Protecting Our Water Environment

RESEARCH AND DEVELOPMENT DEPARTMENT

REPORT NO. 06-42

GROUNDWATER MONITORING REPORT

TUNNEL AND RESERVOIR PLAN
CALUMET TUNNEL SYSTEM
2005 ANNUAL REPORT

AUGUST 2006

August 8, 2006

Ms. Marcia Willhite, Chief
Bureau of Water
Illinois Environmental Protection Agency
P. O. Box 19276
Springfield, IL 62794–9276

Subject: Calumet TARP System Groundwater Monitoring Annual Report for the Year 2005

Dear Ms. Willhite:

Enclosed are three copies of "Groundwater Monitoring Report, Tunnel and Reservoir Plan Calumet Tunnel System 2005 Annual Report."

Very truly yours,

Louis Kollias
Director
Research and Development

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GROUNDWATER MONITORING REPORT

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Research and Development Department
Louis Kollias, Director

August 2006

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Introduction

This report contains 2005 data for the TARP Calumet Tunnel System compiled from the monitoring of the groundwater level elevations in the observation wells and monitoring of water quality in the water quality monitoring wells. The observation and monitoring wells are located along the Calumet Tunnel System. The tunnel between Crawford Avenue and the Calumet Water Reclamation Plant has four water quality wells (QC–1,

Operations Department. Water quality well QC–29 was not sampled on March 23, 2005, because the pump could not be activated. Water quality well QC–30 could not be sampled on January 6, 2005, or March 23, 2005, because there was a pump malfunction. Water quality well QC–31 could not be sampled on March 23, 2005, because of a pump malfunction. Water quality well QC–32 could not be sampled on March 23, 2005, May 5, 2005, July 20, 2005, September 1, 2005, or November 10, 2005, because there was insufficient water in the well to collect a sample. Water quality wells QC–33 through QC–37 were not sampled during 2005 because there was insufficient water in the wells to collect a sample.

Summary of Data

Observation Wells Water Level Elevation Data. In Figure 1, the 2005 groundwater level elevation data for the observation wells (OC–1 through OC–11) of the Calumet Tunnel System have been plotted. In this figure, yearly minimum, mean, and maximum water level elevations of all 11 wells are plotted to show fluctuations in the water level elevations during 2005.

Figure 1: 2005 MINIMUM, MEAN, AND MAXIMUM WATER LEVEL ELEVATIONS FOR THE CALUMET TUNNEL SYSTEM OBSERVATION WELLS

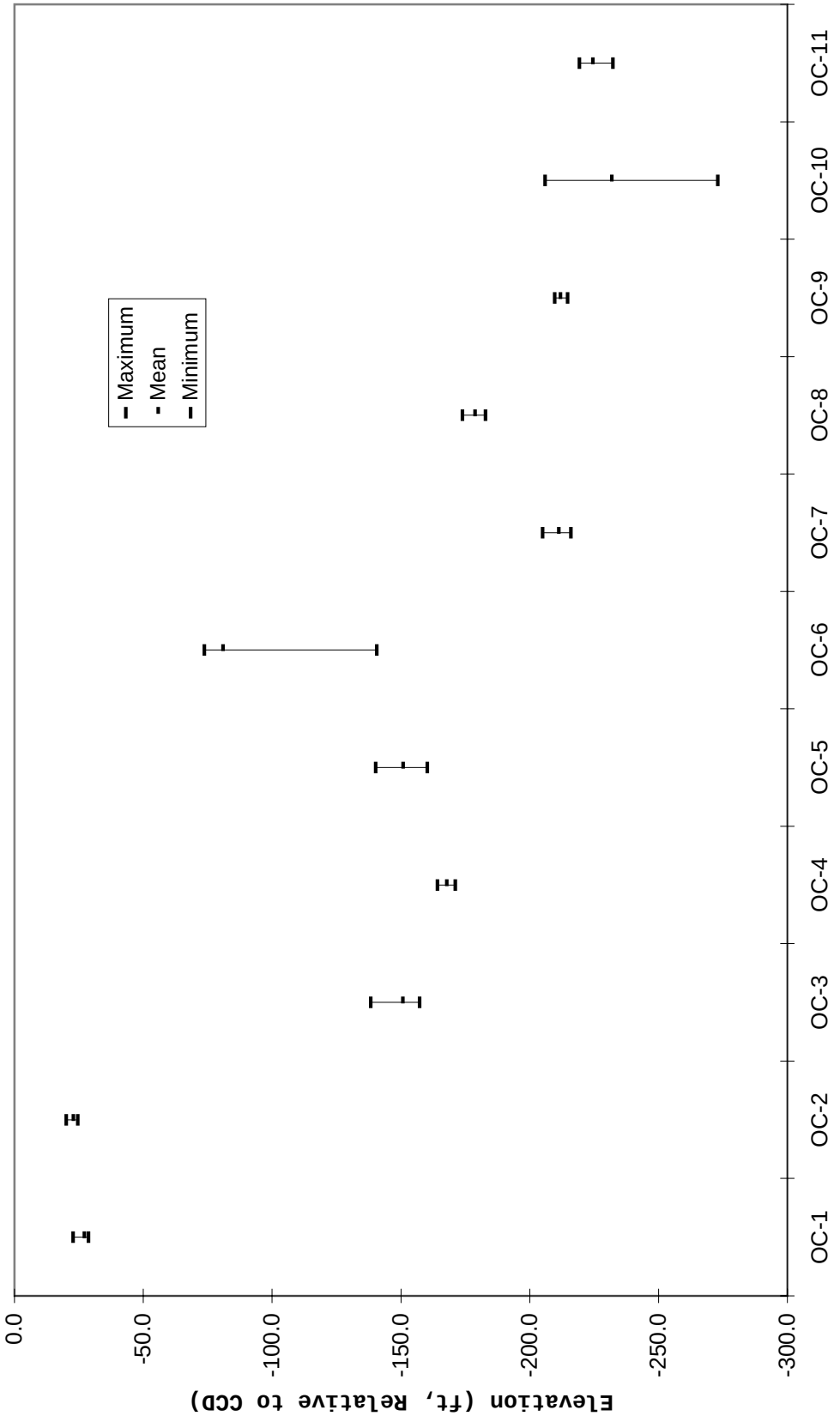

TABLE 1: SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–1, QC–2, QC–2.1, QC–2.2, AND QC–3

Parameter		Well Number				
		QC–1	QC–2	QC–2.1	QC–2.2	QC–3
Cl, mg/L	Minimum	61	30	34	14	11
	Mean	64	38	35	15	12

TABLE 1 (Continued): SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–1, QC–2, QC–2.1, QC–2.2, AND QC–3

Parameter		Well Number				
		QC–1	QC–2	QC–2.1	QC–2.2	QC–3
pH	Minimum	7.2	6.9	7.5	7.4	6.9
	Mean	7.4	7.4	7.6	7.6	7.3
	Maximum	7.6	7.7	7.6	7.7	7.6
	Std. Dev.	0.2	0.3	0.1	0.2	0.4
	Median	7.5	7.4	7.6	7.6	7.4
	Coeff. Var.	2.0	3.7	0.8	2.0	4.9
SO_4, mg/L	Minimum	223	24	0**	32	23
	Mean	241	27	2	57	24
	Maximum	256	29	5	105	25
	Std. Dev.	13	2	3	42	1
	Median	237	27	1	34	24
	Coeff. Var.	5	6	132	73	4
TDS, mg/L	Minimum	746	340	496	336	368
	Mean	826	388	579	369	399
	Maximum	884	412	702	388	424
	Std. Dev.	50	27	108	28	29
	Median	830	394	540	382	406
	Coeff. Var.	6	7	19	8	7
TOC, mg/L	Minimum	2	1	1	1	1
	Mean	3	3	1	2	1
	Maximum	4	4	2	3	2
	Std. Dev.	1	1	1	1	1
	Median	3	3	1	2	1
	Coeff. Var.	30	45	43	50	43

*For purposes of statistical evaluation, fecal coliform values less than 1 were set equal to 1.

**A zero value indicates that the test result was below the detection limit (DL). The DL for sulfate is 0.4 mg/L.

TABLE 2: SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–4, QC–5, QC–6, QC–7, AND QC–9

Parameter		Well Number				
		QC–4	QC–5	QC–6	QC–7	QC–9
Cl, mg/L	Minimum	10	27	15	11	9
	Mean	11	28	16	12	10
	Maximum	11	30	16	12	10
	Std. Dev.	1	2	1	1	1
	Median	11	28	16	12	10
	Coeff. Var.	5	5	4	5	6
Cond., µmhos/cm	Minimum	340	505	417	509	296
	Mean	440	579	490	548	358
	Maximum	541	720	617	584	397
	Std. Dev.	101	122	110	38	54
	Median	439	512	436	550	380
	Coeff. Var.	23	21	23	7	15
FC,* cfu/100 mL	Minimum	1	1	1	1	1
	Geo. Mean	1	1	1	1	1
	Maximum	1	1	1	1	1
	Geo. Std. Dev.	0	0	0	0	0
	Median	1	1	1	1	1
	Coeff. Var.	0	0	0	0	0
Hard., as $CaCO_3$, mg/L	Minimum	10	9	9	10	58
	Mean	10	10	16	12	60
	Maximum	11	10	19	15	61
	Std. Dev.	1	1	6	3	2
	Median	10	10	19	12	60
	Coeff. Var.	6	6	37	20	3
NH_4^+–N, mg/L	Minimum	0.13	0.15	0.29	0.25	0.18
	Mean	0.15	0.15	0.32	0.27	0.33
	Maximum	0.19	0.16	0.36	0.28	0.59
	Std. Dev.	0.03	0.01	0.04	0.02	0.23
	Median	0.13	0.15	0.30	0.27	0.21
	Coeff. Var.	23.09	3.77	11.96	5.73	69.96

TABLE 2 (Continued): SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM:

TABLE 3: SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY

TABLE 3 (Continued): SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–10 THROUGH QC–14

Parameter		Well Number				
		QC–10	QC–11	QC–12	QC–13	QC–14
pH	Minimum	7.6	7.1	6.9	7.1	7.1
	Mean	7.6	7.5	7.2	7.4	7.5
	Maximum	7.7	7.8	7.5	7.6	7.7
	Std. Dev.	0.1	0.4	0.3	0.3	0.3
	Median	7.6	7.6	7.3	7.4	7.6
	Coeff. Var.	0.8	4.8	4.2	3.4	4.3
SO_4, mg/L	Minimum	0**	1	199	40	0**
	Mean	1	1	264	42	1
	Maximum	1	2	354	45	3
	Std. Dev.	1	1	80	3	2
	Median	1	1	239	41	1
	Coeff. Var.	87	43	30	6	115
TDS, mg/L	Minimum	314	214	728	406	662
	Mean	375	246	818	457	666
	Maximum	408	290	968	500	670
	Std. Dev.	53	39	131	48	6
	Median	402	234	758	466	666
	Coeff. Var.	14	16	16	10	1

TABLE 4: SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–15 THROUGH QC–19

Parameter		Well Number				
		QC–15	QC–16	QC–17	QC–18	QC–19
Cl, mg/L	Minimum	20	21	13	8	4
	Mean	20	21	13	8	5
	Maximum	21	22	14	8	5
	Std. Dev.	1	1	1	0	1
	Median	20	21	13	8	5
	Coeff. Var.	3	3	4	0	12
Cond., µmhos/cm	Minimum	292	354	352	332	565
	Mean	342	437	497	405	574
	Maximum	393	587	643	479	582
	Std. Dev.	51	130	146	74	9
	Median	340	370	495	404	574
	Coeff. Var.	15	30	29	18	1
FC,* cfu/100 mL	Minimum	1	1	1	1	1
	Geo. Mean	1	1	1	1	1

TABLE 4 (Continued): SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–15 THROUGH QC–19

Parameter		Well Number				
		QC–15	QC–16	QC–17	QC–18	QC–19
pH	Minimum	7.0	7.2	7.5	7.5	6.9
	Mean	7.7	7.4	7.6	8.0	7.1
	Maximum	8.2	7.6	7.7	8.7	7.4
	Std. Dev.	0.6	0.2	0.1	0.6	0.3
	Median	7.8	7.3	7.6	7.9	7.0
	Coeff. Var.	8.0	2.8	1.3	7.6	3.7
SO_4,	Minimum	0**	49	191	33	158
mg/L	Mean	1	53	192	36	163
	Maximum	1	55	194	38	169
	Std. Dev.	1	3	2	3	6
	Median	1	54	192	37	161
	Coeff. Var.	87	6	1	7	3
TDS,	Minimum	332	464	546	364	396
mg/L	Mean	365	509	555	396	449
	Maximum	426	570	568	426	482
	Std. Dev.	53	55	11	31	47
	Median	336	494	552	398	470
	Coeff. Var.	15	11	2	8	10
TOC,	Minimum	1	0**	1	0**	1
mg/L	Mean	1	1	1	0	1
	Maximum	2	1	1	1	2
	Std. Dev.	1	1	0	1	1
	Median	1	1	1	0	1
	Coeff. Var.	43	87	0	173	43

*For purposes of statistical evaluation, fecal coliform values less than 1 were set equal to 1.

**A zero value indicates that the test result was below the detection limit (DL). The DLs for sulfate and total organic carbon are 0.4 mg/L and 0.3 mg/L, respectively.

TABLE 5: SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–20 THROUGH QC–24

Parameter		Well Number				
		QC–20**	QC–21	QC–22	QC–23	QC–24
Cl,	Minimum	—	16	14	19	26

TABLE 5 (Continued): SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–20 THROUGH QC–24

Parameter		Well Number				
		QC–20**	QC–21	QC–22	QC–23	QC–24
pH	Minimum	—	7.5	7.5	7.6	7.5
	Mean	—	7.5	7.5	7.8	7.6
	Maximum	—	7.6	7.6	7.9	7.8
	Std. Dev.	—	0.1	0.1	0.1	0.1
	Median	—	7.5	7.5	7.8	7.6
	Coeff. Var.	—	0.8	0.8	1.3	1.4
SO_4, mg/L	Minimum	—	0***	2	0***	0***
	Mean	—	1	2	1	1
	Maximum	—	1	2	1	5
	Std. Dev.	—	1	0	1	2
	Median	—	1	2	1	1
	Coeff. Var.	—	87	0	110	140
TDS, mg/L	Minimum	—	256	179	292	212
	Mean	—	321	240	332	257
	Maximum	—	358	290	352	288
	Std. Dev.	—	57		-	0 .

TABLE 6: SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–25 THROUGH QC–29

Parameter		Well Number				
		QC–25	QC–26	QC–27	QC–28	QC–29
Cl, mg/L	Minimum	14	11	32	13	59
	Mean	15	12	32	19	71
	Maximum	16	12	33	29	88
	Std. Dev.	1	0.41	1	9	11
	Median	14	12	32	16	69
	Coeff. Var.	8	3	2	44	15
Cond., µmhos/cm	Minimum	215	218	256	234	475
	Mean	247	305	282	272	639
	Maximum	268	374	318	311	737
	Std. Dev.	28	58	32	39	99
	Median	257	304	271	271	663
	Coeff. Var.	11	19	11	14	16
FC,* cfu/100 mL	Minimum	1	1	1	1	1
	Geo. Mean	1	1	1	1	1
	Maximum	1	1	1	1	1
	Geo. Std. Dev.	0	0	0	0	0
	Median	1	1	1	1	1
	Coeff. Var.	0	0	0	0	0
Hard., as $CaCO_3$, mg/L	Minimum	17	6	23	15	149
	Mean	18	7	25	16	162
	Maximum	19	7	26	17	177
	Std. Dev.	1	1	2	1	13
	Median	18	7	26	16	156
	Coeff. Var.	6	8	7	6	8
NH_4^+–N, mg/L	Minimum	0.10	0.00**	0.11	0.01	0.35
	Mean	0.13	0.04	0.13	0.03	0.48
	Maximum	0.16	0.07	0.16	0.06	0.54
	Std. Dev.	0.03	0.03	0.03	0.03	0.07
	Median	0.14	0.05	0.13	0.03	0.49
	Coeff. Var.	22.91	66.88	18.87	75.50	15.62

TABLE 6 (Continued): SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–25 THROUGH QC–29

Parameter		Well Number				
		QC–25	QC–26	QC–27	QC–28	QC–29
pH	Minimum	7.5	7.5	7.5	7.6	7.0
	Mean	7.7	7.8	7.6	7.7	7.5
	Maximum	7.9	8.0	7.7	7.8	7.8
	Std. Dev.	0.2	0.2	0.1	0.1	0.3
	Median	7.7	7.8	7.6	7.8	7.5
	Coeff. Var.	2.6	2.4	1.3	1.5	3.9
SO_4, mg/L	Minimum	0**	0**	0**	0**	90
	Mean	1	1	0	1	97
	Maximum	1	2	1	1	106
	Std. Dev.	1	1	1	1	7
	Median	1	1	0	1	97
	Coeff. Var.	87	63	173	87	8
TDS, mg/L	Minimum	178	228	248	252	552
	Mean	223	276	256	261	570
	Maximum	246	298	266	272	608
	Std. Dev.	39	25	9	10	22
	Median	244	280	254	260	564
	Coeff. Var.	17	9	4	4	4
TOC, mg/L	Minimum	1	0**	1	1	1
	Mean	1	1	1	2	1
	Maximum	1	1	1	2	1
	Std. Dev.	0	1	0	1	0
	Median	1	1	1	2	1
	Coeff. Var.	0	77	0	35	0

*For purposes of statistical evaluation, fecal coliform values less

TABLE 7: SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–30 THROUGH QC–34

Parameter		Well Number				
		QC–30	QC–31	QC–32	QC–33**	QC–34**
Cl, mg/L	Minimum	14	21	28	—	—
	Mean	15	26	28	—	—
	Maximum	16	28	28	—	—
	Std. Dev.	1	3	0	—	—
	Median	15	27	28	—	—
	Coeff. Var.	6	11	0	—	—
Cond., µmhos/cm	Minimum	481	494	545	—	—
	Mean	509	638	545	—	—
	Maximum	532	706	545	—	—
	Std. Dev.	22	83	0	—	—
	Median	512	669	545	—	—
	Coeff. Var.	4	13	0	—	—
FC,* cfu/100 mL	Minimum	1	1	1	—	—
	Geo. Mean	1	1	1	—	—
	Maximum	1	1	1	—	—
	Geo. Std. Dev.	0	0	0	—	—
	Median	1	1	1	—	—
	Coeff. Var.	0	0	0	—	—
Hard., as $CaCO_3$, mg/L	Minimum	57	230	46	—	—
	Mean	60	245	46	—	—
	Maximum	63	253	46	—	—
	Std. Dev.	3	9	0	—	—
	Median	60	246	46	—	—
	Coeff. Var.	4	4	0	—	—
NH_4^+–N, mg/L	Minimum	0.06	0.78	0.63	—	—
	Mean	0.09	0.92	0.63	—	—
	Maximum	0.11	1.03	0.63	—	—
	Std. Dev.	0.02	0.09	0.00	—	—
	Median	0.10	0.94	0.63	—	—
	Coeff. Var.	24.00	9.82	0.00	—	—

TABLE 7 (Continued): SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–30 THROUGH QC–34

Parameter		Well Number				
		QC–30	QC–31	QC–32	QC–33**	QC–34**
pH	Minimum	7.2	7.3	7.9	—	—
	Mean	7.4	7.5	7.9	—	—
	Maximum	7.5	7.7	7.9	—	—
	Std. Dev.	0.2	0.2	0.0	—	—
	Median	7.5	7.4	7.9	—	—
	Coeff. Var.	2.0	2.0	0.0	—	—
SO_4						

TABLE 8: SUMMARY STATISTICS OF THE 2005 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: WELLS QC–35 THROUGH QC–37

Parameter		Well Number		
		QC–35*	QC–36*	QC–37*
Cl, mg/L	Minimum	—	—	—
	Mean	—	—	—
	Maximum	—	—	—
	Std. Dev.	—	—	—
	Median	—	—	—
	Coeff. Var.	—	—	—
Cond., µmhos/cm	Minimum	—	—	—
	Mean	—	—	—
	Maximum	—	—	—
	Std. Dev.	—	—	—
	Median	—	—	—
	Coeff. Var.	—	—	—
FC, cfu/100 mL	Minimum	—	—	—
	Geo. Mean	—	—	—
	Maximum	—	—	—
	Geo. Std. Dev.	—	—	—
	Median	—	—	—
	Coeff. Var.	—	—	—
Hard., as $CaCO_3$, mg/L	Minimum	—	—	—
	Mean	—	—	—
	Maximum	—	—	—
	Std. Dev.	—	—	—
	Median	—	—	—
	Coeff. Var.	—	—	—
NH_4^+—N, mg/L	Minimum	—	—	—
	Mean	—	—	—
	Maximum	—	—	—
	Std. Dev.	—	—	—
	Median	—	—	—
	Coeff. Var.	—	—	—

APPENDIX AI

LOCATION MAP OF GROUNDWATER OBSERVATION WELLS
OC–1 THROUGH OC–11
IN THE CALUMET TUNNEL SYSTEM

FIGURE AI–1

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APPENDIX AII

2005 GROUNDWATER LEVEL ELEVATION DATA FOR OBSERVATION WELLS OC–1 THROUGH OC–11 IN THE CALUMET TUNNEL SYSTEM

TABLE AII–1: 2005 GROUNDWATER LEVEL ELEVATION* DATA FOR OBSERVATION WELLS OC–1 THROUGH OC–11 IN THE CALUMET TUNNEL SYSTEM

Date	Observation Well					
	OC–1	OC–2	OC–3	OC–4	OC–5	OC–6
	feet					
1/12/05	-25.8	-22.6	-151.3	-170.2	-160.3	-78.7
1/28/05	-25.8	-21.1	-148.3	-167.2	-148.3	-74.2
2/4/05	-25.8	-23.6	-150.3	-168.2	-149.3	-73.7
2/24/05	-22.8	-20.6	-138.3	-167.2	***	-73.7
3/4/05	-23.8	-21.6	-144.3	-167.2	-149.8	-75.7
3/18/05	-24.8	-22.1	-150.3	-167.2	-149.3	-80.7
4/15/05	-26.3	-23.1	-152.3	-168.2	-150.8	-81.7
5/6/05	-26.8	-22.6	-152.3	-171.2	-151.3	-83.7
5/20/05	-26.8	-22.6	-152.3	-167.7	-150.3	-80.7
6/3/05	-26.8	-22.6	-153.3	-168.2	-153.3	-140.7
6/17/05	-27.3	-22.6	-152.8	-167.7	-150.8	-80.7
7/1/05	-26.8	-20.1	-138.3	-164.2	-140.3	-76.7
7/15/05	-28.8	-23.6	-153.3	-168.2	-151.3	-80.7
8/5/05	-27.8	-23.6	-153.3	-168.2	-151.3	-79.7
8/12/05	-28.8	-22.6	-152.3	-168.2	-152.3	-79.7
8/26/05	-28.8	-24.6	-152.3	-167.2	-150.3	-78.7
9/9/05	-27.8	-23.6	-152.3	-167.2	-151.3	-78.7
9/26/05	-28.8	-23.6	-152.3	-166.2	-151.3	-78.7
10/7/05	-28.3	-23.6	-152.3	-168.2	-151.3	-78.7
10/21/05	-28.3	-23.6	-152.3	-168.2	-151.8	-78.7
10/28/05	-28.8	-24.6	-153.3	-168.2	-152.3	-75.7
11/18/05	-28.3	-23.6	-152.3	-167.7	-151.8	-79.2
11/29/05	-28.8	-23.6	-157.3	-168.2	-151.3	-78.2
12/2/05	-28.8	-23.6	-152.3	-167.7	-151.8	-79.2
12/16/05	-28.8	*****	-150.3	*****	-149.3	-77.7
Minimum	-28.8	-24.6	-157.3	-171.2	-160.3	-140.7
Mean	-27.2	-22.9	-150.8	-167.8	-150.9	-81.0
Maximum	-22.8	-20.1	-138.3	-164.2	-140.3	-73.7

TABLE AII–1 (Continued): 2005 GROUNDWATER LEVEL ELEVATION* DATA FOR OBSERVATION WELLS OC–1 THROUGH OC–11 IN THE CALUMET TUNNEL SYSTEM

Date	Observation Well				
	OC–7	OC–8	OC–9	OC–10	OC–11
	feet				
1/12/05	-210.0	**	-212.7	-217.0	-222.3
1/28/05	-205.0	-173.9	-211.2	-216.5	-221.3
2/4/05	-205.0	-174.9	-211.7	-220.0	-222.3

APPENDIX AIII

LOCATION MAP OF GROUNDWATER QUALITY MONITORING WELLS
QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37
IN THE CALUMET TUNNEL SYSTEM

FIGURE AIII–1

APPENDIX AIV

2005 GROUNDWATER QUALITY DATA FOR MONITORING WELLS
QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37
IN THE CALUMET TUNNEL SYSTEM

TABLE AIV–1: 2005 pH, CONDUCTIVITY, TEMPERATURE, HARDNESS, AMMONIA NITROGEN, AND CHLORIDE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Well	Date of Sampling	pH[1]	Cond.[1] µmhos/cm	Temp. °C	Hard. as $CaCO_3$ mg/L	NH_4^+–N mg/L	Cl mg/L
QC–1	2/16/05	7.2	431	12	525	0.43	64
QC–1	5/19/05	7.6	862	13	531	0.35	64
QC–1	6/30/05	7.5	672	14	548	0.35	63
QC–1	8/25/05	7.5	949	13	529	0.36	61
QC–1	11/17/05	7.4	293	11	504	0.29	67
QC–1	12/15/05	Well could not be sampled					
QC–2	2/16/05	6.9	356	12	88	0.68	44
QC–2	5/19/05	7.4	490	13	96	0.99	44
QC–2	6/30/05	7.5	395	15	86	0.70	36
QC–2	8/25/05	7.2	481	15	77	0.40	30
QC–2	11/17/05	7.7	261	10	82	0.67	39
QC–2	12/15/05	7.4	442	12	78	0.21	36
QC–2.1	5/19/05	7.6	674	13	62	0.57	36
QC–2.1	6/30/05	7.6	610	17	55	0.42	34
QC–2.1	11/17/05	7.5	356	11	60	0.56	35
QC–2.2	2/16/05	7.4	361	12	41	0.54	16
QC–2.2	5/19/05	7.7	437	13	43	0.43	14
QC–2.2	11/17/05	7.6	261	11	41	0.25	15
QC–3	1/27/05	6.9	367	11	65	0.43	12
QC–3	6/2/05	7.6	495	13	63	0.39	12
QC–3	9/22/05	7.4	330	13	65	0.34	11
QC–4	1/27/05	7.1	439	10	10	0.19	10
QC–4	6/2/05	7.4	541	12	11	0.13	11
QC–4	9/22/05	7.6	340	12	10	0.13	11
QC–5	1/27/05	7.0	512	11	10	0.16	27
QC–5	3/3/05	6.8	720	12	10	0.15	30
QC–5	5/5/05	7.9	505	13	9	0.15	28

TABLE AIV–1 (Continued): 2005 pH, CONDUCTIVITY, TEMPERATURE, HARDNESS, AMMONIA NITROGEN, AND CHLORIDE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Well	Date of Sampling	pH[1]	Cond.[1] µmhos/cm	Temp. °C	Hard. as $CaCO_3$ mg/L	NH_4^+–N mg/L	Cl mg/L
QC–6	1/27/05	7.1	436	11	19	0.36	16
QC–6	6/2/05	7.4	617	13	19	0.30	15
QC–6	9/22/05	7.5	417	8	9	0.29	16
QC–7	1/27/05	7.1	509	11	15	0.27	12
QC–7	3/3/05	7.1	584	12	12	0.25	12
QC–7	7/14/05	7.6	550	14	10	0.28	11
QC–9	1/27/05	7.4	380	12	58	0.59	10
QC–9	6/2/05	7.5	397	13	60	0.21	10
QC–9	9/22/05	7.4	296	14	61	0.18	9
QC–10	1/13/05	7.7	369	12	11	0.05	31
QC–10	3/30/05	7.6	488	13	12	0.09	29
QC–10	7/13/05	7.6	376	13	13	0.10	36
QC–11	1/20/05	7.1	347	12	22	0.11	22
QC–11	3/30/05	7.6	350	13	22	0.12	21
QC–11	7/13/05	7.8	289	13	19	0.19	22
QC–12	1/20/05	6.9	1069	11	115	0.26	37
QC–12	3/30/05	7.3	1065	13	146	0.25	47
QC–12	7/13/05	7.5	701	14	200	0.30	40
QC–13	1/20/05	7.1	512	10	33	0.19	46
QC–13	3/30/05	7.4	555	13	34	0.18	48
QC–13	7/13/05	7.6	446	13	35	0.17	43
QC–14	2/16/05	7.1	475	12	111	0.27	88
QC–14	7/28/05	7.6	490	13	106	0.19	95
QC–14	9/15/05	7.7	852	13	105	0.17	85
QC–15	2/16/05	7.0	340	12	14	0.17	20
QC–15	7/28/05	8.2	292	13	13	0.19	21
QC–15	9/15/05	7.8	393	13	13	0.18	20

TABLE AIV–1 (Continued): 2005 pH, CONDUCTIVITY, TEMPERATURE, HARDNESS, AMMONIA NITROGEN, AND CHLORIDE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Well	Date of Sampling	pH[1]	Cond.[1] µmhos/cm	Temp. °C	Hard. as $CaCO_3$ mg/L	NH_4^+–N mg/L	Cl mg/L
QC–16	1/27/05	7.2	587	11	75	0.04	22
QC–16	5/5/05	7.6	370	13	74	0.07	21
QC–16	9/22/05	7.3	354	14	76	0.04	21
QC–17	6/30/05	7.6	495	13	170	0.29	13
QC–17	7/28/05	7.5	352	12	188	0.28	14
QC–17	9/15/05	7.7	643	12	187	0.27	13
QC–18	6/30/05	7.5	404	13	7	0.08	8
QC–18	7/28/05	8.7	332	12	7	0.09	8
QC–18	9/15/05	7.9	479	12	7	0.09	8
QC–19	1/27/05	7.0	565	11	114	0.27	5
QC–19	3/3/05	6.9	574	12	119	0.28	5
QC–19	7/14/05	7.4	582	13	119	0.28	4
QC–20	1/13/05	Well could not be sampled					
QC–20	3/8/05	Well could not be sampled					
QC–20	5/18-11494.5(W)89.5(e)-0.5(ll could not be sam)8.5(pled)]TJ 0 -11 0 g (4 814 me)-0.5(0 0 3e)-0.4(						

TABLE AIV–1 (Continued): 2005 pH, CONDUCTIVITY, TEMPERATURE, HARDNESS, AMMONIA NITROGEN, AND CHLORIDE DATA FOR WATER QUALITY MONITORING

TABLE AIV–1 (Continued): 2005 pH, CONDUCTIVITY, TEMPERATURE, HARDNESS, AMMONIA NITROGEN, AND CHLORIDE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Well	Date of Sampling	pH[1]	Cond.[1] µmhos/cm	Temp. °C	Hard. as $CaCO_3$ mg/L	NH_4^+–N mg/L	Cl mg/L
QC–30	1/6/05			Well could not be sampled			
QC–30	3/23/05			Well could not be sampled			
QC–30	5/5/05	7.5	503	11	60	0.11	14
QC–30	7/20/05	7.5	532	13	63	0.10	15
QC–30	9/1/05	7.5	521	14	59	0.09	14
QC–30	11/10/05	7.2	481	11	57	0.06	16
QC–31	1/6/05	7.7	494	12	250	1.03	27
QC–31	3/23/05			Well could not be sampled			
QC–31	5/5/05	7.4	648	13	246	0.95	28
QC–31	7/20/05	7.5	669	14	244	0.92	28
QC–31	9/1/05	7.3	706	13	253	0.78	25
QC–31	11/10/05	7.4	672	12	230	0.94	21
QC–32	1/6/05	7.9	545	11	46	0.63	28
QC–32	3/23/05			Well could not be sampled			
QC–32	5/5/05			Well could not be sampled			
QC–32	7/20/05			Well could not be sampled			
QC–32	9/1/05			Well could not be sampled			
QC–32	11/10/05			Well could not be sampled			
QC–33	1/6/05			Well could not be sampled			
QC–33	3/3/05			Well could not be sampled			
QC–33	5/5/05			Well could not be sampled			
QC–33	7/14/05			Well could not be sampled			
QC–33	9/22/05			Well could not be sampled			
QC–33	10/27/05			Well could not be sampled			
QC–34	1/6/05			Well could not be sampled			
QC–34	3/24/05			Well could not be sampled			
QC–34	5/12/05			Well could not be sampled			
QC–34	7/21/05			Well could not be sampled			
QC–34	9/15/05			Well could not be sampled			
QC–34	11/10/05			Well could not be sampled			

TABLE AIV–1 (Continued): 2005 pH, CONDUCTIVITY, TEMPERATURE, HARDNESS, AMMONIA NITROGEN, AND CHLORIDE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Well	Date of Sampling	pH[1]	Cond.[1] µmhos/cm	Temp. °C	Hard. as $CaCO_3$ mg/L	NH_4^+–N mg/L	Cl mg/L
QC–35	1/6/05			Well could not be sampled			
QC–35	3/24/05			Well could not be sampled			
QC–35	5/12/05			Well could not be sampled			
QC–35	7/21/05			Well could not be sampled			
QC–35	9/15/05			Well could not be sampled			
QC–35	11/10/05			Well could not be sampled			
QC–36	1/6/05			Well could not be sampled			
QC–36	3/24/05			Well could not be sampled			
QC–36	5/12/05			Well could not be sampled			
QC–36	7/21/05			Well could not be sampled			
QC–36	9/15/05			Well could not be sampled			
QC–36	11/10/05			Well could not be sampled			
QC–37	1/6/05			Well could not be sampled			
QC–37	3/24/05			Well could not be sampled			
QC–37	5/12/05			Well could not be sampled			
QC–37	7/21/05			Well could not be sampled			
QC–37	9/15/05			Well could not be sampled			
QC–37	11/10/05			Well could not be sampled			

[1]Unfiltered samples, all others were filtered through 0.45 µm membrane.
[2]Zero values indicate that the test result was below the detection limit (DL). The DL for ammonia nitrogen is 0.02 mg/L.

TABLE AIV–2: 2005 SULFATE, TOTAL ORGANIC CARBON,

TABLE AIV–2 (Continued): 2005 SULFATE, TOTAL ORGANIC CARBON, TOTAL DISSOLVED SOLIDS, FECAL COLIFORM, WATER ELEVATION, AND RECHARGE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Well	Date of Sampling	SO_4 mg/L	TOC mg/L	TDS mg/L	FC[1] cfu/100 mL	Water Elevation[2] Feet	Recharge[3] Hours
QC–6	1/27/05	14	3	488	<1	-202	<48
QC–6	6/2/05	14	2	526	<1	-215	<48
QC–6	9/22/05	12	1	446	<1	-217	<48
QC–7	1/27/05	4	2	392	<1	-154	<48
QC–7	3/3/05	2	2	346	<1	-165	<48
QC–7	7/14/05	2	2	418	<1	-174	<48

TABLE AIV–2 (Continued): 2005 SULFATE, TOTAL ORGANIC CARBON, TOTAL DISSOLVED SOLIDS, FECAL COLIFORM, WATER ELEVATION, AND RECHARGE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Well	Date of Sampling	SO_4 mg/L	TOC mg/L	TDS mg/L	FC[1] cfu/100 mL	Water Elevation[2] Feet	Recharge[3] Hours
QC–15	2/16/05	1	2	336	<1	-218	<48
QC–15	7/28/05	0[4]	1	332	<1	-227	<48
QC–15	9/15/05	1	1	426	<1	-225	<48
QC–16	1/27/05	49	1	494	<1	-194	<48
QC–16	5/5/05	54	1	570	<1	-195	<48
QC–16	9/22/05	55	0[4]	464	<1	-186	<48
QC–17	6/30/05	191	1	552	<1	-156	<48
QC–17	7/28/05	194	1	546	<1	-156	<48
QC–17	9/15/05	192	1	568	<1	-157	<48
QC–18	6/30/05	38	1	398	<1	-204	<48
QC–18	7/28/05	37	0[4]	364	<1	-203	<48
QC–18	9/15/05	33	0[4]	426	<1	-205	<48
QC–19	1/27/05	161	1	470	<1	-87	<48
QC–19	3/3/05	158	2	396	<1	-103	<48
QC–19	7/14/05	169	1	482	<1	-118	<48
QC–20	1/13/05			Well could not be sampled			
QC–20	3/8/05			Well could not be sampled			
QC–20	5/18/05			Well could not be sampled			
QC–20	8/25/05			Well could not be sampled			
QC–20	11/1/05			Well could not be sampled			
QC–20	12/16/05			Well could not be sampled			
QC–21	1/13/05	1	2	358	<1	-266	<48
QC–21	3/10/05	0[4]	7	256	<1	-266	<48
QC–21	7/14/05	1	1	350	<1	-263	<48

TABLE AIV–2 (Continued): 2005 SULFATE, TOTAL ORGANIC CARBON, TOTAL DISSOLVED SOLIDS, FECAL COLIFORM, WATER ELEVATION, AND RECHARGE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Well	Date of Sampling	SO_4 mg/L	TOC mg/L	TDS mg/L	FC[1] cfu/100 mL	Water Elevation[2] Feet	Recharge[3] Hours
QC–22	1/13/05	2	2	252	<1	-265	<48
QC–22	3/10/05	2	2	179	<1	-265	<48
QC–22	7/14/05	2	1	290	<1	-264	<48
QC–23	1/13/05	0[4]	1	330	<1	-240	<48
QC–23	3/10/05	0[4]	2	292	<1	-241	<48
QC–23	5/18/05	0[4]	1	330	<1	-240	<48
QC–23	7/14/05	1	1	348	<1	-236	<48
QC–23	8/25/05	1	0[4]	340	<1	-240	<48
QC–23	11/3/05	1	0[4]	352	<1	-240	<48
QC–24	1/13/05	0[4]	1	256	<1	-234	<48
QC–24	3/10/05	5	1	212	<1	-234	<48
QC–24	5/18/05	1	1	274	<1	-233	<48
QC–24	7/14/05	1	1	248	<1	-229	<48
QC–24	8/25/05	1	0[4]	266	<1	-233	<48
QC–24	11/3/05	0[4]	0[4]	288	<1	-233	<48
QC–25	1/13/05	1	1	244	<1	-235	<48
QC–25	3/17/05	0[4]	1	178	<1	-236	<48
QC–25	7/14/05	1	1	246	<1	-235	<48
QC–26	1/13/05	1	1	284	<1	-228	<48
QC–26	3/17/05	0[4]	1	228	<1	-228	<48
QC–26	5/19/05	1	1	294	<1	-227	<48
QC–26	7/14/05	1	1	298	<1	-228	<48
QC–26	9/1/05	2	0[4]	274	<1	-225	<48
QC–26	11/3/05	1	0[4]	276	<1	-227	<48
QC–27	1/13/05	0[4]	1	266	<1	-205	<48
QC–27	3/17/05	0[4]	1	248	<1	-206	<48
QC–27	7/14/05	1	1	254	<1	-207	<48

TABLE AIV–2 (Continued): 2005 SULFATE, TOTAL ORGANIC CARBON, TOTAL DISSOLVED SOLIDS, FECAL COLIFORM, WATER ELEVATION, AND RECHARGE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Date of	SO_4	TOC	TDS	FC[1]	Water Elevation[2]	Recp -0Lf BT 6NELTHR

TABLE AIV–2 (Continued): 2005 SULFATE, TOTAL ORGANIC CARBON, TOTAL DISSOLVED SOLIDS, FECAL COLIFORM, WATER ELEVATION, AND RECHARGE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Well	Date of Sampling	SO_4 mg/L	TOC mg/L	TDS mg/L	FC[1] cfu/100 mL	Water Elevation[2] Feet	Recharge[3] Hours
QC–33	1/6/05			Well could not be sampled			
QC–33	3/3/05			Well could not be sampled			
QC–33	5/5/05			Well could not be sampled			
QC–33	7/14/05			Well could not be sampled			
QC–33	9/22/05			Well could not be sampled			
QC–33	10/27/05			Well could not be sampled			
QC–34	1/6/05			Well could not be sampled			
QC–34	3/24/05			Well could not be sampled			
QC–34	5/12/05			Well could not be sampled			
QC–34	7/21/05			Well could not be sampled			
QC–34	9/15/05			Well could not be sampled			
QC–34	11/10/05			Well could not be sampled			
QC–35	1/6/05			Well could not be sampled			
QC–35	3/24/05			Well could not be sampled			
QC–35	5/12/05			Well could not be sampled			
QC–35	7/21/05			Well could not be sampled			
QC–35	9/15/05			Well could not be sampled			
QC–35	11/10/05			Well could not be sampled			
QC–36	1/6/05			Well could not be sampled			
QC–36	3/24/05			Well could not be sampled			
QC–36	5/12/05			Well could not be sampled			
QC–36	7/21/05			Well could not be sampled			
QC–36	9/15/05			Well could not be sampled			
QC–36	11/10/05			Well could not be sampled			
QC–37	1/6/05			Well could not be sampled			
QC–37	3/24/05			Well could not be sampled			
QC–37	5/12/05			Well could not be sampled			
QC–37	7/21/05			Well could not be sampled			

TABLE AIV–2 (Continued): 2005 SULFATE, TOTAL ORGANIC CARBON, TOTAL DISSOLVED SOLIDS, FECAL COLIFORM, WATER ELEVATION, AND RECHARGE DATA FOR WATER QUALITY MONITORING WELLS QC–1, QC–2, QC–2.1, QC–2.2, QC–3 THROUGH QC–7, AND QC–9 THROUGH QC–37 IN THE CALUMET TUNNEL SYSTEM

Date of	SO_4	Water