

**Arkansas Division of Environmental Quality  
Water Quality Management Plan Update Summary Sheet**

Date: April 12, 2021

Prepared by: Shane Byrum

New Permit                       Renewal Permit                       Amended Permit

**Type of Discharge:** Municipal Wastewater

**Facility Name:** City of Melbourne

**Permit No.:** AR0020036

**Flow Rate (MGD):** 0.41

**Receiving Stream:** Mill Creek, thence to Piney Creek, thence to the White River

**Assessment Unit:** AR\_11010004\_907                      **7Q10:** 0 cfs<sup>1</sup>

**Planning Segment:** 4F                      **County:** Izard

**Proposed Monthly Average Effluent Limits in mg/L:**

May-October: 10/15/3.9/6.0\*/0.011\*\* (CBOD5/TSS/NH3-N/DO/TRC)  
 November-March: 20/30/3.9/7.0\*/0.011\*\* (CBOD5/TSS/NH3-N/DO/TRC)  
 April: 20/30/3.9/7.0\*/0.011\*\* (CBOD5/TSS/NH3-N/DO/TRC)

\*DO is Inst. Min.  
 \*\*TRC is Inst. Max.

**Current Monthly Average Effluent Limits in mg/L:**

May-October: 10/15/3.9/6.0 (CBOD5/TSS/NH3-N/DO)  
 November-March: 25/30/10.3/6.0 (CBOD5/TSS/NH3-N/DO)  
 April: 25/30/3.9/6.0 (CBOD5/TSS/NH3-N/DO)

\*DO is Inst. Min.

**TMDL Limits:** None

**Justification (Sag = Minimum Modeled Value ≠ Difference in Value):**

Reach No.	Length (miles)	DO WQS <sub>C</sub> (mg/L)	DO Sag <sub>C</sub> (mg/L)	Distance to DO Sag <sub>C</sub> (miles)	DO WQS <sub>P</sub> (mg/L)	DO Sag <sub>P</sub> (mg/L)	Distance to DO Sag <sub>P</sub> (miles)
1	0.8	2.0	5.4	0.2	6.0	6.0	0.3
2	0.2	5.0	6.0	0.0	6.0	6.2	0.0

Values in above table are from modeling analysis dated April 12, 2021.

**Outfall Location (Lat/Long):** 36° 3' 33.7" N; 91° 55' 37.4" W

<sup>1</sup> USGS StreamStats web-based program.

**Remarks:**

This is for the reissuance of the discharge permit for this existing facility. An updated model was performed with updated stream hydraulics and updated SOD rates. Based on the updated model, the following 208 Plan updates are being made with this permit renewal:

1. The monthly average CBOD<sub>5</sub> limit during November-April is being revised from 25 to 20 mg/l.
2. The monthly average NH<sub>3</sub>-N limit during November-March is being revised from 10.3 to 3.9 mg/l.
3. The instantaneous minimum DO limit during November-April is being revised from 6.0 to 7.0 mg/l.
4. A year-round instantaneous maximum TRC limit of 0.011 mg/l is being added.

		Ammonia Calculations		COLORKEY	
POTW?	Yes (Yes or No)				
Facility Name	City of Melbourne				User Inputs
Major or Minor	Minor				Calculated values
Permit Number	AR0020036				
Receiving Stream	Mill Creek		Ecoregion or River name	Ozark Highlands	
7Q10, cfs	0 USGS StreamStats		Watershed area (mi <sup>2</sup> )	6.38	
0.25/0.67 multiplier	0.67		Regulation No. 2 Chronic Toxicity Criteria (Instream Concentration)		
Qb, cfs	0.00		AML, mg/l	DML, mg/l	
Qe, MGD	0.41 Design flow		April	3.9	3.9
Qe, cfs	0.63		May - October	3.9	3.9
Cb, mg/l	0.1 Model input upstream		November - March	10.3	10.3
Allowable Effluent Conc., mg/l					
(Qe * Ce) + (Qb * Cb) = (Qe + Qb) * IWC			Allowable Effluent Conc. (Ce), mg/l		
Qe	Effluent Flow		Ce = (IWC (Qe + Qb) - Cb X Qb) / Qe		
Ce	Allowable Effluent Concentration		Monthly Avg., mg/l	7-Day Avg, mg/l	
Qb	% of Low Flow of Receiving Stream		April	3.9	3.9
Cb	Background Concentration		May - October	3.9	3.9
IWC	Instream Waste Concentration Chronic Toxicity Criteria		November - March	10.3	10.3
<b>Chronic Toxicity Criteria vs. D.O. Model Limits</b>					
	Monthly Average, mg/l		Permit Limits	7-Day Average, mg/l	Permit Limits
Month	Toxicity limit	D.O. limit		Toxicity limit	D.O. limit
April	3.9	3.9	3.9	3.9	5.9
May - October	no fishery	3.9	3.9	no fishery	5.9
November - March	10.3	3.9	3.9	10.3	5.9

Ammonia Toxicity Criteria					
<b>Minor Permits</b>					
Fish Early Life Stages Absent - Primary Season (November - March), mg/L					
Ecoregion	Temperature	pH	4-day average	30-day average	
Arkansas River	14	7.6	7.6	10.3	10.3
Arkansas River Valley	14	6.7	6.7	16.7	16.7
Boston Mountains	14	6.9	6.9	15.8	15.8
Delta	14	7.1	7.1	14.7	14.7
Gulf Coastal Plains	14	6.6	6.6	17	17
Ouachita Mountains	14	7.1	7.1	14.7	14.7
Ouachita River (L. Missouri to LA state line)	14	6.7	6.7	16.7	16.7
<b>Ozark Highlands</b>	<b>14</b>	<b>7.6</b>	<b>7.6</b>	<b>10.3</b>	<b>10.3</b>
Red River	14	7.5	7.5	11.3	11.3
White River (Dam #1 to Mouth)	14	7.7	7.7	9.3	9.3
Fish Early Life Stages Present - Critical Season (April - October), mg/L					
Ecoregion	Temperature	pH	4-day average	30-day average	
Arkansas River	32	7.6	7.6	3.2	3.2
Arkansas River Valley	31	6.7	6.7	5.6	5.6
Boston Mountains	31	6.9	6.9	5.3	5.3
Delta	30	7.1	7.1	5.2	5.2
Gulf Coastal Plains	30	6.6	6.6	6.1	6.1
Ouachita Mountains	30	7.1	7.1	5.2	5.2
Ouachita River (L. Missouri to LA state line)	32	6.7	6.7	5.2	5.2
<b>Ozark Highlands</b>	<b>29</b>	<b>7.6</b>	<b>7.6</b>	<b>3.9</b>	<b>3.9</b>
Red River	32	7.5	7.5	3.5	3.5
White River (Dam #1 to Mouth)	32	7.7	7.7	2.9	2.9

# Mill Creek watershed = 6.38 sq mi

Region ID:

AR

Workspace ID:

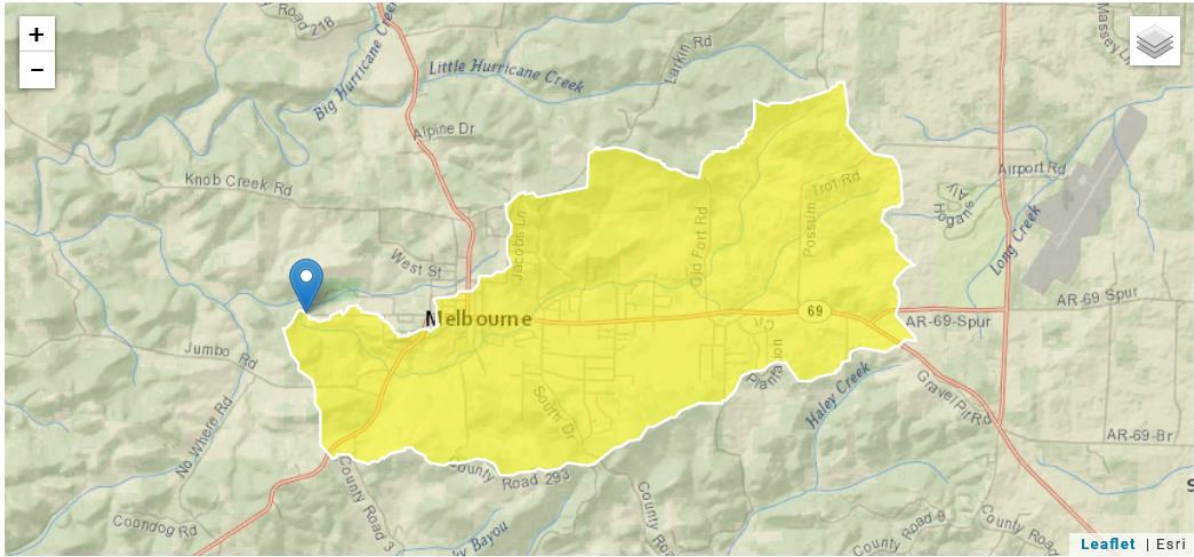
AR20210412141103277000

Clicked Point (Latitude, Longitude):

36.05949, -91.92720

Time:

2021-04-12 09:11:23 -0500



### Basin Characteristics

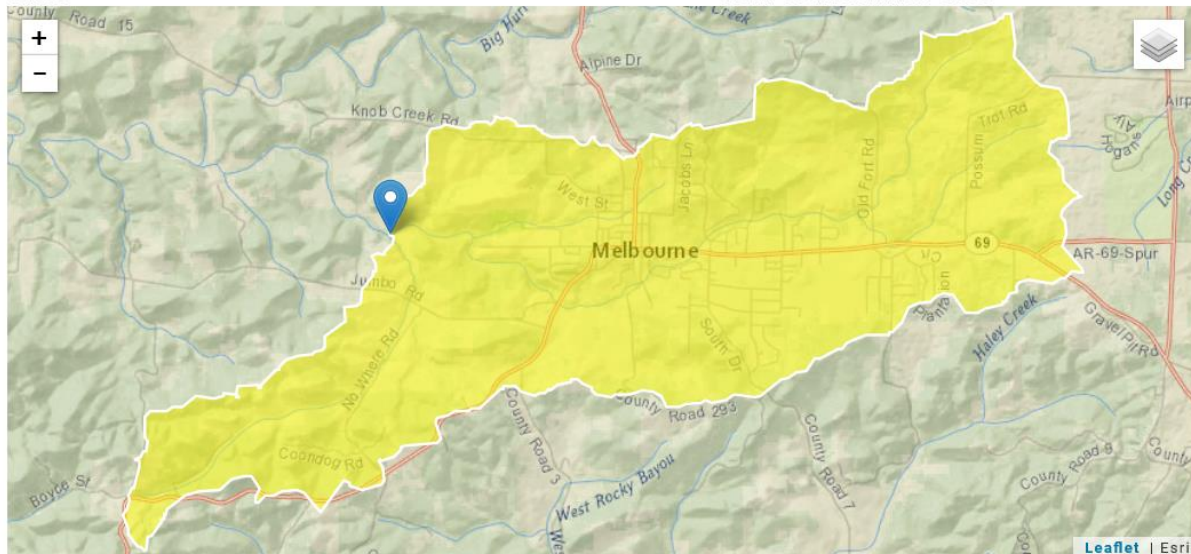
Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	6.38	square miles

Statistic	Value	Unit
Probability zero flow 7Day	0.102	dim

Since probability of zero flow is greater than 0.1, then  $7Q_{10} = 0$  cfs.

# Mill Creek at confluence with White Oak Branch = 10.1 sq mi

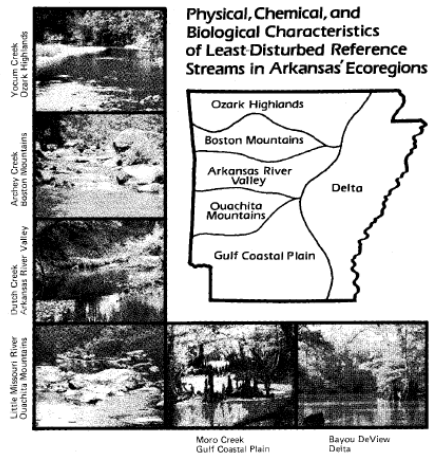
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Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	10.1	square miles

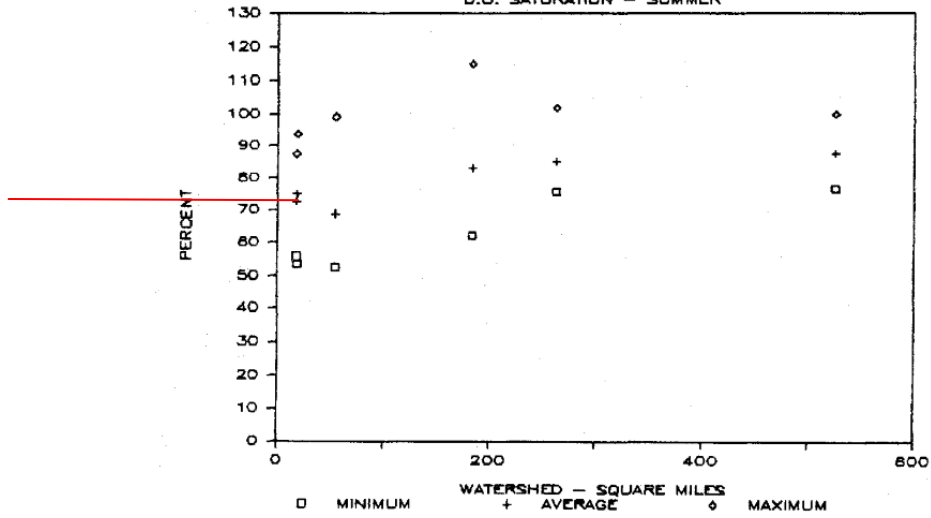
This is designated Reach 1b in the model. This reach designates the point where DO water quality standard changes from 2 mg/l to 5 mg/l. This point occurs approximately 0.8 miles downstream of the Melbourne outfall.



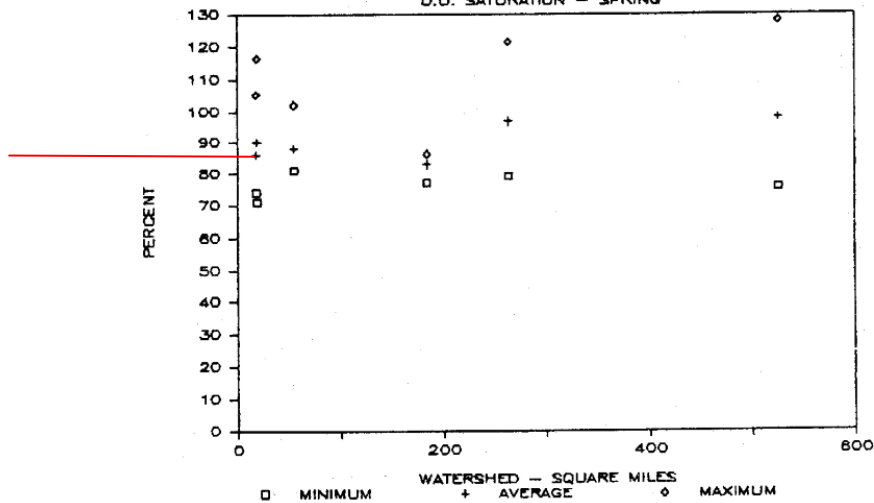
**Volume II: Data Analysis  
1987**

State of Arkansas  
Department of Pollution Control and Ecology

**OZARK HIGHLANDS  
D.O. SATURATION - SUMMER**



**OZARK HIGHLANDS  
D.O. SATURATION - SPRING**



**Sediment Oxygen Demand (SOD) for Various Temperatures and Ecoregion <sup>5</sup>**

Critical season

Primary season

Rocky Substrate <sup>4</sup>						Applicable Ecoregions <sup>6</sup> Ozark Highlands Boston Mountains Ouachita Mountains
TSS <sup>1</sup>	SOD <sub>20</sub>	SOD <sub>22</sub>	SOD <sub>29</sub>	SOD <sub>30</sub>	SOD <sub>31</sub>	
15 <sup>2</sup>	0.3	0.34	0.51	0.54	0.57	
20 <sup>2</sup>	0.5	0.56	0.84	0.90	0.95	
30 <sup>2</sup>	1.0	1.12	1.69	1.79	1.90	
45 <sup>3</sup>	1.4	1.57	2.37	2.51	2.66	
90 <sup>3</sup>	1.8	2.02	3.04	3.22	3.42	
Mixed Substrate						Arkansas River Valley Gulf Coastal Plain
TSS <sup>1</sup>	SOD <sub>20</sub>	SOD <sub>22</sub>	SOD <sub>29</sub>	SOD <sub>30</sub>	SOD <sub>31</sub>	
15 <sup>2</sup>	0.4	0.45	0.68	0.72	0.76	
20 <sup>2</sup>	0.7	0.79	1.18	1.25	1.33	
30 <sup>2</sup>	1.3	1.46	2.20	2.33	2.47	
45 <sup>3</sup>	1.6	1.80	2.70	2.87	3.04	
90 <sup>3</sup>	1.9	2.13	3.21	3.40	3.61	
Sandy Substrate <sup>4</sup>						Arkansas River Valley Gulf Coastal Plain Delta
TSS <sup>1</sup>	SOD <sub>20</sub>	SOD <sub>22</sub>	SOD <sub>30</sub>	SOD <sub>31</sub>	SOD <sub>32</sub>	
15 <sup>2</sup>	0.5	0.56	0.90	0.95	1.01	
20 <sup>2</sup>	0.8	0.90	1.43	1.52	1.61	
30 <sup>2</sup>	1.5	1.69	2.69	2.85	3.0	
45 <sup>3</sup>	1.8	2.02	3.22	3.42	3.62	
90 <sup>3</sup>	2.0	2.25	3.58	3.80	4.02	

- <sup>1</sup> Projected TSS instream after mixing.
- <sup>2</sup> TSS values are from MOA with EPA found in the CPP. SOD values for rocky substrate are the lower end of range given in the MOA. SOD values for sandy substrate are the upper end of range given in the MOA.
- <sup>3</sup> These TSS concentrations are outside of the range given in the MOA, so the corresponding SOD values are estimated.
- <sup>4</sup> SOD values given in this table are the lower and upper ends of the recommended range. SOD values between the upper and lower values are acceptable based on nature of substrate.
- <sup>5</sup> Deviations from these rates may take place in situations of high instream dilution, which significantly reduces the impact of the benthic (sediment) deposits on oxygen consumption. In these situations, justification on a case by case basis will be provided in the documentation submitted to EPA.
- <sup>6</sup> Applicable ecoregions are based on the general characteristics of waterbodies within each ecoregion (Rocky, Gravel, or Mixed). A different substrate type may be used based on site specific observations of the particular stream in question.



## Model Input Data

W.S. Drainage Area (mi<sup>2</sup>) : 6.38 (Reach 1a, Mill Creek at outfall)

10.1 (Reach 1b, Mill Creek at confluence with White Oak Branch)

Ecoregion: Ozark Highlands

Q<sub>DESIGN</sub> : 0.41 MGD

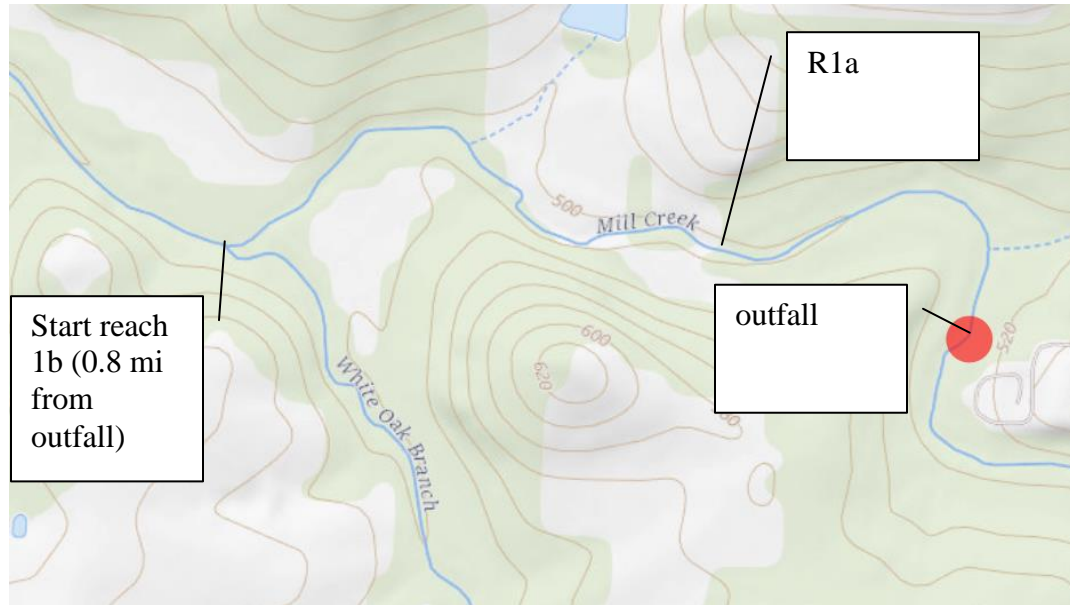
7Q10: 0 cfs (USGS StreamStats)

### Input Model Coefficients

Reach 1a				
Coefficient – at 20° C	Input value	Justification		
BOD <sub>ult.</sub> /BOD <sub>5</sub>	2.3	EPA Guidance		
K <sub>d</sub> (1/day)	0.5	MOA, rocky substrate		
K <sub>n</sub> (1/day)	0.3	MOA, rocky substrate		
SOD (g/m <sup>2</sup> /day)	0.3 (critical season)	MOA, rocky substrate, TSS = 15		
	1.0 (primary season)	MOA, rocky substrate, TSS = 30		
K <sub>a</sub> (1/day)	10.5 (critical season)	O’Conner Dobbins equation		
	9.0 (primary season)	O’Conner Dobbins equation		
Reach 1b				
Coefficient – at 20° C	Input value	Justification		
BOD <sub>ult.</sub> /BOD <sub>5</sub>	2.3	EPA Guidance		
K <sub>d</sub> (1/day)	0.5	MOA, rocky substrate		
K <sub>n</sub> (1/day)	0.3	MOA, rocky substrate		
SOD (g/m <sup>2</sup> /day)	0.3 (critical season)	MOA, rocky substrate, TSS = 15		
	1.0 (primary season)	MOA, rocky substrate, TSS = 30		
K <sub>a</sub> (1/day)	10.5 (critical season)	O’Conner Dobbins equation		
	9.0 (primary season)	O’Conner Dobbins equation		
Applicable Water Quality Standards				
	Critical Season (May-Oct.)		Primary Season (Nov.-Apr.)	
	Reach 1a	Reach 1b	Reach 1a	Reach 1b
D.O. Standard (mg/L)	2	5	6	
Temp. Standard (°C)	29		22	



## Model Diagram



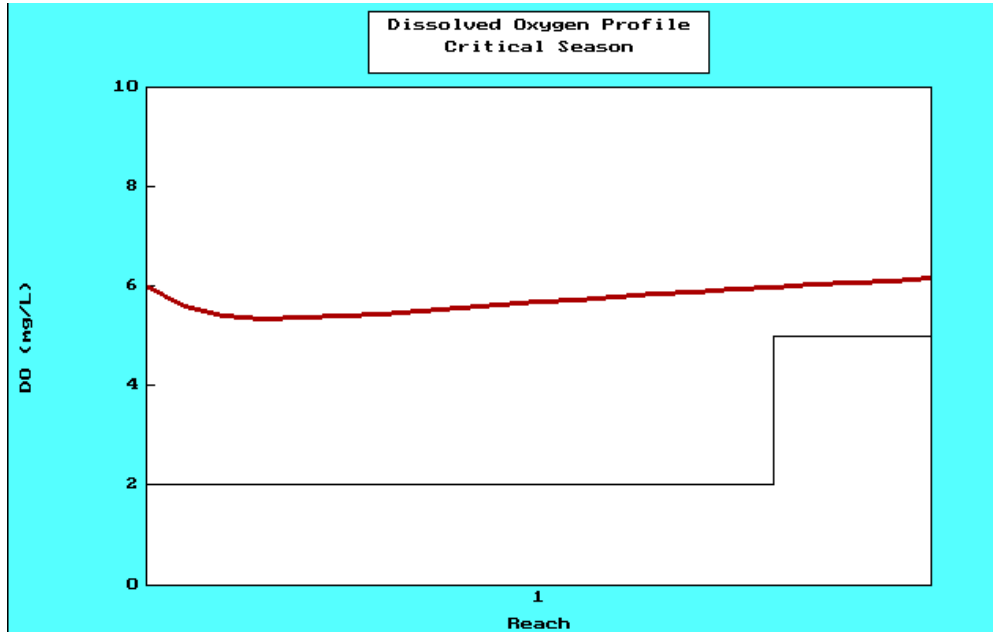
### Critical Season Stream Hydraulics

<b>Quick Calculator</b>									
0	Headwater in CFS		0.0739796	0.5	0.5353916	0.4	25.2474	0.1	Accum
				FPS		Feet		Feet	MGD
0.41	Discharger 1 in MGD	Reach 1 Velocity	0.059	Depth	0.446	Width	24.124		0.410

### Primary Season Stream Hydraulics

<b>Quick Calculator</b>									
0.36	Headwater in CFS		0.0739796	0.5	0.5353916	0.4	25.2474	0.1	Accum
				FPS		Feet		Feet	MGD
0.41	Discharger 1 in MGD	Reach 1 Velocity	0.074	Depth	0.534	Width	25.233		0.643

**Critical Season Model (20036\_C.smp)**  
**10/15/3.9/6 simulation (CBOD5/TSS/NH3/DO)**



Critical Season	TABULAR MODEL OUTPUT			
	River Mile	DO (mg/L)	BOD (mg/L)	NH3 (mg/L)
1	1.00	6.00	23.00	3.90
2	0.95	5.58	22.12	3.78
3	0.90	5.40	21.27	3.67
4	0.85	5.35	20.45	3.55
5	0.80	5.35	19.67	3.44
6	0.75	5.39	18.91	3.34
7	0.70	5.44	18.18	3.24
8	0.65	5.49	17.49	3.14
9	0.60	5.55	16.82	3.04
10	0.55	5.61	16.17	2.95
11	0.50	5.67	15.55	2.86
12	0.45	5.72	14.95	2.77
13	0.40	5.78	14.38	2.69
14	0.35	5.83	13.83	2.60
15	0.30	5.88	13.30	2.52
16	0.25	5.93	12.78	2.45
17	0.20	5.97	12.29	2.37
18	0.15	6.02	11.82	2.30
19	0.10	6.06	11.37	2.23
20	0.05	6.10	10.93	2.16
21	-0.00	6.14	10.51	2.10

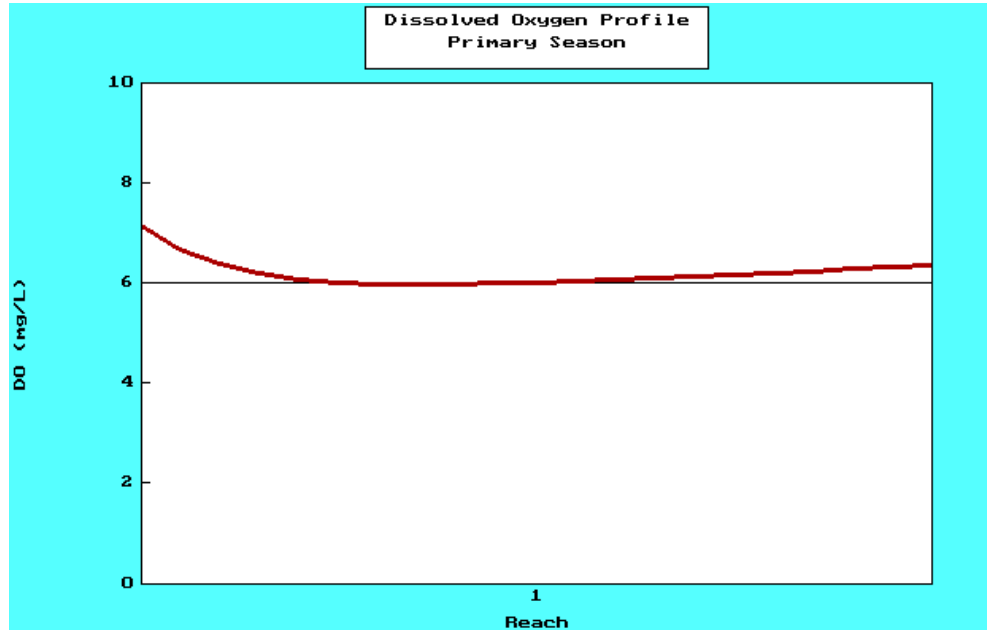
Run information screen		
Name of receiving stream		Mill Creek
Number of discharges	(max = 10)	1
Number of reaches	(max = 10)	1
Reaeration type	(O, T, M)	O'Connor-Dobbins
Run title for screen display		Critical Season
Graphics printer type	(HP, FX, LQ, None)	None
Printed graph resolution	(Low, Med, High)	None

Upstream River Parameters			Comments
Flow	(cfs)	0.00	7Q10 = 0
Temperature	(°C)	29.00	WQS Ozark High
Dissolved Oxygen	(mg/l)	5.50	72%sat ERstudy
5-Day BOD	(mg/l)	1.00	default
Ult. CBOD / 5-Day BOD		2.30	default
pH	(su)	7.00	default
Ammonia	(mg/l)	0.10	default
Alkalinity	(mg/l)		
Upstream river mile		1.00	model length

Parameters for Discharge 1			Comments
Flow	(MGD)	0.41	design flow
Temperature	(°C)	29.00	WQS Ozark High
Dissolved Oxygen	(mg/l)	6.00	permit
5-Day BOD	(mg/l)	10.00	permit
Ult. CBOD / 5-Day BOD		2.30	default
pH	(su)	7.00	default
Ammonia	(mg/l)	3.90	permit
Alkalinity	(mg/l)		
Beginning of Reach Number		1	
Name of Discharger		Melbourne	

Critical Season	Parameters for Reach 1		Comments
Length	(mile)	1.00	model length
Velocity	(fps)	0.06	spreadsheet
Slope	(ft/mile)	-0.00	
Average Depth	(ft)	0.45	spreadsheet
Temperature	(°C)	29.00	Calculated
BOD Removal Rate	(1/day)	0.50	MDA, rocky sub
NH3 Decay Rate	(1/day)	0.30	MDA, rocky sub
Sediment Oxygen Demand	(g/m <sup>2</sup> /day)	0.51	k20=0.3(TSS=15)
Photosynthesis/respiration	(mg/L/day)	-0.00	

**Primary Season Model (22004\_P.smp)  
20/30/3.9/7 simulation (CBOD5/TSS/NH3/DO)**



Primary Season		TABULAR MODEL OUTPUT		
	River Mile	DO (mg/L)	BOD (mg/L)	NH3 (mg/L)
1	1.00	7.14	30.17	2.52
2	0.95	6.68	29.50	2.49
3	0.90	6.37	28.84	2.45
4	0.85	6.18	28.19	2.42
5	0.80	6.06	27.56	2.38
6	0.75	6.00	26.94	2.35
7	0.70	5.97	26.34	2.31
8	0.65	5.96	25.75	2.28
9	0.60	5.97	25.17	2.25
10	0.55	5.99	24.61	2.22
11	0.50	6.01	24.06	2.18
12	0.45	6.04	23.52	2.15
13	0.40	6.07	23.00	2.12
14	0.35	6.10	22.48	2.09
15	0.30	6.13	21.98	2.06
16	0.25	6.17	21.49	2.03
17	0.20	6.20	21.01	2.00
18	0.15	6.23	20.54	1.97
19	0.10	6.27	20.08	1.95
20	0.05	6.30	19.63	1.92
21	-0.00	6.33	19.19	1.89

Primary Season	Run information screen	
Name of receiving stream		Mill Creek
Number of discharges (max = 10)		1
Number of reaches (max = 10)		1
Reaeration type (0, T, M)		O'Connor-Dobbins
Run title for screen display		Primary Season
Graphics printer type (HP, FX, LQ, None)		None
Printed graph resolution (Low, Med, High)		None

Primary Season	Upstream River Parameters		Comments
Flow (cfs)		0.36	seasonal fishery
Temperature (°C)		22.00	WQS Ozark High
Dissolved Oxygen (mg/l)		7.40	85%sat ERstudy
5-Day BOD (mg/l)		1.00	default
Ult. CBOD / 5-Day BOD		2.30	default
pH (su)		7.00	default
Ammonia (mg/l)		0.10	default
Alkalinity (mg/l)		-0.00	
Upstream river mile		1.00	model length

Primary Season	Parameters for Discharge 1		Comments
Flow (MGD)		0.41	design flow
Temperature (°C)		22.00	WQS Ozark High
Dissolved Oxygen (mg/l)		7.00	permit
5-Day BOD (mg/l)		20.00	permit
Ult. CBOD / 5-Day BOD		2.30	default
pH (su)		7.00	default
Ammonia (mg/l)		3.90	permit
Alkalinity (mg/l)		-0.00	
Beginning of Reach Number		1	
Name of Discharger		Melbourne	

Primary Season	Parameters for Reach 1		Comments
Length	(mile)	1.00	model length
Velocity	(fps)	0.07	spreadsheet
Slope	(ft/mile)	-0.00	
Average Depth	(ft)	0.53	spreadsheet
Temperature	(°C)	22.00	Calculated
BOD Removal Rate	(1/day)	0.50	MOA, rocky sub
NH3 Decay Rate	(1/day)	0.30	MOA, rocky sub
Sediment Oxygen Demand	(g/m <sup>2</sup> /day)	1.12	k20=1.0(TSS=30)
Photosynthesis/respiration	(mg/L/day)	-0.00	