Jul 19, 2013 11:52am mpratschner

L:\AutoCAD Project Files_Projects\0243-City of NB\Lower NB Dredging\HASP\0234-RP HASP006-PHASE-2-SAMP-STATIONS.dwg FIG 3

SOURCE: Drawing prepared from Bing maps. Dredge units from U.S. Army Corps of Engineers.
HORIZONTAL DATUM: California State Plane, Zone 6, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

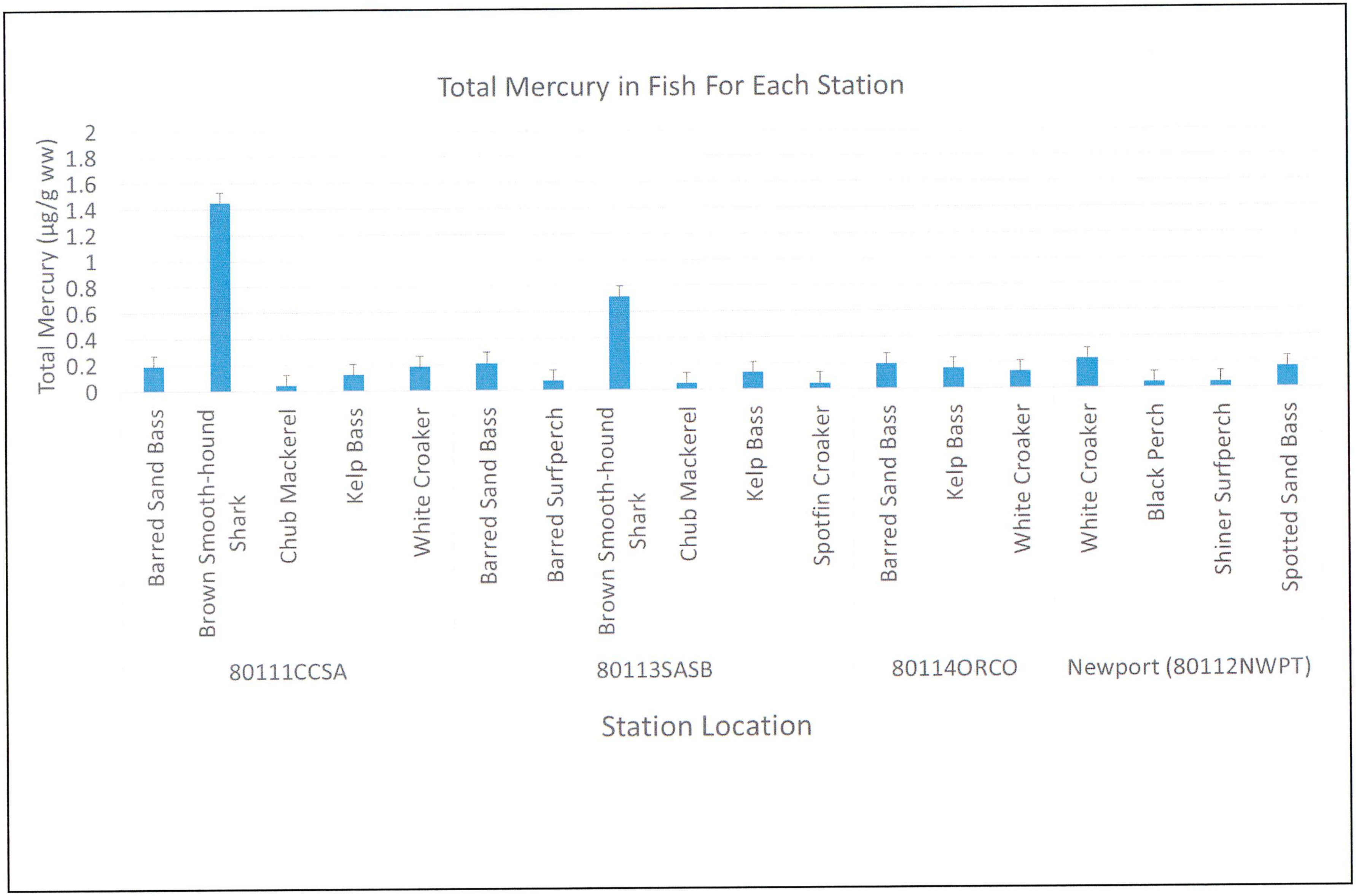
LEGEND:

- Phase I Dredge Unit
- Phase II Dredge Unit
- (-10) Dredge Depth
- REF# Reference Site
- Sampling Locations

0 1000
Scale in Feet

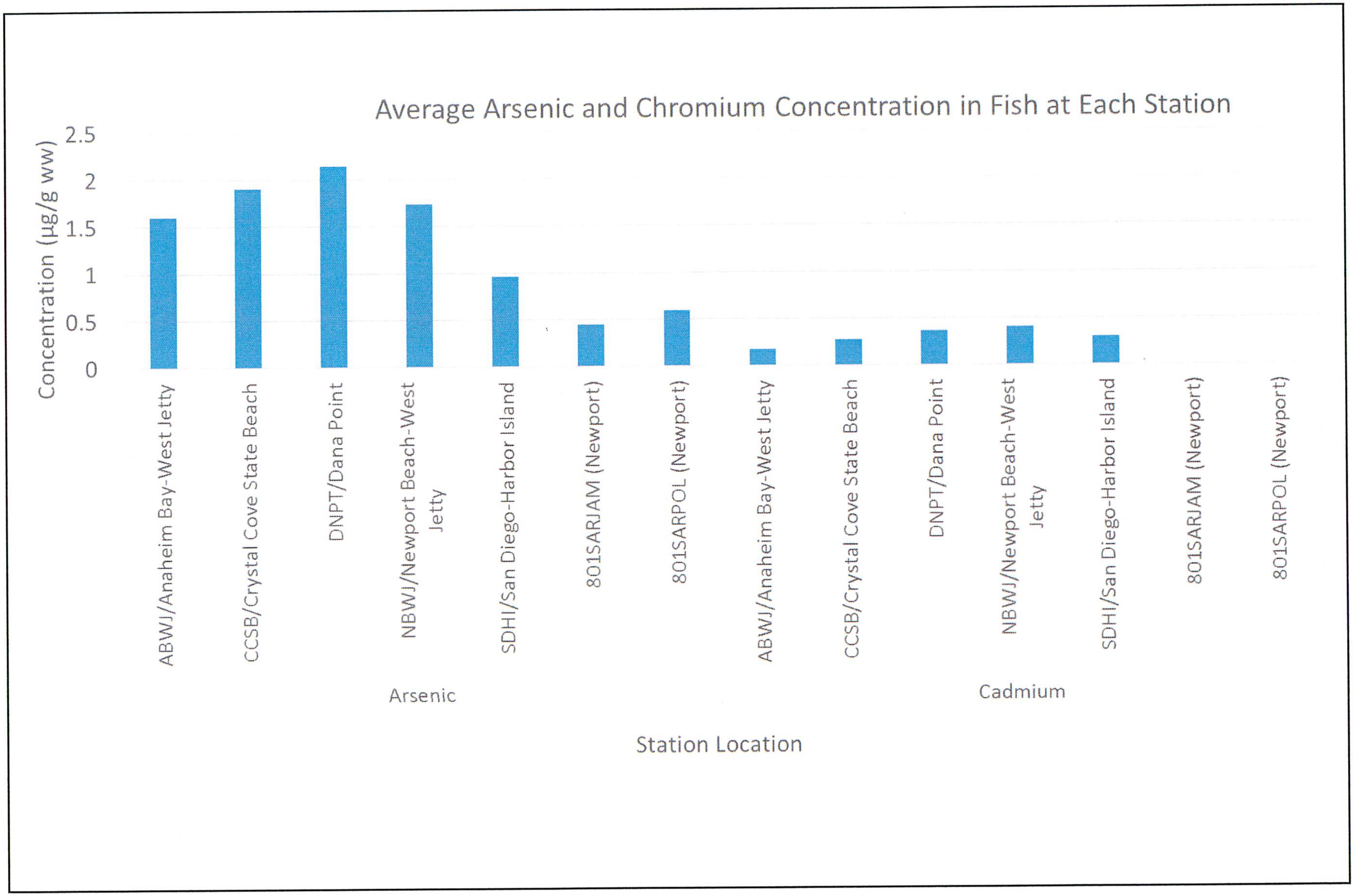
ANCHOR QEA

Figure 6
Post-Dredge Sediment Sampling Locations
Newport Bay Copper TMDLs and Non-TMDL Action Plans
City of Newport Beach



ANCHOR QEA

Figure 7
Total Mercury in Fish for Each Station
Newport Bay Copper TMDLs and Non-TMDL Action Plans
City of Newport Beach



ANCHOR QEA

Figure 8
Average Arsenic and Chromium Concentration in Fish at Each Station
Newport Bay Copper TMDLs and Non-TMDL Action Plans
City of Newport Beach

ATTACHMENT 4

ANCHOR QEA

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MEMORANDUM

To:	Bob Stein, Assistant City Engineer; Chris Miller, Harbor Resources Manager; and Dave Webb, Public Works Director, City of Newport Beach	**Date:**	July 10, 2015
From:	Shelly Anghera, Ph.D., and Chris Gardner, Anchor QEA	**Project:**	150243-01.04
Cc:	Chris Osuch, Anchor QEA		
Re:	Random Sample Points Methodology		

In 1996, Newport Bay (the Bay) was listed on the 303 (d) list for metals, pesticides, and organic pollutants. A total maximum daily load (TMDL) for metals is currently required for dissolved copper, lead, and zinc in the Upper and Lower Bay as well as the Rhine Channel. The TMDL is being updated to include an implementation plan requiring the conversion of 87% of the boats to non-copper-based paints to address water quality concerns for dissolved copper in Newport Bay.

Numeric targets for metals in the Bay are adopted from the California Toxics Rule (CTR). The CTR chronic target for dissolved copper for saltwater is 3.1 micrograms per liter (L). Previous investigations within the Bay have identified elevated copper concentrations in water from boat paint. However, these investigations sampled water adjacent to boats and were not designed to capture representative copper concentrations throughout the extent of the Bay. Anchor QEA designed a sampling plan whereby water samples were collected from 40 discrete locations that were randomly selected from within the sampling extent presented in Figure 1. Collecting water samples from randomly-generated locations will enable the establishment of a general condition of copper concentration throughout the Bay with a high degree of objectivity.

METHODS

Randomized Sampling Design Method

ArcGIS 10.2 geographic information systems (GIS) software was used to delineate the sample extent area and generate the random sample locations from which water samples were collected for copper analysis. The generation of the random sample locations was accomplished using the *Create Random Points* tool within ArcGIS's ArcToolbox module (Esri 2015). This tool enables a user to generate random points within a constraining feature class (a polygon) and ensures that these random points are spaced no closer than a specified distance. The tool's relevant parameters for our analysis were as follows:

- **Constraining Feature Class** – A feature class whose shape defines the area within which the random sample locations will be generated. This feature class corresponds to the Sampling Extent polygon presented in Figure 1.
- **Number of Points** – The desired number of random sample points to generate within the Constraining Feature Class.
- **Minimum Allowed Distance** – The minimum distance in feet between the sample points that are generated within the Constraining Feature Class.

The *Create Random Points* tool works by first partitioning the polygon representing the Constraining Feature Class into triangles of varying sizes, using a standard polygon partitioning algorithm. To place the first point in the polygon, one of the triangles in the polygon is randomly selected. The probability of selecting a particular triangle is influenced by the size of the triangle, such that the larger the triangle, the higher the probability the triangle will be selected. Two legs of the triangle become the two axes from which to place the random point. Random values are then selected along each of the two legs, and a point is produced within the triangle using these two values. Then another triangle within the polygon representing the constrained extent is randomly selected, and the process repeats itself until the number of desired random samples is generated.

A Constraining Feature Class polygon was digitized from high-resolution orthographic photos to enclose the in-water areas of the Bay and Beacon Bay up to the approximate shoreline, extending northward to a point just south of the Newport Aquatic Center (Figure 1). This polygon was then fed into the *Create Random Points* tool as the Constraining Feature Class parameter. Values of "40" and "300 ft." were entered for the Number of Points and Minimum Allowed Distance parameters, respectively, and the tool was executed, producing a point feature class containing the 40 randomly generated sample points. Fields named "Latitude" and "Longitude" were added to the attribute table of this feature class and were populated with each point's latitude and longitude values in units of decimal degrees.

Field Sample Collection Methods

Water samples were collected for chemical analysis using a 3-L Van Dorn bottle oriented horizontally. Samples were collected mid-depth at each station. Each sample was analyzed for dissolved copper. Water column chemistry was performed by Eurofins Environmental Laboratories, Inc., located in Garden Grove, California.

Results

The results of chemical analyses are presented in Table 1. Chemical concentrations were compared to water quality criteria. Raw data are provided in the complete chemistry reports (Attachment A forthcoming).

REFERENCES

Esri, 2015. ArcGIS Resources, *Create Random Points*. Accessed: June 30, 2015. Available from: http://resources.arcgis.com/en/help/main/10.2/index.html#//00170000002r000000.

Table 1
Newport Bay Metals TMDL Water Quality Copper Study

Sample ID	Sample Date	Latitude	Longitude	Copper (μg/L)
NB-01-063015	6/30/2015	32.60132	-117.88972	1.64
NB-02-070115	7/1/2015	32.61472	-117.92678	6.4
NB-03-070115	7/1/2015	32.61140	-117.9072	2.14
NB-04-063015	6/30/2015	32.59537	-117.87962	0.287
NB-05-063015	6/30/2015	32.61003	-117.9219	5.51
NB-06-070115	7/1/2015	32.61073	-117.90926	2.11
NB-07-063015	6/30/2015	32.62070	-117.93562	5.75
NB-08-063015	6/30/2015	32.60003	-117.88053	0.309
NB-09-070115	7/1/2015	32.60782	-117.90701	1.89
NB-10-063015	6/30/2015	32.60769	-117.90376	2.81
NB-11-070115	7/1/2015	32.61177	-117.90393	2.66
NB-12-070115	7/1/2015	32.60734	-117.91168	2.64
NB-13-063015	6/30/2015	32.60861	-117.88832	3.72
NB-14-070115	7/1/2015	32.61642	-117.92587	4.65
NB-15-063015	6/30/2015	32.60958	-117.89508	4.07
NB-16-063015	6/30/2015	32.60288	-117.88453	3.44
NB-17-070115	7/1/2015	32.60430	-117.88895	0.739
NB-18-063015	6/30/2015	32.61393	-117.90273	3.66
NB-19-070115	7/1/2015	32.61381	-117.91540	2.37
NB-20-063015	6/30/2015	32.61060	-117.92328	5.73
NB-21-063015	6/30/2015	32.62030	-117.93361	5.2
NB-22-063015	6/30/2015	32.60190	-117.88824	2.29
NB-23-070115	7/1/2015	32.61749	-117.92578	3.36
NB-24-063015	6/30/2015	32.62057	-117.9015	3.16
NB-25-070115	7/1/2015	32.61209	-117.90503	1.81
NB-26-063015	6/30/2015	32.61388	-117.90468	4.99
NB-27-063015	6/30/2015	32.59855	-117.88043	0.303
NB-28-070115	7/1/2015	32.61352	-117.91277	1.95
NB-29-070115	7/1/2015	32.61830	-117.92445	3.02
NB-30-070115	7/1/2015	32.61348	-117.90565	2.36
NB-31-063015	6/30/2015	32.61959	-117.92596	3.52
NB-32-063015	6/30/2015	32.60501	-117.90134	2.6
NB-33-063015	6/30/2015	32.60936	-117.92439	5.63
NB-34-063015	6/30/2015	32.60105	-117.89430	2.26

Sample ID	Sample Date	Latitude	Longitude	Copper (µg/L)
NB-35-063015	6/30/2015	32.60098	-117.88608	0.992
NB-36-070115	7/1/2015	32.61057	-117.91887	4.13
NB-37-063015	6/30/2015	32.60299	-117.89870	1.3
NB-38-063015	6/30/2015	32.60676	-117.90237	2.42
NB-39-063015	6/30/2015	32.61538	-117.90313	4.6
NB-40-070115	7/1/2015	32.61692	-117.92275	3.2

Notes:

(yellow shading) Detected concentration is greater than California Toxics Rule screening level (3.1 µg/L)

µg/L microgram per liter

TMDL total maximum daily load

FIGURE

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Figure 1

Dissolved Copper Concentrations

Frame 1 of 4

Newport Bay Copper Study

City of Newport Beach

ANCHOR QEA

Figure 1
Dissolved Copper Concentrations
Frame 2 of 4
Newport Bay Copper Study
City of Newport Beach

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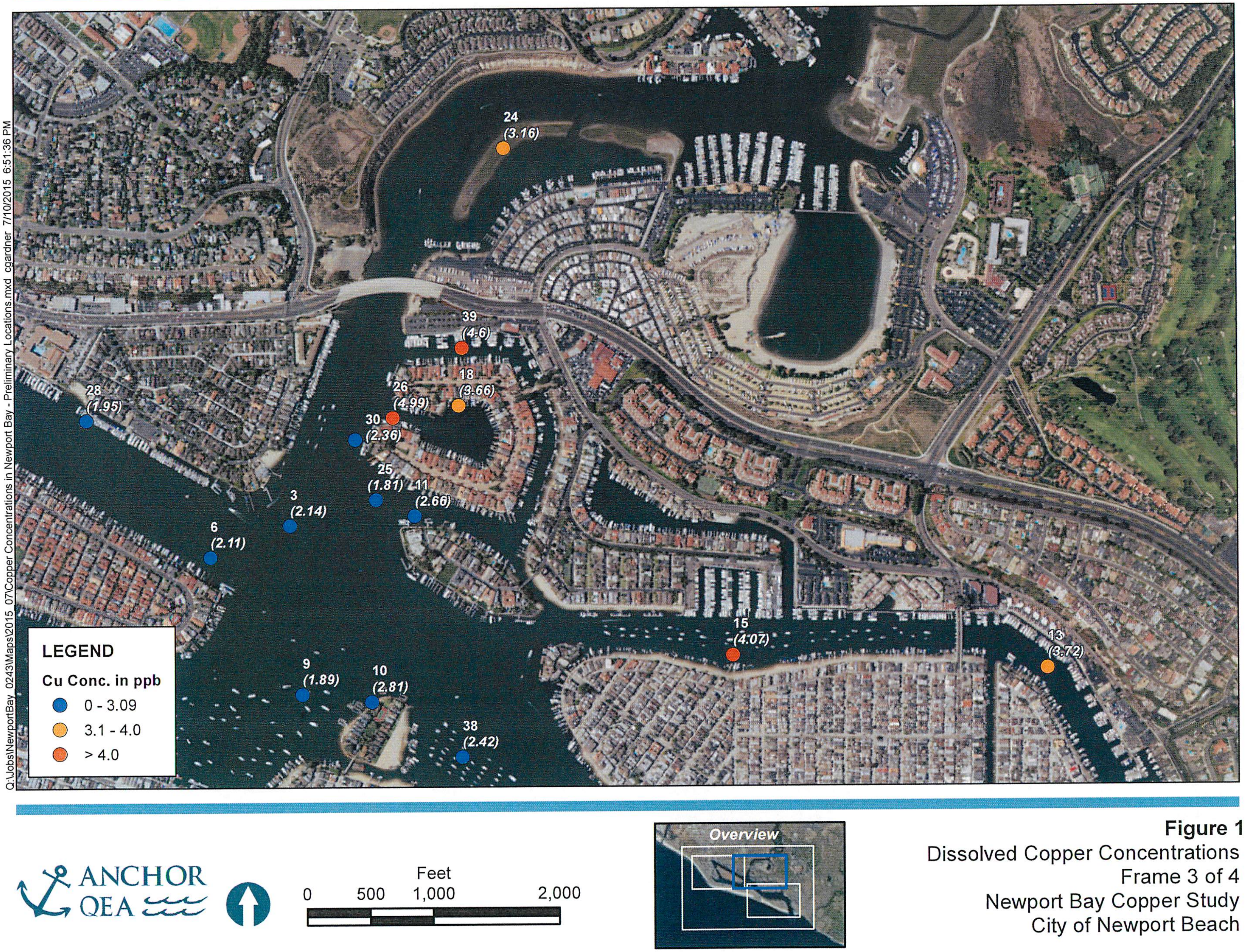

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ANCHOR QEA

Figure 1
Dissolved Copper Concentrations
Frame 3 of 4
Newport Bay Copper Study
City of Newport Beach

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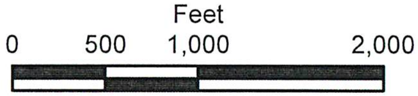

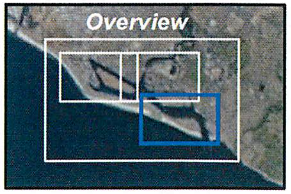

Figure 1
Dissolved Copper Concentrations
Frame 4 of 4
Newport Bay Copper Study
City of Newport Beach

ATTACHMENT 5

ANCHOR QEA
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MEMORANDUM

To:	Robert Stein, Ph.D., Assistant City Engineer; Chris Miller, Harbor Resources Manager; and Dave Webb, Public Works Director, City of Newport Beach	**Date:**	March 25, 2016
From:	Shelly Anghera, Ph.D., and Chris Osuch, Anchor QEA, LLC	**Project:**	160243-01.01
Re:	Newport Bay Copper Study: Winter 2016		

In 1996, Newport Bay (the Bay) was listed on the Clean Water Act Section 303(d) List for metals, pesticides, and organic pollutants. A total maximum daily load (TMDL) for metals is currently required for dissolved copper, lead, and zinc in the Upper and Lower Bay as well as the Rhine Channel. The TMDL is being updated to include an implementation plan requiring the conversion of 87% of the boats to non-copper-based paints to address water quality concerns for dissolved copper in the Bay. Numeric targets for metals in the Bay are adopted from the California Toxics Rule (CTR). The CTR chronic target for dissolved copper for saltwater is 3.1 micrograms per liter (μg/L). Previous investigations within the Bay have identified elevated copper concentrations in water from boat paint.

SURVEY OF COPPER WITHIN NEWPORT BAY

In June 2015, Anchor QEA, LLC, designed a sampling plan whereby water samples were collected from 40 discrete locations that were randomly selected from within the sampling extent presented in Figure 1 (Anchor QEA 2015). Collecting water samples from randomly generated locations enables the establishment of a general condition of copper concentration throughout the Bay with a high degree of objectivity. Results of the June 2015 study showed water quality exceedances for copper in portions of the harbor (Anchor QEA 2015).

In February 2016, the study was repeated to further evaluate dissolved copper patterns throughout the harbor. This study includes monitoring at the same 40 locations to assess the general dissolved copper conditions in the Bay.

FOCUSED BOAT HULL INFLUENCE

In addition to the 40 previous monitoring locations, 14 new targeted locations at specific distances from around two specified vessels were sampled. The goal of this sampling was to assess the movement of copper away from the hull of the vessel, both upcurrent and downcurrent. These two vessels have recently applied copper-based antifouling paint that represents potential sources of copper to the water column. The two moorings selected are located on the edge of a mooring field in an area of unrestricted circulation.

METHODS

Survey of Copper within Newport Bay: Sampling Design Method

ArcGIS 10.2 geographic information systems (GIS) software was used to delineate the sample extent area and generate the random sample locations from which water samples were collected for copper analysis. The generation of the random sample locations was accomplished using the *Create Random Points* tool within ArcGIS's ArcToolbox module (Esri 2015), following methods described in the June 2015 study report (Anchor QEA 2015). A total of 40 randomly generated stations were designated for sampling throughout the Bay. Sampling locations are shown in Figure 1.

Focused Boat Hull Influence: Sampling Design Method

Two vessels, located at moorings A-154 and A-124, were selected for an additional 14 sampling locations (Figure 2). These vessels represent potential sources of copper to the water column. Sampling was designed such that these locations were sampled during a slack tide to isolate inputs from a source other than the moored vessel and focus on its input of copper to the Bay. Samples were collected 1 foot below the water's surface at the following locations:

- 0.5, 3, and 10 feet off the stern
- 0.5 and 3 feet off the bow
- 0.5 foot off both the port and starboard sides

This sampling approach was designed to study the distance from the vessel that copper may dilute in the water column.

Field Sample Collection Methods

Water samples were collected for copper and dissolved organic carbon (DOC) analyses using a 6-L Van Dorn bottle oriented horizontally. The Van Dorn bottle was decontaminated prior to sample collection at each station. Samples were collected mid-depth at each station. Water samples were placed in coolers with ice and stored at less than 4 °C until delivery to the appropriate laboratory for analysis. Proper chain-of-custody procedures were followed.

Each sample was analyzed for dissolved copper. Dissolved copper analysis was performed by Eurofins Calscience, Inc. (ECI), located in Garden Grove, California. DOC samples were shipped overnight to Analytical Resources Inc. (ARI), located in Tukwila, Washington. Upon receipt, DOC samples were filtered and preserved for potential analysis following the receipt of dissolved copper results from ECI. Samples with elevated copper concentrations (greater than CTR [3.1 μg/L]) were analyzed for DOC. DOC in the water column provides an indication of the bioavailability of copper that may be toxic to marine life.

RESULTS

Survey of Copper within Newport Bay

The results of chemical analyses for both June 2015 and February 2016 are presented in Table 1 for comparison. Chemical concentrations were compared to CTR water quality criteria. In February 2016, samples were collected on February 10 and February 11, when tide height ranged from 0.3 to 5.0 feet. Copper concentrations during this event ranged from 0.27 to 12.7 μg/L (Figure 3), and DOC concentrations ranged from 1.40 to 2.20 mg/L. In June 2015, samples were collected on June 30 and July 1, when tide height ranged from 2.2 to 3.2 feet. Copper concentrations during this event ranged from 0.3 to 6.4 μg/L. Raw data are provided in the complete chemistry reports (Attachment A).

For ocean conditions, DOC concentrations often range from 0.9 to 1.1 mg/L. The higher the DOC the higher the binding potential of copper to the organics, therefore, making the copper not bioavailable. Models are currently being evaluated by the Environmental Protection Agency to examine the relationship between observed copper concentrations within water that contains a specified concentration of DOC to predict the bioavailable fraction of copper. It is hoped that in the future this method will be available to assess compliance with the water quality standard through estimation of the bioavailable fraction of copper. These data are provided to allow for that comparison in the future.

Focused Boat Hull Influence

The results of chemical analyses for the February 2016 boat-specific sampling are presented in Table 2. Copper concentrations ranged from 0.374 to 0.962 µg/L for the vessel at mooring A-154 and from 0.509 to 0.743 µg/L for the vessel at mooring A-124. Copper concentrations for specified distances from each vessel are shown in Figure 4.

REFERENCES

Anchor QEA, 2015. *Memorandum: Random Sample Points Methodology*. Newport Bay Copper Sampling in Support of the Newport Bay Metals TMDL. Prepared for the City of Newport Beach. July 2015.

Esri, 2015. ArcGIS Resources, *Create Random Points*. Accessed: June 30, 2015. Available from: http://resources.arcgis.com/en/help/main/10.2/index.html#//00170000002r000000.

TABLES

Table 1
Newport Bay Metals TMDL Water Quality Copper Survey

Sample ID	February 2016				June 2015
	Latitude	Longitude	Copper (µg/L)	DOC (mg/L)	Copper (µg/L)
NB-01-021016	33.60130	-117.88969	0.404	--	1.64
NB-02-021116	33.61462	-117.92666	12.7	2.11	6.4
NB-03-021116	33.61147	-117.90715	1.84	--	2.14
NB-04-021016	33.59432	-117.87975	0.217	--	0.287
NB-05-021116	33.60973	-117.92178	5.42	2.20	5.51
NB-06-021116	33.61071	-117.90928	1.66	--	2.11
NB-07-021116	33.62078	-117.9359	6.53	1.51	5.75
NB-08-021016	33.59997	-117.8054	0.27	--	0.309
NB-09-021116	33.60785	-117.90751	2.17	--	1.89
NB-10-021116	33.60771	-117.90388	1.08	--	2.81
NB-11-021116	33.61181	-117.90389	2.31	--	2.66
NB-12-021116	33.60726	-117.91162	3.05	--	2.64
NB-13-021016	33.60888	-117.88866	1.96	--	3.72
NB-14-021116	33.61638	-117.92596	3.99	2.24	4.65
NB-15-021016	33.60951	-117.89503	3.06	--	4.07
NB-16-021016	33.60288	-117.88488	0.83	--	3.44
NB-17-021016	33.60436	-117.88898	0.441	--	0.739
NB-18-021016	33.61384	-117.90271	2.96	--	3.66
NB-19-021116	33.61382	-117.9153	2.09	--	2.37
NB-20-021116	33.61057	-117.92326	7.54	2.10	5.73
NB-21-021116	33.62030	-117.93366	5.91	2.10	5.2
NB-22-021016	33.60190	-117.88818	0.251	--	2.29
NB-23-021116	33.61758	-117.92582	3.28	2.06	3.36
NB-24-021016	33.62063	-117.90151	1.64	--	3.16
NB-25-021116	33.61208	-117.90498	1.94	--	1.81
NB-26-021016	33.61390	-117.90464	2.82	--	4.99
NB-27-021016	33.59538	-117.88033	0.401	--	0.303
NB-28-021116	33.61351	-117.91273	2.52	--	1.95
NB-29-021116	33.61832	-117.92446	2.81	--	3.02
NB-30-021116	33.61346	-117.90563	1.87	--	2.36
NB-31-021116	33.61961	-117.92598	2.77	--	3.52
NB-32-021016	33.60496	-117.90132	1.54	--	2.6
NB-33-021116	33.60946	-117.9258	8.19	1.54	5.63
NB-34-021016	33.60131	-117.88967	0.491	--	2.26