

2.1 Introduction

Tumblin Creek flows through south-central Gainesville, in a south to south-westerly direction, to Bivens Arm Lake (Figures 2.1 and 2.2). The outflow of the lake, also known as Tumblin Creek, flows onto Paynes Prairie.

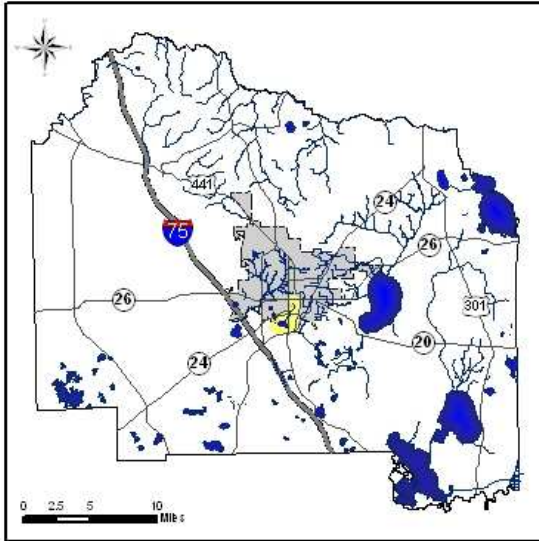


Figure 2.1 Location of the Tumblin Creek Watershed in Alachua County

The Tumblin Creek Watershed encompasses 3.8 square miles of urban Gainesville. CH2M Hill (1985) reported that 60% of the watershed is impervious. The entire basin, except for the Bivens Arm floodplain, has been developed. In many cases, the development stops only inches from the creek channel. The elevation in the vicinity of the Tumblin Creek headwaters is approximately 170 feet National Geodetic Vertical Datum of 1929 (NGVD) and falls to 65 feet NGVD near Bivens Arm.

The watershed is located along the southwestern margin of the Northern Highlands physiographic province (White 1970). As the main stream channel flows southwest, elevations decrease and expose recent sands, as well as, Plio-Pleistocene Terrace

deposits (comprised of sands and clays) and Miocene age formations of the Hawthorn Group (Thomas et al 1985). The Hawthorn Group formations are extremely variable but generally consist of sands, silts, clays, carbonates (limestone and dolostone), and phosphates (Scott 1988). As the elevation decreases throughout the watershed, sediments of the Hawthorn Group formations can be observed along the creek banks and in the streambed. The clayey sediments and dolostone are less easily eroded and are frequently observed to resist down cutting.

The major soil types in the upper portion of the Tumblin Creek Watershed are the well drained Millhopper-Urban land complex, Blichton-Urban land complex, and Urban land (Thomas et al 1985). The urban land complexes generally contain 50-85% of the soils for which the complex was named. Small areas of Blichton sand and Lochloosa fine sand were reported to be present in areas surrounding the creek channel in the mid-portion of the watershed (Thomas et al 1985). The Blichton sand and Lochloosa fine sand are poorly drained soils, with the former containing ironstone and phosphatic limestone (Thomas et al 1985). Montechoa loamy sand and Bivens sand dominate the forested wetland upstream of Bivens Arm Lake. Bivens sand contains ironstone and phosphatic limestone. The presence of the phosphatic limestone is indicative of the presence of Hawthorn Group formations that are observed as outcrops in the stream channel.

The dominant land uses in the Tumblin Creek Watershed are primarily residential, commercial, and institutional. The residential

land use category includes low density single family homes and high density apartment complexes serving students at the University of Florida. The commercial property within the watershed, mostly restaurants and strip malls, is located in the vicinity of the headwaters and the area adjacent to SW 16th Avenue and U.S. Highway 441 (US 441). Institutional land uses include Shands at Alachua General Hospital (AGH), Tumblin Creek Park, and P.K. Yonge Developmental Research School at the University of Florida (P.K. Yonge School).

2.2 Watershed Description

Tumblin Creek begins approximately 100 feet north of SW 5th Ave and flows an estimated 1.7 miles southward into Bivens Arm Lake, just west of US 441 (Figure 2.2). East Tumblin Creek, also a tributary to Bivens Arm Lake, originates underground near Main Street and University

Avenue. It flows south to Colclough Pond then travels through the Kirkwood subdivision to the eastern lobe of Bivens Arm Lake. The lake discharge flows south through a dredged channel, under Bivens Dike. The discharge then sheet flows across Paynes Prairie toward Alachua Sink, which discharges to the Floridian aquifer system. ACEPD personnel performed four stream surveys on this creek. A detailed description of each section is given.

2.2.1 Headwaters

The headwaters extend north from SW 5th Avenue to NW 8th Avenue, west to NW 13th Street, and southeast to Main Street and are channelized through underground concrete culverts. Sources of baseflow include springs and seeps at the base of the surficial aquifer and, lower in the basin, permeable units within the intermediate aquifer system.

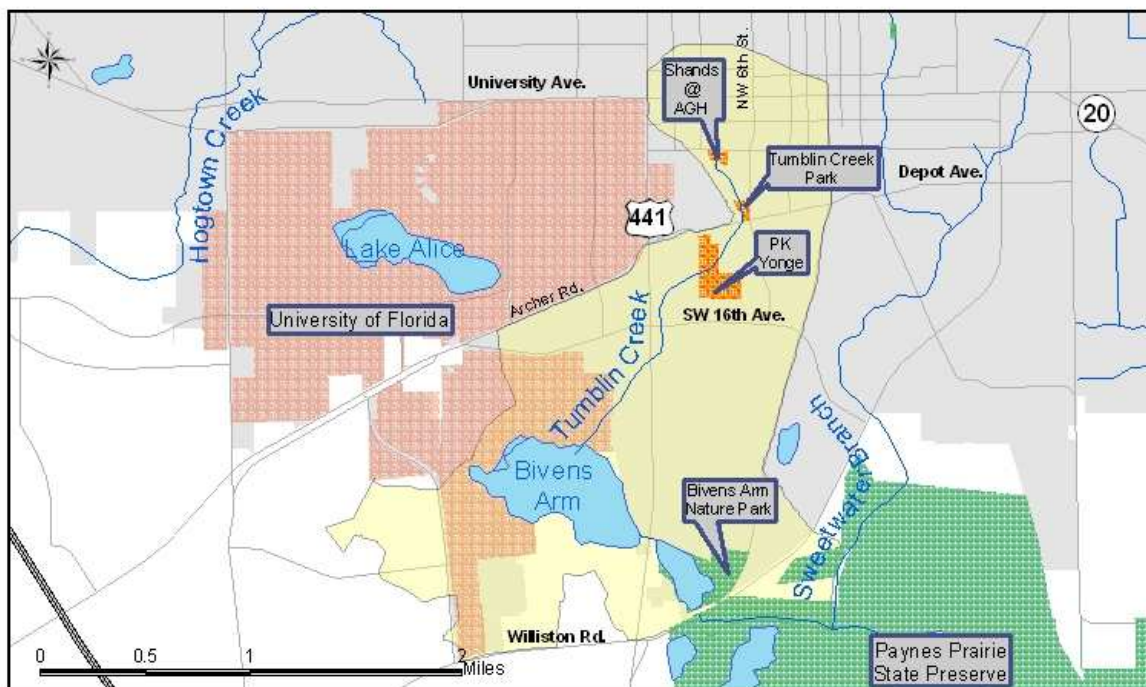


Figure 2.2 Notable features in the Tumblin Creek Watershed

2.2.2 Shands at AGH to Depot Avenue

The stream emerges from a 60-inch reinforced concrete pipe (RCP) culvert at the southern end of the Shands at AGH parking area. (Fig. 2.2). The stream flows south through a residential area that includes St. Croix Apartments and several single-family homes. At the end of SW 7th Terrace, a 72-inch RCP culvert provides a second source of baseflow to Tumblin Creek. A large deep pool at the base of this culvert, formed by erosion processes, indicates the large volumes of water the culvert inputs to Tumblin Creek during storm events. This confluence occurs at the north end of Tumblin Creek Park, located on the corner of SW 6th Street and Depot Avenue. The stream has eroded the banks in the park, exposing landfill debris which includes glass bottles that appear to date from the early 1900's.



Tumblin Creek at the 60-inch culvert at Shands at AGH just north of SW 5th Avenue

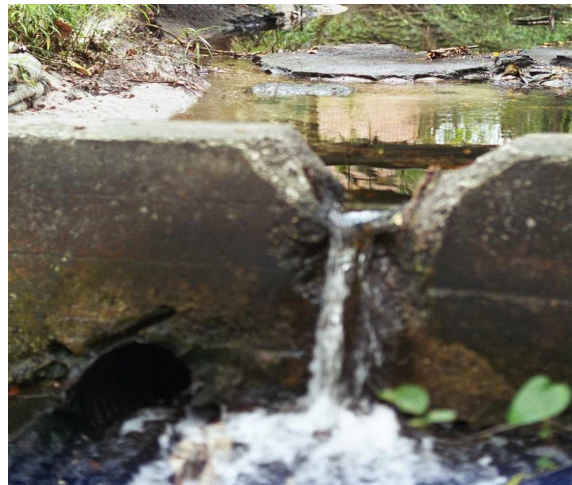
2.2.3 Depot Avenue to P.K. Yonge

As the stream continues south, it flows under Depot Avenue where it is severely channelized and turns 90° toward the west for approximately 300 feet. This unnatural sharp turn has caused tremendous erosion. The stream becomes slightly more sinuous

as it flows southwest through a residential area and crosses under SW 9th Street before reaching the campus of P.K. Yonge School.

2.2.4 P.K. Yonge to SW 16th Avenue

Tumblin Creek flows through the middle of the P.K. Yonge campus. Bank stability is a problem in this area. Two concrete weirs were constructed in the creek in an attempt to direct the majority of flow to the channel's center. These weirs do not appear to solve the problem however, as bank scouring is still obvious. The stream continues flowing southwesterly through a residential and commercial area. The stream channel is deeply incised and the banks are steep. Evidence of bank scouring is common. The creek continues flowing south under SW 16th Avenue.



Flow control weir on Tumblin Creek at the P.K. Yonge Developmental Research School

2.2.5 SW 16th Avenue to Bivens Arm

The creek emerges beneath SW 16th Avenue in a concrete-lined channel that continues west under US 441 through box culverts. The concrete channel and larger culverts under US 441 were installed in 1969 to increase the stream velocity, thus alleviating the flooding problems of the

highway (Rankeillor 2000). Several hundred feet west of US 441, the concrete channel ends and the stream flows southwest through a dredged channel to the Bivens Arm forested wetland before entering Bivens Arm Lake.



Tumblin Creek flowing through a concrete channel behind Subway at US 441

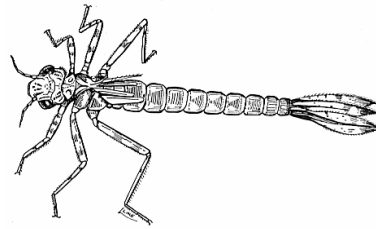
2.2.6 East Tumblin Creek

East Tumblin Creek originates in an area west of Colclough Pond and enters Bivens Arm Nature Park from the north, flowing into a small marsh. The stream is intermittent, flowing only during and after storm events. The stream is channelized through Bivens Arm Nature Park.

2.3 Physical Habitat and Biology

Most of Tumblin Creek lacks adequate habitat to support a diverse benthic macroinvertebrate community. Sand smothering, low quality substrate, and channelization are all responsible for the poor macroinvertebrate community found in the creek.

Historical data from Hester Dendy sampling in 1996 showed that Tumblin Creek had the lowest diversity of macroinvertebrate organisms compared to all



Damselfly (*Argia* spp.), a common macroinvertebrate species in Tumblin Creek

other streams sampled in Alachua County (Evans 1996).

Productive habitats for macroinvertebrates in Tumblin Creek (i.e. woody debris or snags, leaf packs/mats, rock/shell rubble, undercut banks/roots, and aquatic vegetation) averaged only about 10% in coverage, based on stream habitat surveys. Under optimal conditions productive habitats would total 30% coverage or more. Over half of the stream habitat was smothered with a sand layer ranging from 0.6 to over 3 feet deep.

BioRecons were completed at four sites on Tumblin Creek in 1999 and 2000 (FDEP 1999; Line et al. 2000). The average BioRecon results (Table 2.1) and Habitat Assessment scores (Figure 2.3) all indicate impaired conditions. Results at the four monitored sites are described.



Macroinvertebrate sampling as part of the BioRecon studies on Tumblin Creek at US 441

Table 2.1 Average BioRecon scores for four sites on Tumblin Creek

Metric	Target Value	SW 5 th Ave.	PK Yonge	US 441	Flood plain
Taxa Richness	≥ 18	8	9	14	13
EPT	≥ 4	0	0	0	0
FL Index	≥ 10	2	2	3	4
Metrics Passed		0	0	0	0
Biological Condition		All Sites Impaired			

2.3.1 SW 5th Avenue

Tumblin Creek at SW 5th Avenue scored an average of 89, or 56%, of the total possible score on the Habitat Assessments. It received low scores in the water velocity, riparian buffer zone width, and vegetation quality categories. The overall score would have been even lower if the concrete rubble in the streambed, a decidedly unnatural element, had not been considered a potential substrate for macroinvertebrates. The extremely low BioRecon scores further substantiated the impaired status.

2.3.2 P.K. Yonge School

Habitat Assessments at this site resulted in an average score of 81, or 51%. It also received low scores due to slow water ve-



Concrete rubble in Tumblin Creek at P. K. Yonge School

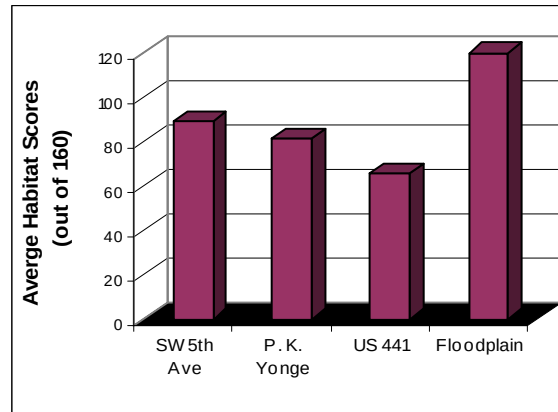


Figure 2.3 Average Habitat Assessment scores for four sites on Tumblin Creek

locity, lack of a sufficient riparian zone, and poor quality of vegetation in the riparian zone. This site also has concrete rubble in the streambed, implying the Habitat Assessment score might have been even lower if the rubble had not been considered habitat. BioRecon scores were similarly very poor at this site, indicating an impaired status.

2.3.3 US 441

This site received the lowest average Habitat Assessment score of 66, or 41%, of the total possible points. Low scores were received in the following habitat characteristic categories: substrate availability, habitat smothering, artificial channelization, bank stability, riparian zone width, and riparian vegetation quality. Due to these factors, a diverse macroinvertebrate population could not be supported in this degraded stretch of creek as proven by the impaired BioRecon rating.

2.3.4 Bivens Arm floodplain

Tumblin Creek, as it flows through the Bivens Arm floodplain, had the highest average Habitat Assessment score (120) of all sites on Tumblin Creek. However, it too was characterized impaired by the



Bivens Arm forested wetland

BioRecon. The primary cause for the impairment is extensive sand smothering.

These results indicate that the habitat quality in Tumblin Creek is impaired, and not of sufficient quality to support a healthy macroinvertebrate community. In the upper reaches, the majority of the streambed is covered with rubbish including concrete debris, bricks, and glass. The lower reaches of Tumblin Creek are almost completely smothered with sand. The intense urbanization of this watershed will make habitat improvement and restoration efforts difficult and costly.

2.4 Pollution Sources

Throughout the study of Tumblin Creek, it became apparent that numerous pollution sources, both point and nonpoint, affect the watershed. Several undocumented discharges were discovered during the stream survey, some of which have since been corrected.

2.4.1 Point sources

Several point source discharges to Tumblin Creek were observed throughout the watershed (Figure 2.4). Municipal sewer lines sometimes run under, parallel to, and

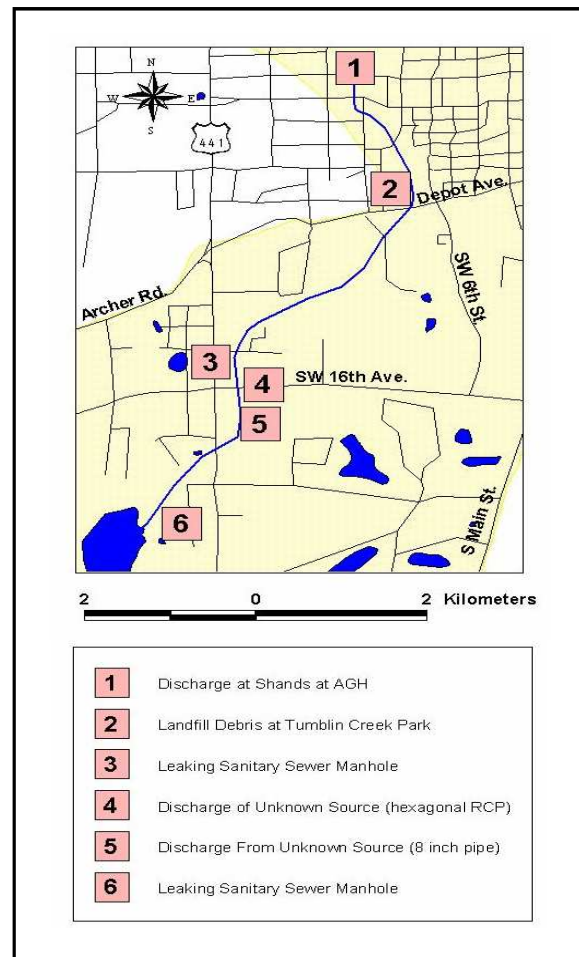


Figure 2.4 Point source pollution sites along Tumblin Creek

across Tumblin Creek in certain segments. Near SW 5th Avenue, a sewer line runs below the creek bed and parallel to the channel. It crosses the creek at St. Croix Apartments. At SW 9th Street, a lift station is located within 10 feet of the stream. As the channel parallels SW 13th Street (US 441), a sewer line runs adjacent to the creek. Finally, west of US 441, several manholes along the south bank indicate the presence of a sewer line running toward the forested floodplain. Most of the sanitary sewage in this area is transported to the Gainesville Regional Utilities (GRU)

Main Street Water Reclamation Facility (WRF). A small portion of the area, including the P.K. Yonge School, is served by the University of Florida Water Reclamation Facility.

Two GRU sanitary sewer manholes were discovered leaking directly into Tumblin Creek at the time the stream survey was conducted. These leaks were the result of sewage backing up through manholes due to blockages in the lines. The first leaky manhole was located behind Joe's Deli on US 441. The second was found west of US 441, along the dredged channel just upstream of the forested wetland. In both cases, GRU was notified immediately and repairs were made. GRU has recently completed a wastewater collection system integrity testing program in both the Tumblin Creek and Sweetwater Branch Watersheds. This program is part of a larger effort to inspect all of GRU's sewer facilities and perform rehabilitation or repairs as needed to ensure the integrity of the system. The testing program includes smoke testing, dye testing, and closed circuit TV viewing of the insides of the sewer piping to identify potential leaks and damage to the system.



Sign along Tumblin Creek warning of a sewage leak

During a sampling event on Tumblin Creek near Shands at AGH, ACEPD personnel observed the Tumblin Creek water turned a rusty red color. The source was found to be the hospital. Shands at AGH personnel were washing out their fire lines and the discharge was flowing down a storm drain and into the creek. The hospital was asked to discharge these waters to the city sewer in the future.

Two continually flowing pipes were also discovered feeding Tumblin Creek during severe drought conditions. Both were located south of SW 16th Avenue. The first discharge came from a hexagonal RCP under SW 16th Avenue. The source was unknown but the water appeared to be clean. The second discharge was located on the east bank of the creek just south of Pat's Quick Stop parking lot (off of US 441/SW 13th Street). The flow from this 8-inch pipe almost doubled the flow in Tumblin Creek, with water constantly flowing out at a high velocity. ACEPD collected a water sample for analysis. The water quality was representative of water from



Continually flowing discharge into Tumblin Creek near the parking lot off of SW 16th Avenue

the Floridan aquifer. The discharge was later determined to be cooling water from a heating and cooling system at Park 16 Apartments. The discharge, estimated to be over 1.0 MGD, ceased in April 2002 when the apartment complex installed a new heating and cooling system.

In Tumblin Creek Park, the stream has eroded the banks, exposing landfill debris including glass, brick material, and pottery pieces. Several deep holes along the east bank are evidence of the bottle looting that takes place here.



Evidence of bottle looters at Tumblin Creek Park

2.4.2 Nonpoint sources

Over 60% of the Tumblin Creek watershed has impervious surfaces. Stormwater runoff is therefore a major pollution concern. Many of the stream segments in Tumblin Creek lack an effective riparian buffer. This combination of large areas of impervious surfaces along with the absence of riparian buffers allows fertilizer and pesticide runoff to flow directly to the creek. Street stormwater containing petroleum products, antifreeze, and sediments washes directly into Tumblin Creek

during rain events. In addition, dumpsters line the east bank of the creek as it parallels US 441. Holes in the dumpsters allow rainwater to percolate through the contents, and spillways permit this leachate to flow directly to the creek.

Another pollution concern for Tumblin Creek is the consistent high levels of fecal coliform bacteria present. Despite ACEPD locating and correcting two leaking manholes, the high bacterial numbers persist. There has been an extensive investigation by ACEPD to determine the source of these high levels, but at this time no positive identification has been made. Possible sources include runoff from animal and human activity, leaking septic tanks, leaking sanitary sewer lines, and failing private connections to the city's sewer lines. ACEPD and GRU are planning additional work to assess the potential source(s) of the fecal coliform bacteria in Tumblin Creek.

2.5 Baseflow Water Quality

ACEPD personnel have sampled three sites on Tumblin Creek on a monthly basis: at SW 5th Avenue, at US 441, and at SR 331 (Williston Road). Water quality characteristics at these sites are described.

2.5.1 Field parameters

Parameters measured in the field include water temperature, specific conductance, pH, dissolved oxygen, and turbidity. Tumblin Creek at US 441 (TUM441) and at SR 331 (TUM331) had the highest median water temperature (23.2°C and 23.8°C respectively) of all streams monitored for at least one year in this study (Table 2.2). This is likely caused by the lack of a riparian canopy in the urbanized downstream part of the watershed, the amount of impervious

Table 2.2 Comparison of median values for field parameters among the three sites monitored on Tumblin Creek

Parameter	TUMSW5	TUM441	TUM331
Water Temp (°C)	21.1	23.2	23.8
pH (SU)	7.56	7.61	6.88
Sp. Cond. (µS/cm)	447	469	227
Turbidity (NTU)	1.2	1.9	2.0
DO (mg/L)	5.75	8.91	2.13

area (above TUM441), and warming of the water in Bivens Arm before flowing downstream to TUM331.

The median specific conductance values for TUMSW5 and TUM441 were 447 and 469 µS/cm respectively. These conductivity levels were the highest recorded for all streams in this study, except for Sweetwater Branch downstream of the GRU Main Street WRF (Table 4.2). These high conductivities may be partially caused by groundwater discharges from the Floridan aquifer into the stream.

The median pH value for sites in Tumblin Creek upstream of Bivens Arm is 7.61, which is similar to other streams monitored in this study. The pH in Tumblin Creek below Bivens Arm (TUM331) was lower, with a median value of 6.88. This reduced pH is caused by the stream flowing through a wetland area (the marsh east of 441), and as such, is similar to pH values in Little Hatchet Creek.

Dissolved oxygen (DO) showed high variability in Tumblin Creek (Figure 2.5). The lowest DO of all sites monitored in this study occurred at TUM331, with a median

concentration of 2.13 mg/L. DO is likely reduced as Tumblin Creek flows through the wetlands upstream of TUM331. In contrast, one of the highest DO values in this study occurred on Tumblin Creek at US 441, with a median value of 8.91 mg/L. The DO in the upper part of the watershed, at TUMSW5, was 5.75 mg/L, somewhat lower than the majority of the urban streams in this study.

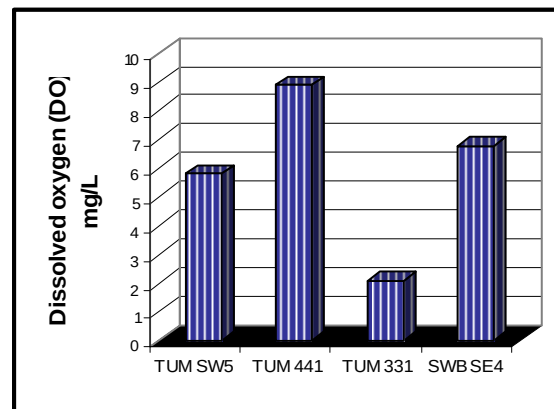


Figure 2.5 Comparison of median dissolved oxygen (DO) concentrations for the three sites on Tumblin Creek and Sweetwater Branch at SE 4th Street

2.5.2 Nutrients

Total nitrate plus nitrite concentrations ($\text{NO}_x\text{-T}$) in Tumblin Creek were relatively low compared to other urban stream sites. The median $\text{NO}_x\text{-T}$ concentration below Bivens Arm was 0.020 mg/L, similar to levels in the forested wetlands of Little Hatchet Creek. $\text{NO}_x\text{-T}$ concentrations upstream of Bivens Arm were substantially higher (0.109 and 0.198 mg/L at TUM441 and TUMSW5 respectively), but these levels were lower than most of the other urban streams in this study.

Total phosphorus (TP-T) levels in Tumblin Creek were relatively low at all sites (Figure 2.6). Median concentrations were similar to those observed in Sweetwater

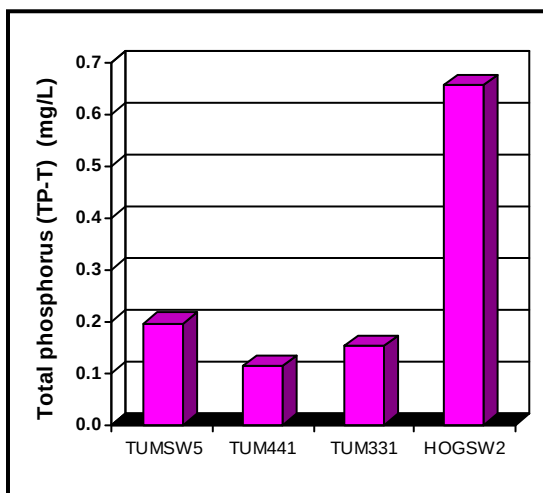


Figure 2.6 Comparison of median total phosphorus (TP-T) concentrations for the three sites on Tumblin Creek and Hogtown Creek at SW 2nd Avenue

Branch upstream of the GRU Main Street WRF, but were substantially lower than total phosphorus concentrations observed in Possum Creek and Hogtown Creek.

Total ammonia ($\text{NH}_4\text{-T}$) concentrations in Tumblin Creek were higher than almost all other sites in this study. Median total ammonia concentrations in the upper part

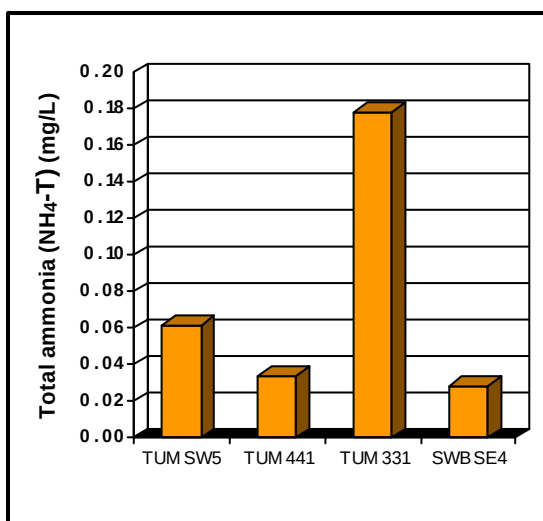


Figure 2.7 Comparison of median total ammonia ($\text{NH}_4\text{-T}$) concentrations for the three sites on Tumblin Creek and Sweetwater Branch at SE 4th Street

of the watershed, at TUMSW5, were 0.062 mg/L (Figure 2.7) which is higher than all other urban stream sites except for Sweetwater Branch at NE 10th Avenue. The median total ammonia concentration further downstream at TUM441 was 0.034 mg/L. Median total ammonia concentrations on TUM331, below Bivens Arm, was 0.178 mg/L, the second highest concentration observed in this study. These high concentrations are likely caused by the downstream transport of organic nitrogen compounds from Bivens Arm, which are converted to ammonia by biologic processes in the wetland.

2.5.3 General chemical constituents

Total organic carbon (TOC) concentrations in Tumblin Creek, upstream of Bivens Arm, were the lowest of all sites monitored in this study. Dissolved organic carbon (DOC) compounds dominated the composition of total organic carbon at these sites.

Median alkalinity concentrations at both TUMSW5 (153.8 mg/L) and at TUM441

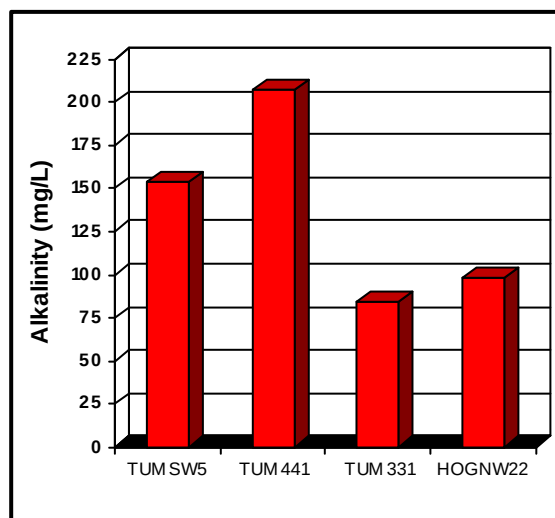


Figure 2.8 Comparison of median alkalinity for the three sites on Tumblin Creek and Hogtown Creek at NW 22nd Street

(206.8 mg/L) were substantially higher than all other sites in this study (Figure 2.8). High alkalinities indicate the presence of a high concentration of inorganic carbon (Manahan 1984). In addition, the high alkalinity at TUM441 may have been influenced by the two discharges from the Floridan aquifer.

2.5.4 Coliform bacteria

From a human health standpoint, the consistently high levels of fecal coliform bacteria found in Tumblin Creek are the most important water quality concern in the watershed (Figure 2.9). The Class III water quality standards allow for a one time maximum of 800 colony forming units (CFU)/100mL, and a monthly average no greater than 200 CFU/100mL (FDEP 1996a). Sites throughout the Tumblin Creek Watershed all failed to meet this standard and, in some cases, have had levels several orders of magnitude higher than the standard.

In August 2000, ACEPD contracted with the University of South Florida to conduct bacterial source tracking (BST) studies using antibiotic resistance analysis (ARA), and with BCS of North Florida, Inc. to do BST studies using the ribotyping method. These studies were focused on determining the source of the fecal coliform bacteria. Results indicate lower concentrations of fecal coliform bacteria overall in 2002 and less contamination from human sources in 2002 than samples obtained in 2000 and 2001 (Harwood, 2003a).

2.6 Stormwater

Several storm events were monitored for water quality changes in Tumblin Creek during 2000 and 2001 by ACEPD person-

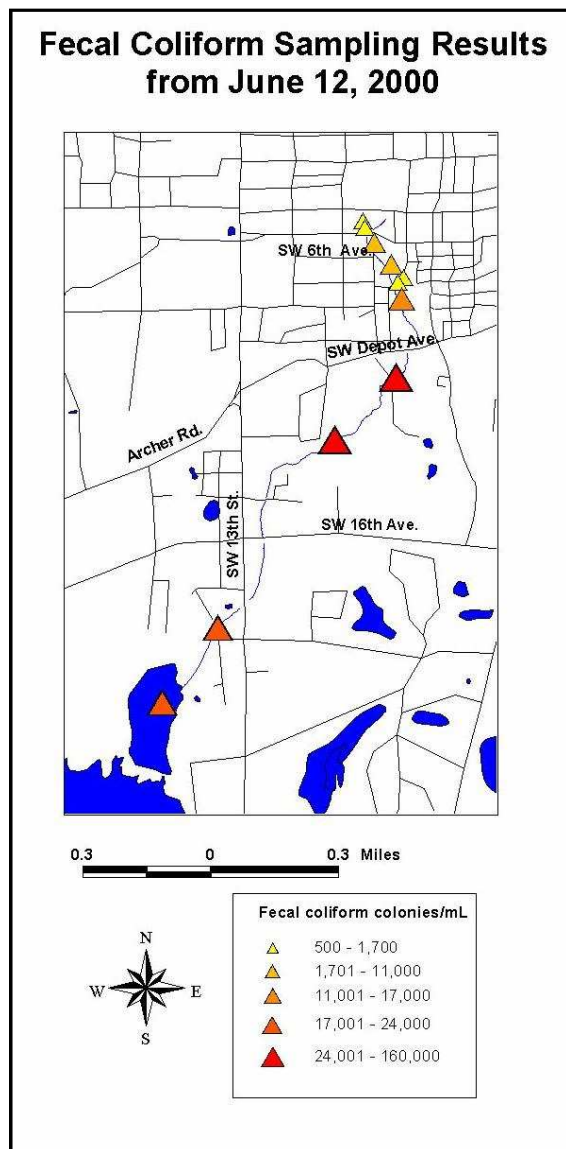


Figure 2.9 Fecal coliform bacteria sampling results in the Tumblin Creek Watershed from June 12, 2000

nel at TUM441 and TUM331. While significant water quality changes occurred at TUM331, downstream from Bivens Arm, the changes in stormflow water quality were most dramatic at TUM441 for all parameters. Both Bivens Arm and the downstream wetlands that Tumblin Creek flow through mute the changes in stormflow water quality that occur further upstream.

Total suspended solids (TSS) increased by 1,800% at TUM441 during stormflow, compared to median baseflow concentrations (Figure 2.10). This was the second highest percent increase in TSS of all sites monitored in this study; only Possum Creek showed a higher increase in TSS. Median TSS concentrations during stormflow periods were 59 mg/L, compared to the median concentration of 5 mg/L during baseflow periods.

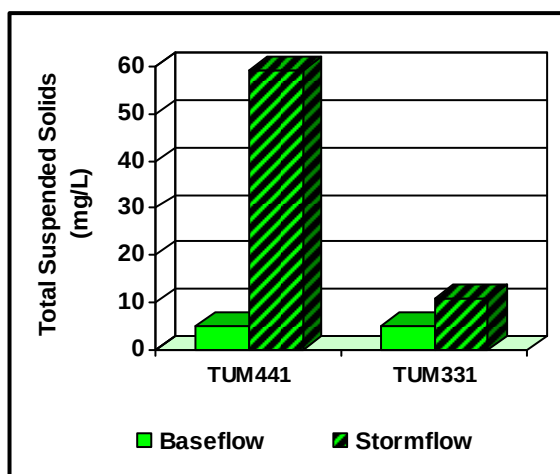


Figure 2.10 Increase in total suspended solids (TSS) during stormflow compared to baseflow periods in Tumblin Creek

Total organic carbon (TOC) increased by 215% (from a median value of 3.20 to 10.09 mg/L) at TUM441 during stormflow periods. This was the highest percent increase in TOC of all sites monitored in this study.

All forms of nutrients, including nitrogen and phosphorus species, increased dramatically at TUM441. Total ammonia ($\text{NH}_4\text{-T}$) and total nitrogen (TN-T) showed the highest percent increases, 462% and 507% respectively, of all sites monitored in this study (Figure 2.11). Median total ammonia values increased from 0.034 to 0.191 mg/L, while median total nitrogen

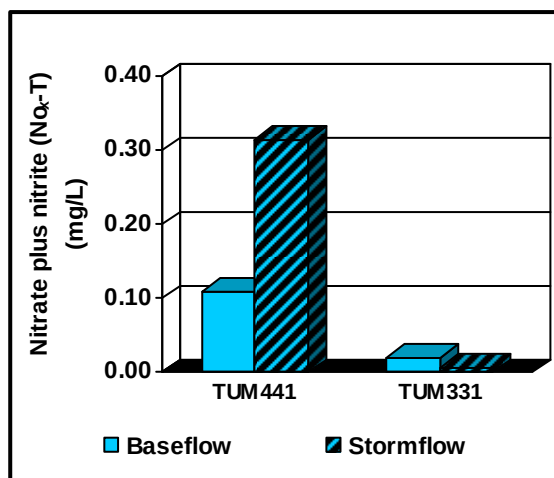


Figure 2.11 Increase in total nitrate plus nitrite ($\text{NO}_x\text{-T}$) during stormflow compared to baseflow periods in Tumblin Creek

values increased from 0.365 to 2.216 mg/L. Total nitrate plus nitrite ($\text{NO}_x\text{-T}$) concentrations at TUM441 had the third highest percent increase, 189% during stormflow conditions, off all monitored sites during stormflow conditions (median value increase from 0.109 to 0.315 mg/L).

The increase in total orthophosphate ($\text{PO}_4\text{-T}$) during stormflow at TUM441, from 0.065 to 0.150 mg/L, was the highest percentage increase, 131%, of all sites

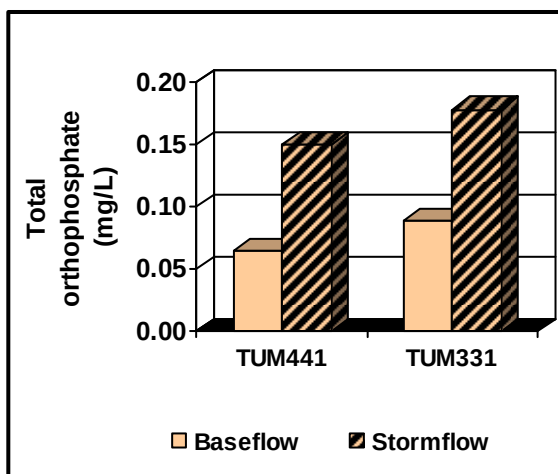


Figure 2.12 Increase in total orthophosphate ($\text{PO}_4\text{-T}$) during stormflow compared to baseflow periods in Tumblin Creek

monitored (Figure 2.12). Total phosphorus (TP-T) at TUM441 had the second highest percent increase, 389%, of all sites in this study (from 0.114 to 0.557 mg/L).

These dramatic increases in total suspended solids, total organic carbon, nitrogen, and phosphorus reflect the highly urbanized nature of this watershed, which includes large areas of impervious surfaces. Surface runoff into Tumblin Creek is significant. Increased stormflow volumes and velocities contribute to greater erosion by widening and deepening the stream channel, resulting in increased suspended sediment in stormflow.



Stormflow on Tumblin Creek at US 441

The proximity of the stream banks and streambed to the highly phosphatic Hawthorn Group formations increases the transport of phosphorus during stormflows. Runoff from fertilizers used in maintaining landscapes, animal waste, leakage from failing septic tanks, sewer lines, and private sewer line connections may further contribute to the increased nitrogen and phosphorus concentration during stormflow.

2.7 Ecosystem Health

Tumblin Creek was once a sinuous stream with the twists and turns typical of a natural watercourse. Today the stream is drastically altered, and the health of the Tumblin Creek Watershed is continually degrading. The majority of the understory vegetation surrounding the creek is exotic and in some cases invasive. This has contributed to increased velocities during rain events causing severe erosion problems.

2.7.1 Biological Integrity

The width of riparian buffer along Tumblin Creek varies from zero in the more urbanized stretches to greater than 60 feet in the forested wetland. Except for the concrete and dredged channel segments, most of the creek displays a moderately shaded canopy. Many of the large trees along the stream are native and include water oak (*Quercus nigra*), sweetgum (*Liquidambar styraciflua*), cabbage palm (*Sabal palmetto*), and loblolly pine (*Pinus taeda*). Camphor tree (*Cinamomum camphora*), although not native, is also common in the watershed. Several tree species such as camphor and water oak are considered “weedy” and are not indicative of a high quality overstory.

The quality of the understory vegetation along the creek can be described as poor. Many non-native, invasive species inhabit areas once dominated by native understory plants. Mexican petunia (*Ruellia brittoniana*), both non-native and invasive, is the dominant plant seen along the stream’s edge. Glossy privet (*Ligustrum lucidum*) and coral ardisia (*Ardisia crenata*), both of which are invasive, are quite common near the stream channel. The presence of certain opportunistic native

plants such as southern elderberry (*Sambucus canadensis*) and Carolina willow (*Salix caroliniana*) further characterize the disturbed nature of the watershed. These disturbed plant communities can alter soil characteristics, affect animal populations, and change the ecology of an area (Drummond 2000).

Aquatic vegetation, both submergent and emergent, is practically non-existent through-out Tumblin Creek. The exception is the Bivens Arm forested wetland which, in some places, is covered with the native wetland emergent plant golden club (*Orontium aquaticum*). However, there is also a large amount of exotic vegetation present in this reach.



Exotic vegetation in the Bivens Arm forested wetland

Despite the degraded conditions in Tumblin Creek, the stream corridor does support some native wildlife. Birds such as the red-bellied (*Melanerpes carolinus*) and red-headed (*Melanerpes erythrocephalus*) woodpeckers, barred owls (*Strix varia*), and red-tailed hawks (*Buteo jamaicensis*) have been seen on numerous occasions near the Tumblin Creek Park. Belted kingfishers (*Ceryle alcyon*) travel

the stream channel between Depot and SW 16th avenue. The Bivens Arm forested wetland supports the most diverse wildlife in the basin, including osprey (*Pandion haliaetus*), hawks, and alligators (*Alligator mississippiensis*).

2.7.2 Physical Integrity

Near Shands at AGH, the streambed is comprised of concrete slabs that carry the flow of water south from SW 5th Avenue. Just south of Depot Avenue, the creek is forced to take a 90° turn to the west and shortly after that, a 90° turn south. The most extreme case of channel modification begins on the south side of SW 16th Avenue, where the stream is channelized and the streambed is lined with concrete. The concrete ends west of US 441 where the creek opens up to a wider dredged channel.

These modifications have been detrimental to the health of Tumblin Creek. Channelization has increased water velocity, thereby increasing sediment erosion, particularly during high flow conditions. Sharp, unnatural turns have caused serious bank erosion. These stream channel alterations are a primary concern for the Tumblin Creek Watershed.

The concrete-lined channel, in the stream segment between SW 16th Avenue and US 441 was installed in 1969 to increase the flow of water under US 441, with the intent to curb flooding problems (Rankeillor 2000). However, this also increased water velocity upstream of the channel, leading to severe vertical streambed erosion. Downstream of the P.K. Yonge School, the streambed has been eroded approximately 5 feet since the concrete channel was installed at US 441 (Simons 1999). Sewer and gas lines, set several feet under the



Sanitary sewer and gas lines that were originally laid below the streambed of Tumblin Creek

streambed, now lie two to three feet above the bed. Under current conditions, the streambed will continue to erode.

The increase in stream velocity is most destructive during rain events. Fragile banks are scoured, sending more sediment downstream. Scouring results in a stream channel that is constantly widening and deepening in some areas. Officials at the P.K. Yonge School have been addressing this problem as the creek bisects the campus. Two weirs were constructed in an attempt to concentrate flow to the middle of the chan-



Tumblin Creek bank failure at PK Yonge School

nel and minimize bank scouring. Concrete debris has been placed along the banks to increase stability. Despite these efforts, the banks continue to erode. Presently, there are concerns about the long-term structural stability of some of the buildings adjacent to the creek.

Sediment eroded from the streambed and banks during storm events turns the water gray. This increased turbidity affects light penetration, impairs fish spawning, and clogs gills of fish and aquatic invertebrates. The sediment is carried downstream and deposited in the dredged channel west of US 441 and in the Bivens Arm floodplain. Sand deposition in these areas can reach depths greater than three feet. Habitat for benthic macroinvertebrates is smothered, and the soft sand bottom is incapable of supporting rooted vegetation.



Sand deposition in the dredged channel of Tumblin Creek west of US 441

2.8 Hydrology

Stream flow data were collected extensively on Tumblin Creek at both TUM441 and at TUM331. The mean streamflow at TUM441 is 1.6 cubic feet per second (cfs), while it is 2.6 cfs further downstream at TUM331 (Appendix F). It should be noted that although the mean

flow for TUM331 is higher than TUM441, the prior site is characterized by intermittent flow, while the later flows continually through the seasons. The maximum streamflow measured during the nearly four year period of record was 35.1 cfs at TUM441 and 69.4 cfs at TUM331.

The mean flows in Tumblin Creek are the lowest of all urban streams in Gainesville. Stormflows were higher than those on Possum Creek, but substantially less than those on both Sweetwater Branch and Hogtown Creek.

Flow at TUM441 is less than 0.5 cfs approximately 11% of the time, while it is less than 0.5 cfs at TUM331 about 22% of the time, based on the flow exceedance curves in Appendix G. Stormflows, indexed here as those flows exceeded only 5% of the time over the period of record, were 4.5 cfs at TUM441 and 10.7 cfs at TUM331.

These higher stormflows at TUM331 reflect the additional storm runoff entering Bivens Arm from sources other than Tumblin Creek and the storm runoff entering Tumblin Creek downstream of Bivens Arm. In contrast, baseflows below 0.5 cfs occur more frequently at TUM331 because of flow attenuation by Bivens Arm Lake.

2.9 Summary

The Tumblin Creek Watershed is highly urbanized and almost completely developed. Much of this development occurred prior to the implementation of state and local requirements for stormwater management. Significant areas of the watershed have impervious surfaces. During rain events, high volumes of water flow

into storm drains leading directly to the creek. Stormwater retention is almost non-existent since the basin lacks large plots of available space. Rainfall that previously soaked into the soils and slowly migrated into the creek as lateral seepage or small springs, now flows unimpeded into the creek.

The overall restoration goals for the Tumblin Creek Watershed are:

- Decreasing bank and streambed erosion
- Controlling streambed sediment deposition
- Restoring riparian buffer zones and native riparian vegetation
- Restoring in-stream habitat quality
- Enhancing stream water quality
- Improving stream corridor aesthetics

The primary restoration need in the watershed is improved management of stormwater. Both stormwater volume and stream channel velocities need to be decreased. Reducing peak stormflow volumes and velocities will reduce stream bank and streambed erosion and will subsequently reduce downstream sediment deposition and the resulting habitat smothering. Reductions in sediment erosion and deposition will improve the quality of streambed habitat for benthic macroinvertebrate populations. Major restoration strategies for Tumblin Creek will require significant capital investments, extensive engineering designs, and considerable land area.

These restoration strategies are grouped into five categories:

- Property acquisition to increase natural buffer widths along the stream corridor and retain remaining natural forested lands within the watershed
- Addition of stormwater retention basins for water storage to attenuate the volume and rate at which stormwater enters the creek
- Construction of treatment wetlands and the restoration of historic wetlands to improve water quality as well as decrease flow rates
- Replacement of existing impervious surfaces with alternative materials such as porous pavement or vegetation
- Removal of landfill materials in Tumblin Creek Park and concrete rubble and debris used in many areas for erosion abatement

The channelized area in the vicinity of US 441 and SW 16th Avenue is also in critical need of restoration. The existing concrete channel is becoming eroded and unstable. Further downstream, on the west side of US 441, the unstable earthen berms con-

tribute to the sediment load. Both could be reconfigured to restore natural flow regimes to forested areas above Bivens Arm. Placement of a trash screen to prevent litter from accumulating in the forested wetland on the north side of Bivens Arm Lake is also important.

Public awareness of the need for restoration as well as for improving the aesthetics of the creek is critical. Area residents have shown their interest in Tumblin Creek by participating in the Tumblin Creek Work Group and in volunteer clean-ups in the watershed. Students at P.K. Yonge School are interested in learning more about water quality and finding solutions to Tumblin creek's water quality problems.

The City of Gainesville Public Works Department is planning to conduct stream restoration activities in the Tumblin Creek Watershed. During the next one to two years, a litter screen will be installed on Tumblin Creek at US 441. The City will also be contracting for consulting services to remove the berm and restore hydraulic functionality to a forested floodplain area on the west side of US 441. These efforts are critical initial steps toward restoring the Tumblin Creek Watershed.