Corrected Report
Upper Oyster Creek Dissolved Oxygen Assessment

Upper Oyster Creek (Segment 1245)
Dissolved Oxygen & Bacteria TMDL

Report to
TMDL Team
Texas Commission on Environmental Quality
Work Order No. 582-6-70859-10

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TABLE OF CONTENTS

TABLES

FIGURES

Upper Oyster Creek Dissolved Oxygen Assessment

From winter 2003 through summer 2004, the Texas Institute for Applied Environmental Research (TIAER) conducted 24-hr dissolved oxygen (DO) assessment surveys at selected stations on Upper Oyster Creek (Segment 1245) to determine whether or not present DO concentrations support the segment's aquatic life use. Due to the small magnitude of some DO exceedances and large differences in occurrences of exceedances between years 2003 and 2004, it was deemed that additional surveys were necessary to better assess support of the aquatic life use for segment 1245. This report contains updates to Houser and Hauck (2005) with the inclusion of additional survey data from the 2005 index period and Adams *et al.* (2005) with revisions based on a change in TCEQ assessment methods. This report also corrects errors in the assessment reported in Adams et al. (2006) in Table 3 on page 10 and summary of assessment on page 11. This report provides the methodology used in the DO assessment, assessment criteria, and findings.

Assessment Stations

From previous assessments, the Texas Commission on Environmental Quality (TCEQ) has divided segment 1245 into six assessment units. For the present DO assessment, each assessment unit was established with either one or two stations (Figure 1):

- Assessment unit 1: From lower end of segment to Dam #3, just upstream of Lexington Blvd. (stations 12074 and 12077)
- Assessment unit 2: From Dam #3, just upstream of Lexington Blvd. to the Brooks Lake outfall (station 12079)
- Assessment unit 3: From the Brooks Lake outfall to Hwy 90A (station 12082)
- Assessment unit 4: From Hwy 90A to Dam #1, located 1.5 miles upstream of Harmon St. (station 12083)
- Assessment unit 5: From Dam #1 to Oyster Creek/Jones Creek confluence (stations 12086 and 12087)
- Assessment unit 6: From Oyster Creek/Jones Creek confluence to upper end of segment (station 12090)

Methodology

The DO assessment for Upper Oyster Creek utilizes the methodology prescribed by the TCEQ, Office of Compliance and Enforcement, Monitoring Operations Division, Surface Water Quality Monitoring Program in their publication *Guidance for Assessing Surface and Finished Drinking Water Quality, 2004*, August 15, 2003 (TCEQ, 2003).

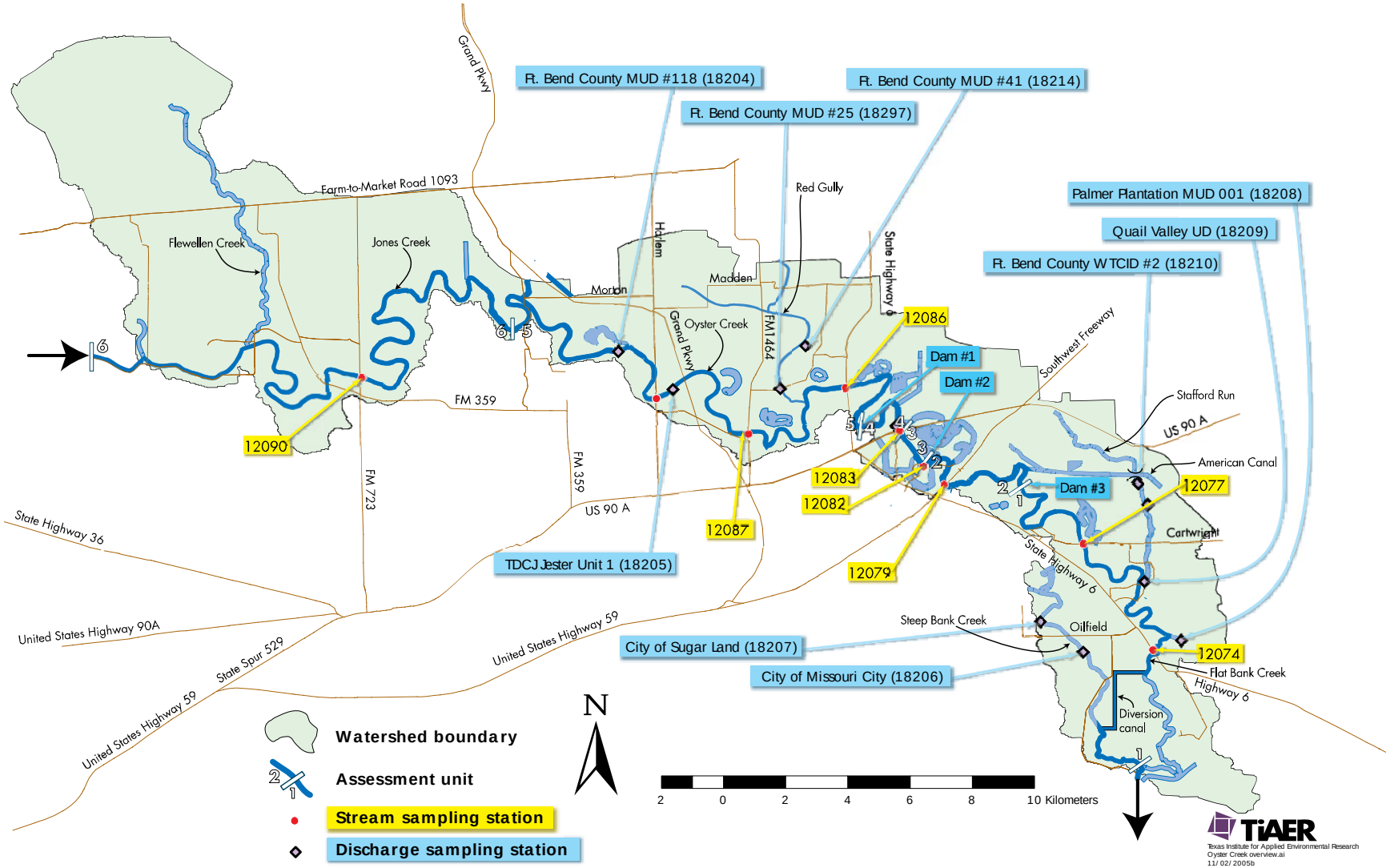

Figure 1 Upper Oyster Creek watershed (Segment 1245) with assessment stations.

All data used in the assessment were collected under a quality assurance project plan that ensures the data are of a known and appropriate quality. A description of the methodology and data requirements for application of the assessment is as follows.

Constraints on Sampling Events

A minimum of ten 24-hr measurement events within a two- to five-year period are required to assess the aquatic life use. Measurement interval for DO data should be no more than once every 15 minutes and no less than once per hour. For this assessment, data were collected at a 15-minute interval. From the data of each 24-hr event an average DO concentration and an absolute minimum DO concentration are obtained. A streamflow measurement should be obtained with each 24-hr event.

When there are less than 10 sample events, water quality data can not be assessed for impairments of aquatic life. However, with four to nine sets Tier 1 primary concerns can be ascertained.

No more than two thirds of the events should occur in any year. The events must be spaced over an Index Period representing warm-weather seasons (March 15 – October 15) with annually between one half to two thirds of the measurements occurring during the Critical Period (July 1 – September 30). A period of about one month (or four weeks) must separate each 24-hr sampling event.

Assessment Criteria

DO criteria consist of 24-hr average and absolute minimum concentrations. In previous studies it was determined that Upper Oyster Creek's attainable aquatic-life use was intermediate (TWC, 1991a), and the intermediate aquatic life use is applicable per the present State of Texas Surface Water Quality Standards (TNRCC, 2000). The criteria for protection of intermediate aquatic life use are:

- 24-hr average DO concentration $\geq$ 4.0 mg/l
- 24-hr absolute minimum DO concentration $\geq$ 3.0 mg/l

and to protect fish spawning during any of the first 6 months of the year when average water temperature is between 63 and 73 °F (17.2 and 22.8 °C):

- 24-hr average DO concentration $\geq$ 5.0 mg/l
    - 24-hr absolute minimum DO concentration $\geq$ 4.0 mg/l

Flow Conditions

Until recently, in order for a sample event to be considered valid for assessment, the streamflow at the time of the 24-hr event must exceed the seven-day, two-year low flow (7Q2). Personal communications on February 3, 2006 with Ms. Jill Csekitz, TCEQ SWQM Team indicated the following modification to the TCEQ methodology effective with any new assessments. The sample event is excluded from assessment if the streamflow is less than the 7Q2 and if the sample event includes an exceedance of the relevant water quality criterion, which is the same as previously. However, the event is

included in the assessment even if the streamflow is less than the 7Q2 as long as the event does not include an exceedance, which is the modification in methodology.

Streams located in the eastern and southern regions of Texas, including Upper Oyster Creek, have 7Q2 flow (or critical low flow) defined by the larger of the actual 7Q2 flow determined from statistical analysis of streamflow data and the value obtained from Table 5 of the Texas State Water Quality Standards (TNRCC, 2000) as based on streambed slope.

The hydrology of Upper Oyster Creek is a response to rainfall-runoff from a combination of an urban and rural land use watershed, likely shallow groundwater interactions, and several anthropogenic modifications, which include pumping, damming, and municipal wastewater treatment plant (WWTP) effluents. Assessment unit 1, itself, contains two reasonably distinct hydrologic sections. An upper portion, which is defined from immediately above the confluence with Stafford Run upstream to Dam # 3, contains as a major modification the presence of the dam, which at low flow interrupts the normal hydrologic pathway except for minimal seepage. A lower portion, which is defined from the downstream end of the stream segment to the confluence with Stafford Run, contains as the major anthropogenic modification significant WWTP effluents.

The hydrology of Upper Oyster Creek reach in assessment units 2-6 is often dominated by the Gulf Coast Water Authority's (GCWA) use of this reach as a conveyance channel for water pumped via the Shannon Lift Station from the Brazos River into the headwaters of Upper Oyster Creek. Limited water delivery points occur along assessment units 2-6, and most of the water is pumped out of the system at the Second Lift Station into the American Canal for an ultimate destination in the Texas City area. Minimum flows occur in this reach when pumping is not occurring and several days have elapsed since rainfall runoff. With this combination of circumstances, the streamflow may approach that of the effluents from the point source dischargers. Measurement of such reduced flows, however, is extremely difficult, if not impossible, because of the pooled and impounded nature of much of assessment units 2-6, which results in very low velocities especially at low flows. Historically the occurrence of no pumping is most common in the winter when water demands are the least, though such occurrences may happen at any time of year when repairs are required by the GCWA.

Because of the southeast Texas location of Upper Oyster Creek and the slight slopes of its streambed, the slope-based (bedslope) definition of 7Q2 flow is applicable for this DO assessment. The Fort Bend County Drainage District (District) provided elevation and stream distance information for assessment units 1 and 6 that were used to determine bed slope (personal communication, David Jalowy, Fort Bend County Drainage District, September 30, 2004 and March 2, 2005).

The District's information for assessment unit 1 begins 3,300 feet upstream of the Brazos River and ends at Dulles Avenue just downstream of Dam 3. That entire stretch of the channel (55,100 ft) was divided by the District into three separate design gradients. Their design gradients are as follows:

- From the beginning flowline elevation to Highway 6 the slope is 0.050 percent. Therefore, the change in elevation is 0.5 m/km.
- The channel slope from Highway 6 to F.M. 1092 is 0.041 percent, or 0.41 m/km.
- The channel slope from F.M. 1092 to Dulles Avenue is 0.032 percent, or 0.32 m/km.

The full gradient length is 55,000 ft with an elevation change of 23.65 ft, which gives an overall slope of 0.42 m/km. For a DO criteria of 4.0 mg/l, the critical low flow based on the overall bedslope is 0.5 cfs. In the upper portion of the assessment unit by station 12077, the slighter slope of 0.3 m/km allows a critical low flow of 0.8 cfs.

For assessment units 2 –5, ending streambed elevations of the surveys performed for the District in assessment units 1 and 6 were used to determine the change in elevation from Dulles Avenue near the upstream end of assessment unit 1 to the junction of Jones and Oyster Creeks very near the downstream end of assessment unit 6. Channel distance for the combined length of assessment units 2–5 was determined from information provided in the TCEQ Upper Oyster Creek waste load evaluation report (TWC, 1991b). Based on this information, an average bedslope for assessment units 2 – 5 was calculated to be 0.15 m/km. For a DO criterion of 4.0 mg/l, the bedslope adjusted critical low flow is 1.3 cfs for these assessment units.

District-provided survey information for the portion of Jones Creek that constitutes assessment unit 6 of Segment 1245 was used to calculate an average bedslope of 0.009 percent or 0.09 m/km. For a DO criterion of 4.0 mg/l, the bedslope adjusted critical low flow is 3.0 cfs for assessment unit 6.

TCEQ determination of 7Q2 flow for Upper Oyster Creek based strictly on hydrologic data (personal communication, Ms. Kenda Smith, TCEQ, November 2004) and bedslope adjusted critical low flow determined from District information are found in Table 1. For assessment purposes the critical low flow is the larger of the 7Q2 and bedslope adjusted flows.

Table 1. Seven-day, two-year low flow (7Q2) assessment showing TCEQ determined 7Q2 and bedslope adjusted critical low flow from Table 5 of TNRCC (2000). For each station the critical low flow used in the assessment is indicated by yellow shading.

Station Id	TCEQ Determined 7Q2 Flow (cfs)	Bedslope Adjusted Critical Low Flow (cfs)
12074	6.77	0.5
12077	0.1	0.8
12079	0.86	1.3
12082	0.73[a]	1.3
12083	0.86	1.3
12086	0.86	1.3
12087	0.38	1.3
12090	0.1	3.0

a. Based on Gulf Coast Water Authority information, it is estimated that 15 % of the flow at station 12083 is diverted through Brooks Lake, thus effectively bypassing station 12082, and that flow reenters Oyster Creek before station 12079.

Assessment of Exceedances

Whether the water body supports the DO criteria is based on the number of exceedances that occur in the data set (with DO criteria an "exceedance" actually refers to DO concentrations that fall *below* the established criteria). If either one or both of the 24-hr average and 24-hr minimum DO concentrations for that sample event are less than the relevant criterion, the event is counted as an exceedance. Based on the number of samples in exceedance the water body is considered *fully supporting*, *partially supporting*, or *not supporting*. In addition, even if the water body is *fully supporting* a determination can be made as to whether or not there are Tier 2 *concerns* or *no concerns* about impairment of the water body.

Until recent years, TCEQ has considered that the water body is *fully supporting* if 10 percent or less of the sample sets are in exceedance, *partially supporting* if greater than 10 and 25 percent or less of the sample sets are in exceedance, and *not supporting* if greater than 25 percent of the sample sets are in exceedance. However, TCEQ has recognized that the chance of falsely classifying a station or assessment unit as impaired (Type I error) is relatively high for the historically utilized method. Basing decisions on the simple 10 percent exceedance calculation results in a 26.4 to 61.2 percent chance of falsely classifying a water body as impaired. Therefore, TCEQ developed new exceedance criteria, using the binomial method, that maintain a Type I error probability below 20 percent for all standards and criteria.

The three years of DO surveys resulted in a sample size of 14 to 16 for the stations in this assessment. Based on the binomial approach in TCEQ (2003), the range of sample sizes results in two groupings (14 and 15 samples, and 16 and 17 samples) that define the number of exceedances defining level of support.

For a sample size of 14 and 15, the level of support is defined as follows:

- If there are two or less sample sets in exceedance, the water body is considered as *fully supporting*. If there are two exceedances, then there is a Tier 2 *primary concern* about the impairment of the water body. If there are one or less exceedances then there are *no concerns* about water body impairment.
- If there are three, four, or five sample sets in exceedance, the water body is considered as *partially supporting*, and
- If there were six or more sample sets in exceedance, the water body is considered *not supporting.*

For a sample size of 16 and 17, the level of support is defined as follows:

- If there are three or less sample sets in exceedance, the water body is considered as *fully supporting*. For a sample size of 16, if there are two or three exceedances, then there is a Tier 2 *primary concern* about the impairment of the water body and if there are one or less exceedances then there are *no concerns* about water body impairment. For a sample size of 17, if there are three exceedances, then there is a Tier 2 *primary*

concern about the impairment of the water body and if there are two or less exceedances then there are *no concerns* about water body impairment.
- If there are four or five sample sets in exceedance, the water body is considered as *partially supporting*, and
- If there were six or more sample sets in exceedance, the water body is considered *not supporting.*

From a strict interpretation perspective, however, both the U.S. Environmental Protection Agency and TCEQ do not make a distinction between *partially supporting* and *not supporting*—both are considered as *not supporting*, and for the TCEQ year 2006 assessment, the distinction of *partially supporting* and *not supporting* will no longer exist (personal communication, Dr. Patrick Roques, TCEQ, SWQM Team Leader, November 2004). Therefore the intermediate distinction regarding level of support will not be used in this assessment, which results in the following for a sample size of 14 to 16:

For a sample size of 14 and 15, the level of support is defined as follows:

- If there are two or less sample sets in exceedance, the water body is considered as *fully supporting*. If there are two exceedances, then there is a Tier 2 *primary concern* about the impairment of the water body. If there are one or less exceedances then there are *no concerns* about water body impairment.
- If there are three or more sample sets in exceedance, the water body is considered as *not supporting*.

For a sample size of 16 and 17, the level of support is defined as follows:

- If there are three or less sample sets in exceedance, the water body is considered as *fully supporting*. For a sample size of 16, if there are two or three exceedances, then there is a Tier 2 *primary concern* about the impairment of the water body and if there are one or less exceedances then there are *no concerns* about water body impairment. For a sample size of 17, if there are three exceedances, then there is a Tier 2 *primary concern* about the impairment of the water body and if there are two or less exceedances then there are *no concerns* about water body impairment.
- If there are four or more sample sets in exceedance, the water body is considered as *not supporting*.

Water Temperature and Streamflow During Events

Sampling stations, beginning date of sampling, streamflow and 24-hr average water temperature for each sampling event are listed in Table 2. In addition, the 24-hr average temperatures for surveys occurring during the first six months of the year are provided in Table 2. Therefore, Table 2 can also be used to determine which events should be used for DO assessment based on streamflow at or above the 7Q2 values in Table 1, presence or absence of required streamflow measurement for the event, and whether the temperature-based DO criteria to protect fish spawning applies for the event.

Table 2. Sample stations, dates of sampling, and the flow rate at each station for the 24-hr DO assessment (NA – not applicable, NM – not measured, MD – missing data; gray shaded temperatures indicate that DO criteria to protect fish spawning pertain because of time of year and water temperature.)

Beginning Date of 24-hr Event	Stations (assessment units)															
	12090 (6)		12087 (5)		12086 (5)		12083 (4)		12082 (3)		12079 (2)		12077 (1)		12074 (1)	
	Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp	Flow	Temp
	cfs	°C	cfs	°C	cfs	°C	cfs	°C	cfs	°C	cfs	°C	cfs	°C	cfs	°C
5/19/2003	214	30.0	111	30.2	189	29.5	NM	30.7	122	30.6	NM	30.2	NM	28.1	14.7	28.9
6/16/2003	114	28.1	113	28.6	104	29.4	NM	28.7	83.0	29.2	NM	29.4	53.4	28.9	51.8	27.5
7/14/2003	MD	NA	42.1	NA	144	NA	NM	NA	87.9	NA	NM	NA	66.0	NA	162	NA
8/11/2003	85.2	NA	97.1	NA	89.8	NA	NM	NA	77.7	NA	NM	NA	NM	NA	30.0	NA
9/9/2003	114	NA	109	NA	103	NA	NM	NA	72.9	NA	NM	NA	3.2	NA	22.8	NA
3/23/2004	126	20.4	110	20.6	105	20.6	NM	20.8	57.8	20.9	NM	21.3	5.8	20.5	25.3	21.4
4/20/2004	124	22.5	112	23.3	109	23.2	NM	23.8	61.7	24.0	NM	23.5	2.6	23.3	13.9	24.2
5/25/2004	128	27.8	79.1	28.3	68.8	28.4	NM	29.0	59.8	29.0	NM	28.8	7.6	28.3	24.3	27.5
7/1/2004	31.9	NA	94.1	NA	189	NA	NM	NA	124	NA	NM	NA	NM[a]	NA	NM[a]	NA
8/2/2004	141	NA	66.9	NA	91.1	NA	NM	NA	178	NA	NM	NA	51.2	NA	58.3	NA
8/30/2004	121	NA	86.2	NA	90.4	NA	NM	NA	77.8	NA	NM	NA	8.9	NA	51.5	NA
9/29/2004	118	NA	NM	NA	NM	NA	NM	NA	NM	NA	NM	NA	2.0	NA	12.7	NA
5/3/2005	117	22.8	115	22.7	138	23.3	126	23.2	88.7	23.2	127	23.1	2.5	24.2	12.0	23.6
6/8/2005	126	30.5	113	30.8	113	30.7	NM	31.1	45.5	30.6	115	31.0	3.0	31.0	14.9	29.8
7/13/2005	112	NA	83.0	NA	104	NA	108	NA	48.9	NA	94.1	NA	2.2	NA	11.4	NA
8/17/2005	125	NA	133	NA	140	NA	88.0	NA	55.8	NA	104	NA	4.1	NA	23.0	NA
9/20/2005	NM[b]	NA	NM[b]	NA	NM[b]	NA	NM[b]	NA	NM[b]	NA	NM[b]	NA	3.8	NA	10.0	NA

a. Not measured due to backwater from the Brazos River flooding.

b. Not measured, water velocities too low due to no pumping at the Shannon Lift and Second Lift Stations prior to and during event.

It can be seen from the distribution of dates in Table 2 that the minimum frequency and duration of sampling requirements are met by the data set. The events span two seasons (Spring and Summer), and include a 3-year period from May of 2003 to September of 2005. No more than two thirds of the samples are from the same year. All of the sampling dates occur within the Index Period (March 15 – October 15) and one half or more of the sample events in each year occurred during the Critical Period (3 of 5 in year 2003, 3 of 6 in year 2004, and 3 of 5 in year 2005).

Gray shaded values in Table 2 are temperatures that fall within the range of 17.2 °C to 22.8 °C during the first six months of the year. Sampling events with temperatures shaded gray were evaluated against the higher DO criteria of 5.0 mg/l average 24-hr DO and 4.0 mg/l absolute minimum 24-hr DO.

All measured flows were above the 7Q2 flows or the bedslope adjusted critical low flows based on information presently available (Table 1), so all the sample sets with measured flows could be used for the DO assessment.[1] There were two dates (5/19/2003 and 8/11/2003) at station 12077 during which flow was too low to be measured. Due to lack of flow data for these dates, these sampling events cannot be used for the DO assessment. On 7/1/2004 there was backwater from a flooding event on the Brazos River that prevented flow measurements from being taken at both stations (12077 and 12074) in assessment unit 1 of Upper Oyster Creek. Starting 9/29/2004 a 24-hr DO event was conducted only at stations 12074, 12077, and 12090 to replace the event missed at 12074 and 12077 due to backwater conditions and the missing July 2003 event data from failed instrumentation at station 12090. Because pumping had stopped from both the Shannon and the Second Lift Stations prior to and during the September 2005 monitoring survey, flow was not attainable at any station in assessment units 2-6. Therefore, data from these stations were not included in this assessment.

Prior to 2005, flow could not be measured at stations 12083 and 12079, because these stations are located in reservoir-like impoundment areas between small dams where extremely low velocities do not allow accurate measurement of flow. Based on contiguous streamflow and proximity of stations 12083 and 12079 to station 12082, where flow could be measured (see Figure 1), it was assumed that the flow at station 12082 reasonably represented the flow at the other two stations. All streamflows at station 12082 were well above the critical low flows in Table 1. For the 2005 monitoring period, acoustic Doppler technology allowed flow measurements to be made at these low velocity stations. As shown in Table 2, only one event on 6/8/2005 at station 12083 did not yield a flow measurement. However, because a flow measurement was obtained at station 12082 during the same monitoring period, this event was included in the assessment. For all events and stations where flow was measurable, streamflows were above critical low flow, which allows all such data to be used in this assessment.

Assessment Results

Table 3 shows the 24-hr average and absolute minimum DO concentrations for all sampling dates and stations. Based on the sample size and the number of exceedances, the aquatic life use assessment is provided in the last row in Table 3. The DO concentrations in red font do not meet the DO criteria. The values shaded in gray are samples that are subject to the higher DO criteria based on average water temperature and time of year. It can be seen that all events during the period of higher restrictions meet the higher criteria. The values that are shaded in yellow in Table 3 are samples that should not be used in the assessment due to absence of streamflow data.

[1] Station 12077 presented a challenge regarding measurement of low streamflows, because the entire stream channel along that reach was mildly pooled, which prohibited measurement at lower flows. Beginning September 2003, station 18211(location of a small riffle) was established about 1 km downstream from station 12077 as an alternative location for streamflow measurement when flow could not be measured at station 12077. Twenty-four hr DO assessment, however, could not be moved to station 18211. Unacceptable exposure of instrumentation to vandalism at this station would occur, because its location was adjacent to a heavily trafficked walking and jogging trail.

Table 3. 24-hr average and absolute minimum DO concentrations for all sampling dates and stations, the number of sample sets that exceed the DO criteria, and the use attainment assessment based on the binomial method (MD – Missing Data, NM – Not Measured, FS – Fully Supporting, NS – Not Supporting, nc – no concerns, pc – primary concerns, T2 – Tier 2; red font identifies values in exceedance; yellow shading indicates DO values that can not be used due to absence of flow measurements and occurrence of a DO exceedance; blue shading indicates an absence of flow measurements, but DO values can be used as no exceedance occurred; gray shading indicates values subject to the higher DO criteria)

Beginning Date of 24-hr DO event	Stations (assessment units)															
	12090 (6)		12087 (5)		12086 (5)		12083 (4)		12082 (3)		12079 (2)		12077 (1)		12074 (1)	
	Ave	Min	Ave	Min	Ave	Min	Ave	Min	Ave	Min	Ave	Min	Ave	Min	Ave	Min
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	Mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	Mg/l	mg/l
5/19/2003	**3.4**	**2.0**	5.7	4.9	6.6	5.2	5.9	4.8	6.5	5.4	7.2	6.0	7.0	0.4	6.6	4.1
6/16/2003	**3.9**	3.0	4.6	4.2	5.0	4.7	4.1	3.4	4.4	3.4	4.7	3.8	6.2	4.0	4.3	**2.9**
7/14/2003	MD	MD	6.2	5.9	5.4	4.7	5.8	4.8	6.1	3.9	6.2	4.9	6.8	**2.9**	5.0	3.8
8/11/2003	5.0	4.5	4.6	4.1	4.2	4.0	**3.5**	**2.9**	**3.6**	**2.5**	4.2	3.4	6.9	2.3	4.4	**2.8**
9/9/2003	5.6	5.3	5.8	5.4	5.7	5.4	4.5	4.3	4.4	3.5	5.2	3.6	7.6	**2.2**	4.1	**2.5**
3/23/2004	7.6	7.4	7.5	7.3	7.0	6.9	6.4	6.2	6.4	5.9	5.6	5.3	9.7	4.1	7.1	6.1
4/20/2004	6.8	6.6	6.7	6.5	6.4	6.3	5.8	5.5	5.6	5.3	6.0	5.7	8.3	**1.9**	6.7	5.3
5/25/2004	4.9	4.6	5.0	4.6	4.5	4.3	4.8	4.2	4.8	4.4	5.4	4.7	8.3	**2.5**	4.9	3.4
7/1/2004	**3.2**	**2.8**	**3.0**	**2.7**	**2.5**	**2.4**	**1.8**	**1.2**	**2.4**	**1.9**	**3.2**	**2.4**	4.1	3.3	4.4	3.5
8/2/2004	4.6	**2.8**	4.6	3.9	**3.9**	3.6	**2.7**	**2.1**	**3.5**	**2.1**	4.7	3.2	5.0	3.4	**3.6**	**1.7**
8/30/2004	5.4	5.2	4.8	4.3	**3.5**	**2.8**	**1.8**	**1.4**	**2.8**	**2.0**	4.5	3.4	7.4	3.5	5.6	3.8
9/29/2004	6.3	6.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	9.0	**1.4**	6.9	5.3
5/03/2005	7.9	6.9	7.5	7.0	7.4	7.2	6.6	5.4	6.7	5.9	7.5	6.9	7.8	**2.0**	9.2	7.0
6/08/2005	5.0	4.9	4.8	4.1	4.4	4.2	4.2	**2.4**	5.9	3.9	6.3	3.4	7.1	**1.2**	6.3	4.2
7/13/2005	**3.4**	**1.3**	5.0	3.4	5.2	4.6	4.7	3.4	5.8	3.9	4.7	**2.9**	5.4	**0.9**	4.8	3.3
8/17/2005	4.6	4.2	4.2	4.0	**3.9**	3.7	**3.3**	3.0	**3.1**	**1.8**	4.7	**2.9**	8.2	**1.3**	4.0	3.0
9/20/2005	3.4	1.7	8.6	6.8	5.0	3.1	7.1	3.0	7.3	4.8	5.4	4.1	7.8	**0.6**	**3.3**	**1.8**
Exceedance	5/15		1/16		4/16		6/16		5/16		3/16		10/15		5/17	
Assessment	NS		FS (nc)		NS		NS		NS		FS (pc)		NS		NS	

All stations, except 12087 and 12079, were assessed as *not supporting* the intermediate aquatic life use. Station 12087 was found to be in *full support* of the intermediate aquatic life with *no concerns* about impairment. Station 12079 was determined to be in *full support* of the intermediate aquatic life with *primary concerns* about impairment.

Figures 2-9 graphically show the pattern of DO at each station. The blue and red lines represent the 24-hr DO average and absolute minimum limitation respectively. Values that are in exceedance of the criteria are circled. All sampling data are shown on the

figures regardless of whether or not the data point was used in the DO assessment due to flow limitations.

Summary and Discussions

In general, the assessment found that the Upper Oyster Creek system is *not supporting* of the intermediate aquatic life use; however, there are some areas of exception. DO concentrations were particularly low during the second year, especially at stations 12082, 12083 and 12086 where both 24-hr average and absolute minimum DO concentrations were frequently in exceedance (Table 3). A summary of assessment findings regarding support of the intermediate aquatic life use is as follows:

- Assessment unit 1, lower portion, station 12074: *not supporting*
- Assessment unit 1, upper portion, station 12077: *not supporting*
- Assessment unit 1, combined stations: *not supporting*
- Assessment unit 2, station 12079: *fully supporting*, Tier 2 primary concern
- Assessment unit 3, station 12082: *not supporting*
- Assessment unit 4, station 12083: *not supporting*
- Assessment unit 5, station 12086: *not supporting*
- Assessment unit 5, station 12087: *fully supporting*, no Tier 2 primary concern
- Assessment unit 5, combined stations: *fully supporting*, Tier 2 primary concern
- Assessment unit 6, station 12090: *not supporting*

The fact that most exceedances in assessment unit 1 (both stations 12075 and 12077) are caused by DO concentrations below the minimum criterion while the average DO concentrations are acceptable (Table 3) indicates a system influenced by aquatic plant growth. During daylight hours a large increase in DO occurs as oxygen is released into the water by the photosynthetic process. At night, however, when photosynthesis is not occurring, respiration of the large aquatic plant population depletes much of the DO. Therefore, there are large daily swings in DO concentration resulting in high 24-hr average DOs, but low 24-hr absolute minimum DO concentrations.

Diel variations in DO concentrations are not nearly as pronounced in assessment units 2-6 as in assessment unit 1. In these other assessment units, exceedances often included both average and minimum DO concentrations from the same event.

Four supplementary DO assessment events were conducted during the winter (February 2003, December 2003, January 2004, and February 2004). No DO exceedances occurred with any of these events. Historical data from the 1980s and 1990s indicated occurrences of low DO concentrations within assessment units 2-4 during the winter when Gulf Coast Water Authority pumping was often lowest. Past winter DO excursions occurred when significantly greater amounts of point source effluents were present in the area of assessment units 2-4. While these recent winter surveys portend that present condition in Segment 1245 are not conducive to low winter DO concentrations, the data are inadequate to definitively reach that conclusion.

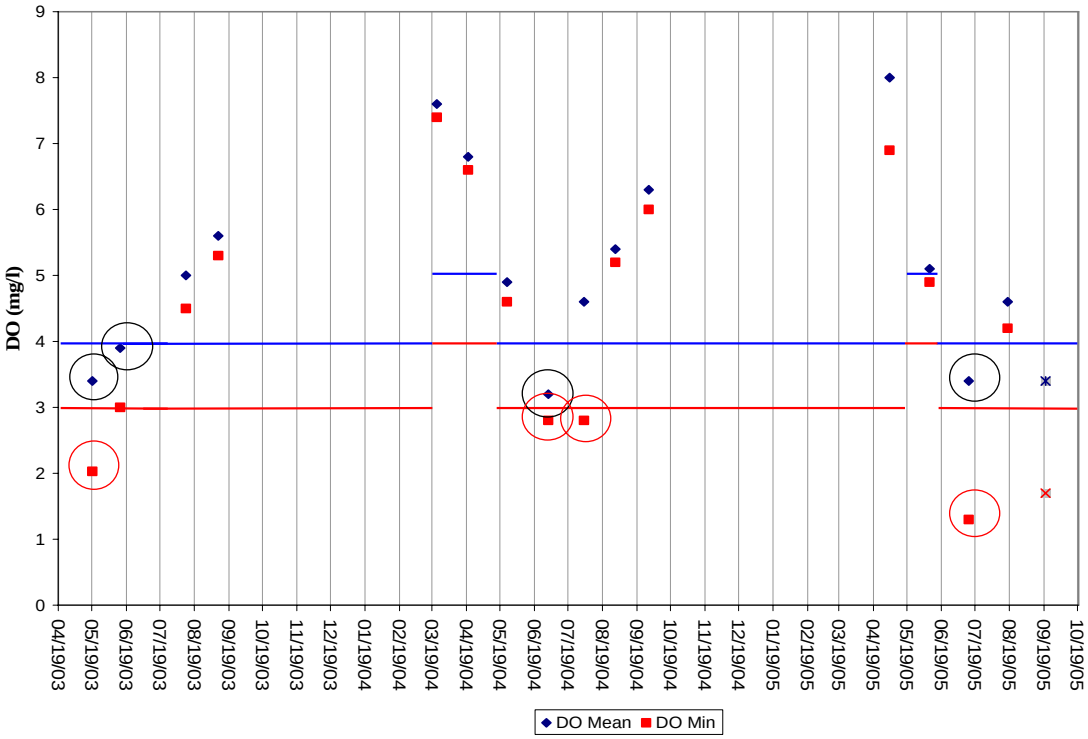

Figure 2. Station 12090 24-hr average and absolute minimum DO, showing average (blue line) and minimum (red line) criteria (values in exceedance are circled). Values that could not be used in the assessment are marked with a "x."

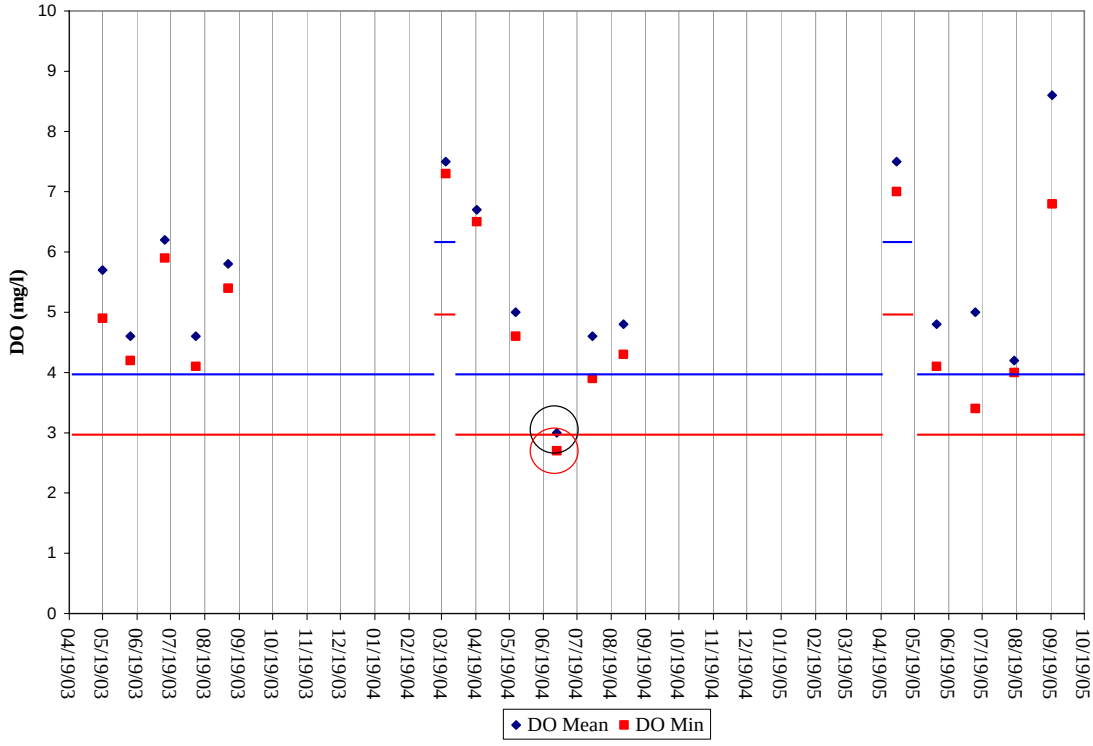

Figure 3. Station 12087 24-hr average and absolute minimum DO, showing average (blue line) and minimum (red line) criteria (values in exceedance are circled).

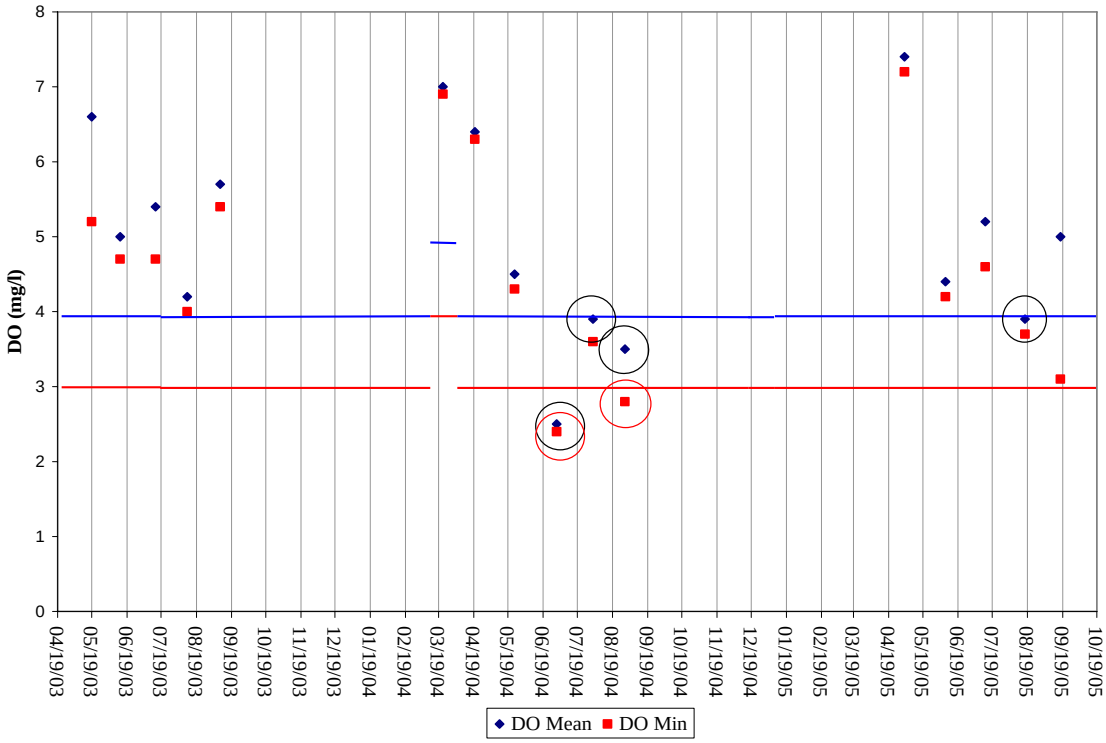

Figure 4. Station 12086 24-hr average and absolute minimum DO, showing average (blue line) and minimum (red line) criteria (values in exceedance are circled).

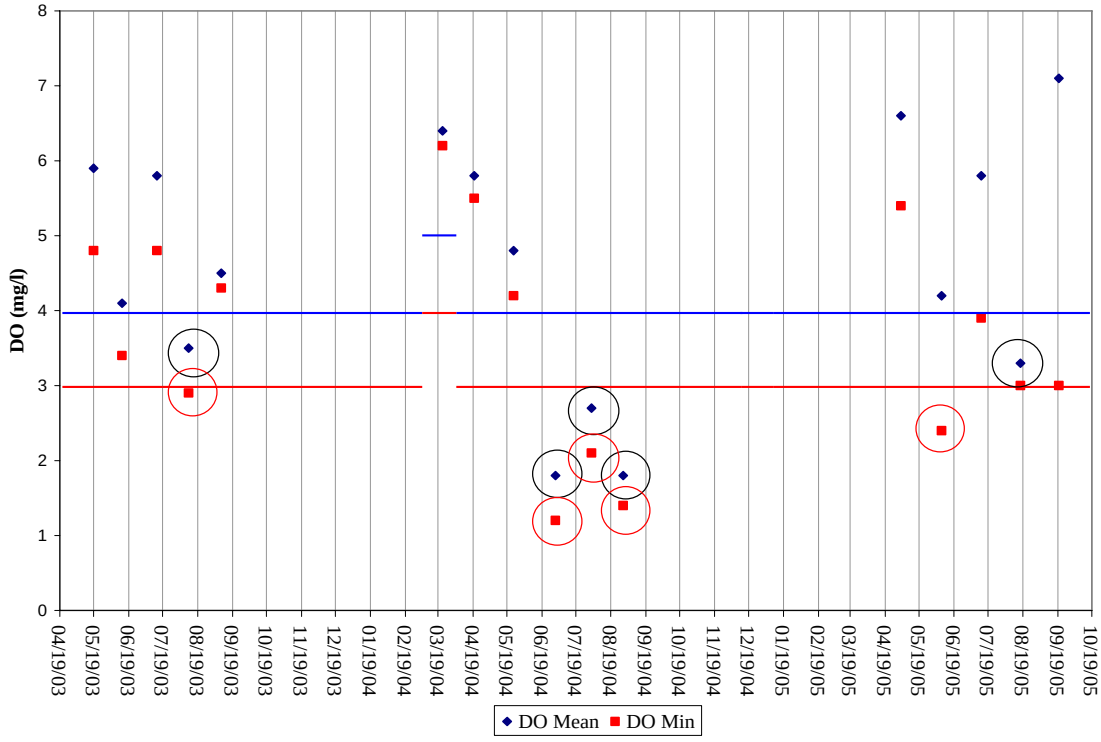

Figure 5. Station 12083 24-hr average and absolute minimum DO, showing average (blue line) and minimum (red line) criteria (values in exceedance are circled).

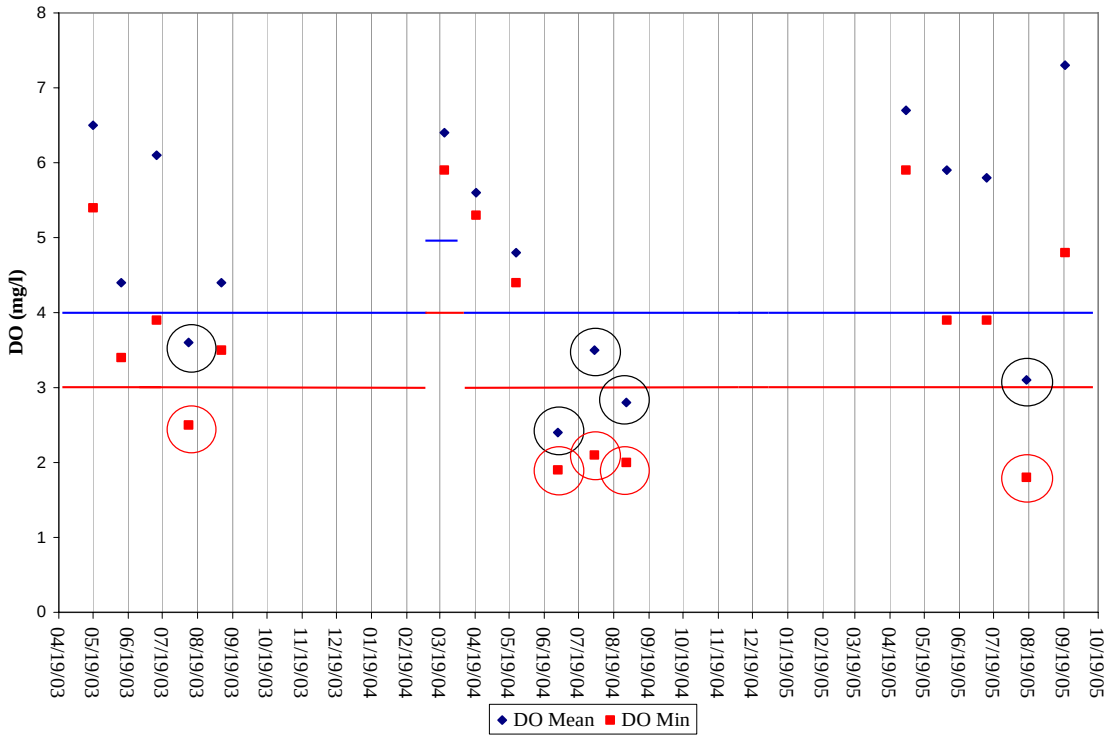

Figure 6. Station 12082 24-hr average and absolute minimum DO, showing average (blue line) and minimum (red line) criteria (values in exceedance are circled).

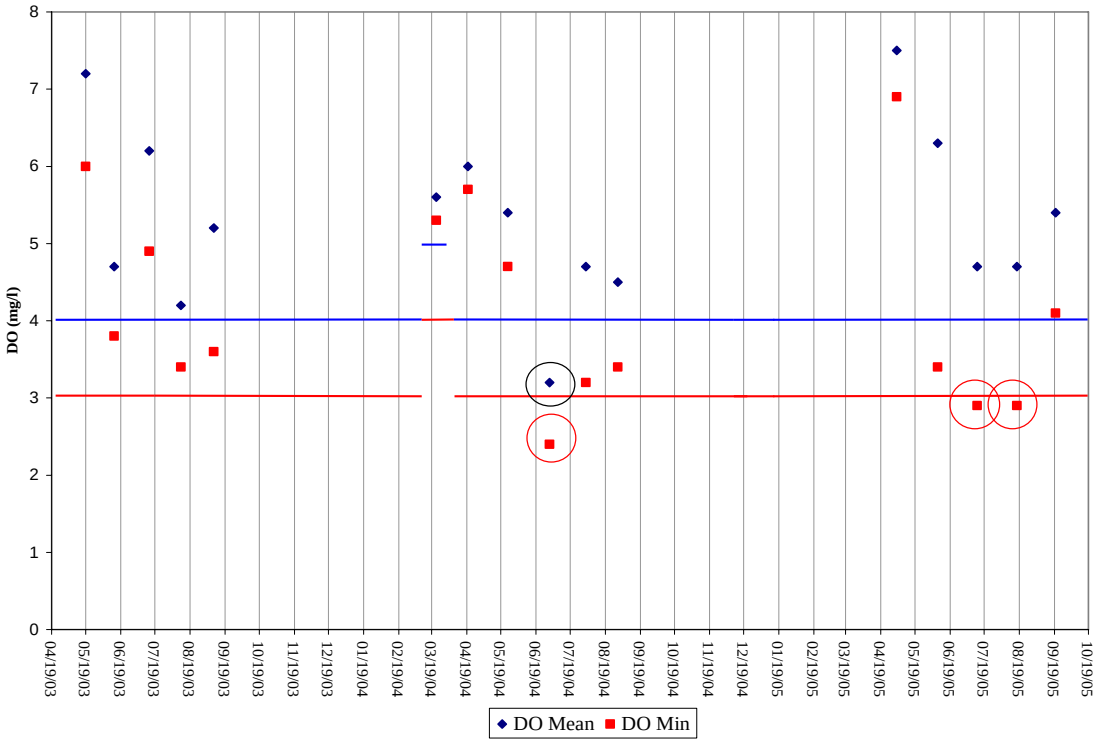

Figure 7. Station 12079 24-hr average and absolute minimum DO, showing average (blue line) and minimum (red line) criteria (values in exceedance are circled).

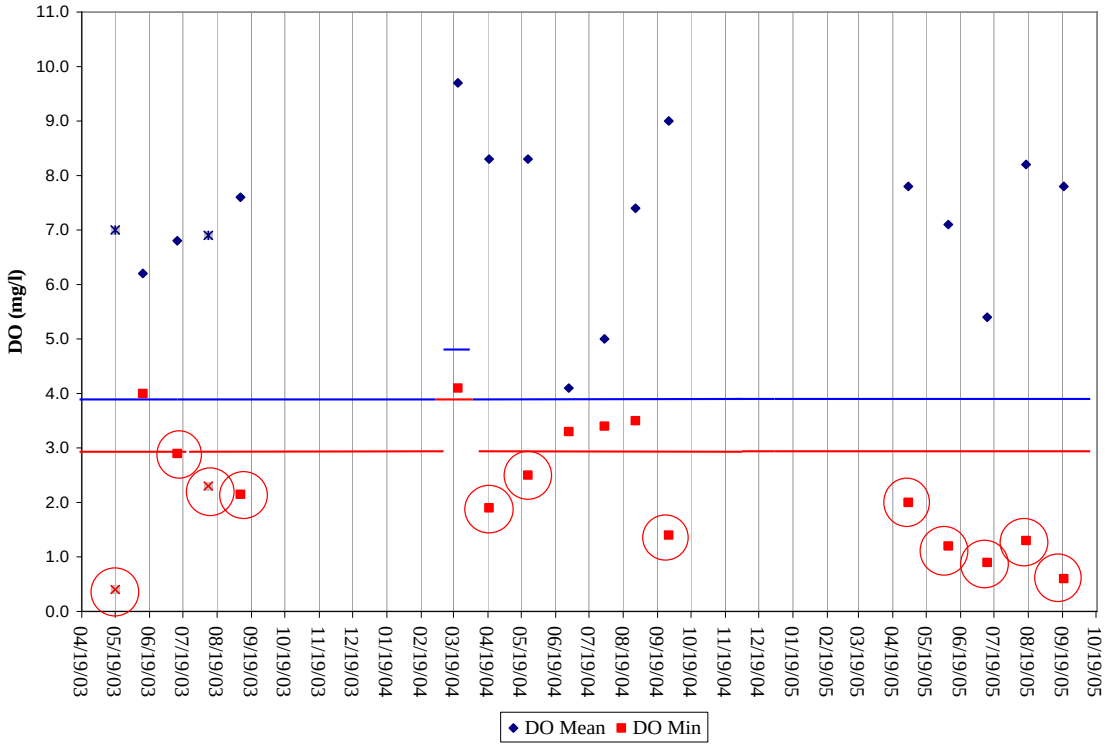

Figure 8. Station 12077 24-hr average and absolute minimum DO, showing average (blue line) and minimum (red line) criteria (values in exceedance are circled). Values that could not be used in the assessment are marked with a "x."

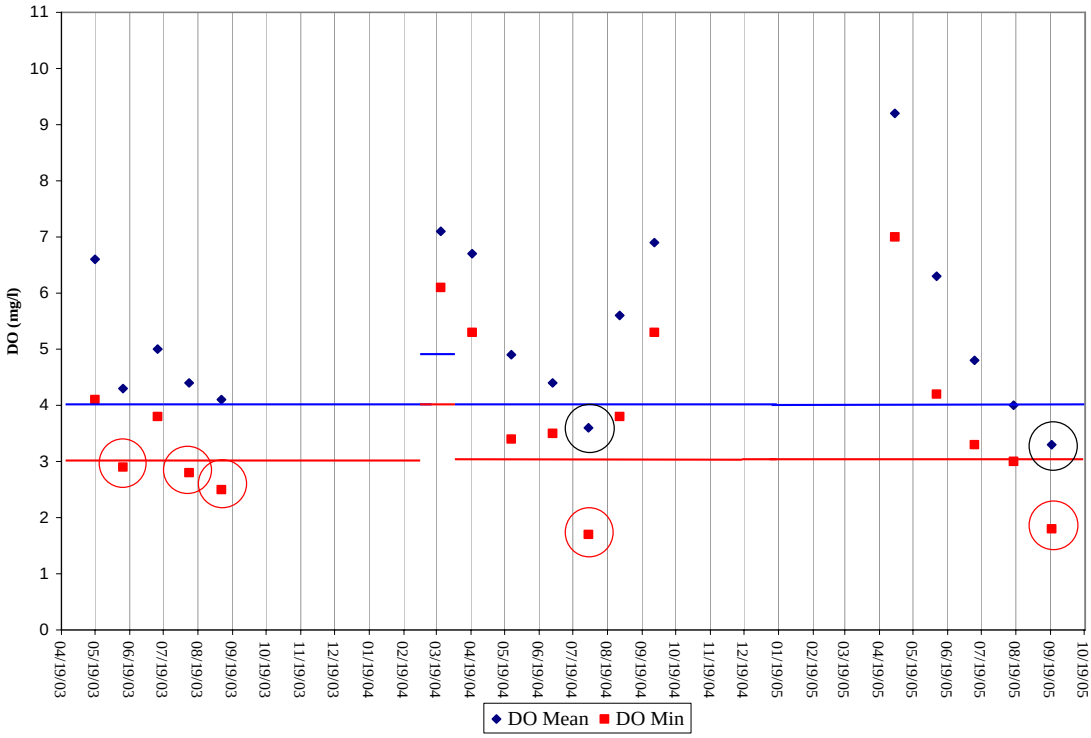

Figure 9. Station 12074 24-hr average and absolute minimum DO, showing average (blue line) and minimum (red line) criteria (values in exceedance are circled - values that could not be used due to low flow conditions have an "x" in them).

As indicated in Table 3 and Figures 2-9, the data from the 24-hour DO assessment surveys for the Index Period of 2003 showed pronounced differences in the number of criteria exceedances at stations 12086, 12083, and 12082 when compared to the data for the Index Period of 2004. Also, within some assessment units and during some surveys, the measured exceedances were only 0.1 to 0.2 mg/l below the criteria. Some steering committee members at their December 9, 2004 meeting noted the small magnitudes of some exceedances and that ignoring these small exceedances would result in more assessment units supporting the segment's aquatic life use.

Regarding observation of some stakeholders that the measured exceedances for some surveys were only slightly (0.1 to 0.2 mg/l) below the criteria, review of Table 3 also indicates a roughly equal number of non-exceedances that are at or only slightly above the criteria. While it is both unfortunate that the measured values occasionally were very near the criteria and acknowledged that these slight differences are within the instrumentation accuracy, the roughly equal number of slight exceedances and slight non-exceedances must be presumed to offset one another in lieu of any contrary information. That is while some of the slight exceedances might actually not have been exceedances, some of the slight non-exceedances might actually have been exceedances.

The additional monitoring performed during the 2005 Index Period and recently revised assessment methodology did not yield a change in the overall finding of previous assessments that indicated segment 1245 is *not supporting* the DO criteria for an intermediate aquatic life use; however, some assessment unit specific changes did occur. Assessment unit 2 (station 12079) is assessed as fully supporting with Tier 2 primary concern using the revised assessment methodology. Assessment unit 5 (combination of stations 12086 and 12087) was previously assessed as not supporting, but with the revised methodology it is assessed as fully supporting with Tier 2 primary concern. Finally, the year 2005 survey events on average had more exceedances than in 2003 but less than in 2004.

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