APPENDIX M

TDCS PROBE HOLE INSTALLATION DATA

Contents of Appendix M

SUMMARY OF PROBE HOLE DRILLING AND SAMPLING

This summary reflects conditions as of December 2010 regarding Probe Holes PH-1 and PH-2 drilled from Work room 2-1 in TDCS Tunnel 2. Tables P-1 and P-2 summarize the drilling data and PCB sampling and testing results respectively.

Summary of Probe Hole PH-1

Between December 10 and 15, 2008, probe hole PH-1 (formerly known as P-1) was drilled from Workroom 2-1. The purpose of drilling the probe hole was to evaluate the extent of DNAPL beyond the end of Tunnel 2. The hole was drilled 300 feet in a southerly direction with an upward slope of approximately 2 degrees (refer to Figure PH-1). The probe hole was drilled by the diamond core method using HQ-size coring equipment. Continuous rock core was collected during the drilling of PH-1. Groundwater and crushed rock core samples were collected and tested for PCB. The PH-1 boring log is attached.

The work performed for the installation of probe hole PH-1 included:

- Core drilling a nominal 4-inch diameter hole,
- Observation of drilling for changes in conditions (water, DNAPL etc.)
- Core logging and evaluation of joints and fracture
- Preparation and storage in wooden core boxes
- Installing borehole packer and stem pipe with valve at the end of each day
- Sampling of accumulated groundwater from borehole packer valve at beginning of each day
- Testing of groundwater sample for PCB
- Decontamination and rinse blank PCB testing of borehole packer, stem piping and valve prior to each day of use
- Selection, sampling, preparation and testing of rock core samples for PCB
- Final fit-out of the probe hole well head with a PVC pipe, 3 inch diameter, DNAPL collection and sampling reservoir and tubing drain to tunnel gutter

In the effort to collect daily water samples from PH-1, during the drilling, a packer and pipe fitted with a valve were installed to isolate the interval of the borehole drilled that day. The

following morning the valve was opened to collect groundwater that had accumulated in the packed-off interval of the borehole. Only one section of the borehole (250 to 300 feet) yielded a water sample. Because no water samples could be collected from the first 250 feet of the borehole, rock core samples were collected for PCB analyses. These rock core samples were collected from depths where, based on examination of the core, there appeared to be open fractures. Table P-2 summarizes the results of the PCB analyses of water and rock core samples. During the drilling of PH-1 there were no observations, visual or olfactory, that indicated PCB was present on the rock core or in the drill return water. However, on December 16, one day after the completion of probe hole drilling, DNAPL was observed flowing from the borehole into Workroom 2-1.

On December 30, 2008, a reservoir was installed at the collar of PH-1 to collect the DNAPL flowing from the hole. At the time of the DNAPL reservoir installation, approximately 500 ml of DNAPL that had accumulated in a low spot in the cross drain in Workroom 2-1 was collected. Between December 30 and January 30, 2008, DNAPL recovery from PH-1 has been at a rate of approximately 0.8 L per week.

DNAPL was collected from PH-1 during Phase Three construction when access was readily available. During that time DNAPL collection from PH-1 ranged from 0.25 to 0.95 liters per week, and the rate of inflow of groundwater and DNAPL was declining by the end of Phase Three construction. On May 14, 2009, the groundwater flow from PH-1 was measured, to be one drop per minute. The DNAPL collection reservoir was left connected at the collar of the hole and re-fitted with a plastic tube draining all flow directly to the Tunnel 2 gutter.

On September 16, 2010 700 ml of DNAPL was collected and the valve closed to allow DNAPL to continue to separate from groundwater and accumulate in the reservoir.

Summary of Probe Hole PH-2

Probe hole PH-2 was drilled from workroom 2-1 between May 6 and 11, 2009, to the full length of 300 feet and left with a continuous open interval in rock from the end of the stainless steel casing (at 2.5 ft depth) to the end of the hole. Probe hole PH-2 was drilled to evaluate the extent of DNAPL beyond the end of Tunnel 2, similar to probe hole PH-1. PH-2 was drilled 300 feet in a southerly direction (approximately 30° southwest of PH-1) with an upward slope of

approximately 5 degrees from horizontal (refer to Figure PH-2). The probe hole was drilled by the diamond core method using HQ-size coring equipment. Continuous rock core was collected during the drilling of PH-2. Groundwater and crushed rock core samples were collected and tested for PCB. The PH-2 boring log is attached.

The work performed during installation of probe hole PH-2 included:

- Installation of a 6-inch diameter stainless steel collar casing grouted in an 8-inch diameter core hole;
- Core drilling a nominal 4-inch diameter hole;
- Observation of drilling for changes in conditions (water, DNAPL etc.);
- Core logging and evaluation of joints and fracture;
- Preparation and storage in wooden core boxes;
- Installing borehole packer and stem pipe with valve at the end of each day;
- Sampling of accumulated groundwater from borehole packer valve at beginning of each day;
- Testing of groundwater sample for PCB;
- Decontamination of borehole packer, stem piping and valve prior to each day of; use including rinse blank PCB testing
- Selection, sampling, preparation and testing of rock core samples for PCB;
- Performing borehole alignment survey after every 50 feet of drilling;
- Verification of final borehole depth based on evaluation of borehole survey results; and
- Final fit-out of the probe hole well head with the stainless steel flange and 2 inch diameter ball valve and piping to tunnel gutter.

Observations for the presence of DNAPL made during the drilling of PH-2 indicated that a chemical odor was noticed when the hole was at a length of 190 feet. The driller noted possible water inflow at a depth of 189.5 feet. Sampling of the groundwater entering the borehole and the rock core for PCB analysis was conducted during the drilling of PH-2. In an effort to collect daily water samples from PH-2, during the drilling, a packer and pipe fitted with a valve were installed in the borehole to isolate the portion of the borehole drilled each day. The

following morning the valve was opened to collect water that had accumulated in the packed-off portion of the borehole. Only one section of the borehole (170 to 225 feet) yielded a water sample. Because no water samples could be collected from the first 170 feet and the last 75 feet of the borehole, rock core samples were collected for PCB analyses. These rock core samples were collected from locations where, based on examination of the core, there appeared to be open fractures. Table P-2 summarizes the results of the PCB analyses of water and rock core samples. One day after the completion of probe hole drilling, DNAPL was observed dripping from the borehole into Workroom 2-1.

The groundwater flow from PH-2 was measured on May 14, 2009, to be 5 milliliters per minute. The well head valve was left open and the flow allowed to drain through a plastic tube to the Tunnel 2 gutter drain.

PH-2 was converted to multi level vibrating wire piezometer, PZ-202, on March 3, 2010. Prior to installing the piezometer string, a small quantity of PCB oil had accumulated in the well head casing and was removed using absorbant pads. Data from PZ-202 is saved hourly via a newly installed multiplexer in workroom 1-1 and MUX cable from the multiplexer to the data logger at the top of the shaft. Tetra Tech GEO collects, saves to network, transfers to database, prepares plots and reports to NYSDEC weekly.

Table P-1 TDCS Probe Hole Summary Drilling Data

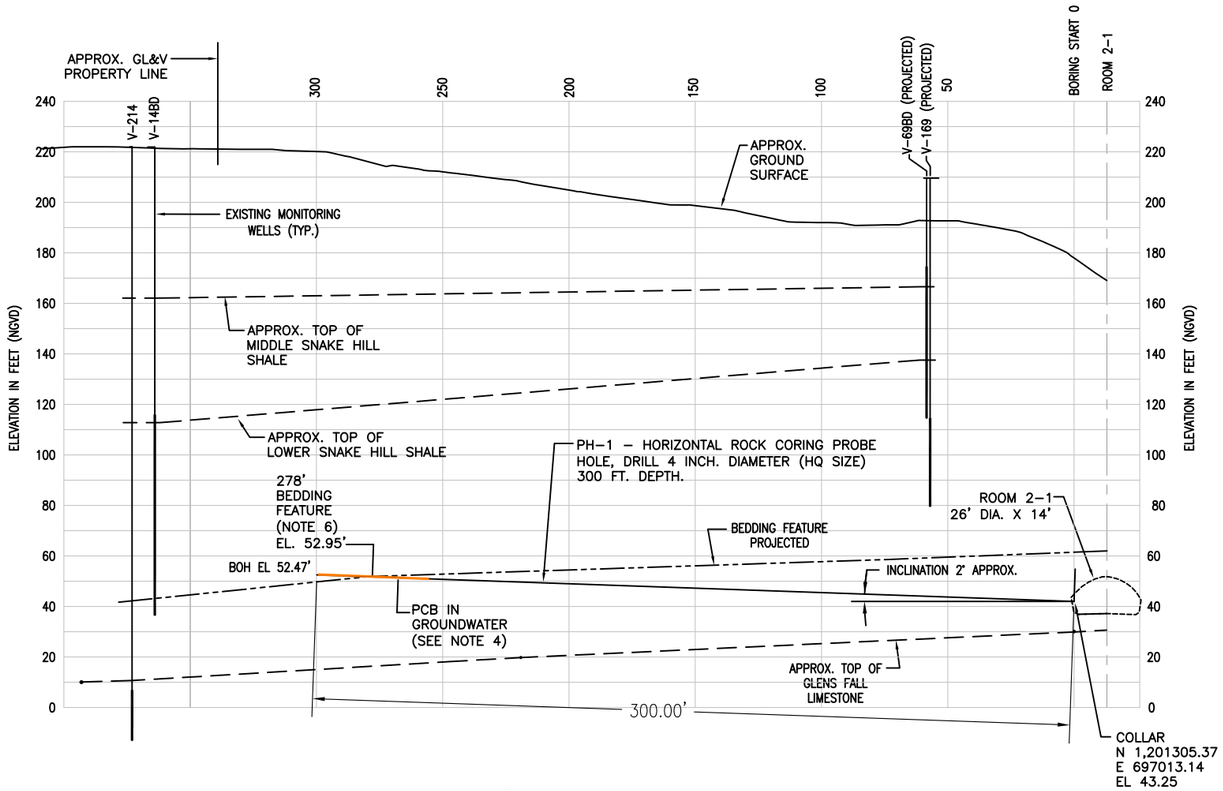
Borehole ID	Location Tunnel: Station	Azimuth (Grid)	Inclination Up From Horizontal	Drilled Length (ft)	Depth (ft)	Elevation (ft. NGVD)	Rock Unit	Initial Flow (gpm) 5/14/2009	Remarks
TUNNEL 2									
PH-1	2:2+87	220°	2°	300	0	43.25	LSHS	*	HQ Core, * water flow = 1 drop/1 minute
					300	53.72	LSHS		
PH-2	2:2+92	187.5°	5°	300	0	44.12	LSHS	*	HQ Core, * water flow = 5 milliliters/1 minute
					300	66.36	LSHS		

TABLE P-2 TDCS Probe Hole Drilling - PCB Testing Results

Probe Hole ID	Date Drilled	Drilled Interval (ft to ft)	Water Sample	Rock Sample Interval (ft to ft)	PCB Test Results (µg/L) Water	PCB Test Results (µg/g) Rock	Remarks
PH-1	12/10/2008	0 to 49.7	No	8.2	No Test	0.0678	
	12/11/2008	49.7 to 156?	No	99	No Test	0.135	
	12/12/2008	156? to 221.6	No	Not Taken	No Test	No Test	
	12/13/2008	221.6 to 255.6	No	274	No Test	3.42	
	12/15/2008	255.6 to 300	2 Liter	Not Taken	1,700,000.00	No Test	
PH-2	5/6/2009	0 to 5.5	No	Not Taken	No Test	No Test	
	5/7/2009	5.5 to 95	No	10.2 to 10.7	No Test	0.548	
	5/8/2009	95 to 170	No	147.4 to 150	No Test	0.708	
	5/9/2009	170 to 225	2 Liter	Not Taken	21,200.00	No Test	
	5/10/2009	225 to 300	No	235 to 239.4	No Test	5.03	

Notes:

1. Two one liter groundwater samples were taken and analyzed for PCBs for each sampling event.
2. "No" indicates that no groundwater had accumulated.
3. PH-2 was converted to a fully grouted multi level vibrating wire piezometer, PZ-202, on March 3, 2010. The fully grouted installation seals the hole from fluid flow, and, therefore, no DNAPL or groundwater can be collected.

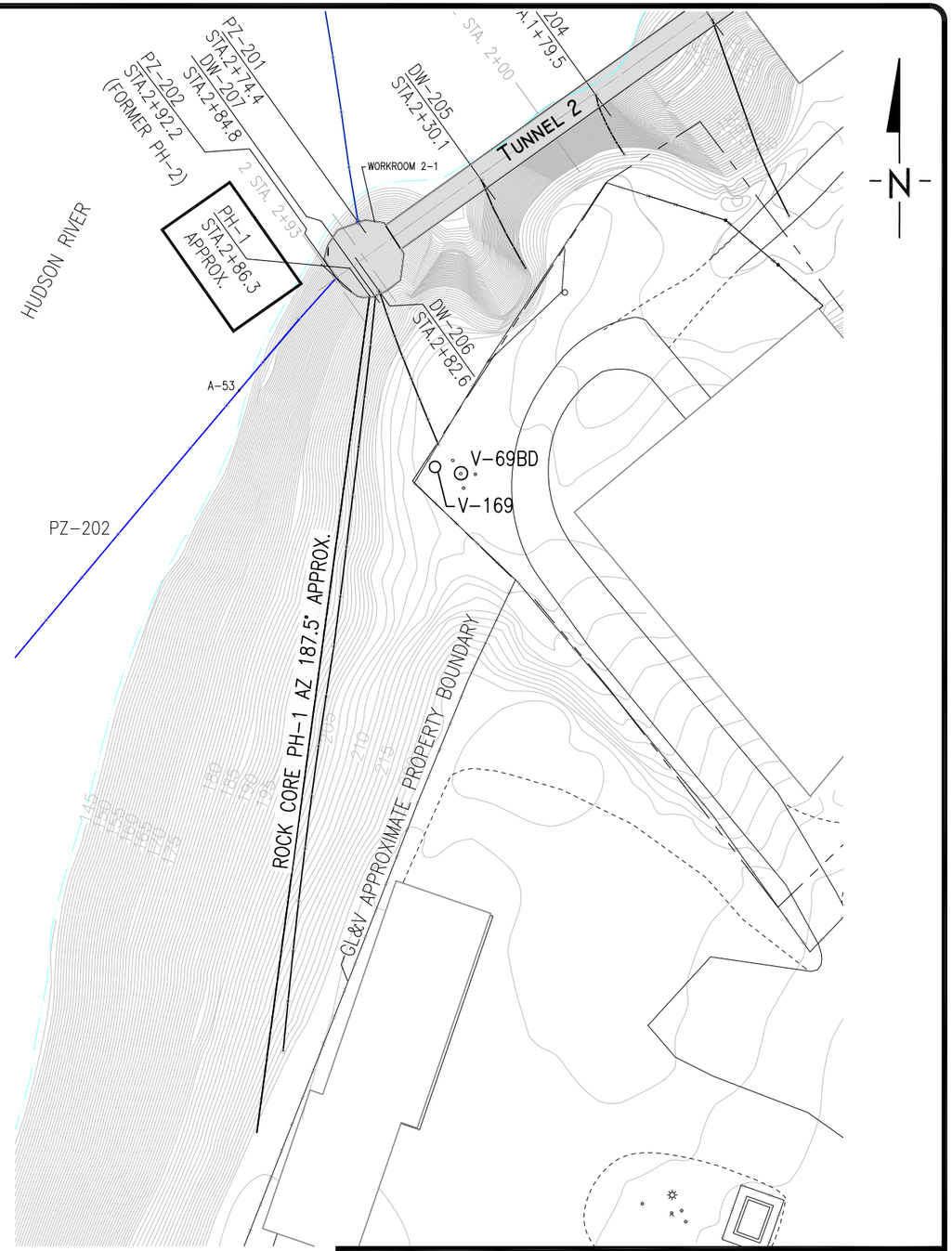


SECTION AT PH-1

0 60
Scale in feet

NOTE:

1. PROBE HOLE COLLAR LOCATION FROM SURVEY SUBMITTED MAY 2009 BY MERCO/OBAYASHI
2. PROBE HOLE ALIGNMENT AND INCLINATION BASED ON FIELD MEASUREMENTS OF DRILL RODS AT INITIAL SET UP
3. PH-1 CORED DRILLED, HQ SIZE REFER TO CORE BORING REPORT
4. PCB ENCOUNTERED IN GROUNDWATER SAMPLES COLLECTED FROM DEPTH 255.6' TO 300' ON 12/15/2008
5. WATER IN FLOW RATE: NIL (LESS THAN 0.01 GPM) AT END OF DRILLING 12/15/2008
6. BEDDING FEATURE ENCOUNTERED AT DEPTH 278'



PLAN VIEW

0 50
Scale in feet

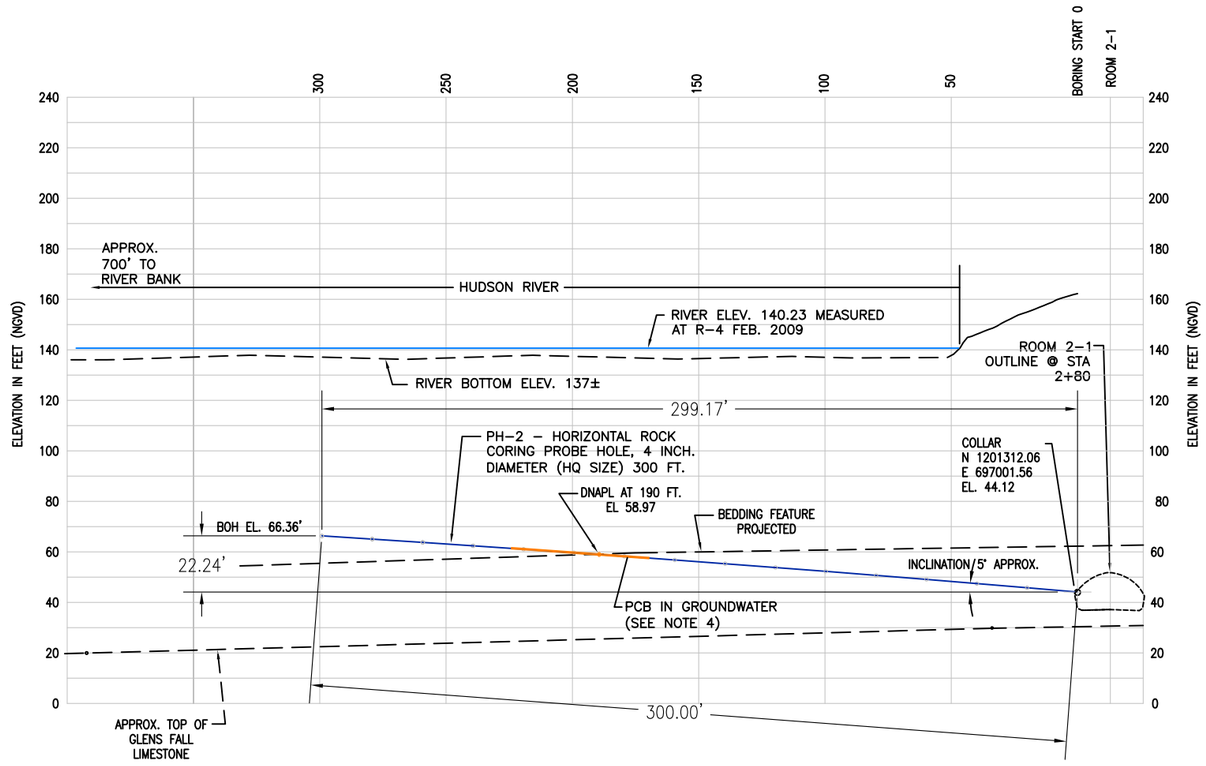
TITLE:	PROBE HOLE PH-1 TUNNEL DRAIN COLLECTION SYSTEM
LOCATION:	GE HUDSON FALLS, NEW YORK

TETRA TECH GEO

APPROVED	JFB
DRAFTED	RMK
PROJECT#	117-2204
DATE	APRIL 2011

FIGURE
PH-1

G:\GE_HUDSY 2011\4-11_HYRO_MON_RPT_AS-BUILS-FINAL_DRAIN\PIEZ\PH.DWG

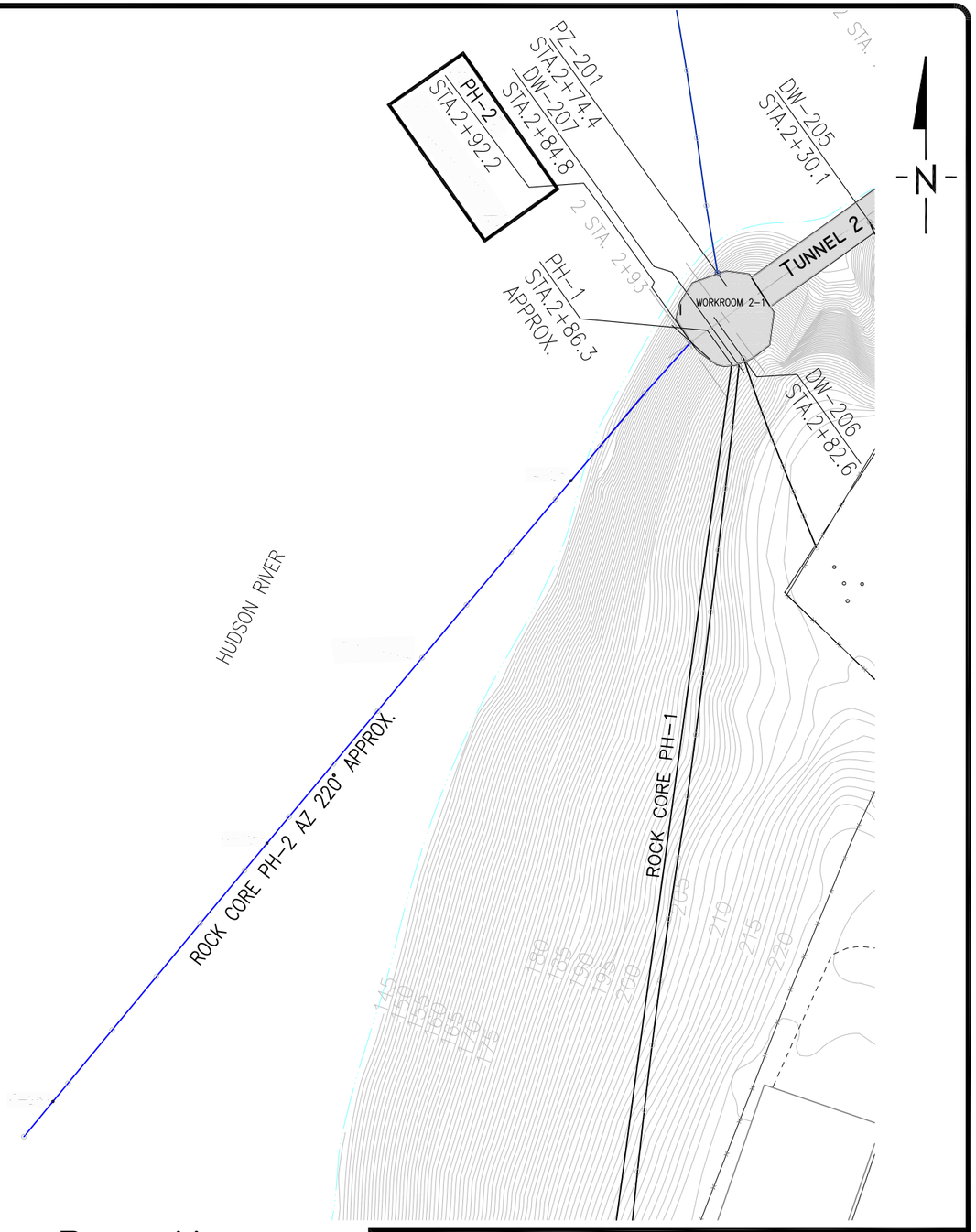


SECTION AT PH-2

0 60
Scale in feet

NOTE:

1. PROBE HOLE COLLAR LOCATION FROM SURVEY SUBMITTED MAY 2009 BY MERCO/OBAYASHI
2. PROBE HOLE ALIGNMENT AND INCLINATION BASED ON FIELD MEASUREMENTS OF DRILL RODS AT INITIAL SET UP AND BOREHOLE DEVIATION SURVEY SUBMITTED MAY 2009 BY MERCO/OBAYASHI
3. PH-2 CORED DRILLED, HQ SIZE REFER TO CORE BORING REPORT
4. PCB ENCOUNTERED IN GROUNDWATER SAMPLES COLLECTED FROM DEPTH 170' TO 225' ON 5/9/2009. DNAPL OBSERVED ON ROCK CORE AT DEPTH OF 190
5. WATER IN FLOW RATE: NIL (LESS THAN 0.01 GPM) AT END OF DRILLING 5/11/2009
6. BEDDING FEATURE ENCOUNTERED AT DEPTH 190'



PLAN VIEW

0 40
Scale in feet

TITLE:	PROBE HOLE PH-2 TUNNEL DRAIN COLLECTION SYSTEM
LOCATION:	GE HUDSON FALLS, NEW YORK

TETRA TECH GEO

APPROVED	JFB
DRAFTED	RMK
PROJECT#	117-2204
DATE	APRIL 2011

FIGURE
PH-2

G:\GE_HUDS\2010\01-10_DW-ASBLTS\AS-BUILS-FINAL_DRAIN\PIEZPH.DWG

GeoTrans, Inc.
A TETRA TECH COMPANY

CORE BORING REPORT

BORING NO. **PH-1**

PROJECT: **TDCS, Hudson Falls, NY**
CLIENT: **General Electric**
CONTRACTOR: **Merco**
EQUIPMENT USED: **Beretta T-43**

JOB NO.: **2204177**
PAGE NO.: **1 of 6**
ELEVATION: **42**
DATE START: **12/9/2008**
DATE FINISH: **12/15/2008**
DRILLER: **Crux**
PREPARED BY: **JAL**
LOCATION: PH-1, Work Room 2-1

GROUND WATER		DEPTH TO:			ORIENTATION		CORE BARREL	
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE		VERTICAL	TYPE	**T-46 Rotary Bit**
					X	HORIZONTAL	SIZE	**2.4**
						INCLINED	Bit (ft)	
						BEARING	Barrel (ft)	
					88	ANG. FROM VERT.	Total (ft)	

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
		0-1.1	0	0	0	0	Hand-drilled to 1.1 ft
5		1.1-6.1	1	5.2	104	100	Mod. Hard, fresh black SHALE; near horizontal to midangular(0° to 50°) calcite healed fractures/veins and stringers, 1/16" to 1/4" thick; occasional pyrite nodules (up to 2"); occasional horizontal pyrite partings/laminae (1/16" to 1/4" thick); trace fossils.
10	5.33	6.1-11.1	2	4.95	99	97	SHALE, similar to above; except 4.5' - 6.1' Lower Basal Shear Fracture, calcite healed, near vertical (80°-90°); 6.1' - 10.7' calcite healed fractures and veins imparting "marbled" appearance, near vertical, (80°-90°)
15	3.42	11.1-14.7	3	3.8	106	100	SHALE, similar to above; except 7.5' - 9.6' near vertical Lower Basal Shear Fracture, calcite healed, smooth slickensides, at 80°-90°; 6.1'-10.7' calcite healed fractures and veins, near vertical (80° - 90°)
20	2.29	14.7-19.7	4	5.1	102	100	
25	2.53	19.7-24.7	5	4.95	99	99	
30	3.25	24.7-29.7	6	4.7	94	94	
35	2.68	29.7-34.7	7	5.1	102	100	
40	1.26	34.7-39.7	8	5.2	104	100	
45	1.35	39.7-44.7	9	5	100	100	
	1.12	44.7-49.7	10	5	100	100	
	1.36						

(Continued)

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

GeoTrans, Inc.
A TETRA TECH COMPANY

CORE BORING REPORT

BORING NO. **PH-1**
PAGE 2 OF 6

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
		49.7-54.7	11	5	100	100	Mod. Hard, fresh black SHALE; near horizontal to midangular(0° to 50°) calcite healed fractures/veins and stringers, 1/16" to 1/4" thick; occasional pyrite nodules (up to 2"); occasional horizontal pyrite partings/laminae (1/16" to 1/4" thick); trace fossils. *(continued)*
55	1.20						
		54.7-59.7	12	5.15	103	100	
60	1.35						
		59.7-64.7	13	5	100	100	
65	1.29						
		64.7-69.7	14	5.1	102	100	
70	1.13						
		69.7-74.7	15	5	100	100	
75	1.04						
		74.7-79.7	16	5.1	102	100	
80	1.10						
		79.7-84.7	17	5	100	100	
85	0.97						
		84.7-89.7	18	5.1	102	100	
90	1.03						
		89.7-94.7	19	4.8	96	96	
95	1.13						
		94.7-99.7	20	4.1	82	100	
100	1.11						SHALE, similar to above; 98.7' - 99.3' Joint at 35°, polished to smooth.
		99.7-102.2	21	3.4	136	100	
	2.04	102.2-104.7	22	2.5	100	100	
105	1.46						SHALE, similar to above; except 103.9' - 104.7' Low angle fracture
		104.7-109.7	23	5	100	100	Mod. Hard to Hard; fresh black SHALE, occasional calcite healed fractures and veins, stringers occasionally imparting a marbelized appearance, moderate to wide spacing, near horizontal to subvertical (0° - 85°), 1/16" to 1/4" thick; occasional pyrite nodules (up to 1"); occasional pyrite stringers, tightly healed, (1/16" to 1/4" thick); occasional very thin fossil shell horizons.
110	1.17						*(Continued)*

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

GeoTrans, Inc.
A TETRA TECH COMPANY

CORE BORING REPORT

BORING NO. **PH-1**
PAGE 3 OF 6

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
		109.7-114.7	24	5	100	100	Mod. Hard to Hard; fresh black SHALE, occasional calcite healed fractures and veins, stringers occasionally imparting a marbelized appearance, moderate to wide spacing, near horizontal to subvertical (0° - 85°), 1/16" to 1/4" thick; occasional pyrite nodules (up to 1"); occasional pyrite stringers, tightly healed, (1/16" to 1/4" thick); occasional very thin fossil shell horizons. *(continued)*
115	1.38	114.7-119.7	25	4.9	98	98	
120	1.48	119.7-124.7	26	5.1	102	100	
125	1.29	124.7-129.7	27	5.1	102	100	
130	1.54	129.7-134.7	28	4.9	98	98	SHALE, similar to above; Open fracture, smooth to rough face, midangular at 40°
135	2.95	134.7-139.7	29	5	100	100	
140	1.63	139.7-144.7	30	5	100	100	
145	1.32	144.7-149.7	31	5.25	105	100	
150	1.62	149.7-154.7	32	5	100	100	Mod. Hard to Hard; black SHALE, occasional calcite veins, near horizontal to midangualr (10° -40°), 1/16" to 1/4" thick; occasional pyrite nodules (up to 1"); occasional pyrite stringers; occasional very thin fossil shell horizons.
155	1.50	154.7-159.7	33	5.1	102	100	
160	2.08	159.7-164.7	34	5	100	100	
165	1.75	164.7-169.7	35	5.9	118	100	
170	1.79						

(Continued)

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

GeoTrans, Inc.
A TETRA TECH COMPANY

CORE BORING REPORT

BORING NO. **PH-1**
PAGE 4 OF 6

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
		169.7-174.7	36	4.8	96	100	Mod. Hard to Hard; black SHALE, occasional calcite veins, near horizontal to midangualr (10° -40°), 1/16" to 1/4" thick; occasional pyrite nodules (up to 1"); occasional pyrite stringers; occasional very thin fossil shell horizons. *(continued)*
175	1.50	174.7-179.7	37	5	100	90	SHALE, similar to above; except Joint at 175', smooth, midangular at 60°
180	1.70	179.7-184.7	38	5	100	100	SHALE, similar to above; except Joint at 178.6', smooth, midangular at 60°
185	1.47	184.7-189.7	39	5	100	100	Mod. Hard, fresh black SHALE; near horizontal to midangular calcite veins and stringers, near horizontal to vertical (0° to 50°), 1/16" to 1/4" thick; occasional pyrite nodules (up to 2"); occasional very thin fossil shell horizons.
190	1.75	189.7-194.7	40	5	100	100	
195	1.47	194.7-199.7	41	5	100	100	
200	1.73	199.7-204.7	42	4.9	98	100	
205	1.83	204.7-209.7	43	5	100	100	
210	1.63	209.7-214.7	44	4.9	98	100	
215	2.07	214.7-219.7	45	5.2	104	100	
220	2.43	219.7-224.7	46	5	100	100	
225	1.87	224.7-229.7	47	5.1	102	100	
230	1.76						

(Continued)

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

GeoTrans, Inc.
A TETRA TECH COMPANY

CORE BORING REPORT

BORING NO. **PH-1**
PAGE 5 OF 6

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
		229.7-234.7	48	5	100	100	Mod. Hard, fresh black SHALE; near horizontal to midangular calcite veins and stringers, near horizontal to vertical (0° to 50°), 1/16" to 1/4" thick; occasional pyrite nodules (up to 2"); occasional very thin fossil shell horizons. *(continued)*
235	1.91	234.7-239.7	49	5.2	104	100	
240	1.80	239.7-244.7	50	4.8	96	100	
245	1.75	244.7-249.7	51	4.4	88	100	SHALE, similar to above; Two partings/fresh breaks at 247.2' and 248.2', angle to core at 60°, cleavage spacing 0.1', trace fossils
250	1.56	249.7-254.7	52	5.2	104	100	
255	NM	254.7-259.7	53	5.2	104	100	
260	1.99	259.7-264.7	54	5.25	105	100	
265	1.81	264.7-269.7	55	5.3	106	100	
270	NM	269.7-274.7	56	4.6	92	92	
275	1.67	274.7-279.7	57	4.2	84	84	SHALE, similar to above; except 273' to 276.3', JT Bedding plane, calcite lined along outside edge, smooth to rough, subvertical (80°); Joints at 278.2' and 278.95', horizontal (0°), calcite lined, smooth to rough.
280	1.91	279.7-284.4	58	5.35	114	100	
285	2.10						
290	1.59						

(Continued)

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

GeoTrans, Inc.
A TETRA TECH COMPANY

CORE BORING REPORT

BORING NO. **PH-1**
PAGE 6 OF 6

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
295	NM	284.4-300	59	15.6	100	100	SHALE, similar to above; except 273' to 276.3', JT Bedding plane, calcite lined along outside edge, smooth to rough, subvertical (80°); Joints at 278.2' and 278.95', horizontal (0°), calcite lined, smooth to rough. *(continued)*
300	NM						Bottom of boring at 300 ft Note: See separate detailed Discontinuity Log for description of joints and fractures observed in core for boring PH-1. Note that with few exceptions, the fractures detailed in log are considered to be Drill Breaks (DB) or drilling induced (di) fractures along intact incipient features.
305							
310							
315							
320							
325							
330							
335							
340							
345							
350							

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

GeoTrans, Inc.
A TETRA TECH COMPANY

CORE BORING REPORT

BORING NO. PH-2

PROJECT:	TDCS, Hudson Falls, NY								JOB NO.:	117-2204189
CLIENT:	General Electric								PAGE NO.:	1 of 6
CONTRACTOR:	Merco								ELEVATION:	
EQUIPMENT USED:	Beretta T43								DATE START:	5/6/2009
GROUND WATER		DEPTH TO:			ORIENTATION		CORE BARREL		DATE FINISH:	5/11/2009
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE	X	VERTICAL	TYPE	HQ	DRILLER:	Crux
						HORIZONTAL	SIZE	5.2 feet	PREPARED BY:	SL & JL
						INCLINED	Bit (ft)		LOCATION:	TDCS
						BEARING	Barrel (ft)		Workroom 2-1	
					95	ANG. FROM VERT.	Total (ft)			

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
		0-2.5	1	n/a	0	n/a	8" Core Collar; Grout 2.5-2.95'
5		2.5-5.7	2	3.5	109	100	Mod. hard, black, SHALE; occasional calcite veins with some marbelization, mostly near horizontal and mid-angle (<10° - 50°), <1 mm to 1mm thick; high angle open fractures, tight, smooth, fresh, near vertical (80° - 90°); occasionall healed fractures, calcite filled, near vertical (80° - 90°).
		5.7-10	3	4.35	101	100	
10		10-15	4	5	100	100	Mod. hard, black, SHALE; occasional calcite veins and stringers with some marbelization, mostly near horizontal and mid-angle (<10° - 50°), <1 mm to 1mm thick; occasional pyrite nodules, 1" to 2.5" thick; high angle open fractures, calcite, slicks, striations, undulating (70°-80°); occasional healed fractures, calcite filled, near vertical (80° - 90°).
15		15-20	5	5.15	103	100	Mod. hard, black, SHALE; occasional calcite veins and stringers with some marbelization, mostly near horizontal (<10° - 40°), <1 mm to 1mm thick; high angle open fractures, tight, smooth, fresh, mid-angle to near vertical (40° - 90°); occasional healed fractures, calcite and pyrite filled, near vertical (80° - 90°).
20		20-25	6	5	100	100	
25		25-30	7	5	100	100	Mod. hard, black, SHALE; occasional calcite veins and stringers, mostly near horizontal (<10° - 40°), <1 mm to 1mm thick; occasional healed fractures, calcite filled, near vertical (70° - 90°).
30		30-35	8	5.05	101	100	
35		35-40	9	5.15	103	100	Mod. hard, black, SHALE; occasional calcite veins and stringers, mostly near horizontal (<10° - 30°), <1 mm to 1mm thick; trace fossils, calcite; occasional healed fractures, calcite filled, near vertical (80° - 90°).
40		40-45	10	5.05	101	100	
45		45-50	11	5	100	100	
							(Continued)

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

BORING NO. **PH-2**
PAGE 2 OF 6

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
55		50-55	12	5.15	103	100	Mod. hard, black, SHALE; occasional calcite veins and stringers, near horizontal to mid-angle(10° - 50°), <1 mm to 1mm thick; calcite, trace fossils; high angle open fractures, rough, fresh to slightly weathered, mid-angle to near vertical (50° - 80°); occasional healed fractures, calcite and pyrite filled, near vertical (70° - 90°).
60		55-60	13	4.95	99	100	
65		60-65	14	5	100	100	Mod. hard, black, SHALE; occasional calcite veins and stringers, mostly near horizontal (<10° - 30°), <1 mm to 1mm thick; pyrite, trace fossils, calcite; occasional healed fractures, calcite and pyrite filled, near vertical (70° - 90°).
70		65-70	15	5.25	105	100	
75		70-75	16	5.05	101	100	SHALE, similar to above, except low angle open fracture, slightly open, rough, fresh, horizontal (0°).
80		75-80	17	5.1	102	100	
85		80-85	18	5.1	102	100	
90		85-90	19	5	100	100	
95		90-95	20	5	100	100	Mod. hard, black, SHALE; occasional calcite veins, near horizontal to mid-angle (<10° - 30°), <1 mm to 1mm thick; trace fossils throughout, calcite and pyrite; high angle open fractures, tight, fresh, mid-angle to near vertical (50° - 80°); ocassional healed fractures, some calcite and pyrite filled, near vertical (60° - 70°); pyrite nodules, 1/2".
100		95-100	21	5.2	104	100	
105		100-105	22	5.15	103	100	Mod. hard, black, SHALE; occasional calcite veins, near horizontal to mid-angle (<10° - 50°), <1 mm to 1mm thick; trace fossils throughout, calcite and pyrite; occasional healed fractures, some calcite and pyrite filled, near vertical (70° - 90°).
110		105-110	23	5.05	101	100	

(Continued)

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

BORING NO. **PH-2**
PAGE 3 OF 6

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
		110-115	24	5.1	102	100	Mod. hard, black, SHALE; occasional calcite veins, near horizontal to mid-angle (<10° - 50°), <1 mm to 1mm thick; trace fossils throughout, calcite and pyrite; occasional healed fractures, some calcite and pyrite filled, near vertical (70° - 90°). *(continued)*
115		115-120	25	5	100	100	
120		120-125	26	5.15	103	100	
125		125-130	27	5.3	106	100	
130		130-135	28	5	100	100	
135		135-140	29	5	100	100	SHALE, similiar to above, except high angle open fracture, near vertical, tight to slightly open, fresh to slightly weatherd, smooth, @ 134.1-135'.
140		140-145	30	4.9	98	100	SHALE, similiar to above, except high angle (80°-90°) open fracture, tight, smooth, fresh, @ 138.6'.
145		145-150	31	5.1	102	100	SHALE, similiar to above, except high angle (90°) open fracture, tight to slightly open, fresh to slightly weathered, smooth, @ 147.4-150'.
150		150-155	32	5.1	102	100	
155		155-160	33	4.85	97	100	Mod. hard, black, SHALE; occasional calcite veins and stringers, near horizontal to mid-angle (<10° - 50°), <1 mm to 2mm thick; trace fossils throughout, calcite and pyrite; high angle open fractures, tight to open, fresh to slightly weathered, some graphite coating, calcite and pyrite, mid-angle to near vertical (70° - 90°); occasional healed fractures, some calcite and pyrite filled, near vertical (60° - 90°).
160		160-165	34	5.25	105	100	
165		165-170	35	5.1	102	100	
170							*(Continued)*

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

BORING NO. **PH-2**
PAGE 4 OF 6

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
		170-175	36	5	100	100	Mod. hard, black, SHALE; occasional calcite veins and stringers, near horizontal to mid-angle (<10° - 50°), <1 mm to 2mm thick; trace fossils throughout, calcite and pyrite; high angle open fractures, tight to open, fresh to slightly weathered, some graphite coating, calcite and pyrite, mid-angle to near vertical (70° - 90°); occasional healed fractures, some calcite and pyrite filled, near vertical (60° - 90°).*(continued)*
175		175-180	37	4.9	98	100	
180		180-185	38	5.25	105	100	
185		185-190	39	5.2	104	100	
190		190-195	40	5.1	102	100	
195		195-200	41	5	100	100	
200		200-205	42	5.05	101	100	
205		205-210	43	5	100	100	
210		210-215	44	5	100	100	Shale, similar to above, except high angle open fracture along bedding plane, smooth fresh, near vertical (70° - 90°).
215		215-220	45	5	100	100	
220		220-225	46	5.1	102	100	
225		225-230	47	5.1	102	100	Mod. hard to hard, black, SHALE; occasional calcite veins, near horizontal to mid-angle (<10° - 60°), <1 mm to 1mm thick; trace fossils, calcite and pyrite; pyrite nodules, 1/2" thick; occasional healed fractures, some calcite filled, near vertical (40° - 90°).
230							*(Continued)*

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

BORING NO. **PH-2**
PAGE 5 OF 6

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
235		230-235	48	5.1	102	100	Mod. hard to hard, black, SHALE; occasional calcite veins, near horizontal to mid-angle (<10° - 60°), <1 mm to 1mm thick; trace fossils, calcite and pyrite; pyrite nodules, 1/2" thick; occasional healed fractures, some calcite filled, near vertical (40° - 90°). *(continued)*
240		235-240	49	5.15	103	100	
245		240-245	50	5.1	102	100	
250		245-250	51	4.95	99	100	Shale, similar to above, except high angle open fracture, tight, smooth, fresh, pyrite, near vertical (80° - 90°).
255		250-255	52	4.85	97	100	
260		255-260	53	5.2	104	100	
265		260-265	54	5	100	100	Mod. hard, black, SHALE; occasional calcite veins, some clustering and displacement, near horizontal to mid-angle (<10° - 50°), <1 mm to 1mm thick; trace fossils, calcite and pyrite; occasional healed fractures, some calcite filled, near vertical (60° - 90°).
270		265-270	55	5	100	100	
275		270-274.9	56	4.9	100	100	
280		274.9-280.1	57	5.2	100	100	
285		280.1-285.1	58	5	100	100	Hard, black, SHALE; occasional calcite veins, some clustering and displacement, near horizontal to mid-angle (<10° - 60°), <1 mm to 1mm thick; occasional healed fractures, some calcite filled, near vertical (60° - 90°); bedding planes, spaced 0.4 - 0.6 feet, near vertical (60° - 80°).
290		285.1-290.1	59	5	100	100	SHALE, similiar to above, except high angle open fracture, tight, fresh to slighly weathered, smooth, (50°-90°), @ 287.55-288.55'.
							(Continued)

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

GeoTrans, Inc.
A TETRA TECH COMPANY

BORING NO. **PH-2**
PAGE 6 OF 6

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD (%)	FIELD CLASSIFICATION AND REMARKS
295		290.1-295.1	60	5	100	100	Hard, black, SHALE; occasional calcite veins, some clustering and displacement, near horizontal to mid-angle (<10° - 60°), <1 mm to 1mm thick; occasional healed fractures, some calcite filled, near vertical (60° - 90°); bedding planes, spaced 0.4 - 0.6 feet, near vertical (60° - 80°)*(continued)*
		295.1-300.1	61	5	100	100	
300							Bottom of boring at 300.1 feet. PH-2 converted to PZ-202 on 3/2/10-3/3/10.
305							
310							
315							
320							
325							
330							
335							
340							
345							
350							

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Groundwater Sampling Procedure
for
TDCS Tunnels Rock Core Probe Holes

1 MO-JV deliver to GE Water Treatment Plant: probe hole drill string (core bits, drill steel and stabilizers); groundwater sampling equipment (borehole packer, down-hole pump and pipe) and; any other components to be used in-hole. All drill string and groundwater sampling components that will be going in-hole shall be decontaminated before use.

2 GEOTRANS decontaminate all probe hole drill string components using steam cleaner and take "Rinse Blank" sample for testing.

3 GEOTRANS wrap all probe hole drill string components in plastic for transportation to workroom 2-1 in tunnel 2.

4 MO-JV transport decontaminated drill string components (plastic wrapped) to Workroom 2-1 in tunnel 2.

5 MO-JV set-up drill string for drilling – only unwrap drill string pieces immediately prior to use. MO-JV personnel to use only new and unused gloves to handle decontaminated components.

6 GEOTRANS decontaminate groundwater sampling equipment with steam cleaner at the decon pad on the ground surface and take "Rinse Blank" sample for testing.

7 GEOTRANS wrap groundwater sampling equipment in plastic for transportation to workroom 2-1 in tunnel 2. All personnel use only new unused gloves to handle decontaminated components.

8 MO-JV start next shift of core drilling for probe hole.

9 MO-JV, after drilling last core run for the shift, transport groundwater sampling equipment (plastic wrapped) to workroom 2-1.

10 GEOTRANS unwrap and install, with MO-JV assistance, groundwater sampling equipment in borehole. All personnel use only new unused gloves to handle decontaminated components.

11 MO-JV inflate packer at depth directed by the engineer.

12 MO-JV close water return valve to keep water flow in probe hole.

13 MO-JV, at the start of the next shift of drilling, open water return valve.

14 MO-JV, operate pump if necessary as directed by engineer

15 GEOTRANS collect water sample (2 liter maximum) for PCB from the interval drilled during each shift. All personnel use only new unused gloves when taking samples.

16 GEOTRANS measure volume of water drained from sampling interval.

17 MO-JV remove groundwater sampling equipment and transport to GE Water Treatment Plant for decontamination.

18 GEOTRANS transport groundwater sample to surface for testing.

19 Repeat steps 6 through 18 until probe hole is drilled to full depth.

APPENDIX D

Protocol for Collecting and Analyzing Rock Core Samples for Organic Chemical Concentrations

Prepared for General Electric, Inc.
Hudson Falls, New York Facility

Prepared by Beth L. Parker, Ph.D.
Department of Earth Sciences
University of Waterloo
Waterloo, ON N2L 3G1

February 10, 1999

The purpose of the proposed rock core analyses adjacent to fractures is to gain better insight into the number, position and characteristics of the discrete fracture pathways that control DNAPL and groundwater flow. This document presents a proposed method for measuring organic chemical concentrations in rock core subsamples collected at depth-discrete locations adjacent to hydraulically active fractures evident in continuous core. Rock samples are crushed then submerged in hexane in order to extract the hydrophobic chemicals from aqueous and sorbed phases. The hexane extract is analyzed for polychlorinated biphenyls (PCBs) and other semi-volatile organic chemicals known to be present in the DNAPL at the site (specifically, trichlorobenzene (TCB), bis-(2-ethylhexyl)phthalate (BEHP), and phenyl xylyl ethane (PXE). This method of extraction and analysis is similar to the EPA methods for analysis of sediment on soil for semi-volatile organic compounds (SVOC).

The low solubility and high affinity for sorption to the rock matrix will cause these organic contaminants to be present in a narrow zone immediately adjacent to the contaminant migration pathways in hydraulically active fractures and bedding planes. These same properties enhance the likelihood of detection in depth-discrete samples.

Methods:

PCB and SVOC samples: The subsamples of NX or HQ rock core will be taken on both sides of a targeted fracture or bedding plane feature, see Figure D-1. A targeted feature is an open fracture or bedding plane that offers potential for being a fluid flow pathway (water or DNAPL). The first set of samples will include the fracture surface and the core up to 1 cm distance away from this surface. A second set of samples will be taken immediately adjacent to the first set extending 1 to 2 cm away from the targeted feature. Wherever the targeted fracture/bedding plane occurs at a change in lithology or mineral alterations, samples from both sides of the fracture will be analyzed in the initial round of analyses. Where there is no distinction in rock matrix, the sample pairs may be considered to be field duplicates.

Wipe samples will be taken along specific fracture or bedding planes where DNAPL phase is observed or suspected in order to capture the chemical composition of the mobile DNAPL at the time of core collection. These wipe samples will consist of a clean fabric soaked in hexane and wiped over the two opposing fracture surfaces. The mass of contaminants can be reported on a total surface area basis. Comparison of wipe samples to the rock matrix samples along the same fracture may be used to infer past and present day DNAPL characteristics.

Field duplicates consist of sample pairs on both sides of a fracture or bedding plane where the lithology appears to be the same. Sample duplicates will be obtained by taking duplicate aliquots of hexane from the sample container at the same time, hence after the same extraction time. Equipment blanks consist of hexane wipes of the core tube and rock crusher following decontamination procedures. Trip blanks will consist of sample containers containing a known weight and volume of high purity hexane that is placed among the other prepared sample containers. A trip blank will be kept with each batch of sample containers being sent to the field. The field blank will be stored in the cooler or refrigerator and returned to the laboratory with the

samples. Aliquots of hexane from the trip blanks will be obtained in a similar manner as the sample extract aliquots and at least on trip blank per shipment of samples to the laboratory for analysis.

Field Procedures:

The fresh rock core will be removed from the core barrel and placed in a aluminum foil-lined tray. A foil-lined split PVC tube at least the length of the core barrel will be used for inspecting the core. A continuous sheet of clean foil will be used to cover the sample during the core logging, inspection and subsampling activities. These precautions are to prevent contact with sorbing surfaces, cross contamination, and moisture loss from the rock core. The core will be logged immediately and the fractures/bedding planes identified for sampling. The sample size will be 1 cm length of core including the fracture plane (1 cm thick disk of NX or HQ core) providing an estimated 30 to 50 grams of sample (wet-weight basis), respectively. A spacer (wooden block) will be placed in the core box with the core to indicate the position of the samples taken and sample ID.

The core subsamples will be crushed as soon as possible after collection to avoid cross-contamination or moisture loss from the water-saturated rock matrix. If a sample cannot be crushed immediately after collection, it will be tightly wrapped in a clean piece of aluminum foil unit it is crushed and placed into the sample containers. Each individual sample will be handled separately. If there is evidence of DNAPL phase running along the inside of the core barrel and possibly cross-contaminating the outside of the core, the outer few mm of core will be trimmed using a chisel. Cross contamination of DNAPL fluid due to drilling may also cause previously uninvaded fractures to become contaminated. The combination of wipe samples and two successive matrix samples should allow interpretation of this condition.

The sample will then placed in the clean rock crusher sleeve, crushed using several blows of a stainless steel piston and emptied directly into a pre-weighed sample container holding a

known volume and weight of hexane. The sample container will be a 120 ml clear glass sample bottle, a screw cap with teflon-lined septum and a continuous sheet of aluminum foil to avoid hexane and sample contact with the septum. The container containing the crushed rock sample will be weighed again to determine the wet-weight of rock sample will be determined from the difference in weights. This allows concentrations of chemical constituents to be reported on a mass per unit mass of wet rock (ug/g). A 1:1 ratio of sample to analytical grade hexane is desired, therefore, if 30 to 50 grams of rock core can be obtained from 1-cm slices of NX and HQ cores, respectively, than 30 to 50 milliliters of hexane should be placed into each of the sample containers with the screw cap, septum and foil liner and weighed prior to sample collection. Once sample containers have been prepared and weighed they will be kept at 4°C in a refrigerator or in a cooler with ice before and after sample collection.

Extraction rate and completeness can be enhanced using a Soxhlet or heated technique. It is desired to extract all of the aqueous, sorbed and any immiscible phase mass into the hexane prior to taking an aliquot of hexane for analysis. Crushing the rock core to sand or pea gravel size pieces should enhance extraction rates. If PCB analyses on the samples is to be performed separately as a priority prior to SVOC constituent analyses, the separate aliquots should be collected at the same time to maintain consistent conditions and truer comparisons of results.

Equipment Decontamination:

After each core run, the core barrel should be cleaned with alconox detergent and water to remove rock flour and contaminants and rinsed thoroughly with clean water. The wash and rinse waters should be collected and treated or disposed of in the proper manner. Between samples, the rock hammer, chisels and rock crusher used in sample collection should be decontaminated using a series of wet, disposable wipes; beginning with hexane, followed by acetone or methanol and finally with water. The equipment should be dry prior to re-use.

NX OR HQ CORE

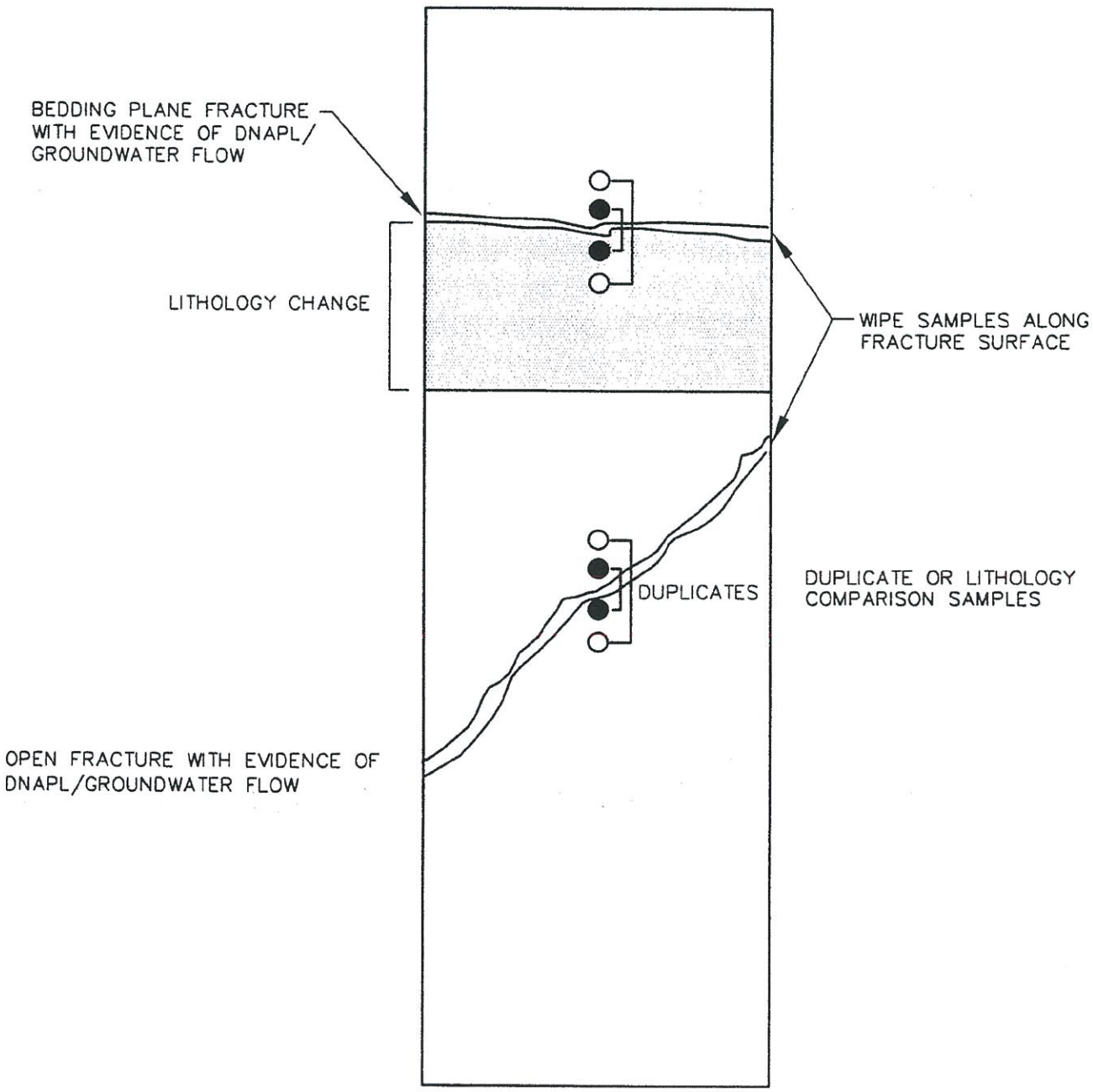


Figure D–1 Rock Core Sub–Sampling Approach at GE Hudson Falls, New York Site.
(to accompany protocol prepared by B.L. Parker, Feb. 10, 1999)