Santa Rosa Subregional Long-Term Wastewater Project

WATER QUALITY AND FLOW MODEL FOR IRRIGATION/STORAGE AREA STREAMS

SANTA ROSA SUBREGIONAL LONG-TERM WASTEWATER PROJECT

Prepared for

City of Santa Rosa
and
U.S. Army Corps of Engineers

MAY 1996

Prepared by
Donald J. Smith, P.E.
Resource Management Associates
4171 Suisun Valley Rd. Suisun, CA 94585 (707) 865-2950

For

HARLAND BARTHOLOMEW & ASSOCIATES, INC.

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1.0 INTRODUCTION

Irrigation could affect surface water flow in West County streams and Tolay Creek, but not other irrigation area streams (*Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report, Questa 1996). Storage reservoirs in West County and Tolay could also affect surface water flow (*Hydrogeology of Storage/Reuse Areas and Evaluation of Potential Impacts to Groundwater* Technical Report, Parsons ES-1996). A watershed flow and water quality model was developed to estimate the potential changes in stream flow and water quality potentially resulting from storage and irrigation in West County and Tolay. In addition, the effect of West County irrigation and storage on the Esteros was evaluated using watershed model output. A water quality model was used to evaluate Estero impacts.

The purpose of this report is to document model methodology. Model output is used in other reports (*Water Quality Impacts Analysis* and *Aquatic Habitat Impacts Analysis* Technical Reports, MSC 1996) to describe and evaluate potential project impacts.

2.0 WATERSHED FLOW AND WATER QUALITY MODEL

The flow and water quality model is designed to predict stream flow and water quality (i.e., TDS and total inorganic nitrogen) on a monthly basis for the combinations of storage and irrigation that have been proposed in Stemple, Americano and Tolay Creeks. Surface water impacts are not expected in other watersheds (*Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report, Questa 1996). The model computes the flow and water quality by mass balance from the aggregate watershed land use tributary to any stream location. Land uses considered include the following:

- Storage reservoir options (locations are described in Section 2 of the EIR/S).
- Dam seepage (described in *Hydrogeology of Storage/Reuse Areas and Evaluation of Potential Impacts to Groundwater* Technical Memorandum Parsons Engineering Science 1996).
- Irrigation acreage (estimated by Sycamore Associates using GIS and the Irrigation Management Guidelines in Section 2.2 of the EIR/S).
- Hydrologic year types (as defined in the *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report, Questa 1996).
- Irrigation technology (as defined in *Estimation of Nitrogen, Salts and Herbicide / Pesticide Concentrations in Surface Water and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives* Technical Report, Questa 1996).

Changes in water quality associated with passage through the stream system are ignored.
The assumptions and modeling approach are summarized.

2.1 RESERVOIR EFFECTS

Project effects on flow and water quality were evaluated for each storage alternative in each watershed, as described in Table 1.

Table 1.

Summary of Storage Alternatives Evaluated in Each Watershed

Americano	Stemple	Tolay	Adobe Road Site	Lakeville
No Storage	No Storage	No Storage	No Storage	No Storage
Valley Ford	Huntley	Tolay A	Adobe Road	Lakeville Hillside
Carroll Road	Two Rock	Tolay C		
Bloomfield		Sears Point		

With the exception of Tolay A, Tolay C, Sears Point, and Adobe Road, all runoff tributary to each dam site is assumed to flow into the impoundment with no direct downstream flow or water quality ramifications. For the Tolay and Adobe watersheds, the drainage from watershed above the Sears Point and Tolay "C" dam sites is assumed intercepted and pumped around the reservoir.

The average seepage rate through each dam has been estimated in *Hydrogeology of Storage/Reuse Areas and Evaluation of Potential Impacts to Groundwater* Technical Report (Parsons ES 1996). The monthly variations are estimated by a scaling factor which reflects the depth of water within the reservoir. The annual average seepage rates and monthly scaling factors are listed in Tables 2 through 5.

The TDS and total inorganic nitrogen concentrations of the seepage from the storage reservoir were assumed equal to the Delta Pond effluent concentrations used in the Russian River water quality study (*Russian River Water Quality Model* Technical Report RMA 1996). The monthly concentrations are shown in Table 2 through 5.

Table 2.

WatershedStatistics, Dam Seepage Rates, Unit Runoff Rates and Quality for Tolay Creek Watershed

Statistics	Total Area = 6171 Acres	Potential Irrigated Area = 1540 acres	
Reservoir Options	**Upstream Area in Acres**	**Upstream Irrigated Area in Acres**	**Dam Seepage Rate in gpm**
Sears Point	2027[a]	1463	1.5
Tolay (A)	3990	none	1.8
Tolay (C)	1300[a]	880	1.2

Watershed Flows and Water Quality	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Dam Seepage Fraction	0.63	0.78	0.93	1.03	1.11	1.18	1.23	1.18	1.03	0.88	0.73	0.58
Flows, AcreFeet/Month												
Average Year Flows, No Irrigation	1.4	829	1413	2256	1401	718	322	41.0	11.7	4.3	1.6	0.0
Dry Year Flows, No Irrigation	0.3	398	749	1271	772	360	143	32.7	9.3	3.4	1.3	0.0
Wet Year Flows, No Irrigation	2.9	1294	2102	3243	2042	1212	575	64.4	22.3	4.8	1.8	0.0
Average Year, Normal Irrigation	5.8	791	1368	2205	1371	692	306	44.9	12.8	4.7	1.7	3.3
Dry Year, Normal Irrigation	5.2	374	720	1234	752	345	136	35.5	10.1	3.7	3.9	4.4
Wet Year, Normal Irrigation	7.3	1246	2047	3185	2005	1190	556	71.1	24.7	5.3	1.9	3.3
Avg. Year Cool Summer Irrigation	11.0	796	1370	2205	1372	692	306	44.9	12.8	4.7	6.7	8.9
Dry Year, Winter Irrigation	5.3	374	737	1276	822	380	156	49.0	17.4	7.5	5.3	4.9
Water Quality, mg/L	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Non Irrigated TDS	400	300	120	100	100	100	200	300	400	500	550	600
Low Tech TDS	1200	500	160	100	100	100	300	1000	1400	1500	1600	1700
Winter Irrigation TDS	1200	500	370	400	500	650	900	1150	1400	1500	1600	1700

Table 2.

WatershedStatistics, Dam Seepage Rates, Unit Runoff Rates and Quality for Tolay Creek Watershed

Reclaimed Water TDS	490	470	450	450	450	460	470	480	490	500	510	510
Non Irrigated Nitrogen	2	1.5	1	0.8	0.8	0.8	1	1.5	1.8	1.9	2	2.1
Low Tech Nitrogen	3.2	1.5	0.8	0.5	0.5	0.5	1	2.8	3.5	3.6	3.7	3.8
Winter Irrigation Nitrogen	3.2	1.5	0.9	1.1	1.5	1.9	2.4	3	3.5	3.6	3.7	3.8
Reclaimed Water Nitrogen	13.6	14.2	16.5	16.5	16.5	15.3	14.1	12.1	11.3	11.1	10.9	10.6
Irrigation Technology Scaling Factors	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Medium Technology-Flow	0.94	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.94	0.94	0.94	0.94
High Technology-Flow	0.88	1.01	1.01	1.01	1.01	1.01	1.01	0.88	0.88.	0.88	.088	0.88
Medium Technology-TDS	1.12	1.01	1.01	1.01	1.01	1.01	1.01	1.12	1.12	1.12	1.12	1.12
High Technology-TDS	1.22	1.01	1.01	1.01	1.01	1.01	1.01	1.22	1.22	1.22	1.22	1.22
Medium Technology-Nitrogen	0.97	1.01	1.01	1.01	1.01	1.01	1.01	0.97	0.97	0.97	0.97	0.97
High Technology-Nitrogen	0.92	1.02	1.02	1.02	1.02	1.02	1.02	0.92	0.92	0.92	0.92	0.92

[a] Flow is intercepted and diverted around reservoir. Area above diversion point is not considered part of the watershed

Table 3.

WatershedStatistics, Dam Seepage Rates, Unit Runoff Rates and Quality for Stemple Creek Watershed

Statistics	Total Area = 6171 Acres	Potential Irrigated Area = 1540 acres	
Reservoir Options	**Upstream Area in Acres**	**Upstream Irrigated Area in Acres**	**Dam Seepage Rate in gpm**
Huntley	388	none	9
Two Rock	727	none	5

Watershed Flows and Water Quality	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Dam Seepage Fraction	0.63	0.78	0.93	1.03	1.11	1.18	1.23	1.18	1.03	0.88	0.73	0.58
Flows, AcreFeet/Month	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Average Year Flows, No Irrigation	42.3	4089	5560	9945	7399	6288	1350	371	141.0	32.1	11.6	1.0
DryYearFlows, No Irrigation	2.6	999	2308	4028	3684	3348	289	200	54.5	20.4	7.5	0.0
WetYearFlows, No Irrigation	101.0	5853	9243	16066	11835	9670	2820	433	179.0	42.3	15.5	2.5
Average Year, Normal Irrigation	37.2	3707	5192	9504	7120	6108	1346	432	175.0	42.2	24.8	19.5
Dry Year, Normal Irrigation	20.0	854	2119	3777	3517	3656	554	314	115.0	31.8	20.8	18.9
Wet Year, Normal Irrigation	75.4	5382	8761	15527	11490	9436	2714	512	223.0	53.0	19.3	16.8
Avg. Year Cool Summer Irrigation	158.0	3727	5200	9507	7121	6108	1346	432	175.0	51.0	39.7	39.2
Dry Year, Winter Irrigation	20.1	854	2189	3948	3798	4007	721	404	171.0	47.4	26.6	20.9
Water Quality, mg/L	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Non Irrigated TDS	400	300	120	100	100	100	200	300	400	500	550	600
Low Tech TDS	1200	500	160	100	100	100	300	1000	1400	1500	1600	1700

Table 3.

WatershedStatistics, Dam Seepage Rates, Unit Runoff Rates and Quality for Stemple Creek Watershed

Winter Irrigation TDS	1200	500	370	400	500	650	900	1150	1400	1500	1600	1700
Reclaimed Water TDS	490	470	450	450	450	460	470	480	490	500	510	510
Non Irrigated Nitrogen	2	1.5	1	0.8	0.8	0.8	1	1.5	1.8	1.9	2	2.1
Low Tech Nitrogen	3.2	1.5	0.8	0.5	0.5	0.5	1	2.8	3.5	3.6	3.7	3.8
Winter Irrigation Nitrogen	3.2	1.5	0.9	1.1	1.5	1.9	2.4	3	3.5	3.6	3.7	3.8
Reclaimed Water Nitrogen	13.6	14.2	16.5	16.5	16.5	15.3	14.1	12.1	11.3	11.1	10.9	10.6
Irrigation Technology Scaling Factors												
Medium Technology-Flow	1.07	1.05	1.05	1.05	1.05	1.05	1.05	1.07	1.07	1.07	1.07	1.07
High Technology-Flow	0.92	1.03	1.03	1.03	1.03	1.03	1.03	0.92	0.92	0.92	0.92	0.92
Medium Technology- TDS	1.19	0.93	0.93	0.93	0.93	0.93	0.93	1.19	1.19	1.19	1.19	1.19
High Technology- TDS	1.22	0.95	0.95	0.95	0.95	0.95	0.95	1.22	1.22	1.22	1.22	1.22
Medium Technology-Nitrogen	1.06	1.08	1.08	1.08	1.08	1.08	1.08	1.06	1.06	1.06	1.06	1.06
High Technology-Nitrogen	0.95	1.16	1.16	1.16	1.16	1.16	1.16	0.95	0.95	0.95	0.95	0.95

Table 4.

WatershedStatistics, Dam Seepage Rates, Unit Runoff Rates and Quality for Americano Creek Watershed

Statistics	Total Area = 6171 Acres	Potential Irrigated Area = 1540 acres	
Reservoir Options	**Upstream Area in Acres**	**Upstream Irrigated Area in Acres**	**Dam Seepage Rate in gpm**
Bloomfield	661	146	38
Carroll Road	892	61	25
Valley Ford	902	109	18

Watershed Flows and Water Quality	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Dam Seepage Fraction	0.63	0.78	0.93	1.03	1.11	1.18	1.23	1.18	1.03	0.88	0.73	0.58
Flows, AcreFeet/Month												
Average Year Flows, No Irrigation	23.7	2994	3813	6073	3807	3237	729	200	74.9	16.8	6	0.8
DryYearFlows, No Irrigation	0.8	560	1100	3455	2473	2155	341	166	57.5	12.3	4.4	0
WetYearFlows, No Irrigation	20.9	5497	6235	9637	5406	5052	1366	235	96.1	22	7.9	1.2
AverageYear, Normal Irrigation	27.6	2611	3447	5668	3597	3094	726	252	103.5	25.7	17.9	17.2
DryYear, Normal Irrigation	18.3	445	954	3142	2296	2030	384	200	77	22.6	16.4	16.8
Wet Year, Normal Irrigation	36.8	5088	5778	9155	5148	4849	1294	293	130	31.3	11.2	14
Avg. Year Cool Summer Irrigation	45.8	2630	3454	5671	3598	3094	726	252	103.5	24.1	26.9	33.7
DryYear, Winter Irrigation	18.3	445	1016	3292	2544	2340	531	275	127	36.3	21.5	18.5
Water Quality, mg/L	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Non Irrigated TDS	400	300	120	100	100	100	200	300	400	500	550	600

Table 4.

WatershedStatistics, Dam Seepage Rates, Unit Runoff Rates and Quality for Americano Creek Watershed

Low Tech TDS	1200	500	160	100	100	100	300	1000	1400	1500	1600	1700
Winter Irrigation TDS	1200	500	370	400	500	650	900	1150	1400	1500	1600	1700
Reclaimed Water TDS	490	470	450	450	450	460	470	480	490	500	510	510
Non Irrigated Nitrogen	2	1.5	1	0.8	0.8	0.8	1	1.5	1.8	1.9	2	2.1
Low Tech Nitrogen	3.2	1.5	0.8	0.5	0.5	0.5	1	2.8	3.5	3.6	3.7	3.8
Winter Irrigation Nitrogen	3.2	1.5	0.9	1.1	1.5	1.9	2.4	3	3.5	3.6	3.7	3.8
Reclaimed Water Nitrogen	13.6	14.2	16.5	16.5	16.5	15.3	14.1	12.1	11.3	11.1	10.9	10.6
Irrigation Technology Scaling Factors	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Medium Technology-Flow	0.88	1.08	1.08	1.08	1.08	1.08	1.08	0.88	0.88	0.88	0.88	0.88
High Technology-Flow	0.76	1.06	1.06	1.06	1.06	1.06	1.06	0.76	0.76	0.76	0.76	0.76
Medium Technology- TDS	1.17	0.89	0.89	0.89	0.89	0.89	0.89	1.17	1.17	1.17	1.17	1.17
High Technology- TDS	1.25	0.92	0.92	0.92	0.92	0.92	0.92	1.25	1.25	1.25	1.25	1.25
Medium Technology-Nitrogen	1.02	1.13	1.13	1.13	1.13	1.13	1.13	1.02	1.02	1.02	1.02	1.02
High Technology-Nitrogen	0.88	1.27	1.27	1.27	1.27	1.27	1.27	0.88	0.88	0.88	0.88	0.88

Table 5.

Adobe Road and Lakeview Dam Seepage Rates

Statistics	Total Area = N/A (Watershed flows per acre and water quality assumed equal to Tolay Creek flow and water quality.		
Reservoir Options	**Upstream Area in Acres**	**Upstream Irrigated Area in Acres**	**Dam Seepage Rate in gpm**
Adobe Road	1050	none	4.0
Lakeville	500	none	20.0

Watershed Flows and Water Quality	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Dam Seepage Fraction	0.63	0.78	0.93	1.03	1.11	1.18	1.23	1.18	1.03	0.88	0.73	0.58

Within the reservoir, oxygen uptake by settling phytoplankton and other oxygen consuming materials will likely result in anoxic conditions within the hypolimnion during extended periods of thermal stratification. Consequently, the seepage water may also be anoxic. This potential impact is also described.

The physical conditions in the tailwater area will determine the extent of the reduced oxygen water. To minimize any negative impacts of low dissolved oxygen in the tailwater, the re-aeration potential Could be maximized in the dam design. First, pool areas that could accumulate low dissolved oxygen waters should not be constructed immediately downstream of the dam. Second, enhancing roughness characteristics of natural creeks below dams would facilitate natural reaeration.

Estimates of average seepage rates through the dams of the proposed reclaimed water storage facilities range from 1.8 gallons per minute (gpm) for Tolay (A) Dam to 38 gpm for Bloomfield Dam. Allowing for seasonal variations, the maximum seepage flow rate for the Bloomfield Dam is estimated at 47 gpm or approximately 0.1 cfs.

Assuming a 0.1 cfs flow rate and a one percent slope and a Mannings n of 0.03, a rectangular channel approximately 1 foot wide by 0.1 foot deep would result in a velocity of approximately 1 foot per second. Under these flow conditions, the following recovery of the oxygen deficit might be expected.

Distance (feet)	**Travel Time (minutes)**	**R[a] (day^{-1})**	**Dissolved Oxygen @ 20° C (mg/L)**
60	1	0.72	2.6
120	2	0.51	4.5
180	3	0.36	5.9
240	4	0.26	6.8
300	5	0.19	7.5

[a] R = the ratio of oxygen deficit to saturation assuming a reaeration coefficient of 480/day^{-1} (average of the rates determined by the Churchill et al. (1962) and O'Connor and Dobbins (1958) formulation)

The typical reaeration rate function is proportional to velocity and inversely proportional to depth.
i.e., $K_2 = K\ V^{n1} / D^{n2}$

where: K_2 is the reaeration rate
K = a scaling constant
V = Velocity
n_1 = exponent less or equal to 1.
D = water depth
n_2 = exponent greater than 1

Under normal flow conditions, the flow velocity decreases less rapidly than the normal depth (e.g., $V \cong f[D^{2/3}]$ per Mannings Equation) as the flow rate decreases. Therefore, the ratio of V^{n1} to D^{n2} increases as the flow rate decreases resulting in more rapid reaeration and recovery of the oxygen deficit. Since the predicted seepage rate is the highest for the Bloomfield Dam site, it represents the worst case.

2.2 HYDROLOGY AND WATER QUALITY

The effects of proposed West County and South County reclamation alternatives on local hydrology and selected water quality parameters have been evaluated in *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report (Questa 1996) and *Estimation of Nitrogen, Salts and Herbicide/ Pesticide Concentrations in Surface Water and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives* Technical Report (Questa 1995). The evaluations included estimates of monthly flows for the Americano, Stemple and Tolay Creek watersheds for the combinations of hydrologic, irrigation conditions and irrigation intensity that are described in Table 6. “Irrigation condition” refers to the presence or absence of irrigation, and “irrigation intensity” refers to the type of crops being grown and thus the irrigation practices. Additional information about irrigation condition and intensity is provided in *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report (Questa 1996) and *Estimation of Nitrogen, Salts and Herbicide / Pesticide Concentrations in Surface Water and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives* Technical Report (Questa 1995).

Table 6.

Hydrologic Conditions Under Which Irrigation and Storage Impacts Were Evaluated

Hydrologic Condition	Irrigation Condition	Irrigation Intensity
Average rainfall year	no irrigation, normal irrigation rate cool summer with normal irrigation	 low, medium, high tech low, medium, high tech
Dry rainfall year	no irrigation, normal irrigation rate winter irrigation (contingency)	 low, medium, high tech low, medium, high tech
Wet rainfall year	no irrigation normal irrigation rate	 low, medium, high tech

Source: Questa (1995 and 1995)

The water quality analysis in *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report (Questa 1996) and *Estimation of Nitrogen, Salts and Herbicide/Pesticide Concentrations in Surface Water and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives* Technical Report (Questa 1995) included estimates of the TDS and nitrogen concentrations of surface and sub-surface runoff within each watershed. The estimates included seasonal variation (i.e., winter and summer) for existing conditions and low, medium and high technology cropping scenarios. Monthly values were interpolated to provide smooth transition between the summer and winter season.

The “normal irrigation” flows were assumed to correspond to the low technology irrigation scenario. For variations due to the other cropping technologies, scaling factors were developed from *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report (Questa 1996) and *Estimation of Nitrogen, Salts and Herbicide / Pesticide Concentrations in Surface Water and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives* Technical Report (Questa 1995) which relate the flow and water quality of the low technology irrigation practice to the medium and high technology irrigation scenarios.

The monthly flow rates and TDS and nitrogen concentrations for the Tolay, Stemple and Americano watersheds are shown in Tables 2, 3 and 4 respectively. All of the flow rates and water quality shown in these tables are based on the total watershed and potential irrigated acreage assumed by *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report (Questa 1996) and *Estimation of Nitrogen, Salts and Herbicide / Pesticide Concentrations in Surface Water and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives* Technical Report (Questa 1995). These acreages, which are listed in Table 2 through 5, differ from the latest determination of suitable irrigation lands (*Water Quality Impacts Analysis,* MSC 1996). Therefore, the actual flow and concentrations were computed from the unit flow (i.e., cfs / acre) as determined by the Questa data and revised acreages.

The water quality effects of the winter irrigation option were not explicitly defined by *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report (Questa 1996) and *Estimation of Nitrogen, Salts and Herbicide / Pesticide Concentrations in Surface Water and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives* Technical Report (Questa 1995). Therefore, the TDS and nitrogen concentrations were estimated by using the ratio of precipitation to the winter irrigation application rate. These estimated concentrations are included in Tables 2 through 4.

2.2.1 Irrigation Acreage Changes Associated With Design Discharge Rates

For each watershed, irrigation projects associated with the 1, 5 and 10 percent design discharge components were evaluated. The total irrigated area that is necessary in West County for these irrigation alternatives is 6,200, 4,400 and 2,900 acres, respectively (see

Water Balance Model Technical Report, Parsons E-S 1996). Based on criteria for irrigation suitability in the *Irrigation Management Guidelines* Technical Report (Questa 1996), 3055 acres and 5493 acres have been identified as suitable for irrigation in the Americano and Stemple Watershed, respectively (see Table 6-2 in *Water Quality Impacts Analysis* Technical Report, MSC 1996). For alternatives where the suitable irrigation acreage within a watershed (e.g., Stemple Creek watershed) may exceed the required acreage, the required acreage was assumed to be uniformly distributed throughout the suitable irrigation land. As an example, 49 percent of the available irrigable lands in the Stemple Creek watershed is required for the 10 percent project alternative (i.e., 2,700 / 5,493). Therefore, if a sub-watershed contained 1,000 acres of irrigable land, 490 acres would be assumed irrigated under the 10 percent project option.

2.2.2 Flow and Water Computations

The following procedure was used to compute the flow and water quality at various locations within each watershed. First, the flow rate per unit area was computed from the Questa estimates.

ie.,

$$q_n = Q_n / A_t$$

Where: q_n = Unirrigated flow rate, cfs/acre
Q_n = Unirrigated flow rate, cfs
A_t = Total watershed area, acres

And

$$q_p = (Q_p - q_n (A_t - A_p)) / A_p$$

Where: q_p = Irrigated area flow rate, cfs/acre
Q_p = Irrigated area flow rate, cfs
A_p = Irrigated area, acres

For the area of interest, the total watershed area, the area suitable for irrigation and any dam within the watershed was specified. Using the unit flow rates defined above, the total flow and water quality was computed by mass balance.
i.e.,

$$Q = q_n (A_t - A_p - A_r) + q_p A_p + S_r$$

Where: Q = Total flow rate, cfs
A_r = reservoir watershed area, acres
S_r = Dam seepage rate in cfs

And

$$C = (C_n (q_n (A_t - A_p - A_r)) + C_p q_p A_p + C_r S_r) / Q$$

Where: C = flow-weighted concentration, mg/L
C_n = concentration from non-irrigated lands, mg/L

C_p = concentration from irrigated lands, mg/L
C_r = concentration of dam seepage, mg/L

Monthly flows, TDS and total nitrogen concentrations were computed in each watershed for each combination of the following variables:

- Five hydrologic conditions (see Table 6)
- Three irrigation intensity or technology scenarios (see Table 6)
- Up to four storage alternatives (see Table 1)
- Up to three storage volume alternatives at each storage site (e.g., decreasing storage volume and seepage for the 1, 5 and 10 percent irrigation/storage options).

A typical model generated output table for a single location and set of conditions is shown in Table 7. The output table includes estimates of the monthly flow, origin of the water expressed as a percentage and the TDS and nitrogen concentrations. For comparative analysis, these monthly results were averaged over the months of December through March and June through September to represent winter and summer conditions respectively.

The locations at which flows and water quality were simulated are shown in Figure 1 of the *Water Quality Impacts Analysis* Technical Report (MSC 1996). The seasonally averaged model output occupies approximately 250 pages and is available upon request. Estimates of potential impacts on the aquatic biology and water quality are summarized in the *Aquatic Biological Resources Impacts Analysis* Technical Report (MSC 1996) and the *Water Quality Impacts Analysis* Technical Report (MSC 1996) respectively.

Table 7.

Typical Output Table Generated by the Watershed Water Quality and Hydrologic Model for a Single Location and Set of Conditions

Location EA1 - Americano Watershed, Bloomfield Dam

Month	Outflow						Origin			Estimated WQ	
	Non Irr. cfs/100Ac	Irrig. cfs/100Ac	Non Irr. cfs	Irrig. cfs	Seepage cfs	Total cfs	Non Irr. percent	Irrig. percent	Seepage percent	TDS mg/L	Nitrogen[a] mg/L
Oct	0.0001	0.0040	0.009	0.117	0.052	0.178	4.9	65.6	29.5	1145	5.96
Nov	0.0664	0.0329	6.286	0.958	0.067	7.311	86	13.1	0.9	323	1.67
Dec	0.1262	0.1073	11.949	3.122	0.077	15.148	78.9	20.6	0.5	167	1.11
Jan	0.3964	0.3688	37.531	10.729	0.086	48.346	77.6	22.2	0.2	160	0.96
Feb	0.3141	0.3578	29.742	10.407	0.102	40.252	73.9	25.9	0.3	194	1.13
Mar	0.2473	0.3204	23.41	9.32	0.098	32.828	71.3	28.4	0.3	242	1.3
Apr	0.0404	0.1047	3.828	3.047	0.106	6.98	54.8	43.6	1.5	478	2.09
May	0.0190	0.0390	1.803	1.135	0.098	3.036	59.4	37.4	3.2	729	2.27
Jun	0.0068	0.0214	0.645	0.621	0.089	1.355	47.6	45.8	6.5	1022	3.01
Jul	0.0014	0.0065	0.134	0.188	0.073	0.395	33.8	47.7	18.5	1153	4.21
Aug	0.0005	0.0042	0.048	0.123	0.061	0.232	20.6	53.2	26.2	1307	5
Sep	0.0000	0.0043	0	0.125	0.05	0.175	0	71.5	28.5	1660	5.41
Average	0.1016	0.1143	9.615	3.324	0.08	13.02	50.7	39.6	9.7	715	2.84
Ave(Q.wt)							73.9	25.5	0.6	234	1.24

[a] Assuming no uptake in riparian corridor

3.0 ESTERO HYDRODYNAMIC AND WATER QUALITY MODEL

To estimate the impacts of changes in inflow characteristics on Estero water quality, a link-node model evaluation of the two Esteros was performed. A model representation of the Estero Americano developed during a previous flow and water quality study (RMA, 1989) was modified to meet project needs and a new representation of the Estero de San Antonio was developed. In the following sections, model assumptions, inputs and calibration and predicted impacts of watershed management are described.

3.1 MODEL REPRESENTATION

RMA's link-node hydrodynamic model (RMA 1989) represents the Esteros as variable grid networks of "nodes" and "channels" (i.e., links). Nodes are discrete units of the water-body, characterized by surface area, depth and volume as a function of water surface elevation. The nodes represent the wetted area bounded by the midpoints of the connecting channels and include backwater areas which may not be included in the channel conveyance area. Adjacent nodes are connected by channels, each having associated length and friction factor. The width, cross-section area and hydraulic radius of each channel also varies with water surface elevation.

The link-node model has been applied to many estuaries throughout the country and is appropriate for the Estero Americano and Estero de San Antonio evaluation since both estuaries are one-dimensional in nature. That is, the flow within the estuary is primarily constrained to flow in a single channel throughout its length.

The model is designed to solve the basic equations of continuity and dynamic fluid motion for the generalized network of nodes and channels. The program performs a numerical integration of these equations, stepping forward in time. The results are a time history of velocities and flows in each channel and the head, surface area, and volume at each node.

Implicit in the link node modeling approach is the assumption of uniform water quality with depth. Since both Esteros may be density stratified during periods of fresh water inflow, the model was modified to approximate the hydrodynamic and water quality effects of stratification.

The model assumes uniform concentrations within each of two layers at each node location. The average presented in the plots includes the average of both layers during the tidal cycle (24 hourly results). The maximum computed variation with depth was typically 4 PPT for salinity and occurred near the point of maximum horizontal salinity gradient. During periods of stratification, vertical variations in observed salinity were of the same magnitude except for a few periods of sharper stratification. Dissolved oxygen stratification was more pronounced in the simulation results than in the observed data. Temperature stratification was minimal in both the model results and observed data. No other water column data were available. All other observations were assumed representative of the entire water column.

The revised model separates the water column into two layers of equal volume. The concentration of each water quality parameter is computed in both layers at each node. The upper layer computations include reaeration and the appropriate bottom exchange based on the section geometry. The bottom layer computations include settling from the surface layer and attenuation of light by the surface layer. Vertical diffusion between layers is computed as a function of velocity and is intended to approximate turbulent exchange. Density stratification occurs in the Estero when lower salinity waters “float” above waters of higher salinity. Temperature effects on stratification are minimal within the Esteros. Density stratification results in a net seaward flow in the surface layer relative to the subsurface layer. To approximate this effect, inter-tidal flows are altered to create differential net seaward flow between the surface and bottom layers. During calibration, the vertical diffusion and the differential seaward flow between layers were adjusted to approximate observed salinity and thermal stratification.

The application of the stratification approximation is limited to the range of flow conditions evaluated during model calibration because the stratification approximation of the model is an approximate application of fundamental, density-driven hydrodynamic relationships.

The model representation of the Estero Americano utilizes a single line of 44 nodes and 43 interconnecting channels and extends from the Pacific Ocean upstream approximately 7.5 miles to Valley Ford. The model representation of the Estero de San Antonio utilizes a single line of 26 nodes and 25 interconnecting channels and extends from the Pacific Ocean upstream approximately 7.5 miles to the Highway 1 Bridge. The limits for both model representations are shown on Figure 1 (ocean to QE1 and QS1, respectively).

The model representation of the Estero Americano was developed from channel cross-section measurements, detailed air photos taken near low water and site reconnaissance. The model representation of the Estero de San Antonio was developed from channel cross-sections and bed profiles reported by Williams (1993).

3.2 HYDRODYNAMIC MODEL CALIBRATION

3.2.1 Estero Americano

Hydrodynamic model calibration for the Estero Americano was performed for the period of July 1 - 5, 1989. This period was selected because inflow conditions were similar to the conditions that were simulated and because data were available. This period was simulated using as input the stage recorded at 15 minute intervals at the seaward boundary (Sampling Station 1), no fresh water inflow, and an evaporation rate of 4.0 inches per month. Typical Mannings n values, ranging from 0.027 to 0.038, were assigned based on channel characteristics. Calibration data were limited to observed stage at the Franklin School Road Bridge and estimates of current velocity at selected locations.

Figure 1

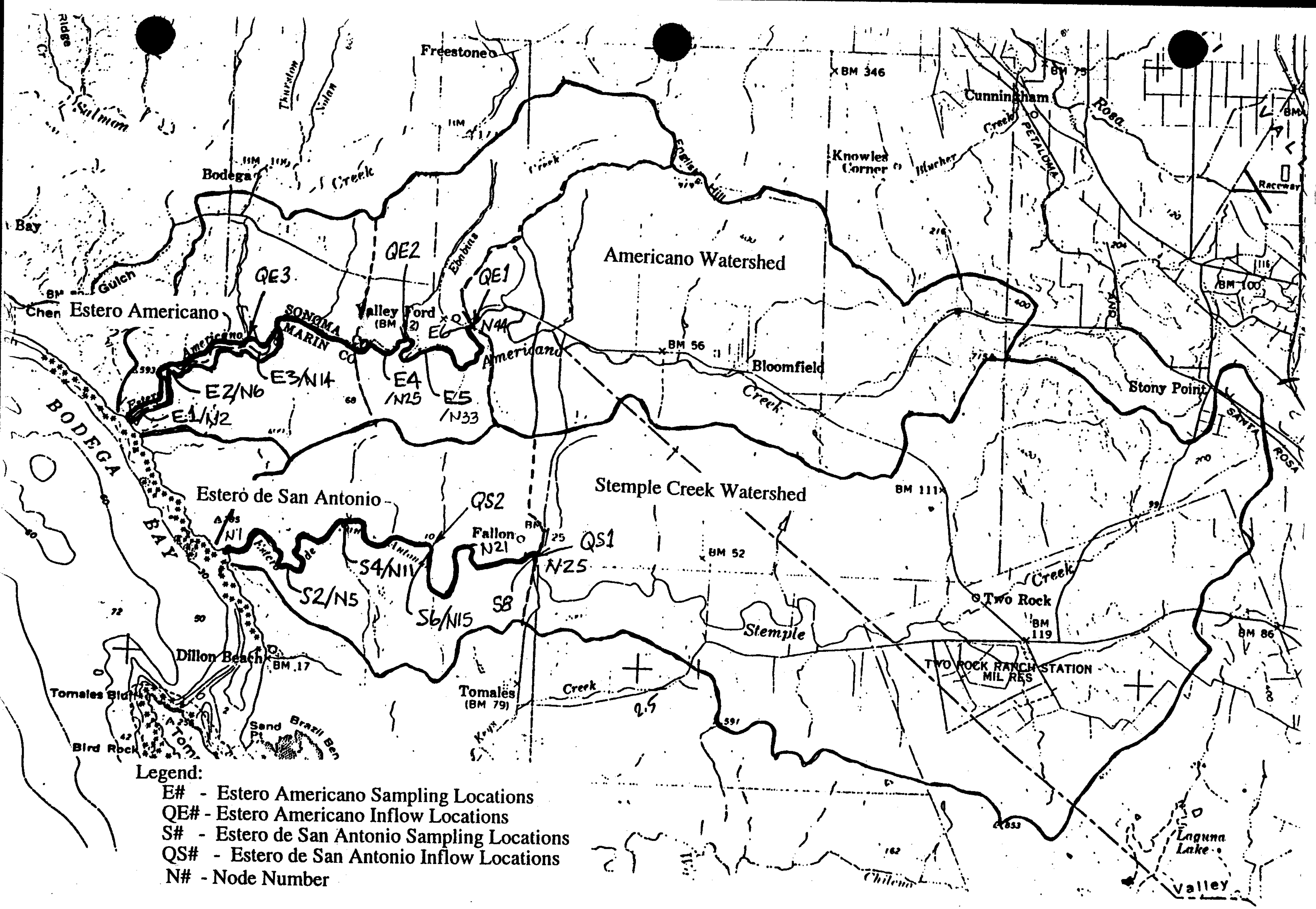


Figure 1 Americano and Stemple Creek Watersheds with Estero Americano and Estero de San Antonio Sampling and Tributary Inflow Locations

The observed tide elevation at the mouth of the Estero and the computed and observed stage at the Franklin School Road Bridge is shown on Figure 2. These results show that the model reproduces the phasing and amplitude of the tide throughout the tidal cycle within one hour and 0.5 feet, respectively. The maximum difference occurs during the period between lower high water and higher low and is probably the result of localized channel restrictions at shallow depths. At the end of the calibration period, the difference diminished as the magnitude of smaller half of the tide increased. This plot shows that the attenuation of the phasing and magnitude during the lower phase of the tide is large relative to the magnitude of the differences between the computed and observed tide at the bridge.

The observed tide at the mouth has a minimum lower low water elevation of approximately -2 feet NGVD (NGVD is equivalent to mean sea level in 1929). Low water outside of the Estero would approach -4 feet NGVD. The difference is due to partial closure of the entrance to the Estero by littoral drift. The potential for total or partial closure increases with increased ocean wave energy and decreased intertidal flow rates, which occur during neap tides with low fresh-water inflow rates.

Velocity estimates based on drogue tracking are available at three locations. The observed inter-tidal extremes are shown below along with corresponding computed velocities during the calibration period.

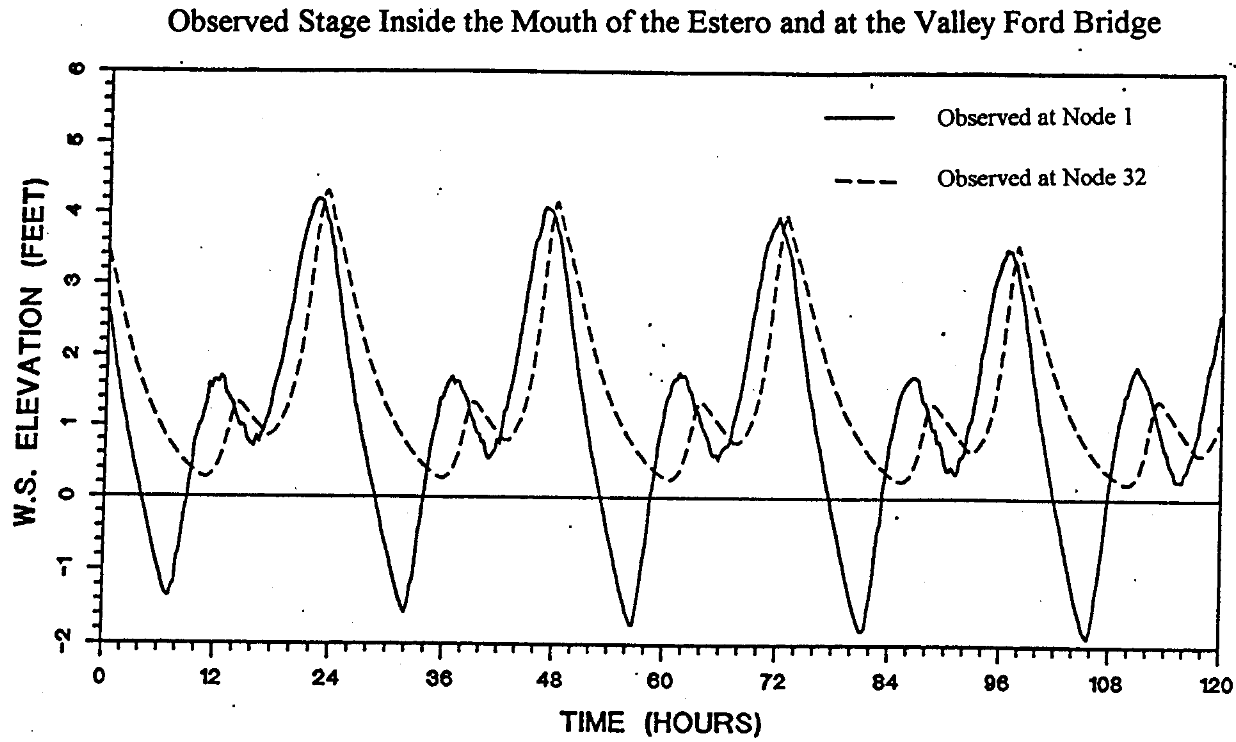
Node Location	Estimated Extremes	Computed Extremes
1	-3.0 to +3.0	-1.5 to +1.4
14	-1.5 to +1.5	-0.7 to +0.6
32	-0.5 to +0.5	-0.3 to +0.5

The velocities computed by the model represent the average over the entire cross section and will always be less than those observed at the surface at mid channel. At nodes 1 and 14, the computed maximum velocity is approximately half that of the observed, which is typical. At node 32, the difference becomes less since the channel is narrow and has steep sides which limits the lateral variation in velocity.

The small difference between the computed and observed stage at the upstream gage and proper magnitude of computed current velocity indicates the model approximates the hydrodynamic responses of the Estero under the tide and entrance conditions which prevailed during the calibration period.

3.2.2 Estero de San Antonio

Hydrodynamic model calibration for the Estero de San Antonio was performed for the period of March 9-11, 1993. This three-day period was simulated using as input predicted tides, Stemple Creek inflow rate of 47 cfs, and an evaporation rate of 2.0 inches per month. Water surface elevations at Middle Road bridge and Franklin School Road bridge as reported by Williams (1993) were used for calibration. The Estero entrance conditions



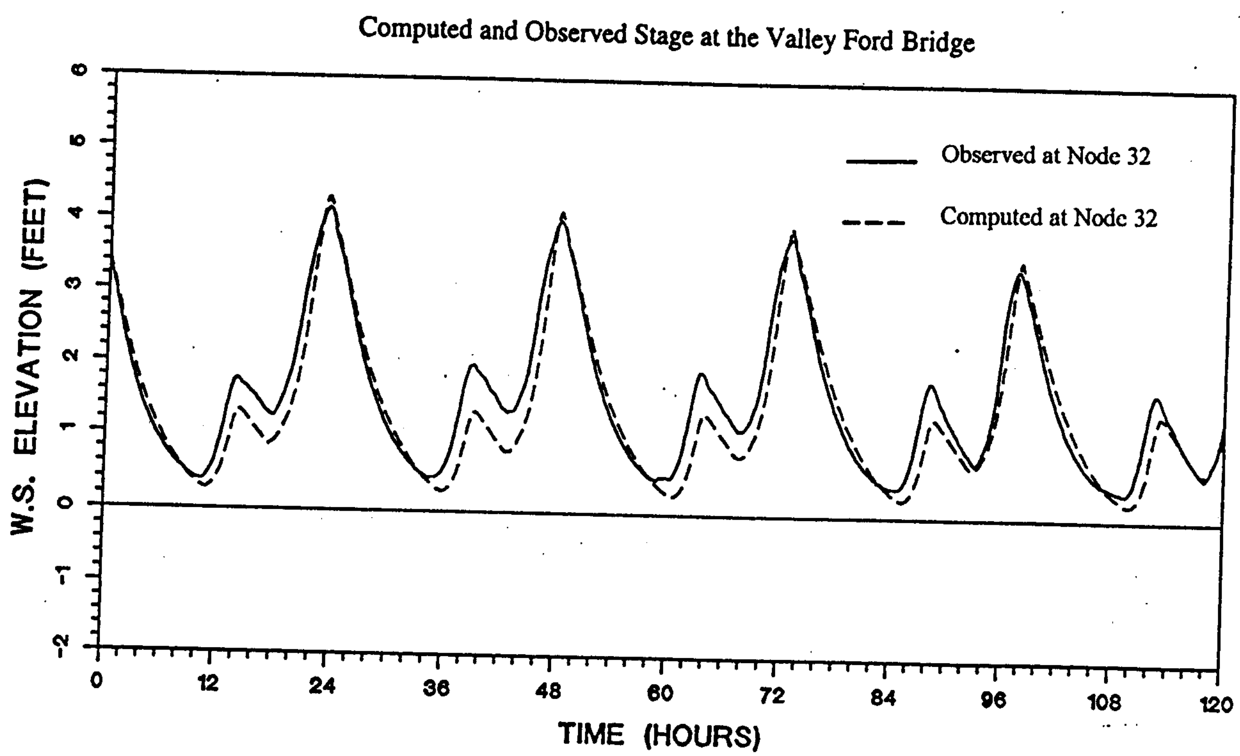


Figure 2 Computed and Observed Water Surface Elevation in the Estero Americano During the Period of July 1 through 5, 1989

that prevailed during this period were approximated by a broad crested weir analogy. A Mannings n value of 0.03 was assigned to all channels.

The predicted tide elevation outside the mouth of the Estero and the computed water surface elevation at the two bridges are shown on Figure 3. Figure 3 also contains a plot extracted from the Williams (1993) report. The computed and observed stage at the two bridges are nearly identical, indicating the model approximates the hydrodynamic responses of the Estero under the tide and entrance conditions which prevailed during the calibration period.

The observed tide inside the mouth of the Estero has a minimum lower low water elevation of approximately 0 feet NGVD. The low water elevation outside of the Estero would approach -4 feet NGVD. The difference is due to partial closure of the entrance to the Estero by littoral transport. The surface area of the Estero de San Antonio is smaller than that of the Estero Americano. Therefore, intertidal flow rates are smaller and the tendency for full or partial closure is greater.

3.3 ESTERO ENTRANCE CLOSURE RAMIFICATIONS

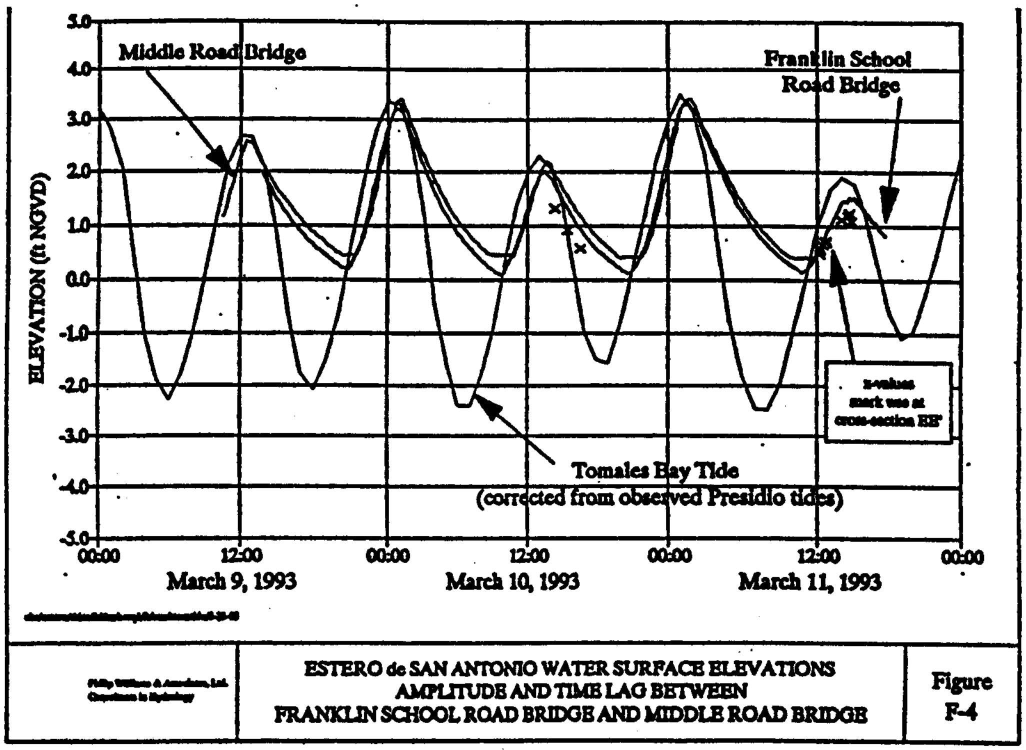
The calibration exercise assumed a single entrance condition. Any number of entrance conditions are possible and may range from fully closed to nearly unrestricted. No attempt has been made to prioritize the calibration events relative to the range of possible entrance conditions. The following volume and flow rates relate specifically to the entrance conditions of the calibration periods under typical tide conditions.

	Minimum Volume Acre-Feet	Maximum Volume Acre-Feet	Maximum Flow Rate cfs	Tidal Range feet
Estero Americano	600	1,600	2,800	3.9
Estero de San Antonio	140	310	600	2.8

The volumes and maximum flow rates provide some insight into the tendency for partial or total closure of the entrances. The ocean conditions affecting the Esteros are similar (e.g., tides, ocean wave energy and availability of littoral sand required for closure). The flows to and from the Estero are the remaining factor influencing closure. The inter-tidal flows for the Estero Americano are approximately four times those of the Estero de San Antonio. Therefore, the Estero de San Antonio is a much more likely candidate for entrance closure.

During all but the highest runoff periods, tributary inflow rates are many times smaller than the inter-tidal flow rates and likely have little effect on the timing of closure. The duration of closure may be shortened by increased water levels within the Esteros due to runoff. Higher water levels may result in over-topping or structural failure of the closure berm or the berm may be removed by local land owners to prevent flooding.

Figure from: "Geomorphic and Hydrodynamic analysis for the Estero de San Antonio Enhancement Plan", Phill Willians & Associates, Ltd., November 30, 1993



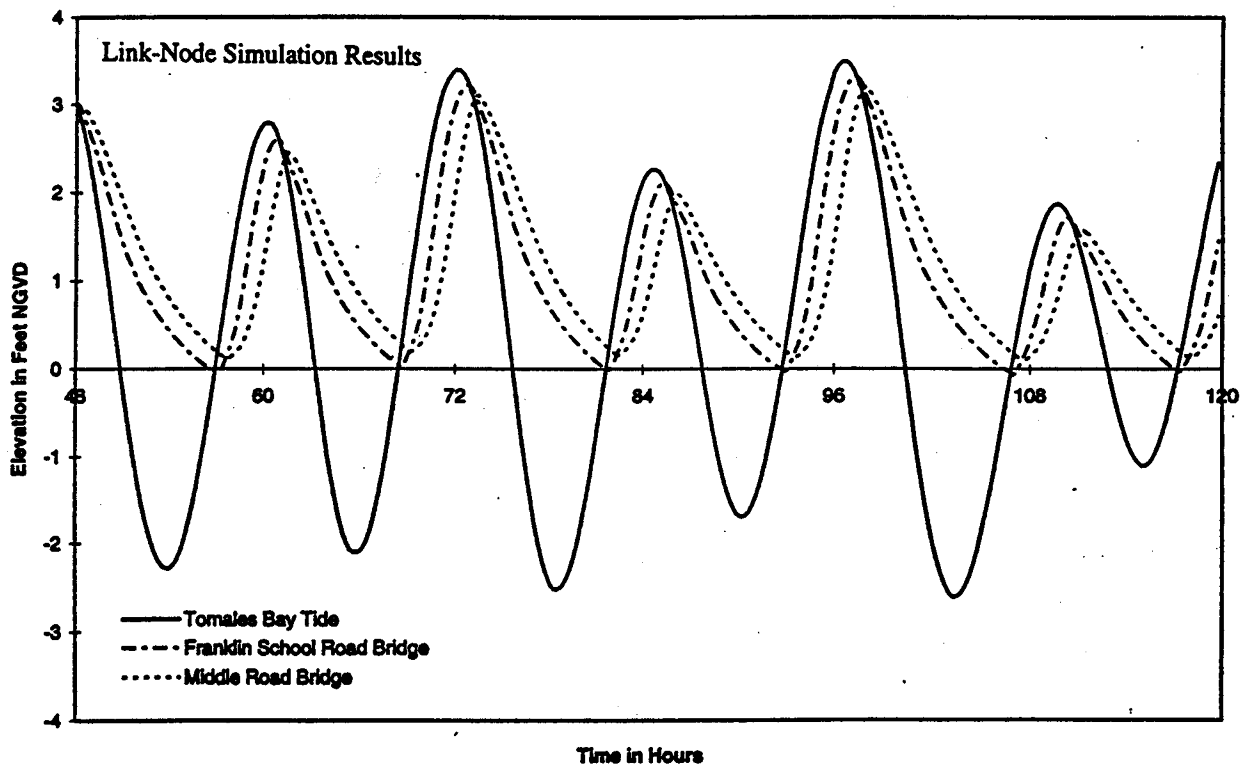


Figure 3 Computed and Observed Water Surface Elevation in the Estero de San Antonio During the Period of March 9 through 11, 1993

Entrance closure results in larger depths, much lower velocities and minimal exchange of water quality parameters at the mouth. To evaluate the effects of entrance closure on water quality, both Esteros were simulated assuming a water surface elevation of 4 feet NGVD. Four feet is the maximum elevation attained in the Estero de San Antonio during the period from March 8, 1993 to May 1, 1993 (Williams, 1993). A small elevation fluctuation was imposed at the mouth to approximate seepage through the berm as a function of tidal elevation.

The initial quality of the water trapped in the Esteros at closure will vary with the antecedent tributary inflow conditions. The effects of antecedent conditions are discussed in the Project Effects Section.

3.4 WATER QUALITY MODEL

Having generated inter-nodal flows by the hydrodynamic component of the link-node model, the temporal variability of heat (which is manifested as water temperature) and other water quality parameters can be traced through the estuary by means of the water quality component of the link-node model. The modeling approach is based on the assumption that the dynamics of heat and each chemical and biological component can be expressed by the law of conservation of either thermal energy or mass and the kinetic principle. The parameters predicted by the model are:

- Temperature
- Total Dissolved Solids (TDS)
- Ammonia as Nitrogen (NH_3-N)
- Nitrate as Nitrogen (NO_3-N)
- Phosphate as Phosphorus (PO_4-P)
- Carbonaceous biochemical oxygen demand (CBOD)
- Organic Detritus
- Dissolved Oxygen
- Phytoplankton
- Benthic Algae

With the exception of benthic algae, which is assumed affixed to the bottom, each parameter is assumed to be passively transported with the movement of water and by turbulent diffusion. The model includes heat exchange with the surface based on standard heat budget computations; uptake and release of plant nutrients by algae growth and respiration; and dissolved oxygen reaeration (surface layer only), production associated with algae growth and consumption by algae respiration and ammonia, BOD and detritus decay. Settling of phytoplankton and detritus between stratified layers and to the bottom is represented by a settling velocity subject to limitations based on flow velocity turbulence. The interactions between each parameter are depicted in Figure 4.

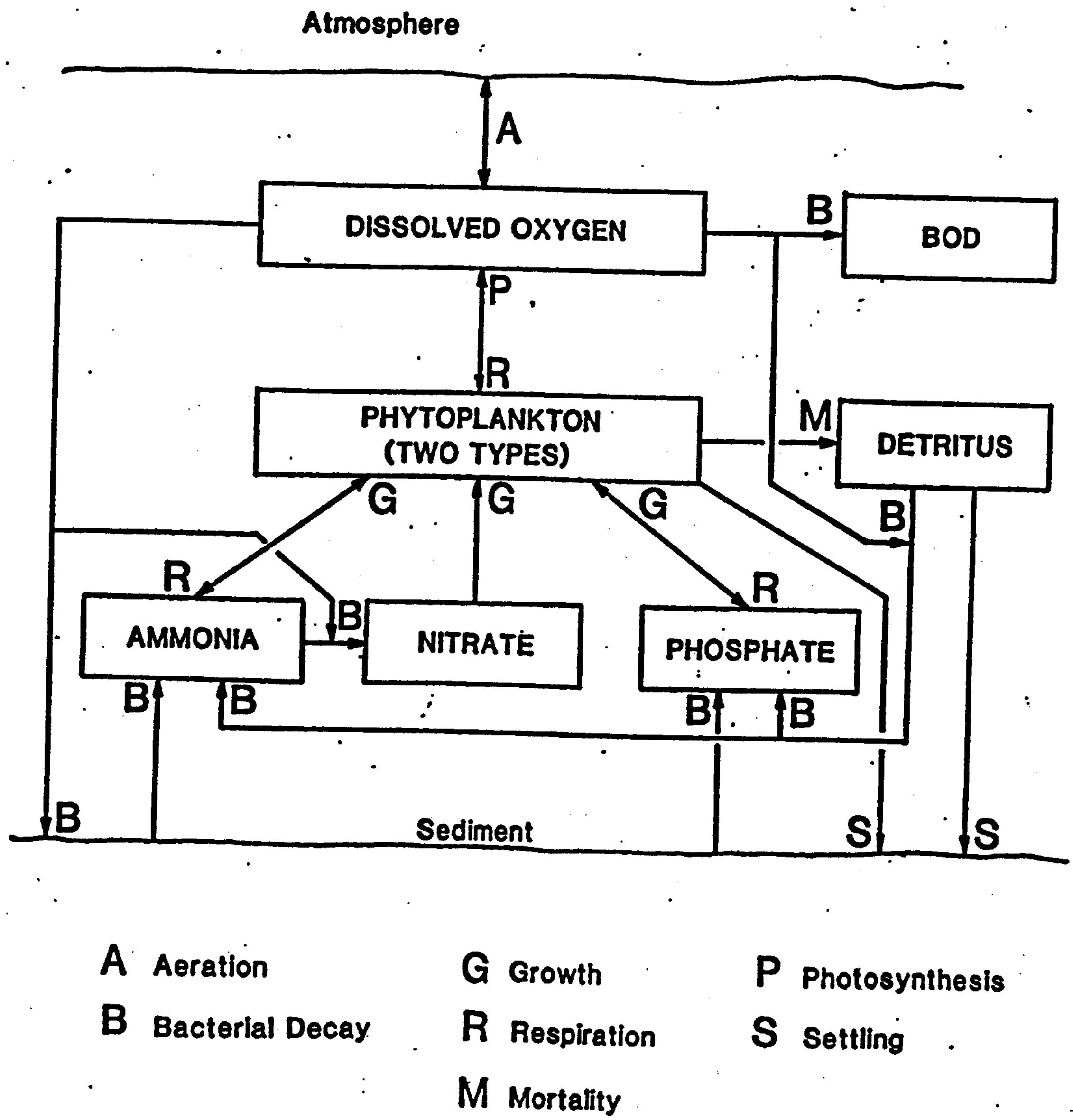


Figure 4 Interactions and Coupling Between Water Quality Parameters

3.5 METEOROLOGICAL DATA

The water quality model requires various meteorological data for the heat budget and primary productivity computations. These data requirements include dew point and dry bulb temperatures, wind speed and cloud cover at hourly intervals.

Meteorological data provided by the Bodega Marine Laboratory (BML 1995) were processed to provide all required data. The BML data consisted of air temperature, relative humidity, wind speed and solar radiation at approximately 20-minute intervals for 1992, 1993 and 1994.

The dew point temperature was computed from the vapor pressure which was computed from the saturation vapor pressure and relative humidity. The saturation vapor pressure was computed from the air temperature using well established regression relationships. The cloud cover was computed from the solar radiation and sun angle which was computed as a function of the time of day and day of the year. The night time cloud cover was assumed equal to average of the sunup and sunset cloud covers. The computed hourly meteorological data for 1992 and 1993 were averaged to provide a composite meteorological data set since these two years represent low and moderate precipitation years. Gaps in the 1994 data set precluded their inclusion in the average.

The monthly evaporation rate was computed from the BML data. The computed average rate was 2 inches +/- 1 inch exclusive of precipitation for all months. Since the marine influence decreases inland, an evaporation rate of 4 inches per month was assumed for all hydrodynamic simulations.

3.6 WATER QUALITY DATA

Water quality data are available at the upstream limits and at selected locations within both Esteros. Table 8 shows the average, minimum, and maximum of the observed data that are of modeling interest for the Estero Americano. Note that two sets of data are provided for each location. The first set is for low monthly runoff conditions and include sampling periods when the total estimated runoff is less than 3 cfs and 5 cfs for the Americano and Stemple watersheds, respectively. The second set is for moderate monthly runoff conditions and include sampling periods when the total estimated runoff ranges between 3 to 15 cfs and 5 to 20 cfs for the Americano and Stemple watersheds, respectively.

Estimates of monthly runoff were based on a regression relationship between Walker Creek monthly flows (Walker Creek is located a few miles south of the Stemple Creek watershed) and the Russian River incremental flow which was developed for the Russian River water quality analysis (see Figure 5). This relationship was then used to extrapolate the Estero inflow beyond the Walker Creek period of record.

Table 9 shows the average water quality for both Esteros. This table includes the depth of 1 percent light penetration which was computed as a function of turbidity. The Estero de San Antonio data are reported separately for open and closed entrance conditions. If there was no indication of entrance condition, the entrance was assumed open. Considerably

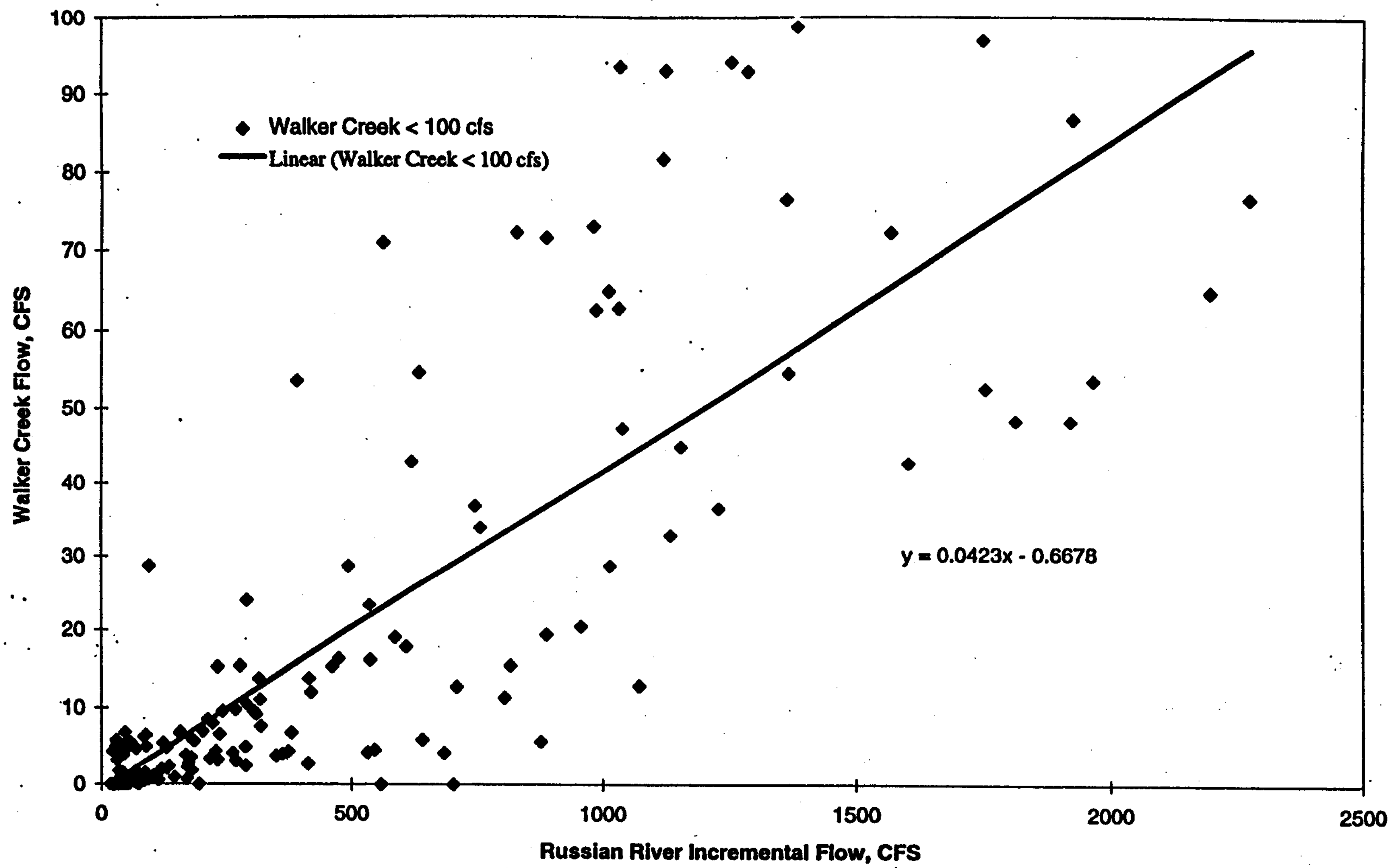


Figure 5 Relationship Between the Monthly Average Incremental Russian River Inflow and "Period of Record" Monthly Average Walker Creek Flow

fewer data are available for Stemple Creek and the Estero de San Antonio. Therefore, minimum and maximum values are not included. The average data were used to define inflow water quality concentrations and for calibration data. The flow rates assumed for model calibration were:

	Low Runoff Period cfs	Moderate Runoff Period cfs
Estero Americano	3	9
Estero de San Antonio	2.5	7.5

3.6.1 Inflow Locations and Inflow and Ocean Exchange Water Quality

The allocation of inflow to each Estero was based on watershed area. For the Estero Americano, three inflow points were assigned (see Figure 1). The percentage of the flow assigned to each and the water quality is listed below. The inflow water quality was based on data for monitoring stations E-5 and E-6 (see DWSC 1990).

The water quality of Americano Creek is degraded by the present agricultural practice. Less intensive agricultural usage in the steeper watersheds nearer the coast would likely reduce the concentrations of nutrients and phytoplankton. Therefore, the quality of QE2 and QE3 (and QS2 in the Estero de San Antonio watershed) was based on water quality data collected in less intensively managed portions of the watersheds (see *Irrigation/Storage Streams Water Quality Monitoring Results* Technical Report MSC 1996). Particular phytoplankton that prosper in fresh water environs are not necessarily compatible with saline environments. Therefore, a portion of the inflowing phytoplankton (defined as 100 times the chlorophyll *a* measurement) was converted to detritus.

The ocean boundary water quality (i.e., water which enters the Estero on the flood tide) for both Esteros was based on the observation at Station E-1.

No attempt was made to base the water quality of the inflow to the Estero de San Antonio on observed data since the available observed data were unfortunately not collected under the outflow conditions used in the analysis. Instead, the water quality of the inflow at QS1 and QS2 was assumed equal to that of QE1 and QE3, respectively. The ocean boundary and tributary water quality used in the model are shown in Table 10 (see DWSC 1990).

Table 8.

Average Minimum and Maximum Water Quality within the Estero Americano During Low and Moderate Runoff Months

Station	No. of Samples	Flow Condition	Temp °C	Salinity ppt	DO mg/L	pH	Turbid. NTU	Secchi cm	Chla µg/L	TDS mg/l	TSS mg/L	NO3-N mg/L	NH3-N mg/L	Total P mg/L	Diss P mg/L	DOC mg/L
E-1	12	Low=3 cfs	13.5	31.8	9.2	7.8	2.9	166.5	98.5		18	0.128	0.078	0.337	0.216	1.4
			9.5	27	8.2	7.2	1.7	91.5	10		4.8	0.015	0.025	0.04	0.02	0.5
			19	34.9	11.5	8.4	4.4	210	262.3		55	0.31	0.16	2.1	1.8	3.6
E-1	13	Mod=9 cfs	11.4	30.9	9	7.8	3.3	135.7	53.3		33.5	0.073	0.055	0.145	0.09	2.1
			9	6.5	7.4	7.3	1.3	15	4.1		13	0.015	0.025	0.01	0.01	0.5
			15.2	35.8	12.3	8.1	6.3	210	243.2		54	0.22	0.12	0.4	0.19	5
E-2	12	Low	13.8	32.2	8.8	7.7	4.2	129.1	68.8		17.2	0.121	0.069	0.327	0.248	1.1
			10.4	28.5	7.5	7	2.2	1	11.6		9.2	0.015	0.025	0.06	0.04	1.1
			18	35.4	10	8.3	5.8	185	206.8		36	0.33	0.14	2.1	2.1	1.1
E-2	13	Mod	12.5	29.3	8.7	7.6	18.2	93.9	66.8		28.8	0.14	0.101	0.197	0.126	
			8.8	4.8	6.8	6.8	1.9	15	9		14	0.015	0.025	0.01	0.01	
			18.5	33.9	10.4	8.1	78	200	197.4		53	0.43	0.39	0.56	0.44	
E-3	12	Low	15.8	32.4	8.1	7.8	12.2	71.1	54.6		35.8	0.107	0.088	0.324	0.264	2
			10.5	30	6.1	7.3	3.6	30	13.8		8	0.015	0.025	0.08	0.05	0.5
			21	35.7	10	8.3	25	120	134.3		68	0.2	0.19	2.2	2	5.5
E-3	13	Mod	14.5	29.4	8.4	7.8	14	61.9	59.3		75.8	0.178	0.183	0.398	0.211	6.3
			9.5	0.7	6.5	6	3.2	20	3.7		18	0.015	0.025	0.1	0.01	0.5
			22	35	9.5	8.5	62	134	170.5		180	0.76	1.1	1.1	0.92	28

Table 8.

Average Minimum and Maximum Water Quality within the Estero Americano During Low and Moderate Runoff Months

Station	No. of Samples	Flow Condition	Temp °C	Salinity ppt	DO mg/L	pH	Turbid. NTU	Secchi cm	Chla µg/L	TDS mg/l	TSS mg/L	NO3-N mg/L	NH3-N mg/L	Total P mg/L	Diss P mg/L	DOC mg/L
E-4	12	Low	18.3	32.1	7.7	7.8	23.5	44.9	323.8		57	0.143	0.236	0.472	0.371	6.6
			9.5	26.2	6.1	7.5	12	20	21		18	0.015	0.01	0.1	0.09	6.6
			26	38.8	10.8	8.2	37	85	1279.1		110	0.42	0.73	2.1	2.1	6.6
E-4	12	Mod	14.9	22.1	6.9	7.7	31.2	39.5	299.7		192	0.505	1.312	1.022	0.733	
			8	10.5	4.8	6.9	8.6	10	20.2		16	0.015	0.025	0.1	0.1	
			23	35	11.6	8.2	92	75	1396.9		460	1.5	4.8	2.4	1.9	
E-5	14	Low	17.2	29.3	8.3	7.8	30.7	39.3	813.1	30022	63.6	0.271	0.511	1.359	0.724	8
			9.5	0.5	4.7	6.8	17	20	60.5	680.0	12	0.015	0.025	0.29	0.13	5.2
			25	38.5	12.5	8.5	60	110	2700	47000	130	1.4	3.3	4.3	3.5	11
E-5	14	Mod	14.3	16.2	7.6	7.6	41.3	25.3	994.3	17518	274	0.556	2.355	1.719	1.114	18.9
			7	5	3.3	6.9	17	5	56.3	360.0	47	0.015	0.025	0.29	0.2	6.2
			23	34.3	16.8	8.7	120	65	5553	48000	730	1.4	10	3.7	2.4	42
E-6	9	Low	16.3	1.1	8.7	7.9	190.5		8245.0	1144	54.8	1.444	10.666	10.875	3.879	41.8
			11.7	0.2	2.7	7	14		153.4	400.0	13	0.015	0.49	3.2	0.93	26
			25.5	3.2	20	9.4	999		32731	4100.0	130	3.2	61	44	7.8	64
E-6	13	Mod	15.2	0.7	8.1	8	135	9	13625	1014	404	1.148	39.785	8.792	6.023	63.3
			8.9	0.2	1.2	7.3	15	9	359.4	350.0	36	0.015	1.5	3.2	2.2	20
			23.5	1.2	20	9.8	999	9	109532	2160	1200	7.8	268	19	13	150

Table 9.

Average, Minimum and Maximum Observed Water Quality within the Estero Americano and Estero de San Antonio

During Low and Moderate Runoff Months

Station	no. of Samples	Flow Condition	Temp °C	Salinity ppt	DO mg/L	pH	1% Light m	Chl-a µg/L	TDS mg/L	TSS mg/L	NO3-N mg/L	NH3-N mg/L	Total P mg/L	Diss P mg/L	DOC mg/L
Americano Creek / Estero Americano[a]															
E-1	12	Low=3cfs	13.5	31.8	9.2	7.8	3.3	98.5	0	18	0.128	0.078	0.337	0.216	1.4
E-1	13	Mod=9cfs	11.4	30.9	9	7.8	2.7	53.3	0	33.5	0.073	0.055	0.145	0.09	2.1
E-2	12		13.8	32.2	8.8	7.7	2.6	68.8	0	17.2	0.121	0.069	0.327	0.248	1.1
E-2	13		12.5	29.3	8.7	7.6	1.9	66.8	0	28.8	0.14	0.101	0.197	0.126	0
E-3	12		15.8	32.4	8.1	7.8	1.4	54.6	0	35.8	0.107	0.088	0.324	0.264	2
E-4	12		18.3	32.1	7.7	7.8	0.9	323.8	0	57	0.143	0.236	0.472	0.371	6.6
E-4	12		14.9	22.1	6.9	7.7	0.8	299.7	0	192	0.505	1.312	1.022	0.733	0
E-5	14		17.2	29.3	8.3	7.8	0.8	813.1	30021.5	63.6	0.271	0.511	1.359	0.724	8
E-5	14		14.3	16.2	7.6	7.6	0.5	994.3	17517.8	274	0.556	2.355	1.719	1.114	18.9
E-6	9		16.3	1.1	8.7	7.9	0	8245	1144.4	54.8	1.444	10.666	10.875	3.879	41.8
E-6	13		15.2	0.7	8.1	8	0.2	13625.6	1014.5	404	1.148	39.785	8.792	6.023	63.3

Table 9. Continued

Average, Minimum and Maximum Observed Water Quality within the Estero Americano and Estero de San Antonio

During Low and Moderate Runoff Months

Station	no. of Samples	Flow Condition	Temp °C	Salinity ppt	DO mg/L	pH	1% Light m	Chl-a µg/L	TDS mg/L	TSS mg/L	NO3-N mg/L	NH3-N mg/L	Total P mg/L	Diss P mg/L	DOC mg/L
Stemple Creek /Estero de San Antonio (Entrance Open)															
S-2	3	Low=2.5 cfs	15.2	28.5	8.2	8.3	3.0	2.2	0	16.0	0.022	0.082	1.380	1.233	5.1
S-2	3	Mod=7.5 cfs	12.5	23.7	5.8	7.9	2.7	6.0	0	24.1	0.095	0.313	0.273	0.330	2.0
S-4	8		17.5	25.0	7.9	8.3	2.7	3.4	28000	41.4	0.086	1.344	2.063	1.697	26.0
S-4	8		16.8	13.0	7.2	8.0	2.3	24.5	20000	14.8	0.390	0.575	0.982	0.658	14.0
S-6	3		16.4	24.7	11.5	8.7	2.4	96.7	0	30.5	0.032	0.470	2.033	1.593	24.0
S-6	3		12.9	16.7	3.7	7.6	2.3	25.8	0	28.3	0.238	1.693	1.577	1.130	12.9
S-8	2		14.0	0.2	9.1	7.8	3.6	0.0	360	44.5	1.508	1.035	1.700	1.085	16.0
S-8	2		12.4	0.0	9.6	7.8	2.3	16.4	480	10.1	0.075	0.068	0.460	0.435	14.0
Stemple Creek/Estero de San Antonio (Entrance Closed)															
S-2	2	Low=4 cfs	15.4	18.2	8.7	8.3	2.7	6.7	0	14.1	0.087	0.025	1.370	1.240	0.0
S-2	1	Mod=9 cfs	17.0	16.4	7.6	8.4	2.6	12.5	0	5.6	0.070	0.050	1.600	1.400	0.0
S-4	2		15.7	15.6	5.9	8.3	2.3	6.1	0	13.8	0.235	0.130	1.550	1.485	17.5
S-4	1		16.5	13.4	9.1	8.8	2.2	27.1	0	14.0	0.015	0.050	2.100	1.900	20.0
S-6	2		16.6	13.5	11.6	8.9	1.9	125.8	0	25.0	0.015	0.065	2.050	1.650	22.5
S-6	1		18.0	11.3	16.5	9.3	2.3	168.6	0	24.0	0.015	0.050	2.500	2.200	26.0

Table 9. Continued

Average, Minimum and Maximum Observed Water Quality within the Estero Americano and Estero de San Antonio

During Low and Moderate Runoff Months

Station	no. of Samples	Flow Condition	Temp ºC	Salinity ppt	DO mg/L	pH	1% Light m	Chl-a µg/L	TDS mg/L	TSS mg/L	NO3-N mg/L	NH3-N mg/L	Total P mg/L	Diss P mg/L	DOC mg/L
S-8	1		17.0	0.2	9.5	8.6	3.6	0.0	390	53.0	0.015	0.170	1.000	0.570	16.0
S-8	0		0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.00	0.000	0.000	0.000	0.0

[a] Reflects bar-open conditions only. No monitoring of Estero Americano has been conducted under bar-closed conditio

Table 10.

Ocean Exchange and Tributary Inflow Water Quality Used
in Estero Americano and Estero de San Antonio Model Calibration

Hydrology	% Area[a]	TDS mg/L	NO3-N mg/L	PO4-P mg/L	Detritus mg/L	BOD mg/L	NH3-N mg/L	DO mg/L	Temp °C	Phyto mg/L
Low Flow		32000	0.13	0.22	4	2	0.075	9	13.5	8
Moderate Flow		31000	0.05	0.06	5	3	0.025	9.5	11.5	4
Tributary Inflows Low Runoff Period										
Location										
QE1	57	1100	1.8	1.6	45	10	2	8	16	60
QE2	22	700	1.5	1.2	30	8	1.2	8	16	30
QE3	21	400	1.2	1	15	5	0.5	8	16	15
Total	100									
QS1	80	1100	1.4	1.6	45	10	2	8	16	60
QS2	20	400	0.8	1	15	5	0.5	8	16	15
Total	100									
Tributary Inflows Moderate Runoff Period										
QE1	57	700	1.3	1.8	75	18	5	8	15	45
QE2	22	500	1.1	1.5	50	12	3	8	15	30
QE3	21	300	0.9	1.2	25	6	1	8	15	15
Total	100									
QS1	80	700	1.3	1.8	75	18	5	8	15	45
QS2	20	330	0.9	1.2	25	6	1	8	15	15
Total	100									

[a] QE and QS represent tributary inflows in Estero Americano and Estero San Antonio, respectively (locations shown in Figure 1). The fraction of each watershed drained by each tributary is shown in this column.

3.6.2 Calibration Periods

Calibration was performed for low monthly and moderate monthly runoff conditions that correspond to the watershed impacts model simulation periods. The low runoff period was assumed typical of June conditions. The length of the day during June maximizes the growth potential for phytoplankton and benthic algae. Later in the summer, inflow diminish to the point where it has little effect on water quality. The moderate runoff period was assumed typical of April conditions. April is the last month when moderate inflows would normally be expected. The length of the daylight period during April maximizes the plant growth potential and related water quality effects. Calibration and impacts simulation was not done for high winter inflow conditions because such flows dominate the Esteros such that water quality in most of each Estero is that of the inflowing stream.

3.6.3 Estero Americano Calibration

The average tide and entrance condition simulated during model calibration were used for all model calibration simulations under bar-open conditions. Insufficient data are available upon which to base a calibration under bar-closed conditions. The results of the Estero Americano model calibration exercise are presented on Figures 6 through 12. The results are presented as profiles of observed and computed water quality along the length of the Estero. Each figure contains the results for the low runoff (top graph) and moderate runoff (bottom graph) hydrologic conditions. The square symbols in Figures 6 through 12 correspond to the average observed data shown on Table 9. Figures 6 through 12 show three lines and square points. The three lines represent the computed daily maximum, average and minimum values, and the square points represent observed data under similar inflow conditions.

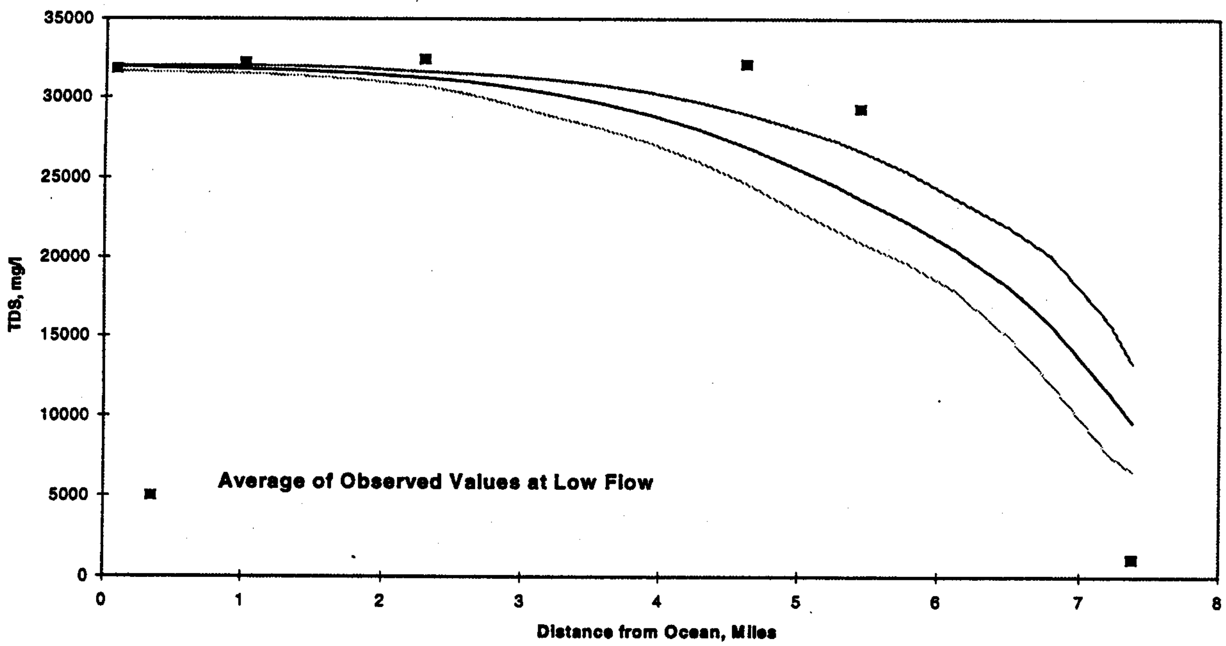
The model was calibrated to reproduce the average trends of the observed water quality data. The variations in observed water quality seen in Table 9 reflect variations in inflow quality, inter-tidal variations, and tributary inflow. The calibration results reflect only inter-tidal effects and stratification. Therefore, the computed and observed extremes are not directly comparable. However, the variations in observed data provide an indication of the range in concentration that might be expected.

The ammonia nitrogen plot (Figure 8) for the moderate flow condition truncates the upper reach of the Estero. This was done to provide detail in the lower Estero and maintain a consistent scale set. The ammonia concentrations in the upper Estero are extremely high and reflect poor watershed agricultural practice.

The abundance of inorganic nitrogen and phosphorus and the large variation in chlorophyll *a* measurements indicate a large potential for algae blooms. At the prevailing concentrations of plant nutrients, phytoplankton growth in the model is limited only by the availability of light and the flow through rate (i.e., hydraulic residence time).

The model predicted large diurnal variations in dissolved oxygen in the upper reaches similar to those observed in the data. The minimum oxygen values reflect the effects of nocturnal respiration and stratification. The maximum stratification occurs in the area of maximum salinity gradient. Therefore, the point of maximum stratification moves upstream as the flow decreases. However, the Esteros are shallower at their upper reaches and the potential for stratification decreases as depth decreases. The minimum and maximum salinity values in the appendix tables include the effects of stratification.

The calibration results seen on Figures 6 through 12 demonstrate that the model reproduces the magnitude and trends seen in the average of the observed data. In nearly all instances, the computed average and daily fluctuations are within the range of values seen in the data presented in Table 9.



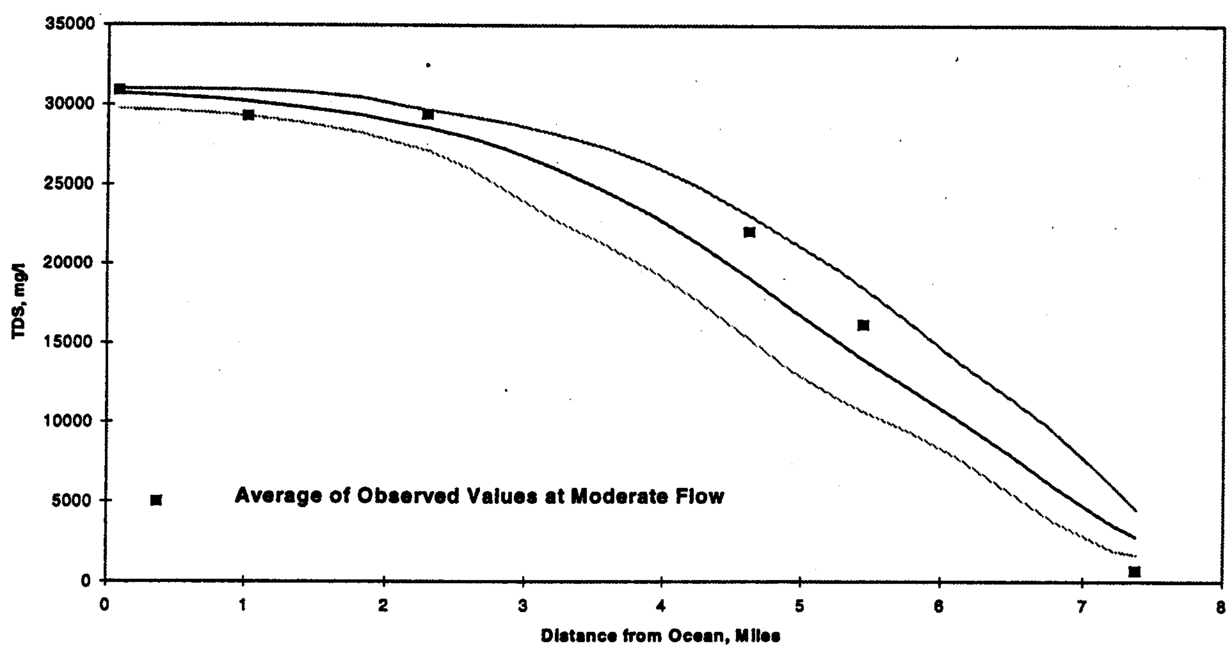
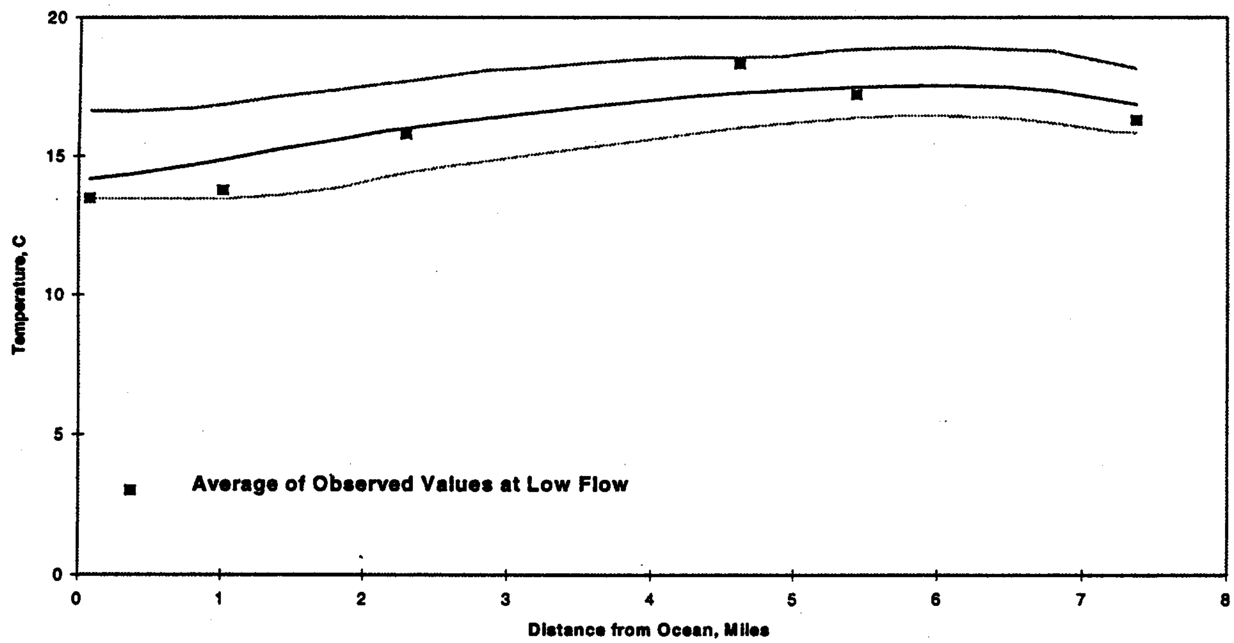


Figure 6 Profiles of Average Observed and Computed Average and Daily Extremes in TDS the Estero Americano for Low and Moderate Inflow Conditions



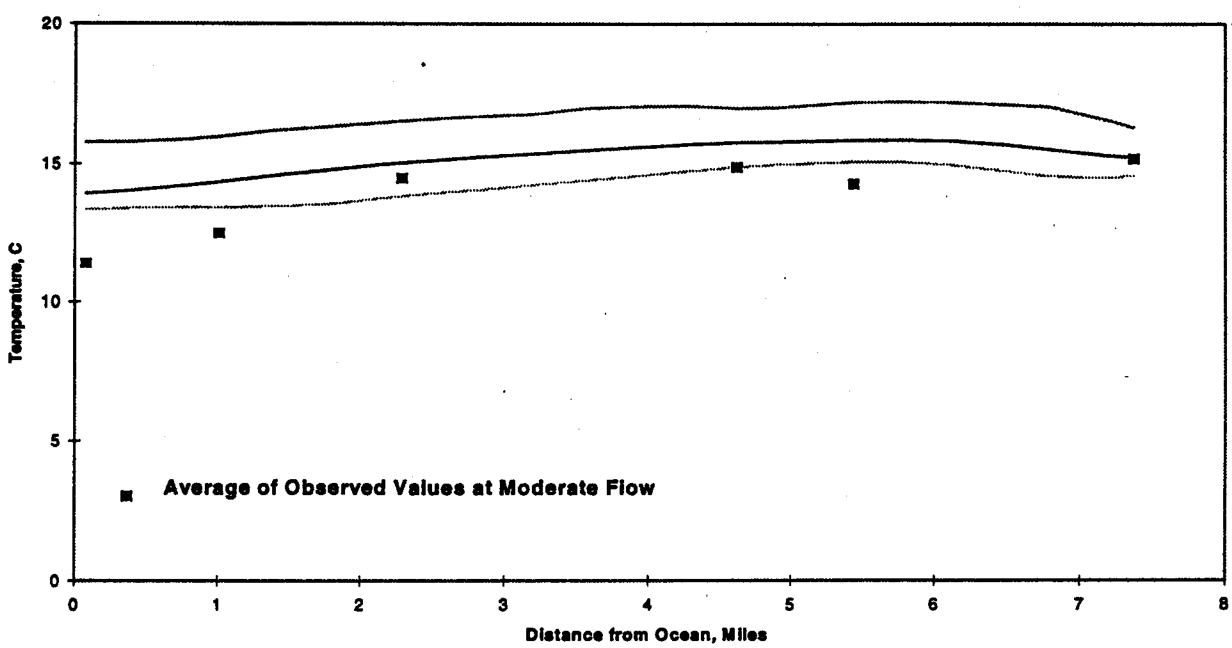
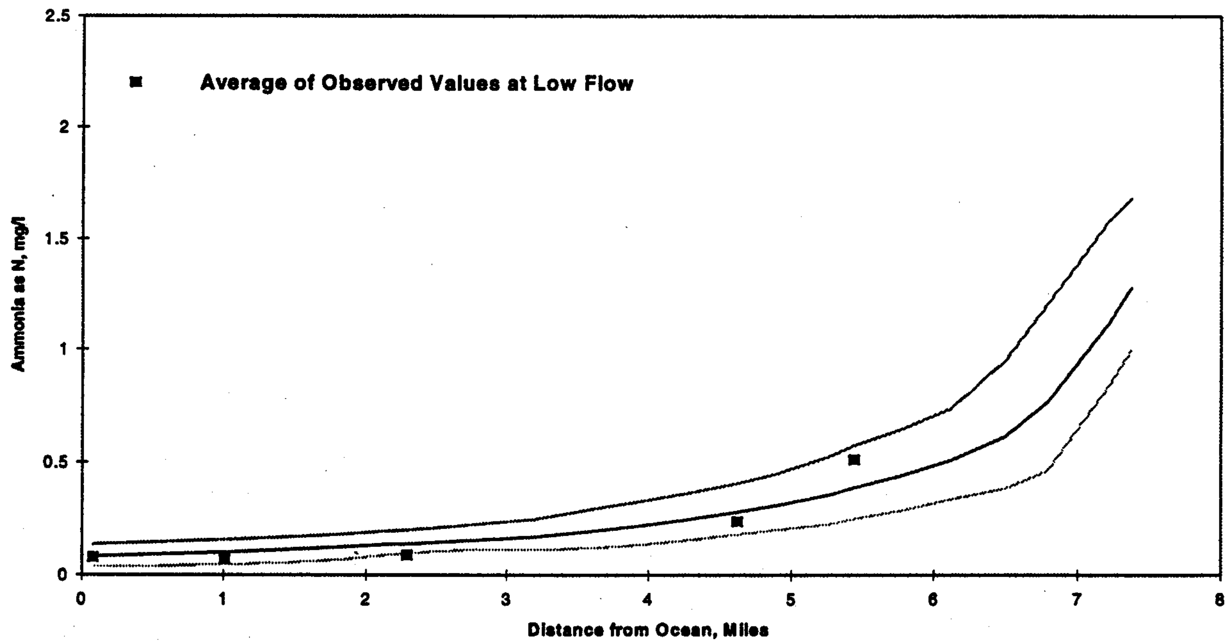


Figure 7 Profiles of Average Observed and Computed Average and Daily Extremes in Temperature in the Estero Americano for Low and Moderate Inflow Conditions



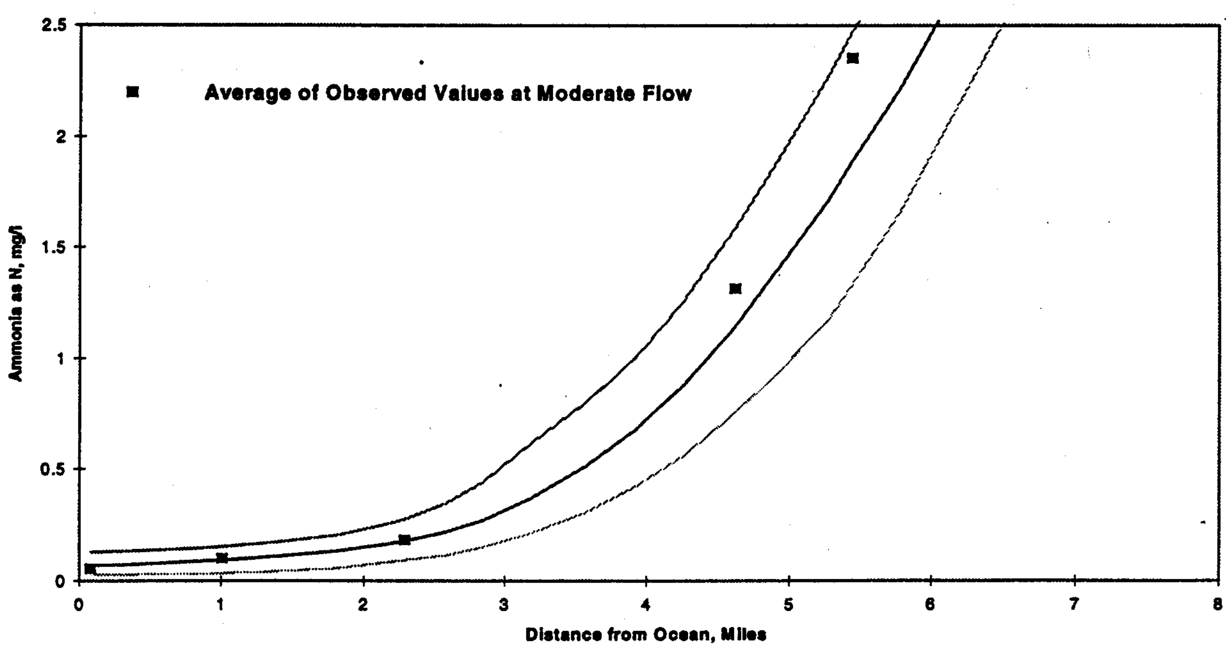
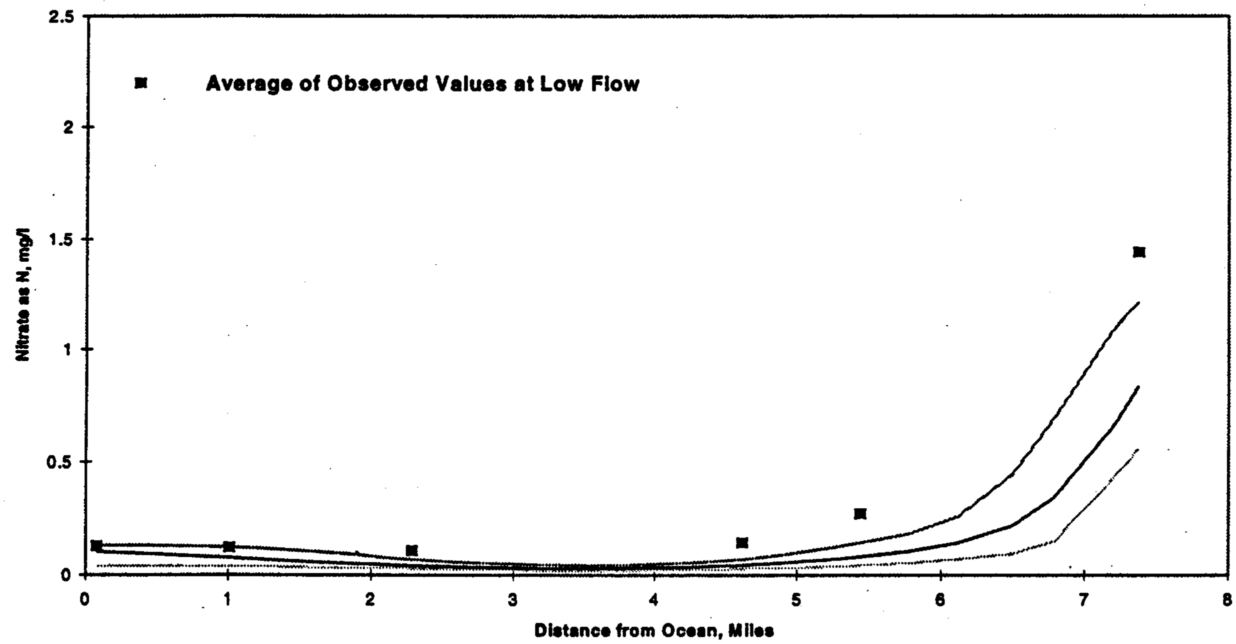


Figure 8 Profiles of Average Observed and Computed Average and Daily Extremes of Ammonia in the Estero Americano for Low and Moderate Inflow Conditions



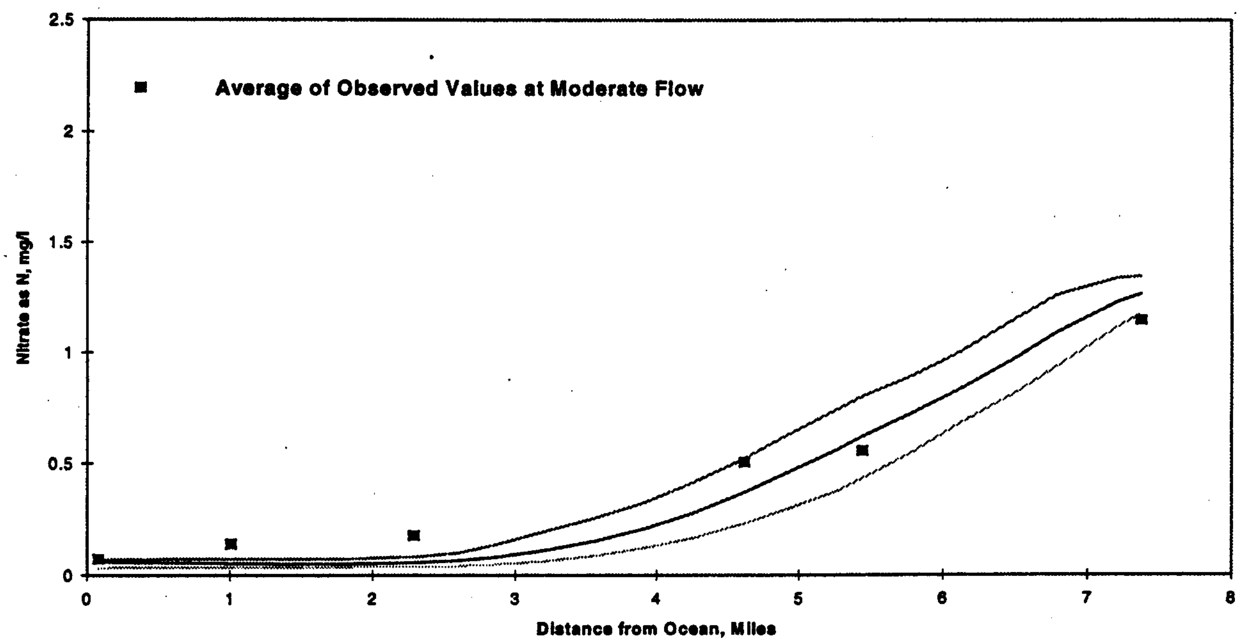
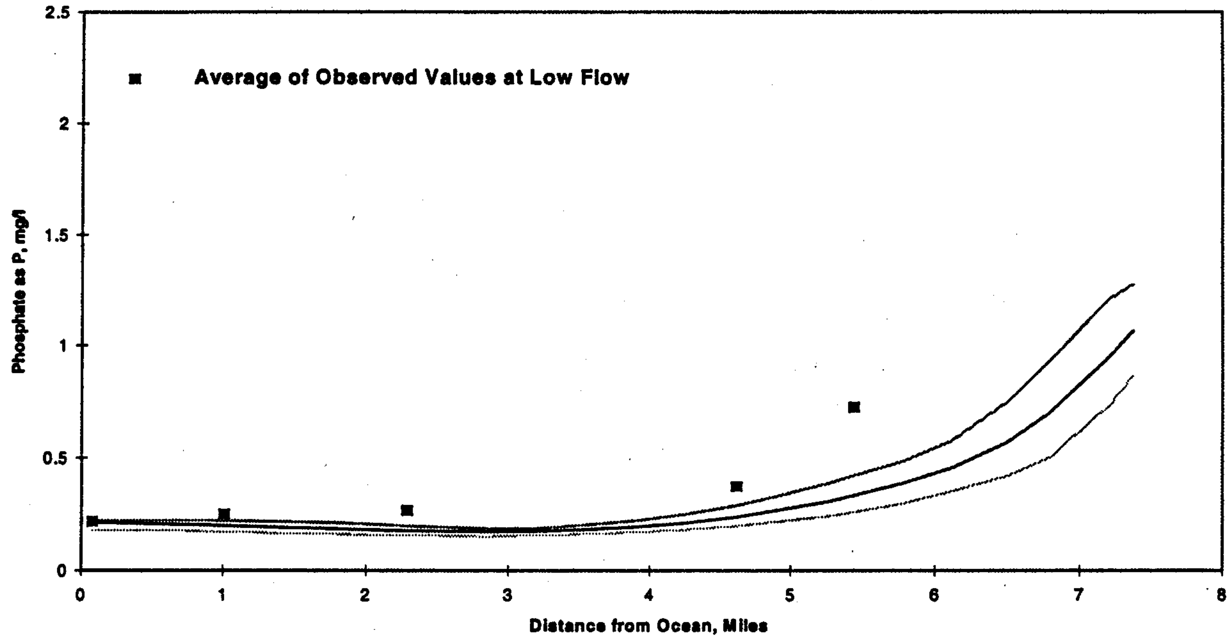


Figure 9 Profiles of Average Observed and Computed Average and Daily Extremes of Nitrate in the Estero Americano for Low and Moderate Inflow Conditions



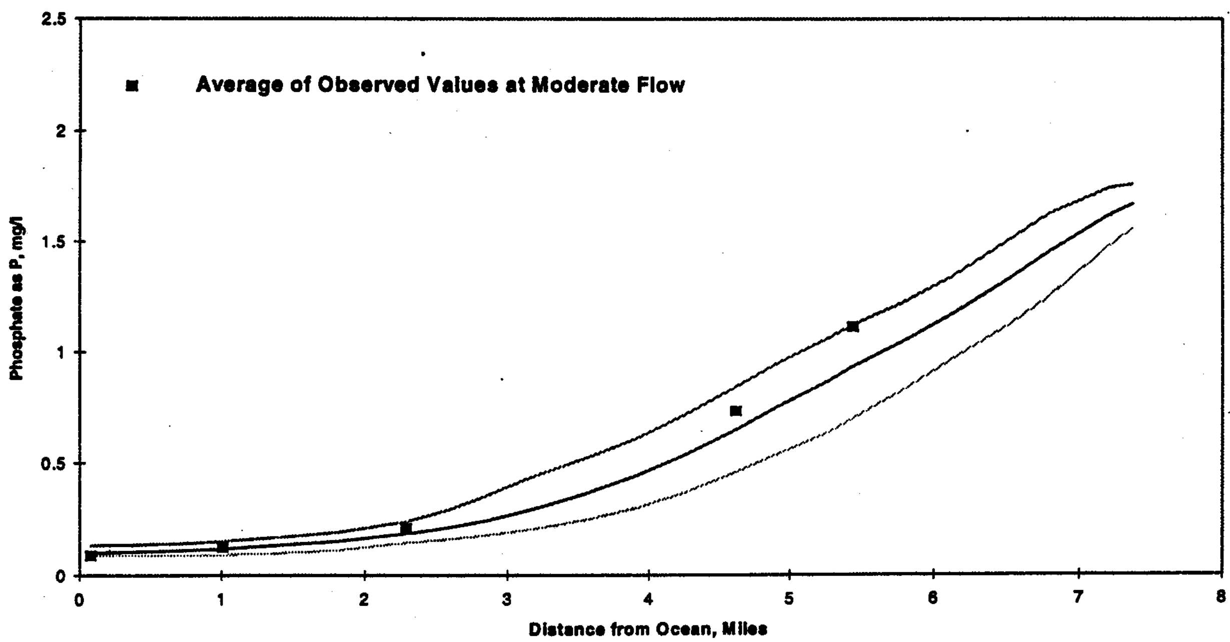


Figure 10 Profiles of Average Observed and Computed Average and Daily Extremes of Phosphate in the Estero Americano for Low and Moderate Inflow Conditions

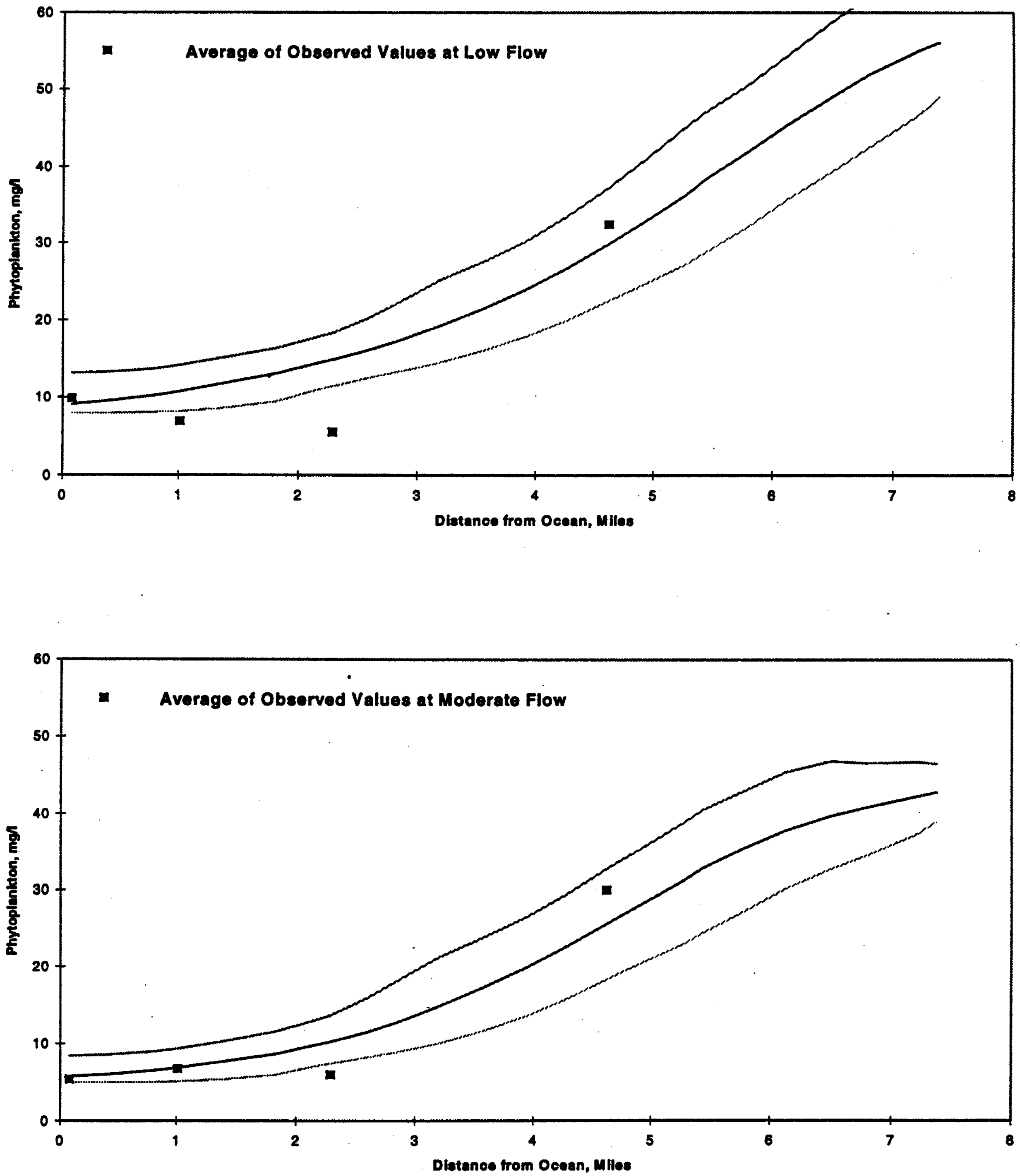


Figure 11 Profiles of Average Observed and Computed Average and Daily Extremes of Phytoplankton in the Estero Americano for Low and Moderate Inflow Conditions

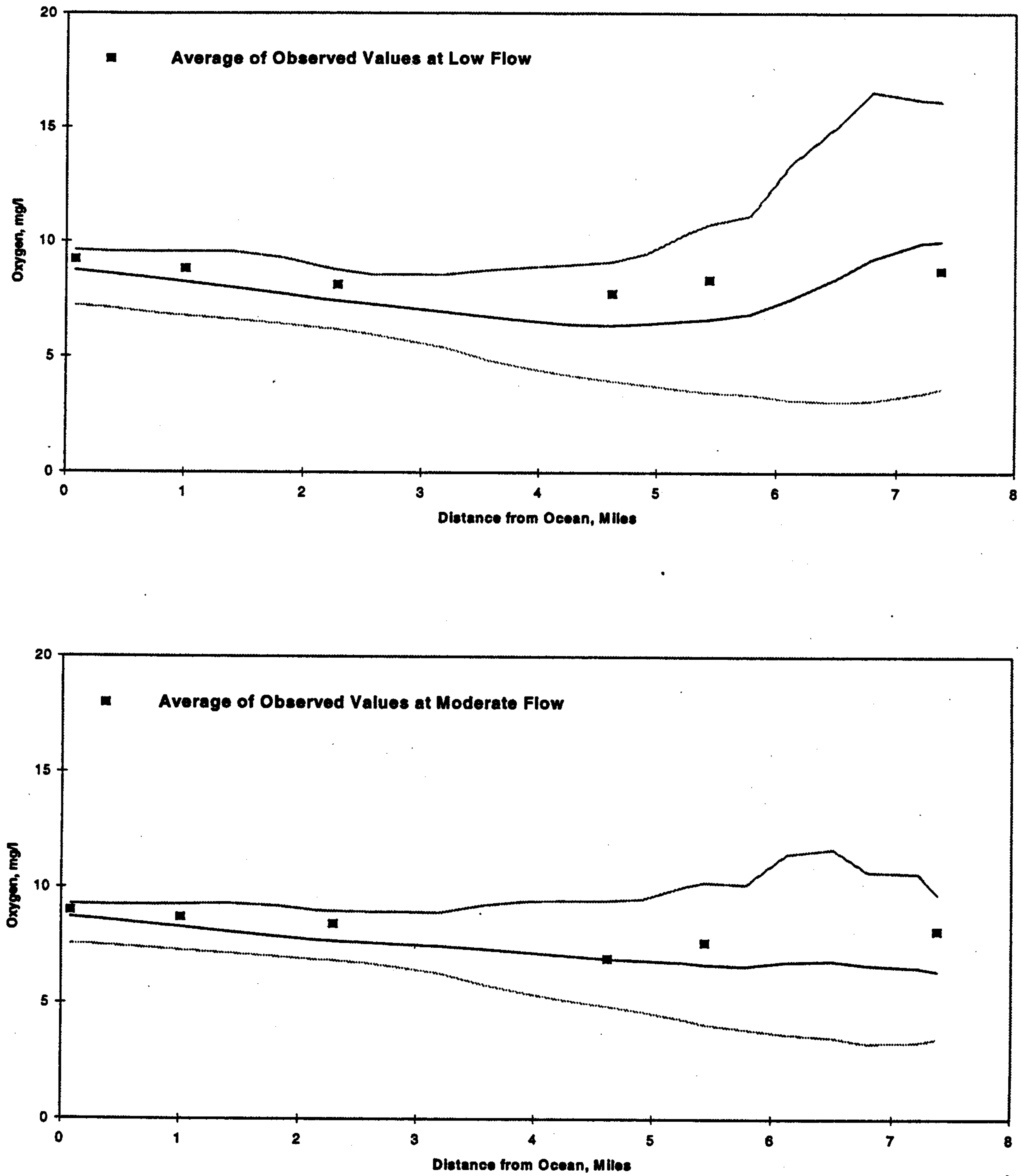


Figure 12 Profiles of Average Observed and Computed Average and Daily Extremes of Oxygen in the Estero Americano for Low and Moderate Inflow Conditions

3.6.4 Estero de San Antonio Calibration

The results of the Estero de San Antonio model calibration under bar-open conditions are presented on Figures 13 through 19. The results are presented as profiles similar to those presented for the Estero Americano.

The Estero de San Antonio bar-open calibration was less rigorous due to smaller observed data set. In the following sections, the limitations of the calibration are addressed. Insufficient data are available upon which to base a calibration under bar-closed conditions.

3.6.4-1 Total Dissolved Solids

The concentration trends seen in the data are generally reproduced by the model. However, the reverse salinity gradient seen in the moderate flow case (see Figure 13) cannot be reproduced by the model unless flows are allowed to vary during the simulation. Under uniform inflow conditions, the model will always predict an increase in salinity towards the ocean unless evaporation creates a reversal in the net flow.

3.6.4-2 Ammonia Nitrate Nitrogen

The model will always predict a decline in ammonia and nitrate concentration from the headwater to the ocean due to high concentrations of the inflow and low concentrations at the ocean boundary. Therefore, no attempt was made to reproduce the high concentration

at mile 3 during the low flow period and the low concentration at the upstream end (S-8) during the moderate flow period. The low concentrations at S-8 are inconsistent with the concentration in the lower Estero.

3.6.4-3 Phosphate Phosphorus

The model will always predict a decline in phosphate concentration from the headwater to the ocean due to high concentrations of the inflow and low concentrations at the ocean boundary. The observed phosphorus concentration is well above the simulated for the low flow case and cannot be matched without a large area source rate. Both the observed data and simulation results indicate that phosphorus is not limiting for plant growth; therefore no attempt was made to refine the calibration results.

3.6.4-4 Phytoplankton

The model predicts much higher phytoplankton levels than suggested by the chlorophyll *a* data. The abundance of plant nutrients in the water and high clarity indicate a large potential for algae blooms not observed in the field data. To reduce the phytoplankton concentration to observed levels, much lower water transparencies would be required. Lower water transparencies are not indicated by the secchi disk data. Thus, the model does not calibrate well for phytoplankton in Estero de San Antonio. The phytoplankton estimates for Estero de San Antonio represent a potential condition that may not occur.

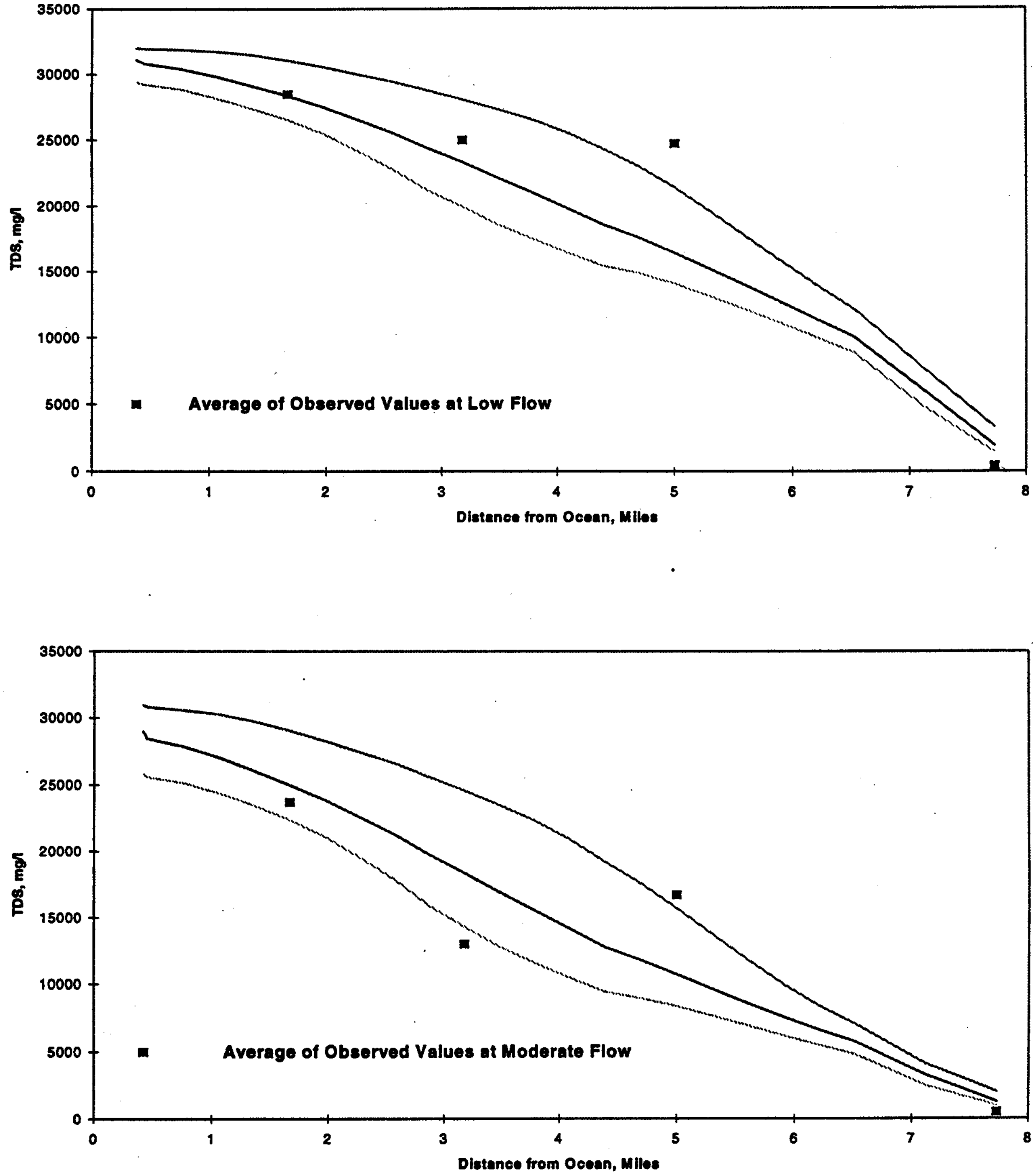
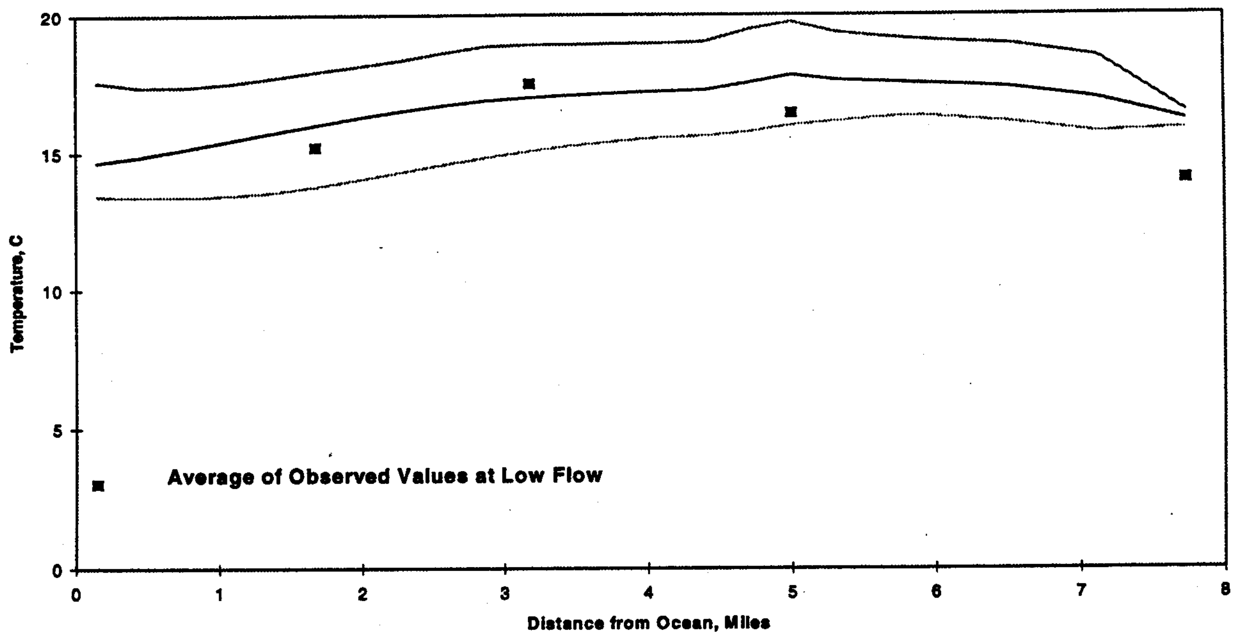


Figure 13 Profiles of Average Observed and Computed Average and Daily Extremes in TDS the Estero de San Antonio for Low and Moderate Inflow Conditions



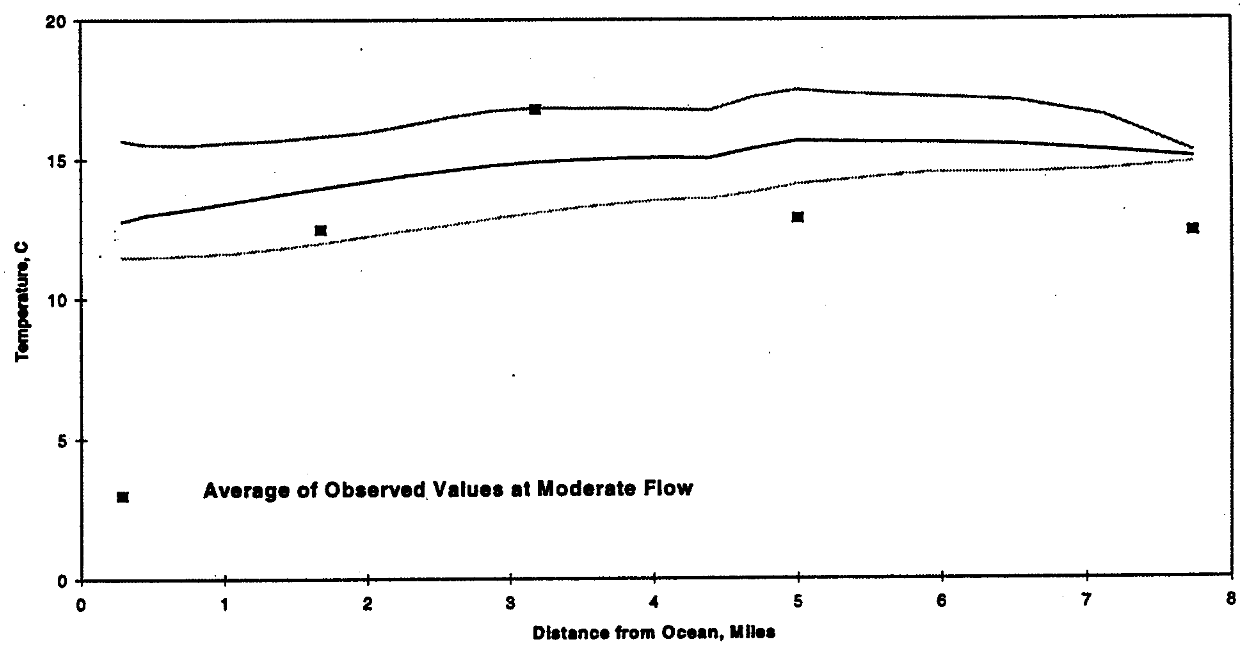


Figure 14 Profiles of Average Observed and Computed Average and Daily Extremes in Temperature in the Estero de San Antonio for Low and Moderate Inflow Conditions

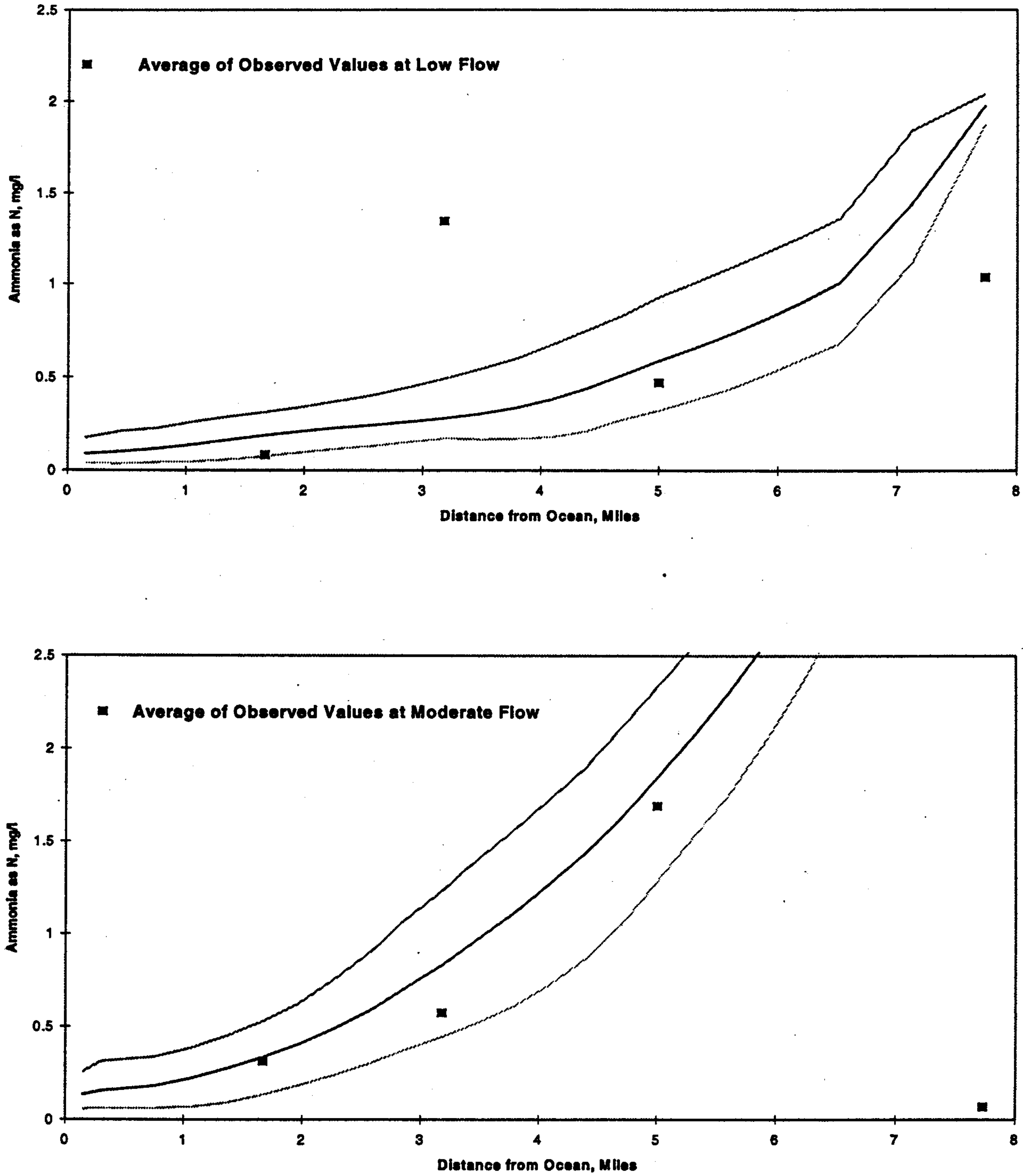


Figure 15 Profiles of Average Observed and Computed Average and Daily Extremes of Ammonia in the Estero de San Antonio for Low and Moderate Inflow Conditions

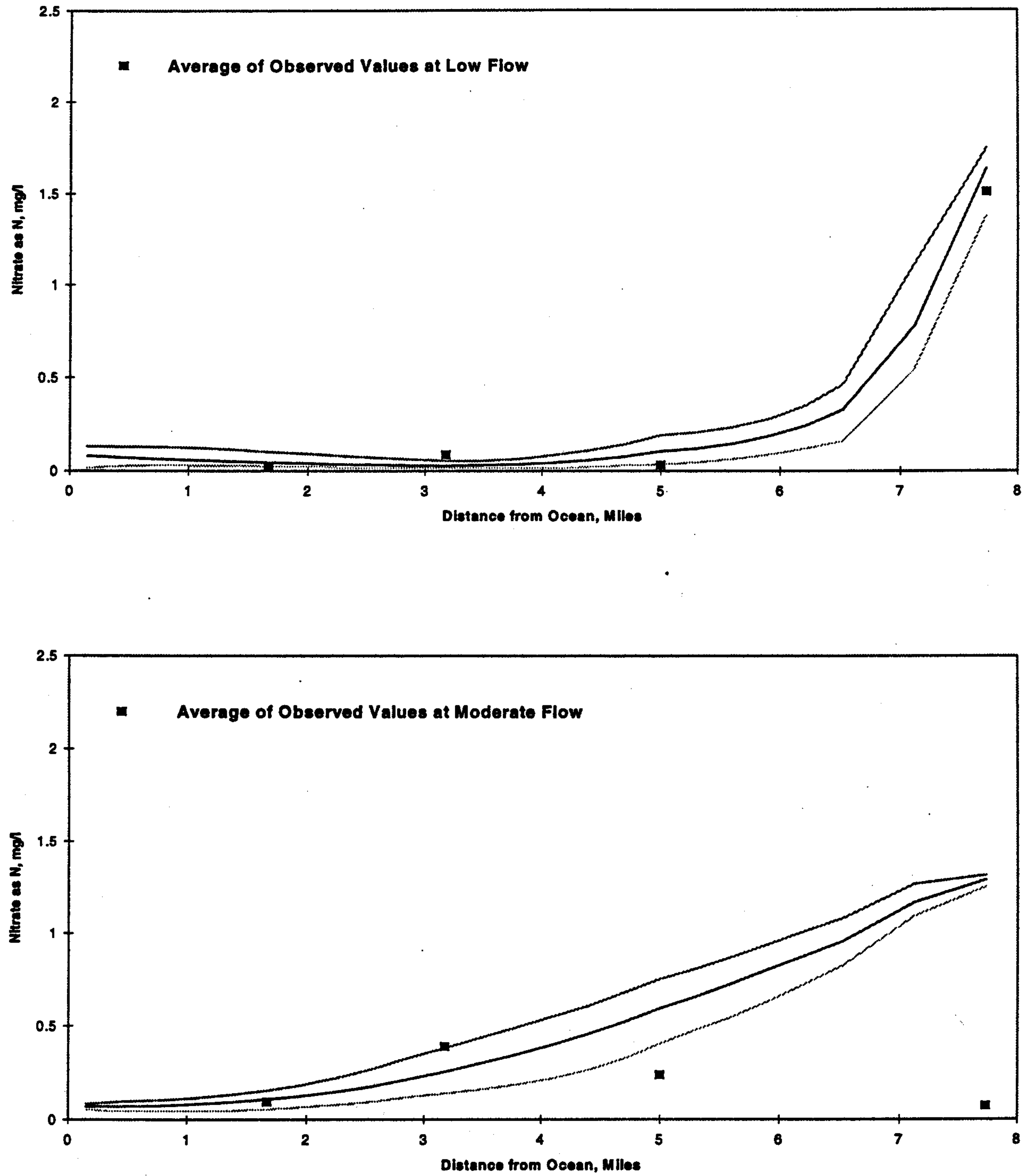


Figure 16 Profiles of Average Observed and Computed Average and Daily Extremes of Nitrate in the Estero de San Antonio for Low and Moderate Inflow Conditions

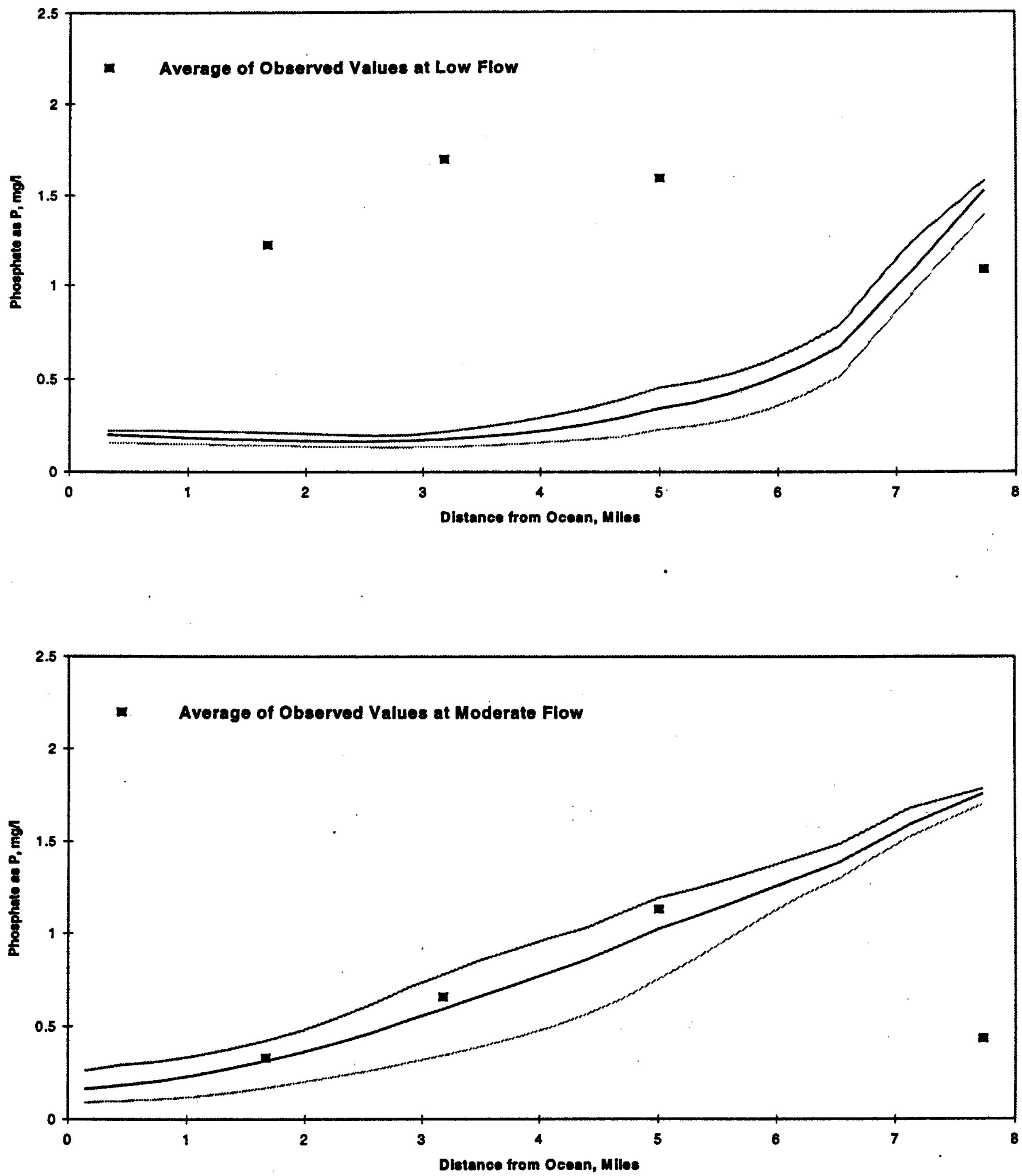


Figure 17 Profiles of Average Observed and Computed Average and Daily Extremes of Phosphate in the Estero de San Antonio for Low and Moderate Inflow Conditions

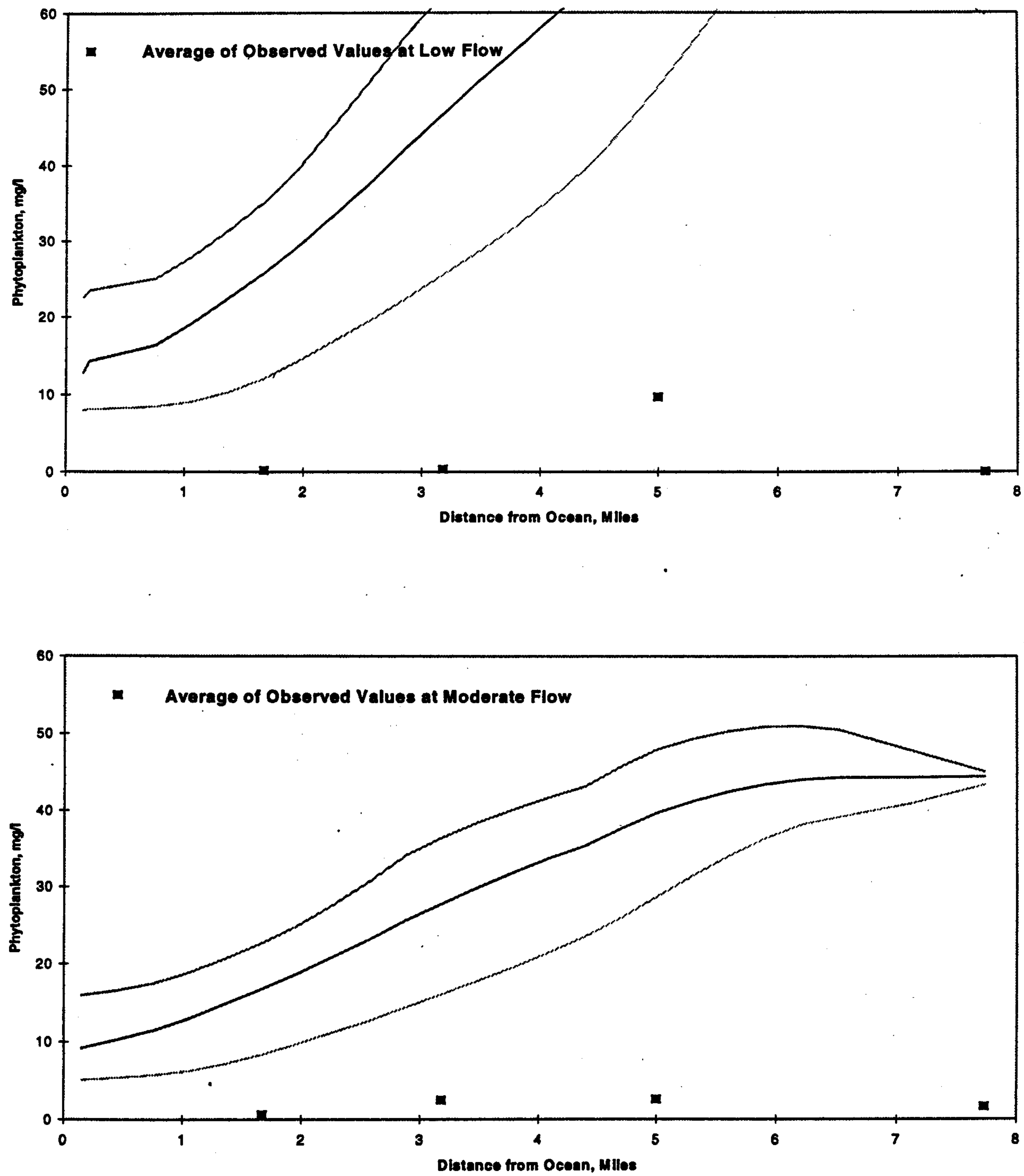
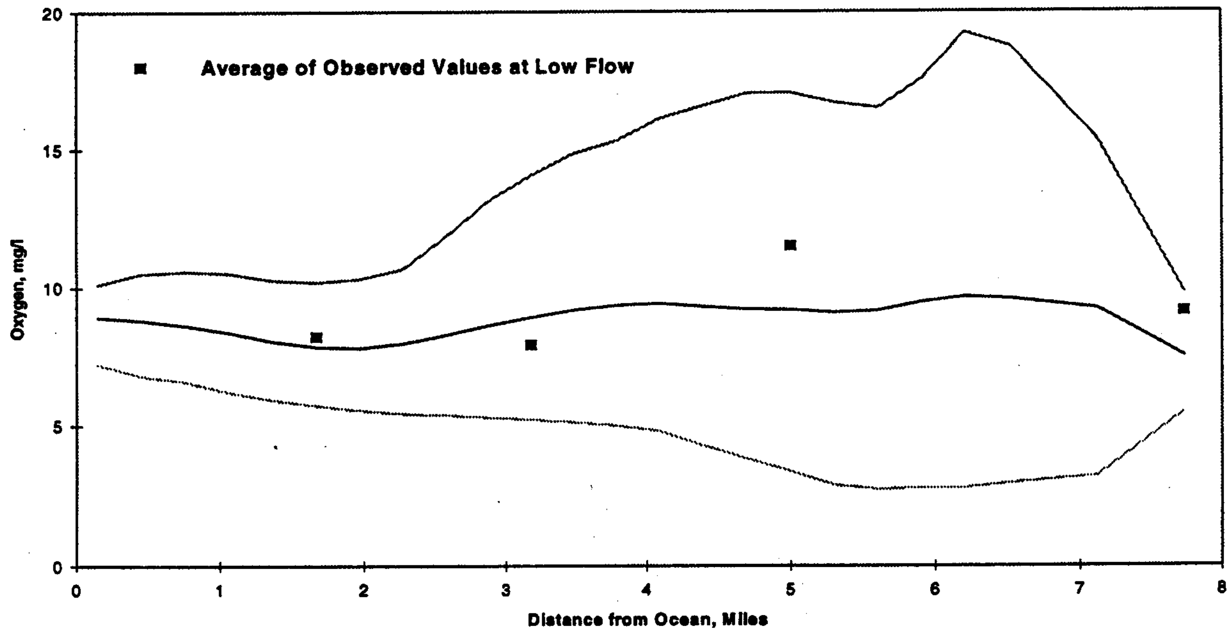


Figure 18 Profiles of Average Observed and Computed Average and Daily Extremes of Phytoplankton in the Estero de San Antonio for Low and Moderate Inflow Conditions



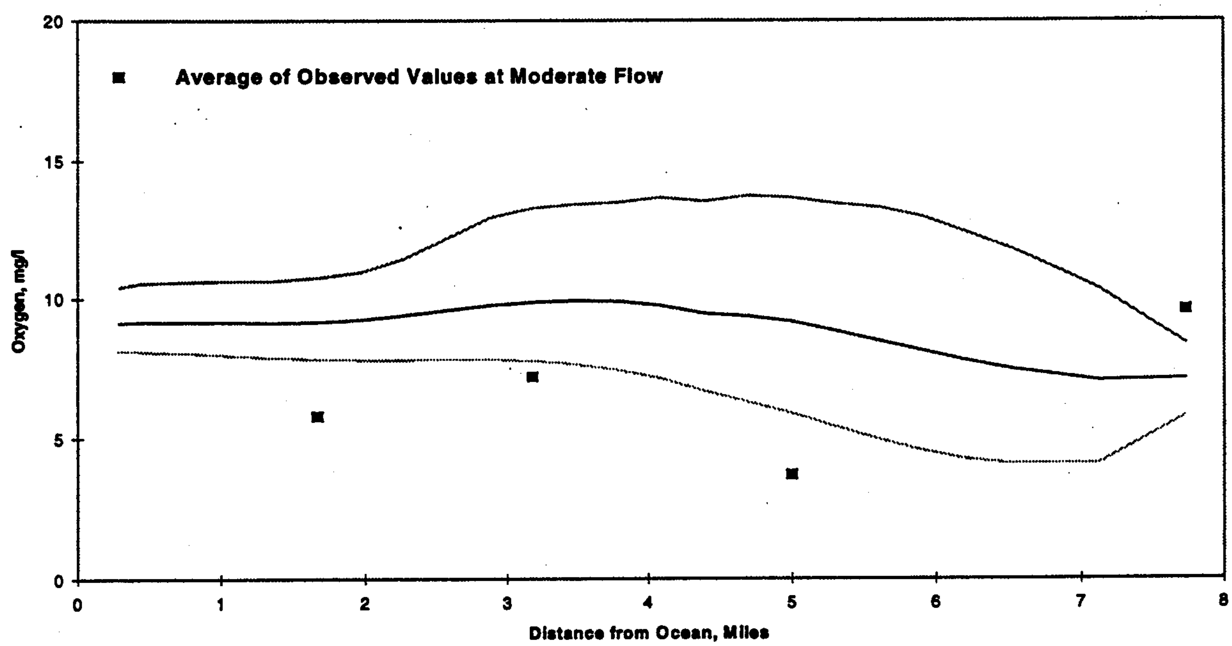


Figure 19 Profiles of Average Observed and Computed Average and Daily Extremes of Oxygen in the Estero de San Antonio for Low and Moderate Inflow Conditions

3.6.4-5 Dissolved Oxygen

The average dissolved oxygen concentration under the moderate flow condition cannot be achieved by the model without a large oxygen sink rate (which includes benthic demand and sulfate reduction). The discrepancy between the observed and the predicted dissolved oxygen data during moderate flow conditions (see Figure 19) could be due to antecedent animal waste load that is greater than the longer term average that was assumed and/or due to the higher estimated than observed phytoplankton density.

3.6.5 Conclusions Based on Calibration

The water quality calibration demonstrates that the Estero Americano model represents observed trends for all parameters for low and moderate runoff periods. However, the Estero de San Antonio model calibration suggests that model estimates for Estero de San Antonio have greater uncertainty.

There is more scatter in the Estero de San Antonio observed data, which may be due in part to the more limited number of observed data. The scatter precluded calibration results comparable to those of the Estero Americano. The phosphate, nitrate and phytoplankton calibration results indicate that the water quality responses of the two estuaries are quite different. The model assumption for the two esteros are similar, therefore the differences observed in the data cannot be replicated.

Sufficient data are unavailable to calibrate the model under the closed entrance conditions. Water quality conditions would be influenced by the timing of the closure. Therefore, a large quantity of water quality data and geometry data defining the bar closure would be required for calibration.

Despite the limitations implicit in the calibrations, the models provide a useful analytical tool for evaluating the relative impacts of the different alternatives. The alternative evaluation used the model coefficients derived primarily from the Estero Americano calibration. These coefficients result in a model which is sensitive to nutrient concentrations. A sensitive model provides a more conservative engineering evaluation.

The ability to model the closed entrance conditions has not been demonstrated. However, the model does represent the fundamental hydraulic and water quality relationships which prevail in a typical estuary. The closed entrance affects only the boundary stage and water quality. The effects of the lower inter-tidal amplitudes and velocities on reaeration, light attenuation and inter-tidal mixing are represented by the fundamental relationships within the model. The closed entrance conditions assumed for alternatives analysis resulted in very low inter-tidal velocities, and therefore the model is sensitive to the potential effects of reduced circulation. These assumptions result in a conservative engineering evaluation.

3.7 EVALUATION OF WATERSHED MANAGEMENT SCENARIOS

3.7.1 Evaluation of Watershed Management Scenarios During Moderate and Low Flow Conditions

Watershed management alternatives include the construction of various reclaimed water storage facilities and various irrigation acreage and technologies. Superimposed on these management alternatives are monthly values for five different hydrologic year types as follows:

1. Dry year, normal irrigation
2. Average year, normal irrigation
3. Average hydrologic year, cool summer, normal irrigation
4. Wet year, normal irrigation
5. Dry year, winter (contingency) irrigation

The permutations of all possible watershed options, time of year, hydrology and Estero entrance condition result in an unmanageable number of possible analytical options. (e.g., For the Americano Creek watershed, the number of analytical options = [dam locations] x [irrigation technology] x [irrigation acreage] x [months] x [hydrology types] x [entrance condition] = 5,784 alternatives). All alternatives were evaluated to determine which alternative management scenarios represented the extremes in changes to flow and water quality tributary to the Esteros. Review of the flow and quality data from this analysis indicates that the following conditions represent the extremes in flow and water quality impacts on the Esteros.

	Estero Americano	Estero de San Antonio
Reservoir:	Bloomfield	Huntley
Irrigation	High Tech., 4,250 Acres[a]	High Tech., 5,500 Acres

[a] Includes approximately 1,350 acres of potential irrigable lands in the Ebabias Creek watershed west of Valley Ford

The 1 percent irrigation/storage option was used since it requires the maximum irrigation acreage and reservoir size, and thus has the greatest potential impact on the streams and the esteros. The three hydrologic conditions (wet, dry with winter irrigation and average with cool summer) were simulated since they produce distinctly different flow and inflow quality and include the extremes in inflow rates. The April and June month were simulated for the reasons expressed previously in the model “Calibration Periods” section. For each combination of the three selected hydrologic conditions and season, water quality impacts under bar-open and bar-closed conditions were simulated. Thus, the model results provide an estimate of the range of potential impacts due to a 1 percent irrigation/storage project.

Water transparencies and benthic source and sink rates used during calibration were used for all simulations. Water transparency may change with watershed management practice since suspended sediment loads may change. However, it was assumed that the abundance of mud flats will continue to provide a source of suspended sediments.

A 30-day simulation period was used for all simulations to minimize the effects of antecedent water quality conditions. The 30-day period may be inappropriate for closed entrance conditions during moderate to high inflows since the inflow volume may preclude a 30-day closure. Under higher inflow conditions, a more reasonable estimate of watershed management effects may be the average of the open and closed results.

The simulation results include the hourly values of all water quality parameters at each node point. For the purposes of alternatives evaluation and comparison, the simulation results were consolidated into a summary table for each alternative. The summary table showing estimated water quality in the Estero under each alternative project is presented in the Appendix. Each table is headed by a list of conditions defining the simulation conditions and include

- Name of the Estero
- Estero entrance condition (open or closed)
- Month (April or June)
- Hydrologic Year type
- Inflow rate, TDS and total inorganic nitrogen upon which the simulation was based

The water quality simulation results follow the heading information in the appendix tables. The simulation results are presented as the average, minimum and maximum temperature or water quality parameter concentration at six locations in each Estero. The average, minimum and maximum values during the 30-day simulation are given. The location is identified by miles from the mouth. For the Estero Americano, the six mile locations correspond to sampling sites E1 through E6. For the Estero de San Antonio, miles 1.57, 3.18, 4.70 and 7.72 correspond to sampling sites S2, S4, S6 and S8 respectively. All units are in mg/L except for temperature and benthic algae which are degrees Celsius and grams/m^2 respectively.

Estero model input for flow rate and TDS that would result from project implementation under the specified hydrology and irrigation conditions are provided by the watershed model as output for 1 percent project conditions. The Estero model input concentration of total inorganic nitrogen that was estimated by the watershed model for project conditions was not used as Estero model input; instead background nitrogen was used as input as described in the following paragraph. The concentrations of the other water quality parameters used for project conditions analysis are listed in Table 11. These concentrations were developed from the ocean boundary and tributary inflow data listed in Table 10. Table 10 values reflect present watershed management practice.

Table 11.

Ocean Exchange and Tributary Inflow Water Quality Used in the Estero Americano and Estero de San Antonio Model Evaluation of Watershed Management Alternatives

	% Area[a]	TDS mg/L	NO3-N mg/L	PO4-P mg/L	Detritus mg/L	BOD mg/L	NH3-N mg/L	DO mg/L	Temp °C	Phyto mg/L
Low Flow		32000	0.08	0.1	4	2	0.035	9	13.5	5
Moderate flow		31000	0.05	0.06	5	3	0.025	9	11.5	5
Tributary Inflows[b]										
Location										

Table 11.

Ocean Exchange and Tributary Inflow Water Quality Used in the Estero Americano and Estero de San Antonio Model Evaluation of Watershed Management Alternatives

QE1	57	[c]	0.8 -2[d]	1.5	15	8	0.3	8	16[e]	20
QE2	22	[c]	0.8 -2[d]	1.2	10	6	0.2	8	16[e]	15
QE3	21	[c]	0.8 -2[d]	0.9	5	4	0.1	8	16[e]	10
Total	100									
QS1	80	[c]	0.8 -2[d]	1.5	15	8	0.3	8	16[e]	20
QS2	20	[c]	0.8 -2[d]	0.9	5	4	0.1	8	16[e]	10
Total	100									

[a] Percent of watershed drained by each tributary.
[b] Tributary inflow used for low and moderate flow conditions shown for each tributary inflow. See Figure 1 for inflow locations.
[c] Watershed model output used.
[d] Background nitrogen values from Questa (1996)
[e] 15^{o} C used for moderate runoff period.

Under present conditions, inflow inorganic nitrogen concentration ranges up to 6 mg/L. The maximum concentration predicted by the watershed model for improved watershed management conditions is less than 3 mg/L, and background nitrogen concentrations are estimated in *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report (Questa 1996) to be 0.8 and 2 mg/L in the wet and dry season, respectively. The watershed model estimates of nitrogen in surface waters in Stemple Creek and Americano Creek do not include the effect of the riparian corridor that was included in the project description after the *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* Technical Report (Questa 1995) was prepared. The analysis in the Water Quality Impacts Analysis report shows that the incremental load of nitrogen to Americano Creek and Stemple Creek from project irrigation will be removed by 33 and 93 acres of riparian corridor, respectively. Therefore, nitrogen concentrations used for Estero model input that are shown in Table 11 reflect the background nitrogen values that are expected from project implementation.

The watershed model also provides TDS and total inorganic nitrogen for the no irrigation case so that the relative impacts of irrigation may be assessed for a consistent set of watershed runoff assumptions. Present day watershed conditions are such that the TDS and total inorganic nitrogen predicted by the watershed model for the no irrigation case are quite different from the Americano and Stemple Creek water quality measured during recent years. To quantify the effects of improved watershed management practice assumed by the watershed model, the "no irrigation" inflow rates were also simulated assuming the present day tributary stream quality. For this analysis, the water quality data presented in Table 10 were assumed and the results are referred to as "current inflow quality" in the appendix tables.

3.7.2 Evaluation of Watershed Management Scenarios During High Runoff Periods

High flow conditions were not extensively evaluated since both Estero become nearly fresh during high flow periods. Therefore, the Esteros become extensions of the stream system and the water quality is essentially that of the inflowing stream water quality. During high flow events, the hydraulic residence time are short due to the size of the watersheds relative to the volumes of the Esteros. For a 24-hour storm, which generates 1/2 inch of runoff from the watersheds, total volume replacement times would be 4 and 26 hours for the Estero de San Antonio and Estero Americano, respectively.

A single model simulation of the Estero Americano was performed assuming the 1/2 inch runoff rate (approximately 500 cfs). The results indicate essentially no change in water quality within the Estero would occur except near the ocean. During the periods when the rising tide forced flow reversals at the mouth, the maximum excursion of the 1 ppt salinity concentration (3 percent ocean water) front extended approximately two miles inland.

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5.0 APPENDIX

Estero Americano : Entrance Open : April
Average Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 11.27
Trib 2 ==> 4.75
Trib 3 ==> 4.87

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	30251	27940	31000	12.2	11.5	14.2	0.066	0.035	0.090	0.089	0.029	0.222
1.01	29055	27015	30885	13.0	11.6	14.8	0.068	0.036	0.099	0.140	0.035	0.278
2.29	25418	22785	27895	14.5	13.4	15.9	0.109	0.055	0.210	0.315	0.135	0.631
4.62	10824	7265	15865	15.6	14.6	16.5	0.753	0.424	1.046	2.169	1.246	3.056
5.44	6105	4162	9976	15.6	14.5	16.7	1.068	0.751	1.296	3.184	2.168	4.003
7.37	976	752	1453	15.1	14.7	15.7	1.334	1.301	1.374	4.884	4.733	4.992

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.118	0.090	0.208	6.6	5.0	11.2	4.0	3.9	4.2	8.6	6.9	10.0
1.01	0.161	0.095	0.247	9.3	5.2	13.6	2.3	2.2	2.5	8.3	6.6	10.4
2.29	0.302	0.196	0.442	17.1	12.4	22.3	3.8	3.7	3.9	8.0	5.5	10.5
4.62	1.077	0.764	1.335	37.3	33.6	42.9	1.4	1.3	1.4	8.0	3.4	15.2
5.44	1.389	1.102	1.581	41.8	37.1	47.5	1.0	1.0	1.1	8.3	3.4	13.8
7.37	1.785	1.753	1.803	44.8	42.7	46.5	1.2	1.2	1.3	7.7	5.0	9.9

Estero Americano : Entrance Open : June
Average Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 1.16
Trib 2 ==> 0.49
Trib 3 ==> 0.50

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	31962	31825	32000	14.2	13.5	16.3	0.104	0.042	0.130	0.091	0.038	0.164
1.01	31890	31750	32000	15.0	13.6	16.9	0.075	0.039	0.125	0.106	0.044	0.176
2.29	31578	31275	31810	16.7	15.5	18.1	0.039	0.028	0.060	0.128	0.082	0.214
4.62	28782	27295	30195	18.4	17.6	19.3	0.038	0.024	0.071	0.235	0.148	0.404
5.44	26595	24800	28685	18.5	17.7	19.5	0.060	0.031	0.114	0.311	0.188	0.522
7.37	14859	11713	18645	18.1	16.9	19.1	0.482	0.293	0.753	0.850	0.596	1.185

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.212	0.189	0.221	8.9	7.9	11.5	5.7	5.6	5.9	8.6	6.7	9.9
1.01	0.200	0.176	0.220	10.3	8.0	13.0	4.3	4.1	4.4	8.3	6.4	9.9
2.29	0.173	0.152	0.186	14.1	11.8	16.7	3.7	3.7	3.8	7.7	5.6	9.3
4.62	0.201	0.160	0.262	25.1	21.5	29.5	1.4	1.3	1.4	6.6	3.5	8.8
5.44	0.261	0.191	0.351	31.1	26.3	37.1	1.0	1.0	1.1	6.4	2.7	9.3
7.37	0.793	0.596	0.973	51.1	44.0	59.8	1.2	1.2	1.3	9.1	2.9	13.7

Estero Americano : Entrance Open : April
Dry Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 5.27
Trib 2 ==> 2.22
Trib 3 ==> 2.28

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	30666	29610	31000	12.2	11.5	14.2	0.061	0.034	0.071	0.074	0.028	0.149
1.01	30117	29155	30955	12.9	11.6	14.8	0.052	0.035	0.072	0.098	0.032	0.173
2.29	28321	26895	29575	14.4	13.4	15.8	0.053	0.036	0.086	0.170	0.086	0.313
4.62	18383	14635	22640	15.7	14.8	16.7	0.339	0.147	0.562	1.075	0.510	1.748
5.44	13162	10114	17865	15.8	14.8	16.8	0.593	0.319	0.839	1.850	1.025	2.645
7.37	2506	1539	4169	15.4	14.8	16.2	1.253	1.172	1.322	4.455	4.045	4.771

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.102	0.089	0.143	5.9	4.9	8.2	3.7	3.6	3.9	8.6	7.2	9.6
1.01	0.120	0.092	0.160	7.4	5.1	9.8	2.1	2.0	2.2	8.3	6.9	9.8
2.29	0.184	0.134	0.255	11.9	9.0	15.2	3.7	3.6	3.8	7.8	6.1	9.4
4.62	0.659	0.425	0.890	29.6	24.4	35.7	1.4	1.4	1.5	7.2	3.6	10.6
5.44	0.953	0.666	1.178	36.7	31.9	43.5	1.0	1.0	1.1	7.4	3.3	11.7
7.37	1.679	1.571	1.750	44.5	41.0	47.4	1.2	1.2	1.3	7.1	4.0	10.3

Estero Americano : Entrance Open : June
Dry Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 0.89
Trib 2 ==> 0.38
Trib 3 ==> 0.38

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	31983	31910	32010	14.2	13.5	16.3	0.103	0.041	0.130	0.090	0.038	0.159
1.01	31943	31865	32000	15.0	13.6	16.9	0.074	0.038	0.125	0.103	0.044	0.170
2.29	31742	31525	31895	16.7	15.5	18.1	0.037	0.026	0.058	0.121	0.079	0.203
4.62	29609	28435	30705	18.4	17.6	19.3	0.031	0.020	0.056	0.209	0.133	0.359
5.44	27870	26405	29535	18.6	17.7	19.6	0.045	0.025	0.086	0.270	0.166	0.455
7.37	17626	14650	21120	18.2	17.1	19.4	0.360	0.186	0.606	0.690	0.436	1.011

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.212	0.188	0.221	8.8	7.9	11.3	5.7	5.6	5.9	8.6	6.8	9.9
1.01	0.199	0.174	0.220	10.2	8.0	12.7	4.3	4.1	4.4	8.3	6.5	9.9
2.29	0.170	0.149	0.185	13.7	11.6	16.1	3.7	3.7	3.8	7.8	5.8	9.3
4.62	0.179	0.146	0.227	23.2	20.2	27.0	1.4	1.3	1.4	6.7	3.8	8.7
5.44	0.223	0.170	0.295	28.4	24.3	33.5	1.0	1.0	1.0	6.4	3.1	9.0
7.37	0.665	0.491	0.834	47.2	40.3	56.2	1.2	1.2	1.3	9.0	3.2	13.6

Estero Americano : Entrance Open : April
Wet Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 21.11
Trib 2 ==> 8.91
Trib 3 ==> 9.13

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	29605	25440	31000	12.2	11.5	14.3	0.080	0.040	0.140	0.123	0.043	0.369
1.01	27444	23905	30770	13.1	11.6	14.9	0.102	0.037	0.179	0.226	0.038	0.490
2.29	21474	17665	25400	14.5	13.5	15.9	0.224	0.095	0.427	0.601	0.229	1.178
4.62	5539	3384	9386	15.4	14.4	16.4	1.114	0.798	1.342	3.197	2.237	3.990
5.44	2705	1796	4715	15.4	14.5	16.5	1.322	1.127	1.466	4.066	3.242	4.710
7.37	727	702	807	15.1	14.8	15.5	1.326	1.306	1.363	4.969	4.927	5.026

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.145	0.090	0.316	7.7	5.0	14.9	4.3	4.2	4.5	8.6	6.5	10.5
1.01	0.229	0.099	0.385	11.9	5.4	18.3	2.4	2.2	2.5	8.4	6.1	11.3
2.29	0.480	0.300	0.697	22.8	16.5	29.7	3.9	3.8	4.0	8.3	4.9	11.6
4.62	1.408	1.132	1.602	40.0	35.4	45.0	1.3	1.3	1.4	8.0	3.4	14.7
5.44	1.631	1.440	1.757	42.6	37.5	47.4	1.0	1.0	1.1	7.6	3.3	12.6
7.37	1.800	1.793	1.809	45.0	43.7	45.8	1.2	1.2	1.2	7.8	6.0	9.1

Estero Americano : Entrance Open : June
Wet Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 1.49
Trib 2 ==> 0.63
Trib 3 ==> 0.64

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	31937	31725	32000	14.2	13.5	16.3	0.104	0.044	0.130	0.092	0.038	0.169
1.01	31824	31615	31995	15.1	13.6	16.9	0.076	0.041	0.125	0.108	0.044	0.182
2.29	31383	30980	31705	16.7	15.5	18.1	0.041	0.031	0.061	0.136	0.086	0.226
4.62	27805	25970	29575	18.4	17.6	19.3	0.047	0.028	0.089	0.265	0.164	0.454
5.44	25121	22990	27670	18.5	17.6	19.5	0.078	0.038	0.150	0.359	0.213	0.601
7.37	12202	9088	16100	17.9	16.8	18.9	0.622	0.395	0.907	1.025	0.768	1.368

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.213	0.190	0.221	8.9	7.9	11.6	5.7	5.6	5.9	8.6	6.6	9.9
1.01	0.201	0.178	0.220	10.5	8.1	13.3	4.3	4.1	4.4	8.2	6.3	10.0
2.29	0.177	0.156	0.190	14.5	12.1	17.3	3.8	3.7	3.8	7.6	5.5	9.3
4.62	0.229	0.176	0.305	27.2	23.0	32.3	1.4	1.4	1.4	6.6	3.3	9.0
5.44	0.309	0.218	0.418	34.1	28.6	40.9	1.0	1.0	1.1	6.6	2.7	9.6
7.37	0.924	0.713	1.104	54.4	47.2	62.4	1.2	1.2	1.3	9.0	2.8	13.8

Estero Americano : Entrance Open : April
Riparian Enhancements - Average Year Hydrology : Cool Summer : 1% Project

Flow, TDS & N :	Trib 1 ==>	8.18	221	1.00
	Trib 2 ==>	3.59	219	1.00
	Trib 3 ==>	4.87	200	1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	30402	28540	31000	12.2	11.5	14.2	0.041	0.019	0.050	0.037	0.013	0.083
1.01	29440	27790	30910	13.0	11.6	14.8	0.032	0.019	0.048	0.050	0.016	0.094
2.29	26488	24355	28500	14.4	13.4	15.9	0.025	0.018	0.040	0.072	0.041	0.128
4.62	13552	9673	18515	15.7	14.7	16.6	0.142	0.046	0.304	0.186	0.102	0.293
5.44	8310	5808	12820	15.7	14.6	16.8	0.300	0.132	0.506	0.270	0.172	0.364
7.37	995	503	1862	15.3	14.8	15.9	0.899	0.822	0.962	0.340	0.318	0.367

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.080	0.060	0.143	4.6	4.0	6.3	2.8	2.6	2.9	9.1	7.9	9.8
1.01	0.110	0.063	0.170	5.7	4.1	7.4	2.1	2.0	2.3	8.9	7.7	9.9
2.29	0.209	0.137	0.301	8.6	6.9	10.6	3.8	3.7	3.9	8.5	7.3	9.6
4.62	0.766	0.529	0.971	15.4	13.9	17.5	1.7	1.6	1.7	8.2	6.0	10.2
5.44	1.032	0.787	1.195	16.3	14.6	18.4	1.1	1.1	1.1	7.7	5.6	10.1
7.37	1.462	1.418	1.490	15.1	14.4	15.8	1.2	1.2	1.3	7.6	6.3	8.7

Estero Americano : Entrance Open : June
Riparian Enhancements - Average Year Hydrology : Cool Summer : 1% Project

Flow, TDS & N :	Trib 1 ==>	0.84	803	1.80
	Trib 2 ==>	0.37	842	1.80
	Trib 3 ==>	0.50	400	1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	31980	31905	32010	14.2	13.5	16.3	0.062	0.021	0.080	0.045	0.018	0.084
1.01	31937	31850	32000	15.0	13.6	16.9	0.042	0.018	0.077	0.051	0.021	0.089
2.29	31730	31520	31885	16.7	15.5	18.1	0.017	0.008	0.031	0.056	0.035	0.101
4.62	29692	28560	30745	18.4	17.6	19.3	0.013	0.005	0.032	0.082	0.048	0.160
5.44	28023	26610	29620	18.6	17.7	19.6	0.023	0.008	0.056	0.105	0.060	0.195
7.37	18042	15100	21475	18.3	17.2	19.4	0.338	0.184	0.576	0.202	0.146	0.273

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.098	0.089	0.102	5.4	4.9	6.6	5.1	4.9	5.2	8.7	7.4	9.3
1.01	0.094	0.085	0.101	6.1	5.0	7.2	3.4	3.3	3.6	8.4	7.2	9.3
2.29	0.089	0.080	0.098	7.7	6.7	8.8	3.4	3.3	3.5	7.9	6.8	8.7
4.62	0.134	0.099	0.182	13.2	11.5	15.3	1.5	1.4	1.5	7.7	6.0	8.9
5.44	0.188	0.129	0.257	15.9	13.9	18.7	1.1	1.0	1.1	7.8	5.8	9.3
7.37	0.631	0.465	0.780	21.2	18.5	24.3	1.2	1.2	1.3	8.9	6.0	11.3

Estero Americano : Entrance Open : April
Riparian Enhancements - Dry Year Hydrology : Winter Irrigation : 1% Project

Flow, TDS & N :				
	Trib 1 ==>	3.83	478	1.00
	Trib 2 ==>	1.68	487	1.00
	Trib 3 ==>	2.28	200	1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	30741	29915	31000	12.2	11.5	14.2	0.040	0.016	0.050	0.035	0.013	0.071
1.01	30314	29565	30965	12.9	11.6	14.8	0.030	0.015	0.048	0.044	0.016	0.077
2.29	28910	27815	29885	14.4	13.3	15.8	0.016	0.011	0.024	0.056	0.033	0.098
4.62	20900	17555	24495	15.7	14.8	16.7	0.044	0.015	0.105	0.112	0.064	0.196
5.44	16168	13100	20515	15.9	14.9	16.9	0.096	0.031	0.207	0.158	0.086	0.253
7.37	3705	2224	6109	15.5	14.8	16.5	0.694	0.535	0.818	0.315	0.294	0.341

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.069	0.060	0.098	4.4	3.9	5.4	2.4	2.3	2.5	9.1	7.9	9.6
1.01	0.082	0.062	0.110	5.0	4.0	6.1	1.5	1.4	1.7	8.8	7.8	9.6
2.29	0.127	0.093	0.174	6.9	5.8	8.3	3.5	3.4	3.6	8.3	7.4	9.2
4.62	0.450	0.289	0.615	13.5	12.0	15.8	1.6	1.6	1.7	8.4	6.5	10.0
5.44	0.668	0.455	0.839	15.6	14.1	18.0	1.1	1.1	1.1	8.3	6.2	10.4
7.37	1.328	1.200	1.404	15.8	14.6	16.7	1.2	1.2	1.3	8.0	6.7	9.4

Estero Americano : Entrance Open : June
Riparian Enhancements - Dry Year Hydrology : Winter Irrigation : 1% Project

Flow, TDS & N :				
	Trib 1 ==>	0.65	1022	1.80
	Trib 2 ==>	0.28	1078	1.80
	Trib 3 ==>	0.38	400	1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	31997	31970	32010	14.2	13.5	16.3	0.061	0.021	0.080	0.044	0.018	0.082
1.01	31982	31945	32010	15.0	13.6	16.9	0.041	0.017	0.077	0.050	0.021	0.086
2.29	31861	31715	31955	16.7	15.5	18.1	0.016	0.008	0.030	0.053	0.033	0.096
4.62	30348	29475	31150	18.4	17.6	19.4	0.009	0.004	0.024	0.073	0.043	0.144
5.44	29049	27925	30300	18.6	17.8	19.6	0.016	0.006	0.040	0.092	0.053	0.173
7.37	20628	17970	23645	18.5	17.3	19.6	0.245	0.122	0.451	0.169	0.111	0.243

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.098	0.088	0.101	5.4	4.9	6.5	5.1	4.9	5.2	8.7	7.5	9.3
1.01	0.094	0.084	0.101	6.0	5.0	7.1	3.4	3.3	3.6	8.4	7.3	9.3
2.29	0.087	0.078	0.094	7.5	6.6	8.6	3.4	3.3	3.5	8.0	6.9	8.7
4.62	0.117	0.090	0.155	12.3	10.8	14.1	1.4	1.4	1.4	7.6	6.1	8.7
5.44	0.157	0.112	0.213	14.6	12.9	17.0	1.0	1.0	1.1	7.7	5.9	9.0
7.37	0.524	0.381	0.660	19.9	17.3	23.2	1.2	1.2	1.3	8.9	6.0	11.2

Estero Americano : Entrance Open : April
Riparian Enhancements - Wet Year Hydrology : 1% Project

Flow, TDS & N : Trib 1 ==>	15.33	218	1.00
Trib 2 ==>	6.72	217	1.00
Trib 3 ==>	9.13	200	1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	29871	26450	31000	12.2	11.5	14.3	0.044	0.024	0.054	0.041	0.013	0.101
1.01	28104	25170	30820	13.0	11.6	14.9	0.039	0.025	0.056	0.059	0.017	0.115
2.29	23080	19800	26405	14.5	13.5	15.9	0.049	0.029	0.089	0.096	0.052	0.169
4.62	7462	4602	12045	15.5	14.5	16.5	0.372	0.153	0.611	0.288	0.189	0.378
5.44	3724	2399	6592	15.5	14.5	16.6	0.593	0.365	0.797	0.357	0.283	0.419
7.37	338	235	588	15.1	14.8	15.6	0.967	0.936	0.994	0.325	0.309	0.352

	PO4-P, mg/l			Algae, mg/l			Ben.Algae, g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.098	0.060	0.218	4.9	4.0	7.3	3.3	3.1	3.4	9.2	7.8	10.0
1.01	0.158	0.067	0.266	6.4	4.1	8.9	2.8	2.6	3.0	8.9	7.6	10.3
2.29	0.337	0.211	0.484	10.2	8.1	12.7	3.9	3.8	4.0	8.6	7.0	10.1
4.62	1.055	0.818	1.226	15.3	13.6	17.2	1.7	1.6	1.7	7.5	5.4	9.6
5.44	1.272	1.084	1.383	15.4	13.6	17.2	1.1	1.1	1.1	7.0	5.3	9.0
7.37	1.495	1.482	1.501	15.0	14.5	15.5	1.2	1.2	1.2	7.9	6.9	8.7

Estero Americano : Entrance Open : June
Riparian Enhancements - Wet Year Hydrology : 1% Project

Flow, TDS & N : Trib 1 ==>	1.08	797	1.80
Trib 2 ==>	0.40	831	1.80
Trib 3 ==>	0.64	400	1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	31960	31820	32000	14.2	13.5	16.3	0.062	0.022	0.080	0.045	0.018	0.086
1.01	31886	31745	32000	15.1	13.6	16.9	0.042	0.019	0.077	0.053	0.021	0.092
2.29	31576	31285	31805	16.7	15.5	18.1	0.018	0.009	0.031	0.059	0.037	0.106
4.62	28934	27520	30270	18.4	17.6	19.3	0.017	0.007	0.042	0.093	0.055	0.177
5.44	26855	25140	28840	18.6	17.7	19.6	0.032	0.011	0.077	0.121	0.069	0.218
7.37	15421	12284	19170	18.1	17.0	19.2	0.454	0.261	0.715	0.236	0.186	0.302

	PO4-P, mg/l			Algae, mg/l			Ben.Algae, g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.098	0.090	0.102	5.4	4.9	6.7	5.1	4.9	5.2	8.7	7.4	9.3
1.01	0.095	0.086	0.102	6.1	5.0	7.4	3.4	3.3	3.6	8.4	7.2	9.3
2.29	0.092	0.083	0.103	8.0	6.9	9.2	3.4	3.4	3.5	7.9	6.8	8.8
4.62	0.155	0.110	0.216	14.3	12.3	16.6	1.5	1.5	1.5	7.8	6.0	9.1
5.44	0.225	0.150	0.310	17.2	15.1	20.3	1.1	1.1	1.1	7.9	5.7	9.6
7.37	0.747	0.562	0.907	22.1	19.4	25.0	1.2	1.2	1.3	9.0	6.0	11.3

Estero Americano : Entrance Closed : April
Average Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 11.27
Trib 2 ==> 4.75
Trib 3 ==> 4.87

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	24241	22770	26810	14.0	13.1	15.0	0.875	0.527	1.110	0.610	0.346	0.822
1.01	21153	21060	21270	14.8	14.3	15.4	1.343	1.313	1.366	0.927	0.868	1.011
2.29	18414	18370	18505	15.1	14.4	15.8	1.652	1.623	1.683	1.163	1.099	1.283
4.62	7904	7827	8016	15.4	14.9	15.9	2.421	2.357	2.486	2.975	2.836	3.115
5.44	4491	4430	4578	15.5	14.9	16.0	2.488	2.432	2.545	3.808	3.661	3.946
7.37	1038	1034	1045	15.1	14.7	15.8	1.654	1.619	1.697	4.964	4.852	5.097

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.306	0.204	0.376	19.0	13.9	22.5	1.5	1.4	1.6	5.8	3.7	8.1
1.01	0.434	0.419	0.449	26.0	25.1	26.9	0.2	0.2	0.2	5.5	3.2	9.4
2.29	0.554	0.528	0.580	34.5	32.4	36.5	1.7	1.6	1.8	7.0	3.2	11.1
4.62	1.463	1.436	1.490	38.5	36.4	40.7	0.5	0.4	0.5	7.2	3.4	10.8
5.44	1.709	1.683	1.733	40.7	38.8	43.0	0.5	0.5	0.6	7.4	3.4	10.8
7.37	1.839	1.821	1.861	43.1	41.0	44.9	1.0	1.0	1.1	6.2	3.7	8.6

Estero Americano : Entrance Closed : June
Average Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 1.16
Trib 2 ==> 0.49
Trib 3 ==> 0.50

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	30993	30690	31420	15.7	14.8	16.8	0.517	0.318	0.665	0.269	0.158	0.353
1.01	30326	30295	30375	16.8	16.3	17.3	0.787	0.776	0.799	0.387	0.365	0.417
2.29	29660	29640	29690	17.1	16.4	17.8	0.988	0.979	0.995	0.469	0.449	0.498
4.62	25319	25220	25455	17.2	16.8	17.8	1.521	1.511	1.533	0.801	0.753	0.856
5.44	21996	21870	22170	17.3	16.8	17.9	1.820	1.806	1.836	1.067	0.998	1.166
7.37	13436	13394	13523	17.1	16.3	17.9	2.135	2.064	2.249	1.627	1.454	1.896

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.250	0.196	0.298	8.3	7.5	9.4	4.5	4.3	4.6	5.8	4.2	7.6
1.01	0.275	0.269	0.280	8.3	7.8	8.6	0.4	0.4	0.4	4.4	3.6	5.0
2.29	0.305	0.301	0.310	8.3	7.9	8.6	0.6	0.6	0.6	4.5	3.5	5.4
4.62	0.464	0.455	0.473	16.5	15.9	17.2	0.2	0.2	0.2	4.5	3.3	5.7
5.44	0.568	0.553	0.583	27.0	26.0	28.1	0.3	0.3	0.3	4.9	3.0	6.8
7.37	0.935	0.878	0.990	58.0	52.5	63.7	1.0	1.0	1.0	10.3	2.7	22.6

Estero Americano : Entrance Closed : April
Dry Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 5.27
Trib 2 ==> 2.22
Trib 3 ==> 2.28

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	27976	27210	29200	13.8	12.9	14.8	0.605	0.363	0.770	0.368	0.211	0.485
1.01	26197	26145	26265	14.7	14.2	15.2	0.948	0.930	0.963	0.564	0.529	0.604
2.29	24363	24335	24410	15.0	14.3	15.7	1.199	1.182	1.215	0.722	0.689	0.781
4.62	14369	14259	14519	15.3	14.8	15.8	1.852	1.811	1.887	1.532	1.365	1.693
5.44	9682	9582	9825	15.4	14.9	16.0	2.154	2.099	2.204	2.255	2.049	2.452
7.37	3148	3138	3171	15.2	14.6	16.0	2.114	2.052	2.180	4.506	4.306	4.705

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.218	0.152	0.263	10.1	8.1	11.7	1.7	1.6	1.7	5.8	4.2	7.6
1.01	0.301	0.293	0.308	13.4	13.0	13.9	0.2	0.2	0.2	4.8	3.6	5.9
2.29	0.376	0.364	0.388	18.3	17.3	19.1	1.1	1.1	1.2	5.5	3.6	7.5
4.62	0.982	0.954	1.012	37.4	35.3	39.7	0.4	0.4	0.5	7.3	3.3	10.9
5.44	1.307	1.273	1.342	44.8	42.2	47.7	0.5	0.5	0.5	8.2	3.2	15.7
7.37	1.791	1.758	1.823	43.6	40.4	46.8	1.0	1.0	1.1	7.9	3.5	14.5

Estero Americano : Entrance Closed : June
Dry Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 0.89
Trib 2 ==> 0.38
Trib 3 ==> 0.38

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	31120	30855	31495	15.7	14.8	16.8	0.506	0.311	0.652	0.261	0.154	0.343
1.01	30537	30510	30585	16.7	16.3	17.3	0.770	0.759	0.781	0.375	0.353	0.404
2.29	29965	29940	30000	17.1	16.4	17.8	0.965	0.957	0.972	0.450	0.432	0.479
4.62	26293	26200	26420	17.2	16.8	17.8	1.468	1.459	1.479	0.729	0.688	0.776
5.44	23429	23305	23595	17.3	16.8	17.9	1.754	1.738	1.769	0.955	0.895	1.036
7.37	15562	15516	15665	17.1	16.4	18.0	2.092	2.037	2.185	1.454	1.312	1.690

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.248	0.194	0.294	8.1	7.4	9.3	4.5	4.3	4.6	5.8	4.3	7.6
1.01	0.271	0.265	0.276	8.0	7.6	8.4	0.4	0.4	0.4	4.4	3.7	5.0
2.29	0.298	0.294	0.303	7.8	7.5	8.2	0.6	0.6	0.6	4.2	3.5	5.1
4.62	0.440	0.432	0.447	13.8	13.4	14.4	0.2	0.2	0.2	4.9	3.4	6.1
5.44	0.532	0.520	0.545	22.1	21.3	23.0	0.3	0.3	0.3	4.9	3.1	8.1
7.37	0.838	0.788	0.888	51.2	46.4	56.1	1.0	1.0	1.0	11.2	2.6	22.1

Estero Americano : Entrance Closed : April
Wet Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 21.11
Trib 2 ==> 8.91
Trib 3 ==> 9.13

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	18504	16470	22725	14.3	13.4	15.2	1.294	0.794	1.614	0.972	0.554	1.310
1.01	14784	14679	14913	15.0	14.5	15.5	1.880	1.837	1.910	1.404	1.304	1.555
2.29	12084	12035	12176	15.2	14.6	16.0	2.189	2.145	2.243	1.684	1.577	1.887
4.62	3902	3852	3972	15.4	14.9	15.9	2.518	2.464	2.580	3.936	3.832	4.040
5.44	1821	1791	1863	15.4	14.8	16.0	2.185	2.130	2.234	4.535	4.389	4.653
7.37	715	715	716	15.1	14.8	15.5	1.411	1.393	1.433	5.007	4.945	5.081

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.457	0.298	0.564	35.6	26.0	41.7	1.9	1.8	2.0	6.7	2.9	9.7
1.01	0.635	0.608	0.663	45.3	43.5	47.1	0.3	0.3	0.4	6.5	2.7	10.8
2.29	0.817	0.769	0.865	52.9	49.1	56.9	2.2	2.1	2.2	9.0	3.1	14.4
4.62	1.732	1.712	1.752	36.4	34.8	38.1	0.5	0.4	0.5	6.7	3.4	10.0
5.44	1.835	1.812	1.854	39.7	37.9	42.0	0.5	0.5	0.6	7.3	3.2	11.3
7.37	1.818	1.808	1.829	44.1	43.0	45.1	1.0	1.0	1.1	6.1	4.5	7.3

Estero Americano : Entrance Closed : June
Wet Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 1.49
Trib 2 ==> 0.63
Trib 3 ==> 0.64

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	30833	30490	31325	15.7	14.8	16.8	0.530	0.326	0.682	0.278	0.163	0.365
1.01	30064	30030	30115	16.8	16.3	17.3	0.808	0.797	0.821	0.403	0.380	0.433
2.29	29282	29260	29310	17.1	16.4	17.8	1.016	1.007	1.024	0.492	0.472	0.522
4.62	24162	24055	24305	17.2	16.8	17.8	1.581	1.569	1.595	0.884	0.830	0.952
5.44	20378	20245	20560	17.3	16.8	17.9	1.892	1.878	1.909	1.193	1.112	1.313
7.37	11412	11377	11486	17.0	16.3	17.8	2.175	2.079	2.314	1.795	1.588	2.092

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.254	0.197	0.302	8.4	7.6	9.6	4.4	4.3	4.6	5.8	4.2	7.6
1.01	0.281	0.275	0.286	8.5	8.1	8.9	0.4	0.3	0.4	4.5	3.6	5.5
2.29	0.313	0.309	0.319	8.8	8.4	9.1	0.6	0.6	0.6	4.5	3.5	5.5
4.62	0.492	0.481	0.503	19.9	19.2	20.7	0.2	0.2	0.2	4.8	3.2	7.6
5.44	0.608	0.591	0.627	32.9	31.6	34.2	0.3	0.3	0.3	5.9	2.9	12.4
7.37	1.045	0.983	1.104	63.3	57.3	69.5	1.0	1.0	1.1	10.8	2.6	19.6

Estero Americano : Entrance Closed : April
Riparian Enhancements - Average Year Hydrology : Cool Summer : 1% Project

Flow, TDS & N :				
	Trib 1 ==>	8.18	221	1.00
	Trib 2 ==>	3.59	219	1.00
	Trib 3 ==>	4.87	200	1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	25602	24330	27705	13.9	13.0	14.9	0.552	0.330	0.705	0.348	0.193	0.473
1.01	22894	22810	22995	14.8	14.3	15.3	0.847	0.833	0.860	0.529	0.492	0.576
2.29	20367	20330	20445	15.1	14.4	15.8	1.028	1.015	1.042	0.636	0.602	0.702
4.62	9921	9833	10044	15.4	14.9	15.9	1.126	1.109	1.153	0.679	0.642	0.739
5.44	5983	5908	6091	15.5	14.9	16.0	1.047	1.026	1.074	0.646	0.603	0.702
7.37	1203	1196	1216	15.2	14.6	15.9	1.052	0.993	1.116	0.489	0.469	0.512

	PO4-P, mg/l			Algae, mg/l			Ben.Algae, g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.214	0.144	0.264	11.4	8.7	13.4	1.4	1.3	1.4	5.9	4.0	7.9
1.01	0.306	0.297	0.315	15.5	15.0	16.1	0.2	0.2	0.2	5.3	3.6	8.2
2.29	0.389	0.374	0.403	20.3	19.1	21.5	1.7	1.6	1.7	5.7	3.8	7.5
4.62	1.038	1.022	1.056	19.2	17.9	20.5	0.7	0.6	0.7	7.0	4.2	12.8
5.44	1.278	1.263	1.293	17.7	16.6	18.9	0.7	0.7	0.7	6.6	4.4	9.2
7.37	1.501	1.491	1.512	14.6	13.6	15.6	1.1	1.1	1.1	6.0	4.9	7.1

Estero Americano : Entrance Closed : June
Riparian Enhancements - Average Year Hydrology : Cool Summer : 1% Project

Flow, TDS & N :				
	Trib 1 ==>	0.84	803	1.80
	Trib 2 ==>	0.37	842	1.80
	Trib 3 ==>	0.50	400	1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	31092	30815	31480	15.7	14.8	16.8	0.431	0.260	0.556	0.192	0.110	0.255
1.01	30490	30460	30535	16.8	16.3	17.3	0.670	0.660	0.679	0.287	0.269	0.307
2.29	29903	29880	29940	17.1	16.5	17.8	0.845	0.841	0.851	0.349	0.333	0.370
4.62	26354	26260	26480	17.2	16.8	17.8	1.279	1.268	1.289	0.551	0.519	0.588
5.44	23574	23450	23740	17.3	16.8	17.9	1.515	1.498	1.531	0.698	0.652	0.761
7.37	15844	15790	15945	17.1	16.4	18.0	1.791	1.742	1.887	0.908	0.843	1.028

	PO4-P, mg/l			Algae, mg/l			Ben.Algae, g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.166	0.121	0.200	5.2	4.8	5.9	2.9	2.8	3.1	5.9	4.6	7.3
1.01	0.210	0.205	0.213	5.4	5.1	5.6	0.3	0.3	0.3	4.4	3.9	4.8
2.29	0.246	0.243	0.250	5.6	5.3	5.8	0.6	0.6	0.6	4.3	3.6	5.1
4.62	0.380	0.373	0.387	10.6	10.2	11.1	0.2	0.2	0.2	4.5	3.6	5.7
5.44	0.463	0.452	0.474	16.7	16.1	17.5	0.3	0.3	0.3	4.8	3.4	7.7
7.37	0.756	0.719	0.792	32.6	29.3	36.1	1.0	1.0	1.1	7.8	3.4	13.5

Estero Americano : Entrance Closed : April
Riparian Enhancements - Dry Year Hydrology : Winter Irrigation : 1% Project

Flow, TDS & N :	Trib 1 ==>	3.83	478	1.00
	Trib 2 ==>	1.68	487	1.00
	Trib 3 ==>	2.28	200	1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	28571	27930	29560	13.7	12.8	14.8	0.448	0.267	0.574	0.240	0.135	0.321
1.01	27085	27040	27140	14.7	14.2	15.2	0.703	0.694	0.713	0.369	0.345	0.396
2.29	25527	25505	25560	15.0	14.3	15.7	0.877	0.870	0.885	0.456	0.434	0.493
4.62	16821	16715	16970	15.3	14.8	15.8	1.154	1.146	1.166	0.633	0.596	0.699
5.44	12030	11917	12184	15.4	14.9	16.0	1.215	1.209	1.228	0.693	0.650	0.772
7.37	4472	4457	4504	15.2	14.6	16.1	1.161	1.070	1.251	0.630	0.583	0.676

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.167	0.115	0.201	6.8	5.7	7.7	1.3	1.2	1.4	6.0	4.5	7.6
1.01	0.234	0.228	0.239	8.7	8.4	9.0	0.2	0.2	0.2	4.5	3.8	5.1
2.29	0.291	0.284	0.298	11.3	10.8	11.9	1.1	1.0	1.1	5.6	3.8	9.0
4.62	0.689	0.671	0.707	20.5	19.2	21.8	0.5	0.5	0.6	6.2	4.0	8.2
5.44	0.939	0.917	0.961	23.5	21.9	25.2	0.6	0.6	0.6	6.9	4.0	9.3
7.37	1.399	1.382	1.415	17.7	16.1	19.5	1.1	1.1	1.1	6.4	4.3	8.6

Estero Americano : Entrance Closed : June
Riparian Enhancements - Dry Year Hydrology : Winter Irrigation : 1% Project

Flow, TDS & N :	Trib 1 ==>	0.65	1022	1.80
	Trib 2 ==>	0.28	1078	1.80
	Trib 3 ==>	0.38	400	1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	31195	30950	31540	15.7	14.8	16.8	0.425	0.256	0.548	0.188	0.107	0.250
1.01	30662	30630	30710	16.8	16.3	17.3	0.660	0.650	0.669	0.279	0.262	0.299
2.29	30154	30130	30195	17.1	16.5	17.8	0.832	0.828	0.837	0.338	0.323	0.359
4.62	27138	27050	27260	17.3	16.8	17.8	1.254	1.244	1.265	0.516	0.487	0.549
5.44	24759	24640	24920	17.3	16.8	17.9	1.487	1.470	1.503	0.646	0.605	0.700
7.37	17891	17830	18005	17.2	16.4	18.0	1.780	1.740	1.860	0.851	0.791	0.961

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.164	0.120	0.197	5.1	4.7	5.8	3.0	2.8	3.1	5.9	4.6	7.3
1.01	0.207	0.202	0.210	5.2	5.0	5.4	0.3	0.3	0.3	4.3	3.9	4.8
2.29	0.242	0.239	0.245	5.3	5.1	5.6	0.6	0.6	0.6	4.8	3.6	7.3
4.62	0.365	0.358	0.371	9.1	8.8	9.5	0.2	0.2	0.2	4.9	3.6	7.8
5.44	0.441	0.431	0.451	14.0	13.5	14.6	0.3	0.3	0.3	5.0	3.5	8.2
7.37	0.687	0.654	0.718	29.0	26.1	32.1	1.0	1.0	1.1	7.5	3.4	11.8

Estero Americano : Entrance Closed : April
Riperian Enhancements - Wet Year Hydrology : 1% Project

Flow, TDS & N :	Trib 1 ==>	15.33	218	1.00
	Trib 2 ==>	6.72	217	1.00
	Trib 3 ==>	9.13	200	1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	20695	18775	24365	14.2	13.3	15.2	0.712	0.433	0.891	0.512	0.286	0.696
1.01	17037	16930	17170	14.9	14.4	15.5	1.039	1.020	1.055	0.741	0.684	0.825
2.29	14186	14138	14284	15.2	14.5	15.9	1.204	1.184	1.228	0.842	0.791	0.949
4.62	5215	5154	5300	15.4	14.9	15.9	1.135	1.085	1.188	0.754	0.712	0.796
5.44	2488	2444	2550	15.4	14.9	15.9	1.015	0.969	1.056	0.667	0.634	0.699
7.37	318	316	321	15.1	14.8	15.7	0.988	0.953	1.028	0.386	0.375	0.398

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.300	0.198	0.370	20.3	14.9	24.0	1.8	1.7	1.9	6.3	3.6	9.2
1.01	0.421	0.404	0.437	26.5	25.4	27.5	0.3	0.3	0.3	5.9	3.4	8.5
2.29	0.543	0.515	0.571	31.3	29.1	33.7	2.2	2.1	2.3	7.4	3.6	10.8
4.62	1.290	1.277	1.303	15.8	14.8	16.8	0.8	0.7	0.8	7.0	4.4	12.2
5.44	1.438	1.427	1.447	14.7	14.0	15.6	0.7	0.7	0.7	6.3	4.4	8.4
7.37	1.510	1.504	1.516	14.6	14.0	15.2	1.1	1.1	1.1	6.7	6.0	7.4

Estero Americano : Entrance Closed : June
Riperian Enhancements - Wet Year Hydrology : 1% Project

Flow, TDS & N :	Trib 1 ==>	1.08	797	1.80
	Trib 2 ==>	0.40	831	1.80
	Trib 3 ==>	0.64	400	1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	30968	30660	31405	15.7	14.8	16.8	0.439	0.265	0.566	0.198	0.113	0.263
1.01	30285	30255	30335	16.8	16.3	17.3	0.682	0.673	0.692	0.296	0.278	0.316
2.29	29607	29585	29645	17.1	16.5	17.8	0.861	0.856	0.867	0.362	0.346	0.384
4.62	25457	25360	25590	17.2	16.8	17.8	1.306	1.296	1.317	0.591	0.555	0.635
5.44	22253	22125	22425	17.3	16.8	17.9	1.544	1.528	1.560	0.756	0.705	0.831
7.37	13820	13773	13910	17.1	16.3	17.9	1.795	1.734	1.907	0.960	0.889	1.087

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.08	0.168	0.122	0.202	5.4	4.9	6.1	2.9	2.8	3.1	5.8	4.4	7.3
1.01	0.213	0.208	0.217	5.6	5.3	5.8	0.3	0.3	0.3	4.4	3.9	4.8
2.29	0.252	0.248	0.255	5.9	5.7	6.2	0.6	0.6	0.6	4.3	3.6	5.0
4.62	0.398	0.389	0.406	12.5	12.1	13.1	0.3	0.2	0.3	4.7	3.6	6.1
5.44	0.490	0.476	0.502	20.1	19.3	21.0	0.3	0.3	0.3	5.2	3.4	9.4
7.37	0.841	0.800	0.879	35.5	31.9	39.4	1.1	1.0	1.1	8.7	3.3	16.0

Estero de San Antonio : Entrance Open : April
Average Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 22.69
Trib 2 ==> 5.62

Mile	TDS, mg/l Avg.	TDS, mg/l Min.	TDS, mg/l Max.	Temperature, C Avg.	Temperature, C Min.	Temperature, C Max.	NO3-N, mg/l Avg.	NO3-N, mg/l Min.	NO3-N, mg/l Max.	NH3-N, mg/l Avg.	NH3-N, mg/l Min.	NH3-N, mg/l Max.
0.15	23908	15220	30910	12.9	11.5	15.7	0.216	0.071	0.434	0.564	0.060	1.278
1.57	14670	10017	24580	13.9	12.7	15.4	0.471	0.182	0.659	1.379	0.462	1.964
3.18	5891	2888	13180	14.3	13.2	15.6	0.802	0.455	1.033	2.446	1.355	3.188
4.70	1772	1152	3398	15.1	14.0	16.7	1.158	0.872	1.339	3.704	2.708	4.335
6.21	987	856	1173	15.3	14.4	16.5	1.303	1.222	1.395	4.472	4.118	4.812
7.72	705	701	714	15.1	14.8	15.3	1.307	1.298	1.322	4.979	4.953	5.011

Mile	PO4-P, mg/l Avg.	PO4-P, mg/l Min.	PO4-P, mg/l Max.	Algae, mg/l Avg.	Algae, mg/l Min.	Algae, mg/l Max.	Ben.Algae. g/m^2 Avg.	Ben.Algae. g/m^2 Min.	Ben.Algae. g/m^2 Max.	Oxygen, mg/l Avg.	Oxygen, mg/l Min.	Oxygen, mg/l Max.
0.15	0.356	0.093	0.675	17.0	5.2	34.9	6.5	6.3	6.7	10.2	7.7	16.4
1.57	0.730	0.323	0.935	31.0	16.9	40.5	2.8	2.6	3.0	10.9	6.9	15.5
3.18	1.136	0.767	1.336	41.5	34.5	49.5	5.9	5.8	6.1	11.7	6.2	17.0
4.70	1.535	1.257	1.671	47.0	41.3	53.6	3.8	3.7	3.9	10.9	4.8	16.4
6.21	1.714	1.639	1.772	47.0	42.3	51.0	3.9	3.8	4.0	9.7	4.8	14.1
7.72	1.799	1.795	1.804	44.8	44.2	45.3	2.2	2.1	2.2	8.1	7.2	8.8

Estero de San Antonio : Entrance Open : June
Average Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 2.37
Trib 2 ==> 0.59

Mile	TDS, mg/l Avg.	TDS, mg/l Min.	TDS, mg/l Max.	Temperature, C Avg.	Temperature, C Min.	Temperature, C Max.	NO3-N, mg/l Avg.	NO3-N, mg/l Min.	NO3-N, mg/l Max.	NH3-N, mg/l Avg.	NH3-N, mg/l Min.	NH3-N, mg/l Max.
0.15	31142	29930	31990	14.8	13.5	17.4	0.084	0.024	0.129	0.108	0.046	0.219
1.57	29377	28250	31220	16.2	14.6	18.0	0.049	0.031	0.087	0.168	0.066	0.291
3.18	25919	23760	29345	17.8	16.3	19.5	0.036	0.018	0.073	0.228	0.112	0.483
4.70	20758	19050	24660	19.1	18.1	20.7	0.087	0.023	0.186	0.414	0.163	0.747
6.21	16859	15720	19015	18.9	17.8	20.2	0.176	0.075	0.316	0.623	0.353	0.971
7.72	4153	2903	7782	16.7	16.3	17.3	1.423	1.012	1.560	1.776	1.470	1.901

Mile	PO4-P, mg/l Avg.	PO4-P, mg/l Min.	PO4-P, mg/l Max.	Algae, mg/l Avg.	Algae, mg/l Min.	Algae, mg/l Max.	Ben.Algae. g/m^2 Avg.	Ben.Algae. g/m^2 Min.	Ben.Algae. g/m^2 Max.	Oxygen, mg/l Avg.	Oxygen, mg/l Min.	Oxygen, mg/l Max.
0.15	0.211	0.186	0.220	12.4	8.0	19.8	5.9	5.8	6.0	8.7	6.7	10.2
1.57	0.204	0.172	0.227	20.9	12.4	27.7	4.1	3.9	4.2	8.4	5.8	11.2
3.18	0.224	0.172	0.295	35.4	22.1	46.8	5.8	5.6	5.9	9.2	4.6	13.3
4.70	0.346	0.221	0.454	54.7	42.5	67.1	3.8	3.7	3.9	10.4	3.0	17.0
6.21	0.483	0.340	0.593	64.0	55.8	75.1	3.9	3.8	4.0	10.6	2.2	17.7
7.72	1.386	1.115	1.467	60.8	58.8	63.1	2.0	2.0	2.1	7.3	5.4	9.0

Estero de San Antonio : Entrance Open : April
Dry Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 4.86
Trib 2 ==> 1.20

Mile	TDS, mg/l Avg.	TDS, mg/l Min.	TDS, mg/l Max.	Temperature, C Avg.	Temperature, C Min.	Temperature, C Max.	NO3-N, mg/l Avg.	NO3-N, mg/l Min.	NO3-N, mg/l Max.	NH3-N, mg/l Avg.	NH3-N, mg/l Min.	NH3-N, mg/l Max.
0.15	29242	26840	30980	12.7	11.5	15.3	0.053	0.024	0.070	0.099	0.039	0.215
1.57	25874	23810	29405	14.0	12.5	15.7	0.052	0.032	0.077	0.197	0.060	0.353
3.18	19995	16565	25730	15.2	14.0	16.9	0.098	0.032	0.202	0.420	0.126	0.834
4.70	12790	10581	17880	16.2	15.1	17.8	0.305	0.093	0.473	1.105	0.378	1.691
6.21	8530	7357	10616	16.2	15.0	17.6	0.568	0.338	0.722	2.027	1.264	2.560
7.72	1593	1183	2759	15.2	15.0	15.5	1.248	1.148	1.282	4.691	4.253	4.831

Mile	PO4-P, mg/l Avg.	PO4-P, mg/l Min.	PO4-P, mg/l Max.	Algae, mg/l Avg.	Algae, mg/l Min.	Algae, mg/l Max.	Ben.Algae. g/m^2 Avg.	Ben.Algae. g/m^2 Min.	Ben.Algae. g/m^2 Max.	Oxygen, mg/l Avg.	Oxygen, mg/l Min.	Oxygen, mg/l Max.
0.15	0.146	0.090	0.231	9.4	5.1	16.4	5.3	5.1	5.4	8.9	7.5	10.3
1.57	0.257	0.136	0.346	17.8	9.5	24.4	3.5	3.3	3.7	9.0	6.9	11.8
3.18	0.474	0.248	0.644	31.0	19.4	41.1	5.9	5.7	6.0	10.0	6.1	14.2
4.70	0.847	0.543	0.999	45.6	37.8	55.6	3.9	3.8	4.0	10.6	4.5	17.1
6.21	1.121	0.931	1.227	50.3	43.6	58.8	3.9	3.8	4.0	9.9	3.4	15.5
7.72	1.732	1.634	1.764	45.1	44.4	45.7	2.0	2.0	2.0	7.2	6.1	8.0

Estero de San Antonio : Entrance Open : June
Dry Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 0.92
Trib 2 ==> 0.23

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	31724	31315	32000	14.8	13.5	17.4	0.085	0.024	0.129	0.098	0.045	0.183
1.57	31095	30675	31745	16.2	14.6	18.0	0.048	0.028	0.088	0.134	0.058	0.224
3.18	29714	28795	31095	17.8	16.3	19.7	0.029	0.012	0.056	0.167	0.088	0.342
4.70	27308	26490	29200	19.3	18.2	21.0	0.052	0.015	0.109	0.281	0.114	0.507
6.21	25163	24575	26460	19.3	18.2	20.6	0.079	0.036	0.137	0.402	0.232	0.623
7.72	9430	6633	16925	17.4	16.7	18.2	1.081	0.532	1.286	1.434	0.934	1.655

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.207	0.179	0.220	10.7	8.0	15.5	5.9	5.8	6.0	8.6	6.9	9.8
1.57	0.189	0.162	0.206	16.0	10.7	20.6	4.4	4.3	4.6	8.2	6.2	10.5
3.18	0.181	0.151	0.218	25.2	16.8	32.5	5.7	5.6	5.8	8.3	5.1	10.8
4.70	0.229	0.165	0.289	38.5	29.6	47.0	3.8	3.7	3.9	8.6	3.5	13.2
6.21	0.262	0.176	0.329	46.2	41.0	53.5	3.8	3.7	3.9	8.1	2.5	13.4
7.72	1.120	0.681	1.254	56.9	52.8	60.8	2.0	2.0	2.1	7.6	4.9	10.2

Estero de San Antonio : Entrance Open : April
Wet Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 47.39
Trib 2 ==> 11.74

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	18835	7321	30775	12.9	11.5	15.4	0.446	0.075	0.806	1.240	0.074	2.372
1.57	8546	4681	19355	13.6	12.3	14.9	0.821	0.403	1.024	2.427	1.109	3.072
3.18	2444	1157	6367	13.5	12.4	14.8	1.050	0.836	1.208	3.309	2.496	3.888
4.70	844	695	1179	14.9	13.9	16.4	1.281	1.113	1.411	4.324	3.661	4.790
6.21	718	705	736	15.2	14.4	16.3	1.335	1.280	1.402	4.766	4.561	5.010
7.72	700	700	700	15.1	14.8	15.6	1.305	1.289	1.324	4.954	4.894	5.023

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.591	0.099	1.043	21.4	5.4	40.4	6.5	6.3	6.6	10.3	7.0	16.5
1.57	1.046	0.558	1.246	33.7	22.4	41.2	2.3	2.1	2.4	9.9	5.9	14.5
3.18	1.341	1.113	1.474	39.5	33.3	46.6	5.9	5.8	6.0	10.1	5.4	15.5
4.70	1.667	1.480	1.763	45.3	40.7	50.5	3.7	3.6	3.8	10.2	4.8	15.1
6.21	1.772	1.734	1.813	46.0	42.3	49.1	3.7	3.6	3.8	9.6	5.3	13.4
7.72	1.797	1.787	1.807	45.2	44.1	46.1	2.1	2.0	2.1	8.7	7.2	10.1

Estero de San Antonio : Entrance Open : June
Wet Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 3.01
Trib 2 ==> 0.75

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	30894	29345	31990	14.8	13.5	17.4	0.084	0.024	0.129	0.111	0.046	0.233
1.57	28665	27260	30990	16.2	14.6	18.0	0.050	0.032	0.086	0.179	0.069	0.315
3.18	24440	21850	28605	17.7	16.4	19.5	0.039	0.020	0.082	0.247	0.120	0.526
4.70	18469	16525	22910	18.9	18.0	20.5	0.103	0.027	0.217	0.454	0.179	0.814
6.21	14246	13020	16505	18.7	17.6	20.0	0.217	0.092	0.389	0.685	0.386	1.068
7.72	3240	2328	5896	16.6	16.3	17.1	1.497	1.144	1.613	1.837	1.589	1.939

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.215	0.191	0.225	13.0	8.1	21.4	5.9	5.8	6.0	8.7	6.7	10.4
1.57	0.215	0.178	0.245	22.7	13.1	30.4	4.0	3.8	4.1	8.5	5.7	11.5
3.18	0.252	0.185	0.339	38.8	24.1	51.3	5.8	5.7	5.9	9.6	4.5	14.3
4.70	0.411	0.255	0.534	58.9	46.6	72.2	3.9	3.8	3.9	11.0	2.9	18.2
6.21	0.587	0.429	0.707	67.5	58.7	79.3	3.9	3.8	4.0	11.2	2.2	18.7
7.72	1.441	1.229	1.506	60.9	59.3	63.1	2.0	2.0	2.1	7.3	5.6	8.8

Estero de San Antonio : Entrance Open : June
Riparian Enhancements - Average Year Hydrology : Cool Summer : 1% Project

Flow, TDS & N :	Trib 1 ==>	17.67	219	1.00
	Trib 2 ==>	5.62	200	1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	24860	17150	30925	12.8	11.5	15.6	0.026	0.000	0.049	0.036	0.000	0.109
1.57	16242	11680	25480	13.8	12.7	15.3	0.027	0.006	0.068	0.065	0.016	0.148
3.18	7037	3515	14980	14.3	13.1	15.5	0.107	0.011	0.257	0.127	0.031	0.242
4.70	2014	1157	4283	15.1	14.0	16.7	0.365	0.112	0.572	0.244	0.120	0.343
6.21	849	635	1159	15.3	14.4	16.5	0.620	0.449	0.780	0.311	0.264	0.367
7.72	237	226	267	15.0	14.9	15.2	0.977	0.965	0.993	0.309	0.303	0.319

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.250	0.062	0.483	8.3	4.1	15.3	6.4	6.1	6.6	10.3	9.2	13.8
1.57	0.530	0.227	0.683	13.5	8.4	17.6	4.7	4.5	4.9	11.3	9.4	14.0
3.18	0.865	0.562	1.022	16.9	14.4	20.2	6.0	5.8	6.1	11.9	9.2	14.7
4.70	1.214	0.976	1.316	18.2	15.8	21.1	4.0	3.9	4.1	11.6	8.7	14.2
6.21	1.388	1.314	1.424	17.6	15.1	19.5	4.0	3.9	4.1	10.7	8.1	12.9
7.72	1.498	1.495	1.500	15.1	14.8	15.2	2.4	2.3	2.5	8.1	7.8	8.5

Estero de San Antonio : Entrance Open : June
Riparian Enhancements - Average Year Hydrology : Cool Summer : 1% Project

Flow, TDS & N :	Trib 1 ==>	1.85	831	1.80
	Trib 2 ==>	0.59	400	1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	31300	30305	31990	14.8	13.5	17.4	0.052	0.015	0.079	0.058	0.023	0.124
1.57	29837	28895	31360	16.2	14.6	18.0	0.031	0.019	0.054	0.088	0.034	0.154
3.18	26907	25060	29820	17.7	16.3	19.5	0.025	0.012	0.057	0.114	0.057	0.235
4.70	22441	20960	25835	19.1	18.1	20.7	0.071	0.015	0.159	0.186	0.077	0.323
6.21	18997	18005	20940	19.0	17.9	20.3	0.127	0.050	0.232	0.250	0.151	0.373
7.72	5009	3376	9692	16.9	16.4	17.6	1.343	0.869	1.489	0.343	0.321	0.370

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.110	0.100	0.131	7.0	5.0	10.4	5.5	5.4	5.6	8.6	7.3	9.3
1.57	0.133	0.105	0.162	11.0	7.0	14.4	4.3	4.2	4.5	8.3	6.8	9.9
3.18	0.198	0.127	0.266	17.8	11.6	23.2	5.8	5.6	5.9	8.5	6.1	10.6
4.70	0.353	0.220	0.430	26.6	21.2	32.7	3.9	3.8	4.0	9.1	5.4	12.5
6.21	0.480	0.379	0.546	30.0	26.0	35.6	4.0	3.9	4.1	8.7	4.7	12.4
7.72	1.267	0.995	1.352	22.4	21.1	25.9	2.0	2.0	2.1	7.5	6.4	8.3

Estero de San Antonio : Entrance Open : June
Riparian Enhancements - Dry Year Hydrology : Winter Irrigation : 1% Project

Flow, TDS & N : Trib 1 ==> 3.78 641 1.00
Trib 2 ==> 1.20 200 1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	29547	27540	30985	12.7	11.5	15.3	0.031	0.007	0.050	0.040	0.013	0.090
1.57	26706	24950	29680	14.0	12.5	15.7	0.019	0.011	0.033	0.062	0.024	0.112
3.18	21566	18500	26610	15.2	14.0	16.9	0.019	0.008	0.046	0.080	0.039	0.169
4.70	14940	12860	19715	16.3	15.2	17.8	0.067	0.012	0.144	0.138	0.055	0.237
6.21	10757	9565	12890	16.3	15.1	17.6	0.148	0.054	0.256	0.197	0.111	0.286
7.72	2051	1440	3826	15.3	15.0	15.7	0.864	0.700	0.915	0.313	0.305	0.321

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.106	0.060	0.173	5.6	4.0	8.4	4.7	4.5	4.8	9.2	8.2	9.9
1.57	0.197	0.099	0.264	8.8	5.7	11.5	4.2	4.0	4.4	9.1	7.9	10.6
3.18	0.375	0.194	0.501	13.5	9.5	17.3	5.9	5.7	6.0	9.3	7.6	11.2
4.70	0.674	0.439	0.781	18.5	16.0	22.4	4.0	3.9	4.0	9.6	7.1	12.2
6.21	0.888	0.753	0.952	19.8	17.2	23.3	4.0	3.9	4.1	9.1	6.6	11.6
7.72	1.419	1.312	1.452	15.5	15.1	16.5	2.0	2.0	2.1	7.8	7.2	8.1

Estero de San Antonio : Entrance Open : June
Riparian Enhancements - Dry Year Hydrology : Winter Irrigation : 1% Project

Flow, TDS & N : Trib 1 ==> 0.71 1324 1.80
Trib 2 ==> 0.23 400 1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	31795	31485	32000	14.8	13.5	17.4	0.053	0.015	0.079	0.054	0.023	0.109
1.57	31309	30975	31810	16.2	14.6	18.0	0.031	0.018	0.055	0.076	0.031	0.127
3.18	30213	29475	31315	17.8	16.3	19.7	0.022	0.009	0.044	0.093	0.048	0.185
4.70	28287	27635	29800	19.4	18.2	21.0	0.050	0.010	0.108	0.147	0.061	0.255
6.21	26580	26130	27630	19.4	18.3	20.6	0.057	0.025	0.099	0.196	0.117	0.296
7.72	11264	8173	19330	17.6	16.9	18.5	0.999	0.444	1.195	0.317	0.286	0.346

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.102	0.096	0.112	6.2	5.0	8.5	5.4	5.3	5.6	8.5	7.3	9.2
1.57	0.110	0.094	0.125	8.8	6.2	11.1	4.1	3.9	4.3	8.1	6.9	9.4
3.18	0.138	0.104	0.175	13.4	9.2	17.2	5.6	5.5	5.7	7.9	6.1	9.2
4.70	0.218	0.150	0.261	20.3	15.8	24.8	3.9	3.8	3.9	8.0	5.3	10.6
6.21	0.259	0.206	0.299	23.7	20.9	27.8	3.9	3.8	4.0	7.6	4.6	10.5
7.72	1.005	0.597	1.146	22.4	20.7	24.9	2.0	2.0	2.1	7.3	5.9	8.6

Estero de San Antonio : Entrance Open : June
Riparian Enhancements - Wet Year Hydrology : 1% Project

Flow, TDS & N :				
	Trib 1 ==>	36.90	216	1.00
	Trib 2 ==>	11.74	200	1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	20260	8898	30825	12.8	11.5	15.3	0.073	0.041	0.150	0.083	0.025	0.192
1.57	9846	5527	20960	13.4	12.2	14.7	0.176	0.046	0.296	0.165	0.053	0.246
3.18	2938	1250	7856	13.4	12.2	14.6	0.360	0.128	0.554	0.235	0.141	0.315
4.70	633	357	1282	14.7	13.6	16.3	0.638	0.404	0.830	0.310	0.238	0.378
6.21	298	249	363	15.1	14.4	16.3	0.821	0.722	0.939	0.331	0.298	0.368
7.72	217	216	218	15.1	14.8	15.5	0.975	0.952	1.000	0.309	0.301	0.320

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.416	0.066	0.782	8.9	4.1	15.6	7.0	6.7	7.2	10.4	9.3	13.9
1.57	0.776	0.391	0.927	13.0	9.2	16.0	4.7	4.5	4.9	11.0	9.1	13.2
3.18	1.040	0.837	1.141	14.6	12.5	17.5	6.0	5.9	6.1	10.7	8.3	13.0
4.70	1.340	1.140	1.416	16.2	14.1	18.7	3.9	3.9	4.0	10.5	7.9	12.8
6.21	1.463	1.428	1.487	16.1	14.3	17.5	4.0	3.9	4.1	9.8	7.6	11.7
7.72	1.500	1.496	1.503	15.1	14.7	15.4	3.7	3.6	3.8	8.3	7.7	8.9

Estero de San Antonio : Entrance Open : June
Riparian Enhancements - Wet Year Hydrology : 1% Project

Flow, TDS & N :				
	Trib 1 ==>	2.34	835	1.80
	Trib 2 ==>	0.75	400	1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	31094	29815	31990	14.8	13.5	17.4	0.052	0.014	0.079	0.059	0.023	0.129
1.57	29237	28055	31170	16.2	14.6	18.0	0.031	0.019	0.053	0.091	0.035	0.162
3.18	25627	23380	29200	17.7	16.3	19.5	0.027	0.013	0.062	0.119	0.060	0.247
4.70	20375	18650	24310	19.0	18.0	20.5	0.082	0.017	0.180	0.196	0.082	0.339
6.21	16534	15415	18645	18.9	17.8	20.1	0.157	0.062	0.285	0.263	0.158	0.391
7.72	3918	2668	7553	16.7	16.4	17.4	1.420	0.996	1.549	0.345	0.325	0.372

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.114	0.100	0.141	7.3	5.0	11.1	5.5	5.4	5.6	8.6	7.3	9.4
1.57	0.146	0.110	0.182	11.7	7.3	15.4	4.5	4.3	4.6	8.4	6.8	10.1
3.18	0.229	0.140	0.311	19.0	12.4	24.7	5.8	5.7	6.0	8.8	6.2	11.1
4.70	0.416	0.258	0.504	27.8	22.6	34.1	3.9	3.8	4.0	9.3	5.4	13.0
6.21	0.574	0.455	0.644	30.7	26.5	36.4	4.0	3.9	4.1	8.9	4.8	12.8
7.72	1.321	1.101	1.389	22.1	20.9	25.2	2.0	2.0	2.1	7.5	6.5	8.2

Estero de San Antonio : Entrance Closed : April
Average Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 22.69
Trib 2 ==> 5.62

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	6249	5409	8226	14.6	13.6	15.8	1.511	1.255	1.629	1.763	1.390	2.116
1.57	4122	4043	4195	14.6	14.0	15.3	1.728	1.707	1.767	2.081	1.949	2.325
3.18	2222	2134	2321	14.2	13.4	15.1	1.695	1.575	1.799	2.586	2.262	2.857
4.70	1063	1046	1085	15.1	14.3	15.8	1.757	1.673	1.822	3.869	3.618	4.068
6.21	813	808	818	15.4	14.4	16.5	1.622	1.508	1.720	4.437	4.095	4.748
7.72	705	704	705	15.2	14.6	16.1	1.327	1.294	1.361	4.893	4.782	5.028

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.802	0.614	0.926	74.9	65.3	83.0	5.8	5.7	5.9	11.9	3.4	20.0
1.57	1.105	1.037	1.164	64.7	59.3	70.9	1.9	1.7	2.0	10.7	3.4	16.8
3.18	1.355	1.300	1.401	52.1	47.7	57.4	3.3	3.1	3.4	10.6	3.8	21.6
4.70	1.673	1.628	1.709	47.4	44.4	51.0	2.0	1.9	2.0	8.6	3.7	14.0
6.21	1.768	1.712	1.819	47.1	42.1	52.4	3.3	3.2	3.4	8.1	3.3	12.6
7.72	1.794	1.776	1.814	45.4	43.3	47.2	2.1	2.0	2.1	9.2	6.6	11.4

Estero de San Antonio : Entrance Closed : June
Average Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 2.37
Trib 2 ==> 0.59

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	26977	26170	27930	16.9	15.8	18.1	0.128	0.098	0.164	0.309	0.206	0.436
1.57	24070	23880	24270	17.8	17.2	18.5	0.235	0.221	0.247	0.554	0.501	0.631
3.18	20033	19700	20380	18.2	17.5	19.0	0.390	0.367	0.414	0.834	0.754	0.954
4.70	14758	14540	14995	19.0	18.3	19.7	0.628	0.597	0.667	1.271	1.163	1.452
6.21	11622	11446	11805	18.9	18.1	19.7	0.707	0.692	0.735	1.476	1.366	1.704
7.72	6840	6565	7167	18.4	17.1	20.0	0.823	0.575	1.090	1.511	1.075	1.967

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.176	0.149	0.201	18.3	16.2	20.5	5.2	5.1	5.4	7.6	5.4	9.8
1.57	0.206	0.194	0.219	21.8	20.8	22.6	0.3	0.3	0.3	4.8	3.3	6.2
3.18	0.278	0.261	0.298	29.7	28.3	30.9	0.6	0.6	0.6	5.0	2.8	9.3
4.70	0.433	0.404	0.466	47.9	45.3	50.0	1.0	0.9	1.0	6.2	2.4	12.5
6.21	0.509	0.475	0.553	62.2	58.2	65.0	1.8	1.7	1.8	8.0	1.8	20.7
7.72	0.905	0.794	1.011	70.2	60.7	80.3	2.1	2.1	2.1	12.3	2.6	20.7

Estero de San Antonio : Entrance Closed : April
Dry Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 4.86
Trib 2 ==> 1.20

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	22673	21510	24135	14.5	13.4	16.0	0.281	0.214	0.345	0.509	0.363	0.671
1.57	18532	18315	18765	15.3	14.6	16.0	0.509	0.491	0.525	0.882	0.812	0.985
3.18	13484	13152	13845	15.5	14.7	16.3	0.791	0.764	0.821	1.320	1.213	1.498
4.70	8229	8076	8399	16.1	15.4	16.9	1.122	1.095	1.160	1.903	1.757	2.165
6.21	5732	5627	5844	16.1	15.3	17.0	1.210	1.165	1.275	2.269	2.033	2.618
7.72	2564	2437	2724	15.9	14.7	17.4	1.316	1.163	1.446	3.818	3.388	4.229

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.190	0.151	0.225	22.4	19.6	25.5	3.8	3.6	3.9	6.8	4.5	9.1
1.57	0.289	0.274	0.307	30.9	29.7	31.9	0.3	0.3	0.3	5.2	3.4	6.8
3.18	0.435	0.409	0.468	47.4	45.3	49.4	1.0	1.0	1.0	6.6	2.8	13.4
4.70	0.751	0.686	0.813	70.3	65.5	75.0	1.5	1.5	1.6	9.9	2.9	16.9
6.21	1.015	0.932	1.087	74.0	67.4	81.4	3.1	3.0	3.2	11.6	3.3	19.6
7.72	1.557	1.487	1.627	54.9	48.4	61.4	2.1	2.1	2.1	10.3	4.3	16.7

Estero de San Antonio : Entrance Closed : June
Dry Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 0.92
Trib 2 ==> 0.23

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	28923	28375	29540	16.9	15.8	18.1	0.070	0.053	0.093	0.206	0.129	0.307
1.57	27061	26900	27220	17.9	17.3	18.6	0.120	0.111	0.129	0.373	0.327	0.436
3.18	24473	24205	24745	18.3	17.6	19.1	0.200	0.184	0.217	0.541	0.477	0.632
4.70	20813	20580	21045	19.3	18.7	20.1	0.344	0.315	0.380	0.821	0.737	0.946
6.21	18395	18190	18600	19.3	18.6	20.2	0.393	0.381	0.412	0.956	0.880	1.100
7.72	14194	13850	14560	19.3	17.9	21.0	0.423	0.292	0.595	0.960	0.680	1.328

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.152	0.130	0.172	15.7	14.0	17.5	5.3	5.2	5.5	7.9	6.0	9.8
1.57	0.158	0.148	0.168	17.9	17.0	18.6	0.4	0.4	0.4	5.4	4.0	6.6
3.18	0.194	0.181	0.210	22.2	21.4	23.1	0.7	0.7	0.8	5.2	3.1	6.7
4.70	0.296	0.273	0.320	32.4	30.5	34.0	1.2	1.1	1.2	5.4	2.9	7.8
6.21	0.322	0.303	0.348	39.2	37.0	40.8	1.3	1.3	1.4	5.8	2.5	10.9
7.72	0.500	0.417	0.582	51.4	44.3	58.6	2.2	2.1	2.2	10.2	2.7	16.1

Estero de San Antonio : Entrance Closed : April
Wet Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 47.39
Trib 2 ==> 11.74

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	581	580	582	15.0	14.1	16.0	1.251	1.077	1.391	2.401	2.006	2.724
1.57	578	577	579	14.5	13.8	15.1	1.466	1.388	1.533	3.002	2.801	3.174
3.18	572	570	574	13.7	12.8	14.6	1.379	1.301	1.441	3.378	3.171	3.553
4.70	673	670	676	15.0	14.1	16.0	1.500	1.408	1.579	4.424	4.111	4.686
6.21	698	698	699	15.3	14.4	16.4	1.440	1.365	1.526	4.755	4.496	5.049
7.72	700	700	700	15.1	14.7	15.7	1.308	1.290	1.328	4.949	4.885	5.025

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	1.308	1.237	1.366	51.7	46.2	58.0	6.1	5.9	6.2	10.7	3.8	17.1
1.57	1.407	1.373	1.437	44.2	41.3	47.5	2.2	2.0	2.3	8.1	3.8	12.3
3.18	1.438	1.402	1.469	40.8	38.1	44.2	3.4	3.2	3.5	8.3	3.6	14.2
4.70	1.730	1.675	1.776	44.8	40.7	49.3	1.9	1.8	2.0	7.7	3.2	11.9
6.21	1.791	1.750	1.839	45.8	41.2	49.9	3.3	3.2	3.4	7.7	3.2	11.9
7.72	1.797	1.786	1.809	45.3	44.1	46.3	2.1	2.0	2.1	8.8	7.2	10.2

Estero de San Antonio : Entrance Closed : June
Wet Year Hydrology : Current Inflow Quality

Flow : Trib 1 ==> 3.01
Trib 2 ==> 0.75

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	26088	25165	27185	16.9	15.8	18.1	0.160	0.122	0.203	0.361	0.244	0.500
1.57	22768	22565	22980	17.8	17.2	18.5	0.293	0.279	0.307	0.639	0.582	0.724
3.18	18279	17935	18645	18.1	17.4	18.9	0.478	0.454	0.505	0.961	0.875	1.095
4.70	12743	12537	12965	18.8	18.2	19.6	0.742	0.711	0.783	1.441	1.322	1.642
6.21	9658	9500	9825	18.7	18.0	19.5	0.820	0.804	0.855	1.646	1.521	1.907
7.72	5254	5027	5528	18.2	16.9	19.7	0.971	0.704	1.250	1.672	1.226	2.127

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.189	0.159	0.216	19.7	17.4	22.0	5.2	5.0	5.3	7.5	5.1	9.8
1.57	0.230	0.218	0.244	23.9	22.8	24.7	0.3	0.3	0.3	4.8	3.2	6.1
3.18	0.316	0.298	0.339	33.3	31.7	34.6	0.6	0.6	0.6	4.9	2.6	7.4
4.70	0.490	0.459	0.528	54.6	51.6	56.9	0.9	0.9	1.0	6.3	2.2	11.3
6.21	0.585	0.541	0.638	70.4	65.6	73.9	2.1	2.1	2.2	8.5	1.6	17.1
7.72	1.042	0.933	1.148	72.5	63.0	82.5	2.1	2.1	2.1	12.4	2.9	21.0

Estero de San Antonio : Entrance Closed : June
Riparian Enhancements - Average Year Hydrology : Cool Summer : 1% Project

Flow, TDS & N : Trib 1 ==> 17.67 219 1.00
Trib 2 ==> 5.62 200 1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	8887	7735	10920	14.4	13.4	15.6	0.227	0.186	0.262	0.543	0.399	0.751
1.57	5787	5669	5910	14.5	13.8	15.1	0.296	0.290	0.304	0.649	0.592	0.772
3.18	3137	3004	3283	14.0	13.2	14.8	0.300	0.291	0.320	0.564	0.516	0.654
4.70	1211	1174	1254	14.8	14.1	15.6	0.355	0.298	0.409	0.479	0.409	0.554
6.21	616	601	634	15.3	14.4	16.3	0.530	0.401	0.642	0.465	0.388	0.533
7.72	246	244	250	15.2	14.5	16.2	0.892	0.820	0.974	0.331	0.303	0.355

	PO4-P, mg/l			Algae, mg/l			Ben.Algae, g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.468	0.357	0.555	45.8	39.5	51.3	5.9	5.7	6.0	10.2	4.3	15.5
1.57	0.710	0.660	0.752	39.5	35.8	43.7	2.7	2.5	2.9	8.9	4.1	12.7
3.18	0.964	0.927	0.994	28.0	25.3	31.4	4.4	4.3	4.6	8.3	4.8	11.7
4.70	1.289	1.259	1.314	21.2	19.5	23.3	2.9	2.8	3.0	7.3	4.8	9.5
6.21	1.427	1.400	1.449	18.9	16.7	21.4	3.7	3.7	3.8	7.6	5.2	9.9
7.72	1.493	1.481	1.507	15.7	14.5	16.8	3.5	3.4	3.6	9.0	7.4	10.5

Estero de San Antonio : Entrance Closed : June
Riparian Enhancements - Average Year Hydrology : Cool Summer : 1% Project

Flow, TDS & N : Trib 1 ==> 1.85 831 1.80
Trib 2 ==> 0.59 400 1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	27548	26805	28405	16.9	15.9	18.1	0.049	0.035	0.066	0.162	0.095	0.243
1.57	24908	24725	25100	17.9	17.3	18.6	0.095	0.086	0.103	0.317	0.275	0.372
3.18	21194	20870	21525	18.2	17.5	19.0	0.169	0.154	0.184	0.491	0.428	0.580
4.70	16242	16025	16475	19.1	18.4	19.8	0.306	0.271	0.349	0.756	0.675	0.884
6.21	13251	13065	13445	19.0	18.3	19.9	0.340	0.327	0.361	0.856	0.775	1.011
7.72	8389	8072	8758	18.8	17.4	20.4	0.469	0.254	0.707	0.650	0.442	0.882

	PO4-P, mg/l			Algae, mg/l			Ben.Algae, g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.099	0.083	0.115	12.2	10.8	13.7	4.3	4.1	4.4	8.0	6.5	9.4
1.57	0.128	0.120	0.138	15.3	14.7	15.9	0.3	0.3	0.3	5.9	4.8	6.9
3.18	0.183	0.169	0.199	21.7	20.6	22.6	0.7	0.6	0.7	5.1	3.2	6.7
4.70	0.308	0.284	0.335	34.6	32.6	36.2	1.1	1.1	1.2	5.8	3.0	10.8
6.21	0.373	0.343	0.408	43.1	40.2	45.5	2.2	2.1	2.3	7.1	2.7	13.1
7.72	0.733	0.658	0.806	41.7	35.4	48.4	2.5	2.4	2.6	10.5	3.1	16.8

Estero de San Antonio : Entrance Closed : June
Riparian Enhancements - Dry Year Hydrology : Winter Irrigation : 1% Project

Flow, TDS & N : Trib 1 ==>	3.78	641	1.00
Trib 2 ==>	1.20	200	1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	23852	22805	25140	14.6	13.4	16.0	0.082	0.061	0.106	0.244	0.160	0.341
1.57	20082	19875	20305	15.3	14.7	16.0	0.154	0.146	0.162	0.442	0.394	0.508
3.18	15231	14895	15590	15.5	14.8	16.3	0.237	0.224	0.251	0.638	0.567	0.751
4.70	9832	9668	10019	16.2	15.5	17.0	0.337	0.315	0.371	0.836	0.748	0.992
6.21	7147	7025	7279	16.2	15.4	17.1	0.354	0.333	0.397	0.840	0.754	1.004
7.72	3485	3312	3696	16.1	14.8	17.8	0.477	0.315	0.649	0.539	0.374	0.698

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.120	0.096	0.143	15.1	13.2	17.1	3.3	3.1	3.4	7.4	5.8	9.0
1.57	0.182	0.171	0.194	20.7	19.9	21.4	0.3	0.3	0.4	5.2	3.9	6.4
3.18	0.276	0.256	0.298	31.2	29.8	32.6	1.2	1.1	1.2	5.7	3.6	7.8
4.70	0.506	0.459	0.548	45.1	41.9	48.3	1.7	1.7	1.8	8.1	3.5	12.7
6.21	0.711	0.653	0.762	46.9	42.4	51.8	3.3	3.2	3.3	9.1	3.8	14.1
7.72	1.188	1.139	1.238	29.1	24.8	33.6	3.0	2.9	3.1	9.5	4.8	14.4

Estero de San Antonio : Entrance Closed : June
Riparian Enhancements - Dry Year Hydrology : Winter Irrigation : 1% Project

Flow, TDS & N : Trib 1 ==>	0.71	1324	1.80
Trib 2 ==>	0.23	400	1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	29134	28615	29715	16.9	15.9	18.1	0.029	0.020	0.044	0.110	0.058	0.176
1.57	27397	27240	27550	18.0	17.3	18.7	0.051	0.045	0.057	0.220	0.184	0.267
3.18	25011	24755	25265	18.4	17.7	19.2	0.092	0.080	0.104	0.334	0.281	0.407
4.70	21693	21470	21920	19.4	18.7	20.2	0.184	0.151	0.223	0.524	0.456	0.619
6.21	19574	19370	19775	19.4	18.7	20.2	0.196	0.185	0.211	0.599	0.538	0.709
7.72	15935	15640	16265	19.5	18.1	21.2	0.216	0.123	0.353	0.474	0.322	0.689

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.085	0.072	0.098	10.4	9.3	11.6	4.3	4.2	4.5	8.3	7.0	9.4
1.57	0.100	0.092	0.108	12.6	12.1	13.1	0.3	0.3	0.3	6.5	5.6	7.4
3.18	0.132	0.121	0.144	16.9	16.0	17.6	0.8	0.7	0.8	5.5	4.0	6.8
4.70	0.219	0.199	0.238	25.0	23.5	26.3	1.3	1.2	1.3	5.4	3.3	7.3
6.21	0.238	0.220	0.258	29.4	27.7	30.7	1.5	1.5	1.6	5.5	3.0	9.9
7.72	0.387	0.330	0.444	33.7	28.8	38.6	2.6	2.5	2.7	9.0	3.4	13.6

Estero de San Antonio : Entrance Closed : June
Riparian Enhancements - Wet Year Hydrology : 1% Project

Flow, TDS & N : Trib 1 ==> 36.90 216 1.00
Trib 2 ==> 11.74 200 1.00

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	275	263	286	14.8	13.9	15.8	0.140	0.121	0.166	0.360	0.292	0.477
1.57	248	241	255	14.3	13.6	14.9	0.175	0.162	0.194	0.377	0.333	0.452
3.18	195	193	197	13.4	12.6	14.3	0.251	0.184	0.306	0.342	0.266	0.409
4.70	208	207	209	14.9	14.0	15.8	0.568	0.457	0.661	0.407	0.350	0.456
6.21	215	215	215	15.3	14.4	16.4	0.745	0.616	0.877	0.390	0.341	0.438
7.72	216	216	216	15.1	14.7	15.8	0.951	0.906	0.998	0.310	0.296	0.324

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	1.013	0.970	1.048	27.1	23.8	31.0	6.1	6.0	6.2	8.5	4.8	11.9
1.57	1.083	1.060	1.102	21.2	19.4	23.4	4.1	3.9	4.3	7.2	4.7	9.4
3.18	1.122	1.105	1.139	16.8	15.4	18.5	5.0	4.9	5.1	7.9	5.8	9.8
4.70	1.391	1.363	1.415	17.0	15.3	18.9	3.1	3.0	3.1	8.5	6.3	10.5
6.21	1.478	1.457	1.501	16.6	14.5	18.7	3.8	3.7	3.9	9.0	6.8	11.0
7.72	1.498	1.490	1.505	15.3	14.7	16.0	3.4	3.2	3.5	8.7	7.7	9.8

Estero de San Antonio : Entrance Closed : June
Riparian Enhancements - Wet Year Hydrology : 1% Project

Flow, TDS & N : Trib 1 ==> 2.34 835 1.80
Trib 2 ==> 0.75 400 1.80

	TDS, mg/l			Temperature, C			NO3-N, mg/l			NH3-N, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	26791	25960	27775	16.9	15.9	18.1	0.059	0.043	0.079	0.186	0.113	0.276
1.57	23792	23600	23995	17.9	17.3	18.6	0.116	0.107	0.125	0.360	0.316	0.420
3.18	19641	19310	19990	18.2	17.5	19.0	0.204	0.188	0.221	0.556	0.490	0.653
4.70	14340	14130	14570	18.9	18.3	19.7	0.354	0.320	0.399	0.839	0.752	0.979
6.21	11294	11124	11472	18.9	18.2	19.7	0.395	0.379	0.434	0.933	0.845	1.104
7.72	6602	6327	6928	18.5	17.2	20.1	0.574	0.336	0.828	0.680	0.472	0.901

	PO4-P, mg/l			Algae, mg/l			Ben.Algae. g/m^2			Oxygen, mg/l		
Mile	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
0.15	0.106	0.088	0.124	13.1	11.5	14.7	4.2	4.1	4.4	7.9	6.3	9.3
1.57	0.142	0.133	0.152	16.6	15.9	17.2	0.3	0.3	0.3	5.6	4.4	6.7
3.18	0.206	0.191	0.223	23.9	22.8	24.9	0.6	0.6	0.7	5.2	3.0	7.3
4.70	0.347	0.320	0.376	38.6	36.4	40.4	1.1	1.1	1.2	6.0	3.0	9.2
6.21	0.432	0.394	0.473	47.9	44.4	50.9	2.6	2.5	2.6	7.9	2.7	17.3
7.72	0.856	0.783	0.928	41.9	35.6	48.6	2.5	2.5	2.6	10.2	3.4	16.4