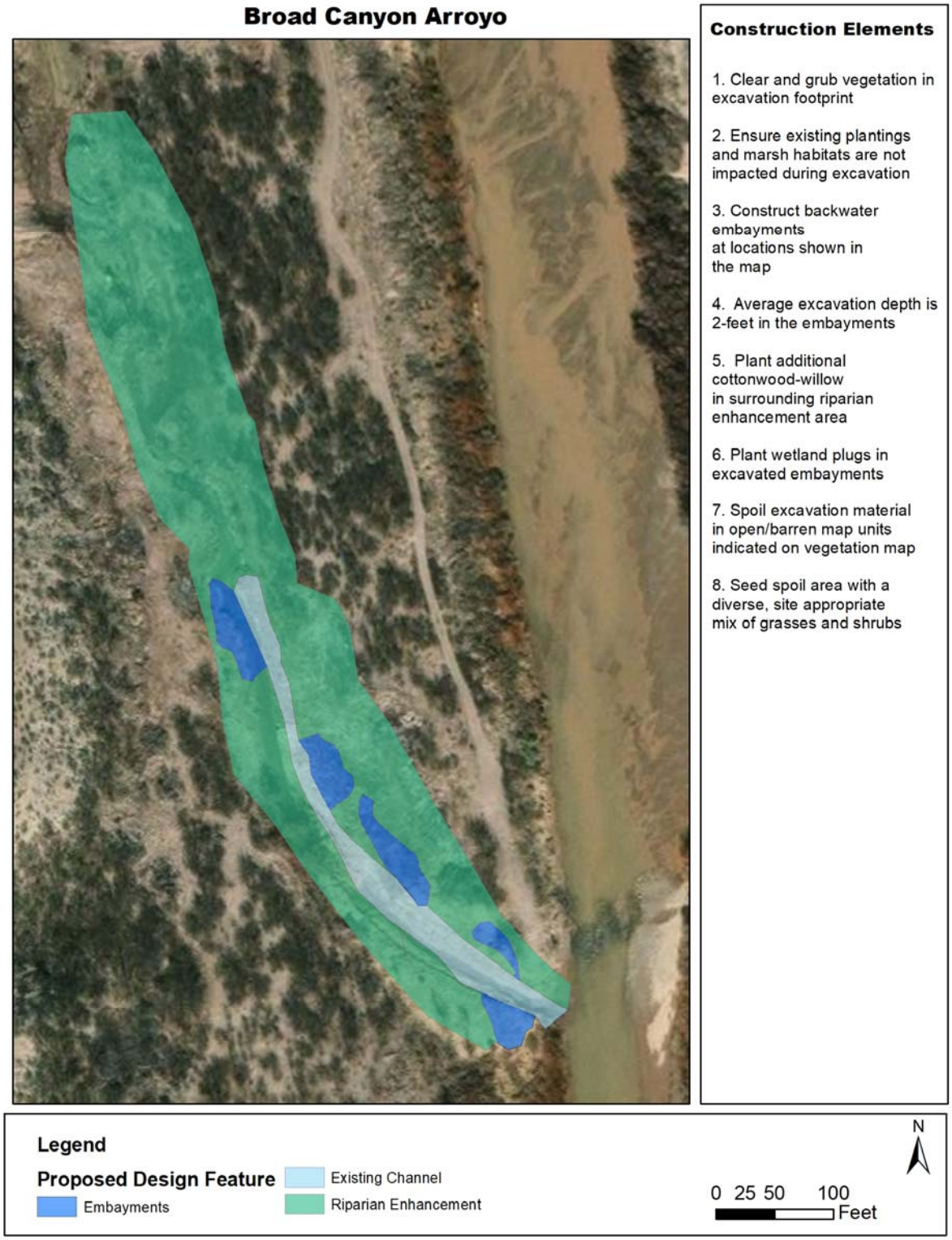


Figure 22. Broad Canyon Arroyo conceptual restoration design map.

3.4 Selden Canyon Point Bar

Selden Canyon Point Bar is a vegetated, bank-attached (point) bar located on the east side of the Rio Grande near RM 66. Selden Canyon arroyo enters the Rio Grande just downstream of the site. A 2008 report (Parametrix 2008) indicates that this location (referred to as the "Martinez Property" in that report but the property was acquired by USIBWC in 2011) contained dense saltcedar. Saltcedar was removed from the site in recent years and the native herbaceous community has colonized portions of the site. Cottonwood/willow poles appear to have been planted near the southern end of the site with mixed success and along the bank (many are dead, likely due to high soil salinity).

Flows at this location may be perennial in most years, but discharge was visibly lower in this river segment compared to near Broad Canyon during our site visit. Deposition of rock into the Rio Grande channel from the arroyo contributes to channel habitat heterogeneity in the vicinity of the restoration area but there is visibly less coarse substrate in the channel compared to the sites upstream.

According to LiDAR topography, the Seldon Canyon Point Bar site is primarily 3 to 5 feet above the riverbed (Appendix B), with marsh dominated areas only 1-2 feet above the riverbed. Hydraulic models indicate that the significant portions of the point bar have potential to inundate at 3,000-3,500 cfs if bankline berms were lowered (Figure 23).

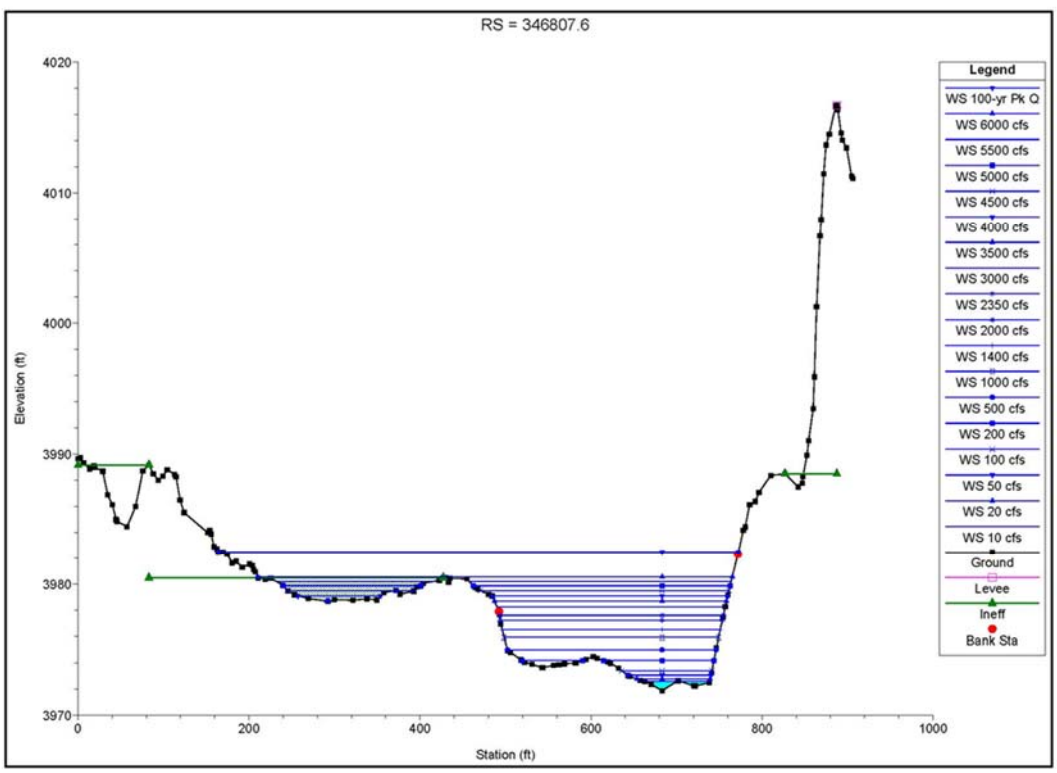


Figure 23. Representative channel cross-section of Rio Grande at the Seldon Canyon Point Bar site showing predicted surface-water elevations under a range of discharges.

Site Assessment

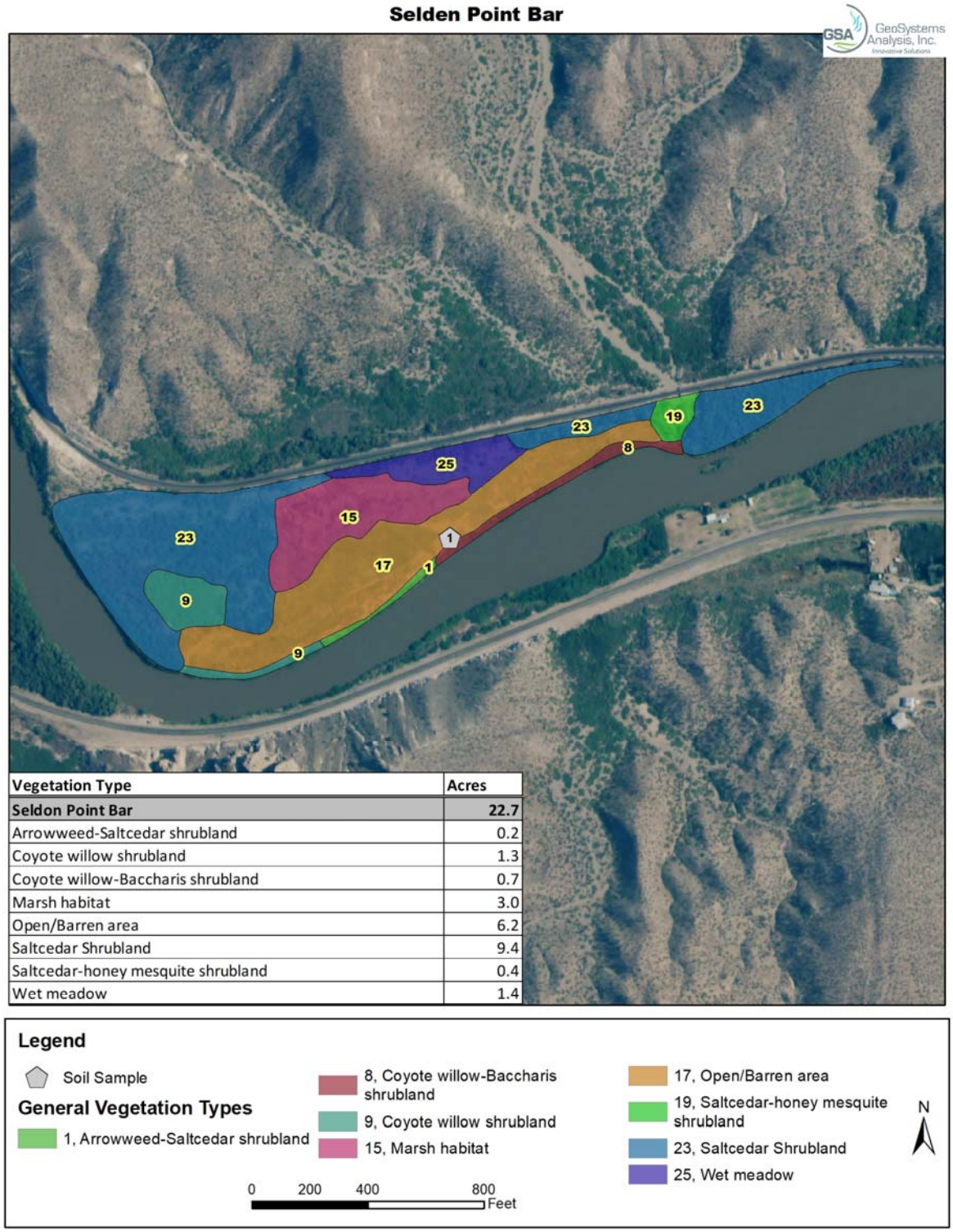
Vegetation types at this site (Figure 24) are largely a mosaic of desirable and uncommon (in the RGCP reach) native herbaceous communities including scratchgrass/saltgrass meadows (Figure 25) with some common threesquare and dense patches of arrowweed. A large cattail marsh is situated in what appears to be a former borrow pit adjacent to the railroad track, with occasional saltcedar between the tracks and marsh. An alkali sacaton (*Sporobolus airoides*) meadow with intermixed honey mesquite, seep willow, saltcedar and wolfberry is located just downstream from the cattail marsh. Open/barren areas indicated behind bankline vegetation are often void of vegetation but become dominated by annual weeds (kochia and Russian thistle) plus alkaliweed (*Cressa truxillensis*) on the downstream end. The open/barren areas also include entirely unvegetated areas with visible salt accumulation (Figure 25). It appears that saltcedar piles were burned in this zone during previous treatment activities. Former revegetation efforts appear concentrated near the downstream most end but had mixed success (numerous dead cottonwood/willow poles were observed).

Untreated saltcedar monocultures dominate the eastern and western edges, occasionally with skunkbush sumac or wolfberry along the saltcedar margins and fringed twinevine climbing throughout. The upstream saltcedar patch transitions into a large coyote willow shrubland. Banklines of tall coyote willow with occasional seep willow and cattail are abundant, but transition into drier areas with less woody cover dominated by arrowweed and saltcedar near the center of the site. Drier bankline segments contain bermudagrass, scratchgrass and knotgrass dominated herbaceous layers.

GSA staff augered one bore hole at this site, however, Parametrix (2008) includes a highly detailed Order 2 soil survey for this location. A sample from within a proposed aquatic habitat feature revealed that visible salts were concentrated in a clay loam found on the top 2-feet and especially abundant on the soil surface (Table 4). Soils were moist throughout the profile, blackening was found in the top 8 inches possibly due to residual organics from burning saltcedar piles, and groundwater was reached at 46 inches. Gleying was evident by approximately 30 inches.

Table 4. Soil texture and depth to groundwater observation from Selden Canyon Point Bar.

Bore Hole	Depth	Texture	Soil Moisture	Notes
1	0 to 25	CL	Moist	In potential excavation. Salts evident through 8". Salt crystals concentrated in this layer
	25 to 34	L	Moist	Gleying, blackened
	34 to 46	Sa	Very Moist	
	46	GW		Auger in weedy barren area, Saltcedar re-sprouts



Vegetation Type	Acres
Seldon Point Bar	**22.7**
Arrowweed-Saltcedar shrubland	0.2
Coyote willow shrubland	1.3
Coyote willow-Baccharis shrubland	0.7
Marsh habitat	3.0
Open/Barren area	6.2
Saltcedar Shrubland	9.4
Saltcedar-honey mesquite shrubland	0.4
Wet meadow	1.4

Figure 24. Selden Canyon Point Bar vegetation map.

Figure 25. Representative field photos from the Selden Point Bar site. Top photo: Abundant surface salt accumulations are generally void of vegetation. Bottom left and right: Saltgrass meadow typical of the herbaceous communities at the site.

Conceptual Design

A conceptual restoration design for this site would involve creating a high-flow channel and a backwater channel supplemented by revegetation with native riparian-wetland plant species. As illustrated in Figure 28, a constructed side channel would be built on the upstream end of the point-bar while two backwaters would be constructed on the downstream end. The channel is designed to begin inundating at 500 cfs and flow through by 1,000 cfs (Figure 27). The backwater features are designed to begin inundating at 500 cfs and will fill with water by 800 cfs (Figure 26). Within the vicinity of this site, riverine habitat is near monotonous and when wetted consists almost entirely of a channel wide, sand-bottomed run except for rock immediately near the arroyo mouth. Construction of a flowing side channel, at least during irrigation season, provides additional habitat diversity. The backwaters add another structural element. Red shiner would be the most likely small-bodied user of the side channel, both for foraging (it is an insectivore) and potentially spawning (eggs deposited amongst pea gravel in flowing water). Depending on its depth, large-bodied channel catfish, flathead catfish and river carpsucker might also use it for feeding. The backwater portions of this site would most likely be used by fathead minnow and western mosquitofish. If sufficiently deep, gizzard shad might feed in the backwaters.

The principal conceptual design elements at this site include:

- Re-treating saltcedar throughout the site
- Excavating a strategically placed (to target barren areas with high concentrations of visible surface salts) flow through channel
- Excavating two strategically placed (to avoid live plantings and target weedy areas) backwaters
- Revegetation

<u>Opportunities and Constraints</u>

In addition to potential benefits for fish species, riparian plantings adjacent to the excavations will diversify the vegetation complexity at the site and improve habitat quality for the southwestern willow flycatcher and yellow-billed cuckoo. During moderate to high flows (e.g. 2,500+ cfs) it's also likely that the proposed aquatic features will promote (groundwater and surface water) inundation beyond the excavated footprints, likely flushing salts from the site.

Perhaps the greatest constructability challenge is access. Heavy equipment will need to be walked onto the site across the active channel and it may be necessary to construct a temporary ramp from the opposite side of the river. Regular sedimentation monitoring will be necessary to validate that the sites continue to function as designed and/or mature on a desirable trajectory. Sediment cleanout is highly likely on a periodic basis.

The northern portion of the site is privately owned and USIBWC acquired remaining portions of the site from a private landowner in 2011 (USIBWC personal communication).

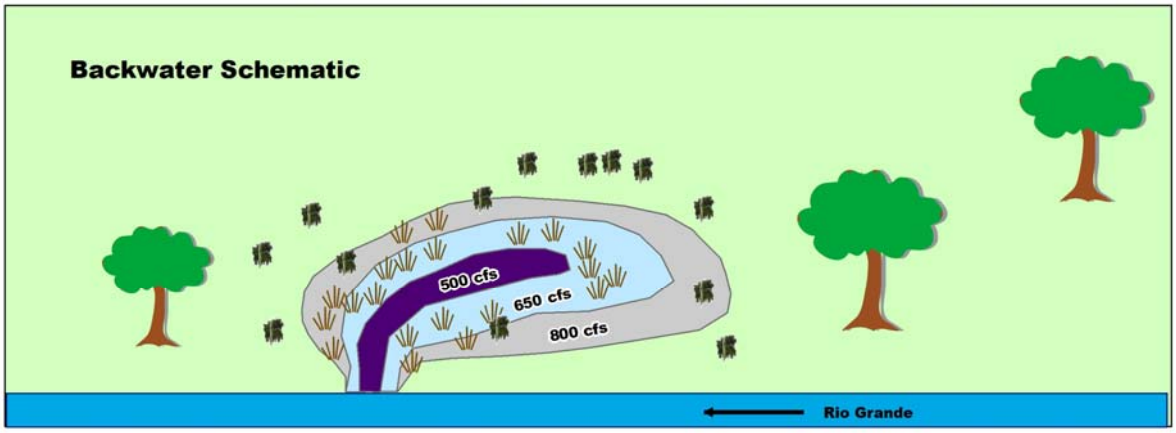


Figure 26. Illustration of a backwater with flow targets that could be used at Selden Canyon.

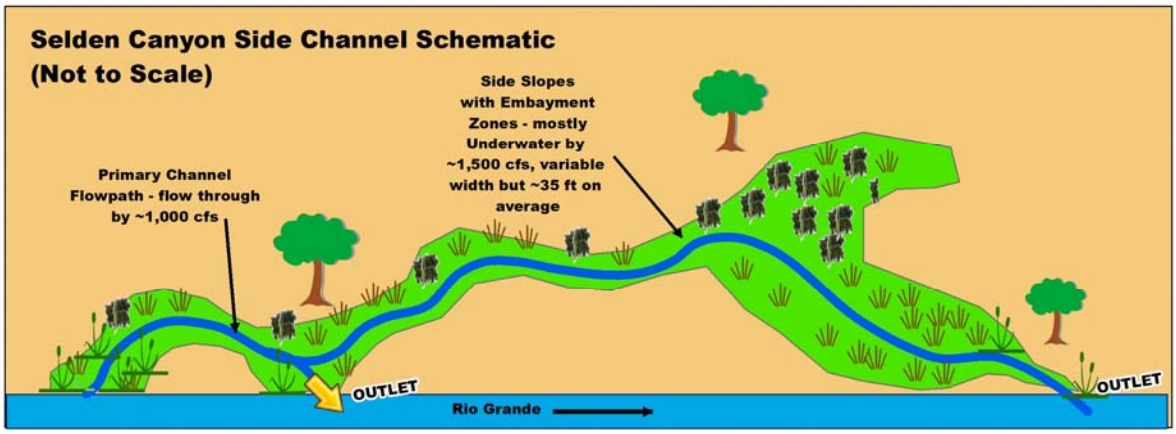


Figure 27. Illustration of a side channel design concept for Selden Canyon.

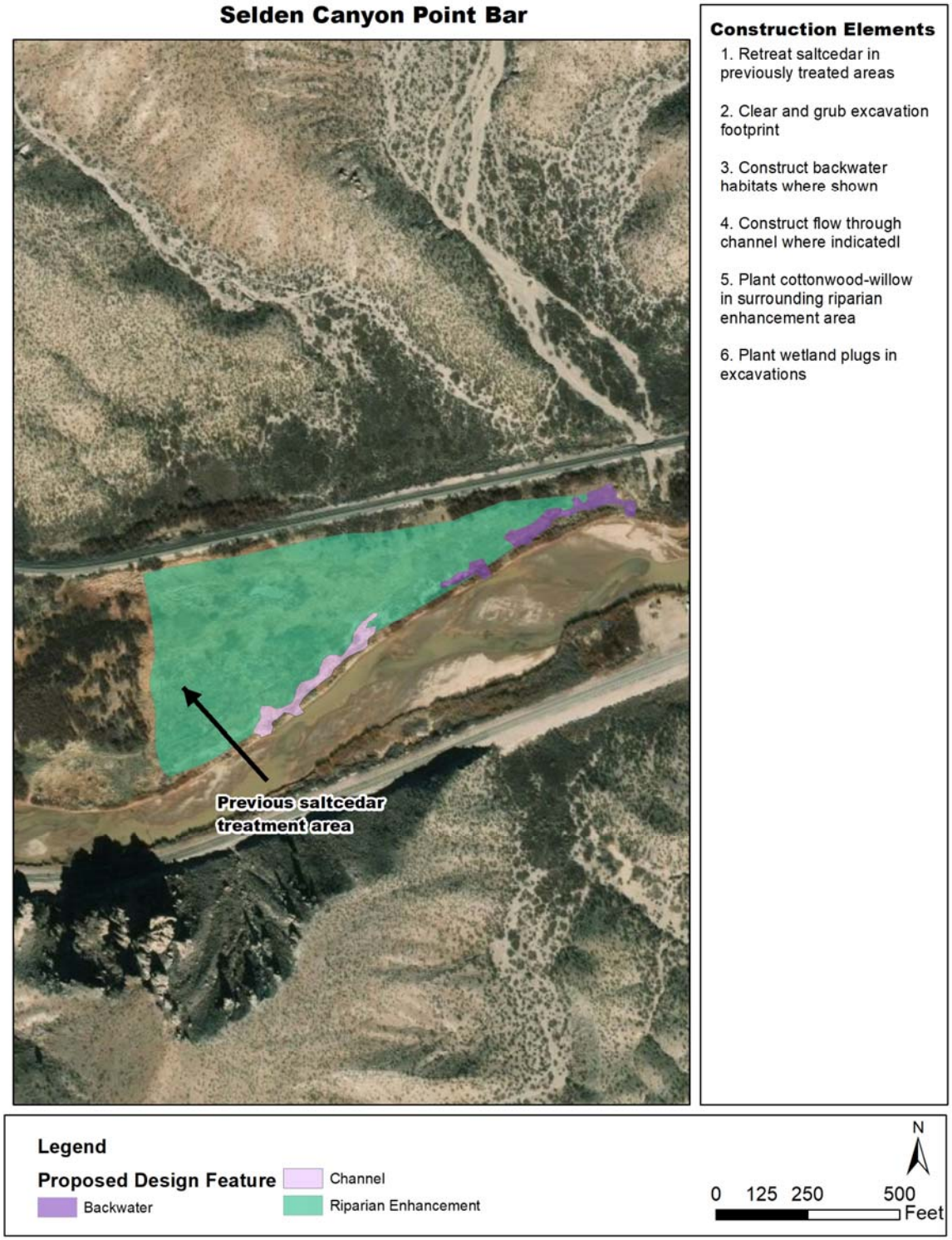


Figure 28. Selden Canyon Point Bar conceptual restoration design map.

3.5 Las Cruces Effluent Site

The Las Cruces Effluent site lies on the east side of the Rio Grande near RM 44. Interstate 10 crosses the Rio Grande near the site and the Las Cruces wastewater treatment plant is east of the project area. The wastewater facility discharges about 8 million gallons of water per day (constant discharge of approximately 5 cfs) and effluent passes directly to the river via a concrete lined channel (**Error! Reference source not found.**). Effluent creates perennial flow in this segment in the Rio Grande that often extends for 2 to 3 river miles through Mesilla Valley State Park before completely seeping into the riverbed. The site is near La Llorona Park and paved walking trails support regular recreation. Propst and Bixby (2018) provide multiple habitat restoration design alternatives that include using effluent discharge to create a new channel or oxbow lake in the east-side floodplain.

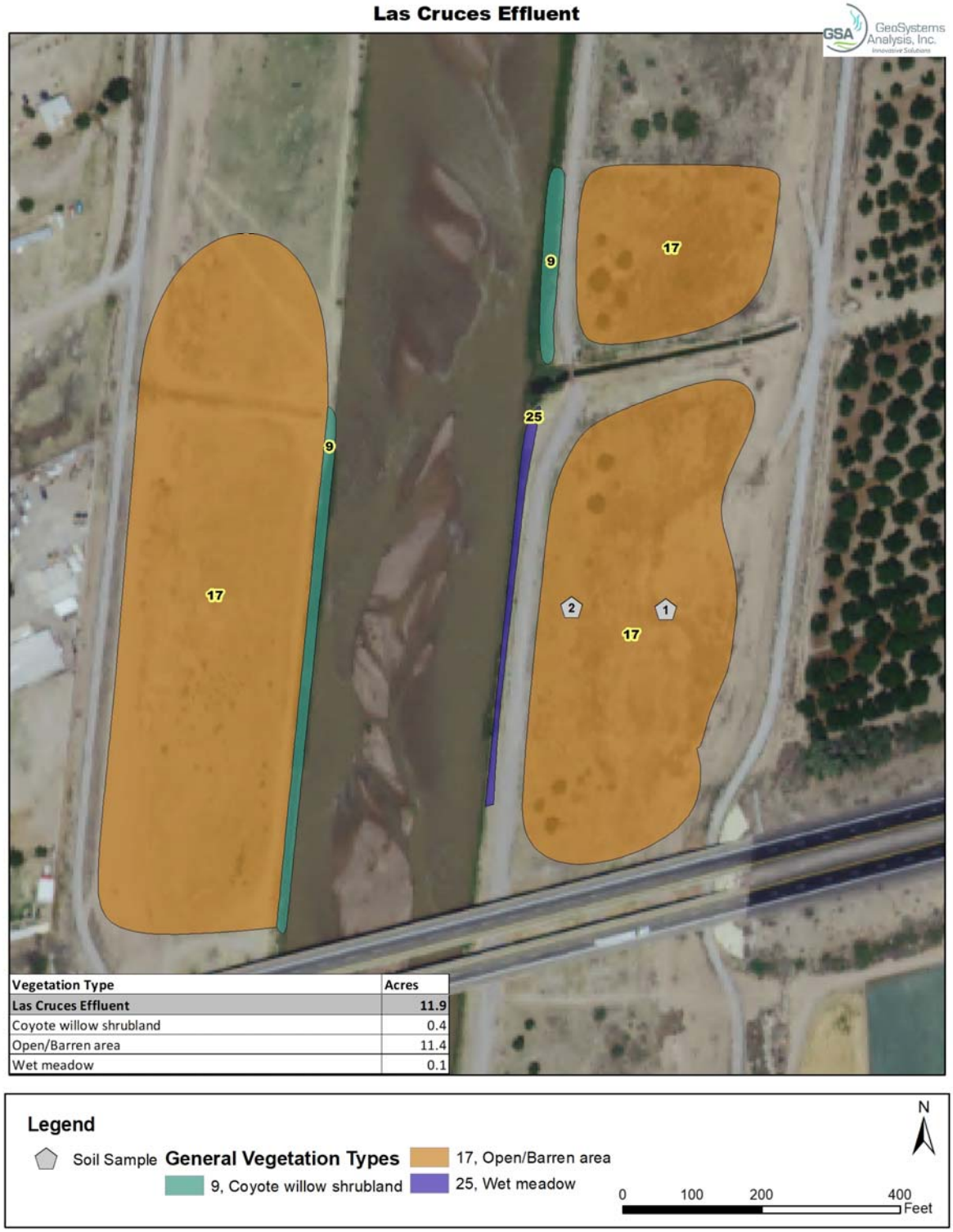
The NM State Engineer considers treated wastewater effluent discharge to the river channel as an offset for groundwater pumping by the treatment facility, and under the current permit, discharge volume must reach the river. Habitat restoration, therefore, must minimize evapotranspiration losses at the site and any proposed design would need to off-set any water depletions (the primary habitat restoration constraint). A gage for measuring inflow and outflow would be recommended to quantify water usage in any habitat restoration feature (if that occurs).

Site Assessment

Three vegetation types are described for this site (**Error! Reference source not found.**). The east side is dominated by a bermudagrass meadow (described as open/barren on the map) with occasional planted cottonwoods situated between the levee and the recreational trail adjacent to the bankline. A small portion of this area is mostly barren (**Error! Reference source not found.**) but supports patches of kochia and sand dropseed. Other occasional herbaceous species include blue grama (*Bouteloua gracilis*), feather fingergrass, silverleaf nightshade, hoary tansyaster (*Dieteria canescens*), and verrucose seapurslane (*Sesuvium verrucosum*). The bankline upstream from the effluent channel is a narrow coyote willow shrubland with some scratchgrass in the herbaceous layer. Downstream of the effluent discharge channel, the bankline is a mix of coyote willow interspersed with cattail, Johnsongrass (*Sorghum halapense*), an occasional saltcedar, spiny chlorocantha, and bermudagrass extending to the river from an adjacent meadow.

The westside floodplain (across the river from the discharge channel) is also dominated by a bermudagrass meadow (open/barren on the map), but with more alkali sacaton than the east side. Occasional saltcedar, Lehman's lovegrass, and kochia also occur. From north to south, a bermudagrass and spiny chlorocantha bankline becomes a healthy coyote willow shrubland with bermudagrass along the ground.

Two soil bore holes were augered at the site as indicated on Table 5. Soils in the top 20 inches appear unnaturally sorted near the river possibly due to previous spreading of soil along the surface, discing, etc. Groundwater was approximately 6 to 6.5 feet below the surface and ribbons of clay to clay loam were encountered 2.5 to 3.5 feet below the ground surface at both locations. Mottles became evident approximately 3.5 feet belowground. Bore Hole 1 was augered in a location that contained a variety of grass species while Bore Hole 2 was exclusively bermudagrass.



Vegetation Type	Acres
Las Cruces Effluent	**11.9**
Coyote willow shrubland	0.4
Open/Barren area	11.4
Wet meadow	0.1

Figure 29. Las Cruces Effluent vegetation map and soil sampling locations.

Figure 30. Representative field photos from the Las Cruces Effluent site. Top: Effluent channel with adjacent terrace where constructed channel is proposed. Bottom left: Rio Grande downstream of the effluent channel. Bottom right: effluent discharge channel.

Table 5. Texture and depth to groundwater observed at the Las Cruces effluent site soil sample locations.

Bore Hole	Depth	Texture	SM	Notes
1	0 to 4	SaL	Slightly moist	
	4 to 6	CL	Moist	
	6 to 18	LS	Very Slightly Moist	
	18 to 40	SaL	Slightly Moist	
	40 to 42	CL	Moist	mottles distinct
	42 to 70	LS	Moist	mottles prominent
	70 to 77	SaL	Very Moist	mottles prominent
	77	GW		
2	0 to 12	L	Moist	Unnaturally sorted, previously mixed?
	12 to 20	SaL	Moist	Disturbance still evident
	20 to 28	SaL	Moist	No evidence of disturbance/mixing
	28 to 31	C	Moist	
	31 to 57	Sand	Slightly moist	mottles distinct
	57 to 72	LS	Moist to very moist	mottles prominent
	72	GW		

Conceptual Design

The habitat creation concept for this site is to install a check structure off the concrete lined channel currently used to convey treated wastewater to the Rio Grande and reroute flows through a relatively long, meandering channel with diverse aquatic habitat features (Figure 31). These aquatic habitats would be enhanced by planting aquatic vegetation within backwaters, and riparian vegetation along the channel margins.

The channel habitat would emphasize variable conditions to support a diversity of native fish species. Springhead habitat at the channel source could provide habitat for the regionally extirpated Mexican tetra (*Astyanax mexicanus*). Large, deep, and structurally complex pools would potentially support large-bodied species such as gizzard shad, bluegill, and largemouth bass (*Micropterus salmoides*). Both bluegills and largemouth bass construct shallow-depression nests in clean substrates near shore in moderately deep water. The primary small-bodied species occupying pool habitats would be fathead minnow and western mosquitofish. With moderate velocity water in close proximity to root mass pools, it might be possible to establish a small population of another regionally extirpated species, Rio Grande chub (*Gila pandora*). Small-bodied fishes and aquatic macroinvertebrates would provide forage for large-bodied occupants of pools. Riffles and runs would provide habitat for red shiner and longnose dace (*Rhinichthys cataractae*). Although recently documented in the region, longnose dace is extremely rare. Channel catfish would mainly inhabit moderate velocity runs but would move into riffles and pools to feed. Rio Grande chub need rapid

velocity riffles with gravel substrates for spawning. Insectivorous longnose dace would occur mainly in riffles but occasionally move into slower-velocity runs.

The principal conceptual design elements for this project site includes:

- Creating a meandering side channel with variable substrate and flow characteristics,
- Installing a check structure to control inflows into the constructed side channel,
- Instrumenting the side channel inlet and outlet with flow volume monitoring equipment that can be used to quantify water loss,
- Installing a pedestrian bridge over the channel,
- Revegetation

Opportunities and Constraints

Because of the proposed complexity, this design feature has the potential to provide habitat for a comparatively large diversity of fish species. It also has the advantage of excluding nonnative fishes by controlling access of fishes from the river. Among the sites, it is the one where restoration of regionally extirpated species has greatest potential. If the mix of habitats includes a spring head and pool-run-riffle sequences with substrates ranging from sand through gravel and cobble, as many as eight locally extant species and two locally extirpated species might inhabit the constructed channel. Cottonwood/willow plantings and cessation of mowing at this site would benefit the southwestern willow flycatcher and yellow-billed cuckoo.

The major constraint at this site is the use of effluent water since it is not USIBWC water and the City of Las Cruces' groundwater permit uses the surface water discharge as offset; water rights would need to be obtained. Per comments at the project scoping meeting, the Las Cruces mayor supports the idea of using effluent to create a meandering channel and has offered water rights to offset potential ET losses in the channel (EBID and USIBWC, personal communication during the scoping meeting). There is also potential to negotiate groundwater for beneficial use with NM State Engineers Office. A local citizens group has proposed a wetland at this site in honor of the late author Charles Bowden. There are no ownership constraints at this site. USIBWC owns the floodplain in the proposed project area and the NM Department of Transportation has a license from USIBWC for the Interstate 10 bridge.

Figure 31. Las Cruces Effluent Site conceptual restoration plan map.

3.6 Mesilla Valley Bosque State Park

Mesilla Valley Bosque State Park (MVBSP), near RM 41, was established in 2005 (Blue Earth 2008). The Park is located on the west side of the Rio Grande near the Town of Mesilla, NM and has been the focal point for other restoration efforts over the past two decades. For example, the Picacho Wetland project was constructed by the Southwest Environmental Center (SWEC), the City of Las Cruces, EBID, and other partners between 2002 and 2005 on a 55-acre tract of land within the Park managed by the New Mexico Department of Game and Fish (NMDGF) (Blue Earth 2008). That project involved excavating two ponds to create aquatic/wetland habitat along the Picacho Drain. A deep 3-acre pond was excavated to a depth of 8 feet with hopes that it would contain perennial surface water to provide year-round aquatic habitat for a variety of species. The deeper pond contains two trenches that connect with the Picacho Drain which allow water to flow between the ponds, the drain, and the Rio Grande. A shallower, adjoining 2-acre shallow pond connects with the deep pond via a culvert and fills when flows in the river are high, thus functioning as a seasonally-flooded meadow. Due to a combination of lower groundwater conditions and sedimentation, the “perennial" pond no longer holds water during droughts and both ponds are being invaded by cattail (Figure 32).

MVBSP provides opportunities for wildlife viewing, recreation, community gatherings, and education. Since the Picacho Wetland Project, numerous other efforts have been completed to revegetate MVBSP with native plant species, enhance wetlands via a mitigation project, and remove saltcedar. Several entities own property within and immediately adjacent to this site, including USIBWC, USFWS, Elephant Butte Irrigation District (EBID), NMSP, NMDGF, and private owners. There is also a current ownership dispute between NMDGF and NMSP. Picacho Drain is located near the entrance by the visitor center and EBID owns the land on either side of the drain. The EBID right of way includes a 50-foot buffer in each direction from the center of the drain (EBID and USIBWC personal communication). USIBWC owns most of the land between Picacho Drain and the Rio Grande except for isolated private land inholdings. NMSP and NMDGF own the land from Picacho Drain to the upland transition (away from the river).

EBID rarely maintains Picacho Drain. It is currently overgrown with cattail and beaver dams frequently interrupt its conveyance efficiency. There is a potential for aquatic/riparian/wetland habitat creation, however; it is crucial that the drain continues to convey irrigation return flows and stormwater back to the river. River flows are perennial through most of the state park due to effluent released from the Las Cruces wastewater treatment facility. Even when the Rio Grande dries, groundwater often surfaces in the drain.

Multiple restoration options for this site were proposed by Propst and Bixby (2018), as well as in an older Resource Management Plan (RMP, Blue Earth 2008). Potential alternatives presented in those reports include deepening existing resaca pool habitats, side channel creation, backwater excavation, and modifications to Picacho Drain. Additional design concepts were shared by EBID and USIBWC during a February 2019 site visit and the recommendations voiced during that meeting are the design concepts largely included in this report.

Figure 32. Representative field photos from the Mesilla Valley Bosque State Park site. Top left: Picacho Drain. Top right: lower (wetter) Resaca pond nearly entirely dry. Bottom: site conditions near proposed channel.

Site Assessment

Twelve different vegetation types are described for the site as indicated in Figure 33. Two large grasslands/wet meadows (described as open/barren areas on the map) occur north of the visitor's center. The grassland on the east side is dominated by alkali sacaton, with over 80% grass cover and low (5-10%) woody species cover, mostly Jimmyweed and wolfberry. A berm divides the alkali sacaton grassland from a saltgrass meadow adjacent to Picacho Drain. The berm includes a narrow Mojave Seablite and kochia dominated strip, with some wolfberry and saltgrass. The saltgrass meadow is 80-90% saltgrass with occasional alkali sacaton, globebmallow, yerba mansa (*Anemopsis californica*); planted honey mesquite, screwbean mesquite, saltbush and wolfberry, with an occasional saltcedar. A band of saltcedar with occasional seep willow line the Picacho Drain west of the saltgrass meadow.

South of the visitor center is a diverse mosaic of different vegetation types. A nearly contiguous narrow band of vigorous coyote willow shrubland occur on the bank line and occasionally also includes saltcedar. A previous wetland mitigation area has matured into a flourishing wet meadow dominated by scratchgrass mixed with common threesquare, arctic rush (*Juncus arcticus*), occasional cattail and yerba mansa. Previously excavated Resaca ponds are shown as open water on the map. The ponds contained large pools of open water during the November 2018 site visit that had dried by our January 2019 site visit. The large triangular area adjacent to the river alternates between a saltgrass meadow, and weedy kochia areas (described as open/barren areas), improving in saltgrass cover in the northern portions, where it is planted with cottonwood and Gooding's willow east of the wetland mitigation area.

The Bosque Ecosystem Monitoring Program (BEMP) has established a monitoring site between the wetland mitigation area and the Picacho Drain. The BEMP area includes a mix of a saltgrass meadow, patches of arrowweed and wolfberry, and a weedy area dominated by Kochia. An untreated saltcedar forest (which remains on a private land inholding) lies south of the BEMP site. The Picacho Drain interior is dense cattail, with occasional seep willow and arrowweed on the drain slopes. The west side of Picacho Drain (between the drain and the upland) is a large treated saltcedar area recolonizing as a large saltgrass meadow with milkweed, sedge, milkweed and a few scattered planted cottonwood and Gooding's willows. The edges of that zone have a mix of seep willow, wolfberry, arrowweed and saltcedar with kochia and saltgrass in the herbaceous layer. South of the wetland meadow are the previously excavated resaca ponds, primarily dry during the January site visit (see Figure 34 for a detailed map of the resaca ponds). Vegetated portions of the ponds have filled with cattail and occasional common threesquare and sedge on the pond margins. A single pampas grass (*Cortaderia sellonana*), listed by the NM Department of Agriculture (NMDA) as a watch list species, was observed on the berm above the Picacho Drain adjacent to the open water portion of the resaca pond.

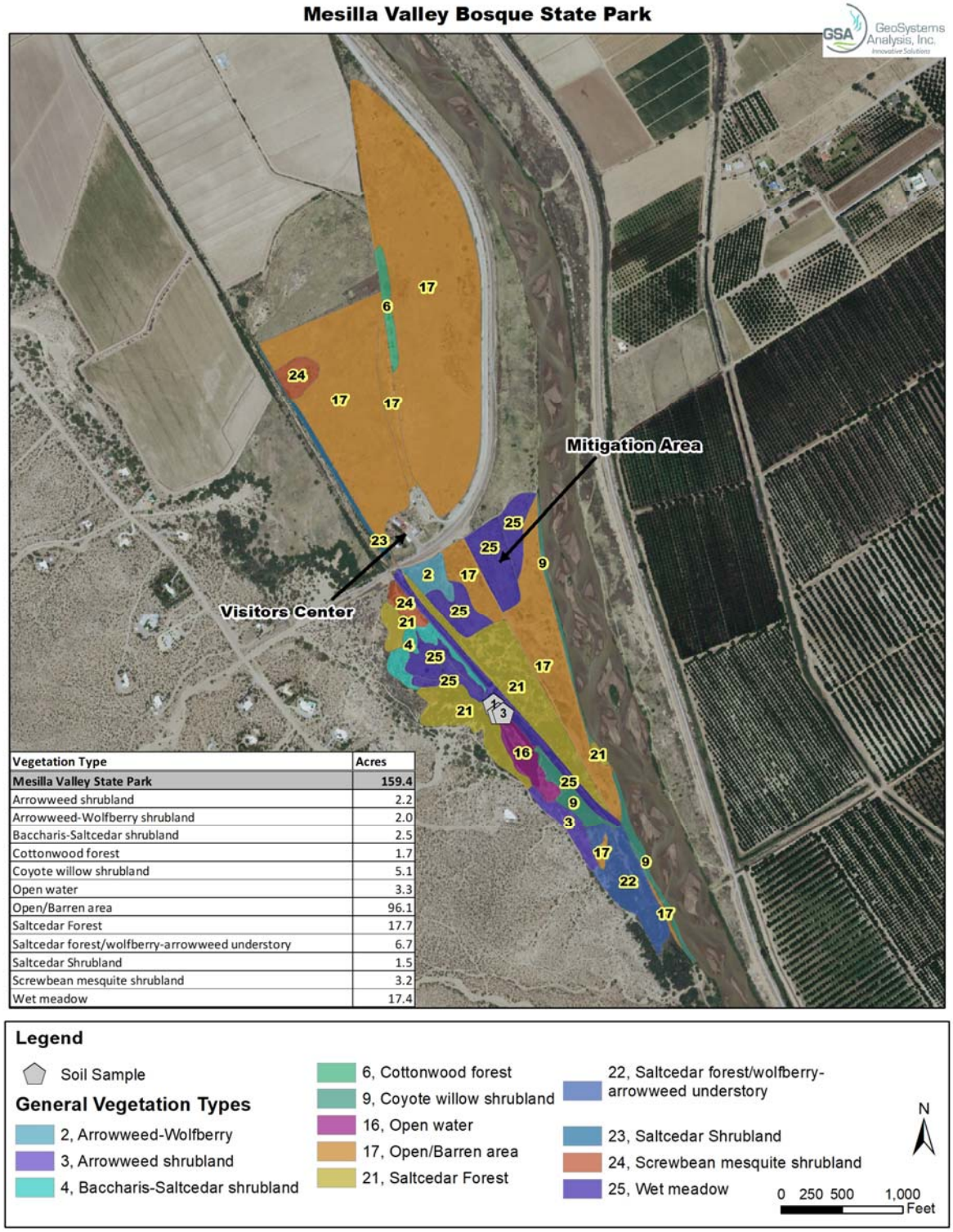
Untreated saltcedar remains between the resaca ponds and the upland includes arrowweed and transitions into wolfberry, honey mesquite and skunkbush sumac as elevation increases. Herbaceous species include mountain pepperweed, fringed twinevine, sacred thorn-apple (*Datura wrightii*), tansymustard and London rocket. South of the resaca ponds is a large coyote willow stand, followed by a mix of saltcedar, wolfberry, arrowweed with some Gooding's willow, honey mesquite

and screwbean mesquite south of where Picacho Drain confluences with the river. Herbaceous species in this area include spike dropseed, kochia, silverleaf nightshade.

A total of four soil bore holes were augered in the constructed resaca ponds, three in the south pond and one in the north pond as indicated in Figure 33 and Table 6. Soil sampling locations in the south pond were intentionally placed in locations with little to no vegetation growth that appeared to be inundated during much of the year. Depth to groundwater ranged from 13 to 20 inches on the day of the site assessment; however, groundwater remained at the surface in a portion of the pond while other portions of the pond the groundwater would have been deeper than 20 inches. Fine sediment has accumulated on the soil surface in the upper 7 to 11 inches at all sites, possibly a result of fines suspended from water entering the ponds via Picacho Drain or overflow from nearby arroyos during storm events.

Table 6. Soil texture and depth to groundwater observed at Mesilla Valley State Park site.

Bore Hole	Depth	Texture	Soil Moisture	Notes
1	0 to 11	SiCL	Moist	South pond
	11 to 20	Sand	Very moist	
	20	GW		
2	0 to 8	SiCL	Moist	South pond
	8 to 19	Sand	Very moist	
	19	GW		
3	0 to 10	CL	Very moist	South pond
	10 to 13	Sand	Very moist	
	13	GW		
4	0 to 7	SiCL	Slightly moist	North pond
	7 to 47	LS	Slightly moist to saturated	
	47	GW		



Vegetation Type	Acres
Mesilla Valley State Park	**159.4**
Arrowweed shrubland	2.2
Arrowweed-Wolfberry shrubland	2.0
Baccharis-Saltcedar shrubland	2.5
Cottonwood forest	1.7
Coyote willow shrubland	5.1
Open water	3.3
Open/Barren area	96.1
Saltcedar Forest	17.7
Saltcedar forest/wolfberry-arrowweed understory	6.7
Saltcedar Shrubland	1.5
Screwbean mesquite shrubland	3.2
Wet meadow	17.4

Figure 33. Mesilla Valley Bosque State Park vegetation map.

Figure 34. Map showing the condition of the resaca ponds during our January site visit.

Conceptual Design

The conceptual design for this project site includes a diversity of habitat features. The first proposed feature is an excavated channel between the Rio Grande and the Picacho Drain to enhance both riparian and aquatic habitat (Figure 35). Several shallow depressions (swales) would be excavated along the length of this channel and densely planted with coyote willow, cottonwood and Gooding's willow. The channel would be intentionally situated to provide water to new and existing riparian plantings plus inundate an existing wetland mitigation site Figure 36). Aquatic habitat in Picacho Drain would be enhanced by controlling cattails that currently dominate the drain and constructed a series of stepped terraces along the eastern edge of the drain that would be inundated under a range of discharges (Figure 37). The water in the Picacho Drain would be from two principal sources, high-flows from the Rio Grande and storm water during summer monsoon flows.

The restoration designs emphasize habitat features for a wide-variety of native fish species. The channel will begin to inundate at relatively low flows (e.g. 200 cfs). Among large-bodied fishes, longnose gar (*Lepisosteus osseus*; regionally extirpated), river carpsucker, and channel catfish could potentially persist in constructed channel/enhanced drain habitats. In addition, bluegill and largemouth bass currently occupy the Resaca and would benefit from habitat improvements. Longnose gar inhabits low-velocity rivers and oxbow lakes and prey on co-occurring fishes while river carpsucker is generally more common in water of somewhat greater velocity where it moves about feeding on bottom organic matter. Western mosquitofish and fathead minnow would occur in both drain and constructed channel habitats. Red shiner would mainly occur in the constructed channel when it had water.

The principal conceptual design elements at this site includes:

- Creation of a side channel from the Rio Grande to Picacho Drain,
- Excavation and planting of willow swales that integrate with the channel,
- Widening and terracing the side slopes of Picacho Drain,
- Excavate cattail in Picacho Drain and the resaca ponds,
- Install new irrigation check structure in Picacho Drain,
- installation of pedestrian bridge over the channel,
- revegetation

<u>Opportunities and Constraints</u>

Like the Las Cruces Effluent site, this proposed project will provide a diverse mix of habitats and consequently would be able to support a comparatively diverse fish assemblage. Groundwater seepage maintains near permanent surface water in portions of the drain.

This conceptual design option has the potential to create interior floodplain and side channel habitats that are rare to nonexistent in the RGCP. We expect these features could become refuge habitats for numerous species. Proposed elements also integrate with previous restoration actions at the Park plus assist with controlling sediment deposition from tributary arroyos in the Park to prevent sedimentation of aquatic and wetland habitats while maintaining delivery of precipitation runoff to the Park and the Rio Grande. Habitat for native wetland- and riparian-dependent wildlife, including southwestern willow flycatcher and yellow-billed cuckoo will be improved.

This site is potentially complicated by a proposed land transfer of the MVBSP from NMSP to NMDGF. Picacho Drain must be maintained for agricultural return flow and floodwater protection; thus, proposed designs must ensure the facility is accessible for periodic maintenance and comply with EBID policy.

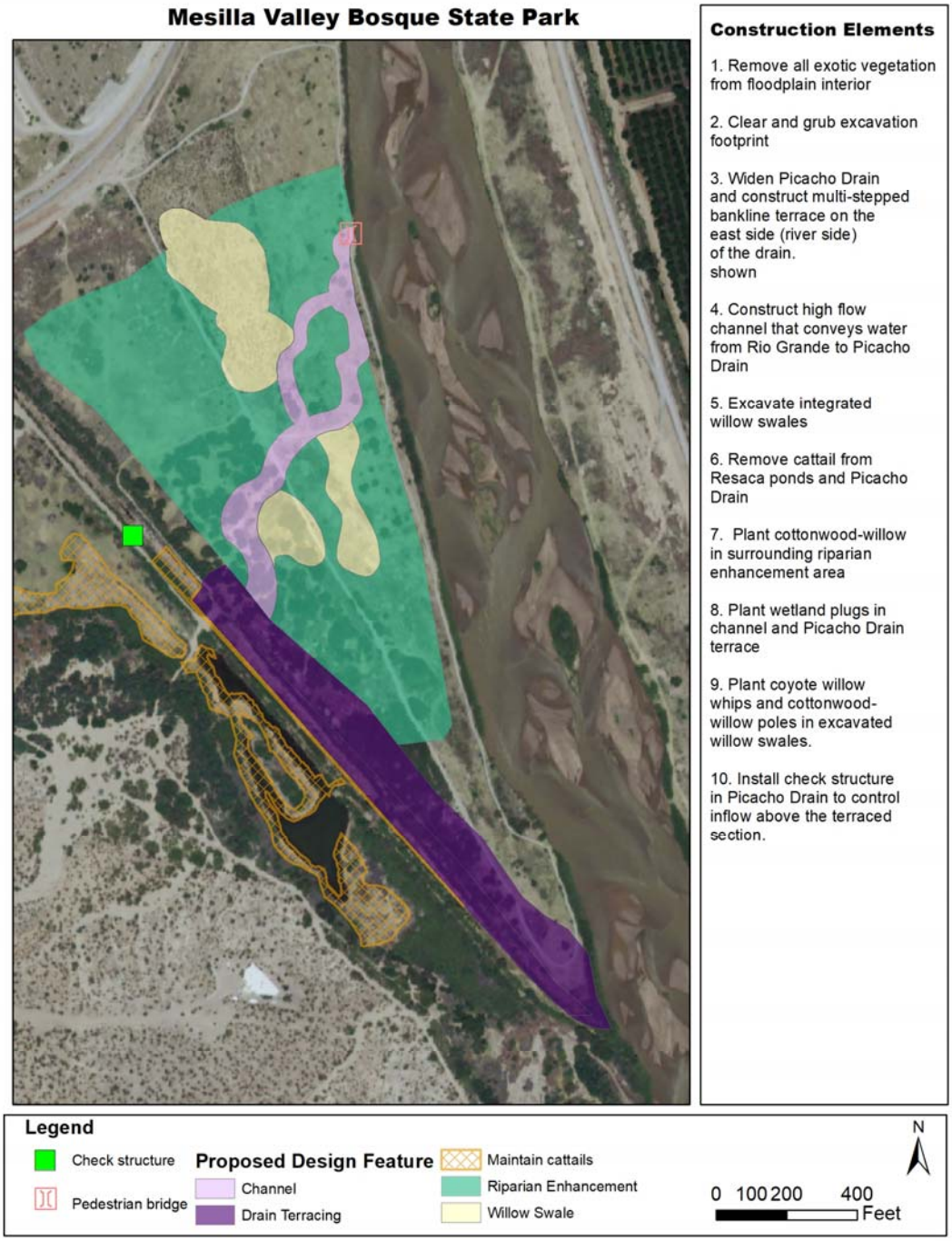


Figure 35. Mesilla Valley State Park conceptual restoration design map.

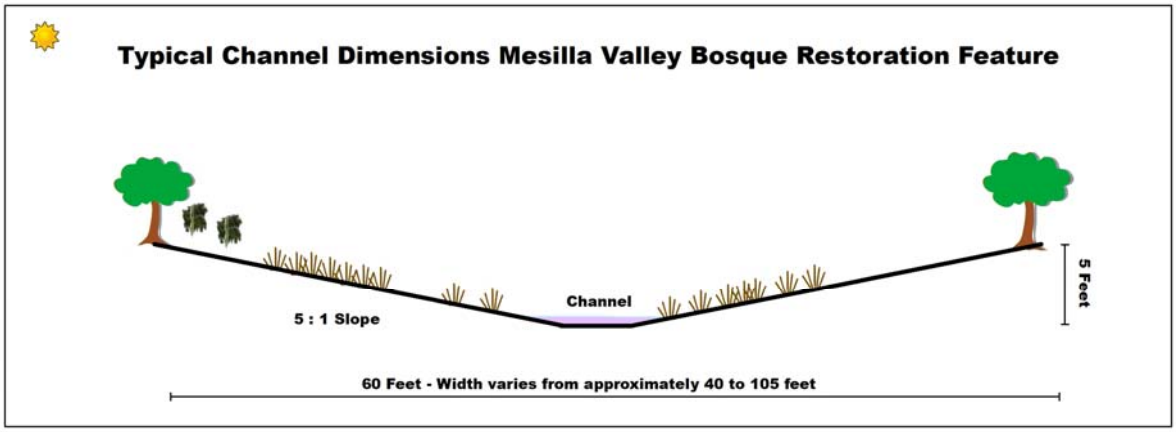


Figure 36. Cross-section of conceptual restoration design for the constructed channel at Mesilla Valley Bosque State Park.

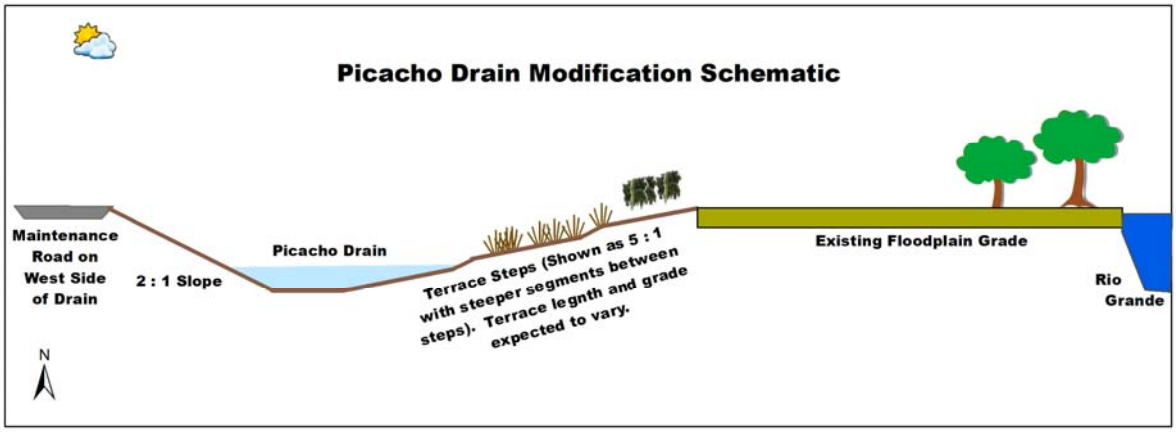


Figure 37. Cross-section showing conceptual design for habitat enhancements along the Picacho Drain.

3.7 Downstream of Courchesne Gage

The Downstream of Courchesne Gage site is near RM 1 in El Paso, TX. The Texas Department of Transportation (TXDOT) recently reconstructed highway 85 near this location; USIBWC's original design included a flood wall or levee along the highway but that flood control feature may no longer be required. Stormwater runoff enters the site below the highway via two 8 ft by 8 ft box culverts, and outlets do not effectively convey water across the site. At the current invert elevation, culverts from below the highway provide supplemental water and promote wetland expansion. A trench was excavated between January and March 2019 site visits to improve stormwater drainage through the site and more effectively return water to the Rio Grande. National wetlands inventory data indicates that the site supported jurisdictional wetland conditions prior to recent modifications of the highway.

The site currently supports a native herbaceous wetland complex with saltcedar largely confined to bankline portions (Figure 39). Groundwater is shallow and the Rio Grande in this reach is perennial due to discharge from Sunland Park Wastewater Treatment Plant. El Paso Irrigation District will not currently allow planting woody vegetation at this site and is encouraging more aggressive mowing at this location. Based on the LiDAR data, much of the site is situated 2 to 4 feet above the riverbed. Hydraulic models indicate inundation has the potential to begin when flows reach approximately 1,400 cfs, particularly with relatively minor bankline excavation (Figure 38).

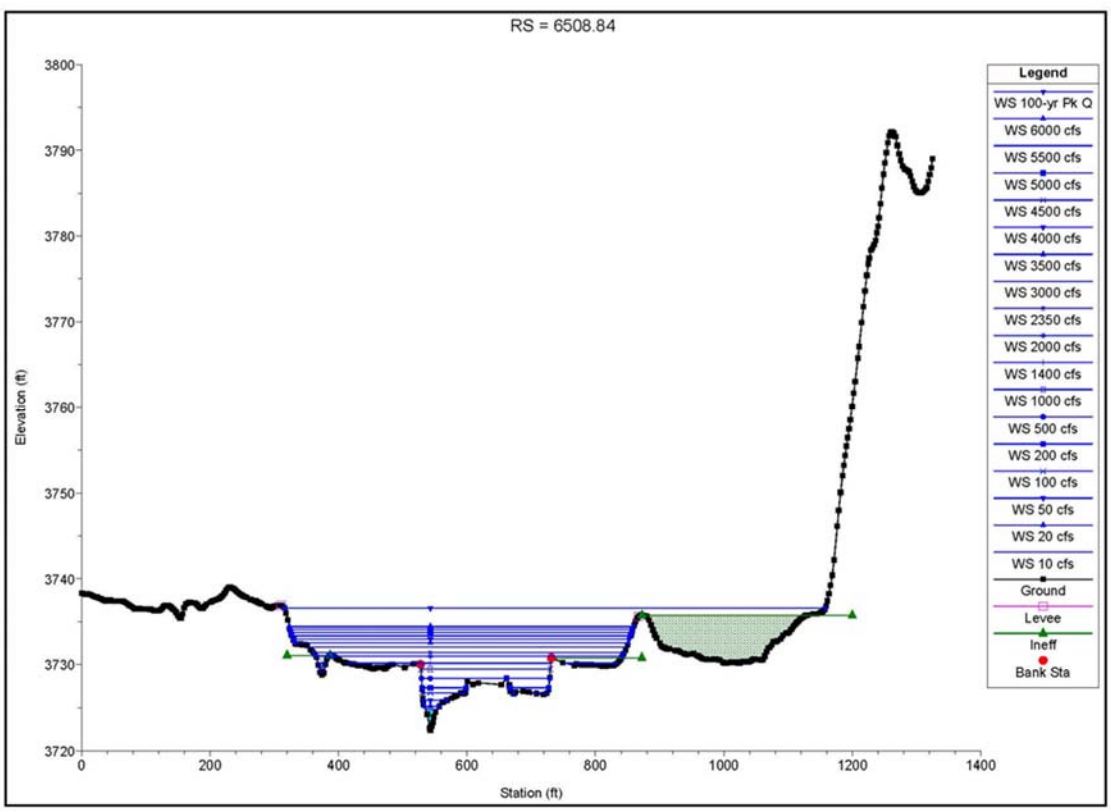


Figure 38. Representative channel cross-section of Rio Grande at the Downstream of Courchesne Gage site showing predicted surface-water elevations under a range of discharges.

Site Assessment

Five vegetation types were identified at the Downstream of Courchesne site, but nearly the entire site is a derivative of a saltgrass/scratchgrass wetland meadow, with varying degrees of overstory cover (Figure 39 & Figure 40). Open/barren areas dominated by kochia and Mojave seablite are found adjacent to the road in locations that appear to have been used for staging equipment during recent construction on the adjacent highway. Two trenches have been excavated to drain water from below the highway towards the river. The upstream trench contained water while the downstream trench was dry during the November and January site visits.

Marsh habitats dominated by a mix of cattail and hardstem bulrush occur immediately downstream of the northern drainage trench and numerous pools of open water were observed during the January site visit. Some common reed (*Phragmites australis*) can also be found in the marshy areas, as well as some perennial pepperweed (*Lepidium latifolium*) listed as a Class B noxious weed in NM (but not in TX). Herbaceous communities become drier moving away from the upstream drainage trench, but the diversity of herbaceous vegetation also increases. Marsh habitats disappear and transition into sedge (*Carex* sp.) communities, wild licorice (*Glycyrrhiza lepidota*), Indianhemp (*Apocynum cannabinum*), Canada wild rye (*Elymus canadensis*), dock (*Rumex* sp.).

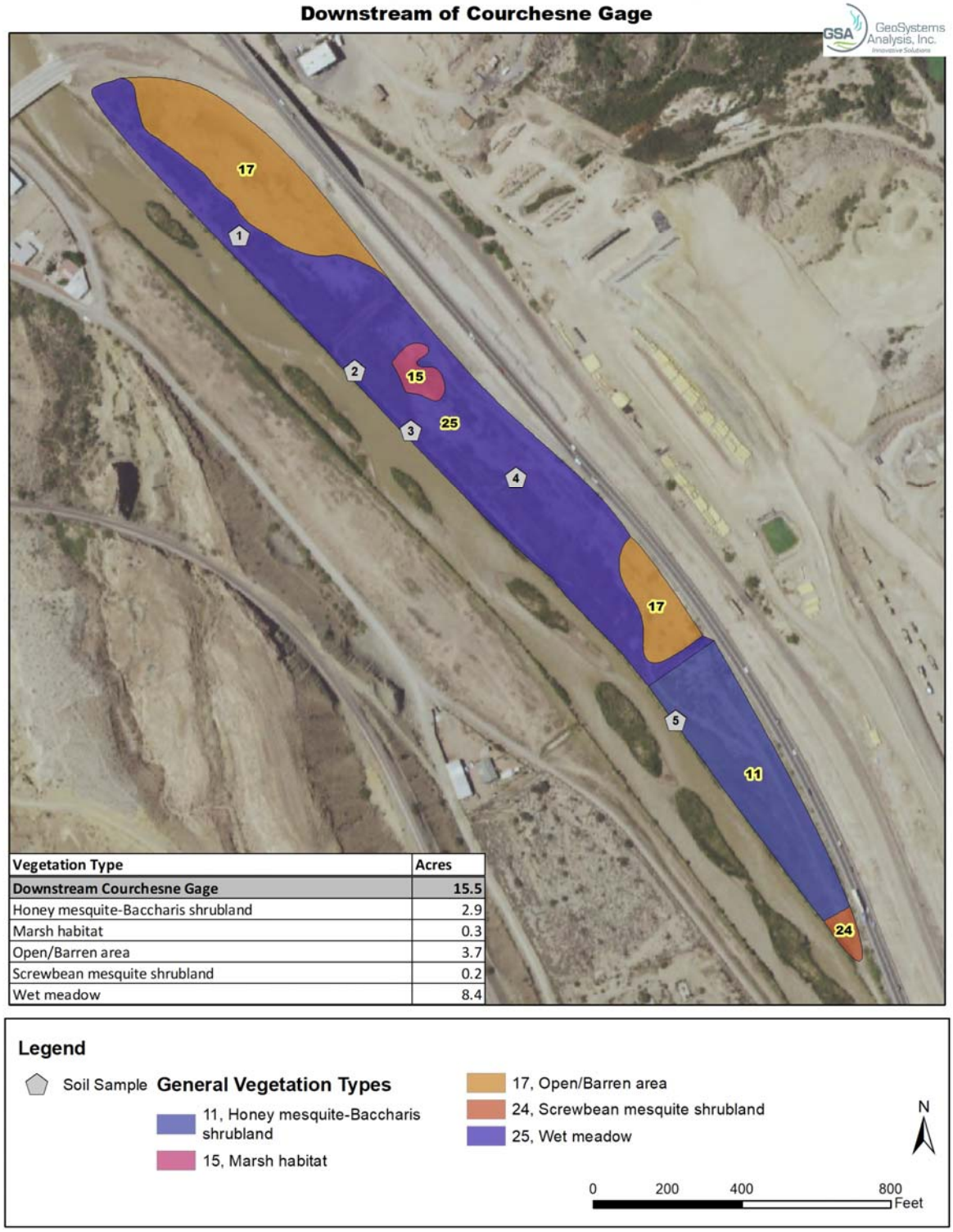
Bankline, slightly drier, portions of the wetland meadow include a more diverse mix of species and more woody vegetation. Saltcedar is the most abundant woody species, followed by seep willow. Cattail and spiny chlorachantha were observed on the active channel margin.

The downstream drainage trench is lined with seep willow. South of the channel, the site becomes significantly drier and becomes a honey mesquite-Baccharis shrubland. Saltcedar nearly disappears in this zone while saltgrass/scratchgrass remain dominant in the herbaceous layer. Other herbaceous species south of the lower drainage channel include bristlegrass, milkweed (*Asclepias* sp.), giant sacaton, and silver beard grass (*Bothriochloa laguroides*). In the downstream-most end, screwbean mesquite becomes more dominant, but with a diverse mix of other woody species like seep willow, honey mesquite, Jimmyweed, and Jerusalem thorn (*Parkinsonia aculeata*). The southernmost end of the site described as a screwbean mesquite shrubland continues to become dryer. There is more saltcedar in this map unit compared to the bordering honey mesquite-Baccharis shrubland.

Soil bore holes were augered at five locations (Figure 39 and Table 7). Groundwater was reached in three holes while gravels blocked auger penetration at the other two locations. Pools of water occur in portions of the site and groundwater was detected within 6-inches of the surface throughout that area. Groundwater occurred within 5-feet at bore holes 1 and 3. Favorable soil moisture was found throughout the profile in every hole and mottling was evident by 2 to 2.5 feet at every auger location. Fine textured soils, with variable thickness and depth, were encountered at each sample. As would be expected given the abundance of salt tolerant plant species, surface salts were observed at several locations and most concentrated in drier zones near the bankline.

Table 7. Texture and depth to groundwater observed at soil auger locations within downstream of Courchesne Gage site.

Bore Hole	Depth	Texture	Soil Moisture	Notes
1	0 to 4	LS	Slightly moist	
	4 to 11	SaL	Moist	
	11 to 22	Sand	Slightly moist	
	22 to 25	SiC	Very Moist	
	25 to 30	SaL	Moist	Mottles many, distinct
	30 to 58	Sand	On moisture gradient	Gleying towards bottom, strong mottling throughout this section, increase with depth
	58	GW		
2	0 to 8	CL	Moist	Salts evident, saltgrass, scratchgrass
	8 to 10	GrSa	Moist	Gravels 0.5 inch
	10 to 16	SaC	Very Moist	
	16 to 19	C	Moist	Very heavy soil
	19 to 22	GrSa	Moist	Could not penetrate, groundwater not determined
3	0 to 2	Sand	Moist	Barren with heavy surface salt, many salt crystals through top 2 inches
	2 to 10	SiL	Moist	Salts
	10 to 13	C	Moist	
	13 to 29	GrLS	Moist	Surprised was able to penetrate
	29 to 37	SaC	Moist	Mottles many, prominent
	37 to 41	C	Moist	Mottles many, prominent
	41 to 56	Sand	On moisture gradient	Prominent mottling throughout more abundant with depth, gleying towards bottom,
	56	GW		
4	0 to 3	SiCL	Near saturated	
	3 to 6	C	Saturated	Filled with water on tarp
	6	GW		Near pools of standing water, thick saltgrass
5	0 to 5	CL	Dry	
	5 to 14	CL	Moist	Lots of roots
	14 to 17	GrSa	Slightly moist	Hit rock and couldn't penetrate



Vegetation Type	Acres
Downstream Courchesne Gage	**15.5**
Honey mesquite-Baccharis shrubland	2.9
Marsh habitat	0.3
Open/Barren area	3.7
Screwbean mesquite shrubland	0.2
Wet meadow	8.4

Figure 39. Downstream of Courchesne Gage vegetation map.

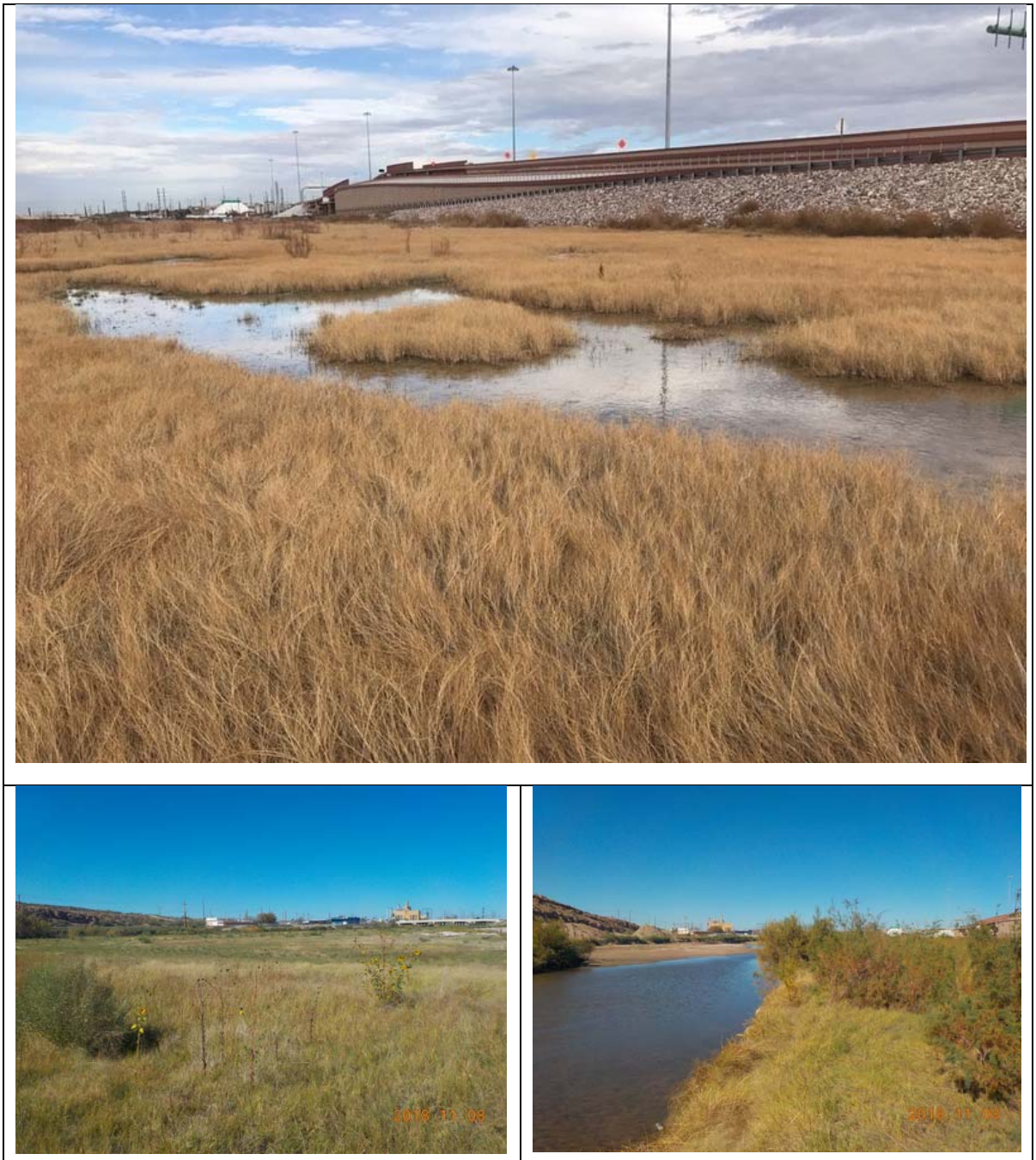


Figure 40. Representative field photos from the downstream of Courchesne Gage site. Top: standing water in an herbaceous wetland. Bottom left, typical wet meadow vegetation conditions. Bottom right: saltcedar along bankline.

Conceptual Design

The conceptual design at this site focuses primarily on creating a meandering channel that routes stormwater from below the highway, through the site, and into the Rio Grande. Design elements would include benches, embayments, and pools within the channel and along the margins (Figure 41 & Figure 42). Supplemental herbaceous wetland plug plantings and low density, overhanging woody vegetation will increase native wetland species diversity and aquatic habitat complexity at the site.

The channel habitat emphasizes variable conditions to support a diversity of native fish species. Large, deep, pools can potentially support large-bodied species such as gizzard shad, bluegill, and largemouth bass. The primary small-bodied species occupying pool habitats would be fathead minnow and western mosquitofish. With moderate velocity water in close proximity to root mass pools, it might be possible to establish a small population of another regionally extirpated species, Rio Grande chub (Gila pandora). Small-bodied fishes and aquatic macroinvertebrates would provide forage for large-bodied occupants of pools. During periods of elevated flow when wetland and terrestrial vegetation is flooded, fish species that occur in the adjacent river would also move onto the wetted terraces. The most likely river occupants that would move onto the wetted terraces would be western mosquitofish and red shiner. If the terrace was wetted for a sufficient time both species might spawn on it. Primary conceptual design elements include:

- Excavating floodplain terraces along the active Rio Grande channel
- Planting native riparian-wetland plant species
- Treating saltcedar and perennial pepperweed
- Conserving unique, herbaceous wetlands that currently inhabit the site

<u>Benefits and Constraints</u>

This area certainly has potential for multiple sites and expansion of restoration activities in the future, including wetland mitigation sites, or even creation of a wetland mitigation bank. While future mitigation requirements still need to be determined, USIBWC is considering using a portion of the site for mitigation for levee floodwall construction. The property is owned by USIBWC.

Challenges at this site include buried utilities, future floodwall or levee construction, and uncertainty surrounding how TXDOT may respond to drainage challenges below the highway. Future restoration activities will need to be coordinated with TXDOT, as there is potential to integrate storm water outfall improvements with habitat restoration. Recent trenching of new drainages through the site could potentially impact existing wetlands, thus conserving the high-quality wetlands that currently inhabit the site should be considered high importance.

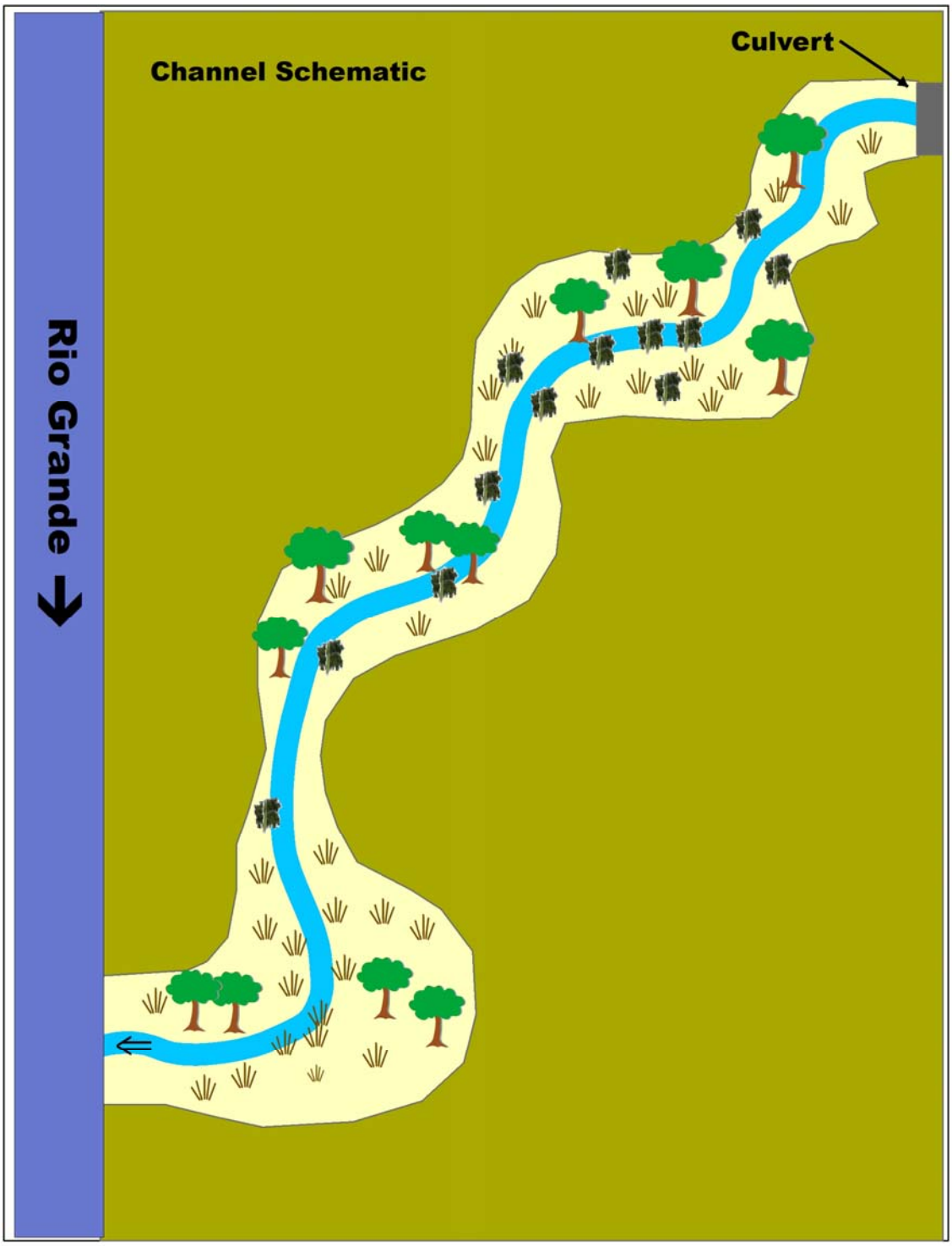


Figure 41. Conceptual meandering channel at Downstream of Courchesne.

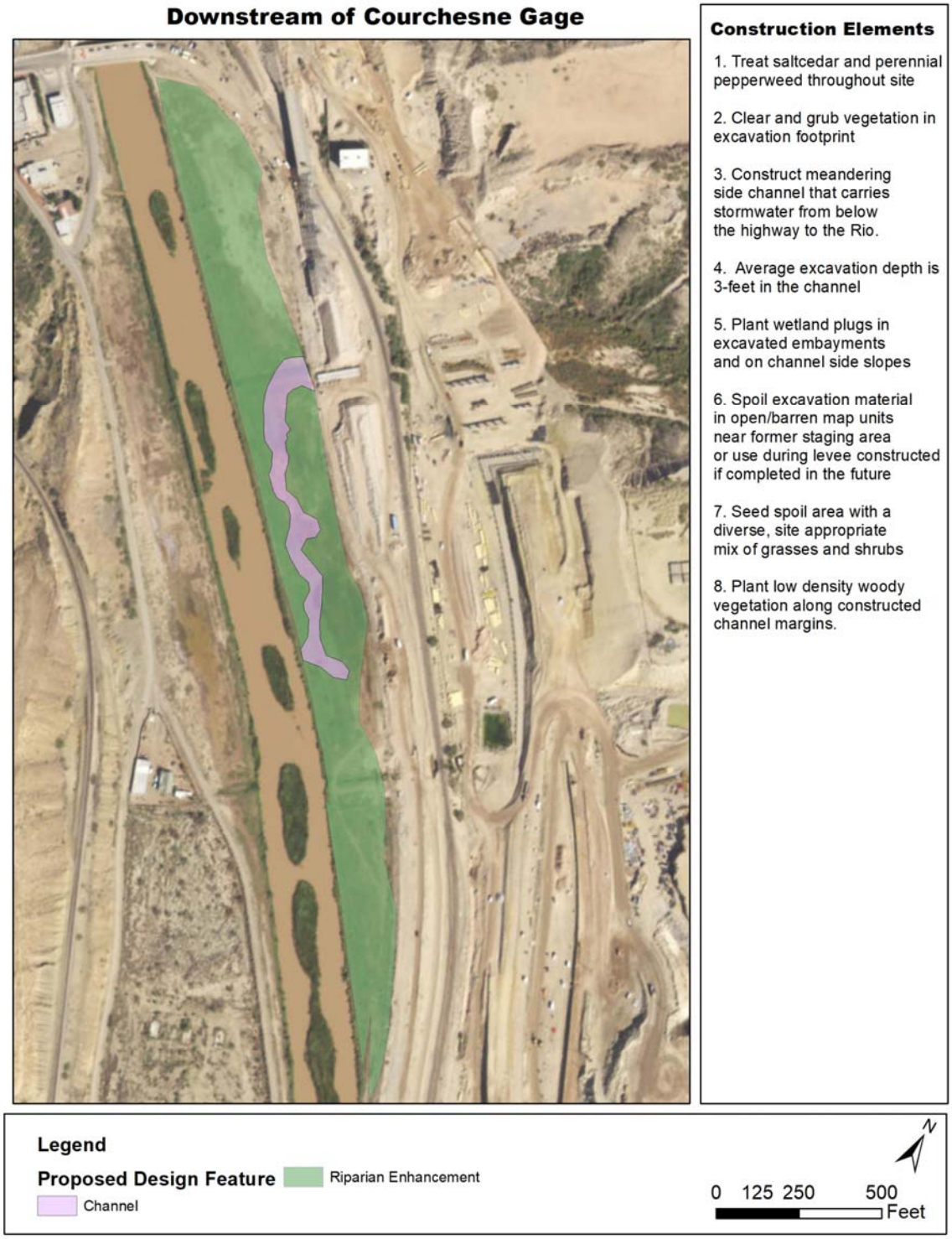


Figure 42. Downstream of Courchesne Gage conceptual restoration map.

3.8 Additional Sites and Concepts

Several additional sites were assessed during this process but eliminated from further evaluation due to various uncertainties often related to land ownership, future proposed projects, etc. that will predictably delay construction or prevent the project from moving forward altogether. However, several of these locations do have high potential for future restoration projects, most notably the NeMexas Siphon and El Paso Electric/Montoya Drain project sites. Observations from the November 2018 and January 2019 site visits along with general descriptions of these sites are included in the following subsections.

3.8.1 NeMexas Siphon

NeMexas Siphon site is near RM 7. A spur dyke parallels the Rio Grande and a large cattail marsh has formed behind the dyke in a previously excavated wetland (part of the EBID Dias Lagos project). Managing agencies are currently considering whether levee reconstruction is required, and if that happens, it would cause expansion of the levee footprint into adjacent riparian habitats. A siphon under the levee carries stormwater into the river. While this location has potential for integrating storm water retention, wetland construction, and habitat restoration; numerous potential obstacles exist related to land ownership and possible levee reconstruction. The property is currently in an ownership dispute between Sunland Park, NM and the Boy Scouts of America and litigation may be required. Due to these uncertainties, this site was removed from the restoration alternatives considered and no conceptual restoration design was developed. However, prior to eliminating this alternative, GSA staff completed a site assessment and those observations are included below.

Riverside portions contain dense saltcedar and wetlands that have formed in excavated borrow pits within the riparian vegetation. A portion of the site has recently burned. Soil and groundwater conditions appear to support a restoration approach that includes Goodding's willow forests, herbaceous wetlands, aquatic habitats, and excavated backwaters, that in combination, would be highly beneficial for the southwestern willow flycatcher and yellow-billed cuckoo. The Rio Grande riverbed was entirely dry at this location during the November 2018 and January 2019 site visits.

Site Assessment

Eight vegetation types are described for the assessment area at NeMexas Siphon (Figure 43). The site was previously vegetated with dense saltcedar, coyote willow, and cottonwood; however, the site burned approximately five years ago (Figure 44). Remaining stands of dense, mature saltcedar still occur in unburned areas, such as the upstream and western segments of the site. Saltcedar (forest or shrubland) map units are nearly saltcedar monocultures in the interior, but mix with wolfberry, fourwing saltbush, Mojave seablite and seep willow on the outer edges, and herbaceous species such as mountain pepperweed (*Lepidium montanum*), Russian thistle, Canadian horseweed (*Conyza canadensis*) and kochia also occur on the outside edge of the near closed saltcedar canopy. Open water wetlands have formed in borrow pits excavated within the saltcedar shrublands.

Marsh habitats and a tiered slope to the west were constructed as part of the EBID Dias Largos project. The marshes are cattail dominated with occasional common threesquare on the outer fringe at the toe of the slope. Adjacent to the cattail marsh are remnants of alternating patches of planted cottonwood and coyote willow swales (shown as an open/barren area on our map), but plantings have low survival and vigor. Multiple furrows tier upslope with planted desert willow

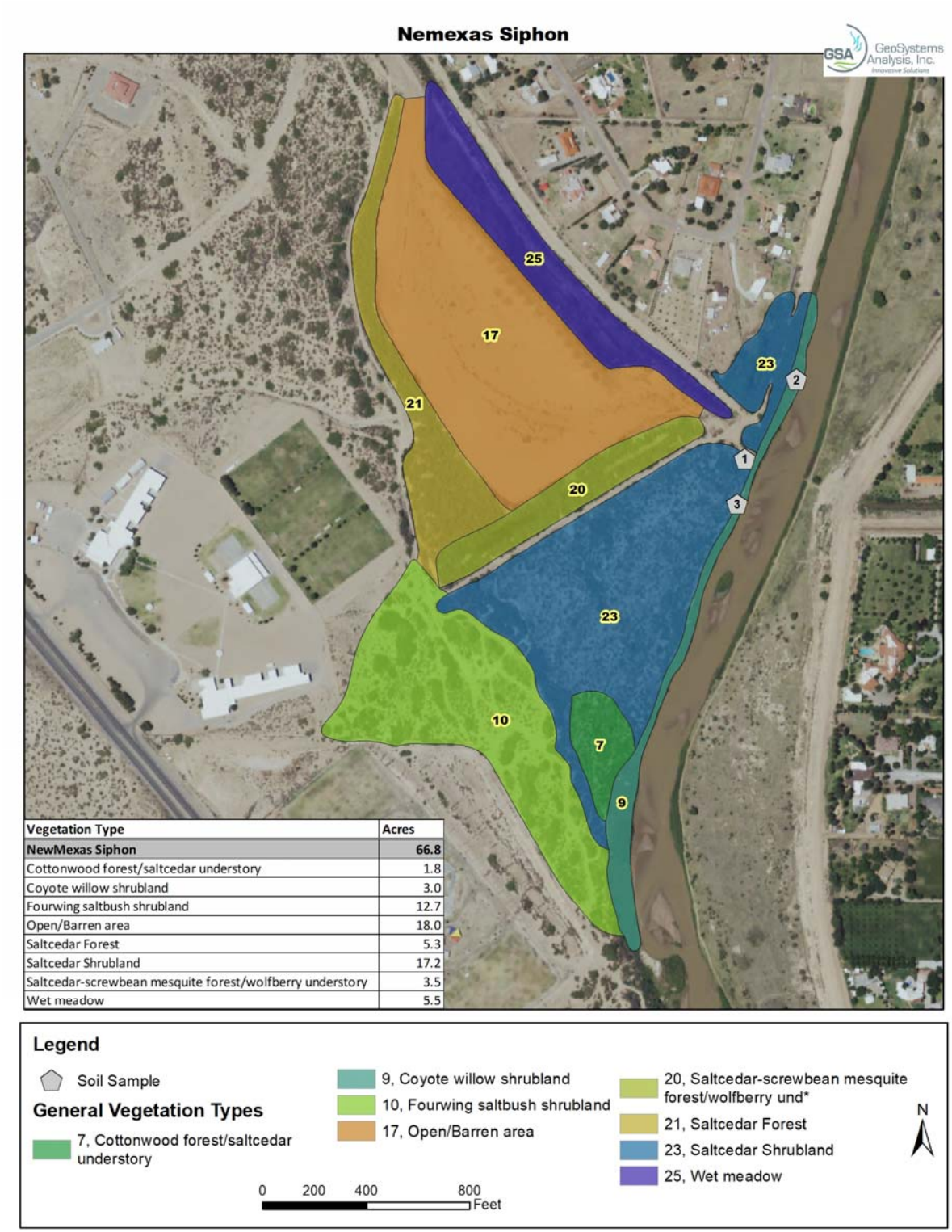
(*Chilopsis linearis*), wolfberry, fourwing saltbush, honey mesquite and screwbean mesquite. Planting survival appears highly variable throughout this revegetation site. Saltcedar is recolonizing the tiers, and the herbaceous layer is mostly barren and weedy.

Other portions of the site's interior are primarily dominated by saltcedar and wolfberry with occasional seep willow and screwbean mesquite, plus honey mesquite. While the bankline is a narrow band of healthy coyote willow, widening at the southern end to form nice southwestern willow flycatcher habitat. A few large cottonwoods remain in the burn along with occasional screwbean mesquite and coyote willow. Surface salts are visible in much of the burned area.

Three holes were augered at the site (Figure 43 and Table 8). Depth to groundwater ranged from about 5 to 7.5 feet though mottles were evident by about 2 feet at each sampling location. Soil texture was highly variable by site and with depth.

Table 8. Texture and depth to groundwater observed at soil sampling locations within the NeMexas Siphon site.

Bore Hole	Depth	Texture	Soil Moisture	Notes
1	0 to 8	LS	Slightly moist	Cottonwood and Baccharis on fan
	8 to 10	SaL	Moist	
	10 to 14	C	Moist	
	14 to 20	SaL	Moist	Mottles distinct
	20 to 30	LS	Moist	very fine loamy sand
	30 to 33	SaL	Moist	Mottles distinct
	33 to 35	C	Moist	
	35 to 45	L	Moist	Mottles prominent
	45 to 66	LS	Moist	Mottles prominent
	66 to 68	C	Moist	
	68 to 87	Sand	Very Moist	On moisture gradient, gleying at 82
	87	GW		
2	0 to 27	CL	Moist	No evidence of salt. Coyote willow and saltcedar
	27 to 33	SaL	Moist	Fine, Mottles distinct
	33 to 44	Sa	Moist	Mottles distinct
	44 to 47	L	Moist	Mottles prominent
	47-79	Sa	Moist	Mottles prominent
	79	GW		
3	0 to 17	SaL	Moist	In willow bankline, Mottles
	17 to 20	Sa	Moist	Mottles prominent
	20 to 28	SaL	Moist	
	28 to 30	Sa	Moist	
	30 to 36	L	Moist	
	36 to 65	SaCL	Moist	Mottles distinct
	65	GW		



Vegetation Type	Acres
NewMexas Siphon	**66.8**
Cottonwood forest/saltcedar understory	1.8
Coyote willow shrubland	3.0
Fourwing saltbush shrubland	12.7
Open/Barren area	18.0
Saltcedar Forest	5.3
Saltcedar Shrubland	17.2
Saltcedar-screwbean mesquite forest/wolfberry understory	3.5
Wet meadow	5.5

Figure 43. NeMexas Siphon vegetation map.

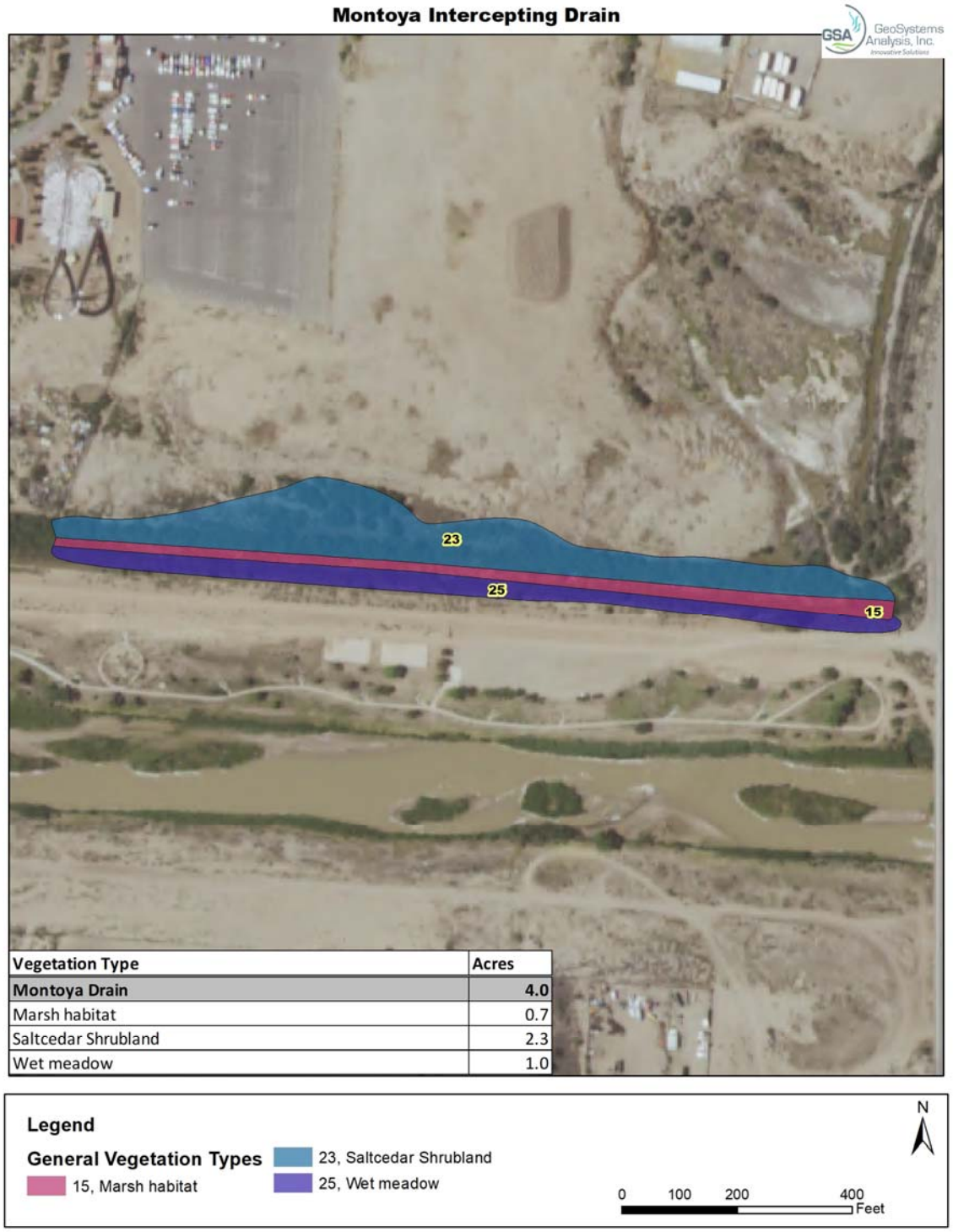
Figure 44. Field photos from NeMexas Siphon site. Top: burn area. Bottom left: mature cottonwood tree outside the burn. Bottom right: constructed wetland at previous EBID site.

3.8.2 Montoya Intercepting Drain

The Montoya Intercepting Drain site is an EBID owned irrigation facility near RM 3. The drain does not appear to be actively maintained and is currently overgrown with cattail (Figure 45). Depending on EBID's long term vision for this facility, the site has potential for aquatic habitat creation in the drain, possibly integrated with water conveyance requirements. Groundwater is shallow in the vicinity and standing water was observed in the facility during our November 2018 and January 2019 site visits. This site was removed from the restoration alternatives considered because better potential sites are available, the site is owned by multiple jurisdictions, and USIBWC does not have any ROW at this site. No formal conceptual restoration design was developed for this site. However, a site visit was conducted at this location during January 2019 and the results of that assessment are presented here.

Figure 45. Representative field photo from Montoya Drain Site

Three vegetation types are present at Montoya Drain (Figure 46). Cattail dominated marsh habitats are prominent in the drain interior, with some hardstem bulrush on the toe of the slope. The riverside of the drain, described as a wet meadow because most of the cover is saltgrass, does have consistent seep willow and occasional saltcedar, screwbean mesquite, Mojave seablite and wolfberry. Levee slopes are dominated by kochia. The upland side of the drain is a monoculture saltcedar shrubland.



Vegetation Type	Acres
Montoya Drain	**4.0**
Marsh habitat	0.7
Saltcedar Shrubland	2.3
Wet meadow	1.0

Figure 46. Montoya Drain site vegetation map. Note: this site has the potential to go all the way downstream to Montoya Drain, and further upstream as well. The benefits of this site would be

maximized if it went all the way down to the Montoya Drain at the EP Electric and was integrated with that project

3.8.3 El Paso Electric/Montoya Drain

The El Paso Electric/Montoya Drain site, near RM 2, is located near an electricity generation station Figure 47). Numerous potential restoration approaches have been voiced by USIBWC, project partners, and other parties including excavation of wetland features along the river near the Montoya Drain outlet, integrating stormwater runoff with new wetland creation, and modifying the drain outlet to improve aquatic habitat quality. El Paso Water and El Paso Electric are considering new storm water catchments in a large open area on the northwest side of Montoya Drain. Due to land ownership complexities, multiple jurisdictions, limited USIBWC ROW, future levee improvements, and uncertain plans for future projects, this site was removed from consideration for this project. During the scoping meeting it was agreed that El Paso Electric and El Paso Water Utilities could collaborate with a third-party proponent (e.g. SWEC or another non-profit), in the future, possibly with USIBWC as a partner. Prior to eliminating this alternative, a rapid site assessment was conducted in January 2019 and observations are included below.

Figure 47. Field photo from EP Electric/Montoya Drain site confluence with the Rio Grande from the USIBWC floodplain.

Site Assessment

Only three vegetation types are present at the site (Figure 48). The fenced property owned by El Paso Electric was not traversed but from the perimeter, it appears to be dominated by saltcedar, iodinebush (*Allenrolfea occidentalis*), Mojave seablite and wolfberry. Other woody species observed include indigobush, Jimmyweed, and screwbean mesquite. Dominant herbaceous species include blazing star, scorpionweed, mountain pepperweed and needle grama.

Along Montoya drain, the upland side is a near monotypic saltcedar shrubland. The bottom of the drain is cattail dominated with a small amount of common reed and with hardstem bulrush on the upper fringe of the channel. The riverside of the drain is bermudagrass dominated with occasional silverleaf nightshade, saltgrass, hoary tansyaster and Australian saltbush (*Atriplex semibaccata*). Additional woody species include saltcedar, seep willow, screwbean mesquite and Mojave seablite.

By the river, the floodplain is mostly barren with occasional Mojave seablite, saltcedar, honey mesquite, and wolfberry plus kochia, Russian thistle, and Australian saltbush in the herbaceous layer. The bankline is composed of saltcedar with occasional coyote willow upstream from the outfall plus seep willow, honey mesquite, and screwbean mesquite. Herbaceous species along the bankline include scratchgrass, alkali sacaton, bermudagrass, foxtail barley (*Hordeum jubatum*), common reed and Indianhemp. Perennial pepperweed, a Class B Noxious Weed in New Mexico was found along the river immediately downstream from the outfall.

Two holes were augured in barren areas directly adjacent to the active channel (Figure 48; Table 9). While the land topography appears nearly identical, groundwater was substantially deeper downstream of the outfall than upstream, likely due to a thick restrictive layer of clays/silty clays located from 4 to 6 feet below the surface. Groundwater was detected at 76 inches, once sand was reached below the restrictive layer. Except for a 3-inch-thick layer of clay, soils were coarser above the outfall and groundwater was reached at 55 inches.

Table 9. Texture and depth to groundwater observed at soil sample locations from the EP Electric/Montoya Drain site.

Bore Hole	Depth	Texture	Soil Moisture	Notes
1	0 to 10	SaL	Dry	Salts
	10 to 12	C	Dry	Salts
	12 to 20	SaL	Very Slightly Moist	
	20 to 23	C	Slightly moist	Salts
	23 to 25	C	Moist	
	25 to 50	LS	Moist	Mottles distinct
	50 to 76	SiC	Moist	Near black, restrictive layer, subsurface fines appear nice for herbaceous wetland
	76	GW		Sand, groundwater evident as soon as sand was reached
2	0 to 10	SaCL	Dry	
	10 to 13	C	Moist	Gleying, mottles
	13 to 30	SaL	Moist	Mottles prominent
	30 to 55	LS	Moist	Nears saturation at 50, mottles
	55	GW		

Vegetation Type	Acres
EP Electric/Montoya Drain	**33.4**
Open/Barren area	31.6
Saltcedar Shrubland	1.2
Saltcedar-coyote willow shrubland	0.3
Wet meadow	0.3

Figure 48. EP Electric/Montoya Drain site vegetation map.

3.8.4 Placitas Arroyo

Placitas Arroyo is an aquatic habitat restoration site recommended in the Conceptual Plan (USACE 2009). The proposed design in that report includes removal of the existing riprap toe protection plus bankline destabilization across from the arroyo confluence and cessation of future dredging (USACE 2009). The Conceptual Plan (USACE 2009) suggests that the proposed design will facilitate natural channel migration, contribute to reduced channel conveyance capacity, and more frequent overbank flooding in locations immediately upstream of the arroyo mouth. During the project scoping meeting, it was revealed that there are currently plans to create a sediment retention facility in Placitas Arroyo above the confluence with the Rio Grande. Since a sediment dam will reduce flow velocity and sediment-laden tributary flows, this site was removed from further alternatives analysis and no conceptual restoration design was developed.

3.8.5 Trujillo

Trujillo canyon enters the Rio Grande from the west side of the river just below Percha Dam. EBID expressed interest in exploring habitat restoration potential at this site in the future. The site was not evaluated in this report because EBID's interest in this location was not formally indicated until after the draft report with conceptual designs was completed.

3.8.6 Las Cruces Effluent Subterranean Pipe

EBID expressed interest in piping effluent discharged from the Las Cruces wastewater treatment plant below the Rio Grande and into Picacho Drain on the opposite side of the river. This action may benefit the habitat improvements recommended at MVBSP, however, designing this type of structure is beyond the scope of this report. Additionally, project engineers tasked with designing later phases of this project do not recommend this type of active hydraulic control or mechanism in river restoration.

4.0 ESTIMATED CONSTRUCTION QUANTITIES, CONSUMPTIVE WATER USE, AND COSTS

Implementation costs were determined for each project via assessing unit costs for various restoration activities from similar sized projects in the Rio Grande watershed. The basic method for determining construction quantities for major restoration activities is described in Table 10. Consumptive water use was quantified for each restoration project with an identical method as USACE 2009 (See Section 4.1 Evapotranspiration Evaluation) and summary results are shown in Table 11.

Table 10. Basic process used to determine quantities for various restoration activities. Note that sediment cleanout and ongoing feature operation and maintenance costs are not summarized in this report.

Activity	Notes
All costs only include predicted initial construction costs. Operational and maintenance costs are not included in this table or otherwise in this report.	

Activity	**Notes**
Earthwork (cu yds)	Quantities based on analysis that combines HEC-RAS derived water surface elevations at target discharges, target discharges discussed in this report, and 2011 LiDAR based elevation. Supporting GIS shapefiles include the average estimated excavation depth and estimated quantity for each feature. Off-site hauling may be necessary but costs for hauling were not evaluated because determining off-site spoil locations was outside the scope of this project.
Contingencies	Contingency costs included to cover potential project uncertainties that may be encountered in subsequent project phases. Formal engineering design plans will help to alleviate uncertainties and increase cost estimation accuracy.
Grass Seeding	Assumes spoil areas would be targeted for seeding. Acreage based on earthwork volume and size of predicted spoil areas. Note that many sites have weedy sections that could be targeted for spreading spoil, however, spoiling against levees (and possibly within the floodplain) is not allowable by USIBWC.
Flow monitoring	Cost based on estimate obtained during a phone conversation with Xylem (GWI - Flow System). Cost includes DC powered flow monitor (Model BI2000), cellular data loggers, water level sensors, solar panels, batteries, enclosure, web hosting, misc. model engineering fees.
Pedestrian Bridge	Cost based on previous bridges installed in habitat restoration projects in the Middle Rio Grande. Typical cost on those projects was approximately $200 per square foot.
Selective Fish Passage	Cost assumes structure like Propst and Bixby (2018) would be used at the Las Cruces Effluent site. Cost estimation accuracy will be improved if a formal design is developed during engineering design phase.
Exotic Species Control (ac)	Quantities conservatively assume that some level of exotic species treatment will be required at all sites. Note that woody exotic species density is highly variable and certain sites also have herbaceous noxious weeds that should be treated prior to excavation plus monitored and retreated thereafter.

Table 11. Consumptive water use by site under existing condition, after restoration activities, and the predicted change. Note that Broad Canyon, Selden Canyon, Mesilla Valley Bosque, and Downstream of Courchesne sites were composed of dense saltcedar prior to previous vegetation management activities.

Site	**Pre-Restoration (ac-ft/yr)**	**Post-Restoration (ac-ft/yr)**	**Difference (ac-ft/yr)**
Yeso Arroyo	40.7	59.0	18.3
Angostura Arroyo	42.5	62.0	19.5
Broad Canyon Arroyo	9.1	8.1	-0.9
Selden Canyon Point Bar	45.5	31.6	-13.9
Las Cruces Effluent	10.7	17.2	6.5
Mesilla Valley Bosque State Park	154.5	135.3	-19.2
Downstream of Courchesne Gage	59.9	35.4	-24.5

Planting rates recommended in this report are intended to achieve specific cover goals by 10 years after revegetation. Electronic GIS data created in support of this report include the recommended tree, shrub, willow whip, and herbaceous wetland plug planting rate for each map feature. In summary, specific plant installation density classes (low, moderate, and high) were used to recommend plant quantities as shown in Table 12.

Table 12. Plant installation quantities, classes, and cover goals.

	Tree Poles		Potted Shrubs		Willow Whips		Herbaceous Wetland Plugs	
Density	Cover Goal Increase	Per Acre Planting Rate	Cover Goal Increase	Per Acre Planting Rate	Cover Goal Increase	Per Acre Planting Rate	Cover Goal Increase	Per Acre Planting Rate
Low	10%	8	10%	100	10%	250	10%	200
Mod	25%	20	25%	375	25%	700	25%	500
High	50%	40	50%	750	50%	1400	50%	1000

Since the extent to which ephemeral habitats will be used by and of value to riverine fish and other aquatic species, among many factors, will depend on duration of inundation; the designs in this report intend to provide prolonged wetting of the floodplain whenever possible. Among the sites considered, two (Las Cruces Effluent and Mesilla Valley Bosque State Park) will provide perennial habitats while all others will provide habitats mainly during irrigation season elevated flows. The stormwater channel at the Downstream of Courchesne site is likely to provide near perennial conditions during many years. As summarized in Table 13, the projects proposed in this report are

predicted to benefit fish species in varying degrees. The projects also range significantly in cost, size, potential benefits to southwestern willow flycatcher and yellow-billed cuckoo, and numerous additional factors. A detailed description of our preliminary cost estimate for constructing the sites as indicated in the conceptual designs within this report is shown in Table 14.

The complexity with estimating cost at this stage of the project also varies by site, so contingencies were added to cover potential additional costs that might arise during subsequent project design and engineering phases.

Table 13. Site alternatives summary including acreage, site proximity, ownership, total estimated costs, benefits to important fish and wildlife including southwestern willow flycatcher (WiFL) and yellow-billed cuckoo (YBCU).

Site Name	River Mile and Bank	Proximity	Total Acres	Aquatic Features (excludes riparian enhancement)	Acres of Newly Constructed Aquatic Features	ET difference (ac-ft/yr)	Ownership	Estimated Restoration Cost	Direct Benefits to WiFL/YBCU	Predicted Number of Beneficiary Fish Species
Yeso Arroyo	94 E	Hatch, NM	14.3	Bankline terrace	6.9	18.3	USIBWC	$836,900.00	Yes	4
Angostura Arroyo	80 E	Hatch, NM	14.9	Bankline terrace	7.5	19.5	USIBWC	$690,800.00	Yes	4
Broad Canyon Arroyo	68 W	Radium Springs, NM	2.1	Embayments	0.2	-0.9	USIBWC, USFWS, State of NM, BLM	$ 37,665.00	Yes	8
Selden Point Bar	66 E	Radium Springs, NM	8.8	Backwater, channel	0.8	-13.9	USIBWC	$146,550.00	Yes	7
Las Cruces Effluent	44 E	Las Cruces, NM	4.5	Channel	0.9	6.5	USIBWC	$199,300.00	Yes	10
Mesilla Valley Bosque State Park	41 W	Mesilla, NM	31.3	Channel, willow swale, drain terracing, cattail control	15.8	-19.2	USIBWC, EBID, NM State Parks, private	$657,700.00	Yes	8
Downstream of Courchesne Gage	1 E	El Paso, TX	12.9	Channel	1.4	-24.5	USIBWC	$101,600.00	Yes	7

Table 14. Detailed cost table.

	Yeso Arroyo	Angostura Arroyo	Broad Canyon Arroyo	Selden Point Bar	Las Cruces Effluent	Mesilla Valley Bosque State Park	Downstream of Courchesne Gage
Earthwork (cu yds)							
Unit Cost	*$ 9.00*	*$ 9.00*	*$ 9.00*	*$ 9.00*	*$ 9.00*	*$ 9.00*	*$ 9.00*
Units (cu yd)	74,000	57,000	560	4,300	4,400	33,000	7,000
Total Cost	*$ 666,000.00*	*$ 513,000.00*	*$ 5,040.00*	*$ 38,700.00*	*$ 39,600.00*	*$ 297,000.00*	*$ 63,000.00*
Contingencies							
Unit Cost	$ 40,000.00	$ 40,000.00	$ 5,000.00	$ 5,000.00	$ 25,000.00	$ 40,000.00	$ 5,000.00
Units (misc)	1	1	1	1	1	1	1
Total Cost	*$ 40,000.00*	*$ 40,000.00*	*$ 5,000.00*	*$ 5,000.00*	*$ 25,000.00*	*$ 40,000.00*	*$ 5,000.00*
Cottonwood/Willow Trees							
Unit Cost	*$ 50.00*	*$ 50.00*	*$ 50.00*	*$ 50.00*	*$ 50.00*	*$ 50.00*	*$ 50.00*
Units (poles)	160	208	35	65	65	450	50
Total Cost	*$ 8,000.00*	*$ 10,400.00*	*$ 1,750.00*	*$ 3,250.00*	*$ 3,250.00*	*$ 22,500.00*	*$ 2,500.00*
Potted Riparian Shrubs							
Unit Cost	*$ 20.00*	*$ 20.00*	*$ 20.00*	*$ 20.00*	*$ 20.00*	*$ 20.00*	*$ 20.00*
Units (shrubs)	3,500	4,000	650	3,000	1,200	4,500	250
Total Cost	*$ 70,000.00*	*$ 80,000.00*	*$ 13,000.00*	*$ 60,000.00*	*$ 24,000.00*	*$ 90,000.00*	*$ 5,000.00*
Wetland Plugs							
Unit Cost	*$ 2.00*	*$ 2.00*	*$ 2.00*	*$ 2.00*	*$ 2.00*	*$ 2.00*	*$ 2.00*
Units (plugs)	1,800	1,750	175	600	2,000	7,000	2,000
Total Cost	*$ 3,600.00*	*$ 3,500.00*	*$ 350.00*	*$ 1,200.00*	*$ 4,000.00*	*$ 14,000.00*	*$ 4,000.00*
Willow Whips							
Unit Cost	*$ 6.00*	*$ 6.00*	*$ 6.00*	*$ 6.00*	*$ 6.00*	*$ 6.00*	*$ 6.00*
Units (whips)	4,500	3,500	1,200	5,500	775	15,000	1,000
Total Cost	*$ 27,000.00*	*$ 21,000.00*	*$ 7,200.00*	*$ 33,000.00*	*$ 4,650.00*	*$ 90,000.00*	*$ 6,000.00*
Grass Seeding							
Unit Cost	*$ 1,600.00*	*$ 1,600.00*	*$ 1,600.00*	*$ 1,600.00*	*$ 1,600.00*	*$ 1,600.00*	*$ 1,600.00*
Units (acres)	5	5	3	2	3	0	2
Total Cost	*$ 8,000.00*	*$ 8,000.00*	*$ 4,800.00*	*$ 3,200.00*	*$ 4,800.00*	*$ -*	*$ 3,200.00*
Flow Monitoring							
Unit Cost	*$ -*	*$ -*	*$ -*	*$ -*	*$ 10,000.00*	*$ -*	*$ -*
Units (station)	0	0	0	0	2	0	0
Total Cost	*$ -*	*$ -*	*$ -*	*$ -*	*$ 20,000.00*	*$ -*	*$ -*
Pedestrian Bridge							
Unit Cost	*$ -*	*$ -*	*$ -*	*$ -*	*$ 1.00*	*$ 1.00*	*$ -*
Units (bridge)	*0*	*0*	*0*	*0*	*60,000*	*60,000*	*0*
Total Cost	*$ -*	*$ -*	*$ -*	*$ -*	*$ 60,000.00*	*$ 60,000.00*	*$ -*
Check Structure							
Unit Cost	*$ -*	*$ -*	*$ -*	*$ -*	*$ 1.00*	*$ -*	*$ -*
Units (facility)	*0*	*0*	*0*	*0*	*10,000*	*0*	*0*
Total Cost	*$ -*	*$ -*	*$ -*	*$ -*	*$ 10,000.00*	*$ -*	*$ -*
Cattail Control (ac)							
Unit Cost	*$ 1,500.00*	*$ 1,500.00*	*$ 1,500.00*	*$ 1,500.00*	*$ 1,500.00*	*$ 1,500.00*	*$ 1,500.00*
Units (acres)	*0*	*0*	*0*	*0*	*0*	*6*	*0*
Total Cost	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ 8,700.00*	*$ -*
Exotic Species Control (ac)							
Unit Cost	$ 1,000.00	$ 1,000.00	$ 250.00	$ 250.00	$ 1,000.00	$ 1,250.00	$ 1,000.00
Units (acres)	14	15	2	9	4	28	13
Total Cost	*$ 14,300.00*	*$ 14,900.00*	*$ 525.00*	*$ 2,200.00*	*$ 4,000.00*	*$ 35,500.00*	*$ 12,900.00*
TOTAL	**$ 836,900.00**	**$ 690,800.00**	**$ 37,665.00**	**$ 146,550.00**	**$ 199,300.00**	**$ 657,700.00**	**$ 101,600.00**

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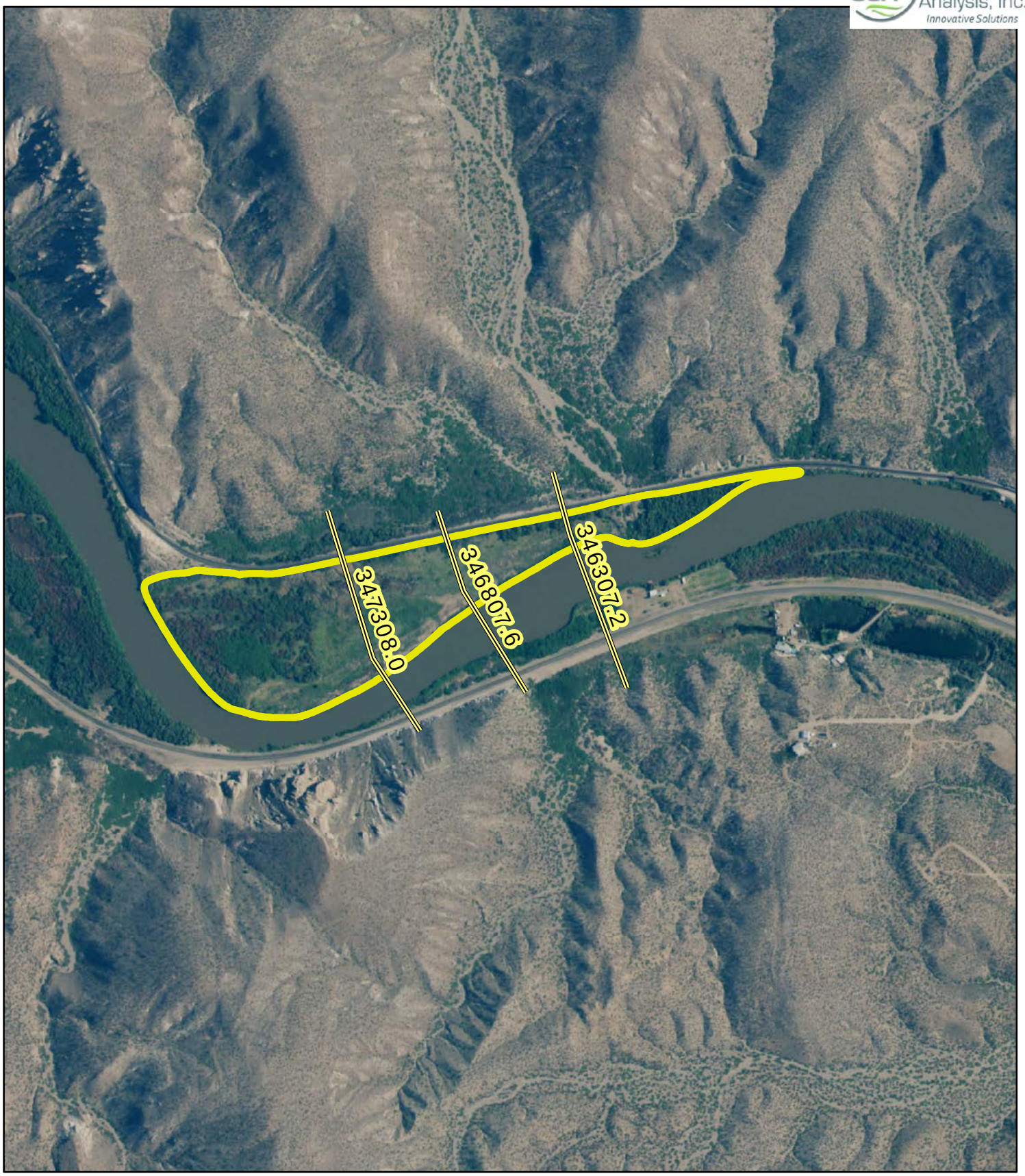
Appendix A. HEC-RAS Model Outputs at Representative Cross-Sections for Restoration Sites in this Report

Yeso Arroyo



Legend

Selected Hec-RAS Cross-Sections

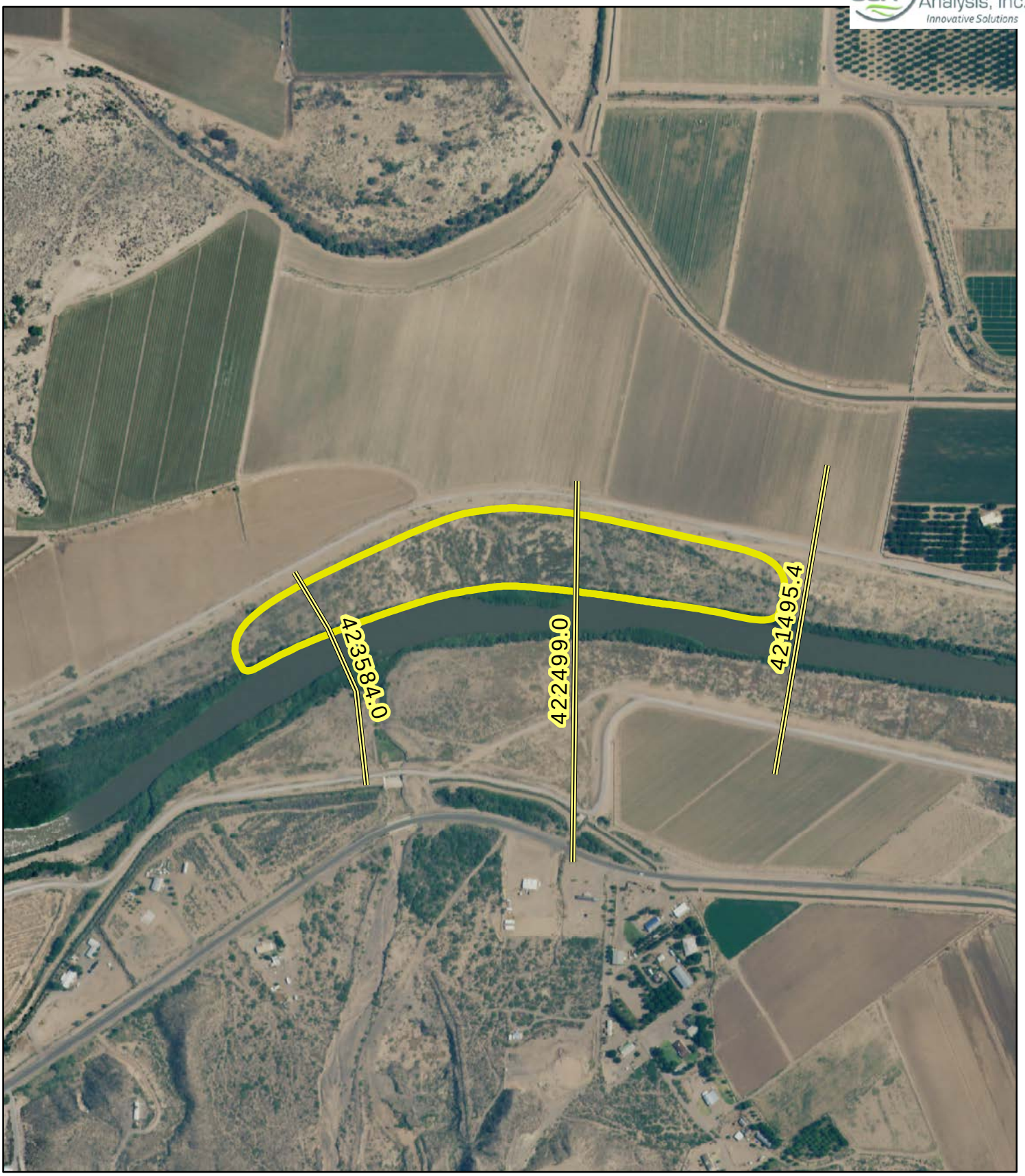
Site Assessment Boundary

Feet

0 200 400 800

N

Angostura Arroyo



Legend

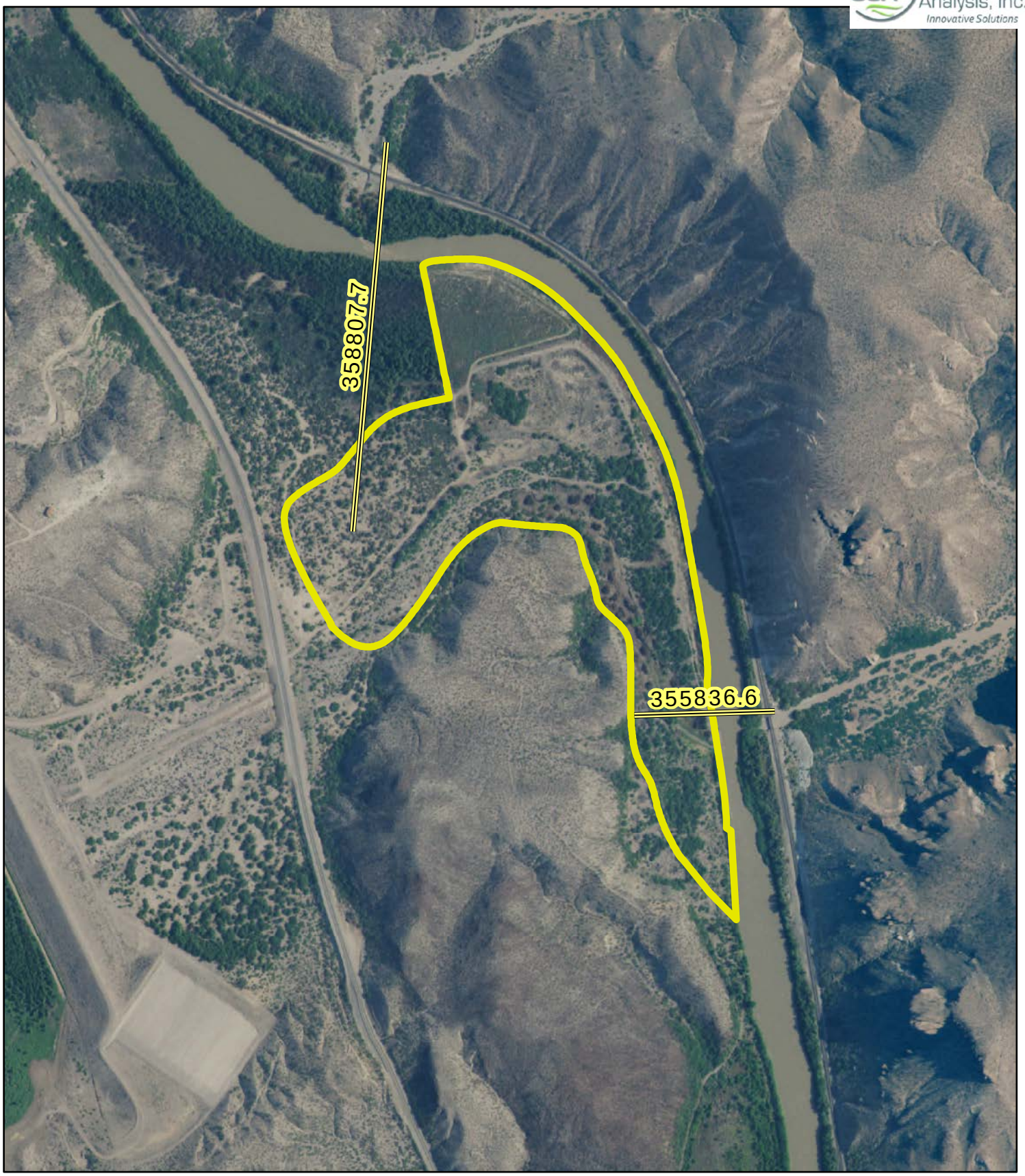
Selected Hec-RAS Cross-Sections

Site Assessment Boundary

Feet
0 200 400 800

N

Broad Canyon Arroyo



Legend

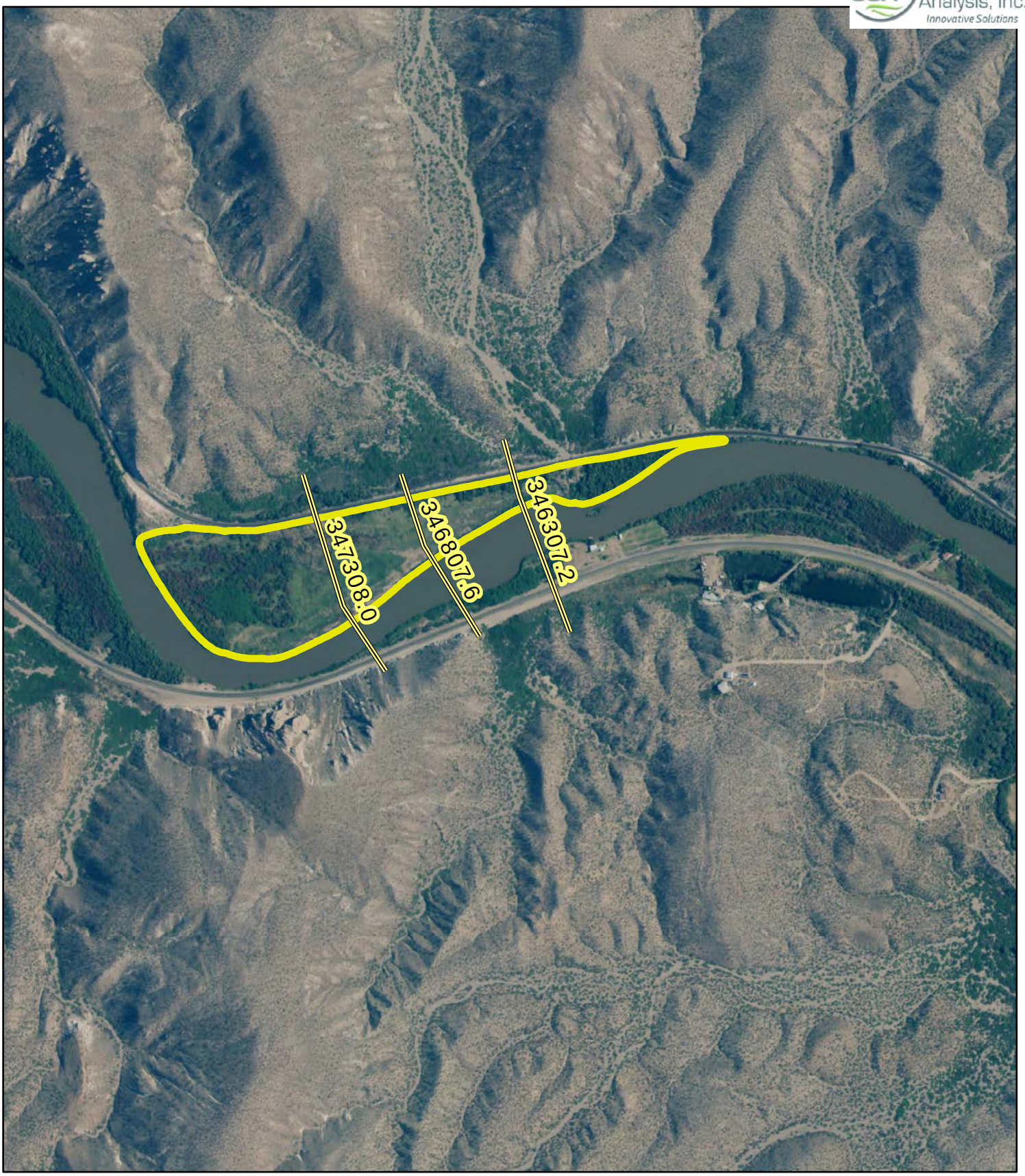
Selected Hec-RAS Cross-Sections

Site Assessment Boundary

Feet
0 200 400 800

N

Selden Point Bar



Legend

Selected Hec-RAS Cross-Sections

Site Assessment Boundary

0 500 1,000 2,000 Feet

N

Las Cruces Effluent

Legend

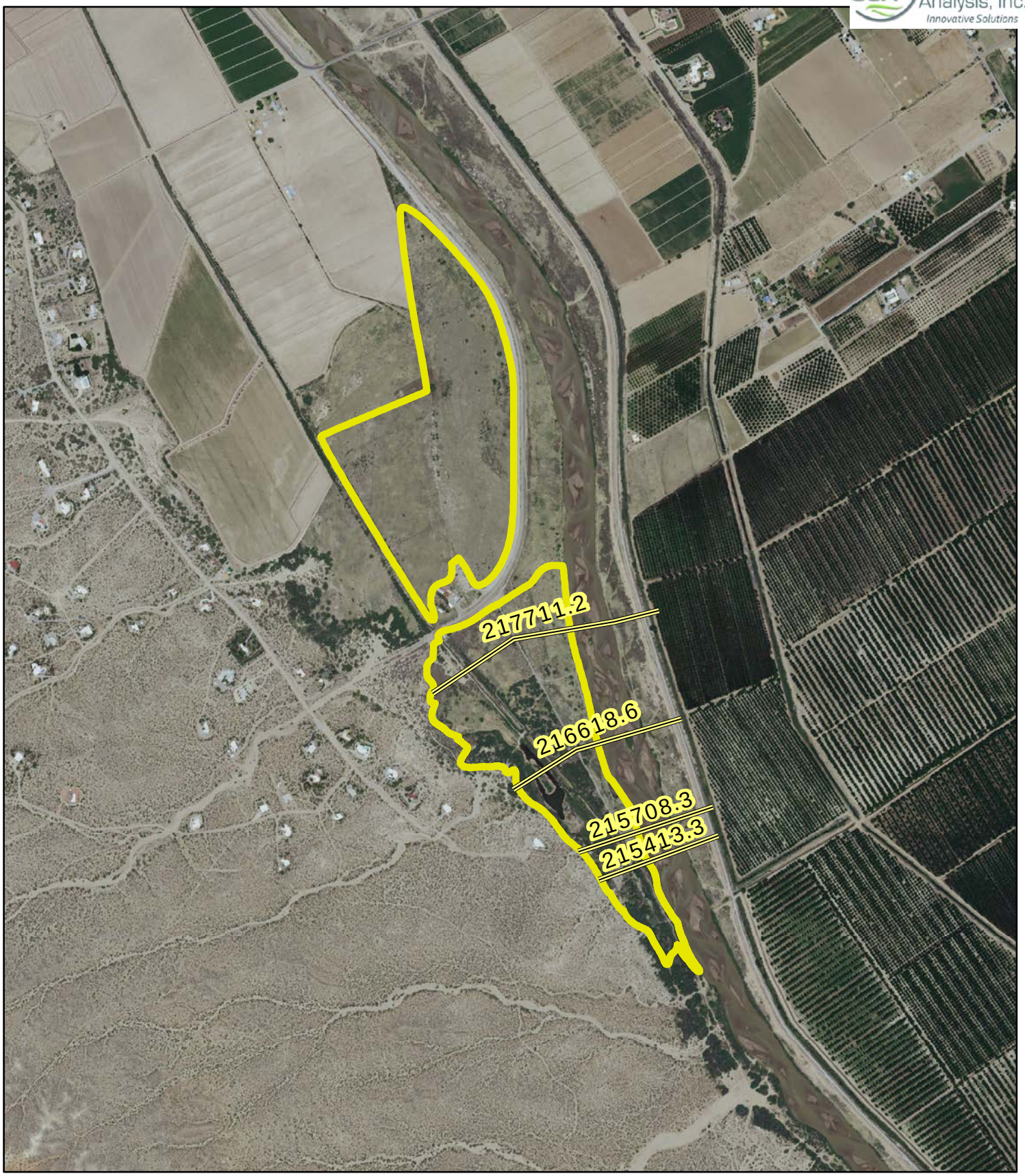
Selected Hec-RAS Cross-Sections

Site Assessment Boundary

0 200 400 800 Feet

N

Mesilla Valley Bosque State Park



Legend

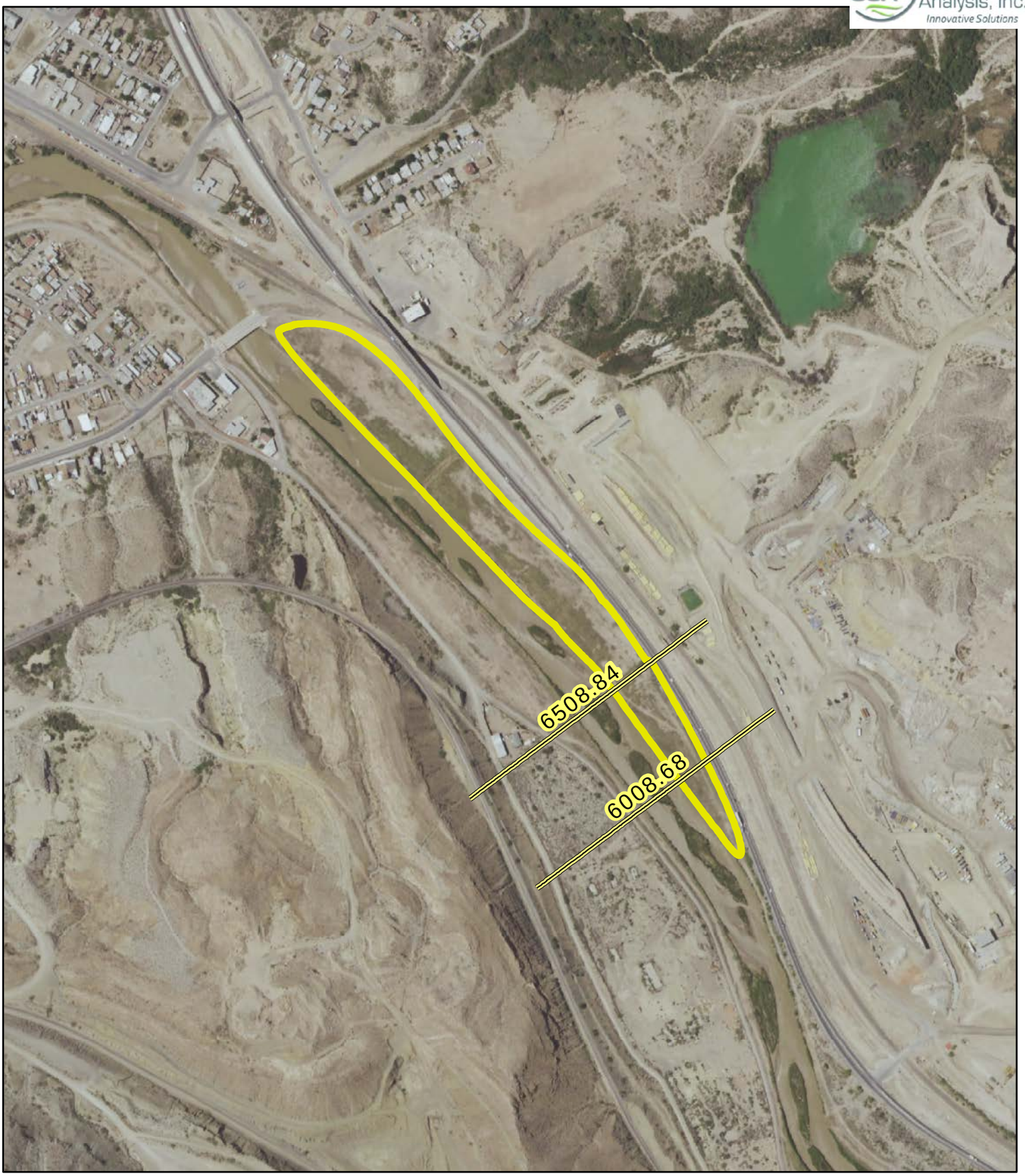
Feet
0 500 1,000 2,000

N

Selected Hec-RAS Cross-Sections

Site Assessment Boundary

Downstream of Courchesne Gage



Legend

Selected Hec-RAS Cross-Sections

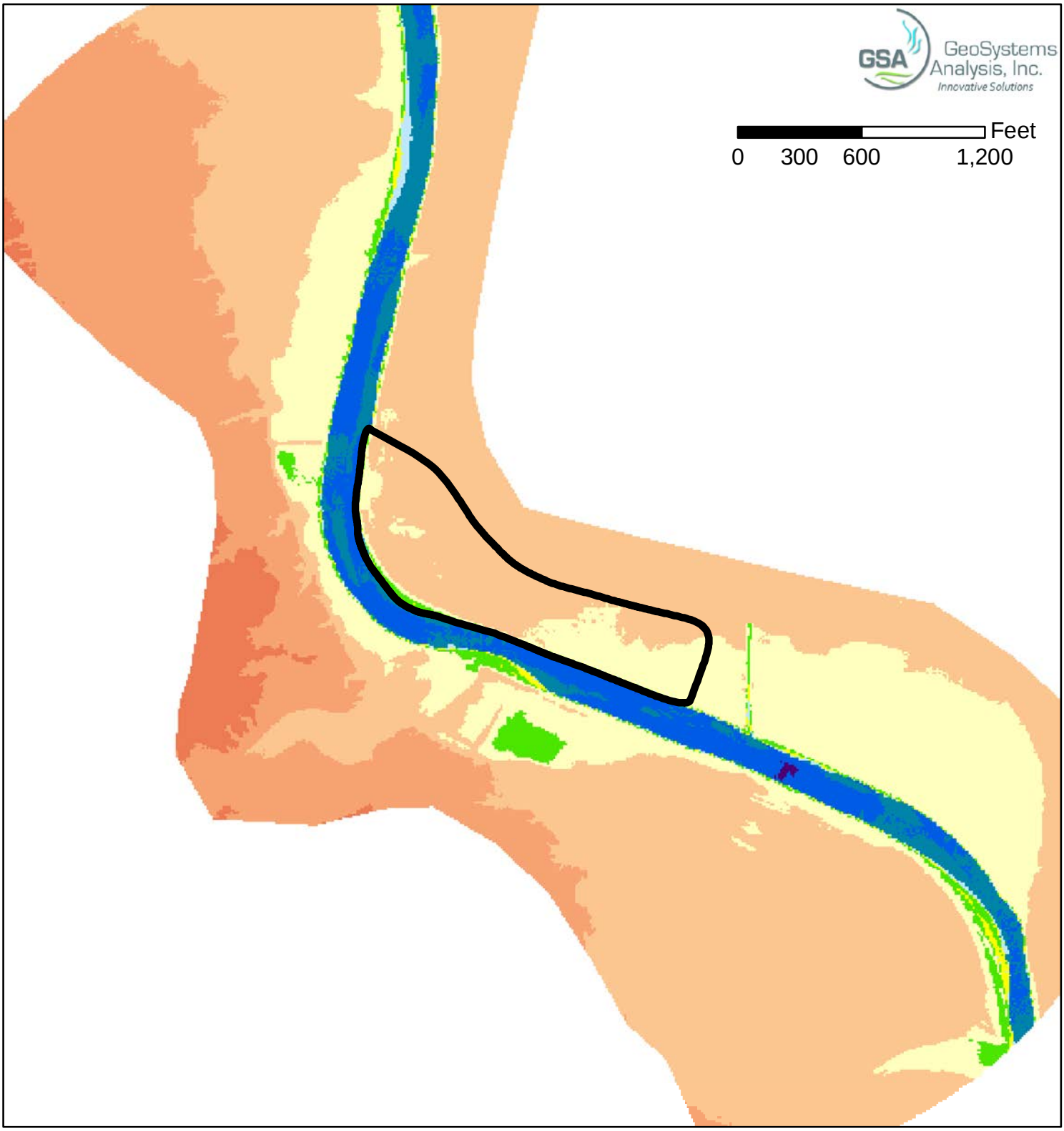
Site Assessment Boundary

Feet
0 200 400 800

N

Appendix B. LiDAR Maps

Yeso Arroyo



Legend

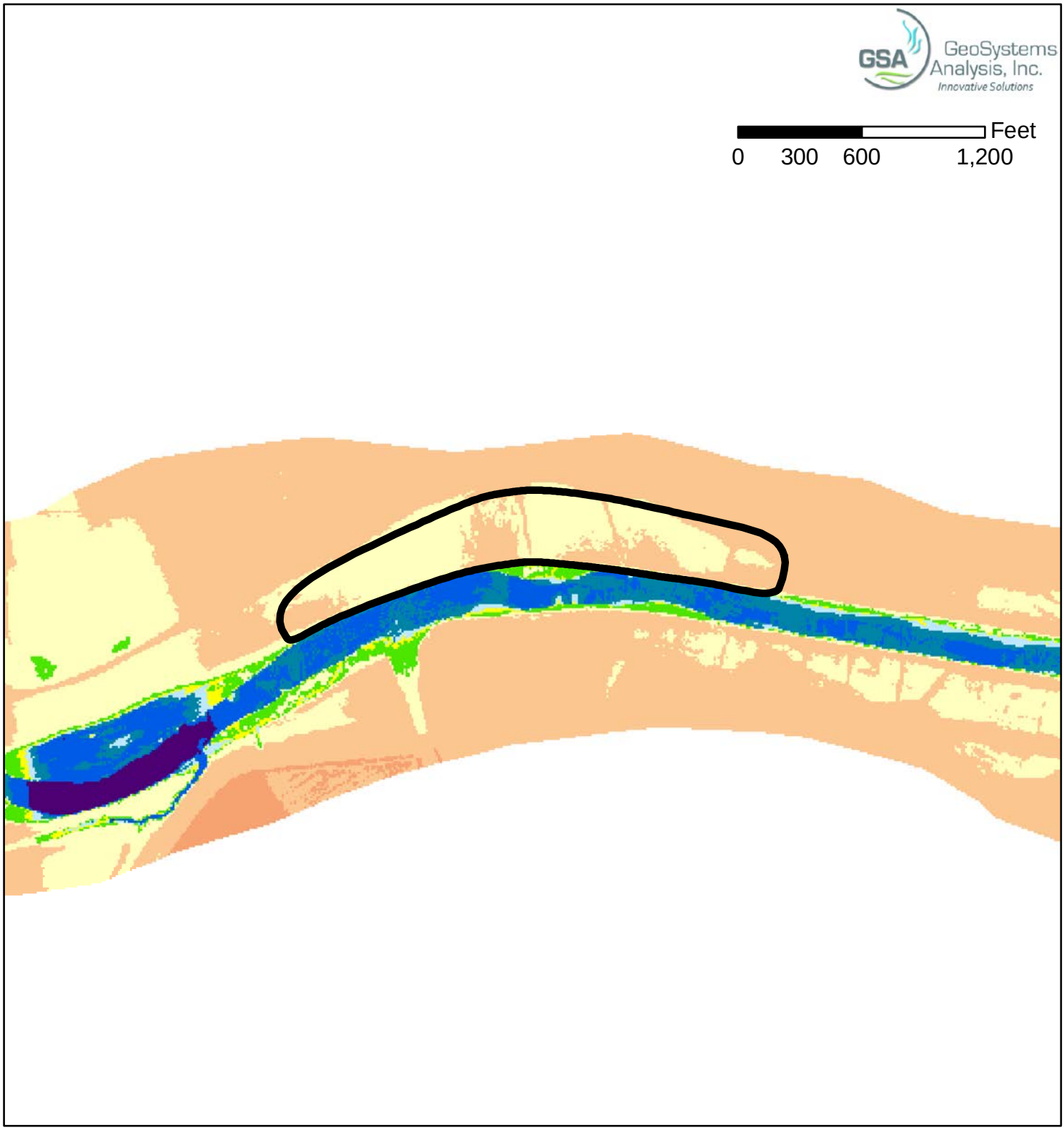
Site Assessment Boundary

LiDAR Predicted Height Above the RiverBed (Feet)

- -6 to - 2 Feet
- -2 to 0 Feet
- 0 to 1 Foot
- 1 to 2 Feet
- 2 to 3 Feet
- 3 to 5 Feet
- 5 to 10 Feet
- 10 to 25 Feet
- 25 to 50 Feet
- 50 to 100 Feet
- 100 to 250 Feet
- >250 Feet

N

Angostura Arroyo



Legend

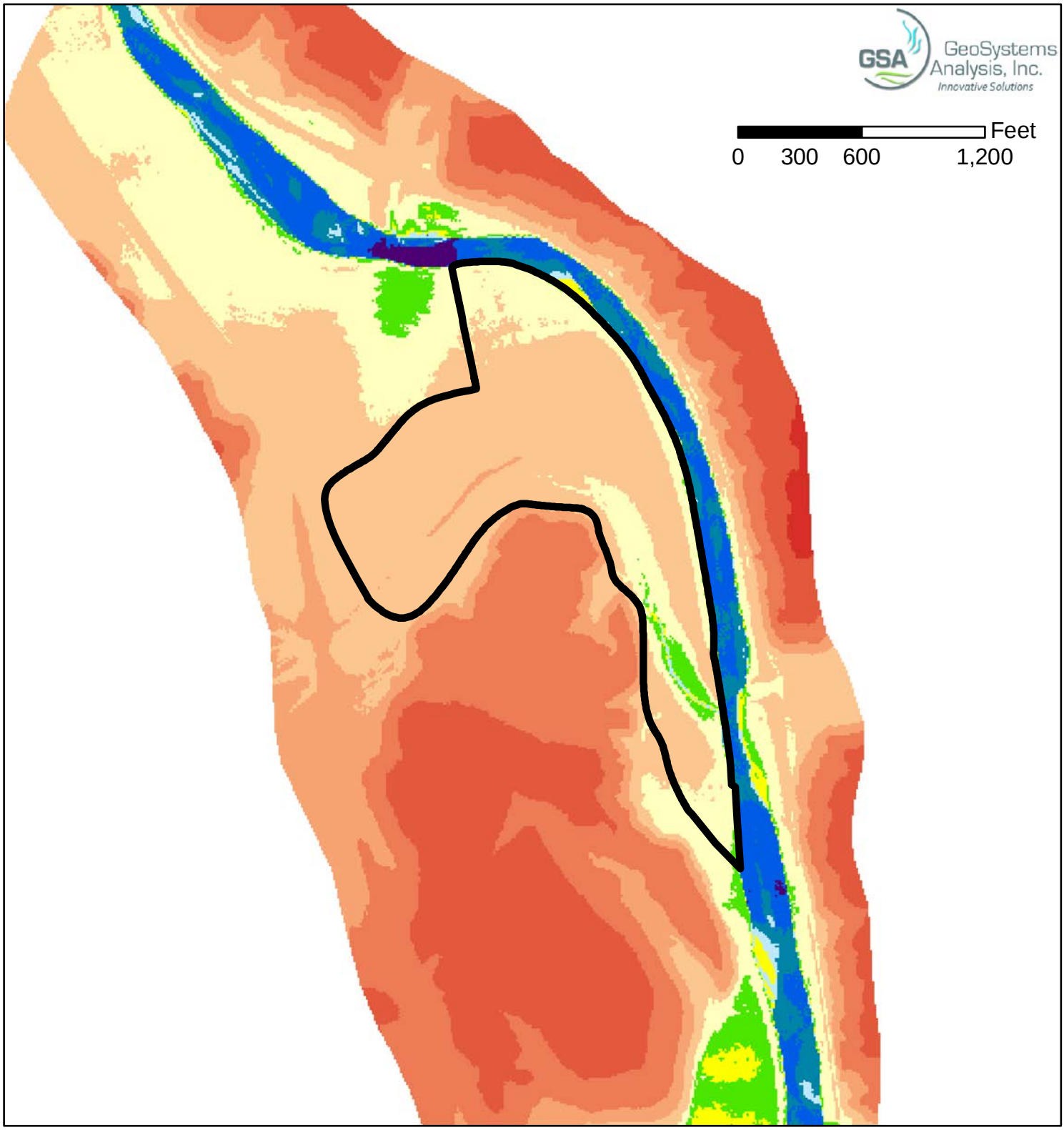
Site Assessment Boundary

LiDAR Predicted Height Above the RiverBed (Feet)

- -6 to - 2 Feet
- -2 to 0 Feet
- 0 to 1 Foot
- 1 to 2 Feet
- 2 to 3 Feet
- 3 to 5 Feet
- 5 to 10 Feet
- 10 to 25 Feet
- 25 to 50 Feet
- 50 to 100 Feet
- 100 to 250 Feet
- >250 Feet

N

Broad Canyon Arroyo



Legend

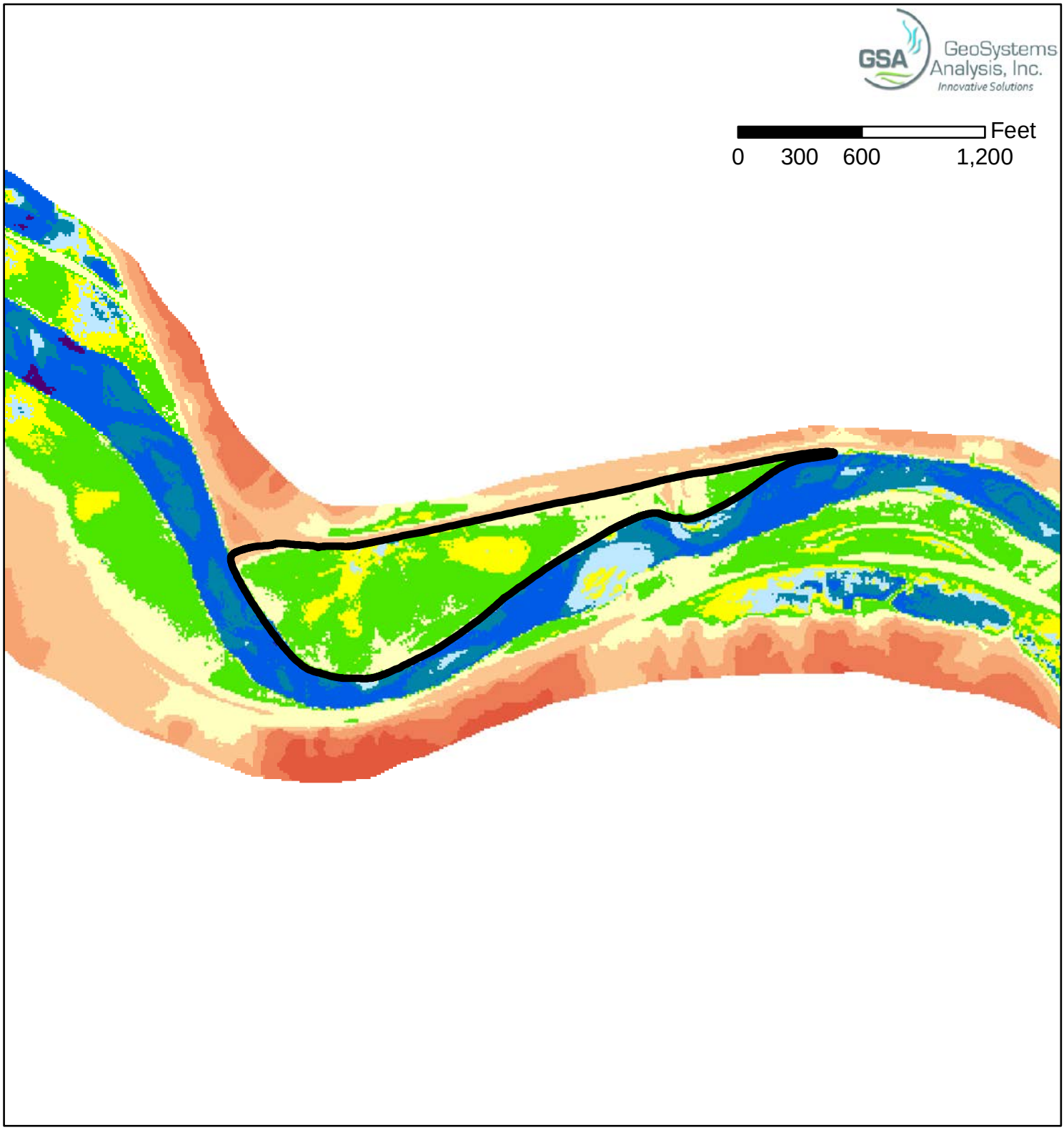
Site Assessment Boundary

LiDAR Predicted Height Above the RiverBed (Feet)

- -6 to - 2 Feet
- -2 to 0 Feet
- 0 to 1 Foot
- 1 to 2 Feet
- 2 to 3 Feet
- 3 to 5 Feet
- 5 to 10 Feet
- 10 to 25 Feet
- 25 to 50 Feet
- 50 to 100 Feet
- 100 to 250 Feet
- >250 Feet

N

Selden Canyon Point Bar



Legend

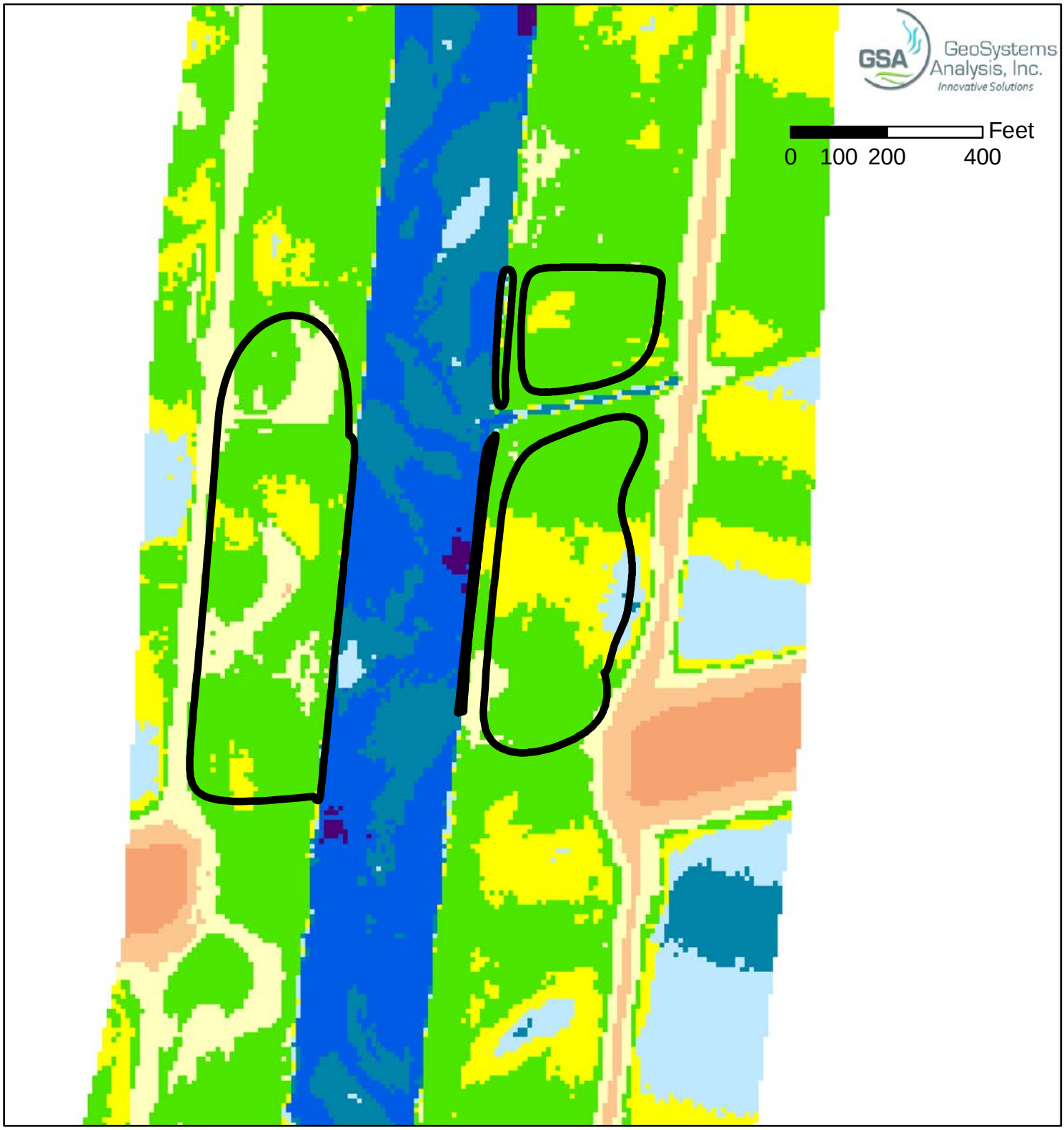
Site Assessment Boundary

LiDAR Predicted Height Above the RiverBed (Feet)

- -6 to - 2 Feet
- -2 to 0 Feet
- 0 to 1 Foot
- 1 to 2 Feet
- 2 to 3 Feet
- 3 to 5 Feet
- 5 to 10 Feet
- 10 to 25 Feet
- 25 to 50 Feet
- 50 to 100 Feet
- 100 to 250 Feet
- >250 Feet

N

Las Cruces Effluent



Legend

Site Assessment Boundary

LiDAR Predicted Height Above the RiverBed (Feet)

- -6 to - 2 Feet
- -2 to 0 Feet
- 0 to 1 Foot
- 1 to 2 Feet
- 2 to 3 Feet
- 3 to 5 Feet
- 5 to 10 Feet
- 10 to 25 Feet
- 25 to 50 Feet
- 50 to 100 Feet
- 100 to 250 Feet
- >250 Feet

N

Mesilla Valley Bosque State Park

Legend

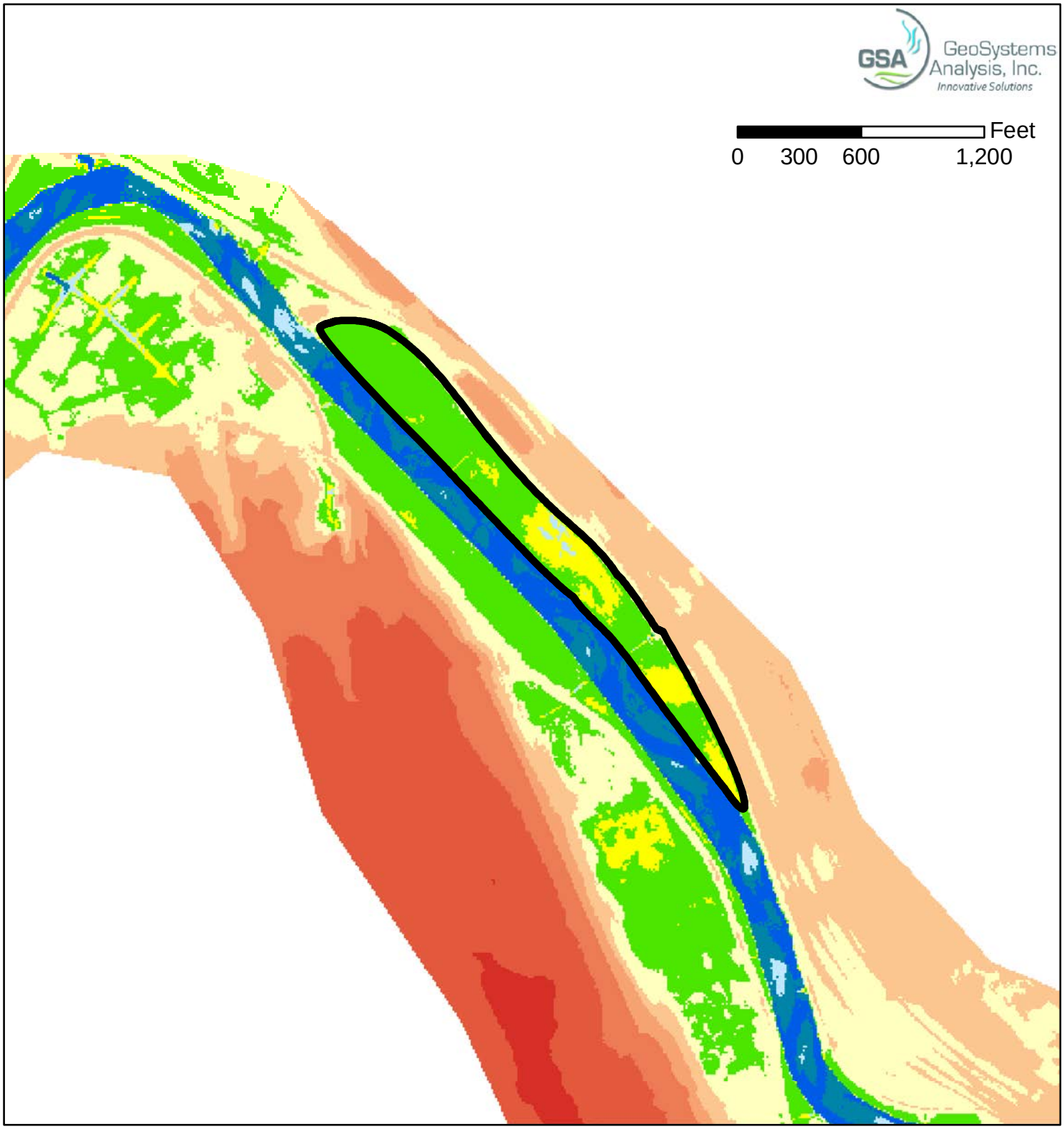
Site Assessment Boundary

LiDAR Predicted Height Above the RiverBed (Feet)

- -6 to - 2 Feet
- -2 to 0 Feet
- 0 to 1 Foot
- 1 to 2 Feet
- 2 to 3 Feet
- 3 to 5 Feet
- 5 to 10 Feet
- 10 to 25 Feet
- 25 to 50 Feet
- 50 to 100 Feet
- 100 to 250 Feet
- >250 Feet

N

Downstream of Courchesne Gage



Legend

Site Assessment Boundary

LiDAR Predicted Height Above the RiverBed (Feet)

- -6 to - 2 Feet
- -2 to 0 Feet
- 0 to 1 Foot
- 1 to 2 Feet
- 2 to 3 Feet
- 3 to 5 Feet
- 5 to 10 Feet
- 10 to 25 Feet
- 25 to 50 Feet
- 50 to 100 Feet
- 100 to 250 Feet
- >250 Feet

N

Appendix C. List of Observed Plant Species and their Relative Prominence by Site

		Yeso Arroyo	Angostura Arroyo	Broad Canyon Arroyo	Selden Canyon Arroyo	Las Cruces Effluent	Mesilla Valley Bosque State Park	NeMexas Siphon	Montoya Drain	EP Electric/ Montoya Drain	Downstream Courchesne Gage
Tree											
Whitethorn acacia	*Acacia constricta*	R	R			R	R				
Netleaf hackberry	*Celtis laevigata* var. *reticulata*			R							
Desert willow	*Chilopsis linearis*			U				R			
Russian olive	*Elaeagnus angustifolia*		R								
Jerusalem thorn	*Parkinsonia aculeata*										R
Rio Grande cottonwood	*Populus deltoides*	R		U		R	C	U			
Honey mesquite	*Prosopis glandulosa*	C	U	A	U	U	C	C		U	C
Screwbean mesquite	*Prosopis pubescens*	R	U	U		R	C	U	U	U	U
Gooding's willow	*Salix goodingii*			U			U				
Saltcedar	*Tamarix chinensis*	C	C		C	U	C	A	A	A	C
Siberian elm	*Ulmus pumila*									R	R
Shrub											
Iodinebush	*Allenrolfea occidentalis*									A	
False indigo-bush	*Amorpha fruticosa*					R					
Fourwing saltbush	*Atriplex canescens*	U	U	U	U		C	C	U	U	U
Seep willow	*Baccharis salicifolia*	R	U	U	U	R	U	C		U	U
Seep willow	*Baccharis salicina*	C	C	U	C		C	U		U	C
Desertbroom	*Baccharis sarothroides*									R	R
Feather plume	*Dalea formosa*	R									
Longleaf jointfir	*Ephedra trifurca*	U		U	R			R			
Apache plume	*Fallugia paradoxa*			U							
Broom snakeweed	*Gutierrezia sarothrae*			U		R					
Singlewhorl burrobrush	*Hymenoclea monogyra*	R		U							
Jimmyweed	*Isocoma pluriflora*	A	C	C	U		C	U		U	U
Creosote	*Larrea tridentata*			U			R	R			
Wolfberry	*Lycium torreyi*	U	U	C	C		C	C		C	U
Prickly pear	*Opuntia phaeacantha*	U	U	U							
Arroweed	*Pluchea sericea*	C	U		A		C			R	
Indigobush	*Psorothamnus scoparius*	U		R						U	
Skunkbush sumac	*Rhus trilobata*		R		R		U			R	
Coyote willow	*Salix exigua*	U	C	C	C	U		U		U	
Soaptree yucca	*Yucca elata*						R	R			
Graythorn	*Ziziphus obtusifolia*			R	R						
Forb											
Amaranth	*Amaranthus sp.*		U	U							
Careless weed	*Amaranthus palmeri*									R	
flatspine bur ragweed	*Ambrosia acanthicarpa*							U		U	
Yerba mansa	*Anemopsis californica*						U				
Indianhemp	*Apocynum cannabinum*									R	U
Milkweed	*Asclepias* sp.			U	U	U	U				U

		Yeso Arroyo	Angostura Arroyo	Broad Canyon Arroyo	Selden Canyon Arroyo	Las Cruces Effluent	Mesilla Valley Bosque State Park	NeMexas Siphon	Montoya Drain	EP Electric/ Montoya Drain	Downstream Courchesne Gage
Asparagus	*Asparagus officinalis*						R				
Austrailian saltbush	*Atriplex semibaccata*									C	
Desert marigold	*Baileya multiradiata*	R									
Kochia	*Bassia scoparia*		U	C	C	C	C	U	U	U	C
Spiderling	*Boerhavia* sp.			U							
Field mustard	*Brassica rapa*					R					
Stinging serpent	*Cevallia sinuata*			R							
Goosefoot	*Chenopodium* sp.			R							
Spiny chloracantha	*Chloracantha spinosa*		C			U	U			U	U
Canadian horseweed	*Conyza canadensis*							R			
Spreading alkaliweed	*Cressa truxillensis*				U		R		U	U	
Winged-pigweed	*Cycloloma atriplicifolium*				R						
Sacred thorn-apple	*Datura wrightii*			R			R				
Western tansymustard	*Descuriania pinnata*	U	U	R		U	U				
Hoary tansyaster	*Dieteria canescens*			U		C		U		U	
Spectacle pod	*Dimorphocarpa wislizenii*	U									
Fetid goosefoot	*Dysphania graveolens*			R							
Buckwheat	*Eriogonum* sp.			R							
Redstem filaree	*Erodium cicutarium*	U									
Fringed twinevine	*Funastrum cynanchoides*	U		A	C		C	C			
Wild licorice	*Glycyrrhiza lepidota*										U
Common sunflower	*Helianthus annuus*	R									R
Indian rushpea	*Hoffmannseggia glauca*						U				
Prickly lettuce	*Lactuca serriola*					R					
Perennial pepperweed	*Lepidium latifolium*									R	R
Mountain pepperweed	*Lepidium montanum*						U	U		C	
Tansyaster	*Machaeranthera tanacetifolia*	R									
Snapdragon vine	*Maurandya antirrhiniflora*					R					
Sweetclover	*Melilotus officinalis*					U					
Blazingstar	*Mentzelia* sp.	R	R	U							
Velvetweed	*Oenothera curtiflora*	R								R	
Scorpionweed	*Phacelia* sp.		U			R		U		A	
Twinpod	*Physaria* sp.	R									
Curlytop knotweed	*Polygonum lapathifolium*					R					
Cottonbatting plant	*Pseudognaphalium stramineum*					R					
Dock	*Rumex* sp.					R					R
Russian thistle	*Salsola tragus*	U	A	C	U	U		C		C	
Verrucose seapurslane	*Sesuvium verrucosum*					R					
London rocket	*Sisymbrium irio*		U			U	U	U		U	
Silverleaf nightshade	*Solanum elaeagnifolium*	C		C		U	U			U	U
Common sowthistle	*Sonchus oleraceus*					R					
Globemallow	*Sphaeralcea* sp.	C		U		C	U				
Alkali swainsonpea	*Sphaerophysa salsula*						R				

		Yeso Arroyo	Angostura Arroyo	Broad Canyon Arroyo	Selden Canyon Arroyo	Las Cruces Effluent	Mesilla Valley Bosque State Park	NeMexas Siphon	Montoya Drain	EP Electric/ Montoya Drain	Downstream Courchesne Gage
Mojave seablite	*Suaeda nigra*			C	U		C	C	C	C	C
Annual Townsend daisy	*Townsendia annua*	U									
Golden crownbeard	*Verbesina encelioides*		R	R	R		R	R			
Lacy sleepy daisy	*Xanthisma spinulosum*					R					
Rough cocklebur	*Xanthium strumarium*					R					R
Graminoid											
Sixweeks threeawn	*Aristida adscensionis*					U	U		U		
Giant cane	*Arundo donax*	R									
Silver beard grass	*Bothriochloa laguroides*	R									
Needle grama	*Bouteloua aristidoides*	U	U				U			C	
Sixweeks grama	*Bouteloua barbata*			U							
Sideoats grama	*Bouteloua curtipendula*	R									
Blue grama	*Bouteloua gracilis*					U					
Brome	*Bromus* sp.	R				R					
Sedge	*Carex* sp.						U				U
Feather fingergrass	*Chloris virgata*		U	C		U					
Pampas grass	*Cortaderia selloana*						R				
Bermuda grass	*Cynodon dactylon*	U	U	A	C	A	U			C	
Yellow nutsedge	*Cyperus esculentus*					R					
Woollygrass	*Dasyochloa pulchella*	U		U							
Saltgrass	*Distichlis spicata*				A	U	C		C	U	A
Jungle rice	*Echinochloa colona*			C							
Spike rush	*Eleocharis* sp.			R	U						
Canada wildrye	*Elymus canadensis*	R				R					U
Stink grass	*Eragrostis cilianensis*			U							
Lehmann lovegrass	*Eragrostis lehmanniana*	R		U		U					
Vine mesquite	*Hopia obtusa*			R							
Foxtail barley	*Hordeum jubatum*									U	
Arctic rush	*Juncus arcticus*						U				
Bearded sprangletop	*Leptochloa fusca*		U								U
Scratchgrass	*Muhlenbergia asperifolia*	U	U		A	U					A
Bush Muhly	*Muhlenbergia porteri*	U		U	R						
Witchgrass	*Panicum capillare*			U							
Knotgrass	*Paspalum distichum*				U						
Common reed	*Phragmites australis*									U	U
Annual rabbit's-foot grass	*Polypogon monspeliensis*										R
Split grass	*Schismus* sp.	C	U			U					
Hardstem bulrush	*Schoenoplectus acutus*		R	U	U	U			U	U	U
Common threesquare	*Schoenoplectus pungens*				U		U	U			U
Bristlegrass	*Setaria* sp.	U		C	R			U			
Johnsongrass	*Sorghum halapense*					U					U
Alkali sacaton	*Sporobolus airoides*		C	U	C	U	C			U	C

		Yeso Arroyo	Angostura Arroyo	Broad Canyon Arroyo	Selden Canyon Arroyo	Las Cruces Effluent	Mesilla Valley Bosque State Park	NeMexas Siphon	Montoya Drain	EP Electric/ Montoya Drain	Downstream Courchesne Gage
Spike dropseed	*Sporobolus contractus*	C	C	C			C	C		U	
Sand dropseed	*Sporobolus cryptandrus*			C	U	U					
Mesa dropseed	*Sporobolus flexuosus*		R	R							
Giant dropseed	*Sporobolus giganteus*			R			R				
Big sacaton	*Sporobolus wrightii*			U				R			R
Cattail	*Typha domingensis*		R	U	C	U	C	C		C	U

APPENDIX C
STAKEHOLDER MEETING

FINAL
USIBWC Stakeholder's Meeting Minutes
Environmental Planning and Design for Aquatic Habitat Restoration
in the Rio Grande Canalization Project

Location: City Hall, Las Cruces, New Mexico
Date: November 09, 2018
Time: 9:00 AM (Mountain)

Participants:

Elizabeth Verdecchia, U.S. International Boundary and Water Commission (USIBWC)
Andrea Glover, USIBWC
Crystal Cadillo, USIBWC
Sidney Webb, Audubon Society (On behalf of Gill Sorg)
Bill Hargrove, CERM-University of Texas El Paso (UTEP)
Bert Cortez, U.S. Bureau of Reclamation (Reclamation)
Conrad Keyes, Jr., Paso del Norte Watershed Council (PdNWC)
Ana R. Donohue: Elephant Butte Irrigation District
Kevin Bixby, Southwest Environmental Center
Chad McKernna, GeoSystems Analysis (GSA)
Todd Caplan, GSA
Malia Volke, New Mexico Department of Game and Fish (NMDGF)
Daniel Lusk, NMGF
Tyler Rogers, U.S. Fish and Wildlife Service
Adrian Tafoya, Natural Resources Conservation Service
Kurt Anderson, Sierra Club
Woody Irving, Reclamation
Howard Nass, Gulf South Research Corporation (GSRC)
Sandra Villarreal, GSRC

The meeting began with Elizabeth Verdecchia, USIBWC Contracting Officer, giving a brief introduction; she went over the background of the project and gave an overview of the preliminary alternatives. She then said there are two phases to the scope of the project and commented that the purpose of the meeting is to obtain comments from stakeholders. Ms. Verdecchia introduced GSRC as the USIBWC contractor responsible for managing the project.

Howard Nass, GSRC Project Manager, then proceeded to describe the process of the project and mentioned that the first phase of the project was the conceptual design and development of alternatives, and the second phase would be the design of two projects from the selected alternative. He also mentioned that SWCA and GSA are a part of the GSRC Team. Mr. Nass introduced Todd Caplan and Chad McKenna from GSA.

Mr. Nass then presented the preliminary alternatives currently identified for the project:

Preliminary Alternative 1 – Yeso Arroyo
Mr. Nass gave a brief overview, as well as pros and cons of the site. He mentioned that the restoration concept included destabilizing the bank, allowing the river to meander in the floodplain, and planting wetland vegetation. The arroyo is uncontrolled (no sediment control dams or lesser retention structures). Mr. Nass informed the audience that this alternative was included in the 2009 U.S. Army Corps of

Engineers (USACE) Conceptual Report. Mr. McKenna presented a map showing the proposed project area and photographs from the previous day's site visit.

Preliminary Alternative 2 – Angostura Arroyo
Mr. Nass gave a brief overview, as well as pros and cons of the site. He mentioned that the restoration concept was similar to Yeso Arroyo and was included in the 2009 USACE Conceptual Report. The arroyo is uncontrolled (no sediment control dams or lesser retention structures). Mr. McKenna presented a map showing the proposed project area and photographs from the previous day's site visit. There is coarse material and large rocks coming from the arroyo. Ms. Glover said the USIBWC built box culverts at the arroyou mouth in early 2012.

Preliminary Alternative 3 – Placitas Arroyo
Mr. Nass gave a brief overview, as well as pros and cons of the site. He mentioned that the restoration concept was similar to Yeso Arroyo and was included in the 2009 USACE Conceptual Report. He indicated the alternative was no longer feasible because of proposed sediment control structures to be constructed within the arroyo.

Mr. Conrad Keys, Jr, PdNWC, questioned why this alternative could not still be considered and would it be possible to do restoration work adjacent to the sediment structures.

Ms. Verdecchia indicated that USIBWC feels the sediment structures would reduce the water velocity in the arroyo to the point that it would not have the energy to destabilize the opposite bank to allow the river to meander.

Preliminary Alternative 4 – Broad Canyon Arroyo
Mr. Nass gave a brief overview, presented restoration concepts, and mentioned the pros and cons of the site. Mr. McKenna presented a map showing the proposed project area and photographs from the site visit on November 7, 2018.

Mr. Keyes asked if there was a control structure upstream, USIBWC confirmed. The conditions created by the sediment structure (controlled velocity) are optimal for backwater areas.

Mr. Keyes asked if ownership was an issue at this site. Ms. Verdecchia mentioned that ownership at this site may be an issue since there is more than owner. She explained that USIBWC owns the north bank and the State of New Mexico owns the south bank. Ms. Verdecchia indicated that land ownership needs to be confirmed for this site. Mr. Rogers then mentioned that the Bureau of Land Management also owns a small portion of land near the site.

Mr. Nass mentioned that USFWS had already done some restoration planting at the site. Mr. Rogers, USFWS, then described the previous restoration work at the site and its potential for flooding.

Mr. McKenna, GSA, described three potential options for the site. One option includes diverting the river onto the site and creating an artificial spring, another option is allow the spring to flow down the arroyo to the river, and the third option is to modify the mouth of the arroyo to allow backwater flooding and plant wetland vegetation. It appears the backwater channel area is under USIBWC ownership.

Mr. Rogers discussed how the arroyo backs up when mainstem flows rise but was not clear regarding what discharge volumes are required for this to happen. He also mentioned issues with soil salinity as reason why some planted willows did not survive.

Ms. Verdecchia indicated that the diversion of water onto the site could be a potential issue. Bert Cortez, Bureau of Reclamation (BOR), mentioned that a diversion permit would be needed from the New Mexico Office of the State Engineer if water diversion is in the selected option.

Kevin Bixby, SWEC, asked if the diversion of water onto the site could be assessed. Mr. McKenna replied that it could be possible. Kevin encouraged analysis of the diversion in order to evaluate feasibility.

Mr. Keyes asked if the cost for each option would be assessed. Ms. Verdecchia confirmed and mentioned that USIBWC's statement of work for GSRC included various components including to assess costs for each of the alternatives.

Mr. McKenna confirmed that all options and their costs should be analyzed in the Environmental Assessment.

There was General support for manipulating arroyo mouth/backwater topography to diversify emergent wetland vegetation and to provide backwater aquatic habitat for fish.

Preliminary Alternative 5 – Mesilla Valley Bosque State Park
Mr. Nass gave a brief overview, presented restoration concepts, and mentioned the pros and cons of the site. He indicated that potential restoration efforts could include deepening existing Resaca pool habitats, side channel creation, and modification to Picacho Drain. He mentioned this is a proposed site from SWEC's *Conserving Native Rio Grande Fishes in Southern New Mexico and West Texas: A Conceptual Approach.* Mr. McKenna presented a map showing the proposed project area and photographs from the site visit on November 7, 2018.

Ms. Verdecchia mentioned that there are several agencies with property ownership at this site: USIBWC, USFWS, Elephant Butte Irrigation District (EBID), New Mexico State Parks, New Mexico Game and Fish, and private owners, and there is a current ownership dispute between New Mexico Game and Fish and New Mexico State Parks. Picacho Drain is owned by EBID, USIBWC owns a small portion of land adjacent to Picacho Drain, and the headgate is located on New Mexico State Parks lands, and NMDGF owns land between the drain and USIBWC's property. Ms. Verdecchia asked Malia Volke, NMDGF, if she could provide an update on a resolution to the property dispute. Ms. Volke was unable to provide an update on a resolution to the property dispute. USIBWC has a Memorandum of Understanding with New Mexico State Parks.

Mr. McKenna indicated that EBID no longer maintains Picacho Drain and there is a potential for aquatic/riparian/wetland habitat creation. Water in the drain is perennial due to groundwater but also conveys stormwater and backs up from surface water inundation at some river discharge that has yet to be determined. The drain flows through NMDFG property and would require collaboration with the state entity with management jurisdiction.

Ana Donohue, EBID, mentioned she would send USIBWC an ownership map of this site.

Mr. Bixby said that the current New Mexico State Parks property was being transferred to New Mexico Game and Fish. Kevin mentioned that the downstream area (Option 3 in SWEC's Native Fishes Report) is too dry and elevated to be considered in the alternatives analysis. Nobody suggested otherwise.

Kurt Anderson, Sierra Club, asked what period of record would be analyzed to support designs. Mr. Caplan responded that the GSRC Team would use existing data (1937-2008) from 2009 USACE Conceptual Plan to support conceptual designs and would consider a narrower period of record

to support engineering-level designs that may be more indicative of climate models (e.g. 2000 - 2018). Mr. Anderson indicated the last 10 years should be evaluated due to drought.

Mr. Keyes mentioned that all options should be included in the plan.

Preliminary Alternative 6 – Las Cruces Effluent Site
Mr. Nass gave a brief overview, presented restoration concepts, and mentioned the pros and cons of the site. He mentioned this is a proposed site from SWEC's *Conserving Native Rio Grande Fishes in Southern New Mexico and West Texas: A Conceptual Approach.* Mr. Nass indicated the primary feature at this site would be a side channel and wetland pond. The side channel would meander in the floodplain and return to the Rio Grande. Effluent from the City of Las Cruces Effluent Site would be used to create the side channel. Mr. Nass indicated that the property is USIBWC property. Mr. McKenna presented a map showing the proposed project area and photographs from the site visit on November 7, 2018.

Mr. Nass mentioned that construction of a side channel under the Interstate 10 bridge may be an issue with New Mexico Department of Transportation. There was some discussion acknowledging potential constraints associated with the bridge and dense riparian plantings that could affect flood conveyance.

Andrea Glover, USIBWC, mentioned that the restoration site would need to be designed so that it does not back up water onto the levee. She also indicated that USIBWC owns the property and that the New Mexico Department of Transportation has a license from USIBWC for the Interstate 10 bridge. Further investigation concerning the Interstate 10 bridge would be required if the created channel was to meander under the bridge.

Mr. McKenna measured the length of floodplain area between discharge canal and bridge and the length ranges between 700 and 1,000 feet (straight line). Could create long meandering channel in this zone that empties back to Rio Grande.

Ms. Verdecchia then explained the different options on how to turn this site into a wetland and a discussion ensued.

Mr. Bixby mentioned that the site would be good for the City of Las Cruces' recreation and that there is a permanent fish population in the effluent channel.

Ms. Verdecchia stated that the channel discharges 8 million gallons of water per day.

Mr. McKenna mentioned that the GSRC team liked the potential of the site when they conducted the site visit and that there were many creative options that they could explore.

Ms. Verdecchia mentioned that the major constraint at this site is the use of effluent water since it is not USIBWC water and the City's groundwater permit uses the surface water discharge as offset; water rights would need to be obtained. Discharge volume must reach the river, so designs should minimize evapotranspiration losses. The proposed design would need to off-set any water depletions (primary constraint).

In previous discussions, the City of Las Cruces is supportive and has indicated the willingness to provide water rights to the project.

Mr. Bixby then mentioned that there are very few sites with perennial water such as the Las Cruces Effluent Site, and asked to keep that in consideration for suitable fish populations. He strongly urged for

the conceptual design to include fish habitat features given the perennial flow conditions in the river at this location.

Ms. Glover then mentioned that fish usually like dirty water, but that the water at this site was clean.

There was widespread agreement among the stakeholders that this would be a good site to include in alternatives analysis. After the meeting, Mr. Anderson indicated that the effluent would be preferable because of climate change potentially limiting availability of water at the other sites.

Preliminary Alternative 7 – NeMexas Siphon
Mr. Nass gave a brief overview, presented restoration concepts, and mentioned the pros and cons of the site. He mentioned the site was previously vegetated with dense salt cedar, coyote willows, and cottonwood; however the site burned in the last few years. Ms. Glover indicated that the site burned in 2013. Mr. Nass mentioned the site is adjacent to EBID's stormwater retention and wetland restoration site. Mr. McKenna presented a map showing the proposed project area and photographs from the previous day's site visit.

Mr. Keyes asked if there were any ownership issues at this site; Mr. Nass confirmed.

Mr. Nass mentioned that this site has potential southwestern willow flycatcher habitat.

Ms. Verdecchia explained that the proposed wetland restoration efforts would create wetlands at the site by excavating pits; however, the potential for exposing groundwater would require a permit from the Office of the State Engineer. She mentioned the site has a shallow water table. Ms. Verdecchia also mentioned that there is a property dispute between the Boy Scouts and the City of Sunland. She mentioned that the land ownership dispute may result in a lawsuit so USIBWC is not considering land acquisition of the site at this time.

Ms. Verdecchia mentioned that USIBWC has an existing flowage easement on the site; however, USIBWC does not know if this easement can be used for habitat restoration efforts.

Ms. Glover stated that the site flooded in 2006.

Mr. McKenna mentioned that it would be relatively easy to create wetlands at the site and that woody vegetation has already established, and he reemphasized the potential for flycatcher habitat. Mr. Nass confirmed and stated that cottonwoods have already returned to the site.

Mr. Cortez asked what a flowage easement was. Ms. Glover explained that it was an easement to allow the river to flow and act as a floodplain.

Preliminary Alternative 9 – El Paso Electric and El Paso Water Utilities Potential Montoya Drain Site (Montoya Intercepting Drain)
Mr. Nass gave a brief overview, presented restoration concepts, and mentioned the pros and cons of the site. He indicated the Montoya Drain transports stormwater to the Rio Grande. Mr. McKenna presented a map showing the proposed project area and photographs from the previous day's site visit.

Ms. Verdecchia mentioned that El Paso Electric and El Paso Water Utility have presented a conceptual plan to use the site, which is located west of the power plant, for stormwater overflow. Wetland habitat could be created on the stormwater overflow site.

Ms. Verdecchia indicated USIBWC is working on engineering designs to modify the culvert and concrete wings to get water to river. USIBWC does not own surrounding property; owned by El Paso Electric.

Mr. Keyes inquired about the ownership of a piece of land near the bridge in the area; ownerhsip was not known.

Ms. Verdecchia indicated that 319 grant money could be received from the State for mitigating ecoli issues; however, USIBWC cannot obtain these funds.

It was the general consensus that this project would be outside of USIBWC's restoration program but that they along with El Paso Electric and El Paso Water Utilities, could likely collaborate with a third party proponent (e.g. SWEC).

Preliminary Alternative 10 – Montoya Intercepting Drain
Mr. Nass gave a brief overview, presented restoration concepts, and mentioned the pros and cons of the site. He indicated that the drain is an agricultural drain and that there is a potential to create aquatic habitat in the drain. The intercepting drain connects with Montoya drain. EBID owns the drain; however, they no longer use the drain due to surrounding development. Currently, the drain is filled with cattails. There is a potential for the drain to be cleared of cattails, deepened and aquatic habitat established. Groundwater is shallow in this area, and the drain has water throughout the year. Mr. McKenna presented a map showing the proposed project area and photographs from the previous day's site visit.

Mr. Hargrove mentioned that the drain has never been dry to his knowledge.

Mr. Nass indicated that EBID has expressed that it would consider selling the drain; however, Ms. Verdecchia doubts USIBWC would purchase the drain. Ms. Glover said USIBWC could look at this for the Sunland Park East levee repairs.

Mr. Cortez indicated that the right of way for the drains is typically 50 feet.

Preliminary Alternative 11 – Downstream Courchesne Gate
Mr. Nass gave a brief overview, presented restoration concepts, and mentioned the pros and cons of the site. Vegetation on the site consists of saltcedar, baccharis, and hydrophytic herbaceous species. Mr. McKenna presented a map showing the proposed project area and photographs from the previous day's site visit.

Ms. Verdecchia mentioned that USIBWC plans to use a portion of the site for mitigation for levee floodwall construction. There is a possibility to expand the site for aquatic habitat restoration and integrate aquatic habitat restoration with future mitigation work. She mentioned that groundwater is shallow in this area. Ms. Verdecchia indicated the Rio Grande in this reach is perennial due to discharge from Sunland Park Wastewater Treatment Plant.

Mr. McKenna indicated the site is approximately 10 acres.

Mr. Bixby asked what the water source is? Ms. Glover replied that it was Texas Department of Transportation stormwater from the highway. Texas Department of Transportation did not construct an outlet to the Rio Grande for stormwater conveyance, and stormwater now backs onto the site. She indicated that underground utility lines precluded the excavation of a channel to the river and that the invert elevation of the culverts are too low.

Ms. Verdecchia mentioned that although the site could already be considered a wetland, its conditions could change since stormwater would have to be allowed to flow to the river to prevent the highway from flooding. She did mention that the site was delineated as a wetland prior to construction of the highway. Ms. Glover then mentioned that the culvert drainage being excavated to the river could potentially impact wetlands.

Ms. Glover indicated that a letter from Texas Department of Transportation may be forthcoming that indemnifies USIBWC from litigation should flood damage to Texas Department of Transportation occur from future flooding.

Mr. McKenna stated that this site was the highest quality in terms of current habitat; that it is already a wetland and would need some saltcedar removal and woody plant restoration. He then mentioned it could be easily adopted as a habitat conservation area.

Mr. Bixby asked if the water at this site is perennial; Ms. Glover indicated that the water source is shallow groundwater and stormwater combined.

Mr. Keyes inquired if any work would be needed on the other side of the river, which may contain an EPA Superfund Site; Ms. Glover replied that she did not think so.

Ms. Glover mentioned that USIBWC may not own the site and that it might be a flowage easement. Ms. Verdecchia mentioned she would check ownership.

Ms. Glover then mentioned that it may be easier to use an alternative in New Mexico since ownership was less of an issue there for USIBWC. In many cases, USIBWC does not have ownership of sites in Texas.

Ms. Verdecchia asked Bill Hargrove, University of Texas El Paso (UTEP), to give an update on the Sunland Park effluent site. He said UTEP did a feasibility study of the effluent site; however, Sunland Park lacked the funding but that it is a good site that could easily be developed into a wetland.

Open Discussion

Ms. Verdecchia then asked if there were any other sites that anyone is aware of, and to keep feasibility and quality of the site as top considerations.

Mr. Hargrove stated that there is a stormwater retention site on Mesa Street that could be assessed. This is outside of USIBWC jurisdiction.

The East Drains near the New Mexico/Texas border were also mentioned as a potential restoration site. Mr. Keyes suggested looking at this site that was proposed in the Watershed Council's watershed plan.

Ms. Verdecchia briefly went over the timeline of the current phase of the project.

Mr. Keyes suggested that a public meeting be held when the two alternatives have been selected.

Mr. Anderson asked which sites had perennial outflow. The Las Cruces Effluent, the Montoya Drain, and Downstream Courchesne Bridge were mentioned.

Ms. Verdecchia thanked everyone for attending and participating and asked that any additional comments to be sent to her. Mr. Bixby followed up by stating that this effort is encouraging to SWEC for fish and fish habitat and thanked USIBWC.

Mr. Nass reminded everyone that comment sheets for each preliminary alternative are provided in the meeting handout and requested that written comments be provided by November 16, 2018.

Meeting Adjourned.

November 16, 2018

To: Howard Ness hnass@gsrcrop.com
Elizabeth Verdicchia elizabeth.verdecchia@ibwc.gov

Re: Environmental Planning and Design for Aquatic Habitat Restoration in the Rio Grande Canalization Project

Please accept the following comments from the Southwest Environmental Center.

General comments:

We are encouraged by, and support, USIBWC's efforts to restore aquatic habitat in the Canalization Project. We support consideration and analysis of all the sites that were discussed at the stakeholders meeting on November 9, 2018. The analysis will be valuable because, regardless of the findings, it will provide guidance on the feasibility and obstacles to doing these kinds of projects in the future.

At the same time, we urge USIBWC to consider implementing more than just two projects as part of this current effort. The need for aquatic habitat restoration in this reach of the Rio Grande is enormous and longstanding. Two relatively small projects is a start but inadequate to redress the extensive habitat loss and degradation that has occurred in the river during more than 100 years operation of the Rio Grande Project and 80 years since implementation of the Canalization Project.

Priority in design and selection of projects should be given to projects that provide the greatest benefit to native fish species, especially species for which suitable habitat is currently a limiting factor. More than half of the historic assemblage of native fish species have disappeared from this reach.

Consideration in design and selection of projects should also be given to native fish species that have been extirpated but could be reestablished if sufficient habitat were present, in addition to those species that are still extant. Of the native species that have been extirpated from this reach, only one species (Notropis orca) is globally extinct. The others exist elsewhere and could potentially be reestablished under the right conditions. (See the Southwest Environmental Center's report entitled Conserving Native Rio Grande Fishes in Southern New Mexico and West Texas: a Conceptual Approach for a list of extant and extirpated native fish species from the Canalization Project area.)

According to the U.S. Fish and Wildlife Service (Final Fish and Wildlife Coordination Act Report for the El Paso-Las Cruces Regional Sustainable Water Project, 2001):

> As the habitat modeling and impact analysis demonstrate, crucial habitat needs for nearly all of the existing and potentially occurring fish species, including the native species, are only marginally met under any flow regime. In particular, the quiet and slow waters of moderate depth, which most species require for spawning and juvenile rearing, are essentially non-existent. (p. 41)

> Quiet water less than 3 ft (0.9 m) deep is highly preferred habitat by inost juvenile fish; these habitats appear to be most available at flows greater than or equal to 100 cfs (2.8 ems), but are essentially non-existent at 500 cfs (14.2 ems). This reflects the uniformity of the existing channel morphology and the lack of instream features, such as woody debris that would otherwise create this type of habitat. (p. 11)

> For larger fish referred to as adults, the habitat preferences are more diverse, but tend toward deeper, moderate velocity water compared to juveniles. There does appear to be some overlap in preferred habitat for both juveniles and adults at flows greater than 100 cfs (2.8 ems), but much lower than 500 cfs (14.2 ems). There is rearing habitat available, primarily at moderate flows near 500 cfs (14.2 ems), for only a few larger-sized species such as common carp (Cyprinus carpio) and river carpsucker (Carpi odes carpio). (p. 12)

> For spawning, nearly all of the fish species require quiet water of at least moderate (1ft; 0.3 m) depth. This habitat is limited at any flow, and particularly at higher flows typical of the early irrigation season from March to June when most species spawn. There is some native species spawning habitat at 100 cfs (2.8 ems) and likely more at slightly higher flows, but is extremely limiting at flows above 500 c:tS (14.2 ems). Lack of suitable spawning habitat is undoubtedly a major contributing fuctor to the poor condition of the Rio Grande fishery. (p. 12)

USIBWC should investigate the possibility with the U.S. Army Corps of Engineers of creating a mitigation bank at each potential restoration project site (for both aquatic and riparian projects) within the Canalization Project. Doing so could generate funding from third parties for restoration efforts undertaken in the Canalization Project, enabling more than two aquatic restoration projects to be implemented if USIBWC funding is limited.

According to the EPA:

> A mitigation bank is a wetland, stream, or other aquatic resource area that has been restored, established, enhanced, or (in certain circumstances) preserved for the purpose of providing compensation for unavoidable impacts to aquatic resources permitted under Section 404 or a similar state or local wetland regulation.[1] A mitigation bank may be created when a government agency, corporation, nonprofit organization, or other entity undertakes these activities under a formal agreement with a regulatory agency. (https://www.epa.gov/cwa-404/mitigation-banking-factsheet)

<u>Specific site-related comments:</u>

Las Cruces effluent site:

We strongly support a project at this site because of the high potential to create a diversity of stream habitats using the perennial discharge of treated effluent. We recommend creating the longest possible project given the available water. Please do not eliminate consideration of continuing the project downstream from the I-10 bridge without first engaging in discussions with the federal and state departments of transportation. Also, please do not eliminate or limit this project based on objections from other stakeholders who might prefer to see the discharged effluent remain in the river channel. The conservation value of using the water to maximize aquatic habitat diversity in a stream on the floodway is much greater, in our view, than the value of allowing water to remain in the river channel, although there are certainly benefits to both.

Also, trees should be an important component of this project, to shade the banks of the restored stream, lower water temperatures, and provide additional recreational and scenic value to the project. Please do not eliminate trees because they are too close to the I-10 bridge. We understand exceptions to this guideline can be made and should be for this project.

Finally, please consult with the citizens' group that has proposed a wetland project at this site to honor the memory of the late author Charles Bowden. We are part of that group and believe an aquatic habitat project at this site would align well with what the group would like to do.

Mesilla Valley Bosque State Park:

We strongly support a project that enhances the habitat value of the existing Picacho Drain and ponds. Such a project would essentially restore the site to its original functionality as part of the Picacho Wetland Project, which predates establishment of the park. The project was constructed in 2002-03 as a joint effort among the City of Las Cruces, SWEC, and other entities.

We do not believe the proposed transfer of the MVBSP from State Parks to NM Department of Game and Fish will go forward. The transfer is opposed by SWEC and many others in the conservation community, as well as the NM Legislature. The latter has threatened legal action to stop the transfer.

Thank you for the opportunity to comment on this effort. Let us know if we can be of further assistance: (575) 522-5552.

Sincerely,

Kevin Bixby
Executive Director

Joint Reply from El Paso Water and El Paso County Water Improvement District No. 1

Letter to Commissioner of US Section of the IBWC regarding

Environmental Planning and Design for Aquatic Habitat Restoration in the Rio Grande Canalization Project

December 14, 2018

To: US Section of the International Boundary and Water Commission via email

Dear Commissioner Harkins:

We wish to congratulate you on your new position and wish you well. Both the City of El Paso (El Paso Water) and El Paso Water Improvement District No. 1 (EPCWID) recently received notice of a Stakeholder Meeting regarding "Environmental Planning and Design for Aquatic Habitat Restoration in the Rio Grande Canalization Project". On December 11 EPCWID participated in a meeting with US-IBWC Specialist Ms. Verdecchia along with representatives of Elephant Butte Irrigation District.

We wish to convey our appreciation of Ms. Verdecchia's professionalism and expertise, and the consideration she has given to the District's and City's concerns regarding the Aquatic Habitat Restoration Project.

The Rio Grande, starting at San Marcial, NM to the American Diversion Dam, in El Paso, Texas, is fully located in the United States and subject to the 1906 Reclamation Act under the specific jurisdiction of the federal Rio Grande Project. The water flowing into Elephant Butte Reservoir is subject to the requirements of the 1938 federal and interstate Rio Grande Compact.

EBID and EPCWID are the primary beneficiaries of the Rio Grande Project and the only entities that funded the local cost share of the construction of Elephant Butte Reservoir and the diversion and conveyance facilities that have served the Project since 1916. El Paso Water is the only water user with federal contracts for municipal use and treatment of Rio Grande Project water.

The 1936 Rio Grande Channelization Act does not supersede or amend either of these laws. Any action authorized under the US-IBWC 2009 Record of Decision cannot harm or impair facilities or operation of the Rio Grande Project, including the ability to operate the drainage canals that control the shallow groundwater levels in the Hatch and Mesilla Valleys.

The notice stated, in part, that "USIBWC has determined that the aquatic habitat restoration sites recommended in the Conceptual Plan may have adverse impacts on the RGCP levees." We agree with this statement and are concerned that the Plan will adversely impact the Rio Grande Project. It is the opinion of our experts that the risk of flooding from the Rio Grande has significantly increased over the last 20 years due to sediment deposition and associated vegetation growth in the river's main flow channel. Any proposed modification proposed by US-IBWC to the Rio Grande must be credibly proven to either have no impact on the conveyance capacity of the Rio Grande or must increase the capacity of the river. Please consider this letter as our official written comment in regard to the US-IBWC's Aquatic Habitat Restoration in the Rio Grande Canalization Project.

Sincerely,

John E. Balliew CWB

John E. Balliew, CEO EPW

Jesus Reyes CWB

Jesus Reyes, General Manager, EPCWID

Elephant Butte Irrigation District
Of New Mexico

530 South Melendres
Las Cruces, NM 88005-2826

Telephone
(575) 526-6671
Fax (575) 523-9666
Dispatch Fax (575) 526-8391
Warehouse Fax (575) 526-1530
Engineering Fax (575) 541-5716

www.ebid-nm.org

Staff Members
Gary L. Esslinger, Treasurer/Manager
Leo Barrett, Maintenance Project Director
Gail Norvell, Finance Director
James Narvaez, Irrigation System Director
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Joe Paul Lack
Sam Salopek

January 4, 2019

Elizabeth Verdecchia
Natural Resources Specialist
International Boundary and Water Commission
4171 N. Mesa St, Suite C-100
El Paso, TX 79902-1441

Subject: USIBWC Environmental Planning and Design for Aquatic Habitat Restoration in the Rio Grande Canalization Project

Ms. Verdecchia,

We appreciate the opportunity to comment on the scoping for the Environmental Planning and Design for Aquatic Habitat Restoration in the Rio Grande Canalization Project (RGCP). The USIBWC's management of the RGCP is crucial to our role and responsibilities as an irrigation district within the project area.

EBID is concerned that the proposed aquatic habitat restoration plans do not reflect a realistic understanding of the Rio Grande Project's hydraulics and hydrology. It is a simple fact that this is a heavily engineered river reach, and changes to the engineering design and function can have unanticipated consequences that propagate through the system. Lack of channel maintenance that was an integral part of the Canalization Project design already compromise primary functions of system: conveyance efficiency and flood control. Further impairing these functions will lead to reduced allocation to EBID farmers, depriving them of the full exercise of their rights, and a greater risk of damage to property from flooding.

1. The alternatives matrix indicates "Potential threats to levees" as negatives for the proposed sites at Yeso, Angostura, and Placitas arroyos. These are dangerous sites to be used for restoration sites. Levee impairment should be a disqualifying characteristic as the threat to property is not worth the marginal benefits of the proposed work. The arroyos are also prone to extreme peak flows, as we saw on the Placitas Arroyo in 2006, when the USGS estimates the flow exceeded 10,000 cfs. The resulting damage to the Village of Hatch should be a sobering lesson for restoration planners. The fact that these arroyos present a flood hazard and will very likely destroy restoration sites built in their mouths with scour and sediment on a periodic basis should be included in the assessment of their cost and value as habitat.

2. The Rio Grande Project is in a severe and sustained drought that has persisted for more than 15 years and shows no sign of abating. The restoration sites appear to rely on deepening depressions in the river bed to provide groundwater-fed pools as habitat when the release from Caballo Reservoir is shut down. We have seen dramatic drops in the groundwater level, particularly in 2013 and 2014 that could dry out any likely restoration sites. In designing and assessing the habitat value of these sites, the very likely drying up of the sites should be considered. Complete drying is not necessary to wipe out a site's fish population. When the Caballo release is off and the river recedes to form pools, wading birds, racoons, skunks, and other wildlife converge on the pools to take advantage of the near-literal fish in a barrel. The fish populations that would inhabit these sites would be very vulnerable. For at least 80 years, and very likely more, the fish population in this river reach has been ephemeral, ebbing in times of drought and reestablishing from upstream in wetter times. Any introduced populations should be considered expendable, and the Rio Grande Project water users, including EBID, El Paso County Water Improvement District No. 1, and Mexico will require legal protection from extreme actions to maintain artificial populations of fish.
3. The stated Potential Restoration Concepts such as bank destabilization and meanders in the channel decrease the rivers conveyance efficiency, particularly when the channel is aggraded due to lack of maintenance. Furthermore, sites that modify the return flow from waste water treatment plants (WWTP) and drains are affecting the Project water supply. Interestingly, this is a legal position advanced by the United States and directly at issue in the ongoing Supreme Court case TX v. NM. In fact, WWTP effluent in New Mexico is the subject of return flow credit plans, and any interruption of the return flow would place the municipality in violation of their plans.
4. While the document expresses the need for offsets, no mechanism for offsets is provided. EBID has a policy that was developed in partnership with USIBWC and Audubon New Mexico for providing water to riparian vegetation habitat sites, but it is clearly not applicable to aquatic habitat. One key reason that the existing policy is limited to providing water for riparian vegetation it that the Rio Grande Project is a single purpose project, and that purpose is irrigation. Providing water to riparian vegetation is irrigation. Providing water for aquatic habitat is not irrigation and would require a change of purpose and point of use under New Mexico state law and perhaps a change of purpose of use under the federal 1920 Miscellaneous Purposes Act in order to comply with Reclamation law. None of these significant issues are addressed in the conceptual planning, though the need for offsets is also most certainly an issue in TX v. NM.

EBID has long been an innovative and engaged participant in local water issues. We recognize the potential for establishing aquatic restoration sites but consider it irresponsible to do so where flood hazards are exacerbated, and water rights are impaired. We have long held the opinion that the ideal sites for aquatic habitat are in EBID's drains, where there are no impacts on flood control or, if managed correctly, conveyance efficiency. Of course, in times of severe drought, our drains do dry up periodically, and that is a fact of life in the Rio Grande Project. The use of WWTP effluent could be combined with drain habitat, but the hydrologic impacts would have to be addressed, creating a complicated but not unsolvable legal issue.

Sincerely,

Gary Esslinger
Treasurer/Manager
Elephant Butte Irrigation District

Cc: Jesus Reyes, Manager, El Paso County Water Improvement District #1