Dynegy Moss Landing, LLC

2010 NPDES Hydrographic Survey and Intake Approach Velocity Monitoring

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Submitted to:

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ESLO2010-026

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1.0 Introduction

The Moss Landing Power Plant (MLPP) is a four-unit fossil fueled electrical generating facility located on the shoreline of Monterey Bay approximately midway between Santa Cruz and Monterey, California and about 12 miles northwest of the city of Salinas. The power plant consists of two units constructed during the mid 1960's (Units 6 & 7) with a generating capacity of 754 and 755 Megawatts (MW) respectively, and two new units (Units 1 & 2), with a generating capacity of 510 MW each, that began commercial operation in 2002. Total generating capacity of the facility is 2,529 MW. Cooling water for the facility is drawn from Moss Landing Harbor, which lies immediately west of the plant and opens into Monterey Bay. The plant utilizes two intake structures; one serving Units 1 & 2, with a maximum flow volume of 250,000 gallons per minute (gpm) and the second which supplies a maximum flow of 600,000 gpm to Units 6 & 7 . Cooling water for all four units is discharged through a pair of common conduits, which run parallel to each other to a point approximately 600 feet offshore, in Monterey Bay. Discharge of the cooling water is regulated under the National Pollutant Discharge Elimination System (NPDES). The plant operators, Dynegy Moss Landing, LLC, are required under the terms of their NPDES permit (CA0006254) Monitoring and Reporting Program – Order 00-41 issued by the California Water Quality Control Board, Central Coast Region for the Moss Landing Power Plant, to report annually the results of a hydrographic survey of the harbor bottom immediately surrounding both of the intake structures and bar rack approach water velocity measurements taken in front of each intake. The purpose of these measurements is to provide information about possible shoaling and its effects on the hydrodynamics of the intake structures. The power plant uses this information to monitor the performance of the intakes to determine if dredging is necessary to assure the intakes operate as close as possible to the original design-basis velocities.

This report presents the results of the 2010 intake area hydrographic survey conducted on September 16, 2010, and the bar rack approach velocity measurements taken at the Moss Landing Power Plant Unit 6 & 7 intake on October 14, 2010, and the Unit 1 & 2 intake on November 15, 2010. Field survey methods, plant operating conditions and field conditions are also noted within the report.

2.0 Study Methods

2.1 Hydrographic Survey

A hydrographic survey was conducted in Moss Landing Harbor on September 16, 2010 between 10:56 to 12:51 PST, which encompassed the areas adjacent to the two Moss Landing Power Plant intake structures. The area surveyed in front of Units 6 & 7 included the entire 140 ft width of the intake structure and adjacent areas, 150 feet to the south, 150 feet to the north and 275 feet to the west, offshore. The area in front of Units 1 & 2 included the entire 80 ft width of the intake structure and adjacent areas, 180 feet to the south, 200 feet to the north and 225 feet to the west, offshore.

Conditions were calm inside Moss Landing Harbor with no swell, low winds, and foggy skies. The survey was conducted following the higher low tide of 3.0 ft MLLW that occurred at 08:14. It finished before the 4.7 ft MLLW high tide that occurred at 14:36. Mean tide height during the survey was 3.9 ft MLLW with minimum and maximum tide heights of 3.5 ft and 4.3 ft MLLW.

Moving map navigation software running on a Dell Latitude laptop computer connected to a differential global positioning system (DGPS) was used for piloting an outboard powered 13 ft boat along predetermined set of tracks perpendicular to the shore with 15 ft spacing (**Figure 2-1**). A second set of tracks was made at right angles, i.e. parallel to shore, with 20 ft spacing for quality assurance and correcting any time lags between soundings and positions. Depth measurements were made at a rate of 5 per second (5 Hz) with a BioSonics DTX digital echosounder and 199 kHz 6.5-degree (full beamwidth at half power) transducer submerged about 1.1 ft and connected to a Panasonic Toughbook laptop computer. Laptop computer time was synchronized with UTC using the DGPS and computer program, NMEATime. The resolution of the range measurement was 1.8 cm. Water column measurements made at a 5 Hz rate including bottom reflections and UTC times were recorded on the computer disk for later processing.

Vertical and horizontal positions of the transducer were recorded at a rate 5 Hz using a Sokkia model GSR2650LB L1/L2 geographic positioning system (GPS) mounted 7.79 ft vertically and directly above the transducer's face. Novatel's Waypoint GrafNav post-processing software was used for estimating survey quality horizontal and vertical positions in the NAD 83 and NAVD 88 reference frames using two nearby GPS Continuously Operating Reference Station (CORS) P210 and P211) P210 is in Watsonville, CA (DI7526 CORS) and P211 is in Pajaro, CA (LewisRdLflCN2007). During the 2010 survey, the Sokkia GPS had only the L1 frequency operational.

Digital bottom depths from the echosounder data were post-processed using BioSonics Visual Analyzer software for outputting depth and time in ASCII format. A bar-check calibration of the echosounder was performed using a 7-inch disk at depths of 5, 10 and 15 ft showed that a 0.026 m additional depth correction was necessary. A latency correction (the difference between the

echosounder time and the GPS time) was calculated using data from a crossing of the two sets of tracks using an automated program written in the R statistics package. The soundings and the horizontal and vertical positions were merged in ArcView GIS for creating a bathymetric surface. All depth data were referenced to MLLW by using a -0.14845 ft correction from NAVD 88 elevations. This correction was derived from the Vertical Datum Transformation Software (VDatum ver. 2.2.7) provided by NOAA National Ocean Service where NAVD 88 is 0.14845 ft lower, relative to MLLW.

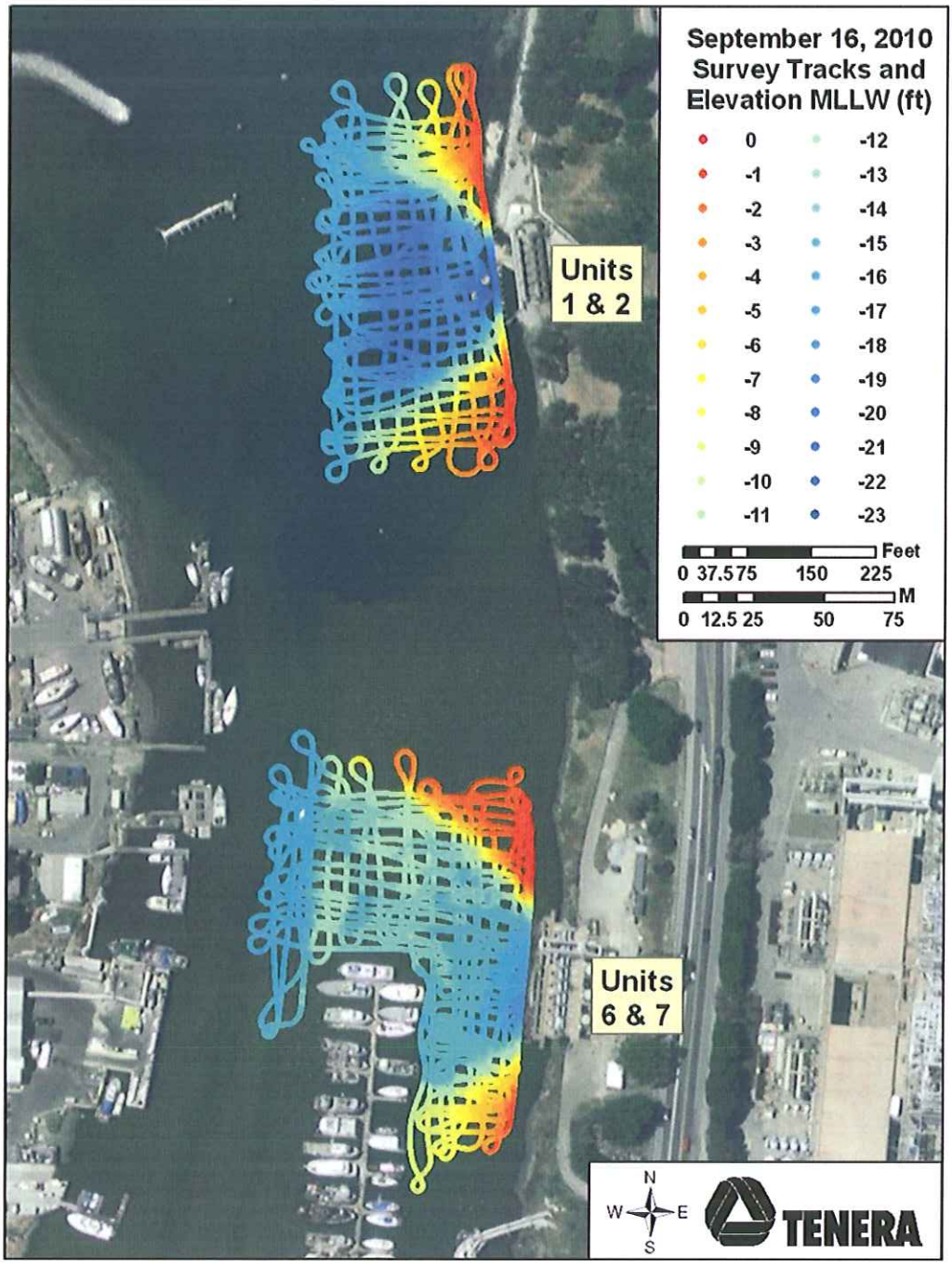

Figure 2-1. Hydrographic survey track at the Moss Landing Power Plant intake area. The figure shows the boat's track and bottom elevation (MLLW) while performing the hydrographic survey in front of Units 1 & 2 (at north) and Units 6 & 7 (at south) on September 16, 2010.

2.2 Intake Approach Velocity Measurement

Normally, intake approach velocity measurements at the Units 1 & 2 and Units 6 & 7 intakes are conducted on the same day. This tends to reduce variability in the test conditions (tide, weather, water temperature and salinity, etc.), and also minimizes the manpower requirements of the surveys. Surveys are usually planned during neap tide periods (half-moon phases) when the amplitude of the tidal fluctuations (differences between high and low tide heights) is reduced in comparison with spring tides (full moon or new moon phase). This year, due to repeated influxes of large jellyfish during neap tide periods, no measurements could be taken in August or September. Surveys of both intakes were rescheduled for October 14, 2010, and the Unit 6&7 intake was surveyed on that date. However, maintenance problems with one of the Unit 2 traveling water screens (TWS) made it inoperable at that time and the survey of the Unit 1&2 intake was postponed until November 15, 2010. As a result, the approach velocity measurements in front of the Units 1 & 2 intake structure were made on November 15, 2010 between 10:47 and 14:02 PST, while the Unit 6 & 7 measurements were taken on October 14, 2010 between 09:08 and 10:59 PST. Velocities at the Units 1 & 2 intake were measured with water level starting at 2.28 ft and ending at 1.98 ft above MLLW around the day's lower high tide of 1.74 ft MLLW (**Figure 2-2**). Velocities at the Units 6 & 7 intake were measured beginning on a falling tide just prior to the day's higher low water from 2.95 ft to 2.93 ft above MLLW and ending at 3.14 ft MLLW. Tidal heights during both periods were estimated from the NOAA predictions for Moss Landing Harbor at the Highway 1 Bridge at Elkhorn Slough using Nobeltec Tides and Currents software.

All four of the Units 6 & 7 circulating water pumps (CWPs) (nominal flow of 600,000 gpm) were in service when the intake velocities were measured. Likewise, all six of the Unit 1 & 2 CWPs (nominal flow of 250,000 gpm) were operating during the survey of that intake structure. The Unit 1 & 2 bar racks were cleaned of debris just prior to the November 15th survey. It should also be noted, that the Units 1 & 2 and Units 6 & 7 intake structures are separated by more than 200 yards and the operational status of one does not significantly affect the flow dynamics of the other.

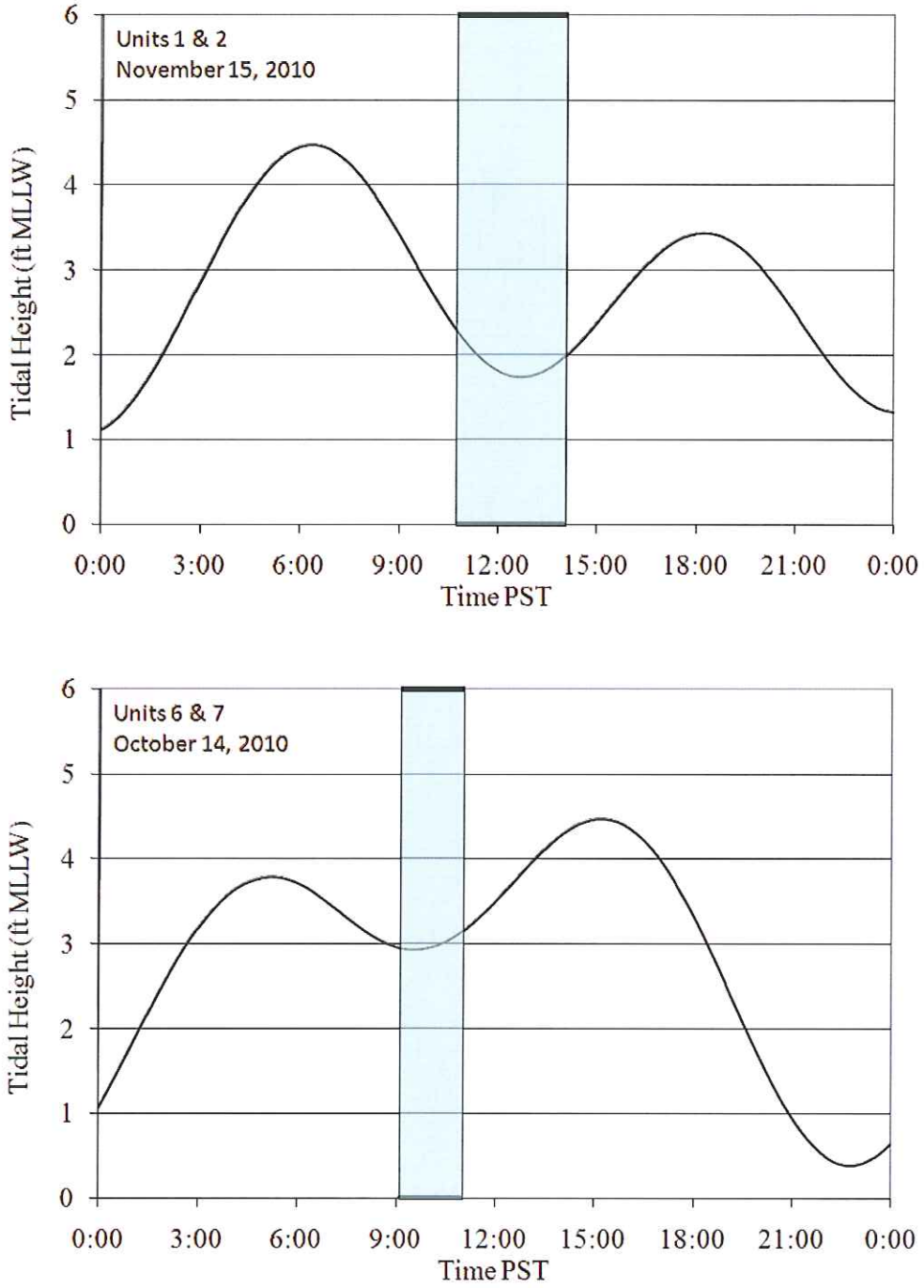

Figure 2-2. Tidal heights from NOAA tide predictions for Moss Landing Harbor on November 15, 2010 (Units 1 & 2 10:47 to 14:02 PST), and October 14, 2010 (Units 6 & 7 09:08 to 10:59 PST). Shaded times correspond to measurements of bar rack approach velocities at Units 1 & 2 and Units 6 & 7 intake structures of the Moss Landing Power Plant; minimum, maximum, and average tides during the survey periods were 2.93, 3.14, and 2.99 ft MLLW at Units 1 & 2 and 1.74, 2.28, and 1.88 ft MLLW at Units 6 & 7.

The Moss Landing Power Plant Units 6 & 7 intake structure consists of eight intake bays serving the four CWPs. Geographically, the northernmost pair of intake bays provides cooling water to the 6-1 CWP with successive pairs of bays directing water to the 6-2, 7-1, and 7-2 CWPs respectively. A curtain wall extends from the intake structure deck and underwater to an elevation of -3.3 ft MLLW. The constructed bottom of the intake bay opening is approximately 30 ft below the 12.66 ft MLLW intake deck level at -18.34 ft MLLW. The original design basis approach velocity estimate at the bar racks is 0.8 feet per second (fps).

The layout of the Units 1 & 2 intake structure differs in a number of ways from that of Units 6 & 7 . Most notably, the Units 1 & 2 CWPs are not located at the intake structure, but are positioned approximately 350 feet east of the intake and are connected to the intake by a pair of conduits that extend under California Highway 1. The traveling water screens (TWS), used for removing debris from the cooling water prior to its arrival at the CWPs, are located at the intake and, as a result, the intake structure is divided into six bays to accommodate this equipment. A single large bar rack lies in front of and extends across the entire width of the intake structure, as opposed to the individual racks found in each bay of Units 6 & 7 intake. The curtain wall originally extended to a depth of -8.0 ft MLLW but was modified during modernization of the plant and now extends below the waterline to a depth of about 0.0 ft MLLW. The bottom of the intake bay opening is at approximately –20.4 ft MLLW. The original design-basis estimate of approach velocity at the bar rack is 0.5 fps.

Intake velocities at the Units 6 & 7 intake structure were measured with a 1 MHz Sontek Acoustic Doppler Profiler (ADP). An ADP measures the velocity of water using the physical principal called the Doppler shift. Sound is broadcast and received in three piezo-ceramic transducers pointed 25 degrees from the central axis, each measuring a Doppler shift in frequency. As particles in the water move away, the frequency of the reflected sound wave decreases. Conversely as particles in the water move toward each ceramic, the frequency of the reflected sound wave increases. By comparing the three measurements, direction and speed is estimated. By measuring the return signal at different times, the ADP measures the water velocity at different distances from the transducer, giving a water column profile of velocities.

The ADP was mounted downward on the end of a length of 2.0 inch, fiberglass tubing and 1¼ inch pipe (**Figure 2-3**). It was deployed from the railing of the floating dock that extends along the entire length of the intake structure, and was positioned in front of the middle of each of the intake bays during the survey. The depth of the ADP's head and piezo-ceramics was 3.0 ft below the surface, at a distance of approximately 9.75 ft horizontally from the intake structure. The elevations of the ADP's samples were referenced to MLLW by measurement of the intake structure deck. The deck elevation was determined in 2005 by using a survey quality GPS over several points on the intake structure's deck. This survey also estimated the orientation of the intake structure from true north. It was found that Units 6 & 7 had a deck elevation of 12.66 ft MLLW with orientation of 5 degrees using a temporary benchmark in conjunction with other nearby recent benchmark measurements.

Intake velocities at the Units 1 & 2 intake structure were measured with a Nortek 1 MHz Aquadopp ADCP with "horizontal-type" housing configuration. This instrument was used in preference to the Sontek ADP in order to avoid the individual beams spreading through water parcels moving in different directions as discussed below. Each intake profile was measured by lowering the ADCP to the bottom of the intakes' bar rack on a 5 ft long sled, and then raising it in 4 ft increments. The horizontal housing allowed the ADCP boresite to point perpendicularly from the intakes' bar rack. The ADCP was mounted with a US Digital three-axis inclinometer above the ADCP in the 2 ft X 5 ft frame (**Figure 2-4**). The outward tilt from vertical was recorded and the roll was compensated to zero with the lowering ropes. As in the case of Units 6 & 7, water velocity measurement locations were referenced to intake deck elevation. The deck elevation at Units 1 & 2 was 9.6 ft MLLW with orientation of 354 degrees.

At Units 1 & 2, the ADCP (**Figure 2-5**) was lowered on the 13 to 15 degree slope from vertical of the bar racks and pointed from the bar racks approximately 14.5 degrees up from horizontal. The deployment, used to avoid a long profile across non-homogeneous velocity water, required analysis of data originating from limited beam spread. The ADCP, pointing outward from the bar racks, used a 0.25 m blanking distance prior to 0.25 m data bins. At each elevation the closest two 0.25 m bins were analyzed for velocity measures. Speeds and velocity vectors were estimated by averages of the two cells. Currents were measured in the 0.25 m cell in three vector directions: x'', y'' and z''. The instrument's x"-axis was oriented downward about 14.5 degrees from vertical, with the z"-axis pointed 14.5 degrees up from horizontal away from the structure at Units 1 & 2. This orientation required rotations using tilt angles measured by the inclinometer in post-processing to produce x, y and z current vectors that are perpendicular and parallel to the intake structure. The transformation of the coordinates is shown in **Figure 2-6**.

At Units 6 & 7, one beam (corresponding to the ADP's x"-axis) was oriented toward the intake and all beams pointed 25 degrees from vertical. At Units 6 & 7 the final coordinates required rotations using the measured very slight pitch and roll. Once pitch and roll corrected measurements orthogonally to horizontal, the x and y axes were switched for reporting purposes: y toward intakes, z upward and x along the intake structure. The ADP used at Units 6 & 7 had a blanking range of 0.7 m over which data could not be taken due to the nature of the acoustic transmitter. Recording cell size was set at a bin width of 0.5 m. At each intake bay, the average and amplitude of the velocity vectors were recorded over nine 60-second intervals. Significant amplitude of the acoustic return signal was monitored in each elevation bin to determine if the bottom or structure interfered with the measurements. The range bin in which the signal amplitude of the acoustic return was greater than the preceding range bin determined the acoustic bottom because the bottom signal was strong relative to water column scatterers.

At Units 6 & 7, it was determined that between seven and eight good quality data bins were available. Elevations ranged from –3.5 to –15.1 ft MLLW. In addition, a lead line was lowered from the intake structure dock to the intake sill at the centerline of each of the bays to confirm the depth bin in which the bottom was detected acoustically. Longer (deeper) ranges were found at 7-3 and 7-4 while 6-1 was the shortest (shallowest).

In summary, during velocity measurements at Units 1 & 2, the closest two 0.25 m data bins were used for intake velocity estimates to avoid beams spreading from one another into parcels of water moving in different directions. The ADCP was lowered and recorded nine to twelve 30-second sets of velocities at each of four different elevations that ranged from –2.9 to –14.5 ft MLLW.

Figure 2-3. Sontek Acoustic Doppler Profiler (ADP) used for measuring intake approach velocities at the Moss Landing Power Plant Units 6 & 7 intake.

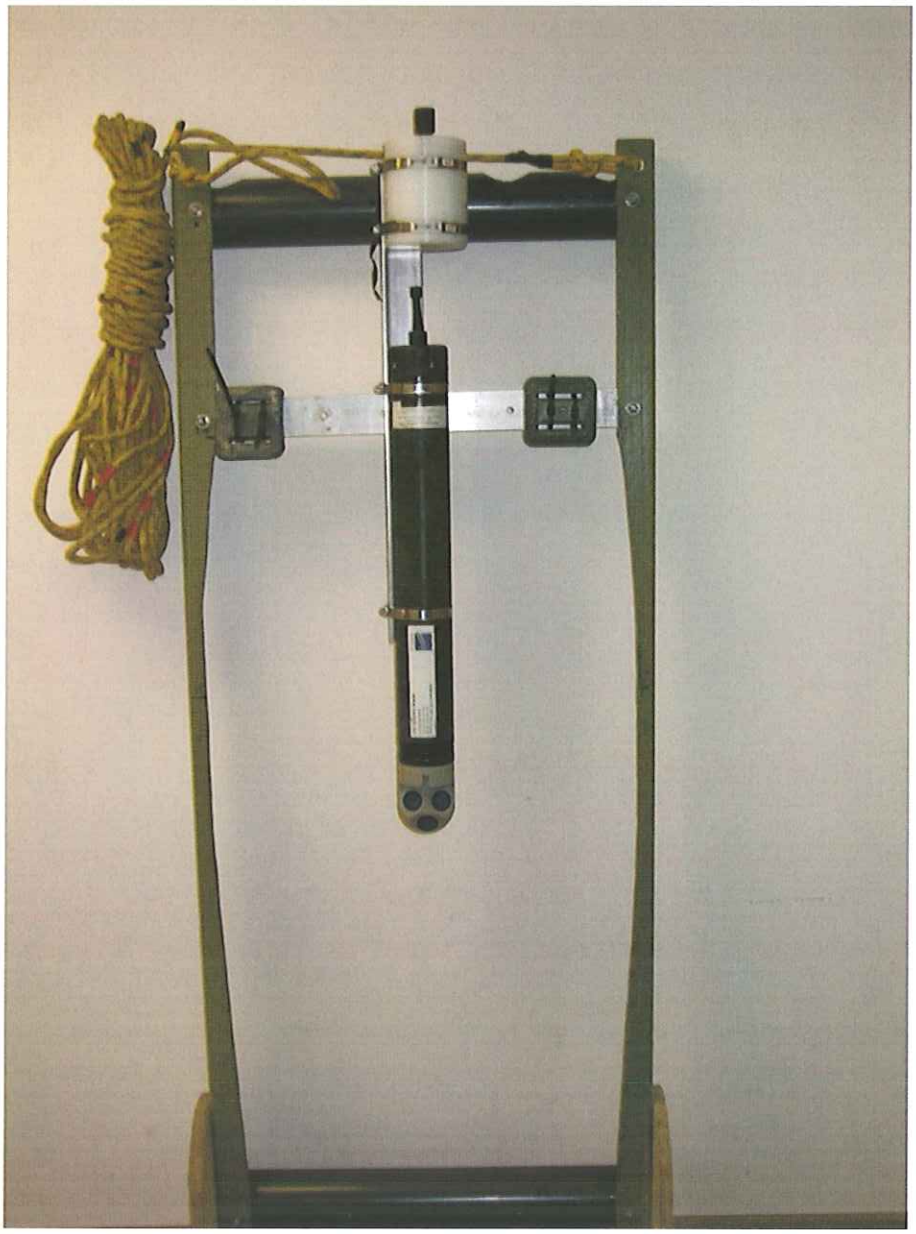

Figure 2-4. Nortek Acoustic Doppler Current Profiler (ADCP) mounted on a sled in a horizontal pointing direction prior to measure intake approach velocities at the Moss Landing Power Plant Units 1 & 2 intakes. Three-axis inclinometer in white housing (above ADCP) allows real time measurement of vertical tilt and adjustment of roll.

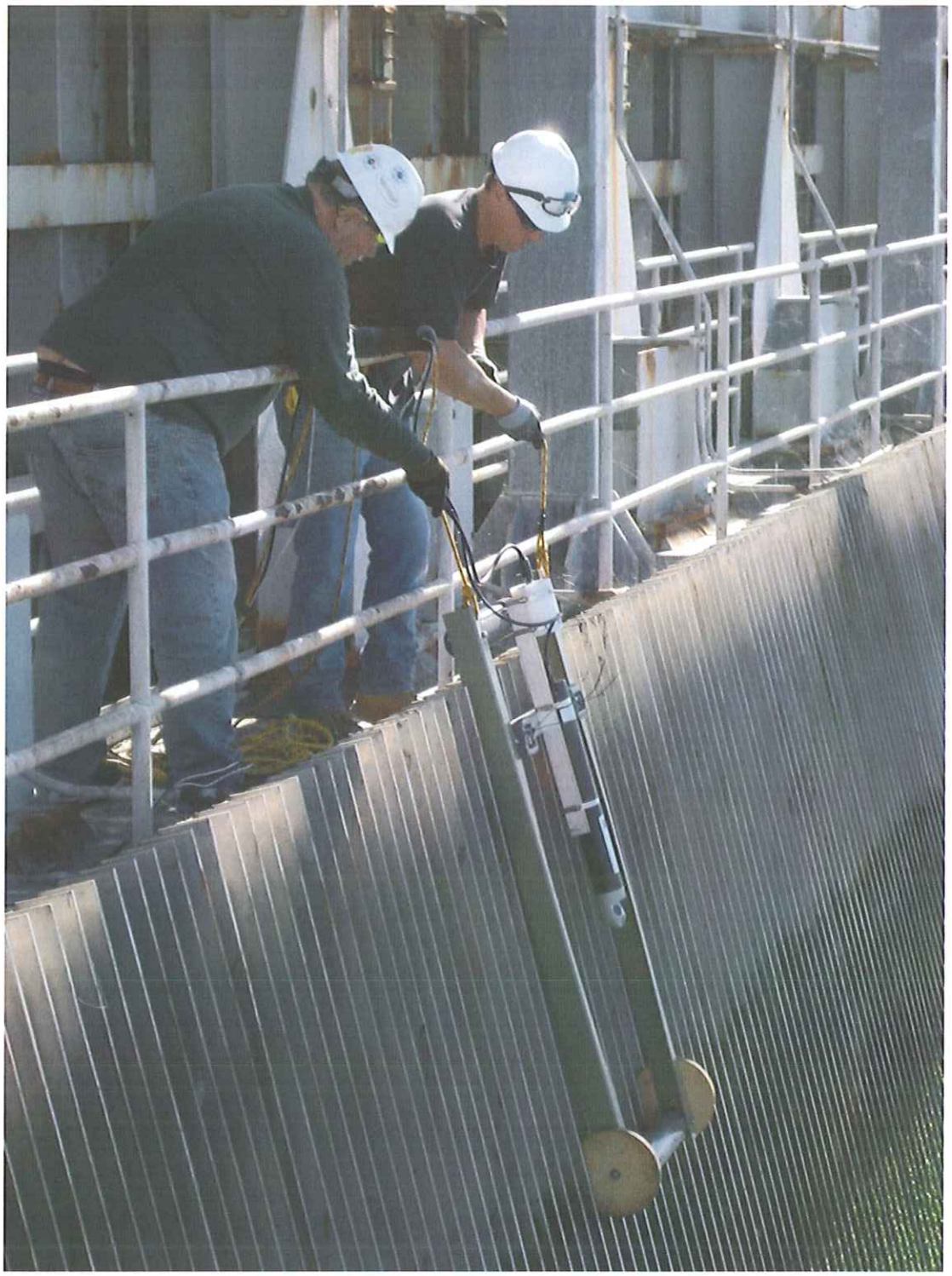

Figure 2-5. Deployment of the Nortek Acoustic Doppler Current Profiler (ADCP) at Units 1 & 2 intake structure during the November 15, 2010 approach velocity measurement survey.

The z''-x'' plane was rotated $\alpha = 14.5°$ about y':

$$z' = x''\sin\alpha + z''\cos\alpha$$
$$x' = x''\cos\alpha - z''\sin\alpha$$

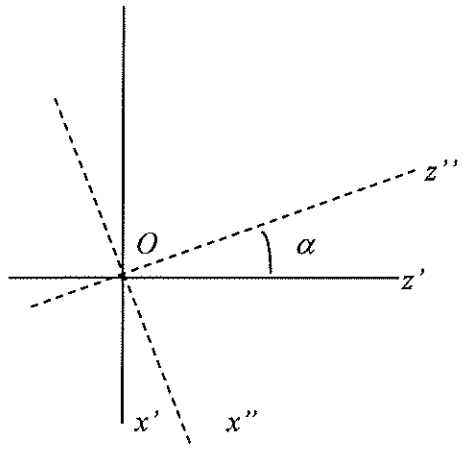

Figure 2-6. At Units 1 & 2, transformation of coordinates involved a rotation for analysis and visualization. The ADCP x''-axis was positioned downward and the z"-axis about 14.5° from horizontal from the intake bar structure at the Moss Landing Power Plant, Units 1 & 2, November 15, 2010. Drawing above illustrates the rotation about the ADCP y'-axis, with z''-axis directed away from intakes. In the final coordinates: y = -z'; x=y'; z=-x'.

3.0 Results

3.1 Hydrographic Survey

The elevations recorded during the September 16, 2010 hydrographic surveys are shown in **Figures 3-1** and **3-2**. **Figure 3-1** shows the bottom elevations in the vicinity of the Units 6 & 7 intake bays. Directly west of the intake and out 180 ft, bottoms ranged between –8.8 ft and –18.3 ft MLLW with an average depth of –15.6 ft MLLW and standard deviation of 1.1 ft. The deepest area in this zone was found 20 feet in front of Unit 7. The elevations in the overall area surveyed ranged from –0.7 ft to –18.3 ft MLLW with average of –11.5 ft MLLW and standard deviation of 5.0 ft. Soundings west-southwest under the boat slips and adjacent to the harbor inner channel were not collected and therefore did not overlap with the east edge of the inner channel. Soundings (**Figure 3-1**) detected shoaling about –13.8 ft MLLW approximately 235 and 280 feet west of the intake and between the intake and the harbor inner channel (designed elevation of –15 ft MLLW). A channel approximately –14 to -15 ft MLLW deep lies north and east of this shoal and leads northwest to the harbor inner channel where depths are about –15 ft MLLW. Shallowest elevations were found in the undredged area north of the intake structure near the shore.

The bottom elevations of the topographic surface estimated in 2010 were generally shallower than 2009 west of the Units 6 & 7 intakes with an average depth change of 0.5 ft. Overall area depths were shallower by 0.5 ft.

Figure 3-2 presents the water depths directly in front of the Units 1 & 2 intake bays and out 225 ft due west, as far as the east edge of the harbor inner channel. Within 180 ft of the intake structure elevations ranged between –10.8 ft and –22.8 ft MLLW with an average of –20.0 ft MLLW and standard deviation of 1.5 ft. The deepest area in this zone was found 31 feet directly in front of Units 1 & 2. Another deep area to 21.6 ft lay 110 ft offshore. Elevations in the overall area surveyed ranged from –1.1 ft to –22.8 ft MLLW with average of –14.0 ft MLLW and standard deviation of 6.0 ft. Shallowest elevations were found north and south of the intake structure. As in previous surveys made 2004 through 2009, a relatively flat area about –21 ft MLLW was found. It is approximately 95-140 feet in front of Unit 2 that separates the two deeper regions. Harbor inner channel elevations were approximately –16.8 ft MLLW.

The bottom elevations of the topographic surface estimated in 2010 were also generally shallower than 2009 west of the Units 1 & 2 intakes with an average depth change of 0.5 ft. Overall area depths were also shallower by 0.6 ft.

Table 3-1 presents the elevations at each intake out approximately 14 ft in front of Units 6 & 7 and out 26 ft in front of Units 1 & 2. **Figures 3-3** and **3-4** show that, at both Units 6 & 7 and Units 1 & 2, shallower approach bathymetry is found at the ends of the intake structures.

Lead line measurements indicated that the annual change in depths 10 ft offshore of the Units 6 & 7 intake in 2010 ranged between +0.88 ft (shallower) to –1.22 ft (deeper) averaging +0.02 ft

(shallower) than in 2009 (**Table 3-1**). Across Units 6 & 7 intakes, echosounder depths in 2010 were shallower averaging a difference of 0.69 ft (**Figure 3-3**). Perpendicular transects away from the intakes and out 250 ft averaged 0.56, 0.41, and 0.60 ft shallower from north to south (**Figure 3-5**) than those made a year earlier. At Units 1 & 2 (**Figure 3-4**), average depth was 0.87 ft shallower across the intake and shallower along the perpendicular transects, averaging 0.40, 0.42 and 0.41 ft shallower from north to south (**Figure 3-6**) than in 2009.

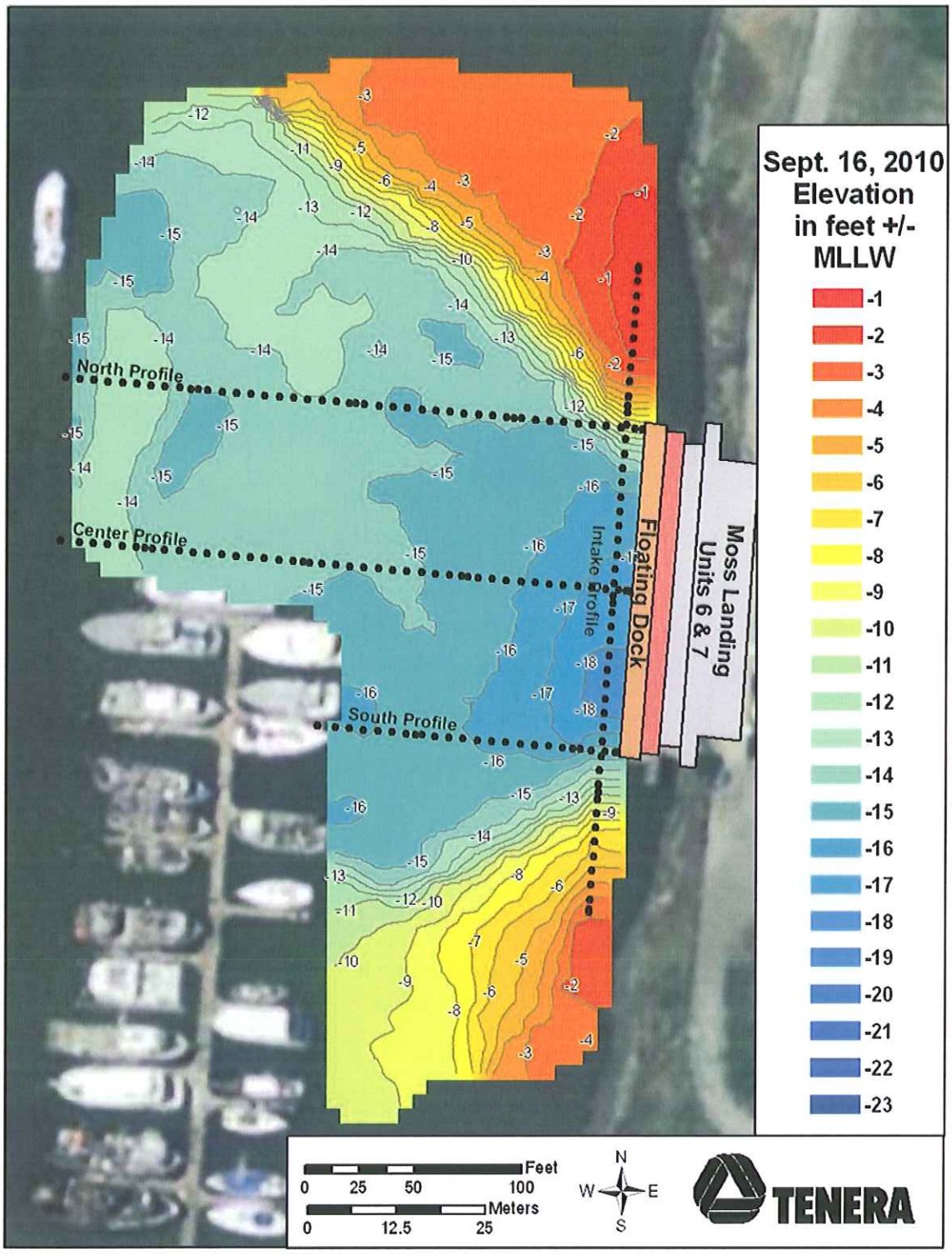

Figure 3-1. Bottom elevations near the Moss Landing Power Plant Units 6 & 7 , September 16, 2010, in feet relative to mean lower low water (MLLW).

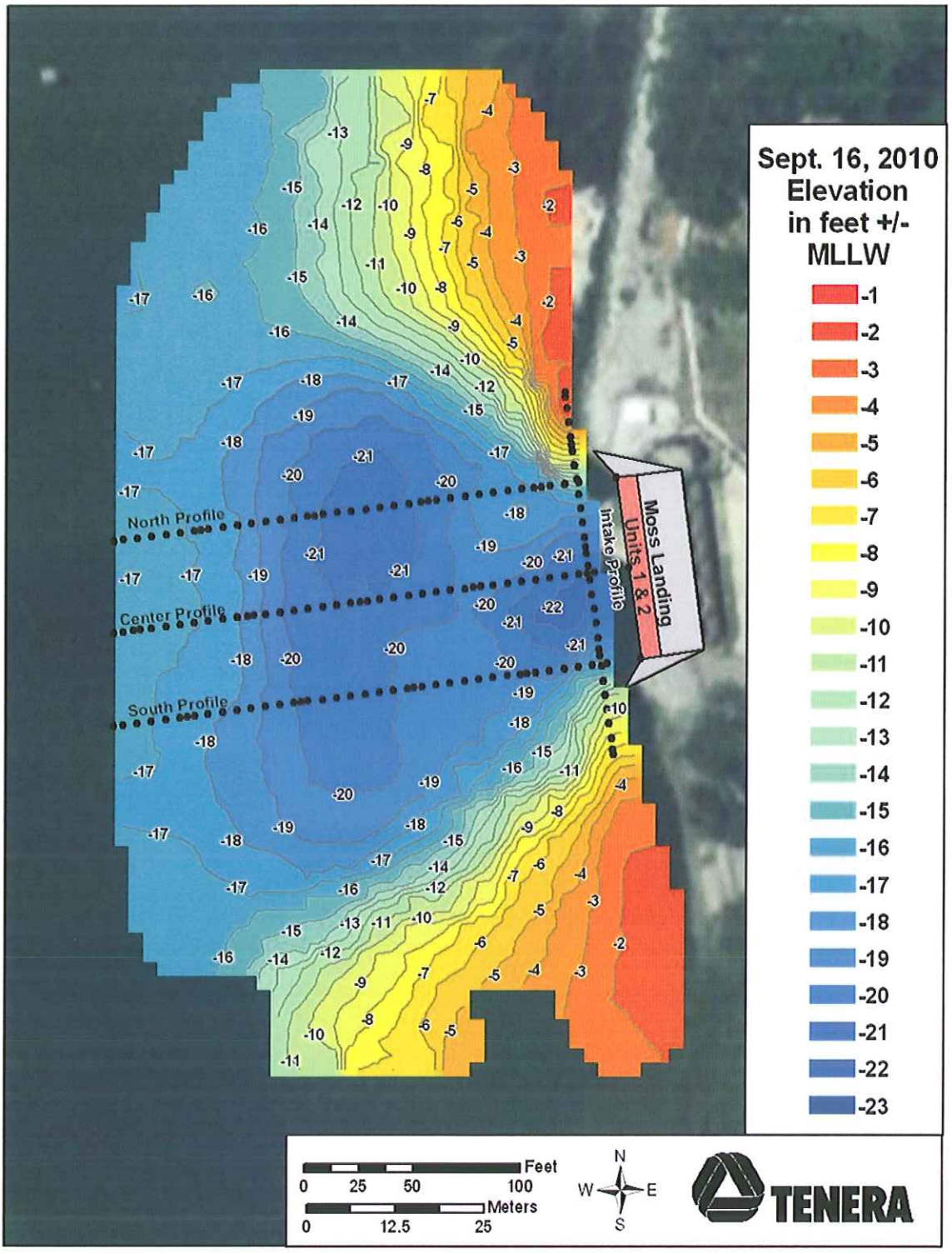

Figure 3-2. Bottom elevations near the Moss Landing Power Plant Units 1 & 2, September 16, 2010, in feet relative to mean lower low water (MLLW).

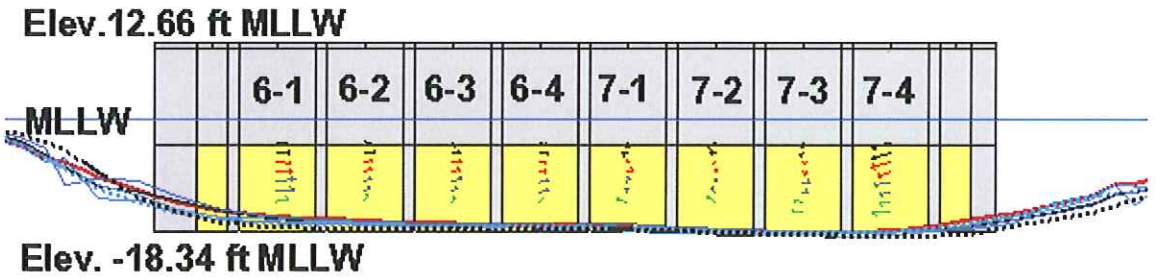

Figure 3-3. Bottom elevations in feet at Units 6 & 7 of the Moss Landing Power Plant intake structure. Profile (in red) was made about 14 ft offshore of the intake structure, from a hydrographic survey September 16, 2010. Black profile was made in 2009, light blue profile was made one year earlier (2008), blue in 2007, dark blue in 2006, dotted in 2005, and light blue dotted in 2004. View is facing the intake structure from Moss Landing Harbor.

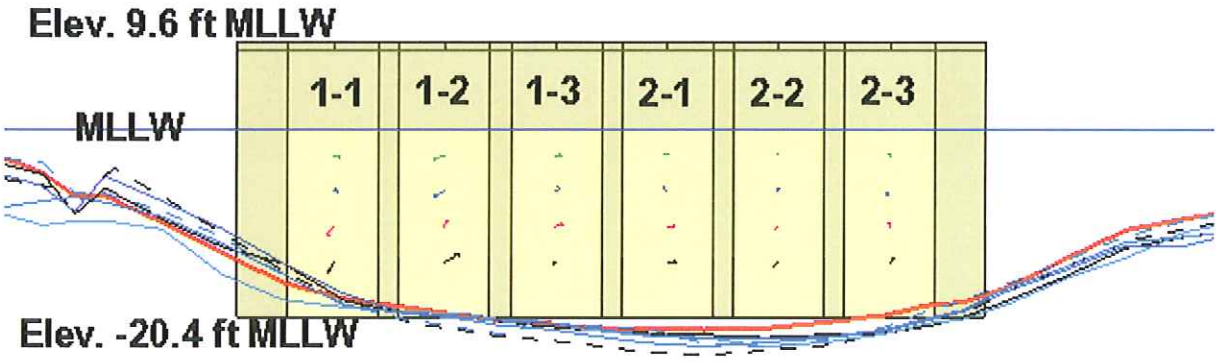

Figure 3-4. Bottom elevations in feet at Units 1 & 2 of the Moss Landing Power Plant intake structure. Profile (in red) was made about 26 ft offshore of the intake structure, from a hydrographic survey September 16, 2010. Black profile was made in 2009, light blue profile was made one year earlier (2008), blue in 2007, dark blue in 2006, black dotted in 2005, and light blue dotted in 2004. View is facing the intake structure from Moss Landing Harbor.

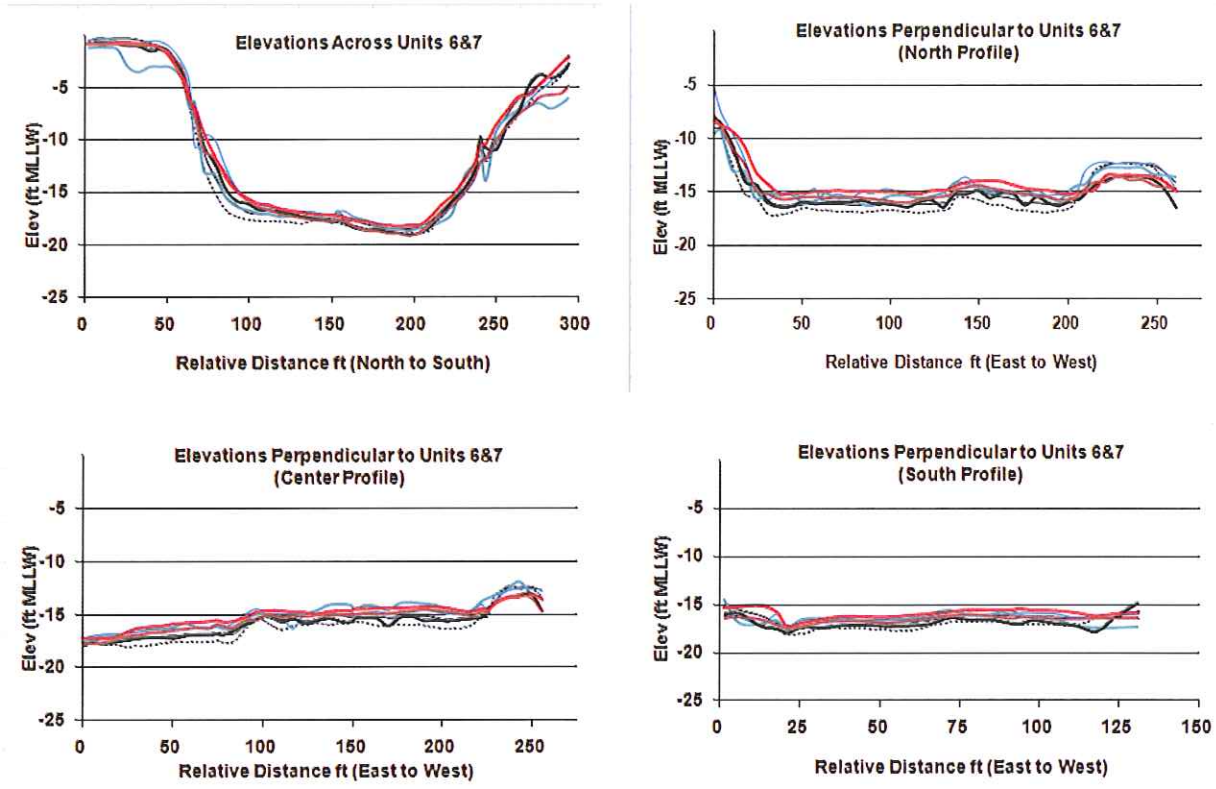

Figure 3-5. Bottom elevations of selected transects near Units 6 & 7 (2004 dashed, 2005 black, 2006 dark blue, 2007 light blue, 2008 heavy black, 2009 dull red, 2010 red).

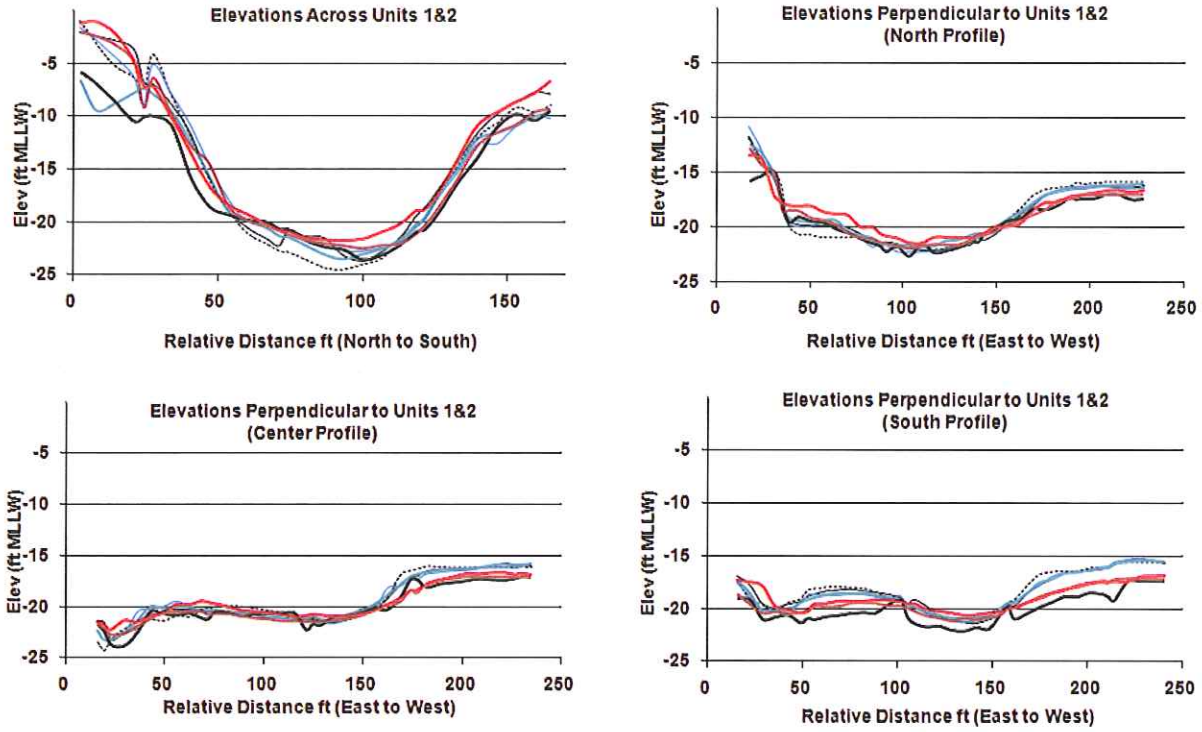

Figure 3-6. Bottom elevations of selected transects near Units 1 & 2 (2004 dashed, 2005 black, 2006 dark blue, 2007 light blue, 2008 heavy black, 2009 dull red, 2010 red).

Table 3-1. Elevations (ft MLLW) at the intake approach of Units 6 & 7 and Units 1 & 2. Lead Line measurements were taken 10 ft from the intake structure, October 14, 2010. Bathymetry elevations are interpolated from a topographic surface across the intake bay offshore from the intake structures using depths surveyed September 16, 2010. Elevations are reported from previous studies 2004-2009.

Unit 6 & 7 Intake Bay	6-1	6-2	6-3	6-4	7-1	7-2	7-3	7-4
2007 Stadia Rod Elevation at Intake	-15.5	-16.8	-16.7	-16.8	-17.0	-17.6	-18.5	-18.3
2007 Stadia Rod Elevation 10 ft Out	-16.2	-16.9	-17.2	-17.4	-17.6	-18.3	-18.8	-18.6
Unit 6 & 7 Intake Bay Lead Line Elevation 10 ft Out								
2010	-16.5	-16.8	-16.9	-17.4	-17.7	-17.9	-18.9	-18.4
2009	-15.3	-16.6	-17.0	-18.3	-18.1	-18.4	-18.5	-18.3
2008	-15.6	-16.6	-17.0	-17.3	-18.6	-18.6	-18.7	-18.9
2007	-16.0	-16.8	-17.5	-17.6	-17.7	-18.2	-18.5	-18.3
2006	-17.2	-18.4	-18.7	-18.8	-18.9	-19.8	-19.7	-19.7
2005	-15.3	-15.9	-16.4	-16.4	-16.6	-17.3	-17.7	-17.4
2004	-17.6	-17.6	-17.7	-17.6	-17.5	-18.3	-18.8	-18.3
Unit 6 & 7 Intake Bay Bathymetry 14 ft Out								
2010	-15.8	-16.5	-17.0	-17.2	-17.6	-18.0	-18.3	-18.2
2009	-16.1	-17.0	-17.5	-17.8	-18.0	-18.7	-19.0	-18.9
2008	-16.4	-16.9	-17.3	-17.8	-18.1	-18.7	-18.9	-19.0
2007	-16.8	-17.2	-17.3	-17.6	-17.5	-18.0	-18.5	-18.5
2006	-15.9	-16.6	-16.9	-17.1	-17.0	-17.8	-18.2	-18.1
2005	-17.0	-17.3	-17.3	-17.5	-17.7	-18.2	-18.5	-18.3

Unit 1 & 2 Intake Bay Bathymetry 26 ft Out	1-1	1-2	1-3	2-1	2-2	2-3
2010	-18.1	-20.0	-21.2	-21.8	-21.5	-20.2
2009	-17.9	-20.3	-21.5	-22.2	-22.6	-22.1
2008	-19.2	-20.0	-21.2	-22.5	-23.5	-22.1
2007	-18.5	-20.4	-21.9	-23.4	-23.1	-21.7
2006	-17.3	-20.3	-21.1	-22.5	-22.7	-21.8
2005	-18.4	-21.3	-21.1	-22.2	-23.6	-21.4

3.2 Intake Approach Velocity Measurement

Table 3-2 shows the centerline velocities measured at Units 6 & 7 intake bay entrances, the average speeds for each bay, and the overall average speeds for half of the intake bays (Unit 6 or 7) and for the entire structure. **Table 3-3** shows the centerline velocities measured at Units 1 & 2 intake bay entrances, the average speeds for each bay, and the overall average speed for the structure. **Figures 3-7 and 3-8** show side views of the velocity vectors at Units 6 & 7 and Units 1 & 2. **Figures 3-9 and 3-10** show plan views of the velocity vectors for each bay at Units 6 & 7 and 1 & 2. **Figures 3-11 and 3-12** depict three-dimensional representations for the two intake structures.

During the study at Units 6 & 7 the Sontek ADP recorded velocities in 10 60-sec intervals. Surface salinity and temperature were 20 ppt and 13.8°C. The average of the standard deviations of ten speed measurements per location was 0.122 fps and ranged from 0.047 to 0.208.

At Units 1 & 2, the Nortek ADCP collected 9 to 12 30-sec samples per location. There were 11 and 12 samples at the two deepest at Unit Bay 1-1, 10 at the shallowest at Unit Bay 1-3, 11 at the penultimate deepest at Unit-Bay 1-3, 10 at deepest at U 2-2 and 11 at shallowest at U 2-3. Surface salinity and temperature were 28 ppt and 13.0°C. The standard deviations of the speeds averaged 0.051 fps with a range from 0.023 to 0.099 fps.

The engineered design velocity for the Units 6 & 7 with all CWPs operating is 0.8 fps. The spatial average speed during the study was 0.67 fps with maximum and minimum speeds of 0.90 fps and 0.52 fps and standard deviation of 0.08 fps over the 58 locations. Average speeds of intake bays varied from 0.58 to 0.76 fps. Higher speeds were found closer to the bottom at the 6-1 intake bay and at the Unit 7 intake bays. Relatively higher intake bay speeds were generally found at mid-depths at the intake bays. Average speed for the four intake bays at the south end of the intake structure (Unit 7) was 0.71 fps and for the four northern intake bays (Unit 6) was 0.62 fps.

The engineered design velocity for the Units 1 & 2 intake structure with all six CWPs operating is 0.5 fps. During the study, the average intake approach velocity was 0.39 fps. The individual average speeds varied from 0.23 to 0.48 fps with a standard deviation of 0.059 fps over the 24 locations. Intake structure approach speeds were greater at the extremities, intake bays 1-1 and 2-3. The 1-1 and 2-3 intake bays had average speeds of 0.44 and 0.41 fps. Average speeds across the three intake bays at the south end of the intake structure (Unit 2) and for the three northern intake bays (Unit 1) were similar, 0.39 fps, and similar to those measured in 2009.

Table 3-2. Intake structure approach velocities (V), Units 6 & 7 of the Moss Landing Power Plant, October 14, 2010 (09:08 to 10:59 PST). Vx is positive in the x direction along the intake structure face (~185° T). Vy is positive in the y direction toward the intakes (~95° T). Vz is positive up. Average speed is shown for individual intake bays, for each Unit, and the entire intake structure.

Unit -Bay	Elev (ft MLLW)	Vx (fps)	Vy (fps)	Vz (fps)	Speed (fps)	St. Dev. Speed (fps)	Bay (fps)	Unit (fps)	Group (fps)
6-1	-3.5	0.18	0.60	-0.08	0.65	0.13	0.70	0.62	0.67
	-5.2	0.22	0.60	-0.07	0.65	0.16			
	-6.8	0.24	0.62	-0.07	0.68	0.12			
	-8.5	0.25	0.63	-0.04	0.68	0.13			
	-10.1	0.30	0.64	0.00	0.72	0.11			
	-11.7	0.29	0.65	-0.01	0.72	0.06			
	-13.4	0.21	0.70	0.00	0.77	0.21			
6-2	-3.5	0.09	0.59	-0.07	0.61	0.12	0.61		
	-5.2	0.18	0.55	-0.03	0.59	0.13			
	-6.8	0.15	0.62	-0.02	0.65	0.14			
	-8.4	0.12	0.57	0.01	0.60	0.12			
	-10.1	0.12	0.57	0.02	0.59	0.17			
	-11.7	0.11	0.64	0.03	0.66	0.08			
	-13.4	0.07	0.55	0.07	0.58	0.10			
6-3	-3.5	0.05	0.55	-0.08	0.58	0.13	0.58		
	-5.2	0.12	0.53	-0.01	0.57	0.11			
	-6.8	0.15	0.55	-0.01	0.58	0.16			
	-8.5	0.13	0.52	0.01	0.54	0.13			
	-10.1	0.16	0.58	0.04	0.62	0.12			
	-11.8	0.08	0.57	0.06	0.59	0.05			
	-13.4	0.06	0.54	0.04	0.56	0.11			
6-4	-3.7	0.10	0.58	-0.07	0.61	0.20	0.59		
	-5.3	0.14	0.59	-0.04	0.62	0.17			
	-7.0	0.11	0.59	-0.03	0.61	0.13			
	-8.6	0.11	0.58	-0.02	0.60	0.10			
	-10.2	0.15	0.55	0.00	0.58	0.14			
	-11.9	0.15	0.60	0.02	0.63	0.11			
	-13.5	0.07	0.50	0.05	0.52	0.12			

(Table continued)

Table 3-2 (continued). Intake structure approach velocities (V), Units 6 & 7 of the Moss Landing Power Plant, October 14, 2010 (09:08 to 10:59 PST), (continued).

Unit -Bay	Elev (ft MLLW)	Vx (fps)	Vy (fps)	Vz (fps)	Speed (fps)	St. Dev. Speed (fps)	Bay (fps)	Unit (fps)	Group (fps)
7-1	-3.7	-0.01	0.68	-0.11	0.71	0.12	0.67	0.71	
	-5.3	-0.08	0.71	-0.05	0.73	0.11			
	-7.0	0.02	0.67	-0.03	0.69	0.11			
	-8.6	0.11	0.74	-0.01	0.76	0.09			
	-10.2	0.05	0.65	0.02	0.66	0.13			
	-11.9	0.01	0.64	0.01	0.65	0.13			
	-13.5	-0.16	0.47	0.03	0.52	0.15			
7-2	-3.6	-0.14	0.62	-0.10	0.66	0.16	0.70		
	-5.3	-0.08	0.72	-0.04	0.73	0.09			
	-6.9	-0.02	0.67	-0.03	0.68	0.15			
	-8.5	0.03	0.78	-0.02	0.79	0.09			
	-10.2	0.03	0.74	0.00	0.75	0.09			
	-11.8	-0.05	0.61	0.04	0.63	0.08			
	-13.5	-0.12	0.60	0.07	0.63	0.11			
7-3	-3.7	-0.04	0.70	-0.10	0.72	0.15	0.71		
	-5.3	-0.07	0.65	-0.06	0.67	0.12			
	-6.9	0.03	0.72	-0.05	0.73	0.14			
	-8.6	0.05	0.78	-0.05	0.80	0.13			
	-10.2	0.12	0.78	-0.04	0.80	0.13			
	-11.9	0.08	0.73	-0.03	0.75	0.11			
	-13.5	-0.14	0.63	0.01	0.66	0.11			
	-15.1	-0.17	0.51	0.01	0.55	0.12			
7-4	-3.6	-0.33	0.53	-0.08	0.65	0.15	0.76		
	-5.3	-0.31	0.62	-0.09	0.72	0.10			
	-6.9	-0.32	0.69	-0.09	0.79	0.11			
	-8.6	-0.21	0.71	-0.06	0.76	0.12			
	-10.2	-0.27	0.84	-0.05	0.90	0.10			
	-11.8	-0.17	0.71	-0.04	0.75	0.14			
	-13.5	-0.15	0.74	-0.02	0.77	0.09			
	-15.1	-0.29	0.66	-0.01	0.73	0.10			

Table 3-3. Intake structure approach velocities (V), Units 1 & 2 of the Moss Landing Power Plant, November 15, 2010 (10:47 to 14:02 PST). Vx is positive in the x direction along the intake structure face (~172° T). Vy is positive toward the intakes in the y direction (~82° T). Vz is positive up. Average speed is shown for individual intake bays, for each Unit, and the entire intake structure.

Unit -Bay	Elev (ft MLLW)	Vx (fps)	Vy (fps)	Vz (fps)	Speed (fps)	St. Dev. Speed (fps)	Bay (fps)	Unit (fps)	Group (fps)
1-1	-2.9	0.09	0.39	-0.02	0.47	0.05	0.44	0.39	0.39
	-6.8	0.04	0.43	0.01	0.46	0.04			
	-10.7	-0.06	0.36	-0.09	0.43	0.04			
	-14.5	-0.06	0.35	-0.10	0.40	0.04			
1-2	-2.9	-0.13	0.42	-0.04	0.43	0.07	0.39		
	-6.8	-0.11	0.44	-0.05	0.46	0.05			
	-10.7	0.04	0.40	0.07	0.40	0.05			
	-14.5	0.15	0.42	0.09	0.28	0.06			
1-3	-2.9	0.06	0.37	0.01	0.40	0.03	0.32		
	-6.7	0.05	0.37	0.03	0.33	0.06			
	-10.6	0.09	0.25	0.02	0.33	0.05			
	-14.5	-0.03	0.22	0.00	0.23	0.05			
2-1	-2.9	0.00	0.40	0.03	0.38	0.04	0.39	0.39	
	-6.8	-0.03	0.43	0.05	0.44	0.02			
	-10.7	0.08	0.43	0.00	0.38	0.05			
	-14.5	0.10	0.44	0.00	0.34	0.05			
2-2	-2.9	0.00	0.32	0.03	0.41	0.05	0.37		
	-6.8	0.01	0.30	0.04	0.37	0.05			
	-10.7	-0.03	0.21	-0.03	0.34	0.04			
	-14.5	-0.06	0.17	-0.04	0.35	0.04			
2-3	-2.9	-0.01	0.38	0.03	0.45	0.06	0.41		
	-6.8	-0.03	0.38	-0.03	0.36	0.04			
	-10.7	0.00	0.31	0.05	0.43	0.10			
	-14.5	0.04	0.31	0.05	0.42	0.04			

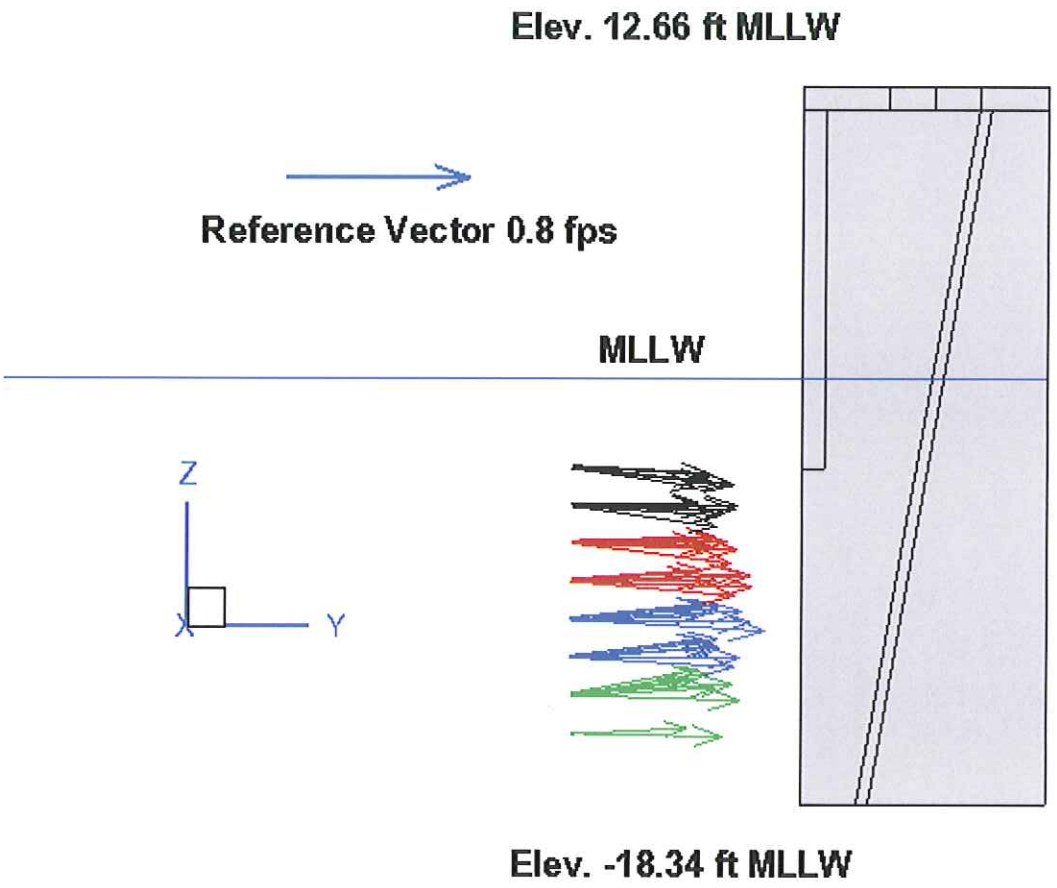

Figure 3-7. Side view of intake approach velocity vectors at the Moss Landing Power Plant, Units 6 & 7 October 14, 2010 (09:08 to 10:59 PST).

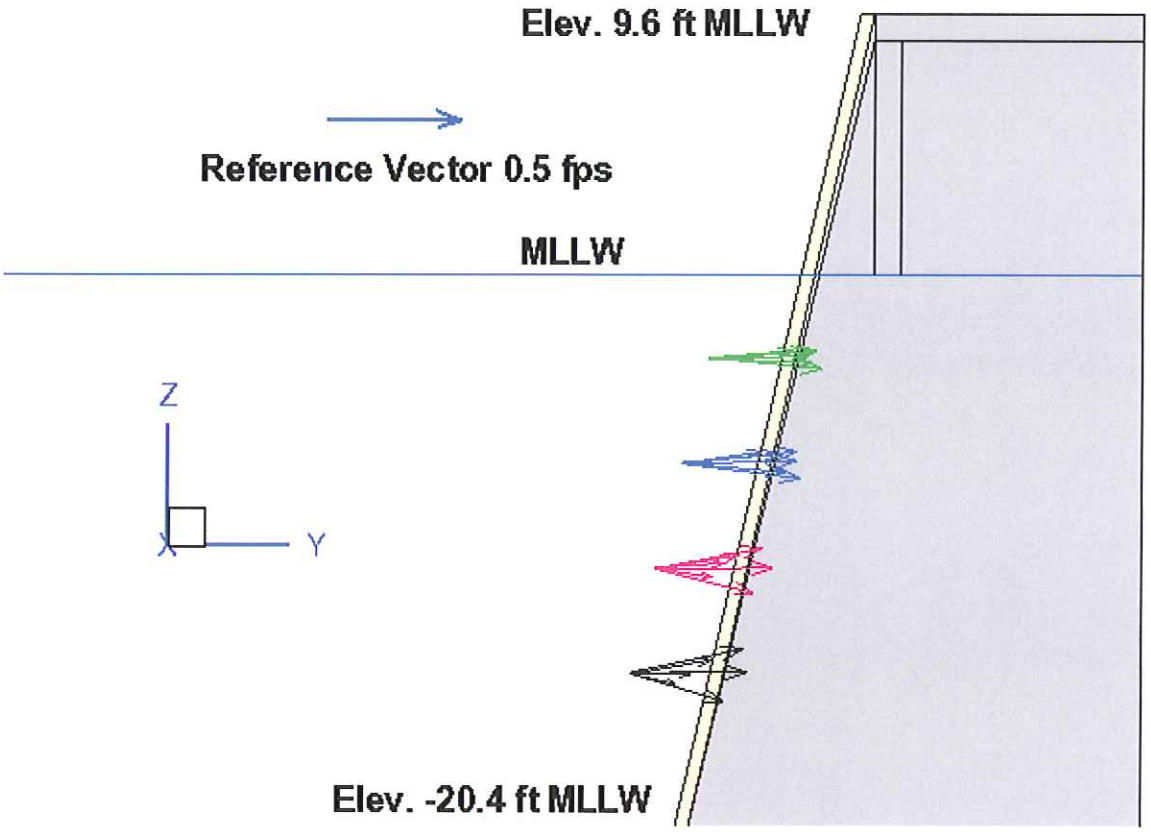

Figure 3-8. Side view of intake approach velocity vectors at the Moss Landing Power Plant, Units 1 & 2 November 15, 2010 (10:47 to 14:02 PST).

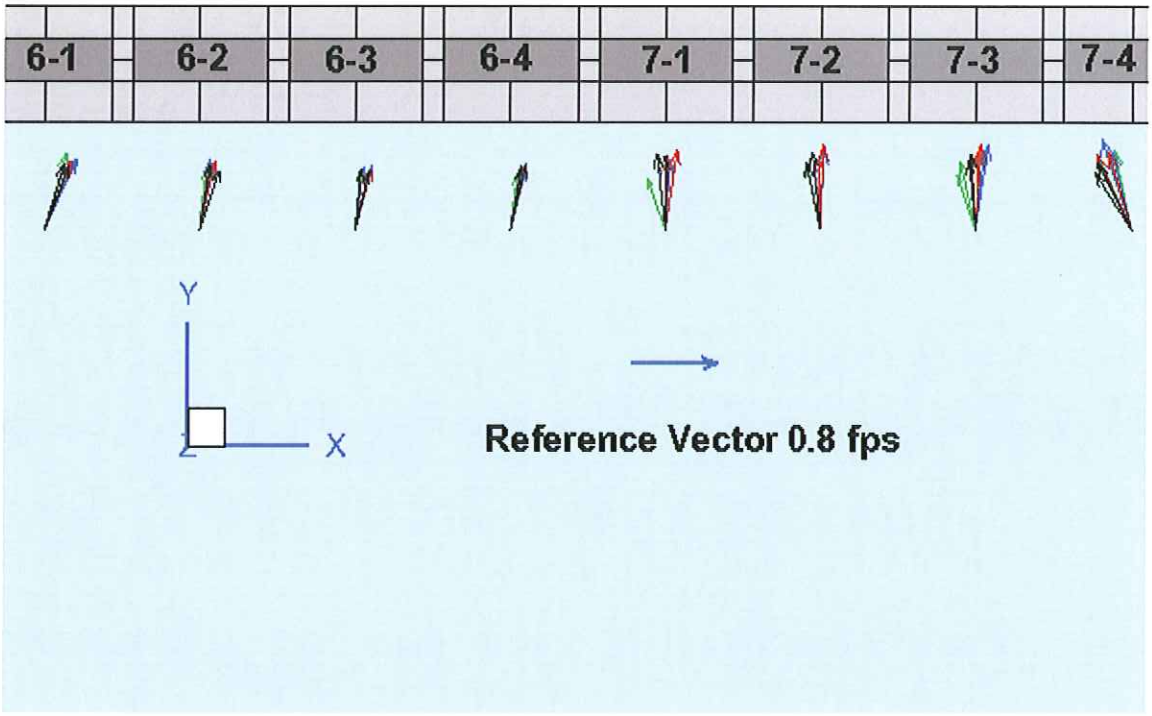

Figure 3-9. Plan view of intake approach velocity vectors at the Moss Landing Power Plant, Units 6 & 7, October 14, 2010 (09:08 to 10:59 PST).

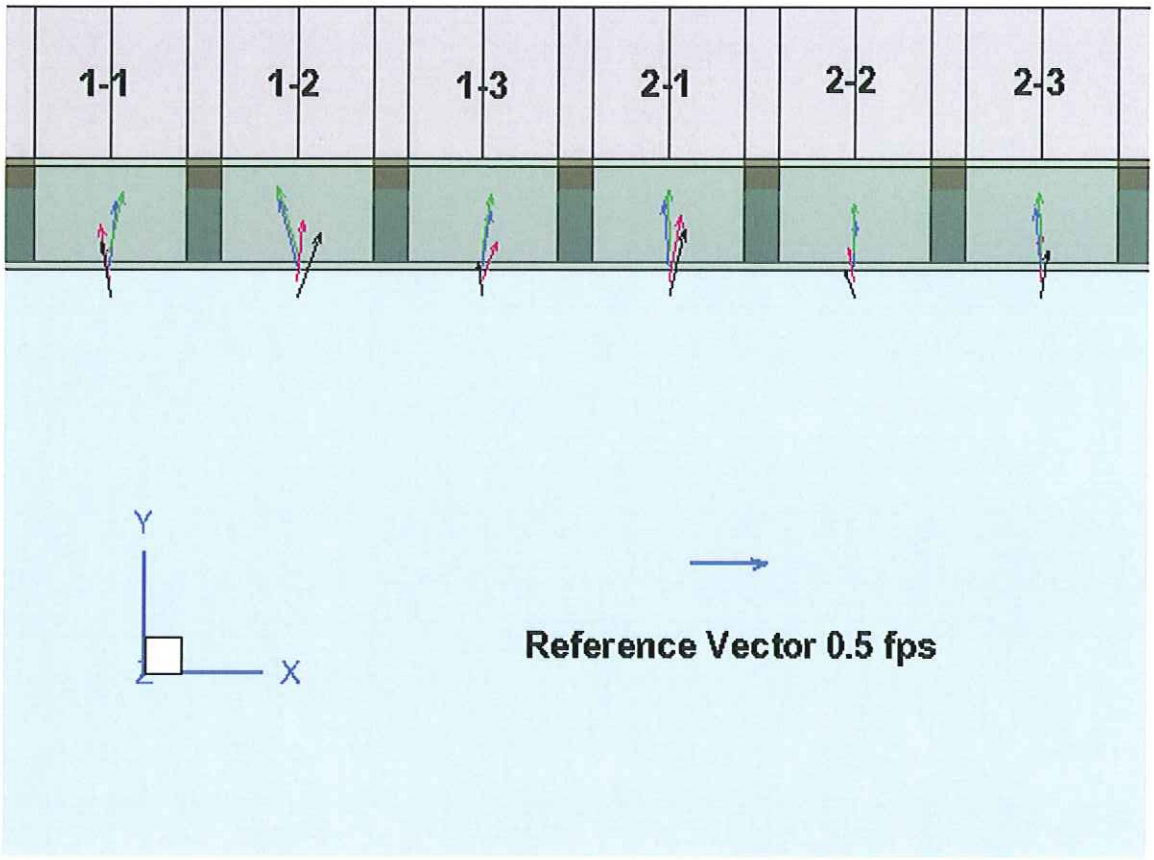

Figure 3-10. Plan view of intake approach velocity vectors at the Moss Landing Power Plant, Units 1 & 2, November 15, 2010 (10:47 to 14:02 PST).

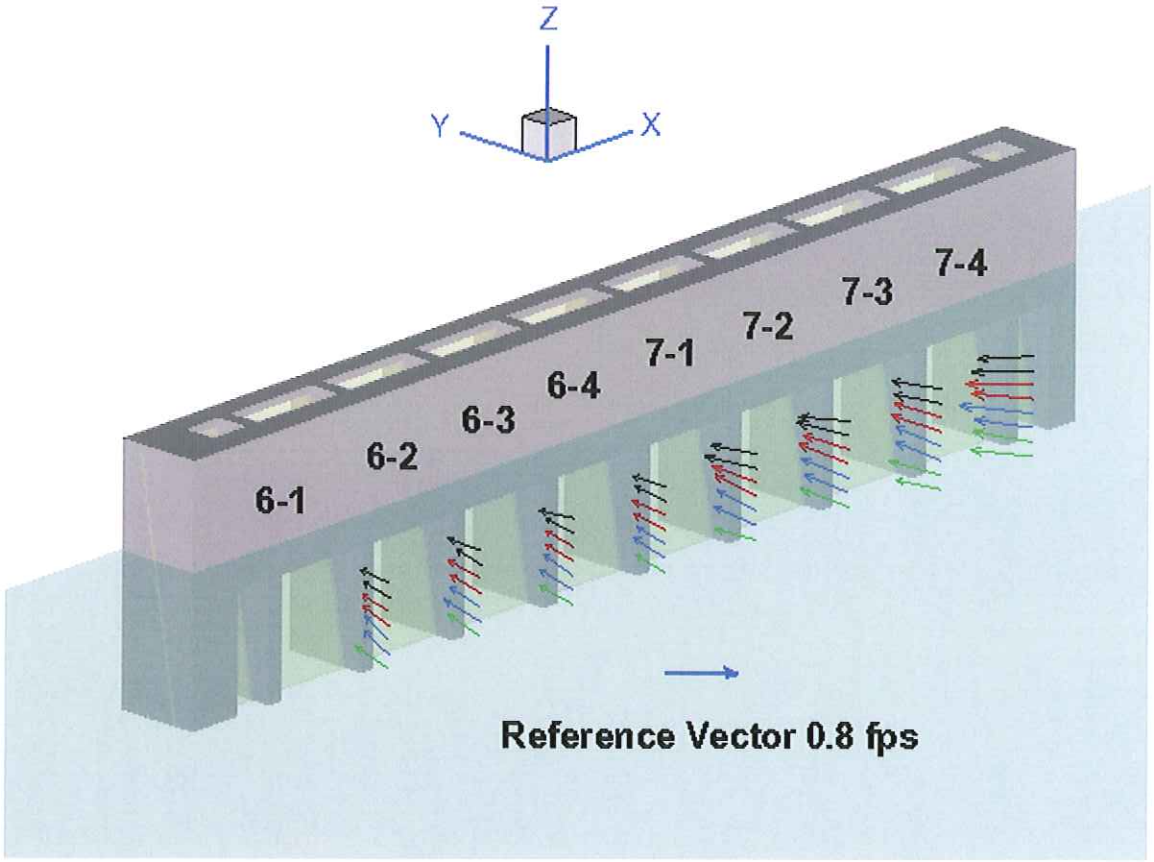

Figure 3-11. Intake approach velocity vectors at Units 6 & 7 of the Moss Landing Power Plant, October 14, 2010 (09:08 to 10:59 PST).

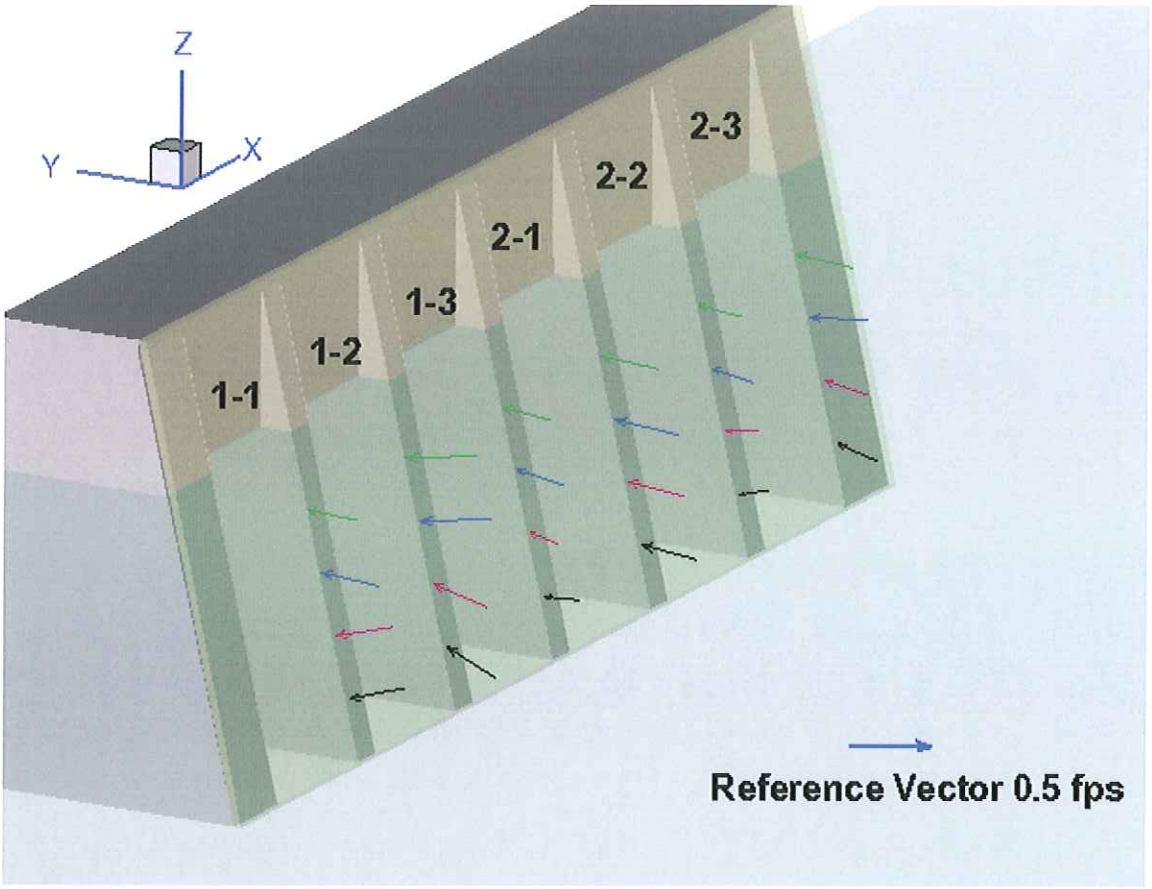

Figure 3-12. Intake approach velocity vectors at Units 1 & 2 of the Moss Landing Power Plant, November 15, 2010 (10:47 to 14:02 PST).