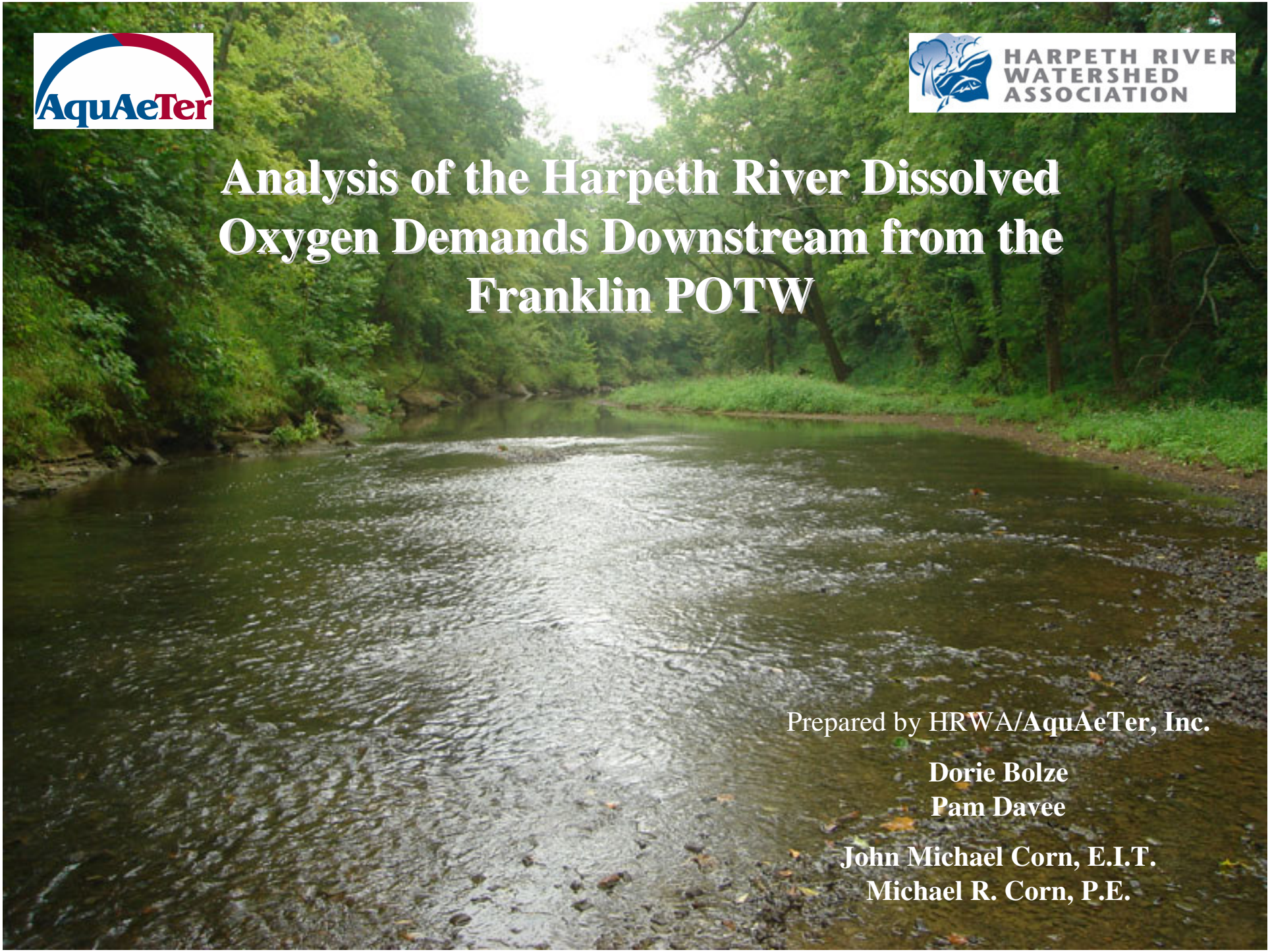

Analysis of the Harpeth River Dissolved Oxygen Demands Downstream from the Franklin POTW

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FRANKLIN POTW PERMITTED LOADS

- **MASS (lbs/day) = CONCENTRATION (mg/L) * FLOW (mgd) * 8.34**
- **OXYGEN (O_2) DEMAND = $CBOD_U$ (mg/L) + TKN (mg/L)**
- **TKN = TOTAL KJELDAHL NITROGEN = ORGANIC NITROGEN + AMMONIA**
- **O_2 DEMAND FROM $CBOD_U$ = BOD_5 * 5.4**
- **O_2 DEMAND FROM TKN = TKN * 4.57**
- **POTW PERMITTED BOD_5 = 5 mg/L**
- **POTW PERMITTED TKN = 1 mg/L**
- **POTW EFFLUENT BOD_5 O_2 DEMAND = 5 mg/L * 5.4 * 12 mgd * 8.34 = 2,702 lbs/day**
- **POTW EFFLUENT TKN O_2 DEMAND = 1 mg/L * 4.57 * 12 mgd * 8.34 = 457 lbs/day**
- **FRANKLIN POTW TOTAL O_2 DEMAND = 3,159 lbs/day**

HARPETH RIVER O_2 DEMAND

- **BACKGROUND $CBOD_U$ = 1 mg/L (USEPA)**
- **BACKGROUND TKN = 0.42 mg/L (USEPA)**
- **TOTAL FLOW IN RIVER AT 7-DAY 10-YEAR LOW FLOW (7Q10) = 0.3 cfs or 0.19 mgd**
- **TOTAL $CBOD_U$ O_2 DEMAND IN RIVER = 1 mg/L * 0.19 mgd * 8.34 = 1.62 lbs/day**
- **TOTAL TKN O_2 DEMAND IN RIVER = 0.42 mg/L * 4.57 * 0.19 mgd * 8.34 = 3.10 lbs/day**
- **TOTAL BACKGROUND O_2 DEMAND IN RIVER = 1.62 lbs/day + 3.10 lbs/day = 4.72 lbs/day**

TOTAL O_2 DEMAND IN HARPETH RIVER AT FRANKLIN POTW

- **TOTAL O_2 DEMAND IN RIVER AFTER FRANKLIN POTW = 3,159 lbs/day + 4.7 lbs/day**
- **TOTAL O_2 DEMAND IN RIVER = 3,164 lbs/day**

OXYGEN AVAILABLE IN RIVER AT FRANKLIN POTW

- **O_2 IN HARPETH RIVER ASSUMED = 6 mg/L**
- **O_2 IN FRANKLIN POTW EFFLUENT ASSUMED = 6 mg/L**
- **FLOW IN HARPETH RIVER = 0.19 mgd (TDEC 7-DAY 10-YEAR LOW FLOW)**
- **FLOW FROM POTW = 12 mgd**
- **O_2 MASS IN RIVER = 6 mg/L * 0.19 mgd * 8.34 = 9.51 lbs/day**
- **O_2 MASS IN EFFLUENT = 6 mg/L * 12 mgd * 8.34 = 600.5 lbs/day**
- **TOTAL O_2 MASS IN RIVER = 9.51 lbs/day + 600.5 lbs/day = 610 lbs/day**

O_2 DEMAND VERSUS INITIAL AVAILABLE O_2

- **TOTAL O_2 DEMAND IN RIVER AFTER FRANKLIN POTW = - 3,164 lbs/day**
- **TOTAL O_2 AVAILABLE IN RIVER AFTER FRANKLIN POTW = + 610 lbs/day**
- **O_2 DEFICIT AT FRANKLIN = - 2,554 lbs/day**

BACKGROUND FLOW TO MEET DEFICIT

- **TOTAL O_2 DEFICIT = - 3,164 lbs/day**
- **TOTAL O_2 IN EFFLUENT = + 600.5 lbs/day**
- **TOTAL O_2 MASS TO BALANCE O_2 IN RIVER AT 5 mg/L =**

  Q_{RIVER} = (+ 600.5 lbs/day – 3,164 lbs/day)/(5 mg/L * 8.34)

  Q_{RIVER} = 2,564 lbs/day/41.7 lbs/day/mgd = 61.5 mgd

  Q_{RIVER} = 61.5 mgd * 1.547 cfs/mgd = 95.1 cfs

NOTES:

1. **ASSUMES NO LOW-FLOW NON-POINT SOURCE OXYGEN DEMANDS FROM SEDIMENT OXYGEN DEMAND OR ALGAL RESPIRATION AND NO OXYGEN ADDITION FROM EITHER REAERATION OR ALGAL PRODUCTION**
2. **AT THE 7Q10 LOW FLOW, NO OTHER NON-POINT SOURCES ARE AVAILABLE**

FRANKLIN POTW REQUIRED EFFLUENT LIMITS

- **USEPA HAS SET A TOTAL MAXIMUM DAILY LOAD (TMDL) LIMIT FOR THE FRANKLIN POTW OF 2 mg/L BOD_5 WHEN FLOW IN THE RIVER UPSTREAM FROM THE POTW WAS 17 cfs.**
- **BECAUSE OF THE ANTI-DEGRADATION REGULATION AND THE REQUIREMENT IN THE HARPETH RIVER NPDES PERMITS (3 PERMITS) THAT THE DISCHARGERS MEET THE WATER QUALITY STANDARDS, THE DISCHARGERS CANNOT FURTHER DEGRADE THE RIVER DISSOLVED OXYGEN DOWNSTREAM FROM EACH OF THE DISCHARGERS.**
- **THE FACT THAT THE RIVER DOES NOT MEET THE DO STANDARD OF 5 mg/L UPSTREAM FROM THE FRANKLIN POTW, THE LYNWOOD UTILITY OR THE CARTWRIGHT CREEK UTILITY MEANS THAT THESE DISCHARGERS ARE IN VIOLATION OF THEIR PERMITS IF THEY REDUCE THE DISSOLVED OXYGEN IN THE RIVER.**
- **USEPA HAS PREDICTED THAT THE FRANKLIN POTW REDUCES OXYGEN IN THE RIVER BY MORE THAN 2 mg/L, THAT THE LYNWOOD UTILITY REDUCES THE DO BY 1 mg/L AND THAT THE CARTWRIGHT CREEK UTILITY REDUCES THE DO BY ABOUT 0.6 mg/L (ESTIMATED FROM LYNWOOD DEFICIT).**
- **THESE DISCHARGERS WOULD BE REQUIRED TO MEET BACKGROUND CONCENTRATIONS OF BOD_5 AND TKN OF 1 mg/L AND 0.42 mg/L, RESPECTIVELY TO BE ABLE TO DISCHARGE TO THE HARPETH RIVER.**