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Appendix A

Reasonable Potential Calculator Outputs for UCSD/SIO Copper Discharges

Reasonable Potential Calculator uses the linear Regression on Order Statistics technique (ROS) for censored data (i.e., non detects) because it is robust, unbiased, and has a smaller variance than most other statistical techniques under the lognormal distribution. In addition, this technique will accept multiple detection limits or censoring levels (Helsel and Cohn 1988). The technique uses the uncensored fraction of the data in a probability plot to statistically reconstruct the censored values. A new data set (labeled X-new in the output file) is then created containing a combination of uncensored values and reconstructed or "fill in" values. Summary statistics are then estimated using the new data set.

Example 1: Reasonable Potential Calculator Output, using all available data, 1994-2003

RPcalc v1.8, Mar 18, 2004 07:56:37

```
Inputs:
  1. Data Notes               : USCD Cu 94-98 & 99-03 Outfall #1
  2. WQ Objective Conc., WQO  : 3
  3. Background Conc., BSC    : 2
  4. Dilution Ratio, Dm       : 2
  5. RP Percentile            : 50
  6. RP Confidence Level      : 95

Unsorted Input Observations:
19, 24, 18, 31, 26, 27, 26, 17, 20, 10, <10, 16, <10, 18, <10, <10, <10, 20,
<10, <10, <10, <10, <10, 15, 14, 27, <10, 15.00, <10, <10  <10, 10.00, 10.00,
<10, <10, <10, <10, <10, <10, <10, 4.32, 4.56, 4.26, 8.10  8.42, 5.77, 10.10,
16.00

Sorted Data Observations:
4.26, 4.32, 4.56, 5.77, 8.1, 8.42, <10, <10, <10, <10, <10, <10, <10, <10,
<10, <10, <10, <10, <10, <10, <10, <10, <10, <10, <10, <10, 10, 10, 10,
10.1, 14, 15, 15, 16, 16, 17, 18, 18, 19, 20, 20, 24, 26, 26, 27, 27, 31
```

Data Summary:	N	%	Min	Max
Censored	21	43.750		
Uncensored	27	56.250		
Total	48			

```
Detection Limit Thresholds  1 present:
  DLs are 10
```

Linear Regression on LogNormal Order Statistics (Helsel & Cohn 1988):

i	X-obs	X-new	Prob	NormZ
1	4.26	4.260	0.080	-1.403
2	4.32	4.320	0.161	-0.992
3	4.56	4.560	0.241	-0.703
4	5.77	5.770	0.321	-0.464
5	8.1	8.100	0.402	-0.249
6	8.42	8.420	0.482	-0.045
7	<10	2.375	0.026	-1.950
8	<10	2.965	0.051	-1.634
9	<10	3.427	0.077	-1.428
10	<10	3.832	0.102	-1.269
11	<10	4.204	0.128	-1.137
12	<10	4.556	0.153	-1.022
13	<10	4.897	0.179	-0.919
14	<10	5.230	0.205	-0.825
15	<10	5.559	0.230	-0.738
16	<10	5.887	0.256	-0.657
17	<10	6.217	0.281	-0.579

18	<10	6.549	0.307	-0.505
19	<10	6.886	0.332	-0.433
20	<10	7.230	0.358	-0.364
21	<10	7.582	0.384	-0.296
22	<10	7.943	0.409	-0.230
23	<10	8.316	0.435	-0.165
24	<10	8.702	0.460	-0.100
25	<10	9.104	0.486	-0.036
26	<10	9.522	0.511	0.028
27	<10	9.961	0.537	0.093
28	10	10.000	0.582	0.208
29	10	10.000	0.602	0.259
30	0	10.000	0.622	0.311
31	10.1	10.100	0.642	0.364
32	14	14.000	0.662	0.418
33	15	15.000	0.682	0.473
34	15	15.000	0.702	0.529
35	16	16.000	0.722	0.588
36	16	16.000	0.741	0.648
37	17	17.000	0.761	0.711
38	18	18.000	0.781	0.776
39	18	18.000	0.801	0.846
40	19	19.000	0.821	0.919
41	20	20.000	0.841	0.998
42	20	20.000	0.861	1.084
43	24	24.000	0.881	1.178
44	26	26.000	0.901	1.285
45	26	26.000	0.920	1.408
46	27	27.000	0.940	1.558
47	27	27.000	0.960	1.753
48	31	31.000	0.980	2.056

(NormZ) vs. (Nat. Log of Uncensored Observations)

Slope	Intercept	Correl r	N
0.702	2.234	0.976	27.000

Summary Statistics for X-new:

N	Mean	SDev	Min	Max	CV
48	11.572	7.607	2.375	31.000	0.657

Sample Percentiles for X-new:

P10	P25	Median	P75	P90	P95
4.167	5.612	8.903	16.750	26.000	27.000

Summary Statistics for Ln(X-new):

N	Mean	SDev	Min	Max	CV
48	2.239	0.663	0.865	3.434	0.296

Reasonable Potential Analysis:

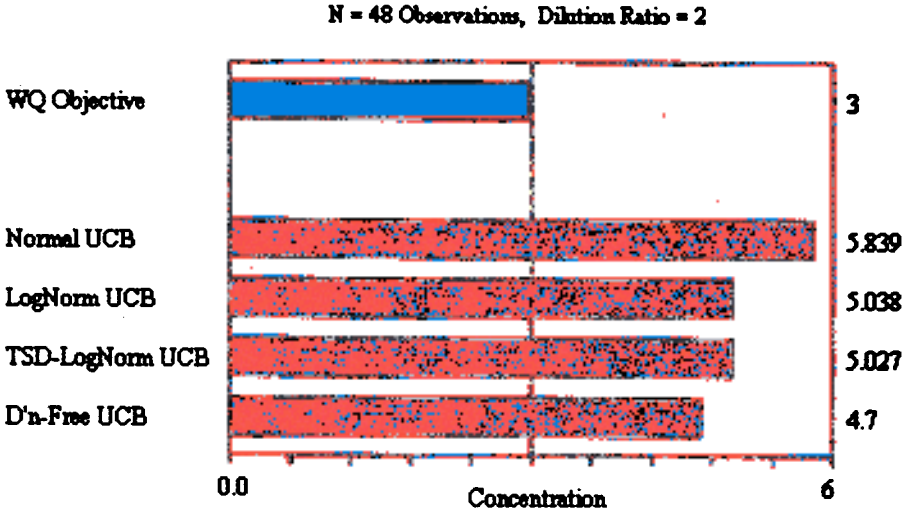
Before Dilution, Upper One-sided Confidence Bound (UCB):
Upper 95% confidence bound for the 50th population percentile with N = 48
Normal Tolerance Factor, g' = 0.256 (Hahn & Meeker 1991, Table A12)

Distribution	UCB(before dilution)	Confidence Coeff.
Normal	13.516 = Mean + SDev * g'	0.950
LogNormal	11.115 = EXP(LnMean + LnSDev * g'	0.950
TSD-LogNorm	11.082 = X(48) * 0.357	0.950?
D'n-Free	10.100 = X(31)	0.970

After Dilution, Reasonable Potential Analysis:
UCB(after dilution) = [UCB(before dilution) + Dm * BSC / (Dm + 1)

Distribution	UCB(after dilution)	RP for WQO=3?
Normal	5.839	Y
LogNormal	5.038	Y
TSD-LogNorm	5.027	Y
D'n-Free	4.700	Y

Comparison of WQ Objective with Calculated Upper 95% Confidence Bounds for the 50th Percentile (UCB).



Notes: USCD Cu 94-98 & 99-03 Outfall #1

Example 2: Reasonable Potential Calculator Output, using data from May - July 2003 only

```
'* Reasonable Potential Calculator Output, RPcalc v1.8
 Mar 10, 2004  13:55:07

Inputs:
  1. Data Notes               : USCD Cu 2003 Outfall Means
  2. WQ Objective Conc., WQO  : 3
  3. Background Conc., BSC    : 2
  4. Dilution Ratio, Dm       : 2
  5. RP Percentile            : 50
  6. RP Confidence Level      : 95

Unsorted Input Observations:
4.32, 4.56, 4.26, 8.10, 8.42, 5.77

Sorted Data Observations:
4.26, 4.32, 4.56, 5.77, 8.1, 8.42
```

Data Summary:

	N	%	Min	Max
Censored	0	0.000		
Uncensored	6	100.000		
Total	6			

Summary Statistics for X-new:

N	Mean	SDev	Min	Max	CV
6	5.905	1.907	4.260	8.420	0.323

Sample Percentiles for X-new:

P10	P25	Median	P75	P90	P95
2.982	4.305	5.165	8.180	8.420	8.420

Summary Statistics for Ln(X-new):

N	Mean	SDev	Min	Max	CV
6	1.734	0.312	1.449		

Reasonable Potential Analysis:

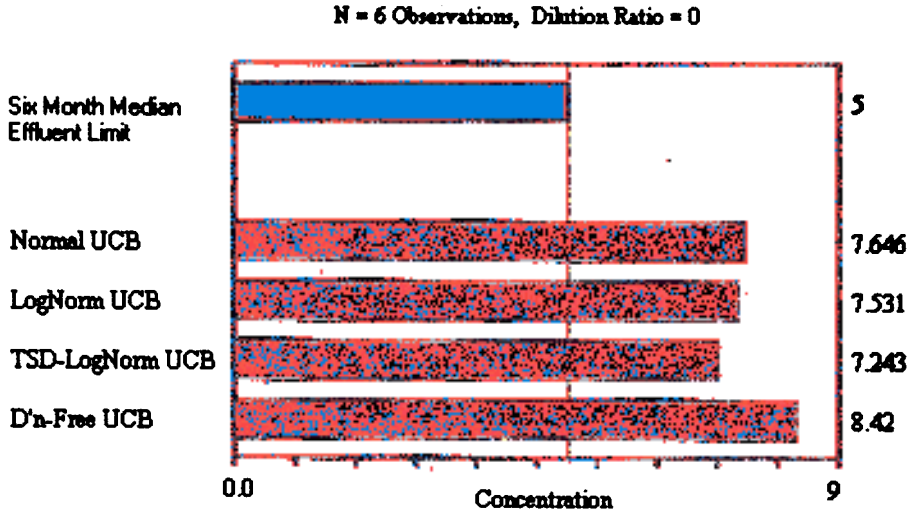
Before Dilution, Upper One-sided Confidence Bound (UCB):
  Upper 95% confidence bound for the 50th population percentile with N = 6
  Normal Tolerance Factor, g' = 0.913 (Hahn & Meeker 1991, Table A12)

Distribution	UCB(before dilution)	Confidence Coeff
Normal	7.646 = Mean + SDev * g'	0.950
LogNormal	7.531 = EXP(LnMean + LnSDev * g')	0.950
TSD-LogNorm	7.243 = X(6) * 0.860	0.950?
D'n-Free	8.420 = X(6)	0.984

After Dilution, Reasonable Potential Analysis:
  UCB(after dilution) = [UCB(before dilution) + Dm * BSC] (Dm + 1

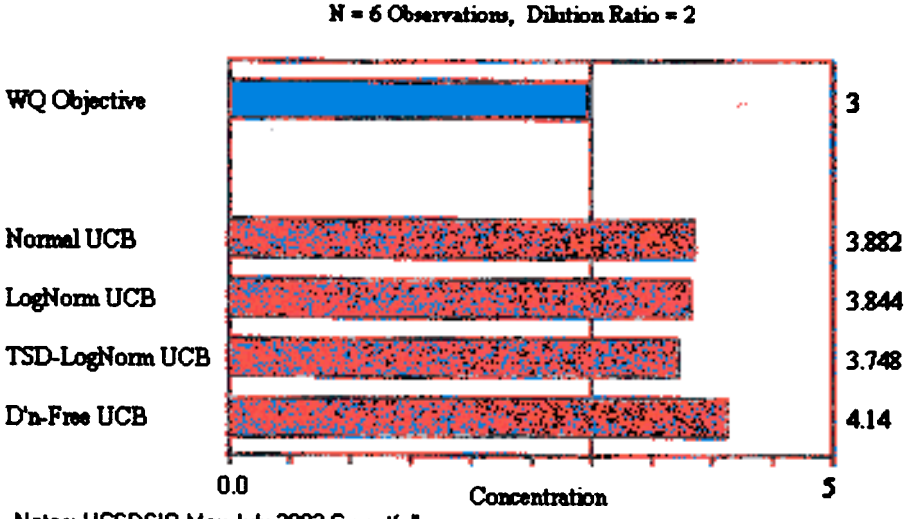
Distribution	UCB(after dilution)	RP_for_WQO=3?
Normal	3.882	Y
LogNormal	3.844	Y
TSD-LogNorm	3.748	Y
D'n-Free	4.140	Y

Comparison of WQ Objective with Calculated Upper 95% Confidence Bounds for the 50th Percentile (UCB).



Notes: UCSDSIO May-July 2003 Outfall Cu Means, with no dilution (end of pipe).

Comparison of WQ Objective with Calculated Upper 95% Confidence Bounds for the 50th Percentile (UCB).



Notes: UCSDSIO May-July 2003 Cu outfall means

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Programmed by Steve Saiz, CalEPA, SWRCB, saizs@swrcb.ca.gov, January 20, 2004

Appendix B

Invertebrate Species Lists for the Shallow Sandy Bottom Communities of the San Diego Marine Refuge (SDMR) ASBS and the San Diego – La Jolla Ecological Reserve (SDLJER) ASBS

1979 (Kobayashi et al) SDLJER ASBS	1980 (Kobayashi et al) SDMR	2003 (AMEC) SDLJ ER	2003 (AMEC) SDMR
	burrowing anemones (*Harenactis attenuata*)	burrowing anemones (*Harenactis attenuata*)	burrowing anemones (*Harenactis attenuata*)
	hydroids (*Obelia dichotoma*)		hydroids (*Obelia dichotoma*)
sea pansies (*Renilla kolliker*)	sea pansies (*Renilla kolliker*)	sea pansies (*Renilla kolliker*)	sea pansies (*Renilla kolliker*)
	clam hydroid (*Clytia baker*),		
sea pens (*Stylatula elongata*),	sea pens (*Stylatula elongata*),		
polychaete worms (*Nephtys californiensis*	polychaete worms (*Nephtys californiensis*		
	polychaete worms (*Onuphis iridescens*),		
parchment tube worms (*Diopatra splendidissima*)	parchment tube worms (*Diopatra splendidissima*)	parchment tube worms (*Diopatra splendidissima*)	parchment tube worms (*Diopatra splendidissima*)
[illegible] (*Spiophanes* sp.)	[illegible] (*Spiophanes* sp.)	[illegible] (*Spiophanes* sp.)	[illegible] (*Spiophanes* sp.)
	bean clams (*Donax gouldi*)	bean clams (*Donax gouldi*)	bean clams (*Donax gouldi*)
pismo clams (*Tivela stultorum*)	pismo clams (*Tivela stultorum*)		pismo clams (*Tivela stultorum*)
unidentified cockles (family Cardiidae),	unidentified cockles (family Cardiidae),		
nudibranchs (*Hermissenda crassicornis*)	nudibranchs (*Hermissenda crassicornis*)		
unidentified Dorid nudibranch (family Doridiidae),	unidentified Dorid nudibranch (family Doridiidae),		
			sea hares (*Aplysia californica*)
	Reclus' moon snail (*Polinices reclusianus*),		
		moon snails (*Polinices lewisii*)	moon snails (*Polinices lewisii*)
[illegible] (*Lirobittium* spp.),	[illegible] (*Epitonium* spp.),		
[illegible] (*Opalia* spp.),	[illegible] (*Epitonium* spp.),	[illegible] (*Opalia* spp.),	
	Eulimid gastropod (*Eulima* spp.),		
tinted wentletrap (*Epitonium tinctum*),	tinted wentletrap (*Epitonium tinctum*),		
basket snails (*Nassarius fossatus*)	basket snails (*Nassarius fossatus*)		basket snails (*Nassarius fossatus*)
olive snails (*Olivella biplicata*)	olive snails (*Olivella biplicata*)		olive snails (*Olivella biplicata*)
Pyramidellid gastropod (*Turbonilla sp.*)			
beach hoppers (*Orchestoidea spp.*)	beach hoppers (*Orchestoidea spp.*)	beach hoppers (*Orchestoidea spp.*)	beach hoppers (*Orchestoidea spp.*)
			elbow crabs (*Heterocrypta occidentalis*)
			sheep crabs (*Loxorynchus grandis*)
sand crabs (*Emerita analoga*)	sand crabs (*Emerita analoga*)		sand crabs (*Emerita analoga*)
spiny sand crab (*Blepharipoda occidentalis*	spiny sand crab (*Blepharipoda occidentalis*		
mole or white sand crab (*Lepidopa myops*	mole or white sand crab (*Lepidopa myops*		
	cancer crab (*Cancer gracilis*),		
	mysid shrimp (*Acanthomysis costata*),		
	swimming crab (*Portunus xantusii*)		
	moss animals (*Diaperoecia californica*)		
brittle stars (*Amphiodia occidentalis*)	brittle stars (*Amphiodia occidentalis*)	[illegible] (*Amphiodia occidentalis*)	[illegible] (*Amphiodia occidentalis*)
sand stars (*Astropecten armatus*)	sand stars (*Astropecten armatus*)	[illegible] (*Astropecten armatus*)	[illegible] (*Astropecten armatus*)
	sweet potato sea cucumber (*Molpadia arenicola*),		
sand dollar (*Dendraster excentricus*)	sand dollar (*Dendraster excentricus*)		
	white sea urchin (*Lytechinus anamesus*		
Total 22 species	**Total 34 species**	**Total 10 species**	**Total 17 species**

Appendix C

SIO Pier Invertebrate Community, 1980 and 2003 Reports

2003 Report (AMEC) Pier Observations	1980 Report (Kobayashi et al) Pier Observations
Sponge (*Haliclona sp.*)	Sponges (Porifera)
Sponge (*Leucetta losangelensis*)	
Sponge (*Leucilla nuttingi*)	
Aggregating anemone (*Anthopleura elegantissima*)	Aggregating anemone (*Anthopleura elegantissima*)
	Green anemone (*Anthopleura xanthogrammica*)
	Calcareous tube worm (*Spirorbis spp.*)
	Calcareous tube worm (*Eupomatus gracillis*)
	Colonial sandy-tubed worm (*Phragmatopoma californica*)
Barnacle (*Chthamalus spp.*)	Buckshot Barnacle (*Chthamalus spp.*)
Barnacle (*Balanus spp.*)	Pacific acorn barnacle (*Balanus glandula*)
	Red and white barnacle (*Balanus tintinn*abulum)
Gooseneck Barnacle (*Pollicipes polymerus*)	Gooseneck barnacle (*Pollicipes polymerus*)
	Gooseneck barnacle (*Mitella spp.*)
	Striped shore crab (*Pachygrapsus crassipes*)
	Porcelain crab *Pachycheles spp.*
	Periwinkle or littorine snail (*Littorina spp.*)
	Chitons (*Nuttalina fluxa*)
	Chitons (*Mopalia spp.*)
	Limpets (previously *Acmaea spp.*, now *Lottia spp.*)
	Limpets (previously *Collisella spp*, now *Lottia spp.*)
	Owl limpet (*Lottia gigantea*)
	Black-turban snail (*Tegula funebralis*)
	Dogwinkle (previously *Thais*, now *Nucella emarginata*)
Sea slug (*Phidiana hiltoni*)	
Rock scallop (*Crassedoma giganteum*)	
Sea slug (*Hermissenda crassicornis*)	
Mussel (*Mytilus spp.*)[1]	California mussel (*Mytilus californianus*)
	Edible mussel (*Mytilus edulis*)[1]
Ochre star (*Pisaster ochraceus*)	Ochre star (*Pisaster ochraceus*)
	Knobby sea star (*Pisaster giganteus*)
	Bat star (*Patiria miniata*)
	Brittle stars (Ophiuroidea)
Purple sea urchin (*Strongylocentrotus purpuratus*)	Purple sea urchin (*Strongylocentrotus purpuratus*)
Bryozoan (*Bugula spp.*)	Bryozoa (Ectoprocta)
Bryozoan (Celleporaria *brunnea*)	
Bryozoan (*Thalamoporella californica*)	
Tunicate (*Ciona intestinalis*)	
Tunicate (*Didemnum carnulentum*)	
Stalked tunicate (*Stvela Clava*)	
Total 19 taxa observed	Total 29 taxa observed

[1] Specimens originally identified as *Mytilus edulis* may include *M. galloprovincialis*, a similar species that was introduced from European waters into California approximately 100 years ago and is now widespread in the intertidal habitats of the Southern California Bight

Appendix D

Fish of the San Diego Marine Refuge (SDMR) ASBS near the SIO Pier and Discharges, and the shallow sandy habitats of the San Diego – La Jolla Ecological Reserve (SDLJER) ASBS

1980 report (Kobayashi et al) sandy bottom, SDMR	2003 report (AMEC), SDMR near SIO pier	1979 shallow sandy bottom SDLJER	2003 northern portion SDLJER near Kellogg Park
sanddabs (*Citharichthys stigmaeus)*		sanddabs (*Citharichthys stigmaeus)*	sanddabs (*Citharichthys stigmaeus)*
thornbacks (*Platyrhinoides triseriata*)			
shovelnose guitarfish (*Rhinobatis productus*)			shovelnose guitarfish (*Rhinobatis productus*)
angel shark (*Squatina californica*)			
round stingray (*Urolophus halleri*)			
California halibut (*Paralichthys californicus*)	California halibut (*Paralichthys californicus*)		
	Sand bass (*Paralabrax nebulifer*)		
	Kelp bass (*Paralabrax clathratus*)		
	Lizardfish (*Synodus lucioceps*)		
	Sardines (*Sardinops sagax*)		
	Halfmoon (*Medialuna californiensis*)		
	Pile perch (*Damalichthys vacca*)		
Total 6 species	Total 7 species	Total 1 species	Total 2 species

Appendix E

Terms and Conditions for the Scripps Institution of Oceanography California Ocean Plan Exception

The discharge must comply with all other applicable provisions, including water quality standards, of the Ocean Plan.

2. UCSD/SIO must take all reasonable and appropriate measures to minimize concentrations of chemical additives, including copper, and antibiotics, in the effluent. UCSD/SIO must consider appropriate alternatives, including alternative treatment techniques, pollutant minimization, source control, and process optimization, to reduce effluent concentrations of copper, antibiotics, and other treatment additives. Formalin shall not be discharged to the ocean. Copper and other additives to the seawater from the Birch Aquarium must be minimized to meet the water quality objectives in Table B of the Ocean Plan.

3. Effluent and receiving water analysis for copper must employ the analytical method (Inductively Coupled Plasma/ Mass Spectrometry) with the lowest minimum detection limits.

4. A quarterly report of all chemical additives discharged via waste seawater must be submitted in the quarterly monitoring report to the Regional Board.

5. Flow measurements (using a flow metering device) for Outfall 001, and estimates for all other permitted outfalls, must be made and reported quarterly to the Regional Board.

6. By January 1, 2007 UCSD/SIO must eliminate all discharges of non-storm water urban runoff (i.e., any discharge of urban runoff to a storm drain that is not composed entirely of storm water), except those associated with emergency fire fighting.

7. UCSD/SIO must specifically address the prohibition of non-storm water urban runoff and the reduction of pollutants in storm water discharges draining to the ASBS in a revised Storm Water Management Plan/Program (SWMP). UCSD/SIO is required to submit their revised SWMP to the Regional Board within six months of permit issuance. The SWMP is subject to the approval of the Regional Board.

8. The revised SWMP must include a map of all entry points (known when the SWMP is prepared) for urban runoff entering the UCSD/SIO drainage system. The SWMP must also include a procedure for updating the map and plan when other entry points are discovered.

9. The revised SWMP must describe the measures by which non-storm water discharges will be eliminated, and interim measures that will be employed to reduce non-storm water flows until the ultimate measures are implemented.

10. The revised SWMP must also address storm water discharges, and how pollutants will be reduced in storm water runoff into the ASBS through the implementation of Best Management Practices (BMPs). The SWMP must describe the BMPs and include an implementation schedule. The implementation schedule must be designed to ensure an improvement in receiving water quality each year (over the permit cycle) due to either a reduction in storm water discharges (due to diversion) or reduction in pollutants (due to on-site treatment or other BMPs). The implementation schedule must be developed to ensure BMPs are implemented within one year of the permit issuance date.

1. Once every permit cycle, a quantitative survey of benthic marine life must be performed. The Regional Board, in consultation with the State Board Division of Water Quality, must approve the survey design. The results of the survey must be completed and submitted to the Regional Board within six months before the end of the permit cycle.

12. Once during the upcoming permit cycle, a bioaccumulation study using sand crabs (*Emerita analoga*) and mussels (*Mytilus californianus*) must be conducted to determine the concentrations of metals near field and far field (up and down coast, and offshore) in the ASBS. The Regional Board, in consultation with the Division of

Water Quality, must approve the study design. The results of the survey must be completed and submitted to the Regional Board at least six months prior to the end of the permit cycle (permit expiration). Based on the study results, the Regional Board, in consultation with the Division of Water Quality, may limit the bioaccumulation test organisms, required in subsequent permits, to only sand crabs or mussels.

13. The effluent from Outfall 001must be sampled and analyzed monthly for copper concentrations.

14. During the first year of the permit cycle two samples must be collected from Outfall 001 (once during dry weather and once during wet weather) and analyzed for all Ocean Plan Table B constituents. During the first year of the permit cycle two composite samples must also be collected (once during dry weather and once during wet weather) representing flows from Outfalls 002, 003, 004A, and 004B; these two composite samples must also be analyzed for all Ocean Plan Table B constituents. Based on these results the Regional Board will determine the frequency of sampling (at a minimum, annually) and the constituents to be tested during the remainder of the permit cycle, except that chronic toxicity must be tested at least annually.

15. Once annually during wet weather, the receiving water in the vicinity of the SIO pier must be sampled and analyzed for Ocean Plan Table B constituents. All Table B constituents must be analyzed during the first year. The Regional Board will determine the sample location(s). Based on the first year sample results the Regional Board will determine specific constituents to be tested during the remainder of the permit cycle, except that chronic toxicity must be tested annually.

16. If the results of receiving water monitoring indicate that wet weather discharges that include storm water are causing or contributing to exceedance(s) of applicable water quality objectives, UCSD/SIO is required to submit a report to the Regional Board within 30 days. Those constituents in storm water which are associated with exceedances of the receiving water objectives must be identified in that report. The report must describe BMPs that are currently being implemented, BMPs that are planned for in the SWMP, and additional BMPs that may be added to the SWMP. The report shall include a new or modified implementation schedule. The Regional Board may require modifications to the report. Within 30 days following approval of the report by the Regional Board, UCSD/SIO must revise its SWMP to incorporate any new or modified BMPs that have been and will be implemented, the implementation schedule, and any additional monitoring required. As long as UCSD/SIO has complied with the procedures described above and is implementing the revised SWMP, then UCSD/SIO does not have to repeat the same procedure for continuing or recurring exceedances of the same constituent.

17. A study must be performed to determine the initial dilution and fate of the discharge during storms (larger waves and lower salinity discharge) and non-storm periods (smaller waves and higher salinity discharge). The study may be empirical (e.g., a dye study) and/or using a model.

18. In addition to the bacterial monitoring requirements in the Ocean Plan, coliform bacteria and total residual chlorine must be tested once monthly in the effluent from Outfall 003, draining the marine mammal holding facility, when in use.

19. UCSD/SIO must pursue and implement the results of a consultant's feasibility study for engineering controls to prevent exotic species from entering the ASBS, to the extent that such engineering controls are allowable under applicable laws, regulations, and permit conditions.