Survey Procedures / Quality Control Plan
Indian River County 2008 Coastal Monitoring Survey
for Applied Technology and Management, Inc.
Onshore/Offshore Profiles Sector 7 (R-94 to R-112)

I. Research and obtain current FDEP range monument designations, coordinates, elevations and azimuths

a). Obtain hard copies and digital files of most recent aerial photography from FDEP
b). Obtain hard copies and digital files for FDEP range monument designations, coordinates and azimuths
c). Plot FDEP monuments on digital images with profile alignments

II. Reconnaissance of FDEP range monuments

a). Upload monument coordinates into Garmin Handheld GPS unit
b). Using aerials, to reach descriptions, and Garmin Handheld GPS unit, navigate to FDEP monument and record designation, (i.e. stamping)
c). Set profile alignment range stakes landward and seaward of FDEP monument using published grid azimuth when missing from previous year's survey

III. Verification of Monument Control

Verification of FDEP published coordinates and elevations using RTK / GPS was performed during previous surveys.

IV. Collect station/elevation data along profile lines

a). The beach profile crew will measure the elevations along the profile alignment at 25' intervals and breaks in slope from the monument out to –6 feet NAVD 88. Data will also be collected along the profile line from the monument landward to building line, roadway or dense vegetation (up to 200' west of monument).
b). The elevation data will be obtained using an automatic level, and fiberglass rod. A laser will be used to obtain station measurements from the monument to the rod.
c). When the profile line is complete, the level loop will be closed from the beach back to the FDEP monument using differential leveling.
d). The beach profile will extend about 300' into the water to allow for overlap with the offshore profile to be obtained using the survey boat

V. Offshore Profiles

a). Horizontal Positioning

The horizontal positioning for the hydrographic survey will rely primarily upon Real-time Differential GPS. A stand-alone GPS receiver is only accurate to within ± 15 meters (with S/A off). To upgrade that accuracy, the Coast Guard broadcasts corrections to the GPS signal that improves the accuracy of the horizontal position to 2-3 meters. The telemetry link that we use to receive this signal is a DSM receiver by Trimble Navigation. It can be programmed to receive signals from the nearest Coast Guard Differential broadcast tower (continuously operating reference station, CORS). The range of the correction broadcast is approximately 300 miles.

Morgan & Eklund, Inc. will utilize our 26' Parker survey vessel, Trimble DSM 232 differential correction receiver, Odom CVM Digital Survey Fathometer, TSS Motion Compensator and Hypack Navigation Software for data collection. Our firm has extensive land and hydrographic survey capabilities, experienced personnel and specialized equipment necessary to perform this extensive survey in a timely, cost effective manner. Calibration of the survey boat's horizontal positioning will be accomplished by positioning the receiver antenna over a known point at the beginning of every survey day. This can be done from the boat or alternatively, the receiver may be set up in a truck and driven to a known point. Calibration of the fathometer (depth sounder) will involve adjusting for vessel squat and settlement while underway, vessel draft, and the speed of sound in water. (bar check) Both analog and digital fathomer readings will be calibrated at the beginning and end of each survey day and after replacing paper charts.

b). Soundings

Prior to the start of the hydrographic survey, the survey fathometer is calibrated using a "bar check". A metal plate is suspended by cables in the water column below the fathometer transducer at varying depths giving a reading on both the analog chart and digitizer. This absolute depth is used to calibrate the fathometer for speed of sound in that particular body of water, since the depth displayed will be affected by the density of the water, (i.e., temperature, salinity, turbidity, etc.)

c). Water Surface Elevations

A Coastal Leasing submersible water level gauge will be deployed in the middle of the survey area each day.

All survey areas will have a tide staff set in addition to the recording submersible gauge, which will be monitored during the bathymetric survey. This will allow the water surface elevation to continue to be observed if the recording gauge becomes inoperative. The tide staff also serves as a check on vertical accuracy of the recording gauge. Both the staff and recording gauge will be leveled through as turning points using differential leveling surveying techniques. (3^{rd} Order) Additionally, all gauge

installations, leveling, and bathymetric surveys will conform to the FDEP specifications, the U.S. Army Corps of Engineers Hydrographic Survey Manual and the Florida Minimum Technical Standards.

The barometric pressure will also be monitored daily for its effect on the submerged tide gauge readings.

d). Offshore Data Collection

1. The survey boat will be navigated along each transect using the steering indicator in Hypack and the coordinates and depth soundings will be simultaneously collected every 25 feet along the profile line
2. Our digital survey fathomer will collect readings to the nearest 0.1 foot. The resultant accuracy of the bottom elevations (i.e., from leveling to gauge, gauge accuracy, positional accuracy, and sounding accuracy) should be within ± 0.5 foot as stipulated in the FDEP specifications
3. As a quality control procedure, the last offshore survey line on day one will be re-run as the first survey line of day two.

VI. Data Reduction/Plotting/Drafting

1. The bathymetric survey data is stored in xyz format by Hypack Navigation Software and will be downloaded onto a CD at the end of each survey day. All of the water surface elevations are referenced to NAVD 88 and those tidal stage elevations will be used to reduce the soundings to bottom elevations. The entire survey data set will be plotted by x, y coordinates (NAD 83) and bottom elevations, z, (referenced to NAVD 88) in plan and profile views.
2. The onshore and offshore profile data sets will be plotted in cross sectional view in two distinct colors to check the nearshore overlap and look for any horizontal or vertical offsets that may have occurred.
3. Once the onshore and offshore profile data sets are merged, we will plot the current FDEP profile line together with the most recent data set from FDEP, the USCOE or M&E as a further confirmation of our current data set

FDEP Profile Quality Control Procedures

To Verify	Procedure
1. Monument designation	Digital photo, record stamping
2. Monument elevation	RTK / GPS, other observations (COE, etc.)*
3. Monument coordinates	RTK / GPS, other observations (COE, etc.)*
4. Profile alignment	RTK / GPS*
5. Onshore profile stations	a). Laser measurements
	b). Offshore profile overlap with onshore
6. Onshore profile elevations	a). Closed bench loop, beach to monument
	b). Offshore profile overlap with onshore
7. Offshore positioning	a). DGPS position check
	b). Onshore overlap with offshore
	c). Check profile between survey days
8. Tide measurements	a). Closed bench loop
	b). Staff vs. gauge
	c). Predicted tides
	d). Check profile between survey days
9. Depth soundings	a). Squat, settlement, draft calibration of vessel
	b). Bar check calibration of fathometer
	c). Check profile between survey days
10. Final profile view	a). Onshore / offshore overlap
	b). Comparative profile with past data set
	c). Plot plan view data on aerial images
	d). Check profile between survey days

* Denotes previous survey