

**ACOUSTIC DOPPLER CURRENT PROFILER SURVEY  
OF CURRENT SPEED AND DIRECTION  
FOR THE NORTON BASIN BASELINE STUDY**

***Data Report***

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## 1.0 INTRODUCTION

Continental Shelf Associates, Inc. (CSA), as subcontractor to Barry A. Vittor & Associates, Inc. (BVA), conducted a study of tidally-driven water movement (current velocity and direction) using an acoustic Doppler current profiler (ADCP) in the Norton Basin area of Jamaica Bay. The purpose of this ADCP survey was primarily to support the U.S. Army Corps of Engineers (USACE) fish bioacoustics study conducted by the Waterways Experiment Station (WES) under the Norton Basin Study baseline survey program. Although the study was conducted primarily because the ADCP tidal data are useful for interpreting the results of fish bioacoustics surveys, the data also will be useful in the water quality and hydrodynamic mixing assessment for Norton Basin and in modeling of hydrodynamics and water quality in Norton Basin in the future. As directed by the USACE, the results of the survey are provided with minimal analysis and interpretation.

The primary objective of the study was to collect tidal data as profiles of current velocity and direction along selected transects in Norton Basin, Little Bay, and Grass Hassock Channel, which are located in Jamaica Bay, New York (**Figure 1-1**). Norton Basin and Little Bay are the primary areas of study, while Grass Hassock is the reference area. Coverage and transect layouts were determined by the USACE WES researchers.

**Figure 1-1** illustrates the location of the study areas on the southeast corner of Jamaica Bay, a few kilometers to the south of John F. Kennedy International Airport. Tidal current data collection consisted of two techniques: 1) spatial surveys (a series of parallel transect lines) within Norton Basin, Little Bay, and Grass Hassock Channel, and 2) occupation of fixed stations at entrance channels to Norton Basin and Little Bay for about 30 to 45 minutes each. Measurements were taken during the ebb and flood phases of the tide. The observations were presented as vector maps for the spatial surveys showing vertically-averaged tidal current arrows representing speed and direction, or as time series graphs for fixed station observations separated into near-bottom and near-surface flow.

The survey area lies within Jamaica Bay, which connects to the mid-Atlantic Bight via the Rockaway Inlet. The Norton Basin/Little Bay complex were originally shallow embayments where historical dredging for fill material left deep borrow pits. Norton Basin is a small inlet off Grass Hassock Channel, with a narrow entrance channel bordered on both sides by tidal flats. Grass Hassock Channel runs northeast-southwest and acts as a passage for tidal flow into and from the upper reaches of southeastern Jamaica Bay. Maximum depths in the channel are approximately 50 to 60 ft.

Norton Basin and Little Bay are enclosed by land on three sides, effectively “dead ends” with limited tidal exchange. These embayments are isolated from Jamaica Bay proper by a shallow sill at the entrance channel to Norton Basin. Both embayments are relatively deep (on the order of 30 to 40 ft, with deep pits of over 55 to 60 ft) compared with the Norton Basin entrance channel (on the order of 15 ft or less). The Norton Basin and Little Bay borrow pits are 55 ft and 64 ft deep (mean low water [MLW]), respectively. These borrow pits represent the deepest locations in Jamaica Bay, including all other pits and scoured channels. Side slopes in both pits are nearly vertical. The surrounding land use of the area is highly industrial/dense residential. The Edgemere Landfill is located to the west of Norton Basin and north of Little Bay and may be leaching contaminants into surrounding waters, which may ultimately be retained in the pits, along with considerable amounts of trash.

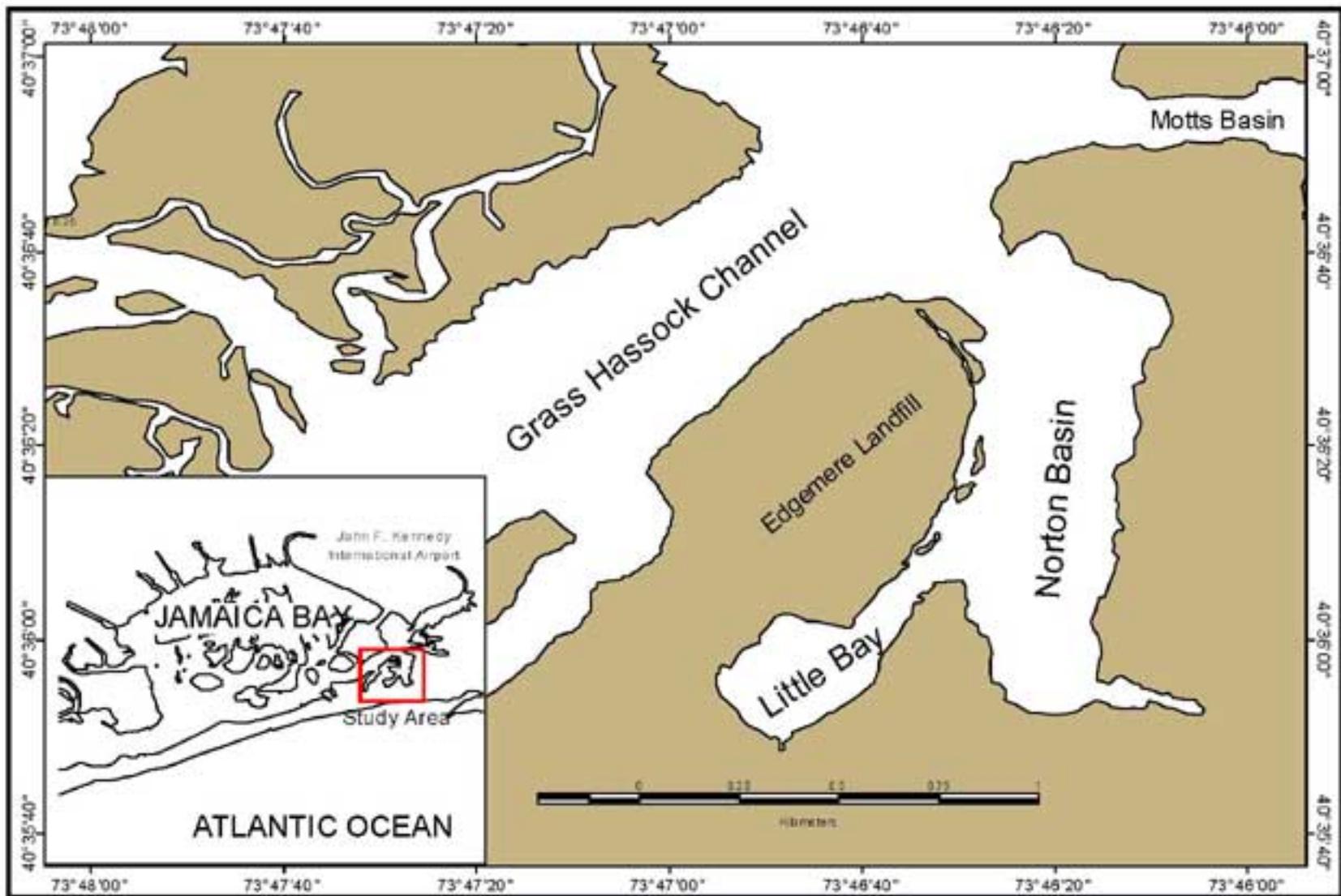


Figure 1-1. Study area for fish bioacoustics and acoustic Doppler current profiler survey on 3 October 2001 in southeastern Jamaica Bay, New York.

This data report documents the results of the ADCP survey within Jamaica Bay on 3 October 2001. The methods used in the survey are discussed in **Section 2.0**. The results of the survey are presented in **Section 3.0**. Summarized results are provided in the body of the report, while detailed ADCP data are provided in the **Appendix** as figures showing vertical profiles of current velocity magnitude and direction for each transect and fixed station completed. Brief commentaries on tidal observations are provided for each area surveyed. A summary of the report is provided in **Section 4.0**.

## 2.0 METHODS

An ADCP uses high-frequency sound pulses and their echoes to measure water velocity and direction. The instrument transmits acoustic signals into the water column, and the frequencies of the transmitted signals are compared with the frequencies of backscatter signals reflected off particles in the water. In this way, the velocity of the particles and, hence, the water, can be calculated. ADCPs are used widely by oceanographers to measure currents in the deep-sea environment. ADCP technology has been adapted to the riverine and estuarine environment and has revolutionized the way tidal and streamflow measurements are made.

The ADCP measures water motion by transmitting sound at fixed frequency. The instrument then measures the Doppler-shifted echoes backscattered from particles (e.g., plankton and sediment) in the water and converts the echoes to along- (acoustic) beam velocity components. An internal flux gate compass allows the instrument to keep track of its position relative to the earth's magnetic field, and software then reduces the along-beam velocities to north/south, east/west, and vertical velocity components. The velocity profiles are delimited by range gating the echoes so that velocities are determined at preset intervals along the acoustic path (called bins). Vessel-mounted ADCPs may be set up with bottom-tracking to correct the ADCP data relative to vessel motion.

### 2.1 SURVEY AREAS

The areas surveyed in Jamaica Bay, New York included Norton Basin and Little Bay as primary survey areas and Grass Haddock Channel as a reference area. Two survey modes were used: transects (or synonymously survey lines in this report) and fixed stations. ADCP data were collected along transects while the vessel was underway along the long axis of a channel or an embayment. Fixed stations were located along the entrance channels to Norton Basin and Little Bay, and ADCP data were collected while the vessel was anchored.

All transects and fixed stations were selected for collection of fish bioacoustics data by USACE WES researchers. Transects were surveyed and fixed stations were occupied in the most efficient sequence possible after considering water depth, tide, time, and channel width. Tidal data along transects were collected during flood and ebb tide and in an upstream or downstream direction. Due to limited time, more transects were surveyed during ebb tide than during flood tide. **Table 2-1** summarizes the tidal conditions on 3 October 2001.

Table 2-1. Times and heights (in feet, mean low water) of high and low tides in Motts Basin, Jamaica Bay, New York on 3 October 2001 from tidal predictions based on the National Oceanic and Atmospheric Administration tide station in Sand Hook, New Jersey. Motts Basin is the next basin northeast of Norton Basin.

Tidal Stage	Time	Height (ft)
Low Tide	3:48 a.m.	0.1
High Tide	9:40 a.m.	6.1
Low Tide	4:14 p.m.	0.3
High Tide	9:57 p.m.	5.9

In Norton Basin, eight transects (in two sets) were surveyed during ebb tide, and four transects were surveyed during flood tide (**Figure 2-1**). The fixed station in the Norton Basin entrance channel was occupied during ebb tide and flood tide. In Little Bay, six transects were surveyed during ebb tide (in two sets), and three transects were surveyed during flood tide (**Figure 2-1**). The fixed station in the Little Bay entrance channel was occupied during ebb tide and flood tide. A single transect in the Norton Basin entrance channel running from Grass Hassock Channel to the entrance of Little Bay also was surveyed during ebb tide and flood tide. In Grass Hassock Channel, four transects each were surveyed during ebb tide and flood tide (**Figure 2-1**). There was no fixed station in Grass Hassock Channel.

## 2.2 DATA COLLECTION

The 32-ft R/V CYPRINODON, which is operated by CR Environmental, East Falmouth, Massachusetts, was the vessel used during the survey. A Trimble NT300D differential global positioning system (DGPS) receiver (12-channel unit with integrated beacon receiver) was used for navigation and positioning. Positions were recorded in geographic (latitude/longitude) coordinates (WGS84 datum) with no offset entered because the DGPS antenna was mounted above the ADCP to assure precise location of each profile. Navigation data were recorded on a laptop computer from the DGPS in NMEA 0183 format. After completing the surveys, post-plots of each trackline were prepared by processing the NMEA 0183 output, importing the GPS fixes into ArcView 3.2, and creating line files. ArcView 3.2 software also was used for mapping.

An RD Instruments (RDI) Workhorse 600 Sentinel ADCP with bottom-tracking (RD Instruments, 1998a) was used to measure tidal currents. The unit is a 600-MHz instrument suitable for the range in water depths expected during the survey. Although a 1,200-MHz instrument would have been adequate for most of the water depths to be encountered in the study area, the deeper pits required a higher frequency transducer, e.g., 600 MHz. The use of a 600-MHz instrument was also recommended for comparability with a previous survey.

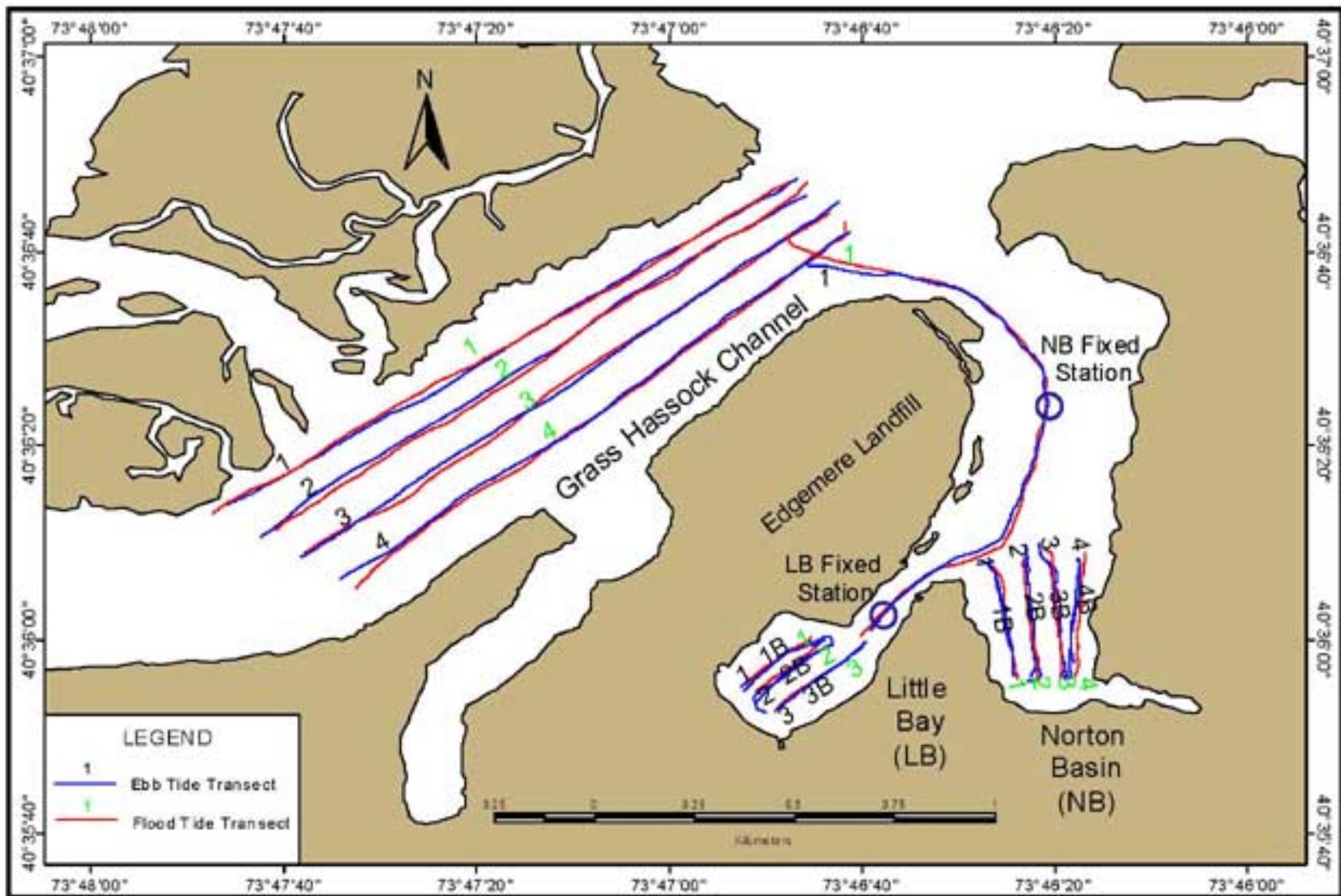


Figure 2-1. Fish bioacoustics and acoustic Doppler current profiler tracklines surveyed on 3 October 2001 during ebb and flood tides. Locations of fixed stations also are indicated.

Prior to data collection, the data collection and recording parameters in the ADCP were set up in an instrument configuration file. Vertical resolution (or bin size) was set to 0.5 m, meaning one measurement of speed and direction per every 0.5 m depth. One profile was obtained every 4 seconds, resulting from an average of five individual acoustic pings. Accuracy of the ADCP (with this configuration) was estimated to be  $\pm 3$  cm/sec (standard deviation). For more information regarding this instrument, see [www.rdinstruments.com](http://www.rdinstruments.com).

Data are collected and stored as “ensembles” of current speed and direction at discrete levels (bin size was set at 50 cm) through the water column. Data files were recorded for each transect line or fixed station in raw binary form, allowing for subsequent re-processing. These files and the bioacoustic data files were recorded simultaneously. The RDI ADCP data stream is stored in a proprietary format that minimizes file sizes and facilitates efficient data access, display, and extraction to other formats. Using RDI software, current velocity and direction may be displayed from the data files for each transect completed in the survey. Data also may be extracted as text files for summary and plotting in other applications.

The ADCP was mounted mid-ship (to avoid vessel wake effects) on a retractable aluminum bracket and pole rigidly fixed to the portside rail so that the ADCP transducer faces were 0.4 m below the water surface. The ADCP was connected by communications cables to the field computer set up in a weatherproof cabin on the survey vessel. External DC power was supplied to the ADCP during data collection. The ADCP was retracted to protect the instrument when the vessel was underway.

The ADCP has four transducer faces, each of which transmits a sound pulse and receives the echo. An internal flux gate compass allows the instrument to correct the ADCP current velocity and direction relative to earth coordinates regardless of vessel orientation, track, and speed. Internal software tracks the instrument's movement relative to the bottom (bottom-tracking) and present water movement data relative to the bottom, resulting in measurement of absolute currents (RD Instruments, 1998b). RDI WinRiver software (RD Instruments, 2000) running on a Pentium III field computer was used during data collection and for display. Data were collected and displayed in real time. A unique serial file name was created by the WinRiver software for each transect data stream. Internal software also corrects for vessel pitch and roll.

Blanking layers exist at surface (near the transducer due to ringing effects) and at bottom (due to bottom echo return contamination). The first measurement was obtained 1.24 m below the water surface; the bottom-most measurement was located generally 1.5 m above the bottom (dependent on water depth).

Depending on a number of factors, e.g., channel width/depth, transect length, wind, etc., the survey vessel proceeded at between 0.5 to 2.0 knots, with speeds generally at 1.5 knots. Vessel speed was reduced when the survey lines were short, especially on narrow channels, when the water was very shallow, and when the end of the line was near. Higher vessel speeds were possible when surveying in deep channels with long tracklines. Some transects could not be run true or straight because of obstructions or tidal or wind conditions.

When a survey line was completed, the data file was closed and saved on the hard drive of the field computer. Upon returning from the field, all ADCP files and associated navigation data were backed up on magneto-optical media and archived on CD-ROM for data security.

A summary of the data (spatially and temporally averaged) is presented in **Section 3.0**; individual profiles for each transect and fixed station are provided in the **Appendix**. ADCP data processing procedures to prepare the summaries consisted of the following:

- Merging vertical profiles with GPS data to geo-locate each measurement;
- Converting data from binary to ASCII file format; and
- Checking data quality, comparing ping-to-ping correlations, echo strengths, and error velocities.

For vector plots of the transects, vertical averages of each profile were calculated. Profiles were spaced approximately 6 m (20 ft) apart along the survey line. A spatial average of adjacent vectors was performed to reduce the visual density on the maps and reduce noise levels. The averaging neighborhood was dependent upon regional scales: more averaging in large regions (to reduce number of vectors displayed) and less averaging in smaller areas.

For time series plots, data from three sets of 20- to 15-minute observations were combined and the upper half of the water column was averaged vertically into the “near-surface” observation; the lower half of the water column was averaged into the “near bottom” observation. Additional temporal averaging also was applied to reduce the data to 1-minute samples (from original 4-second samples). This averaging was required to reduce noise levels.

## **2.3 SURVEY SCHEDULE**

Mobilization and checkout of survey equipment at the Seaway Marine dock in Rockaway Beach, New York was completed by the early morning of 3 October 2001, and the R/V CYPRINODON left the dock at 9:30 a.m. to begin ebb tide surveys in Grass Hassock Channel. After completing two sets of ebb tide survey lines in the three study areas, fixed stations were occupied at the Norton Basin and Little Bay Entrance Channels (**Figure 2-1**). Subsequently, flood tide survey lines were done, and flood tide fixed stations were occupied in Norton Basin and Little Bay. ADCP surveys in Norton Basin, Little Bay, and Grass Hassock Channel continued until 9 p.m. Although ADCP surveys were completed by late evening of 3 October, the fish bioacoustics surveys continued until mid-morning of the next day.

## 3.0 RESULTS AND DISCUSSION

A profile of current velocity magnitude and direction was prepared for each transect completed and each fixed station occupied using the WinRiver software (see **Appendix**). Although data may have been collected at various stages of the tide and in different directions of movement (i.e., downstream or upstream), the ADCP data are presented in a standardized manner. Transects and fixed stations were numbered in series in the sequence that they were collected within a study area according to the survey technique and phase of the tide.

Profiles from transects surveyed in Norton Basin during ebb tide (two sets of four transects) are presented first, followed by the ebb tide data from the Norton Basin entrance channel fixed station (a single set of three 10- to 15-minute observations). Flood tide transects surveyed in Norton Basin (a single set of four transects) and flood tide data from the Norton Basin entrance channel fixed station (three observation periods) are presented next. Profiles from transects surveyed in Little Bay during ebb tide (two sets of three transects) then are presented, followed by the ebb tide data from the Little Bay entrance channel fixed station (three observation periods). Flood tide transects surveyed in Little Bay (a single set of three transects) and flood tide data from the Little Bay entrance channel fixed station (three observation periods) are then presented. The single transects surveyed in the Norton Basin entrance channel during ebb and flood tides are presented, followed by the transects surveyed in Grass Hassock Channel during ebb tide (a single set of four transects) and flood tide (a single set of four transects).

To standardize the ADCP data presentation and assist in interpretation, profiles from transects were displayed left to right depicting data from the lower reaches to upper reaches of the channel or embayment regardless of the actual direction the transect was run in the field. The original ensembles were used in the data display and plotted according to distance along the transect. ADCP data from fixed stations were depicted according to elapsed time.

### 3.1 DATA QUALITY

In general, current profiling from moving platforms does not produce optimal quality observations due to inherent instability of the sensor platform. Instrument motion can introduce unwanted random errors, commonly referred to as noise. Bottom tracking algorithms are effective in removing much of the platform motions, however the accuracy of these corrections is dependent typically upon the quality of the bottom echoes and nature of the platform motion. Severe pitch and roll are difficult motions to correct. Soft bottom sediments also can negatively affect bottom track corrections.

The noise level of the ADCP used in the survey was estimated to be 3 cm/sec, predicted for a stable platform with no motion. Sea conditions were quite mild inside the estuary; hence, pitch/roll would not be large sources of error.

In Grass Hassock Channel, where current speeds were about 15 to 20 cm/sec, the signals were much greater than the random noise level, so these data were of high quality. Data were not obtained for a portion of the ebb phase Norton Basin entrance transect. It was unclear why these data were missing, although there may have been some

water-borne particles (such as bubbles created in a boat's wake) that could have obfuscated the acoustic signals, or it may have been due to masses of macroalgae or other vegetation throughout the water column. Regardless, a portion of the data for the ebb phase in Norton Basin entrance channel was not obtained. Similar breaks in the data were observed in a previous ADCP survey (Continental Shelf Associates, Inc., 2001).

In contrast, currents measured along the Little Bay and Norton Basin transects were quite weak, within the noise level of the instruments (3 cm/sec). Despite averaging during post-processing, the vector plots depict flow always in the direction of the vessel heading. Current magnitudes were on the order of 0 to 5 cm/sec. Because flow speeds were so weak in these embayments, it was also likely that the bottom was composed of soft sediments (bottom tracking may be less accurate in soft sediments). The weak signals relative to random noise levels, in addition to potential bottom-tracking errors, were likely causes for poorer data quality in these regions.

## 3.2 DATA DISCUSSION

The survey was performed 3 October 2001, the day following the full moon. Spring tide range was about 6 ft. High tides were predicted to occur about 9:40 a.m. and 9:57 p.m., while low tides were predicted to occur about 3:48 a.m. and 4:14 p.m. (i.e., the ebb phase of the tide occurred in the late morning and early afternoon; the flood tide occurred in late afternoon and early evening). All times are relative to local Eastern Daylight Time (EDT).

The tide charts show the duration of the ebb tide was about 6.5 hours, while the duration of the flood tide was about 5.75 hours. This asymmetry between the flood and ebb tide duration, or tidal asymmetry, suggests that flood tide currents will be stronger than ebb tide currents. Winds were mild during the morning, about 5 knots from the southwest, strengthening slightly in the afternoon. By 6 p.m., winds were about 15 knots from the south.

For the reasons discussed in **Section 3.1**, data collected during transects within Norton Basin and Little Bay were of poor quality. The poor quality reflected the weak current speeds (less than 10 cm/sec) relative to the instrument noise levels, as well as potential soft sediments that may have introduced errors in the bottom tracking corrections. **Figures 3-1** and **3-2** depict the ebb tide and flood tide vertically averaged current vectors from transects in Norton Basin and Little Bay, respectively. The current vectors depicted in the figures should be viewed with reservation because the vectors generally point to the direction of travel of the survey vessel. The vertically averaged current vectors from the second set of ebb tide transects in Norton Basin and Little Bay also show weak currents. Actual profiles provided in the **Appendix** show these observations in greater detail. Current profiles from the Norton Basin transects during ebb tide are shown in **Figures A-3** to **A-10**, while profiles from the flood tide transects are shown in **Figures A-14** to **A-17**. Profiles from the Little Bay transects during ebb tide and flood tides are shown in **Figures A-21** to **A-26** and **Figures A-30** to **A-32**, respectively.

The ebb tide and flood tide temporally averaged currents in the Norton Basin fixed station are presented in **Figures 3-3** and **3-4**, respectively. **Figures 3-5** and **3-6** depict the temporally averaged currents in the Little Bay fixed station during ebb tide and flood tide, respectively. The fixed station time series at the entrance channels to Norton Basin and

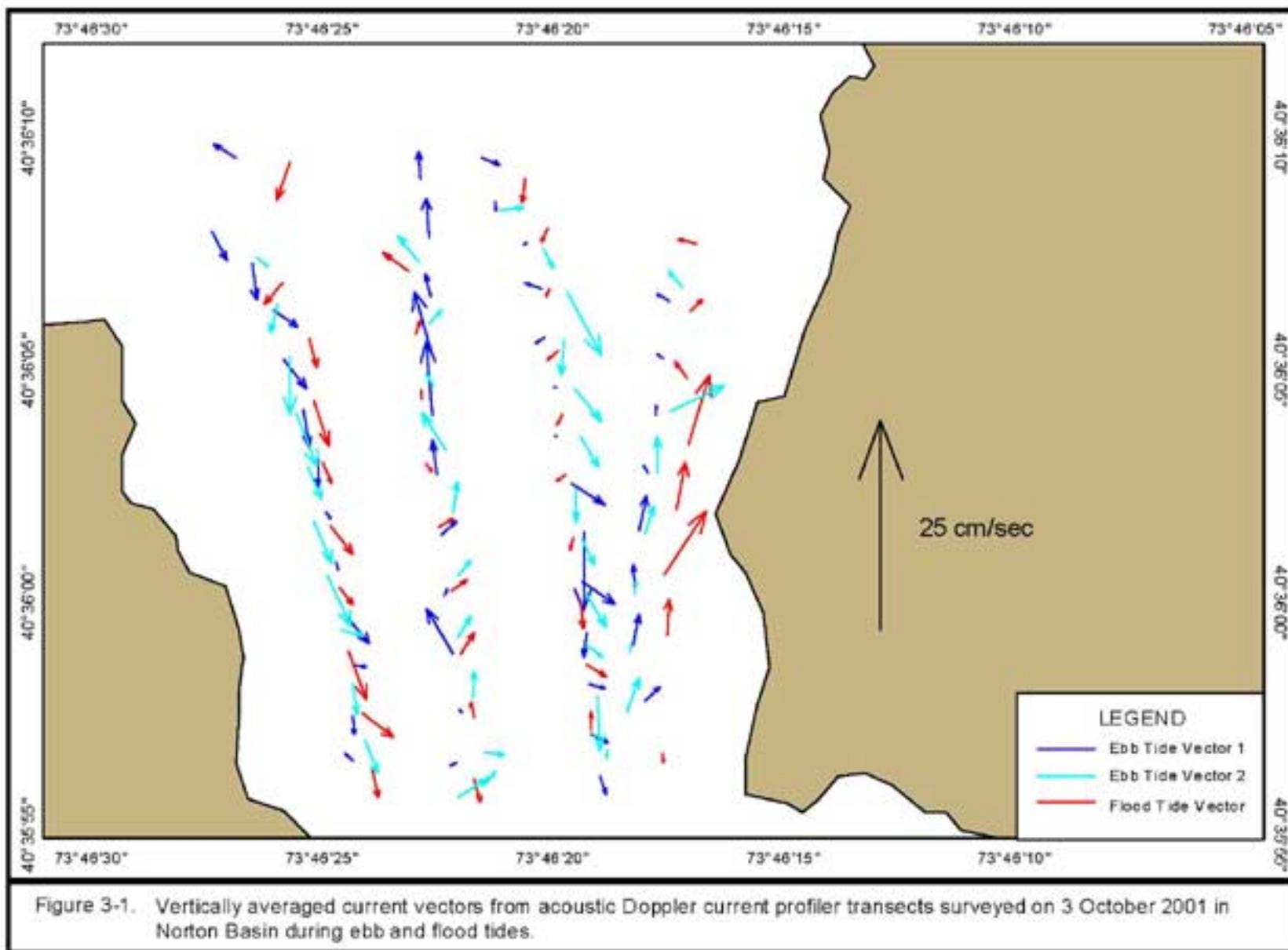
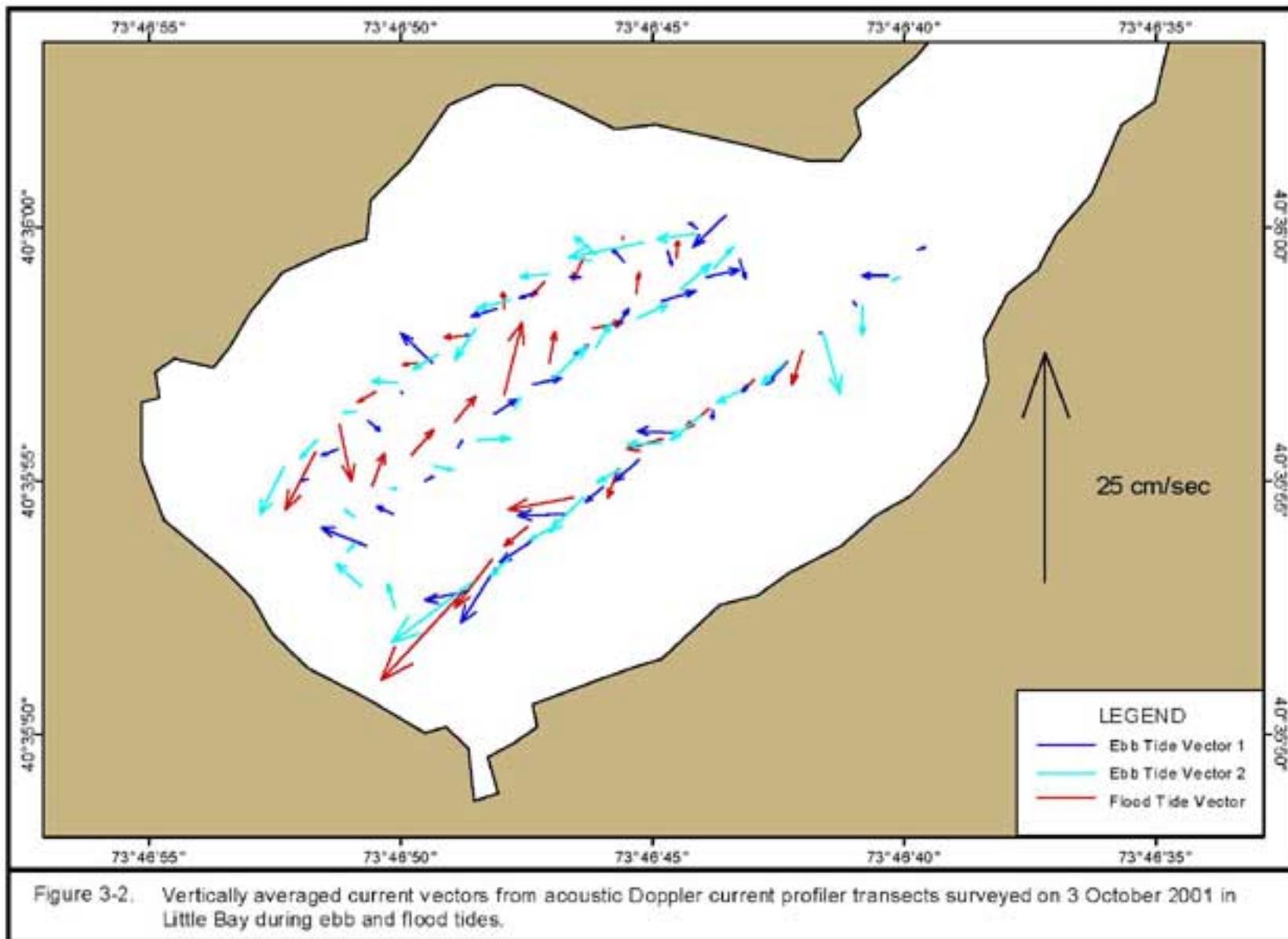


Figure 3-1. Vertically averaged current vectors from acoustic Doppler current profiler transects surveyed on 3 October 2001 in Norton Basin during ebb and flood tides.



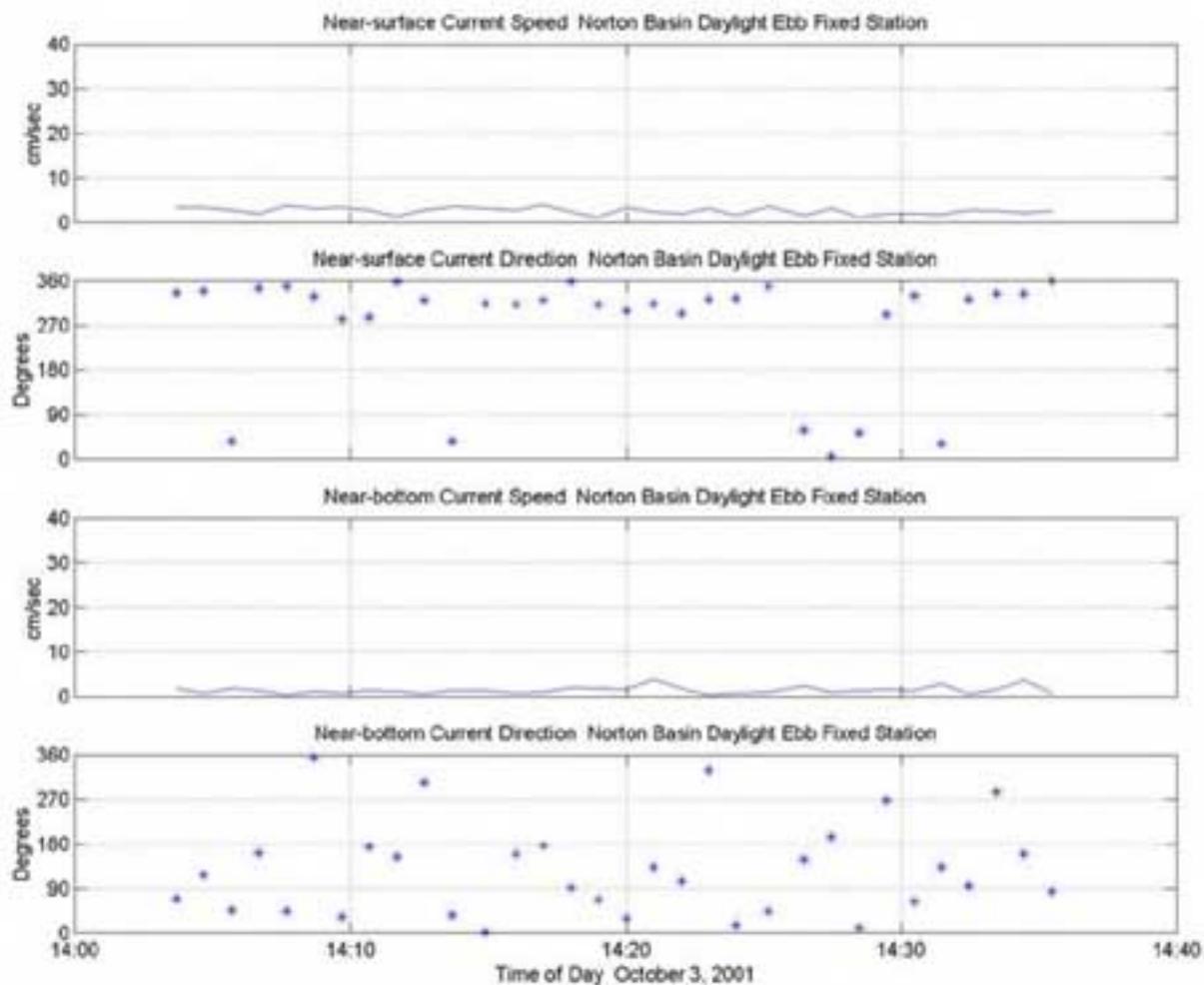


Figure 3-3. Near-surface and near-bottom current speed and direction at the Norton Basin fixed station. Data collection began at 2:03 p.m. on 3 October 2001 during an ebbing tide. High tide was at 9:40 a.m.

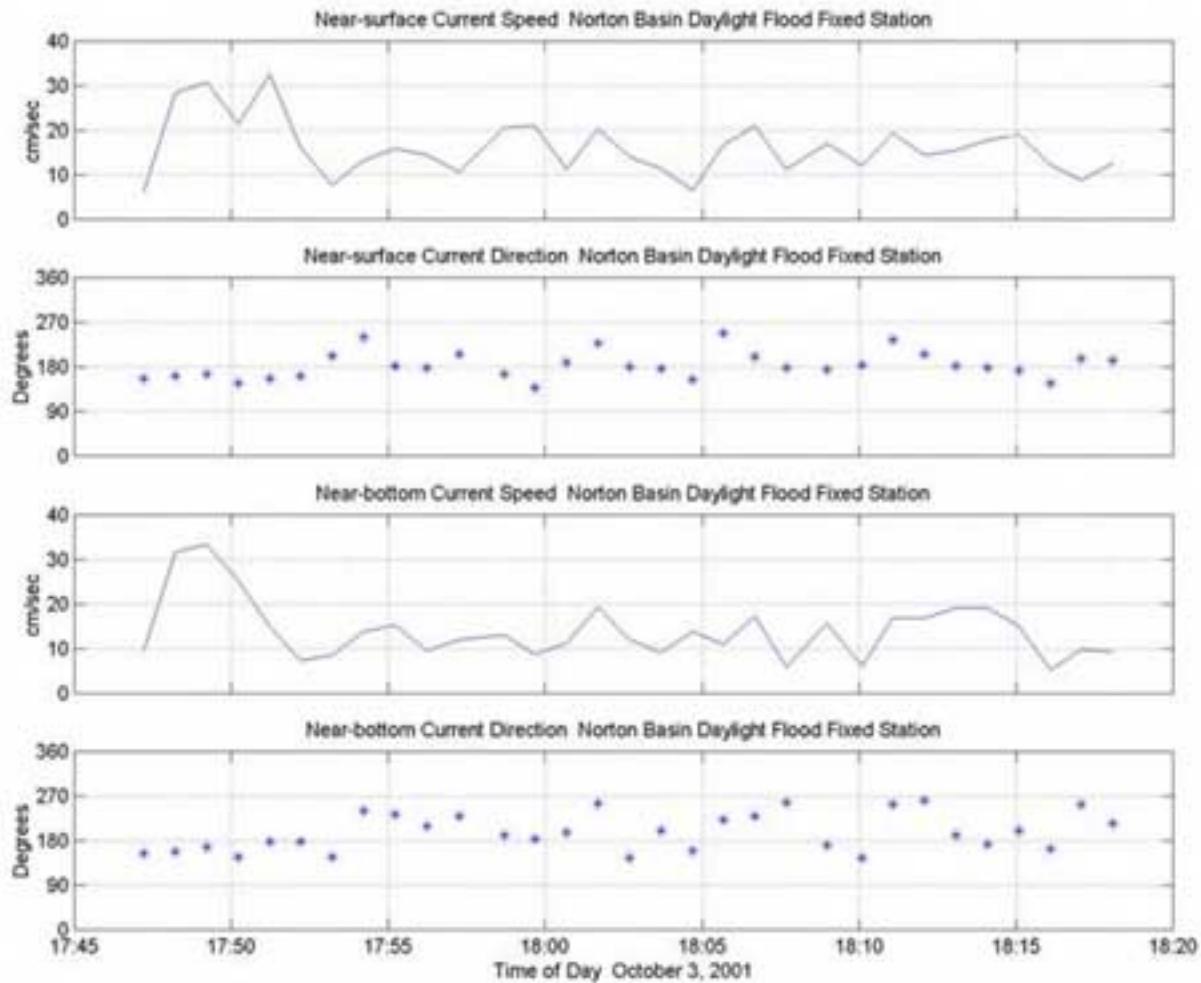


Figure 3-4. Near-surface and near-bottom current speed and direction at the Norton Basin fixed station. Data collection began at 5:47 p.m. on 3 October 2001 during a flooding tide. High tide was at 4:14 p.m.

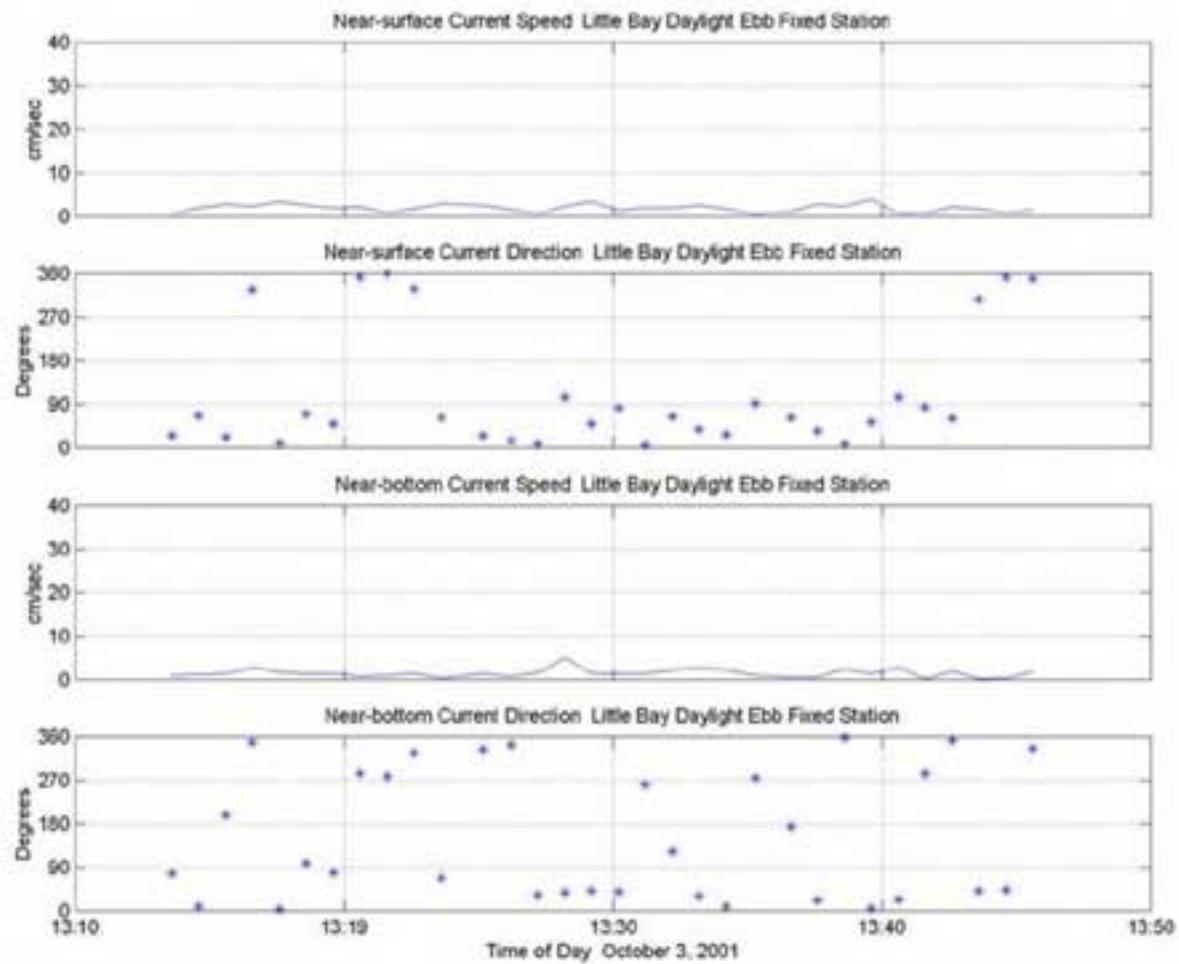


Figure 3-5. Near-surface and near-bottom current speed and direction at the Little Bay fixed station. Data collection began at 1:13 p.m. on 3 October 2001 during an ebbing tide. High tide was at 9:40 a.m.

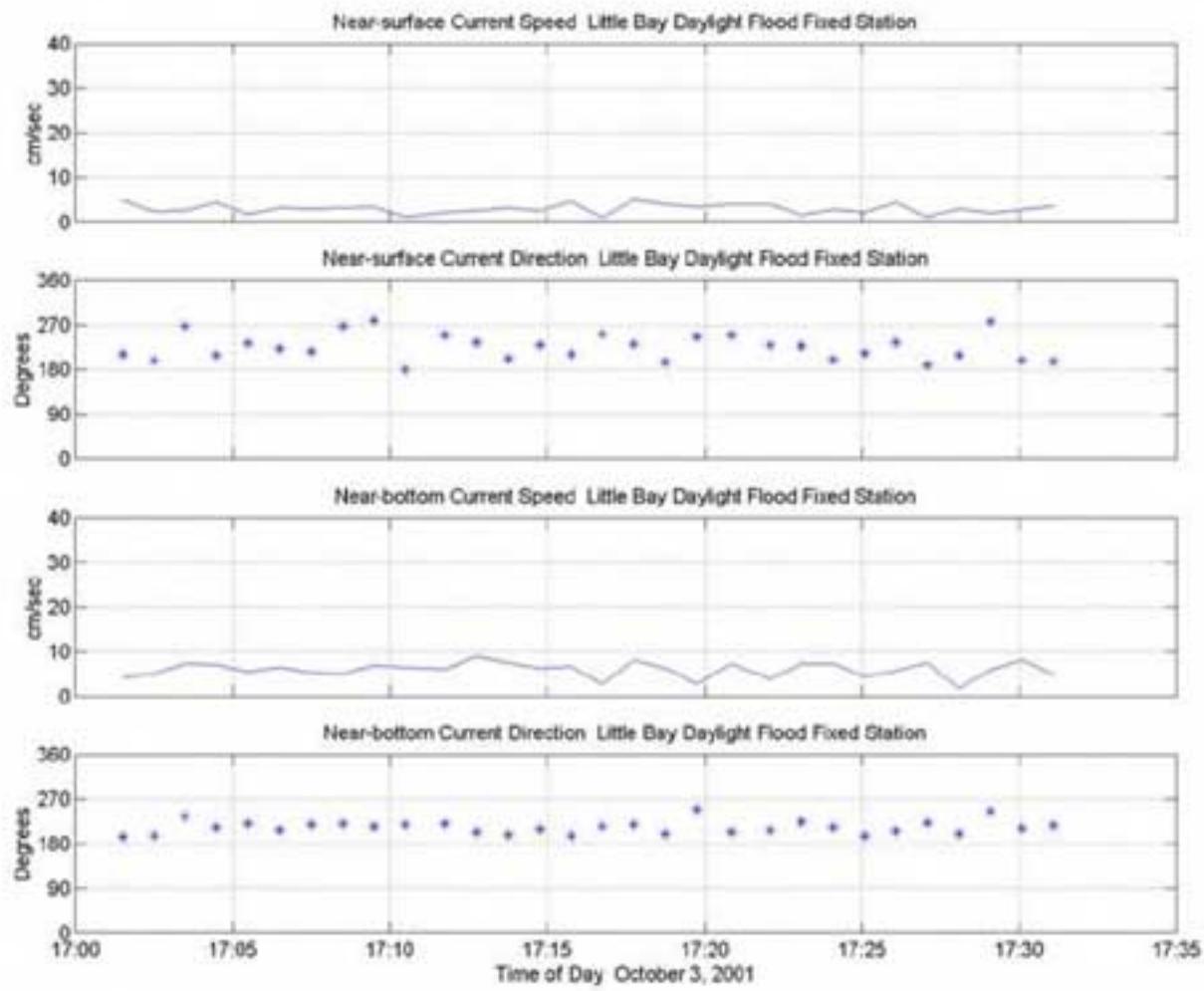


Figure 3-6. Near-surface and near-bottom current speed and direction at the Little Bay fixed station. Data collection began at 5:01 p.m. on 3 October 2001 during a flooding tide. High tide was at 4:14 p.m.

Little Bay clearly illustrate the weak tidal currents in both of these embayments. The fixed station data provide better data quality due to the minimal vessel movement and therefore provide even stronger evidence of the predominance of weak currents within Little Bay and Norton Basin.

Peak ebb tide current speeds did not exceed 5 cm/sec. **Figures A-11 to A-13** depict ebb tide currents for Norton Basin, and **Figures A-27 to A-29** present ebb tide currents for Little Bay. Flood tide currents were stronger, with peak speeds of about 30 to 35 cm/sec and sustained speeds on the order of 10 to 20 cm/sec. These relatively high-speed flood currents were observed primarily in the Norton Basin entrance channel (**Figures A-18 to A-20**). The flood currents observed in the Little Bay entrance channel (**Figures A-33 to A-35**) also were stronger than ebb currents, on the order of 5 to 10 cm/sec, but were weaker than those in the Norton Basin entrance channel.

As mentioned previously, stronger flood currents may have resulted from tidal asymmetry but also may have been due to a south wind that strengthened during the afternoon. These south winds may have further prolonged the ebb phase of the tide, developing a northward-directed wind stress at the surface. As a result, flood currents would have to be stronger than ebb currents to conserve volume between consecutive flood/ebb cycles (i.e., because the duration of flood tide is short relative to ebb tide, flood speeds must be greater to allow the same water volume into the system). The brief peak in velocity to 30 to 35 cm/sec observed about 5:47 p.m. suggests flood currents surging into the channel during a short lull in wind intensity (**Figure A-18**).

**Figure 3-7** depicts the ebb tide and flood tide vertically averaged current vectors from Norton Basin entrance channel transects. Currents measured along the Norton Basin entrance channel transects, when valid (data quality was adequate and the software did not reject the measurements), showed a strong flood phase through the channel at about 8:00 p.m. Flood currents were about 15 cm/sec, strongest in the narrow constriction and weakening within Norton Basin where the embayment widened. Ebb currents did not exceed the instrument noise levels (about 3 cm/sec). Profiles from the ebb tide and flood tide transects in the Norton Basin entrance channel are presented in **Figures A-36 and A-37**.

**Figure 3-8** depicts vertically averaged current vectors in the Grass Hassock Channel transects during ebb tide and flood tide. Ebb currents in Grass Hassock Channel, measured just after high water between 10:15 a.m. and 11:30 a.m., were aligned parallel with the channel axis, flowing southwest at about 20 cm/sec. Currents appeared to strengthen with time; the last transect (about 11:30 a.m.) recorded the strongest flow. Flood currents in Grass Hassock Channel were about the same magnitude as ebb currents, however, they were reversed and flowing northeast. A countercurrent was observed along the northern bank of the channel, approximately near the entrance to Big Mucks Creek. Bathymetry shows a slight shoal along this bank. This shoal feature protruding into the channel may cause the observed countercurrent. Profiles from the ebb tide and flood tide transects in Grass Hassock Channel are presented in **Figures A-38 to A-45**.

The current observations made in this study support observations made in a previous ADCP study where low current velocities also were measured within Little Bay and Norton Basin. Current velocities were generally near zero in both embayments except in the entrance channels. Substantially higher sustained current velocities also were observed in

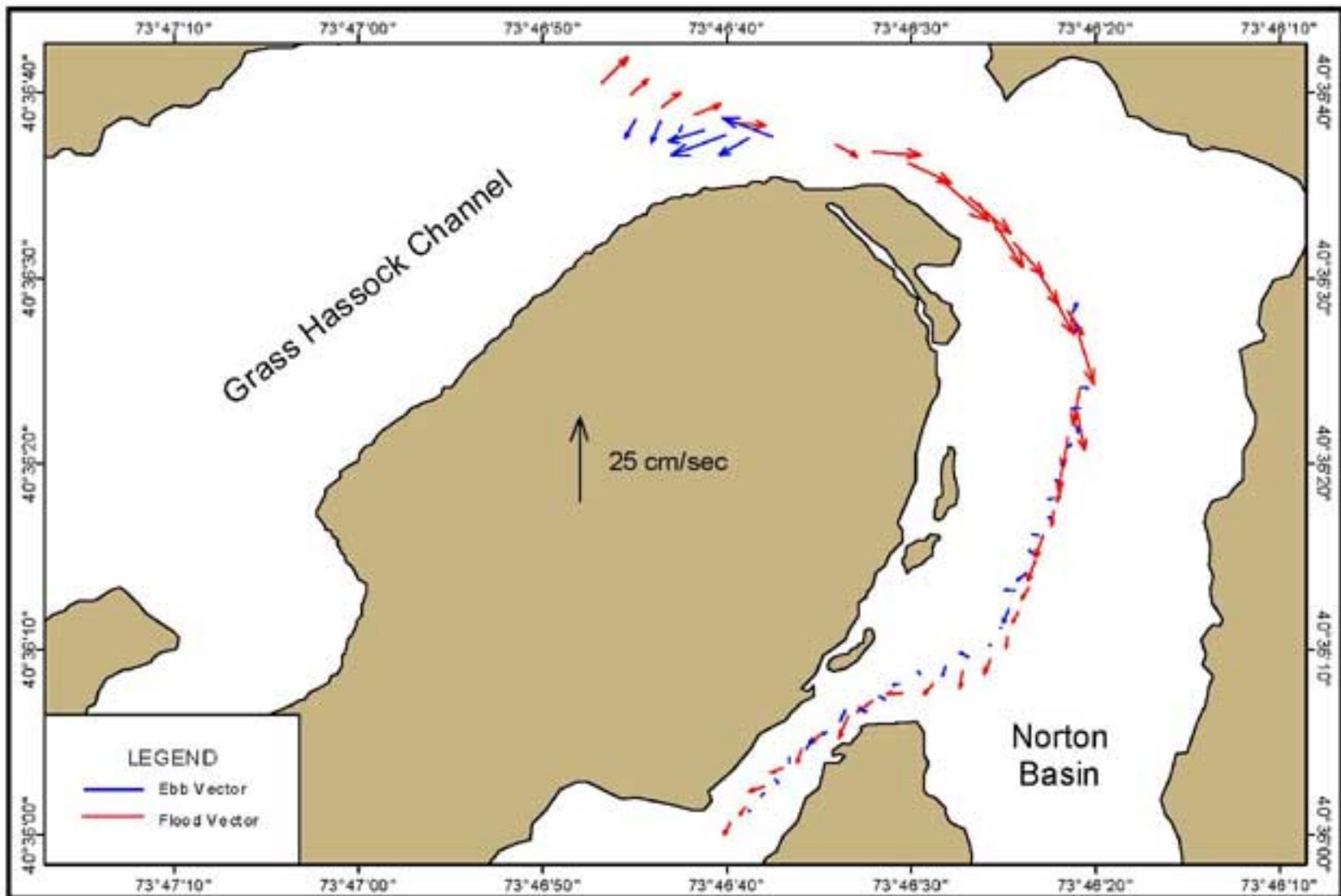


Figure 3-7. Vertically averaged current vectors from acoustic Doppler current profiler transects surveyed on 3 October 2001 in the Norton Basin entrance channel during ebb and flood tides.

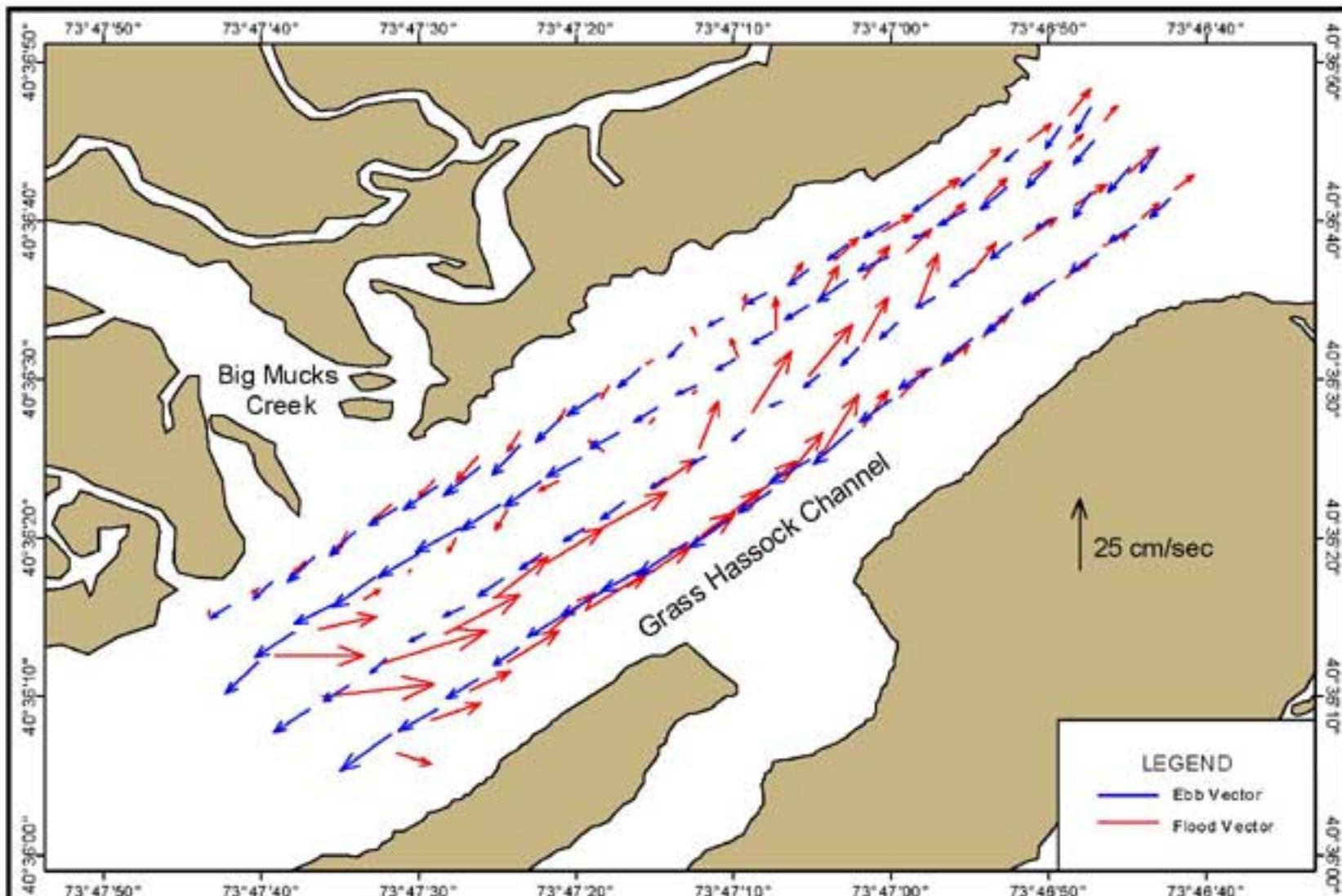


Figure 3-8. Vertically averaged current vectors from acoustic Doppler current profiler transects surveyed on 3 October 2001 in Grass Haddock Channel during ebb and flood tides.

the tidal channels (e.g., in Grass Hassock Channel) compared to the embayments, as was reported in the previous study (Continental Shelf Associates, Inc., 2001).

Poor hydrodynamic mixing, particularly in Little Bay and to a lesser extent in Norton Basin, results in stagnant conditions and allows thermoclines that stratify the water column to set in. Stratified conditions in the water column would allow oxyclines to develop and persist by limiting water exchange between the oxic surface waters and deeper waters where oxygen production is limited and oxygen consumption is high. These conditions may explain the persistence of very cold water and anoxic conditions at the bottom of Little Bay throughout the summer observed during water quality surveys. The cold bottom water layer and anoxic conditions do not persist in Norton Basin where better tidal exchange may be inferred from the stronger currents and proximity to Grass Hassock Channel. Minimal water movement in deep pits may also contribute to degraded conditions by trapping decaying organic matter that promotes and sustains the highly eutrophic conditions observed in the water quality surveys. Minimal water movement due to weak currents and a highly stratified water column coupled with high concentrations of dissolved nutrients and hydrogen sulfide in the deep pits observed in water quality surveys would also contribute to the persistence of anoxic conditions.

## 4.0 SUMMARY

Tidal observations were made in Norton Basin, Little Bay, and Grass Hassock Channel on 3 October 2001 to support a fish bioacoustics survey conducted simultaneously by USACE WES researchers. Current velocity and direction were measured using an ADCP along transects and at fixed stations during ebb and flood phases of the tide in Norton Basin and Little Bay, while along the Norton Basin entrance channel and in Grass Hassock Channel, only transects were surveyed.

Summaries of the transect data were prepared as vertically averaged current vectors. Temporally averaged summaries for near surface and near bottom were prepared from fixed station data. Actual data were plotted as profiles of current velocity and direction for all transects and fixed stations.

Results of the survey and data analysis show that tidal currents were strongest in Grass Hassock Channel and weakest in the semi-enclosed basins in Little Bay and Norton Basin. Because Grass Hassock Channel is a throughflow region or conduit for tidal flow into the upper reaches of southeastern Jamaica Bay, stronger tidal currents within the channel would be expected. Weak currents within Little Bay and Norton Basin, where deep borrow pits exist, imply that there is poor hydrodynamic mixing between Jamaica Bay proper and the Norton Basin/Little Bay complex. This reduced water exchange may result in degradation of water quality and estuarine health. The presence of a narrow entrance channel with a shallow sill downstream of the Norton Basin complex contributes to poor exchange of water between the deep semi-enclosed basins and the main tidal channels in Jamaica Bay.

Results of the current measurements would suggest that recontouring the bottom of Little Bay and Norton Basin by filling in the deep borrow pits could reduce the water volume in the semi-enclosed basins relative to the tidal prism and enhance water exchange between the surface and near bottom waters and between Jamaica Bay and the restricted embayments. Water exchange also would be enhanced by dredging of the entrance channel needed for the bottom recontouring. Shallower depths and enhanced tidal mixing likely would prevent stratified conditions from occurring and persisting.

## 5.0 REFERENCES

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