FINAL

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
4191 North Mesa
El Paso, Texas 79902

Prepared By:

Gulf South Research Corporation
8081 Innovation Park Drive
Baton Rouge, LA 70820
Contract Number: IBM15D0005
Order Number: 191BWC18F0101

October 2021

FINDING OF NO SIGNIFICANT IMPACT

U.S. INTERNATIONAL BOUNDARY AND WATER COMMISSION 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 seeks to identify, develop, and design aquatic restoration projects to implement aquatic habitat, wetland, and riparian habitat restoration that would fulfill USIBWC's commitments in the 2009 Record of Decision (ROD) *USIBWC Record of Decision for River Management Alternatives for the Rio Grande Canalization Project*. In May 2019, 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 RGCP. To address comments received during the public comment period and issues raised during the development of preliminary designs, USIBWC re-evaluated alternative sites for aquatic habitat. The USIBWC prepared an Amended Draft EA, which evaluated nine action alternatives and a No Action Alternative. Based on a review of the facts and analyses contained in both Draft EAs, the USIBWC has selected five Alternatives as the Selected Alternatives: Alternative D – Broad Canyon Arroyo, Alternative F – Las Cruces Effluent, South Option, Alternative G – Mesilla Valley Bosque State Park (MVBSP), Alternative H – Downstream of Courchesne Bridge, and Alternative J - Montoya Intercepting Drain Option A, and the USIBWC has prepared a Finding of No Significant Impact.

PUBLIC INVOLVEMENT

Pursuant to the National Environmental Policy Act (NEPA) guidance (40 Code of Federal Regulation (CFR) 1506.6), the USIBWC made major efforts to involve and notify the public and stakeholders. Efforts included: stakeholder meetings, presentations at watershed council meetings, press releases, and announcements/presentations at Rio Grande Citizens' Forums; site visits with stakeholders; publication of the Notice of Availability of both of the Draft EAs in the Federal Register; distribution to stakeholders including federal, state, local governments, organizations, local congressional representatives, and other interested parties; tribal consultation; extension of the public comment period; posting updates on the USIBWC website, including a press release, the Draft EA, meeting notes, notification of comment period extension; and hosting two public hearings. Details of the public involvement are listed in the EA.

ALTERNATIVE ACTIONS EVALUATED

The No Action Alternative and nine action alternatives were evaluated in the Final 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 ROD. As

part of the planning process, conceptual designs were developed for nine action alternatives. The alternatives included the following:

- Alternative B – Yeso Arroyo: This alternative would construct nested terraces along the bankline opposite the Yeso Arroyo and create 6.9 acres of aquatic restoration features within in a 14.3-acre area.
- Alternative C – Angostura Arroyo: This alternative would construct nested terraces along the bankline opposite the Angostura Arroyo and create 7.5 acres of aquatic restoration features within a 14.9-acre area.
- Alternative D – Broad Canyon Arroyo: This alternative would excavate a series of embayments at the mouth of the Broad Canyon Arroyo and create 0.2 acre of aquatic restoration features within in a 28-acre area. This alternative requires an agreement with New Mexico State Parks.
- Alternative E – Selden Point Bar: This alternative would excavate a high-flow channel and a backwater channel supplemented by revegetation with native riparian and wetland plant species and create 0.8 acre of aquatic restoration features within an 8.8-acre area.
- Alternative F – Las Cruces Effluent: This alternative has three Options. The South Option would include a turnout from the straight concrete-lined channel currently used to convey treated wastewater to the Rio Grande in order to divert flows into meandering channel and create 2.0 acres of aquatic habitat and 3.4 acres of native riparian floodplain habitat. The South with Fish Passage Structure Option would consider a structure at the Rio Grande for sorting fish to preclude non-native fish species from entering the constructed channel while allowing for native fish passage. The North Option would install an irrigation turnout in the parcel north to create an additional 7.1 acres of riparian habitat. Implementation of both South Options require an agreement with the City of Las Cruces; implementation of the North Option requires acquiring appropriate water rights.
- Alternative G – Mesilla Valley Bosque State Park: This alternative would include partnerships with property owners at the Park to create a variety of habitat features such as a side channel off of the Picacho Drain, several shallow depressions (swales), and enhancement of existing wetlands and create 3.9 acres of aquatic habitat and 15.4 acres of native riparian habitat. This alternative requires agreements with various stakeholders and appropriate water rights.
- Alternative H – Downstream of Courchesne Bridge: This alternative, the only one located in Texas, would excavate a meandering channel to route stormwater from below Highway 85, through the site, and into the Rio Grande and would create 1.4 acres of aquatic restoration features.
- Alternative I – Trujillo Arroyo: This alternative would widen the confluence of Trujillo Arroyo with the Rio Grande, create seasonal wetland depressions, and excavate a backwater channel along the riverbank and create 3.8 acres of aquatic restoration features.
- Alternative J – Montoya Intercepting Drain: This alternative has two options. Option A would bring back 4.1 acres of open water from original design conditions of the drain by removing sediment, cattails and saltcedar, and install a levee culvert at Montoya Lateral C as part of Sunland Park levee construction. Option B would create terraces near the confluence with the Montoya Drain planted with native riparian vegetation and install water control structures, creating 8.0 acres of aquatic restoration features.

PREFERRED ALTERNATIVES

USIBWC has selected five Preferred Alternatives in three Tiers:

Tier I - Simple

- Alternative D – Broad Canyon Arroyo
- Alternative J – Montoya Intercepting Drain, Option A

Tier II - Complex

- Alternative F – Las Cruces Effluent, South Option
- Alternative G – Mesilla Valley Bosque State Park

Tier III – Levee Mitigation

- Alternative H – Downstream of Courchesne Bridge

Tier I has projects that are simpler and can be implemented relatively quickly. Tier I Alternative D – Broad Canyon Arroyo would be implemented with conceptual plans and an agreement with New Mexico State Parks. Tier I Alternative J – Montoya Intercepting Drain, Option A would be implemented with Sunland Park East Levee construction.

Tier II has long-term projects that require stakeholder coordination/agreements, construction designs, water rights, and logistics planning. Tier II alternatives (Alternative F – Las Cruces Effluent and Alternative G – Mesilla Valley Bosque State Park) would move forward with the construction design phase.

Tier III site Alternative H – Downstream of Courchesne Bridge would be partially or entirely utilized for levee mitigation work. Alternative H – Downstream of Courchesne Bridge would not be implemented as part of the 2009 ROD acreage but would be implemented as part of compensatory mitigation for future levee improvement projects. USIBWC considered Trujillo as a viable site due to existing water rights, but proposed excavation would impact work already conducted by U.S. Fish and Wildlife Service assisting the USIBWC to implement the Trujillo Restoration Site.

SUMMARY OF FINDINGS

The USIBWC prepared the Draft and Final EAs pursuant to NEPA guidance and the President's Council on Environmental Quality (CEQ) 2020 updated regulations for NEPA Implementing Guidelines (40 CFR 1500-1508), 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*.

EFFECTS OF THE PREFERRED ALTERNATIVES

Biological Resources

All Preferred Alternatives would disturb existing vegetation due to sit preparation activities resulting in short-term, minor impacts related to a reduction in vegetation cover. Native riparian vegetation, including cottonwood and coyote willow, and herbaceous wetland species, would be planted in all Preferred Alternatives. Over time, the native plantings would replace existing vegetation community types dominated by invasive species, such as saltcedar, with community types dominated by native riparian vegetation. Planting herbaceous wetland species would diversify vegetation community types present in the floodplains for all action alternatives Therefore, restoring native vegetation would provide long-term beneficial impacts for all Preferred Alternatives.

All Preferred Alternatives provide beneficial impacts to wildlife by enhancing riparian and aquatic habitat.

Alternative D – Broad Canyon Arroyo: Embayments would provide backwater function 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, including southwestern willow flycatcher (*Empidonax traillii extimus*: SWFL) and yellow-billed cuckoo (*Coccyzus americanus*: YBCU). 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.

Alternative F – Las Cruces Effluent, South Option: Diverse aquatic habitat features in and around the meandering channel would emphasize variable conditions to support a diversity of native fish species. These aquatic habitats would be enhanced by planting aquatic vegetation within backwaters, and native riparian vegetation along the channel margins. A total of 2.0 acres of aquatic habitat and 3.4 acres of riparian habitat would be created.

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.

Alternative G – Mesilla Valley Bosque State Park: Under this alternative, water would be diverted from Picacho Drain to a side channel to enhance both riparian and aquatic habitat. The channel would connect downstream to the Rio Grande and begin to inundate as a backwater off the Rio Grande at relatively low to moderate flows. A backwater spur would be created off the channel to provide slack water habitat that supports aquatic species and adjacent riparian habitat. The side channel would support native riparian vegetation including wetland swales planted with native trees and herbaceous wetlands. Aquatic habitat along Picacho Drain would be enhanced through controlling cattail and constructing stepped terraces along the eastern edge of the drain that would be inundated under a range of discharges. A total of 4.7 acres of aquatic habitat would be restored in the channel and backwater features and 15.4 acres of native riparian habitat would be created.

The aquatic habitat features would create habitat for a diversity of fish species, including regionally extirpated species. Riparian vegetation would enhance habitat conditions for a variety of wildlife, and provide nesting, roosting, and foraging habitat for the SWFL and the YBCU. Alternative G – Mesilla Valley Bosque State Park would have a long-term localized beneficial impact on vegetation and wildlife, including threatened and endangered species, and a long-term moderate beneficial impact on aquatic species as a result of creating aquatic habitat features.

Alternative H – Downstream of Courchesne Bridge: USIBWC would use this site for mitigating impacts associated with levee upgrades. Benches, embayments, and pools would be included within the meandering channel, with native herbaceous plantings rather than tree plantings. Wildlife species that would benefit include 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.

Alternative J – Montoya Intercepting Drain, Option A: Under this alternative, USIBWC would enhance flow velocity in the Montoya Intercepting Drain through removing existing cattails, and excavating sediment to return the drain to design conditions. Increased flow velocities and reconstruction of the culvert could increase the potential for fish and other aquatic species to access the drain. In addition, increased flow through the drain would allow for higher dissolved oxygen levels within the stream system, supporting native fish and aquatic in the area. Saltcedar removal and sloped terracing of the drain's edges would replace invasive species with native riparian plantings allowing for greater dispersal of nutrients and runoff during times of high-water flow. Removal of nonnative species and revegetation with native species would allow for higher ecosystem diversity, supporting greater blackbird and waterfowl activity in the area. Alternative J – Montoya Intercepting Drain, Option A would have a long-term, localized impact on terrestrial and aquatic wildlife.

There would be no impact to any federally listed species. The restoration of riparian habitat would occur in narrow bands, which, along with the proximity to the urban environment, would not likely be attractive breeding or migratory habitat for the southwestern willow flycatcher or yellow-billed cuckoo. Herbaceous wetland habitat would not provide the structure required by these species.

Water Resources

All Preferred Alternatives would have a temporary, localized adverse impact on water quality during construction. 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]). Appropriate Clean Water Act and/or New Mexico Office of the State Engineer permits, as necessary, would be obtained prior to construction.

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.

This alternative would have a long-term negligible beneficial impact on water consumption as a result of reducing evapotranspiration by 1.0 acre-feet per year. USIBWC would not need to compensate water use since the proposed embayment would use less water than existing conditions. 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 F – Las Cruces Effluent, South Option: Riparian planting in the floodway could reduce water conveyance as the trees mature. However, the riparian area at this site is only 5.4 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.

This alternative would increase evapotranspiration by 10.2 acre-feet per year. USIBWC would negotiate appropriate agreements with the City of Las Cruces to compensate this water loss. The City of Las Cruces proposes to use imported La Jornada municipal water as compensation for the minimal annual water consumption of the aquatic feature at this site. Implementation is subject to the ability to compensate water use through water rights as well as the approval of the Department of Justice. This alternative would have a long-term, moderate 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 G – Mesilla Valley Bosque State Park: Beneficial impacts are anticipated from this alternative. Construction of a Picacho Drain side channel could provide additional storage for floodwater that backs up the drain. In addition, shallow swales constructed along the side channel would be inundated 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.

Long-term, localized beneficial impacts are anticipated on water quality due to planting native riparian and wetland vegetation which would stabilize river banks and alleviate downstream sedimentation.

Negative impacts on water consumption are anticipated from creating a side channel off of the Picacho Drain, widening and terracing Picacho Drain, and constructing swales along the high-flow channel. Implementation of Alternative G would result in an increase in water loss of 10.2 acre-feet per year from evapotranspiration. This alternative would have a long-term, moderate adverse impact on water consumption. USIBWC would work with stakeholders to compensate increased consumption with water rights and obtain appropriate permits. Implementation of this alternative is subject to agreements with the irrigation district and state agencies as well as the ability to obtain and apply water rights.

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 adverse impact on flood control. 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. 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.

Alternative J – Montoya Intercepting Drain, Option A: Implementing this alternative is expected to provide positive impacts on water consumption. Saltcedar and cattail removal may decrease ET losses in the short term and sediment removal would not affect ET losses.

Cultural Resources

None of the Preferred Alternatives would have adverse impacts on cultural resources.

Alternative D – Broad Canyon Arroyo: All excavations would occur on USIBWC property. In October 2019, the New Mexico State Historic Preservation Officer (NMSHPO), per the Programmatic Agreement between USIBWC and NMSHPO, concurred that this action would have no effect on cultural resources provided that previously recorded sites are avoided, and a temporary barrier is installed between the access road and the known site.

Alternative F – Las Cruces Effluent, South Option: This alternative site has been previously surveyed for cultural resources. No cultural resources have been previously recorded within the footprint of the alternative. NMSHPO provided concurrence in November 2010 that no historic properties would be affected.

Alternative G – Mesilla Valley Bosque State Park: The MVBSP project area has been completely surveyed for cultural resources, and the NMSHPO provided concurrence in October 2010 that no historic properties would be affected.

Alternative H – Downstream of Courchesne Bridge: This alternative site has been previously surveyed for cultural resources, and both the New Mexico and Texas SHPO provided concurrences in October and November 2019, respectively, that no historic properties would be adversely affected.

Alternative J – Montoya Intercepting Drain, Option A: Proposed ground disturbing activities, such as clearing and grubbing vegetation, replacing the drain connection, and installing gated water control structures or culverts, could potentially disturb previously unrecorded cultural resources. The Montoya Intercepting Drain was constructed in the early 1940s, disturbing ground during the construction; therefore, it is not likely that drain has any cultural resources that would be impacted. USIBWC would coordinate with NMSHPO.

Soils

Soils disturbance could increase soil erosion during and after construction at all Preferred Alternative sites; however, USIBWC employs BMPs under all construction contracts 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 D – Broad Canyon Arroyo: Approximately 0.4 acre would experience long-term, localized adverse impacts as a result of excavation and shaping, and approximately 1.7 acre would experience temporary, negligible adverse impacts as a result of planting riparian vegetation.

Alternative F – Las Cruces Effluent, South Option: Approximately 1.0 acre would experience long-term, localized adverse impacts as a result of excavating and terracing and approximately 0.2 acre would experience temporary, negligible adverse impacts as a result of soil disturbance during construction.

Alternative G – Mesilla Valley Bosque State Park: Approximately 1.2 acres would experience long-term, localized adverse impacts as a result of excavating and terracing, and approximately 2.6 acres would experience temporary, negligible impacts as a result of planting riparian vegetation.

Alternative H – Downstream of Courchesne Bridge: Approximately 1.4 acres would experience long-term, localized adverse impacts as a result of excavation and shaping, and approximately 11.2 acres would experience temporary, negligible adverse impacts as a result of planting riparian vegetation.

Alternative J – Montoya Intercepting Drain, Option A: Approximately 7.7 acres would experience long-term, localized adverse impacts as a result of excavation and cattail and saltcedar removal. Under Option A, there would be no short-term impacts resulting from planting riparian vegetation.

Community Resources

Alternative D – Broad Canyon: Broad Canyon is not open to recreational use, therefore no negative impacts on recreational opportunities are anticipated under this alternative.

Alternative F – Las Cruces Effluent, South Option: Temporary adverse impacts on recreational opportunities are anticipated under this alternative. Construction may temporarily impede access to the recreational trail adjacent to the site. However, constructing a pedestrian bridge should add recreational value and enhance the City of Las Cruces' lease for the existing recreation trail. Construction of backwater habitat areas and enhancing riparian habitat 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 may temporarily impede access to recreational opportunities within the park; however, enhancing riparian habitat could attract bird watchers and nature enthusiasts. The proposed restoration project would enhance the park lease and the state park's trails. Habitat restoration is not expected to have a negative impact on public access.

Alternative H – Downstream of Courchesne Bridge: No negative impacts on recreational opportunities are anticipated under this alternative. Heavy equipment would need to access the area during construction via Highway 85.

Alternative J – Montoya Intercepting Drain, Option A: Temporary, minor adverse impacts are anticipated. Users of the adjacent riverside nature trail and park may be impacted due to noise impacts, dust emissions, soil and vegetation disturbance, excavation, and hauling sediment spoils, and impeding access. There may also be visual impacts until native revegetation becomes established.

MITIGATION

Impacts to jurisdictional wetlands or Waters of the United States (U.S.) resulting from the proposed aquatic restoration projects would be permitted through the U.S. Army Corps of Engineers permitting process, and mitigation would be provided per the permit conditions.

DECISION

Based on the review of the facts and analysis contained in the Amended Draft EA, I conclude the implementation of the five alternatives in three Tiers (Tier I – Simple: Alternative D – Broad Canyon Arroyo, and Alternative J – Montoya Intercepting Drain Option A; Tier II – Complex: Alternative F – Las Cruces Effluent and Alternative G – Mesilla Valley Bosque State Park; and Tier III – Levee Mitigation: 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 CEQ are fulfilled and an Environmental Impact Statement is not required.

MARIAELENA GINER Digitally signed by MARIAELENA GINER
Date: 2021.11.03 15:19:49 -06'00'

Dr. Maria-Elena Giner, P.E.
Commissioner
International Boundary and Water
Commission, United States Section

November 3, 2021
Date

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PHOTOGRAPHS

LIST OF EXHIBITS

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

Ac-ft/year	Acre Feet Per Year
ARMS	State of New Mexico Archaeological Records Management Section
BMP	Best Management Practices
BEMP	Bosque Ecosystem Monitoring Program
BLM	Bureau of Land Management
CLC	City of Las Cruces
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
EA	Environmental Assessment
EBID	Elephant Butte Irrigation District
EPDM	ethylene propylene diene monomer
ET	Evapotranspiration
ESA	Endangered Species Act
EWTP	Environmental Water Transaction Program
EXPN	experimental population, non-essential
FR	Federal Register
GSA	GeoSystems Analysis
GIS	Geographic Information System
HEC-RAS	Hydrologic Engineering Center – River Analysis System
LCE	Las Cruces Effluent
LiDAR	Light Detection and Ranging
MID	Montoya Intercepting Drain
MSCP	Multi-Species Conservation Plan
MVAS	Mesilla Valley Audubon Society
MVBSP	Mesilla Valley Bosque State Park
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMAC	New Mexico Administrative Code
NMCRIS	New Mexico Cultural Resources Information System
NMED	New Mexico Environmental Department
NMDGF	New Mexico Department of Game and Fish
NMISC	New Mexico Interstate Stream Commission
NMOSE	New Mexico Office of State Engineer
NMSHPO	New Mexico State Historic Preservation Office
NMSP	New Mexico State Park
NOA	Notice of Availability
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
PA	Programmatic Agreement
RGCP	Rio Grande Canalization Project
RGP	Rio Grande Project
RM	River Mile
ROD	Record of Decision

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 Load
TRC	TRC Companies
TXDOT	Texas Department of Transportation
TXSHPO	Texas State Historic Preservation Officer
U.S.	United States
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
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
WRA	water right acres
WSA	William Self and Associates
YBCU	Yellow-billed Cuckoo

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 at the 30 sites (USACE 2009). Three aquatic habitat restoration sites (Angostura Arroyo, Yeso Arroyo, and Placitas Arroyo) were proposed in the Conceptual Plan but to date aquatic habitat restoration projects have not been constructed. Each of the three arroyo conceptual aquatic habitat restoration sites is situated on the opposite side of the Rio Grande active channel from a major arroyo confluence. The conceptual plans involve destabilizing the riverbanks to encourage river migration into the abandoned floodplain terrace. However, USIBWC and project stakeholders are concerned that these projects, if constructed, 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 the final report, which was completed in September 2018, included several suggested additional locations to evaluate for possible aquatic restoration (Probst and Bixby 2018), some of which are considered in this Environmental Assessment (EA).

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 requirements of the 2009 ROD (USIBWC 2009) and subsequent River Management Plan (USIBWC 2018). Aquatic habitat includes all areas that have mixed use of riparian habitat and aquatic vegetation. 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.

The project is needed to identify, develop, and design aquatic restoration projects to satisfy the commitment to implement aquatic, wetland, and riparian habitat restoration to fulfill USIBWC's commitments in the 2009 ROD. To date, the USIBWC has developed 22 (approximately 508 acres) out of the original 30 conceptual restoration sites (553 acres) identified in the 2009 ROD. Restoration of aquatic sites authorized in the 2009 ROD was initiated in 2019. The USACE Conceptual Plan (USACE 2009) estimated approximately 50 acres would be created at the arroyo sites; however, the 2009 acreage estimates included both riparian and aquatic habitat totaling the 50 acres. Currently, approximately 45 acres of aquatic habitat restoration remains to be completed based on the ROD restoration acreage (USIBWC 2009; USIBWC 2019a). However, the objective is to restore the best and most feasible sites, not necessarily to meet the ROD restoration acreage.

Per the USACE Conceptual Plan (USACE 2009) and USIBWC Rio Grande Canalization Project, River Management Plan (USIBWC 2018), the principal 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 aquatic habitat implementation plans are to:

- produce enhanced cover and in-channel aquatic diversity,
- restore healthy riparian function, and
- enhance natural riverine processes.

Aquatic environments include many types of habitats that serve multiple ecosystem functions. These habitats can include wetlands, open water, ponds, riffles/runs, etc. These various aquatic habitats support a variety of aquatic fauna, including fish, benthic macroinvertebrates, amphibians, reptiles, and shore birds. The purpose of this project is to create aquatic habitat, though USIBWC does not have objectives for 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 procedures for implementing NEPA are specified in USIBWC's *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 procedures establish both the administrative process and substantive scope of the environmental impact evaluation designed to ensure that regulatory authorities and the public have a proper understanding of the potential environmental consequences of a contemplated course of action (USIBWC 2014).

This Amended EA identifies and evaluates the potential environmental consequences that may result from implementation of ten alternatives: the No Action and nine action alternatives. The ten alternatives are discussed in Section 2.

The following resource areas were 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.), and
- community resources (recreation).

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 Rio Grande Project (RGP) water for aquatic habitat restoration.

During the Public Hearing held on June 12, 2019 (Appendix D) and Public Comment Period, comments were received expressing an interest for Alternative G – Mesilla Valley Bosque State Park (MVBSP) (Appendix E). The USIBWC reevaluated Alternative G, as well as a few other alternatives in a revised technical study in 2020 (GSA 2021).

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 would 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, best management practices (BMPs) would be implemented during construction to eliminate or reduce minor and temporary impacts during construction. The proposed restoration sites 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.

2.0 DESCRIPTION OF PROPOSED ALTERNATIVES

2.1 Summary of Alternatives Evaluated

As part of the project team, GeoSystems Analysis, Inc. (GSA) prepared habitat restoration site alternatives and conceptual design reports (Appendix A, Figure A-2). GSA (2019a) considered a total of 8 alternatives (sites) as potential restoration sites (Appendix B). GSA (2021) considered three additional sites, two of which were carried forward for analysis, and re-analyzed two sites (Appendix C). A total of nine alternative sites, plus the No Action Alternative, are selected in the report to be analyzed in this Amended EA, these include:

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 (LCE)
7. Alternative G – Mesilla Valley Bosque State Park (MVBSP)
8. Alternative H – Downstream of Courchesne Bridge
9. Alternative I – Trujillo Arroyo
10. Alternative J – Montoya Intercepting Drain (MID)

These ten alternatives are summarized in Table 2-1 and discussed below.

Table 2-1. Summary of Alternatives Evaluated

Name	River Mile and Bank	Location	Total Acres	Ownership	Benefits	Constraints	Evapo-transpiration (ET) Difference[1] ((ac-ft/yr)	Estimated Restoration Cost	Created Aquatic Restoration Feature (Acre)	Feasibility
Alternative A: No Action	Not Applicable	Not Applicable								
Alternative B: Yeso Arroyo	94E	Garfield, 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[2] and YBCU[2] • Enhance riparian area • USIBWC owns property	• Levee protection • Significant earthwork • Requires additional water rights due to large increases in ET losses • High total cost • High quantity of excavation • Potential to degrade levee integrity	18.3	$836,900 ($121,290/ac)	6.9	This alternative is less feasible to construct based on high total cost, high quantity of excavation, large ET increase, and the potential for levee degradation.
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 • High channel habitat heterogeneity near restoration site	• Levee protection • Significant earthwork • Requires additional water rights • High total cost • High quantity of excavation • Potential to degrade levee integrity	19.5	$690,800 ($92,107/ac)	7.5	This alternative is less feasible to construct based on high total cost, high quantity of excavation, large ET increase, and the potential for levee degradation
Alternative D: Broad Canyon Arroyo	68W	Radium Springs, New Mexico (32.53325, -106.98412)	28	USIBWC, State of New Mexico, BLM[3] (adjoining parcels)	• Existing, active habitat restoration site • USIBWC no mow zone • Create deep water, structurally diverse habitat (e.g., embayments and backwater aquatic habitat) • Direct benefits for SWFL and YBCU • Channel habitat heterogeneity near restoration site • Enhance riparian/wetland vegetation • USIBWC owns property at proposed work location • Low total cost • Decrease in ET	• Multiple owners on adjoining parcels • Regular sediment monitoring • Periodic maintenance (e.g., sediment removal)	-1.0	$37,665l ($37,665/ac)	0.2	This alternative is feasible to implement due to low construction cost, negligible decrease in ET, benefits to SWFL and YBCU, does not require construction design, and excavations would occur on USIBWC property.
Alternative E: Selden Point Bar	66E	Radium Springs, New Mexico (32.518509, -106.968552)	8.8	USIBWC	• Moderate channel habitat heterogeneity near restoration site • Perennial flows (most years) • Create high flow channel and backwater channel • Direct benefits for SWFL and YBCU • Enhance riparian habitat • Decrease in ET • Moderate total cost • USIBWC owns property	• Limited equipment access, equipment would have to be walked across active channel • High soil salinity • Regular sediment monitoring • Periodic maintenance (e.g., sediment removal)	-13.9	$146,550 ($183,188/ac)	0.8	This alternative is less feasible to implement due to maintenance considerations, limited size of the restored area, and relatively higher restoration costs per acre compared to other alternatives.

Table 2-1. Summary of Alternatives Evaluated, Cont.

Name	River Mile and Bank	Location	Total Acres	Ownership	Benefits	Constraints	Evapo-transpiration (ET) Difference (ac-ft/yr)	Estimated Restoration Cost	Created Aquatic Restoration Feature (Acre)	Feasibility
Alternative F: Las Cruces Effluent Outfall	44E	Las Cruces, New Mexico (32.293155, -106.82351)	South: 5.4 North: 7.1	USIBWC	• Create diverse aquatic riparian habitats • Plant aquatic vegetation in backwater areas • Establish riparian vegetation • USIBWC owns property • Direct benefits for SWFL and YBCU • Enhance recreation along existing path • Perennial water flow • Potential to provide habitat for a variety of fish species due to complex design • City has expressed support	• Cessation of mowing through recreation area • Water rights requirements; USIBWC does not own or have rights to the effluent water • Labor intensive to build (e.g., fish passage structure) • USIBWC does not own outfall	South: 10.2[9] North: 2.3	South: $403,935 ($73,443/ac)[10] North: $20,850 (2,937/ac)[9]	South: 2.0 (aquatic habitat) and 3.4 (riparian habitat) North: 7.1 (riparian habitat	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, and support by the City of Las Cruces and other stakeholders. The major caveat is ensuring appropriate water rights.
Alternative G: MVBSP	41W	Mesilla, New Mexico (32.24301, -106.81606)	159.9	USIBWC, EBID[4], NMSP[5], Private	• Enhance diverse aquatic and riparian habitat • Create diversity of habitats • Improve wetland and riparian habitat • Direct benefits to SWFL and YBCU • Potential to create interior floodplain and side channel habitats • Enhance recreation at the park and along the existing trails • Project would be implemented in partnership with New Mexico State Parks, New Mexico Department of Game and Fish, EBID, and private landowner	• Private landowner easement constricts restoration opportunities. Easement expires in 2033. New Mexico has expressed interest in acquiring the parcel. • Picacho Drain must be maintained for irrigation return flow and floodwater protection • High quantity of excavation • Wetland permitting on non-USIBWC lands • Requires additional water rights due to large increases in ET losses	10.2	$1,072,033 ($55,546/ac)[8]	3.9 (aquatic habitat) and 15.4 (riparian habitat)	This alternative is feasible to construct due to low costs of restoration per acre, the large amount of land being restored, increased recreational opportunities, creation of nesting and foraging habitat for SWFL and YBCU, and opportunities for partnering with state and local agencies. Land transfer issues between NMSP and NMDFG were resolved in 2019.
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 for SWFL and YBCU • Large decrease in ET • Moderate total cost • High water table	• Buried Utility infrastructure • Unknown status of future floodwall or levee construction • Unknown status of future TXDOT[6] drainage solutions	-24.5	$101,600 ($72,571/ac)	1.4	This alternative is feasible to construct due to USIBWC owns the property, large decrease in ET, moderate total cost, enhancement of aquatic habitat, improvement of wetland habitat, moderate total costs, and a high water table.
Alternative I: Trujillo Arroyo	103W	Arrey, New Mexico (32.84144, -107.29788)	14	USIBWC, EBID[8]	• Enhance SWFL and YBCU habitat • Leverages existing riparian restoration work implemented by the USFWS[7] • Improve wetland habitat • Direct benefits to SWFL and YBCU • Moderate total cost • USIBWC owns property • USIBWC has existing water rights • Create low-velocity aquatic habitat for fish, amphibians and aquatic invertebrates	• Limited area to establish backwater channel and swales. • Existing maintenance road fragments the restoration area • Existing temporary sediment spoil pile must be removed prior to implementing the restoration project • Moderate increase in ET • Trujillo Arroyo requires periodic monitoring and sediment management • May have to disrupt/transplant restoration plantings done by USFWS	7.5	$628,808 ($165,476/ac)	3.8	This alternative is feasible to construct due to USIBWC owns the property, moderate decrease in ET, moderate total cost, enhancement of aquatic habitat, improvement of wetland habitat, moderate total costs, and a high water table. High sediment disposal costs; however, if the USIBWC can identify a local deposit site, the costs would decrease, thus increasing the feasibility of the project. Total costs would also be decreased if the optional backwater channel is not constructed.

Table 2-1. Summary of Alternatives Evaluated, Cont.

Name	River Mile and Bank	Location	Total Acres	Ownership	Benefits	Constraints	Evapo-transpiration (ET) Difference (ac-ft/yr)	Estimated Restoration Cost	Created Aquatic Restoration Feature (Acre)	Feasibility
Alternative J: Montoya Intercepting Drain	2E	Sunland Park, New Mexico (31.800038, -106.558886)	21.1	USIBWC[8], EBID	• Cattail removal improves MID function • Enhance potential for fish and other aquatic species to use the drain • Improve habitat for blackbirds and waterfowl • Increase dissolved oxygen levels • Restoring drain improves levee function • For Option A, adding the culvert at Montoya C improves irrigation efficiency and provides infrastructure for future irrigation of other nearby restoration areas • Disturbance would be minimized if construction was done at the same time as levee improvement	• Limited area for revegetation with native riparian species. • Water quality, related to storm water runoff and salinity issues • Construction costs associated with sediment haul and disposal • USIBWC does not own water rights • MID must be maintained for irrigation return flows, requiring periodic monitoring and sediment and cattail control management • May require SHPO concurrence for replacing EBID structures	Option A - 0 Option B - 8.7	$1,189,174 ($148,647/ac)	Option A - 4.13 open water Option B - 8.0 (aquatic and riparian habitat)	This alternative is less feasible to implement due to maintenance considerations, limited size of the restored area, the need to acquire water rights, potential water quality issues, and relatively higher restoration costs per acre compared to other alternatives.

Sources: GSA 2019a, 2021
[1]See Section 3.3 Water Consumption for discussion on water rights acquisition
[2]southwestern willow flycatcher (SWFL, *Empidonax traillii extimus*) and yellow-billed cuckoo (YBCU, *Coccyzus americanus*)
[3] Bureau of Land Management (BLM)
[4]Elephant Butte Irrigation District (EBID)
[5]New Mexico State Parks (NMSP)
[6]Texas Department of Transportation (TXDOT)
[7]U.S. Fish and Wildlife Service (USFWS)
[8]USIBWC owns the lower 1.5 miles, EBID owns the upper 1.9 miles but retains management responsibilities for the entire 3.4-mile MID length.
[9]ET calculations were recalculated and differ from those presented in GSA 2021
[10]Cost per acre based on aquatic plus riparian restoration acreage

2.2 Alternative A – No Action

Under Alternative A, none of the proposed action alternatives would be implemented within the RGCP. USIBWC may implement other non-aquatic restoration projects from the 2009 Conceptual Restoration Plan or expand existing habitat restoration site footprints to meet the ROD acreage.

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 the non-engineered levee on the opposite side of the river (Photograph 2-1). USIBWC has also historically dredged the river channel at this location to maintain channel conveyance capacity and gradient (GSA 2019a).

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

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. The riprap removed from the bankline would be used to reinforce the levee along the edge of the elevated floodplain terrace (GSA 2019a). The design phase would have to evaluate whether the levee would require additional protection to prevent undermining.

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 (GSA 2019a).

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 multi-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 to encourage channel mobility.

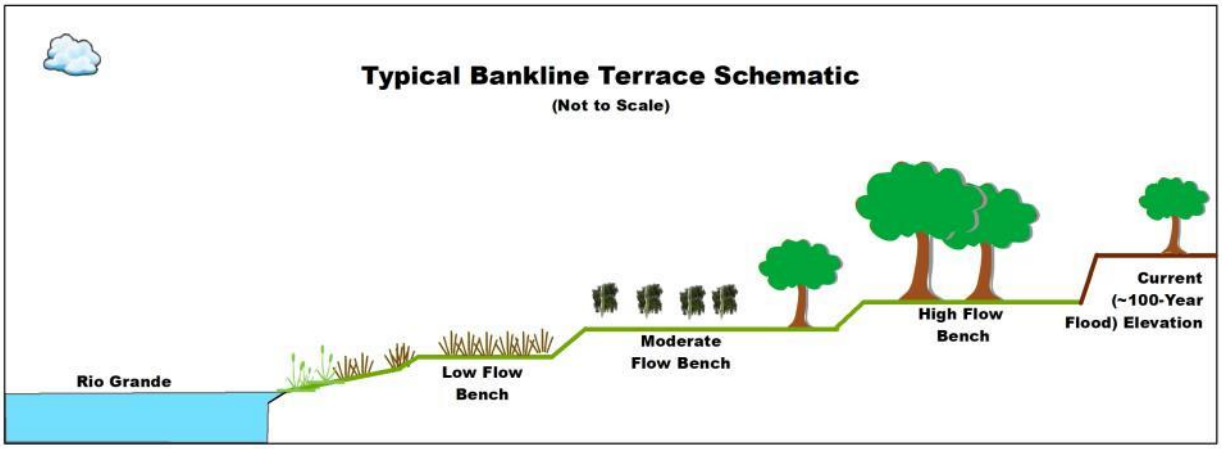

Exhibit 2-1. Schematic cross-section of terraced bankline concept

2.3.1 Benefits 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 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 (GSA 2019a).

2.4 Alternative C – Angostura Arroyo

The Angostura Arroyo site is an approximately 15-acre site located on USIBWC land. 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 original design in the USACE Conceptual Plan is similar to Yeso Arroyo and included 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.

Photograph 2-2. Rio Grande Channel adjacent to the Angostura 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 Appendix 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 (GSA 2019a).

The conceptual design for the Angostura Arroyo site 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 multi-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.

2.4.1 Benefits 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 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. 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 (GSA 2019a).

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 28-acre site, and the site has been the focus of previous riparian habitat enhancement projects by USIBWC and USFWS. NMSP and others have done riparian restoration work on neighboring parcels outside of USIBWC property. These projects have mostly emphasized planting riparian vegetation, although success has been mixed. Currently, Goodding'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 (2019a).

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 excavating 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 Bermudagrass (*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 (GSA 2019a), and
- seed spoil area with a diverse, site appropriate mixture of native grasses and forbs.

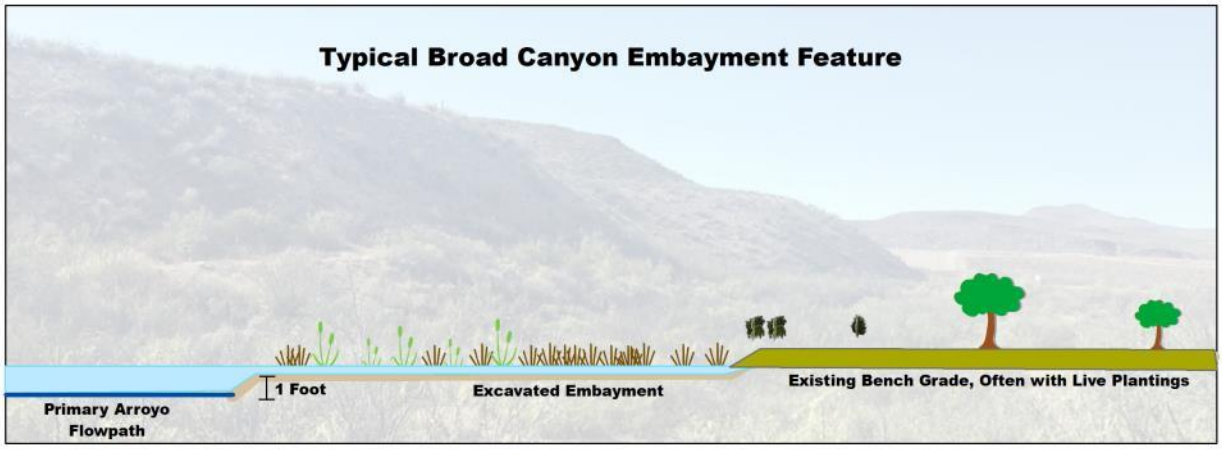

Exhibit 2-2. Schematic cross-section of embayment design concept

This project would require coordination with multiple agencies because there are multiple owners on adjacent parcels. USIBWC does not own the entire east bank where the proposed embayments would be constructed and would need to obtain easements from the landowners or other type of agreement. 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 (GSA 2019a), 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 GSA (2019a) (see Appendix B). The opportunities and constraints at this site are discussed in detail in GSA's alternative sites analysis and conceptual design report (GSA 2019a).

2.5.1 Benefits and Constraints

Implementation of Alternative D – Broad Canyon Arroyo would require coordination with multiple agencies that have adjacent land ownership and/or management responsibilities. USIBWC owns the north bank while USFWS and the State of New Mexico own portions of the south bank. BLM also owns a small portion of land near the site.

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 2019 conceptual design (GSA 2019a), Probst and Bixby (2018) proposed constructing a temporary, artificial spring with two alternative piping routes. This proposal would require a new point of diversion from the Rio Grande and would have effects on Rio Grande Compact deliveries. Regardless, the project team reviewed existing hydraulic models along with the LiDAR data to assess the feasibility of constructing an artificial spring as described in by Propst and Bixby (2018). The proposed location was located in the field and a GPS location marked during the site visit. LiDAR data indicate that the ground elevation at that location is approximately 3,993 feet. A Hydrologic Engineering Center-River Analysis System (HEC-RAS) cross section located near the proposed point of diversion shows that the water surface elevation does not rise to 3,993 feet until river discharge nears 10,000 cfs. At that discharge, hydraulic models indicate 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 pipe, removing debris from screens, servicing pumps, and permitting a new point of diversion, the design does not recommend creation of an artificial spring.

Previous plantings near the confluence reportedly had high mortality, suspectedly due to salinity or prolonged inundation (USIBWC personal communication).

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. Parametrix (2008) reported 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 GSA (2019a).

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 (GSA 2019a).

The proposed conceptual restoration design for the Selden Point Bar site is 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 additional habitat diversity. The backwaters add another structural element to the restoration feature (GSA 2019a).

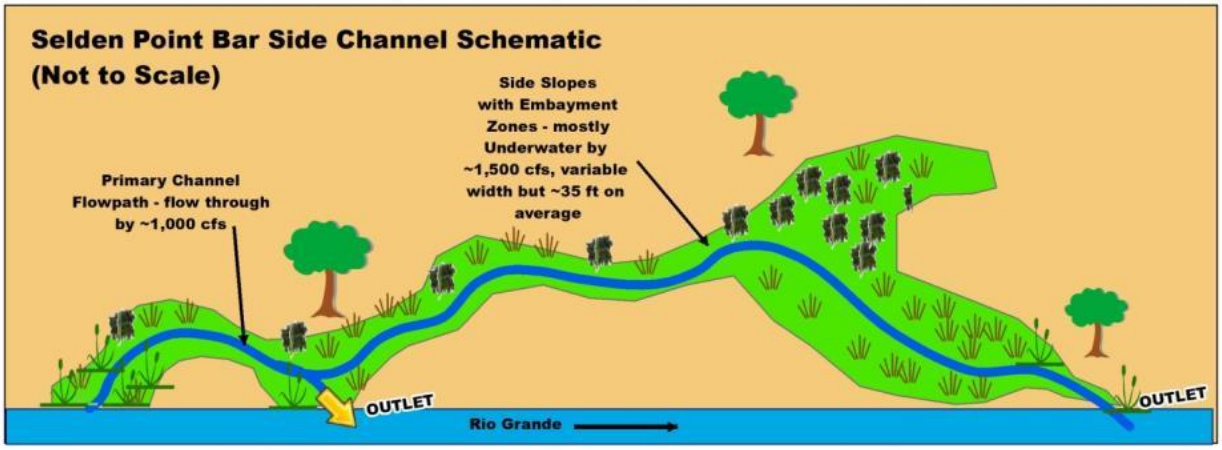

Exhibit 2-3. Illustration of a side channel design concept for Selden Point Bar

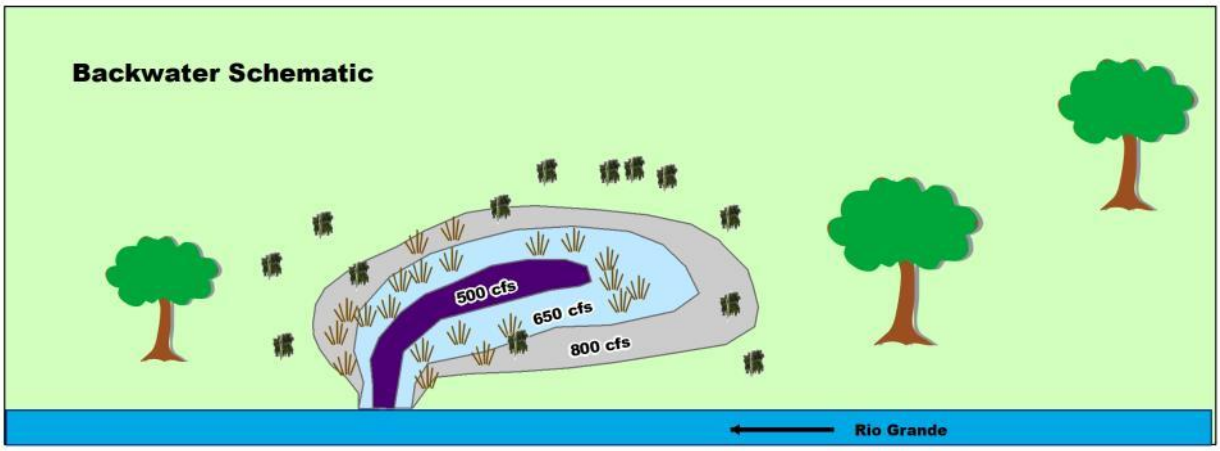

Exhibit 2-4. Illustration of a backwater with inundation flow targets that could be used at Selden Point Bar

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,
- construct two backwater habitat areas (avoiding live plantings and target weedy areas),
- plant cottonwood and willow in surrounding riparian enhancement areas, and
- plant native wetland plant plugs in excavated areas.

2.6.1 Benefits 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., greater than 2,500 cfs), it is also likely that the proposed aquatic features would promote surface water inundation beyond the excavated footprints and recharge groundwater, 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 (LCE) site is an approximately 12.5-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 A-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 reach of the Rio Grande that often extends for 2 to 3 river-miles through MVBSP before completely seeping into the riverbed. The site is near La Llorona Park, and paved walking trails (part of a recreation lease to the City of Las Cruces) support regular recreation (GSA 2021). Probst and Bixby (2018) provide multiple habitat restoration design alternatives that include using effluent discharge to create a new channel or oxbow east of the concrete-lined effluent channel. The Probst and Bixby (2018) proposal included a fish passage structure.

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

The proposed design concept for the LCE site is divided into three options: South, South with Fish Passage Structure, and North.

The South site option would include construction of a turnout from the straight concrete-lined channel currently used to convey treated wastewater to the Rio Grande and divert the effluent into a relatively long, meandering channel with diverse aquatic habitat features (Appendix A, Figure A-12). The conceptual design for the Las Cruces Effluent site (South) would create 1 acre of aquatic habitat and 4.4 acres of native riparian floodplain 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.

The second option is South site with Fish Passage Structure. The purpose of the fish passage structure, as proposed by Probst and Bixby (2018), is to preclude noxious non-native fish species from entering into the constructed channel. The fish passage structure would be located at the mouth of the constructed channel and prevent fish from entering into the constructed channel from the Rio Grande. Fish species would be manually sorted to remove non-native fish species, and native fish species would be allowed to enter the constructed channel. The fish passage structure would need to be operated for several weeks after flows enter the Las Cruces reach

early in the irrigation season. The fish passage structure would be labor intensive and would require manpower to sort and remove non-native fish species. Cost estimates are only for South option and do not include the South with Fish Passage Structure option.

The third option is the riparian habitat expansion of the site North site. Riparian vegetation would be planted in the 7.1-acre area upstream (north) of the concrete-lined channel. A check structure and gate would be installed in the EBID Mesilla Lateral Wasteway 11 to enable irrigation of the riparian plantings.

The proposed conceptual design under Alternative F – LCE includes the following features:

- Creating a meandering side channel with variable substrate and flow characteristics,
- Installing a check structure and gate 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,
- Regrading an existing depression on the north end of the site to promote efficient irrigation inflow and ensure water retention (North option only)
- Installing a check structure and gate in the irrigation return channel (Mesilla Lateral WW11) to enable irrigation of the riparian plantings (North option only),
- Recreation improvements,
- Revegetating with native riparian vegetation, and
- Fish passage structure (South with Fish Passage Structure only).

2.7.1 Benefits and Constraints

Because of the proposed complexity, Alternative F – LCE has the potential to provide habitat for a comparatively large diversity of fish species. Water quality from the effluent discharge should be sufficient to support fish species. Effluent data from the City of Las Cruces indicate that daily chlorine residual in the effluent is negligible. 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. (It is not the intent of USIBWC to stock the channel, so this would only be from natural recruitment).

One major constraint at this site is the use of effluent water, which is not USIBWC water. Therefore, habitat restoration must minimize ET losses at the site, and any proposed design would need to offset any water depletions. Water rights would need to be obtained because of existing legal limitations on the effluent water. Per comments at the project scoping meeting, the City of Las Cruces supports the idea of using the effluent to create wetland features. The City has discussed offering water rights to compensate potential ET losses in the channel (Verdecchia, USIBWC 2019, personal communication). The City of Las Cruces has two sets of groundwater permits issued by the New Mexico Office of the State Engineer (NMOSE) for the water that reaches the effluent. Groundwater permit LRG-430 et al. considers treated wastewater effluent discharge to the river channel as an offset, and some effluent water is required to reach the river system, especially during periods of drought (Shomaker 2009). The other permits (LRG-3283 through 3292) import water from the La Jornada basin and do not have any associated offsets, but the City is required to report data to NMOSE (Shomaker 2009). In response to the February 2021 Amended Draft EA, the City of Las Cruces provided a public comment offering to use the

imported La Jornada water as compensation for the minimal annual water consumption of the aquatic feature at this site(see Section 3.3.3.2.6 for further discussion).

The USIBWC considered applying to NMOSE to transfer existing USIBWC groundwater rights, which would require construction of a groundwater well, as well as changing the use from irrigation to fish and game propagation, changing the place of use, and changing the point of diversion. However, USIBWC, in consultation with the Department of Justice, has determined that use of groundwater in the RGCP is not an option. Connection to the EBID Mesilla Lateral Wasteway 11 would require acquiring surface water for the riparian habitat. Coordination would be required with EBID for the use of surface water in accordance with their policy.

The optional fish passage structure would require individuals to sort and remove 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 EBID between 2002 and 2005 on a 55-acre tract of land within the Park owned by New Mexico Department of Game and Fish (NMDGF) and managed by NMSP. It involved the construction of two ponds to create aquatic/wetland habitat near Picacho Drain. The MVBSP site is approximately 160 acres in size. A detailed description of MVBSP, past restoration efforts, and current restoration efforts is provided in GSA (2021).

Several entities own property within and immediately adjacent to this site, including USIBWC, USFWS, EBID, NMSP, NMDGF, and private owners. 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 2021) (Photograph 2-4). USIBWC owns the segment between the spur levee 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 MVBSP near proposed side channel (GSA 2021)

Multiple restoration options for this site were proposed by Probst and Bixby (2018) and by an older Resource Management Plan (Blue Earth 2008). Potential alternatives presented in those reports include deepening existing resaca pool habitats, creating a side channel, excavating backwater, and modifying the Picacho Drain. Additional design concepts were shared by EBID and USIBWC during a February 2019 site visit. A fire occurred within the park in early 2020 and impacted some of the mature saltcedar.

The Picacho Drain has not been maintained in recent years. In the 2019 site visits, it was overgrown with cattail (*Typhus* spp.) and beaver (*Castor canadensis*) dams frequently interrupt its conveyance efficiency. EBID, who has management responsibilities, conducted maintenance on the drain in early 2020 and removed the overgrowth of cattail to restore the function of the drain.

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 and EBID has indicated a need for improved access to maintain the drain. 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 restoration designs focus on:

- Creating habitat features for a wide variety of native fish species, and
- restoring wetlands and riparian woodland habitat.

The principal conceptual design elements (Appendix A, Figure A-14) include:

- Creating a side channel off Picacho Drain into the floodplain interior,
- installing a new irrigation check structure in Picacho Drain in order to route irrigation water to the restoration area and improve hydrologic connection to the wetland mitigation areas,
- widening and terracing the side slopes of Picacho Drain (already underway/completed),
- constructing a backwater spur off the constructed side channel,
- creating a new wet meadow near the terminus of the side channel,
- constructing a new pedestrian bridge over the Picacho Drain at the removed culvert location (future removal planned by EBID in 2021),
- improving trails, wildlife viewing, and recreation enhancements,
- revegetating with a diverse suite of native, site-adapted plant species, and
- excavating cattail in Picacho Drain (completed in 2020) and restoring the resaca ponds to their original depth.

A side channel would be excavated off of the Picacho Drain to enhance both riparian and aquatic habitat. Exhibit 2-5 provides a schematic drawing of the cross section of the side channel. Side channel flows would be controlled by an irrigation check structure installed in Picacho Drain. The water in Picacho Drain would be from two principal sources: irrigation flows and stormwater during summer monsoon flows. Flows would be managed to provide wetted habitat and maintain restoration plantings. The channel would connect downstream to the Rio Grande and begin to inundate as a backwater off the Rio Grande at relatively low to moderate flows. The backwater spur would provide slack water habitat that supports aquatic species and adjacent riparian habitat. Among large-bodied fishes, river carpsucker and channel catfish (*Ictalurus punctatus*) could potentially persist in constructed channel/enhanced drain habitats. In addition, bluegill (*Lepomis macrochirus*) and river carpsucker (*Carpiodes carpio*) are generally more common in water of somewhat greater velocity where feeding on bottom organic matter is enhanced. Western mosquitofish (*Gambusia affinis*) and fathead minnow (*Pimephales promelas*) would occur in both drain and constructed channel habitats. Red shiner (*Cyprinella lutrensis*) would mainly occur in the constructed channel when it had water.

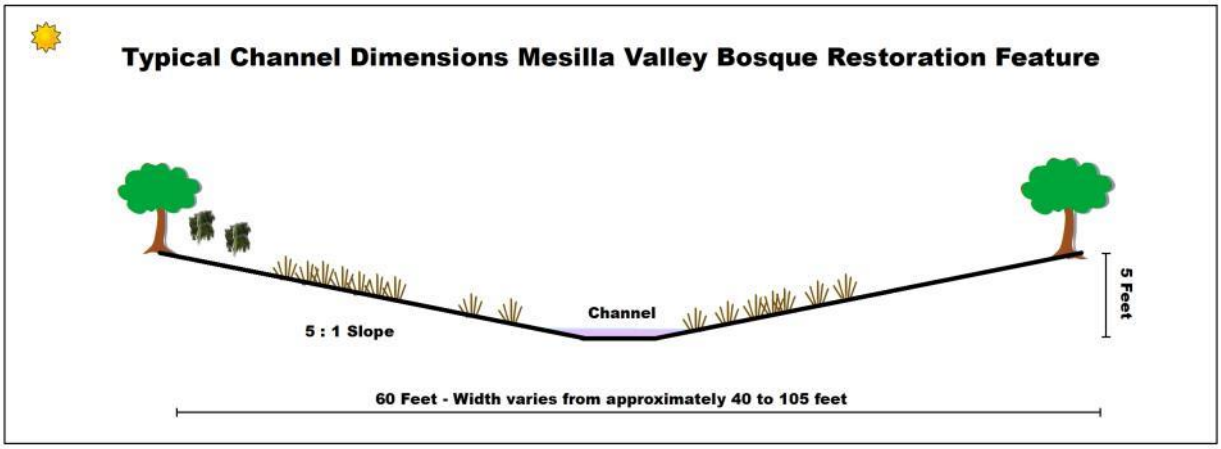

Exhibit 2-5. Schematic cross-section of conceptual restoration design for the MVBSP side channel

Several shallow depressions (swales) would be excavated along the length of this channel and densely planted with coyote willow, cottonwood, and Goodding'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 cattail that currently dominates the drain and constructing a series of stepped terraces (Exhibit 2-6) along the eastern edge of the drain that would be inundated under a range of discharges.

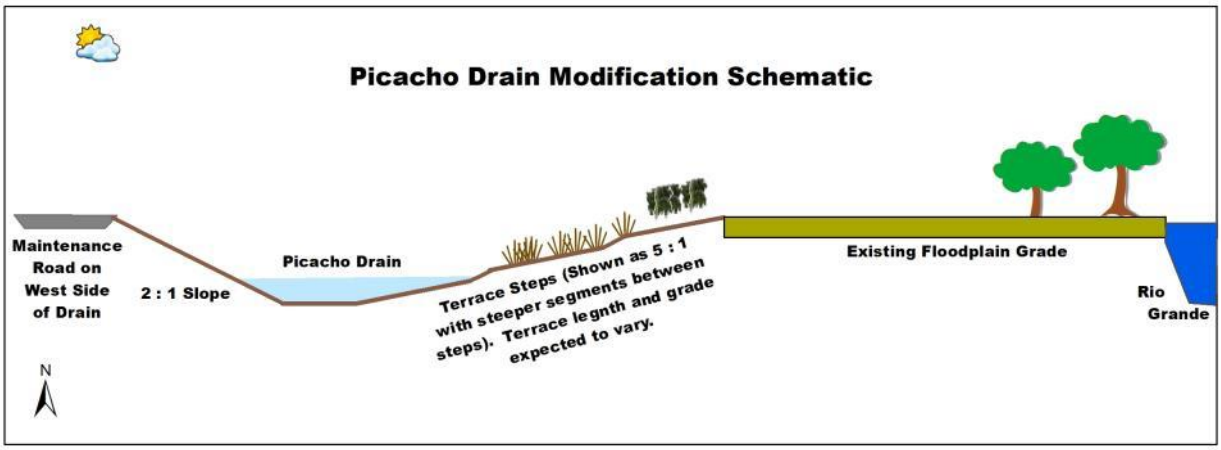

Exhibit 2-6. Schematic cross-section conceptual design for habitat enhancements along Picacho Drain

2.8.1 Benefits and Constraints

Implementation of Alternative G – MVBSP would 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. There is the potential to create interior floodplain and side channel habitats that are rare to nonexistent in the RGCP. These features could become refuge habitats for numerous fish species. Proposed elements also integrate with previous restoration actions at MVBSP creating additional aquatic and wetland habitat. Project implementation would assist with controlling sediment deposition from tributary

arroyos in MVBSP 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, would be improved.

During the drafting of the EA, USIBWC noted issues regarding land transfer of MVBSP from NMSP to NMDGF, which may take many years to resolve. Comments during the public comment period indicated that the issue was subsequently resolved in March 2019.

This alternative would require a large quantity of excavation which makes this alternative extremely expensive. Implementation of this alternative would require acquisition of surface water rights and a diversion of water which would have to 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 flood protection, thus proposed designs must ensure the facility is accessible for periodic maintenance and comply with EBID policy.

Additionally, the side channel connecting Picacho Drain to the Rio Grande presents complexities. Earlier versions of this alternative had the side channel connecting to the Rio Grande upstream of the diversion structure on Picacho Drain. This would have created a new diversion point on the Rio Grande. The revised alternative presented here diverts water off of Picacho Drain which drains downstream to the Rio Grande, thus removing the issue of creating a new Rio Grande diversion point. However, there may be depletions from the Rio Grande, which would require further evaluation. Alternatively, the side channel could be routed to the discharge directly to Picacho Drain. This would require additional design considerations, may result in increased excavation costs, and may decrease the effectiveness of the backwater habitat. The side channel would be designed to minimize sediment management and maintenance but would require periodic sediment removal.

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, Texas (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, during the technical site visit in November 2018, the outlets did 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. Levee designs call for improved stormwater drainage. National Wetland Inventory data indicates that the site supported wetland conditions prior to recent modifications of the highway (GSA 2019a).

Photograph 2-5. Overview of the Downstream of Courchesne 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 would likely increase native wetland species diversity and aquatic habitat complexity at this site. A portion of the Downstream of Courchesne Bridge site would be used by USIBWC for mitigating impacts associated with levee upgrades and construction, and the remainder of the site would be used for aquatic habitat restoration associated with the 2009 ROD.

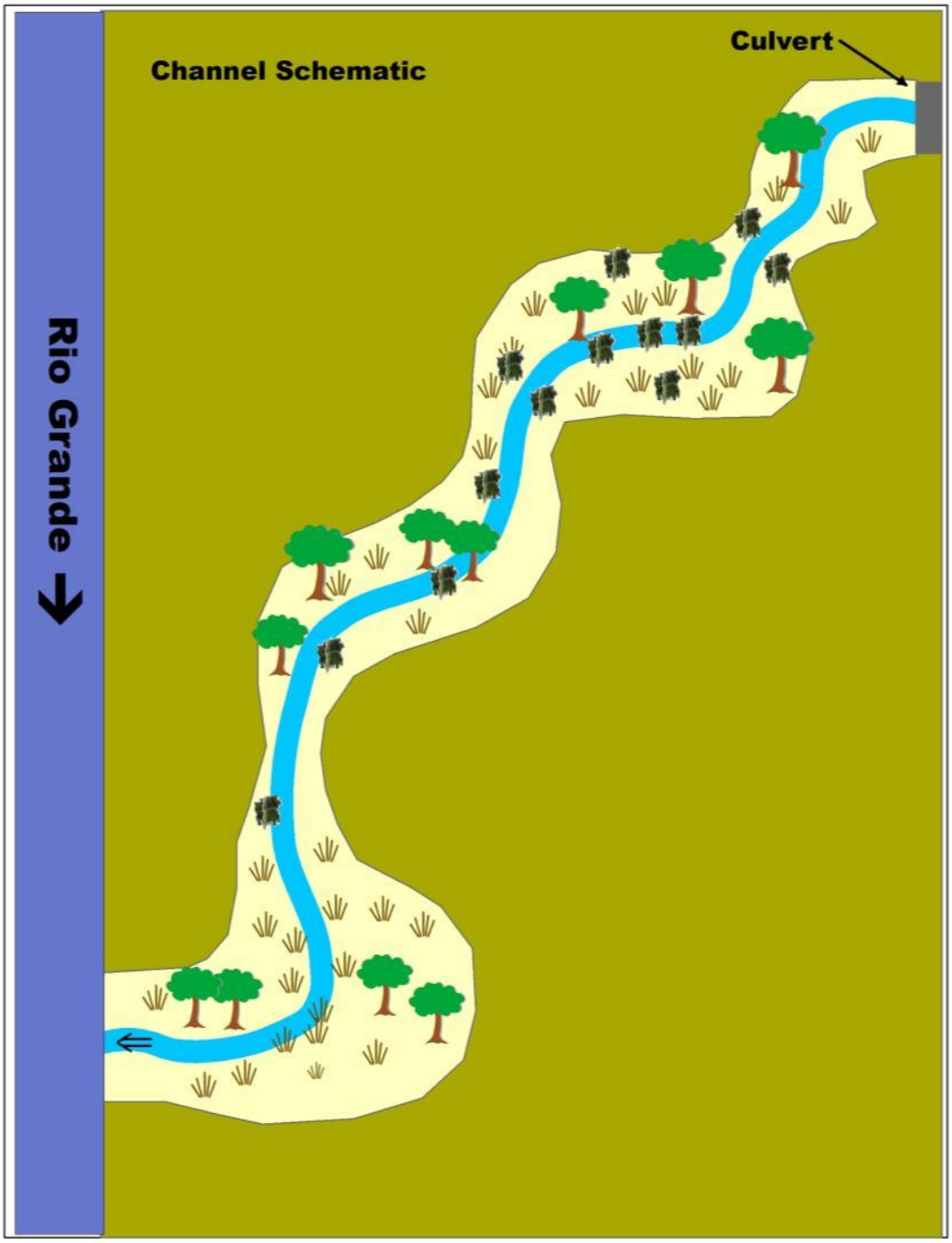

Exhibit 2-7. Conceptual meandering channel at Downstream of Courchesne Bridge site

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

- treat saltcedar and perennial pepperweed (*Lepidium latifolium*) 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 haul off for disposal, and
- seed disturbed areas and spoil area with a diverse, site appropriate mixture of grasses and forbs.

2.9.1 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 Alternative I – Trujillo Arroyo

Trujillo Arroyo is a tributary to the Rio Grande located approximately 4.5 miles downstream of Caballo Dam near the town of Arrey, New Mexico. The project site is a 20.2-acre floodplain terrace on the west side river immediately downstream of the confluence with Trujillo Arroyo (Appendix 2, Figure A-17) (GSA 2021). A north-south maintenance road used to access three USIBWC groundwater monitoring wells bisects the project area. A large, approximately 2-acre (36,000 cubic yards) sediment spoil pile of cobble and gravel is found on the north end of the site adjacent to the confluence. The sediment spoils were excavated from the mouth of Trujillo Arroyo to maintain storm flow conveyance capacity. The arroyo is channelized upstream of the project site (Photograph 2-6).

Photograph 2-6. Photographs of Trujillo Arroyo looking towards the Rio Grande. (GSA 2021)

The USFWS, under a cooperative agreement with the USIBWC, has implemented recent riparian habitat restoration work. Restoration activities include controlling saltcedar and planting coyote willow, Goodding's willow, and cottonwood poles (USFWS 2020). Most of the plantings occur to the west of the maintenance road, although some plantings are installed in linear trenches between the road and the river. The USIBWC has surface water rights to provide supplemental irrigation of the restoration plantings. Water is diverted from the Trujillo Arroyo through a gated control structure. When the gate is lifted, irrigation water is diverted through a 36-inch subsurface culvert into a meandering, 450-foot-long channel excavated by the USFWS.

Native riparian vegetation exists immediately south of the site. The U.S. Bureau of Reclamation (USBR) (USBR 2017) delineated those riparian habitat patches as suitable breeding habitat for the flycatcher. No breeding SWFL have been documented to date; however, migrant SWFL have been recently documented the past few years.

The proposed conceptual restoration design focuses on maximizing use of different surface water sources to expand aquatic habitat across the project area. See Conceptual Design Report – Addendum 1 in GSA (2021) (see Appendix B) for more detail. The principal concepts include the following restoration features:

- Arroyo Mouth Widening: Excavate the floodplain to widen the mouth of Trujillo Arroyo to expand backwater aquatic habitat.
- Wetland Depression: Convert the existing saltcedar stand to a seasonal wetland.
- Backwater Channel and Swale (Optional): Excavate a backwater channel along the riverbank area, extending upstream into the floodplain area currently occupied by weedy vegetation.

See Appendix 2, Figure A-18 for an illustration of the proposed restoration features.

The adjacent floodplain would be excavated approximately four feet to widen the Trujillo Mouth. Coyote willow would be harvested and preserved prior to excavation to be used for revegetating the site. The floodplain area immediate to the west/southwest of the widened arroyo mouth would be excavated to create terraces and planted with coyote willow, seepwillow (aka baccharis: *Baccharis salicifolia* and *B. salicina*), and cottonwood/Goodding's willow poles. Channel maintenance actions to remove sediments from Trujillo Arroyo would continue.

The wetland depression would be created through excavating approximately 2 feet of soil and lining with an impermeable liner, such as bentonite clay or ethylene propylene diene monomer (EPDM) rubber. Excavated soil would be spread on top of the liner and spread across the lined depression. The wetland depression would be planted with facultative and obligate wetland plants, including inland saltgrass (*Distichilis spicata*), yerba mansa (*Anemopsis californica*), and other desirable species. The purpose for lining the depression is to make more efficient use of irrigation water. USIBWC believes the depression lining is necessary to avoid SW-GW interactions that complicate this project. The wetland depression is not a pond intended to stay wet all year. The existing irrigation canal would be extended to allow seasonal irrigation of the wetland depression. This is a pilot project for a wetland depression.

Excavation along the riverbank, extending upstream would create a backwater channel. The downstream outlet would be excavated to inundate at 2,350 cfs (approximately 2 percent to 5 percent exceedance probability). The interior portions of the backwater and swale could be excavated at a lower grade to prolong inundation and retain irrigation water. The swale would be planted with native cottonwood, willow and seepwillow. The existing irrigation canal would be extended to the swale to provide supplemental irrigation water.

2.10.1 Benefits and Constraints

The USIBWC and USFWS have already invested considerable effort and resources into improving the habitat value of the Trujillo Arroyo project site, including expanding native riparian habitat and utilizing USIBWC water rights to deliver irrigation water to the planted areas. The available site data indicates considerable opportunities to expand and diversify both

riparian-wetland and seasonal aquatic habitats to the project site. The HEC-RAS model predicts relatively minor excavation (approximately 1-ft depth) along the river bankline that could facilitate periodic surface-water inundation of the otherwise disconnected floodplain (USACE 2009). The existing irrigation channel could be expanded to strategically irrigate native wetland habitats created in areas currently occupied by weedy plants with low aquatic or terrestrial wildlife value. The confluence of Trujillo Arroyo is currently very narrow, and modeling indicates the 100-year discharge is approximately 4,880 cfs (USACE 2007). Widening the arroyo confluence would significantly increase the area of low-velocity habitat for fish, amphibians, and aquatic invertebrates under a range of Rio Grande discharge levels. Additionally, widening the Trujillo Arroyo mouth could reduce pressure against the Rio Grande east bank and levee (USACE 2007) and could potentially reduce the frequency of arroyo maintenance dredging, although this activity, would remain in the channel maintenance section of the River Management Plan.

2.11 Alternative J – Montoya Intercepting Drain (MID)

The MID is a 3.4-mile long drainage canal that parallels the Rio Grande on the north-east side of the river in Sunland Park, NM (Appendix 2, Figure A-19). The MID was constructed by the USIBWC to drain waterlogged agricultural land (Andrea Glover, USIBWC Engineer, personal communication July 13, 2020). EBID owns the upper 1.75-miles and USIBWC owns the lower 1.57 miles (USIBWC 1986). Despite the division of ownership, EBID is responsible for maintaining the entire 3.3-mile MID length, and use the water captured by the drain to meet RGP delivery obligations to the State of Texas (Z. Libbin, EBID, personal communication July 10, 2020).

The 1.5-mile MID segment owned by USIBWC extends from the MID intersection with the Montoya Lateral Branch C Wasteway 37 (Montoya C Wasteway) to the Montoya Drain adjacent to the El Paso Electric power plant. The MID is perennially wet and water depths are relatively constant, other than periodic discharge pulses from the Montoya C Wasteway (Z. Libbin, EBID, personal communication July 10, 2020). Sediment, dense cattail and saltcedar growth in the channel (Photograph 2-7) impede efficient drainage of MID water to the Montoya Drain. The Montoya Drain structure is scheduled to be replaced by the USIBWC as part of the Courchesne-Nemexas Project's Power Plant Levee segment (currently under design), which would also improve drainage.

The wetted width of survey channel cross-sections range from approximately 35 feet to 50 feet and water depths varied from 2.5 feet to 3.5 feet (GSA 2021). Historically, the maintained drain stored deep water and was primarily free of cattails.

Photograph 2-7. MID levee toe, looking upstream (GSA 2021)

The MID proposed restoration design has been divided into two options, Option A and Option B. Option A consists of:

- Removing existing cattail
- implementing saltcedar removal
- removing sediment from the drain to bring back to design conditions [as documented in USIBWC 1938 Alignment Map No 1 (Baker 1943)].

A second and optional phase would occur after Option A is complete and evaluated. The second phase, Option B, consists of all work in Option A, as well as:

- installing water control structures to manage new cattail infestations and improve drain water conveyance to Montoya Drain,
- terracing the lower portion of the drain near its confluence with the Montoya Drain, and
- planting native vegetation.

Option A would be completed as part of USIBWC's separate Sunland Park East levee improvement construction project. Option A may be accompanied by the construction of a culvert through the levee at Montoya C lateral. This culvert would allow return flows from the

local small tract irrigation events to be diverted back to the river to be reused more efficiently during irrigation seasons with low water availability. For Option A, the proposed culvert at Montoya C Lateral was not included in the conceptual design report (GSA 2021). EBID proposed this culvert during stakeholder discussions in 2020. This proposal is to construct an outlet to the river from EBID's Montoya C Lateral upstream of Sunland Park Drive that would improve conveyance of flows to the river. Aquatic habitat could focus on the area downstream of Racetrack Road fed only by tail end water from Montoya Drain and groundwater seepage being intercepted by the drain as it was originally intended.

Option B would be a separate project that would be completed after Option A, for further riparian and aquatic function enhancement, and would be done in coordination with both irrigation districts.

Appendix 2, Figure A-20 illustrates the proposed restoration conceptual designs for Options A and B. The following discussion provides a summary of the proposed restoration components.

Cattail removal would be accomplished by dredging roots and disposing of all plant waste material off-site. Under Option B, gated water control structures would be added to the upstream end of culverts currently located under Sunland Park Road, Racetrack Road, and at the far downstream end where the MID intersects with the Montoya Drain. The gated structures would enable precise control over water levels in each segment to minimize future cattail establishment and growth. The USFWS found that maintaining 3 to 4 feet of water over the tops of new cattail shoots/leaves would effectively drown the plants (Sojda and Solberg 1993). Seed germination and establishment of new cattail plants only occurs when the marsh substrate is dry. Given that the MID is perennially wet, the primary source of new cattail shoots would likely originate from remnant root material in the drain bottom. Specific guidance on the duration that these 3 to 4 foot water levels would need to be maintained is not provided in Sojda and Solberg (1993), so some level of monitoring and adaptive maintenance would be required to determine minimum duration, frequency and timing of water level management.

Under Option A, saltcedar removal would be conducted in all areas within USIBWC ROW Saltcedar management in Segment 1 must consider the proximity of the industrial development along the MID north bankline. The bankline in Segment 2 is steep and disturbance from saltcedar removal must ensure that the bank is not damaged. Saltcedar removal would be implemented by using methods in the USIBWC River Management Plan for the RGCP (USIBWC 2018). Once the saltcedar is removed, the construction project would rebuild the drain slopes to a 3H:1V slope. Option A would include seeding with native grass and forbs in disturbed areas.

Option B would include planting native vegetation capable of establishing dense root networks that can stabilize the steep bankline as the saltcedar root mass decays. Seepwillow can be planted by hand by opening a hole with a gas-powered hand auger and inserting the root material into moist soil. The plantings would be watered immediately after planting and once or twice in the following growing season. Plantings would be on the landside or north bank only, as non-grass vegetation may not be planted within 15 feet of the levee toe.

The greatest opportunity for restoring native revegetation exists along the north bankline of Segment 3, where the USIBWC boundary is approximately 90-feet north of the north bankline (Appendix 2, Figure A-20). Once the saltcedar aboveground biomass is removed, under Option B, the north bankline would be reconstructed to create three, terrace steps that would serve as revegetation zones. The lower step would be designed to rest approximately 3 feet above the

surface water elevation in the drain. The lower step would be planted with coyote willow and wetland herbs. The middle step would be planted with Goodding's willow, seepwillow, and screwbean mesquite (*Prosopis pubescens*). The upper step would be planted with seepwillow, palo verde (*Cercidium* sp.) or other site adapted species.

2.11.1 Benefits and Constraints

Removing existing dense cattail stands from the MID should greatly enhance potential for fish and other aquatic species to utilize the drain. . Cattails in modest quantities provide important habitat for redwing blackbirds and waterfowl, but the existing cattail stands are so dense that they greatly limit the aquatic habitat quality of the MID. Under Option B, installing gated structures in each segment should assist with cattail management while still allowing other native aquatic plant species (e.g., hardstem bulrush [*Schoenoplectus acutus*]) to establish. Removing existing cattail biomass should increase dissolved oxygen levels for aquatic species and improve MID conveyance to the Montoya Drain.

Installing the culvert at the Montoya C lateral would improve transport of irrigation return flows to the river while restoring original conditions to the remainder of the drain that has historically maintained fish populations. Removing sediment would improve aquatic function and create deeper ponded areas year round. The USIBWC property boundary in Segment 3 is located slightly north and provides opportunities for constructing bankline terrace steps and revegetation with native riparian species under Option B. Disturbance would be minimized if construction was done at the same time as levee improvement. Construction of a culvert here would provide infrastructure for possible future irrigation of USIBWC's nearby Sunland Park Restoration site.

Constraints include the area limitations in Segments 1 and 2, construction and maintenance costs, and potential adverse impacts on the function of the MID; however, those could be alleviated with a proposed culvert at Montoya Lateral C. Construction costs would be minimized if excavating the drain and removing saltcedar are performed concurrently with the Sunland Park East levee construction The proper functioning of the drain would improve the levee function. The potential to diversify the riparian habitat along the MID drain banklines is constrained by the proximity of the levee to the south and the USIBWC property boundary to the north, particularly along Segments 1 and 2. Construction costs could be controlled if haul distance for disposing excavated soil and cattail/saltcedar biomass could be minimized. Long-term maintenance requirements are also a consideration. EBID expressed concern (see Appendix D) that control of cattail through temporary ponding would adversely impact the capacity of the MID to drain high groundwater levels. Returning the drain to its design depth could also help maintain cattail populations. Under Option B, if cattails still persist after Option A work, cattails could be further managed with a series of added culverts and gates.

For both Options A and B, maintenance agreements would need to be discussed and put in place with irrigation districts for the MID (both the aquatic habitat portion of the drain and upstream sections), which must maintain its original purpose of intercepting water. Access ramps to the drain for maintenance are being incorporated into USIBWC's Sunland Park East levee designs. Once the drain is brought back to original depth and conditions, in combination with the new proposed culvert at Montoya C, future sediment deposition would be minimal, and maintenance would focus on cattail and saltcedar maintenance for the first several years.

Regarding water rights, Option A would not increase consumptive use of water and USIBWC anticipates this alternative would not require water rights. Option B terracing and planting would increase ET and may require water rights; implementation of Option B would likely be dependent on securing water rights.

2.12 Alternatives Considered But Eliminated From Further Consideration

A total of six other potential alternative 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 (GSA 2019a, 2021). The sites and the reasons for their elimination from further consideration are discussed in the following subsections and summarized in Table 2-2.

2.12.1 NeMexas Siphon Site

NeMexas Siphon site is near RM 7 (Appendix A, Figure A-2). A spur dike parallels the Rio Grande and a large cattail marsh has formed behind the dike in a previously excavated wetland (part of the EBID Dias Lagos project). Managing agencies are currently considering whether levee reconstruction is required. If required, the levee footprint would expand 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 (see Table 2-2). An assessment for the site is provided in GSA's (2019a) habitat restoration alternatives site and conceptual design report. Riverside portions of the site contain dense saltcedar and wetlands that have formed in excavated borrow pits within the riparian vegetation (Photograph 2-8). 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 SWFL and YBCU. The Rio Grande riverbed was entirely dry at this location during the November 2018 and January 2019 site visits.

Table 2-2. Summary of Eliminated Alternatives

Name	Location	Ownership	Benefits	Constraints	Reasons Eliminated
NeMexas 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
El Paso Electric – Montoya Drain Site	Appendix A, Figure A-2	Multiple owners	• Create aquatic habitat • Create wetland habitat • Integrate stormwater runoff	• Not owned by USIBWC • Uncertain plans for future projects • Landowner complexities • Multiple jurisdictions	• Complexity of ownership • Limited USIBWC Right-of-Way
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 SWFL and YBCU • Enhance riparian area • USIBWC owns property	• Proposed sediment retention facility	• Proposed sediment retention facility would reduce flow velocities
Las Cruces Effluent Subterranean Pipe	Appendix A, Figure A-2	Multiple owners	• 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 • Water ownership and water rights limitations	• Design is beyond Scope of Work for the project

Table 2-2. Summary of Eliminated Alternatives, Cont.

Name	Location	Ownership	Benefits	Constraints	Reasons Eliminated
Keystone Heritage Park	Appendix A, Figure A-2	City of El Paso, Leased to Keystone Heritage Park, LLC	• Restore an example of playa community • Enhance riparian habitat	• USIBWC lacks water rights • City of El Paso owns the land. Keystone Heritage Park, LLC is in the 18th year of a 30year lease • High salinity restricts plantings; plantings that have been implemented have not been successful • Basic evaluation of site conditions, such as soil salinity, water chemistry, depth to groundwater and hydrologic modeling, has not been completed • Limited potential to provide aquatic habitat	• Would not meet the purpose and need because of the limited potential to restore aquatic habitat. • Land ownership requires an additional level of coordination and approvals • Cost and time associated with acquiring the necessary data and information to inform a restoration strategy • Lack of water rights

Photograph 2-8. Dense vegetation at the NeMexas Siphon Site

2.12.2 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). 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 such as a non-profit organization or possibly USIBWC, in the future.

2.12.3 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).

2.12.4 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). There are also limitations on the effluent associated with the City of Las Cruces groundwater water rights. 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. The project would also impact existing riparian and aquatic habitat in the river that depend on the effluent water.

2.12.5 Keystone Heritage Park Site

Keystone Heritage Park (Park, KHP) is 52-acre park in El Paso, Texas located approximately 1.5 miles directly east of the MID. The Park is owned by the City of El Paso and is leased to Keystone Heritage Park, LLC, who manages the Park, which includes an archeological site, a botanical garden, and a groundwater fed wetland and playa basin complex (B. Sargent, Keystone Heritage Park, personal communication, July 1, 2020).

KHP representatives expressed interest in collaborating with USIBWC to enhance and diversify the playa basin complex. The playa basins at KHP are essentially void of vegetation, and previous small-scale trial revegetation efforts have been unsuccessful (M. Gaglio, Keystone Heritage Park, personal communication). Playa basins can be particularly harsh environments for vegetation establishment and growth due to dramatic groundwater fluctuations and associated soil salinization (NMNHP 2000). While not all playa basins have extreme soil salinity, those that do may have relatively low plant species richness and cover (NMNHP 2000).

Site observations indicate the playa basins at KHP are very saline. Extensive salt crusts were visible across the playa surface during the July 1, 2020 site visit (Photograph 2-9). There has been limited soil sampling that has documented high salinity values. However specific values or units were not readily available. Similarly, limited groundwater monitoring suggests that the groundwater in the vicinity of the playa may decline to at least 10 –feet below the surface. However, there is no recent groundwater data available (M. Gaglio, personal communication).

GSA 2021 describes the potential restoration opportunities and constraints. While some habitat enhancement of the playa basins may be possible, the consensus among the project team was that considerable data would be needed to better understand site opportunities and constraints. Soil salinity and groundwater level data within the playa basins are a key data gap that should be filled. A detailed sampling and analysis plan should be developed to guide data collection details. The project team preliminarily recommends installing three groundwater monitoring wells strategically located within or along the margins of the playa basin(s). The wells should be instrumented with a multi-parameter probe so that continuous water-level and chemistry data

(such as salinity, total dissolved solids, and pH) can be collected. The goal would be two-fold: 1) to understand chemistry dynamics under different water level conditions, and 2) combine the water level data with existing LiDAR to develop a groundwater contour map. Similarly, soil samples should be collected along a topographic gradient within one or more playa basins and analyzed to characterize texture and salinity levels within different potential planting zones (from playa bottom to upper edge). These data are considered essential for determining revegetation potential and to identify other potential habitat management opportunities.

Photograph 2-9. Playa Basins at Keystone Heritage Park (GSA 2021)

3.0 AFFECTED ENVIRONMENT AND CONSEQUENCES

3.1 Vegetation

3.1.1 Affected Environment – Vegetation

Vegetation types were mapped during field studies conducted in 2019 (GSA 2019a) and 2020 (GSA 2021). Table 3-1 summarizes the existing vegetative conditions for each site.

Table 3-1. Existing Vegetative Conditions for the Proposed Alternatives

Alternative	Existing Vegetation Type	Acres	Area Impacted (acres)		
			Short Term	Long Term	Total Impacted
Yeso Arroyo	Jimmyweed shrubland	16.26	6.72	4.56	11.28
	Saltcedar-coyote willow shrubland	1.44		1.43	1.43
	Saltcedar-honey mesquite shrubland	0.58	0.06	0.48	0.55
	Total	**18.28**	**6.79**	**6.46**	**13.25**
Angostura Arroyo	Open/Barren area	15.14	6.45	4.19	10.64
	Saltcedar-coyote willow shrubland	1.97	0.00	1.65	1.65
	Total	**17.11**	**6.45**	**5.83**	**12.28**
Broad Canyon	Arrowweed shrubland	0.16			0.00
	Burrobrush shrubland	9.07			0.00
	Coyote willow shrubland	0.61			0.00
	Honey mesquite-Ephedra shrubland	5.22			0.00
	Honey mesquite shrubland	15.42	0.52		0.52
	Open/Barren area	13.5			0.00
	Wet meadow	2.43	1.20	0.39	1.59
	Total	**46.41**	**1.73**	**0.39**	**2.12**
Selden Point Bar	Arrowweed-Saltcedar shrubland	0.13	0.002	0.01	0.01
	Coyote willow-Baccharis shrubland	0.42		0.03	0.03
	Coyote willow shrubland	1.25	0.001		0.00
	Marsh habitat	3.02	2.91		2.91
	Open/Barren area	6.23	4.11	0.70	4.81
	Saltcedar-honey mesquite shrubland	0.43		0.0005	0.00
	Saltcedar Shrubland	9.24	0.19	0.0001	0.19
	Wet meadow	1.39	0.81		0.81
	Total	**22.11**	**8.02**	**0.74**	**8.76**
LCE	Coyote willow shrubland	0.28			0.00
	Open/Barren area	11.41	0.14	0.92	1.06
	Wet meadow	0.13		0.01	0.01
	Total	**11.82**	**0.14**	**0.93**	**1.07**

Table 3-1. Existing Vegetative Conditions for the Proposed Alternatives, Cont.

Alternative	Existing Vegetation Type	Acres	Area Impacted (acres)		
			Short Term	Long Term	Total Impacted
MVBSP	Arrowweed-Wolfberry shrubland	1.98	0.04	0.01	0.05
	Arrowweed shrubland	2.21			0.00
	Baccharis-Saltcedar shrubland	2.5			0.00
	Cottonwood forest	1.69			0.00
	Coyote willow shrubland	3.64			0.00
	Open water	3.31			0.00
	Open/Barren area	94.51	1.93	1.01	2.94
	Saltcedar Forest	17.46	0.08	0.04	0.11
	Saltcedar forest/wolfberry-arrowweed understory	6.54			0.00
	Saltcedar Shrubland	1.35			0.00
	Screwbean mesquite shrubland	3.21			0.00
	Wet meadow	17.38	0.54	0.18	0.72
	Total	**155.78**	**2.59**	**1.23**	**3.82**
Downstream of Courchesne Bridge	Honey mesquite-Baccharis shrubland	2.87	2.52		2.52
	Marsh habitat	0.3	0.19	0.10	0.30
	Open/Barren area	3.64	2.18		2.18
	Screwbean mesquite shrubland	0.18	0.12		0.12
	Wet meadow	8.24	6.17	1.27	7.44
	Total	**15.23**	**11.18**	**1.37**	**12.56**
Trujillo Arroyo	Arrowweed shrubland	2.39		0.17	0.17
	Baccharis-Coyote willow shrubland	0.92			0.00
	Baccharis-Saltcedar shrubland	0.13		0.10	0.10
	Baccharis shrubland	0.04			0.00
	Cottonwood-Coyote willow shrubland	0.02			0.00
	Coyote willow-Baccharis shrubland	4.32		0.04	0.04
	Coyote willow shrubland	2.34		0.47	0.47
	Fourwing saltbush-Jimmyweed shrubland	0.7		0.03	0.03
	Grassland	1.79		0.04	0.04
	Jimmyweed shrubland	0.38			0.00
	Open/Barren area	4.77		2.64	2.64
	Saltcedar shrubland	0.42	0.42	0.28	0.69
	Total	**18.22**	**0.42**	**3.76**	**4.18**

Table 3-1. Existing Vegetative Conditions for the Proposed Alternatives, Cont.

Alternative	Existing Vegetation Type	Acres	Area Impacted (acres)		
			Short Term	Long Term	Total Impacted
MID	Baccharis-Saltcedar shrubland	0.68		0.36	0.36
	Fourwing saltbush-Jimmyweed shrubland	0.38			0.00
	Fourwing saltbush shrubland	0.11			0.00
	Grassland	0.92		0.03	0.03
	Jimmyweed-Baccharis shrubland	0.39			0.00
	Marsh habitat	2.61		2.55	2.55
	Open water	0.25		0.25	0.25
	Open/Barren area	3.31			0.00
	Saltcedar-Baccharis shrubland	0.27			0.00
	Saltcedar shrubland	8.52	3.15	3.19	6.34
	Wet meadow	1.76		1.30	1.30
	Total	**19.2**	**3.15**	**7.68**	**10.83**

3.1.1.1 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 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-21). Additional plant species growing along the bankline slope includes seepwillow, 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*).

3.1.1.2 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-22). Saltcedar-coyote willow shrubland inhabits the bankline slope (GSA 2019a). Other woody species observed on the bankline include arrowweed, screwbean mesquite (seepwillow, honey mesquite, fourwing saltbush, Torrey 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 occur in this area.

3.1.1.3 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 (*Hymenoclea monogyra)* and honey mesquite-ephedra shrubland furthest from the bankline (Appendix A, Figure A-23).

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, Goodding's willow, cottonwood, and Bermudagrass. 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 (*Sporobolus cryptandrus*), sacred datura (*Datura wrightii*), Torrey wolfberry, fringed twinevine (*Funastrum cynanchoides*), broom snakeweed (*Gutierrezia sarothrae*), giant sacaton (*Sporobolus giganticus*) are the primary herbaceous constituents.

3.1.1.4 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-24). 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, seepwillow, saltcedar, and Torrey wolfberry.

3.1.1.5 Alternative F – LCE

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 Bermudagrass meadow with occasional planted cottonwood situated between the levee and the recreational trail adjacent to the bankline (Appendix A, Figure A-25). A small portion of this area is mostly barren but supports patches of kochia and sand dropseed. 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.

The western side of the site is also dominated by a Bermudagrass 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 Bermudagrass and spiny chlorocantha habitat becomes a healthy coyote willow shrubland with Bermudagrass along the ground.

3.1.1.6 Alternative G – MVBSP

Twelve different vegetation types are described for this site. North of the Visitor Center, the vegetation is dominated by grasslands/wet meadow habitat (Appendix A, Figure A-26) (GSA

2019a). The grassland on the eastern side is dominated by alkali sacaton with some jimmyweed and Torrey wolfberry. The wet meadow habitat, on the western side, is dominated by saltgrass while other plants include alkali sacaton, globemallow (*Sphaeracea* spp.), yerba mansa, honey mesquite, screwbean mesquite, saltbush, Torrey wolfberry, and an occasional saltcedar. A narrow band of saltcedar with an occasional seepwillow occurs along 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 Rio Grande bank line and occasionally also includes saltcedar. Patches of previous wetland mitigation areas are now a wet meadow with scratchgrass, common threesquare (*Schoenoplectus pungens*), 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 kochia. As elevation increases north of the ponds, the habitat transitions to areas with arrowweed, Torrey wolfberry, honey mesquite, and skunkbush sumac. South of the ponds, the habitat contains a large coyote willow stand, followed by a mix of saltcedar, Torrey wolfberry, and arrowweed with some Goodding's willow, honey mesquite and screwbean mesquite south of where the Picacho Drain confluences with the river.

3.1.1.7 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-27) (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, 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-seepwillow 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 seepwillow, honey mesquite, jimmyweed, and Jerusalem thorn (*Parkinsonia aculeata*).

3.1.1.8 Alternative I – Trujillo Arroyo

Vegetation mapping identified 33 map units ranging between less than 0.5 acre to nearly 4 acres in size (Appendix 2, Figure A-28) (GSA 2021). Coyote willow (*Salix exigua*) and seepwillow were the most dominant native riparian species, covering nearly half of the 18.5-acre project site. Vegetation north of the artificial channel was indicative of relatively drier conditions, dominated by patches of native grassland (big sacaton (*Sporobolus wrightii),* inland saltgrass, and arrowweed and a small (<0.5 acre) saltcedar patch. Along both sides of the maintenance road the ground was sparsely vegetated or dominated by patches jimmyweed. Other dominant native species included small (< 0.5-acre) patches of Torrey wolfberry, four-wing saltbush, and ash (*Fraxinus* sp.). Notable non-native herbaceous species observed included Bermudagrass, kochia, and Russian Thistle.

3.1.1.9 Alternative J – MID

Five vegetation types were identified at this site (Appendix 2, Figure A-29) (GSA 2021). The site was dominated by a near monoculture of saltcedar at the north edge of the drain, with dense stands of southern cattail (*Typha domingensis*) growing throughout the bottom of the drain. The southern edge of the drain transitioned rapidly from a community containing narrow bands of hardstem bulrush, common threesquare and occasional common reed along the waters to a community of dominated by scratchgrass, saltgrass, occasional commonreed, seepwillow and saltcedar. The last vegetation type was comprised of mostly Mojave seablite and occasional shrubs on otherwise bare soil as the elevation increased upslope towards the levee toe.

3.1.2 Environmental Consequences – Vegetation

3.1.2.1 Alternative A – No Action

Under Alternative A – No Action, restoration projects would not be implemented. There would be no vegetation disturbance due to excavation or clearing and grubbing. Non-native species, such as saltcedar, would not be removed. Thus there would be no adverse impacts to vegetation. Vegetation would not be restored to native riparian and wetland habitat. Therefore, no beneficial impacts are anticipated under this alternative.

3.1.2.2 All Action Alternatives

All action alternatives would disturb existing vegetation (see Table 3-1) due to site preparation activities, including clearing and grubbing existing vegetation and excavating proposed aquatic habitat features in the floodplain. Clearing and grubbing could include removal of non-native species, such as saltcedar, or native vegetation. Therefore, for all action alternatives, there would be short-term adverse impacts related to reducing vegetative cover. Alternative F – LCE would perhaps have the smallest impact because the existing vegetation is primarily mowed grass.

Native riparian vegetation, including cottonwood and coyote willow, and herbaceous wetlands would be planted in all action alternatives. Over time, the native plantings would replace existing vegetation community types dominated by invasive species, such as saltcedar, with community types dominated by native riparian vegetation. Planting herbaceous wetland species would diversify vegetation community types present in the floodplains for all action alternatives Therefore, restoring native vegetation would provide long-term beneficial impacts for all action alternatives.

3.2 Wildlife

3.2.1 Affected Environment – 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 which protects migratory birds, their parts, nests, and eggs thereof during the nesting season. The USFWS has recommended that the regulated nesting season for the region, including the RGCP, is March 1 to August 31.

Some of the common 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). The Mesilla Valley Audubon Society (MVAS) initiated a bird monitoring study at the eBird "Hotspot": Rio Grande Las Cruces: Treatment Water Canal South to I-10. Over the course of 12 months, MVAS identified 86 species and counted 2258 birds in total (MVAS 2021). This study provides a baseline for avian species at the Las Cruces Effluent site.

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, fathead minnow, 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.

3.2.2 Environmental Consequences –Wildlife

3.2.2.1 Alternative A – No Action

Under Alternative A – No Action, no riparian or 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 beneficial impacts are anticipated since no restoration activities would be implemented under this alternative.

3.2.2.2 Alternative B – Yeso Arroyo

When inundated, the terrace benches would 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 might also feed and potentially spawn. Channel catfish 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.

Establishing native riparian trees and shrubs would provide nesting and roosting habitat. The addition of native herbaceous species may support small mammals or herpetofauna. Therefore, Alternative B – Yeso Arroyo would provide a long-term beneficial impact for numerous species of birds, small mammals, and herpetofauna.

3.2.2.3 Alternative C – Angostura Arroyo

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 would also potentially provide habitat for native fishes, including 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 and flooded areas for foraging. Female fathead minnows deposit their eggs on submerged organic matter. Live-bearing western mosquitofish need zero or low-velocity habitats to avoid current entrainment of their young. Red shiner 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. This alternative would have a long-term, localized beneficial impact on aquatic species as a result of creating aquatic habitat.

Establishing native riparian vegetation would have a long-term, localized beneficial impact for numerous species of birds, small mammals, and herpetofauna.

3.2.2.4 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). Floodplain inundation would occur at approximately 1,500 cfs, which would create backwater conditions that 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 habitat for fish and other aquatic species. The addition of embayments to the Broad Canyon backwater would provide low-velocity, deep water, structurally diverse habitats that are not otherwise available in the existing channel. These habitats would provide habitat for small-bodied fish (e.g., fathead minnow and western mosquitofish) and could potentially provide habitat for several large-bodied fish species (e.g., channel catfish and bluegill). 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*). This alternative would have a long-term, localized beneficial impact on aquatic species as a result to of creating aquatic habitat features.

Establishing native riparian vegetation in the surrounding riparian, would have a long-term, localized beneficial impact for numerous species of birds, small mammals, and 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 wildlife.

3.2.2.5 Alternative E – Selden Point Bar

Construction of a flowing side channel, at least during irrigation season, would provide additional habitat diversity. The backwaters would add structural heterogeneity. 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 the water depth, large-bodied channel catfish, flathead catfish, and river carpsucker would potentially use the restored features for feeding. The backwater portions of this site would most likely be used by fathead minnow and western mosquitofish. If sufficiently deep, gizzard shad would potentially feed in the backwaters. This alternative would have a long-term, moderate beneficial impact on wildlife as a result to of creating aquatic habitat features.

Revegetation of nearly 20 acres with native riparian plant species would provide long-term beneficial impacts through supporting a wide range of taxa, including migratory or breeding birds, mammals, or herpetofauna.

3.2.2.6 Alternative F – LCE

Riparian habitat restoration is created through diverting water from the straight concrete lined effluent outfall channel to a meandering channel that contains a mosaic of diverse riparian and aquatic habitat features. The channel design would emphasize variable conditions to support a diversity of native fish species. 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. Channel catfish would mainly inhabit moderate velocity runs but would move into riffles and pools to feed. The primary small-bodied species occupying pool habitats would be fathead minnow and western mosquitofish. 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. Insectivorous longnose dace would occur mainly in riffles but occasionally move into slower-velocity runs. Alternative F – LCE would have a long-term, moderate beneficial impact on aquatic species as a result of creating aquatic habitat features.

Riparian habitat would be enhanced by planting aquatic vegetation within backwaters, wetland, 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 establishing native riparian and

herbaceous wetland vegetation, Alternative F – LCE would have a long-term, localized beneficial impact on wildlife.

3.2.2.7 Alternative G – MVBSP

The restoration design for this site includes a diversity of riparian and aquatic habitat features. Excavating a Picacho Drain side would enhance both riparian and aquatic habitat. 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 cattail that currently dominates 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, river carpsucker, and channel catfish could potentially persist in constructed channel/enhanced drain habitats. In addition, bluegill and largemouth bass currently occupy the resaca ponds and would benefit from habitat improvements. 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.

Several shallow depressions (swales) would be excavated along the length of this channel and densely planted with coyote willow, cottonwood, and Goodding's willow. Numerous wildlife species, including migratory birds, small mammals, and herpetofauna, could benefit from the additional native riparian vegetation. Alternative G would have a long-term, moderate beneficial impact on wildlife.

3.2.2.8 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. The most likely river occupants that would move onto the wetted terrace would be western mosquitofish and red shiner. 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. If the terrace was wetted for a sufficient duration, both species might spawn on it.

This site differs from other alternatives 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 and herpetofauna. Alternative H – Downstream of Courchesne Bridge would have a long-term, localized beneficial impact on vegetation, wildlife, and aquatic species.

3.2.2.9 Alternative I – Trujillo Arroyo

Implementation of proposed riparian habitat improvements, including the arroyo mouth widening, wetland depressions, and the backwater channel and swale, would enhance existing restoration activities. Creating low-velocity aquatic habitat provides habitat for fish, amphibians, and aquatic invertebrates. Red shiner would be the most likely small-bodied occupant of the backwater channel, both for foraging and potentially spawning. Increasing total wetland acreage would allow for a greater biodiversity and supporting area available for aquatic fauna. One such

benefit could be an abundant aquatic macroinvertebrate community, which would support higher numbers of migrant SWFL. Alternative I – Trujillo Arroyo would have a long term, localized beneficial impact on aquatic species.

Establishing native riparian trees and shrubs would provide nesting and roosting habitat. The addition of native wetland herbaceous species may support small mammals or herpetofauna. Therefore, Alternative I – Trujillo Arroyo would provide a localized, long-term beneficial impact for numerous species of birds, small mammals, and herpetofauna.

3.2.2.10 Alternative J – MID

Habitat improvements include enhancing flow velocity in the MID through the removal of cattail in the bottom of the drain. Increased flow velocities and reconstruction of the culvert could increase the potential for fish and other aquatic species to access the drain. In addition, increased flow through the drain would allow for higher dissolved oxygen levels within the stream system, supporting native fish and aquatic in the area.

Saltcedar removal and sloped terracing of the drain's edges would replace invasive species with native riparian plantings allowing for greater dispersal of nutrients and runoff during times of high-water flow. Removal of nonnative species and revegetation with native species would allow for higher ecosystem diversity, supporting greater blackbird and waterfowl activity in the area. Alternative J – MID would have a long-term, localized impact on terrestrial and aquatic wildlife.

3.2.3 Affected Environment – 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 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 3-2 along with a brief description of their habitat. One of these species, the interior least tern (*Sterna antillarum*), has been recently delisted, effective February 1, 2021 (USFWS 2021). For more detailed descriptions, please see the Biological Assessments (SWCA 2011, IDEALS-AGEISS 2017) and Biological Opinions (USFWS 2012, USFWS 2017) for the RGCP. One plant species, the Sneed pincushion cactus (*Escobaria sneedii)*, is federally listed as endangered, but is not included in Table 3-2.

Table 3-2. Federally Listed Species with the Potential to Occur in the RGCP

Common Name	Federal Status[1]	Habitat	Potential to Occur at Sites	Potential Timeframe for Occurrence
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, seepwillow, boxelder (*Acer negundo*), stinging nettle (*Urtica dioca*), blackberry *(Rubus* spp.), cottonwood, arrowweed, saltcedar, 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 MVBSP in winter 2010.	Year-round
Interior Least tern (*Sterna antillarum*)[2]	none[2]	Nesting habitat is bare or sparsely vegetated sand, shell, or gravel beaches, sandbars, islands, or salt flats associated with rivers or reservoirs. This species has been documented at MVBSP.	Not likely; no recent records along the Rio Grande.	N/A
Yellow-billed cuckoo, western distinct population segment (DPS) (*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, this species 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 MVBSP and scattered records elsewhere along the Rio Grande between Hatch, NM and El Paso, Texas.	Spring, summer, and fall

Source: USFWS 2019.
[1]E – endangered, T – threatened, EXPN - experimental population, non-essential
[2]Effective February 1, 2021, the USFWS has delisted the Interior Least Tern (USFWS 2021)

The cactus is found on exposed areas of steep, sloping limestone in grasslands or shrublands in the Chihuahuan desert and is 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 (USFWS 2014a), SWFL (USFWS 2012, 2013), and YBCU (USFWS 2014b).

3.2.3.1 Environmental Consequences – Threatened and Endangered Species

3.2.3.1.1 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.

3.2.3.1.2 Alternative B – Yeso Arroyo and Alternative C – Angostura Arroyo

Under the Alternative B – Yeso Arroyo and 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. 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 and Alternative C – Angostura Arroyo would have a long-term, localized beneficial impact on SWFL.

3.2.3.1.3 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.

3.2.3.1.4 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 may provide potential migratory, nesting, roosting, or foraging habitat for SWFL. 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.

3.2.3.1.5 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 via the pedestrian trail.

This alternative would have no impacts on SWFL and YBCU.

3.2.3.1.6 Alternative G – MVBSP

Habitat enhancement would occur south of the Visitor Center at the state park and would include removing saltcedar vegetation and replacing it with a mix of cottonwood, coyote willow, and Goodding'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.

3.2.3.1.7 Alternative H – Downstream of Courchesne Bridge

Under Alternative H – Downstream of Courchesne Bridge, no adverse impacts to threatened and endangered 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 have no impacts on SWFL or YBCU.

3.2.3.1.8 Alternative I – Trujillo Arroyo

Habitat enhancement would augment existing SWFL and YBCU habitat and coyote willow, Goodding's willow and cottonwood habitat restoration implemented by the USFWS. Restoring willow dominated habitat provides the breeding and migratory habitat required by the SWFL. Cottonwood plantings with a willow and riparian shrub understory create breeding and migratory habitat for the YBCU. Creation of wetland depressions, coupled with supplemental irrigation water, provides the moist soil conditions required by these species during breeding season.

Expansion of the Trujillo Arroyo confluence and creation of the backwater channel provides habitat used by native fish species during spawning season, which occurs during the spring runoff pulse.

Implementation of Alternative I – Trujillo Arroyo would have long-term beneficial impacts on the SWFL, and YBCU.

3.2.3.1.9 Alternative J – MID

Under Alternative J – MID would not impact any federally listed species. The restoration of riparian habitat would occur in narrow bands along the MID. The narrow habitat band and the proximity to the urban environment would not likely be attractive breeding or migratory habitat for the SWFL or YBCU. Herbaceous wetland habitat would not provide the structure required by these species.

3.3 Water Resources

3.3.1 Flood Control

3.3.1.1 Affected Environment – 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. The USIBWC is completing construction of levee rehabilitation throughout the RGCP (USIBWC 2007).

3.3.1.2 Environmental Consequences – Flood Control

3.3.1.2.1 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*.

The No Action Alternative would have no impact on flood control.

3.3.1.2.2 Alternative B – Yeso Arroyo

Destabilizing the bankline and creating the terraces could potentially increase floodplain inundation during spring flood events and summertime convective storm events. However, the site is on the inside bend of river, resulting in relatively lower flow energy and velocities. Sediment inputs from the arroyo across the river channel could push the river over to the restoration site. Implementation of BMPs to stabilize the bankline and revegetation would provide levee protection. There could be a short-term minor to moderate adverse impact as a result of potential loss of levee integrity until native riparian vegetation is established. However, there would be a minor adverse impact to levee integrity once the vegetation is established.

3.3.1.2.3 Alternative C – Angostura Arroyo

Destabilizing the bankline to create the terraces could allow for channel migration. The site is on the outside bend of the river, where flow energy and flow velocity would be expected to be higher, resulting in increased bankline scour and increased meandering during high flow periods associated with spring runoff or summertime convective storm events. In the absence of implementing revegetation and BMPs to stabilize the bank, channel migration could potentially impact the levee. Once native vegetation is established, there would be a minor risk of impacting the levee. Alternative C – Angostura Arroyo would have a short-term minor to moderate adverse impact as a result of the potential loss of levee integrity. However, the long-term risk adverse impact would be minor because establishment of native riparian vegetation would stabilize the terraced bankline and floodplain.

3.3.1.2.4 Alternative D – Broad Canyon Arroyo

Spoil from the construction of embayments would be deposited on-site in barren areas behind the berm or other areas outside of the active floodplain. 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.

3.3.1.2.5 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. Alternative E – Selden Point Bar would have a minor, beneficial, localized impact on flood control as a result of creating additional water storage capacity if sediment deposition is maintained.

3.3.1.2.6 Alternative F – Las Cruces Effluent

Riparian planting in the floodway could reduce water conveyance as the trees mature. Riparian vegetation increases the roughness coefficient and typically decreases 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.

3.3.1.2.7 Alternative G – MVBSP

Beneficial impacts are anticipated from this alternative. Construction of a Picacho Drain side channel could provide additional storage for floodwater that backs up the drain. 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.

3.3.1.2.8 Alternative H – Downstream of Courchesne Bridge

Construction of a meandering channel in the floodplain is not expected to adversely impact flood control. Herbaceous wetland vegetation and low density woody vegetation would be planted along the channel margins. Terracing and planting the Rio Grande bank with herbaceous vegetation would help stabilize the bank and prevent bank erosion. The low-density planting of woody vegetation could increase the potential for fouling floodgates downstream. Alternative H Downstream of Courchesne Bridge would have a long-term, localized beneficial impact on flood control.

3.3.1.2.9 Alternative I – Trujillo Arroyo

Widening the Trujillo Arroyo channel at the confluence of the Rio Grande and constructing backwater swales would increase floodplain inundation during spring runoff, providing storage for floodwater. Widening the Trujillo Arroyo could improve floodwater conveyance from upland areas. Alternative I – Trujillo Arroyo would have a long-term, localized beneficial impact on flood control.

3.3.1.2.10 Alternative J – MID

Removing cattail and saltcedar along the MID would be expected to improve flow conditions within the MID. No activities are proposed under Alternative J – MID within river side of the levee. Alternative J – MID would have long-term moderate beneficial impacts through improving floodwater conveyance from upland areas, if the MID is maintained.

3.3.2 Water Quality

3.3.2.1 Affected Environment – 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 total maximum daily load (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 (New Mexico Environmental Department [NMED] 2013; New Mexico Administrative Code [NMAC] 2013). In the 2012-2014 assessment of the surface water quality from Rio Grande Assessment Unit NW-2101, NMED determined bacteria concentrations exceeded standards spanning from the international boundary to 1 mile below the Percha Dam and labeled the area 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 for bacteria (Recreational Use) (Texas Commission on Environmental Quality [TCEQ] 2018). Designated uses for this stretch of the RGCP include contact recreation, fish consumption, public water supply, and high aquatic life.

3.3.2.2 Environmental Consequences – Water Quality

3.3.2.2.1 Alternative A – No Action

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

3.3.2.2.2 All Action Alternatives

Excavation of habitat features in the floodplain would increase the potential for erosion and sedimentation in the Rio Grande. However, contractors would be required to develop 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 USEPA, NMED (for New Mexico sites), and TCEQ (for the one Texas site). Sedimentation and introduction of contaminants would be reduced or eliminated by using 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 all action alternatives, there may be short-term minor adverse impacts during and shortly following construction. However, long-term, localized beneficial impacts are anticipated on water quality.

3.3.3 Water Consumption

3.3.3.1 Affected Environment -- 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 data collected from USIBWC wells supports the generally accepted concept that shallow groundwater and Rio Grande surface flows have close interaction (USBR 2016, USGS 2017). 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). A review of USIBWC groundwater monitoring indicates that shallow groundwater levels vary about 3 to 14 feet below ground.

The RGCP lies entirely within the RGP geographic area. The RGP supplies irrigation water for approximately 178,000 acres of land in New Mexico (159,560 acres) and Texas (18,440 acres), as well as electric power (USIBWC 2019a). RGP water is supplied through regulated release of stored water in Elephant Butte and Caballo Reservoirs, agricultural return flows to the river, wastewater discharges to the river, and stormwater runoff.

Under the 2009 ROD, the USIBWC developed and implemented the Environmental Water Transaction Program (EWTP) to acquire or lease water rights to offset increased ET consumption from the implementation of habitat restoration sites, or to provide supplemental irrigation of restored habitats (USIBWC 2019b, 2009). USIBWC has committed to acquiring or leasing 677 acre-feet of water annually through the ETWP (USIBWC 2019a, 2018) to compensate ET losses. Per Memorandum of Understanding between USIBWC and EBID and EBID Policy 2013-ENG14 (EBID 2013), surface water rights may be used to support the restoration of native vegetation and riparian habitat if the lands are irrigable and are covered by an incidental take statement. Lands that were not previously eligible for water rights may be reclassified as water righted lands for habitat restoration (EBID 2013). Under this agreement and current EBID policy, surface water consumption of riparian habitat could be compensated by EBID-administered surface water rights.

However, there is no mechanism to compensate consumption of open water, through acquiring or leasing EBID-administered surface water rights. Compensation for open water habitat depletions would require a policy change by EBID. Because all proposed aquatic sites are actually mixed use (both aquatic and riparian), it may be possible to compensate increased water consumption of mixed use habitat sites with EBID-administered surface water rights in order to irrigate the riparian habitat.

A number of non-related and concurrent restoration projects have been implemented by other entities including the EBID Water Habitat Energy Nexus projects (EBID 2018), SWEC La Mancha Wetland project in Las Cruces, USIBWC restoration projects specified in the 2009 ROD (USIBWC 2019b), and USBR/New Mexico Interstate Stream Commission (NMISC) restoration work at Broad Canyon Ranch. For all projects as necessary, USIBWC and/or partnered stakeholders. would obtain any permits that may be required by NMOSE.

3.3.3.2 Environmental Consequences – Water Consumption

All action alternatives would impact water consumption. Three alternatives, Broad Canyon, Selden Point Bar, and Downstream of Courchesne Bridge would have decreased water consumption; one alternative MID, Option A would have no net change in water consumption; all other alternatives would have increased water consumption (Table 3-3). Changes in land cover, vegetation types, and surface water area affects ET rates. ET is a process that accounts for movement of water from the land surface to the air via evaporation of standing water, soil, and transportation by plants (GSA 2019a,). 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 include:

- 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

The difference between the predicted ET rate of pre-restoration plant communities and the predicted optimal restored habitat type was calculated to determine the predicted change in consumptive use attributed to habitat restoration activities. Net depletion volume for each site was then calculated in Geographic Information System (GIS) software by multiplying the feet per year by the total acreage of each map unit (GSA 2019a). The results are summarized in Table 3-3. Negative values reflect a net reduction in water consumption and reduced ET losses.

For riparian and aquatic habitat, USIBWC would use the ET difference for water rights acquisitions as committed to in the Record of Decision and as documented in the River Management Plan and Final ROD Report (USIBWC 2016).

Table 3-3. Consumptive Water Use by Alternative

Alternative	Pre-Restoration (ac-ft/yr)	Post-Restoration (ac-ft/yr)	Difference (ac-ft/yr)	Water rights needed?
Yeso Arroyo	40.7	59.0	18.3	yes
Angostura Arroyo	42.5	62.0	19.5	yes
Broad Canyon	9.1	8.1	-1.0	No
Selden Point Bar	45.5	31.6	-13.9	No
Las Cruces Effluent (North)	17.0	19.3	2.3	yes
Las Cruces Effluent (South)	13.0	23.2	10.2	yes
MVBSP	491.8	502.0	10.2	yes
Downstream of Courchesne Bridge	59.9	35.4	-24.5	no
Trujillo Arroyo	77.5	85.0	7.5	Yes (already appurtenant)
MID Option A[1]	19.5	24.0	0	No
MID Option B	84.5	93.2	8.7	yes

Sources: GSA 2019a, GSA 2021
[1]Habitat is only within the drain because of lack of maintenance, no water rights would be required to clean out the drain.

3.3.3.2.1 Alternative A – No Action

Under this alternative, no habitat restoration projects would be implemented, and water usage would remain *status quo*.

3.3.3.2.2 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 ac-ft/yr of water is expected to be lost from the site each year as a result of ET (see Table 3-3). Overall, annual water consumption at the Yeso Arroyo site is predicted to increase 18.3 ac-ft/yr as a result of implementing Alternative B – Yeso Arroyo. Implementation of this alternative would require acquiring water rights to compensate depletions to RGP water.

Alternative B – Yeso Arroyo would have a long-term, moderate adverse impact on water consumption.

3.3.3.2.3 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 3-3). Overall, annual water consumption at the Angostura Arroyo is predicted to increase approximately 19.5 ac-ft/yr as a result of implementing this alternative. Surface water rights may be acquired as discussed previously. Implementation of this alternative would require acquiring water rights to compensate depletions to RGP water.

Alternative C – Angostura Arroyo would have a long-term, moderate adverse impact on water consumption.

3.3.3.2.4 Alternative D – Broad Canyon Arroyo

Beneficial impacts on water consumption anticipated from creating backwater embayments adjacent to a flow path at Broad Canyon Arroyo. The river backs up routinely into the Broad Canyon Arroyo under current conditions. This project is simply manipulating topography. When embayments are full, local groundwater levels may rise slightly. After restoration activities are complete, water loss associated with ET is expected to decrease 1.0 ac-ft/yr (see Table 3-3). Overall, annual water consumption at the Angostura Arroyo is predicted to decrease approximately 1.0 ac-ft/yr as a result of implementing this alternative. Therefore, the project would not have any depletions of RGP project water and would not require water rights nor NMOSE permits.

This alternative would have a long-term, minor beneficial impact on water consumption.

3.3.3.2.5 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 3-3). Overall, annual water consumption at the Selden Point Bar is predicted to decrease 31.6 ac-ft/yr as a result of implementing this alternative. Implementation of this alternative would require acquiring water rights to compensate depletions to RGP water.

Alternative E would have a long-term, moderate beneficial impact on water consumption.

3.3.3.2.6 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 12.5 ac-ft/yr of water is expected to be lost from the site each year as a result of ET (see Table 3-3), including 10.2 ac-ft/yr on the southern portion and 2.3 ac-ft/yr on the northern portion. Overall, annual losses of groundwater at the Las Cruces Effluent Site (North) are predicted to increase approximately 2.3 ac-ft/yr and (South) are predicted to increase approximately 10.2 ac-ft/yr as a result of implementing Alternative F. USIBWC would work with stakeholders to address increased consumption.

The City of Las Cruces (CLC) provided a comment in March 2021 on the Amended Draft EA noting that the CLC Utilities "considers that the effluent can be used and accounted against its Jornada Basin water rights under State Engineer Permit LRG-3200 et al." USIBWC, CLC, Department of Justice, and NMISC, and NMOSE conducted numerous meetings in 2021 to discuss this option, as follows:

CLC holds a lease to use USIBWC property (IBWC Tract No. CM-42) as a CLC park and currently manages and operates it as such. The aquatic/mixed use feature is located within this CLC park. North of the aquatic feature, the CLC has a concrete channel where its effluent from its wastewater plant is returned to the river system. The CLC effluent is generated in part by groundwater that the CLC imports and pumps under its Jornada Basin permits from the State of New Mexico (LRG-3283 through 3296).

For the South Option, the USIBWC would amend the existing lease with CLC such that CLC diverts water from its return concrete channel into the aquatic feature within the boundaries of the CLC park. The water being diverted would be measured where it leaves the current concrete

channel and then again at the point where the water enters the riverbed as it leaves the aquatic feature or, alternatively, would use modeling to determine the return flow to the river from the aquatic feature.

CLC has 10,200 acre feet of groundwater under its Jornada permits, which accounts for 20 percent of the City's total groundwater permitted diversion amount. The consumptive use of the LCE South site with the aquatic feature, based on ET is estimated at 19.3 ac-ft/yr. The aquatic feature would not be lined. Under this scenario, no transfer of water to USIBWC would occur; instead, the CLC would account for the consumptive use of the aquatic feature using its imported Jornada-derived water. The USIBWC has verbally confirmed with the CLC that it imports and pumps enough Jornada-derived water to account for the water used at the aquatic/mixed use feature. The CLC reports this information regularly to the State of New Mexico.

The Jornada permit for using groundwater does not restrict consumptive use of the effluent – it only requires them to report to NMOSE what is returned to the river system. Therefore, if the aquatic feature uses the City's effluent in the floodplain, the water would be metered going into and out of the aquatic feature. Using the CLC's La Jornada water rights, the USIBWC would cover consumptive losses for the South Option.

For the LCE North Option, USIBWC would acquire EBID surface water rights and irrigate the north parcel with those water rights.

This alternative would have a long-term, moderate adverse impact on water consumption.

3.3.3.2.7 Alternative G – MVBSP

Negative impacts on water consumption are anticipated from creating a side channel off of the Picacho Drain, widening and terracing Picacho Drain, and constructing swales along the high-flow channel. Implementation of Alternative G would result in an increase in water loss of 10.2 ac-ft/yr from ET (see Table 3-3). Overall, annual water consumption due to ET at MVBSP is predicted to increase approximately 10.2 ac-ft/yr as a result of implementing Alternative G – MVBSP. Implementation of this alternative would require acquiring water rights to compensate depletions to RGP water. USIBWC would acquire 19.3 water right acres (WRA) (see Table 3-3) to compensate depletions to RGP water.

This alternative would have a long-term, moderate adverse impact on water consumption.

3.3.3.2.8 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 3-3). Overall, annual losses of groundwater at the site are predicted to decrease approximately 24.5 ac-ft/yr as a result of this alternative. Therefore, there would be no depletions of RGP water.

Alternative H – Downstream of Courchesne Bridge would have a long-term, moderate beneficial impact on water consumption.

3.3.3.2.9 Alternative I – Trujillo Arroyo

Negative impacts on water consumption are anticipated from widening the confluence of Trujillo Arroyo, constructing the wetland depressions, and the backwater/swale.

Implementation of Alternative I – Trujillo Arroyo would result in an increase of water loss of 7.5 ac-ft/yr from ET. Overall annual losses of groundwater at Trujillo Arroyo are predicted to increase approximately 7.5 ac-ft/yr as a result of implementing Alternative I – Trujillo Arroyo. The anticipated increases in ET are not greater than existing water rights at the site. USIBWC has previously acquired 10.8 WRA (USIBWC 2018) to support supplemental irrigation of restoration plantings implemented by the USFWS. The additional 3.8 acres proposed under this alternative, coupled with the USFWS restoration project would not exceed the total WRA acquired by the USIBWC.

The 0.3-acre wetland depression would be lined with an impervious liner, such as bentonite clay, to avoid surface water/groundwater interactions that complicate this project. This pilot project would be a good candidate for additional brokered water rights to ensure multiple irrigation events in the summer. The 0.3-acre depression would result in a loss of less than 0.25-acre feet per year.

If additional water rights are required, USIBWC would work with stakeholders to acquire additional water rights. This alternative would have a minor adverse impact on water consumption.

3.3.3.2.10 Alternative J – MID

For Option A, positive impacts on water consumption are anticipated from removing cattails and saltcedar. Removing sediment, saltcedar, and cattails does not consume water. For Option B, negative impacts on water consumption are anticipated from terracing the lower portion, installing water control structures, and planting native vegetation. Implementation of Alternative J Option B would result in an increase in water loss of 8.7 ac-ft/yr (see Table 3-3). Implementation of Option B would require acquiring water rights to compensate depletions to RGP water. USIBWC would work with stakeholders to address increased consumption.

Alternative J – MID Option A would benefit the conservation of water, while Option B would have a long-term, moderate adverse impact on water consumption.

3.3.4 Waters of the U.S.

3.3.4.1 Affected Environment – Waters of the U.S.

The USACE and USEPA require mitigation for impacts on waters of the U.S., including wetlands under 33 Code of Federal Regulations (CFR) and 40 CFR 230. Wetland delineations were conducted by GSA 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; and between August 18 through August 19, 2020 at two additional sites: Trujillo Arroyo and Montoya Intercept Drain. 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.

3.3.4.1.1 Alternative D – Broad Canyon Arroyo

A total of 0.49 acre of potentially jurisdictional wetland area was delineated at Broad Canyon Arroyo (Appendix A, Figure A-30) (GSA 2019b). Wetland BC-WL1 is a small depressional wetland consisting primarily of cattail 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 emergent cattail wetlands within the arroyo channel, with occasional adjacent coyote willow patches.

3.3.4.1.2 Alternative E – Selden Point Bar

One potential jurisdictional wetland (SC-WL1) is located at Selden Point Bar (Appendix A, Figure A-31) (GSA 2019b). 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.

3.3.4.1.3 Alternative G – MVBSP

Six potential jurisdictional wetlands, totaling 23 acres, were identified near or overlapping the excavation features at MVSP (Appendix A, Figure A-32) (GSA 2019b). During wetland delineation surveys, both constructed wetland Resaca ponds (MVSP-WL1), and the entirety of the Picacho Drain (MVSP-WL6), where cattail maintenance is proposed, met the criteria (i.e., vegetation, soils, and hydrology) of jurisdictional wetlands (GSA 2019b). 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 Bosque Ecosystem Monitoring Program (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 is 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.

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.

3.3.4.1.4 Alternative H – Downstream of Courchesne Bridge

Two wetlands were identified at the Downstream of Courchesne Bridge site (Appendix A, Figure A-33) (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 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.

3.3.4.1.5 Alternative I – Trujillo Arroyo

One wetland was delineated at Trujillo Arroyo (Appendix A, Figure A-34) (GSA 2020). AW-WL1 is a narrow 1- to 2-foot band along the bank of the arroyo, comprising approximately 0.09 acre. It is dominated by coyote willow and arrowweed. The site occurs along the lower tier bankline where hydrology is connected to water backed up in the arroyo confluence. The site qualifies as “Problematic hydrophytic vegetation” and “Problematic hydric soils” under Chapter 5 Difficult Wetland Situations in the Arid West of the Corps’ Arid West Supplement (USACE 2007). USACE guidance places the emphasis on understory species in riparian areas and close examination for redox concentrations in coarse fragments in vegetated sand and gravel bars. No understory species were present, and no redox concentrations in coarse fragments were found the upper tier of the bankline. The size of the coyote willow at upper tier suggest it was established many years ago during a high flow event, and the sediment layer is so far above current water levels, it appears to no longer be connected to the current hydrology of the river.

3.3.4.1.6 Alternative J – MID

Three wetlands were delineated at the MID (Appendix 2, Figure A-35). Each wetland borders the MID channel in Segment 1 (MID-WL1), Segment 2 (MID-WL2) and Segment 3 (MID-WL3). The vegetation along all three MID segments is relatively similar and consists of a monoculture saltcedar on the north edge of the drain. Dense stands of southern cattail grow throughout the bottom of the drain. The vegetation along the southern edge of the drain consists of a narrow band of hardstem bulrush, common threesquare, and occasionally common reed along the water’s edge transitioning to a vegetation dominated by scratchgrass and saltgrass and occasional

common reed, seepwillow, and saltcedar. As the elevation increases moving upslope towards the levee toe, Mojave seablite is commonly found with occasional shrubs upslope of the drain towards the levee toe (GSA2020).

MID-WL1 is approximately 2.3 acres. It occurs along the channel edge. Dominant vegetation includes cattail and scratchgrass. Hydrophytic vegetation is present upslope from the edge of the channel; however, hydrophytic soils were only present at the water's edge.

MID-WL2 is approximately 2.9 acres. The channel slope is gradual, allowing wetland vegetation to extend up to 4 feet from the water edge.

MID-WL3 is approximately 2.4 acres. Hardstem bulrush and common threesquare are the indicators of the wetland boundary in this segment. The wetland extends approximately 3 feet from the water's edge.

3.3.4.2 Environmental Consequences – Waters of the U.S.

3.3.4.2.1 Alternative A – No Action Alternative

No impacts are anticipated from Alternative A – No Action Alternative because there would be no development on or near waters of the U.S., including wetlands.

3.3.4.2.2 Alternative B – Yeso Arroyo, Alternative C – Angostura Arroyo, Alternative F – LCE

These sites do not have any potentially jurisdictional wetlands that would be impacted through restoration activities. Excavation along the banks of the Rio Grande, to create terraces, embayments, or at side channel discharge points could result in discharges to the river. However, these discharges would be mitigated through the implementing BMPs (e.g., installing silt fencing) and abiding by the terms of an approved SWPPP. USIBWC would coordinate with the USACE and identify and obtain all necessary permits and implement necessary mitigation prior to construction. Therefore, there would be no short-term impacts to wetlands and Waters of the U.S. Implementation of the proposed restoration projects at these sites could result in long-term, localized beneficial impacts on wetlands through the creation of additional wetlands and inundated floodplain areas.

3.3.4.2.3 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-30) (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 likely qualify under USACE Nationwide Permit (NWP) 27 Aquatic Habitat Restoration. Implementation of this alternative would improve the heterogeneity and structural diversity of existing wetland habitats, which would result in a potential long-term beneficial impact on wetlands.

3.3.4.2.4 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, and compensatory mitigation may be required. 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 replacing saltcedar with native riparian vegetation in the excavation areas is likely to enhance existing wetlands. USIBWC would coordinate with the USACE to identify and obtain all necessary permits and implement necessary mitigation prior to construction. Implementation of this alternative would have a temporary, impacts on wetlands; however, the restoration project could result in a long-term, localized beneficial impact on wetlands.

3.3.4.2.5 Alternative G – MVBSP

Approximately 7.4 acres of wetlands would be impacted by proposed restoration activities (Appendix A, Figure A-32) (GSA 2019b), of which approximately 4.7 acres would be impacted by the proposed cattail management. Portions of MVSP-WL3, MVSP-WL2, and MVSP-WL5 may lie within proposed channel and swale features. Design alterations could avoid these two wetlands, if necessary. 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. 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. USIBWC would coordinate with the USACE to identify and obtain all necessary permits. The project would have overall net gain of wetlands in the long-term; therefore, USIBWC and stakeholder permits for the project would consider net gain in compensating, for the loss of wetlands. Permitting would require coordination with the landowner(s) because most of the project area is not USIBWC property. USIBWC would also work with USACE and EBID regarding exemption of the Picacho Drain under Clean Water Act Section 404(f). Implementation of this alternative would have minor adverse impacts on existing wetlands; however, implementation of the restoration project would result in a long-term, moderate beneficial impact on wetlands.

3.3.4.2.6 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-33). 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 would not be able to sustain the wetland. The proposed construction of bankline terraces, embayments, and channel pools along with supplemental wetland planting would enhance wetland species diversity and aquatic habitat diversity. USIBWC would coordinate with the USACE to identify and obtain all necessary permits and implement necessary mitigation prior to construction. Implementation of this alternative would have a minor adverse impact on existing wetlands; however, implementation of the restoration project would result in a long-term, localized beneficial impact on wetlands.

3.3.4.2.7 Alternative I – Trujillo Arroyo

Excavation of the Trujillo Arroyo confluence would impact approximately 0.09 acre of wetland (Appendix A, Figure A-34). However, approximately 3.8 acres of open water aquatic habitat would be created, including widening the arroyo mouth, creating wetland depressions and terrace steps, and extending the irrigation channels and an additional 0.4 acres would be planted to native riparian habitat to augment the riparian habitat created by the USFWS. USIBWC would coordinate with the USACE and identify and obtain all necessary permits and implement necessary mitigation prior to construction. Implementation of Alternative I – Trujillo Arroyo would have a minor adverse impact on existing wetlands; however, implementation of the restoration project would result in a long-term, moderate beneficial impact on wetlands.

3.3.4.2.8 Alternative J – MID

Implementation of Alternative J – MID would impact up to 7.6 acres of wetlands through excavating cattail from the channel. These impacts would be temporary as the channel would be maintained as open-water. For Option B, managing the water levels to control cattail would temporarily back up water in the channel, raising the surface water elevation. This could increase the wetted area along the channel margins. Planting additional vegetation would create additional wetland habitat, offsetting losses due to cattail management. USIBWC would conduct appropriate coordination with the USACE prior to construction. For Option A, maintenance of an agricultural drain is likely exempt from Clean Water Act under Section 404(f), provided it does not include any modification that changes the character, scope, or size of the original design. USIBWC would need to request an approved jurisdictional determination (AJD) from USACE for exemption. Terracing in Option B may not be exempt. Alternatively, the sediment removal could be conducted as excavation only under 33 CFR 323.2 (2)(d). Implementing this alternative would have moderate short term, adverse impacts on existing wetlands and potential long-term minor beneficial impacts on wetlands.

3.4 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.

3.4.1 Regulatory Requirements

The National Historic Preservation Act (NHPA) (Public Law 89-665; 54 U.S.C. 300101 et seq) establishes the Federal government's policy to administer federally owned or controlled historic properties in a spirit of stewardship. The NHPA Section 106 requires Federal agencies to consider the effects of their undertakings on historic properties, including National Register of Historic Places (NRHP), and consult with State Historic Preservation Offices and tribes. Even though the code has changed, it is common terminology to use Section 106 for historical continuation. Requests for tribal comments were sent to tribes in January 2020 (Appendix H).

3.4.2 Affected Environment – Cultural Resources

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 B.C. 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. Table 3-4 provides a summary with references for further information for interested readers.

Table 3-4. Cultural Chronology of South Central New Mexico

Period	Phase	Culture(s)	Years B.C./A.D.	References
Historic	American		1847 - Present A.D.	Sánchez 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; Sánchez 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.C.	Simmons et al. 1989; MacNeish and Beckett 1987
	Fresnal	Fresnal	4,500 - 2900 B.C.	
	Keystone	Keystone	6,000 - 4,500 B.C.	
	Gardner Springs	Gardner Springs	8,000 - 6,000 B.C.	
Paleoindian			11,500 to 7,500 B.C.	Simmons et al. 1989; Huckell 1972

3.4.2.1 Previous Investigations

Records of previous investigations in the proximity are on file with the USIBWC and at the State of New Mexico Archaeological Records Management Section (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. 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, Texas and a 100-percent archaeological survey with subsurface testing of 34 high-probability areas identified by USIBWC within El Paso County, Texas and Doña Ana County, New Mexico. One site overlapped Alternative H – Downstream of Courchesne Bridge site by

100 percent (Appendix A, Figure A-42). The WSA archaeological survey included a pedestrian survey along with shovel test excavations. No cultural resources were recorded within the footprint of Alternative H – Downstream of Courchesne Bridge (Stinchcomb et al. 2009). None of the other WSA survey areas corresponds with the current proposed project alternatives.

The second RGCP investigation that overlaps with proposed project alternative locations was conducted by TRC Companies (TRC) between 2010 and 2011. This study 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, Alternative C – Angostura Arroyo, Alternative D – Broad Canyon Arroyo, Alternative E – Selden Point Bar, Alternative G – MVBSP, and Alternative I – Trujillo (Appendix A, Figures A-36 through to A-43). No cultural resources were recorded in any of the TRC survey areas that overlap proposed project alternative areas; however, all five of the TRC survey areas overlap the current proposed project alternative sites have survey gaps.

Four additional surveys unrelated to the RGCP also overlap project alternative locations. In 2006, Advanced Archaeological Solutions conducted a cultural resources pedestrian 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 (Appendix A, Figure A-40). 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 MVBSP (NMCRIS Activity 94004). The survey area completely overlaps the proposed Project Alternative G – MVBSP location (Appendix A, Figure A-41). The survey consisted of pedestrian survey and cultural resources were recorded (Kirkpatrick 2005).

In 2002, Taschek Environmental Consulting performed a linear, pedestrian 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-38). No cultural resources were recorded (Raymond and Sullins 2002).

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-42). 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 Alternative B – Yeso Arroyo, Alternative C –Angostura Arroyo, Alternative D – Broad Canyon Arroyo, Alternative E – Selden Canyon Point Bar, and Alternative I – Trujillo Arroyo have not previously been surveyed for cultural resources. The proposed project alternative locations that have been previously surveyed completely for cultural resources are: Alternative F – LCE, Alternative G – MVBSP, and Alternative H – Downstream of Courchesne Bridge. Alternative J – MID (MID) has not been previously surveyed for cultural resources.

Two of the proposed project alternative locations, Alternatives D and G, contain previously recorded cultural resources. 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 had a similar PA with the Texas State Historic Preservation Officer (TXSHPO) for flood control projects in Texas from 2013 through 2019. USIBWC is currently rewriting a new PA that should be completed in 2021.

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

USIBWC's construction specifications and River Management Plan include BMPs for procedures upon discovery of cultural resources during ground disturbing activities. The USIBWC Cultural Resources Specialist would consult with NMSHPO or TXSHPO, 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 disturbance 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.

3.4.3 Environmental Consequences – Cultural Resources

3.4.3.1 Alternative A – No Action

Under this alternative, no habitat restoration projects would be implemented and as a result, there would be no adverse impact on cultural resources.

3.4.3.2 Alternative B – Yeso Arroyo

The Yeso Arroyo project area has only partially been surveyed for cultural resources (Appendix A, Figure A-36). Within the portion of the assessment area that has been previously surveyed, no cultural resources were recorded. There may be potential adverse impacts on cultural resources if ground disturbing activities, such as clearing and grubbing vegetation, constructing bankline terrace benches, and planting trees, disturb previously unrecorded cultural resources outside previously surveyed areas. If the remaining previously unsurveyed portion of the Yeso Arroyo project area 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.

3.4.3.3 Alternative C – Angostura Arroyo

The Angostura Arroyo project area has only partially been surveyed for cultural resources (Appendix A, Figure A-37). Within the portion of the assessment area that has been previously

surveyed, no cultural resources were recorded. The conceptual design does not extend into the previously unsurveyed area within the western portion of the assessment area; however, it overlaps with the assessment area to the east, including the previously unsurveyed portion within the assessment area. There may be potential adverse impacts on cultural resources if ground disturbing activities disturb previously unrecorded cultural resources outside previously surveyed areas. If the remaining previously unsurveyed portion of the Angostura Arroyo project area 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.

3.4.3.4 Alternative D – Broad Canyon Arroyo

The portion of the Broad Canyon project area owned by USIBWC has been surveyed for cultural resources (Appendix A, Figure A-38) and contains previously recorded cultural resources recommended eligible and of undetermined eligibility for listing on the NRHP. The previously recorded cultural resources appear to be outside of the immediate project footprint; however, portions of the proposed restoration extend into previously surveyed areas. Ground disturbing activities, such as clearing and grubbing vegetation, constructing backwater embayments, and planting trees, could potentially disturb previously unrecorded cultural resources outside previously surveyed areas. Sites with undetermined eligibility for listing on the NRHP may need to be reevaluated. In October 2019, NMSHPO, per the PA between USIBWC and NMSHPO, concurred that this action would have no effect provided that sites are avoided and a temporary barrier is installed between the access road and the known site (Appendix H). Tribal consultation letters received from Comanche Nation and White Mountain Apache tribes indicate there are no historic and/or traditional cultural properties what would be adversely affected (Appendix H).

3.4.3.5 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-39). No cultural resources were recorded as part of the survey; therefore, this alternative would not impact any cultural resources.

3.4.3.6 Alternative F – LCE

The LCE project area has been previously surveyed for cultural resources (Appendix A, Figure A-40). No cultural resources have been previously recorded within the Alternative F footprint. Implementation of Alternative F – LCE would have no adverse impact on cultural resources, and NMSHPO concurred in a letter dated November 2020 (Appendix H). Tribal consultation letters received from Comanche Nation and White Mountain Apache tribes indicate there are no historic and/or traditional cultural properties what would be adversely affected Appendix H).

3.4.3.7 Alternative G – MVBSP

The MVBSP project area has been completely surveyed for cultural resources (Appendix A, Figure A-41). There are multiple cultural resources within the assessment area; however, none are within the proposed project footprint. One previously recorded site recommended eligible for the NRHP borders the area where cattail maintenance would occur, but does not appear to be in the immediate proposed project footprint. Implementation of Alternative G – MVBSP would have no adverse impact on cultural resources. NMSHPO concurred in a letter from October 2019

(Appendix H). Tribal consultation letters received from Comanche Nation and White Mountain Apache tribes indicate there are no historic and/or traditional cultural properties what would be adversely affected Appendix H).

3.4.3.8 Alternative H – Downstream of Courchesne Bridge

Alternative H has been previously surveyed for cultural resources (Appendix A, Figure A-42). Alternative H is within the boundary of a State Register property. Proposed ground disturbing activities, such as clearing and grubbing vegetation, constructing a meandering channel, and depositing spoil material in open barren areas, have the potential to disturb previously recorded cultural resources. However, all of the cultural sites are outside the proposed excavation area; therefore, both the TXSHPO and NMSHPO provided concurrences in October and November 2019 that no historic properties would be adversely affected (Appendix H). Tribal consultation letters received from Comanche Nation and White Mountain Apache tribes indicate there are no historic and/or traditional cultural properties what would be adversely affected Appendix H).

3.4.3.9 Alternative I – Trujillo Arroyo

The Trujillo Arroyo project area has been partially surveyed for cultural resources (Appendix A, Figure A-43). Within the portion of the assessment area that has been previously surveyed, no cultural resources were recorded. The eastern portion of the assessment area has not been previously surveyed for cultural materials. The area previously not surveyed contains a portion of the Arroyo mouth widening conceptual design as well as a portion of the backwater channel and swale excavation. Proposed ground disturbing activities have the potential to disturb previously unrecorded cultural resources. However, the areas were disturbed during the construction of the RGCP, including placing rip rap along the bank and previous arroyo mouth maintenance; therefore, it is not likely that the small, unsurveyed portion has any cultural resources that would be impacted. The action is covered under USIBWC's PA with NMSHPO under determination of USIBWC's Cultural Resources Specialist or other qualified archaeologist.

3.4.3.10 Alternative J – MID

The MID project area has not been previously surveyed for cultural resources. Approximately 197 feet south, bordered on the southern flank of the MID project area, is an area previously surveyed along the entire length of the MID; however, no cultural resources were recorded and it does not appear to be in the immediate footprint of project Alternative J. Proposed ground disturbing activities, such as clearing and grubbing vegetation, replacing the drain connection, and installing gated water control structures or culverts, could potentially disturb previously unrecorded cultural resources. The MID was constructed in the early 1940s, disturbing ground during the construction; therefore, it is not likely that drain has any cultural resources that would be impacted. USIBWC would coordinate with NMSHPO.

3.5 Soils

3.5.1 Affected Environment – Soils

According to the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey, 24 soil types are found at the nine action alternative sites (USDA 2019, 2020). Soil types found at each site alternative site are provided in Table 3-5.

Table 3-5. Soil Types Located in the Project Area

Alternative	Soil Type	Acres	Area Impacted (Acres)		
			Short Term	Long Term	Total
Alternative B – Yeso Arroyo	Anthony-Vinton fine sandy loam	0.07			0.00
	Brazito loamy fine sand, 0 to 1 percent slope	16.53	6.83	4.90	11.73
	Harkey loam	0.46			0.00
	Riverwash	1.54		6.48	6.48
	Total	**18.60**	**6.83**	**11.38**	**18.21**
Alternative C – Angostura Arroyo	Agua silt loam, 0 to 2 percent slopes	0.69	0.06		0.06
	Agua clay loam MLRA 42	1.06	0.39	0.08	0.47
	Brazito loamy fine sand, 0 to 1 percent slopes	7.45	4.24	0.16	4.40
	Brazito very fine sandy loam, thick surface	3.89	1.67	2.14	3.81
	Glendale loam	0.55	0.10		0.10
	Riverwash	3.90		3.60	3.60
	Total	**17.54**	**6.45**	**5.98**	**12.43**
Alternative D – Broad Canyon Arroyo	Agua variant soils, moderately wet	14.44			0.00
	Agua variant and Belen variant soils	<0.01			0.00
	Belen variant soils	1.95			0.00
	Bluepoint-Caliza-Yturbide complex	0.99	<0.01		0.00
	Canutio and Arizo gravelly sandy loams MLRA 42	25.02	1.69	0.38	2.07
	Pajarito fine sandy loam	5.88			0.00
	Riverwash	0.20	0.03	0.01	0.04
	Total	**34.04**	**1.73**	**0.39**	**2.12**
Alternative E – Selden Point Bar	Agua variant and Belen variant soils	9.98	4.30		4.30
	Bluepoint-Caliza-Yturbide complex	7.50	2.89		2.89
	Riverwash	5.48	0.83	0.74	1.57
	Total	**22.96**	**8.02**	**0.74**	**8.76**

Table 3-5. Soil Types Located in the Project Area, Cont.

Alternative	Soil Type	Acres	Area Impacted (Acres)		
			Short Term	Long Term	Total
Alternative F – LCE	Brazito loamy fine sand, 0 to 1 percent slope	4.37	0.14		0.14
	Brazito very fine sandy loam, thick surface	6.99		0.89	0.89
	Riverwash	0.96		0.06	0.06
	Total	**12.32**	**0.14**	**0.95**	**1.09**
Alternative G – MVBSP	Anapra clay loam	17.69			0.00
	Anthony-Vinto loams, 0 to 1 percent slopes	1.20			0.00
	Belen clay	68.05	1.57	0.89	2.46
	Bluepoint-Caliza-Yturbide complex	0.27			0.00
	Brazito loamy fine sandy loam, 0 to 1 percent slope	15.86	<0.01	<0.01	0.01
	Brazito very fine sandy loam, thick surface	47.71	1.02	0.33	1.35
	Glendale loam	1.79			0.00
	Harkey loam	5.42			0.00
	Riverwash	0.19			0.00
	Total	**158.18**	**2.59**	**1.23**	**3.82**
Alternative H – Downstream of Courchesne Bridge	Made land, Gila soil material	15.33	11.09	1.37	12.46
	Riverwash	0.12	0.10		0.10
	Total	**15.45**	**11.19**	**1.37**	**12.56**
Alternative I – Trujillo Arroyo	Brazito loamy fine sand, 0 to 1 percent slope	15.49	0.42		0.42
	Water	3.12		0.42	0.42
	Total	**18.61**	**0.42**	**0.42**	**0.83**
Alternative J – MID	Agua variant and Belen variant soils	19.72	3.15	7.72	10.87
	Total	**19.72**	**3.15**	**7.72**	**10.87**

Sources: USDA, NRCS, Web Soil Survey 2019, 2020

3.5.2 Environmental Consequences – Soils

3.5.2.1 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.

3.5.2.2 All Action Alternatives

All action alternatives would experience short-term and long-term impacts to soil resources. Short-term impacts are temporary adverse impacts resulting from soil disturbances due to site preparation and planting riparian vegetation. Removal of non-native vegetation, seed bed

preparation, and planting riparian tree poles, whips, and container material would result in localized soil disturbances. These disturbances would recover due to the revegetation activities.

Long-term soil impacts would result from excavation to create wetland depressions, swales, and side channels. Long-term soil impacts may also result from the construction of recreation facilities, such as trails and bridges. Soil disturbance could increase soil erosion during and after construction; however, USIBWC requires BMPs (see Section 4.0 *Mitigation Measures*) under all construction contracts to eliminate or reduce impacts from soil disturbance. A SWPPP would be prepared prior to construction, and BMPs (e.g., silt fence) outlined in the SWPPP would be implemented during construction. With the implementation of BMPs, there would be minor adverse long-term impacts for all action alternatives.

Soil impacts for all action alternatives are summarized in Table 3-5.

3.6 Community Resources

3.6.1 Affected Environment – Recreation

An important consideration when weighing alternative actions is to determine the degree and extent to which they influence the local community. Some of the proposed alternative sites provide recreational opportunities in the forms of hiking, jogging, bird watching, hunting, and fishing, and nature watching. Two sites: Alternative F – Las Cruces Effluent and Alternative G – MVBSP have established trails and other recreation facilities to improve access and visitor experience. Three sites: Alternative D – Broad Canyon Arroyo, Alternative E – Selden Point Bar, and Alternative I Trujillo Arroyo are owned by USIBWC and have access restrictions. Evaluating how recreational opportunities would improve or decline as a result of the proposed alternative actions is integral in the site selection process.

3.6.2 Environmental Consequences – Recreation

Three sites: Alternative D – Broad Canyon Arroyo, Alternative E – Selden Point Bar, and Alternative I Trujillo Arroyo would have no impact to recreation opportunities. The restoration of native vegetation and the enhancement of riparian and aquatic habitat may attract bird watchers and nature enthusiasts. However, the USIBWC owns these properties and does not authorize unaffiliated persons on these premises.

One site, Alternative J – MID would have minor short-term adverse construction impacts and no long-term impact on recreation opportunities. Users of the riverside nature trail and park may be impacted during restoration implementation due to noise impacts, dust emissions, soil and vegetation disturbance, excavation, and hauling sediment spoils, and impeding construction access. There may also be visual impacts until native revegetation becomes established. Because the area to be impacted is a narrow band along the MID, there would be no impacts related to restoring native vegetation on recreation activities, such as bird watching.

Three sites: Alternative B – Yeso Arroyo, Alternative C – Angostura Arroyo, and Alternative H – Downstream of Courchesne Bridge would have short-term adverse impacts and minor long-term beneficial impacts on recreation opportunities. Short-term adverse impacts on recreational opportunities would occur during restoration implementation. Excavating the terraces and channels, and removing invasive tree species (e.g., saltcedar and Russian olive) requires the use of heavy equipment; thus, recreation access may be impeded. There would also be noise impacts

and soil and vegetation disturbance during construction, which would reduce the recreation experience. The vegetation disturbance would be visible until native vegetation is established. Long-term beneficial impacts would result from enhancing riparian and aquatic habitat and replacing non-native vegetation with native species, which could attract bird watchers and nature enthusiasts.

Two sites: Alternative F – Las Cruces Effluent and Alternative G – MVBSP would have short-term adverse impacts and moderate long-term beneficial impacts on recreation opportunities. Short-term adverse impacts are related to implementation of the restoration project, which include noise, soil and vegetation disturbance, and impeding access during construction. Proposed recreation improvements, such as expanding or improving trails and improving access, would enhance the visitor's experience. Therefore, a long-term moderate beneficial impact is anticipated.

3.7 Unavoidable Adverse Impacts, and Irreversible and Irretrievable 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 or consumption of 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 minor short-term 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.

4.0 MITIGATION MEASURES

Impacts to jurisdictional wetlands resulting from the proposed aquatic restoration projects would be permitted through the USACE permitting process and mitigation would 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, conducting construction work only during dry or low flow conditions, timing restrictions to avoid impacts to nesting birds, servicing 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. If not completed to date, USIBWC would complete Section 106 consultation for the preferred alternatives. USIBWC would consult with NMSHPO and/or TXSHPO under the appropriate PA or consultation, respectively, prior to implementation of the alternatives.

Water rights and compensation for increased water consumption would be addressed for site-specific projects on the local level with the appropriate stakeholders. USIBWC has and would continue to conduct appropriate coordination with regulatory entities and stakeholders for each project, including NMOSE, EBID, and landowners.

5.0 PUBLIC INVOLVEMENT

The USIBWC made the following efforts to involve and notify the public and stakeholders. The USIBWC discussed the upcoming EA with a local watershed group in October 2018. The USIBWC held a stakeholder meeting on November 9, 2018, to solicit early comments and views on the preliminary alternatives. The USIBWC announced the upcoming EA at USIBWC's Rio Grande Citizens' Forum in April 2019. The USIBWC released for public review the Draft EA on May 31, 2019 and it made available on the USIBWC website: http://www.ibwc.gov/EMD/EIS_EA_Public _Comment.html. The Notice of Availability (NOA) of the document was published in the Federal Register on May 31, 2019. NOA was also sent to a distribution list which includes federal, state, and local governments, organizations, local congressional representatives, and tribes. USIBWC finalized a press release on June 5, 2019 that was distributed to local newspapers and media and posted on USIBWC's website. The USIBWC held a public hearing on June 12, 2019 in Las Cruces, New Mexico. A 35-day review period was originally schedule for the Draft EA; however, a request was received to extend the public review period an additional 60 to 90 days. The USIBWC granted a 17-calendar day extension until July 22, 2019. The extension resulted in a 52-day review period. A Notice of Extension of time for the public comment period was published in the Federal Register and distributed to stakeholder via email, and USIBWC posted an updated press release on its website on July 2, 2019.

After the public comment period and work on furthering conceptual designs of anticipated alternatives, the USIBWC evaluated several new alternatives and issued an Amended Draft EA in February 2021. The USIBWC issued a press release on February 16, 2021 and the NOA was published in the Federal Register on February 19, 2021. The amended draft was posted on the USIBWC website, and USIBWC gave a presentation about the aquatic habitat alternatives at the February 2021 Rio Grande Citizens Forum. The public comment period extended for 40 days through March 31, 2021. A Federal Register notice and posting on USIBWC website will accompany this Final EA.

6.0 LIST OF PREPARERS AND REVIEWERS

Name	Title	Degree	Years' Experience	Contribution
Elizabeth Verdecchia	USIBWC, Natural Resources Specialist	M.A.G., Applied Geography, B.A., Environmental Science & Engineering; Geology	20	Review
Kelly Blough	USIBWC, Environmental Protection Specialist	B.A., Geology	28	Review
Mark Howe	USIBWC, Cultural Resources Specialist	M.A., History	25	Review
Howard Nass	GSRC, Senior Project Manager	B.S., Forestry and Wildlife Management	29	Principal Author and Soils, Land Use, and Environmental Health Sections
Brian Bader	GSRC, Senior Project Manager	M.S. Restoration Ecology B.S. Environmental Science	35	Principal Author – Amended EA
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
John Ginter	Staff Biologist	B.S. Fisheries and Wildlife Biology	27	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
Mark Kudron	Staff Archeologist	B.A. Anthropology	3	Cultural Resources
Christy Guempel	GIS Analyst	B.S., Geography	11	GIS analysis and map production
Sean Graham	Sr. Ecologist	Ph.D., Oceanography and Coastal Sciences	15	Review
Renee Erickson	Archeologist	M.A. Anthropology	3	Review

7.0 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) Sites Southwest Camino Real de Tierra Adentro (CARTA) Oregon Trails Association (OCTA)
Federal Government	U.S. Bureau of Reclamation (USBR) 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) National Park Service National Trails
State/Local Government	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 Las Cruces Historical Preservation Officer City of Sunland Park Village of Hatch City of El Paso El Paso Water Utilities El Paso County El Paso Historic Preservation Officer New Mexico Department of Game and Fish MVBSP

8.0 REFERENCES

Arms, G. L. and J. J. Kovacik. 1999. *Cultural Resource Survey along McNutt Road and the Rio Grande Floodplain for a Section of the Level 3 Fiber Optic Cable Installation, Doña Ana County, New Mexico and El Paso County, Texas*. Prepared by Parsons and Brinckerhoff for Level 3 Communications. NMCRIS Activity 64087.

Baker, W.W. 1943. *Final Report on the Construction of the Canalization Feature of the Rio Grande Canalization Project*. W.W. Baker, Project Engineer. U.S. Boundary and Water Commission. January 31, 1943.

Beck, Colleen M. (editor). 1985. *Views of the Jornada Mogollon*. Eastern New Mexico University, Contributions in Anthropology No. 12, Portales, New Mexico.

Blue Earth Ecological Consultants. 2008. Mesilla Valley Bosque State Park Resource Management Plan. Prepared for New Mexico State Parks. March 2008.

Elephant Butte Irrigation District (EBID). 2018. Rincon WHEN: Water Habitat Energy Nexus. Overview presented to the Paso del Norte Watershed Council. May 4, 2018.

EBID. 2013. Use of Project Water for Native Vegetation Habitat Restoration Sites in Elephant Butte Irrigation District (2013-ENG14). https://www.ebid-nm.org/policies/policies/2013-ENG14.pdf. Accessed 14 August 2020.

Finch, D. M., and W. Yong. 2000. Landbird migration in riparian habitats of the middle Rio Grande: a case study. Studies in Avian Biology (20): 88-98.

GeoSystems Analysis, Inc. (GSA). 2019a. Rio Grande Canalization Reach Aquatic Habitat Restoration Site Alternatives and Conceptual Designs. Prepared for Gulf South Research Corporation. Prepared by GeoSystems Analysis, Inc. Albuquerque, NM. September 18, 2020.

GSA. 2019b. Wetland Delineation Results from Four Proposed Aquatic Habitat Restoration Sites. Prepared for Gulf South Research Corporation. Prepared by GeoSystems Analysis, Inc. Albuquerque, NM. April 17, 2019.

GSA. 2021. Rio Grande Canalization Project Aquatic Habitat Restoration Site Alternatives and Conceptual Designs: Addendum 1. Prepared for Gulf South Research Corporation. Albuquerque, NM.

GSA. 2020. Wetland Delineation Results from Two Sites Proposed as Aquatic Habitat Restoration Sites. September 22, 2020.

Hester, T. R. 1999 Artifacts, Archeology, and Cabeza de Vaca in Southern Texas and Northeastern New Mexico. *Bulletin of the Texas Archeological Society* 70: 17-28.

Hink, V. C., and R. D. Ohmart (Center for Environmental Studies, Tempe, AZ). Middle Rio Grande Biological Survey. Final Report June 1984. U.S. Army Corps of Engineers Contract No. DACW47-81-C-0015.

Huckell, Bruce B. 1972 *A Fragmentary Clovis Point from Southwestern New Mexico*. Kiva 37:114–116.

IDEALS-AGEISS, LLC. 2017. Updated Biological Assessment for Long-Term River Management of the Rio Grande Canalization Project. March 2017. Prepared for U.S. Section International Boundary and Water Commission. https://www.ibwc.gov/Files/Updated_Biological_Assessment_RGCP_032017.pdf. Accessed 14 August 2020.

Kirkpatrick, D. T. 2005 *An Archaeological Survey of 307 AC (124.29 HA) for the Proposed Mesilla Valley Bosque State Park, Doña Ana County, New Mexico.* Prepared by Human Systems Research for New Mexico State Parks. NMCRIS Activity 94004.

Komulainen-Dillenburg, N., G. Henry, C. Frederick, E. Perez, and J. Vasquez. 2011. *USIBWC Rio Grande Canalization Project River Restoration Implementation Plan: Cultural Resources Management Task.* Prepared for the United States Section International Boundary and Water Commission. TRC, El Paso, TX.

Kurota, Alexander and Richard C. Chapman. 2007. *Class III Cultural Resources Inventory of 18.5 Acres near Anthony, Doña Ana County, New Mexico*. Office of Contract Archaeology, University of New Mexico, Albuquerque.

Lower Colorado River Multi-Species Conservation Program (MSCP). 2004. Lower Colorado River Multi-Species Conservation Program Final Habitat Conservation Plan. (J&S 00450.00) Sacramento, CA.

MacNeish, Richard S. and Patrick H. Beckett. 1987. *The Archaic Chihuahua Tradition of South-Central New Mexico and Chihuahua, Mexico*. COAS Monograph No. 7. COAS Publishing and Research, Las Cruces, New Mexico.

Mesilla Valley Audubon Society (MVAS). 2021. MVAS Bird Monitoring and Conservation Project.

Miller, Brian K. 1990. Wetlands and Water Quality. Purdue University Cooperative Extension Service. https://www.extension.purdue.edu/extmedia/WQ/WQ-10.html. Accessed 14 August 2020.

New Mexico Administrative Code (NMAC). 2013. New Mexico Water Quality Standards: Standards for Interstate and Intrastate Surface Waters (Title 20 Environmental Protection, Chapter 6 Water Quality, Part 4) (20.6.4 NMAC). New Mexico Administrative Code, June 2013, New Mexico Water Quality Control Commission(WQCC), https://www.epa.gov/sites/production/files/2014-12/documents/nmwqs.pdf. Accessed 14 August 2020.

New Mexico Environmental Department (NMED). 2013. WQCC-Approved 2012-2014 State of New Mexico Clean Water Act (CWA) 303(d)/305(b) Integrated List and Report. May 2013. https://www.nmenv.state.nm.us/swqb/303d-305b/20122014/. Accessed 14 August 2020.

New Mexico Department of Game & Fish (NMDGF). 2015. Native Fishes of the Rio Grande, New Mexico. Poster.

New Mexico Natural Heritage Program (NMNHP). 2000. Playa wetlands in Northeast New Mexico: A comparative study of vegetation diversity and ecology. Prepared by S. Wood and E. Muldavin, NMNHP, University of New Mexico. Prepared for the New Mexico Environment Department, Santa Fe, NM. May 2000.

Parametrix. 2008. Order 2 Soil Survey and Vegetation Mapping of Five Private Land Parcels Along the Rio Grande Floodplain, Radium Springs, NM. Prepared for World Wildlife Fund. August 2008.

Pittman, Walter Earl. 2011 *New Mexico and the Civil War*. The History Press, Charleston, North Carolina.

Probst, D. L., and K. Bixby. 2018. Conserving Native Rio Grande Fishes in Southern New Mexico and West Texas: A Conceptual Approach. Prepared by the University of New Mexico and Southwest Environmental Center. September 2018.

Raymond, G., and A. Sullins. 2002. *A Cultural Resource Inventory for Proposed Replacement of Rio Grande Bridge on NM 185 near Radium Springs, Doña Ana County, New Mexico NMSHTD Project No. BR-018(6)14, Control Number 2883*. Prepared by Taschek Environmental Consulting for SHTD. NMCRIS Activity 77714.

Roberts, Calvin A. and Susan A. Roberts. 1988 *New Mexico.* University of New Mexico, Albuquerque.

Sallenave, R., C. Carrasco, and D. E. Cowley. 2018. Fishes in the Middle and Lower Rio Grande Irrigation Systems of New Mexico. College of Agricultural, Consumer, and Environmental Sciences, New Mexico State University. Circular 653, Revised February 2018.

Sánchez, J. P. 1992. *From El Paso to Eagle Pass: Spanish Entradas along the Lower Rio Grande in the Sixteenth and Seventeenth Centuries.* Bulletin of the Texas Archeological Society 63: 53-66.

Simmons, Alan H., Ann Lucy Wiener Stodder, Douglas D. Dykeman, and Patricia A. Hicks. 1989. *Human Adaptation and Cultural Change in the Greater Southwest: An Overview of Archaeological Resources in the Basin and Range Province.* Arkansas Archaeological Survey Research Series No. 32, Arkansas Archaeological Survey, Fayetteville, Arkansas.

Sojda, Richard S. and Solberg, Kent L. 1993. Management and Control of Cattails. Waterfowl Management Handbook. 33. https://digitalcommons.unl.edu/icwdmwfm/33

Stinchcombe, E. K., J. W. Karbula, C. Leezer, D. Stone, C. Frederick, and S. O'Mack. 2009. *Archaeological Investigations of the USIBWC Rio Grande Canalization Project, El Paso County, Texas and Doña Ana County, New Mexico, Final Report.* Prepared for United States Section International Boundary and Water Commission and CH2M Hill. William Self Associates, Inc., Austin, TX.

Stowe, M. 2006. *A Cultural Resource Survey of a 1.25 Mile Section Along the Rio Grande in Las Cruces, New Mexico.* Prepared by Advanced Archaeological Solution for Gunaji-Klement & Associates, Inc. NMCRIS Activity 98715.

SWCA. 2011. Final Biological Assessment Integrated Land Management for Long-term River Management of the Rio Grande Canalization Project. SWCA Environmental Consultants, In Association with MWF Americas. http://www.ibwc.gov/EMD/documents/Final_IBWC_RGCP_BA2011.pdf. Accessed 14 August 2020.

Texas Commission on Environmental Quality (TCEQ). 2018. Draft 2018 Texas Integrated Report – Texas 303(d) List (Category 5). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf . Accessed 14 August 2020.

Thompson, Marc, Jason Jurgena, and Lora Jackson (editors). 2005. *Archaeology between the Borders: Papers from the 13th Biennial Jornada Mogollon Conference*. El Paso Museum of Archaeology, El Paso.

U.S. Army Corps of Engineers (USACE). 2009. Conceptual Restoration Plan and Cumulative Effects Analysis, Rio Grande-Caballo Dam to American Dam, New Mexico and Texas. Prepared by Mussetter Engineering, Inc. and Riada Engineering, Inc. under contract with USACE. https://ibwc.gov/EMD/CanalizationWebpage/RestPlanMarch2009.pdf.

USACE. 2007. Baseline Report: Rio Grande-Caballo Dam to American Dam FLO-2D Modeling, New Mexico and Texas. Prepared by the USACE Albuquerque District, Albuquerque, NM. Prepared for the USIBWC, El Paso, TX. September 2007. https://ibwc.gov/EMD/CanalizationWebpage/BaselineReport.pdf.

U.S. Bureau of Reclamation (USBR). 2017. Southwestern Willow Flycatcher Habitat Classification: Lower Rio Grande from Elephant Butte Dam, NM to El Paso, TX. Prepared by the USBR Technical Service Center, Denver, Co. Prepared for the USBR Albuquerque Area Office, Albuquerque, NM. January 2017. https://www.usbr.gov/tsc/techreferences/env/SWFLHabitatclassificationElephantButtetoEl%20Paso2016_508.pdf.

USBR 2016. *Continued Implementation of the 2008 Operating Agreement for the Rio Grande Project, New Mexico and Texas: Final Environmental Impact Statement*. September 30, 2016. U.S. Bureau of Reclamation. U.S. Department of Agriculture (USDA). 2019. Natural Resources Conservation Service Soil Survey SSURGO. https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Accessed 03 April 2019.

USDA. 2020. Natural Resources Conservation Service Soil Survey SSURGO. https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Accessed 03 April 2019. Accessed 28 September 2020 for Trujillo Arroyo and MID.

U.S. Fish & Wildlife Service (USFWS) 2021. Endangered and Threatened Wildlife and Plants; Removal of the Interior Least Tern From the Federal List of Endangered and Threatened Wildlife. 86 Fed. Reg. 2,564 (January 13, 2021).

USFWS 2020. Rio Grande Habitat Restoration Work Conducted by San Andres National Wildlife Refuge, October 2019 to March 2020. IWO# IBM13W0015. April 1, 2020.

USFWS. 2019. Information for Planning and Consultation (IPaC). Proposed, Candidate, Threatened, and Endangered Species. Internet URL: https://ecos.fws.gov/ipac/. Accessed 14 August 2020.

USFWS. 2018. Endangered Species Act. https://www.fws.gov/endangered/laws-policies/. Accessed 11 December 2018.

USFWS. 2017. Biological Opinion for Long-Term Management of the Rio Grande Canalization Project (Consultation # 02ENNM00-2017-F0367). https://www.ibwc.gov/Files/IBWC_BO_2017_FINAL.pdf. Accessed 14 August 2020.

USFWS. 2014a. Northern aplomado falcon (*Falco femoralis septentrionalis*) 5-year Review: Summary and Evaluation. USFWS, New Mexico Ecological Services Field Office, Albuquerque, New Mexico.

USFWS. 2014b. Determination of Threatened Status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (*Coccyzus americanus*). 50 CFR 17.

USFWS. 2013. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Southwestern Willow Flycatcher; Final Rule. 50 CFR 17.

USFWS. 2012. Biological and Conference Opinion on the Effects of USIBWC Integrated Land Management Alternative for Long-Term Management for RGCP. USFWS New Mexico Ecological Services Field Office. U.S. Fish and Wildlife Service (USFWS).

U.S. Geological Service (USGS) 2017. *Geophysics- and Geochemistry-Based Assessment of the Geochemical Characteristics and Groundwater-Flow System of the U.S. Part of the Mesilla Basin/Conejos-Médanos Aquifer System in Doña Ana County, New Mexico, and El Paso County, Texas, 2010–12*, Scientific Investigations Report 2017–5028. By Andrew P. Teeple. U.S. Geological Survey Office of Groundwater, U.S. Geological Survey National Water-Quality Assessment Program, Prepared in cooperation with the Bureau of Reclamation.

U.S. International Boundary and Water Commission (USIBWC). 2019a. Environmental Assessment and Finding of No Significant Impact for the Continued Implementation of the River Management Plan for the Rio Grande Canalization Project. Prepared by IDEALS-AGEISS, Inc. for the U.S. Section, International Boundary and Water Commission. https://www.ibwc.gov/Files/USIBWC-RMP-Final%20EA-signed121619.pdf. Accessed 14 August 2020.

USIBWC. 2019b. Final Report on the Ten-Year Implementation of the "Record of Decision on River Management Alternatives for the Rio Grande Canalization Project": 2009 to 2019. Prepared by U.S. Section, International Boundary and Water Commission. https://ibwc.gov/Files/Final_Report_TenYear_Imp_RodwAppendices_061719.pdf

USIBWC. 2018. USIBWC Rio Grande Canalization Project, River Management Plan. Last Updated 18 September 2018.

USIBWC. 2016. River Management Plan for the Rio Grande Canalization Project. Prepared by USIBWC. December 2016. https://www.ibwc.gov/Files/USIBWC_RGCP_River_Management_Plan_FINAL_December_8_2016_reduced.pdf. Accessed 14 August 2020.

USIBWC. 2014. Final Environmental Assessment Allowing Avian Hunting in Designated Areas Along the Rio Grande Canalization Project, Sierra and Doña Ana Counties, New Mexico. Prepared by U.S. Section, International Boundary and Water Commission. https://ibwc.gov/Files/FINAL_EA_Hunting_in_Canal_072514.pdf.

USIBWC. 2013. Preliminary Analysis of Channel Seepage and Water Budget Components along the Rio Grande Canalization Project: Final Report. Prepared for USIBWC by Tetra Tech, Inc. under Contract No. IBM019D00006 Order No. IBM12T0007. December 6, 2013.

USIBWC. 2012. Final Environmental Assessment for Non-Native Plant Control and Re-Establishment of Riparian Habitat Along the Rio Grande River on U.S. International Boundary and Water Commission and Bureau of Land Management Lands.

USIBWC. 2009. Record of Decision – River Management Alternatives for the Rio Grande Canalization Project. http://www.ibwc.gov/EMD/CanalizationWebpage/ROD_EIS%20June2009.pdf. Accessed 14 August 2020.

USIBWC. 2007. Final Environmental Assessment – Flood Control Improvements to the Rio Grande Canalization Project." ftp://63.96.218.8/Final_EA_RGC_Levee_Raising.pdf. Accessed 14 August 2020.

USIBWC. 2004. *Biological Assessment: River Management Alternatives for the Rio Grande Canalization Project*. Prepared for USIBWC by Parsons, January 2004.

Vierra, Bradley J. (editor). 1992. *Current Research on the Late Prehistory and Early History of New* Mexico. New Mexico Archaeological Council, Special Publication No. 1, Albuquerque.

Whalen, Michael E. 1978. *Settlement Patterns of the Western Hueco Bolson*. Publications in Anthropology No. 6. Centennial Museum. University of Texas, El Paso.

Wiseman, Regge N., Thomas C. O'Laughlin, and Cordelia T. Snow (editors). 200.1 *Following Through: Papers in Honor of Phyllis S. Davis*. Archaeological Society of New Mexico, No.27, Albuquerque.

Yong, W. and D. M. Finch. 1996. Landbird species composition and relative abundance during migration along the Middle Rio Grande. *Desired Future Conditions for Southwestern Riparian Ecosystems.* DW Shaw and DM Finch, Eds. US Department of Agriculture, Forest Service General Technical Report RM- 272: 77-92.

APPENDIX A
FIGURES

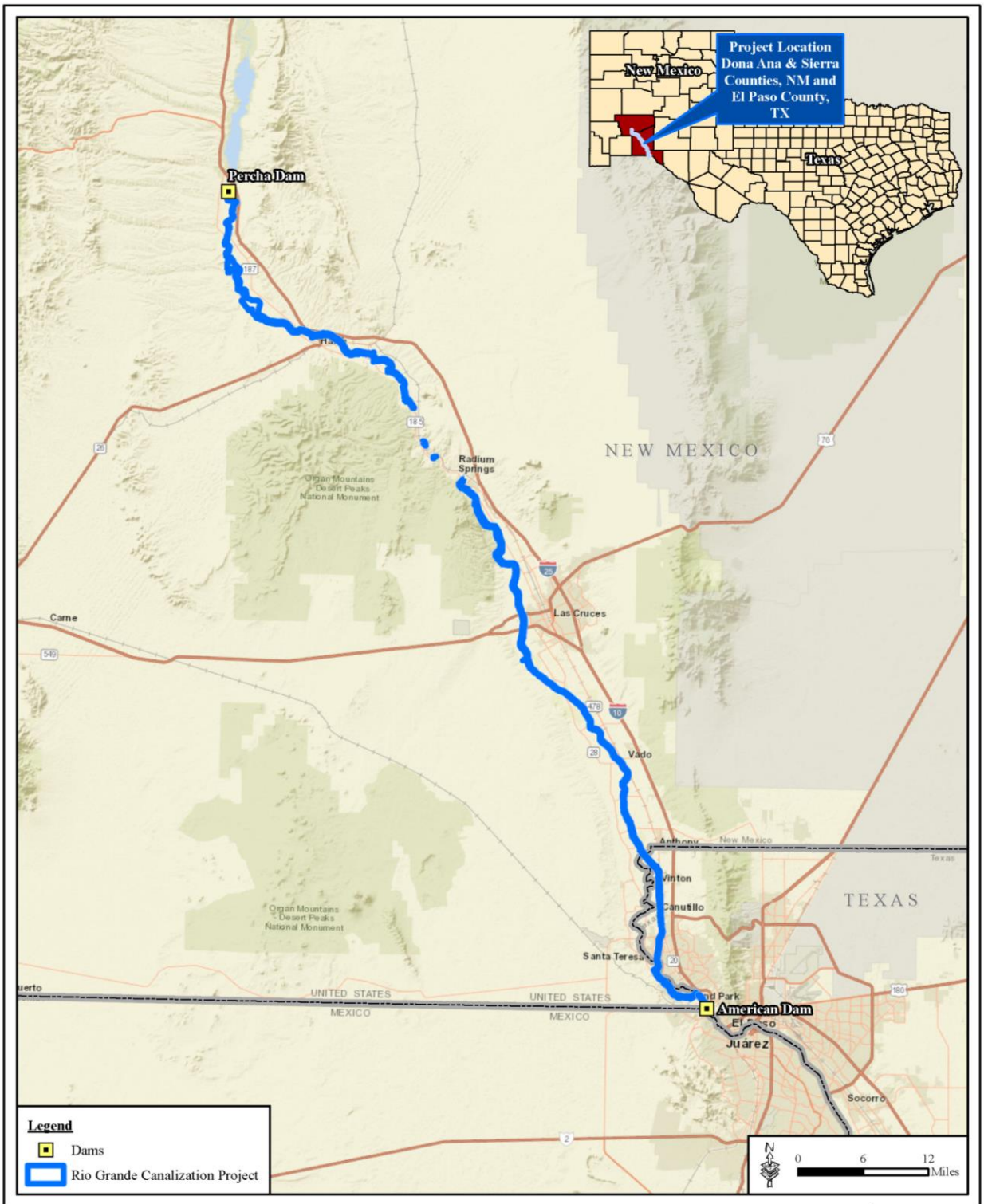

Figure A-1. Rio Grande Canalization Project

Basemap: ESRI World Street Map

GSRC

January 2021

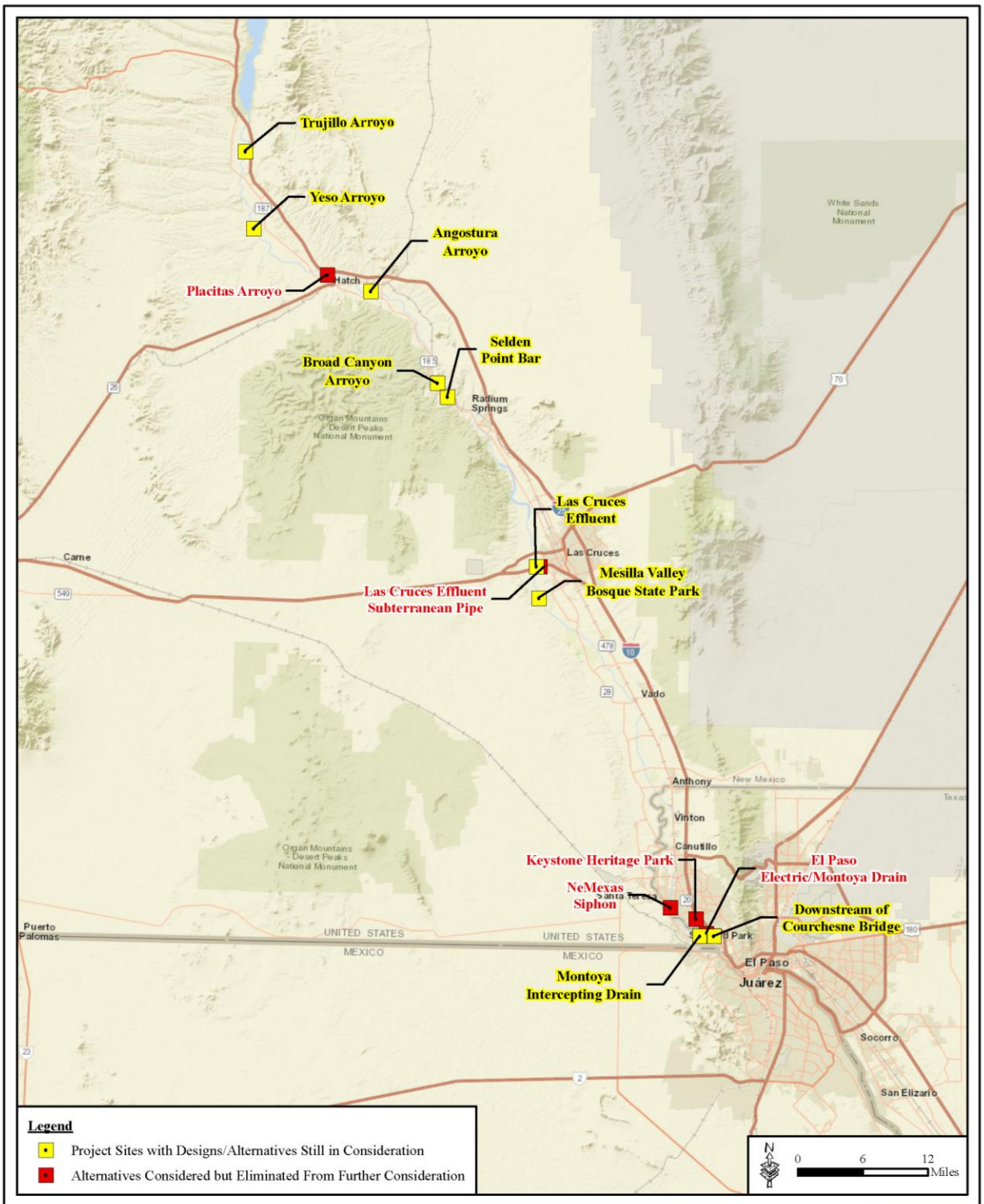

Figure A-2. Project Area Map Showing the Location of Project Sites Under Consideration

Basemap: ESRI World Street Map

GSRC

May 2021

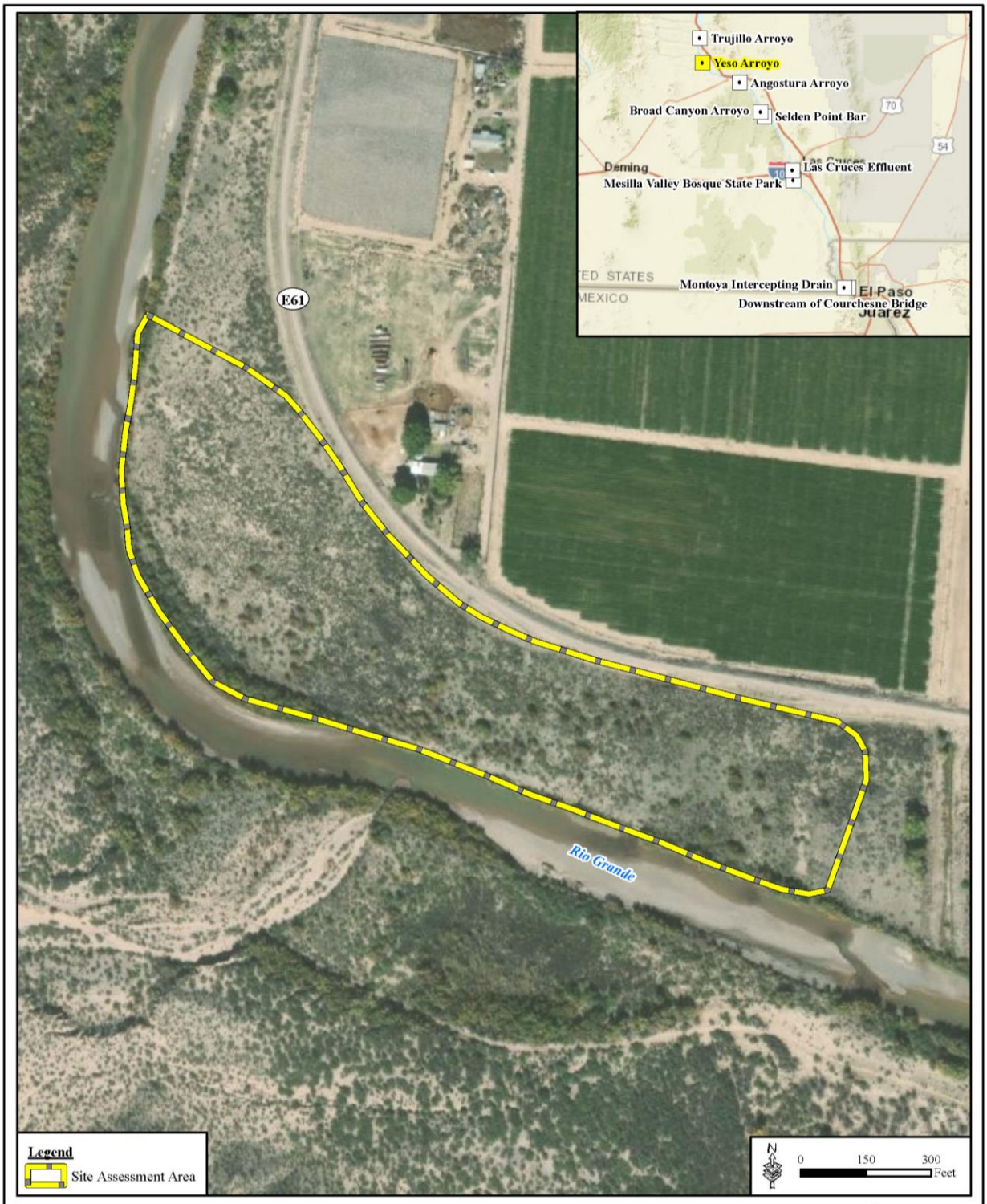

Figure A-3. Yeso Arroyo Alternative Site

Basemap: ESRI World Imagery (11/12/2018)

GSRC

January 2021

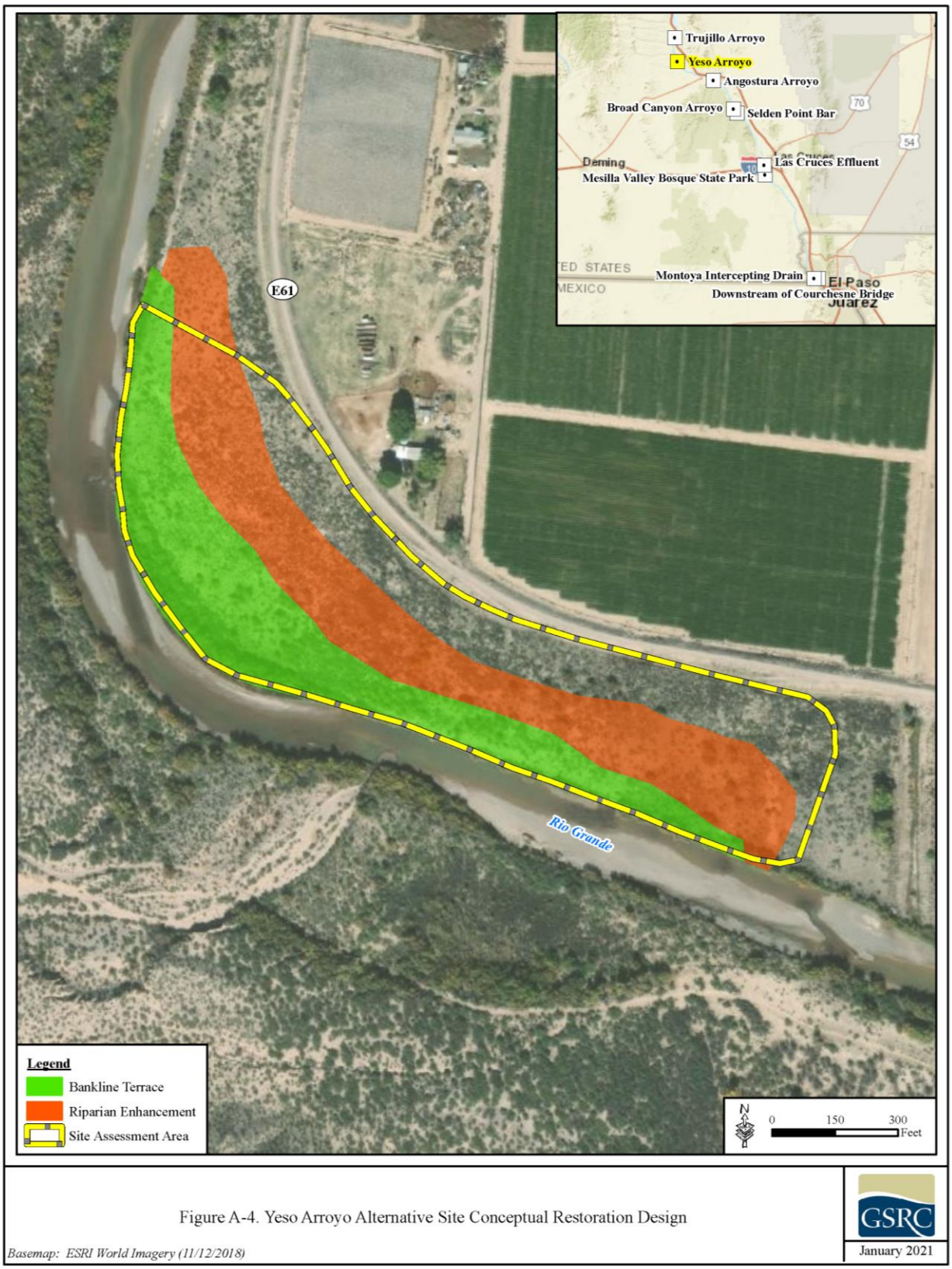

Figure A-4. Yeso Arroyo Alternative Site Conceptual Restoration Design

Basemap: ESRI World Imagery (11/12/2018)

GSRC

January 2021

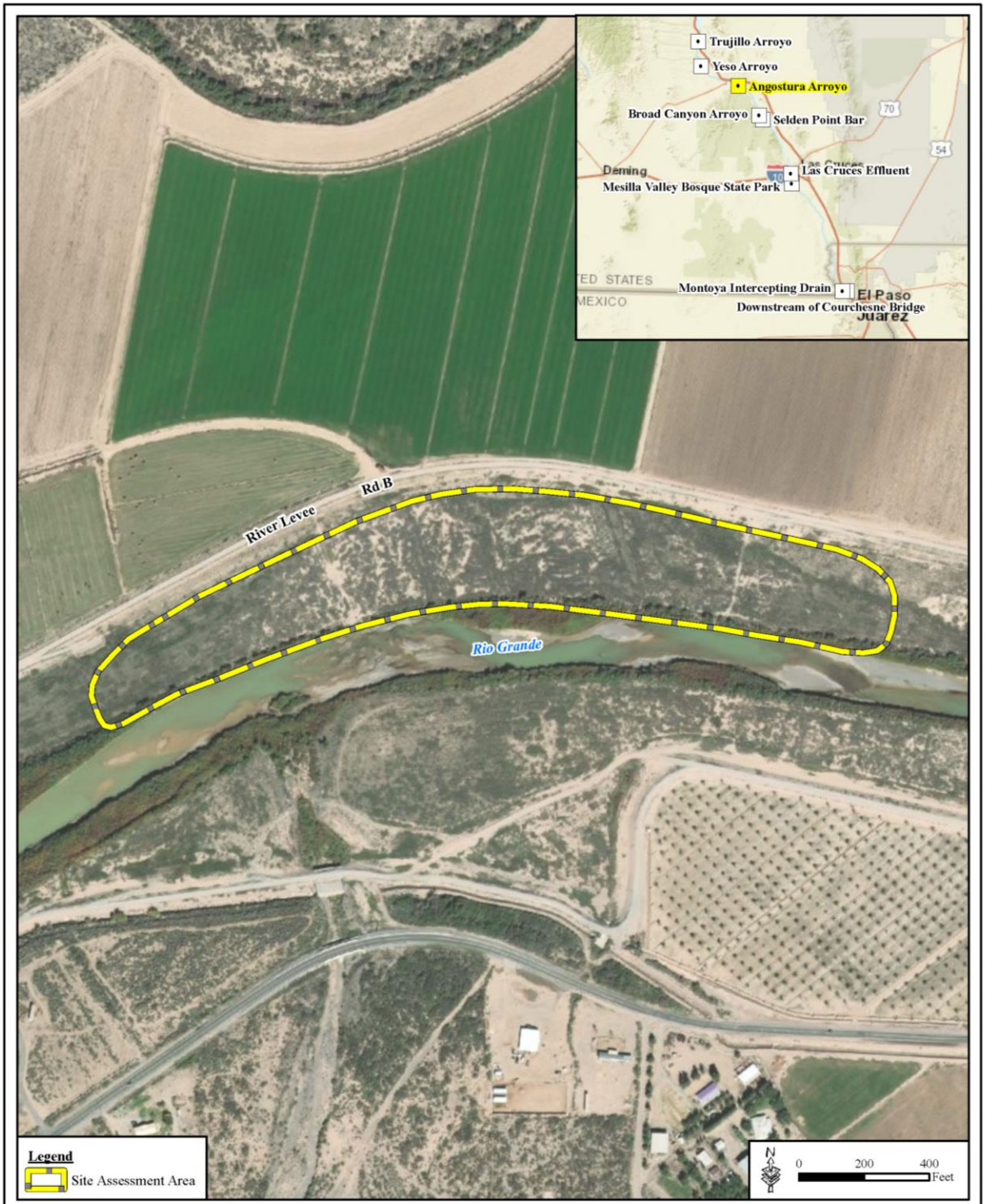

Figure A-5. Angostura Arroyo Alternative Site

Basemap: ESRI World Imagery (10/28/2018)

GSRC

January 2021

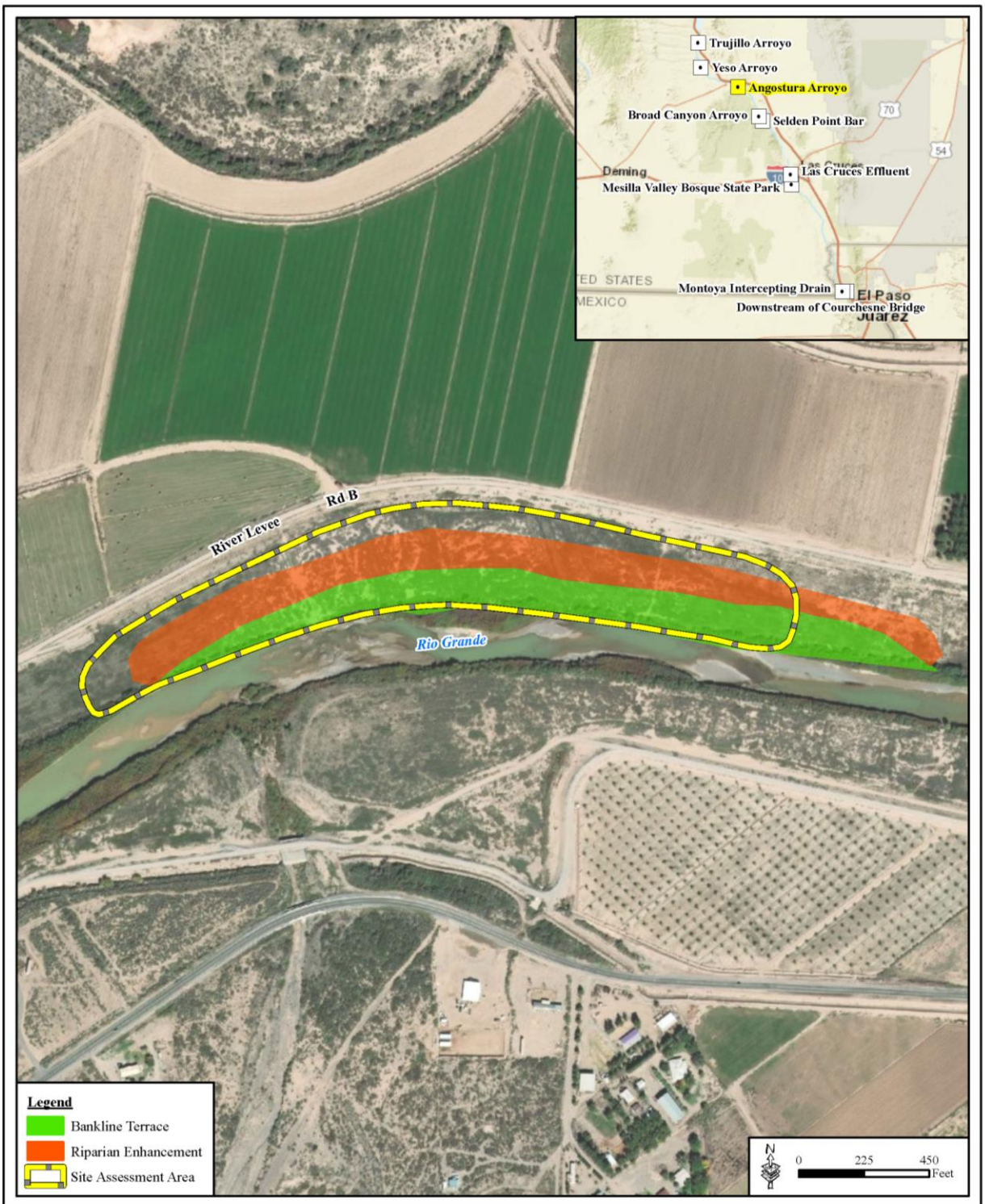

Figure A-6. Angostura Arroyo Alternative Site Conceptual Restoration Design

Basemap: ESRI World Imagery (10/28/2018)

GSRC

January 2021

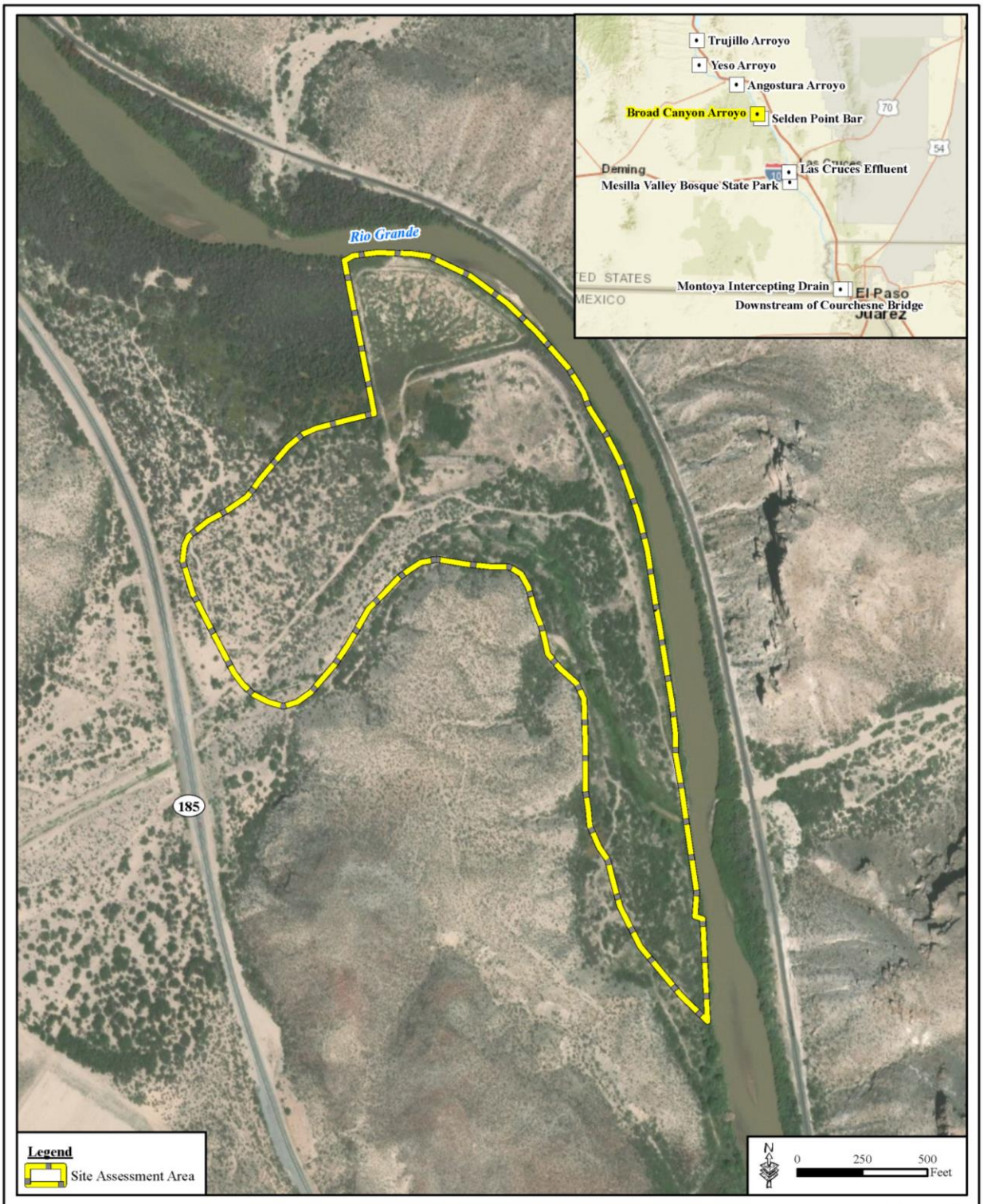

Figure A-7. Broad Canyon Arroyo Alternative Site

Basemap: ESRI World Imagery (9/29/2019)

GSRC

January 2021

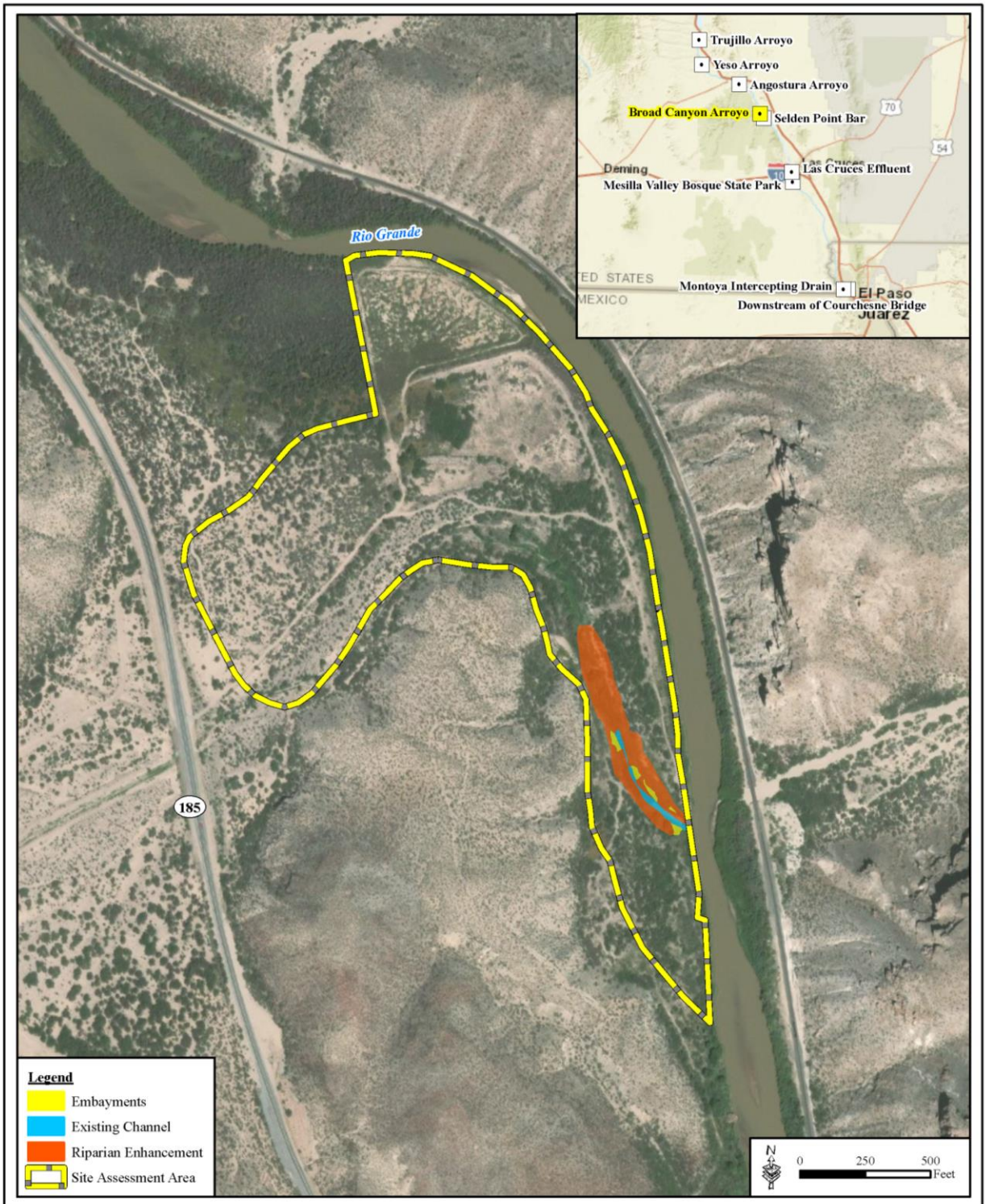

Figure A-8. Broad Canyon Arroyo Alternative Site Conceptual Restoration Design

Basemap: ESRI World Imagery (9/29/2019)

GSRC

January 2021

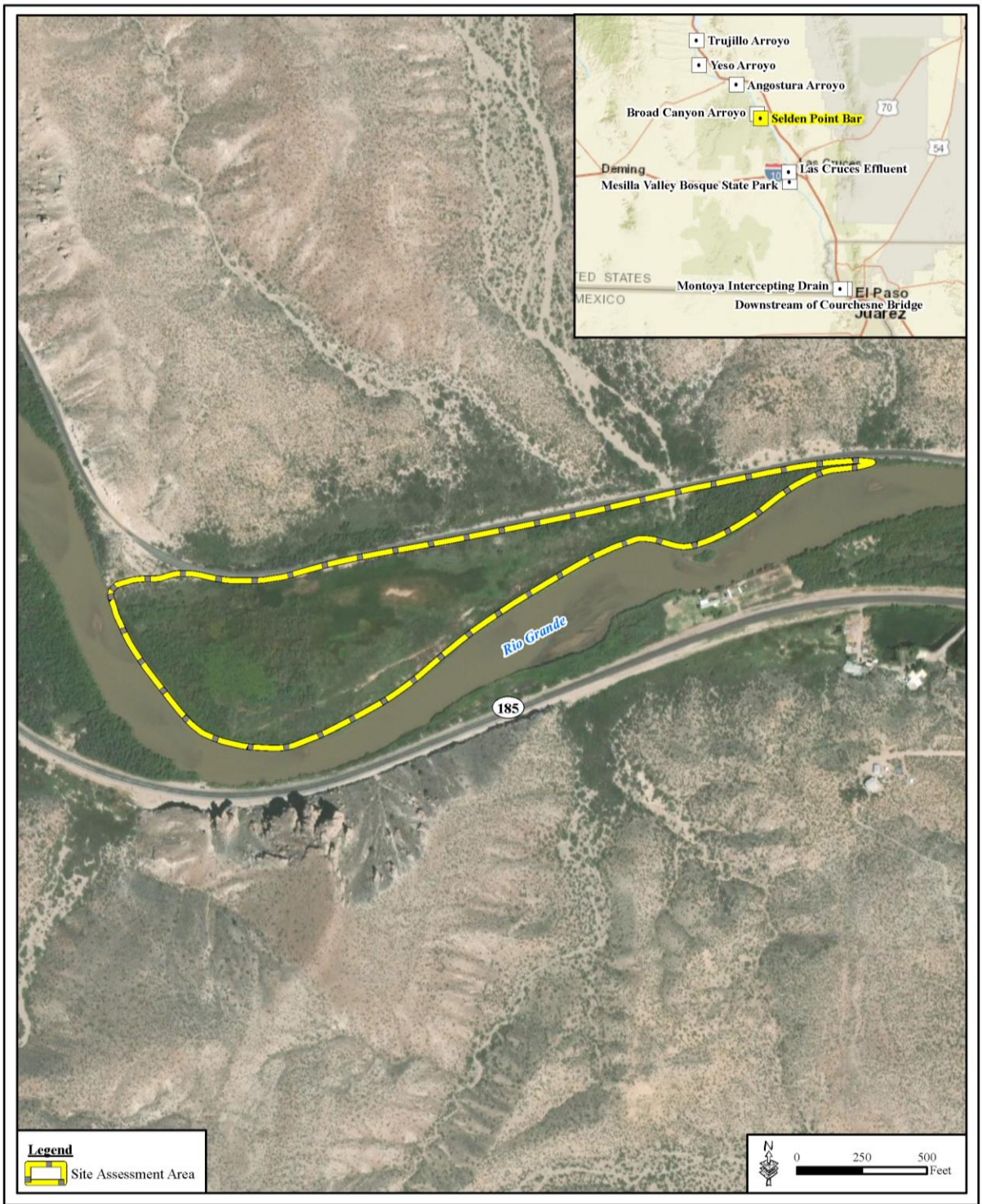

Figure A-9. Selden Point Bar Alternative Site

Basemap: ESRI World Imagery (9/29/2019)

GSRC

January 2021

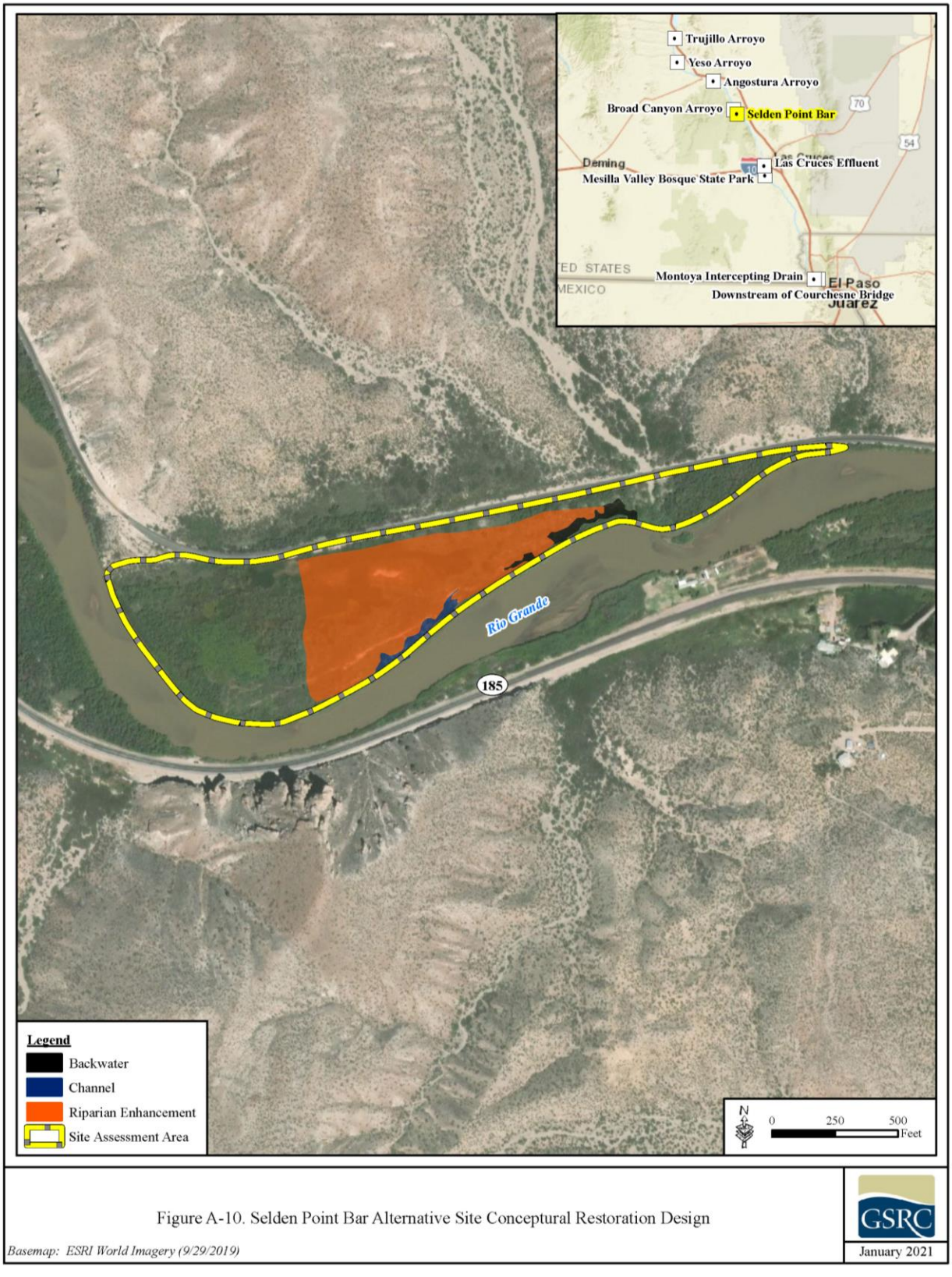

Figure A-10. Selden Point Bar Alternative Site Conceptural Restoration Design

Basemap: ESRI World Imagery (9/29/2019)

GSRC

January 2021

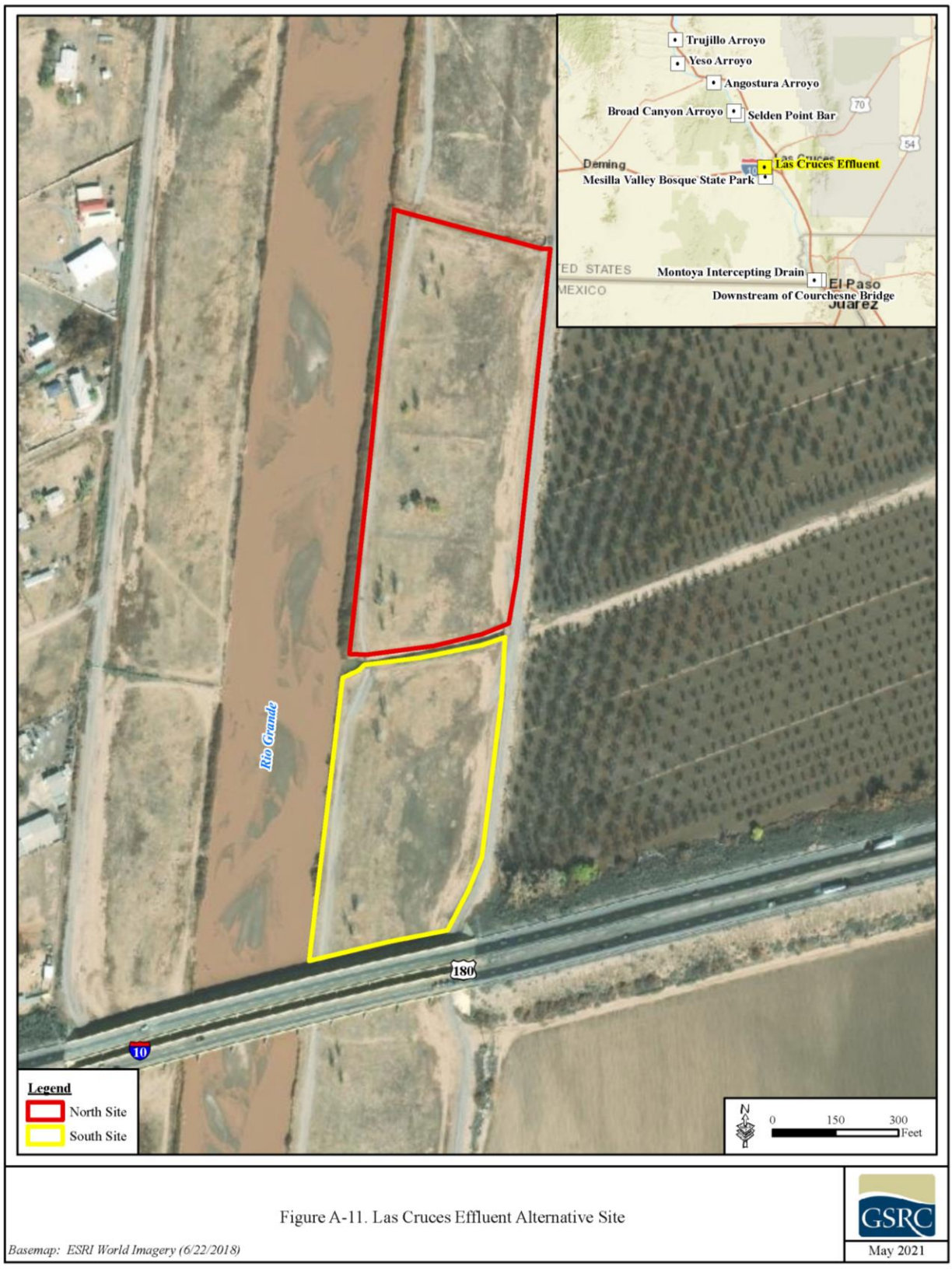

Figure A-11. Las Cruces Effluent Alternative Site

Basemap: ESRI World Imagery (6/22/2018)

GSRC

May 2021

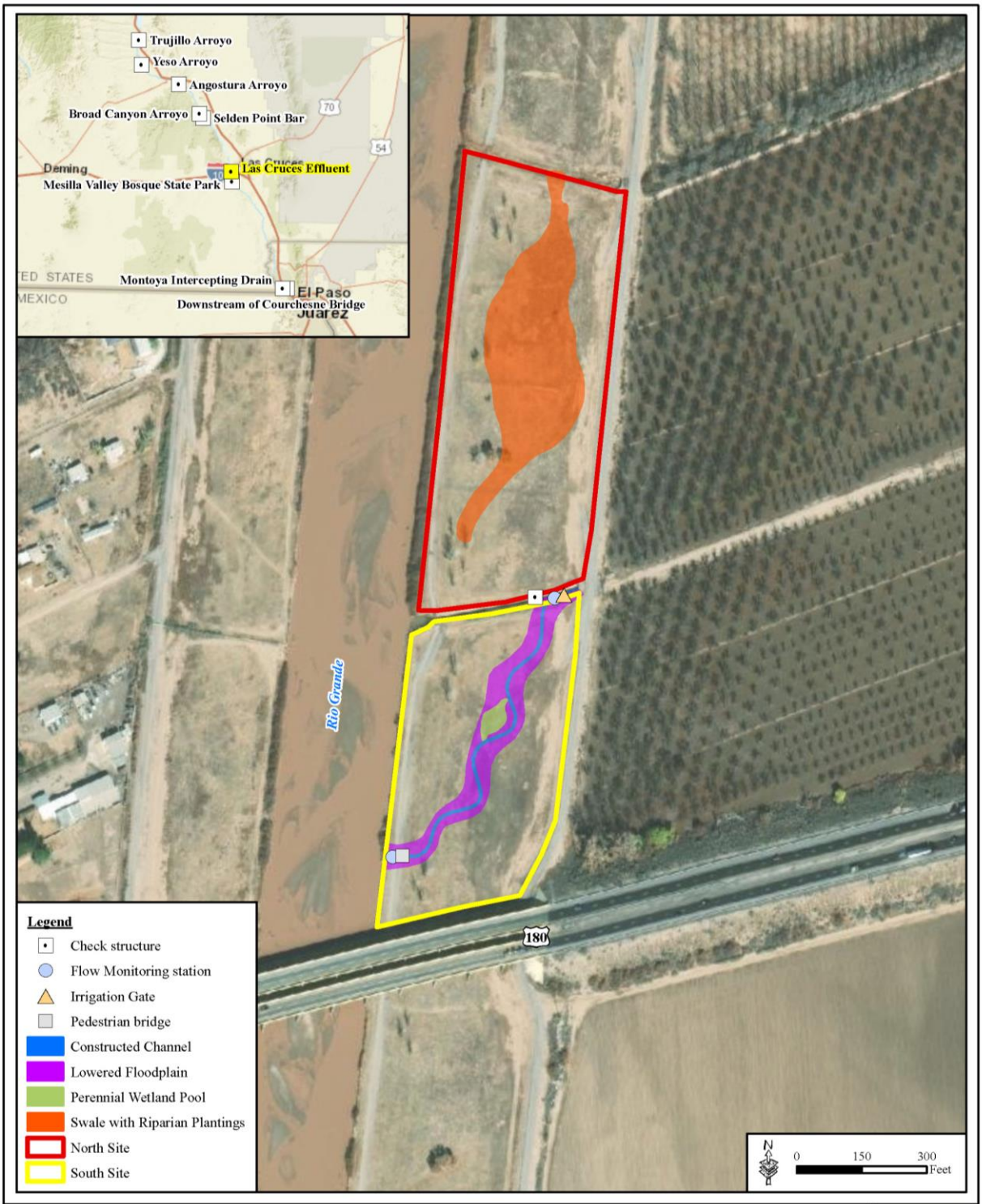

Figure A-12. Las Cruces Effluent Alternative Site Conceptual Restoration Design

Basemap: ESRI World Imagery (6/22/2018)

GSRC

May 2021

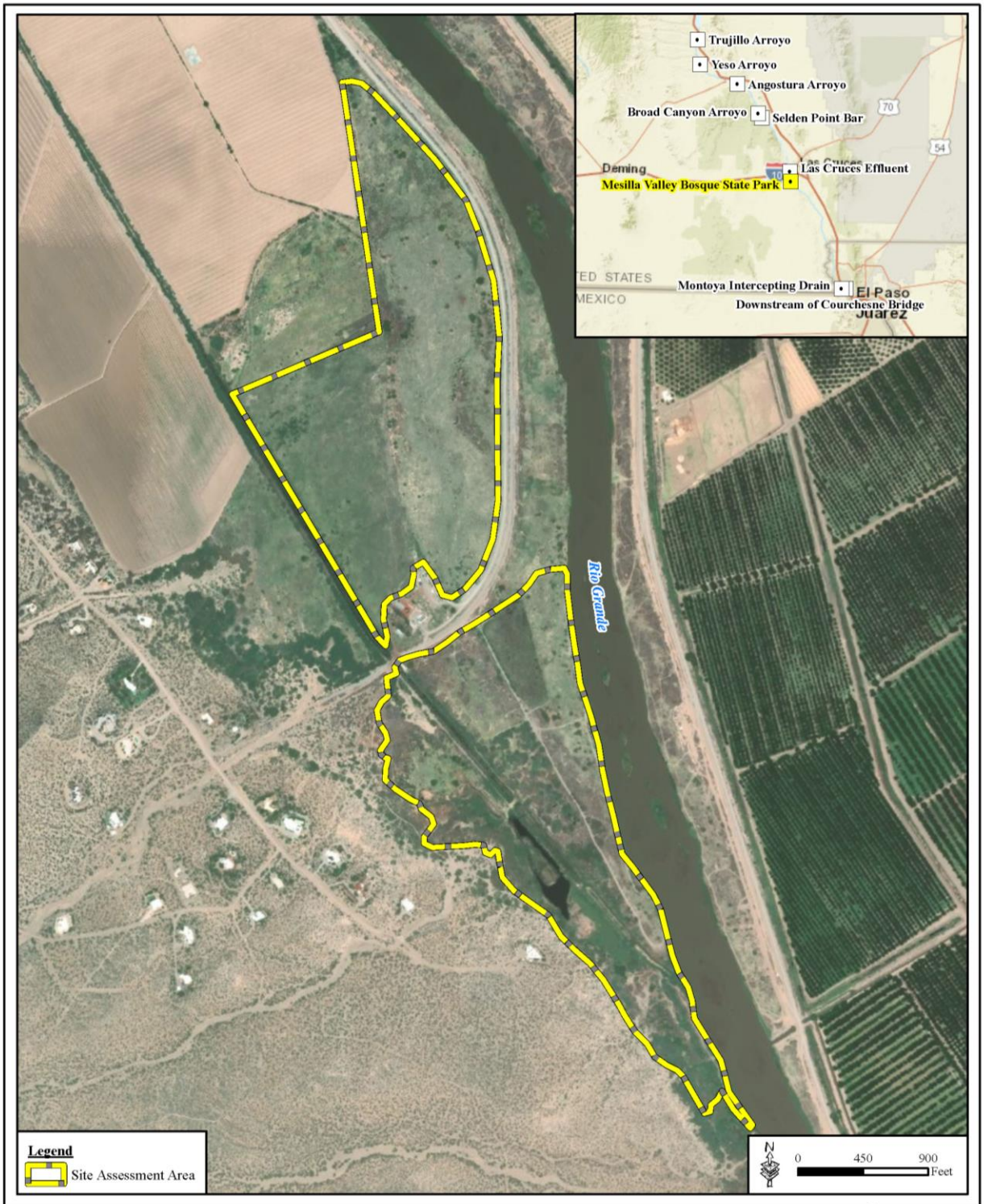

Figure A-13. Mesilla Valley Bosque State Park Alternative Site

Basemap: ESRI World Imagery (6/22/2018)

GSRC

January 2021

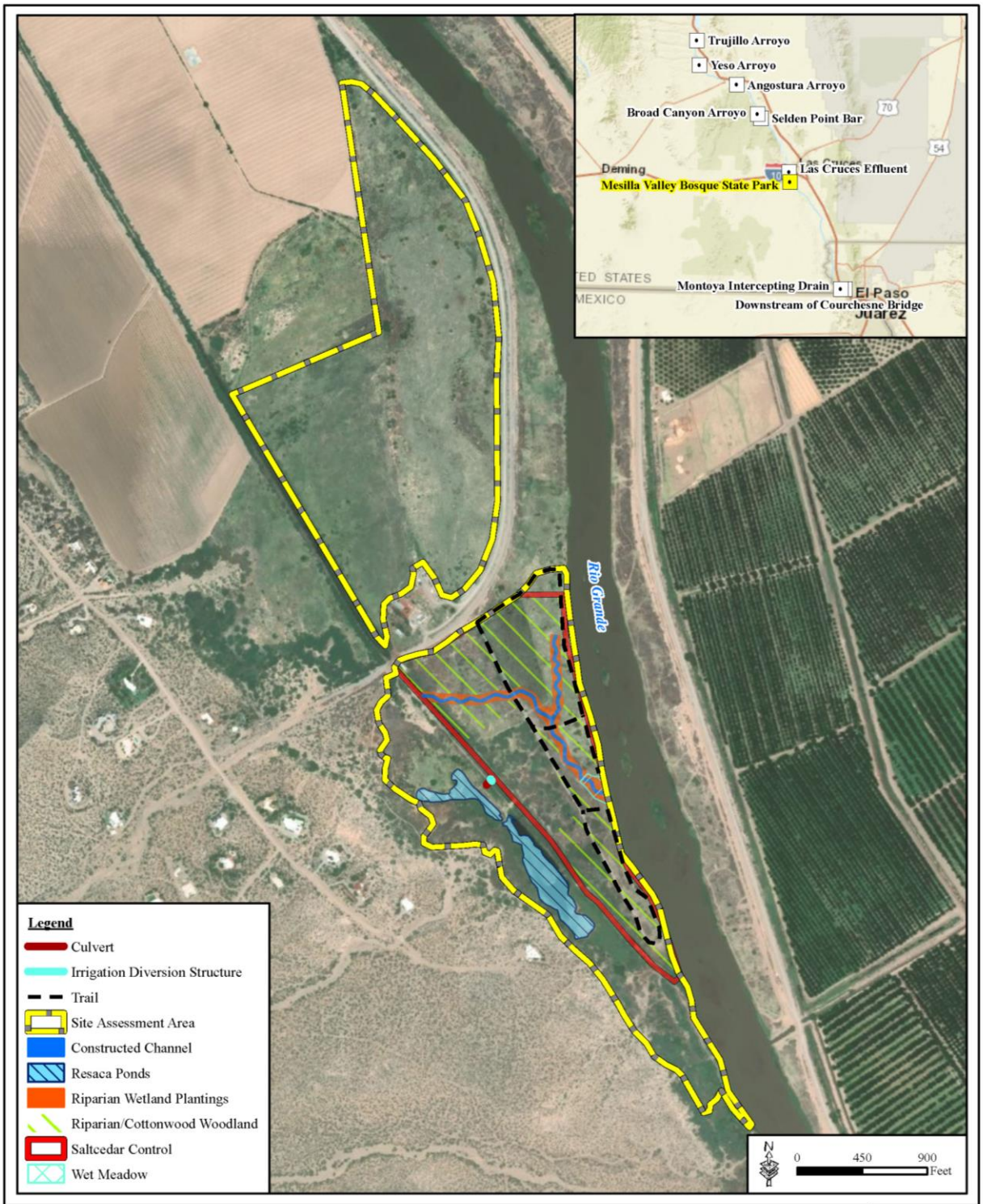

Figure A-14. Mesilla Valley Bosque State Park Alternative Site Conceptual Restoration Design

Basemap: ESRI World Imagery (6/22/2018)

GSRC

January 2021

Figure A-15. Downstream of Courchesne Bridge Alternative Site

Basemap: ESRI World Imagery (5/12/2020)

GSRC

January 2021

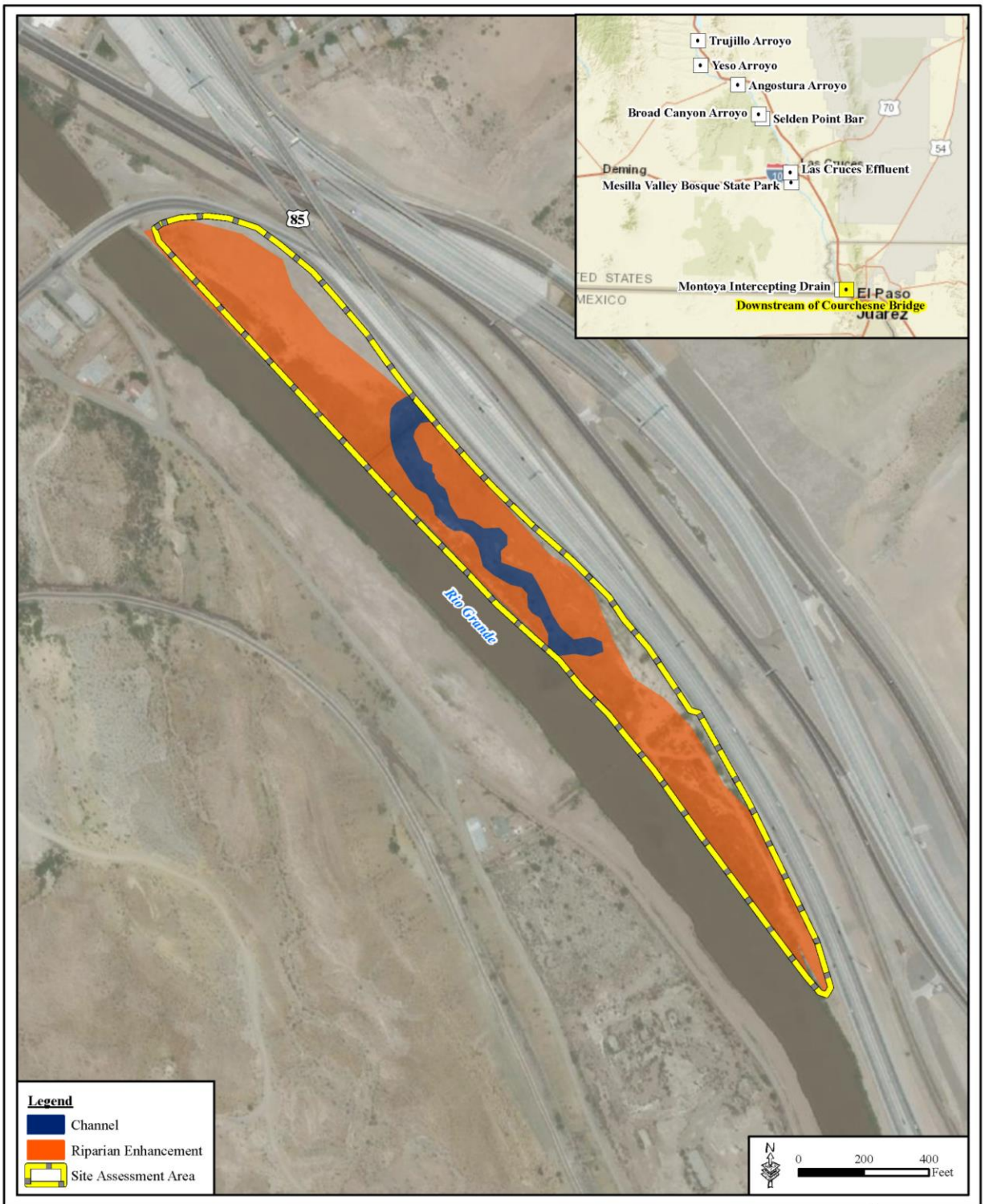

Figure A-16. Downstream of Courchesne Bridge Alternative Site Conceptual Restoration Design

Basemap: ESRI World Imagery (5/12/2020)

GSRC

January 2021

Figure A-17. Trujillo Arroyo Alternative Site

Basemap: ESRI World Imagery (11/12/2018)

GSRC

January 2021

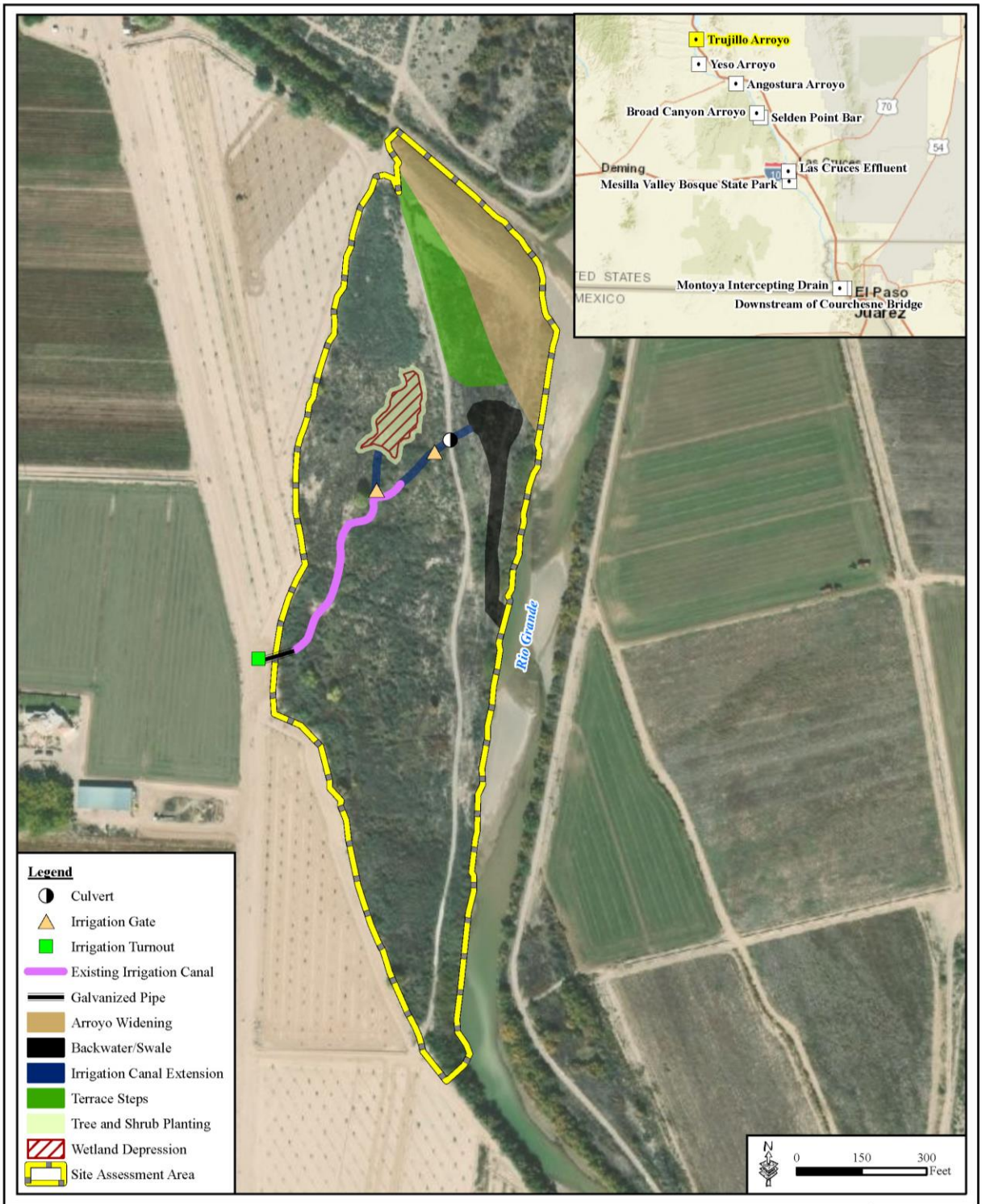

Figure A-18. Trujillo Arroyo Alternative Site Conceptual Restoration Design

Basemap: ESRI World Imagery (11/12/2018)

GSRC

January 2021

Figure A-19. Montoya Intercepting Drain Alternative Site

Basemap: ESRI World Imagery (5/12/2020)

GSRC

January 2021

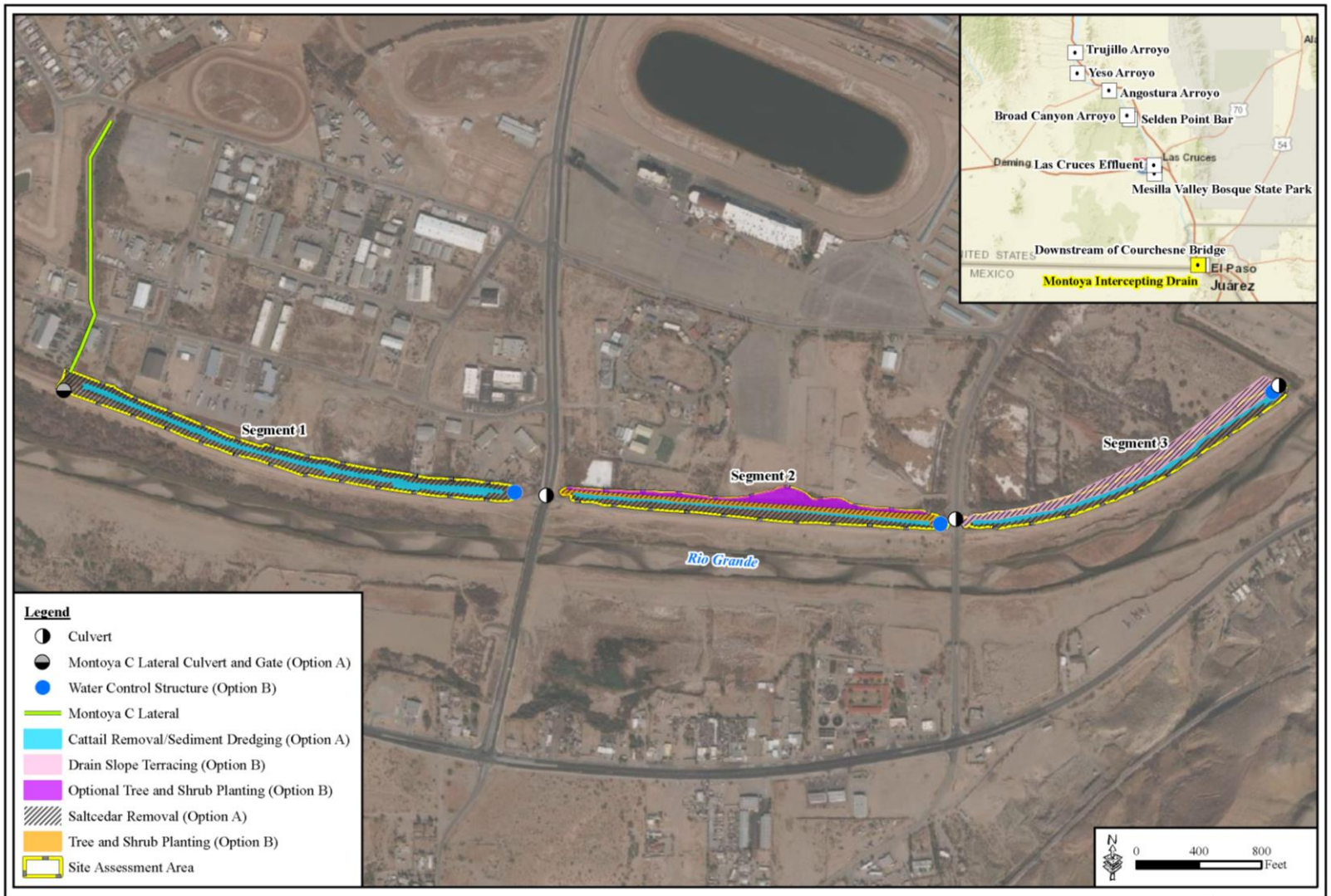

Figure A-20. Montoya Intercepting Drain Alternative Site Conceptual Restoration Design

Basemap: ESRI World Imagery (5/12/2020)

GSRC

September 2021

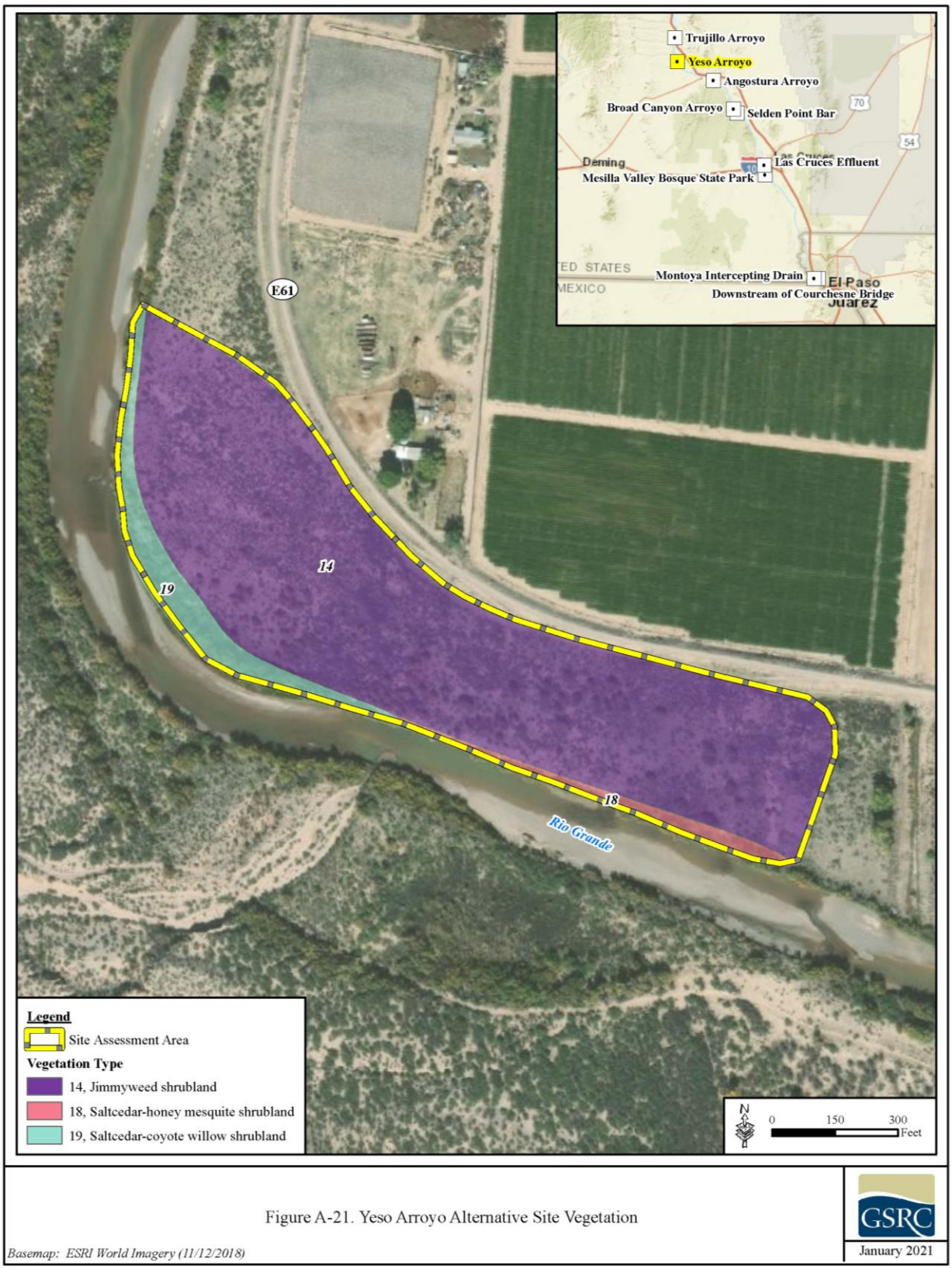

Figure A-21. Yeso Arroyo Alternative Site Vegetation

Basemap: ESRI World Imagery (11/12/2018)

GSRC

January 2021

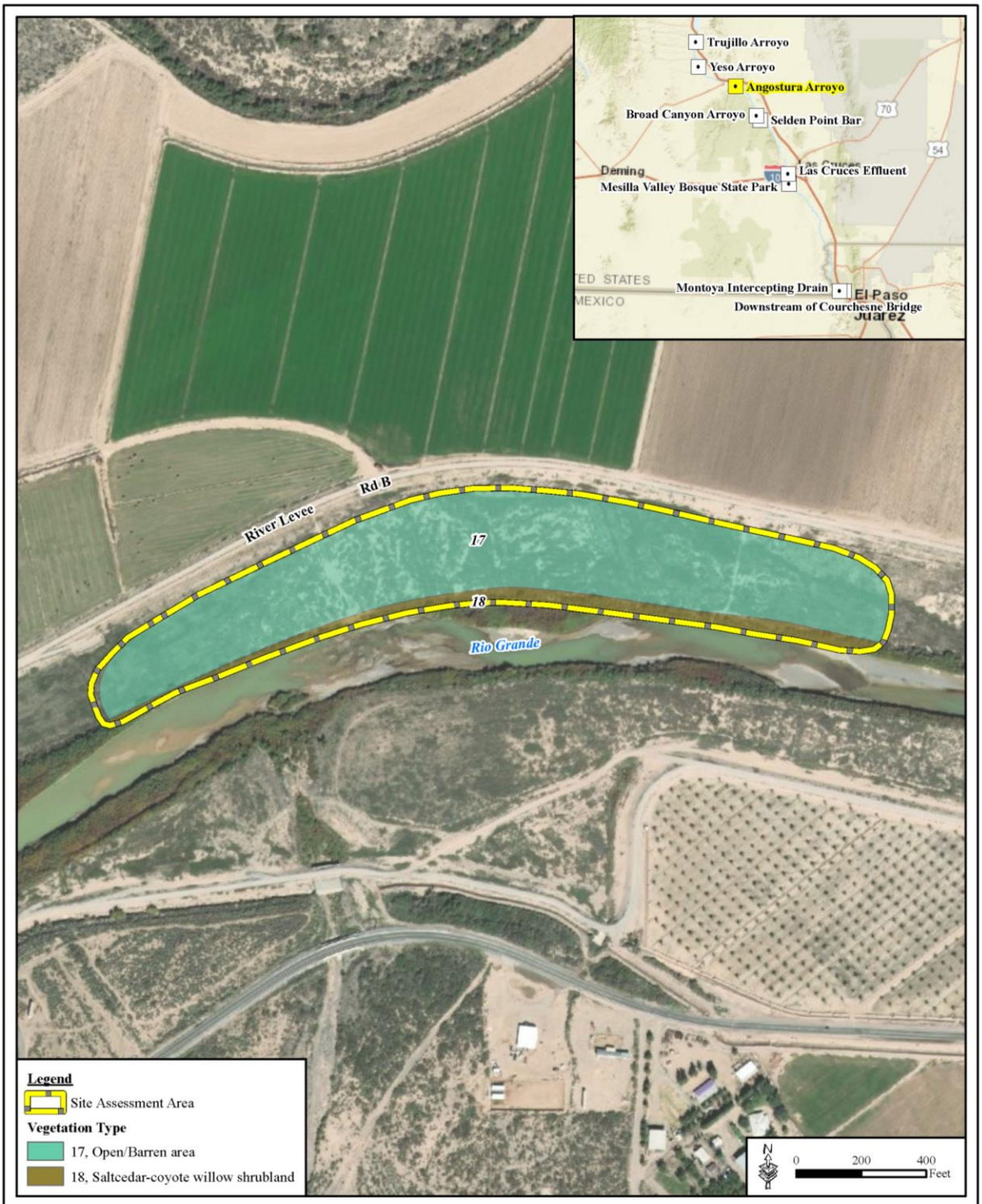

Figure A-22. Angostura Arroyo Alternative Site Vegetation

Basemap: ESRI World Imagery (10/28/2018)

GSRC

January 2021

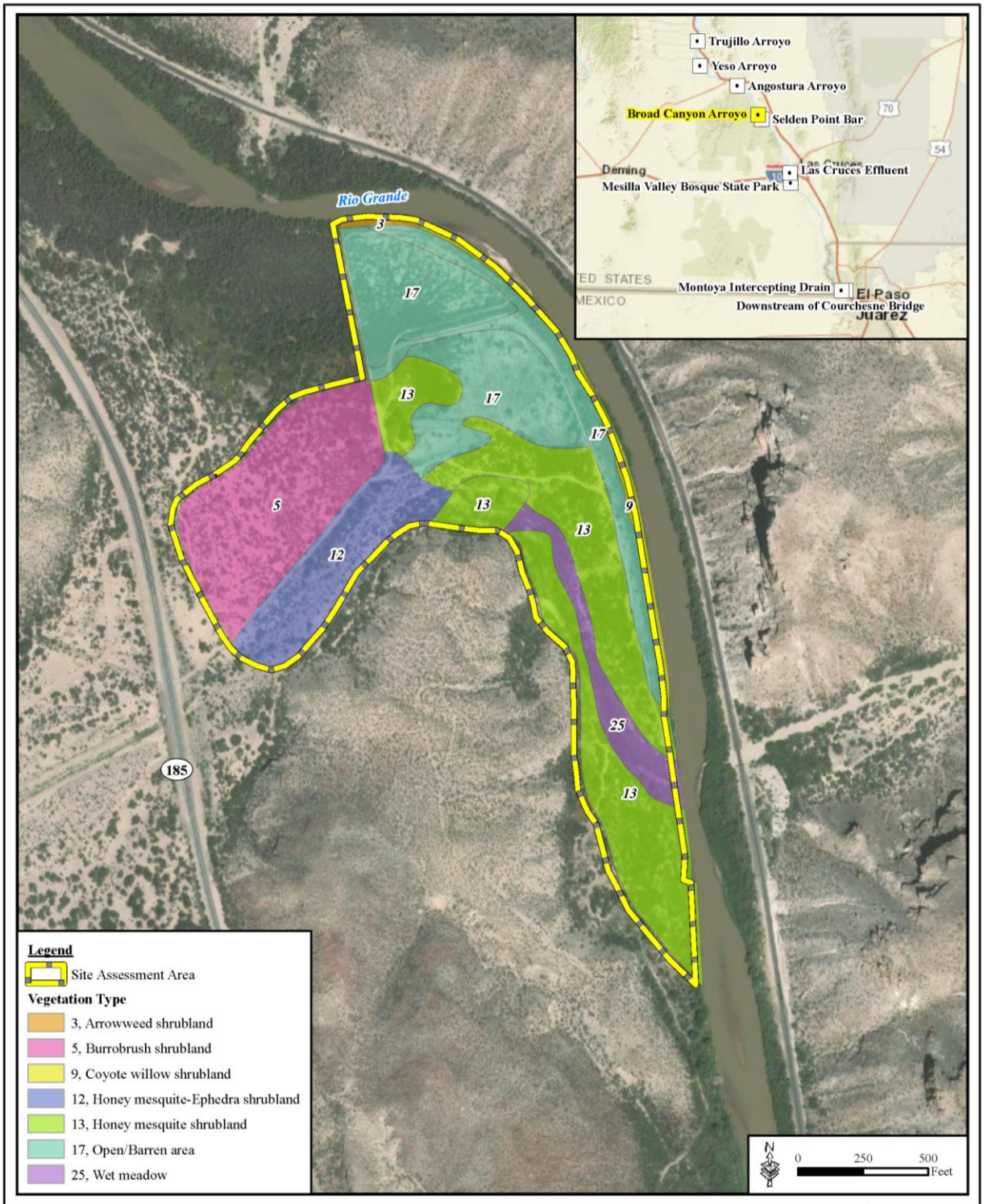

Figure A-23. Broad Canyon Arroyo Alternative Site Vegetation

Basemap: ESRI World Imagery (9/29/2019)

GSRC

January 2021

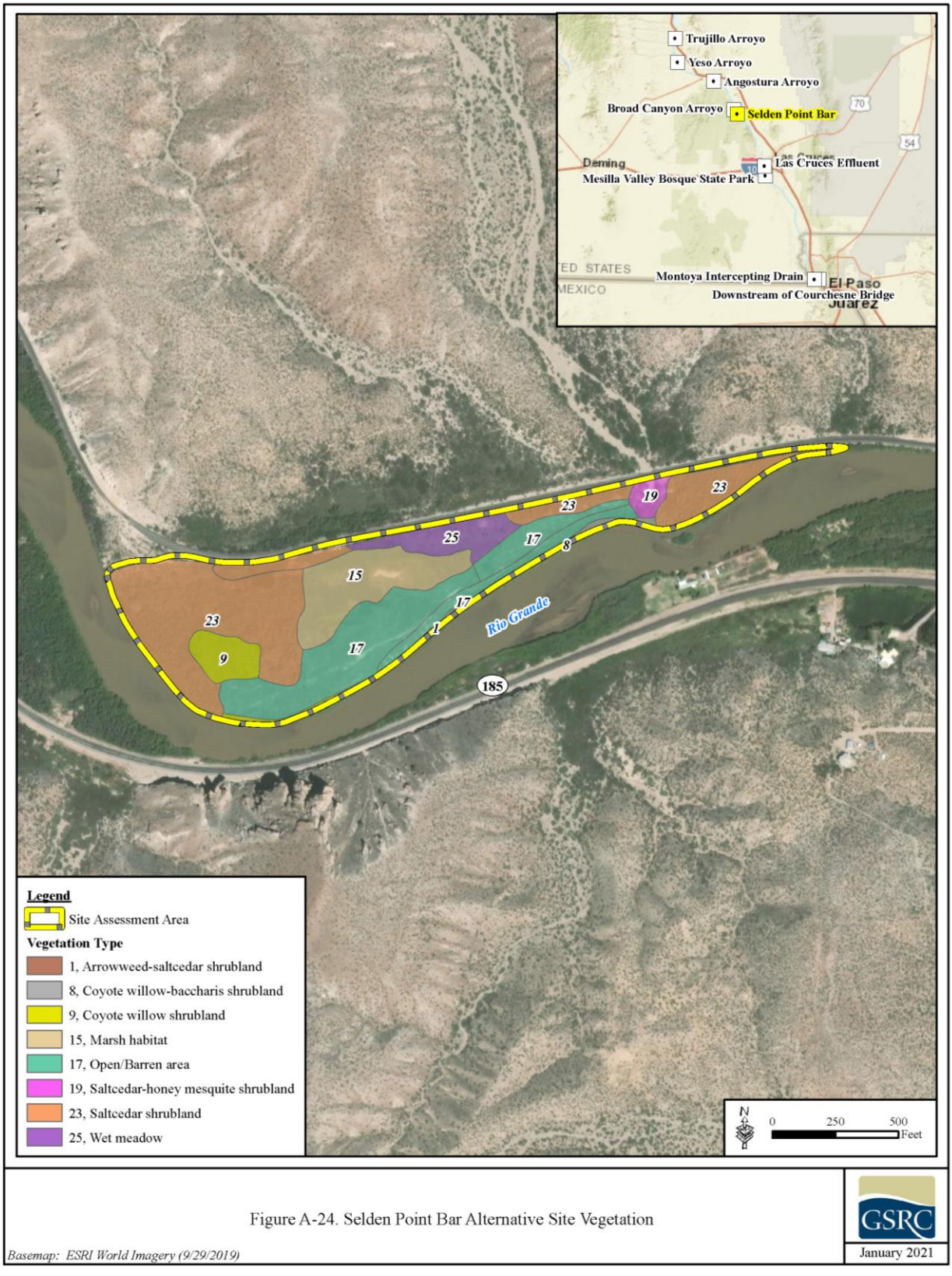

Figure A-24. Selden Point Bar Alternative Site Vegetation

Basemap: ESRI World Imagery (9/29/2019)

GSRC

January 2021

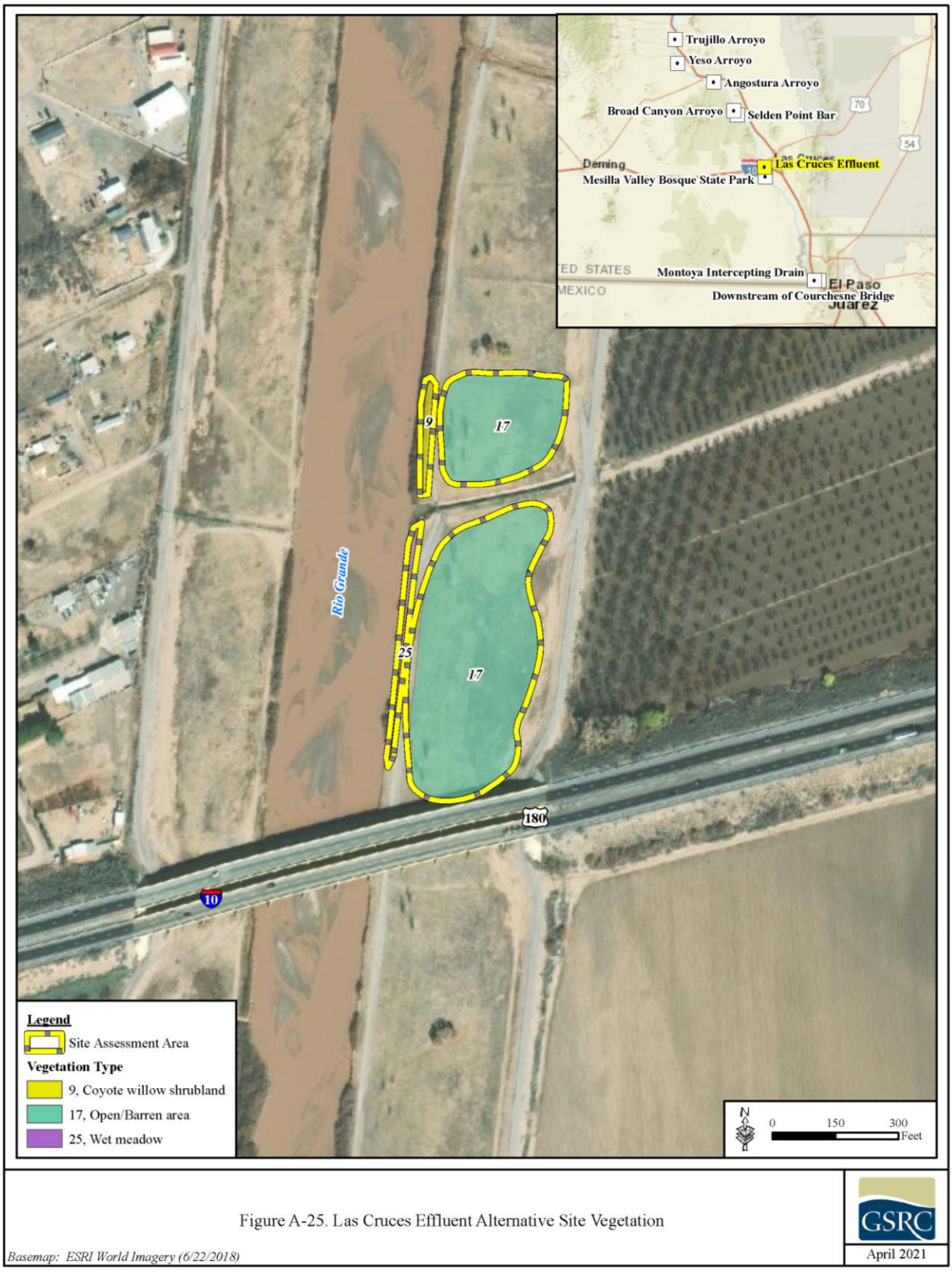

Figure A-25. Las Cruces Effluent Alternative Site Vegetation

Basemap: ESRI World Imagery (6/22/2018)

GSRC

April 2021

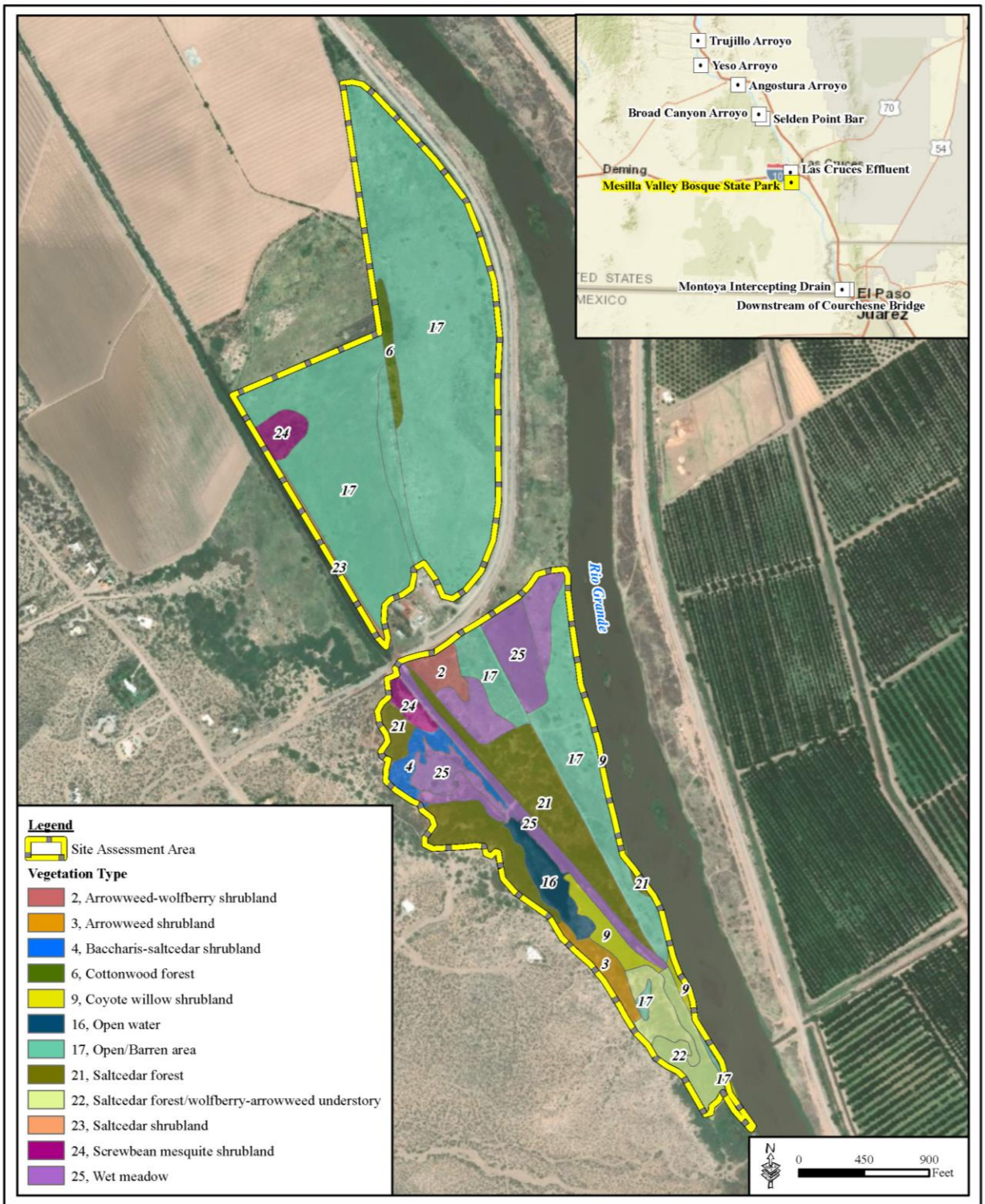

Figure A-26. Mesilla Valley Bosque State Park Alternative Site Vegetation

Basemap: ESRI World Imagery (6/22/2018)

GSRC

January 2021

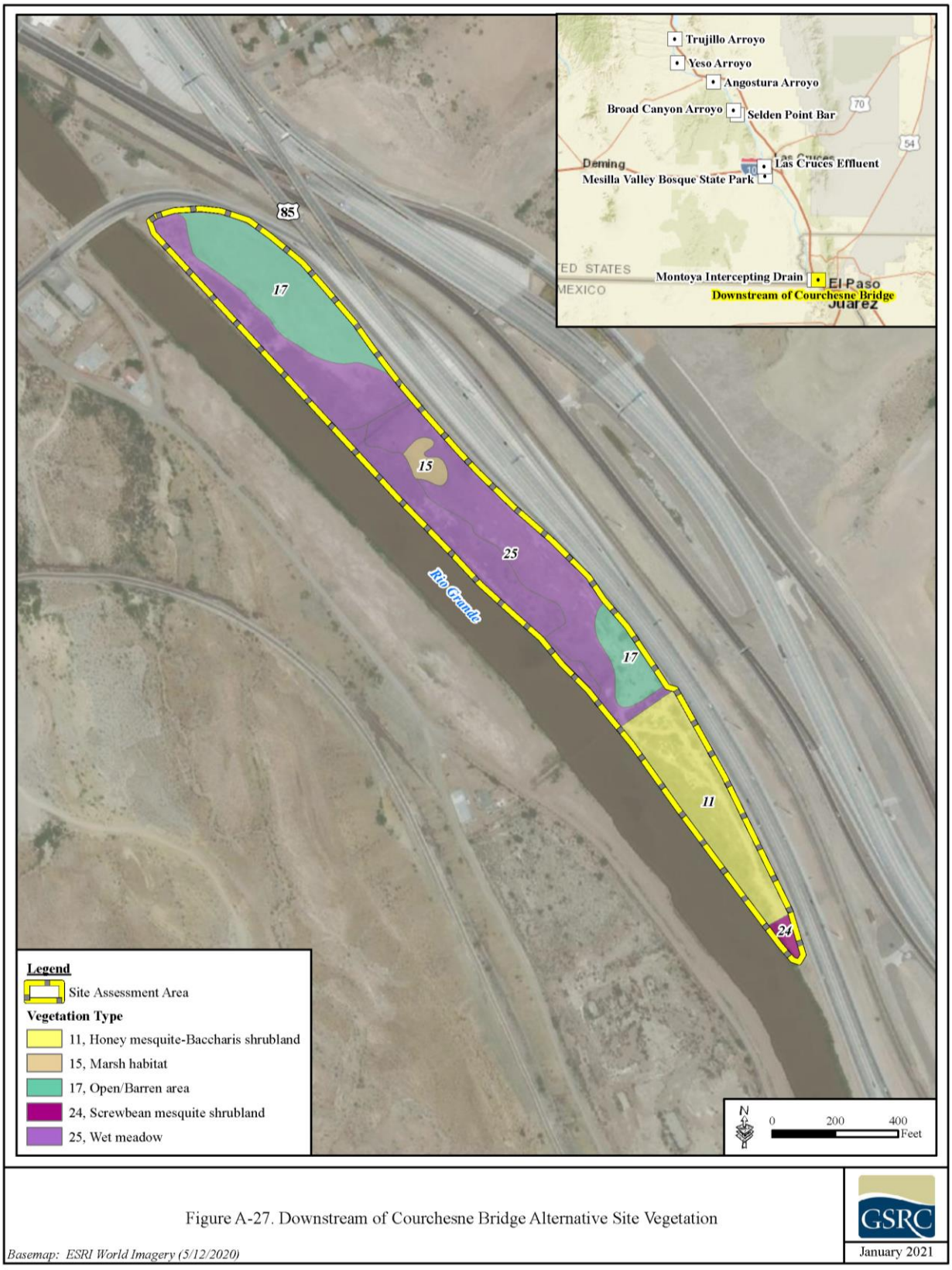

Figure A-27. Downstream of Courchesne Bridge Alternative Site Vegetation

Basemap: ESRI World Imagery (5/12/2020)

GSRC

January 2021

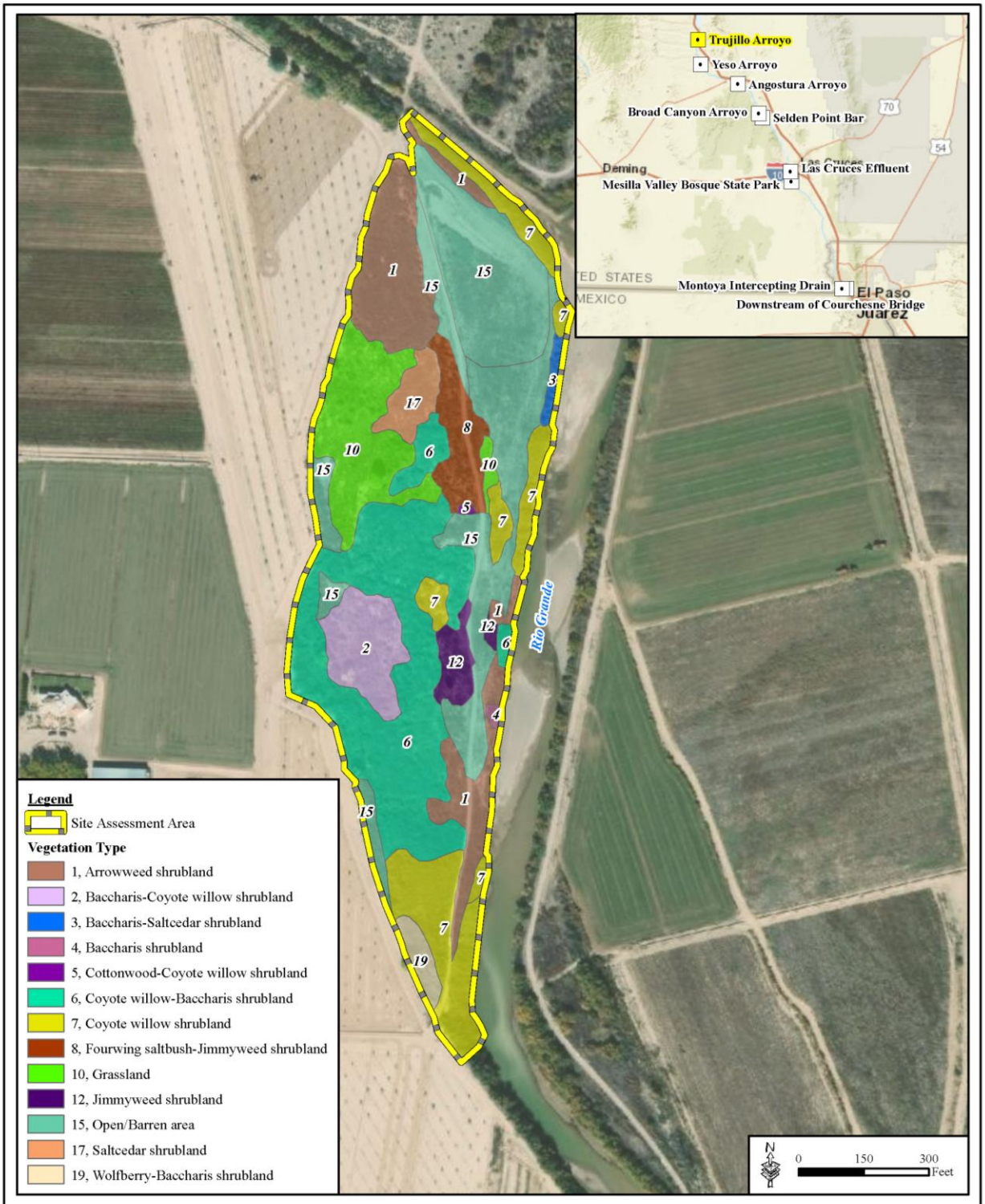

Figure A-28. Trujillo Arroyo Alternative Site Vegetation

Basemap: ESRI World Imagery (11/12/2018)

GSRC

January 2021

Figure A-29. Montoya Intercepting Drain Alternative Site Vegetation

Basemap: ESRI World Imagery (5/12/2020)

GSRC

January 2021

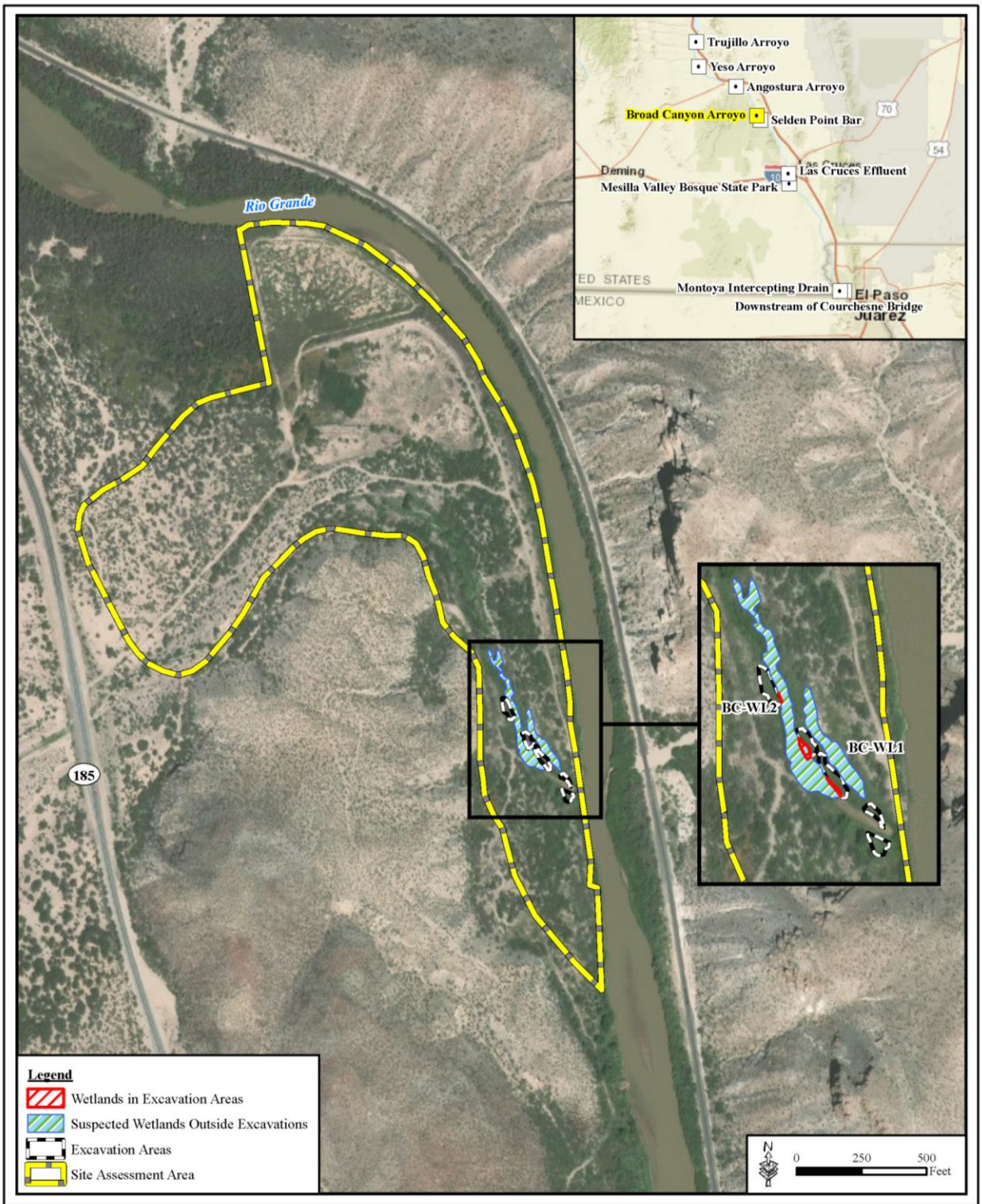

Figure A-30. Broad Canyon Arroyo Alternative Site Wetlands

Basemap: ESRI World Imagery (9/29/2019)

GSRC

January 2021

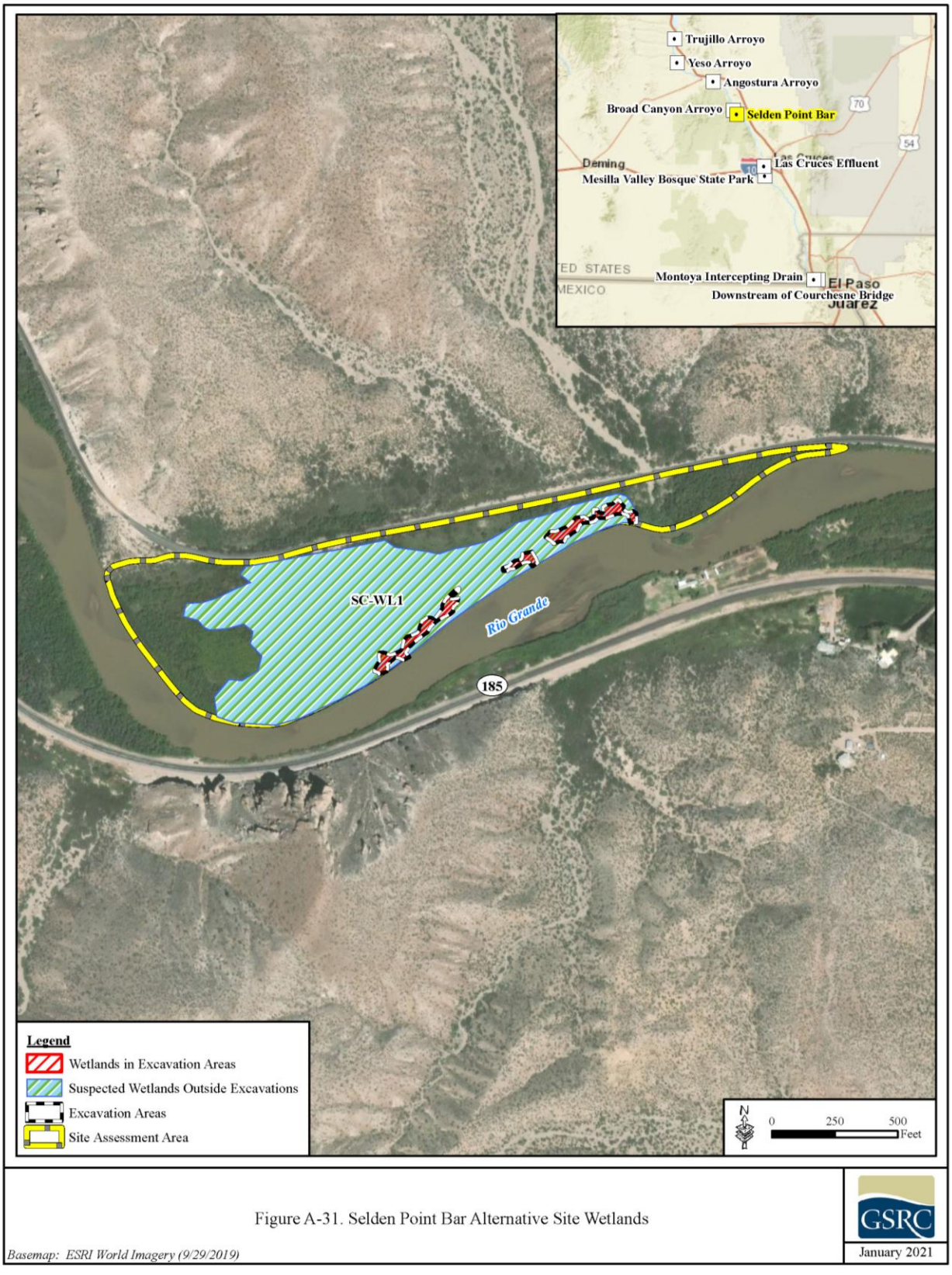

Figure A-31. Selden Point Bar Alternative Site Wetlands

Basemap: ESRI World Imagery (9/29/2019)

GSRC

January 2021

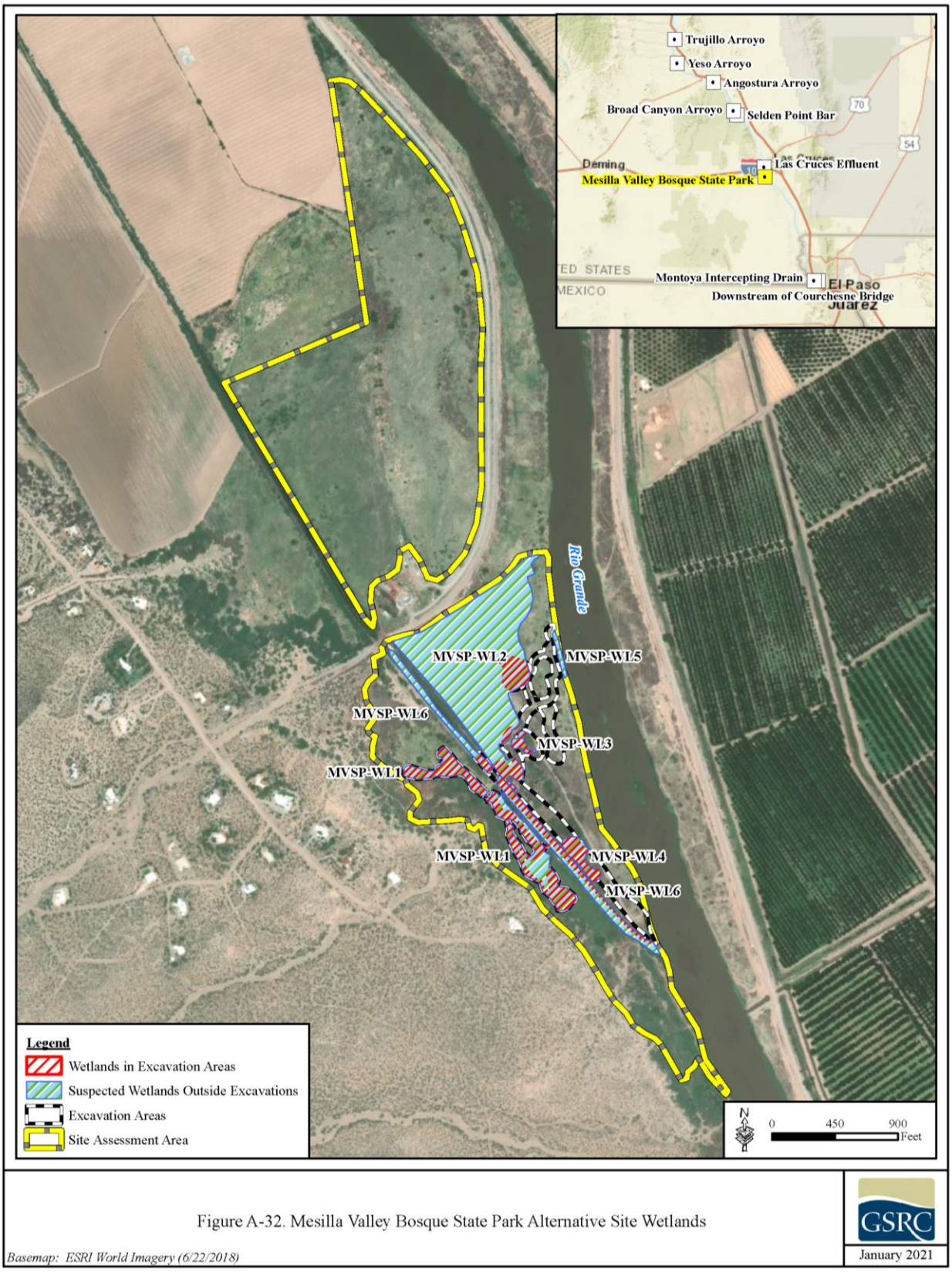

Figure A-32. Mesilla Valley Bosque State Park Alternative Site Wetlands

Basemap: ESRI World Imagery (6/22/2018)

GSRC

January 2021

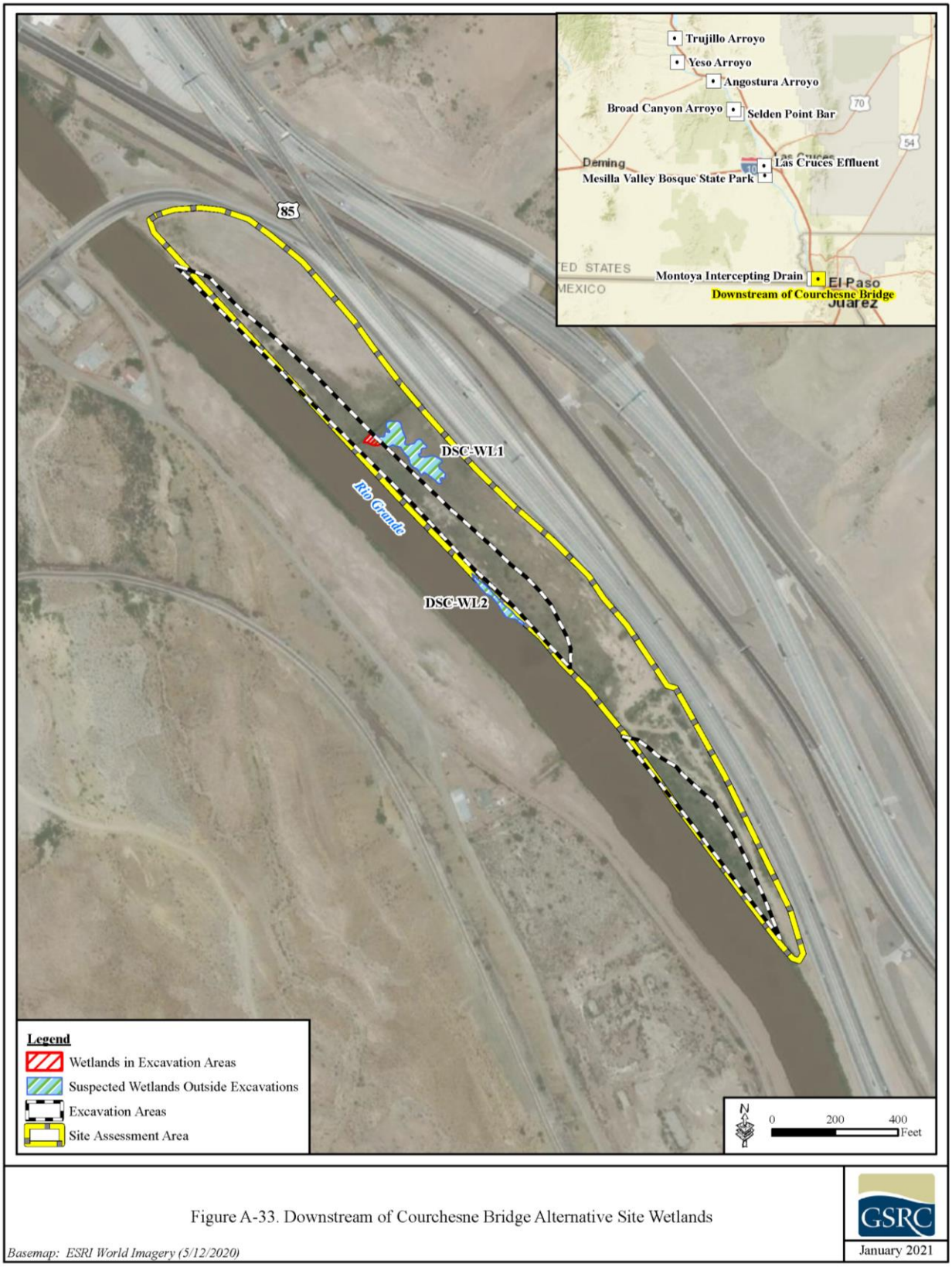

Figure A-33. Downstream of Courchesne Bridge Alternative Site Wetlands

Basemap: ESRI World Imagery (5/12/2020)

GSRC

January 2021

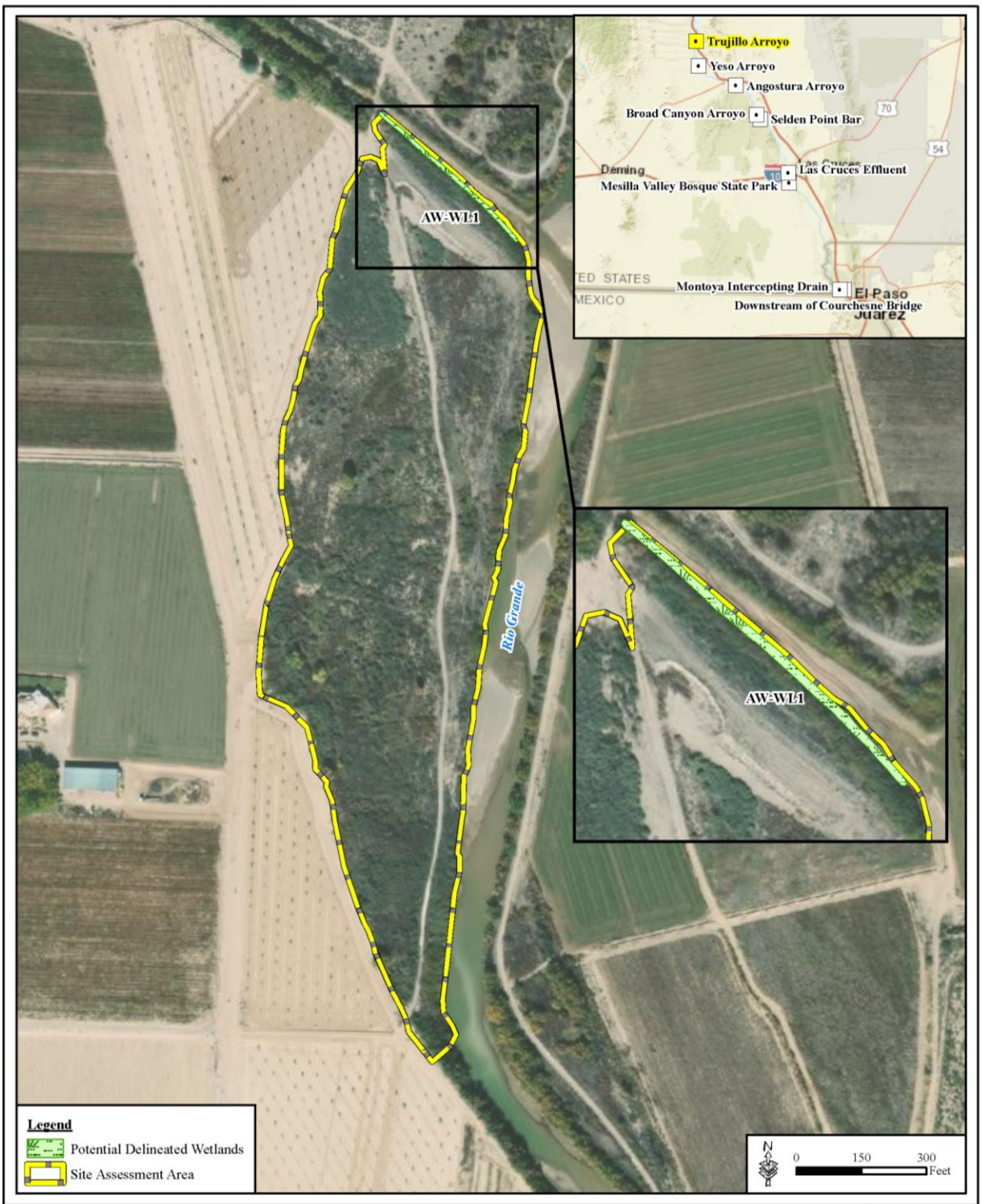

Figure A-34. Trujillo Arroyo Alternative Site Wetlands

Basemap: ESRI World Imagery (11/12/2018)

GSRC

January 2021

Figure A-35. Montoya Intercepting Drain Alternative Site Wetlands

Basemap: ESRI World Imagery (5/12/2020)

GSRC

January 2021

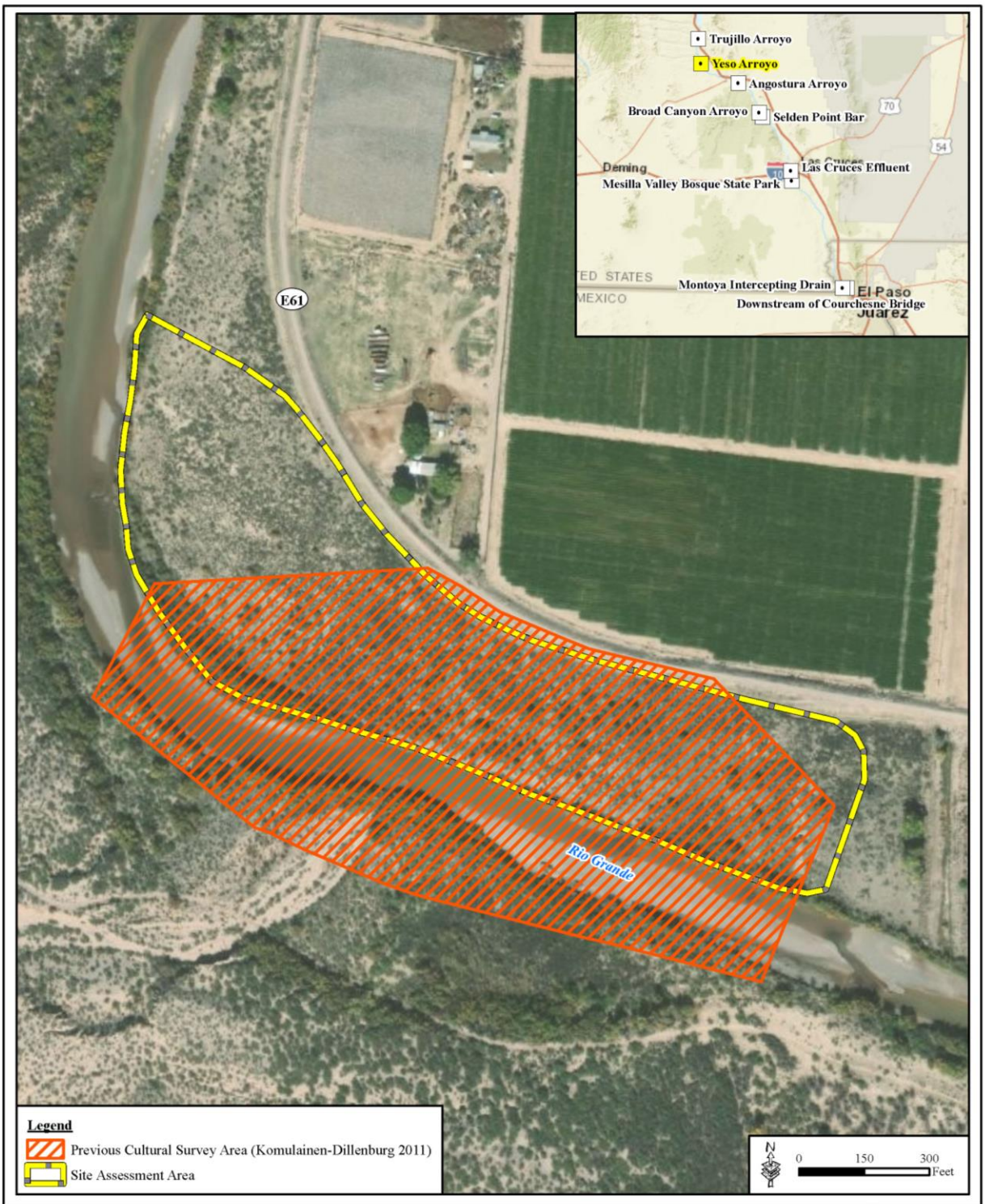

Figure A-36. Previous Cultural Resources Survey of Project Alternative B (Yeso Arroyo)

Basemap: ESRI World Imagery (11/12/2018)

GSRC

January 2021

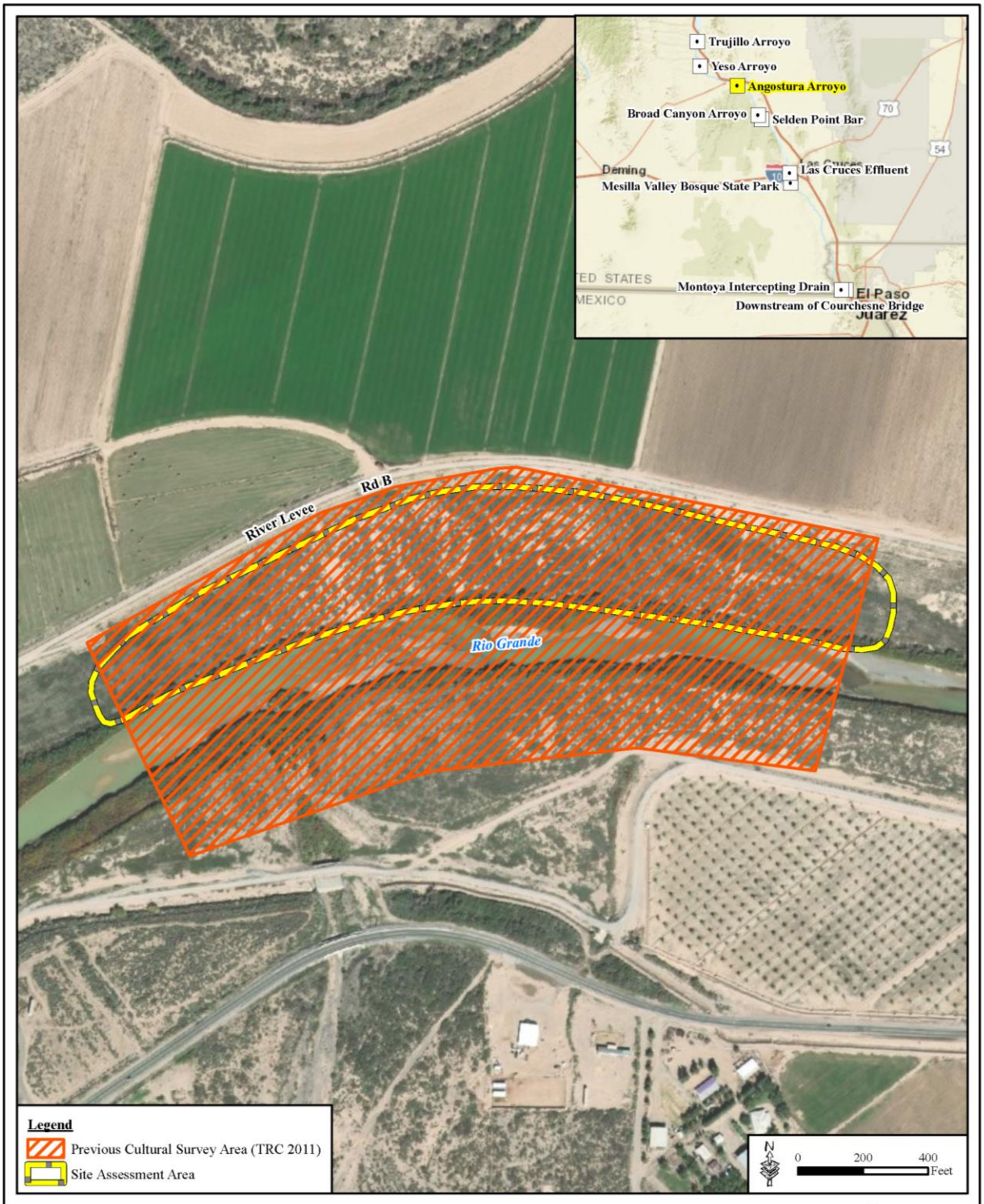

Figure A-37. Previous Cultural Resources Survey of Project Alternative C (Angostura Arroyo)

Basemap: ESRI World Imagery (10/28/2018)

GSRC

January 2021

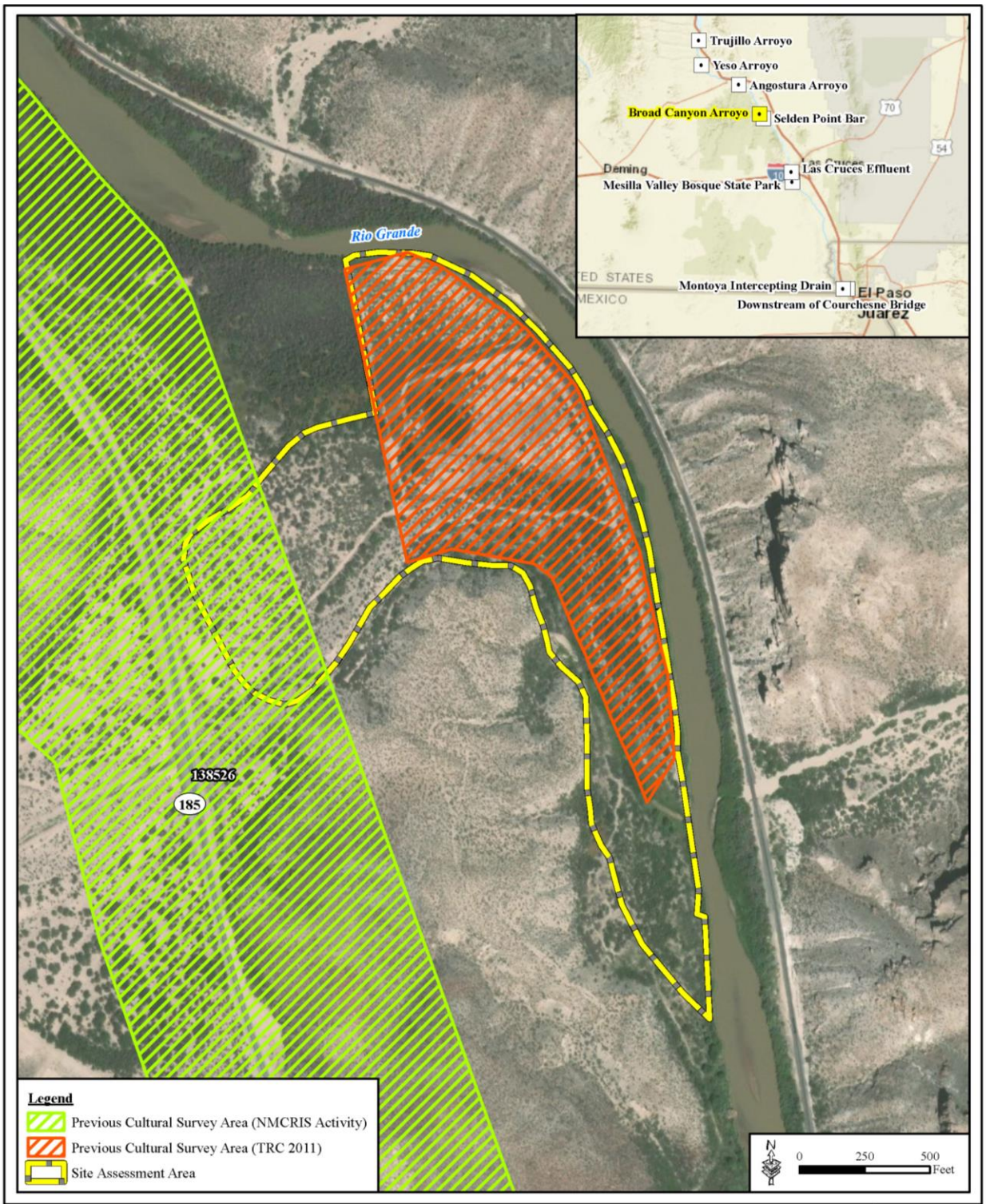

Figure A-38. Previous Cultural Resources Survey of Project Alternative D (Broad Canyon Arroyo)

Basemap: ESRI World Imagery (9/29/2019)

GSRC

January 2021

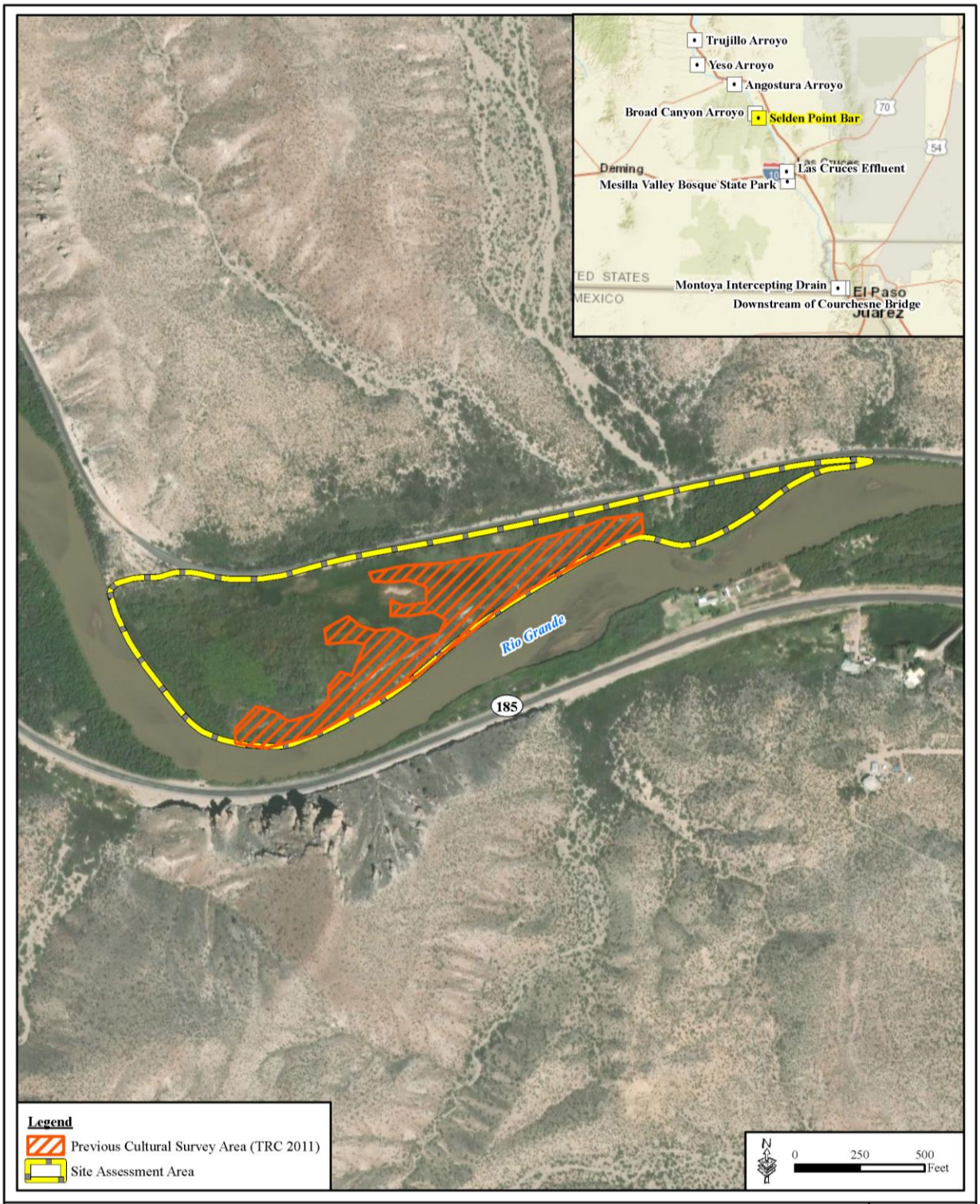

Figure A-39. Previous Cultural Resources Survey of Project Alternative E (Selden Point Bar)

Basemap: ESRI World Imagery (9/29/2019)

GSRC

January 2021

Figure A-40. Previous Cultural Resources Survey of Project Alternative F (Las Cruces Effluent)

Basemap: ESRI World Imagery (6/22/2018)

GSRC

January 2021

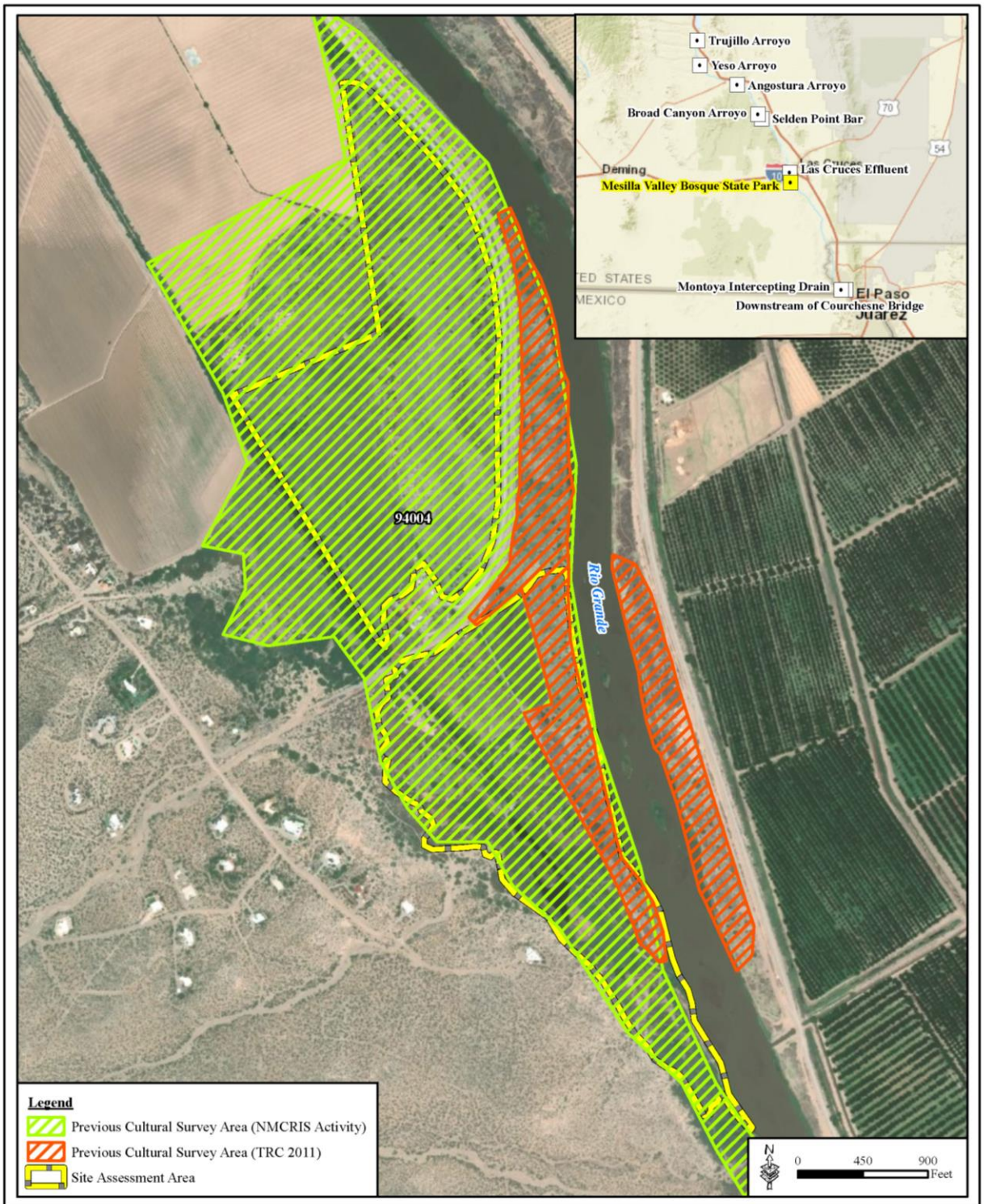

Figure A-41. Previous Cultural Resources Survey of Project Alternative G (Mesilla Valley Bosque State Park)

Basemap: ESRI World Imagery (6/22/2018)

GSRC

January 2021

Figure A-42. Previous Cultural Resources Survey of Project Alternative H (Downstream of Courchesne Bridge)

Basemap: ESRI World Imagery (5/12/2020)

GSRC

January 2021

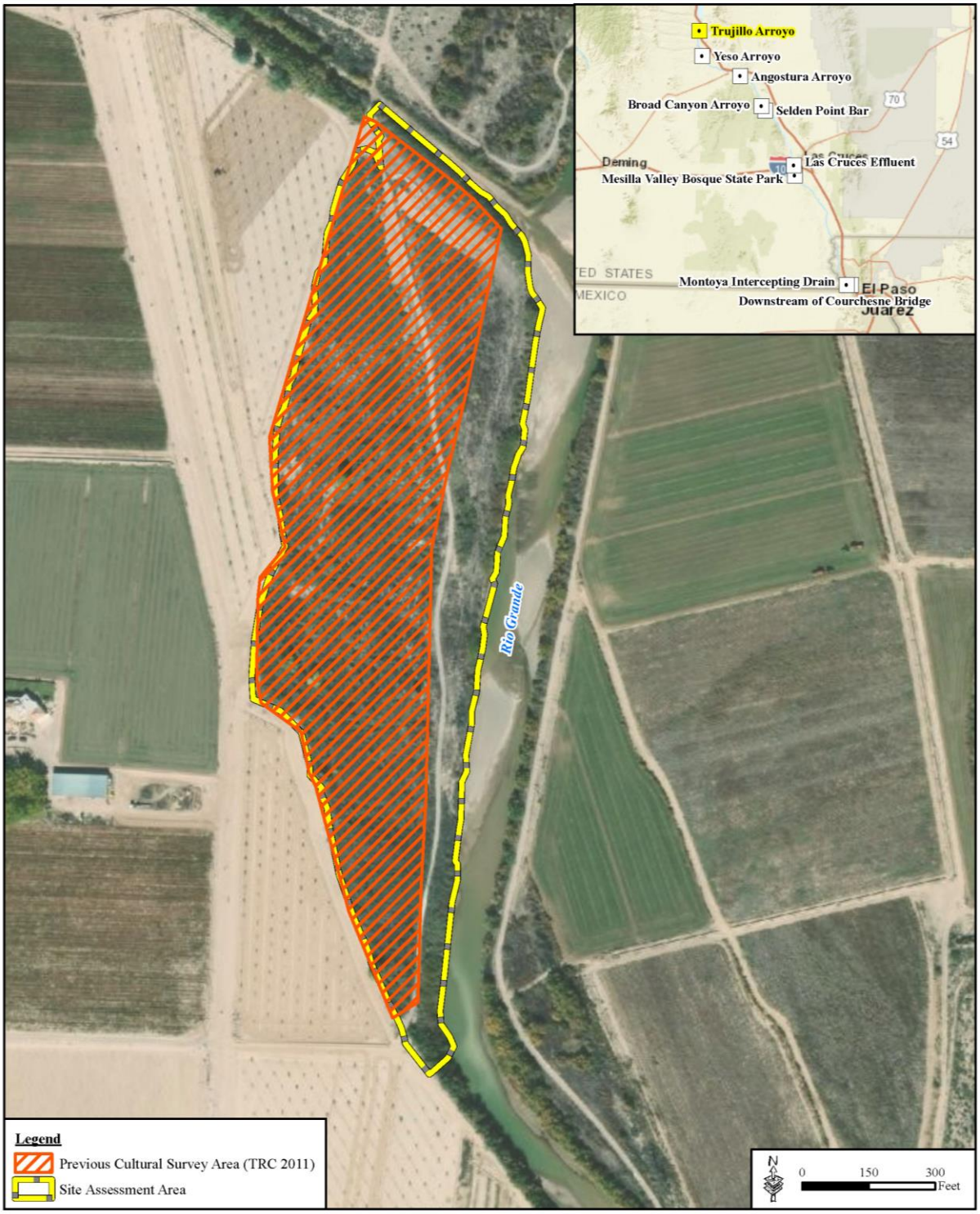

Figure A-43. Previous Cultural Resources Survey of Project Alternative I (Trujillo Arroyo)

Basemap: ESRI World Imagery (11/12/2018)

GSRC

January 2021