

Nonattainment Diagnostics Part Deux

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Analytical Diagnostics Team

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“Problem” Segments: Non-attaining at 170 TN

Open Water

Cbseg	1985 '93-'95	'91 -'00 Base '93-'95	2007 Scenario '93-'95	Trib Strategy '93-'95	190 Load Scenario '93-'95	179 Load Scenario '93-'95	170 Load Scenario '93-'95	E3 2010 Scenario '93-'95	All Forest Scenario '93-'95
CB7PH	8.8%	7.0%	2.2%	0.3%	0.2%	0.1%	0.1%	0.0%	0.0%
GUNOH	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%
MANMH	0.4%	0.6%	5.0%	5.0%	5.0%	5.0%	5.1%	5.1%	0.0%
MDATF	34.3%	38.7%	34.5%	12.1%	12.1%	11.5%	11.3%	0.0%	0.0%
MPCOH	33.1%	42.3%	32.3%	25.0%	17.9%	4.6%	4.6%	4.6%	0.0%
PMKTF	11.0%	11.0%	4.6%	4.6%	4.6%	4.6%	2.3%	0.7%	0.7%
SEVMH	20.5%	15.5%	9.0%	6.4%	5.8%	5.8%	5.8%	1.4%	0.0%
VPCOH	32.5%	40.9%	32.3%	25.0%	17.9%	4.6%	4.6%	4.6%	0.0%
WBEMH	15.3%	11.1%	15.3%	7.8%	7.8%	7.8%	7.8%	0.0%	0.0%
WICMH	11.2%	11.2%	11.2%	4.6%	4.6%	4.6%	4.6%	4.6%	4.4%
WSTMH	9.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
YRKMH	17.6%	24.0%	6.6%	1.0%	0.8%	0.7%	0.4%	0.0%	0.0%

Deep Water

CB5MH	9.8%	6.9%	1.5%	0.3%	0.3%	0.1%	0.0%	0.0%	0.0%
CHSMH	35.5%	24.7%	15.6%	1.8%	1.8%	1.6%	0.5%	0.4%	0.0%
EASMH	25.4%	5.7%	1.4%	0.7%	0.7%	0.2%	0.2%	0.0%	0.0%
MAGMH	34.8%	34.8%	34.8%	15.9%	3.4%	3.4%	0.5%	0.5%	0.0%
MD5MH	11.8%	9.1%	4.2%	1.5%	1.3%	0.9%	0.6%	0.1%	0.0%

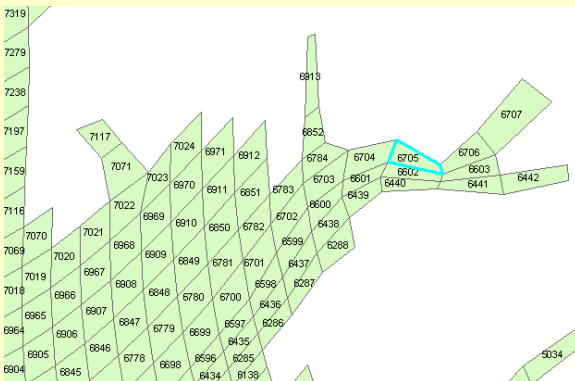
Deep Channel

CHSMH	48.3%	46.1%	29.6%	11.3%	11.0%	11.0%	9.9%	3.6%	0.0%
EASMH	49.6%	43.6%	22.2%	6.3%	6.0%	4.1%	2.0%	0.5%	0.0%

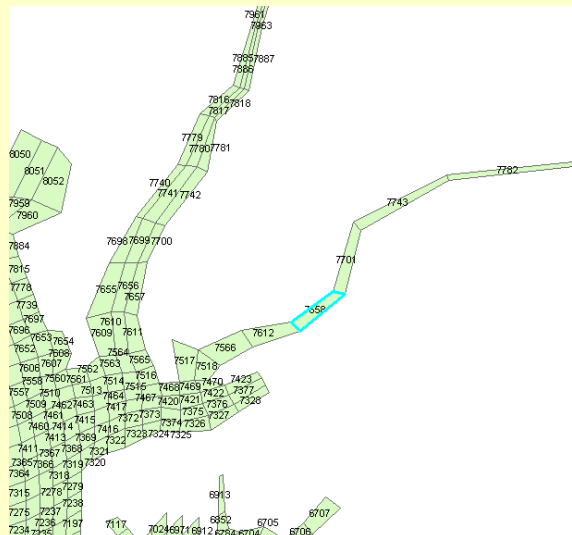
Open Water: General Findings

- 10 out of 12 OW problem segments are located in small tributaries represented by 1 or 2 WQSTM grid cells that overlap land, thus take load inputs directly
- Numerically, they represent 13% of Bay segments
- By volume, they represent about 1% of the Bay's Open Water

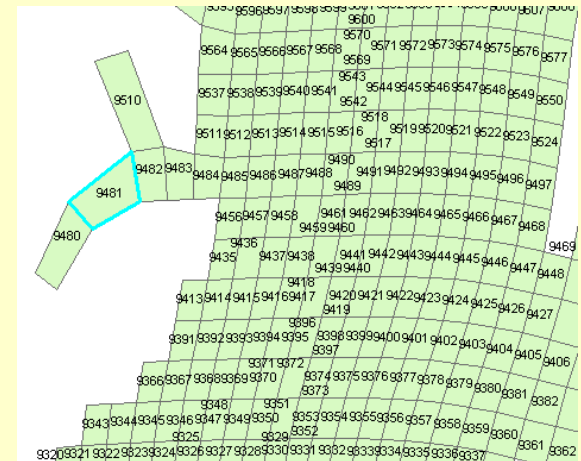
MANMH



POCOH, POCTF



WSTMH



Open Water: General Findings

Generally, non-attainment in any given segment results from 2 or more of the following factors:

- (1) * Less-than-expected change in DO concentrations from calibration to E3 scenario;
- (2) * Range of simulated DO concentrations well outside range of observed DO concentrations;
- (3) Unusually and/or very low observed DO concentrations, which are very difficult to “scenario” into “Open Water” attainment under any conditions

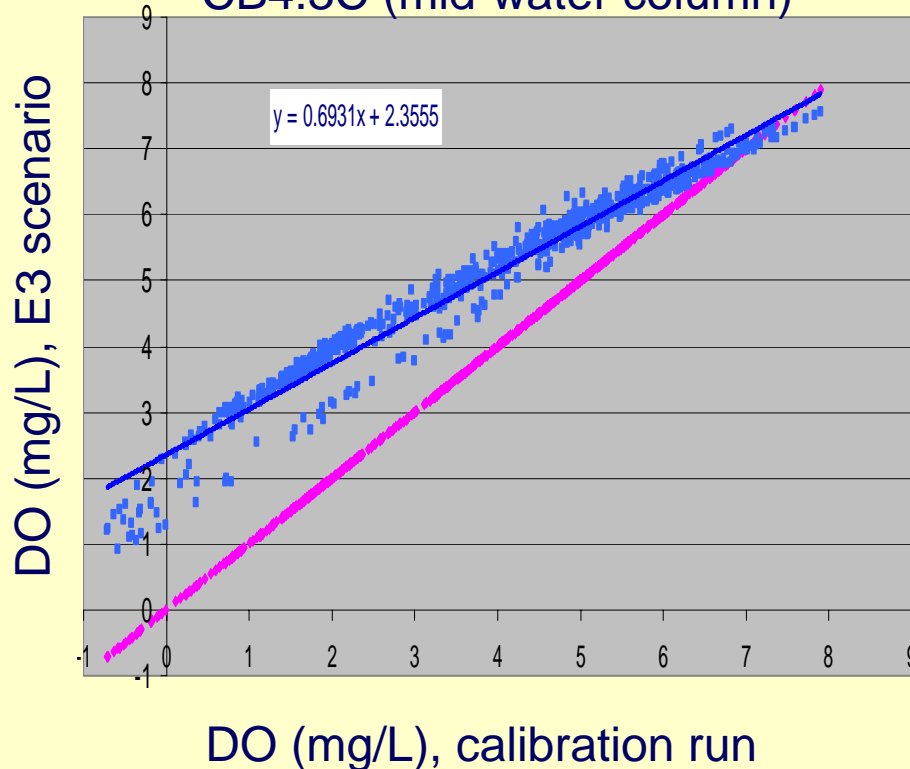
* These factors likely result from limitations in the estuarine model’s ability to integrate multiple drivers of DO concentrations in shallow, shore-adjacent cells.

Open Water: General Findings

(1) Less-than-expected change in DO concentrations from calibration to E3 scenario

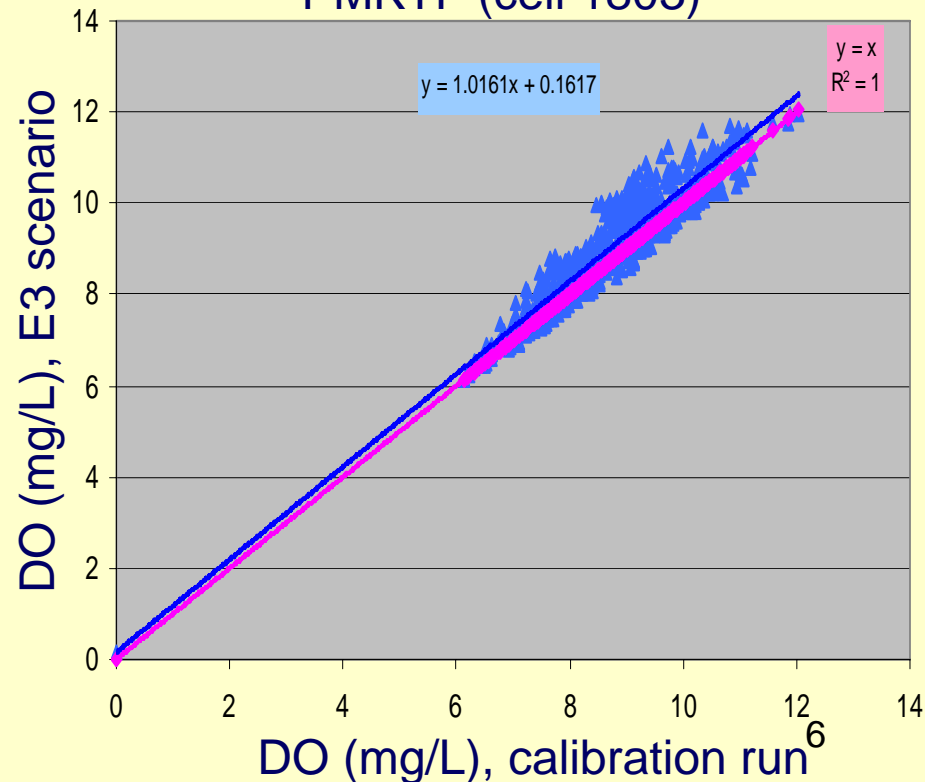
Load reductions reduce hypoxia:

CB4.3C (mid-water column)



Little response to load reductions:

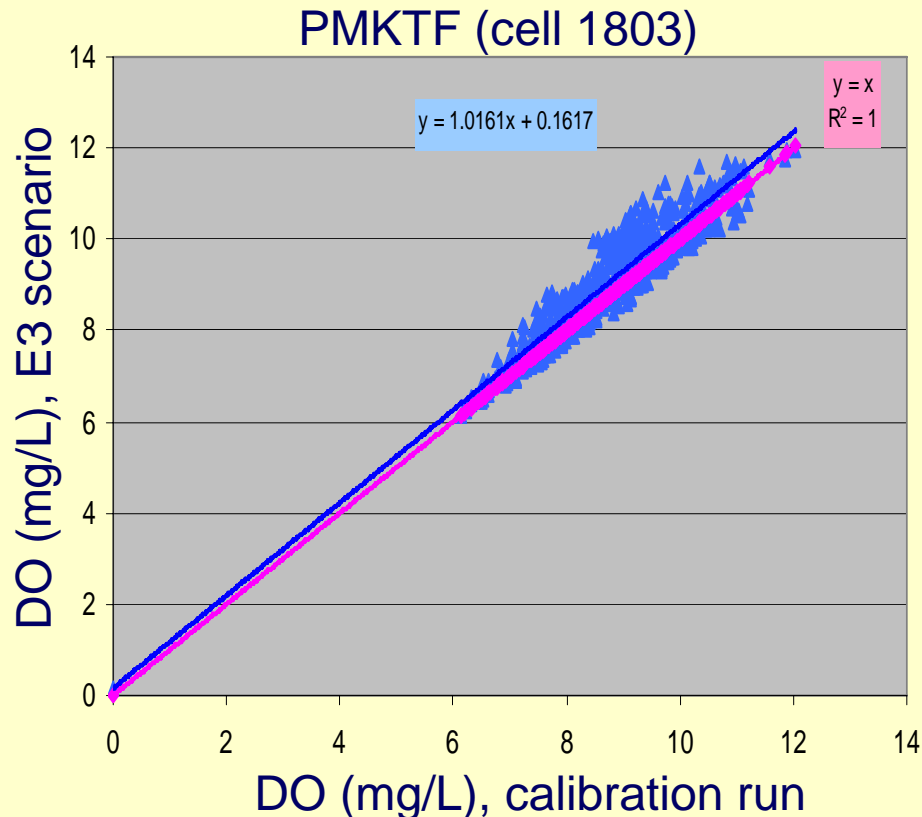
PMKTF (cell 1803)



Open Water: General Findings

(1) Less-than-expected change in DO concentrations from calibration to E3 scenario

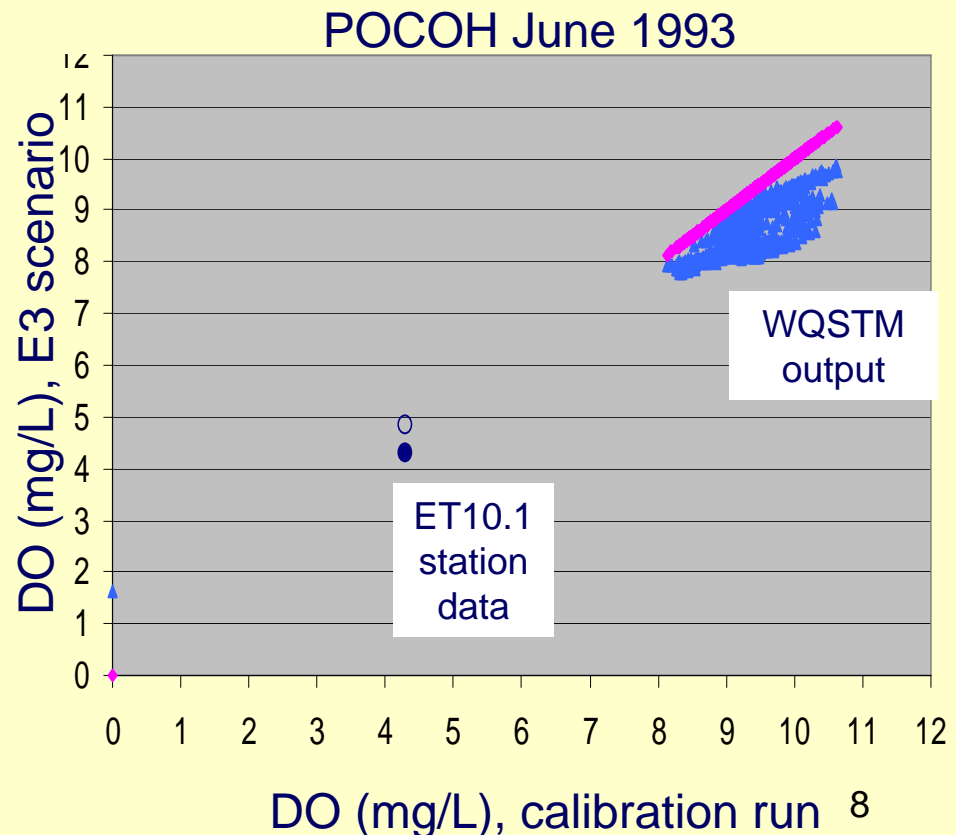
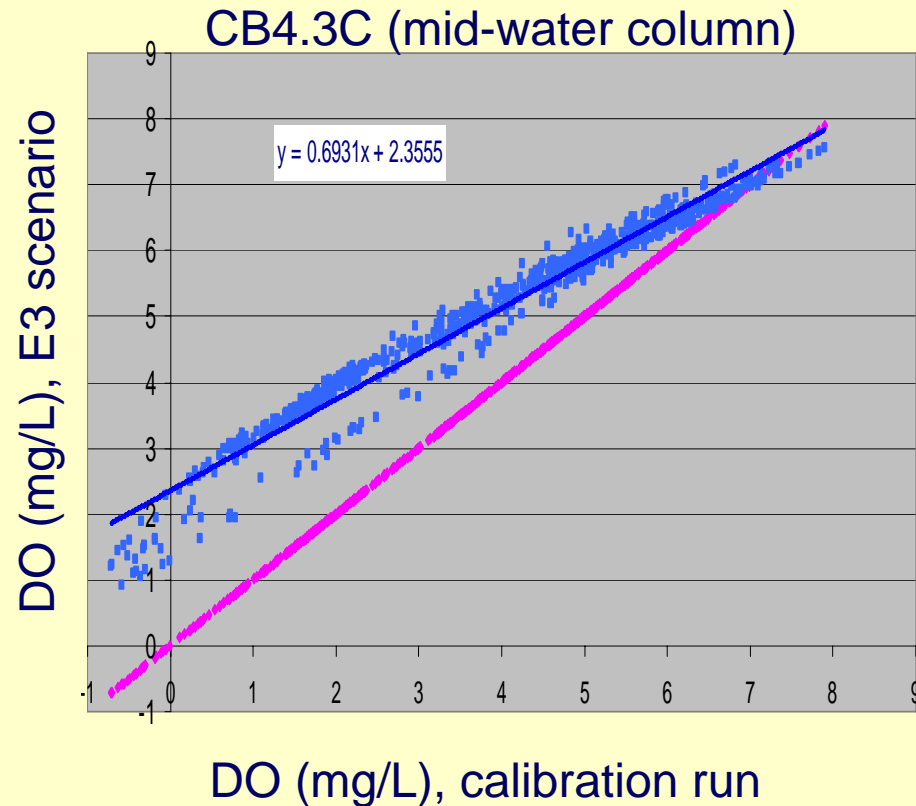
Little response to load reductions:



- Observed almost universally in problem segments
- Not observed in all months
- When poor response occurs in month with measured violations, result is persistent non-attainment

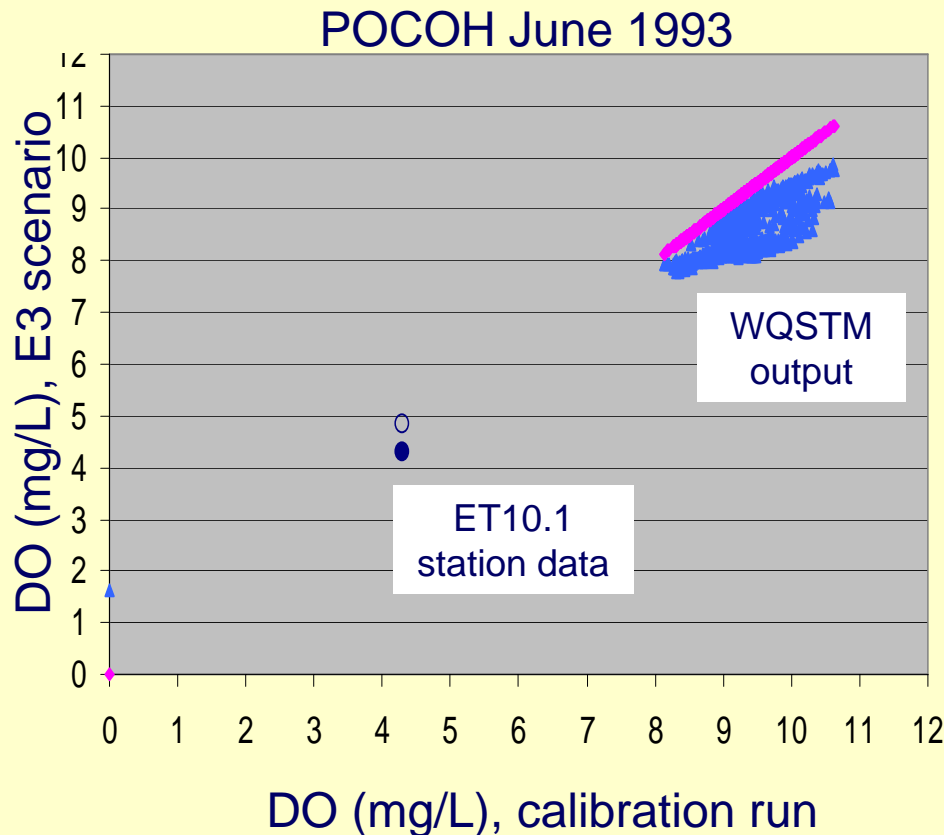
Open Water: General Findings

(2) Range of simulated DO concentrations well outside range of observed DO concentrations



Open Water: General Findings

(2) Range of simulated DO concentrations well outside range of observed DO concentrations

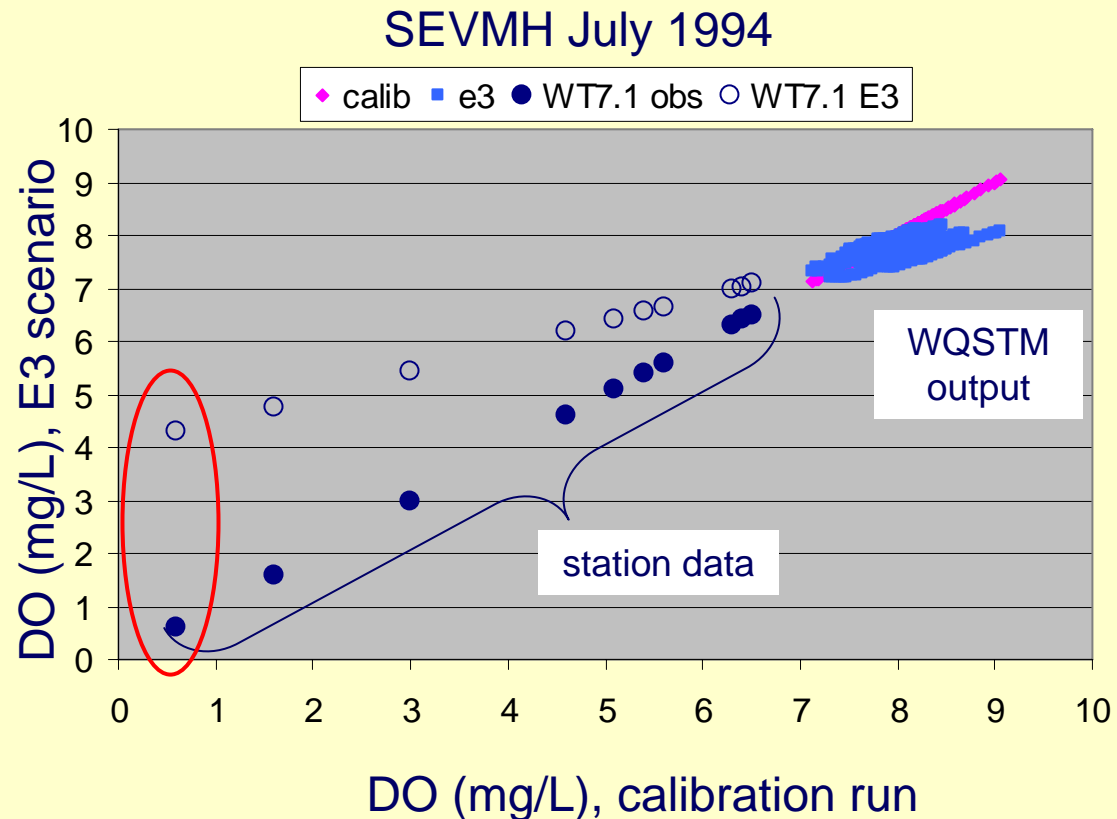


- Observed almost universally in problem segments
 - Varying degrees of severity
- Shallow waters adjacent to land (thus direct watershed model inputs)
- Reduces confidence in ability of regression equation to effectively represent system's response to load reductions

Open Water: General Findings

(3) Unusually and/or very low observed DO concentrations, which are very difficult to “scenario” into “Open Water” attainment under any conditions

		observed	E3
year	month	vio rate	vio rate
1993	6	25.9%	0.0%
1993	7	25.4%	25.4%
1993	8	14.0%	0.0%
1993	9	0.0%	0.0%
1994	6	25.4%	13.4%
1994	7	14.0%	0.7%
1994	8	14.0%	0.0%
1994	9	24.6%	0.0%
1995	6	40.0%	0.0%
1995	7	14.0%	0.0%
1995	8	57.5%	40.4%
1995	9	40.0%	12.0%



Open Water: General Findings

Additional Lines of Evidence For Anticipated Response and Attainment

Cbseg
CB7PH
GUNOH
MANMH
MDATF
MPCOH
PMKTF
SEVMH
VPCOH
WBEMH
WICMH
WSTMH
YRKMH

1. Are violations isolated or persistent?
2. What is condition of nearby waters?
3. What is the estimated response to load reductions in nearby, deeper regions?

Open Water “Problem” Segments

Summary Thus Far

Cbseg
CB7PH
GUNOH ✓
MANMH ✓
MDATF
MPCOH ✓
PMKTF ✓
SEVMH ?
VPCOH ✓
WBEMH
WICMH ✓
WSTMH ✓
YRKMH

- GUNOH: generally healthy DO conditions; 1 unusually low observation; poor regression behavior; nearby regions attain with moderate load reductions
- MANMH: few observed DO violations; poor simulation and regression behavior; most nearby segments attain by 170 Load scenario or sooner
- WICMH: single month prevents attainment at 170 TN; month shows marginal hypoxia (~4.4 mg/L) and poor estuarine model fit
- POCOH, POCTF: represented by same monitoring station and model cell. Single month (June 1993) prevents attainment at 170TN; month shows marginal hypoxia (4.3 mg/L) and poor estuarine model fit
- WSTMH: 2 months with unusually low bottom DO preventing attainment; values well outside range of simulations; nearby segments (e.g. RHDMH, CB4MH OW) attain
- SEVMH: substantial violations in observed data; substantial reduction in violations with load reductions; very low bottom DO values outside range of model simulations

Open Water “Problem” Segments

Summary Thus Far

- MDATF and WBEMH: small and/or narrow tributary locations which may be susceptible to similar limitations in estuarine model simulations and scenario regressions
- CB7PH and YRKMH: below 1% non-attainment at 170 TN

Cbseg
CB7PH ✓
GUNOH ✓
MANMH ✓
MDATF
MPCOH ✓
PMKTF ✓
SEVMH ?
VPCOH ✓
WBEMH
WICMH ✓
WSTMH ✓
YRKMH ✓

Open
Water

Cbseg	1985 '93-'95	'91 -'00 Base '93-'95	2007 Scenario '93-'95	Trib Strategy '93-'95	190 Load Scenario '93-'95	179 Load Scenario '93-'95	170 Load Scenario '93-'95	E3 2010 Scenario '93-'95
CB7PH	8.8%	7.0%	2.2%	0.3%	0.2%	0.1%	0.1%	0.0%
GUNOH	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%
MANMH	0.4%	0.6%	5.0%	5.0%	5.0%	5.0%	5.1%	5.1%
MDATF	34.3%	38.7%	34.5%	12.1%	12.1%	11.5%	11.3%	0.0%
MPCOH	33.1%	42.3%	32.3%	25.0%	17.9%	4.6%	4.6%	4.6%
PMKTF	11.0%	11.0%	4.6%	4.6%	4.6%	4.6%	2.3%	0.7%
SEVMH	20.5%	15.5%	9.0%	6.4%	5.8%	5.8%	5.8%	1.4%
VPCOH	32.5%	40.9%	32.3%	25.0%	17.9%	4.6%	4.6%	4.6%
WBEMH	15.3%	11.1%	15.3%	7.8%	7.8%	7.8%	7.8%	0.0%
WICMH	11.2%	11.2%	11.2%	4.6%	4.6%	4.6%	4.6%	4.6%
WSTMH	9.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
YRKMH	17.6%	24.0%	6.6%	1.0%	0.8%	0.7%	0.4%	0.0%

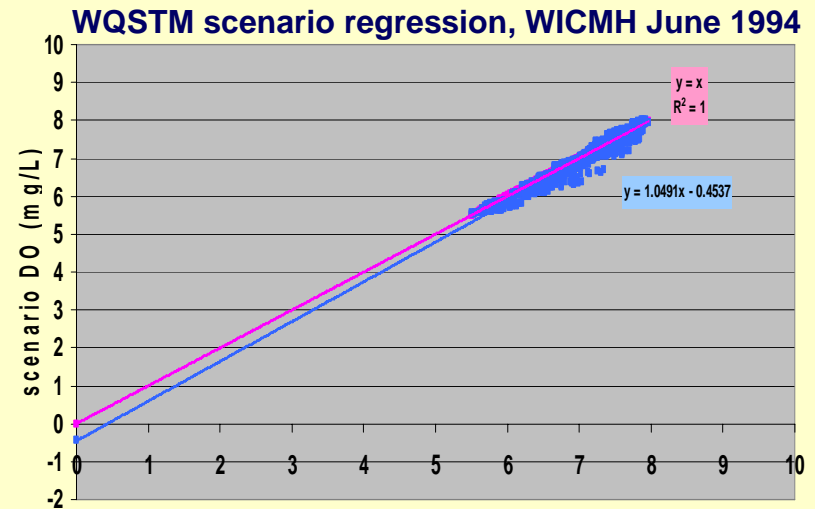
Open Water “Problem” Segments

Summary Thus Far

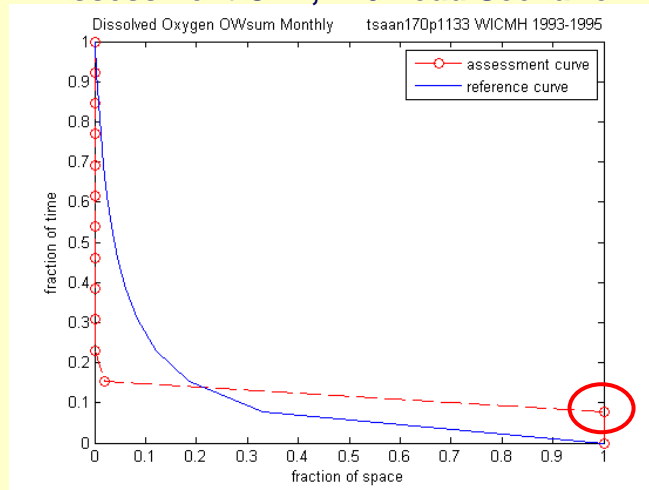
WICMH:

- moderate violations in observed data;
- Single month (June 1994) preventing attainment
- Observed hypoxia in June 1994 is marginal/moderate
- Poor estuarine model response (regression) for June 1994

WICMH		observed	170 TN
year	month	vio rate	vio rate
1993	6	0.0%	0.0%
1993	7	5.5%	1.9%
1993	8	0.0%	0.0%
1993	9	0.0%	0.0%
1994	6	100.0%	100.0%
1994	7	100.0%	0.0%
1994	8	0.0%	0.0%
1994	9	0.0%	0.0%
1995	6	0.0%	0.0%
1995	7	0.0%	0.0%
1995	8	0.0%	0.0%
1995	9	0.0%	0.0%



Assessment CFD, 170 Load Scenario



data

ET7.1	observed	170 TN
0.5	4.6	4.39
1	4.5	4.29
2	4.4	4.28
3	4.4	4.28
4	4.4	4.28
5	4.5	4.38
6	4.55	4.435

Open Water “Problem” Segments

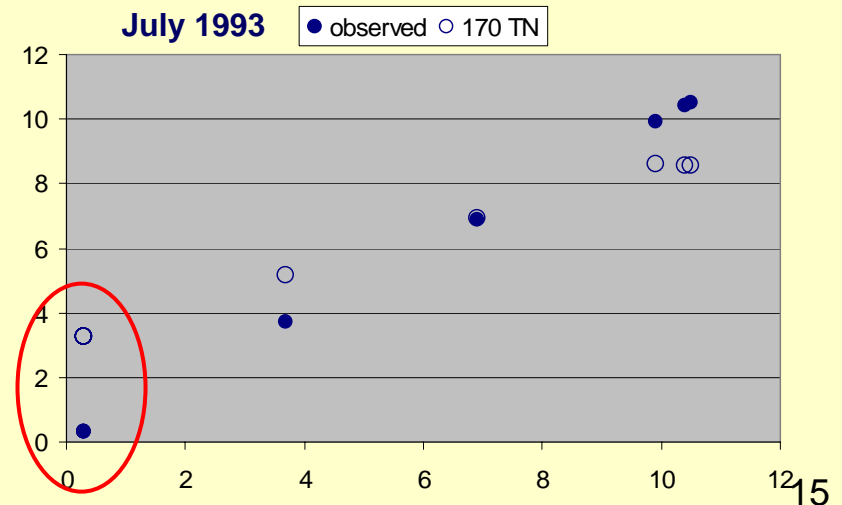
Summary Thus Far

SEVMH:

- substantial violations in observed data;
- moderate reduction in violations with load reductions;
- very low bottom DO concentrations outside range of model simulations
- 6 out of 7 months with persistent violations have observed upper pycnocline boundaries

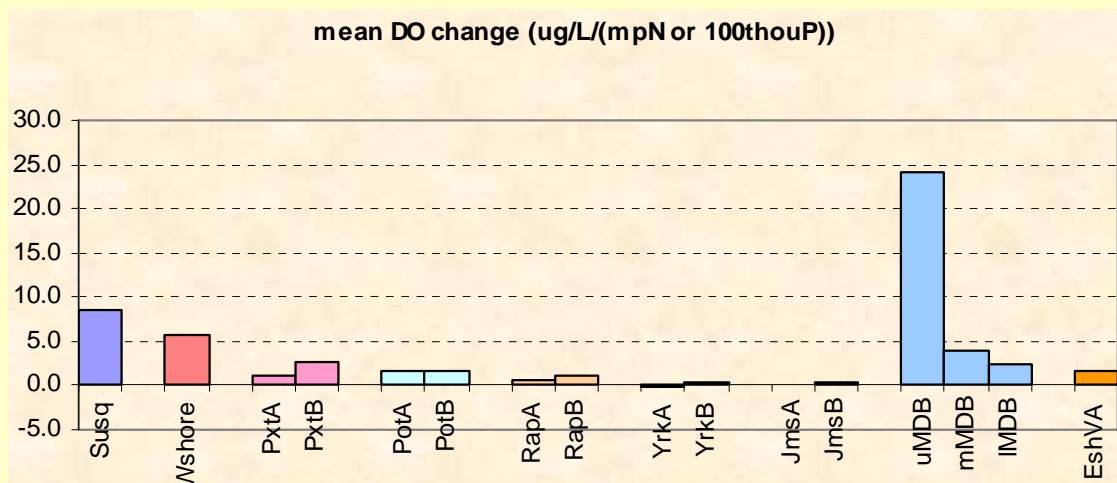
Cbseg	SEVMH		observed	170 TN
	year	month	vio rate	vio rate
CB7PH				
GUNOH ✓	1993	6	25.9%	0.0%
ANMH ✓	1993	7	25.4%	25.4%
MDATF	1993	8	14.0%	0.0%
MPCOH ✓	1993	9	0.0%	0.0%
PMKTF ✓	1994	6	25.4%	25.4%
SEVMH ?	1994	7	14.0%	1.8%
SEVMH ?	1994	8	14.0%	0.0%
VPCOH ✓	1994	9	24.6%	3.6%
WBEMH	1995	6	40.0%	4.8%
WICMH ✓	1995	7	14.0%	0.0%
WSTMH ✓	1995	8	57.5%	57.5%
YRKMH	1995	9	40.0%	40.0%

months with vios at 170 TN	upper pyc	lower pyc
Jul-93	y	n
Jun-94	y	n
Jul-94	n	n
Sep-94	y	y
Jun-95	y	n
Aug-95	y	n
Sep-95	y	y



Deep Water/Deep Channel Segments

Preliminary Findings: CHSMH

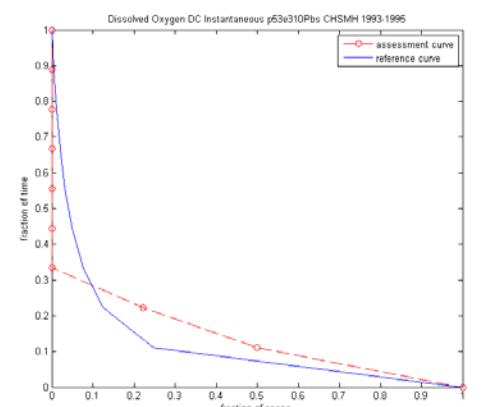
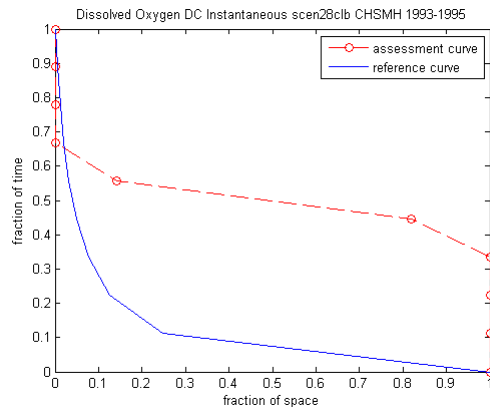
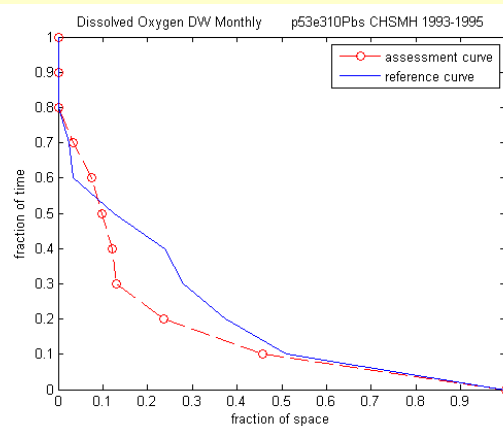
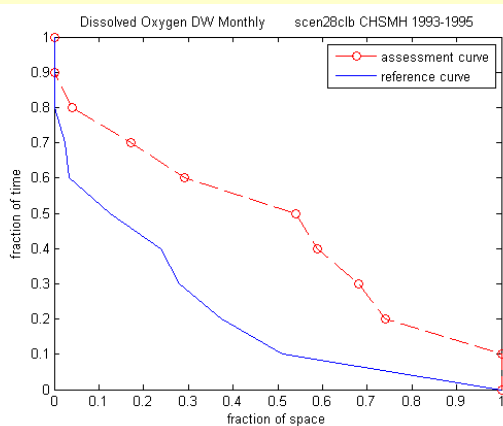


CHSMH DW		observed	E3
year	month	vio rate	vio rate
1993	6	74.0%	3.4%
1993	7	68.1%	45.7%
1993	8	54.1%	12.2%
1994	7	17.2%	7.5%
1994	8	4.1%	0.0%
1994	9	29.2%	9.9%
1995	7	100.0%	23.7%
1995	8	58.9%	13.1%
1995	9	0.0%	0.0%

CHSMH DC		observed	E3
year	month	vio rate	vio rate
1993	6	100.0%	0.0%
1993	7	100.0%	50.0%
1993	8	81.9%	22.2%
1993	8	0.0%	0.0%
1994	7	14.1%	0.0%
1994	9	0.0%	0.0%
1995	8	100.0%	0.0%
1995	9	0.0%	0.0%

Deep Water/Deep Channel Segments

Preliminary Findings: CHSMH

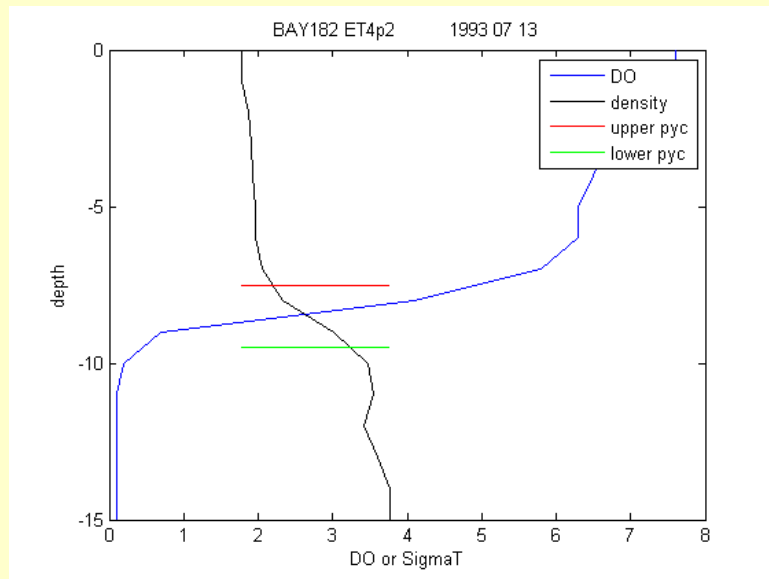


	upper pyc	lower pyc
1993_6_1	3.5	10.5
1993_6_2	5.5	nd
1993_7_1	7.5	9.5
1993_7_2	5.5	nd
1993_8_1	4.5	12.5
1993_8_2	7.5	8.5
1993_9_1	nd	
1993_9_2	nd	
1994_6_1	nd	
1994_6_2	nd	
1994_7_1	6.5	11.5
1994_7_2	nd	
1994_8_1	nd	
1994_8_2	4	nd
1994_9_1	4.5	nd
1994_9_2	2.5	5.5
1995_6_1	nd	
1995_6_2	nd	
1995_7_1	nd	
1995_7_2	10.5	nd
1995_8_1	nd	
1995_8_2	7.5	9.5
1995_9_1	1.5	10.5
1995_9_2	nd	

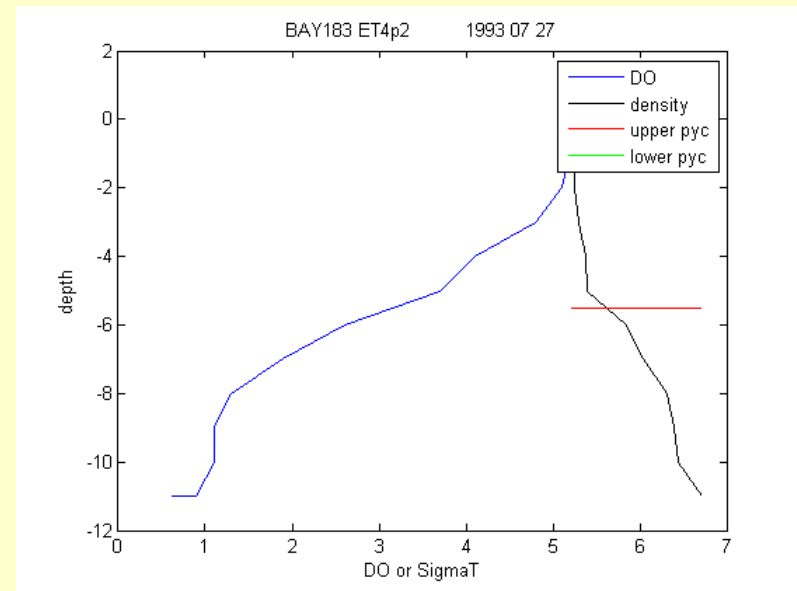
Deep Water/Deep Channel Segments

Preliminary Findings: CHSMH

July 13, 1993

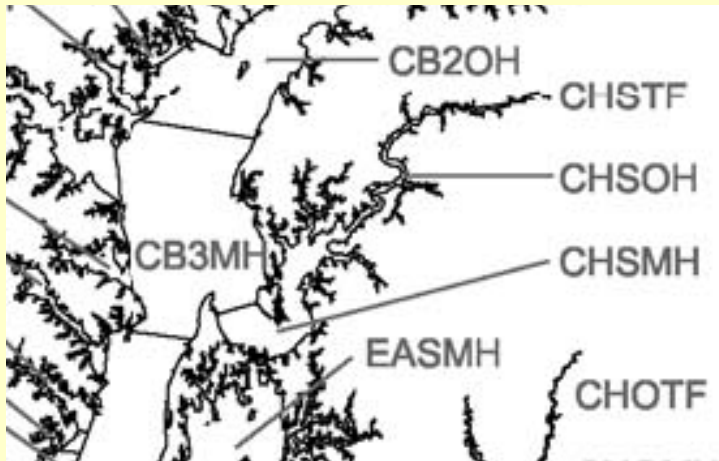


July 27, 1993



Deep Water/Deep Channel Segments

Preliminary Findings: CHSMH

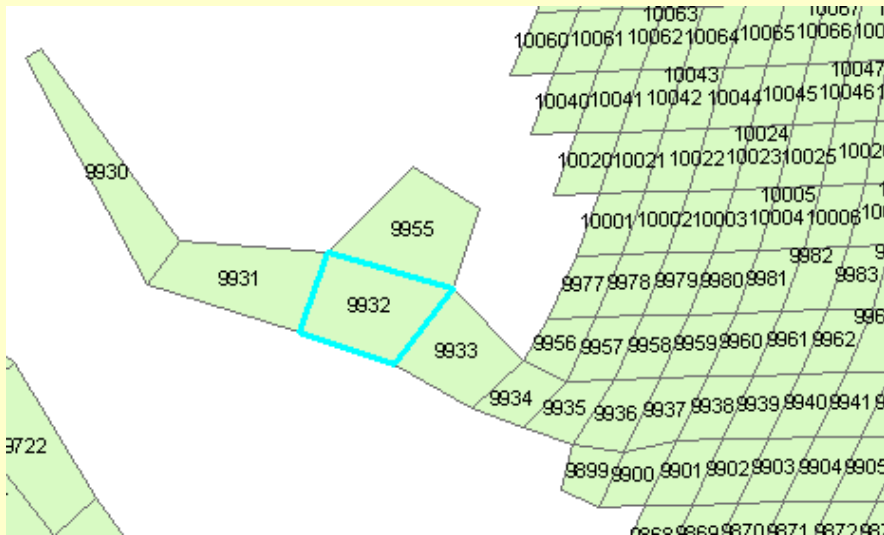


Cbseg	1985 Scenario '93-'95 DO Deep Water	'91-'00 Base '93-'95 DO Deep Water	2007 Scenario '93-'95 DO Deep Water	Tributary Strategy '93-'95 DO Deep Water	190 Loading Scenario '93-'95 DO Deep Water	179 Loading Scenario '93-'95 DO Deep Water	170 Loading Scenario '93-'95 DO Deep Water	E3 2010 Scenario '93-'95 DO Deep Water	All Forest Scenario '93-'95 DO Deep Water
CHSMH	35.5%	24.7%	15.6%	1.8%	1.8%	1.6%	0.5%	0.4%	0.0%
CB3MH	2.6%	2.0%	0.6%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%

Cbseg	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel
CHSMH	38.0%	38.0%	29.4%	14.0%	13.7%	13.7%	9.4%	3.6%	0.0%
CB3MH	17.9%	14.5%	6.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%

Deep Water/Deep Channel Segments

Preliminary Findings: MAGMH



Cbseg	1985 Scenario 342TN, 24.1TP, 9790TS '93-'95 DO Deep Water	'91-'00 Base Scenario 309TN, 19.5TP, 8950TS '93-'95 DO Deep Water	2007 Scenario 254TN, 17.1TP, 6498TS '93-'95 DO Deep Water	Tributary Strategy 191TN 14.4TP, 6462 TSS '93-'95 DO Deep Water	190 Loading Scenario 190TN 12.6TP, 6030TS '93-'95 DO Deep Water	179 Loading Scenario 179TN 12.0TP, 5510TS '93-'95 DO Deep Water	170 Loading Scenario 170TN 11.3TP, 5650TS '93-'95 DO Deep Water	E3 2010 Scenario 141TN 8.5TP, 5060TS '93-'95 DO Deep Water	All Forest Scenario '93-'95 DO Deep Water
CB3MH	2.6%	2.0%	0.6%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
MAGMH	34.8%	34.8%	34.8%	15.9%	3.4%	3.4%	0.5%	0.5%	0.0%

Deep Water/Deep Channel Segments

Preliminary Findings: MAGMH

violations

MAGMH		observed	170 TN
year	month	vio rate	vio rate
1993	6	44.9%	0.0%
1994	9	44.9%	0.0%
1995	7	100.0%	0.0%
1995	8	0.0%	0.0%
1995	9	100.0%	44.9%

July 1995

	observed	170 TN
depth	DO (mg/L)	DO (mg/L)
0.5	7.1	7.15
1	7.1	7.15
2	6.9	6.45
3	5.3	5.9
4	0.6	4.28
5	0.4	4.21

Sept 1995

WT6.1	observed	170 TN
depth	DO (mg/L)	DO (mg/L)
0.5	6	6.32
1	5.7	6.11
2	3.8	4.75
3	0.3	2.06
4	0.85	2.485

Deep Water/Deep Channel Segments

Preliminary Findings

Deep Water		1985	'91 -'00 Base	2007 Scenario	Trib Strategy	190 Load Scenario	179 Load Scenario	170 Load Scenario
	Cbseg	'93-'95	'93-'95	'93-'95	'93-'95	'93-'95	'93-'95	'93-'95
	CB5MH	9.8%	6.9%	1.5%	0.3%	0.3%	0.1%	0.0%
	CHSMH	35.5%	24.7%	15.6%	1.8%	1.8%	1.6%	0.5%
	EASMH	25.4%	5.7%	1.4%	0.7%	0.7%	0.2%	0.2%
	MAGMH	34.8%	34.8%	34.8%	15.9%	3.4%	3.4%	0.5%
	MD5MH	11.8%	9.1%	4.2%	1.5%	1.3%	0.9%	0.6%
Deep Channel								
	CHSMH	48.3%	46.1%	29.6%	11.3%	11.0%	11.0%	9.9%
	EASMH	49.6%	43.6%	22.2%	6.3%	6.0%	4.1%	2.0%