# Comprehensive Recreational Use-Attainability Analysis Of the Arroyo Colorado Above Tidal Segment 2202

Report to TMDL Program
Texas Commission on Environmental Quality
Project Work Order Number
582-11-11308-1

Nueces River Authority
September 16, 2011

**Tables:**



**Figures:**

**LIST OF ACRONYMS**

| | |
|---|---|
| ACBIS | Arroyo Colorado Bacteria Indicator Study |
| ACWP | Arroyo Colorado Watershed Partnership |
| ADCP | Acoustic Doppler Current Profiler |
| AU | Assessment Unit |
| BMP | Best Management Practice |
| CFS | Cubic Feet per Second |
| BMP | Best Management Practice |
| CFS | Cubic Feet per Second |
| CWA | Clean Water Act |
| IBWC | International Boundary and Water Commission |
| NIST | National Institute of Standards and Technology |
| NRA | Nueces River Authority |
| OBS | Observed |
| REP | Represented |
| RUAA | Recreational Use Attainability Analysis |
| SWQM | Surface Water Quality Monitoring |
| TCEQ | Texas Commission on Environmental Quality |
| TPWD | Texas Parks and Wildlife Department |
| TSSWCB | Texas State Soil and Water Conservation Board |
| TSWQS | Texas Surface Water Quality Standards |
| TWRI | Texas Water Resources Institute |
| USGS | United States Geological Survey |
| WWP | Watershed Protection Plan |
| WWTF | Wastewater Treatment Facility |

## Introduction

Under the federal Clean Water Act (CWA) the state of Texas is required to assess all water bodies to ensure they are meeting their designated uses. The state of Texas water quality standards are based on criteria related to the designated uses of specified water bodies. A water body is considered impaired if it does not meet the criteria for support of one or more of its designated uses. Some of the designated uses in the state of Texas include aquatic life use, contact recreation, public water supply, fish consumption, and oyster waters.

After uses have been assigned to water bodies, numeric and narrative criteria are developed and adopted in order to protect the designated uses. Designated uses and associated criteria are defined in the Texas Surface Water Quality Standards (TSWQS) 30 Texas Administrative Code §§307.1-307.10. Every two years the Texas Commission on Environmental Quality (TCEQ) identifies impaired water bodies that are then put on Texas'303(d) list within Texas' Integrated Report for CWA Sections 305(b) and 303(d). The CWA requires states to take action to restore all impaired water bodies that are on the state's 303(d) list.

Prior to 2010 the TSWQS included two recreational uses, contact recreation and noncontact recreation. Contact recreation included activities involving a significant risk of ingestion of water, such as wading by children and swimming. Noncontact recreation included activities not involving a significant risk of ingestion, such as fishing and limited body contact related to shoreline activity. In 2010 the state of Texas revised the recreational use categories by adopting a primary contact and adding two additional categories (secondary contact 1 and secondary contact 2). Table 1 below shows the 2000 and 2010 recreation categories and their associated criteria (TCEQ 2010).

| | **Geometric Mean Criteria (colonies/100 ml)** | | | |
|---|---|---|---|---|
| | *E. coli* (Fresh Water) | Enterococci (Salty inland Fresh Water) | Enterococci (Salt Water) | Fecal coliform (Fresh Water and Salt Water) |
| **2000 Standards** | | | | |
| Contact recreation | 126 | -- | 35 | 200 |
| Noncontact recreation | 605 | -- | 168 | 2000 |
| **2010 Standards** | | | | |
| Primary contact | 126 | 33 | 35 | 200** |
| Secondary contact 1 | 630 | 165 | 175*** | 1000 |
| Secondary contact 2 | 1030 | 270 | -- | 1000 |
| Noncontact recreation | 2060 | 540 | 350 | 2000 |

**Table 1: 2000 and 2010 Recreational Use Standards**

*Salty (high saline) inland FW=High saline inland water bodies (conductivity $\geq$ 9000 µmhos/cm)

**Fecal coliform has been gradually phased out as criteria has been developed for salty inland waters However, fecal coliform will continue to be used for oyster waters criterion (14/100ml median)

***Secondary contact 1 for SW would only be applicable when not in conflict with the federal Beach Act

### Problem Statement

The Arroyo Colorado Above Tidal is currently designated as having a primary contact recreation use, but has been included in Texas' 303(d) list since 1996 due to levels of indicator bacteria that exceed the criteria for safe primary contact recreation. To address water quality concerns in the Arroyo Colorado, with support from TCEQ, TSSWCB, and TWRI, stakeholders in the watershed formed the Arroyo Colorado Watershed Partnership and, in 2007, developed "A Watershed Protection Plan for the Arroyo Colorado Phase I," a watershed based plan to restore and protect the water quality in the Arroyo Colorado. However, given that the segment is used primarily to convey wastewater, storm water, and irrigation tail water, and that it has been extensively modified to accommodate these uses, the TCEQ is conducting a Recreational Use Attainability Analysis (RUAA) to determine if primary contact recreation is an attainable and appropriate designated use.

### Objectives

The TCEQ tasked the Nueces River Authority (NRA) with conducting a Comprehensive RUAA to examine and determine the appropriate recreational uses for Segment 2202, Arroyo Colorado Above Tidal, for the purposes of establishing the proper water quality assessment standards. The primary objective of the Comprehensive RUAA on the Arroyo Colorado Above Tidal, Segment 2202, was to characterize the historic and current recreational uses. To thoroughly document recreational uses on Segment 2202 NRA completed a historical research, and 23 sites were visited and surveyed on two separate occasions, during times when water related recreation activities were most likely to occur. In addition to the historical research and field activities, multiple interviews were conducted to further document the frequency and types of recreation that occur on the Arroyo Colorado Above Tidal, Segment 2202.

## Study Area

### Description of Water Body and Designated Uses and Criteria

The Arroyo Colorado is a coastal stream located in the Nueces – Rio Grande Coastal Basin of South Texas. It is characterized by warm temperatures and high humidity. It is considered to be semi-arid and subtropical. The average annual precipitation in the watershed is 26 inches with a

mean temperature of 72.4 degrees Fahrenheit. The area suffers frequent droughts and sporadic flooding (*Arroyo Colorado Watershed Protection Plan*, 2007).

The Arroyo Colorado originates near the City of Mission, and flows in an easterly direction through the center of the Lower Rio Grande Valley, and was once thought to have been a channel of the Rio Grande that became separated from the main channel during a flood event (*Arroyo Colorado Watershed Protection Plan*, 2007). The Arroyo Colorado is composed of two designated segments: the tidal portion, Segment 2201, and the portion above tidal influence, Segment 2202. The Arroyo Colorado Above Tidal, Segment 2202, is the focus of this RUAA.

### Environmental Features and Population Characteristics

The Arroyo Colorado Watershed drains approximately 706 square miles into the Laguna Madre, which is considered to be one of the most productive hypersaline lagoon systems in the world (TPWD, 2006a). The Arroyo Colorado serves as a major freshwater source to the Laguna Madre and is considered the main drainage system in that area (*Arroyo Colorado Watershed Protection Plan*, 2007).

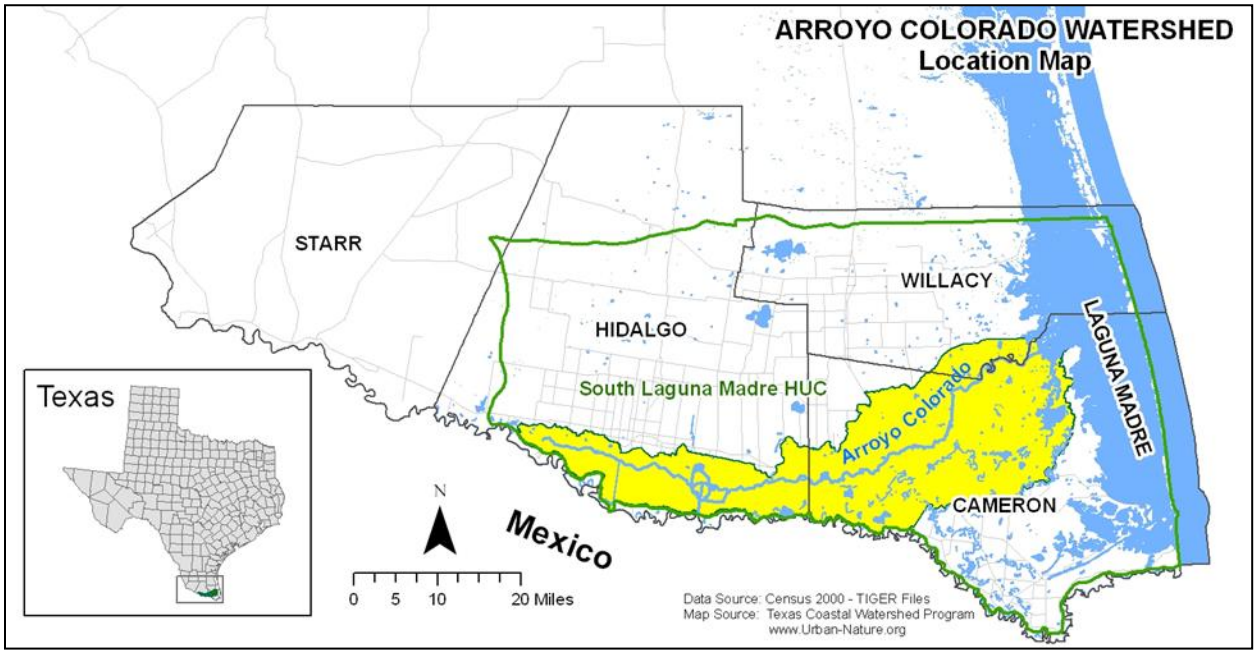


**Figure:1 Arroyo Colorado Watershed Map (Figure from Arroyo Colorado Partnership Maps and Imagery)**

The Arroyo Colorado is considered to be one of the last remaining undisturbed habitat corridors in the Lower Rio Grande Valley. The area is home to array of wildlife including migratory birds and endangered species such as the ocelot and the jaguarundi (*Arroyo Colorado Habitat Restoration Plan, 2006).*

In addition to the Arroyo Colorado's ecological attributes, it also serves as the main floodway for the Rio Grande. In the 1920s the International Boundary and Water Commission (IBWC) began the Lower Rio Grande Valley Flood Control Project, which designated the Arroyo Colorado as the main floodway for the Lower Rio Grande. The flood control project was completed in 1947 and has since protected surrounding populations from catastrophic flooding. During flood conditions the IBWC diverts around 80 percent of the Arroyo Colorado's flow to the North Floodway (*Arroyo Colorado Watershed Protection Plan*, 2007). The flood control system includes the Banker Floodway, Main Floodway, North Floodway and Arroyo Colorado Floodways. The headwaters of the Arroyo Colorado are used as the pilot channel for the Main Floodway (*Arroyo Colorado Watershed Protection Plan*, 2007). See Figure 2 for a hydrography map.

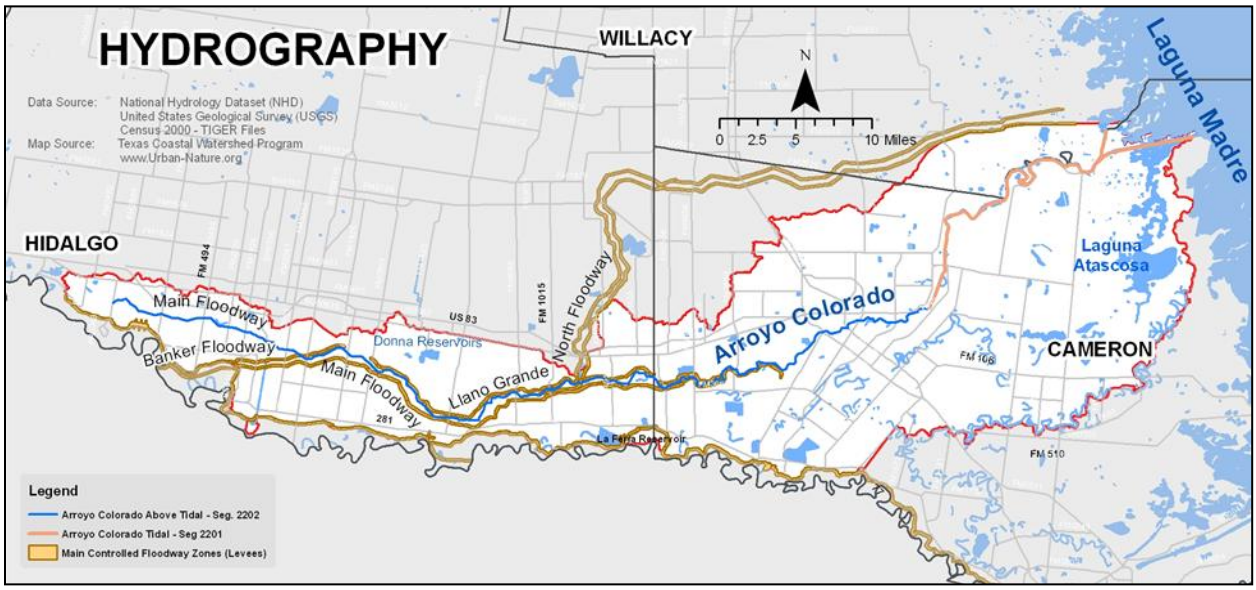


**Figure 2: Hydrography Map (Figure from *Arroyo Colorado Partnership Maps and Imagery)***

Extreme modifications have occurred over the years on the main channel to accommodate conveyance of floodwaters from the Rio Grande. Modifications have included dredging, vegetation removal, widening of the channel, and manipulations to flow regimes. The above tidal segment of the Arroyo Colorado is characterized by steep walled channels designed for flood control. The IBWC has jurisdictional authority over land use in the floodways of the Arroyo Colorado to ensure that the stream continues to serve as the main conveyer of floodwaters from the Rio Grande Valley. In order to maintain its ability to convey floodwaters, the IBWC has initiated projects that include vegetation removal, channelization and straightening, greatly modifying the natural sinuosity found in undisturbed streams.

The Arroyo Colorado Above Tidal (segment 2202) includes four assessment units flowing 64 miles from FM 2062 in Hidalgo County to a point 100 m (110 yards) downstream of Cemetery Road south of the Port of Harlingen in Cameron County. The area lies within Cameron and Hidalgo counties and encompasses the cities of La Joya, Palmview, Alamo, Mission, McAllen, Pharr, Edinburg, San Juan, Donna, Weslaco, La Feria, Mercedes, Harlingen, San Benito, and multiple *colonias,* economically distressed unincorporated areas within 50 miles of the U.S Mexico border that lack adequate wastewater infrastructure (Texas Secretary of State, 2011).

The area is considered one of the fastest growing in the nation. Due to its proximity to the US and Mexico border, the area benefits from a large flow of international trade of goods and services, particularly manufacturing, and is considered to be an important commercial hub in the region (*Arroyo Colorado Watershed Protection Plan*, 2007). The local population within the study area is roughly 1,181,000, with McAllen being the most populated city (US census 2010). Although this area is growing at a fast rate, it is considered to have a high incidence of poverty. In 2009 the percent of people living below the poverty level in Cameron county was 34% and 35.2% in Hidalgo county. In comparison, in 2009 the percent of people living below the poverty level in the state of Texas was 17.1% (US census 2010). See Figure 4 below for a map of population distributions.

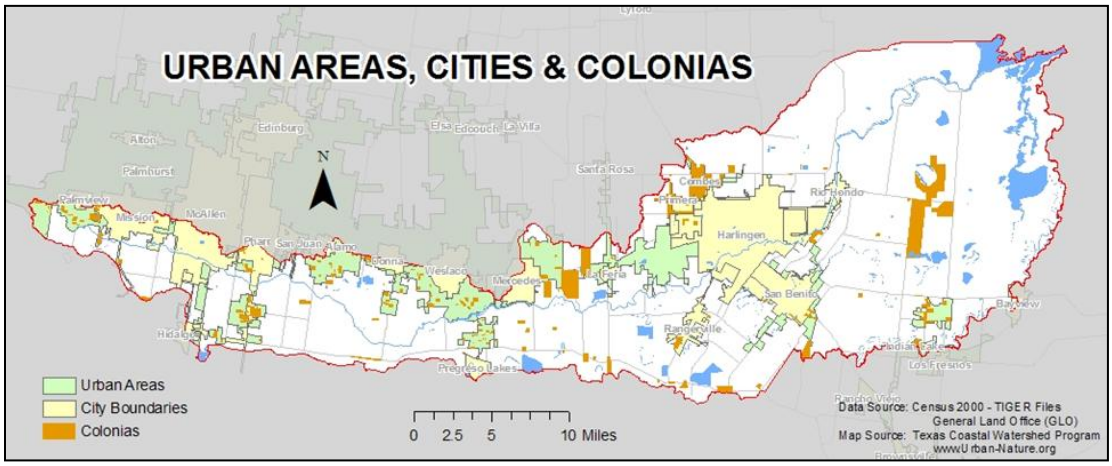


**Figure 3: Urban Areas, Cities & Colonias (Figure from *Arroyo Colorado Partnership Maps and Imagery)***

### Watershed Characterization

The watershed for Segment 2202 is characterized by extensive agricultural development interspersed with areas of rapid urban development. An estimated 95% of the natural habitat in the Arroyo Colorado Watershed has been cleared to make room for agriculture and urban development. Approximately 333,000 acres within the watershed are used for agriculture (*Arroyo Colorado Watershed Protection Plan*, 2007). Although agriculture is still the dominant land use, starting in the 1980's significant urbanization has occurred in the study area contributing to a major shift from agricultural use to urban land use (TCEQ, 2003). Figure 5 below illustrates the land use cover of the Arroyo Colorado Watershed.

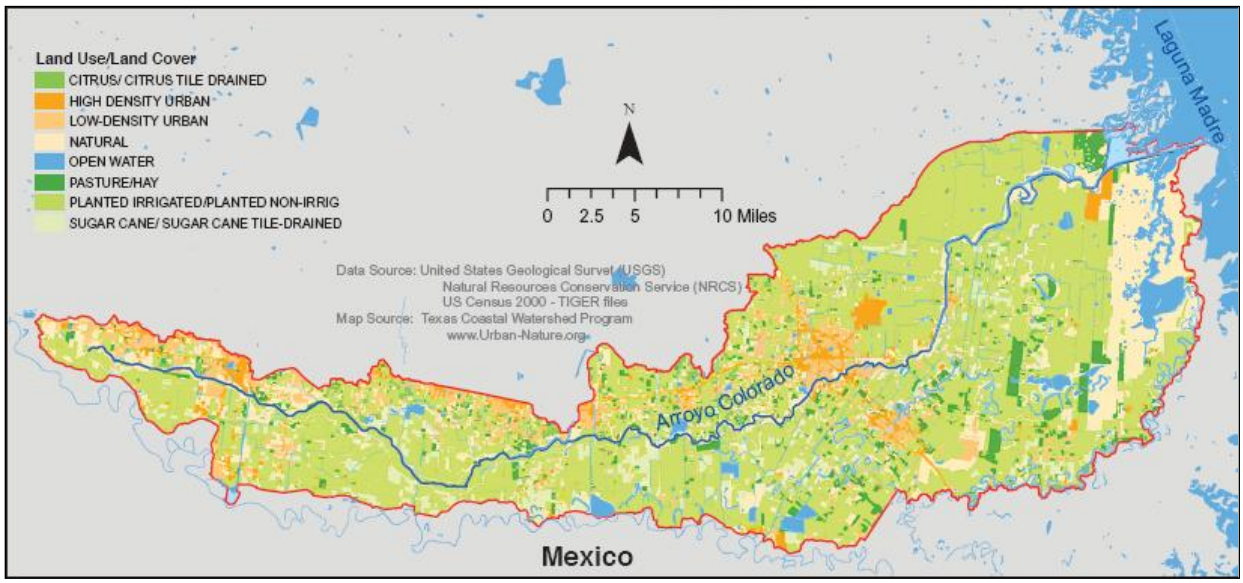


**Figure 4: Land Use of the Arroyo Colorado Watershed (Figure from *Arroyo Colorado Watershed Protection Plan*, 2007)**

### Public Recreation Areas

A total of 15 public recreation areas are located on segment 2202, including 5 county parks, 2 golf courses, 1 National Wildlife Refuge, 4 Wildlife Management Areas, 1 state park, and 2 city parks. The 5 county parks include Ramsey and McCullough on AU_01; and McKelvey, Victor, and Wood on AU_02. The two golf courses include Harlingen Municipal Golf Course on AU_02; and Llano Grande Country Club on AU_03. The Lower Rio Grande National Wildlife Refuge is on AU_02. The Macwhorter, Chapote, Taormina, and Baird Las Palomas Wildlife Management Areas and the Estero Llano Grande State Park are on AU_03. The two city parks include Spring Fest Park and the Motorcycle Park in McAllen on AU_04.

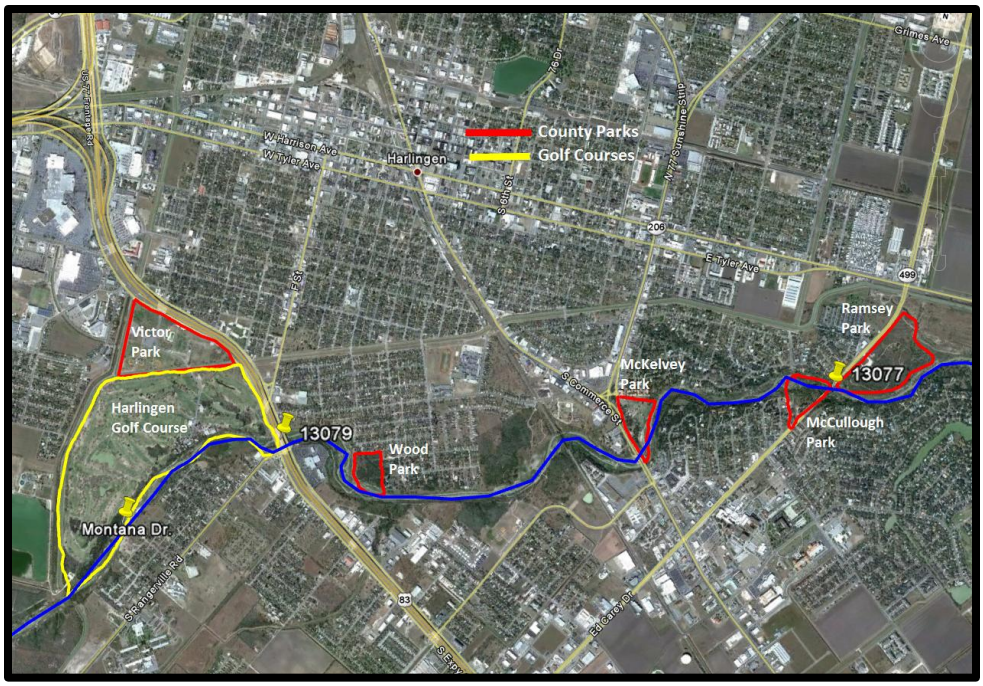


**Figure 5: Recreational Areas**


**Figure 6: Recreation Areas**


**Figure7: Recreation Areas**

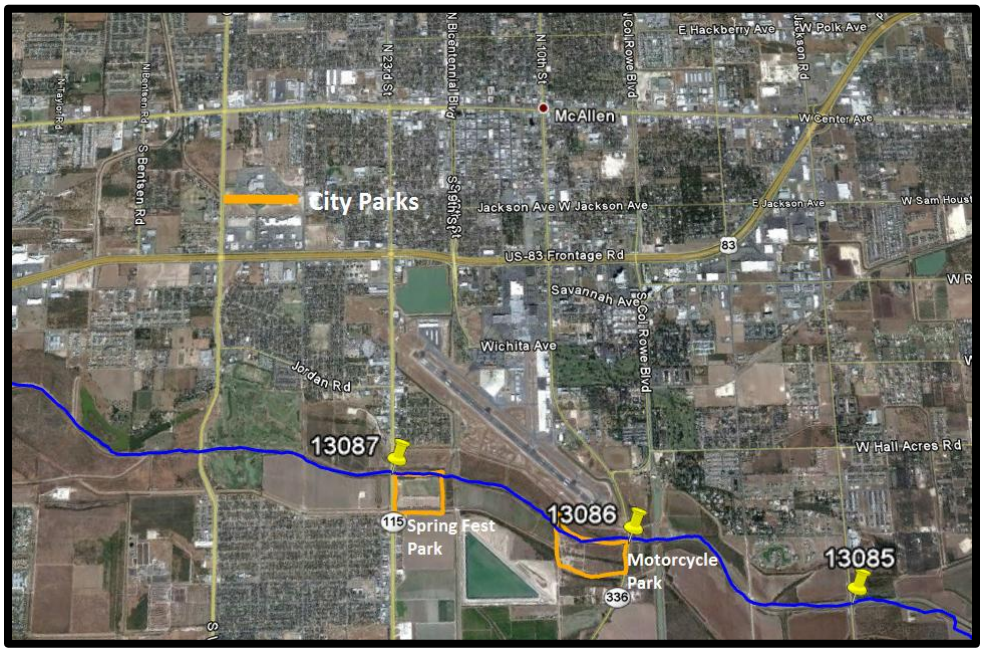


**Figure 8: Recreation Areas**

### Permitted Discharges (Municipal, Industrial, Stormwater)

Municipal and industrial wastewater and irrigation tail water return dominate the flow regime during dry periods and the stream bank has been extensively modified for the conveyance of storm water runoff. There are currently 21 permitted wastewater outfalls on segment 2202, 6 domestic sewage outfalls less than 1 million gallons per day, 14 wastewater treatment plant outfalls greater than or equal to 1 million gallons per day, and 1 permitted cooling water discharge (TCEQ, 2011 Permitted Wastewater Outfalls). The following maps show the permitted wastewater outfall locations in relation to the stations surveyed.

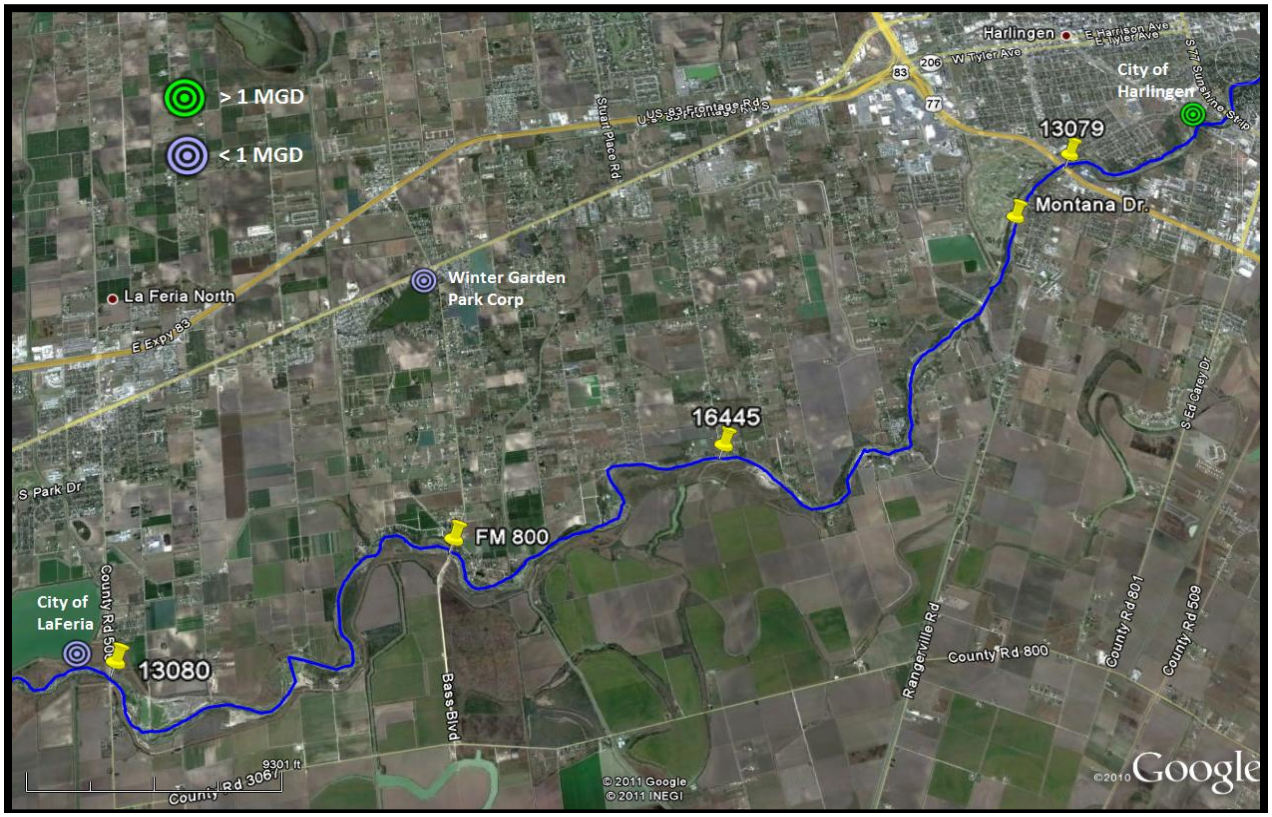


**Figure 9: Permitted Discharge**

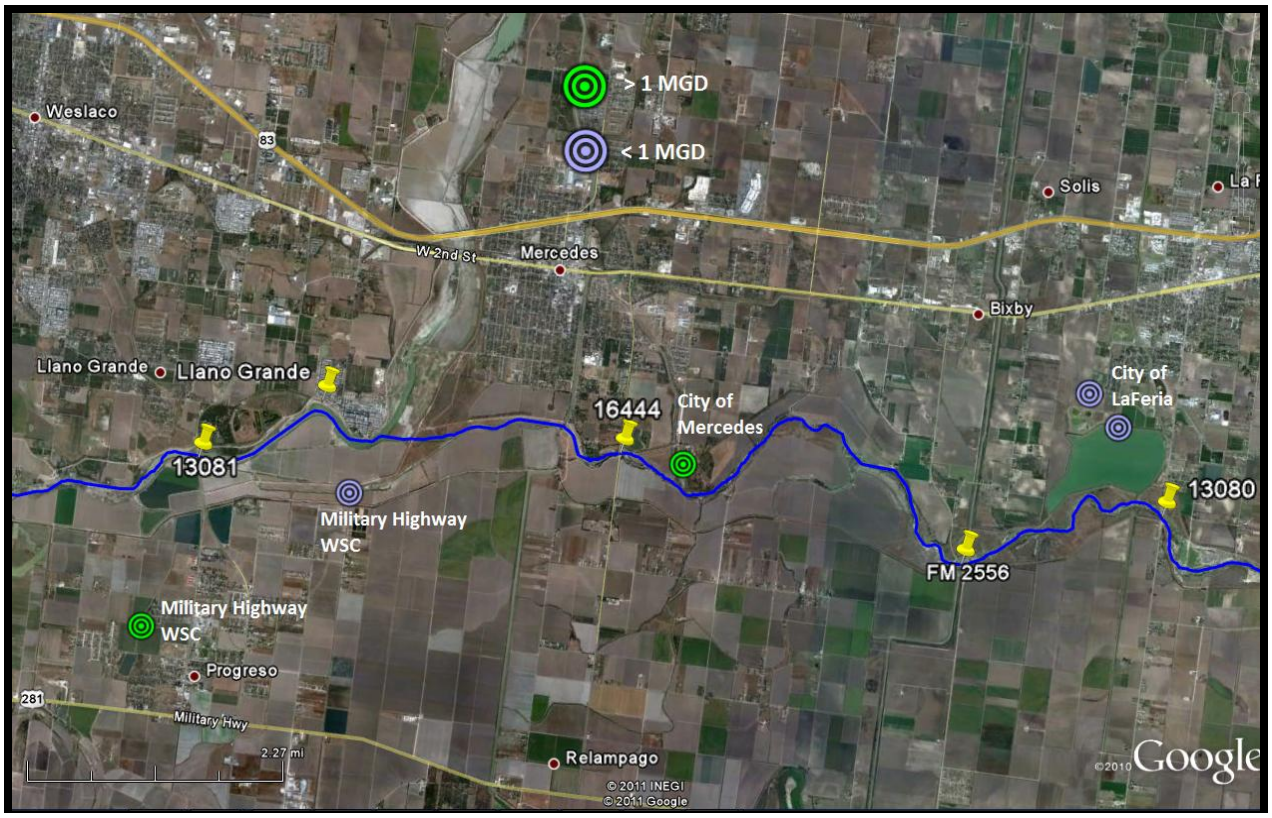


**Figure 10: Permitted Discharges**

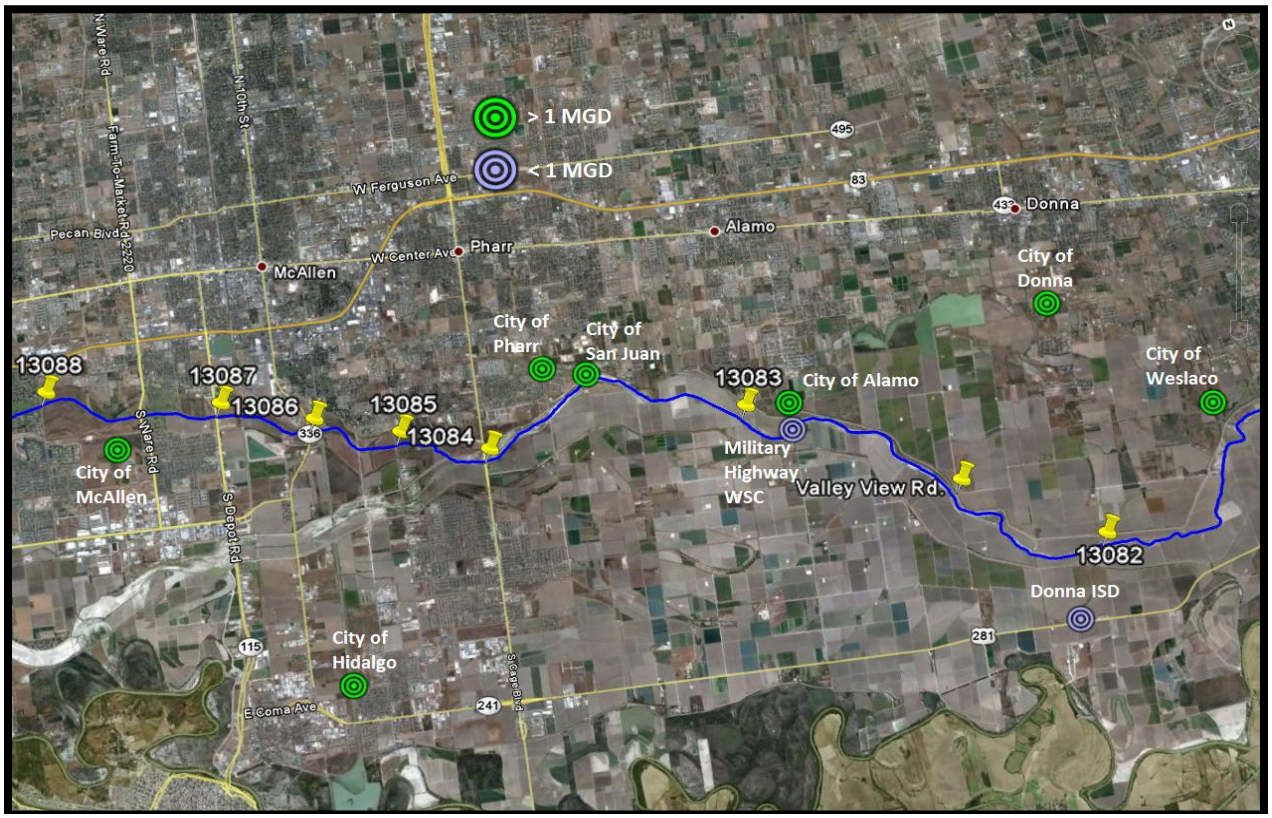


**Figure 11: Permitted Discharges**

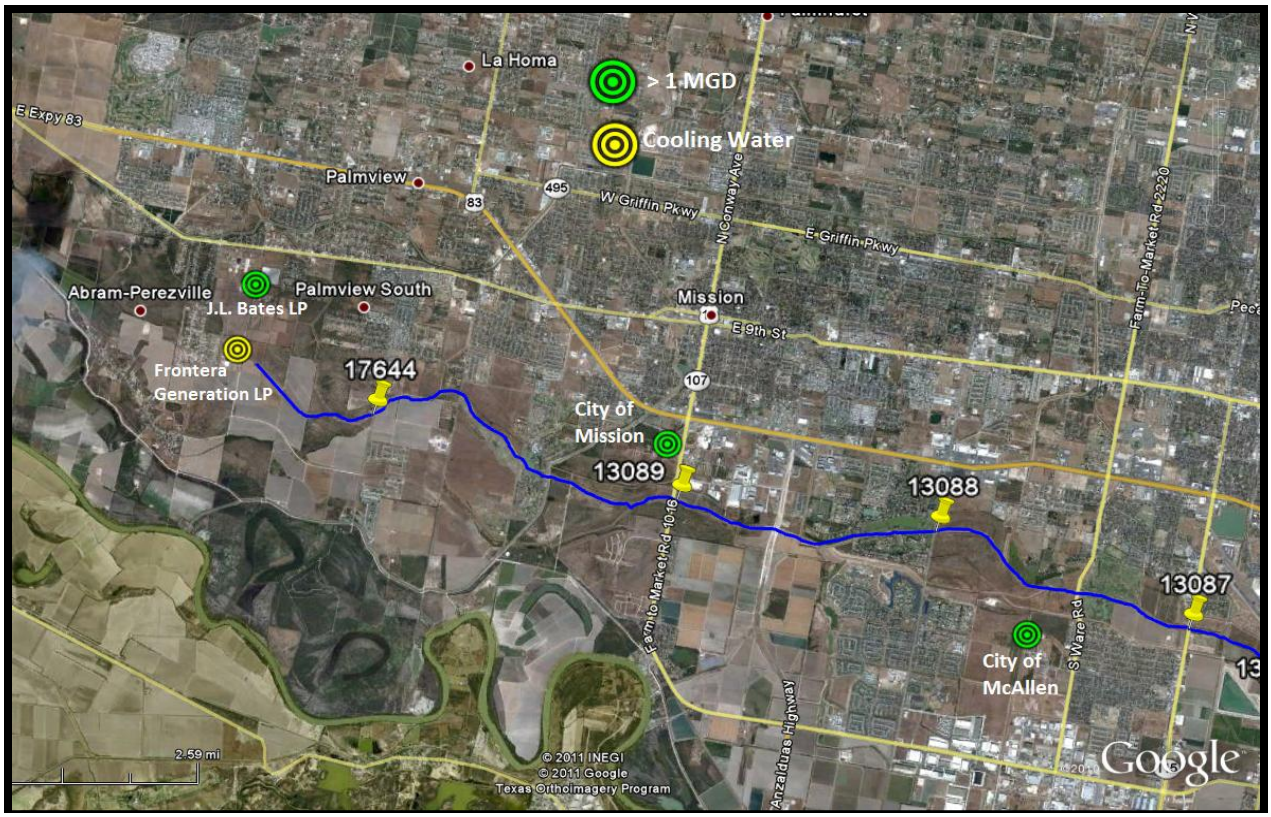


**Figure 12: Permitted Discharges**

In addition, multiple *colonias* discharge large volumes of poorly treated and raw wastewater into the Arroyo Colorado (*Arroyo Colorado Watershed Protection Plan*, 2007). The Arroyo Colorado Watershed Partnership (ACWP) has been working with municipalities and *colonia* residents to improve the quality of wastewater being discharged into the Arroyo Colorado. The Watershed Protection Plan (WPP) will add an additional 68,000 *colonia* residents to existing wastewater systems. In addition, 6 new Wastewater Treatment Facilities (WWTFs) are planned for construction and 9 upgrades will be added to existing facilities. The plan also includes the construction of settling ponds and wetlands (*Arroyo Colorado Watershed Protection Plan*, 2007). The maps below shows the permitted waste water discharges to the Arroyo Colorado Above Tidal Segment 2202 and Tidal Segment 2201.

**Potential Nonpoint Sources**

There are a number of possible nonpoint sources contributing to the bacteria loadings in the Arroyo Colorado, including sanitary sewer overflows, compromised septic systems, storm water runoff, pet waste, livestock, and wildlife. The ACWP has initiated multiple projects to address nonpoint source pollution, including BMPs, public outreach campaigns, enhancing existing water treatment infrastructure. More information about these and other projects can be found on the ACWP website.

**Summary of Historical Information**

A historical research was conducted regarding the recreational uses for the Arroyo Colorado above tidal section. The research dated back to November 28th, 1975 to the present time, in accordance with the RUAA guidance.

**Government Sources**

**IBWC**

NRA contacted IBWC staff including the library department, Environmental Division, and Mercedes field crew and there were no reports of any kind of recreation.

**Texas Parks and Wildlife Department**

Texas Parks and Wildlife Department (TPWD) management responsible for archived photos was contacted on April 18, 2011. Photographs or other documents that may indicate recreation in the Arroyo Colorado Above Tidal segment were requested. After a thorough research, TPWD could not find any documentation of recreation on Segment 2202.

**Texas Stream Team**

Texas Stream Team currently has volunteer monitors that collect data on the Arroyo Colorado. NRA contacted staff at Texas Stream Team to obtain field notes from these monitoring events to verify that recreation had not been observed during monitoring. Most of the field notes referred to trash in the area and references to fisherman, confirming secondary contact recreation. On October 23, 2010 and November 13, 2010 station field notes for site number 32473 at FM 493, noted people fishing at the site.

**Arroyo Colorado Partnership**

Stakeholders in the ACP confirmed that many people fish in this segment and often times when the fishermen's lines get caught up they will swim in the river to untangle their lures. Many of the stakeholders also stated that they have heard of people swimming in the Arroyo Colorado. Stakeholders also felt that because the segment downstream of segment 2202, the Arroyo Colorado Tidal segment, is used for primary contact recreation and that, in order to protect the downstream uses, the standards should not change.

**Library Search**

The La Ferria Library, Mercedes Library, Harlingen Library, Hidalgo Library, Texas A&M-Kingsville Library, Weslaco Library, Brownsville Library, and Weslaco Museum archives were all searched during April of 2011 for photographs or other documentation of people recreating in the Arroyo Colorado Above Tidal Segment 2202. No documentation of recreation was found.

**Local Knowledge**

Interviews were attempted at each site during field surveys. During May 30-31, 2010 survey recreational use information was obtained from 14 individuals at 4 sites. See Table 5 on pg. 21. All of the interviews confirmed secondary contact recreation relating to boating or fishing. None of those interviewed reported knowing of any primary contact recreation.

During the April 23-24, 2011survey, recreational use information was obtained from 8 people. Of those interviewed on April 23-24, 6 confirmed primary contact recreation and all of them confirmed secondary contact recreation. See Table 5 on pg. 21.

**On Line Search**

As part of the RUAA historical review, an online search of the websites was conducted during April thru July 2011 to identify any documentation of recreational activities that occur on, or in the Arroyo Colorado. The only documentation found was a video posted of a group of people kayaking in sit-on-tops in the Arroyo Colorado Above Tidal near Harlingen on July 10, 2008. Below is a list of the websites searched:

on the Valley Morning Star online http://www.tshaonline.org/handbook/online/articles/rba64
http://www.mission.lib.tx.us/centennial%5CHistofMission.pdf
http://news.google.com/newspapers?id=024cAAAAIBAJ&sjid=QlEEAAAAIBAJ&pg=5147,2237305&dq=arroyo+colorado+history&hl=en
http://www.exploremcallen.com/culture/museums/historymuseum.aspx
http://southtexastourism.com/MUSEUMOFSOUTHTEXASHISTORY.html
http://www.mosthistory.org/Archive-Artifact-Collections/Museum-Archives
http://www.rice.edu/armadillo/Past/Book/Appendices/append-a.html
http://cameroncountyhistoricalcommission.org/ArroyoColoradoHistory.htm
http://www.valleymorningstar.com/video/v/1659857895/texas-texas-videos

**Site Reconnaissance Summary**

Prior to site selection, a reconnaissance trip was conducted on January 18th and 19th, 2010 to select representative sites, beginning at the segment boundary of the tidal portion and progressing upstream. During the reconnaissance, information was collected to determine where recreation was most likely to occur. NRA field staff selected 23 survey sites based on public access, a high potential for recreational activity to occur, and appropriate coverage and representation of the segment. The maps below indicate the selected locations and Assessment Units (AUs). See Appendix A for a list of site locations with coordinates and descriptions.

## Methodologies

### RUAA Survey and Site Descritions

Approximately 64 miles of the Arroyo Colorado were evaluated based on 45 field surveys (Table 2). The site descriptions below include information such as approximated normal flow conditions and depth that were collected during the ACBIS. Stream profiles were created for the ACBIS to determine flow estimates at stations 13086, 13084, 13082, 13081, and 13074. The substrate throughout the segment was consistently fine silt to clay.

### Assessment Unit_01 (Figure 6)

AU_01 flows 6 miles from Cemetery Road just above the Port of Harlingen to the confluence with Little Creek just upstream of State Loop 499. A total of 3 stations were selected and surveyed on AU_01. The stations and descriptions are listed below.

**Site #1 TCEQ Station 13074** is located near the boundary of segment 2202 (Arroyo Colorado Above Tidal) and 2201 (Arroyo Colorado Tidal). This site has been visited by NRA staff on numerous occasions as a location for 24 hour dissolved oxygen monitoring as well as the Arroyo Colorado Bacteria Indicator Study (ACBIS) conducted in 2009. Fishing and biological (terrapin) studies have been observed at this site. The thalweg depth is approximately 2 meters and the flow approximately 350 cubic feet per second (cfs) under normal flow conditions.

| **Site # 1, 13074 Cemetery Rd Bridge** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #2 TCEQ Station 16446** is located at FM 509 in northeast Harlingen. This site was chosen based on its proximity to a golf course (Treasure Hills Golf Club) and the City of Harlingen. The bank is steep and wooded; access is limited and the current is swift.

**Site #2, 16446 FM509**

Upstream

Downstream

**Site #3 TCEQ Station 13077** is located at Loop 499 bridge in northeast Harlingen. This site was chosen due to its proximity to McCullough and Ramsey Parks. The bank is steep and wooded; access is limited and the current is swift.

**Site #3, 13077 Loop 499 Bridge**

Upstream

Downstream

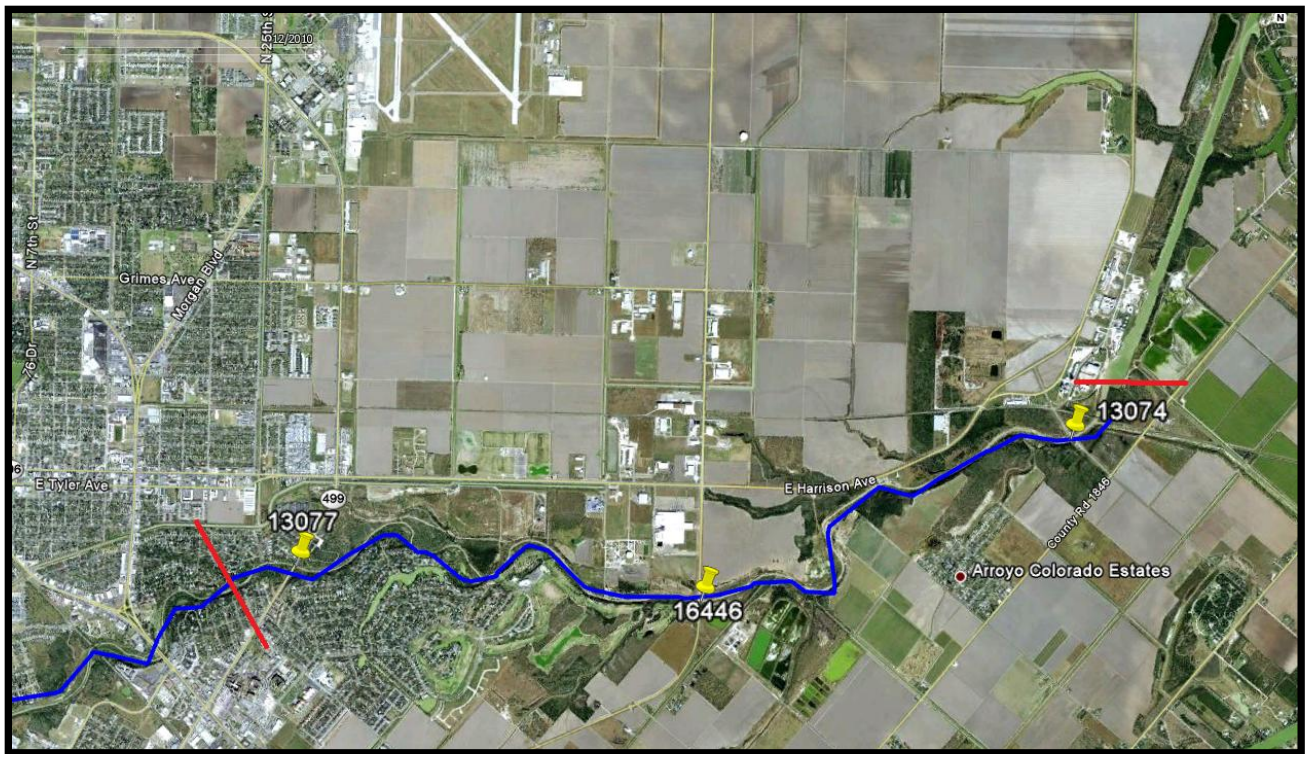


**Figure 13: Map of AU_ 01**

**Assessment Unit_ 02 (Figure 7)**

AU_02 flows 15 miles from the confluence with the Little Creek to the confluence with La Feria Main Canal just upstream of Dukes Highway. A total of 5 stations were selected and surveyed on AU_02. The stations and descriptions are listed below.

**Site #4 TCEQ Station 13079** is located at US 77 in southwest Harlingen. This site was chosen due to its proximity to Harlingen Municipal Golf Course. In addition, there is a walking trail along the steep and wooded stream bank.

| **Site #4, 13079 US 77 in SW Harlingen** | |
|---|---|
|  |  |
| Upstream | Downstream May, 2010 |

**Site #5 Arroyo Colorado at Montana Dr. is located in Rangerville.** This site was selected for spatial representativeness within the segment and its proximity to Harlingen Municipal Golf Course, using Google Earth, which indicates possible accessibility.

| **Site #5, Montana Dr. in Rangerville** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #6 TCEQ Station 16445** is located at the crossing of Dilworth Road. The area has elements of both rural and urban development. The site was selected for spatial representativeness. The stream bank is well vegetated and the current is swift. Access is limited.

| **Site #6, 16445 Dilworth Rd.** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #7 Arroyo Colorado at FM 800** was chosen due to its proximity to a large subdivision and the Lower Rio Grande Valley Nation Wildlife Reserve. FM 800 becomes narrow at the crossing and the bank is heavily wooded and steep with large rocks lining the bridge. This site is in close proximity to the Lower Rio Grande National Wildlife Refuge. Access is limited but evidence of fishing is apparent.

| **Site #7, FM 800** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #8 TCEQ Station 13080** is located at the crossing of FM 506 south of La Feria. The site was noted for its steep and vegetated banks. This site is more rural than urban and was chosen for spatial representativeness.

| **Site #8, 13080 FM 506 South of La Feria** | |
|---|---|
|  |  |
| Upstream | Downstream |

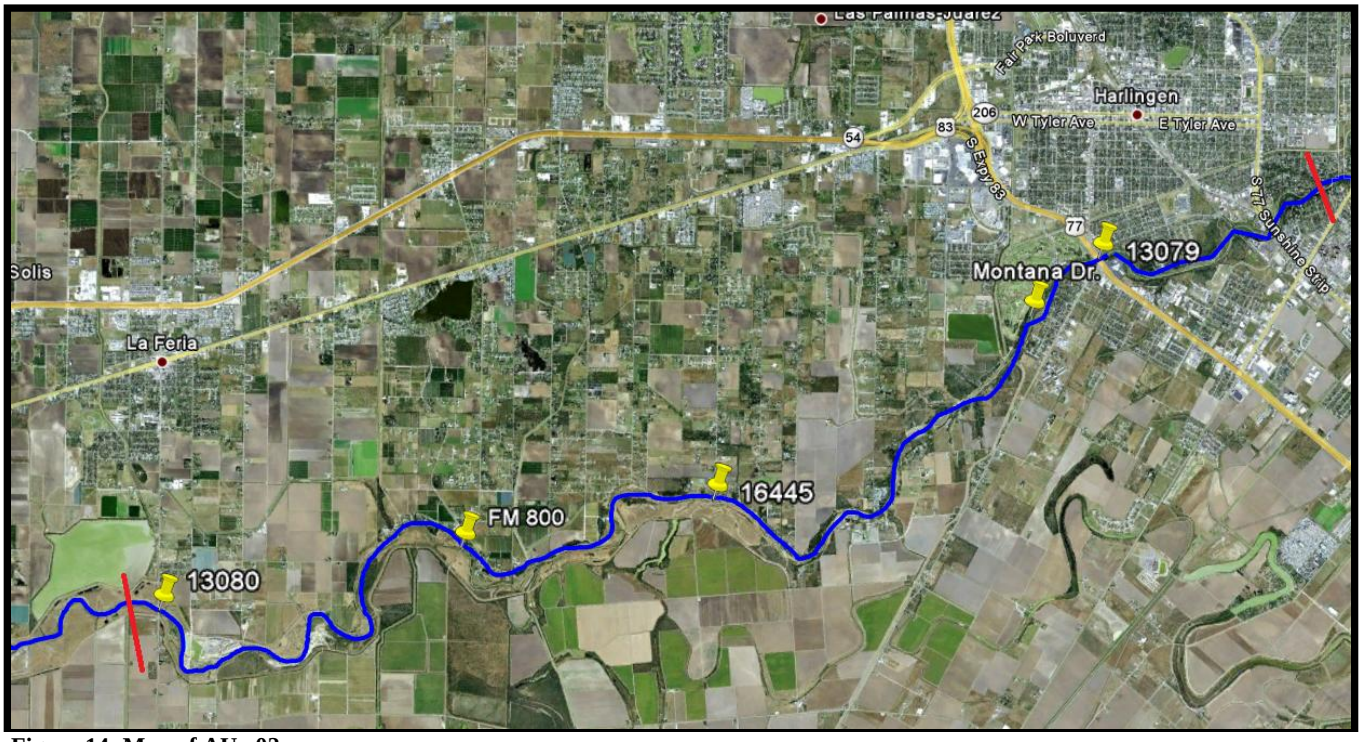


**Figure 14: Map of AU_ 02**

**Assessment Unit_ 03 (Figure 8)**
AU_03 flows 25 miles from the confluence with La Feria Main Canal just upstream of Dukes Highway to the confluence with La Cruz Resaca just downstream of FM 907. A total of 7 stations were selected and surveyed on AU_03. The stations and descriptions are listed below.

**Site #9 Arroyo Colorado at FM 2556** is more rural than urban and was chosen for spatial representativeness.

| **Site #9, FM 2556** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #10 TCEQ Station 16444** is located at FM 491 near New Hope Ranch SW of Mercedes. This site was chosen based on its proximity to the town of Mercedes.

| **Site #10, 16444 FM 491 SE of Mercedes** | |
|---|---|
|  |  |
| Upstream | Downstream April, 2011 |

**Site #11 Arroyo Colorado at Llano Grande RV Park** is located just east of FM 1015 and was chosen due to the high potential for contact recreation. The Arroyo Colorado here is referred to as Llano Grande Lake. It is very wide (approximately 150 meters) and noticeably different from other stations in this respect. Additionally, the attendant at the front gate of the busy park communicated the desire of residents to canoe and kayak the Arroyo Colorado. However, large alligators in excess of 12 feet have been observed.

| **Site #11, Llano Grande RV Park** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #12TCEQ Station 13081** is located at the crossing of FM 1015. This site has been visited by NRA staff on numerous occasions as a location for 24 hour dissolved oxygen monitoring as well as for ACBIS. Fishing has been observed at this site. The stream bank is wide (approximately 75 meters), the thalweg depth is approximately 1.5 meters and the stream flow is approximately 150-200 cfs under normal flow conditions and has very low velocity.

| **Site #12, 13081 FM 1015 South of Weslaco** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #13 Arroyo Colorado at Texas Blvd.** is located south of Weslaco near the Las Palomas Wildlife Management Area-Chapote Unit in a semi urban area. It was chosen for spatial representativeness within the segment using Google Earth which indicates possible accessibility.

| **Site #13, Texas Blvd. South of Weslaco** | |
|---|---|
|  |  |
| Upstream | Downstream April, 2011 |

**Site #14 TCEQ Station 13082** is located at the crossing of FM 493 south of Donna. This site has been visited by NRA staff on numerous occasions for ACBIS. The station is bordered by cropland and was chosen for spatial representativeness. The banks are moderately steep and vegetated. The thalweg depth is approximately 1.0 meter and is aproximately 200 cfs under normal flow conditions.

| **Site #14, 13082 FM 493 South of Donna** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #15 Arroyo Colorado at Valley View Rd.** is located south of Val Verde. The station is bordered by cropland and was chosen for spatial representativeness within the segment using Google Earth which indicates possible accessibility.

| **Site #15, Valley View Rd. South of Val Verde** | |
|---|---|
|  |  |
| Upstream | Downstream May, 2010 |

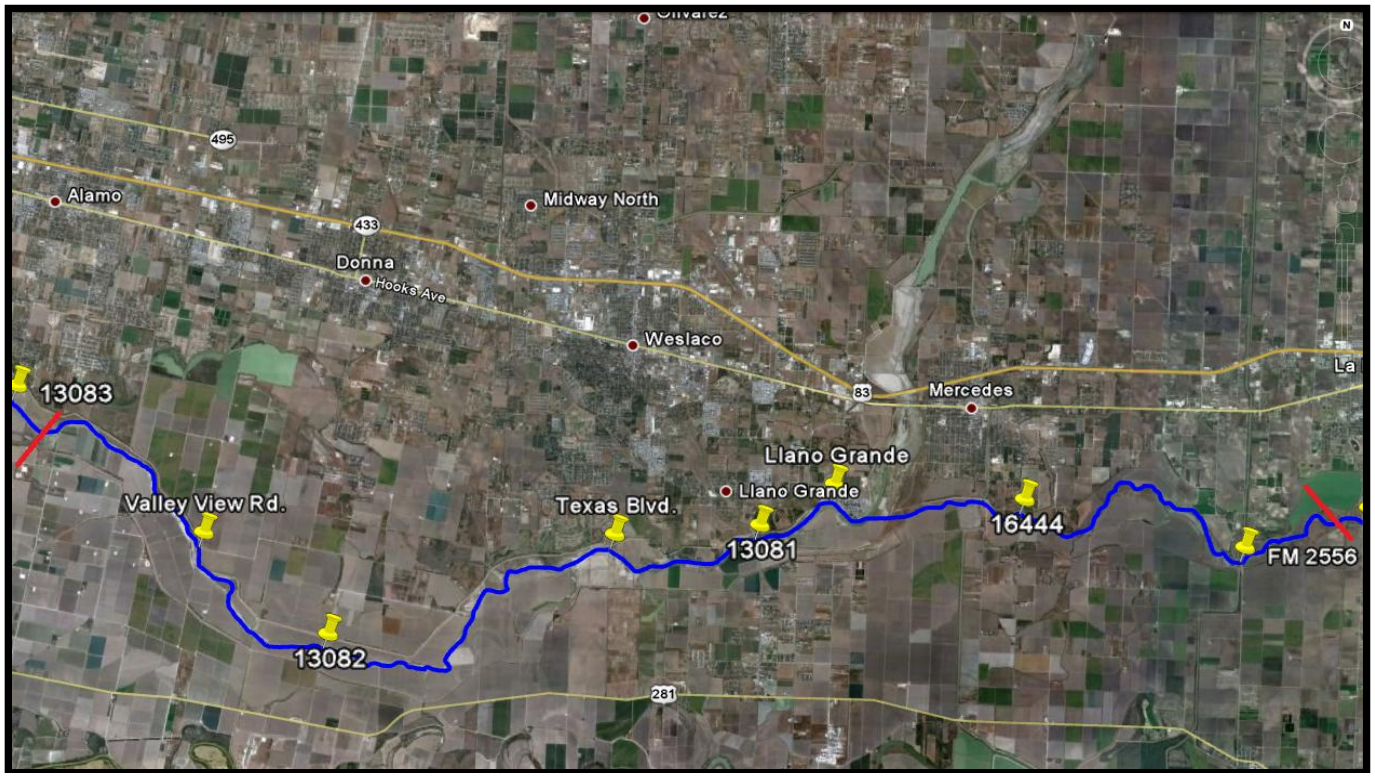


**Figure 15: Map of AU_03**

**Assessment Unit_04 (Figure 9)**
AU_04 flows 18 miles from the confluence with La Cruz Resaca to the upper end of the segment at FM 2062. A total of 8 stations were selected and surveyed on AU_04. The stations and descriptions are listed below.

**Site #16 TCEQ Station 13083** is located at the crossing of FM 907 south of Alamo. This station is bordered by cropland and was chosen for spatial representativeness.

| **Site #16, 13083 FM 907 South of Alamo** | |
|---|---|
|  |  |
| Upstream | Downstream April, 2011 |

**Site #17 TCEQ Station 13084** is located at the crossing of US 281 south of Pharr. This is an extremely busy area. The Arroyo Colorado in this run of the river is part of the main floodway and is bordered by a large grassy floodplain. The stream banks are relatively short and moderately vegetated, and there is a significant riffle zone made of concrete rubble just downstream. The thalweg depth is approximately 1.0 and is approximately 150 cfs under normal flow conditions.

| **Site #17, 13084 US281 South of Pharr** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #18 TCEQ Station 13085** is located in an urban area at FM 2061 southeast of McAllen. This site was chosen for spatial representativeness. This site has little vegetation.

| **Site #18, 13085 @ 2061 SE of McAllen** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #19 TCEQ Station 13086** is located at the crossing of FM 336 South of McAllen. The site is near the McAllen Motorcycle Park. This is an extremely busy area. The banks of the Arroyo Colorado are very steep but not wooded. The thalweg depth is approximately 0.3 to 0.6 meters under normal flow conditions are approximately 20-40 cfs.

| **Site #19, 13086 FM 336 South of McAllen** | |
|---|---|
|  |  |
| Upstream | Downstream April, 2011 |

**Site #20 TCEQ Station 13087** is located at the crossing of FM 115 south of McAllen near Spring Fest Park and Soccer Field in an urban area. This site was chosen for spatial representativeness. The water had a biofilm or oiled scum layer and did not appear desirable for contact recreation.

| **Site #20 13087 FM 115 South of McAllen** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #21 TCEQ Station 13088** is located at FM 494 west of McAllen in an urban area. This site is located adjacent to a golf course and a growing subdivision.

| **Site #21 13088 FM 494 West of McAllen** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #22 TCEQ Station 13089** is located at FM 1016 south of Mission. The site was chosen due to its proximity to the City of Mission WWTF and for its relatively clear water.

| **Site #22 13089 FM 1016 South of Mission** | |
|---|---|
|  |  |
| Upstream | Downstream |

**Site #23 TCEQ Station 17644** is located at FM 2062 south of Palmview. This site is at the upper segment boundary for segment 2202 Arroyo Colorado Above Tidal. Many people were observed walking around enjoying the day along FM 2062. The Arroyo Colorado at this site resembles a ditch and is characterized by a maintained and straightened channel with little natural habitat. The stream bank is very steep.

| Site #23 17644 FM 2062 | |
|---|---|
|  |  |
| Upstream | Downstream |

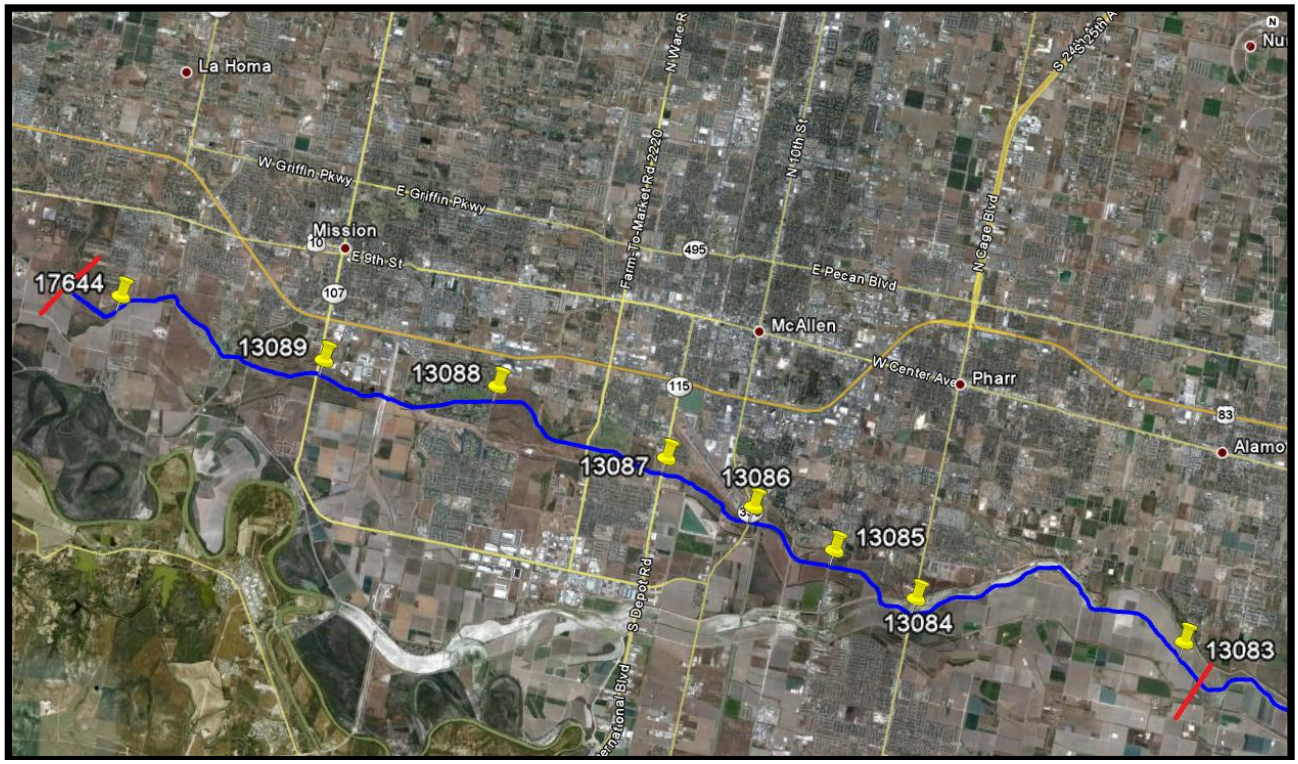


**Figure 16: Map of AU_04**

## Sampling Methods

The data collection activities were conducted as outlined in the *Procedures for a Comprehensive Recreational UAA and a Basic UAA Survey* during two sampling events. A total of 23 field surveys were conducted May 30- 31, 2010 and a total of 22 field surveys were conducted April 23- 24, 2011. All field surveys were conducted during normal season (air temperatures greater than or equal to 70ºF) during base flow conditions, when recreational activities were most likely

to occur. Base flow conditions are defined as sustained or typical dry, warm weather flows between rainfall events, excluding unusual antecedent conditions of drought or wet weather. As of August 2011, there are no United States Geological Survey (USGS) gauges collecting flow information on Segment 2202 of the Arroyo Colorado. However, the IBWC has two flow gauges on Segment 2202, IBWC station 08-4704.00 at site13079 in Harlingen and IBWC station 08-4703.01 at site 16444 in Mercedes.

| ***Date*** | **IBWC 08-4704.00 at Harlingen Site 13079** | **IBWC 08-4703.01 at El Fuste South of Mercedes Site 16444** |
|---|---|---|
| May 30, 2010 | 324 cfs | 194 cfs |
| May 31, 2010 | 323 cfs | 197 cfs |
| April 23, 2011 | 300 cfs | 205 cfs |
| April 24, 2011 | 314 cfs | 215 cfs |

**Table 2: IBWC Flow Data**

### Survey Descriptions

To acquire flow information, NRA measured the instantaneous flow where possible. However, due to the length of the stream segment (64 miles), the number of potential stations (23), and deeper sections where thalweg depth is in excess of 2.0 meters, collecting instantaneous stream flow measurements at each station was not feasible. *Procedures for a Comprehensive Recreational UAA and a Basic UAA Survey* state that if the stream flow taken at one site is representative of the flow at another site(s), then that flow can be used as the observed flow.

Measuring each transect was accomplished, where wadeable, using a surveyor's rod to measure depth. At some locations, where water depth would not allow wading, or submerged obstructions created unsafe situations, a Teledyne RDI StreamPro™ ADCP was used to identify the thalweg.

Anecdotal information was recorded on field data sheets during all surveys using the field data sheets for Basic and Comprehensive UAA Surveys from the RUAA Procedures manual (TCEQ, 2009).

Types of observational and anecdotal records include, but are not limited to, the following:

- channel flow status,
- stream type (e.g., ephemeral, intermittent, etc.),
- streamflow,
- general weather conditions (cloud cover/rain), including 30-day conditions and antecedent rainfall record,
- substrate type,

- accessibility, and
- anecdotal information related to observed human contact activities.

Water temperature was measured using 600 XLM YSI multiprobes and a 650 MDS datalogger. Water temperature, in degrees C, was used on the field data sheet. Air temperature was measured by a handheld thermometer in degrees C. The YSI temperature sensor was checked against a National Institute of Standards and Technology (NIST) certified thermometer.

NRA staff created photographic records of each site during the site surveys. Photographs include an upstream view, left and right bank views, downstream view (as described in the Field Data Sheets), any evidence of observed uses or indications of human use, hydrologic modifications, etc. Photographs clearly depict the entire channel and each location where depth measurements were taken. Photographs show evidence of recreational use (e.g. fishing equipment) and actual recreation

| Assessment Units | Approximate Total Stream Miles | # of First Surveys | # of Second Surveys | # of Road-side Surveys |
|---|---|---|---|---|
| **01** | 6 | 3 | 3 | 0 |
| **02** | 15 | 5 | 4 | 0 |
| **03** | 25 | 7 | 7 | 0 |
| **04** | 18 | 8 | 8 | 2 |
| **Totals** | **64** | **23** | **22** | **2** |

**Table 3: Stream Miles and Number of Surveys Completed**

## Results and Discussions

The first field survey was conducted on Memorial Day weekend of 2010 and the second field survey was conducted during Easter weekend of 2011. The surveys completed in 2011were originally scheduled to be completed in 2010. However, due to persistent flooding occurred in the Rio Grande Valley between June and August of 2010 NRA staff were not able to complete the second round of field surveys until the spring of 2011. One roadside survey was conducted at Valley View Road during the second sampling event due to road construction that blocked access to the river.

### Physical Evaluation and flow

Shrub was the dominant riparian zone recorded for all the AUs except for AU_04 where denude bank was the recorded dominant riparian zone (Table B2.2). Out of a total of 12 observed left bank and right bank riparian zone types, 40% were shrub dominated corridors followed by forest (15.5%), denuded eroded bank (14%), row crops (8%), mowed grass (7.5%), and herbaceous marsh (5%). Six other bank riparian zone types were recorded, but each represents less than 10% of the total.

It should be noted that after the RUAA surveys were completed the IBWC began vegetation removal below the 21,000 cfs line during the projected 100 year flood event to increase flood capacity in the Arroyo Colorado. Large canopy under the 21,000 cfs have been budgeted for removal. The total project area through Harlingen is approximately 343 acres. The vegetation removal could impact the accuracy of the descriptions of observed riparian areas.

| Site ID | Shrub | Forest | Denuded Eroded bank | Row Crops | Mowed Grass | Herbaceous Marsh | Urban | Rip Rap | Pasture | Concrete | Unmowed Grass | Levee |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **#1 - 13074** | 4 | 2 | | | | | | | | | | |
| **#2 - 16446** | 4 | 2 | | | | | | | | | | |
| **#3 - 13077** | 4 | 4 | 1 | | | | 1 | | | | | |
| **Total** | **12** | **8** | **1** | | | | **1** | | | | | |
| **Total AU_01 %** | **55%** | **36%** | **4.5%** | | | | **4.5%** | | | | | |
| **#4 - 13079** | 4 | 4 | | | | | 4 | | | | | |
| **#5** | 4 | 2 | 3 | | | | 1 | | | | 1 | |
| **#6 - 16445** | 4 | | | | | | | | 4 | | | |
| **#7** | 2 | 2 | | | | | | | | | | |
| **#8 - 13080** | 4 | 4 | | | | | | | | | | |
| **Total** | **18** | **12** | **3** | | | | **5** | | **4** | | **1** | |
| **Total AU_02 %** | **42%** | **28%** | **7%** | | | | **12%** | | **9%** | | **2%** | |
| **#9** | 4 | | | | | | | 2 | | | | |
| **#10 - 16444** | 4 | 2 | | | | | | | | | | |
| **#11** | 4 | | | 2 | | | | | | | | 1 |
| **#12 - 13081** | 3 | 1 | 1 | 1 | | | | | | | | |
| **#13** | 4 | 2 | | | | | | | | | | |
| **#14 - 13082** | 4 | 2 | 2 | 2 | | | | | | | | |
| **#15** | 4 | 2 | | | 2 | | | | | | | |
| **Total** | **27** | **9** | **3** | **5** | **2** | | | **2** | | | | **1** |
| **Total AU_03 %** | **55.1%** | **18.4%** | **6.1%** | **10.2%** | **4.1%** | | | **4.1%** | | | | **2%** |
| **#16 - 13083** | 2 | | 2 | 2 | | 2 | | | | | | |
| **#17 - 13084** | 4 | | | 1 | | 2 | | 2 | | | | |
| **#18 - 13085** | 2 | | 2 | 4 | 2 | 2 | | | | | | |
| **#19 - 13086** | 2 | | 3 | | 2 | 2 | | | | | | |
| **#20 - 13087** | | | 2 | 1 | 4 | 2 | | 1 | | 2 | | |
| **#21 - 13088** | 2 | | 4 | | 2 | | | | | | | |
| **#22 - 13089** | 4 | | 2 | | 2 | | | | | | | |
| **#23 - 17644** | 2 | | 4 | 2 | | | | | | | | |
| **Total** | **18** | | **19** | **10** | **12** | **10** | | **3** | | **2** | | |
| **Total AU_04 %** | **24%** | | **26%** | **14%** | **16%** | **13%** | | **4%** | | **3%** | | |
| **Total** | **75** | **29** | **26** | **15** | **14** | **10** | **6** | **5** | **4** | | **1** | **1** |
| **Total %** | **40%** | **15.5%** | **14%** | **8%** | **7.5%** | **5%** | **3%** | **3%** | **2%** | **1%** | **0.5%** | **0.5%** |

**Table 4: Sum of the left bank and right bank riparian zone corridor categorical observations with the percent of the dominant riparian zone categories calculated for each station**

Multiple categorical hydrologic field observations indicate the amount of water present in RUAA streams (Table 4). Station 13081 had the widest width (34.80 meters), followed by 13074 (28.96 meters). Station 16446 had the highest recorded depth (2.9 meters), followed by station 13074 (2.0 meters). Out of 34 recorded depth measurements, 32 were greater than 0.5 meters needed for primary contact recreation.

| AU | Station ID | May 30-31, 2010 | | | | | April 23-24, 2011 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Air Temp (C)* | *Water Temp (C)* | *Avg. Width (m)* | *Avg. Thalweg (m)* | *Flow (cfs)* | *Air Temp (C)* | *Water Temp (C)* | *Avg. Width (m)* | *Avg. Thalweg (m)* | *Flow (cfs)* |
| **01** | *#1-13074* | 29.1 | 28.0 | | | *480 | 28.2 | 27.9 | | | |
| | *#2-16446* | 29.7 | 27.9 | | | | 30.5 | 26.8 | | | |
| | *#3-13077* | 29.9 | 28.4 | | | | 30.2 | 26.9 | | | |
| **02** | #4-13079 | 33.5 | 30.0 | | | **324 | 31.3 | 27.4 | | | **300 |
| | #5 | 32.5 | 29.3 | | | | 32.3 | 27.7 | | | |
| | #6-16445 | 33.5 | 29.3 | | | | 31.4 | 28.0 | | | |
| | #7 | 35.2 | 28.9 | | | | Site under construction | | | | |
| | #8-13080 | 32.4 | 28.9 | | | | 30.8 | 27.2 | | | |
| **03** | #9 | 32.6 | 29.8 | | | | 27.9 | 32.2 | | | |
| | #10-16444 | 33.5 | 29.2 | | | **194 | 30.8 | 27.7 | | | **205 |
| | #11 | 31.2 | 29.3 | | | | 29.7 | | | | |
| | #12-13081 | 31.1 | 29.5 | | | *157 | 30.0 | 28.3 | | | |
| | #13 | 33.0 | 29.6 | | | | 30.7 | 27.4 | | | |
| | #14-13082 | | 29.6 | | | *150 | 30.9 | 27.5 | | | |
| | #15 | | | | | | | | | | |
| 04 | #16-13083 | | 32.0 | | | | 31.3 | 28.3 | | | |
| | #17-13084 | 32.7 | 29.5 | | | *59 | 31.3 | 26.9 | | | |
| | #18-13085 | 33.8 | 29.6 | | | | 32.1 | 27.5 | | | |
| | #19-13086 | 33.5 | 28.9 | | | *26 | 32.0 | 27.0 | | | |
| | #20-13087 | 33.0 | 28.7 | | | | 31.0 | 26.5 | | | |
| | #21-13088 | 30.7 | 27.4 | | 0.31 | | 29.8 | 26.7 | | | 12.1 |
| | #22-13089 | 30.7 | 27.3 | | | | 27.8 | 25.0 | | | 2.6 |
| | #23-17644 | 26.9 | 26.1 | | | 2.8 | 25.8 | 25.0 | | | 1.3 |

**Table 5: Hydrologic stream characteristics of recorded categorical field observations for each station.**
***flow estimated using ACBIS methodology**
****** **Flow received from IBWC gauge**

### Recreational Uses

The RUAA summary analysis for each station (Table 5) indicates that primary contact, secondary contact (1 & 2), and non-contact recreation activities occur on segment 2202.

| Station ID | Date | Primary Contact | Secondary Contact Rec 1 | Secondary Contact 2 | Non-contact | Depth(M) | General Public Access |
|---|---|---|---|---|---|---|---|
| #1-13074 | 5/30/2010 | Not Obs or Rep | Observed | Observed | Observed | | Easy |
| #1-13074 | 4/23/2011 | Observed | Observed | Observed | Observed | | Moderately Difficult |
| #2-16446 | 5/30/2010 | Not Obs or Rep | Observed | Observed | Observed | | Moderately Easy |
| #2-16446 | 4/23/2011 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Represented | | Moderately Difficult |
| #3-13077 | 5/30/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Moderately Difficult |
| #3-13077 | 4/23/2011 | Not Obs or Rep | Represented | Represented | Represented | | Moderately Difficult |
| **AU_01** | **Frequency** | **Observed 1** | **Obs 3 Rep 1** | **Obs 3 Rep 1** | **Obs 3 Rep 2** | | |
| #4-13079 | 5/30/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Represented | | Difficult |
| #4-13079 | 4/23/2011 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Represented | | Difficult |
| #5 | 5/30/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Moderately Difficult |
| #5 | 4/23/2011 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Difficult |
| #6-16445 | 5/30/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Difficult |
| #6-16445 | 4/23/2011 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Inaccessible |
| #7 | 5/30/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Difficult |
| #7- N/A | 4/23/2011 | NA | NA | NA | NA | | NA |
| #8-13080 | 5/30/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Difficult |
| #8-13080 | 4/23/2011 | Not Obs or Rep | Observed | Observed | Observed | | Easy |
| **AU_02** | **Frequency** | **Obs 0 Rep 0** | **Obs 1** | **Obs 1** | **Obs 1 Rep 2** | | |
| #9 | 5/30/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Moderately Easy |
| #9 | 4/23/2011 | Not Obs or Rep | Represented | Represented | Represented | | Moderately Easy |
| #10-16444 | 5/30/2010 | Not Obs or Rep | Observed | Observed | Observed | | Moderately Easy |
| #10-16444 | 4/23/2011 | Not Obs or Rep | Observed | Observed | Observed | | Moderately Difficult |
| #11 | 5/30/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Moderately Difficult |
| #11 | 4/23/2011 | Not Obs or Rep | Observed | Observed | Observed | | Moderately Difficult |
| #12-13081 | 5/30/2010 | Not Obs or Rep | Observed | Observed | Observed | | Moderately Difficult |
| #12-13081 | 4/23/2011 | Not Obs or Rep | Observed | Observed | Observed | | Easy |
| #13 | 5/31/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Represented | | Moderately Easy |
| #13 | 4/24/2011 | Not Obs or Rep | Represented | Represented | Represented | | Moderately Easy |
| #14-13082 | 5/31/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Moderately Difficult |
| #14-13082 | 4/24/2011 | Not Obs or Rep | Represented | Represented | Represented | | Difficult |
| #15 | 5/31/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Difficult |
| #15 | 4/24/2011 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | |
| **AU_03** | **Frequency** | **Obs 0 Rep 0** | **Obs 5 Rep 3** | **Obs 5 Rep 3** | **Obs 5 Rep 4** | | |
| #16-13083 | 5/31/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | | Moderately Difficult |
| #16-13083 | 4/24/2011 | Not Obs or Rep | Observed | Observed | Observed | | Moderately Difficult |

| | | | | | | |
|---|---|---|---|---|---|---|
| #17-13084 | 5/31/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Difficult |
| #17-13084 | 4/24/2011 | Observed | Observed | Observed | Observed | Moderately Easy |
| #18-13085 | 5/31/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Represented | Moderately Difficult |
| #18-13085 | 4/24/2011 | Not Obs or Rep | Represented | Represented | Represented | Moderately Difficult |
| #19-13086 | 5/31/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Represented | Moderately Difficult |
| #19-13086 | 4/24/2011 | Not Obs or Rep | Represented | Represented | Observed | Moderately Difficult |
| #20-13087 | 5/31/2010 | Not Obs or Rep | Represented | Represented | Observed | Moderately Difficult |
| #20-13087 | 4/24/2011 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Represented | Moderately Difficult |
| #21-13088 | 5/31/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Observed | Moderately Difficult |
| #21-13088 | 4/24/2011 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Observed | Moderately Difficult |
| #22-13089 | 5/31/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Moderately Difficult |
| #22-13089 | 4/24/2011 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Moderately Difficult |
| #23-17644 | 5/31/2010 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Moderately Difficult |
| #23-17644 | 4/24/2011 | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Not Obs or Rep | Moderately Difficult |
| **AU_04** | **Frequency** | **Observed 1** | **Obs 2 Rep 3** | **Obs 2 Rep 3** | **Obs 6 Rep 4** | |
| **Total** | **Frequency** | **Observed 2** | **Obs 11 Rep 7** | **Obs 11 Rep 7** | **Obs 15 Rep 12** | |

**Table 6: RUAA summary for each sit**

Primary contact recreation activities were observed at stations 13074 on AU_01 and 13084 on AU_ 04. Both observations of primary contact recreation were of children wading in the river. Eleven children were observed wading at the above sites, and additional families with children arrived as the NRA field crew finished sampling at station 13084 . Secondary contact 1 recreation activities, primarily related to fishing, were observed at 11 stations on all AUs.

**Figure 17: Site 13074 AU_01 at Cemetery Rd. Bridge.**

**Figure 18: Site 13084 AU_04 at US 281 South of Pharr.**

**Figure 19: Site 16444 AU_03 at FM 491 SE of Mercedes.**

A total of 55 indications of human use were recorded on segment 2202 across all AUs (Table 7). A total of 13 fishing tackle, 12 foot paths, 11 roads, and 4 RV tracks were recorded on segment 2202. Toys and remnants of kid's play were found at two sites on segment 2202.

A total of 87 surrounding conditions that promote recreational use were found on segment 2202 across all AUs (Table 8). Based on these observations made in the field, a total of 20 roads were found on all AUs, 19 bridges were noted on all AUs, 17 rural areas noted on all AUs, 7 power line corridors were noted on AU_01, 03, and 04, 1 nearby school was noted on AU_02, and 1 RV park was noted on AU_03.

| AU | Site ID | Date | Primary Contact Recreation Activities | Count |
|---|---|---|---|---|
| 01 | #1-13074 | 04/23/2011 | Wading-Children | 1 |
| 04 | #17-13084 | 04/24/2011 | Wading-Children | 10 |

| | Site ID | Date | Secondary Contact Recreation Activities | Count |
|---|---|---|---|---|
| 01 | #1-13074 | 05/30/2010 | Fishing | 1-10 |
| 01 | #2-16446 | 05/30/2010 | Fishing | 1-10 |
| 03 | #10-16444 | 05/30/2010 | Fishing | 1-10 |
| 03 | #12-13081 | 05/30/2010 | Casting for bait | 1-10 |
| 01 | #1-13074 | 04/23/2011 | Fishing | 1-10 |
| 02 | #8-13080 | 04/23/2011 | Fishing | 1-10 |
| 03 | #10-16444 | 04/23/2011 | Fishing | 11-20 |
| 03 | #11 | 04/23/2011 | Fishing | 1-10 |
| 03 | #12-13081 | 04/23/2011 | Fishing | 1-10 |
| 04 | #16-13083 | 04/24/2011 | Casting for bait | 1-10 |
| 04 | #17-13084 | 04/24/2011 | Fishing | 20-50 |

| | Site ID | Date | Non Contact Activities | Count |
|---|---|---|---|---|
| 01 | #1-13074 | 05/30/2010 | Standing, sitting, and playing on shore. | 1-10 |
| 04 | #20-13087 | 05/31/2010 | People on shore | 1-10 |
| 04 | #21-13088 | 05/31/2010 | Individual on shore | 1 |
| 01 | #1-13074 | 04/23/2011 | People on shore | 1-10 |
| 02 | #8-13080 | 04/23/2011 | People on shore | 1-10 |
| 03 | #10-16444 | 04/23/2011 | People on shore | 11-20 |
| 03 | #11 | 04/23/2011 | People on shore | 1-10 |
| 03 | #12-13081 | 04/23/2011 | People on shore | 1-10 |
| 04 | #16-13083 | 04/24/2011 | People on shore | 1-10 |
| 04 | #17-13084 | 04/24/2011 | People on shore | 20-50 |
| 04 | #19-13086 | 04/24/2011 | People on ATV | 1-10 |

**Table 7: Recreation activities observed at each site during RUAA field surveys.**

| Site ID | Foot Paths | Trash | Fishing Tackle | Toys | Graffiti | RV ATV Tracks | Chairs | Fire Pit | Roads | Remnants of Kids Play | Shotgun Shells | NPDES Discharge | Gates on corridor | Camp Sites | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **#1 - 13074** | 1 | 1 | 1 | 1 | | | | 1 | | | | | | | **5** |
| **#2 - 16446** | 1 | | 1 | | 1 | | | | 1 | | | | | | **4** |
| **#3 - 13077** | | | 1 | | | 1 | | | | | | | | | **2** |
| **Total** | **2** | **1** | **3** | **1** | **1** | **1** | | **1** | **1** | | | | | | **11** |
| **AU_01 %** | **18.1%** | **9.1%** | **27.2%** | **9.1%** | **9.1%** | **9.1%** | | **9.1%** | **9.1%** | | | | | | **20%** |
| **#4 - 13079** | 1 | | | | | | | | | | | | | | **1** |
| **#5** | | | | | | | | | | | | | | | |
| **#6 - 16445** | | | | | | | | | | | | | | | |
| **#7** | | | | | | | | | | | | | | | |
| **#8 - 13080** | 1 | | 1 | | | | 1 | | | | | | | | **3** |
| **Total** | **2** | | **1** | | | | **1** | | | | | | | | **4** |
| **AU_02%** | **50%** | | **25%** | | | | **25%** | | | | | | | | **7%** |
| **#9** | | | 1 | | | | | | | | | | | | **1** |
| **#10 - 16444** | 1 | | 1 | | | 1 | | 1 | 1 | | | | | 1 | **6** |
| **#11** | | | | | | | | | | | | | | | |
| **#12 - 13081** | 1 | | 1 | | | | | | 1 | | | | | | **3** |
| **#13** | 1 | | 1 | | 1 | 1 | | | 1 | 1 | | | | | **6** |
| **#14 - 13082** | | | 1 | | | | | | 1 | | | | | | **2** |
| **#15** | | | | | | | | | | | | | | | |
| **Total** | **3** | | **5** | | **1** | **2** | | **1** | **4** | **1** | | | | **1** | **18** |
| **AU_03%** | **17%** | | **28%** | | **5.5%** | **11%** | | **5.5%** | **22%** | **5.5%** | | | | **5.5%** | **33%** |
| **#16 - 13083** | 1 | | | | | | | | | | | | | | **1** |
| **#17 - 13084** | 1 | | 1 | | | | | | 1 | | | | | | **3** |
| **#18 - 13085** | 1 | | 1 | | | | | | 1 | | 1 | | | | **4** |
| **#19 - 13086** | 1 | | 1 | | | 1 | | | 1 | | | | | | **4** |
| **#20 - 13087** | 1 | | 1 | | | | | | 1 | | | 1 | | | **4** |
| **#21 - 13088** | | | | | | | | | 1 | | | 1 | 1 | | **3** |
| **#22 - 13089** | | | | | | | | | | | | | | | |
| **#23 - 17644** | | | | | | | | | 1 | | | 1 | 1 | | **3** |
| **Total** | **5** | | **4** | | | **1** | | | **6** | | **1** | **3** | **2** | | **22** |
| **AU_04** | **22.7%** | | **18.2%** | | | **4.5%** | | | **27.2%** | | **4.5%** | **13.6%** | **9.1%** | | **40%** |
| **Total** | **12** | **1** | **13** | **1** | **2** | **4** | **1** | **2** | **11** | **1** | **1** | **3** | **2** | **1** | **55** |
| **Total %** | **22%** | **1.8%** | **24%** | **1.8%** | **3.6%** | **7%** | **1.8%** | **3.6%** | **20%** | **1.8%** | **1.8%** | **5%** | **3.6%** | **1.8%** | |

**Table 8: Surrounding indications of human use observed during field surveys.**

| Site ID | Rural Area | Bridge Crossing | Trails Paths | Roads | Power Line Corridor | Golf Course | Populated Area | Urban Suburban | Unimproved Parking | Residential Area | Nearby School | RV Park | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **#1 - 13074** | 1 | 1 | 1 | 1 | 1 | | | | | | | | **5** |
| **#2 - 16446** | 1 | 1 | | 1 | 1 | 1 | 1 | | | | | | **6** |
| **#3 - 13077** | 1 | 1 | | 1 | 1 | | | 1 | | 1 | | | **6** |
| **Total** | **3** | **3** | **1** | **3** | **3** | **1** | **1** | **1** | | **1** | | | **17** |
| **AU_01%** | **17.6%** | **17.6%** | **5.9%** | **17.6%** | **17.6%** | **5.9%** | **5.9%** | **5.9%** | | **5.9%** | | | **19.5%** |
| **#4 - 13079** | | 1 | 1 | | | | 1 | | 1 | | | | **4** |
| **#5** | | | | | | | | 1 | | 1 | 1 | | **3** |
| **#6 - 16445** | | 1 | | 1 | | | | | | 1 | | | **3** |
| **#7** | 1 | 1 | | 1 | | | | | | | | | **3** |
| **#8 - 13080** | 1 | 1 | | 1 | | | | | | | | | **3** |
| **Total** | **2** | **4** | **1** | **3** | | | **1** | **1** | **1** | **2** | **1** | | **16** |
| **AU_02%** | **12.5%** | **25%** | **6.3%** | **19%** | | | **6.3%** | **6.3%** | **6.3%** | **12.5%** | **6.3%** | | **18.4%** |
| **#9** | 1 | 1 | | 1 | | | | | | | | | **3** |
| **#10 - 16444** | 1 | 1 | 1 | 1 | | | | | | | | | **4** |
| **#11** | | | | 1 | | | 1 | 1 | | 1 | | 1 | **5** |
| **#12 - 13081** | 1 | 1 | | 1 | | | | | | | | | **3** |
| **#13** | | 1 | | 1 | 1 | | 1 | | | | | | **4** |
| **#14 - 13082** | 1 | 1 | | 1 | | | | | | | | | **3** |
| **#15** | 1 | | | 1 | | | | | | | | | **2** |
| **Total** | **5** | **5** | **1** | **7** | **1** | | **2** | **1** | | **1** | | **1** | **24** |
| **AU_03** | **20.8%** | **20.8%** | **4.2%** | **29.2%** | **4.2%** | | **8.3%** | **4.2%** | | **4.2%** | | **4.2%** | **27.6** |
| **#16 - 13083** | 1 | 1 | | 1 | 1 | | | | | | | | **4** |
| **#17 - 13084** | 1 | 1 | | 1 | 1 | | 1 | 1 | | | | | **6** |
| **#18 - 13085** | 1 | 1 | | 1 | | | | | | | | | **3** |
| **#19 - 13086** | 1 | 1 | 1 | 1 | | | | | | | | | **4** |
| **#20 - 13087** | 1 | 1 | | 1 | | | | | | | | | **3** |
| **#21 - 13088** | | 1 | | 1 | | 1 | | 1 | | 1 | | | **5** |
| **#22 - 13089** | 1 | 1 | | 1 | 1 | | | | | | | | **4** |
| **#23 - 17644** | 1 | | | | | | | | | | | | **1** |
| **Total** | **7** | **7** | **1** | **7** | **3** | **1** | **1** | **2** | | **1** | | | **30** |
| **AU_04** | **23.3%** | **23.3%** | **3.3%** | **23.3%** | **10%** | **3.3%** | **3.3%** | **6.7%** | | **3.3%** | | | **34.5%** |
| **Total** | **17** | **19** | **4** | **20** | **7** | **2** | **5** | **5** | **1** | **5** | **1** | **1** | **87** |
| **Total %** | **19.5%** | **22%** | **4.6%** | **23%** | **8%** | **2.3%** | **5.7%** | **5.7%** | **1.1%** | **5.7%** | **1.1%** | **1.1%** | |

**Table 9: Conditions that promote recreation observed during field surveys.**

A total of 60 surrounding conditions that impede recreational use were found on segment 2202 (Table 9). A total of 21 or 35% of the conditions that impede recreational use were steep slopes. Other dominant conditions were thick vegetation (23%), and private property/no trespassing signs (22%). AU_04 had the most observed surrounding conditions that impede recreation followed by AU_02, AU_03, and AU_01.

A total of 31 channel obstructions were observed for segment 2202 (Table 10). Channel obstructions include 7 or 22.6% bridge pillars followed by low bridges (16%), thick vegetation (16%), and rip rap (16%). Thick vegetation accounted for 23.3% of the impeding conditions and 16% of total channel obstructions. As mentioned earlier in this report, the IBWC is in the process of removing vegetation below the 21,000 cfs for 100 year flooding. This vegetation removal could possibly change the observed conditions that both impede recreation and obstruct channel. Access to the Arroyo Colorado Above Tidal for recreational use could possibly increase as a result of the vegetation removal.

| Site ID | Steep Slopes | Muddy | No Trespassing Sign | Thick Vegetation | Private Property | No Public Access | No Roads | Fence | No Fishing sign | Swift Water | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **#1- 13074** | 1 | 1 | | | | | | | | | **2** |
| **#2 - 16446** | 1 | 1 | 1 | 1 | | | | | | | **4** |
| **#3 - 13077** | 1 | | | 1 | | | | | | | **2** |
| **Total** | **3** | **2** | **1** | **2** | | | | | | | **8** |
| **AU_01%** | **37.5%** | **25%** | **12.5%** | **25%** | | | | | | | **13.3%** |
| **#4 - 13079** | 1 | | | 1 | | | | | | | **2** |
| **#5** | 1 | | | | 1 | 1 | 1 | | | | **4** |
| **#6 - 16445** | 1 | | | 1 | 1 | | | 1 | | | **4** |
| **#7** | 1 | | | 1 | 1 | | | 1 | | | **4** |
| **#8 - 13080** | 1 | | | 1 | 1 | | | | | | **3** |
| **Total** | **5** | | | **4** | **4** | **1** | **1** | **2** | | | **17** |
| **AU_02%** | **29.4%** | | | **23.5%** | **23.5%** | **5.9%** | **5.9%** | **11.7%** | | | **28.3%** |
| **#9** | 1 | | 1 | 1 | 1 | | | 1 | 1 | | **6** |
| **#10 - 16444** | 1 | | | | | | | | | | **1** |
| **#11** | | | | 1 | | | | | | | **1** |
| **#12 - 13081** | | | | 1 | | | | | | | **1** |
| **#13** | 1 | | | 1 | | | | | | | **2** |
| **#14 - 13082** | 1 | | | | | | | | | | **1** |
| **#15** | 1 | | | 1 | | | | | | 1 | **3** |
| **Total** | **5** | | **1** | **5** | **1** | | | **1** | **1** | **1** | **15** |
| **AU_03%** | **33.3%** | | **6.7%** | **33.3%** | **6.7%** | | | **6.7%** | **6.7%** | **6.7%** | **25%** |
| **#16 - 13083** | 1 | | | | | | | | | | **1** |
| **#17 - 13084** | 1 | | | 1 | | | | 1 | | | **3** |
| **#18 - 13085** | 1 | | | 1 | | | | | | | **2** |
| **#19 - 13086** | 1 | | | | | | | | | | **1** |
| **#20 - 13087** | 1 | | 1 | 1 | 1 | 1 | | 1 | | | **6** |
| **#21 - 13088** | 1 | | 1 | | 1 | | | | | | **3** |
| **#22 - 13089** | 1 | | | | | | | | | | **1** |
| **#23 - 17644** | 1 | | 1 | | 1 | | | | | | **3** |
| **Total** | **8** | | **3** | **3** | **3** | **1** | | **2** | | | **20** |
| **AU_04%** | **40%** | | **15%** | **15%** | **15%** | **5%** | | **10%** | | | **33%** |
| **Total** | **21** | **2** | **5** | **14** | **8** | **2** | **1** | **5** | **1** | **1** | **60** |
| **Total %** | **35%** | **3.3%** | **8.3%** | **23.3%** | **13.3%** | **3.3%** | **1.6%** | **8.3%** | **1.6%** | **1.6%** | |

**Table 10: Conditions that impede recreation observed during field surveys.**

| Site ID | Bridge Pillar | Thick Vegetation | Low Bridges | Dams | Pipeline | Rip Rap | Culverts | Fences | Totals |
|---|---|---|---|---|---|---|---|---|---|
| **#1 - 13074** | | | | | | | | | |
| **#2 - 16446** | | | | | | | | | |
| **#3 - 13077** | | | | | | | | | |
| **Total** | | | | | | | | | |
| **AU_01%** | | | | | | | | | |
| **#4 - 13079** | | | | | | | | | |
| **#5** | | | | | | | | | |
| **#6 - 16445** | | 1 | 1 | | | | | | **2** |
| **#7** | 1 | | | | | | | | **1** |
| **#8 - 13080** | 1 | | | | | | | | **1** |
| **Total** | **2** | **1** | **1** | | | | | | **4** |
| **AU_02%** | **50%** | **25%** | **25%** | | | | | | **13%** |
| **#9** | | 1 | 1 | | | | | 1 | **3** |
| **#10 - 16444** | | | | 1 | | 1 | | | **2** |
| **#11** | | | | | | | | | |
| **#12 - 13081** | | | 1 | | | | | | **1** |
| **#13** | 1 | | | | 1 | | | | **2** |
| **#14 - 13082** | 1 | 1 | | | | | | | **2** |
| **#15** | | 1 | | | | 1 | | | **2** |
| **Total** | **2** | **3** | **2** | **1** | **1** | **2** | | **1** | **12** |
| **AU_03%** | **16.6%** | **25%** | **16.6%** | **8.3%** | **8.3%** | **16.6%** | | **8.3%** | **38.7%** |
| **#16 - 13083** | 1 | | | | | | | | **1** |
| **#17 - 13084** | | | 1 | | | 1 | | | **2** |
| **#18 - 13085** | 1 | | | | | | | | **1** |
| **#19 - 13086** | 1 | | | | | | | | **1** |
| **#20 - 13087** | | 1 | | | 1 | 1 | 1 | | **4** |
| **#21 - 13088** | | | 1 | | | | 1 | | **2** |
| **#22 - 13089** | | | | | 1 | 1 | 1 | | **3** |
| **#23 - 17644** | | | | | | | 1 | | **1** |
| **Total** | **3** | **1** | **2** | | **2** | **3** | **4** | | **15** |
| **AU_04%** | **20%** | **6.7%** | **13.3%** | | **13.3%** | **20%** | **26.7%** | | **48.3%** |
| **Total** | **7** | **5** | **5** | **1** | **3** | **5** | **4** | **1** | **31** |
| **Total %** | **22.6%** | **16%** | **16%** | **3.2%** | **9.7%** | **16%** | **12.9%** | **3.2%** | |

**Table 11: Chanel obstructions recorded during field surveys.**

### Interviews

A total of 6 interviews were conducted on May 30-31, 2011 at sites 16446, 16445, 16444, and 13081. Of those interviewed, all confirmed secondary contact recreation related to fishing or boating. A total of 8 interviews were conducted on April 23-24, 2011 at sites 13074, 13080, 16444, Site #11-Llano Grande RV park, and 13084. Of those interviewed 6 confirmed primary contact recreation and 8 confirmed secondary contact recreation.

Summary

A total of 45 site surveys were conducted on the Arroyo Colorado segment 2202 along 4 AUs in the Nueces Rio Grande Coastal Basin to evaluate existing recreational uses of this stream. Important data collected in this RUAA included general stream characteristics, physical measurements and evidence of recreational use, surrounding conditions that promote recreation, and surrounding conditions that impede recreation including channel obstruction.Shrub was the dominant riparian zone recorded for all the AUs combined (40%), followed by forest (15.5%), and denuded/eroded bank (14%). Field observations indicate vegetation was consistently dense at many of the sites.

Multiple categorical hydrologic field observations indicate that the Arroyo Colorado Above Tidal segment had significant quantity of water at the time of the survey despite moderate to mid-range drought conditions. Eleven children were observed carrying out primary contact recreation activities on Segment 2202. A child was observed wading at station 13074 AU_01 and the parents of the small boy also stated that kids are often seen wading at this site. The second account of observed primary contact recreation was at site 13084 AU_04 where 11 children were seen wading and playing in the water. More than 11 people were observed carrying out secondary contact recreation activities on all AUs. The dominant secondary contact recreation activity observed was fishing. Fishing tackle was found at 13 of the sites. Remnants of kid's play and toys were found at 2 sites.

Of all surrounding conditions that impede recreational use, 35% were steep slopes followed by thick vegetation (23.3%), private property/no trespassing signs (21.6%), and fences (8.3%). RUAA summary analysis indicates 21 of the 23 sites had very limited public access due to steep slopes. In addition 22.6% of all channel obstructions were bridge pillars followed by low bridges (16%), and thick vegetation (16 %).

After a thorough historical research and analysis of the current recreational uses occurring in the Arroyo Colorado Above Tidal, the NRA found no references or record of Primary Contact Recreation. Many of the stakeholders interviewed and present at the public meetings stated that they did not want the designated use to change and feel that primary contact is the appropriate designation for this segment.

**Literature Cited**

Arroyo Colorado Watershed Partnership (2011) . *Maps, Imagery and Census Data.* Retrieved July 9, 2011, from http://arroyocolorado.org/about-the-watershed/maps.

Arroyo Colorado Watershed Partnership, TCEQ, and EPA (2007). *A Watershed Protection Plan for the Arroyo Colorado: Phase I.*

TCEQ, (2003). *Twelve Total Maximum Daily Loads for Legacy Pollutants in the Arroyo Colorado Above Tidal and the Donna Reservoir and Canal System.* Field Operations Division, Region 4, Strategic Assessment Division, TMDL Team.

TCEQ, (2010*). Overview of Major Revisions to the Water Quality Standards.* Retrieved June 24, 2011, from http://www.tceq.texas.gov/waterquality/standards/2010standards.html#the-2010-standards-and.

TCEQ, (2011). *Permitted Wastewater Outfalls*. Retrieved July 31, 2011, from http://www.tceq.texas.gov/gis/sites.html.

Texas Secretary of State. Retrieved September 13, 2011, from http://www.sos.state.tx.us/border/colonias/what_colonia.shtml.

Jenkins, K. and Habitat Restoration Workgroup, (2006). *Arroyo Colorado Habitat Restoration Plan.* TPWD.

Spiller, K., and Blankinship, R. TPWD, (2006). *Laguna Madre.* Retrieved September 13, 2001, from http://www.tpwd.state.tx.us/fishboat/fish/didyouknow/lagunamadre.phtml>.

U.S. Census Bureau (2010). State & County QuickFacts. Retrieved September 15, 2011, from http://quickfacts.census.gov/qfd/states/48/48061.html.

U.S. Census Bureau (2010). *Texas State Population County Map.* Retrieved July 9, 2011, from http://2010.census.gov/2010census/data/.

**RUAA Summary**
**(Not part of the Field Data Sheet)**

*This form should be filled out after RUAA data collection is completed. Use the Contact Information Form, Field Data Sheets from all sites, Historical Information Review, and other relevant information to answer the following questions on the water body.*

Name of water body: Arroyo Colorado Above Tidal
Segment No. or Nearest Downstream Segment No.: 2202
Classified?: Yes
County: Cameron and Hidalgo

1. Observations on Use
   a. Do primary contact recreation activities occur on the water body?
      ☑ frequently ☐ seldom ☐ not observed or reported ☐ unknown

   b. Do secondary contact recreation 1 activities occur on the water body?
      ☑ frequently ☐ seldom ☐ not observed or reported ☐ unknown

   c. Do secondary contact recreation 2 activities occur on the water body?
      ☑ frequently ☐ seldom ☐ not observed or reported ☐ unknown

   d. Do noncontact recreation activities occur on the water body?
      ☑ frequently ☐ seldom ☐ not observed or reported ☐ unknown

2. Physical Characteristics of Water Body
   a. What is the average thalweg depth? _____ meters

   b. Are there substantial pools deeper than 1 meter? ☐ yes ☑ no

   c. What is the general level of public access?
      ☐ easy ☑ moderate ☐ very limited

3. Hydrological Conditions (Based on Palmer Drought Severity Index)
☐ Mild-Extreme Drought ☐ Incipient dry spell ☑ Near Normal ☐ Incipient wet spell ☐ Mild-Extreme Wet

# Appendix A

# Site IDs and Descriptions

| AU | # | Station ID# | Site Description | Latitude | Longitude | Approx Distance to Next Station (miles) |
|---|---|---|---|---|---|---|
| 01 | 1 | 13074 | Arroyo Colorado at Cemetery Rd Bridge | 26.19494 | -97.601596 | 2.6 |
| 01 | 2 | 16446 | Arroyo Colorado at FM 509 | 26.18205 | -97.63228 | 2.6 |
| 01 | 3 | 13077 | Arroyo Colorado at Loop 499 Bridge | 26.18393 | -97.66628 | 2.9 |
| 02 | 4 | 13079 | Arroyo Colorado at US 77 in SW Harlingen | 26.173465 | -97.700825 | 0.9 |
| 02 | 5 | | Arroyo Colorado at Montana Dr. in Rangerville | 26.16647 | -97.7097 | 3.8 |
| 02 | 6 | 16445 | Arroyo Colorado at Dilworth Rd | 26.144061 | -97.750957 | 3.0 |
| 02 | 7 | | Arroyo Colorado at FM 800 | 26.13772 | -97.78403 | 4.3 |
| 02 | 8 | 13080 | Arroyo Colorado at FM 506 South of La Feria | 26.129583 | -97.823586 | 2.3 |
| 03 | 9 | | Arroyo Colorado at FM 2556 | 26.12003 | -97.85112 | 4.3 |
| 03 | 10 | 16444 | Arroyo Colorado at FM 491 SE of Mercedes | 26.12787 | -97.90147 | 3.0 |
| 03 | 11 | | Arroyo Colorado at Llano Grande RV Park | 26.12915 | -97.94457 | 1.2 |
| 03 | 12 | 13081 | Arroyo Colorado at FM 1015 South of Weslaco | 26.119743 | -97.960962 | 2.4 |
| 03 | 13 | | Arroyo Colorado at Texas Blvd. South of Weslaco | 26.1163 | -97.9936 | 5.3 |
| 03 | 14 | 13082 | Arroyo Colorado at FM 493 South of Donna | 26.092377 | -98.057108 | 2.6 |
| 03 | 15 | | Arroyo Colorado at Valley View Rd. south of Val Verde | 26.1112 | -98.0789 | 3.8 |
| 04 | 16 | 13083 | Arroyo Colorado at FM 907 South of Alamo | 26.14132 | -98.13037 | 4.5 |
| 04 | 17 | 13084 | Arroyo Colorado at US 281 South of Pharr | 26.147333 | -98.191983 | 1.4 |
| 04 | 18 | 13085 | Arroyo Colorado at 2061 SE of McAllen | 26.156341 | -98.211145 | 1.4 |
| 04 | 19 | 13086 | Arroyo Colorado at FM 336 South of McAllen | 26.16433 | -98.230087 | 1.5 |
| 04 | 20 | 13087 | Arroyo Colorado at FM 115 South of McAllen | 26.173357 | -98.250532 | 2.7 |
| 04 | 21 | 13088 | Arroyo Colorado at FM 494 West of McAllen | 26.18617 | -98.28985 | 3.7 |
| 04 | 22 | 13089 | Arroyo Colorado @ FM 1016 South of Mission | 26.19338 | -98.32957 | 3.4 |
| 04 | 23 | 17644 | Arroyo Colorado @ FM 2062 | 26.20045 | -98.37676 | |

# Appendix B

# Permitted Domestic and Wastewater Treatment Plant Outfalls on Segment 2202

| AU | Permit Number | Permittee | Type | County | Lat | Long |
|---|---|---|---|---|---|---|
| 01 | 14454-001 | CITY OF SAN BENITO | >1 MGD | CAMERON | 26.174816 | -97.625082 |
| 01 | 10490-003 | CITY OF HARLINGEN | >1 MGD | CAMERON | 26.182174 | -97.640369 |
| 02 | 10490-002 | CITY OF HARLINGEN | >1 MGD | CAMERON | 26.177726 | -97.682675 |
| 02 | 11628-001 | WINTER GARDEN PARK CORP | <1 MGD | CAMERON | 26.169081 | -97.783702 |
| 02 | 10697-002 | CITY OF LA FERIA | <1 MGD | CAMERON | 26.14371 | -97.836289 |
| 03 | 10697-001 | CITY OF LA FERIA | <1 MGD | CAMERON | 26.139991 | -97.831541 |
| 03 | 10347-001 | CITY OF MERCEDES | >1 MGD | HIDALGO | 26.170815 | -97.902385 |
| 03 | 13462-001 | MILITARY HIGHWAY WSC | <1 MGD | HIDALGO | 26.118035 | -97.938918 |
| 03 | 04754-000 | MILITARY HIGHWAY WSC | >1 MGD | HIDALGO | 26.097599 | -97.965692 |
| 03 | 10619-005 | CITY OF WESLACO | >1 MGD | HIDALGO | 26.116217 | -98.021095 |
| 03 | 10504-001 | CITY OF DONNA | >1 MGD | HIDALGO | 26.147627 | -98.05175 |
| 03 | 13680-001 | DONNA ISD | <1 MGD | HIDALGO | 26.078127 | -98.06758 |
| 03 | 13633-001 | CITY OF ALAMO | >1 MGD | HIDALGO | 26.141722 | -98.118304 |
| 03 | 13462-006 | MILITARY HIGHWAY WSC | <1 MGD | HIDALGO | 26.135766 | -98.119451 |
| 04 | 11512-001 | CITY OF SAN JUAN | >1 MGD | HIDALGO | 26.160123 | -98.162826 |
| 04 | 10596-001 | CITY OF PHARR | >1 MGD | HIDALGO | 26.163926 | -98.172539 |
| 04 | 11080-001 | CITY OF HIDALGO | >1 MGD | HIDALGO | 26.107376 | -98.236873 |
| 04 | 10633-003 | CITY OF MCALLEN | >1 MGD | HIDALGO | 26.171929 | -98.275314 |
| 04 | 10484-001 | CITY OF MISSION | >1 MGD | HIDALGO | 26.197463 | -98.33142 |
| 04 | 04051-000 | FRONTERA GENERTION LP | COOLING WATER | HIDALGO | 26.209085 | -98.397825 |
| 04 | 01254-000 | J.L. BATES LP | >1 MGD | HIDALGO | 26.218349 | -98.39531 |