



ENVIRONMENTAL RESOURCE GROUP

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FEB 18 2003

MPCA, MAR Division
Superfund Section

MEMORANDUM

TO: Dave Douglas and Mark Rys

COMPANY: Minnesota Pollution Control Agency

FROM: Dan Comeau and Paul Book

DATE: February 13, 2003

RE: 3M Cottage Grove; Area D1 Initial Groundwater Sampling Results

NOTES/COMMENTS:

Enclosed are the laboratory analytical results from new monitoring wells (MW-101 and MW-102) which were recently installed at the D1 area of 3M Cottage Grove. The well locations relative to D1 are shown on Figure 1.

Samples from the wells were collected by Environmental Resource Group, LLC (ERG) on December 3, 2002 and shipped overnight on ice to Exygen Research, Inc. (Exygen) for the requested analyses of eight fluorocarbon (FC) compounds.

QA/QC

As indicated to you previously, Exygen revised and re-issued its preliminary report due to quality assurance/quality control (QA/QC) issues. Seven of the eight requested compounds were successfully analyzed and quantified. QA/QC issues were associated with the C4 acid (Heptafluorobutyric acid) analyses. As indicated in Section 5.7 of the accompanying laboratory report, the C4 acid analyses had low spike recoveries and did not meet the laboratory protocols. Sample quantitation for the C4 acid is not reported in Exygen's final laboratory report.

Flux Analysis

Using the December 2002 sample analytical data from the new monitoring wells, ERG employed a conservative evaluation of the potential D1 FC groundwater flow. The evaluation uses the conservative assumption that all FCs measured in the groundwater move without attenuation. This exercise indicates that even when using these very conservative assumptions, groundwater FC levels at D1 should have no adverse effects on Mississippi River water quality.

The following relationship was used to estimate FC concentrations in the river:

$$\text{Concentration}_{\text{Aquifer}} * \text{Discharge}_{\text{Aquifer}} = \text{Concentration}_{\text{River}} * \text{Discharge}_{\text{River}}$$

**Exhibit
1883**

State of Minnesota v. 3M Co.,
Court File No. 27-CV-10-28862

3M_MN01010361

To calculate the discharge of the aquifer, the following equation was used:

$$Q(\text{gal/min}) = \frac{H * W * K * \frac{dh}{dl}}{1440}$$

Where:

H (ft) = Plume Thickness
W (ft) = Plume Width
K (gpd/ft²) = Hydraulic Conductivity
dh/dl (ft/ft) = Hydraulic Gradient

This equation was obtained from the MPCA Water Quality Division, Request for Surface Water Toxics Impact Assessment form. The selection of parameter values is discussed below.

Plume Thickness (H)

H = 66 feet

Plume thickness was assumed to equal the saturated zone thickness from the measured water table elevations at the new D1 area wells to the top of the St. Lawrence Formation. The St. Lawrence Formation has an upper surface elevation of approximately 625 feet as found in wells elsewhere at the site. The saturated zone thickness was estimated by using the static water level data from well MW-102 at the time the well was sampled in December 2002 (690.93 feet above sea level). The difference between the water table elevation at MW-102 and the approximate upper surface of the St. Lawrence Formation is 66 feet. This value is conservative as it assumes complete dispersion of the FC constituents through the entire thickness of the aquifer within the plume.

Plume Width (W)

W = 300 feet

The plume width was determined based on the assumption that the plume would disperse downgradient and form an ellipse with an average plume width equal to ½ the distance from the source area to the river (600 feet). This value is approximately 300 feet.

Hydraulic Gradient (dh/dl)

dh/dl = 0.00655 ft/ft

The hydraulic gradient was determined based on the change in water table elevation between MW-102 and the river, divided by the distance from MW-102 to the river (600 feet). The pool elevation of the river (687.0) was initially determined from a USGS Quadrangle map and verified from measurements at Lock and Dam 2 (located at Hastings) collected by the St. Paul District U.S. Army Corps of Engineers within 2-4 hours of water level measurements taken in the new wells by ERG.

$$dh/dl = (690.93 - 687.00 \text{ ft}) / (600.00 \text{ ft}) = 0.00655 \text{ ft/ft}$$

Hydraulic Conductivity (K)
K = 27.7 gallons/day/ft²

ERG used the hydraulic conductivity value (27.7 gpd/ft² estimated for the nearest site monitoring well (MW-13) by Roy F. Weston, Inc. in the February 1986 Final Remedial Investigation Report for Cottage Grove.

Using the selected plume width and hydraulic conductivity, the discharge was calculated for the aquifer:

	W = 300 (feet) K = 27.7 (gpd/ft ²)
Aquifer Discharge =	2.493 gal/min

The discharge value used for the river is 25 percent of the median baseflow. That value (obtained from 3M) is 1.879 billion gallons per day or 1,304,861 gallons per minute (gpm). Aquifer concentrations were based on analytical results from the December 2002 sampling event as summarized below:

D1 Analytical Results - December 2002				
	PFOA		PFOS	
	MW-101 (ppm)	MW-102 (ppm)	MW-101 (ppm)	MW-102 (ppm)
Sample	0.170	0.324	0.325	0.384
Lab Duplicate	0.180	0.404	0.356	0.394
Field Duplicate	0.172	0.369	0.358	0.336
Average	0.174	0.366	0.346	0.371
Conc. Aquifer (Average ppm) =	0.174	0.366	0.346	0.371

$$\text{Concentration}_{\text{Aquifer}} * \text{Discharge}_{\text{Aquifer}} = \text{Concentration}_{\text{River}} * \text{Discharge}_{\text{River}}$$

or

$$\text{Concentration}_{\text{River}} = \frac{\text{Concentration}_{\text{Aquifer}} * \text{Discharge}_{\text{Aquifer}}}{\text{Discharge}_{\text{River}}}$$

Analyte	Well	Groundwater Analytical Results (ppm) Dec. 2002	Predicted River Concentration (ppm)	Comparison Levels (ppm)	
Total SUM FCs	MW-101	2.6703	5.48E-06	HBV	1.00E-03
	MW-102	0.9227	1.70E-06	HBV	1.00E-03
PFOA	MW-101	0.1740	3.32E-07	HBV	7.00E-03
	MW-102	0.3657	6.99E-07	HBV	7.00E-03
PFOS	MW-101	0.3463	5.62E-07	HBV	1.00E-03
	MW-102	0.3713	7.09E-07	HBV	1.00E-03

The interim health based values (HBV) for PFOA/PFOS recently developed by the Minnesota Department of Health (MDH) are summarized above for comparison to the predicted river FC concentrations. There are no known users of the river for drinking water between Cottage Grove and the junction of the Mississippi and St. Croix rivers. As a conservative evaluation, the most restrictive of the FC HBV's (1.00E-03 ppm) was compared to the maximum sum of all FC's (5.48E-06 ppm). Although using the HBV in this manner has no technical basis, this comparison affirms that the groundwater flux from the site causes no unacceptable risk.

In summary, ERG's evaluation of potential groundwater discharge effects to the river (given the FC concentrations present at D1 in December 2002) indicates groundwater FC levels at D1 should have no adverse effects on Mississippi River water quality.

ERG proposes conducting the second and final sampling of the two new wells at D1 the week of March 3, 2003. The analytical data from that sampling event will be provided to you when it becomes available.

Please contact Dan Comeau (612.339.2478) or Paul Book (612.339.4779) of this office or Todd Fasking at 3M (651.778.5344) if you have any questions or comments concerning the information provided in this memorandum.

Enclosures (As noted)

CC: Mr. Todd Fasking, 3M ET & SS
 Mr. Mark Gaetz, 3M ET & SS