



**Harpeth River
Watershed Association
Dissolved Oxygen Study
June – July 2007**



Final Report

Harpeth River Watershed Association
PO Box 1127
Franklin, TN 37065
615-790-9767

July 2007



Figure 2: Lowhead dam at noon on July 16th. Cover, lowhead dam on June 23rd.



Figure 3: Lowhead dam showing excessive algal growth above water withdrawal.

HRWA Dissolved Oxygen Study

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By Michael Cain and Dorene Bolze

Between June 19 and July 7, 2007, HRWA staff and volunteers conducted a Dissolved Oxygen Study to measure the effects of drought conditions on dissolved oxygen (DO) levels in the Harpeth River in the Franklin area. Of special concern are ongoing seeps of acetone, toluene and other chemicals into the Harpeth River and Liberty Creek discovered in December 2006. The seeps originate from a nearby company (Egyptian Lacquer). Also of interest are the effects that the City of Franklin's drinking water withdrawal and the sewage effluent discharge from Franklin's sewer treatment plant (STP) have on water quality in the Harpeth River during low flows. For this study, we concentrated on a four mile stretch of the river beginning ½ mile above the lowhead dam on Franklin's south side to the Williamson County Recreation Center (Rec Center) just north of town that brackets the lowhead dam/water withdrawal location, the hazardous chemical seeps in Liberty Creek and the Harpeth River, and the sewage treatment discharge.

Due to the immediacy imposed by the drought conditions, four volunteers and five staff members were enlisted to gather data. Sites 1, 2, 2a and 6 were managed by HRWA staff and sites 3, 4, 5 and 7 were managed by volunteers trained by HRWA. Site 1 was upstream of the lowhead dam and site 2 just downstream of the dam. Site 2a (added after the other sites were set) was at Hwy. 96 where the USGS gage is located. Site 3 was located downstream from the hazardous chemical seeps on the Harpeth mainstem above Liberty Creek and Site 4 was just downstream of the seeps under the bridge at Franklin Rd. Site 5 was near the intersection of 4th Avenue and Hillsboro Rd. Site 6 was in the Chestnut Bend Subdivision just upstream of the STP and Site 7 was near the Rec Center just downstream of the STP (see map).

Methods

The timeframe on data collection was to gather data around 6:00 a.m. before the sun was up, and approximately every six hours after that (i.e. noon, 6:00 p.m., midnight). There were a total of three days of collection per site, with a day between each, and four monitoring events per day. For each event, three titrations of different samples were taken, with time, temperature and DO results noted each time. In addition, weather was noted for each event. For further discussion on the methods and how this methodology can record the diurnal swing in dissolved oxygen levels similar to that recorded by continuous diurnal probe, see HRWA's *Dissolved Oxygen Study in the Harpeth River: August-September 2006* (<http://www.harpethriver.org/studies.html>).

A sample was collected for analysis from a run in the river at each location and titration was done on site using a LaMotte DO Kit #5860 that utilizes the Winkler method to determine dissolved oxygen content. The only exception to this was at Sites 1 & 2

where a Hach DO Kit #OX-DT with digital titrator using Hach method 8229 was used for six events at each site.

Results and Preliminary Findings

HRWA's preliminary data indicate significant impacts to water quality are occurring in relation to three specific areas. The first area is the lowhead dam and water withdrawal for the drinking water plant. The second area of concern is the hazardous chemical seeps in Liberty Creek and on the Harpeth River near Liberty Creek, and the third area of concern is downstream of the Franklin STP.

Water in the impoundment above appears to be degraded due to higher temperatures and excessive algal growth, but this will require further study to measure DO above and below the withdrawal during various flow conditions over the dam (see photos). The sites that bracket the withdrawal (Sites 1 and 2) had mean DO concentrations above 4.5 mg/l, with Site 2, below the dam having the highest of all the sites at 5.32 mg/l. The state standard for dissolved oxygen is 5.0 mg/l at all times. During this study, there was adequate flow over the dam, at some time every day, to promote aeration.

The only other site with the mean DO above 4.0 mg/l (4.46 mg/l) was at the Highway 96 Bridge where the USGS gage is at Pinkerton Park. The data from Sites 1, 2, 2a and 3 that are before the river meets the hazardous chemical seeps had the highest DO levels. During this time, the river's flow at the USGS gage was typically between 3 to 6 cfs, excluding one rain event that increased flows to 10-20 cfs for a day.

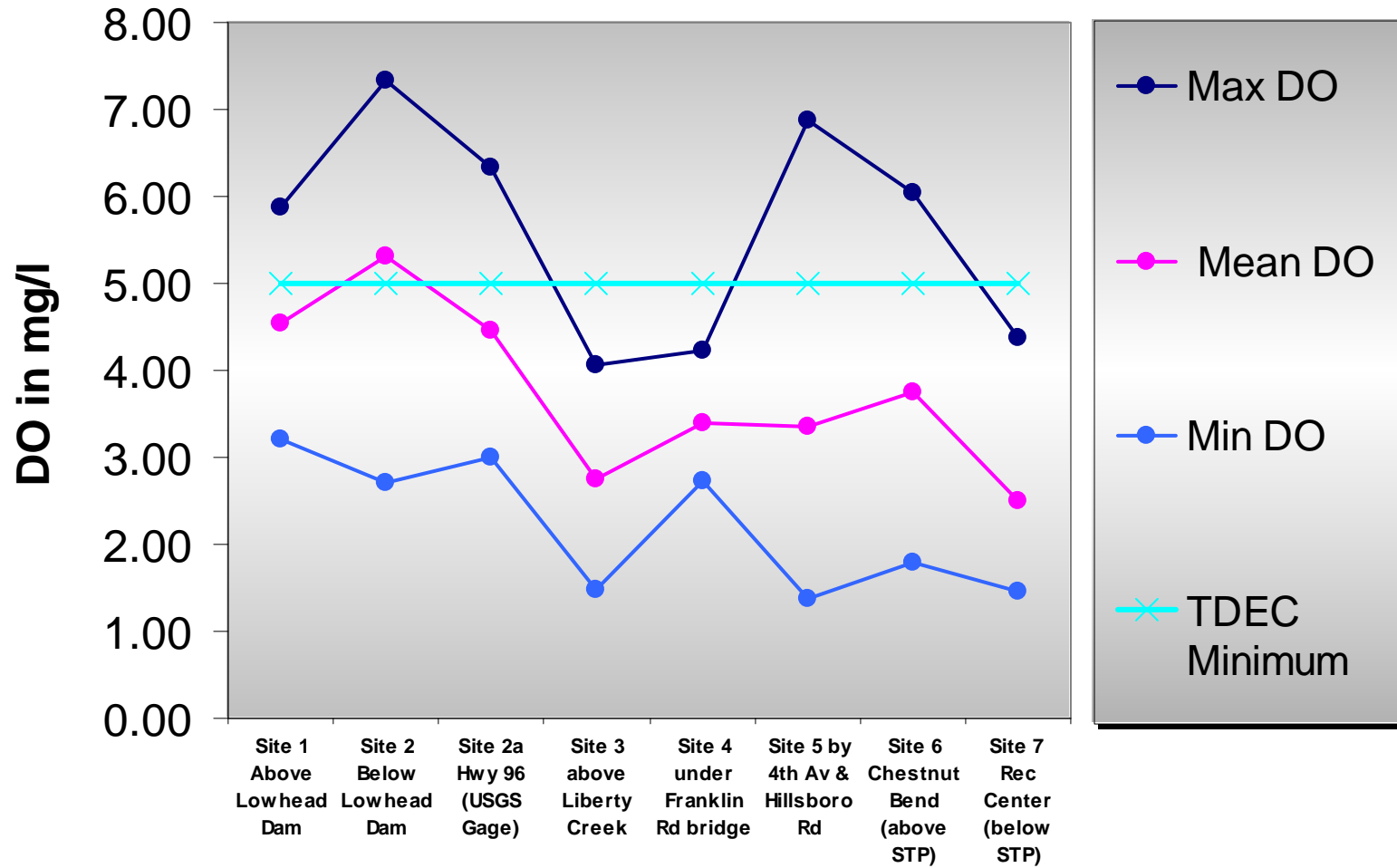
The seeps around Liberty Creek are having an effect on all the sites below the USGS location, where AVERAGE DO concentrations never got above 4 mg/l. Notably, the lowest average was 2.51 mg/l at the site below the Franklin STP discharge and the site at the chemical seeps into the Harpeth was the next lowest at 2.75 mg/l.

This DO data indicates that the chemical seeps are having an effect on dissolved oxygen concentrations and putting further stress on the river during drought low flow conditions. A news story on the local NBC affiliate in June captured sunfish in the area of the river seeps lying on their sides struggling to breathe.

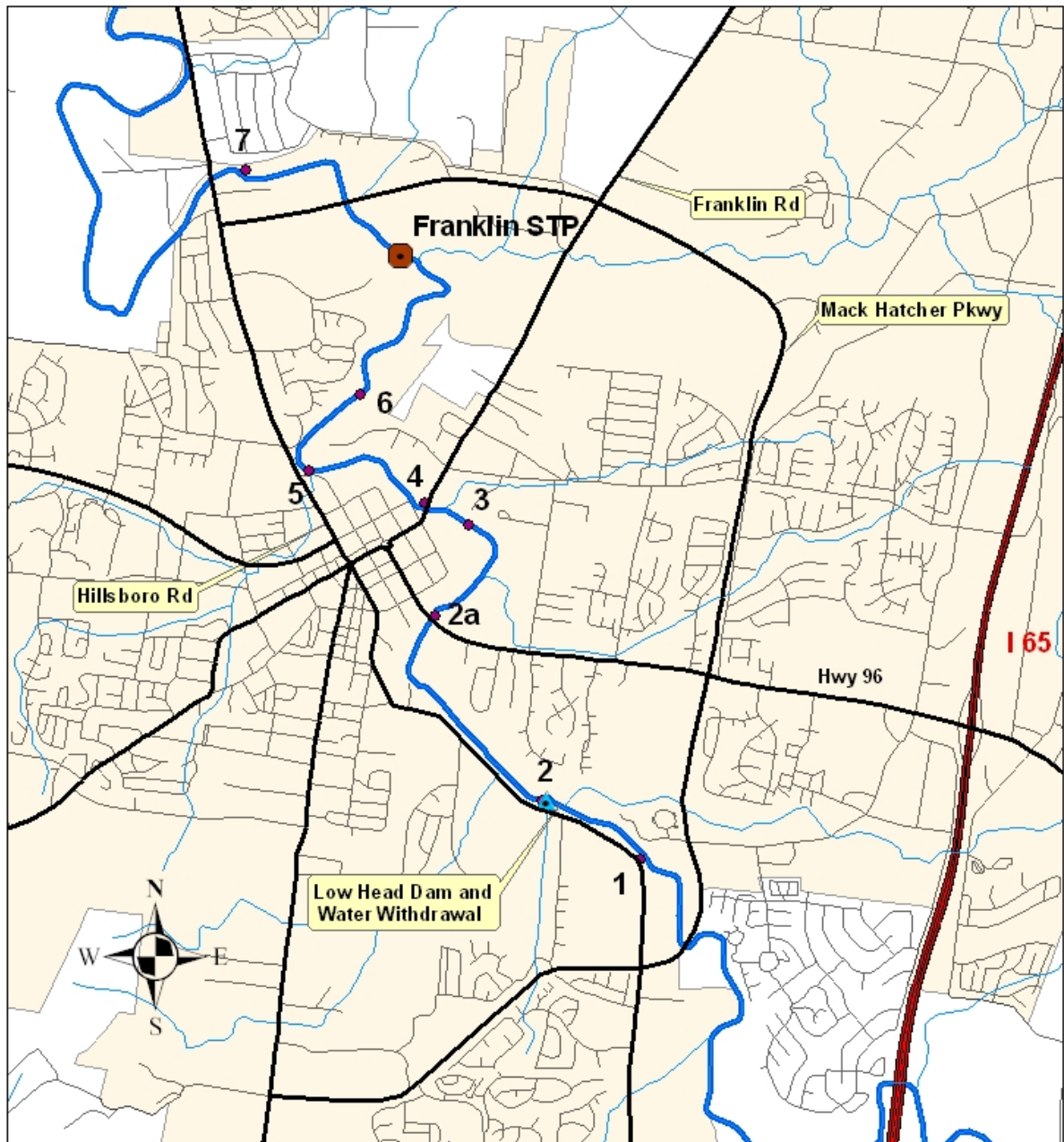
This data also found the same drop in oxygen levels below the Franklin STP that has been recorded by TDEC in 2002 and 2003, and by HRWA in 2006, as noted in the 2006 report referenced above. Again, at Site 7 below the STP outfall and near the USGS gage on Hillsboro Road (about 0.8 rivers miles downstream) the DO concentrations had lows of 1.4 mg/l, averages of 2.5 mg/l, and a high of 4.37 mg/l.

It is possible that the low DO concentrations measured below the STP outfall are a combined effect with the chemical seeps, though TDEC's monitoring data related to the seeps has not recorded high concentrations of toluene and acetone by this location in the river. Data that TDEC has collected regarding the Egyptian Lacquer/Liberty Creek hazardous chemical release are on the TDEC website.

Dissolved Oxygen Levels by Site



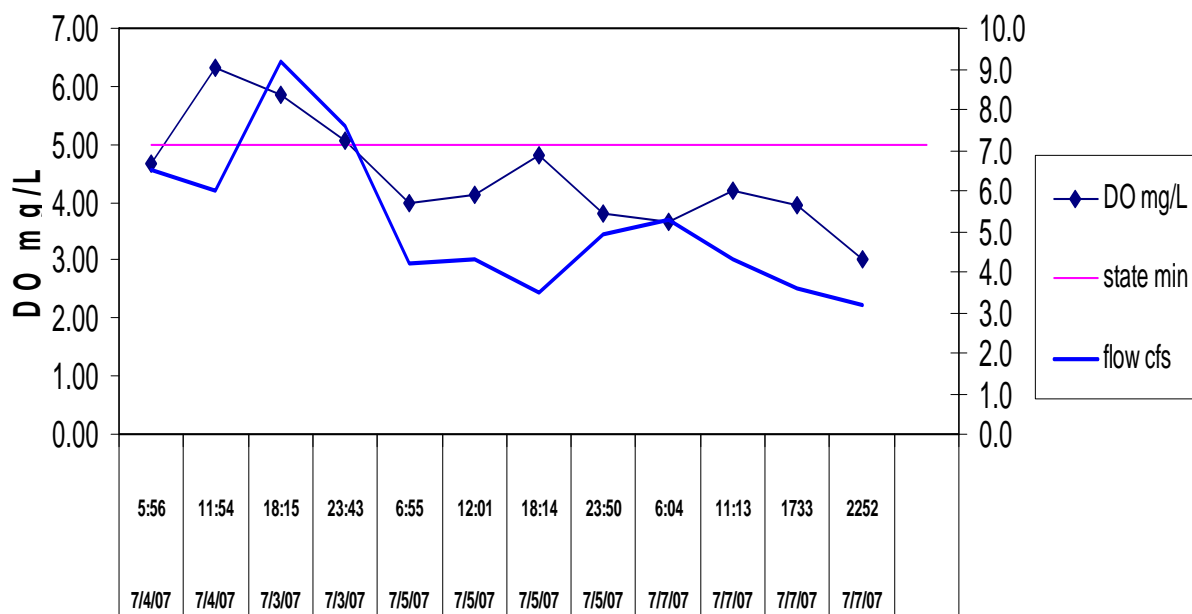
Harpeth River Watershed Association Dissolved Oxygen Study June - July 2007



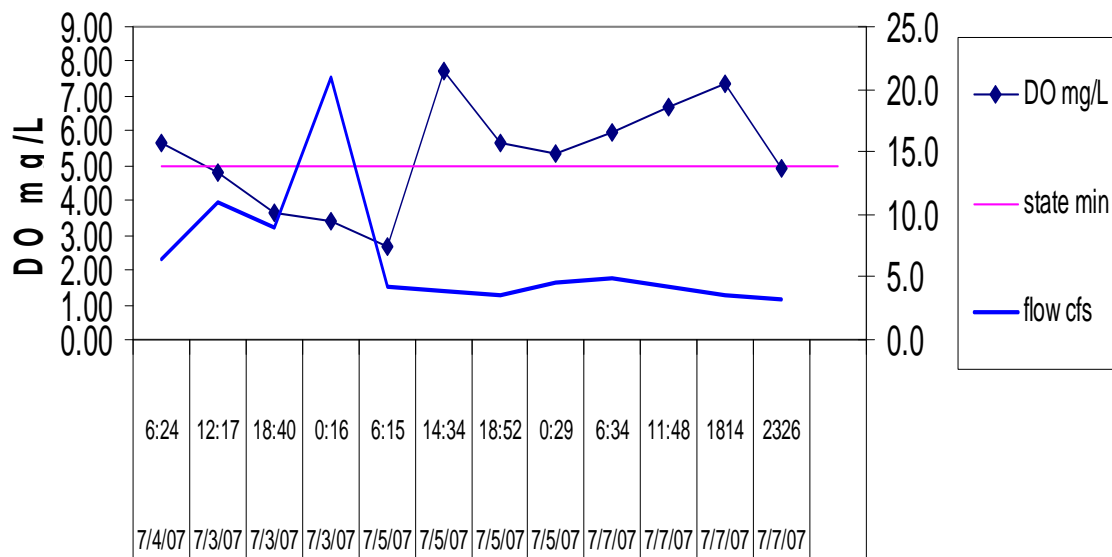
This map created for Harpeth River Watershed Association by M Cain using ESRI software and data from tngis.org and data gathered by HRWA staff.



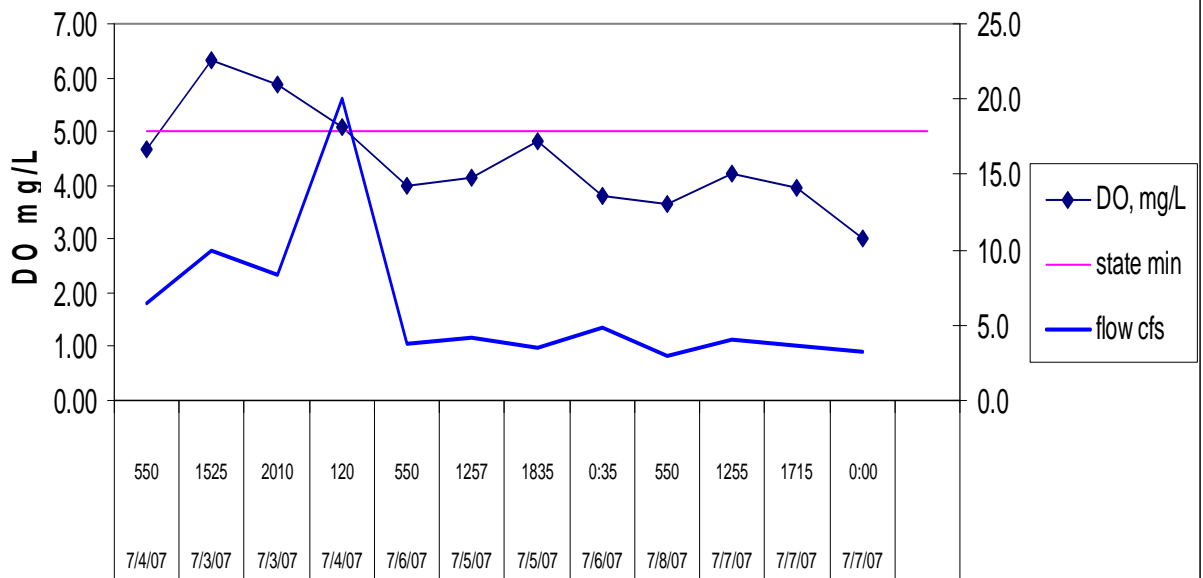
DO Site 1, Lewisburg Pk. above Lowhead Dam



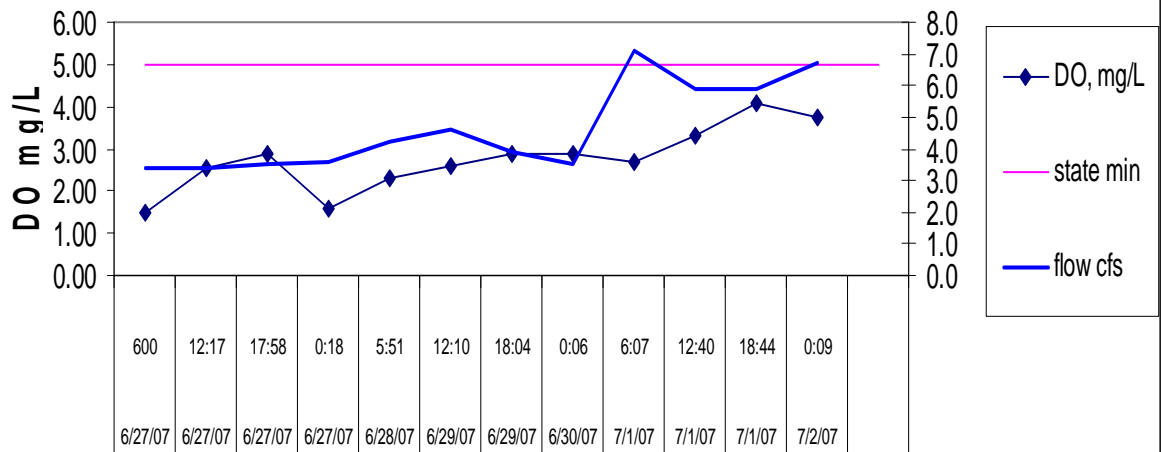
DO Site 2, Lewisburg Pk. below Lowhead Dam



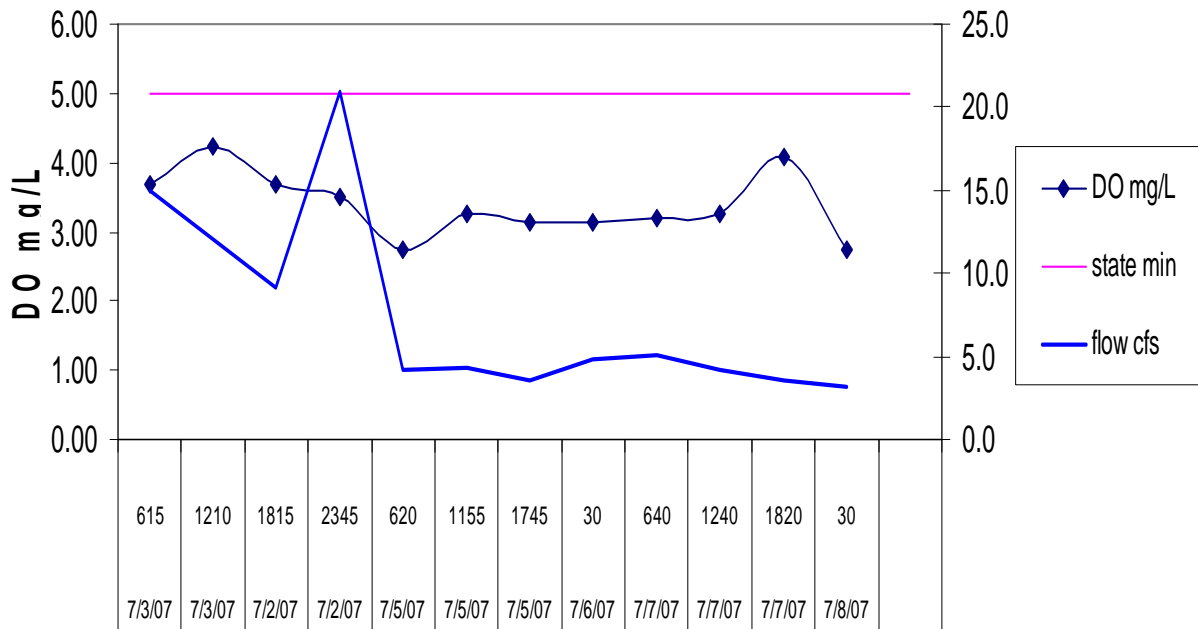
DO Site 2a, Pinkerton Park (Hwy. 96)



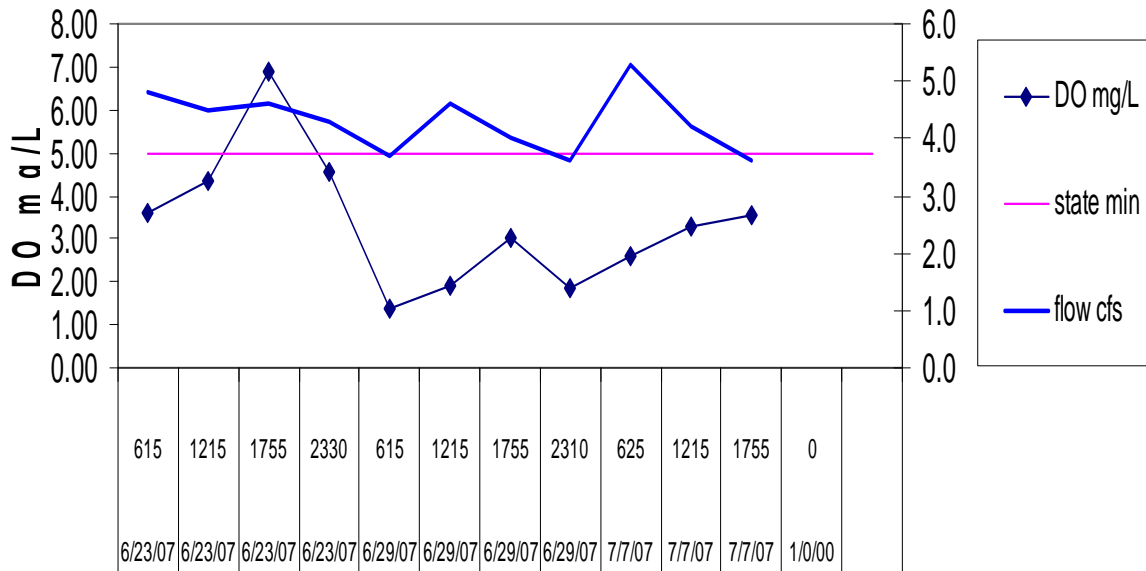
DO Site 3, below RR bridge off Daniels Dr. (near Liberty Creek)



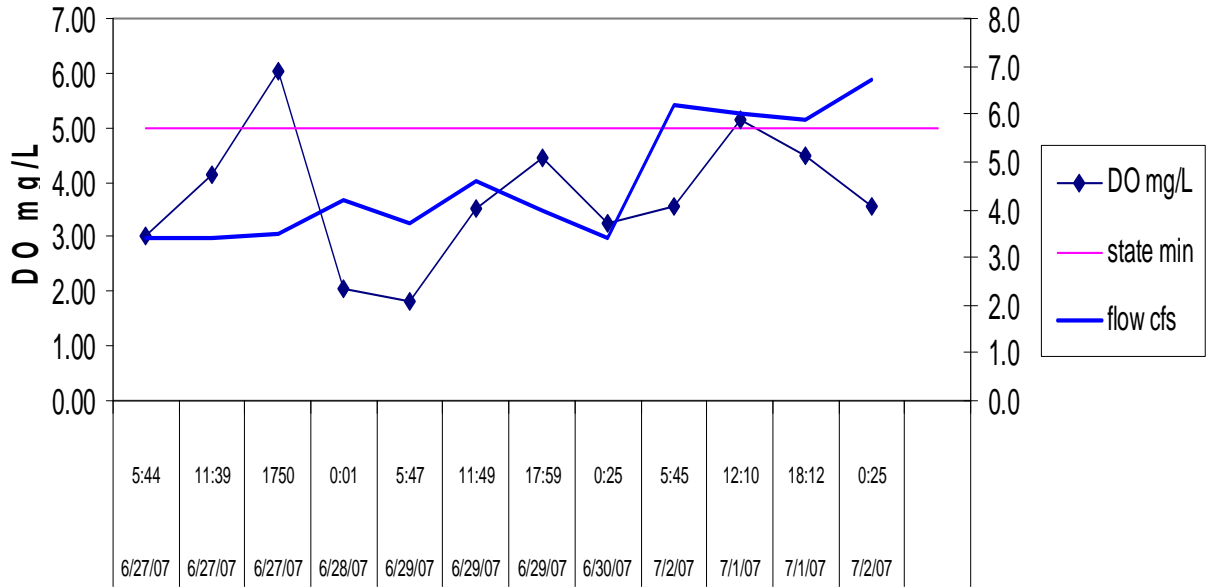
DO Site 4, below Franklin Rd. Bridge (near BGA)



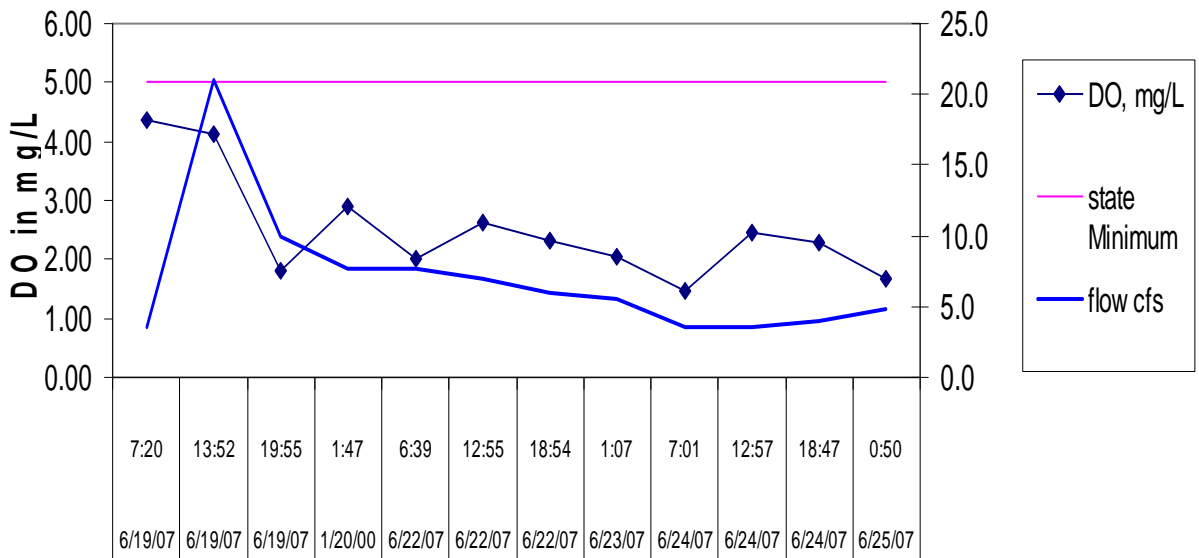
DO Site 5, 4th Ave. at Hillsboro Rd.



DO Site 6, Chestnut Bend Subdivision (upstream of FSTP)



DO Site 7, Fulton Greer Rd (near Rec Center, down stream of FSTP)



HRWA Dissolved Oxygen Field Data Summary, June & July 2007

Site 1	24 hr	temp	DO	flow	%	Site 2	24 hr	temp	DO	flow	%
date	time	°C	mg/L	cfs	Sat	date	time	°C	mg/L	cfs	Sat
7/4/07	5:56	24.0	4.70	6.5	61.61	7/4/07	6:24	24	5.63	6.5	73.84
7/4/07	11:54	24.5	3.27	6.0	43.24	7/3/07	12:17	25.5	4.80	11.0	64.77
7/3/07	18:15	25.0	3.83	9.2	51.23	7/3/07	18:40	25	3.67	8.9	49.00
7/3/07	23:43	24.5	4.11	7.6	54.44	7/3/07	0:16	24.5	3.42	21.0	45.27
7/5/07	6:55	24.0	3.20	4.2	41.95	7/5/07	6:15	24	2.70	4.2	35.39
7/5/07	12:01	28.0	5.87	4.3	83.02	7/5/07	14:34	27.5	7.73	3.9	108.40
7/5/07	18:14	25.0	5.63	3.5	75.19	7/5/07	18:52	26	5.67	3.5	77.29
7/5/07	23:50	27.0	5.13	4.9	71.28	7/5/07	0:29	26	5.33	4.5	72.65
7/7/07	6:04	25.0	4.40	5.3	58.80	7/7/07	6:34	25	5.93	4.9	79.29
7/7/07	11:13	26.0	3.78	4.3	51.49	7/7/07	11:48	27	6.66	4.2	92.47
7/7/07	1733	27.0	5.46	3.6	75.81	7/7/07	1814	29	7.33	3.6	105.74
7/7/07	2252	26.5	5.17	3.2	71.06	7/7/07	2326	27	4.91	3.2	68.13

Site 1 Above Lowhead Dam 4.55 mean

Site 2 Below Lowhead Dam 5.32 mean

Note:

- 1) times indicated are the middle of the three sampling times for each of the four time slots: 4-6am, 10-Noon, 4-6pm, 10-12pm
- 2) temperatures are averages but almost no variance was seen between samples (see raw data)
- 3) DO measurements are in mg/L as determined by a LaMotte DO kit # 5860, average of three samples (see field data sheets) Sites in gray were titrated using a Hach DO kit #OX-DT
- 4) flow in cfs from nearest USGS gage
- 5) % saturation is based on an average altitude above sea level of 550 feet

Site 2a	24 hr	temp	DO	flow	%	Site 3	24 hr	temp	DO	flow	%
date	time	°C	mg/L	cfs	Sat	date	time	°C	mg/L	cfs	Sat
7/4/07	550	25.00	4.67	6.5	62.36	6/27/07	600	25.00	1.47	3.4	19.64
7/3/07	1525	27.00	6.33	10.0	87.94	6/27/07	12:17	27.50	2.53	3.4	35.46
7/3/07	2010	27.00	5.87	8.4	81.46	6/27/07	17:58	28.50	2.90	3.5	41.42
7/4/07	120	26.00	5.07	20.0	69.02	6/27/07	0:18	27.00	1.60	3.6	22.22
7/6/07	550	26.00	4.00	3.7	54.49	6/28/07	5:51	26.00	2.30	4.2	31.33
7/5/07	1257	26.00	4.13	4.2	56.31	6/29/07	12:10	28.00	2.60	4.6	36.79
7/5/07	1835	27	4.80	3.5	66.65	6/29/07	18:04	27.00	2.87	3.9	39.85
7/6/07	0:35	25.5	3.80	4.8	51.27	6/30/07	0:06	26.50	2.87	3.5	39.47
7/8/07	550	25.00	3.67	3.0	49.00	7/1/07	6:07	25.00	2.67	7.1	35.68
7/7/07	1255	26.00	4.20	4.0	53.58	7/1/07	12:40	26.00	3.33	5.9	45.36
7/7/07	1715	26.00	3.93	3.6	53.58	7/1/07	18:44	26.00	4.07	5.9	55.44
7/7/07	0:00	26.00	3.00	3.2	40.87	7/2/07	0:09	26.00	3.73	6.7	50.81

Site 2a Hwy 96 (USGS Gage)

4.46 mean

Site 3 above Liberty Creek 2.75 mean

Site 4	24 hr	temp	DO	flow	%
date	time	°C	mg/L	cfs	Sat
7/3/07	615	28.00	3.70	15.0	52.36
7/3/07	1210	26.00	4.23	12.0	57.67
7/2/07	1815	30.00	3.70	9.2	54.36
7/2/07	2345	30.00	3.50	21.0	51.42
7/5/07	620	26.00	2.73	4.2	37.24
7/5/07	1155	27.00	3.27	4.3	45.36
7/5/07	1745	27.00	3.13	3.6	43.51
7/6/07	30	26.00	3.13	4.8	42.68
7/7/07	640	25.00	3.20	5.1	42.76
7/7/07	1240	25.50	3.27	4.2	44.08
7/7/07	1820	26.00	4.07	3.6	55.40
7/8/07	30	25.00	2.73	3.2	36.53

Site 4 under Franklin Rd bridge 3.39 mean

TDEC min.
acceptable
DO level: 5.00
mg/L

Site 5	24 hr	temp	DO	flow	%
date	time	°C	mg/L	cfs	Sat
6/23/07	615	24.00	3.60	4.8	47.19
6/23/07	1215	26.00	4.33	4.5	59.03
6/23/07	1755	26.50	6.87	4.6	94.44
6/23/07	2330	25.00	4.53	4.3	60.58
6/29/07	615	26.00	1.37	3.7	18.62
6/29/07	1215	27.00	1.93	4.6	26.84
6/29/07	1755	27.00	3.00	4.0	41.65
6/29/07	2310	26.00	1.87	3.6	25.43
7/7/07	625	25.50	2.60	5.3	35.08
7/7/07	1215	26.50	3.27	4.2	44.93
7/7/07	1755	26.47	3.55	3.6	48.80
1/0/00	0	0.00	n/a	n/a	n/a

Site 5 by 4th Av & Hillsboro Rd 3.36 mean

Site 6	24 hr	temp	DO	flow	%
date	time	°C	mg/L	cfs	Sat
6/27/07	5:44	24.0	3.00	3.4	39.32
6/27/07	11:39	25.0	4.13	3.4	55.24
6/27/07	1750	27.0	6.03	3.5	83.77
6/28/07	0:01	26.0	2.07	4.2	28.15
6/29/07	5:47	25.0	1.80	3.7	24.06
6/29/07	11:49	26.0	3.53	4.6	48.13
6/29/07	17:59	26.5	4.47	4.0	61.43
6/30/07	0:25	26.0	3.23	3.4	44.05
7/2/07	5:45	24.0	3.57	6.2	46.75
7/1/07	12:10	25.0	5.13	6.0	68.60
7/1/07	18:12	25.0	4.50	5.9	60.14
7/2/07	0:25	25.0	3.57	6.7	47.66

Site 6 Chestnut Bend (above STP) 3.75 mean

Site 7	24 hr	temp	DO	flow	%
date	time	°C	mg/L	cfs	Sat
6/19/07	7:20	24.0	4.37	3.6	57.24
6/19/07	13:52	25.0	4.13	21.0	55.24
6/19/07	19:55	27.0	1.80	10.0	24.99
1/20/00	1:47	26.0	2.90	7.6	39.51
6/22/07	6:39	25.0	2.00	7.6	26.73
6/22/07	12:55	25.0	2.63	6.9	35.19
6/22/07	18:54	27.0	2.33	5.9	32.40
6/23/07	1:07	26.0	2.03	5.5	27.70
6/24/07	7:01	24.0	1.47	3.5	19.23
6/24/07	12:57	25.0	2.47	3.5	32.96
6/24/07	18:47	25.0	2.30	4.0	30.74
6/25/07	0:50	25.0	1.67	4.8	22.27

Site 7 Rec Center (below STP) 2.51 mean