MARINA DEL REY HARBOR: WATER EFFECT RATIO (WER) STUDY

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TODAY'S PRESENTATION

- Study Objectives
- WER Sampling and Testing Design
- Study Results
  - Summary of findings
  - Sample WERs

TOXICS/COPPER TMDL

- 2014 TMDL Revisions included a finding of copper impairment in the water column
  - Established load allocation for copper in the water column
  - Dissolved copper target of 3.1 µg/L
- To meet the TMDL target, there must be an 85% reduction of copper leaching from boat hull paints by 2024
  - Minor inputs of Cu from other sources
- A site-specific objective study was approved

STUDY OBJECTIVES

- Characterize variability of key water quality parameters in MdRH
  - Dissolved copper
  - DOC
- Generate a Water Effects Ratio (WER) using up to six sampling events under varying water quality conditions
  - Winter and summer dry weather
  - Wet weather
  - Spring and neap tidal cycles

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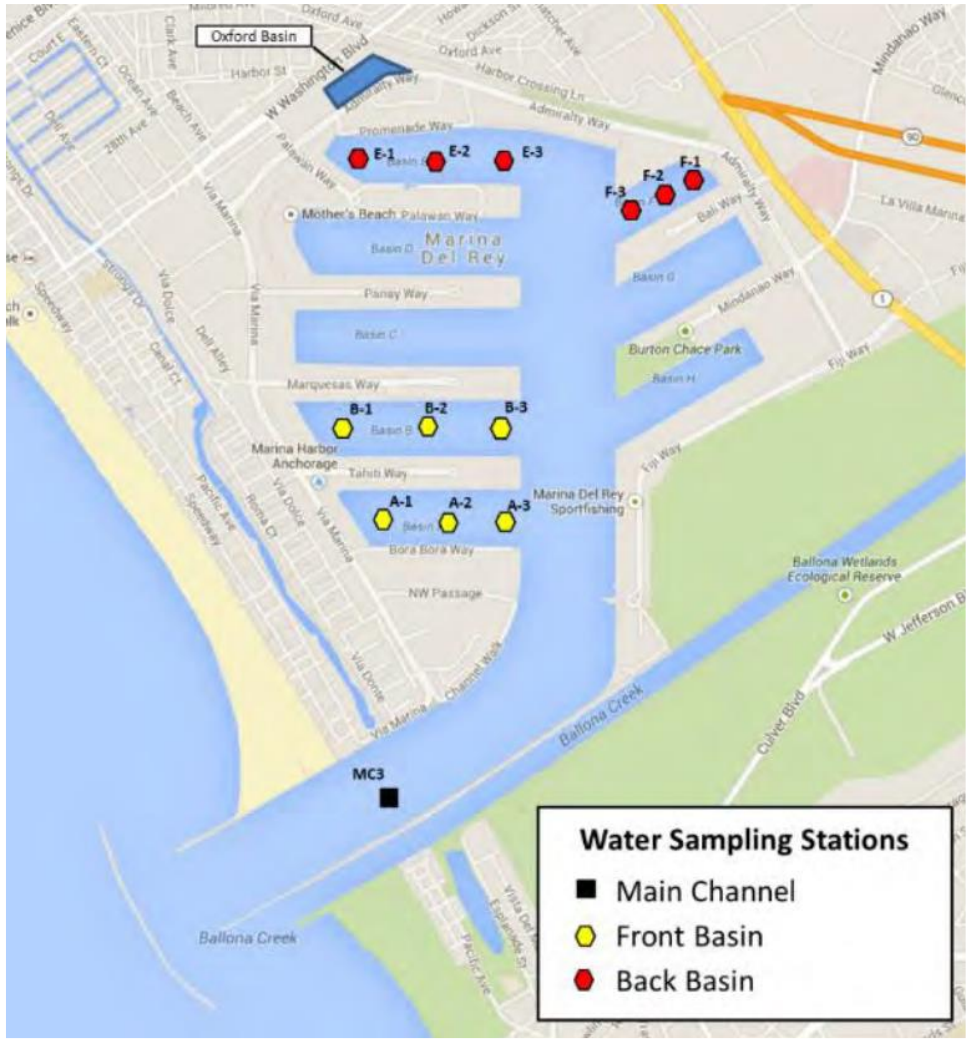
SAMPLING EVENTS

WER sampling	Tide Type		Summer	Winter	
			Dry Weather	Dry Weather	Wet Weather
	Spring	Neap	April – October	November – March	November – March
#1		X	X		
#2	X		X		
#6		X		X	
#7	X			X	
#3	NA	NA			X
#5	NA	NA			X

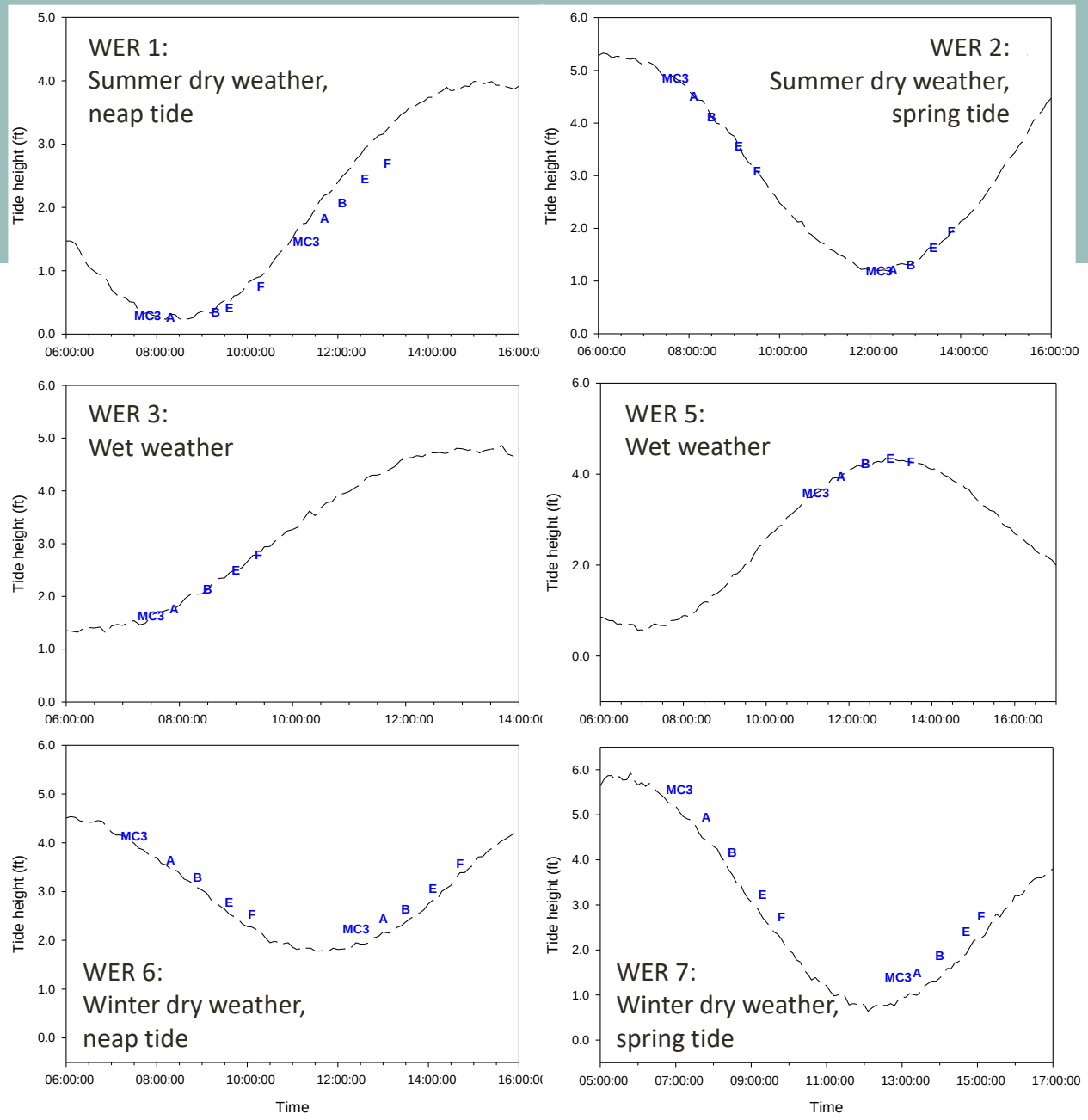
SAMPLING LOCATIONS

- 5 stations were selected to represent spatial variability within harbor
  - Spatial composites of each basin
  - Tidal composites (ebb and flood) for dry weather events



SAMPLING EVENTS: TIDAL CYCLES

- For wet weather events, each station was sampled once
- For dry weather events, each location was sampled at flood and ebb tides and further composited for one sample per station



PARAMETERS ANALYZED

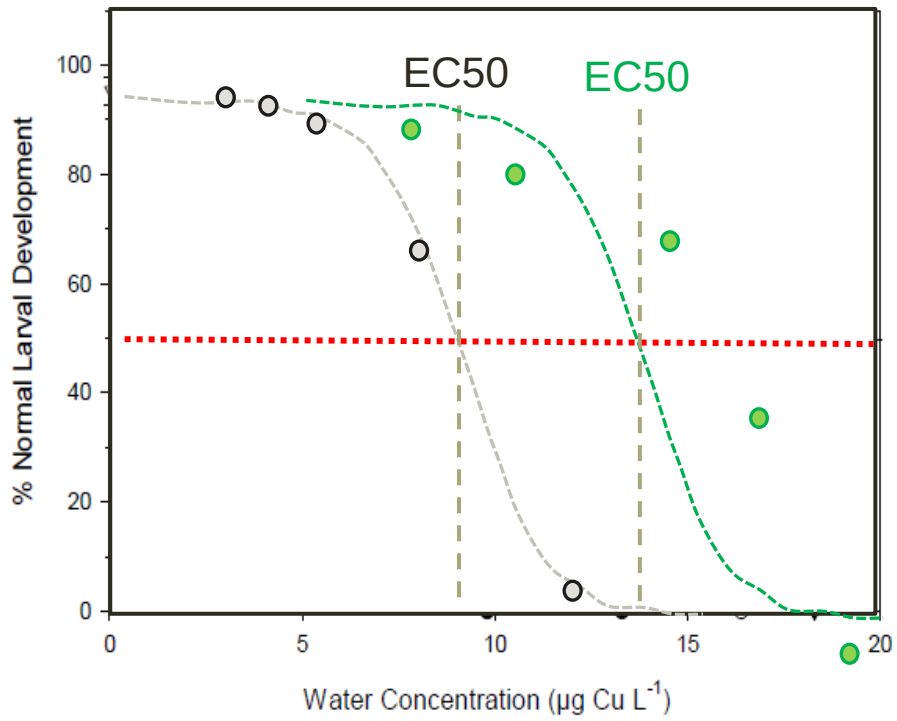
Analyte	Occasion of Measurement	
	Field	Laboratory
pH	X	X
Temperature	X	X
Salinity	X	X
Dissolved Oxygen	X	X
Dissolved Organic Carbon		X
Total and Dissolved Copper		X
Total and Dissolved Zinc		X
Toxicity		X

- Dose-response toxicity tests performed on water samples
  - Copper added to create a range of concentrations from 0-23 µg/L

WATER EFFECT RATIO (WER) CALCULATION

- EPA-recommended method to develop site-specific aquatic life criteria
  - Compares toxicity of metal in site water to reference water

$$WER = \frac{\text{Site Water EC50}}{\text{Reference Water EC50}}$$



EC50 = Toxicant concentration causing 50% effect

WER INTERPRETATION

- WER = 1
  - Water quality objective accurate with respect to site conditions
- WER > 1
  - Site conditions reduce toxic potency
- WER < 1
  - Site conditions increase toxic potency
- WER can be used to develop a site-specific objective (SSO)
  - SSO = Criterion x WER

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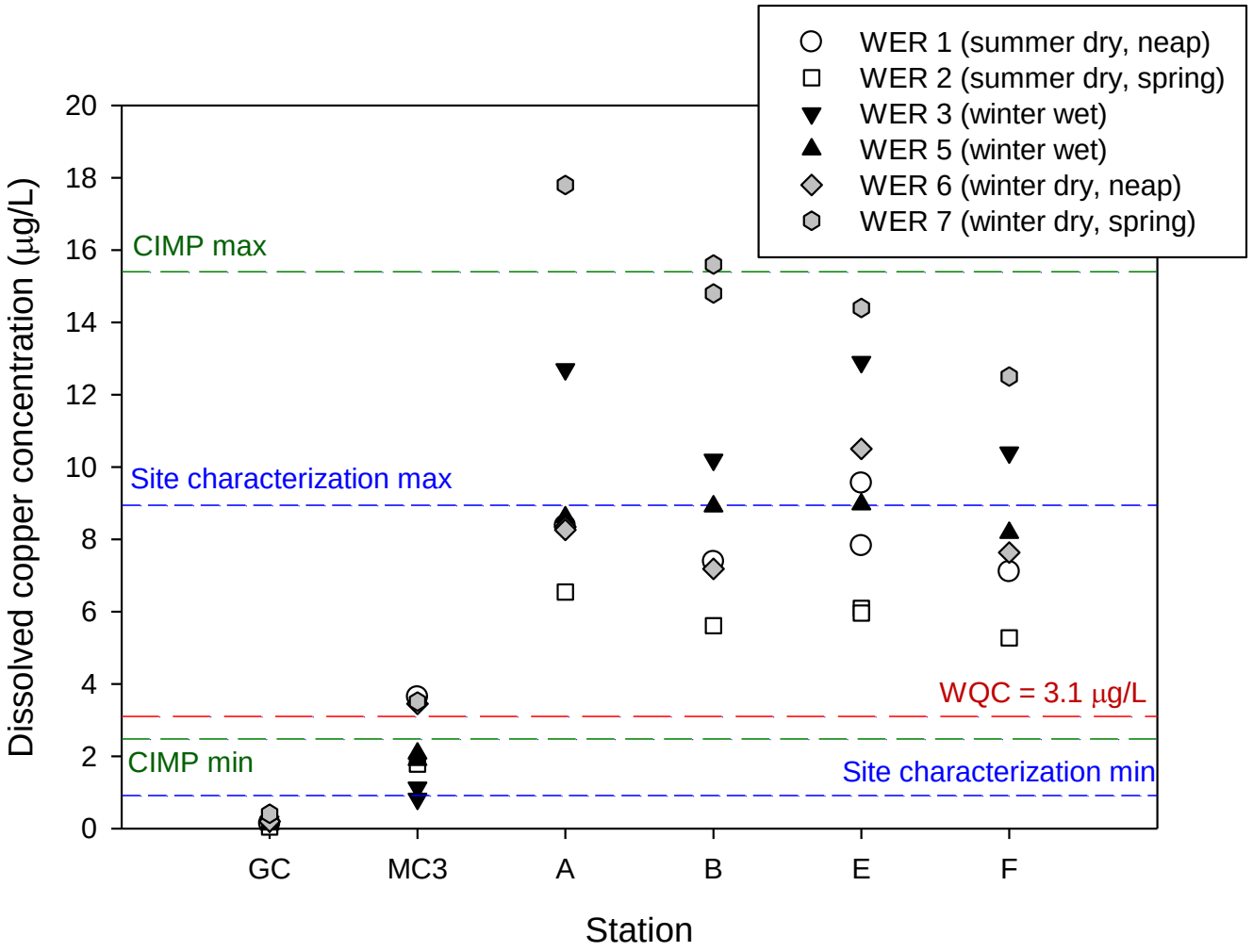
STUDY FINDINGS

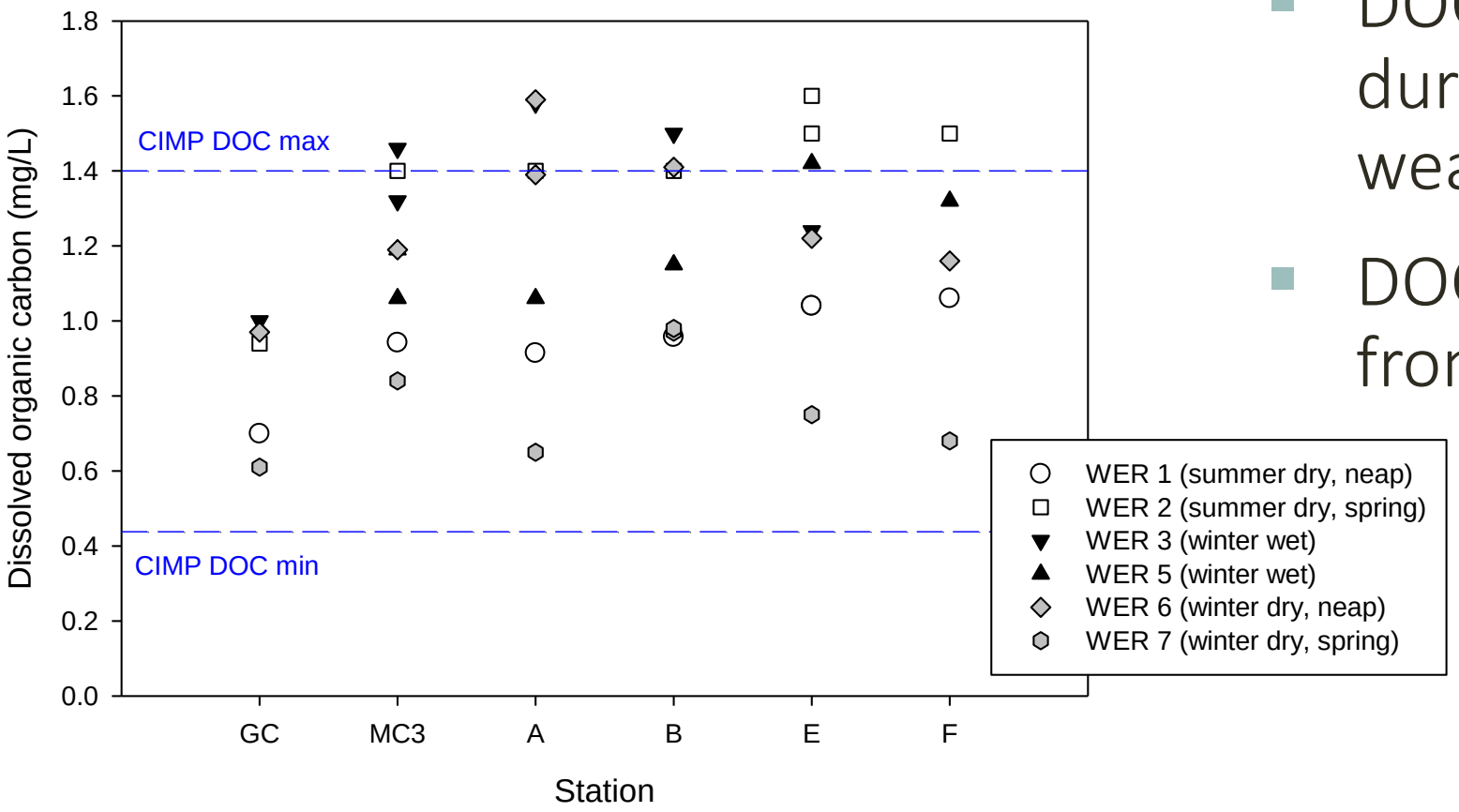
- Dissolved copper concentrations frequently exceeded current water quality objective (>3.1 µg/L)
- DOC concentrations lowest in winter dry weather with spring tide
- Toxicity-based Water Effects Ratios suggest possible reduced copper bioavailability relative to reference water (WER > 1)
  - Dependent on season and weather
- WERs higher in wet weather > summer dry weather > winter dry weather
  - Suggests greater copper bioavailability during winter dry weather

WER SAMPLING SUMMARY: DISSOLVED COPPER



- Lowest MdRH copper concentrations are at Main Channel station
- Highest MdRH copper concentrations are at basin stations
  - WER 7 event had highest copper concentrations
  - WER 2 had lowest copper concentrations

WER SAMPLING SUMMARY: DISSOLVED ORGANIC CARBON CONCENTRATION



- DOC concentrations lowest during WER 7 (winter dry weather, spring tide)
- DOC concentration ranged from 0.65-1.60 mg/L

TOXICITY-BASED WATER EFFECT RATIOS

	Laboratory Toxicity Test Results						
Station	WER 1 (summer dry, neap)	WER 2 (summer dry, spring)	WER 3 (wet)	WER 5 (wet)	WER 6 (winter dry, neap)	WER 7 (winter dry, spring)	All Events
MdRH-MC3	1.28	1.33	--	1.62 (mean)	1.00	1.27	
MdRH-A	1.30	1.35	1.54	1.72	0.925 (mean)	--	
MdRH-B	1.34	1.35	1.59	1.76	1.01	--	
MdRH-E	1.28 (mean)	1.44 (mean)	1.59	1.94	--	--	
MdRH-F	1.36	1.44	1.57	2.04	1.09	--	
Geometric mean	**1.31**	**1.38**	**1.57**	**1.81**	**1.00**	--	**1.40**

- Lowest WERs in winter dry weather
  - Assumed highest copper bioavailability
- Dry weather WERs range:
  - 0.925 - 1.44
- Wet weather WERs range:
  - 1.54 – 2.04

FINAL WER

- MdRH SSO Study final WER calculation is based on the toxicity test results
  - Geometric mean
  - All 24 sample WERs
  - fWER = 1.40
- An fWER > 1 indicates site conditions reduce toxic potency of copper

QUESTIONS?