Appendix D

Baseline Assessment and Monitoring Program

TECHNICAL MEMORANDUM

COASTAL WETLANDS REUSE REHYDRATION DEMONSTRATION PROJECT MONITORING PROGRAM BASELINE ASSESSMENT

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TECHNICAL MEMORANDUM

COASTAL WETLANDS REUSE REHYDRATION DEMONSTRATION PROJECT MONITORING PROGRAM BASELINE ASSESSMENT

1.0 Background

As part of the May 10, 2006 Interim Water Use Agreement with the South Florida Water Management District (District), the Miami Dade County Water and Sewer department (MDWASD) agreed to undertake a coastal wetlands reuse (rehydration) demonstration project in South Dade.

Milian, Swain & Assoc., Inc. performed a review of readily available water quality, vegetation, soil, wetlands hydrologic, topographic, land use, and utility data to characterize the existing conditions of the subject areas, including the Cutler (formerly Lennar) Flow Way and nearby water bodies. To identify this baseline information, specific tasks performed included: conducting a site visit of the subject areas to determine existing site conditions; obtaining and reviewing existing reports, investigations, and data regarding the subject area; and developing an inventory of existing conditions data including identification of data gaps.

The following is a description of the findings of the above-described work effort.

2.0 Purpose

This investigation serves two primary purposes:

- Provide information needed to design, construct, and develop a monitoring plan for the Coastal Wetlands Reuse Rehydration Demonstration Project (CWRRDP). The project will use advanced treated reuse water from the South District Wastewater Treatment Plant (SDWWTP)

- Characterize an environmental baseline, where physical, chemical and biological responses to the constructed wetlands demonstration project can be assessed.

3.0 Environmental Assessment

3.1 Site Description

The area proposed for constructed wetlands consists of 14 acres within a 60-acre parcel (TA500-001) in South Dade (CDM and CH2M Hill, 2007). The area immediately north and east of the property is a wetland mitigation area. The parcel is bounded to the south by SW 232nd St. and to the west by SW 97th Ave. The area is located within the Biscayne Bay Coastal Wetlands (BBCW) Project Area (FNAI, 2006). A detailed location map is included in Figure 1.

The 60-acre Parcel TA500-001 is located at the intersection four Township and Range boundaries closely coinciding with the intersection of SW 232nd Street and SW 97th Avenue. The largest block (roughly 90%) of the 60-acre parcel is located within Township 56S, Range 40E, Section 16. Township 56S, Range 40E, Section 17, contains the next largest section (less than 9%) on the western edge of property running along SW 97th Avenue. Township 56S, Range 40E, Section 20, contains a small block in the southwestern corner of the parcel. Township 56S, Range 40E, Section 21 contains a long, narrow section running along most of the southern border against SW 232nd Street.

3.2 Land Use

Between 1922 and 1960, the land use in the surrounding area was predominantly agricultural. The area supported cultivation of malanga, yucca and potatoes (URS, PSI, 2006). By 1970, agricultural operations ceased, allowing the area to become overgrown with vegetation. Today, the area is a mixture of residential, conservation, utilities, wetlands and saltwater marshes, canals, and transportation land use. A map of the general land use is included as Figure 2.

Specifically, the 60-acre test area is bordered to the north and east by a 160-acre mitigation area constructed for the Lakes by the Bay South Commons (Ford Engineers, 2003). A 20-acre section of the mitigation area was a construction and demolition landfill for Lennar Land Partners Inc.

This property was subject to an assessment in May of 2006. This report, entitled “Supplemental Phase II Environmental Site Assessment for the Biscayne Bay Coastal Wetlands Project, Miami-Dade County, Florida” is available in Insert C (PSI, 2006).

Professional Services Industries, Inc. provided a supplemental report in January of 2007 to the South Florida Water Management District (SFWMD) for the BBCW Project, Phase I Cutler Flow Way. The report concluded that “no remedial action is planned” for Tract TA500-001. This conclusion was based on the review of an earlier contamination assessment and additional field investigations (CDM and CH2M Hill, 2007).

There is a 10-acre area to the east of the adjacent mitigation area containing similar vegetation to the test area. The test area, along with the southern portion of the 160-acre mitigation area, and the 10-acre area to the east, is identified as being part of the Biscayne Coastal Wetlands and is currently held in conservation status by the South Florida Water Management District.

Fixed single family residences are currently being constructed by Lennar Land Partners, Inc. immediately north of the mitigation area.

The land to the south of the proposed test plot is contained by the South District Waste Water Treatment Plant. A solid waste landfill lies just south of the wastewater treatment facility. It is not expected that land use in this area will change substantially.

Figure 1. Location of Project Area

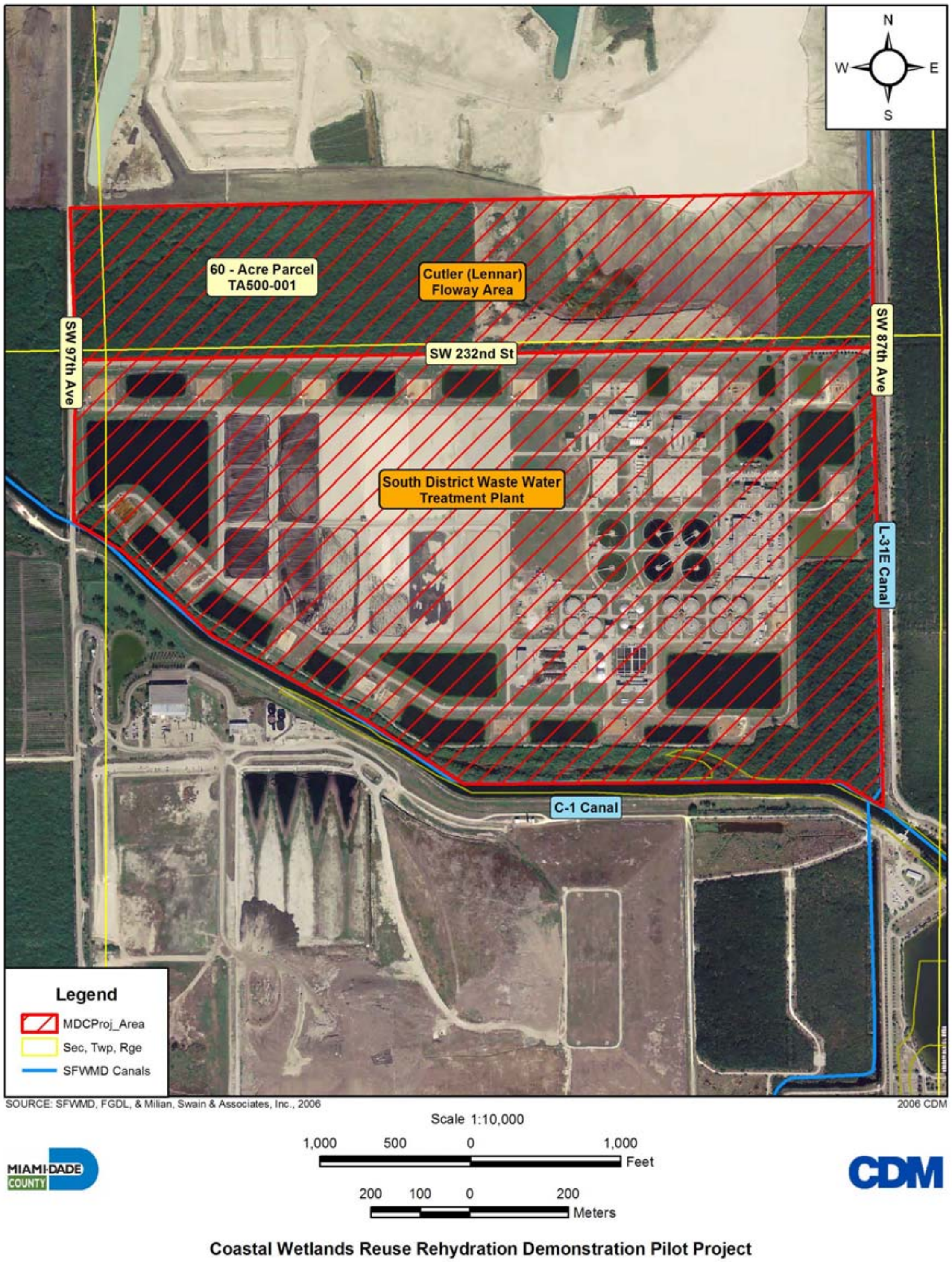
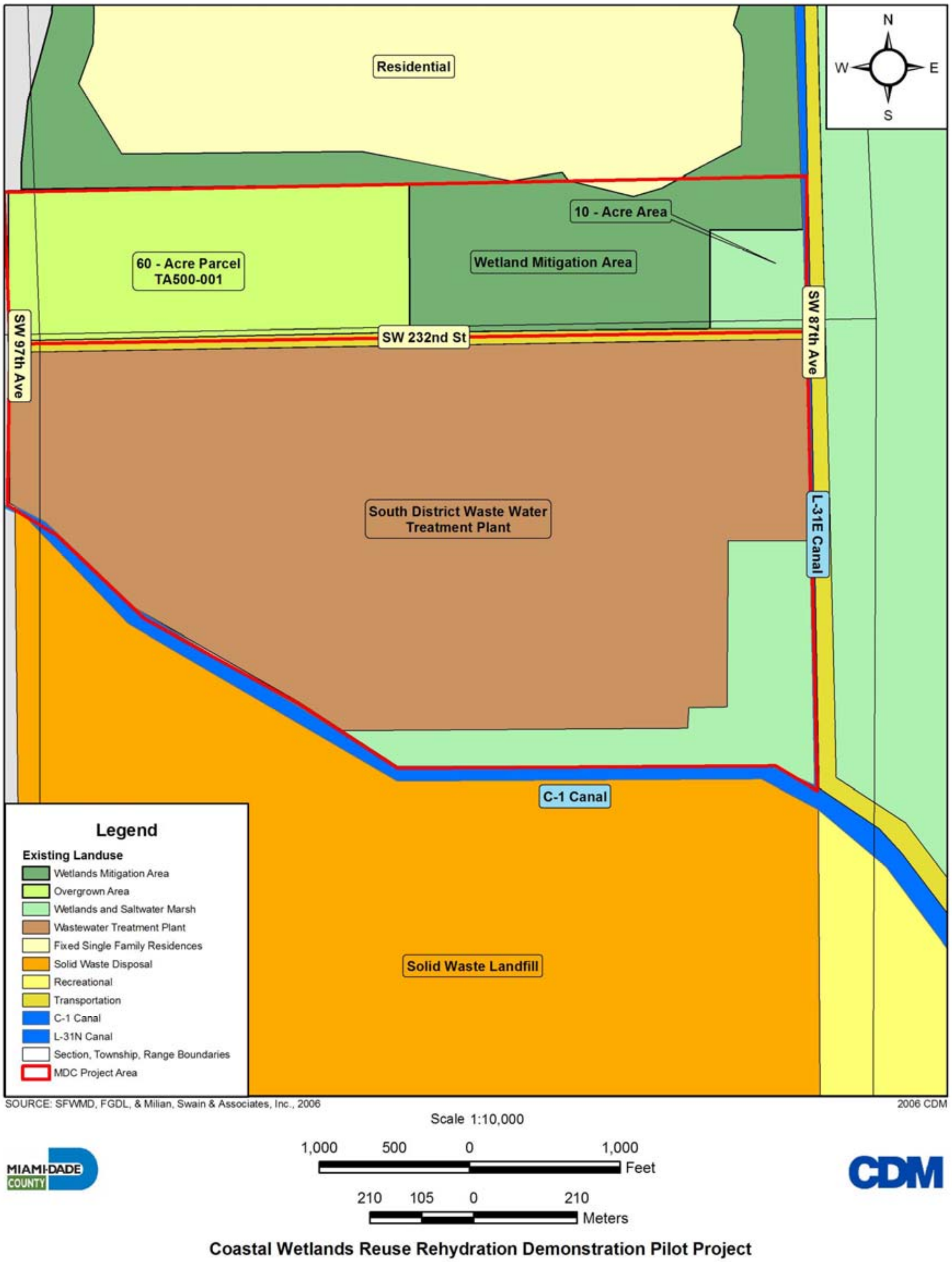


Figure 2. General Land Use Map



3.3 Utilities

FP&L has overhead transmission lines along the southern right-of-way of SW 232nd Street, and along the east side of SW 97th Avenue north from SW 232nd Street to the Lennar Mitigation Parcel. Miami-Dade County Water and Sewer Department (WASD) has their large force main service lines along the right-of-way of SW 232nd Street, and along the eastern right-of-way of SW 97th Avenue.

Additional utilities may be present in the project area. A more detailed utilities investigation should be performed during the final design of the project.

3.4 Geologic Conditions

Miami-Dade County is a part of a larger region characterized by a relatively flat landscape. The Eastern Miami-Dade County area is underlain by the Biscayne Aquifer that is composed chiefly of permeable sandy limestone and sand that range in age from late Miocene through Pleistocene. The area lies on the eastern edge of the Atlantic Coastal Ridge with an average elevation of +4 to +8 feet National Geodetic Vertical Datum (NGVD).

The upper materials consist of Oolitic Miami limestone, and limestones and sands of the Fort Thompson, Anastasia, or Key Largo formations together forming the Biscayne Aquifer. A surface layer of organic peats and silty marls typically mantles the upper Miami Oolite Formation. The Miami Limestone, which consists of sandy, oolitic limestone, and the saltwater facies of the Fort Thompson Formation, has likely deteriorated due to freshwater solutioning. Due to the intrusion of salt water, which naturally occurs along the coast, the ground water at the project site is anticipated to be saline, thus preventing further solutioning.

Beneath the upper Pleistocene deposits are the deep-seated Miocene Tamiami and Hawthorn formations, and the Tampa and St. Mark's formations. Below the deep-seated Miocene deposits, Oligocene deposits consist of Suwannee Limestone. Beneath the Suwannee Limestone of the Oligocene period, limestones of the Avon Park, Lake City and Oldsmar formations can be found down to depths of 3200 feet below land surface.

Geotechnical borings and muck probes were conducted during the investigations of the Lennar Flow Way as per the Acceler8 Draft Basis of Design Report (BODR) preparation. Those borings indicate limestone in the immediate area between 30 and 40 feet think underlain by a 10 to 20 foot layer of fine sand. Further detail of the geotechnical investigation can be found in the CDM and CH2M Hill report Coastal Wetlands Reuse Rehydration Demonstration Project Constructed Wetland (CDM and CH2MHill, 2007).

3.5 Soils

The Soil Conservation Service has completed extensive mapping of surficial soils in eastern Miami-Dade County. Miami-Dade County has been divided into four (4) areas based on its landforms features. Most of the county lies in the Everglades province, which is bound on the east by the Sandy Flatlands, Atlantic Coast Ridge, and Coastal Marshes. The area in the vicinity of the SDWWTP lies in the Atlantic Coast Ridge, and Coastal Marshes and Mangroves. The majority of the soils in the vicinity of the SDWWTP site are Opalocka, Matecumbe muck, Pennsuco marl, tidal, Terra Ceia muck, tidal, and Perrine marl. The area adjacent to the coastline is flat and is characterized by saltwater marshes. The muck probes in the Lennar Flow Way conducted during the BODR preparation found muck ranges from 0 to 4.0 feet with an average of 0.5 feet (CDM and CH2MHill, 2007).The soils within the immediate SDWWTP area are Perrine marl, as indicated by a 2003 site visit (Ford Engineers, 2003).

3.6 Topography

Miami-Dade County's topography is nearly level and generally composed of sands and marl. The elevation of Miami-Dade County ranges from +4 feet to +8 feet above mean sea level. Ground surface elevations in the SDWWTP area range between elevations +4.5 and +7.5 feet NGVD. The site slopes from west to east, towards Biscayne Bay. The topography reported on the USGS Perrine, Florida Quadrangle map ranges from ± 8 along the roadway to +3 and generally slopes from the west to the east.

3.7 Hydrology

Historically, surface water drained to the south and east via sheet flow. A series of transverse glades existed prior to development. The present canal system flows along the location of the transverse glades.

Prior to 1950, the Everglades surface water was reduced by four to six feet, reducing significantly the head and discharge through the transverse glades. Dr. Meeder, long time researcher of Biscayne Bay, indicated that the construction of the C-1 canal was near the center of a major transverse glade, and received water from three other canals (C-100s) that also followed the alignment of existing transverse glades. Figure 3 shows the historical creeks and the transverse Glades.

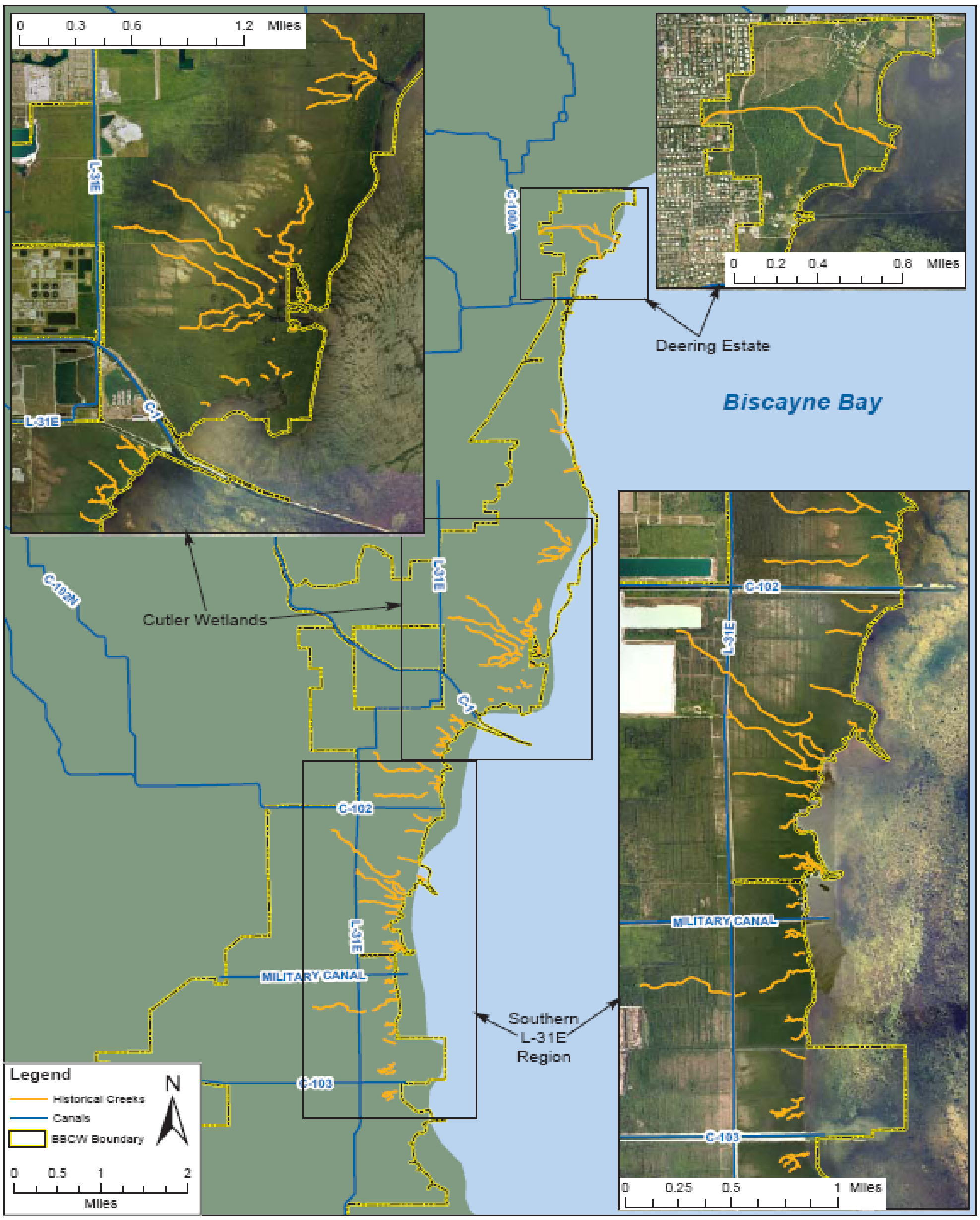
The canalization of the transverse glades disrupted the historical volumes, distribution and timing of flows along the Biscayne Bay coastline. This event significantly reduced the volume and timing of sheet flow across the project area and increased the amount of point discharge of fresh water into Biscayne Bay (Meeder, 2002).

Over the years, the characteristics of freshwater inflow to Biscayne Bay have changed. The predevelopment pattern of rainy season flow through low drainage lands and prolonged dry season groundwater discharge has been replaced by regulated releases through drainage canals and has decreased the volume of groundwater discharge (Buchanan and Klein, 1976). Drainage improvements have effectively lowered the groundwater table approximately 5 to 6 feet in the watershed behind the coastal ridge.

Today, surface water flows to the south-central bay originate in the primary basins of C-100 (Cutler Drain), C-1 (Black Creek), C-102 (Princeton Canal), and C-103 (Mowry Canal) (Figure 4). Secondary basins include North Canal, Florida City Canal, and Military Canal, serving the Homestead Air Reserve Base. A minor amount of overland sheet flow, directly to the bay, also occurs in the small coastal basins east of the L-31E canal.

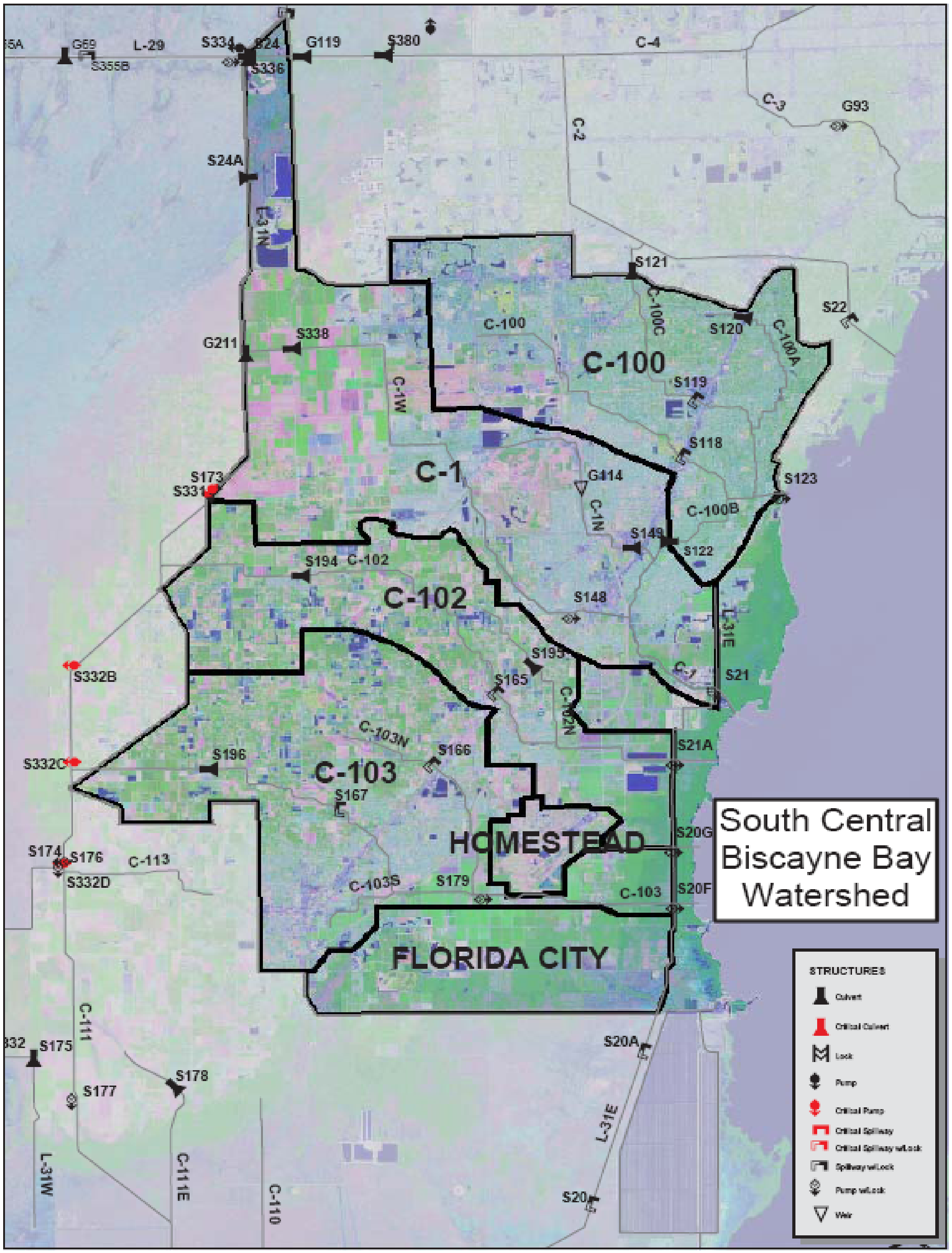
Each primary canal basin is divided operationally into western and eastern sub-basins by control structures near the coastal ridge. Surface flow follows the historical pattern with flow from western sub-basins through coastal ridge structures to the eastern sub-basins. Water management in each sub-basin involves balancing conflicting objectives. The basins have limited capacity to store water, primarily in lakes, drainage conveyances, and soil.

Figure 3. Historical Creeks and Transverse Glades



Source: Meeder et,al ., 1999

Figure 4. Coastal Canals Drainage Basins



During periods of high rainfall, this capacity is exceeded and surface water is released to prevent flooding. During periods of little rainfall, basin storage is depleted, primarily through evaporation and seepage, and surface water is kept behind water control structures to maintain groundwater levels for agricultural irrigation and protection against saltwater intrusion (SFWMD Water Control Manual). The closing stage elevations and highest headwater elevations for the control structures in the major canals are shown in Table 1.

Table 1. Operational criteria of canals in the area

Basin	Structure	Closing Stage ft. NGVD	Highest Headwater Recorded Elev. ft.
C-100 CANAL	S-118	3.5	4.94
C-100 CANAL	S-119	4.2	N/A
C-100 CANAL	S-123	2.5	3.87
C-1 CANAL	S-148	3.7	5.80
C-1 CANAL	S-149	4.8	4.90
C-1 CANAL	S-21	1.5	2.80
C-102 CANAL	S-165	5.1	7.55
C-102 CANAL	S-195	5.5	7.10
C-102 CANAL	S-21A	1.4[1]	2.87
C-103 CANAL	S-166	4.7	4.70
C-103 CANAL	S-167	5.1	5.10
C-103 CANAL	S-20F	1.3	3.05

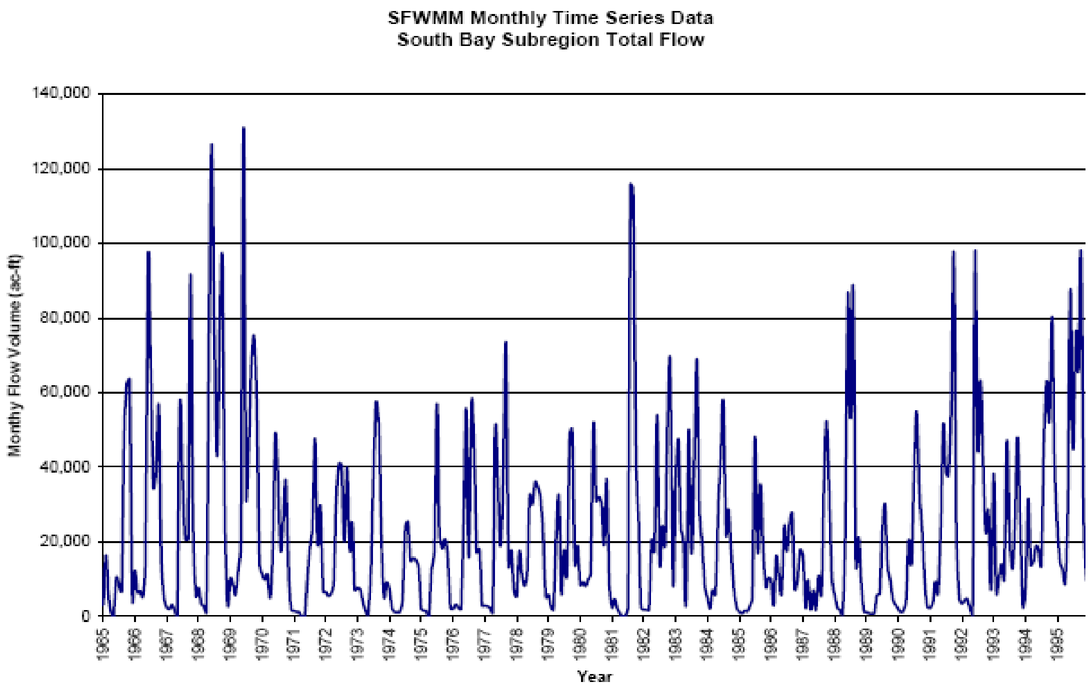
[1] From December 30 thru April 30 unless rainfall persists in the basin
Source: SFWMD Operations Manual

The high seasonality of rainfall, as well as drainage improvements throughout the watershed, suggest that the discharge of surface water dominates the flow of freshwater to the bay. In fact, approximately 80 percent of the total flow to the bay in an average year occurs as surface water discharge. This flow is highly variable between individual rainfall years and between wet and dry seasons as shown in the Figure 5 below. On a day-to-day basis, minimal direct correlation exists between individual rainfall events and discharges due to the influence of structural water management, i.e., smaller rainfall events may be held within the watershed. A volumetric correlation between cumulative rainfall and discharge becomes apparent after periods of 30 or more days. During drought events, water is held behind structures in the watershed in order to maintain groundwater stages to prevent saltwater intrusion.

3.7.1 Secondary Canals in the Vicinity of Project Area

Miami-Dade County maintains operational control of a borrow canal west of SW 97th Avenue. This canal directs discharge into the C-1 Canal from upstream properties. As part of the Lennar Mitigation Parcel construction, the canal was filled in through application of a Class III permit. In order to limit the need for seepage control and crossing of this canal, the BBCW Acceler8 project intends to abandon the remaining length of this canal north of SW 232nd Street.

Figure 5. Simulated flows to Biscayne Bay



3.8 Groundwater Hydrology

Groundwater is a significant source of freshwater to the south-central region of Biscayne Bay. The Biscayne Aquifer consists of sandstone and cavity-riddled limestone and reaches depths of 60 to 160 feet below sea level along the western coast of Biscayne Bay. Based on its high transmisivity, the Biscayne Aquifer is considered one of the most permeable aquifers in the world.

The natural flow of groundwater is from northwest to southeast, although local flows may be diverted by the drainage canals or withdrawal from wellfields. The Biscayne Aquifer is larger than the overlaying surface water hydrography. For this reason, a portion of the groundwater flow to Biscayne Bay is seepage flowing from the Everglades, north and west of the local watershed. This regional source of groundwater constitutes a base flow to the local watershed and is usually sufficient to maintain dry season target stages behind control structures.

Geotechnical borings in the Lennar Flow Way conducted during the BODR preparation indicate groundwater averages between 3 to 4 feet below grade with average elevation of 0 feet NGVD. Tidal influence is seen as having little or no influence on the freshwater head due to flow in the coastal canal system (CDM and CH2MHill, 2007).

3.9 Vegetation

3.9.1 The 60-Acre Constructed Wetland Site

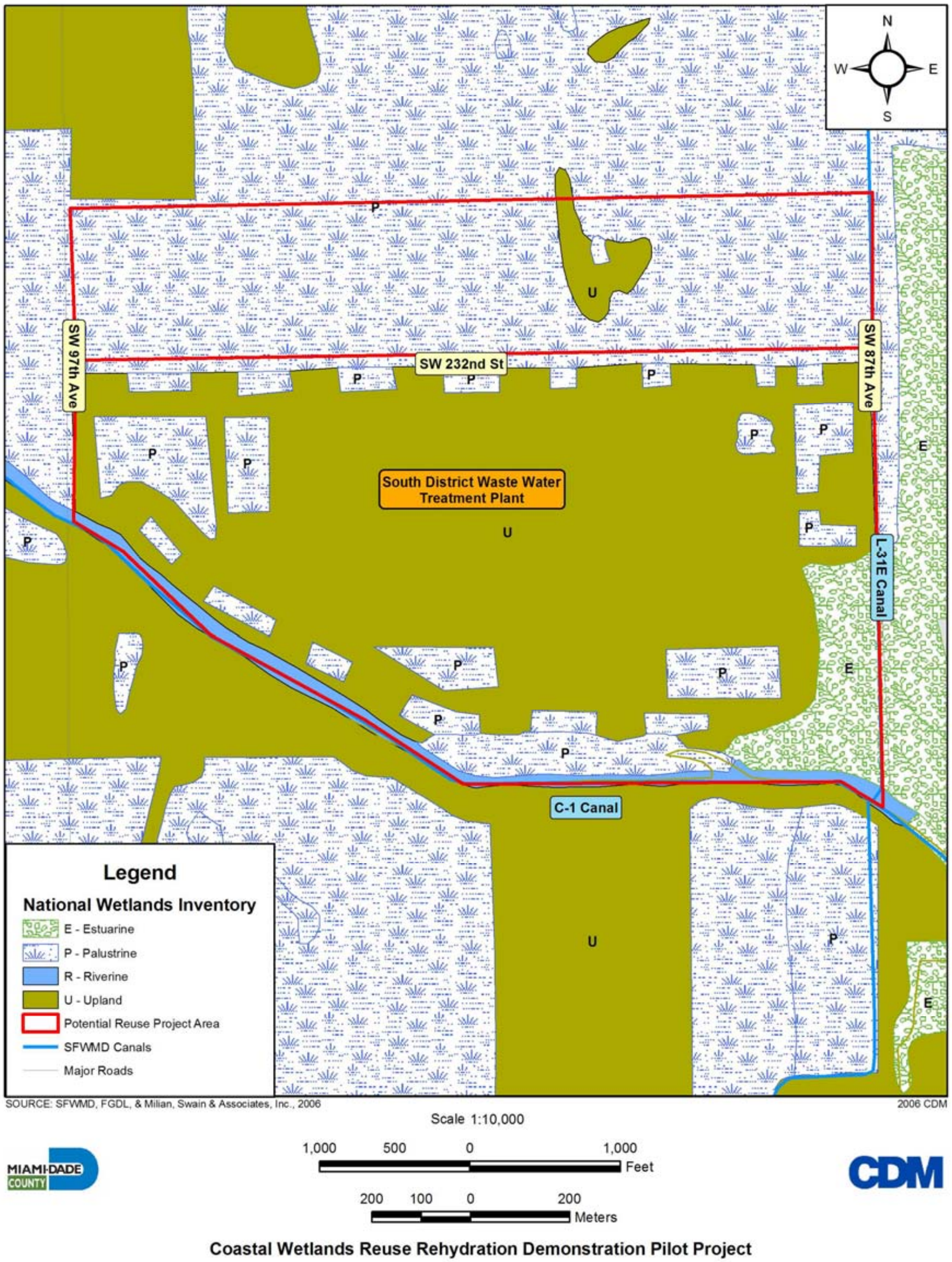
The National Wetlands Inventory survey conducted from 1971 to 1992 characterized the test area as a palustrine wetland (USFWS, 1992). The NWI data is included in Figure 6. Vegetation within the vicinity of the 60-acre constructed wetland site was historically comprised of coastal mangrove, saltwater and freshwater marshes, tropical and hardwood hammock, pine rockland, and embayments with aquatic vegetation (URS 2006).

Between the early 1900's and the late 1970's cultivation of malanga (Xanthosoma spp.), yucca (Yucca spp.), and potatoes (Solanum spp.) changed the naturally occurring vegetation, leaving it vulnerable to exotic recruitment once agricultural practices ceased by 1980.

Currently, the test area contains large stands of maiden cane (*Panicum hemitomon)* and is predominantly overgrown with Brazillian pepper (*Schinus terebinthifolius*), vines (*Ipomoea* spp., and *Dioscorea alata*), and castor bean (*Ricinus* spp.). There were a few hardwoods, silk trees (*Albizia julibrissin*) and Australian pine (*Causarina equisetifolia* L.), observed on the edge of the property. However, hardwoods within the interior were not readily identifiable, as the interior of the test area was not readily accessible by foot. Following are picture is representative of the vegetation at the site.

South side of the 60-Acre area (facing west)

Figure 6. National Wetlands Inventory Map



3.9.2 Lakes by the Bay South Commons Mitigation Area

Only cursory observations were made for the vegetation within the 160-acre mitigation area constructed immediately to the north and west of the test site. However, the mitigation and monitoring plan developed for this area indicates that 138.08 acres of the area are shallow, freshwater marsh, 15.67 acres of deep water habitat, and 6.58 acres of upland buffer (Ford Engineers, 2003). A baseline report was generated for this area in 2004, and a one-year monitoring report was generated in 2005. Today, this constructed wetland contains mostly cattail (*Typha* spp.) and other low lying aquatic vegetation. The following picture is typical of the interior of the Lennar development mitigation area.

3.9.3 The 10-Acre Property

The vegetation of the 10-acre site to the east of the mitigation wetland is nearly identical to that found in the 60-acre test area. Absent only are the large stands of Maiden Cane (*Panicum hemitomon)* seen in the 60-acre site.

3.10 Water Quality

The water quality section of this environmental assessment summarizes the datasets that were readily available within the vicinity of the project area, Biscayne Bay, and the Biscayne Bay Coastal Wetlands. The water quality investigation results are presented in the following two sections. The section following those two discusses the status of the Bay's status as an Outstanding Florida Water (OFW) and the reuse project targets Time series graphics of the datasets from all water quality stations presented in the water quality section is presented in Insert A, and box plots of selected parameters are shown in Insert B.

3.10.1 Water Quality in Project Vicinity and Biscayne Bay

This following section presents a summary of water quality parameters developed by DERM and FIU in the vicinity of the MDWASD South District Waste Water Treatment Plant (SDWWTP) and Biscayne Bay. The following stations from the DERM Status and Trends Report, presented in Figure 7 below, were chosen as representative of the water quality conditions in the study area; BB37, BB38, BB39A, BB41, BB52, BB53, BL01, BL02, BL03, GL02, GL03, MI01, MI03, MW01, MW04, PR01, and PR03. Figures 8 contains a map showing those monitoring stations in close proximity to the project area.

The designation of the stations is based on the location where the samples were taken. For example, the designation BB is for stations located in open waters in Biscayne Bay, the designation BL is for stations located in the Black Creek (C-1) canal, the designation GL is for stations located in the Goulds canal, the designation MI is for stations located in the Military Canal, the designation MW is for stations located in the Mowry (C-103) canal and the designation PR is for stations located in the Princeton (C-102) canal.

The DERM Status and Trends Report also presents analyses of temporal trends and produced time series plots of parameters. The period of record analyzed was from January 1988 through September 2003. DERM has records from 1979 thru 1988 and after 2003 thru the present, but this information was not contained within the report. Recent data has not been reported in the DBHYDRO database and, according to DERM staff, does not significantly differ from the data already reported.

For consistency purposes, the FIU stations were not chosen because FIU used a different type of analysis, fewer parameters and a smaller period of record than DERM. The results of both sets of data were very similar with the exception of ammonia in which the results were different due to the filtering of the samples.

A summary of canals and Biscayne Bay water quality, taken from, the Status and Trends Report and is shown in Tables 2A, 2B, and 2C below. From this summary, it is evident that ammonia and total phosphorus concentrations in Black Creek (C-1) and Goulds Canals are higher than the remaining canals. Those two canals also have low dissolved oxygen, and high values of fecal and total coliform compared to stations in Biscayne Bay. The cause for these anomalies is groundwater seeping from the nearby landfills (Meeder, 2002). The Princeton (C-102) and Mowry canals showed elevated values of nitrate-nitrite concentrations due to runoff and seepage from adjacent farmland.

From Table 2A, and 2B, it can be concluded that Black Creek and Goulds canals contribute the majority of the ammonia loading to Biscayne Bay. This is a probable cause of toxicity in benthic organisms in the bay according to DERM. Phosphorous loading is relatively uniform, while nitrate-nitrite loading is coming primarily from the C-102 and C-103 canals. Nevertheless, rapid mixing of canal waters with Bay waters and short Biscayne Bay water renewal time appear to prevent pollutant concentration buildup.

Figure 7. Location of Water Quality Stations

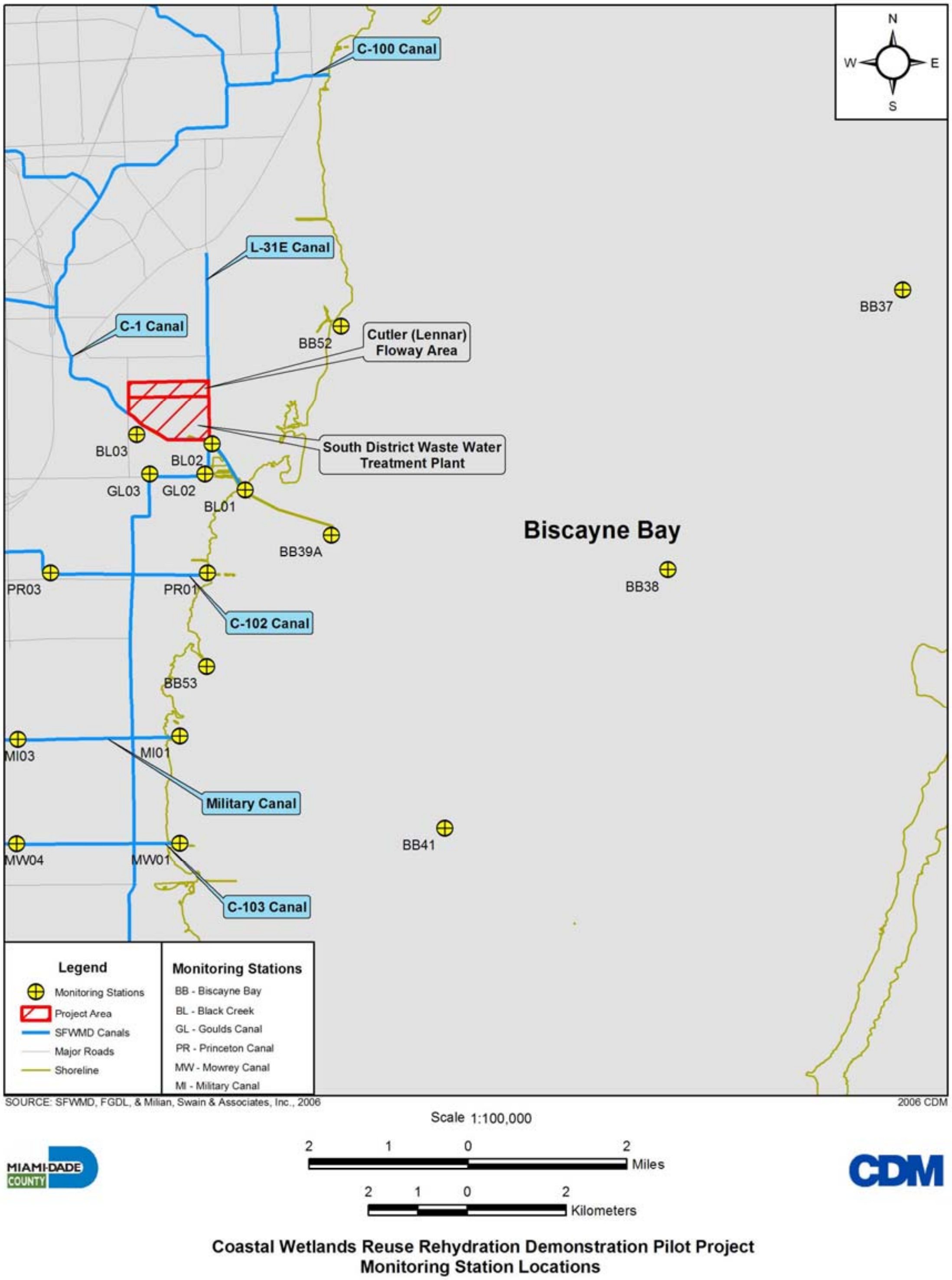
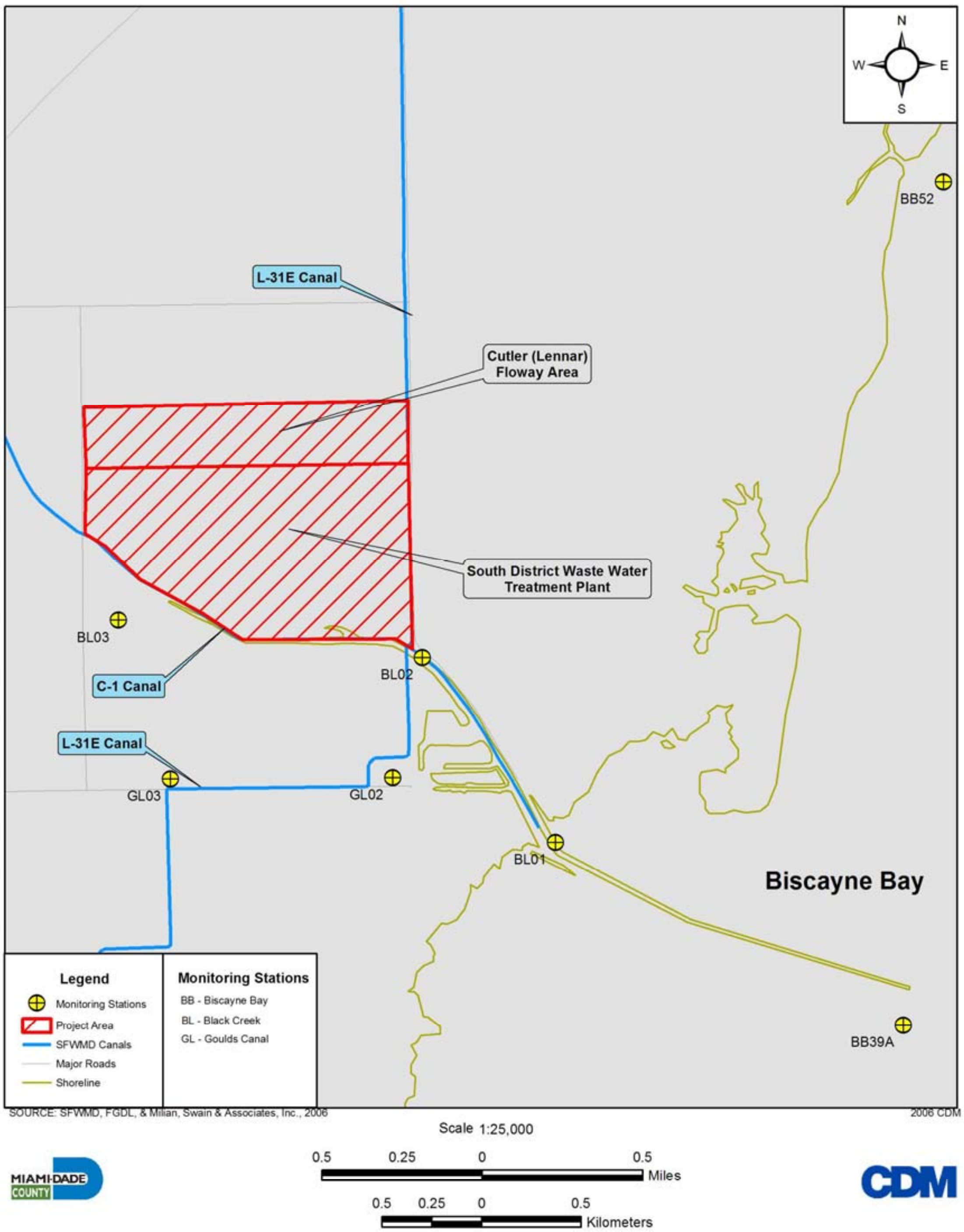


Figure 8. Water Quality Stations in the Project Area Vicinity



Coastal Wetlands Reuse Rehydration Demonstration Pilot Project
Monitoring Station Locations

Table 2A. Water Quality Data for Selected Parameters in the Project Area Vicinity and Biscayne Bay

Black Creek (C-1) Canal, Goulds Canal and Biscayne Bay Stations

Station No.	General Location	Year of Sample	Surface Dissolved Oxygen			Dissolved Oxygen (Bottom)			Ammonia Nitrogen (1 m depth)			Nitrite/Nitrate as Nitrogen			Total Kjeldahl Nitrogen		
			Min (mg/l)	Max (mg/l)	Mean (mg/l)	Min (mg/l)	Max (mg/l)	Mean (mg/l)	Min (mg/l)	Max (mg/l)	Mean (mg/l)	Min (mg/l)	Max (mg/l)	Mean (mg/l)	Min (mg/l)	Max (mg/l)	Mean (mg/l)
BL01	C-1 Canal	1988-03	0.9	8.5	5.0	1.2	10.9	5.4	0.01	1.78	0.26	0.01	0.82	0.13	N/A	N/A	N/A
BL02	C-1 Canal	1988-03	0.4	9.4	5.0	0.2	9.0	4.7	0.01	3.71	0.25	0.01	0.81	0.14	N/A	N/A	N/A
BL03	C-1 Canal	1988-03	0.2	11.1	5.7	0.2	11.7	5.1	0.04	0.44	0.07	0.01	0.87	0.22	0.05	1.80	0.51
GL02	Gould Canal	1988-03	0.1	13.8	3.5	0.0	8.3	3.3	0.20	21.24	3.00	0.01	1.12	0.13	N/A	N/A	N/A
GL03	Gould Canal	1989-03	1.5	12.8	6.9	0.8	12.1	6.7	0.01	6.45	0.47	0.01	4.98	1.57	0.10	8.68	1.23
BB37	Biscayne Bay	1988-03	3.7	8.1	6.1	4.1	8.3	6.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BB38	Biscayne Bay	1988-03	4.2	8.5	5.9	0.0	8.34	6.0	0.01	0.22	0.07	0.01	0.11	0.01	N/A	N/A	N/A
BB39A	Biscayne Bay	1997-03	2.9	10.0	6.2	3.7	10.2	6.40	0.00	0.17	0.07	0.01	0.54	0.09	N/A	N/A	N/A
BB52	Biscayne Bay	1999-03	3.8	9.9	6.3	3.8	10.1	6.5	0.00	0.20	0.08	0.01	0.35	0.03	N/A	N/A	N/A
Princeton (C-102) Canal, and Biscayne Bay Stations																	
PR01	C-102 Canal	1990-03	2.9	8.7	5.6	0.1	11.1	5.5	0.01	1.00	0.14	0.01	4.48	1.46	0.13	0.51	0.32
PR03	C-102 Canal	1990-03	2.3	10.5	5.7	2.3	10.9	5.6	0.00	0.32	0.04	0.22	5.66	4.09	0.05	4.80	0.59
BB53	Biscayne Bay	1999-03	4.0	11.6	7.6	4.4	11.8	8.5	0.00	0.22	0.08	0.01	1.97	0.31	N/A	N/A	N/A
A. Mowry (C-103) Canal, Biscayne Bay Stations																	
MW01	C-103 Canal	1989-03	2.4	9.5	5.6	1.8	9.6	5.5	0.04	0.33	0.07	0.01	2.72	0.50	0.44	0.44	0.44
MW04	C-103 Canal	1991-03	0.6	12.9	6.4	0.2	13.0	5.8	0.04	0.17	0.03	0.18	6.02	2.34	0.05	2.60	0.48
BB41	Biscayne Bay	1988-03	4.6	9.7	6.3	5.0	8.7	6.6	0.00	0.21	0.07	0.01	0.20	0.03	N/A	N/A	N/A
Military Canal																	
MI01	Military Canal	1988-03	0.6	7.2	4.2	0.2	10.1	5.0	0.04	0.25	0.09	0.01	0.96	0.17	N/A	N/A	N/A
MI03	Military Canal	1988-03	1.6	13.6	6.5	0.0	14.9	6.2	0.04	0.38	0.05	0.01	1.90	0.60	0.05	3.60	0.49

Source: Miami Dade Department of Environmental Resources Management (DERM), Biscayne Bay Water Quality Status and Trends Report, March, 2005

Table 2B. Water Quality Data for Selected Parameters in the Project Area Vicinity and Biscayne Bay

Station No.	General Location	Year of Sample	Ortho -Phosphate as P (1 m depth)			Total Phosphate as P (1 m depth)			Total Suspended Solids)			Fecal Coliform			Total Coliform		
			Min (mg/l)	Max (mg/l)	Mean (mg/l)	Min (mg/l)	Max (mg/l)	Mean (mg/l)	Min (mg/l)	Max (mg/l)	Mean (mg/l)	Min cfu/ 100ml	Max cfu/100 ml	Mean cfu/100ml	Min cfu/ 100ml	Max cfu/100 ml	Mean cfu/100ml
Black Creek (C-1) Canal, Goulds Canal and Biscayne Bay Stations																	
BL01	C-1 Canal	1988-03	N/A	N/A	N/A	0.001	0.085	0.012	1.0	54.0	9.7	5	3,000	104	1	24,000	380
BL02	C-1 Canal	1988-03	N/A	N/A	N/A	0.001	0.085	0.012	1.0	31.0	7.0	5	2,600	90	5	4,500	247
BL03	C-1 Canal	1988-03	0.001	0.030	0.006	0.001	0.320	0.012	1.0	24.0	3.1	4	2,300	105	5	5,000	334
GL02	Gould Canal	1988-03	N/A	N/A	N/A	0.001	0.202	0.021	2.0	35.0	12.3	5	160,000	1,254	5	200,000	2,828
GL03	Gould Canal	1989-03	0.002	0.200	0.012	0.001	0.085	0.018	0.0	54.4	5.5	5	2,800	99	5	17,500	432
BB37	Biscayne Bay	1988-03	N/A	N/A	N/A	N/A	N/A	N/A	1.0	51.0	10.3	1	150	6	1	300	7
BB38	Biscayne Bay	1988-03	N/A	N/A	N/A	N/A	N/A	N/A	1.0	34.0	9.4	1	5	5	1	20	5
BB39A	Biscayne Bay	1997-03	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	4600	65	5	7,500	121
BB52	Biscayne Bay	1999-03	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	20	6	5	200	15
Princeton (C-102) Canal, and Biscayne Bay Stations																	
PR01	C-102 Canal	1990-03	0.005	0.007	0.006	0.001	0.100	0.0104	2.0	27.0	14.5	5	2300	74	5	24000	407
PR03	C-102 Canal	1990-03	0.001	0.080	0.006	0.001	0.240	0.009	0.0	28.0	3.7	5	3500	128	5	8000	602
BB53	Biscayne Bay	1999-03	N/A	N/A	N/A	0.001	0.085	0.008	N/A	N/A	N/A	5	350	13	5	2000	59
B. Mowry (C-103) Canal, Biscayne Bay Stations																	
MW01	C-103 Canal	1989-03	0.007	0.007	0.007	0.001	0.085	0.010	1.0	37.0	9.4	2	300	26	4	8000	197.35
MW04	C-103 Canal	1991-03	0.001	0.067	0.006	0.001	0.280	0.009	0.0	24.0	3.7	4	3000	60	5	24000	331
BB41	Biscayne Bay	1988-03	N/A	N/A	N/A	N/A	N/A	N/A	1.0	40.0	11.0	1	10	5	1	15	5
BB42	Biscayne Bay	1988-00	N/A	N/A	N/A	N/A	N/A	N/A	1.0	44.0	12.1	1	10	5	1	30	5
BB43	Biscayne Bay	1988-00	N/A	N/A	N/A	N/A	N/A	N/A	1.0	40.0	10.9	1	10	5	1	19	5
BB44	Biscayne Bay	1988-00	N/A	N/A	N/A	0.001	0.085	0.004	1.0	37.0	9.4	1	20	5	1	30	5

Source: Miami Dade Department of Environmental Resources Management (DERM), Biscayne Bay Water Quality Status and Trends Report, March, 2005

Table 2B (continued). Water Quality Data for Selected Parameters in the Project Area Vicinity and Biscayne Bay

Military Canal																		
Station No.	General Location	Year of Sample	Ortho -Phosphate as P (1 m depth)			Total Phosphate as P (1 m depth)			Total Suspended Solids)			Fecal Coliform			Total Coliform			
			Min (mg/l)	Max (mg/l)	Mean (mg/l)	Min (mg/l)	Max (mg/l)	Mean (mg/l)	Min (mg/l)	Max (mg/l)	Mean (mg/l)	Min cfu/ 100ml	Max cfu/100ml	Mean cfu/100ml	Min cfu/ 100ml	Max cfu/100 ml	Mean cfu/100ml
MI01	Military Canal	1988-03	0.640	7.220	4.152	0.180	10.130	4.972	0.0	0.3	0.1	0	1	0	N/A	N/A	N/A
MI03	Military Canal	1988-03	1.620	13.610	6.547	0.000	14.880	6.183	0.0	0.4	0.1	0	2	1	0	4	0

Source: Miami Dade Department of Environmental Resources Management (DERM), Biscayne Bay Water Quality Status and Trends Report, March, 2005

Table 2C. Water Quality Data for Selected Parameters in the Project Area Vicinity and Biscayne Bay

Black Creek (C-1) Canal, Goulds Canal and Biscayne Bay Stations

Station No.	General Location	Year of Sample	Surface Salinity			Bottom Salinity			pH (1 m depth)			Lead			Zinc			Cadmium		
			Min (ppt)	Max (ppt)	Mean (ppt)	Min (ppt)	Max (ppt)	Mean (ppt)	Min (pH units)	Max (pH units)	Mean (pH units)	Min (ug/l)	Max (ug/l)	Mean (ug/l)	Min (ug/l)	Max (ug/l)	Mean (ug/l)	Min (ug/l)	Max (ug/l)	Mean (ug/l)
BL01	C-1 Canal	1988-03	0.0	43.8	18.5	0.3	43.8	24.5	7.0	8.5	7.9	0.1	1.0	0.6	1.0	6.1	3.3	0.1	0.1	0.1
BL02	C-1 Canal	1988-03	0.0	40.4	17.2	0.3	40.4	24.4	7.0	8.5	7.8	1.0	1.0	1.0	1.5	1.5	1.5	0.2	0.2	0.2
BL03	C-1 Canal	1988-03	0.0	13.4	0.5	0.0	13.4	0.7	7.0	8.2	7.6	0.1	5.0	1.2	0.5	30.0	4.8	0.0	0.5	0.1
GL02	Gould Canal	1988-03	0.0	36.1	15.5	2.5	36.1	17.9	6.0	8.2	7.6	1.0	1.0	1.0	3.2	3.2	3.2	0.1	0.1	0.1
GL03	Gould Canal	1989-03	0.0	1.2	0.5	0.0	1.2	0.5	6.7	8.1	7.6	0.16	34.6	2.0	1.5	20.0	5.0	0.1	0.5	0.1
BB37	Biscayne Bay	1988-03	14.0	43.4	35.4	27.4	43.2	35.4	7.0	8.6	8.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BB38	Biscayne Bay	1988-03	10.3	50.2	35.6	28.7	42.2	35.7	7.0	8.6	8.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BB39A	Biscayne Bay	1997-03	1.8	40.9	28.7	14.0	40.8	29.2	7.6	8.4	8.1	0.1	0.7	0.1	6.1	6.1	6.1	N/A	N/A	N/A
BB52	Biscayne Bay	1999-03	8.3	37.4	24.4	9.3	37.4	24.5	8.1	8.4	8.3	0.1	0.1	0.1	6.1	6.1	6.1	0.0	0.0	0.0
Princeton (C-102) Canal, and Biscayne Bay Stations																				
PR01	C-102 Canal	1990-03	0.0	34.6	7.8	0.4	38.2	20.1	7.0	8.5	7.8	0.0	2.0	0.8	0.9	10.0	2.5	0.0	1.0	0.2
PR03	C-102 Canal	1990-03	0.0	0.9	0.3	0.0	18.3	0.5	6.6	8.0	7.3	0.0	2.0	1.0	0.9	29.0	4.6	0.0	0.5	0.1
BB53	Biscayne Bay	1999-03	2.9	40.0	20.8	3.6	40.1	21.6	7.9	8.4	8.1	0.1	0.3	0.1	6.1	6.1	6.1	0.0	0.0	0.0
Mowry (C-103) Canal, Biscayne Bay Stations																				
MW01	C-103 Canal	1989-03	0.1	40.2	16.0	0.4	41.3	26.5	7.0	8.6	7.9	0.1	2.0	0.8	1.5	10.0	2.4	0.0	1.0	0.2
MW04	C-103 Canal	1991-03	0.0	1.1	0.4	0.0	19.9	1.2	6.0	8.10	7.5	0.1	2.3	1.0	0.9	30.0	4.6	0.0	3.3	0.1
BB41	Biscayne Bay	1988-03	9.3	41.7	33.7	24.4	41.7	33.9	7.0	8.4	8.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BB42	Biscayne Bay	1988-00	19.7	42.1	35.5	28.8	42.1	35.8	7.8	8.3	8.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BB43	Biscayne Bay	1988-00	25.6	41.4	35.4	29.8	41.5	35.6	7.0	8.3	8.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BB44	Biscayne Bay	1988-00	1.2	42.9	34.6	22.3	42.5	35.2	7.0	8.4	8.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Miami Dade Department of Environmental Resources Management (DERM), Biscayne Bay Water Quality Status and Trends Report, March, 2005

Table 2C (continued). Water Quality Data for Selected Parameters in the Project Area Vicinity and Biscayne Bay

Military Canal																					
Station No.	General Location	Year of Sample	Surface Salinity			Bottom Salinity			pH (1 m depth)			Lead			Zinc			Cadmium			
			Min (ppt)	Max (ppt)	Mean (ppt)	Min (ppt)	Max (ppt)	Mean (ppt)	Min (pH units)	Max (pH units)	Mean (pH units)	Min (ug/l)	Max (ug/l)	Mean (ug/l)	Min (ug/l)	Max (ug/l)	Mean (ug/l)	Min (ug/l)	Max (ug/l)	Mean (ug/l)	
MI01	Military Canal	1988-03	0.4	38.3	15.8	0.5	40.7	22.9	7.0	8.4	7.8	0.1	0.4	0.1	6.1	6.1	6.1	N/A	N/A	N/A	
MI03	Military Canal	1988-03	0.0	2.0	0.3	0.0	8.5	0.5	5.8	8.7	7.5	0.1	5.0	1.1	0.5	110.0	6.0	0.0	0.9	0.1	

Source: Miami Dade Department of Environmental Resources Management (DERM), Biscayne Bay Water Quality Status and Trends Report, March, 2005

3.10.2 Water Quality in the Biscayne Bay Coastal Wetlands

There is very little information regarding water quality in the Biscayne Bay coastal wetlands. Dr. John Meeder, a long-time FIU Biscayne Bay researcher, conducted the majority of the information related to the water quality of this area.

In a report from February 2001, submitted to Biscayne National Park (BNP), Dr. Meeder summarized the findings of a monitoring program in the vicinity of Black Point and a nutrient survey along the coastal shoreline.

The Black Point monitoring program (shown on Figure 9 below) was designed to produce a monthly characterization of nutrient concentrations in the receiving waters surrounding the South Dade landfill. The study showed that nutrient concentrations, especially ammonium, were elevated in the canals adjacent to the landfill. In addition, very low concentrations of dissolved oxygen were reported. These stressed conditions are well known to be highly detrimental to marine ecosystems.

A Shoreline Nutrient Survey was conducted by Dr. Meeder to produce a high resolution map of ammonia along the western shoreline of BNP and to point out any hot spots within the mangroves, surface water, and marine sediments.

During the 1998 dry season, nutrient concentrations in nearshore surface water (50 m offshore), marine sediment pore water (50 m offshore), mangrove soils (25 m onshore), and mangrove surface waters (25 m onshore) were sampled approximately every 1 km along the west shoreline for a total of 22 locations (See Figure 10). Meeder also sampled near canal mouths and at significant features.

Figure 9. **Black Point Monitoring Sampling Sites**

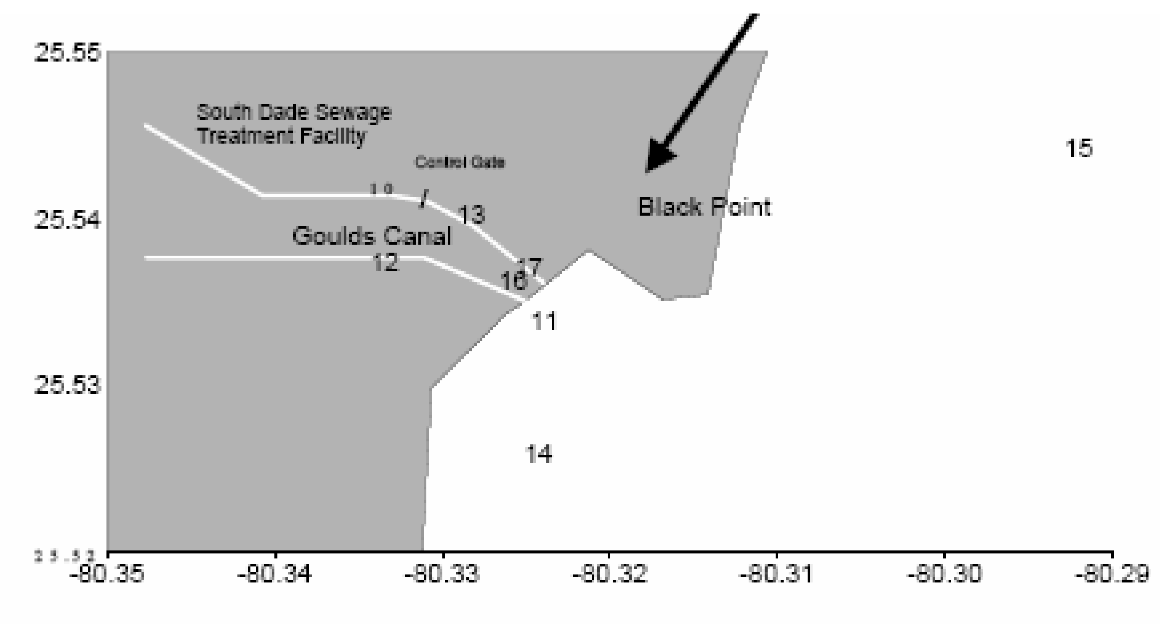
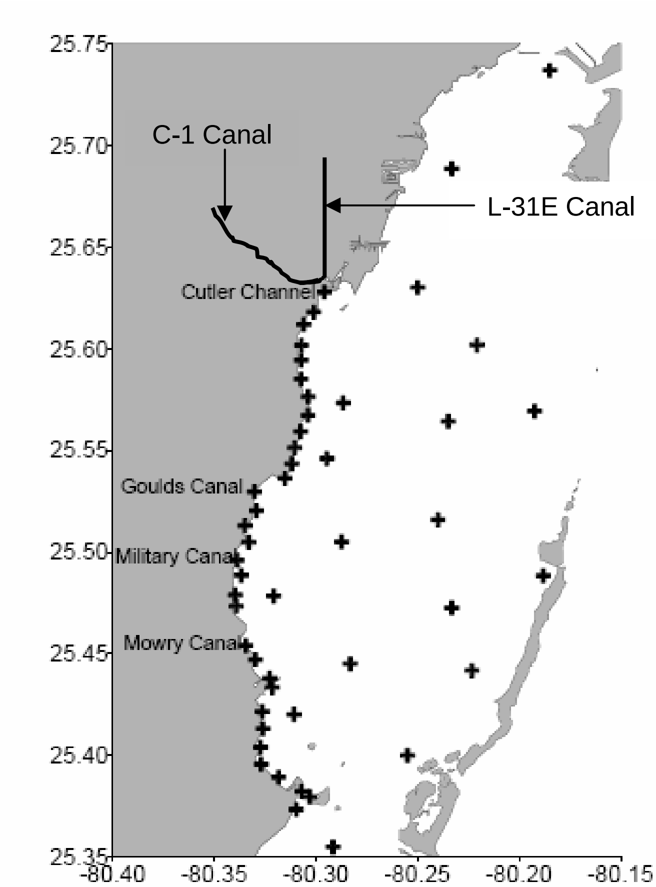


Figure 10. Nutrient Survey Shoreline Sampling Sites



Source: Meeder J.F. and Boyer J.N., Total Ammonia Concentration in Soil, Sediments, Surface Water, and Groundwater along the Western Shoreline of Biscayne Bay with the Focus on Black Point and a Reference Mangrove Site. Southeast Environmental Research Center, Florida International University, Miami, Florida; 2001.

The Shoreline Nutrient Survey showed that ammonium concentrations were highest in the nearshore waters off Black Point, the Cutler Canal, and the Mowry Canal area. A very different distribution was observed for nitrate where highest concentrations were found off the Cutler Canal and very low levels were found in the nearshore waters between Cutler Channel and Goulds Canal. Another interesting aspect was the correlation between sediment and water column nutrient levels. Levels of ammonium in the sediments are approximately an order of magnitude higher than the water column and generally follow each other. This also was the case for total phosphorus although the concentrations in sediment and water were only different by a factor of three (3).

The summary of results from the monthly Black Point monitoring program reported concentrations of DO from 0.2 – 11.4 mg /l, pH from 6.90 – 8.78, $(NH4)^+$ from 0.004 – 26.97 mg /l, and NH3 from 0.0 – 654 ug/l. Additional nutrient values also showed large ranges: Nitrite-Nitrate from 0.002 – 0.415 mg /l and TP from 0.002 – 0.94 mg /l. These large ranges are indicative of terrestrial/groundwater nutrient loading to the canals and inshore areas of Biscayne Bay. Table 3, provided below, shows the results of the monitoring program for selected parameters. Figures 11 and 12 show plots of the Ammonia and Phosphorus concentrations comparison in the water column and the sediments in ppm (mg/l).

Groundwater nutrient levels obtained 50 m offshore along Biscayne Bay, from the Dinner Key to Mowry Canal, have total ammonia concentrations 30 or more times greater than those of overlying surface waters (Meeder et al. 1997).

Table 3. Summary of Water Quality Data for the Black Point Monitoring Report

Station No.	General Location	Year of Sample	Surface Dissolved Oxygen			Dissolved Oxygen (Bottom)			Ammonia Nitrogen $(NH_4)^+$			Nitrate			Total Phosphorus		
			Min (mg/l)	Max (mg/l)	Med (mg/l)	Min (mg/l)	Max (mg/l)	Med (mg/l)	Min (mg/l)	Max (mg/l)	Med (mg/l)	Min (mg/l)	Max (mg/l)	Med (mg/l)	Min (mg/l)	Max (mg/l)	Med (mg/l)
10	Wetlands	1998	1.10	8.10	5.70	N/A	N/A	N/A	0.017	0.353	0.055	0.019	0.412	0.202	0.004	0.323	0.011
11	C-1 Canal	1998	1.10	6.80	4.75	2.10	8.70	5.00	0.097	0.672	0.219	0.009	0.415	0.109	0.003	0.042	0.010
12	Goulds Canal	1998	0.40	5.90	3.80	0.20	6.60	2.50	0.222	26.97	3.265	0.004	0.387	0.123	0.002	0.030	0.011
13	C-1 Canal	1998	1.00	7.30	4.95	1.20	6.80	4.55	0.103	0.752	0.176	0.014	0.369	0.129	0.002	0.015	0.008
14	Bayshore	1998	2.70	11.20	5.30	2.70	11.4	5.70	0.011	0.515	0.211	0.002	0.195	0.095	0.004	0.020	0.008
15	Biscayne Bay	1998	3.80	8.10	6.90	4.80	11.2	7.55	0.004	0.135	0.042	0.000	0.338	0.062	0.002	0.017	0.005
16	Wetlands	1998	1.90	5.10	3.50	N/A	N/A	N/A	0.079	0.481	0.113	0.034	0.082	0.041	0.006	0.940	0.024
17	C-1 Canal	1998	2.30	4.40	3.35	N/A	N/A	N/A	0.037	0.048	0.047	0.002	0.031	0.030	0.006	0.014	0.012

Source: Meeder J.F. and Boyer J.N., Total Ammonia Concentration in Soil, Sediments, Surface Water, and Groundwater along the Western Shoreline of Biscayne Bay with the Focus on Black Point and a Reference Mangrove Site. Southeast Environmental Research Center, Florida International University, Miami, Florida; 2001.

Figure 11. Ammonia (NH4)+ Concentration along the Nutrient Survey Shoreline

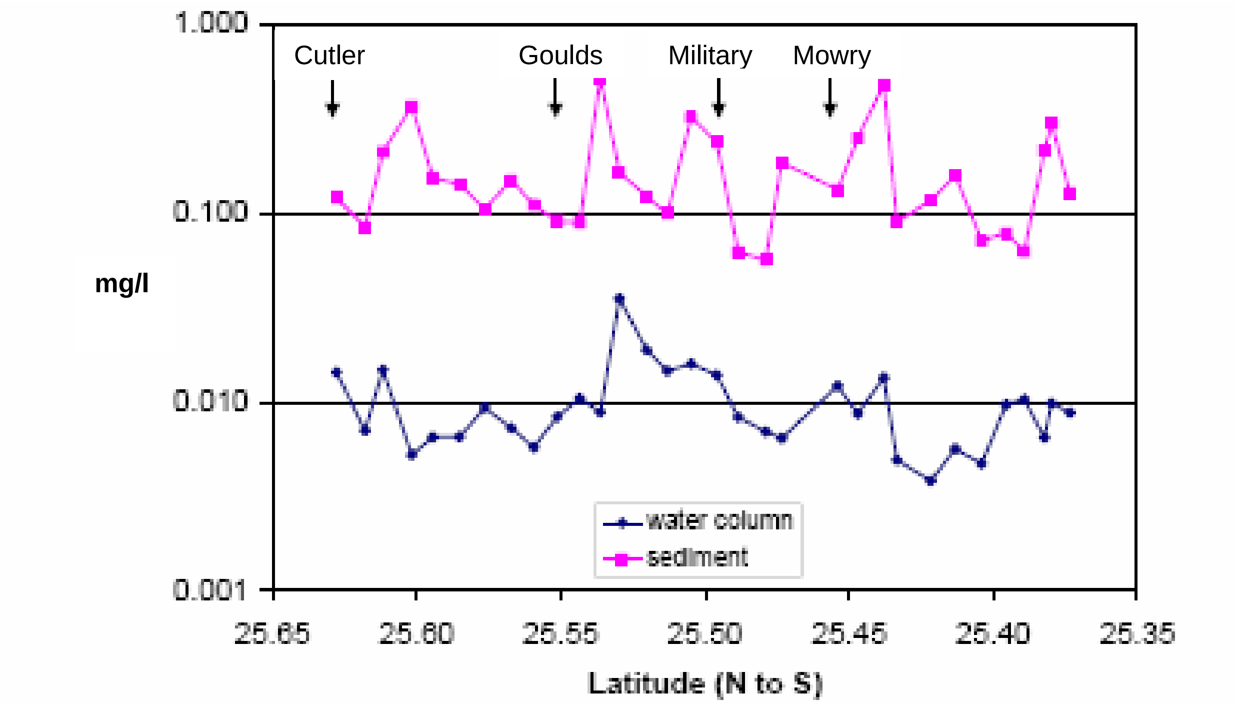
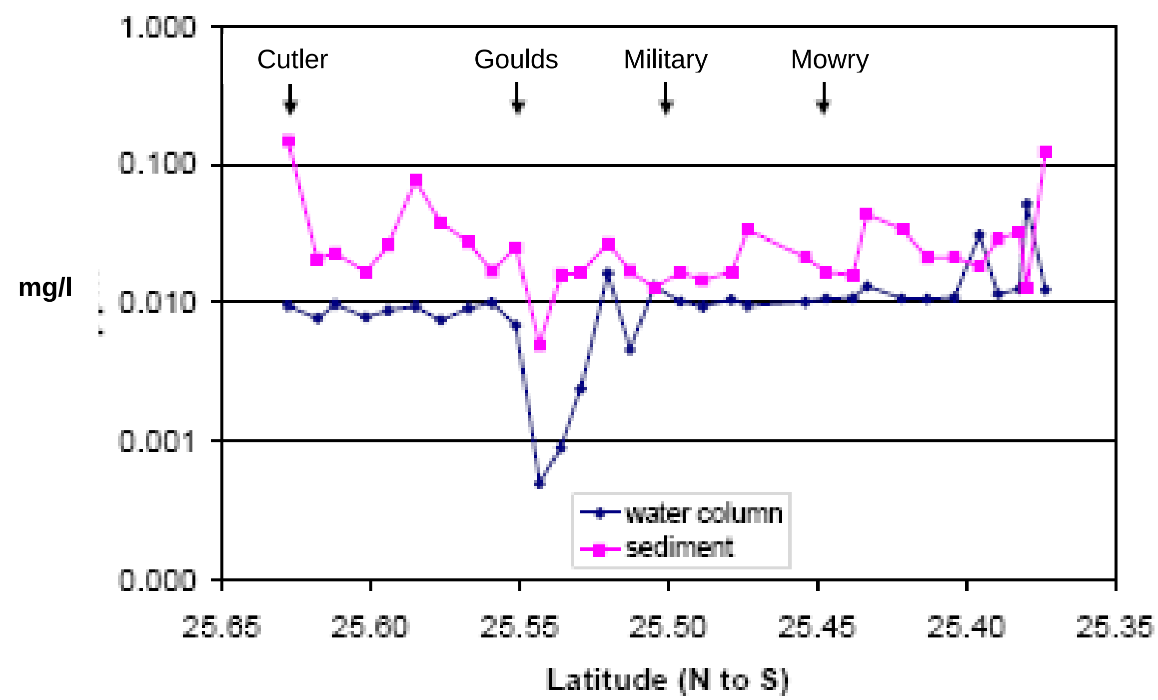


Figure 12. Phosphorus Concentration along the Nutrient Survey Shoreline



Source: Meeder J.F. and Boyer J.N., Total Ammonia Concentration in Soil, Sediments, Surface Water, and Groundwater along the Western Shoreline of Biscayne Bay with the Focus on Black Point and a Reference Mangrove Site. Southeast Environmental Research Center, Florida International University, Miami, Florida; 2001.

4.0 Water Quality Targets

Biscayne Bay National Park and the Biscayne Bay Aquatic Preserve are classified as an Outstanding Florida Water (OFW) under Section 17-302.530(48)(b), Florida Administrative Code (FAC). This classification prohibits the degradation of ambient surface water quality by sources subject to permit requirements. Numeric standards do not currently exist by which to implement this rule. Discharge to Outstanding Florida Waters is regulated by Chapter 62-302.700; FAC. This standard is stringent with respect to new or expanded surface water discharges, requiring that discharges must not degrade the ambient water quality. However, the term "ambient water quality" is ambivalent without the specification of water quality parameters as well as time and spatial distribution.

Tables 4A, 4B, and 4C, are presented to compare the water quality at stations in canal, canal/bay Interface and Biscayne Bay waters to the demonstration plant effluent water quality goals, as outlined in the Final Report South Dade Advanced Wastewater Treatment Alternatives (USCOE, 2004). The water quality goals included in this table include targets for standard public access reuse projects, wetland applications, heavy metals, Class III & OFW standards, and other targets outlined by the Biscayne Bay Partnership Initiative (BBPI), and baseline water quality in Biscayne Bay recommended by the Waste Water Reuse Pilot Project Delivery Team (WWRU PDT).

The mean datasets for those parameters listed in Tables 4A, 4B, and 4C, were separated into three location categories based on station salinity levels. Canal Stations show no visible evidence of prolonged saltwater influence from Biscayne Bay, containing salinity levels between 0 and 1.5 parts per thousand (ppt.). Canal/Bay Interface Stations show some visible evidence of saltwater influence from Biscayne Bay, containing salinity levels between 7 and 27 ppt. Biscayne Bay Stations listed are all located within the Bay and have salinity levels between 20 and 36 ppt. These tables demonstrate that the water surrounding the project area exceeds the effluent water quality goals being considered for this reuse project.

5.0 Summary of Findings

The CWRRDP Monitoring Program Baseline Assessment was performed to summarize the existing conditions in the proposed project area and to review the readily available water quality data that will be required to evaluate the physical, chemical, and biological responses to introducing reclaimed water into the proposed constructed wetland site.

Although multiple datasets for the surrounding canals, the coastal wetland fringe, and the Bay were provided, no data was readily available for the coastal wetlands specifically. Available datasets were provided to characterize the surrounding water quality and to provide existing conditions of the surrounding water bodies. Existing datasets consistent with the parameters anticipated for testing during the pilot testing were included. The CWRRDP effluent water quality goals being considered for this project are expected to exceed that of the surrounding areas. No data was readily available for microconstituents in the vicinity of the project area.

Table 4A. Effluent Water Quality Standards / Goals and Canal Conditions

Parameter	Effluent Water Quality Standards / Goals[a]				BBPI[b]	WWRU PDT[c]	Canal Stations					
	Irrigation Reuse	Wetlands Application	Heavy Metals	Class III Goal OFW			BL03*	GL03*	PR03	MI03	MW04	Mean
Total Nitrogen (mg/L)	-	3	-	0.27	-	-	0.80	3.26	4.72	1.13	2.85	**2.55**
Total Kjeldahl Nitrogen (mg/L)	-	-	-	0.22	-	0.36	0.51	1.23	0.59	0.49	0.48	**0.66**
Nitrite/ Nitrate (mg/L)	-	-	-	0.01	0.01	0.01	0.22	1.57	4.09	0.60	2.34	**1.76**
Ammonia Nitrogen (mg/L)	-	-	-	0.02 - 0.05	0.05	0.05	0.07	0.47	0.04	0.05	0.03	**0.13**
Total Phosphorus (mg/L)	-	1.000	-	0.005	0.005	0.005	0.012	0.018	0.009	0.015	0.009	**0.013**
Orthophosphate (mg/L)	-	-	-	0.002	-		0.006	0.012	0.006	0.008	0.006	**0.008**
Total Coliform (cfu/100ml)	<1.0	<1.0	-	<1.0	-	<10.0	334	432	602	166	331	**373**
Fecal Coliform (cfu/100ml)			-		-		105	99	128	39	60	**86**
Cadmium (ug/L)	-	-	0.1	-	-	-	0.1	0.1	0.1	0.1	0.1	**0.1**
Lead (ug/L)	-	-	0.7	-	-	-	1.2	2.0	1.0	1.1	1.0	**1.3**
Zinc (ug/L)	-	-	10.0	-	-	-	4.8	5.0	4.6	6.0	4.6	**5.0**
DO Surface (mg/L)	-	-	-	5.0 to 7.3	-	6.43	5.7	6.9	5.7	6.5	6.4	**6.2**
DO Bottom (mg/L)	-	-	-		-		5.1	6.7	5.6	6.1	5.8	**5.9**
Surface Salinity (ppt)	-	-	-	No change > 5 ppt	-	-	0.5	0.5	0.3	0.3	0.4	**0.4**
Bottom Salinity (ppt)	-	-	-		-	-	0.7	0.5	0.5	0.5	1.2	**0.7**
Total Suspended Solids (mg/L)	5.0**	5.0	-	3.5	-	-	3.1	5.5	3.7	2.9	3.7	**3.8**
pH	-	-	-	6.5 to 7.5*	-	-	7.0	6.7	6.6	5.8	6.0	**6.4**
Emerging Pollutants of Concern (EPOC)	-	-	-	Lowest Possible Level***	-	-	No Data Available					
Cryptosporidium and Giardia	-	-	-		-	-						

* Appropriate limits for pH in the estuarine zone will require further evaluation.

** Single sample maximum

*** Even though, currently there are no established numerical criteria or antidegradation targets for these parameters, available information shall be gathered on removal efficiency of various treatment technologies and detectable levels after advanced treatment for these parameters for comparative assessment. In practical terms, the objective would be to identify the technology that reduces such contaminants to the lowest level.

(a) Task 5 – Final Report South Dade Advanced Wastewater Treatment Alternatives, (USCOE, 2004)
(b) Biscayne Bay Partnership Initiative (BBPI)
(c) Waste Water Reuse Pilot Project Delivery Team (WWRU PDT)

Table 4B. Effluent Water Quality Standards / Goals and Canal/Bay Interface Conditions

Parameter	Effluent Water Quality Standards /Goals[a]				BBPI[b]	WWRU PDT[c]	Canal/Bay Interface (Brackish) Stations						
	Irrigation Reuse	Wetlands Application	Heavy Metals	Class III Goal OFW			BL01*	BL02*	GL02*	PR01	MI01	MW01	Mean
Total Nitrogen (mg/L)	-	3	-	0.27	-	-	-	-	-	1.92	-	1.00	**1.46**
Total Kjeldahl Nitrogen (mg/L)	-	-	-	0.22	-	0.36	-	-	-	0.32	-	0.44	**0.38**
Nitrite/ Nitrate (mg/L)	-	-	-	0.01	0.01	0.01	0.13	0.14	0.13	1.46	0.17	0.50	**0.42**
Ammonia Nitrogen (mg/L)	-	-	-	0.02 - 0.05	0.05	0.05	0.26	0.25	3.00	0.14	0.09	0.07	**0.63**
Total Phosphorus (mg/L)	-	1.000	-	0.005	0.005	0.005	0.012	0.012	0.021	0.010	0.012	0.010	**0.013**
Orthophosphate (mg/L)	-	-	-	0.002	-		-	-	-	0.006	-	0.007	**0.007**
Total Coliform (cfu/100ml)	<1.0	<1.0	-	<1.0	-	<10.0	380	247	2828	407	121	197	**697**
Fecal Coliform (cfu/100ml)			-		-		104	90	1254	74	29	26	**263**
Cadmium (ug/L)	-	-	0.1	-	-	-	0.1	0.2	0.1	0.2	-	0.2	**0.1**
Lead (ug/L)	-	-	0.7	-	-	-	0.6	1.0	1.0	0.8	0.1	0.8	**0.7**
Zinc (ug/L)	-	-	10.0	-	-	-	3.3	1.5	3.2	2.5	6.1	2.4	**3.2**
DO Surface (mg/L)	-	-	-	5.0 to 7.3	-	6.43	5.0	5.0	3.6	5.6	4.2	5.6	**4.8**
DO Bottom (mg/L)	-	-	-		-		5.4	4.7	3.3	5.5	5.0	5.5	**4.9**
Surface Salinity (ppt)	-	-	-	No change > 5 ppt	-	-	18.5	17.2	15.5	7.8	15.8	16.0	**15.1**
Bottom Salinity (ppt)	-	-	-		-	-	24.5	24.4	17.9	20.1	22.9	26.5	**22.7**
Total Suspended Solids (mg/L)	5.0**	5.0	-	3.5	-	-	9.7	7.0	12.3	14.5	-	9.4	**10.5**
pH	-	-	-	6.5 to 7.5*	-	-	7.0	7.0	6.0	7.0	7.0	7.0	**6.8**
Emerging Pollutants of Concern (EPOC)	-	-	-	Lowest Possible Level***	-	-	No Data Available						
Cryptosporidium and Giardia	-	-	-		-	-							

* Appropriate limits for pH in the estuarine zone will require further evaluation.

** Single sample maximum

*** Even though, currently there are no established numerical criteria or antidegradation targets for these parameters, available information shall be gathered on removal efficiency of various treatment technologies and detectable levels after advanced treatment for these parameters for comparative assessment. In practical terms, the objective would be to identify the technology that reduces such contaminants to the lowest level.

(a) Task 5 – Final Report South Dade Advanced Wastewater Treatment Alternatives, (USCOE, 2004)
(b) Biscayne Bay Partnership Initiative (BBPI)
(c) Waste Water Reuse Pilot Project Delivery Team (WWRU PDT)

Table 4C. Effluent Water Quality Standards / Goals and Biscayne Bay Conditions

Parameter	Effluent Water Quality Standards / Goals[a]				BBPI[b]	WWRU PDT[c]	Biscayne Bay Stations						
	Irrigation Reuse	Wetlands Application	Heavy Metals	Class III Goal OFW			BB39 A*	BB52	BB53	BB38	BB41	BB37	Mean
Total Nitrogen (mg/L)	-	3	-	0.27	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (mg/L)	-	-	-	0.22	-	0.36	-	-	-	-	-	-	**-**
Nitrite/ Nitrate (mg/L)	-	-	-	0.01	0.01	0.01	0.09	0.03	0.31	0.01	0.03	-	**0.09**
Ammonia Nitrogen (mg/L)	-	-	-	0.02-0.05	0.05	0.05	0.07	0.08	0.08	0.07	0.07	-	**0.07**
Total Phosphorus (mg/L)	-	1.000	-	0.005	0.005	0.005	-	-	0.008	-	-	-	**0.01**
Orthophosphate (mg/L)	-	-	-	0.002	-		-	-	-	-	-	-	-
Total Coliform (cfu/100ml)	<1.0	<1.0	-	<1.0	-	<10.0	121	15	59	5	5	7	**35.25**
Fecal Coliform (cfu/100ml)			-		-		65	6	13	5	5	6	**16.65**
Cadmium (ug/L)	-	-	0.1	-	-	-	-	0.0	0.0	-	-	-	**0.04**
Lead (ug/L)	-	-	0.7	-	-	-	0.1	0.1	0.1	-	-	-	**0.11**
Zinc (ug/L)	-	-	10.0	-	-	-	6.1	6.1	6.1	-	-	-	**6.10**
DO Surface (mg/L)	-	-	-	5.0 to 7.3	-	6.43	6.2	6.3	7.6	5.9	6.3	6.1	**6.39**
DO Bottom (mg/L)	-	-	-		-		6.4	6.5	8.5	6.0	6.6	6.3	**6.69**
Surface Salinity (ppt)	-	-	-	No change > 5 ppt	-	-	28.7	24.4	20.8	35.6	33.7	35.4	**29.75**
Bottom Salinity (ppt)	-	-	-		-	-	29.2	24.5	21.6	35.7	33.9	35.4	**30.05**
Total Suspended Solids (mg/L)	5.0**	5.0	-	3.5	-	-	-	-	-	9.4	11.0	10.3	**10.23**
pH	-	-	-	6.5 to 7.5*	-	-	7.6	8.1	7.9	7.0	7.0	7.0	**7.42**
Emerging Pollutants of Concern (EPOC)	-	-	-	Lowest Possible Level***	-	-	No Data Available						
Cryptosporidium and Giardia	-	-	-		-	-							

* Appropriate limits for pH in the estuarine zone will require further evaluation.

** Single sample maximum

*** Even though, currently there are no established numerical criteria or antidegradation targets for these parameters, available information shall be gathered on removal efficiency of various treatment technologies and detectable levels after advanced treatment for these parameters for comparative assessment. In practical terms, the objective would be to identify the technology that reduces such contaminants to the lowest level.

(a) Task 5 – Final Report South Dade Advanced Wastewater Treatment Alternatives, (USCOE, 2004)
(b) Biscayne Bay Partnership Initiative (BBPI)
(c) Waste Water Reuse Pilot Project Delivery Team (WWRU PDT)

Vegetation data has also been provided to characterize the existing conditions within the proposed constructed wetland site. It is not anticipated that any of the current vegetation will be used in the constructed wetland. Vegetation consistent with that found in the Coastal Wetlands Rehydration Area east of the SOWWTP will need to be planted in the constructed wetland areas. This vegetation will need an establishment period of more than a year to stabilize so that the response evaluations can begin in a "mature" system.

Specific recommendations for water quality and biological data collection will be outlined in the CWRRDP Monitoring Plan and will be based on monitoring plans implemented during other reuse pilots, the operations schedule of the plant, and physical site conditions dictated through design and construction.

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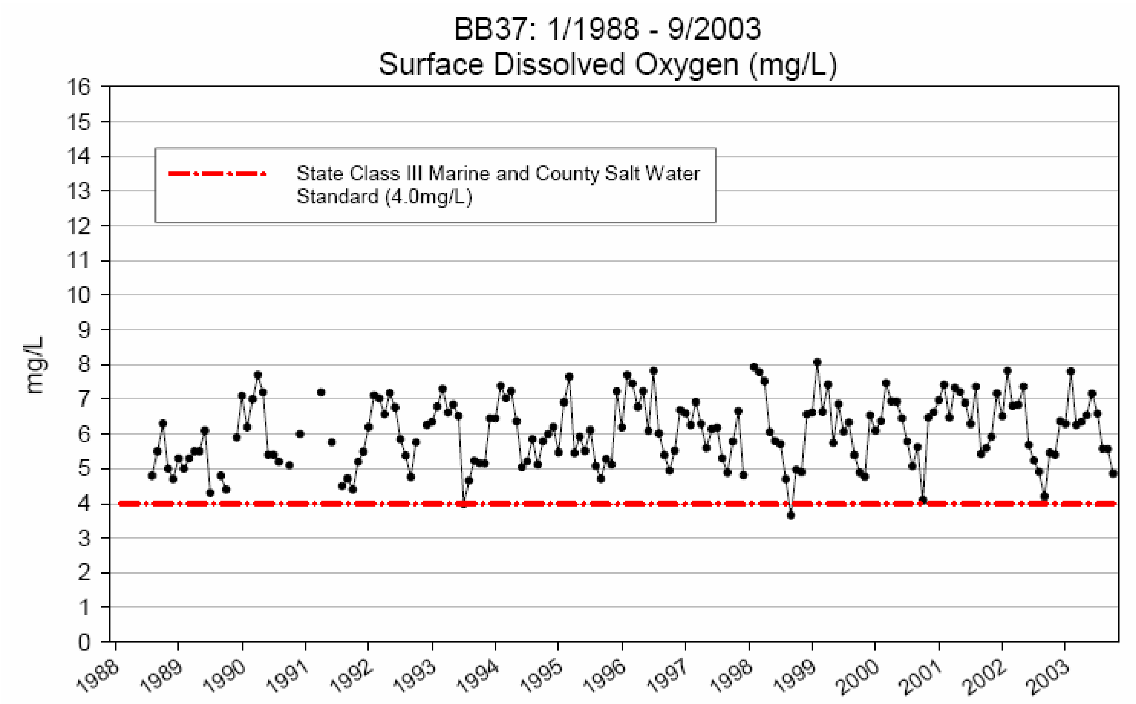
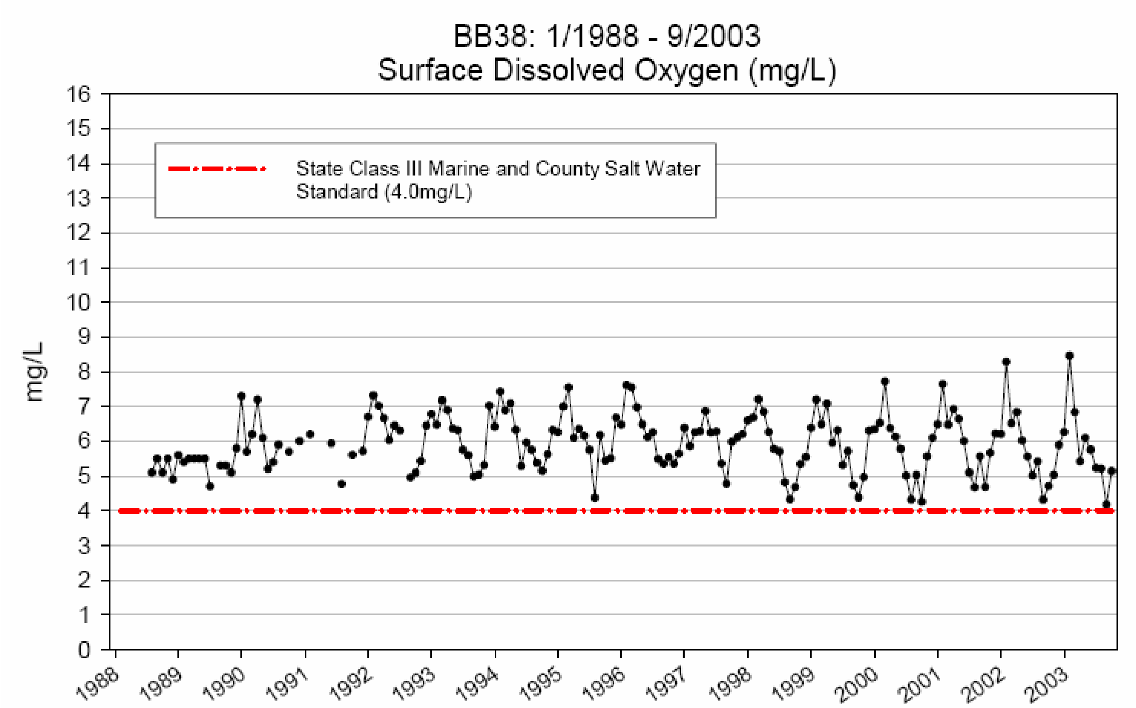
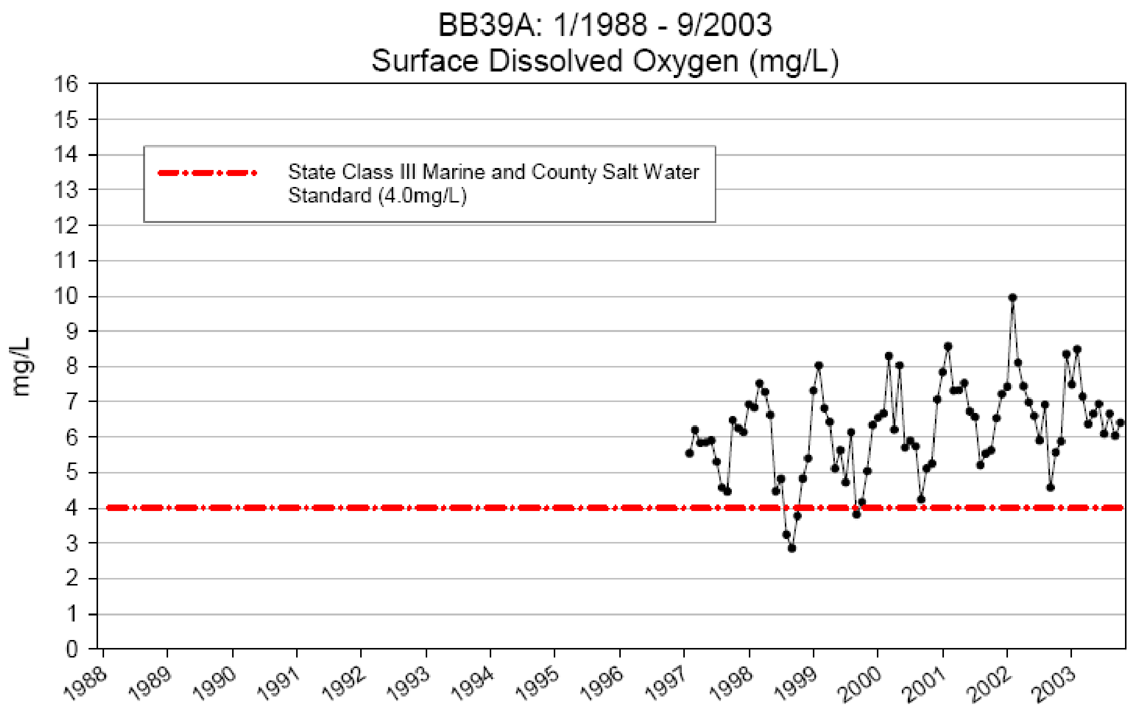
INSERT A
TIME SERIES GRAPHICS OF PARAMETERS BY STATIONS*



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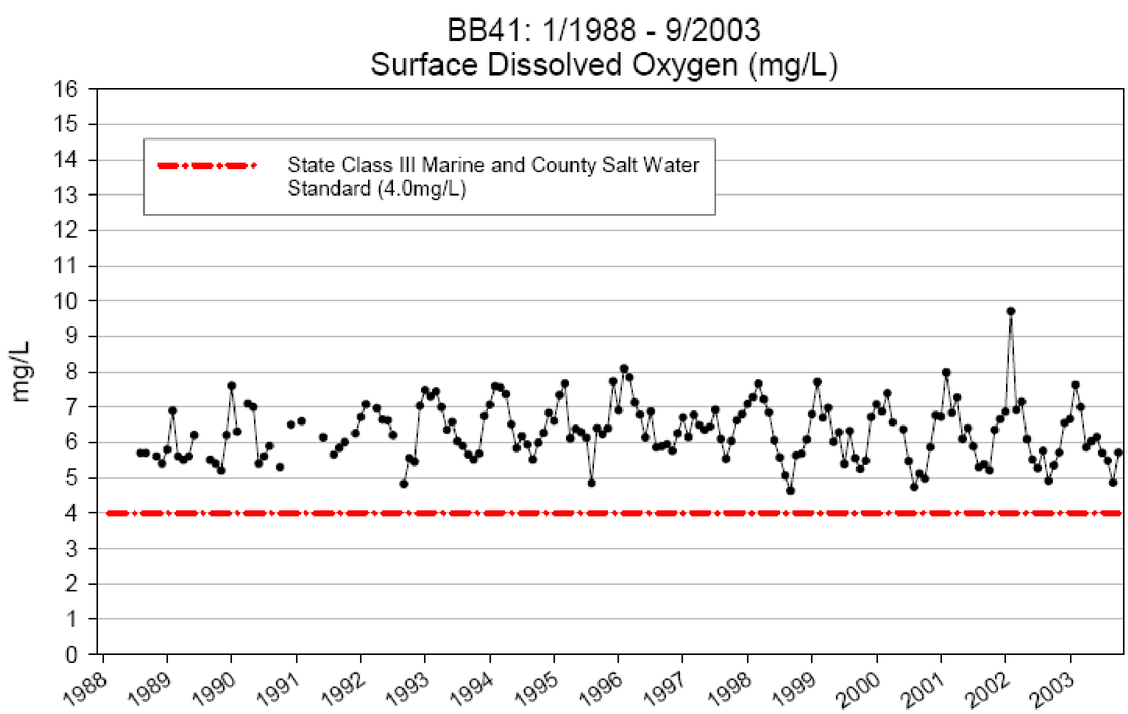
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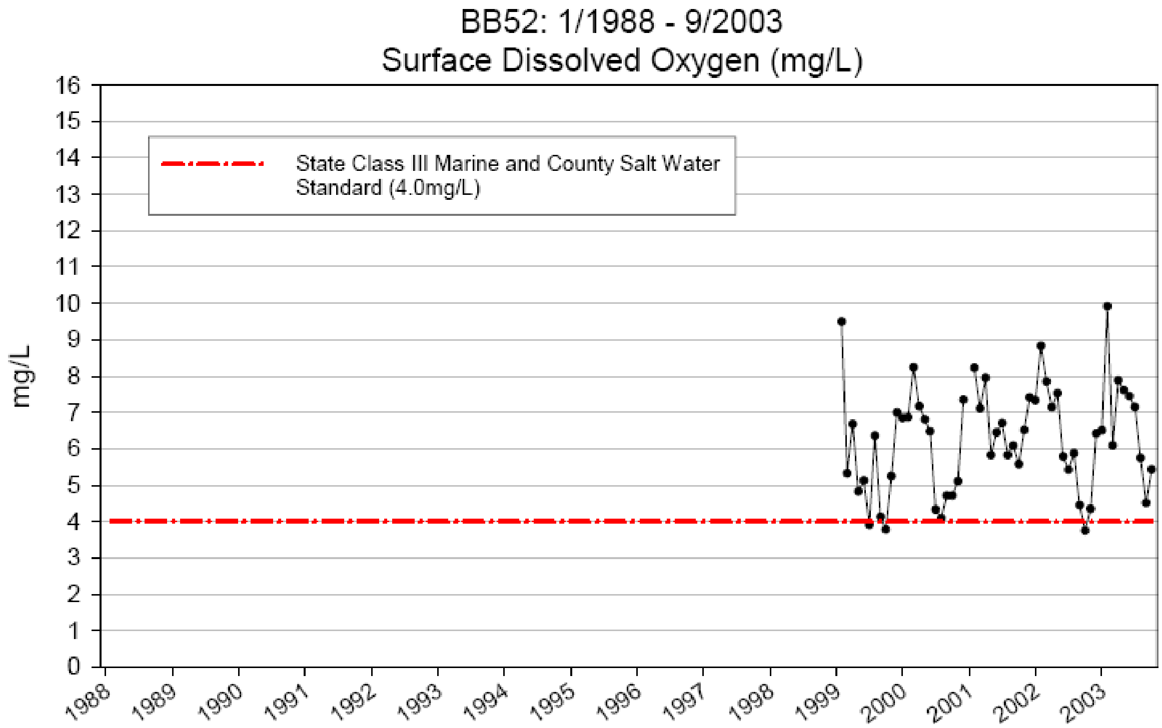
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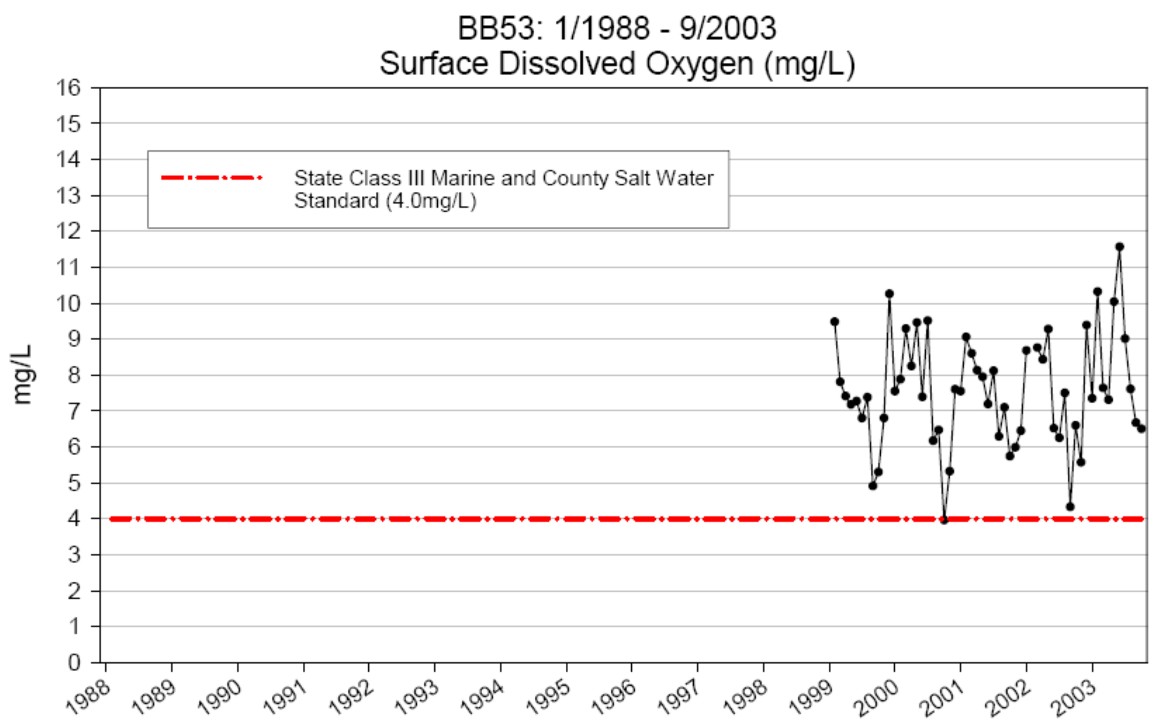
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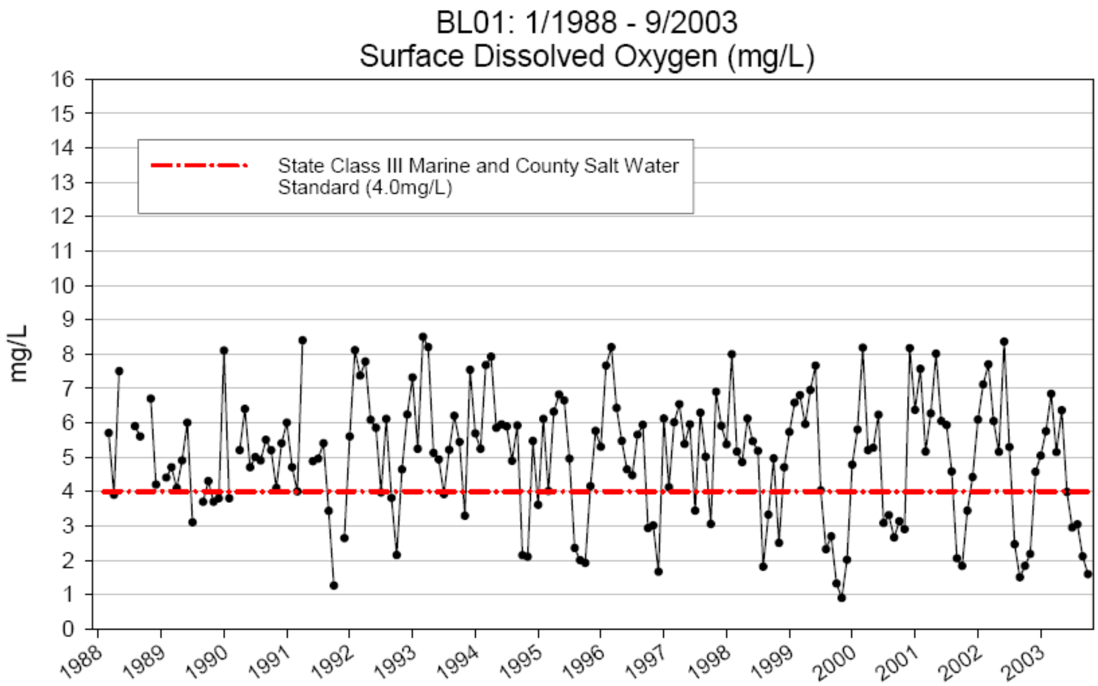
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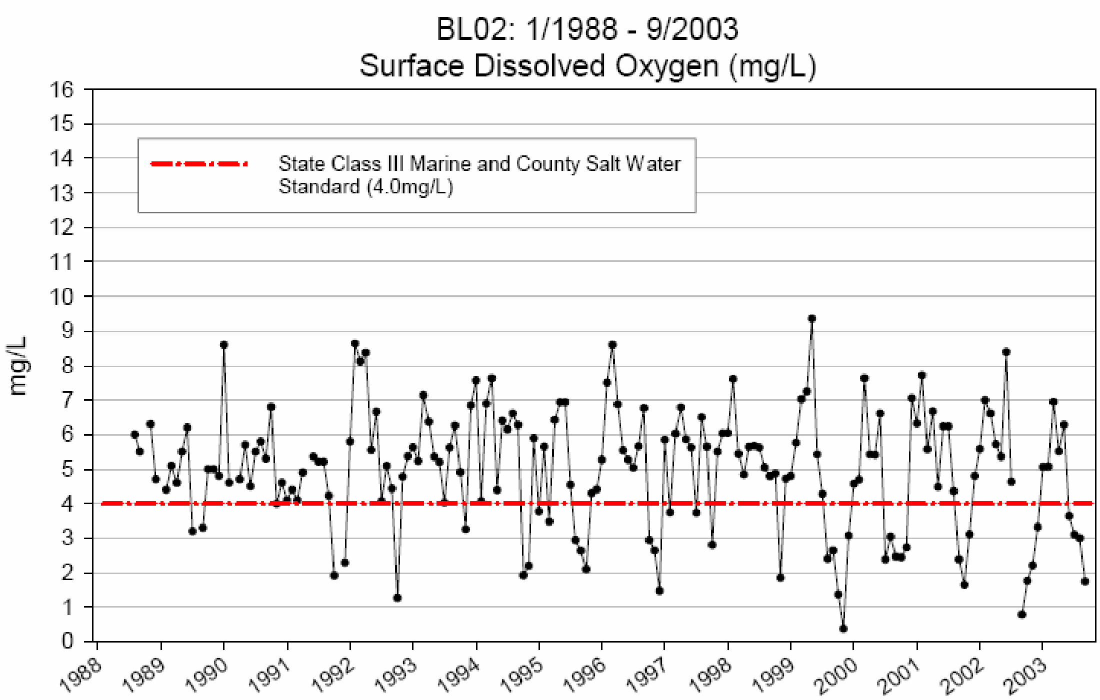
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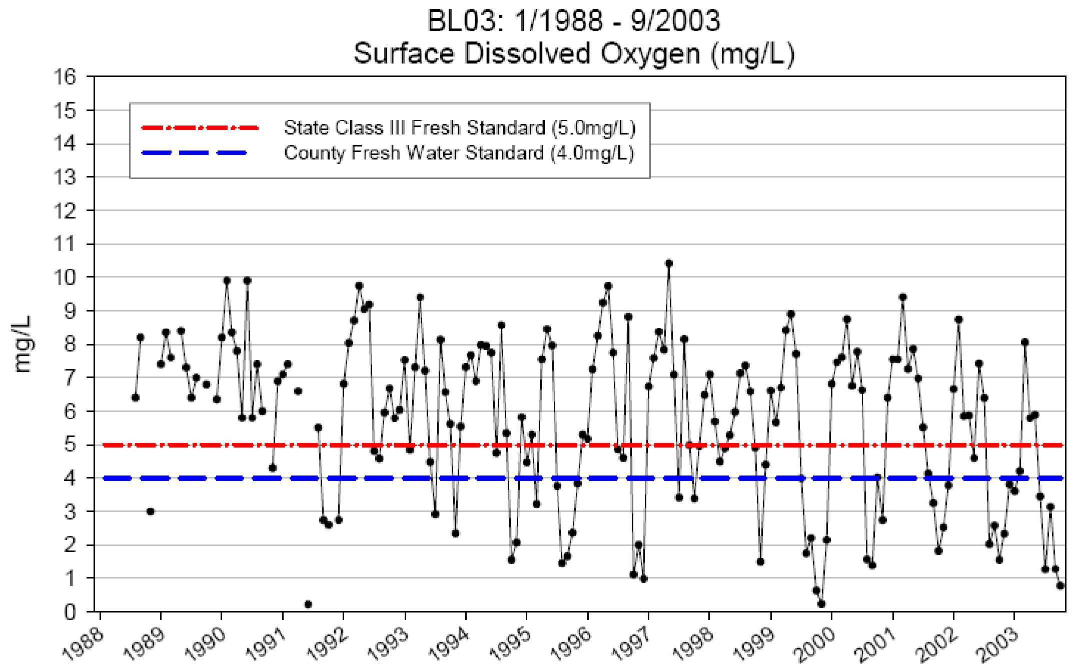

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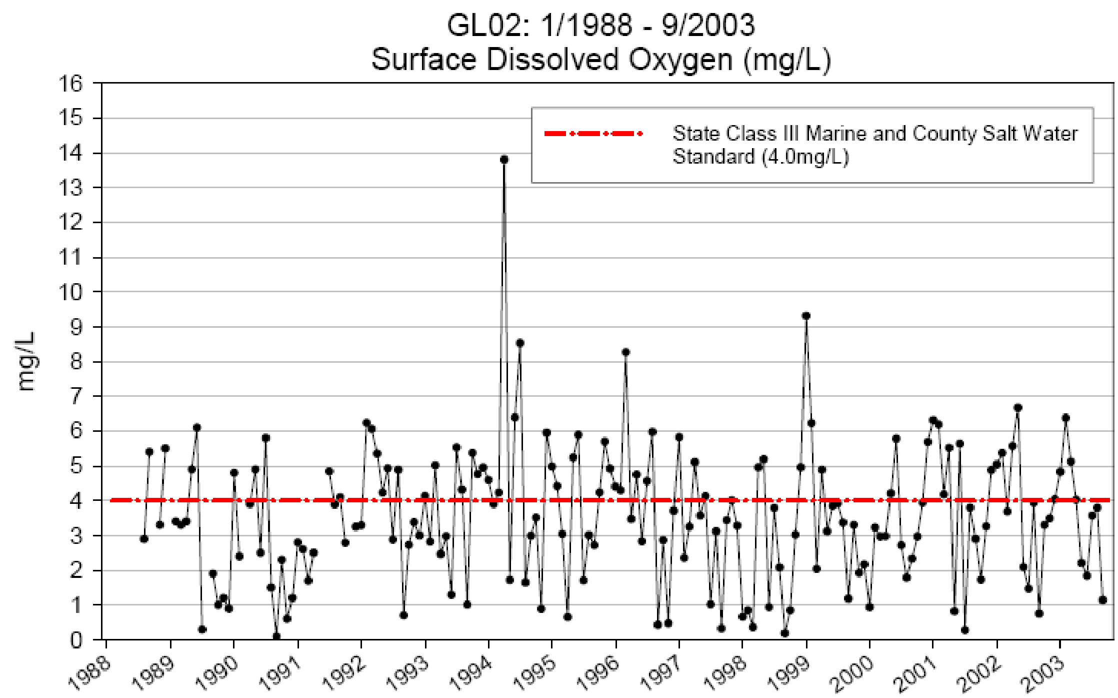
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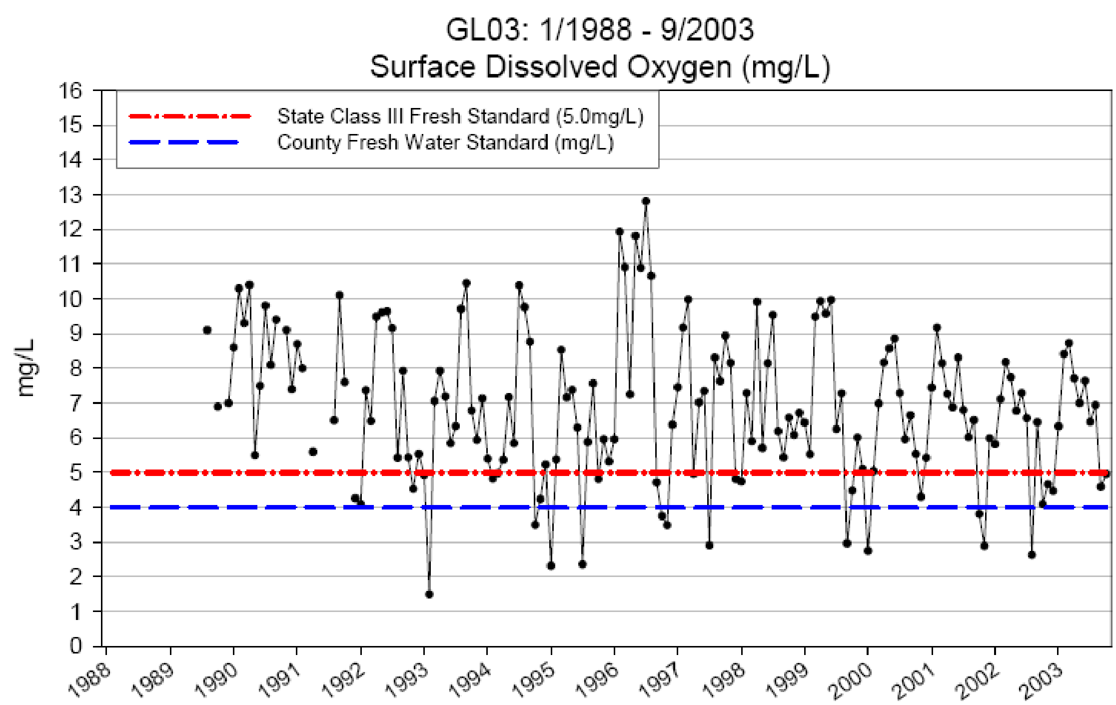
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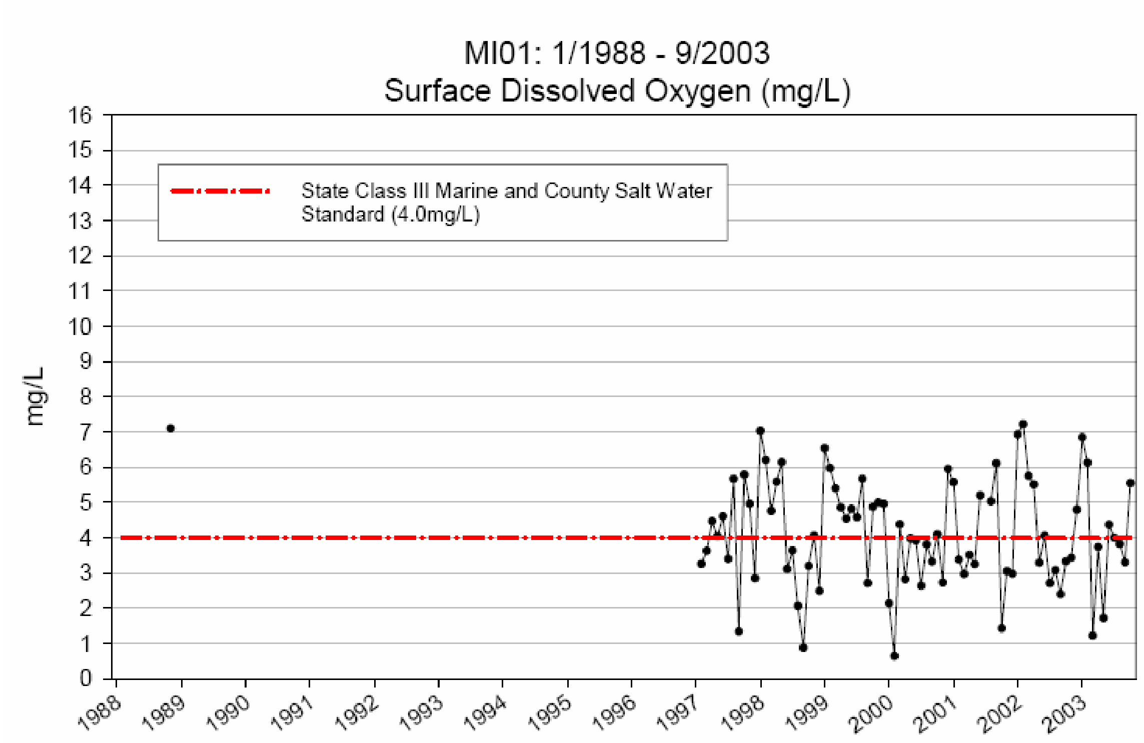
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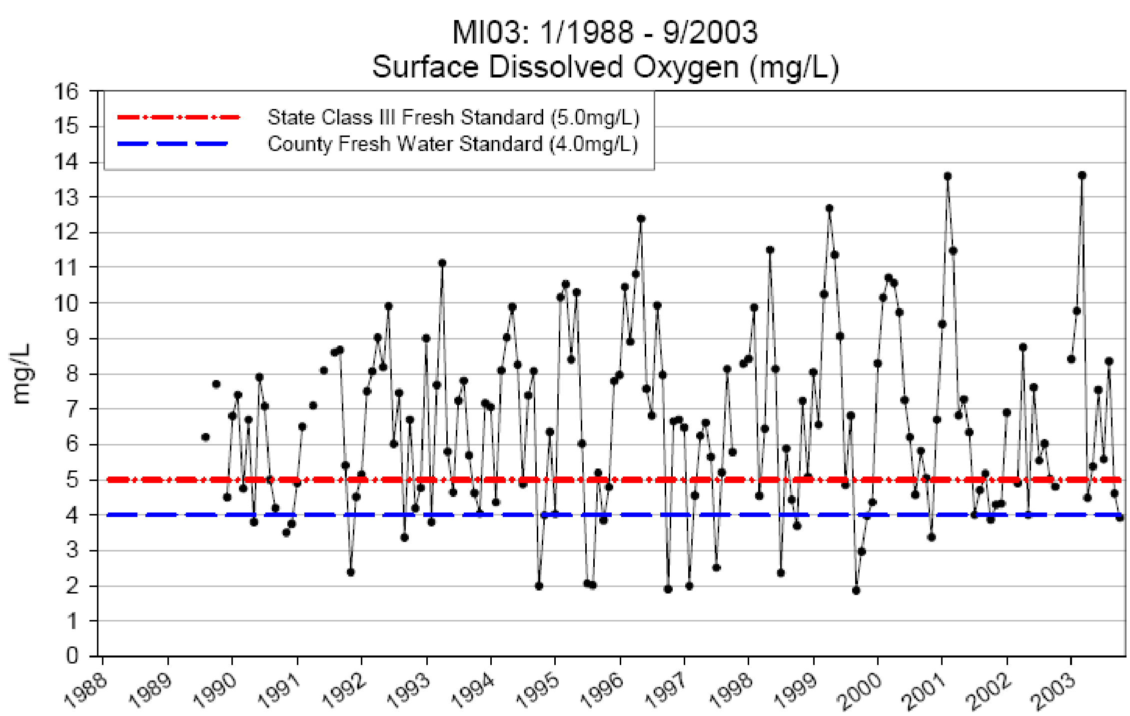
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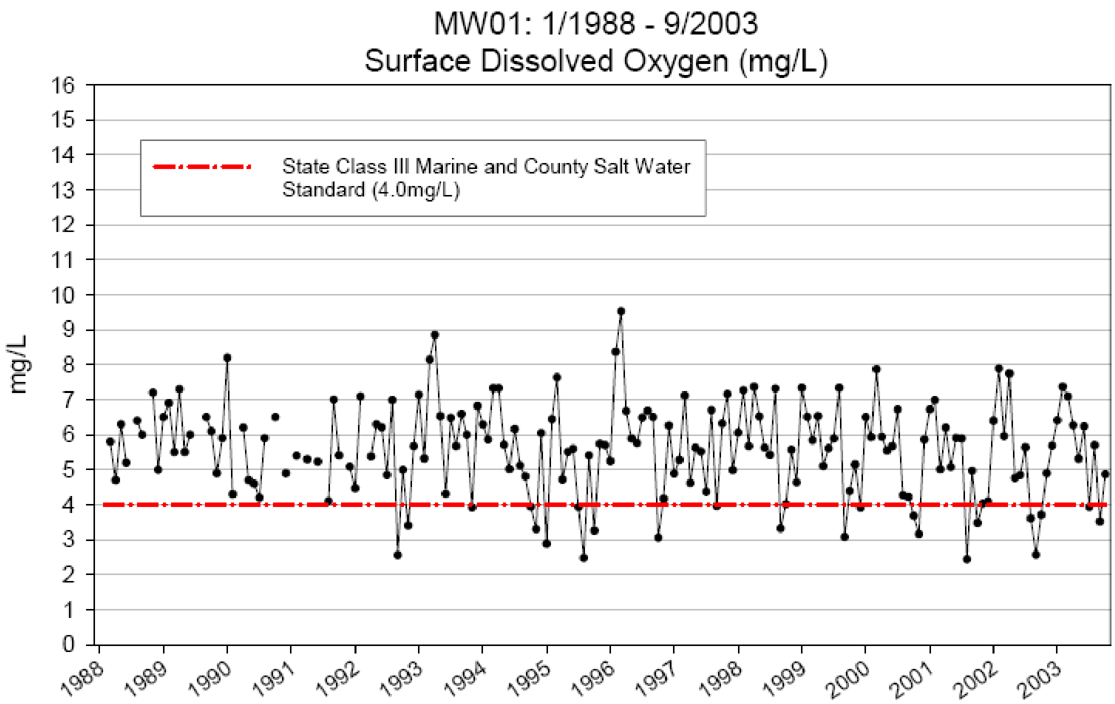
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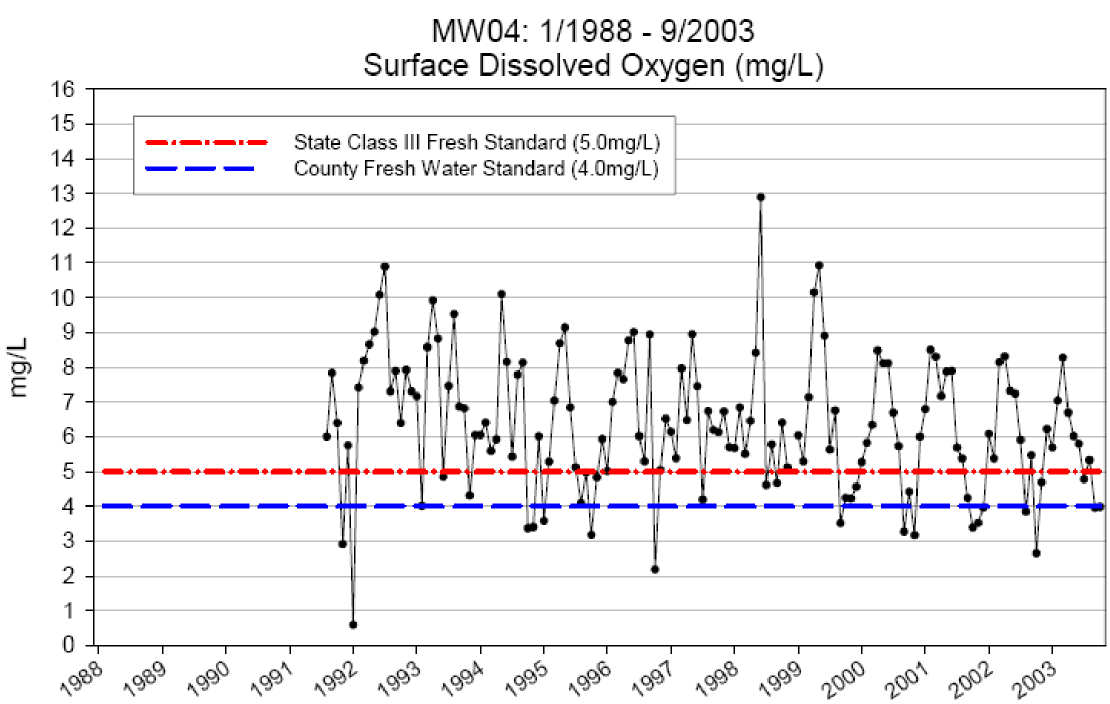
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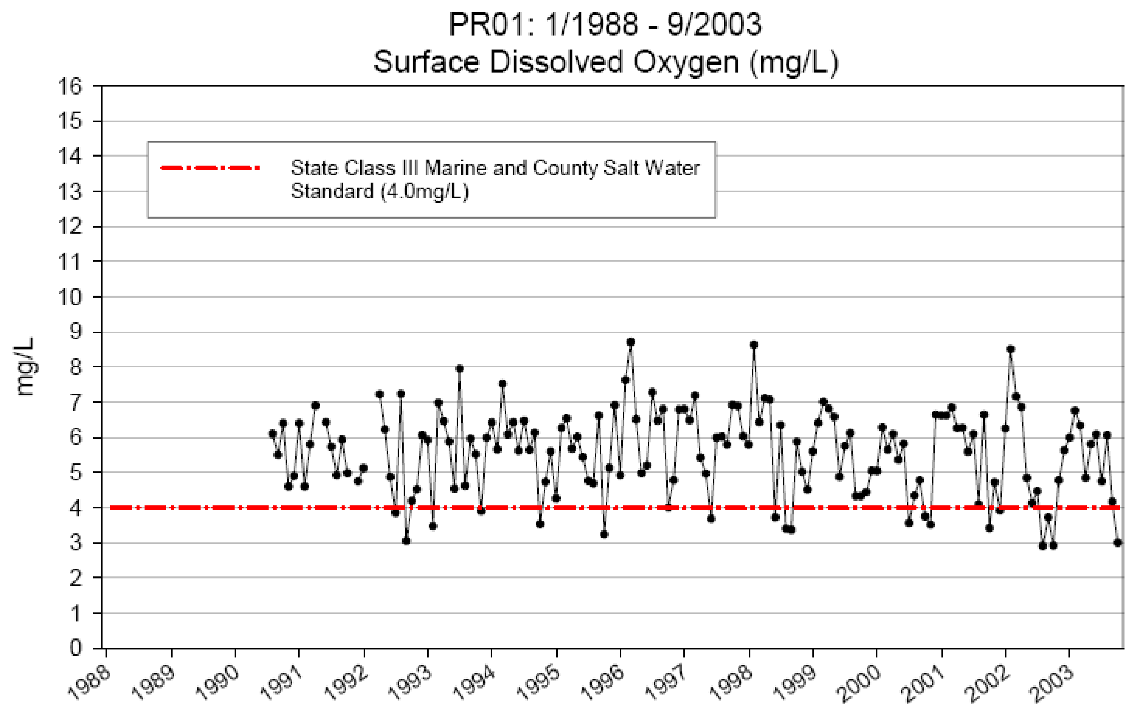

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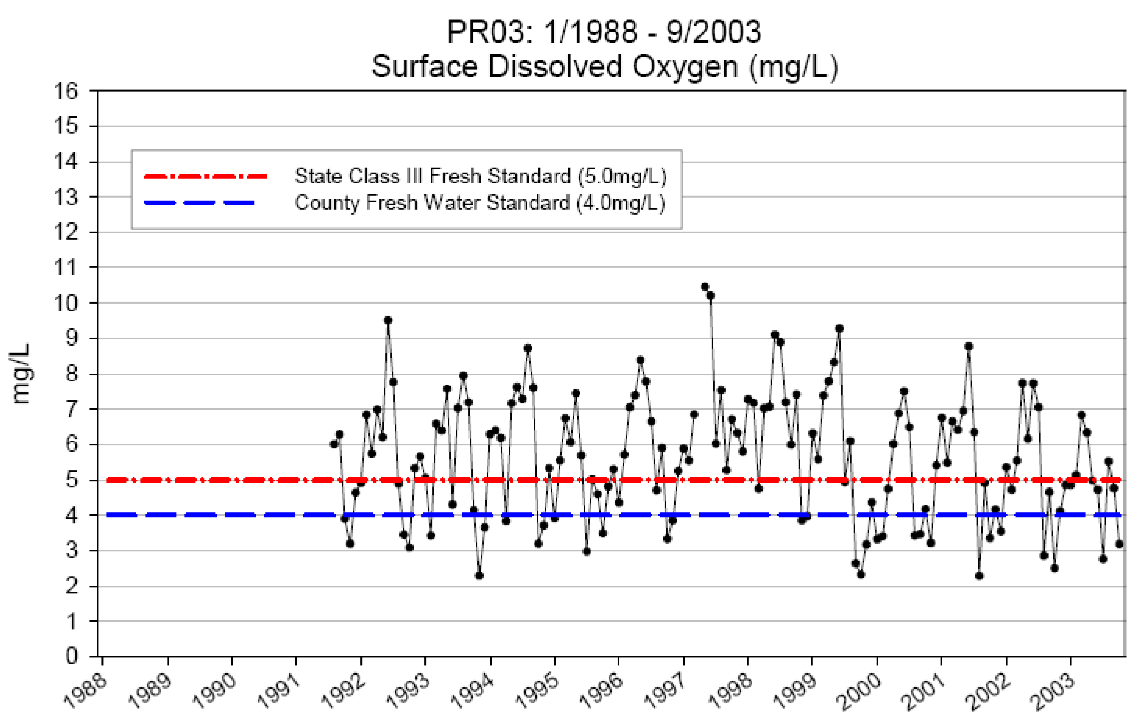

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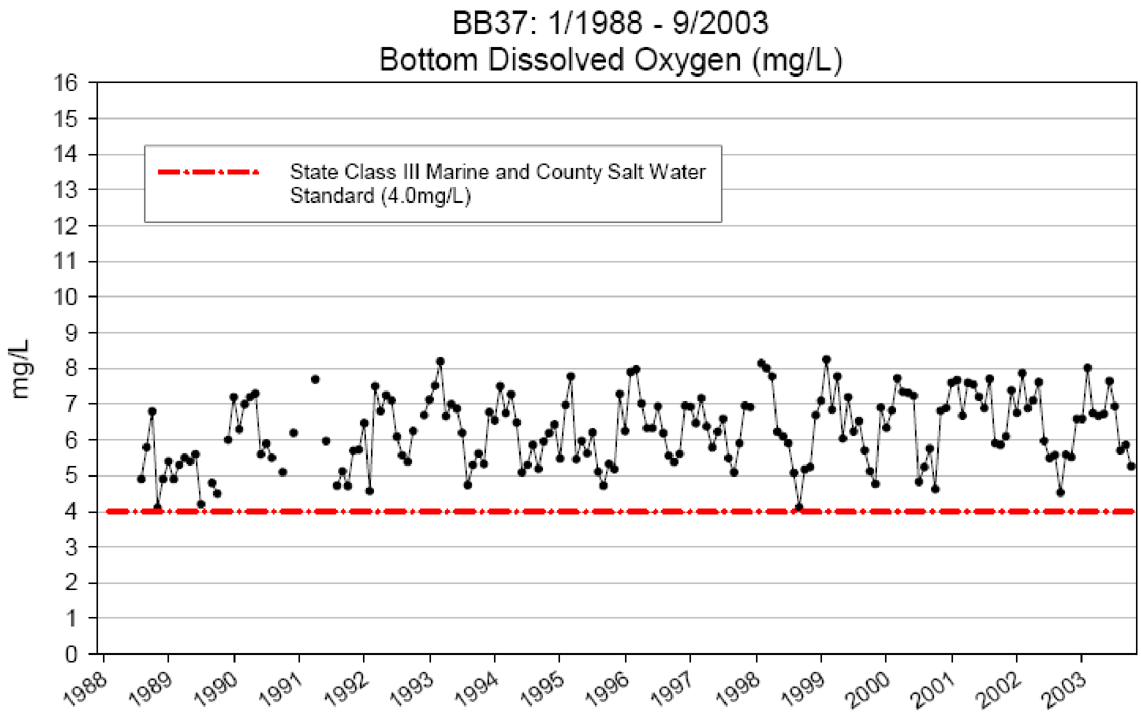
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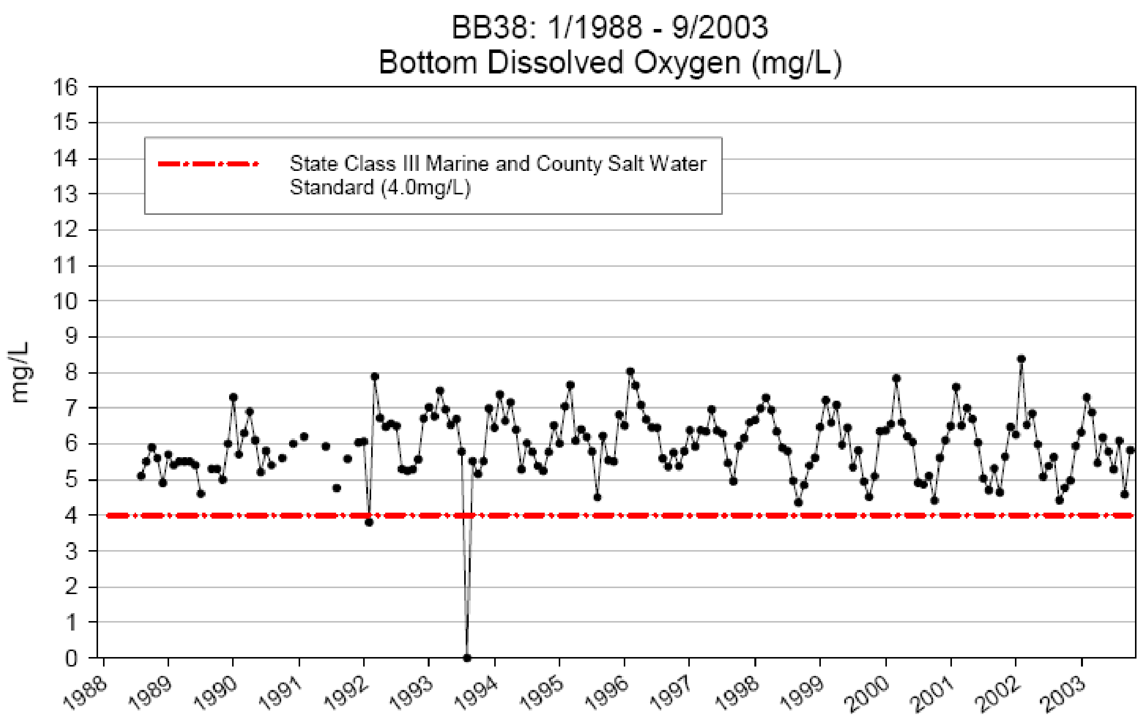
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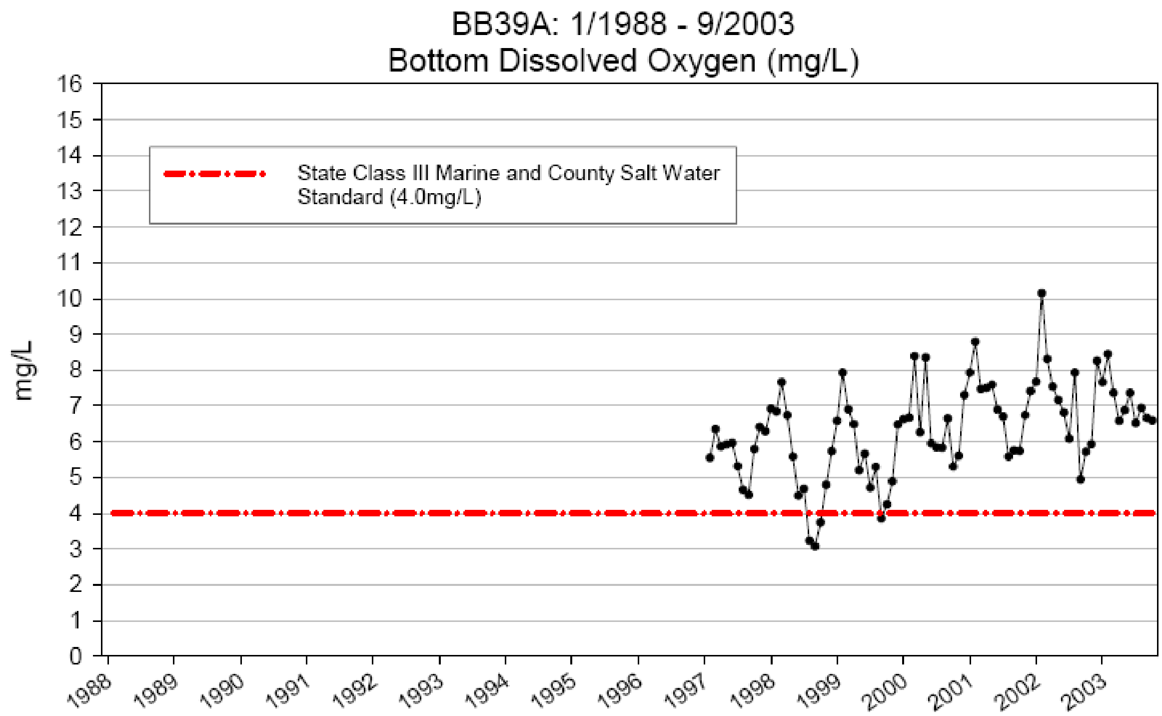
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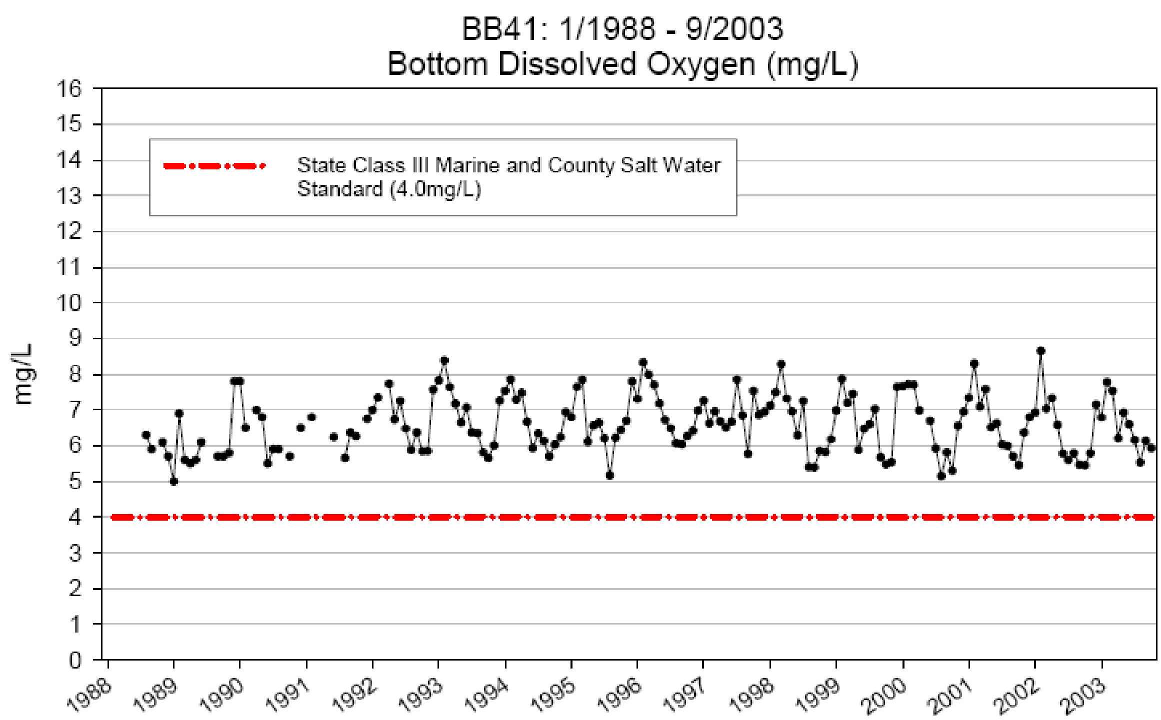
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1989
1990
1991
1992
1993
1994
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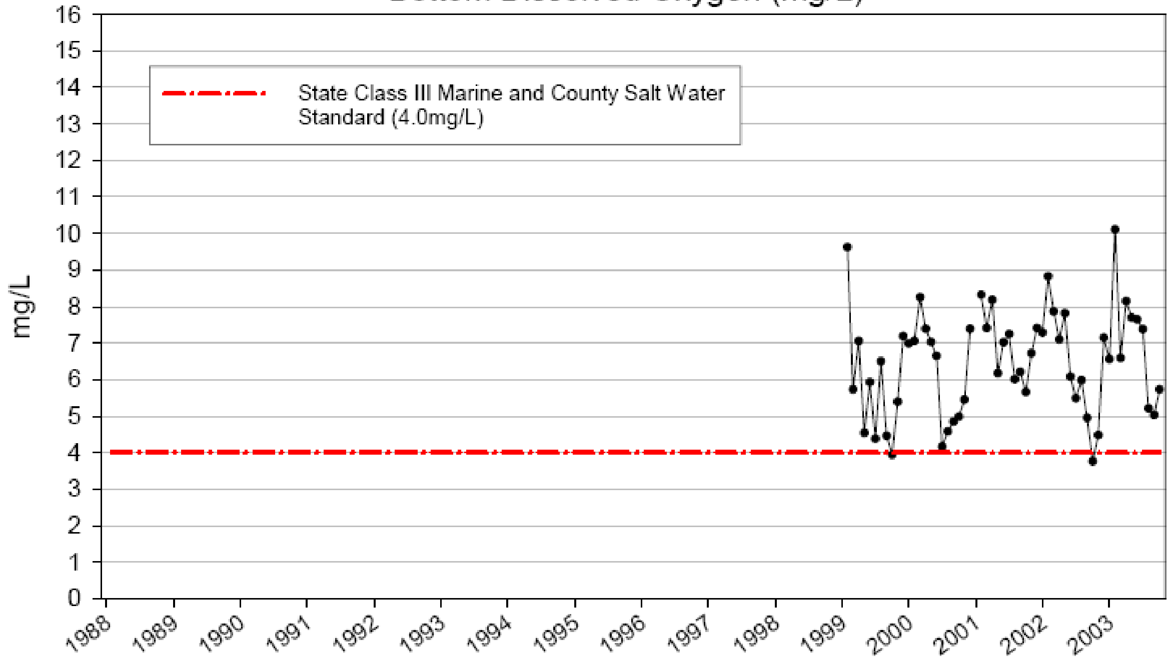
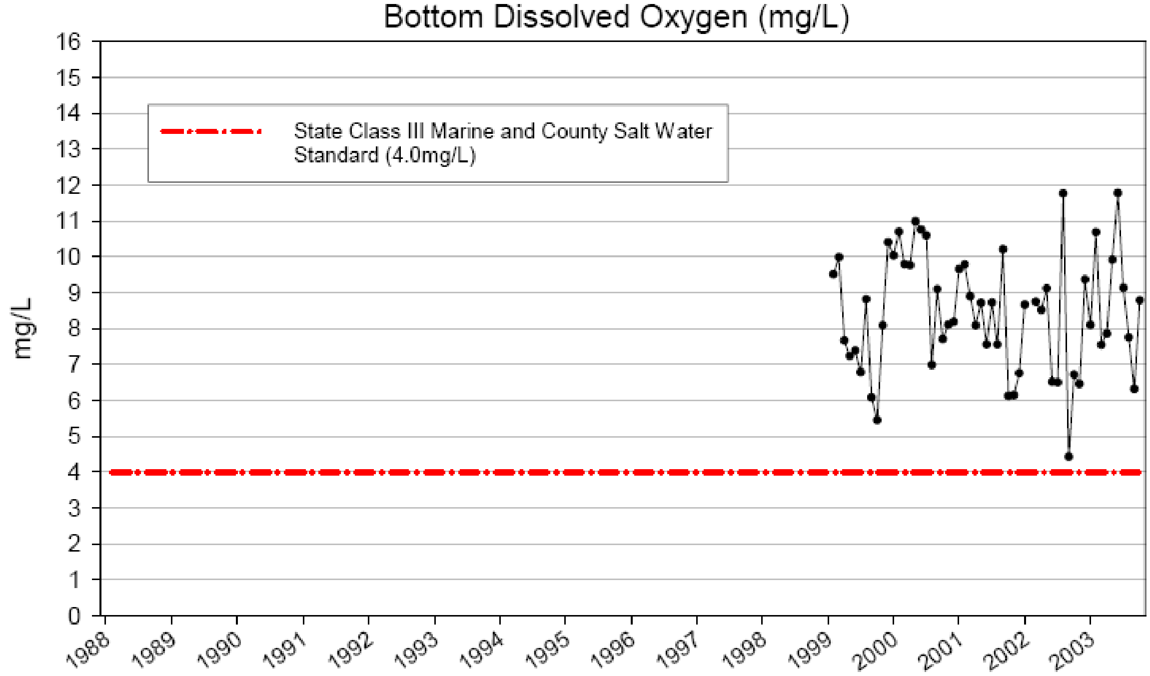
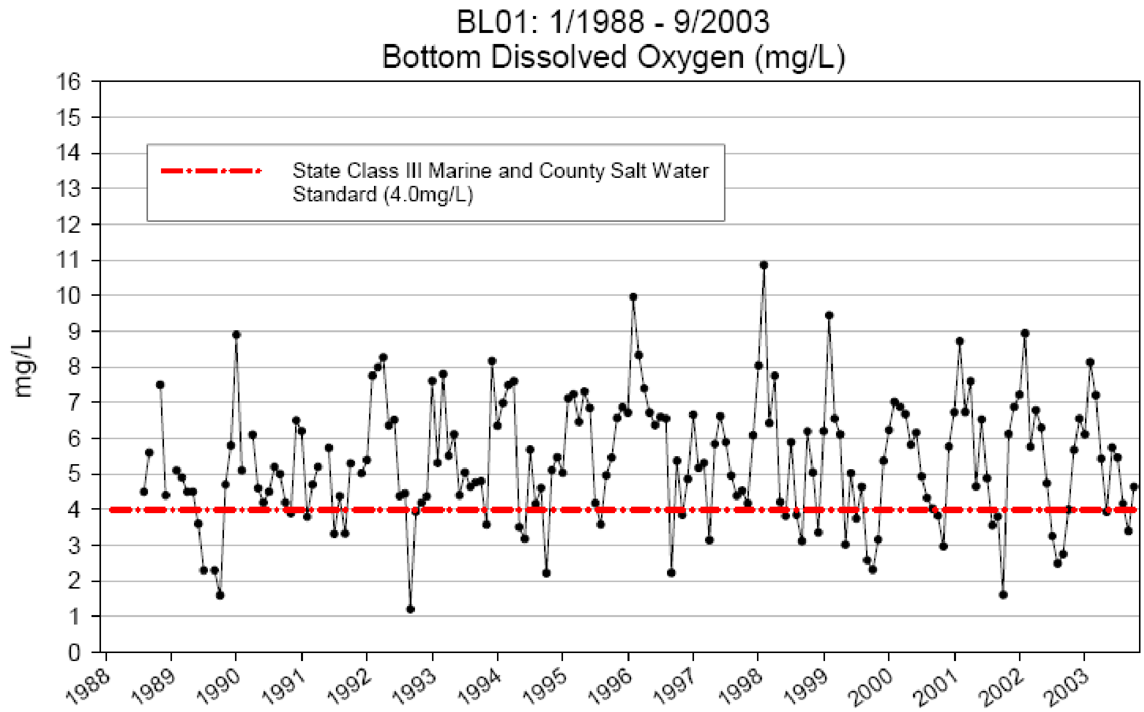
1996
1997
1998
1999
2000
2001
2002
2003

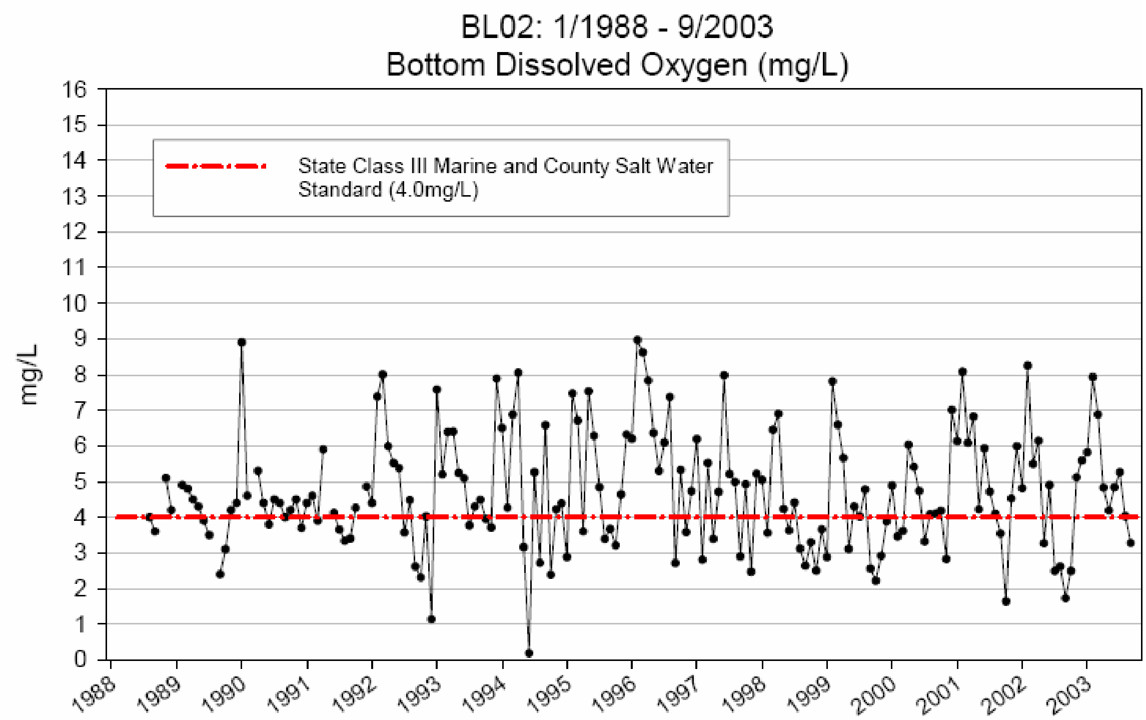
BB52: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)

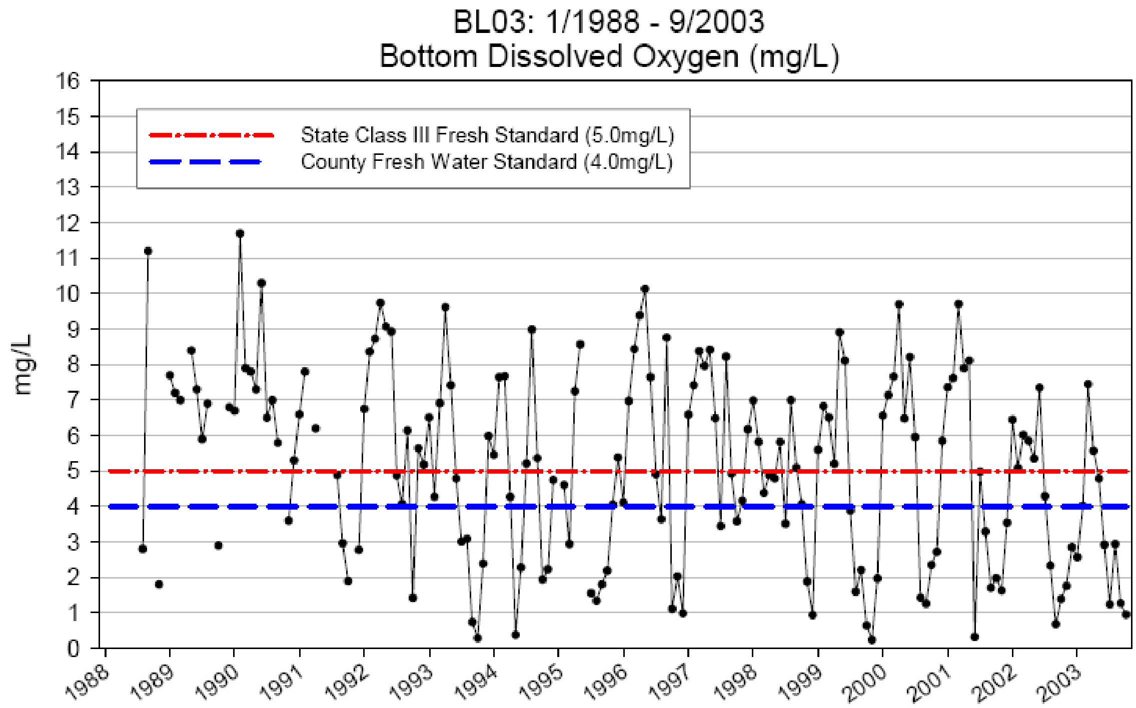


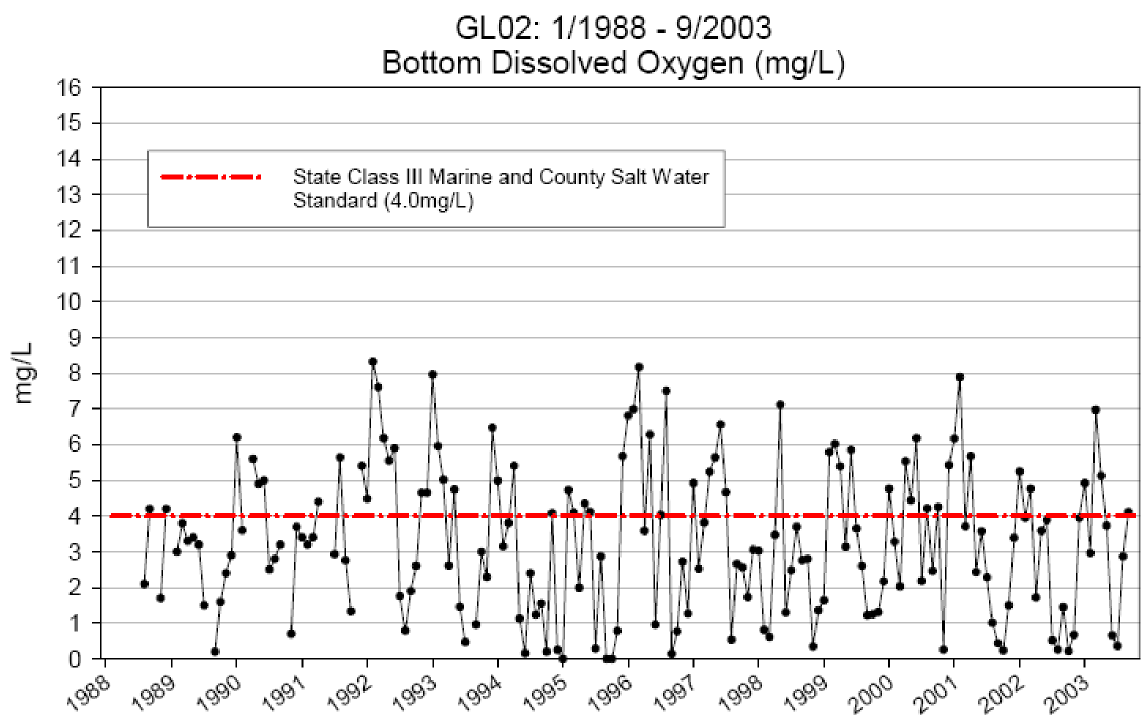
BB53: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)

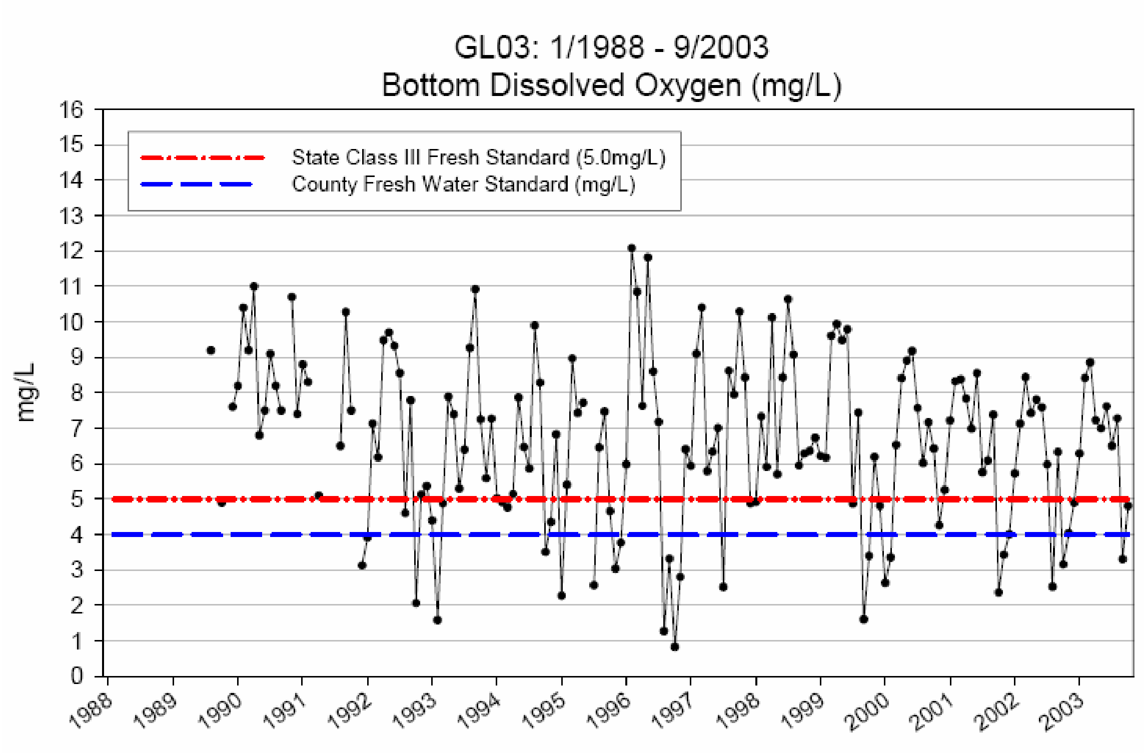



BL01: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
mg/L
State Class III Marine and County Salt Water Standard (4.0mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BL02: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
mg/L
State Class III Marine and County Salt Water Standard (4.0mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BL03: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
State Class III Fresh Standard (5.0mg/L)
County Fresh Water Standard (4.0mg/L)
mg/L
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


GL02: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
State Class III Marine and County Salt Water Standard (4.0mg/L)
mg/L
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


GL03: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
State Class III Fresh Standard (5.0mg/L)
County Fresh Water Standard (mg/L)
mg/L
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1988
1989
1990
1991
1992
1993
1994
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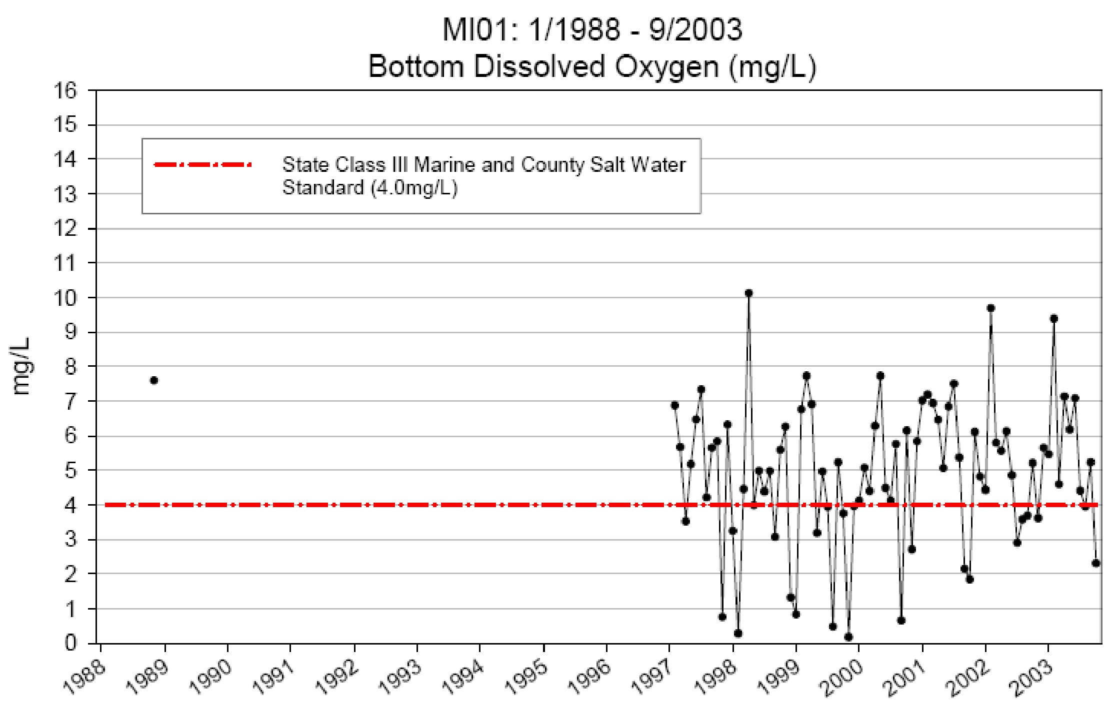
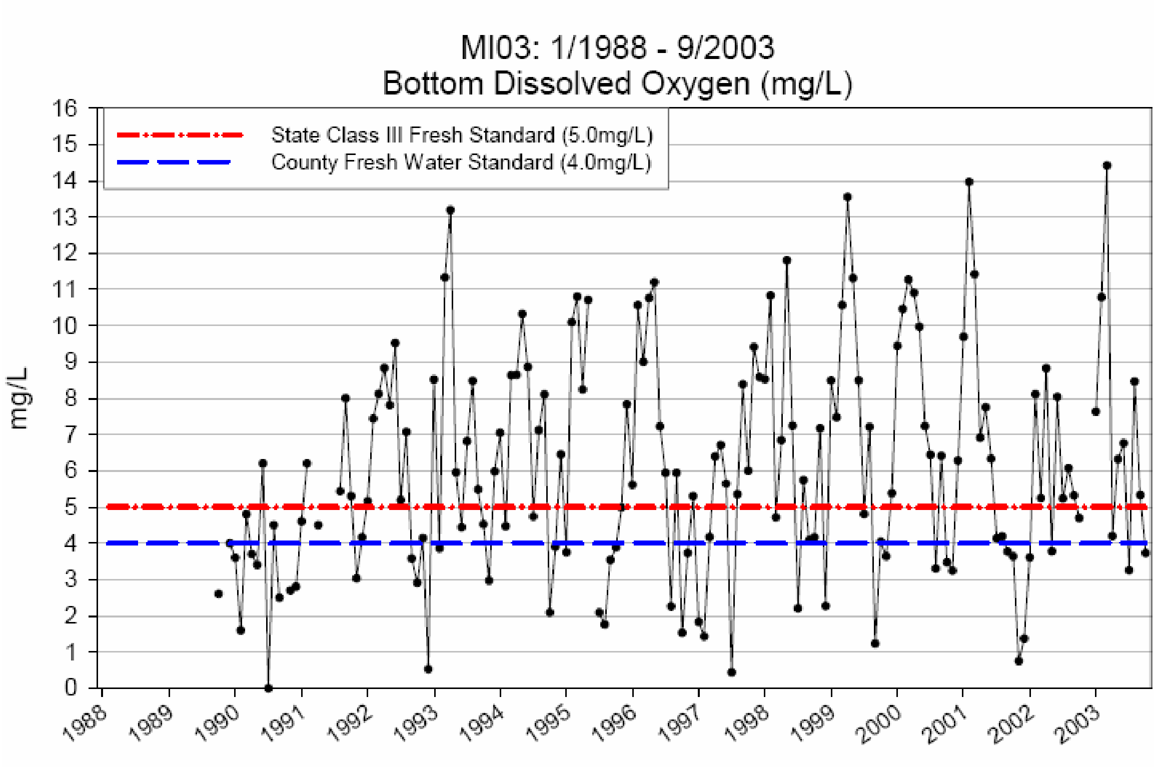
1996
1997
1998
1999
2000
2001
2002
2003


MI01: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
State Class III Marine and County Salt Water Standard (4.0mg/L)
mg/L
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MI03: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
State Class III Fresh Standard (5.0mg/L)
County Fresh Water Standard (4.0mg/L)
mg/L
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
1988
1989
1990
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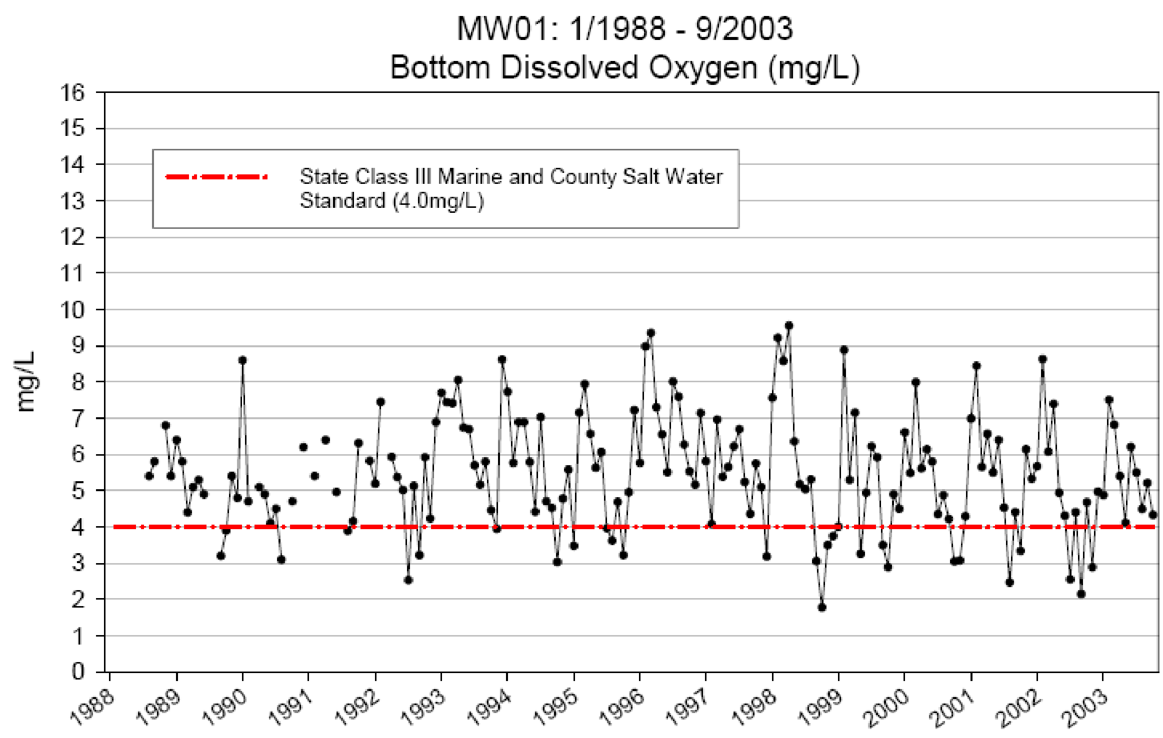
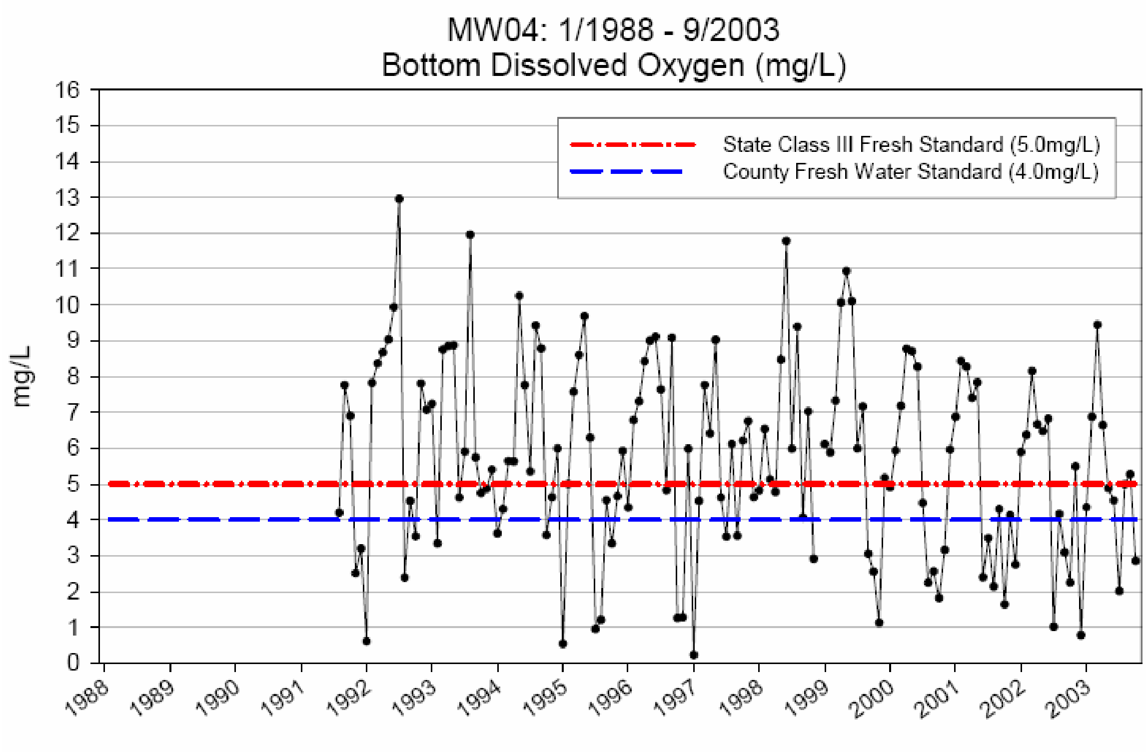
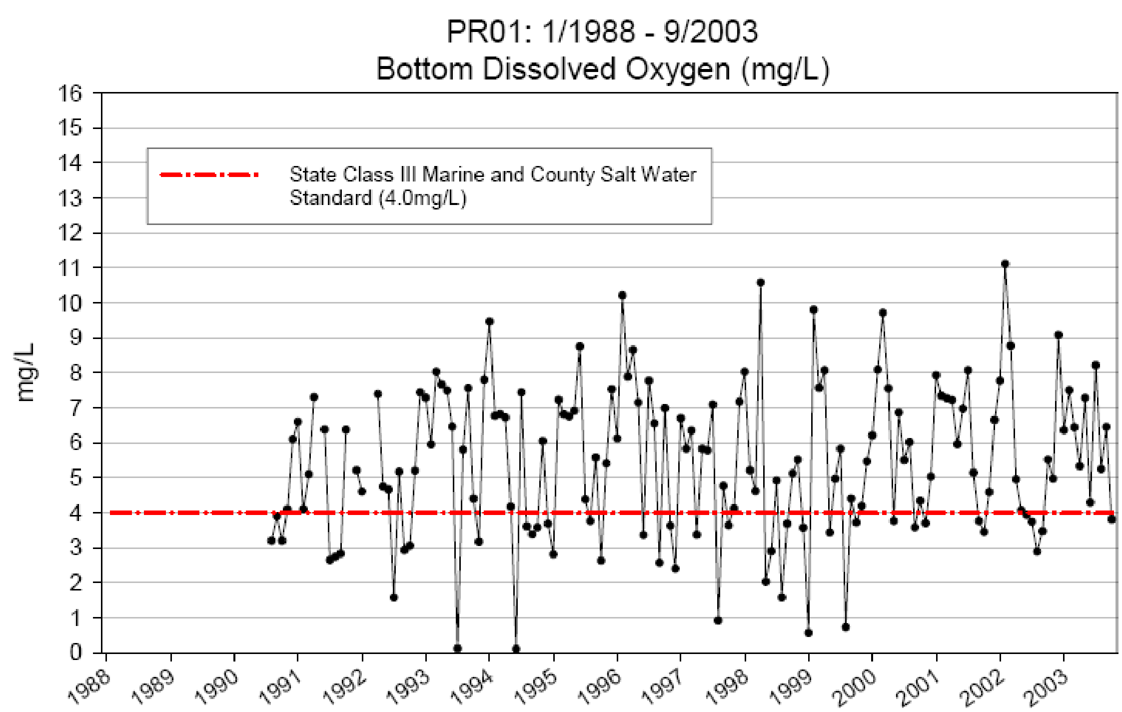
1998
1999
2000
2001
2002
2003

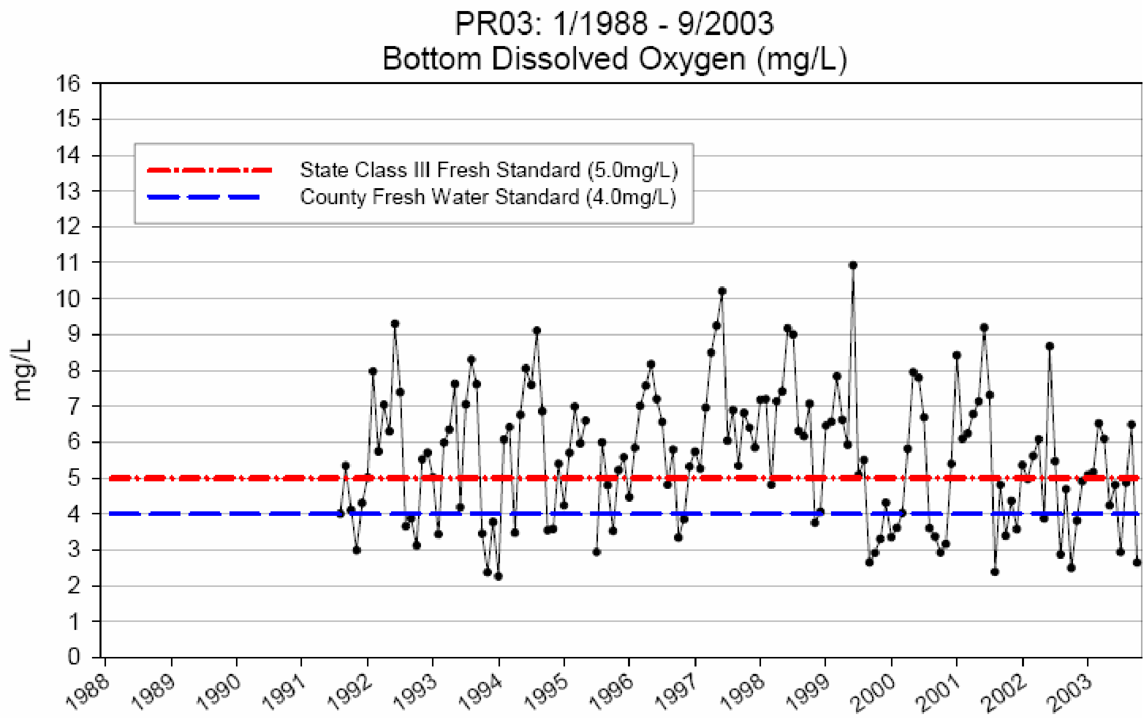

MW01: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
State Class III Marine and County Salt Water Standard (4.0mg/L)
mg/L
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

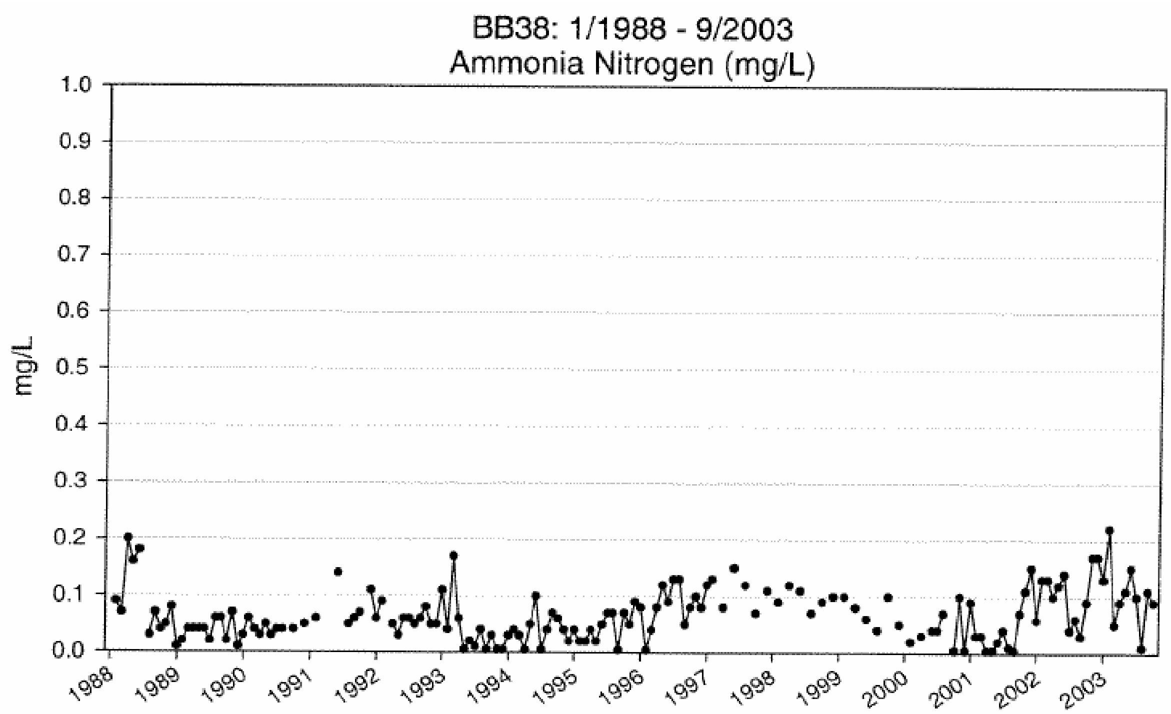


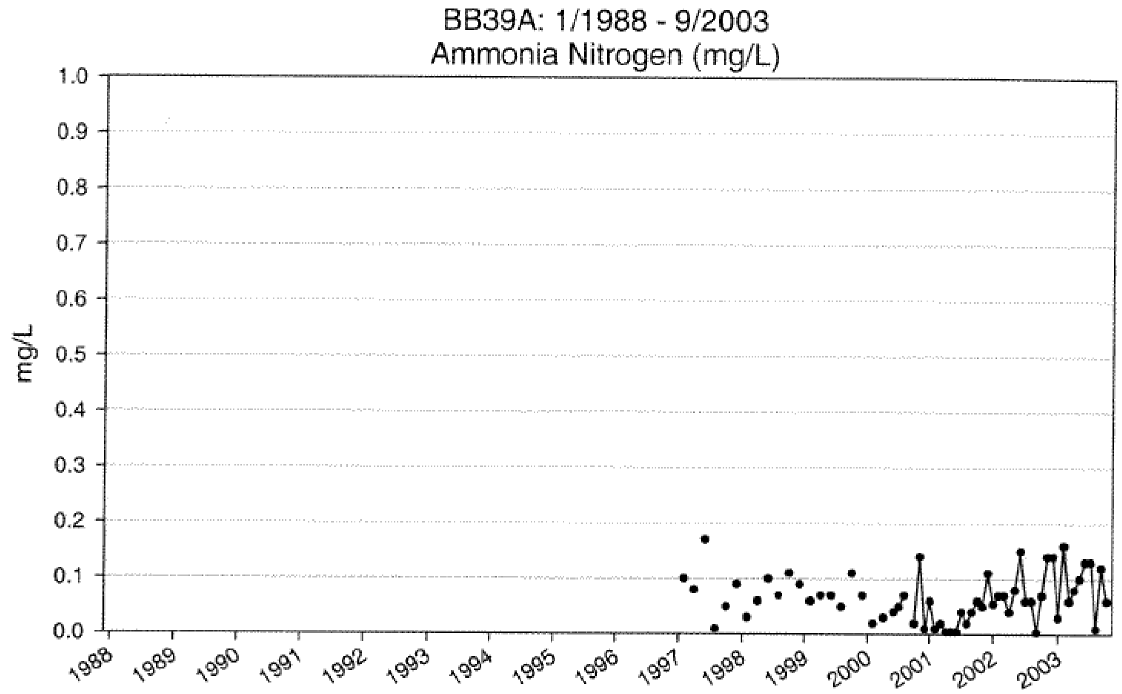
MW04: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
State Class III Fresh Standard (5.0mg/L)
County Fresh Water Standard (4.0mg/L)
mg/L



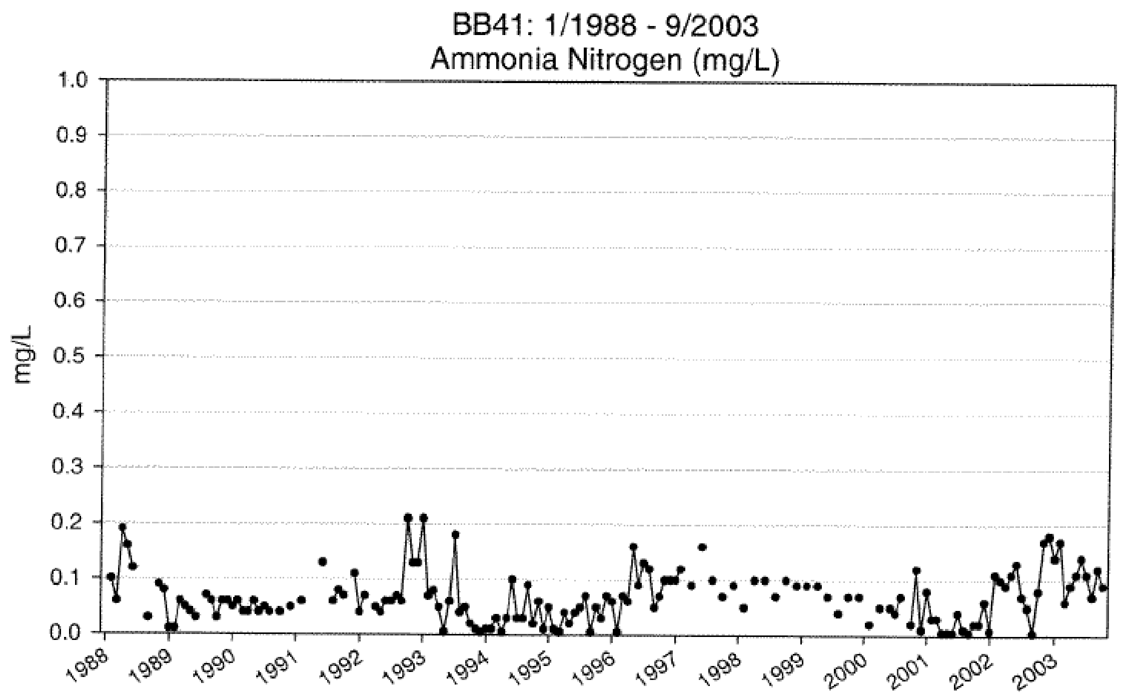
PR01: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
State Class III Marine and County Salt Water Standard (4.0mg/L)
mg/L


PR03: 1/1988 - 9/2003
Bottom Dissolved Oxygen (mg/L)
State Class III Fresh Standard (5.0mg/L)
County Fresh Water Standard (4.0mg/L)
mg/L
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

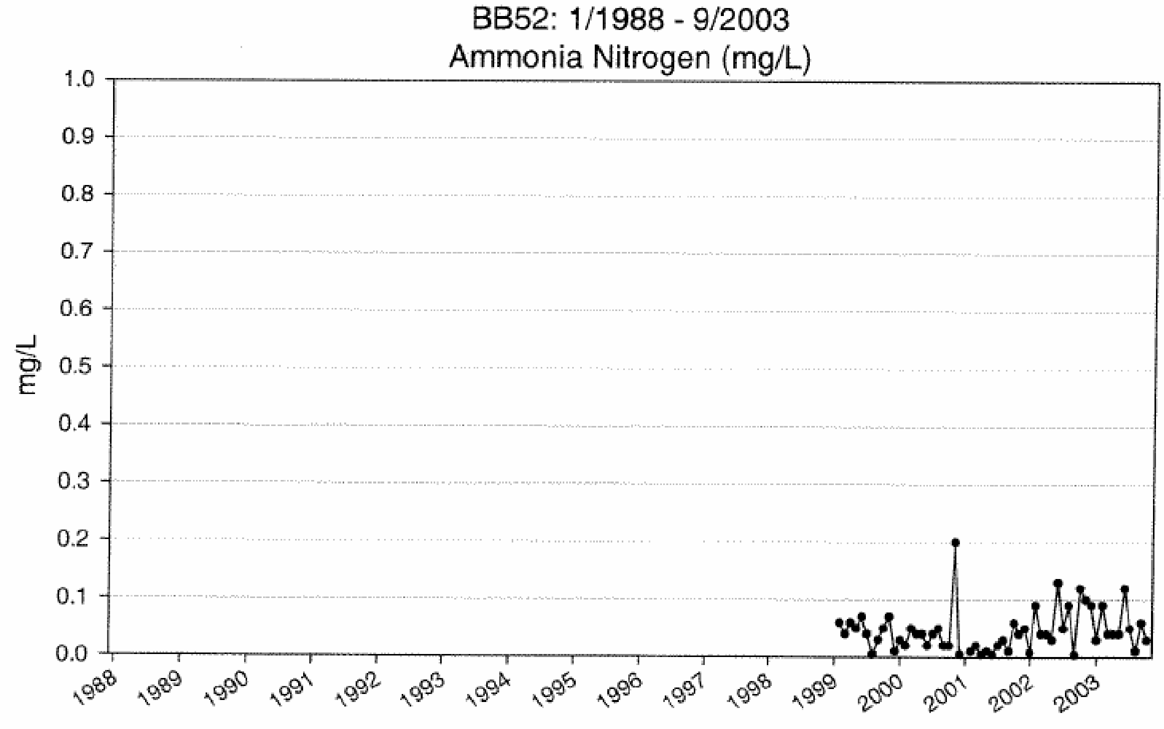

BB38: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

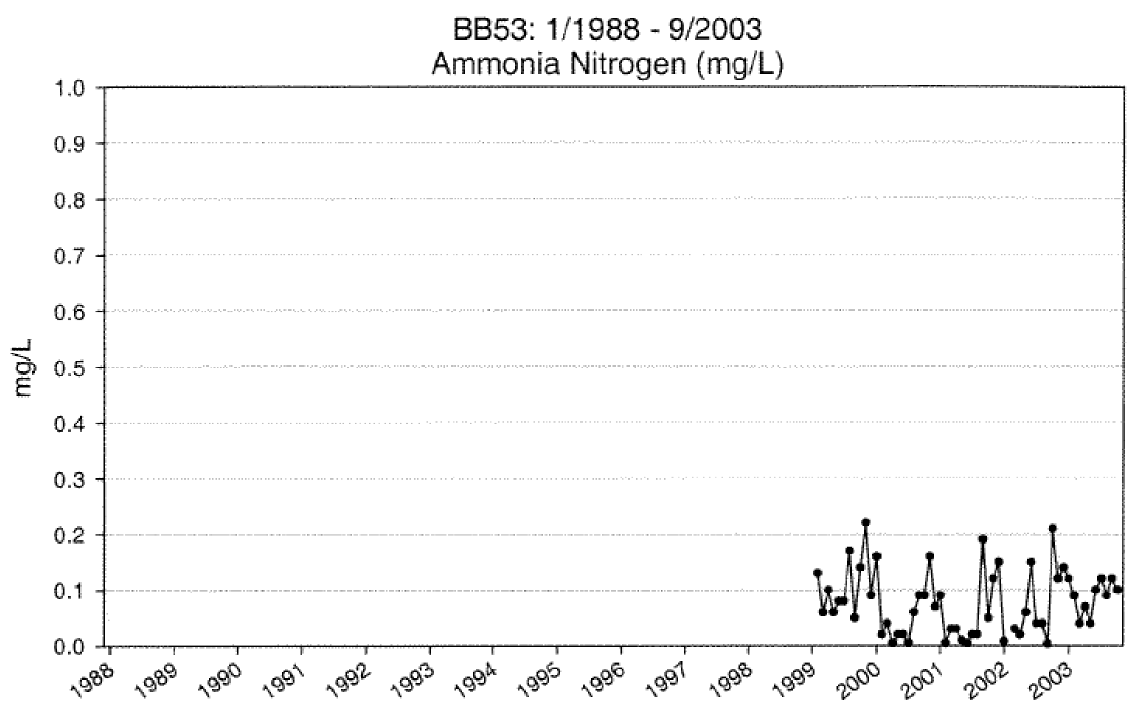


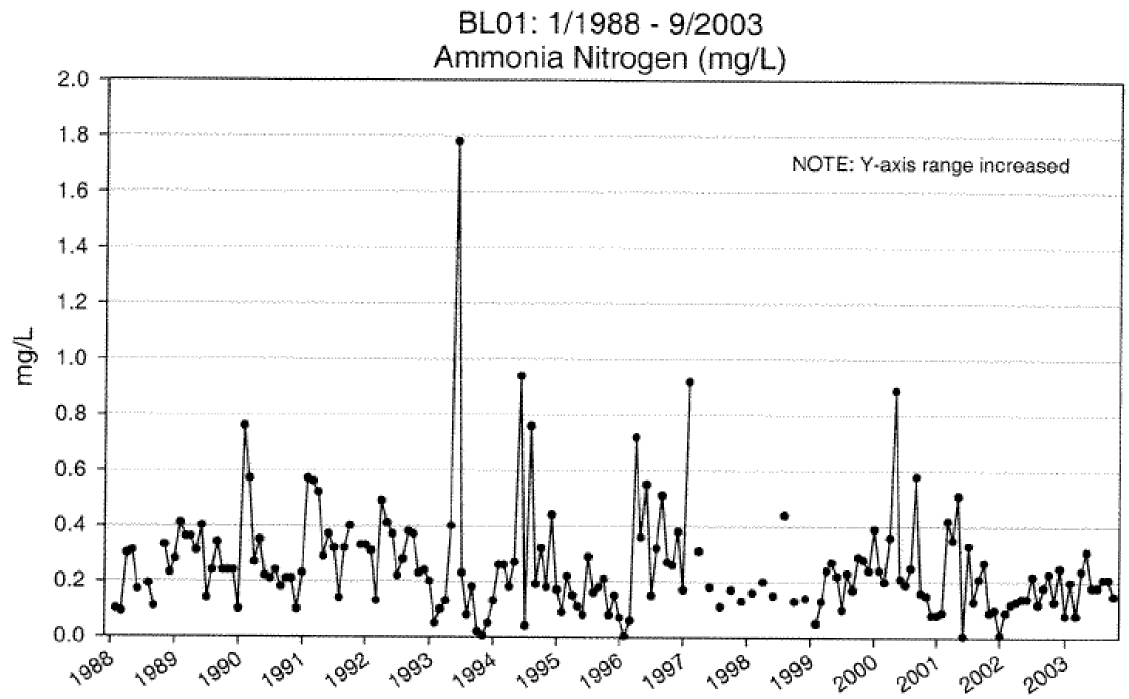
BB39A: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

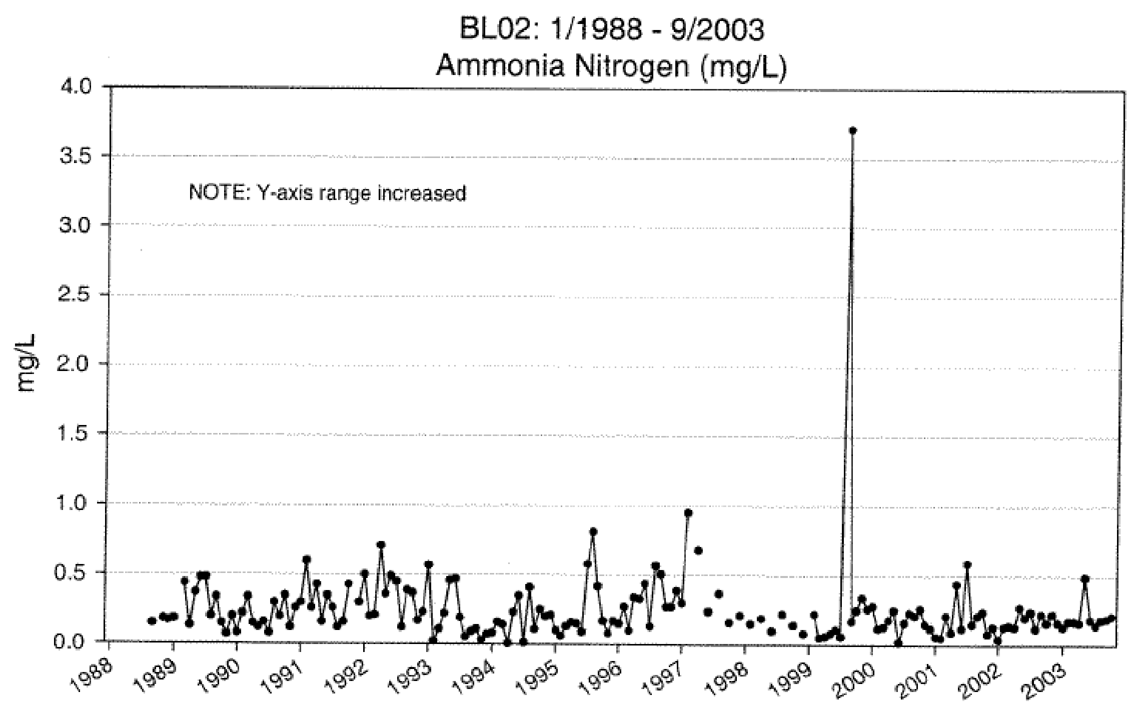


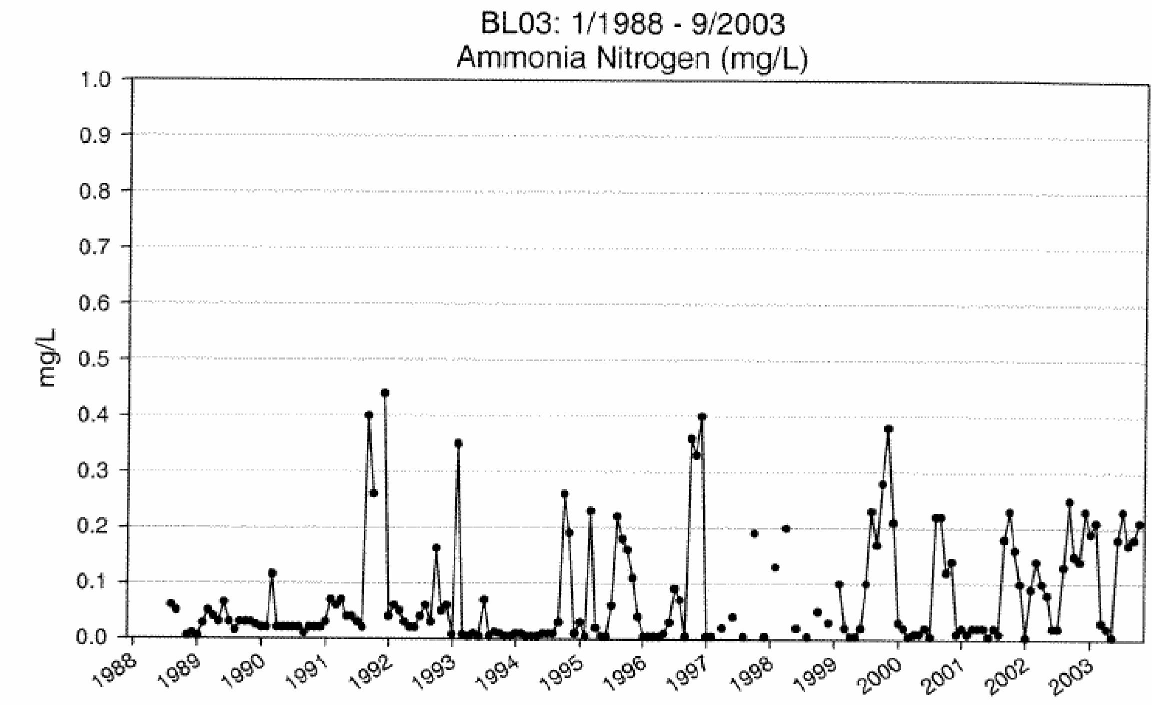
BB41: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

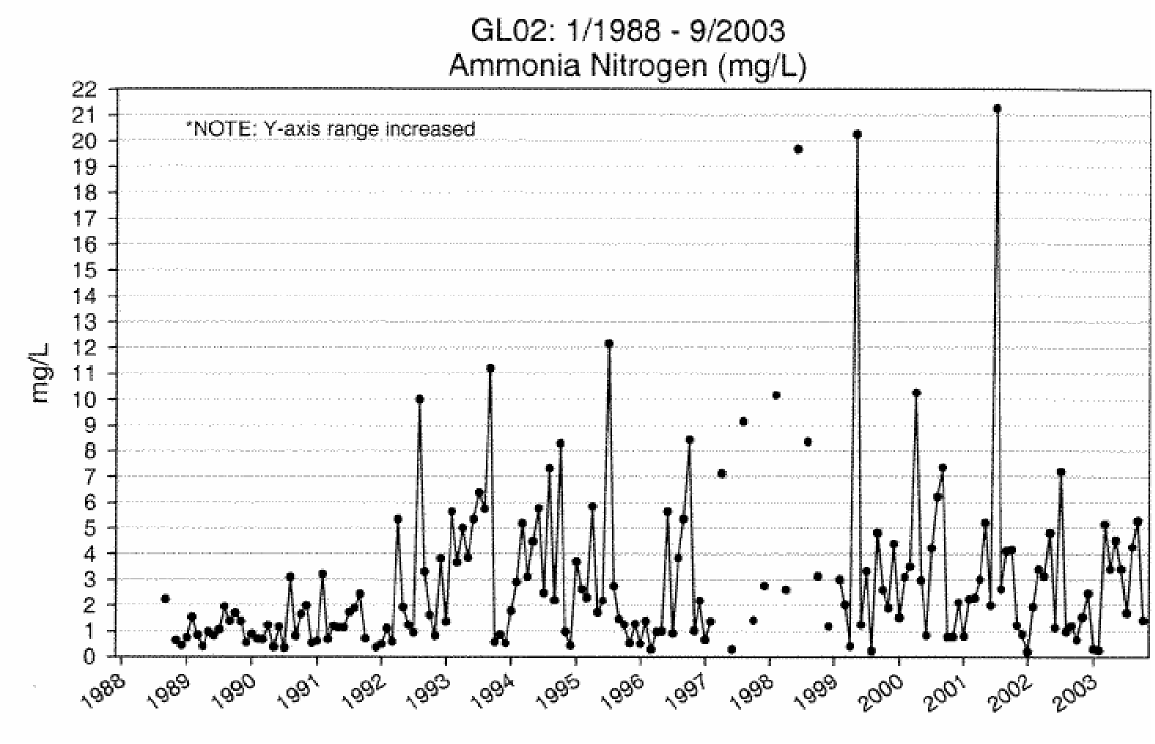

BB52: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

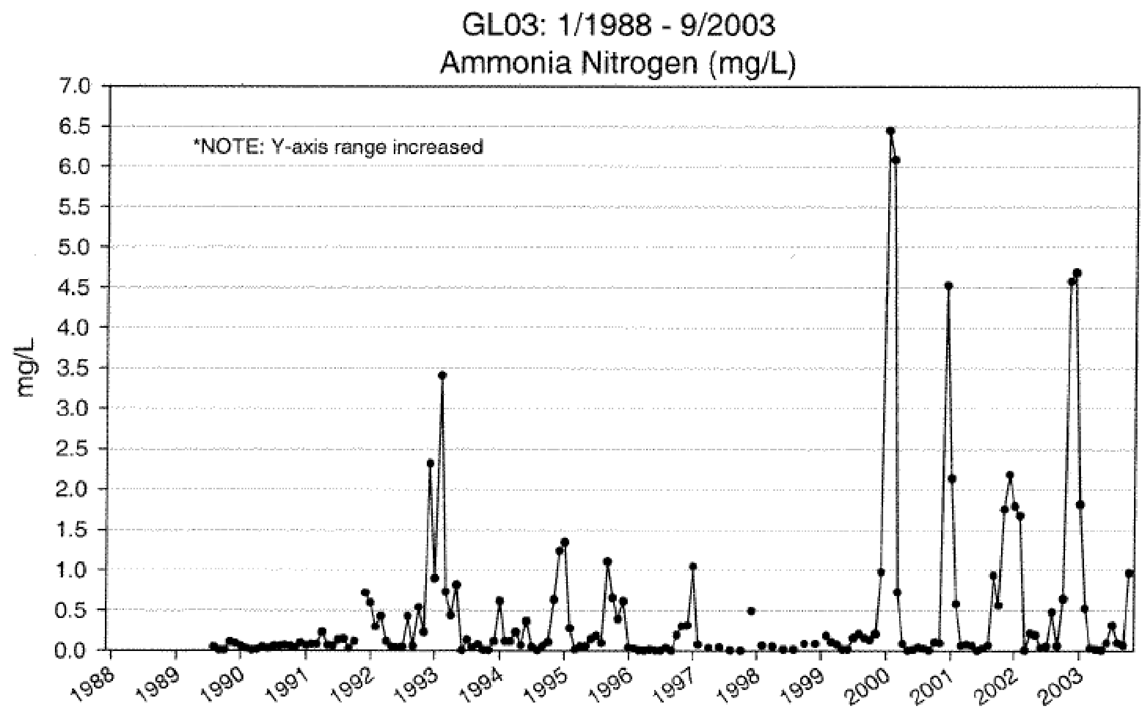

BB53: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

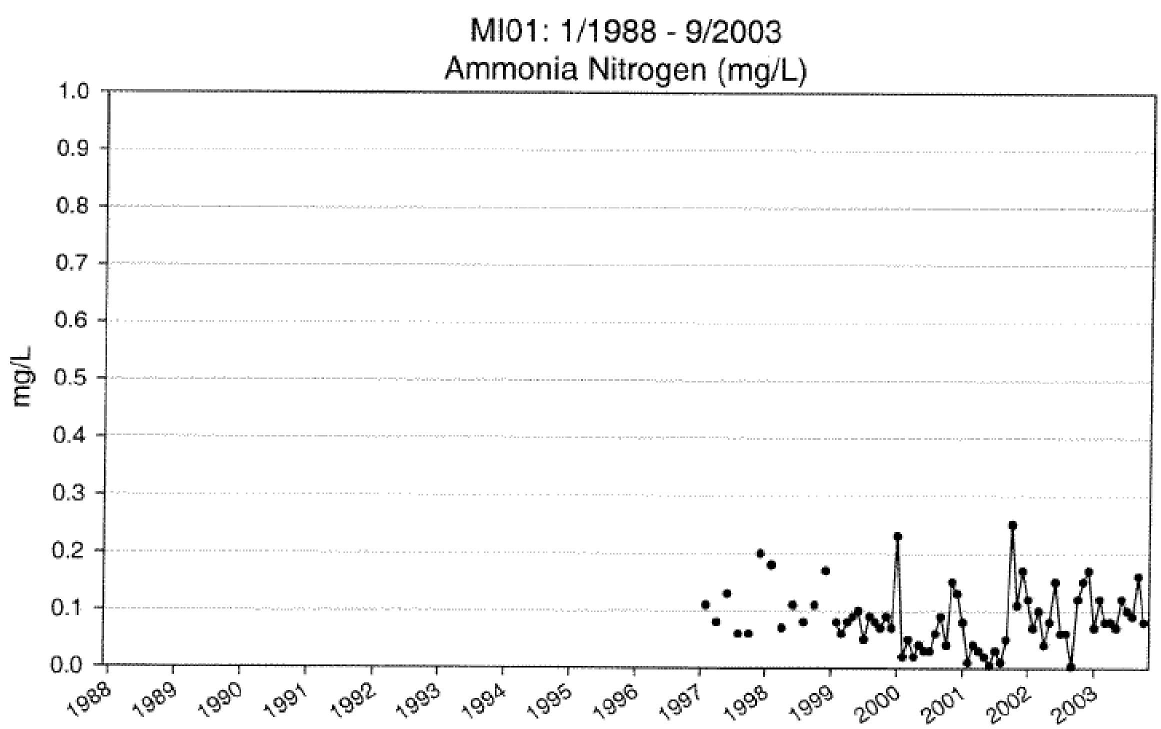

BL01: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
NOTE: Y-axis range increased
mg/L
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BL02: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
NOTE: Y-axis range increased
mg/L
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BL03: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


GL02: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
*NOTE: Y-axis range increased
mg/L
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


GL03: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
*NOTE: Y-axis range increased
mg/L
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MI01: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
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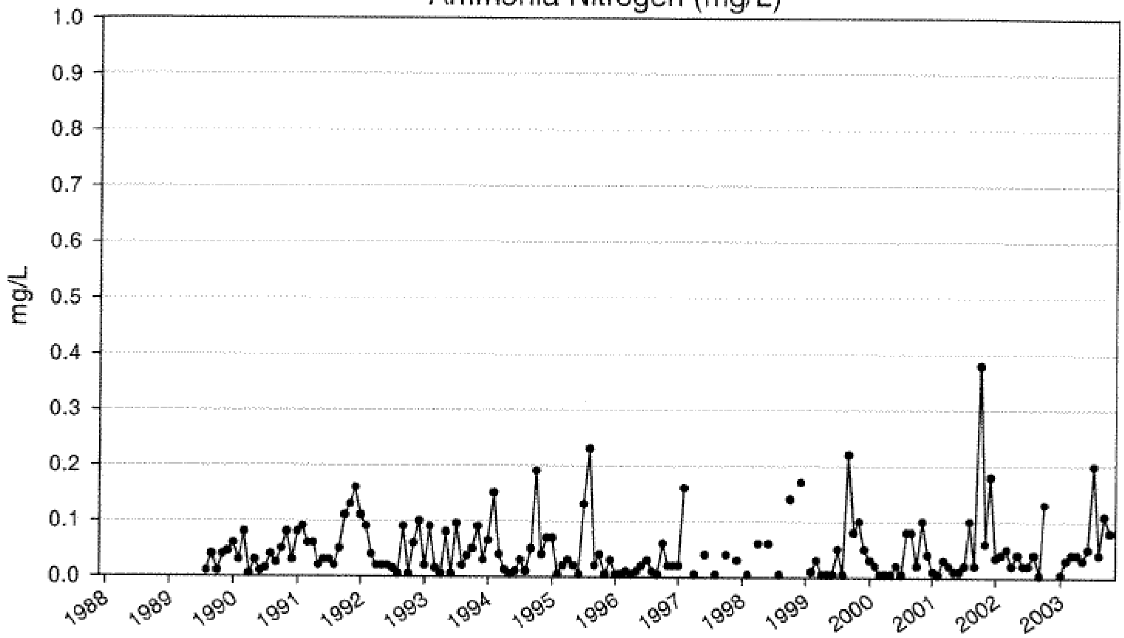
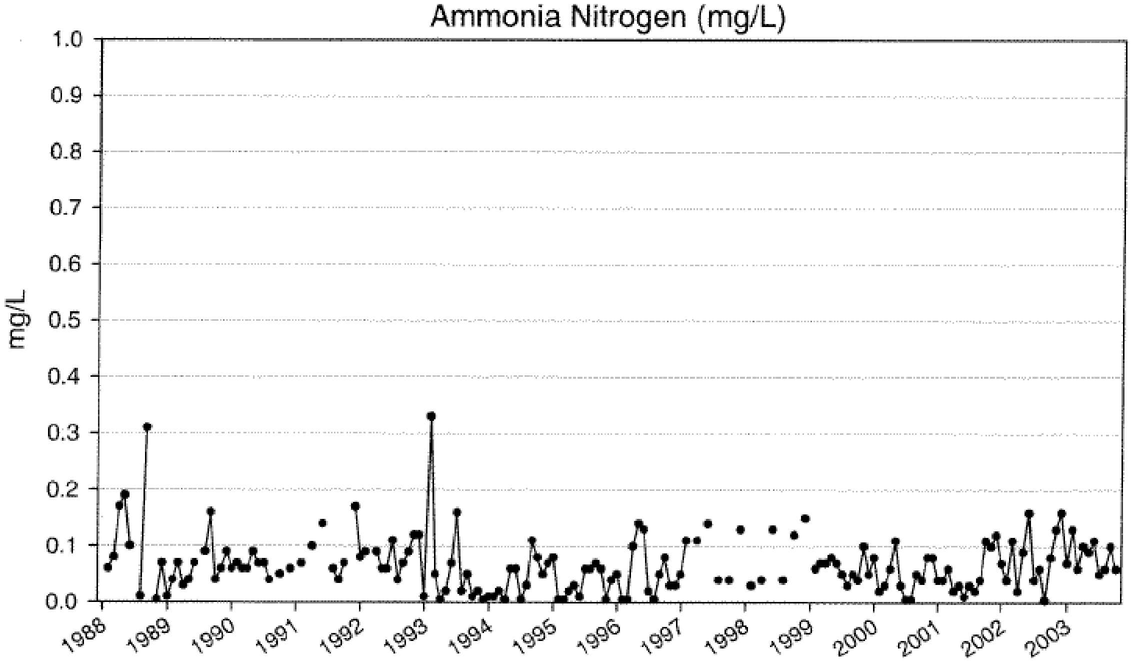
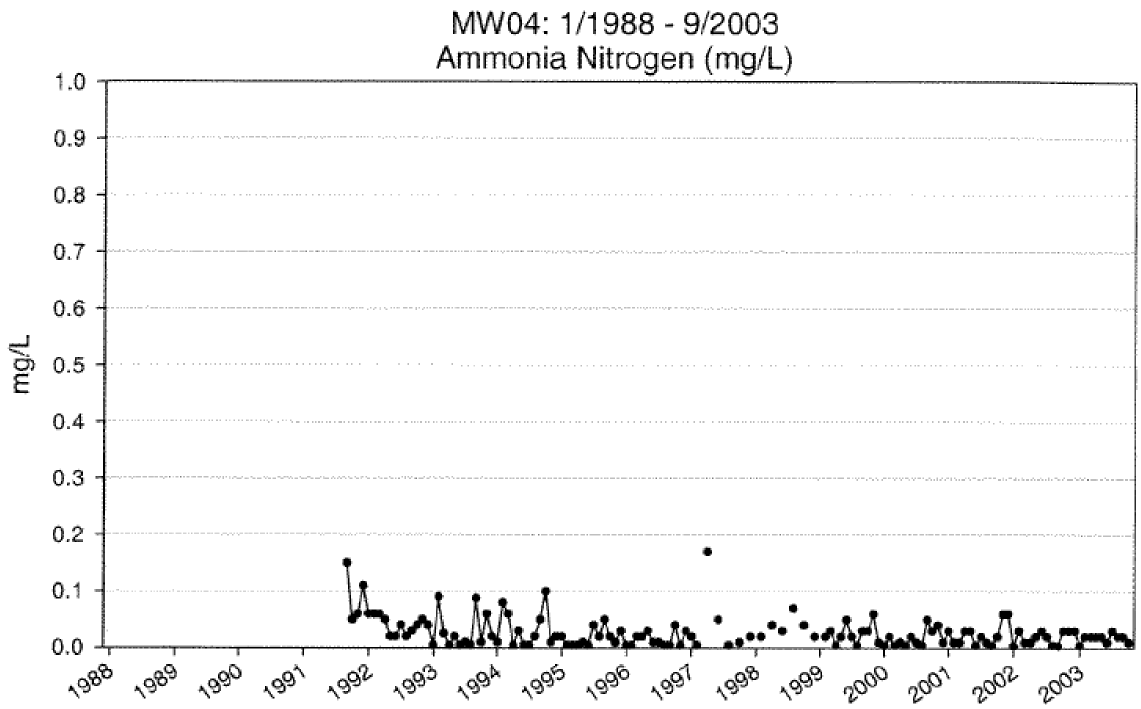
1998
1999
2000
2001
2002
2003

MI03: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)



MW01: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)




MW04: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
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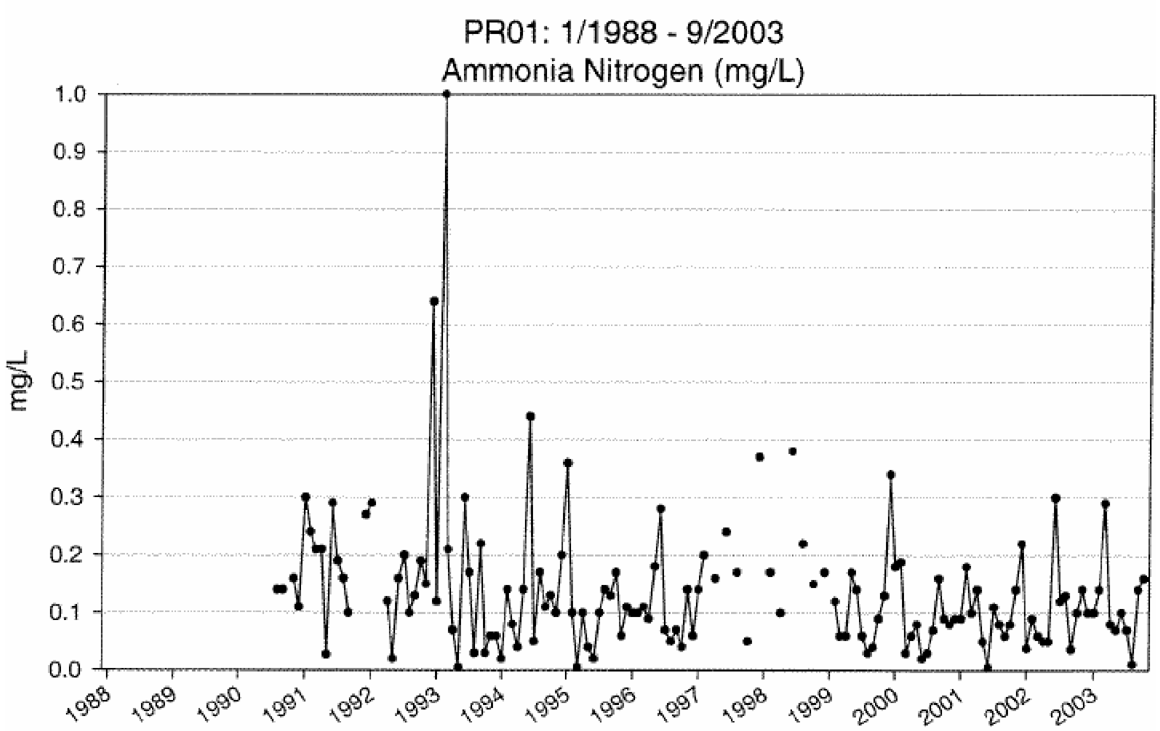
1997
1998
1999
2000
2001
2002
2003


PR01: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
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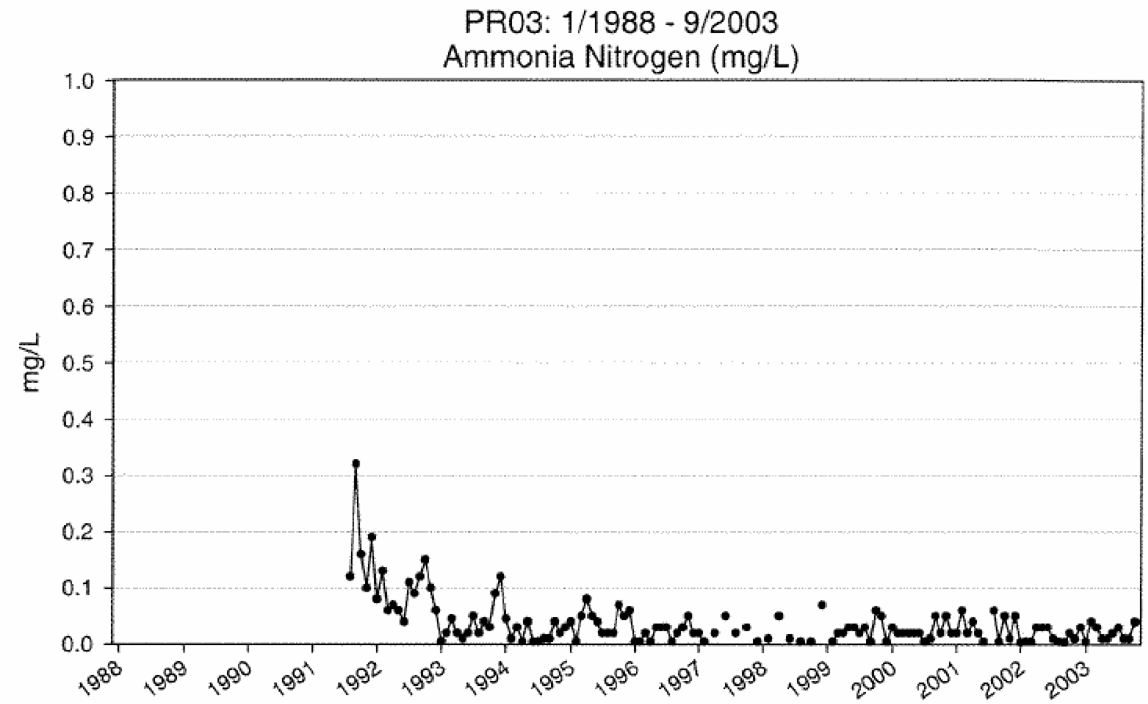
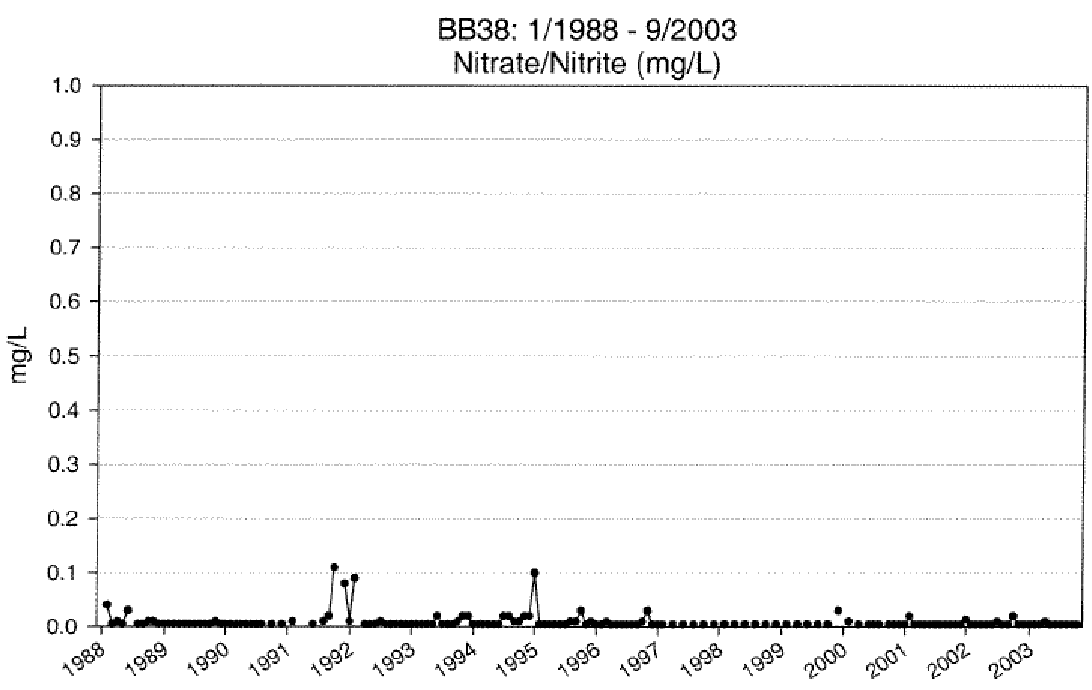
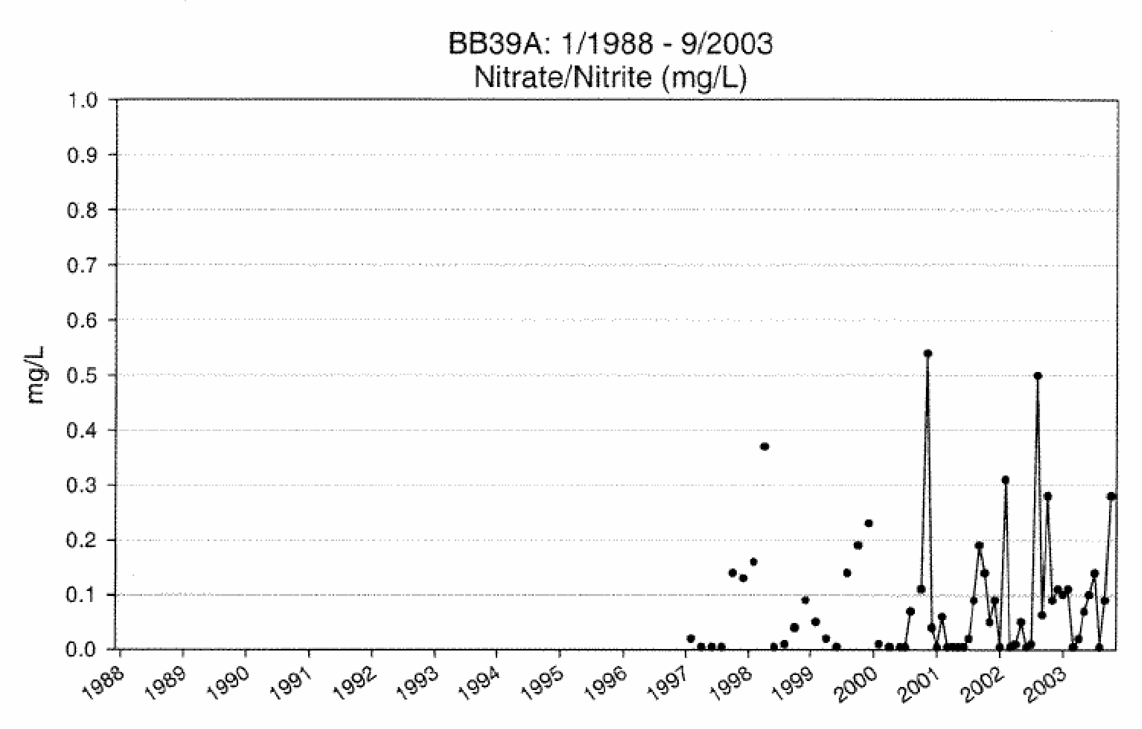
2001
2002
2003


PR03: 1/1988 - 9/2003
Ammonia Nitrogen (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB38: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB39A: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
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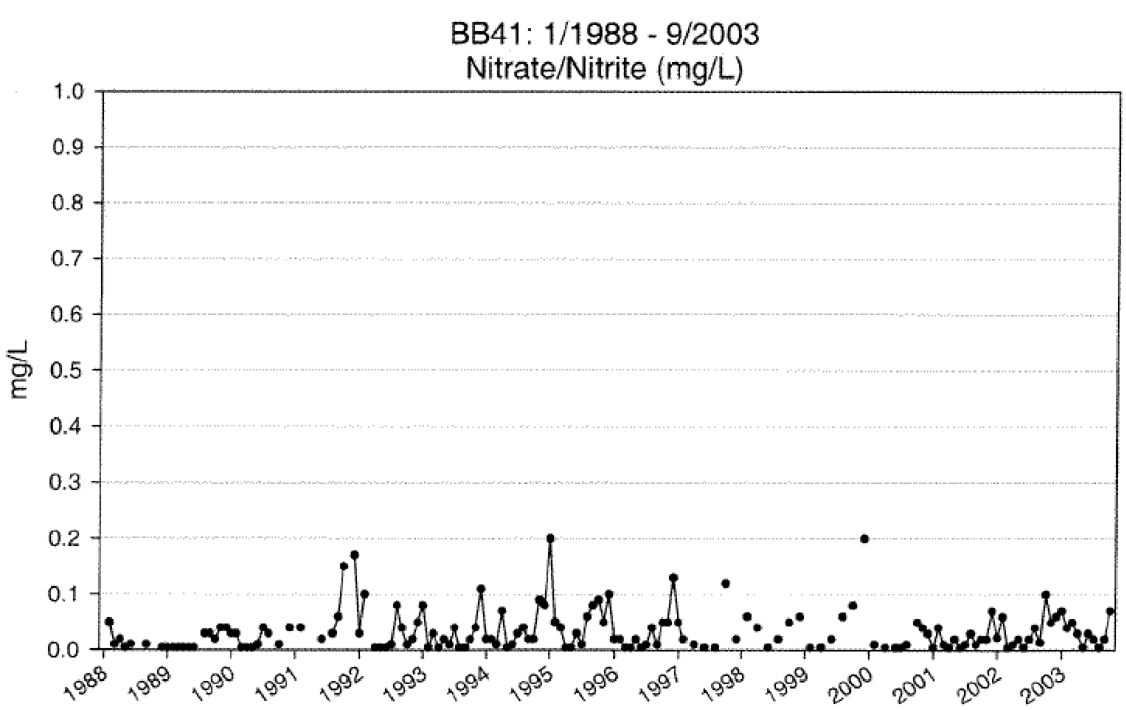
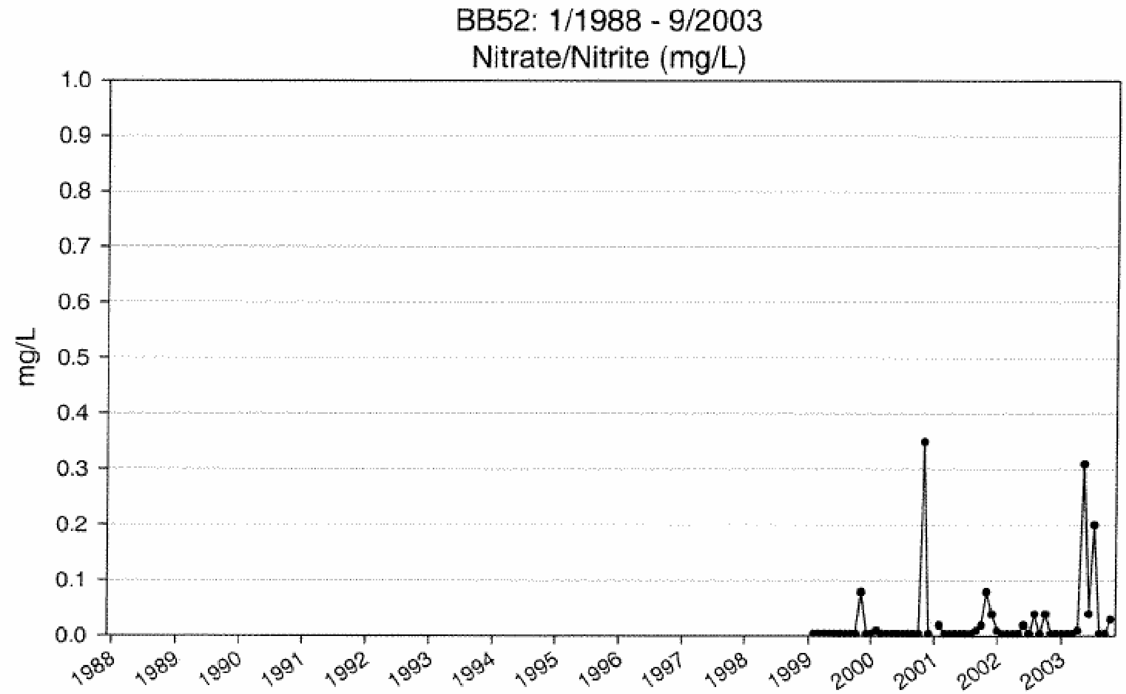
1996
1997
1998
1999
2000
2001
2002
2003


BB41: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB52: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
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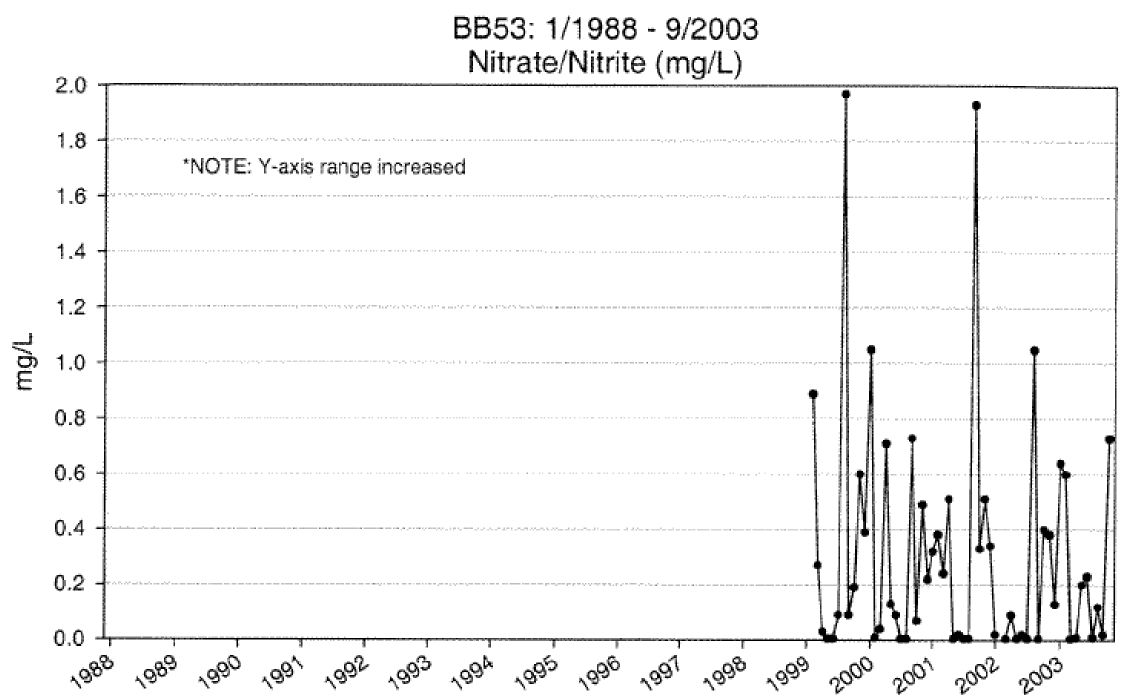
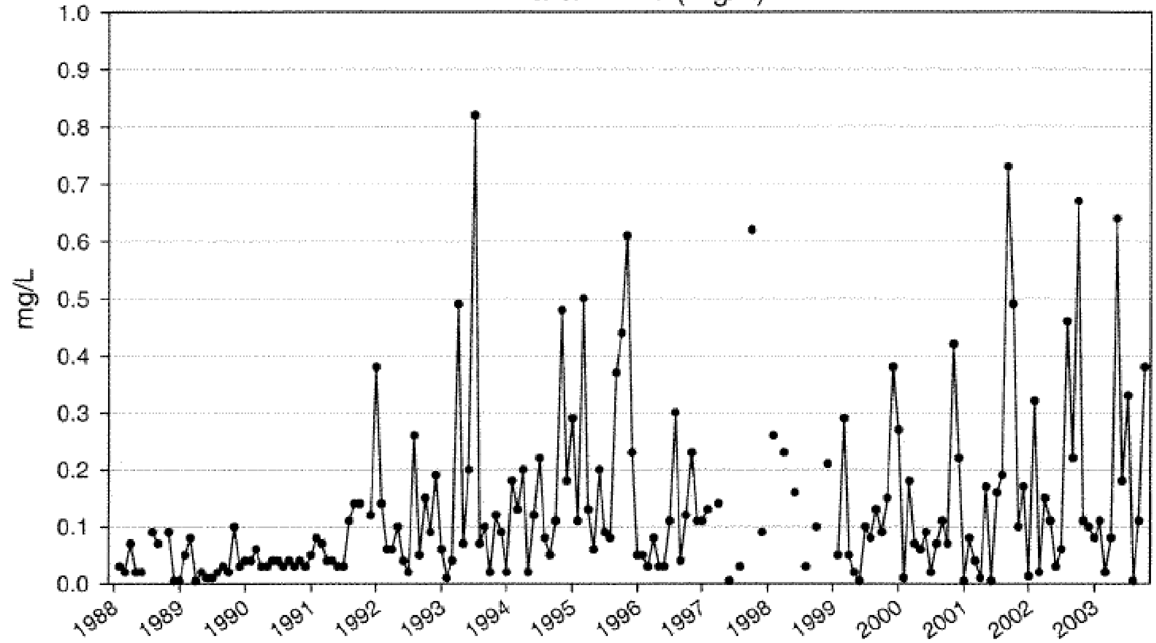
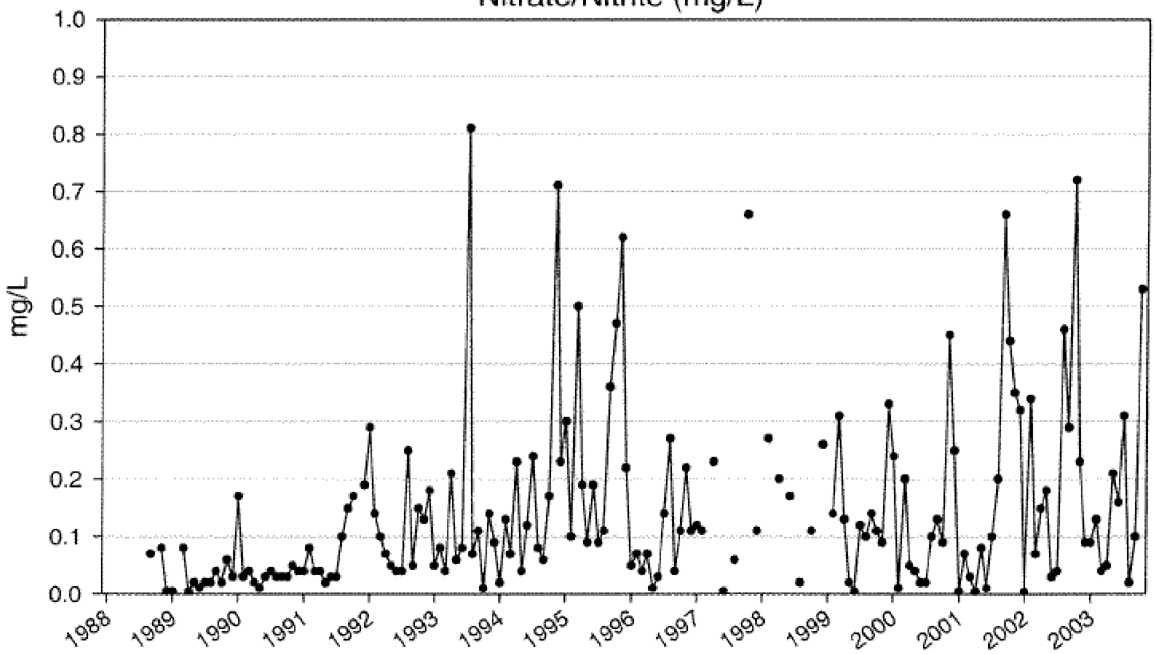
1996
1997
1998
1999
2000
2001
2002
2003

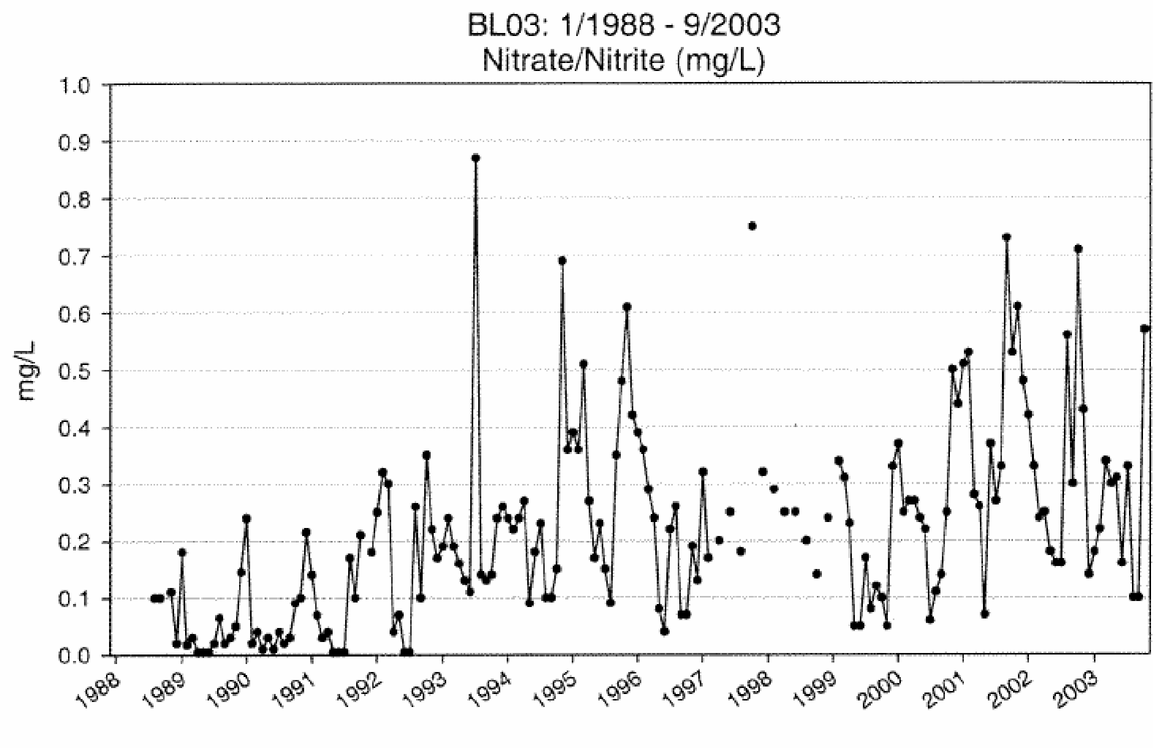

BB53: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
*NOTE: Y-axis range increased
mg/L
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

BL01: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)



BL02: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)




BL03: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
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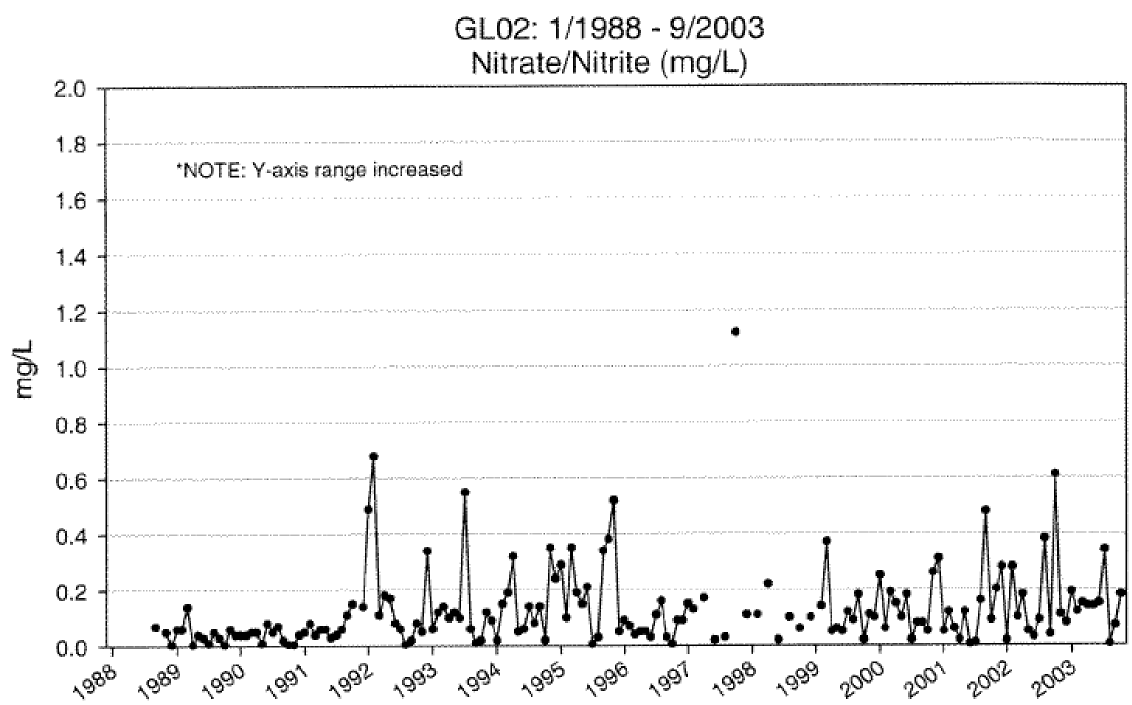
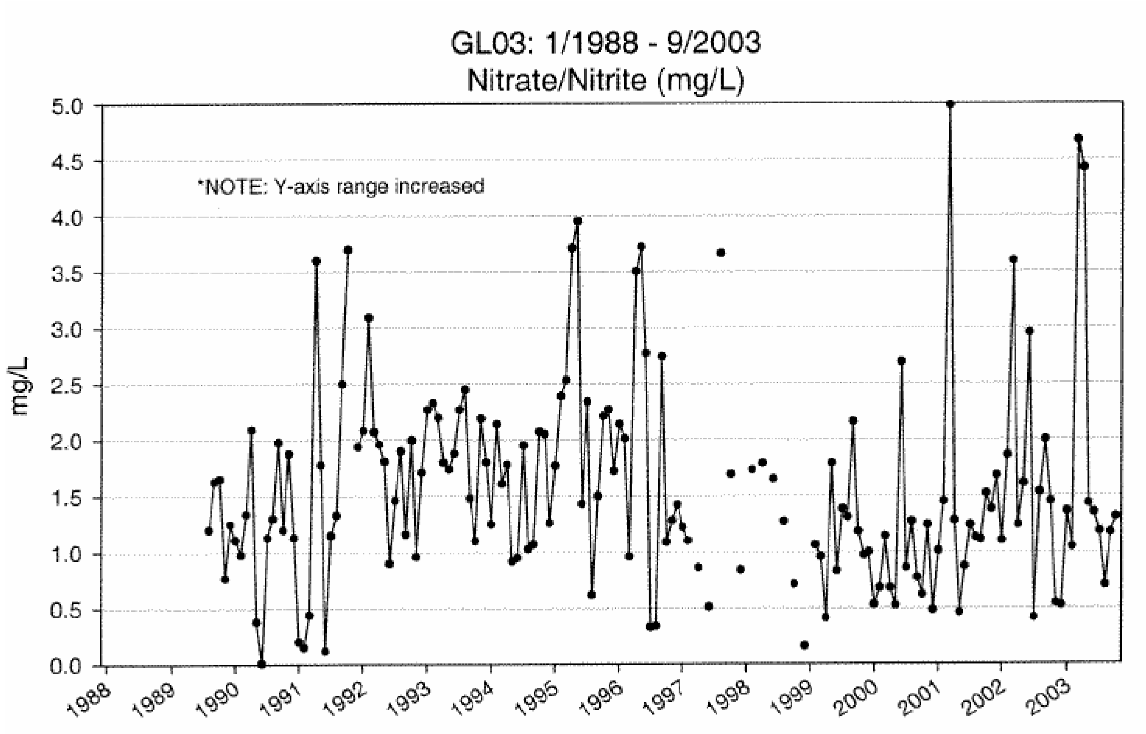
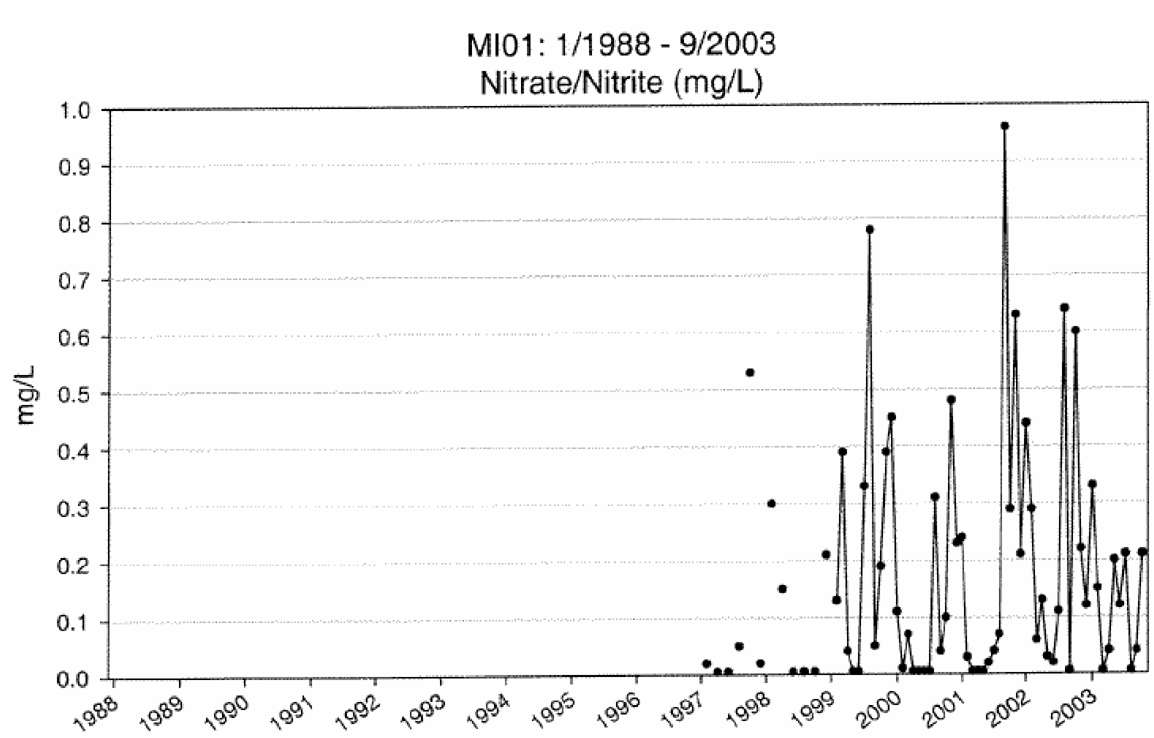
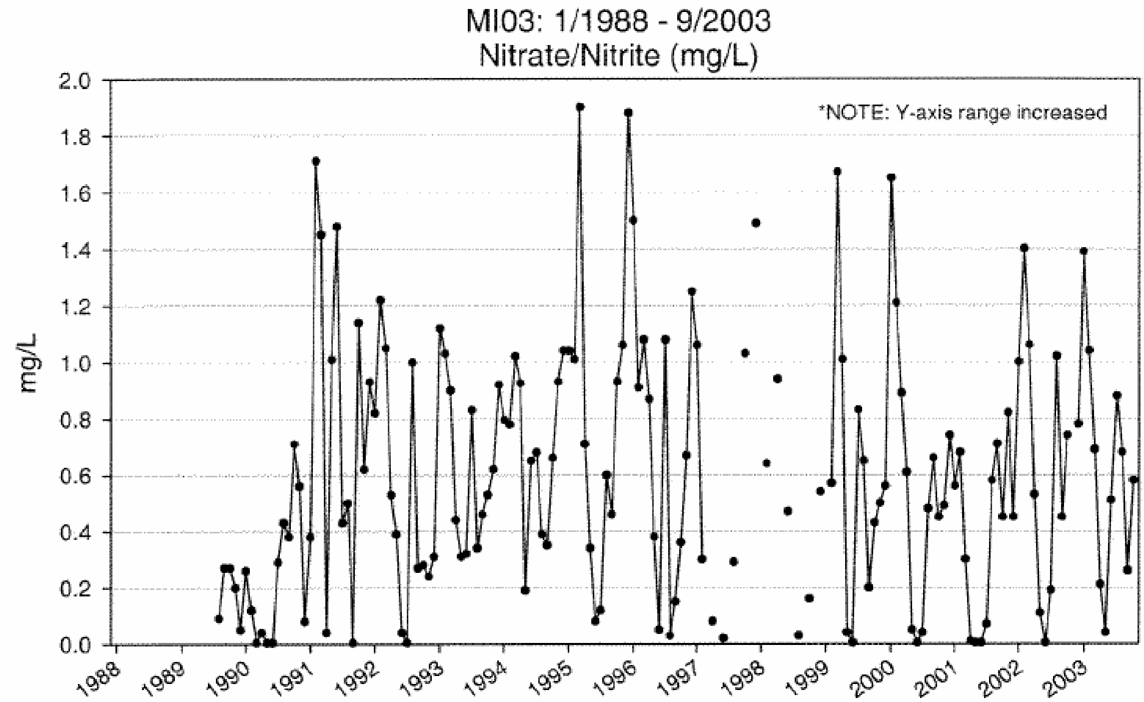
1996
1997
1998
1999
2000
2001
2002
2003


GL02: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
*NOTE: Y-axis range increased
mg/L
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


GL03: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
*NOTE: Y-axis range increased
mg/L
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MI01: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
mg/L
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MI03: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
*NOTE: Y-axis range increased
mg/L
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
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1998
1999
2000
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2002
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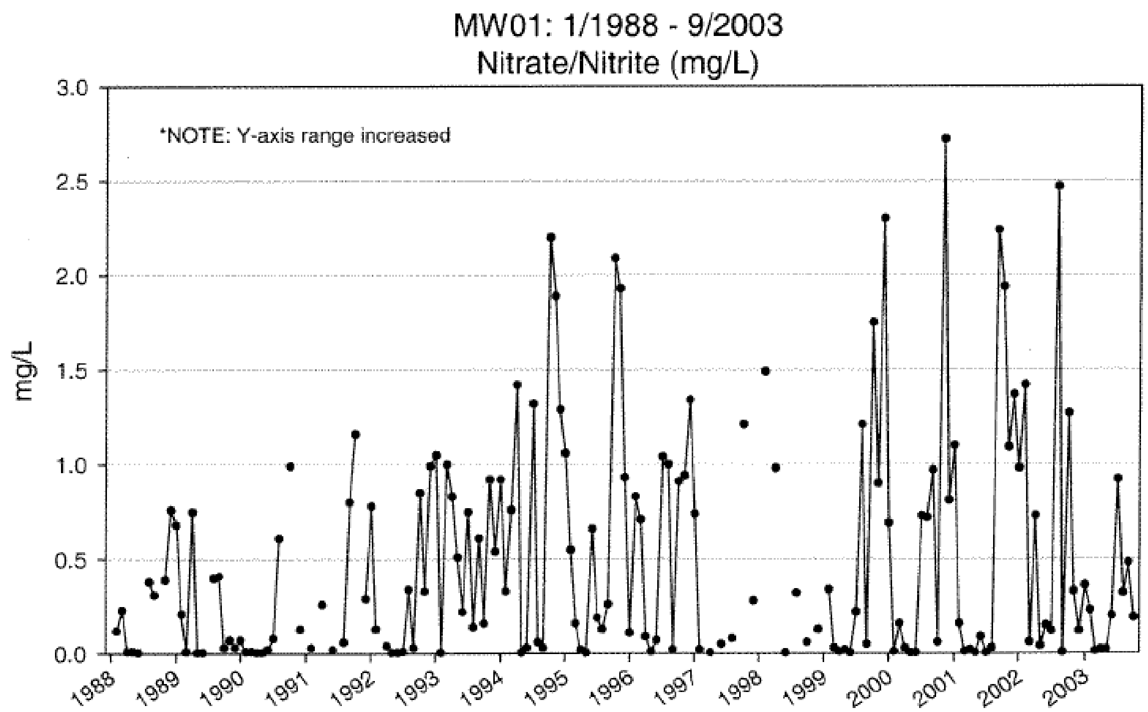
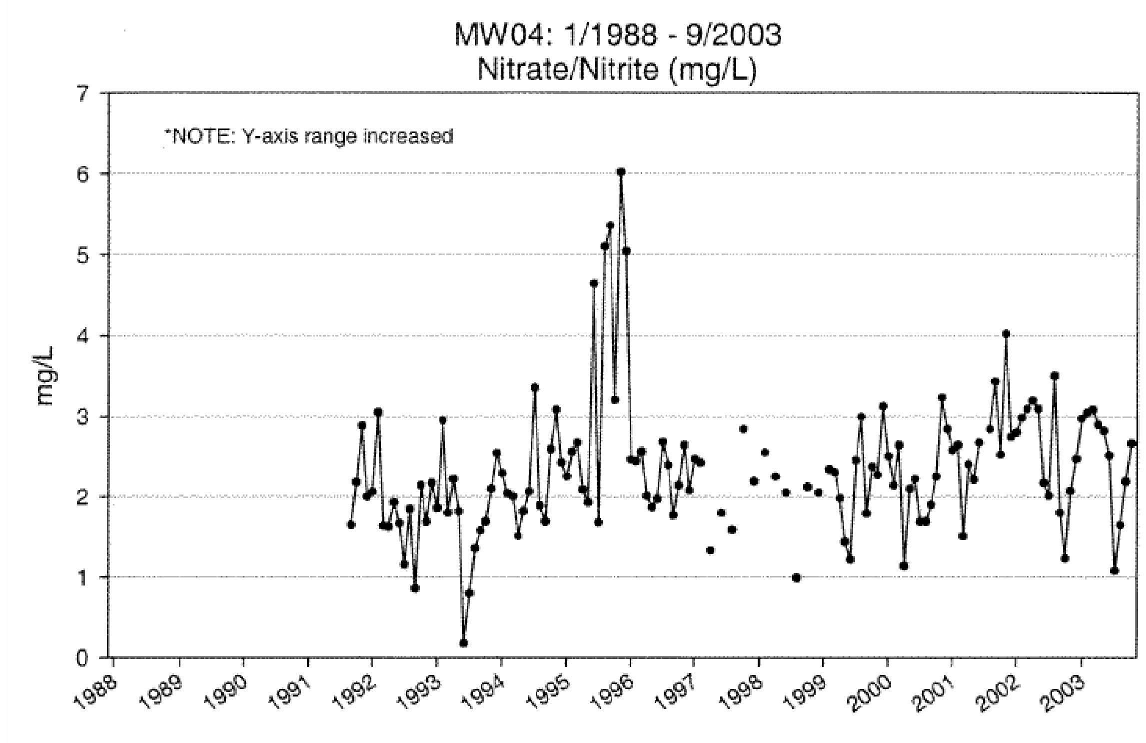
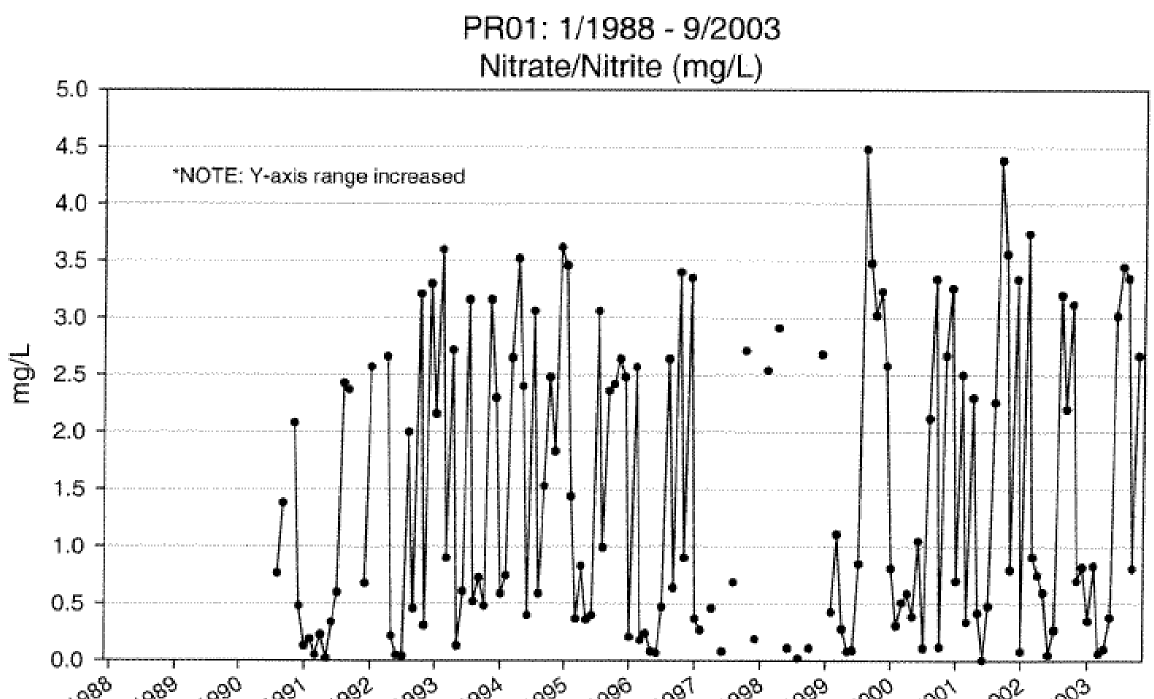
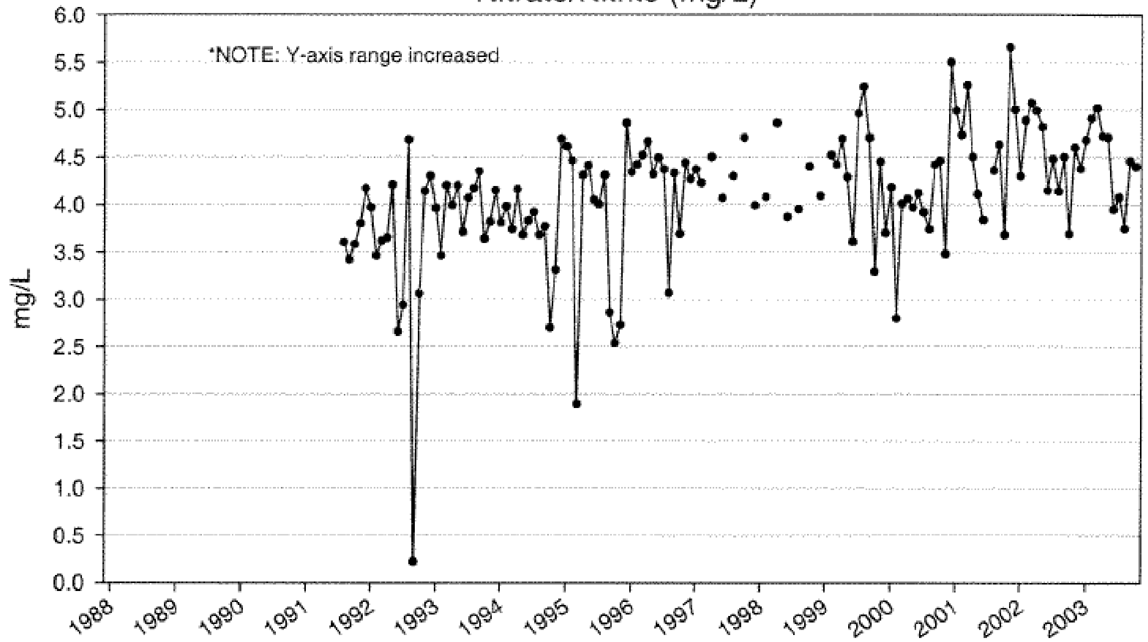

MW01: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
*NOTE: Y-axis range increased
mg/L
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

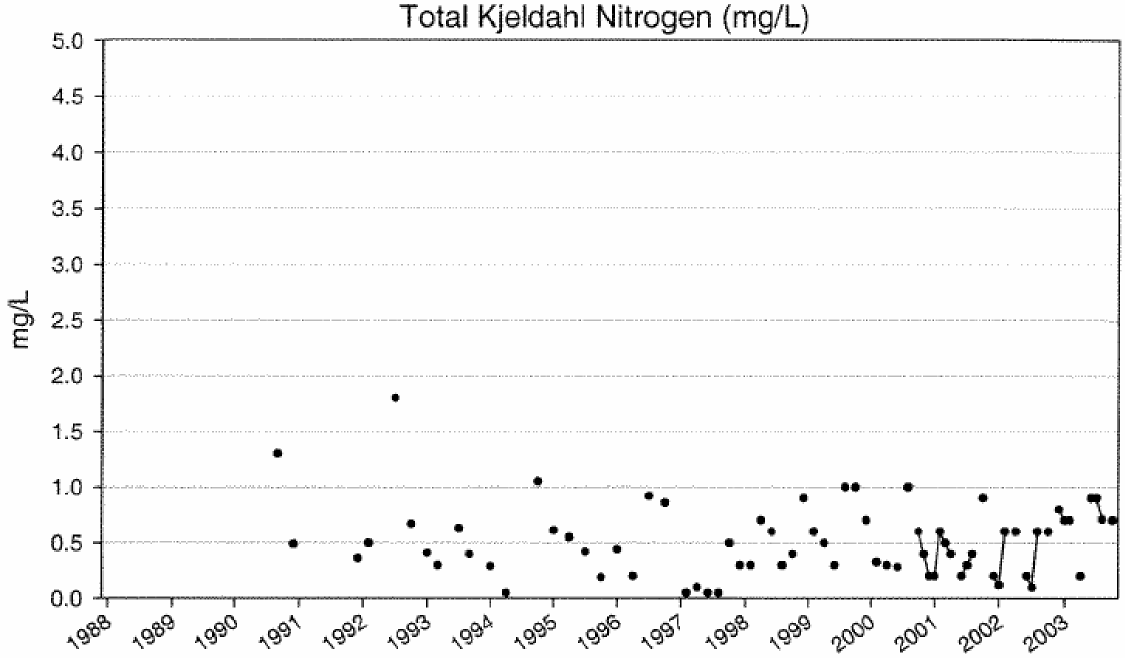

MW04: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
*NOTE: Y-axis range increased
mg/L
0
1
2
3
4
5
6
7
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

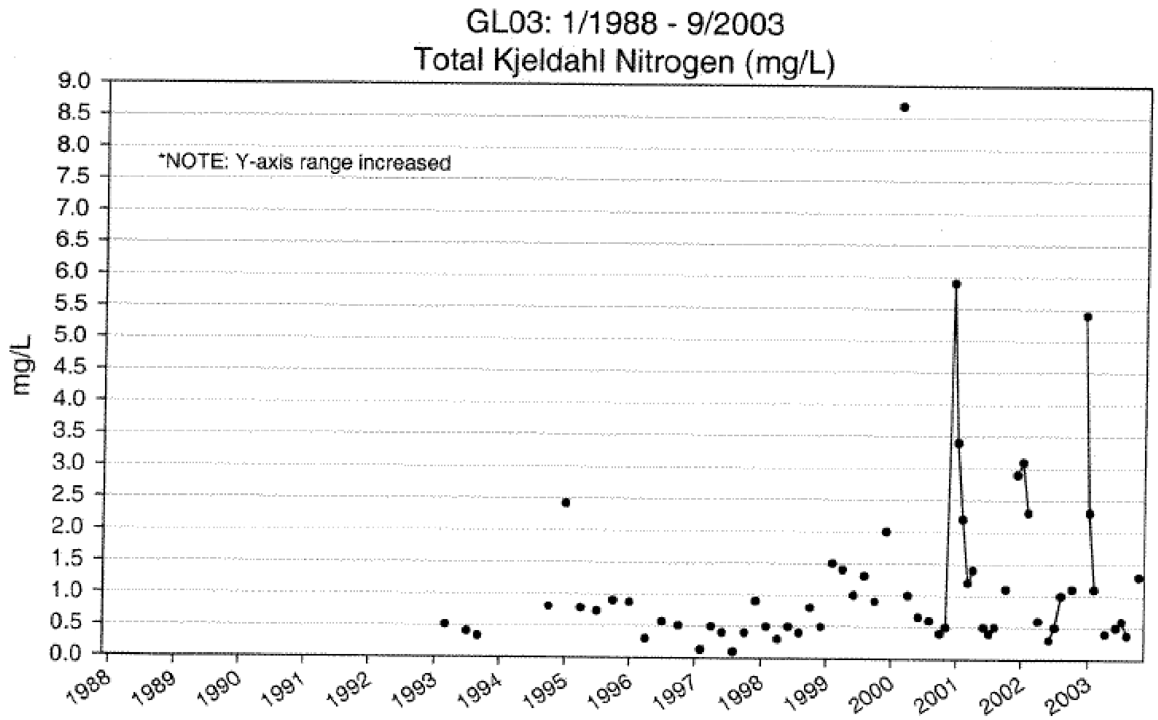

PR01: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)
*NOTE: Y-axis range increased
mg/L
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

PR03: 1/1988 - 9/2003
Nitrate/Nitrite (mg/L)



BL03: 1/1988 - 9/2003
Total Kjeldahl Nitrogen (mg/L)




GL03: 1/1988 - 9/2003
Total Kjeldahl Nitrogen (mg/L)
*NOTE: Y-axis range increased
mg/L
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1988
1989
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1991
1992
1993
1994
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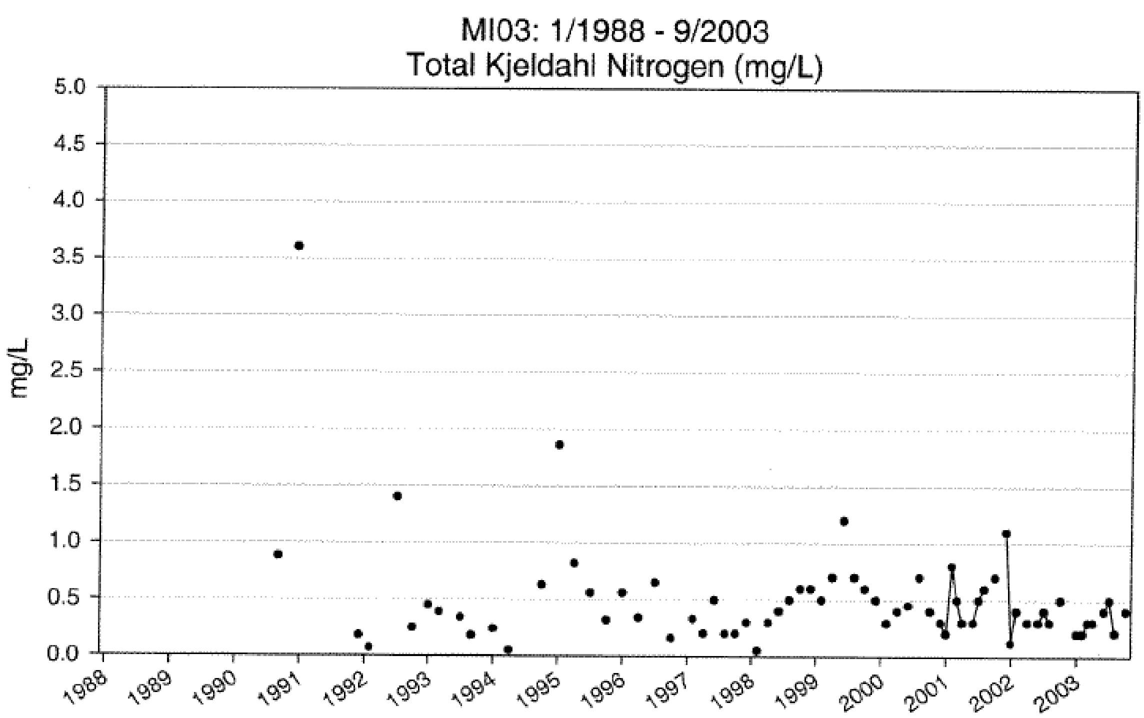
2002
2003


MI03: 1/1988 - 9/2003
Total Kjeldahl Nitrogen (mg/L)
mg/L
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1988
1989
1990
1991
1992
1993
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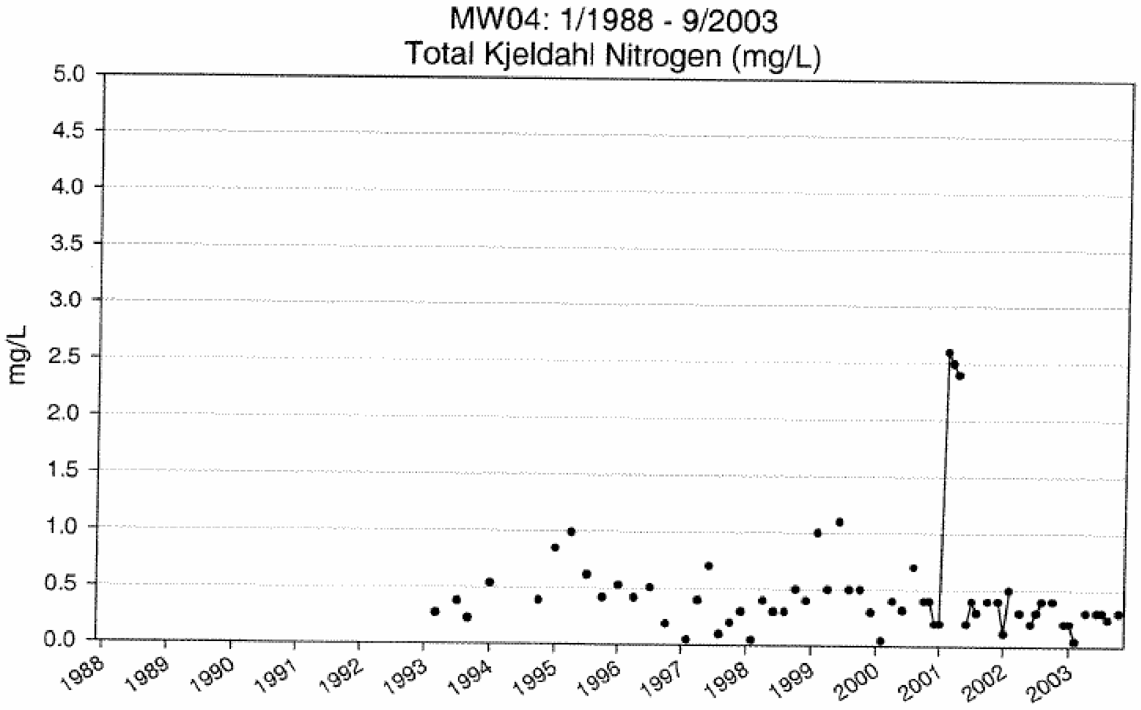
1999
2000
2001
2002
2003


MW04: 1/1988 - 9/2003
Total Kjeldahl Nitrogen (mg/L)
mg/L
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1988
1989
1990
1991
1992
1993
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1997
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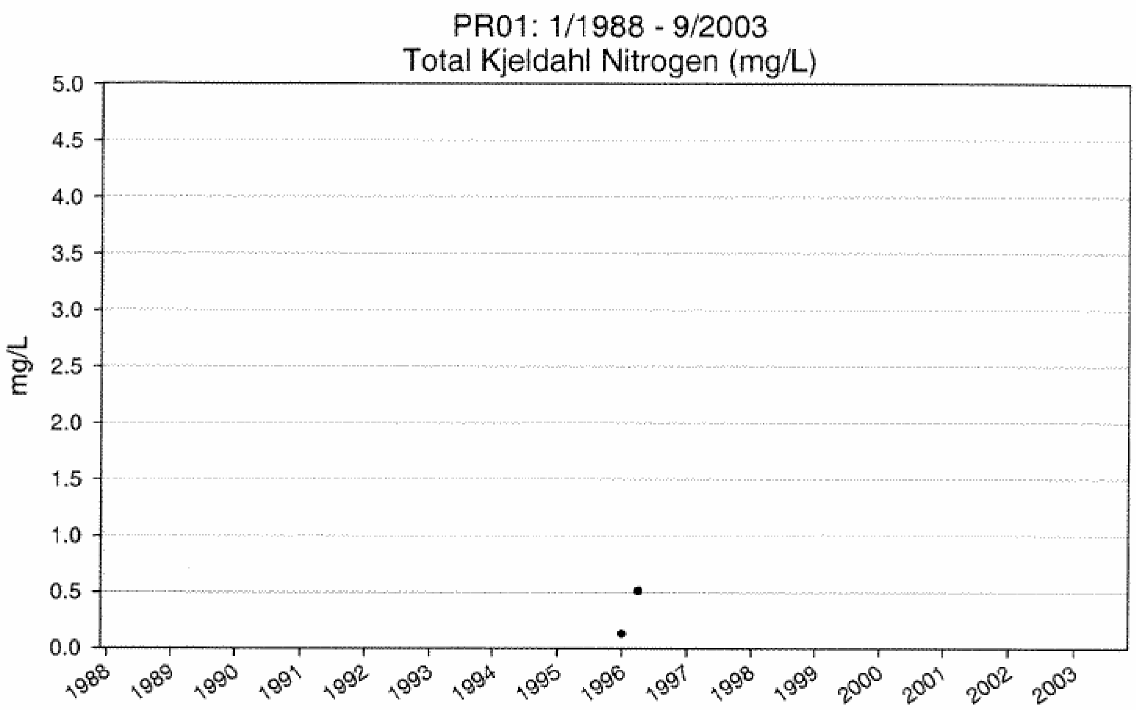
1999
2000
2001
2002
2003


PR01: 1/1988 - 9/2003
Total Kjeldahl Nitrogen (mg/L)
mg/L
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1988
1989
1990
1991
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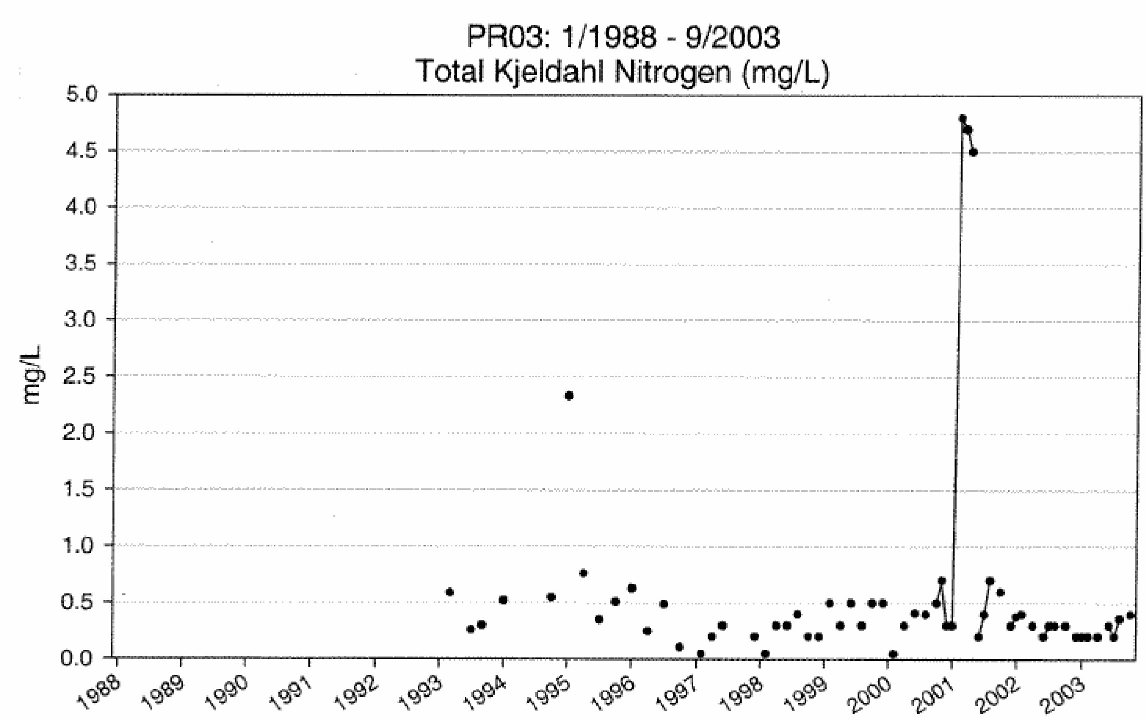
2000
2001
2002
2003


PR03: 1/1988 - 9/2003
Total Kjeldahl Nitrogen (mg/L)
mg/L
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1988
1989
1990
1991
1992
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2001
2002
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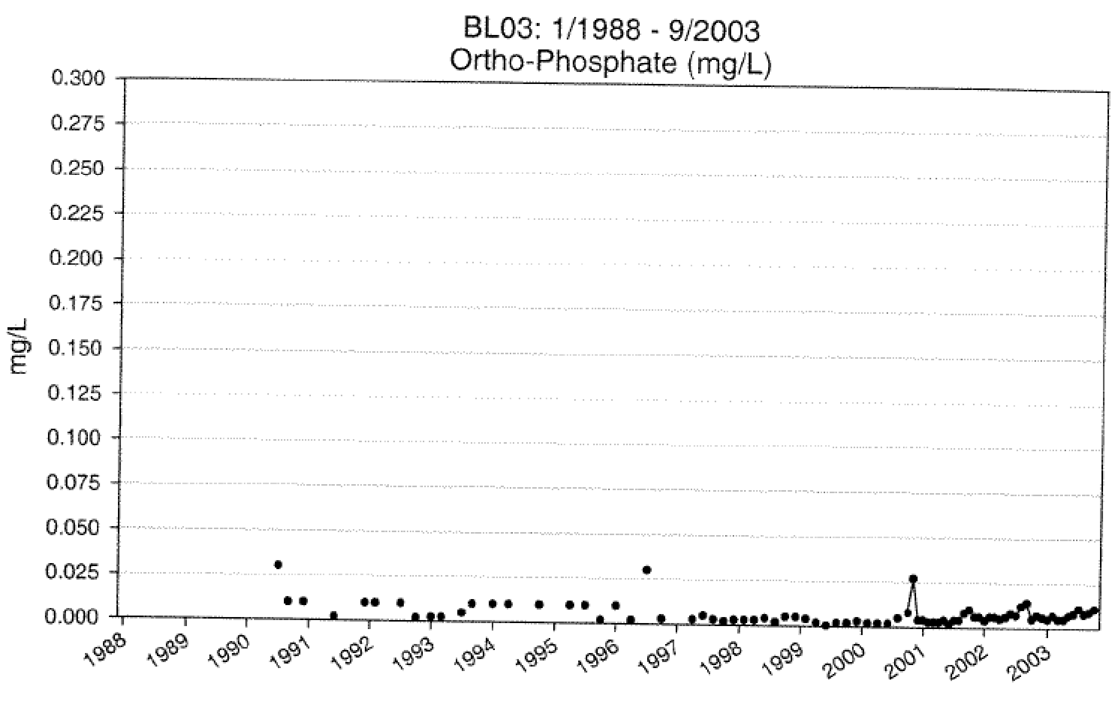
BL03: 1/1988 - 9/2003
Ortho-Phosphate (mg/L)
mg/L
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1988
1989
1990
1991
1992
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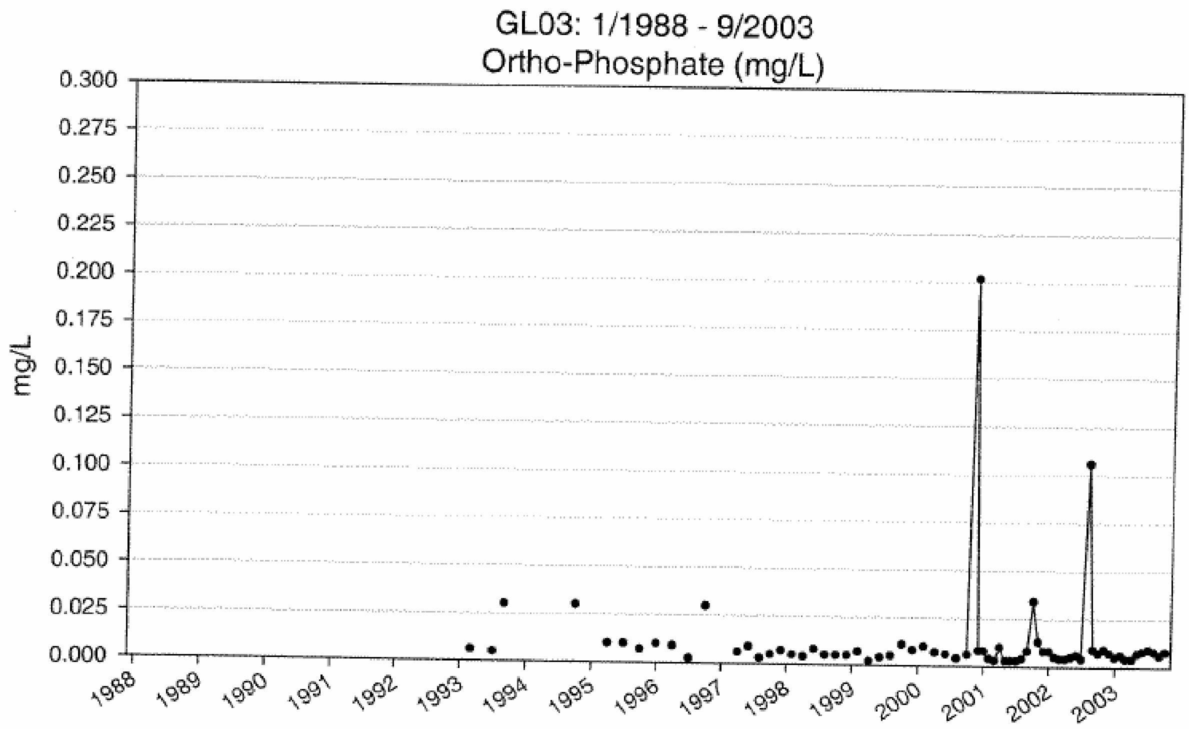
1999
2000
2001
2002
2003



GL03: 1/1988 - 9/2003
Ortho-Phosphate (mg/L)
mg/L
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1988
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1992
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1999
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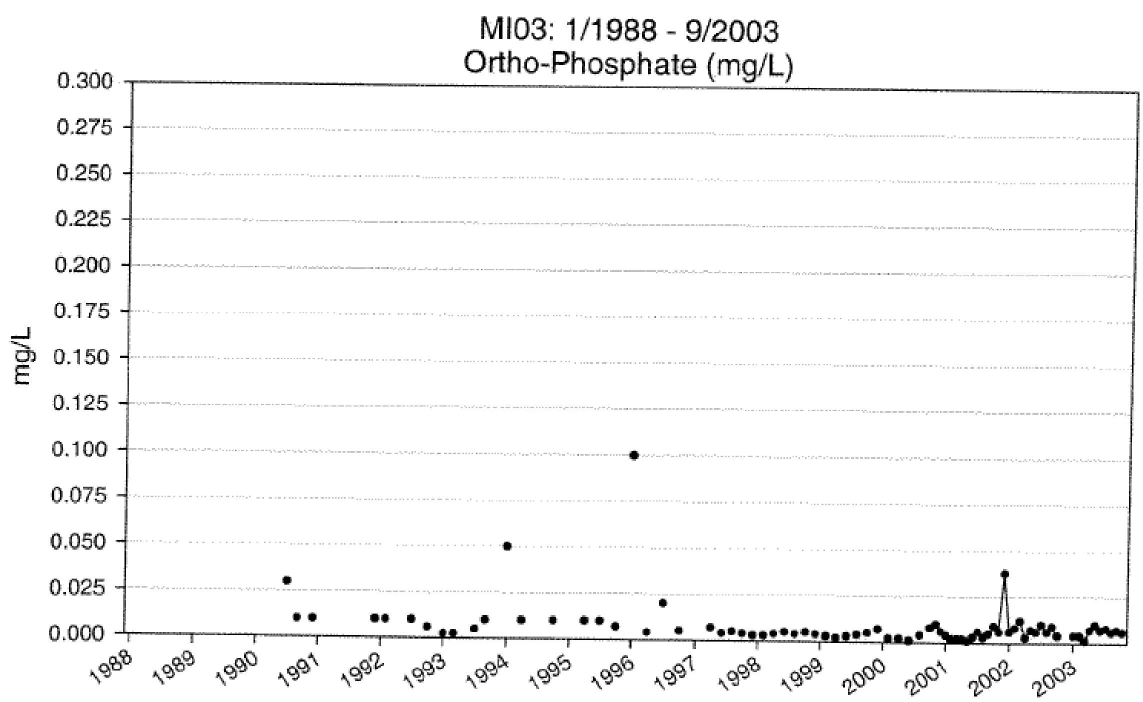
2001
2002
2003



MI03: 1/1988 - 9/2003
Ortho-Phosphate (mg/L)
mg/L
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1988
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1999
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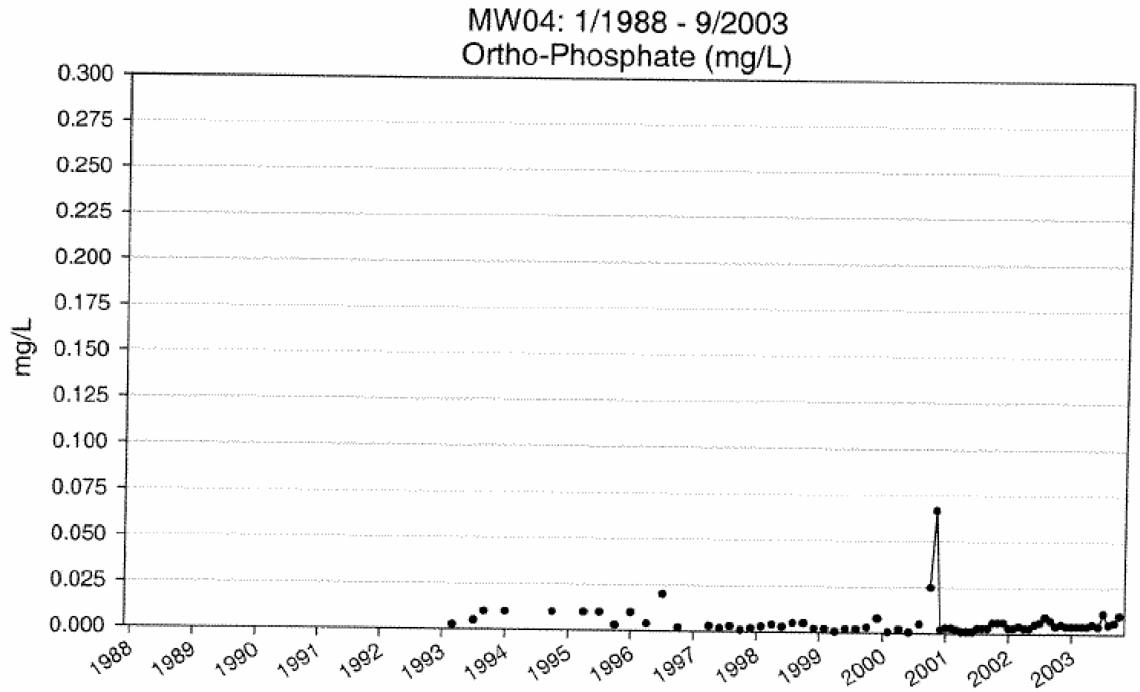
2001
2002
2003


MW04: 1/1988 - 9/2003
Ortho-Phosphate (mg/L)
mg/L
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1988
1989
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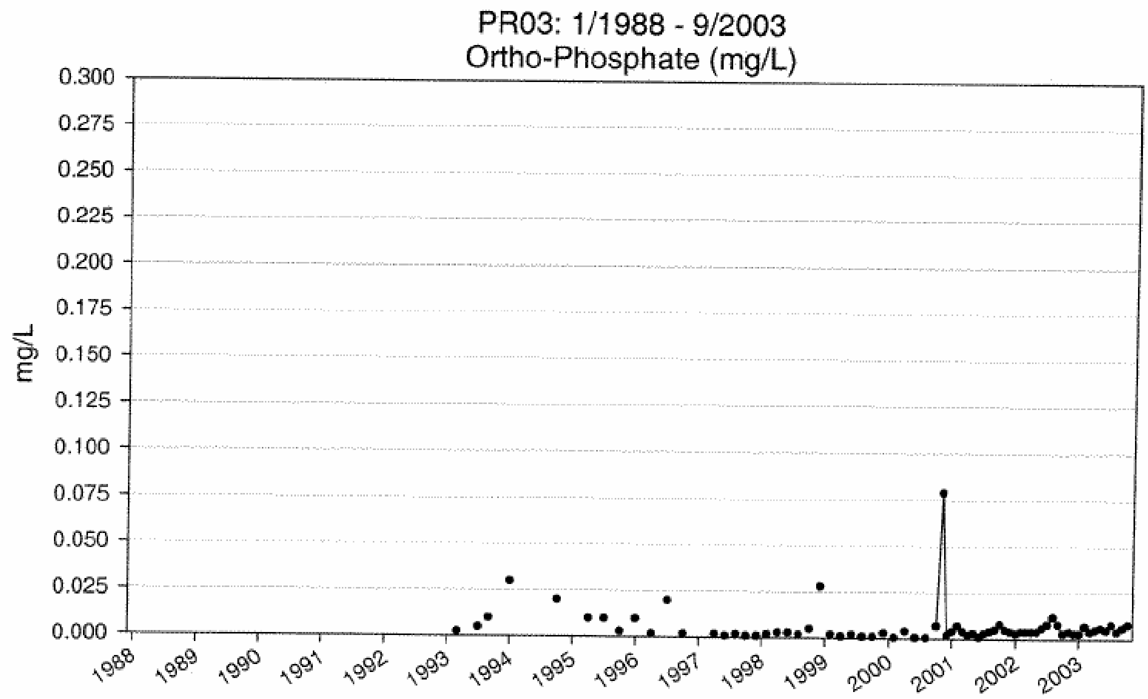
PR03: 1/1988 - 9/2003
Ortho-Phosphate (mg/L)
mg/L
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1988
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2002
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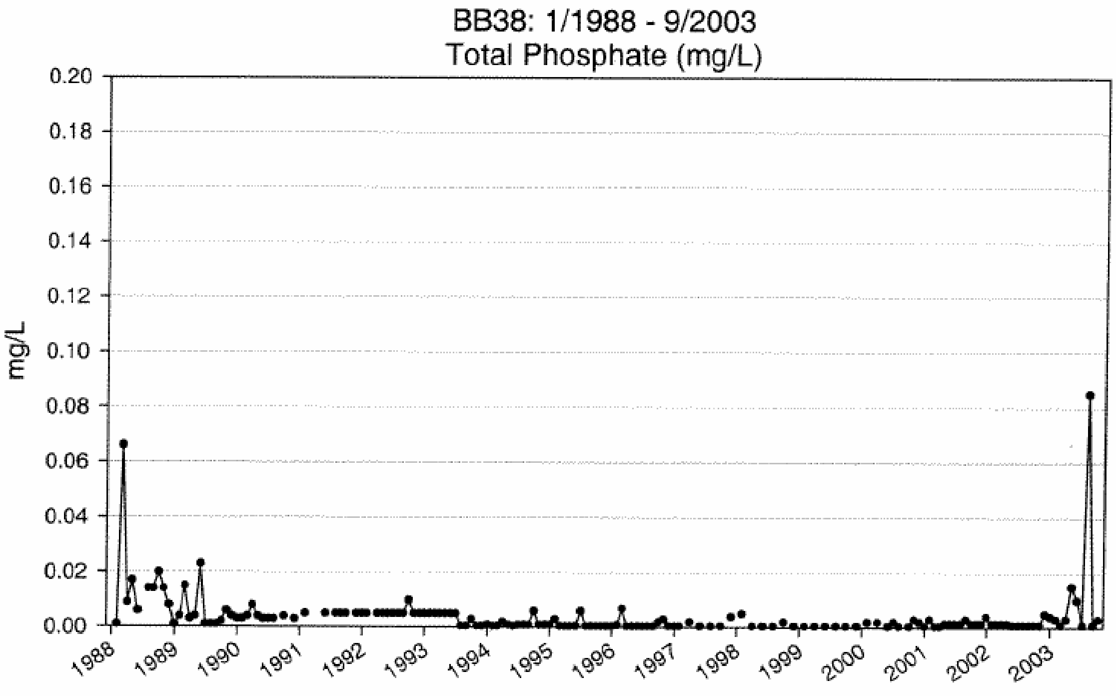
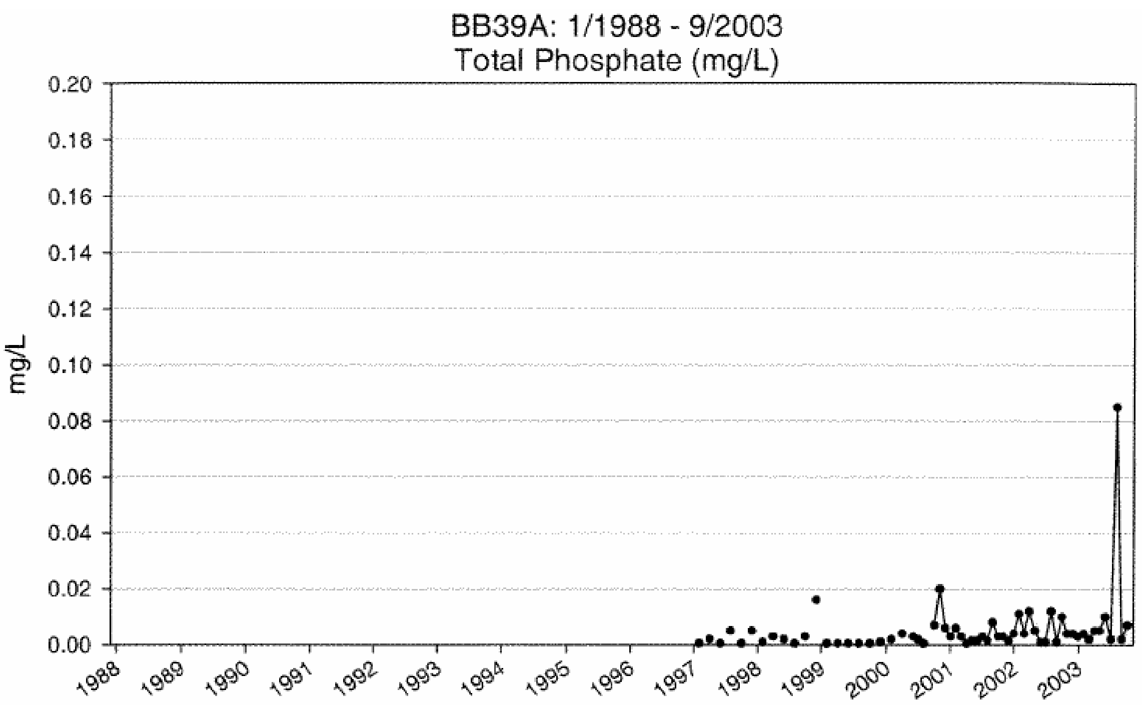

BB38: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB39A: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
1993
1994
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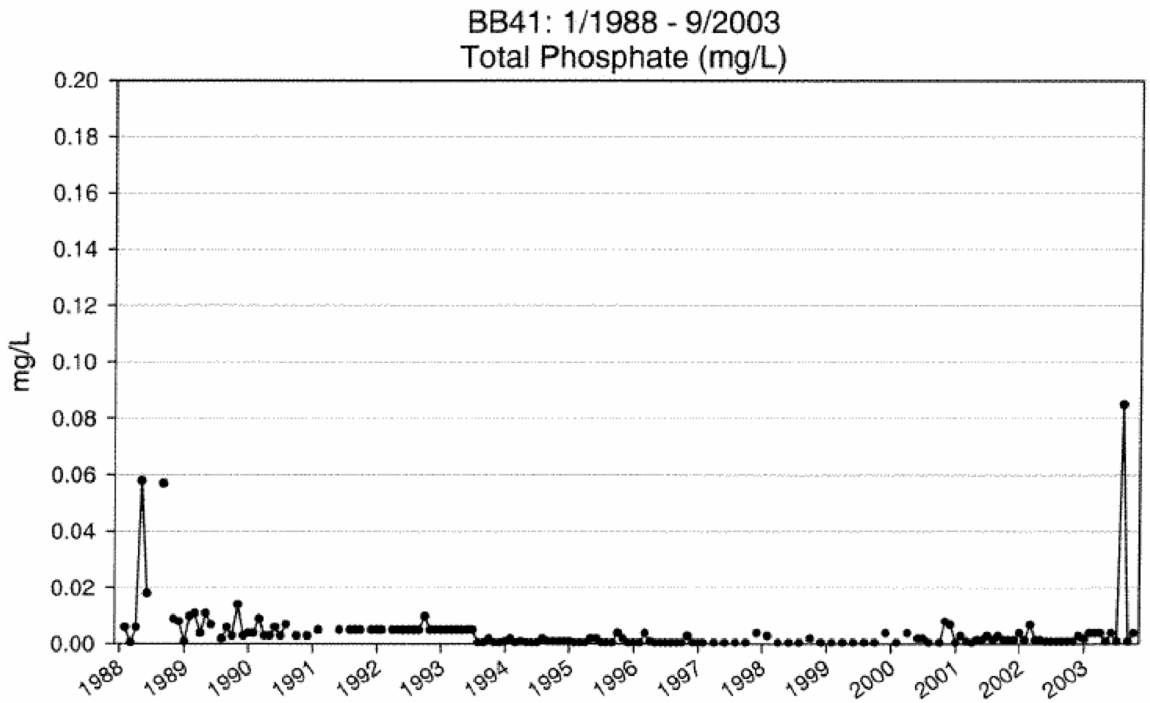
1996
1997
1998
1999
2000
2001
2002
2003


BB41: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
1993
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1996
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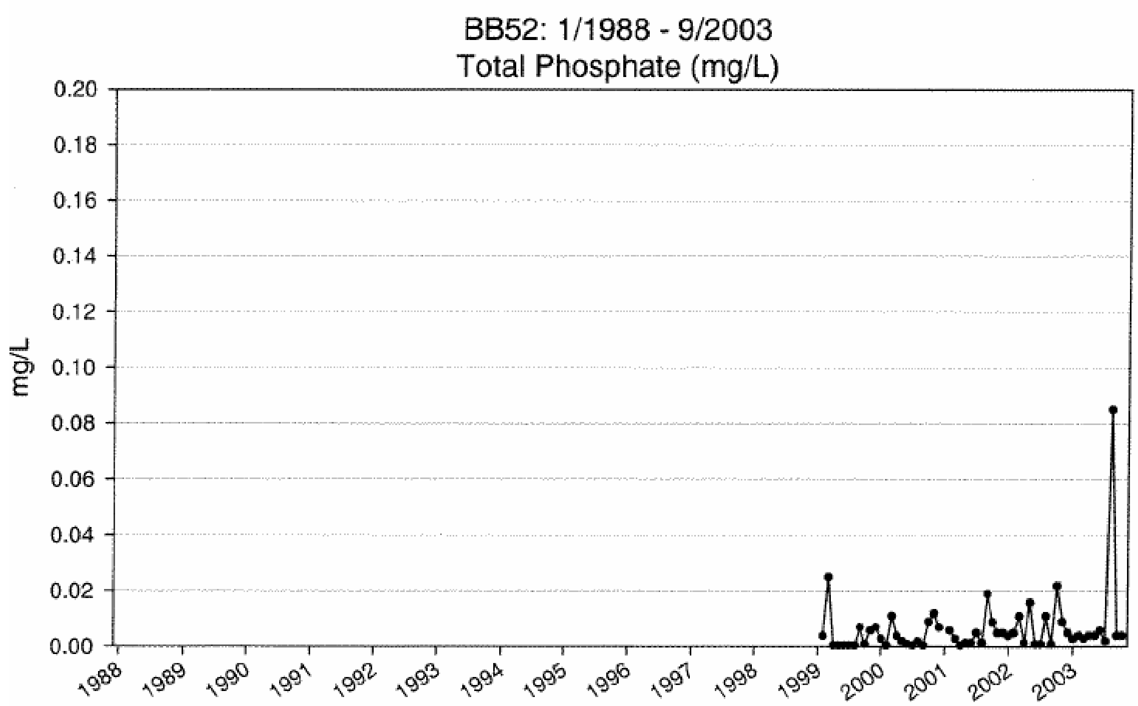
1999
2000
2001
2002
2003


BB52: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
1993
1994
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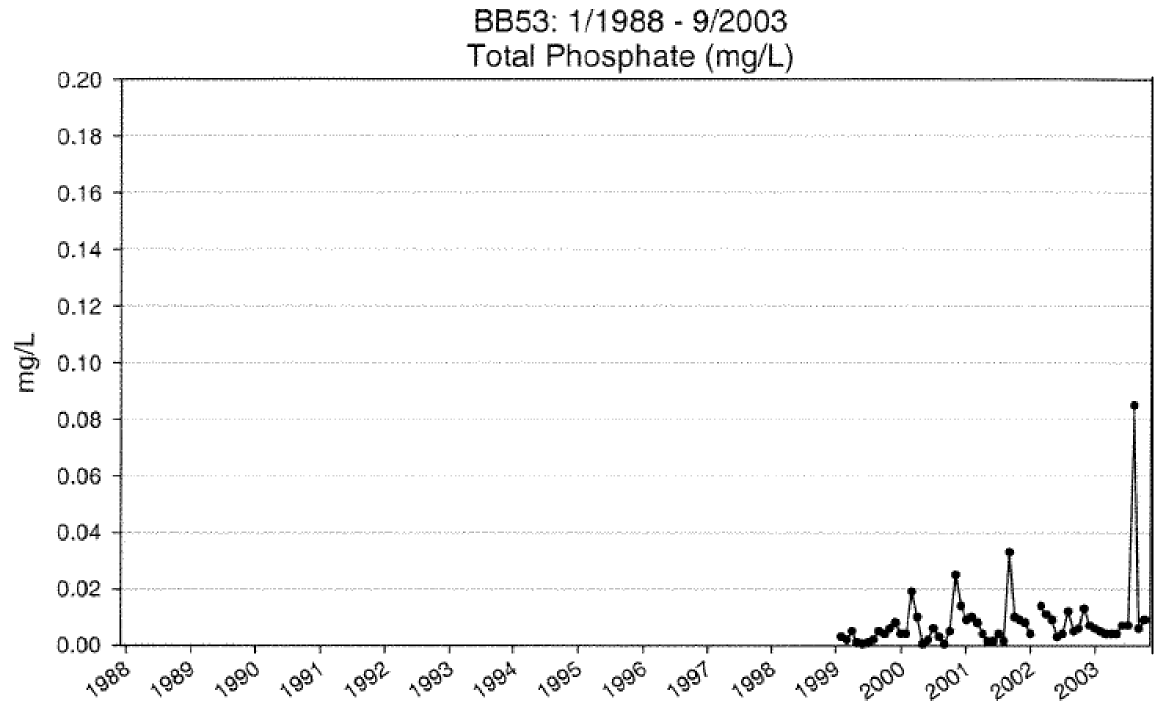
1996
1997
1998
1999
2000
2001
2002
2003


BB53: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
1993
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1996
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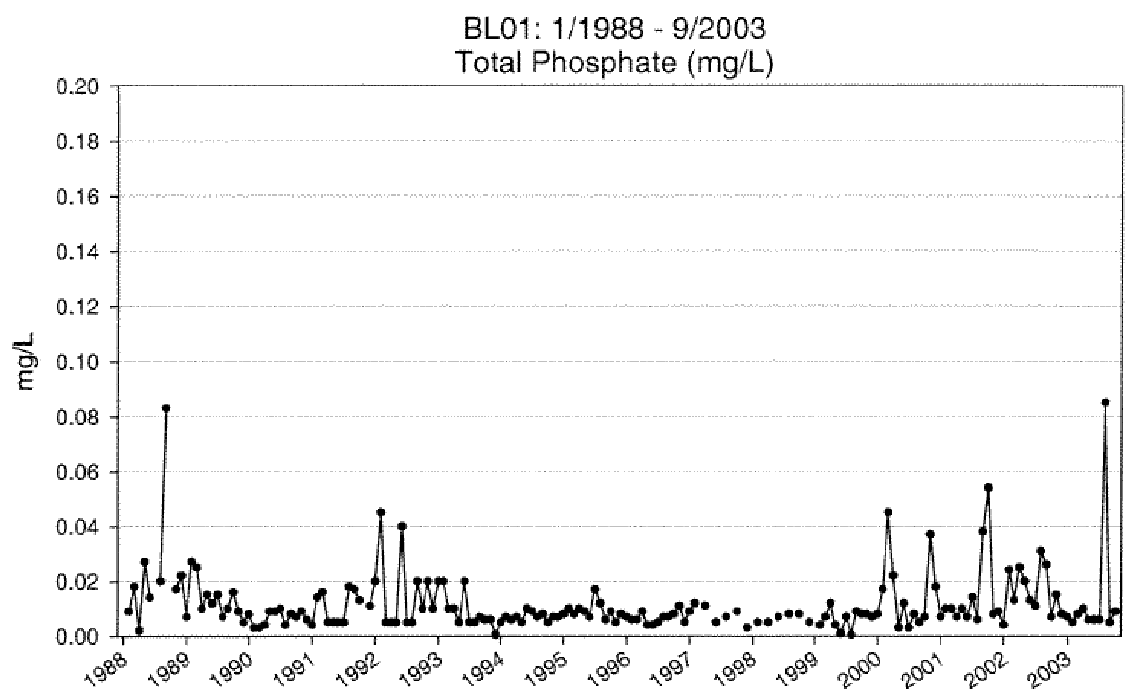
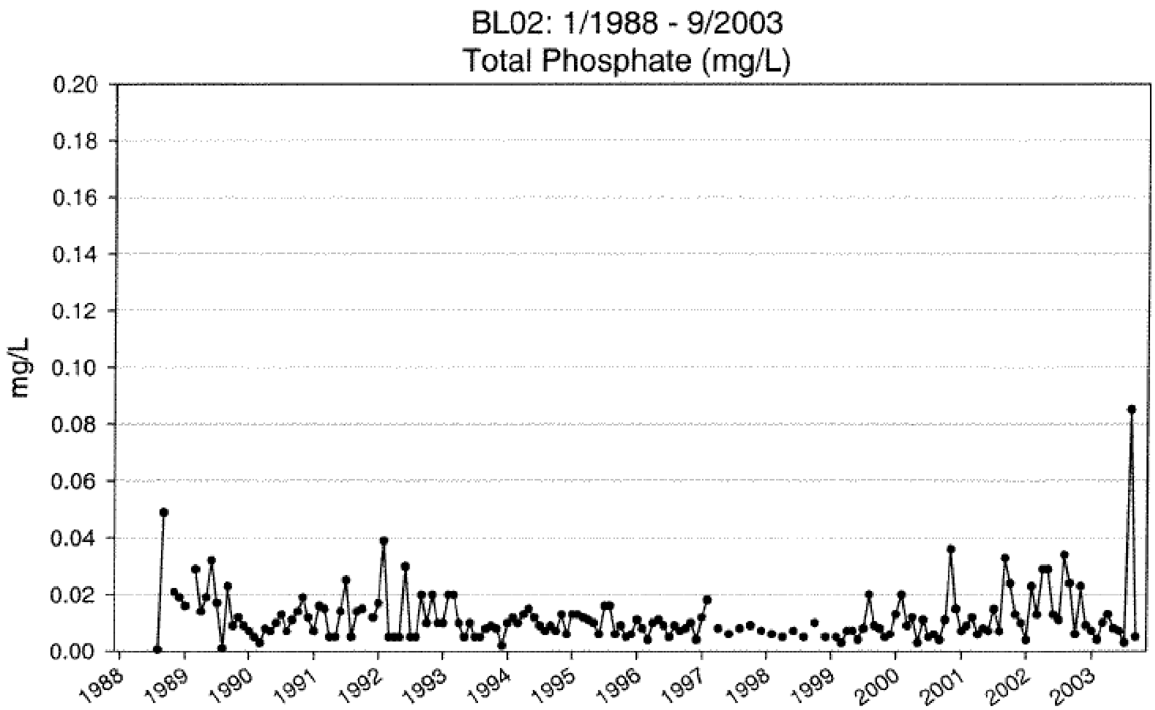
1999
2000
2001
2002
2003


BL01: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BL02: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
1993
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1996
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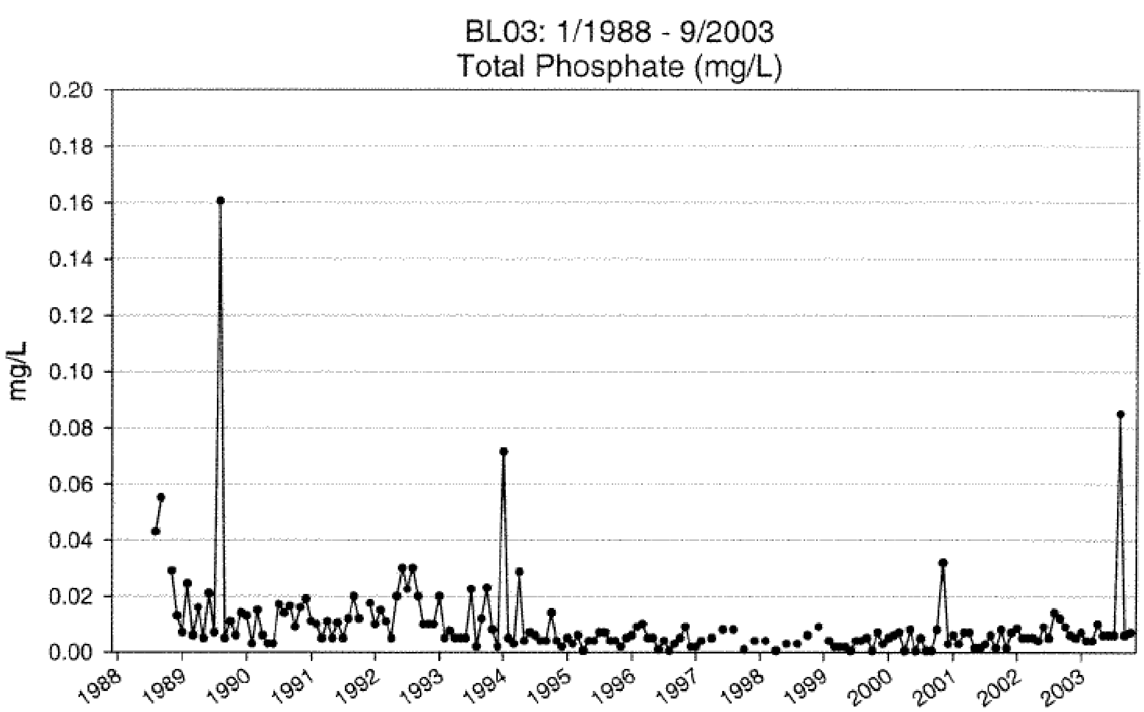
1999
2000
2001
2002
2003


BL03: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
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2002
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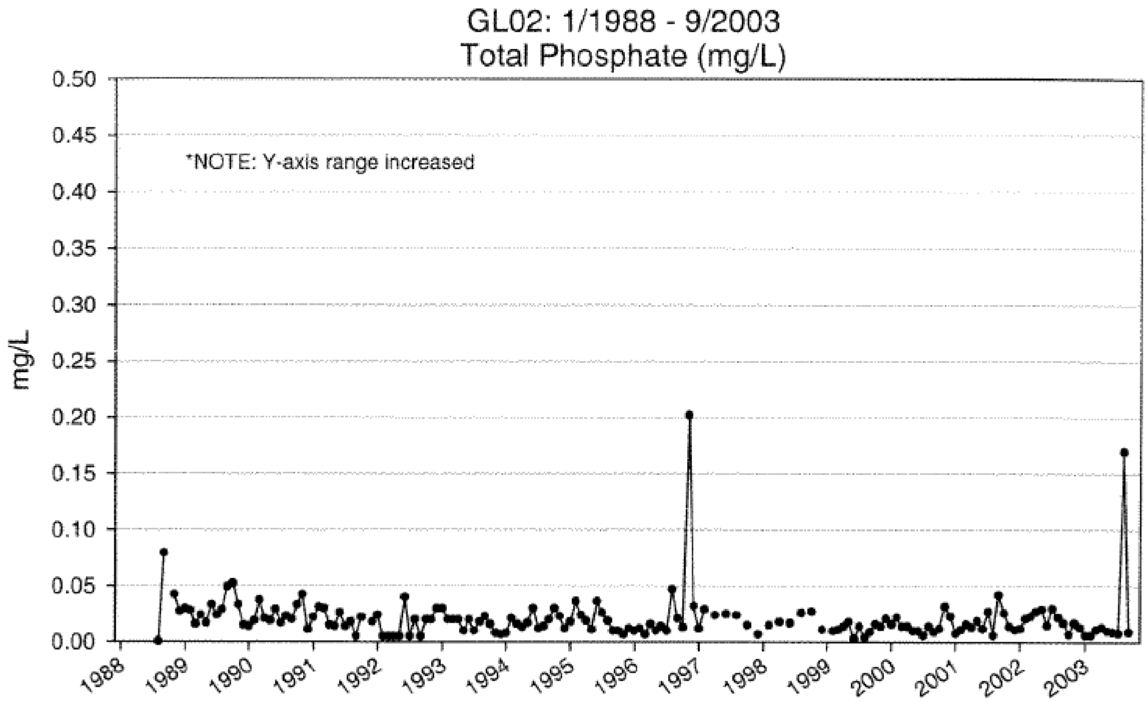
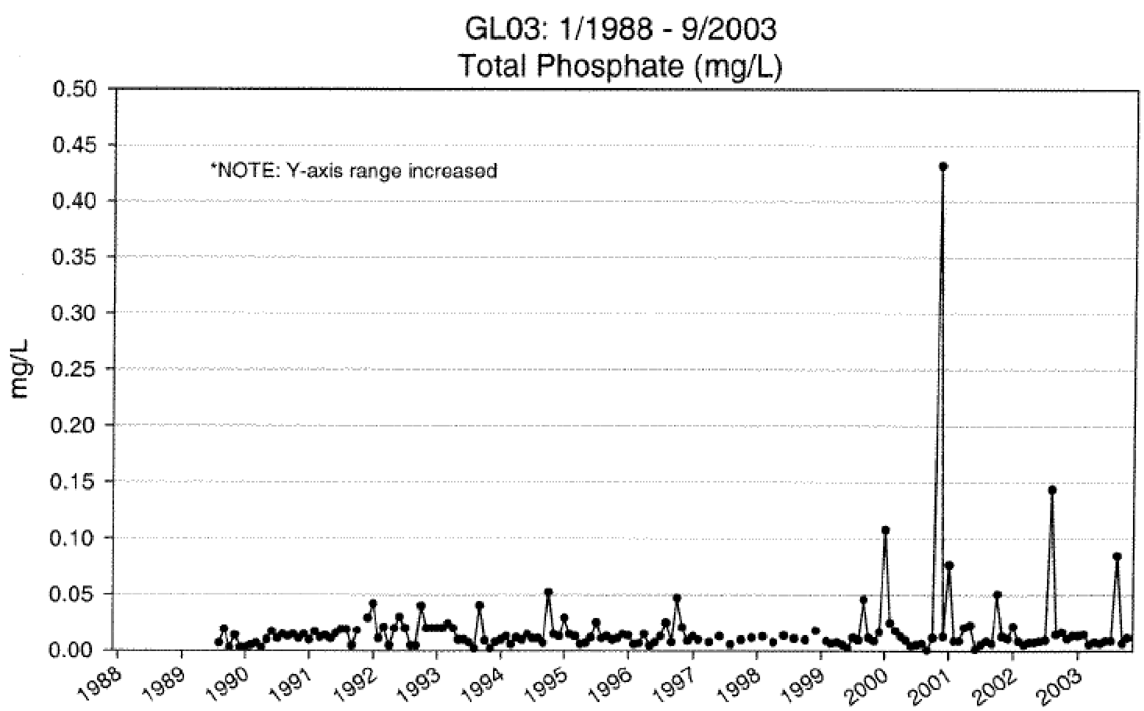

GL02: 1/1988 - 9/2003
Total Phosphate (mg/L)
*NOTE: Y-axis range increased
mg/L
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


GL03: 1/1988 - 9/2003
Total Phosphate (mg/L)
*NOTE: Y-axis range increased
mg/L
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1988
1989
1990
1991
1992
1993
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1996
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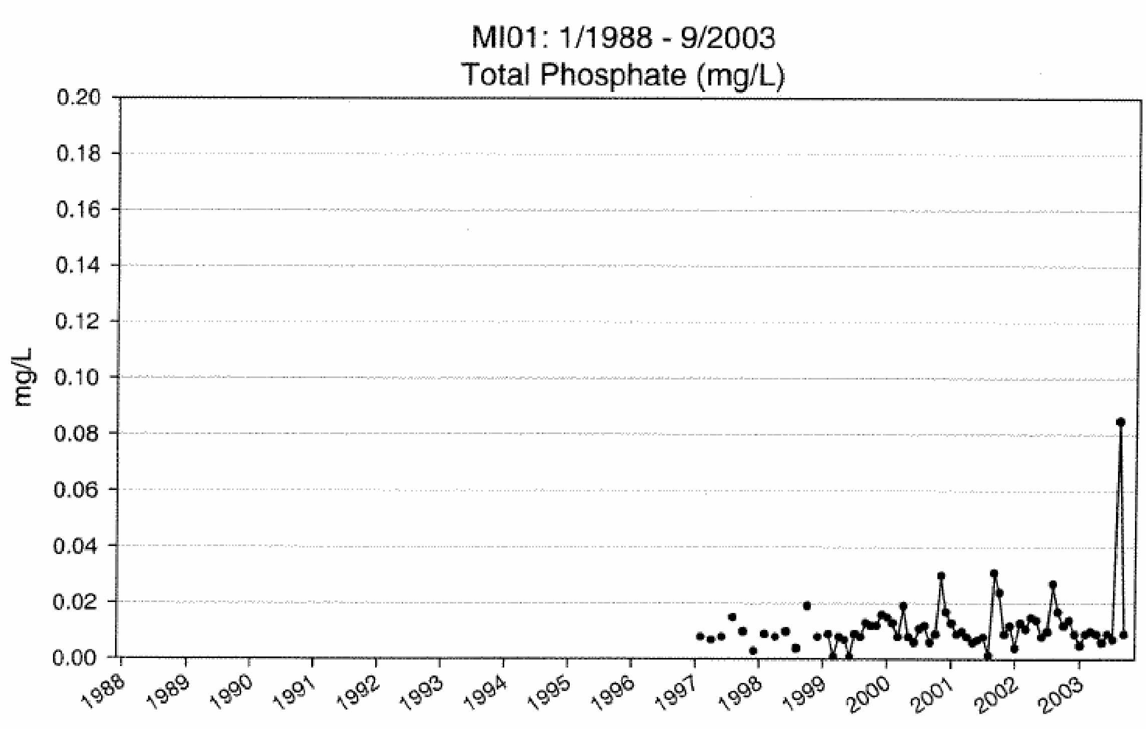
2000
2001
2002
2003


MI01: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
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1996
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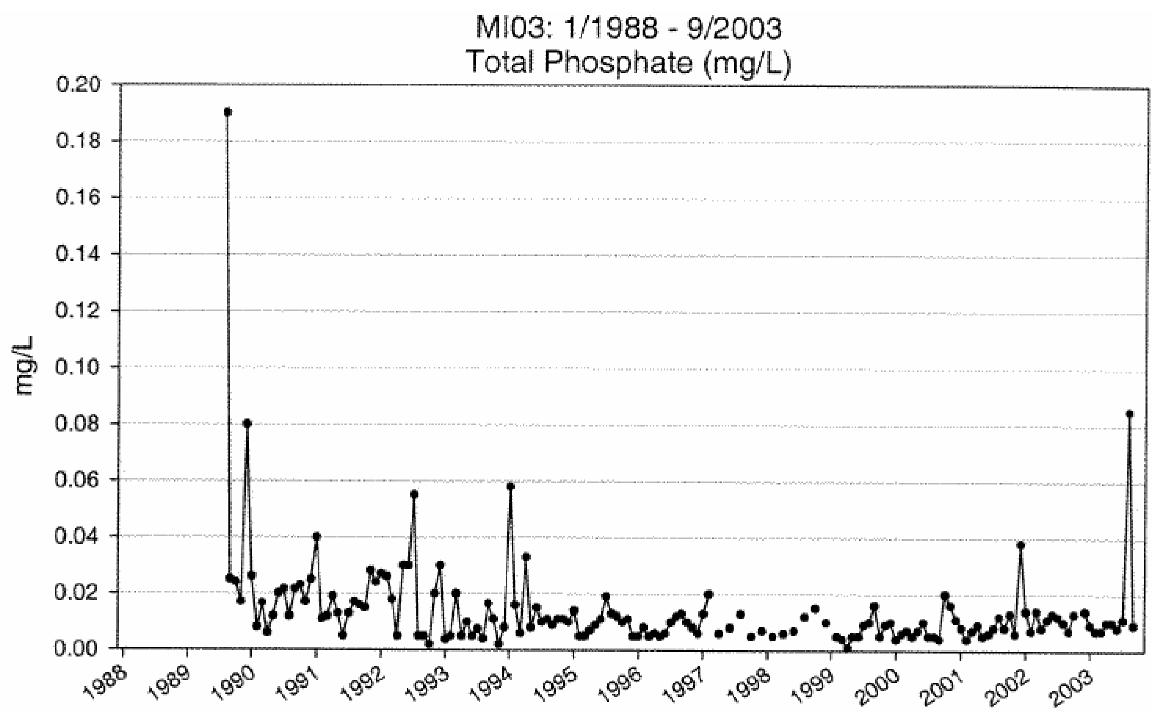
2000
2001
2002
2003


MI03: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
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1996
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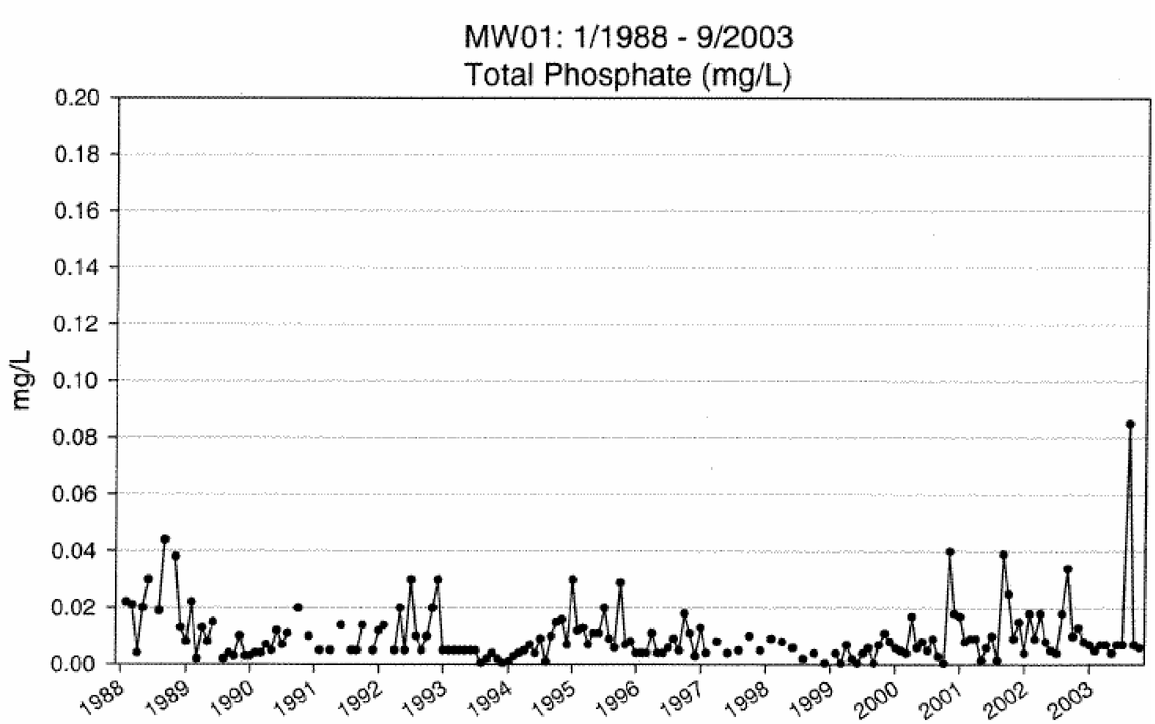
2001
2002
2003


MW01: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
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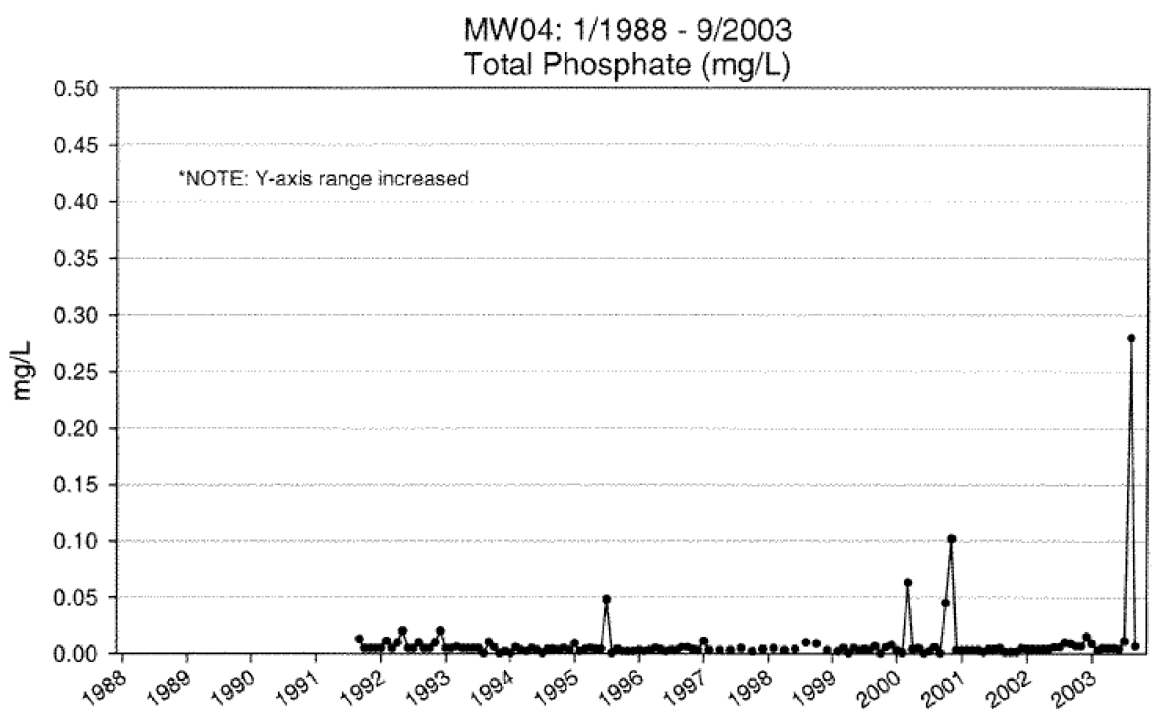
2001
2002
2003


MW04: 1/1988 - 9/2003
Total Phosphate (mg/L)
*NOTE: Y-axis range increased
mg/L
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1988
1989
1990
1991
1992
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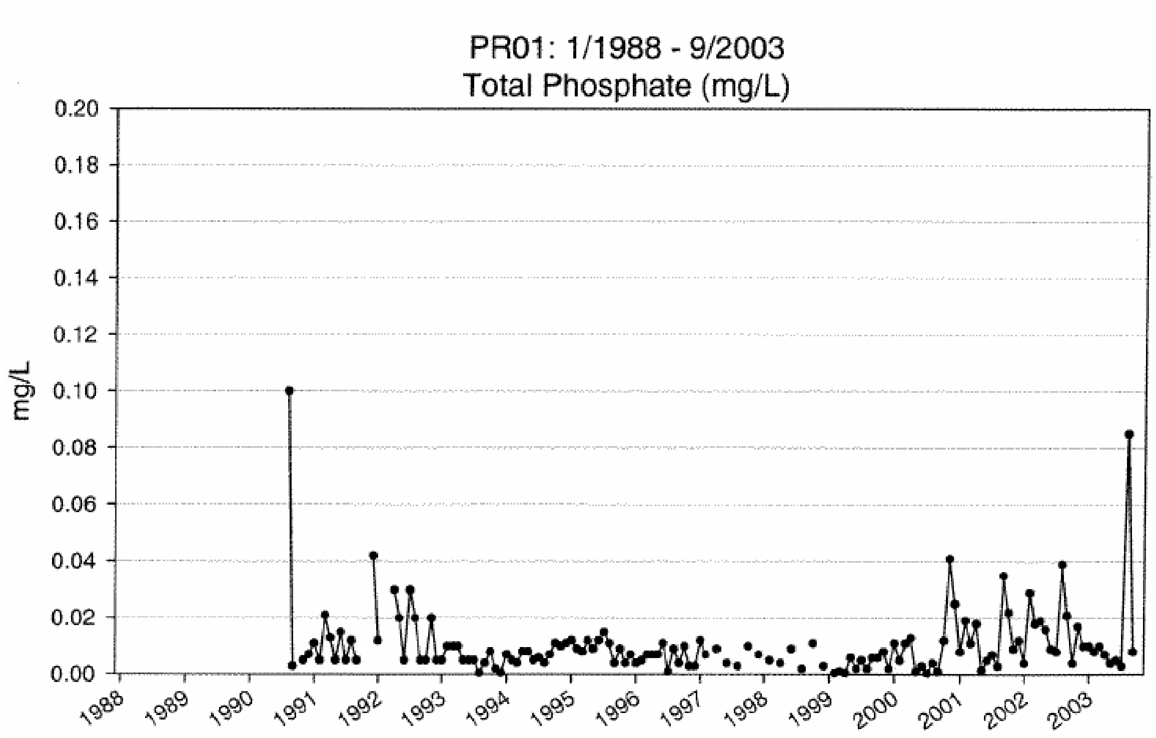
1999
2000
2001
2002
2003


PR01: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
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1992
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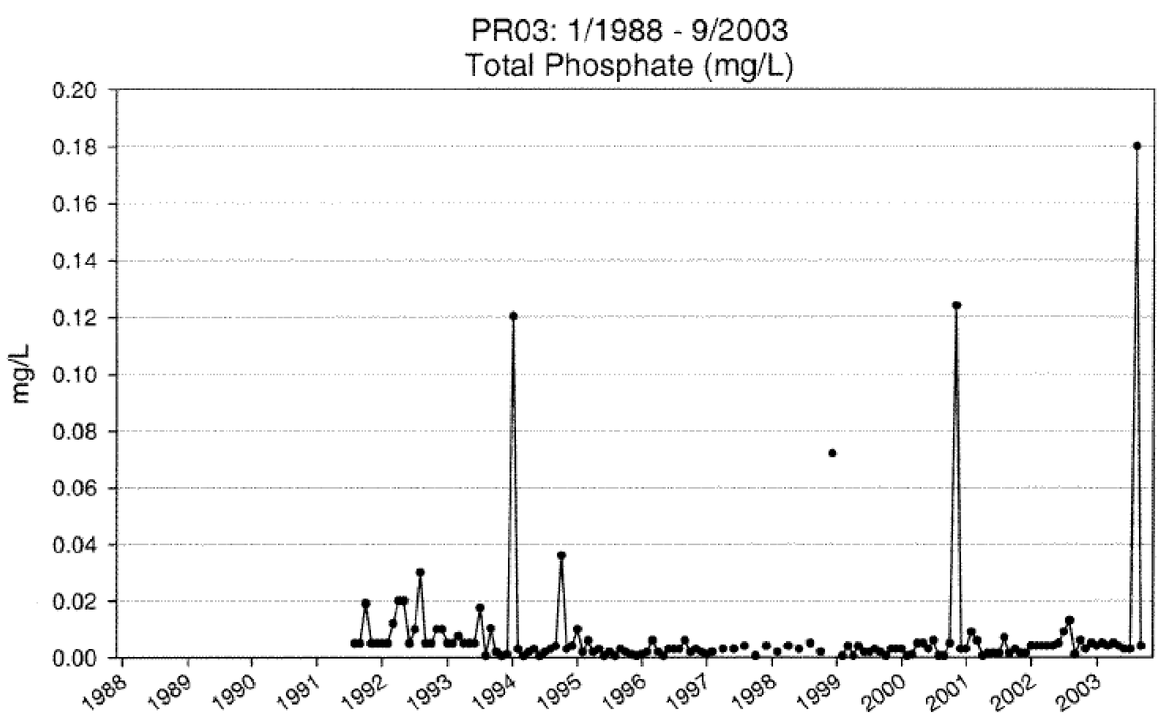
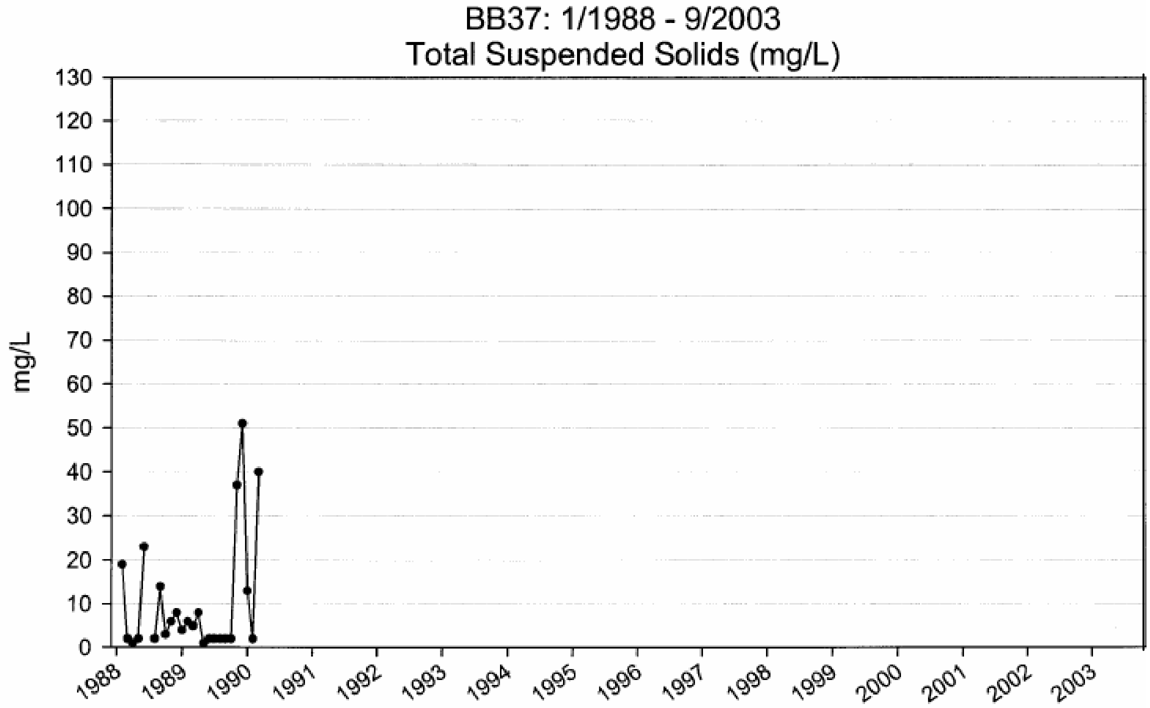
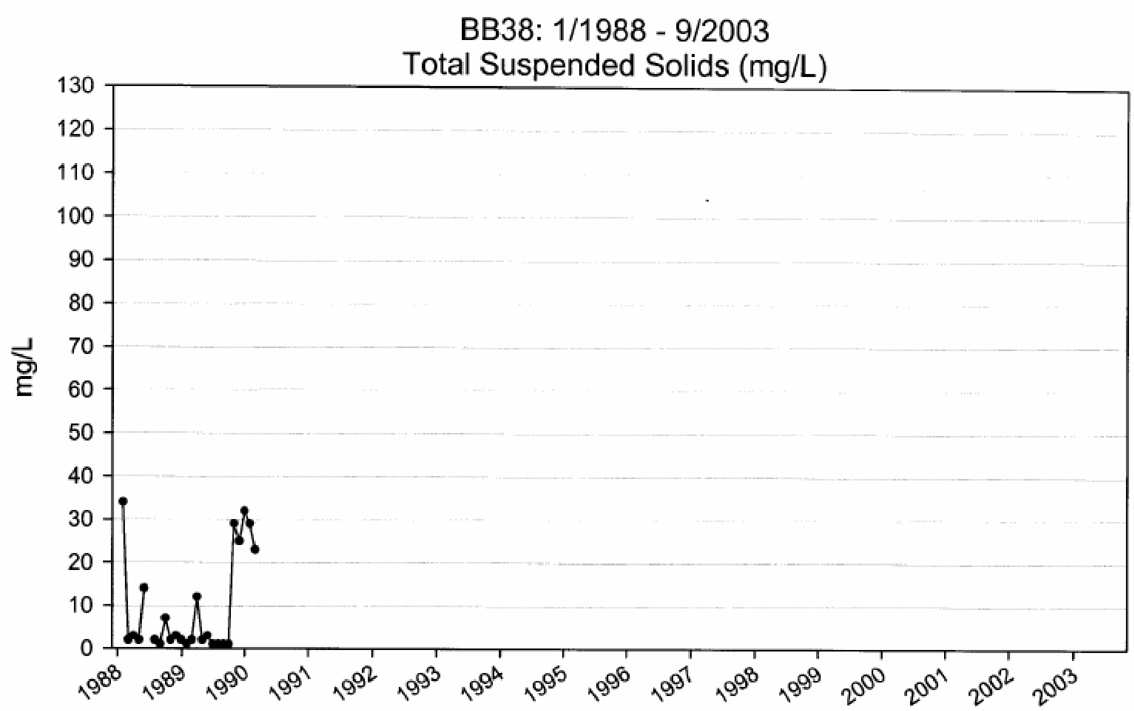
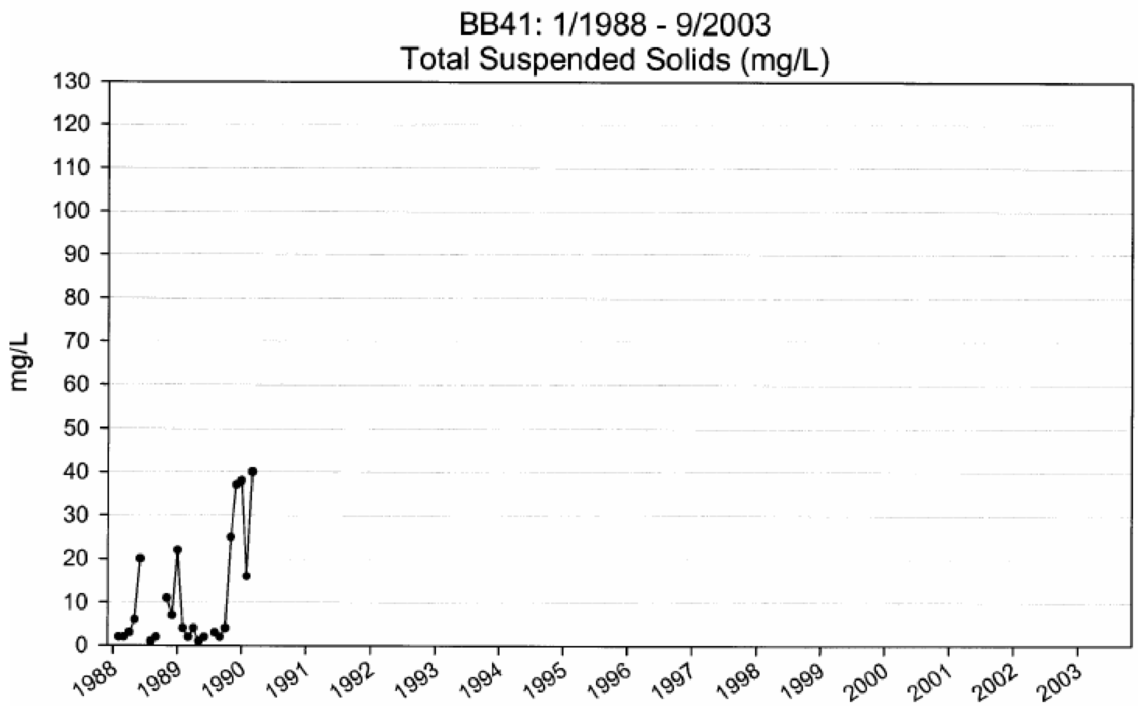
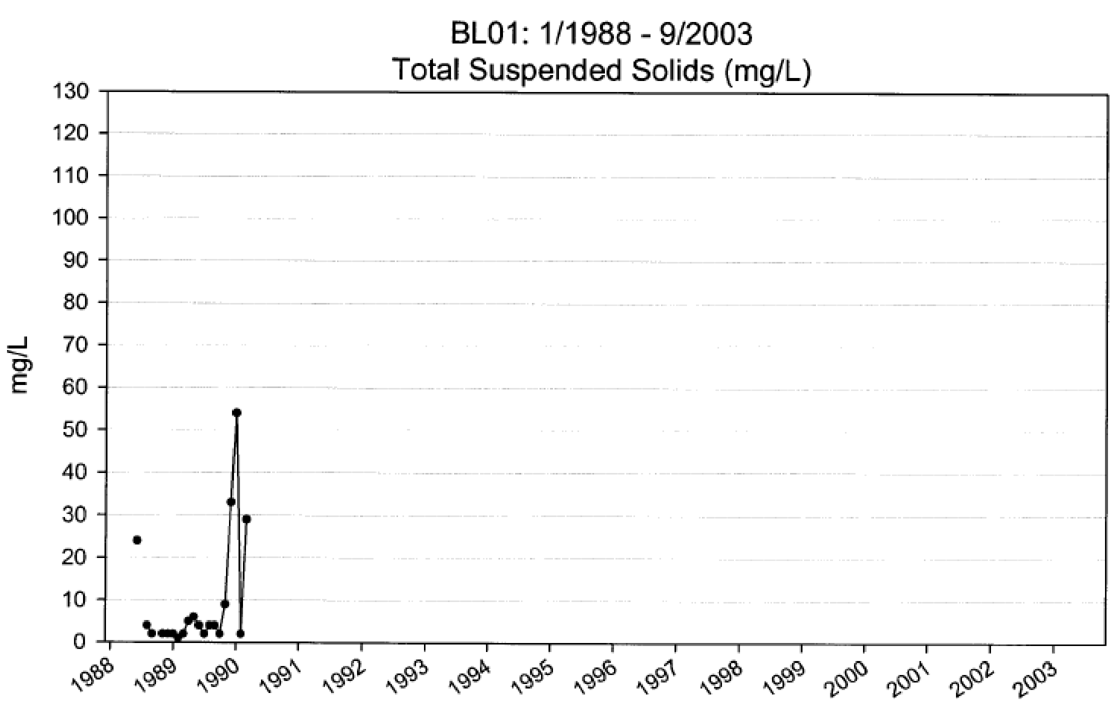
2002
2003


PR03: 1/1988 - 9/2003
Total Phosphate (mg/L)
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

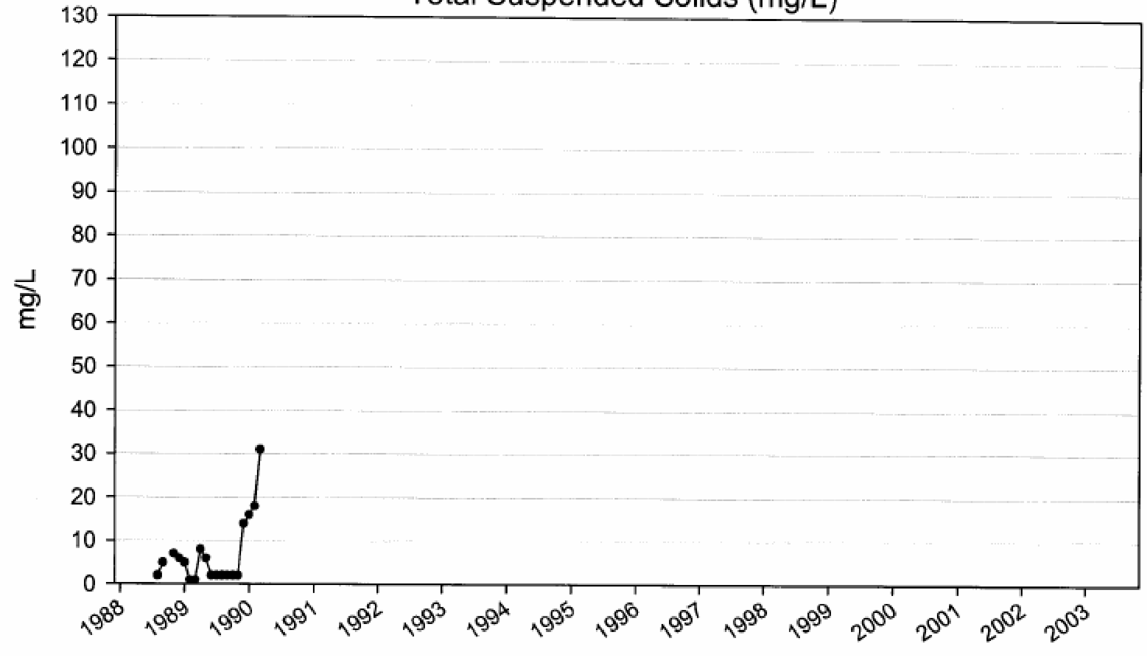

BB37: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB38: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

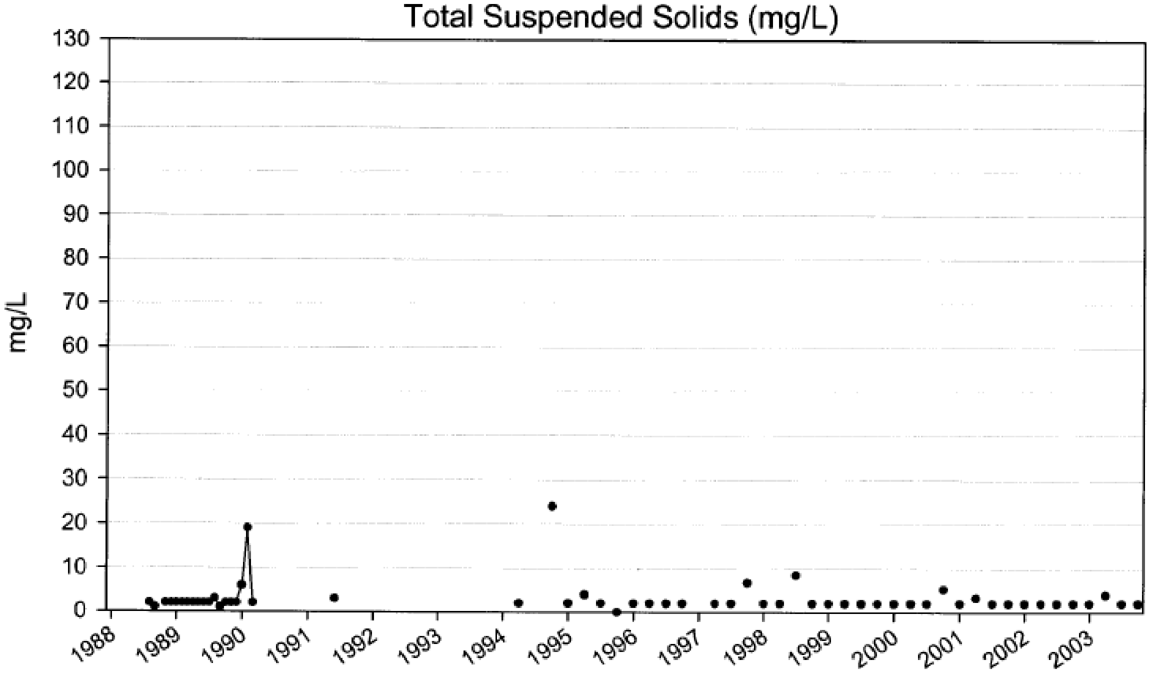

BB41: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
0
10
20
30
40
50
60
70
80
90
100
110
120
130
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

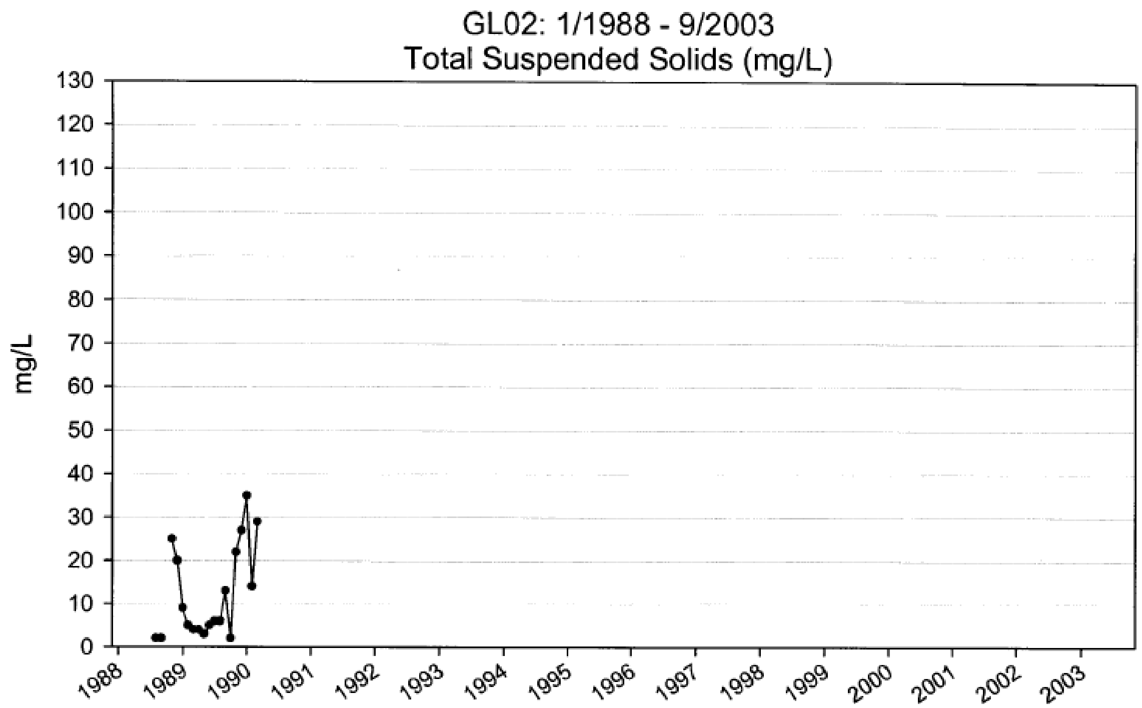

BL01: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
0
10
20
30
40
50
60
70
80
90
100
110
120
130
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

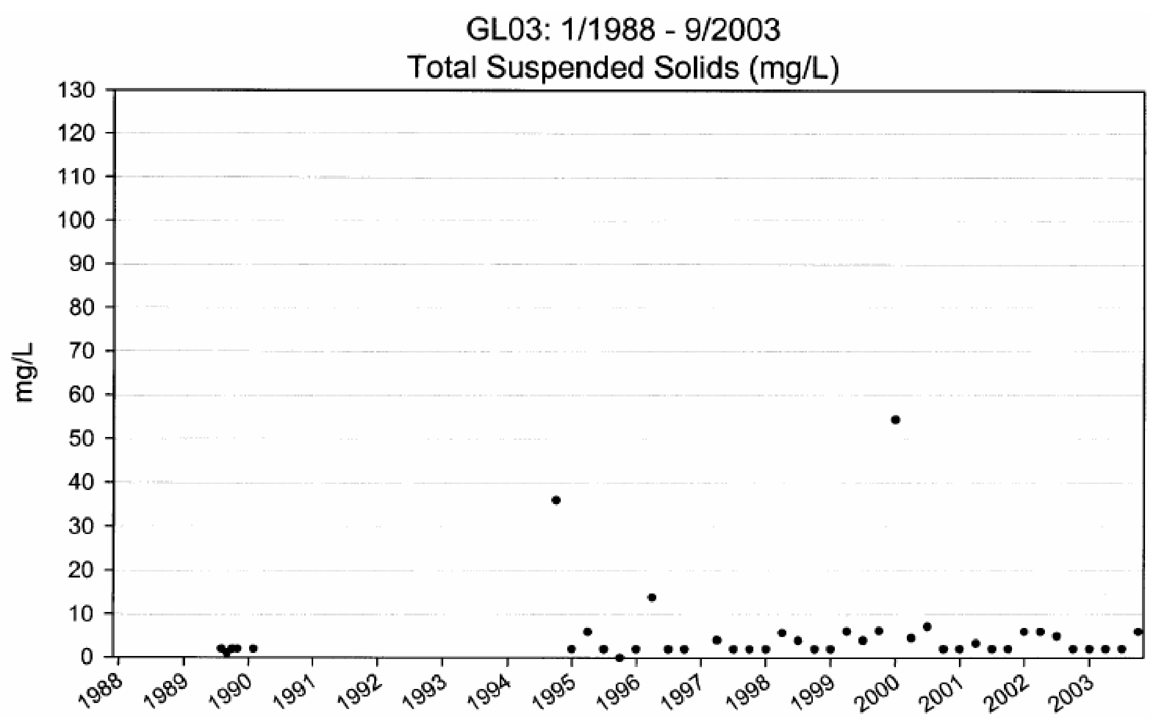
BL02: 1/1988 - 9/2003
Total Suspended Solids (mg/L)

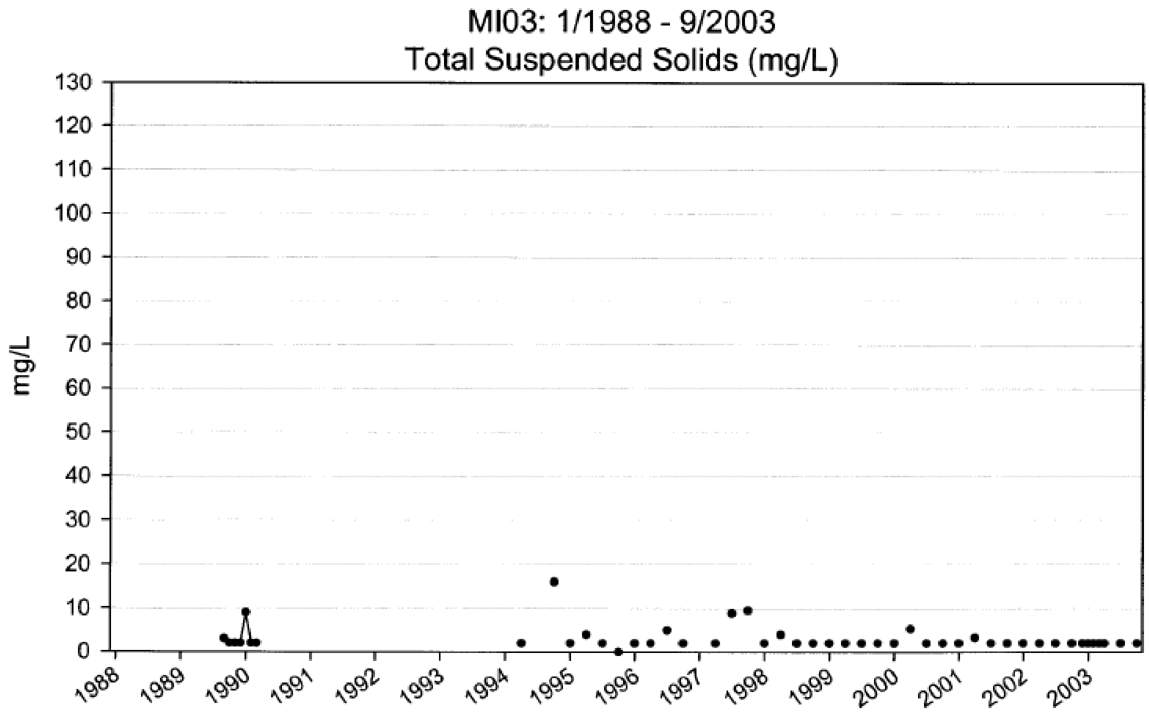


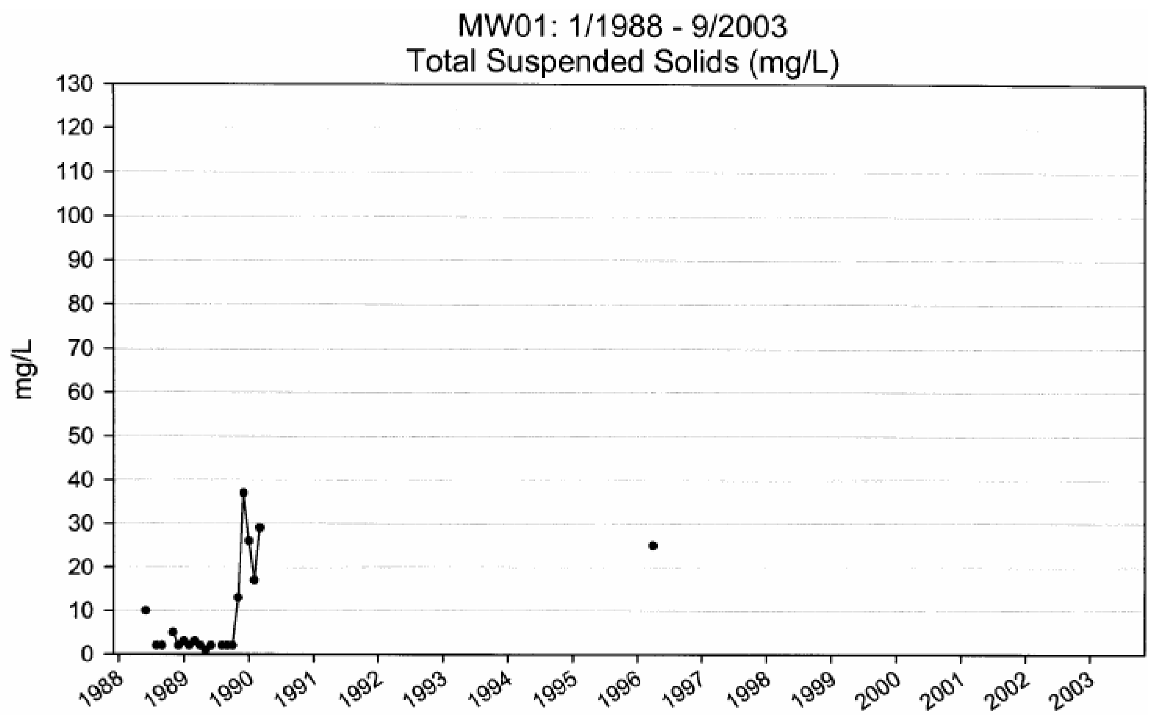
BL03: 1/1988 - 9/2003
Total Suspended Solids (mg/L)

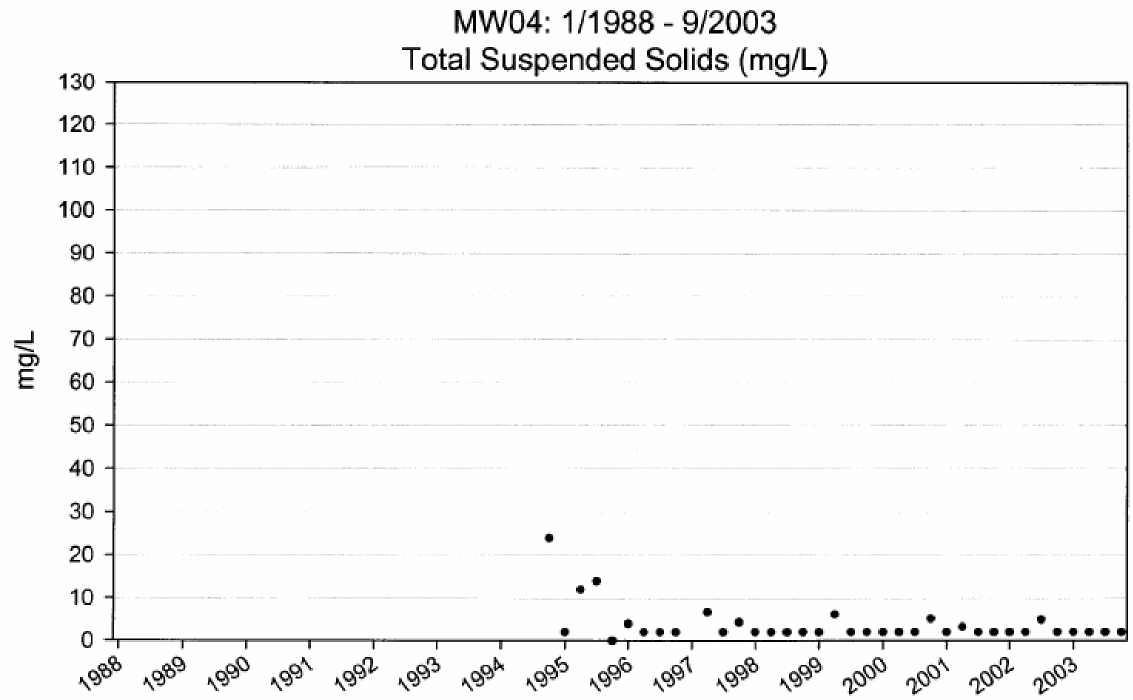



GL02: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

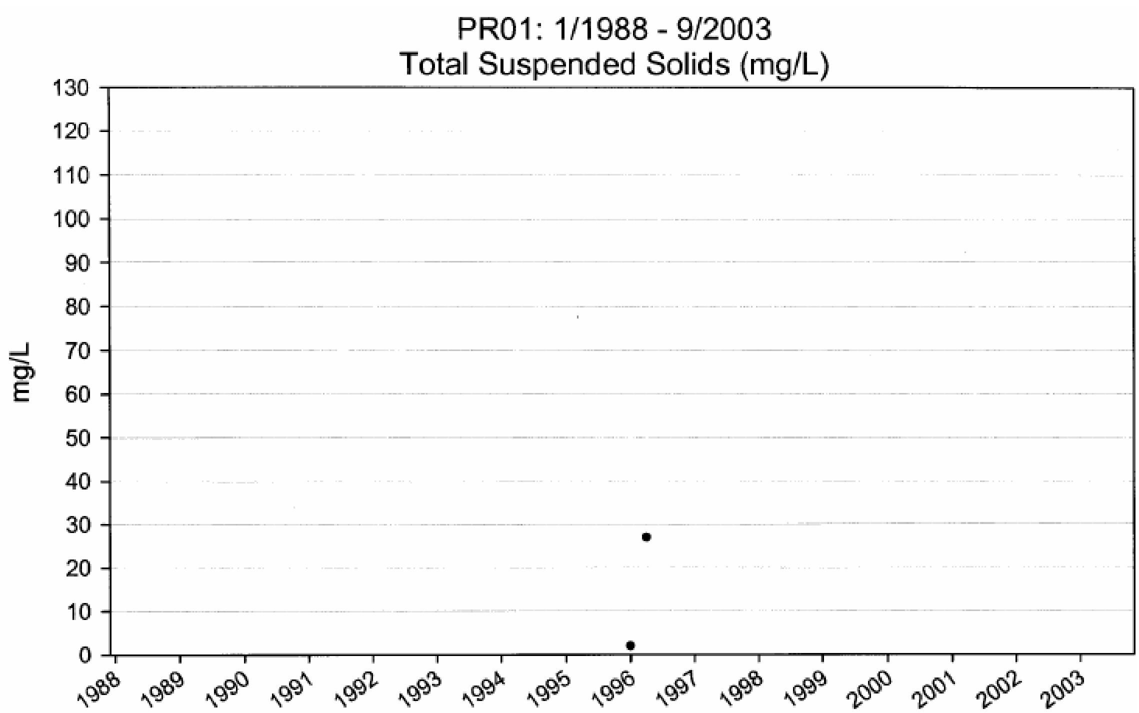

GL03: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MI03: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

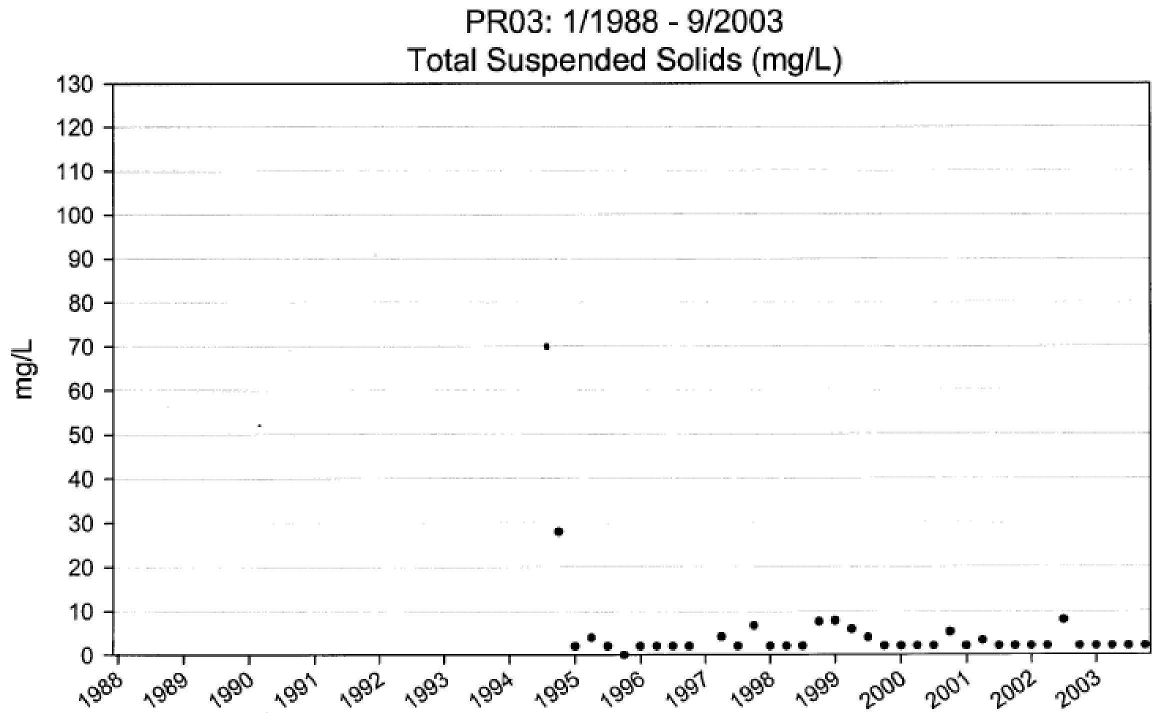

MW01: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

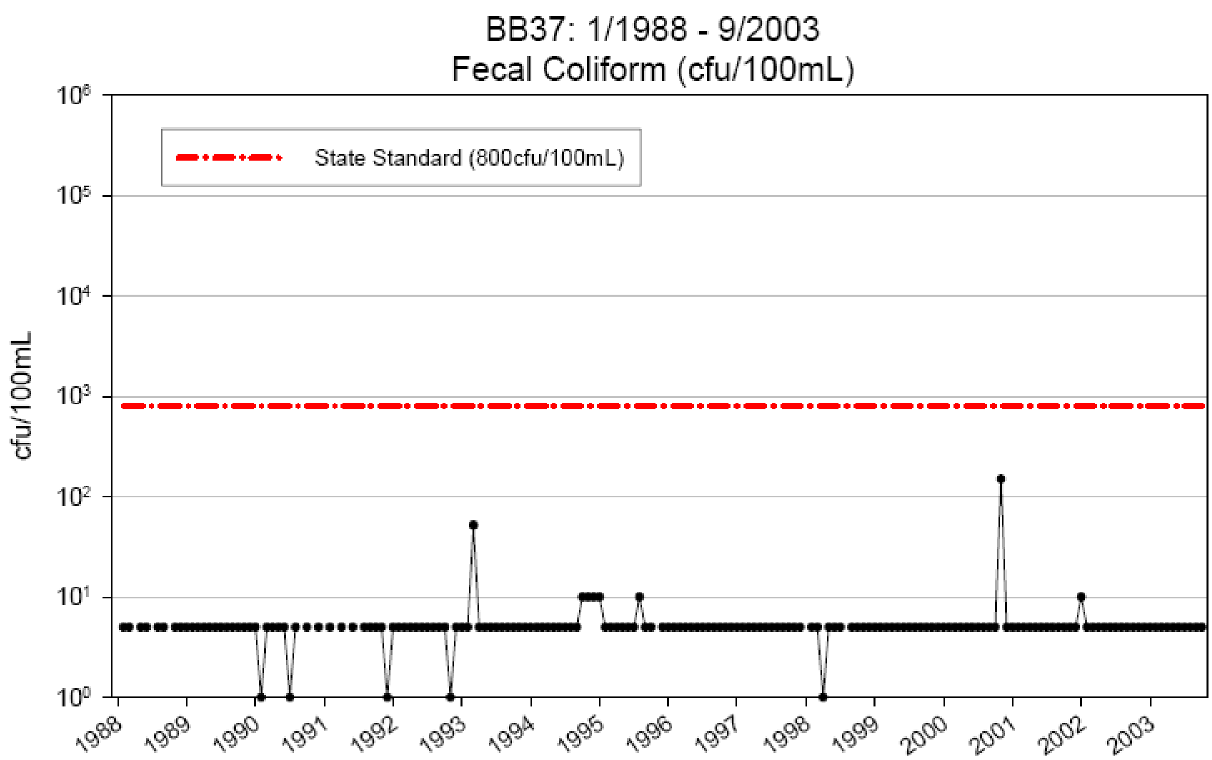


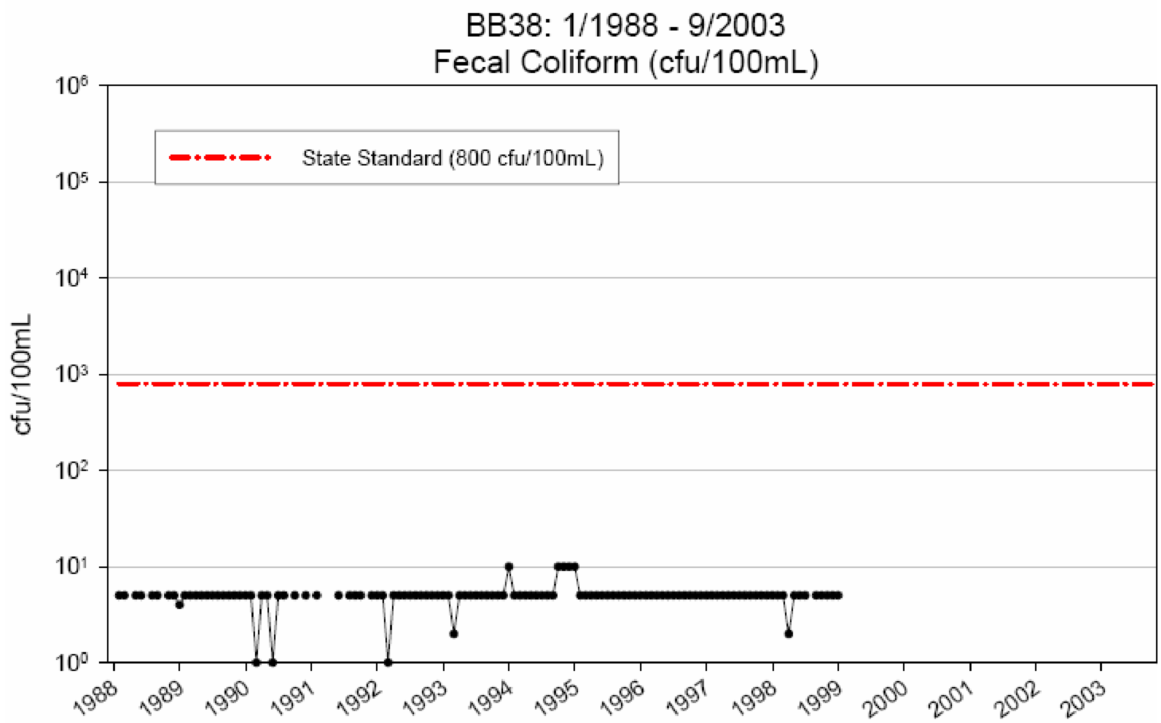
MW04: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

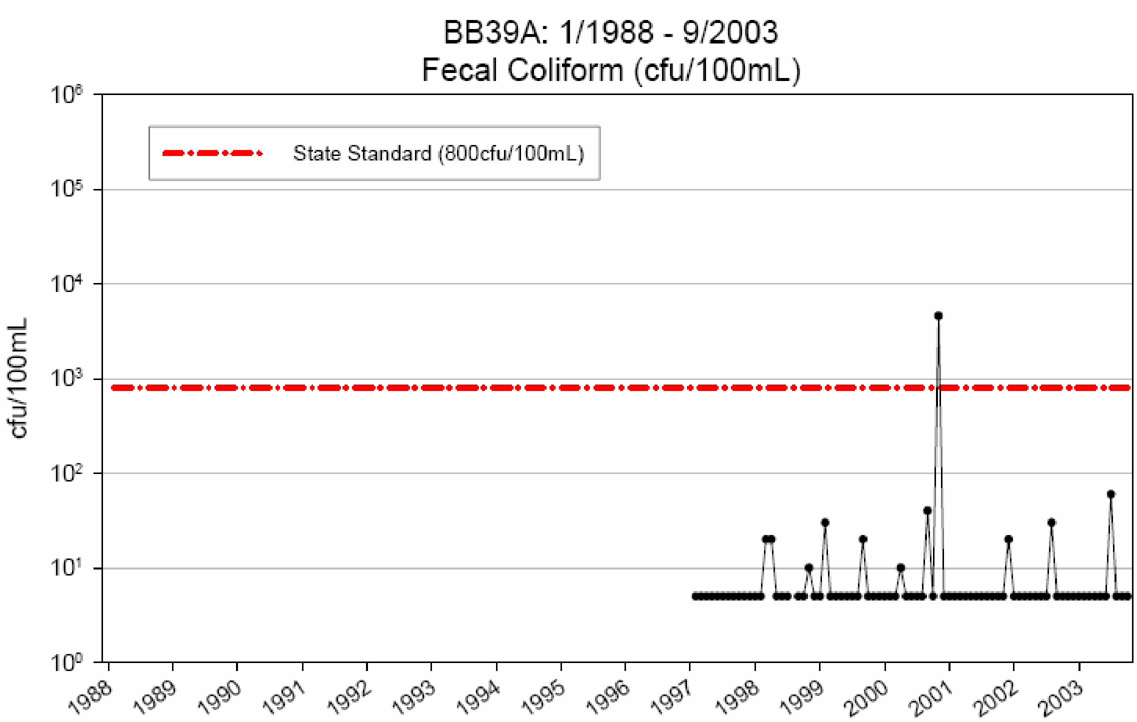


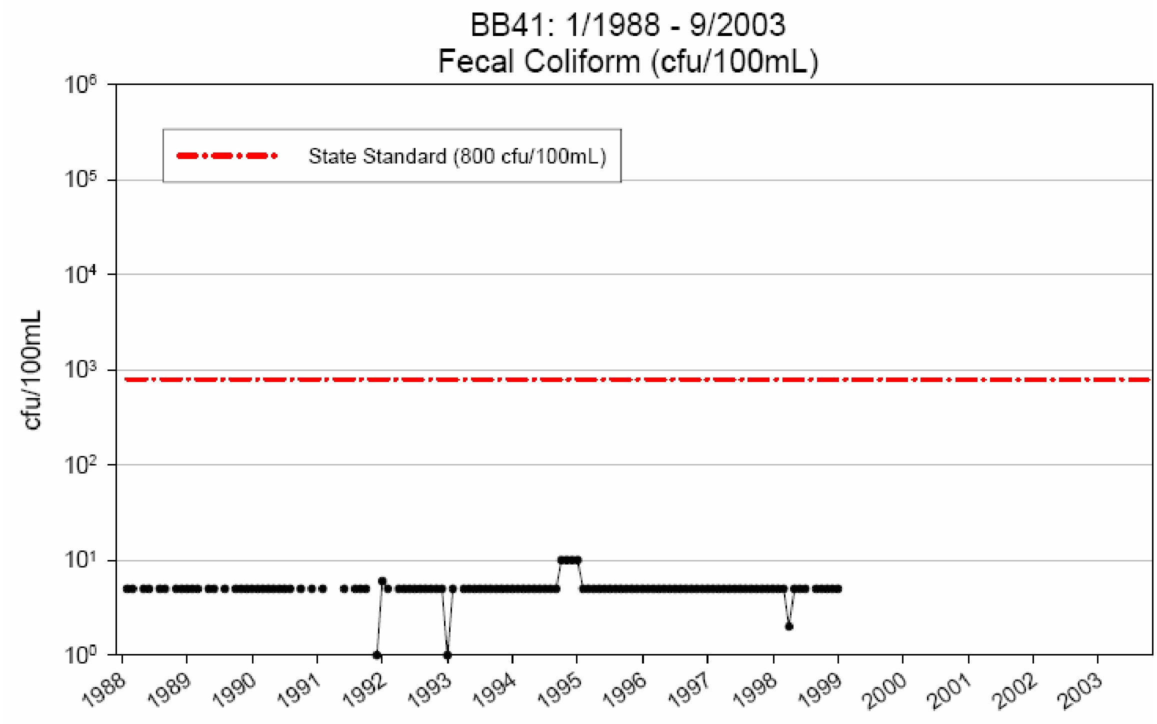
PR01: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

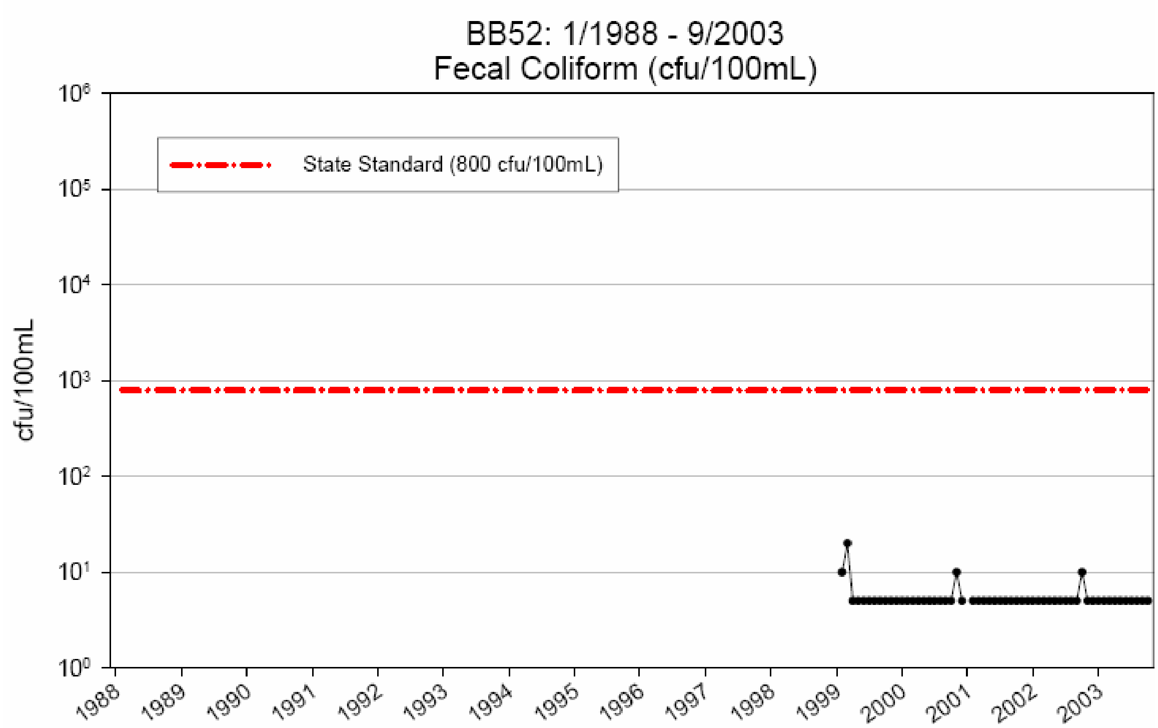

PR03: 1/1988 - 9/2003
Total Suspended Solids (mg/L)
mg/L
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

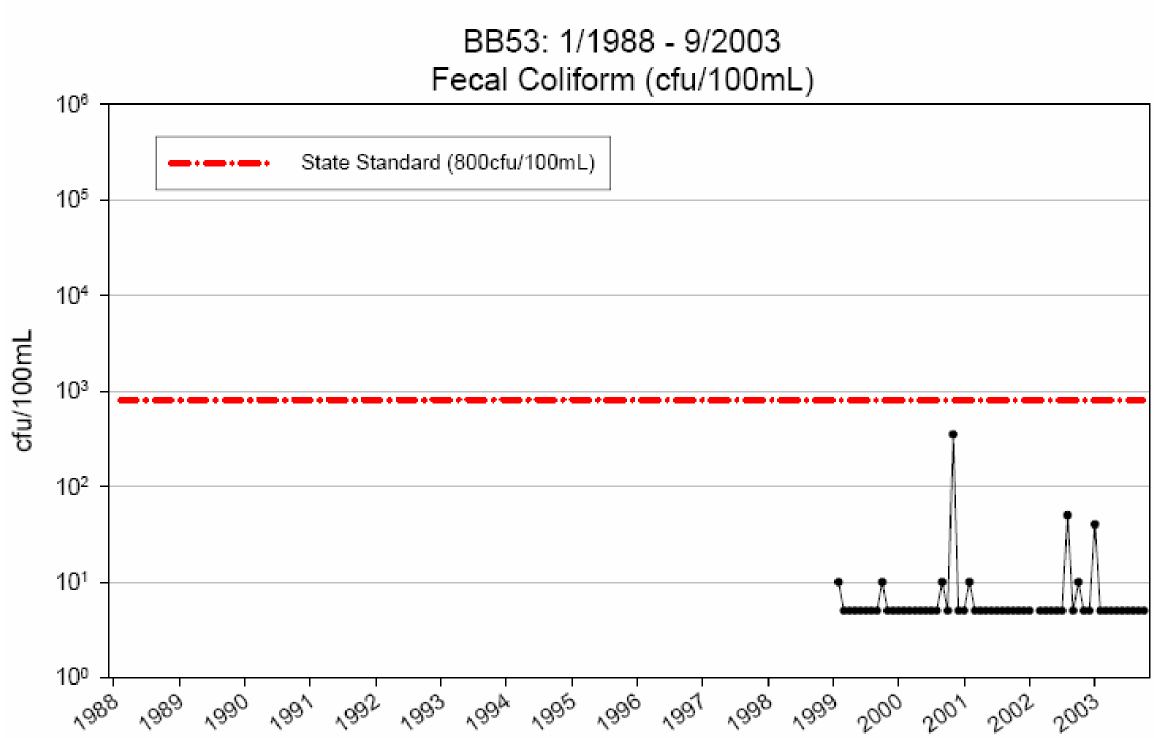

BB37: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800cfu/100mL)
cfu/100mL
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

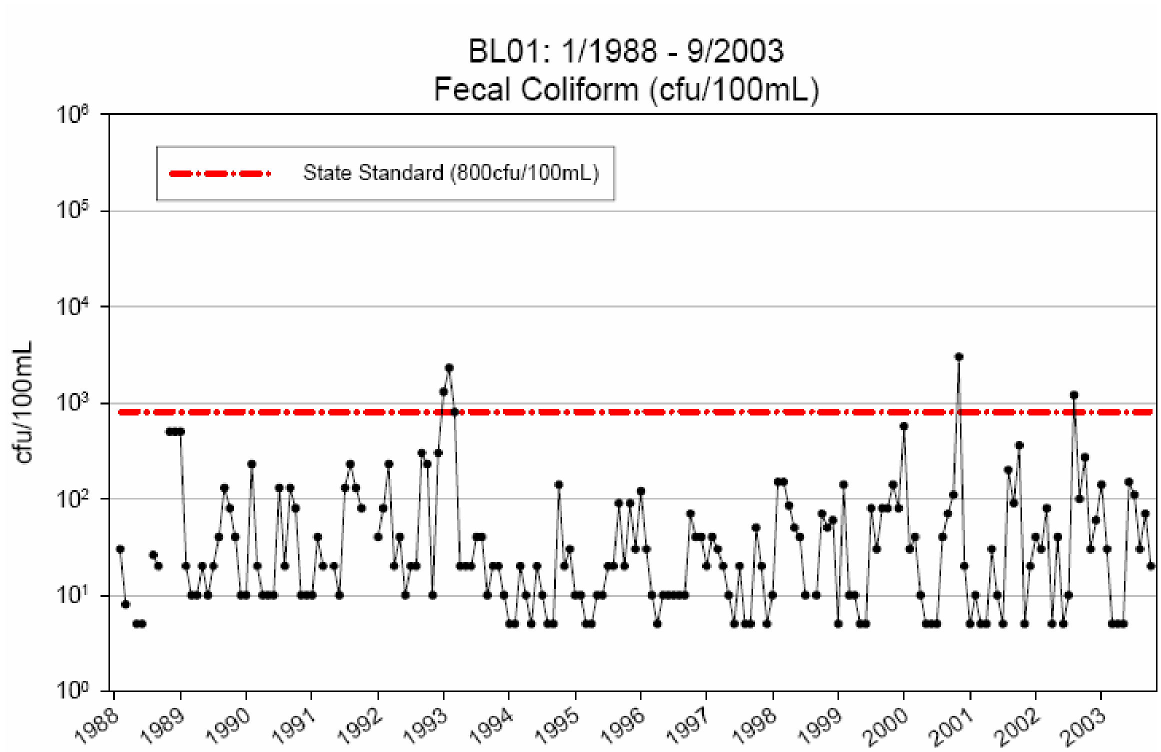

BB38: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800 cfu/100mL)
cfu/100mL
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB39A: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800cfu/100mL)
cfu/100mL
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

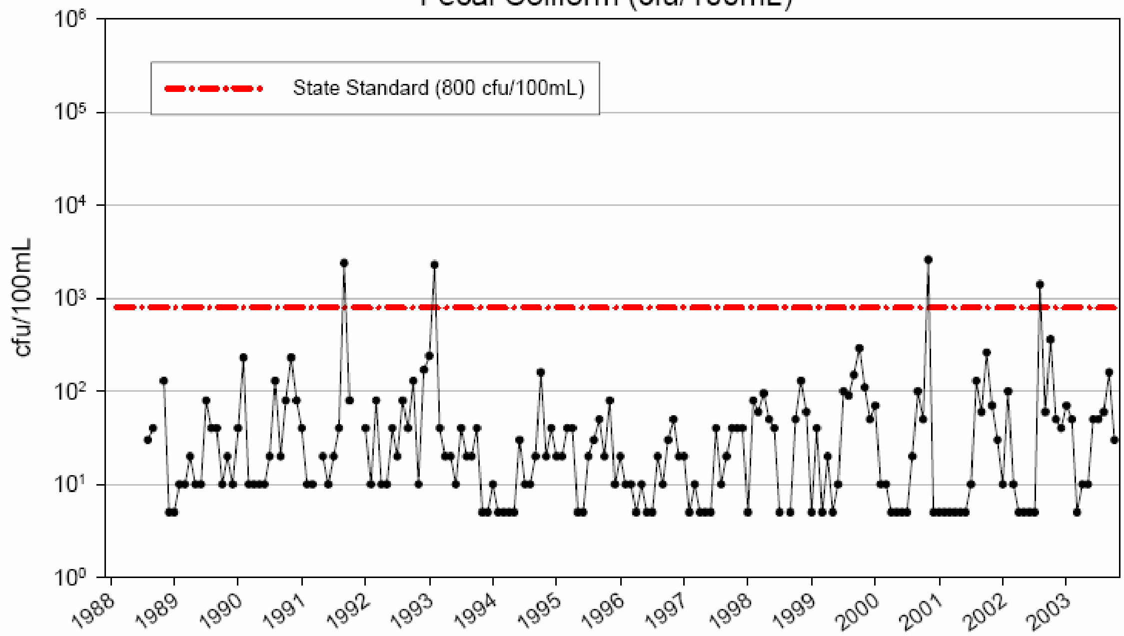

BB41: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800 cfu/100mL)
cfu/100mL
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB52: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800 cfu/100mL)
cfu/100mL
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

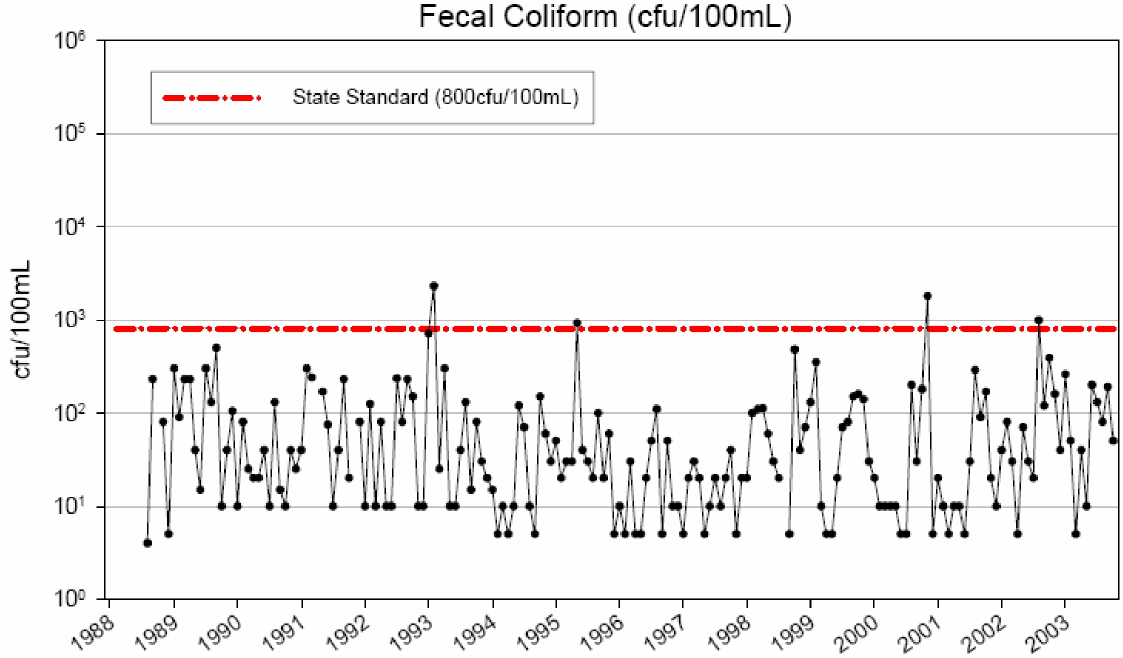

BB53: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800cfu/100mL)
cfu/100mL
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

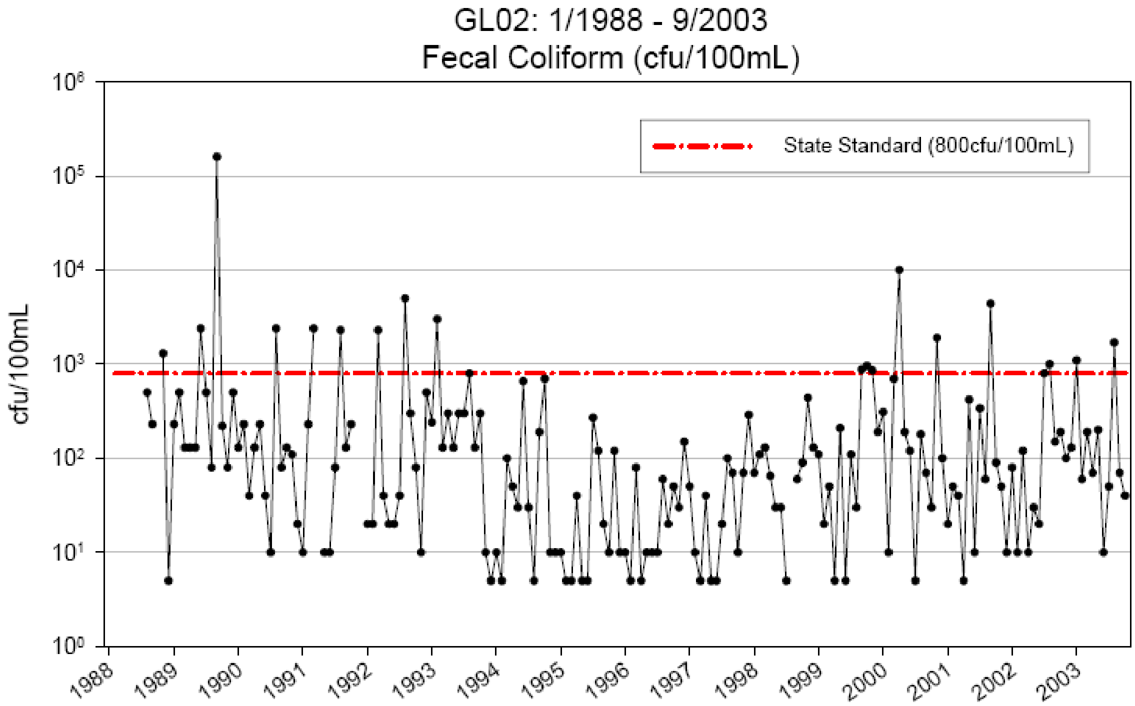

BL01: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800cfu/100mL)
cfu/100mL
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

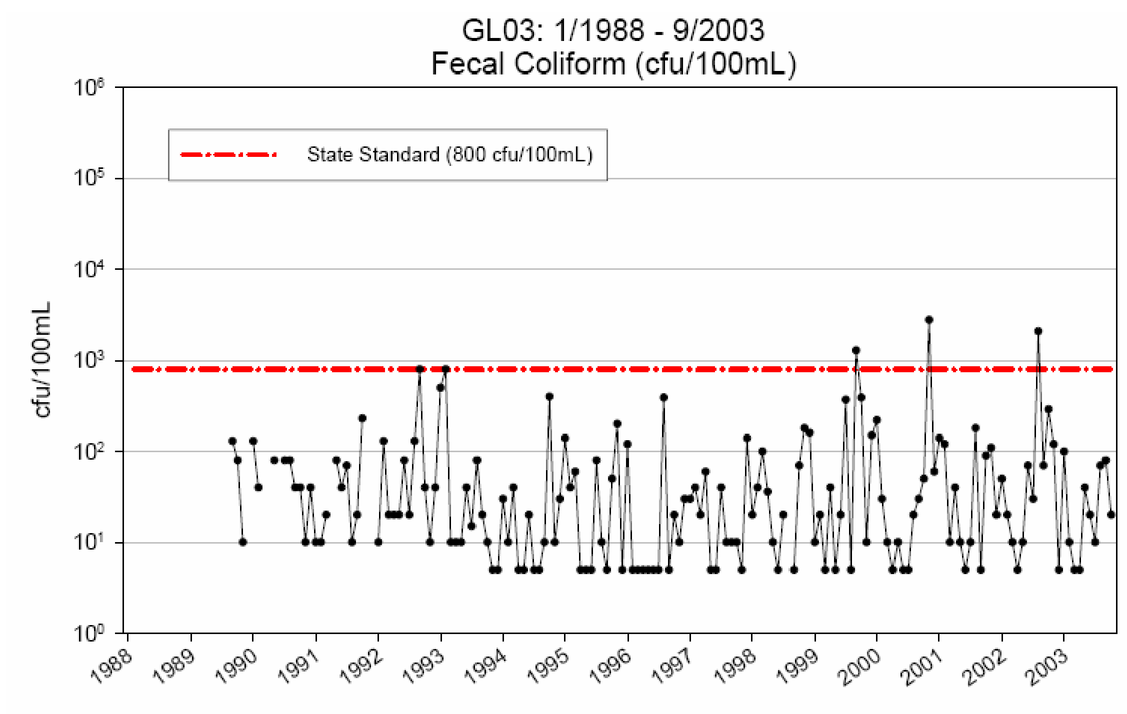
BL02: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)

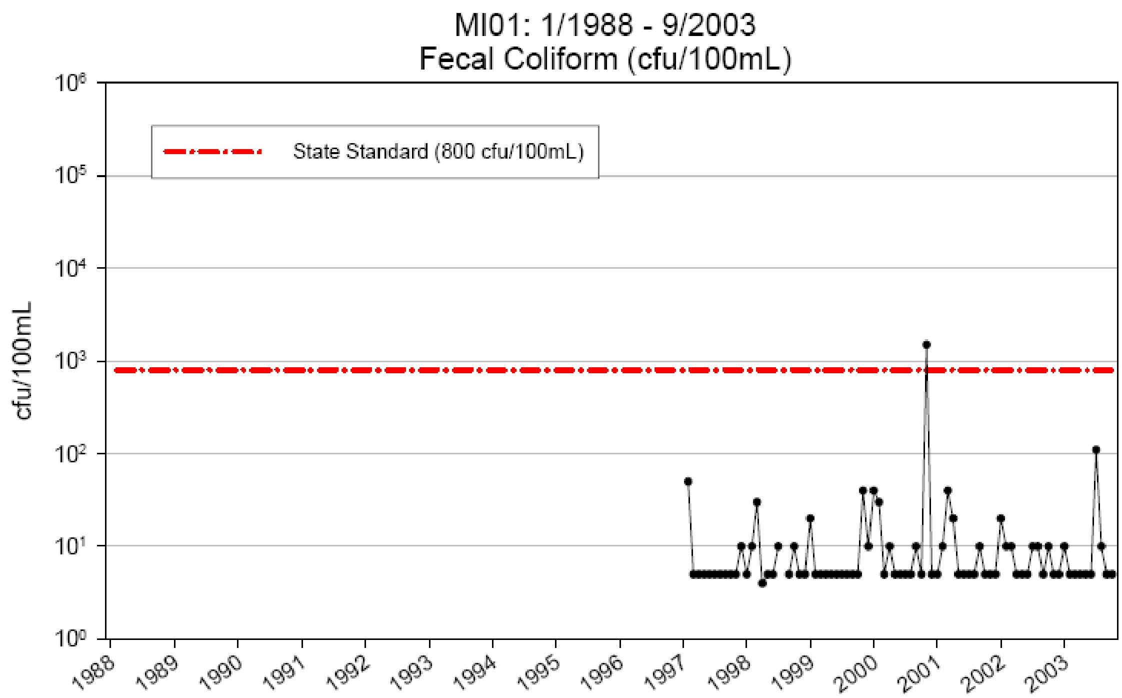


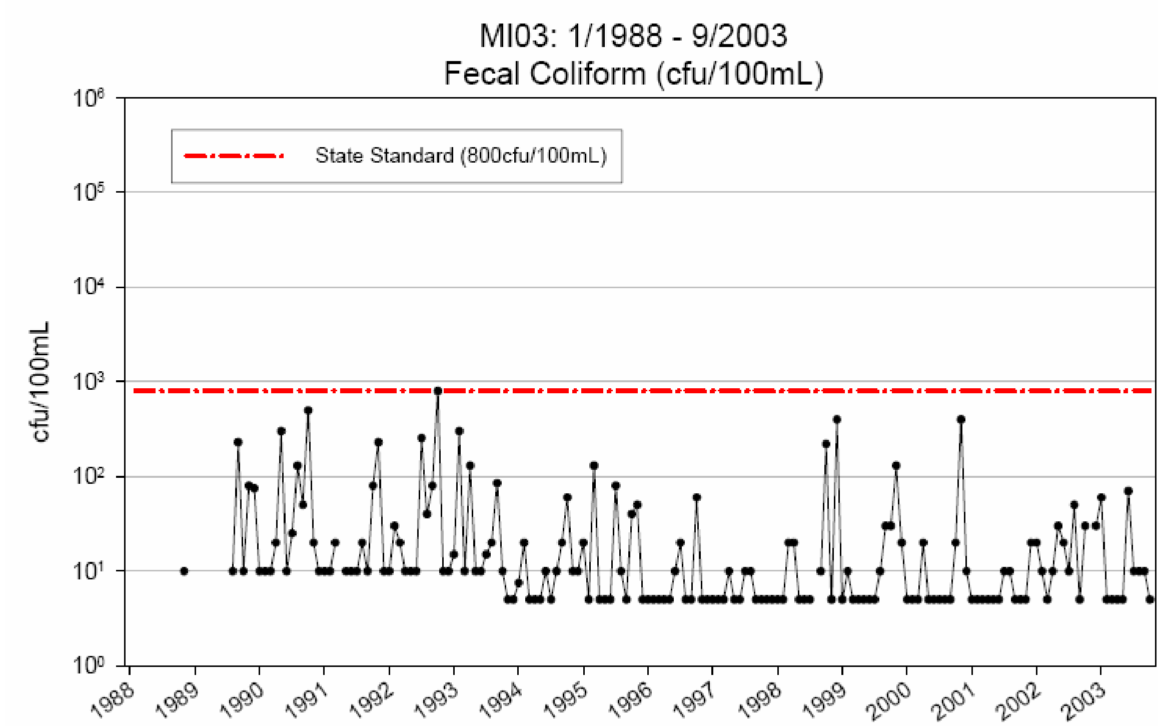
BL03: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)

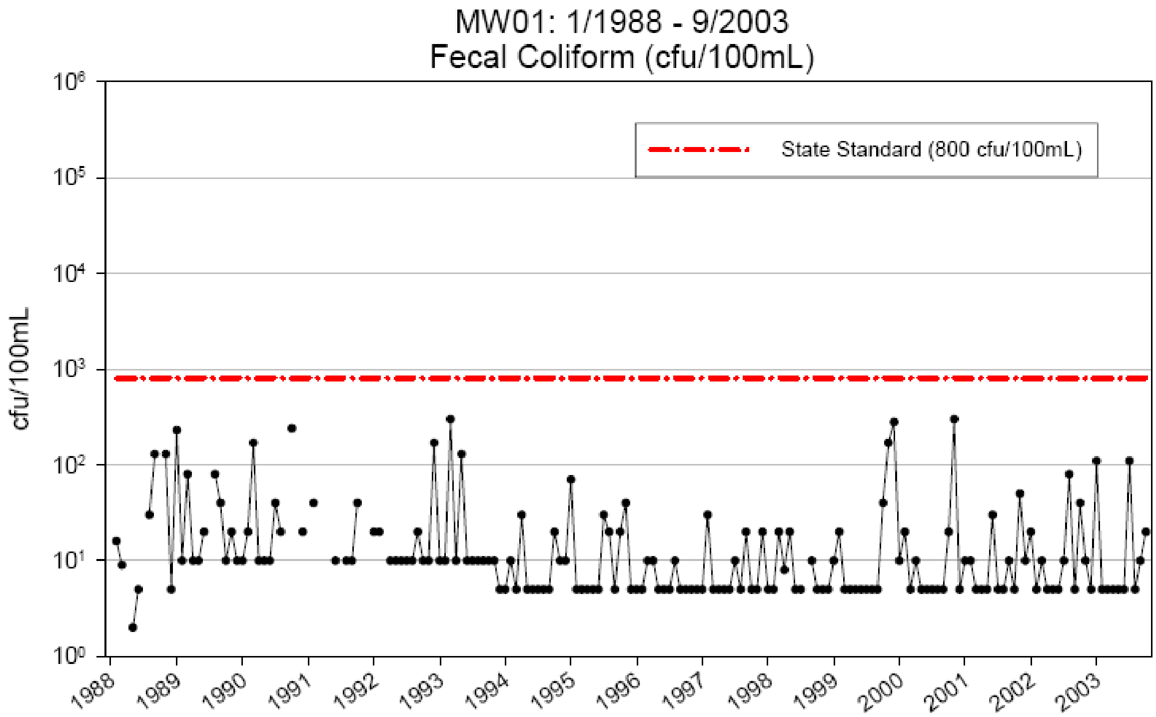



GL02: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800cfu/100mL)
cfu/100mL
10^0
10^1
10^2
10^3
10^4
10^5
10^6
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

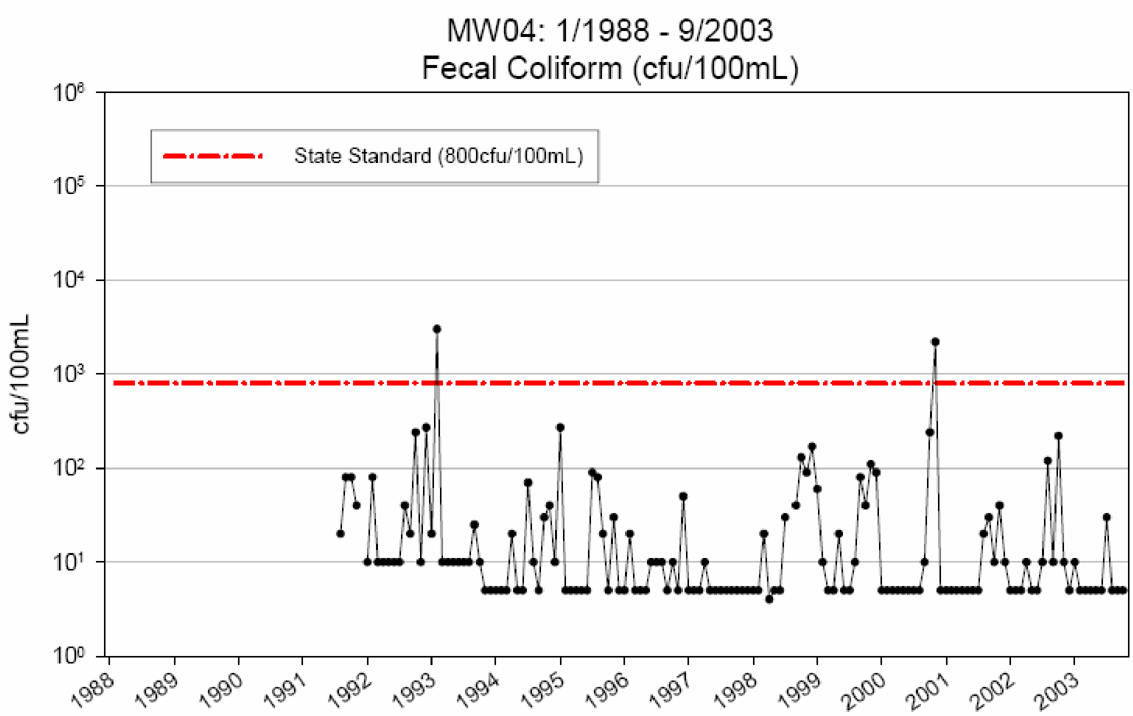

GL03: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800 cfu/100mL)
cfu/100mL
10^0
10^1
10^2
10^3
10^4
10^5
10^6
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MI01: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800 cfu/100mL)
cfu/100mL
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

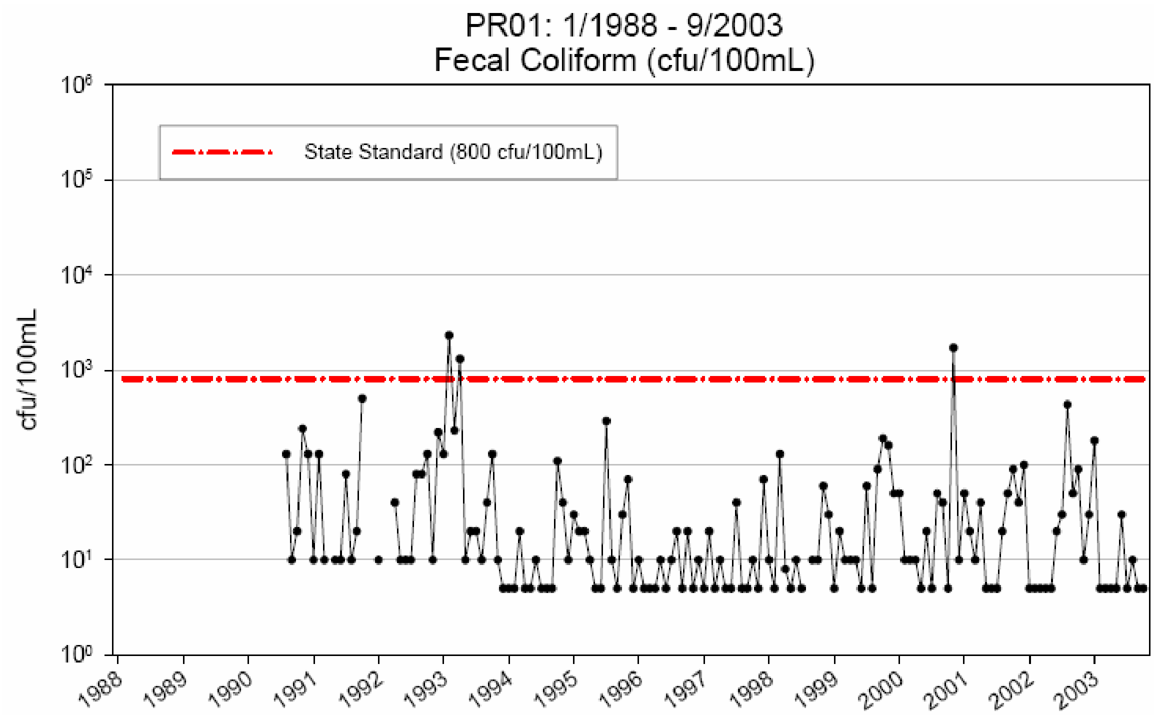

MI03: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800cfu/100mL)
cfu/100mL
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

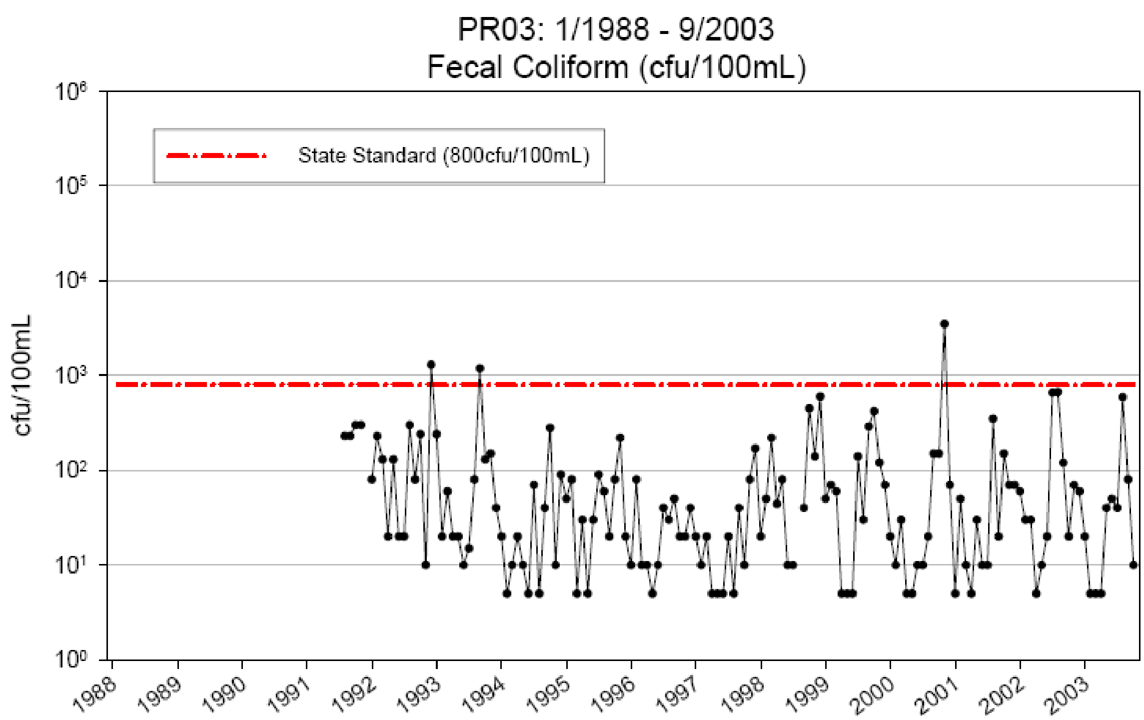


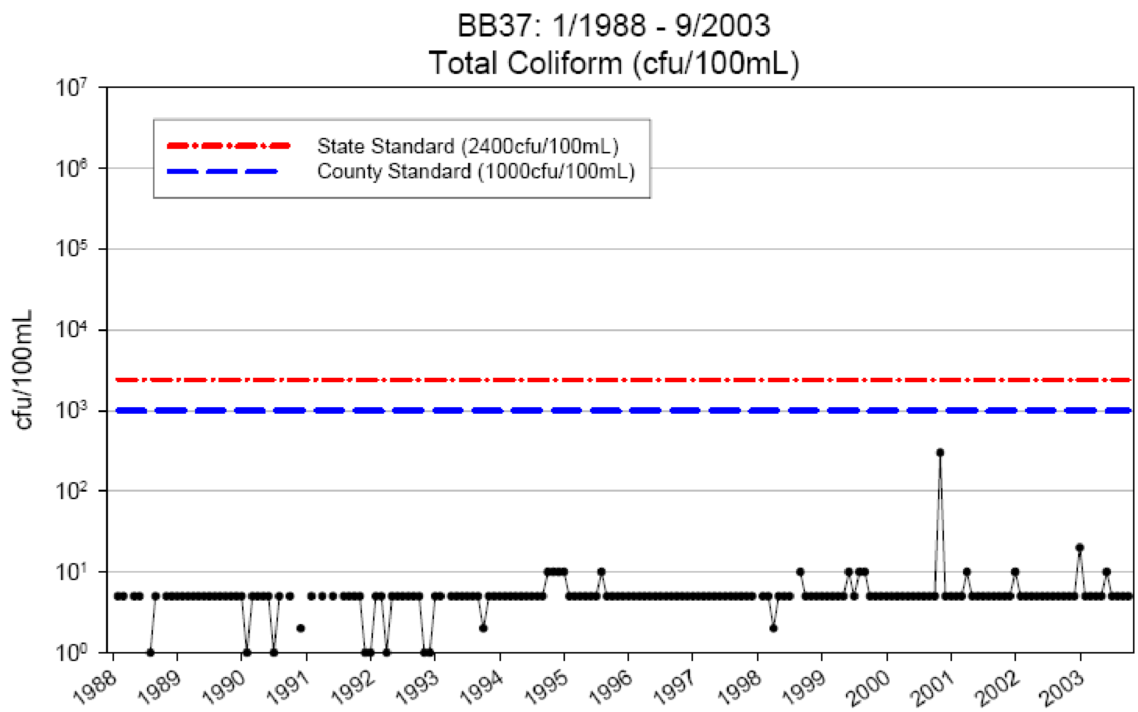
MW01: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800 cfu/100mL)
cfu/100mL
10^0
10^1
10^2
10^3
10^4
10^5
10^6
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003



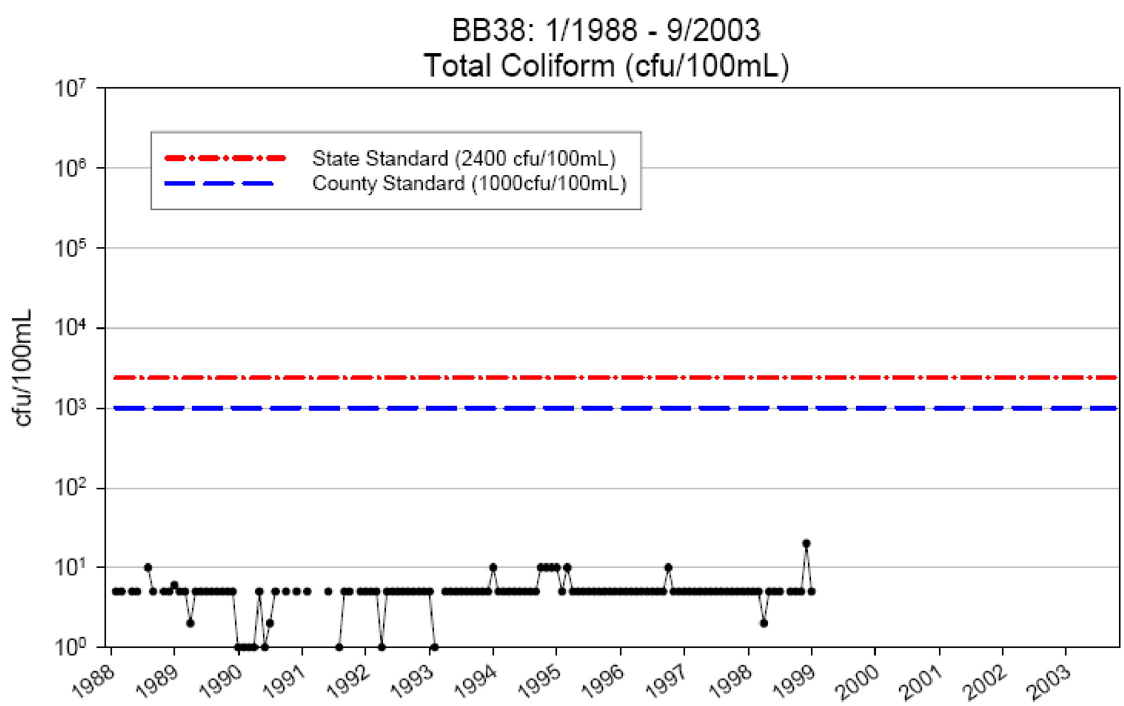
MW04: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800cfu/100mL)
cfu/100mL
10^0
10^1
10^2
10^3
10^4
10^5
10^6
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


PR01: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800 cfu/100mL)
cfu/100mL
10^0
10^1
10^2
10^3
10^4
10^5
10^6
1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003

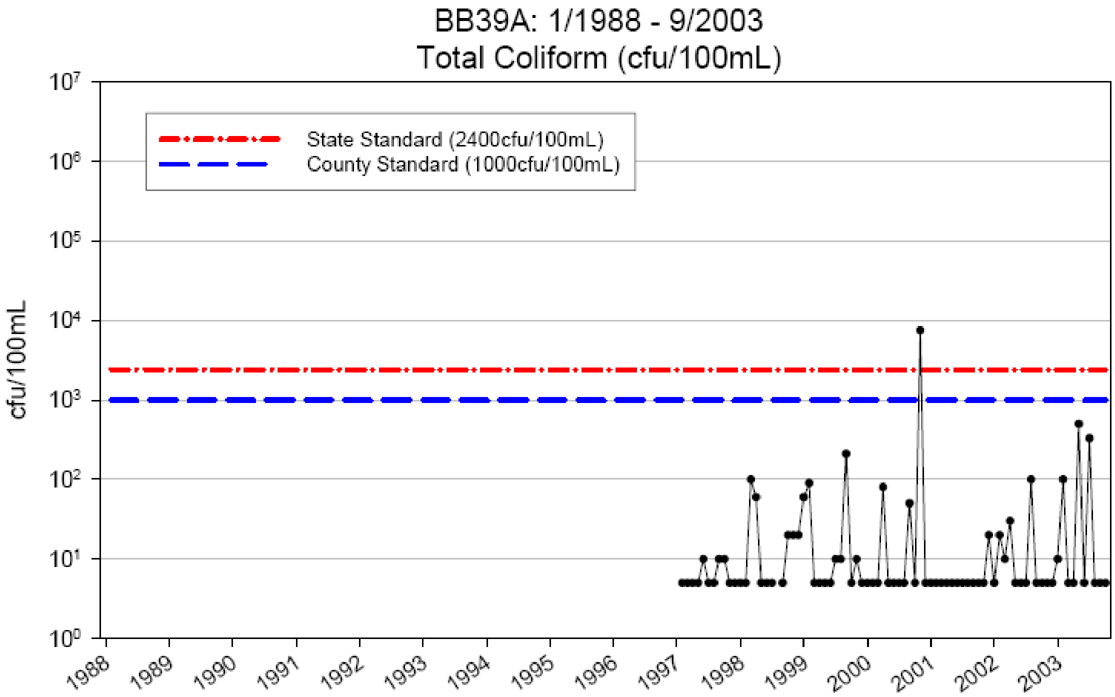

PR03: 1/1988 - 9/2003
Fecal Coliform (cfu/100mL)
State Standard (800cfu/100mL)
cfu/100mL
10^0
10^1
10^2
10^3
10^4
10^5
10^6
1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003

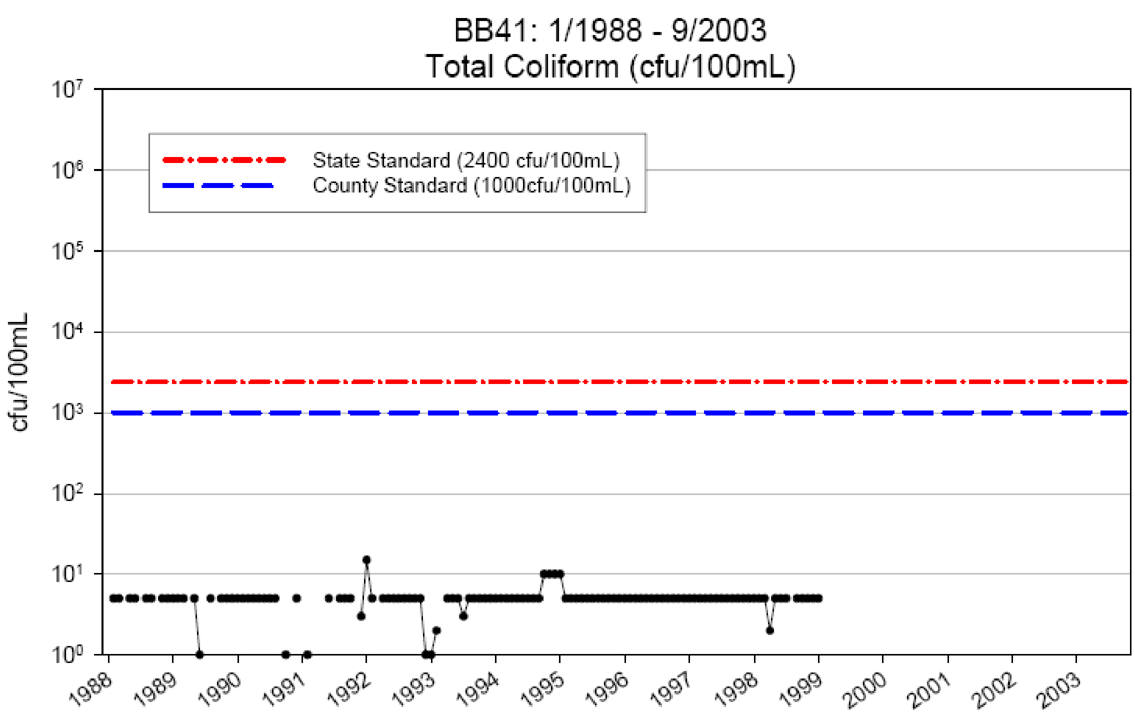


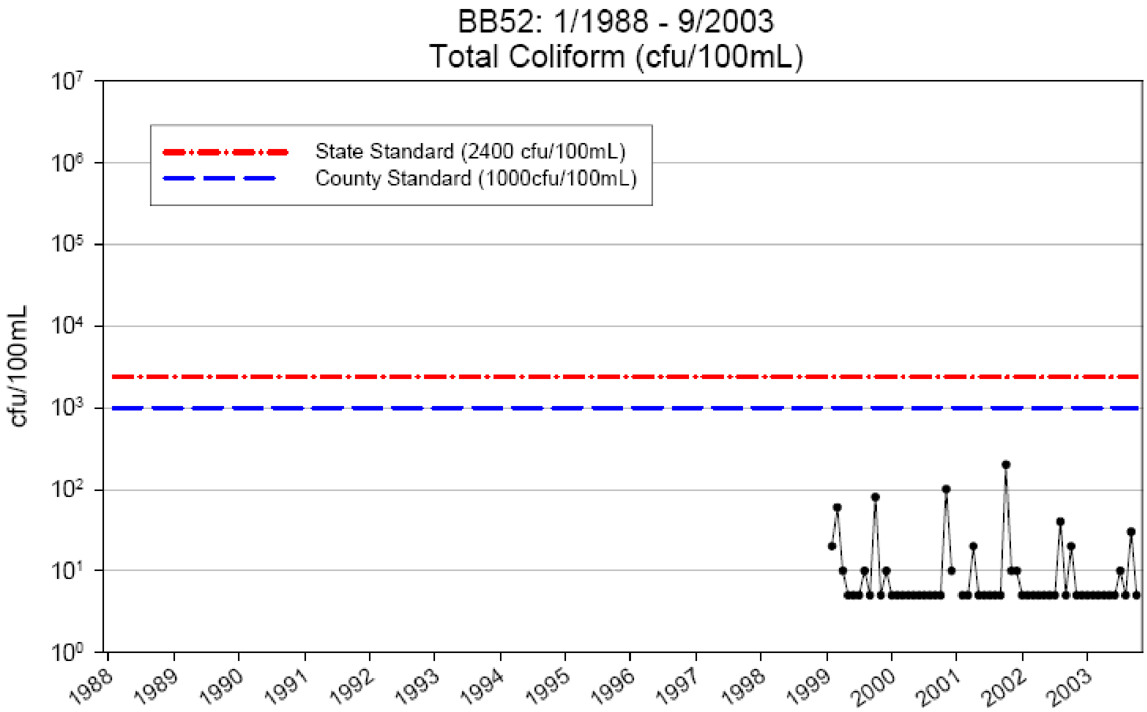
BB37: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003



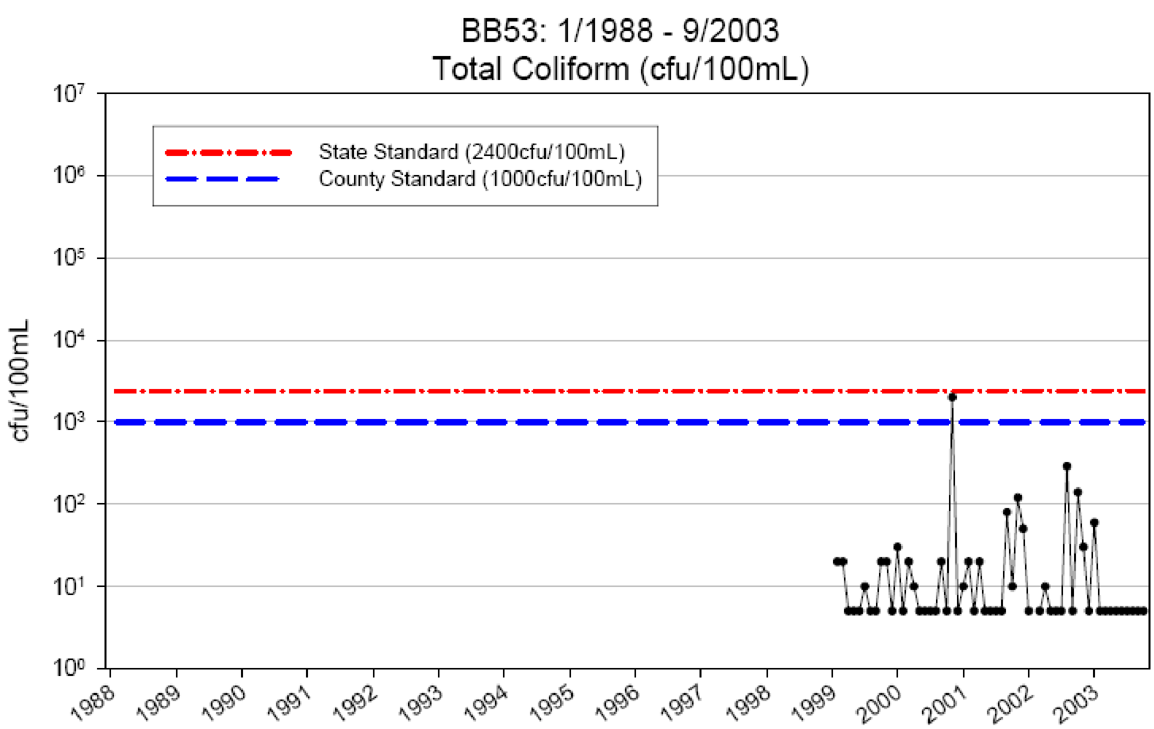
BB38: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400 cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB39A: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

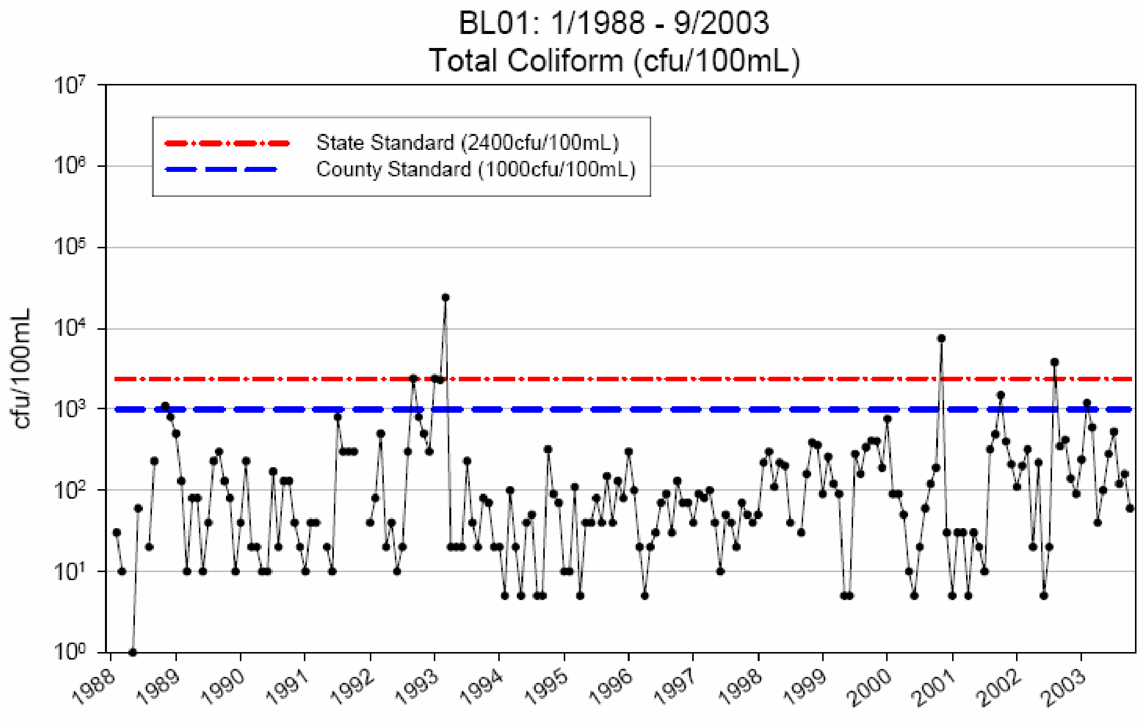

BB41: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400 cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003



BB52: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400 cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003



BB53: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BL01: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1988
1989
1990
1991
1992
1993
1994
1995
1996
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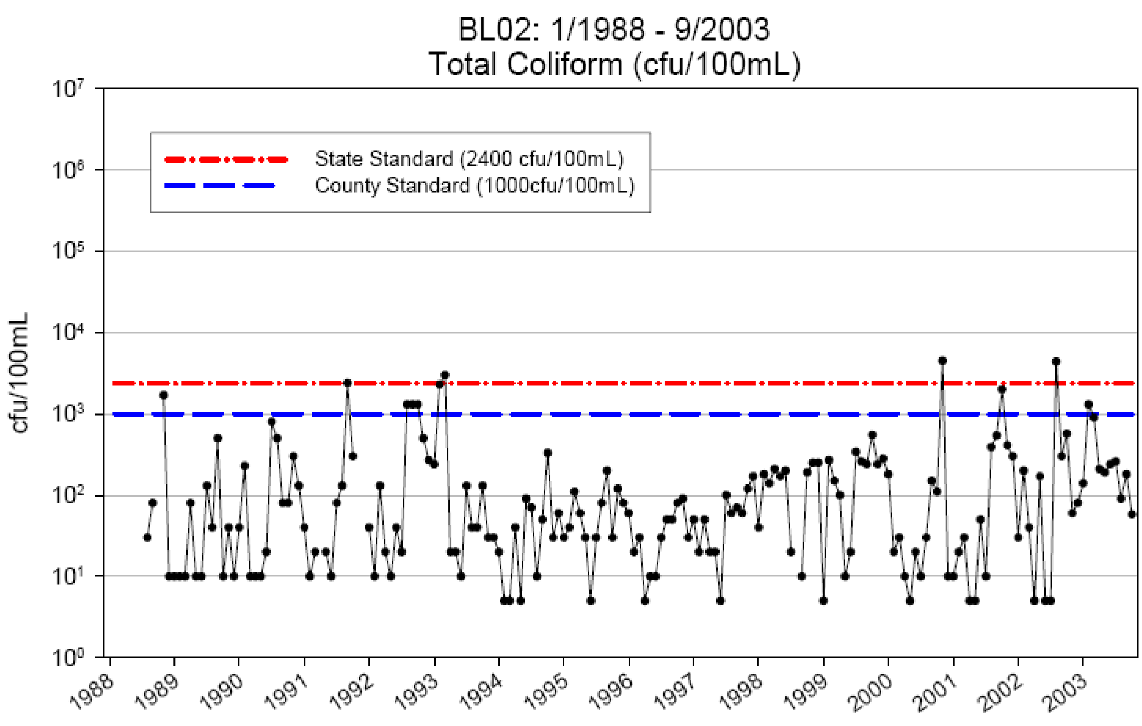
BL02: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400 cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
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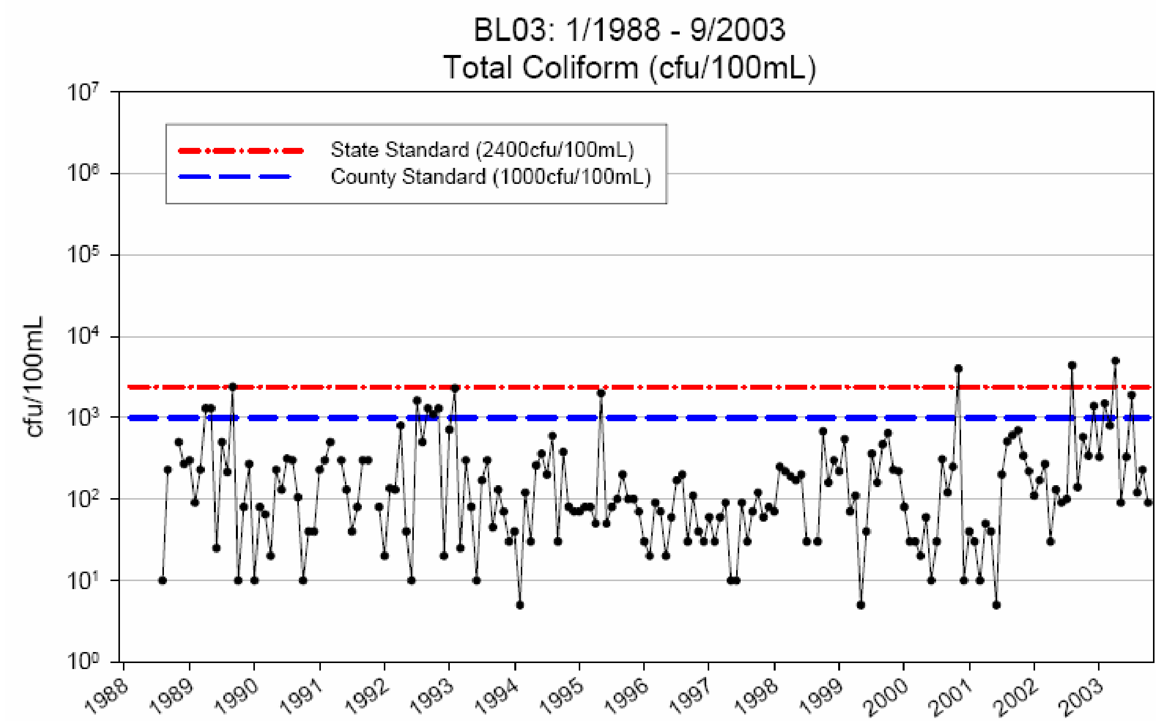
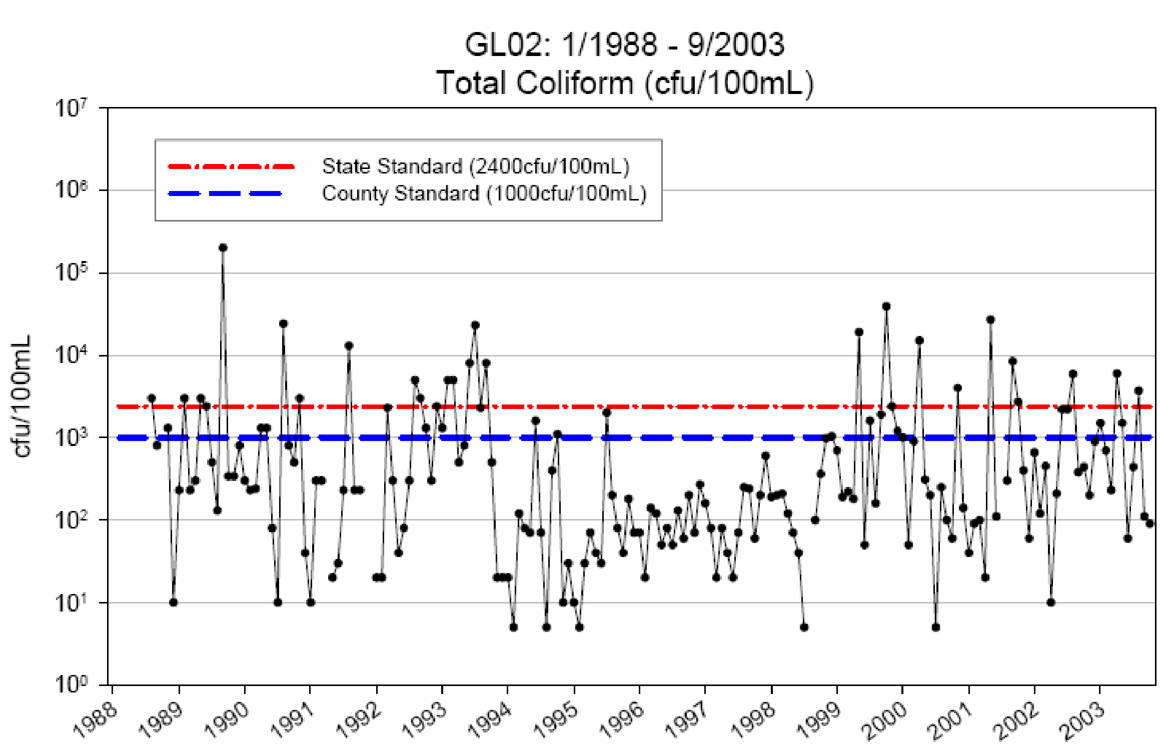
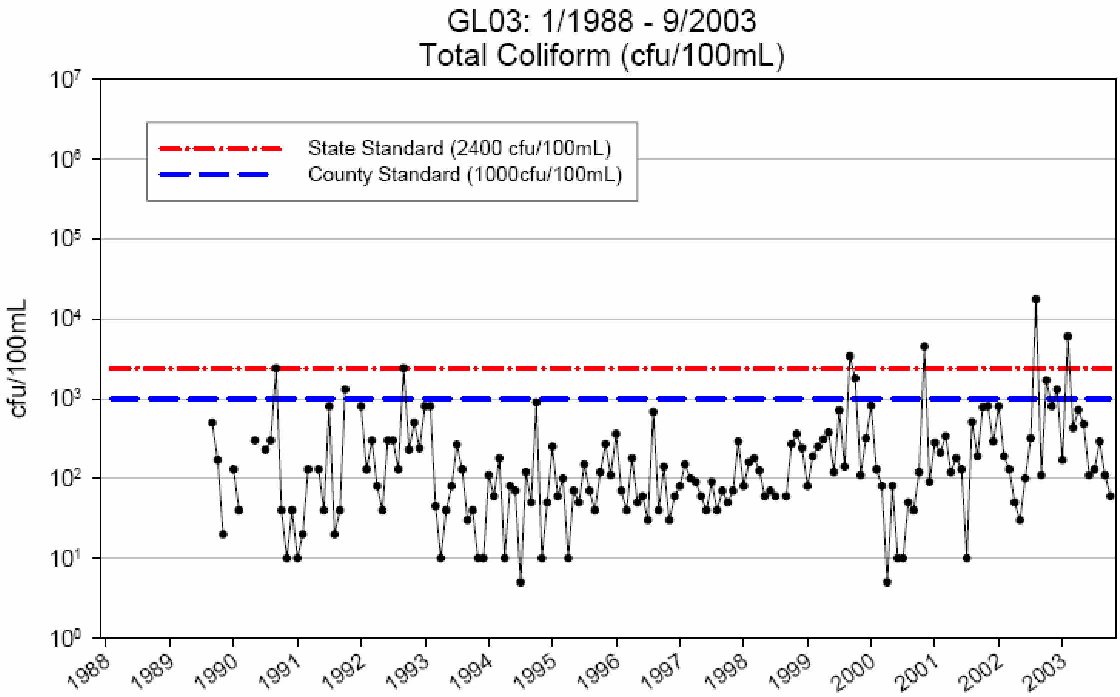


BL03: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^0 10^1 10^2 10^3 10^4 10^5 10^6 10^7
1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003



GL02: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^0 10^1 10^2 10^3 10^4 10^5 10^6 10^7
1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003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Total Coliform (cfu/100mL)
State Standard (2400 cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
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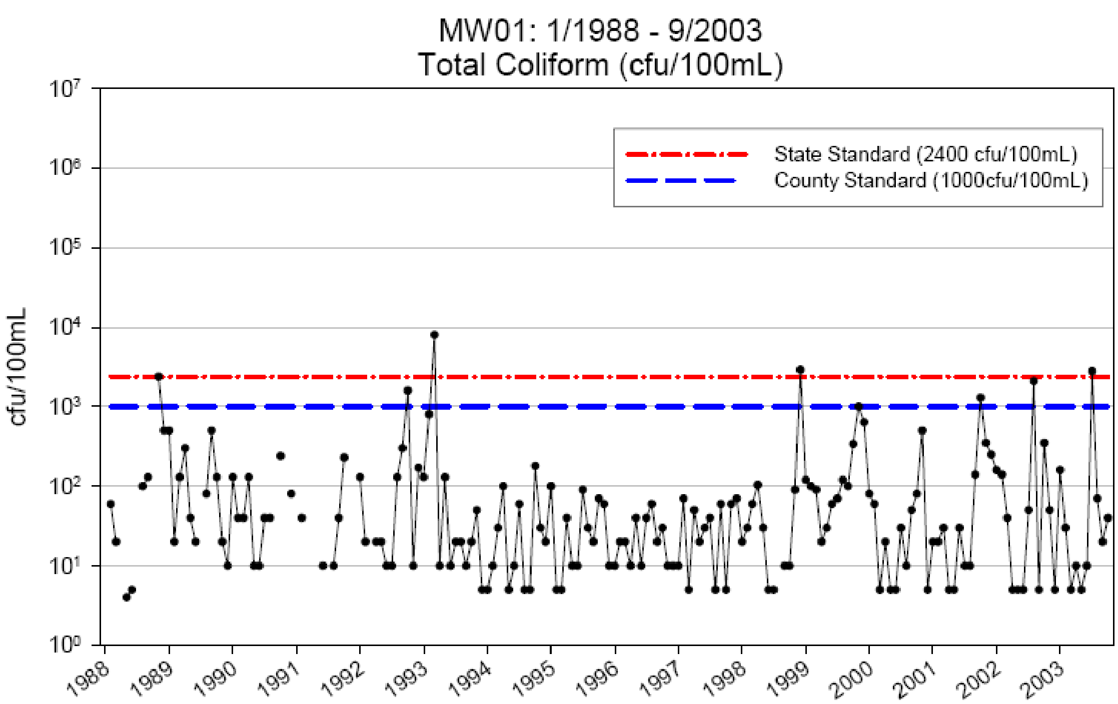
MW01: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400 cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^0
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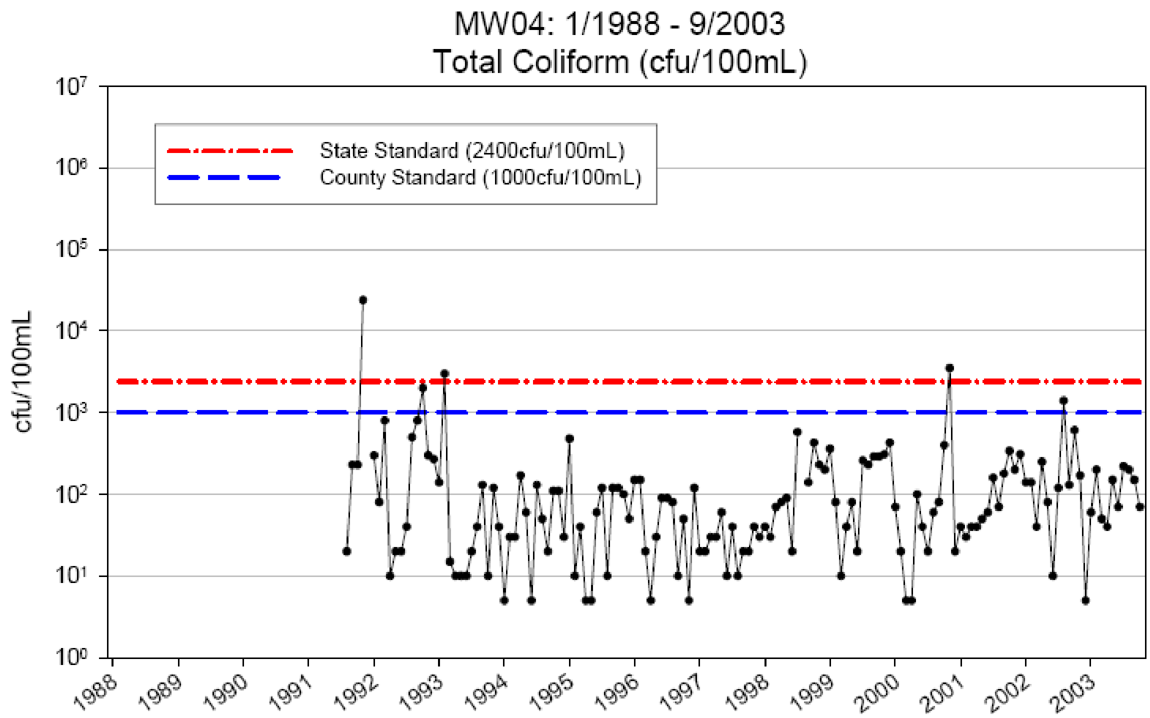
MW04: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
10^7
10^6
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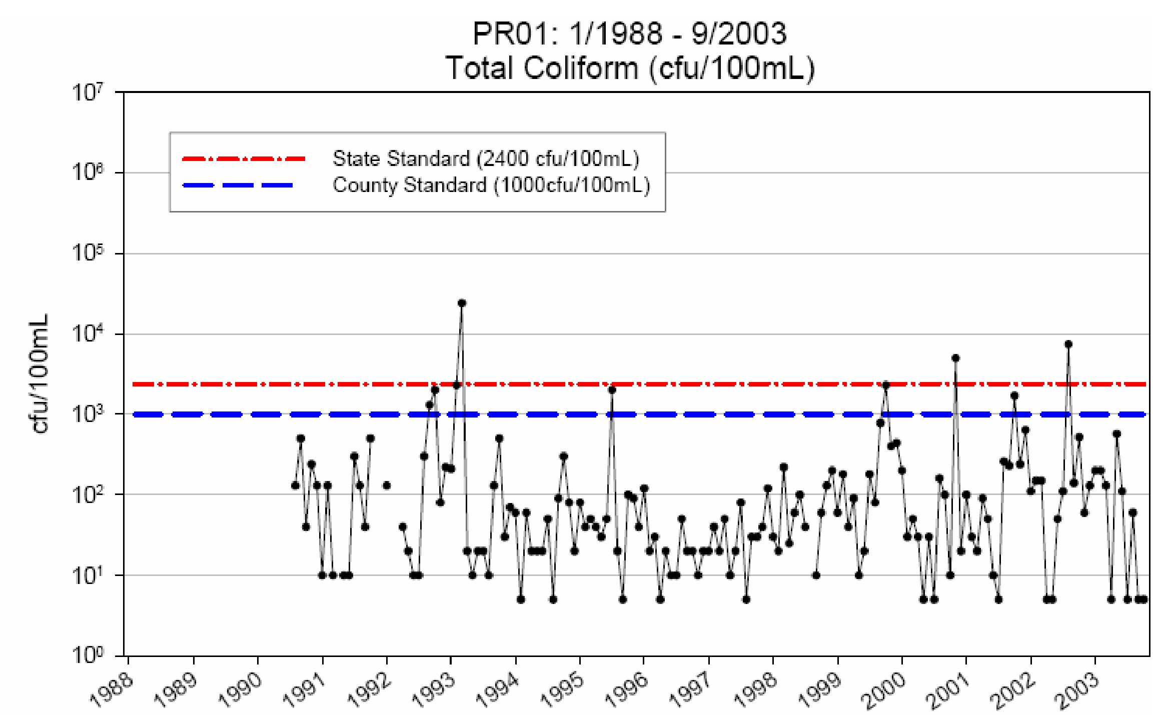
PR01: 1/1988 - 9/2003
Total Coliform (cfu/100mL)
State Standard (2400 cfu/100mL)
County Standard (1000cfu/100mL)
cfu/100mL
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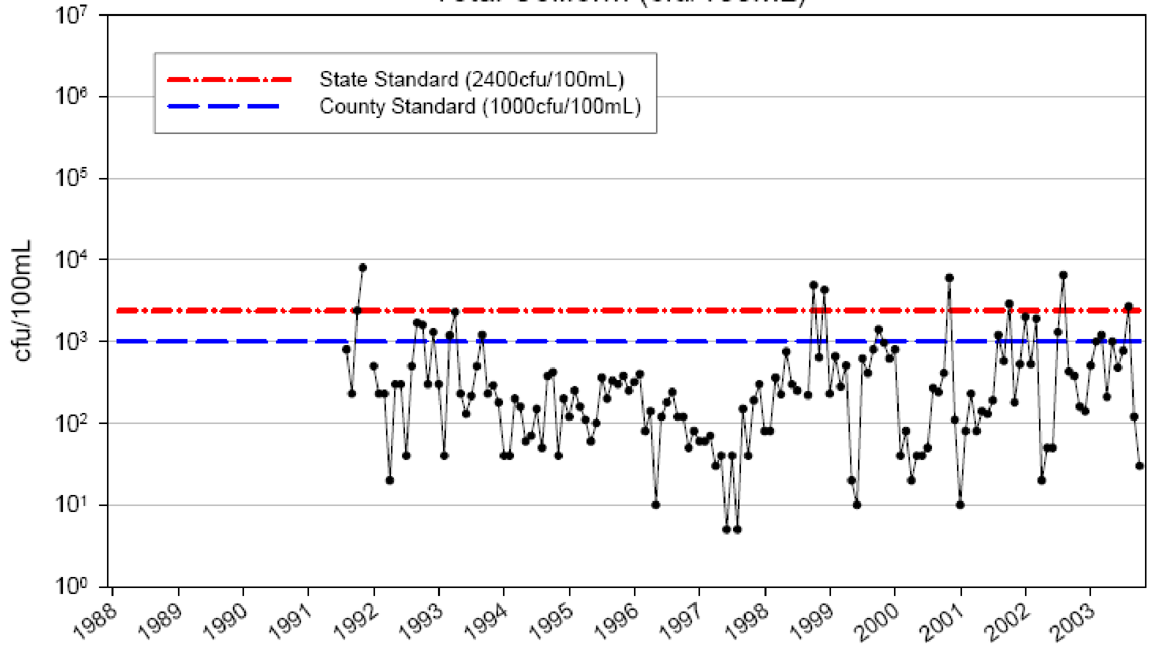
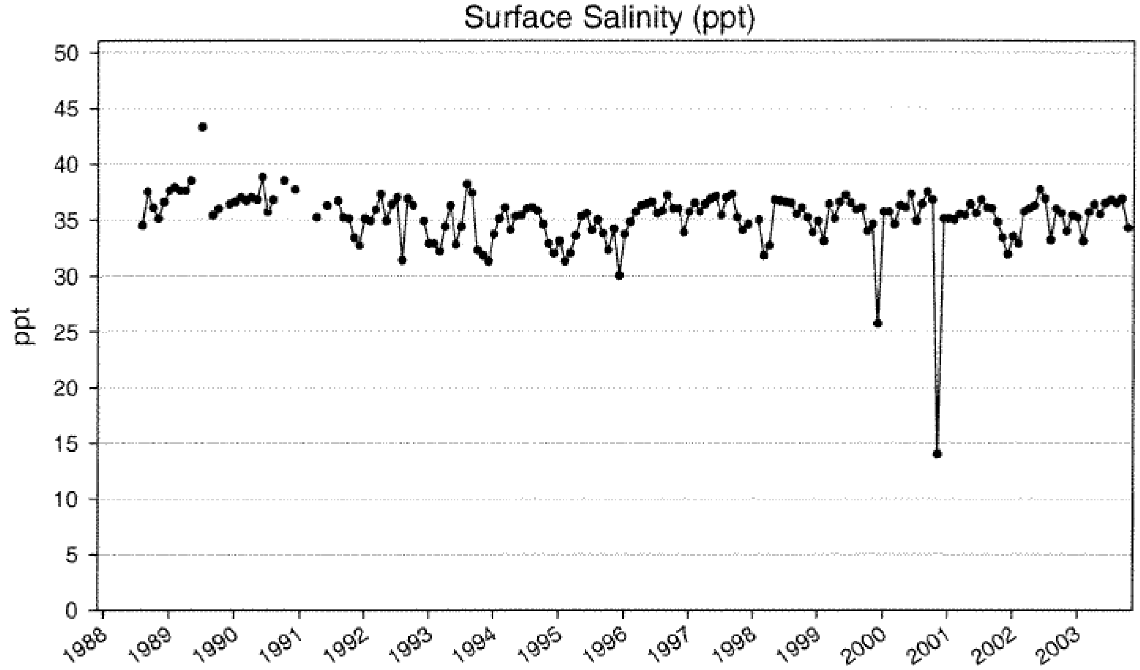
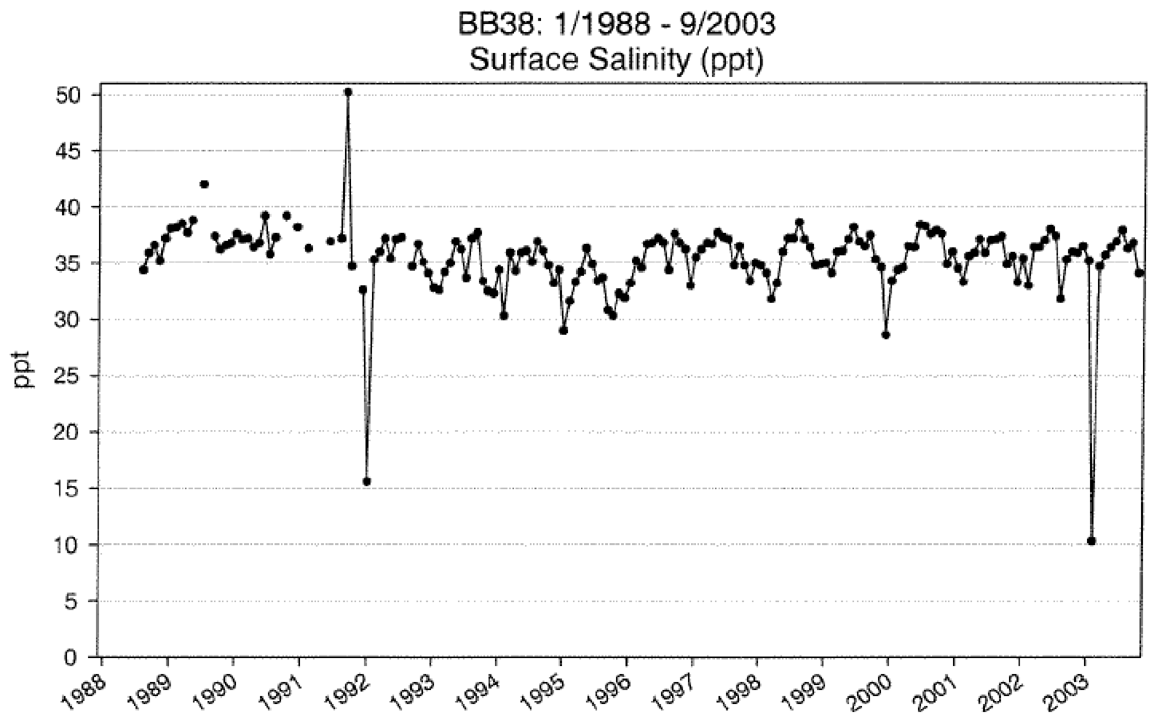
PR03: 1/1988 - 9/2003
Total Coliform (cfu/100mL)



BB37: 1/1988 - 9/2003
Surface Salinity (ppt)




BB38: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
0
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1988
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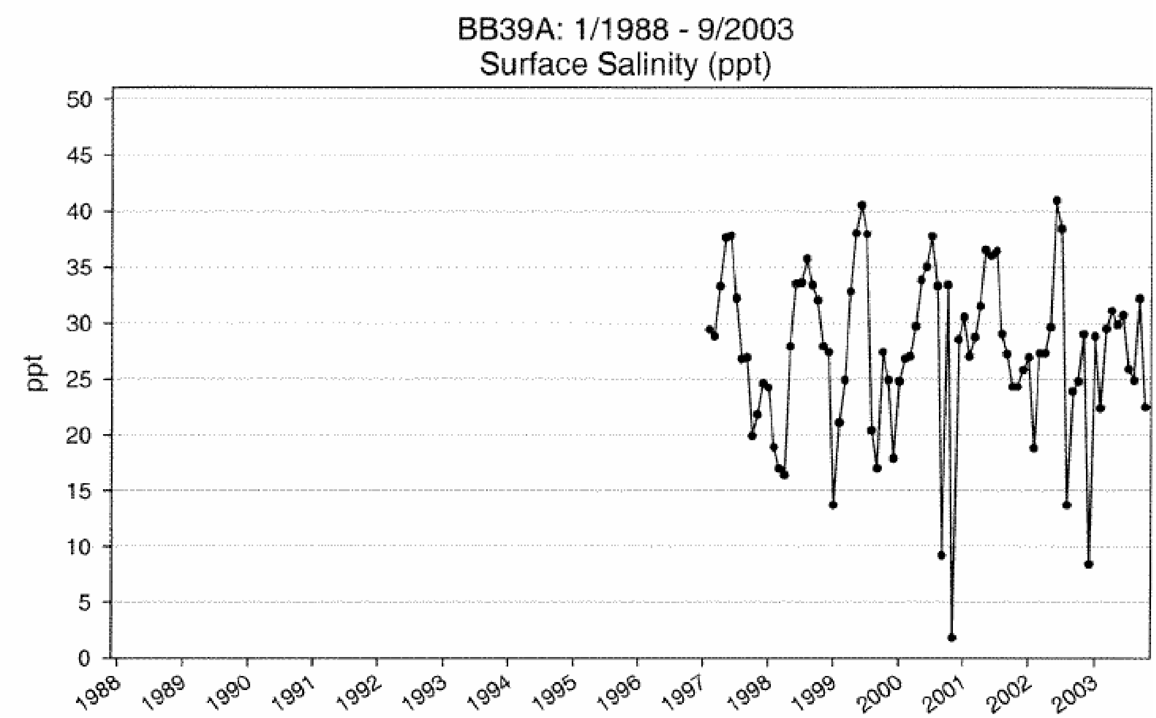
BB39A: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
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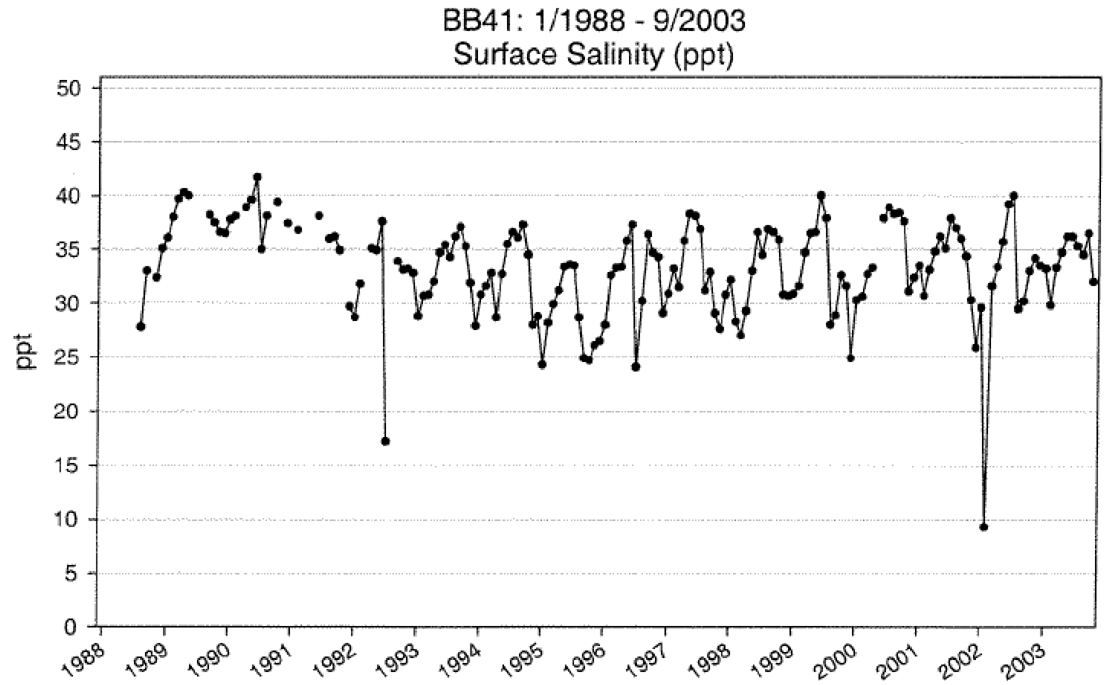
BB41: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
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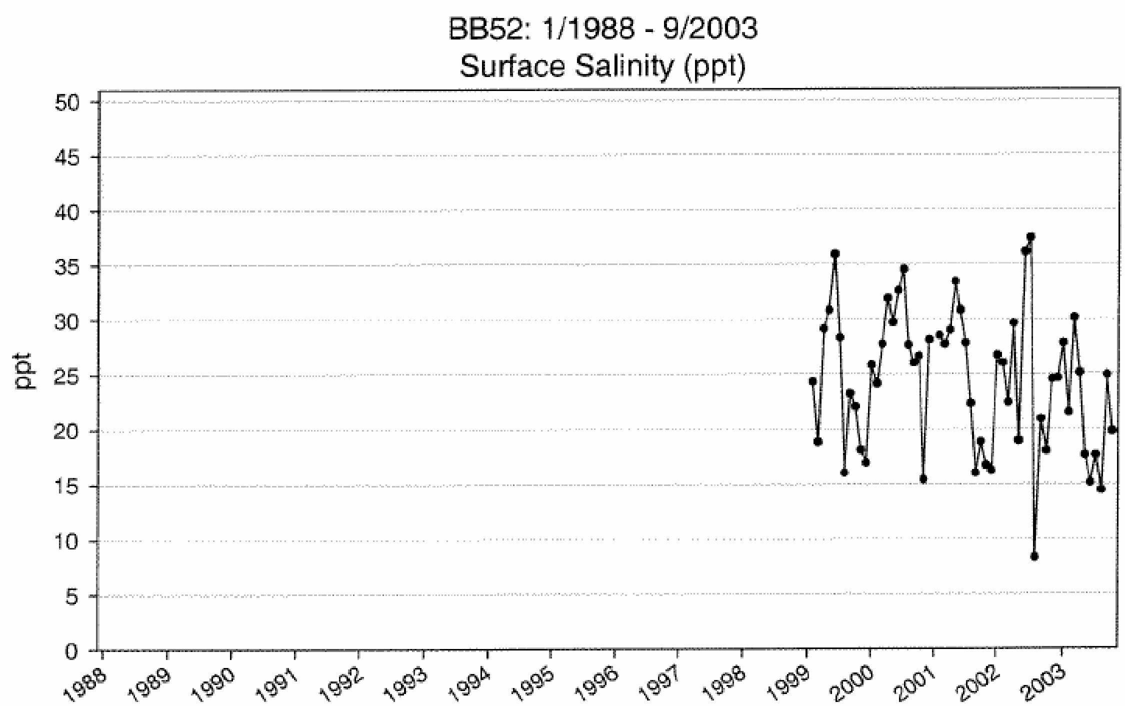
BB52: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
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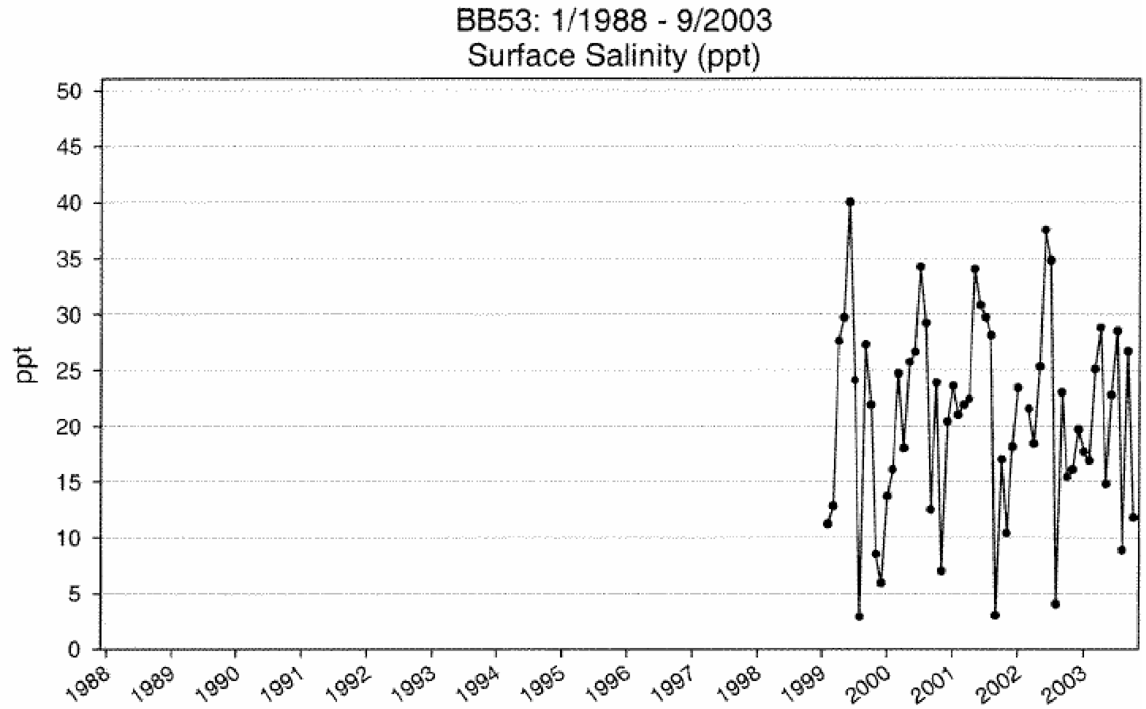
BB53: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
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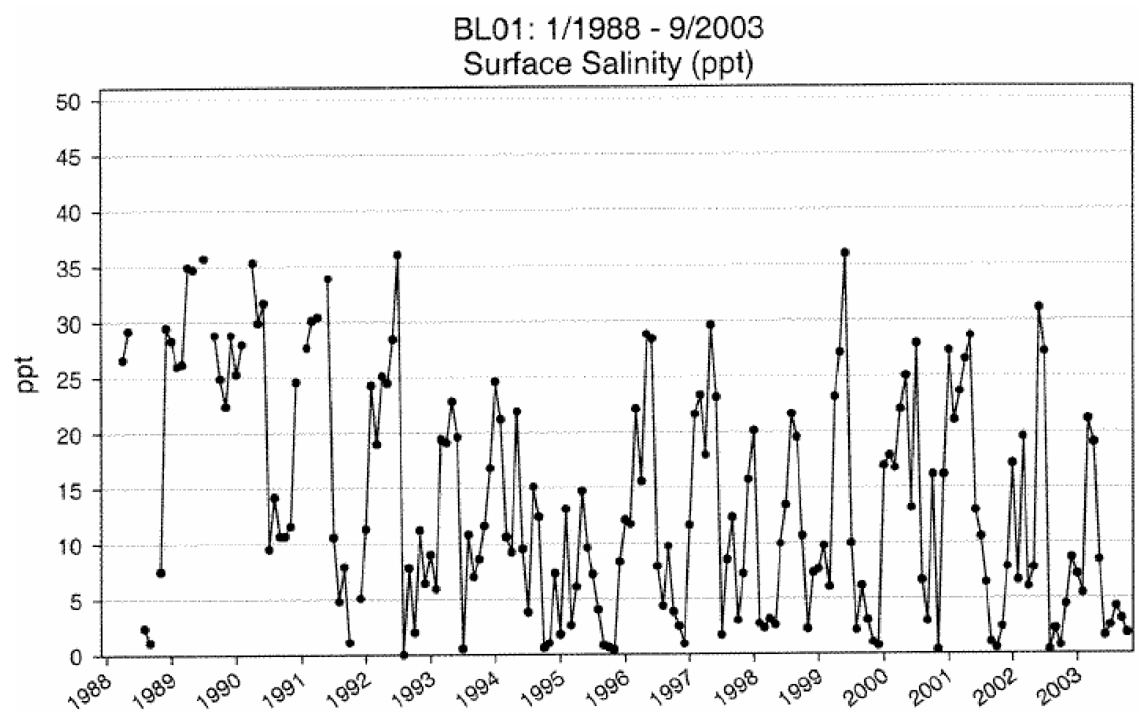
BL01: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
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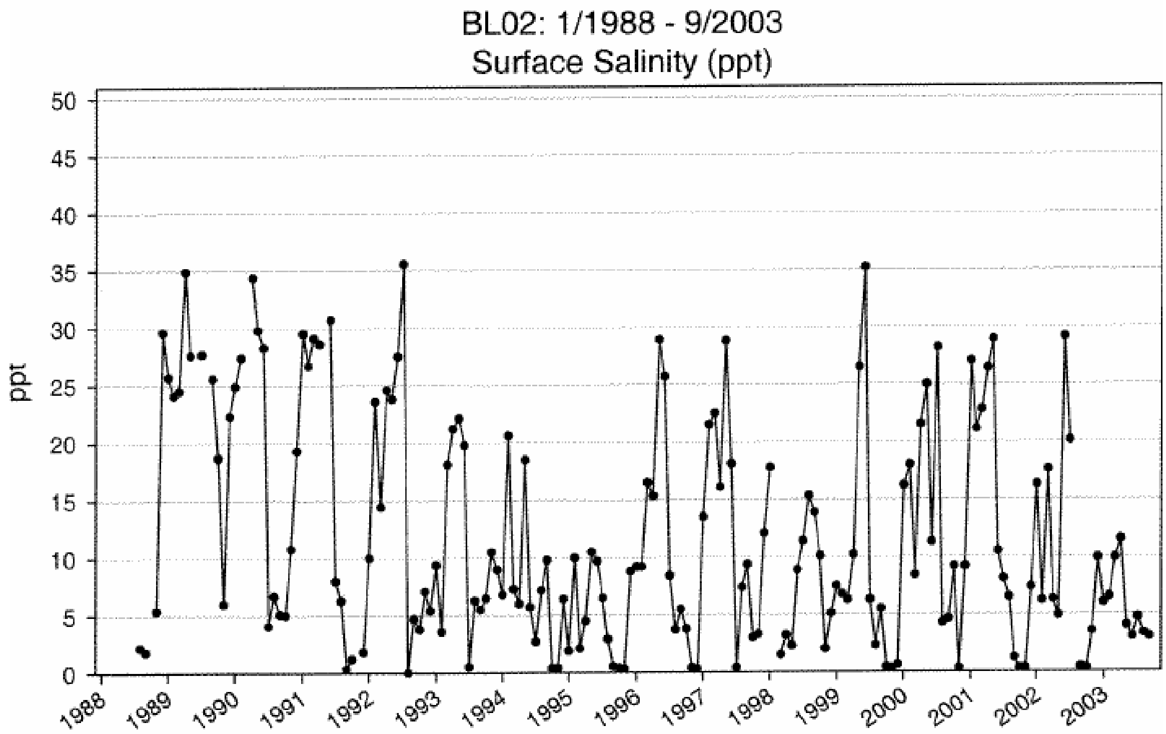
BL02: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
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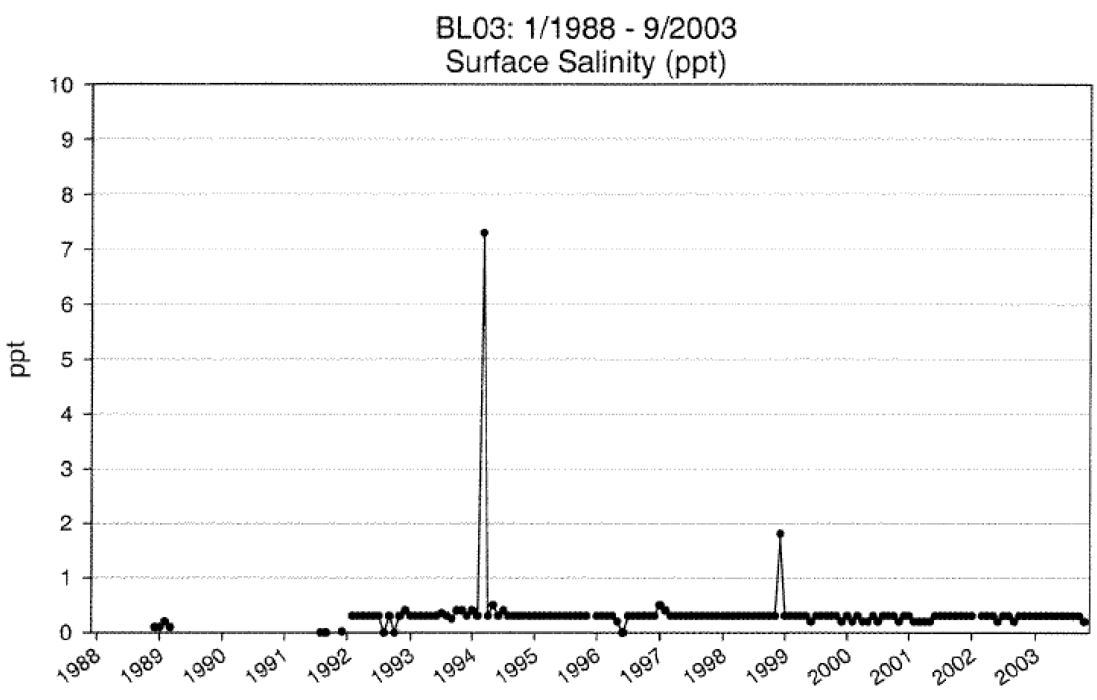
BL03: 1/1988 - 9/2003
Surface Salinity (ppt)
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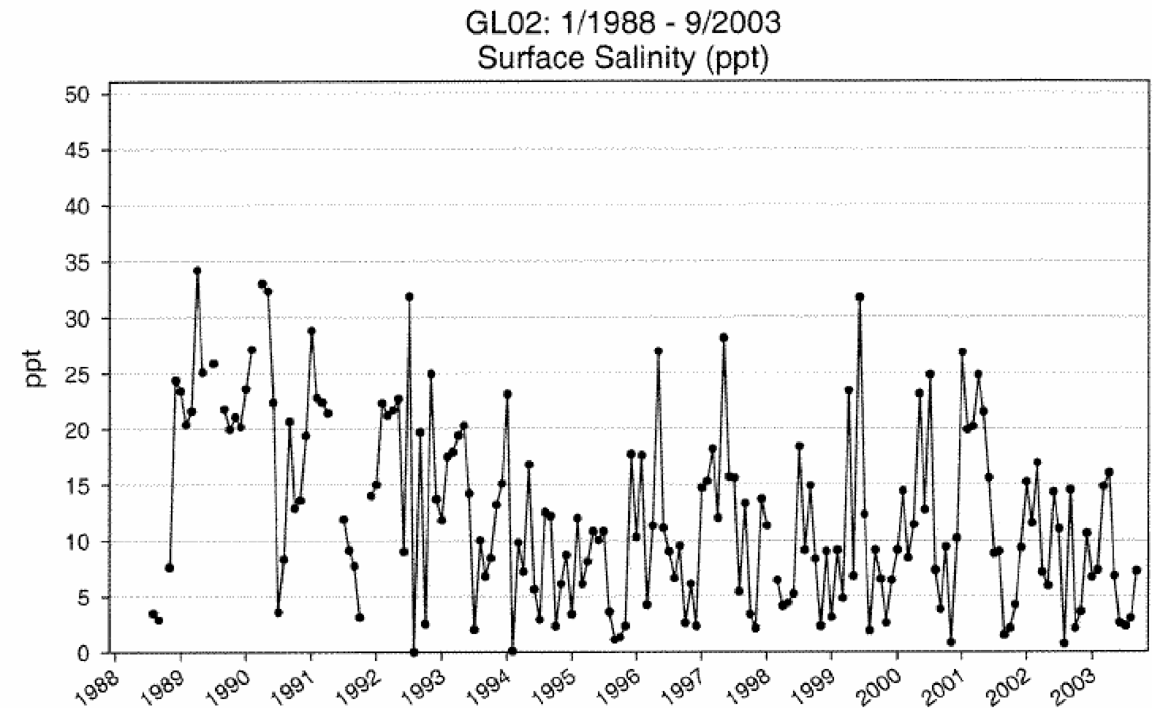
GL02: 1/1988 - 9/2003
Surface Salinity (ppt)
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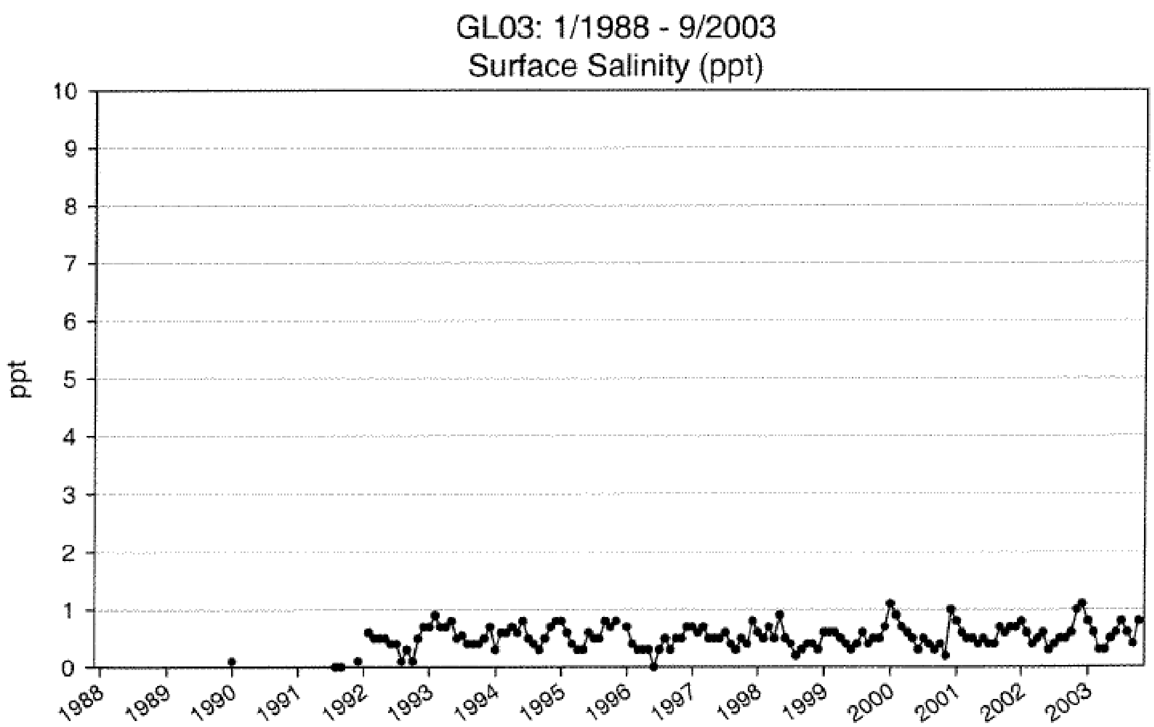
GL03: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
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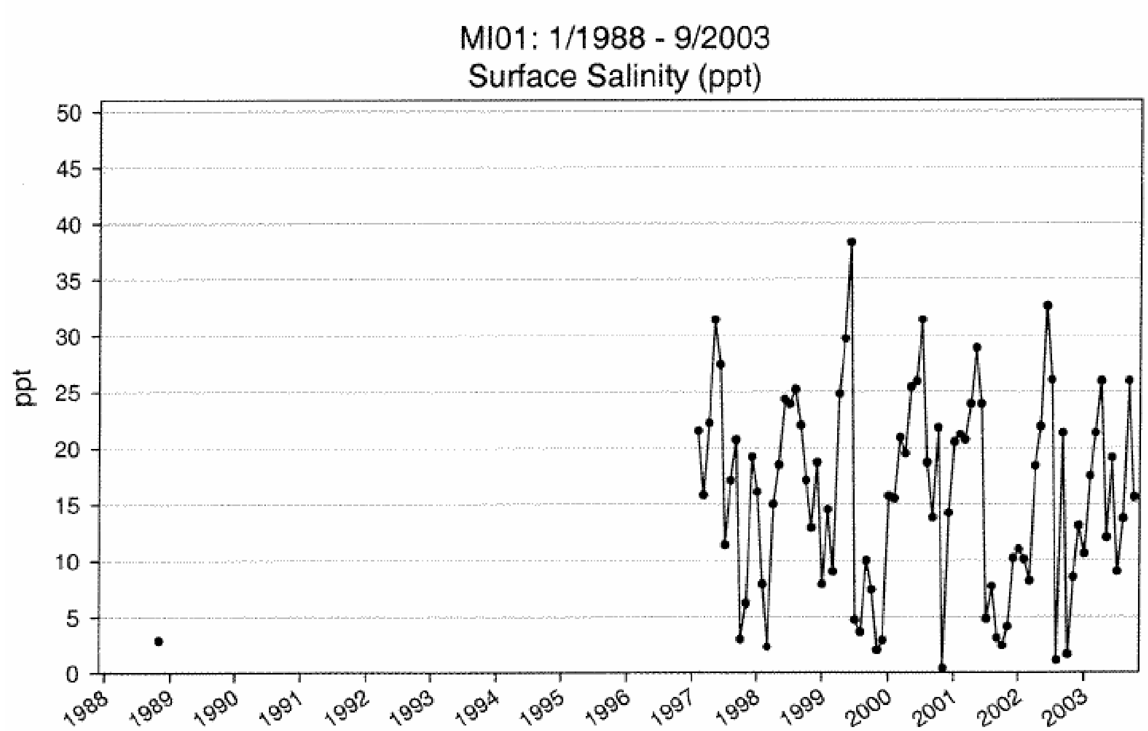

MI01: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
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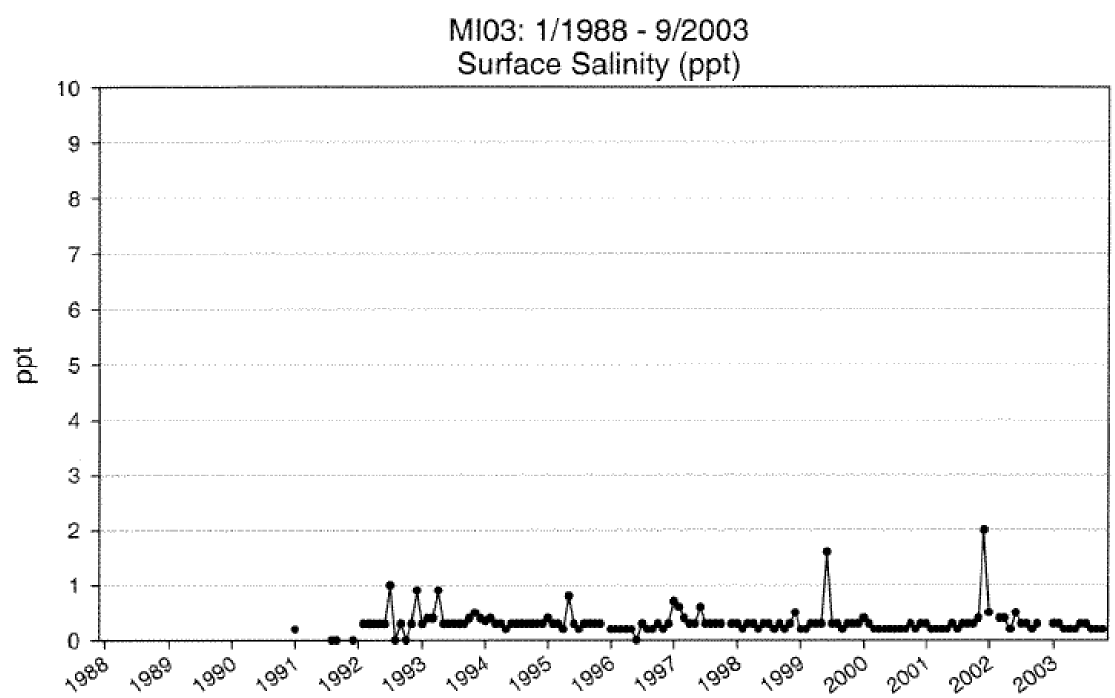

MI03: 1/1988 - 9/2003
Surface Salinity (ppt)
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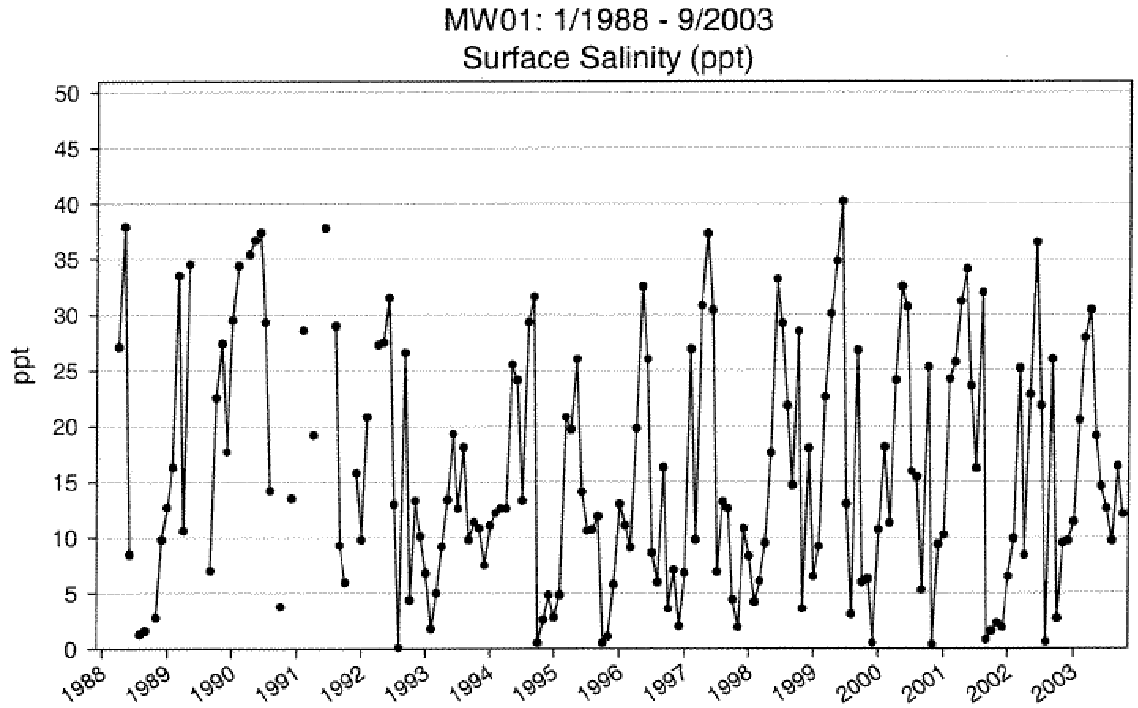
MW01: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
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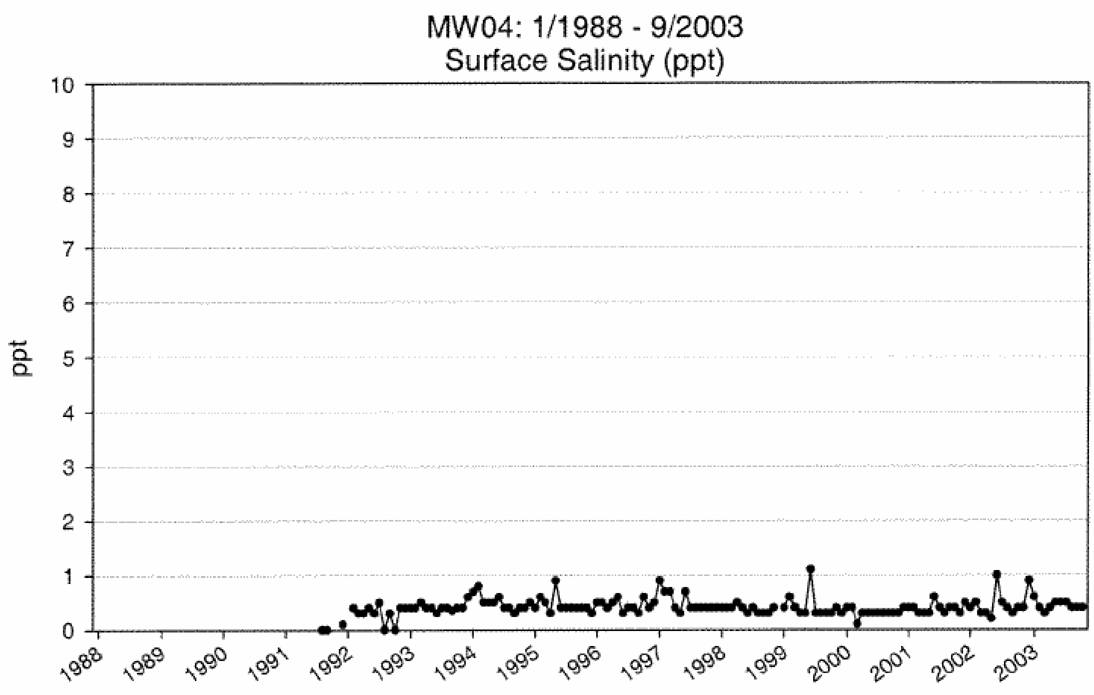
MW04: 1/1988 - 9/2003
Surface Salinity (ppt)
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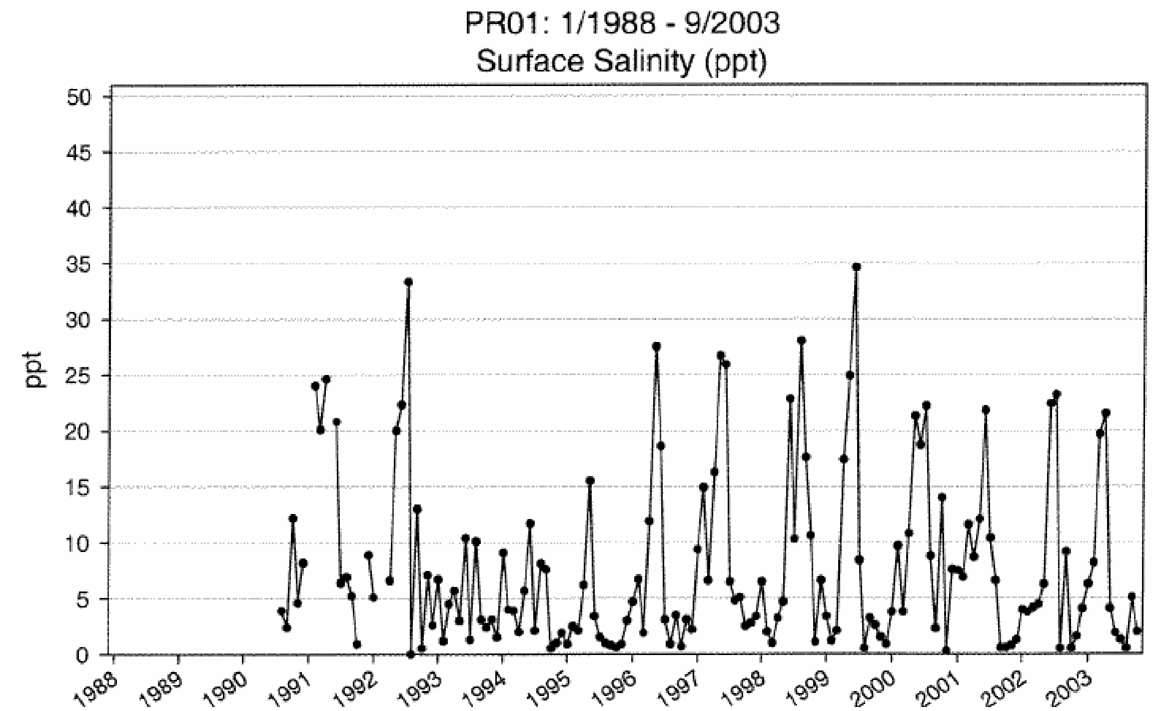
PR01: 1/1988 - 9/2003
Surface Salinity (ppt)
ppt
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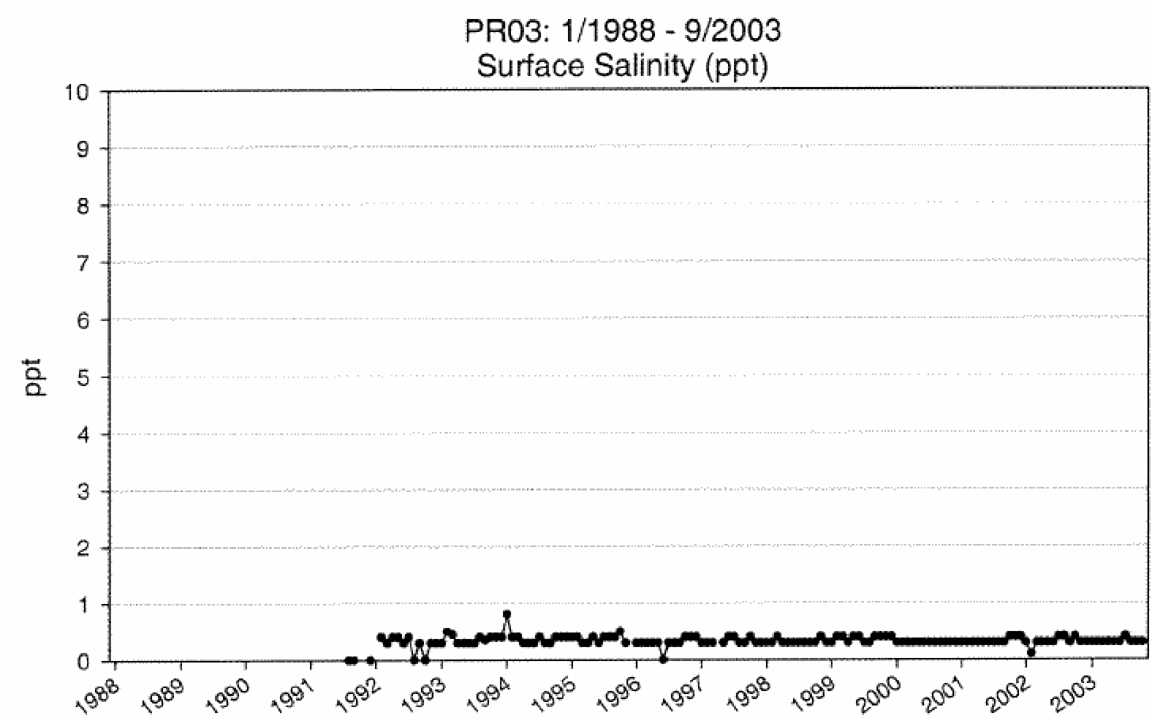
PR03: 1/1988 - 9/2003
Surface Salinity (ppt)
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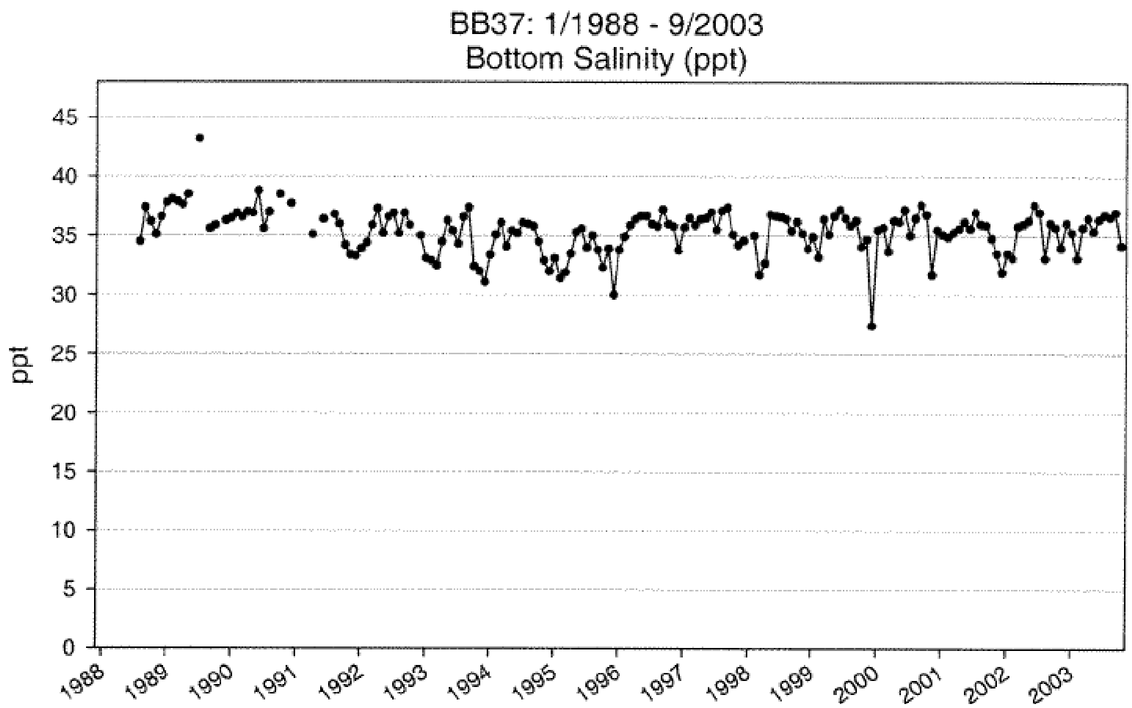
BB37: 1/1988 - 9/2003
Bottom Salinity (ppt)
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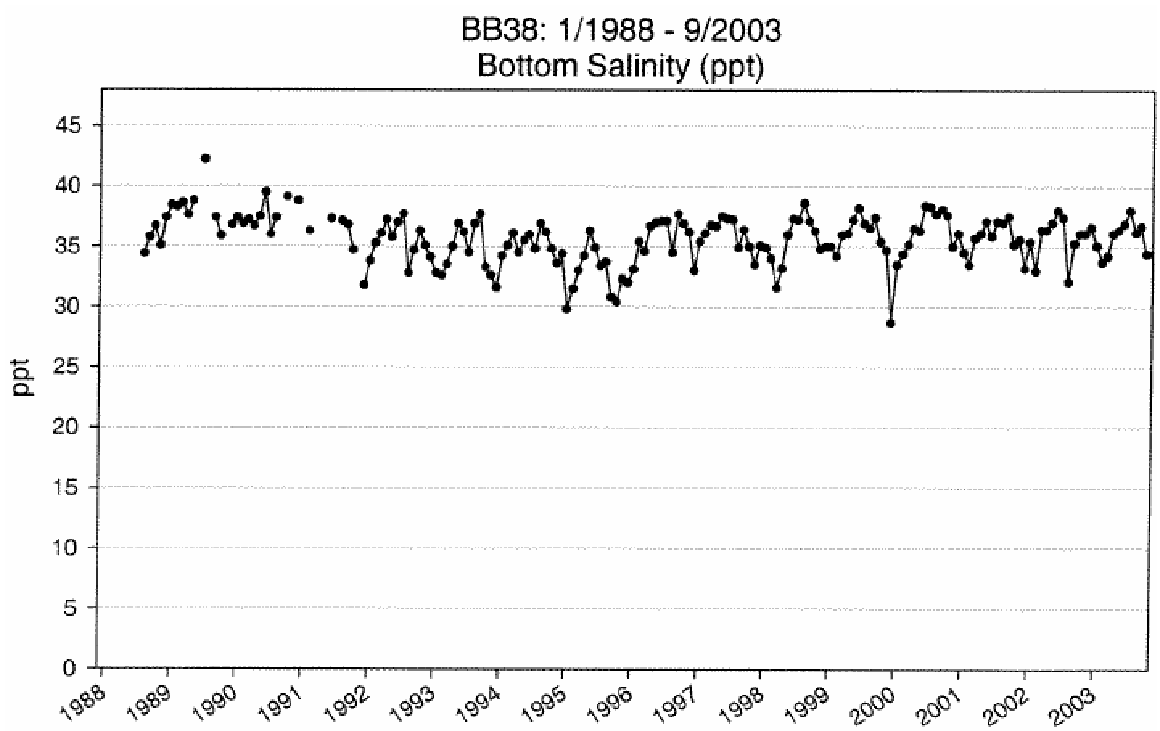
BB38: 1/1988 - 9/2003
Bottom Salinity (ppt)
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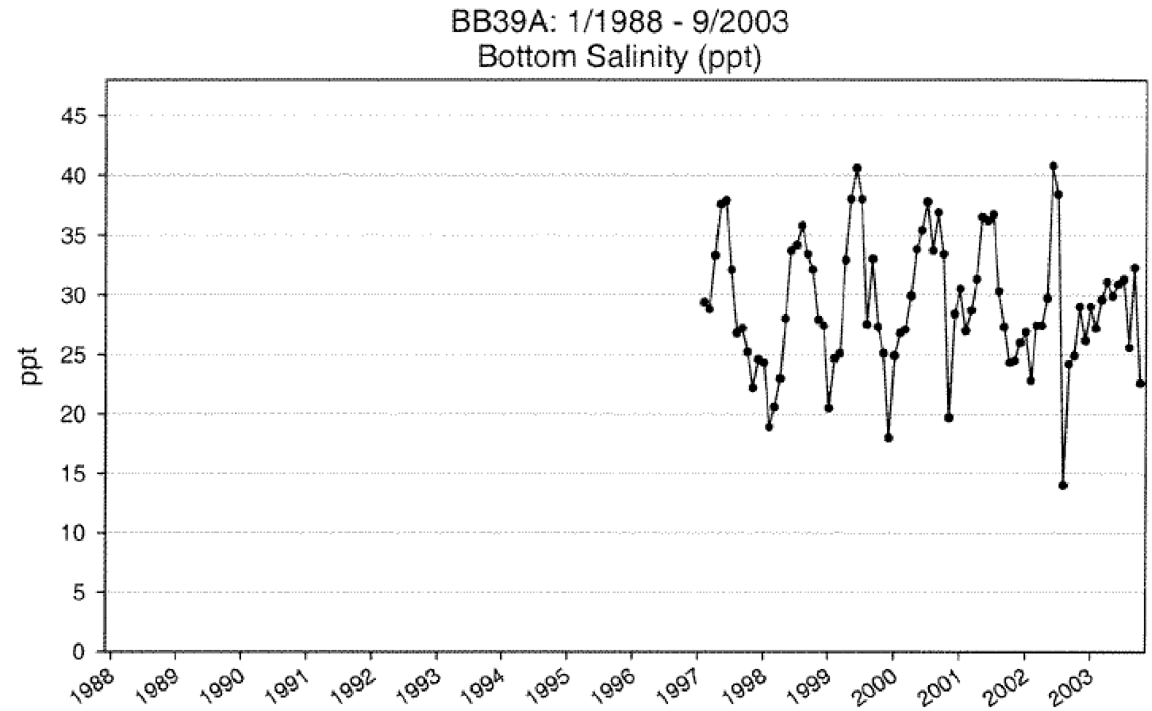
BB39A: 1/1988 - 9/2003
Bottom Salinity (ppt)
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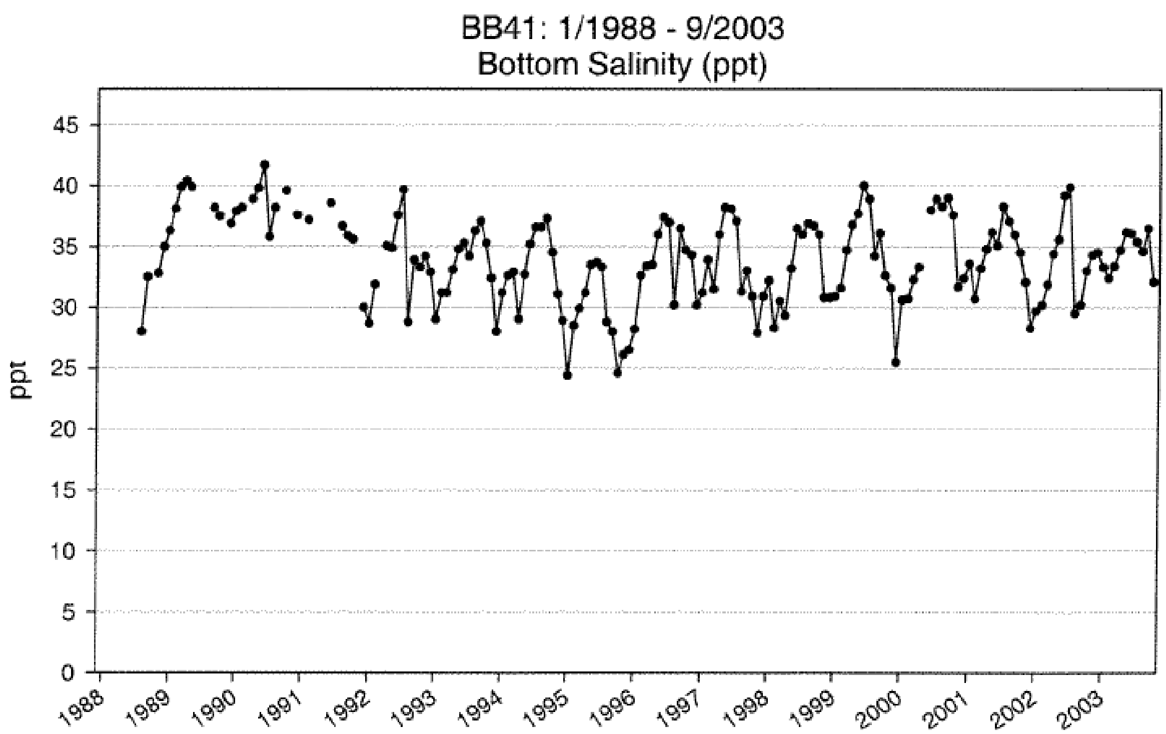
BB41: 1/1988 - 9/2003
Bottom Salinity (ppt)
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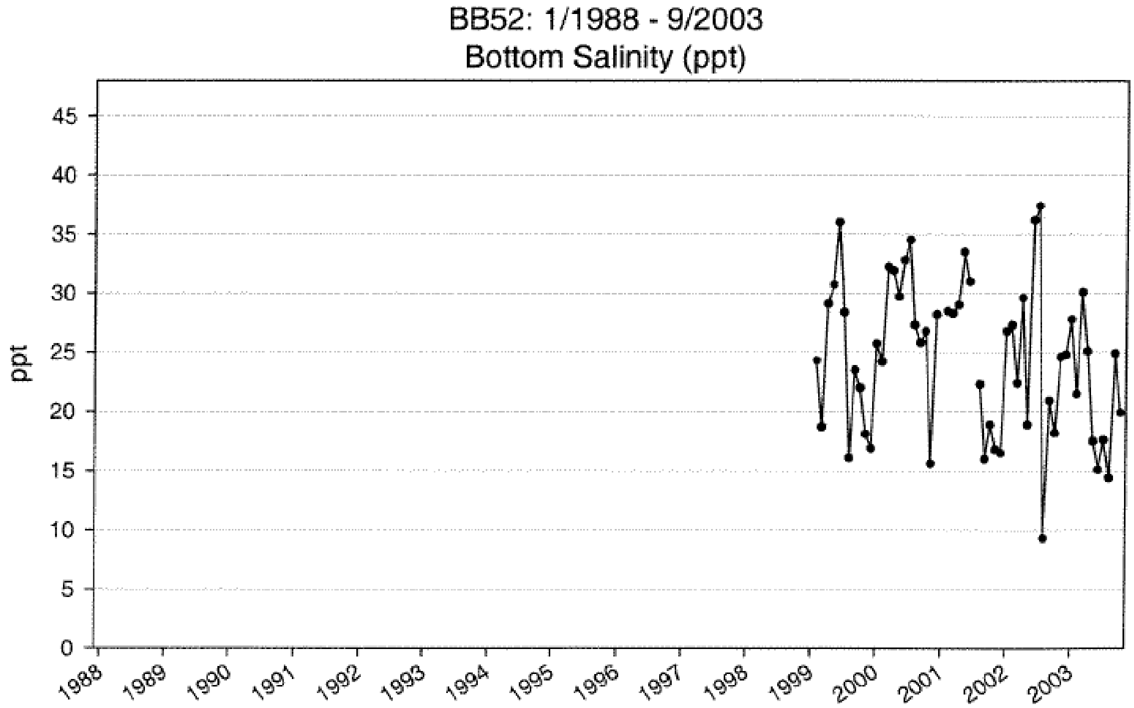
BB52: 1/1988 - 9/2003
Bottom Salinity (ppt)
ppt
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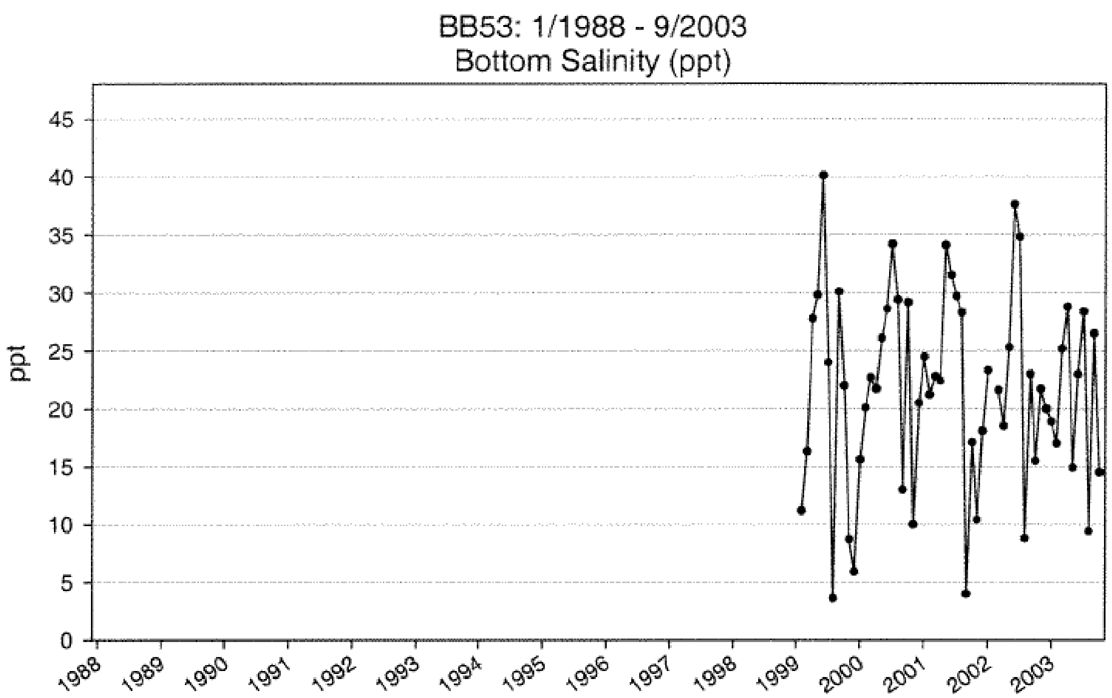
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Bottom Salinity (ppt)
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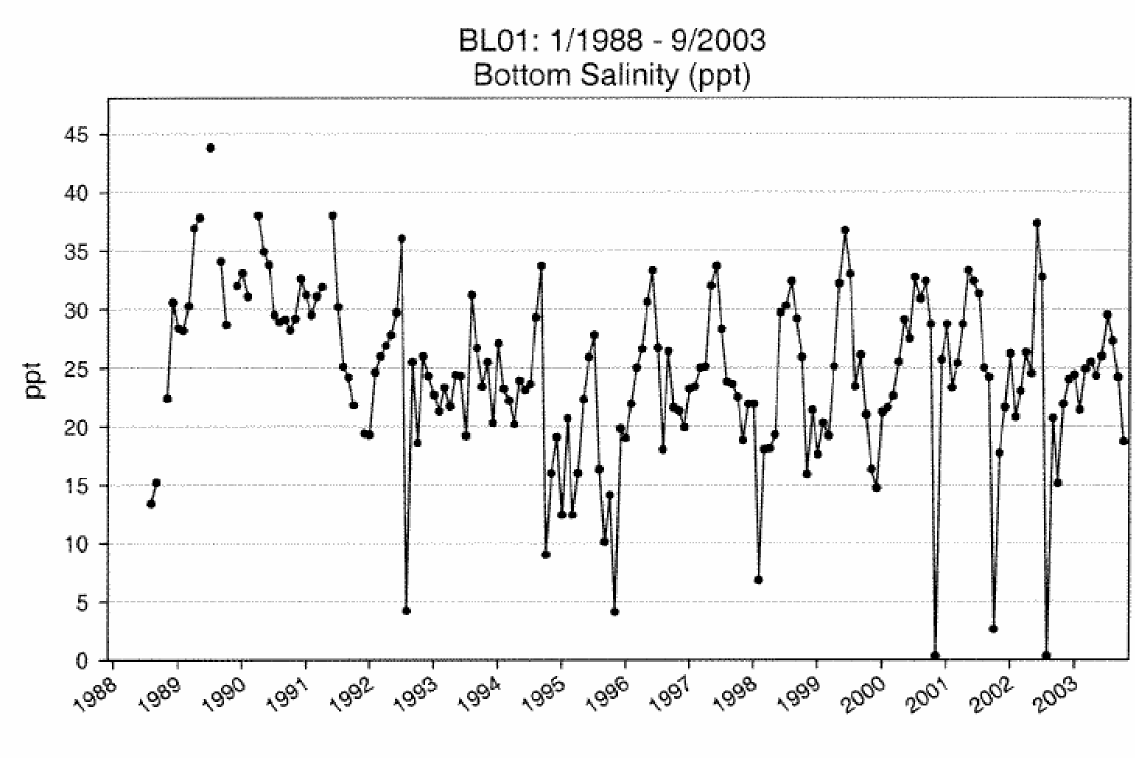
BL01: 1/1988 - 9/2003
Bottom Salinity (ppt)
ppt
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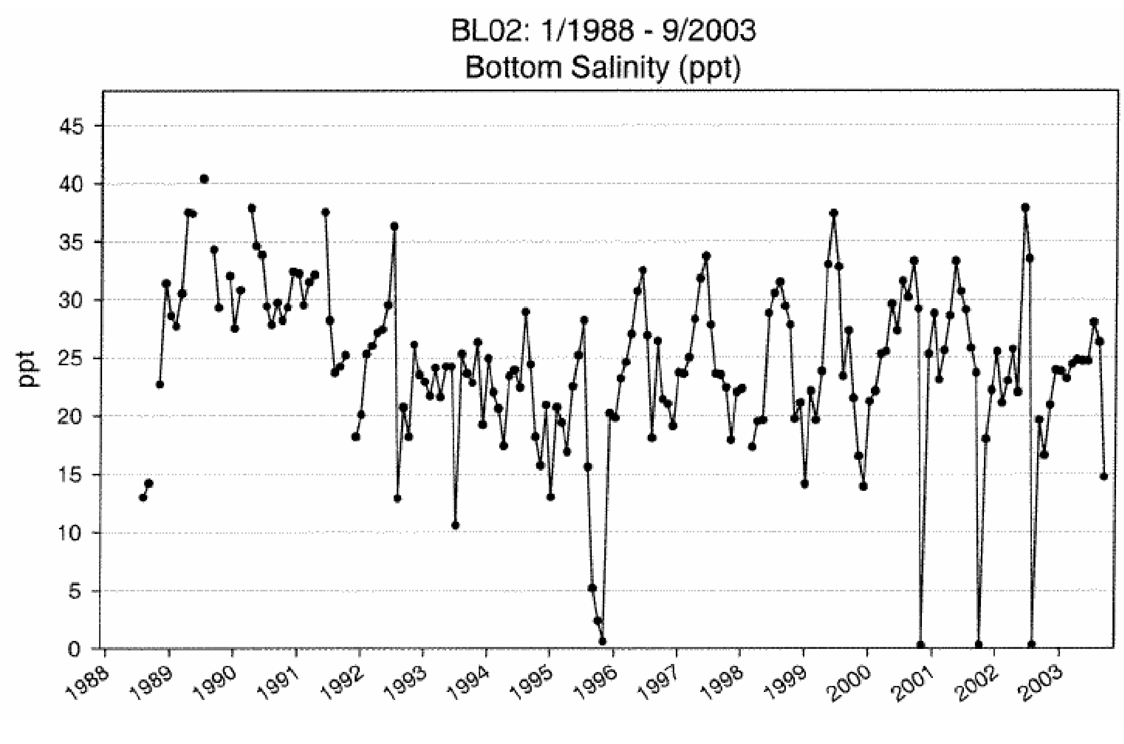
BL02: 1/1988 - 9/2003
Bottom Salinity (ppt)
ppt
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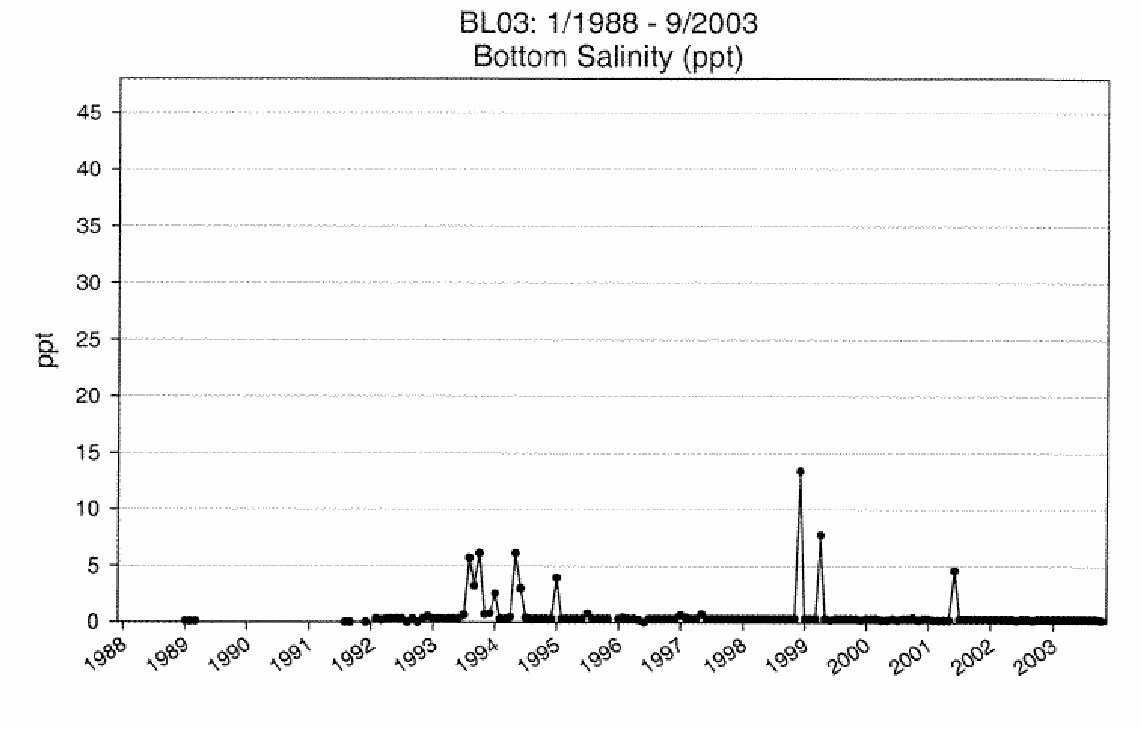
BL03: 1/1988 - 9/2003
Bottom Salinity (ppt)
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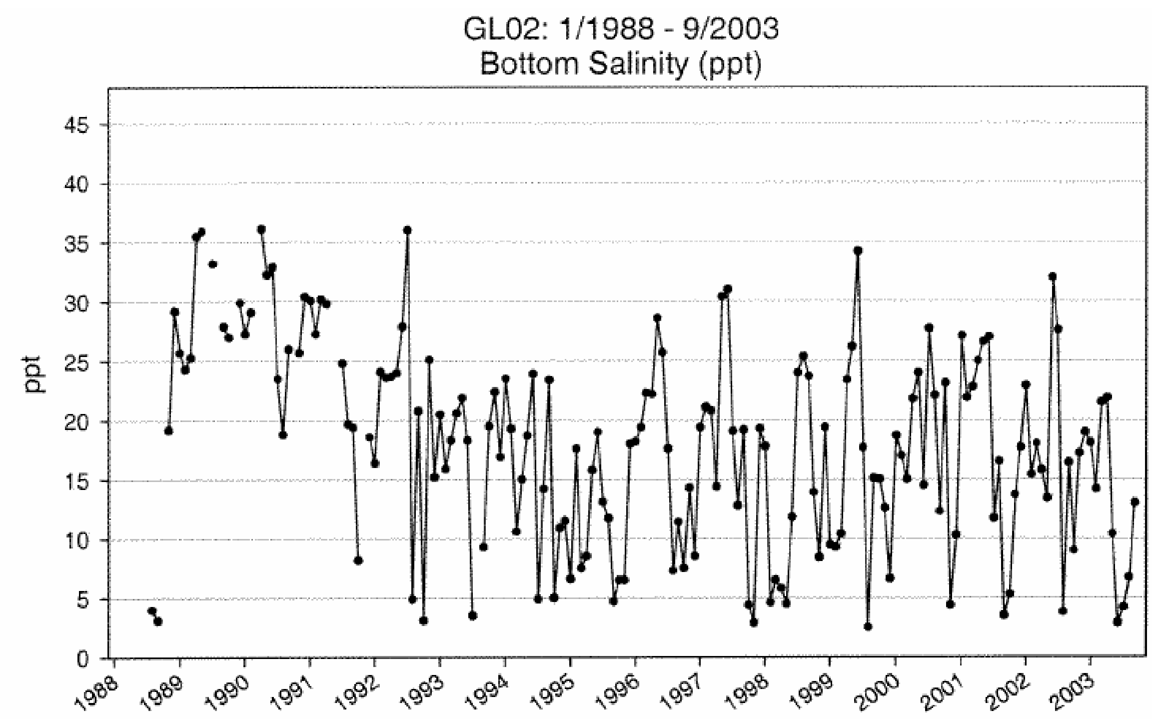
GL02: 1/1988 - 9/2003
Bottom Salinity (ppt)
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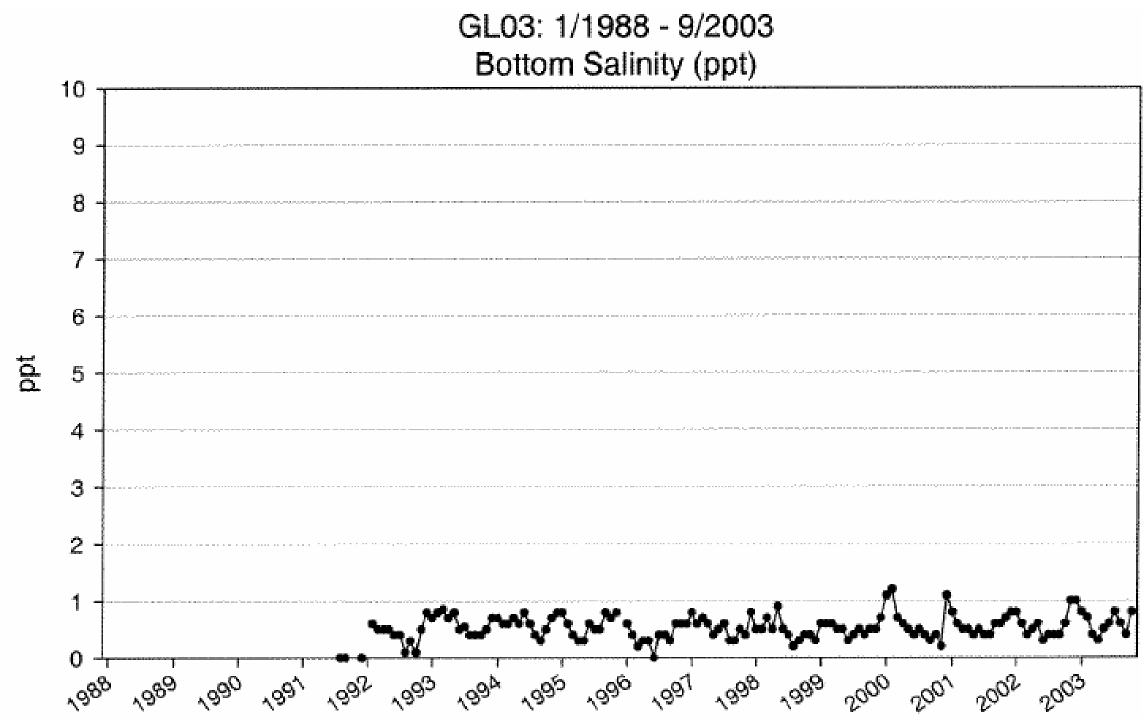
GL03: 1/1988 - 9/2003
Bottom Salinity (ppt)
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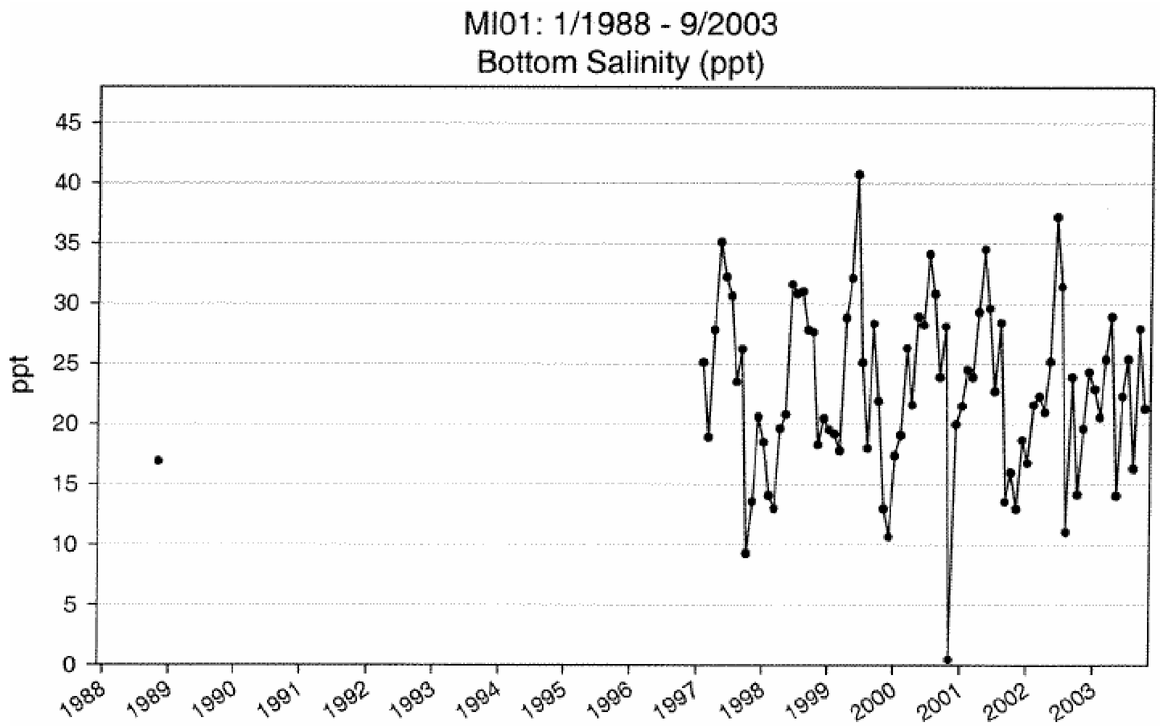
MI01: 1/1988 - 9/2003
Bottom Salinity (ppt)
ppt
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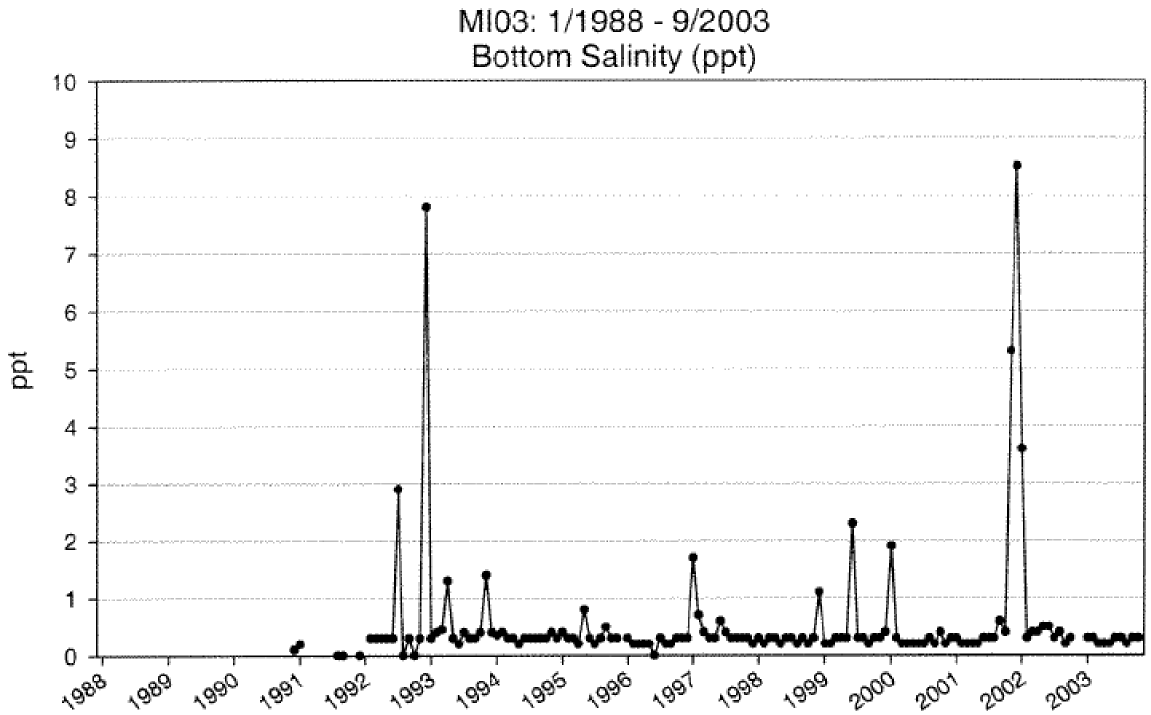
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Bottom Salinity (ppt)
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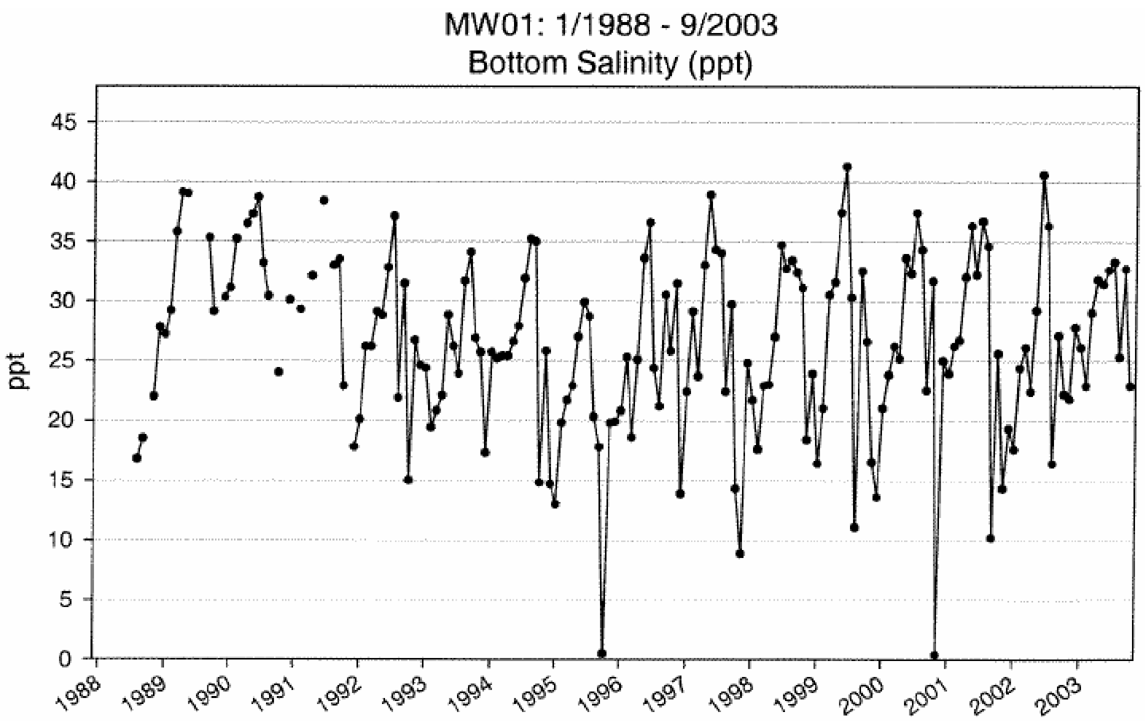
MW01: 1/1988 - 9/2003
Bottom Salinity (ppt)
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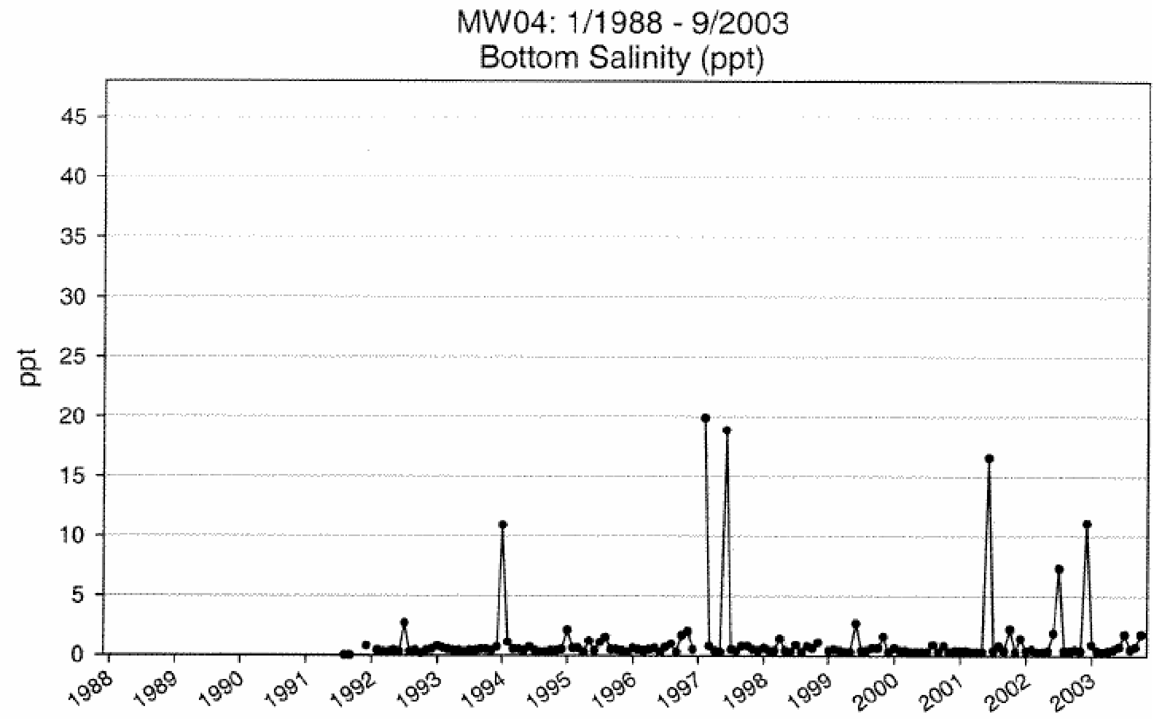
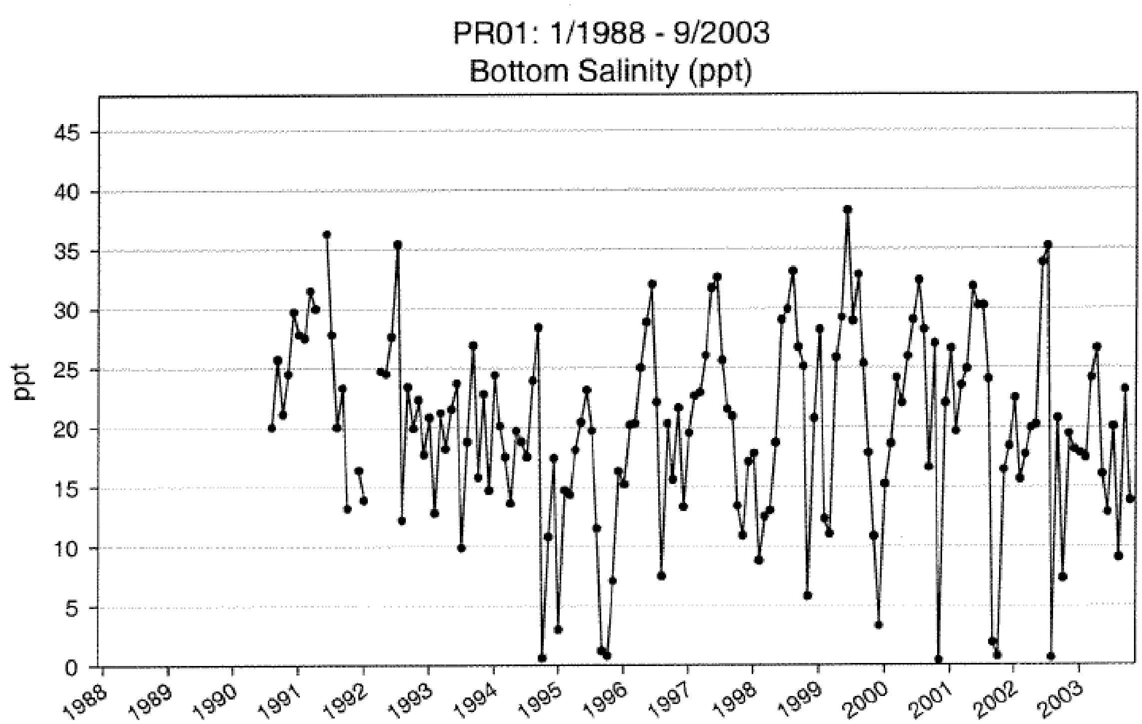
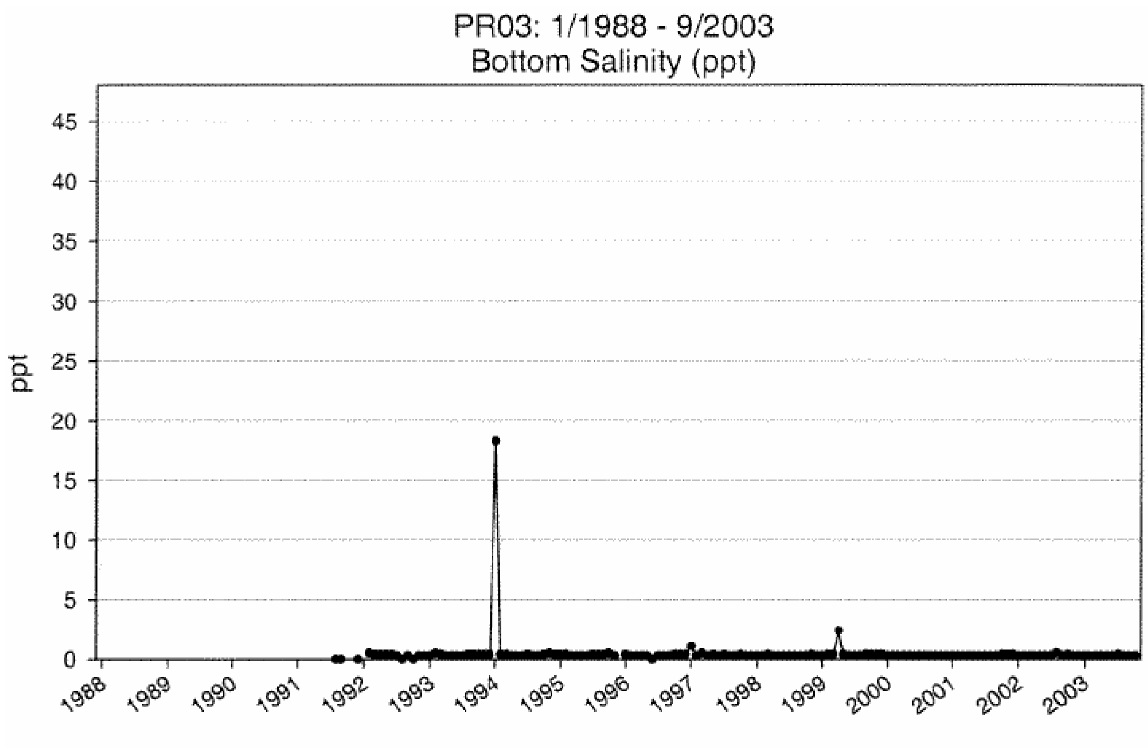
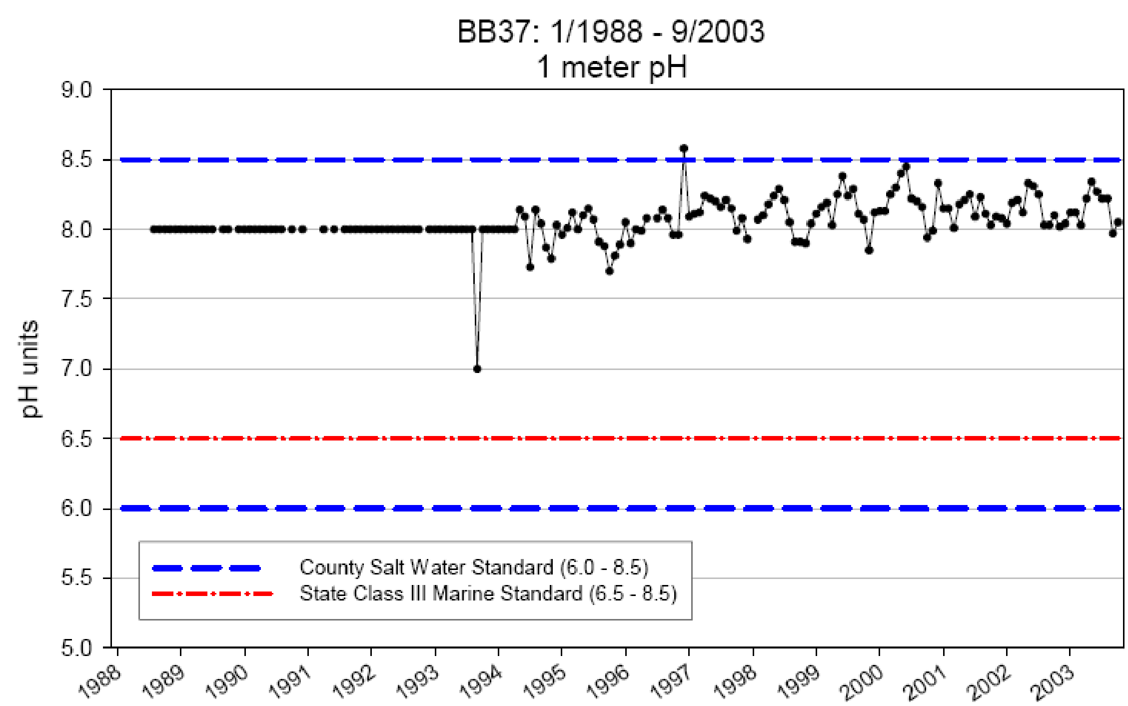
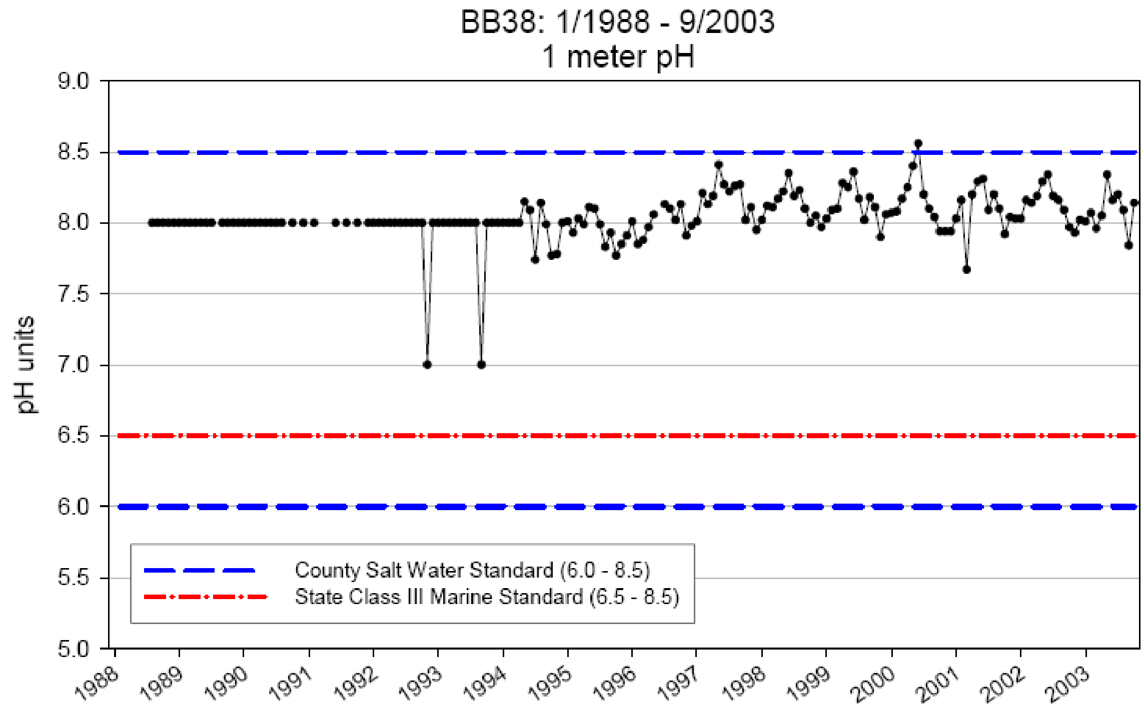
2002
2003


MW04: 1/1988 - 9/2003
Bottom Salinity (ppt)
ppt
0
5
10
15
20
25
30
35
40
45
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


PR01: 1/1988 - 9/2003
Bottom Salinity (ppt)
ppt
0
5
10
15
20
25
30
35
40
45
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


PR03: 1/1988 - 9/2003
Bottom Salinity (ppt)
ppt
45
40
35
30
25
20
15
10
5
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB37: 1/1988 - 9/2003
1 meter pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB38: 1/1988 - 9/2003
1 meter pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
1989
1990
1991
1992
1993
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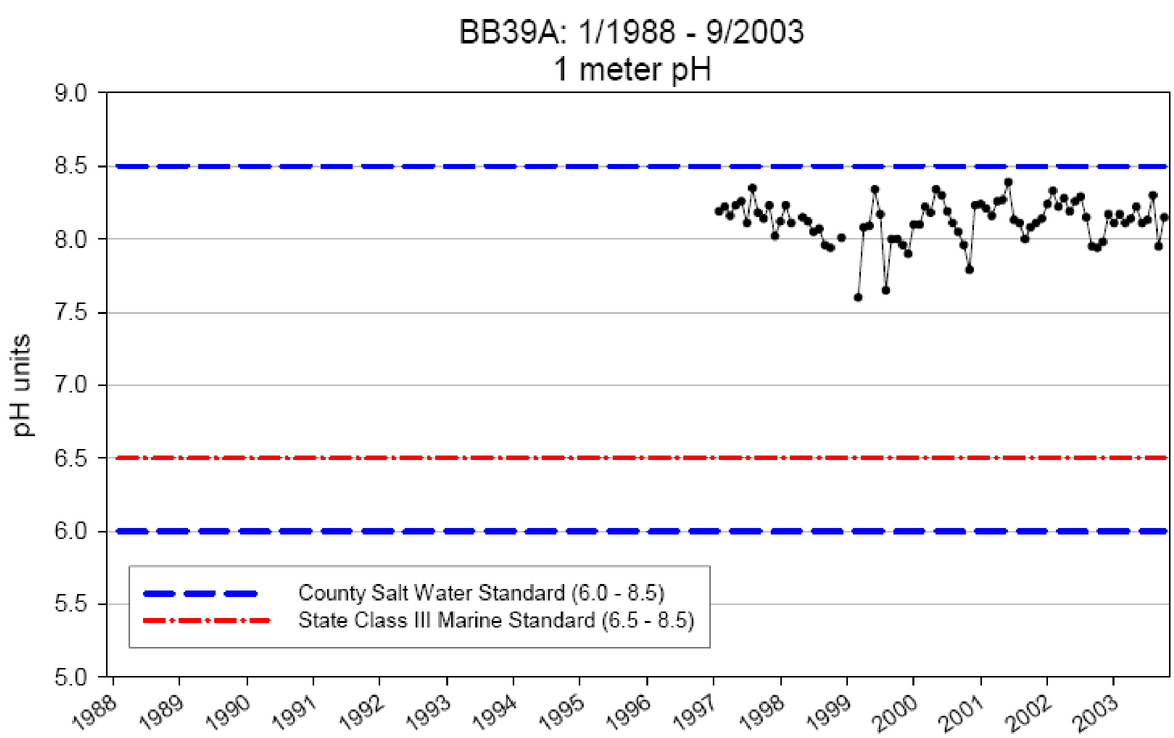
1997
1998
1999
2000
2001
2002
2003


BB39A: 1/1988 - 9/2003
1 meter pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
1989
1990
1991
1992
1993
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1996
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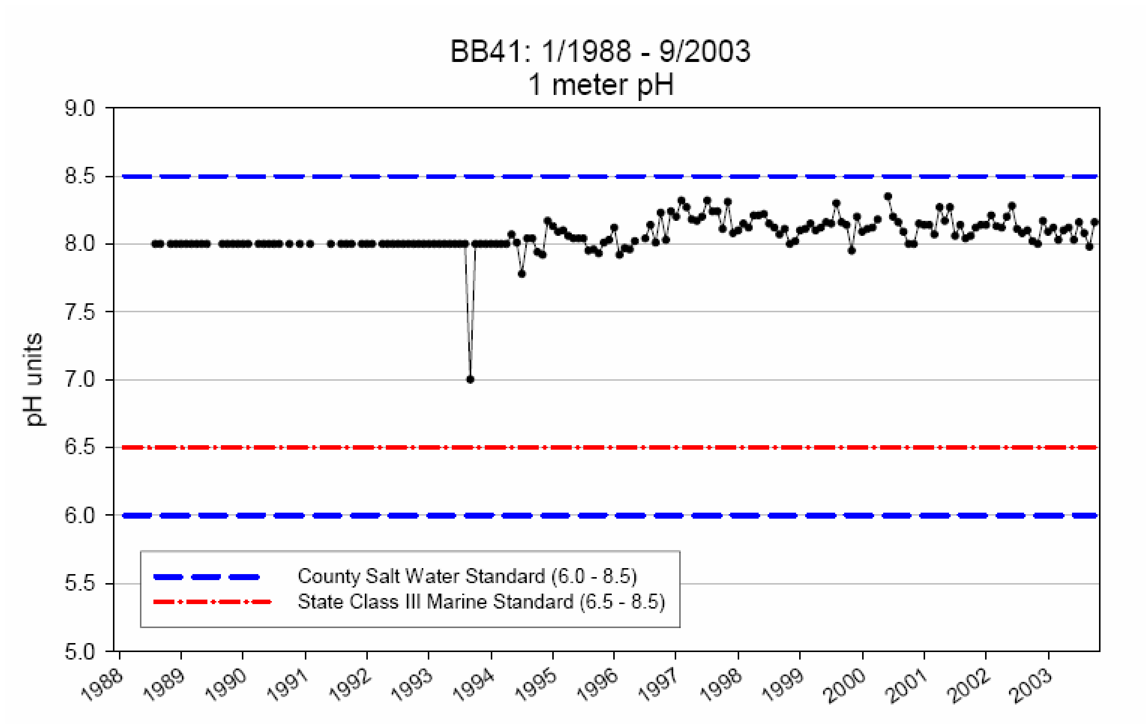
2001
2002
2003


BB41: 1/1988 - 9/2003
1 meter pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
1989
1990
1991
1992
1993
1994
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1996
1997
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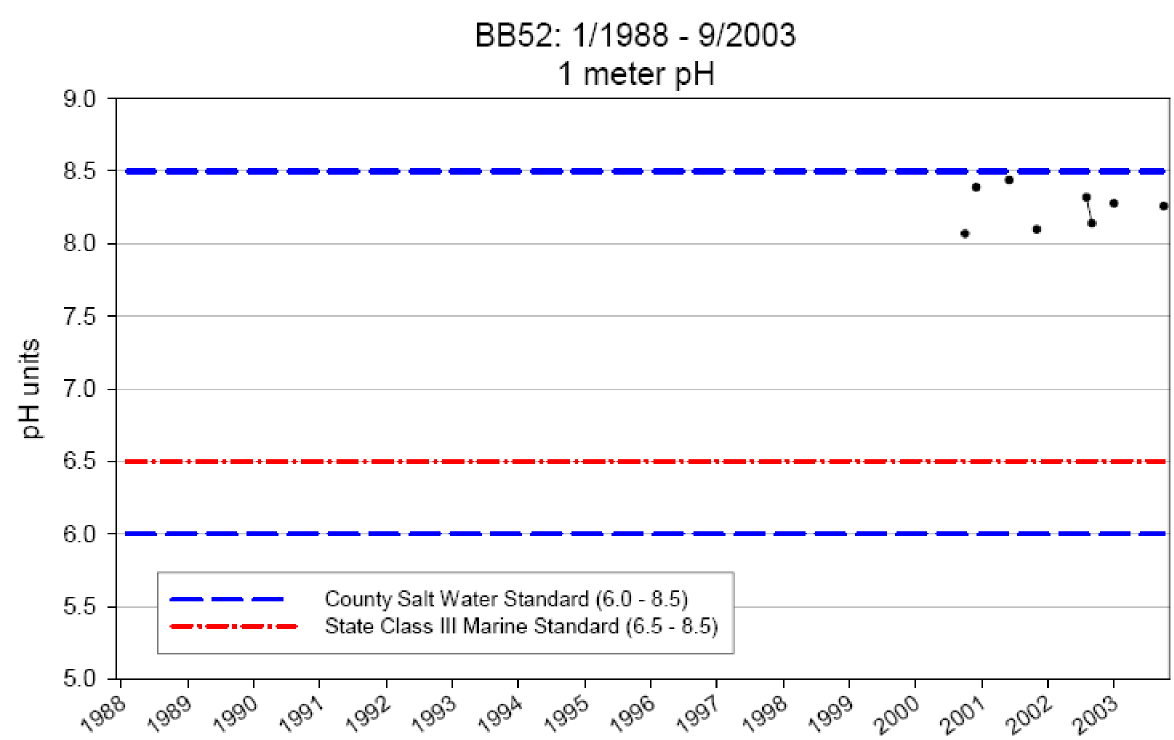
1999
2000
2001
2002
2003


BB52: 1/1988 - 9/2003
1 meter pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
1989
1990
1991
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1999
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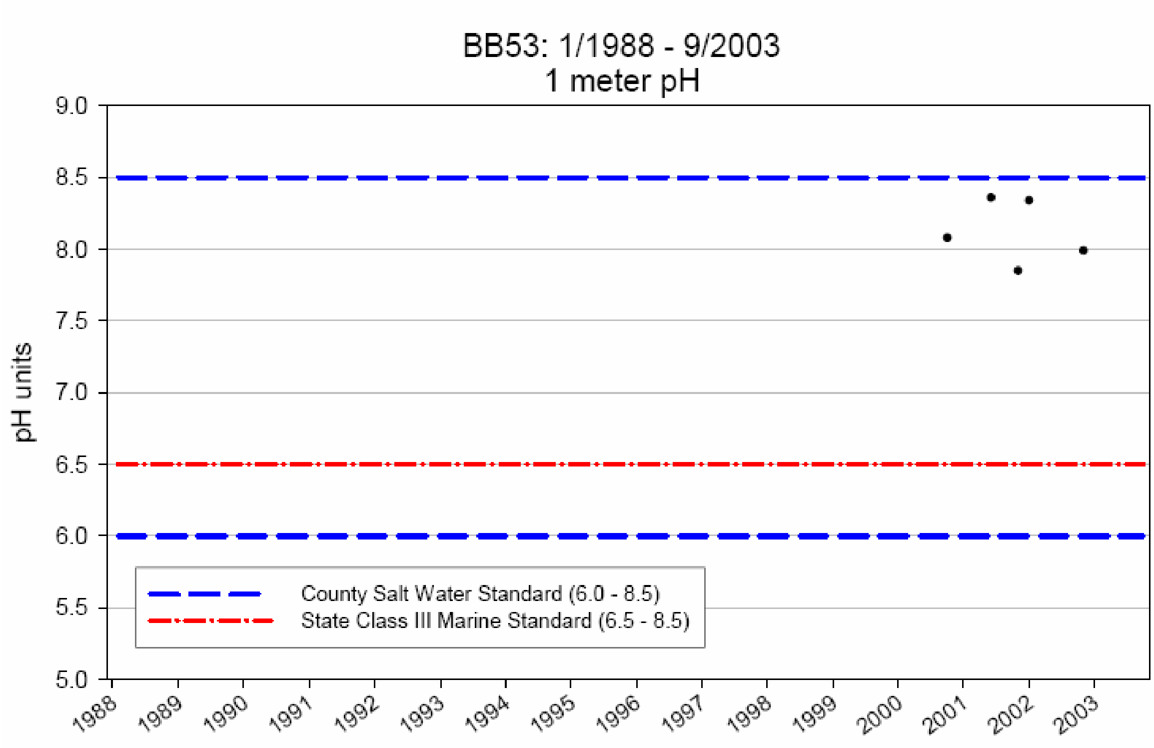
2001
2002
2003


BB53: 1/1988 - 9/2003
1 meter pH
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
pH units
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
1989
1990
1991
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1993
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1997
1998
1999
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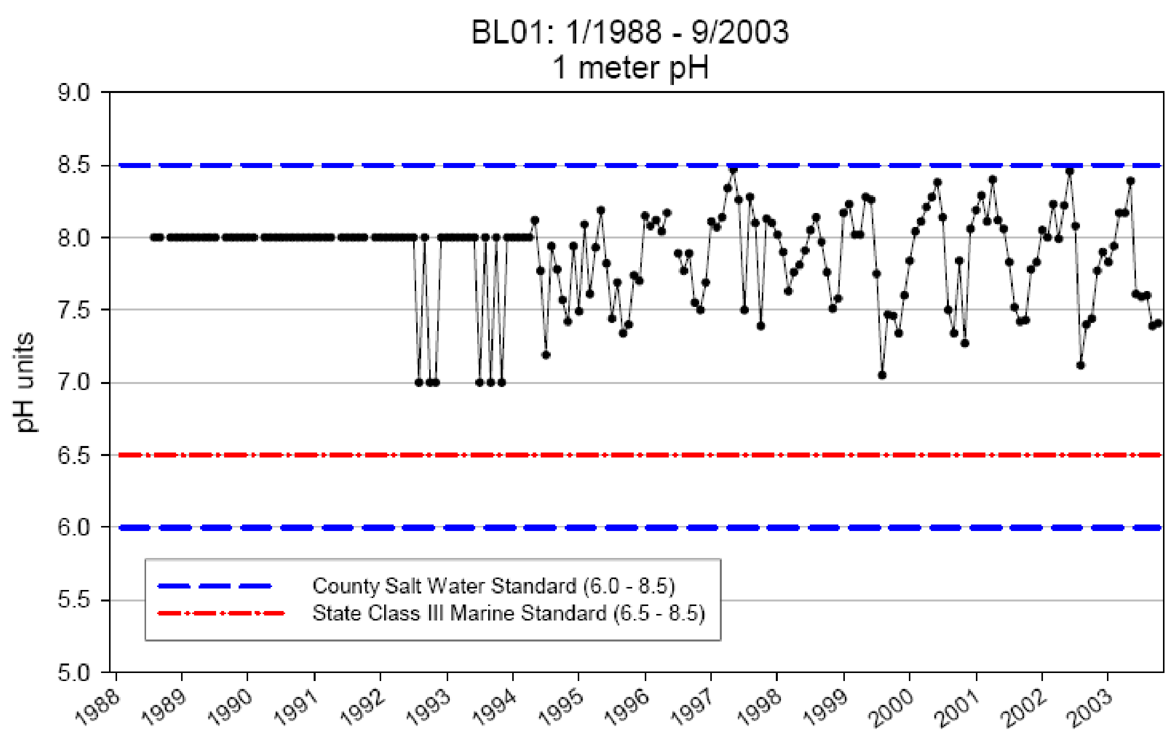
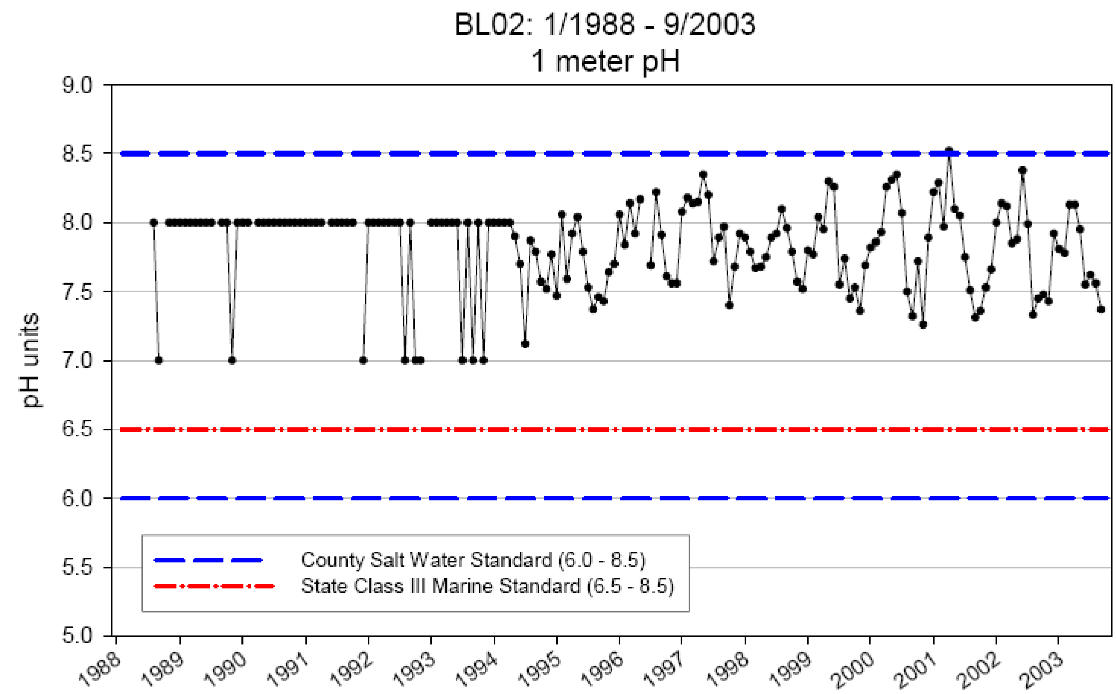
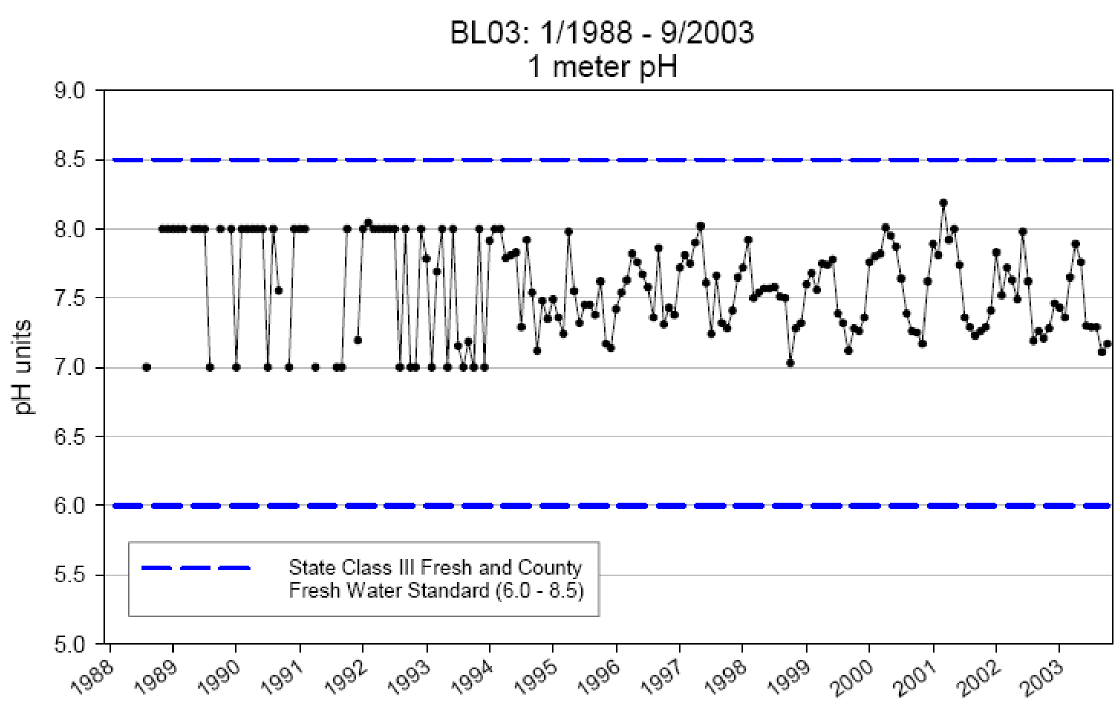
2001
2002
2003


BL01: 1/1988 - 9/2003
1 meter pH
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
pH units
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003



BL02: 1/1988 - 9/2003
1 meter pH
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
pH units
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003



BL03: 1/1988 - 9/2003
1 meter pH
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
pH units
State Class III Fresh and County
Fresh Water Standard (6.0 - 8.5)
1988
1989
1990
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1992
1993
1994
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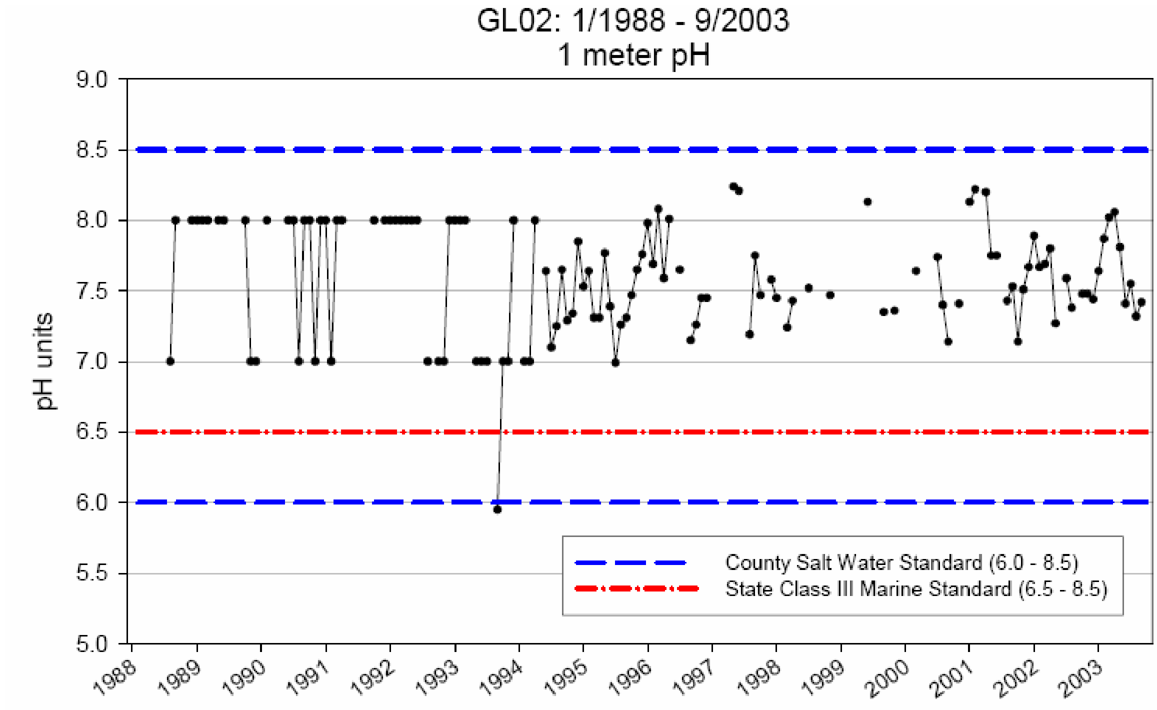
1996
1997
1998
1999
2000
2001
2002
2003



GL02: 1/1988 - 9/2003
1 meter pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
1988
1989
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1992
1993
1994
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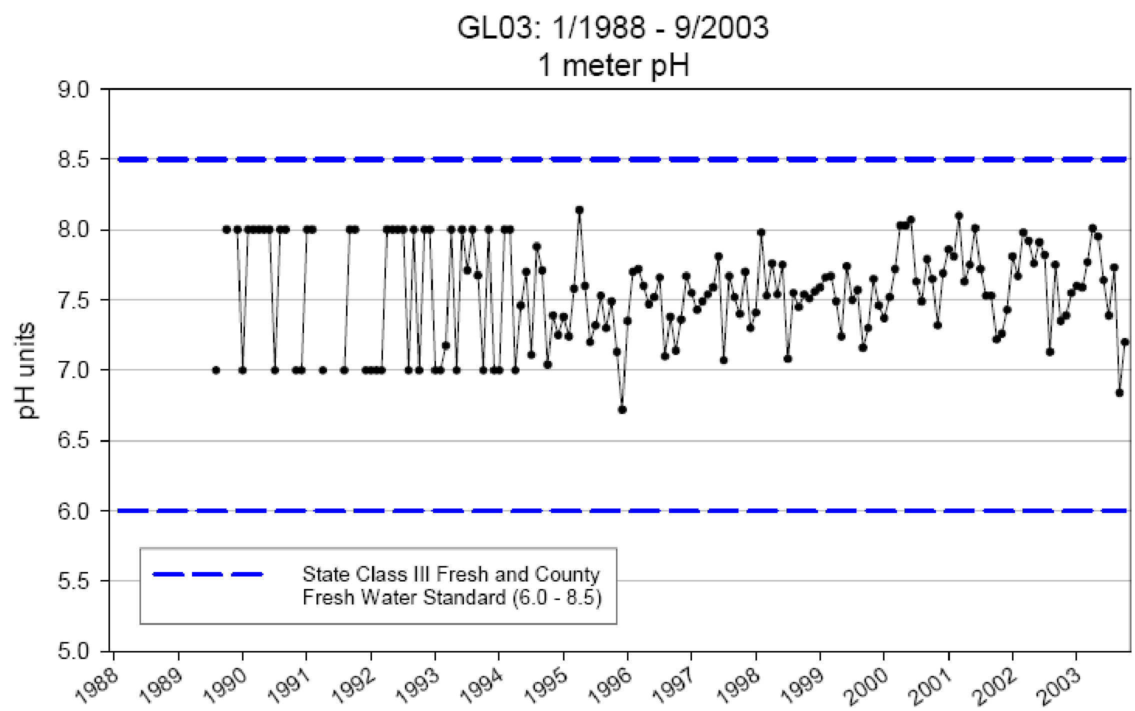
1996
1997
1998
1999
2000
2001
2002
2003
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)



GL03: 1/1988 - 9/2003
1 meter pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
1988
1989
1990
1991
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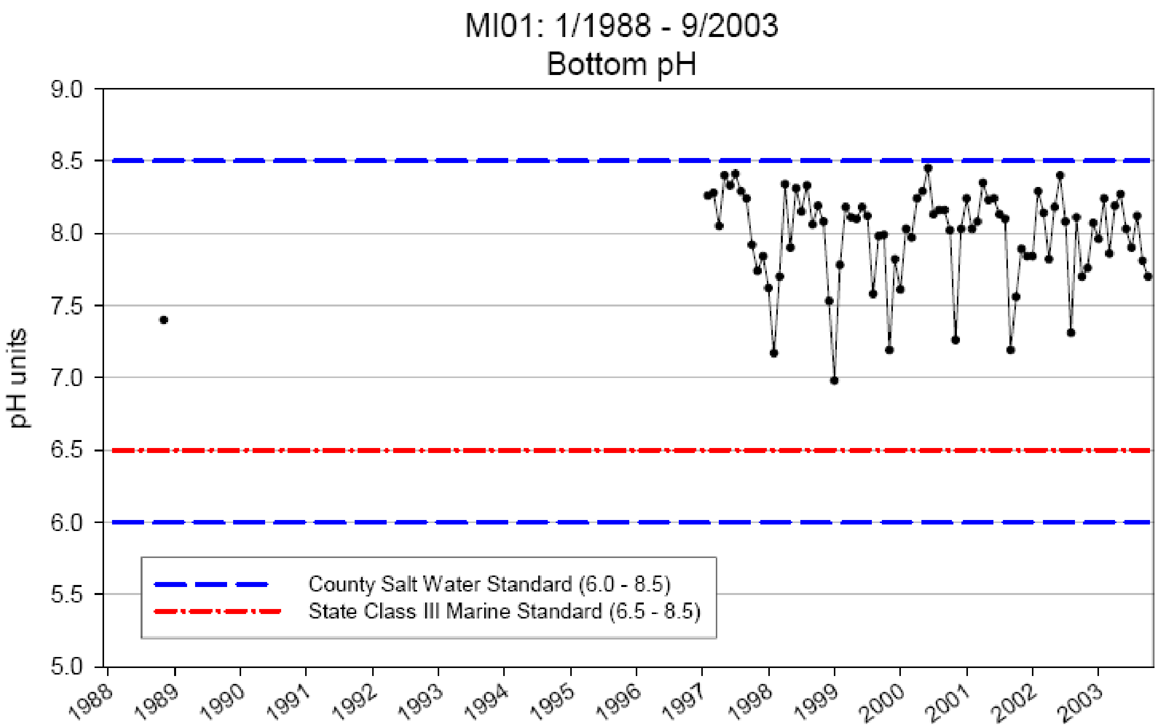
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
State Class III Fresh and County
Fresh Water Standard (6.0 - 8.5)


MI01: 1/1988 - 9/2003
Bottom pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
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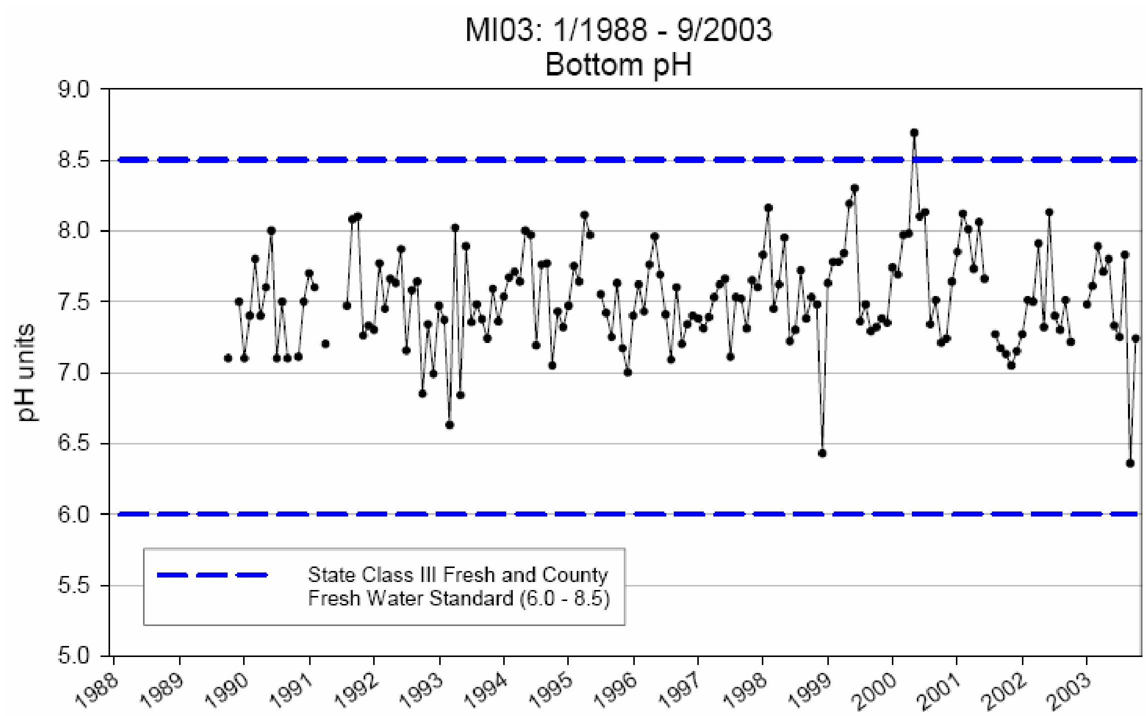
2001
2002
2003


MI03: 1/1988 - 9/2003
Bottom pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
State Class III Fresh and County
Fresh Water Standard (6.0 - 8.5)
1988
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1999
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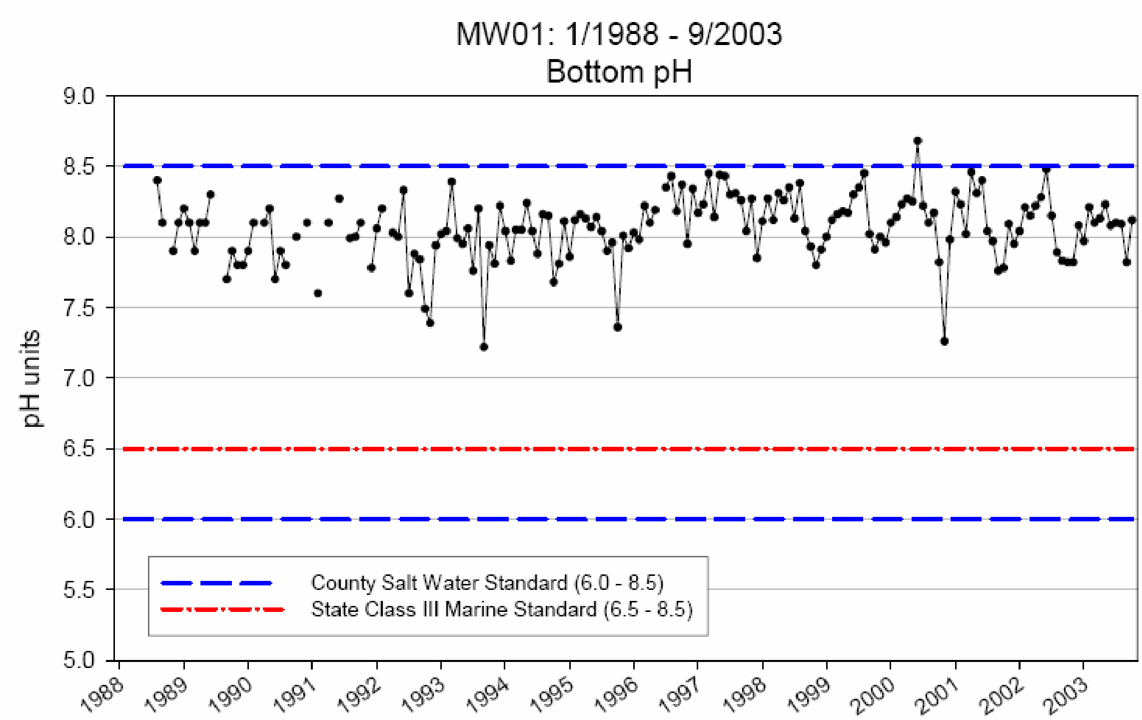
2001
2002
2003


MW01: 1/1988 - 9/2003
Bottom pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
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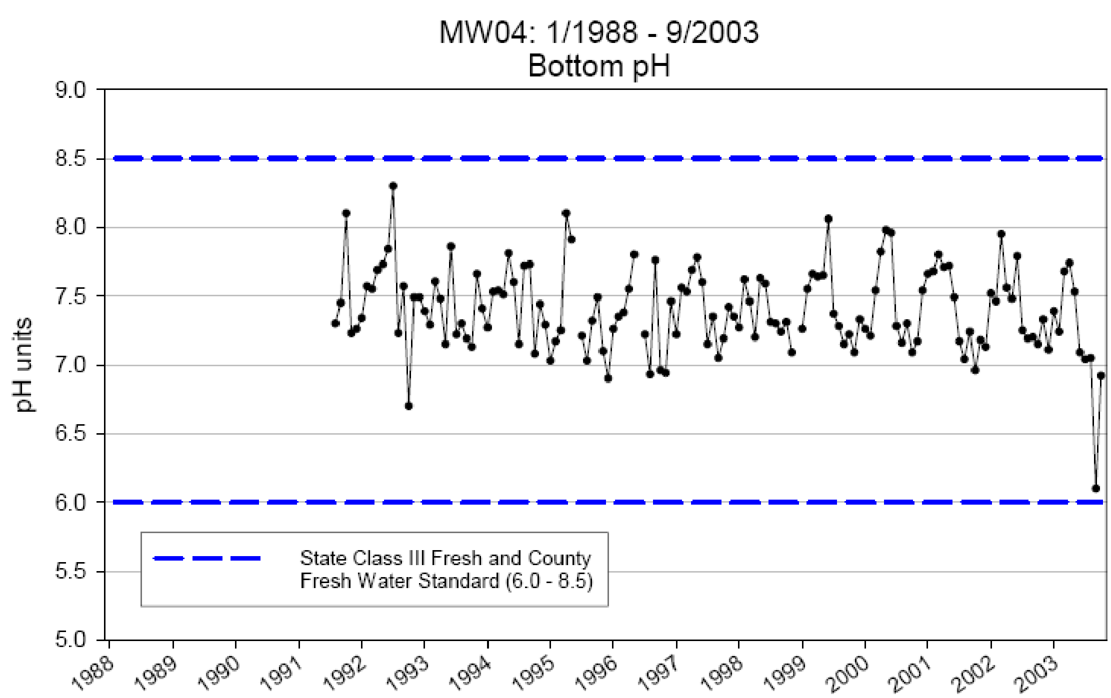
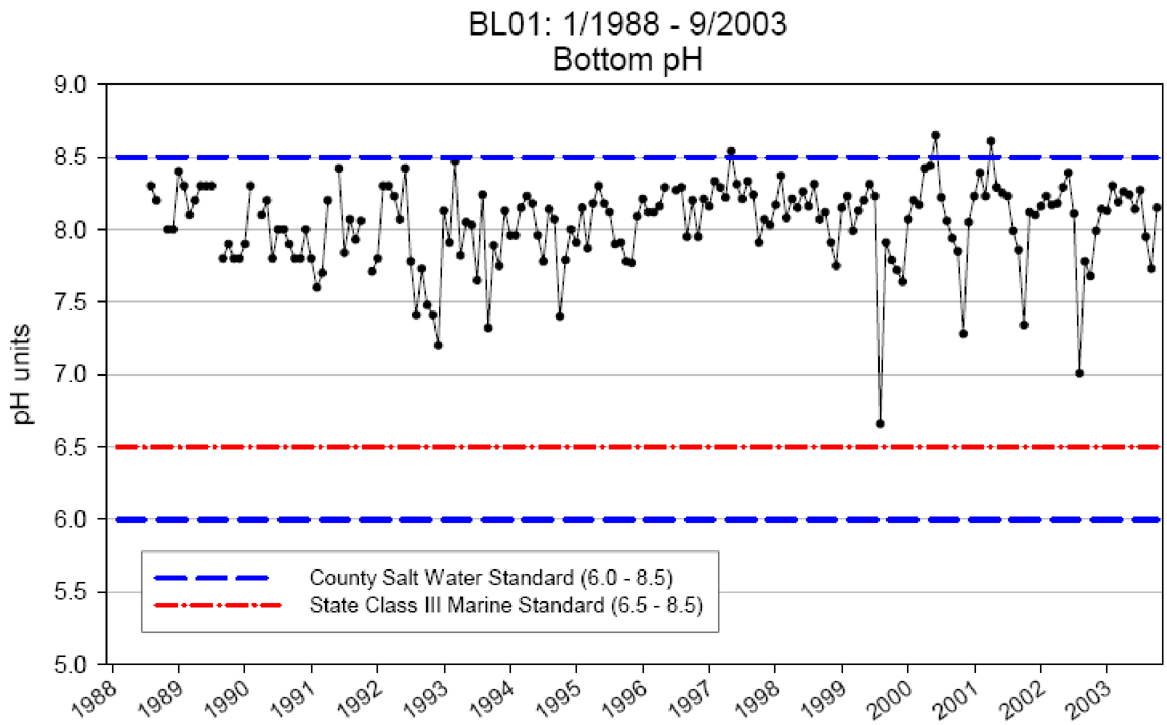
1999
2000
2001
2002
2003


MW04: 1/1988 - 9/2003
Bottom pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
State Class III Fresh and County
Fresh Water Standard (6.0 - 8.5)
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BL01: 1/1988 - 9/2003
Bottom pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
County Salt Water Standard (6.0 - 8.5)
State Class III Marine Standard (6.5 - 8.5)
1988
1989
1990
1991
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1993
1994
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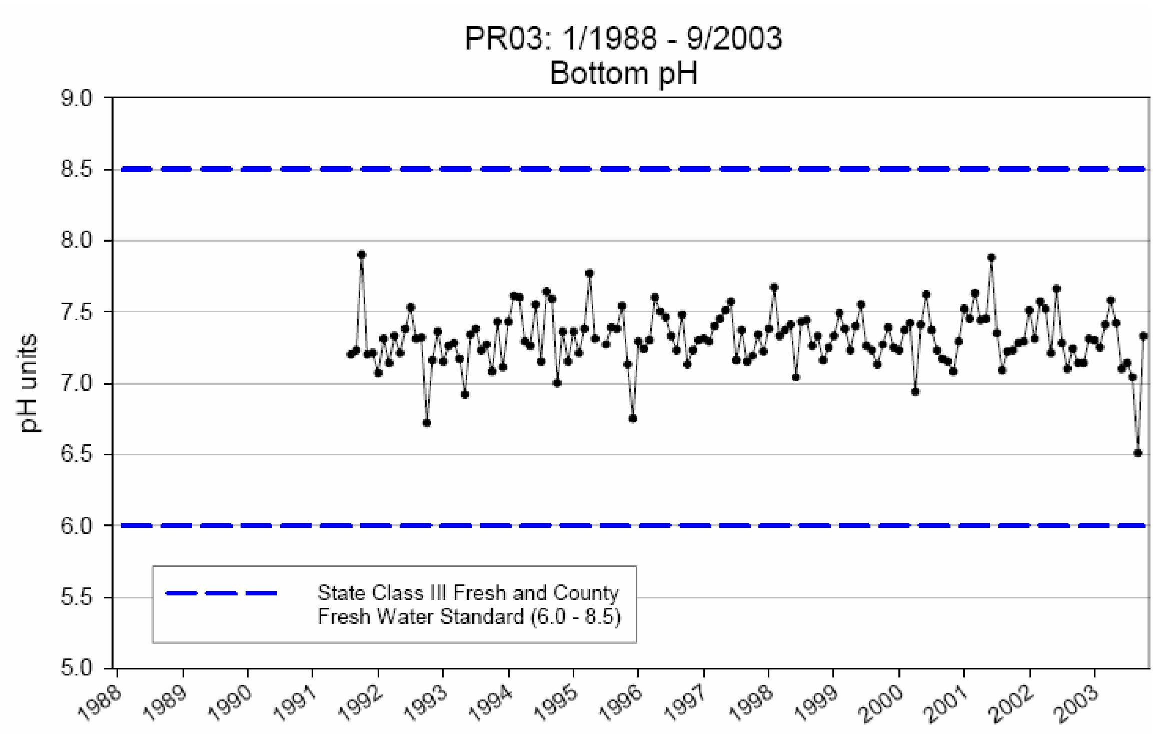
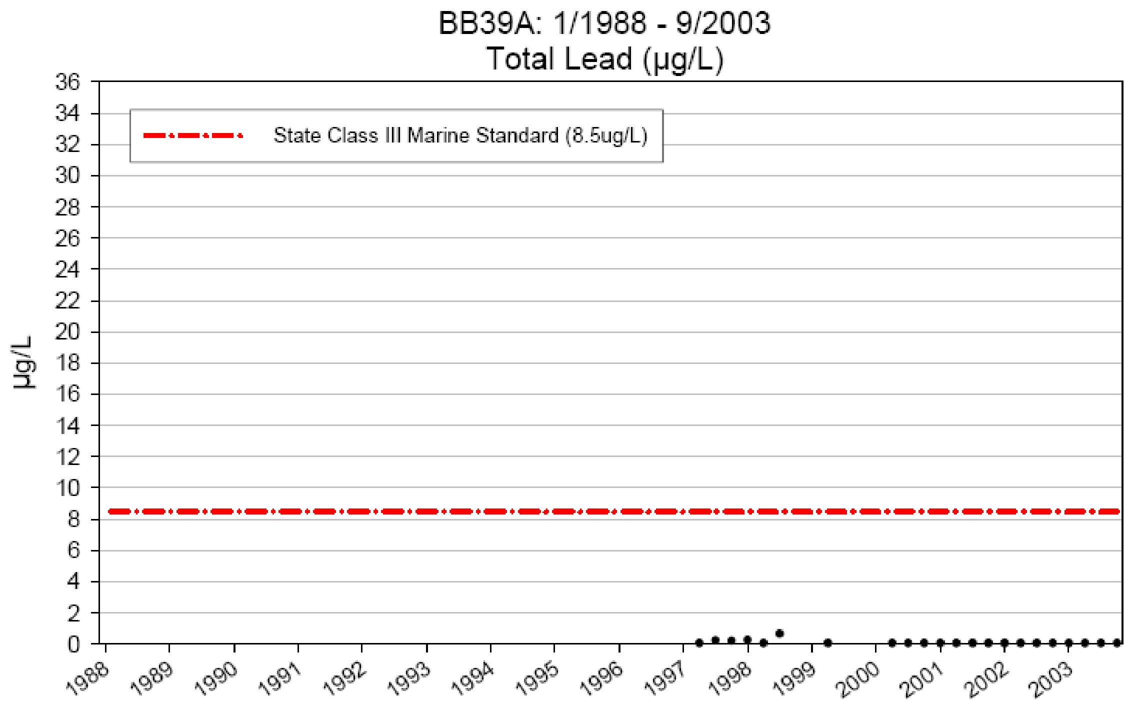
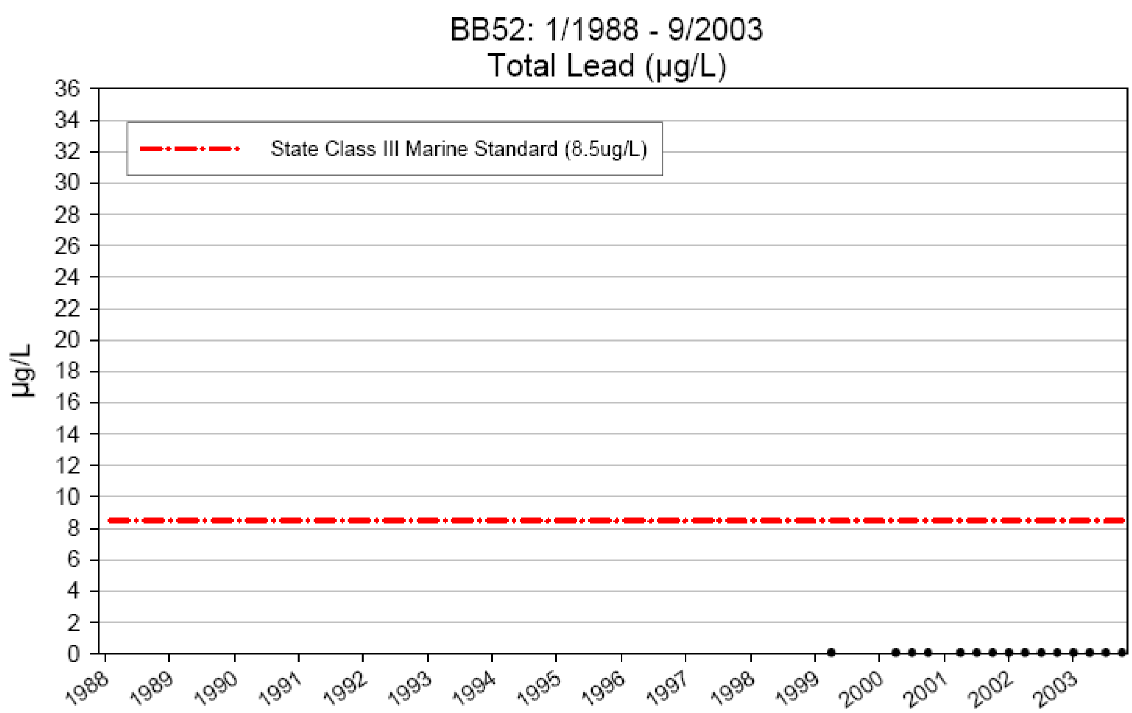
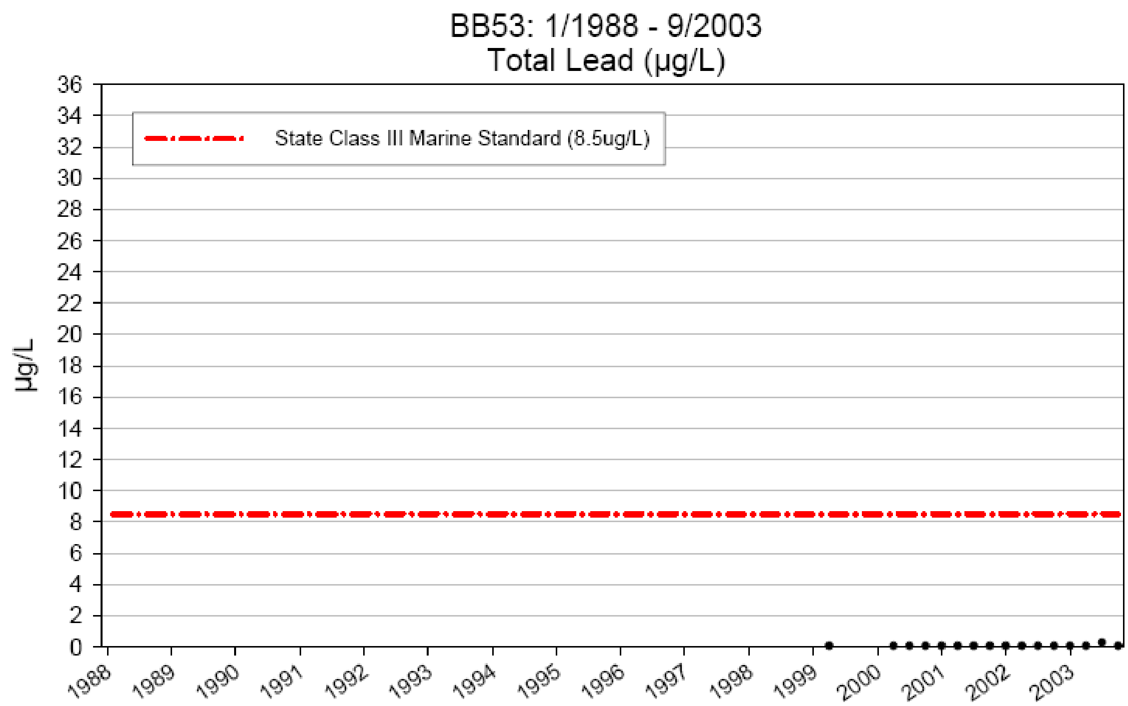
1996
1997
1998
1999
2000
2001
2002
2003

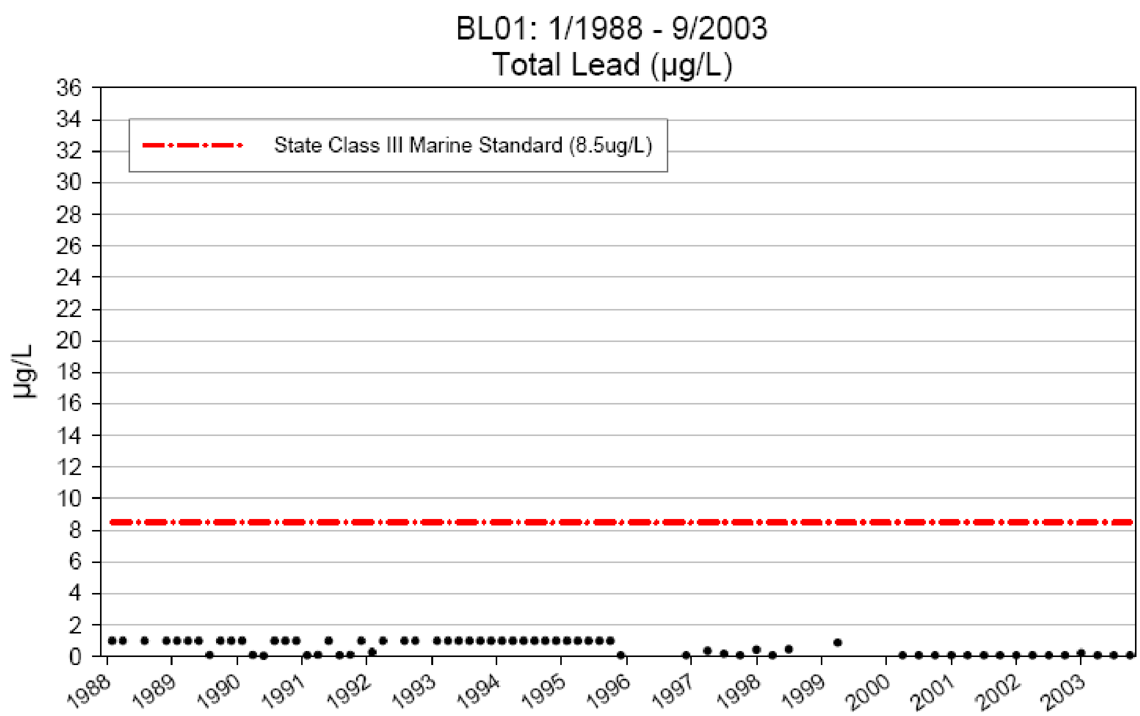

PR03: 1/1988 - 9/2003
Bottom pH
pH units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
State Class III Fresh and County
Fresh Water Standard (6.0 - 8.5)
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


BB39A: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Marine Standard (8.5ug/L)
µg/L
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

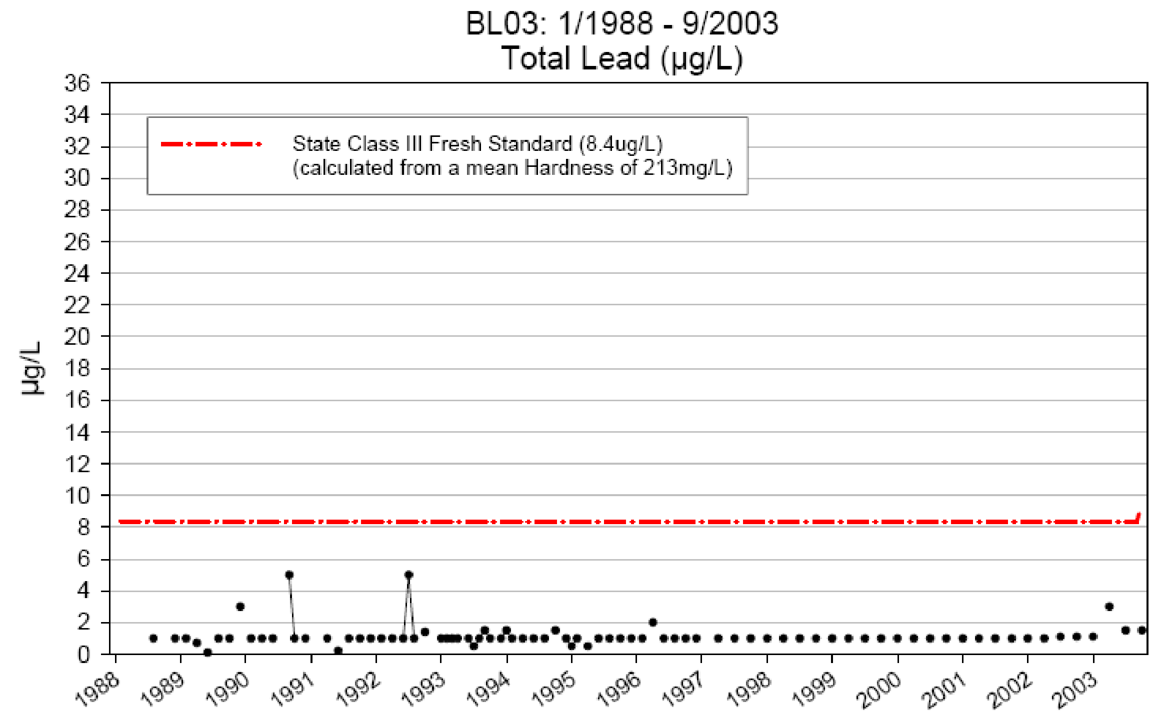

BB52: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Marine Standard (8.5ug/L)
µg/L
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

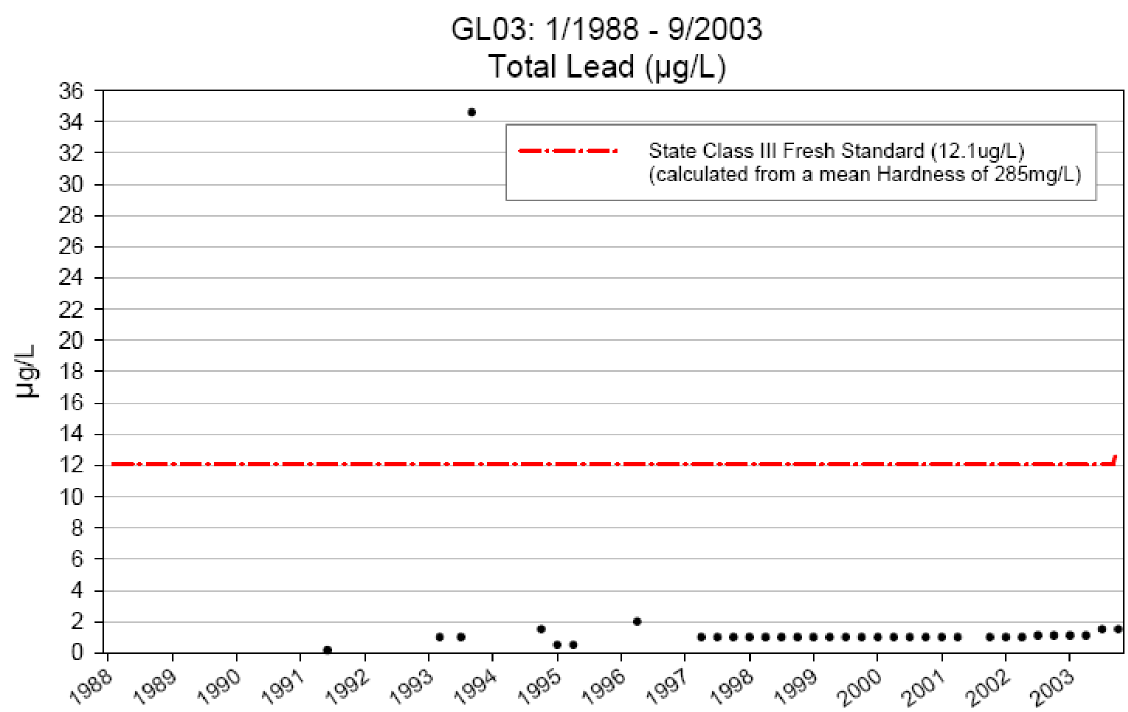


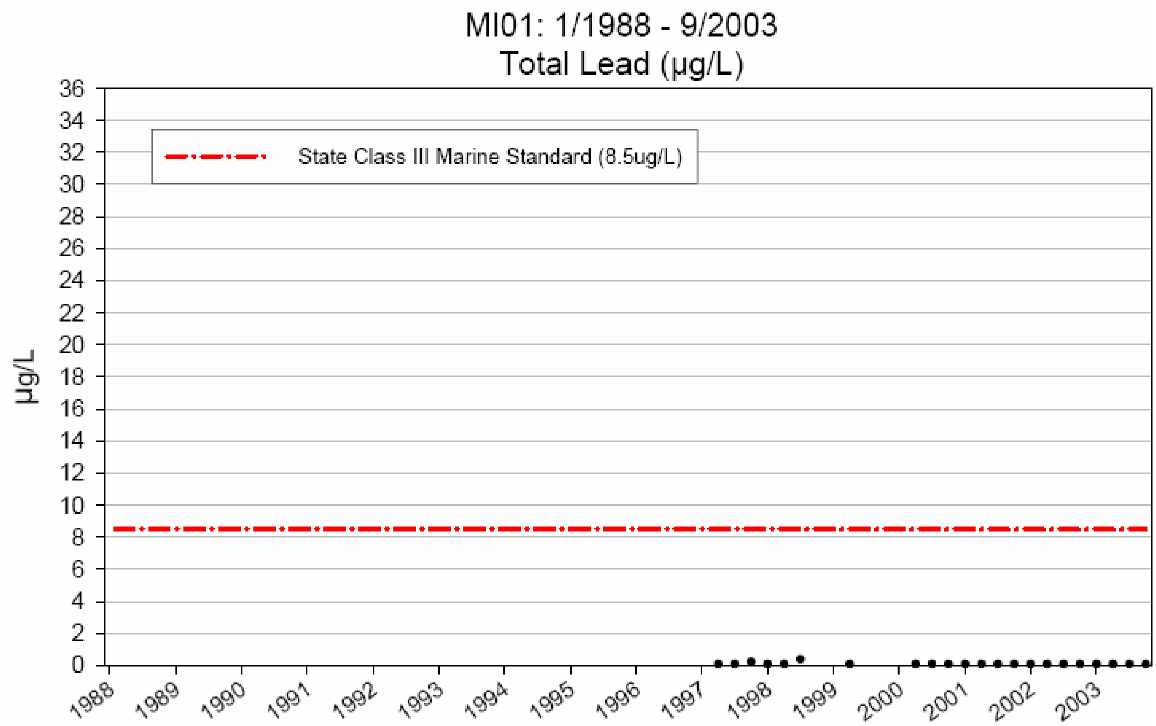
BB53: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Marine Standard (8.5ug/L)
µg/L
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

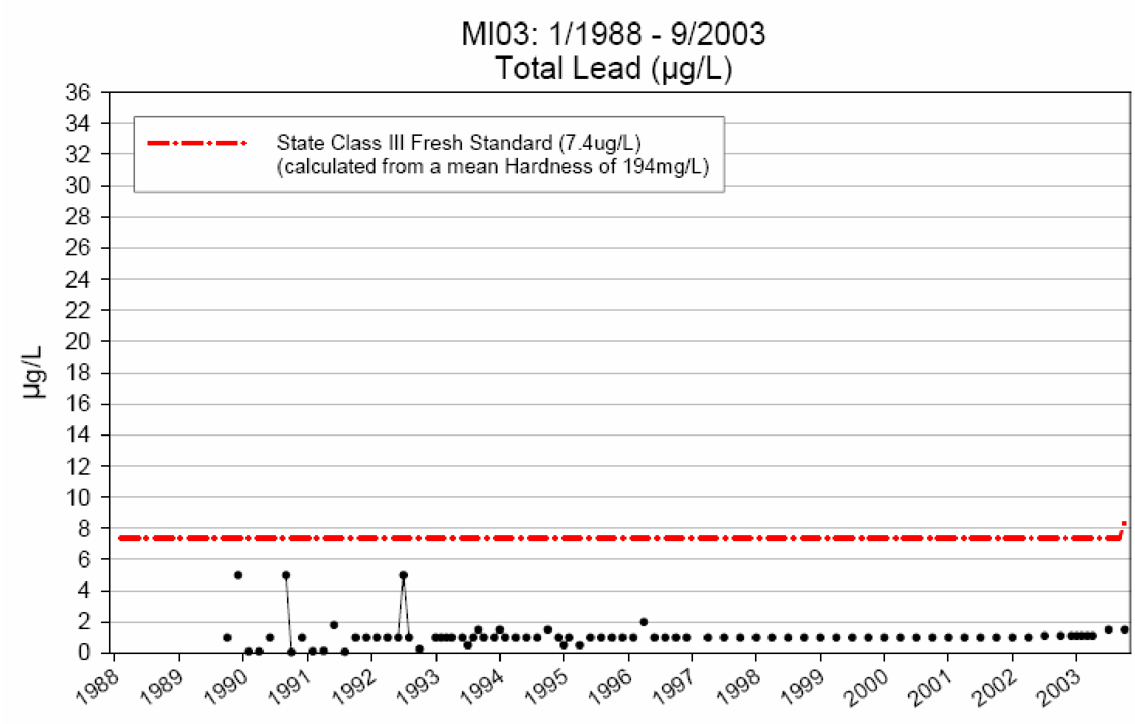


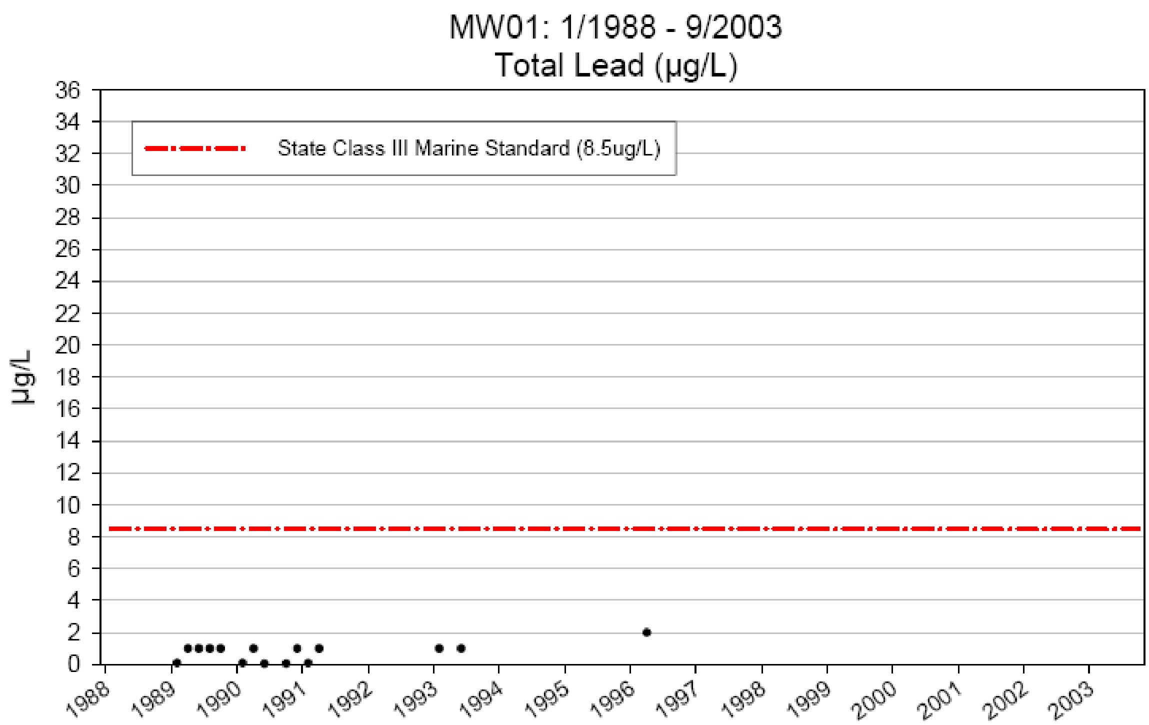
BL01: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Marine Standard (8.5ug/L)
µg/L
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

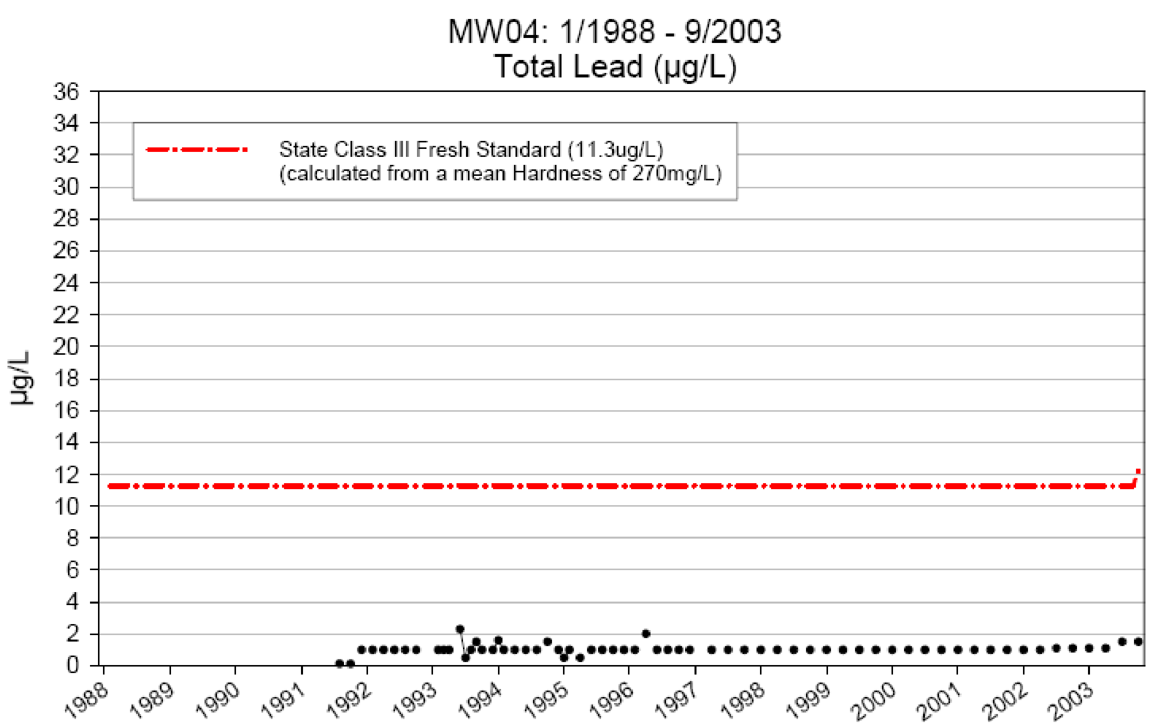

BL03: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Fresh Standard (8.4ug/L)
(calculated from a mean Hardness of 213mg/L)
µg/L
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

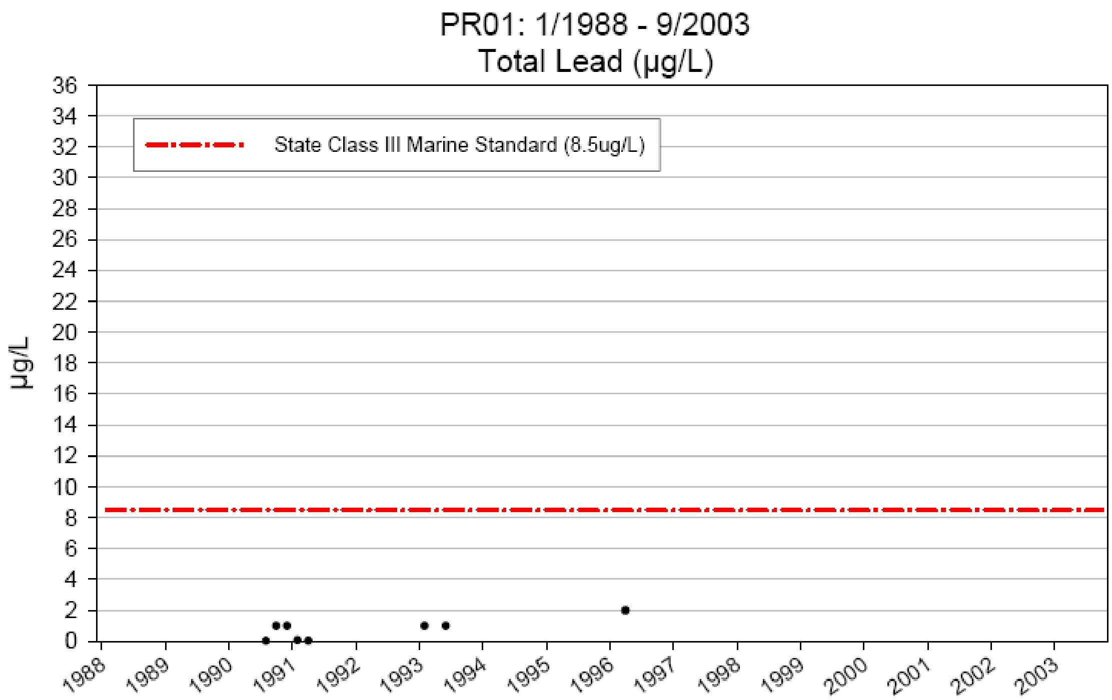

GL03: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Fresh Standard (12.1ug/L)
(calculated from a mean Hardness of 285mg/L)
µg/L
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MI01: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Marine Standard (8.5ug/L)
µg/L
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

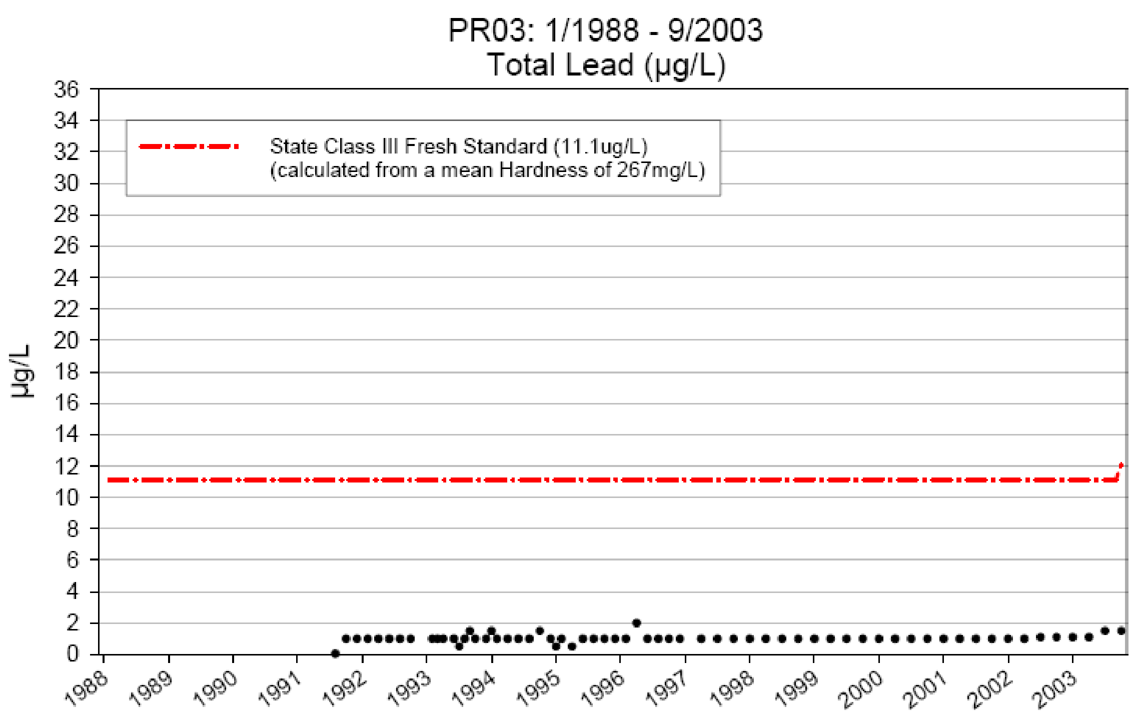

MI03: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Fresh Standard (7.4ug/L)
(calculated from a mean Hardness of 194mg/L)
µg/L
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MW01: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Marine Standard (8.5ug/L)
µg/L
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

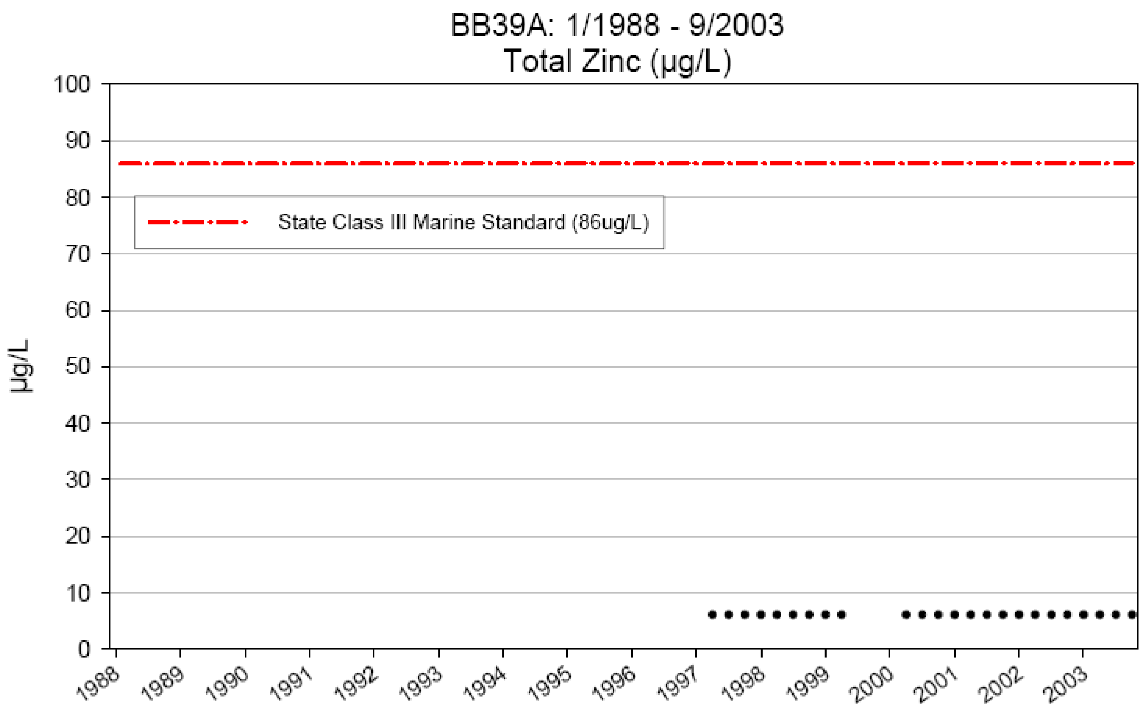

MW04: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Fresh Standard (11.3ug/L)
(calculated from a mean Hardness of 270mg/L)
µg/L
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003



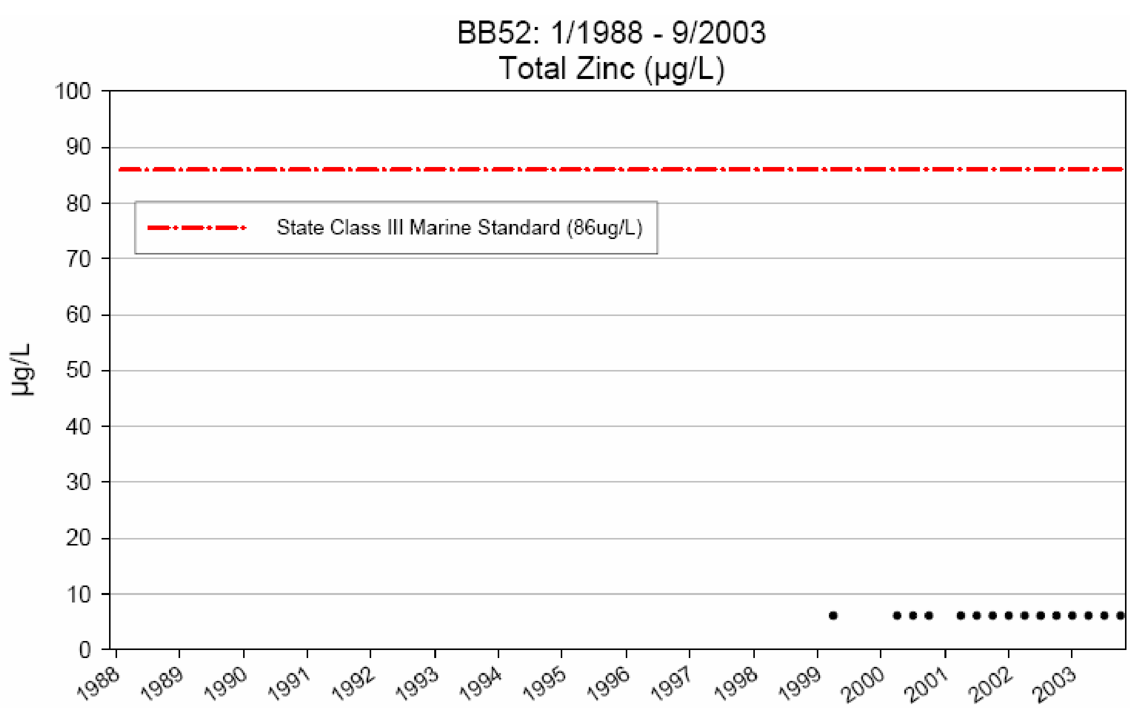
PR01: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Marine Standard (8.5ug/L)
µg/L
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003



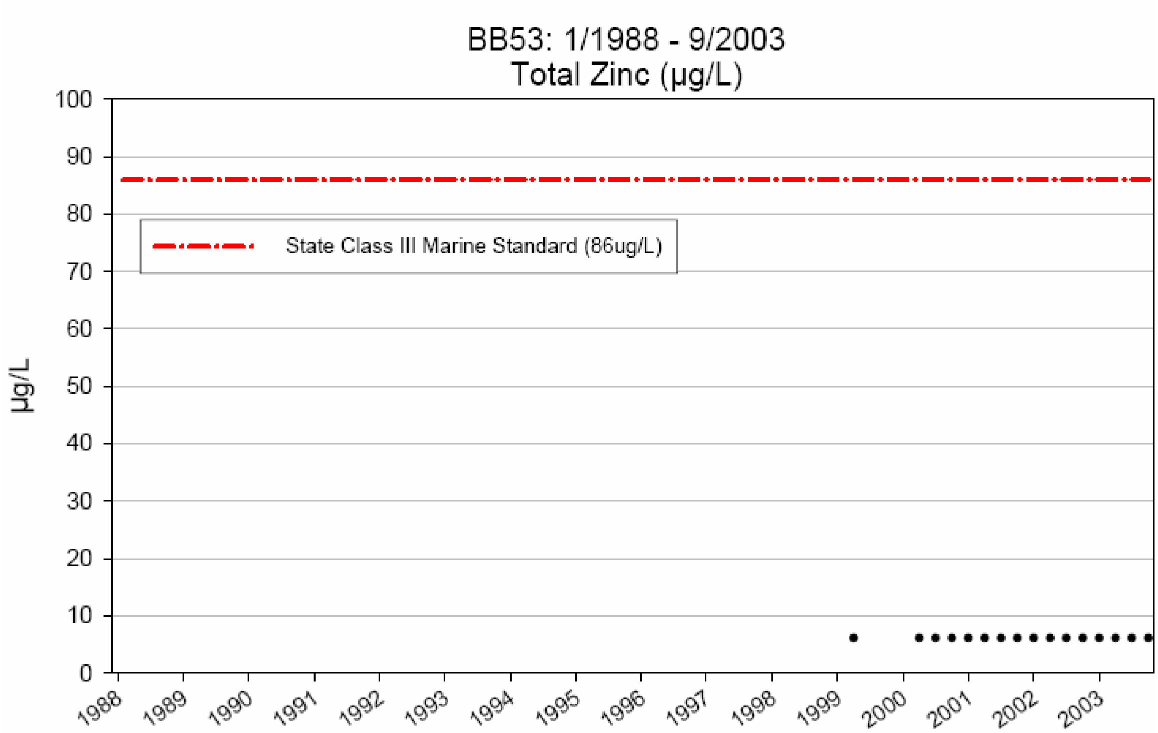
PR03: 1/1988 - 9/2003
Total Lead (µg/L)
State Class III Fresh Standard (11.1ug/L)
(calculated from a mean Hardness of 267mg/L)
µg/L
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

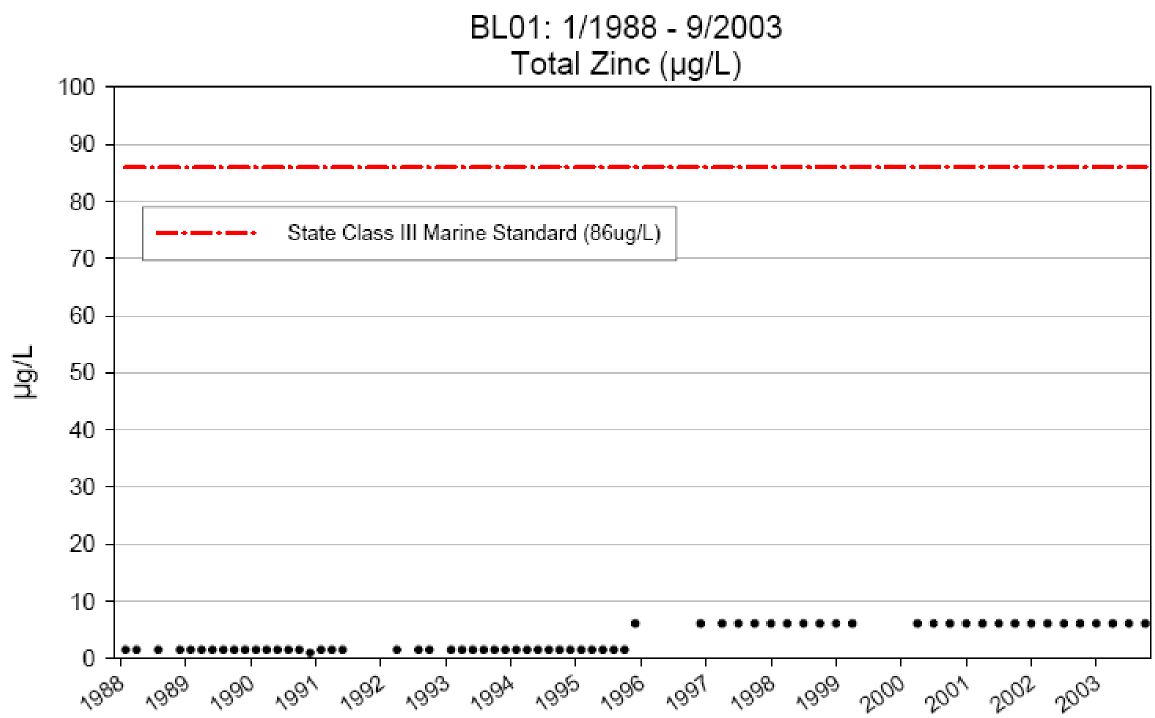


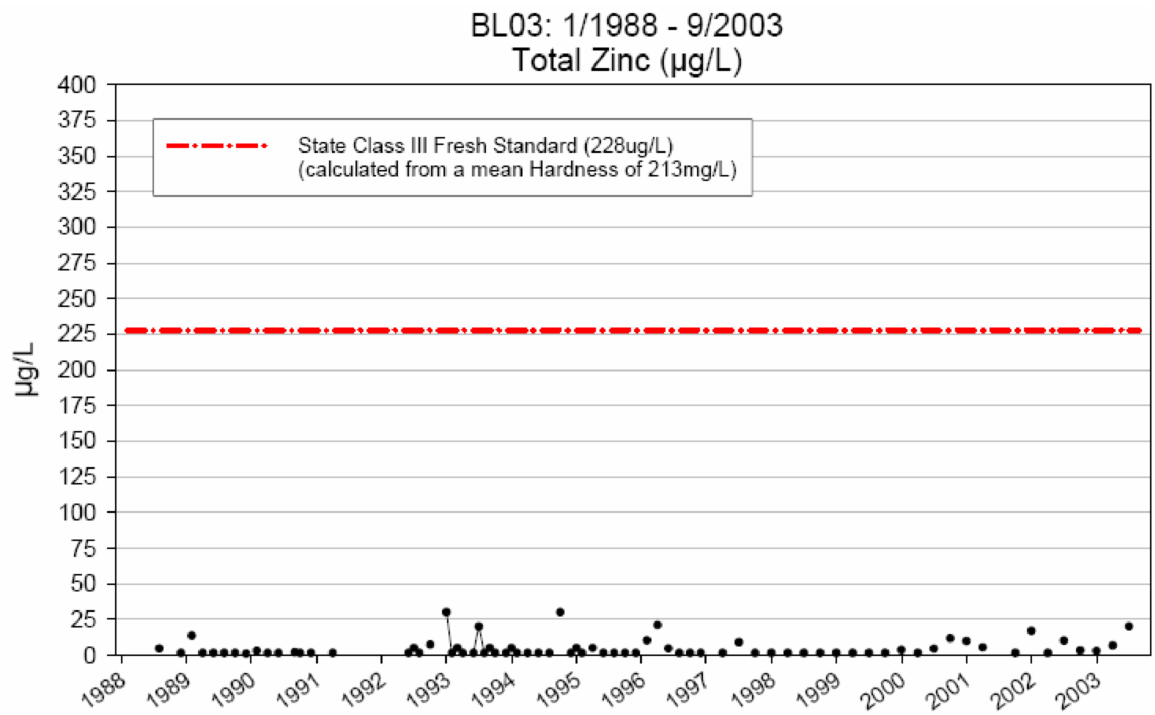
BB39A: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Marine Standard (86ug/L)
µg/L
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

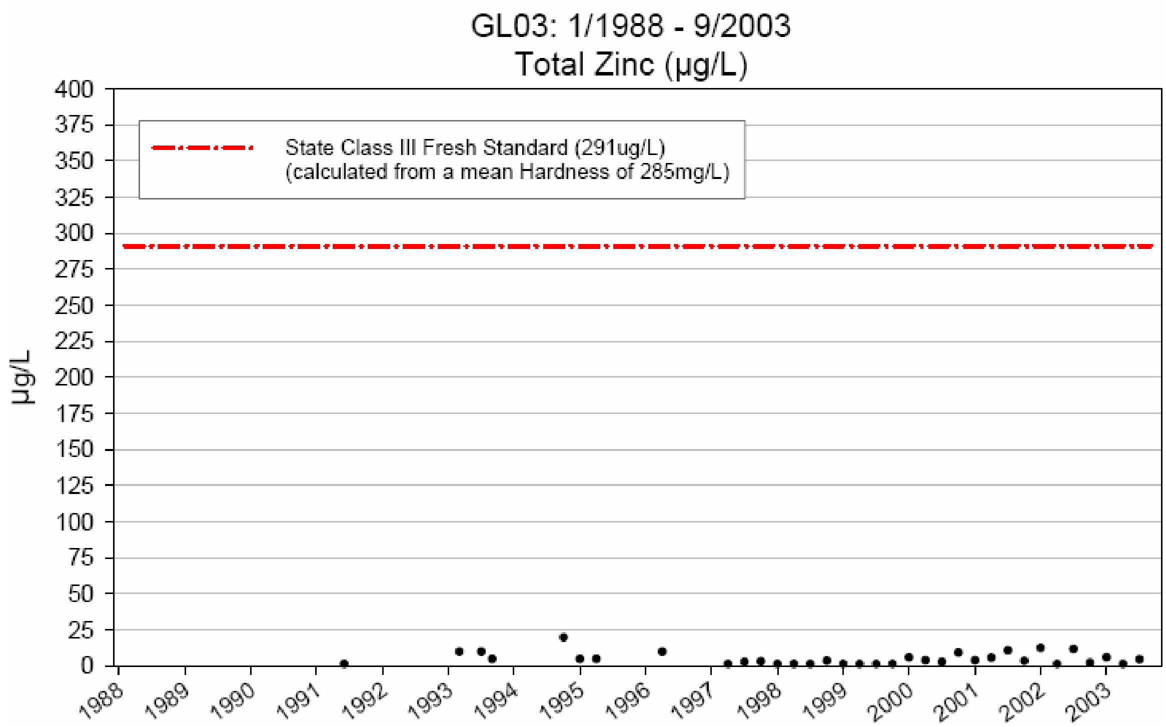


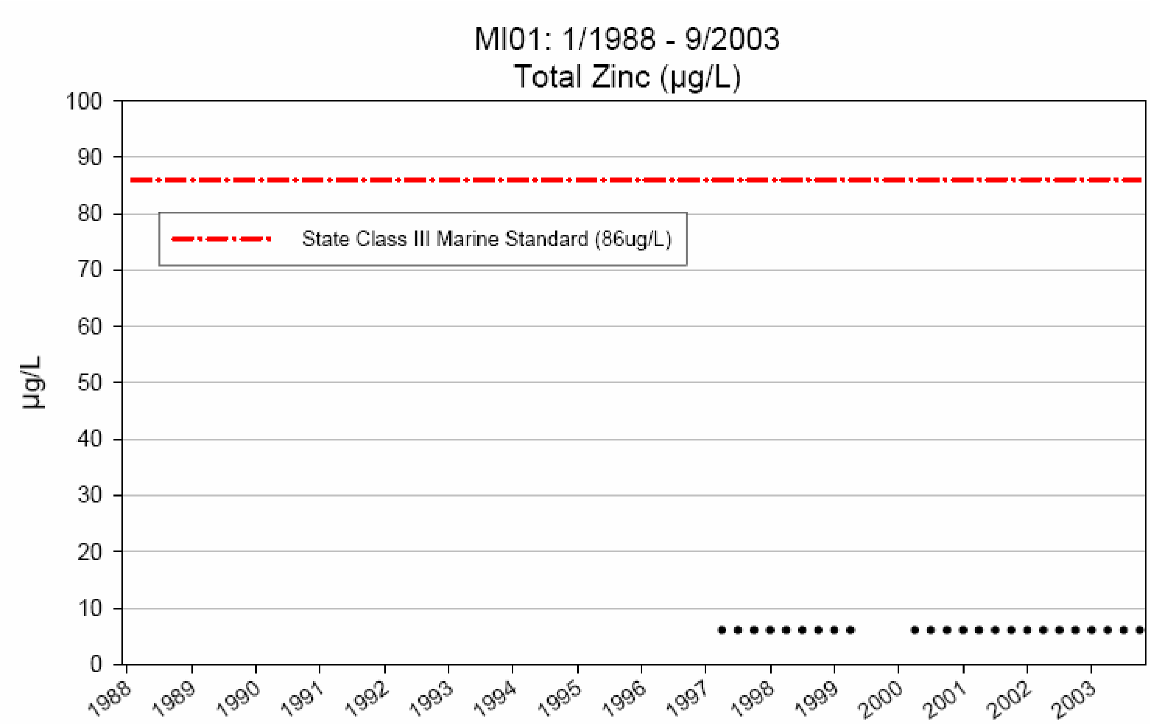
BB52: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Marine Standard (86ug/L)
µg/L
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

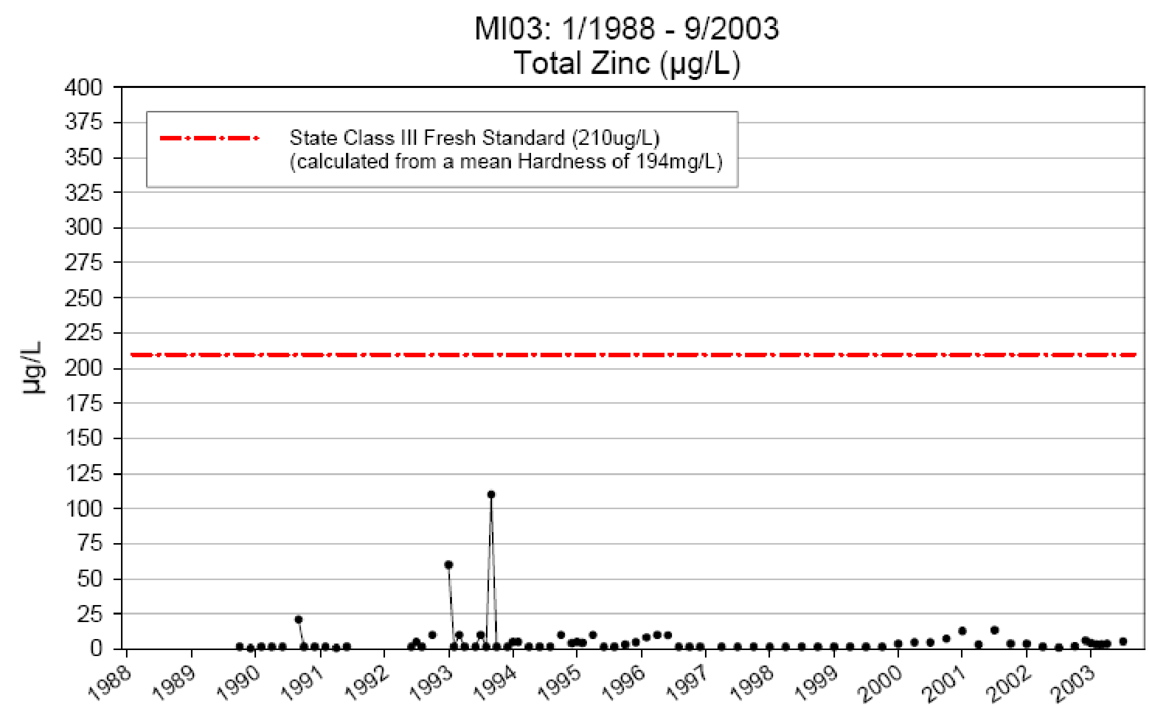

BB53: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Marine Standard (86ug/L)
µg/L
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

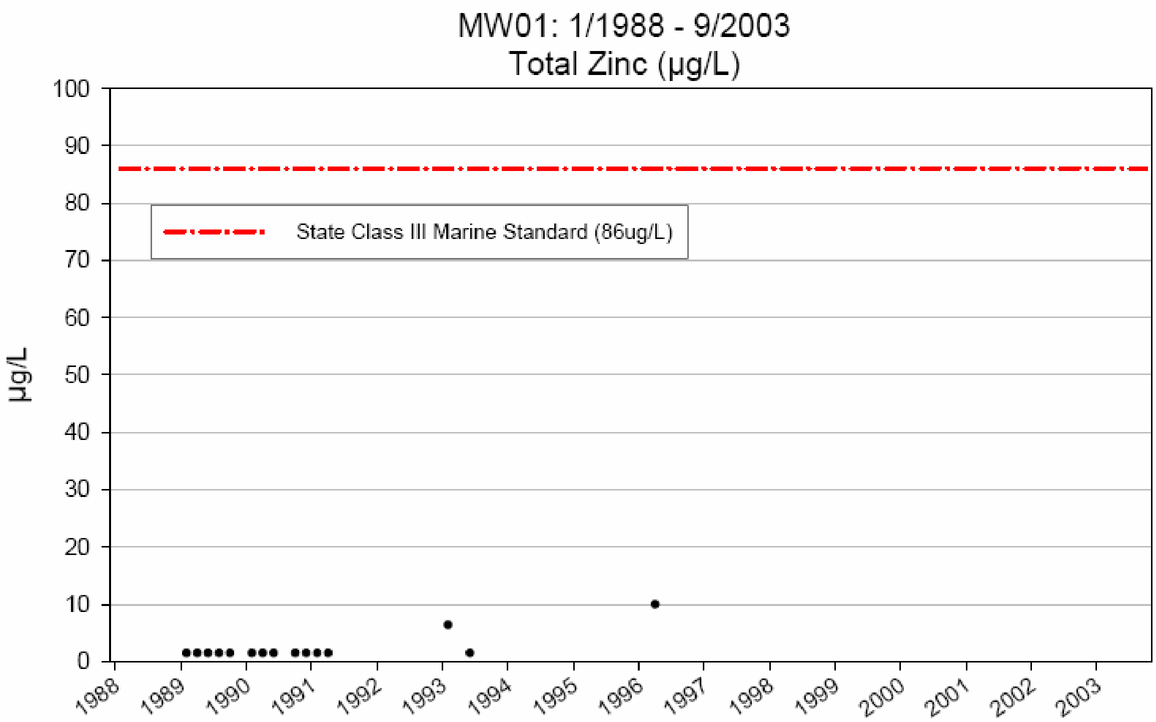

BL01: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Marine Standard (86ug/L)
µg/L
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

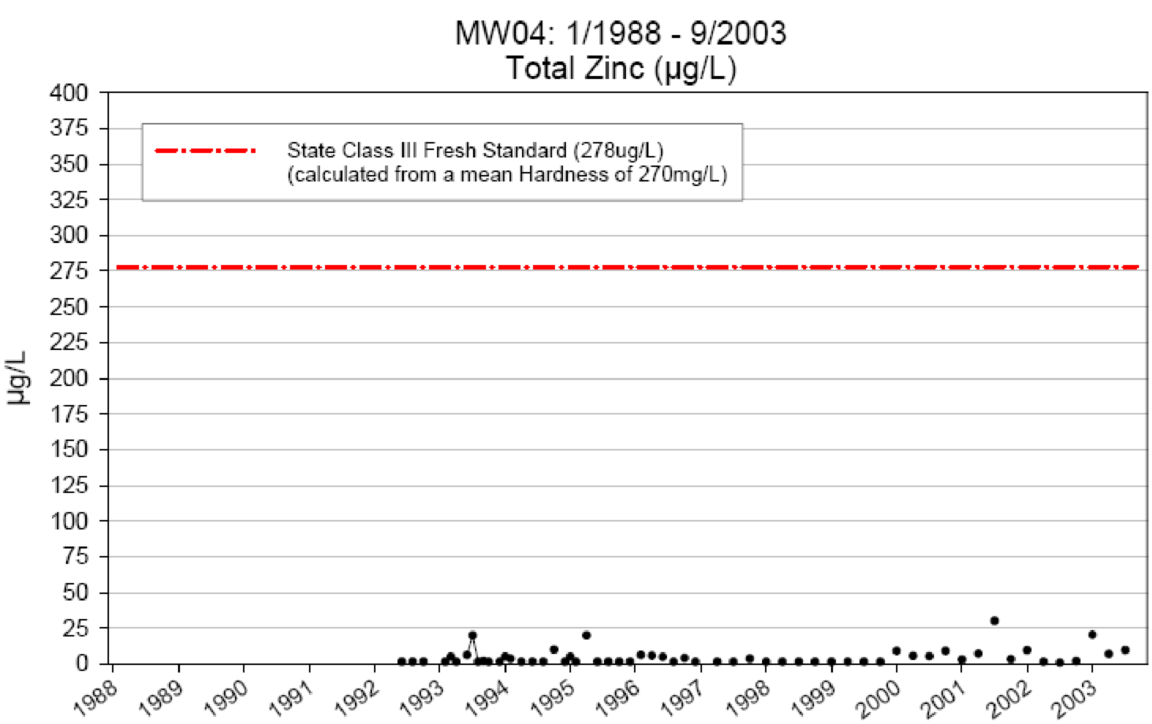

BL03: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Fresh Standard (228ug/L)
(calculated from a mean Hardness of 213mg/L)
µg/L
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

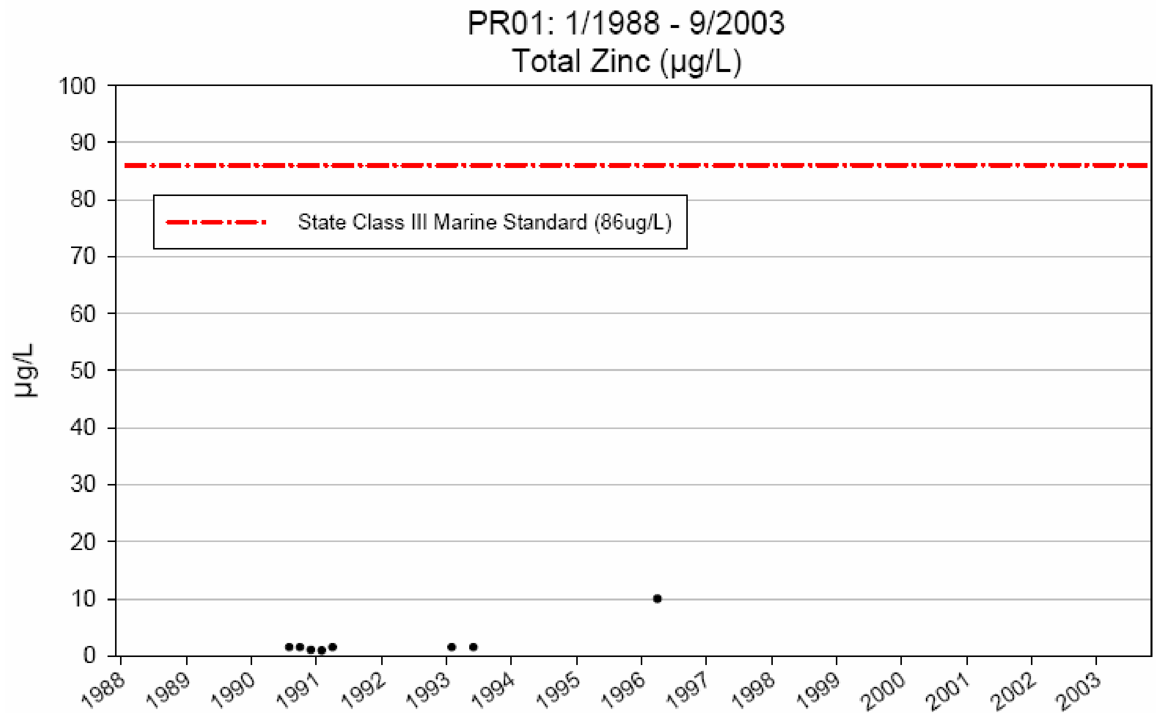

GL03: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Fresh Standard (291ug/L)
(calculated from a mean Hardness of 285mg/L)
µg/L
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MI01: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Marine Standard (86ug/L)
µg/L
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

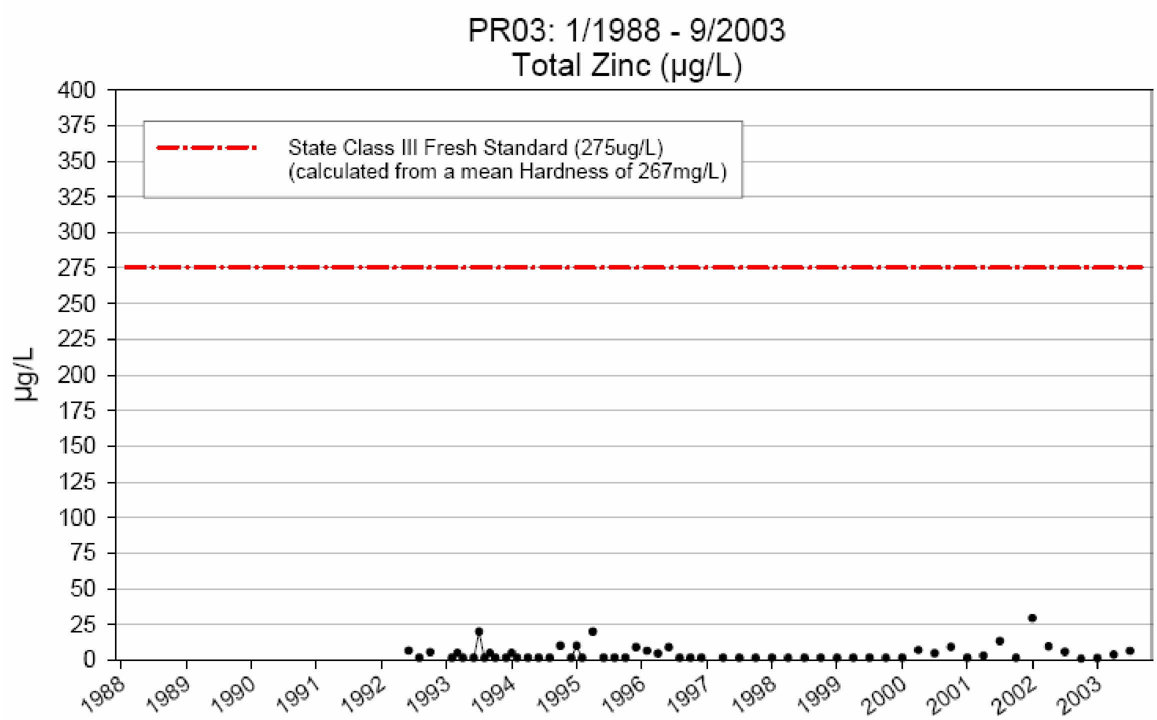

MI03: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Fresh Standard (210ug/L)
(calculated from a mean Hardness of 194mg/L)
µg/L
400
375
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MW01: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Marine Standard (86ug/L)
µg/L
100
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

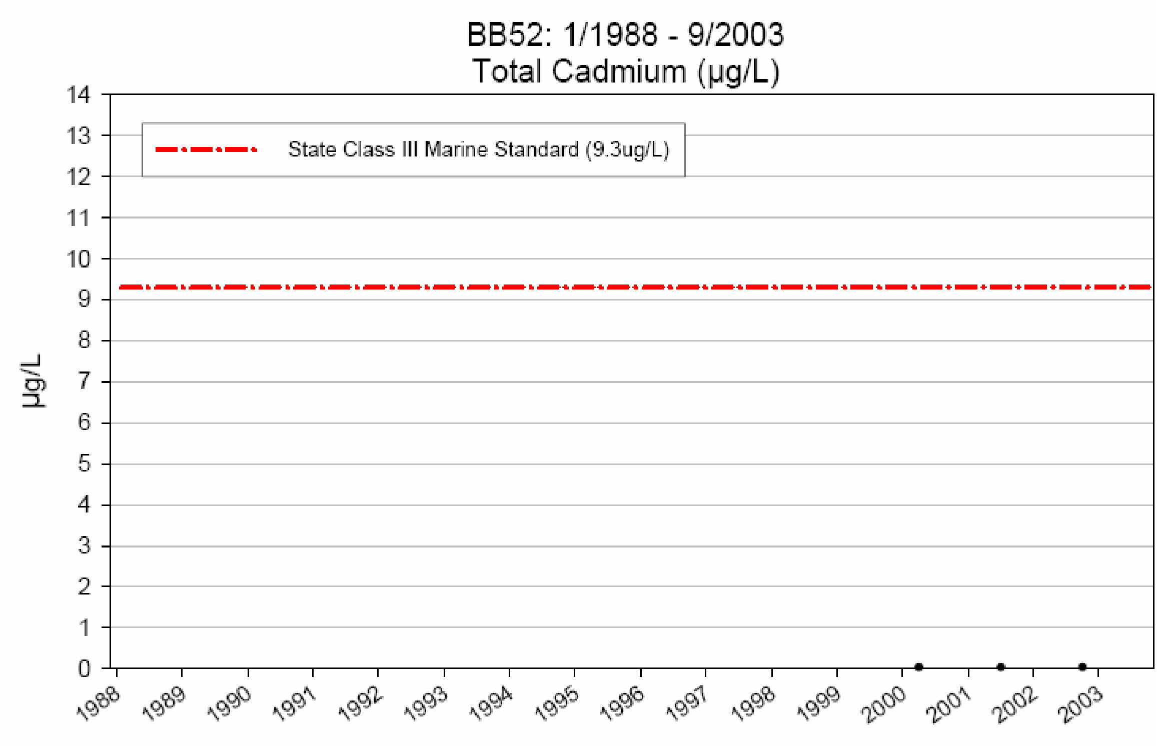

MW04: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Fresh Standard (278ug/L)
(calculated from a mean Hardness of 270mg/L)
µg/L
400
375
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

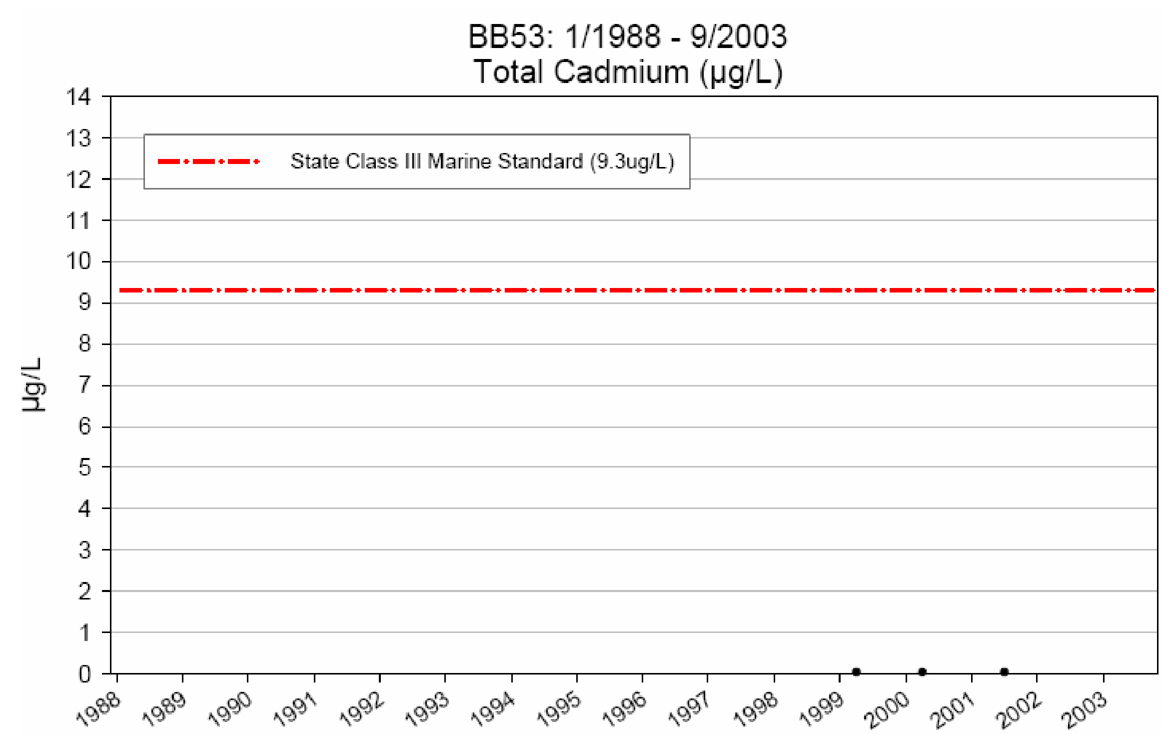


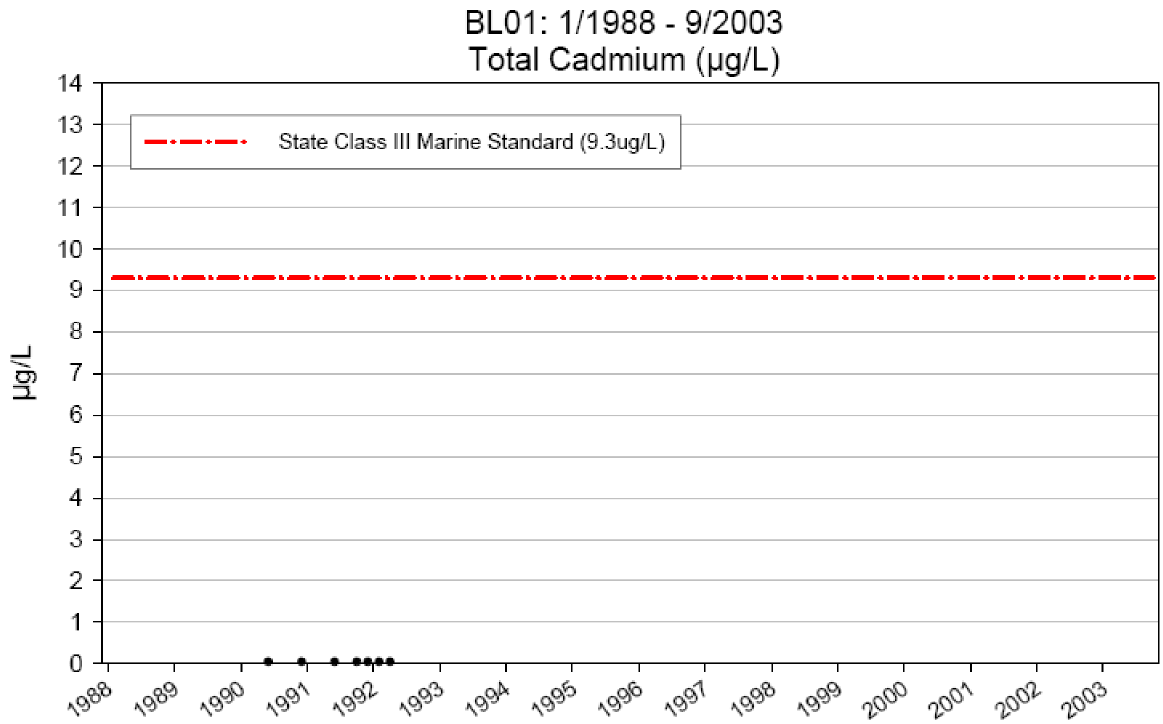
PR01: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Marine Standard (86ug/L)
µg/L
0
10
20
30
40
50
60
70
80
90
100
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

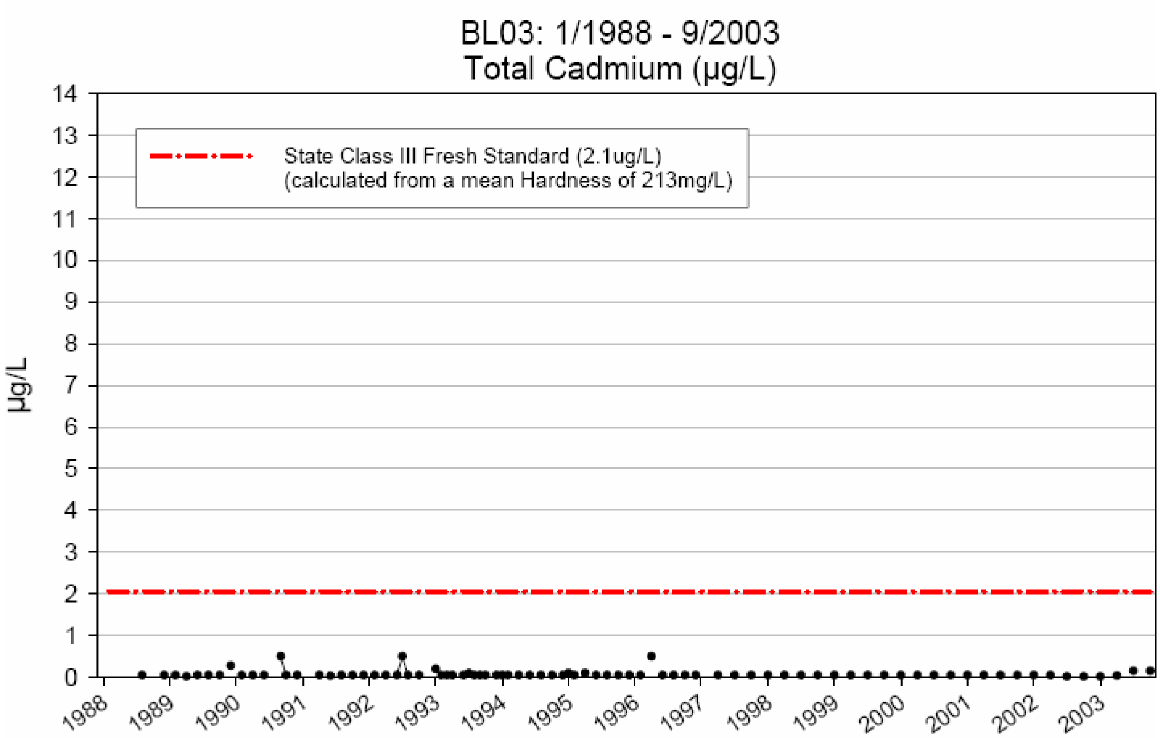


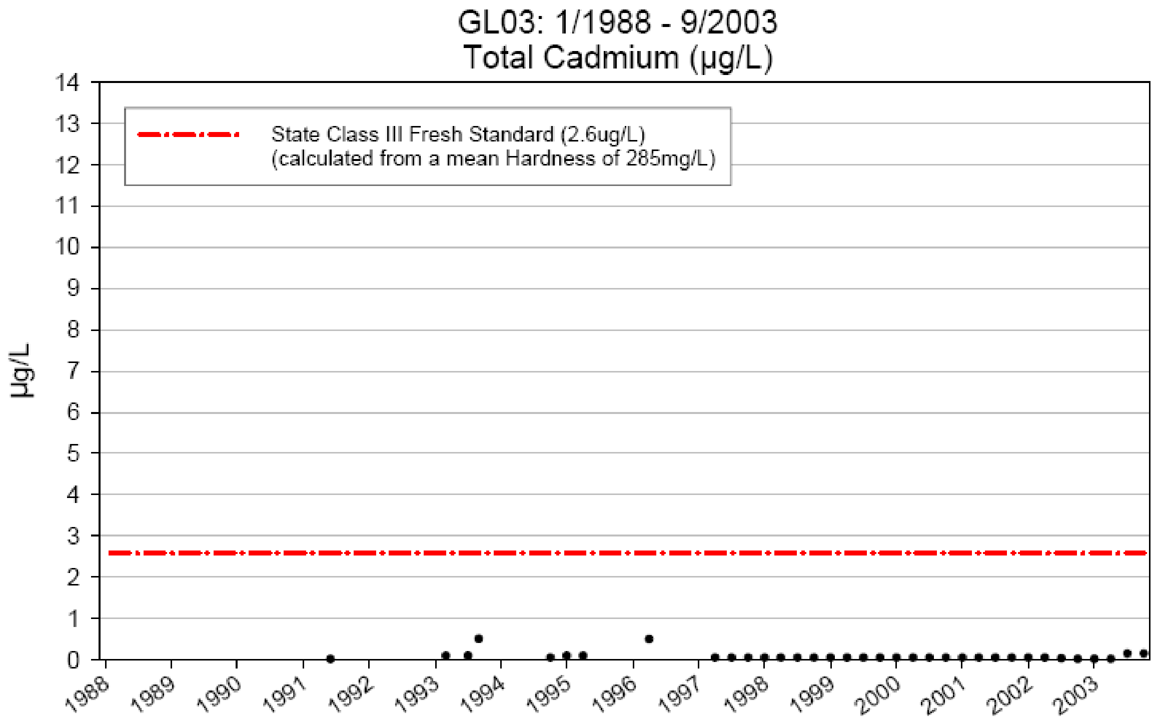
PR03: 1/1988 - 9/2003
Total Zinc (µg/L)
State Class III Fresh Standard (275ug/L)
(calculated from a mean Hardness of 267mg/L)
µg/L
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

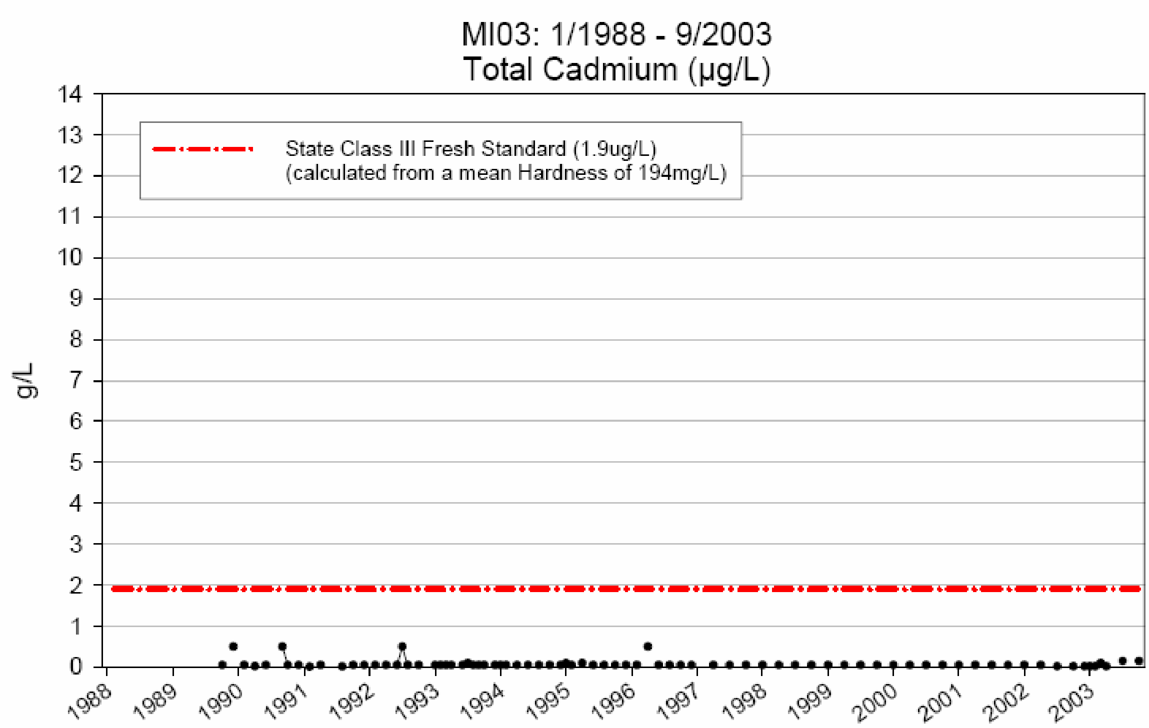

BB52: 1/1988 - 9/2003
Total Cadmium (µg/L)
State Class III Marine Standard (9.3ug/L)
µg/L
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

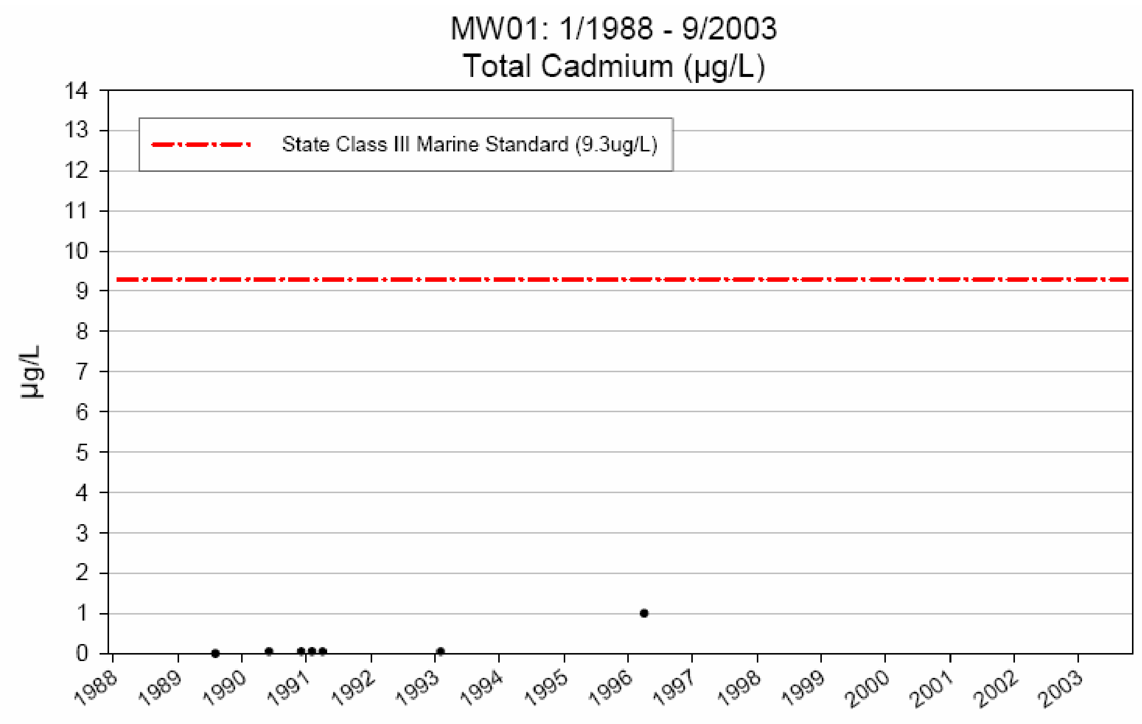

BB53: 1/1988 - 9/2003
Total Cadmium (µg/L)
State Class III Marine Standard (9.3ug/L)
µg/L
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

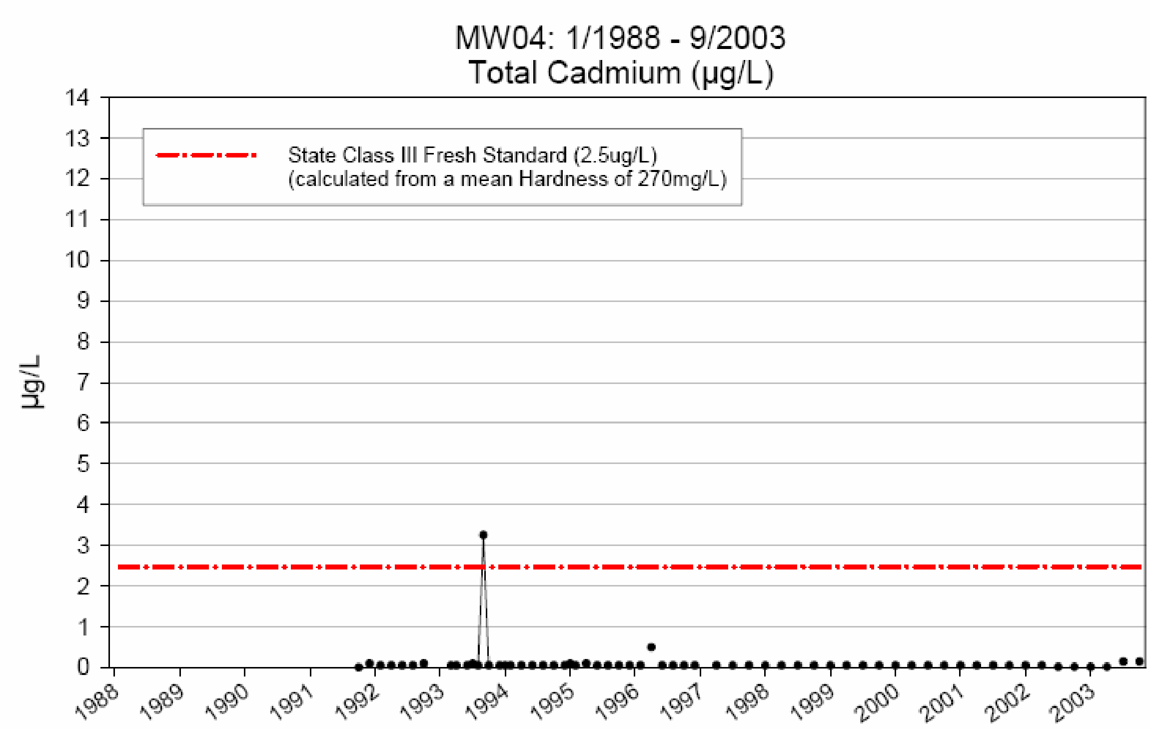

BL01: 1/1988 - 9/2003
Total Cadmium (µg/L)
State Class III Marine Standard (9.3ug/L)
µg/L
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

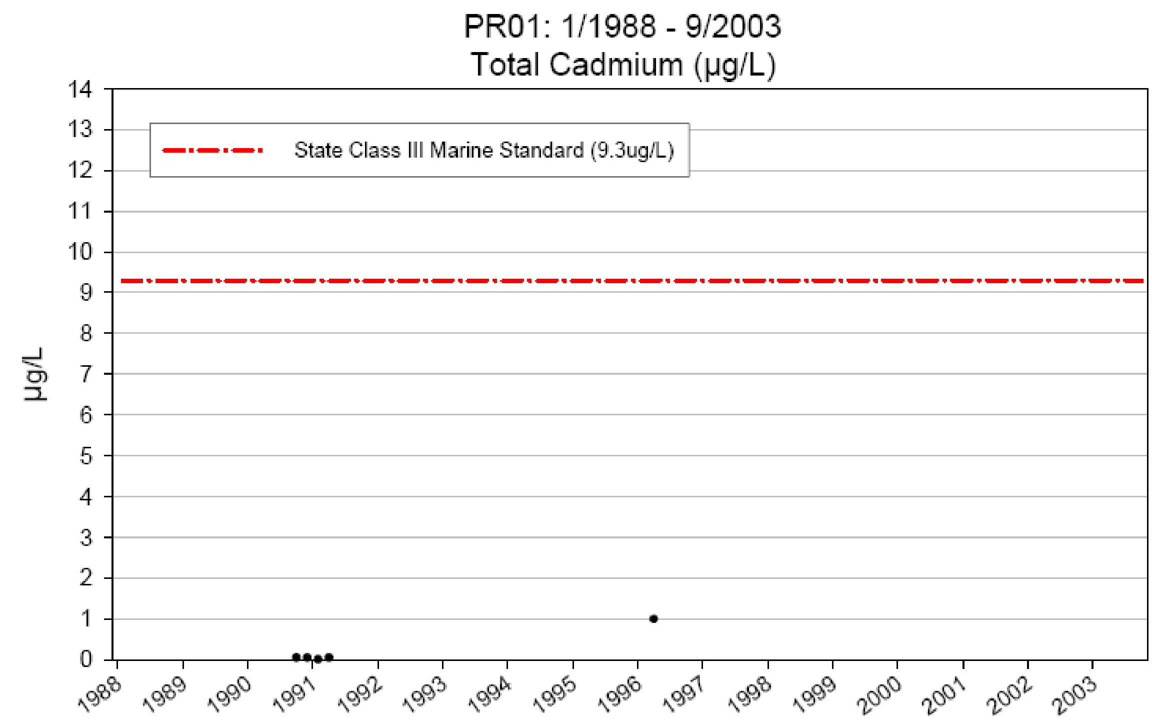

BL03: 1/1988 - 9/2003
Total Cadmium (µg/L)
State Class III Fresh Standard (2.1ug/L)
(calculated from a mean Hardness of 213mg/L)
µg/L
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

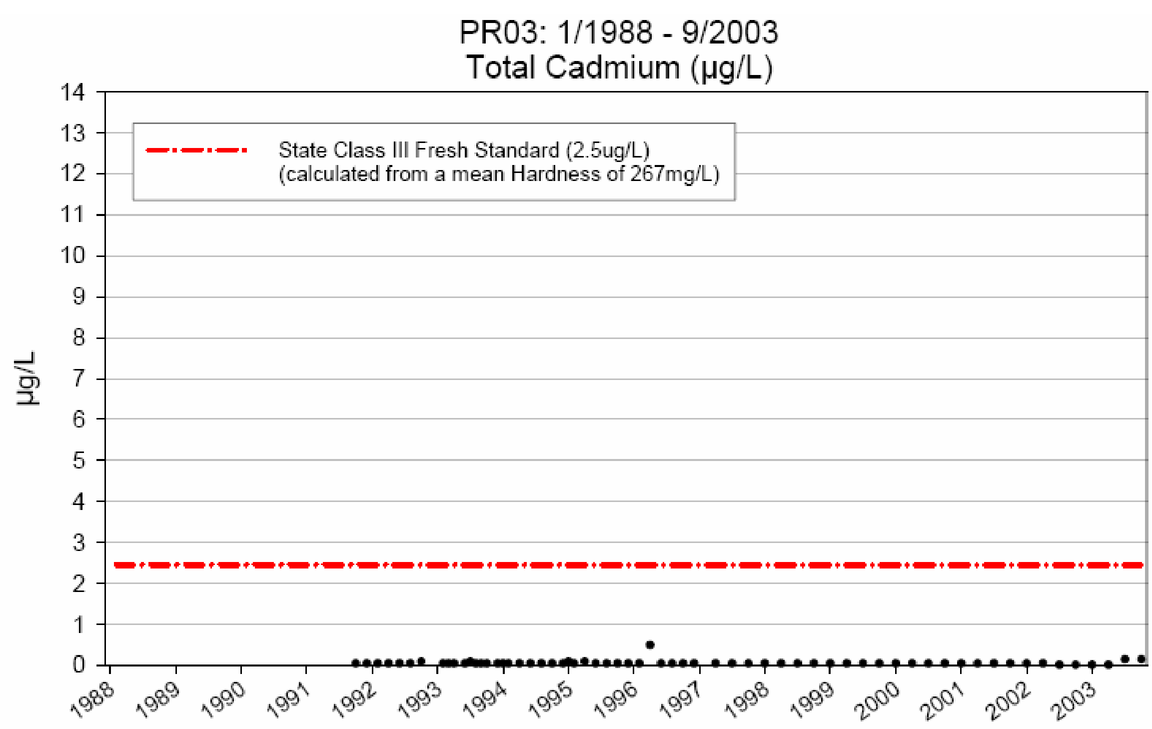

GL03: 1/1988 - 9/2003
Total Cadmium (µg/L)
State Class III Fresh Standard (2.6ug/L)
(calculated from a mean Hardness of 285mg/L)
µg/L
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MI03: 1/1988 - 9/2003
Total Cadmium (µg/L)
State Class III Fresh Standard (1.9ug/L)
(calculated from a mean Hardness of 194mg/L)
g/L
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MW01: 1/1988 - 9/2003
Total Cadmium (µg/L)
State Class III Marine Standard (9.3ug/L)
µg/L
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


MW04: 1/1988 - 9/2003
Total Cadmium (µg/L)
State Class III Fresh Standard (2.5ug/L)
(calculated from a mean Hardness of 270mg/L)
µg/L
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003



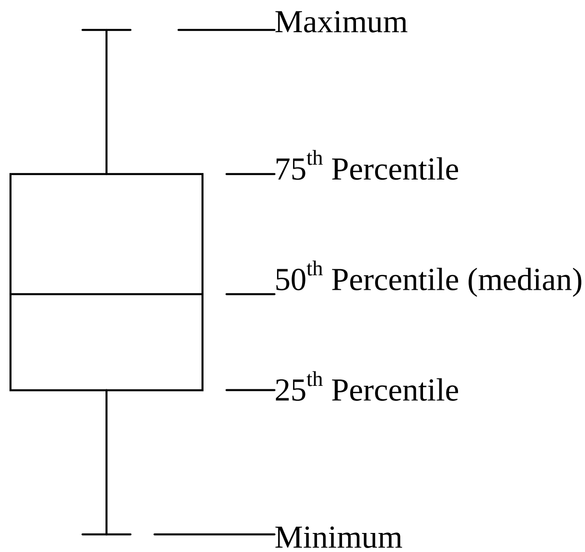


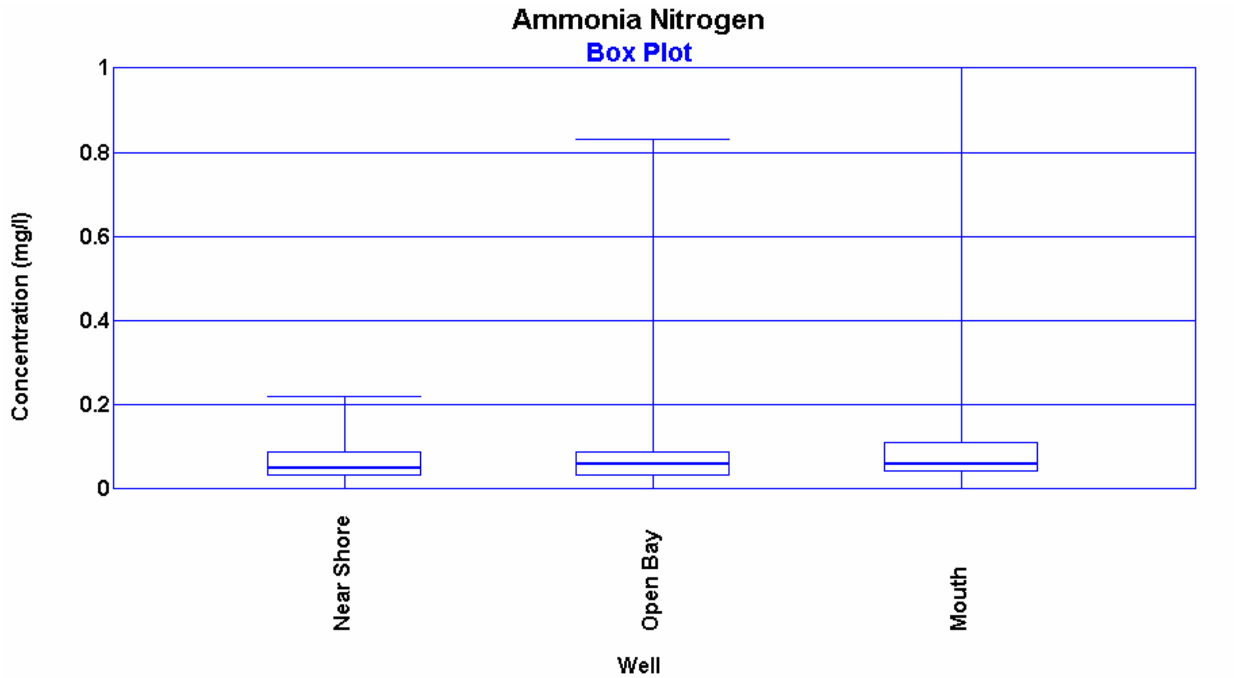
* The graphics presented in this Insert A were obtained from the BISCAYNE BAY WATER QUALITY STATUS AND TRENDS REPORT C-15864, prepared by the
Miami-Dade County Department of Environmental Resources Management (DERM) and completed in March of 2005. The 1587 page report contains additional information not shown in this appendix for other areas of South Miami-Dade County and Biscayne Bay.

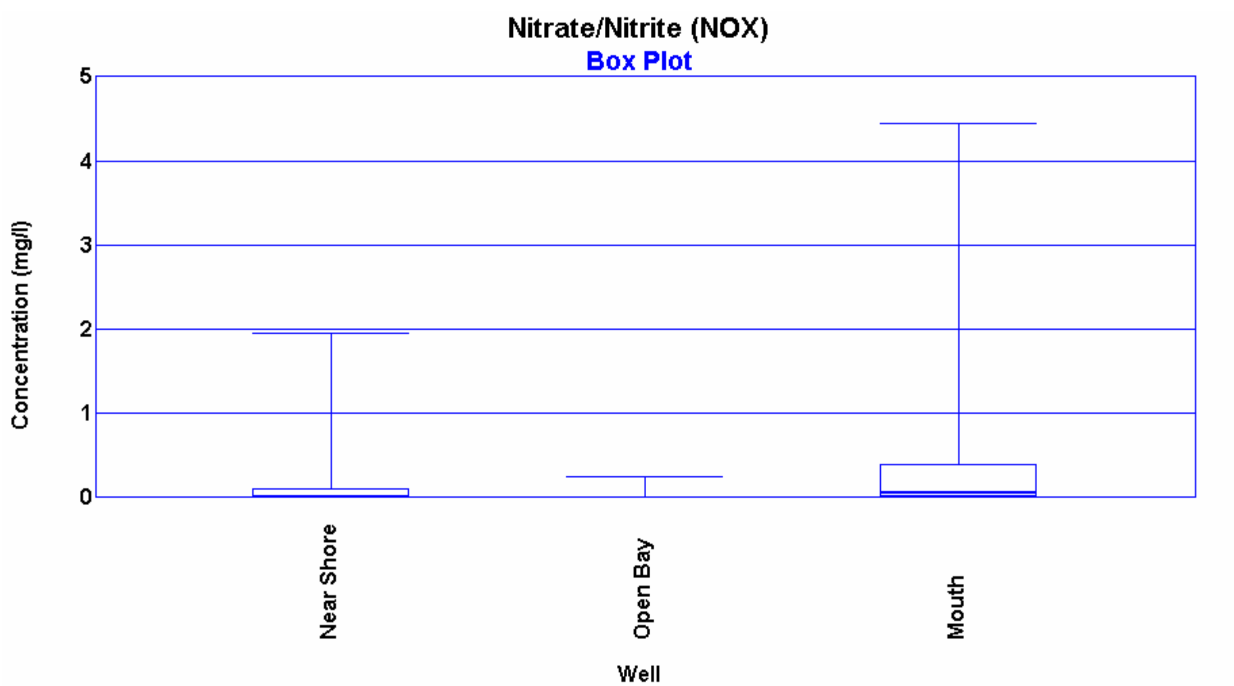
INSERT B*

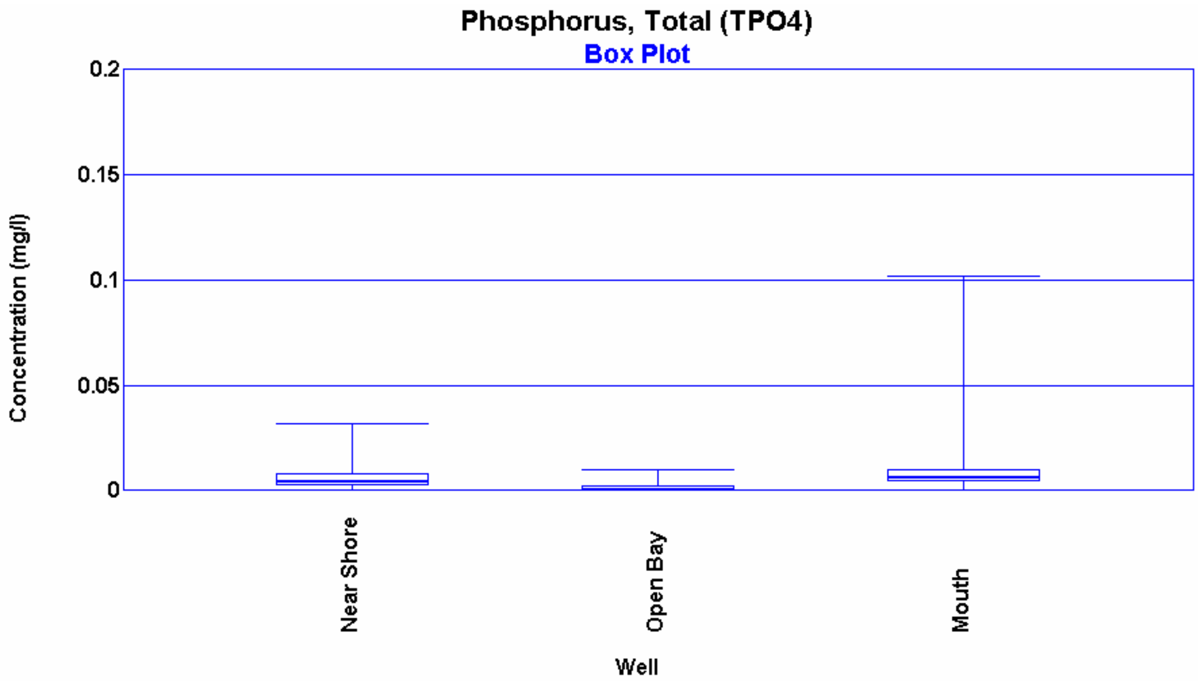
Box Plots for Nitrogen and Phosphorus

The box-whiskers plot presented below is a commonly used statistical technique that helps in visualizing the distribution of sample concentrations. The top-most and bottom-most points on the plot (the whiskers) indicate the maximum and minimum values respectively. The box portion is made up of the 25th, 50th (median), and 75th percentiles of the concentration distribution.




Ammonia Nitrogen
Box Plot
Concentration (mg/l)
1
0.8
0.6
0.4
0.2
0
Near Shore
Open Bay
Mouth
Well


Nitrate/Nitrite (NOX)
Box Plot
Concentration (mg/l)
5
4
3
2
1
0
Near Shore
Open Bay
Mouth
Well



***** The graphics presented in Insert B were obtained from the SUMMARY OF BISCAYNE BAY WATER QUALITY DATA report of August 25, 2003.

INSERT C

SUPPLEMENTAL PHASE II ENVIRONMENTAL SITE ASSESSMENT

1.0 INTRODUCTION

1.1 Property/Project Description

The BBCW project is being conducted as a component of the Comprehensive Everglades Restoration Plan (CERP) and Acceler8, an expedited funding program to expedite critical projects within CERP, with the objective to restore more natural flows to Biscayne Bay by restoring coastal wetlands and tributaries through rehydrating and reconnecting freshwater and marine wetlands along Biscayne Bay. Surface water from the C-1 and C-100 canals will be re-distributed to flow across two major flow ways through the project area, which are described as the Cutler Wetlands Flow Way and the Deering Estates Flow Way. The project area includes 153 separate parcels which are both publicly and privately owned.

The subject of the Supplemental Phase II ESA activities described herein includes an evaluation of soil and/or groundwater quality potentially associated with a former construction and demolition (C&D) debris landfill and a county wastewater treatment plant. The District is concerned that surface water and groundwater flows from these facilities may be adversely affecting the project area. In addition, the District is considering a fee simple acquisition or flowage easement on the C&D landfill parcel.

1.1 Project Background

URS Corporation (URS) was previously contracted by the District to compile general environmental information and current/historical land use within the project area and to summarize available environmental reports that had been prepared for individual tracts within the project area. A Draft Environmental Assessment Summary Report was issued by URS on August 31, 2005. Land use within the project area was historically agricultural, with cultivation of malanga, yucca, and potatoes. An approximate 20-acre portion of one parcel (TA500-038) was identified as a former C&D landfill previously operated by Lennar Land Partners, Inc. (Lennar). A county wastewater treatment plant and landfill were also identified immediately outside the project boundaries.

PSI has previously completed a Phase II Environmental Site Assessment (ESA) for publicly owned lands within the project study area, as documented in our report dated January 23, 2006. In addition, PSI recently completed a combined Phase I/II ESA for three privately-owned tracts located within the project study area, as documented in our report dated April 20, 2006. These assessments included the following general tasks:

- Soil and groundwater sampling was conducted at the Lennar C&D landfill area to determine if landfilling activities had resulted in impacts to soil and groundwater beneath the landfill.

- A regional groundwater assessment was performed to determine whether the South Dade wastewater treatment facility and/or South Dade Landfill might be affecting the groundwater within the project area. This task included research and the installation and sampling of several monitoring wells along the project boundary with these facilities.
- Surficial soil sampling was conducted within agricultural areas of the project area in accordance with the USFWS protocol in order to determine whether historical farming activities resulted in any impacts to the soil.

Specific findings related to the current assessment are described in the following sections.

1.2.1 Lennar Landfill

Tract No. TA500-038 (Figure 1) was previously occupied by an approximate 20-acre C&D debris landfill owned and operated by Lennar Land Partners, Inc. under Miami Dade County Department of Environmental Resource Management (DERM) Permit No. SW-1014. The landfill was reportedly operated from about 1975 until 1993 when the landfill was closed by DERM. The landfill was re-opened in 1993 by the US Army Corps of Engineers as a repository for debris from Hurricane Andrew. DERM has inspected the facility on a number of occasions and a number of non-compliance letters had been issued, primarily for accepting materials not suitable for a C&D landfill (plastics, metals, and wood products).

Hydrologic Associates, Inc. (HLA) previously performed a Phase I/Phase II ESA on this property on behalf of Lennar. The Phase II ESA included a limited number of sampling points and a limited laboratory analytical protocol. However, ammonia and arsenic were detected in the groundwater within the landfill area and upgradient of the landfill at concentrations exceeding the state regulatory standards. Arsenic was also detected in the site soils at concentrations exceeding the soil cleanup target level for residential direct exposure.

In a letter dated July 15, 2005, Lennar Land Partners, Inc. issued a Solid Waste Removal Plan to DERM for the removal of all material at the landfill site. On August 5, 2005, DERM approved the plan. The plan called for the excavation and processing of the landfill material. This processing was to be limited to manual sorting and mechanical size separation. Clean concrete was allowed under the plan to be used as fill material. During meetings and discussions between DERM and Lennar Land Partners, Inc., it was decided to excavate and remove all materials to a Class I Landfill. In addition, DERM’s approval of the Solid Waste Removal Plan, dated August 5, 2005, requires Lennar to submit a groundwater monitoring plan and to conduct groundwater monitoring once the solid waste removal activities are complete.

The removal of landfill material was completed in December 2005. PSI personnel observed the site toward the end of this process. At that time approximately 85 % of the landfill material had been removed, however materials not suitable for a C&D landfill were observed in the remaining portion not excavated. These materials consisted of wood, plastic, tires and various metal objects. PSI conducted interviews with Mr. Rainer Schael with Ford Engineers, Inc., about the material excavated from the landfill. Mr. Schael observed a majority of the landfill material as it was excavated. Mr. Schael did not observe any evidence of hazardous materials or any burned material in the excavated landfill material. During the time PSI was on site completing our previous Phase

II Investigation, no evidence of hazardous materials or any previously burned wastes were observed.

At that time, PSI conducted soil and groundwater sampling at the Lennar C&D landfill area to determine if landfilling activities had resulted in impacts to soil and groundwater beneath the landfill. Soil samples obtained from immediately beneath the landfill indicated the presence of barium, cadmium, chromium, lead, DDE, dieldrin, PCBs, and numerous PAH compounds in one or more soil samples at concentrations exceeding the Sediment Quality Assessment Guidelines (SQAGs). The groundwater results indicated the presence of ammonia, sulfate, chloromethane, and TDS in one or more wells at concentrations exceeding the Groundwater Cleanup Target Levels (GCTLs). Currently, Lennar is conducting additional assessment to meet DERM closure requirements. According to an April 20, 2006 correspondence with Mr. Hardeep Anand of DERM, both the Certificate of Completion and a groundwater assessment report remain outstanding from Lennar at this time.

1.2.2 Regional Groundwater Assessment

As part of our previous investigations, PSI conducted a DERM file review, reviewed previous environmental studies completed in the area and completed a site reconnaissance of the area. During the investigation, PSI noted two potential sources for negative groundwater impacts, the Miami-Dade County South Landfill and the Miami-Dade Waste Water Treatment Plant.

The Miami-Dade County South Landfill (MDCSL) is located south of SW 232nd Street and West of 87th Avenue and is a Class I sanitary landfill. The landfill property encompasses 320 total acres with a disposal area of approximately 205 acres. The facility is located in Section 21, Township 56S with a range of 40E. Landfill operations at this property began around 1985 and remains in operation today.

During the DERM file review, PSI personnel reviewed a report prepared by the Miami-Dade Solid Waste Management Environmental Compliance Division for the FDEP. This semiannual monitoring report for the South Dade Landfill is a requirement under permit No. 0126800-002-SO and covers surface water monitoring, leachate sampling and groundwater analysis. The Report is dated August 27, 2004. The summarized results obtained from the discussion section of this report are listed below. Groundwater samples are collected at 15 ft, 30 ft and 60 ft bls.

- Ammonia concentrations in the groundwater samples ranged between 0.1 mg/l and 70.7 mg/l. Trend graphs for two of the monitoring wells (S4 and S5) indicate that ammonia results are at the lowest since February 1985 with peaks occurring in 1996 and following a decline to 2004. This data is consistent with both trend graphs for all three sampling depths (15 ft, 30 ft and 60 ft bls). The remaining general chemistry parameters with the exception of total dissolved solids (TDS) were in compliance with the Drinking Water Standards in FAC 62-550. The highest TDS reading was 34,400 mg/l.
- With the exception of iron and antimony in one well (S17 60 ft) all metals analyzed were below their FAC 62-550 standards. Barium was detected in 54 of 57 wells tested, but was below its MCL. Other metals were detected at or below their respective MCLs.
- Volatile organic compounds, pesticides and PCB’s were all below laboratory detection limits.

Surface water sample results were compared to FAC 62-302.530, Surface Water Quality Criteria for Predominantly Marine, Class III: Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife.

- Two of the surface water monitoring points (SSW1 and SSW6) had a dissolved oxygen level below the 5 mg/L minimum standard.
- Unionized ammonia was below detection limits for the all fresh water samples.
- Fecal Coliform results for the surface water samples were below the standard value of 800 cfu/100 ml. Chlorophyll-a values varied from a low of 3.2 mg/m3 to a high of 28.3 mg/m3.
- All samples were below detection limits for metals with the exception of SSW6 located in the Black Marina basin. This location was re-sampled. Iron was detected at 0.570 µg/L exceeding its MCL of 0.3 µg/L. It was noted that results obtained from the marina are questionable in relation to the landfill.

Leachate sample results were all below the limits established in 40 CFR 261.24.

The Miami-Dade WWTP is located south of SW 232nd Street and West of 87th Avenue. The WWTP has numerous shallow groundwater monitoring well and Biscayne Aquifer monitoring wells surrounding the facility. PSI reviewed a study completed in the area by MACTEC Engineering and Consulting, Inc. The MACTEC report included groundwater data provided by the WWTP for a monitoring well located on the WWTP property. The sample results are summarized below.

- Nitrogen, Nitrate, Total (as N) had a reading 0.825 mg/l with a detection limit of 0.2 mg/l.
- Total Dissolved Solids (TDS) were measured at 996 mg/L with a detection limit of 1 mg/l.
- Total Recoverable Arsenic results were 0.006 mg/l with a detection limit of 0.005 mg/l.
- Chloride results were 375 mg/L with a detection limit of 0.5 mg/l
- Cadmium and Chromium results were below detection limits of 0.005 mg/l.
- Total Recoverable Lead was below detection limits of 0.001 mg/l.
- Fecal Coliform was below a detection limit of 1 CFU/100 ml.
- Total Sulfate was measured at 55.7 mg/L with a detection limit of 2.0 mg/l.
- Total Phosphorous results were 0.06 mg/L with a detection limit of 0.02 mg/l.
- The pH of the groundwater sample was 7.34.

The groundwater results reviewed for the WWTP are under the Groundwater Cleanup Target Levels (GCTLs) for all analytes tested. The groundwater data provided to MACTEC is dated March 20, 2003 and does not rule out the WWTP as causing negative groundwater impacts to the region.

Based on PSI's review of available data for both the Miami-Dade County South Landfill and the Miami-Dade Waste Water Treatment Plant, a regional groundwater assessment was recommended. Subsequently, on November 12, 2005, PSI installed a series of shallow and intermediate depth groundwater monitoring wells at the locations shown on Figure 3. The regional assessment identified the presence of arsenic in the groundwater at concentrations that slightly exceeded the GCTL in all of the wells sampled by PSI at that time. In addition, aluminum and iron were found to be elevated with respect to the GCTLs at one location

(TMW 7).

1.3 Authorization

This Supplemental Phase II ESA was performed in substantive compliance with PSI Proposal No. 552-G6035 dated February 2, 2006, which was authorized by SFWMD Contract and Work Order No. OTO-60916-WO04.

1.4 Purpose

The scope of work for this Supplemental Phase II ESA was specifically designed to further address several environmental concerns identified by previous work in the study area. The objectives of the study included:

- Further evaluate the environmental condition of the former C&D Landfill to allow the District to make informed decisions regarding the acquisition of this parcel.
- Further evaluate regional groundwater quality to determine whether outflows from several facilities of concern may be affecting groundwater quality in the area.

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1.5 Special Terms And Conditions

1.5.1 Property Access

Instructions as to the location of the property and an explanation of the property and facilities to be assessed were provided by Mr. Robert Taylor of SFWMD, Land Management and Operations Support.

1.5.2 Use By Third Parties

This report was prepared pursuant to the contract PSI has with the SFWMD. That contractual relationship included an exchange of information about the property that was unique and between PSI and its client and serves as the basis upon which this report was prepared. Because of the importance of the communication between PSI and its client, reliance or any use of this report by anyone other than the SFWMD, for whom it was prepared, is prohibited and therefore not foreseeable to PSI.

Reliance or use by any such third party without explicit authorization in the report does not make said third party a third party beneficiary to PSI's contract with SFWMD. Any such unauthorized reliance on or use of this report, including any of its information or conclusions, will be at the third party's risk. For the same reasons, no warranties or representations, expressed or implied in this report, are made to any such third party. Third party reliance letters may be issued on request and upon payment of the, then current fee for such letters. All third parties relying on PSI’s reports, by such reliance, agree to be bound by the proposal and PSI’s General Conditions. No reliance by any party is permitted without such agreement, regardless of the content of the reliance letter itself.

2.0 PHYSICAL SETTING

2.1 Topographic Map Review

According to the contour lines on the 1988 United States Geological Survey (USGS) 7.5 minute, "Perrine, FL" quadrangle topographic map, the project area surface elevations average approximately 5 feet National Geodetic Vertical Datum (NGVD). The contour lines in the area of the property indicate the site to be generally level with a slight slope to the east, toward Biscayne Bay.

2.2 Geology and Hydrogeology

Surface soils in the area consist of Perrine Marl and low permeability calcium carbonate, clay-like deposits (weathered limestone). Previous work performed by PSI in the project area confirms the presence of these materials at shallow depth. These surficial deposits are underlain by the Miami Oolite, Fort Thompson Formation, Key Largo Formation, and Tamiami Formation, which collectively make up the Biscayne aquifer. The Biscayne aquifer consists of very high permeability limestone sands and marl.

3.0 PHASE II ESA METHODOLOGY

The intent of the Phase II ESA was to address potential environmental concerns identified by SFWMD by conducting invasive sampling for laboratory analysis in areas of interest throughout the property. PSI understands that data from this Phase II ESA will be used by SFWMD to evaluate whether any remedial action is necessary in order to utilize the property for its intended purpose.

A PSI field supervisor directed all sampling activities, and all field personnel were OSHA-trained in accordance with 29 CFR 1910.120. Field investigation and sampling activities were directed by Mr. David Thornburg of PSI in March 2006. The assessment was performed in general accordance with the authorized scope of work. All field sampling activities were performed in accordance with the FDEP Standard Operating Procedures for Field Investigation Activities (DEP-SOP 001/01). All field sampling was performed in general accordance with the SFWMD QA/QC protocol including 10% of all laboratory analytical being split with a secondary NELAC approved laboratory. Laboratory analytical services were provided by Millenium Laboratories, Inc. (MLI), a Florida Department of Environmental Health (FLDOH) approved laboratory. Split sample analysis was performed by Severn Trent Laboratories (STL) in Tampa.

3.1 Landfill Investigation Methodology

PSI collected twenty surficial soil samples (SB-10 through SB-29) within the landfill, with each boring representing approximately 1 acre. The soil boring locations were established after first considering the previous PSI sample locations in an effort to provide relatively complete coverage of the former landfill area. The soil boring locations are shown on Figure 2.

The soil borings were collected from the interval 0-6 inches below land surface (bls) using a decontaminated, stainless steel hand auger. The soil samples were homogenized in a stainless steel mixing bowl until a uniform appearance was achieved, then placed into sample containers, labeled and placed on ice for delivery to MLI under chain of custody procedures. All soil samples were analyzed for organochlorine pesticides by EPA method 8081, PCBs by EPA Method 8082, polynuclear aromatic hydrocarbons by EPA method 8270, and the RCRA 8 metals by EPA method 6010/7471. All soil boring locations were surveyed using global positioning service (GPS) equipment.

Groundwater samples were also collected by PSI from three existing shallow monitoring wells (MW-1 through MW-3) which were previously installed by Hydrologic Associates on behalf of Lennar. A fourth well installed by Lennar (MW-4) and five wells installed by PSI during the previous Phase II activities (TMW-1 through TMW-5) were also to be sampled, however, none of these wells could be located and appear to have been destroyed by landfill reclamation and construction activities in the area. The monitor well locations are shown on Figure 2.

Groundwater samples were collected from monitoring wells MW-1 through MW-3 using a peristaltic pump and new polypropylene tubing in accordance with the FDEP SOP. Prior to collecting groundwater samples, the depth to water was measured from the top of casing using an electronic water level indicator. The wells were then purged of a minimum of 3 well volumes. Field measurements, including pH, conductivity, temperature, dissolved oxygen, and turbidity were collected at each well volume and purging was continued until all parameters were within 5% of the previous measurement and the turbidity was less than 10 nephlometric turbidity units (NTU). Groundwater samples were collected into the appropriate containers supplied by the laboratory and immediately placed in an iced cooler. The samples were then transported to MLI under chain of custody procedures. The groundwater samples were analyzed for total and dissolved RCRA 8 metals, plus aluminum and iron.

3.2 Regional Groundwater Assessment Methodology

Groundwater samples were collected by PSI from the six wells (TMW-6 through TMW-11) previously installed by PSI within the 87th Avenue right of way (ROW) east and southeast of the county wastewater plant and former Lennar Landfill, respectively (**Figure 3**). Groundwater samples were collected from each monitoring well using a peristaltic pump and new polypropylene tubing in accordance with the FDEP SOP. Prior to collecting groundwater samples, the depth to water was measured from the top of casing using an electronic water level indicator. The wells were then purged of a minimum of 3 well volumes. Field measurements, including pH, conductivity, temperature, dissolved oxygen, and turbidity were collected at each well volume and purging was continued until all parameters were within 5% of the previous measurement and the turbidity was less than 10 nephlometric turbidity units (NTU). Groundwater samples were collected into the appropriate containers supplied by the laboratory and immediately placed in an iced cooler. The samples were then transported to MLI under chain of custody procedures. The groundwater samples were analyzed for total and dissolved arsenic by EPA method 6010. The groundwater sample from TMW-7 was also be analyzed for total and dissolved aluminum, cadmium and iron by EPA method 6010.

In addition, PSI installed shallow soil borings in the immediate vicinity of each of the regional groundwater assessment wells. The intent of these borings was to evaluate the presence of arsenic in soils around each wellhead, and any potential relationship between arsenic in soil and arsenic in groundwater at these locations. The soil borings were manually advanced to 5 ft bls using a decontaminated, stainless steel hand auger. Soil samples were collected at 0-6 inches bls, 2 ft bls, and 5 ft bls for laboratory analysis of arsenic by EPA Method 6010.

3.3 Data Validation

Quality assurance and quality control (QA/QC) samples for data validation were collected during the assessment activities described herein, including:

- Duplicate samples were collected and sent blind to the primary laboratory. The purpose of the duplicate sampling was to assess the precision in the sampling and analytical techniques. Duplicate samples were collected at a rate of 10%, or one duplicate sample for every 10 samples collected.
- Equipment blanks were collected to assess the adequacy of field decontamination procedures. The equipment blanks were collected by rinsing the sampling equipment (e.g., hand auger bucket, mixing spoons, etc.) with analyte-free water, then decanting the water into laboratory-supplied containers for analysis. Equipment blanks were collected at a rate of 5%, or one equipment blank for every 20 samples collected.
- Split samples were collected to provide a check on variability in the analytical results and to assess the accuracy of the primary laboratory. Primary samples were sent to MLI and

split samples were sent to STL for an independent analysis. Split samples were collected at a rate of 10%, or 1 split sample for every 10 samples collected.

4.0 PHASE II ESA RESULTS

4.1 Regulatory Guidance Concentrations

Analyte concentrations in all media were compared to applicable or relevant and appropriate requirements, depending upon current and future proposed usage of each tract. These criteria are summarized below.

4.1.1 Soil

The following human-health based criteria are established by the FDEP in Chapter 62-777 of the Florida Administrative Code (FAC 62-777), for both direct exposure and leachability.

- Residential – The Soil Cleanup Target Level for direct exposure in a residential setting (SCTL-RDE) is the default standard for site screening purposes in Florida, and assumes potential contact with soils on a regular basis by adults and children.

- Industrial – The Soil Cleanup Target Level for direct exposure in a non-residential setting (SCTL-IDE) assumes extended contact with soils on a daily basis by adult workers at commercial/industrial sites, or on agricultural properties where farming practices result in frequent site contact. Use of this standard requires that a deed restriction be recorded against the property.

- Leaching to Groundwater – The Soil Cleanup Target Level for leaching to groundwater (SCTL-LGW) also represents a default standard for site screening purposes in Florida, and is based on soil concentrations which are considered likely to result in an exceedance of the groundwater quality standard for a particular chemical.

- Leaching to Surface Water – The Soil Cleanup Target Level for leaching to surface water (SCTL-LSW) is applicable where impacted soils may be in contact with a surface water body.

4.1.2 Sediment

The FDEP has previously indicated that soils within proposed reservoir areas should be regulated as sediments, as these soils will ultimately become inundated. For sediments, the Sediment Quality Assessment Guidelines (SQAGs) as defined in Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4, (MacDonald, 2000) have generally been applied for screening purposes. The SQAGs are not a human health-based criteria, but are instead relevant only to the evaluation of ecological risk. The referenced guideline outlines two potential standards which were developed specifically with respect to benthic macroinvertebrate species, which represent the bottom of the food chain, as follows:

- No Observed Adverse Effects Level – The threshold effects concentration (SQAG-TEC) is the more conservative value and is utilized as a screening tool in evaluating sediments. Contaminant concentrations below the SQAG-TEC generally do not warrant further investigation.

- Lowest Observed Adverse Effects Level – The probable effects concentration (SQAG-PEC) represents the level above which adverse effects are likely to occur. It should also be noted here that SFWMD and FWS have agreed to an Interim Effects Concentration for copper only, which replaces the SQAG-PEC for copper recommended in MacDonald 2000.

However, it should be noted that SQAGs may not be established for all analytes of interest. FWS protocols for ecological risk assessment (FWS, March 2004) recommend consideration of Ecological Screening Values (ESV) established by EPA Region IV in Ecological Screening Values or Surface Water, Sediment, and Soil (WSRC, November 1998) when Florida SQAGs are not available.

In the case of selenium, no SQAG or ESV values have been established. USFWS utilizes a screening value of 1 milligram per kilogram (mg/kg) for selenium. In the case of copper, the USFWS utilizes an interim screening value of 85 mg/kg, instead of the published SQAG-TEC.

4.1.3 Water Quality

The following water quality parameters are also established by the FDEP:

- Groundwater – Groundwater Cleanup Target Levels (GCTL) are established by the FDEP in FAC 62-777.
- Surface Water – Surface water quality standards are established by the FDEP in FAC 62-302.

4.1.4 Applicable Criteria

All of the above criteria have been considered in evaluating the analytical results obtained during the Phase II assessment activities described herein. Since some portions of the site may not become inundated, it is appropriate to compare analyte concentrations in the soil to the human health-based SCTLs established in FAC 62-777. Therefore, soil data was compared to both the SCTLs for residential direct exposure (SCTL-RDE) and to the SCTLs for leaching to groundwater (SCTL-LGW) and leaching to surface water (SCTL–LSW).

It is likely that most of the site will be inundated, at least for a portion of each year, and that important ecological receptors will utilize the property. Therefore, it is also necessary to compare the site data to the SQAGs. For most analytes of interest (arsenic being the notable exception), the SQAG-TEC criteria are more stringent than the SCTL criteria. Therefore, in most cases, a cleanup to SQAG-TEC criteria is also protective of human health. It should also be noted that the SQAGs are not standards or deterministic values (i.e., an exceedance does not indicate absolutely that adverse affects will occur); the SQAGs are merely screening values. Data exceeding the SQAG values generally indicate the need for further study. Conversely, chemical concentrations which do not exceed the SQAGs are generally screened out from any further consideration with respect to ecological risk.

The SCTLs for leaching to surface water (SCTL-LSW) have also been considered for soils which may become inundated.

4.2 Former Lennar C&D Landfill Results

These results have been evaluated by comparison with the appropriate human-health based SCTLs established in Chapter 62-777, FAC and the ecologically-based SQAG criteria recommendations for sediments.

- Arsenic was detected in all 20 soil samples at concentrations ranging from 3.9 mg/kg to 24 mg/kg. All of the sample results exceed the SCTL-RDE criteria of 2.1 mg/kg, and 7 of these also exceed of the SCTL-IDE criteria of 12 mg/kg. The SQAG-TEC of 9.8 mg/kg is exceeded in nine of the 20 samples.
- Barium was detected in three of 20 samples at concentrations in excess of the SQAG-TEC (20 mg/kg). Applicable regulatory criteria were otherwise not exceeded.
- Cadmium was detected in four of 20 samples at concentrations in excess of the SQAG-TEC (1 mg/kg). Applicable regulatory criteria were otherwise not exceeded.
- Chromium was detected in all 20 soil samples at concentrations exceeding the SCTL-LSW (4.2 mg/kg). Applicable regulatory criteria were otherwise not exceeded.
- Lead was detected in two of 20 samples at concentrations in excess of the SQAG-TEC (36 mg/kg). Applicable regulatory criteria were otherwise not exceeded.
- Mercury was detected in two of 20 soil samples at concentrations exceeding the SQAG-TEC (0.18 mg/kg). In addition, the SCTL-LSW criteria of 0.01 mg/kg was exceeded in all but one sample.
- Selenium was detected in four of 20 soil samples at concentrations in excess of the SCTL-LSW (0.5 mg/kg). Applicable regulatory criteria were otherwise not exceeded.
- Silver was detected in one of 20 soil samples at a concentration in excess of the SCTL-LSW (0.01 mg/kg). Applicable regulatory criteria were otherwise not exceeded.
- Alpha-Chlordane was detected in 4 of 20 soil samples at concentrations exceeding the SCTL-LSW (0.003 mg/kg) and the SQAG-TEC (0.0032 mg/kg). In addition, one of these also exceeded the SQAG-PEC criteria of 0.018 mg/kg.
- Gamma-Chlordane was detected in 4 of 20 soil samples at concentrations exceeding the SCTL-LSW (0.003 mg/kg) and the SQAG-TEC (0.0032 mg/kg). In addition, one of these also exceeded the SQAG-PEC criteria of 0.018 mg/kg.
- 4,4-DDE was identified in 10 of 20 soil samples at concentrations exceeding the SQAG-TEC criteria of 0.0032 mg/kg. In addition, one of these also exceeded the SQAG-PEC criteria of 0.031 mg/kg.
- Acenaphthene was identified in 1 of 20 soil samples at a concentration in excess of the SQAG-TEC (0.0067 mg/kg). Applicable regulatory standards were otherwise not exceeded.
- Anthracene was identified in 7 of 20 soil samples at concentrations exceeding the SQAG-TEC of 0.0057 mg/kg. Applicable regulatory standards were otherwise not exceeded.

- Benzo(a)anthracene was identified in 4 of 20 soil samples at concentrations exceeding the SQAG-TEC of 0.11 mg/kg. In addition, two of these also exceeded the SCTL-LSW (0.8 mg/kg).
- Benzo(a)pyrene was identified in 5 of 20 soil samples at concentrations exceeding the SCTL-RDE of 0.1 mg/kg. In addition, two of these also exceeded the SQAG-TEC (0.15 mg/kg).
- Chrysene was identified in 3 of 20 soil samples at concentrations exceeding the SQAG-TEC of 0.17 mg/kg. Applicable regulatory standards were otherwise not exceeded.
- Fluoranthene was identified in 2 of 20 soil samples at concentrations exceeding the SQAG-TEC of 0.42 mg/kg. In addition, both of these also exceeded the SCTL-LSW (1.3 mg/kg).
- Fluorene was identified in 1 of 20 soil samples at a concentration in excess of the SQAG-TEC (0.077 mg/kg). Applicable regulatory standards were otherwise not exceeded.
- Phenanthrene was identified in 2 of 20 soil samples at concentrations exceeding the SQAG-TEC of 0.2 mg/kg. Applicable regulatory standards were otherwise not exceeded.
- Pyrene was identified in 4 of 20 soil samples at concentrations exceeding the SQAG-TEC of 0.2 mg/kg. In addition, one of these also exceeded the SQAG-PEC (1.5 mg/kg). The SCTL-LSW (1.3 mg/kg) was also exceeded in one sample.
- Aroclor-1260 was identified in 1 of 20 soil samples at a concentration in excess of the SCTL-LSW (0.002 mg/kg). Applicable regulatory standards were otherwise not exceeded.

Groundwater results obtained during these supplemental Phase II activities for the former Lennar landfill (MW-1, 2 and 3) have been compared with the FAC 62-777 GCTLs.

- Arsenic was detected in the background well, MW-1, at concentrations exceeding the Primary Standard of 0.01 milligrams per liter (mg/L) for both total and dissolved analyses. The GCTL for arsenic was not exceeded at monitor wells MW-2 and MW-3 located within the former landfill property.

- Aluminum (total) was detected in monitor well MW-2 at a concentration in excess of the Secondary Standard (0.2 mg/L). However, the aluminum concentration on dissolved analysis dropped to 0.065 mg/L. The GCTL for aluminum was not exceeded at monitor wells MW-1 and MW-3.

- Iron (total) was identified in all three samples at concentrations ranging from 0.67 mg/L to 1.7 mg/L, which exceed the Secondary Standard of 0.3 mg/L. Iron concentrations on dissolved analyses were significantly lower, however, remained above the GCTL at monitor wells MW-1 and MW-2.

4.3 Regional Groundwater Assessment Results

Groundwater results obtained during these supplemental Phase II activities for the regional groundwater monitoring wells (TMW-6 through TMW-11) have been compared with the FAC 62-777 GCTLs.

- Arsenic was not identified above the Primary Standard of 0.01 mg/L in any of the regional groundwater samples.

- Cadmium and iron were not detected on resampling of regional monitor well TMW-7. Aluminum was identified in the sample but did not exceed the GCTL.

These results have been evaluated by comparison with the appropriate human-health based SCTLs established in Chapter 62-777, FAC and the ecologically-based SQAG criteria recommendations for sediments.

- Arsenic was detected in most of the soil samples at concentrations exceeding the SCTL-RDE criteria of 2.1 mg/kg, and 2 of these also exceeded the SCTL-IDE criteria of 12 mg/kg. The SQAG-TEC of 9.8 mg/kg was exceeded in 4 of the samples collected at depth (2 and 5 ft bls), however, the SQAG-TEC for arsenic was not exceeded in any of the surficial soil samples (0-6 inches bls) collected.

4.4 Qualifications

Validation of the laboratory data was performed to ensure that all required quality control targets were met. In most cases, the data met the quality control requirements for both field and laboratory activities. The data generated during the assessment activities described herein are presented with the following qualifications:

- In general, both duplicate and split sample results showed strong correlation with primary sample results, with one exception. Split sample results (samples SP-1 and SP-2) for PAH analysis were rejected due to the presence of target analytes in the laboratory method blank.
- Detectable concentrations of the target analytes were not identified in any of the equipment blanks.

5.0 ECOLOGICAL RISK ASSESSMENT RESULTS

Analytical results obtained during the supplemental Phase II assessment activities described herein have been input to the draft SFWMD Risk Assessment Simulator, Version 1.3 (September 2002) developed by NewFields, Inc. for a preliminary estimate of hazard quotients (HQs) for selected Receptors of Concern (ROC). The selected ROCs are not based on a formal ecological survey of the site, but are instead limited to avian and mammalian species considered by the NewFields model which are also listed as Endangered, Threatened, or of Special Concern by the Florida Fish and Wildlife Conservation Commission (FFWCC, January 2004). The NewFields model currently includes 11 of the listed avian and mammalian ROCs, as follows:

Endangered Species

- Florida panther
- snail kite
- wood stork

Threatened Species

- American kestrel
- bald eagle
- scrub jay

Species of Special Concern:

- Sherman's fox squirrel
- little blue heron
- osprey
- tricolored heron
- white ibis

HQs are determined by estimating the average daily dose of a specific chemical to which an ROC is predicted to be exposed, and then dividing that value by an estimated threshold limit value for the chemical which can be tolerated by the ROC. Two HQs are developed in this manner, one representing the No Observed Adverse Effects Level (HQ-NOAEL) and corresponding to the SQAG-TEC, and one representing the Lowest Observed Adverse Effects Level (HQ-LOAEL) and corresponding to the SQAG-PEC. An HQ exceeding unity ($HQ > 1$) indicates the potential for adverse effects to an organism, whereas an HQ less than unity ($HQ < 1$) suggests that there is no significant ecological risk present.

As a first step, HQs were calculated using the maximum detected concentration for each chemical of potential ecological concern (COPEC) exceeding a SQAG in the former landfill area. For any COPEC with a resulting $HQ > 1.0$, the HQs were then recalculated using the average concentration for a particular COPEC based on the 95% upper confidence level (UCL95) of the arithmetic mean. For HQs associated with organic contaminants, the average fraction organic carbon (foc) identified in BBCW soils (4.2%) was used. In addition, for the organic contaminants, partition coefficients proposed in PSI's Technical Memorandum dated April 17, 2006 have been utilized.

For the purposes of this screening level ecological risk assessment, the discussion below will be limited to the most sensitive ROC for a given condition, as follows:

- For organic contaminants in sediment, the little blue heron is the most sensitive ROC.
- For metals in sediment, the snail kite is the most sensitive ROC.

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5.1 Metals

5.1.1 Arsenic

Arsenic was identified in 9 soil samples collected within the former landfill area at concentrations in excess of the SQAG-TEC. The HQ-NOAEL for the snail kite based on the maximum detected arsenic concentration (24 mg/kg) was 0.492.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with identified concentrations of arsenic in soils associated with the former landfill area.

5.1.2 Barium

Barium was identified in 3 soil sample collected within the former landfill area at concentrations in excess of the SQAG-TEC. The HQ-NOAEL for the snail kite based on the maximum detected barium concentration (54 mg/kg) was 0.217.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with identified concentrations of barium in soils associated with the former landfill area.

5.1.3 Cadmium

Cadmium was identified in 4 of the soil samples collected within the former landfill area at concentrations in excess of the SQAG-TEC. The HQ-NOAEL for the snail kite based on the maximum detected cadmium concentration (1.3 mg/kg) was 0.0462.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with identified concentrations of cadmium in soils associated with the former landfill area.

5.1.4 Chromium

Chromium was identified in all 20 of the soil samples collected within the former landfill area at concentrations in excess of the SCTL-LSW. The HQ-NOAEL for the snail kite based on the maximum detected chromium concentration (29 mg/kg) was 0.308.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with identified concentrations of chromium in soils associated with the former landfill area.

5.1.5 Lead

Lead was identified in 2 of the soil samples collected within the former landfill area at concentrations in excess of the SQAG-TEC. The HQ-NOAEL for the snail kite based on the maximum detected lead concentration (39 mg/kg) was 0.0537.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with identified concentrations of lead in soils associated with the former landfill area.

5.1.6 Mercury

Mercury was identified in 2 soil samples collected within the former landfill area at concentrations in excess of the SQAG-TEC. The HQ-NOAEL for the snail kite based on the maximum detected mercury concentration (0.2 mg/kg) was 0.187.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with the identified concentrations of mercury in soils associated with the former landfill area.

5.1.7 Selenium

Selenium was identified in 4 soil samples collected within the former landfill area at concentrations in excess of the SCTL-LSW. The HQ-NOAEL for the snail kite based on the maximum detected selenium concentration (1.0 mg/kg) was 0.0851.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with the identified concentrations of selenium in soils associated with the former landfill area.

5.1.8 Silver

Silver was identified in 1 soil sample collected within the former landfill area at a concentration in excess of the SCTL-LSW. The HQ-NOAEL for the snail kite based on the maximum detected silver concentration (0.26 mg/kg) was 0.00166.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with the identified concentrations of silver in soils associated with the former landfill area.

5.2 Organochlorine Pesticides

5.2.1 Alpha-Chlordane

Alpha-Chlordane was identified in 4 soil sample collected within the former landfill area at concentrations in excess of the SQAG-TEC. In addition, alpha-Chlordane was also identified in a single soil sample (SB-10) at a concentration in excess of the SQAG-PEC. The HQ-NOAEL for the little blue heron based on the maximum detected alpha-Chlordane concentration (0.025 mg/kg) was 0.161.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with identified concentrations of alpha-Chlordane in soils associated with the former landfill area.

5.2.2 Gamma-Chlordane

Gamma-Chlordane was identified in 4 soil samples collected within the former landfill area at concentrations in excess of the SQAG-TEC. In addition, gamma-Chlordane was also identified in a single soil sample (SB-10) at a concentration in excess of the SQAG-PEC. The HQ-NOAEL for the little blue heron based on the maximum detected gamma-Chlordane concentration (0.031 mg/kg) was 0.161.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with identified concentrations of gamma-Chlordane in soils associated with the former landfill area.

5.2.3 4,4-DDE

4,4-DDE was identified in 6 soil samples collected within the former landfill area at concentrations in excess of the SQAG-TEC. In addition, 4,4-DDE was also identified in a single soil sample (SB-10) at a concentration in excess of the SQAG-PEC. The HQ-NOAEL for the little blue heron based on the maximum detected 4,4-DDE concentration (0.038 mg/kg) was 1.19, with an HQ-LOAEL of 0.328. Recalculation based on the mean (UCL95) concentration of 0.0173 mg/kg resulted in an HQ-NOAEL of 0.54.

Based on this discussion, the HQ results generated by the NewFields model suggest that there is no significant ecological risk associated with identified concentrations of 4,4-DDE in soils associated with the former landfill area.

5.3 Polynuclear Aromatic Hydrocarbons

Polynuclear aromatic hydrocarbons (PAH) were identified in 9 soil samples collected within the former landfill area at concentrations in excess of the SQAG-TEC. PAH concentrations in excess of the SQAG-PEC were identified in only one soil sample (SB-10).

The current version of the SFWMD Risk Assessment Simulator does not consider the petroleum-related PAH compounds. However, mean PAH concentrations based on the 95 percent Upper Confidence Limit (UCL95), as calculated using the FDEP-approved FL-UCL software, suggest that significant ecological risk will not be associated with average PAH concentrations in site soils, as follows:

- Acenapthene was identified in a single sample at a concentration in excess of the SQAG-TEC (0.0067 mg/kg). The UCL95 for acenapthene (0.0067 mg/kg) did not exceed the SQAG-TEC.

- Anthracene was identified in 7 samples at concentrations in excess of the SQAG-TEC (0.0057 mg/kg). The UCL95 for anthracene (0.1262 mg/kg) remained above the SQAG-TEC but was significantly less than the SQAG-PEC of 0.85 mg/kg.
- Benzo(a)anthracene was identified in 4 samples at concentrations in excess of the SQAG-TEC (0.11 mg/kg). The UCL95 for benzo(a)anthracene (0.37 mg/kg) remained above the SQAG-TEC but was significantly less than the SQAG-PEC of 1.1 mg/kg.
- Benzo(a)pyrene based on Toxic Equivalency (TEQ) as established in FAC 62-777 was identified in 4 samples at concentrations in excess of the SQAG-TEC (0.15 mg/kg). The UCL95 for benzo(a)pyrene based on the TEQ (0.41 mg/kg) remained above the SQAG-TEC but was significantly less than the SQAG-PEC of 1.5 mg/kg.
- Chrysene was identified in 3 samples at concentrations in excess of the SQAG-TEC (0.17 mg/kg). The UCL95 for chrysene (0.35 mg/kg) remained above the SQAG-TEC but was significantly less than the SQAG-PEC of 1.3 mg/kg.
- Fluoranthene was identified in 2 samples at concentrations in excess of the SQAG-TEC (0.42 mg/kg). The UCL95 for fluoranthene (0.59 mg/kg) remained above the SQAG-TEC but was significantly less than the SQAG-PEC of 2.2 mg/kg.
- Fluorene was identified in a single sample at a concentration in excess of the SQAG-TEC (0.077 mg/kg). The UCL95 for fluorene was found to be significantly less than the SQAG-TEC at 0.026 mg/kg.
- Phenanthrene was identified in 2 samples at concentrations in excess of the SQAG-TEC (0.2 mg/kg). The UCL95 for phenanthrene (0.3 mg/kg) remained above the SQAG-TEC but was significantly less than the SQAG-PEC of 1.2 mg/kg.
- Pyrene was identified in 4 samples at concentrations in excess of the SQAG-TEC (0.2 mg/kg). In addition, pyrene was also identified in a single sample (SB-10) at a concentration in excess of the SQAG-PEC (1.5 mg/kg). The UCL95 for pyrene (0.7 mg/kg) remained above the SQAG-TEC but was significantly less than the SQAG-PEC.
- Total PAH was identified in 2 samples at concentrations in excess of the SQAG-TEC (1.6 mg/kg). The UCL95 for total PAH (2.3 mg/kg) remained above the SQAG-TEC but was significantly less than the SQAG-PEC of 23 mg/kg.

6.0 SUMMARY OF FINDINGS

6.1 Former Lennar C&D Landfill Area

All debris has been removed from the landfill area and the closure of the landfill is pending with DERM. PSI previously collected 5 soil samples on the site from depths of 2-4 ft bls and 4-6 ft bls, based on organic vapor readings and field observations, as documented in our Phase II ESA report dated January 23, 2006. At that time, various metals (arsenic, barium, cadmium, chromium, lead, and mercury) and organic contaminants (aroclor-1260, DDE, and polynuclear aromatics) were identified in the soil samples at concentrations exceeding applicable regulatory standards based on human health and/or ecological receptors.

The intent of the current assessment was to systematically evaluate the presence of these contaminants in surficial soils (0-6 inches bls) across the site. To this end, 20 samples each representing an approximate 1-acre area were collected for laboratory analysis. These results were compared to the applicable regulatory standards and then subjected to a screening level ecological risk assessment (SLERA). The following results are reported:

- There is no apparent ecological risk associated with soils on the former Lennar landfill site.
- However, the PAH pyrene and the organochlorine pesticides alpha-Chlordane, gamma-Chlordane, and 4,4-DDE were identified in a single sample (SB-10) at concentrations which exceed the SQAG-PEC. Additional sampling will be required at this location to address FWS concerns and to delineate any potential source removal area.
- Arsenic was present in all samples at concentrations which exceed the human-health based standards (SCTL-RDE and SCTL-IDE). However, these standards will not be applicable if the site is flooded. Ecological standards (the SQAG-TEC) are also exceeded in many samples, but results of the SLERA indicate that unacceptable risk will not be associated with arsenic in soils following inundation of the property.
- The PAH benzo(a)pyrene was also noted in several samples at concentrations which exceed the SCTL-RDE. However, this standard will not be applicable if the site is flooded. Ecological standards (the SQAG-TEC) are also exceeded in several samples, but mean PAH concentrations across the site suggest that there is no significant ecological risk associated with PAH in soils following inundation of the property.

PSI's previous assessment activities also identified exceedances of Secondary Standards for TDS in groundwater samples collected from the former Lennar property. This result was considered consistent with groundwater quality for a shallow coastal aquifer and not necessarily indicative of a pollution source. Nonetheless, the current assessment included resampling of all available wells for both total and dissolved metals analyses. It should be noted, however, that only three of the previously installed wells remain on-site, with the remainder apparently destroyed by landfill reclamation and construction activities. The following results are reported:

- Primary Standards are not exceeded in groundwater beneath the landfill at any of the tested locations. Arsenic was identified above the Primary Standard in the background well only, which is located approximately one-half mile west and upgradient from the landfill.
- Exceedances of secondary standards are identified only for total aluminum and total iron, however, filtered samples for dissolved metals analyses did not exceed this standard.

Additional soil and groundwater data will be submitted to DERM by Lennar's consultant as a requirement of the landfill closure. This information is not available at the time of this report.

In addition, it should be noted that the results of PSI's recent Phase I/II ESA report (dated April 20, 2006) for three additional parcels in the BBCW project area indicate that the former Lennar landfill property (as well as contiguous tracts 500-001 and 500-002 to the west) are located within a State of Florida designated Brownfield Area. A Brownfield Area is a contiguous area of one or more Brownfield sites which have been designated by a local government resolution. A Brownfield Site is typically a commercial/industrial property that has been generally abandoned, idled, or under-utilized and where expansion or redevelopment is complicated by actual or perceived environmental contamination. Brownfield Areas may include all or portions of community redevelopment areas, enterprise zones, empowerment zones, closed military bases or other such designated economically deprived communities and areas, and EPA designated Brownfield pilot projects. There are numerous financial, regulatory and technical incentives for state and local governments to provide for the redevelopment and sustainable reuse of Brownfield Sites. These incentives can include fee waivers, property tax abatements or exemptions, local matches for federal and state programs, and fee moratoriums to encourage Brownfield redevelopment and cleanup. Some of the state incentives can include a loan trust fund, a loan guarantee program, a job bonus refund program, a 35% tax credit, a sales tax refund, and liability protection.

6.2 Regional Groundwater Assessment

The results of PSI's previous groundwater assessment activities in this area are documented in our Phase II ESA reported dated January 23, 2006. Arsenic was identified at low concentration but slightly above the GCTL in all of the samples collected. In addition, aluminum, cadmium, and iron were identified above the GCTLs in monitor well TMW-7 located east and downgradient from the county wastewater facility. These wells were resampled as part of the current investigation. The following results are reported:

- Arsenic is not present in area groundwater above the GCTL at any of the tested locations.

- Groundwater in the area is not obviously impacted by the presence of the county wastewater facility. Aluminum, cadmium, and iron were not identified above the GCTLs on resampling of TMW-7.

In addition, soil samples were collected at each wellhead to evaluate these materials as a potential source for arsenic in groundwater samples collected from the regional assessment wells. The following results are reported:

- Soils at the wellhead do not appear to represent a significant potential source for arsenic in groundwater in the area, given the groundwater analytical results discussed above.

- Arsenic concentrations in wellhead soils do not appear to impact the District's plans in the BBCW project area. Identified arsenic concentrations typically exceed the human-health based standards (both SCTL-RDE and SCTL-IDE), however, these soils are located in county-owned right-of-way. The presence of arsenic in these soils may be attributed to historical pesticide applications for right-of-way maintenance.

7.0 RECOMMENDATIONS

Based on the findings of this Supplemental Phase II ESA, PSI has the following recommendations:

- Based on the results of the regional groundwater assessment, no further investigation of groundwater quality appears to be warranted at this time.

- With one exception (SB-10), surficial soils on the former Lennar landfill site appear to be acceptable for the intended use of this property as a floodway. However, if alternate land uses are proposed it may be necessary to consider human health risks associated with arsenic and benzo(a)pyrene.

- Further delineation of the SB-10 area is required for the PAH pyrene and the organochlorine pesticides alpha-Chlordane, gamma-Chlordane, and 4,4-DDE to address FWS concerns and to delineate any potential source area removal. PSI recommends that the District provide remedial action for the impacted areas identified below:

Recognized Environmental Condition	Approximate Remedial Cost
Lennar Landfill SB-10 area	$100,000

  Specifically, PSI recommends that soils impacted with organics at the SB-10 sample location be further delineated, and that impacted soils so delineated be excavated for reuse in other areas of the project which will not be inundated at any time. Following this action in the above identified area, the subject property should meet the District requirements for the intended use as a conservation/flood area. The total estimated cost for all remedial actions identified above is $100,000.00.

- PSI recommends further research with respect to the Brownfield Area designation for the former Lennar landfill property (as well as contiguous tracts TA500-001 and TA500-002).


SW 232nd ST
SW 87th Avenue
Legend
LANDFILL PROJECT BOUNDARY
REGIONAL GROUNDWATER ASSESSMENT AREA
REFERENCE: THE AERIAL WAS OBTAINED FROM LABINS (2004 COQQ - 1FT RES)
0
425
850
1,700
2,550
3,400
Feet
552-5G173
PAV
4/26/2006
psi Information To Build On
Engineering • Consulting • Testing
FIGURE 1
BISCAYNE BAY COASTAL WETLANDS PROJECT
VICINITY MAP
MIAMI-DADE COUNTY, FLORIDA

PSI Information To Build On

BISCAYNE BAY COASTAL WETLANDS PROJECT

FORMER C&D LANDFILL SOIL BORING AND MONITORING WELL LOCATIONS

MIAMI-DADE COUNTY, FLORIDA

FIGURE 2

TMW-9 B1A - B1C
SW 232nd ST
TMW-11, B2A - B2C
TMW-10 B3A - B3C SP-3 D-3
SW 87th Avenue
TMW-6 B4A - B4C
TMW-7 B5A - B5C
TMW-8 B6A - B1C
Legend
0 150 300 600 900 1,200 1,500
Feet
psi Information To Build On
BISCAYNE BAY COASTAL WETLANDS PROJECT
REGIONAL GROUNDWATER ASSESSMENT
SOIL BORING & MONITORING WELL LOCATIONS
MIAMI-DADE COUNTY, FLORIDA
FIGURE 3