

Photographic field reconnaissance of bayous between Green Lake and Mission Lake in the Guadalupe River Estuary

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Introduction

A short field reconnaissance of the bayous at the head of Mission Lake and Guadalupe Bay was conducted by the author with the assistance of Mr. Jack Campbell on January 10, 2013. The purpose of this reconnaissance was to familiarize the author with the connectivity in the bayou system. This report provides some of the key photographs taken by the author with Google Earth satellite images to provide context.

Note that on January 9, the day before the reconnaissance trip, Victoria, Texas recorded 1.84 inches of rain, bringing the January total to 2.48 inches, vice the 0.82 inches that is normal for this early in the year.² Graphs of river flows and water levels from USGS gaging station 081888800 (Guadalupe River nr Tivoli, TX) are provided in the appendix.

This report contains only a subset of the photographs that were taken on January 10, 2013. Other photographs and higher resolution copies are available. Please contact the author at for further information. Google Earth aerial photographs in this summary are dated 3/10/2011.

Overview

Figure 1 provides an overview of the waypoints and their relationships to the main features near the mouth of the Guadalupe River. Of principal interest is the saltwater barrier (wp02) in the upper left-hand corner of Figure 1. This barrier prevents saltwater intrusion upstream into the Guadalupe River and the freshwater diversion canal (wp03). The diversion canal feeds the upper end of Hog Bayou, Alligator Slide Lake, and the freshwater industrial canals on the east side of the Victoria Barge Canal. The Victoria Barge Canal is identifiable as the relatively straight channel running roughly north-south along the east side of Guadalupe Bay, Mission Lake, and Green Lake.

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² Rainfall and climate data from <http://www.wunderground.com>, with the direct link of:
http://www.wunderground.com/history/airport/KVCT/2013/1/9/DailyHistory.html?req_city=NA&req_state=NA&req_statename=NA



Figure 1. Location of field trip showing waypoints where photographs were taken. Imagery from Google Earth dated 3/10/2011

Saltwater barrier

Figure 2 shows the relationship between the saltwater barrier and the freshwater diversion canal that is used to carry water across the top of the bayous and supply industrial users across the Victoria Barge Canal. Figure 3 shows the flow over the saltwater barrier during the morning of January 10, 2013 (after more than 1.5 inches of rain upstream during the previous day). Figure 4 provides a view of the Guadalupe River looking upstream from the saltwater barrier.

Entrance to the freshwater diversion canal

Figure 5 shows the entrance to the freshwater diversion canal, which uses wooden pilings to prevent floating debris from jamming the gates. Figures 6 and 7 provide upstream and downstream view from the gate structure.

Upper connections of the freshwater diversion canal

Figure 8 shows the upstream section of the freshwater diversion canal that winds around the west side of Green Lake. Between the diversion canal and the Guadalupe River are creeks that are the upper end of Schwings Bayou. Note that nowhere in this area does Schwings Bayou form a surface water connection with the diversion canal or the Guadalupe River at normal bankfull levels. Near wp04, shown in Figure 8, the diversion canal splits with the southern branch being the start of Hog Bayou, and the northern branch (closer to Green Lake) providing the diversion canal that feeds Goff Bayou and the industrial canals east of the Victoria Barge Canal.

The connection between Hog Bayou is shown in greater detail in Figure 9. Figures 10 and 11 show the view upstream and downstream on the diversion canal at wp04 on the morning of January 10, 2013. The channel was completely blocked with plants (apparently water hyacinth), in both directions. Figure 12 shows the water level gage at the bridge. During our visit to the bridge, a worker from GBRA came by to make a water depth measurement.

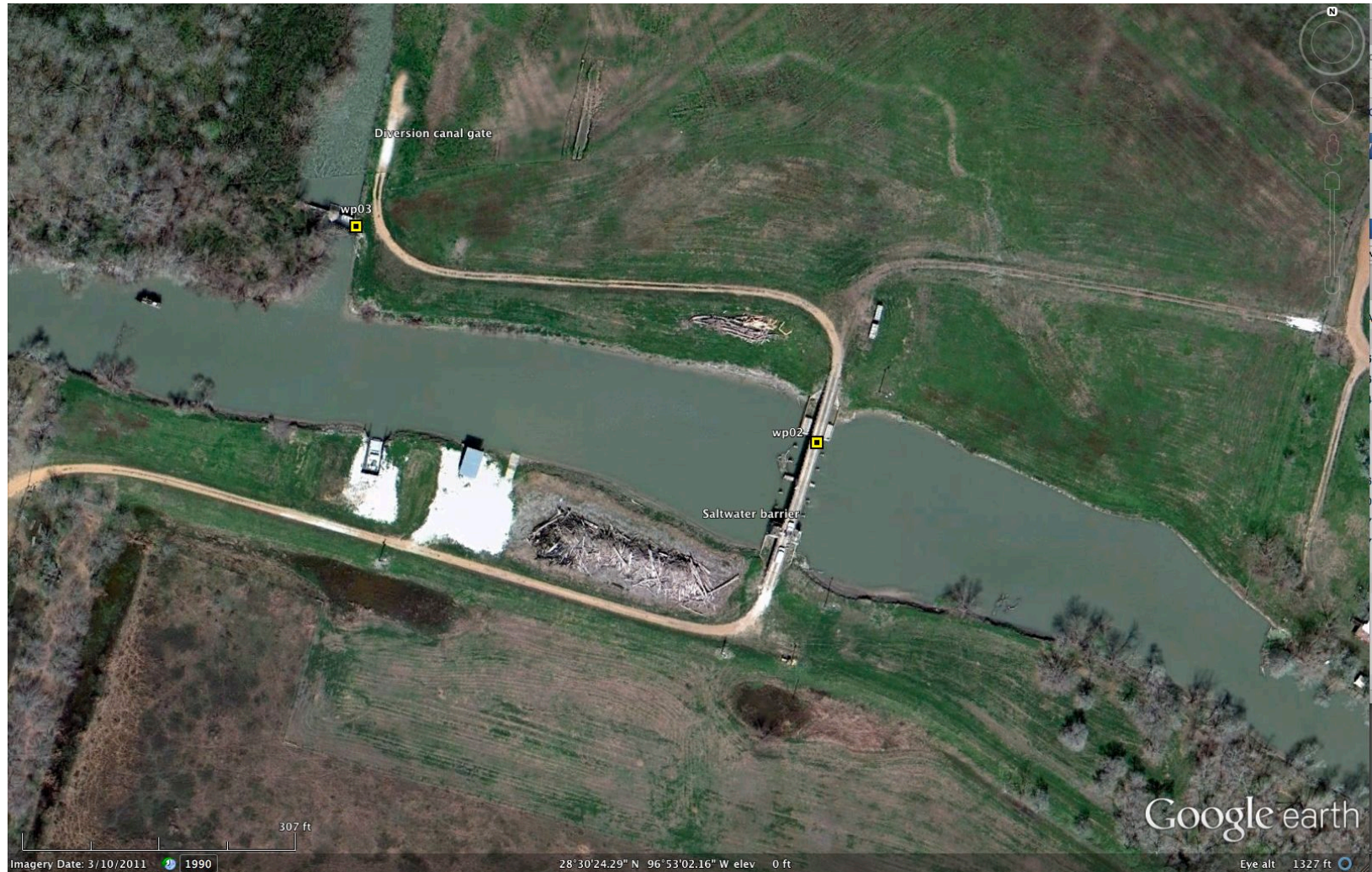


Figure 2. Saltwater barrier on Guadalupe River (wp02), with freshwater diversion channel and gate (wp03). Guadalupe River flows from left to right. The lack of any significant color difference in the river is an indication that there was likely significant flow over the saltwater barrier and through the diversion channel at this time. Imagery from Google Earth dated 3/10/2011.



Figure 3. Saltwater barrier viewed from northern bank of Guadalupe River, looking southwest (wp02). Photograph by Ben R. Hodges, ©2013. File wp002 bSW GuadalupeSaltBarrier i017.



Figure 4. Looking upstream from the saltwater barrier on the Guadalupe River (wp02). Gate structure for freshwater diversion canal (wp03) is just visible on right of frame as grey rectangle. Photograph by Ben R. Hodges, ©2013. File wp002 bW GuadalupeSaltBarrier i015.



Figure 5. Diversion canal upstream of the saltwater barrier (wp03). Guadalupe River is to the left. Diversion canal flow is from left to right. Wooden pilings prevent river flotsam from clogging gates, which are part of concrete structure on right. Composite panorama photo using DoubleTake software distorts linear relationships. Photograph by Ben R. Hodges, ©2013. File wp003 bSWtoWNW UpstreamDiversionChannelGate p022to24.



Figure 6. View upstream towards the Guadalupe River from the gates of the diversion canal (wp03). Photograph by Ben R. Hodges, ©2013. File wp003 bS UpstreamDiversionChannelGate i030.



Figure 7. Freshwater diversion canal (wp03) looking downstream from gate structure. High banks require extreme flows to connect with the upstream reaches of Schwings Bayou. Composite panorama photo using DoubleTake software distorts linear relationships. Photograph by Ben R. Hodges, ©2013. File wp003 bNNetoS DiversionChannelFromUpstreamGate p028to030.

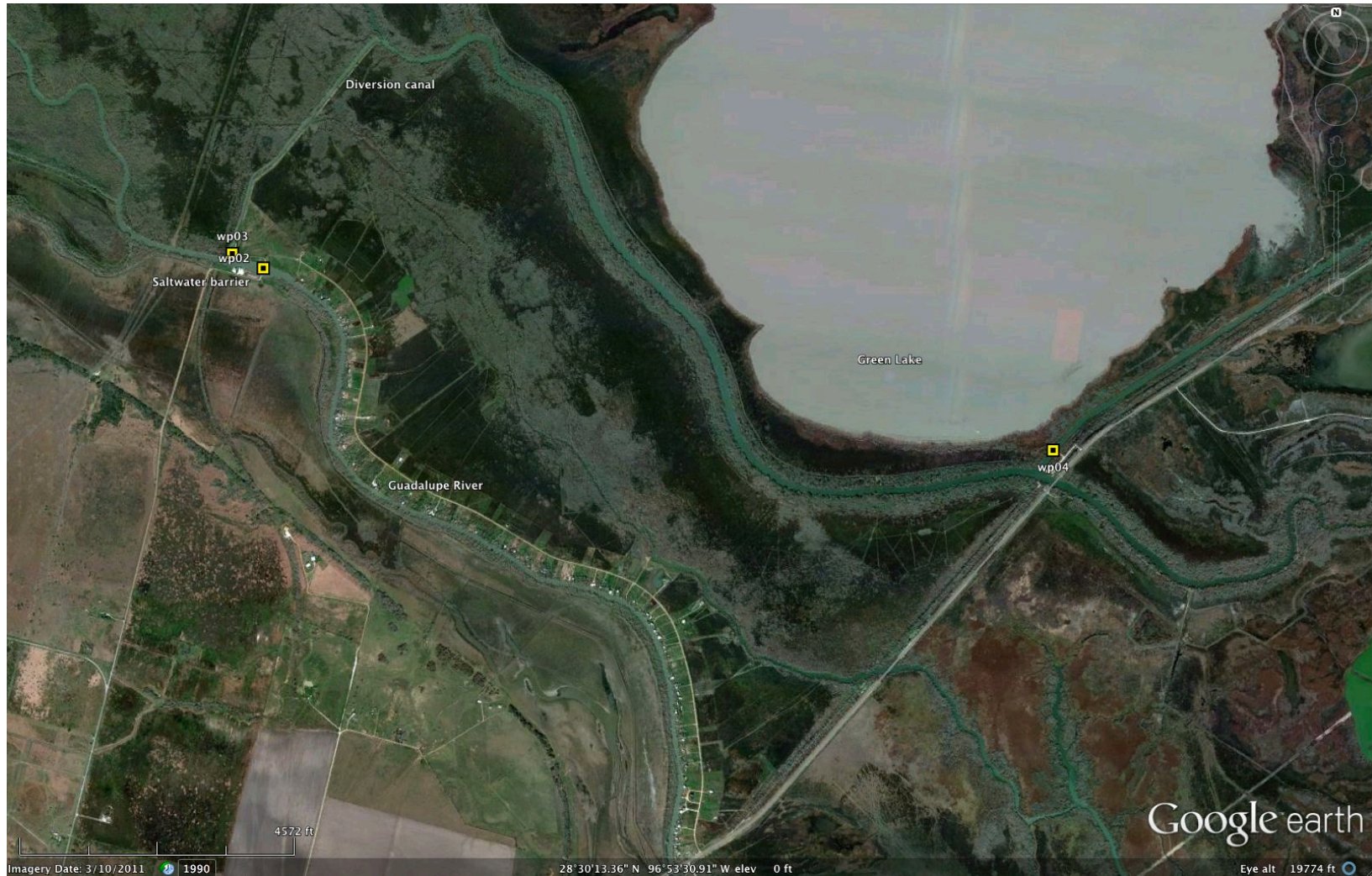


Figure 8. Upstream portion of diversion canal, which runs around the southern boundary of Green Lake. Note the lack of any surface water connection from the diversion canal to the Schwings Bayou exiting through the lower side of the figure. However, the diversion canal does have a direct connection (right side of frame) that leads to Hog Bayou and Alligator Slide Lake. Imagery from Google Earth dated 3/10/2011.



Figure 9. Connection of Diversion canal and Hog Bayou near wp04. Upstream in the canal is to the left, which connects to the Guadalupe River upstream of the saltwater barrier. Imagery from Google Earth dated 3/10/2011.



Figure 10. Downstream view of diversion canal from bridge that is accessible off TX-35 (wp04). Canal is completely choked by floating plants (appears to be water hyacinth). Photograph by Ben R. Hodges, ©2013. File wp004 bENE BridgeOverDiversionChannel i032.



Figure 11. Upstream view of diversion canal from bridge that is accessible off TX-35 (wp04). Canal is completely choked by floating plants (appears to be water hyacinth). Photograph by Ben R. Hodges, ©2013. File wp004 bNNE BridgeOverDiversionChannel i033.



Figure 12. Water level gage on diversion canal from bridge that is accessible off TX-35 (wp04). Photograph by Ben R. Hodges, ©2013. File wp004 bSSE BridgeOverDiversionChannel i038.

Overview of bayous

Proceeding from west to east, there are four main bayous between the Guadalupe River and the Victoria Barge Canal: Schwings Bayou, Mamie Bayou, Hog Bayou, and Goff Bayou. These are labeled in Figure 13. Between Green Lake and Mission Lake (which is really part of the Guadalupe estuary rather than a lake), the largest water body is Alligator Slide Lake. The obviously man-made revetments in this lake were designed to reduce wind-driven wave action and improve duck habitat. The Google Earth satellite imagery of Figure 13 is striking as the highly productive water of Alligator Slide Lake takes on a bright green color that can be readily traced through Mamie Bayou into Mission Lake.

Schwings Bayou

Schwings Bayou is shown in Figure 14. None of this color from Alligator Slide Lake is seen in Schwings Bayou outside of a narrow connection to Mamie Bayou on the right branch, just barely visible in Figure 14. Detailed review of Google Earth (not shown) indicates that Schwings Bayou is also connected to the Guadalupe River near the loop in the river south of TX-35.

Upper Hog Bayou and Alligator Slide Lake

Figure 15 shows that Hog Bayou connects with the upper end of Alligator Slide Lake, but as shown in Figure 16, this connection is at least partially obstructed. From the satellite photos it is not clear whether the obstruction is a bridge or a road with culverts.

Mamie Bayou

Figure 17 shows that Mamie Bayou provides a clear connection from the south end of Alligator Slide Lake and the north side of Mission Lake. There is a narrow connection between Mamie Bayou and Schwings Bayou, but it is not clear whether this has a preferred flow direction. From the satellite photographs, the connection appears to be minor.

Lower end of Hog Bayou

Where Hog Bayou connects with the estuarine waters of Mission Lake (Figure 18), the bayou has been blocked by revetments. It is not clear from these photos whether there are any gates or culverts providing connectivity between the fresh water on the upstream side and the marine waters on the downstream side. Figure 19 shows that the mouth of Hog Bayou was choked by plants on January 10, 2013. Figure 20 shows that the Hog Bayou entrance south of the plant mats was relatively clear.

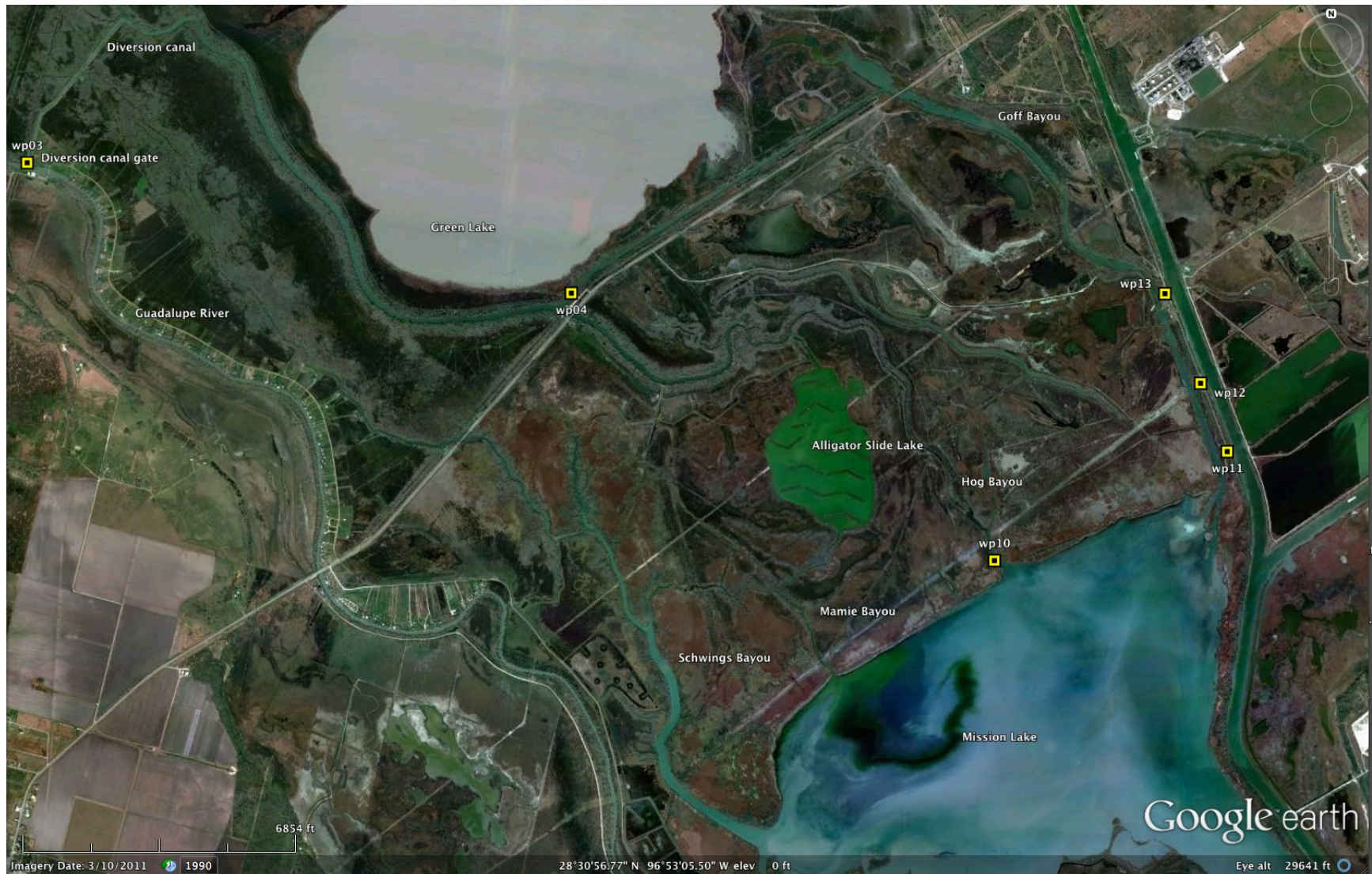


Figure 13. Overview of bayous. The road running southwest to northeast is TX-35. Note the significant color difference between water in Schwings Bayou and Alligator Slide Lake and the exit from Mamie Bayou. Imagery from Google Earth dated 3/10/2011.



Figure 14. Schwings Bayou. Note that this bayou does not have a surface water connection to either the Guadalupe River upstream of the salt barrier or the diversion canal. There is apparently a culvert connection near the river bend. There are no significant blockages for upstream exchange of marine water. Imagery from Google Earth dated 3/10/2011.



Figure 15. Hog Bayou is directly connected to the diversion channel, and feeds Alligator Slide Lake through an obstruction (see Figure 16).

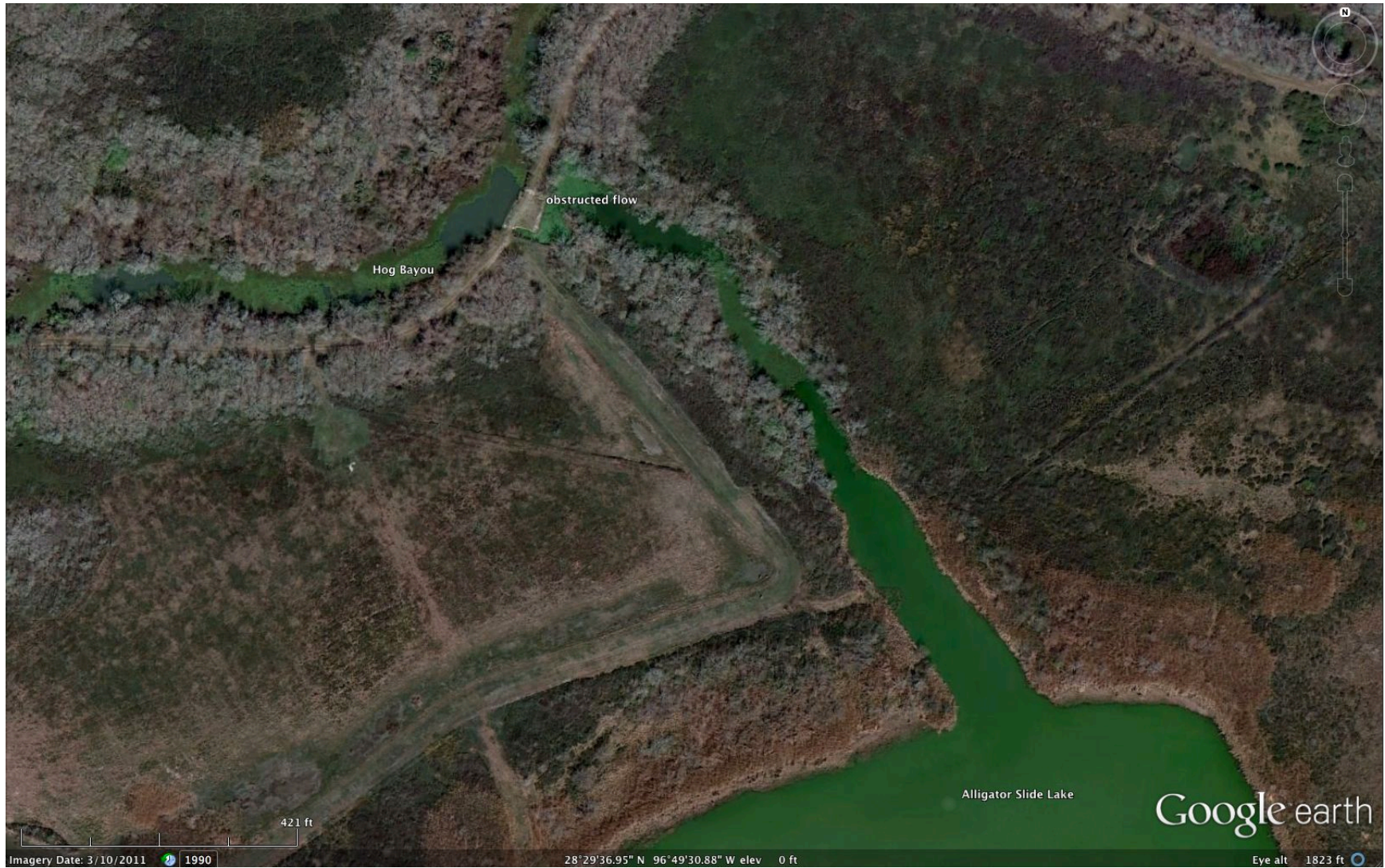


Figure 16. Obstructed flow connection between Hog Bayou and Alligator Slide Lake. The nature of the obstruction is not clear from the image.

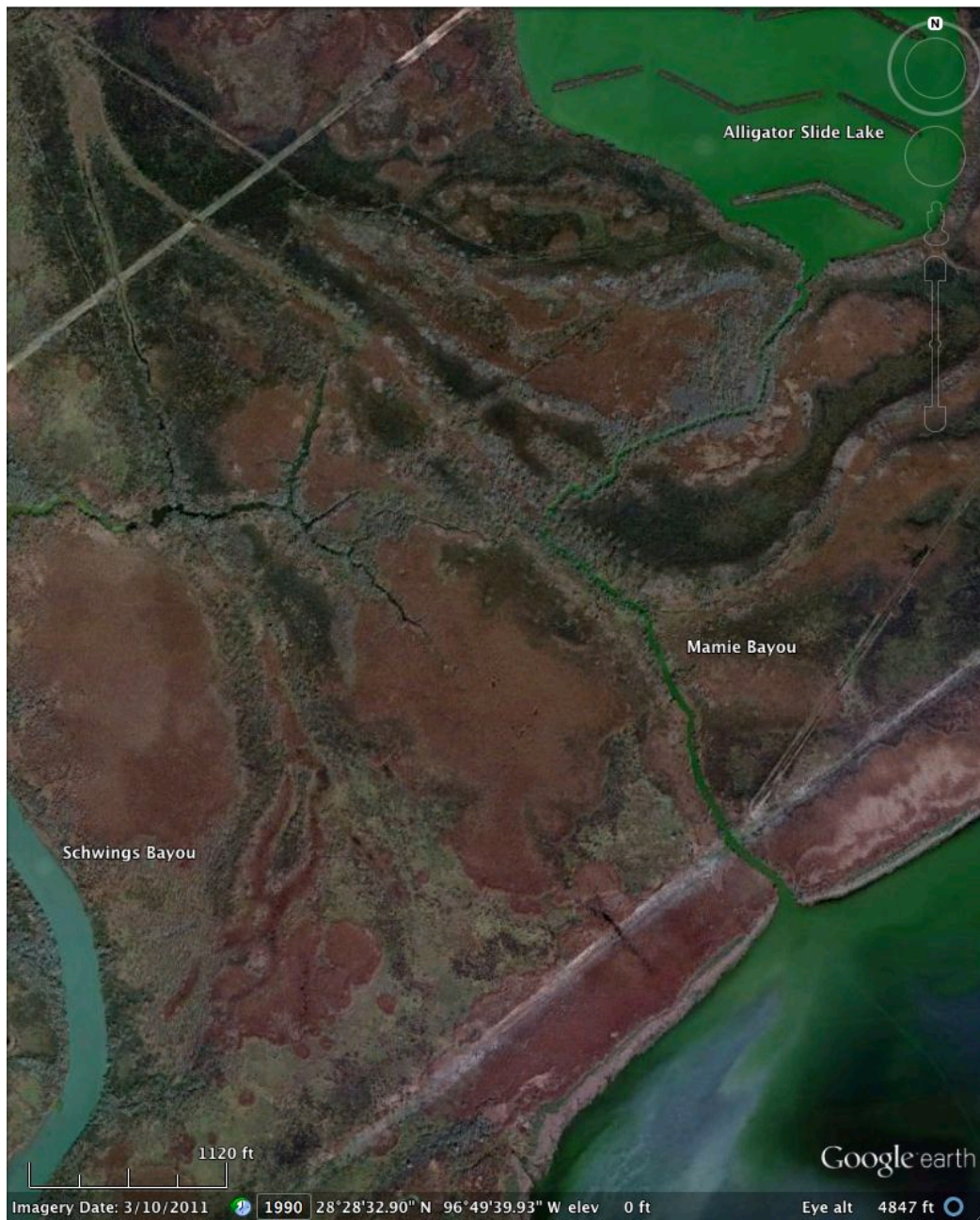


Figure 17. Mamie Bayou, which connects to Alligator Slide Lake and has a very minor connection with Schwings Bayou. This small bayou appears the only relatively unobstructed connection between freshwater and marine water. The color indicates the high algal productivity in the lake is passing through the bayou into the bay. Imagery from Google Earth dated 3/10/2011.

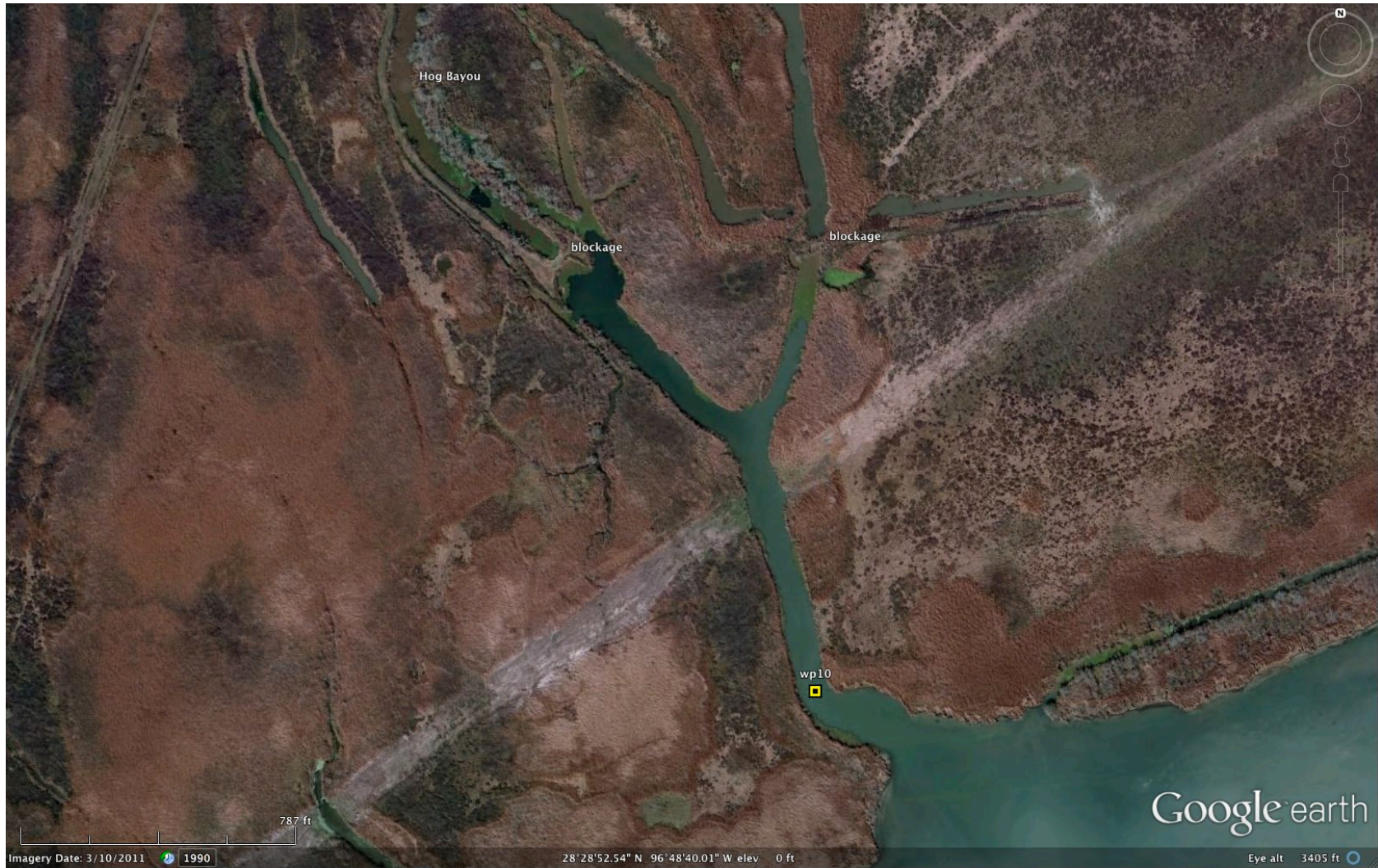


Figure 18. The mouth of Hog bayou is blocked so that the marine waters do not appear to have a significant exchange with the upstream freshwaters. It is not clear whether there are gates on these blockages. Note the dramatic change of water colors at the blockage indicating flow stagnation and development of plant mats (likely water hyacinth). Imagery from Google Earth dated 3/10/2011.



Figure 19. Mouth of Hog Bayou (wp10) choked by plants. Composite panorama photo using DoubleTake software distorts linear relationships. Photograph by Ben R. Hodges, ©2013. File wp010 bNWtoN HogBayouMouth p068to069



Figure 20. Looking to the southeast into Mission Lake at entrance to Hog Bayou (wp10). Photograph by Ben R. Hodges, ©2013. File wp010 bESE HogBayouMouth i072.

Goff Bayou

As shown in Figure 21, Goff Bayou extends from the freshwater diversion canal in the north and runs southward parallel, but just to the west of, the Victoria Barge Canal. Figures 22-24 show views from the embankment separating the two channels at wp11, wp12 and wp13.

Waypoints 13 and 14 are critical locations in Goff Bayou, shown in greater detail in Figure 25. At wp13, a set of gates (open on Jan. 10, 2013) connect Goff Bayou to a culvert that runs beneath the Victoria Barge Canal, providing a freshwater source for the industrial canals to the east (Figure 26). At wp14, a set of gates (closed on Jan. 10, 2013) separates the freshwater upstream segment of Goff Bayou from marine waters in the lower segment (Figures 27-30).



Figure 21. Goff Bayou connection with diversion canal and Mission Lake. Note the freshwater diversion from wp13 goes underneath the Victoria Barge Canal and connects to industrial supply canals to the east of the barge canal. Imagery from Google Earth dated 3/10/2011.



Figure 22. View to the southwest from wp11 on the embankment between the Victoria Barge Canal and Goff Bayou. Goff Bayou is not visible. Composite panorama photo using DoubleTake software distorts linear relationships. Photograph by Ben R. Hodges, ©2013. File wp011 bSSWtoW NearGoffBayou p077to079.



Figure 23. Panoramic view to the west from wp12 on the embankment between the Victoria Barge Canal and Goff Bayou. Goff Bayou is just visible to center left. Composite panorama photo using DoubleTake software distorts linear relationships. Photograph by Ben R. Hodges, ©2013. File wp012 bSWtoWNW NearGoffBayou p081to084.



Figure 24. Panoramic view from south to west of Goff Bayou and the gates connecting the bayou to the industrial canals on the opposite side of the Victoria Barge Canal. Goff Bayou is entirely choked with floating plants (appears to be water hyacinth). In center of the photo are the downstream gates at wp14. Composite panorama photo using DoubleTake software distorts linear relationships. Photograph by Ben R. Hodges, ©2013. File wp013 bStoW GoffBayouGates p086to089.



Figure 25. Overview of gates connecting to industrial canals on east bank of the Victoria Barge Canal (wp13) and the gates separating upstream freshwater from downstream marine water in Goff Bayou (wp14). Imagery from Google Earth dated 3/10/2011.

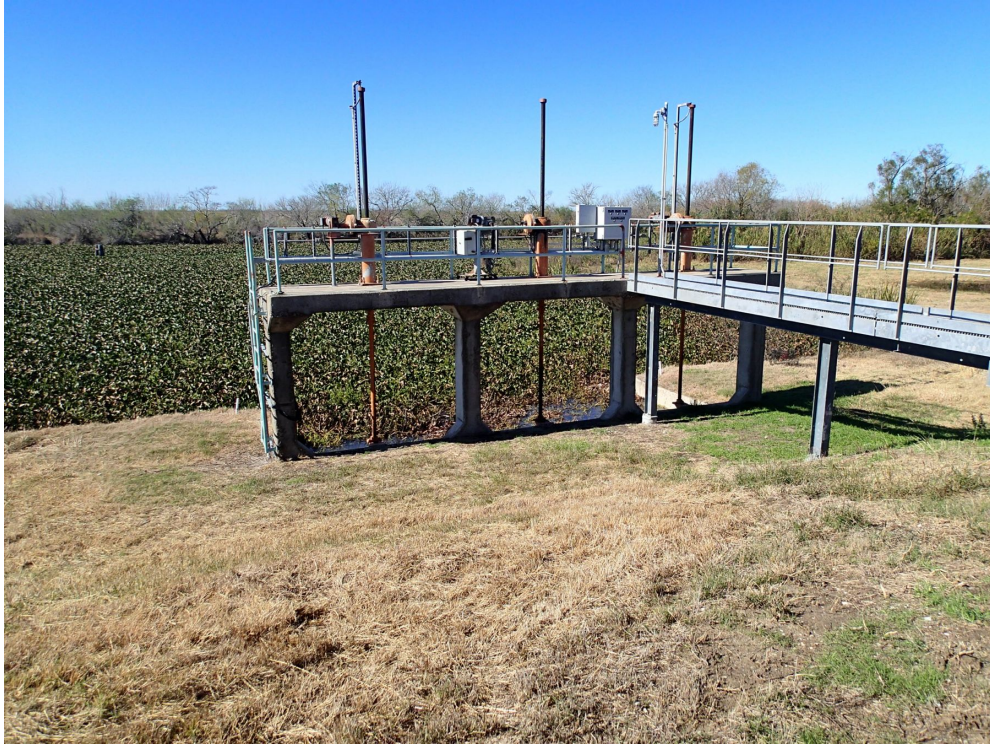


Figure 26. Gates at wp13 connecting Goff Bayou with industrial canals on the opposite side of the Victoria Barge Canal. Photograph by Ben R. Hodges, ©2013. File wp013 bW GoffBayouGates i085.



Figure 27. Downstream gate on Goff Bayou (wp14) separating downstream water (to left of gate) from upstream water (to right), as view from wp13 with telephoto lens. Composite panorama photo using DoubleTake software distorts linear relationships. Photograph by Ben R. Hodges, ©2013. File wp013 bSW GoffBayouGates p090to091.



Figure 28. Goff Bayou upstream of gates separating upper and lower portion (wp14). Bayou is completely choked by floating plants (appears to be water hyacinth). Note the gates for the freshwater diversion to industrial canals on the east bank of the Victoria Barge Canal is just visible at center right in the distance. Composite panorama photo using DoubleTake software distorts linear relationships. Photograph by Ben R. Hodges, ©2013. File wp014 bNWtoNE GoffBayouGates p100to102



Figure 29. Looking downstream from gates separating upper from lower sections of Goff Bayou (wp14). Note rapid decline of floating plants downstream, likely indicating brackish water with salt in excess of plant tolerance. Composite panorama photo using DoubleTake software distorts linear relationships. Photograph by Ben R. Hodges, ©2013. File wp014 bSSEtoS GoffBayouGates p098to099.



Figure 30. Close gates separating upstream and downstream sections of Goff Bayou at wp14. Photograph by Ben R. Hodges, ©2013.

Summary of observations

Because of the rainstorm on the previous day, we were not able to view the operation of the saltwater barrier during low flow conditions.

Connectivity of the bayous with Mission Lake is fairly limited. Because of the barriers at Goff and Hog Bayou, the tidally driven exchange of marine and freshwater that is characteristic of Gulf Coast Bayous does not readily occur. It appears that under low flow conditions when marine water reaches the saltwater barrier of the Guadalupe River the entire Schwing Bayou will be marine water. This state is expected as the diversion canal bypasses the headwaters of Schwing Bayou, such that there is no significant source of upstream freshwater in the absence of local rain or flooding. Only Mamie Bayou appears to operate as a natural bayou, although it is not clear how much freshwater flow there is through Alligator Slide Lake.

It appears that the hydraulic structures in this area have changed the functioning of the natural bayou system. It appears likely that the brackish nursery habitats of estuarine species, which is usually supported by extensived bayous, is fairly limited. In Goff and Hog Bayous the principal cause is structures that segment the bayous, whereas in Schwing Bayou the diversion of fresh water by the upstream canal appears likely to make this bayou principally marine water.

Appendix

Equipment

The camera used was an Olympus TG-1 with 12 megapixel resolution. Camera image direction was inconsistent, so was adjusted based on review of Google Earth imagery.

Photograph file names

Photograph file names are assigned as wp### bDDD item iNNN.jpg, where

is the waypoint number

DDD is the estimated bearing of camera using table below

iNNN is the photo number

True heading to approximate bearing

NW 304 – 315 – 326

NNW 327 – 337 – 348

N 349 – 000 – 010

NNE 011 – 022 – 033

NE 034 – 045 – 056

ENE 057 – 067 – 078

E 079 – 090 – 101

ESE 102 – 112 – 114

SE 115 – 135 – 146

SSE 147 – 157 – 168

S 169 – 180 – 191

SSW 192 – 202 – 213

SW 214 – 225 – 236

WSW 237 – 247 – 258

W 259 – 270 – 281

WNW 282 – 292 – 303

Waypoint locations

Photographs were taken at 14 waypoints, designated by wp01 – wp014. Approximate locations were determined from integrated GPS in the camera, then adjusted through examination on Google Earth. Locations and descriptions are as follows:

wp01	28°29'47.59"N	96°46'14.21"W	Industrial freshwater channel under TX-185
wp02	28°30'21.33"N	96°53'2.86"W	Guadalupe River salt barrier
wp03	28°30'23.72"N	96°53'8.67"W	Upstream gate of diversion channel
wp04	28°29'51.50"N	96°50'35.24"W	Bridge over freshwater diversion channel off of TX-35
wp05	28°26'49.73"N	96°45'56.14"W	Boat ramp on Victoria Barge Canal
wp06	28°27'14.73"N	96°46'51.18"W	Connection between Guadalupe Bay and the Victoria Barge Canal
wp07	28°27'32.40"N	96°48'57.60"W	Mission Lake
wp08	28°27'27.77"N	96°49'6.92"W	Outside New Cut mouth of the Guadalupe River
wp09	28°27'26.10"N	96°49'12.79"W	New Cut mouth of the Guadalupe River
wp10	28°28'45.33"N	96°48'35.99"W	Hog Bayou mouth
wp11	28°29'12.32"N	96°47'30.39"W	Embankment between Goff Bayou and Victoria Barge Canal (downstream)
wp12	28°29'29.24"N	96°47'37.89"W	Embankment between Goff Bayou and Victoria Barge Canal at oil pipeline crossing
wp13	28°29'51.42"N	96°47'47.93"W	Gate connecting Goff Bayou to freshwater canals on east side of Victoria Barge Canal
wp14	28°29'47.29"N	96°47'49.59"W	Gate separating upstream and downstream Goff Bayou.

USGS data

The Guadalupe River discharge from the gaging station at the saltwater barrier (28° 30' 20" N; 96° 35' 04" W) is shown for the first ten days of January, 2013 in Figure 31. For context, the flows during 2011 and 2012 are shown in Figure 32.

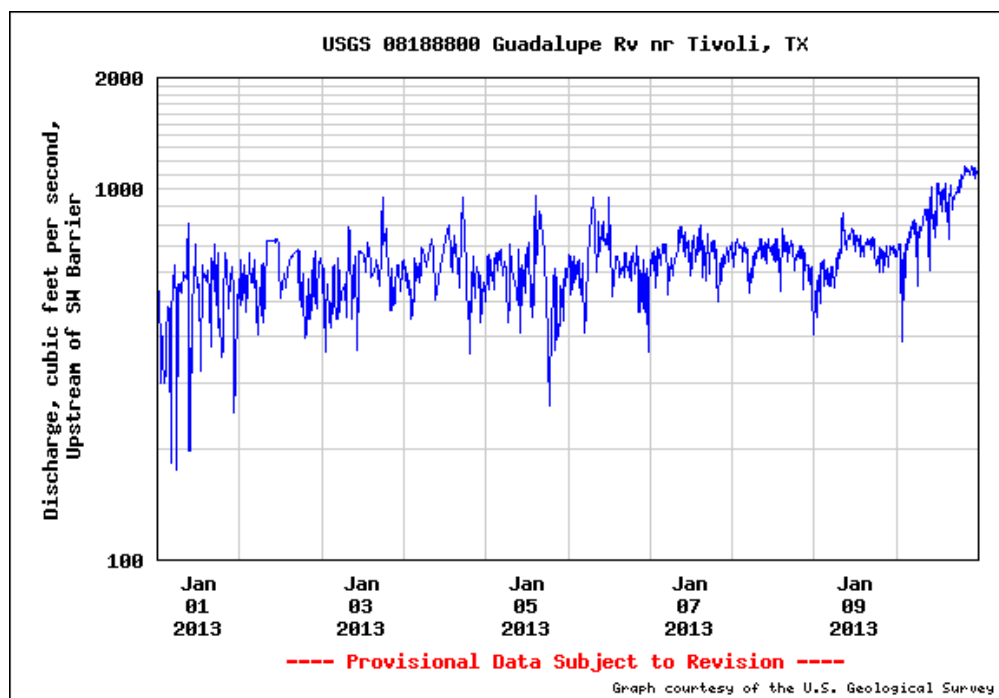


Figure 31. Guadalupe River discharge for the first 10 days of January, 2013.

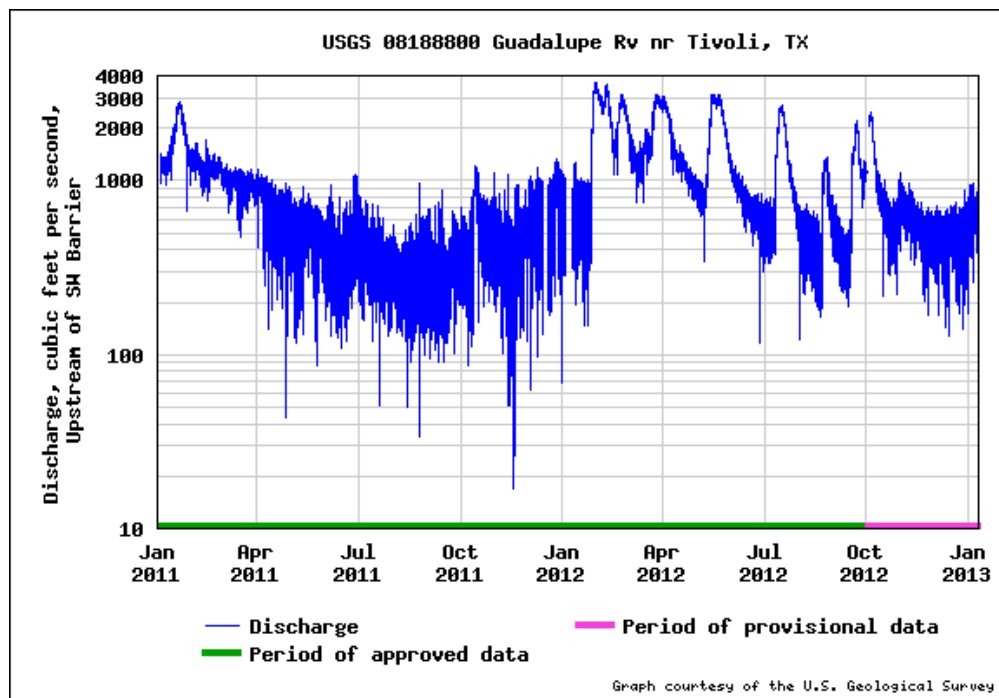


Figure 32. Guadalupe River discharge for 2011-2012.

The USGS gage heights, for the first ten days of January, upstream and downstream of the saltwater barrier are shown in Figure 33 and 34.

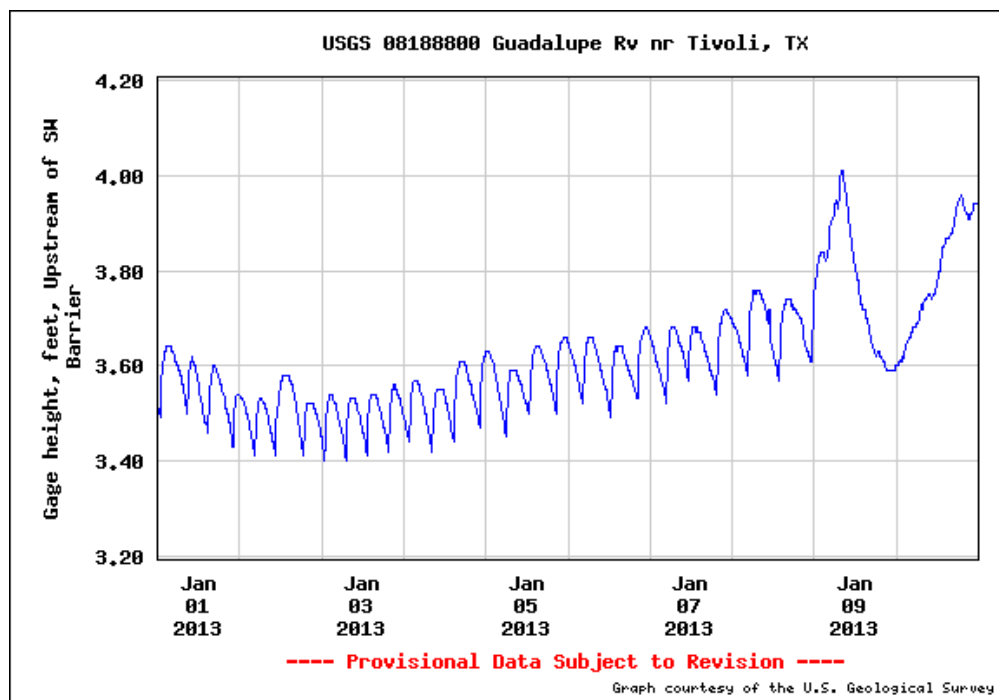


Figure 33. Guadalupe River gage height upstream of saltwater barrier (zero datum is 0.04 ft above NGVD29).

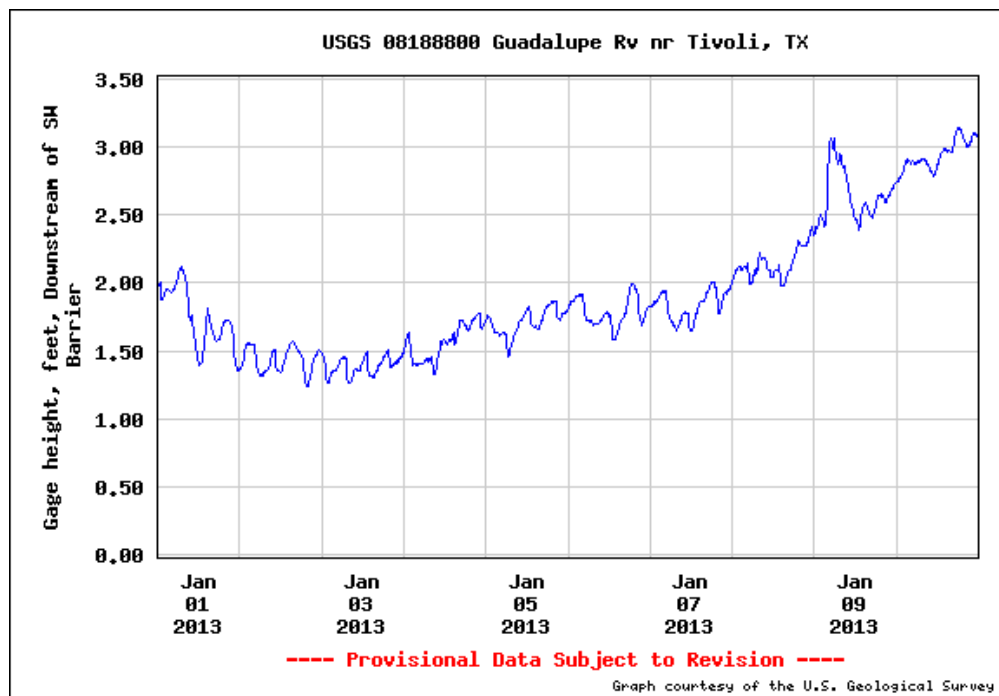


Figure 34. Guadalupe River gage height downstream of saltwater barrier (zero datum is 0.04 ft above NGVD29).