

**WETLAND CONDITION EVALUATION:
D'OLIVE CREEK, TIAWASEE CREEK, AND JOE'S
BRANCH WATERSHEDS
(BALDWIN COUNTY, ALABAMA)**

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INTRODUCTION

The following report provides an overview of current characteristics of, and impacts to, wetlands found within the D'Olive Creek, Tiawasee Creek, and Joe's Branch watersheds in Baldwin County, Alabama. Specifically, the studied wetlands are located in the Daphne and Spanish Fort areas north of County Road 64, west of Mobile Bay, east of Highway 181, and south of Highway 31. D'Olive Creek, Tiawasee Creek, and Joe's Branch are three distinct sub-watersheds within the overall study area. Together they form the D'Olive Bay watershed. A summary of conditions recorded during Vittor & Associates' annual submerged aquatic vegetation (SAV) study within D'Olive Bay itself are also included.

Barry A. Vittor & Associates, Inc. performed a field survey, utilized aerial photography to gather information on the current condition of wetlands within the study area, and created a simple grading system to aid in determining relative impacts. The field survey consisted of pre-selecting sample locations based on accessibility, location within each sub-watershed, and the site's similarity to adjacent wetlands. At each sample location, observations were recorded on canopy species and closure, midstory and understory species and density, degree of apparent sedimentation, exotic species present, impacts to the surrounding upland buffer, and potential methods that could be used to enhance or restore the wetlands. In addition to the initial field survey and examination of aerial photography, detailed photographs taken during Tetra Tech Inc.'s watershed erosion activity assessment were used to determine conditions in areas that were not observed by Vittor & Associates personnel. To foster compatibility between the wetlands assessment and the erosion activity assessment report prepared by Tetra Tech, the sample site location identifiers were labeled using the same nomenclature scheme used by Tetra Tech.

The wetlands referred to in this report are Section 404 jurisdictional wetlands as defined by the U.S. Army Corps of Engineers. Isolated or man-made ponds, ditches, and retention basins were not considered wetlands for the sake of this survey. Three distinct types of jurisdictional wetlands occur within the D'Olive Bay watershed:

(1) Brackish tidal marsh – The brackish tidal marsh is associated with the mouth of D'Olive creek and the vegetated wetland fringe surrounding D'Olive Bay. It is characterized by a thick cover of native marsh species such as southern cattail (*Typha domingensis*), common three square (*Schoenoplectus pungens*), and common reed (*Phragmites australis*).

(2) Bottomland hardwood forested wetlands – The bottomland hardwood forested wetlands are primarily located along the creeks and tributaries and are relatively narrow in the study area watersheds due to the hilly topography of the area. Vegetative characteristics varied widely from location to location, but most wetlands of this type within the watershed are characterized by mature native

canopy species such as sweetbay magnolia (*Magnolia virginiana*), swamp tupelo gum (*Nyssa biflora*), and yellow-poplar (*Liriodendron tulipifera*).

(3) Seepage-slope forested pine/hardwood wetlands – Seepage-slope forested pine/hardwood wetlands were very similar to bottomland hardwood wetlands in vegetative composition, but were located on the hillsides surrounding the creek bottoms and contained scattered loblolly pine (*Pinus taeda*) and slash pine (*Pinus elliottii*).

WETLAND IMPACTS

Primary impacts in all wetlands of the listed watersheds are related to sedimentation and/or hydrologic modifications which have altered stream channel characteristics. Much of the watersheds are heavily developed, and much of the development took place on steep slopes that are characteristic of the upland buffers surrounding wetlands in west-central Baldwin County. Unfortunately, Best Management Practices (BMPs) were not always used during the construction process, and large quantities of sediment washed into the wetlands during heavy rain events. BMPs were not required for construction activities until around 1992, and BMPs such as sediment fencing to manage post-construction runoff were not required until recently.

When wetlands become heavily impacted by sedimentation, their native vegetative structure is often altered. Seeds from aggressive exotic species such as Chinese privet (*Ligustrum sinense*) and Chinese tallowtree (*Triadica sebifera*) germinate quickly in freshly deposited sediment where competing native species have either died or become stressed. Exotic species are less desirable than native species for a number of reasons. Because they are growing outside of their normal range and beyond the reach of their established diseases and pests, exotics are often able to out-compete native species that would occupy a similar niche in a native ecosystem. This can lead to the replacement of dozens of diverse native species with one or two exotic species that cannot provide the same natural food source or shelter as the original vegetative community. This process has occurred in most wetlands within the studied watershed to varying degrees.

Severe stream and channel erosion are causing impacts to the wetlands adjacent to the stream channels in many areas. During the survey, it was noted that many large trees growing alongside the streams have recently fallen or are leaning due to their root systems being undercut. When large trees fall, they often crush and shade smaller shrub and herbaceous species which creates openings in both the canopy and understory. As the tree decays, exotic species often become established due to their ability to out-compete native species, as discussed above.

WETLAND CONDITION SURVEY

Sixteen locations within the study area were sampled by Vittor & Associates during a three-day field survey conducted in October, 2009. The 16 sites were chosen based on a number of factors; including their respective positions within each of the three sub-watersheds; accessibility by road (to save man hours in the field by cutting hiking times); representative nature of the impacts and overall condition compared to surrounding wetlands (at least one site was located in each wetland area with unique characteristics in each of the three sub-watersheds); and spatial distribution throughout the study area. Stream reaches and associated wetlands above and below the selected sites were visually inspected on foot and by vehicle to ensure that each site was not located in an area that had unusual characteristics. The sites were treated as individual plots, that is, all observations were made from a single location. This method was used to allow greater consistency between sites. The wetlands and uplands adjacent to each survey location were examined and relevant characteristics were noted. The survey locations were labeled by location within each watershed using the nomenclature approach used in Tetra Tech's Watershed Assessment Report to facilitate comparison between the two studies.

Notes on wetland vegetation (understory, midstory and canopy species composition), health of the vegetation, surrounding buffers, estimated percent cover of exotic species, and apparent impacts were recorded at each location. The results of the field survey were used in conjunction with aerial photography to grade the current condition of wetlands at each sample location, and within each individual sub-watershed. Vittor & Associates created a simple methodology to grade each wetland survey site according to the most important factors affecting the overall watershed: stability of the surrounding upland buffers, current vegetative composition and health, evidence of past impacts, and potential for future impacts. The grading scale is presented in Table 1:

Table 1. Wetland evaluation methodology (1=most impacts, 5=least impacts)

SCORE	CHARACTERISTICS
1	Severely impacted/impaired wetland system. Wetlands are severely impacted by sedimentation, upland buffers are unstable and continue to supply sediment during rain events, greater than 50% exotic species composition, canopy trees (natives) are dead or dying, drainage patterns may be altered, and understory vegetation dominated by exotic species.
2	Low-Medium quality wetlands. Canopy trees (native) are stressed and many are dead or dying vegetative strata contain 25-50% exotic species, sedimentation is causing/has caused impacts to drainage patterns, and upland buffers are altered and unstable and may cause further sedimentation in heavy rain events.
3	Medium quality wetlands. Canopy trees are predominately (>75%) native, sedimentation is present but wetlands have stabilized and are functional despite the past sediment, understory vegetation is <25% exotic, upland buffer has been altered but is stable and future sedimentation should be minor.
4	Medium-high quality wetland system. Canopy trees are >95% native, understory vegetation contains <5% exotic species, uplands are stable and have vegetated buffers 50-100 feet wide, past sedimentation has not caused significant reduction in wetland function.
5	Relatively undisturbed/high-quality wetland system. Canopy trees are native and healthy, sedimentation has not caused damage to the original wetland function, understory is free from exotic species, and upland buffers are greater than 100 feet (vegetated) and stable with a low likelihood of future sedimentation.

SURVEY RESULTS

Joe's Branch

Wetlands bordering Joe's Branch, which flows from north to south and empties into D'Olive Creek just west of the Lake Forest Lake Dam, are the most heavily impacted of those found within the three primary drainage ways. Commercial development associated with the recently constructed Spanish Fort Town Center northeast of the intersection of Interstate 10 and Highway 98 surrounds the south half of Joe's Branch. During the site preparation for the new commercial complex, approximately 235 acres of the Joe's Branch watershed were cleared. However, it should also be noted that severe erosion and high sediment source potential has been documented in tributaries to Joe's Branch upstream of drainage from the Spanish Fort Town Center.

Three survey points were examined in the Joe's Branch sub-watershed. Characteristics of the jurisdictional wetlands were very similar at each of the locations. TABLE 2 shows the summary of scores given to the wetland sites surveyed by Vittor & Associates in the Joe's Branch sub-watershed.

Table 2. Joe's Branch Summary of scores

LOCATION	SCORE
Site J1W	1
Site JB1W	2
Site J2W	3

Site J1W (J=Joe's Branch, W=Wetland) was located adjacent to the new Spanish Fort Town Center, in between its southern entrance road (Bass Pro Drive) and the northern entrance road (Town Center Avenue). This section of Joe's Branch has been severely impacted by sedimentation. Approximately 50% of the mature, native canopy trees are dead or dying, the understory is dominated by exotic species. The sediment deposits are over 12 inches deep across much of the wetland, and the upland buffer has been cleared. Site J1W scored a 1 (highest impacts) on our wetland grading scale. While the recently constructed shopping plaza cannot be discounted as a possible source for some of the sediment in this reach of Joe's Branch, it appears that the most significant sources of the sediment have originated from upstream of the site. Tetra Tech's erosion activity assessment has documented actively advancing headcuts, resulting in channel incision and bank erosion, in both tributaries JA and JB. However, it should be noted that it was beyond the scope of this study to comprehensively quantify the relative contributions of sediment sources.

Two locations were sampled north of Site J1W. Sites JB1W and J2W were located approximately 0.5 mile upstream of Site J1W. Site JB1W scored 2 points, and Site J2W scored 3 points using our wetland grading scale. Primary impacts to these two sites were (1) sedimentation due to commercial development and road construction, and (2) exotic species, primarily (*Ligustrum sinense*), in the under and mid-stories. North of the new commercial development and the surveyed sites, aerial photography was used to examine the main branch of Joe's Branch and tributaries JA and JB. Tributaries JA and JB are clearly impacted by fresh layers of sediment and contain very little understory vegetation. The wetlands adjacent to the main stream channel have experienced less sedimentation for approximately 1500 feet, but sedimentation becomes apparent again south of Maury Court. Maury Court is a residential road in the Westminster Subdivision which contains approximately 21 lots. Homes are currently being built on several of the lots, or have been built within the last few years, and a detention pond was built to slow runoff from the Court.

Tiawasee Creek

The wetlands associated with Tiawasee Creek have been impacted primarily by sedimentation associated with the Lake Forest Subdivision Development, and increased volume and velocity of runoff entering the system during rain events. Approximately 3,700 lots have been developed within the Lake Forest community over the past few

decades, but detention ponds were never installed to slow the runoff of water from the residential lots. At the time the Lake Forest subdivision was developed there were no requirements for BMPs during construction or for post-construction stormwater runoff management. Fortunately, the mature hardwood trees that occupy the riparian areas of the watershed were never cleared and most are relatively healthy.

Four sites were surveyed within the Tiawasee Creek sub-watershed. TABLE 3 shows the summary of scores given to the wetland sites surveyed by Vittor & Associates in the Tiawasee Creek sub-watershed.

Table 3. Tiawasee Creek Summary of scores

LOCATION	SCORE
Site T2W	4
Site TC1W	3
Site TA1W	4
Site T1W	2

Site T2W, was located near a bridge inside the Tiawasa Subdivision west of Highway 13 and scored a 4 on our wetland grading scale. Although the wetlands have been impacted by sediment, most canopy trees were healthy, and few exotic species have become established along this section of Tiawasee Creek. It should be noted that most of the upland buffer upstream of Site T2W has not been developed for residential housing or commercial purposes. Site TC1W was located southwest of Site T2W just east of Pollard Road, and scored a 3 on the grade scale. It had very similar characteristics to Site T2W, but had a much higher percentage of exotic seedlings in the understory and deeper sediment deposits which might have entered the wetland from an adjacent dirt pit during heavy rain events. Wetlands in the riparian area of Tiawasee Creek east of Tributary TG were relatively undisturbed and the surrounding upland buffer was undeveloped. The only significant impact to wetlands in that section on the Creek was scattered exotics species throughout the understory, resulting in a score of 4 on the grade scale. South of TC1W, wetlands surrounding Tributary TC retain the same characteristics and, therefore, the score of 3 on the grade scale. However, sub-tributary TCC was one of the most heavily impacted wetlands within the study area. TCC flowed through an agricultural field and all native vegetation had been cleared. All wetlands surrounding TCC scored a 1 due to extreme manipulation of the historical wetland system.

Sites TA1W and T1W were approximately 900 feet apart and located near the center of the Lake Forest subdivision. Site TA1W was located near the tennis courts in a seepage-slope type wetland (adjacent to Tributary TA) that drains into the main branch of Tiawasee Creek. The canopy trees at Site TA1W were very healthy and created a closed canopy, which allowed very little light penetration into the understory. The wetland showed evidence of extreme (>12 inches in many locations) sedimentation that likely

occurred many years ago, but the system has recovered well in terms of species composition. Site TA1W scored a 4 on our grading scale. Site T1W was located approximately 900 feet east of Site TA1W in the riparian area of Tiawasee Creek. Wetlands around Site T1W were heavily impacted by sedimentation and the removal of much of the native/natural vegetation. The dominant canopy tree species is currently planted loblolly pine, and the midstory was dominated by exotics and green titi (*Cyrilla racemiflora*). Sedimentation has altered the natural hydrology to the point that upland exotics such as cogongrass (*Imperata cylindrica*) and camphortree (*Cinnamomum camphora*) have become established in areas along the creek that were historically bottomland hardwood swamp. Site T1W scored a 2, rather than a 1, on our grade scale because the upland buffer is heavily vegetated in most areas and danger of future sedimentation is minor compared to sites surrounded by new development.

D'Olive Creek

Seven sites were sampled within the D'Olive Creek sub-watershed, and two additional sites, Sites D1W and D2W, were sampled just east of the point where D'Olive Creek empties into D'Olive Bay. Conditions within the D'Olive Creek watershed vary dramatically depending upon location, but the majority of the wetlands have been impacted by sedimentation from commercial and residential developments associated with the Lake Forest and Timber Creek subdivisions. TABLE 4 shows the summary of scores given to the wetland sites surveyed by Vittor & Associates in the D'Olive Creek sub-watershed.

Table 4. *D'Olive Creek Summary of scores
(Includes confluence of all sub-watersheds near D'Olive Bay)*

LOCATION	SCORE
Site D1W	1
Site D2W	4
Site DC1W	2
Site D6W	2
Site D4W	5
Site DA1W	4
Site D3W	2
Site DB1W	4
Site D5W	4

Site D1W was located just southwest of the Interstate 10 and Highway 98 interchange. Nearly all of the wetlands associated with D'Olive Creek in this area have been severely altered or filled, and Site D1W scored a 1 on our grade scale as a result. The narrow wetland fringe that remains on either side of the creek is dominated by young exotic species such as Chinese tallowtree (*Triadica sebifera*) and the native tree species, black willow (*Salix nigra*).

Site D2W was located east of Highway 98 approximately 1200 feet upstream (east) of Site D1W. The Mature forested canopy of Site D2W was healthy, mature, and contained primarily native trees such as Sweetbay (*Magnolia virginiana*), swamp tupelo gum (*Nyssa biflora*), bald cypress (*Taxodium distichum*), and red maple (*Acer rubrum*). Young exotics such as Chinese tallowtree (*Triadica sebifera*) and Chinese privet (*Ligustrum sinense*) were present in the under and mid-stories, but had not become dominant in those strata. Site D2W scored a 4 on the grade scale, and only lost a point due to the presence of scattered exotic species.

Sites DA1W and DB1W were located on separate tributaries of D'Olive Creek, but had very similar characteristics. Site D5W was located on the main drainage way of D'Olive creek, but also had similar characteristics to Sites DA1W and DB1W. Each of the three sites was dominated by a healthy canopy of native hardwood tree species, and sparsely vegetated understories occupied by native species such as wax myrtle (*Myrica cerifera*), giant gallberry (*Ilex coriacea*), and native ferns. Each of the three sites scored a 4 using our numerical evaluation method due to scattered exotics and evidence of previous sedimentation. DA1W was located on the main tributary of D'Olive Creek, tributary DA. Sections of Tributary DA's riparian wetlands are relatively undisturbed and scored 4 on the grade scale. However, areas such as the confluence of DA and sub-tributary DAC have narrow wetland buffers which have been heavily impacted by the erosion of the stream banks. The headwaters of tributary DA have also been heavily impacted by commercial development and the placement of a detention pond in the historical stream channel. Site DB1W was located on Tributary DB, which has relatively few wetland impacts compared to other wetlands within the D'Olive Creek sub-watershed. The entire length of DB scored a 4 on the grade scale due to sparse exotics and minimal siltation due to a primarily undeveloped upland buffer.

Site D4W was the only surveyed wetland point that we scored as a 5 using our grading methodology. It was vegetated with native species in all strata, sediment deposits were not negatively impacting the health of the desirable tree species at the time of the survey, and the upland buffer was stable and contributing little if any additional sediment to the system. Debris deposits were noted on the shrubs and on tree trunks in the wetlands at Site D4W suggesting that, during heavy rain events, the water level rises very rapidly. The high, fast-moving water could be the reason silt deposits had not accumulated in the area surrounding Site D4W. Another factor contributing to Site D4W's score of 5, despite the fact that it is downstream of wetlands that scored 2, 3, or 4, could be the lack of development in the surrounding upland buffer and the buffer's lack of exotic species.

Sites DC1W and D6W, which were located upstream of Site D4W within the Timber Creek subdivision and each scored a 2 on the grade scale, were heavily impacted by sedimentation and exotic species. The native canopy at Site DC1W, had been totally cleared, leaving only small sweetbay (*Magnolia virginiana*), yellow-poplar (*Liriodendron tulipifera*), and Chinese tallowtree (*Triadica sebifera*) in the midstory. Site D6W had numerous large native canopy trees that were dead or dying, most likely due to deep sediment deposits. The wetlands to the east and west of Site D6W had similar characteristics and impacts, and also scored a 2 on the grade scale. The impacts to wetlands north of Site DC1W became less significant towards the headwaters of the tributary, and were graded as a 3, then 4 (see map) as exotic species in the under and mid-stories became less numerous and impacts siltation less severe.

Site D3W was located just east of the eastern tip of the lake in Lake Forest Subdivision. The wetland had been severely altered to the point that it was hard to distinguish what the pre-development conditions might have been. Currently, the wetland is devoid of large canopy trees, is colonized in the midstory by exotic species, and seems to be inundated beyond its natural state due to the impoundment caused by the lake as evidenced by the depth of the creek waters on the surviving trees. The severe hydrologic alteration and exotic species earned Site D3W a score of 2 on the grade scale.

D'Olive Bay

D'Olive Bay receives the runoff from the three sub-watersheds discussed in the previous paragraphs. It is a very shallow body of water bordered to the north and west by brackish tidal marsh, Mobile Bay to the south, and the western shore of the city of Daphne to the east. D'Olive Creek (which carries the water from all three sub-watersheds) flows in to the Bay in its northeast corner.

The brackish tidal marsh that surrounds D'Olive Bay is dominated by cattail (*Typha sp.*) and bulrush (*Schoenoplectus*) species. There are scattered patches of common reed (*Phragmites australis*) in the marsh buffer, but they are confined to the islands of slightly higher ground within the marsh surface. Each of these species is adaptable to fluctuations in water quality and salinity, and plays an important role in filtering the runoff that exits the mouth of D'Olive Creek. There are also several patches of submersed aquatic vegetation (SAV) that occur in the north half of D'Olive Bay. Southern water nymph (*Najas guadalupensis*), grassleaf mudplantain (*Heteranthera dubia*) Eurasian watermilfoil (*Myriophyllum spicatum*) are the dominant SAV species in the bay. It should be noted that Eurasian watermilfoil (*Myriophyllum spicatum*) is an exotic species. In addition to providing habitat and forage for aquatic fauna and birds, the SAV beds perform the valuable function of helping catch sediments that may remain suspended in the discharge from D'Olive creek after heavy rain events.

CONCLUSIONS AND RECOMMENDATIONS

Joe's Branch

Wetlands surrounding Joe's Branch are the most severely impacted of those found within the three sub-watersheds. As Joe's Branch flows from north to south, the impacts increase until the water flows into a series of culverts under Interstate 10. At that point, the original wetland is nonexistent and the primary function of the waterway is to carry runoff to D'Olive Bay.

There are opportunities to enhance or restore segments of wetlands surrounding Joe's Branch, especially the section just north of Bass Pro Drive. Restoration activities could include mechanical removal of the sediment deposits, and supplemental planting of desirable native trees and shrubs. To increase the chance that the restoration activities would be successful, it would be necessary to control stream erosion upstream of the Spanish Fort Town Center. Stream bank and bottom erosion provide the major source of sediment impacting the wetlands. While reducing the sediment bed load transported into the wetlands from stream erosion is considered a priority, it would also be important to better stabilize and maintain the steep upland slopes surrounding the wetlands to protect the wetland from sediments generated by on-site erosion of steep slopes.

Sections of Joe's Branch near survey Sites JB1W and J2W could be enhanced by removal of shallow sediment deposits, and would not require supplemental planting due to the healthy, closed canopy that currently exists in those areas.

Tiawasee Creek

Much of Tiawasee Creek and its tributaries have been heavily impacted by sedimentation over the past few decades. The tributaries and sections of Tiawasee Creek that are located south and east of Lake Forest Subdivision have healthy canopies of mature bottomland hardwood tree species, but exotic species have become established throughout much of the understory and would need to be actively treated and managed to enhance the existing vegetative composition of the wetlands.

Sections of Tiawasee Creek that are surrounded by homes in the Lake Forest Subdivision would be much more difficult to enhance due to the steep topography of the surrounding uplands and the close proximity of the homes, some of which are built on pilings and overhang the jurisdictional wetlands adjacent to the creek. There is a section of the creek just east of the Lake Forest Lake that is not surrounded by development and could be restored or enhanced through a series of steps designed to reduce or eliminate sedimentation during rain events. The first step could be the elimination of runoff from dirt lanes and roads that provide access to the wetland bottom. This could be achieved by limiting traffic with gates, or by placing rock in the tire ruts where most of the sediment originates. The second step would be the removal of existing sediment deposits that have not been washed into the wetlands. The third and final step would be clearing the undesirable planted pines and exotic vegetation in the riparian areas and replanting native species that occupied the wetlands prior to disturbance. It should be noted that

enhancement/restoration of the wetlands would be very difficult to execute if steps aren't taken to reduce the quantity and velocity of storm water runoff that flows through the Tiawasee Creek drainage way during heavy rain events.

D'Olive Creek

D'Olive Creek and its associated wetlands have been severely impacted within the majority of the sub-watershed due to dense commercial and residential development. The construction of the Lake Forest Subdivision impacted the western half of the creek, but more recently the Timber Creek Subdivision has contributed to the rapid degradation of habitat quality within the northeastern region of the watershed. Home building within Timber Creek has contributed large quantities of sediment to the upper reaches of D'Olive Creek and its tributaries, and the subdivision's road network, golf course, and driveways/roofs of homes have all contributed greatly to the amount of runoff that the creek must accommodate during storm events. The quantity and velocity of the water has caused severe erosion within the creek bottom and has pushed sediment far downstream, altering the vegetative composition of much of the surrounding wetland acreage. As with the other two watersheds, D'Olive Creek has been impacted primarily by sedimentation.

Wetlands within the D'Olive Creek watershed could be enhanced or restored using the same measures detailed above for the Tiawasee Creek and Joe's Branch wetlands. The first priority in enhancing the wetlands would be to stabilize the sources of runoff and sedimentation that continue to impact the system. For example, there is an old dirt pit just west of Douglas Road that is (or was) frequently used by ATV riders and off-road trucks for recreation. Aerial photography of the area depicts the tire ruts and their paths leading to the wetlands surrounding D'Olive Creek. If these areas could be closed to recreational vehicles, the area could be seeded with appropriate grasses and allowed to re-vegetate and stabilize. Wetlands adjacent to the roads in the Timber Creek subdivision have areas of deep sediment deposits and could be enhanced through removal of the sediment deposits using a conveyor belt system and shovel labor, or through the use of heavy equipment. An exotic species management plan would need to be developed to detail methods of treatment that could be used to rid the wetland's understory of Chinese privet (*Ligustrum sinense*) and Chinese tallowtree (*Triadica sebifera*).

Summary

Restoration or enhancement of any of the wetlands found in the three studied watersheds is possible, but would be labor and time intensive. Establishment of erosion control measures should be first on the list of priorities when examining methods that could be used in the process, followed by development of an aggressive exotic species management plan. Finally, after success has been proven in the efforts to reduce sedimentation and the spread of most exotic species, a vegetative enhancement/restoration plan could be developed that would provide a methodology for returning the wetlands to their pre-development species composition.

D'OLIVE CREEK WATERSHED, STREAM NAMES AND WETLAND CLASSIFICATION

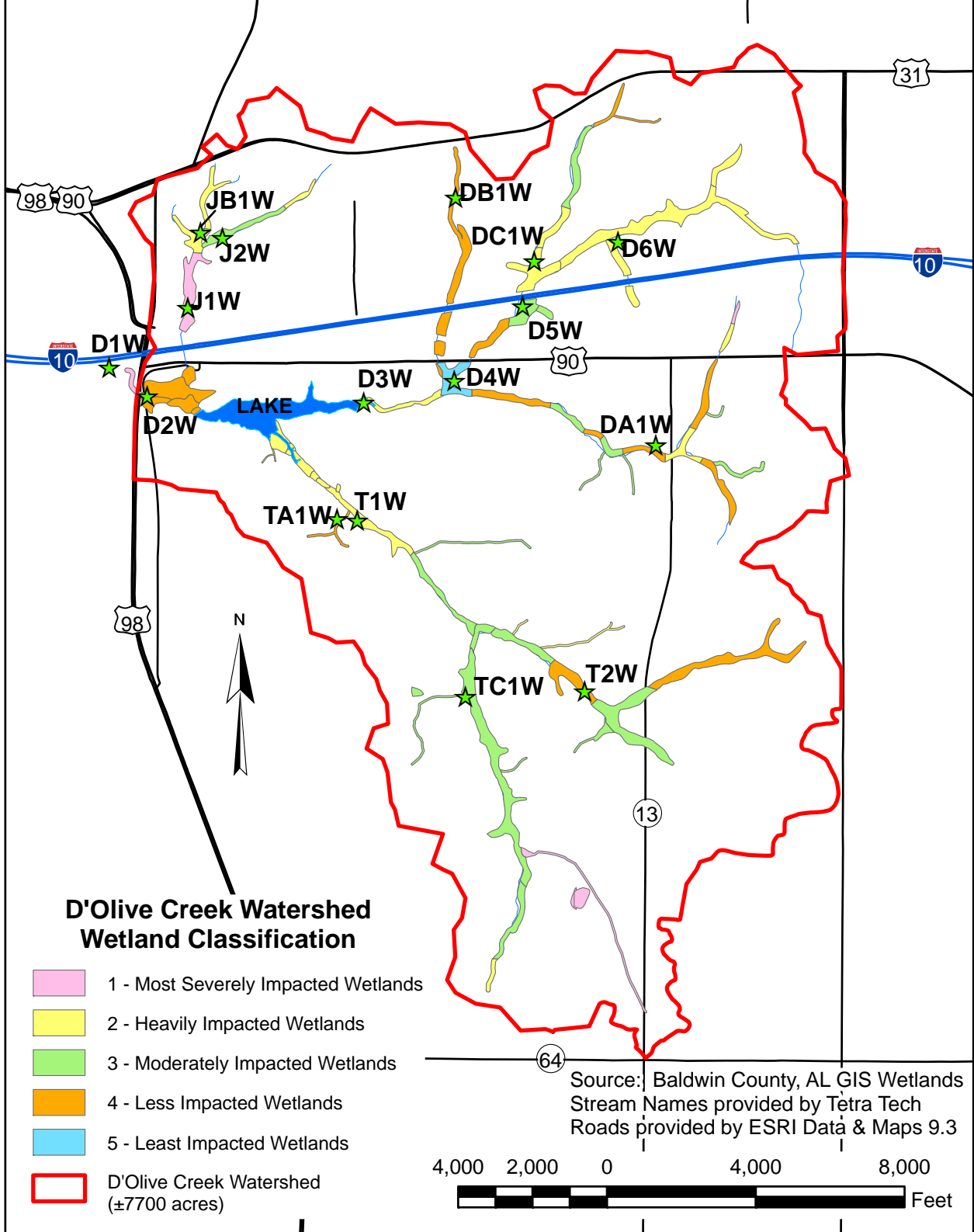




PHOTO 1: View of Site D1W looking southwest across D'Olive Creek. Note the exotic vegetative cover in the riparian area and lack of natural canopy.



PHOTO 2: View of Site D2W looking northeast across D'Olive Creek. Note the natural vegetative cover in the riparian area and healthy native canopy.



PHOTO 3: Site J1 W understory (Joe's Branch). Note the heavy cover of exotic species and light penetration due to the stressed/open canopy.



PHOTO 4: Taken from the same location as Photo 3, this angle shows the large openings in the canopy caused by tree death and/or defoliation.



PHOTO 5: Site JB1W looking north. Most significant impact to this area was the heavy sediment deposit and resulting stress in some canopy trees.



PHOTO 6: Site JB1W looking south. Same situation as seen in Photo 5. Sediment deposits had altered the understory vegetative composition, but were not old/deep enough to kill the canopy trees.



PHOTO 7: Site J2W looking north. Note the re-contouring of the upland buffer to the edge of the wetland line.



PHOTO 8: Site DC1W looking south. Note the extremely dense Chinese tallowtree (*Triadica sebifera*) in the mid and understories. The canopy had also been cleared of mature trees.



PHOTO 9: Site DC1W looking north. This view shows more clearly the damage done to the canopy of this wetland. The houses in the photo are located in the Timber Creek subdivision.



PHOTO 10: Site D6W looking north. Again, sedimentation has severely stressed the canopy and eliminated much of the native understory vegetation in this section of D'Olive Creek.



PHOTO 11: Site D4W was the only location that received a score of 5 on our grade scale. Note the native canopy, mid and understories. Exotic species are extremely sparse in this area of D'Olive Creek.



PHOTO 12: Site T2W was located on Tiawasee Creek in the Tiawasa Subdivision. Primary impacts to this section of Tiawasee Creek are associated with the establishment of exotic species in the understory.



PHOTO 13: This photo was taken from the upland buffer just west of the Site TC1W wetland (visible as the bottom of the hill). Though the canopy trees at Site TC1W were relatively healthy, the understory was dominated by the exotic shrub Chinese privet (*Ligustrum sinense*).



PHOTO 14: Site TA1W was located on a seepage slope near stream TA. Though the area had deep sediment deposits, the native vegetation in all strata had adapted and were relatively healthy.



PHOTO 15: Wetlands at Site T1W were heavily impacted in several ways. In this photo, you can see exotic cogongrass (*Imperata cylindrica*) and Chinese privet (*Ligustrum sinense*) growing at the waters edge. Also, the nature hardwood canopy had been cleared and loblolly pine (*Pinus taeda*) planted in the riparian area.



PHOTO 16: Site D3W was located just east of the Lake Forest pond and was dominated by exotic species in all strata. The water level in the wetland also appeared to have been artificially raised due the impoundment of the pond water.