GROUNDWATER CONCEPTUAL SITE MODEL
HARSHAW FUSRAP SITE

U.S. Army Corps of Engineers
Buffalo District

Building Strong®

Formerly Utilized Sites Remedial Action Program (FUSRAP)

November 2010

Site Description and Location

The Harshaw Chemical Company is located at 1000 Harvard Avenue, in Cleveland, Ohio, approximately three miles south of downtown Cleveland, and it is adjacent to the Cuyahoga River and Big Creek. It is a 55-acre property located in an industrialized area of Cleveland, and includes several developed and undeveloped land parcels. Developed site parcels include former production areas with remaining facility buildings, former production area foundations, parking areas associated with previously demolished buildings, and re-developed privately-owned commercial properties. The site includes areas of pavement, broken pavement, and non-paved (vegetated, dirt, or gravel) surfaces. The Harshaw Site was divided by U.S. Army Corps of Engineers into Investigative Areas (IAs) to aid in Remedial Investigation (RI) planning and fieldwork. Site investigations related to groundwater characterization were developed as a separate investigative area referred to as IA10.

Site History

The Harshaw Chemical Company conducted radiological compound research and production activities under contract to the Manhattan Engineer District (MED) and the Atomic Energy Commission (AEC). Beginning in 1944, the primary role of the former Harshaw Chemical Company was converting uranium concentrate feed materials to uranium tetrafluoride (UF4), uranium hexafluoride (UF6) and uranium trioxide (UO3). These operations ceased by May 1953. UO3 produced from recycled uranium was purified in the Harshaw refinery in 1953 into early 1954, at which point all FUSRAP-related process operations ceased.

Conceptual Model

The Corps follows the process outlined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan for FUSRAP sites. This section describes hydrogeologic conditions at the Harshaw Site and the groundwater monitoring program performed in support of the CERCLA action.

Groundwater monitoring was performed during the remedial investigation and is currently being performed on an annual basis at the Harshaw Site. A total of 57 monitoring wells (MW), temporary piezometers (TP), and temporary well points (TW) were originally installed during both historical investigations and the RI. A total of 14 additional monitoring wells were installed in 2008, to supplement the RI data. Figure 1 shows the location of all the existing groundwater monitoring wells at the Harshaw Site.

Groundwater characterization during the RI was focused on groundwater occurring within the saturated soil zone with most wells located north of Big Creek and west of the Cuyahoga River. Groundwater monitoring focused on this area based on known elevated levels of chemical and radiological contamination associated with former production activities at the site. Monitoring wells were installed in 2008 to extend the monitoring network further south of Big Creek and provide additional groundwater data beyond the former production area.

Hydrogeology

Groundwater flow at the Former Harshaw Chemical Company Site is controlled by the nature of the unconsolidated deposits, the topography of the underlying shale bedrock, and the relative

elevation of the Cuyahoga River and Big Creek. Geologic cross sections for the Harshaw Site have been developed and are presented in Figures A-A' to F-F'.

In general, groundwater flow across the site is from west to east with groundwater flow influenced by changes in surface water levels and flow in the Cuyahoga River and Big Creek to which groundwater discharges (Figures 2 and 3). Groundwater levels are generally highest during the middle to late spring, and lowest during the summer to early fall. A bedrock high in the vicinity of Building G-1 and the Boiler House is responsible for the localized groundwater mounding observed onsite which causes groundwater to flow away from this area of elevated bedrock. The effects of the actively operating pump and treat system on groundwater flow in this area is discussed below in a subsequent section.

There are two groundwater-bearing saturated zones at the site. Primary groundwater flow occurs within the saturated zone of originally deposited (native) sediments that consist of variably textured fluvial sediments. The fluvial sediments underlie more recently place fill materials and overlie shale bedrock which underlies the area. Both the fill and native sediments thicken to the east from the bedrock high toward the Cuyahoga River (Figures A-A' to D-D'). Due to the highly fractured nature of the uppermost portion of shale bedrock at the site, groundwater in the overlying sediments appears to extend into the upper portion of the shale bedrock. Groundwater within this relatively thin, fractured, upper bedrock zone is present as a result of direct contact with the overlying saturated fluvial sediments at the site. Similarities observed between groundwater levels within the fluvial sediment and the fractured bedrock zone suggest these zones are hydraulically connected. Water levels measured in monitoring wells installed during the remedial investigation are shown in Table 1.

Data generated during the RI showed high variation in hydraulic conductivity values across the site due to the heterogeneity of the site lithology. Monitoring wells located to the north and west of the main portion of the site show relatively high groundwater production rates as compared to other wells located on-site. The screened intervals of these wells show a composition of silt and clay, but also an abundance of sand and/or gravel layers, through which groundwater is transmitted.

In contrast, many of the existing pre-RI wells and RI wells located in the main industrial portion of the site proved to be relatively poor producers of groundwater. Clay has been shown to be the predominant soil type in these areas. These low-producing wells within the main developed portions of the site appear to be screened mostly within fill material. These predominantly fine-grained fill materials are poor transmitters of groundwater.

Constituents of Interest and Groundwater Impacts

Constituents of Interest (COIs) identified as groundwater impacts, and associated U.S. Environmental Protection Agency (USEPA) Maximum Contaminant Levels (MCLs) include isotopic radium (5 µg/L), isotopic thorium (15 µg/L), isotopic uranium (30 µg/L), and total uranium (sum of these three isotopes).

The groundwater analysis currently includes monitoring for all the aforementioned COIs. Groundwater analytical data generated during the remedial investigation indicated that the following wells have historically contained COIs above the USEPA MCLs (Tables 2 and 3).

Total Uranium		Thorium-230
BKA-48	IA03-TW0002	IA03-TW0006
DM-15	IA03-TW0005	
DM-27R	IA03-TW0006	
RMW-38	IA04-TW0003	

All monitoring wells, except one, that exceeded USEPA MCLs are located in or adjacent to Building G-1. The location of these wells, in proximity to the location where former uranium feed materials were processed, explains the observed groundwater concentrations. Levels of total uranium in groundwater were also observed to decrease significantly down-gradient of Building G-1 (to the south and east) with increased distance.

A number of the wells adjacent to Building G-1 are no longer sampled due to low groundwater recharge rates (IA03-TW0005, IA03-TW0006 and IA04-TW0003). The samples obtained from these wells during the RI were highly turbid and the results are not representative of groundwater due to the high sediment concentration.

Monitoring well DM-27R, located adjacent to the Cuyahoga River, was sampled during the RI and it exceeded the MCL for total uranium. The casing of DM-27R has since become compromised due to ground movement, and a new well (IA10-MW008) has been installed in the vicinity to capture groundwater samples in this area.

Pump and Treat System Influence

A groundwater pump and treat system (P&T) was installed on-site in June of 1994. It is an owner operated (BASF Group) system of eight bedrock wells that promote localized capture of nickel impacted groundwater in select areas of the site (Figure 4). Each well in the system operates on a water-level float mechanism that actuates a well-specific pump, which routes groundwater to a subsurface trunk line connected directly to the groundwater treatment facility found on site (i.e., all well discharge is coalesced into one feed line to the facility). Each well pumps independently like a sump pump, therefore individual well discharges are unknown and groundwater influx to the treatment facility can have multiple providence. Owner information (anecdotal) indicates the treatment facility averages about five gallons per minute and uses a proprietary resin (or similar material) to remove nickel from the groundwater, which supposedly is discharged to the Cleveland sewer system. The Corps was not allowed to sample effluent when operating due to the proprietary nature of the facility. The Corps has witnessed long periods of system shut down and non-operation of the individual wells, thus the reliability of the average pumping data is unknown.

Water level variations of selected monitoring wells, related to the P&T system operation, were analyzed during the RI. A comparison of static water levels against operating extraction system levels is presented in Table 4. The estimated zone of influence (ZOI) (Figure 4), indicates the pump and treat system preferentially captures groundwater in an upgradient direction, as would be expected. This ZOI is colocated with an area that shows highly nickel-impacted groundwater, so the system is targeting the intended area of interest.

As previously mentioned, monitoring wells in and adjacent to Building G-1 are known to contain elevated levels of total uranium. If uranium is drawn into the system in the P&T Well #1 and #2 area west of Building G-1, the system may capture groundwater impacted at uranium levels that would be a drinking water concern. The Corps is not privy to operational data from this system, so the levels of uranium uptake by the system and exchange media are unknown.

The northwestward extent of the uranium plume may then have a two-fold reason for this morphology:

- Soil contamination leaching to the groundwater within the light orange hatched area in Figure 2 (i.e. areas of soil concentration higher than 30pCi/g total U).
- The draw of contaminated groundwater impacts have noticeably overlying soil impacts and the geochemical environment around Building G-1/G-2 plant towards the two northernmost pumping wells.

Both of these reasons are viable and contribute to the observed plume outline.

If greater uranium impacts to groundwater were seen historically in the western part of the site, then the P&T system may have partly captured it since installation. This is speculative though since most groundwater impacts have noticeable overlying soil impacts and the geochemical environment around Building G-1 does not promote high uranium flux through the soil.

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Table 1. Groundwater Level Measurement Events

Well Identification	OHSP Easting (ft)	OHSP Northing (ft)	TOC Elevation (ft)	Ground Surface Elevation (ft)	Water Levels									
					06/03/2003 Event	07/03/2003 Event	12/03/2003 Event	05/23/2004 Event	08/24/2004 Event	08/27/2004 Event	10/21/2004 Event	12/14/2004 Event	05/03/2005 Event	11/16/2006 Event
BKA-48	2191690	650842.78	594.8675	592.6951	581.6651	583.2067	584.7575	586.6475	581.9675	581.8775	581.6275	584.1475	586.1475	584.6475
BKA-51	2191592.3	649653.75	595.7644	593.1833	568.6833	582.3963	576.8944	585.0444	575.1244	NM	574.8344	576.1944	577.9044	579.3044
BKA-52	2191758.1	649730.48	593.1334	593.4032	573.9032	578.8188	575.7134	585.4634	574.1534	NM	573.8734	575.0334	576.3334	NM[a]
BKA-53	2191937.3	649459.32	593.3973	591.1571	571.3571	580.0958	575.4173	585.9173	573.7973	NM	573.6573	574.8773	575.5873	580.0473
BKG-MW0001	2191081.1	649708.88	592.0973	592.6716	NM[a]	NM[a]	581.3073	584.0173	580.5873	NM	580.3973	592.0973	582.3573	581.9873
BKG-MW0002	2191322	649989.17	593.4181	594.3908	NM[a]	NM[a]	581.8681	580.0281	580.0081	NM	578.3281	577.8981	581.0081	580.4081
BKG-MW0003	2191324.8	650473.3	591.9827	592.7324	NM[a]	NM[a]	584.7727	587.2527	582.2827	NM	581.7327	583.9727	586.7627	NM[a]
BKG-MW0004	2191331.2	650541.24	592.3026	592.6853	NM[a]	NM[a]	584.8026	587.1626	582.2826	NM	581.6926	583.9626	586.7426	584.3226
BKG-MW0005	2191218.2	651099.73	592.196	592.3664	NM[a]	NM[a]	584.596	586.476	582.126	NM	581.766	583.916	585.996	583.806
CDT-MW0001	2191310.4	649612.52	588.0922	588.4163	NM[b]	NM[b]	578.7922	583.4122	577.3022	NM	577.0422	578.1022	580.5722	NM[a]
CDT-MW0002	2191471.7	649538.84	587.2084	587.4314	NM[b]	NM[b]	577.6984	581.0484	575.8084	NM	575.2484	576.0984	577.9584	NM[a]
DM-1	2191465.8	650137.02	596.1269	593.7089	580.6689	584.9362	582.7469	582.3169	581.6169	578.0869	578.4369	580.7969	586.0569	585.2369
DM-10	2191405.9	650534.87	592.7064	593.2064	582.7	583.38	583.14	585.6064	580.5764	580.4664	579.9864	582.3664	585.2664	NM[a]
DM-11	2191520.5	650597.82	595.8884	593.8771	582.1671	584.4113	585.2884	587.8384	582.3484	582.2184	581.6684	584.5984	587.3284	584.4884
DM-12	2191426	650643.8	596.1311	593.9329	581.7929	583.7085	584.9311	587.3211	582.1611	582.0611	581.6211	584.1611	587.0211	584.2811
DM-14	2191443.5	650747.03	596.3342	594.1857	581.4157	581.922	584.7342	587.1042	582.0542	581.9042	581.5142	584.0642	586.9242	584.4142
DM-15	2191564.9	650795.45	596.4613	594.2605	581.2705	581.7972	584.7213	587.1113	582.0613	581.8913	581.2813	584.2513	586.7513	584.0313
DM-2	2191511.8	650188.4	594.0159	594.2506	586.3806	586.8162	586.8459	589.1559	584.7359	584.5059	582.8659	586.2159	586.0859	587.0259
DM-22R	2191721.4	649560.49	594.8122	592.6995	571.7095	579.0609	575.8422	585.9622	574.0822	NM	573.8822	575.2022	576.1222	579.9022
DM-23R	2191933.5	649357.34	593.0635	590.817	571.347	583.6618	575.6035	586.1835	573.8435	NM	573.7035	575.0235	575.7335	580.2635
DM-25R	2191937.1	650039.94	592.8395	593.3682	573.6182	575.8782	575.3595	582.4295	573.9495	NM	573.5395	574.5295	575.5995	578.1295
DM-26	2191850.7	650200.89	592.986	593.4788	574.0588	575.7864	575.536	582.366	574.406	NM	573.966	574.616	576.316	580.296
DM-27R	2192072.4	650184.85	594.778	592.2889	570.7089	572.5346	575.198	582.238	573.848	NM	573.388	574.358	575.258	577.988
DM-28R	2192219.3	650346.09	595.0901	592.571	570.301	577.5188	574.5101	583.6401	573.3901	NM	572.9301	573.9501	574.7401	579.0301
DM-29R	2192116.3	650463.86	595.4928	593.1618	570.8118	579.6565	574.6328	582.9328	573.5328	NM	572.9628	574.0228	575.0028	578.1728
DM-3	2191431.2	650291.16	594.1355	594.4801	592.1101	590.9601	592.5055	592.7555	591.6555	591.4855	591.6055	592.6255	592.4655	592.8055
DM-30R	2192328.3	650525.05	594.9123	593.0228	570.8028	576.3969	574.3623	582.9423	573.3023	NM	572.7123	573.8023	574.6923	578.2323
DM-4	2191471.9	650294.53	593.8376	594.202	589.832	589.1376	590.1376	590.8976	589.0976	588.9176	588.6476	589.9676	590.4176	589.7376
DM-5	2191432.2	650360.73	596.3614	594.1329	581.9929	582.6113	584.9914	587.2014	582.6714	582.5614	582.0914	584.2514	587.0814	584.9514
DM-9	2191527	650452.64	598.0055	594.8335	583.9335	582.731	584.1855	586.3355	581.7655	581.5155	581.0655	583.6155	585.9655	584.0955
ERM-47	2191934.6	650347.59	593.0587	593.5637	573.5637	577.4317	NM	583.4287	574.0787	NM	573.4387	574.4587	575.8887	579.1787
IA03-TP0001	2191564.5	650912.66	594.1646	591.503	NM[a]	NM[a]	NM	NM	NM	NM	580.7046	582.8446	582.8446	582.6746
IA03-TW0001	2191929.1	650543.65	596.5031	593.9031	NM[a]	589.2831	NM	589.9531	588.7931	NM	591.3031	591.9731	586.8731	592.8031
IA03-TW0002	2191860.4	650782.56	595.39	592	NM[a]	581.57	585.98	586.77	585.22	NM	584.71	585.08	586.61	586.35
IA03-TW0003	2191537.9	650917.84	593.3908	590.4908	NM[a]	580.6008	582.1408	584.4608	579.4308	579.3708	579.3108	581.4108	583.0608	NM[a]
IA03-TW0004	2191684.6	650974.55	592.9191	589.7991	NM[a]	582.0991	583.4491	584.9691	580.6691	NM	580.3391	582.8891	584.5391	583.2791
IA03-TW0005[d]	2191736.9	650685.07	NA	596	NM[a]	NM[a]	NM	591.4	594.6	NM	NM	587.6351	591.3451	NM[a]
IA03-TW0006[d]	2191832.9	650657.07	NA	596	NM[a]	NM[a]	NM	NM	595	NM	NM	587.5951	591.3251	NM[a]
IA04-TP0001	2191682.6	650370.27	596.3221	594.3403	NM[a]	NM[a]	NM	595	585.5121	NM	584.0821	584.7521	585.4021	584.0721
IA04-TP0002	2191844.2	650322.94	595.7426	593.3293	NM[a]	NM[a]	NM	582.1226	574.5826	NM	573.9026	574.6726	576.3926	577.5526
IA04-TP0003	2192021.5	650325.15	595.3946	592.7745	NM[a]	NM[a]	NM	NM	573.8046	NM	573.2746	574.1846	574.1846	578.1946
IA04-TP0004	2192065.1	650553.99	595.2046	593.3016	NM[a]	NM[a]	NM	582.3946	578.2946	NM	578.6546	580.3946	581.9546	580.8546
IA04-TP0005	2192240.1	650616.47	594.4736	591.9167	NM[a]	NM[a]	NM	576.1136	573.3936	NM	572.8236	573.6236	574.8336	578.0136
IA04-TW0001	2191867.5	649878.02	595.1598	592.7098	NM[a]	576.5798	575.0598	582.3398	573.5998	NM	573.1898	574.4498	575.3698	NM[a]

Source: Former Harshaw Chemical Site
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Table 1. Groundwater Level Measurement Events (continued)

Well Identification	OHSP Easting (ft)	OHSP Northing (ft)	TOC Elevation (ft)	Ground Surface Elevation (ft)	Water Levels									
					06/03/2003 Event	07/03/2003 Event	12/03/2003 Event	05/23/2004 Event	08/24/2004 Event	08/27/2004 Event	10/21/2004 Event	12/14/2004 Event	05/03/2005 Event	11/16/2006 Event
IA04-TW0002	2191510.3	649967.14	593.5893	591.8593	NM[a]	579.3193	577.7893	NM	576.2793	NM	575.6693	576.9093	579.1593	NM[a]
IA04-TW0003	2192075.2	650700.56	596.0285	592.9385	NM[a]	579.4585	585.8685	585.4185	583.5185	NM	583.3885	585.7085	586.5285	586.2985
IA04-TW0004	2192426.4	650466.22	594.4423	591.2223	NM[a]	577.6923	575.8623	584.8923	574.7423	NM	574.1323	575.2823	576.1223	NM[a]
IA04-TW0005	2192128	650840.91	593.234	590.244	NM[a]	583.074	583.034	584.824	581.184	NM	580.594	582.224	584.164	582.754
IA04-TW0006	2192521.6	650652.21	589.7125	586.3525	NM[a]	574.0025	572.6725	576.9025	571.6925	NM	571.2125	571.9825	573.0625	574.8325
IA05-TW0001	2191929.2	649644.71	598.6367	596.2667	NM[a]	580.1567	578.4367	578.8267	577.0267	NM	576.8067	577.9267	578.6567	NM[a]
IA10-MW0001	2191641.1	651100.68	593.856	591.6059	NM[a]	NM[a]	584.926	586.356	581.936	NM	581.676	585.356	585.826	584.656
IA10-MW0002	2191965.7	650913.46	595.7199	593.6943	NM[a]	NM[a]	584.8699	586.3899	582.1499	NM	581.7699	584.1199	585.9899	584.6699
IA10-MW0003	2191901.6	650614.32	597.9843	595.5487	NM[a]	NM[a]	585.1543	585.6643	583.3843	NM	582.8543	584.1843	586.4743	584.7843
IA10-MW0004	2192091.1	650693.74	595.8802	593.5437	NM[a]	NM[a]	585.8802	587.5102	582.6702	NM	581.8002	584.5202	586.7602	585.5502
RMW-35	2191566.1	650682.82	596.4441	594.6467	582.5467	583.8734	585.4441	587.9341	582.6441	NM	581.8441	584.7841	587.2441	NM[a]
RMW-38	2191739	650453.12	596.7645	594.546	583.336	586.0111	NM	587.7645	584.7145	NM	583.8645	585.3545	587.5345	586.2645
RMW-39	2191523.3	650696.53	595.9333	593.7831	581.8431	584.1216	585.3833	587.4933	582.4333	582.2133	581.4333	585.1533	587.2133	584.8733

[a] Well not installed at the time.

[b] Well not accessible due to property rights of entry.

NA – not applicable

NM - not measured

OHSP – Ohio State Plane

TOC – Top of Casing

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Table 2. RI Data Summary - IA10 Phase I Groundwater Significant COPC Results

Station	Sample Number	Th-230 (pCi/L)	Total Uranium (µg/L)	Lithium (µg/L)
BKA48	HSGW0015		**578**	
BKA48	HSGW0041	**0.814** (U)	**367**	**110** (J)
BKA51	HSGW0030		0.0771 (U)	
BKA52	HSGW0029		0.119 (U)	
BKA53	HSGW0007		0.0233 (U)	
BKA53	HSGW0043	-0.0595 (U)	0 (U)	33 (J)
CDT-MW0001	HSGW0077	**0.621** (U)	0.309	**35.7** (J)
CDT-MW0002	HSGW0075	0.236 (U)	-0.0751 (U)	19.6 (J)
DM1	HSGW0024		0 (U)	
DM1	HSGW0038	0.166 (U)	0 (U)	**86.6** (J)
DM10	HSGW0014		0.125 (U)	
DM11	HSGW0017		-0.0392 (U)	
DM12	HSGW0006		0.224	
DM12	HSGW0042	0.145 (U)	0 (U)	30.9 (J)
DM14	HSGW0019		3.56	
DM14	HSGW0079	**1.09** (U)	3.04	**451** (J)
DM15	HSGW0018		**20.5**	
DM2	HSGW0025		0.316	
DM22R	HSGW0032		0 (U)	
DM22R	HSGW0044	0.287 (U)	0 (U)	17.2 (J)
DM23R	HSGW0033		0.557	
DM25R	HSGW0008		0.0602 (U)	
DM25R	HSGW0039	0.184 (U)	0.293	12.8 (J)
DM26	HSGW0022		0.199	
DM27R	HSGW0013		**15.9**	
DM27R	HSGW0073	**0.863** (U)	**23.3**	28.1 (J)
DM28R	HSGW0010		0.559	
DM28R	HSGW0040	0.264 (U)	0 (U)	**154** (J)
DM29R	HSGW0009		0.484	
DM3	HSGW0016		0.127 (U)	
DM30R	HSGW0026		0.189 (U)	
DM30R	HSGW0078	1.07 (U)	-0.351 (U)	**104** (J)
DM4	HSGW0021		0 (U)	
DM5	HSGW0012		0.341	
DM5	HSGW0076	**0.567** (J)	0.228	24.3 (J)
DM9	HSGW0011		0.293	
ERM47	HSGW0028		0.037 (U)	
ERM47	HSGW0074	**0.938** (J)	-0.0933 (U)	**154** (J)
IA03-TW0001	HSGW0045		5.32	
IA03-TW0002	HSGW0046		**38.9**	
IA03-TW0003	HSGW0047		0 (U)	
IA03-TW0004	HSGW0051		0.225	
IA03-TW0005	HSGW0055		**4130**	
IA03-TW0005	HSGW0082			**142** (J)

Source: Former Harshaw Chemical Site
Remedial Investigation Report
Revision 1
December 2009

US Army Corps of Engineers
Buffalo District
BUILDING STRONG®

Table 2. RI Data Summary - IA10 Phase I Groundwater Significant COPC Results (continued)

Station	Sample Number	Th-230 (pCi/L)	Total Uranium (µg/L)	Lithium (µg/L)
IA04-TW0001	HSGW0054		0 (U)	
IA04-TW0002	HSGW0052		0 (U)	
IA04-TW0002	HSGW0081			10.4 (J)
IA04-TW0003	HSGW0048		**96.4**	
IA04-TW0004	HSGW0056		**9.89**	
IA04-TW0004	HSGW0080			**210** (J)
IA04-TW0005	HSGW0050		0 (U)	
IA04-TW0006	HSGW0049		0 (U)	
IA05-TW0001	HSGW0053		0.117 (U)	
IA10-MW0001	HSGW0088	**0.459** (U)	**29.3**	**58.1** (J)
IA10-MW0002	HSGW0089	0.208 (U)	0.289	**40.7** (J)
IA10-MW0003	HSGW0090	**0.424** (U)	6.26	**144** (J)
IA10-MW0004	HSGW0091	0.281 (U)	**9.46**	**102** (J)
RMW35	HSGW0023		1.85	
RMW38	HSGW0027		**38.2**	
RMW38	HSGW0037	0.417 (U)	**82.3**	**124** (J)
RMW39	HSGW0020		4.24	

U - not detected

Bold indicates values above background.

Results for Total Uranium (chemical) are presented from KPA method.

Lithium not included in RI Phase II sampling.

For a full explanation of presented data surrogates and their rationales see Table 8-1.

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Table 3. RI Data Summary - IA10 Phase II Groundwater Significant COPC Results

Station	Sample No	Th-230 (pCi/L)	Total Uranium (µg/L)
BKA48	HSGW-0103	0.15 (U)	**453.00**
BKA53	HSGW-0125	**0.80** (U)	0.22
CDT-MW0001	HSGW-0097	**0.52** (U)	0.00 (U)
CDT-MW0002	HSGW-0098	**0.68** (U)	0.00 (U)
DM11	HSGW-0110	0.03 (U)	0.26
DM15	HSGW-0104	**1.76**	**29.80**
DM23R	HSGW-0126	0.05 (U)	1.38
DM25R	HSGW-0124	**1.41** (U)	-0.02 (U)
DM26	HSGW-0122	**0.60** (U)	0.11 (U)
DM27R	HSGW-0123	**0.91**	**40.50**
DM28R	HSGW-0121	**1.12** (U)	-0.05 (U)
DM29R	HSGW-0118	**1.02** (U)	0.66
DM30R	HSGW-0113	**0.82** (U)	0.10 (U)
DM9	HSGW-0115	0.09 (U)	0.26
IA03-TP0001	HSGW-0106	**0.59** (U)	1.26
IA03-TW0002	HSGW-0105		**27.00**
IA03-TW0004	HSGW-0100	**0.51** (U)	0.58
IA03-TW0005	HSGW-0109	**0.79**	**1,170.00**
IA03-TW0006	HSGW-0130		**184,000.00**
IA03-TW0006	HSGW-0131	**17,400.00**	
IA04-TP0001	HSGW-0119	0.27 (U)	**10.20**
IA04-TP0002	HSGW-0120	0.26 (U)	0.42
IA04-TP0003	HSGW-0117	**0.44** (U)	0.00 (U)
IA04-TP0004	HSGW-0101	**0.93** (U)	0.79
IA04-TP0005	HSGW-0112	**1.49**	1.27
IA04-TW0004	HSGW-0114	**1.03** (U)	4.81
IA10-MW0001	HSGW-0099	**0.66** (U)	6.63
IA10-MW0002	HSGW-0102	**0.70** (U)	0.79
IA10-MW0003	HSGW-0111	**0.85**	**11.60**
IA10-MW0004	HSGW-0107	0.37 (U)	5.77
RMW35	HSGW-0108	**1.11** (U)	2.39
RMW38	HSGW-0116	**0.62** (U)	**54.00**

U - not detected

Bold indicates values above background.

Results for Total Uranium (chemical) are presented from KPA method.

Lithium not included in RI Phase II sampling.

For a full explanation of presented data surrogates and their rationales see Table 8-1.

Source: Former Harshaw Chemical Site
Remedial Investigation Report
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Table 4. Comparison of Static Water Levels Against Operating Extraction System Levels

Well	Non-Operating Condition		Operating Condition		Drawdown	Distance[a] (ft)
	8/24/2004	8/24/2004	8/27/2004	8/27/2004		
BKA-48	12.90	581.97	12.99	581.88	0.09	70
DM-15	14.40	582.06	14.57	581.89	0.17	18
DM-1	14.51	581.62	18.04	578.09	3.53	3
DM-2	9.28	584.74	9.51	584.51	0.23	11
DM-10	12.13	580.58	12.24	580.47	0.11	120
DM-11	13.54	582.35	13.67	582.22	0.13	10
DM-12	13.97	582.16	14.07	582.06	0.10	95
DM-14	14.28	582.05	14.43	581.90	0.15	83
RMW-39	13.50	582.43	13.72	582.21	0.22	13
DM-3	2.48	591.66	2.65	591.49	0.17	125
DM-4	4.74	589.10	4.92	588.92	0.18	82
DM-5	13.69	582.67	13.80	582.56	0.11	110
DM-9	16.24	581.77	16.49	581.52	0.25	10
IA03-TP0001	13.24	580.93	13.31	580.86	0.07	55
IA03-TW0003	13.96	579.43	14.02	579.37	0.06	80
		Without DM-1				
Minimum Drawdown	0.06	0.06				
Maximum Drawdown	3.53	0.25				
Average Drawdown	0.37	0.14				

[a]Indicates distance to nearest point along the sewer line during pumping.

Source: Former Harshaw Chemical Site
Remedial Investigation Report
Revision 1
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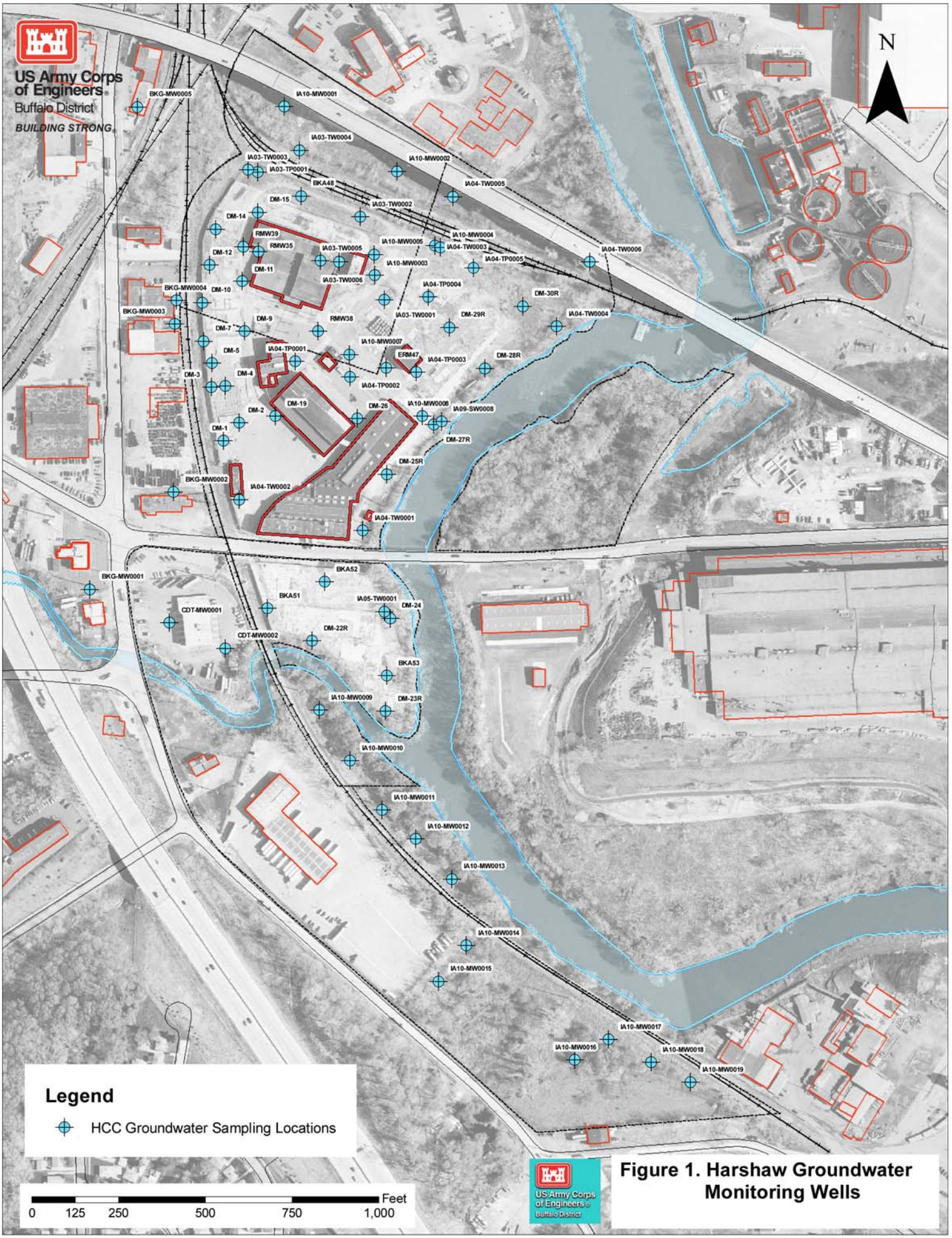
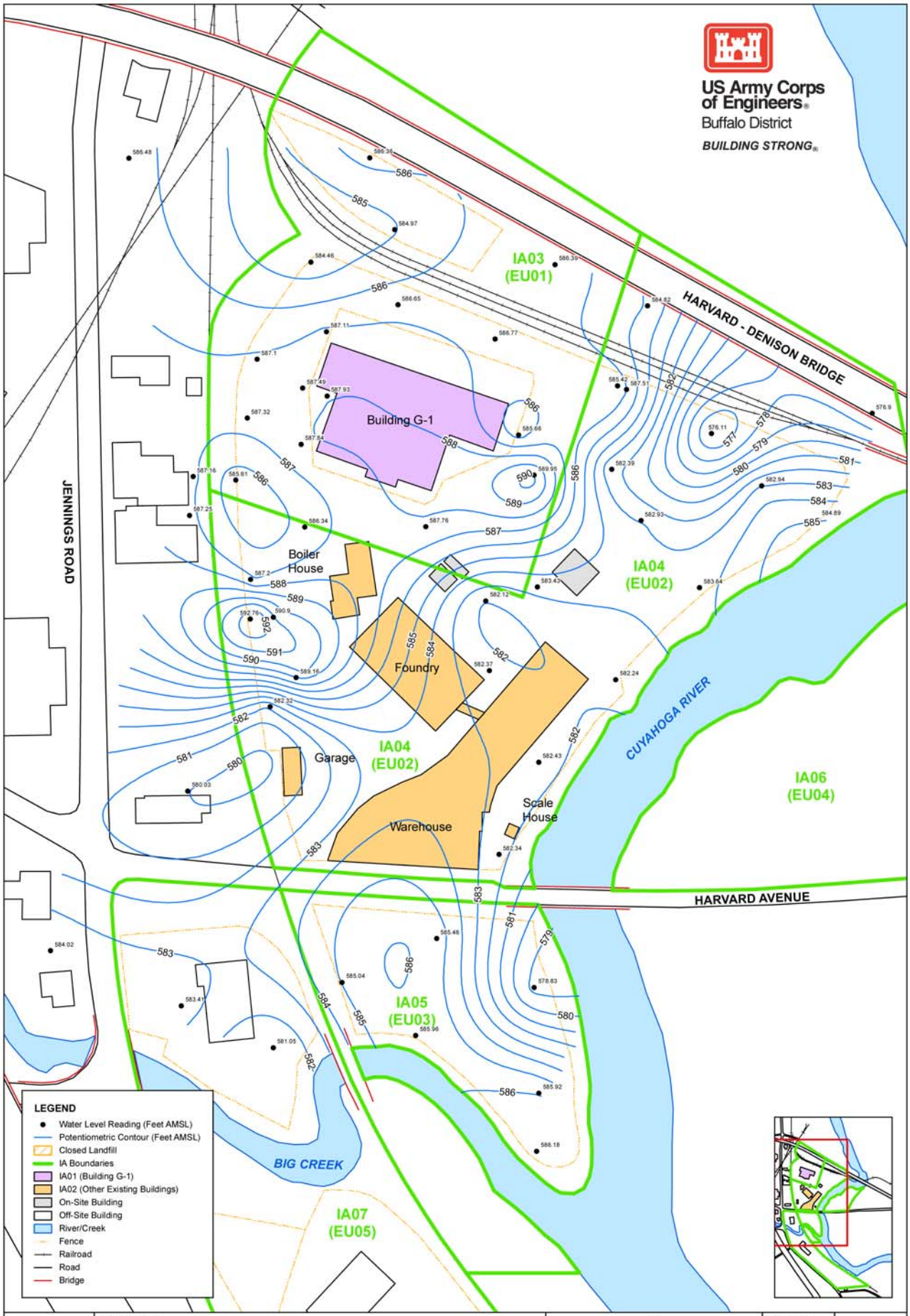
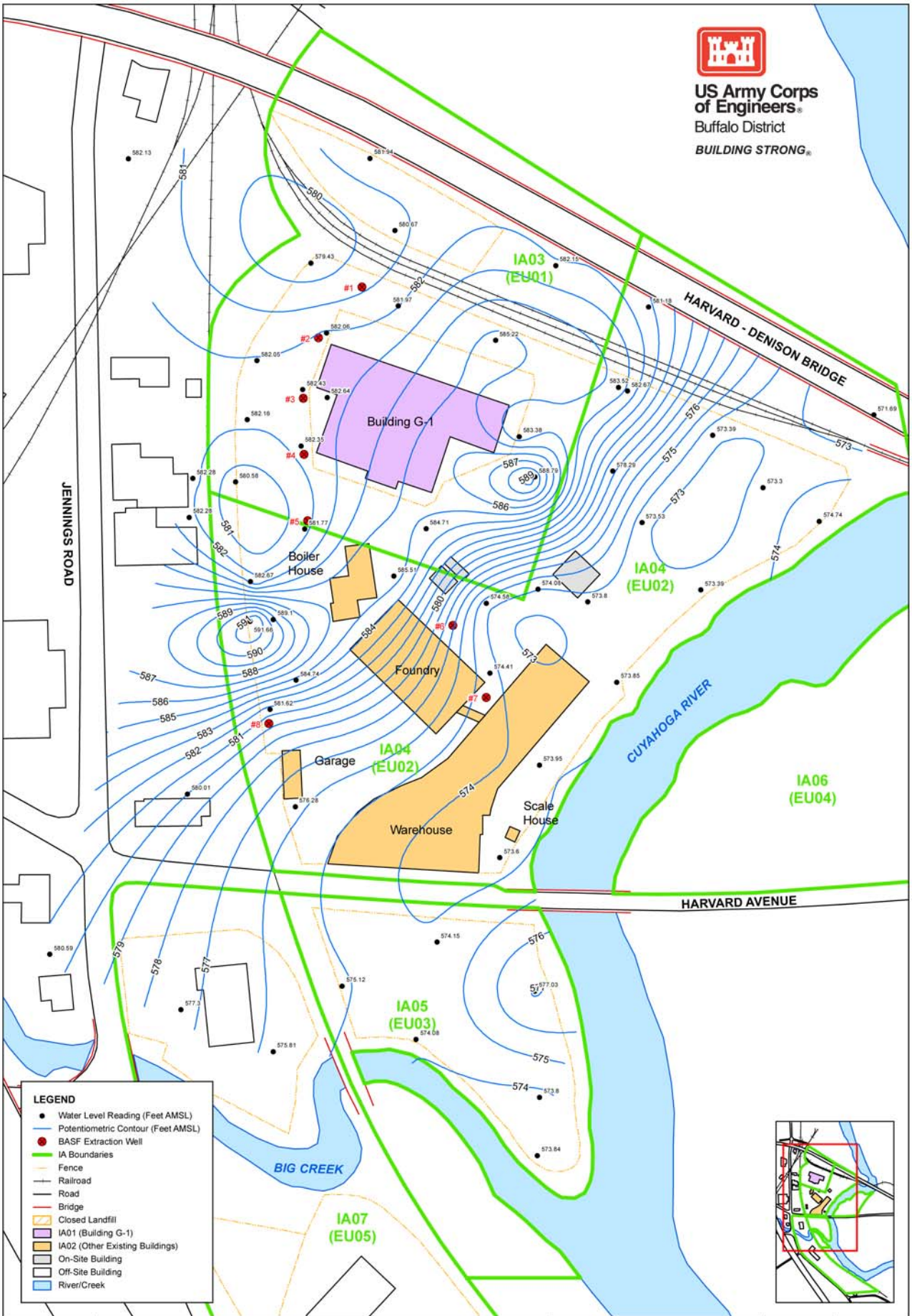


Figure 1. Harshaw Groundwater Monitoring Wells



SAIC From Science to Solutions™	PROJECT NAME: Former Harshaw Chemical Site Remedial Investigation Report DRAWING TITLE: Figure 2: Groundwater Potentionmetric Surface Map: May 2004		DRAWN BY: JDV 10/17/08 CHECKED BY: JG 10/17/08	Figure 2



SAIC From Science to Solutions

PROJECT NAME:
Former Harshaw Chemical Site Remedial Investigation Report

DRAWING TITLE:
Figure 3: Groundwater Potentiometric Surface Map: August 2004

DRAWN BY:
JDV 10/17/08

CHECKED BY:
JG 10/17/08

Figure 3

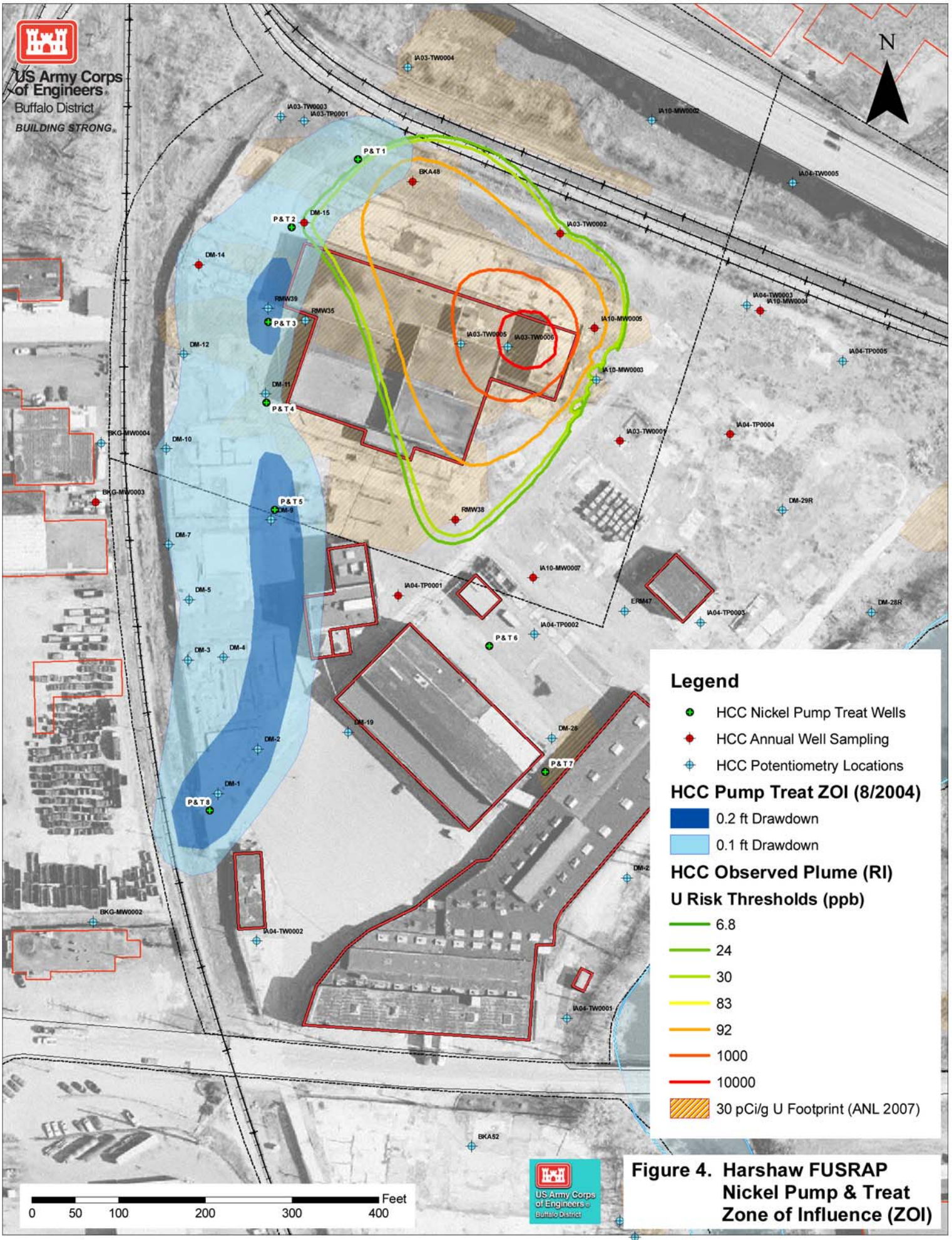
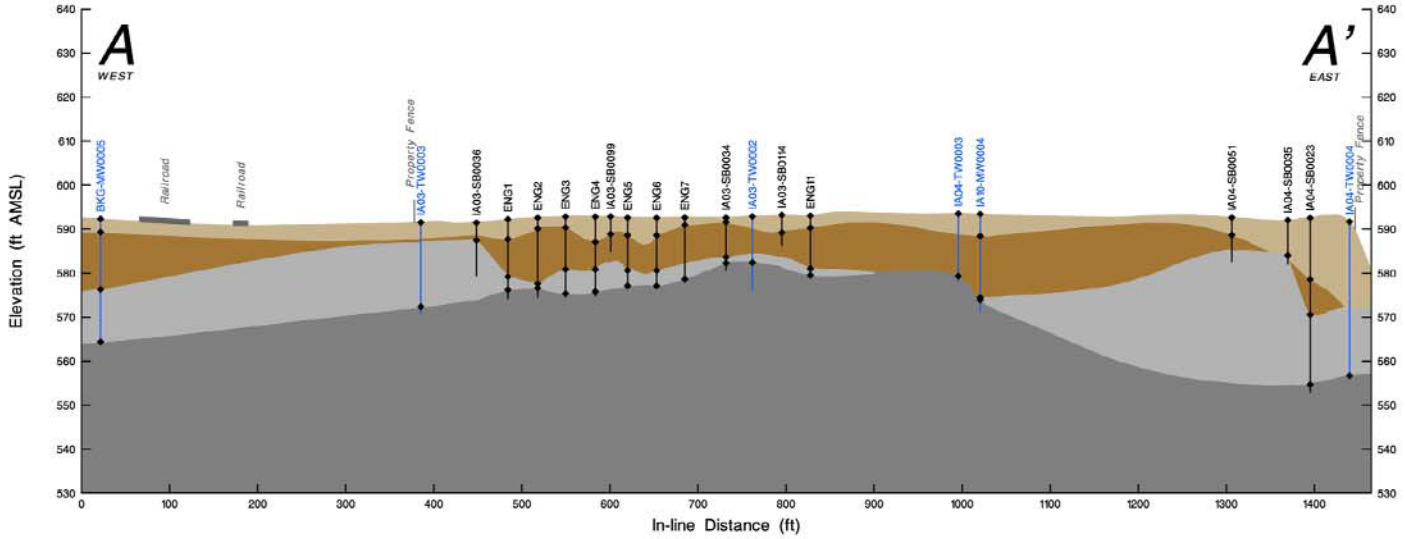
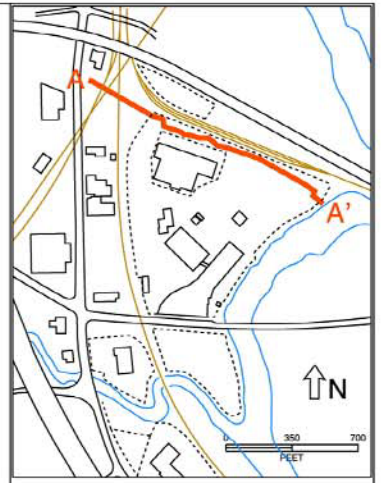


Figure 4. Harshaw FUSRAP Nickel Pump & Treat Zone of Influence (ZOI)





Notes

1. Scale as shown; vertical exaggeration = 5x.
2. Cross-section is cut from a 3D geologic model developed from borehole stratigraphic picks (diamond symbols). Only wells lying on the traverse are posted on the section. However, off-section wells impact the displayed stratigraphic interpretations.

Well/Boring Symbology

Statigraphic Units

- New Fill
- Old Fill
- Native Sediment
- Bedrock

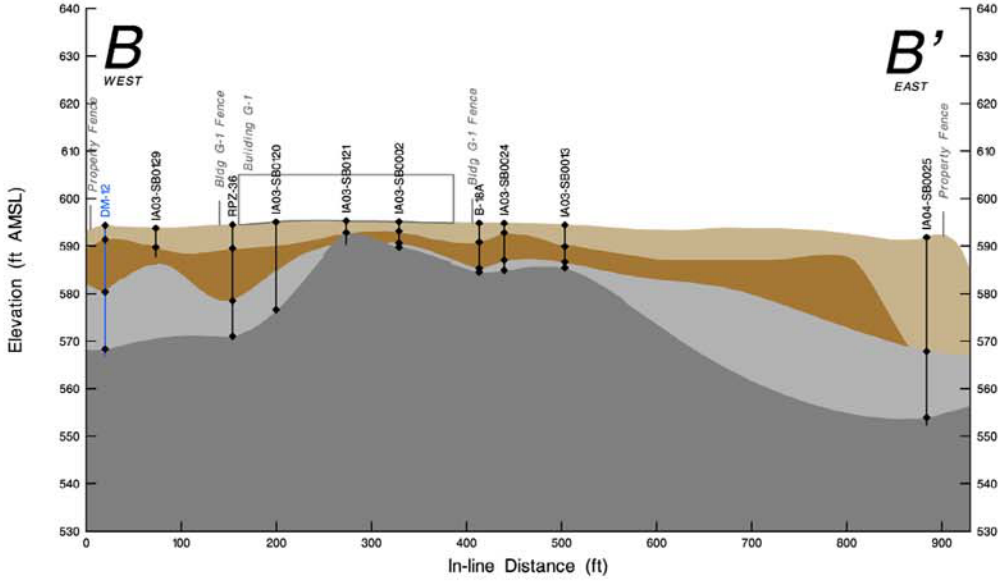
US Army Corps of Engineers.

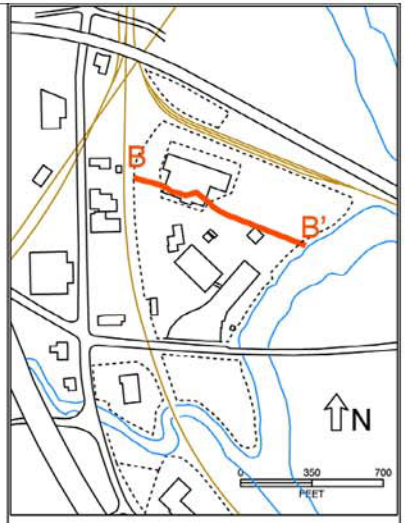
Geologic Cross-Section A-A'

Former Harshaw Chemical Company Site

Date: 2010-06-08 *File/Loc: A-A.plt&.pdf/TwinsOH*

Revision: 0.0 *Analyst: VoorhiesN*

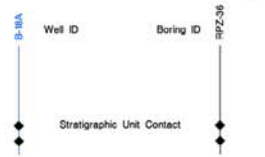




Notes

1. Scale as shown; vertical exaggeration = 5x.
2. Cross-section is cut from a 3D geologic model developed from borehole stratigraphic picks (diamond symbols). Only wells lying on the traverse are posted on the section. However, off-section wells impact the displayed stratigraphic interpretations.

Well/Boring Symbology



Statigraphic Units

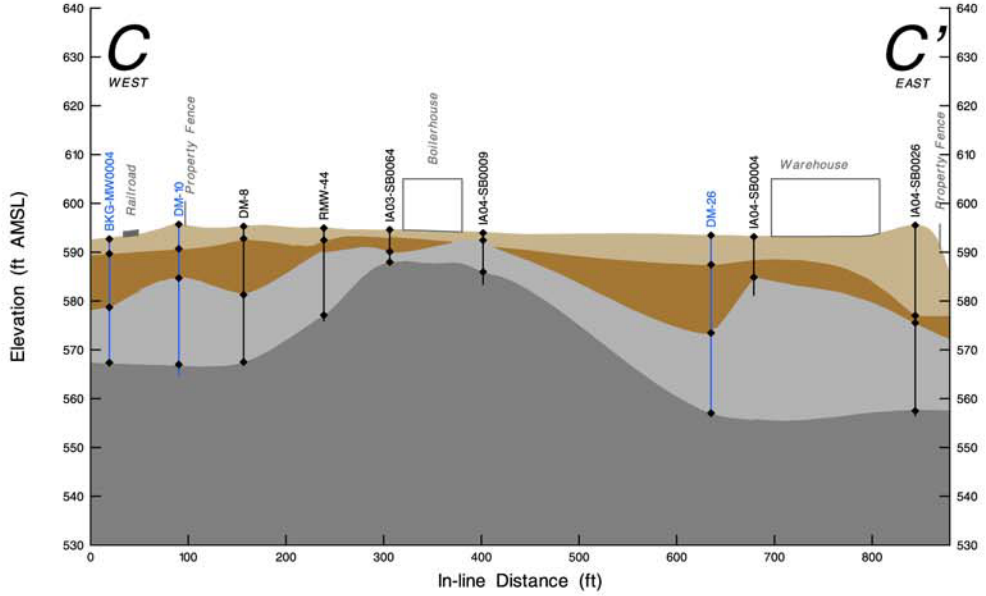
US Army Corps of Engineers

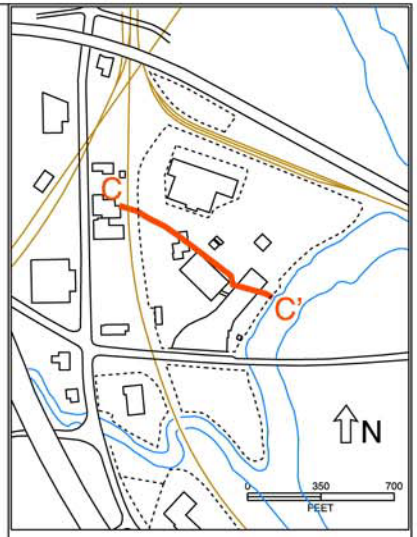
Geologic Cross-Section B-B'

Former Harshaw Chemical Company Site

Date: 2010-06-08 *File/Loc: B-B.plt&pdf/TwinsOH*

Revision: 0.0 *Analyst: VoorhiesN*





Notes

1. Scale as shown; vertical exaggeration = 5x.
2. Cross-section is cut from a 3D geologic model developed from borehole stratigraphic picks (diamond symbols). Only wells lying on the traverse are posted on the section. However, off-section wells impact the displayed stratigraphic interpretations.

Well/Boring Symbology

Statigraphic Units

- New Fill
- Old Fill
- Native Sediment
- Bedrock

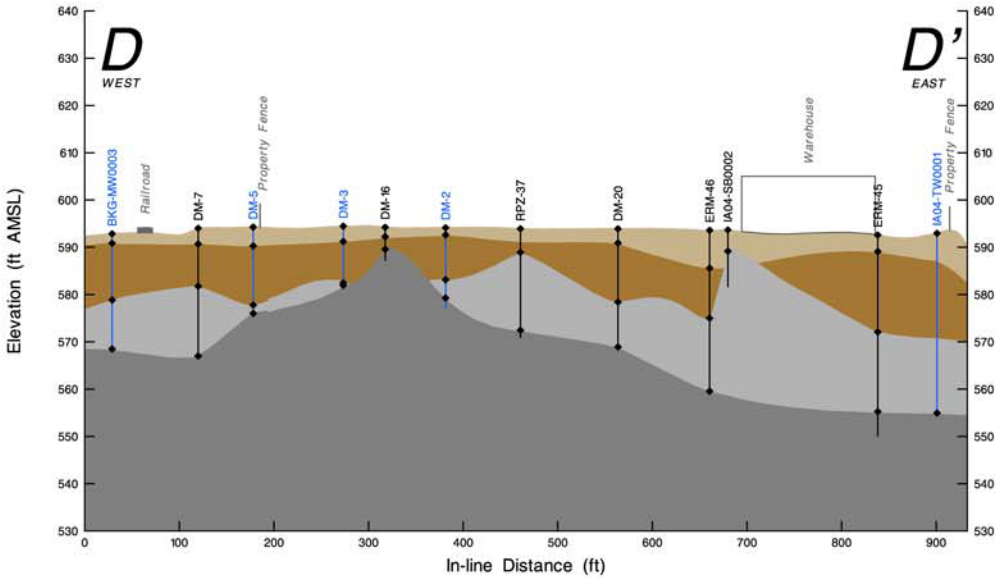
US Army Corps of Engineers.

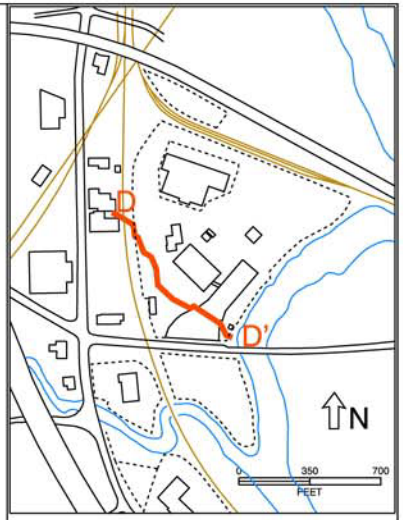
Geologic Cross-Section C-C'

Former Harshaw Chemical Company Site

Date: 2010-06-08 *File/Loc: C-C.plt&.pdf/TwinsOH*

Revision: 0.0 *Analyst: VoorhiesN*

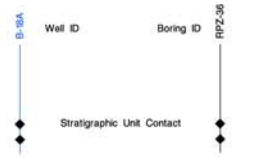




Notes

1. Scale as shown; vertical exaggeration = 5x.
2. Cross-section is cut from a 3D geologic model developed from borehole stratigraphic picks (diamond symbols). Only wells lying on the traverse are posted on the section. However, off-section wells impact the displayed stratigraphic interpretations.

Well/Boring Symbology



Statigraphic Units

- New Fill
- Old Fill
- Native Sediment
- Bedrock

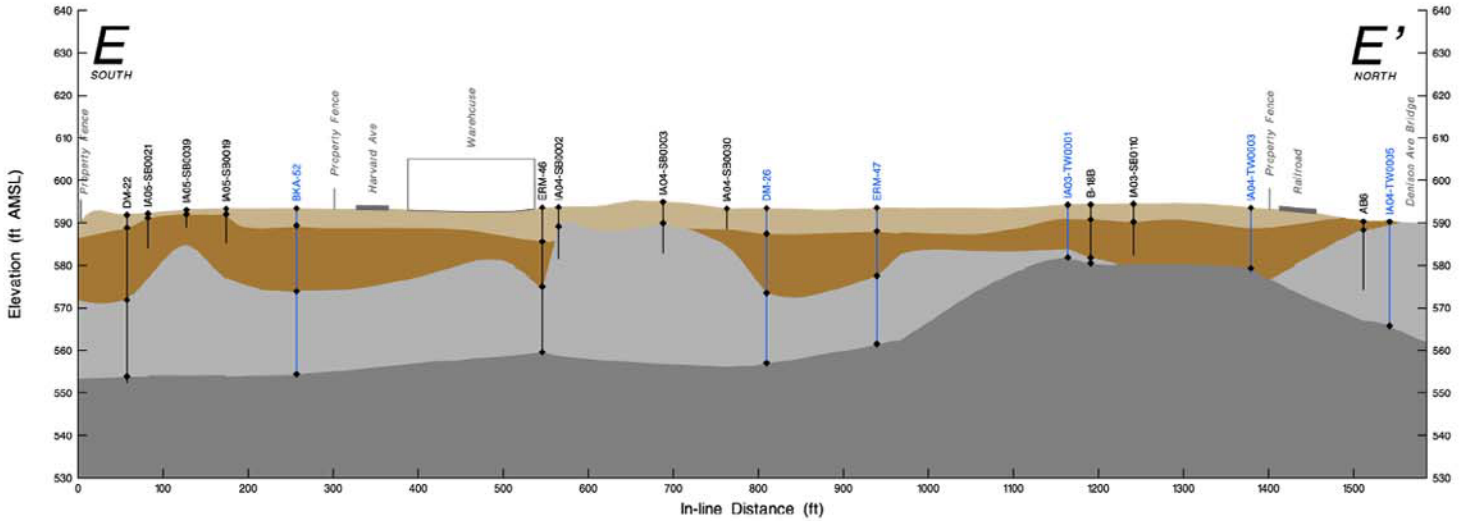
US Army Corps of Engineers

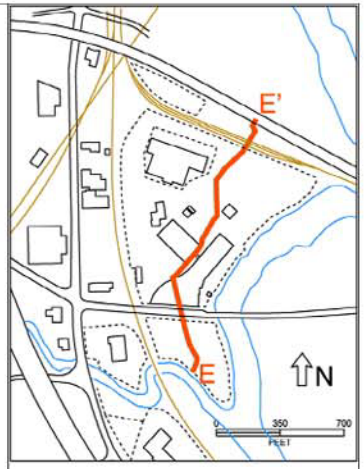
Geologic Cross-Section D-D'

Former Harshaw Chemical Company Site

Date: 2010-06-08 *File/Loc: D-D.plt&.pdf/TwinsOH*

Revision: 0.0 *Analyst: VoorhiesN*

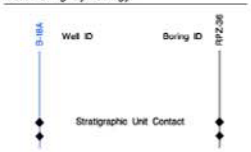




Notes

1. Scale as shown; vertical exaggeration = 5x.
2. Cross-section is cut from a 3D geologic model developed from borehole stratigraphic picks (diamond symbols). Only wells lying on the traverse are posted on the section. However, off-section wells impact the displayed stratigraphic interpretations.

Well/Boring Symbology



Statigraphic Units

- New Fill
- Old Fill
- Native Sediment
- Bedrock

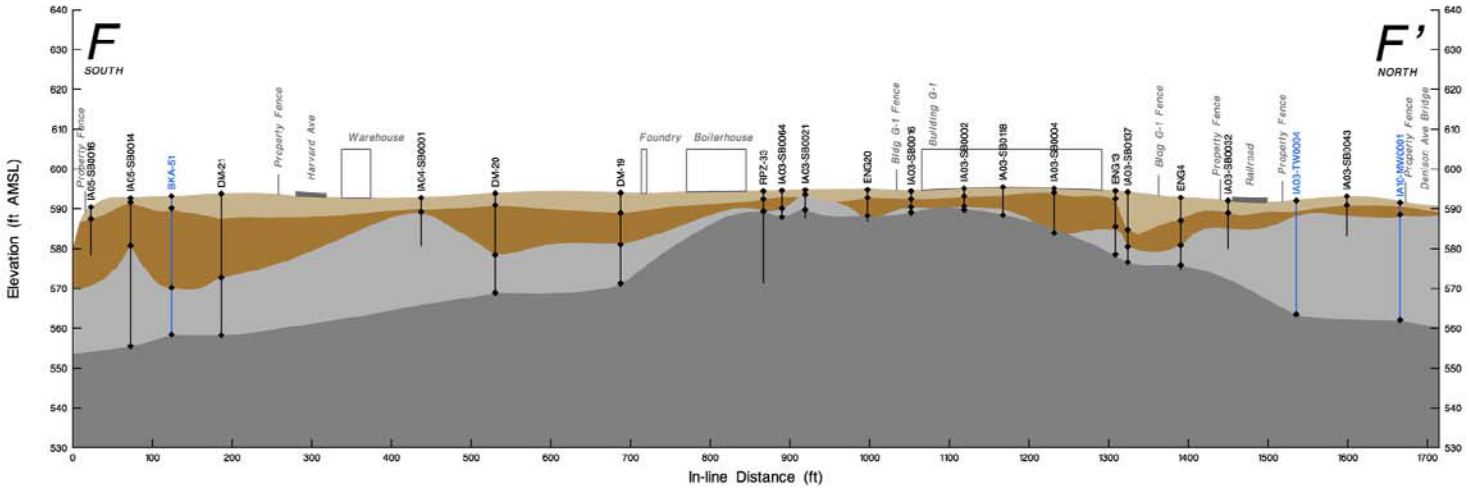
US Army Corps of Engineers.

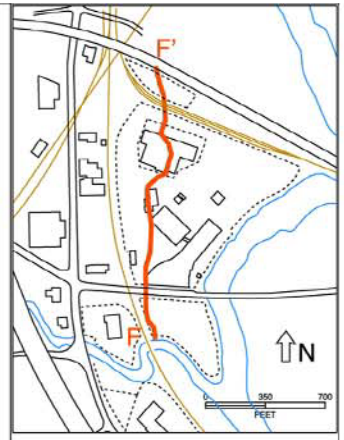
Geologic Cross-Section E-E'

Former Harshaw Chemical Company Site

Date: 2010-06-08 *File/Loc: E-E.plt&pdf/TwinsOH*

Revision: 0.0 *Analyst: VoorhiesN*





Notes

1. Scale as shown; vertical exaggeration = 5x.
2. Cross-section is cut from a 3D geologic model developed from borehole stratigraphic picks (diamond symbols). Only wells lying on the traverse are posted on the section. However, off-section wells impact the displayed stratigraphic interpretations.

Well/Boring Symbology

Statigraphic Units

- New Fill
- Old Fill
- Native Sediment
- Bedrock

US Army Corps of Engineers.

Geologic Cross-Section F-F'

Former Harshaw Chemical Company Site

Date: 2010-08-08 | File/Loc: F-F.plt&.pdf/TwinsOH
Revision: 0.0 | Analyst: VoorhiesN