

# DEVELOPMENT OF AN ULTIMATE OXYGEN DEMAND (UOD) TMDL FOR FLOYD'S FORK AND ITS TRIBUTARIES

## Problem Definition

Floyd's Fork drains 284 square miles of land, primarily in Oldham, Jefferson, and Bullitt Counties in Kentucky. Major tributaries are Curry's Fork, Chenoweth Runs (upper and lower), Long Run, Pope Lick, Cane Run, Cedar Creek, and Brooks Run. Floyd's Fork was placed on the 1990, 1992, and 1994 303(d) lists as a water body not meeting water quality uses. Specifically, the 1994 303(d) list identified Floyd's Fork as not meeting warmwater aquatic life use for 13.0 miles in water segments KY5140102-007, -011, and -014. Measurements and observations in 1991 demonstrated that approximately 13 miles of Floyd's Fork (primarily below the Oldham/Shelby County line) did not meet Kentucky's criteria for dissolved oxygen, which stipulates that the daily average D.O. cannot be less than 5.0 mg/l, with no instantaneous levels below 4.0 mg/l. Other areas of Floyd's Fork also exhibit problems, mostly with algal blooms in quiescent pools, but are not as severe as the targeted 13 miles. Contributing to the D.O. problem in the main stem of Floyd's Fork is the fact that stream slopes here are moderate to nearly flat. Low slope streams do not have a high capacity to assimilate wastewater discharge.

The natural 7Q10 of Floyd's Fork is 0 cfs. Water flows in the stream vary due to water withdrawals and varying volumes of wastewater discharge from approximately 60 package plants discharging to Floyd's Fork or its tributaries. During low flow events, D.O. violations occur below lower Chenoweth Run, Cedar Creek, and Brooks Run due to the input of wastewater effluent.

## Endpoint Identification

The pollutants affecting the D.O. in the river are oxygen demanding substances that are measured as carbonaceous biochemical oxygen demand (CBOD) and nitrogenous biochemical oxygen demand (NBOD). Generally, in KPDES permits the NBOD is represented and measured as NH<sub>3</sub>-N. These are the pollutants of concern and the pollutants for which this TMDL will be developed.

For a point source dominated stream such as Floyd's Fork, the critical time period or time of concern is during summer months (i.e. May - October) when temperatures are highest (yielding low D.O. saturation concentrations) and stream flows are lowest (yielding low dilution of the wastewater). This is supported by the desk-top model run predictions and the intensive water quality monitoring data that indicate D.O. violations occur during summer months.

## Source Analysis

An analysis of wastewater discharges was performed simulating

existing conditions with numerous package plants discharging to Floyd's Fork and its tributaries. Headwater 7Q10 flows were determined to be 0 cfs. Effluent quality was characterized with temperature set at 77 F, while CBOD5 and NH3-N were based on current permitted concentrations. In-stream flows were based on measured flows at USGS stations or as measured by the sampling survey during low-flow events.

A second analysis evaluated elimination of most package plants and connection to regional advanced treatment facilities. Where regionalization is not feasible, existing package plants were evaluated for their impacts on water quality.

Several model runs were made at various upstream flows. The modeling showed that in-stream dissolved oxygen was lowest when stream flows approached low-flow conditions of 0 cfs.

#### Linkage of Endpoints and Sources

QUAL2EU is a one-dimensional, steady state dissolved oxygen model, and was used to develop a model of the Floyd's Fork basin. The model was run under the scenarios detailed above to determine the level of treatment required to protect water quality. Under existing conditions, model runs predicted that D.O. sags below the D.O. standard would occur at several locations downstream of the dischargers. The regionalization alternative predicted no D.O. violations and is the basis for the dissolved oxygen TMDL.

#### Allocation of Responsibility

The TMDL for oxygen-consuming wastes in Floyd's Fork was developed from the regionalization alternative. The attached table specifies the loads and concentrations for each discharging facility. The following summarizes the wasteload allocation, the load allocation and the margin of safety that are elements of a TMDL.

##### Wasteload Allocation:

CBOD5: 1691.61 lbs/day

NH3-N: 385.40 lbs/day

The loadings (lbs/day) are based on a simple conversion of the QUAL2E model concentration (mg/l) inputs multiplied by the wastewater treatment (WWTP) plant size (MGD). Thus, as WWTP's are in need of expansions the model runs will be revisited and an increase in loading (lbs/day) could be approved. A revision to the TMDL will be prepared, as necessary.

##### Load Allocation (Background stream loading):

The critical period for in-stream D.O. concentrations is during low-flow events. For Floyd's Fork the 7Q10 (low flow event) is 0

cfs. Model runs with higher flows were conducted which showed that the in-stream dissolved oxygen concentration was not as depressed as during low-flow events. Thus the load allocation for Floyd's Fork during low flow events is:

CBOD5: 0 lbs/day

NH3-N 0 lbs/day

Margin of Safety (MOS)

The MOS for this TMDL is implicit because of the conservative temperature (77 F) and conservative flow (7Q10 = 0 cfs) used in the model.

Total Maximum Daily Load:

Ultimate Oxygen Demand (UOD) = 1691.61 lbs/day + 385.40 lbs/day  
+ 0 lbs/day + 0 lbs/day  
= 2077.01 lbs/day

The desk top model developed for Floyd's Fork predicts that a total maximum daily load of 2077.01 lbs/day of UOD during critical conditions (7Q10 = 0 cfs) will yield in-stream dissolved oxygen concentrations above the D.O. standard of 5 mg/l.

In light of the extremely limited assimilative capacity for oxygen-consuming wastes in Floyd's Fork and its tributaries, several recommendations have been made to implement this TMDL:

1. Restrict water withdrawals in Floyd's Fork such that withdrawals are not allowed when flow in Floyd's Fork is 2 cfs or less.
2. No new package wastewater treatment plants will be approved on the main stem of Floyd's Fork in Jefferson or Bullitt Counties. A regional advanced treatment plant that eliminates existing package plants could be approved.
3. No new wastewater facilities will be approved on lower Chenoweth Run, upper Chenoweth Run, Cedar Creek and Brooks Run.
4. Expansions of existing facilities will be examined on a case-by-case basis.

### Breakdown of Wasteload Allocation

Facility	Design Flow (MGD)	CBOD Limit (mg/l)	NH3-N Limit (mg/l)	CBOD Load (lb/day)	NH3-N Load (lb/day)
LaGrange	.775	20	4	129.35	25.87
Green Valley	.030	30	4	7.51	1.00
Lakewood Valley	.100	10	4	8.35	3.34
Centerfield Elem.	.010	30	20	2.50	1.67
Lockwood Estates	.045	25	4	9.39	1.50
Country Village	.060	30	4	15.02	2.00
MSD Regional Fac.*	4.0	10	2	333.8	66.76
Whitney Young	.04	30	4	10.01	1.34
Southfield Training	.002	30	4	.50	.067
I-64 Rest Area	.003	30	4	.75	.10
Jeffersontown*	4.0	20	4	667.6	133.52
Oaks MHP	.026	30	4	6.51	.87
MSD Cedar Creek	2.5	10	4	208.63	83.45
Overdale Elem.	.01	30	4	2.5	.33
Bullitt Hills	.35	25	4	73.02	11.68
Maryville #1	.23	15	4	28.79	7.68
Camp Shantituck	.01	30	20	2.5	1.67
L&N Golf Club	.005	30	4	1.25	.17
Brooks Elem.	.01	30	4	2.50	.33
Interstate Fac.	.035	30	4	8.76	1.17
Maryville #2	.32	15	4	40.06	10.68
Briarwood Village	.125	15	4	15.65	4.17
Hunters Hollow	.24	15	4	30.04	8.01
Maryville #3	.148	15	4	18.53	4.94

Willowbrook	.12	10	2	10.01	2.00
Maryville #4	.45	10	2	37.55	7.51
Hebron Jr High	.02	30	4	5.01	.67
Big Valley MHP	.075	20	4	12.52	2.5
Lake Columbia Estates	.012	30	4	3.00	.4
Total	13.751			1691.61	385.40

\*These facilities will have a Total Phosphorus limit of 1 mg/l placed in their KPDES permits for control of algal production in-stream.

FACILITIES TO BE ELIMINATED WHEN SEWERS BECOME AVAILABLE

Facility	Design Flow (MGD)
Starview Estates	.1
Berrytown	.075
Florida Steel	.001
Middle Industrial	.160
Beckley Woods	.47
Polo Fields	.11
English Station	.033
Copperfield	.16
Ashmoor Woods	.03
Cross Creek	.27
Running Creek	.11
Tucker Station	.06
Women's Prison	.065
Crestwood Elem	.015
Maple Springs Apts	.025
Thornhill MHP	.002

Cherrywood Apts	.007
Ash Avenue	.300
Friendship Manor	.080
Chenoweth Hills	.200
Lake of the Woods	.044
Idlewood	.600
Fern Creek Sewer	.020
Cedar Lake Park	.200
Birchwood Sub.	.250
Cedar Heights MHP	.031
Farmgate	.150
Gainsborough	.090
Zelma Fields	.125
Beulah Land Estates	.150
McNeely Lake Bypass	
Pleasant Valley	.225
Apple Valley Sub.	.200
The Pines	.200
Jefferson Square Dev.	.120
Maple Grove	.205
Larkgrove	.120

Public Availability

The Floyd's Fork Report dated December 1991 was mailed to affected wastewater treatment plant owners, local governments, interested citizens and environmental groups for their input and comments. Comments were addressed appropriately.

Approval

This TMDL is hereby approved as meeting the requirements of Section 303(d) of the Clean Water Act.

Virginia Buff 8-27-97

Virginia Buff  
Technical Reviewer

Jim Greenfield 9/2/97

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