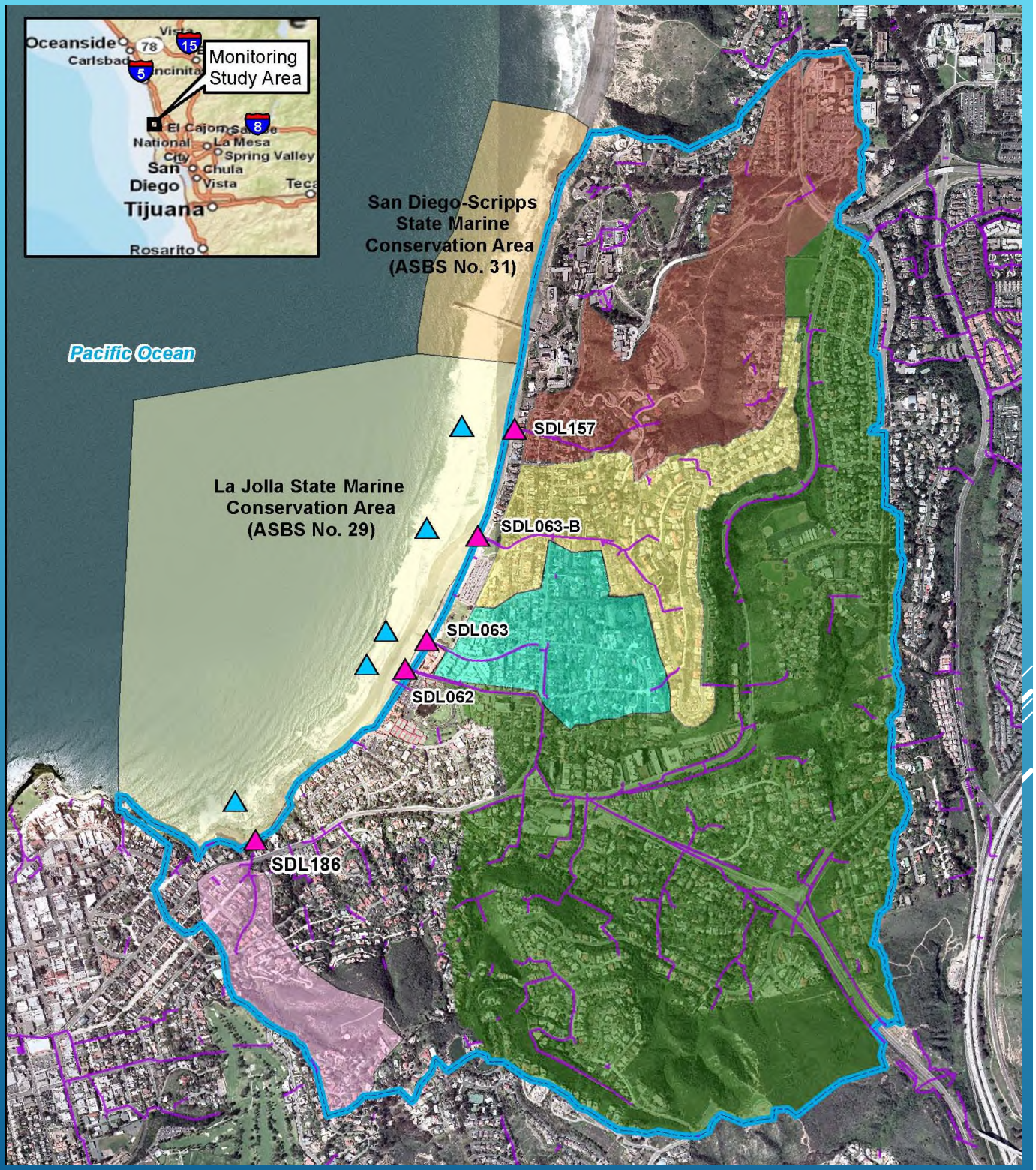
Potential Impacts upon the Rocky Intertidal Community of La Jolla ASBS from Short-duration Exposures to Storm Water Runoff

Dan McCoy- Weston Solutions

ASBS: AREA OF SPECIAL BIOLOGICAL SIGNIFICANCE

- **34 ASBS, designated by the State Water Resources Control Board, along the length of CA coastline**
- **ASBS were set aside to preserve areas that contain rare and unique habitat and biodiversity for future generations**
- **Act as building blocks for the coastal environment and occur in many of the state's most popular coastal locations**
- **Protected under the California Ocean Plan**

- La Jolla, CA contains two ASBS: ASBS 31 and ASBS 29
- ASBS 29 includes approximately 1.7 mi shoreline with 453 acres of marine habitat
- ASBS 29 contains a variety of habitats including: rocky intertidal, kelp forest, sandy bottom, submarine canyon, rocky reef, and open ocean

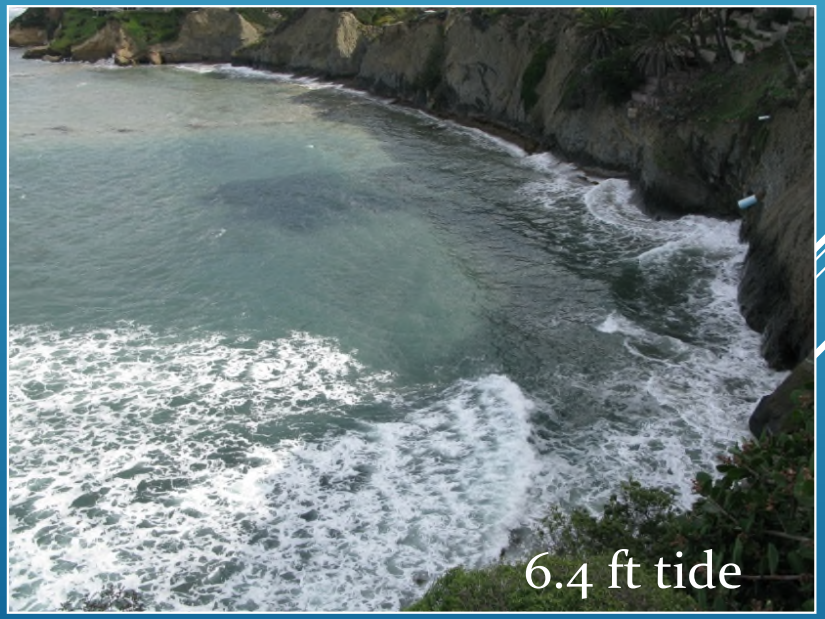


SITUATION IN LA JOLLA ASBS DURING A STORM EVENT

Large Storm drain outlets onto rocky intertidal zone near La Jolla Caves

- **During a falling tide storm water does not get flushed from intertidal zone**
- **Organisms may be exposed to storm water contaminants and freshwater for up to 6 hours before tide rises enough to flush out storm water**

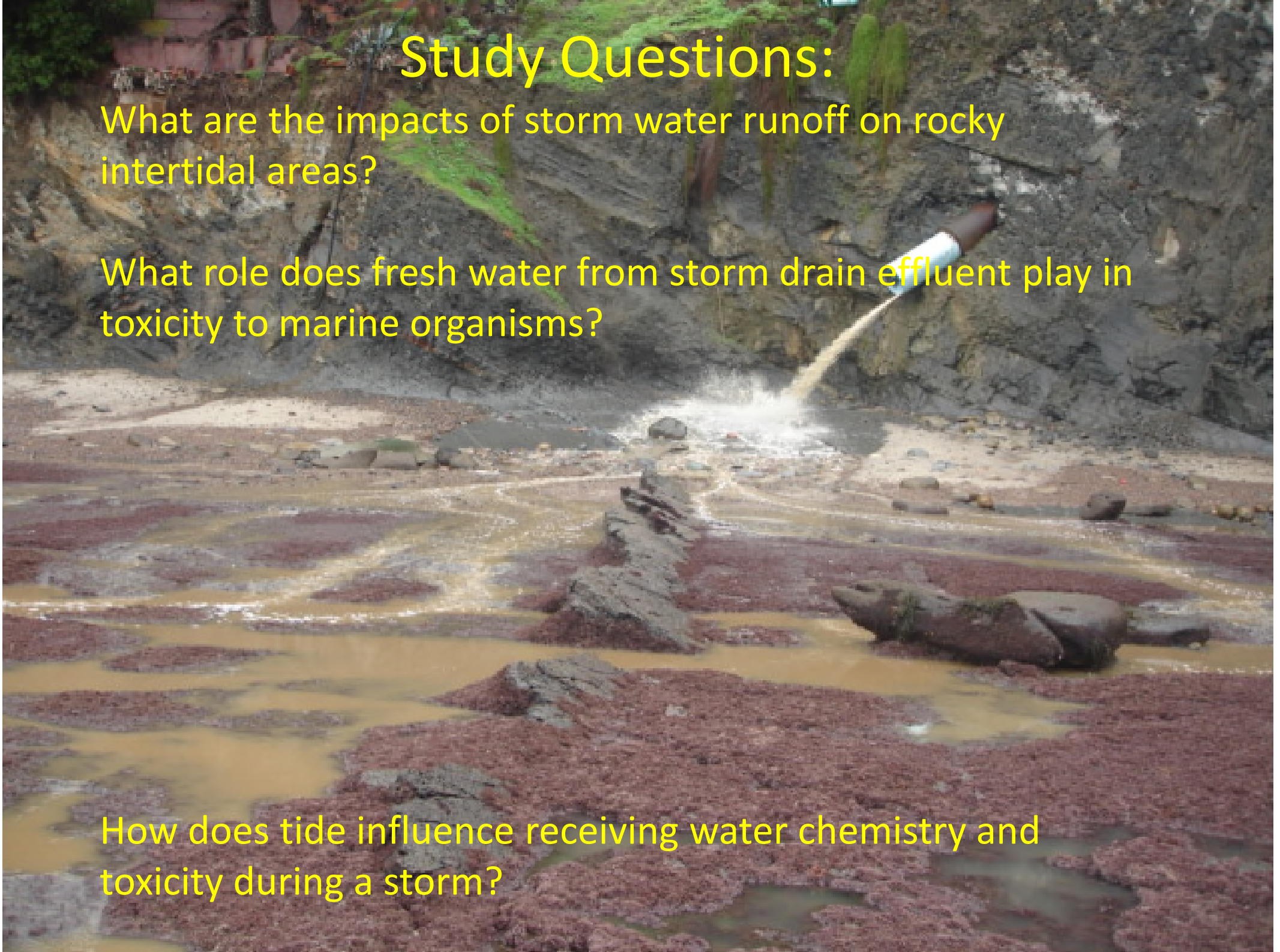
TIDAL RANGE IN LA JOLLA



Contrast in water quality prior to and during a storm event

Prior to Storm Water Runoff Entering Rocky Intertidal Zone

After Storm Water Runoff Has Entered Rocky Intertidal Zone



Study Questions:

What are the impacts of storm water runoff on rocky intertidal areas?

What role does fresh water from storm drain effluent play in toxicity to marine organisms?

How does tide influence receiving water chemistry and toxicity during a storm?

STUDY DESIGN

- Storm water was collected from storm drain 186 at La Jolla and also from Cabrillo National Monument (Reference Area) for toxicity testing and chemical analysis
- A series of grab samples were collected over the course of the storm event from La Jolla tide pools as storm water mixed with sea water
- Sediment samples collected from tide pools at La Jolla and Cabrillo National Monument following storm event

WATER QUALITY RESULTS

Analyte		California Ocean Plan WQO			Storm water from SDL-186	Ocean Receiving Water at SDL-186 during -1.0 ft tide (15:05)	Ocean Receiving Water at SDL-186 during 3.0 ft tide (18:25)	Ocean Receiving Water at CNM Reference Site (0.4 ft tide) (16:30)
		Six-Month Median	Daily Maximum	Instant-aneous Maximum				
Arsenic (µg/L)		8	32	80	3.8	7.3	2.1	1.2
Cadmium (µg/L)		1	4	10	0.38J	0.36J	0.13	0.03
Chromium (µg/L)		2	8	20	22.4	27.6	3.2	0.7
Copper (µg/L)		3	12	30	104.2	107.7	12.5	0.6
Lead (µg/L)		2	8	20	25.2	24.8	6.5	0.9
Nickel (µg/L)		5	20	50	8.8	11.7	2.3	0.6
Selenium (µg/L)		15	60	150	3.33	5.80	0.09	0.02
Silver (µg/L)		0.7	2.8	7	<0.5	<0.5	0.07	0.05
Zinc (µg/L)		20	80	200	233.1	240.0	38.4	2.6
TSS (mg/L)					352	7.3	156.4	32.8
Salinity (ppt)					0.1	0.4J	29.6	30.3
OP pesticides (ng/L)		No values listed in California Ocean Plan for protection of marine aquatic life			ND	ND	ND	ND
Pyrethroids (ng/L)	Bifenthrin	4.0 ng/L 96-h LC_{50} for Mysid shrimp*			1,818	5,242	38.9	ND
	Cyfluthrin	2.42 ng/L 96-h LC_{50} for Mysid shrimp*			140	25.4	2.8	ND
	Cyper-methrin	36.0 ng/L 96-h LC_{50} for *Penaeus sp.***			196	21.8	11.5	ND

Values exceeding daily maximum and Instantaneous California Ocean Plan WQOs are highlighted in yellow and orange, respectively.
Values exceeding the pyrethroid LC_{50} value for marine organisms are highlighted in purple

REFERENCE SITE: CABRILLO NATIONAL MONUMENT

- Salinity > 29 ppt throughout storm
- No toxicity with any sample
- No constituent concentrations greater than COP WQOs

SEDIMENT RESULTS

Analyte	TEL (Marine)	PEL (Marine)	SDL-186 Upper Intertidal	SDL-186 Lower Intertidal	CNM Upper Intertidal	CNM Lower Intertidal
Metals (µg/g)						
Arsenic	7.2	41.6	2.9	4.8	2.1	2.3
Cadmium	0.68	4.2	0.03J	0.03J	<0.025	<0.025
Chromium	52.3	160	5.8	7.5	2.3	2.3
Copper	18.7	108	3.3	3.2	0.7	0.7
Lead	30.2	112	2.8	2.0	0.9	1.0
Nickel	15.9	42.8	2.8	3.5	0.9	0.9
Selenium	No value	No value	0.13	0.12	0.04J	0.07
Silver	0.73	1.8	<0.025	<0.025	<0.025	<0.025
Zinc	124	271	15.9	17.3	5.6	5.7
PCBs (ng/g)						
Total PCBs	21.6	189	<1	<1	<1	<1
PAHs (ng/g)						
Total PAHs (ng/g)	1,684	16,770	1.4	1.1	1.4	1.9
OP pesticides (ng/g)						
Organophosphorus Pesticides	No value	No value	ND	ND	ND	ND
Synthetic Pyrethroids (ng/g)						
Bifenthrin	No value	No value	<0.5	<0.5	<0.5	<0.5
Cyfluthrin	No value	No value	<0.5	<0.5	<0.5	<0.5
Cypermethrin	No value	No value	<0.5	<0.5	<0.5	<0.5
Grain Size (%)						
Sand and gravel composition	NA	NA	97	97	98	98

Values at SDL-186 are generally higher for metals than CNM Reference site; all values however are substantially below Threshold Effects Levels (TELs) and Probable Effects Levels (PELs).

TOXICITY TESTING

- 5 Species of Intertidal Organisms Were Tested

- Abalone,
- Bivalves,
- Mysid shrimp,
- Echinoderms,
- Diatoms

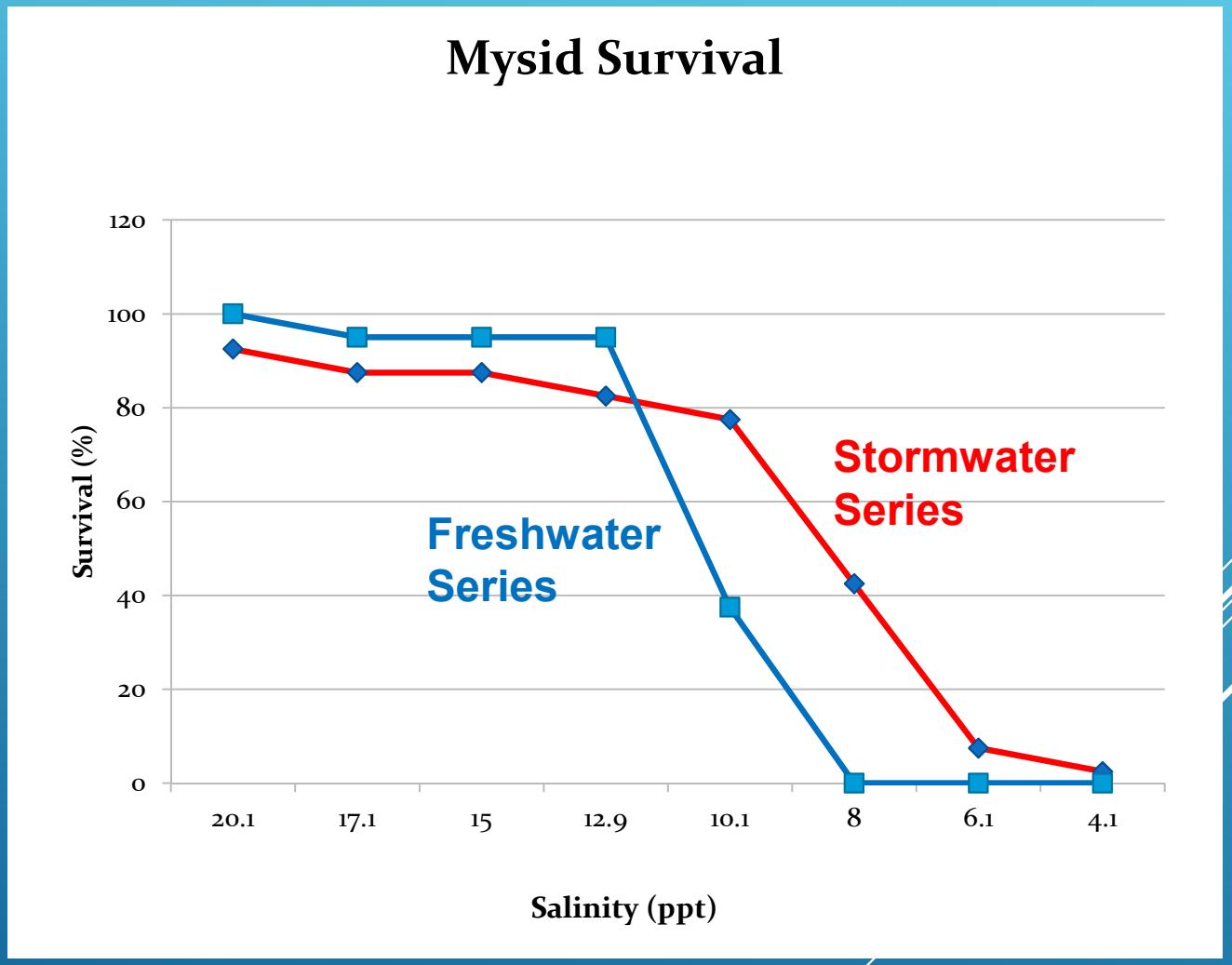
- Range finding tests were conducted initially to determine suitable salinity ranges for organisms

2 Test Treatments:

- Stormwater Series (Stormwater + Clean Seawater);
- Freshwater Series (Clean Seawater + Clean Freshwater);
- After 6-hour exposure to test treatment organisms placed into 32 ppt Seawater control to mimic tidal cycle

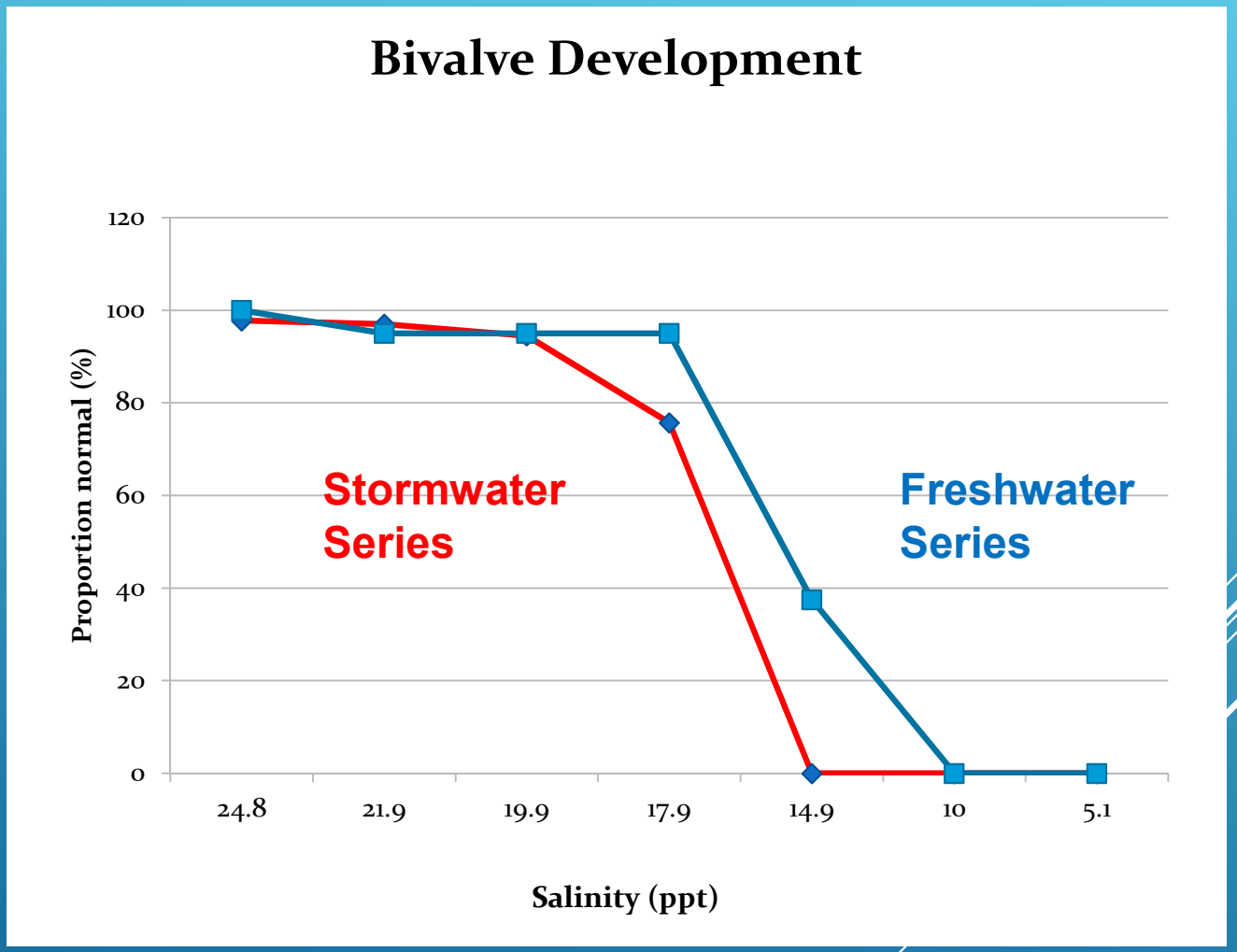
TOXICITY RESULTS- MYSID SHRIMP SURVIVAL

- EC_{50s} were identical in Stormwater Series and Freshwater Series
- EC_{50}= 10.6 ppt
- Stormwater NOEC= 12.9ppt LOEC= 10.1 ppt
- Freshwater NOEC= 13.1 ppt LOEC= 10.0 ppt



TOXICITY RESULTS- BIVALVE DEVELOPMENT

- EC_{50s} were identical in Stormwater Series and Freshwater Series
- EC_{50}= 16.9 ppt
- Stormwater NOEC= 17.9ppt LOEC= 14.9 ppt
- Freshwater NOEC= 19.9 ppt LOEC= 17.9 ppt



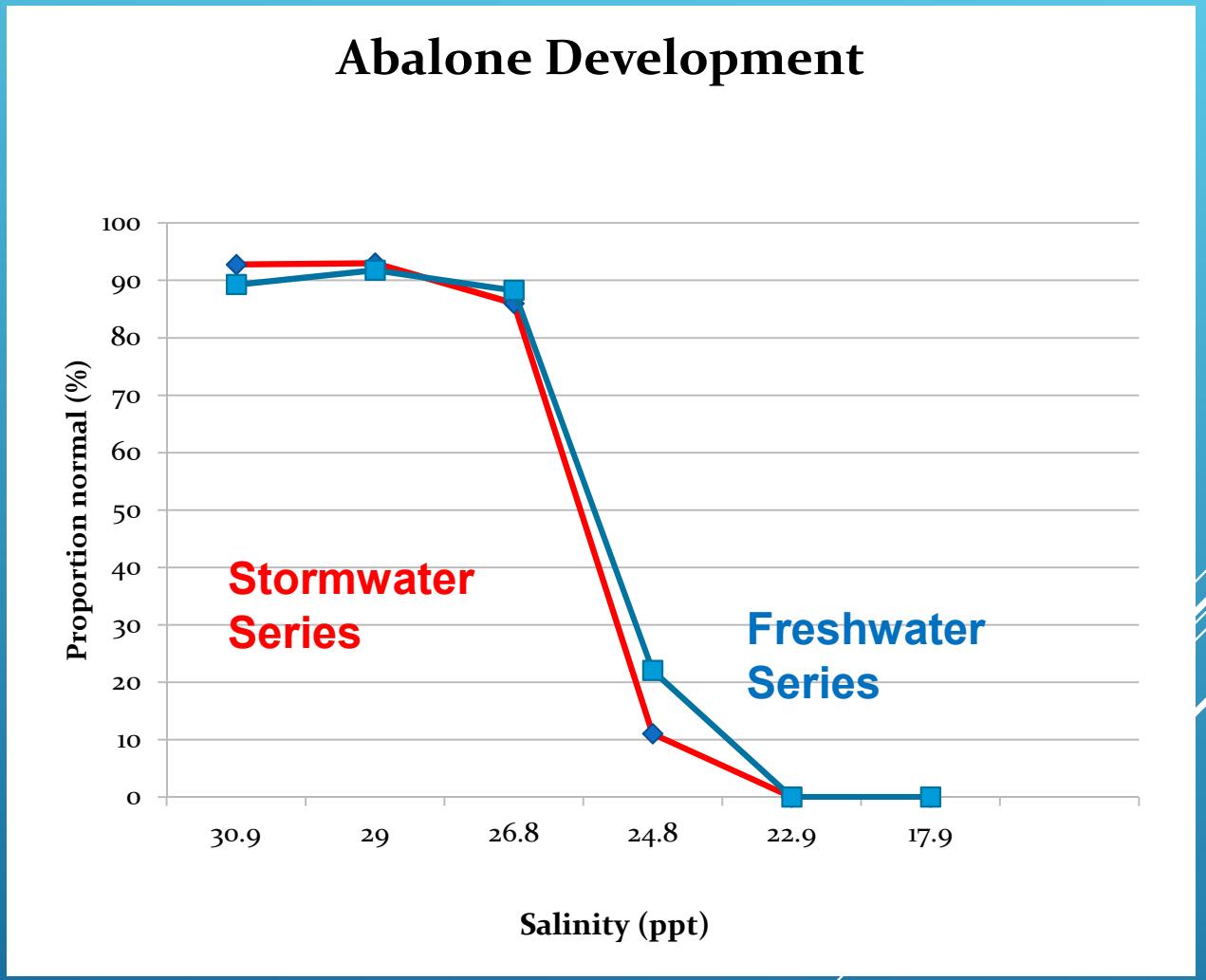
TOXICITY RESULTS- ABALONE DEVELOPMENT

- EC_{50s} were similar in Stormwater Series and Freshwater Series

  SW EC_{50}= 25.7 ppt

  FW EC_{50}= 25.4 ppt

- Stormwater NOEC= 26.8 ppt LOEC= 24.8 ppt
- Freshwater NOEC= 26.8 ppt LOEC= 24.9 ppt



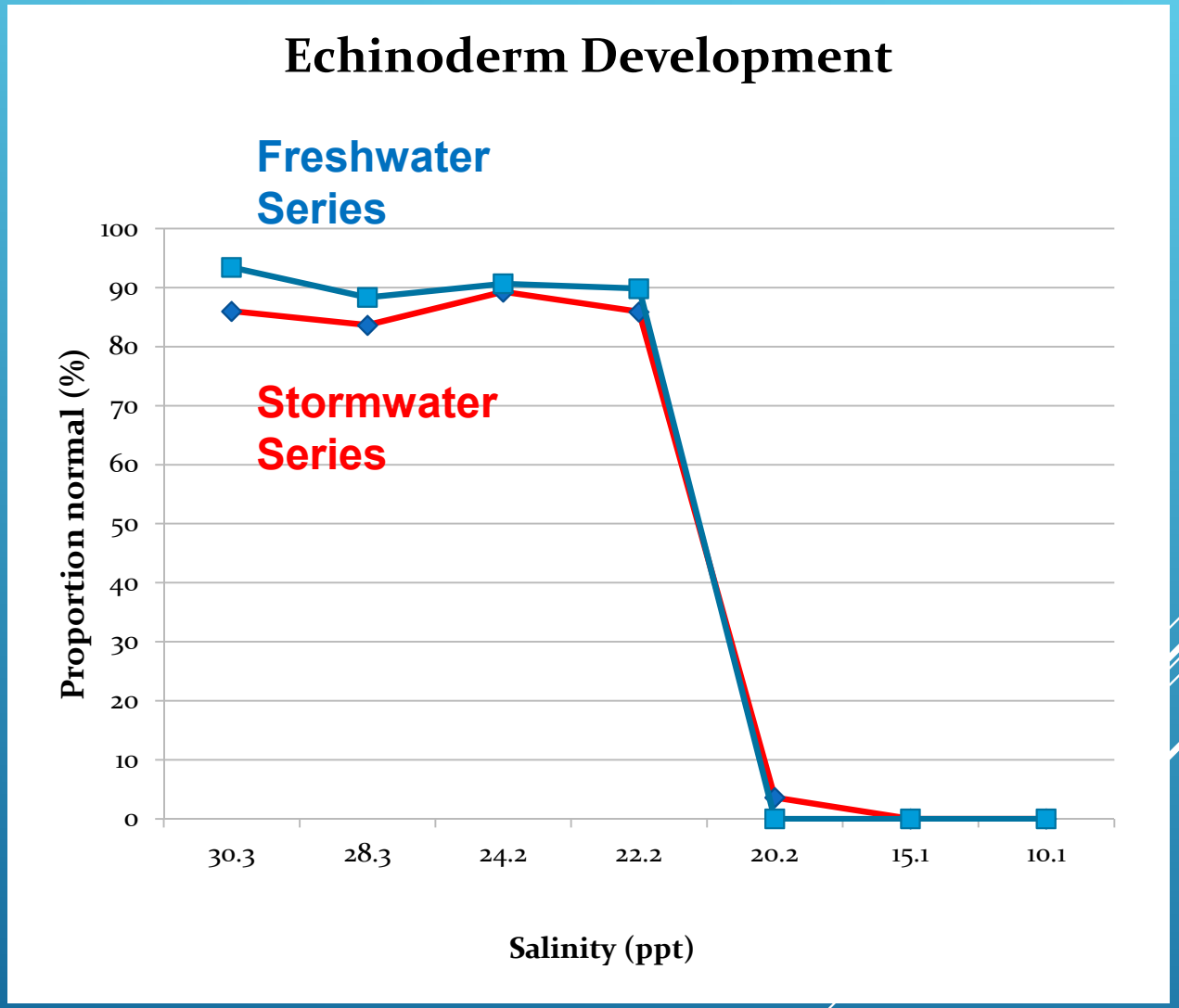
TOXICITY RESULTS- ECHINODERM DEVELOPMENT

- EC_{50s} were similar in Stormwater Series and Freshwater Series

  SW EC_{50}= 21.2 ppt

  FW EC_{50}= 21.4 ppt

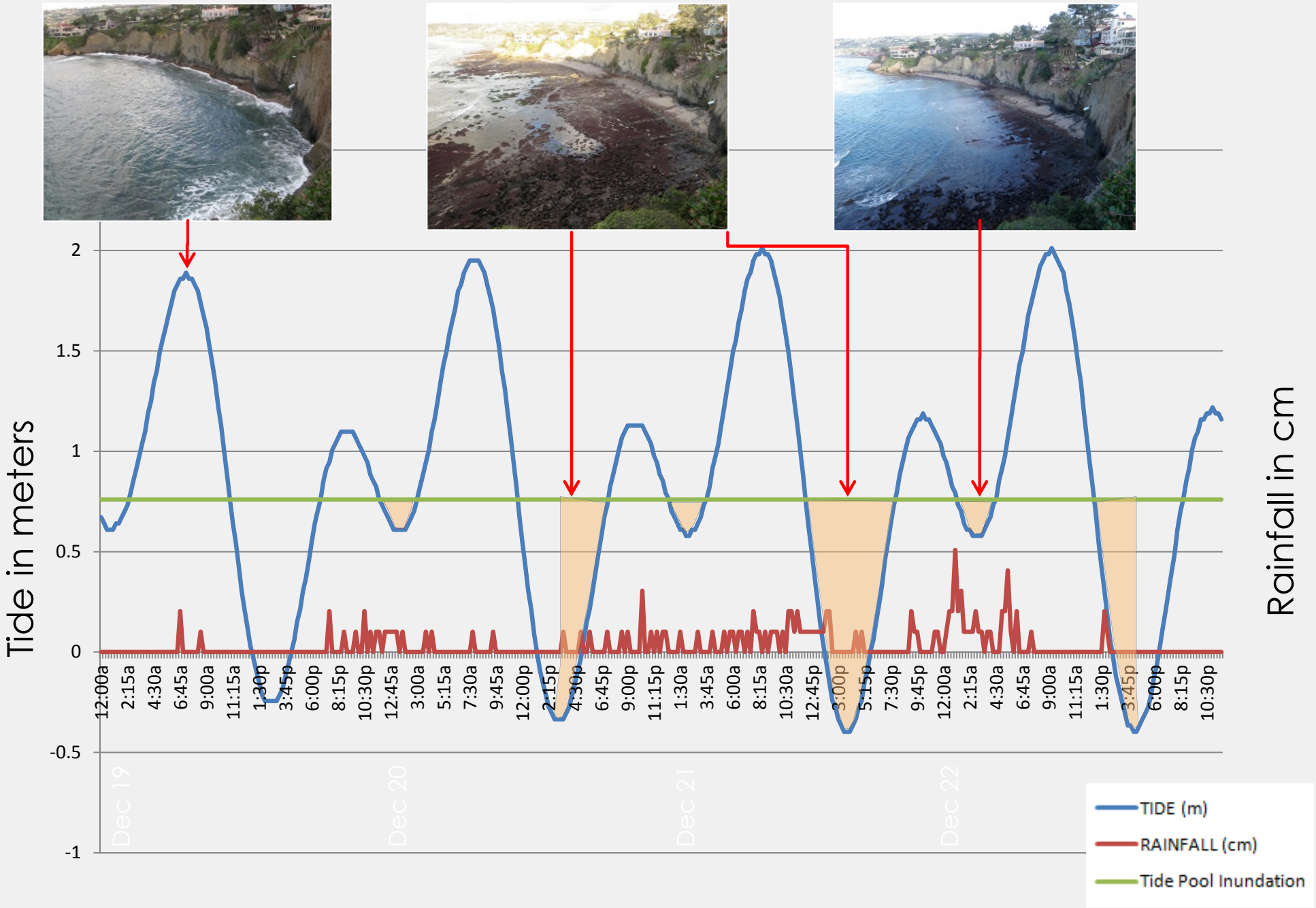
- Stormwater NOEC= 22.2 ppt LOEC= 20.2 ppt
- Freshwater NOEC= 22.2 ppt LOEC= 20.2 ppt



SUMMARY

- Stormwater- concentrations of Cu, Cr, Pb, and Zn above COP criteria and pyrethroid concentrations above LC_{50} values
- Upper Tidepools (Receiving Water Monitoring)- high concentrations of metals; pyrethroid concentrations up to 450 x LC_{50} during storm event at low tide
- Concentrations quickly dissipate when tide reaches tide pools
- Reference site receiving water below COP criteria throughout tidal cycle
- Observed toxicity in laboratory experiments appears to be correlated with fresh water impact rather than storm water contaminants

Potential Impacts Depend on Timing of Storm & Tide



CONCLUSIONS

- Potential impacts from stormwater on ASBS are site specific.
- Water chemistry alone, particularly end of pipe, may not be a good predictor of impacts to ASBS beneficial uses.
- Site specific studies that integrate water quality, toxicity, and the biological community are needed to protect the ASBS.

Questions?