Procedures for Establishing the Mean High Water Line Boundaries

This document lists the procedures for establishing the Mean High Water (MHW) line. This will be used as a *guide* for all surveys related to tidal boundaries performed by or for the County of Orange – G/L.I.S. department.

Establishing tidal boundaries can be a difficult task. Tidal boundaries are unique in that this line is *ambulatory* (moving about or from place to place; not stationary) and therefore must be related to a specific point in time. One must know what the law requires and the terminology pertaining to tidal boundaries must be understood.

We must first know what the definition of the *Mean High Water* line is. According to the U.S. Supreme Court's landmark decision in *Borax Ltd. v. City of Los Angeles 1935*, the definition of tidal water boundary is the following:

"In view of the definition of the mean high tide, as given by the United States Coast and Geodetic Survey that mean high water at any place is the average height of all the high waters at that place over a considerable period of time, and the further observation that from theoretical considerations of an astronomical character there should be a period variation in the rise of the water above sea level having a period of 18.6 years, the Court of Appeals directed that in order to ascertain the mean high tide line with requisite certainty in fixing the boundary of valuable tidelands, such as those in question appear to be 'an average of 18.6 years should be determined as near as possible.' We find no error in that instruction."

This case still prevails in U.S. common law. The MHW line must be established by the United States Coast and Geodetic Survey and based on an average of 18.6 years.

There are two procedures one must look at before a boundary can be established. Is the boundary to be established being created for the first time or is it being re-established based on a record boundary? When re-establishing a boundary, artificial accretions must be investigated.

In California under state rule, a shoreline change artificially caused (even by third parties) has no effect upon the littorial boundaries as between the state and upland owner; the boundary will remain as it existed at the last natural location of the shoreline. Artificial accretion may be caused by the construction of piers, jetties and sea walls, which cause changes in the natural currents thus altering conditions of the shore. In the state of California, all land bordering navigable waters created by artificial accretions belong to the state of California. The upland riparian owner takes tidal to the line of the last natural MHW line.

If the boundary has been changed due to artificial accretion, then the last natural MHW line must be used. If this boundary has been documented on a recorded map or deed, then it should be re-established in the *same horizontal* location as described.

Establishing Current MHW line boundaries

Getting Tidal Datum for your Project

The first step in establishing the current MHW line is to get the most recent tidal datum publication for the area in concern. This tidal datum must be from the United States Coast and Geodetic Survey, which is now known as the National Geodetic Survey (NGS). This document pertains to establishing current MHW line boundaries in Orange County. NGS publishes tidal datums for Newport Beach, Newport Bay Entrance, which will be used for Orange County. This publication is based on a 19-year series, from January 1960 to December 1978. The tidal epoch is known as 1960-1978. This tidal datum publication can be found @ http://co-ops.nos.noaa.gov/benchmarks/9410580.html and is attached to the end of this document. This publication shows the relationship between various elevations of tidal datums including the National Geodetic Vertical Datum 1929 (NGVD 29) and the North American Vertical Datum 1988 (NAVD 88). See "NGVD 29 and NAVD 88 Definitions" at the end of this document.

Establishing the Relationship between MHW Line and Vertical Datum

Orange County Geomatics publishes two different fixed datums on their benchmarks, NGVD 29 and NAVD 88, OCS 1995 adjustment, which are based on and conform to the NGS published fixed datums. The differences must be known between the datum you are using and the MHW line. The MHW line is 4.65 feet (1.416 meters) above the Mean Lower Low Water line (MLLW) as shown on the tidal datum publication. Establishing this elevation will determine the boundary.

For example, if NGVD 29 is being used, the difference between NGVD 29 and MLLW is 2.72 feet. Therefore 4.65 - 2.72 = 1.93 feet. To establish the MHW line using NGVD 29, you would find the 1.93 feet NGVD 29 elevation contour line.

MHW	4.65'
MSL	2.76'
NGVD 29	2.72'
NAVD 88	0.37'
MLLW	0.00

After verifying that your benchmarks are accurate and consistent, run levels along the shore of your project and mark or stake points at intervals in a manner that the ground at each point is at the elevation of the MHW tidal datum.

Verifying Benchmarks

The second step is to locate and verify the vertical control that will be used in establishing the MHW line. The benchmark elevations must be related to the elevations shown on the publication. Benchmarks published by NGS are probably the best stations to use but if none are available in the area, local benchmarks can be used as long as the elevations are related to the elevations shown on the publication.

A level run should be performed to verify that the published elevations are consistent with the current benchmark heights. If closures are not within the required accuracies, additional leveling to more benchmarks may be necessary until closures are acceptable.

Establishing MHW Line – Horizontal

It may be necessary to know the horizontal position of the boundary established. This can be done by tying the staked points to cadastral monuments within the project. This would be done using standard surveying techniques.

Establishing Record MHW line boundaries

This section will be broken into two parts. Again, one must look closely as to whether the boundary has been affected by artificial accretion.

Re-establishing MHW Line – No Artificial Accretion

If the shore has not been changed due to artificial accretion, then re-establishing the boundary will be based on the current location of the MHW line. This would be performed by following the same procedures as described in the *Establishing MHW Line* section. This current boundary may not be in the same horizontal location as it was before due to the fact that littorial boundaries are ambulatory; they are based on elevation and continually change. The horizontal location of the boundary you're re-establishing is based on the MHW line (elevation) at that point in time.

Re-establishing MHW Line – Artificial Accretion

This is probably the hardest of all the boundaries to identify. According to California state law, the boundary will remain as it existed at the last natural location of the shoreline. From my experience with these boundaries, the last natural location of the shoreline would be the recorded Parcel, Tract, or deed that originally describes the littorial boundary as it was first established. Some of these documents show the MHW line stating the year it was established and also have horizontal ties to the tract boundaries. These horizontal ties may be distances shown to the nearest 10 feet +/-. In these cases, I believe that re-establishing the boundary should be based on and to the accuracy the record data shows. Other documents describe the boundary as "to the MHW line" with no horizontal ties. In these cases, you will need to find where the MHW line was at that time. This could be done by researching record documents, aerial images from that time, coastal mapping, and any other documents, which would show the coast at that time.

NGVD 29 and NAVD 88 Definitions (NGS)

Mean Sea Level (MSL) is a tidal datum determined over a 19-year National Tidal Datum Epoch. It pertains to local mean sea level and should not be confused with the fixed datums of North American Vertical Datum of 1988 (NAVD 88).

NGVD 29 is a fixed datum adopted as a national standard geodetic reference for heights but is now considered superseded. NGVD 29 is sometimes referred to as Sea Level Datum of 1929 or as Mean Sea Level on some early issues of Geological Survey Topographic Quads. NGVD 29 was originally derived from a general adjustment of the first-order leveling networks of the U.S. and Canada after holding mean sea level observed at 26 long term tide stations as fixed. Numerous local and wide-spread adjustments have been made since establishment in 1929. Benchmark elevations relative to NGVD 29 are available from the National Geodetic Survey (NGS) data base via the World Wide Web at <u>National Geodetic Survey</u>.

NAVD 88 is a fixed datum derived from a simultaneous, least squares, minimum constraint adjustment of Canadian/Mexican/United States leveling observations. Local mean sea level observed at Father Point/Rimouski, Canada was held fixed as the single initial constraint. NAVD 88 replaces NGVD 29 as the national standard geodetic reference for heights. Benchmark elevations relative to NAVD 88 are available from NGS through the World Wide Web at <u>National Geodetic Survey</u>.

NGVD 29 and NAVD 88 are fixed geodetic datums whose elevation relationships to local MSL and other tidal datums may not be consistent from one location to another.

References:

Water Boundaries, by George M. Cole Tidal Datums and Their Applications, NOAA Special Publication NOS CO-OPS 1

Websites:

http://co-ops.nos.noaa.gov/

Datums Page

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Station ID:	9410580	PUBLICATION DATE: SUPERCEDED DATE:	04/12/2001 04/21/2003
Name:	NEWPORT BEACH, NEWPORT BAY ENTRANCE		
	CALIFORNIA		
NOAA Chart:	18754	Latitude:	33° 36.2' N
USGS Quad:	NEWPORT BEACH	Longitude:	117° 53.0' W

To reach the tidal bench marks from the Jamboree/Corona Del Mar exit of U.S. Interstate 405, proceed 8.8 km (5.5 mi) SW on Jamboree Road to Bayside Drive, then 1.1 km (0.7 mi) SE to the Orange County Harbor District Office grounds entrance at 1901 Bayside Drive. The bench marks are on the grounds and along Bayside Drive. The tide gage was located on the Orange County Harbor District Office pier.

TIDAL BENCH MARKS

PRIMARY	BENCH	MARK	STAMPING:	1 NH	? 19 5!	5		
	DESIG	IOITAN	N :	941	0580	TIDAL	1	NF

MONUMENTATION:	Bench Mark disk	VM#:	912
AGENCY:	US Coast & Geodetic Survey (USC&GS)	PID#:	DX1968
SETTING CLASSIFICATION:	Concrete flagpole base		

The primary bench mark is a disk set in the concrete flagpole base at Orange County Harbor District Office, 29.29 m (96.1 ft) SW of bench mark 0580 N 1977, 17 m (56 ft) NE of the north corner of a boat shop, and 0.61 m (2.0 ft) NW of the flagpole.

BENCH MARK STAMPING: NO 1 1926 DESIGNATION: 941 0580 TIDAL 1

MONUMENTATION:	Tidal Station disk	VM#:	913
AGENCY:	US Coast & Geodetic Survey (USC&GS)	PID#:	DX1959
SETTING CLASSIFICATION:	Rock outcrop		

The bench mark is a disk set in a rock outcrop extending south from William O. Kerkoff Marine Laboratory, 0.2 km (0.1 mi) SW of the junction of Ocean Boulevard and Dahlia Avenue, 11.43 m (37.5 ft) SW of the SW wall of the lab, 6.10 m (20.0 ft) SE of the SE edge of a small pier leading from the west corner of the lab to the bay, 2.74 m (9.0 ft) SW of the SW edge of a stone and cement wall around the SW end of the lab, and 2.43 m (8.0 ft) below the top of the wall.

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		PUBLICATION DATE:	04/12/2001
Station ID:	9410580	SUPERCEDED DATE:	04/21/2003
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NOAA Chart:	18754	Latitude:	33° 36.2' N
USGS Quad:	NEWPORT BEACH	Longitude:	117° 53.0' W

TIDAL BENCH MARKS

BENCH MARK STAMPING: NO 2 1926 DESIGNATION: 941 0580 TIDAL 2

MONUMENTATION:	Tidal Station disk	VM#:	914
AGENCY:	US Coast & Geodetic Survey (USC&GS)	PID#:	DX1960
SETTING CLASSIFICATION:	Rock outcrop		

The bench mark is a disk set in a rock outcrop extending south from William O. Kerkoff Marine Laboratory, 0.2 km (0.1 mi) SW of the junction of Ocean Boulevard and Dahlia Avenue, 12.04 m (39.5 ft) south of the south corner of the lab, 8.11 m (26.6 ft) SE of bench mark NO 1 1926, 7.32 m (24.0 ft) north of the south edge of the rock ledge, 3.20 m (10.5 ft) south of the south edge of the stone and cement wall around the SW end of the lab, and 1.83 m (6.0 ft) below the top of the wall.

BENCH MARK STAMPING:2 NP 1955DESIGNATION:941 0580 TIDAL 2 NP

MONUMENTATION:	Bench Mark disk	VM#:	915
AGENCY:	US Coast & Geodetic Survey (USC&GS)	PID#:	DX1969
SETTING CLASSIFICATION:	Concrete sea wall		

The bench mark is a disk set in the concrete sea wall on the Orange County Harbor District Office grounds, 62 m (204 ft) NW of bench mark COORS 1974 TOPOGRAPHIC, 6.49 m (21.3 ft) south of the south corner of the Sheriff Harbor Patrol office, 0.76 m (2.5 ft) NW of the NW wall of a marine railway, and 0.46 m (1.5 ft) east of the west edge of the sea wall.

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		PUBLICATION DATE:	04/12/2001
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TIDAL BENCH MARKS

BENCH MARK STAMPING: 3 NP 1955 DESIGNATION: 941 0580 TIDAL 3 NP

MONUMENTATION:	Bench Mark disk	VM#:	916
AGENCY:	US Coast & Geodetic Survey (USC&GS)	PID#:	DX1970
SETTING CLASSIFICATION:	Concrete sea wall		

The bench mark is a disk set in the concrete sea wall on the Orange County Harbor District Office grounds, 69 m (226 ft) NW of bench mark 2 NP 1955, 21.31 m (69.9 ft) NW of the west corner of the Sheriff Harbor Patrol office, 13.69 m (44.9 ft) SW of the SW wall of a shop building, and 1.10 m (3.6 ft) SE of a chain link fence.

> BENCH MARK STAMPING: 6 NP 1959 DESIGNATION: 941 0580 TIDAL 6 NP

MONUMENTATION:	Bench Mark disk	VM#:	917
AGENCY:	US Coast & Geodetic Survey (USC&GS)	PID#:	DX1967
SETTING CLASSIFICATION:	Concrete curb		

The bench mark is a disk set in the SW curb of the entrance to Orange County Harbor District Office, 7.89 m (25.9 ft) SE of the centerline of the entrance road, 6.10 m (20.0 ft) SE of the centerline of Bayside Drive, 4.60 m (15.1 ft) NW of the NW edge of a driveway to the residence at 1915 Bayside Drive, 3.66 m (12.0 ft) east of a fire hydrant, and 0.18 m (0.6 ft) above road level.

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Chatien ID.	0410590	PUBLICATION DATE:	04/12/2001
station ID:	9410580	SUPERCEDED DATE:	04/21/2003
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NOAA Chart:	18754	Latitude:	33° 36.2' N
USGS Quad:	NEWPORT BEACH	Longitude:	117° 53.0' W

TIDAL BENCH MARKS

BENCH MARK STAMPING:0580 L 1977DESIGNATION:941 0580 L TIDAL

MONUMENTATION:	Tidal Station disk	VM#:	918
AGENCY:	National Ocean Survey (NOS)	PID#:	DX3418
SETTING CLASSIFICATION:	Copper-clad steel rod		

The bench mark is a disk set near the south end of a curve on the east side of Bayside Drive, opposite the residence at 1645 Bayside Drive, 16.61 m (54.5 ft) NE of a fire hydrant, 6.80 m (22.3 ft) east of the centerline of Bayside Drive, 3.29 m (10.8 ft) south of utility pole #3503, 0.34 m (1.1 ft) west of a metal witness post, and 0.21 m (0.7 ft) east of the east edge of a sidewalk. The bench mark is set 6 cm (0.2 ft) above grade, crimped to a copper-clad steel rod driven 4.9 m (16 ft), and encased in a 4-inch PVC pipe and concrete kickblock.

BENCH MARK STAMPING:0580 M 1977DESIGNATION:941 0580 M TIDAL

MONUMENTATION:	Tidal Station disk	VM#:	919
AGENCY:	National Ocean Survey (NOS)	PID#:	DX3419
SETTING CLASSIFICATION:	Copper-clad steel rod		

The bench mark is a disk set on the NE side of Bayside Drive, 0.2 km (0.1 mi) NW of the entrance to Orange County Harbor District Office, 26.49 m (86.9 ft) NE and across Bayside Drive from the BALBOA YACHT CLUB sign, 18.11 m (59.4 ft) SE and across Bayside Drive from the NE corner of a fence surrounding the yacht club, 7.32 m (24.0 ft) east of the centerline of Bayside Drive, and 0.43 m (1.4 ft) west of a metal witness post. The bench mark is set 6 cm (0.2 ft) above grade, crimped to a copper-clad steel rod driven 6.1 m (20 ft), and encased in a 4-inch PVC pipe and concrete kickblock.

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TIDAL BENCH MARKS

BENCH MARK STAMPING:0580 N 1977DESIGNATION:941 0580 N TIDAL

MONUMENTATION:	Tidal Station disk	VM#:	920
AGENCY:	National Ocean Survey (NOS)	PID#:	DX3420
SETTING CLASSIFICATION:	Copper-clad steel rod		

The bench mark is a disk set on the Orange County Harbor District Office grounds, 34.69 m (113.8 ft) SW of the centerline of Bayside Drive, 28.59 m (93.8 ft) SW of bench mark 6 NP 1959, 26.06 m (85.5 ft) east of a flagpole, 4.60 m (15.1 ft) SE of the centerline of a driveway, 0.61 m (2.0 ft) SE of the SE curb of the driveway, and 0.46 m (1.5 ft) north of a metal witness post. The bench mark is set 6 cm (0.2 ft) above grade, crimped to a copper-clad steel rod driven 6.7 m (22 ft), and encased in a 4-inch PVC pipe and concrete kickblock.

BENCH MARK STAMPING: COORS 1974 TOPOGRAPHIC DESIGNATION: 941 0580 TIDAL COORS

MONUMENTATION:	Bench Mark disk	VM#:	921
AGENCY:	National Ocean Survey (NOS)	PID#:	DX3663
SETTING CLASSIFICATION:	Concrete sea wall		

The bench mark is a disk set in a concrete sea wall at Orange County Harbor District Office, about 76 m (250 ft) south of bench mark 1 NP 1955, 19.39 m (63.6 ft) SE of the east corner of the Coast Guard pier, 4.60 m (15.1 ft) south of a white Coast Guard signal mast, and 1.10 m (3.6 ft) NW of the SE corner of the sea wall.

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TIDAL BENCH MARKS

BENCH MARK STAMPING:NB4-41-82DESIGNATION:941 0580 NB4-41-82

MONUMENTATION:	Bench Mark disk	VM#:	923
AGENCY:	Orange County	PID:	
SETTING CLASSIFICATION:	Concrete storm drain		

The bench mark is a disk set flush in the NW corner of a concrete storm drain fronting the residence at 2137 Bayside Drive, 0.3 km (0.2 mi) east of the entrance to Orange County Harbor District Office, 11 m (35 ft) east of the centerline of the residence driveway, and 0.27 m (0.9 ft) south of the south curb.

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TIDAL DATUMS

Tidal datums at NEWPORT BEACH, NEWPORT BAY ENTRANCE based on:

LENGTH OF SERIES:	19 YEARS
TIME PERIOD:	January 1960 - December 1978
TIDAL EPOCH:	1960-1978
CONTROL TIDE STATION:	

Elevations of tidal datums referred to Mean Lower Low Water (MLLW), in METERS:

HIGHEST OBSERVED WATER LEVEL (01/28/1983)	=	2.395
MEAN HIGHER HIGH WATER (MHHW)	=	1.643
MEAN HIGH WATER (MHW)	=	1.416
MEAN TIDE LEVEL (MTL)	=	0.849
MEAN SEA LEVEL (MSL)	=	0.841
MEAN LOW WATER (MLW)	=	0.283
NORTH AMERICAN VERTICAL DATUM-1988 (NAVD)	=	0.113
MEAN LOWER LOW WATER (MLLW)	=	0.000
LOWEST OBSERVED WATER LEVEL (01/20/1988)	=	-0.659

National Geodetic Vertical Datum (NGVD 29)

Bench Mark Elevation Information	In METERS	above:
Stamping or Designation	MLLW	MHW
1 NP 1955 NO 1 1926 NO 2 1926 2 NP 1955 3 NP 1955 6 NP 1959 0580 L 1977 0580 M 1977 0580 N 1977 COORS 1974 TOPOGRAPHIC	3.641 3.216 3.150 3.339 3.358 4.651 6.452 4.753 4.061 3.333	2.226 1.800 1.734 1.923 1.942 3.235 5.036 3.337 2.646 1.917
NB4-41-82	3.826	2.410

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DEFINITIONS

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NAVD 88 is a fixed datum derived from a simultaneous, least squares, minimum constraint adjustment of Canadian/Mexican/United States leveling observations. Local mean sea level observed at Father Point/Rimouski, Canada was held fixed as the single initial constraint. NAVD 88 replaces NGVD 29 as the national standard geodetic reference for heights. Bench mark elevations relative to NAVD 88 are available from NGS through the World Wide Web at National Geodetic Survey.

NGVD 29 and NAVD 88 are fixed geodetic datums whose elevation relationships to local MSL and other tidal datums may not be consistent from one location to another.

The Vertical Mark Number (VM#) and PID# shown on the bench mark sheet are unique identifiers for bench marks in the tidal and geodetic databases, respectively. Each bench mark in either database has a single, unique VM# and/or PID# assigned. Where both VM# and PID# are indicated, both tidal and geodetic elevations are available for the bench mark listed.

The NAVD 88 elevation is shown on the Elevations of Tidal Datums Table Referred to MLLW only when two or more of the bench marks listed have NAVD 88 elevations. The NAVD 88 elevation relationship shown in the table is derived from an average of several bench mark elevations relative to tide station datum. As a result of this averaging, NAVD 88 bench mark elevations computed indirectly from the tidal datums elevation table may differ slightly from NAVD 88 elevations listed for each bench mark in the NGS database.