## ECOREGION 34 – WESTERN GULF COASTAL PLAIN

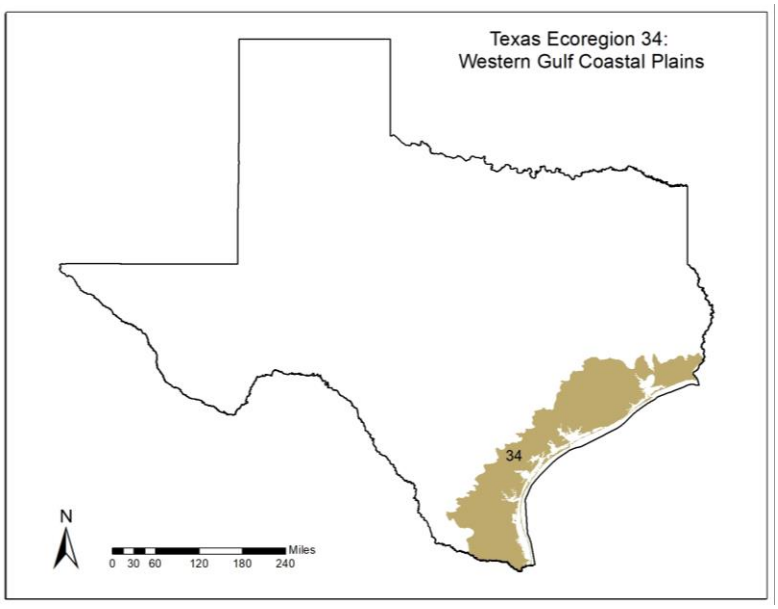


**Figure 380. Map of Texas Ecoregion 34 – Western Gulf Coastal Plain.**

**Figure 381. Site photo from Garcitas Creek.**

## Ecoregion 34 Characterization

The Gulf Coastal Plains Ecoregion (Ecoregion 34) is relatively flat and narrow, ranging from 80 to 145 km wide along the Gulf of Mexico coast extending from southeastern Louisiana through Texas and into the Mexican state of Tamaulipas (Figure 380). In Louisiana the region is often referred to as the "Cajun Prairie" and in Texas as the "Coastal Prairie". The ecoregion is relatively diverse and includes coastal marshes, barrier islands, and dunes as well as tidally influenced and freshwater streams. Only freshwater streams above the extent of tidal influence were sampled for this project. The freshwater streams in the ecoregion may be found in forested or prairie-like watersheds.

Most of the region, especially close to the gulf coast, is characterized by relatively flat topography and mainly grassland potential natural vegetation (Griffith et al. 2007). Inland from the gulf coast, the plains become more irregular and forested or savannah-like. These characteristics result in a larger proportion of the land being in cropland than in adjacent ecoregions. Soybeans, rice, and grain sorghum constitute the main crops. Urban and industrial land uses as well as oil and gas production are common in the region.

Vegetation in the ecoregion is relatively diverse and includes hackberry, cedar elm, ash, pecan, live oak (*Quercus virginiana)*, and mesquite trees as well as a wide variety of grasses. Griffin et al. (2007) identified nine Level IV ecoregions within the Western Gulf Plains in Texas and provide greater details on the physiographic characteristics, soils, geology, and vegetation of this ecoregion. Greater detail on the physiographic characteristics of the region is also given in this report under the physical characterization for each sample site.

### Streams sampled in Ecoregion 34.

| | | |
|---|---|---|
| Arenosa Creek | Placedo Creek | West Carancahua Creek |
| Big Creek | San Bernard River | West Mustang Creek |
| Garcitas Creek | West Bernard Creek | |

## ARENOSA CREEK

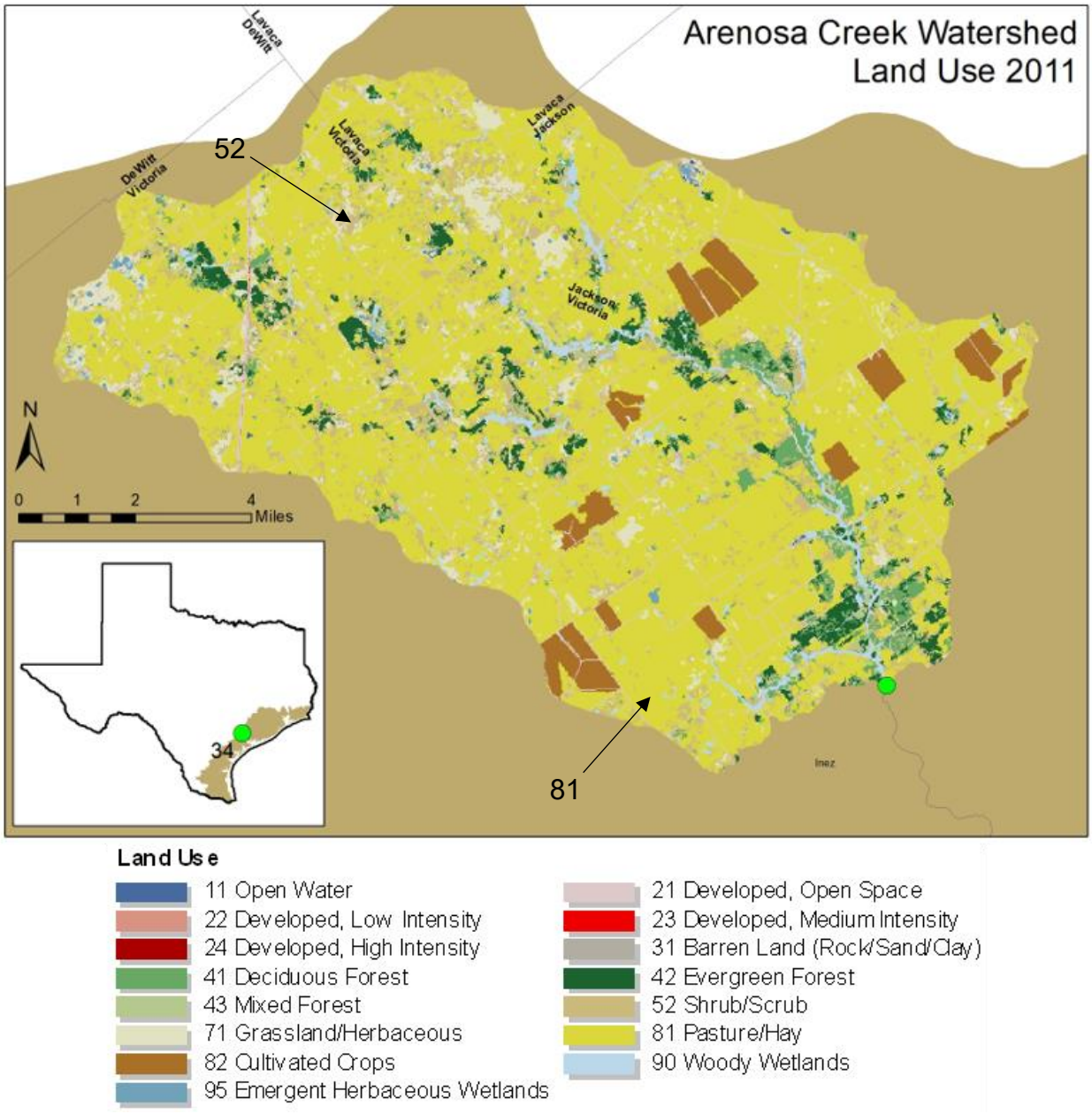


**Figure 382. Map of Arenosa Creek watershed and 2011 land use; pasture/hay and shrub/scrub were the most common land uses.**

### Sampling Dates for Arenosa Creek

| | |
|---|---|
| Physical Habitat: | September 6, 1988; September 17, 2015; July 13, 2016; July 11, 2017 |
| Water Quality: | 51 sampling events |
| Fish: | September 8, 1988; March 27, 1989; September 1, 2015; July 1, 2016; July 11, 2017 |
| Benthic Invertebrates: | September 6, 1988; September 17, 2015; July 13, 2016; July 11, 2017 |

## Physical Characterization

### Watershed and Land Use

Arenosa Creek lies within the Lavaca-Guadalupe Coastal Basin. Sample site 13295 is located at CR 103 north of Victoria, near Inez, on the border of Victoria and Jackson counties (Figure 382).

The Arenosa Creek watershed at site 13295 is approximately 293.99 sq km. The entire watershed lies within the Level IV Ecoregion 34a, the Northern Humid Gulf Coastal Prairies. The watershed is dominated by pasture/hay at 65.68% (Homer et al. 2015; Figure 382 and Figure 383). Shrub/scrub is the secondary land cover encompassing 10.52%. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 3.58% and total cover for cultivated crops is 3.84%.

From 1992-2011 there was a 78.04 sq km decrease in grassland and a 51.66 sq km decrease in shrub. There was a 143.28 sq km increase in pasture/hay and a 10.33 sq km increase in open space development (Figure 384). Cattle were observed in the creek bed during the 2016 sampling event.

As of October 2024 there are no wastewater outfalls within the Arenosa Creek watershed.

### In Channel and Riparian Physical Habitat

Physical habitat for Arenosa Creek was evaluated during four sampling events from 1988 to 2017. Arenosa Creek is a perennial stream that drains to the tidal portion of Garcitas Creek. Habitat Quality Index scores are available for three sample events and indicate intermediate to high aquatic life use ratings (16.5-22). Riparian areas were well vegetated throughout the reach with an average riparian buffer ranging from 19.5 meters wide to greater than 20 meters. The riparian zone was generally dominated by shrubs followed by trees then grasses. The average percentage of tree canopy cover ranged from 54% to 85%.

The dominant stream substrate was sand, and the average percent of substrate gravel size or larger varied from 0% to 14%. Average percent instream cover was 28% to 39%; instream cover types consisted of overhanging vegetation, leaf packs, snags, woody debris, root mats, algae, and gravel. Arenosa Creek ranged from 0.1-0.2 meters deep on average and 6-10 meters wide. Average stream bank slope ranged from 20-27 degrees. Stream flow at the site was measured at a minimum value of 0 cfs and a maximum of 1.4 cfs. Average stream bank erosion potential was 37%-41.5%. The deepest pool measured at Arenosa Creek was 1.6 meters. Number of riffles observed at the site varied from zero to four, and total number of stream bends ranged from four to five.

### Water Quality

Water samples were collected at station 13295 over 51 sampling events from September 1988 through July 2017. Parameters measured included temperature, flow, transparency, specific conductance, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen,

phosphorus, chloride, sulfate and chlorophyll-*a*. Between the July 2016 and July 2017 sampling events there was a sludge application event upstream of station 13295.

## Biological Characterization

### Fish

Arenosa Creek was sampled for fish in September 1988 and March 1989, where it received an aquatic life use rating of high and intermediate, respectively. Recent sampling shows a much-improved waterbody. The fish assemblage rated high in September 2015 and exceptional in July 2016 and 2017. Species richness of fish overall and particularly sunfish had doubled since the early collections.

Overall, 25 species (nine families) were collected over the five sampling events. Centrarchidae yielded the most species (10) followed by Cyprinidae with five. Western Mosquitofish was the most abundant species in every collection but the 2015 one where Longear Sunfish outnumbered it. The metric score for number of native cyprinid species rose from three to five. Only Red Shiner and Pugnose Minnow were collected in the samples from the 1980s. No Red Shiner were collected in the recent collections; however, two other native cyprinids were collected along with Pugnose Minnow. These minnows were Golden Shiner and Weed Shiner.

Early samples did not yield any benthic invertivore or intolerant species. Recent samples picked up three benthic invertivore species (one which is classified as an intolerant species) - Slough Darter, Bluntnose Darter, and Tadpole Madtom (intolerant). Number of individuals collected was also slightly higher in the recent collections, resulting in a metric score increase from two to three.

Though neither case resulted in a decrease in respective metric score, a very small incidence of anomalies was detected in recent years and non-native fish species were collected in 2015 and 2016. The non-native species collected were Common Carp and Redbreast Sunfish. In 1988 and 1989 no non-native species were collected, and no anomalies were detected.

Of special significance is the presence of American Eel from three of the five collections. There has been recent concern over the status of this migratory species throughout the United States.

### Benthic Macroinvertebrates

A total of 1,635 individuals representing 14 orders of macroinvertebrates were identified in the Surber sample collected on September 6, 1988 and the three RBP kicknet samples collected September 17, 2015, July 13, 2016 and July 11, 2017 (Appendix E). Diptera and Ephemeroptera were the most abundant orders, representing 36.9% and 28.2%, respectively, of the total number of individuals collected. Odonata (9.3%), Pelecypoda (5.5%), Coleoptera (5%), and Oligochaeta (5.3%) were also well represented in the collection. Other taxa, representing greater than 1% of the samples combined, include Amphipoda (3.8%), Decapoda (2%), Gastropoda (1.5%), and Ostracoda (1.2%).

Results for Ecoregion 34 BIBI ranged from intermediate aquatic life use for the samples collected on July 13, 2016 and July 11, 2017 to high aquatic life use for the sample collected

September 17, 2015. The differences are likely related to the highly variable flow which greatly affects the available instream habitat.

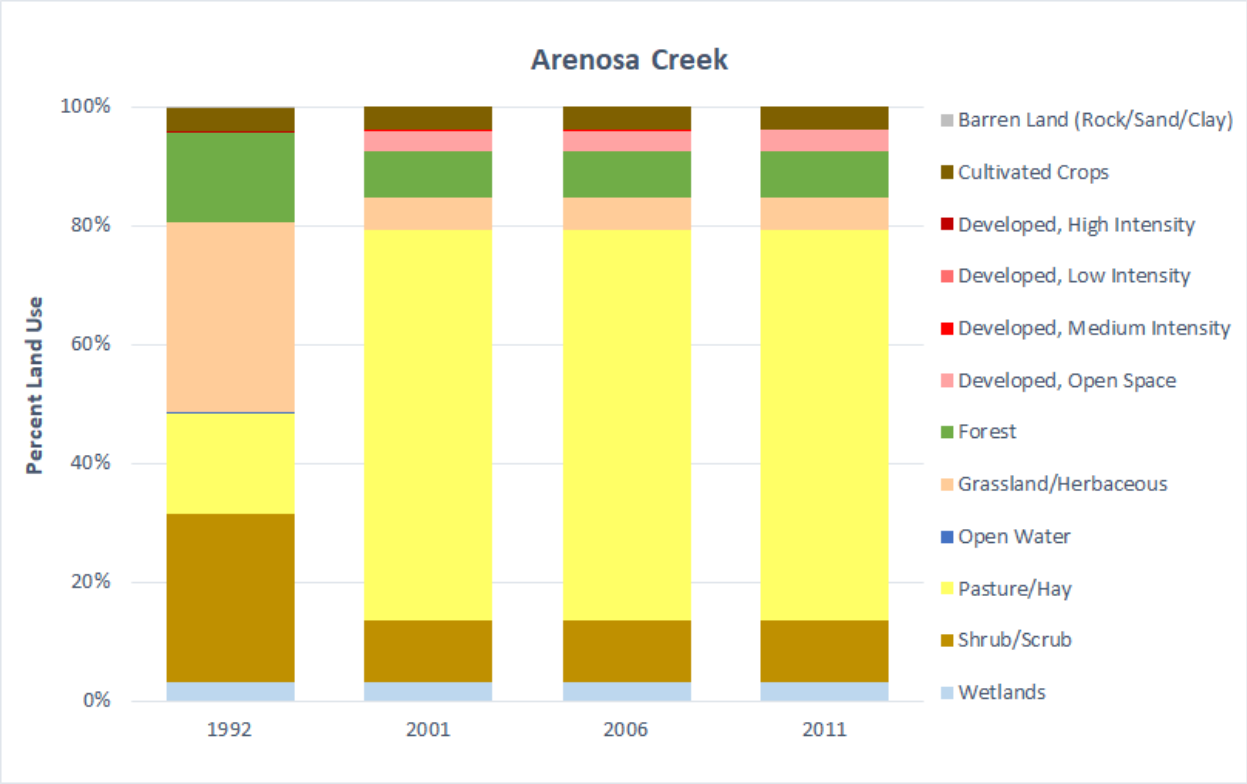


**Figure 383. Percent land use in the Arenosa Creek watershed from 1992-2011.**

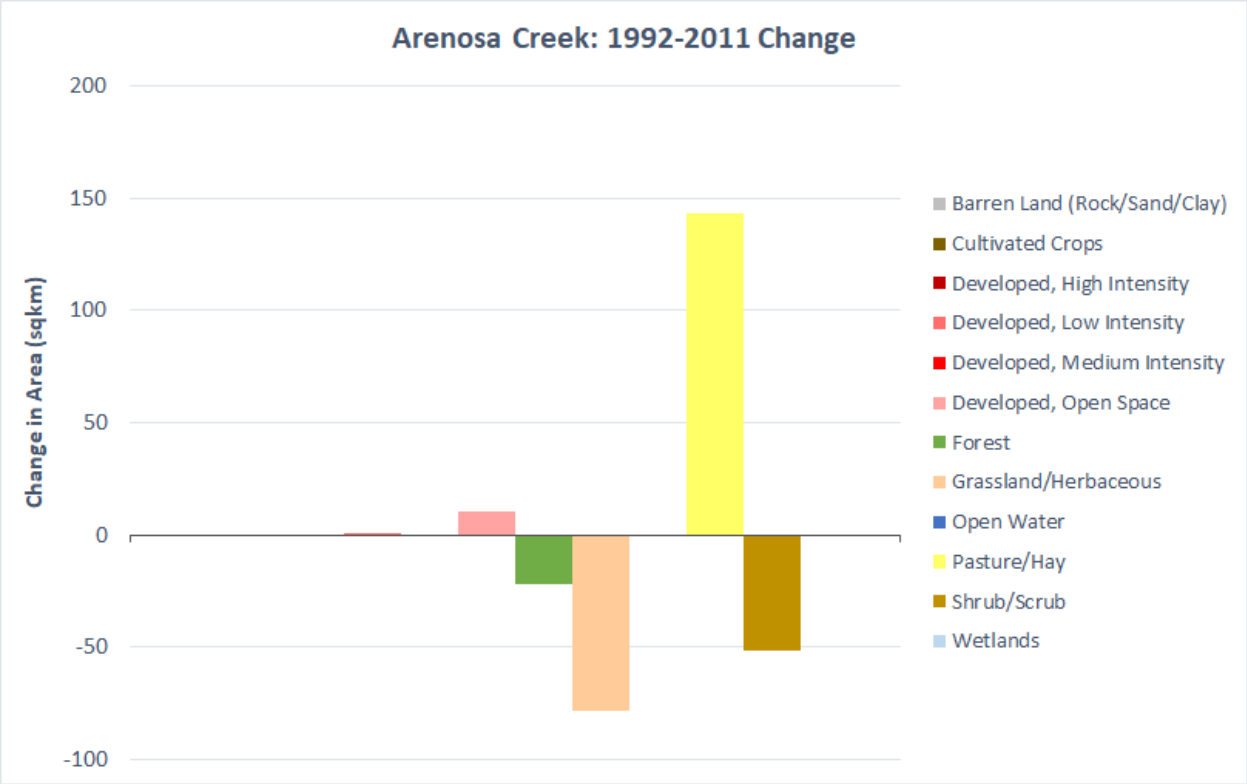


**Figure 384. Land use change in area (sq km) from 1992-2011 for the Arenosa Creek watershed.**

## BIG CREEK

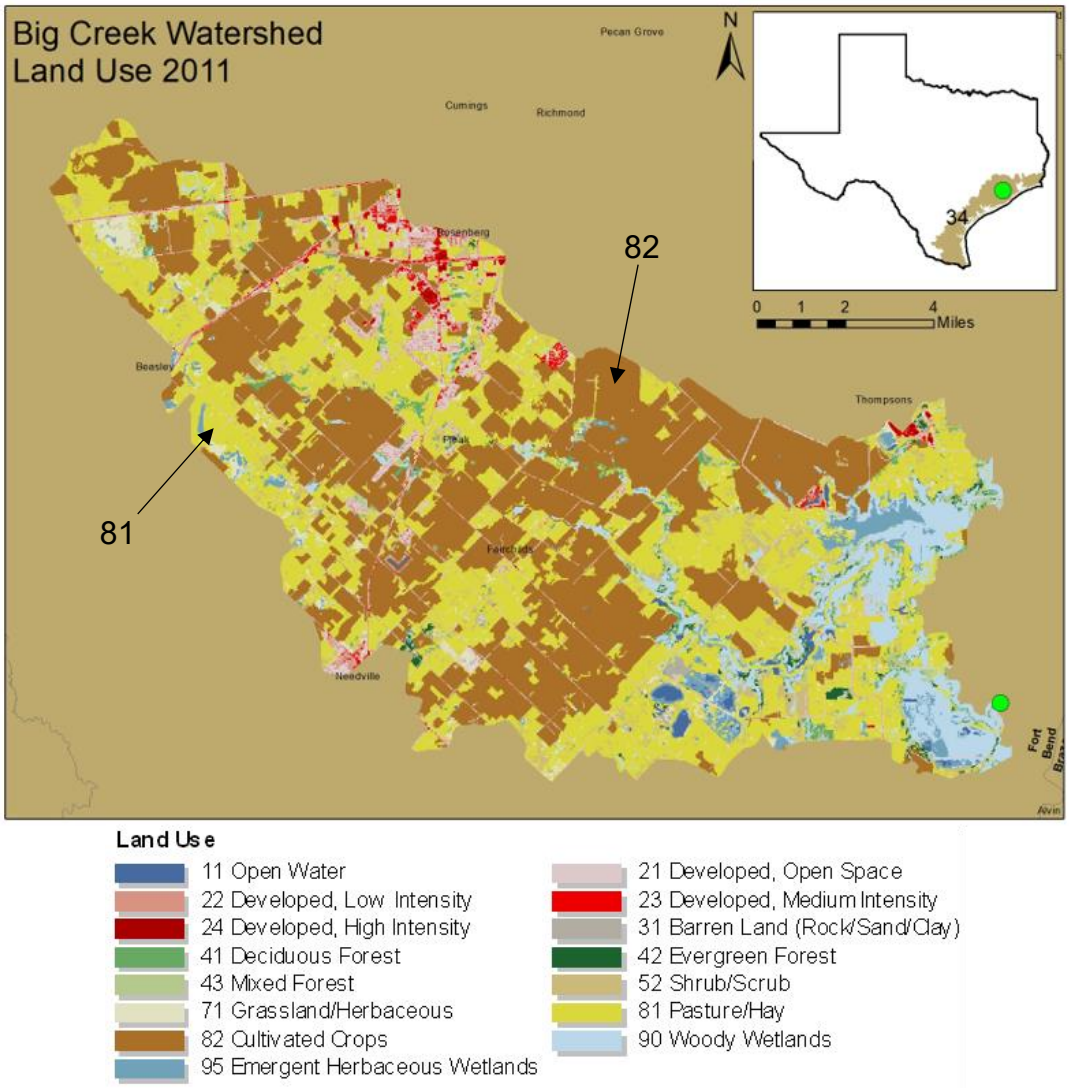


**Figure 385. Map of Big Creek watershed and 2011 land use; cultivated crops and pasture/hay were the most common land uses.**

### Sampling Dates

| | |
|---|---|
| Physical Habitat: | Station 11518 - June 20, 1990; Station 16353 - June 4, 2009; April 29, 2010; Station 17932 - May 12, 2003; August 13, 2003; April 6, 2004; June 9, 2005; April 18, 2006 |
| Water Quality: | 144 sampling events at stations 11518 (38 events), 16353 (79 events and 17932 (27 events) |
| Fish: | Station 11518 - June 20, 1990; Station 16353 - June 4, 2009; September 3, 2009; April 29, 2010; October 6, 2010; Station 17932 - May 12, 2003; August 13, 2003; April 6, 2004; September 3, 2004; June 9, 2005; July 29, 2005; April 18, 2006; October 15, 2006 |

Benthic Invertebrates: Station 11518 - June 20, 1990; Station 16353 - June 6, 2009; September 3, 2009; April 29, 2010; October 7, 2010; Station 17932 - May 12, 2003; August 13, 2003; April 6, 2004; September 3, 2004; June 9, 2005; July 29, 2005; April 18, 2006; October 5, 2006

## Physical Characterization

### Watershed and Land Use

Big Creek lies within the Brazos River Basin. Sample site 17932 is located in Brazos Bend State Park, 0.8 km upstream of the confluence with Waters Lake Bayou in Fort Bend County (Figure 385).

The Big Creek watershed at site 17932 is approximately 429.77 sq km. The station and a very small portion of the lower watershed lies within Level IV Ecoregion 34c, the Floodplains and Low Terraces, while the majority of the watershed lies within Level IV Ecoregion 34a, the Northern Humid Gulf Coastal Prairies. The dominant land cover in the watershed is cultivated crop at 37.33% and is present throughout the middle and upper watershed (Homer et al. 2015; Figure 385 and Figure 386). Pasture/hay is the secondary land cover encompassing 35.6% and is present throughout the watershed. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 7.45% of the watershed.

From 1992-2011 there was a 45.18 sq km decrease in forest and a 30.43 sq km decrease in pasture/hay. There was a 49.47 sq km increase in cultivated crops and an 18.6 sq km increase in open space development (Figure 387).

As of October 2024, there are a total of twelve domestic wastewater outfalls: 10 of which each discharge $< 1$ million gallons per day, and two larger wastewater outfalls (each discharges $\geq 1$ million gallons per day) within the Big Creek watershed. Additionally, permits for two wastewater facilities are pending.

Alligators and seven species of freshwater mussels have been observed in Big Creek.

### In Channel and Riparian Physical Habitat

Physical habitat for Big Creek was evaluated at three sites over eight sampling events from 1990 to 2010. Big Creek is a perennial stream that drains to the Brazos River at Brazos Bend State Park. Habitat Quality Index scores are available for seven sample events, three indicate an intermediate aquatic life use (14 – 18) and four indicate a high aquatic life use rating (20-25). Riparian areas were generally well vegetated throughout the reach with an average riparian buffer ranging from 8 meters wide to greater than 20 meters. The riparian zone was generally dominated by trees followed by shrubs then grasses. The average percentage of tree canopy cover ranged from 21% to 51%.

The dominant stream substrate was clay, and the average percent of substrate gravel size or larger varied from 0% to 40%. Average percent instream cover was 4% to 20% and instream cover types include overhanging vegetation, woody debris, root mats, undercut banks,

logs/snags, and gravel. Big Creek ranged from 0.04-0.70 meters deep on average and 5-10 meters wide. Average stream bank slope ranged from 25-46 degrees. Stream flow at the sites was measured at a minimum value of 0.6 cfs and a maximum of 17 cfs. Average stream bank erosion potential was 15%-47%. The deepest pool measured at Big Creek was 1.75 meters. Number of riffles observed at the sites varied from zero to five, and count of total number of stream bends within the reach ranged from one to six.

### Water Quality

Water samples were collected at three stations: 11518, 16353 and 17932. Sampling at 11518 consisted of 38 sampling events from June 1990 through May 2002. Samples at 16353 were collected at 79 events from January 2009 through November 2019. Samples at station 17932 were collected at 27 events from May 2003 through August 2008. Parameters measured included temperature, flow, transparency (except at station 11518), specific conductance, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, total organic carbon (except at station 11518), chloride, sulfate and chlorophyll-*a*.

## Biological Characterization

### Fish

Fish collections from three sample stations (within approximately 28 km of each other) were used in the evaluation of this river reach. Overall, 44 species (15 families) were collected over the 13 sampling events. Cyprinidae yielded the most species (14) followed by Centrarchidae with ten. Red Shiner, Western Mosquitofish, and Bullhead Minnow were found in every collection. Red Shiner was the most numerous fish in all but two collections, June 1990 and April 2010, where Western Mosquitofish and Striped Mullet (*Mugil cephalus*) outnumbered them, respectively. Of the 13 collections, four rated a high aquatic life use (all within station 17932), seven intermediate, and one limited (August 2003 - also within station 17932). The percentage of individuals classified as tolerant species was very high in 11 of the 13 collections (as high as 85%), intolerant species and benthic invertivores were absent in over one-half of the collections, trophic structure was out of balance, and low numbers of individuals were collected.

### Benthic Macroinvertebrates

A total of 3,426 individuals representing 12 orders of macroinvertebrates were collected from three sites on Big Creek on 13 sample dates (Appendix E). Ephemeroptera, Trichoptera, and Coleoptera were the three most abundant orders. Odonata, Amphipoda, Gastropoda, and Diptera were also well represented in the collections.

The results for the Ecoregion 34 BIBI for the Big Creek benthic assemblage ranged from intermediate to exceptional, with two samples falling in the exceptional aquatic life use category, ten samples falling in the high aquatic life use category, and one sample falling in the intermediate aquatic life use category.

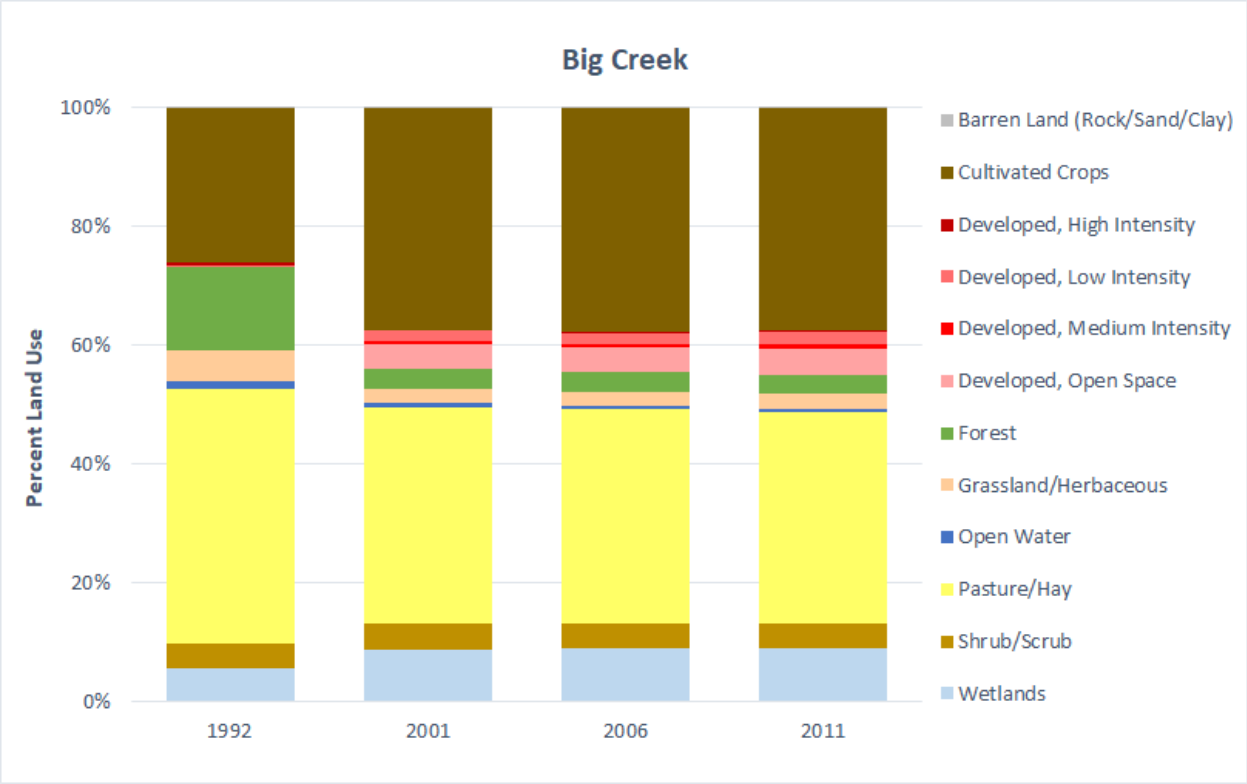


**Figure 386. Percent land use in the Big Creek watershed from 1992-2011.**

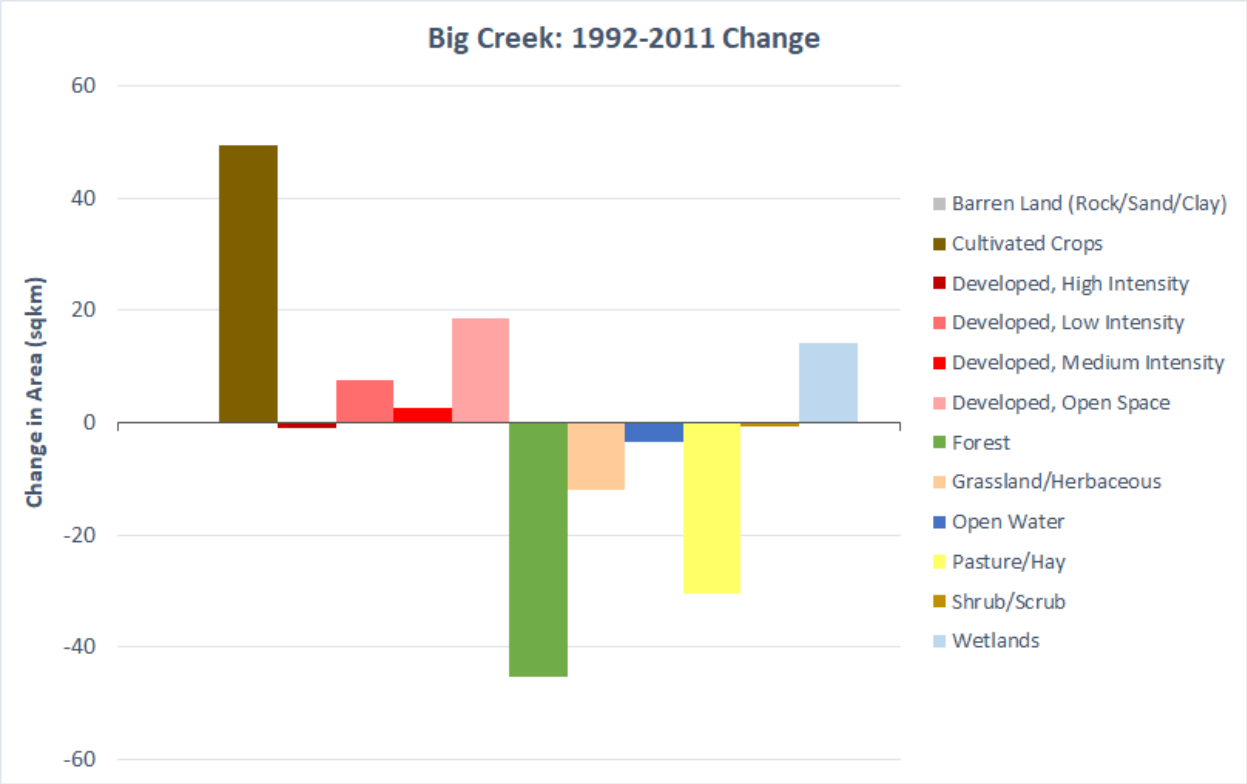


**Figure 387. Land use change in area (sq km) from 1992-2011 for the Big Creek watershed.**

## GARCITAS CREEK

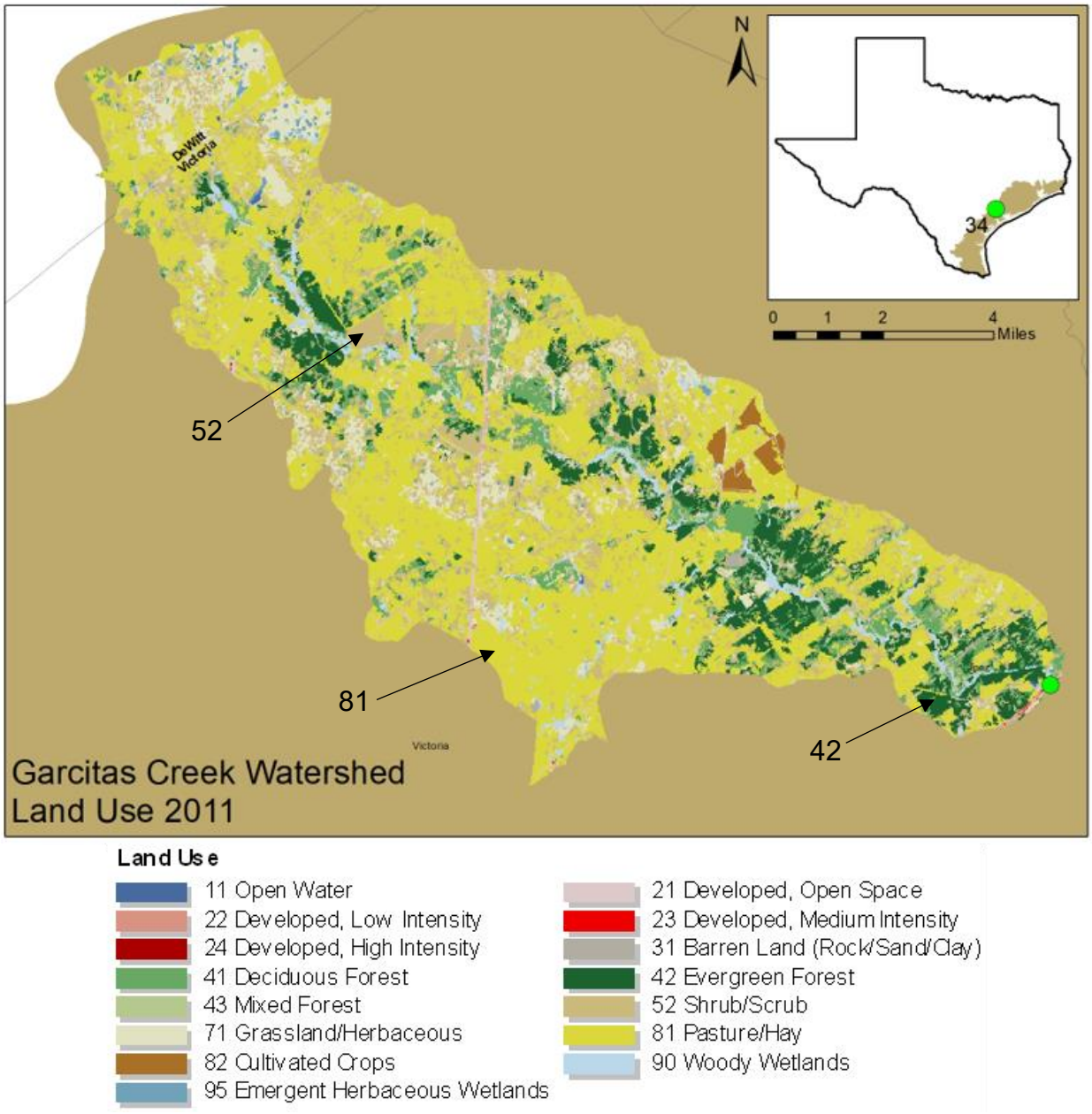


**Figure 388. Map of Garcitas Creek watershed and 2011 land use; pasture/hay, forest, and shrub/scrub were the most common land uses.**

### Sampling Dates

| | |
|---|---|
| Physical Habitat: | August 21, 1987; September 17, 2015; July 13, 2016 |
| Water Quality: | 67 sample events |
| Fish: | August 12, 1987; September 17, 2015; July 13, 2016 |
| Benthic Invertebrates: | August 13, 1988; September 17, 2015; July 13, 2016 |

## Physical Characterization

### Watershed and Land Use

Garcitas Creek lies within the Lavaca-Guadalupe Coastal Basin. Sample site 13291 is located at US Highway 59 north of Victoria, near Inez, in northern Victoria County (Figure 388).

The Garcitas Creek watershed at site 13291 is approximately 239.54 sq km. The entire watershed lies within the Level IV Ecoregion 34a, the Northern Humid Gulf Coastal Prairies. The watershed is dominated by pasture/hay at 48.47% (Homer et al. 2015; Figure 388 and Figure 389). Forest and shrub are the secondary land cover types, encompassing 18.5% and 17.56% of the watershed, respectively. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 3.04% and total cover for cultivated crops is 0.82%.

From 1992-2011 there was a 59.77 sq km decrease in shrub and a 24.91 sq km decrease in grassland. There was a 98.55 sq km increase in pasture/hay (Figure 390).

As of October 2024, there is one domestic wastewater outfall (discharges < 1 million gallons per day) permitted to the Texas Department of Transportation which is located right at the access point to the sample site. Sampling occurred upstream of the wastewater outfall.

### In Channel and Riparian Physical Habitat

Physical habitat for Garcitas Creek was evaluated during three sampling events from 1987 to 2016. Garcitas Creek is an intermittent stream with perennial pools that drains to Garcitas Cove in Lavaca Bay. Habitat Quality Index scores are available for two sample events and both indicate a high aquatic life use rating (21.5 and 24). Riparian areas were well vegetated throughout the reach with an average riparian buffer ranging from 20 meters wide to greater than 20 meters. The riparian zone was generally dominated by trees followed by shrubs then grasses. The average percentage of tree canopy cover ranged from 66% to 96%.

The dominant stream substrate was sand, and the average percent of substrate gravel size or larger varied from 27% to 39%. Average percent instream cover was 46% to 71% and instream cover types include overhanging vegetation, leaf packs, snags, woody debris, root mats, algae, undercut banks, and gravel. Garcitas Creek was 0.2 meters deep on average and 5.5-6.4 meters wide. Average stream bank slope ranged from 26-35 degrees. Stream flow at the site was measured at a minimum value of 0.9 cfs and a maximum of 6.9 cfs. Average stream bank erosion potential was 46%-53%. The deepest pool measured at Garcitas Creek was 1.3 meters. Number of riffles observed at the site varied from one to six, and total number of stream bends ranged from four to nine.

### Water Quality

Water samples were collected at station 13291 over 67 sampling events from November 1986 through July 2016. Parameters measured included temperature, flow, transparency, specific conductance, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen,

phosphorus, total organic carbon, chloride, sulfate and chlorophyll-a. Data include two biological sampling events which were conducted in September 2015 and July 2016.

Continuous flow data is available from USGS gage 08164600 (Figure 391). Between January 1985 through December 2019, the median flow was 2.14 cfs and daily average flows range from 0 cfs to 13,100 cfs. Flows increase sharply with rain events throughout the year and 1.1 percent of daily mean flows are greater than 1000 cfs. Data have been log transformed to better visualize flow patterns.

## Biological Characterization

### Fish

Twenty-four species (nine families) were collected over the course of the three sampling events. Centrarchidae yielded the greatest number of species (eight), followed by Cyprinidae with five. Blacktail Shiner was the most abundant species in the 1987 collection, Bluegill in 2015, and Weed Shiner in 2016. The fish assemblage reflected a slight depression in quality between 1987 and the two most recent collections, declining from a high aquatic life use to intermediate. The main reasons for this decline are the large decrease in native cyprinid species, absence of intolerant species, and the presence of non-native species.

Five native cyprinid species were collected in 1987. In recent collections only one was collected, Weed Shiner (which was also present in the early collection). There was one intolerant species (Dusky Darter) present in the 1987 collection, which was not collected in the 2015 or 2016 sample events.

Non-native species were not found in 1987; however, 10% of the catch in 2015 and 5% of the catch in 2016 was comprised of Redbreast Sunfish. One metric showed an increase in the most recent collections but could signal a shift in overall habitat and flow conditions.

Only three sunfish species were collected in 1987 compared to more than twice that in recent collections. This typically indicates the system has become more lentic in nature. Another indication of this is the apparent loss of Burrhead Chub (*Macrhybopsis marconis*). Burrhead Chub are broadcast spawners, requiring flowing water to successfully reproduce. Being a short-lived species, the absence of optimum flow conditions for two to three successive years can eliminate a population.

### Benthic Macroinvertebrates

Considering all three samples, a total of 564 individuals representing 15 orders of macroinvertebrates were collected from Garcitas Creek (Appendix E). Trichoptera, Ephemeroptera, Odonata, Diptera, Pelecypoda, and Coleoptera were the most commonly collected orders.

The results for the Surber BIBI sample collected in 1988 and the Ecoregion 34 BIBI sample collected in 2015 fell in the exceptional aquatic life use category. The 2016 sample indicated a high aquatic life use category. In contrast to the results for the fish assemblage, which seem to

reflect a slight decline in integrity over time, these results indicate that the biological integrity of the benthic macroinvertebrate assemblage in Garcitas Creek has remained constant or improved slightly over the 22-year period that the three sample events span.

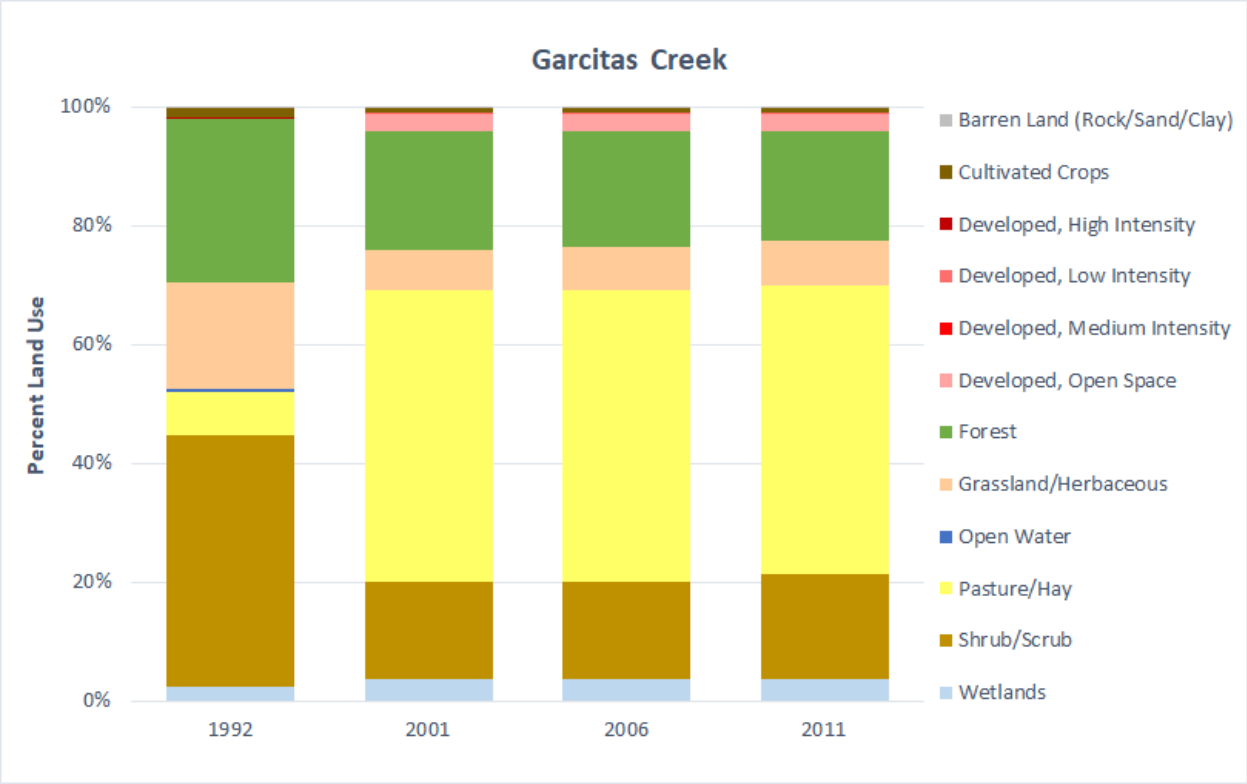


**Figure 389. Percent land use in the Garcitas Creek watershed from 1992-2011.**

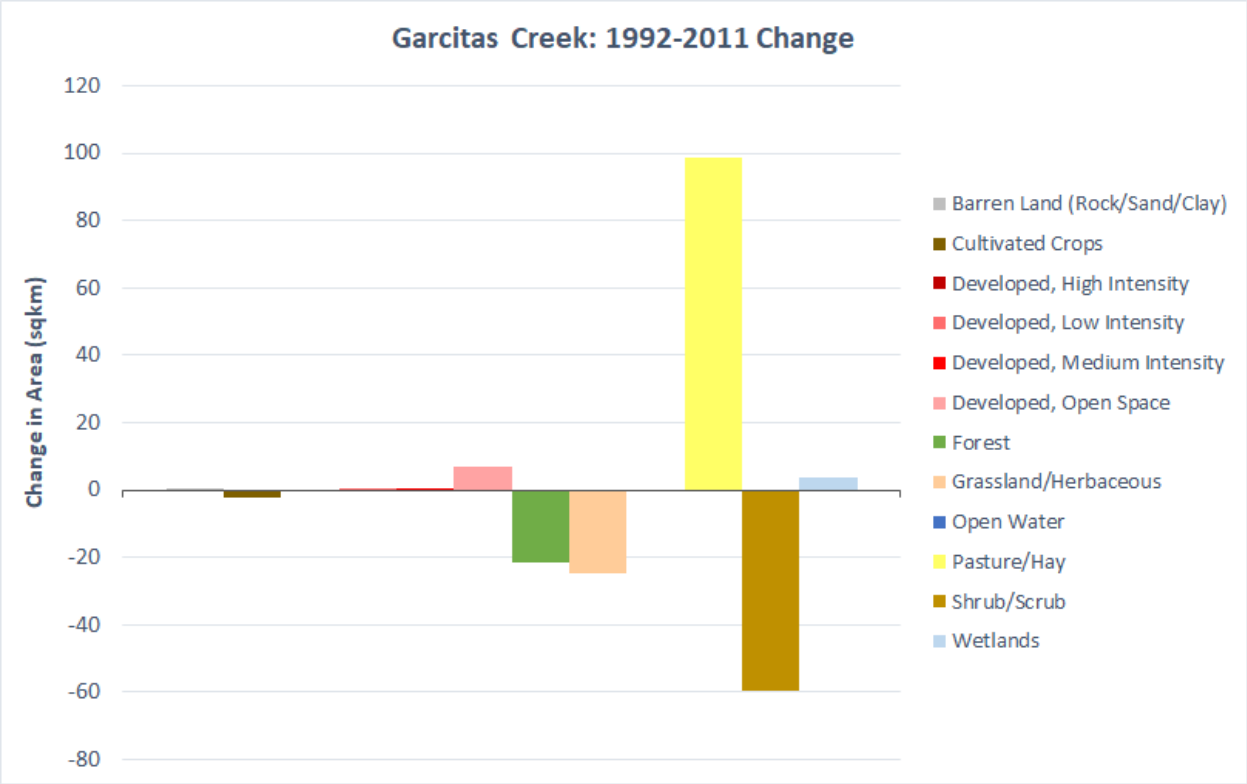


**Figure 390. Land use change in area (sq km) from 1992-2011 for the Garcitas Creek watershed.**

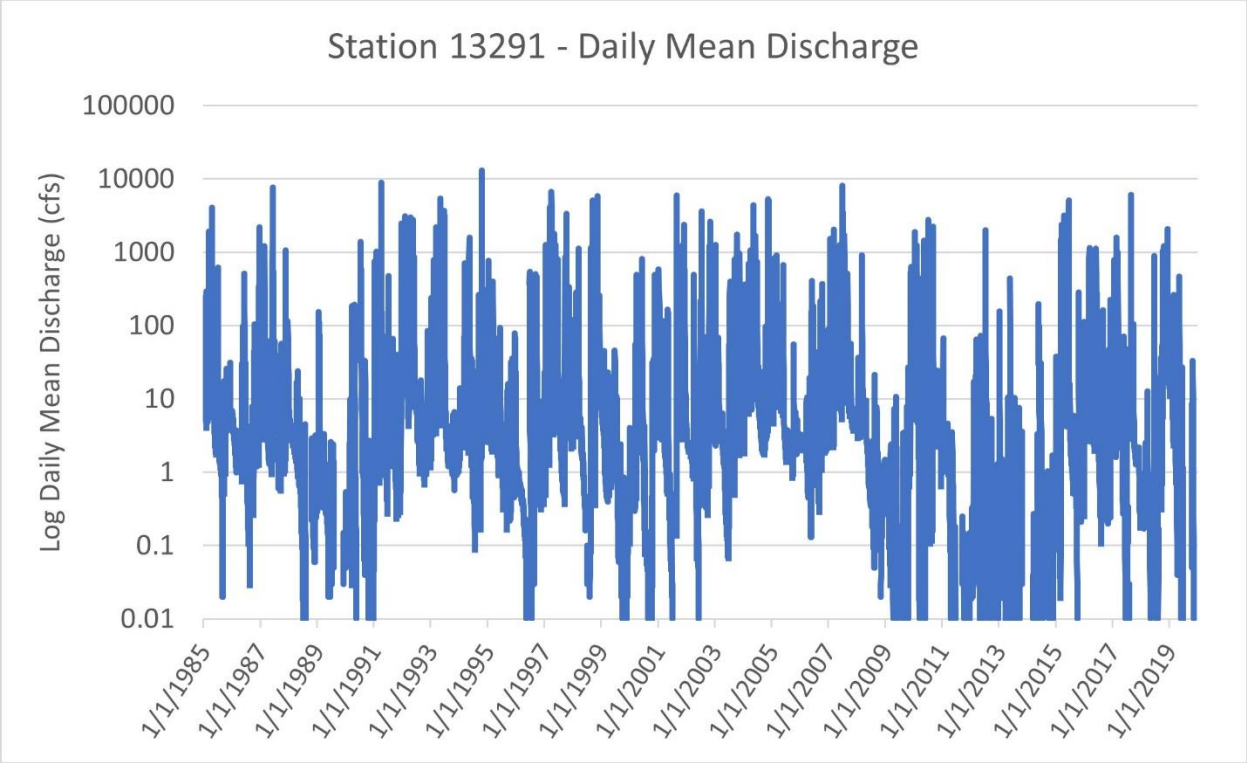


**Figure 391. Log transformed daily mean discharge for Garcitas Creek at station 13291.**

## PLACEDO CREEK

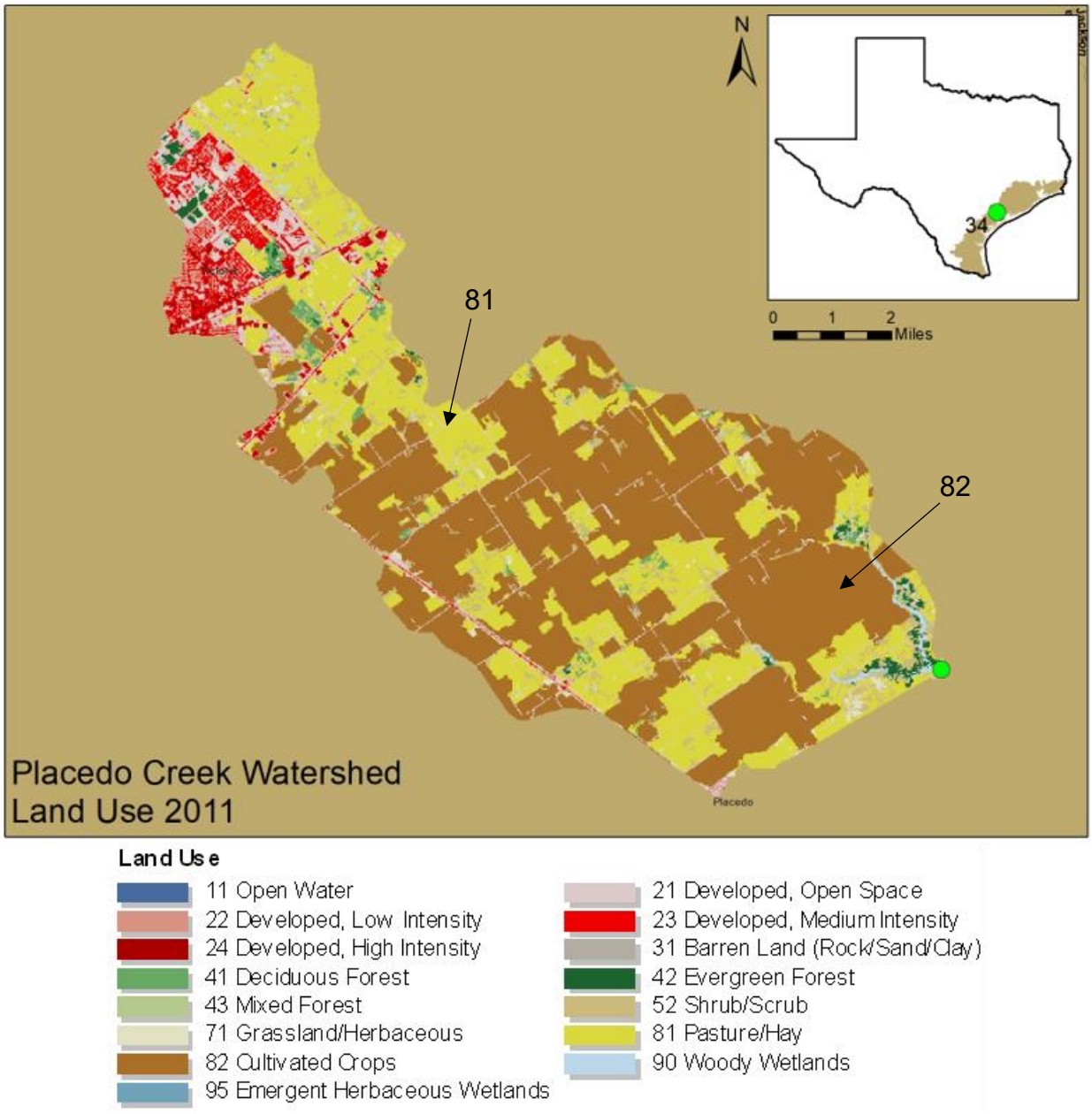


**Figure 392. Map of Placedo Creek watershed location and 2011 land use; cultivated crops and pasture/hay were the most common land uses.**

### Sampling Dates

| | |
|---|---|
| Physical Habitat: | September 6, 1988; July 11, 2017 |
| Water Quality: | 19 sampling events |
| Fish: | September 7, 1988; March 28, 1989; July 11, 2017 |
| Benthic Invertebrates: | September 7, 1988; July 11, 2017 |

## Physical Characterization

### Watershed and Land Use

Placedo Creek lies within the Lavaca-Guadalupe River Coastal Basin. Sample site 13288 is located at FM 616 northeast of Placedo in Victoria County (Figure 392).

The Placedo Creek watershed at site 13288 is approximately 176.07 sq km. The entire watershed lies within the Level IV Ecoregion 34a, the Northern Humid Gulf Coastal Prairies. The dominant land cover in the watershed is cultivated crop at 47.82% and is most dense in the middle and lower portions of the watershed (Homer et al. 2015; Figure 392 and Figure 393). Pasture/hay is the secondary land cover encompassing 30% and is present throughout the watershed. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 12.74% of the watershed.

From 1992-2011 there was a 16.78 sq km decrease in grassland and a 10.17 sq km decrease in forest. There was a 14 sq km increase in cultivated crops and a 9.14 sq km increase in pasture/hay (Figure 394).

As of October 2024, there are no permitted wastewater outfalls within the Placedo Creek watershed.

### In Channel and Riparian Physical Habitat

Physical habitat for Placedo Creek was evaluated on September 6, 1988 and again on July 11, 2017. Placedo Creek is a coastal stream that drains to Lavaca Bay. The following summary is based on data collected during the sampling event in 2017. The Habitat Quality Index score of 16 indicates an intermediate aquatic life use rating. Riparian areas were well vegetated throughout the reach with an average riparian buffer measured at greater than 20 meters. The riparian zone was dominated by grasses, which make up an average of 75% of the total riparian species, followed by shrubs (15%) then trees (10%). The average percentage of tree canopy cover was 95%.

The dominant substrate was silt, and the average percent of substrate that was gravel size or larger was 11%. Average percent instream cover was 86% and instream cover types include woody debris, undercut banks, and tree roots. Placedo Creek was 0.25 meters deep on average and 5 meters wide. Average stream bank slope was 42 degrees, and average stream bank erosion potential was 26%. The deepest pool measured at Placedo Creek was 0.97 meters. Stream flow at the site was measured at a minimum value of 0 cfs in 1988 and a maximum of 1 cfs in 2017. One riffle was observed at the site and there were three total stream bends within the reach.

### Water Quality

Water samples were collected at station 13288 over 19 sampling events from September 1988 through July 2017. Parameters measured included temperature, flow, specific conductance, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, total organic carbon, chloride, sulfate and chlorophyll-*a*.

Continuous flow data is available from USGS gage 08164800 (Figure 395). Between January 1985 through December 2019, the median flow was 10.2 cfs and daily average flows range from 0 cfs to 10,100 cfs. Flows increase sharply with rain events throughout the year and 1.2 percent of daily mean flows are greater than 1000 cfs. Data have been log transformed to better visualize flow patterns.

## Biological Characterization

### Fish

Only 13 species (eight families) were collected over the course of the three sampling events. Centrarchidae was the richest family, yielding five species. Western Mosquitofish was the most abundant species in each collection. All three fish collections yielded an intermediate aquatic life use rating. No intolerant or benthic invertivore species were collected. Only one cyprinid species (Red Shiner) was in the assemblage, and low numbers of individuals were collected.

Of special significance, however, was the collection of four American Eel in 1988. There has been recent concern over the status of this migratory species throughout the United States.

### Benthic Macroinvertebrates

A total of 16,585 individuals representing 77 macroinvertebrate taxa from 14 orders were identified in the Surber sample collected in 1988 and the RBP kicknet sample collected in 2017 from Placedo Creek (Appendix E). Oligochaeta and Ostracoda were collected in large numbers in the Surber sample, representing 99% of the individuals collected. Other groups well represented in both samples included the Gastropoda, Diptera, Coleoptera, Odonata, Trichoptera, and Ephemeroptera.

Despite the predominance of oligochaetes in the sample, the quantitative Surber BIBI score for the sample falls in the range indicating a high aquatic life use. A relatively high taxa richness, high number of intolerant taxa, and high percent collector-gatherer taxa contributed to the sample BIBI falling in the high aquatic life use category. There was more even distribution of individuals among taxa in the RBP kicknet sample. The result for the Ecoregion 34 RBP BIBI also indicated that the benthic assemblage in Placedo Creek falls in the high aquatic life use category. These results indicate that the integrity of the benthic assemblage in Placedo Creek has remained high over the 29-year interim period between collections.

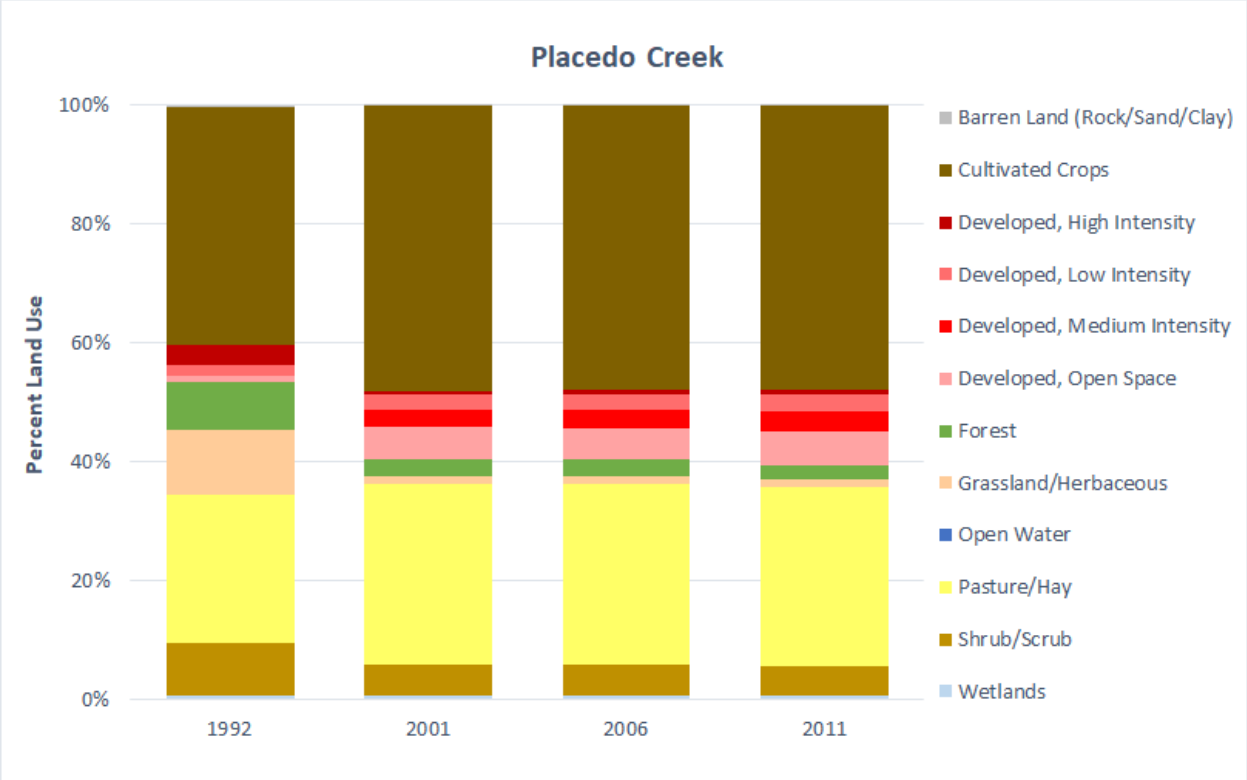


**Figure 393. Percent land use in the Placedo Creek watershed from 1992-2011.**

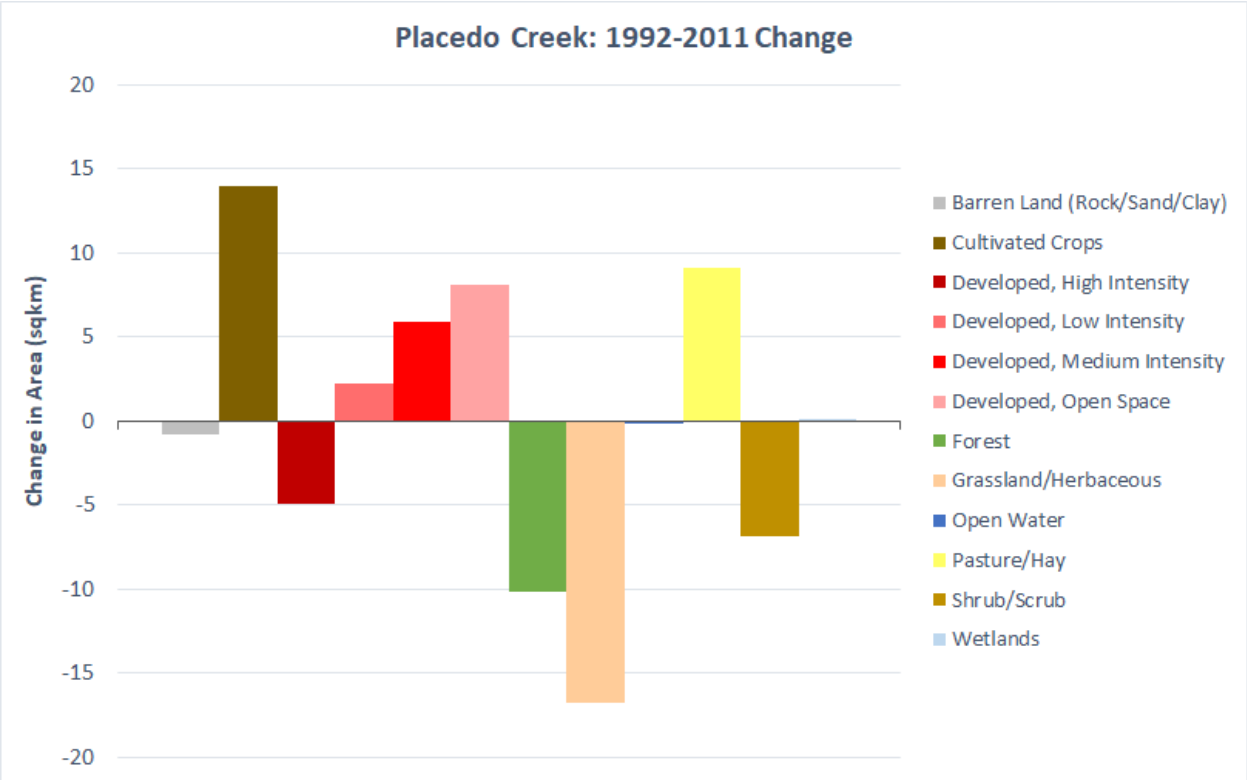


**Figure 394. Land use change in area (sq km) from 1992-2011 for the Placedo Creek watershed.**

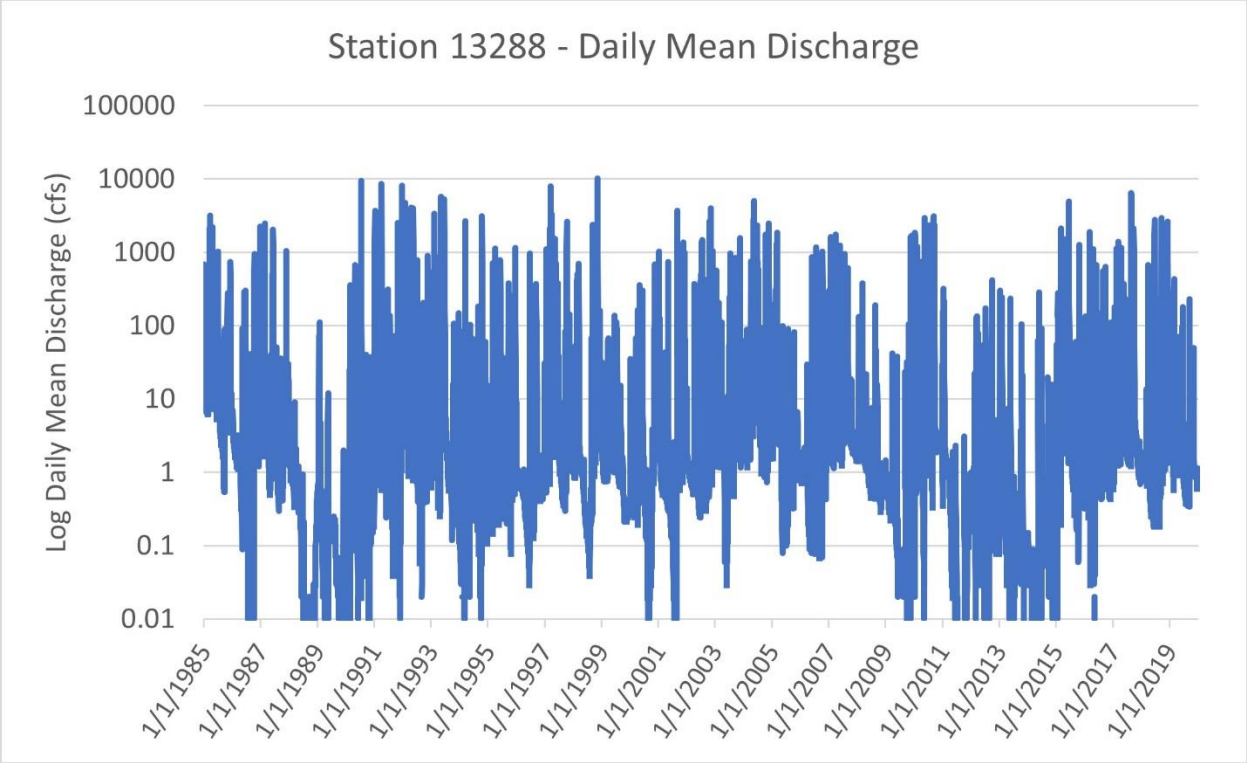


**Figure 395. Log transformed daily mean discharge for Placedo Creek at station 13288.**

## SAN BERNARD RIVER

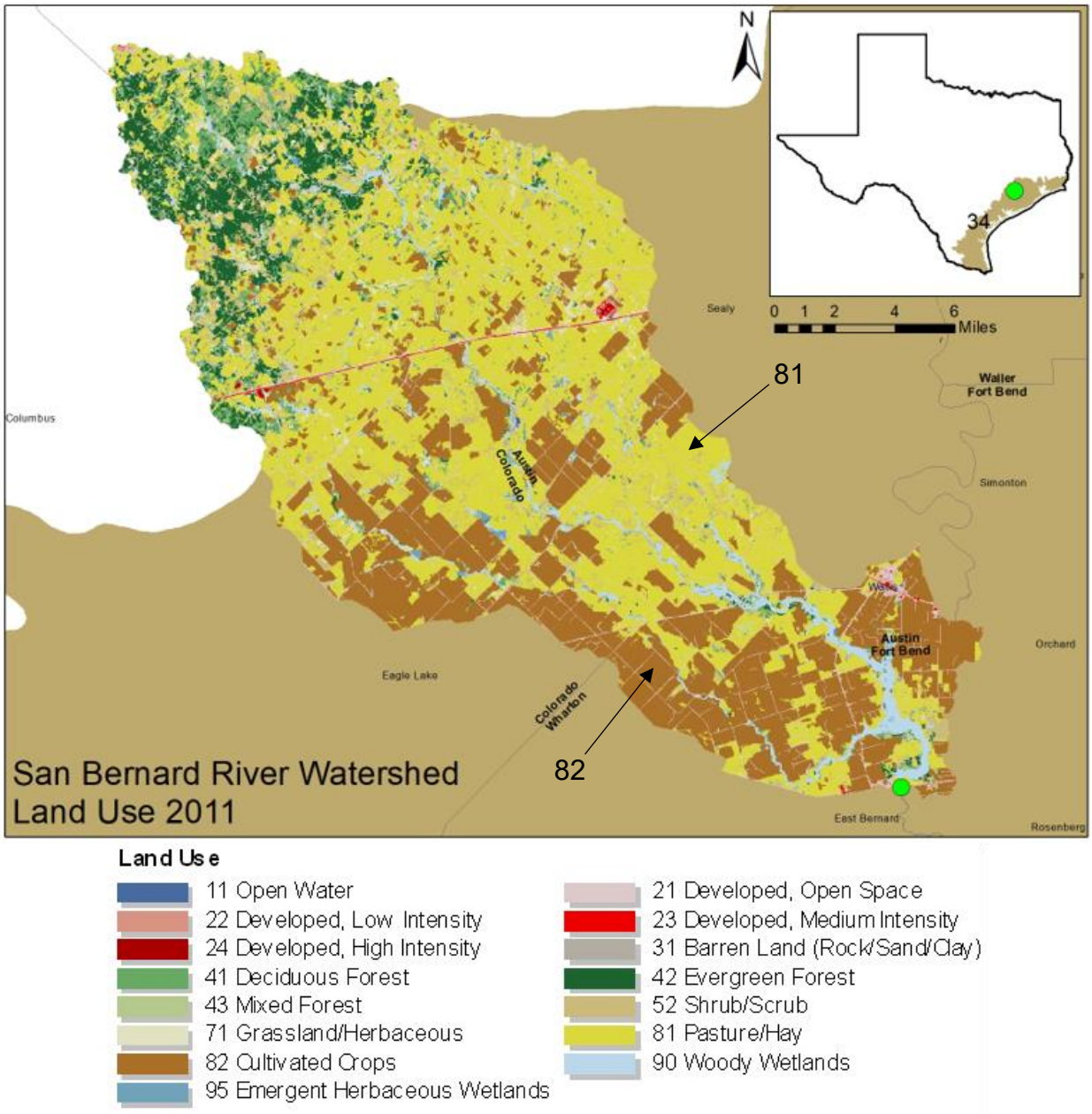


**Figure 396. Map of San Bernard River watershed and 2011 land use; pasture/hay and cultivated crops were the most common land uses.**

### Sampling Dates

| | |
|---|---|
| Physical Habitat: | June 23, 2003; August 26, 2003; May 17, 2006 |
| Water Quality: | 99 sampling events |
| Fish: | June 23, 2003; August 26, 2003; May 17, 2006; October 5, 2006 |
| Benthic Invertebrates: | June 23, 2003; August 26, 2003; May 17, 2006; October 5, 2006 |

## Physical Characterization

### Watershed and Land Use

The San Bernard River lies within the Brazos-Colorado River Coastal Basin. Sample site 16373 is located downstream of US 90A in East Bernard in Wharton County (Figure 396).

The San Bernard River watershed at site 16373 is approximately 885.18 sq km. Most of the watershed lies within the Level IV Ecoregion 34a, the Northern Humid Gulf Coastal Prairies. The upper watershed lies within the Level IV Ecoregion 33b, the Southern Post Oak Savannah. The dominant land cover in the watershed is pasture/hay at 44.56% and is most dense in the middle of the watershed (Homer et al. 2015; Figure 396 and Figure 397). Cultivated crop is the secondary land cover encompassing 26.44% and is most dense in the lower watershed. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 4.7% of the watershed.

From 1992-2011 there was a 127.76 sq km decrease in pasture/hay and a 24.56 sq km decrease in forest. There was a 112.09 sq km increase in cultivated crops and a 35.51 sq km increase in open space development (Figure 398).

As of October 2024, there are four domestic wastewater outfalls (discharges < 1 million gallons per day) and one pending permit within the San Bernard River watershed. None of these facilities discharge directly into the San Bernard River.

### In Channel and Riparian Physical Habitat

Physical habitat for the San Bernard River was evaluated during three sampling events from 2003 to 2006. The San Bernard River is a perennial stream that drains to the Gulf of Mexico. Habitat Quality Index scores for all three events indicate an intermediate to high aquatic life use rating (18-21). Riparian areas were generally well vegetated throughout the reach with an average riparian buffer ranging from 9.5 meters wide to greater than 20 meters. The riparian zone was dominated by trees followed by shrubs then grasses. The average percentage of tree canopy cover ranged from 75% to 98%.

The dominant stream substrate was sand, and the average percent of substrate gravel size or larger varied from 6% to 16%. Average percent instream cover was 5% to 27% and instream cover types include undercut banks, woody debris, tree roots, and gravel. The San Bernard River ranged from 0.15-0.53 meters deep on average and 5.4-9.4 meters wide. Average stream bank slope ranged from 28-53 degrees. Stream flow at the site was measured at a minimum value of 2.4 cfs and a maximum of 20 cfs. Average stream bank erosion potential was 11%-38%. The deepest pool measured at the San Bernard River was 1.3 meters. Number of riffles observed at the site varied from one to two, and total number of stream bends ranged from four to five.

### Water Quality

Water samples were collected at station 16373 over 99 sampling events from July 1997 through October 2019. Parameters measured included temperature, flow, transparency, specific

conductance, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, total organic carbon, chloride, sulfate and chlorophyll-*a*.

## Biological Characterization

### Fish

Twenty-five species (eight families) were collected over the course of four sampling events. Cyprinidae and Centrarchidae were the two richest families, yielding seven and six species, respectively. Blacktail Shiner was the most abundant species in June 2003 and May 2006 whereas Western Mosquitofish and Ribbon Shiner were the most abundant species in August 2003 and October 2006, respectively. Three of the four fish assemblages scored as having an exceptional aquatic life use. When the coefficient of variability is applied, all score as exceptional.

### Benthic Macroinvertebrates

Forty-eight taxa representing 13 orders of macroinvertebrates were collected in the four RBP kicknet samples (Appendix E). Taxa richness for individual samples ranged from 25 for the sample collected in June 2003, to 30 in the sample collected in October 2006. Ephemeroptera, Trichoptera, Odonata, and Coleoptera were the most common taxa in the samples, collectively representing approximately 80% of the total number of individuals collected over the four sample dates. Other groups well represented in the samples included class Bivalvia (primarily *Corbicula fluminea* and *Eupera cubensis*), Decapoda (primarily Cambaridae and *Palaemonetes*), and the amphipod *Hyallela azteca*.

Results for the Ecoregion 34 macroinvertebrate IBI fell in the exceptional aquatic life use category for all four samples.

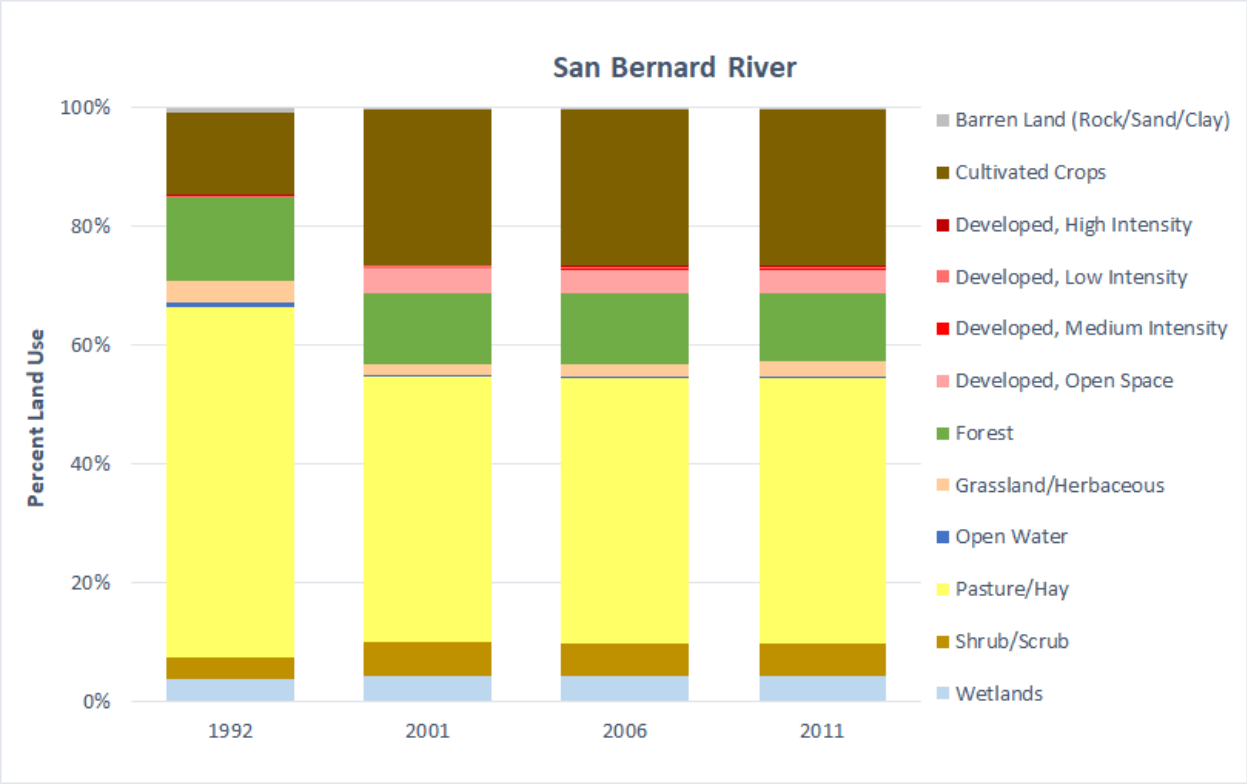


**Figure 397. Percent land use in the San Bernard River watershed from 1992-2011.**

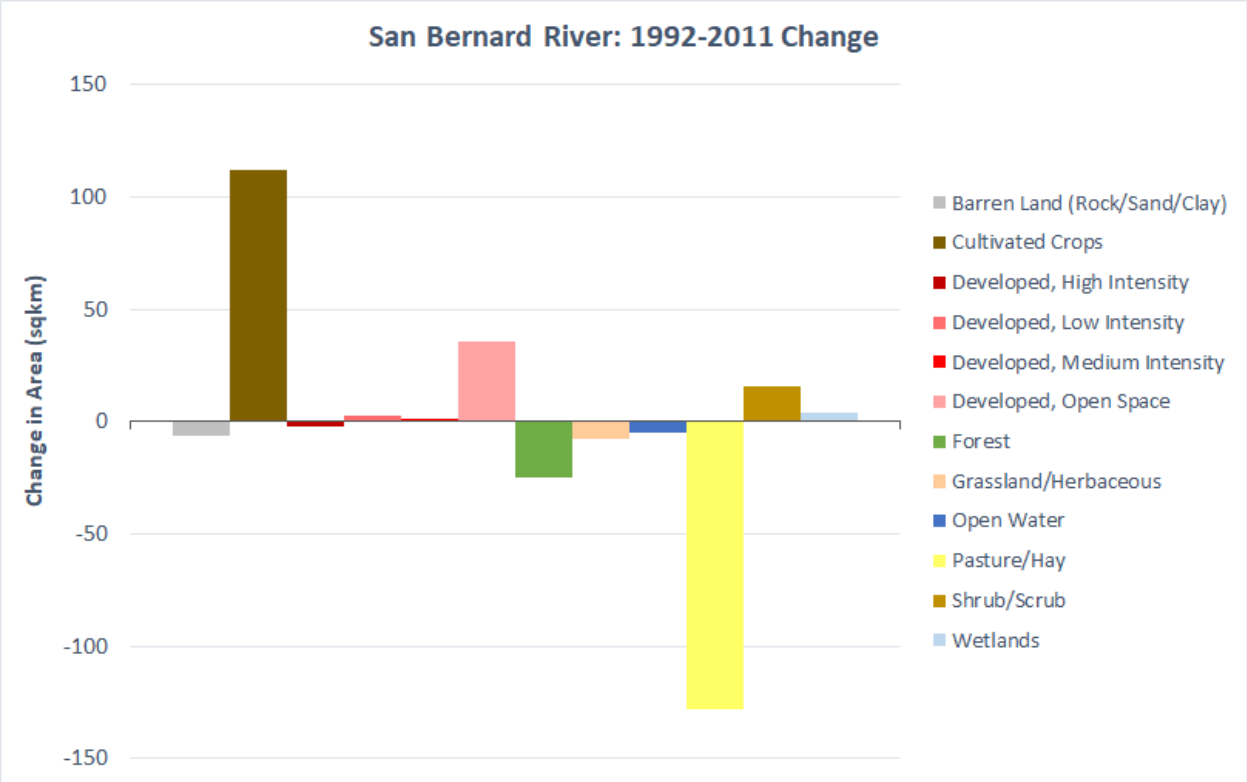


**Figure 398. Land use change in area (sq km) from 1992-2011 for the San Bernard River watershed.**

## WEST BERNARD CREEK

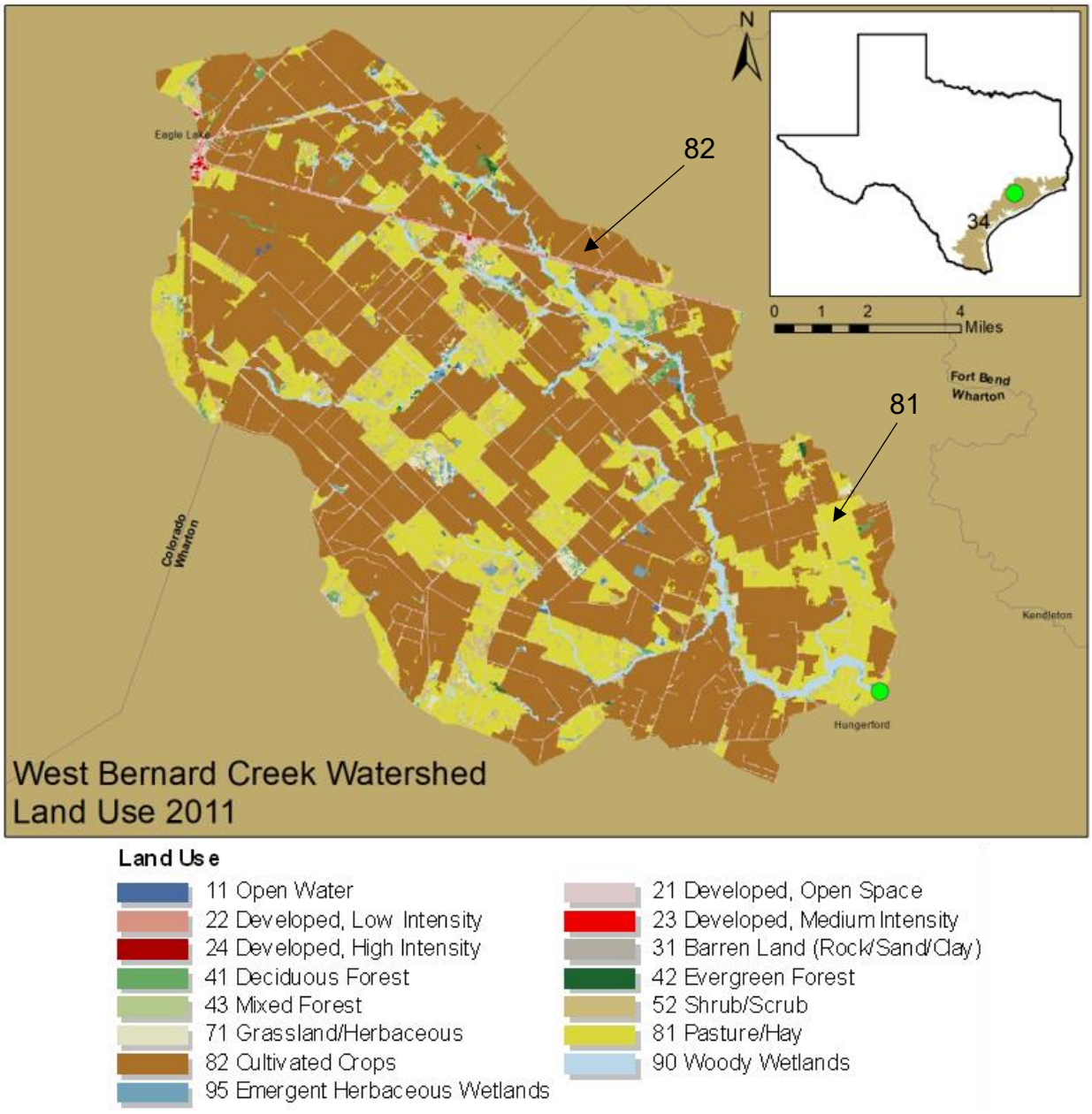


**Figure 399. Map of West Bernard Creek watershed and 2011 land use; cultivated crops and pasture/hay were the most common land uses.**

### Sampling Dates

| | |
|---|---|
| Physical Habitat: | June 20, 1990; August 26, 2008; April 14, 2009, June 15, 2010 |
| Water Quality: | 20 sampling events |
| Fish: | June 20, 1990; August 26, 2008; April 14, 2009, June 15, 2010 |
| Benthic Invertebrates: | June 20, 1990; August 26, 2008; April 14, 2009, June 15, 2010 |

## Physical Characterization

### Watershed and Land Use

West Bernard Creek lies within the Brazos-Colorado River Coastal Basin. Sample site 12131 is located 50 m downstream of SH 60, 4.8 km north of Hungerford in Wharton County (Figure 399).

The West Bernard Creek watershed at site 12131 is approximately 387.15 sq km. The entire watershed lies within the Level IV Ecoregion 34a, the Northern Humid Gulf Coastal Prairies. The dominant land cover in the watershed is cultivated crop at 61.74% and is present throughout the watershed (Homer et al. 2015; Figure 399 and Figure 400). Pasture/hay is the secondary land cover encompassing 23.43%. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 4.81% of the watershed.

From 1992-2011 there was a 70.72 sq km decrease in forest and a 20.33 sq km decrease in grassland. There was a 118.28 sq km increase in cultivated crops and a 15.98 sq km increase in open space development (Figure 401).

As of October 2024, there are no permitted wastewater outfalls within the West Bernard Creek watershed.

### In Channel and Riparian Physical Habitat

Physical habitat for West Bernard Creek was evaluated during four sampling events from 1990 to 2010. West Bernard Creek is a perennial stream that drains to the San Bernard River. Habitat Quality Index scores are available for three sample events and indicate an intermediate aquatic life use rating (16-18). Riparian areas were well vegetated throughout the reach with an average riparian buffer ranging from 16 meters wide to greater than 20 meters. The riparian zone was generally dominated by trees followed by grasses then shrubs. The average percentage of tree canopy cover ranged from 65% to 94%.

The dominant stream substrate was clay, and the average percent of substrate gravel size or larger varied from 0% to 15%. Average percent instream cover was 20% to 29% and instream cover types include overhanging vegetation, woody debris, undercut banks, logs, and gravel. West Bernard Creek ranged from 0.4-0.7 meters deep on average and 4-14 meters wide. Average stream bank slope ranged from 33-39 degrees. Stream flow at the site was measured at a minimum value of 9.3 cfs and a maximum of 78 cfs. Average stream bank erosion potential was 10%-31%. The deepest pool measured at West Bernard Creek was 1 meter deep in 1990, and no pools were documented during later sampling events. Number of riffles observed at the site varied from zero to one, and total number of stream bends ranged from one to seven.

### Water Quality

Water samples were collected at station 12131 over 20 sampling events from June 1990 through September 2012. Parameters measured included temperature, flow, transparency, specific

conductance, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, total organic carbon, chloride, sulfate and chlorophyll-*a*.

## Biological Characterization

### Fish

Thirty species (10 families) were collected over the course of the four sampling events. Centrarchidae and Cyprinidae yielded most of the species with nine and eight, respectively. Western Mosquitofish was the most abundant species collected in 1990, 2008 (equally abundant with Blacktail Shiner), and 2010. Longear Sunfish was the most abundant species in 2009. Based on the fish assemblage, the aquatic life use rated as exceptional in 1990 and 2010, and high in 2008 and 2009; however, when the coefficient of variability is applied, the 2009 sample also rates as exceptional. Non-native fish species were only collected in one sample (2010), when Common Carp comprised 1.3% of the individuals. Number of individuals collected was consistently low and percentage of individuals classified as tolerant species was moderately high in three of the four samples, mostly due to the moderately large numbers of Green Sunfish.

Of special significance was the collection of one American Eel in 2010. There has been recent concern over the status of this migratory species throughout the United States.

### Benthic Macroinvertebrates

A total of 2,436 individuals representing 77 taxa from 16 orders of benthic macroinvertebrates were collected over the four sample dates (Appendix E). Taxa richness for the 1990 Surber sample was 49, while the RBP kicknet samples collected in 2008, 2009 and 2010 yielded taxa richness values of 21,19, and 22, respectively. Across all four sample dates, Trichoptera, Coleoptera, Ephemeroptera, Diptera, and Gastropoda were the most abundant groups, representing approximately 63.4% of total numbers collected. Oligochaetes represented approximately 29.7% of the total number of individuals collected; however, they were all collected in the 1990 Surber sample and were not represented in the three RBP kicknet samples.

The aquatic life use characterization, based on the Ecoregion 34 quantitative Surber BIBI, fell in the exceptional category. The Ecoregion 34 RBP BIBI results for both the 2008 and the 2010 samples also indicated an exceptional aquatic life category, while the results for the 2009 RBP sample fell in the high aquatic life use category. These results indicate that the biological integrity of West Bernard Creek has remained relatively constant in the high to exceptional aquatic life use category over the 20-year span covered by the four samples.

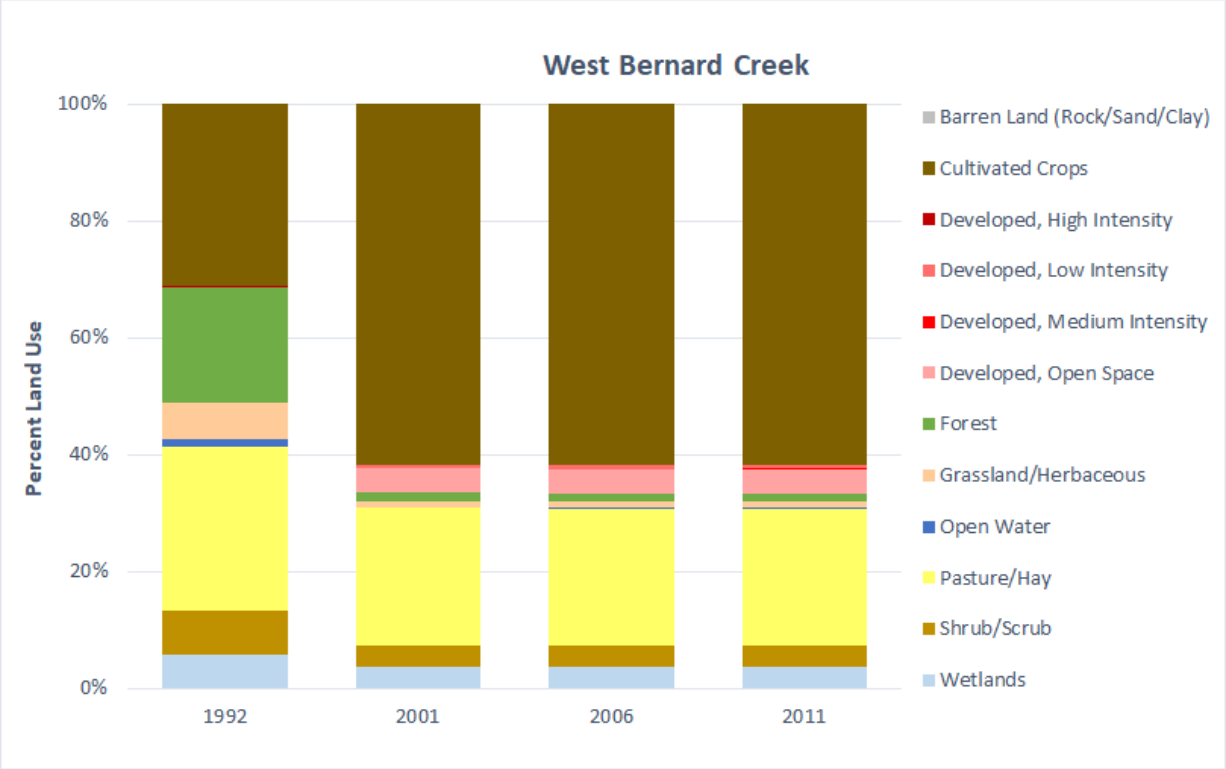


**Figure 400. Percent land use in the West Bernard Creek watershed from 1992-2011.**

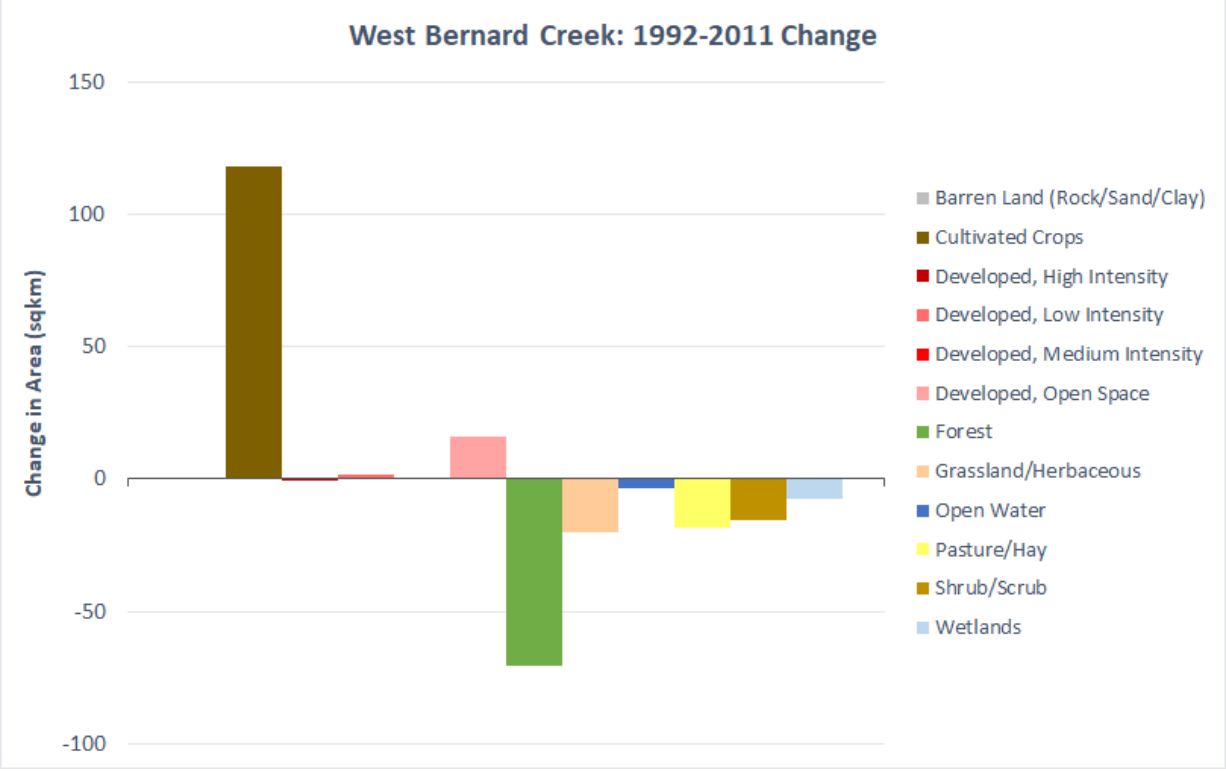


**Figure 401. Land use change in area (sq km) from 1992-2011 for the West Bernard Creek watershed.**

## WEST CARANCAHUA CREEK

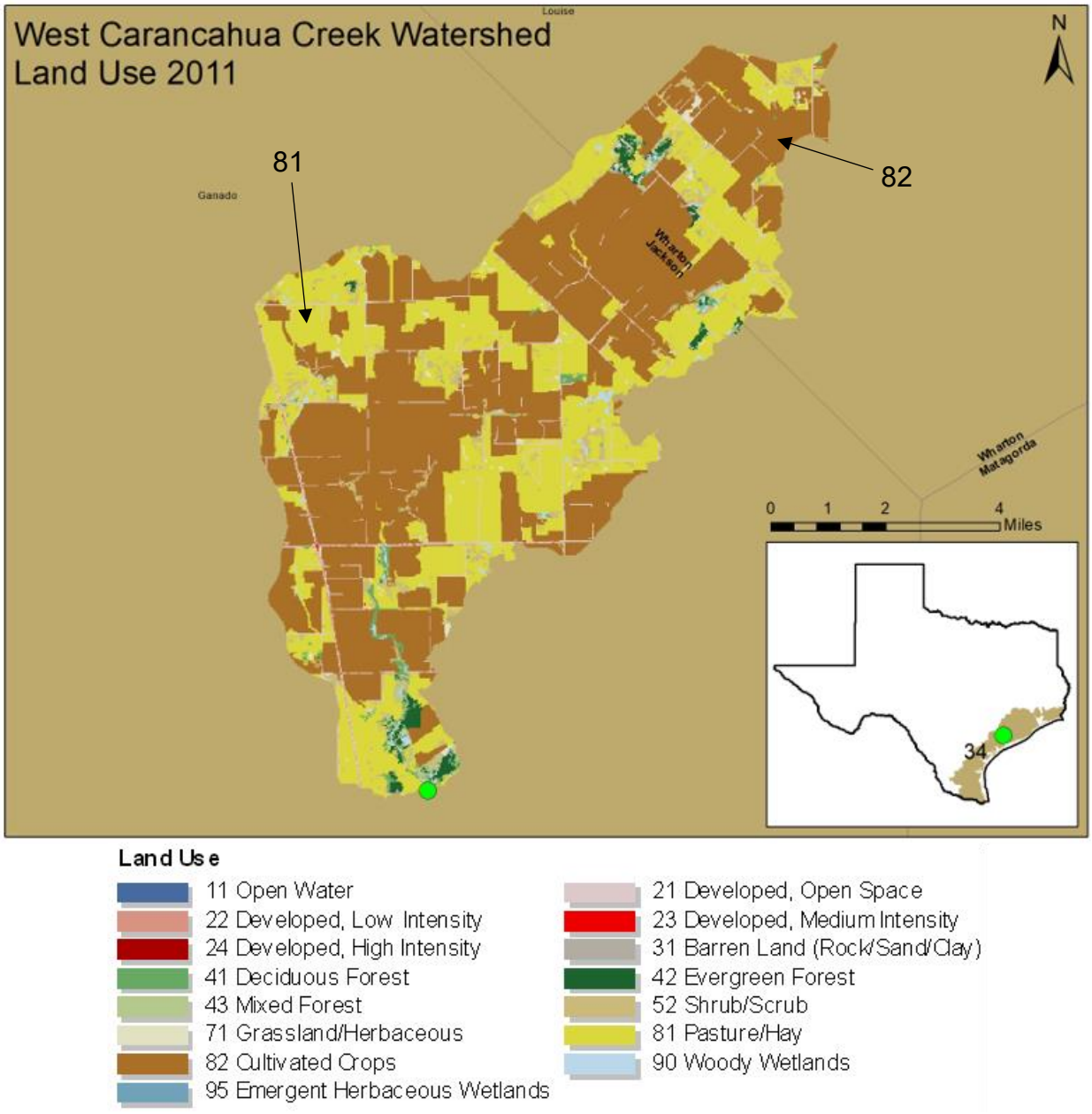


**Figure 402. Map of West Carancahua Creek watershed and 2011 land use; cultivated crops and pasture/hay were the most common land uses.**

### Sampling Dates

| | |
|---|---|
| Physical Habitat: | September 6, 1988; June 15, 2010; June 7, 2012 |
| Water Quality: | 25 sampling events |
| Fish: | September 7, 1988; March 28, 1989; June 15, 2010; June 7, 2012 |
| Benthic Invertebrates: | September 7, 1988; June 15, 2010; June 7, 2012 |

## Physical Characterization

### Watershed and Land Use

West Carancahua Creek lies within the Colorado-Lavaca River Coastal Basin. Sample site 13293 is located at CR 440, 5.6 km northeast of La Ward in Jackson County (Figure 402).

The West Carancahua Creek watershed at site 13293 is approximately 154.82 sq km. The entire watershed lies within the Level IV Ecoregion 34a, the Northern Humid Gulf Coastal Prairies. The dominant land cover in the watershed is cultivated crop at 54.46% and is present throughout the watershed (Homer et al. 2015; Figure 402 and Figure 403). Pasture/hay is the secondary land cover encompassing 33.32%. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 3.7% of the watershed.

From 1992-2011 there was a 4.98 sq km decrease in grassland and a 4.69 sq km decrease in forest. There was a 5.26 sq km increase in open space development and a 4.61 sq km increase in cultivated crops (Figure 404).

As of October 2024, there are no permitted wastewater outfalls within the West Carancahua Creek watershed.

### In Channel and Riparian Physical Habitat

Physical habitat for West Carancahua Creek was evaluated during three sampling events from 1988 to 2012. West Carancahua Creek is a stream that drains to Carancahua Bay. Habitat Quality Index scores are available for two sample events and indicate an intermediate aquatic life use rating (16 and 18). Riparian areas were generally well vegetated throughout the reach with an average riparian buffer ranging from 13 to 14 meters wide. The riparian zone was dominated by trees followed by shrubs and grasses. The average percentage of tree canopy cover ranged from 74% to 97%.

The dominant stream substrate was sand, and the average percent of substrate gravel size or larger varied from 2% to 10%. Average percent instream cover was 8% to 19% and instream cover types include overhanging vegetation, woody debris, and root mats. West Carancahua Creek ranged from 0.1-0.2 meters deep on average and 2.7-4.3 meters wide. Average stream bank slope was 32.5 degrees. Stream flow at the site was measured at a minimum value of 0.3 cfs and a maximum of 0.6 cfs. Average stream bank erosion potential was 38%-48%. The deepest pool measured at West Carancahua Creek was 1.5 meters. Number of riffles observed at the site varied from zero to three, and total number of stream bends ranged from two to seven.

### Water Quality

Water samples were collected at station 13293 over 25 sampling events from September 1988 through June 2012. Parameters measured included temperature, flow, transparency, specific conductance, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, total organic carbon, chloride, sulfate and chlorophyll-*a*.

## Biological Characterization

### Fish

Twenty-five species (10 families) were collected over the course of the four sampling events. Cyprinidae and Centrarchidae were the richest families, each yielding seven species. Red Shiner was the most abundant species in the two earliest collections. Western Mosquitofish was the most abundant species in the two most recent samples. All four fish collections rated as having a high aquatic life use. Two of those ratings increase to exceptional when the coefficient of variability is applied (1988 and 2012 samples).

The samples taken in 1988 and 1989 came from FM 453, which is about 13 km downstream of CR 440 where the 2010 and 2012 samples were collected. The biggest differences noted between the fish assemblages in the 1980s and those observed in the 2010s were the large decline in the percentage of individuals identified as tolerant species and a subsequent increase in species richness. Over 70% of the individuals collected in the early samples consisted of tolerant species (mostly Red Shiner), resulting in metric scores of 1. Only 15% or less of the individuals in the latter samples were tolerant species (metric scores of 5). Even though species richness increased by 35%, the metric scores for the 1980s samples were already at 5 thus the scores could not increase.

Most of the 11 species added in the 2010s consisted of either one individual or limited numbers except in the 2010 collection where Mimic Shiner made up 24% of the catch. Three species - American Eel, Blacktail Shiner, and Bullhead Minnow - were unique to the 1980s samples. In each instance the species was represented by only one individual.

### Benthic Macroinvertebrates

A total of 1,686 individuals representing 59 taxa from 15 orders of macroinvertebrates were collected in the 1988 Surber sample and the RBP samples from 2010 and 2012 (Appendix E). Ephemeroptera, Diptera, Coleoptera, and Bivalvia were the most abundant taxa, collectively representing approximately 83% of the total number of individuals collected.

The Surber BIBI results for the sample collected in 1988 fell in the exceptional aquatic life use category, while the ecoregion 34 BIBI results for the 2010 and 2012 RBP samples fell in the intermediate aquatic life use category. The apparent difference in the indicated aquatic life use category between the 1988 sample and the 2010 and 2012 RBP samples may be related to changes in land use patterns in the watershed, i.e., the increase in cultivated crops and the decrease in forest, noted above in the land use analysis.

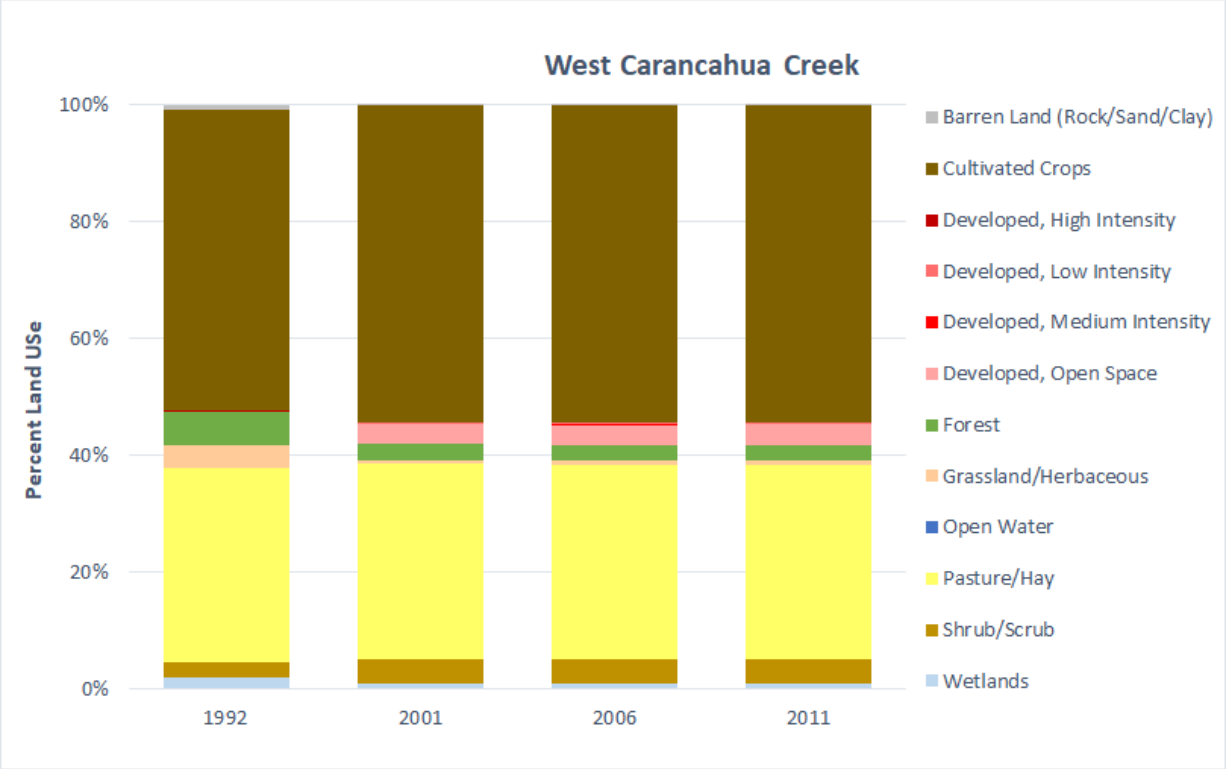


**Figure 403. Percent land use in the West Carancahua Creek watershed from 1992-2011.**

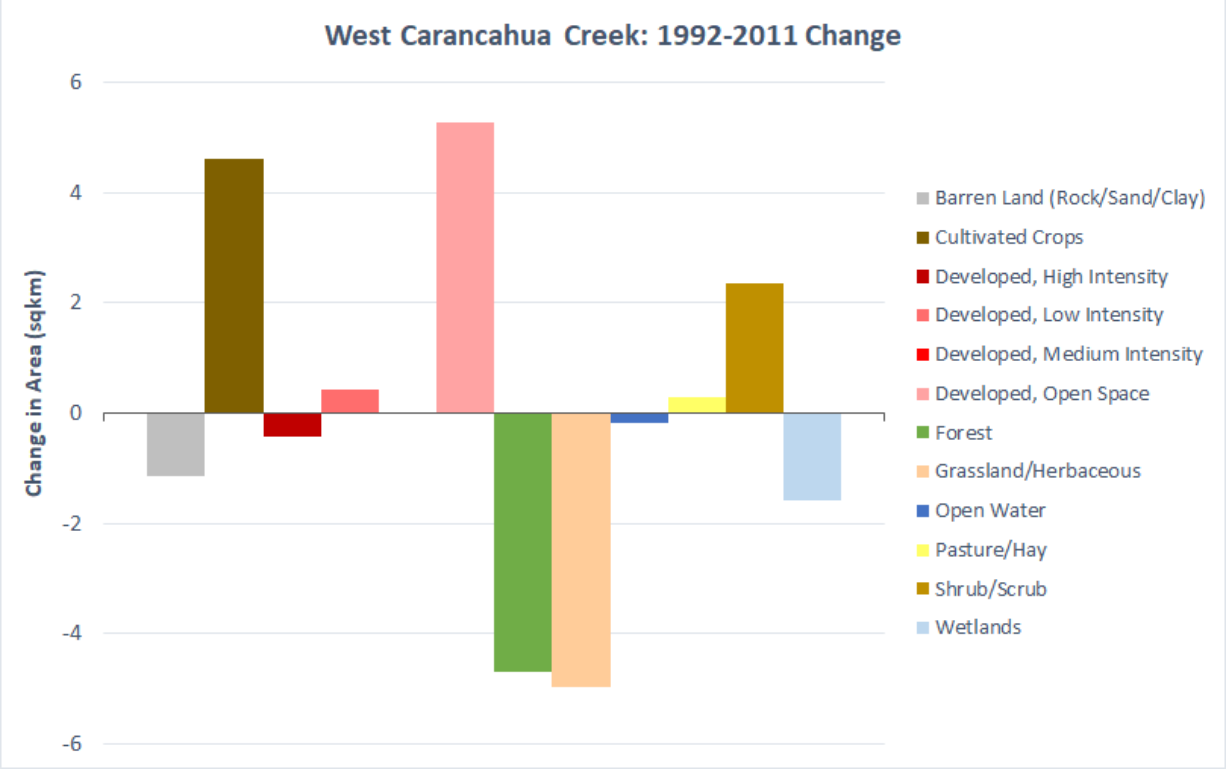


**Figure 404. Land use change in area (sq km) from 1992-2011 for the West Carancahua Creek watershed.**

## WEST MUSTANG CREEK

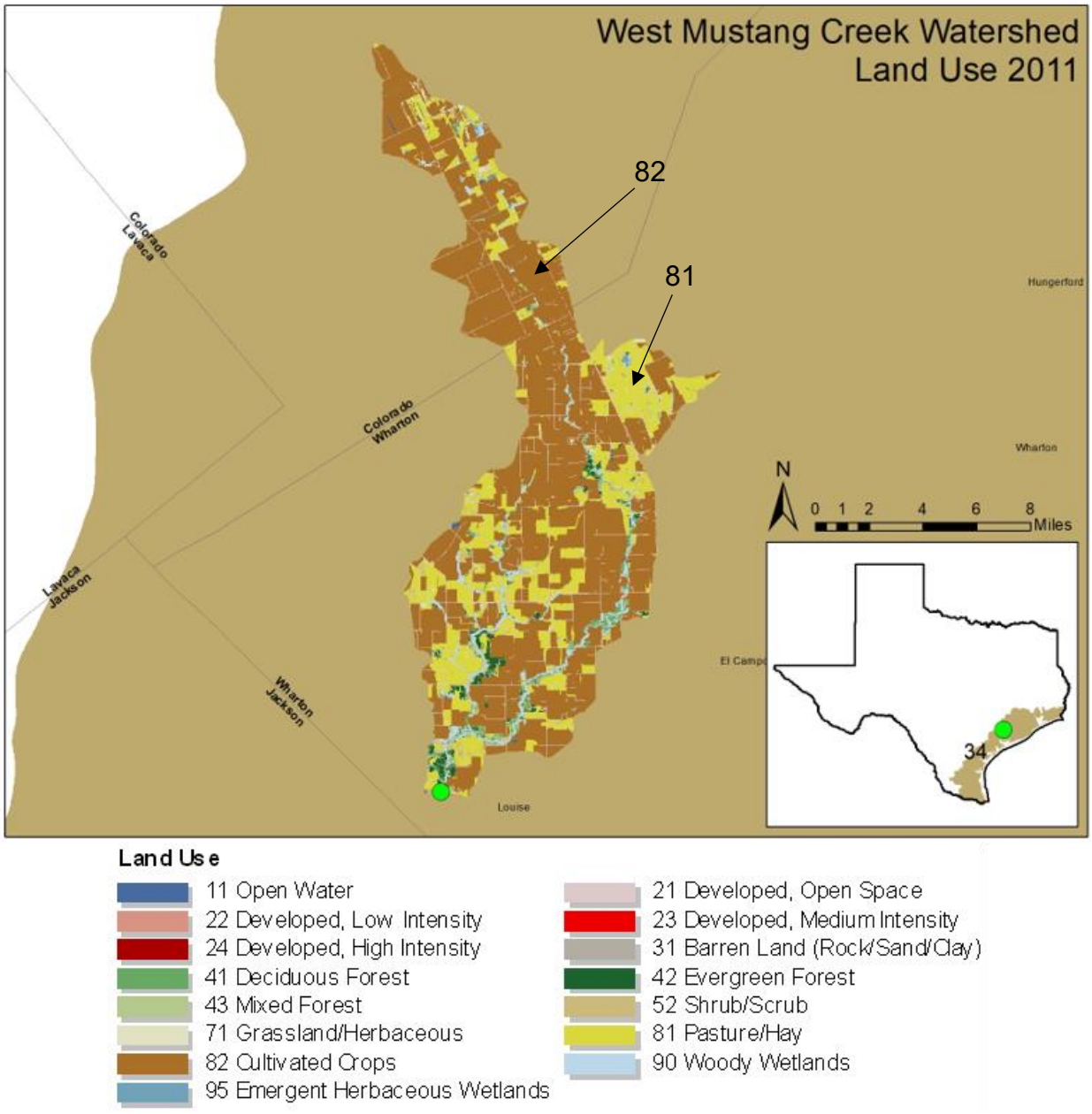


**Figure 405. Map of West Mustang Creek watershed and 2011 land use; cultivated crops and pasture/hay were the most common land uses.**

### Sampling Dates

| | |
|---|---|
| Physical Habitat: | June 21, 1990; June 17, 2010; June 6, 2012; September 12, 2012 |
| Water Quality: | June 19, 1990; July 14, 1999; June 16, 2010 |
| Fish: | June 21, 1990; June 17, 2010; June 6, 2012; September 12, 2012 |
| Benthic Invertebrates: | June 21, 1990; June 17, 2010; June 6, 2012; September 12, 2012 |

## Physical Characterization

### Watershed and Land Use

West Mustang Creek lies within the Lavaca River Basin. Sample site 12522 is located downstream of CR 328, 11.3 km northwest of Louise in Wharton County (Figure 405).

The West Mustang Creek watershed at site 12522 is approximately 360.64 sq km. The entire watershed lies within the Level IV Ecoregion 34a, the Northern Humid Gulf Coastal Prairies. The dominant land cover in the watershed is cultivated crop at 63.55% and is present throughout the watershed (Homer et al. 2015; Figure 405 and Figure 406). Pasture/hay is the secondary land cover encompassing 21.18%. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 3.59% of the watershed.

From 1992-2011 there was a 30.13 sq km decrease in forest and an 18.66 sq km decrease in grassland. There was a 71.8 sq km increase in cultivated crops and a 12.34 sq km increase in open space development (Figure 407).

As of October 2024, there are no permitted wastewater outfalls within the West Mustang Creek watershed.

### In Channel and Riparian Physical Habitat

Physical habitat for West Mustang Creek was evaluated during four sampling events from 1990 to 2012. West Mustang Creek is a perennial stream that drains to the East Mustang Creek arm of Lake Texana. Habitat Quality Index scores are available for three sample events and indicate an intermediate to high aquatic life use rating (14-21). Riparian areas were well vegetated throughout the reach with an average riparian buffer ranging from 16 meters wide to greater than 20 meters. The riparian zone was generally dominated by trees followed by shrubs then grasses. The average percentage of tree canopy cover ranged from 70% to 86%.

The dominant stream substrate was sand, and the average percent of substrate gravel sized or larger was zero for all sampling events. Average percent instream cover was 22% to 27% and instream cover types include snags, woody debris, root mats, and undercut banks. West Mustang Creek ranged from 0.2-0.6 meters deep on average and 6-10 meters wide. Average stream bank slope ranged from 23-44 degrees. Stream flow at the site was measured at a minimum value of 0.2 cfs and a maximum of 5.5 cfs. Average stream bank erosion potential was 27%-35%. The deepest pool measured at West Mustang Creek was greater than 1.5 meters. Number of riffles observed at the site varied from zero to two, and total number of stream bends ranged from five to six.

### Water Quality

Water samples were collected at station 12522 over 3 sampling events from June 1990 through June 2010. Parameters measured included temperature, flow, transparency, specific conductance, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, total organic carbon, chloride, sulfate and chlorophyll-*a*.

## Biological Characterization

### Fish

Twenty-nine species representing nine families were collected in the four sampling events. Centrarchidae was the richest family, represented by nine species. The two early fish collections (1990 and 2010) rated as having high aquatic life uses. Both collections from 2012 rated as exceptional. The 1990 sample yielded the lowest aquatic life use score with only seven of the individual metrics scoring as a five. All but one metric (number of individuals) in the September 2012 sample received a five. Number of individuals was lacking in all four collections.

The top three species (by numbers) were identical in the 1990 and 2010 collections with Western Mosquitofish being most abundant followed by Red and Blacktail shiners. Western Mosquitofish was also the most abundant species in the September 2012 sample; however, Bullhead Minnow (which was second most abundant in September 2012) was greatest in June of that year. Longear Sunfish was the only sunfish species collected in 1990, likely due to no electrofishing being performed. Seven additional species were added over the next three collections (Longear Sunfish was always the most abundant) when both electrofishing and seining was employed.

### Benthic Macroinvertebrates

A total of 3,154 individuals representing 81 taxa from 15 orders of macroinvertebrates were collected in the 1990 Surber sample and the RBP samples from 2010 and 2012 (Appendix E). Trichoptera, Diptera, and Ephemeroptera were the most abundant orders in the collections, collectively representing approximately 87% of the total number of individuals collected. Other orders representing greater than 1% of the collections were Coleoptera, Odonata, Amphipoda, and Gastropoda.

The Surber BIBI results for the sample collected in 1990 fell in the exceptional aquatic life use category. The Ecoregion 34 BIBI results for the RBP samples collected June 17, 2010, and September 12, 2012, were in the high aquatic life use category, and in the intermediate aquatic life use category for the RBP sample collected June 6, 2012. These results represent relative stability in the condition of the benthic assemblage over the 22-year interval between 1990 and 2012.

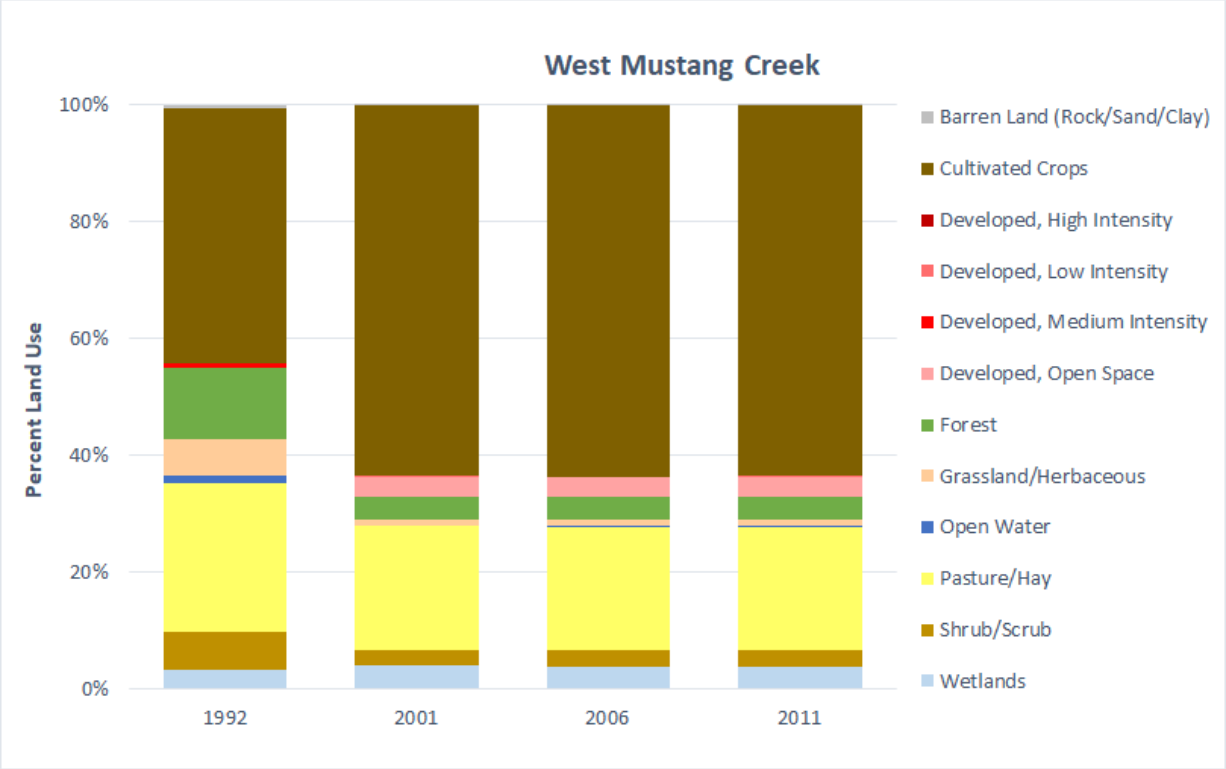


**Figure 406. Percent land use in the West Mustang Creek watershed from 1992-2011.**

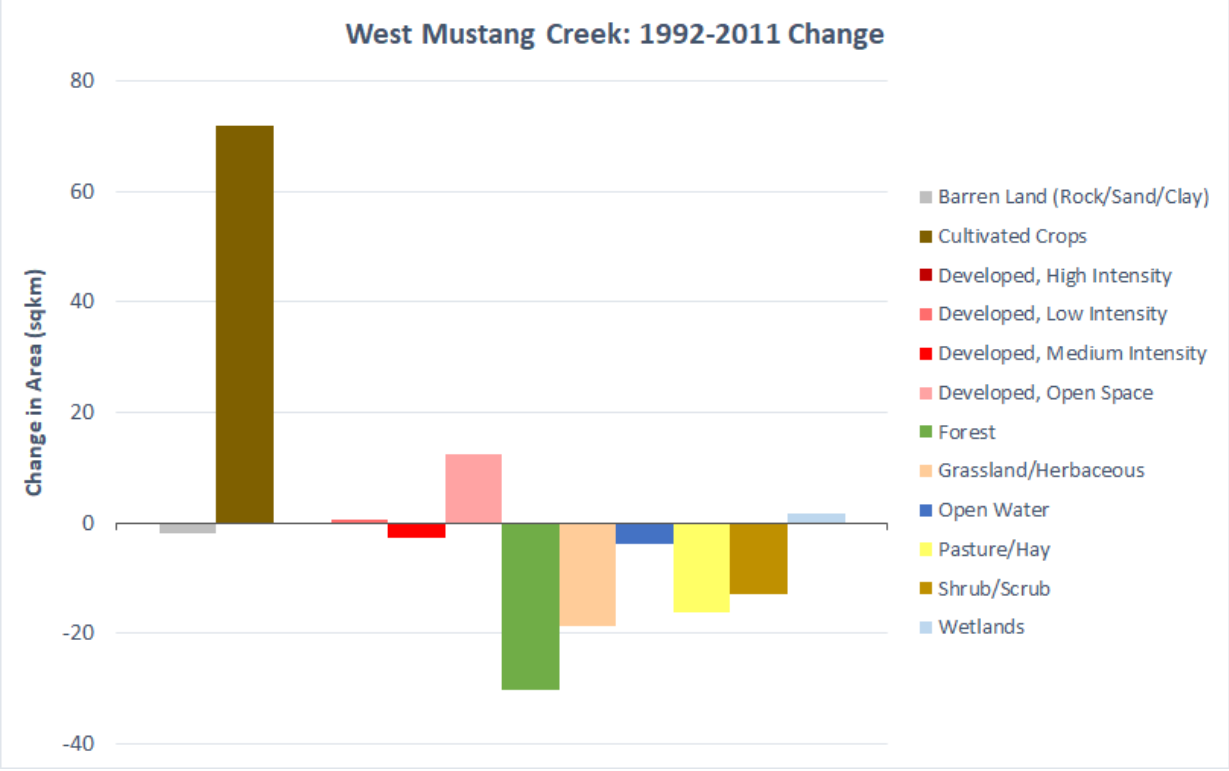


**Figure 407. Land use change in area (sq km) from 1992-2011 for the West Mustang Creek watershed.**

## Ecoregion 34 Summary and Historical Characterization

### Watershed and Land Use

Ecoregion 34 is primarily flat topography with grasslands. A high percentage of the land encompasses croplands, such as rice, grain sorghum, cotton, and soybeans. In recent decades, urban and industrial land uses have expanded, especially oil and gas production (Griffith et al. 2007). In 2011 the overall primary land cover in the study watersheds was cultivated crop and the secondary land cover was pasture/hay. Between 1992-2011, forest experienced the largest decrease in combined land cover area across all watersheds (~146.03 sq km) and cultivated crop experienced the largest increase (~365.64 sq km).

### In Channel and Riparian Physical Habitat

Physical habitat for the Western Gulf Coastal Plain was evaluated at eight streams over 31 sampling events from 1987 to 2017. Watershed area varied from a minimum of 155 sq km at West Carancahua Creek to a maximum of 885 sq km at the San Bernard River. The sites generally had well vegetated riparian zones, and the riparian buffer was 32 meters on average with a minimum of 6 meters and maximum of 107 meters. Trees were the dominant riparian species (51% on average), followed by shrubs (21%) then grasses (20%), and average percent tree canopy coverage was 64%.

Dominant substrate at the sites was generally sand or clay. Average percentage of substrate gravel sized or larger was 10%, and varied from a minimum of 0% to a maximum of 40%. Average percent instream cover was 25% and common instream cover types include overhanging vegetation, leaf packs, snags, woody debris, root mats, algae, gravel and undercut banks. Average stream depth and width measurements were 0.3 meters and 7 meters, respectively. Average stream bank slope was 35 degrees and erosion potential was moderate, with an average of 35% which was reflected in the average bank stability HQI score (1.9) indicating moderately stable to moderately unstable stream banks. Maximum pool depth ranged from a minimum of 0.5 meters to a maximum of 1.8 meters. Total number of riffles varied from zero to six, and total number of stream bends ranged from one to nine. Additional in-channel and riparian physical habitat attributes are summarized in Appendix B.

HQI scores are available for 24 events and range from a maximum score of 25 (high) at Big Creek in May 2003 to a minimum score of 14 (intermediate) at Big Creek in 2010 and West Mustang Creek in 2012. Of the 24 sampling events with an HQI score, 11 (46%) received a habitat assessment rating of high and the remaining 13 (54%) received a rating of intermediate. The highest scoring HQI metrics for the Western Gulf Coastal Plain were the dimensions of largest pool metric and the riparian buffer vegetation metric. The lowest scoring HQI metrics on average were the bottom substrate stability metric, the aesthetics of reach metric, and the channel flow status metric.

### Water Quality

Water quality data from Ecoregion 34 is primarily represented by the northern half of the ecoregion, as there were more streams available to sample in that portion of the ecoregion. As this ecoregion encompasses both tidally influenced and freshwater streams, specific conductivity had the largest range of any ecoregion, and ranged from 39 to 101,800 us/cm. The secchi values observed were indicative of turbid waters with a median value of 0.2 meters and 95% of the secchi values were at or below 0.64 meters. The pH values had a median of 7.65 and ranged from 5.9 to 9.54. Chlorophyll-a data was highly variable between stations with a range of 0.5 to 346.3 ug/L. Additional water quality variables are summarized in Appendix C of the report.

**Fish**

A total of 22,225 individuals consisting of 20 families and 64 species have been documented in 40 sampling events across eight streams in the Western Gulf Coast Plain from 1987 to 2017 (Appendix D - 7). For individual sites, taxa richness ranged from 44 species at Big Creek across 13 sampling events from 1990 to 2009 to a low of 14 species at Placedo Creek across three sampling events from 1988 to 2017. Taxa richness at each site was heavily correlated with the number of sampling events during the period of record. The most abundant species collected across all sites and sampling events were Red Shiner (n = 8,346), Western Mosquitofish (n = 7,753), Longear Sunfish (n = 828), Striped Mullet (n = 780), and Bullhead Minnow (n = 643).

IBI scores across all sites and sampling events ranged from 30 to 53 resulting in aquatic life use categories of limited (n = 1), intermediate (n = 14), high (n = 16), and exceptional (n = 9; Figure 408). Of the 40 sampling events in this ecoregion, 62.5% received an ALU rating of high or exceptional; 37.5% received an ALU of intermediate or limited. Most sites that were sampled multiple times received ALUs in at least two different categories. All sites received one ALU score of high or better except for Placedo Creek which received ALU scores of intermediate only.

Overall, IBI scores and individual metrics 2-3, 5-8, and 11-12 did not change through time (Figure 409; Figure 410; Figure 411); however, the number of fish species and the number of sunfish species significantly increased through time (Figure 410(1): $R^2 = 0.17$, $p < 0.01$; Figure 410(4): $R^2 = 0.13$, $p = 0.02$) and the number of individuals per seine haul significantly decreased through time (Figure 411(10): $R^2 = 0.29$, $p < 0.01$). Although these were significant relationships, $R^2$ values were very low.

It is difficult to discern why the number of fish and sunfish species significantly increased over time. It is likely related to additional sampling effort rather than a change in water quality or habitat, given that IBI scores did not change over the sampling period. The decrease in the number of individuals per seine haul is likely due to several isolated sampling events that occurred in 1988-89 at a single site with unusually large numbers of cyprinids which were collected using a seine.

**Benthic Macroinvertebrates**

A total of 30,207 individuals representing 26 orders of aquatic macroinvertebrates were collected in seven Surber samples and 30 RBP samples collected at eight streams in the Western Gulf Coastal Plain ecoregion from August 1988 to July 2017 (Appendix E). Eleven orders (Amphipoda, Basommatophora, Coleoptera, Decapoda, Diptera, Ephemeroptera, Hemiptera, Hirudinida, Odonata, Trichoptera, and Veneroida) were represented at all eight streams, which collectively represented 45% of the total number of individuals collected.

In terms of relative abundance, the aquatic worm *Aulodrilus pigueti* (Tubificida, Naididae) was the most abundant species, representing 15.8% of the total number of individuals collected at all sites. However, it should be noted that 4,682 individuals of this taxon were collected in a single Surber sample at Placedo Creek. Other taxa that were relatively abundant include the aquatic worms *Limnodrilus hoffmeisteri* and *Dero digitata*, the ostracod *Limnocythere* sp., the caddisfly *Cheumatopsyche* sp., the mayfly *Fallceon quilleri*, and the riffle beetle *Stenelmis* sp.

*Stenelmis* sp., *Hyalella* sp., *Palaemonetes* sp., *Cheumatopsyche* sp., *Fallceon quilleri*, *Caenis* sp., *Argia* sp., and *Hydroptila* sp. were the most widely distributed taxa, each occurring in at least one collection from all eight streams. *Tricorythodes* sp., *Nectopsyche* sp., *Oecetis* sp., *Limnodrilus* sp., *Polypedilum* sp., *Stenacron* sp., *Corbicula fluminea*, *Rhagovelia* sp., *Scirtes* sp., and *Physa* sp. were also widely distributed genera/species, occurring in collections from seven of eight streams. This abundance of widely distributed taxa in the Western Gulf Coastal Plain may be a result of the proximity of sites in this ecoregion compared to other aggregated ecoregions.

The BIBI scores for six of the seven Surber samples collected from August 1988 to June 1990 fell in the exceptional aquatic life use category, while the BIBI score for the Surber sample collected on Placedo Creek in September 1988 fell in the high category (Figure 412). Eight of 30 RBP IBI scores for kicknet samples fell in the exceptional aquatic life use category, 16 RBP IBI scores indicated high, and six ranked in the intermediate category. Overall, results for the regionalized benthic macroinvertebrate IBI's indicate relatively constant benthic biotic integrity over the interval from 1988 to 2017 (Figure 413).

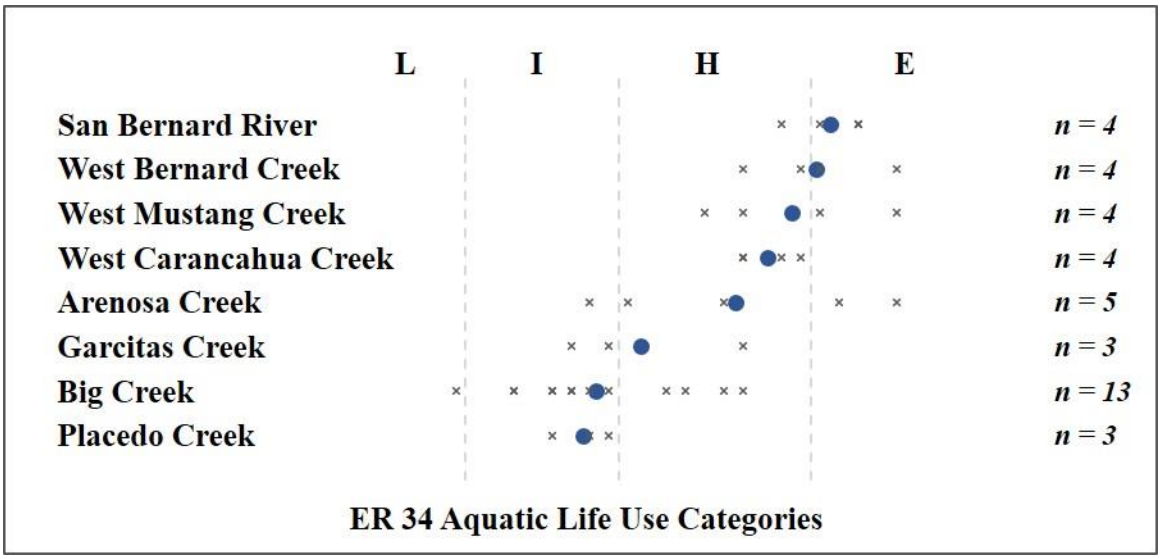


**Figure 408. Aquatic life use categories (L – limited; I – intermediate; H – high; E – exceptional) for all fish sampling events in Ecoregion 34 grouped by site and ranked by mean ALU score (blue dot); number of sampling events per site noted on right.**

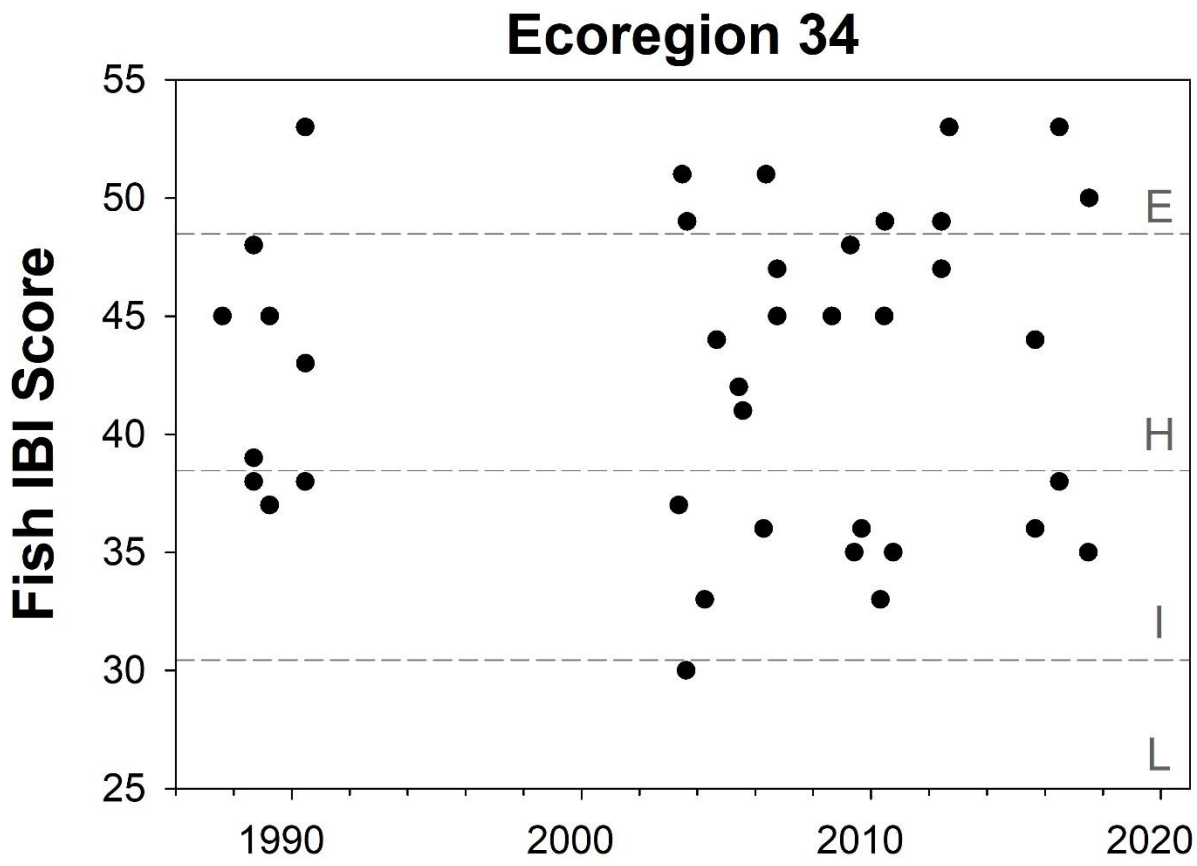


**Figure 409. Fish index of biotic integrity scores through time for all sampling events in Ecoregion 34; break lines for aquatic life use categories (i.e., limited, intermediate, high, and exceptional) shown on each graph for reference (see Linam et al. 2002).**

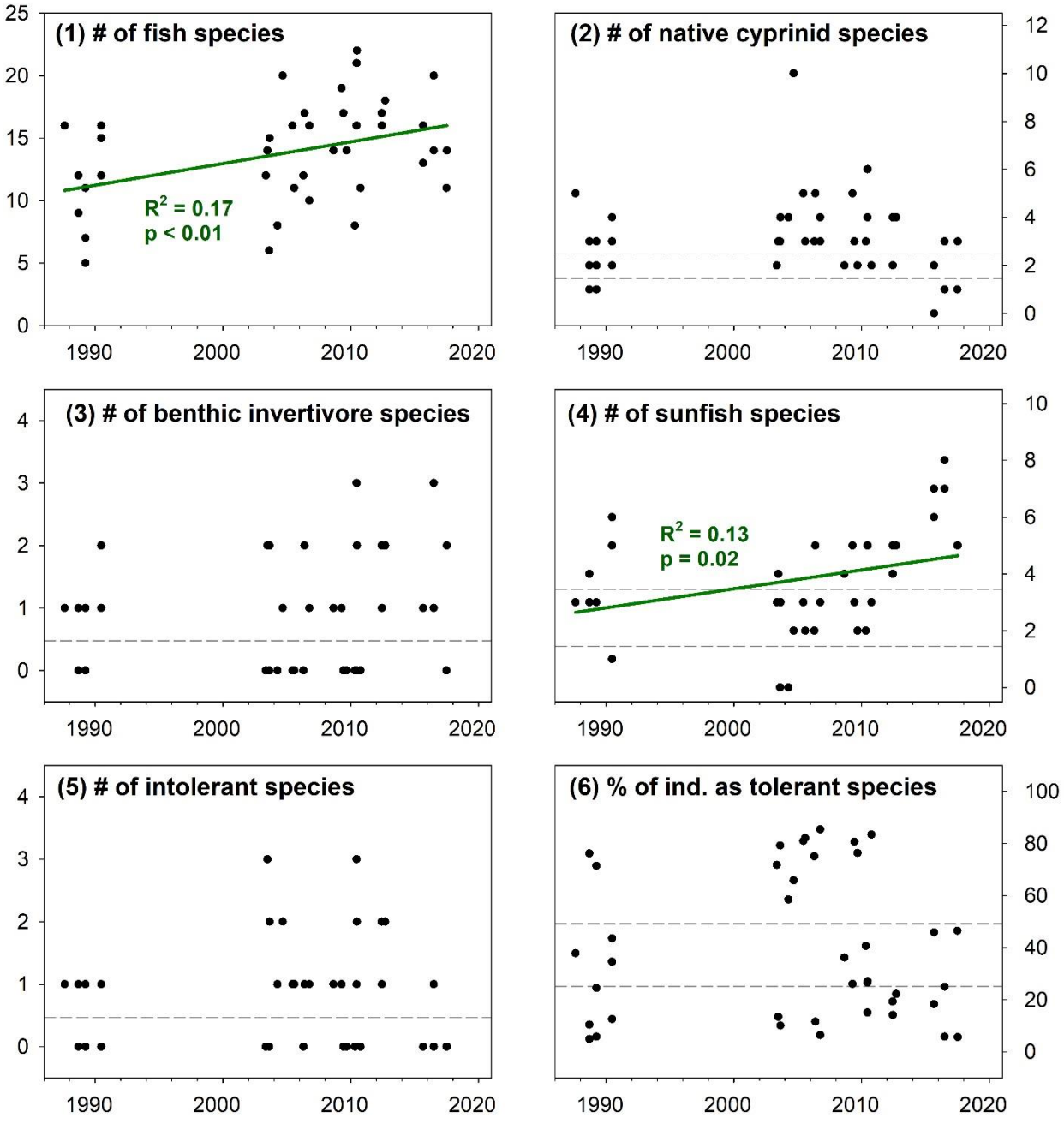


**Figure 410. Raw values for fish index of biotic integrity metrics 1-6 through time for all sampling events in Ecoregion 34; break lines for scoring criteria (i.e., 1, 3, and 5) shown on each graph for reference (see Linam et al. 2002).**

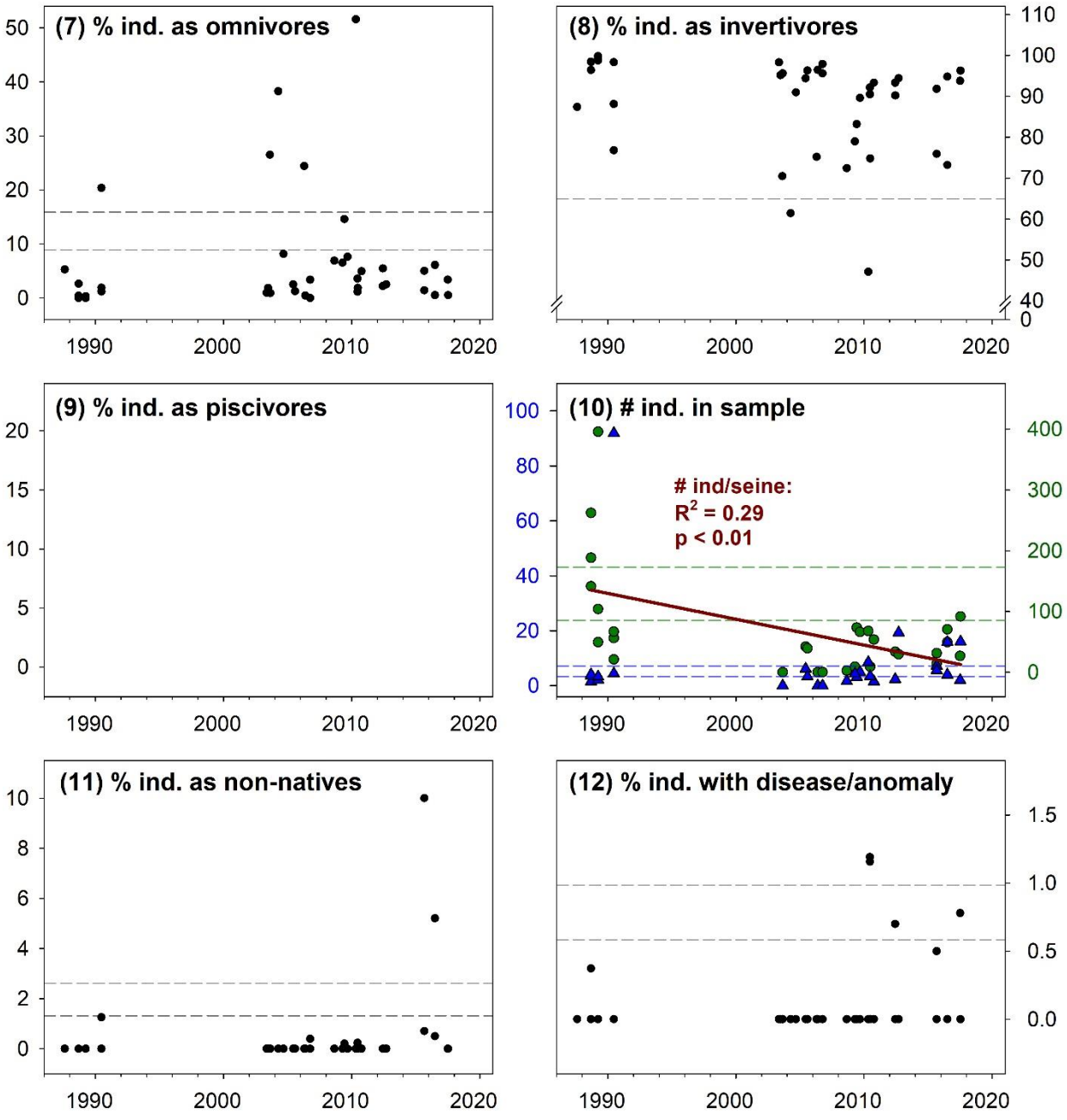


**Figure 411. Raw values for fish index of biotic integrity metrics 7-12 through time for all sampling events in Ecoregion 34; break lines for scoring criteria (i.e., 1, 3, and 5) shown on each graph for reference (see Linam et al. 2002); metrics with no data are not included in the IBI for this ecoregion; number of ind./seine haul represented by green circles and number of ind./min electrofishing represented by blue triangles for metric number 10; metrics that are not included in the IBI for this ecoregion are blank.**

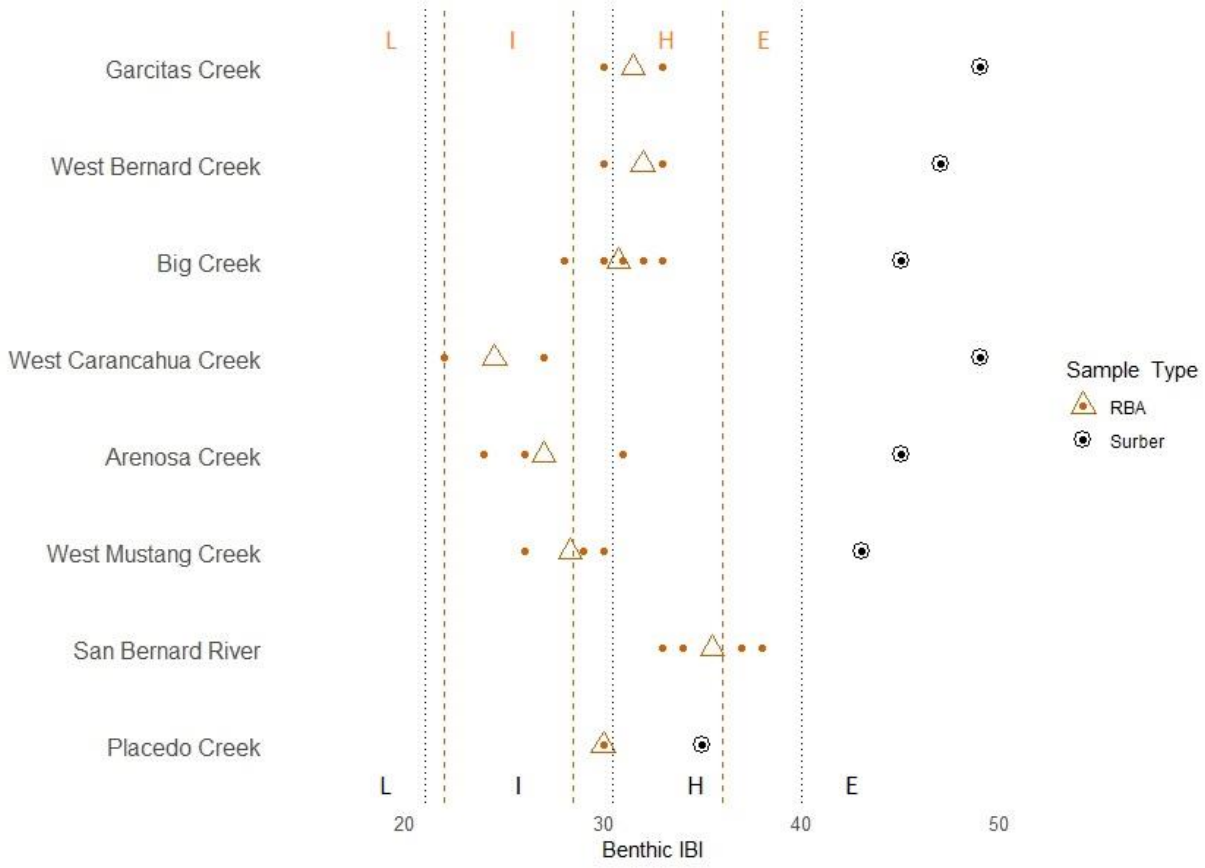


**Figure 412. Benthic IBIs and aquatic life use categories (L – limited; I – intermediate; H – high; E – exceptional) for all benthic sampling events in Ecoregion 34 grouped by site and ranked by mean IBI score. Site scores are solid circles, and mean scores are hollow circles for Surber IBI sample and hollow triangles for RBP IBI samples. RBP IBI ALU cut offs are red dashed lines and Surber ALU cutoffs are in black dotted lines.**

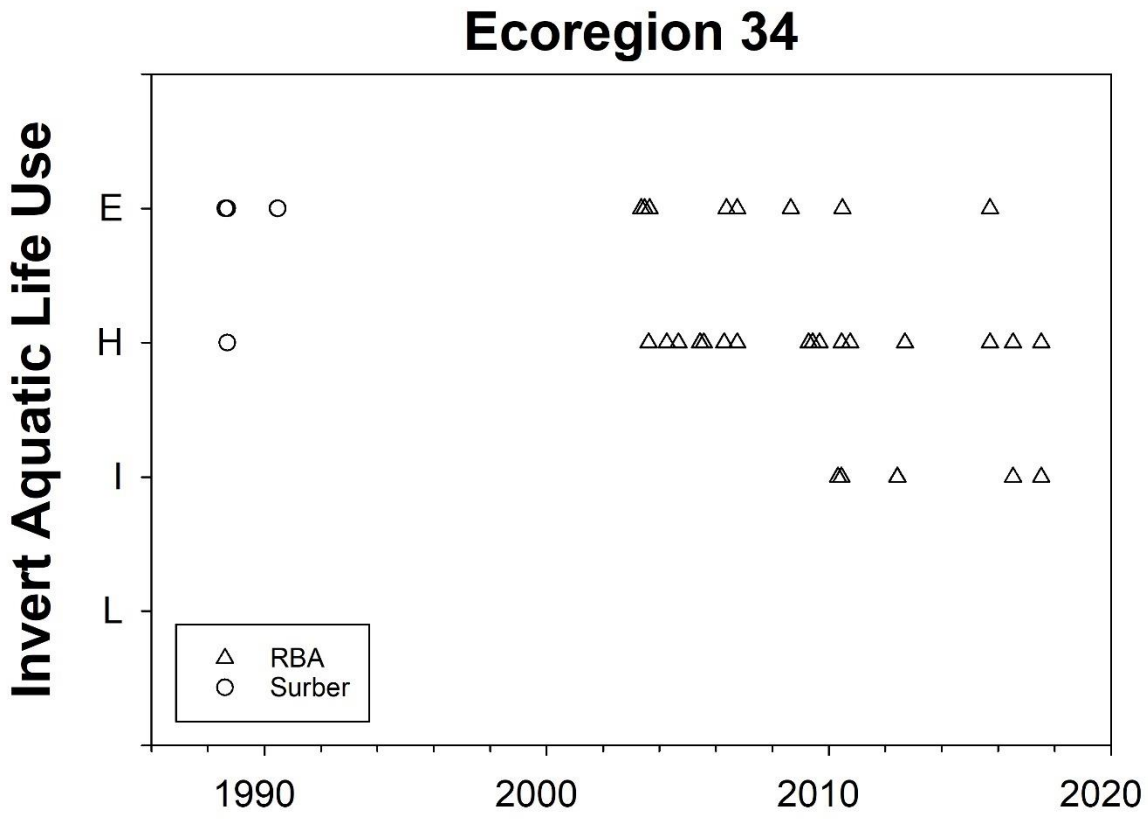


**Figure 413. Benthic aquatic life use (ALU) categories through time for all sampling events in Ecoregion 34; Surber ALUs are noted by circles and RBP ALUs are noted by triangles.**