

Technical Memorandum No. 96-

1993 MEASUREMENTS OF SHORELINE LOCATION,
WATER DEPTH AND SEDIMENT THICKNESS,
WITH NOTATIONS ON SEDIMENT CHARACTERISTICS,
IN TURKEY CREEK AND SEBASTIAN RIVER, INDIAN RIVER LAGOON

by

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INTRODUCTION

The St. Johns River Water Management District (SJRWMD) is responsible for conducting investigations that lead to improved understanding of certain bodies of water within the northeast portion of the State of Florida. In the early 1990s hydrologic studies had been initiated in Turkey Creek and Sebastian River, tributaries of the Indian River Lagoon (IRL) in Brevard and Indian River Counties. Shoreline locations on available maps, such as 7-1/2 minute U.S.G.S. (U.S. Geological Survey) quadrangle sheets at 1:24,000 scale, and local real estate maps, were found to be too inaccurate for scientific work.

In 1993 the District developed a contract to obtain more accurate measurements, than were currently available, of shoreline locations, water depth and sediment thickness in these two tributaries. This contract was negotiated with Morgan & Eklund, Inc., a land and hydrographic survey company with extensive experience in the Indian River Lagoon area. The results of Morgan & Eklund measurements and analyses were successfully reported to the District in 1994.

This report combines two separate final reports received from Morgan & Eklund, one for Turkey Creek and one for Sebastian River (Creek). The data received from Morgan & Eklund, consisting of digital shorelines, water depths, sediment thicknesses, and sediment types have been converted into several convenient formats. One of these formats is the theme for Arc-Info and Arc-View Geographic Information Systems (GIS).

This report also establishes an archive for these data. The complete Morgan & Eklund reports received for Turkey Creek and Sebastian River, except for Appendix A, the Field Survey Log, are included as two appendices (I and II) to this report.

LOCATIONS AND SURVEY AREAS

Turkey Creek is a shallow tributary on the west side of the Indian River lagoon. This basin routes runoff collected in the Turkey Creek Basin from the eastern end of the C-1 drainage canal, west of the towns of Palm Bay and Malabar, to the IRL through Palm Bay. The surveys extended from the Florida East Coast Railroad Bridge westward to structure MS-1 on canal C-1, and included the Jersey Waterway extending towards the south from Turkey Creek.

Sebastian River (also called Sebastian Creek on maps and in the literature) is another shallow tributary on the western side of the IRL, located south of Grant and the City of Sebastian, and north of the Wabasso Bridge. It is fed by runoff from watershed basins to the North, West, and South, including Canal C-54, the Fellsmere Main Canal, North Prong, and South Prong. The surveys extended from the mouth of the river at the IRL, approximately to the head of tide in the North Prong, westward to Structure S-157 on Canal C-54 and the structure on Fellsmere Main Canal, and southward several miles in the South Prong to State Road 512 Bridge.

The locations of Turkey Creek and Sebastian River are shown in Figure 1.

OBJECTIVES

The objectives of the two studies were to obtain accurate shoreline locations, water depths, and sediment thicknesses and descriptions for use in a variety of District projects. These data have since been used in many different studies, including the definition of shorelines and bathymetry for receiving water/hydrodynamic and water quality) dynamic models.

The objectives of this report are to present additional information on the Morgan & Eklund surveys, to document the data for the District's GIS system, and to provide documentation and data to District investigators, other agencies, and the public in convenient working formats.

BACKGROUND

The thickness of sediments in tributaries increases every year as a result of erosion by storms and development in the tributary basins. Some of these sediments, called "muck" in the Indian River Lagoon system, are fine-grained, partially decomposed organic material mixed with considerable amounts of silt and clay. Muck is washed into tributaries during land development and canal maintenance, entrained into the tributaries by erosion during storms, and tends to precipitate out of the water column in areas where water currents are low. The resulting shoaling can cover submerged seagrasses, causing them to die off over time, and is a concern to boaters and recreational users of the tributary. Also, muck often contains nutrients and toxic materials that are washed from the land surface, which can be resuspended from the bottom by wind and storm action. These pollutants can harm marine life and require closing of shellfish harvest areas.

Therefore, the District needs to know whether muck is present in a tributary, and its volume. The projects documented in this report provide measurements from which the District can calculate the volumes of muck deposited on the bottoms of these tributaries.

SCOPE OF WORK

In both tributaries Morgan & Eklund obtained shoreline locations by DGPS (Differential Global Positioning System), and bottom elevation, thickness of the muck layer, and descriptions of the type of muck layer by hand probes at selected locations. In addition, in the Sebastian River, but not Turkey Creek, lateral transects of water depths in the wide part of the river were conducted by recording fathometer.

Table 1. Numbers of surveyed probes, transects, and points on transects

LOCATON	# PROBES	# TRANSECTS	# POINTS
Turkey Creek	93	(none)	(none)
Sebastian River	379	39	2132

HORIZONTAL CONTROL

As described in the Morgan & Eklund reports, references of locations to horizontal survey control points were accomplished with differentially-corrected GPS (DGPS). A field check of the accuracy of the system was conducted by locating a DNR survey marker at Sebastian Inlet, and several other survey monuments in the area, with the DGPS. The horizontal accuracy of locations is estimated to be +/- 5 meters.

VERTICAL CONTROL

As described in the Morgan & Eklund reports, depths of water and muck were corrected by surveying to benchmarks with published vertical references to NGVD (National Geodetic Vertical Datum, Mean Sea Level 1929). Water surface elevations were typically corrected three times each day by local measurements of water level, which were continually changing by the action of tide, wind, and other disturbing factors.

PROCEDURES

Shoreline locations were obtained using DGPS in a boat that ran along all the shorelines as closely as it was possible to navigate. These data were conveyed to the District in AutoCAD format.

A bathymetric survey was conducted in Sebastian River using an Odom Echotrack Digital fathometer. Locations were controlled with DGPS. The locations of the fathometer transects overlaid on the shorelines of Sebastian River, as measured by Morgan & Eklund, are shown in Figure 2.

Except for the fathomer survey in the Sebastian River, bottom elevations and muck depths were obtained by inserting a pole graduated in 0.1 ft units into the bottom at selected locations. Two different individuals used the probe throughout the sampling in both tributaries, reading the probe depth to approximately 1/4 increment (0.025 ft). Wave action at the surface additionally limited the resolution and accuracy of probe readings. This procedure is described in greater detail in the Morgan & Eklund reports. The precision of probe depth measurement is estimated to be approximately +/- 0.2 ft.

ERROR CHECKS

The probe depth data from both tributaries were checked by repeating twenty stations. The return of the survey crew to the initial stations was controlled by DGPS. Results of duplicate sampling are compared in Table 2.

Table 2. Results of duplicate sampling

LOCATION	TYPE	MEAN	STD. DEV.
Turkey Creek	Water Depth	0.174	0.217
	Hard Bottom	0.650	1.047
Sebastian River	Water Depth	0.085	0.079
	Hard Bottom	0.740	1.636

The contractor concluded that "these data indicate that sampling is extremely repeatable ..." (Turkey Creek, p. 17).

PROBE RESULTS

As reported by Morgan & Eklund, the bottom elevations in Turkey Creek ranged from 0.5 to 12.6 ft, with a mean of 3.9 ft NGVD. Water depths were generally greater in the southern part near the Melbourne-Tillman (C-1) Canal.

"The thickness of the muck layer overlying stations sampled in Turkey Creek ranged from 0 to 14.4 ft with a mean of 5.6 ft. In many locations throughout Turkey Creek muck layers are covered with a thin veneer of coarse sand ranging from 0.3 to 4.0 ft. The thickness of the muck layer generally appears greater at stations located in the northern portions of Turkey Creek nearer the Indian River Lagoon. In the southern portion of the study area bottom sediments are predominantly sand with very little muck." (M&E, Turkey Creek, 1994, p. 10).

The locations of probe depths overlaid on the shorelines of Turkey Creek are shown in Figure 3.

As reported by Morgan & Elkhund, the bottom elevations in Sebastian River ranged from 0.5 to 16.7 ft, with a mean of 5.4 ft NGVD. Water depths were generally greater in the northern part of the study area near the IRL.

"The thickness of the muck layer overlying stations sampled in the Sebastian Creek ranged from 0 to 13.6 ft with a mean of 5.4 ft. In a few locations throughout the Sebastian Creek muck layers are covered with a thin veneer of coarse sand overlying muck layers ..." (M&E, Sebastian Creek, 1994, p. 9).

The locations of probe depths overlaid on the shorelines of Sebastian River are shown in Figure 4.

DATA ARCHIVE

The data delivered by Morgan & Elkhund were coded in ASCII and/or in AutoCAD ".dxf" formats. They were organized into several groups:

1. Tables of locations of probes, in terms of probe number, latitude, longitude, northing and easting in state plane coordinates (Florida East Zone, NAD27)(ASCII, Appendix B)
2. Tables of uncorrected depth data, in terms of probe number, water elevation (ft), bottom elevation (ft below surface), and hard bottom elevation (ft below surface) (ASCII, Appendix C)
3. Tables of corrected depths of probes, in terms of probe number, bottom elevation (ft below surface), hard bottom elevation (ft below surface), muck depth (ft), and sediment description (Table 2). The latter is further described as:
 - (a) muck, with individual descriptions of type and thickness of sand on top of muck in some cases)
 - (b) coarse sand
 - (c) hard sand
 - (d) sand bottom
 - (e) silty sand
 - (f) soft sand
 - (g) hard rock
 - (h) sand bottom
4. Bottom elevation by fathometer on transects (Sebastian River only)
5. Shoreline location by GPS in state plane coordinates.

The District found that these data could be reorganized into a more useful form for AutoCAD and GIS applications. In the process, the District created coordinates in the UTM (Universal Transverse Mercator) system to conform with new standards for District GIS, for the Arc-Info GIS. Depths remain in feet, since this is the common unit for engineering analysis and can be easily converted to meters by users.

The following files have been created for distribution with this report. All point locations are in Florida State Plane Coordinates, East Zone, NAD27:

1. Turkey Creek Data
 - a. Shorelines:
 1. Coordinates in AutoCAD format (ASCII file name "tcsshore.dxd")
 2. Coordinates in Arc export format (Arc file name "tcsshore.e00")
 - b. Probe locations and depths:
 1. All original (uncorrected) data combined into a single file with probe coordinates, bottom elevation, hard bottom elevation, muck depth, and sediment description (ASCII file "trk93mor.dat").
 2. Probe coordinates, bottom elevation and muck depth only (ASCII file "trk93.dat").
 3. Probe coordinates, bottom elevation, muck depth, and muck description, (ASCII file "trk93ano.dat").
 - c. Probe locations and depths as a point coverage in Arc export format. Including probe number, probe ID, probe coordinates, bottom elevation (ft), and muck depth (ft) (Arc file name "tprobe.e00").
2. Sebastian River Data:
 - a. Shorelines:
 1. Coordinates in AutoCAD format (ASCII file name "sebshore.dxd")
 2. Coordinates in Arc export format (Arc file name "sebshore.e00")
 - b. Probe locations and depths:
 1. All original (uncorrected) data combined into a single file with probe coordinates, bottom elevation, hard bottom elevation, muck depth, and sediment description (ASCII file name "seb93mor.dat")
 2. Probe locations, bottom elevation, and muck depth (ASCII file name "seb93.dat")
 3. Probe locations, bottom elevation, muck depth, and muck description (ASCII "seb93ano.dat")
 - c. Probe location and depth as a point coverage in Arc export format, including probe number, probe ID, probe location, bottom elevation (ft), and muck depth (ft) (Arc file name "sebprobe.e00").
 - d. Transect point location and depth as a point coverage in Arc export format, including point number, point ID, point location, and bottom elevation (ft) (Arc file name "sebbath.e00").

CONCLUSIONS

The surveys described in this report have provided vital information on the depths of muck and other sediments in Turkey Creek and Sebastian River. The ranges and mean values of depths and muck thickness have been measured, and shorelines and bathymetry have been mapped for use in hydrodynamic models and other studies. The data from these surveys have been reformatted so that they can be conveniently used by AutoCAD and Arc software.

REFERENCES

- Morgan & Eklund, Inc. 1994. Investigations of Water depth and Sediment Characteristics: Turkey Creek, Brevard County, Florida. Vero Beach, FL: Final Report to SJRWMD, January 25, 1994.
- Morgan & Eklund, Inc. 1994. Investigations of Water depth and Sediment Characteristics: Sebastian Creek, Indian River & Brevard Counties, Florida. Vero Beach, FL: Final Report to SJRWMD, January 25, 1994.