

WATER SEGMENT ASSESSMENT
TWO HOLE BRANCH (WBID 1489)

TAMPA BAY TRIBUTARIES (GROUP 2)
HILLSBOROUGH RIVER PLANNING UNIT
HILLSBOROUGH RIVER WATERSHED
HILLSBOROUGH COUNTY, FLORIDA

TAMPA BAY STAKEHOLDERS

MARCH 18, 2011



APPLIED TECHNOLOGY AND MANAGEMENT, INC.
5550 NW 111 BLVD.
GAINESVILLE, FLORIDA 32653
386-418-6400
WWW.APPLIEDTM.COM

TABLE OF CONTENTS

1.0	INTRODUCTION	1-1
1.1	Background and Report Purpose	1-1
1.2	Characterization of Waterbody	1-3
1.2.1	Hydrology	1-4
1.2.2	Source Assessment	1-4
2.0	WATER QUALITY DATA ASSESSMENT	2-1
2.1	Summary of Available Water Quality Data	2-1
2.2	Impairment Determination	2-2
2.3	Correlation Analyses	2-2
2.4	Comparative Analyses	2-4
2.5	Comparison with EPA Numeric Nutrient Criteria	2-5
3.0	BIOLOGICAL DATA ASSESSMENT	3-1
3.1	The Stream Condition Index (SCI)	3-1
3.2	BioRecon	3-1
3.3	Biological Evaluations of Two Hole Branch	3-2
3.4	Conclusions from the Biology	3-3
4.0	RECOMMENDED PATH FORWARD	4-1
5.0	LITERATURE CITED	5-1

APPENDICES

Appendix A	Memorandum of Agreement
Appendix B	Two Hole Branch - WBID 1489 - Refinement to Proposed TMDL for Dissolved Oxygen and Nutrients for Two Hole Branch
Appendix C	Two Hole Branch BioRecon Data

LIST OF TABLES

- 2-1 Number of Paired Data Available for Analyses
- 2-2 Water Quality Statistics
- 3-1 Analysis of BioRecon Data from Samples Taken in Two Hole Branch (WBID 1489)

LIST OF FIGURES

- 1-1 Location Map
- 1-2 WBID Boundaries, Stream Reach, and Water Quality Stations
- 1-3 WBID Land Use
- 2-1 Plot of Total Nitrogen
- 2-2 Plot of Total Phosphorus
- 2-3 Plot of Nitrogen Species
- 2-4 Plot of Dissolved Oxygen
- 2-5 Plot of Percent Saturation
- 2-6 Plot of 5-Day Biochemical Oxygen Demand
- 2-7 Plot of Chl *a*
- 2-8 Correlation Plot of TN versus DO
- 2-9 Correlation Plot of TN versus Percent Saturation
- 2-10 Correlation Plot of TN and Inorganic Nitrogen Species versus Color
- 2-11 Correlation Plot of Organic Nitrogen versus Color
- 2-12 Correlation Plot of Percent Saturation versus Color
- 2-13 Plot of Dissolved Oxygen at FDEP Reference Station (Cypress Branch)

1.0 INTRODUCTION

1.1 BACKGROUND AND REPORT PURPOSE

Several water segments in the Tampa Bay area appeared on Florida's 303(d) list in 1998 as impaired for dissolved oxygen (DO) or DO and nutrients. Since that time, The U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (FDEP) have developed total maximum daily loads (TMDLs) for the various water bodies, some of which are still in draft form and some finalized by EPA.

The Two Hole Branch water segment (WBID 1489) (Figure 1-1) was placed on the 1998 303(d) List for nutrients. On the 2004 303(d) List, Two Hole Branch was listed for DO, with total nitrogen (TN) identified as the causative parameter, due to it being the limiting nutrient. On the 2009 303(d) List, the segment was listed for nutrients, with the 2004 DO listing identified. In the 2009 assessment report, TN is identified as the limiting nutrient, although total phosphorus (TP) is identified as the causative pollutant.

FDEP proposed a TMDL for Two Hole Branch in June 2009 (FDEP, 2009). This TMDL identified the need for 60.2 percent reductions in both TN and TP, based upon models that targeted meeting the 5.0 milligrams per liter (mg/L) DO standard. The in-stream targets identified through that effort were 0.46 mg/L for TN and 0.134 mg/L for TP. Written comments, and comments presented at a September 3, 2009 administrative hearing by various Stakeholders [Florida Department of Transportation (FDOT), Pasco County, and Hillsborough County], raised significant issues with the technical assumptions used in the modeling (ATM 2009a, ATM 2009b, ATM 2009c). Based upon those comments, FDEP postponed finalization of the TMDLs until February 2010. On September 30, 2009, EPA proposed the FDEP TMDL in compliance with its consent decree order. On November 30, 2009, comments similar to those provided to FDEP were sent to EPA. The EPA TMDL was not finalized in March 2010 but remained in draft form. In February 2010, FDEP proposed a revised TMDL based upon the use of local reference stations to define TN and TP targets. The revised TMDL identified a 0 percent reduction in TP and a 4.4 percent reduction in TN. The in-stream targets identified for TN and TP through this effort were 1.16 mg/L and 0.473 mg/L, respectively. In February 2010, local Stakeholders filed a challenge on the Two Hole Branch TMDL proposed by FDEP. Through negotiations, the challenge was put in abeyance while the local Stakeholders worked with FDEP to identify a resolution pathway.

A Memorandum of Agreement (MOA) was developed in cooperation with FDEP and EPA that outlined a path forward for resolution. The MOA was developed through multiple coordination meetings and a site visit to Two Hole Branch by representatives of the local Stakeholder group, FDEP, and EPA. The MOA is included as Appendix A.

The first step under the MOA is the development of a Water Body ID (WBID) Assessment Report. The report provides an assessment of the water segment using available water quality, land use, hydrologic, and biological data to examine its impairment status with special emphasis on DO and nutrients. It is intended to provide additional information to assist FDEP and local Stakeholders in determining an appropriate path forward relative to the need for restoration, future management, and/or restoration of this water body. The potential paths forward include the following or some combination of the following:

1. TMDL for nutrients and/or biochemical oxygen demand (BOD) with potential for revised DO target using regional DO criteria
2. Class III Limited re-designation
3. Physical or habitat restoration
4. TMDL not needed (TNN) or Class 4 redesignation

For water bodies that have significant historical physical modifications, it may be determined that trying for a Class III Limited designation may be the appropriate path forward. In those cases, where the water body is impaired for the state's DO standard, but the water quality data do not show a strong connection of depressed DO to nutrients or BOD, the water body may be considered as TNN status (per EPA) or placement under Category 4 (per FDEP). In those cases where the depressed DO condition can be traced to past significant physical disturbances to the water body and it is expected that restoration activities will make the water body attain its designated use, physical restoration will be recommended. Finally, where data indicate that load reductions will achieve restoration of the designated use of the water body, then the path to an appropriate final TMDL will be defined.

This document presents the pathway forward for Two Hole Branch (WBID 1489). The MOA between the FDEP and Stakeholders included specific work tasks to guide determination of the category for the path forward. As outlined in the MOA, these analyses include the following:

- Examine more closely the available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors within Two Hole Branch against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine data from the Stream Condition Index (SCI) or BioRecon data, if available, to assess biological health.

These analyses along with additional technical analyses are presented herein.

1.2 CHARACTERIZATION OF WATERBODY

The Two Hole Branch water segment (WBID 1489) is located in the Hillsborough River watershed in Hillsborough County, Florida. It has been placed in the Hillsborough River Planning Unit, which is part of the Tampa Bay Tributaries Basin Group. This group is assessed as part of FDEP's Group 2 and is currently in its third cycle. Figure 1-1 provides the location of the Two Hole Branch segment within the Hillsborough River Planning Unit.

Two Hole Branch is an intermittent stream that flows to the Hillsborough River (Morgan and Denson, 1995). It is classified by FDEP as Class III Freshwater. The WBID encompasses approximately 6,300 acres and accounts for the complete drainage area for the tributary. Figure 1-2 provides the outline of the WBID and the stream course overlain onto an aerial photograph.

The land uses within the watershed are primarily a mixture of agriculture, upland forest and wetlands (FDEP, 2009; FDEP, 2010a). Figure 1-3 shows the land use distribution within the WBID and surrounding areas. Approximately 10 percent of the watershed is made up of medium- and low-density residential. The remaining lands are split between agriculture, upland forests, and wetlands.

The Two Hole Branch watershed has a sub-tropical climate with an annual rainfall of 45 inches. The average summer temperature is 89.9 degrees Fahrenheit (°F) and the average winter temperature is 72.8°F. The ecoregion is located in the Southwestern Florida Flatwoods and has elevations ranging from 30 to 40 feet above sea level in the downstream

portion and 80 to 90 feet above sea level in the upstream areas. Soils are predominantly composed of medium fine sands and silts. There are no major human population centers in the watershed.

1.2.1 HYDROLOGY

The Two Hole Branch water segment is contained in the Hillsborough Hydrologic Unit (03100205). The WBID boundaries define the hydrologic drainage area. There are no flow gages located within the contributing watershed and, therefore, no measure of flow conditions. The hydrology of Two Hole Branch is driven by rainfall, and the stream has been classified as having intermittent flow.

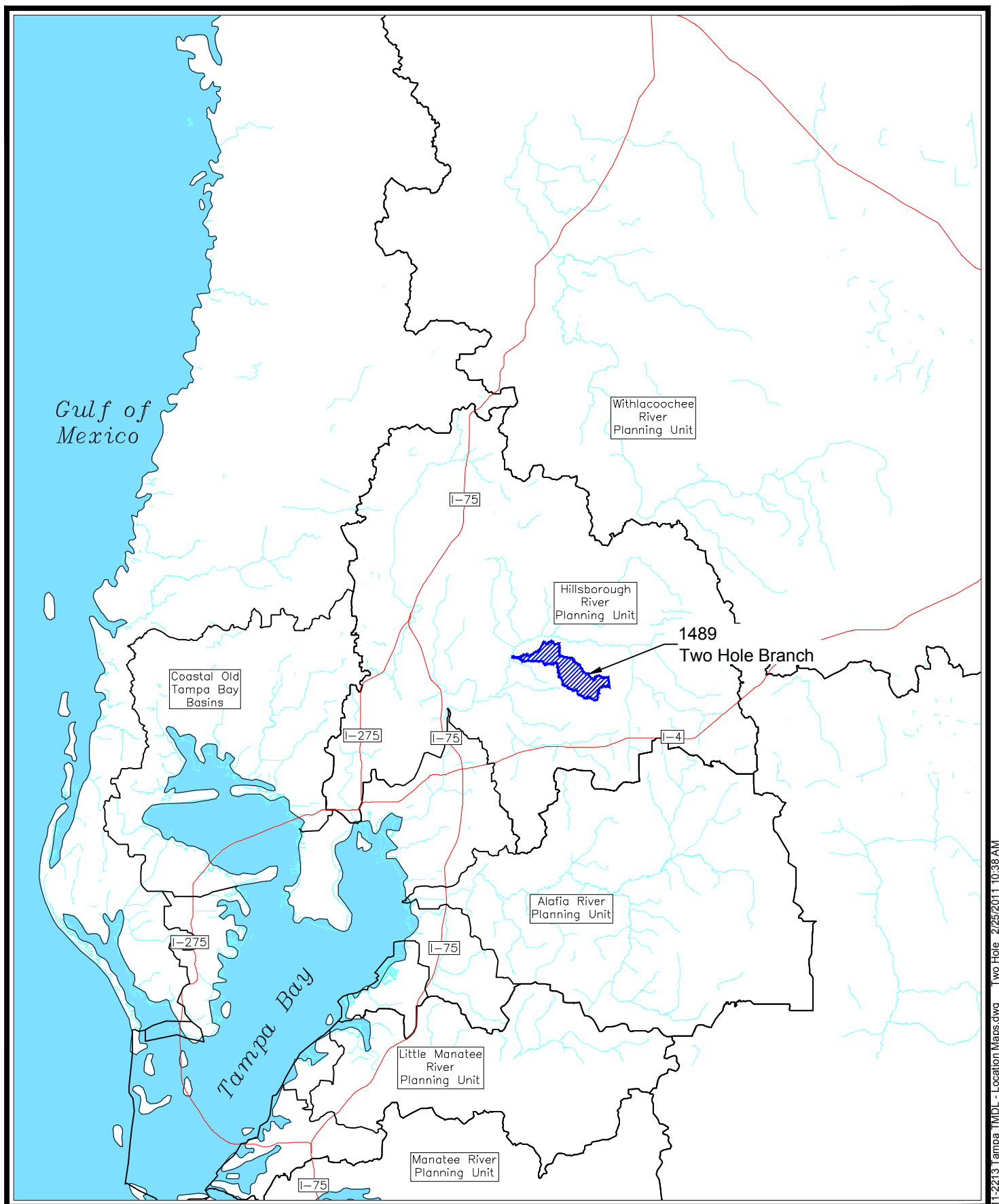
1.2.2 SOURCE ASSESSMENT

1.2.2.1 Point Sources

There are currently no permitted point source discharges within the Two Hole Branch WBID.

1.2.2.2 Non-Point Sources

The storm water collection systems in the Two Hole Branch water segment are owned and operated by Hillsborough County (#FLS 000006) and FDOT and are covered by Phase I Municipal Separate Storm Sewer System (MS4) permits. There is very limited stormwater infrastructure maintained by either entity within the watershed. Potential anthropogenic non-point sources of pollutants come from the low- and medium-density residential lands and agriculture.



11-2213 Tampa TMDL - Location Maps.dwg 11/25/2011 10:38 AM

Figure 1-1
Location Map - Two-Hole Branch (1489)

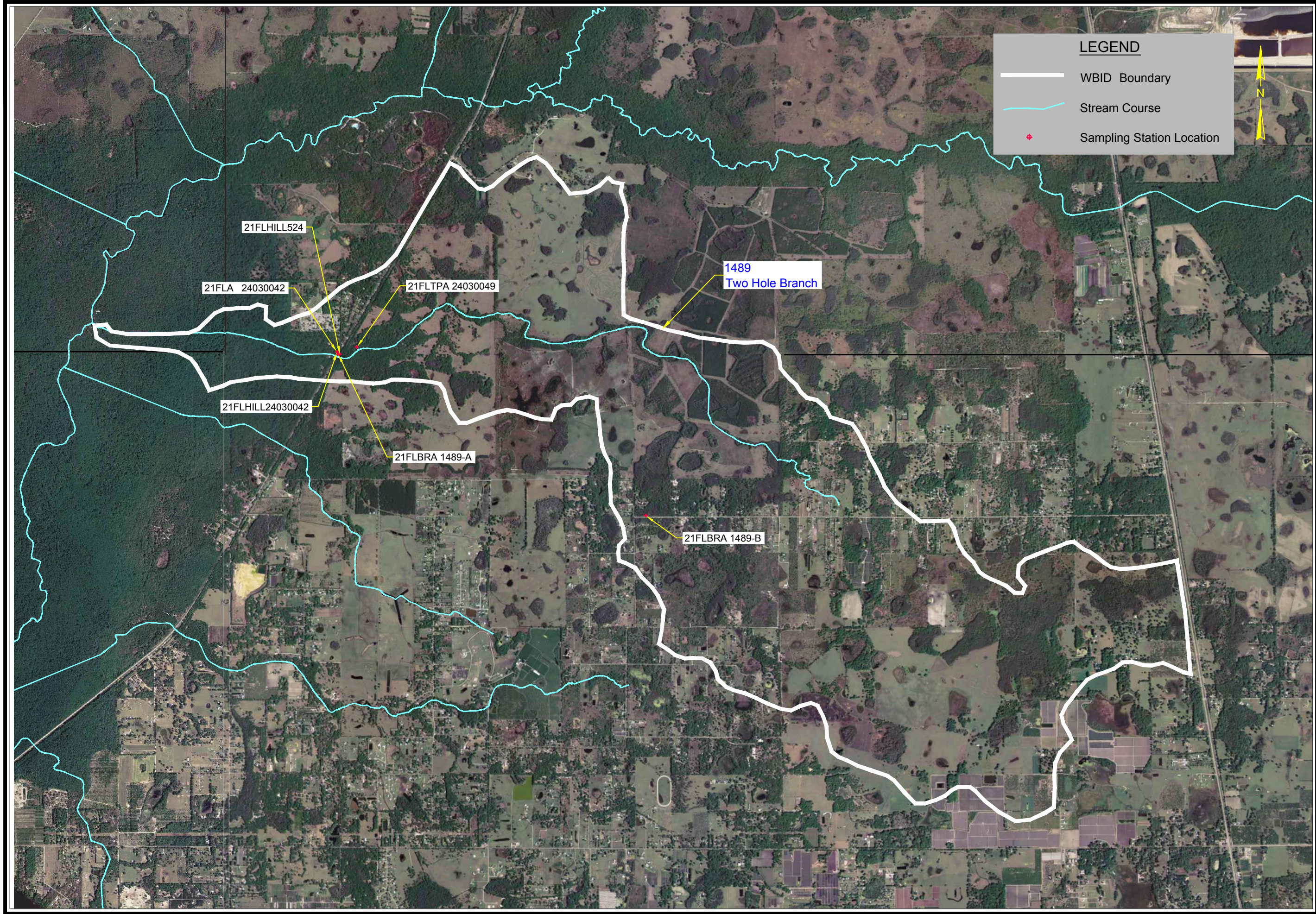


Figure 1-2
WBID Boundaries, Stream Reach, and Water Quality Stations - Two-Hole Branch (1489)

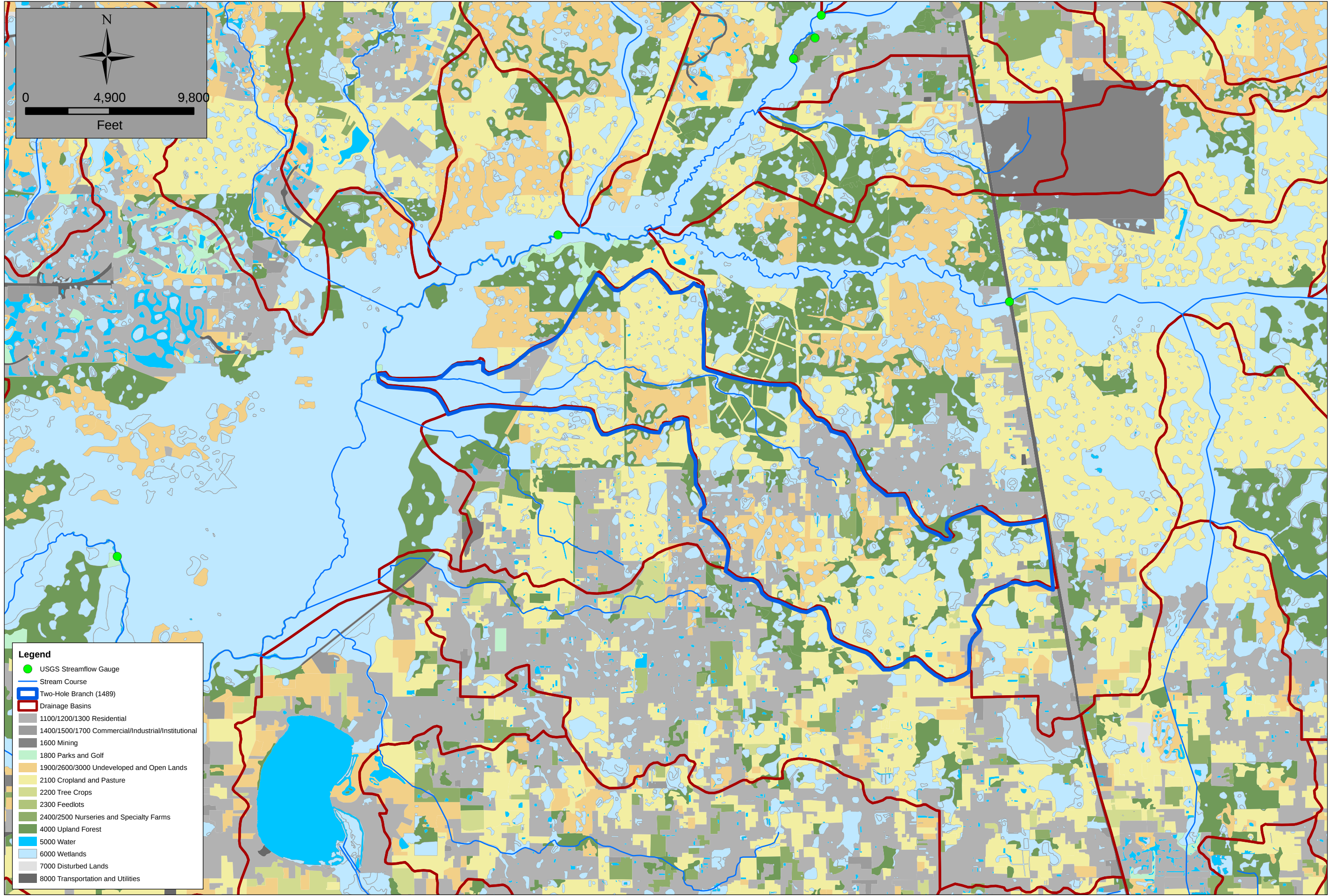


Figure 1-3
WBID Land Use - Two-Hole Branch (1489)

2.0 WATER QUALITY DATA ASSESSMENT

The following provides a series of analyses for the purpose of presenting a weight of evidence argument for the determination of the proper path forward for this WBID.

2.1 SUMMARY OF AVAILABLE WATER QUALITY DATA

Figure 1-2 presents the locations of the water quality monitoring stations within the Two Hole Branch WBID. Nearly all of the data were collected at a single location, where the creek crosses US Highway 301 prior to its confluence with the Hillsborough River. This location captures the majority of the waters draining from the system and, therefore, provides a good representation of the system. The station in the upstream of the WBID (21FLBRA 1489-B) has a single sample taken in 2008, with no nutrients measured.

At the US 301 crossing stations, paired nutrient, BOD, DO and chlorophyll a (Chl a) measurements are available from 2002, 2005, 2006, 2008, and 2009. Table 2-1 presents the number of paired measurements available during each year. The data come from measurements taken by FDEP and Environmental Protection Commission of Hillsborough County (EPCHC). The table shows that the amount of paired data available for assessing the WBID is highly limited, with only 1 year having sufficient data for assessment purposes. This is an important point, as the Stakeholders have identified in previous reports (ATM, 2010a) that the amount of data on this system is highly limited and, therefore, all data analyses must be assessed in this light.

Table 2-1. Number of Paired Data Available for Analyses

Year	2002	2005	2006	2008	2009
Number of Paired Data	17	5	1	1	1

Figures 2-1 through 2-7 present plots of the raw data for TN, TP, Organic Nitrogen, Ammonia, Nitrate-Nitrite, DO, percent saturation, BOD5, and Chl a for the years 2002 through 2009. Table 2-2 presents statistics calculated from the paired data.

Table 2-2. Water Quality Statistics

	Total Nitrogen (mg/L)	Ammonia (mg/L)	Organic Nitrogen (mg/L)	Nitrate- Nitrite (mg/L)	Total Phosphorus (mg/L)	BOD 5 (mg/L)	Chl a (µg/L)
Geometric							
Mean	0.96	0.07	0.83	0.01	0.26	2.00	3.10
Median	1.16	0.07	0.92	0.01	0.26	2.00	3.40
Maximum	3.93	0.74	2.46	0.73	2.20	5.00	21.70
Minimum	0.29	0.01	0.21	0.00	0.09	0.65	1.00
2002	1.12				0.28		
2005	0.48				0.14		

2.2 IMPAIRMENT DETERMINATION

As stated earlier, FDEP listed Two Hole Branch as impaired primarily upon the measured DO. Using the available data from 2002 to the present, a total of 27 DO measurements were taken. Of those, 23 were below the State standard of 5.0 mg/L (85 percent). FDEP defined TN as the causative variable, based upon the low BOD measurements and the fact that the data show the system is nitrogen limited. The geomean of the TN/TP ratio is 3.8, with a maximum of 7.0. Chl a measurements did not trip the Impaired Waters Rule (IWR) criteria, with only one measurement out of 27 greater than 20 micrograms per liter (µg/L) and the majority of the measurements less than 5 µg/L. The geomean of the Chl a data is 3.1 µg/L.

2.3 CORRELATION ANALYSES

FDEP and EPA have identified anthropogenic sources of nitrogen as the causative parameter and have indicated it as the reason for the low DO measurements in the system. The following provides analyses of relationships between DO, nitrogen, and other key parameters to determine if the assertions by FDEP and EPA are supported.

Figure 2-8 presents a plot of DO versus TN. A linear trend line was overlain onto the plot showing a decreasing trend of DO with increasing TN. The R^2 for the analysis showed a value of 0.11. The trend is driven somewhat by the outlying TN value. When the outlying data point is removed, the resulting R^2 value drops down to 0.04. This indicates that there is a very weak relationship between the in-stream TN concentrations and the DO. Figure 2-9 presents a similar plot using percent saturation. Percent saturation isolates the impacts of

temperature on DO and represents the degree to which oxygen demand is impacting the water column. The R^2 value is even lower and, as with the DO relationship, the correlation worsens with the removal of the outlying data point. In the report submitted by the Stakeholders in February of 2010, additional correlation analyses were conducted. The report submitted is included in this document as Appendix B. The results of the analyses within that report showed no correlation between DO and loads or concentrations of TN or TP. Appendix B provides the analyses and summary conclusions.

A key point to note based upon the percent saturation data is that at no time does the data show that the water column supersaturates. Supersaturation occurs when algal blooms increase DO production during the daytime hours, causing impacts to DO through production and respiration. As all of the data were collected during daytime hours, there is no indication that in-stream algal production is impacting the system.

The above analyses showed that no evidence can be found that water column processes are negatively impacting DO. Therefore, it must be determined if anthropogenic sources are negatively impacting benthic uptake of DO, or if there are external natural sources of low DO, or benthic processes impacting DO. In comments to EPA on the development of numeric nutrient criteria, FDEP acknowledge the existence of naturally low DO, high color systems within Florida. FDEP stated:

It follows then that these waters should not be excluded when developing a reference site population. By excluding perfectly healthy, but naturally low DO reference sites, the reference site distribution is no longer representative of the full range of Florida waters that support a healthy, well balanced aquatic community. Because many of these wetland influenced, naturally low DO waters also have naturally elevated levels of color, TOC, and organic nitrogen, exclusion of these sites can result in shifting the TN distribution downward, resulting in excessive Type I errors.

FDEP has conclusively demonstrated that non-anthropogenic TN concentrations are most influenced by the percent area of wetlands in the drainage basin because wetlands naturally discharge water high in humic acid substances, color, and organic nitrogen.

Figures 2-10 and 2-11 present plots of TN, inorganic nitrogen (ammonia, nitrate-nitrite), and organic nitrogen versus color in the system. It is clear that through the full range of color values, the concentration of inorganic nitrogen species remains low and constant, while organic nitrogen increases with increasing color. The inorganic nitrogen actually

shows a decrease in concentration with the higher color. This is indicative of the type of system that FDEP has described above. Two Hole Branch has numerous wetland areas that contribute to its flow.

If the low DO values were solely due to the influx of low DO, high color, wetland drainage, there should be a correlation evident between color and the percent saturation in the system. Figure 2-12 presents a plot of the color versus percent saturation. This also does not show a clear correlation, indicating that a number of processes are governing the DO levels in the system, not least of which would be the intermittent nature of the stream.

2.4 COMPARATIVE ANALYSES

Based upon the arguments presented so far, a key item is to determine if Two Hole Branch could be deemed a healthy system under the present DO conditions. Evidence presented so far indicates that the DO conditions in the system may be naturally low, or, at least, that there is no discernable link between DO and nutrients.

During the numeric nutrient criteria development process, FDEP extensively studied the phenomena being observed in many of the Hillsborough River tributary streams. In their formal comments to the draft EPA numeric nutrient criteria proposed in January 2010 (FDEP, 2010b), FDEP observed that:

“[n]atural vegetation, which contributes large quantities of leaf litter and which is subsequently decomposed in wetlands, ultimately provides the source of both the color (humic acid substances) and organic nitrogen...Therefore, the strong relationship between color and organic nitrogen is truly indicative of natural nitrogen sources”

Figure 2-10 demonstrated that the TN in the Two Hole Branch system is dominated by organic nitrogen, and the organic nitrogen levels are correlated with color.

In 2005 EPA finalized a TMDL for Blackwater Creek, another tributary to the Hillsborough River. In that TMDL, EPA stated:

Since the low in-stream DO is a result of low DO water flowing from groundwater and wetlands, and not the result of in-stream algae, nutrient, and BOD oxygen

consumption, no load reductions are specified in this TMDL report. It is recommended that loads of nutrients and BOD be maintained at current levels. Florida standards state at 62-302.300(15) FAC, "Pollution which causes or contributes to new violations of water quality standards or to continuation of existing violations is harmful to the waters of this State and shall not be allowed. Waters having water quality below the criteria established for them shall be protected and enhanced. However, the Department shall not strive to abate natural conditions."

Another line of evidence is to present plots of measured DO within a similar system that has been deemed healthy by FDEP. As part of its numeric nutrient criteria development process, FDEP identified a series of reference sites that were deemed healthy through biological assessments. Cypress Creek is a higher order tributary system, similar to Two Hole Branch, that flows into the Caloosahatchee River. In its overview of the reference station, FDEP states:

Experienced FDEP scientists conducted a series of observations and measurements (habitat assessment, hydrology, and local land use) at Cypress Branch. Based on our analyses, the Department concluded that the site was influenced only by very low levels of anthropogenic stressors and that it clearly maintained healthy biological assemblages. Thus, not only are the nutrient concentrations reflective of minimally disturbed conditions, they are associated with biota which demonstrate full support of the most sensitive designated use (propagation and maintenance of a healthy, well-balanced population of fish and wildlife).

Figure 2-13 presents the measured DO at Cypress Branch. As the data show, the levels are similar to those found within Two Hole Branch. It should be noted here that comparative analyses for DO are only useful to show general similarities. DO conditions at any site are driven by many factors, and temperature and hydrology are the most critical. This analysis shows that low DO measurements, by themselves, are not indicators of anthropogenic impacts, but rather must be evaluated in terms of causative factors and the potential for natural sources.

2.5 COMPARISON WITH EPA NUMERIC NUTRIENT CRITERIA

The following presents a comparison of the present nutrient conditions within Two Hole Branch to the EPA numeric nutrient criteria for freshwater streams that was promulgated on December 6, 2010 in 40 CFR Part 131 (Water Quality Standards for the State of Florida's Lakes and Flowing Waters). Many of the Stakeholders involved with TMDLs in the Tampa Bay watershed have submitted extensive comments regarding the EPA criteria. The comparison of ambient nutrient data to the EPA criteria is presented herein

in recognition of the existence of the criteria at present, and that EPA will play a role in the review of these WBID assessments. The use of the criteria in no way indicates that the Tampa Stakeholders support their validity.

At present, the available data within the Two Hole Branch WBID are insufficient for a full comparison to the EPA criteria due to the fact that there are not 3 consecutive years of data with sufficient samples to generate annual geometric means. Therefore, the comparison here is only qualitative for the years 2002 and 2005. While 2002 has sufficient data, 2005 has barely enough samples for a meaningful statistical analysis, with one data point within each of three quarters and two within the fourth. In 2002, the annual geometric means are 1.12 mg/L and 0.28 mg/L for TN and TP, respectively. In 2005, they are 0.48 mg/L and 0.14 mg/L, respectively. As the Two Hole Branch WBID falls within the Bone Valley region according to the EPA criteria, the EPA TN and TP criteria are 1.65 mg/L and 0.49 mg/L, respectively. In both years, the ambient conditions are well below the EPA criteria.

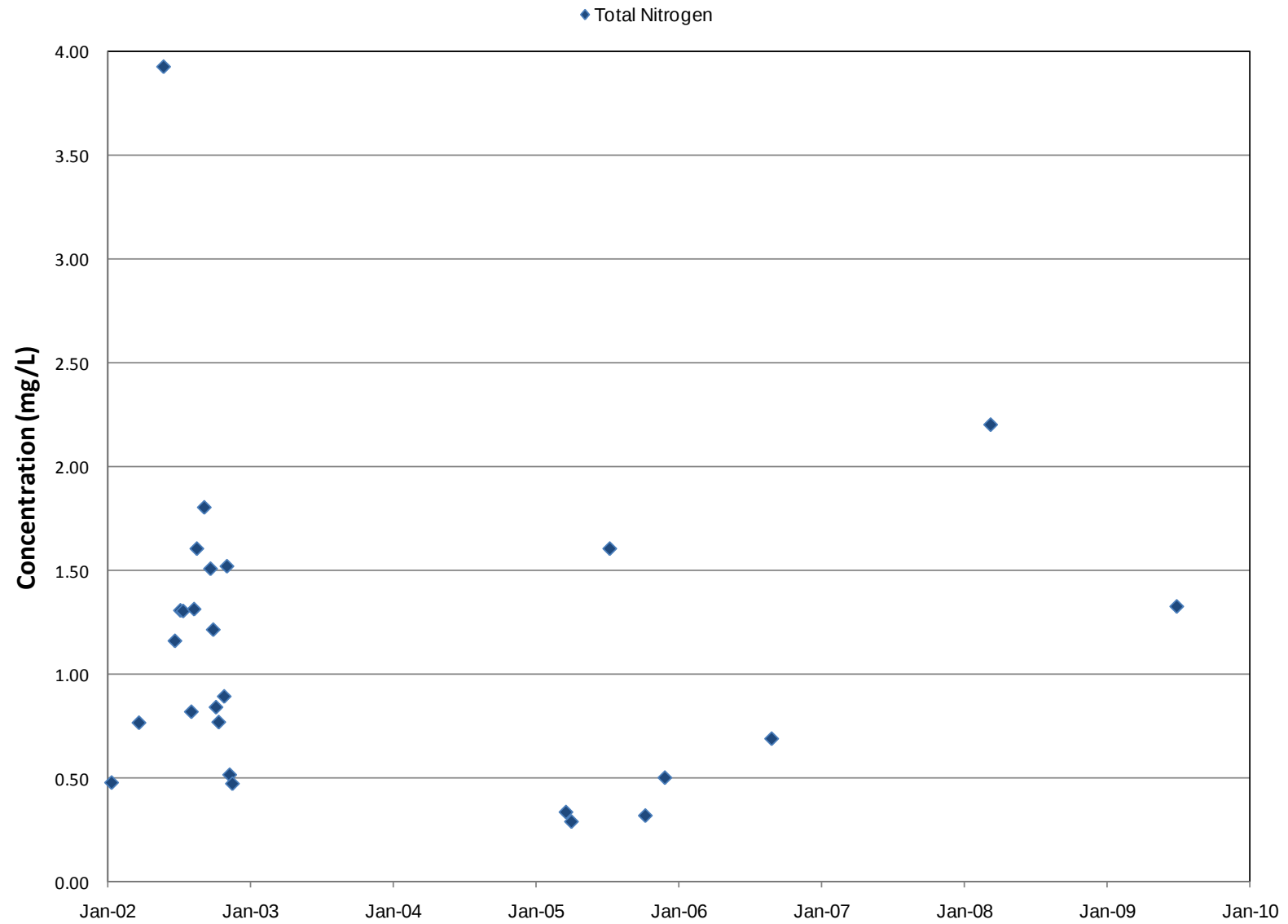


Figure 2-1
Plot of Total Nitrogen

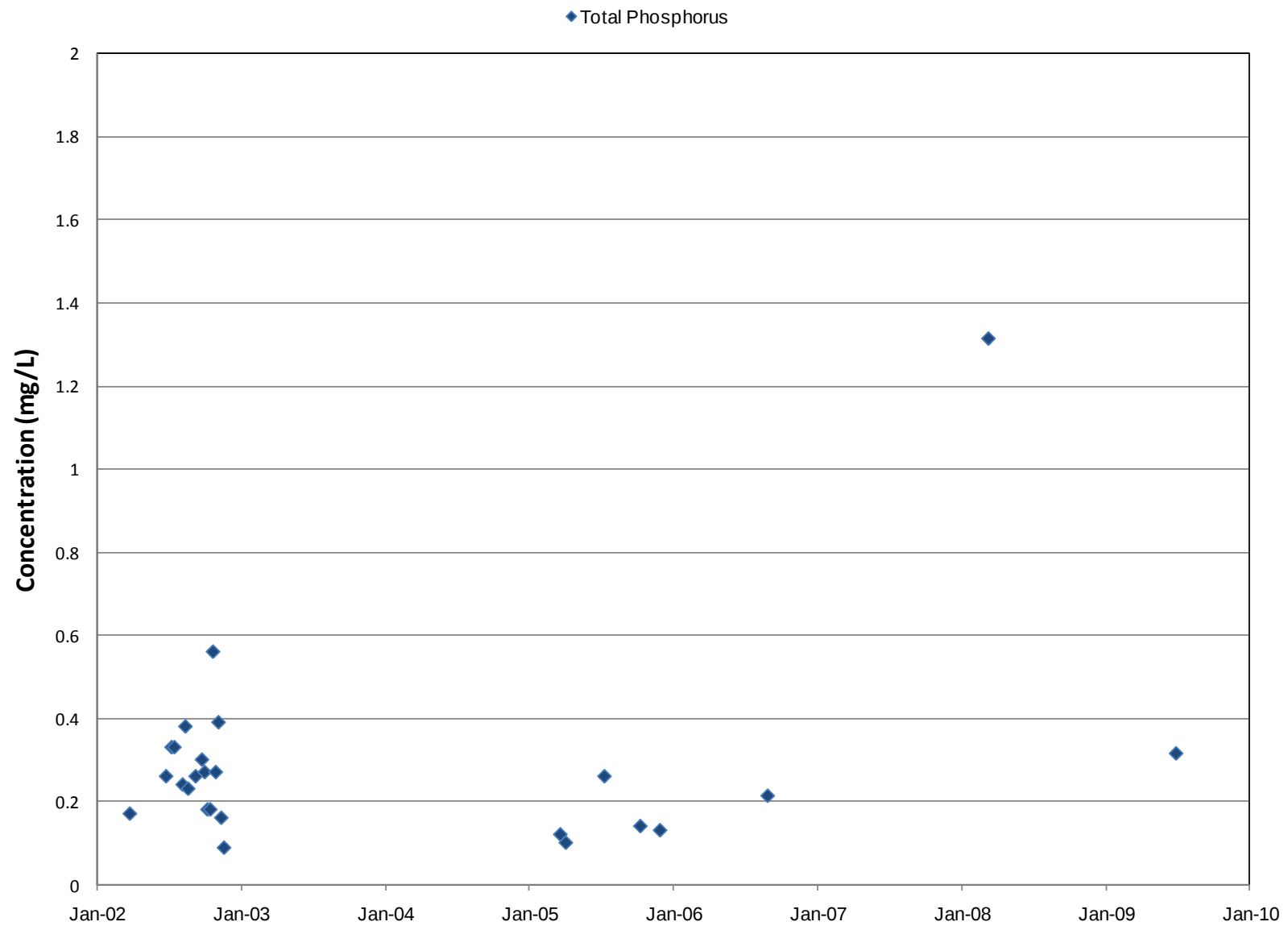


Figure 2-2
Plot of Total Phosphorus

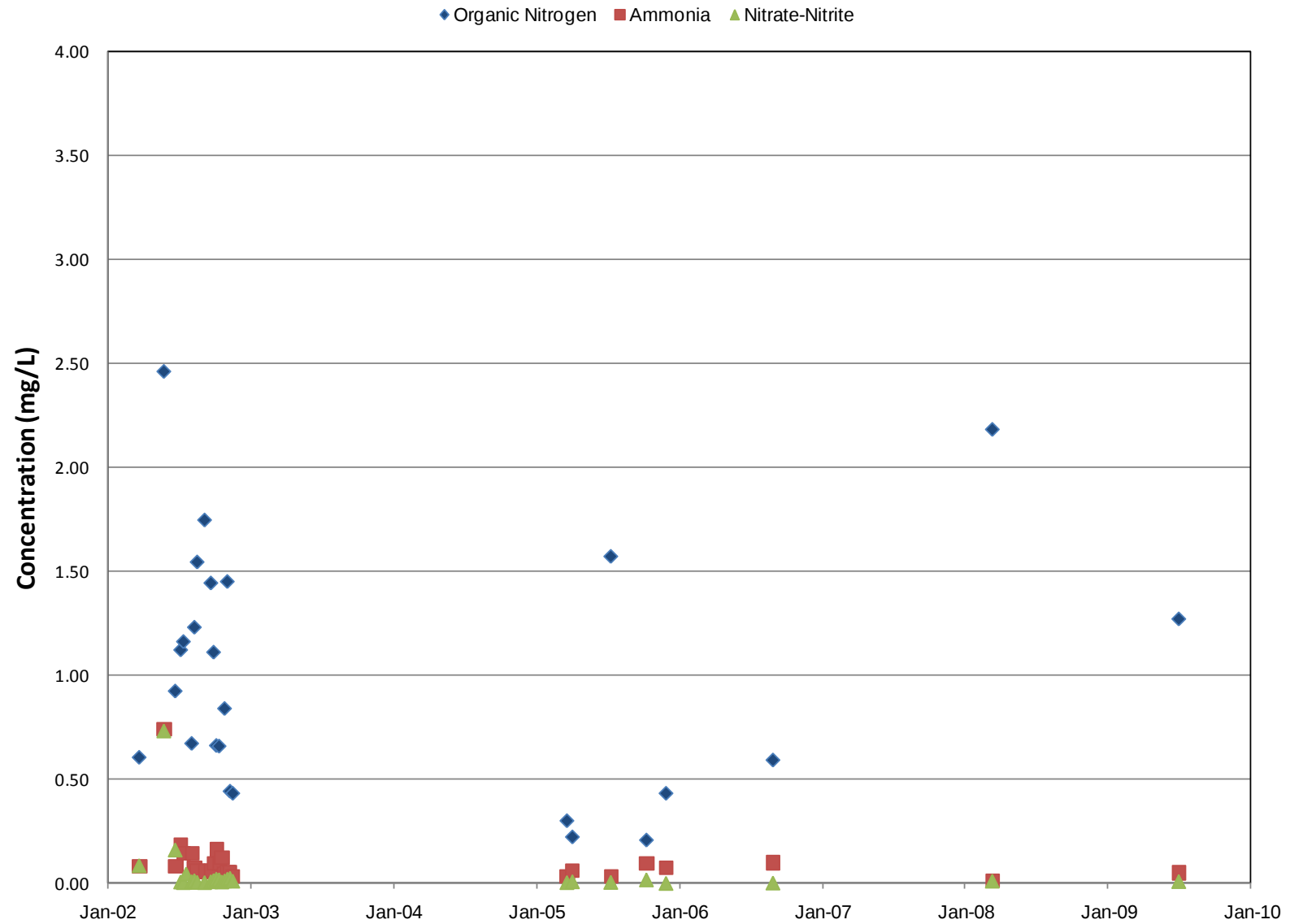


Figure 2-3
Plot of Nitrogen Species

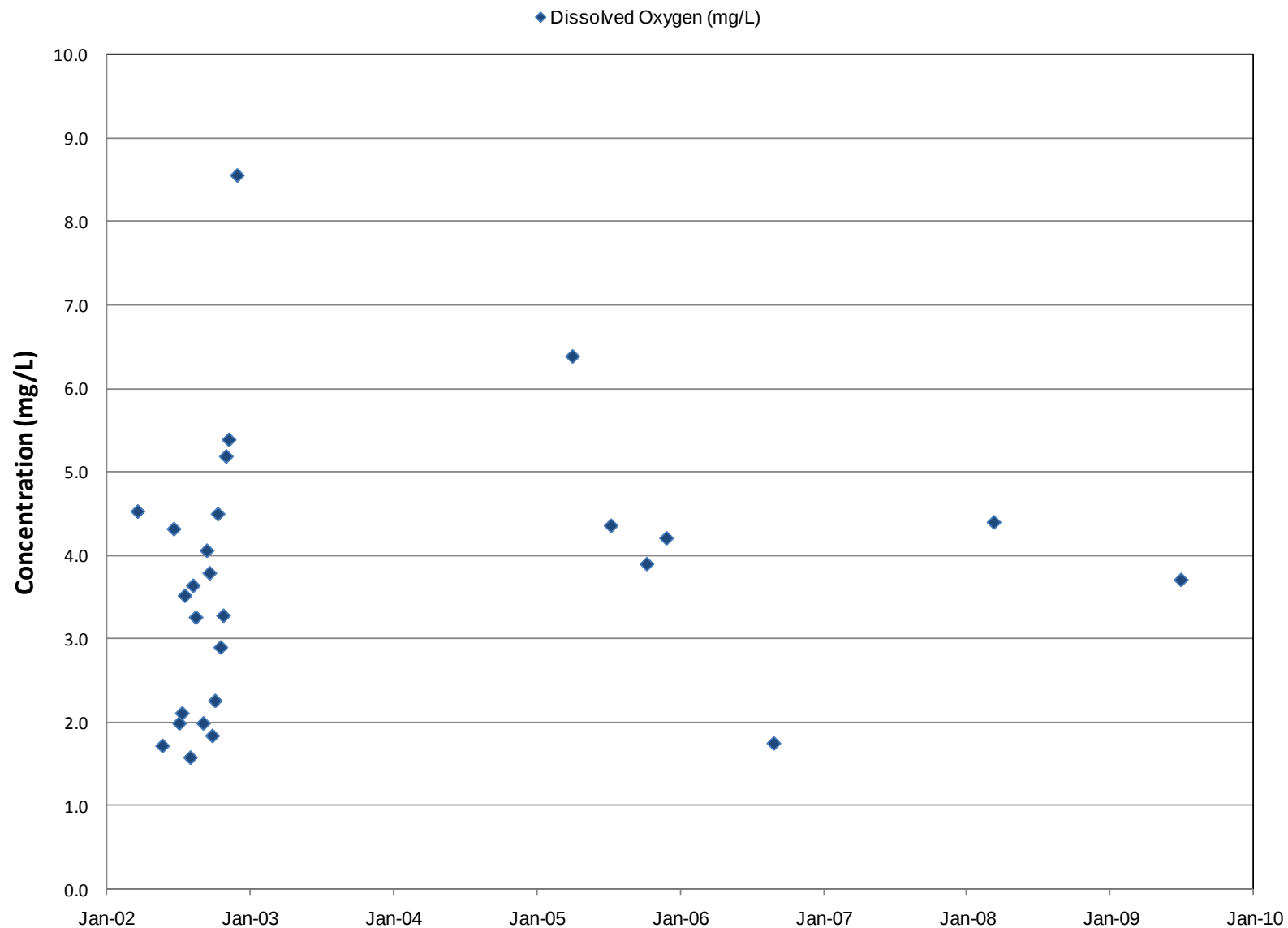


Figure 2-4
Plot of Dissolved Oxygen

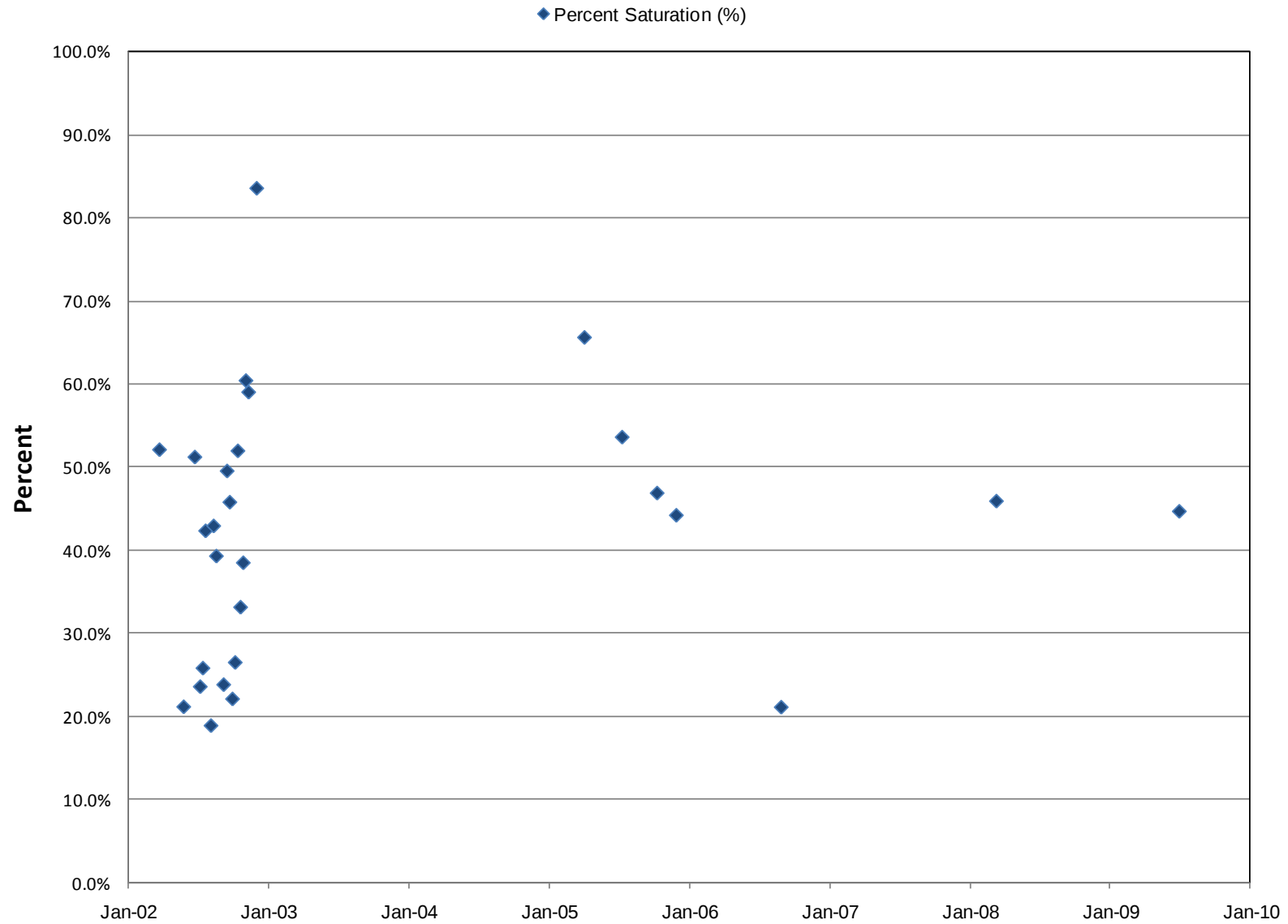


Figure 2-5
Plot of Percent Saturation

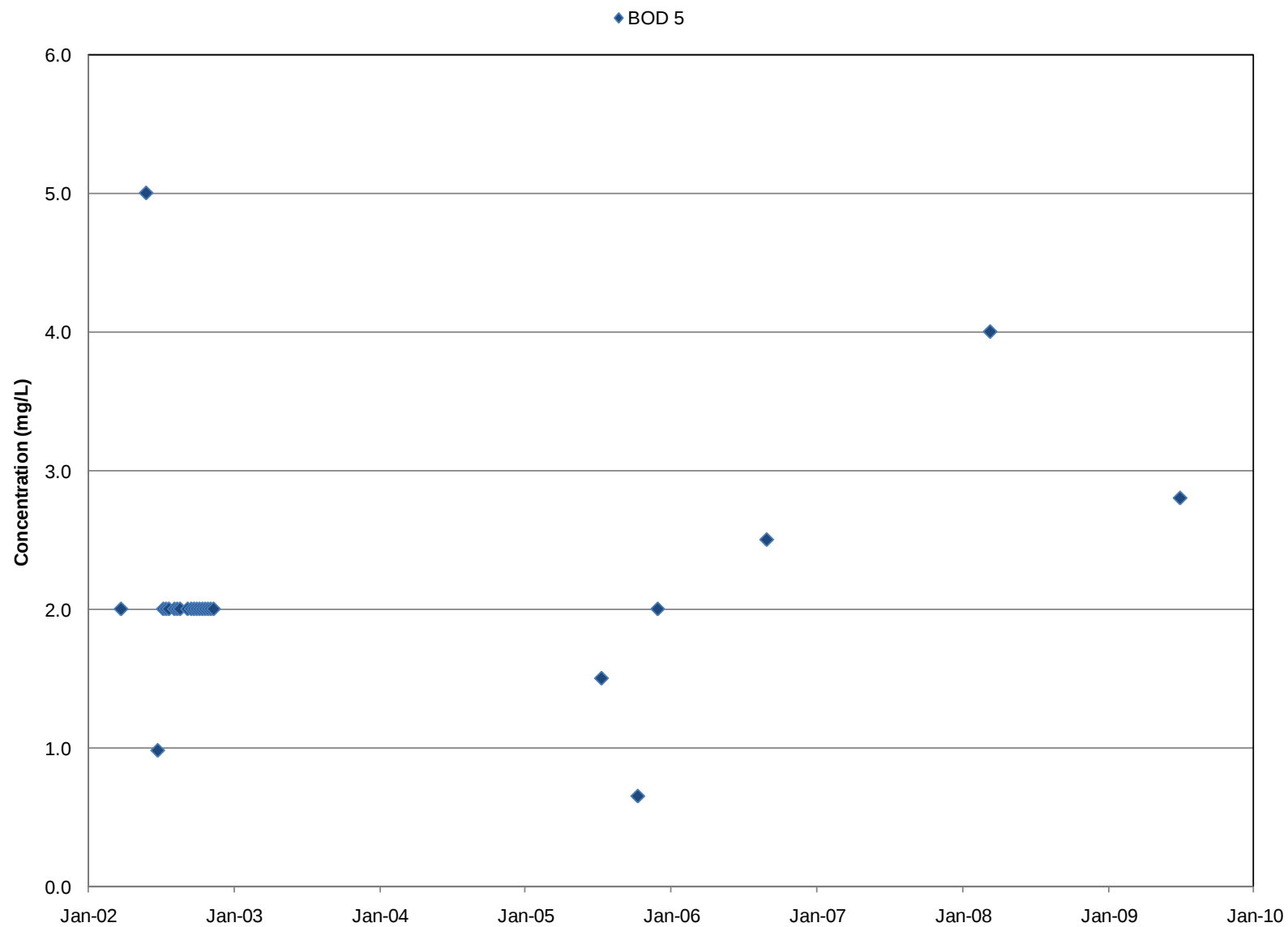


Figure 2-6
Plot of 5-Day Biochemical Oxygen Demand

ATM
APPLIED TECHNOLOGY & MANAGEMENT

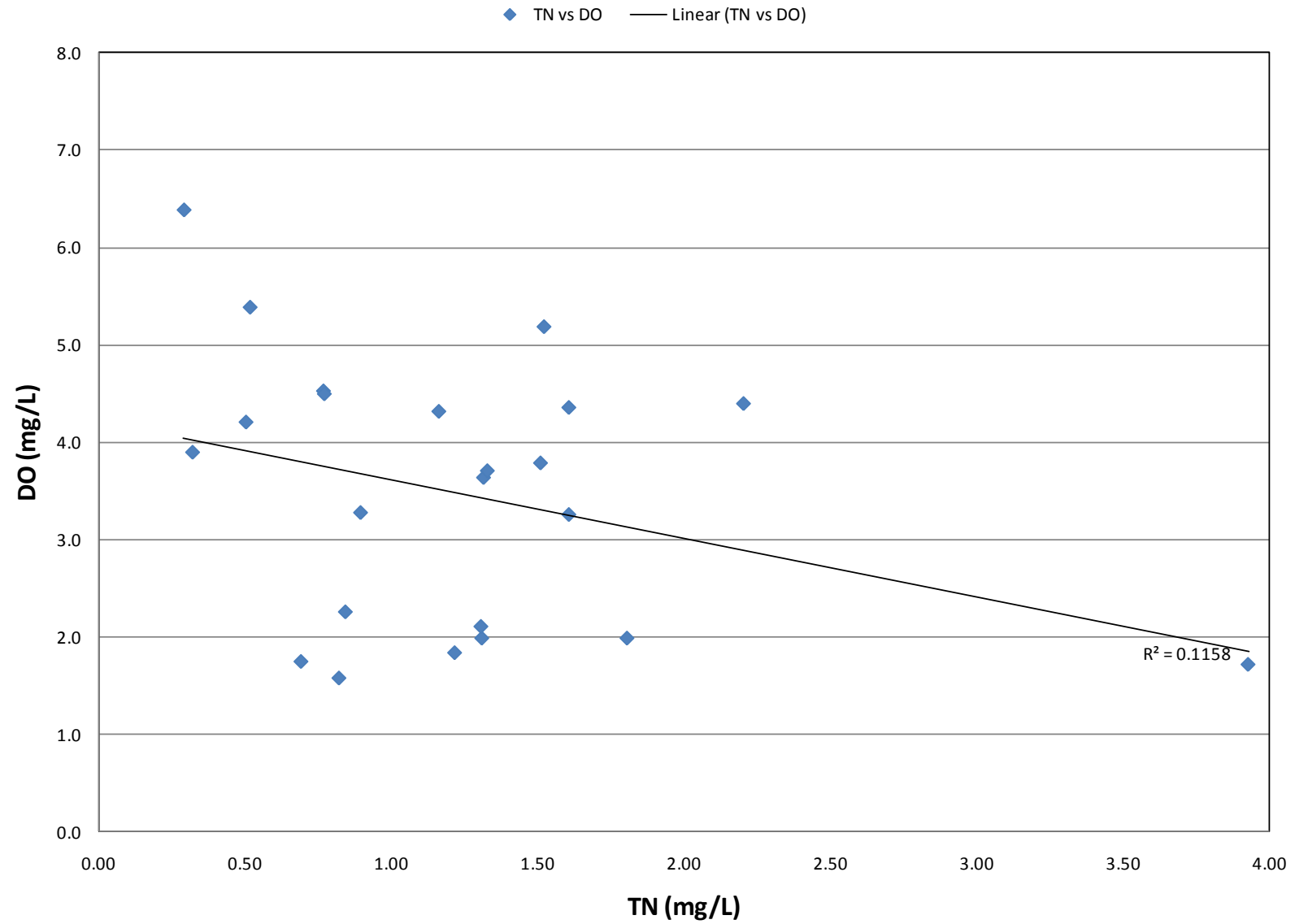


Figure 2-8
Correlation Plot of TN versus DO

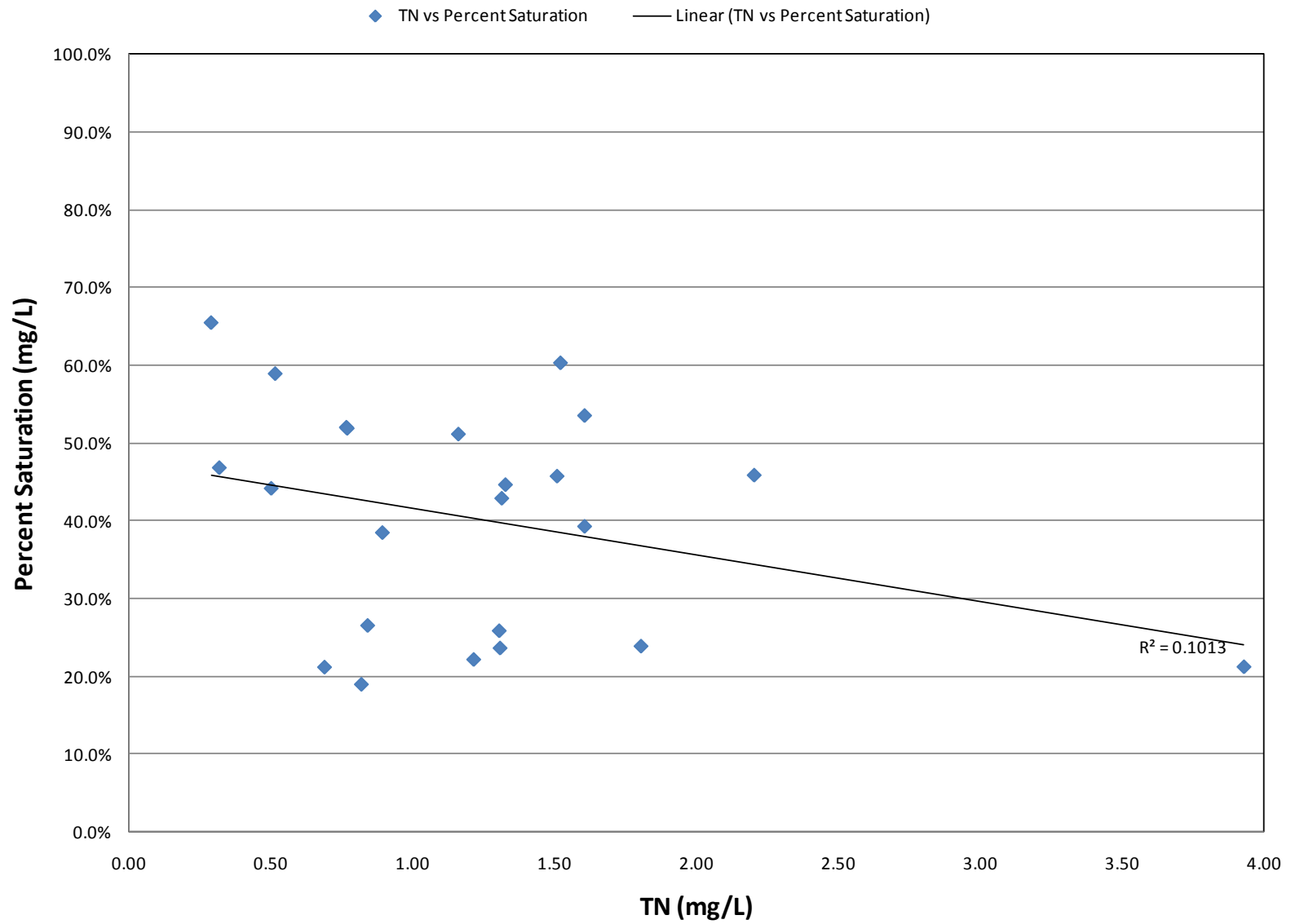


Figure 2-9
Correlation Plot of TN versus Percent Saturation

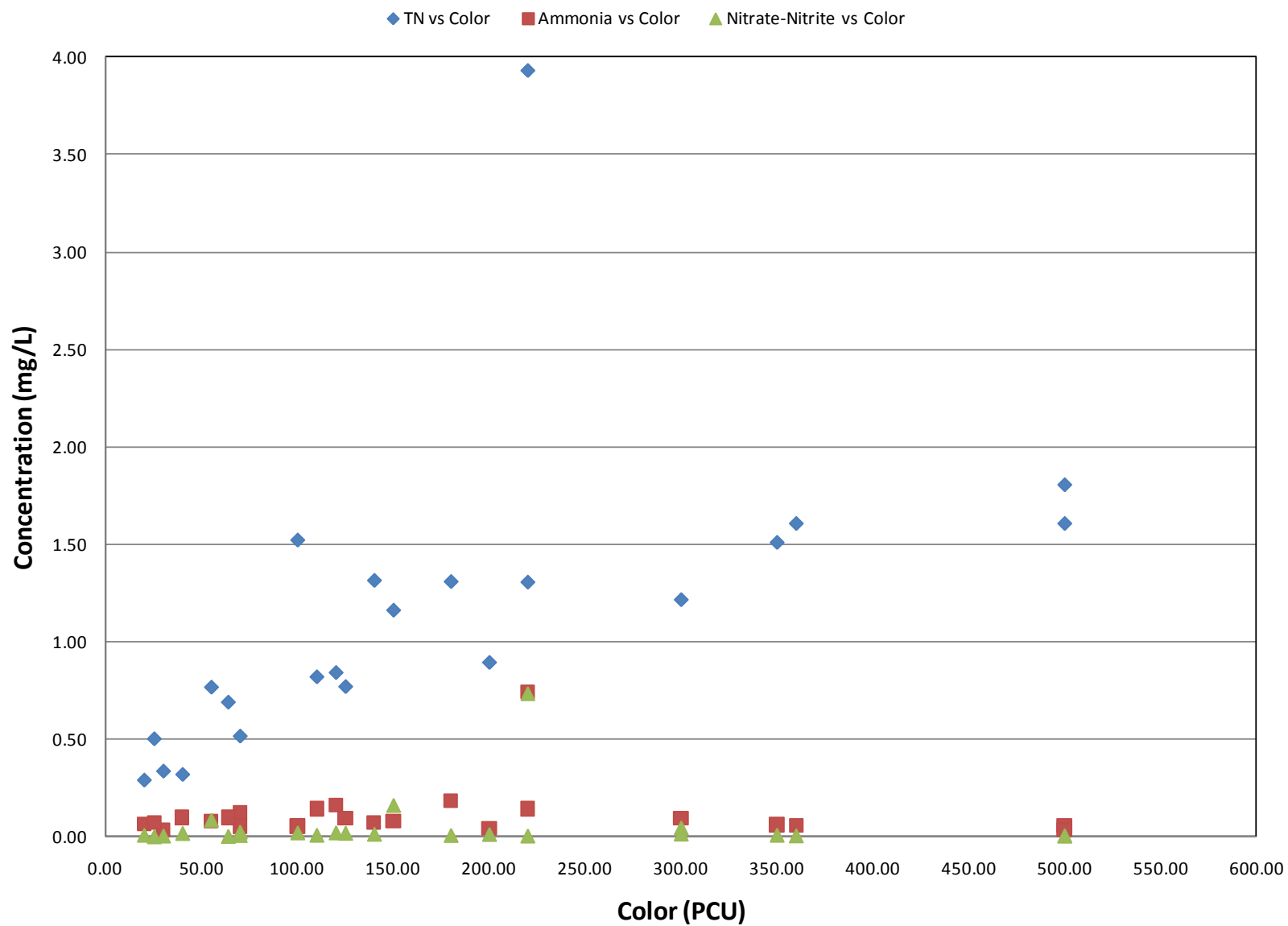


Figure 2-10
Correlation Plot of TN and Inorganic Nitrogen Species versus Color

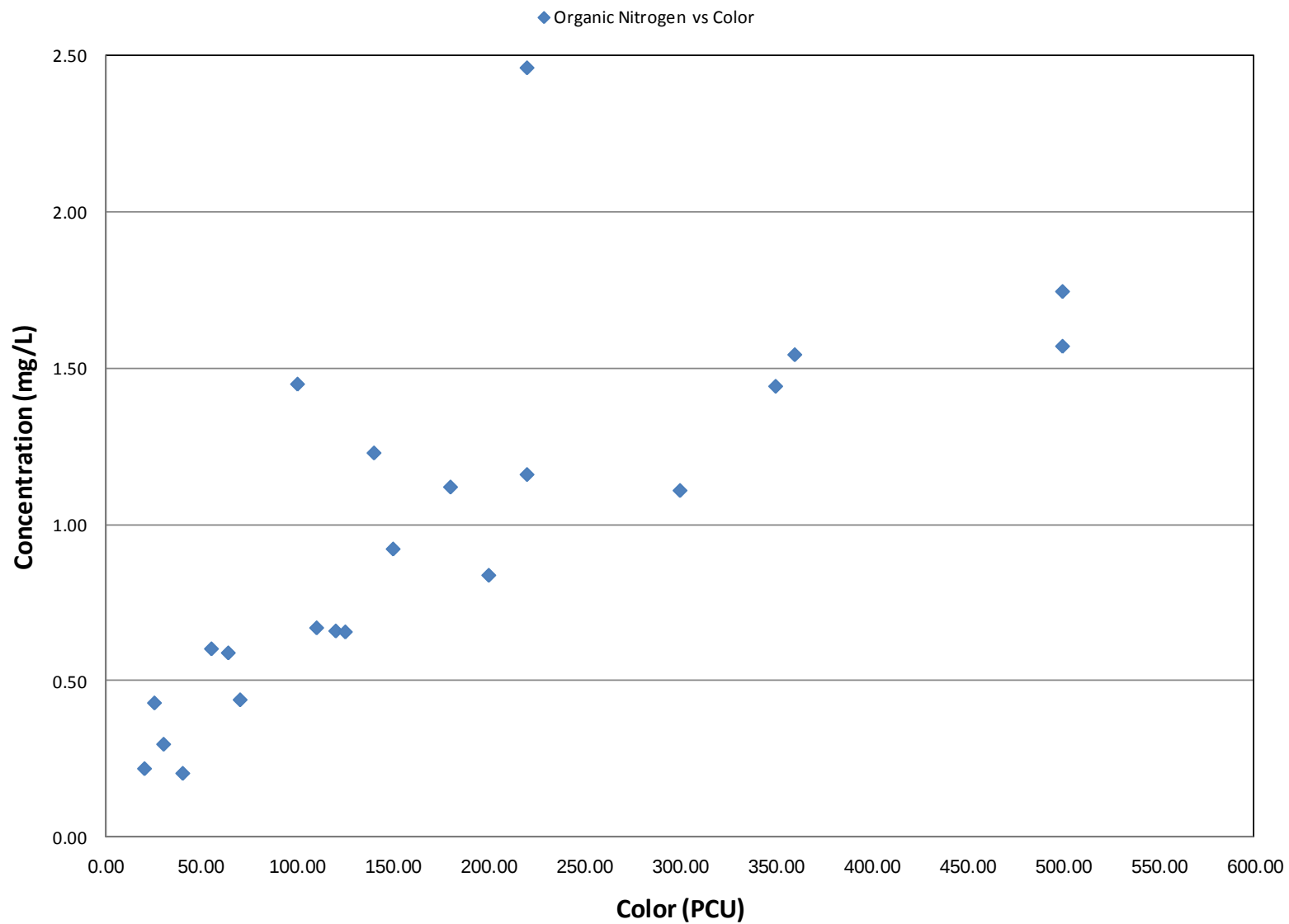


Figure 2-11
Correlation Plot of Organic Nitrogen versus Color

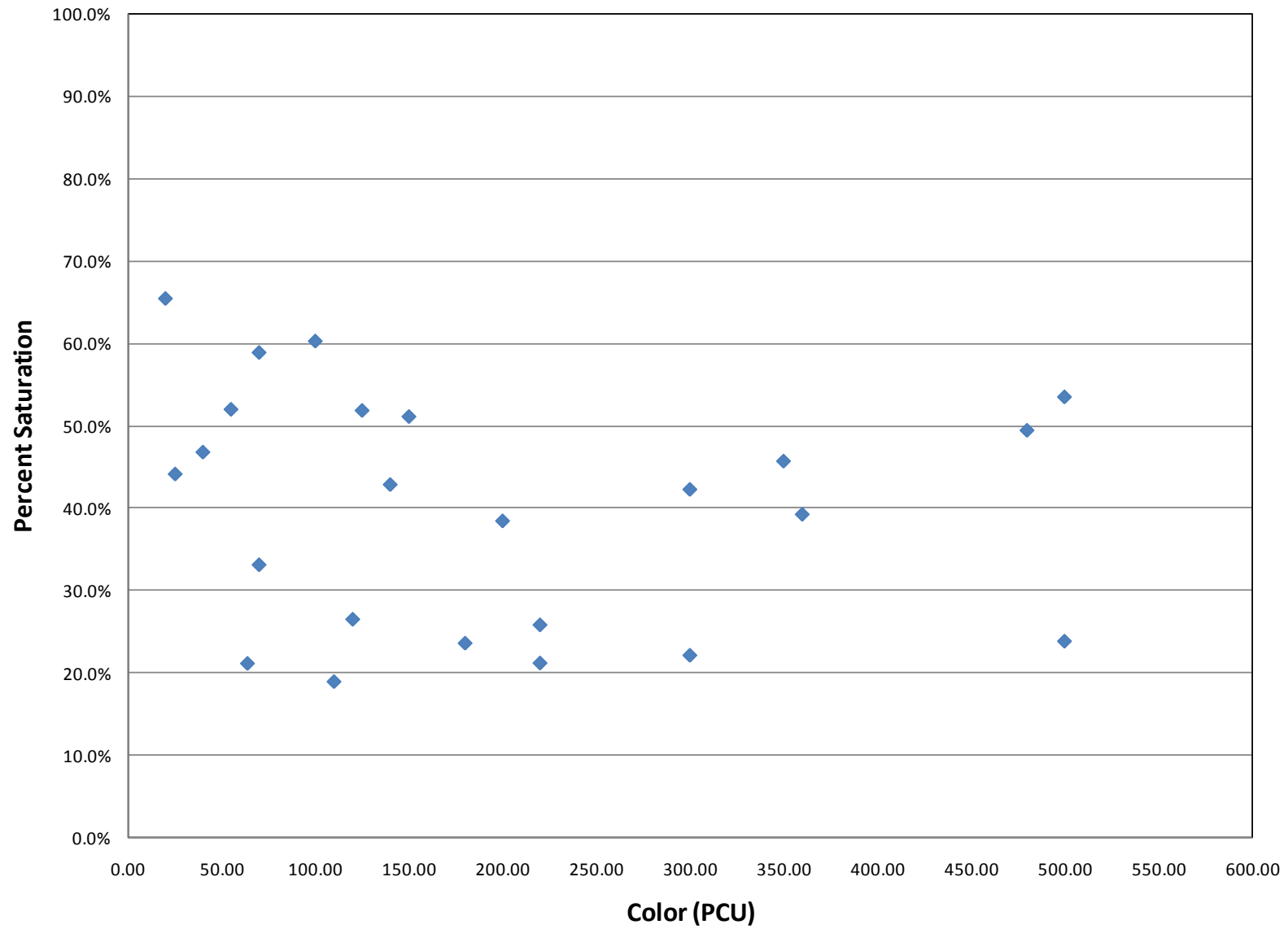


Figure 2-12
Correlation Plot of Percent Saturation versus Color

Figure 2-13
Plot of Dissolved Oxygen at FDEP Reference Station (Cypress Branch)

3.0 BIOLOGICAL DATA ASSESSMENT

The FDEP utilizes two standard approaches for assessing streams for biological health. These include the Stream Condition Index (SCI), a composite macroinvertebrate index, and a screening tool or rapid assessment called a BioRecon.

3.1 THE STREAM CONDITION INDEX (SCI)

To develop the SCI score, 20 dipnet sweeps are conducted from the most productive habitats in a 100-meter reach of the stream. Organisms collected in these sweeps are preserved and placed into containers according to standard procedures and transported to the laboratory for processing and analysis. The species identified, the counts, and the abundance of these organisms are then used to calculate 10 biological metrics that have been shown to respond predictably to human disturbance. The metrics are:

- Number of total taxa
- Number of long lived taxa, those that require more than one year to complete their lifecycle
- Number of Ephemeroptera (mayflies) taxa
- Number of Tricoptera (caddisflies) taxa
- Number of Florida sensitive taxa
- Number of clinger taxa
- Percent dominant taxon
- Percent Tanytarsini
- Percent very tolerant taxa
- Percent filterers

3.2 BIORECON

BioRecon is the screening tool version of the SCI that is intended to rapidly assess a site to prioritize it for more intensive sampling. For BioRecon, only four dipnet sweeps of the most productive habitats are performed. BioRecon also differs from an SCI sampling effort in that the organisms are sorted in the field and relative species abundance is recorded on the BioRecon Field Sheet. While the protocol is intended to bypass the laboratory procedure, samples are typically taken of each taxa found and are verified in the laboratory. FDEP has

established thresholds specific to this method for each region for each of six calculated metrics (a subset of the 10 metrics used in the SCI). These include:

- Number of total macroinvertebrate species (taxa)
- Number of long lived taxa, those that require more than one year to complete their life cycle
- Number of sensitive taxa
- Number of clinger taxa
- Number of Ephemeroptera (mayflies) taxa
- Number of Trichoptera (caddisflies) taxa.

3.3 BIOLOGICAL EVALUATIONS OF TWO HOLE BRANCH

Within Two Hole Branch, two BioRecon measurements and one SCI assessment have been performed. BioRecons were conducted in August 1995 and again in March 1996 at the US 301 crossing location. An SCI assessment was performed in 2005 at the same location.

For the 1995-1996 assessments, based upon adjacent watershed flow measurements, it is surmised that the stream was experiencing better than average flow. The results of the BioRecon measurements from August of 1995 were summarized in a report by the local FDEP office (Morgan and Denson, 1995). Additionally, the raw taxa tables and the taxa scores were retrieved from FDEP. These are presented in Appendix C. Utilizing the raw scores, and assessing those scores against criteria outlined within the FDEP report, a summary of the BioRecon assessment is presented in Table 3-1. While in a number of categories the system passed the criteria, the overall assessment for the system was suspect. In the 1995 report, the results from Two Hole Branch are summarized for the August 1995 BioRecon.

This site, which flows toward the Hillsborough from the east, is located where Highway 301 crosses the stream. Two Hole Branch is a small tributary, flowing strongly at the time of sampling, although during much of the year it is dry, or nearly so, never reaching the Hillsborough. There is moderately adequate habitat present and the immediate banks are wooded. The primary impacts are from rangeland and loss of habitat and buffering protection due to tree clearing. Two Hole Branch failed our biorecon. Although plenty of animals were collected, the Florida Index and EPT scores were both only 3. However, we feel that the runoff impacts alone can not account for this impairment. The intermittent nature of the stream undoubtedly limits the kind of invertebrates that can live there to some degree. Water chemistry sample

collection and a second Biorecon study in the dry season are needed to help clarify the situation.

The 2005 SCI score, based upon data provided by the local FDEP office, was a 51. In recent discussions with Peggy Morgan (author of the 1995 study) she identified that the system has intermittent flow and that during typical flow years, the system would not be flowing during the dry months. Additionally, she identified that the SCI score of 51, from the 2005 assessment, represents a fairly healthy system. This is an improved finding over what was found from the BioRecon work in 1995-1996. It should be noted that SCI is the more comprehensive analysis and, therefore, the more recent, more comprehensive data indicate that Two Hole Branch is biologically healthy and would not be deemed impaired for biology.

Table 3-1. Analysis of BioRecon Data from Samples Taken in Two Hole Branch (WBID 1489)

Station	Date	Total Taxa	Grade (>12 pass)	FL Index Score	Grade (>8 pass)	EPT Taxa	Grade (>4 pass)	Overall Evaluation
Two Hole Branch at US 301	August 16, 1995	17	Passed	4	Failed	4	Failed	Suspect
Two Hole Branch at US 301	March 12, 1996	21	Passed	7	Failed	5	Passed	Suspect

3.4 CONCLUSIONS FROM THE BIOLOGY

Based upon the limited recent biological data (i.e., the recent SCI test in 2005), the system appears to be healthy biologically and, therefore, one would conclude that the system is balanced under the present DO conditions.

4.0 RECOMMENDED PATH FORWARD

The purpose of the analyses presented in Sections 2 and 3 was to identify the appropriate path forward for Two Hole Branch. As stated in Section 1, The MOA between the FDEP and the Tampa stakeholders included specific work tasks to guide determination of the category for the path forward. This section will outline the recommended path forward and summarize the findings from the analyses.

The recommended path forward for Two Hole Branch based upon the analyses is a TNN at this time per EPA, and a reclassification of this waterbody to an appropriate Category 4 designation. While much of the analyses presented in Sections 2 and 3 indicate that a 4c category may be appropriate, with the limited water quality and biological data, a conclusive determination that there are no anthropogenic impacts within the system cannot be made at this time. Therefore, it may be more appropriate to move to a reclassification of the water body as Class 4d, i.e., that the system is impaired based upon the present DO standard, but that no causative pollutant can be identified. The information presented herein does not support that any nutrient load reduction will have an appreciable impact upon the DO conditions, and that it appears that the nutrient levels within the system are from natural sources. The following provides a summary of key findings from Sections 2 and 3.

1. The available data within the system are highly limited and, for a proper assessment of the system, multiple years of data are needed.
2. There are only limited recent biological data. But the available data indicate that the system is biologically healthy.
3. Correlation analyses did not identify any statistically significant relationship between nutrients and DO, either using nutrient concentrations or loads.
4. Assessment of the nitrogen species points toward nitrogen within the system being from natural sources such as wetlands due to the high levels of organic nitrogen, the low levels of inorganic nitrogen, and the correlations between organic nitrogen and color.
5. Comparison of the measured DO within Two Hole Branch and a comparable higher order intermittent blackwater stream deemed healthy by FDEP showed similar levels of DO, identifying that the low DO values, on their own, do not necessarily point to the system being impaired by anthropogenic sources.

6. Comparison of the limited data to the proposed EPA numeric nutrient criteria show that the levels within Two Hole Branch are well below the EPA-proposed numeric criteria.

5.0 LITERATURE CITED

- Applied Technology and Management, Inc. (ATM). 2009a. WAMview and WASP Model Review and TMDL Assessment, Trout Creek (WBID 1455) and Big Ditch (WBID 1469), Comments Submitted by Pasco County, September 2009.
- Applied Technology and Management, Inc. (ATM). 2009b. WAMview and WASP Model Review and TMDL Assessment, Trout Creek (WBID 1455), Big Ditch (WBID 1469), Baker Creek (WBID 1522C), Mill Creek (WBID 1542A), Spartman Branch (WBID 1561), Comments Submitted by Hillsborough County, September 2009.
- Applied Technology and Management, Inc. (ATM). 2009c. WAMview and WASP Model Review and TMDL Assessment, Trout Creek (WBID 1455), Big Ditch (WBID 1469), Baker Creek (WBID 1522C), Mill Creek (WBID 1542A), Spartman Branch (WBID 1561), Comments Submitted by Florida Department of Transportation, September 2009.
- Applied Technology and Management, Inc. (ATM). 2010a. Two Hole Branch - WBID 1489 - Refinement to Proposed TMDL for Dissolved Oxygen and Nutrients for Two Hole Branch, January 2010. Prepared by: Applied Technology and Management, Inc.
- Florida Department of Environmental Protection (FDEP). 2010a. FDEP Comments on EPA's Notice of Data Availability, Noticed August 3, 2010, Federal Register Vol. 75, No. 148, September 1, 2010. Florida Department of Environmental Protection.
- Florida Department of Environmental Protection (FDEP). 2010b. Review of Proposed Criteria for the Protection of Streams and Springs/Clear Streams, Proposed January 26, 2010 by the Environmental Protection Agency, March 12, 2010. Florida Department of Environmental Protection.
- Florida Department of Environmental Protection (FDEP). 2009. TMDL Report - Dissolved Oxygen and Nutrient TMDLs for Trout Creek (WBID 1455), Channelized Stream (WBID 1483), Big Ditch (WBID 1469) and Two Hole Branch (WBID 1489), June 2009. Tallahassee, Florida: Florida Department of Environmental Protection.
- Florida Department of Environmental Protection (FDEP). 2010a. TMDL Report - Dissolved Oxygen and Nutrient TMDLs for Trout Creek (WBID 1455), Channelized Stream (WBID 1483), Big Ditch (WBID 1469) and Two Hole Branch (WBID 1489), February 2010. Tallahassee, Florida: Florida Department of Environmental Protection.
- Morgan, P. & Denson, D., 1995. The Biological View - Hillsborough River System, Summer 1995. Florida Department of Environmental Protection.
- Southwest Florida Water Management District (SWFWMD). 2010. Southwest Florida Water Management District Photo Interpretation Key for Land Use Classification, Updated January 15, 2010. Southwest Florida Water Management District.

Southwest Florida Water Management District (SWFWMD). 2011. Shapefile Library / Physical Dense / lu09. [Online] Available at:
http://www.swfwmd.state.fl.us/data/gis/layer_library/category/physical_dense
[Accessed February 2011]

APPENDIX A

Memorandum of Agreement

EXHIBIT A

MEMORANDUM OF AGREEMENT

The purpose of this memorandum is to outline agreements made between the Florida Department of Environmental Protection (FDEP) and the Parties working on the Tampa Bay Tributary Total Maximum Daily Load (TMDL) challenge. This memo outlines agreements made on a waterbody identification (WBID) basis on the pathways forward to resolution of the TMDLs under challenge and currently in abeyance.

For each WBID, the following outlines the determination made between the Parties and FDEP in relation to the path forward. Additionally, the timelines for completion of deliverables (where applicable) and the specific work tasks to complete the deliverables are provided. The potential outcomes for each WBID include the following:

- I. TMDL for nutrients and/or biochemical oxygen demand (BOD) with potential for revised dissolved oxygen (DO) target using regional DO criteria
- II. Class III Limited re-designation
- III. Physical or habitat restoration
- IV. TMDL not needed (TNN)

Specific work tasks outlined below will lead to the determination of the category for the path forward. For waterbodies that have significant historical physical modifications, it may be determined that trying for a Class III Limited designation may be the appropriate path forward. Additionally, where it is determined that the WBID is showing low DO values, but no direct impact from nutrient enrichment can be found either through assessment of primary productivity or other mechanisms, then the waterbody may be considered for TNN status. Finally, where data indicate that load reductions will achieve restoration of the designated use of the WBID, then the path to a final TMDL will be defined.

The deliverables outlined below will either define the final outcome, or will outline steps to reach the final outcome. If the determination is Option II, III, or IV, the report will outline and support the finding. The timeline for completion of the Class III Limited re-designation or the habitat restoration cannot be identified under this process and will be identified at a later time. If it is determined that Option I is the pathway (a revised TMDL needs to be developed), the report will outline the work to be done to complete the TMDL. The timeline for the development of the TMDLs will be at latest December 31, 2011 for all waterbodies where a determination is made to move forward with a revised TMDL.

Trout Creek (1455)

Determination:

- This WBIDs will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors within Trout Creek against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine the high chlorophyll a (Chl a) measurement to try to determine the potential cause of the apparent anomalous measurement.
- Look at other data that may be available upstream to determine if there are distinct differences in the upstream and downstream conditions to decide if splitting the WBID makes sense.
- Examine Stream Condition Index (SCI) data to determine level of biological health.
- Examine more recent data from the Environmental Protection Commission of Hillsborough County (EPCHC) to see conditions in recent years. Specifically, examine if there are three consecutive years after 2007 that are below the impairment threshold to support a delisting for nutrients.
- Provide WBID Assessment Report outlining path forward with any future timelines.

Baker Creek (1522C), Mill Creek (1542A), and Spartman Branch (1561)

Determination:

- These WBIDs will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for each WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors within Baker Creek, Mill Creek, and Spartman Branch against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine how representative the Baker Creek station is of the inflowing waters versus being representative of conditions in Lake Thonotosassa.
- Examine Pemberton Creek DO values in relation to measurements in Baker Creek.
- Examine the local issues within Mill Creek to determine potential local and downstream impacts due to the discharge from the National Pollutant Discharge Elimination System (NPDES) permittee Crystals International.
- Examine potential for determining the downstream protective value (DPV) approach for Lake Thonotosassa as possible solution.
- Examine SCI data (if available) to determine level of biological health.
- Examine more recent data from EPCHC to see conditions in recent years.
- Review Mill Creek and Spartman Branch separate from Baker Creek.
- Provide WBID Assessment Report outlining path forward with any future timelines.

Two-Hole Branch (1489)

Determination:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for each WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks

- Examine more closely the available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors within Two-Hole Branch against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine SCI data if available to assess biological health.
- Provide WBID Assessment Report outlining path forward with any future timelines.

Channelized Stream (1483)

Determination:

- As no Parties participating within the group have specific interests within this WBID, it will be removed from the challenge
- FDEP will deal with other Parties on the TMDL.
- FDEP will examine the TMDL report to remove the reference to Hillsborough County and Florida Department of Transportation (FDOT) from the list of municipal separate storm water sewer system (MS4) permittees because there are no MS4 responsibilities within this WBID.
- Hillsborough County will withdraw the challenge for Channelized Stream by February 28, 2011.

Tampa Bypass Canal Tributary (1536C)

Determination:

- This WBID will undergo a localized evaluation of conditions at the site to determine potential for Class III Limited designation. Also, a more detailed assessment of potential sources will be evaluated to define if a TMDL is needed to address specific known sources. This more localized work will be completed in conjunction with an evaluation of potential causes of low DO. Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely the available data on DO relative to hydrology and other potential factors causing the low DO values.

- Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine SCI data if available to assess biological health.
- Review sampling field sheets to determine hydrologic conditions during sampling.
- Conduct assessment of sources within the WBID and examine sources against local data to assess nutrient species.
- Meet with Hillsborough County to do a detailed infield assessment.
- Examine need for additional monitoring.
- Provide WBID Assessment Report outlining path forward with any future timelines.

Sweetwater Creek (1516) and Brushy Creek (1498)

Determination:

- FDEP discussed the potential for withdrawing these TMDLs with EPA at their regularly scheduled conference call on October 12, 2010. EPA responded that at this time they will not withdrawal the TMDLs for Sweetwater Creek and Brushy Creek.
- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks: (if TMDLs not withdrawn)

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine SCI data to determine level of biological health.
- Examine more recent data to see conditions in recent years.
- Provide WBID Assessment Report outlining path forward with any future timelines.

Lake Tarpon Canal (Freshwater) (1541B)

Determinations:

- Pinellas County will identify if it is interested in pursuing a Class III Limited designation.
- If Pinellas County decides not to pursue reclassification, then this WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- Pinellas County Recommendation (based upon completion of Class III Limited feasibility assessment) – 02/15/11
- WBID Assessment Report (optional)– 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine SCI data to determine level of biological health.
- Examine more recent data to see conditions in recent years.
- Review Lake Tarpon pollutant load reduction goals (PLRG) for use in TMDL development
- Examine data on DO within Brooker Creek, which was recently identified as TNN, to determine if similar condition exists for Lake Tarpon Canal.

Alligator Lake (1574A) and Alligator Creek (1574B)

Determinations:

- Alligator Lake
 - Complete data analyses.
 - FDEP and Pinellas County will make determination on desired path forward for Alligator Lake designation following analysis of data.
- Alligator Creek
 - WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- Alligator Lake Determination – 02/15/11
- Alligator Creek WBID Assessment Report – 02/28/11

Work Tasks:

- Alligator Lake
 - Complete analysis of recent data collected in August and September.
 - Determine appropriateness of weir data to represent the lake as a whole.
 - Examine recent data in relation to total nitrogen (TN) target to determine if TNN designation appropriate based upon recent data.
 - Meet with FDEP and make determination on path forward.
- Alligator Creek
 - Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
 - Compare low DO values and other key water quality factors, against data from adjacent WBIDs with low DO that are currently not listed as impaired.
 - Examine SCI data to determine level of biological health.
 - Examine more recent data to see conditions in recent years.
 - Provide WBID Assessment Report outlining path forward with any future timelines.

Bellows Lake (1579A) and Bellows Lake Outlet (1579)

Determinations:

- Bellows Lake
 - o DEP will provide Scope of Work for Paleolimnologic Study to Hillsborough County for review.
 - o Following completion of the Paleolimnologic Study, a path forward will be developed by FDEP and Hillsborough County based upon analysis of new data. An approach document will be developed with schedule and detailed approach to complete the TMDL once paleolimnologic data is received.
- Bellows Lake Outlet
 - o Bellows Lake Outlet will be determined to be in compliance upon completion of the Bellows Lake TMDL.

Timeline/Deliverable:

- Paleolimnologic Study Report – 6/30/11
- Bellows Lake TMDL – 9/30/11

Work Tasks:

- Work tasks to be developed between FDEP and Hillsborough County

Allen Creek Tidal (1604)

Determinations:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Examine available biological data/information to identify biological health of system
- Examine more recent data to see conditions in recent years.
- Look at nitrogen species compared to salinity levels to help isolate potential sources.
- Document timeframes for septic tank removal and restoration projects to see if they align with recent water quality improvements
- Examine the measured DO values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.

Bishop Creek Tidal (1569)

Determination:

- This WBID will undergo an evaluation of the data to determine if the high nutrient levels measured are a local condition, i.e., not coming from upstream sources. The evaluation

will lead to the determination of the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Initial Assessment
 - o Examine data to determine if the higher nutrient levels are local and not coming from upstream sources.
 - o Potentially do some coordinated sampling in the upstream (freshwater) and downstream (estuarine) areas to see if the upstream watershed is the source or is it a more local issue, i.e., associated with mangroves in old sampling location.
- Further Assessment (if Initial Assessment does not identify path forward).
 - o Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
 - o Examine available biological data/information to identify biological health of system
 - o Examine more recent data to see conditions in recent years.
 - o Examine the measured DO values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.

Mullet Creek Tidal (1575)

Determinations:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine the one year (2002) where Chl a values were high to determine any issues with data.
- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Examine available biological data/information to identify biological health of system
- Examine more recent data to see conditions in recent years.
- Evaluate the upstream freshwater area measurements against historical downstream estuarine measurements by Pinellas County.
- Examine the measured DO values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.

Lake Tarpon Canal (marine) (1541A)

Determinations:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Examine available biological data/information to identify biological health of system
- Examine more recent data to see conditions in recent years.
- Evaluate the potential upstream freshwater sources to determine potential for impacts on marine section (i.e., Lake Tarpon freshwater resolution solving issue).
- Examine the measured DO and Chl a values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.

Double Branch Tidal (1513)

Determination:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values. Examine potential local wetland contributions.
- Examine potential contributions from local point sources in watershed.
- Examine available biological data/information to identify biological health of system
- Examine more recent data to see conditions in recent years.
- Evaluate the upstream freshwater area measurements against downstream measurements if available.
- Examine the measured DO values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.

Moccasin Creek Tidal (1530),

Determination:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values. Examine potential local wetland contributions.
- Examine potential contributions from local point sources in watershed.
- Examine available biological data/information to identify biological health of system
- Examine more recent data to see conditions in recent years.
- Evaluate the upstream freshwater area measurements against downstream measurements if available.
- Examine the measured DO values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.
- Examine possible link between when the ponds are discharging and the data results. Also need to parse data for times of fresh versus marine conditions.

Cross Canal (1625)

Determination:

- This WBID will be examined to determine if it will be utilized as a pilot study for the Class III Limited designation.
- Pinellas County will make determination on working for Class III Limited status.
- Possibly utilize data coming from Watershed Study.

Timeline/Deliverable:

- Pinellas County Recommendation (based upon completion of Class III Limited feasibility assessment) – 02/15/11

Work Tasks:

- None at this time

Bullfrog Creek (1666A)

Determination:

- FDEP will utilize new data and examine the relationships previously developed to see if relationships hold. FDEP will also provide explanation for the lack of relationship using data from the entire period of record.
- If the relationships hold, then investigations will be done for the development of alternative Chl a target for the tidal creek segment.

- If relationships do not hold, this WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBIDs.

Timeline/Deliverable:

- Revised analysis completed by FDEP - 12/15/10
- Evaluation of FDEP Methodology – 2/15/11
- Chl a Target Determination Report (if relationships hold) – To be determined
- WBID Assessment Report (if relationships do not hold) – 02/28/11

Work Tasks:

- Chl a Target Determination
 - Examine tidal creek data to identify potential Chl a targets as they relate to the biotic health of these systems
- WBID Assessment Report
 - Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
 - Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
 - Examine available biological data to assess biological health.
 - Examine more recent data to see conditions in recent years.
 - Given the appropriateness of the empirical relationships derived by FDEP and the proposed Chl a targets, estimate critical loads to meet the Chl a targets.

Cockroach Bay (1778)

Determination:

- FDEP will utilize new data and examine the relationships previously developed to see if relationships hold. FDEP will also provide explanation for the lack of relationship using data from the entire period of record.
- If the relationships hold, then investigations will be done for the development of alternative Chl a target for the tidal creek segment.
- If relationships do not hold, this WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report outlining the findings for the WBIDs will be provided.

Timeline/Deliverable:

- Revised analysis completed by FDEP - 12/15/10
- Evaluation of FDEP Methodology – 2/15/11
- Chl a Target Determination Report (if relationships hold) – To be determined
- WBID Assessment Report (if relationships do not hold) – 02/28/11

Work Tasks:

- Chl a Target Determination
 - Examine tidal creek data to identify potential Chl a targets as they relate to the biotic health of these systems

- WBID Assessment Report
 - o Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
 - o Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
 - o Examine available biological data to assess biological health.
 - o Examine more recent data to see conditions in recent years.
 - o Given the appropriateness of the empirical relationships derived by FDEP and the proposed Chl a targets, estimate critical loads to meet the Chl a targets.

Lower Rocky Creek (1563)

Determination:

- FDEP will utilize new data and examine the relationships previously developed to see if relationships hold. FDEP will also provide explanation for the lack of relationship using data from the entire period of record.
- If the relationships hold, then investigations will be done for the development of alternative Chl a target for the tidal creek segment.
- If relationships do not hold, this WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report outlining the findings for the WBIDs will be provided.

Timeline/Deliverable:

- Revised analysis completed by FDEP - 12/15/10
- Evaluation of FDEP Methodology – 2/15/11
- Chl a Target Determination Report (if relationships hold) – To be determined
- WBID Assessment Report (if relationships do not hold) – 02/28/11

Work Tasks:

- Chl a Target Determination
 - o Examine tidal creek data to identify potential Chl a targets as they relate to the biotic health of these systems
- WBID Assessment Report
 - o Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
 - o Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
 - o Examine available biological data to assess biological health.
 - o Examine more recent data to see conditions in recent years.
 - o Given the appropriateness of the empirical relationships derived by FDEP and the proposed Chl a targets, estimate critical loads to meet the Chl a targets.

Coffee Pot Bayou (1700), Smacks Bayou (1683)

Determination:

- Will examine the potential for these two WBIDs to be taken off the list (i.e., TNN) based upon recent TN and DO data and trends, historic restoration activities within these two WBIDs, and the use of inappropriate canal data (Smacks Bayou) to identify impairment.

Timeline/Deliverable:

- Smacks Bayou and Coffee Pot Bayou Determination - 2/28/11

Work Tasks:

- Smacks Bayou and Coffee Pot Bayou
 - o Examination of data within Smacks Bayou and Coffee Pot Bayou to determine if those waterbodies should be taken off the impaired list for DO based on use of canal data and due to watershed restoration activities that have taken place previously.
 - o A determination report will be developed that will outline the findings for these two WBIDs.

APPENDIX B

Two Hole Branch - WBID 1489
Refinement to Proposed TMDL for
Dissolved Oxygen and Nutrients for
Two Hole Branch

TWO-HOLE BRANCH
WBID 1489

RECOMMENDATIONS ON PROPOSED TMDL FOR
DISSOLVED OXYGEN AND NUTRIENTS
FOR TWO-HOLE BRANCH

PREPARED BY
APPLIED TECHNOLOGY AND MANAGEMENT, INC.

JANUARY 2010



APPLIED TECHNOLOGY AND MANAGEMENT, INC.
5550 NW 111 BLVD.
GAINESVILLE, FLORIDA 32653
386-418-6400

TABLE OF CONTENTS

1.0	INTRODUCTION	1-1
1.1	Objective	1-1
1.2	Waterbody Overview	1-1
2.0	SUMMARY OF PROPOSED FDEP TMDL	2-1
2.1	Data	2-1
2.2	Approach	2-1
2.3	Endpoints	2-1
2.4	Proposed TMDL	2-1
2.5	Key Issues Raised Relative to the TMDL	2-1
3.0	REFINEMENT OF THE PROPOSED TMDL	3-1
3.1	Data Analyses	3-1
3.1.1	Data Used	3-1
3.1.2	Flow Correlations	3-1
3.1.3	Concentration Correlations	3-1
3.1.4	Load Correlations	3-2
3.1.5	Blackwater Stream Considerations	3-2
3.2	Recommendations on the Two-Hole Branch TMDL	3-2
4.0	REFERENCES	4-1

LIST OF FIGURES

- 1-1 Two-Hole Branch Watershed with Station Locations
- 3-1 Measured TN Concentration vs. Flow
- 3-2 Measured TP Concentration vs. Flow
- 3-3 Measured BOD Concentration vs. Flow
- 3-4 Measured DO Concentration vs. Flow
- 3-5 Measured DO Deficit Concentration vs. Flow
- 3-6 Measured Chl-a Concentration vs. Flow
- 3-7 Measured DO vs. TN Concentration
- 3-8 Measured DO Deficit vs. TN Concentration
- 3-9 Measured Chl-a vs. TN Concentration
- 3-10 Measured DO vs. TP Concentration
- 3-11 Measured DO Deficit vs. TP Concentration
- 3-12 Measured Chl-a vs. TP Concentration
- 3-13 Measured DO vs. BOD Concentration
- 3-14 Measured DO Deficit vs. BOD Concentration
- 3-15 Measured DO Deficit vs. 2-Month Previous TN Load
- 3-16 Measured DO Deficit vs. 2-Month Previous TP Load
- 3-17 Measured DO Deficit vs. 2-Month Previous BOD Load

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) published a proposed Total Maximum Daily Load (TMDL) for dissolved oxygen (DO) and nutrients in Two-Hole Branch (WBID 1489) on September 30, 2009. The report was developed by the Florida Department of Environmental Protection (FDEP) and posted by EPA Region 4. Under the Public Comment period, Applied Technology and Management, Inc. (ATM) provided a review of the TMDL, which was submitted to EPA on November 30, 2009. The review raised issues with the model(s) and analyses that were used in the development of the TMDL. Following completion of the TMDL review, a consortium of Stakeholders within the Hillsborough River watershed authorized ATM to conduct additional studies for the purpose of providing recommendations on changes to the TMDL for Two-Hole Branch. The studies included additional data analyses and site visits to provide a more accurate assessment of the instream processes relative to nutrients, and assess the in-stream responses of dissolved oxygen and chlorophyll-a (Chl-a) to nutrient and biochemical oxygen demand (BOD) loadings. This report provides a summary of the findings of the studies, along with recommendations on the path forward for the Two-Hole Branch TMDL.

1.1 OBJECTIVE

The objective of this report is to briefly summarize the proposed TMDL and present recommendations for changes to the TMDL for Two-Hole Branch.

1.2 WATERBODY OVERVIEW

The Two-Hole Branch WBID covers a total of 6,302 acres and is located entirely within Hillsborough County. Impacted land uses make up approximately 48 percent of the overall watershed with a split between low density residential and agriculture. The un-impacted area (52 percent) is split between wetlands and undeveloped rangeland and forest. Figure 1-1 shows the WBID along with locations of monitoring stations. Two-Hole Branch is a Class III waterbody, with designated uses of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. There are presently no permitted point source discharges within Two-Hole Branch. Hillsborough County (FLS 000006) is the lead co-permittee for the Two Hole Branch watershed.

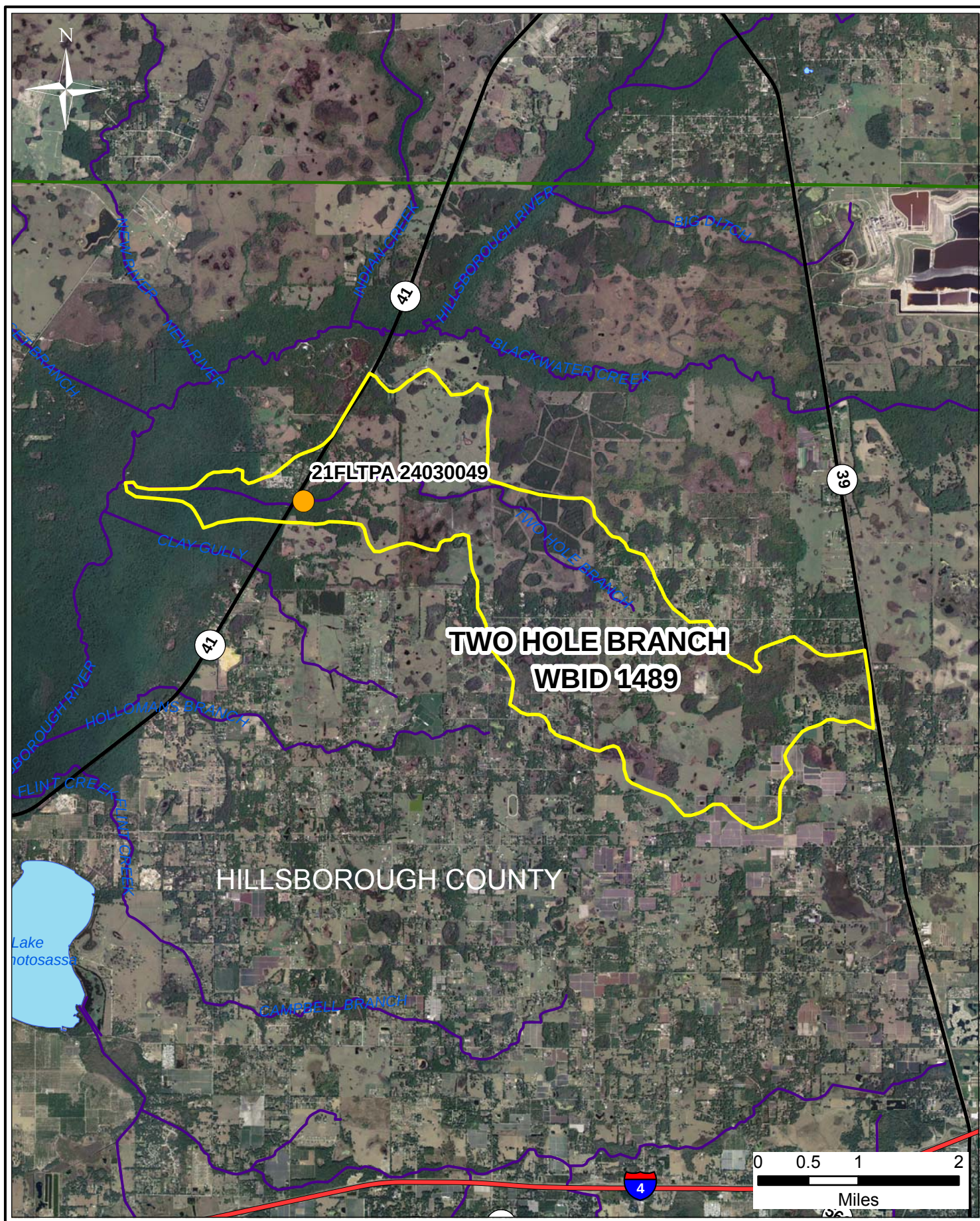


Figure 1-1
Two-Hole Branch Watershed with Station Locations

2.0 SUMMARY OF PROPOSED FDEP TMDL

2.1 DATA

The only data available for the development of the TMDL for Two-Hole Branch were collected in 2002 and 2005. All data were collected at a single station by FDEP as shown in Figure 1-1. A total of 17 measurements were made in 2002 and 4 in 2005. No flow measurements were available on Two-Hole Branch.

The evaluation performed by FDEP using the Impaired Waters Rule (IWR) found that for Two-Hole Branch, 19 out of 23 dissolved oxygen measurements were below the 5.0 mg/L criteria. The analysis of the Chl-a data showed very low values with all values of corrected Chl-a less than 6.0 ug/L.

2.2 APPROACH

The FDEP approach for establishing the TMDL within Two-Hole Branch was to utilize available data from various waterbodies in the area (Baker Creek, Mill Creek, Spartman Branch, Two-Hole Branch, Trout Creek, Channelized Stream, and Big Ditch), along with various load reduction runs using the Trout Creek model, to establish relationships between total nitrogen (TN) and percent violation of the DO criteria. Using these relationships, a target concentration of TN was developed. The load reductions were then based upon reducing the available measured TN and total phosphorus (TP) levels to meet the targets.

2.3 ENDPOINTS

For the Two-Hole Branch WBID, the TN and TP targets established were 0.46 mg/L and 0.134 mg/L, respectively.

2.4 PROPOSED TMDL

For the Two-Hole Branch TMDL, the load reductions specified under the TMDL were for TN and TP. The load reductions were 60.2 percent for both nitrogen and phosphorus.

2.5 KEY ISSUES RAISED RELATIVE TO THE TMDL

The following key issues were raised in the model review. These issues relate primarily to the method used to establish the relationship of TN to DO and the use of the Trout Creek model results.

1. The Trout Creek modeling work was utilized as part of the basis for extrapolating the targets used in the Two-Hole Branch TMDL. Significant concerns relative to the accuracy of the Trout Creek model were established, therefore, these concerns carry over to the use of the model results to establish the TN to DO violation relationships.
2. The Trout Creek DO/TN relationships may not apply to the other WBIDs. Therefore, the extrapolation of the relationships that are primarily driven by the model results is not appropriate for establishing the TMDLs in the other WBIDs. Additionally, the use of modeled data in conjunction with measured data to establish regressions, especially when the modeled information controls the curves, is not sound.
3. The limited Chl-a data do not indicate significant eutrophication issues on the stream.

3.0 REFINEMENT OF THE PROPOSED TMDL

The following presents an alternative proposal for the development of the TMDL. The alternative proposal is based upon analyses of the limited data and the conclusion that the limited nature of the data would not support accurate development of a TMDL for the Two-Hole Branch WBID.

3.1 DATA ANALYSES

3.1.1 DATA USED

For the alternative TMDL analyses, data from IWR Run 37 were utilized. The data included the same station used by FDEP. Figure 1-1 shows the location of the data station. The limited quantity of data available creates significant issues with development of meaningful relationships as the data do not necessarily reflect the hydrologic variations throughout the years. The data analyses presented below must therefore be evaluated with this in mind.

3.1.2 FLOW CORRELATIONS

Figures 3-1 through 3-6 provide plots of the measured instream concentrations of DO, DO Deficit, Chl-a, TN, TP, and BOD versus the measured flow values on the day of the sampling. The DO deficit is provided to allow an assessment of the depletion of oxygen from the saturation value with the variations due to temperature effects on saturation value removed.

Examination of the plots does not indicate a significant relationship between TN, TP, and BOD concentrations as a function of flow. DO and DO deficit values do show some similarities with results found for Trout Creek, where DO and DO deficits were highly variable at low flow conditions and become more constant at higher flows (i.e., correlated with hydrologic loads) but the data are not of sufficient quantity to make a definitive statement. The Chl-a data are limited, generally low values, and are bracketed around reporting or detection limits (based upon flags found within the IWR database). These data do not indicate issues with instream algal production.

3.1.3 CONCENTRATION CORRELATIONS

Figures 3-7 through 3-14 provide correlations between the instream response variable concentrations (DO, DO Deficit, and Chl-a) and the potential causative parameters (TN, TP,

and BOD). The limited data do not show any significant relationship between the instream causative parameters and the DO and Chl-a response.

3.1.4 LOAD CORRELATIONS

Figures 3-15 through 3-17 present correlation plots between the loads of the potential causative parameters [from loads provided by Janicki Environmental (2010)] and the DO deficits. As with the plots versus concentrations, the limited data do not show any significant relationship between the loads and the DO response instream.

3.1.5 BLACKWATER STREAM CONSIDERATIONS

Examination of the available data shows that color levels on Two-Hole Branch are relatively high with a range of measured colors (20 PCU up to 500 PCU). Additionally, the system has relatively high total organic carbon (TOC) values (7 mg/L up to 38 mg/L). It is important when assessing the potential DO impairment issues that the nature of the stream is taken into consideration.

Streams with blackwater characteristics (such as Two-Hole Branch) are found throughout Florida and the southeast United States. Mild slopes, high summertime temperatures, large changes in seasonal flow patterns, high allochthonous inputs (such as leaf litter), and extensive floodplain inundation during high rainfall periods characterize these streams. These streams are also often characterized by large variations in DO and depressions below state water quality standards (especially in low flow and summertime conditions). While few streams are immune from anthropogenic inputs of oxygen demanding substances, considerable research has found that low DO may be a natural condition for summer months in these streams (Utley et al., 2008).

3.2 RECOMMENDATIONS ON THE TWO-HOLE BRANCH TMDL

Two potential approaches are provided as the path forward for the TMDL for Two-Hole Branch. These recommendations are supported from the following conclusions derived from the assessments presented above. In the options presented, Option 1 is identified as the most appropriate path forward.

1. The available data within the WBID is highly limited and is insufficient for the development of a TMDL.

2. Using the data that was available, no significant relationships were identified that tied the loading or concentrations of nutrients or BOD to changes in the DO conditions in the stream.
3. The limited results indicate that Two-Hole Branch has some characteristics similar to Trout Creek, such as an indication that hydrology plays a significant role in the dissolved oxygen within the stream (ATM, 2010) and similar TN and TP concentration levels.
4. Two-Hole Branch has characteristics of a blackwater system which extensive research has identified have naturally low DO conditions.

Option 1

Given the lack of available data, the primary recommendation is to redefine the WBID as a category 4d due to insufficient data.

Category 4d – represents waterbodies that have been identified as not meeting water quality standards applying the Impaired Waters rule; however a causative pollutant cannot be identified.

This category is typically applied to waterbodies that are determined to be impaired for dissolved oxygen or biology based on the macroinvertebrate community. In these instances, the Department is required by state law to identify the pollutant causing the impairment such that a Total Maximum Daily Load can be developed. Often after reviewing all available information, the Department or local stakeholders are unable to identify the cause of the impairment and the waterbody is put into Category 4d. Waterbodies placed into Category 4d will then be targeted for monitoring before the next cycle of assessments for that waterbody.

Placing the WBID in the 4d category will allow for the collection of additional data to provide a more definitive evaluation of the potential causes of the impairment, or provide sufficient data to determine that no causative pollutant can be identified.

Option 2

A second potential approach is to follow the reasoning utilized in establishment of several of the proposed TMDLs for Tampa Bay tributaries and embayments. This approach utilized endpoints considered to be protective of the downstream waters of Tampa Bay. As

protection of downstream waters is a key aspect of establishing a TMDL within a waterbody, if analyses do not support the establishment of load reductions to be protective of the local waterbody, the establishment of load reductions to be protective of downstream uses can be an appropriate TMDL. Through the Reasonable Assurance process, it was determined that maintaining the hydrologically normalized 2003-2007 segment TN loads is protective of water quality in each segment (Tampa Bay Estuary Program and Janicki Environmental, 2009). Using this logic for freshwater systems, even those that do not drain directly to Tampa Bay, which was successfully utilized to assign loading allocations through the Reasonable Assurance process, the second potential refinement to the TMDL for the Two-Hole Branch WBID would be to maintain the 2003-2007 hydrologically normalized TN loads from the WBID and its watershed to the ultimate receiving water of Hillsborough Bay.

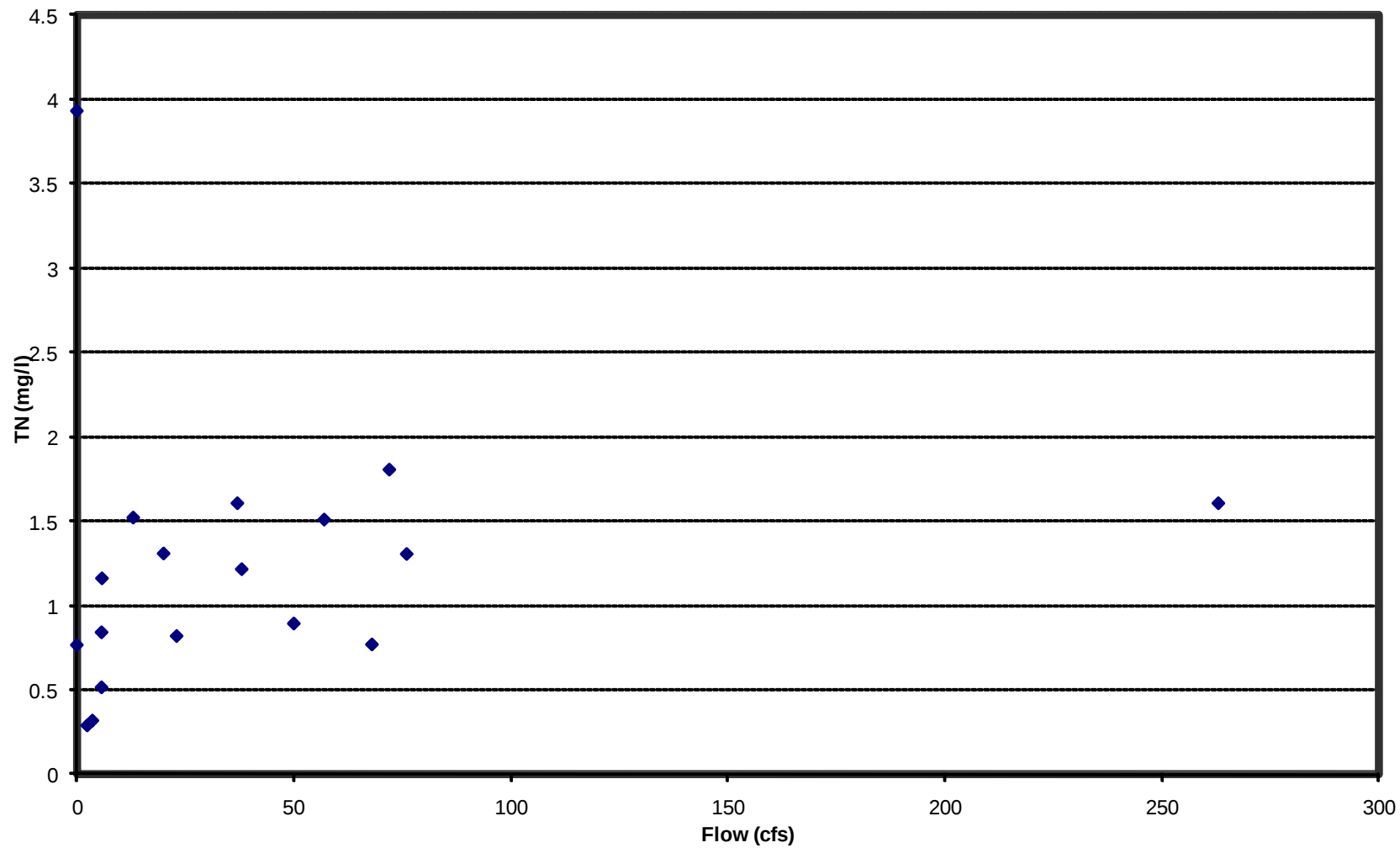


Figure 3-1
Measured TN Concentration vs. Flow

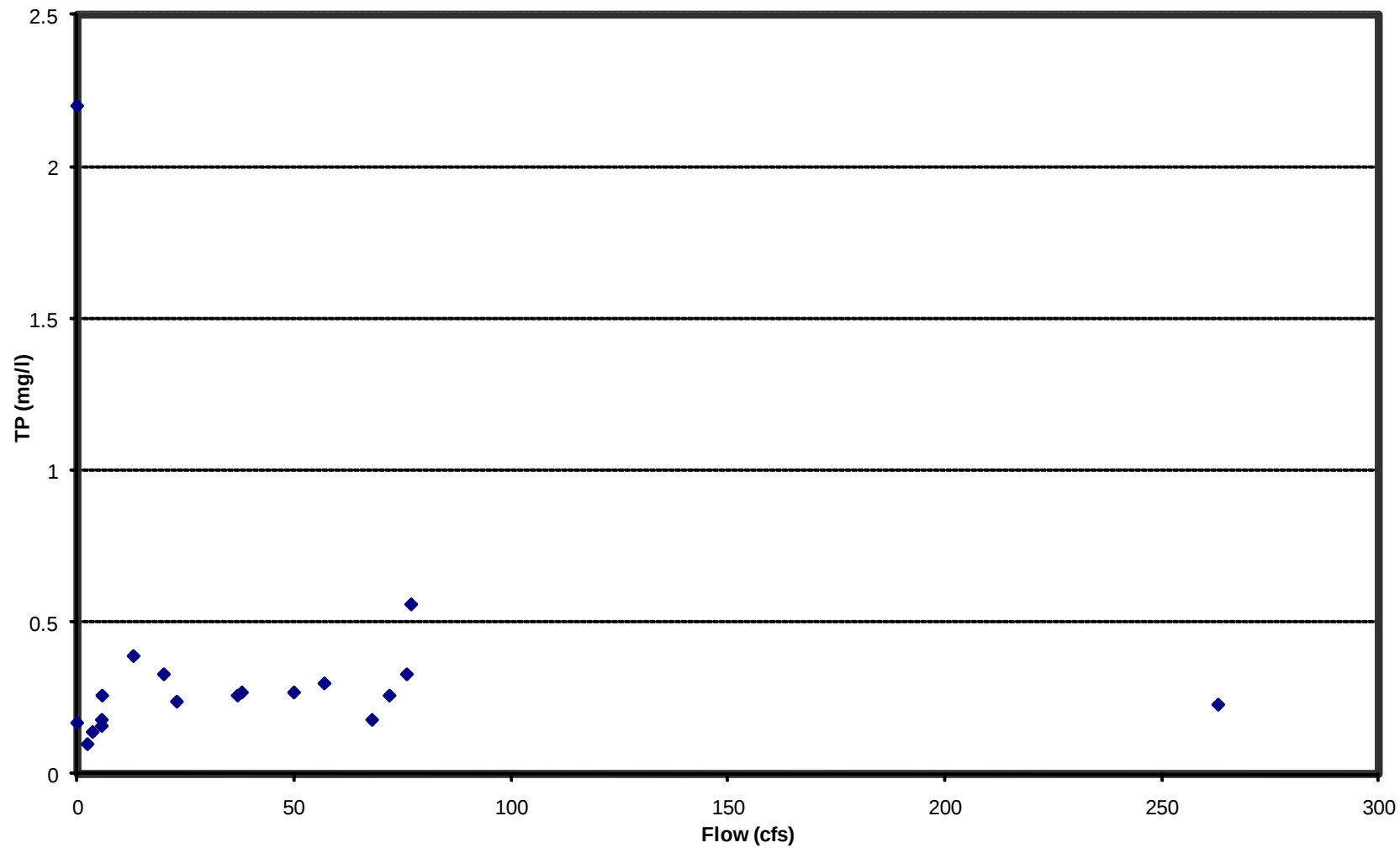


Figure 3-2
Measured TP Concentration vs. Flow

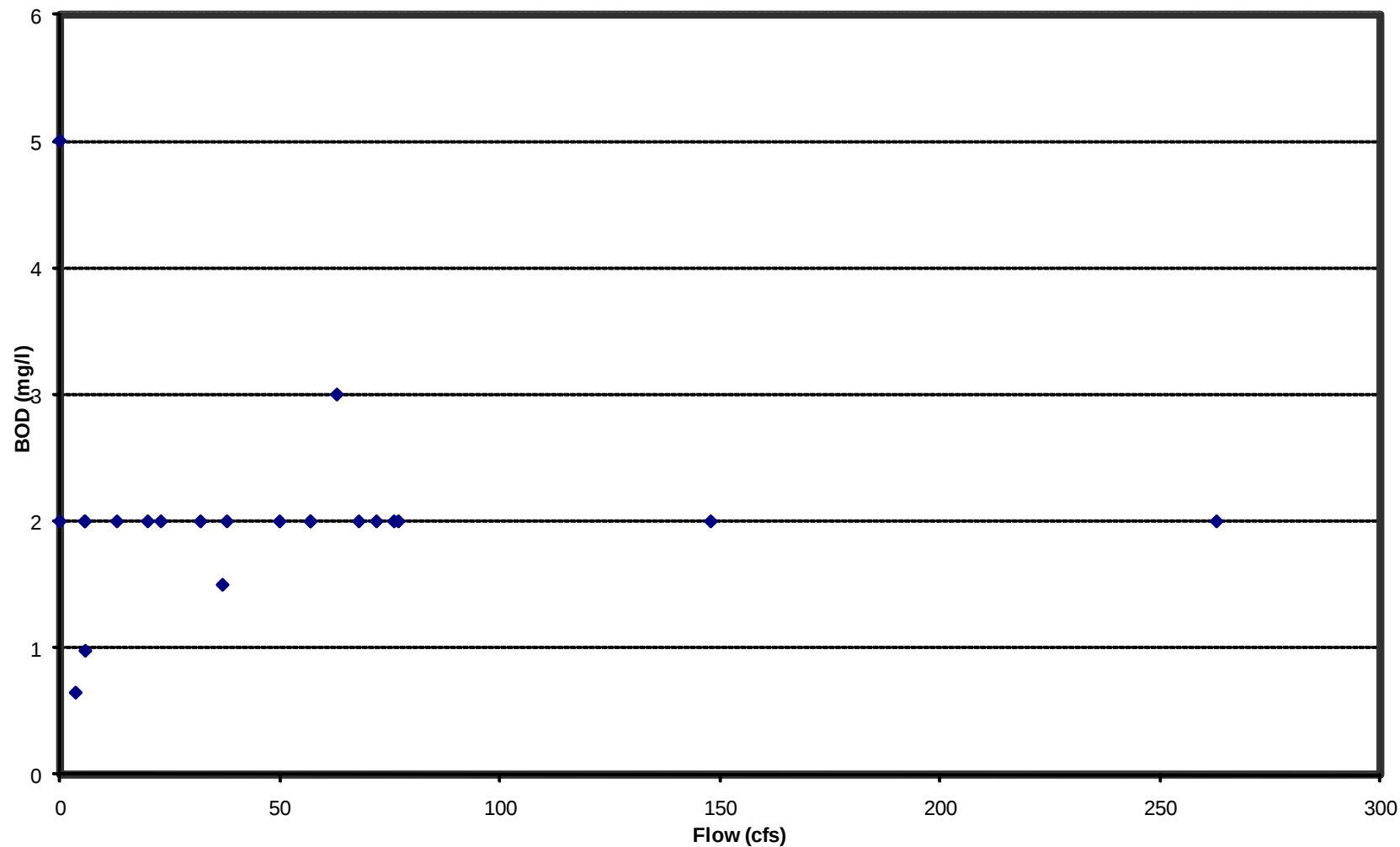


Figure 3-3
Measured BOD Concentration vs. Flow

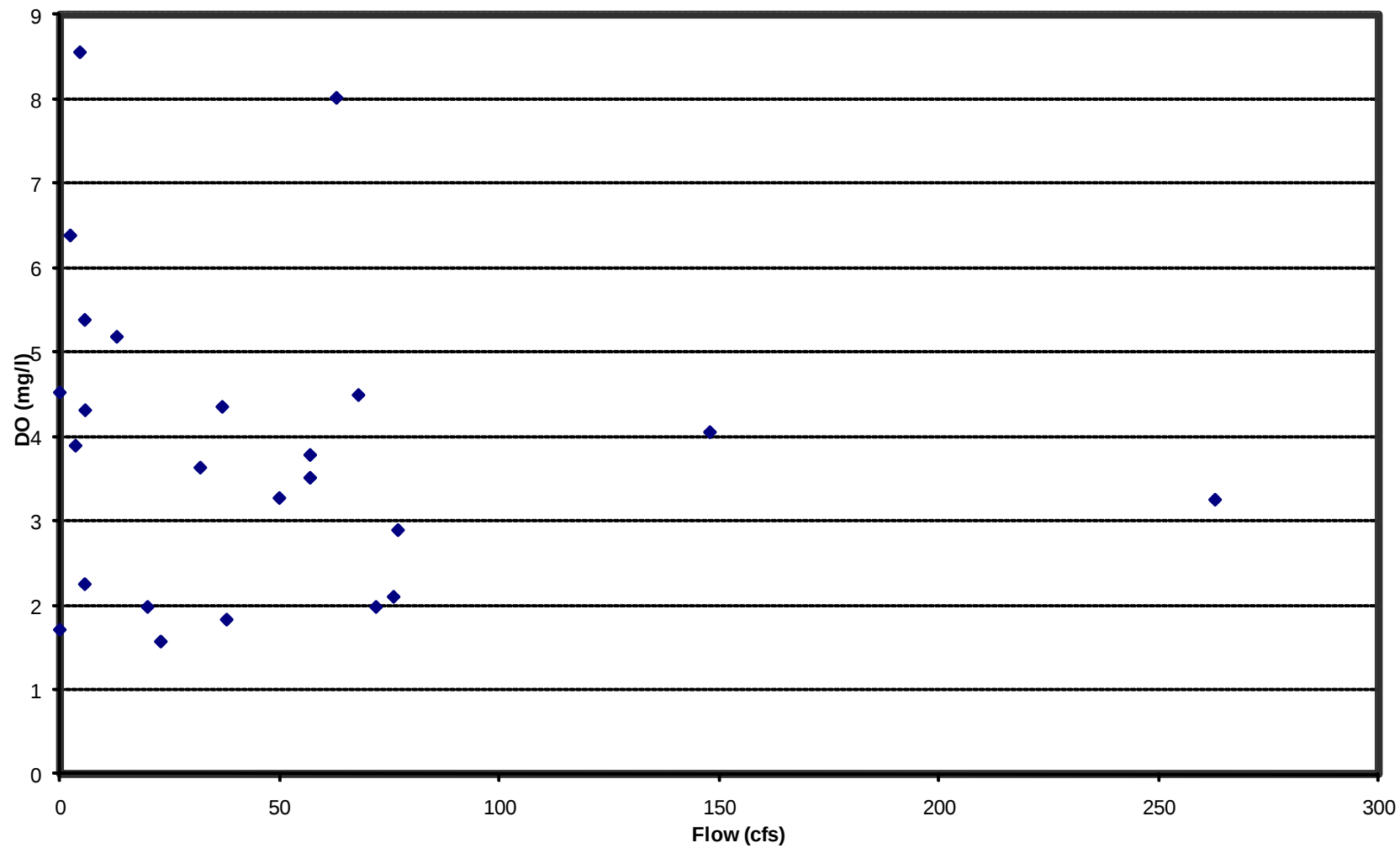


Figure 3-4
Measured DO Concentration vs. Flow

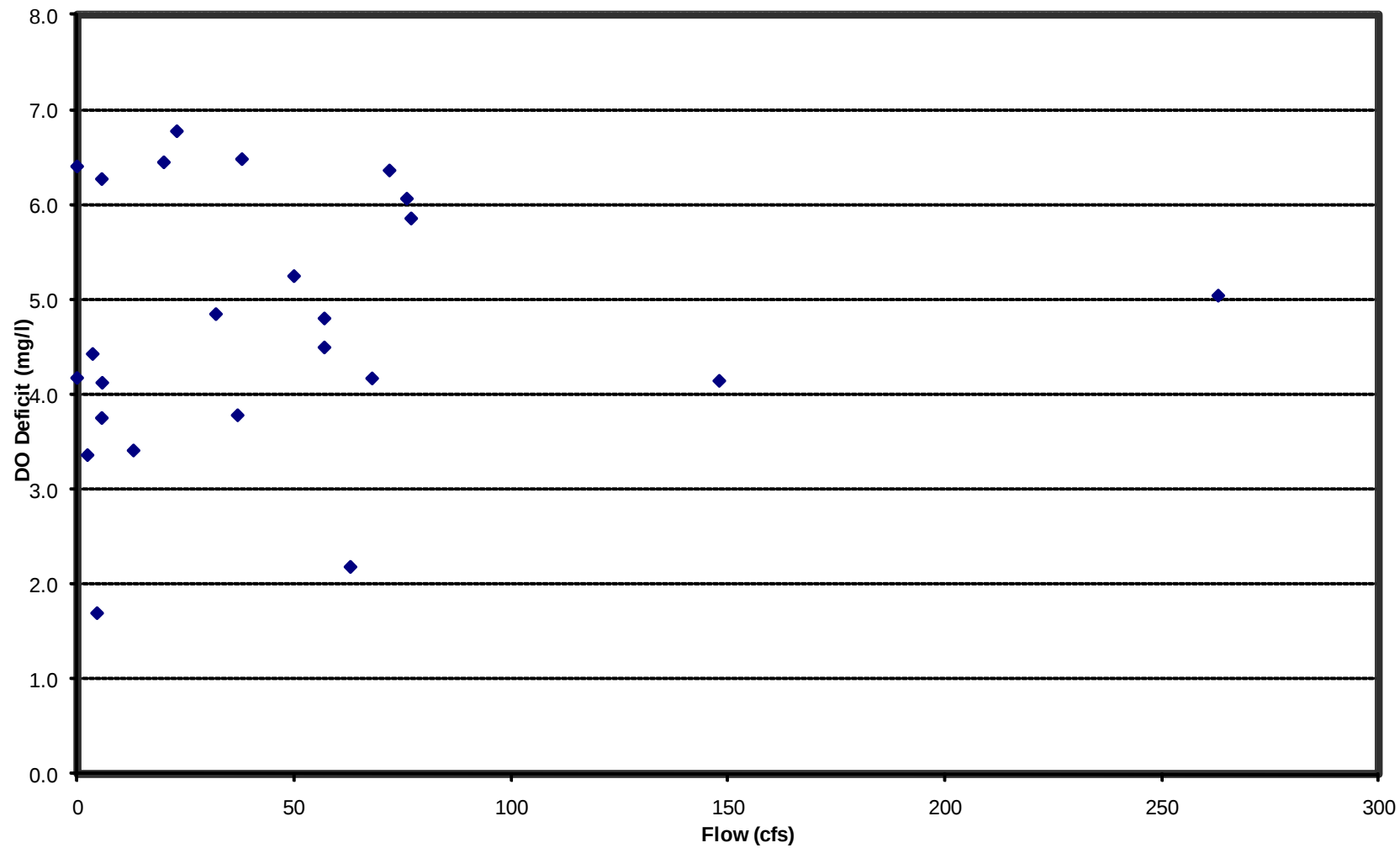


Figure 3-5
Measured DO Deficit Concentration vs. Flow

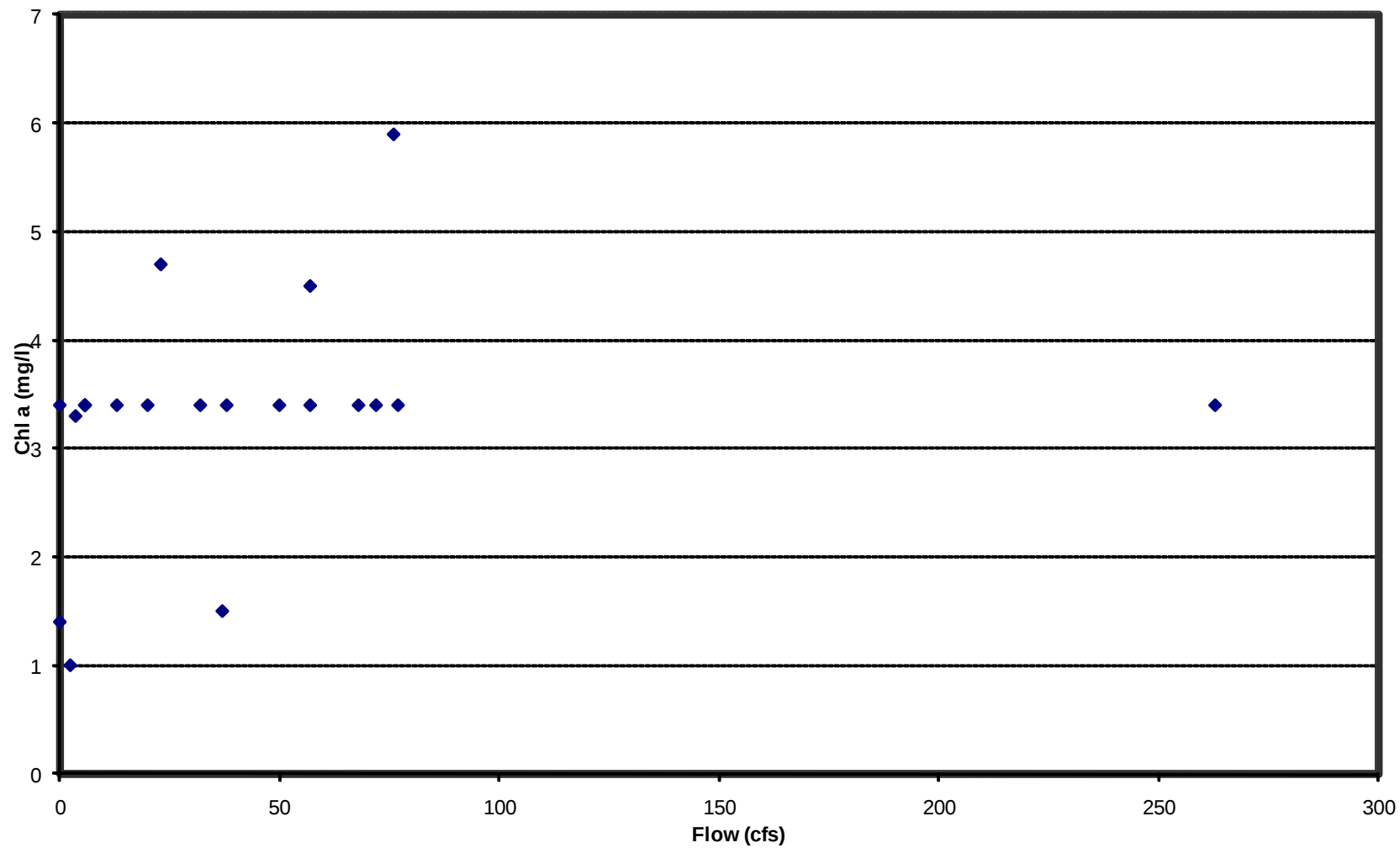


Figure 3-6
Measured Chl-a Concentration vs. Flow

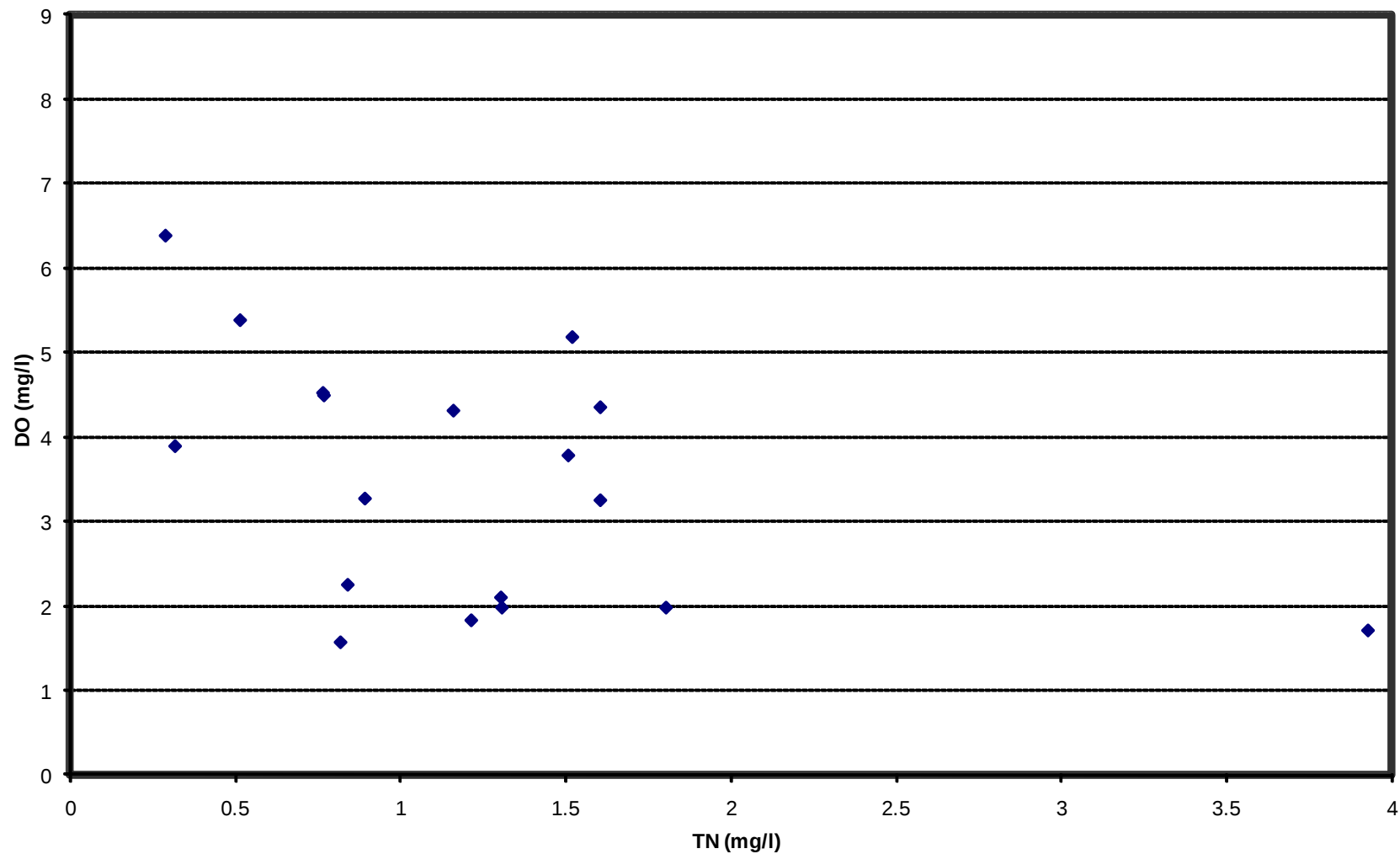


Figure 3-7
Measured DO vs. TN Concentration

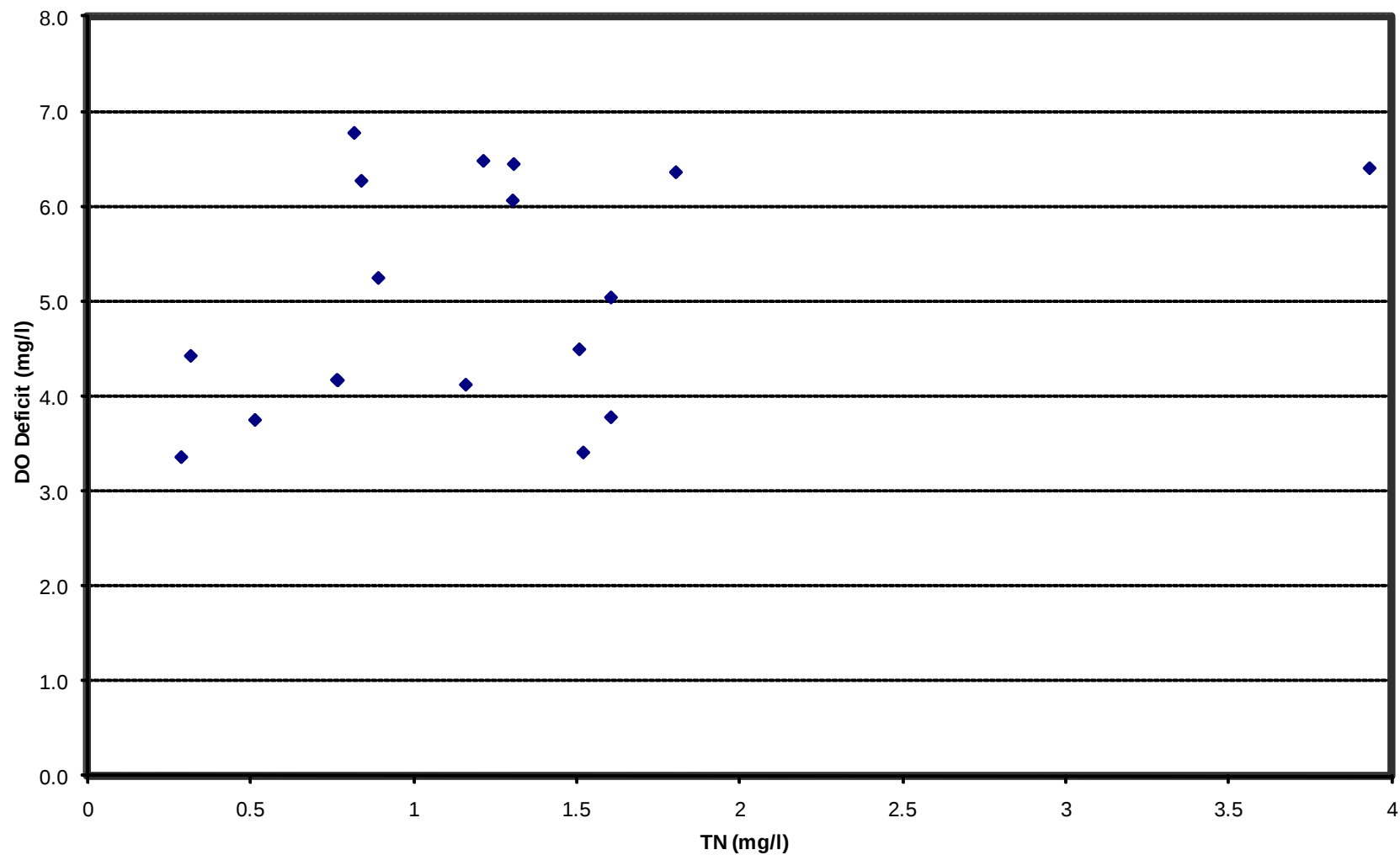


Figure 3-8
Measured DO Deficit vs. TN Concentration

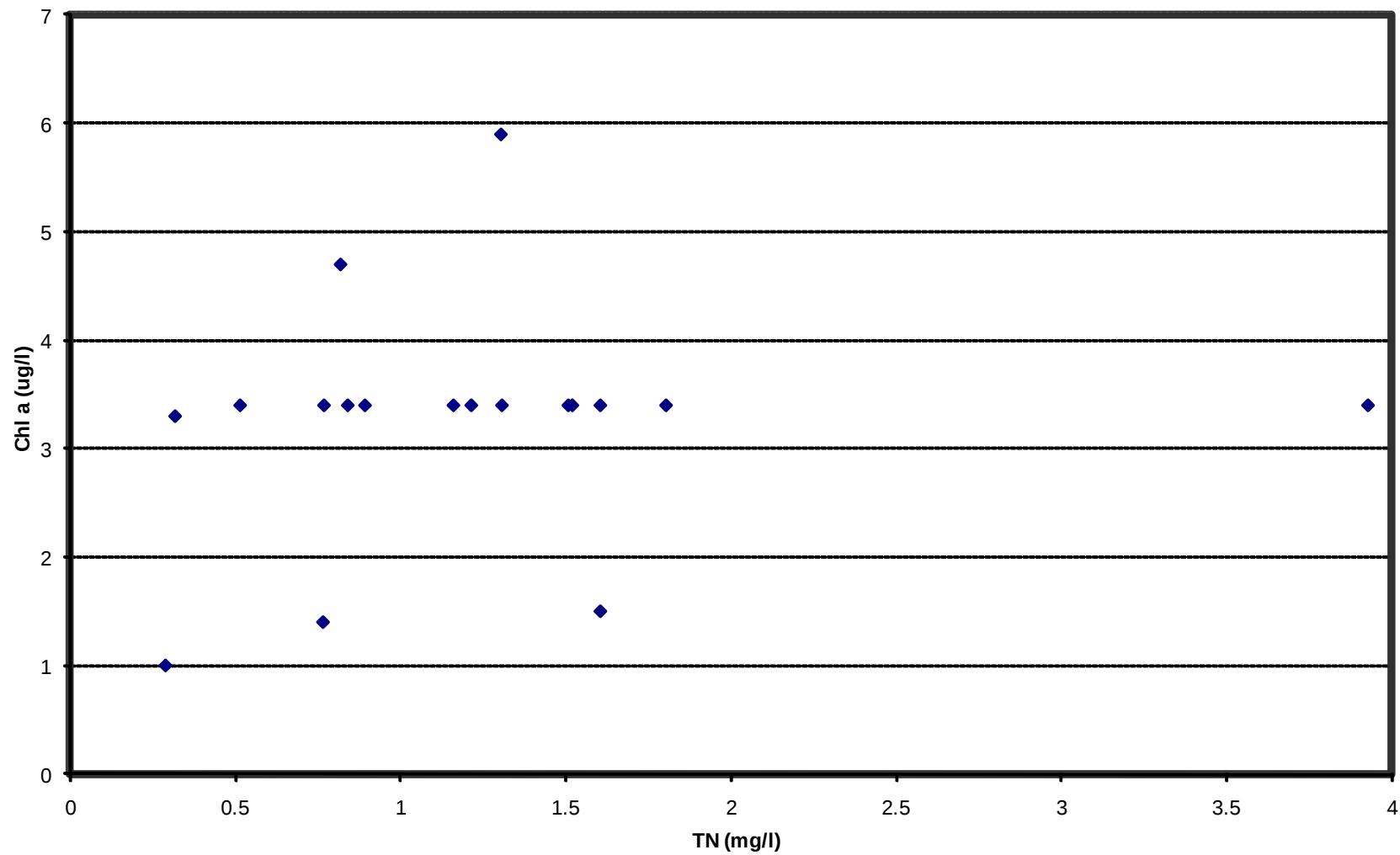


Figure 3-9
Measured Chl-a vs. TN Concentration

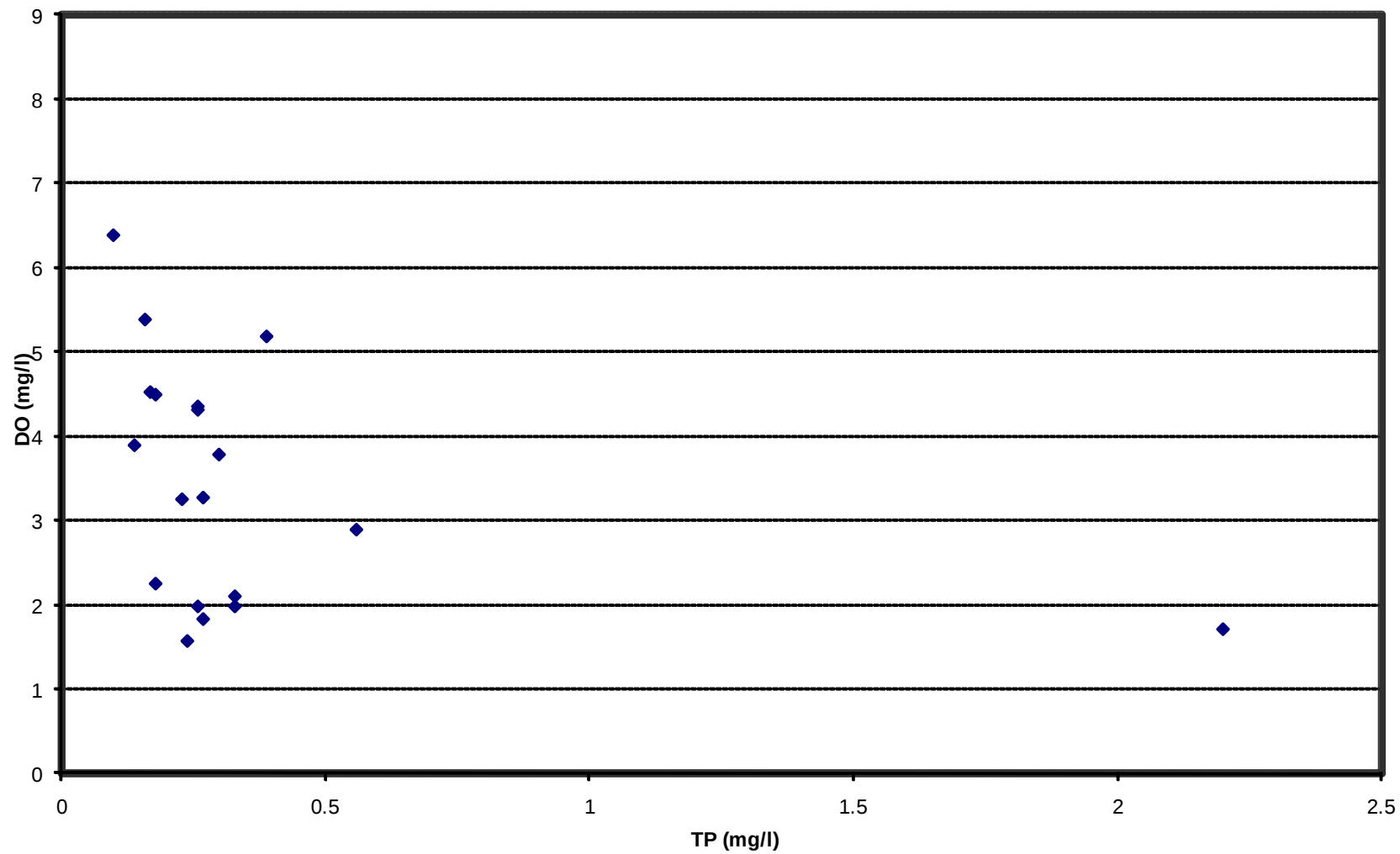


Figure 3-10
Measured DO vs. TP Concentration

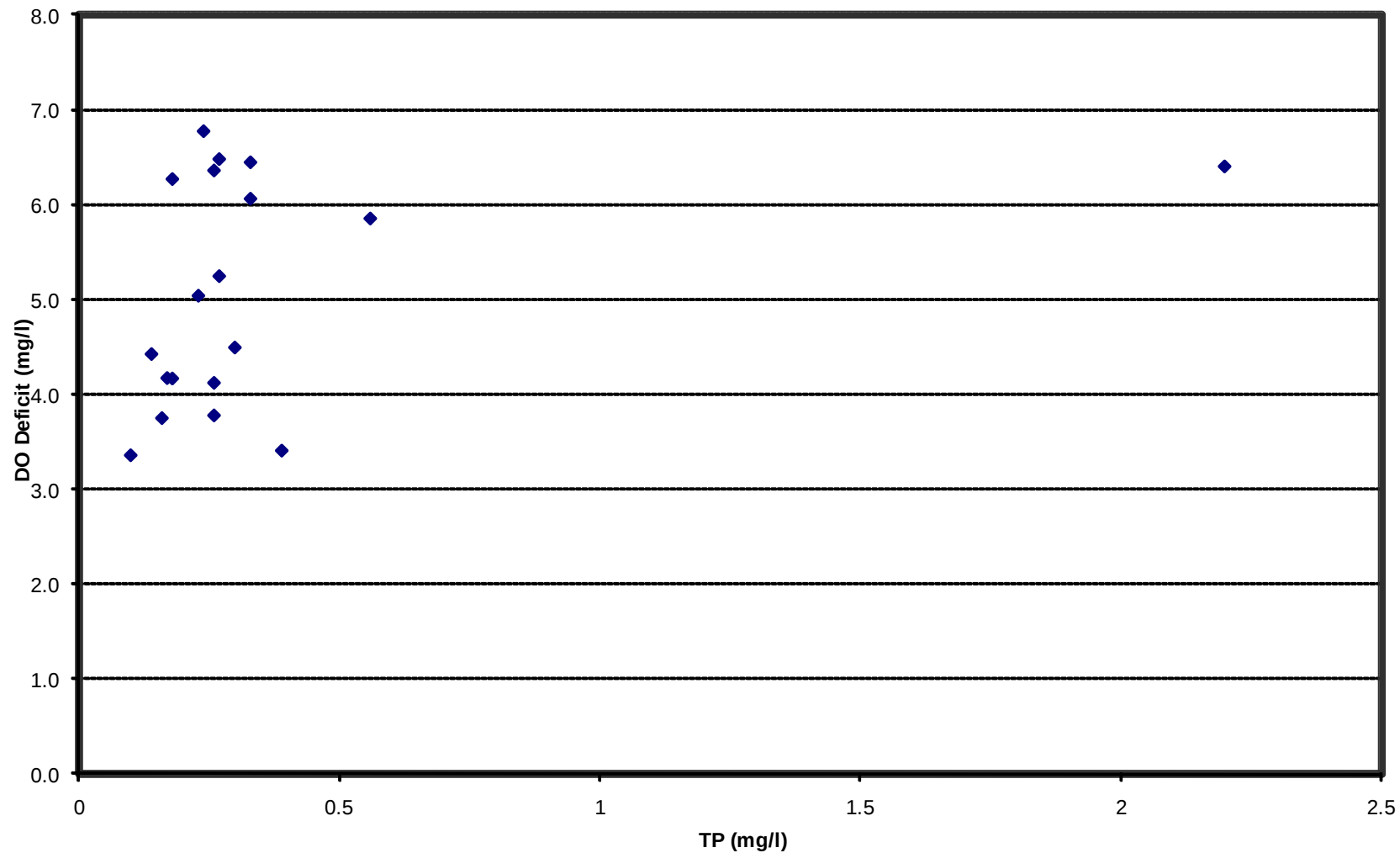


Figure 3-11
Measured DO Deficit vs. TP Concentration

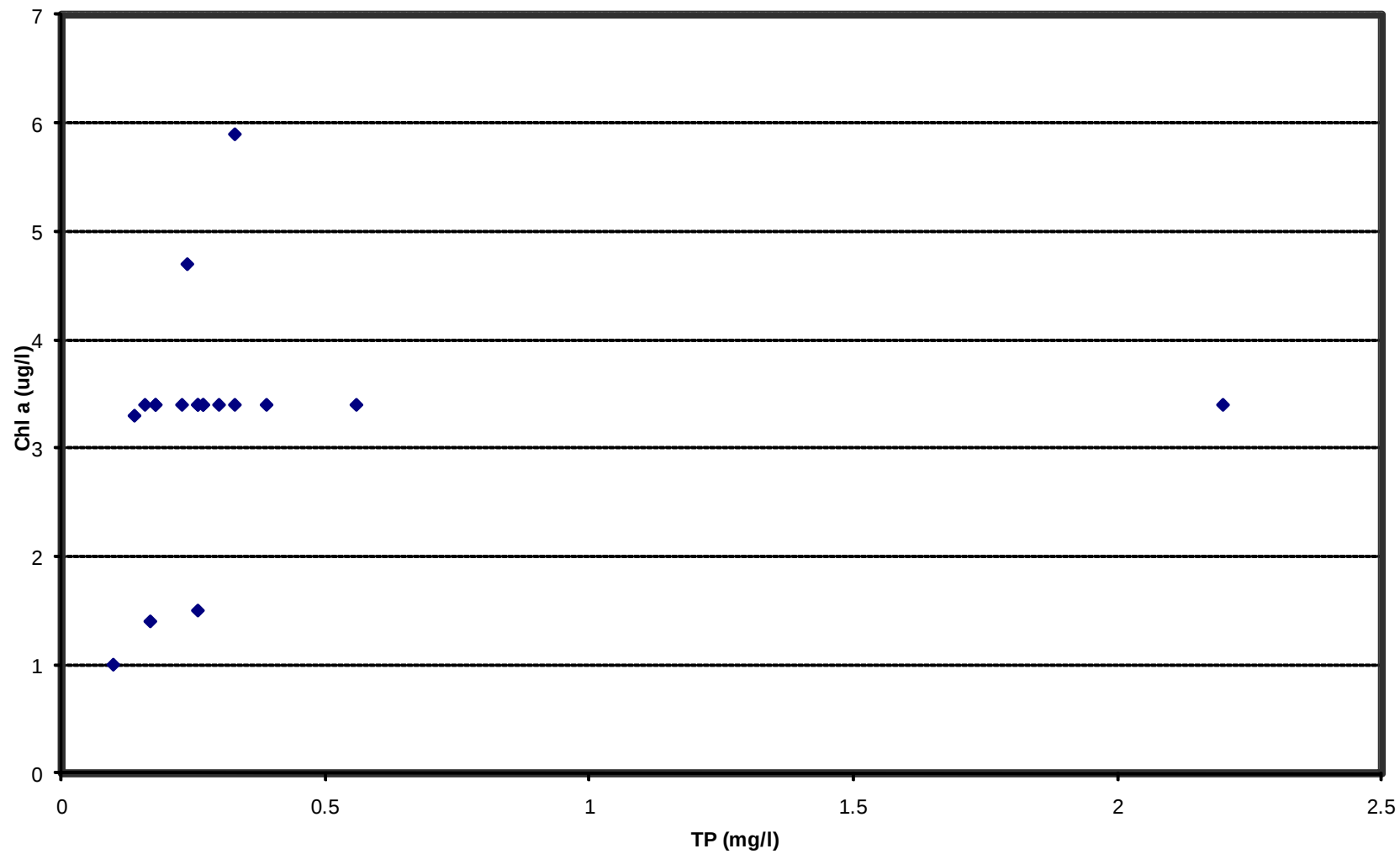


Figure 3-12
Measured Chl-a vs. TP Concentration

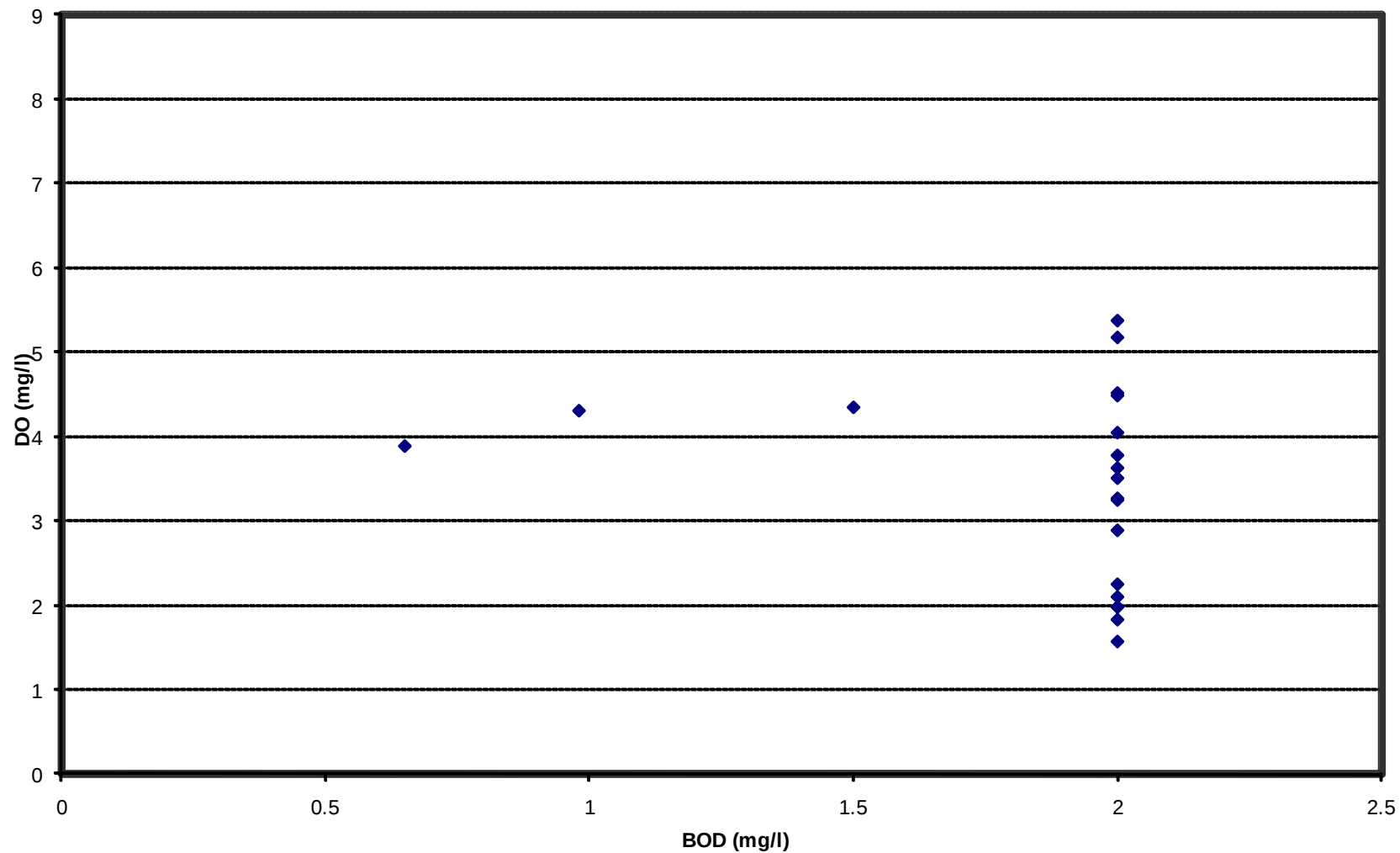


Figure 3-13
Measured DO vs. BOD Concentration

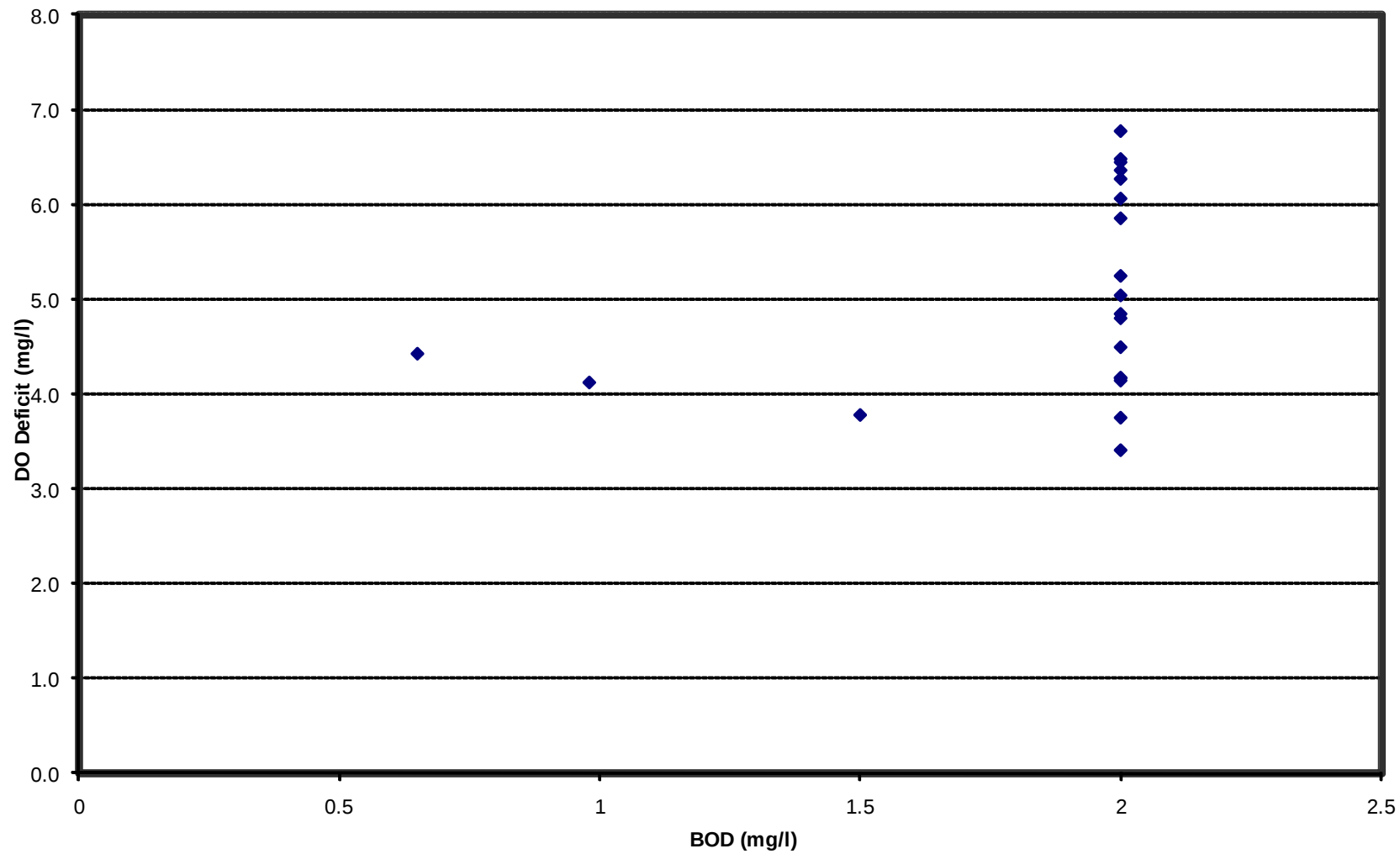


Figure 3-14
Measured DO Deficit vs. BOD Concentration

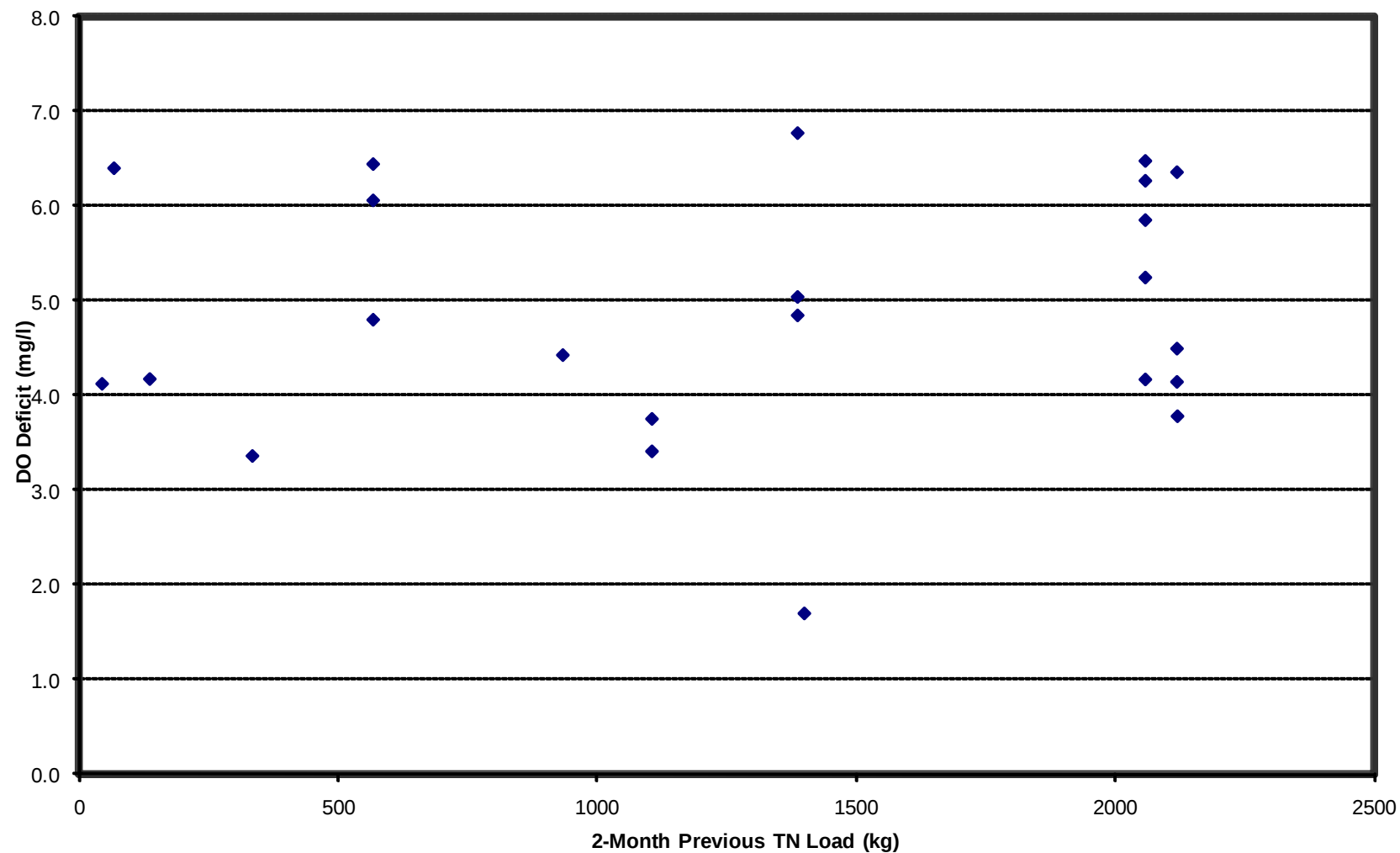


Figure 3-15
Measured DO Deficit vs. 2-Month Previous TN Load

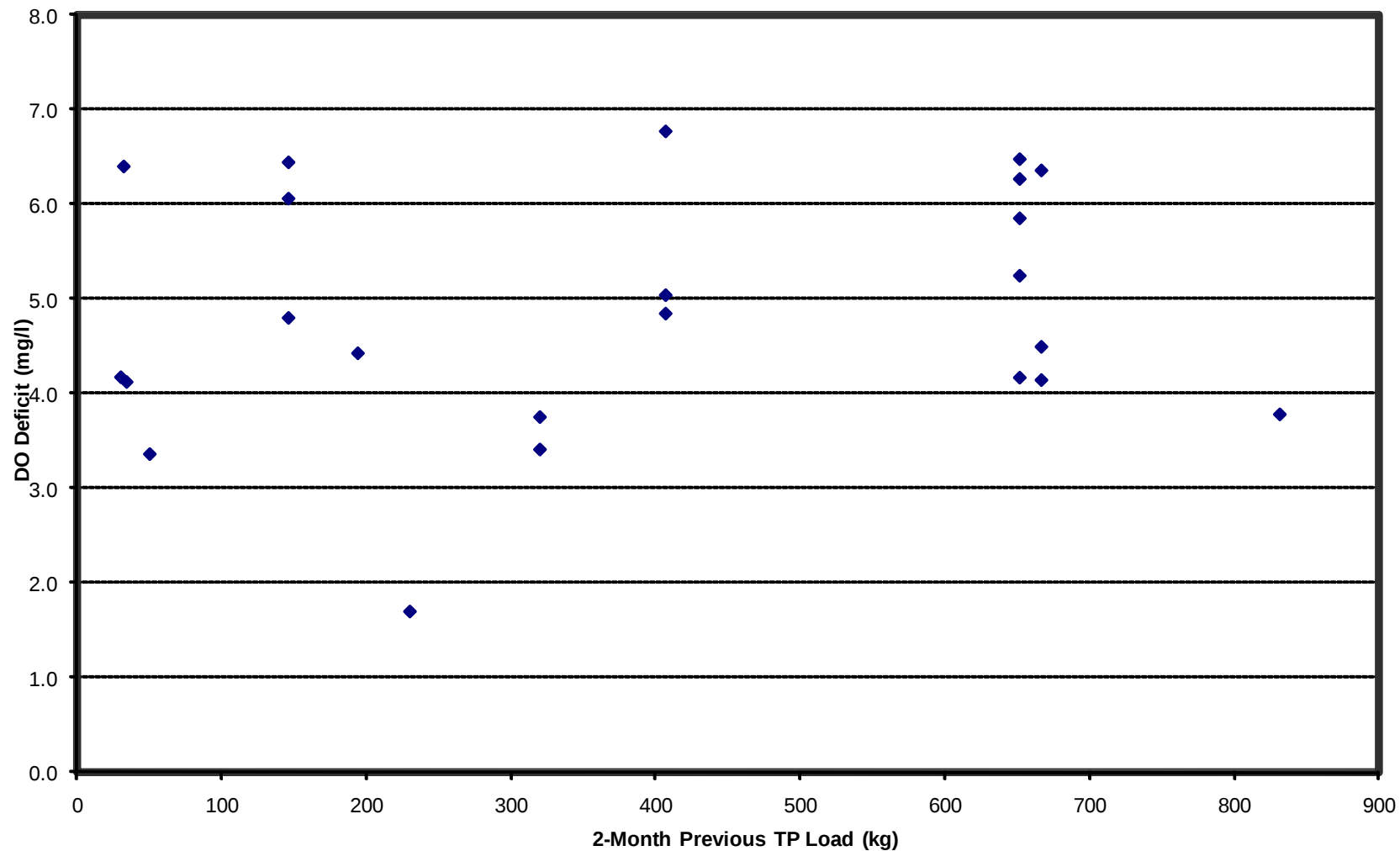


Figure 3-16
Measured DO Deficit vs 2-Month Previous TP Load

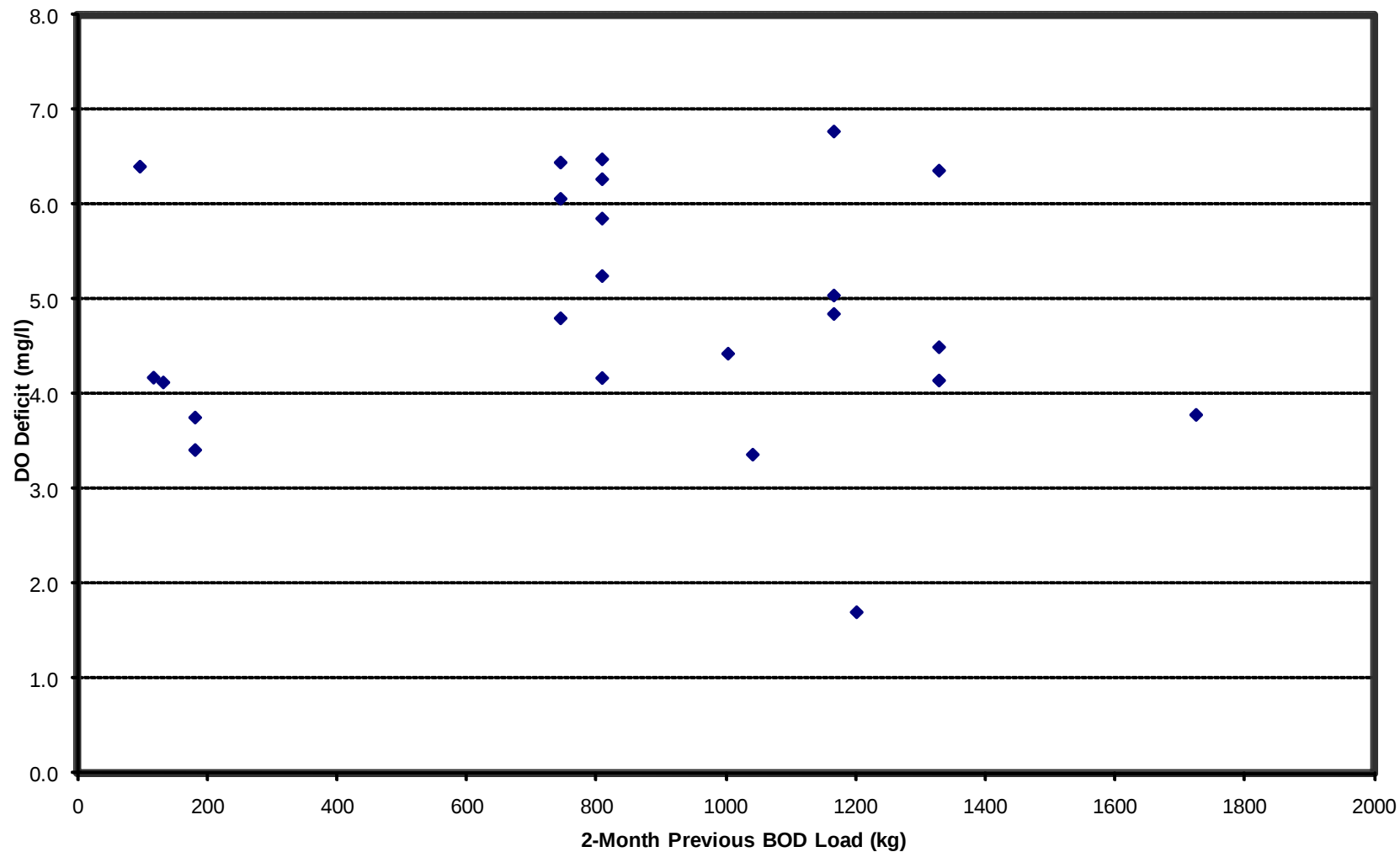


Figure 3-17
Measured DO Deficit vs 2-Month Previous BOD Load

4.0 REFERENCES

- Applied Technology and Management, Inc. (ATM). 2009. Review of Proposed TMDL for Dissolved Oxygen and Nutrients in Trout Creek (WBID 1455), Channelized Stream (WBID 1483), Big Ditch (WBID 1469), and Two-Hole Branch (WBID 1489).
- Tampa Bay Estuary Program and Janicki Environmental. 2009. Draft Final 2009 Reasonable Assurance Addendum: Allocation & Assessment Report. Prepared for Florida Department of Environmental Protection.
- United States Environmental Protection Agency. 2009. Proposed Total Maximum Daily Load (TMDL) For Dissolved Oxygen and Nutrients in Trout Creek (WBID 1455), Channelized Stream (WBID 1483), Big Ditch (WBID 1469), and Two Hole Branch (WBID 1489). Prepared by: FDEP, Tallahassee, FL.
- Utle et al., 2008. Factors Affecting Sediment Oxygen Demand Dynamics in Blackwater Streams of Georgia's Coastal Plain. Journal of the American Water Resources Association, Vol. 44, No. 3.

APPENDIX C

Two-Hole Branch BioRecon Data

Two-Hole Branch BioRecon Data

As Entered / STORET station ->	24030049	24030049	
Sample date ->	8/16/1995	3/12/1996	
	Sampleid 17791/ BenID 15564	Sampleid 17792/ BenID 15565	
Taxon Name / SampleID/BenID ->	(# counted)	(# counted)	Current Name
Acerpenna pygmaea	+	+	
Astacidae	+	-	Cambaridae
Baetis intercalaris	+	-	
Belostoma	+	-	
Caecidotea	-	+	
Caenis	+	-	
Caenis diminuta	-	+	
Cheumatopsyche	-	+	
Chironomidae	+	+	
Clathrosperchon	-	+	
Crangonyx	+	-	
Dineutus	+	+	
Enallagma cardenium	-	+	Enallagma coecum
Helobdella fusca	-	+	
Labiobaetis	-	+	Pseudocloeon
Labiobaetis propinquus	+	-	Pseudocloeon propinquum
Macromia	-	+	
Microcylloepus pusillus	+	-	
Micromenetus dilatatus avus	-	+	
Neoporus	-	+	
Palpomyia	-	+	
Pentaneura inconspicua	+	-	
Physella	+	+	Physa
Pisidiidae	-	+	Sphaeriidae(mollusca)
Pisidium	+	-	
Rheotanytarsus	-	+	
Scirtes	+	-	
Simulium	+	+	
Sphaerium striatinum	+	-	
Stenacron	-	+	
Stenelmis	-	+	
Stenelmis fuscata	+	-	
Synurella	-	+	
Tubificidae	+	+	
	18	22	

As Entered / STORET station ->

24030049

Sample date ->

6/29/2005

Sampleid 43075/BenID 29944

Taxon Name / SampleID/BenID ->	(# counted)	Current Name
Caenis	11	
Cambaridae	4	
Centroptilum triangulifer	1	
Chironomidae	3	
Cryptochironomus	1	
Dero pectinata	1	
Dicrotendipes	1	
Dicrotendipes simpsoni	2	
Dubiraphia vittata	2	
Enchytraeidae	1	
Eupera cubensis	1	
Haitia	1	Physa
Hyaella azteca	3	
Microcylloepus pusillus	4	
Micromenetus	3	
Parachironomus carinatus	2	
Pericoma	2	
Pisidium	12	
Polypedilum halterale grp.	1	
Polypedilum illinoense grp.	2	
Polypedilum tritum	3	
Pseudocloeon	1	
Rheotanytarsus exiguus grp.	2	
Scirtes	1	
Simulium	13	
Sphaeriidae(mollusca)	11	
Stenelmis	1	
Stenochironomus	1	
Tanytarsus sp. c epler	1	
Tanytarsus sp. t epler	2	
Tanytarsus sp. v epler	3	
Tubificidae	5	