

Appendix A: Gopher Ordnance Works Site Summary

Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
UMORE East - most sites and data (unless cited) taken from 2011 Remedial Investigation Report (Barr, 2012). Not all potential subareas captured here.					
GOW East (Figure 4)					
GOW Nitric Acid Plant Area	This area was constructed as part of GOW to produce nitric acid. After GOW was decommissioned, portions of the area were used by the University as an aeronautical research laboratory and hazardous waste storage. Other uses included explosives manufacturing and storage, labs, plastics production, and storage of antifreeze.	39 soil samples. No groundwater samples were collected in this area, but monitoring wells MW-B7-013, MW-B7-014 & MW-B7-015 are downgradient and have detected no site-related contaminants. See below for subsection results.	Figure 14; Figure D1 (Barr, 2012)	See subsections below for detailed discussion of health hazards related to soil contamination. There are no groundwater exposures in the GOW Nitric Acid Plant Area, and therefore no public health hazard associated with groundwater.	See subsections below.
Acid Area Shop (Bldg 722Y)		In 2006, two samples were analyzed for metals and SVOCs. cPAHs were detected at 0.17 ppm at a depth of 2-5 ft. Two test trenches were excavated in 2011 and no indications of soil impacts were observed, and therefore no samples were taken for analysis.	Figure D1 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern.	More data may be needed prior to development.
Anhydrous Ammonia Storage (Bldg 301ALP)		In 2011, six samples were analyzed for metals. Mercury was detected at 0.54 ppm at a depth of 6 in.	The aboveground storage tank used by GOW to store anhydrous ammonia is still present. Figure D1 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although mercury is above the SRV for residential land use, current exposure is expected to be very limited and infrequent.	Areas of mercury above the SRVs may need to be removed if land use changes.
Nitric Acid Concentrator Bldg (303-A2)		In 2006, cadmium was elevated in one sample (48 ppm) at a depth of 3.5 ft. Four samples were analyzed for metals in 2011. No evidence of contamination was found.	The building was dismantled during GOW decommissioning and the University has left the area dormant. Figure D1 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although cadmium is above the SRV for residential land use, current exposure is expected to be very limited and infrequent.	Areas of cadmium above the SRVs may need to be removed if land use changes.
Nitric Acid Concentrator Bldg (303A); the University used the building to store hazardous waste.		In 2006, lead (8090 ppm) and cPAHs (19 ppm) were elevated in one sample at a depth of 0-1 ft. 18 soil samples were collected in 2011 and analyzed for metals, SVOCs, and sulfate. Lead was elevated at a depth of 6 in. in 9 samples (840-2800 ppm) and at a depth of 9 ft in one sample (8400 ppm). cPAHs were detected in five samples (0.011-0.97 ppm) at a depth of 6 in.	The building still exists, unused. Figure D1 (Barr, 2012)	This area poses a public health hazard because lead in the surface soil is significantly above the SRV for industrial land use and current exposure to the contaminants could occur.	Lead should be removed in the short-term to prevent exposure. cPAHs are above SRVs and may need to be removed if land use changes.
Nitric Acid Storage Tanks (302A); University tenants used 302A as a research lab and to store and manufacture explosives.		In 2006, mercury was elevated in one sample (1.2 ppm) at a depth of 0-1 ft. In 2011, three soil samples at 1 ft were analyzed for metals and SVOCs. Mercury (0.49 ppm) and cPAHs (0.22, 0.91, 0.93 ppm) were detected.	The building exists. The tank farm area has been dormant since GOW decommissioning. Figure D1 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although one sample of mercury exceeds the residential SRV and cPAH concentrations may be of concern, current exposure is expected to be very limited and infrequent.	Areas of mercury above the SRVs and cPAHs may need to be removed if land use changes.
Acid Change House (707A)		In 2002, mercury was elevated in one sample (42 ppm) in surface soil. In 2011, three samples at 6 in. were analyzed for metals. Mercury was detected in one sample (0.38 ppm).	The building was demolished by GOW and the area is not used by the University. Figure D1 (Barr, 2012)	This area poses an indeterminate public health hazard. Mercury in the soil is above the SRV for industrial land use; however, current exposure is expected to be very limited and infrequent.	Areas of mercury above the SRVs may need to be removed if land use changes.
Fuel Oil Tanks (303SA-AB)		In 2011, two samples at a depth of 2 and 2.5 ft were analyzed for metals and SVOCs and no evidence of contamination was found.	Aboveground storage tanks have been removed; the area is not used by the University. Figure D1 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
Oleum Storage Tanks		In 2002, arsenic (14 ppm) and lead (310 ppm) were elevated in the surface soils. DRO was detected at 5900 ppm. In 2011, buried treated wood was found at 5 ft and no analytical samples were collected.	Aboveground storage tanks have been removed; the area is not used by the University. Figure D1 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although arsenic and lead exceed the residential SRV, current exposure is expected to be very limited and infrequent.	Concentrations of arsenic and lead above the SRVs may need to be removed if land use changes.
GOW Oleum Plant Area	Used by GOW to produce sulphuric acid that was later used to concentrate nitric acid at the facility.	In 2002, 14 samples were collected and 12 samples were analyzed for metals, 2 for SVOCs, 1 for PCBs, and 1 for explosives. No contaminants were found except sulfate was measured in five samples from 140-30,000 ppm. In 2006 and 2011 one sample was analyzed for metals and SVOCs and no contaminants were found. Groundwater sampling for sulfate in this area did not detect elevated levels.	The building was dismantled by GOW and only the foundations exist. The University has not used this area. Figure D1 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern.	More data may be needed prior to development.

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GOW Coal Ash Pond and Drainageway	This area was constructed by GOW to dispose of coal ash generated by Power Plant A. As part of decommissioning, the ash was reportedly removed. The University never operated the power plant or the coal ash pond.	In 2003, three soil samples were found to have elevated mercury (20 ppm at 0-2 ft, and 420 and 590 ppm at a depth of 2 ft). Dibutylphthalate (DBP) was detected in two samples (0.83, 1.1 ppm). In 2011, 38 samples were analyzed for metals, 18 for SVOCs, and 2 for PCBs. Arsenic was elevated in two samples (9.9 ppm at a depth of 1 ft and 11 ppm at 6 in.). Mercury was elevated in two samples (0.8 ppm at 6 in. and 2.7 ppm at a depth of 1 ft). DBP was detected in four samples (0.068-1.9 ppm). Coal ash is present. Groundwater samples within the pond (MW-OX-1 and MW-C7-016) did not detect site-related contaminants.	This area is open space. Figure D2 (Barr, 2012)	This area poses an indeterminate public health hazard. Mercury in the soil is above the SRV for industrial land use; however, current exposure is expected to be very limited and infrequent. Arsenic is also above the residential SRVs. There are no groundwater exposures in this area.	Areas of mercury and arsenic above the SRVs may need to be removed if land use changes.
GOW Wastewater Treatment Plant Area	This area was used to treat wastewater from the sanitary sewer system that was linked to GOW buildings in the manufacturing area of the facility. The University operated it until about 1959.	In 2003, three soil samples were found to be elevated with mercury (23-30 ppm) at depths between 0-2 ft. One sample had a detection of BTEX, indicating petroleum contamination. In 2011, 34 samples were analyzed for metals and 8 for SVOCs. Arsenic was slightly elevated in 2 samples (9.2 ppm at a depth of 2 ft, and 10 ppm at 6 in.). cPAHs were detected at low levels in five samples (0.01-0.22 ppm). Two coal samples were analyzed for metals and SVOCs and no analytes were above residential SRVs. Surficial coal, ash, slag, and vitrified materials present. Groundwater samples in this area (MW-21D and MW-28) detected chlorinated VOCs associated with UMRRC Burn Pit plume, TCE exceeds HBV; no other site-related contaminants were detected.	This area is used for agriculture and open space. Figure D2 (Barr, 2012)	This area poses an indeterminate public health hazard. Mercury in the soil is above the SRV for industrial land use; however, current exposure is expected to be very limited and infrequent. Arsenic is also above the residential SRVs. There are no groundwater exposures in this area.	Areas of mercury and arsenic above the SRVs may need to be removed if land use changes.
Post-GOW Oxidation Pond	This area is located within the outside limit of the GOW Coal Ash Pond. The Oxidation Pond was constructed in 1959 by the University to treat wastewater.	In 1984, thallium was found slight elevated at 4 ppm (TCT, 1986). In 1984-85 PCBs and chlordane were detected in the Oxidation Pond (Barr, 2011a). In 2011, 21 soil samples were collected and 21 analyzed for metals, 14 for SVOCs, 14 for PCBs, and 12 for organochlorine pesticides. One sample in a non-agricultural area at a depth of 2 ft had elevated mercury (7.3 ppm) and detections of cPAHs (0.95 ppm), PCBs (0.28 ppm) and chlordane (0.04 ppm). DBP was detected in three samples (0.07-1.1 ppm). The soils contain coal ash, white/gray granular material, pea gravel, and yellow to rusty orange discoloration. As noted above for the Coal Ash Pond, groundwater samples here did not detect site-related contaminants	This area is used for agriculture and open space. Figure D2 (Barr, 2012)	This area poses an indeterminate public health hazard. Mercury in the soil is above the SRV for industrial land use and cPAHs may be of concern; however, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Areas of mercury above the SRVs and cPAHs may need to be removed if land use changes.
GOW Patrol Road Clearing Area	Arsenic-containing pesticides may have been applied along the sides of the roads to control vegetation during the GOW period.	In 2011, two samples at a depth of 6 in. were analyzed for metals and no evidence of contamination was found, so no groundwater samples collected.	This area is adjacent to agricultural use and open space. Figure D2 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW Ballistics Lab and Firing Range	This area was constructed to test the ballistic value of manufactured rifle powder but reportedly used for storage since rifle powder was not produced. The University used the area for ballistic testing research.	In 2006, one sample detected low levels of cPAHs (0.14 ppm) and DBP (0.139 ppm) at a depth of 5 ft. In 2011, two samples (one at 6 in. and one at 12 ft) were analyzed for metals and SVOCs and no evidence of contamination was found, so no groundwater samples collected.	This area is wooded and adjacent to agricultural use. Recent dumping and charred debris was observed in the woods east of bldg 228A during the Phase I site visit (Barr, 2011a) Figure D2 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern.	More data may be needed prior to development.
Grid Space D7	A borrow pit and surface water infiltration basin were constructed here during the operation of GOW. It continued to be used as a borrow pit and became dormant land.	In 2011, three samples were analyzed for metals and SVOCs and no evidence of contamination was found, so no groundwater samples collected.	This area is open space. Figure D3 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.

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GOW Powerhouse A Area (AOC7 and associated 26.7 acres)	USACE subdivided this area into four subquadrants for data collection in 2007. Based on 2007 sampling, two quadrants were further investigated in 2009: AOC7A and AOC7D. The NW quadrant (AOC7A) contained the former water reservoir including the pump house, transformer pads, water inlet house and the boiler house. The SW quadrant (AOC7D) contained the steam plant and associated buildings, a drainage ditch, electrical substation, fuel oil tanks, and ash disposal pit.	In 2003, samples from 12 test pits were collected in the later-defined AOC7 area (WWTP samples 1-12 from Peer, 2003). Mercury was elevated (25 ppm) in one sample at a depth of 10 ft. Other debris was tested (tar, trash (at 4-5 ft), electrical insulation) and cPAHs (2800, 1200, and 45 ppm), PCBs (2.7 ppm), and arsenic (84 ppm), were elevated. In 2007 (USACE, 2009a) soil sampling in AOC7A found elevated lead (440, and 520 ppm at 0-6 in. and 2100 ppm at 2-4 ft), cPAHs over 2 ppm in 5 samples (13 ppm at 2-4 ft and 16-130 ppm at 0-6 in.), and PCBs over 1 ppm in 6 samples (3.4 ppm at 2-4 ft, and 1.3-26 ppm at 0-6 in.). In 2009 (USACE, 2009b) sampling in AOC7A include elevated PCBs (1.4 ppm at 2-4 ft) and BaP (7.2 ppm at 0-6 in.). In 2007 soil sampling in AOC7D found elevated arsenic (9.3, 11 ppm at 0-6 in., 12 ppm at 2-4 ft, 33 ppm at 6-8 ft), lead (730 ppm at 0-6 in. and 5400 ppm at 2-4 ft), mercury (0.55, 0.96 at 2-4 ft, and 1.1 ppm at 0-6 in.), and cPAHs over 2 ppm in 6 samples (2.2 and 7.9 ppm at 0-6 in., 4.7, 14, 52 ppm at 2-4 ft, and 46 ppm at 6-8 ft). PCBs found were less than 1 ppm. In 2009 sampling in AOC7D found elevations at 0-6 in. of mercury (1.2 ppm), cPAHs (3.1, 5.6, 9.9 ppm) and PCBs (1.6 ppm). 13 groundwater samples were collected from borings; site-related contaminants (VOCs, SVOCs, nitrocellulose and DRO) detected in 12 - benzo(a)pyrene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, DRO, 2,4,6-trichlorophenol, TCE were above drinking water criteria in at least one sample. These contaminants were not detected in MWs downgradient of AOC7, except chlorinated VOCs associated with the UMRRC Burn Pit plume.	AOC7A contains some farmland and ruins of collapsed buildings; AOC7D contains ruins of buildings. Stockpiled soil that was reportedly removed from AOC7B is also present in AOC7C and AOC7D - and has not been investigated. Figure D2 (Barr, 2012); Figure 9, 9A, 9D (USACE, 2009a); Figure 5a, 5b (USACE, 2009b)	This area poses a public health hazard because cPAHs and PCBs in the soil are significantly above SRVs for industrial land use in surface soils and current exposure to the contaminants could occur. Mercury, arsenic, and lead are also above the industrial SRVs. There are no groundwater exposures in this area.	cPAHs and PCBs should be removed in the short-term to prevent exposure. Mercury, arsenic, and lead, above the SRVs may need to be removed if land use changes.
ABC Line (Figures 5 and 12)					
GOW Temporary Shops Area	This area contained many shops that were used in the construction and operation of GOW. Most shops were removed as part of GOW decommissioning.	See subsections below for sampling results. No groundwater samples were collected in the GOW Temporary Shops area; downgradient monitoring well MW-A6-006 detected trace level PERC, possibly related to the UMRRC Burn Pit plume but not really downgradient of that area; MW-B7-013 has not detected site-related contaminants.	Entire area is used for agriculture with the exception of the water tower area. Figure 15 (Barr, 2012)	See subsections below for discussion of public health hazards associated with soil contamination. There are no groundwater exposures in the GOW Temporary Shops Area.	See subsections below.
Auto Repair Shop (32T)		In 2011, nine samples were analyzed for metals and two for SVOCs. An additional two samples were analyzed for arsenic only. Arsenic was elevated in three samples (9.4 ppm at a depth of 3 ft and 12 and 43 ppm at 6 in.) and mercury was elevated in one sample (12 ppm) at a depth of 6 in..	This area is used for agriculture. Figure D4 (Barr, 2012)	This area poses an indeterminate public health hazard. Arsenic and mercury in the soil is above the SRVs for industrial land use; however, current exposure is expected to be very limited and infrequent.	Areas of arsenic and mercury above the SRVs may need to be removed if land use changes.
Gas Pumps (MSA8)		In 2011, one soil sample was analyzed for metals, SVOCs, and VOCs at a depth of 3 ft. No evidence of contamination was found.	This area is used for agriculture. Figure D4 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
Oil Storage House (29T)		In 2011, two soil samples at a depth of 6 in. were analyzed for metals and SVOCs. No evidence of contamination was found.	This area is used for agriculture. Figure D4 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
Pipe Shop Office (229T)		In 2011, one soil sample at a depth of 6 in. was analyzed for metals and SVOCs. cPAHs were found at 0.18 ppm.	This area is used for agriculture. Figure D4 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern.	More data may be needed prior to development.
Pipe Shop Tools (230T)		In 2011, one soil sample at a depth of 1.5 ft was analyzed for metals and SVOCs. cPAHs were found at 0.18 ppm.	This area is used for agriculture. Figure D4 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern.	More data may be needed prior to development.
Crane Repair Shop (24T)		In 2011, one soil sample at a depth of 3 ft was analyzed for metals and SVOCs. cPAHs were found at 0.47 ppm.	This area is used for agriculture. Figure D4 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent.	More data may be needed prior to development.
Paint Shop (14T)		In 2011, one soil sample at a depth of 6 in. was analyzed for metals and SVOCs. No evidence of contamination was found.	This area is used for agriculture. Figure D4 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
Machine Shop (16T)		In 2011, five soil samples were analyzed for metals (three at a depth of 6 in., one at 1 ft, and one at 4 ft) and two for SVOCs (at 6 in. and 1 ft). Arsenic was elevated in one sample (11 ppm) at a depth of 1 ft.	This area is used for agriculture. Figure D4 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although arsenic is above the SRV for residential land use, current exposure is expected to be very limited and infrequent.	Areas of arsenic above the SRVs may need to be removed if land use changes.

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	Drinking Water Pump House (411B)	In 2011, one soil sample was analyzed for metals and SVOCs. DBP was detected at 0.1 ppm at a depth of 6 in..	This area is used for agriculture. The water tower is in this area. Figure D4 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern.	More data may be needed prior to development.
	Unknown Bldg (MSA-TC4)	In 2011, one soil sample at a depth of 6 in. was analyzed for metals and SVOCs. No evidence of contamination was found.	This area is used for agriculture. Figure D4 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW Warehouse (Bldg EEAS)	This GOW construction warehouse building burned down before 1945.	In 2011, three test trenches were excavated and two soil samples were analyzed for metals and SVOCs at a depth of 6 in. and 1 ft. No evidence of contamination was found, so no groundwater samples were collected. Cinders, nails, and wood debris were present in test trenches.	This area is used for agriculture. Figure D5 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW Lead Burner Shop (Bldg 46T)	This shop supported construction and operation of GOW. This building was dismantled as part of the decommissioning of GOW.	In 2011, 14 test trenches were excavated and soil samples were analyzed for metals for each trench. Two samples were elevated for lead (3500 ppm at a depth of 6 in. and 780 ppm at 1 ft). No groundwater samples were collected in this subarea, but MW-B7-014 and MW-B7-015 are located downgradient and did not detect lead in the groundwater.	This area is used for agriculture. Figure D5 (Barr, 2012)	This area poses a public health hazard because concentrations of lead in the soil are significantly above SRVs for industrial land use in surface soils and current exposure to the contaminants could occur.	Lead should be removed in the short-term to prevent exposure. The University has indicated that they will no longer harvest crops in this area for human consumption.
GOW Cotton Dry House/Auto Body Shop (Bldg 101C)	This building was used for GOW powder production. The University leased it to tenants for an auto body shop.	In 2011, two test trenches were excavated and two soil samples at a depth of 6 in. were analyzed for metals and SVOCs. No evidence of contamination was found, so no groundwater samples collected.	This building is currently leased to a tenant for storage of personal items. Figure D6 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW Cotton Dry House/US Transformer (Bldg 101A) - part of UMRRC NPL site	This building was used for GOW powder production. In the 1970s, the University leased it to a tenant (US Transformer) who used the building for reclamation of electrical equipment which resulted in release of PCBs. Soils containing PCBs which were excavated to <10 ppm and either disposed offsite or treated and managed within the UMRRC NPL site. Contaminated sewers, concrete slabs, and debris were removed during the remedial action. The area was backfilled with <1 ppm PCB soil and 6 inches of clean topsoil.	In 1984, thallium was found slight elevated at 4 ppm (Twin City Testing Corp., 1986). In 2011, seven soil samples (two at a depth of 4 ft and five at 6 in.) were taken outside of the remediated area and analyzed for PCBs. Five samples were ND for PCBs, while Aroclor 1260 was detected at 2.3 and 0.64 ppm in two 6 inch samples. One sample was analyzed for metals and three samples for SVOCs. No other contaminants were found. No groundwater samples were collected.	By remedial design, soils may contain up to 10 ppm PCBs where no excavation occurred and up to 1 ppm PCBs below the top six inches where soil was excavated. The building still exists. The site is adjacent to an agricultural field and other current tenant sites. Figure D6 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although the PCBs exceed the SRV for residential land use, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Concentrations of PCBs are expected to be above residential SRVs below the surface soils in this area. More data will need to be collected before the site is developed.
Metro Mosquito (Bldg 101B)	This building was used for GOW powder production. The University leased it to tenants including the Metropolitan Mosquito Control for an office and chemical storage.	In 2006, two samples at a depth of 0-1 ft were analyzed for metals. In 2011, two test trenches were excavated and two soil samples were analyzed for metals at a depth of 6 in. No evidence of contamination was found, so no groundwater samples collected.	This building is currently leased to a tenant for storage of personal items. Figure D6 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW Boiling Tub Houses (Bldgs 108)	These buildings were used for GOW powder production. After decommissioning, the buildings were burned by the Army and trees were planted around the remaining structures.	In 2006, lead was found in surface soil at 1710 ppm. In 2011, five samples at a depth of 6 in. were analyzed for metals and SVOCs and no evidence of contamination was found, so no groundwater samples collected.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D6 (Barr, 2012)	This area poses an indeterminate public health hazard. Lead in the soil is above the SRV for industrial land use; however, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Lead is above SRV for industrial land use and may need to be removed if land use changes.
GOW Poacher Tub Nitrocellulose Slurry Tanks (Bldgs 111)	These buildings were used for GOW powder production. After decommissioning, the buildings were dismantled by the Army and may have been burned down.	In 2006, arsenic was found at a depth of 5 ft at 9.8 ppm. In 2011, two test trenches were excavated and three soil samples taken for metals and SVOCs (one at a depth of 6 in. and two at 5 ft) with no evidence of contamination found, so no groundwater samples collected.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D7 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although arsenic is above the SRV for residential land use, current exposure is expected to be very limited and infrequent.	Areas of arsenic above the SRVs may need to be removed if land use changes.
GOW Blending Tub Houses (Bldg 113)	These buildings were used for GOW powder production. After decommissioning, the buildings were burned by the Army and trees were planted around the remaining structures.	In 2006, lead was found at a depth of 2 ft at 308 ppm. In 2011, four soil samples at 6 in. and two at 5 ft were analyzed for metals and SVOCs. No evidence of contamination was found, so no groundwater samples collected.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D7 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although lead is above the SRV for residential land use, current exposure is expected to be very limited and infrequent.	Areas of lead above the SRVs may need to be removed if land use changes.

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GOW Garage/George's Used Equipment (Bldgs 716A, 716B) - part of UMRRC NPL site	These buildings were used during the GOW period as a car grease shop and gasoline station. The University leased the building to tenants including George's Used Equipment (GUE) who used the area for reclamation of electrical equipment and supplies. GUE's activities resulted in releases of PCBs, lead, and copper to the soil. This area became part of the 1986 UMRRC CERCLA site and impacted soil was either excavated and disposed offsite or treated and managed onsite.	In 1984, in addition to the high PCBs, lead, and copper that were found at the site, antimony was found elevated in 3 of 4 samples (28, 37, and 676 ppm) and thallium was elevated in two of four samples (4, 11 ppm) (Twin City Testing Corp., 1986). In 2006, eight soil samples from outside the soil remediation area were analyzed for metals and PCBs (two samples for SVOCs, six samples for VOCs). PCBs were detected over 1 ppm in four of the eight samples (1.4 ppm at a depth of 1.5 ft, 2.7 ppm at 0-1 ft, and 130 and 270 ppm in sediment in floor drains). Lead was elevated in three of the samples (897 ppm at 1.5 ft, and 1390 and 2470 ppm in sediment in floor drains). Also in the sample at 1.5 ft was mercury (5.5 ppm) and cPAHs (16 ppm). 1,4-dichlorobenzene (48.7 ppm) was found in a surface sample. In 2011, five samples at a depth of 6 in. were collected on the roads in this area where PCB oil was suspected to have been applied, and three samples near GUE at 12 ft (three 6 inch samples had detections for PCBs: 0.32, 1, 1.3 ppm). Three samples taken for metals and one for VOCs at 12 ft showed no evidence of contamination (except very low detections of methylene chloride (0.15 ppm) and tetrahydrofuran (0.4 ppm) in one sample. In 2013 the impacted sediment from the floor drains of the concrete slab was removed. Additional PCB sampling in 2013 found elevated levels on the north side of GUE (up to 60 ppm at 0-6 inches) (UMN, 2013c). Groundwater samples from GUE-MW-19 and GUE-MW-20 were tested for metals: detected antimony, cadmium, chromium, lead, thallium, and zinc above their drinking water criteria and elevated levels of copper; the samples were not tested for other site-related contaminants.	GUE Deep, an area containing 10-25 ppm PCBs and elevated lead in the soil, was covered with up to 2 ppm PCBs and is fenced. Maintenance of a 10 inch soil cover over other areas of contamination up to 10 ppm PCBs is required. Building 716B was demolished but the slab is in place. The site has use restrictions. Further investigation of PCB contamination is pending. Figure D8 (Barr, 2012)	This area poses a public health hazard because concentrations of PCBs in the soil are significantly above SRVs for industrial land use in surface soils and current exposure to the contaminants could occur. Mercury and cPAHs are also above the industrial SRVs. There are no groundwater exposures in this area.	Concentrations of PCBs in surface soils are significantly above SRVs for industrial land use and should be removed in the short-term to prevent exposure. Areas of mercury and cPAHs above the SRVs may need to be removed if land use changes. Elevated metal levels detected in groundwater indicate these metals should be tested for in future samples from monitoring and private wells downgradient of this area.
GOW Dry Ingredients Storage/Porter Electric (Bldgs 227A & 227B) - part of UMRRC NPL site	These buildings were used during the GOW period as dry ingredients storage. The University leased the buildings to tenants including Porter Electric who used the area for reclamation of electrical equipment which resulted in a release of PCBs to the soil. This area became part of the 1986 UMRCC CERCLA site and PCB impacted soil was excavated and either disposed of offsite or treated and managed onsite.	In 2011, one sample was analyzed for SVOCs, RCRA metals, PCBs, and VOCs at a depth of 14 ft. No evidence of contamination was found, so no groundwater samples were collected.	This area is wooded and a portion of the building slab is still present. No soil cap was needed because after excavations the soil contained < 1 ppm PCBs. Figure D8 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW Storehouse/Dole Explosives (Bldg 713A)	This building was used during the GOW period as a general warehouse. The University leased the building to tenants including Dole Explosives, an explosives manufacturer, for truck storage and shop. Other tenant's uses included fiberglass production, auto repair, and welding. Two underground storage tanks (USTs) were installed by Dole Explosives.	In 2011, one test trench was excavated and two soil samples were analyzed at 6 in. for metals, SVOCs, and explosives and at 12 ft for metals, SVOCs, and VOCs. No evidence of contamination was found. A previous Phase I report (Peer, 2006a) notes staining observed below the dispenser for one UST. One UST was removed in 2011. No groundwater samples were collected in this area.	This building is currently leased to a tenant for storage of merchandise. This area may still contain an UST. Figure D8 (Barr, 2012)	Based on current sampling, this area poses no public health hazard although evidence of a leaking underground storage tank was previously found. There are no groundwater exposures in this area.	More data may be needed prior to development. MPCA regulations for USTs need to be followed.
GOW & Post-GOW Shop/Dole Explosives (Bldg 717A)	This building was used during the GOW period as a combined shop. The University continued to use the building as a combined shop and then leased portions to tenants including Dole Explosives for office and storage, a machine shop, and a mechanic shop.	In 2011, 13 soil samples were taken for one or more of the following: PCBs, metals, SVOCs, and VOCs. Four out of nine samples analyzed for PCBs had detections at a depth of 6 in. (2.2-4.8 ppm). The PCBs are likely related to the adjacent George's Used Equipment site (see above). cPAHs were elevated in two samples at 6 in. (1.7-3.2 ppm). A UST was removed in 1991 and soil was excavated in 1992. No groundwater samples were collected in this area.	This building is currently leased to a tenant for the storage of a vehicle. A previous Phase I report (Peer, 2006a) notes the building contains two indoor fuel oil aboveground storage tanks (ASTs) that were installed in 1944. Figure D8 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although concentrations of PCBs and cPAHs exceed the residential SRVs, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Areas of PCBs and cPAHs above the SRVs may need to be removed if land use changes; MPCA regulations for ASTs need to be followed.
GOW Locomotive House (Bldg 718A)	This building was used during the GOW period to store and service locomotive engines and as a gas station. The University continued to use it as a locomotive house and leased it for construction equipment storage.	In 2011, two soil samples, one at a depth of 12 ft and the other at 6 in., were analyzed for metals, SVOCs, and VOCs. No evidence of contamination was found, so no groundwater samples were collected.	This building is currently leased to a tenant for the storage of construction equipment. A 12,000 gallon UST from 1943 may be present on the north side of the building. Figure D8 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development. MPCA regulations for USTs need to be followed.

Appendix A: Gopher Ordnance Works Site Summary

Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
GOW Fuel Oil Pump House (Bldg 718C)	The University continued to use this building as a fuel oil pump house after the GOW period.	In 2011, one soil sample at a depth of 6 in. was analyzed for metals, SVOCs, and VOCs. No evidence of contamination was found, so no groundwater samples were collected. This area contained a fuel oil UST.	The building still exists. The area may still contain an UST. Figure D8 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW Paint Area Shop (Bldg 722D)	The University continued to use this building as a paint shop after the GOW period.	In 2011, one soil sample at a depth of 6 in. was analyzed for metals and SVOCs. cPAHs were found at 0.55 ppm. No groundwater samples were collected in this area.	The building still exists. Figure D8 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	More data may be needed prior to development.
GOW Paint Storage/Pipe Fabrication (Bldg 715B)	The University continued to use this building for paint storage after the GOW period and leased the building to tenants including a pipe fabrication company.	In 2011, one soil sample at a depth of 6 in. was analyzed for metals, SVOCs, VOCs, and PCBs. cPAHs were found at 0.67 ppm. No groundwater samples were collected in this area.	The building still exists. Figure D8 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	More data may be needed prior to development.
Post-GOW Lab/Circuit Fabrication/ Machine Shop (Bldg 707FFF)	This building was used as the GOW transportation change house. The University used it as a radiological research lab. Tenants uses include animal research, circuit fabrication, and a machine shop.	In 2011, eleven soil samples were analyzed for SVOCs (five for metals, two for VOCs). cPAHs were detected in all of the samples from (0.012-5.7 ppm). All samples were at a depth of 6 in. except one at 1.5 ft. DBP was detected at a trace level (0.059 ppm). No groundwater samples were collected in this area; wells MW-B7-013 and MW-B7-014, distantly downgradient, did not detect site-related contaminants.	This building is currently leased to a tenant for a machine shop. Figure D8 (Barr, 2012)	This area poses a public health hazard because cPAHs in the soil are above SRVs for industrial land use and the property is currently being leased for industrial use. There are no groundwater exposures in this area.	Areas of cPAHs above the SRVs for industrial land use should be removed.
GOW Field Canteen/Auto Repair (Bldg 746B)	This building was used as a GOW field canteen. University tenants included auto repair and a welding shop.	In 2011, two soil samples at a depth of 6 in. were analyzed for metals and SVOCs. cPAHs were found at 0.35 and 1.0 ppm. No groundwater samples were collected in this area.	The building still exists. Figure D8 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	More data may be needed prior to development.
GOW Shops Change House/Machine Shop (Bldg 707LL)	This building was used as a GOW change house for the shops area. The University used it for storage, and an animal surgery lab and animal shelter. Tenants uses included a paint shop and a machine shop.	In 2011, one soil sample at a depth of 1 ft was analyzed for metals, SVOCs, and VOCs. No evidence of contamination was found, so no groundwater samples were collected in this area.	The building still exists. Figure D8 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW Ether Mix Houses (Bldgs 206)	These buildings were used to dissolve DPA, DNT, and DBP in ether for GOW powder production. The Army partially dismantled the buildings during decommissioning.	In 2006, two samples were analyzed for metals and SVOCs. cPAHs were elevated in one sample at a depth of 5 ft (1.6 ppm) and DBP was detected in two samples (0.13 ppm at 5 ft and 2.19 ppm at 1.5 ft). In 2011, three soil samples (two at 5 ft and one at 6 in.) were analyzed for metals and SVOCs. No evidence of contamination was found, so no groundwater samples were collected.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D9 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	More data may be needed prior to development.
GOW Mixer Macerator Houses (Bldgs 208)	These buildings were used to mix in DPA, DNT, and/or DBP for GOW powder production. The Army partially dismantled the buildings during decommissioning.	In 2006, two samples were analyzed for metals and SVOCs. No evidence of contamination was found. In 2011, eight soil samples were analyzed for SVOCs and four for metals. cPAHs were detected at very low levels in five samples, and at 3.1 ppm in one sample in surface soil. 2,4-DNT was detected in five samples (0.46 to 10 ppm) and 2,6-DNT was detected in two samples (0.13-0.72 ppm) at the surface or at a depth of 6 in. DBP was detected in five samples (0.42-9.2 ppm) and n-nitrosodiphenylamine was detected in three samples (0.057-0.96 ppm) also at the surface or at 6 in. MW-C6-020 is located in this area and was sampled for metals, VOCs, and SVOCs - 1.6 ppb chloroform was detected, likely associated with the UMRRC Burn Pit plume.	The building foundations are still present and the surrounding area is open space with trees. Figure D9 (Barr, 2012)	This area poses an indeterminate public health hazard. cPAHs in the soil are above the SRV for industrial land use; however, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Areas of cPAHs above the SRVs may need to be removed if land use changes.

Appendix A: Gopher Ordnance Works Site Summary

Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
GOW Tray Dryer/Circulation Houses (Bldgs 237)	These buildings were used for GOW powder production. The Army dismantled and burned the buildings during decommissioning.	In 2006, three samples were analyzed for metals and two for SVOCs and two had elevated arsenic (10.2 ppm at a depth of 1.5 ft and 13.4 ppm in surface soil). One surface sample had 2,4-DNT at 0.24 ppm and DBP at 0.97 ppm. In 2011, six soil samples were taken for metals and SVOCs (and one sample for explosives) along with one sample from the sump at former bldg 237B. DBP was detected in one sample at a depth of 6 in. at 0.085 ppm. 2,4-DNT (1.4 ppm), 2,6-DNT (0.076 ppm), DBP (3.7 ppm), and n-nitroso-DPA (0.16 ppm) were detected in another sample at a depth of 6 in. A 2008 boring at Bldg. 237G detected a liquid "...that smelled of mothballs...from 25-45 feet below ground surface" which may indicate naphthalene or other PAHs, but no groundwater samples have been collected in this area.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D10 (Barr, 2012)	Based on current soil sampling, this area poses no apparent public health hazard because although concentrations of arsenic are above the SRVs for residential land use, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area, but there are private wells are present within one mile downgradient, in the town of Coates.	A groundwater sample should be collected near Building 237G. Areas of arsenic above the SRVs may need to be removed if land use changes.
GOW Glaze Barrel Houses (Bldgs 238)	These buildings were used for GOW powder production. The Army dismantled and burned the buildings during decommissioning.	In 2006, three samples were analyzed for metals and one for SVOCs. Arsenic (10, 15 ppm) and lead (392, 429 ppm) were elevated in two surface soil samples. In 2011, six soil samples were analyzed for metals and SVOCs. cPAHs were detected in two samples (0.26, 1.1 ppm) at a depth of 6 in. DBP was detected in one sample at 0.09 ppm at 6 in. No groundwater samples were collected.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D32 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although concentrations of arsenic and lead are above the SRVs for residential land use and the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Areas of arsenic and lead above the SRVs and cPAHs may need to be removed if land use changes.
GOW Rifle Powder Water Dry Houses (Bldgs 235)	These buildings were reportedly not used during GOW powder production. The Army dismantled the buildings during decommissioning.	In 2006, two soil samples were analyzed for metals, and one for SVOCs. One sample at a depth of 3.5 ft had elevated arsenic (15.7 ppm) and cPAHs (8.9 ppm). In 2011, 7 samples were analyzed for metals and 23 for SVOCs. cPAHs were elevated in four samples at a depth of 6 in. (2.5-31 ppm), and 3.1 ppm at 1 ft and 2.9 ppm at 3.5 ft. Five additional samples had cPAHs under 1 ppm. Tar debris was observed. No groundwater samples were collected.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D12 (Barr, 2012)	This area poses an indeterminate public health hazard. cPAHs in the soil are above the SRV for industrial land use; however, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	cPAHs above the SRVs may need to be removed if land use changes.
University-FBI Firing Range	This area has been an active firing range since 2001. The University is implementing best management practices (BMPs).	No soil or groundwater data was collected. Wells MW21D, MW-28, MW-29, MW-C7-004 downgradient of this area detect only chlorinated VOCs associated with UMRRC Burn Pit plume.	This area is an active firing range. The future development plans keep the land use the same. Figure 4 (Barr, 2011a)	Active shooting ranges using BMPs are not expected to cause adverse health impacts. There are no groundwater exposures in this area.	More data may be needed prior to development.
GOW Knife Grinding and Die Shop/Fluidyne (Bldg 217A)	This building was used as a GOW knife-grinding/die shop. The University used it as an aeronautical lab. Tenant's uses include a research lab, welding/fabrication, fertilizer storage, and cabinet manufacturing.	In 2011, 13 soil samples were analyzed for SVOCs, 10 for arsenic, 7 for metals, and 1 for VOCs. Arsenic was elevated in two samples (10 ppm at a depth of 6 in., 140 ppm at 1 ft). cPAHs were detected in 8 of the 13 samples (0.058-16 ppm at 6 in., 130 ppm at 1 ft). MW-C6-020 is located in this area and was sampled for metals, VOCs, and SVOCs - only chloroform (1.6 ppb) was detected, likely associated with the UMRRC Burn Pit plume.	The building exists. A 1,000 gallon fuel oil AST is inside of the building. Figure D13 (Barr, 2012)	This area poses an indeterminate public health hazard. Arsenic and cPAHs in the soil are above the SRVs for industrial land use; however, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Areas of cPAHs and arsenic above the SRVs may need to be removed if land use changes.
GOW Lab/Auto Shop (Bldg 706A)	This building was used as a GOW powder testing lab. Tenant's uses included paint and tool storage, paint sprayer manufacturing, and auto equipment storage.	In 2011, 13 soil samples were analyzed for metals and four for SVOCs. Mercury was elevated in four samples at a depth of 6 in. (0.67-4.4 ppm). No groundwater samples were collected.	The building still exists. Figure D14 (Barr, 2012)	This area poses an indeterminate public health hazard. Mercury in the soil is above the SRV for industrial land use; however, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Areas of mercury above the SRVs may need to be removed if land use changes.
GOW Lab/Tech Ordnance (Bldg 706D)	This building was used as a GOW powder testing lab. Tenants included an explosives manufacturer.	In 2011, one soil sample at a depth of 6 in. was analyzed for metals, SVOCs, and explosives. No evidence of contamination was found, so no groundwater samples were collected.	The building still exists. Figure D14 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW Scrap Rework House (Bldg 209A)	This building was used during the GOW period to dissolve and reclaim off-spec powder. The Army dismantled and burned the building during decommissioning.	In 2006, one soil sample at a depth of 0-1 ft was analyzed for metals, SVOCs, and VOCs. One sample at 4 ft was analyzed for just SVOCs. Both samples had detectable levels of DBP (4.1, 0.25 ppm) and DPA (0.16, 0.58 ppm). 2,4-DNT (1.8 ppm) and 2,6-DNT (0.06 ppm) were detected at the 0-1 ft sample. cPAHs were detected at 0.49 ppm in the 4 ft sample. Three soil samples at a depth of 6 in. were analyzed in 2011 for SVOCs (one sample also analyzed for metals). No evidence of contamination was found in the 2011 sampling. No groundwater samples were collected in this area; wells MW21D, MW-28, MW-29 downgradient of this area detect only chlorinated VOCs associated with UMRRC Burn Pit plume.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D14 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	More data may be needed prior to development.

Appendix A: Gopher Ordnance Works Site Summary

Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
GOW DNT Screening House (Bldg 205A)	This building was used to ensure GOW powder particle size. The Army dismantled and burned the building during decommissioning.	In 2006, two samples were analyzed for metals, SVOCs, and PCBs. No contamination was found. In 2011, two samples were analyzed for metals and SVOCs at a depth of 6 in. 2,4-DNT was measured in both samples (0.05, 1.3 ppm) and 2,6-DNT was detected in one sample at 0.096 ppm. No groundwater samples were collected in this area; wells MW21D, MW-28, MW-29 downgradient of this area detect only chlorinated VOCs associated with UMRRC Burn Pit plume.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D15 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern. There are no groundwater exposures in this area.	More data may be needed prior to development.
Activated Carbon Recovery System/ Technical Ordnance (Bldg 251A)	This building was used during the GOW period to house an activated carbon solvent recovery system. The University continued to operate the system then later leased the building to Technical Ordnance, an explosives manufacturer.	In 2011, nine samples were analyzed for SVOCs (three sampled for explosives and metals also). cPAHs were detected in six of the nine samples at a depth of 6 in. (0.07-5.8 ppm). Groundwater samples from nearby, downgradient monitoring wells (MW-21D, 28, and 29) detected only chlorinated VOCs associated with the UMRRC Burn Pit plume - SVOCs were not detected.	The building still exists. Figure D16 (Barr, 2012)	This area poses an indeterminate public health hazard. cPAHs in the soil are above the SRV for industrial land use; however, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Areas of cPAHs above the SRVs may need to be removed if land use changes.
Activated Carbon Recovery System/ Minneapolis Bomb Squad (Bldg 251B)	This building was used during the GOW period to house an activated carbon solvent recovery system. The University continued to operate the system then later leased the building and surrounding land to the Minneapolis bomb squad.	In 2006, two samples were analyzed for SVOCs and VOCs around bldg 251B and cPAHs were detected (0.26 ppm at a depth of 5 ft and 15 ppm in the surface soil). Because this is an active tenant site it was not investigated in 2011. According to the 2011 Phase I (Barr, 2011a) soil that was brought on site to construct a berm in 1987 contained debris. Annual soil sampling from 1992-1997 did not detect a release. Groundwater samples from nearby, downgradient monitoring wells (MW-21D, 28, and 29) detected only chlorinated VOCs associated with the UMRRC Burn Pit plume - SVOCs were not detected.	The current tenant is the Minneapolis Bomb Squad. The site is surrounded by a chain-link fence. Figure 4 (Barr, 2011a)	This area poses an indeterminate public health hazard. cPAHs in the soil are above the SRV for industrial land use; however, public access is restricted and current tenant exposure is unknown. There are no groundwater exposures in this area.	Areas of cPAHs above the SRVs may need to be removed if land use changes.
GOW Controlled Circulation Dryer Houses (Bldgs 220)	These buildings were used during the GOW period to remove volatiles and moisture from the powder. The Army dismantled and burned the buildings during decommissioning.	In 2006, two samples (one at a depth of 6 in. and the other at 0-1 ft) contained elevated arsenic (22.3 ppm), lead (547 ppm), cPAHs (2 ppm), 2,4-DNT (3.8, 0.2 ppm), DBP (6.5, 1.6 ppm), and DPA (0.2, 0.24 ppm). In 2011, eight soil samples were analyzed for SVOCs (two surface samples, one at a depth of 6 in., and five at a depth of 1 ft). The 1 ft samples were also analyzed for metals. Four samples contained cPAHs (0.09-1.2 ppm) and 2,4-DNT (0.046-0.8 ppm), and 2,6-DNT was detected in one sample (0.065 ppm). DBP was detected in all samples (0.13-6.1 ppm). No groundwater samples were collected in this area, but no site-related contaminants were detected in MW-C7-016 or MW-OX-1 which are located distantly downgradient.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D17 (Barr, 2012)	This area poses an indeterminate public health hazard. Arsenic in the soil is above the SRV for industrial land use, lead is above the SRV for residential land use, and the cPAH mixture potency is underestimated. However, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Areas of arsenic, lead, and cPAHs above the SRVs may need to be removed if land use changes.
GOW Change Houses (Bldgs 707X, 707XX)	These buildings were used as GOW changing rooms. The Army dismantled and burned the buildings during decommissioning.	In 2011, two soil samples at a depth of 6 in. were analyzed for metals and SVOCs. cPAHs were found at 0.05 and 0.74 ppm. No groundwater samples were collected in this area.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D18 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	More data may be needed prior to development.
GOW Supervisor's Office (Bldg 704E)	This building was used as GOW office space. The Army dismantled and burned the building during decommissioning.	In 2011, one soil sample at a depth of 6 in. was analyzed for metals and SVOCs. No evidence of contamination was found besides cPAHs at 0.06 ppm, so no groundwater samples were collected.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D18 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern. There are no groundwater exposures in this area.	More data may be needed prior to development.
GOW Cotton Dry Lab (Bldg 706J)	This building was used during the GOW period to analyze characteristics of nitrocellulose. The Army dismantled and burned the building during decommissioning.	In 2006, three samples were analyzed for metals (two at a depth of 0-1 ft and one at 5 ft) and one for SVOCs (at 5 ft) near this building and no evidence of contamination was found, so no groundwater samples were collected. It was not investigated in 2011.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D8 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW Acid Area and Supply Lab (Bldg 706B)	This building was used during the GOW period as a lab to determine the degree of nitration and ensure quality of acids and nitrocellulose. After decommissioning the University continued to use it as a laboratory.	No soil or groundwater data was collected. MW-B7-014 is located downgradient of this area and did not detect site-related contaminants.	The building still exists. Figure 4 (Barr, 2011a)	Because no data has been collected, this area is an indeterminate public health hazard. There are no groundwater exposures in this area.	More data may be needed prior to development.

Appendix A: Gopher Ordnance Works Site Summary

Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
GOW Central (Figures 6 and 11)					
UMRRC Burn Pit plus temporary burn pit - part of NPL site	This area was used as a GOW surface water drainage ditch. The University used this area from the 1960s to 1974 to burn/bury chemical wastes. A chloroform plume was detected in the groundwater from the leaching of wastes. The burn pit was closed with a layer of lime and a clay cap.	No soil or groundwater data was collected in the UMRRC Burn Pit. In 2011, a geophysical survey was conducted to identify buried metallic debris and one small metallic object was identified. Two soil samples at a depth of 6 in. were analyzed for metals and SVOCs near the temporary burn pit to the east and no evidence of contamination found. Chlorinated VOCs have been detected in monitoring wells (MW-21D, MW-22, MW-23D, MW-25, MW-28, MW-29, MW-C6-020, and T00006) and private wells located as far as 3.5 miles downgradient of the burn pit.	The burn pit was lined with lime, backfilled with sand, and capped with clay in 1980 (EPA, 2007). Four fence posts mark the location, but no fence exists. There is a limited activity use restriction on the property. The temporary burn pit has not been capped or marked. Figure D19 (Barr, 2012)	This area is an indeterminate public health hazard because there is subsurface contamination and the area is a source of groundwater contamination. Based on the remedial design, there is no current public health hazard due to exposure to soil contamination because the burn pit was capped. There are no groundwater exposures in this area, but VOC plume extends off UMore property to the NE. Recent (2013) sampling detected VOCs in a private well which is no longer used for drinking water; it is unclear if additional wells may be at risk.	More data will be needed prior to development. A thorough well search should be completed and any private wells w/ 1,000 ft. downgradient of UMore property should be tested for site-related contaminants.
GOW Central/East 160th St. Dump	This area was used during the GOW period as a borrow pit and then as a demolition dump during decommissioning. Dumping occurred in the 1950/60s through the 1980s. Pathological specimens preserved in formaldehyde were disposed here. The southern portion was used to detonate shock sensitive or unstable materials. The dump was never formally closed. Surface debris is visible.	In 2011, a geophysical survey was conducted and several small metallic objects were identified. Sixteen soil samples (14 at a depth of 6 in., two at 3 ft) were analyzed for metals and SVOCs (four sampled for VOCs). Arsenic (9.1 ppm at 3 ft and 11 ppm at 6 in.) was slightly elevated in two samples. cPAHs were elevated in three samples at 6 in. (1.0, 9.8, 27 ppm). Trace levels of three VOCs were found in two 3-ft samples. Trace levels of three SVOCs were found in one surface sample. No groundwater samples were collected.	The dump was never formally closed. Currently it is vegetated and surficial debris is visible. Figure D19 (Barr, 2012)	This area poses an indeterminate public health hazard. cPAHs in the soil are above the SRV for industrial land use and arsenic is above the SRV for residential land use; however, current exposure is expected to be very limited and infrequent. No subsurface data has been collected and dump debris can be a physical as well as chemical public health hazard. There are no known groundwater exposures in this area, but a well is in use at a nearby cattle barn. Alternate water is available, but incidental use for drinking water may occur.	Access to dump materials should be restricted. Areas of cPAHs and arsenic above SRVs may need to be removed if land use changes. The well at the nearby cattle barn should be sampled for VOCs, bacteria, and nitrate OR signs should be posted to warn staff that water is not tested and may not be potable.
Suspected Disposal Area	This area is suspected to be a dump site or burn pit for University lab wastes and/or miscellaneous wastes. Disturbances were observed in 1957 and 1964 aerial photos.	In 2011, a geophysical survey was conducted and significant amount of metal was found in this area. Fourteen soil samples were analyzed (13 for metals, 14 for SVOCs, 5 for VOCs, 3 for pesticides - all at a depth of 6 in. except one sample at two ft - and one coal sample. The coal sample had a total cPAH of 0.11 ppm. Arsenic was elevated in one sample (13 ppm) at 2 ft. cPAHs were detected in 11 of the 14 samples (0.006-2.4 ppm). Very low levels of several VOCs were found in four of the five samples analyzed for VOCs. DBP was detected in two samples (0.048, 0.056 ppm). Small metal debris in surface soil throughout area. No groundwater samples were collected in this area.	This area is wooded and near agricultural areas. Figure D19 (Barr, 2012)	This area is an indeterminate public health hazard because no subsurface data has been collected and dump debris can be a physical as well as chemical public health hazard. Based on current sampling, this area poses no public health hazard to soil contamination because although cPAHs and arsenic are above the SRVs for residential land use, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Access to dump materials should be restricted. Areas of cPAHs and arsenic above SRVs may need to be removed if land use changes.
GOW Combination Rifle and Cannon Powder Blending Tower and Packing Houses (Bldgs 222)	These buildings were used as part of the GOW powder production line. The buildings were dismantled by the Army during decommissioning. The University left the area dormant.	In 2006, three samples (at surface, 3 and 3.5 ft) were analyzed. The surface sample had elevated arsenic (16.1 ppm) and detected 2,4-DNT (0.21 ppm). All three detected DBP (0.1-0.4 ppm). In 2011, eleven soil samples (10 at a depth of 6 in. and one at 3 ft) were analyzed for metals and six also for SVOCs. Arsenic was elevated in one sample (14 ppm). cPAHs were elevated in one sample (1.2 ppm), 2,4-DNT detected in two samples (0.1, 0.17 ppm) and DBP detected in three samples (0.16-0.64 ppm). No groundwater samples were collected in this area.	This area contains trees around the remaining structures and the surrounding area is agriculture. Figure D20 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although concentrations of arsenic are above the SRVs for residential land use and the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Areas of arsenic and cPAHs above SRVs may need to be removed if land use changes.
GOW Finished Powder Houses (Bldgs 229)	These buildings were used as part of the GOW powder production line. The sixty buildings were constructed with treated wood. The buildings were dismantled by the Army during decommissioning.	In 2011, eleven soil samples were analyzed for metals (ten at a depth of 6 in., one at 4 ft) and seven samples also analyzed for SVOCs. Two samples were elevated for arsenic (10 ppm at 4 ft and 13 ppm at 6 in.). Samples were collected near bldg 229-19 and 229-26 only. No groundwater samples were collected in this area.	This area is agricultural, with the exception of the wooded area around former bldg 229-26. Figure D21 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although concentrations of arsenic are above the SRVs for residential land use, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	Areas of arsenic above the SRVs for may need to be removed if land use changes.
Grid Space D5, E5	Within this space is a former GOW staging area and drainage ditch, and area of soil disturbance visible on a 1945 photograph. The University left these areas dormant between agricultural fields.	In 2011, four soil samples at a depth of 6 in. were analyzed for metals and SVOCs. No evidence of contamination was found, so no groundwater samples were collected.	This is area is agricultural with dormant land between fields. Figure D22 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found. There are no groundwater exposures in this area.	More data may be needed prior to development.
GOW Box Storehouses (223A, 223B)	After GOW decommissioning, the University used these buildings for storage. The University also leased the buildings for uses including industrial equipment storage, light manufacturing, storage of electrical supplies, and plastic extruding.	No soil or groundwater data was collected.	The buildings are currently leased for electrical supply storage, office space, and light manufacturing. Figure D22 (Barr, 2012)	Because no data has been collected, this area is an indeterminate public health hazard. There are no groundwater exposures in this area.	More data may be needed prior to development.

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Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
Bldg 709A	This building was used during the GOW period as the fire headquarters. The University also used it as a fire headquarters and for storage. The University also leased the building for uses including equipment and auto repair and storage.	No soil or groundwater data was collected because the building was leased at the time of 2011 RI.	This building is currently not leased. Figure 16 (Barr, 2012)	Because no data has been collected, this area is an indeterminate public health hazard. There are no groundwater exposures in this area.	More data may be needed prior to development.
DEF Line (Figure 7)					
GOW Aniline Plant Area	The GOW aniline plant was constructed to manufacture DPA but was cancelled due to an increase of DPA production elsewhere. It is unclear whether plant was ever used. The University used one building for hazardous waste storage (where soil has been previously excavated for PCBs) and leased to tenants including the Jensen Airfield.	In 2011, twelve samples were analyzed for metals and SVOCs (ten at a depth of 6 in., two at 7-8 ft). No evidence of contamination was found except for cPAHs at 6 in. (0.006 and 0.3 ppm), so no groundwater samples were collected.	Some buildings are still present. Figure D23 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	More data may be needed prior to development.
"L" and "J" Street Dumps	It is uncertain if this area was used during the GOW period. The "L" Street Dump may have been a soil borrow pit or an intended future building site. The sites have been identified as potential former disposal sites and the University has left the area dormant.	In 2011, thirteen soil samples (eleven at a depth of 6 in. and two at 1 ft) were analyzed for metals and SVOCs and three for VOCs. One 6 in. sample that included a tar-like substance was elevated for arsenic (28 ppm), cPAHs (230 ppm), naphthalene (54 ppm) and other PAHs. Two samples showed DBP just above the detection limit at 0.048 and 0.051 ppm. Buried building materials including concrete, asphalt, and shingles were observed in test trenches. No groundwater samples were collected in this area.	This area is dormant, wooded land between agricultural fields. Figure D24 (Barr, 2012)	This area poses a public health hazard because concentrations of cPAHs in the soil are significantly above SRVs for industrial land use in surface soils and current exposure to the contaminants could occur. Arsenic is also above the SRV for industrial land use. Dump debris can be a physical as well as chemical public health hazard. There are no groundwater exposures in this area.	Concentrations of cPAHs in surface soils are significantly above SRVs for industrial land use and should be removed in the short-term to prevent exposure. Areas of arsenic above SRVs may need to be removed if land use changes. Access to dump materials should be restricted.
"G" Street Dump	This area is likely to have been in mid-construction when GOW was decommissioned. The foundation appeared to have been excavated in 1945. The University has left the area dormant and it has been identified as a potential former disposal site.	Two samples at a depth of 6 in. were analyzed for metals and SVOCs. No evidence of contamination was found, so no groundwater samples were collected. No debris was found in four test trenches.	This area is wooded. Figure D25 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
Grid Spaces C4, D4 (DEF line ruins)	This area includes the majority of the GOW DEF powder production lines that were reportedly never used. The University has left the area dormant but limited military training has been conducted in the area.	In 2011, seven soil samples at a depth of 6 in. were analyzed for metals and SVOCs. No evidence of contamination was found with the exception of cPAH detections of 0.13 and 0.26 ppm, so no groundwater samples were collected. Asbestos-containing mastic still remains on some of the foundations at the DEF line ruins.	This area is dormant and contains GOW ruins. Figure D26 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although the cPAH mixture potency is underestimated, current exposure is expected to be very limited and infrequent. Asbestos found on site poses an indeterminate public health hazard because although pieces of ACBM are found at the site, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area.	May need to collect more data before the site is developed. Asbestos needs to be removed if land use changes.
Navy/Burning Grounds (Figure 8)					
GOW Burning Grounds	The GOW burning grounds were constructed in 1944 and operated until 1948. The area was used to detonate gunpowder and to burn nitro-body-contaminated building materials and hazardous waste. After burning, the top two inches were removed and thin spread. The University leased the area to the Navy in 1954.	In 2002, 37 soil samples found elevated concentrations at a depth of 0-1 ft of arsenic (14 ppm), lead (390, 1000, 3100 ppm), mercury (13, 16 ppm), and two elevated cPAH samples in surface soil (1.8, 420 ppm). In 2011, 20 soil samples were analyzed for metals, 17 for SVOCs and 9 for VOCs. Lead was elevated at a depth of 6 in. (480 ppm) and 2,4-DNT was detected (0.06 ppm). Methylene chloride was measured in six samples at 2 and 6 ft (0.49-0.63 ppm). No groundwater samples were collected during the investigations, but no site related contaminants (except transient, trace levels of 1,2-dichloropropane) were detected in the three nearby former drinking water wells (see "Navy Operations" subarea) or the UM community water supply well (UN207611) or MW-A5-018 downgradient of this area.	This area is dormant, wooded land. Figure D27 (Barr, 2012)	This area poses a public health hazard because concentrations of lead and cPAHs in the surface soil are significantly above SRVs for industrial land use and current exposure to the contaminants could occur. Mercury is also above the SRV for industrial land use and arsenic is above the SRV for residential land use. There are no current groundwater exposures in this area; the three wells at the former Navy Burning Ground property were sealed in 2009. The UM community water supply well is routinely tested.	Concentrations of lead and cPAHs are significantly above levels of concern for industrial land use and should be removed in the short-term to prevent exposure. Areas of mercury arsenic above the SRVs may need to be removed if land use changes.
Air Force Building 12 (AF12)	The University leased this area to the Air Force after GOW decommissioning. The building was used to store small quantities of hazardous waste.	In 2011, two soil samples at 2 and 6 ft were sampled for metals, SVOCs, VOCs, and PCBs. No evidence of contamination was found, so no groundwater samples were collected in this area.	The buildings were demolished in 2009. This area is open space, surrounded by trees and near agriculture. Figure D27 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.

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Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
Rosemont Ammunition Storage Bunker (RASB)	The University leased this area to the Air Force and Navy after decommissioning of GOW. The building was used to store ammunition magazines.	In 2011, eight soil samples at a depth of 1.5 ft were sampled for metals and SVOCs. One sample contained 2,4-DNT (1.3 ppm), 2,6-DNT (0.043 ppm) and DBP (0.38 ppm). No groundwater samples were collected in this area, but well MW-A5-018, which is located downgradient, did not detect any site related contaminants.	The buildings were demolished in 2009. This area is open space, surrounded by trees and near agriculture. Figure D27 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern	More data may be needed prior to development.
Navy Operations - Navel Intelligence Reserve Center (NIRC)	The University leased the area to the Navy for the NIRC after GOW decommissioning. In 2009, the Navy demolished bldgs, sealed the drinking water wells, and disposed of PCB-impacted soil, concrete, and asphalt in the vicinity of bldg 4U.	The Navy conducted an investigation in 2009 and removed 49 tons of PCB contaminated soil, concrete and asphalt. 28 soil confirmation samples were analyzed and PCBs were detected in 5 samples at low levels (0.07-0.52 ppm in surface, 1, and 2 ft samples) (Versar, 2010). No groundwater samples were collected during the investigations, but no site related contaminants (except transient, trace levels of 1,2-DCP) were detected in the three former drinking water wells in this subarea.	The buildings were demolished in 2009. This area is open space, surrounded by trees and near agriculture. Figure D27 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern. There are no current groundwater exposures in this area.	More data may be needed prior to development.
Navy Firing and Shooting Ranges	The area is near the GOW Burning Grounds but not occupied during GOW. The University leased the area to Navy and they constructed recreational firing and shooting ranges on the east side of NIRC.	In 2009, 88 surface soil samples were analyzed for metals by XRF. Only arsenic was elevated (9.12-13 ppm) in the surface soil in five locations. Lead appeared to be at about natural background. In 2011, four samples at a depth of 6 in. were analyzed for arsenic and none were elevated. Five samples were analyzed in the middle of the shooting range (four at 6 in. and one at 5 ft) and lead was elevated (1300 ppm) in one 6 inch sample. No groundwater samples were collected in this area, but well MW-A5-018, located downgradient, did not detect any site-related contaminants.	This area is open space, surrounded by trees and near agriculture. Figure D27 (Barr, 2012)	This area poses an indeterminate public health hazard. Lead in the soil is above the SRV for industrial land use, and arsenic is above the residential SRV; however, current exposure is expected to be very limited and infrequent.	Areas of lead and arsenic above SRVs and may need to be removed if land use changes.
10th Street Dump	This area was a GOW borrow source and possibly a demolition dump. The University leased this area to the Navy/Air Force after GOW decommissioning. The Navy may have used it for a disposal area.	In 2011, 18 soil samples were analyzed for metals, 14 for SVOCs, and 4 for VOCs. Two samples were elevated for lead (730 ppm at a depth of 1.5 ft, and 4500 ppm at 6 in.). The sample at 1.5 ft also contained mercury (0.79 ppm), silver (4.8 ppm) and DBP (0.17 ppm). Five samples at 6 in. contained methylene chloride at low levels (0.36-0.54 ppm). Dump materials including slag, metal, concrete, and discolored soil were observed in test trenches. No groundwater samples were collected, but no site related contaminants (except transient, trace levels of 1,2-DCP) were detected in three former drinking water wells downgradient of this area (see "Navy Operations" subarea).	This area is open space, surrounded by trees and near agriculture. Figure D28 (Barr, 2012)	This area poses a public health hazard because concentrations of lead in the soil are significantly above SRVs for industrial land use in surface soils and current exposure to the contaminants could occur. Dump debris can be a physical as well as chemical public health hazard. There are no groundwater exposures in this area.	Concentrations of lead in surface soils are significantly above SRVs for industrial land use and should be removed in the short-term to prevent exposure. Access to dump materials should be restricted.
GOW Aniline Spread Area	During the GOW period this area was constructed to spread aniline sludge waste, but it reportedly was not used due to the cancellation of the Aniline Plant.	In 2011, three soil samples at a depth of 6 in. were analyzed for metals and SVOCs in the northern portion of the area and no evidence of contamination was found, so no groundwater samples were collected.	The area is in a dormant, wooded area, adjacent to agricultural fields. Figure D28 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
"B" Street Dump	During the GOW period this area was a borrow source and possibly a dump. The University has left this area dormant.	In 2011, a geophysical survey of this area was conducted and small subsurface anomalies were found but no large metallic objects. Surficial and buried concrete and asphalt and water distribution pipes were encountered in test trenches. Ten samples (six at a depth of 6 in., and 3, 4, 7, and 10 ft) were analyzed for metals and 7 for SVOCs. One sample at 4 ft was elevated for lead (360 ppm). No groundwater samples were collected.	This area is dormant open space and is surrounded by trees and near agricultural areas. Figure D29 (Barr, 2012)	This area poses an indeterminate public health hazard. Dump debris can be a physical as well as chemical public health hazard. There are no groundwater exposures in this area.	Access to dump materials should be restricted.
30th Street Dump	During the GOW period it appeared to be the location of an intended future building and subsequently used as a dump. The University has not used the area.	In 2011, a geophysical survey of this area was conducted and a number of anomalies were identified but no large metallic objects. Seven soil samples (five at a depth of 6 in. and 3 and 10 ft) were analyzed for metals and SVOCs and one for VOCs (at 6 in.). No evidence of contamination was found, so no groundwater samples were collected. Dump materials including tar, metal, concrete, and asphalt were found in seven test trenches.	This area is wooded and adjacent to agricultural use. Figure D29 (Barr, 2012)	This area poses an indeterminate public health hazard. Dump debris can be a physical as well as chemical public health hazard.	Access to dump materials should be restricted.
GOW West (Figure 9)					
Grid Spaces A2, A3, B3	The site history of this area is unknown. A drainage ditch and an area of disturbance are in this area.	In 2011, three samples at a depth of 6 in. were analyzed for metals and SVOCs. No evidence of contamination was found, so no groundwater samples were collected.	This area is used for agriculture. Figure D30 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.

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Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
154th Street Dump (AOC6)	During the GOW period this area was used as a borrow source for sand and gravel and for disposal of debris at decommissioning. The University continued to use it as a borrow source and a dump. It is a football-field-sized depression containing surface and buried construction debris.	In 2007, (USACE, 2009a) 12 soil samples were analyzed for metals and PAHs. Six soil samples were elevated for cPAHs (2-10 ppm at 0-6 in., 70 ppm at 5 ft, and 710 ppm at 3 ft). Mercury was elevated in three samples (0.56 and 0.74 ppm at 0-6 in., 0.59 ppm at 2 ft). One sample was elevated for arsenic at 14 ppm (5 ft). In 2009, (USACE, 2009b) 18 soil samples were analyzed for metals and PAHs. One sample contained cPAHs at 23 ppm at a depth of 2-4 ft. ACBM is likely present. This area was not included in 2011 RI. Although BaP and other PAHs exceeded the SLVs, no groundwater samples were collected in this area and the nearest downgradient monitoring well is >1 mi.	This area is overgrown with weeds, brush, and trees and is surrounded by agriculture. Debris is present at the ground surface. Figure D30 (Barr, 2012); Figure 4 (USACE, 2009b)	This area poses an indeterminate public health hazard. cPAHs in the soil are above the SRV for industrial land use, mercury and arsenic are above residential SRVs, cPAHs are above the SLVs, and asbestos is present. However, current exposure is expected to be very limited and infrequent. There are no groundwater exposures in this area, but it is located upgradient of the community well(s). Dump debris can be a physical as well as chemical public health hazard.	Vertical soil sampling should be completed to determine whether PAH contamination extends to groundwater in this area. Areas of cPAHs, mercury, and arsenic above SRVs may need to be removed if land use changes. Access to dump materials should be restricted. Asbestos needs to be removed if land use changes.
Future Ballfields	The site history of this area is unknown. This area is across the street from planned future ballfields.	In 2009, two soil samples at a depth of 6 in. were analyzed for metals and SVOCs. No evidence of contamination was found, so no groundwater samples were collected.	This area is used for agriculture. Figure D30 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
GOW North (Figure 10)					
Former Betz Residence (Bldg MSA-TC-42)	During the GOW period this was used as a guard tower. The University leased it to tenants, including a resident who reportedly used PCB oil to heat the building.	In 2011, two samples (one at a depth of 6 in. and one at 5 ft near a former heating oil tank and furnace) were analyzed for metals, SVOCs, and PCBs. No evidence of contamination was found, so no groundwater samples were collected. A shallow well was sealed on this property in 2006 and replaced by a deeper well (UN 745851) which in 2013 was converted to a monitoring well for future use. A second shallow well was also sealed in 2013. MDH found no record of water samples from any of these wells.	This area is wooded and adjacent to agricultural use. Figure D31 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
Grid Spaces A5, A6, A7	During the GOW period this area was used as the septic drain fields for the administrative offices. The University has used this area for agriculture and leased it for use as a model airplane landing strip.	In 2011, five soil samples at a depth of 6 in. and one at 12 ft were analyzed for metals and SVOCs. No evidence of contamination was found, so no groundwater samples were collected.	This area is used for agriculture. Figure D31 (Barr, 2012)	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	More data may be needed prior to development.
Site Wide					
GOW Heavy Gauge Railroad	During the GOW period, heavy gauge railroad tracks were constructed and operated. The rails and ties were removed during decommissioning of GOW and the land was returned to agriculture or left dormant.	In 2009, 17 total soil samples were analyzed (5 for metals, 12 for SVOCs, 3 for VOCs and pesticides). No evidence of contamination was found besides one surface sample with elevated cPAHs (2.8 ppm). In 2011, nine samples at a depth of 6 in. were analyzed for metals and SVOCs. No evidence of contamination was found, so no groundwater samples were collected associated with the railroad.	The railroad samples taken were mainly in wooded areas adjacent to agriculture. Figure D35 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because although cPAHs are above the SRV for residential land use, current exposure is expected to be very limited and infrequent.	Areas of cPAHs above SRVs may need to be removed if land use changes.
GOW Laminex Wood Box Sewer and Clay Pipe Trunks	During the GOW period, approximately 11,160 linear ft of Laminex wood box sewer was installed to transport process water across the site and it served as the main trunk of the sewer. The University continued to use limited sections of the sewer until the 1980s. The sewers remain in place.	Nineteen sewer sediment samples were analyzed for metals, SVOCs, VOCs, and 18 for pesticides and PCBs. Arsenic was elevated in three samples (21, 24, 18 ppm). Mercury was elevated in eight samples (1.8-100 ppm). cPAHs were elevated in five samples (3.9-60 ppm) and detected in five more (0.37-1.3 ppm). 2,4-DNT was detected in six samples (0.05-10 ppm) and 2,6-DNT detected in three samples (0.36-0.88 ppm). DBP was detected in nine samples (0.069-23 ppm). NDPA was detected in three samples (0.80-0.17 ppm). 4,4-DDT (0.63 ppm) and chlordane (0.18 ppm) were detected in one sample. PCBs (1.2-2.1 ppm) were also detected in three samples. Very low levels of a few VOCs were also detected. Asbestos containing material was present at the joints of the clay pipe sewer in the ABC line. Groundwater samples collected in borings and MWs near the woodbox sewer and clay pipe trunks did not detect any of the contaminants found in soil samples associated with those structures.	The sewer system remains largely in place. A video of approximately 650 ft of the GOW sewers was taken during the RI and the sewer was found to be in good condition. Figure D36 (Barr, 2012)	This area poses an indeterminate public health hazard. cPAHs, mercury, and arsenic in the sediment are above SRVs for industrial land use; however, current exposure is expected to be very limited and infrequent. Groundwater in this area does not appear to have been impacted by the wood box sewers or clay pipe trunks.	Areas of cPAHs, mercury, and arsenic in the sewer sediment above SRVs may need to be removed if land use changes.

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Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
GOW Transformers (501 Bldgs in GOW East, GOW Central, ABC Line, and DEF Line subareas)	During the GOW period, twelve substations were constructed and operated. These were left energized after decommissioning. It is not clear when the University stopped using them. PCB-containing oils have been historically used in electrical transformers.	In 2006, three soil samples near one transformer showed high lead at a depth of 6 ft (550 ppm) and cPAHs in the surface soil (18 ppm). In 2011, 39 soil samples were collected and analyzed (27 for metals, 21 for SVOCs, 1 for VOCs, and 23 for PCBs). Mercury was elevated in two samples at a depth of 6 in. (0.95, 6.3 ppm). Lead was elevated in one 6 inch sample (340 ppm) and PCBs found in two samples (1.9 at 6 in. and 3.5 ppm at 2 ft). cPAHs were detected in 16 samples - above the industrial SRVs in two samples at 6 in. (3.2, 39 ppm) and detected in 12 more (0.01 -1.7 ppm) all at 6 in. except one at 2 ft and one at 3 ft. Groundwater samples collected from wells near the 501 buildings in GOW East (MW-21D, MW-28, MW-29, MW-C7-004, MW-C7-016), GOW Central (T00006), and ABC Line (MW-21D, MW-28, MW-29) did not detect cPAHs, lead or mercury, but were not tested for PCBs. No groundwater samples were collected near the 501 buildings in the DEF Line subarea.	The buildings still exist. Pole-mounted transformers are also present throughout the property. Figure D37 (Barr, 2012)	This area poses an indeterminate public health hazard. cPAHs and mercury in the soil are above SRVs for industrial land use, and lead and PCBs are above residential SRVs; however, current exposure is expected to be very limited and infrequent. There do not appear to be any groundwater exposures associated with these sites.	Areas of cPAHs, mercury, lead, and PCBs above SRVs may need to be removed if land use changes.
Ditches	Ditches were constructed during the GOW period to transport surface water to surface water collection ponds and the ditches remained in use after GOW was decommissioned.	Six soil samples at a depth of 6 in. were analyzed for metals and SVOCs. No evidence of contamination was found except for three low detections of cPAHs (0.075-0.15 ppm). No groundwater samples were collected in the ditches, but no SVOCs were detected in nearby well samples (T00006, MW-C6-020, MW21D, MW-28, MW-29, MW-C7-004).	The ditches are still present. Figure D38 (Barr, 2012)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern.	More data may be needed prior to development.
Vermillion Highlands - sites (unless cited) taken from 2010 Vermillion Highland Phase I report (Barr, 2010)					
Area 1 - Former GOW operations (Figure 14)					
Abandoned Farmington Farm	This is an abandoned farm that reportedly has physical hazards associated with farm remnants (Barr, 2010). May have an abandoned well.	No soil or groundwater data was collected.	This abandoned farmstead is North of the Lone Rock Trail and may be visited by the occasional hunter/recreator. Figure 3 (Barr, 2010)	Physical hazards are public health hazards.	Physical hazards should be removed or access restricted. All wells not in use should be located and sealed.
Christmas Tree Railroad Spurs/Grid Space E7 (Barr, 2012)	This area was reportedly used during the GOW period to temporarily store smokeless gunpowder in cars on the railroad spurs.	In 2003, 15 soil samples at a depth of 0-1 ft were taken along the railroad spurs and north of this area for construction of a dog park. The soil samples were analyzed for metals, PAHs, and explosives and the only evidence of contamination was low cPAHs (0.13 and 0.19 ppm). In 2011, three samples at a depth of 6 in. were analyzed for metals and SVOCs and no evidence of contamination was found, so no groundwater samples collected.	This wooded area is just South of the current dog park. It may be visited by the occasional hunter/recreator. Figure 3 (Barr, 2010); Figure D3 (Barr, 2011b)	Based on current sampling, this area poses no apparent public health hazard because detected levels are too low to be of health concern.	May need to collect more data if land use changes.
GOW Finished Powder Houses (also under GOW Central - adjacent land)	These buildings were used during the GOW period as part of the powder production line. The sixty buildings were constructed with treated wood. The buildings were dismantled by the Army during decommissioning.	In 2009, six soil samples at two locations at various depths analyzed for DNT, diphenylamine, and nitrocellulose as part of AOC2, and all were nondetectable (USACE, 2009a), so no groundwater samples were collected. Also see results under GOW Central.	This area is agricultural, with the exception of the wooded area around former bldg 229-26. This area is north of the Lone Rock Trail. Figure 3 (Barr, 2010); ACE March 2009 Figure 4	Based on current sampling, this area poses no public health hazard because no evidence of contamination was found.	May need to collect more data if land use changes.
Northern 1945 Disturbed Areas	This area was identified as a potential area of concern because soil was disturbed in a 1945 aerial photograph. The area was later planted with trees.	No soil or groundwater data was collected. During the 2010 VH Phase I (Barr, 2010) site visit, this area was noted to be elevated and concrete debris and a crushed 55-gallon drum were observed.	This area is North of the Lone Rock Trail. It may be visited by the occasional hunter/recreator. Figure 3; Photo 1 (Barr, 2010)	Because historical dumping is suspected and no data has been collected, this area is an indeterminate public health hazard.	Further investigation should occur to provide more confidence in the safety of the area.
Northern Notch Area - GOW Shaker Sieve and Reworked Powder Houses (Bldg 239) (Barr, 2012)	These buildings were used for the GOW powder production line. The buildings were burned as part of GOW decommissioning and the foundations are still present.	In 2006, two soil samples were analyzed for metals and 2,4-DNT and one sample for VOCs. No evidence of contamination was found. Suspected ACBM was observed on the ground during 2010 VH Phase I (Barr, 2010) site visit. In 2011, four soil samples at a depth of 6 in. were analyzed for metals and SVOCs. No evidence of contamination was found, so no groundwater samples were collected.	This area contains trees around the remaining structures and the surrounding area is agriculture. This area is restricted by a fence due to physical hazards and asbestos. Figure 3 (Barr, 2010); Figure D32 (Barr, 2012)	Because this area is restricted by a fence, it poses no public health hazards.	Further investigation should occur and physical hazards and asbestos removed prior to allowing public access.

Appendix A: Gopher Ordnance Works Site Summary

Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
Northern Notch Area - GOW Blending Tower and Packing Houses (Bldg 240) (Barr, 2012)	These buildings were used for the GOW powder production line. The buildings were burned as part of GOW decommissioning.	In 2006, arsenic (12.6, 16.3 ppm) and lead (332 ppm) were elevated in surface soils and cPAHs (0.18 ppm) were detected at a depth of 2 ft. In 2011, five samples at 6 in. were analyzed for SVOCs and three for metals. 2,4-DNT was detected at 0.13 ppm and DBP at 0.4 ppm. ACBM was observed on the ground during the 2010 VH Phase I (Barr, 2010) site visit. No groundwater samples were collected in this area.	This area contains trees around the remaining structures and the surrounding area is agriculture. This area is restricted by a fence due to physical hazards and asbestos. Figure 3 (Barr, 2010); Figure D33 (Barr, 2012)	Because this area is restricted by a fence, it poses no public health hazards.	Further investigation should occur and physical hazards and asbestos removed prior to allowing public access.
Northern Notch Area - GOW Air Test Houses (Bldg 224) (Barr, 2012)	These buildings were used for the GOW powder production line. The buildings were burned as part of GOW decommissioning.	In 2006 and 2011, two samples were analyzed for metals and SVOCs at depths between 0-1 ft. No evidence of contamination was found, so no groundwater samples were collected.	This area contains trees around the remaining structures and the surrounding area is agriculture. This area is restricted by a fence due to physical hazards and asbestos. Figure 3 (Barr, 2010); Figure D33 (Barr, 2012)	Because this area is restricted by a fence, it poses no public health hazards.	Further investigation should occur and physical hazards and asbestos removed prior to allowing public access.
Dole Explosives	Dole Explosives leased this site from 1969-2010; site usage include storage of explosives for quarrying and demolition applications.	No environmental data was collected. Ash was observed on the ground during the 2010 VH Phase I (Barr, 2010) site visit.	This area is mainly wooded and adjacent to agriculture. Figure 3; Photos 7 and 8 (Barr, 2010)	Because historical waste burning and explosive storage is suspected and no data has been collected, this area is an indeterminate public health hazard.	Further investigation should occur to provide more confidence in the safety of the area.
Lone Rock Trail Shooting Range (Dakota County Gun Club)	This area was undeveloped during the GOW period and was agricultural until 1997. Currently it is a shooting range that implements best management practices (BMPs) and annually reclaims spent shot.	No soil or groundwater data was collected.	This is an active shooting range north of the Lone Rock Trail. Figure 3 (Barr, 2010)	Active shooting ranges using BMPs are not expected to cause adverse health impacts.	May need to collect more data if land use changes.
Area 2 - RROC Research Area (Figure 15)					
Sewage Sludge Application Research Area	This area was a sewage sludge application research area that received biosolids nearly every year from 1974-1993.	Sloan et al. 2001 reported mercury concentrations up to 0.5 ppm measured in 1995 at the sludge application areas. No other soil data was collected. A water sample (BG-W-GP8) from a "background" soil boring immediately downgradient of this area contained 310 ppb barium; this is below the HRL, but the highest Ba detection in groundwater on the UMore property.	This area is adjacent to the Lone Rock Trail Head Parking lot. Figure 4; Photo 14 (Barr, 2010)	Because historical sewage sludge application occurred and very little data has been collected, this area is an indeterminate public health hazard. A well (UN 207609) is present at the South Beef Farm - current use is unknown but may be a potential route for groundwater exposures. The nearby Lone Rock Trail has only non-potable water available.	Further investigation should occur to provide more confidence in the safety of the area. Due to its proximity to the UM sewage sludge application site, the well at the South Beef Farm should be sampled for nitrate, barium, bacteria and PFCs OR should be posted to warn workers that it is not tested and may not be potable.
Forage Hill	This is a current site of University agricultural research activities. During the Phase I site visit (Barr, 2010), stained soil was observed below an above ground storage tank (AST).	No soil or groundwater data was collected.	This area is adjacent to the Lone Rock Trail and SW of RROC. Figure 4; Photos 11-13 (Barr, 2010)	Because stained soil was observed, and no data has been collected, this area is an indeterminate public health hazard. A transient, non-community public supply well (UN 490565) is still used at the NPR radio transmitter bldg. and may be a pathway for groundwater exposure.	MPCA regulations for ASTs need to be followed. Due to the proximity to the UM sewage sludge application site, the NPR well should be sampled for nitrate, bacteria, barium, and PFCs OR posted to warn workers that it is not tested and may not be potable.
Area 3 - Lone Rock Area (Figure 16)					
Abandoned Manes Farm	This is an abandoned farm that reportedly has physical hazards associated with farm remnants including foundations and fencing (Barr, 2010).	In 2009, (USACE, 2009a) four samples were taken as background samples and analyzed for metals. No evidence of contamination was found, so no groundwater samples were collected.	This abandoned farm is in a wooded area near the Lone Rock Trail. It may be visited by the occasional hunter/recreator. Figure 5 (Barr, 2010)	Physical hazards are public health hazards.	Physical hazards should be removed or access restricted.
Southgate Blaine Ave Dump	This is a potential dump site; however, no evidence of large-scale dumping was found during the Phase I site visit (Barr, 2010).	No soil or groundwater data was collected.	This area is near the southernmost parking area for hunting and near the Lone Rock Trail. It may be visited by the occasional hunter/recreator. Figure 5 (Barr, 2010)	Because historical dumping is suspected and no data has been collected, this area is an indeterminate public health hazard.	Further investigation should occur to provide more confidence in the safety of the area.

Appendix A: Gopher Ordnance Works Site Summary

Site Name	Site Description/Waste Disposal History	Soil & Groundwater Investigation Results	Current Status/Maps	Evaluation of Public Health Hazard	Recommendations
Area 4 - GOW Drainage Area (Figures 17 and 20)					
GOW Drainage Ditch	The GOW drainage ditch was reportedly designed to handle 100 million gallons of wastewater/day. It includes a primary settling basin, a lower process wastewater ditch, a secondary settling basin, and a secondary acid neutralization plant. The GOW wastewater flowed out to the Vermillion River. USACE divided this area into northern, middle and southern sections (AOC1N, AOC1M, and AOC1S).	In 1984, six soil samples were analyzed for metals - antimony was elevated in five samples up to 36 ppm; thallium in three samples (4, 23, 36 ppm) (Twin City Testing Corp., 1986). Later soil samples were not analyzed for antimony and thallium. 2,4-DNT (0.37, 0.75 ppm) and 2,6-DNT (0.52, 0.88 ppm) were detected in soil in the primary settling basin at depths of 6 ft and 3-4 ft, respectively (Peer, 2003). In 2007, (USACE, 2009a) mercury was elevated (11 ppm) and 2,4-DNT was detected (0.55 ppm) in one surface soil sample in AOC1N. In AOC1M, mercury was elevated in three surface samples (0.86-4.9 ppm), 2,4-DNT was detected at 2-4 ft (0.32, 1.4 ppm) and estimated in other samples at very low levels. AOC1S had elevated arsenic (9.3 ppm in surface soil and 9.5 ppm at 8-10 ft) and lead (320 ppm) and cPAHs (22 ppm) in a surface sample. Nitrocellulose was reported throughout AOC1, at up to 18,000 ppm. Several SVOCs and VOCs were estimated at very low levels throughout AOC1. In 2009, (USACE, 2009b) one surface sample in AOC1N had elevated mercury (7.3 ppm) and detected 2,4-DNT (0.67 ppm). In AOC1M, mercury was elevated in a surface sample at 1.5 ppm, and 2,4-DNT was detected at 0.37 ppm at 2-4 ft (and estimated in very low levels in several samples). No contaminants were detected in 2009 AOC1S soil samples, but two surface sediment samples in AOC1S were elevated for arsenic (10, 11 ppm). 1984 groundwater samples (PWL-1, PWL-2, PWL-3) contained antimony and thallium above current HRLs, but 1985 samples (PWL-2 and PWL-3) did not detect these metals. 2007 water samples from borings detected low levels of VOCs, SVOCs, and possibly nitrocellulose; TCE and bis(2-ethylhexyl)phthalate exceeded current drinking water criteria (in AOC1M-W-GP3, AOC1N-W-GP1). This area was not included in the 2011 RI.	The drainage ditch is partly wooded and adjacent to agricultural fields. The Lone Rock Trail crosses the drainage basin twice in the Middle and Southern sections. Figure 6 (Barr, 2010)	This area poses an indeterminate public health hazard. Mercury and cPAHs in the soil are above SRVs for industrial land use, and arsenic and lead are above SRVs for residential land use. However, current exposure is expected to be very limited and infrequent. Groundwater from this area does not appear to pose a public health hazard. Residential wells are present <1 mile downgradient of this subarea, four of which were sampled for VOCs and metals in 1988 and 2003 as part of the Coates Dump monitoring project - in 1988 0.4 ppb carbon tetrachloride (CT) was detected in one well (UN 174676, downgradient of AOC1M-W-GP3); in 2003 that well had an unquantified trace level detection of CT <0.2 ppb; VOCs were not detected in the other wells, metals were at naturally occurring levels, and elevated nitrate was consistent with regional groundwater concentrations.	Further investigation should occur to provide more confidence in the safety of the area. Areas of elevated cPAHs, arsenic, mercury, lead, antimony, and thallium may need to be removed. MDH should attempt to resample UN 174676 to confirm water quality trend.
Abandoned Peine Farm	This is an abandoned farm that reportedly has physical hazards associated with farm remnants, including foundations, walls, and concrete structures (Barr, 2010). An abandoned well was identified during the Phase I site visit.	No soil or groundwater data was collected.	This abandoned farmstead is adjacent to the Lone Rock Trail and may be visited by the occasional hunter/recreator. Figure 6 (Barr, 2010)	Physical hazards are public health hazards.	Physical hazards should be removed or access restricted. All wells not in use should be sealed.
Coates Dump (location shown on Fig. 20)	This dump was reportedly constructed over the former wastewater ditch during the demolition of GOW in 1946 or 1947 (Barr, 2010) and operated as an open, unregulated dump until the 1970s or 1980s, accepting mixed municipal waste and possibly industrial and hazardous waste.	No soil data was apparently collected at the site. Two monitoring wells (MW-D-1 and MW-17) were installed in 1984-1985. A 1984 sample from MW-D-1 detected antimony & thallium above the HRLs and low levels of toluene and xylenes. Since 1994, MDH has periodically sampled residential wells downgradient of the dump for VOCs, metals, and nitrate. Chlorinated VOCs (TCA, TCE, PCE, carbon tetrachloride) were detected in some wells, but concentrations did not exceed levels of health concern and concentrations have decreased over time.	Evidence of fugitive dumping of construction debris was noted during the Phase I site visit (Barr, 2010). Figure 6 (Barr, 2010)	This area poses an indeterminate public health hazard. Dump debris can be a physical as well as chemical public health hazard. Residential well sampling has not detected any contaminants above levels of health concern, but samples have not been tested for antimony, thallium, or 1,4-dioxane.	Access to dump materials should be restricted. Residential wells should continue to be tested periodically to confirm decreasing VOC trend; they should also be tested for metals (including antimony & thallium) and 1,4-dioxane.
Former Law Enforcement Shooting Range	Lead bullets were observed on the ground of this former shooting range during the Phase I site visit (Barr, 2010). Three monitoring wells are at the site (PWL-1, PWL-2, PWL-3).	According to the 2010 VH Phase I, a 1996 draft Phase II report includes data that indicates lead contamination in the soil and 1985 water samples from PWL-2 and PWL-3 contained elevated lead levels (15 and 13 ppb, respectively), but 2007 geoprobe samples did not detect lead. As noted above, 1984 samples contained elevated levels of antimony & thallium, but these metals were not detected in 1985.	This area is adjacent to the Lone Rock Trail and may be visited by the occasional hunter/recreator. Figure 6 (Barr, 2010)	This area is an indeterminate public health hazard, based on unknown levels of elevated lead reported in 1996 (Peer, 1996), although exposure is currently infrequent.	Lead data from 1996 should be evaluated and areas of elevated lead may need to be removed. Monitoring wells not in use should be sealed.
Abandoned Ohmann Farm battery dumping	This is an abandoned farm that reportedly has physical hazards associated with farm remnants (Barr, 2010). Approximately 10 car batteries (some broken) were observed during the Phase I site visit. An abandoned well (UN 235759) was identified during the site visit.	No soil or groundwater data was collected, but 2007 downgradient groundwater samples (AOC1M-W-GP1 and AOC1M-W-GP2) detected only 2.1 ppb of bis(2-ethylhexyl)phthalate.	This abandoned farmstead is near parking for hunting and may be visited by the occasional hunter/recreator. Figure 6; photo 15 of an abandoned well (Barr, 2010)	Physical hazards are public health hazards. Because historical dumping is suspected and no data has been collected, this area is an indeterminate public health hazard.	Physical hazards should be removed or access restricted. All wells not in use should be sealed.

Appendix B: Groundwater Investigations – Detailed Description and Data Tables

Investigation Activities On and Downgradient of UMore East

In 1984, chlorinated organic compounds were detected in the groundwater beneath the University's Burn Pit Area (OU1 of the former UMRRRC Superfund Site) and in 16 private wells located northeast (downgradient) of the OU1 site (Twin City Testing, 1985 as summarized in MDH, 1989). The maximum concentrations of the groundwater contaminants detected at that time are shown below:

Maximum concentrations of groundwater contaminants detected at and downgradient of UMore East in 1984

Contaminant	On-site (ppb, max.)	Private Wells (ppb, max.)	Current HRL or HBV*
Chloroform	72	16	30
Carbon tetrachloride	14	1.5	1
1,2-dichloroethane (DCA)	16	1.1	100
1,1,1-trichloroethane (TCA)	1.1	0.6	9,000
Trichloroethene (TCE)	4.4	0.4	0.4

*Health Risk Limits (HRLs) and Health Based Values (HBVs) are health based drinking water guidance values derived by the Minnesota Department of Health.

In 1991, the University of Minnesota installed two water supply wells (UN 457167 and 474335, completed in the Jordan Sandstone) and water lines as a drinking water supply for the affected residential area; this system is now operated by the City of Rosemount (MDH, 1993). No site related contaminants have been detected in the wells and nitrate+nitrite concentrations range from 1,200 – 5,000 ppb, below the Maximum Contaminant Level (MCL, the federal drinking water standard) of 10,000 ppb.

In 1985-1986, monitoring wells were installed at two locations in UMore East: GUE (in the ABC Line area) and the Oxidation Pond (in the GOW East area) (Twin City Testing, 1986). Samples from two monitoring wells at GUE (GUE-MW-19 and GUE-MW-20) were analyzed for metals, PCBs, and TCDDs/TCDFs. PCBs and TCDD/TCDF were not detected. Antimony, cadmium, thallium, and zinc were detected at concentrations above their HRLs. A sample from one monitoring well at the Oxidation Pond (MW-OX-1) was analyzed for PCBs, VOCs, nitrate, and oil & grease. Only nitrate was detected, below the HRL.

Between 1990 and 2002, the MPCA's consultant sampled monitoring wells MW-21D, MW-22, MW-23, MW-25 and MW-28 five times for VOCs (Delta, 2002). The five chlorinated VOCs detected in 1984 (see table above) all decreased in concentration during this time period (see Table B-1). By 2002, only one well (MW-28) had any chlorinated VOCs (carbon tetrachloride) present above its HRL.

In 2007, USACE collected ten groundwater samples from temporary borings in the former steam plant area (AOC7) within GOW East (USACE, 2009a). Temporary borings, while commonly used in site investigations, are more prone to false detections than monitoring wells due to soil contamination of the probe. Low concentrations, below levels of health concern, were measured for a number of VOCs

Table B-1 – Chlorinated VOCs in Monitoring Wells, 1990 - 2002

Analyte			Carbon Tetrachloride	Chloroform	1,2-DCA	1,1,1-TCA	1,1,2-TCE
Drinking Water Criteria			1	30	1	9,000	0.4
Well	Year	Units					
MW-21D	1990	ppb	2.1	26	1.4	0.7	2.4
	1992	ppb	1.1	26	1	ND	0.6
	1993	ppb	1.3	23	0.8	0.7	1.4
	1995	ppb	1	14	0.8	1.1	1.7
	2002	ppb	ND	11	ND	ND	ND
MW-22	1990	ppb	ND	6	ND	ND	ND
	1992	ppb	ND	2.8	ND	ND	ND
	1993	ppb	ND	2.7	ND	ND	ND
	1995	ppb	ND	3.4	ND	0.7	ND
	2002	ppb	ND	2.3	ND	ND	ND
MW-23D	1990	ppb	0.5	9.9	0.6	ND	0.7
	1992	ppb	0.5	14	0.3	0.2	3.4
	1993	ppb	ND	4.7	ND	ND	2.4
	1995	ppb	0.5	8.6	0.4	ND	6.4
	2002	ppb	ND	8.9	ND	ND	2.6
MW-25	1990	ppb	ND	2	ND	ND	ND
	1992	ppb	ND	1	ND	ND	ND
	1993	ppb	ND	1.8	ND	ND	ND
	1995	ppb	ND	2.3	ND	ND	ND
	2002	ppb	ND	2.7	ND	ND	ND
MW-28	1990	ppb	1.4	29	ND	0.6	2
	1992	ppb	1.2	31	1.8	ND	0.7
	1993	ppb	1.7	36	1.6	0.9	2.1
	1995	ppb	1.4	23	1.2	0.9	2.4
	2002	ppb	1.1	23	ND	ND	1.8

NOTES:


Data from Delta (2002) summary tables; lab reports not available so results (if any) for other analytes are unknown.

ppb = parts per billion

DCA = dichloroethane

TCA = trichloroethane

TCE = trichloroethene

 Indicates concentration exceeds drinking water criterion

and SVOCs (Table B-2). Only five compounds were detected above any state or federal drinking water standards: benzo(a)pyrene, bis(2-ethylhexyl)phthalate, 2,4,6-trichlorophenol, diesel range organics (DRO), and total cPAHs. Bis(2-ethylhexyl)phthalate was also detected in quality control samples, suggesting its presence in these particular samples may have been due to laboratory contamination. Except for carbon tetrachloride, chloroform, and trichloroethene, none of these VOCs or SVOCs were detected in later monitoring well samples; DRO was not analyzed for in the monitoring well samples.

In September 2009, USACE obtained one additional groundwater sample in AOC7D which contained low concentrations of acetone, chloroform, and methyl ethyl ketone (USACE, 2009b). These did not exceed any state or federal drinking water standards.

The 2011 RI (Barr, 2012) included groundwater sampling from fifteen monitoring wells - six new and nine existing. Locations of the six new wells were chosen to increase confidence that contamination of the former GOW operational area was not affecting groundwater, including 2,4- and 2,6-DNT, which had been detected at concentrations exceeding the soil leaching values (SLVs); contaminant concentrations in soil above the SLVs are considered to represent unacceptable potential risk to groundwater via the leaching pathway.

Total nitrate + nitrite greater than or equal to the drinking water standard of 10,000 ppb was detected in 7 of 15 monitoring wells, with the highest at 30,000 ppb. However, upgradient monitoring well MW-E4-010 (Figure 20) had the second highest nitrate level (22,000 ppb), suggesting the nitrate in the groundwater at the site reflects concentrations related to agricultural activities in this area rather than any GOW-related activities.

None of the groundwater samples in the 2011 RI were analyzed for antimony, thallium, or zinc, which had been detected in earlier samples at several locations at concentrations above health concern.

Four chlorinated VOCs were detected in the monitoring well samples. Chloroform was detected in seven of the samples, TCE in three samples, tetrachloroethylene in one sample, and carbon tetrachloride in one sample (Table B-2). TCE was the only compound to exceed the drinking water standards. Four of the monitoring wells sampled by Barr in 2011 (MW-21D, MW-22, MW-23D, and MW-28) were also sampled in 2002 (Delta, 2002), as described above; in each of these wells the concentrations of chloroform and/or TCE decreased during the nine years between the sampling events. The nearest monitoring wells downgradient of AOC7 (MW-B7-014 and MW-B7-015) did not show VOCs, PAHs, or other SVOCs.

Although no groundwater samples collected outside of AOC7 detected contaminants at levels of concern, there is at least one area with high soil contaminant concentrations that has had no groundwater sampling (Figure 20). The deepest samples (ranging from 2 to 5 feet) collected by the USACE from two sample locations (FGOW-AOC6-S-TP3 and FGOW-AOC6-S-TP5), spanning a distance of more than 325 feet in the north half of AOC6, contained levels of BaP and other PAHs that significantly exceeded the SRVs and SLVs. PAHs generally have low mobility in soil, so it is possible that groundwater has not been impacted in this area. However, the lack of sampling at depths below 5 feet makes it impossible to rule out possible groundwater contamination. PAHs have not been detected in monitoring wells MW-A5-018 and MW-A6-006, but these wells are located more than a mile to the northeast of area AOC6 and may not provide an adequate monitoring network for this portion of the site, particularly as the water table in this portion of the site is present within a thick sequence of unstratified glacial till (Barr, 2012). In such deposits, localized groundwater flow patterns may be

different from the overall regional flow direction and monitoring wells nearer to AOC6 may be necessary. Additional delineation of the vertical extent of soil contamination will be needed before any planned development can occur. If additional soil sampling indicates contaminants have migrated downward in these locations, groundwater monitoring wells may be needed to ensure soil contaminants are not migrating to and degrading the groundwater.

Another area of possible concern is located in the former ABC Line area. A soil boring advanced during a 2008 geological assessment encountered soils that contained “a frothy liquid that smelled of mothballs...from 25-45 feet below ground surface outside of Building 237G” (as cited in Barr, 2011a). This odor may indicate naphthalene or other related PAHs. The depth to groundwater in this area is approximately 50 – 55 feet, based on nearby monitoring well water level data (based on Figure 10, Barr, 2012). Subsequent surface and near surface sampling near this location and a sample collected at 30 feet from a deep soil boring (237G-SB1) located 5 feet from the original boring did not detect any PAHs or VOCs (Barr, 2012). The disparity between the visual and olfactory observations of contamination in the initial soil boring and the absence of detectable contaminants in the second boring leaves this as something of an unresolved question. There are no monitoring wells downgradient of the former Building 237G area, but there are drinking water wells located less than a mile in the downgradient direction, in the town of Coates.

In 2013, the City of Rosemount provided city water connection information to MDH that indicated approximately a dozen properties located north and northeast of UMore East may still use private wells as their primary drinking water source. MDH contacted the owners of the six closest properties and obtained permission to sample at four. Samples were analyzed for VOCs (including 1,4-dioxane), antimony, and thallium. 1,4-dioxane and several chlorinated VOCs were detected in one well (“Well A”, Fig. 20 of Public Health Assessment) at concentrations below their individual HRLs, but the combined concentrations exceeded an acceptable health risk level and MDH issued a drinking water advisory for the well. The property where the well is located already has a connection to city water and use of the affected well was only incidental; the owner indicated it would be posted as “non-potable”. No VOCs were detected in the other wells tested; antimony and thallium were not detected in any of the wells. MDH plans to expand private well sampling to determine if additional wells have been contaminated in this area.

Investigation Activities On and Downgradient of Vermillion Highlands:

In 1984-1985, Twin City Testing installed monitoring wells and collected groundwater samples at two locations in the Vermillion Highlands: Coates Dump Site and the Process Water Lagoon in the Area 4-GOW Drainage Area (Twin City Testing, 1986). A surface water sample was also collected in the process water lagoon. Samples collected from two monitoring wells at the Coates Dump Site (MW-D-1 and MW-17) were analyzed for VOCs. Only toluene and xylenes were detected, below their HRLs, in well MW-D-1, but were not detected in a subsequent sample from that well. The initial sample from MW-D-1 was also tested for metals, chloride, sulfate, and nitrate; antimony and thallium exceeded their HRLs. Samples collected from three monitoring wells at the Process Water Lagoon (PWL-1, PWL-2, and PWL-3) and a surface water sample collected from the former lagoon area were analyzed for metals, chloride, sulfate, and nitrate; antimony, thallium and nitrate exceeded their HRLs in all of the samples (except nitrate in PWL-1).

Five groundwater samples were collected by the USACE in 2007 from temporary boreholes within the middle and southern sections of the former GOW drainage ditch in Area 4 (Figure 20). No contaminants

were found at or above levels of health concern; however many of the reporting limits were higher than the relevant drinking water criteria, especially for SVOCs. Bis(2-ethylhexyl) phthalate was detected in three samples, one of which (AOC1N-W-GP1) exceeded the MCL of 6 ppb, but not the HRL of 20 ppb. [Note: bis(2-ethylhexyl)phthalate is a common laboratory contaminant, but was not detected in quality control samples associated with these samples]. The following contaminants were detected at concentrations below levels of health concern: phenanthrene, acetone, chloromethane, hexachlorobutadiene, 1,2,3-trichlorobenzene, trichloroethylene, and nitrocellulose.

A groundwater sample collected in 2007 from a temporary boring in AOC1N contained bis(2-ethylhexyl) phthalate (74 ppb) above the HRL (20 ppb) and low amounts of chromium, 1,2,3-trichlorobenzene, chloromethane, and hexachlorobutadiene (USACE, 2009a). 2,4-dinitrotoluene was found at 0.26 ppb, just over half of the MPCA screening value of 0.5 ppb. In the 2012 Remedial Investigation (Barr, 2012) one well sample was collected from MW-E4-010, near the northwest corner of Area 1 in the Vermillion Highlands. Only nitrate+nitrite was detected, at 22,000 ppb. However, the detection limits for 2,4- and 2,6-DNT may not have been low enough to detect the presence of the explosives in the groundwater samples. See the "Dinitrotoluene" section in the text of the Public Health Assessment for more discussion.

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	GUE MW-19			GUE MW-20		Screening Criteria	
		Oct. 1985 TCT, 1986	Jan. 1986 TCT, 1986	Jan. 1986 (dupl) TCT, 1986	Oct. 1985 TCT, 1986	Jan. 1986 TCT, 1986	Drinking Wtr. Criterion	Source
Units								
General Parameters								
Chloride	ppb	NA	NA	NA	NA	NA	250,000	MCL ₂
Nitrate + Nitrite	ppb	NA	NA	NA	NA	NA	10,000	HRL
Sulfate	ppb	NA	NA	NA	NA	NA	250,000	MCL ₂
Metals								
Antimony	ppb	12	NA	NA	7	NA	6	HRL
Arsenic	ppb						10	MCL
Barium	ppb	NA	NA	NA	NA	NA	2,000	HRL
Cadmium	ppb	10	3.8	<1	10	<1	4	HRL
Copper	ppb	<10	830	<10	<10	<10	1,300	AL
Chromium	ppb	<10	160	<10	<10	<10	100	HRL**
Lead	ppb	15	900	<2	9	5	15	AL
Selenium	ppb	<3	NA	NA	<3	NA	30	HRL
Thallium	ppb	2	NA	NA	<2	NA	0.6	HRL
Zinc	ppb	6,090	20,200	3,550	1,440	2,090	2,000	HRL
VOCs								
Acetone	ppb	NA	NA	NA	NA	NA	4,000	HRL
Benzene	ppb	NA	NA	NA	NA	NA	2	HRL
Carbon tetrachloride	ppb	NA	NA	NA	NA	NA	1	HRL
Chloroform	ppb	NA	NA	NA	NA	NA	30	HRL
Chloromethane	ppb	NA	NA	NA	NA	NA	NE	
Ethylbenzene	ppb	NA	NA	NA	NA	NA	50	HRL
Hexachlorobutadiene	ppb	NA	NA	NA	NA	NA	1	HRL
Methylene chloride	ppb	NA	NA	NA	NA	NA	5	MCL
Methyl ethyl ketone (MEK)	ppb	NA	NA	NA	NA	NA	4,000	HRL
n-Butylbenzene	ppb	NA	NA	NA	NA	NA	NE	
Tetrachloroethylene	ppb	NA	NA	NA	NA	NA	5	HRL
Toluene	ppb	NA	NA	NA	NA	NA	200	HRL
1,2,3-Trichlorobenzene	ppb	NA	NA	NA	NA	NA	NE	
Trichloroethene (TCE)	ppb	NA	NA	NA	NA	NA	0.4	HBV
Xylenes	ppb	NA	NA	NA	NA	NA	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting limit
 [shaded] indicates compound present above drinking water criterion

HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Sample ID	Sample date	GUE MW-19			GUE MW-20		Screening Criteria	
		Oct. 1985 TCT, 1986	Jan. 1986 TCT, 1986	Jan. 1986 (dupl) TCT, 1986	Oct. 1985 TCT, 1986	Jan. 1986 TCT, 1986	Drinking Wtr. Criterion	Source
Analyte	Units							
SVOCs								
2,4-Dinitrotoluene	ppb	NA	NA	NA	NA	NA	0.5	SV
2,4,6-Trichlorophenol	ppb	NA	NA	NA	NA	NA	30	HRL
2-Methylnaphthalene	ppb	NA	NA	NA	NA	NA	NE	
4-Nitroanaline	ppb	NA	NA	NA	NA	NA	NE	
4-Nitrophenol	ppb	NA	NA	NA	NA	NA	NE	
Benzidine	ppb	NA	NA	NA	NA	NA	NE	
Benzo(a)anthracene	ppb	NA	NA	NA	NA	NA	0.6	HBV*
Benzo(a)pyrene	ppb	NA	NA	NA	NA	NA	0.06	HBV
Benzo(ghi)perylene	ppb	NA	NA	NA	NA	NA	NE	
Benzo(k)fluoranthene	ppb	NA	NA	NA	NA	NA	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb	NA	NA	NA	NA	NA	NE	
bis(2-ethylhexyl)phthalate	ppb	NA	NA	NA	NA	NA	6	MCL
Butyl benzyl phthalate	ppb	NA	NA	NA	NA	NA	100	HRL
Carbazole	ppb	NA	NA	NA	NA	NA	NE	
Chrysene	ppb	NA	NA	NA	NA	NA	6	HBV*
Fluoranthene	ppb	NA	NA	NA	NA	NA	300	HRL
Phenanthrene	ppb	NA	NA	NA	NA	NA	NE	
Pyrene	ppb	NA	NA	NA	NA	NA	200	HRL
TPH								
Diesel range organics	ppb	NA	NA	NA	NA	NA	200	HBV
Gasoline range organics	ppb	NA	NA	NA	NA	NA	200	HBV
Other								
Nitrocellulose	ppb	NA	NA	NA	NA	NA	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level

SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

█ indicates compound present above drinking water criterion

TPH = total petroleum hydrocarbons

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Units	Sample ID Sample date Data source	MW-OX-1	Coates MW-D-1		Coates MW-17	Lagoon PWL-1	Screening Criteria	
			Oct. 1985 TCT, 1986	11/20/1984 TCT, 1986	10/16/1985 TCT, 1986	10/16/1985 TCT, 1986	11/20/1984 TCT, 1986	Drinking Wtr. Criterion	Source
General Parameters									
Chloride	ppb		NA	11,000	NA	NA	6,000	250,000	MCL ₂
Nitrate + Nitrite	ppb		3,000	9,200	NA	NA	2,000	10,000	HRL
Sulfate	ppb		NA	52,000	NA	NA	20,000	250,000	MCL ₂
Metals									
Antimony	ppb		NA	16	NA	NA	9	6	HRL
Arsenic	ppb		NA	4	NA	NA	<1	10	MCL
Barium	ppb		NA	NA	NA	NA	NA	2,000	HRL
Cadmium	ppb		NA	<10	NA	NA	<10	4	HRL
Copper	ppb		NA	<10	NA	NA	<10	1,300	
Chromium	ppb		NA	<10	NA	NA	<10	100	HRL**
Lead	ppb		NA	<10	NA	NA	<10	15	
Selenium	ppb		NA	8	NA	NA	<1	30	HRL
Thallium	ppb		NA	8	NA	NA	8	0.6	HRL
Zinc	ppb		NA	20	NA	NA	<10	2,000	HRL
VOCs									
Acetone	ppb		NA	NA	NA	NA	NA	4,000	HRL
Benzene	ppb		NA	<1	NA	NA	NA	2	HRL
Carbon tetrachloride	ppb		<0.1	NA	<0.1	<0.1	NA	1	HRL
Chloroform	ppb		<0.1	NA	<0.1	<0.1	NA	30	HRL
Chloromethane	ppb		<0.1	NA	<0.1	<0.1	NA	NE	
Ethylbenzene	ppb		NA	NA	NA	NA	NA	50	HRL
Hexachlorobutadiene	ppb		NA	NA	NA	NA	NA	1	HRL
Methylene chloride	ppb		<0.3	NA	<0.3	<0.3	NA	5	MCL
Methyl ethyl ketone (MEK)	ppb		NA	NA	NA	NA	NA	4,000	HRL
n-Butylbenzene	ppb		NA	NA	NA	NA	NA	NE	
Tetrachloroethylene	ppb		<0.1	NA	<0.1	<0.1	NA	5	HRL
Toluene	ppb		NA	63	<0.1	<0.1	NA	200	HRL
1,2,3-Trichlorobenzene	ppb		NA	NA	NA	NA	NA	NE	
Trichloroethene (TCE)	ppb		<0.1	NA	<0.1	<0.1	NA	0.4	HBV
Xylenes	ppb		NA	25	<0.1	<0.1	NA	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting limit
 [shaded box] indicates compound present above drinking water criterion

HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	MW-OX-1	Coates MW-D-1		Coates MW-17	Lagoon PWL-1	Screening Criteria	
		Oct. 1985 TCT, 1986	11/20/1984 TCT, 1986	10/16/1985 TCT, 1986	10/16/1985 TCT, 1986	11/20/1984 TCT, 1986	Drinking Wtr. Criterion	Source
Units								
SVOCs								
2,4-Dinitrotoluene	ppb	NA	NA	NA	NA	NA	0.5	SV
2,4,6-Trichlorophenol	ppb	NA	NA	NA	NA	NA	30	HRL
2-Methylnaphthalene	ppb	NA	NA	NA	NA	NA	NE	
4-Nitroanaline	ppb	NA	NA	NA	NA	NA	NE	
4-Nitrophenol	ppb	NA	NA	NA	NA	NA	NE	
Benzidine	ppb	NA	NA	NA	NA	NA	NE	
Benzo(a)anthracene	ppb	NA	NA	NA	NA	NA	0.6	HBV*
Benzo(a)pyrene	ppb	NA	NA	NA	NA	NA	0.06	HBV
Benzo(ghi)perylene	ppb	NA	NA	NA	NA	NA	NE	
Benzo(k)fluoranthene	ppb	NA	NA	NA	NA	NA	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb	NA	NA	NA	NA	NA	NE	
bis(2-ethylhexyl)phthalate	ppb	NA	NA	NA	NA	NA	6	MCL
Butyl benzyl phthalate	ppb	NA	NA	NA	NA	NA	100	HRL
Carbazole	ppb	NA	NA	NA	NA	NA	NE	
Chrysene	ppb	NA	NA	NA	NA	NA	6	HBV*
Fluoranthene	ppb	NA	NA	NA	NA	NA	300	HRL
Phenanthrene	ppb	NA	NA	NA	NA	NA	NE	
Pyrene	ppb	NA	NA	NA	NA	NA	200	HRL
TPH								
Diesel range organics	ppb	NA	NA	NA	NA	NA	200	HBV
Gasoline range organics	ppb	NA	NA	NA	NA	NA	200	HBV
Other								
Nitrocellulose	ppb	NA	NA	NA	NA	NA	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level

SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

█ indicates compound present above drinking water criterion

TPH = total petroleum hydrocarbons

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	Lagoon PWL-1	Lagoon PWL-2		Lagoon PWL-3		Screening Criteria	
		Oct. 1985 TCT, 1986	11/20/1984 TCT, 1986	Oct. 1985 TCT, 1986	11/20/1984 TCT, 1986	Oct. 1985 TCT, 1986	Drinking Wtr. Criterion	Source
Units								
General Parameters								
Chloride	ppb	NA	23,000	NA	20,000	NA	250,000	MCL ₂
Nitrate + Nitrite	ppb	NA	18,000	NA	18,000	NA	10,000	HRL
Sulfate	ppb	19,000	21,000	21,000	19,000	67,000	250,000	MCL ₂
Metals								
Antimony	ppb	<4	16	<4	19	<4	6	HRL
Arsenic	ppb	<3	<1	<3	<1	<3	10	MCL
Barium	ppb	NA	NA	NA	NA	NA	2,000	HRL
Cadmium	ppb	<0.1	<10	0.2	<10	<0.1	4	HRL
Copper	ppb	<10	<10	<10	<10	70	1,300	
Chromium	ppb	<10	<10	<10	<10	<10	100	HRL**
Lead	ppb	<2	<10	15	<10	13	15	
Selenium	ppb	<2	7	<2	<1	<2	30	HRL
Thallium	ppb	<2	13	<2	12	<2	0.6	HRL
Zinc	ppb	30	<10	20	<10	40	2,000	HRL
VOCs								
Acetone	ppb	NA	NA	NA	NA	NA	4,000	HRL
Benzene	ppb	NA	NA	NA	NA	NA	2	HRL
Carbon tetrachloride	ppb	NA	NA	NA	NA	NA	1	HRL
Chloroform	ppb	NA	NA	NA	NA	NA	30	HRL
Chloromethane	ppb	NA	NA	NA	NA	NA	NE	
Ethylbenzene	ppb	NA	NA	NA	NA	NA	50	HRL
Hexachlorobutadiene	ppb	NA	NA	NA	NA	NA	1	HRL
Methylene chloride	ppb	NA	NA	NA	NA	NA	5	MCL
Methyl ethyl ketone (MEK)	ppb	NA	NA	NA	NA	NA	4,000	HRL
n-Butylbenzene	ppb	NA	NA	NA	NA	NA	NE	
Tetrachloroethylene	ppb	NA	NA	NA	NA	NA	5	HRL
Toluene	ppb	NA	NA	NA	NA	NA	200	HRL
1,2,3-Trichlorobenzene	ppb	NA	NA	NA	NA	NA	NE	
Trichloroethene (TCE)	ppb	NA	NA	NA	NA	NA	0.4	HBV
Xylenes	ppb	NA	NA	NA	NA	NA	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting limit
 [shaded box] indicates compound present above drinking water criterion

HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	Lagoon PWL-1	Lagoon PWL-2		Lagoon PWL-3		Screening Criteria	
		Oct. 1985 TCT, 1986	11/20/1984 TCT, 1986	Oct. 1985 TCT, 1986	11/20/1984 TCT, 1986	Oct. 1985 TCT, 1986	Drinking Wtr. Criterion	Source
Units								
SVOCs								
2,4-Dinitrotoluene	ppb	NA	NA	NA	NA	NA	0.5	SV
2,4,6-Trichlorophenol	ppb	NA	NA	NA	NA	NA	30	HRL
2-Methylnaphthalene	ppb	NA	NA	NA	NA	NA	NE	
4-Nitroanaline	ppb	NA	NA	NA	NA	NA	NE	
4-Nitrophenol	ppb	NA	NA	NA	NA	NA	NE	
Benzidine	ppb	NA	NA	NA	NA	NA	NE	
Benzo(a)anthracene	ppb	NA	NA	NA	NA	NA	0.6	HBV*
Benzo(a)pyrene	ppb	NA	NA	NA	NA	NA	0.06	HBV
Benzo(ghi)perylene	ppb	NA	NA	NA	NA	NA	NE	
Benzo(k)fluoranthene	ppb	NA	NA	NA	NA	NA	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb	NA	NA	NA	NA	NA	NE	
bis(2-ethylhexyl)phthalate	ppb	NA	NA	NA	NA	NA	6	MCL
Butyl benzyl phthalate	ppb	NA	NA	NA	NA	NA	100	HRL
Carbazole	ppb	NA	NA	NA	NA	NA	NE	
Chrysene	ppb	NA	NA	NA	NA	NA	6	HBV*
Fluoranthene	ppb	NA	NA	NA	NA	NA	300	HRL
Phenanthrene	ppb	NA	NA	NA	NA	NA	NE	
Pyrene	ppb	NA	NA	NA	NA	NA	200	HRL
TPH								
Diesel range organics	ppb	NA	NA	NA	NA	NA	200	HBV
Gasoline range organics	ppb	NA	NA	NA	NA	NA	200	HBV
Other								
Nitrocellulose	ppb	NA	NA	NA	NA	NA	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level

SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

█ indicates compound present above drinking water criterion

TPH = total petroleum hydrocarbons

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	AOC1N-W-GP1	AOC1M-W-GP1	AOC1M-W-GP2	AOC1M-W-GP3	AOC1S-W-GP1	Screening Criteria	
		9/18/2007 USACE, 2009a	9/19/2007 USACE, 2009a	9/20/2007 USACE, 2009a	9/21/2007 USACE, 2009a	9/24/2007 USACE, 2009a	Drinking Wtr. Criterion	Source
General Parameters	Units							
Chloride	ppb	NA	NA	NA	NA	NA	250,000	MCL ₂
Nitrate + Nitrite	ppb	NA	NA	NA	NA	NA	10,000	HRL
Sulfate	ppb	NA	NA	NA	NA	NA	250,000	MCL ₂
Metals								
Antimony	ppb	NA	NA	NA	NA	NA	6	HRL
Arsenic	ppb	<25	<25	<25	<25	<25	10	MCL
Barium	ppb	33	30	63	71	63	2,000	HRL
Cadmium	ppb	<5	<5	<5	<5	<5	4	HRL
Copper	ppb	NA	NA	NA	NA	NA	1,300	
Chromium	ppb	2.6 J	<15	<15	<15	<15	100	HRL**
Lead	ppb	<15	<15	<15	<15	<15	15	
Selenium	ppb	<22	<22	<22	<22	<22	30	HRL
Thallium	ppb	NA	NA	NA	NA	NA	0.6	HRL
Zinc	ppb	NA	NA	NA	NA	NA	2,000	HRL
VOCs								
Acetone	ppb	<10	<10	<10	3.6 J	<10	4,000	HRL
Benzene	ppb	<1.0	<1.0	<1.0	<1.0	<1.0	2	HRL
Carbon tetrachloride	ppb	<2.0	<2.0	<2.0	<2.0	<2.0	1	HRL
Chloroform	ppb	<1.0	<1.0	<1.0	<1.0	<1.0	30	HRL
Chloromethane	ppb	0.31 J	<2.0	<2.0	<2.0	<2.0	NE	
Ethylbenzene	ppb	<1.0	<1.0	<1.0	<1.0	<1.0	50	HRL
Hexachlorobutadiene	ppb	0.15 J	<1.0	<1.0	<1.0	<1.0	1	HRL
Methylene chloride	ppb	<5.0	<5.0	<5.0	<5.0	<5.0	5	MCL
Methyl ethyl ketone (MEK)	ppb	<6.0	<6.0	<6.0	<6.0	<6.0	4,000	HRL
n-Butylbenzene	ppb	<1.0	<1.0	<1.0	<1.0	<1.0	NE	
Tetrachloroethylene	ppb	<1.0	<1.0	<1.0	<1.0	<1.0	5	HRL
Toluene	ppb	<1.0	<1.0	<1.0	<1.0	<1.0	200	HRL
1,2,3-Trichlorobenzene	ppb	0.42 J	<1.0	<1.0	<1.0	<1.0	NE	
Trichloroethene (TCE)	ppb	<1.0	<1.0	<1.0	0.47 J	<1.0	0.4	HBV
Xylenes	ppb	<3	<3	<3	<3	<3	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting limit
 indicates compound present above drinking water criterion

HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	AOC1N-W-GP1	AOC1M-W-GP1	AOC1M-W-GP2	AOC1M-W-GP3	AOC1S-W-GP1	Screening Criteria	
		9/18/2007 USACE, 2009a	9/19/2007 USACE, 2009a	9/20/2007 USACE, 2009a	9/21/2007 USACE, 2009a	9/24/2007 USACE, 2009a	Drinking Wtr. Criterion	Source
SVOCs	Units							
2,4-Dinitrotoluene	ppb	0.26 J	<0.4	<0.4	<0.4	<0.4	0.5	SV
2,4,6-Trichlorophenol	ppb	<20	<20	<20	<20	<20	30	HRL
2-Methylnaphthalene	ppb	<10	<10	<10	<10	<10	NE	
4-Nitroanaline	ppb	<50	<50	<50	<50	<50	NE	
4-Nitrophenol	ppb	<50	<50	<50	<50	<50	NE	
Benzdine	ppb	<200	<200	<200	<200	<200	NE	
Benzo(a)anthracene	ppb	<10	<10	<10	<10	<10	0.6	HBV*
Benzo(a)pyrene	ppb	<10	<10	<10	<10	<10	0.06	HBV
Benzo(ghi)perylene	ppb	<10	<10	<10	<10	<10	NE	
Benzo(k)fluoranthene	ppb	<10	<10	<10	<10	<10	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb	<10	<10	<10	<10	<10	NE	
bis(2-ethylhexyl)phthalate	ppb	74 J	2.1 J	<10	<10	1.8 J	6	MCL
Butyl benzyl phthalate	ppb	<20	<20	<20	<20	<20	100	HRL
Carbazole	ppb	<10	<10	<10	<10	<10	NE	
Chrysene	ppb	<10	<10	<10	<10	<10	6	HBV*
Fluoranthene	ppb	<20	<20	<20	<20	<20	300	HRL
Phenanthrene	ppb	<10	<10	<10	2.2 J	<10	NE	
Pyrene	ppb	<10	<10	<10	<10	<10	200	HRL
TPH								
Diesel range organics	ppb	NA	NA	NA	NA	NA	200	HBV
Gasoline range organics	ppb	NA	NA	NA	NA	NA	200	HBV
Other								
Nitrocellulose	ppb	<500	<500	<500	130 B	<500	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level

SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

TPH = total petroleum hydrocarbons

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Units	Sample ID	AOC1S-W-GP2	AOC5-W-GP7	AOC7B-W-GP1	AOC7B-W-GP2	AOC7B-W-GP3	AOC7C-W-GP3	Screening Criteria	
		Sample date	9/24/2007	9/6-18/2007	8/16/2007	8/17/2007	8/20/2007	8/21/2007	Drinking Wtr. Criterion	Source
		Data source	USACE, 2009a	USACE, 2009a	USACE, 2009a	USACE, 2009a	USACE, 2009a	USACE, 2009a		
General Parameters										
Chloride	ppb		NA	NA	NA	NA	NA	NA	250,000	MCL ₂
Nitrate + Nitrite	ppb		NA	NA	NA	NA	NA	NA	10,000	HRL
Sulfate	ppb		NA	NA	NA	NA	NA	NA	250,000	MCL ₂
Metals										
Antimony	ppb		NA	NA	NA	NA	NA	NA	6	HRL
Arsenic	ppb		<25	<25	<25	<25	<25	<25	10	MCL
Barium	ppb		73	130	100 B	100 B	79	70	2,000	HRL
Cadmium	ppb		<5	<5	<5	<5	<5	<5	4	HRL
Copper	ppb		NA	NA	NA	NA	NA	NA	1,300	
Chromium	ppb		<15	<15	<15	11 J	<15	31	100	HRL**
Lead	ppb		<15	<15	<15	<15	<15	<15	15	
Selenium	ppb		<22	<22	<22	<22	<22	<22	30	HRL
Thallium	ppb		NA	NA	NA	NA	NA	NA	0.6	HRL
Zinc	ppb		NA	NA	NA	NA	NA	NA	2,000	HRL
VOCs										
Acetone	ppb		<10	NA	<10	3.8 J	<10	5.8 J	4,000	HRL
Benzene	ppb		<1.0	NA	<1.0	<1.0	<1.0	0.21 J	2	HRL
Carbon tetrachloride	ppb		<2.0	NA	<2.0	<2.0	<2.0	<2.0	1	HRL
Chloroform	ppb		<1.0	NA	3.1	3	<1.0	1	30	HRL
Chloromethane	ppb		<2.0	NA	<2.0	<2.0	<2.0	<2.0	NE	
Ethylbenzene	ppb		<1.0	NA	<1.0	<1.0	<1.0	<1.0	50	HRL
Hexachlorobutadiene	ppb		<1.0	NA	<1.0	<1.0	<1.0	<1.0	1	HRL
Methylene chloride	ppb		<5.0	NA	<5.0	<5.0	<5.0	<5.0	5	MCL
Methyl ethyl ketone (MEK)	ppb		<6.0	NA	<6.0	<6.0	<6.0	2.3 J	4,000	HRL
n-Butylbenzene	ppb		<1.0	NA	<1.0	0.15 J	<1.0	<1.0	NE	
Tetrachloroethylene	ppb		<1.0	NA	<1.0	<1.0	<1.0	<1.0	5	HRL
Toluene	ppb		<1.0	NA	<1.0	0.37 J	0.24 J	0.35 J	200	HRL
1,2,3-Trichlorobenzene	ppb		<1.0	NA	<1.0	0.24 J	<1.0	<1.0	NE	
Trichloroethene (TCE)	ppb		<1.0	NA	0.4 J	0.32 J	0.39 J	0.23 J	0.4	HBV
Xylenes	ppb		<3	<3	<3	<3	<3	<3	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting limit
 indicates compound present above drinking water criterion

HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	AOC1S-W-GP2 9/24/2007 USACE, 2009a	AOC5-W-GP7 9/6-18/2007 USACE, 2009a	AOC7B-W-GP1 8/16/2007 USACE, 2009a	AOC7B-W-GP2 8/17/2007 USACE, 2009a	AOC7B-W-GP3 8/20/2007 USACE, 2009a	AOC7C-W-GP3 8/21/2007 USACE, 2009a	Screening Criteria	
								Drinking Wtr. Criterion	Source
SVOCs	Units								
2,4-Dinitrotoluene	ppb	<0.4	<0.4	<20	<20	<20	<20	0.5	SV
2,4,6-Trichlorophenol	ppb	<20	NA	<20	<20	<20	<20	30	HRL
2-Methylnaphthalene	ppb	<10	NA	<10	<10	<10	<10	NE	
4-Nitroanaline	ppb	<50	NA	<50	<50	1.1 J	<50	NE	
4-Nitrophenol	ppb	<50	NA	<50	<50	1.8 J	<50	NE	
Benzdine	ppb	<200	NA	<200	<200	1.5 J	<200	NE	
Benzo(a)anthracene	ppb	<10	<10	<10	<10	<10	<10	0.6	HBV*
Benzo(a)pyrene	ppb	<10	<10	<10	<10	0.91 J	<10	0.06	HBV
Benzo(ghi)perylene	ppb	<10	<10	<10	<10	1.1 J	<10	NE	
Benzo(k)fluoranthene	ppb	<10	<10	<10	4.4 J	<80	<10	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb	<10	NA	<10	<10	4.5 J	<10	NE	
bis(2-ethylhexyl)phthalate	ppb	<10	NA	2.5 J B	6.4 J B	<20	6.6 J	6	MCL
Butyl benzyl phthalate	ppb	<20	NA	<20	<20	1.3 J	<20	100	HRL
Carbazole	ppb	<10	NA	<10	<10	1.4 J	<10	NE	
Chrysene	ppb	<10	<10	<10	<10	<10	<10	6	HBV*
Fluoranthene	ppb	<20	1.3 J	<20	<20	<20	<20	300	HRL
Phenanthrene	ppb	<10	<10	<10	<10	<10	<10	NE	
Pyrene	ppb	<10	1.6 J	<10	<10	<10	<10	200	HRL
TPH									
Diesel range organics	ppb	NA	410	<100	<100	<100	NA	200	HBV
Gasoline range organics	ppb	NA	54 J B	NA	NA	NA	NA	200	HBV
Other									
Nitrocellulose	ppb	<500	<500	NA	NA	NA	NA	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level

SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

0.91 J indicates compound present above drinking water criterion

TPH = total petroleum hydrocarbons

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	AOC7C-W-GP6	AOC7C-W-GP7	AOC7D-W-GP1	AOC7D-W-GP2	AOC7D-W-GP5	Screening Criteria	
		8/22/2007 USACE, 2009a	8/23/2007 USACE, 2009a	8/27/2007 USACE, 2009a	8/28/2007 USACE, 2009a	8/31/2007 USACE, 2009a	Drinking Wtr. Criterion	Source
General Parameters	Units							
Chloride	ppb	NA	NA	NA	NA	NA	250,000	MCL ₂
Nitrate + Nitrite	ppb	NA	NA	NA	NA	NA	10,000	HRL
Sulfate	ppb	NA	NA	NA	NA	NA	250,000	MCL ₂
Metals								
Antimony	ppb	NA	NA	NA	NA	NA	6	HRL
Arsenic	ppb	<25	<25	<25	<25	<25	10	MCL
Barium	ppb	57	100	81	91	87	2,000	HRL
Cadmium	ppb	<5	<5	<5	<5	<5	4	HRL
Copper	ppb	NA	NA	NA	NA	NA	1,300	
Chromium	ppb	<15	<15	<15	<15	<15	100	HRL**
Lead	ppb	<15	<15	<15	<15	<15	15	
Selenium	ppb	<22	<22	<22	<22	<22	30	HRL
Thallium	ppb	NA	NA	NA	NA	NA	0.6	HRL
Zinc	ppb	NA	NA	NA	NA	NA	2,000	HRL
VOCs								
Acetone	ppb	<10	<10	2.6 J	4.8 J	<10	4,000	HRL
Benzene	ppb	<1.0	<1.0	<1.0	<1.0	0.26 J	2	HRL
Carbon tetrachloride	ppb	<2.0	<2.0	<2.0	<2.0	<2.0	1	HRL
Chloroform	ppb	1	1	0.99 J	0.45 J	1	30	HRL
Chloromethane	ppb	<2.0	<2.0	<2.0	<2.0	<2.0	NE	
Ethylbenzene	ppb	<1.0	<1.0	<1.0	<1.0	0.45 J	50	HRL
Hexachlorobutadiene	ppb	<1.0	<1.0	<1.0	<1.0	<1.0	1	HRL
Methylene chloride	ppb	<5.0	<5.0	<5.0	<5.0	0.77 J	5	MCL
Methyl ethyl ketone (MEK)	ppb	<6.0	<6.0	<6.0	<6.0	<6.0	4,000	HRL
n-Butylbenzene	ppb	<1.0	<1.0	<1.0	<1.0	<1.0	NE	
Tetrachloroethylene	ppb	<1.0	<1.0	<1.0	<1.0	<1.0	5	HRL
Toluene	ppb	<1.0	<1.0	0.29 J	0.18 J	1	200	HRL
1,2,3-Trichlorobenzene	ppb	<1.0	<1.0	<1.0	<1.0	<1.0	NE	
Trichloroethene (TCE)	ppb	0.17 J	<1.0	0.27 J	0.17 J	0.18 J	0.4	HBV
Xylenes	ppb	<3	<3	<3	<3	<3	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting limit
 indicates compound present above drinking water criterion

HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	AOC7C-W-GP6	AOC7C-W-GP7	AOC7D-W-GP1	AOC7D-W-GP2	AOC7D-W-GP5	Screening Criteria	
		8/22/2007 USACE, 2009a	8/23/2007 USACE, 2009a	8/27/2007 USACE, 2009a	8/28/2007 USACE, 2009a	8/31/2007 USACE, 2009a	Drinking Wtr. Criterion	Source
SVOCs	Units							
2,4-Dinitrotoluene	ppb	<0.4	<0.4	<20	<20	<20	0.5	SV
2,4,6-Trichlorophenol	ppb	<20	<20	<20	<20	94	30	HRL
2-Methylnaphthalene	ppb	<10	<10	<10	<10	75	NE	
4-Nitroanaline	ppb	<50	2 J	<50	<50	<50	NE	
4-Nitrophenol	ppb	<50	2.6 J	<50	<50	<50	NE	
Benzdine	ppb	<200	<200	<200	<200	<200	NE	
Benzo(a)anthracene	ppb	<10	1.4 J	<10	<10	<10	0.6	HBV*
Benzo(a)pyrene	ppb	<10	<10	<10	<10	<10	0.06	HBV
Benzo(ghi)perylene	ppb	<10	<10	<10	<10	<10	NE	
Benzo(k)fluoranthene	ppb	<10	<10	<10	<10	<10	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb	<10	<10	<10	<10	<10	NE	
bis(2-ethylhexyl)phthalate	ppb	2.2 J	2.3 J B	2 J	<10	<10	6	MCL
Butyl benzyl phthalate	ppb	<20	<20	<20	<20	<20	100	HRL
Carbazole	ppb	<10	1.9 J	<10	<10	<10	NE	
Chrysene	ppb	<10	1.5 J	<10	<10	<10	6	HBV*
Fluoranthene	ppb	<20	1.2 J	<20	<20	<20	300	HRL
Phenanthrene	ppb	<10	<10	<10	<10	<10	NE	
Pyrene	ppb	<10	1.1 J	<10	<10	<10	200	HRL
TPH								
Diesel range organics	ppb	NA	NA	35 J B	68 J B	<100	200	HBV
Gasoline range organics	ppb	NA	NA	NA	NA	NA	200	HBV
Other								
Nitrocellulose	ppb	870*	220 B	NA	<500	NA	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level

SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

94 indicates compound present above drinking water criterion

TPH = total petroleum hydrocarbons

* nitrocellulose was not detected in two duplicates of this sample (<0.5)

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	AOC7D-W-GP8	AOC7A-W-HSA104	AOC7A-W-HSA105	AOC7D-W-HSA105	Screening Criteria	
		8/30/2007 USACE, 2009a	9/25/2009 USACE, 2009b	9/25/2009 USACE, 2009b	9/25/2009 USACE, 2009b	Drinking Wtr. Criterion	Source
General Parameters	Units						
Chloride	ppb	NA	NA	NA	NA	250,000	MCL ₂
Nitrate + Nitrite	ppb	NA	NA	NA	NA	10,000	HRL
Sulfate	ppb	NA	NA	NA	NA	250,000	MCL ₂
Metals							
Antimony	ppb	NA	NA	NA	NA	6	HRL
Arsenic	ppb	<25	<25	<25	<25	10	MCL
Barium	ppb	75	80 J	78 J	88	2,000	HRL
Cadmium	ppb	<5	<0.56	<5	<5	4	HRL
Copper	ppb	NA	NA	NA	NA	1,300	
Chromium	ppb	<15	<0.71	<15	<15	100	HRL**
Lead	ppb	<15	<15	<15	<15	15	
Selenium	ppb	<22	6 J	<22	<22	30	HRL
Thallium	ppb	NA	NA	NA	NA	0.6	HRL
Zinc	ppb	NA	NA	NA	NA	2,000	HRL
VOCs							
Acetone	ppb	<10	<10	<10	9.1 J	4,000	HRL
Benzene	ppb	<1.0	<1.0	<1.0	<1.0	2	HRL
Carbon tetrachloride	ppb	<2.0	<2.0	<2.0	<2.0	1	HRL
Chloroform	ppb	1.1	<1.0	3.4 J	0.79 J	30	HRL
Chloromethane	ppb	<2.0	<2.0	<2.0	<2.0	NE	
Ethylbenzene	ppb	<1.0	<1.0	<1.0	<1.0	50	HRL
Hexachlorobutadiene	ppb	<1.0	<1.0	<1.0	<1.0	1	HRL
Methylene chloride	ppb	0.45 J	<5.0	<5.0	<5.0	5	MCL
Methyl ethyl ketone (MEK)	ppb	<6.0	<6.0	<6.0	2.2 J	4,000	HRL
n-Butylbenzene	ppb	<1.0	<1.0	<1.0	<1.0	NE	
Tetrachloroethylene	ppb	<1.0	<1.0	<1.0	<1.0	5	HRL
Toluene	ppb	0.19 J	<1.0	<1.0	<1.0	200	HRL
1,2,3-Trichlorobenzene	ppb	<1.0	<1.0	<1.0	<1.0	NE	
Trichloroethene (TCE)	ppb	0.25 J	<1.0	0.48 J	<1.0	0.4	HBV
Xylenes	ppb	<3	<3	<3	<3	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting lii
 indicates compound present above drinking water criterion

HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

	Sample ID Sample date Data source	AOC7D-W-GP8	AOC7A-W-HSA104	AOC7A-W-HSA105	AOC7D-W-HSA105	Screening Criteria	
		8/30/2007 USACE, 2009a	9/25/2009 USACE, 2009b	9/25/2009 USACE, 2009b	9/25/2009 USACE, 2009b	Drinking Wtr. Criterion	Source
Analyte	Units						
SVOCs							
2,4-Dinitrotoluene	ppb	<20	NA	NA	NA	0.5	SV
2,4,6-Trichlorophenol	ppb	<20	NA	NA	NA	30	HRL
2-Methylnaphthalene	ppb	<10	NA	NA	NA	NE	
4-Nitroanaline	ppb	<50	NA	NA	NA	NE	
4-Nitrophenol	ppb	<50	NA	NA	NA	NE	
Benzidine	ppb	<200	NA	NA	NA	NE	
Benzo(a)anthracene	ppb	<10	NA	NA	NA	0.6	HBV*
Benzo(a)pyrene	ppb	<10	NA	NA	NA	0.06	HBV
Benzo(ghi)perylene	ppb	<10	NA	NA	NA	NE	
Benzo(k)fluoranthene	ppb	<10	NA	NA	NA	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb	<10	NA	NA	NA	NE	
bis(2-ethylhexyl)phthalate	ppb	<10	NA	NA	NA	6	MCL
Butyl benzyl phthalate	ppb	<20	NA	NA	NA	100	HRL
Carbazole	ppb	<10	NA	NA	NA	NE	
Chrysene	ppb	<10	NA	NA	NA	6	HBV*
Fluoranthene	ppb	<20	NA	NA	NA	300	HRL
Phenanthrene	ppb	<10	NA	NA	NA	NE	
Pyrene	ppb	<10	NA	NA	NA	200	HRL
TPH							
Diesel range organics	ppb	<100	NA	NA	NA	200	HBV
Gasoline range organics	ppb	NA	NA	NA	NA	200	HBV
Other							
Nitrocellulose	ppb	NA	NA	NA	NA	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level

SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

█ indicates compound present above drinking water criterion

TPH = total petroleum hydrocarbons

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

	Sample ID	MW-21D (aka T00019)		MW-22 (aka T00020)		MW-23D (aka T00022)		Screening Criteria	
		Sample date	1/17/2002 Delta, 2002	7/13/2011 Barr, 2012	1/17/2002 Delta, 2002	12/8/2011 Barr, 2012	1/17/2002 Delta, 2002	7/14/2011 Barr, 2012	Drinking Wtr. Criterion
Analyte	Units								
General Parameters									
Chloride	ppb	NA	16,000	NA	96,000	NA	11,000	250,000	MCL ₂
Nitrate + Nitrite	ppb	NA	11,000	NA	2,000	NA	9,000	10,000	HRL
Sulfate	ppb	NA	24,000	NA	27,000	NA	33,000	250,000	MCL ₂
Metals									
Antimony	ppb	NA	NA	NA	NA	NA	NA	6	HRL
Arsenic	ppb	NA	<10	NA	<10	NA	<10	10	MCL
Barium	ppb	NA	53	NA	66	NA	51	2,000	HRL
Cadmium	ppb	NA	<1	NA	<1	NA	<1	4	HRL
Copper	ppb	NA	NA	NA	NA	NA	NA	1,300	
Chromium	ppb	NA	<10	NA	<10	NA	<10	100	HRL**
Lead	ppb	NA	<3	NA	<3	NA	<3	15	
Selenium	ppb	NA	<20	NA	<20	NA	<20	30	HRL
Thallium	ppb	NA	NA	NA	NA	NA	NA	0.6	HRL
Zinc	ppb	NA	NA	NA	NA	NA	NA	2,000	HRL
VOCs									
Acetone	ppb	<5.0	<3.8	<5.0	<3.8	<5.0	<3.8	4,000	HRL
Benzene	ppb	<1.0	<0.071	<1.0	<0.071	<1.0	<0.071	2	HRL
Carbon tetrachloride	ppb	<1.0	0.25 J	<1.0	<0.15	<1.0	<0.15	1	HRL
Chloroform	ppb	11	4.2	2.3	<0.15	8.9	5	30	HRL
Chloromethane	ppb	<1.0	<0.24	<1.0	<0.24	<1.0	<0.24	NE	
Ethylbenzene	ppb	<1.0	<0.28	<1.0	<0.28	<1.0	<0.28	50	HRL
Hexachlorobutadiene	ppb	<1.0	<0.42	<1.0	<0.42	<1.0	<0.42	1	HRL
Methylene chloride	ppb	<1.0	<0.85	<1.0	<0.85	<1.0	<0.85	5	MCL
Methyl ethyl ketone (MEK)	ppb	<5.0	<0.65	<5.0	<0.65	<5.0	<0.65	4,000	HRL
n-Butylbenzene	ppb	<1.0	<0.15	<1.0	<0.15	<1.0	<0.15	NE	
Tetrachloroethylene	ppb	<1.0	<0.28	<1.0	<0.28	<1.0	<0.28	5	HRL
Toluene	ppb	<1.0	<0.1	<1.0	<0.1	<1.0	<0.1	200	HRL
1,2,3-Trichlorobenzene	ppb	<1.0	<0.35	<1.0	<0.35	<1.0	<0.35	NE	
Trichloroethene (TCE)	ppb	<1.0	0.43 J	<1.0	<0.18	2.6	0.92 J	0.4	HBV
Xylenes	ppb	<3	<0.8	<3	<0.8	<3	<0.8	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting limit
 indicates compound present above drinking water criterion

HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

	Sample ID	MW-21D (aka T00019)		MW-22 (aka T00020)		MW-23D (aka T00022)		Screening Criteria	
		Sample date	1/17/2002	7/13/2011	1/17/2002	12/8/2011	1/17/2002	7/14/2011	Drinking Wtr. Criterion
Analyte	Units	Delta, 2002	Barr, 2012	Delta, 2002	Barr, 2012	Delta, 2002	Barr, 2012		
SVOCs									
2,4-Dinitrotoluene	ppb	NA	<0.42	NA	<0.42	NA	<0.42	0.5	SV
2,4,6-Trichlorophenol	ppb	NA	<0.55	NA	<0.55	NA	<0.55	30	HRL
2-Methylnaphthalene	ppb	NA	<0.81	NA	<0.81	NA	<0.81	NE	
4-Nitroanaline	ppb	NA	<0.83	NA	<0.83	NA	<0.83	NE	
4-Nitrophenol	ppb	NA	<0.72	NA	<0.72	NA	<0.72	NE	
Benzdine	ppb	NA	<7.0	NA	<7.0	NA	<7.0	NE	
Benzo(a)anthracene	ppb	NA	<0.46	NA	<0.46	NA	<0.46	0.6	HBV*
Benzo(a)pyrene	ppb	NA	<0.38	NA	<0.38	NA	<0.38	0.06	HBV
Benzo(ghi)perylene	ppb	NA	<0.41	NA	<0.41	NA	<0.41	NE	
Benzo(k)fluoranthene	ppb	NA	<0.43	NA	<0.43	NA	<0.43	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb	NA	<0.21	NA	<0.21	NA	<0.21	NE	
bis(2-ethylhexyl)phthalate	ppb	NA	<0.75	NA	<0.75	NA	<0.75	6	MCL
Butyl benzyl phthalate	ppb	NA	<0.42	NA	<0.42	NA	<0.42	100	HRL
Carbazole	ppb	NA	<0.31	NA	<0.31	NA	<0.31	NE	
Chrysene	ppb	NA	<0.56	NA	<0.56	NA	<0.56	6	HBV*
Fluoranthene	ppb	NA	<0.56	NA	<0.56	NA	<0.56	300	HRL
Phenanthrene	ppb	NA	<0.32	NA	<0.32	NA	<0.32	NE	
Pyrene	ppb	NA	<0.61	NA	<0.61	NA	<0.61	200	HRL
TPH									
Diesel range organics	ppb	NA	NA	NA	NA	NA	NA	200	HBV
Gasoline range organics	ppb	NA	NA	NA	NA	NA	NA	200	HBV
Other									
Nitrocellulose	ppb	NA	NA	NA	NA	NA	NA	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level

SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

█ indicates compound present above drinking water criterion

TPH = total petroleum hydrocarbons

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	MW-25	MW-28		MW-29	MW-A5-018	MW-A6-006	Screening Criteria	
		1/17/2002 Delta, 2002	1/17/2002 Delta, 2002	7/14/2011 Barr, 2012	7/14/2011 Barr, 2012	12/7/2011 Barr, 2012	12/7/2011 Barr, 2012	Drinking Wtr. Criterion	Source
General Parameters	Units								
Chloride	ppb	NA	NA	14,000	20,000	4,400	14,000	250,000	MCL ₂
Nitrate + Nitrite	ppb	NA	NA	10,000	11,000	600	9,800	10,000	HRL
Sulfate	ppb	NA	NA	26,000	25,000	8,500	30,000	250,000	MCL ₂
Metals									
Antimony	ppb	NA	NA	NA	NA	NA	NA	6	HRL
Arsenic	ppb	NA	NA	<10	<10	<10	<10	10	MCL
Barium	ppb	NA	NA	66	70	48	71	2,000	HRL
Cadmium	ppb	NA	NA	<1	<1	<1	<1	4	HRL
Copper	ppb	NA	NA	NA	NA	NA	NA	1,300	
Chromium	ppb	NA	NA	<10	<10	<10	<10	100	HRL**
Lead	ppb	NA	NA	<3	<3	<3	<3	15	
Selenium	ppb	NA	NA	<20	<20	<20	<20	30	HRL
Thallium	ppb	NA	NA	NA	NA	NA	NA	0.6	HRL
Zinc	ppb	NA	NA	NA	NA	NA	NA	2,000	HRL
VOCs									
Acetone	ppb	<5.0	<5.0	<3.8	<3.8	<3.8	<3.8	4,000	HRL
Benzene	ppb	<1.0	<1.0	<0.071	<0.071	<0.071	<0.071	2	HRL
Carbon tetrachloride	ppb	<1.0	<1.0	<0.15	<0.15	<0.15	<0.15	1	HRL
Chloroform	ppb	2.7	18	7.9	1.2	<0.15	<0.15	30	HRL
Chloromethane	ppb	<1.0	<1.0	<0.24	<0.24	<0.24	<0.24	NE	
Ethylbenzene	ppb	<1.0	<1.0	<0.28	<0.28	<0.28	<0.28	50	HRL
Hexachlorobutadiene	ppb	<1.0	<1.0	<0.42	<0.42	<0.42	<0.42	1	HRL
Methylene chloride	ppb	<1.0	<1.0	<0.85	<0.85	<0.85	<0.85	5	MCL
Methyl ethyl ketone (MEK)	ppb	<5.0	<5.0	<0.65	<0.65	<0.65	<0.65	4,000	HRL
n-Butylbenzene	ppb	<1.0	<1.0	<0.15	<0.15	<0.15	<0.15	NE	
Tetrachloroethylene	ppb	<1.0	<1.0	<0.28	<0.28	<0.28	0.37 J	5	HRL
Toluene	ppb	<1.0	<1.0	<0.1	<0.1	<0.1	<0.1	200	HRL
1,2,3-Trichlorobenzene	ppb	<1.0	<1.0	<0.35	<0.35	<0.35	<0.35	NE	
Trichloroethene (TCE)	ppb	<1.0	<1.0	0.75 J	<0.18	<0.18	<0.18	0.4	HBV
Xylenes	ppb	<3	<3	<0.8	<0.8	<0.8	<0.8	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting limit
 indicates compound present above drinking water criterion

HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

	Sample ID Sample date Data source	MW-25	MW-28		MW-29	MW-A5-018	MW-A6-006	Screening Criteria	
		1/17/2002 Delta, 2002	1/17/2002 Delta, 2002	7/14/2011 Barr, 2012	7/14/2011 Barr, 2012	12/7/2011 Barr, 2012	12/7/2011 Barr, 2012	Drinking Wtr. Criterion	Source
Analyte	Units								
SVOCs									
2,4-Dinitrotoluene	ppb	NA	NA	<0.42	<0.42	<0.42	<0.42	0.5	SV
2,4,6-Trichlorophenol	ppb	NA	NA	<0.55	<0.55	<0.55	<0.55	30	HRL
2-Methylnaphthalene	ppb	NA	NA	<0.81	<0.81	<0.81	<0.81	NE	
4-Nitroanaline	ppb	NA	NA	<0.83	<0.83	<0.83	<0.83	NE	
4-Nitrophenol	ppb	NA	NA	<0.72	<0.72	<0.72	<0.72	NE	
Benzdine	ppb	NA	NA	<7.0	<7.0	<7.0	<7.0	NE	
Benzo(a)anthracene	ppb	NA	NA	<0.46	<0.46	<0.46	<0.46	0.6	HBV*
Benzo(a)pyrene	ppb	NA	NA	<0.38	<0.38	<0.38	<0.38	0.06	HBV
Benzo(ghi)perylene	ppb	NA	NA	<0.41	<0.41	<0.41	<0.41	NE	
Benzo(k)fluoranthene	ppb	NA	NA	<0.43	<0.43	<0.43	<0.43	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb	NA	NA	<0.21	<0.21	<0.21	<0.21	NE	
bis(2-ethylhexyl)phthalate	ppb	NA	NA	<0.75	<0.75	<0.75	<0.75	6	MCL
Butyl benzyl phthalate	ppb	NA	NA	<0.42	<0.42	<0.42	<0.42	100	HRL
Carbazole	ppb	NA	NA	<0.31	<0.31	<0.31	<0.31	NE	
Chrysene	ppb	NA	NA	<0.56	<0.56	<0.56	<0.56	6	HBV*
Fluoranthene	ppb	NA	NA	<0.56	<0.56	<0.56	<0.56	300	HRL
Phenanthrene	ppb	NA	NA	<0.32	<0.32	<0.32	<0.32	NE	
Pyrene	ppb	NA	NA	<0.61	<0.61	<0.61	<0.61	200	HRL
TPH									
Diesel range organics	ppb	NA	NA	NA	NA	NA	NA	200	HBV
Gasoline range organics	ppb	NA	NA	NA	NA	NA	NA	200	HBV
Other									
Nitrocellulose	ppb	NA	NA	NA	NA	NA	NA	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level

SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

█ indicates compound present above drinking water criterion

TPH = total petroleum hydrocarbons

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	MW-B7-013	MW-B7-014	MW-B7-015	MW-C6-020	MW-C7-004	MW-C7-016	Screening Criteria	
		12/7/2011 Barr, 2012	12/7/2011 Barr, 2012	12/7/2011 Barr, 2012	12/7/2011 Barr, 2012	7/12/2011 Barr, 2012	12/7/2011 Barr, 2012	Drinking Wtr. Criterion	Source
General Parameters	Units								
Chloride	ppb	17,000	21,000	17,000	15,000	9,400	3,300	250,000	MCL ₂
Nitrate + Nitrite	ppb	8,700	30,000	8,000	8,500	4,100	370	10,000	HRL
Sulfate	ppb	30,000	14,000	15,000	17,000	16,000	8,100	250,000	MCL ₂
Metals									
Antimony	ppb	NA	NA	NA	NA	NA	NA	6	HRL
Arsenic	ppb	<10	<10	<10	<10	<10	<10	10	MCL
Barium	ppb	93	85	92	90	99	67	2,000	HRL
Cadmium	ppb	<1	<1	<1	<1	<1	<1	4	HRL
Copper	ppb	NA	NA	NA	NA	NA	NA	1,300	
Chromium	ppb	<10	<10	<10	<10	<10	<10	100	HRL**
Lead	ppb	<3	<3	<3	<3	<3	<3	15	
Selenium	ppb	<20	<20	<20	<20	<20	<20	30	HRL
Thallium	ppb	NA	NA	NA	NA	NA	NA	0.6	HRL
Zinc	ppb	NA	NA	NA	NA	NA	NA	2,000	HRL
VOCs									
Acetone	ppb	<3.8	<3.8	<3.8	<3.8	<3.8	<3.8	4,000	HRL
Benzene	ppb	<0.071	<0.071	<0.071	<0.071	<0.071	<0.071	2	HRL
Carbon tetrachloride	ppb	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	1	HRL
Chloroform	ppb	<0.15	<0.15	<0.15	1.6	<0.15	<0.15	30	HRL
Chloromethane	ppb	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	NE	
Ethylbenzene	ppb	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	50	HRL
Hexachlorobutadiene	ppb	<0.42	<0.42	<0.42	<0.42	<0.42	<0.42	1	HRL
Methylene chloride	ppb	<0.85	<0.85	<0.85	<0.85	<0.85	<0.85	5	MCL
Methyl ethyl ketone (MEK)	ppb	<0.65	<0.65	<0.65	<0.65	<0.65	<0.65	4,000	HRL
n-Butylbenzene	ppb	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	NE	
Tetrachloroethylene	ppb	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	5	HRL
Toluene	ppb	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	200	HRL
1,2,3-Trichlorobenzene	ppb	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	NE	
Trichloroethene (TCE)	ppb	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	0.4	HBV
Xylenes	ppb	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting limit
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HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Sample ID Sample date Data source	MW-B7-013	MW-B7-014	MW-B7-015	MW-C6-020	MW-C7-004	MW-C7-016	Screening Criteria	
		12/7/2011 Barr, 2012	12/7/2011 Barr, 2012	12/7/2011 Barr, 2012	12/7/2011 Barr, 2012	7/12/2011 Barr, 2012	12/7/2011 Barr, 2012	Drinking Wtr. Criterion	Source
SVOCs	Units								
2,4-Dinitrotoluene	ppb	<0.42	<0.42	<0.37	<0.42	<0.42	<0.42	0.5	SV
2,4,6-Trichlorophenol	ppb	<0.55	<0.55	<0.55	<0.55	<0.55	<0.55	30	HRL
2-Methylnaphthalene	ppb	<0.81	<0.81	<0.81	<0.81	<0.81	<0.81	NE	
4-Nitroanaline	ppb	<0.83	<0.83	<0.83	<0.83	<0.83	<0.83	NE	
4-Nitrophenol	ppb	<0.72	<0.72	<0.72	<0.72	<0.72	<0.72	NE	
Benzdine	ppb	<7.0	<7.0	<7.0	<7.0	<7.0	<7.0	NE	
Benzo(a)anthracene	ppb	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	0.6	HBV*
Benzo(a)pyrene	ppb	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	0.06	HBV
Benzo(ghi)perylene	ppb	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	NE	
Benzo(k)fluoranthene	ppb	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	NE	
bis(2-ethylhexyl)phthalate	ppb	<0.75	<0.75	<0.75	<0.75	<0.75	<0.75	6	MCL
Butyl benzyl phthalate	ppb	<0.42	<0.42	<0.42	<0.42	<0.42	<0.42	100	HRL
Carbazole	ppb	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	NE	
Chrysene	ppb	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	6	HBV*
Fluoranthene	ppb	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	300	HRL
Phenanthrene	ppb	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32	NE	
Pyrene	ppb	<0.61	<0.61	<0.61	<0.61	<0.61	<0.61	200	HRL
TPH									
Diesel range organics	ppb	NA	NA	NA	NA	NA	NA	200	HBV
Gasoline range organics	ppb	NA	NA	NA	NA	NA	NA	200	HBV
Other									
Nitrocellulose	ppb	NA	NA	NA	NA	NA	NA	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level


SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

 indicates compound present above drinking water criterion

TPH = total petroleum hydrocarbons

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Units	Sample ID	T00006	BG-W-GP8	BG-W-GP14	Screening Criteria		
		Sample date	7/13/2011	7/13/2011	9/14/2007	9/21/2007	Drinking Wtr. Criterion	Source
		Data source	Barr, 2012	Barr, 2012	USACE, 2009a	USACE, 2009a		
General Parameters								
Chloride	ppb		24,000	6,800	NA	NA	250,000	MCL ₂
Nitrate + Nitrite	ppb		22,000	4,700	NA	NA	10,000	HRL
Sulfate	ppb		26,000	24,000	NA	NA	250,000	MCL ₂
Metals								
Antimony	ppb		NA	NA	NA	NA	6	HRL
Arsenic	ppb		<10	<10	<25	<25	10	MCL
Barium	ppb		86	83	310	77	2,000	HRL
Cadmium	ppb		<1	<1	<5	<5	4	HRL
Copper	ppb		NA	NA	NA	NA	1,300	
Chromium	ppb		<10	<10	<15	<15	100	HRL**
Lead	ppb		<3	<3	<15	<15	15	
Selenium	ppb		<20	<20	<22	<22	30	HRL
Thallium	ppb		NA	NA	NA	NA	0.6	HRL
Zinc	ppb		NA	NA	NA	NA	2,000	HRL
VOCs								
Acetone	ppb		<3.8	<3.8	NA	NA	4,000	HRL
Benzene	ppb		<0.071	<0.071	NA	NA	2	HRL
Carbon tetrachloride	ppb		<0.15	<0.15	NA	NA	1	HRL
Chloroform	ppb		<0.15	0.24 J	NA	NA	30	HRL
Chloromethane	ppb		<0.24	<0.24	NA	NA	NE	
Ethylbenzene	ppb		<0.28	<0.28	NA	NA	50	HRL
Hexachlorobutadiene	ppb		<0.42	<0.42	NA	NA	1	HRL
Methylene chloride	ppb		<0.85	<0.85	NA	NA	5	MCL
Methyl ethyl ketone (MEK)	ppb		<0.65	<0.65	NA	NA	4,000	HRL
n-Butylbenzene	ppb		<0.15	<0.15	NA	NA	NE	
Tetrachloroethylene	ppb		<0.28	<0.28	NA	NA	5	HRL
Toluene	ppb		<0.1	<0.1	NA	NA	200	HRL
1,2,3-Trichlorobenzene	ppb		<0.35	<0.35	NA	NA	NE	
Trichloroethene (TCE)	ppb		<0.18	<0.18	NA	NA	0.4	HBV
Xylenes	ppb		<0.8	<0.8	NA	NA	300	HRL

NOTES:
 ppb = parts per billion
 NA = not analyzed
 HRL = MDH Health Risk Limit
 HBV = MDH Health Based Value

AL = Action Level (USEPA)
 J indicates concentrations is estimated
 B indicates compound also detected in sample blank
 < indicates compound not detected at or above method reporting limit
 indicates compound present above drinking water criterion

HRL** - this HRL is for chromium VI
 MCL = Maximum Contaminant Level
 MCL₂ = secondary MCL
 NE = none established

Table B-2: Summary of Chemicals Detected in Groundwater Investigation Samples

Analyte	Units	Sample ID Sample date Data source	MW-E4-010 7/13/2011 Barr, 2012	T00006 7/13/2011 Barr, 2012	BG-W-GP8 9/14/2007 USACE, 2009a	BG-W-GP14 9/21/2007 USACE, 2009a	Screening Criteria	
							Drinking Wtr. Criterion	Source
SVOCs								
2,4-Dinitrotoluene	ppb		<0.42	<0.42	NA	NA	0.5	SV
2,4,6-Trichlorophenol	ppb		<0.55	<0.55	NA	NA	30	HRL
2-Methylnaphthalene	ppb		<0.81	<0.81	NA	NA	NE	
4-Nitroanaline	ppb		<0.83	<0.83	NA	NA	NE	
4-Nitrophenol	ppb		<0.72	<0.72	NA	NA	NE	
Benzidine	ppb		<7.0	<7.0	NA	NA	NE	
Benzo(a)anthracene	ppb		<0.46	<0.46	NA	NA	0.6	HBV*
Benzo(a)pyrene	ppb		<0.38	<0.38	NA	NA	0.06	HBV
Benzo(ghi)perylene	ppb		<0.41	<0.41	NA	NA	NE	
Benzo(k)fluoranthene	ppb		<0.43	<0.43	NA	NA	0.6	HBV*
bis(2-chlorisopropyl)ether	ppb		<0.21	<0.21	NA	NA	NE	
bis(2-ethylhexyl)phthalate	ppb		<0.75	<0.75	NA	NA	6	MCL
Butyl benzyl phthalate	ppb		<0.42	<0.42	NA	NA	100	HRL
Carbazole	ppb		<0.31	<0.31	NA	NA	NE	
Chrysene	ppb		<0.56	<0.56	NA	NA	6	HBV*
Fluoranthene	ppb		<0.56	<0.56	NA	NA	300	HRL
Phenanthrene	ppb		<0.32	<0.32	NA	NA	NE	
Pyrene	ppb		<0.61	<0.61	NA	NA	200	HRL
TPH								
Diesel range organics	ppb		NA	NA	NA	NA	200	HBV
Gasoline range organics	ppb		NA	NA	NA	NA	200	HBV
Other								
Nitrocellulose	ppb		NA	NA	NA	NA	NE	

NOTES:

ppb = parts per billion

NA = not analyzed

HRL = MDH Health Risk Limit

HBV = MDH Health Based Value

MCL = Maximum Contaminant Level

SV = Minnesota screening value

HBV* - these values based on compound toxicity relative to benzo(a)pyrene

J indicates concentrations is estimated

B indicates compound also detected in sample blank

< indicates compound not detected at or above method reporting limit

█ indicates compound present above drinking water criterion

TPH = total petroleum hydrocarbons

Appendix C, Table 1: Soil screening levels from MPCA and ATSDR

Contaminant	MPCA Soil Reference Value ¹ (ppm)		ATSDR Residential Comparison Value ² (ppm)		
	Residential	Industrial	Child	Adult	cancer
Lead	300	700	--	--	--
PCBs	1.2	8	--	--	0.35
Arsenic	9	20	15	210	0.47
Mercury	0.5	1.5	--	--	--
Mercury (elemental)	--	--	--	--	--
Mercuric Chloride (mercury salts)	--	--	15	210	--
cPAHs (BaPE)	2	3	--	--	0.096
2,4-DNT	50	355	100	1400	
2,4- and 2-6 DNT mixture	12	23	--	--	1
DBP	2,440	16,300	5,000	70,000	--
2,3,7,8-TCDD (dioxin)	20 ppt	35 ppt	50 ppt	700 ppt	--
Antimony	12	100	20	280	--
Thallium	3	21	--	--	--

Soil screening values that are calculated by state and federal agencies may use slightly different exposure assumptions, toxicity values, and cancer risk levels to arrive at different values. Sites in Minnesota generally use the MPCA SRVs as screening and/or cleanup levels.

¹ Minnesota Pollution Control Agency Site Remediation Section Draft Guidelines: Risk-Based Guidance for the Soil-Human Health Pathway, Volume 2 Technical Support Document. January 1999.

² Agency for Toxic Substances and Disease Registry Soil Comparison Values from ATSDR's Sequoia Database, March 2013.

Appendix C, Table 2: Equations and Assumptions for the SRVs

Residential Noncancer SRV - based on child up to age 6

$$\text{Res}_{\text{NC}} \text{SRV} = \frac{\text{HQ}}{\left\{ \left(\frac{\text{IR} \times \text{RBA} \times \text{CF} \times \text{ED} \times \text{EF}_{\text{ing}}}{\text{BW} \times \text{AT}} \right) / \text{RfD} \right\} + \left\{ \left(\frac{\text{SA} \times \text{AF} \times \text{CF} \times \text{EF}_{\text{der}} \times \text{ED} \times \text{ABS}_{\text{d}}}{\text{BW} \times \text{AT}} \right) / (\text{RfD} \times \text{ABS}_{\text{GI}}) \right\} + \left\{ \frac{\text{EF}_{\text{inh}} \times \text{ED} \times \left(\frac{1}{6 \text{ yr VF}} + \frac{1}{\text{PEF}} \right)}{\text{AT}} \right\} / \text{RfC} \right\}}$$

HQ	hazard quotient	0.2
RfD	reference dose	chemical specific
BW	body weight (kg)	15
AT	averaging time (days)	2190
RBA	relative bioavailability	chemical specific
IR	soil ingestion rate (mg/day)	100
CF	conversion factor	0.000001
ED	exposure duration (years)	6
EF _{ing}	exposure frequency ingestion (days)	350
EF _{der}	exposure frequency dermal (days)	150
EF _{inh}	exposure frequency inhalation (days)	350
SA	surface area (cm ²)	2000
AF	adhesion factor (mg/cm ²)	0.2
ABS _d	dermal absorption fraction	chemical specific
ABS _{GI}	gastrointestinal absorption fraction	chemical specific
6 yr VF	volatilization factor	chemical specific
PEF	particulate emission factor	7.7E+08

Appendix C, Table 2: Equations and Assumptions for the SRVs

Residential Cancer SRV- based on age-adjusted exposure parameters

$$Res_C^{SRV} = \frac{CR \times AT}{\left(\left\{ CSF \times RBA \times EF_{ing} \times CF \times \left(\frac{ED \times IR}{BW} \right) \right\} + \left\{ \frac{CSF}{ABS_{GI}} \times EF_{der} \times ABS_d \times CF \times \left(\frac{ED \times AF \times SA}{BW} \right) \right\} + \left\{ EF_{inh} \times 1000 \times (ED \times IUR) \times \left(\frac{1}{VF} + \frac{1}{PEF} \right) \right\} \right)}$$

CR	cancer risk level	0.00001
AT	averaging time (days)	25550
CSF	cancer slope factor	chemical specific
RBA	relative bioavailability	chemical specific
CF	conversion factor (kg/mg)	0.000001
ED	exposure duration (years)	33
IR	ingestion rate, adult (mg/day)	68
EF _{ing}	exposure frequency - ingestion (days)	350
EF _{der}	exposure frequency - dermal (days)	97
EF _{inh}	exposure frequency - inhalation (days)	350
BW	body weight, 2-16 years (kg)	51
ABS _d	dermal absorption fraction	chemical specific
ABS _{GI}	gastrointestinal absorption fraction	chemical specific
AF	dermal adhesion factor, 16-30 years (mg/cm ²)	0.17
SA	skin surface area, 16-30 years (cm ²)	3609
IUR	inhalation unit risk	chemical specific
VF	volatilization factor (m ³ /kg)	chemical specific
1/PEF	particulate emission factor (m ³ /kg)	7.7E+08

Appendix C, Table 2: Equations and Assumptions for the SRVs

Industrial Noncancer

$$\text{Ind}_{\text{NC}} \text{SRV} = \frac{\text{HQ}}{\left(\left(\frac{\text{IR} \times \text{RBA} \times \text{CF} \times \text{ED} \times \text{EF}_{\text{ing}}}{\text{BW} \times \text{AT}} \right) / \text{RfD} \right) + \left(\frac{\text{SA} \times \text{AF} \times \text{CF} \times \text{EF}_{\text{der}} \times \text{ED} \times \text{ABS}_{\text{d}}}{\text{BW} \times \text{AT}} \right) / (\text{RfD} \times \text{ABS}_{\text{GI}}) + \left(\frac{\text{EF}_{\text{inh}} \times \text{ED} \times \left(\frac{1}{6 \text{ yr VF}} + \frac{1}{\text{PEF}} \right)}{\text{AT}} \right) / \text{RfC} \right)}$$

HQ	hazard quotient	0.2
RfD	reference dose	chemical specific
BW	body weight (kg)	70
AT	averaging time (days)	9125
RBA	relative bioavailability	chemical specific
IR	soil ingestion rate (mg/day)	80
CF	conversion factor	0.000001
ED	exposure duration (years)	25
EF _{ing}	exposure frequency ingestion (days)	250
EF _{der}	exposure frequency dermal (days)	150
EF _{inh}	exposure frequency inhalation (days)	250
SA	skin surface area (cm ²)	3400
AF	dermal adhesion factor (mg/cm ²)	0.13
ABS _d	dermal absorption fraction	chemical specific
ABS _{GI}	gastrointestinal absorption fraction	chemical specific
VF _{IND}	volatilization factor	chemical specific
PEF	particulate emission factor	3.8E+08

Appendix C, Table 2: Equations and Assumptions for the SRVs

Industrial Cancer

$$\text{Ind}_c \text{SRV} = \frac{CR \times AT}{\left(\left\{ CSF \times RBA \times EF_{ing} \times CF \times \left(\frac{ED \times IR}{BW} \right) \right\} + \left\{ \frac{CSF}{ABS_{GI}} \times EF_{der} \times ABS_d \times CF \times \left(\frac{ED \times AF \times SA}{BW} \right) \right\} + \left\{ EF_{inh} \times 1000 \times (ED \times IUR) \times \left(\frac{1}{VF} + \frac{1}{PEF} \right) \right\} \right)}$$

CR	cancer risk level	0.00001
AT	averaging time (days)	25550
CSF	cancer slope factor	chemical specific
RBA	relative bioavailability	chemical specific
CF	conversion factor (kg/mg)	0.000001
ED	exposure duration (years)	25
IR	soil ingestion rate (mg/day)	80
EF _{ing}	exposure frequency - ingestion (days)	250
EF _{der}	exposure frequency - dermal (days)	150
EF _{inh}	exposure frequency - inhalation (days)	250
BW	body weight (kg)	70
ABS _{GI}	gastrointestinal absorption fraction	chemical specific
ABS _d	dermal absorption fraction	chemical specific
AF	dermal adhesion factor (mg/cm ²)	0.13
SA	skin surface area (cm ²)	3400
IUR	inhalation unit risk	chemical specific
VF	volatilization factor (m ³ /kg)	chemical specific
PEF	particulate emission factor (m ³ /kg)	3.8E+08

Appendix C, Table 3: Toxicity Values Used in the SRV Equations

SRV contaminant	Toxicity value used		Source ²
	Reference dose	Cancer Slope Factor	
PCBs	5.0E-05		MDH, 2001 ³
Arsenic Residential SRV	3.0E-04		USEPA, 1993
Arsenic Industrial SRV		1.5	USEPA, 1998
Mercury ¹	3.0E-04		USEPA, 1995
cPAHs		7.3	USEPA, 1994
2,4 DNT	2.0E-03		USEPA, 1995
2,4-and 2,6-DNT mixture		6.8E-01	USEPA, 1995
DBP	1.0E-01		USEPA, 1995
Dioxin		1.4E+06	MDH, 2009 ⁴
Antimony	4.0E-04		USEPA, 1991
Thallium	8.0E-05		USEPA, 1990

¹ The mercury SRV uses both the mercuric chloride RfD (USEPA, 1995) as well as the RfC for elemental mercury (USEPA, 1995)

² The USEPA sources are all from the US EPA Integrated Risk Information System (IRIS) and can be found here: <http://www.epa.gov/ncea/iris/index.html>

³ The PCB reference dose is used in deriving an MDH multi-media Health Risk Value: <http://www.health.state.mn.us/divs/eh/risk/rules/air/hrvsonar.pdf>

⁴ Current MDH guidance for estimating cancer risks from dioxin: <http://www.health.state.mn.us/divs/eh/risk/guidance/dioxinmemo1.pdf>

Appendix D: Gopher Ordnance Works data used in the cPAH analysis

Sample ID	TT-60-716B	717A-TT2	707FFF-SS7	746B-SS2	TT-25-206B	208E-SS1	235A-TT4	251A-TT3	E160D-TT2	207-DD-TT1											
Date	9/11/2006	7/1/2011	10/13/2011	6/27/2011	9/7/2006	10/28/2011	6/23/2011	6/28/2011	7/14/2011	6/24/2011											
Depth (ft)	1.5-1.5	0.5-0.5	0.5-0.5	0.5-0.5	5-5	0-0.5	0.5-0.5	0.5-0.5	0.5-0.5	0.5-0.5											
Location	GUE (716B)	717A	707FFF	746B	206	208	235	251A	160th St. Dump	L and J Dump											
BaPE, NDs at zero (ppm)	16	3.2	5.7	1	1.6	3.1	31	5.8	9.8	230											
	Conc. (ppm)	%	Conc. (ppm)	%	Conc. (ppm)	%	Conc. (ppm)	%	Conc. (ppm)	%	Conc. (ppm)	%	Conc. (ppm)	%	Conc. (ppm)	%	Conc. (ppm)	%	Conc. (ppm)	%	Average %
Acenaphthene	2.9	2%	0.42	1%	0.75	1%	0.2	2%	0.32	2%	0.23	1%	8.2	2%	0.42	1%	2	2%	82	3%	2%
Anthracene	5.9	4%	0.64	2%	0.88	1%	0.42	4%	0.6	4%	0.56	2%	18	5%	1.4	3%	4.9	5%	170	6%	4%
Benz(a)anthracene	13.11	8%	2.5	8%	4.1	7%	0.79	7%	1.2	8%	2	8%	26	8%	4.5	9%	7.8	8%	210	8%	8%
Benzo(a)pyrene	10.54	7%	2.2	7%	4	7%	0.67	6%	1.1	7%	2.1	8%	21	6%	4	8%	6.9	7%	160	6%	7%
Benzo(b)fluoranthene	15.26	10%	3.1	10%	6.4	11%	1	9%	1.3	8%	3	11%	26	8%	5.2	11%	8.4	8%	190	7%	9%
Benzo(g,h,i)perylene	6.1	4%	1.2	4%	1.7	3%	0.47	4%	0.5	3%	1.3	5%	9.9	3%	1.8	4%	2.3	2%	57	2%	3%
Benzo(k)fluoranthene	5.8	4%	1.1	3%	1.9	3%	0.37	4%	0.5	3%	1.1	4%	11	3%	2.1	4%	3.7	4%	78	3%	4%
Chrysene	14.51	9%	2.8	9%	5	9%	0.81	8%	1.2	8%	2.5	10%	27	8%	4.5	9%	8.2	8%	200	7%	8%
Dibenz(a,h)anthracene	2.9	2%	0.32	1%	0.43	1%	0.12	1%	0.25	2%	0.35	1%	3.5	1%	0.56	1%	0.9	1%	21	1%	1%
Dibenzofuran	1.8	1%	0.19	1%	0.2	0%	0.14	1%	0.22	1%	0.08	0%	4.8	1%	0.23	0%	1	1%	52	2%	1%
Fluoranthene	23.5	15%	6.2	19%	11	19%	1.7	16%	2.5	16%	4.5	17%	53	16%	8.1	17%	19	18%	420	16%	17%
Fluorene	3.6	2%	0.37	1%	0.36	1%	0.2	2%	0.4	3%	0.19	1%	8.8	3%	0.47	1%	2.1	2%	100	4%	2%
Indeno(1,2,3-cd)pyrene	6.63	4%	1.3	4%	2.1	4%	0.66	6%	0.52	3%	1.5	6%	12	4%	2.2	5%	3.1	3%	66	2%	4%
Phenanthrene	21.6	14%	4.5	14%	9	15%	1.5	14%	2.3	15%	2.8	11%	57	17%	5.1	11%	17	16%	500	19%	15%
Pyrene	23.2	15%	5.5	17%	11	19%	1.5	14%	2.5	16%	3.9	15%	45	14%	6.9	15%	16	15%	390	14%	15%
total PAHs	157.35		32.34		58.82		10.55		15.41		26.11		331.2		47.48		103.3		2696		

Data sources:

2011 data from the Remedial Investigation Report, UMore East, Dakota County, Minnesota. Prepared by Barr Engineering for the University of Minnesota, February 2012.

2006 data from the Concrete and Soil Assessment, UMore Park, Rosemount, Minnesota. Prepared by Peer Engineering, October 2006.

Appendix E: Surface Soil Contaminants Above Industrial Soil Reference Values (SRVs)

Contaminant	Concentration (ppm)	Date	Depth (ft)	location	Sample ID
Arsenic	43	6/21/2011	0.5 ft	ABC Line	32T-TT2
Arsenic	22	9/11/2006	0-1 ft	ABC Line	TT-63-220C
Mercury	42	12/30/2002	0 ft	GOW East	NA-TP-4
Mercury	30	1/2/2003	0-2 ft	GOW East	WWTP-TP-14
Mercury	29	1/2/2003	0-1 ft	GOW East	WWTP-TP-13
Mercury	20	1/2/2003	0-2 ft	GOW East	WWTP-TP-22
Mercury	16	12/31/2002	0-1 ft	Navy/B.G.	BG-TP-8
Mercury	13	12/31/2002	0-1 ft	Navy/B.G.	BG-TP-2
Mercury	12	10/11/2011	0.5 ft	ABC Line	32T-SS1
Mercury	11	9/27/2007	0-0.5 ft	GOW East	AOC1N-SS1
Mercury	7.3	9/28/2009	0-0.5 ft	GOW East	AOC1N-GP102
Mercury	6.3	7/7/2011	0.5 ft	Sitewide	501C-SS1
Mercury	4.9	9/27/2007	0-0.5 ft	Vermillion Highlands	AOC1M-SS2
Mercury	4.4	10/28/2011	0.5 ft	ABC Line	706A-SS7
Mercury	4.4	6/19/2009	0.5 ft	Outside of 1948 Parcel	BF-SS3
Mercury	1.9	9/27/2007	0-0.5 ft	Vermillion Highlands	AOC1M-GP1
Mercury	1.7	10/28/2011	0.5 ft	ABC Line	706A-SS8
Mercury	1.5	9/24/2009	0-0.5 ft	Vermillion Highalnds	AOC1M-GP101
PCBs	60	10/4/2013	0-0.5 ft	ABC Line - GUE	716A SS13-1
PCBs	26	8/15/2007	0-0.5 ft	GOW East – AOC7A	AOC7A-SS1
PCBs	11	10/4/2013	0-0.5 ft	ABC Line - GUE	716A SS12-1
PCBs	8.9	10/4/2013	0-0.5 ft	ABC Line - GUE	716A SS10-1
Lead	8090	9/11/2006	0-1 ft	GOW East – Bldg 303A	TT-56-303A
Lead	4500	6/27/2011	0.5 ft	Navy/B.G.	10SD-TT3
Lead	3500	6/21/2011	0.5 ft	ABC Line	46T-TT6
Lead	3100	12/31/2002	0-1 ft	Navy/B.G.	BG-TP-15
Lead	2800	10/10/2011	0.5 ft	GOW East – Bldg 303A	303A-SS9
Lead	2400	6/22/2011	0.5 ft	GOW East – Bldg 303A	303A-SS1
Lead	2000	6/22/2011	0.5 ft	GOW East – Bldg 303A	303A-SS2
Lead	1710	9/6/2006	0-0.4 ft	ABC Line	TT-9-108B
Lead	1400	6/22/2011	0.5 ft	GOW East – Bldg 303A	303A-SS5
Lead	1400	6/22/2011	0.5 ft	GOW East – Bldg 303A	303A-SS3
Lead	1300	6/27/2011	0.5 ft	Navy/B.G.	10SD-TT9
Lead	1100	10/28/2011	0.5 ft	GOW East – Bldg 303A	303A-TT3
Lead	1100	10/10/2011	0.5 ft	GOW East – Bldg 303A	303A-SS6
Lead	1000	12/31/2002	0-1 ft	Navy/B.G.	BG-TP-1
Lead	970	6/22/2011	0.5 ft	GOW East – Bldg 303A	303A-SS4
Lead	840	10/10/2011	0.5 ft	GOW East – Bldg 303A	303A-SS10
Lead	730	8/30/2007	0-0.5 ft	GOW East	AOC7D-GP5
cPAHs	260	10/1/2009		Vermillion Highlands	AOC1S-S110
cPAHs	130	8/15/2007	0-0.5 ft	GOW East – AOC7A	AOC7A-SS3

Appendix E: Surface Soil Contaminants Above Industrial Soil Reference Values (SRVs)

Contaminant	Concentration (ppm)	Date	Depth (ft)	location	Sample ID
cPAHs	54	8/7/2007	0-0.5 ft	GOW West	AOC6-TP3
cPAHs	54	8/15/2007	0-0.5 ft	GOW East – AOC7A	AOC7A-SS1
cPAHs	39	10/10/2011	0.5 ft	Sitewide	501A2-SS4
cPAHs	31	6/23/2011	0.5 ft	ABC Line	235A-TT4
cPAHs	29	8/15/2007	0-0.5 ft	GOW East – AOC7A	AOC7A-SS2
cPAHs	27	7/14/2011	0.5 ft	GOW Central	E160D-TT1
cPAHs	19	9/11/2006	0-1 ft	GOW East – Bldg 303A	TT-56-303A
cPAHs	18	9/6/2006	0-0.3 ft	ABC Line	TT-12-501B
cPAHs	16	10/14/2011	0.5 ft	ABC Line	217A-SS6
cPAHs	16	10/13/2011	0.5 ft	ABC Line	235A-SS2
cPAHs	16	8/15/2007	0-0.5 ft	GOW East – AOC7A	AOC7A-SS4
cPAHs	15	9/7/2006	0-0.5 ft	ABC Line	TT-33-251B
cPAHs	13	10/14/2011	0.5 ft	ABC Line	217A-SS4
cPAHs	10	10/13/2011	0.5 ft	ABC Line	235A-SS3
cPAHs	10	8/7/2007	0-0.5 ft	GOW West	AOC6-TP4
cPAHs	10	9/29/2009	0-0.5 ft	GOW East – AOC7A	AOC7A-SS107
cPAHs	9.9	9/29/2009	0-0.5 ft	GOW East	AOC7D-SS109
cPAHs	9.8	7/14/2011	0.5 ft	GOW Central	E160D-TT2
cPAHs	7.9	8/28/2007	0-0.5 ft	GOW East	AOC7D-GP3
cPAHs	5.8	6/28/2011	0.5 ft	ABC Line	251A-TT3
cPAHs	5.7	10/13/2011	0.5 ft	ABC Line	707FFF-SS7
cPAHs	5.6	9/30/2009	0-0.5 ft	GOW East	AOC7D-SS113
cPAHs	5.5	6/24/2011	0.5 ft	ABC Line	707FFF-SS2
cPAHs	4.6	8/7/2007	0-0.5 ft	GOW West	AOC6-TP6
cPAHs	4.3	7/13/2011	0.5 ft	ABC Line	217A-TT1
cPAHs	3.4	10/13/2011	0.5 ft	ABC Line	251A-SS5
cPAHs	3.2	6/29/2011	0.5 ft	Sitewide	501A2-SS1
cPAHs	3.2	7/1/2011	0.5 ft	ABC Line	717A-TT2
cPAHs	3.1	10/28/2011	0-0.5 ft	ABC Line	208E-SS1
cPAHs	3.1	9/22/2009	0-0.5 ft	GOW East	AOC7D-GP102

It is recommended to remove or prevent access to soil for contaminant concentrations shaded in gray.

Two surface samples of building materials, both containing elevated cPAHs and one containing elevated arsenic, were excluded from Appendix E because they are not soil samples. However, pieces of building materials should also be removed from the surface soils.