ATTACHMENT 4

FLOW MINIMIZATION ALTERNATIVES

THROUGH-SCREEN VELOCITIES

&

LONG-TERM WEST BASIN WATER LEVEL ANALYSIS FOR ASSESSING TRESHOLD IMPINGEMENT EFFECTS OF REDUCED INTAKE FLOWS AT AGUA HEDIONDA LAGOON

FLOW MINIMIZATION ALTERNATIVES - THROUGH-SCREEN VELOCITY ASSESSMENT

EXISTING INTAKE PUMPS, SCREENS AND SCREEN VELOCITIES

Power Plant Unit Number	Pump Size			Maximum Velocity (fps) Upstream of Screens		Maximum Velocity (fps) Through the Screens		Size of Openings (in)	Screens Number	Ratio Total Area/ Openings
	gpm	MGD	cfs	High Tide 4.83	Low Tide -5.07	High Tide 4.83	Low Tide -5.07			
Unit 1										
Pump 1 S	24,000	34.56	53.52							
Pump 1 N	24,000	34.56	53.52							
Total Pump Capacity Unit 1 =	**48,000**	**69.12**	**107.04**	0.7	1.2	**1.2**	**2.1**	**3/8-inches**	**2**	**1.75**
									Shared w/ Units 1 & 2	
Unit 2										
Pump 2 S	24,000	34.56	53.52							
Pump 2 N	24,000	34.56	53.52							
Total Pump Capacity Unit 2 =	**48,000**	**69.12**	**107.04**	0.7	1.2	**1.2**	**2.1**	**3/8-inches**	**2**	**1.75**
									Shared w/ Units 1 & 3	
Unit 3										
Pump 3 S	24,000	34.56	53.52							
Pump 3 N	24,000	34.56	53.52							
Total Pump Capacity Unit 3 =	**48,000**	**69.12**	**107.04**	0.7	1.2	**1.2**	**2.1**	**3/8-inches**	**2**	**1.75**
									Shared w/ Units 1 & 3	
Unit 4										
Pump 4 E	100,000	144.01	223							
Pump 4 W	100,000	144.01	223							
Total Pump Capacity Unit 4 =	**200,000**	**288.02**	**446**	1.0	1.6	**1.8**	**2.8**	**3/8-inches**	**2**	**1.75**
Unit 5										
Pump 5 E	104,000	149.76	231.92							
Pump 5 W	104,000	149.77	231.92							
Total Pump Capacity Unit 5 =	**208,000**	**299.54**	**463.84**	0.7	1.1	**1.0**	**1.6**	**5/8-inches**	**3**	**1.46**

Note: Pump and Screen Parameters Listed Above Are Provided by the Encina Power Plant Staff.

CHANNEL AND SCREEN VELOCITIES WITH ALL PUMPS IN OPERATION - TOTAL INTAKE FLOW OF 794.92 MGD

Channels for Units 1,2 & 3 — **Total** — **Unit 1, 2 & 3 Flow = 322.2 cfs** — **322.2 cfs (check)**

Number of Screen Channels =	2
Channel Bottom Elevation =	-20
Channel Width =	12.5
Channel Depth =	25
Water Depth in Channels (Low Tide)	10.73
Water Depth in Channels (High Tide)	19.93

Low Tide In-Channel	Velocity =	1.20	fps	Low Tide Through-Screen Velocity = 2.10

R = 5.7737839

High Tide In-Channel	Velocity =	0.65	fps	High Tide Through-Screen Velocity = 1.13

Channel for Unit 4 — **Total** — **Unit 4 Flow = 446.0 cfs** — **446 cfs (check)**

Number of Screen Channels =	2
Channel Bottom Elevation =	-20
Channel Width =	11.25
Channel Depth =	25.75

Low Tide In-Channel	Velocity =	1.88	fps	Low Tide Through-Screen Velocity = 3.29

R = 5.439049587

Water Depth in Channels (Low Tide) 10.53

Water Depth in Channels (High Tide) 19.43

High Tide In-Channel	Velocity =	1.02	fps	High Tide Through-Screen Velocity =	1.79

Channel for Unit 5

Number of Screen Channels = 3

Total **Unit 5 Flow = 463.84 cfs** **463.84 cfs (check)**

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.33	fps	Low Tide Through-Screen Velocity =	1.94

R = 6.407599706

Channel Width = 11.25

Channel Depth = 27.75

Water Depth in Channels (Low Tide) 10.33

Water Depth in Channels (High Tide) 19.23

High Tide In-Channel	Velocity =	0.71	fps	High Tide Through-Screen Velocity =	1.04

OPERATIONAL CONDITION 1 - TOTAL INTAKE FLOW = 316.96 MGD

Unit 1 (Both Pumps) =	69.12 MGD	107.04 cfs
Unit 2 (One Pump) =	34.56 MGD	53.52 cfs
Unit 3 (Both Pumps) =	69.12 MGD	107.04 cfs
Unit 4 (One Pump) =	144.01 MGD	223 cfs
Total Pump Flow =	**316.82 MGD**	**490.6 cfs**

Channels for Units 1,2 & 3

Number of Screen Channels = 2

Total **Unit 1, 2 & 3 Flow = 267.6 cfs** **267.6 cfs (check)**

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.14	fps	Low Tide Through-Screen Velocity =	2.00

R = 5.355509831

Channel Width = 12.5

Channel Depth = 25

Water Depth in Channels (Low Tide) 9.37 ft

Water Depth in Channels (High Tide) 18.27 ft

High Tide In-Channel	Velocity =	0.59	fps	High Tide Through-Screen Velocity =	1.03

Channel for Unit 4

Number of Screen Channels = 2

Total **Unit 4 Flow = 223.0 cfs** **223 cfs (check)**

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.55	fps	Low Tide Through-Screen Velocity =	2.72

R = 4.073220868

Channel Width = 11.25

Channel Depth = 25.75

Water Depth in Channels (Low Tide) 6.39

Water Depth in Channels (High Tide) 15.29

High Tide	High Tide

In-Channel	Velocity =	0.65	fps	Through-Screen Velocity =	1.13

OPERATIONAL CONDITION 2 - TOTAL INTAKE FLOW = 322.58 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 4 (Both Pumps) =	288.02 MGD	446 cfs
Total Pump Flow =	**322.58 MGD**	**499.52 cfs**

Channels for Units 1,2 & 3 — **Total** — **Unit 1, 2 & 3 Flow = 53.5 cfs** — **53.52 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 12.5

Channel Depth = 25

Water Depth in Channels (Low Tide) 3.117 ft

Water Depth in Channels (High Tide) 12.017 ft

Low Tide In-Channel	Velocity =	0.69	fps	Low Tide Through-Screen Velocity =	1.20

R = 2.494877377

High Tide In-Channel	Velocity =	0.18	fps	High Tide Through-Screen Velocity =	0.31

Channel Elevation @ Screen Velocity of 0.5 fps = 0.49925989 7.5 ft

Tide Level @ Screen Velocity of 0.5 fps = -0.687 ft

Channel for Unit 4 — **Total** — **Unit 4 Flow = 446.0 cfs** — **446 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 11.25

Channel Depth = 25.75

Water Depth in Channels (Low Tide) 10.53

Water Depth in Channels (High Tide) 19.43

Low Tide In-Channel	Velocity =	1.88	fps	Low Tide Through-Screen Velocity =	3.29

R = 5.439049587

High Tide In-Channel	Velocity =	1.02	fps	High Tide Through-Screen Velocity =	1.79

OPERATIONAL CONDITION 3 - TOTAL INTAKE FLOW = 328.33 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 4 (One Pump) =	144.01 MGD	223 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**328.33 MGD**	**508.44 cfs**

Channels for Units 1,2 & 3 — **Total** — **Unit 1,2 or 3 Flow = 53.5 cfs** — **53.52 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 12.5

Channel Depth = 25

Low Tide In-Channel	Velocity =	0.69	fps	Low Tide Through-Screen Velocity =	1.20

R = 2.494877377

Water Depth in Channels (Low Tide) 3.12 ft

Water Depth in Channels (High Tide) 12.02 ft

High Tide In-Channel	Velocity =	0.18	fps	High Tide Through-Screen Velocity =	0.31

Channel for Unit 4   **Total**   **Unit 4 Flow = 223.0 cfs**   **223 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.55	fps	Low Tide Through-Screen Velocity =	2.72

R = 4.073220868

Channel Width = 11.25

Channel Depth = 25.75

Water Depth in Channels (Low Tide) 6.39

Water Depth in Channels (High Tide) 15.29

High Tide In-Channel	Velocity =	0.65	fps	High Tide Through-Screen Velocity =	1.13

Channel for Unit 5   **Total**   **Unit 5 Flow = 231.74 cfs**   **231.92 cfs (check)**

Number of Screen Channels = 3

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.07	fps	Low Tide Through-Screen Velocity =	1.57

R = 4.640171858

Channel Width = 11.25

Channel Depth = 27.75

Water Depth in Channels (Low Tide) 6.40

Water Depth in Channels (High Tide) 15.3

High Tide In-Channel	Velocity =	0.45	fps	High Tide Through-Screen Velocity =	0.66

OPERATIONAL CONDITION 5 - TOTAL INTAKE FLOW = 184.32 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**184.32 MGD**	**285.44 cfs**

Channels for Units 1,2 & 3   **Total**   **Unit 1, 2 & 3 Flow = 53.5 cfs**   **53.52 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	0.69	fps	Low Tide Through-Screen Velocity =	1.20

R = 2.494877377

Channel Width = 12.5

Channel Depth = 25

Water Depth in Channels (Low Tide) 3.117 ft

Water Depth in Channels (High Tide) 12.017 ft

High Tide In-Channel	Velocity =	0.18	fps	High Tide Through-Screen Velocity =	0.31

Channel Elevation @ Screen Velocity of 0.5 fps = 0.77509611   7.5 ft

Tide Level @ Screen Velocity of 0.5 fps = -0.687 ft

Channel for Unit 5		**Total**	**Unit 5 Flow =**	**231.74**	**cfs**	**231.92 cfs (check)**
Number of Screen Channels =	3					
Channel Bottom Elevation =	-20					
Channel Width =	11.25					
Channel Depth =	27.75					
Water Depth in Channels (Low Tide)	6.40					
Water Depth in Channels (High Tide)	15.3					

Low Tide In-Channel	Velocity =	1.07	fps	Low Tide Through-Screen Velocity =	1.57
	R =	4.640171858			
High Tide In-Channel	Velocity =	0.45	fps	High Tide Through-Screen Velocity =	0.66

OPERATIONAL CONDITION 4 - TOTAL INTAKE FLOW = 218.88 MGD

Unit 1, 2 or 3 (Two Pumps) =	69.12 MGD	107.04 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**218.88 MGD**	**338.96 cfs**

Channels for Units 1,2 & 3		**Total**	**Unit 1, 2 & 3 Flow =**	**107.0**	**cfs**	**107.04 cfs (check)**
Number of Screen Channels =	2					
Channel Bottom Elevation =	-20					
Channel Width =	12.5					
Channel Depth =	25					
Water Depth in Channels (Low Tide)	4.937 ft					
Water Depth in Channels (High Tide)	13.837 ft					

Low Tide In-Channel	Velocity =	0.87	fps	Low Tide Through-Screen Velocity =	1.52
	R =	3.539169582			
High Tide In-Channel	Velocity =	0.31	fps	High Tide Through-Screen Velocity =	0.54

Channel for Unit 5		**Total**	**Unit 5 Flow =**	**231.74**	**cfs**	**231.92 cfs (check)**
Number of Screen Channels =	3					
Channel Bottom Elevation =	-20					
Channel Width =	11.25					
Channel Depth =	27.75					
Water Depth in Channels (Low Tide)	6.40					
Water Depth in Channels (High Tide)	15.3					

Low Tide In-Channel	Velocity =	1.07	fps	Low Tide Through-Screen Velocity =	1.57
	R =	4.640171858			
High Tide In-Channel	Velocity =	0.45	fps	High Tide Through-Screen Velocity =	0.66

FLOW MINIMIZATION ALTERNATIVES - THROUGH-SCREEN VELOCITY ASSESSMENT

EXISTING INTAKE PUMPS, SCREENS AND SCREEN VELOCITIES

Power Plant Unit Number	Pump Size			Maximum Velocity (fps) Upstream of Screens		Maximum Velocity (fps) Through the Screens		Size of Openings (in)	Screens Number	Ratio Total Area/ Openings
	gpm	MGD	cfs	High Tide 4.83	Low Tide -5.07	High Tide 4.83	Low Tide -5.07			
Unit 1										
Pump 1 S	24,000	34.56	53.52							
Pump 1 N	24,000	34.56	53.52							
Total Pump Capacity Unit 1 =	**48,000**	**69.12**	**107.04**	0.7	1.2	1.2	**2.1**	**3/8-inches**	**2**	**1.75**
									Shared w/ Units 1 & 2	
Unit 2										
Pump 2 S	24,000	34.56	53.52							
Pump 2 N	24,000	34.56	53.52							
Total Pump Capacity Unit 2 =	**48,000**	**69.12**	**107.04**	0.7	1.2	1.2	**2.1**	**3/8-inches**	**2**	**1.75**
									Shared w/ Units 1 & 3	
Unit 3										
Pump 3 S	24,000	34.56	53.52							
Pump 3 N	24,000	34.56	53.52							
Total Pump Capacity Unit 3 =	**48,000**	**69.12**	**107.04**	0.7	1.2	1.2	**2.1**	**3/8-inches**	**2**	**1.75**
									Shared w/ Units 1 & 3	
Unit 4										
Pump 4 E	100,000	144.01	223							
Pump 4 W	100,000	144.01	223							
Total Pump Capacity Unit 4 =	**200,000**	**288.02**	**446**	1.0	1.6	1.8	**2.8**	**3/8-inches**	**2**	**1.75**
Unit 5										
Pump 5 E	104,000	149.76	231.92							
Pump 5 W	104,000	149.77	231.92							
Total Pump Capacity Unit 5 =	**208,000**	**299.54**	**463.84**	0.7	1.1	1.0	**1.6**	**5/8-inches**	**3**	**1.46**

Note: Pump and Screen Parameters Listed Above Are Provided by the Encina Power Plant Staff.

CHANNEL AND SCREEN VELOCITIES WITH ALL PUMPS IN OPERATION - TOTAL INTAKE FLOW OF 794.92 MGD

Channels for Units 1,2 & 3 | **Total** | **Unit 1, 2 & 3 Flow = 322.2 cfs** | **322.2 cfs (check)**

Number of Screen Channels =	2
Channel Bottom Elevation =	-20
Channel Width =	12.5
Channel Depth =	25
Water Depth in Channels (Low Tide)	10.73
Water Depth in Channels (High Tide)	19.93

Low Tide In-Channel	Velocity =	1.20	fps	Low Tide Through-Screen Velocity =	2.10

R = 5.7737839

High Tide In-Channel	Velocity =	0.65	fps	High Tide Through-Screen Velocity =	1.13

Channel for Unit 4 | **Total** | **Unit 4 Flow = 446.0 cfs** | **446 cfs (check)**

Number of Screen Channels =	2
Channel Bottom Elevation =	-20
Channel Width =	11.25
Channel Depth =	25.75

Low Tide In-Channel	Velocity =	1.88	fps	Low Tide Through-Screen Velocity =	3.29

R = 5.439049587

Water Depth in Channels (Low Tide) 10.53

Water Depth in Channels (High Tide) 19.43

High Tide In-Channel	Velocity =	1.02	fps	High Tide Through-Screen Velocity =	1.79

Channel for Unit 5 — **Total** — **Unit 5 Flow = 463.84 cfs** — **463.84 cfs (check)**

Number of Screen Channels = 3

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.33	fps	Low Tide Through-Screen Velocity =	1.94

Channel Width = 11.25

R = 6.407599706

Channel Depth = 27.75

Water Depth in Channels (Low Tide) 10.33

Water Depth in Channels (High Tide) 19.23

High Tide In-Channel	Velocity =	0.71	fps	High Tide Through-Screen Velocity =	1.04

OPERATIONAL CONDITION 1 - TOTAL INTAKE FLOW = 316.96 MGD

Unit 1 (Both Pumps) =	69.12 MGD	107.04 cfs
Unit 2 (One Pump) =	34.56 MGD	53.52 cfs
Unit 3 (Both Pumps) =	69.12 MGD	107.04 cfs
Unit 4 (One Pump) =	144.01 MGD	223 cfs
Total Pump Flow =	**316.82 MGD**	**490.6 cfs**

Channels for Units 1,2 & 3 — **Total** — **Unit 1, 2 & 3 Flow = 267.6 cfs** — **267.6 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.14	fps	Low Tide Through-Screen Velocity =	2.00

Channel Width = 12.5

R = 5.355509831

Channel Depth = 25

Water Depth in Channels (Low Tide) 9.37 ft

Water Depth in Channels (High Tide) 18.27 ft

High Tide In-Channel	Velocity =	0.59	fps	High Tide Through-Screen Velocity =	1.03

Channel for Unit 4 — **Total** — **Unit 4 Flow = 223.0 cfs** — **223 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.55	fps	Low Tide Through-Screen Velocity =	2.72

Channel Width = 11.25

R = 4.073220868

Channel Depth = 25.75

Water Depth in Channels (Low Tide) 6.39

Water Depth in Channels (High Tide) 15.29

High Tide — High Tide

In-Channel	Velocity =	0.65	fps	Through-Screen Velocity =	1.13

OPERATIONAL CONDITION 2 - TOTAL INTAKE FLOW = 322.58 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 4 (Both Pumps) =	288.02 MGD	446 cfs
Total Pump Flow =	**322.58 MGD**	**499.52 cfs**

Channels for Units 1,2 & 3 **Total** **Unit 1, 2 & 3 Flow = 53.5 cfs** **53.52 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 12.5

Channel Depth = 25

Water Depth in Channels (Low Tide) 3.117 ft

Water Depth in Channels (High Tide) 12.017 ft

Low Tide In-Channel	Velocity =	0.69	fps	Low Tide Through-Screen Velocity =	1.20

R = 2.494877377

High Tide In-Channel	Velocity =	0.18	fps	High Tide Through-Screen Velocity =	0.31

Channel Elevation @ Screen Velocity of 0.5 fps = 0.49925989 7.5 ft

Tide Level @ Screen Velocity of 0.5 fps = -0.687 ft

Channel for Unit 4 **Total** **Unit 4 Flow = 446.0 cfs** **446 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 11.25

Channel Depth = 25.75

Water Depth in Channels (Low Tide) 10.53

Water Depth in Channels (High Tide) 19.43

Low Tide In-Channel	Velocity =	1.88	fps	Low Tide Through-Screen Velocity =	3.29

R = 5.439049587

High Tide In-Channel	Velocity =	1.02	fps	High Tide Through-Screen Velocity =	1.79

OPERATIONAL CONDITION 3 - TOTAL INTAKE FLOW = 328.33 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 4 (One Pump) =	144.01 MGD	223 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**328.33 MGD**	**508.44 cfs**

Channels for Units 1,2 & 3 **Total** **Unit 1,2 or 3 Flow = 53.5 cfs** **53.52 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 12.5

Channel Depth = 25

Low Tide In-Channel	Velocity =	0.69	fps	Low Tide Through-Screen Velocity =	1.20

R = 2.494877377

Water Depth in Channels (Low Tide) 3.12 ft

Water Depth in Channels (High Tide) 12.02 ft

High Tide In-Channel	Velocity =	0.18	fps	High Tide Through-Screen Velocity =	0.31

Channel for Unit 4
Number of Screen Channels = 2

Total **Unit 4 Flow = 223.0 cfs** **223 cfs (check)**

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.55	fps	Low Tide Through-Screen Velocity =	2.72

Channel Width = 11.25

R = 4.073220868

Channel Depth = 25.75

Water Depth in Channels (Low Tide) 6.39

Water Depth in Channels (High Tide) 15.29

High Tide In-Channel	Velocity =	0.65	fps	High Tide Through-Screen Velocity =	1.13

Channel for Unit 5
Number of Screen Channels = 3

Total **Unit 5 Flow = 231.74 cfs** **231.92 cfs (check)**

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.07	fps	Low Tide Through-Screen Velocity =	1.57

Channel Width = 11.25

R = 4.640171858

Channel Depth = 27.75

Water Depth in Channels (Low Tide) 6.40

Water Depth in Channels (High Tide) 15.3

High Tide In-Channel	Velocity =	0.45	fps	High Tide Through-Screen Velocity =	0.66

OPERATIONAL CONDITION 5 - TOTAL INTAKE FLOW = 184.32 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**184.32 MGD**	**285.44 cfs**

Channels for Units 1,2 & 3
Number of Screen Channels = 2

Total **Unit 1, 2 & 3 Flow = 53.5 cfs** **53.52 cfs (check)**

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	0.69	fps	Low Tide Through-Screen Velocity =	1.20

Channel Width = 12.5

R = 2.494877377

Channel Depth = 25

Water Depth in Channels (Low Tide) 3.117 ft

Water Depth in Channels (High Tide) 12.017 ft

High Tide In-Channel	Velocity =	0.18	fps	High Tide Through-Screen Velocity =	0.31

Channel Elevation @ Screen Velocity of 0.5 fps = 0.77509611 7.5 ft

Tide Level @ Screen Velocity of 0.5 fps = -0.687 ft

Channel for Unit 5
Number of Screen Channels = 3

Channel Bottom Elevation = -20

Channel Width = 11.25

Channel Depth = 27.75

Water Depth in Channels (Low Tide) 6.40

Water Depth in Channels (High Tide) 15.3

Total **Unit 5 Flow = 231.74 cfs** **231.92 cfs (check)**

Low Tide In-Channel	Velocity =	1.07	fps	Low Tide Through-Screen Velocity =	1.57

R = 4.640171858

High Tide In-Channel	Velocity =	0.45	fps	High Tide Through-Screen Velocity =	0.66

OPERATIONAL CONDITION 4 - TOTAL INTAKE FLOW = 218.88 MGD

Unit 1, 2 or 3 (Two Pumps) =	69.12 MGD	107.04 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**218.88 MGD**	**338.96 cfs**

Channels for Units 1,2 & 3
Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 12.5

Channel Depth = 25

Water Depth in Channels (Low Tide) 4.937 ft

Water Depth in Channels (High Tide) 13.837 ft

Total **Unit 1, 2 & 3 Flow = 107.0 cfs** **107.04 cfs (check)**

Low Tide In-Channel	Velocity =	0.87	fps	Low Tide Through-Screen Velocity =	1.52

R = 3.539169582

High Tide In-Channel	Velocity =	0.31	fps	High Tide Through-Screen Velocity =	0.54

Channel for Unit 5
Number of Screen Channels = 3

Channel Bottom Elevation = -20

Channel Width = 11.25

Channel Depth = 27.75

Water Depth in Channels (Low Tide) 6.40

Water Depth in Channels (High Tide) 15.3

Total **Unit 5 Flow = 231.74 cfs** **231.92 cfs (check)**

Low Tide In-Channel	Velocity =	1.07	fps	Low Tide Through-Screen Velocity =	1.57

R = 4.640171858

High Tide In-Channel	Velocity =	0.45	fps	High Tide Through-Screen Velocity =	0.66

Long-Term West Basin Water Level Analysis for Assessing Threshold Impingement Effects of Reduced Intake Flows at Agua Hedionda Lagoon

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21 January 2007

1) Introduction:

This study evaluates the long term water level variation in the West Basin of Agua Hedionda Lagoon. The objective of this analysis is to determine the persistence of water levels occurring higher than the threshold elevation for impingement losses during reduced flow rate operations of a stand alone desalination plant co-located at Encina Generating Station. There are two threshold water levels of interest for reduced flow operations ranging from 149.8 mgd to 304 mgd. These thresholds are -0.687 ft MSL and + 4.83 ft MSL. The persistence analysis of these thresholds is performed by hydrodynamic model simulation of the water elevation history in the West Basin due to tidal forcing at the ocean inlet by historic ocean water levels measured at the nearby Scripps Pier tide gage (NOAA # 931-0230) during the period of record 1980-2000. This time period was chosen because it coincides with the period of record used in the hydrodynamic studies in

Appendix E of the certified EIR (Jenkins and Wasyl, 2005). The verified ocean water level data on which this analysis is based was obtained from NOAA (2006).

Because of tidal muting by frictional losses through the ocean inlet of Agua Hedionda, it is not possible to use the Scripps Pier tide gage measurements directly to determine persistence analysis of. Such a simple approach would err on the side of over-estimating the percentage of time the water elevation in the West Basin of the lagoon met or exceeded the two threshold elevations of interest. Instead the tidal muting of the measured ocean water levels was determined through computer simulation of the lagoon tidal hydraulics. The TIDE_FEM tidal hydraulics model presented in Jenkins and Inman (1999) was gridded for a computational mesh of Agua Hedionda Lagoon as shown in Figure 1, using pre- and post dredging bathymetry from the 2002 dredge event from Jenkins and Wasyl (2003). The pre-dredging bathymetry featured the inlet bar in the west basin that was mapped during the October 2002 sounding shown in Figure 2. The post-dredging survey performed in April 2003 indicated uniform deep water throughout the west basin with depths ranging from -20 ft NGVD to – 30ft NGVD, similar to that found in Figure 2-2 of Elwany, et al (2005). The lagoon model was excited at the ocean inlet by the ocean water level elevation time series measured by the Scripps Pier tide gage for the period 1980-2000. The simulated lagoon water levels in the west basin of Agua Hedionda were then sampled at 1 hour intervals, resulting in 183,432 separate outcomes of water elevation that could be subject to statistical analysis of persistence at or above the threshold elevations of interest.

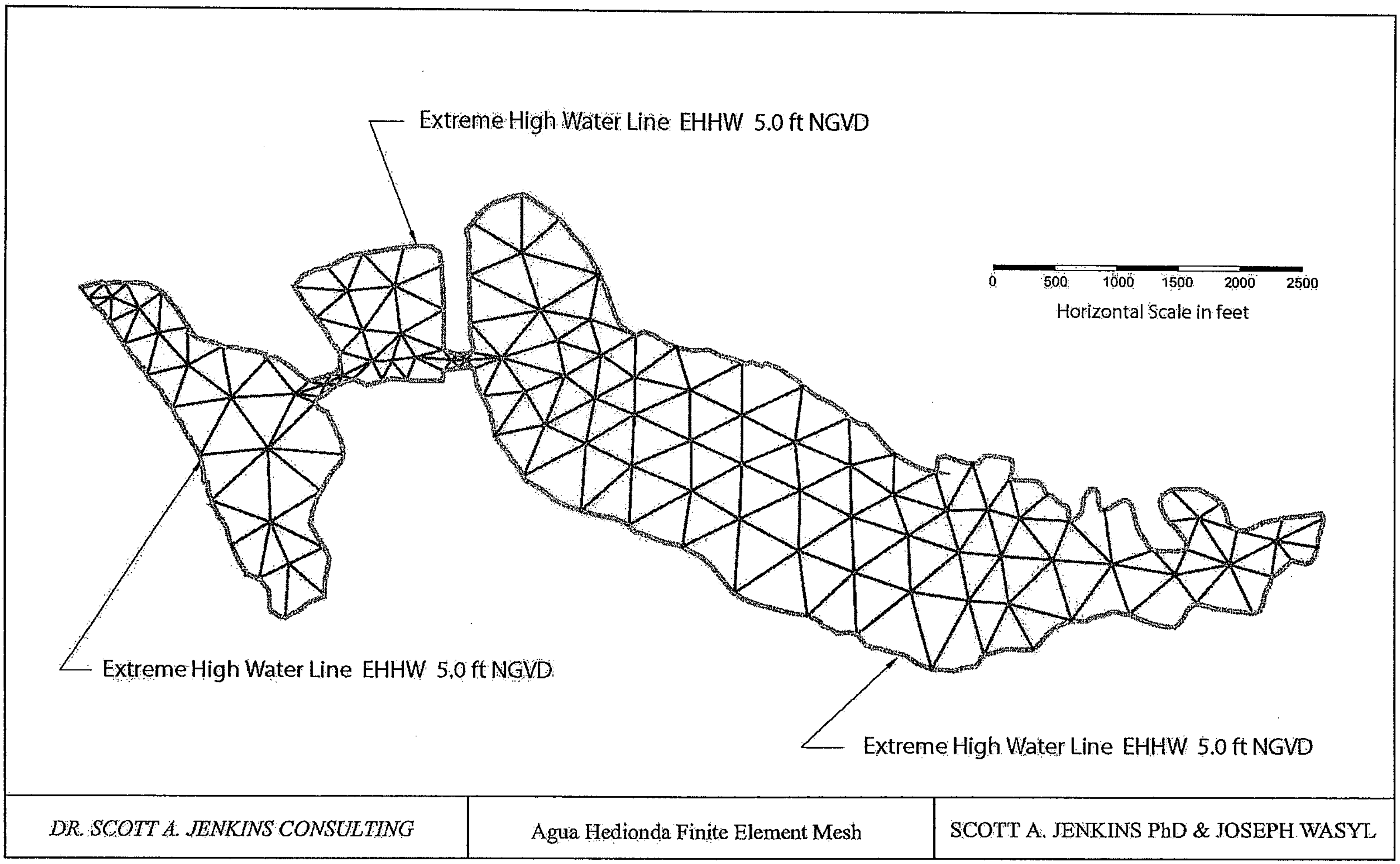

Figure 1. Computational mesh for TIDE_FEM tidal hydraulics model of Agua Hedionda Lagoon.

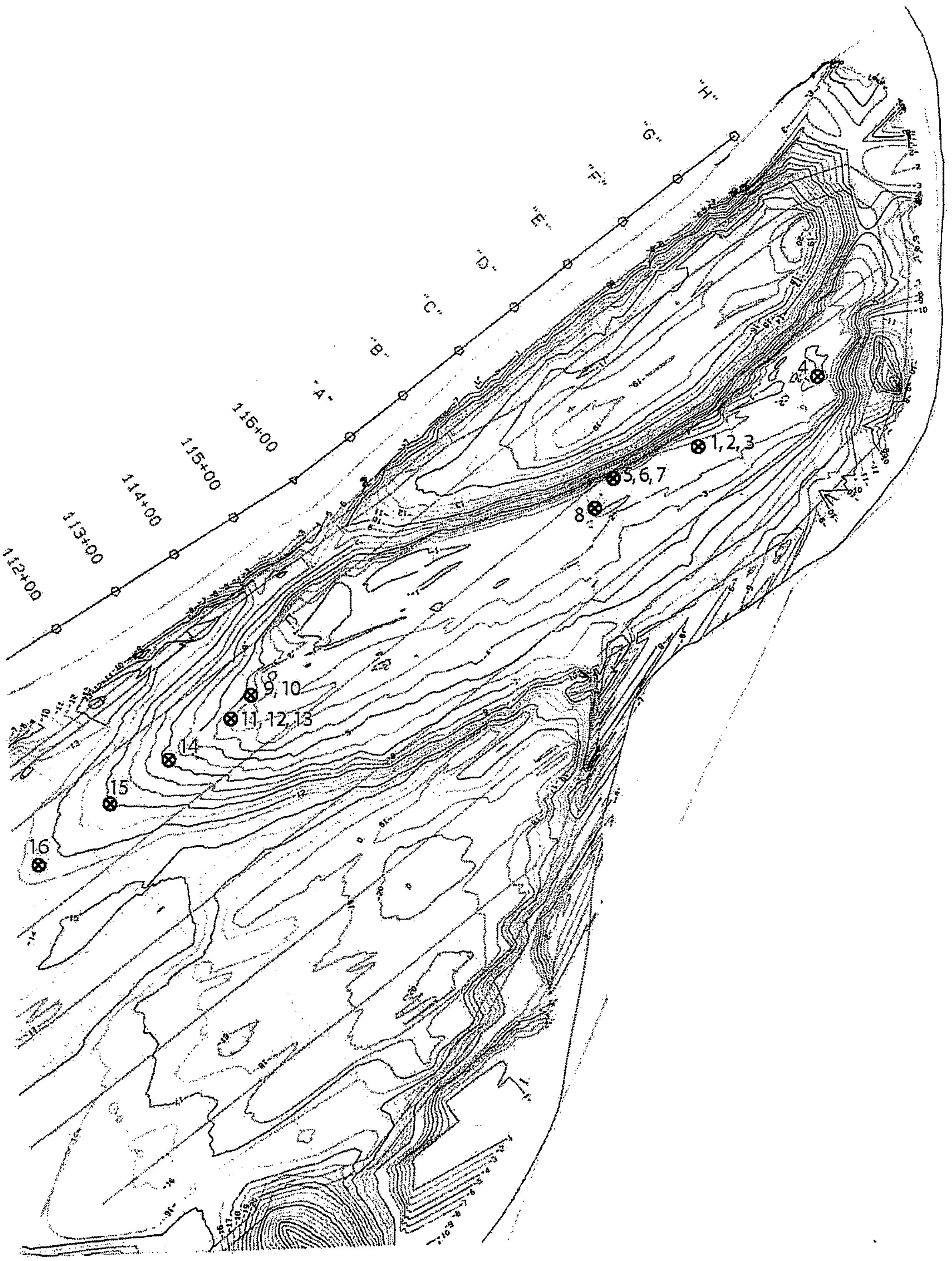

Figure 2. Location key for 12 October 2002 bottom sediment sampling.

2) Results:

Time series of the simulated West Basin water levels for each from 1980 through 2000 are given in the upper panel of Figures A-1 through A-21 in Appendix-A. The lower panel of these Figures gives the west basin water level variation for the month containing the highest water level occurring that particular year. Figure 3 presents the probability density function (defined by red histogram bars) resulting from the 183,432 hourly realizations of West Basin water level. The blue curve in Figure 3 is the cumulative probability that the water level will be greater than or equal to a particular water level. The vertical dashed green line in Figure 3 defines the water elevation at -0.687 ft MSL, above which intake flow velocities at the Unit 1 intakes are below the impingement threshold. From the cumulative probability curve, we find that water elevations equal or exceed the -0.687 ft MSL threshold 67% of the time during this 21 year period of record. Thus it is more probable that impingement would not occur at the Unit 1 intakes. On the other hand, there was only one hourly outcome in the 21 year period of record when water elevations exceeded the Unit 5 threshold elevation at +4.83 (light blue dashed vertical line); and hence impingement would remain a definite possibility for nearly any tidal regime around the Unit 5 intake.

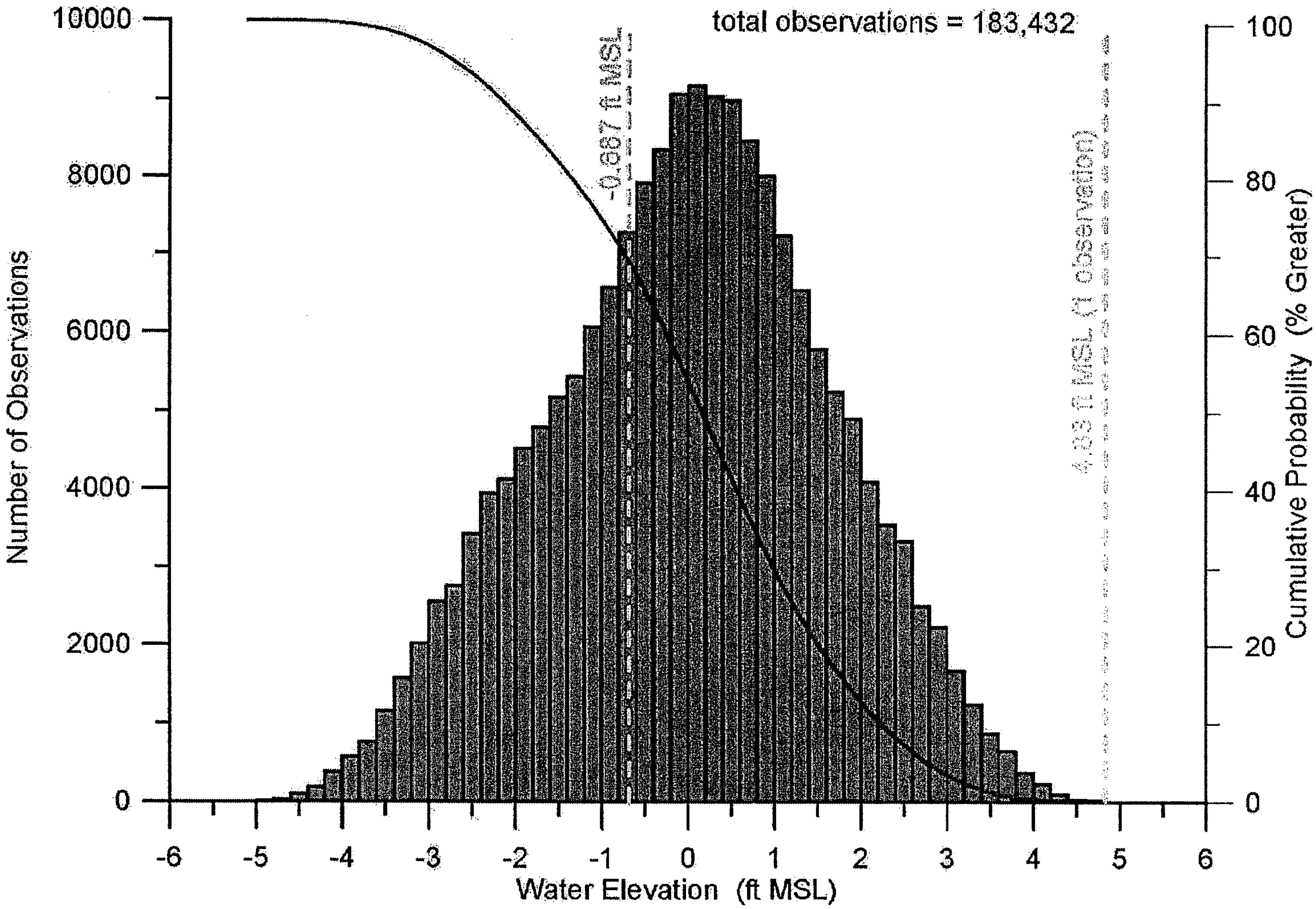

Figure 3. Probability density function and cumulative probability of the water level in the West Basin of Agua Hedionda Lagoon for the period of record 1980-2000.

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APPENDIX-A: Time Series of West Basin Water Levels

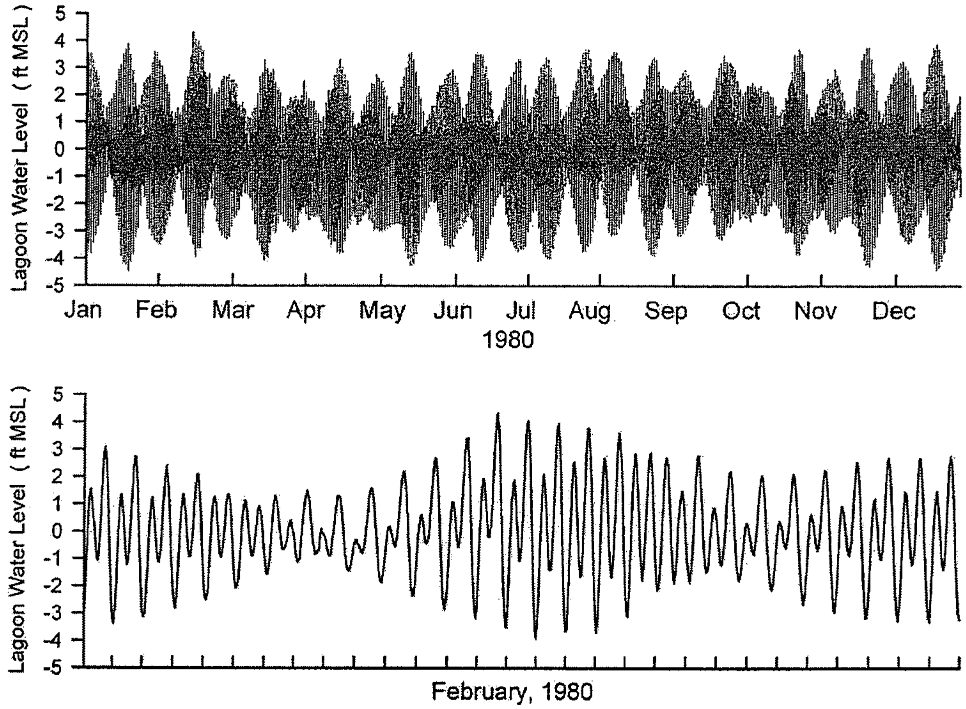

Figure A-1. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1980 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

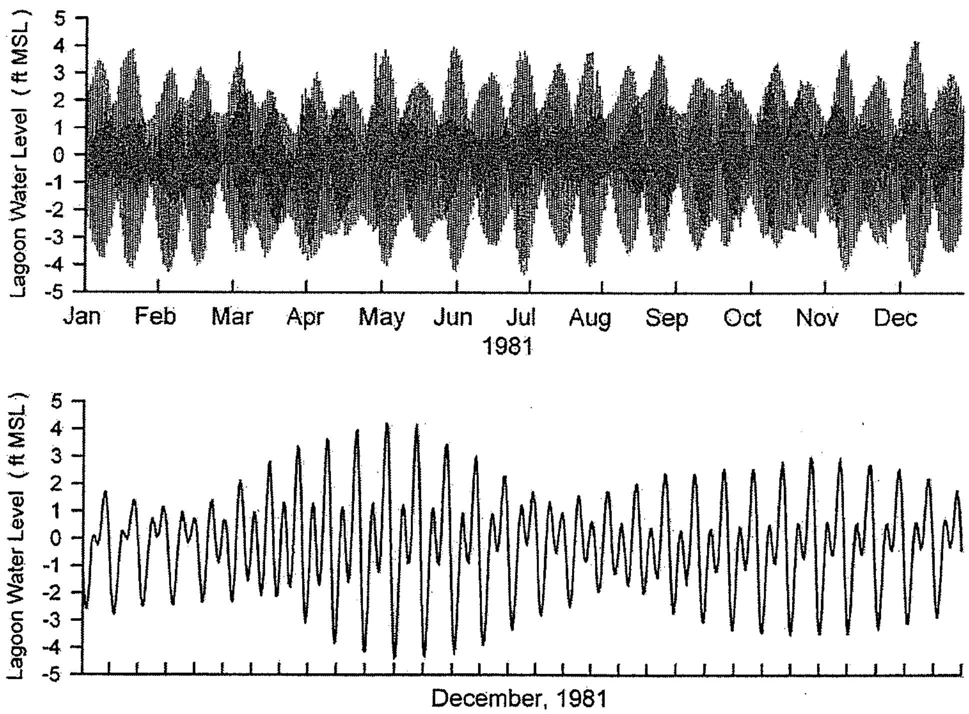

Figure A-2. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1981 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

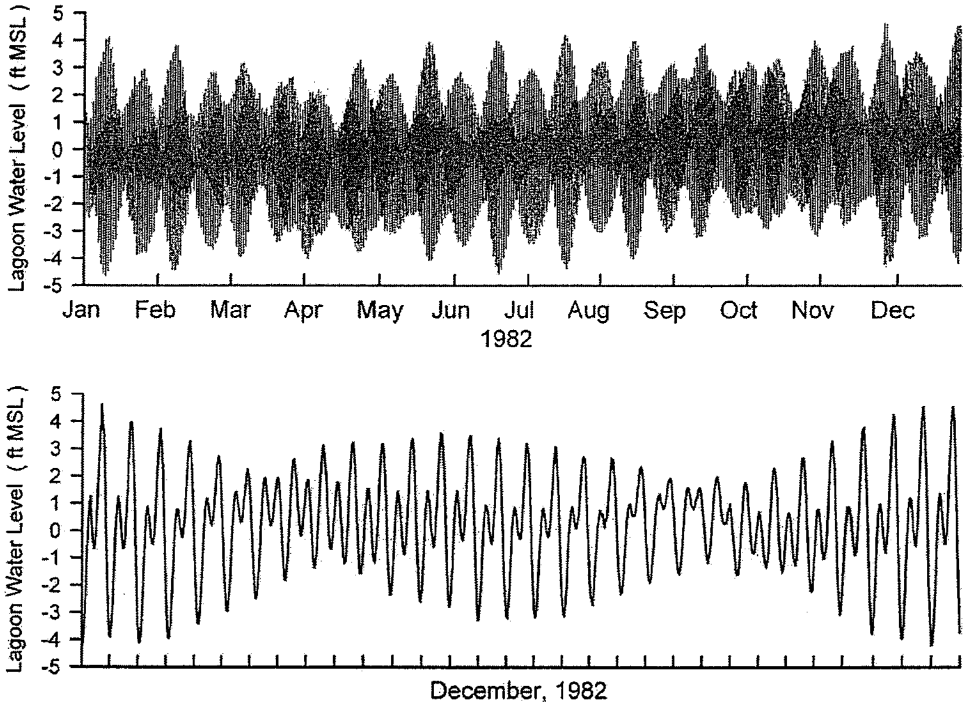

Figure A-3. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1982 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

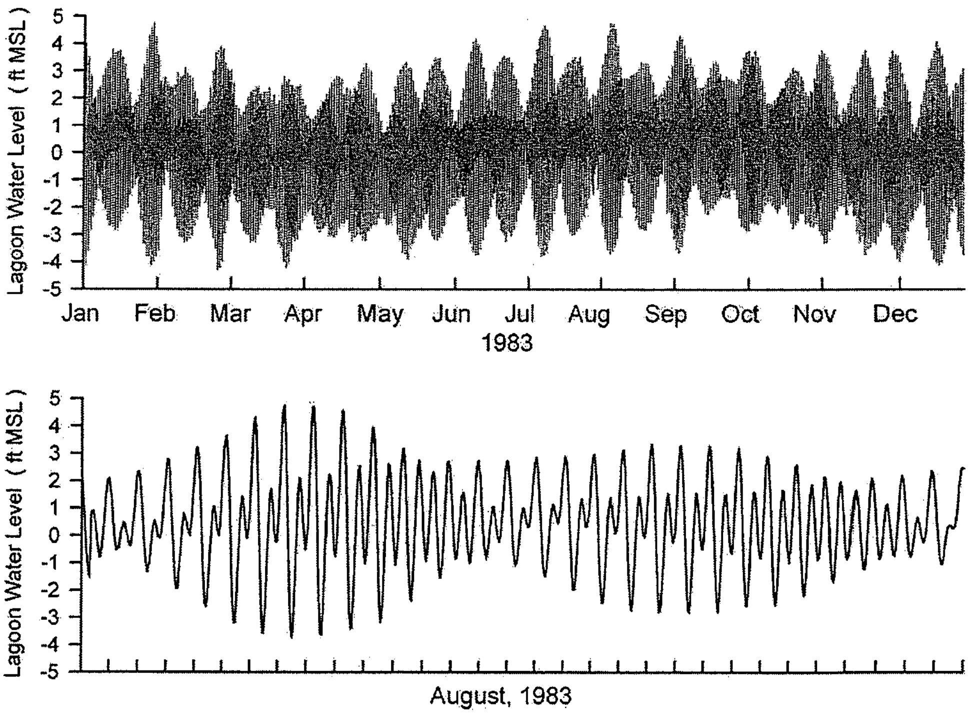

Figure A-4. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1983 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

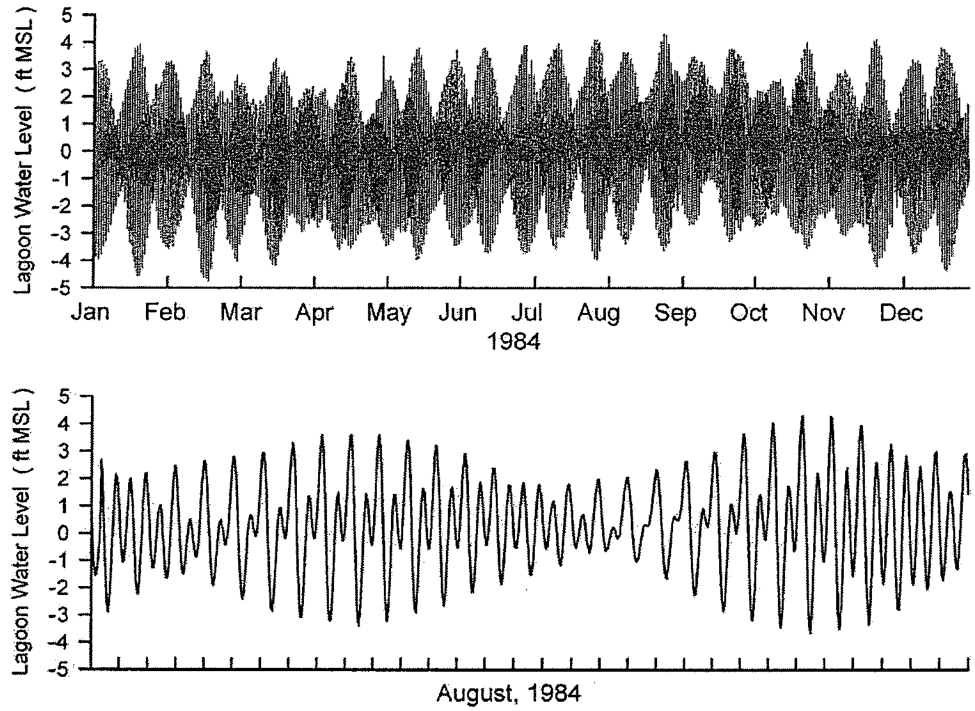

Figure A-5. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1984 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

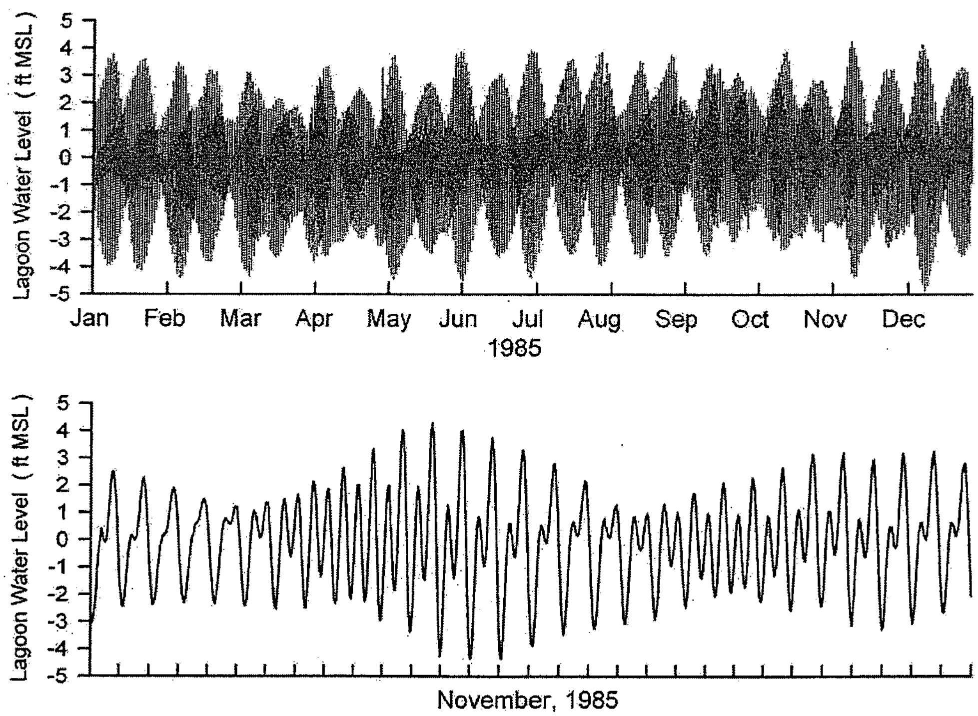

Figure A-6. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1985 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

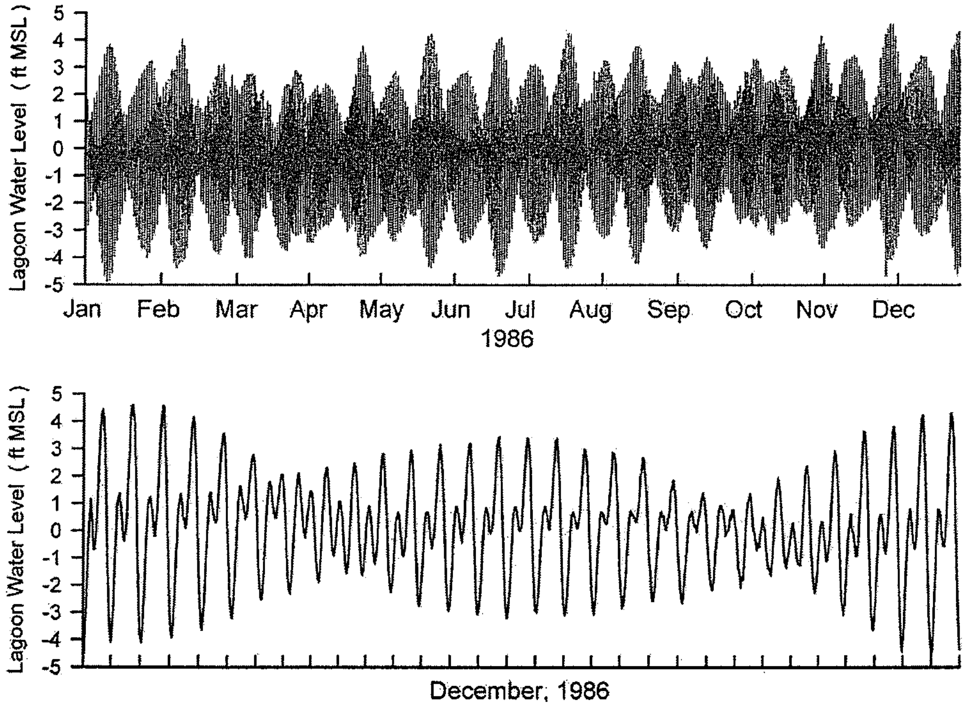

Figure A-7. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1986 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

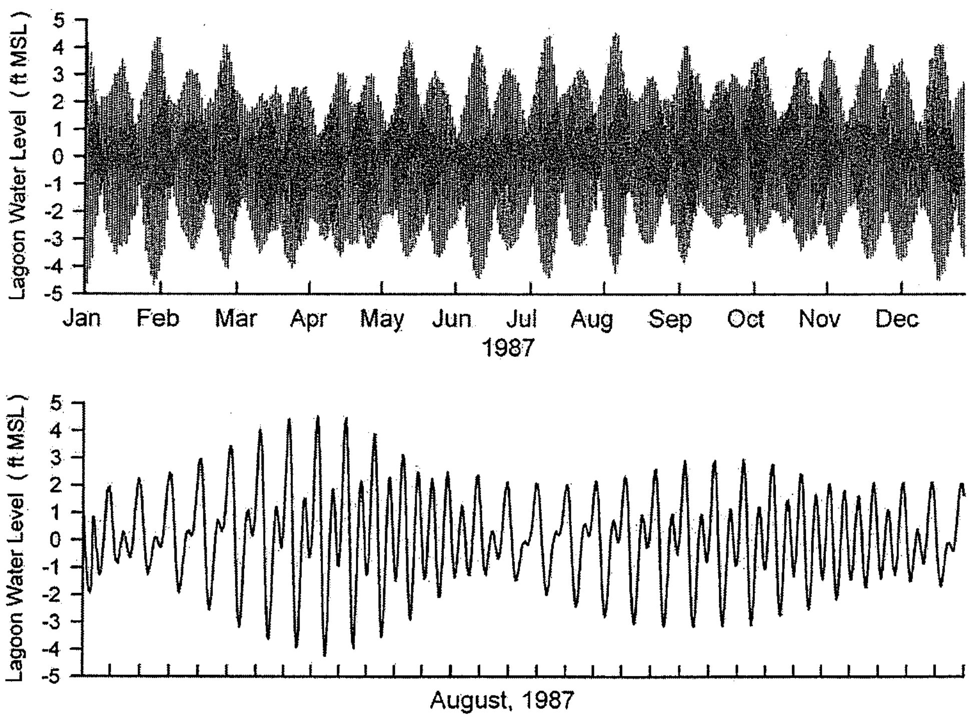

Figure A-8. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1987 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

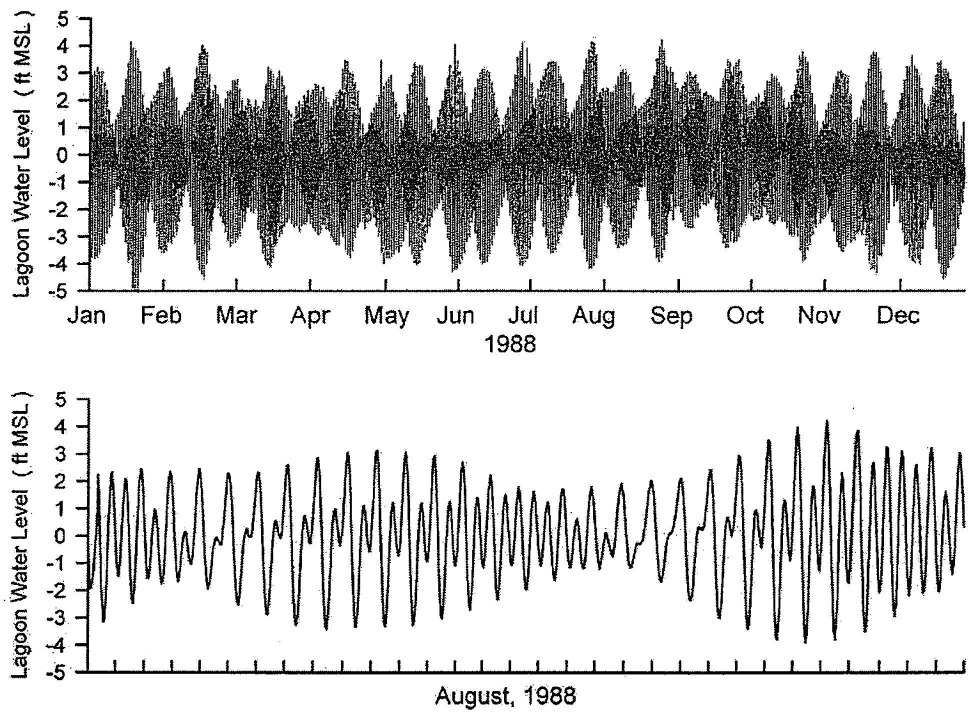

Figure A-9. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1988 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

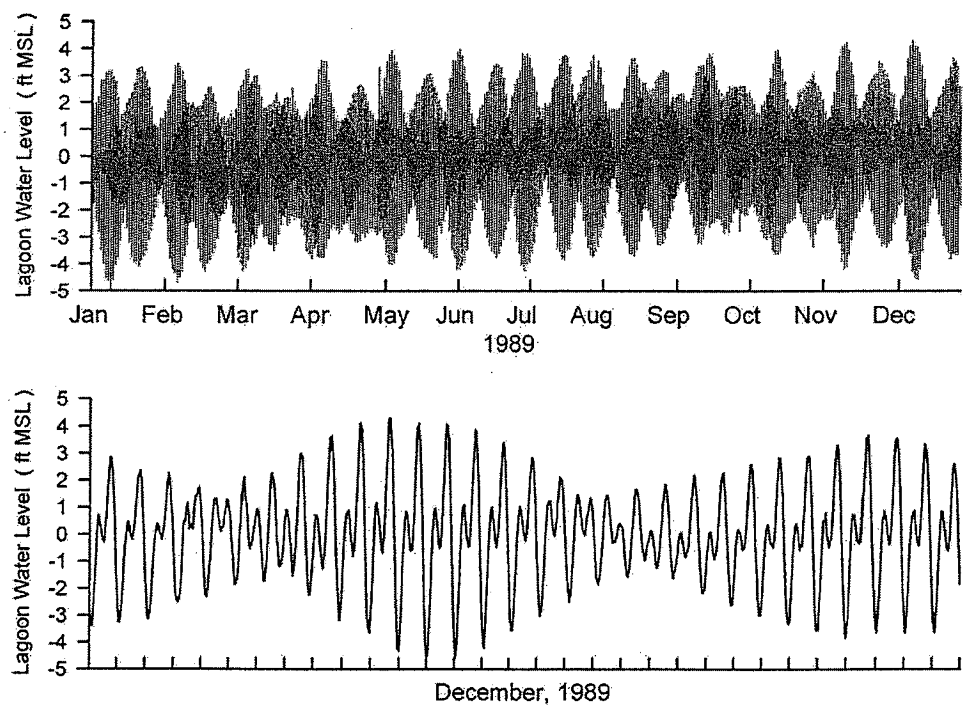

Figure A-10. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1989 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

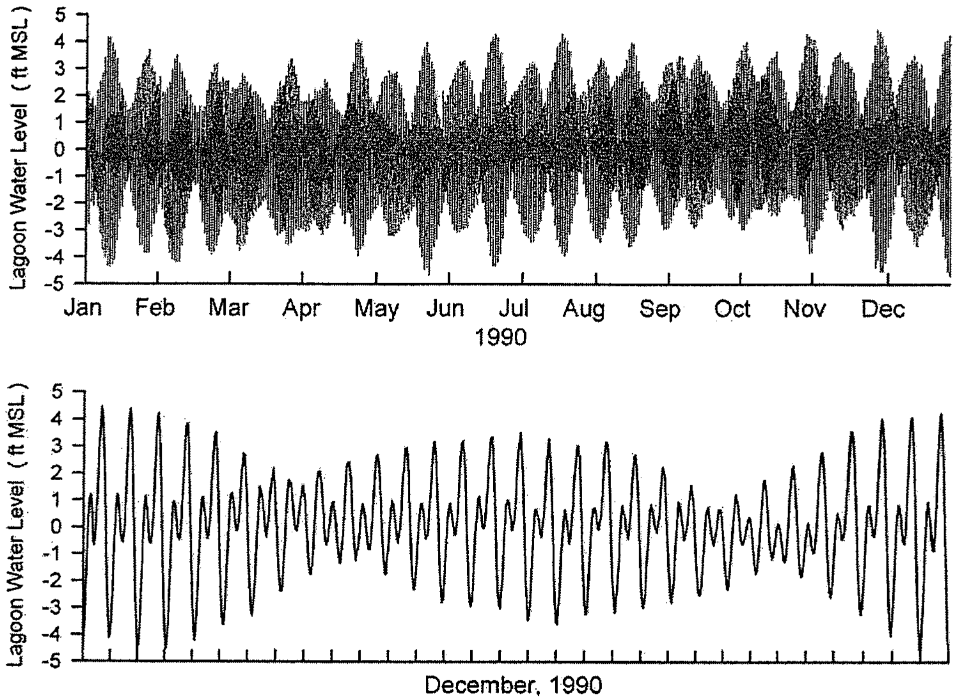

Figure A-11. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1990 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

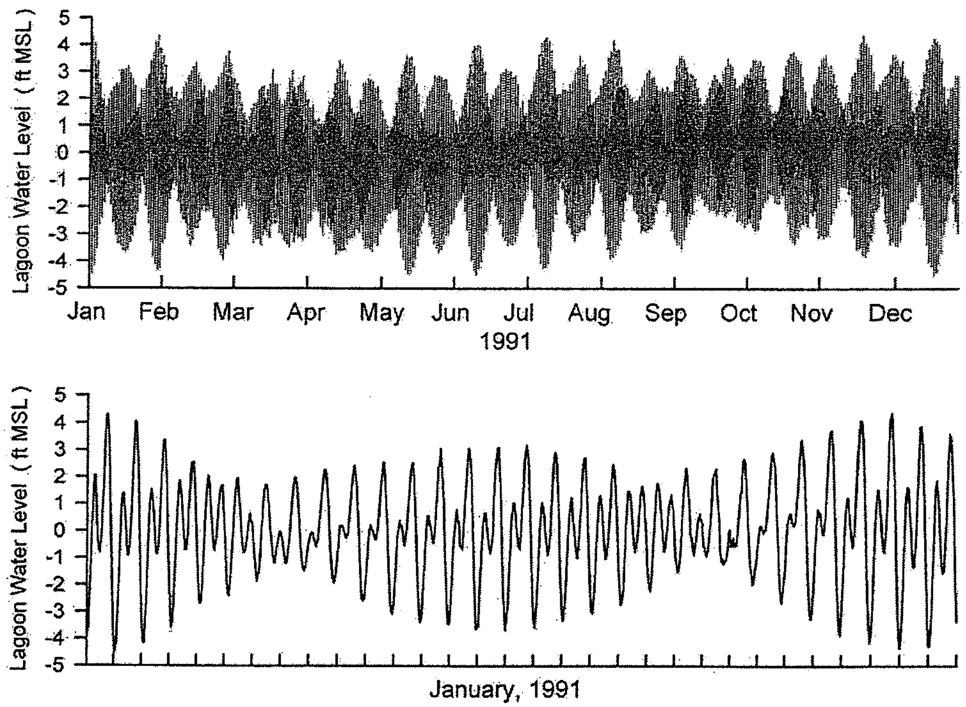

Figure A-12. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1991 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

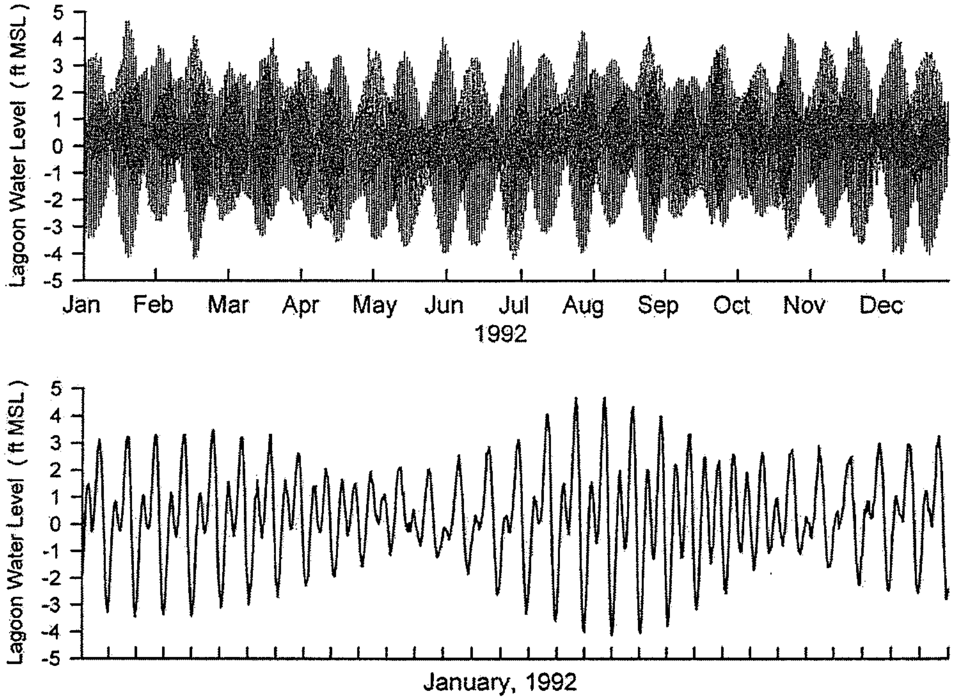

Figure A-13. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1992 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

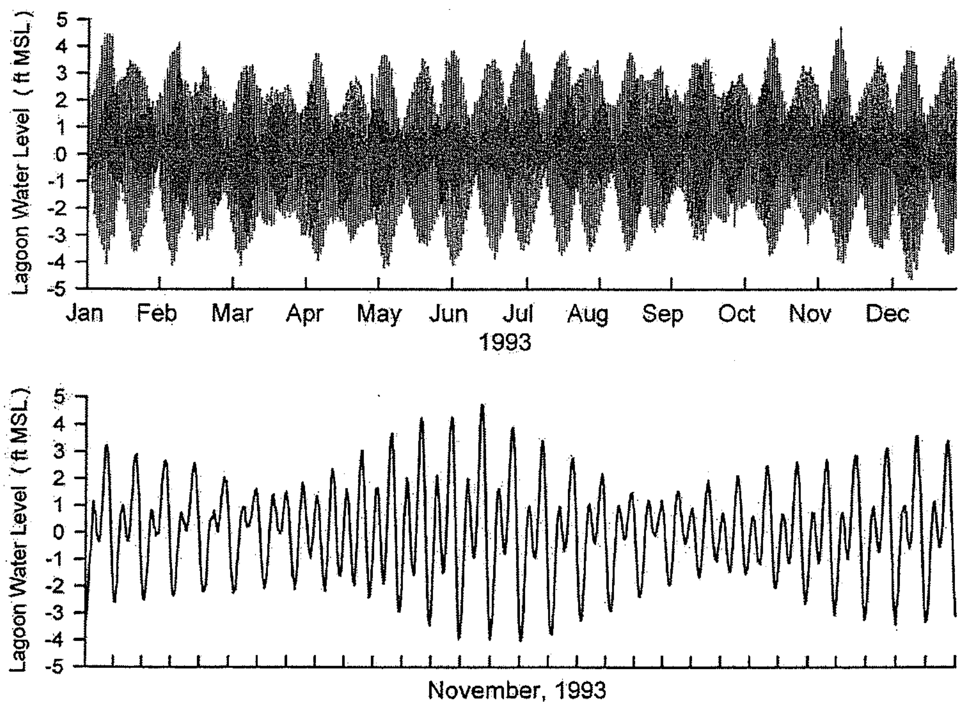

Figure A-14. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1993 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

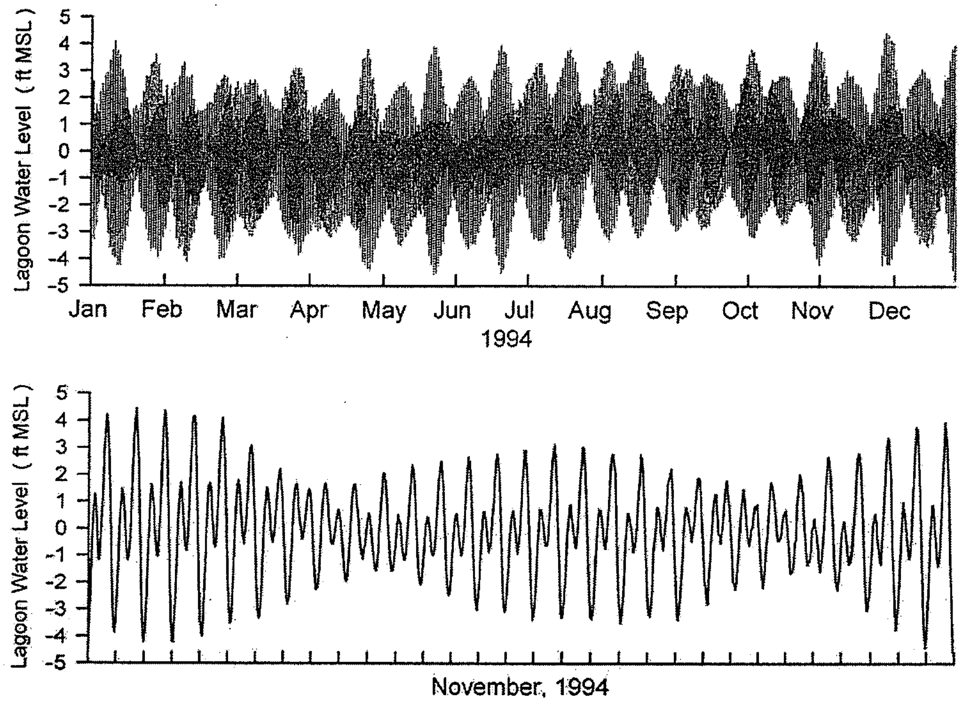

Figure A-15. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1994 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

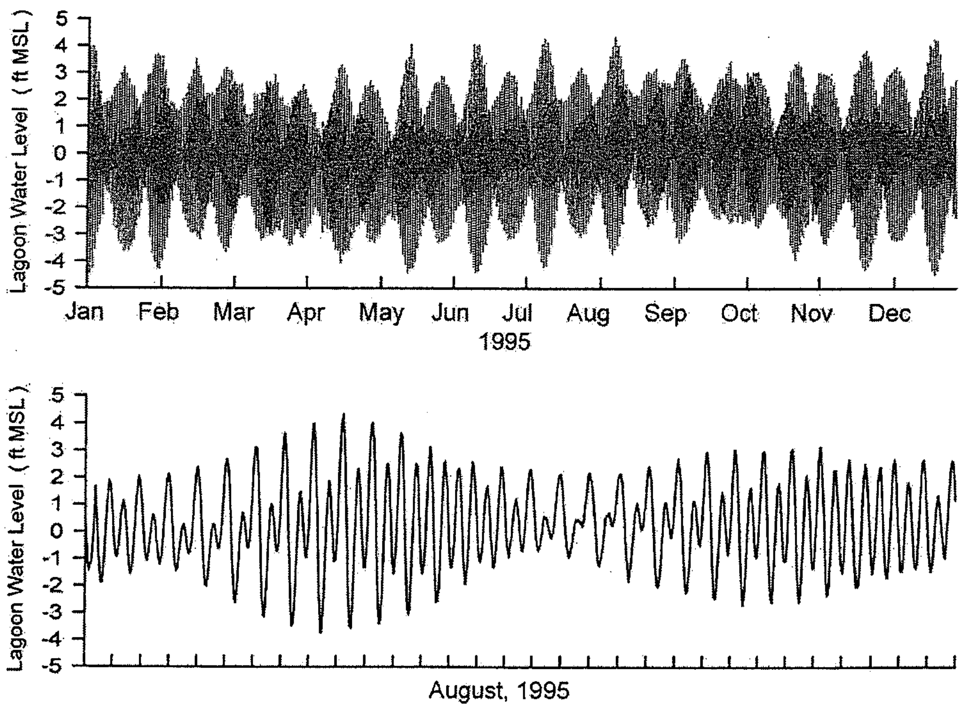

Figure A-16. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1995 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

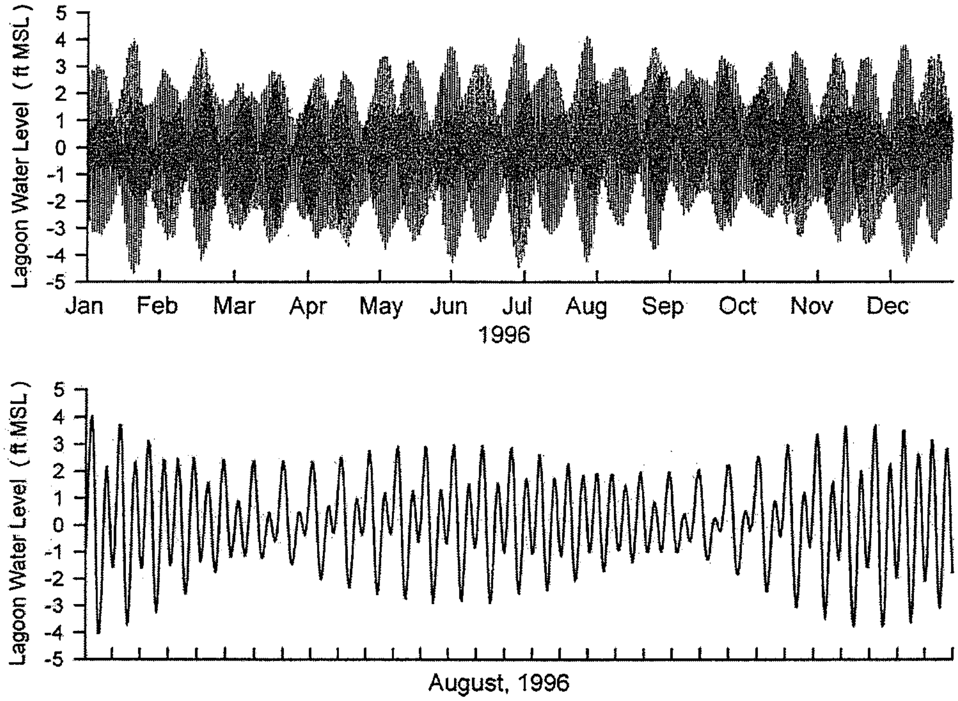

Figure A-17. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1996 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

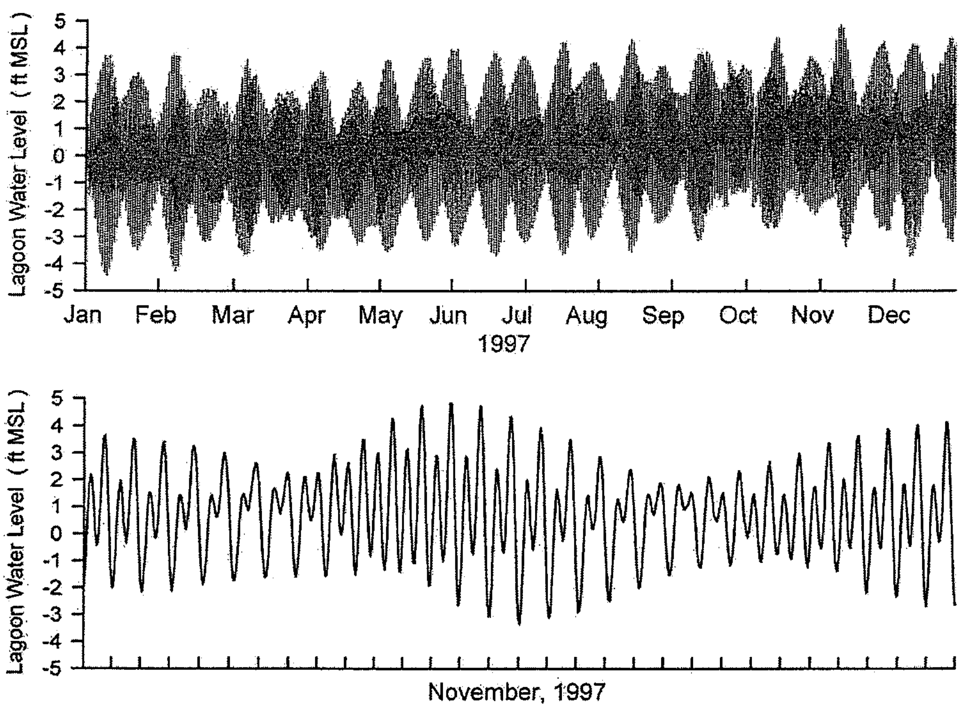

Figure A-18. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1997 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

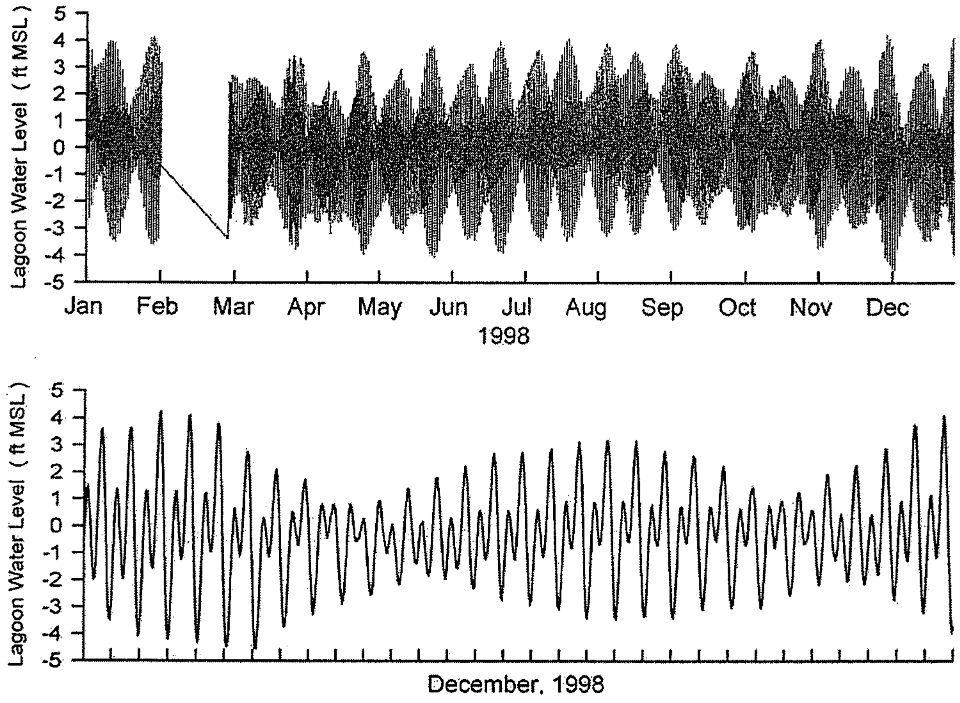

Figure A-19. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1998 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

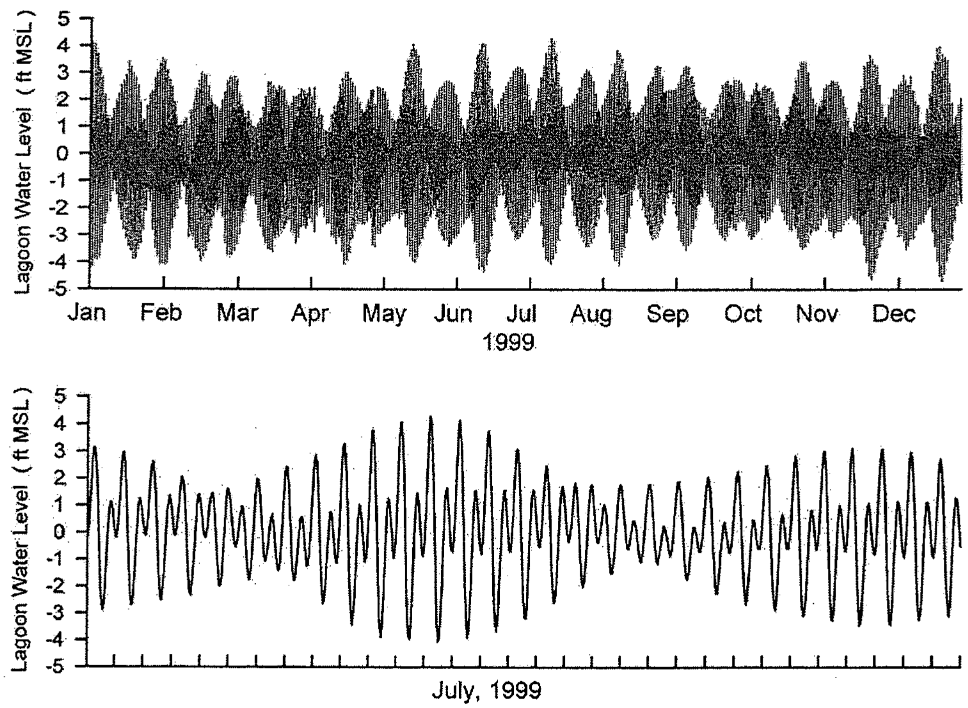

Figure A-20. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1999 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

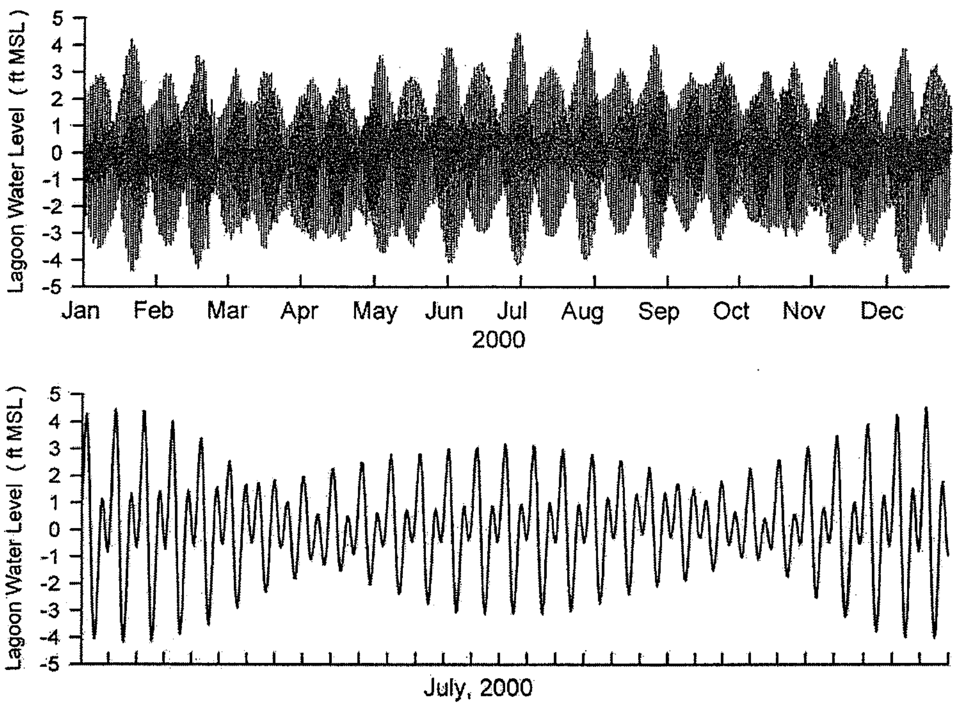

Figure A-21. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 2000 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).