4. Tides and Water Levels Requirements

4.1. General Project Requirements and Scope

4.1.1. Scope

The requirements and specifications contained in this section cover the water level and vertical datum requirements for operational support of hydrographic surveys conducted as part of the NOAA Nautical Charting Program. The scope of this support comprises the following functional areas:

1. Tide and water level requirement planning
2. Preliminary tidal zoning development

3a. Control water level station operation;
3b. Supplemental water level station installation, operation and removal

4. Data quality control, processing, and tabulation
5. Tidal datum computation and tidal datum recovery
6. Generation of water level reducers and final tidal zoning

For in-house surveys, personnel from the National Ocean Service (NOS) Center for Operational Oceanographic Products and Services (CO-OPS) are responsible for functional areas 1, 2, 4, 5, and 6. NOS hydrographers and CO-OPS Field Operations Division will be responsible for functional area 3 above.

For contract surveys, CO-OPS personnel are responsible for functional areas 1, 2 and 3a. NOS contract hydrographers will be responsible for functional areas 3b through 6 above. NOS continues to be responsible for operating, maintaining, and processing data from the control stations (e.g., the NWLON).

4.1.2. Objectives

The work performed under the requirements and specifications of this section is required for NOS major program areas of navigational products and services. The first objective for the support detailed in this section is to provide time series of water level reducers that can be applied to hydrographic soundings so that they can be corrected to chart datum. A second objective is to establish and/or recover tidal datums relative to local benchmarks at each station that can be used for continuing and future hydrographic surveys in the area. A third objective is to provide new or updated information that can be used to update NOAA tide prediction products and tidal zoning for promoting safe navigation applications.

4.1.3. Planning and Preliminary Tidal Zoning

CO-OPS is responsible for all planning of tide requirements for NOS hydrographic surveys. CO-OPS will analyze historical data and tidal characteristics for each project area, specify operational NOS control stations, specify subordinate tide station locations to be installed, and provide the preliminary tidal zoning to be used during survey operations. CO-OPS will provide 6-minute interval tide predictions relative to chart datum for appropriate NOS control stations prior to each survey and will also provide historical published bench mark information available for all historical tide stations specified for reoccupation. If CO-OPS provides a new preliminary tidal zoning scheme, the contractor must use that zoning scheme first for each project, and then, may generate a new scheme if the one provided is not adequate. At the conclusion of the survey, the contractor shall suspend the use of preliminary zoning scheme and develop final zoning scheme using correctors derived from the subordinate stations installed during the survey. Refer to Section 4.5.2 for further details.

Figure 4.7 - Monthly Mean Simultaneous Comparison Example (cont.)

COMPARISON OF MONTHLY MEANS (JAN-98 - JUN-98) 1960-78 TIDAL EPOCH
(A) SUBORDINATE: 9414863 RICHMOND, CA TM (000W) TIDE TYPE:MIXED
(B) CONTROL: 9414290 SAN FRANCISCO, CA TM (000W) TIDE TYPE:MIXED

OUTLIER REPORT: MAXIMUMS AND MINIMUMS WHEN INDIVIDUAL MONTHLY MEAN DIFFERENCE EXCEEDS TWO STANDARD DEVIATIONS FROM OVERALL MEAN

	MTL	MSL	HWI	LWI	MN	DHQ	DLQ
STD.DEV.	0.004	0.003	0.018	0.019	0.008	0.012	0.017
MAXIMUM	1.752	1.762	0.384	0.791	1.095	0.994	1.041
MINIMUM	1.734	1.750	0.313	0.715	1.062	0.948	0.974
month/year							
Jan-98		1.745	0.390	0.670	1.062		
Feb-98					1.097		0.962
Mar-98						0.944	
Apr-98							1.041
May-98							
Jun-98							

	MHW	MLW	DTL	GT	MHHW	MLLW
STD.DEV.	0.003	0.006	0.003	0.006	0.004	0.004
MAXIMUM	1.796	1.708	1.746	1.068	1.794	1.703
MINIMUM	1.785	1.684	1.734	1.045	1.779	1.685
month/year						
Jan-98	1.776			1.037	1.770	
Feb-98						
Mar-98						
Apr-98						1.683
May-98						
Jun-98						

Figure 4.8: Published Bench Mark Sheet

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CALIFORNIA 941 4290
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
TIDAL BENCH MARKS
THE PRESIDIO, SAN FRANCISCO
LATITUDE: 37° 48.4' N LONGITUDE: 122° 27.9' W
NOAA CHART: 18649 USGS QUAD: SAN FRANCISCO NORTH

TO REACH TIDE STATION: To reach the tide station from the intersection of U.S. Highway 101 (north) and Lincoln Boulevard (last exit before the Golden Gate toll plaza), proceed NE on Lincoln Boulevard approximately 1.6 km (1.0 mile) to Cowles Street, turn left onto Cowles Street and proceed 0.8 km (0.5 mile) to McDowell Avenue, turn left onto McDowell Avenue and proceed 0.5 km (0.3 mile) to Crissey Field Avenue, turn left onto Crissey Field Avenue and proceed 0.3 km (0.2 mile) to a stop sign, turn right and then immediately left onto Mason street, proceed along the National Parks Service parking lot fence where Mason Street turns into Hamilton Street, and proceed 0.5 km (0.3 mile) to a parking lot at the end of the street. The tide station is located in the 2nd building on the L-shaped wooden pier formerly owned by the U.S.Coast Guard, now owned by the National Park Service.

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BENCH MARK STAMPING: 180 1936
MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: USC&GS Tidal Bench Mark
SETTING CLASSIFICATION: Concrete Seawall
The primary bench mark is set in the top of a 0.9-m (3') high concrete seawall at the NW end of Crissy Field on the Coast Guard property, 15 m (49') east of the NE corner of the crews quarters building, 6 m (20') south of the south side of the garage building, and 1.1 m (3.5') north of an angle in the seawall.

BENCH MARK STAMPING: 181 1945
MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: USC&GS Tidal Bench Mark
SETTING CLASSIFICATION: Concrete Seawall
The bench mark is set in the top of the NW corner of a seawall at the Fort Point Coast Guard Station, 62 m (204') west of the inshore end of the Coast Guard wharf, 46 m (151') NW of a flagpole, 22 m (71') NE of the north corner of Building S.F. 19.4 (paint shop and storage building), and 1.2 m (4.0') above grade.

Figure 4.8 (cont.)
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THE PRESIDIO, SAN FRANCISCO

BENCH MARK STAMPING: 4290 J 1976
MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: NOS Tidal Bench Mark
SETTING CLASSIFICATION: Copper Clad Steel Rod
The bench mark is in an elevated beach area midway between the Fort Point Coast Guard pier and the engineer's dock, 133 m (435') WNW of the west end of the seawall surrounding the Coast Guard crews quarters, 27 m (89') SW of the shoreward end of the old seaplane ramp, 18.3 m (60.0') SE of the shoreward end of the concrete discharge pipe, and 0.8 m (2.5') north of a chain link fence surrounding U.S. Army Field Maintenance Building #937. The mark is crimped to a copper-clad steel rod driven 15 m (48'), encased in a 4-inch diameter PVC pipe, and marked by a witness post.

BENCH MARK STAMPING: 4290 K 1976
MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: NOS Tidal Bench Mark
SETTING CLASSIFICATION: Bedrock
The bench mark is set vertically in bedrock on the south side of Marine Drive, 24 m (79') SSW of the SE corner of National Park Service building #T989, 14.7 m (48.2') SW of Bench Mark 174 1925, and 2.4 m (8.0') south of the south curb of Marine Drive.

BENCH MARK STAMPING: BM 174 1925
MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: USC&GS Tidal Bench Mark
SETTING CLASSIFICATION: Concrete Monument
The bench mark is set in a concrete monument level with the ground inside a brick circle in the pavement at the center of the Y-junction between Marine Drive and the road leading SE to Fort Winfield Scott, 38 m (125') west of the extension of the west edge of the engineer's dock where it crosses Marine Drive, 13.0 m (42.5') SW of a fire hydrant, and 8.7 m (28.5') south of the south edge of an iron manhole cover.

BENCH MARK STAMPING: BM 175 1925
MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: USC&GS Tidal Bench Mark
SETTING CLASSIFICATION: Concrete Seawall
The bench mark is set in the seawall near the National Park Service building, 62.2 m (214') NE of Bench Mark 4290 L 1976, 59 m (193') west of the NW corner of the park service building, 28.9 m (94.8') WNW of the northernmost post of a pedestrian gate, 6.9 m (22.5') north of the centerline of Marine Drive, and 0.7 m (2.4') south of the north edge of the seawall. (Note: The seawall was repaired in April 1981 and the elevation of the bench mark was changed after the repair, but the elevation seems stable since then.)

Figure 4.8 (cont.)

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THE PRESIDIO, SAN FRANCISCO

BENCH MARK STAMPING: BM 176 1925
MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: USC&GS Tidal Bench Mark
SETTING CLASSIFICATION: Concrete Step
The bench mark is set in the west end of the lowest concrete step at the main entrance to the porch of the U.S. Army Logistic Control office at #651 Mason Avenue, 30 m (98') SE of the intersection of Crissy Field and Mason Avenues, 15 m (50') south of the centerline of Mason Avenue, and about 0.2 m (0.7') above the sidewalk.

BENCH MARK STAMPING: CLARK 1948
MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: USC&GS Triangulation Mark
SETTING CLASSIFICATION: Concrete Seawall
The bench mark is set in the top of a concrete seawall, about 549 m (1800') NW of the Fort Point Coast Guard station, 24.2 m (79.5') west of the west edge of the engineer's dock, 6.9 m (22.5') NE of the NW corner of corrugated iron building #985, 3.0 m (10') west of the NW corner of a stucco paint locker building, and about 1.1 m (3.6') above ground.

BENCH MARK STAMPING: NO 2 1948
MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: USC&GS Reference Mark
SETTING CLASSIFICATION: Concrete Seawall
The bench mark is set flush in the top of a concrete seawall, 11.4 m (37.5') west of the west edge of the engineer's dock, 8.1 m (26.5') NE of the NE corner of corrugated iron building #985, and about 0.9 m (3.0') above ground.

Figure 4.8 (cont.)

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CALIFORNIA 941 4290
THE PRESIDIO, SAN FRANCISCO

Tidal datums at THE PRESIDIO, SAN FRANCISCO are based on the following:

LENGTH OF SERIES = 19 YEARS
TIME PERIOD = 1960-1978
TIDAL EPOCH = 1960-1978
CONTROL TIDE STATION =

Elevations of tidal datums referred to mean lower low water (MLLW) are as follows:

HIGHEST OBSERVED WATER LEVEL (01/27/1983) = 8.87 FEET
MEAN HIGHER HIGH WATER (MHHW) = 5.83 FEET
MEAN HIGH WATER (MHW) = 5.23 FEET
MEAN TIDE LEVEL (MTL) = 3.18 FEET
MEAN SEA LEVEL (MSL) = 3.13 FEET
MEAN LOW WATER (MLW) = 1.13 FEET
*NORTH AMERICAN VERTICAL DATUM-1988 (NAVD) = 0.14 FEET
MEAN LOWER LOW WATER (MLLW) = 0.00 FEET
LOWEST OBSERVED WATER LEVEL (12/17/1933) = -2.67 FEET

*NAVD is based on elevations published in Quad 371221, 1993, and NOS leveling of 1995.

Bench mark elevation information:

	ELEVATION IN FEET ABOVE:	
BENCH MARK STAMPING	MLLW	MHW
180 1936	13.24	8.01
181 1945	13.29	8.06
4290 J 1976	11.18	5.95
4290 K 1976	19.31	14.08
BM 174 1925	16.65	11.42
BM 175 1925	13.84	8.61
BM 176 1925	15.99	10.76
CLARK 1948	14.08	8.85
NO 2 1948	14.04	8.81

Figure 4.8 (cont.)

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THE PRESIDIO, SAN FRANCISCO

MSL is the local mean sea level and should not be confused with the fixed datums of NGVD (sometimes referred to as Sea Level Datum of 1929) or NAVD 88. NGVD is a fixed datum adopted as a standard geodetic reference for heights. It was derived from a general adjustment of the first order leveling nets of the U.S. and Canada. Mean sea level was held fixed as observed at 26 stations in the U.S. and Canada. Numerous adjustments have been made since originally established in 1929.

NAVD 88 involved a simultaneous, least squares, minimum-constraint adjustment of Canadian-Mexican-United States leveling observations. Local mean sea level at Father Point/Rimouski, Canada was held fixed as the single constraint. These fixed datums do not take into account the changing stands of sea level and because they represent a "best" fit over a broad area, their relationship to local mean sea level is not consistent from one location to another.