

Appendix E

Tide and Current Evaluation

10 10th Street NE #1400
Atlanta, GA 30309
United States
T +1.404.386.7383
www.jacobs.com

Subject Todd Creek Streambank Stabilization – Tidal Variations and Current Velocities
From Jacobs Engineering
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This technical memorandum documents pre-design investigation activities performed at the Todd Creek Streambank Stabilization Project at the Union Carbide Corporation (UCC) Woodbine facility in Camden County, Georgia. The project area involves the reaches of Todd Creek and the southern streambank that borders the buffer area lying north of the RCRA landfill. The pre-design activities included an evaluation of tidal variations and current velocities in Todd Creek adjacent to the landfill area.

1. Fixed Acoustic Doppler Current Profiles

Between June 6 and June 21, 2017, acoustic doppler current profiles (ADCPs) were deployed for 2 weeks to obtain a set of current profiles at two locations within Todd Creek. The ADCPs were deployed at one location east and one location west of the site (designated ADCP East and ADCP West, respectively, on Figure 1). Each ADCP was deployed on the bottom of Todd Creek and upward facing to collect current data through the water column. Current speed measured by the fixed ADCPs are plotted on Figure 2 and summarized in Table 1. The current speed data show the water column generally to be well mixed. There is some stratification during the incoming tide where some reduction in velocity is shown near the creek surface.

Figure 2 shows the influence of inundation of the marsh flats in the water velocity time series. The peak velocities occur during ebb flow with notably smaller peak flood velocities. During the flood tide, at one point the rising tide begins to inundate the marsh flats, resulting in flow out of the channel onto the marsh flats, limiting the flow and flow velocities inside the channel. Conversely, during the falling tide, water flows off the marsh flats adding water to the channel, resulting in increased peak water velocities. The flood velocity is limited at ADCP West to approximately 2 fps compared to peak ebb flows, which are roughly doubled.

The ADCP East showed a greater inequality between the flood and ebb currents throughout the deployment (Figure 2). This is likely because of the ADCP location, which appears to be at an inflection point in the shoreline that transitions from being on the inside of the bend (depositional area) northeast of the ADCP and on the outside of the bend (erosional area) to the southwest, consistent with observational evidence with eroding bluffs along the bank southwest of the ADCP and marsh flats developing to the northeast. Flow velocities in a meandering stream

are greatest on the outside of the bend, typically resulting in erosion at the outside bank and deposition on the inside. On inflowing tides, the main channel flow approaching ADCP East is along the northwestern bank of the bend to the northeast. On the ebb tide, the main channel flow follows the bank on the outside bend of the shoreline southwest of the ADCP. The ADCP is located adjacent to the same shore.

2. Current Speed Profiles

Additionally, on June 7 and June 21, 2017, ADCP transects were collected using a boat-mounted, downward-facing ADCP unit at four transect locations established across Todd Creek upstream and downstream of the site (Figure 1):

- Site 1 – at the location of ADCP West
- Site 2 – near the western boundary of the project site
- Site 3 – near the eastern boundary of the project site
- Site 4 – at the location of ADCP East

Six to eight separate profiles were collected at each site during flood and ebb tides. Figure 3 presents the depth-averaged current speed profiles collected along each transect during the ebb tide. Figure 4 presents profiles collected at each transect during flood tide.

3. Water Levels

The water level data recorded by each fixed ADCP show similar phase and amplitude of the tidal fluctuations from one location to the other with water levels ranging from about -4.5 to 4.0 feet mean sea level (MSL) (Figure 5). Comparison of water surface elevation data from the 2008 site survey and St. Simons Island Lighthouse demonstrated that water elevation at St. Simons Island tracked closely with those collected at the site for much of the record (CH2M 2008b). Table 2 presents the tidal datums for St. Simons Island Lighthouse relative to NAVD88 and MSL.

Based on these datums, mean tide level is at an elevation of -0.71 foot NAVD88, MSL is at -0.66 foot NAVD88, and mean lower low water is at -4.23 foot NAVD88.

Tables

Table 1. Summary of ADCP Current Velocity Measurements*Todd Creek Streambank Stabilization, Union Carbide Corporation, Woodbine, Georgia*

Location	Latitude	Longitude	Current Speed (fps)		Highest Recorded Water Level (feet, MSL)	Lowest Recorded Water Level (feet, MSL)
			Mean	Maximum		
Fixed East ADCP	30° 57' 26.6338"	081° 31' 56.983"	1.23	3.17	4.08	-4.46
Fixed West ADCP	30° 57' 23.364"	081° 32' 42.3197"	1.60	3.72	3.91	-4.55

ADCP = acoustic doppler current profiler

fps = feet per second

MSL = mean sea level

Table 2. Tidal Datums for St. Simons Island Lighthouse Station, Station ID 8677344*Todd Creek Streambank Stabilization, Union Carbide Corporation, Woodbine, Georgia**(Accepted September 27, 2011)*

Datum	Elevation (feet, above mean sea level)	Elevation (feet, NAVD88)
Mean Higher High Water	3.63	2.97
Mean High Water	3.26	2.6
North American Vertical Datum of 1988	0.66	0
Diurnal Tide Level	0.03	-0.63
Mean Sea Level	0	-0.66
Mean Tide Level	-0.05	-0.71
Mean Low Water	-3.36	-4.02
Mean Lower Low Water	-3.57	-4.23

NAVD88 – North American Vertical Datum of 1988

The North American Vertical Datum of 1988 is at an elevation of 4.23 feet above the mean lower low water based on the National Oceanic and Atmospheric Administration tidal datum.

Figures

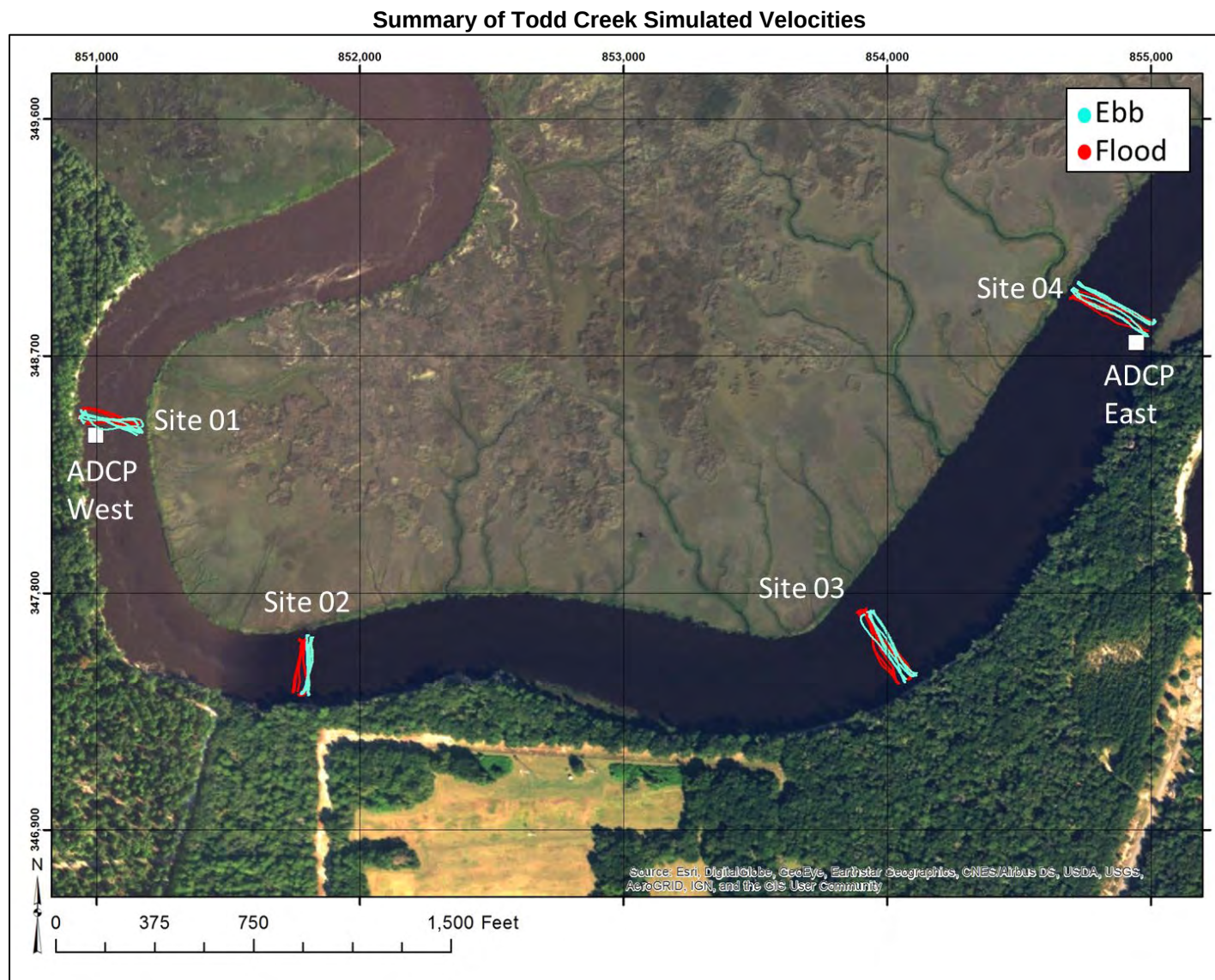


Figure 1. Acoustic Doppler Current Profile Locations – Fixed and Transect
Todd Creek Streambank Stabilization, Union Carbide Corporation, Woodbine, Georgia

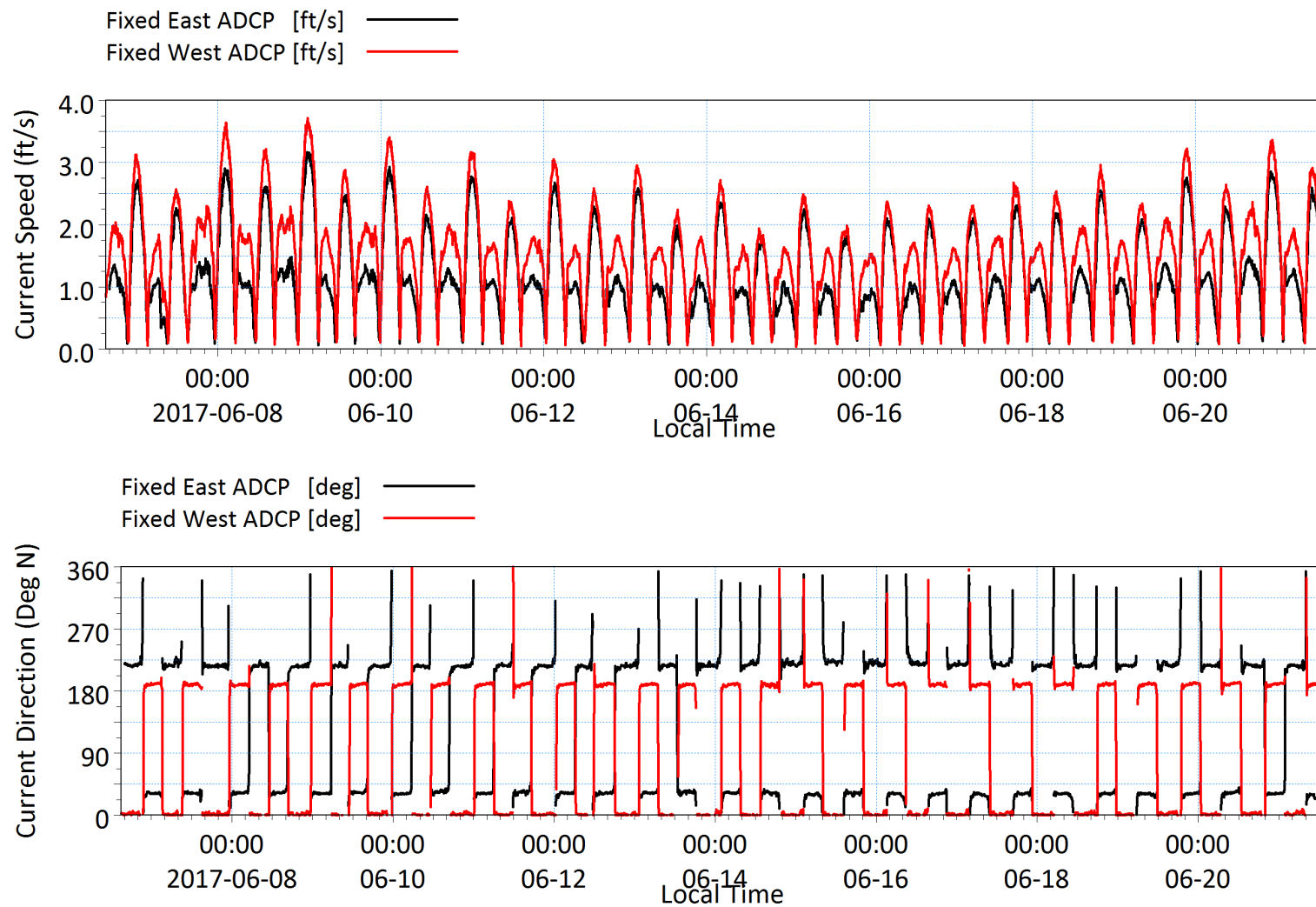


Figure 2. Fixed ADCPs Current Speed and Current Direction Data

(June 6 – June 21, 2017)

Todd Creek Streambank Stabilization, Union Carbide Corporation, Woodbine, Georgia

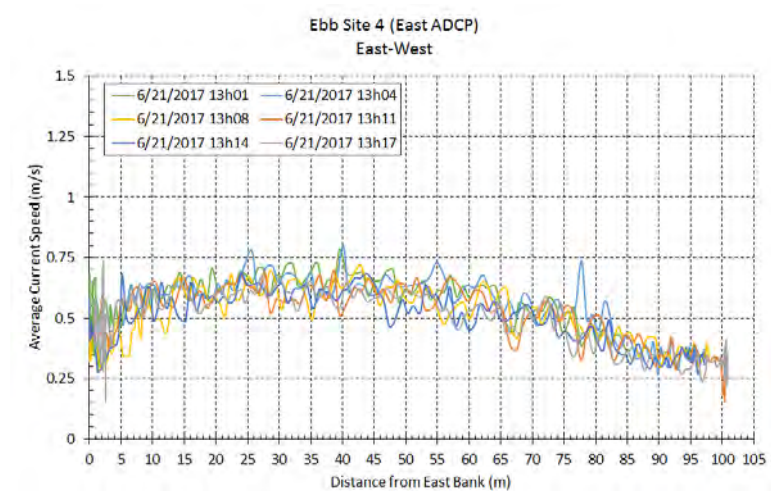
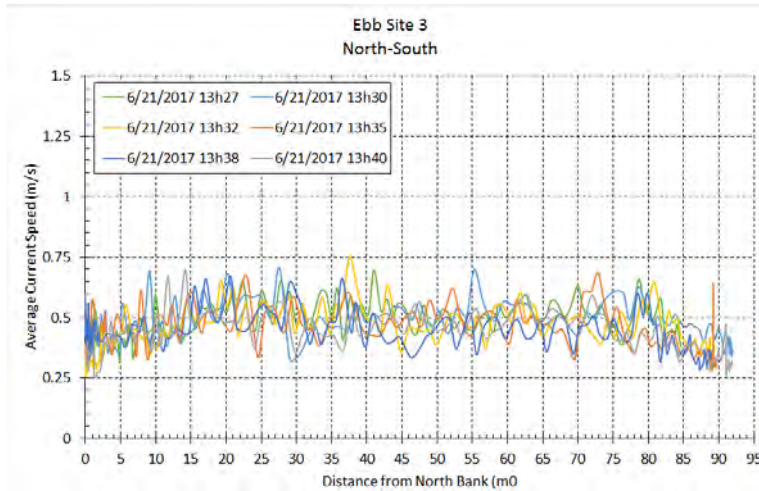
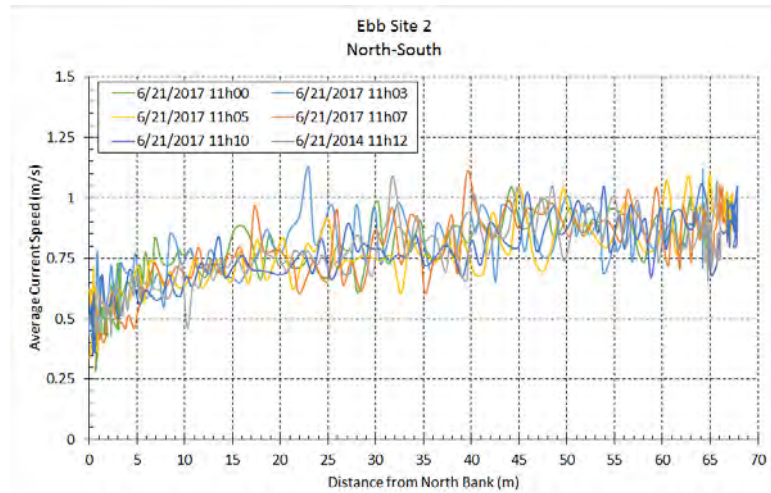
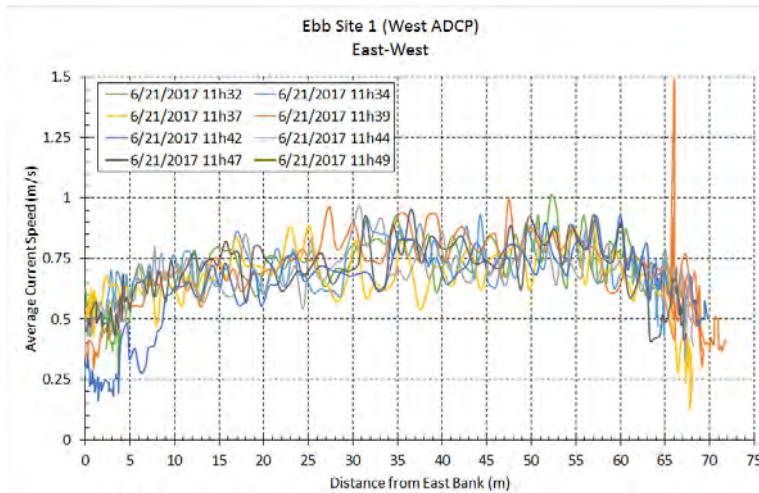


Figure 3. Current Speed (m/s) Along Each of the Four Transects during Ebb Tide
(Date and time stamp in the legends indicate time transect was taken)
 Todd Creek Streambank Stabilization, Union Carbide Corporation, Woodbine, Georgia

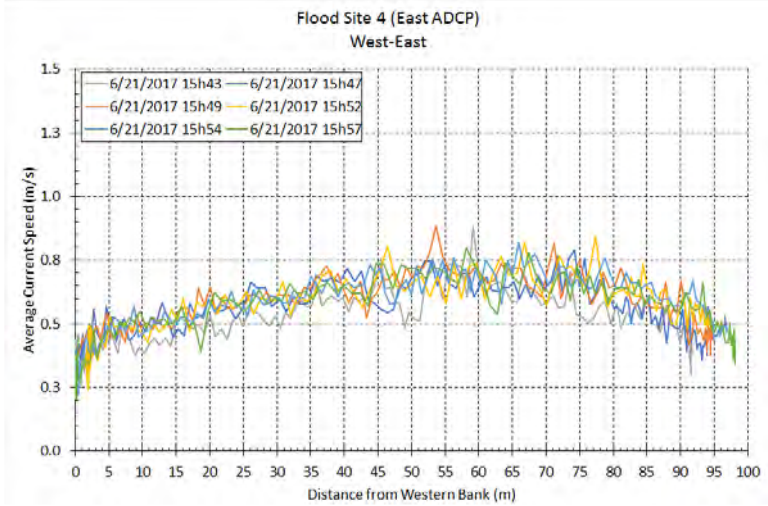
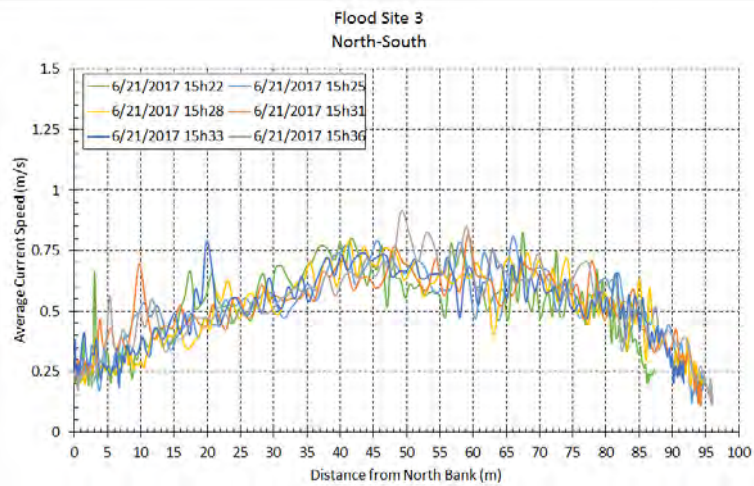
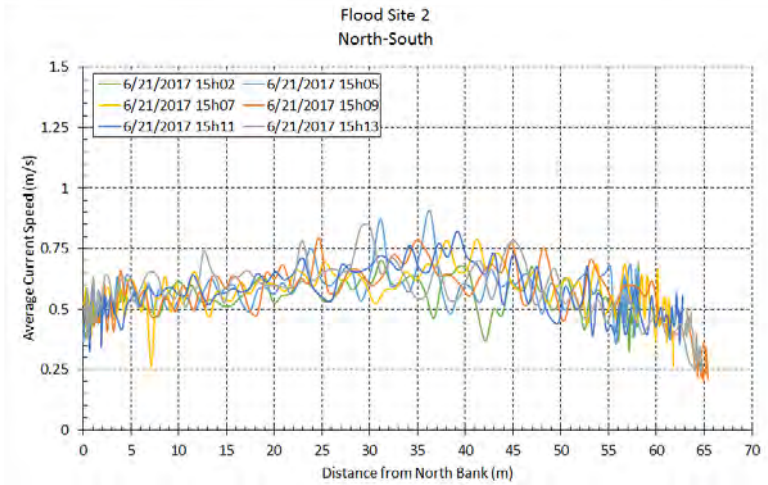
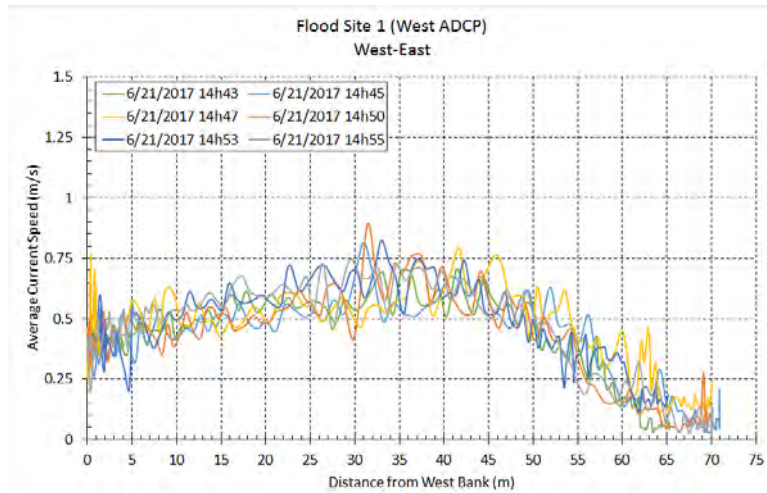


Figure 4. Current Speed (m/s) Along Each of the Four Transects during Flood Tide
(Date and time stamp in the legends indicate time transect was taken)
Todd Creek Streambank Stabilization, Union Carbide Corporation, Woodbine, Georgia

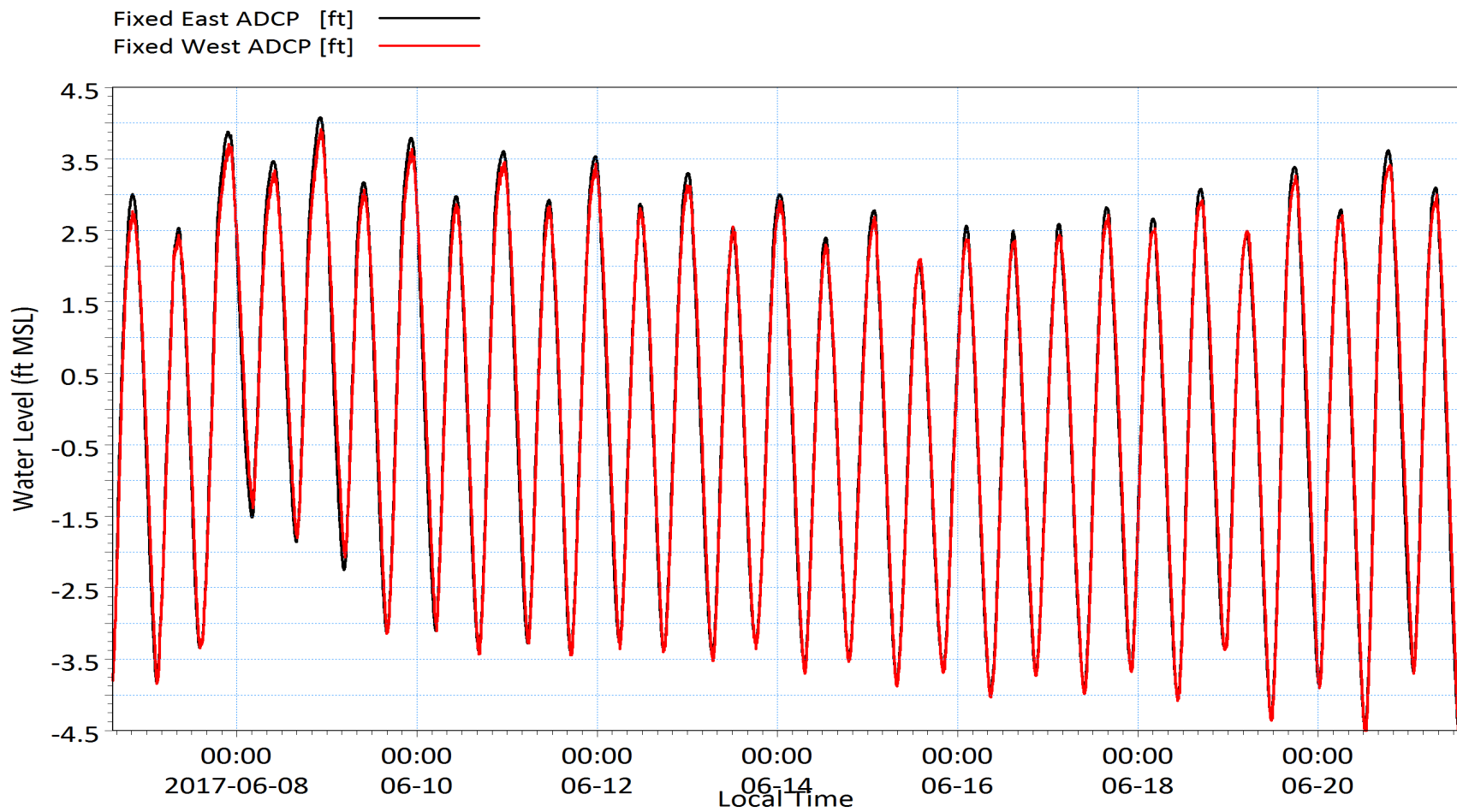


Figure 5. Water Level Data Collected by Fixed East and West ADCPs
(June 6 through June 21, 2017)
Todd Creek Streambank Stabilization, Union Carbide Corporation, Woodbine, Georgia