BA-04

West Pointe a la Hache Siphon Construction Summary Data and Graphics

06/25/03

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West Pointe a la Hache Siphon Construction (BA-04)

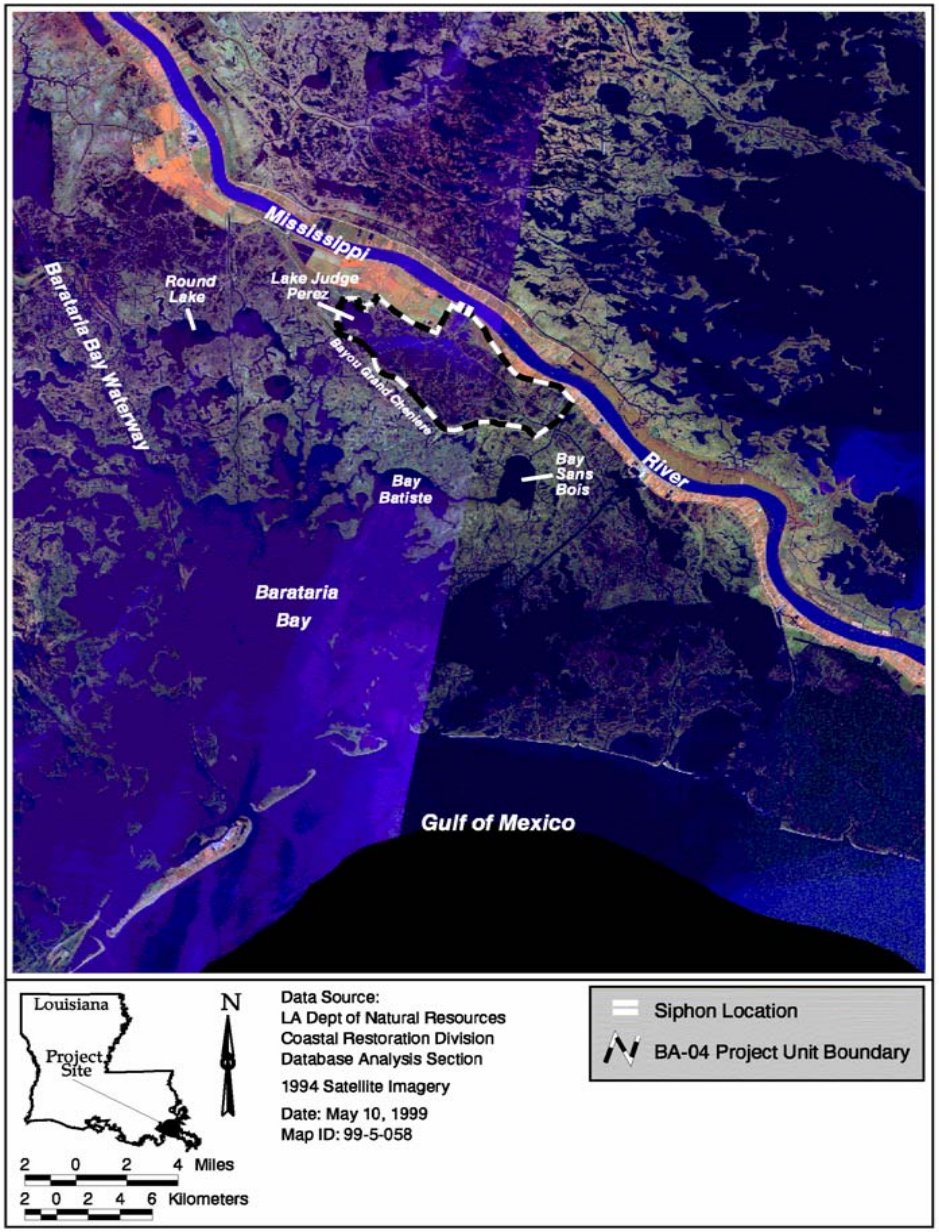
Project Overview

The project area is located within the Barataria Basin in Plaquemines Parish, Louisiana and contains approximately 16,297 acres (6,519 ha) of open water and brackish marsh. The BA-04 project is owned and operated by the Plaquemines Parish Government. Monitoring, technical advice and some maintenance is provided by the Louisiana Department of Natural Resources, Coastal Restoration Division.

The main project feature is the re-introduction of freshwater into the project area through a set of eight siphons. The freshwater re-introduction is intended to replace some of the ecological functions supported by periodic over-bank flooding that occurred prior to the placement of the flood-control levee system.

Construction was completed in 1992 and included a discharge pond with four outfall channels to distribute the siphoned freshwater into the marshes surrounding the discharge pond. The quantity of water flow through the siphons depends on the relative elevation of the Mississippi River. When all siphons are in operation, flow at normal high water exceeds 2,000 cubic feet per second (ft^3s^{-1}), 56 cubic meters per second (56 m^3s^{-1}).

BA-04 West Pointe a la Hache Siphon Construction Project Boundary.



BA-04 West Pointe a la Hache Siphons

West Pointe a la Hache Siphon Construction (BA04)

Project Objectives

- To protect the project area from continued degradation by introducing freshwater from the Mississippi River.
- Increase the inflow of sediment and nutrients into the project area.

Specific Goals

- Reduce and stabilize mean salinity.
- Improve the growing conditions and increase the relative abundance of the target plant species *Spartina patens*.
- Increase marsh to open-water ratio.

West Pointe a la Hache Siphon Construction (BA04)

Monitoring Elements

Salinity: Discrete salinity measurements will be recorded monthly at 12 stations. In addition, hourly salinity measurements will be taken by continuous recorders at 5 stations. Data will be used to characterize the spatial and temporal variation in salinity throughout the project area. Discrete salinity measurements will be collected from 1993-2011 and hourly readings will be taken from 1993 – 2003.

Water elevation: While not a goal of the project, hourly water level data will be taken from the five continuous recorder stations and discrete water level measurements will be recorded monthly from ten staff gauges. Data will be used to characterize the spatial and temporal variation in water level throughout the project area. Discrete water level data will be collected from 1993-2011 and hourly readings will be taken 1993 – 2003.

Vegetation: Species composition and relative abundance of emergent vegetation will be quantified using techniques described in Steyer et al. (1995). Twenty-one stations will be monitored in 1992 (pre-construction) and 1995 post-construction. Thirty-six Plots (4m2) will be monitored in years 1997, 2000, 2003, 2006, 2009.

Habitat Mapping: To document vegetated and non vegetated areas, color-infrared aerial photography (1:12,000 scale with ground controls) will be obtained and analyzed following procedures outlined in Steyer et al. (1995). The photography will be obtained in 1993 (pre-construction) and in 1999, and 2007 post-construction.

BA-04 Siphon Flow

Daily siphon discharge is estimated from the head differential between the river and the immediate outfall area and the number of siphons in operation.

- Table: Monthly mean siphon flow (ft^3s^{-1})
- Table: Monthly mean siphon flow (m^3s^{-1})
- Histogram: Siphon flow by operational category and year (ft^3s^{-1})
- Histogram: Siphon flow by operational category and year (m^3s^{-1})
- Histogram: Yearly mean siphon flow (ft^3s^{-1})
- Histogram: Yearly mean siphon flow (m^3s^{-1})

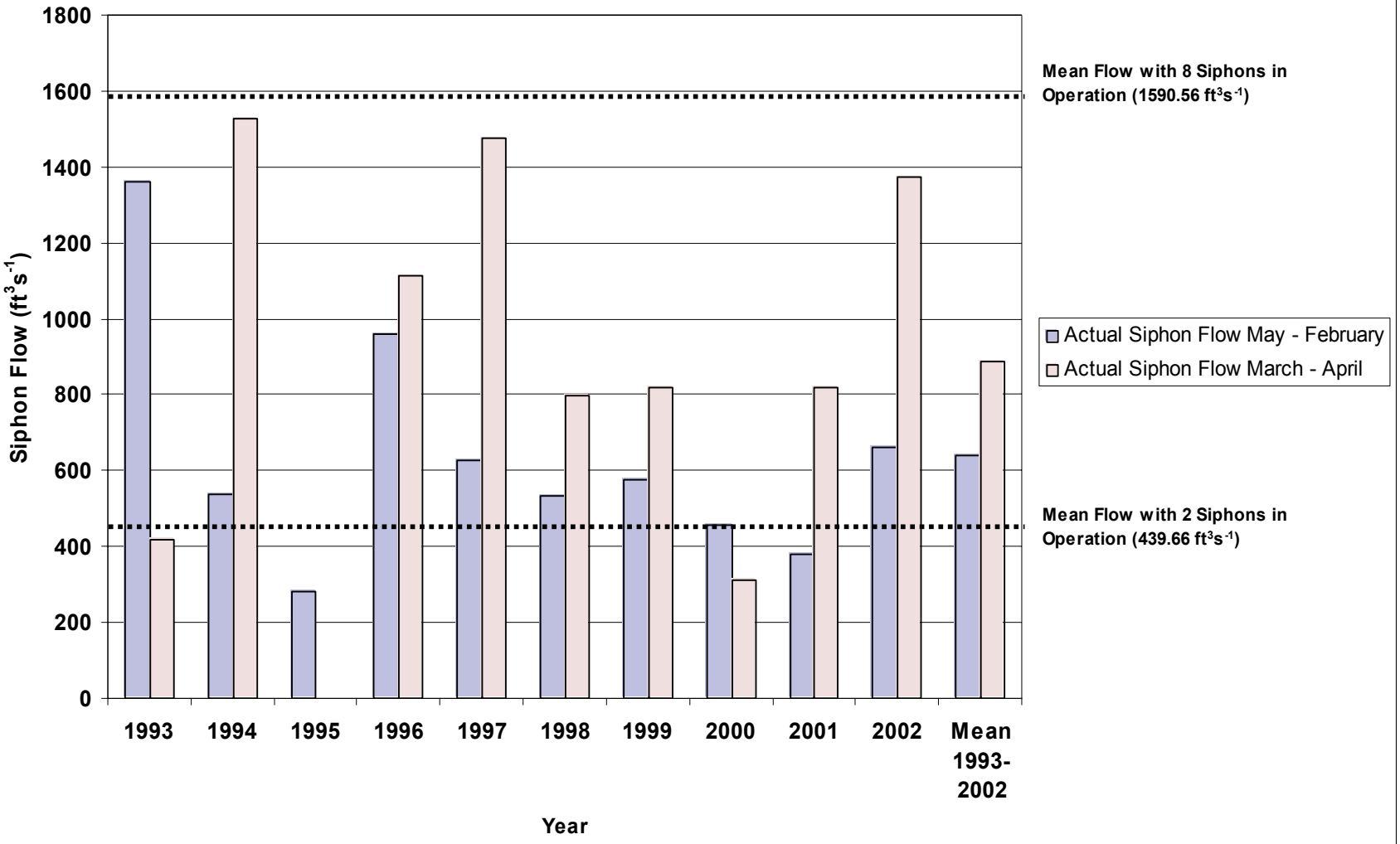
BA-04 Monthly Mean Siphon Flow (ft^3s^{-1}) 1992 - 2002

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
January	1699	1482	0	0	1467	248	1248	0	558	1129
February	1400	1868	0	892	1737	857	1497	0	878	1558
March	433	1968	0	976	1884	944	405	0	1101	1023
April	400	1082	0	1250	1071	651	1236	623	537	1727
May	1491	566	0	1796	*	534	1301	313	117	1891
June	1313	604	0	1649	1797	404	1150	395	335	1841
July	1244	308	1246	1241	*	416	564	643	565	200
August	773	137	812	1269	29	277	1	639	0	0
September	796	393	749	327	0	107	0	693	0	0
October	1689	0	0	168	0	320	0	549	0	0
November	1271	0	0	488	0	1060	0	684	0	0
December	1929	0	0	1785	0	1106	0	648	1336	0
* No Data Available										

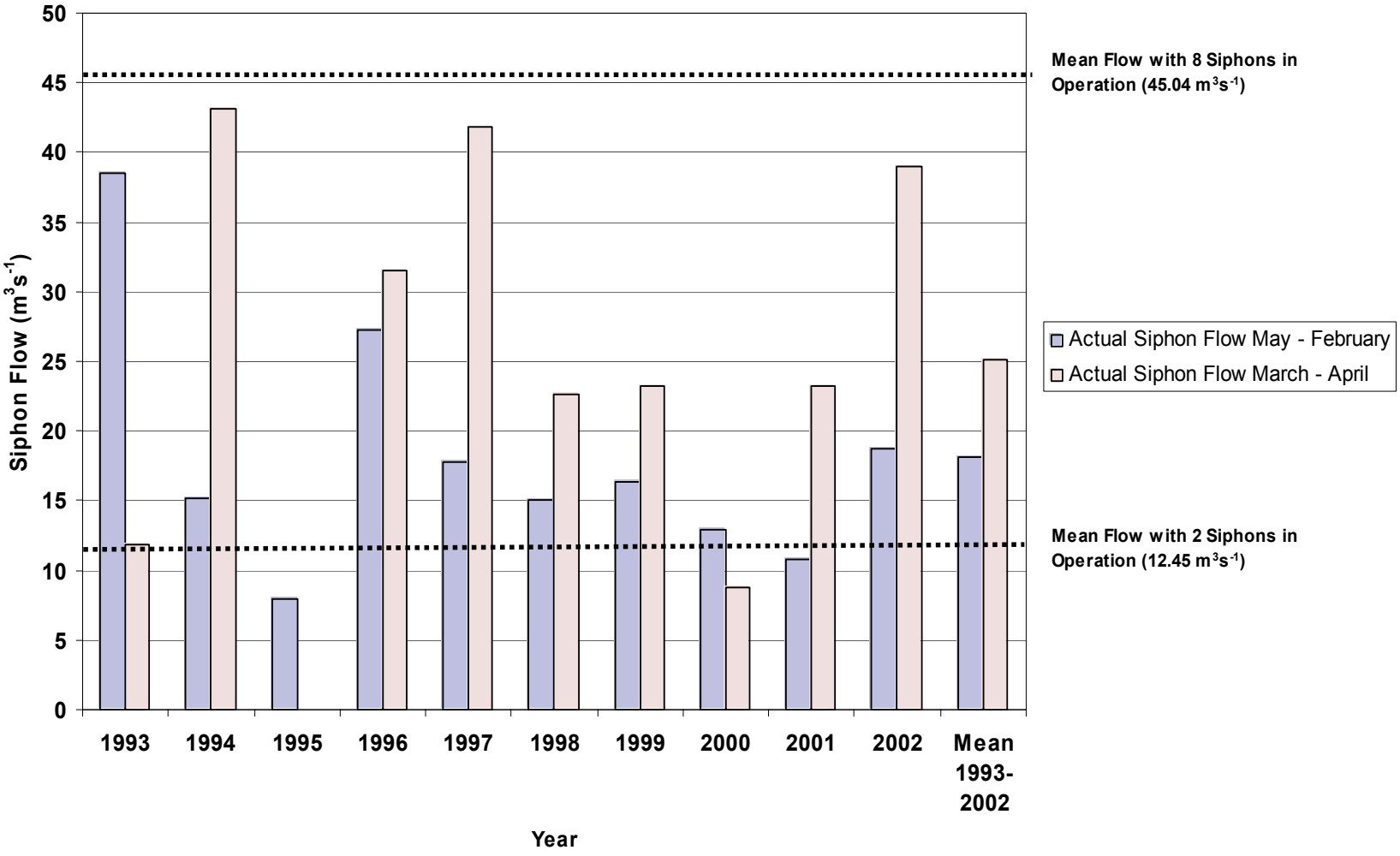
BA-04 Monthly Mean Siphon Flow (m^3s^{-1}) 1992 - 2002

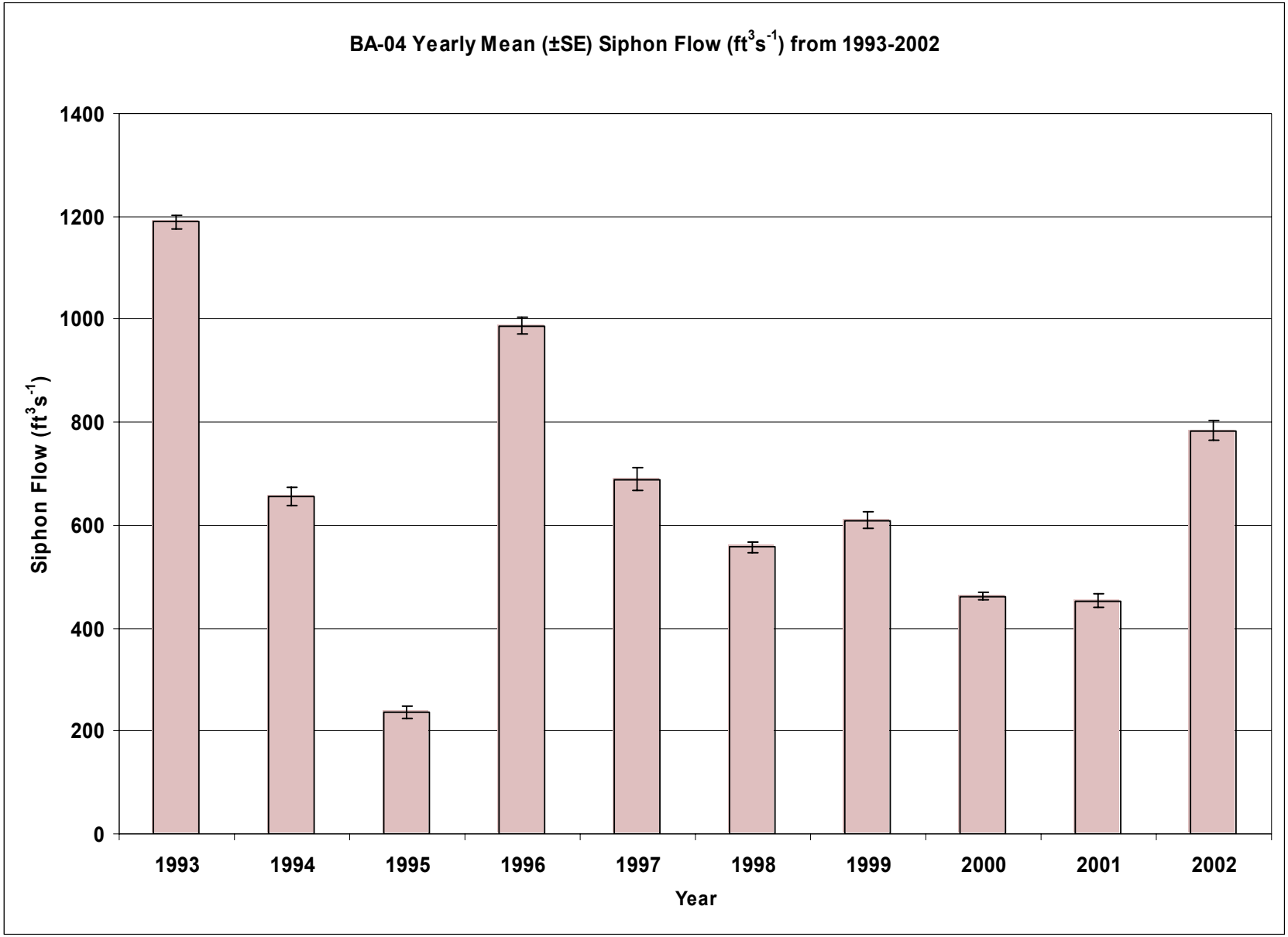
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
January	48	42	0	0	42	7	35	0	16	32
February	40	53	0	25	49	24	42	0	25	44
March	12	56	0	28	53	27	11	0	31	29
April	11	31	0	35	30	18	35	18	15	49
May	42	16	0	51	*	15	37	9	3	54
June	37	17	0	47	51	11	33	11	9	52
July	35	9	35	35	*	12	16	18	16	6
August	22	4	23	36	1	8	0	18	0	0
September	23	11	21	9	0	3	0	20	0	0
October	48	0	0	5	0	9	0	16	0	0
November	36	0	0	14	0	30	0	19	0	0
December	55	0	0	51	0	31	0	18	38	0
* No Data Available										

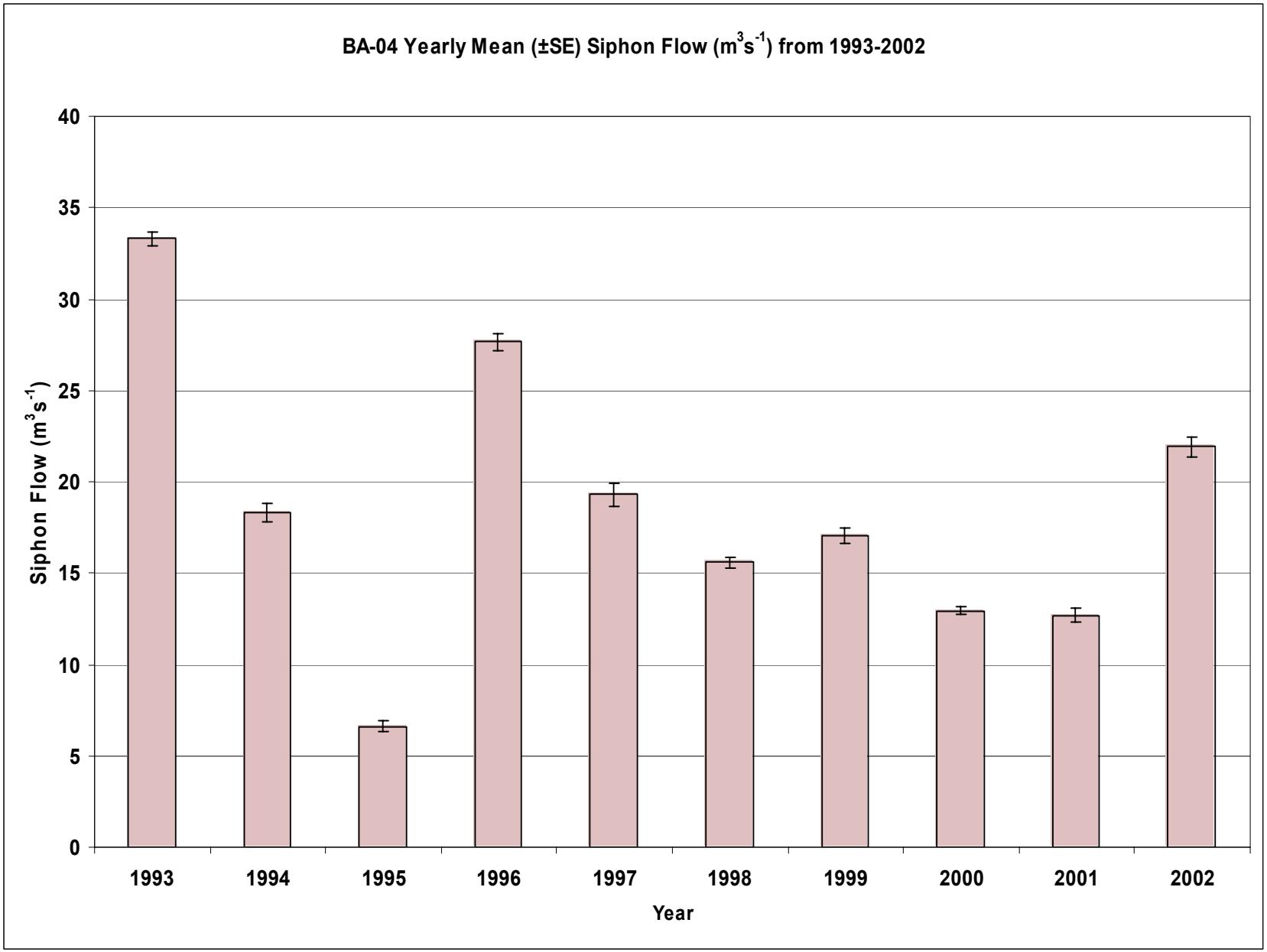
BA-04 Yearly mean siphon flow for two operation time periods from 1993 - 2002. Dotted lines represents mean flow for all years when either two or eight siphons were in operation.



BA-04 Yearly mean siphon flow for two operation time periods from 1993 - 2002. Dotted lines represents mean flow for all years when either two or eight siphons were in operation.




BA-04 Yearly Mean (±SE) Siphon Flow (ft^3s^{-1}) from 1993-2002
Siphon Flow (ft^3s^{-1})
1400
1200
1000
800
600
400
200
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year


BA-04 Yearly Mean (±SE) Siphon Flow (m^3s^{-1}) from 1993-2002
Siphon Flow (m^3s^{-1})
0
5
10
15
20
25
30
35
40
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year

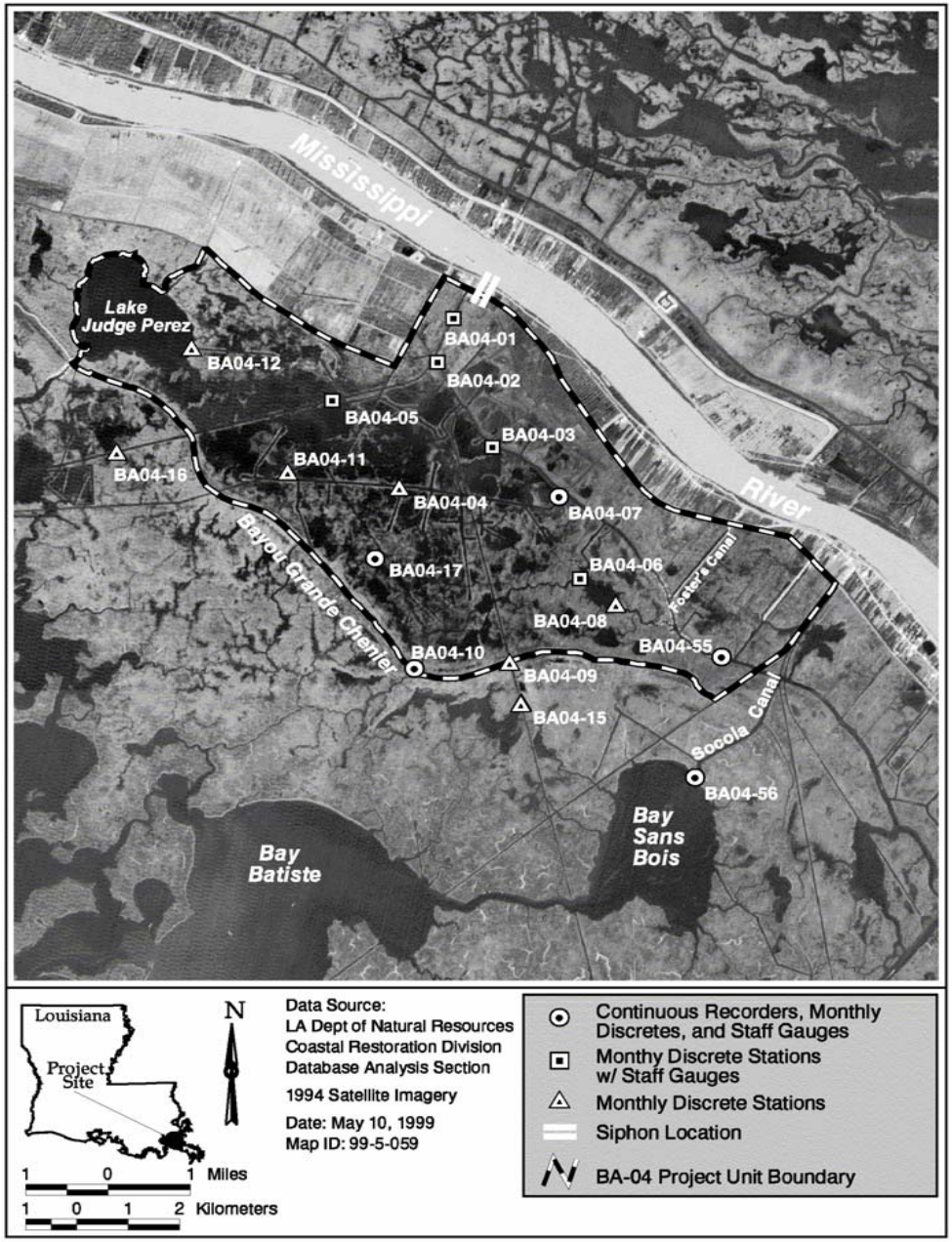
BA-04 Salinity

Continuous Data:

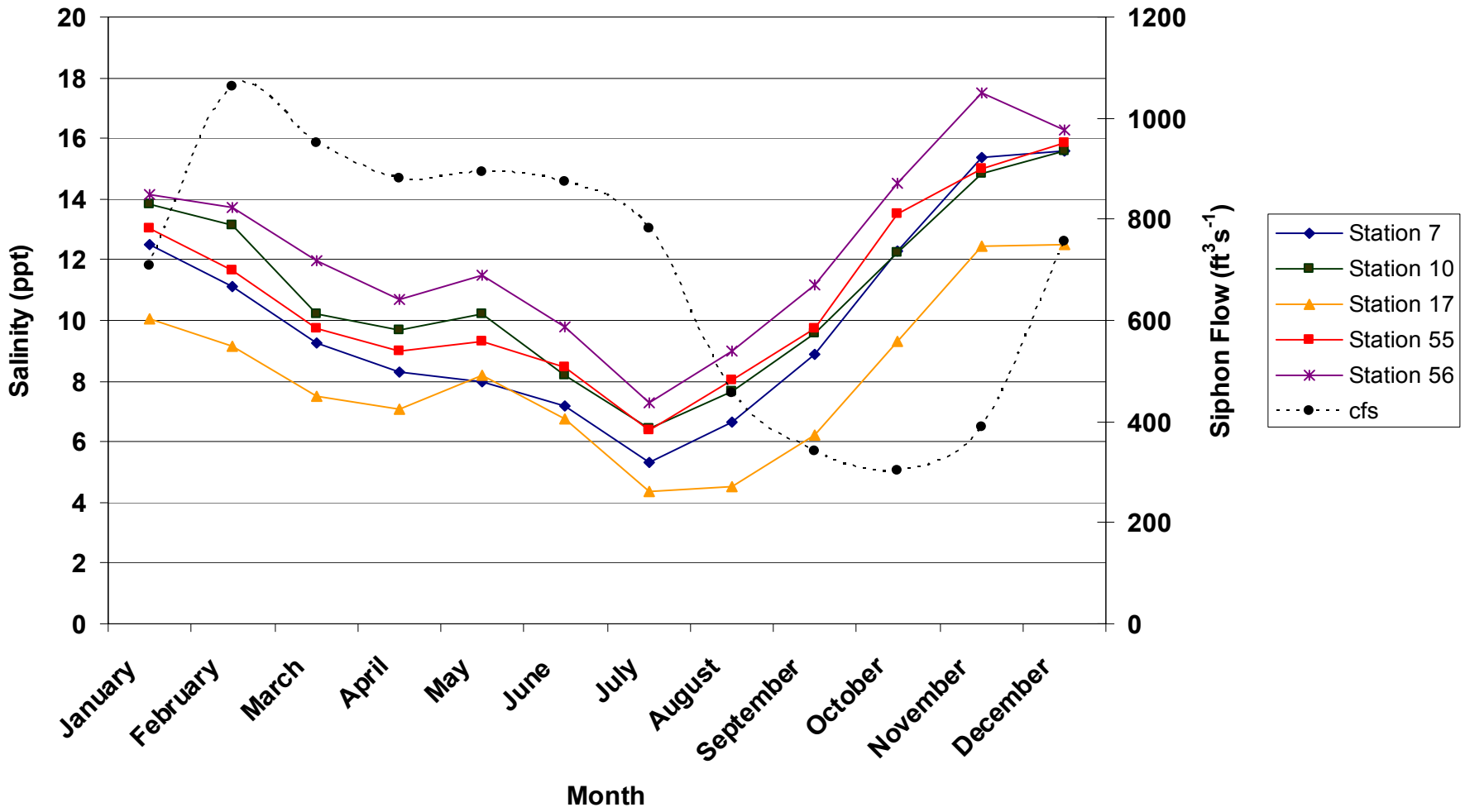
Salinity was monitored hourly at 5 continuous recorder stations from 1993 - 2002.

- Map: Continuous recorder stations, discrete monitoring stations, and staff gauge locations
- Graph: Mean station salinity and siphon flow (ft^3s^{-1})
- Graph: Mean station salinity and siphon flow (m^3s^{-1})
- Histogram: Mean salinity during three operational siphon categories by station
- Graph: Yearly mean salinity and siphon flow (ft^3s^{-1})
- Graph: Yearly mean salinity and siphon flow (m^3s-1)
- Graph: Linear regression showing siphon flow and salinity for individual stations (ft^3s^{-1})
- Graph: Linear regression showing siphon flow and salinity for individual stations (m^3s^{-1})

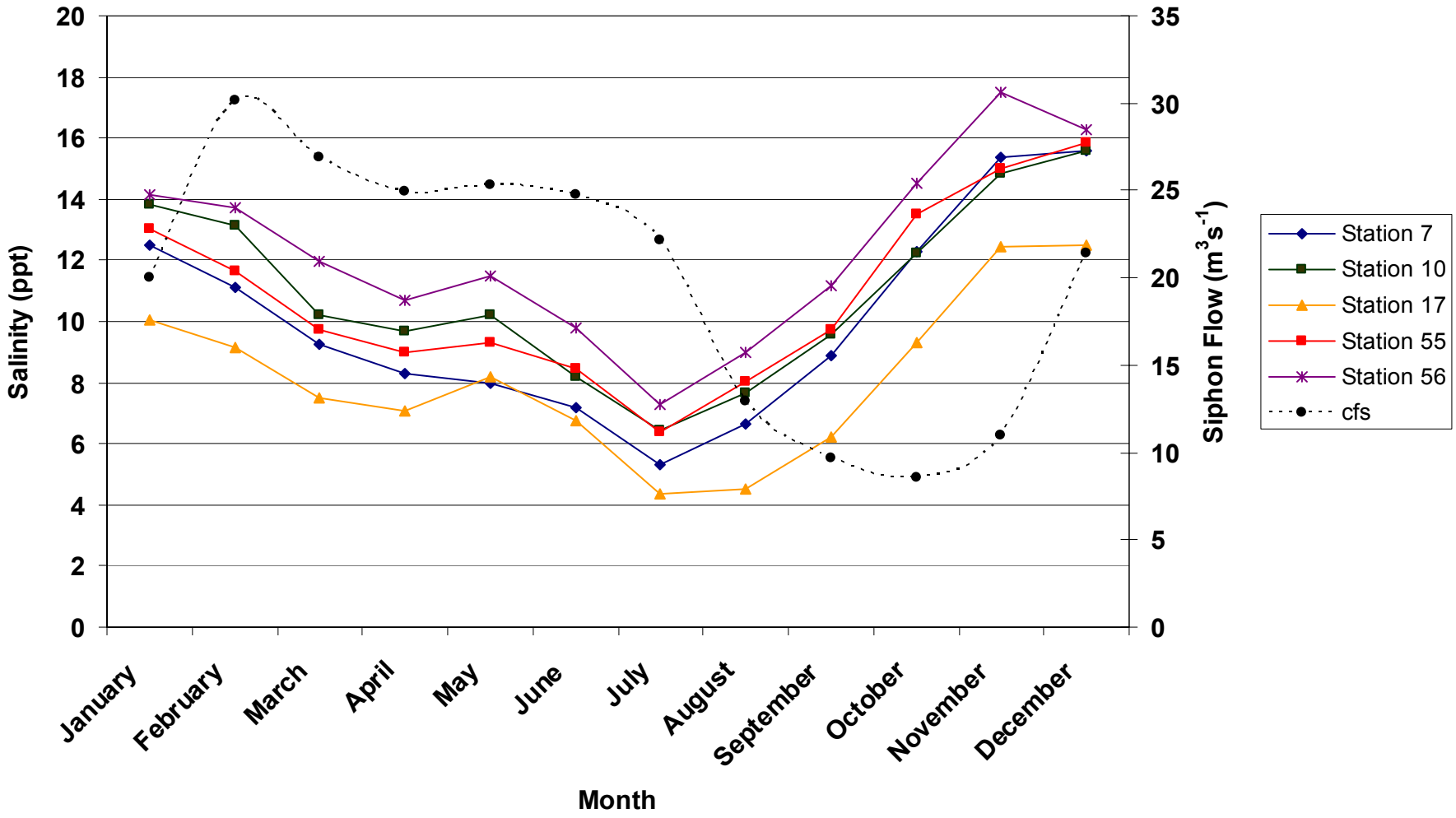
BA-04 Hourly continuous recorder stations, monthly discrete monitoring stations and stations 1, 2, 3, 5, 6, 7, 10, 17, 55, and 56 staff gauge locations.



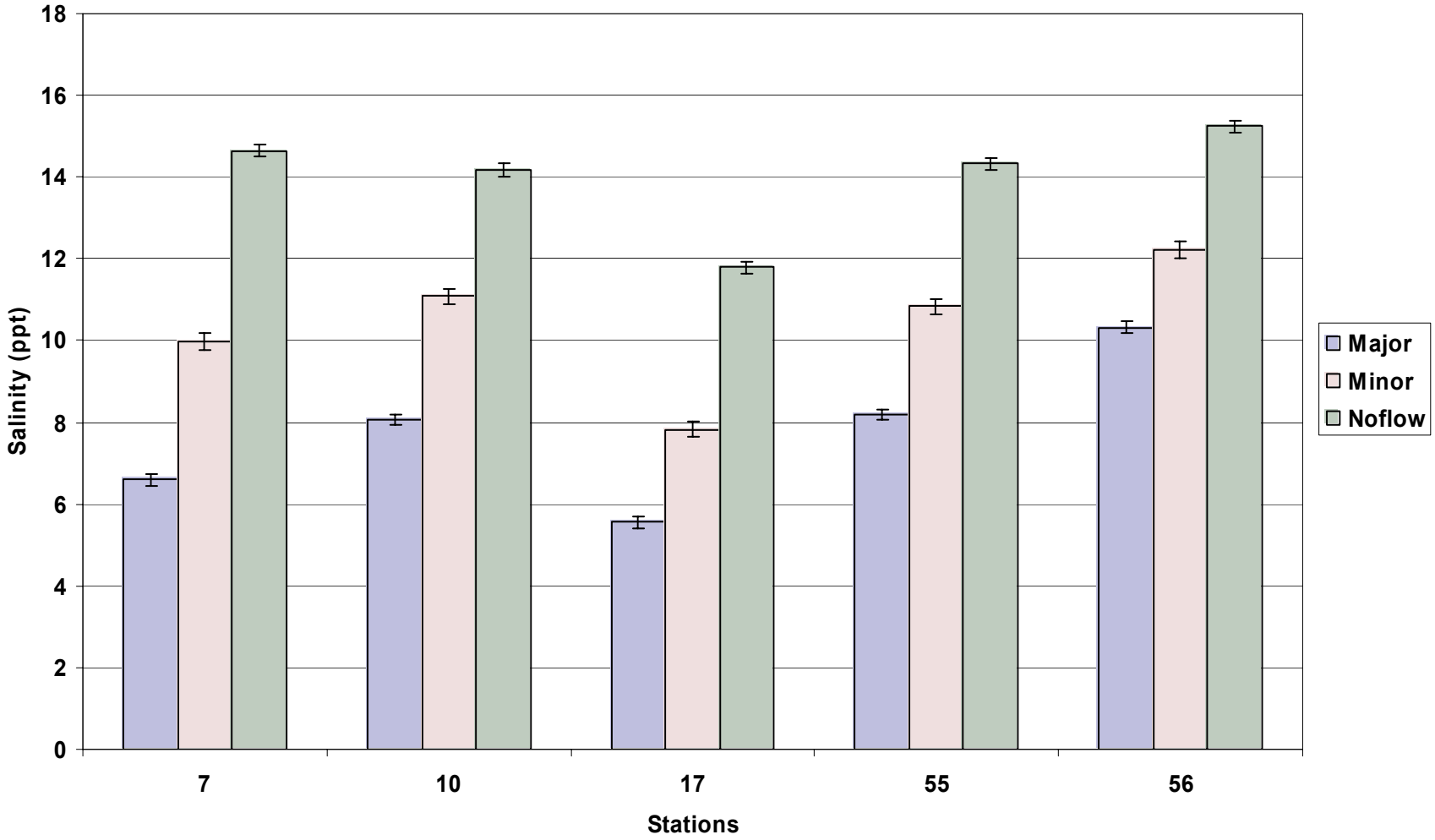
BA-04 Mean Salinity for Continuous Recorder Stations and Mean Siphon Flow (ft^3s^{-1}) for the period 1993-2002

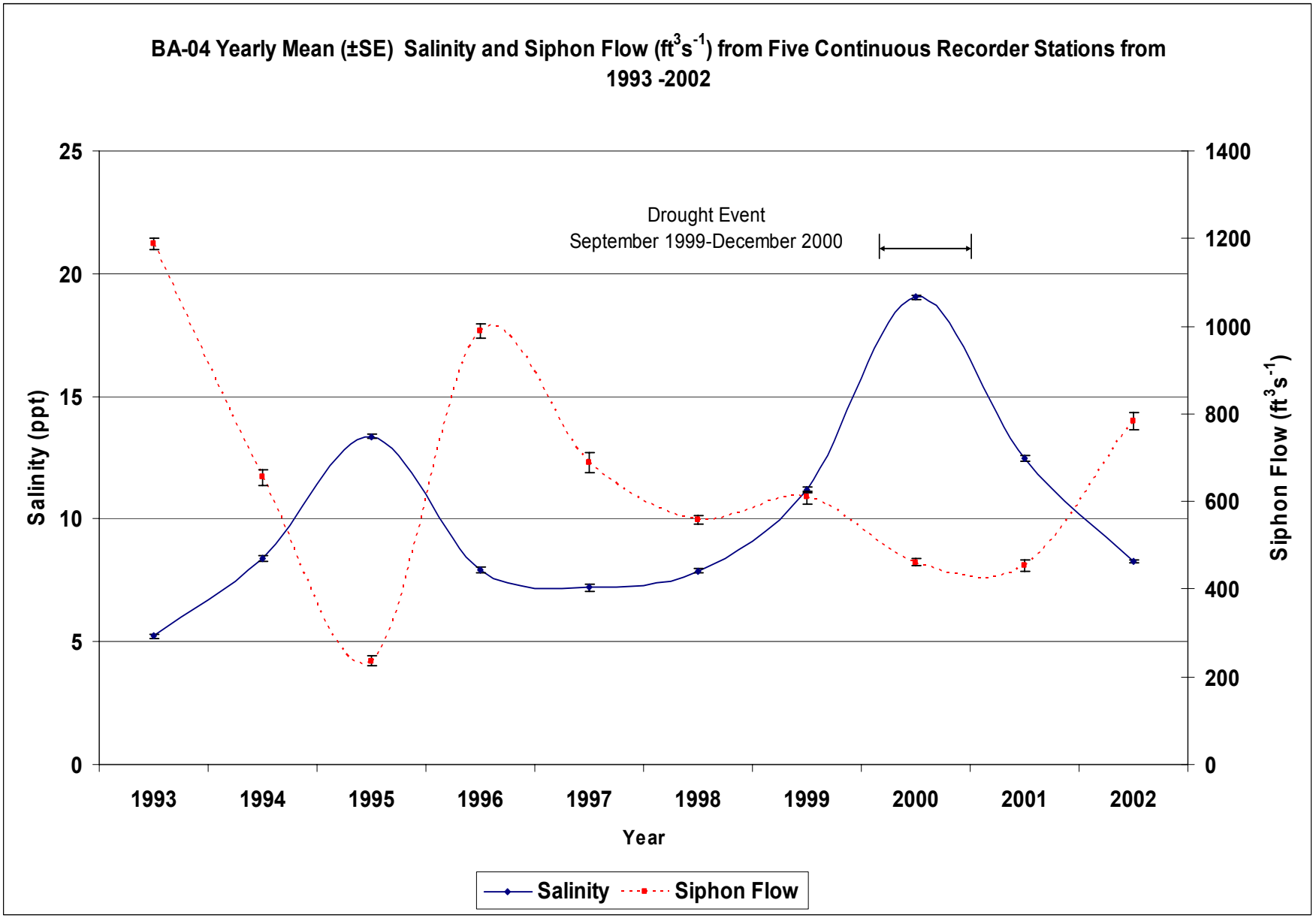


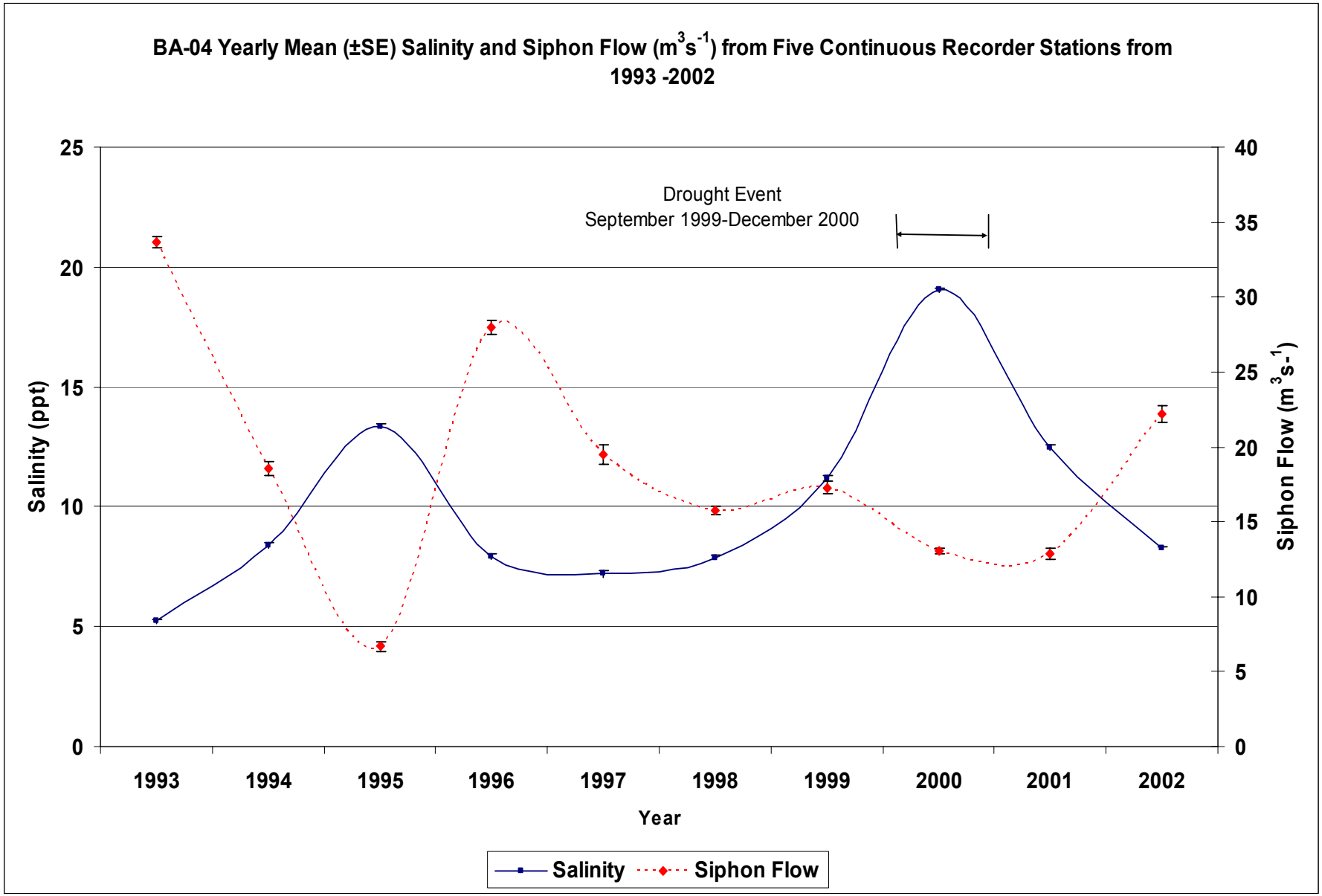
BA-04 Mean Salinity for Continuous Recorder Stations and Mean Siphon Flow (m^3s^{-1}) for the period 1993 - 2002



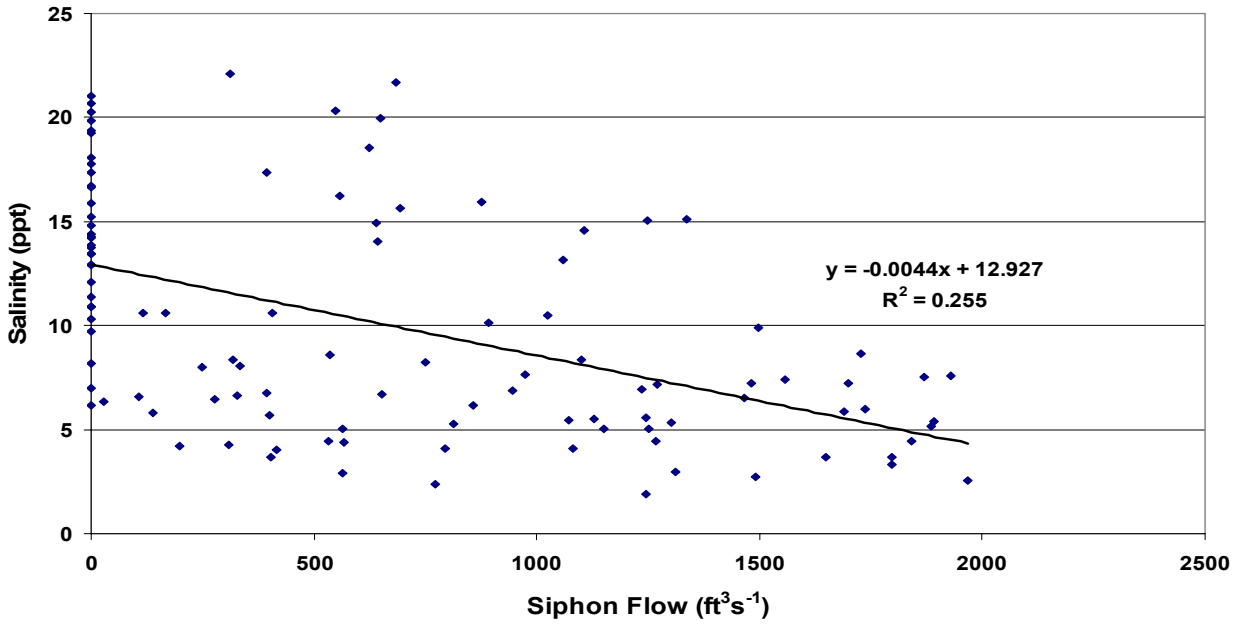
BA-04 Mean (±SE) Salinity for the period 1993-2002 during 3 Operational Categories for 5 Continuous Hydrologic Stations (Major discharge, >1,072 ft^3s^{-1} [30 m^3s^{-1}]/month; Minor, 0-1,072 ft^3s^{-1} [30 m^3s^{-1}]/month; No flow, 0 ft^3s^{-1} [0 m^3s^{-1}]/month)

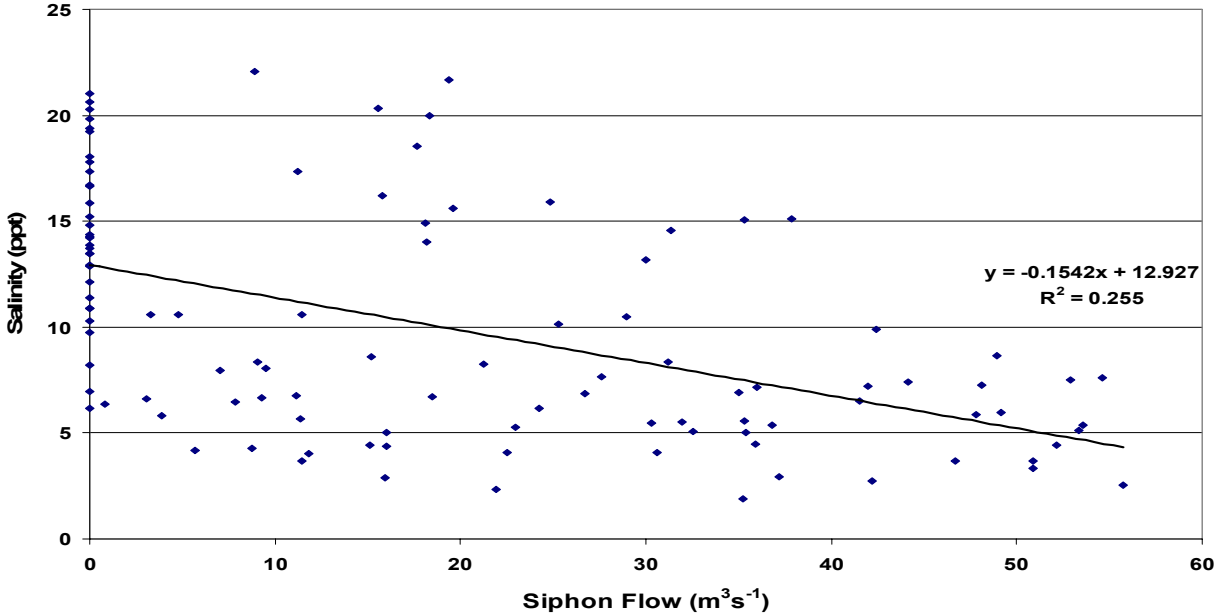



BA-04 Yearly Mean (±SE) Salinity and Siphon Flow (ft3s-1) from Five Continuous Recorder Stations from 1993 -2002
Drought Event
September 1999-December 2000
Salinity (ppt)
Siphon Flow (ft3s-1)
Year
0
5
10
15
20
25
0
200
400
600
800
1000
1200
1400
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Salinity
Siphon Flow

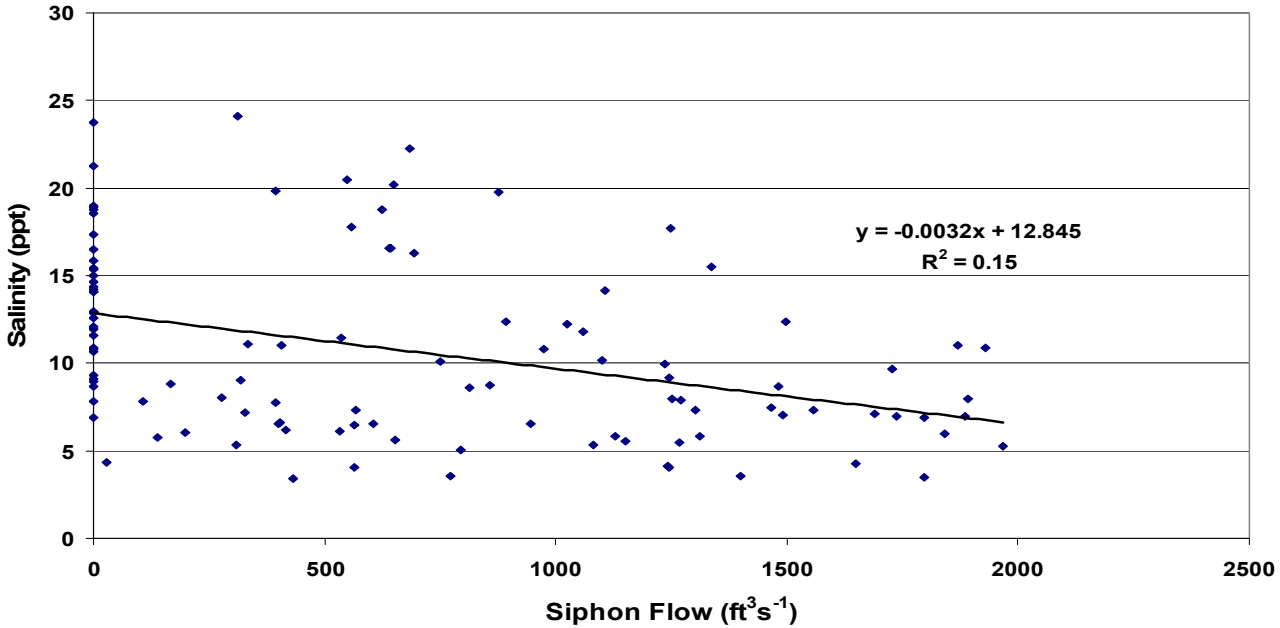

BA-04 Yearly Mean (±SE) Salinity and Siphon Flow (m^3s^{-1}) from Five Continuous Recorder Stations from 1993 -2002
Drought Event
September 1999-December 2000
Salinity (ppt)
Siphon Flow (m^3s^{-1})
0
5
10
15
20
25
0
5
10
15
20
25
30
35
40
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
Salinity
Siphon Flow

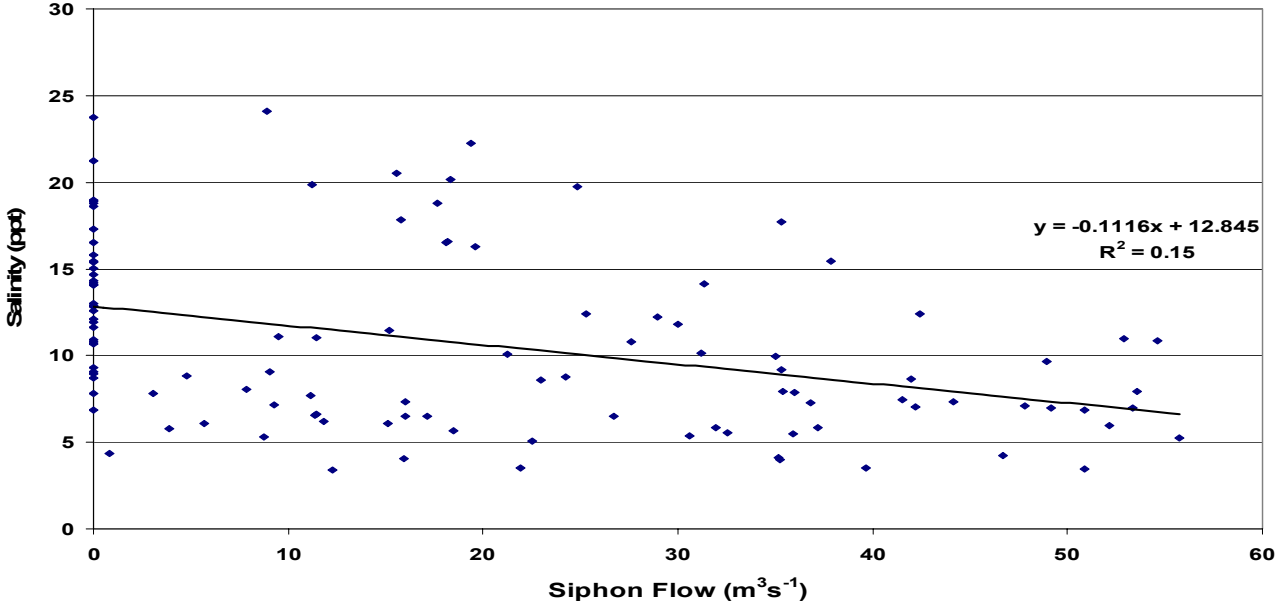
BA04-07 Monthly Mean Continuous Data Showing The Relationship between Salinity and Diversion Flow for Years 1993-2002



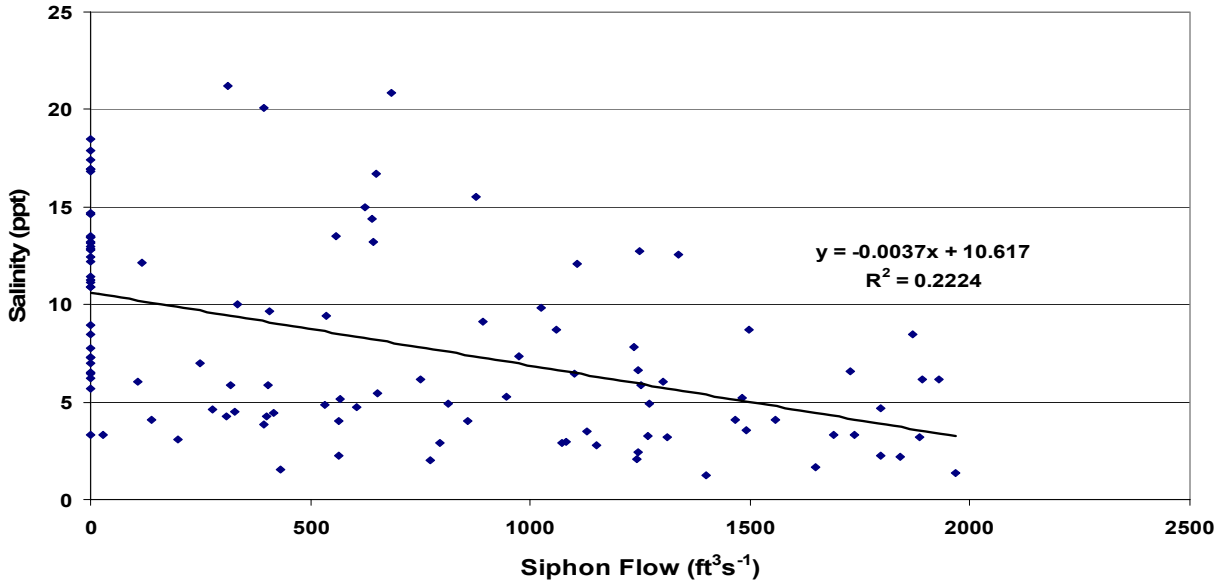


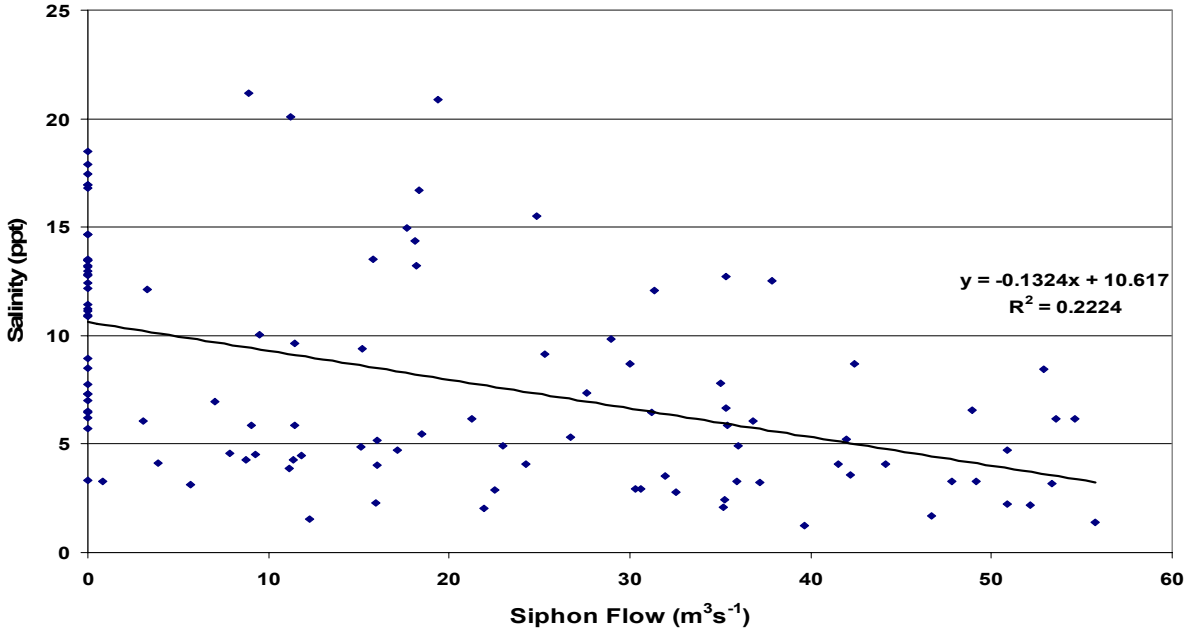
BA04-10 Monthly Mean Continuous Data Showing The Relationship between Salinity and Diversion Flow for Years 1993-2002



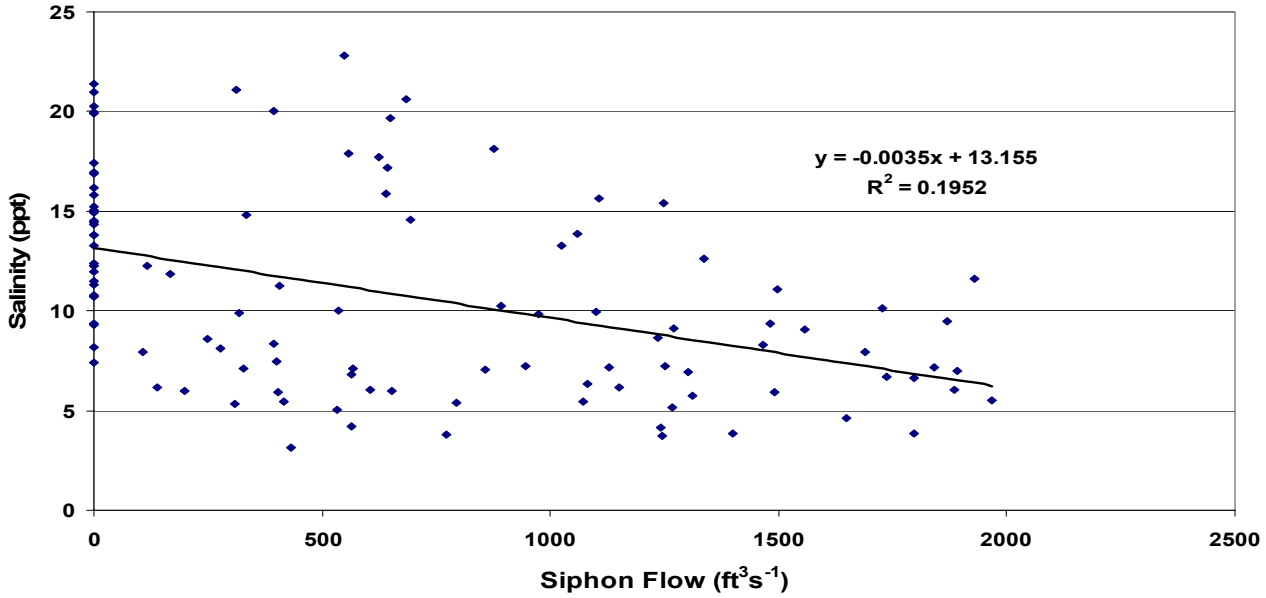


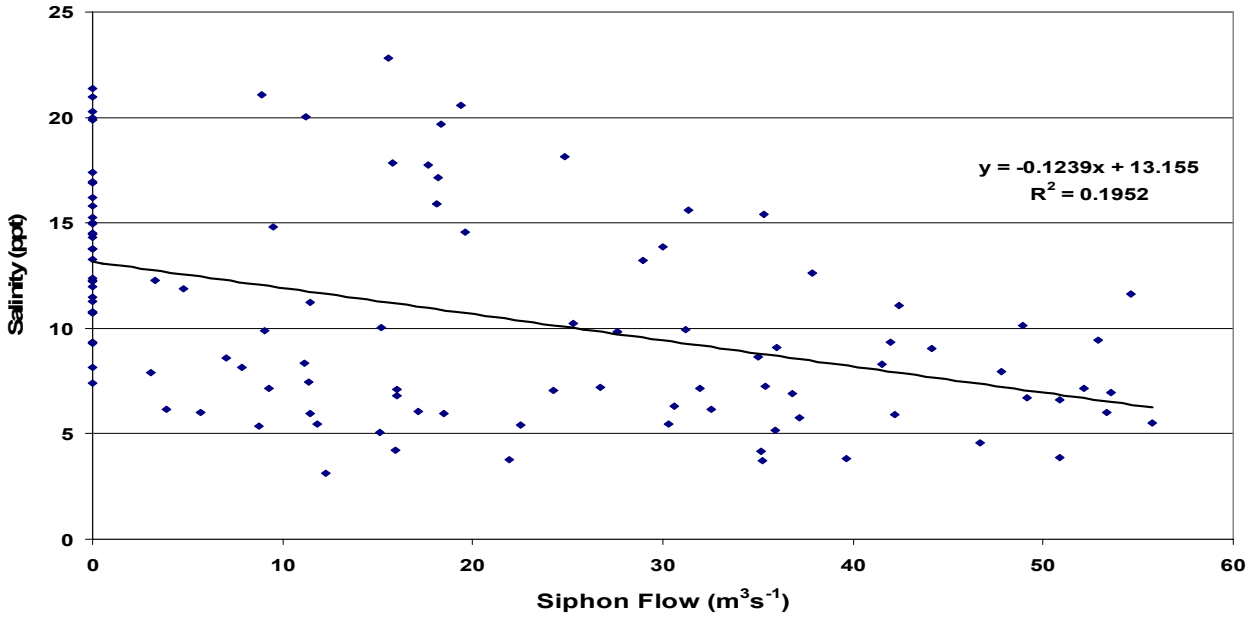
BA04-17 Monthly Mean Continuous Data Showing The Relationship between Salinity and Diversion Flow for Years 1993-2002



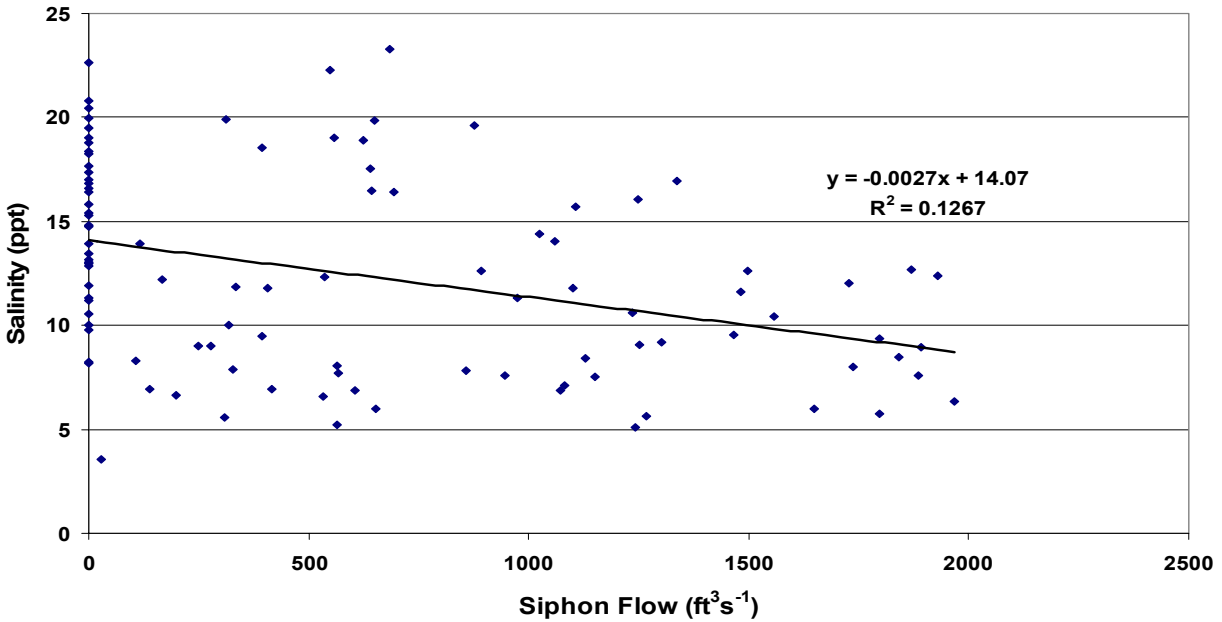


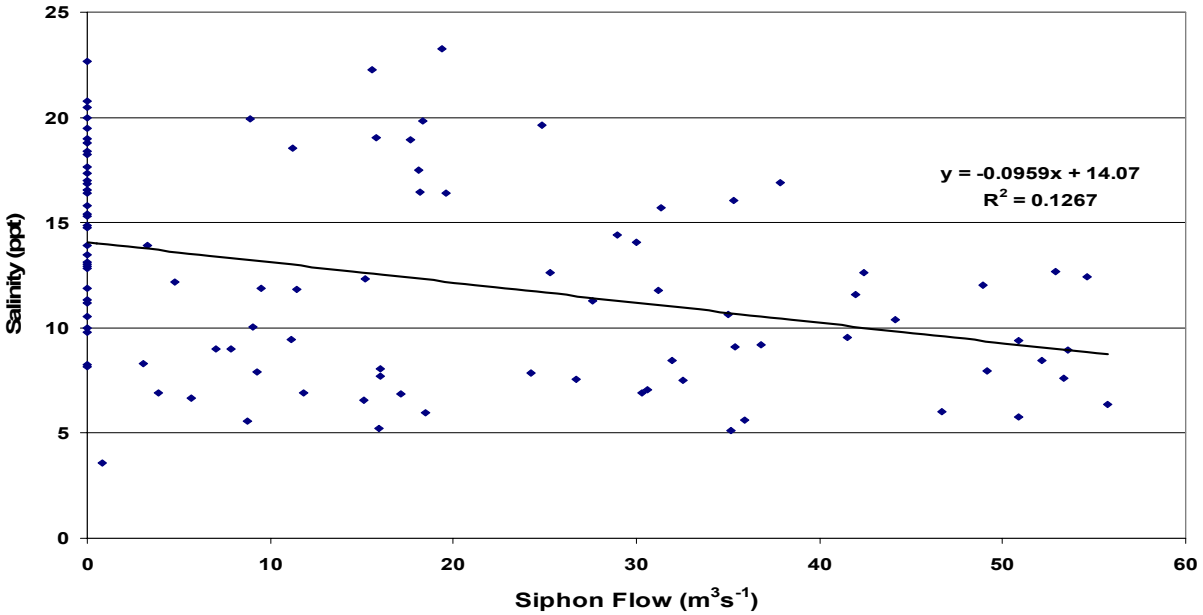
BA04-55 Monthly Mean Continuous Data Showing The Relationship between Salinity and Diversion Flow for Years 1993-2002





BA04-56 Monthly Mean Continuous Data Showing The Relationship between Salinity and Diversion Flow for Years 1993-2002



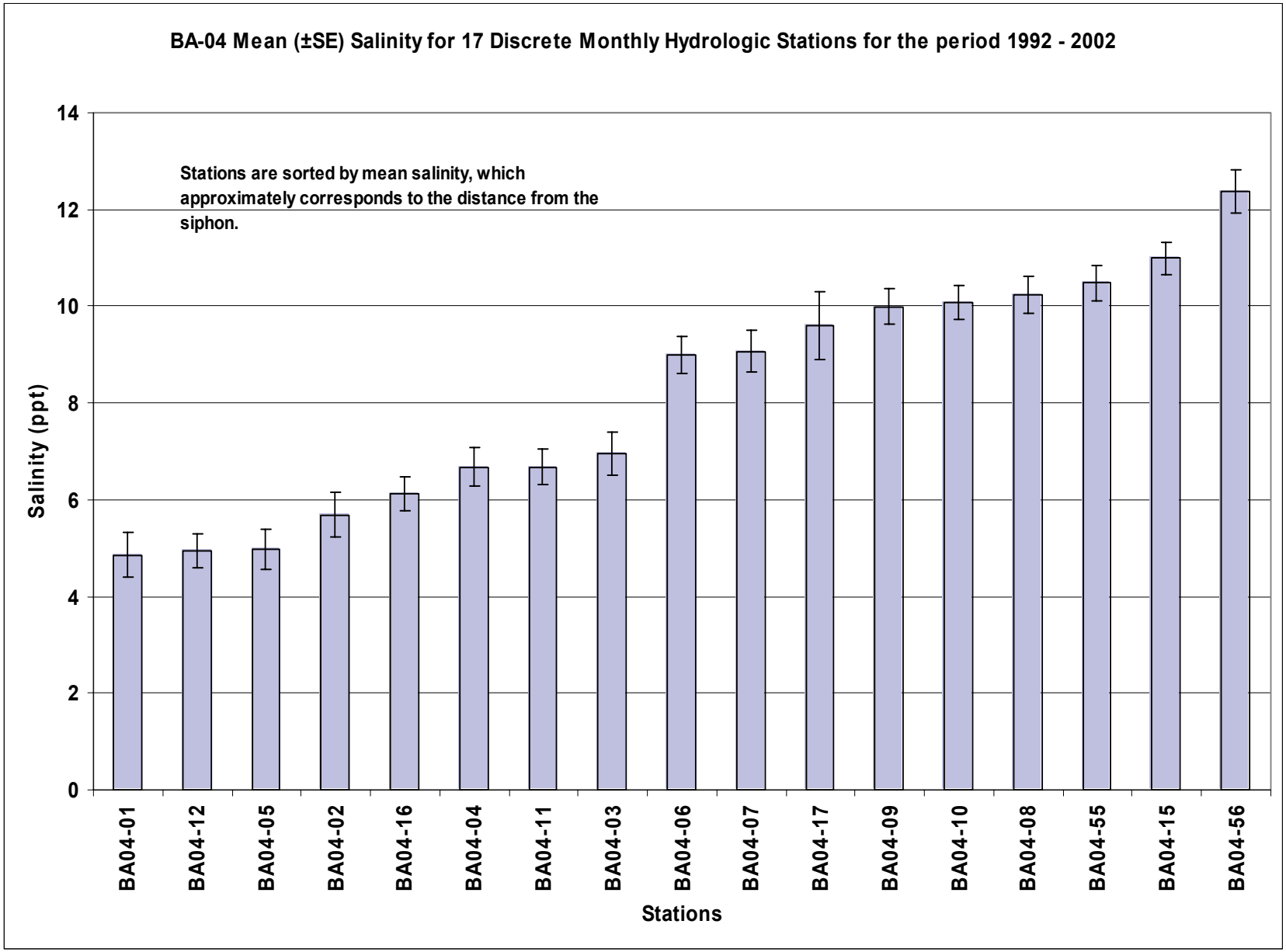


BA-04 Salinity

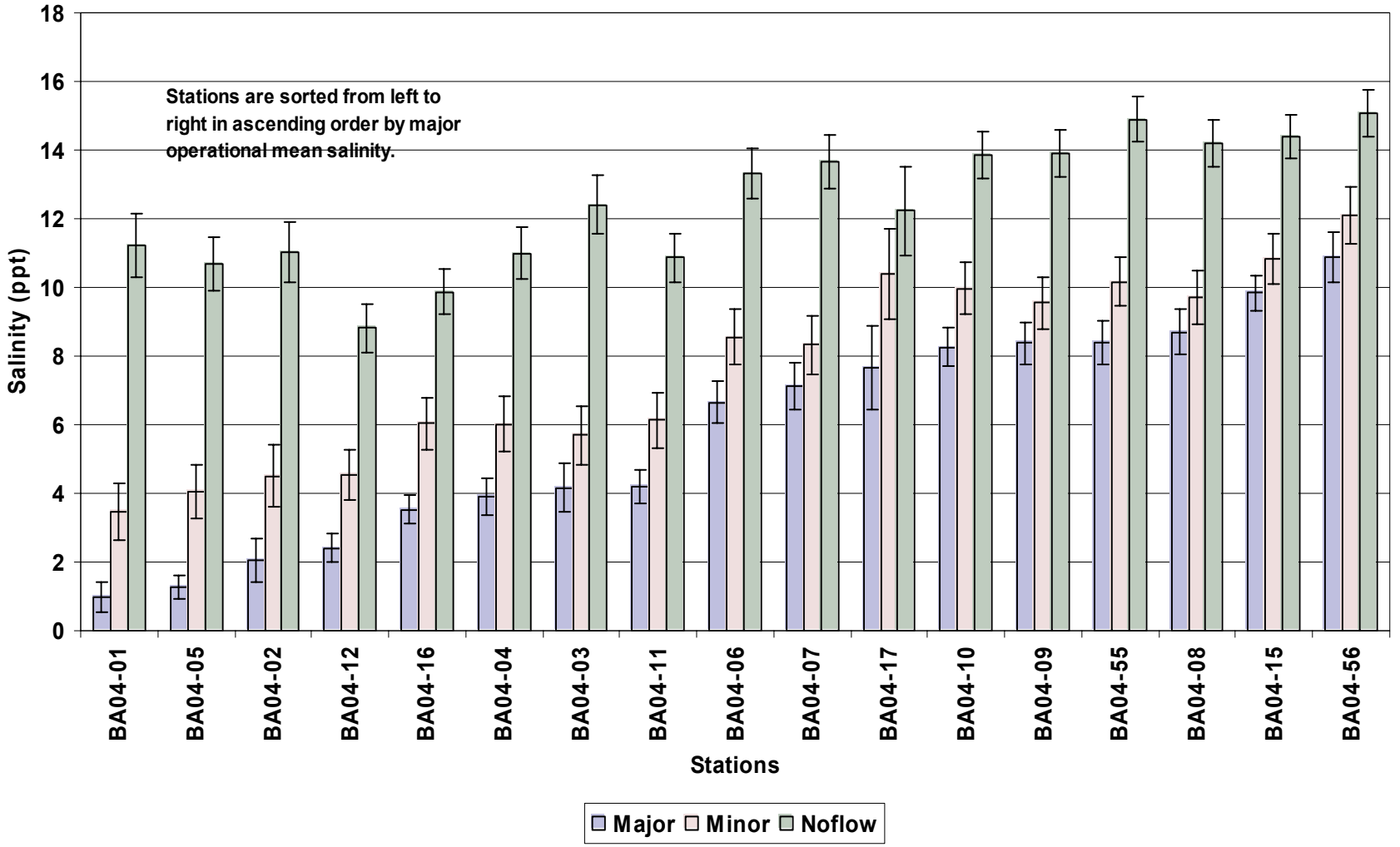
Discrete Data:

Salinity was monitored monthly at 17 discrete stations from 1992 - 2002.

- Histogram: Mean salinity by project stations
- Histogram: Mean salinity during three operational siphon categories by station


BA-04 Mean (±SE) Salinity for 17 Discrete Monthly Hydrologic Stations for the period 1992 - 2002
Stations are sorted by mean salinity, which approximately corresponds to the distance from the siphon.
Salinity (ppt)
0
2
4
6
8
10
12
14
BA04-01
BA04-12
BA04-05
BA04-02
BA04-16
BA04-04
BA04-11
BA04-03
BA04-06
BA04-07
BA04-17
BA04-09
BA04-10
BA04-08
BA04-55
BA04-15
BA04-56
Stations

BA-04 Mean (±SE) Salinity for the period 1993-2001 during 3 Operational Categories for 17 Discrete Monthly Hydrologic Stations (Major discharge, >1,072 ft^3s^{-1} [30m^3s^{-1}]/month; Minor, 0-1,072 ft^3s^{-1} [30m^3s^{-1}]/month; Noflow, 0 ft^3s^{-1} [0 m^3s^{-1}]/month)

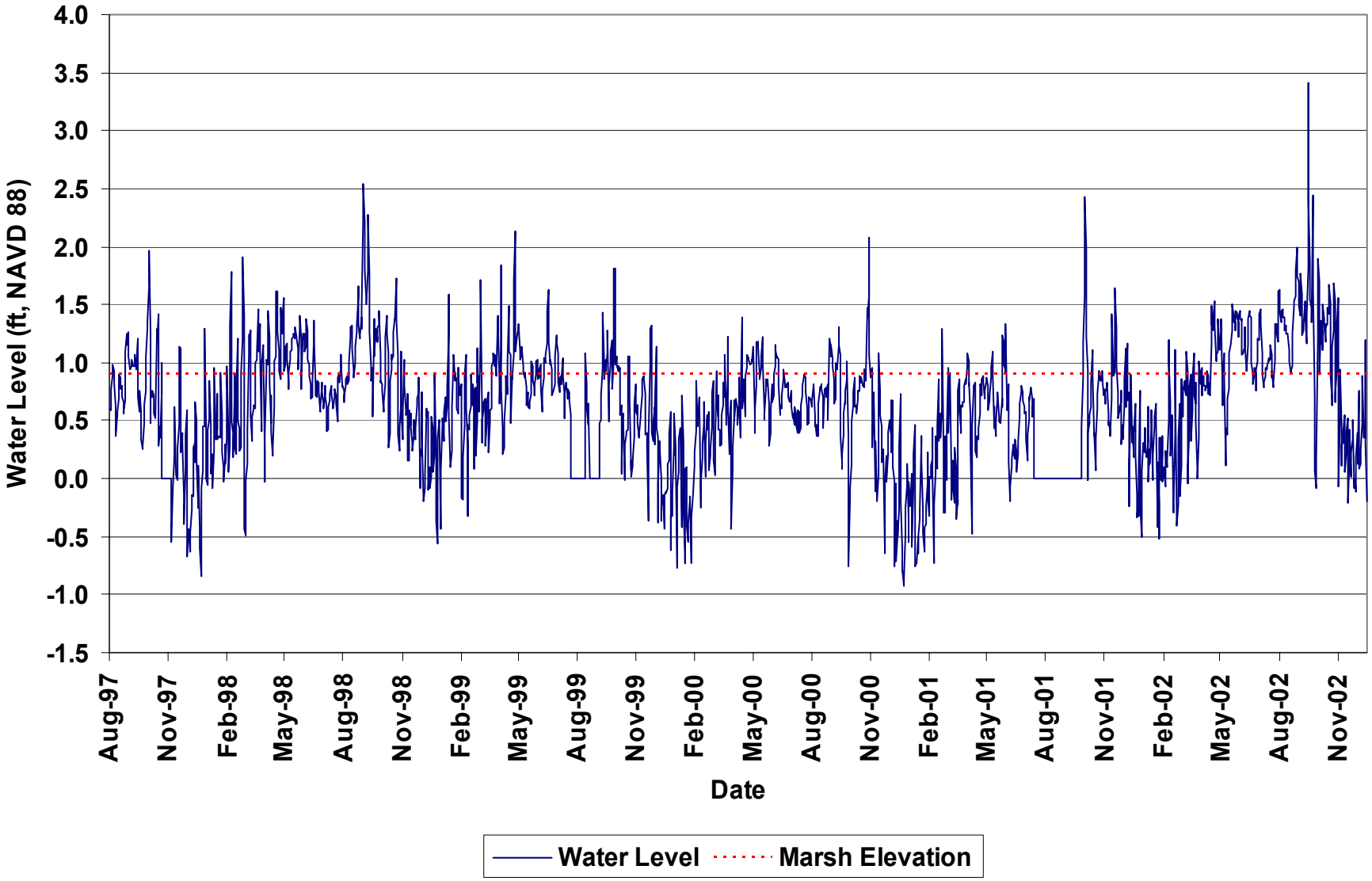


BA-04 Water Level

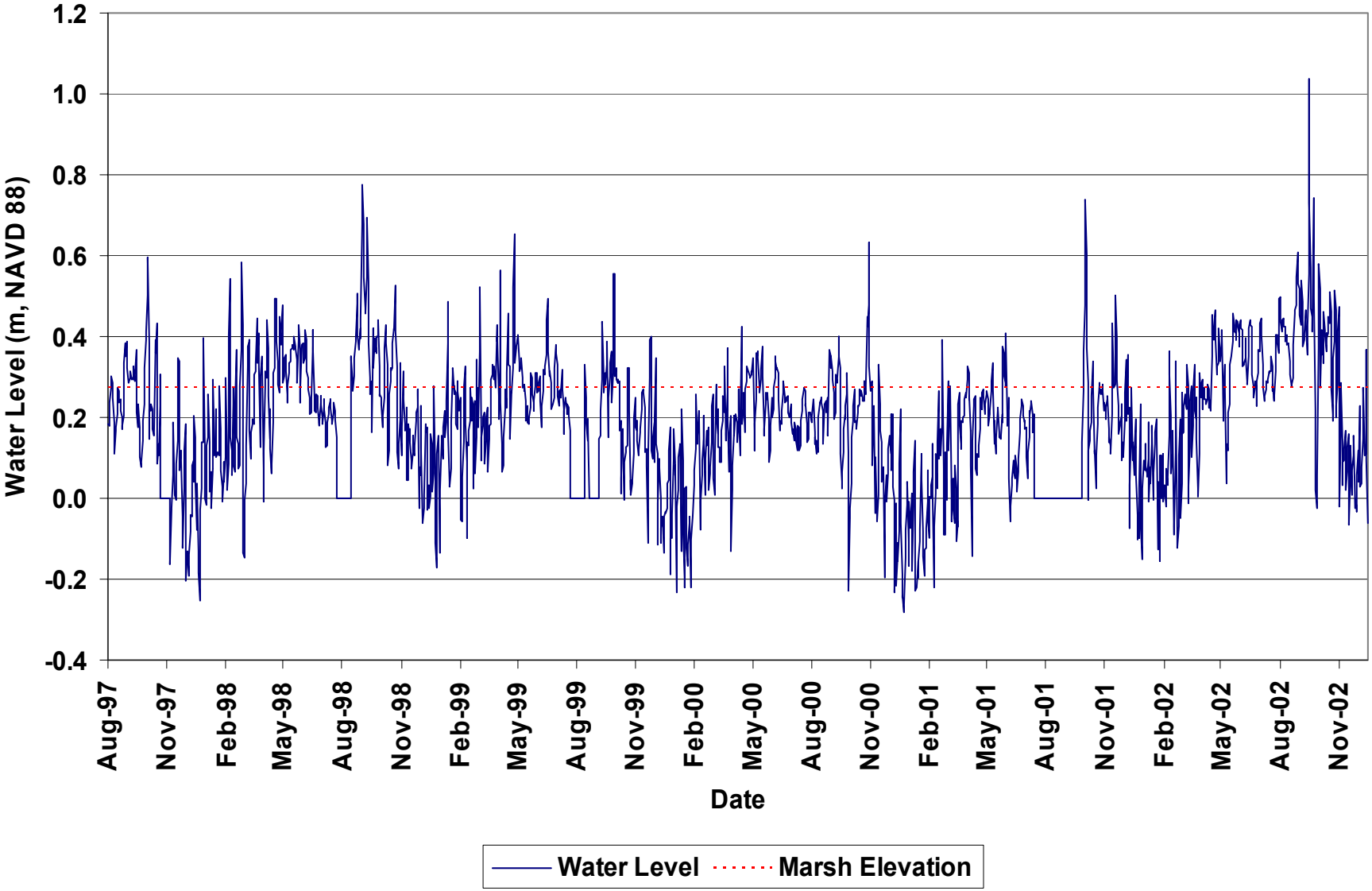
Water level was recorded at 5 staff gauges from 1992 – 1997. Ten staff gauges and 5 continuous recorders were monitored from 1998-2002.

- Hydrographs: Mean Daily Water Level NAVD 88 (feet) at the five continuous recorder stations
- Hydrographs: Mean Daily Water Level NAVD 88 (meters) at the five continuous recorder stations
- Histogram: Water levels and three operational siphon categories (ft^3s^{-1})
- Histogram: Water levels and three operational siphon categories (m^3S^{-1})

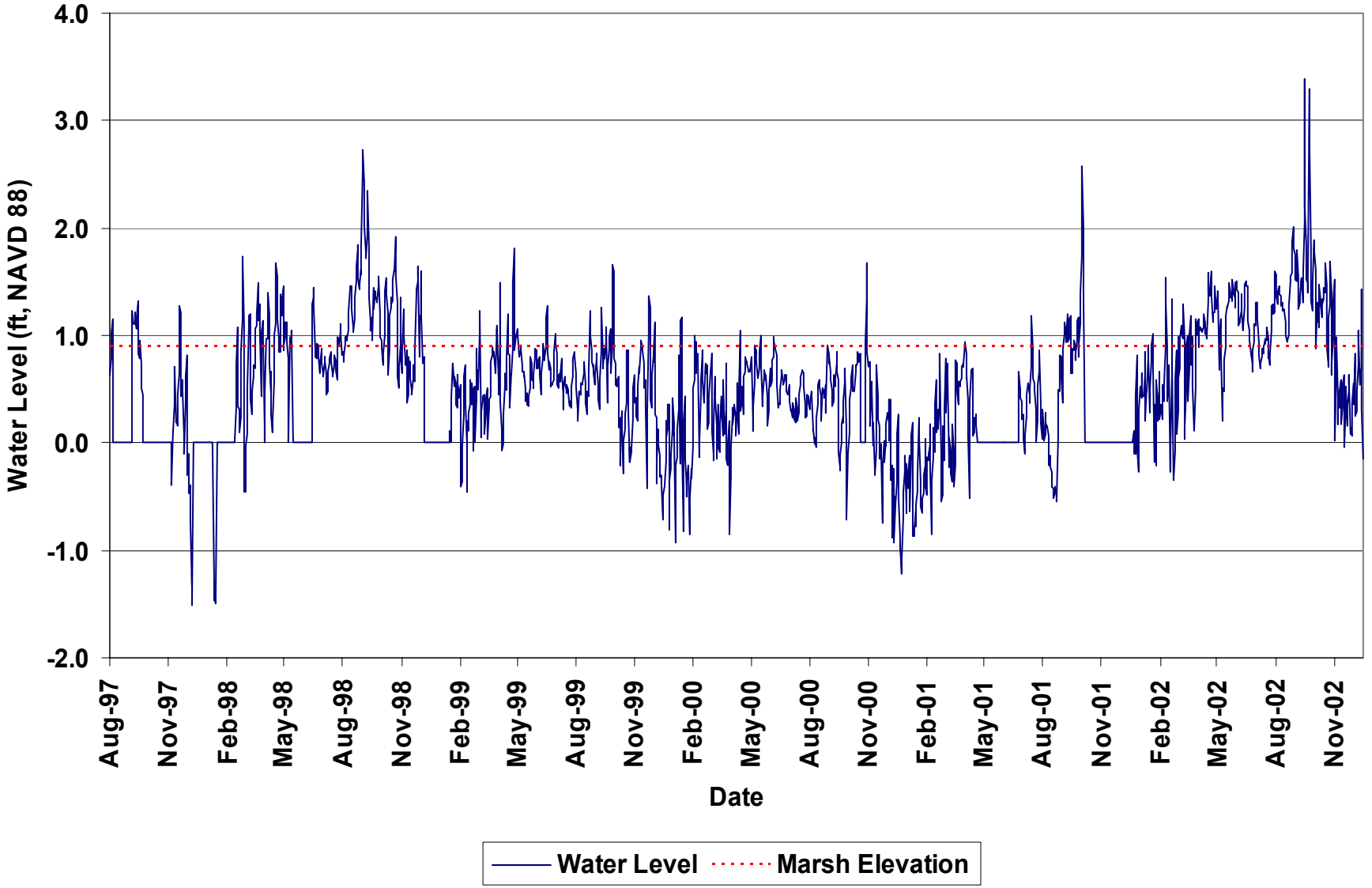
BA-04 Daily Mean Water Levels at Station 7 From 1997-2002



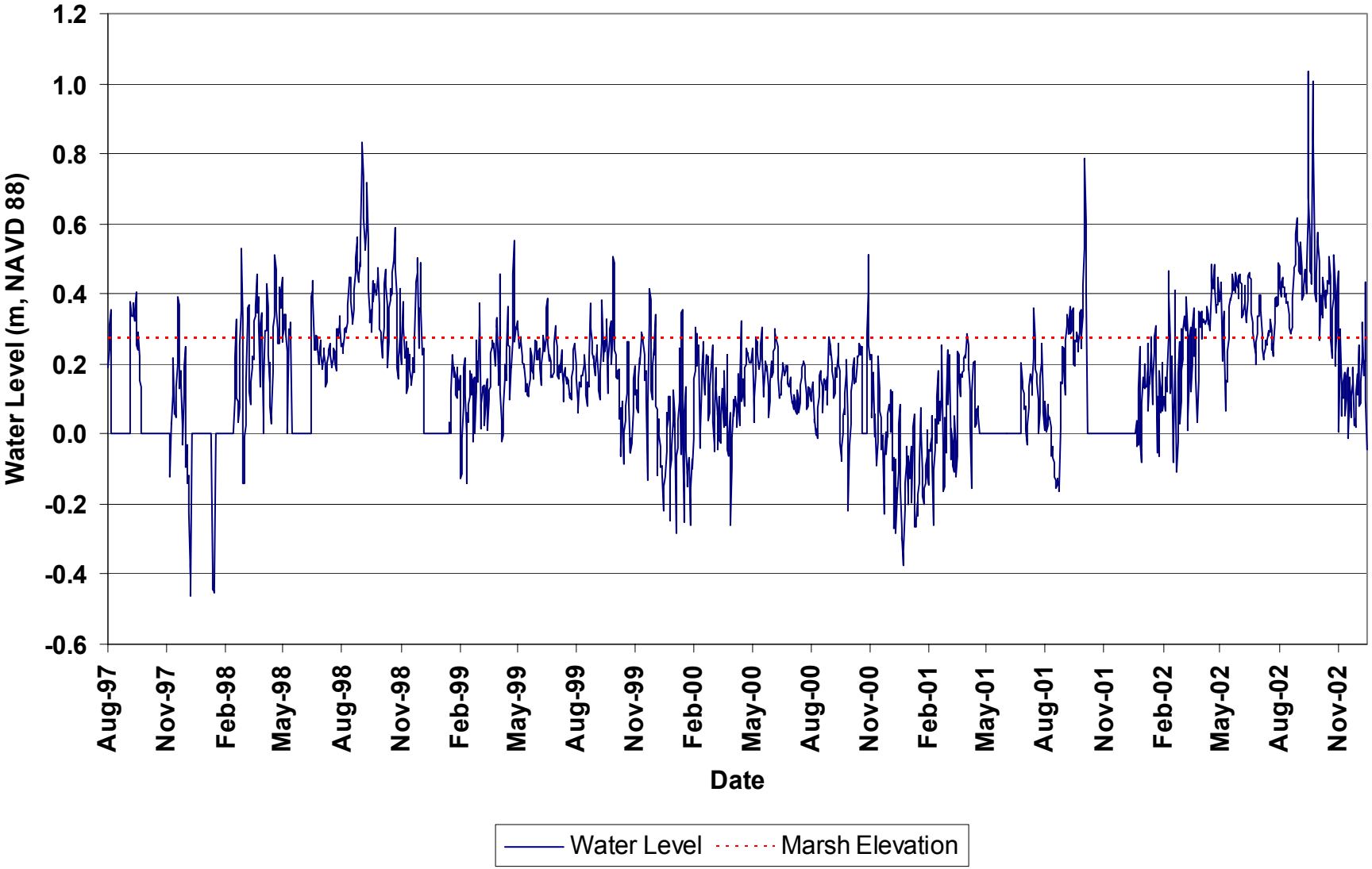
BA-04 Daily Mean Water Levels at Station 7 From 1997-2002



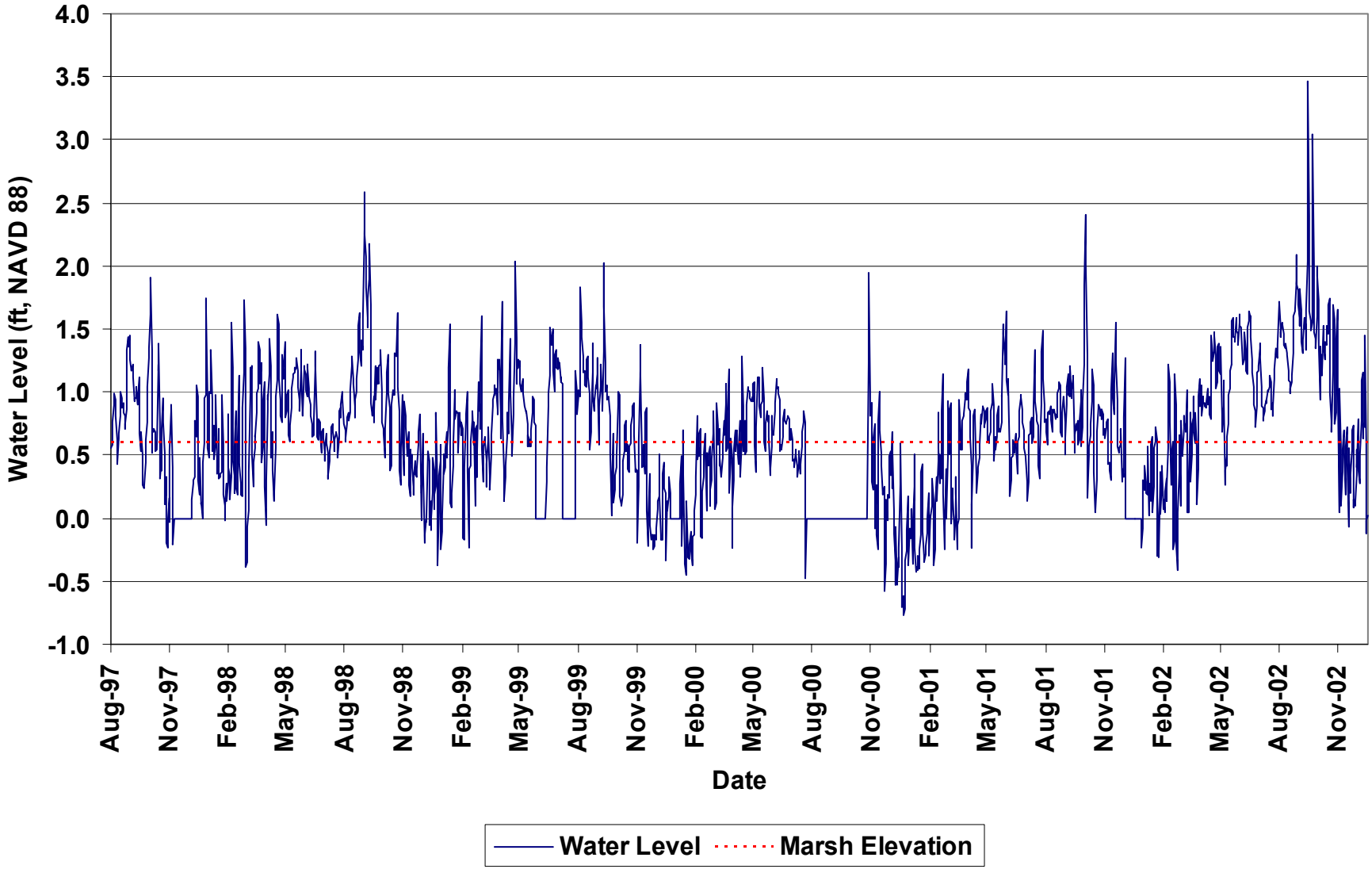
BA-04 Daily Mean Water Levels at Station 10 From 1997-2002



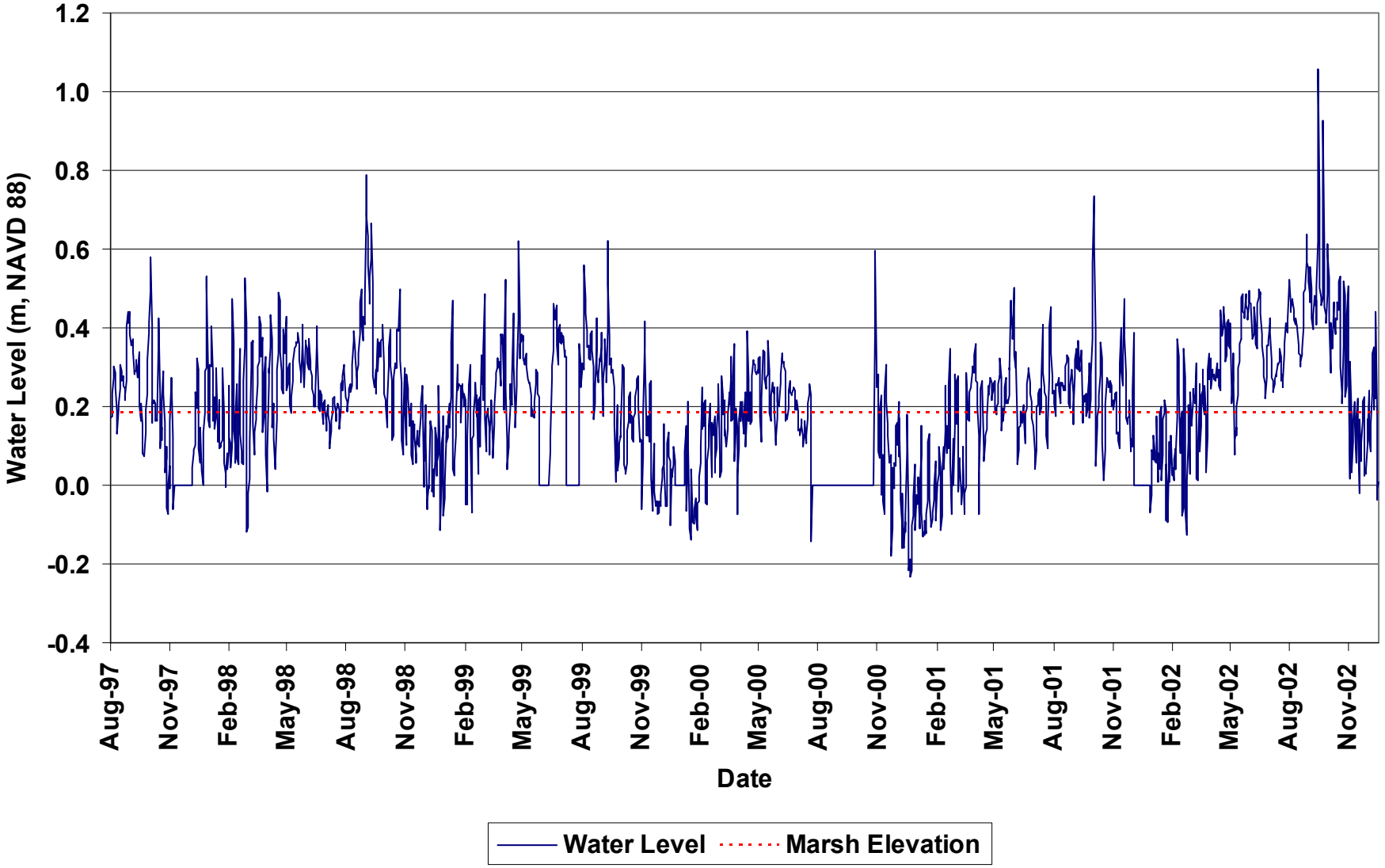
BA-04 Daily Mean Water Levels at Station 10 From 1997-2002



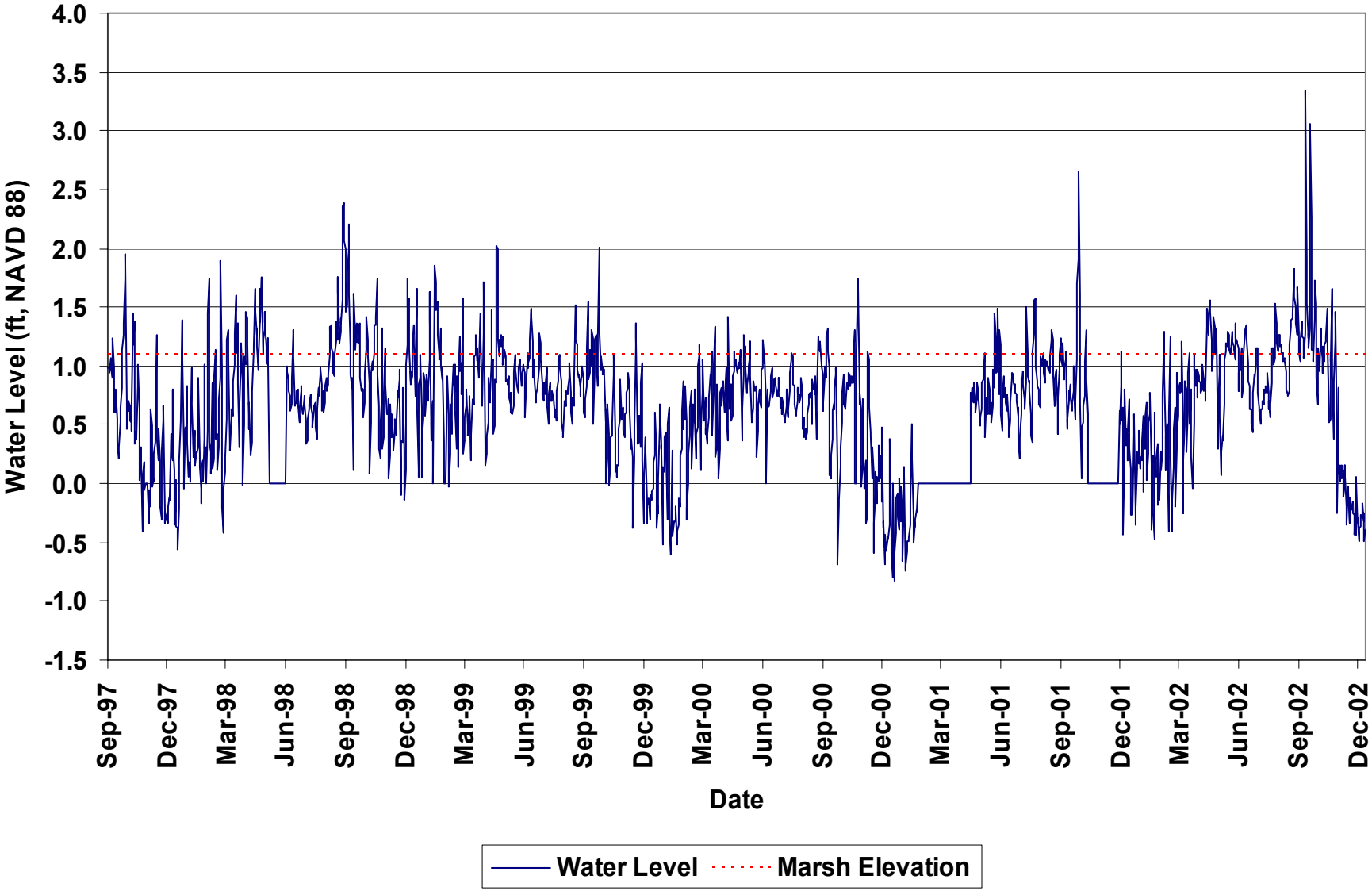
BA-04 Daily Mean Water Levels at Station 17 From 1997-2002



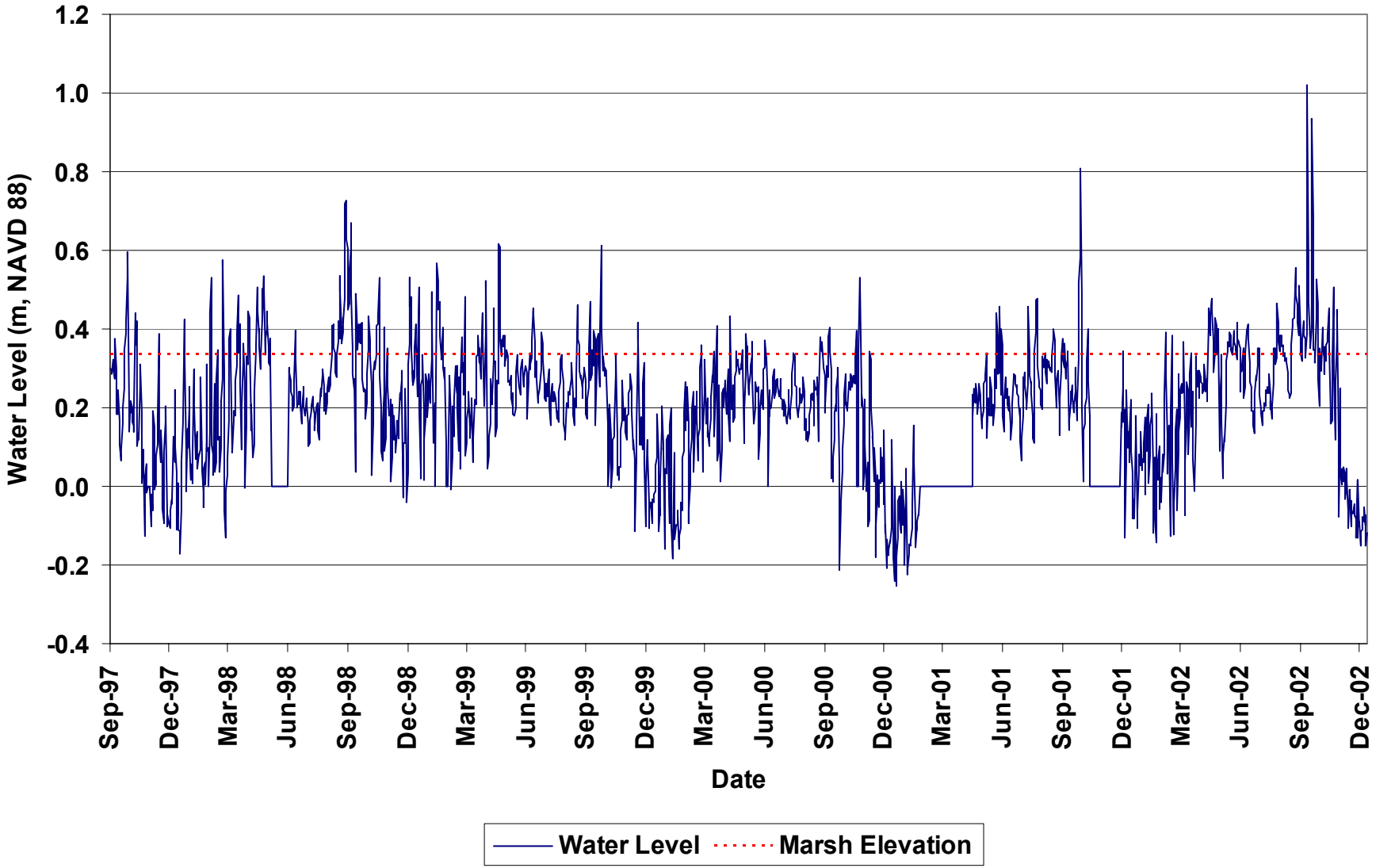
BA-04 Daily Mean Water Levels at Station 17 From 1997-2002



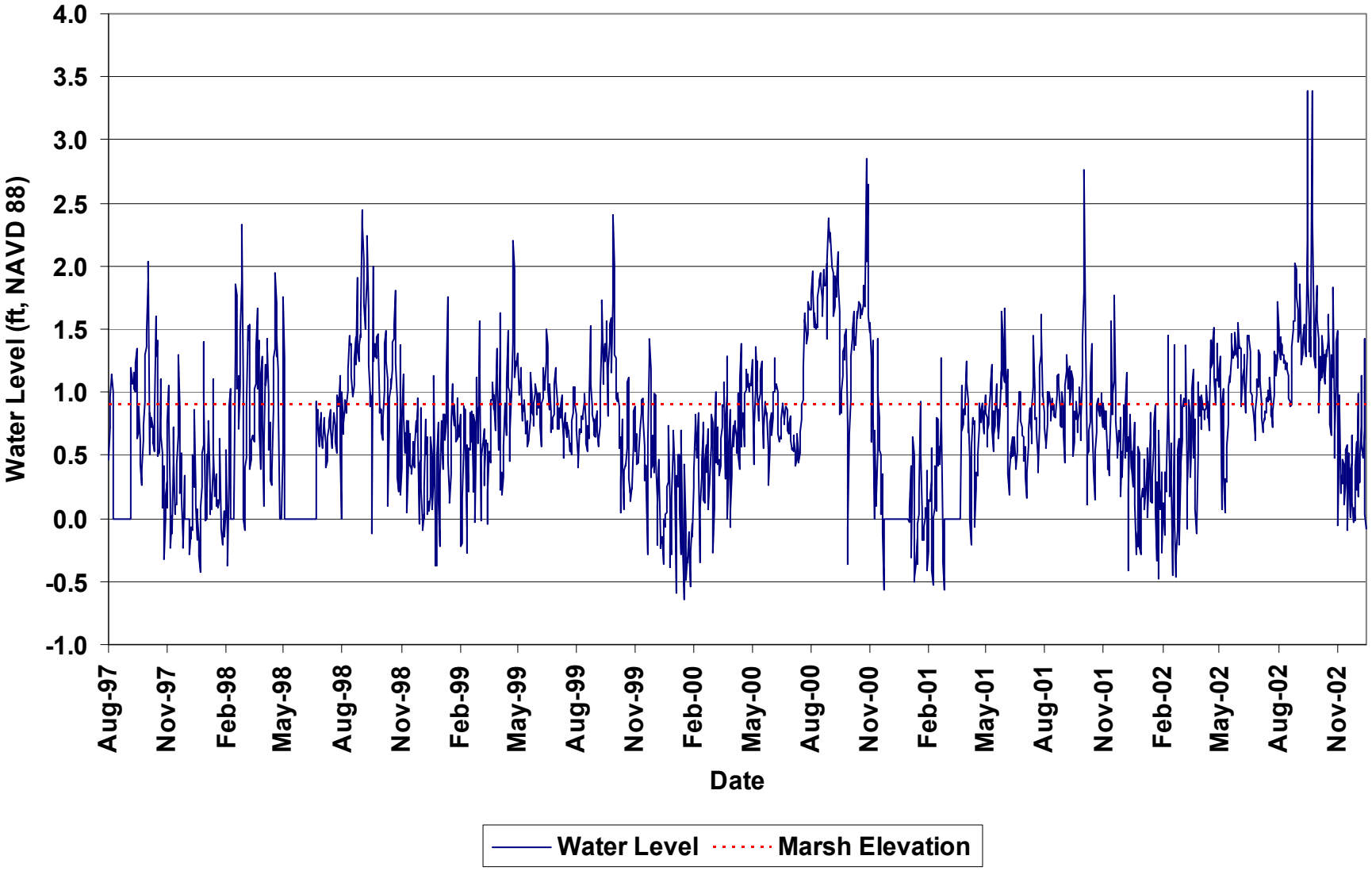
BA-04 Daily Mean Water Levels at Station 55 From 1997-2002



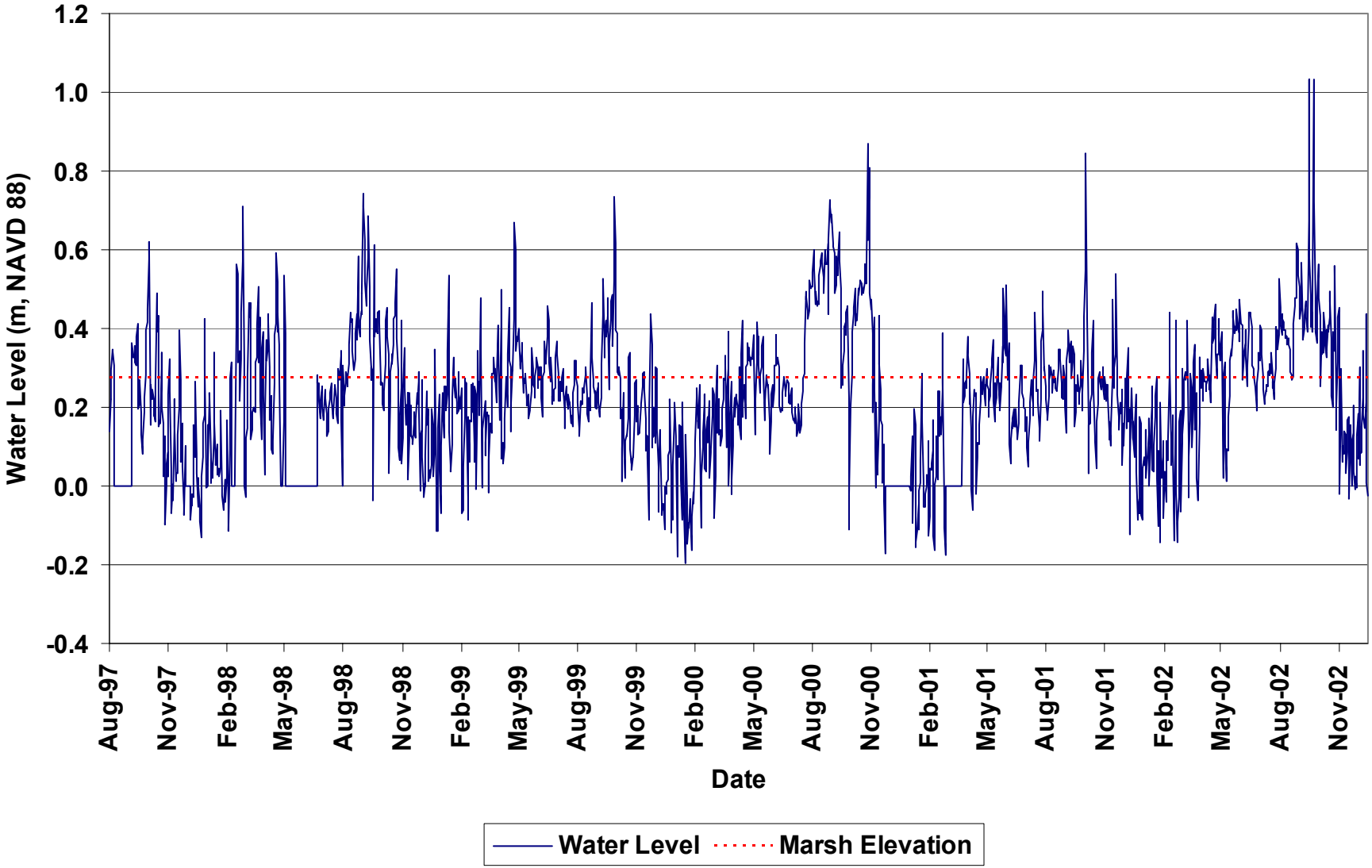
BA-04 Daily Mean Water Levels at Station 55 From 1997-2002



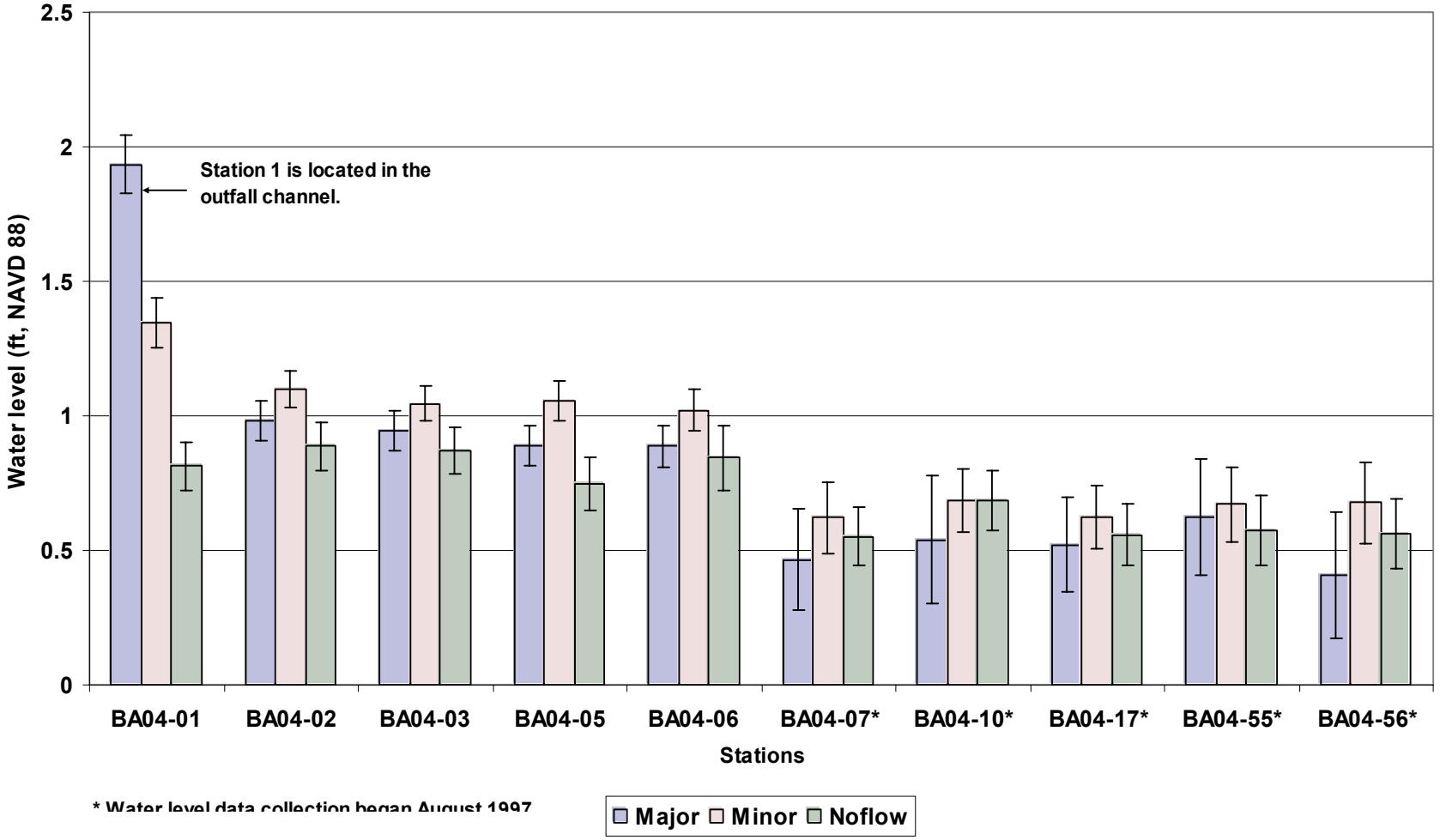
BA-04 Daily Mean Water Levels at Station 56 From 1997-2002

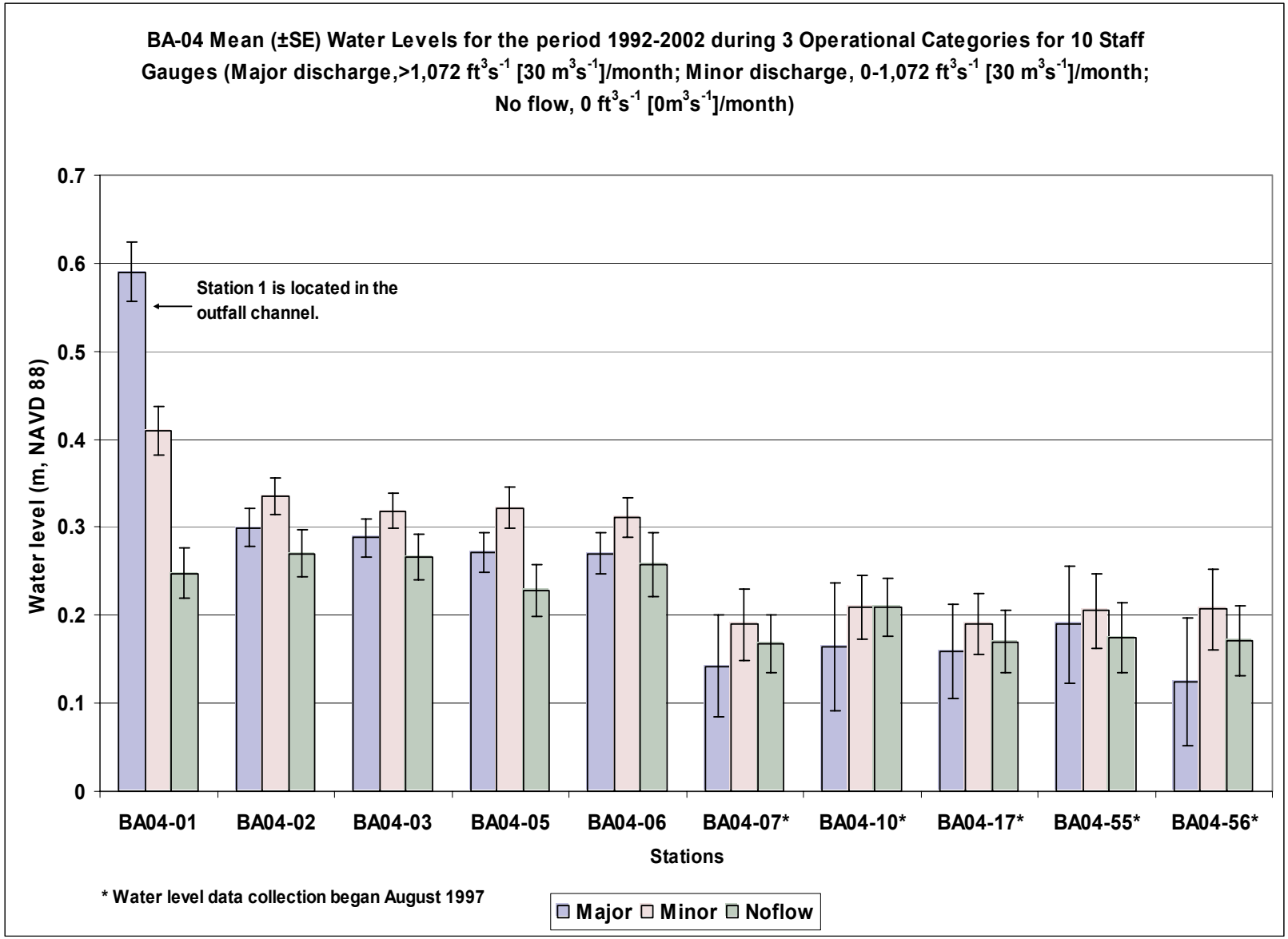


BA-04 Daily Mean Water Levels at Station 56 From 1997-2002



BA-04 Mean (± SE) Water Levels for the period 1992-2002 during 3 Operational Categories for 10 Staff Gauges (Major discharge,>1,072 ft^3s^{-1} [30 m^3s^{-1}]/month; Minor discharge, 0-1,072 ft^3s^{-1} [30 m^3s^{-1}]/month; No flow, 0 ft^3s^{-1} [0m^3s^{-1}]/month)



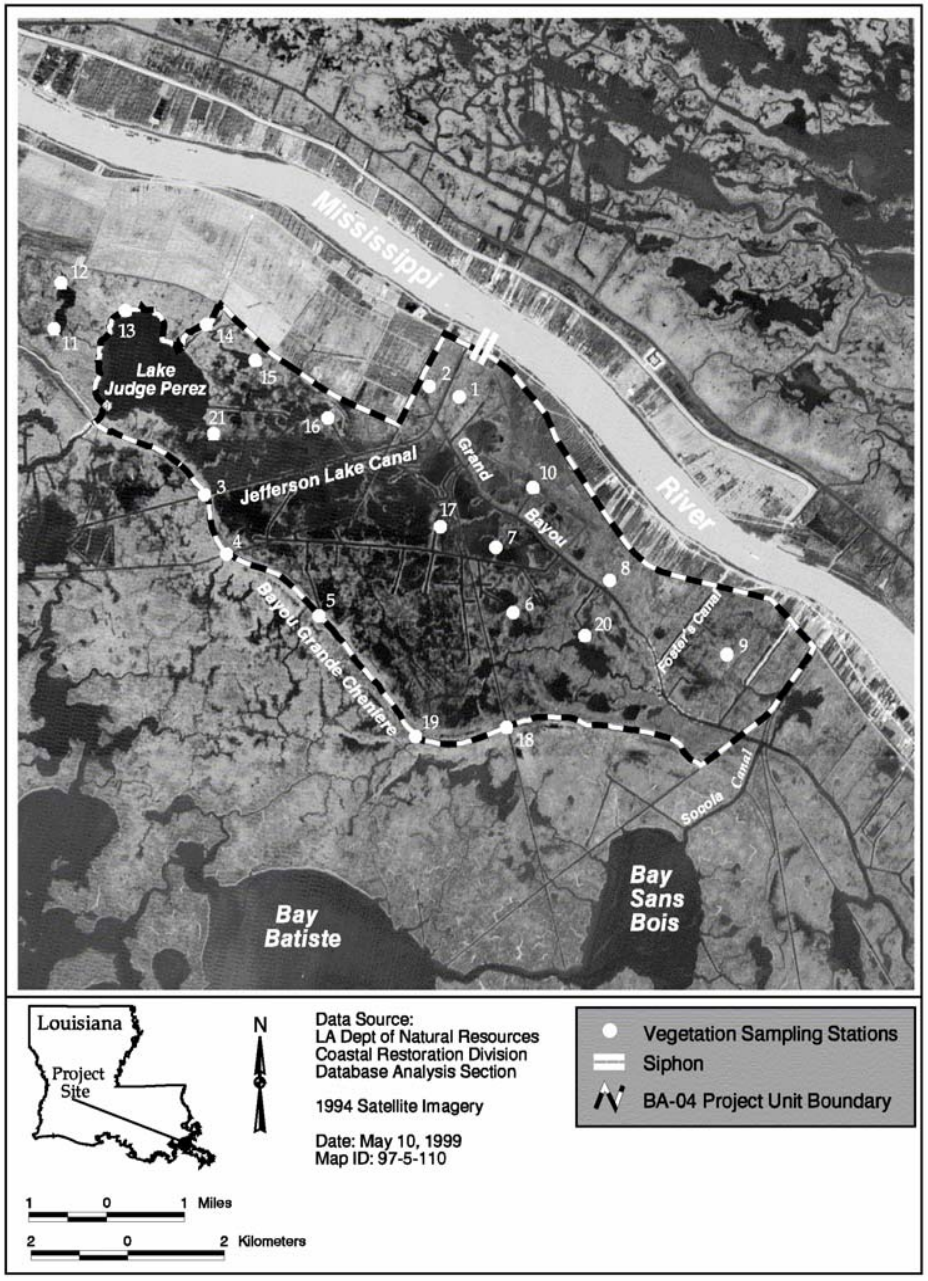

BA-04 Mean (±SE) Water Levels for the period 1992-2002 during 3 Operational Categories for 10 Staff Gauges (Major discharge,>1,072 ft3s-1 [30 m3s-1]/month; Minor discharge, 0-1,072 ft3s-1 [30 m3s-1]/month; No flow, 0 ft3s-1 [0m3s-1]/month)
Water level (m, NAVD 88)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Station 1 is located in the outfall channel.
BA04-01
BA04-02
BA04-03
BA04-05
BA04-06
BA04-07*
BA04-10*
BA04-17*
BA04-55*
BA04-56*
Stations
* Water level data collection began August 1997
Major
Minor
Noflow

BA-04 Vegetation Data

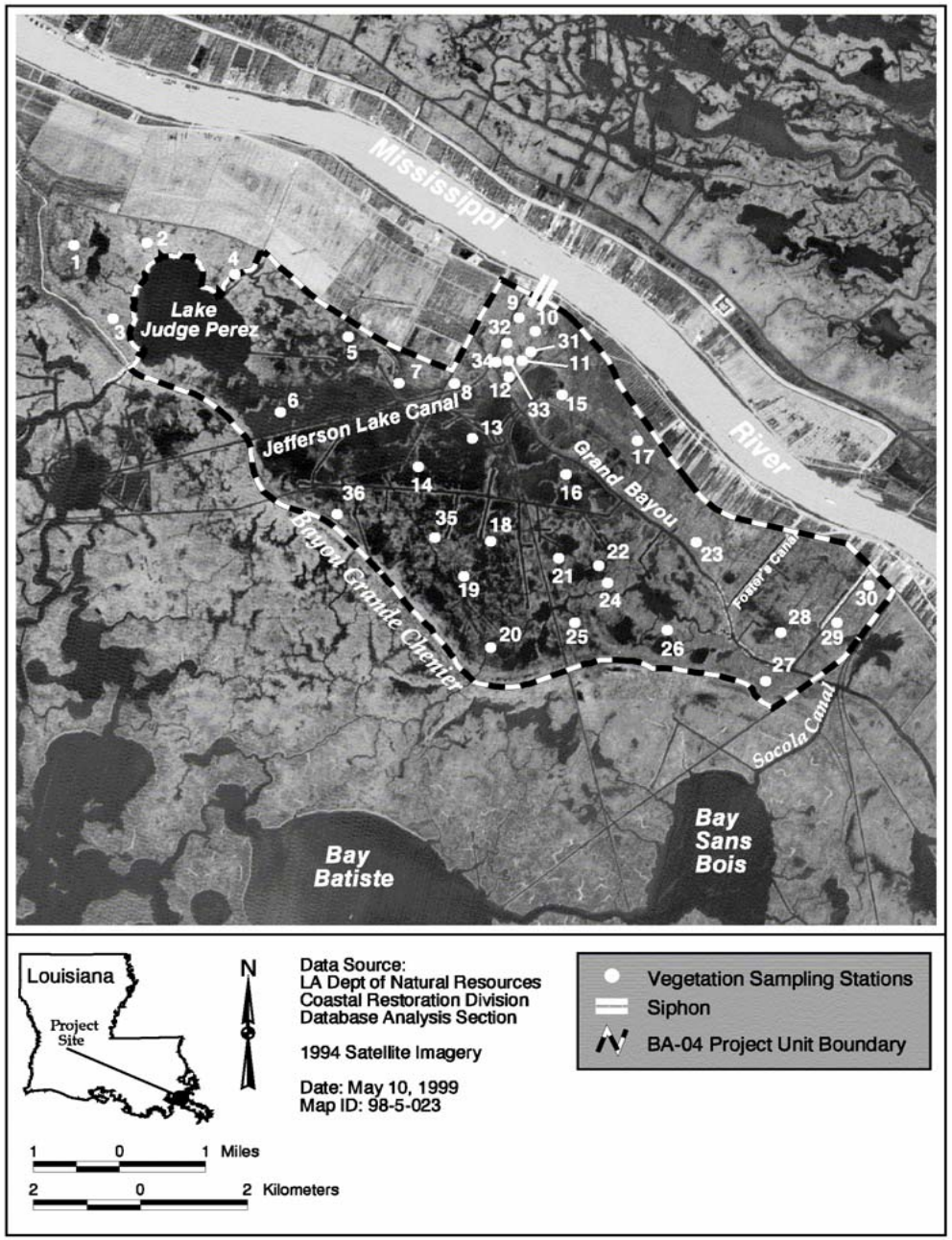
Vegetation surveys were conducted in 1992, 1995, 1997, 2001 and will be surveyed again in 2004, 2007 and 2010. Vegetation was surveyed using Braun-Blanquet 4-m^2 plots following procedures outlined in Steyer et al. (1995).

- Map: Vegetation station locations for 1992 and 1995
- Map: Vegetation station locations for 1997 and 2001
- Table: Mean % cover for all vegetation species by year
- Histogram: Mean % cover of dominant vegetation cover for 1992
- Histogram: Mean % cover of dominant vegetation cover for 1995
- Histogram: Mean % cover of dominant vegetation cover for 1997
- Histogram: Mean % cover of dominant vegetation cover for 2001

BA-04 1992 and 1995 vegetation station locations.



BA-04 1997 and 2001 vegetation station locations.



BA-04 Mean % Cover for all Vegetation Species by Year

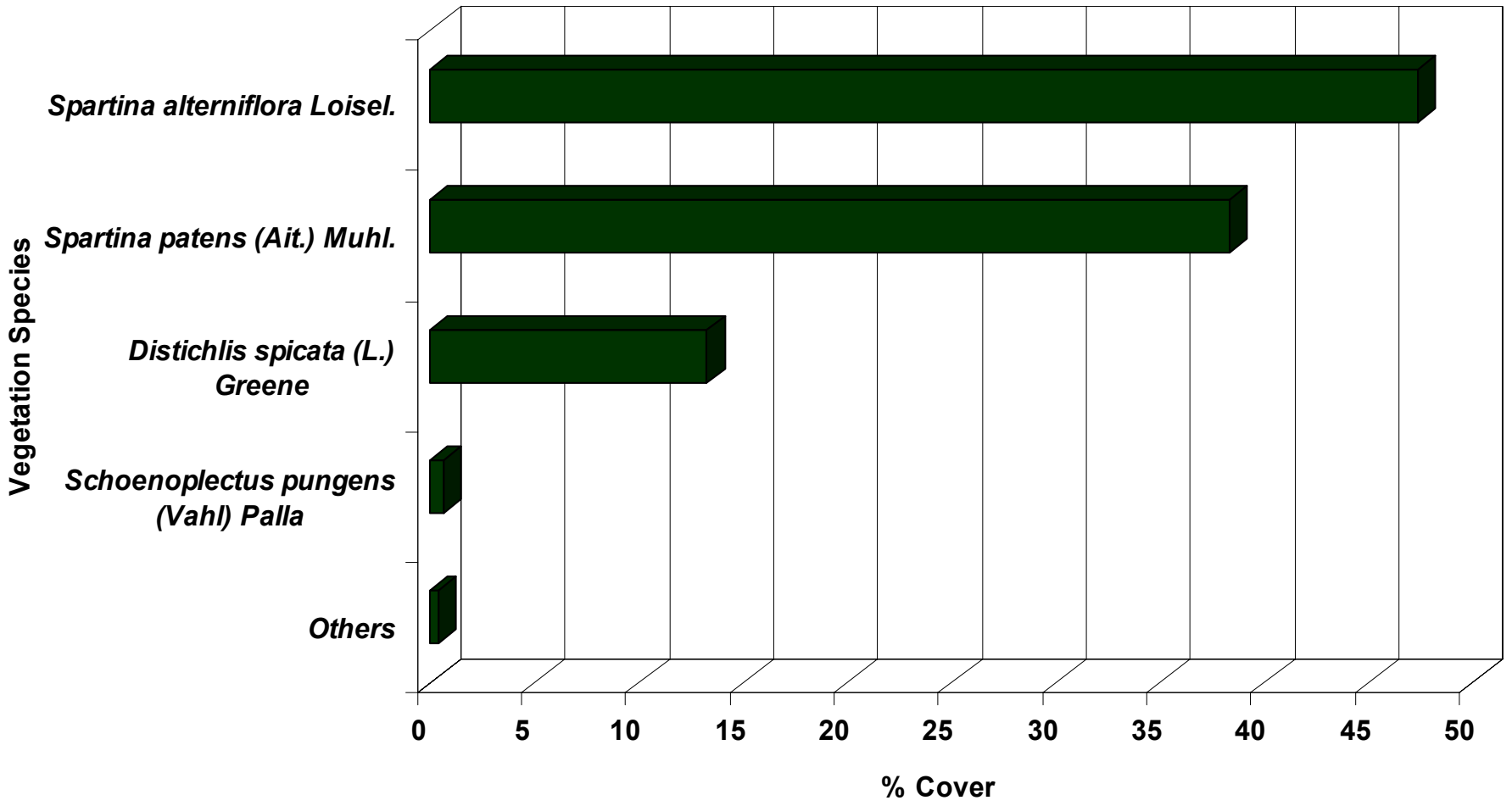
Scientific Name	Common Name	1992	1995	1997	2001
Alternanthera philoxeroides (Mart.) Gris	Aligatorweed	.	0.02	0.00	0.15
Amaranthus australis (Gray) Sauer	Southern amaranth	.	.	.	1.62
Baccharis halimifolia L.	Eastern baccharis	0.10	.	.	0.15
Colocasia esculenta (L.) Schott	Coco yam	.	.	.	0.15
Cyperus odoratus L.	Fragrant flatsedge	.	.	5.02	0.21
Distichlis spicata (L.) Greene	Seashore saltgrass	13.29	24.29	39.23	19.97
Echinochloa walteri (Pursh) Heller	Coast cockspur	.	0.02	0.38	.
Eleocharis parvula (Roemer & J.A. Schult	Dwarf spikesedge	.	0.02	.	.
Ipomoea sagittata Poir.	Saltmarsh morninglory	.	0.45	0.79	0.21
Iva frutescens L.	Bigleaf sumpweed	.	2.69	.	0.03
Juncus effusus L.	Common rush	.	.	.	0.94
Juncus roemerianus Scheele	Needlegrass rush	.	4.86	3.08	.
Kosteletzkya virginica (L.) K. Presl ex	Virginia saltmarsh mallow	.	0.02	0.02	.
Lemna L.	Duckweed	.	0.02	.	.
Lythrum lineare L.	Wand lythrum	.	.	2.71	.
Panicum hemitomon J.A. Schultes	Maidencane	.	.	.	1.47
Panicum repens L.	Torpedograss	.	.	.	2.50

(continued)

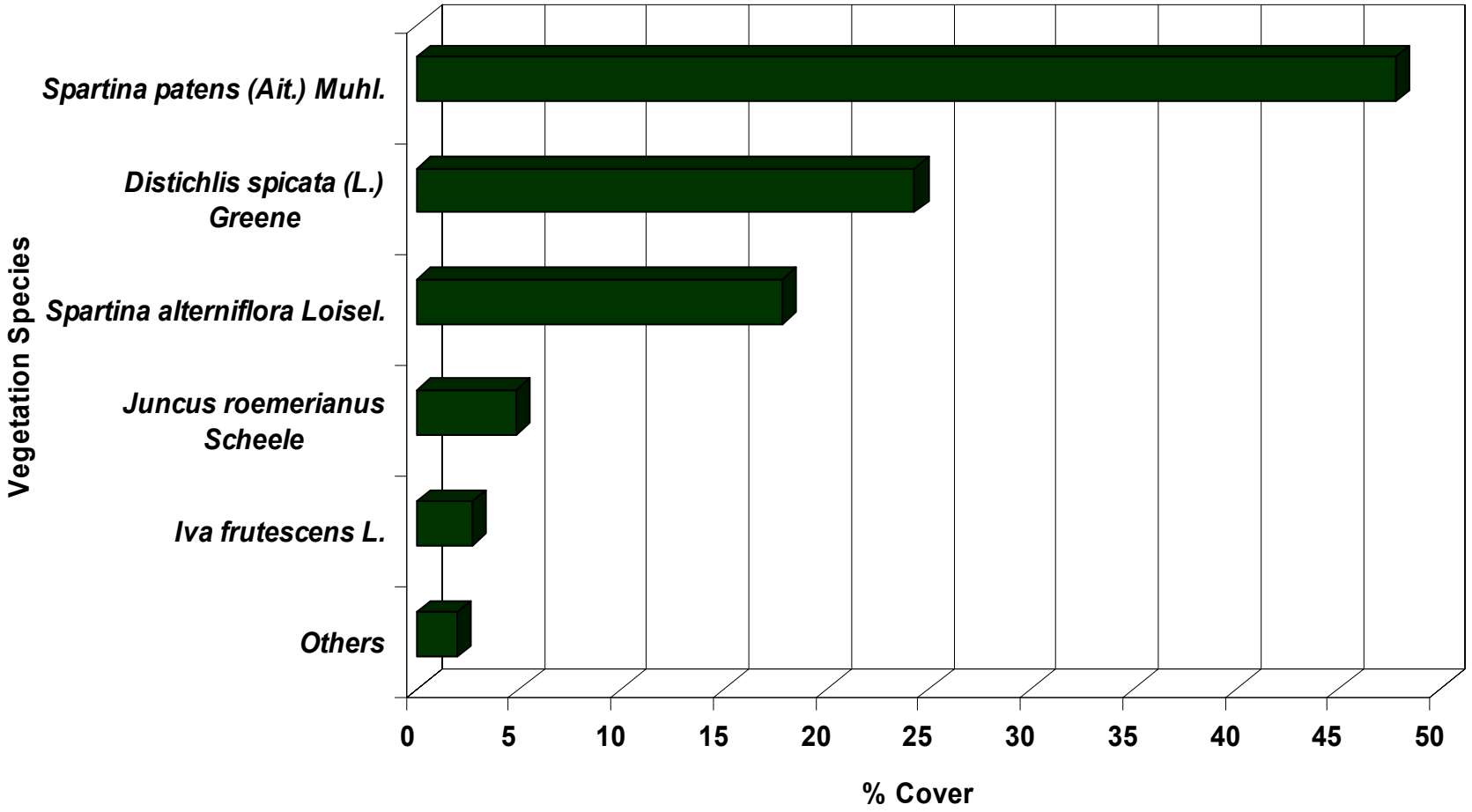
BA-04 Mean % Cover for all Vegetation Species by Year (continued)

Scientific Name	Common Name	1992	1995	1997	2000
Paspalum distichum L.	Knotgrass	.	.	1.15	.
Paspalum L.	Crowngrass	.	.	0.38	.
Pluchea odorata (L.) Cass.	Sweetscent	.	.	0.77	.
Polygonum punctatum Ell.	Dotted smartweed	.	.	5.77	8.97
Schoenoplectus maritimus (L.) Lye	Cosmopolitan bulrush	0.24	0.24	.	.
Schoenoplectus pungens (Vahl) Palla	Common threesquare	0.62	0.69	.	.
Schoenoplectus robustus (Pursh) M.T. Str	Sturdy bulrush	.	0.02	1.27	.
Setaria magna Griseb.	Giant bristlegrass	.	.	.	0.15
Solidago sempervirens L.	Seaside goldenrod	.	.	.	0.00
Sorghum halepense (L.) Pers.	Johnsongrass	.	.	.	0.65
Spartina alterniflora Loisel.	Smooth cordgrass	47.38	17.86	19.91	21.18
Spartina cynosuroides (L.) Roth	Big cordgrass	.	0.02	.	.
Spartina patens (Ait.) Muhl.	Marshay cordgrass	38.33	47.81	26.08	23.59
Symphyotrichum subulatum (Michx.) Nesom	Coastal Waterhyssop	.	.	0.77	.
Symphyotrichum tenuifolium (L.) Nesom	Perennial saltmarsh aster	.	.	1.06	0.02
Toxicodendron radicans (L.) Kuntze	Eastern poison iwy	.	.	1.15	.
Triadica sebifera (L.) Small	Tallowtree	.	0.02	.	.
Vigna luteola (Jacq.) Benth.	Hairypod cowpea	0.10	0.38	25.89	13.15
Vitis L.	Grape	.	.	1.15	.

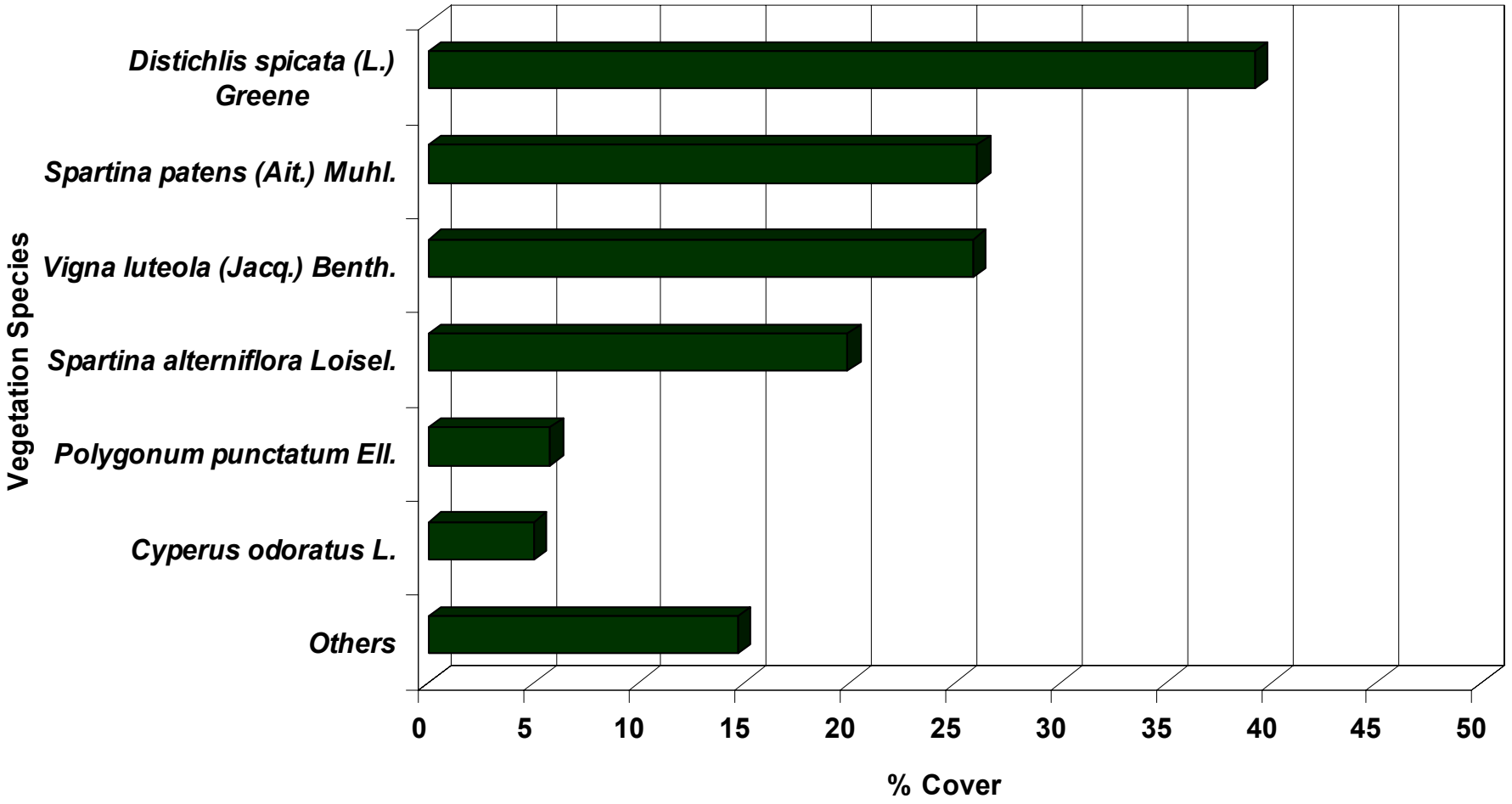
BA-04 Mean % Cover of Dominant Vegetation Species Across All Plots (N=21) for 1992



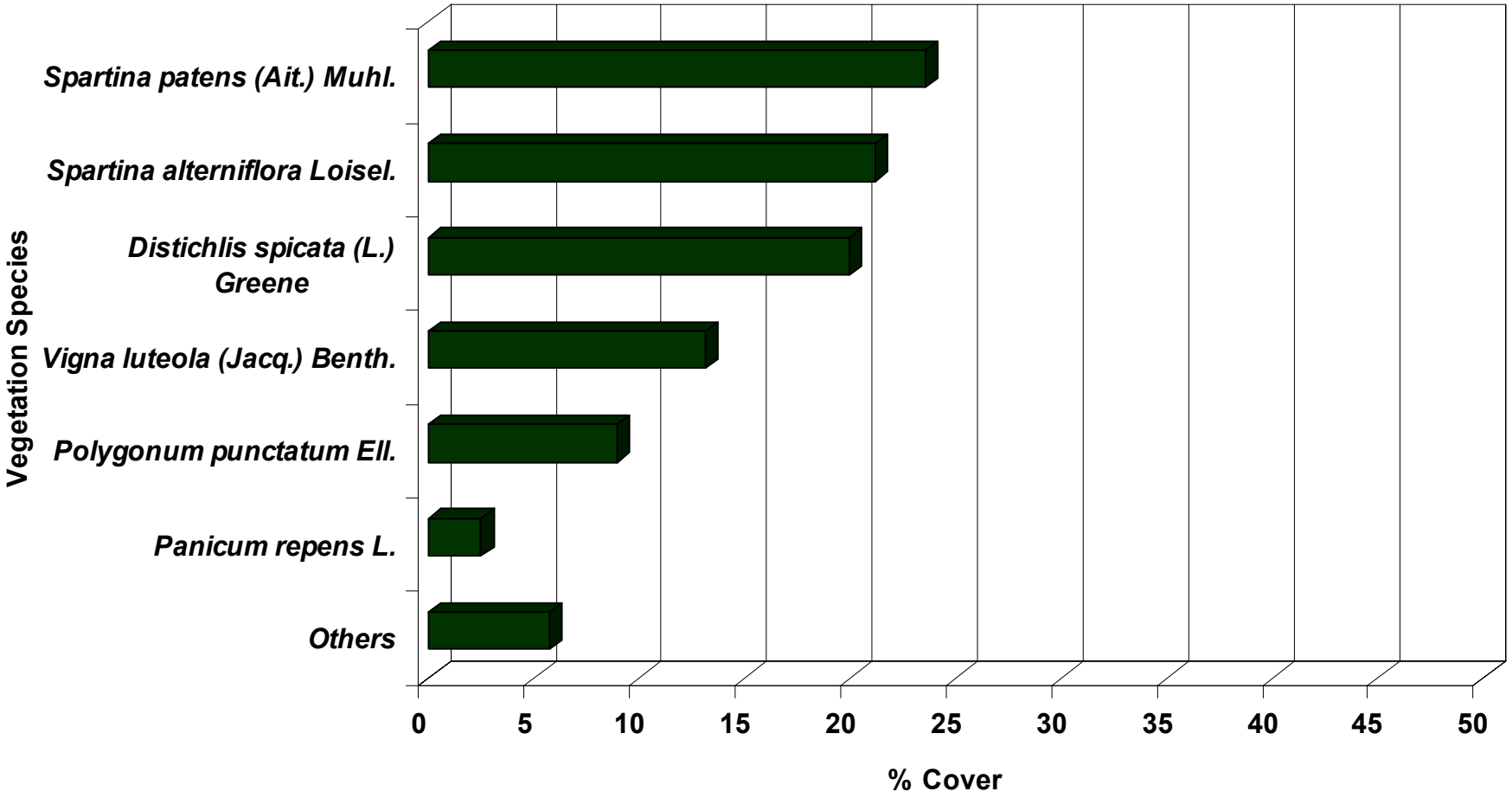
BA-04 Mean % Cover of Dominant Vegetation Species Across All Plots (N=21) for 1995



BA-04 Mean % Cover of Dominant Vegetation Species Across All Plots (N=36) for 1997



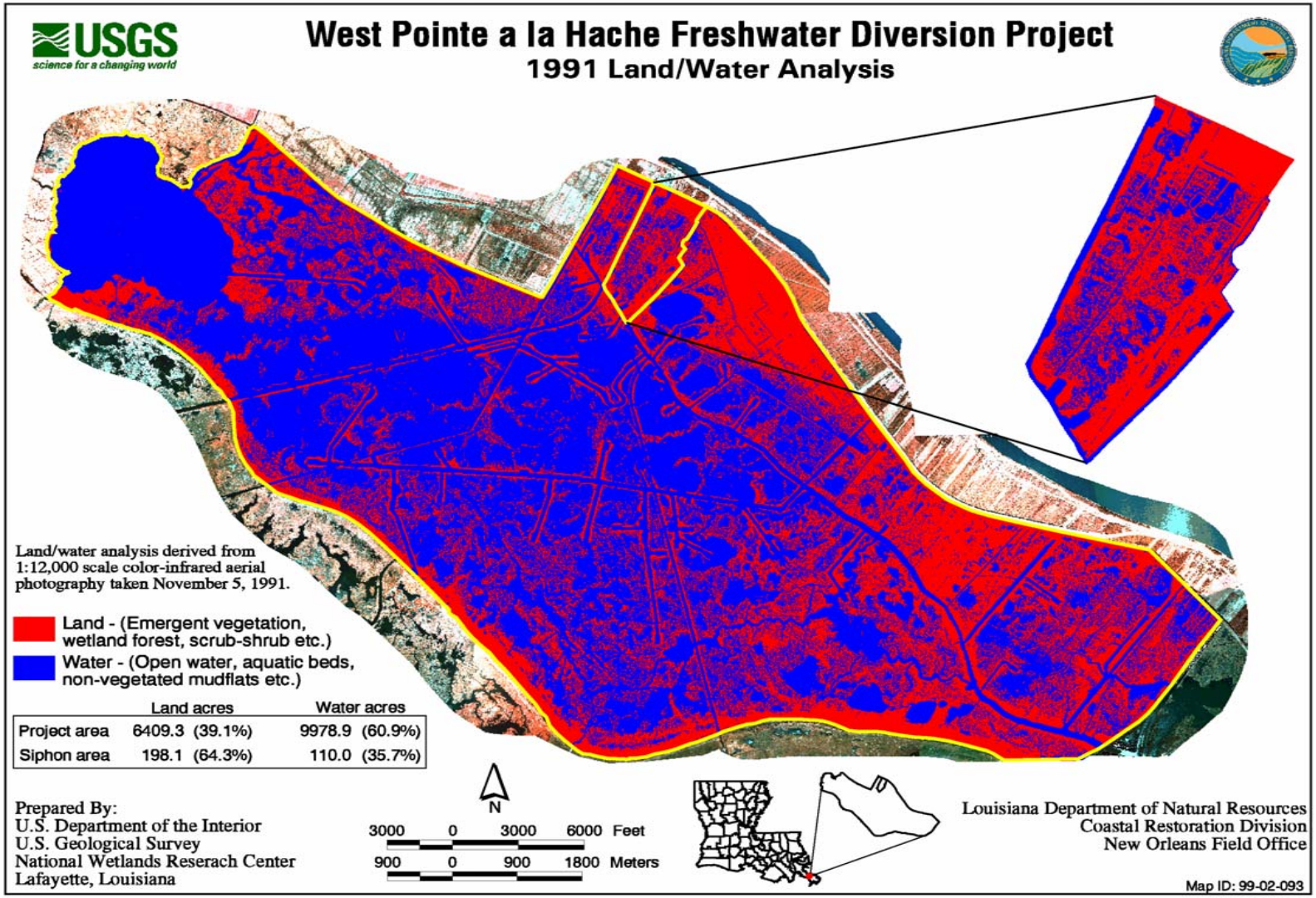
BA-04 Mean % Cover of Dominant Vegetation Across All Plots (N=36) for 2001



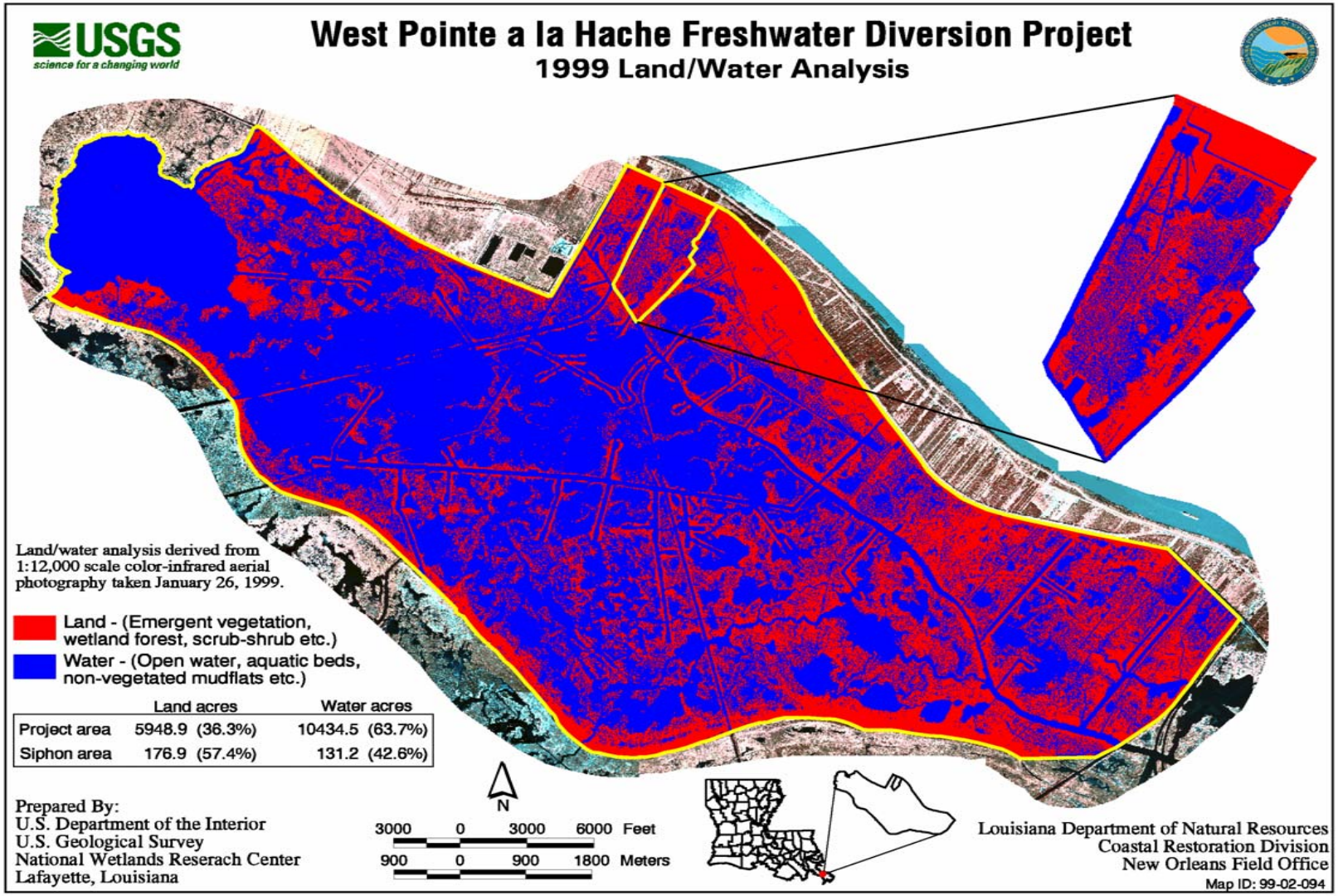
BA-04 Land:Water Analysis

Aerial photography (1:12,000) was obtained in November 1991 pre-construction and in January 1999 post-construction and will again be flown in 2007.

- 1991 Land:Water color infrared aerial photography
- 1999 Land:Water color infrared aerial photography



West Pointe a la Hache project area classification of 1991 data. GIS land/water analysis figures for project and siphon area (inset) before construction.



West Pointe a la Hache project area classification of 1999 data. GIS land/water analysis figures for project and siphon area (inset) after construction.

BA-04 West Pointe a la Hache Siphon Construction

Preliminary Findings

Siphon Flow:

- The revised operation plan called for the structure to have all eight pipes operating at just over 1,000 ft^3s^{-1} ($28m^3s^{-1}$) for all months except March and April when only two pipes are to be in operation. Through 2002, the structure was in operation 72% of the time and averaged 940 ft^3s^{-1} ($26m^3s^{-1}$) when operating. Flows were highest in the spring period, which was opposite than planned.
- Low river stage limited operations; loss of prime at low stages rendered siphons inoperable.
- Additional obstacles to operation were: marine fisheries issues, tropical storms, oil spills, maintenance problems and staffing limitations.

Salinity:

- Salinity reduction occurred during periods when all siphons were in either major or minor operation, indicating that the siphons are capable of reducing salinity in the project area. However, during periods of minor and no-flow operations, salinity was also influenced by factors other than siphon operation, particularly seasonal variability. Siphon operation is a function of river stage; thus, the ability to control salinity during drought or normal low river stages (e.g. late summer and fall) is limited.

BA-04 West Pointe a la Hache Siphon Construction

Preliminary Findings

Siphon Flow-Salinity Relationship:

- Siphon flow and salinity were negatively correlated at every continuous recorder station. The slope of the line and the strength of the correlation generally decreased with increasing distance from the siphon structure. Table values are from the salinity (ppt) and flow (cfs) regression analyses.

Station (closest to farthest)	Slope (relationship)	R-square value (strength of relationship)
BA04-07	-0.0044	0.2550
BA04-17	-0.0037	0.2224
BA04-10	-0.0032	0.1500
BA04-55	-0.0035	0.1952
BA04-56	-0.0027	0.1267

Water Level:

- Monthly discrete staff gauge data collected during siphon operation showed that water level was significantly higher ($P<0.05$) at the monitoring station nearest the outfall structure (station 1) than the remaining stations. Water level at station 1 during major flow (>1,072 ft^3s^{-1}) (30 m^3s^{-1}) was an average of 13 inches (33cm) above mean water level then during no-flow. However, water surface elevations dissipated with distance from the discharge area. Hourly continuous water level data showed no significant difference ($P>0.05$) during periods of operation however seasonal variability and daily tidal effects moderated the relationship between siphon operation and water level.

BA-04 West Pointe a la Hache Siphon Construction

Preliminary Findings

Vegetation:

- Vegetation data within the project area suggest a freshening between 1992 and 1995. Between 1997 and 2001, vegetation type at many sites remained the same; however, some sites (furthest from the siphon) became more saline, and some (closest to the siphon) became fresher (Evers and Sasser 2002). Drought conditions from 1998-2000 were most likely the cause for some sites reverting to more saline vegetation types. These results show that the diversion has been effective at changing the vegetation towards a fresher and more diverse community overall. However, areas furthest from the diversion site are influenced less by the diversion waters.

Habitat Mapping:

- The project area lost 460.4 acres (184.2 ha) of land between 1991 and 1999. This represents a loss of 7.2% of land present in 1991 or 1.03% per year. Historical loss rates for the project area taken from the Pointe a la Hache Quadrangle were as follows: 0.18%/yr between 1932-1956, 0.54%/yr between 1956-1974, 1.10%/yr between 1974-1983, and 1.29%/yr between 1983-1990. Wetland loss had been accelerating prior to the construction of the project, however, since the siphons have been operating, the wetland loss rate has declined.