GROUNDWATER SCIENCES CORPORATION

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September 14, 2017

Ms. Jessica LaClair
Program Manager
New York State Department of
Environmental Conservation
Division of Environmental Remediation
Remedial Bureau D, 12th Floor
625 Broadway
Albany, New York 12233-7017

Mr. Henry Wilkie
Environmental Engineer 1
New York State Department of
Environmental Conservation
Division of Environmental Remediation
Remedial Bureau A, 11th Floor
625 Broadway
Albany, New York 12233-7015

Re: *Extraction Well 618 Shutdown Test Findings*
B/322 Area of Concern (Operable Unit 7)
Former IBM East Fishkill Facility, East Fishkill, New York

Dear Ms. LaClair and Mr. Wilkie:

On behalf of the IBM Corporation (IBM), Groundwater Sciences Corporation (GSC) has prepared this letter report describing the findings of a shutdown test of groundwater extraction well GW-618 located within the Building 322 (B/322) Area of Concern (AOC) of the Former IBM East Fishkill Facility in East Fishkill, New York (Site). Well GW-618 was installed and operated to remediate a localized low concentration presence of the volatile organic compound (VOC) dichlorodifluoromethane (Freon®12) in groundwater near the western limits of the B/322 AOC. As of the fourth quarter 2013, groundwater quality at GW-618 and nearby monitoring wells met the 6NYCRR Part 703 New York State Groundwater Quality Standard (NYSGQS) for over eight years, and IBM proposed a three year shutdown test[1] to confirm that operation of extraction well GW-618 can be discontinued without a meaningful change in B/322 AOC groundwater quality. The shutdown test was initiated in the first quarter of 2014, shortly after IBM's receipt of an approval of the plan[2] from the New York State Department of Environmental Conservation (NYSDEC). This shutdown test was conducted as part of IBM's groundwater Corrective Action (CA) program which is regulated by the NYSDEC under the Site's New York State Part 373 permit[3].

BACKGROUND

The Site consists of a semiconductor manufacturing and development facility located in south-central Dutchess County within the Town of East Fishkill, New York. As shown on the Site Location Map

[1] IBM Environmental Engineering to NYSDEC, December 16, 2013, *Termination Petition, Extraction Well 618, B/322 Remediation Area*.
[2] NYSDEC to IBM Environmental Engineering, January 15, 2014, *Regarding Termination Petition, Extraction Well 618, B/322 Remediation Area*.
[3] New York State Department of Environmental Conservation, November 2, 2011, *6NYCRR Part 373 Hazardous Waste Management Permit, IBM Corporation East Fishkill Facility*.

(Figure 1), the Site is located between Interstate 84 to the south and New York State Route 52 to the north. The B/322 AOC includes the area adjacent to the B/322 building along with paved parking and lawn areas west of B/322, in the area between the B/322 and Gildersleeve Brook. The B/322 AOC is also referred to as Operable Unit #7 (OU7) in the Final Statement of Basis, dated September 2013 (effective date of April 16, 2014), that was developed by the NYSDEC in consultation with the New York State Department of Health (NYSDOH) under the authority of RCRA. On July 1, 2015, the Site was acquired by GLOBALFOUNDRIES U.S. 2LLC (GF). GF is listed as the facility owner under the current NYSDEC Part 373 Permit, with IBM maintaining responsibility for the CA program[4]. The Site was subsequently subdivided, with National Resources acquiring several parcels on September 1, 2017. The B/322 AOC is located on parcels owned by GF.

B/322 has been used historically for manufacturing purposes, and the AOC includes the area adjacent to the building and extends west to Gildersleeve Brook. Soil and groundwater RCRA Facility Investigations (RFIs) were completed in the B/322 AOC in the mid-1990s. Overburden (soil) conditions in the B/322 AOC include a downward sequence of soil fill, alluvial sandy soils, and a glaciolacustrine silt and clay which serves to inhibit vertical movement of groundwater and contaminants. The glaciolacustrine silt/clay layer is widespread but discontinuous across the site, with perched groundwater typically found in the overlying alluvial sandy soils. Beneath the glaciolacustrine unit and overlying the bedrock glaciofluvial ice-contact and glacial till soils are present. These deeper soil units are unsaturated in the central portions of the Site due to ongoing withdrawals from Site bedrock production wells. As shown on Figure 2, groundwater in the alluvium flows westerly from the area of the northeast corner of B/322 towards B/323 to the south-southwest and towards Gildersleeve Brook to the southwest. Due to the surface topography of the underlying glaciolacustrine silt and clay, a natural groundwater flow divide is present that separates a more southerly component of groundwater flow towards B/323 from a more westerly component of groundwater flow towards Gildersleeve Brook.

Corrective action implemented in the B/322 AOC includes groundwater recovery from wells GW-612, GW-617 and GW-618 to hydraulically contain and remove VOC-containing groundwater in the shallow perched aquifer VOCs. Extracted groundwater is pumped to the Site's Water Pollution Control Facility (WPCF) for treatment and ultimately discharged to Gildersleeve Brook under the Site's SPDES permit. Trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and to a lesser extent tetrachloroethene (PCE) are the primary VOCs detected in groundwater samples from wells 612 and 617. Extraction well GW-618 was installed to contain a small area near the western limits of the B/322 AOC where low concentrations of Freon®12 were detected in shallow groundwater near Gildersleeve Brook. PCE, TCE and cis-1,2-DCE have not been detected is this portion of the B/322 AOC.

SHUTDOWN TEST RESULTS

As proposed in the December 2013 shutdown petition, following the January 2014 shutdown of GW-618 groundwater, wells GW-068 and GW-618 were sampled for VOCs at time of intervals of approximately one week, one month, two months, and three months. After this initial three month monitoring period, both wells were then sampled quarterly for three consecutive years. Results of laboratory analyses for the presence of VOCs in the GW-618 shutdown test groundwater samples are

[4] NYSDEC, July 1, 2015, Facility Permit Transfer IBM Corporation to GLOBALFOUNDRIES U.S. 2LLC, East Fishkill Facility.

summarized in Table 2.

Figure 3 and Figure 4 are semi-logarithmic concentration versus time graphs for monitoring wells GW-068 and GW-618, respectively. The semi-log graphs depict concentrations of Freon®12, and include timelines depicting the start of the GW-618 shutdown test and the start of the shutdown of the other B/322 AOC extraction wells GW-612 and GW-617. As indicated on Figures 3 and 4, groundwater quality in the two monitored wells continued to meet the 6NYCRR Part 703 New York State Groundwater Quality Standard (NYSGQS) of 5 µg/L during the shutdown test. The highest Freon®12 concentration detected in samples collected from well GW-068 during the shutdown test period was 2.2 µg/L, and the highest Freon®12 concentration detected in samples collected from well GW-618 was 0.6 µg/L. Although Freon®12 has been detected more frequently in well GW-068 post-shutdown as compared to pre-shutdown of GW-618, there is no apparent increasing trend. No other VOCs were detected in the two monitoring wells during the shutdown test.

CONCLUSIONS AND RECOMMENDATIONS

Groundwater in the vicinity of monitoring well GW-068 and groundwater extraction well GW-618 has not exceeded the NYSGQS of 5 µg/L for Freon®12 for more than eleven years. A review of the time versus concentrations graphs of wells GW-068 and GW-618 suggests that concentrations have stabilized during the three year period of the GW-618 shutdown test. The shutdown test confirms that operation of this system can be discontinued without a meaningful change in B/322 AOC groundwater quality. The permanent shutdown of extraction well GW-618 is expected to have no meaningful effects that would constitute a threat to human health and the environment.

Considering the above conclusions, GSC recommends termination of GW-618 groundwater extraction and treatment operations. We recommend that the water quality sampling for extraction well GW-618 be discontinued and that quarterly sampling of GW-068 continue as per the approved Groundwater Monitoring Plan (GMP)[5].

Should you have any questions concerning this shutdown test letter report, please contact Dean Chartrand of IBM at (703) 257-2583.

Very truly yours,
GROUNDWATER SCIENCES CORPORATION

C. Edward Stoner, P.G.
Project Manager

[5] IBM to NYSDEC via e-mail, Groundwater Sciences Corporation, September 17, 2015, *Groundwater Monitoring Plan, Former IBM East Fishkill Facility.*

Attachments:

Table 1 – Volatile Organic Compound Data, GW-618 Shutdown Test Groundwater Sampling
Figure 1 – Site Location Map
Figure 2 – B/322 AOC (OU7), Elevation Contour Map–Soil Groundwater Table, April 24-26, 2017
Figure 3 – Former IBM East Fishkill Facility, GW-068 Freon®12 Concentration
Figure 4 – Former IBM East Fishkill Facility, GW-618 Freon®12 Concentration

Table 1
Volatile Organic Compound Data, GW-618 Shutdown Test Groundwater Sampling
B/322 Area of Concern (Operable Unit 7)
Former IBM East Fishkill Facility, East Fishkill, New York

Parameter	Sample Location	068	068	068	068	068	068	068	068	068	068	068	068
	Sample Description	GW	GW	GW	GW	REP	GW	GW	GW	GW	GW	GW	GW
	Sample Date	1/27/2014	2/19/2014	3/21/2014	4/21/2014	4/21/2014	7/15/2014	10/15/2014	1/14/2015	4/29/2015	7/27/2015	10/15/2015	1/19/2016
	Laboratory Sample I.D.	R1400651-006	R1401218-004	R1402048-003	R1402853-004	R1402883-006	R1405464-003	R1408217-003	R1500345-004	7868962	7982363	8092465	8212527
1,1,1-TRICHLOROETHANE		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (Freon®TF)		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE (Freon®123a)		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
1,2-DICHLOROBENZENE		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
ACETONE		ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
CHLOROBENZENE		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
CIS-1,2-DICHLOROETHYLENE		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
DICHLORODIFLUOROMETHANE (Freon®12)		ND@1.0	2.0	ND@1.0	1.3	1.3	1.3	ND@1.0	ND@1.0	1.4	1.3	1.3	2.2
ETHYLBENZENE		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
M,P-XYLENE		ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
O-XYLENE		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
TETRACHLOROETHYLENE		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
TRICHLOROETHYLENE		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
TRICHLOROFLUOROMETHANE		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5
VINYL CHLORIDE		ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5

All Results reported in micrograms per liter (ug/L)

Parameter	Sample Location	068	068	068	068	068	068	618	618	618	618	618	618
	Sample Description	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
	Sample Date	4/21/2016	7/12/2016	10/13/2016	1/10/2017	4/18/2017	7/7/2017	01/27/2014	02/19/2014	03/21/2014	04/21/2014	07/15/2014	10/15/2014
	Laboratory Sample I.D.	8346068	8473076	8645034	8785322	8947290	9092428	R1400651-005	R1401218-003	R1402048-004	R1402883-003	R1405464-004	R1408217-004
1,1,1-TRICHLOROETHANE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (Freon®TF)		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE (Freon®123a)		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
1,2-DICHLOROBENZENE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
ACETONE		ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
CHLOROBENZENE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
CIS-1,2-DICHLOROETHYLENE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
DICHLORODIFLUOROMETHANE (Freon®12)		2.0	1.4	1.2	2.2	1.3	ND@0.5	0.54J	0.62J	ND@1.0	ND@1.0	0.6J	ND@1.0
ETHYLBENZENE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
M,P-XYLENE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0	ND@2.0
O-XYLENE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
TETRACHLOROETHYLENE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
TRICHLOROETHYLENE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
TRICHLOROFLUOROMETHANE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0
VINYL CHLORIDE		ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0	ND@1.0

All Results reported in micrograms per liter (ug/L)

Key:

GW Groundwater
REP Replicate
ND@X Not Detected at Detection Limit X
J Estimated Value

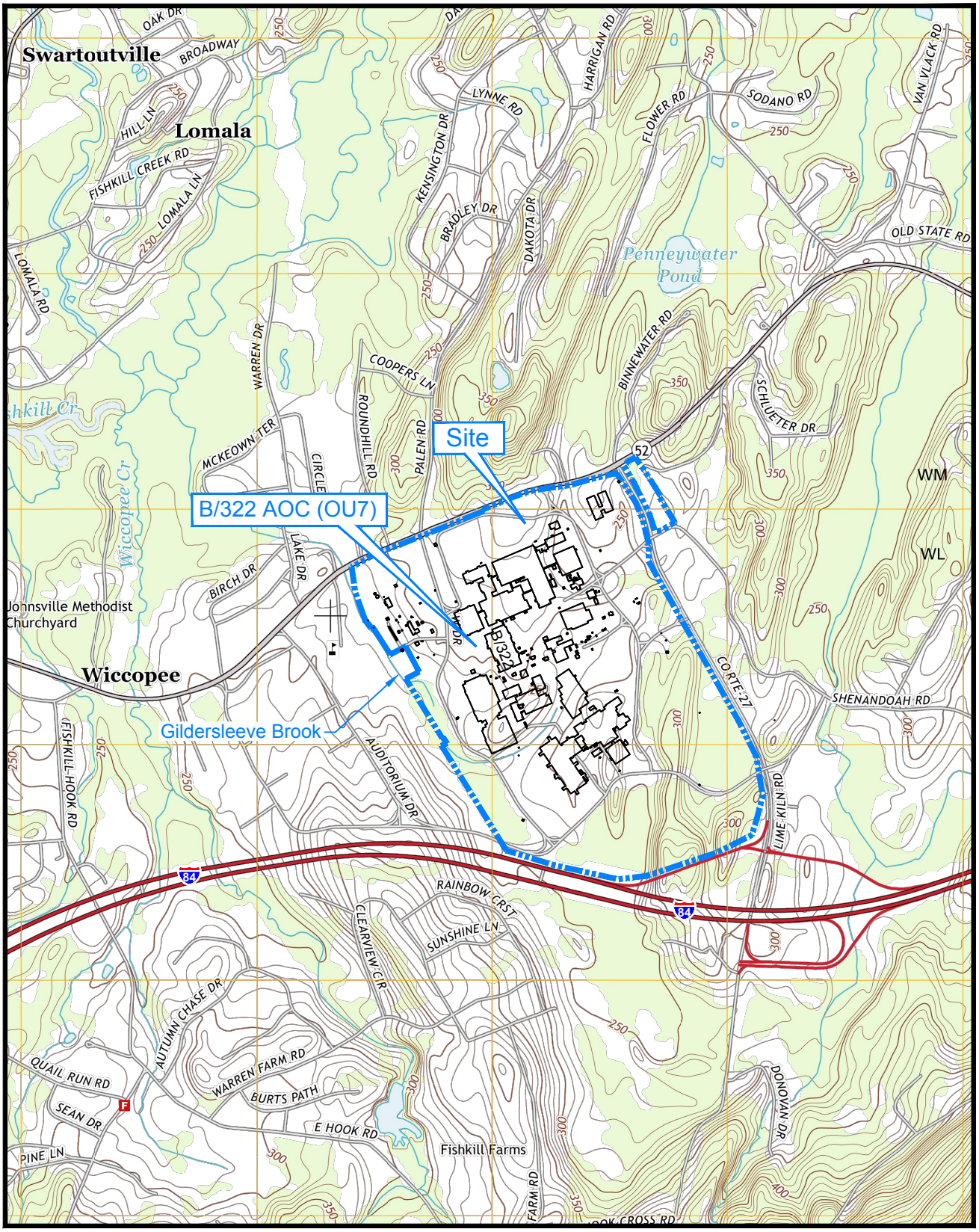
Table 1
Volatile Organic Compound Data, GW-618 Shutdown Test Groundwater Sampling
B/322 Area of Concern (Operable Unit 7)
Former IBM East Fishkill Facility, East Fishkill, New York

	Sample Location	618	618	618	618	618	618	618	618	618	618	618
	Sample Description	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
	Sample Date	01/14/2015	04/29/2015	07/27/2015	10/15/2015	01/19/2016	04/21/2016	07/15/2016	10/13/2016	01/10/2017	04/18/2017	07/07/2017
Parameter	Laboratory Sample I.D.	R1500345-003	7868954	7982396	8092480	8212830	8346081	8478110	8645028	8785337	8947289	9092409
1,1,1-TRICHLOROETHANE		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (Freon®TF)		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE (Freon®123a)		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
1,2-DICHLOROBENZENE		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
ACETONE		ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0	ND@5.0
CHLOROBENZENE		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
CIS-1,2-DICHLOROETHYLENE		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
DICHLORODIFLUOROMETHANE (Freon®12)		ND@1.0	0.4J	0.4J	0.3J	0.3J	0.4J	0.6	0.6	0.3J	0.3J	0.4J
ETHYLBENZENE		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
M,P-XYLENE		ND@2.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
O-XYLENE		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
TETRACHLOROETHYLENE		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
TRICHLOROETHYLENE		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
TRICHLOROFLUOROMETHANE		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
VINYL CHLORIDE		ND@1.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5

All Results reported in micrograms per liter (ug/L)

Key:

GW Groundwater
REP Replicate
ND@X Not Detected at Detection Limit X
J Estimated Value



Portion of the Hopewell Junction, NY
7.5-minute USGS Quadrangle
(The National Map US Topo, 2013)
Latitude/Longitude: 41°32'27"N, 73°49'28"W (41.540714, -73.824185)

N

Scale
0 1000' 2000'

Figure 1

Former IBM East Fishkill Facility

Site Location Map

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95007-044-E3 / 1-21-16

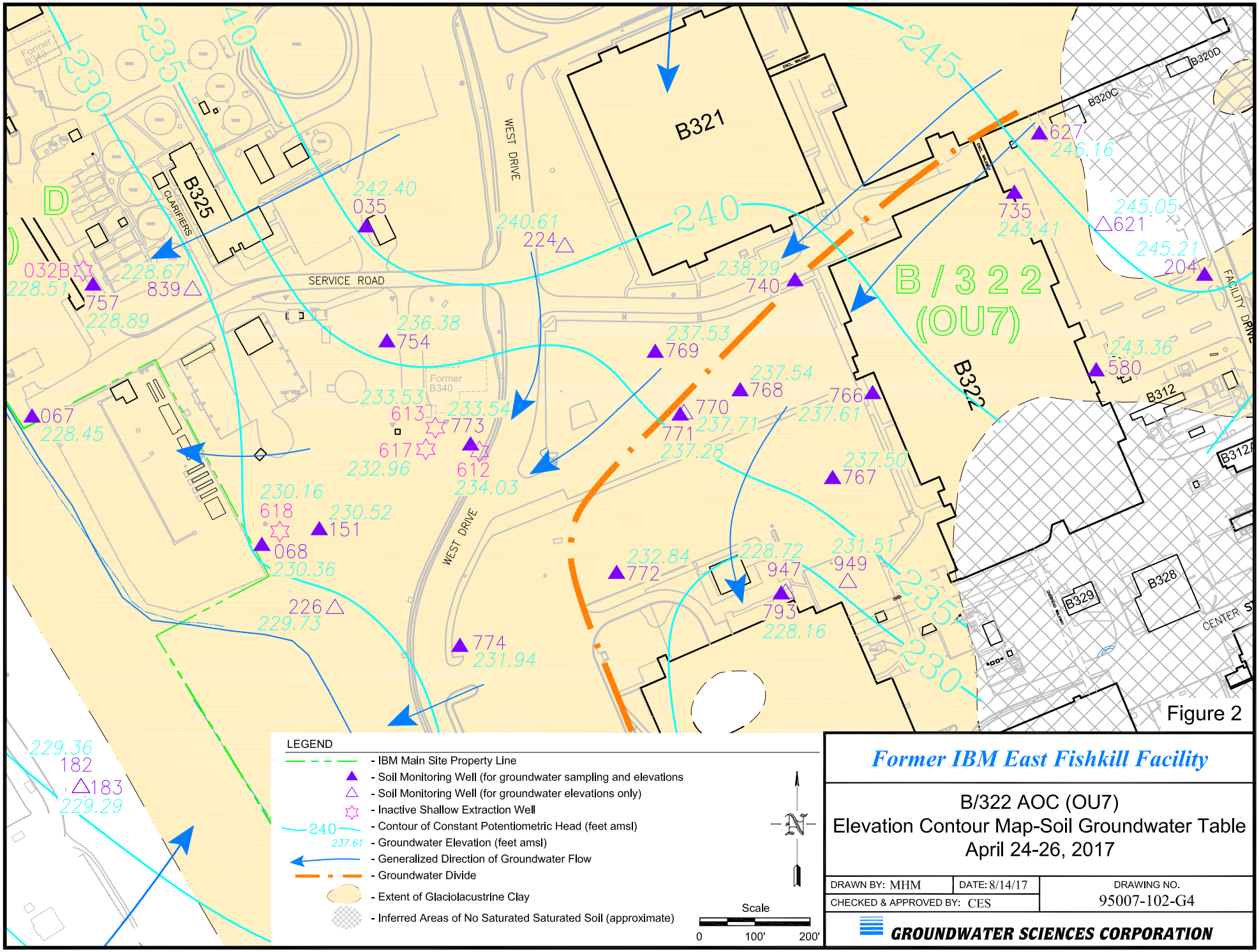

Figure 2

Former IBM East Fishkill Facility

B/322 AOC (OU7)
Elevation Contour Map-Soil Groundwater Table
April 24-26, 2017

DRAWN BY: MHM	DATE: 8/14/17	DRAWING NO.
CHECKED & APPROVED BY: CES		95007-102-G4

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Figure 3
Former IBM East Fishkill Facility
GW-068 Freon®12 Concentration

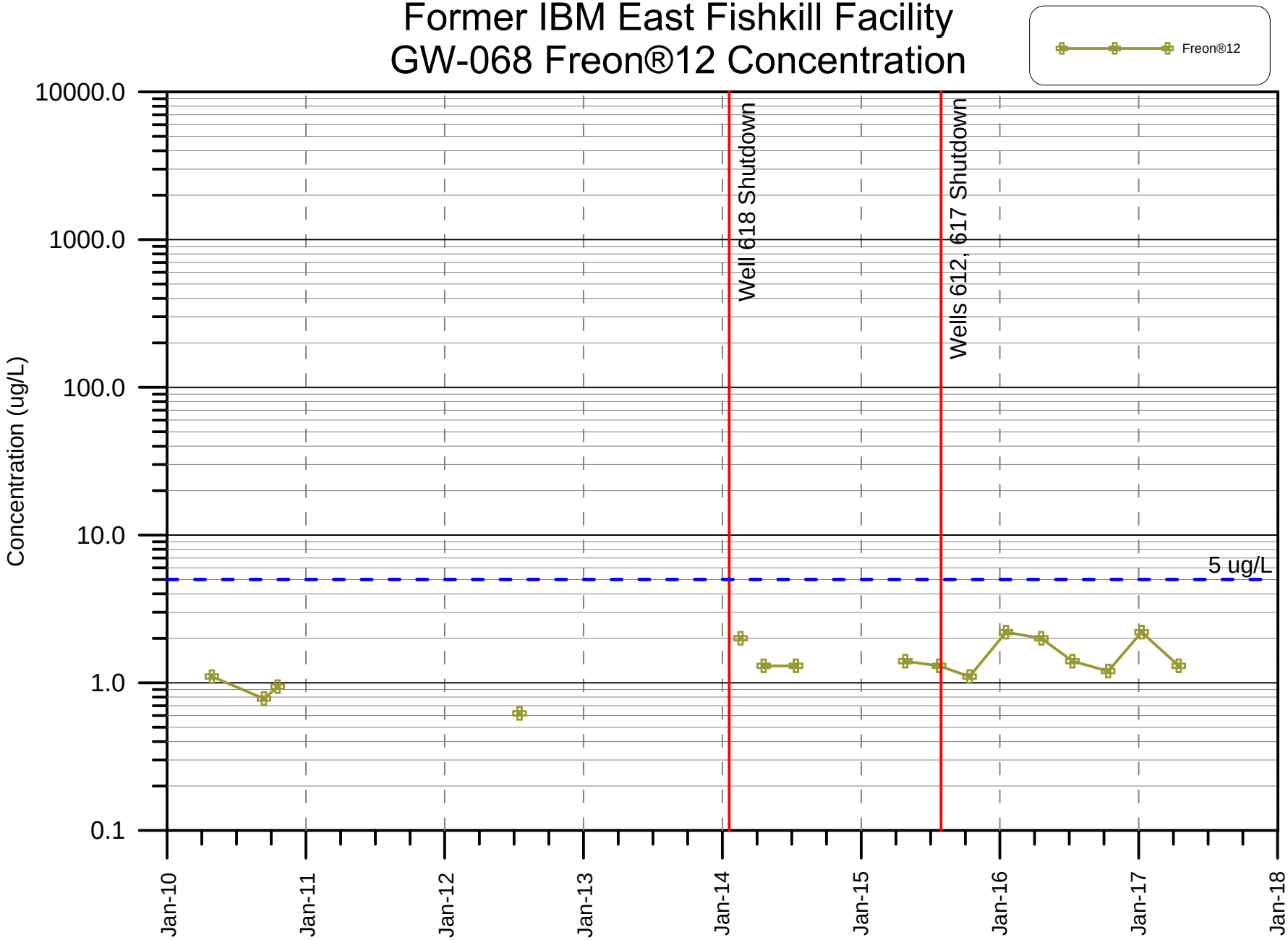

Figure 4
Former IBM East Fishkill Facility
GW-618 Freon®12 Concentration