12 GROUNDWATER DQOs

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Environmental Restoration DQOs

Environmental Surveillance DQOs

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Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
106-04	Chemical/Animal Holes Sr-90		Plume Perimeter	Xb																			X		2b
106-100	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-101	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-102	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-103	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-104	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-105	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-13	Chemical/Animal Holes Sr-90		Plume Perimeter	X																			X		1b
106-14	Chemical/Animal Holes Sr-90		Plume Perimeter	X																			X		1b
106-15	Chemical/Animal Holes Sr-90		Plume Perimeter	X																			X		1b
106-16	Chemical/Animal Holes Sr-90		Plume Core	Xb																			X	X	2d
106-17	Chemical/Animal Holes Sr-90		Plume Perimeter	Xb																			X		2d
106-20	Chemical/Animal Holes Sr-90		Sentinel	X																			X		1b
106-21	Chemical/Animal Holes Sr-90		Sentinel	X																			X		1b
106-22	Chemical/Animal Holes Sr-90		Sentinel	X																			X		1b
106-23	Chemical/Animal Holes Sr-90		Sentinel	X																			X		1b
106-24	Chemical/Animal Holes Sr-90		Sentinel	X																			X		1b
106-25	Chemical/Animal Holes Sr-90		Sentinel	X																			X		1b
106-43	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-44	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-45	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-46	Chemical/Animal Holes Sr-90		Plume Perimeter	X																			X		1b
106-47	Chemical/Animal Holes Sr-90		Plume Perimeter	X																			X		1b
106-48	Chemical/Animal Holes Sr-90		Plume Perimeter	Xb																			X		2d
106-49	Chemical/Animal Holes Sr-90		Plume Core	Xb																			X	X	2d
106-50	Chemical/Animal Holes Sr-90		Plume Core	Xb																			X		2d
106-62	Chemical/Animal Holes Sr-90	OU III Middle Road	Sentinel	X																			X		1b
106-63	Chemical/Animal Holes Sr-90		Sentinel	X																			X		1b
106-64	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-94	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-95	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-96	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-97	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-98	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
106-99	Chemical/Animal Holes Sr-90		Plume Core	X																			X		1b
114-01	Chemical/Animal Holes Sr-90		Sentinel	X																			X		1b
CH-A-2007	Chemical/Animal Holes Sr-90			Xb																			X		4
CH-B-2007	Chemical/Animal Holes Sr-90			Xb																			X		4
CH-C-2007	Chemical/Animal Holes Sr-90			Xb																			X		4
CH-D-2007	Chemical/Animal Holes Sr-90			Xb																			X		4
CH-E-2007	Chemical/Animal Holes Sr-90			Xb																			X		4
087-09	CLF		Background	X[f]					X	X	X	X	X	X	X	X	X		X[a]		X[a]	X[a]	X[a]		4
087-11	CLF		Downgradient	X[f]					X	X	X	X	X	X	X	X	X		X[a]		X[a]	X[a]	X[a]		4
087-23	CLF		Downgradient	X[f]					X	X	X	X	X	X	X	X	X		X[a]		X[a]	X[a]	X[a]		4
087-24	CLF		Downgradient	X[a]					Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X[a]	X[a]		2f
087-26	CLF		Downgradient	X[f]					X	X	X	X	X	X	X	X	X		X[a]		X[a]	X[a]	X[a]		4
087-27	CLF		Downgradient	X[f]					X	X	X	X	X	X	X	X	X		X[a]		X[a]	X[a]	X[a]		4
088-109	CLF		Downgradient	X					X	X	X	X	X	X	X	X	X		X[a]		X[a]	X[a]	X[a]	X	4

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
088-110	CLF		Downgradient	X[f]					X	X	X	X	X	X	X	X	X		X[a]		X[a]	X[a]	X[a]		4
088-21	CLF		Downgradient	X[f]					X	X	X	X	X	X	X	X	X		X[a]		X[a]	X[a]	X[a]		4
088-22	CLF		Downgradient	X[a]					Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X[a]	X[a]		2f
088-23	CLF		Downgradient	X[a]					Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X[a]	X[a]		2f
086-42	FLF		Background	X[a]			X[a]	X[a]	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X	X[a]		2f
086-72	FLF		Background	X[a]			X[a]	X[a]	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X[a]	X[a]		2f
087-22	FLF		Background	X[a]			X[a]	X[a]	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X[a]	X[a]		2f
097-17	FLF		Downgradient	X			X[a]	X[a]	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X[a]	X[a]		2f
097-277	FLF		Downgradient	X			X[a]	X[a]	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X[a]	X[a]		2f
097-64	FLF		Downgradient	X			X[a]	X[a]	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X[a]	X[a]		2f
106-02	FLF		Downgradient	X			X[a]	X[a]	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X[a]	X[a]		2f
106-30	FLF		Downgradient	X			X[a]	X[a]	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf	Xf		X[a]		X[a]	X[a]	X[a]	X	2f
065-01	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1a
065-37	OU III (AOC 29/HFBR Tritium)	BGRR/WCF Sr-90	Outer Plume Perimeter																	X		X	X		1a
065-38	OU III (AOC 29/HFBR Tritium)	BGRR/WCF Sr-90	Plume Perimeter																			X	X		1
065-39	OU III (AOC 29/HFBR Tritium)	BGRR/WCF Sr-90	Plume Perimeter	Xa																		X	X		1
065-40	OU III (AOC 29/HFBR Tritium)	BGRR/WCF Sr-90	Plume Perimeter	Xa																		X	X		1
065-41	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1
065-42	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1
075-11	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X		X	2f
075-12	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
075-208	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1
075-209	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1
075-210	OU III (AOC 29/HFBR Tritium)		Plume Perimeter	Xa																		X			1
075-211	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1
075-224	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			4
075-225	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			12
075-226	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
075-227	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
075-228	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			12
075-229	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			4
075-230	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
075-231	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			12
075-232	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-233	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
075-234	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			12
075-235	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-236	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-237	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			12
075-238	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-239	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
075-240	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			12
075-241	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
075-242	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
075-244	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			12
075-245	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
075-285	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-286	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			1a

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
075-287	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			1a
075-288	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1a
075-289	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			1a
075-291	OU III (AOC 29/HFBR Tritium)		Plume Core																			X		X	2f
075-292	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			Xf			2f
075-293	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-294	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			1a
075-295	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			1a
075-296	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-297	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-298	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-299	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-39	OU III (AOC 29/HFBR Tritium)	BGRR/WCF Sr-90	Plume Perimeter																			X	X		1a
075-40	OU III (AOC 29/HFBR Tritium)	BGRR/WCF Sr-90	Plume Perimeter	Xa																		X	X		1a
075-41	OU III (AOC 29/HFBR Tritium)	BGRR/WCF Sr-90	Plume Perimeter	Xa																		X	X		1a
075-413	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-414	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
075-415	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-416	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-417	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-418	OU III (AOC 29/HFBR Tritium)		Plume Core																			X		X	2f
075-419	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
075-42	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			12
075-43	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X		X	12
075-44	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			12
075-45	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			12
075-558	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
075-88	OU III (AOC 29/HFBR Tritium)		Plume Core																			X		X	2f
075-89	OU III (AOC 29/HFBR Tritium)		Plume Core	Xa																		X	Xa		2f
076-172	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
076-173	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
076-174	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
076-175	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
076-177	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
077-10	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
077-11	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
085-01	OU III (AOC 29/HFBR Tritium)		Plume Perimeter	Xa																		X			2f
085-02	OU III (AOC 29/HFBR Tritium)		Plume Perimeter	Xa																		X			1a
085-285	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1a
085-286	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1a
085-287	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
085-288	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
085-289	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
085-290	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
085-291	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
085-337	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
085-338	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
085-40	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1a

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
085-77	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			1a
085-78	OU III (AOC 29/HFBR Tritium)		Plume Core	Xa																		X		X	1a
086-09	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
095-139	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1a
095-140	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			1a
095-272	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
095-273	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
095-274	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
095-275	OU III (AOC 29/HFBR Tritium)		Plume Perimeter																			X			2f
095-276	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
095-48	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			2f
095-51	OU III (AOC 29/HFBR Tritium) VOCs every Quarter		Plume Perimeter	X																					4
095-53	OU III (AOC 29/HFBR Tritium)	OU III (Carbon tet)	Sentinel	X																		Xa			4
095-54	OU III (AOC 29/HFBR Tritium)		Sentinel	Xa																		X			4
095-55	OU III (AOC 29/HFBR Tritium)		Sentinel																			X			4
095-90	OU III (AOC 29/HFBR Tritium)	OU III (Carbon tet)	Sentinel	X																		X			4
095-93	OU III (AOC 29/HFBR Tritium)		Plume Perimeter	Xf																		X			2f
096-55	OU III (AOC 29/HFBR Tritium)		Sentinel																			X			4
096-82	OU III (AOC 29/HFBR Tritium)		Sentinel																			X			4
096-83	OU III (AOC 29/HFBR Tritium)		Outer Plume Perimeter																			Xa			1a
096-84	OU III (AOC 29/HFBR Tritium)		Outer Plume Perimeter																			X			4
096-88	OU III (AOC 29/HFBR Tritium)		Sentinel																			X			4
105-22	OU III (AOC 29/HFBR Tritium)		Outer Plume Perimeter																			X			4
105-23	OU III (AOC 29/HFBR Tritium)	OU III Middle Road, OU III (Carbon tet)	Outer Plume Perimeter	Sampled under OU III Middle Road																					4
105-29	OU III (AOC 29/HFBR Tritium)		Outer Plume Perimeter																			X			4
105-43	OU III (AOC 29/HFBR Tritium)		Outer Plume Perimeter																			X			4
105-44	OU III (AOC 29/HFBR Tritium)	OU III Middle Road	Outer Plume Perimeter	Xa																		X			4
HFBR-A-2007	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
HFBR-B-2007	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
HFBR-C-2007	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
HFBR-D-2007	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
HFBR-E-2007	OU III (AOC 29/HFBR Tritium)		Plume Core																			X			4
000-108	OU III North Street		Plume Core	X															Xa		Xa	Xa	Xa		2f
000-153	OU III North Street		Plume Core	X																		Xa			2f
000-154	OU III North Street		Plume Core	X															Xa		Xa	Xa	Xa		2f
000-211	OU III North Street	OU III (Industrial Park East)	Plume Perimeter	X															Xa		Xa	Xa	Xa		2f
000-212	OU III North Street		Plume Core	X															Xa		Xa	Xa	Xa		2f
000-213	OU III North Street		Bypass Detection	X																		Xa			4
000-463	OU III North Street	A1	Plume Core	X															Xa		Xa	Xa	Xa		2f
000-464	OU III North Street	A2	Plume Core	X															Xa		Xa	Xa	Xa		2f
000-465	OU III North Street	B	Plume Core	X															Xa		Xa	Xa	Xa		2f
000-466	OU III North Street	C	Bypass Detection	X															Xa		Xa	Xa	Xa		4
000-467	OU III North Street	E	Plume Core	X															Xa		Xa	Xa	Xa		2f
000-468	OU III North Street	I1	Bypass Detection	X															Xa		Xa	Xa	Xa		4
000-469	OU III North Street	I2	Bypass Detection	X															Xa		Xa	Xa	Xa		4
000-470	OU III North Street	K	Plume Core	X															Xa		Xa	Xa	Xa		2f
000-472	OU III North Street	F	Plume Core	X															Xa		Xa	Xa	Xa		2f
000-474	OU III North Street	D	Plume Core	X															Xa		Xa	Xa	Xa		2f

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
000-475	OU III North Street	G	Plume Perimeter	X															Xa		Xa	Xa	Xa		2f
000-476	OU III North Street	H	Plume Perimeter	X															Xa		Xa	Xa	Xa		2f
086-05	OU III North Street		Background	X															Xa		Xa	Xa	Xa		1a
086-43	OU III North Street		Background	X															Xa		Xa	Xa	Xa		1a
086-70	OU III North Street		Background	X															Xa		Xa	Xa	Xa		1a
115-32	OU III North Street		Plume Core	X															Xa		Xa	Xa	Xa		2f
115-33	OU III North Street		Plume Perimeter	X															Xa		Xa	Xa	Xa		2f
115-34	OU III North Street		Plume Perimeter	X															Xa		Xa	Xa	Xa		2f
115-35	OU III North Street		Plume Perimeter	X															Xa		Xa	Xa	Xa		2f
800-115	OU III North Street		Bypass Detection	X															Xa		Xa	Xa	Xa		4
800-63	OU III North Street	OU III Airport	Bypass Detection	X																		Xa			4
000-124	OU III North Street East		Plume Core	X																	Xa	X	Xa	X	2f
000-137	OU III North Street East		Plume Perimeter	X																	Xa	X	Xa		2f
000-138	OU III North Street East		Plume Core	X																	Xa	X	Xa		2f
000-215	OU III North Street East		Plume Perimeter	X															Xa		Xa	Xa	Xa		2f
000-477	OU III North Street East		Plume Core	X															Xa		Xa	Xa	Xa		2f
000-478	OU III North Street East		Plume Core	X															Xa		Xa	Xa	Xa		2f
000-479	OU III North Street East		Plume Core	X															Xa		Xa	Xa	Xa		2f
000-480	OU III North Street East		Plume Core	X															Xa		Xa	Xa	Xa		2f
000-481	OU III North Street East		Plume Core	X															Xa		Xa	Xa	Xa		2f
000-482	OU III North Street East		Plume Core	X															Xa		Xa	Xa	Xa		4
000-483	OU III North Street East		Plume Core	X															Xa		Xa	Xa	Xa		4
000-484	OU III North Street East		Plume Core	X															Xa		Xa	Xa	Xa		4
000-485	OU III North Street East		Plume Core	X															Xa		Xa	Xa	Xa		2f
000-486	OU III North Street East		Bypass Detection	X															Xa		Xa	Xa	Xa		4
800-54	OU III North Street East		Sentinel	X																	Xa	X	Xa		4
000-112	OU III (Industrial Park)		Plume Core	X																					2f
000-114	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-245	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-246	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-247	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-248	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-249	OU III (Industrial Park)	OU III Magothy	Plume Core	X																					4
000-250	OU III (Industrial Park)	OU III Magothy	Plume Perimeter	X																					4
000-251	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-252	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-253	OU III (Industrial Park)		Plume Core	X																				X	2f
000-254	OU III (Industrial Park)		Plume Perimeter	Xa																					1a
000-255	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-256	OU III (Industrial Park)		Plume Core	X																				X	2f
000-257	OU III (Industrial Park)		Plume Perimeter	Xa																					1a
000-258	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-259	OU III (Industrial Park)		Plume Core	X																					2f
000-260	OU III (Industrial Park)		Plume Perimeter	Xa																					1a
000-261	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-262	OU III (Industrial Park)		Plume Core	X																					2f
000-263	OU III (Industrial Park)		Plume Perimeter	Xa																					1a
000-264	OU III (Industrial Park)		Plume Perimeter	X																					2f

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
000-265	OU III (Industrial Park)		Plume Core	X																					2f
000-266	OU III (Industrial Park)		Plume Perimeter	Xa																					1a
000-267	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-268	OU III (Industrial Park)		Plume Core	X																					2f
000-269	OU III (Industrial Park)		Plume Perimeter	Xa																					1a
000-270	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-271	OU III (Industrial Park)		Plume Core	X																					2f
000-272	OU III (Industrial Park)		Plume Perimeter	X																					2f
000-273	OU III (Industrial Park)		Bypass Detection	X																					4
000-274	OU III (Industrial Park)		Bypass Detection	X																					4
000-275	OU III (Industrial Park)		Bypass Detection	X																					4
000-276	OU III (Industrial Park)		Bypass Detection	X																					4
000-277	OU III (Industrial Park)		Bypass Detection	X																					4
000-278	OU III (Industrial Park)		Bypass Detection	X																					4
000-279	OU III (Industrial Park)		Plume Core	X																					2f
000-280	OU III (Industrial Park)	OU III South Boundary	Plume Perimeter	X																	Xc	Xc	Xc		4
000-431	OU III (Industrial Park)		Bypass Detection	X																					4
000-432	OU III (Industrial Park)		Bypass Detection	X																					4
000-211	OU III (Industrial Park East)	OU III North Street	Plume Perimeter	X															Xa		Xa	Xa	Xa		4
000-489	OU III (Industrial Park East)	A1	Plume Perimeter	X																					4
000-490	OU III (Industrial Park East)	A2	Plume Perimeter	X																					4
000-491	OU III (Industrial Park East)	B1	Plume Perimeter	X																					4
000-492	OU III (Industrial Park East)	B2	Plume Perimeter	X																					4
000-493	OU III (Industrial Park East)	D1	Bypass Detection	X																					4
000-494	OU III (Industrial Park East)	D2	Bypass Detection	X																					4
000-495	OU III (Industrial Park East)	C	Plume Perimeter	X																					4
122-24	OU III (Industrial Park East)	OU III (South Boundary) Radionuclide	Plume Core	X																	Xc	Xc	Xc		4
122-25	OU III (Industrial Park East)	OU III (South Boundary) Radionuclide	Plume Core	X																	Xc	Xc	Xc		4
000-513	OU III (Industrial Park East)	MW-E	Plume Perimeter	X																					4
000-514	OU III (Industrial Park East)	MW-F	Plume Core	X																					4
065-03	OU III (BGRR/WCF Sr-90)		Plume Perimeter	X																		Xg	X		1a
065-04	OU III (BGRR/WCF Sr-90)		Plume Perimeter	X																		Xg	X		1a
065-06	OU III (BGRR/WCF Sr-90)		Background	X																			X		1a
065-11	OU III (BGRR/WCF Sr-90)		Background																				X		1a
065-160	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
065-161	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
065-162	OU III (BGRR/WCF Sr-90)		Outer Plume Perimeter																				X		1a
065-163	OU III (BGRR/WCF Sr-90)		Background																				X		1a
065-164	OU III (BGRR/WCF Sr-90)		Plume Core																				X	X	1a
065-165	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
065-166	OU III (BGRR/WCF Sr-90)		Background																				X		1a
065-167	OU III (BGRR/WCF Sr-90)		Background																				X		1a
065-168	OU III (BGRR/WCF Sr-90)		Plume Perimeter																	X			X		1a
065-169	OU III (BGRR/WCF Sr-90)		Plume Perimeter																	X			X		1a
065-170	OU III (BGRR/WCF Sr-90)		Plume Perimeter																	X			X		1a
065-171	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
065-172	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
065-173	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
065-174	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
065-175	OU III (BGRR/WCF Sr-90)		Plume Core																				X	X	1a
065-176	OU III (BGRR/WCF Sr-90)		Background																				X		1a
065-177	OU III (BGRR/WCF Sr-90)		Background																				X		1a
065-178	OU III (BGRR/WCF Sr-90)		Plume Perimeter																			Xg	X		1a
065-18	OU III (BGRR/WCF Sr-90)		Plume Perimeter	X																			X		1a
065-19	OU III (BGRR/WCF Sr-90)		Plume Perimeter	X																			X		1a
065-20	OU III (BGRR/WCF Sr-90)		Plume Perimeter	X																			X		1a
065-37	OU III (BGRR/WCF Sr-90)	OU III (AOC 29/HFBR Tritium)	Plume Perimeter	Sampled under OU III (AOC 29/HFBR Tritium) Program.																X					
065-38	OU III (BGRR/WCF Sr-90)	OU III (AOC 29/HFBR Tritium)	Plume Perimeter	Sampled under OU III (AOC 29/HFBR Tritium) Program.																					
065-39	OU III (BGRR/WCF Sr-90)	OU III (AOC 29/HFBR Tritium)	Plume Core	Sampled under OU III (AOC 29/HFBR Tritium) Program.																					
065-40	OU III (BGRR/WCF Sr-90)	OU III (AOC 29/HFBR Tritium)	Plume Perimeter	Sampled under OU III (AOC 29/HFBR Tritium) Program.																					
075-09	OU III (BGRR/WCF Sr-90)		Plume Perimeter	X																			X		1a
075-10	OU III (BGRR/WCF Sr-90)		Plume Perimeter	X																			X		1a
075-188	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-189	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-190	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-191	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-192	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-193	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-194	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-195	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-196	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-197	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-198	OU III (BGRR/WCF Sr-90)		Plume Core																				X	X	1a
075-199	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-200	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-201	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-202	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-203	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-39	OU III (BGRR/WCF Sr-90)	OU III (AOC 29/HFBR Tritium)	Plume Perimeter	Sampled under OU III (AOC 29/HFBR Tritium) Program.																					
075-40	OU III (BGRR/WCF Sr-90)	OU III (AOC 29/HFBR Tritium)	Plume Perimeter	Sampled under OU III (AOC 29/HFBR Tritium) Program.																					
075-41	OU III (BGRR/WCF Sr-90)	OU III (AOC 29/HFBR Tritium)	Plume Perimeter	Sampled under OU III (AOC 29/HFBR Tritium) Program.																					
075-46	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-47	OU III (BGRR/WCF Sr-90)		Sentinel																				X		1a
075-48	OU III (BGRR/WCF Sr-90)		Sentinel																				X		1a
075-85	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-86	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-87	OU III (BGRR/WCF Sr-90)		Sentinel																				X		1a
065-360	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
065-361	OU III (BGRR/WCF Sr-90)		Plume Core																			Xg	X		1a
065-362	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
065-363	OU III (BGRR/WCF Sr-90)		Plume Perimeter																			Xg	X		1a
065-364	OU III (BGRR/WCF Sr-90)		Plume Core																			Xg	X		1a
065-365	OU III (BGRR/WCF Sr-90)		Plume Perimeter																			Xg	X		1a
075-662	OU III (BGRR/WCF Sr-90)		Plume Perimeter																			Xg	X		1a
075-663	OU III (BGRR/WCF Sr-90)		Plume Core																			Xg	X		1a
065-366	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
065-367	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-674	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-675	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-664	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-665	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-666	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-667	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-668	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-669	OU III (BGRR/WCF Sr-90)		Plume Core																				X		1a
075-670	OU III (BGRR/WCF Sr-90)		Sentinel																				X		1a
075-671	OU III (BGRR/WCF Sr-90)		Sentinel																				X		1a
075-672	OU III (BGRR/WCF Sr-90)		Plume Perimeter																				X		1a
075-673	OU III (BGRR/WCF Sr-90)		Plume Core																				X		2f
065-384	OU III (BGRR/WCF Sr-90)		Sentinel																			X			2f
065-385	OU III (BGRR/WCF Sr-90)		Sentinel																			X			2f
MW-BGRR07-A	OU III (BGRR/WCF Sr-90)																						X		2f
MW-BGRR07-B	OU III (BGRR/WCF Sr-90)																						X		2f
MW-BGRR07-C	OU III (BGRR/WCF Sr-90)																						X		2f
MW-BGRR07-D	OU III (BGRR/WCF Sr-90)																						X		2f
MW-BGRR07-E	OU III (BGRR/WCF Sr-90)																						X		2f
085-293	OU III (Bldg 96) (formerly well ID 095-160)		Plume Core	X																					4
085-335	OU III (Bldg 96)		Plume Core	X																					4
085-97	OU III (Bldg 96)		Plume Perimeter	X																					4
095-159	OU III (Bldg 96)		Plume Core	X																					4
095-161	OU III (Bldg 96)		Plume Perimeter	X																					4
095-162	OU III (Bldg 96)		Plume Core	X																					4
095-163	OU III (Bldg 96)		Bypass Detection	X																					4
095-164	OU III (Bldg 96)		Bypass Detection	X																					4
095-165	OU III (Bldg 96)		Bypass Detection	X																				X	4
095-166	OU III (Bldg 96)		Bypass Detection	X																					4
095-167	OU III (Bldg 96)		Bypass Detection	X																					4
095-168	OU III (Bldg 96)		Bypass Detection	X																					4
095-169	OU III (Bldg 96)		Bypass Detection	X																					4
095-170	OU III (Bldg 96)		Bypass Detection	X																					4
095-171	OU III (Bldg 96)		Plume Perimeter	X																					4
095-172	OU III (Bldg 96)		Plume Core	X																					4
095-294	OU III (Bldg 96)		Plume Core	X																					4
095-295	OU III (Bldg 96)		Plume Perimeter	X																					4
095-296	OU III (Bldg 96)	OU III Carbon Tet	Plume Perimeter	X																					4
095-84	OU III (Bldg 96)		Plume Core	X																					4
095-85	OU III (Bldg 96)		Plume Core	X																					4
095-305	OU III (Bldg 96)		Plume Core	X																					4
095-306	OU III (Bldg 96)		Plume Core	X																					4
095-307	OU III (Bldg 96)		Plume Core	X																					4
095-308	OU III (Bldg 96)		Plume Core	X																					4
085-347	OU III (Bldg 96)		Plume Core	X																					4
085-348	OU III (Bldg 96)		Plume Core	X																					4
085-349	OU III (Bldg 96)		Plume Core	X																					4

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Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
085-350	OU III (Bldg 96)		Plume Core	X																					4
085-351	OU III (Bldg 96)		Plume Core	X																					4
085-352	OU III (Bldg 96)		Plume Core	X																					4
085-353	OU III (Bldg 96)		Plume Core	X																					4
085-354	OU III (Bldg 96)		Plume Core	X																					4
105-23	OU III Middle Road	OU III (AOC 29/HFBR Tritium)	Plume Core	Xf																		X			4
105-25	OU III Middle Road		Plume Core	X																					2f
105-44	OU III Middle Road	OU III (AOC 29/HFBR Tritium)	Plume Core	X																		Xa			2f
105-52	OU III Middle Road		Plume Perimeter	X																					2f
105-53	OU III Middle Road		Plume Core	X																					2f
105-54	OU III Middle Road		Plume Core	X																					2f
106-55	OU III Middle Road		Plume Core	X																					2f
106-56	OU III Middle Road		Plume Core	X																					2f
106-58	OU III Middle Road		Plume Core	X																					2f
106-62	OU III Middle Road	Chemical/Animal Holes Sr-90	Plume Perimeter	X																			Xf		2f
113-06	OU III Middle Road		Plume Perimeter	X																					2f
113-07	OU III Middle Road		Plume Core	X																					2f
113-08	OU III Middle Road		Plume Core	X																					2f
113-09	OU III Middle Road		Plume Core	X																				X	2f
113-11	OU III Middle Road		Plume Core	X																					2f
113-16	OU III Middle Road		Bypass Detection	X																					4
113-17	OU III Middle Road		Bypass Detection	X																					4
113-18	OU III Middle Road		Bypass Detection	X																					4
113-19	OU III Middle Road		Bypass Detection	X																					4
113-20	OU III Middle Road		Bypass Detection	X																					4
113-21	OU III Middle Road		Plume Core	X																					2f
113-22	OU III Middle Road		Plume Core	X																					2f
114-12	OU III Middle Road		Bypass Detection	X																					4
OU3SBMW-01-2006	OU III Middle Road		Bypass Detection	X																					4
000-280	OU III (South Boundary)	OU III Industrial Park and (South Boundary) Radionuclide	Bypass Detection	Sampled With OU III Industrial Park																					
114-06	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
114-07	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc		2f
121-06	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xc																	Xc	Xc	Xc		1c
121-07	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
121-08	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
121-09	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xc																	Xc	Xc	Xc		1c
121-10	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc		2f
121-11	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc	X	2f
121-12	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xc																	Xc	Xc	Xc		1c
121-13	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc	X	2f
121-14	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc		2f
121-18	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xc																	Xc	Xc	Xc		1c
121-19	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
121-20	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc		2f
121-21	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xc																	Xc	Xc	Xc		1c
121-22	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
121-23	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc		2f
121-43	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Bypass Detection	Xf																	Xc	Xc	Xc		2f

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
122-02	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
122-04	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc		2f
122-05	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc		2f
122-09	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
122-10	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xc																	Xc	Xc	Xc		1c
122-15	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xc																	Xc	Xc	Xc		1c
122-16	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
122-17	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc	X	2f
122-18	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xc																	Xc	Xc	Xc		1c
122-19	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
122-20	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	X																	Xc	Xc	Xc		4
122-21	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc		2f
122-22	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc		2f
122-31	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
122-32	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	Xf																	Xc	Xc	Xc		2f
122-33	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	Xf																	Xc	Xc	Xc		2f
122-34	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Bypass Detection	X																	Xc	Xc	Xc		4
122-35	OU III (South Boundary)	OU III (South Boundary) Radionuclide	Bypass Detection	X																	Xc	Xc	Xc		4
OU3SBMW-01-2006	OU III (South Boundary)		Plume Core	Sampled with Middle Road Program																					
119-03	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter (Recha	X																	Xc	Xc	Xc		2f
121-42	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	X																	Xc	Xc	Xc		2f
124-02	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Background	X																	Xc	Xc	Xc		2f
125-01	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter (Recha	X																	Xc	Xc	Xc		2f
126-01	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	X																	Xc	Xc	Xc		2f
126-11	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	X																	Xc	Xc	Xc		2f
126-13	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	X																	Xc	Xc	Xc		2f
126-14	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	X																	Xc	Xc	Xc		2f
126-15	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	X																	Xc	Xc	Xc		2f
126-16	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Bypass Detection	X																	Xc	Xc	Xc		4
127-04	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	X																	Xc	Xc	Xc		2f
127-06	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Core	X																	Xc	Xc	Xc		2f
127-07	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Bypass Detection	X																	Xc	Xc	Xc		4
130-02	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	X																	Xc	Xc	Xc		2f
130-03	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	X																	Xc	Xc	Xc	X	2f
130-04	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Plume Perimeter	X																	Xc	Xc	Xc		2f
130-08	OU III (Western South Boundary)	OU III (South Boundary) Radionuclide	Bypass Detection	X																	Xc	Xc	Xc		4
064-03	OU III (central)			Xa																					1a
065-02	OU III (central)			Xa																					1a
065-05	OU III (central)			Xa																					1a
066-08	OU III (central)			Xa																					1a
066-09	OU III (central)			Xa																					1a
075-01	OU III (central)			Xa																					1a
075-02	OU III (central)			Xa																					1a
076-28	OU III (central)	OU IV (AOC 6 Sr-90)		Xa																			Xd		2da
076-314	OU III (central)	OU IV (AOC 6 Sr-90)		Xa																			Xd		2da
076-317	OU III (central)	OU IV (AOC 6 Sr-90)		Xa																			Xd		2da
076-373	OU III (central)	OU IV (AOC 6 Sr-90)		Xa																			Xd		2da
083-01	OU III (central)			Xa																					1a

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
083-02	OU III (central)			Xa																					1a
084-04	OU III (central)			Xa																					1a
084-05	OU III (central)			Xa																					1a
096-07	OU III (central)			Xa																					1a
105-05	OU III (central)			Xa																					1a
105-06	OU III (central)			Xa																					1a
109-03	OU III (central)			X																	X	X	X	X	4
109-04	OU III (central)			X																	X	X	X		4
085-07	OU III (Carbon tet)		Plume Core	X																					2f
085-13	OU III (Carbon tet)		Plume Core	X																					2f
085-16	OU III (Carbon tet)		Plume Core	X																					2f
085-160	OU III (Carbon tet)		Plume Core	X																					2f
085-161	OU III (Carbon tet)		Plume Core	X																					2f
085-162	OU III (Carbon tet)		Plume Core	X																					2f
085-163	OU III (Carbon tet)		Plume Core	X																					2f
085-17	OU III (Carbon tet)		Plume Core	X																				X	2f
085-236	OU III (Carbon tet)		Plume Core	X																					2f
085-237	OU III (Carbon tet)		Plume Core	X																					2f
085-238	OU III (Carbon tet)		Plume Perimeter	X																					2f
085-98	OU III (Carbon tet)		Plume Core	X																					2f
095-183	OU III (Carbon tet)		Plume Core	X																					2f
095-185	OU III (Carbon tet)		Plume Core	X																					2f
095-186	OU III (Carbon tet)		Plume Perimeter	X																					1a
095-277	OU III (Carbon tet)		Plume Core	X																					2f
095-279	OU III (Carbon tet)		Plume Core	X																					2f
095-280	OU III (Carbon tet)		Sentinel	X																					2f
095-42	OU III (Carbon tet)		Sentinel	X																					2f
095-43	OU III (Carbon tet)		Plume Core	X																					2f
095-45	OU III (Carbon tet)		Plume Core	X																					2f
095-47	OU III (Carbon tet)		Plume Core	X																		X			2f
095-53	OU III (Carbon tet)	OU III (AOC 29/HFBR Tritium)	Sentinel	Sampled under OU III (AOC 29/HFBR Tritium) Program.																					
095-88	OU III (Carbon tet)		Plume Core	X																					2f
095-89	OU III (Carbon tet)		Plume Core	X																					2f
095-90	OU III (Carbon tet)	OU III (AOC 29/HFBR Tritium)	Sentinel	Sampled under OU III (AOC 29/HFBR Tritium) Program.																					
095-92	OU III (Carbon tet)		Sentinel	X																					2f
104-11	OU III (Carbon tet)		Sentinel (Middle Rd. Tra	X																					2f
104-36	OU III (Carbon tet)		Sentinel (Middle Rd. Tra	X																					2f
105-23	OU III (Carbon tet)	OU III Middle Road, OU III (AOC 29/HFBR Tritium)	Sentinel	Sampled under OU III Middle Road																					
105-42	OU III (Carbon tet)		Sentinel (Middle Rd. Tra	X																					2f
095-301	OU III (Carbon tet)	CT East	Plume Core	X																					2f
095-300	OU III (Carbon tet)	CT West	Plume Perimeter	X																					4
095-296	OU III (Carbon tet)	OU III (Bldg 96)	Plume Perimeter	X																					4
000-130	OU III (Magothy)	OU III LIPA	Magothy	X																					4
000-249	OU III (Magothy)	OU III (Industrial Park)	Magothy	Sampled under OU III Industrial Park																					
000-250	OU III (Magothy)	OU III (Industrial Park)	Magothy	Sampled under OU III Industrial Park																					
000-343	OU III (Magothy)			X																					4
000-425	OU III (Magothy)	OU III LIPA		X																					4
000-426	OU III (Magothy)	OU III LIPA		X																					4

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
000-427	OU III (Magothy)			X																					4
000-428	OU III (Magothy)			X																					4
000-429	OU III (Magothy)			X																					4
000-458	OU III (Magothy)			X																					4
000-459	OU III (Magothy)			X																					4
000-460	OU III (Magothy)	OU III LIPA		X																					4
109-12	OU III (Magothy)			X																					4
109-13	OU III (Magothy)			X																					4
115-50	OU III (Magothy)			X																					4
121-40	OU III (Magothy)			X																					2f
121-44	OU III (Magothy)			X																					2f
122-41	OU III (Magothy)			X																					2f
800-90	OU III (Magothy)	OU III Airport		X																					4
000-107	OU III (off-site)			X																					1a
000-97	OU III (off-site)			X																					1a
000-98	OU III (off-site)			X																					1a
000-99	OU III (off-site)			X																					1a
800-21	OU III (off-site)			X																					1a
800-22	OU III (off-site)			X																					1a
800-23	OU III (off-site)			X																					1a
800-40	OU III (off-site)			X																					1a
800-41	OU III (off-site)			X																					1a
800-51	OU III (off-site)			X																					1a
800-52	OU III (off-site)			X																					1a
800-53	OU III (off-site)			X																					1a
000-101	OU III (LIPA)		Plume Perimeter	X																					2f
000-102	OU III (LIPA)		Plume Perimeter	X																					2f
000-104	OU III (LIPA)		Plume Core	X																				X	2f
000-105	OU III (LIPA)		Plume Perimeter	X																					2f
000-130	OU III (LIPA)	Magothy	Plume Core	X																					2f
000-131	OU III (LIPA)		Bypass Detection	X																					4
000-425	OU III (LIPA)	Magothy	Plume Core	X																					2f
000-445	OU III (LIPA)	MW-A	Plume Perimeter	X																					2f
000-446	OU III (LIPA)	MW-B	Plume Perimeter	X																					2f
000-447	OU III (LIPA)	MW-C	Plume Core	X																					2f
000-448	OU III (LIPA)	MW-D	Plume Core	X																					2f
000-449	OU III (LIPA)	MW-E	Plume Core	X																					2f
000-450	OU III (LIPA)	MW-F	Plume Perimeter	X																					4
000-451	OU III (LIPA)	MW-G	Bypass Detection	X																					4
000-452	OU III (LIPA)	MW-H	Bypass Detection	X																					4
000-460	OU III (LIPA)	OU III (Magothy)	Plume Perimeter	Sample with Magothy																					
800-90	OU III (Airport)	OU III (Magothy)	Plume Core	Sample with Magothy																					
800-92	OU III (Airport)	OU III (Magothy)	Plume Core	X																					4
800-100	OU III (Airport)	MW-N	Plume Core	X																					4
800-101	OU III (Airport)	MW-O2	Plume Core	X																					4
800-102	OU III (Airport)	MW-O1	Plume Core	X																					4
800-103	OU III (Airport)	MW-P	Plume Core	X																					4
800-104	OU III (Airport)	MW-Q1	Plume Perimeter	X																					4

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
800-105	OU III (Airport)	MW-Q2	Plume Perimeter	X																					4
800-106	OU III (Airport)	MW-R	Plume Core	X																					4
800-107	OU III (Airport)	MW-S	Bypass Detection	X																					4
800-108	OU III (Airport)	MW-T	Bypass Detection	X																					4
800-43	OU III (Airport)		Plume Core	X																					4
800-44	OU III (Airport)		Plume Core	X																					4
800-50	OU III (Airport)		Plume Perimeter	X																					4
800-59	OU III (Airport)		Plume Core	X																		Xa			4
800-60	OU III (Airport)		Sentinel	X																		Xa			4
800-63	OU III (Airport)	OU III North Street	Plume Core	Sample with OU III North Street																					
800-94	OU III (Airport)	MW-I	Plume Core	X																					4
800-95	OU III (Airport)	MW-J	Plume Core	X																				X	4
800-96	OU III (Airport)	MW-K	Plume Perimeter	X																					12
800-97	OU III (Airport)	MW-L	Plume Core	X																					4
800-98	OU III (Airport)	MW-M1	Plume Core	X																					4
800-99	OU III (Airport)	MW-M2	Plume Core	X																				X	4
AP-A-2007	OU III (Airport)			X																					4
AP-B-2007	OU III (Airport)			X																					4
AP-C-2007	OU III (Airport)			X																					4
AP-D-2007	OU III (Airport)			X																					4
AP-E-2007	OU III (Airport)			X																					4
AP-F-2007	OU III (Airport)			X																					4
076-04	OU IV (AOC 5 AS/SVE)			X		X																			2d
076-06	OU IV (AOC 5 AS/SVE)			X		X																			2d
076-185	OU IV (AOC 5 AS/SVE)			X																					2d
066-17	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
066-189	OU IV (AOC 6 Sr-90)		Background																				X		2d
066-190	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-05	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X	X	1b
076-07	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		1b
076-09	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		1b
076-10	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		1b
076-13	OU IV (AOC 6 Sr-90)		Plume Core																				X	X	2d
076-167	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-168	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-169	OU IV (AOC 6 Sr-90)		Plume Core																				X	X	2d
076-181	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		1b
076-182	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		1b
076-183	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-184	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		1b
076-20	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-22	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		1b
076-24	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-25	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-26	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-262	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-263	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-264	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
076-265	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		1b
076-27	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
076-28	OU IV (AOC 6 Sr-90)	OU III (central)	Plume Perimeter	Sample with OU III Central																					2d
076-314	OU IV (AOC 6 Sr-90)	OU III (central)	Plume Perimeter	Sample with OU III Central																					2d
076-317	OU IV (AOC 6 Sr-90)	OU III (central)	Plume Perimeter	Sample with OU III Central																					2d
076-373	OU IV (AOC 6 Sr-90)		Plume Perimeter																				X		2d
000-122	OU V		Plume Core	X														X				X		X	1b
000-123	OU V		Plume Core	X														X				X			1b
000-141	OU V		Sentinel	X																		X			1b
000-142	OU V		Sentinel	X																		X			1b
000-143	OU V		Sentinel	X																		X			1b
000-144	OU V		Sentinel	X																		X			1b
000-145	OU V		Sentinel	X																		X			1b
000-146	OU V		Sentinel	X																		X			1b
000-147	OU V		Plume Core	X																		X			1b
037-02	OU V		Background	X																		X			1b
037-03	OU V		Background	X																		X			1b
037-04	OU V		Background	X																		X			1b
041-01	OU V		Sentinel	X																		X			1b
041-02	OU V		Sentinel	X																		X			1b
041-03	OU V		Sentinel	X																		X			1b
049-05	OU V		Sentinel	X														X				X			1b
049-06	OU V		Sentinel	X														X				X			1b
050-01	OU V		Plume Core	X														X				X		X	1b
050-02	OU V		Plume Core	X														X				X			1b
061-03	OU V		Plume Core	X																		X			1b
061-04	OU V		Plume Core	X														X				X			1b
061-05	OU V		Plume Core	X														X				X		X	1b
600-15	OU V		Sentinel	X																		X			1b
600-16	OU V		Sentinel	X																		X			1b
600-18	OU V		Sentinel	X																		X			1b
600-19	OU V		Sentinel	X																		X			1b
600-20	OU V		Sentinel	X																		X			1b
600-21	OU V		Sentinel	X																		X			1b
600-22	OU V		Sentinel	X																		X			1b
600-23	OU V		Sentinel	X																		X			1b
600-24	OU V		Sentinel	X																		X			1b
600-25	OU V		Sentinel	X																		X			1b
600-26	OU V		Sentinel	X																		X			1b
600-27	OU V		Sentinel	X																		X			1b
000-110	OU VI EDB		Plume Core	Xa	X																				2f
000-173	OU VI EDB		Plume Core	Xa	X																			X	2f
000-174	OU VI EDB		Plume Perimeter	Xa	X																				2f
000-175	OU VI EDB		Plume Core	Xa	X																				2f
000-176	OU VI EDB		Plume Perimeter	Xa	X																				2f
000-177	OU VI EDB		Plume Perimeter	Xa	X																				2f
000-178	OU VI EDB		Sentinel	Xa	X																				4
000-179	OU VI EDB		Plume Perimeter	Xa	X																				2f

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
000-180	OU VI EDB		Plume Perimeter	Xa	X																				2f
000-201	OU VI EDB		Plume Perimeter	Xa	X																				2f
000-209	OU VI EDB		Plume Core	Xa	X																				2f
000-283	OU VI EDB		Plume Core	Xa	X																				2f
000-284	OU VI EDB		Plume Core	Xa	X																				2f
000-285	OU VI EDB		Plume Perimeter	Xa	X																				2f
058-02	OU VI EDB		Background	Xa	X																				4
089-13	OU VI EDB		Background	Xa	X																				4
089-14	OU VI EDB		Background	Xa	X																				4
099-06	OU VI EDB	OU III (South Boundary) Radionuclide	Plume Perimeter	Xa	X																	Xc			2f
099-10	OU VI EDB	OU III (South Boundary) Radionuclide	Plume Perimeter	Xa	X																	Xc			2f
099-11	OU VI EDB	OU III (South Boundary) Radionuclide	Plume Perimeter	Xa	X																	Xc		X	2f
100-12	OU VI EDB	OU III (South Boundary) Radionuclide	Plume Perimeter	Xa	X																	Xc			2f
100-13	OU VI EDB	OU III (South Boundary) Radionuclide	Plume Perimeter	Xa	X																	Xc			2f
100-14	OU VI EDB		Plume Perimeter	Xa	X																				2f
000-497	OU VI EDB	A1	Plume Perimeter	Xa	X																				2f
000-498	OU VI EDB	A2	Plume Perimeter	Xa	X																				2f
000-499	OU VI EDB	B1	Plume Perimeter	Xa	X																				2f
000-500	OU VI EDB	B2	Plume Perimeter	Xa	X																				2f
000-501	OU VI EDB	C1	Plume Core	Xa	X																				2f
000-507	OU VI EDB	EDB Core	Plume Core	Xa	X																				2f
000-508	OU VI EDB	EDB Bypass	Bypass Detection	Xa	X																				4
000-394	OU I (South Boundary)		Sentinel	X																	Xb	Xd	Xd		2d
087-21	OU I (South Boundary)		Background	Xb																	Xb	Xb	Xb		1b
088-13	OU I (South Boundary)		Background	Xb																	Xb	Xb	Xb		1b
088-14	OU I (South Boundary)		Background	Xb																	Xb	Xb	Xb		1b
088-20	OU I (South Boundary)		Background	Xb																	Xb	Xb	Xb		1b
088-26	OU I (South Boundary)		Plume Perimeter	X																	Xb	Xd	Xd		2d
098-21	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
098-22	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
098-30	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
098-33	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
098-58	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
098-59	OU I (South Boundary)		Plume Core	Xd																	Xb	Xd	Xd	X	2d
098-61	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
099-04	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
107-10	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
107-23	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
107-24	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
107-25	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
107-26	OU I (South Boundary)		Plume Core	Xd																	Xb	Xd	Xd		2d
107-34	OU I (South Boundary)		TBD																				X		4
107-35	OU I (South Boundary)		TBD																				X		4
108-08	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
108-12	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
108-13	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xdc	Xd		2dc
108-14	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
108-17	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d

Table 12-1. LTRA Monitoring Schedule for CY2008

Well ID	Project 1	Project 2	Decision Subunit	EPA 524.2 VOCs	EPA 504 EDB	EPA 625 Semi-VOCs	Pesticides Method 608	PCBs Method 608	TSS/TDS	Sufates/Chloride/Alkalinity	TK Nitrogen	Total Nitrogen	Nitrates	Nitrites	Ammonia	TAL Metals	Cyanide	Perchlorate	EPA 900 Gross Alpha/Beta	Isotopic Ce -137	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr 90	Blind Duplicate/MS/MSD	Frequency (events/year)
108-18	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd		2d
108-43	OU I (South Boundary)		TBD																				X		4
108-44	OU I (South Boundary)		TBD																				X		4
115-03	OU I (South Boundary)		Plume Perimeter	Xd																	Xb	Xd	Xd	X	2d
115-13	OU I (South Boundary)		Plume Core	Xd																	Xb	Xd	Xd		2d
115-14	OU I (South Boundary)		Plume Core	Xd																	Xb	Xd	Xd		2d
115-15	OU I (South Boundary)		Plume Core	Xd																	Xb	Xd	Xd		2d
115-16	OU I (South Boundary)		Plume Core	Xd																	Xb	Xd	Xd		2d
115-28	OU I (South Boundary)		Plume Core	Xd																	Xb	Xd	Xd		2d
115-29	OU I (South Boundary)		Plume Core	Xd																	Xb	Xd	Xd		2d
115-30	OU I (South Boundary)		Plume Perimeter	X																	Xb	Xd	Xd		2d
115-31	OU I (South Boundary)		Plume Core	Xd																	Xb	X	X		2d
115-36	OU I (South Boundary)		Plume Core	Xd																	Xb	Xd	Xd		2d
115-41	OU I (South Boundary)		Bypass Detection	X																	Xb	X	X		4
115-42	OU I (South Boundary)		Bypass Detection	X																	Xb	X	X		4
116-05	OU I (South Boundary)		Plume Perimeter	X																	Xb	Xd	Xd		2d
116-06	OU I (South Boundary)		Plume Perimeter	X																	Xb	Xd	Xd		2d
OUISBMW152	OU I (South Boundary)		Plume Core	X																	Xb	Xd	Xd		4
017-01	Site Background		Background	X																					1b
017-03	Site Background		Background	X																					1b
017-04	Site Background		Background	X																					1b
018-01	Site Background		Background	X																					1b
018-02	Site Background		Background	X																					1b
018-04	Site Background		Background	X																					1b
018-05	Site Background		Background	X																					1b
034-02	Site Background		Background	X																					1b
034-03	Site Background		Background	X																					1b
063-09	Site Background		Background	X																				X	1b

NOTES:
a: Collect in 4th Quarter only.
b: Collect in 3rd Quarter Only.
c: Collect in 2nd Quarter only.
d: Collect in 1st and 3rd Quarters
f: Collect in 2nd and 4th Quarters.

CHEMICAL/ANIMAL HOLES STRONTIUM-90

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, October 2, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

SUMMARY OF CHANGES

Monitoring changes for the Chemical/Animal Holes Strontium-90 Treatment System and groundwater monitoring program, which were issued in the 2006 Annual Groundwater Status Report, include:

- Begin pumping two new extraction wells, as per 2006 Annual Groundwater Status Report recommendations.
- Based on low influent concentrations over 2006 and to help evaluate improving the effectiveness of removing Sr-90 from the aquifer, continue pulse pumping (EW-1 cycle of one month on and one month off), which was implemented in October 2007, to help evaluate rebounding of the Sr-90 influent concentrations. If concentrations in the extraction well increase significantly, the extraction well will be put back into full-time operation.
- Remove gross beta from the analyte list for the treatment system sampling; this sampling is no longer needed. It was previously used as a means to confirm that there was not rapid breakthrough of the resin. However, based on the 3 years of operations data, breakthrough is a slow and gradual process. Thus, the 2-week turnaround on Sr-90 analyses is now adequate for continued verification.
- Change the monitoring well sampling frequency from startup (semi-annual and quarterly) to the O&M phase (semi-annual and annually). However, maintain the new monitoring wells to be installed as part of the semi-annual frequency for approximately two years.

DESCRIPTION AND TECHNICAL BASIS

Between 1960 and 1966, waste, glassware containing chemical and radioactive waste, and animal carcasses containing radioactive tracers were disposed in shallow pits in an area directly east of the Chemical/Animal Holes area. Used glassware continued to be disposed in shallow pits directly north of this area from 1966 through 1981. Remediation of the impacted soil in the Chemical/Animal Holes area, including waste excavation, treatment and disposal, was completed in September 1997.

The monitoring well network for the Chemical/Animal Holes consists of 41 wells. Fifteen wells are downgradient of the Chemical/Animal Holes area (106-04, 106-13 through 106-17, 106-43 through 106-50, and 106-64). There are also eight sentinel wells along Middle Road (106-20 through 106-25, 106-62, and 106-63) and one sentinel well south of Middle Road (114-01). No upgradient wells are sampled as part of this program. The wells comprising the Chemical/Animal

Holes program are listed in Table 12.2.2. Well locations are shown on Figure 12.2.1. The wells have been sampled semi-annually for Sr-90 analysis and annually for analysis of VOCs.

Sr-90 has routinely been detected downgradient of the Chemical/Animal Holes at levels exceeding the New York State groundwater standard. During calendar year 2006, ten wells in the downgradient area contained Sr-90 at concentrations exceeding the New York State groundwater standard, indicating individual disposal pits as the sources for the Sr-90. None of the sentinel wells contained Sr-90 at levels exceeding the New York State groundwater standard. In February 2003, the Sr-90 Pilot Study began operation. The objective of this study was to evaluate the effectiveness of extraction and treatment of Sr-90 in groundwater prior to implementation of the final remedy. The Sr-90 Pilot Study, now known as the Chemical/Animal Holes Sr-90 Treatment System, currently extracts groundwater at a rate of between 5 to 15 gallons per minute, treats it with an ion exchange system, and discharges the groundwater to dry wells located just east of the treatment system building.

VOCs have also been routinely detected downgradient of the Chemical/Animal Holes, but generally at levels below New York State groundwater standards. During calendar year 2006, the highest concentration of VOCs was detected in well 106-102, with a TVOC concentration of 5.3 µg/L.A plume of VOC-impacted groundwater originating in the area of the Chemical/Animal Holes and extending off site will be addressed by the North Street Groundwater Remediation System.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The Chemical/Animal Holes area has been an historic source of Sr-90 contamination to groundwater. In response, BNL has conducted remediation (waste excavation, treatment, and disposal) to eliminate future releases. Data are needed to confirm that the soil remediation was adequate and to track existing contaminant plumes downgradient of the Chemical/Animal Holes area. In addition, data are required during the design process in the immediate pilot study area for design decisions and potential system modifications. The pilot study was targeted for the area of high Sr-90 concentrations.

Problem Statement: Existing Sr-90 and VOC plumes have degraded groundwater quality downgradient of the Chemical/Animal Holes area and could impact downgradient receptors. Data are needed to:

- Verify that the soil source areas have been remediated
- Track the portions of the Sr-90 plumes that are targeted for remediation by monitored natural attenuation
- Track the distribution of the high concentration area currently being addressed by the treatment system

- Verify the effectiveness of the treatment system in removing Sr-90 from the groundwater

Step 2: Identify the Decisions

Is the BNL Groundwater Contingency Plan triggered?
Is the Sr-90 plume targeted for monitored natural attenuation attenuating as planned?
Is the treatment system operating as planned?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Sr-90 and VOC results in groundwater
- Locations of existing wells relative to flow patterns
- Regulatory drivers (OU I ROD and OU III ROD)
- Action Levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL Environmental Monitoring Plan
- Estimated retardation rate for Sr-90
- Variability of data

Step 4: Define the Study Boundaries

The decision unit limits for this project are the area impacted by detectable activities of Sr-90 from the Chemical/Animal Holes and Former Landfill areas. The vertical limits are from the water table surface to the deep zone of the Upper Glacial aquifer.

Due to the low travel velocity for Sr-90 in groundwater, decisions for most wells will be made on a timeframe of 180 days. Since wells 106-04, 106-16, 106-17, 106-48, 106-49, and 106-50 are located within the high-concentration area to be addressed by the ongoing treatment system and Sr-90 concentrations in this area have recently shown fluctuations, decisions will be made using a timeframe of 90 days to ensure that the design of the system will be effective.

Step 5: Develop the Decision Rules

Decision 1

Was the BNL Groundwater Contingency Plan triggered?

Analytical results from all wells will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

If the detected Sr-90 activities are consistent with the groundwater model results and professional judgment, **then** continue monitoring. If not, consider refining the conceptual model and/or conducting an evaluation to determine whether outside factors (such as additional contaminant sources) are affecting the results.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate identified in the Explanation of Significant Difference to the OU III Record of Decision?

This decision applies to the plume core and sentinel wells. If the system is performing as planned, actual Sr-90 concentrations in plume core and sentinel wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation. Note: When the majority and/or "key" wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Have the cleanup goals been met? Can the groundwater treatment system be shut down?

If evaluation of analytical results for any contaminant of concern in any upgradient or plume core well sample, in conjunction with historic analytical results and trends indicates that the treatment system have met the shutdown criteria of achieving the cleanup goal within 40 years, **then** a petition for shutdown will be issued to the regulatory agencies.

Step 6: Specify Acceptable Error Tolerances

Table 12.2.1 summarizes the decision and possible decision errors for this project.

Table 12.2.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Are the Sr-90 plumes targeted for monitored natural attenuation attenuating as planned?	See Step 3 for inputs.	(1) Data indicate that the plumes are not attenuating as planned when they are. (2) Data indicate that the plumes are attenuating as planned when they are not.	(1) Wasted resources refining conceptual model and conducting evaluations of other factors. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the high-concentration Sr-90 plume to be addressed by the upcoming pilot study still located in the pilot study area?	See Step 3 for inputs.	(1) Data indicate plume is not located in pilot study area when it is. (2) Data indicate plume is located in pilot study area when it is not.	(1) Wasted resources modifying system design, potentially inaccurate results/conclusions from pilot study. (2) Potentially inaccurate results/ conclusions from pilot study.

Step 7: Optimize the Design

Number and Locations of Wells

The existing monitoring well network consists of 41 wells, five of which were added during the installation of the new extraction wells during the last half of 2007.

Parameters and Frequency

All 41 wells in the groundwater monitoring program will be sampled on an O&M phase schedule (semi-annual and annually) and analyzed for Sr-90. VOCs will be sampled and analyzed annually.

A summary of the proposed revised sampling program for this project is shown in Table 12.2.2,

Annual Cost Impact Due to Proposed Change

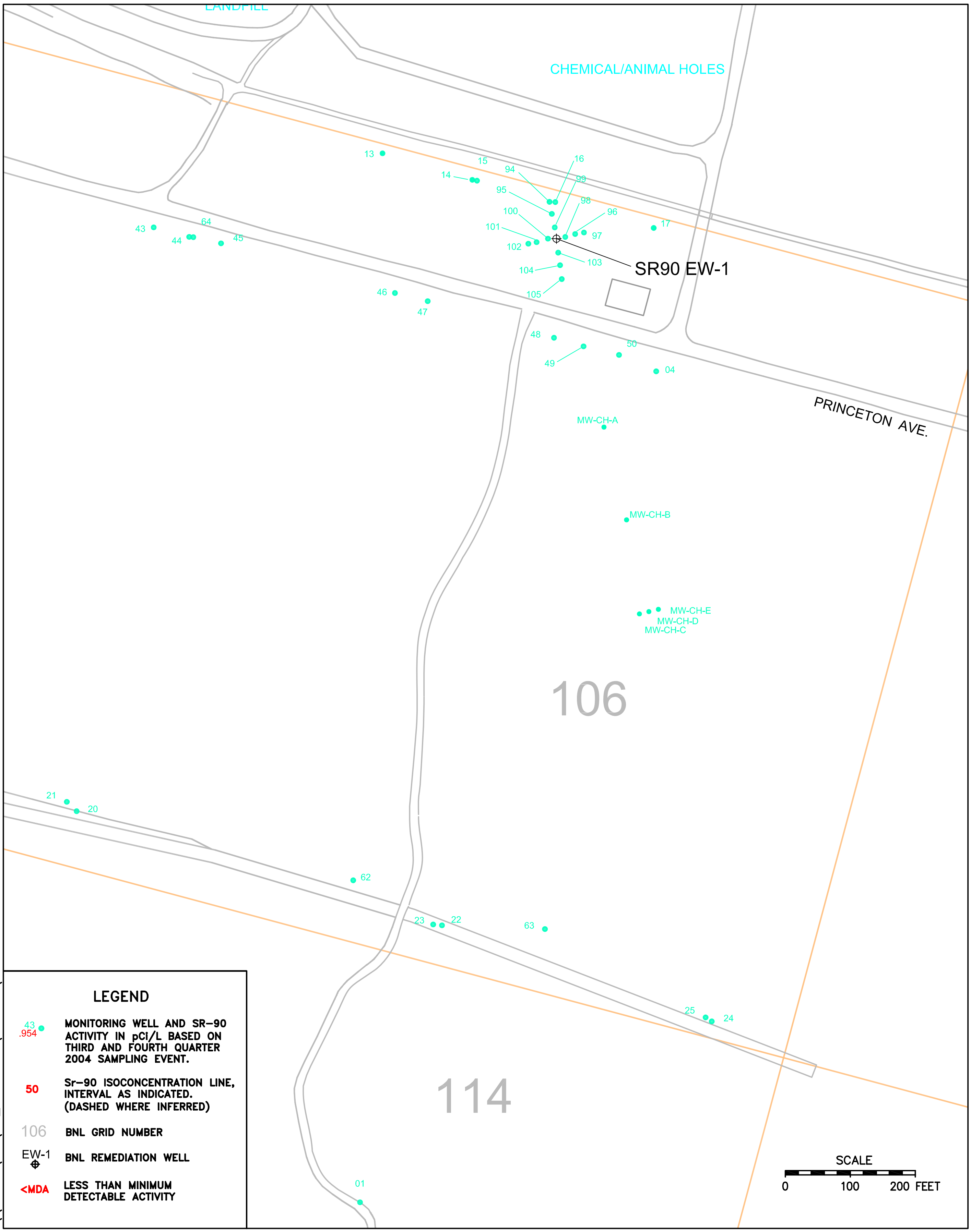
Due to the changes in the sampling schedule, the sampling program costs will decrease $2,721 per year.

Total Cost for Monitoring Program

FY 2007	$42,900
FY 2008	$40,179
Difference	-$2,721

Table 12.2.2 Proposed Modifications to the Chemical/Animal Holes Monitoring Wells

Well ID	Current Sampling Frequency	Proposed Sampling Frequency	Affected Parameters
106-04	Quarterly	No Change	None
106-13	Semi-annually	No Change	None
106-14	Semi-annually	No Change	None
106-15	Semi-annually	No Change	None
106-16	Quarterly	No Change	None
106-17	Quarterly	No Change	None
106-20	Semi-annually	No Change	None
106-21	Semi-annually	No Change	None
106-22	Semi-annually	No Change	None
106-23	Semi-annually	No Change	None
106-24	Semi-annually	No Change	None
106-25	Semi-annually	No Change	None
106-43	Semi-annually	No Change	None
106-44	Semi-annually	No Change	None
106-45	Semi-annually	No Change	None
106-46	Semi-annually	No Change	None
106-47	Semi-annually	No Change	None
106-48	Quarterly	No Change	None
106-49	Quarterly	No Change	None
106-50	Quarterly	No Change	None
106-62	Semi-annually	No Change	None
106-63	Semi-annually	No Change	None
106-64	Semi-annually	No Change	None
114-01	Semi-annually	No Change	None
106-94	Semi-annually	No Change	None
106-95	Semi-annually	No Change	None
106-96	Semi-annually	No Change	None
106-97	Semi-annually	No Change	None
106-98	Semi-annually	No Change	None
106-99	Semi-annually	No Change	None
106-100	Semi-annually	No Change	None
106-101	Semi-annually	No Change	None
106-102	Semi-annually	No Change	None
106-103	Semi-annually	No Change	None
106-104	Semi-annually	No Change	None
106-105	Semi-annually	No Change	None
MW-CH-A	Not Sampled	Semi-annually	Sr-90
MW-CH-B	Not Sampled	Semi-annually	Sr-90
MW-CH-C	Not Sampled	Semi-annually	Sr-90
MW-CH-D	Not Sampled	Semi-annually	Sr-90
MW-CH-E	Not Sampled	Semi-annually	Sr-90



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BROOKHAVEN NATIONAL LABORATORY EWMS DIVISION	TITLE: CHEMICAL/ANIMAL HOLES Sr-90 WELL LOCATIONS 2008 EMP	DWN: JEB	VT: HZ.: –	DATE: 12/13/07	PROJECT NO.: 07926
		CHKD: JEB	APPD: --	REV.: –	NOTES: –
		FIGURE NO.: 12.2.1			

FORMER LANDFILL POST-CLOSURE

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 5, October 8, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Robert Howe (631) 344-5588

SUMMARY OF CHANGES

There are no proposed changes for CY2008.

DESCRIPTION AND TECHNICAL BASIS

The Former Landfill Area includes three unlined areas historically used for waste disposal: the Former Landfill, the Slit Trench, and the Interim Landfill. Due to the proximity of these three areas, they have been addressed collectively under the term Former Landfill Area.

The Former Landfill was used by the United States Army during World War I and World War II and by BNL from 1947 through 1966. Material disposed in the landfill by BNL included construction and demolition debris, sewage sludge, chemical and low level radioactive waste, used equipment, and animal carcasses. The Slit Trench was reportedly used during the 1960s. In November 1996, the Former Landfill and Slit Trench were capped in accordance with NYCRR Part 360 requirements. The Interim Landfill was reportedly used for one year after closure of the Former Landfill and was capped in October 1997.

The monitoring well network for the Former Landfill Area consists of eight existing wells, including three wells upgradient of the Former Landfill Area (086-42, 086-72, and 087-22), one well upgradient of the Former Landfill and downgradient of the Interim Landfill (097-277), and four wells downgradient of the Former Landfill Area (097-17, 097-64, 106-02, and 106-30). All wells except 86-42 are screened in the shallow Upper Glacial aquifer. Well 86-42 is screened in the mid-Upper Glacial aquifer. This well is also used to monitor for VOCs originating from the OU IV AOC 6 1977 Soil/Solvent Spill Area. The screen zone and aquifer screened by each of the wells currently sampled are summarized in Table 12.3.1. For well locations, see Figure 12.3.1.

Table 12.3.1 Former Landfill Area Well Network

Well	Screen Zone	Aquifer Screened
086-42	65–75	Mid Upper Glacial
086-72	41.5–56.5	Shallow Upper Glacial
087-22	43–53	Shallow Upper Glacial
097-17	29–39	Shallow Upper Glacial
097-64	29–44	Shallow Upper Glacial
097-277	40–55	Shallow Upper Glacial
106-02	55–65	Shallow Upper Glacial
106-30	29–44	Shallow Upper Glacial

There were no VOC detections exceeding groundwater standards in the Former Landfill Area wells during 2004. Contaminants of concern for the former landfill wells are VOCs and Sr-90.

VOC concentrations have been low in all of the Former Landfill Area wells over the past several years with no exceedances of the NYS AWQS since June 1998. Little or no VOCs have been detected in upgradient wells 87-22, 87-72, and 86-42. TCE and DCA consistently were detected in the downgradient wells (97-17, 97-64, 106-02, and 106-30), though NYS AWQS for these compounds have not been exceeded since 1998 (in well 106-30).

Sr-90 formerly was detected in well 97-64, which is screened at the water table and located less than 100 feet downgradient of the landfill footprint. Sr-90 concentrations in this well have shown a steadily declining trend since 1998 when it was last detected above the NYS DWS of 8 pCi/L (at a concentration of 12 pCi/L).

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

_x_ Compliance
_x_ Support Compliance
___ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Potential failure of the landfill cap could lead to continued releases from the Former Landfill Area into groundwater at levels exceeding New York State groundwater standards.

Step 2: Identify the Decisions

The decision for the project is:

Are the controls effectively improving groundwater quality below and downgradient of the Former Landfill Area?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow.
- Comparison of pre- and post-capping groundwater quality by analysis of VOCs, pesticides, PCBs, metals, cyanide, radionuclides, tritium and landfill water quality parameter concentrations in groundwater.
- Locations of existing wells relative to flow patterns (Figure 12.3.1)
- Regulatory drivers (NYCRR Part 360).
- Action Levels (MCLs and/or baseline groundwater concentrations).
- Analytical methods and detection limits, as described in the BNL Environmental Monitoring Plan.

Step 4: Define the Study Boundaries

The decision unit limits for this project are the immediate vicinity of the Former Landfill and the eight wells that comprise the groundwater monitoring program. The period for which the decisions will be made depends on the individual parameters, as summarized in Table 12.3.2.

The periods over which decisions will be made were determined based on the low risk to potential receptors of contamination from the Former Landfill. The factors considered to determine that risk is low are:

- engineered control (landfill cap) is a proven conventional technology with a low failure rate
- low travel velocities for some of the contaminants
- proximity of the downgradient monitoring network
- absence of downgradient receptors
- the resource has already been degraded

Table 12.3.2 Factors Affecting the Period for Decisions for the Former Landfill

Parameter	Relative Travel Time*	Above MCLs 1997–2006	Trend, 1997–2006	Time for Decision
VOCs	< 60 days	Yes	Stable	365 days
Tritium	< 60 days	No	Stable	365 days
Metals/Cyanide	Varies	Yes	Stable to increasing	365 days
Sr-90	1,200 days	Yes	Stable toDecreasing	2 years **
Gross alpha	--	No	Stable	2 years **
Gross beta	--	No	Stable	2 years **
Gamma Spectroscopy	--	NA	--	2 years **
Leachate Parameters	< 60 days	No	Stable to decreasing	365 days

* Relative travel time is an approximate time for contamination to travel from the waste pile to downgradient wells.
** Based on trend

Step 5: Develop the Decision Rules

Decision 1

Are the controls effectively eliminating further discharges to soils and groundwater below the landfill?

The sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If, for any downgradient well, the current annual mean concentration for an individual contaminant of concern exceeds the mean concentration in that well computed from data collected from that well over the past three years AND is greater than MCLs, and this result is confirmed by resampling appropriate wells as well as by an evaluation of upgradient and downgradient conditions, **then** an evaluation will be made as to whether an increase in sampling frequency for that parameter or parameter group (for example, metals) would be appropriate. If not, then continue detection monitoring.

Decision 2

Is the capping system performing as planned?

If the system is performing as planned (based on groundwater model prediction, trend analysis and expert judgment), then continue monitoring. If not, then consider an engineering evaluation.

Notes:
1. Use concentration plots over time to visually assess data for trends and model predictions.
2. Slope analysis suggests that the goal will be achieved within the planned period (2–10 years).
3. If the water quality for the majority or key wells (as defined by the Subject Matter Expert) is improving as planned, then the entire system is considered to be properly operating.

Step 6: Specify Acceptable Error Tolerances

Table 12.3.3 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Are the controls effective at eliminating further discharges to groundwater below the Former Landfill?	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are.	(1) A discrete contaminant slug could exist and not be detected. (2) Delay in notifying stakeholders and taking corrective actions.

There are no potential receptors immediately downgradient of the Former Landfill, and groundwater travel time to the site boundary is approximately 10 to 15 years. Due to these factors, it is very unlikely that decision error will result in adverse consequences to human health or noncompliance with the OU III Record of Decision. The consequences of decision error relate primarily to possible enforcement actions for environmental degradation, and erosion of stakeholder trust and BNL credibility.

Step 7: Optimize the Design

Number and Locations of Wells

The eight monitoring wells around the Former Landfill Area are adequate, considering the potential consequences of a decision error. The current well network was developed using expert judgment and groundwater modeling. No refinements are recommended at this time, as the groundwater flow direction has been relatively constant in recent years and the size of the source area is relatively small.

Parameters and Frequency

There were no recommended changes to the sampling schedule.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program costs will increase by $160 per year, due to a contracted 5 percent increase in sampling prices.

TOTAL COST FOR MONITORING PROGRAM

FY2007	$17,958
FY2008	$18,118
Difference	$160

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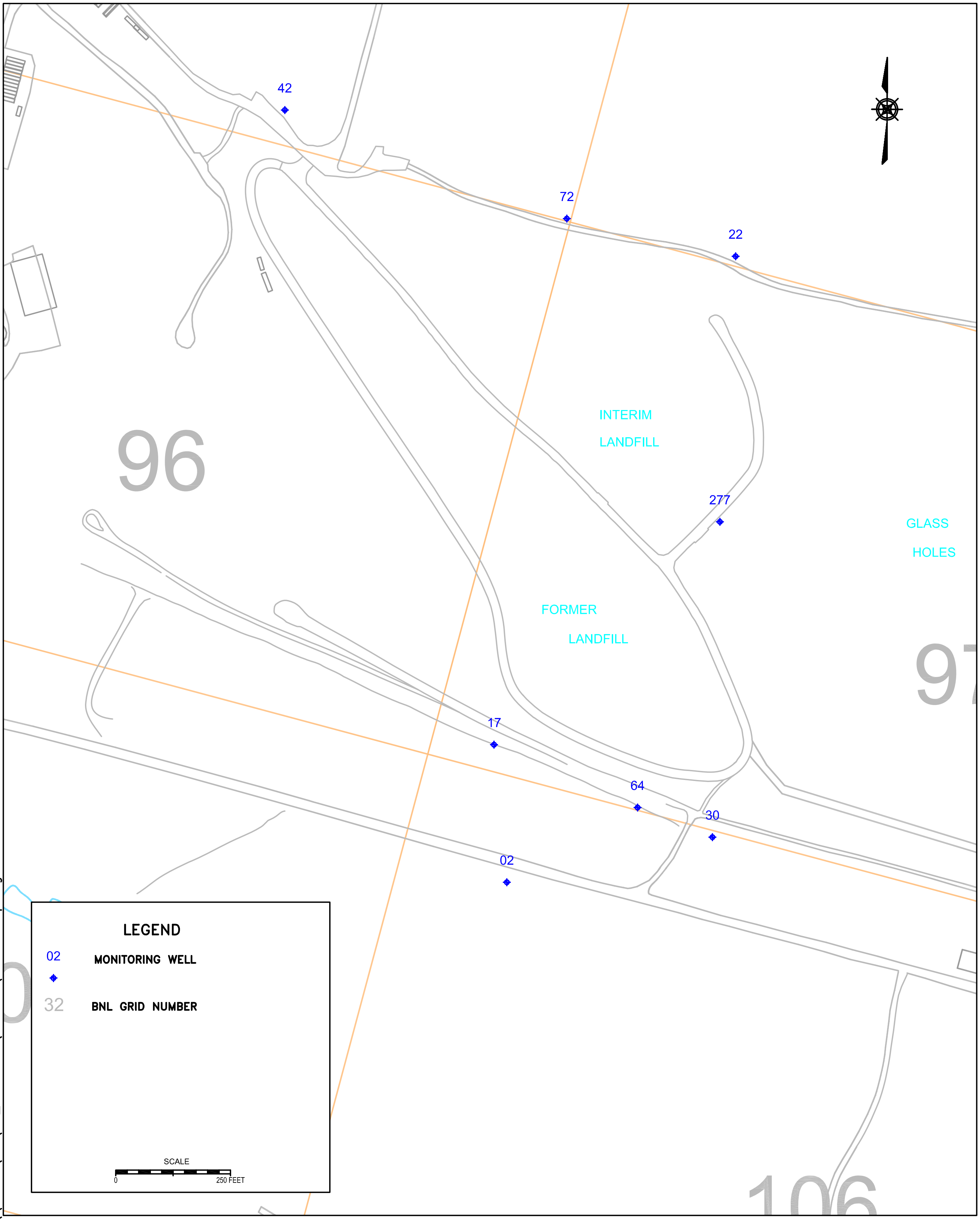


BROOKHAVEN NATIONAL LABORATORY

EWMSD

TITLE:

OU I FORMER LANDFILL POST–CLOSURE MONITORING WELL LOCATIONS 2008 EMP

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
JEB	–	12/13/07	7926
CHKD:	APPD:	REV.:	NOTES:
– –	– –	1	–

FIGURE NO.: 12.3.1

CURRENT LANDFILL POST-CLOSURE

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 5, October 8, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Robert Howe (631) 344-5588

SUMMARY OF CHANGES

There are no proposed changes for CY2008.

DESCRIPTION AND TECHNICAL BASIS

The Current Landfill operated from 1967 through 1990. Putrescible waste, sludge from the BNL Water Treatment Plant, anaerobic digester sludge from the Sewage Treatment Plant, and limited quantities of Laboratory waste were disposed in the landfill. The landfill was capped in accordance with NYCRR Part 360 requirements in 1995.

The monitoring well network for the Current Landfill consists of 11 existing wells, including 1 upgradient well (087-09), 3 wells immediately downgradient of the landfill (087-11, 088-109 and 088-110), and 7 wells further downgradient of the landfill (087-23, 087-24, 087-26, 087-27, 088-21, 088-22 and 088-23). Well locations are shown in Figure 12.4.1. All 11 wells are sampled and analyzed for volatile organic compounds (VOCs), metals, radionuclides, tritium, and landfill leachate parameters.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

_x_ Compliance (NYCRR Part 360)
_x_ Support Compliance
___ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The Current Landfill has been an historic source of contamination and remains a potential source of contaminants to groundwater. In response, BNL has constructed an engineered cap over the landfill to mitigate future releases.

Problem Statement: Potential failure of the landfill cap could lead to continued releases from the Current Landfill into groundwater at levels exceeding MCLs.

Step 2: Identify the Decision

Are the controls effectively improving groundwater quality below and downgradient of the landfill?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow.
- Comparison of pre- and post-capping groundwater quality by analysis of VOCs, metals, radionuclides, tritium and landfill water quality parameter concentrations in groundwater.
- Locations of existing wells relative to flow patterns.
- Regulatory drivers (NYCRR Part 360).
- Action Levels (MCLs and/or baseline groundwater concentrations).
- Analytical methods and detection limits as described in this EMP.

Step 4: Define the Study Boundaries

The decision unit limits for this project are the immediate vicinity of the Current Landfill and the 11 wells that comprise the groundwater monitoring program. The period for which the decisions will be made depends on the individual parameters, as summarized in Table 12-4.1.

Table 12.4.1 Factors Affecting the Period for Decisions for the Current Landfill

Parameter	Historical Detection?	Relative Travel Time **	Above MCLs 1995–2002?	Trend1995–2002	Time for Decision
VOCs	Yes	< 60 days	Yes	Decreasing	365 days
Tritium	Yes	< 60 days	No	Decreasing	365 days
Metals	Yes	Varies	Yes	Stable	2 years *
Sr-90	Yes	1,200 days	Yes	Stable	2 years *
Gross alpha	Yes	--	No	Stable	2 years *
Gross beta	Yes	--	No	Stable	2 years *
Gamma spectroscopy	Yes	--	NA	Stable	2 years *
Leachate parameters	Yes	< 60 days	Yes	Decreasing	365 days

Notes: * Based on trend.
** Relative travel time is approximate time for contamination to travel from waste pile to surrounding wells.

The 1995–2004 concentration trends for the wells are steadily decreasing and contain no large variabilities. Exceptions to this are iron and manganese.

The periods over which decisions will be made were determined based on the low risk to potential receptors of contamination from the Current Landfill. The factors considered to determine that risk is low are:

- Engineered control (landfill cap) is a proven conventional technology with a low failure rate
- Low travel velocities for contaminants.
- Absence of downgradient receptors.
- The resource has already been degraded.
- A groundwater pump and treat system is currently operating downgradient of the Current Landfill (to address historical releases from the landfill).

Step 5: Develop the Decision Rules

Decision 1

Are the controls effectively eliminating further discharges below the landfill?

The sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If for any downgradient well, the current annual mean concentration for an individual contaminant of concern exceeds the mean concentration in that well computed from data collected from that well over the past three years AND is greater than MCLs, and this result is confirmed by re-sampling appropriate wells, as well as by an evaluation of upgradient and downgradient conditions, **then** an evaluation will be made as to whether an increase in sampling frequency for that parameter or parameter group (for example, metals) would be appropriate. In addition, consider conducting an engineering evaluation to determine whether the capping system is performing as planned. If the current annual mean concentration for an individual contaminant of concern does not exceed the mean concentration in that well computed from data collected from that well over the past three years, then continue detection monitoring.

Notes:

a. Use concentration plots over time to visually assess data for trends and model predictions.
b. Slope analysis suggests that the goal will be achieved within the planned period (2–10 years).
c. If the water quality for the majority and/or key wells (as defined by the subject matter expert) is improving as planned, then "the system" as a whole is considered to be properly operating.

Step 6: Specify Acceptable Error Tolerances

Table 12.4.2 summarizes the decision and possible decision errors for this project.

Table 12.4.2 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Are the controls effective at eliminating further discharges to groundwater below the Current Landfill?	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are.	(1) A discrete VOC contaminant slug of up to 300 feet long and 300 feet wide could exist and not be detected. (2) Delay in notifying stakeholders and taking corrective actions, prolonged operation of the OU I RA V groundwater treatment system.

There are no potential receptors immediately downgradient of the Current Landfill and groundwater travel time to the site boundary is approximately 10 to 15 years. In addition, a groundwater treatment system is already operating and treating historical releases from the landfill.

Due to these factors, it is very unlikely that decision error will result in adverse consequences to human health or noncompliance with the OU I ROD. The consequences of decision error relate primarily to possible enforcement actions for environmental degradation, and erosion of stakeholder trust and BNL credibility.

Step 7: Optimize the Design

Number and Locations of Wells

The 11 existing monitoring wells around the landfill are adequate considering the potential consequences of a decision error. The current network was developed using expert judgment, groundwater models and particle-tracking computer codes. No refinements are recommended at this time since the groundwater flow direction has been relatively constant in this area in recent years and the potential source is relatively small in size.

Parameters and Frequency

There were no recommended changes to the sampling schedule.

Table 12.4.3 Proposed Modifications to the Current Landfill Monitoring Wells

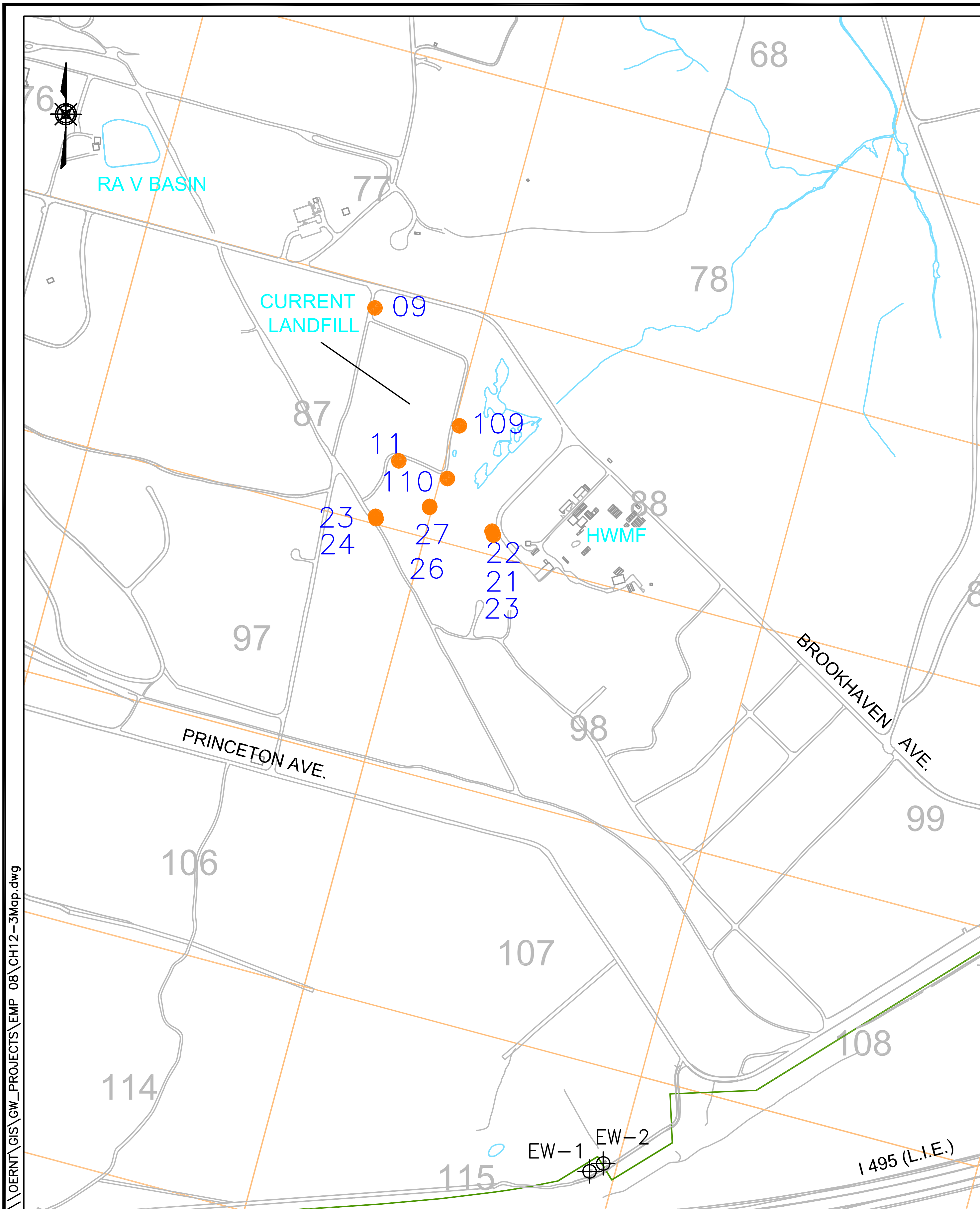
Well	Current Sampling Frequency	Sampling Frequency Changes	Affected Parameters
087-09	Quarterly	None	None
087-11	Quarterly	None	None
087-23	Quarterly	None	None
087-24	Semi-annual	None	None
087-26	Quarterly	None	None
087-27	Quarterly	None	None
088-21	Quarterly	None	None
088-22	Semi-annual	None	None
088-23	Semi-annual	None	None
088-109	Quarterly	None	None
088-110	Quarterly	None	None

TOTAL COST FOR MONITORING PROGRAM

The sampling program costs will increase by $220 per year, due to a contracted 5 percent increase in sampling prices.

TOTAL COST FOR MONITORING PROGRAM

- FY2007 $20,434
- FY2008 $20,654
- Difference $120



BROOKHAVEN NATIONAL LABORATORY

EWMSD

TITLE:

OU I CURRENT LANDFILL POST-CLOSURE MONITORING WELL LOCATIONS

2008 EMP

DWN: JEB	VT:HZ.: –	DATE: 12/13/07	PROJECT NO.: 7926
CHKD: --	APPD: --	REV.: 1	NOTES: –
FIGURE NO.:		12.4.1	

OU I SOUTH BOUNDARY (RA V REMEDIAL ACTION)

DQO START DATE	January 1, 2003
REVISION NUMBER/DATE	Rev. 5, October 9, 2007
IMPLEMENTATION DATE	January 1, 2008
POINT OF CONTACT	William Dorsch (631) 344-5186 Vincent Racaniello (631) 344-5436

SUMMARY OF CHANGES

Changes for the OU I South Boundary Pump and Treat System and groundwater monitoring program include:

- Based on TVOC concentration increases in well 115-13 and upgradient plume core well 107-40, the leading edge of the high concentration segment of the VOC plume is approaching the south boundary and should reach it during 2007. As a result, full-time operation of extraction wells EW-1 and EW-2 during the third quarter of 2007 will resume.
- For consistency with previous changes made to the Current Landfill plume monitoring, delete monitoring of the system influent and effluent for metals (including iron and manganese), pesticides, PCBs, and gross alpha/beta.

DESCRIPTION AND TECHNICAL BASIS

The Operable Unit (OU) I South Boundary project monitors the downgradient extent of commingled contaminant plumes from several sources, including the Current Landfill and the former Hazardous Waste Management Facility (HWMF). The groundwater contaminant plume, consisting of VOCs, extends approximately 3,000 feet south of the BNL property boundary. Since December 1996, a remediation system comprised of two extraction wells screened within the deep Upper Glacial aquifer has been in operation at the southern property boundary to prevent groundwater with total VOCs exceeding 50 micrograms per liter (µg/L) from migrating off site. The extracted groundwater is treated via air stripping and recharged northwest of the source areas. In addition, radiological parameters, including tritium and Sr-90, have been detected in several wells near the source areas.

The monitoring well network for the OU I South Boundary project consists of 43 wells. Well locations are shown on Figure 12.5.1. The wells are sampled semi-annually for analysis of VOCs, tritium, and Sr-90, and annually for gamma spectroscopy, as shown in Table 12.1.2.

The contaminants of concern associated with the OU I South Boundary plume are primarily VOCs. During CY2006, the plume core wells consistently contained total VOC concentrations greater than 50 µg/L. The perimeter wells contained total VOC concentrations less than New York State groundwater standards. No exceedances of New York State groundwater standards for VOCs were detected in any of the upgradient wells during CY2006.
Three wells exceeded the NYS groundwater standards Sr-90 during CY2006. Tritium was not detected above NYS groundwater standards during CY2006. Since the area impacted by Sr-90 at

levels above New York State groundwater standards is limited, this evaluation will focus on the VOC contamination only. However, recommendations regarding sampling and analysis for radiological parameters are made in Step 7 below.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A plume of groundwater contaminated by VOCs has been identified within the Upper Glacial aquifer in the southern portion of the BNL Site and off site. In response, groundwater remediation was implemented at the southern site boundary in December 1996. An existing plume of contaminated groundwater off site to the south will be addressed by the North Street East remediation system.

Data are needed to demonstrate that:

- The existing groundwater remediation system is intercepting the on-site groundwater plume.
- Influent concentrations to the existing treatment system will not exceed the design criteria.
- Groundwater quality is improving according to plan.

Problem Statement: A VOC plume that could represent a potential risk to human health has been defined on the BNL site. Remediation of the on-site plume has been conducted since December 1996. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decision

The decisions for the project are:

1. Is the BNL Groundwater Contingency Plan triggered?
2. If not, has the plume been controlled?
3. Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?
4. Can the groundwater treatment system be shut down?

Step 3: Identify Inputs to the Decision

The project was divided into four decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Background (upgradient) wells (Decisions 1 and 3).
- Plume Core wells (Decisions 1, 2, and 4).
- Plume Perimeter wells, used to define the extent of the plume (Decisions 1 and 2).

- Bypass Detection wells (Decisions 1, 2, and 4).

The wells included in each subunit are shown in Table 12.5.1. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow.
- Analytical results for VOCs and radionuclides in groundwater.
- Locations of existing wells relative to flow patterns (Figure 12.5.1).
- Evaluation of capture zone for extraction wells.
- Action levels.
- Analytical methods and detection limits as described in the BNL Environmental Monitoring Plan.
- Variability of data.

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- north side of the Current Landfill to the north
- Crestwood Drive East (well 000-054) to the south
- west side of the Current Landfill and well 077-02 to the west
- wells 088-19, 088-62, 088-63, and 108-30 to the east
- saturated thickness of the Upper Glacial aquifer

Separate decisions will be made in the four subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire study system. The temporal boundaries of the study area vary, based on the decision. Some decisions are based on the most recent sampling event, while others are based on historic trends (2 to 3 years).

- *Background:* Background water quality results will be utilized to determine whether a contaminant slug is traveling toward the remediation system. Therefore, the timeframe for decisions utilizing background results is 365 days.
- *Plume Core:* Because the rate of water quality improvement in this area is relatively slow and historic results indicate that the on-site plume is being controlled by the extraction system, the timeframe for decisions for this subunit is 180 days.
- *Plume Perimeter:* Because the wells included in this subunit define the plume horizontally and vertically, which is used to determine whether the plume is being captured, the timeframe for decisions here is 180 days.
- *Bypass Detection Area:* Because the wells in this area indicate whether plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan activated?

Analytical results from wells in all subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

This decision applies to the plume perimeter and bypass detection wells. **If** the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume perimeter or bypass detection wells to above 50 μg/L (if currently less than 50 μg/L) or a significant increase in total VOC concentration (if currently above 50 μg/L).

If the trend in each plume perimeter and bypass detection well has a negative or zero slope, based on the four most recent consecutive samples, **if** this trend is consistent with professional judgment, and **if** the total VOC concentration is less than 50 μg/L, **then** continue to operate the system. If not, consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?

This decision applies to the plume core and bypass detection wells. **If** the system is performing as planned, **then** actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis, and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation. Note: When the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Can the groundwater treatment system be shut down?

All of the following decision subunits must be satisfied in order to shut down an extraction well.

4a. Have asymptotic TVOC concentrations been reached in core wells?

This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in TVOC concentrations in the plume core wells. The Kendall-Mann statistical test is a nonparametric trend analysis

(Gilbert, 1987) used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.

To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

4b .Is the mean TVOC concentration in core wells less than 50 µg/L?

This decision also applies to the plume core wells. It is anticipated that approximately 7 to 10 years of active groundwater treatment will reduce the mean TVOC concentrations in the plume core to less than 50 µg/L.

If this occurs, **then** it is reasonable to expect (based on model projections) that MNA of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs within 30 years. **If** the TVOC concentration remains above 50 µg/L, **then** consider operational adjustments and/or engineering evaluation.

4c. How many individual plume core wells are above 50 µg/L TVOC ?

If the total VOC concentration in each plume core well has been reduced to less than 50 µg/L in less than 7 to 10 years of active remediation, **then** proceed with pulsed operation of the system (see Decision subunit 4c). **If** not and treatment has occurred for less than 7 to 10 years, **then** continue treatment. **If** not and treatment has occurred for at least 7 to 10 years, **then** perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2030.

4d. During pulsed operation, is there significant concentration rebound in the core wells?

This decision is to determine whether there is significant concentration rebound after system pulsing. **If** yes, and system has operated for less than 7 to 10 years, **then** continue operation. **If** yes and system has operated for more than 7 to 10 years, **then** an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted (see Decision subunit 4d to help with this decision). **If** no significant rebound is observed within a 1-year time period, **then** petition for system shutdown and continue with MNA.

Decision 5

Have the groundwater cleanup goals been met? Specifically, have MCLs been achieved by 2030?

If the mean concentration of TVOCs in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 50 µg/L, and if the mean TVOC concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous two years, is less than 50 µg/L, and pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations, **then** petition for system shutdown and continue with MNA until MCLs are met. **If** not, **then** consider the need for continued remediation. Note: This assumes that system operation is already considered “optimal.”

Step 6: Specify Acceptable Error Tolerances

Table 12.5.1 summarizes the decision and possible decision errors for this project.

Table 12.5.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based On Data	Potential Consequences
Is the Contingency Plan activated?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Can the groundwater treatment system be shut down?	See Step 3 for inputs.	(1) Determine system can be shut down when operation should continue. (2) Determine to continue operating system when shut down is warranted.	(1) Plume growth continues, ultimate project delays. (2) Wasted resources , project delays.
Is the system operating as planned?	See Step 3 for inputs.	(1) Determine system operating as planned when it is not. (2) Determine system isn't operating as planned when it is.	(1) Premature petition for system shutoff, potential to have to restart system. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Locations of Wells

The well network consists of 44 wells located both on and off site.

Parameters and Frequency

The wells are sampled semi-annually for analysis of VOCs, tritium and Sr-90, and annually for gamma spectroscopy, as shown in Table 12.1.2.

Annual Cost Impact Due to Proposed Change

Based on the addition of two new wells and the new sampling and analytical contract prices, the sampling program costs will decrease $996 per year.

Total Cost for Monitoring Program

FY2007	$33,756
FY2008	$32,760
Difference	-996

See Appendix B for the monitoring program for this DQO.

Table 12.5.2 Proposed Modifications to the OU I South Boundary Monitoring Wells

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
087-21	Annually	No Change	None
088-13	Annually	No Change	None
088-14	Annually	No Change	None
088-20	Annually	No Change	None
088-26	Quarterly	No Change	None
098-21	Semi-annual	No Change	None
098-22	Semi-annual	No Change	None
098-30	Semi-annual	No Change	None
098-33	Semi-annual	No Change	None
098-58	Semi-annual	No Change	None
098-59	Semi-annual	No Change	None
098-61	Semi	No Change	None
099-04	Semi	No Change	None
107-10	Semi	No Change	None
107-23	Semi	No Change	None
107-24	Semi	No Change	None
107-25	Semi	No Change	None
107-26	Semi-annual	No Change	None
108-08	Semi	No Change	None
108-12	Semi	No Change	None
108-13	Semi	No Change	None
108-14	Semi	No Change	None
108-17	Semi	No Change	None
108-18	Semi	No Change	None
115-03	Semi	No Change	None
115-13	Semi-annually	No Change	None
115-14	Semi-annually	No Change	None
115-15	Semi-annually	No Change	None
115-16	Semi-annually	No Change	None
115-28	Semi-annually	No Change	None
115-29	Semi-annually	No Change	None
115-30	Semi-annual	No Change	None
115-31	Quarterly	No Change	None
115-36	Semi-annually	No Change	None
115-41	Quarterly	No Change	None
115-42	Quarterly	No Change	None
116-05	Semi	No Change	None
116-06	Semi	No Change	None
108-43	Quarterly	No Change	None
108-44	Quarterly	No Change	None
107-34	Quarterly	No Change	None
107-35	Quarterly	No Change	None
OUISBM W152	New	No Change	None

Note:
For analysis of VOCs, tritium, and Sr-90. Sampling for analysis of gross alpha, gross beta, and gamma spectroscopy to be conducted annually for all wells.

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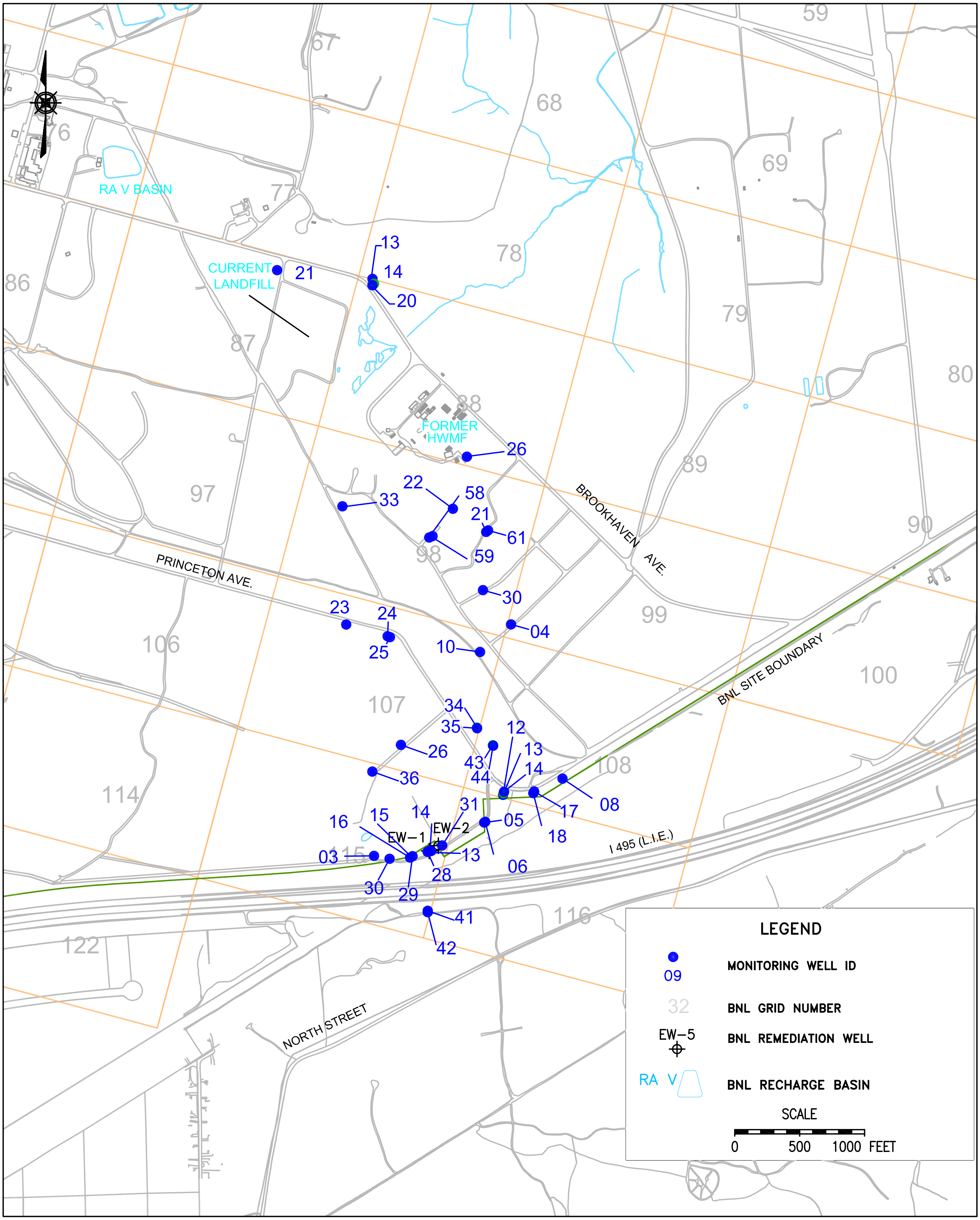

BROOKHAVEN NATIONAL LABORATORY

EWMSD

TITLE: OU I SOUTH BOUNDARY (RA V REMOVAL ACTION) PUMP AND TREAT SYSTEM MONITORING WELL LOCATIONS

2008 EMP

DWN: JEB	VT: HZ.: —	DATE: 12/13/07	PROJECT NO.: 7926
CHKD: ——	APPD: ——	REV.: 1	NOTES: —
FIGURE NO.: 12.5.1			

OU III North Street

DQO Start Date January 1, 2003

Revision Number/Date Rev. 5, October 9, 2007

Implementation Date January 1, 2008

Point of Contact William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

Summary of Changes

Changes for the OU III North Street and groundwater monitoring program include:

- Change monthly sampling of the extraction wells to quarterly.
- Change system influent, midpoint, and effluent sampling frequency from weekly to twice per month

Description and Technical Basis

The Operable Unit (OU) III North Street project monitors the downgradient extent of commingled contaminant plumes from several sources, including the Former Landfill, Chemical/Animal Holes, and the OU IV fuel oil/solvent spill. A groundwater remediation system was installed and began full operation in 2004. Groundwater treatment consists of two extraction wells operating at a combined pumping rate of 450 gpm. This pumping will capture the higher concentration portion of the VOC plume (i.e., TVOC concentrations greater than 50 to 60 µg/L) in the Upper Glacial aquifer, and minimize the potential for VOC migration to the Magothy aquifer. The source areas for this plume, including the Former Landfill, Chemical/Animal Holes, and Building 650 area, are monitored under separate projects.

The monitoring well network for the North Street project presently consists of 27 wells. Well locations are shown on Figure 12.6.1. The wells are sampled quarterly for analysis of VOCs and annually for gross alpha/beta, gamma spectroscopy, tritium, and/or Sr-90. A monitoring schedule is provided in Table 12.1.1.

The primary VOCs associated with this plume are carbon tetrachloride, PCE, and TCA. Monitoring well 000-154 has historically shown the highest VOC concentrations (primarily carbon tetrachloride) in the North Street area. TVOC concentrations greater than 1,000 µg/L were observed in 1997 and 1998, but have steadily declined since then Monitoring well 000-154 had historically shown the highest VOC concentrations (primarily carbon tetrachloride) in the North Street area. TVOC concentrations greater than 1,000 µg/L were observed in 1997 and 1998, but have steadily declined since then to less than 11 µg/L in 2005 and 2006. High concentrations of VOCs continue to be observed in wells 000-463, 000-464, and 000-465 immediately upgradient of extraction well NS-1. Concentrations of TVOCs ranged from a low of 46 µg/L in well 000-464 in the fourth quarter of 2006, to a high of 603 µg/L in well 000-465 in the first quarter of 2006. Values at bypass detection well 800-63, located about 2,500 feet upgradient of the Airport System, ranged from 34 µg/L in the second quarter of 2006 to 73 µg/L in the fourth quarter. This suggests that the leading edge of the higher concentration segment has reached this location. This contamination should be captured by the Airport system.

The III North Street project wells also serve as downgradient monitoring points for historic Sr-90 and tritium releases from the Building 650 sump that are monitored under the OU IV AOC 6 project. These data are used to evaluate a migration scenario raised by outside stakeholders that the historic Sr-90 releases from the Building 650 sump may be migrating faster than predicted due to the activity of chelating agents within the aquifer. Based on groundwater modeling studies, the radionuclide plume could be mobilized by commingling with chelating agents discharged to nearby Basin HO. Under the worst-case scenario (retardation factor of 1), it was estimated that a plume could reach the BNL southern boundary by 1999. Radionuclide detections are summarized in the 2006 BNL Groundwater Status Report. These results, which are consistent with previous results dating back to 1997, do not support the scenario that chelating agents are mobilizing the radionuclides from the Building 650 sump.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater in the south-central portion of the BNL site and off site has been impacted by VOCs at concentrations exceeding New York State groundwater standards. Since active remediation of these commingled plumes is currently being planned or designed, data are needed to verify that the contaminants are naturally degrading in the interim and to determine the nature and extent of the VOC plumes for system design. In addition, data from this program are used to monitor for any evidence of a mobile radionuclide plume from the Building 650 sump.

Problem Statement**:** A VOC plume that could represent a potential risk to human health has been defined both on the BNL site and off site. Remediation of the contaminant plume will be initiated in the near future. Data are needed to determine whether the existing contaminant plume represents a potential risk to downgradient receptors and to confirm the vertical and horizontal extent of the VOC plume so that the design of the remediation system can be optimized. Data are also needed to monitor for any evidence of a mobile radionuclide plume from the Building 650 sump.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Does the existing contaminant plume represent a potential risk to downgradient receptors?
- Is the remediation system adequate to intercept and treat the existing contamination to prevent impacts to potential downgradient receptors?
- Is there evidence of a mobile radionuclide plume from the Building 650 sump that would trigger additional actions?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow.
- VOC and radionuclide analytical results in groundwater.
- Locations of existing wells relative to flow patterns.
- Action levels (New York State groundwater standards and/or baseline groundwater concentrations).
- Analytical methods and detection limits, as described in the BNL Environmental Monitoring Plan.

Step 4: Define the Study Boundaries

The project decision unit limits are:

- Background water quality is defined by the three monitored wells upgradient of the plume core wells (086-05, 086-43, and 086-70).
- The VOC plume core is defined as the area impacted by total VOCs above 50 µg/L, including wells 000-108, 000-153, 000-154, 000-212, 000-463, 000-464, 000-465, 000-467, 000-470, 000-472, and 115-32.
- The VOC plume fringe is the area surrounding the plume core (horizontally and vertically) where total VOC concentrations are less than 50 µg/L.

Because the VOC contaminant plume has already passed the southern BNL site boundary and therefore has the potential to impact off-site receptors, tracking the plume configuration over time is of critical importance. In addition, the remediation system design will depend on the VOC plume configuration. Since the analytical results from the plume core and plume fringe wells will be used to monitor the VOC plume configuration, the timeframe for decisions using these results is 90 days. Because the analytical results from 1997 to the present do not support the scenario that chelating agents are mobilizing radionuclides from the Building 650 sump area, the timeframe for decisions relating to radionuclides is 365 days.

Background water quality results will be utilized to evaluate the need for project-specific remediation and to determine whether a contaminant slug is traveling toward the remediation system. Therefore, the timeframe for decisions utilizing background results is 365 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

If not, has the plume been controlled?

If the cleanup goals have not been met, then it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume perimeter or bypass detection wells to above 50 µg/L (if currently less than 50 µg/l) or a significant increase in total VOC concentration (if currently above 50 µg/L).

If the trend in each plume perimeter and bypass detection well has a negative or zero slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 µg/L, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate?

This decision applies to the plume core and bypass detection wells. **If** the system is performing as planned, **then** actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation to find the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis, and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation. Note: When the majority and/or "key" wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Are there off-site radionuclides that would trigger additional actions?

If analytical results for radionuclides in groundwater, in conjunction with evaluation of historic analytical results and trends, groundwater model predictions, the site conceptual model, and professional judgment, indicate the presence of a mobile radionuclides, and these results are confirmed by resampling, **then** take appropriate actions to address the radionuclide plume.

Decision 5

5a. Can the groundwater treatment system be shut down?

If evaluation of analytical results for any contaminant of concern in any upgradient or plume core well sample, in conjunction with historic analytical results and trends indicates that the treatment system have met the shutdown criteria listed below in 5a through 5d, **then** a petition for shutdown will be issued to the regulatory agencies.

5b. Have asymptotic TVOC concentrations been reached in core wells?

This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in TVOC concentrations in the plume core wells. The Kendall-Mann statistical test is a nonparametric trend analysis (Gilbert, 1987), used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.

To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

5c. Are there individual plume core wells above 50 µg/L TVOC ?

If the total VOC concentration in each plume core well has been reduced to less than 50 µg/L in less than 7 to 10 years of active remediation, **then** proceed with pulsed operation of the system (see Decision subunit 4c). If not and treatment has occurred for less than 7 to 10 years, then continue treatment. If not and treatment has occurred for at least 7 to 10 years, then perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2030.

5d. During pulsed operation, is there significant concentration rebound in the core wells?

This decision is to determine whether there is significant concentration rebound after system pulsing. **If** yes, and system has operated for less than 7 to 10 years, **then** continue operation. If yes and system has operated for more than 7 to 10 years, then an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted (see Decision subunit 4d to help with this decision). If no significant rebound is observed within a 1-year time period, then petition for system shutdown and continue with MNA.

5e. Have the groundwater cleanup goals been met? Have MCLs been achieved by 2030?

If the mean concentration of TVOCs in groundwater (calculated from analytical results from all plume core wells for the most recent sampling event) is less than 50 µg/L, and if the mean TVOC concentration of each contaminant of concern in groundwater in each plume core well (computed from measurements over the previous 2 years) is less than 50 µg/L, and **if** pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations, **then** petition for system shutdown and continue with MNA until MCLs are met. If not, then consider the need for continued remediation.

Step 6: Specify Acceptable Error Tolerances

Table 12.6.2 summarizes the decision and possible decision errors for this project.

Table 12.6.2 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Does the existing contaminant plume represent a potential risk to downgradient receptors?	See Step 3 for inputs.	(1) Data indicate the plume represents a risk when it does not. (2) Data indicate the plume does not represent a risk when it does.	(1) Wasted resources conducting technical evaluations and possible system modifications. (2) Potential risk to downgradient receptors.
Is the planned remediation system adequate to intercept and treat the existing contamination to prevent impacts to potential downgradient receptors?	See Step 3 for inputs.	(1) Data indicate the system will not be adequate when it will be. (2) Data indicate the system will be adequate when it will not be.	(1) Wasted resources conducting technical evaluations and possible system modifications. (2) Potential bypass of contaminants.
Are there off-site radionuclides that would trigger additional actions?	See Step 3 for inputs.	(1) Data indicate evidence for a plume when one does not exist. (2) Data indicate no evidence for a plume when one exists.	(1) Wasted resources evaluating and implementing additional actions. (2) Potential risk to downgradient receptors.

Step 7: Optimize the Design

Number and Locations of Wells

The well network consists of 27 wells located both on and off-site. The location of the wells are shown in Figure 12.6-1

Parameters and Frequency

Based on the successful start-up of the treatment system, the monitoring well sampling schedule will be changed from startup to O&M phase (core and perimeter wells sampled semiannually and sentinel wells sampled quarterly). A summary of the revised sampling program is provided in Table 12.6.3.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Based on the changes to the sampling contract prices, the sampling program costs will increase by $330 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2007	$38,509
FY2008	$38,839
Difference	$-17,655

Table 12.6.3 Proposed Modifications to the OU I/IV North Street Monitoring Wells

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
000-108	Quarterly	No Change	None
000-153	Quarterly	No Change	None
000-154	Quarterly	No Change	None
000-211	Quarterly	No Change	None
000-212	Quarterly	No Change	None
000-213	Quarterly	No Change	None
000-463	Quarterly	No Change	None
000-464	Quarterly	No Change	None
000-465	Quarterly	No Change	None
000-466	Quarterly	No Change	None
000-467	Quarterly	No Change	None
000-468	Quarterly	No Change	None
000-469	Quarterly	No Change	None
000-470	Quarterly	No Change	None
000-472	Quarterly	No Change	None
000-474	Quarterly	No Change	None
000-475	Quarterly	No Change	None
000-476	Quarterly	No Change	None
086-05	Annually	No Change	None
086-43	Annually	No Change	None
086-70	Annually	No Change	None
115-32	Quarterly	No Change	None
115-33	Quarterly	No Change	None
115-34	Quarterly	No Change	None
115-35	Quarterly	No Change	None
800-115	Quarterly	No Change	None
800-63	Quarterly	No Change	None

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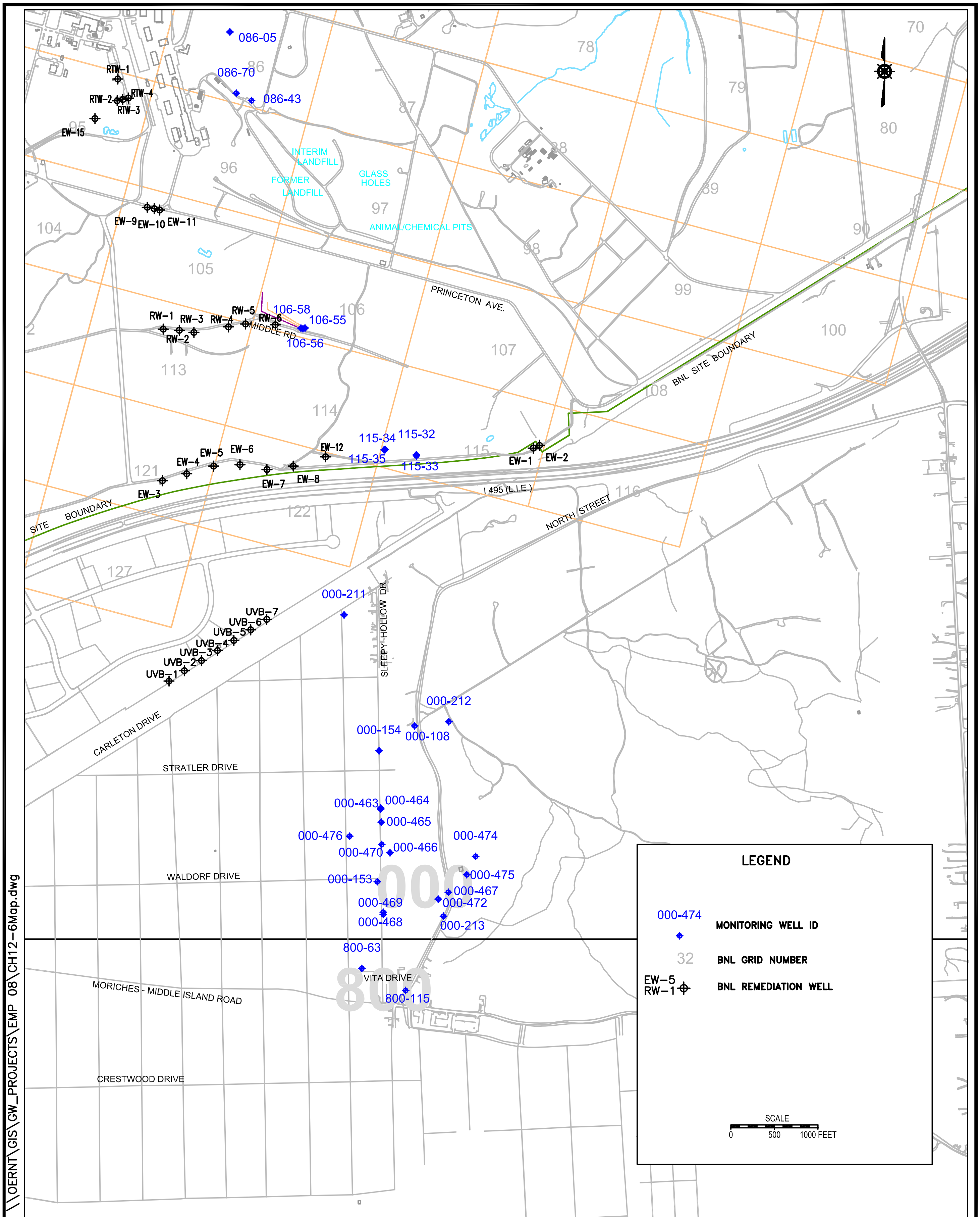

BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL SERVICES DIVISION

TITLE:

OU III NORTH STREET
PRE-DESIGN
MONITORING WELL LOCATIONS

2008 EMP

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
KCK	–	12/13/07	07926
CHKD: WRD	APPD: WRD	REV.: JEB	NOTES: –

FIGURE NO.: 12.6.1

OU III HIGH FLUX BEAM REACTOR

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 5, October 9, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

SUMMARY OF CHANGES/PROPOSED CHANGES

Recommendations for the HFBR groundwater monitoring program issued in the 2006 Annual Groundwater Status Report that have been completed include:

- Install and operate a fourth extraction well (EW-16) approximately 400 feet south of Weaver Drive.
- Temporary wells will be installed twice per year over the next several years to characterize the location of the high concentration area, and results will be communicated to the regulators via the IAG conference call and quarterly/annual reports.
- Install and sample five permanent monitoring wells to monitor the effects of the new extraction well on the tritium plume.

DESCRIPTION AND TECHNICAL BASIS

In late 1996, tritium was detected in wells near the HFBR. The source of the release was traced to the HFBR spent fuel pool. In response, the fuel rods were removed from the pool for off-site disposal, the spent fuel pool was drained, and the HFBR was removed from service in 1997. Also, numerous monitoring wells were constructed to characterize the tritium plume downgradient of the HFBR. In May 1997, operation of a three-well groundwater extraction system began. This system was constructed on Princeton Avenue approximately 3,500 feet downgradient of the HFBR to capture the tritium contamination, to ensure that off-site migration of the plume would not occur. Extracted water was recharged through the RA V recharge basin. Because it has been demonstrated that the tritium plume will naturally attenuate to below drinking water standards before reaching the BNL site boundary, the extraction system was placed on standby status in September 2000.

As described in the OU III ROD, the selected remedy to address the HFBR tritium plume included implementation of monitoring and low-flow extraction programs to prevent or minimize plume expansion. A tritium activity above 25,000 picoCuries per liter (pCi/L) in wells at the Chilled Water Plant Road or above 20,000 pCi/L in wells along Weaver Drive will necessitate implementation of specific actions described in the ROD, including possible reactivation of the Princeton Avenue pumping system.

The monitoring well network for the OU III HFBR project includes 116 wells that provide groundwater quality data in the vicinity of the source area and at downgradient locations. The locations of many of the wells were selected using the BNL Regional Groundwater Flow Model. Well locations are shown on Figure 12.7.1. Depending on location, wells are sampled, monthly, quarterly, semi-annually or annually for analysis of tritium. Twelve monitoring wells are analyzed annually for VOCs, as shown in Table 12.1.1.

The contaminant of concern associated with the OU III HFBR wells is tritium. The extent of the tritium plume, determined using data collected during the fourth quarter of calendar year 2006, is shown on Figure 12.7-1.

Groundwater flow in the vicinity of the HFBR can be influenced by BNL pumping and recharge sources in the area. In general, groundwater flow is toward the south or southeast. Evaluation of groundwater flow and quality data indicates that the downgradient portion of the tritium plume (south of Brookhaven Avenue) has shifted to the east since 1997 in response to changing flows to the HO recharge basin, the use of the OU III recharge basin, and the pumping of BNL supply wells 10, 11, and 12.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater beneath the BNL site has been impacted by tritium from leakage from the HFBR spent fuel pool. Data are needed to verify that the tritium is naturally degrading according to the attenuation model.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Is the tritium plume growing?
- Have the OU III ROD contingencies been triggered?
- Are observed conditions consistent with the attenuation model?
- Is the tritium plume migrating toward the zone of influence of BNL water supply wells 10, 11, and 12?
- Has any segment of the plume migrated beyond the current monitoring network?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the tritium plume. The identified subunits and the decisions supported by each are:

- Plume core wells, located within the high concentration segment of the plume (Decisions 1 and 3)
- Perimeter wells, located outside the high concentration segment of the plume and contain tritium at low or non-detect activities (Decisions 1, 2, 3, and 5)
- Outer perimeter wells, located further from the high concentration segment of the plume than the perimeter wells (Decisions 1, 3, 4, and 5)

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow.
- Tritium analytical results in groundwater.
- Locations of existing wells relative to flow patterns.
- Action levels defined in the OU III ROD.
- Analytical methods and detection limits.
- Variability of data.

Step 4: Define the Study Boundaries

The project decision unit limits are defined by:

- Rutherford Drive on the north
- Middle Road (wells 113-08, 113-09, and 113-11) on the south
- RA V Basin, on the east
- Rochester Street, on the west
- Upper Glacial aquifer

Due to variability in groundwater flow direction for different areas of the plume and the specific actions to be taken in response to certain observed conditions (as specified in the ROD), the project has also been divided into geographic segments based on the timeframe for decisions to be made for wells in these areas. The segments and timeframes for each decision subunit within the area are:

- *HFBR Area:* This segment encompasses the wells around the HFBR, including upgradient wells and the area extending to approximately 250 feet south of Temple Place. The decision timeframe for plume core and perimeter wells in the HFBR Area is 90 days, due to the expected slow change in tritium activities for these wells. For the outer perimeter wells, decisions will be made using a 365-day timeframe, because perimeter wells are located between the outer perimeter wells and the plume core wells.
- *RA V Recharge Basin:* This segment includes the wells surrounding the RA V Basin (076-171 through 076-175, 076-177, 077-10, and 077-11), which are utilized to monitor water quality from the basin. The decision timeframe for these wells is 90 days.
- *Brookhaven Avenue:* This segment is downgradient of the HFBR Area and includes the wells along Brookhaven Avenue except those around the RA V Basin. Wells in this area measure the rate of attenuation. Decisions for plume core and perimeter wells will be made using a 90-day timeframe. As with the HFBR Area, the decision timeframe for outer perimeter wells in this segment is 365 days.
- *Rowland Street:* This segment includes the wells along Rowland Street. Evaluation of data from these wells measures plume attenuation. Therefore, a timeframe for decisions of 90 days for plume core and perimeter wells in this area is warranted. As with the HFBR Area, the decision timeframe for outer perimeter wells in this segment is 365 days.

- *Chilled Water Plant Road and Weaver Drive:* The wells in these two segments are located along and east of the Chilled Water Plant Road (Chilled Water Plant Road segment) and along Weaver Drive and Grove Street (Weaver Drive segment). Because data from wells in these segments will be utilized to determine whether the contingency actions specified in the ROD will be implemented, the decision timeframe for plume core and perimeter wells in these segments is 90 days. As with the HFBR Area and Rowland Street segments, the decision timeframe for outer perimeter wells in these segments is 365 days.
- *Princeton Avenue:* This segment includes outer perimeter wells downgradient of the plume along Princeton Avenue and Middle Road. As with the other outer perimeter wells, because perimeter wells are located between these wells and the plume core wells, the decision timeframe is 365 days.

The wells included in each project segment and decision subunit are shown in Table 12.1.1.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Is the tritium plume growing?

As described in the OU III ROD, plume growth is defined as a detection of tritium at an activity above 25,000 pCi/L in wells at the Chilled Water Plant Road or above 20,000 pCi/L in wells along Weaver Drive. Exceedances of these activities will necessitate implementation of specific actions described in the ROD.

If the detected tritium activity exceeds 25,000 pCi/L in perimeter wells at the Chilled Water Plant Road or 20,000 pCi/L in perimeter wells at Weaver Drive, **then** implement the response actions prescribed in the OU III ROD.

Decision 3

Are observed conditions consistent with the attenuation model?

If the detected tritium concentrations are consistent with the attenuation model, groundwater model results and professional judgment, **then** continue attenuation monitoring. If not, consider refining the conceptual model or conducting an engineering evaluation to determine if other actions are required.

Decision 4

Is the tritium plume migrating toward the zone of influence of water supply wells 10, 11, and 12?

If evaluation of supply well zones of influence, drawdown measurements in key monitoring wells, and detected tritium activities in outer perimeter wells located between the plume and the supply wells indicates that the plume is migrating toward the supply well zone of influence, **then** consider an evaluation of alternatives to prevent capture of the tritium plume by the supply wells.

Decision 5

Has any segment of the plume migrated beyond the current monitoring network?

If tritium activities detected in perimeter wells indicate that the plume has migrated beyond the current monitoring network, **then** consider an engineering evaluation to determine if other monitoring wells are required.

Step 6: Specify Acceptable Error Tolerances

Table 12.7-1 summarizes the decision and possible decision errors for this project.

Step 7: Optimize the Design

The eastward shift of the HFBR plume since 1997 has resulted in much of the central and western portion of the monitoring well network being located outside of the plume. It is recommended that the focus of the groundwater monitoring program be shifted to key wells in the eastern portion of the monitoring well network supplemented by temporary well sampling as necessary. As a result, the sampling of the western wells will be reduced to either an annual frequency or suspended indefinitely, and focus monitoring on optimally located wells (based on current plume position) to the east in conjunction with the sampling of temporary wells semi-annually.
There is now a sampling history of 6 to 10 years for most of the wells in the program. Given the current knowledge of the position of the plume, based on the recent characterization data and the extensive volume of historical data, the sampling frequencies have been reduced in the following manner:

- The sampling frequency for wells significantly west of the current plume is annual or sampling was suspended altogether. No monitoring wells will be abandoned at this time and the flexibility will remain for these sampling frequencies to be increased should the plume shift back to the west.

- Quarterly sampling frequencies only for those wells immediately downgradient of the HFBR and in a position to intercept tritium as it is flushed from the vadose zone beneath the building. Also maintain quarterly frequencies for sentinel wells in the vicinity of Princeton Avenue.

- Based on the large volume of historical data, the remaining monitoring is now at a semiannual frequency. Based on current knowledge of the plume position, the semiannual installation of temporary wells, and the rate of plume movement, this frequency will be sufficient to meet the goals of the OU III ROD.

Number and Locations of Wells

A network of 116 wells monitors the HFBR tritium plume, as shown in Figure 12.7.1. Table 12.1.1 presents the decision subunits. In 2008, several temporary wells will be installed along Cornell Avenue, Grove Street south of Rowland Street to characterize the core of the tritium plume.

Parameters and Frequency

The monitoring schedule is shown in Table 12.1.1. The analytical parameters and sampling frequency currently conducted for this project are considered adequate with the addition of five new monitoring wells installed during 2007.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Based on the changes to the sampling schedule, the sampling program costs will increase by $6,882 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2007	$42,193
FY2008	$ 49,075
Difference	$6,882

Table 12.7-1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Is the tritium plume growth minimized?	See Step 3 for inputs.	(1) Data indicate that the plume is growing when it is not. (2) Data indicate that the plume is not growing when it is.	(1) Wasted resources, loss of stakeholder confidence. (2) Potential bypass of tritium, project delays, potential risk to downgradient receptors.
Are observed conditions consistent with attenuation model?	See Step 3 for inputs.	(1) Data indicate that conditions are not consistent with model when they are. (2) Data indicate that conditions are consistent with model when they are not.	(1) Wasted resources conducting attenuation model refinements. (2) Potential bypass of tritium, project delays, potential risk to downgradient receptors.
Is the tritium plume migrating toward the zone of influence of BNL water supply wells 10, 11, and 12?	See Step 3 for inputs.	(1) Data indicate that the plume is migrating toward the supply wells when it is not. (2) Data indicate that the plume is not migrating toward the supply wells when it is.	(1) Wasted resources conducting continued unnecessary monitoring. (2) Potential bypass of tritium, project delays, potential risk to receptors.
Has any segment of the plume migrated beyond the current monitoring network?	See Step 3 for inputs.	(1) Data indicate that plume has migrated beyond the network when it has not. (2) Data indicate that plume has not migrated beyond the network when it has.	(1) Wasted resources conducting evaluation of alternatives. (2) Potential bypass of tritium, project delays, potential risk to downgradient receptors.

Note: See also Table 12.7.2 for sampling frequency and affected parameters.

Table 12.7- Modifications to the HFBR Monitoring Wells

Well	Current Sampling Frequency	Sampling Frequency Changes	Affected Parameters
065-01	Annually	No Change	None
065-37	Annually	No Change	None
065-38	Annually	No Change	None
065-39	Annually	No Change	None
065-40	Annually	No Change	None
065-41	Annually	No Change	None
065-42	Annually	No Change	None
075-11	Semi-annually	No Change	None
075-12	Semi-annually	No Change	None
075-208	Annually	No Change	None
075-209	Annually	No Change	None
075-210	Annually	No Change	None
075-211	Annually	No Change	None
075-224	Quarterly	No Change	None
075-225	Semi-annually	No Change	None
075-226	Semi-annually	No Change	None
075-227	Semi-annually	No Change	None
075-228	Semi-annually	No Change	None
075-229	Quarterly	No Change	None
075-230	Quarterly	No Change	None
075-231	Semi-annually	No Change	None
075-232	Semi-annually	No Change	None
075-233	Quarterly	No Change	None
075-234	Quarterly	No Change	None
075-235	Semi-annually	No Change	None
075-236	Semi-annually	No Change	None
075-237	Quarterly	No Change	None
075-238	Semi-annually	No Change	None
075-239	Quarterly	No Change	None
075-240	Quarterly	No Change	None
075-241	Quarterly	No Change	None
075-242	Quarterly	No Change	None
075-244	Quarterly	No Change	None
075-245	Quarterly	No Change	None
075-285	Semi-annually	No Change	None
075-286	Annually	No Change	None
075-287	Annually	No Change	None
075-288	Annually	No Change	None
075-289	Annually	No Change	None
075-291	Semi-annually	No Change	None
075-292	Semi-annually	No Change	None
075-293	Semi-annually	No Change	None
075-294	Annually	No Change	None
075-295	Annually	No Change	None
075-296	Semi-annually	No Change	None
075-297	Semi-annually	No Change	None
075-298	Semi-annually	No Change	None
075-299	Semi-annually	No Change	None
075-39	Annually	No Change	None
075-40	Annually	No Change	None
075-41	Annually	No Change	None
075-413	Semi-annually	No Change	None
075-414	Semi-annually	No Change	None
075-415	Semi-annually	No Change	None
075-416	Semi-annually	No Change	None

Well	Current Sampling Frequency	Sampling Frequency Changes	Affected Parameters
075-417	Semi-annually	No Change	None
075-418	Semi-annually	No Change	None
075-419	Semi-annually	No Change	None
075-42	Semi-annually	No Change	None
075-43	Quarterly	No Change	None
075-44	Semi-annually	No Change	None
075-45	Semi-annually	No Change	None
075-558	Semi-annually	No Change	None
075-88	Semi-annually	No Change	None
075-89	Semi-annually	No Change	None
076-172	Semi-annually	No Change	None
076-173	Semi-annually	No Change	None
076-174	Semi-annually	No Change	None
076-175	Semi-annually	No Change	None
076-177	Semi-annually	No Change	None
077-10	Semi-annually	No Change	None
077-11	Semi-annually	No Change	None
085-01	Semi-annually	No Change	None
085-02	Annually	No Change	None
085-285	Annually	No Change	None
085-286	Annually	No Change	None
085-287	Semi-annually	No Change	None
085-288	Semi-annually	No Change	None
085-289	Semi-annually	No Change	None
085-290	Semi-annually	No Change	None
085-291	Semi-annually	No Change	None
085-40	Annually	No Change	None
085-77	Annual	No Change	None
085-78	Annual	No Change	None
086-09	Semi-annual	No Change	None
095-139	Annual	No Change	None
095-140	Annual	No Change	None
095-272	Semi-annual	No Change	None
095-273	Semi-annual	No Change	None
095-274	Semi-annual	No Change	None
095-275	Semi-annual	No Change	None
095-276	Semi-annual	No Change	None
095-48	Semi-annual	No Change	None
095-53	Annual	No Change	None
095-54	Quarterly	No Change	None
095-55	Quarterly	No Change	None
095-90	Quarterly	No Change	None
095-93	Semi-annual	No Change	None
096-55	Quarterly	No Change	None
096-82	Quarterly	No Change	None
096-83	Annually	No Change	None
096-84	Quarterly	No Change	None
096-88	Quarterly	No Change	None
105-22	Quarterly	No Change	None
105-23	Quarterly	No Change	None
105-29	Quarterly	No Change	None
105-43	Quarterly	No Change	None
105-44	Quarterly	No Change	None
MW-HFBR-A	Not Sampled	Quarterly	Tritium
MW-HFBR-B	Not Sampled	Quarterly	Tritium
MW-HFBR-C	Not Sampled	Quarterly	Tritium

Well	Current Sampling Frequency	Sampling Frequency Changes	Affected Parameters
MW-HFBR-D	Not Sampled	Quarterly	Tritium
MW-HFBR-E	Not Sampled	Quarterly	Tritium

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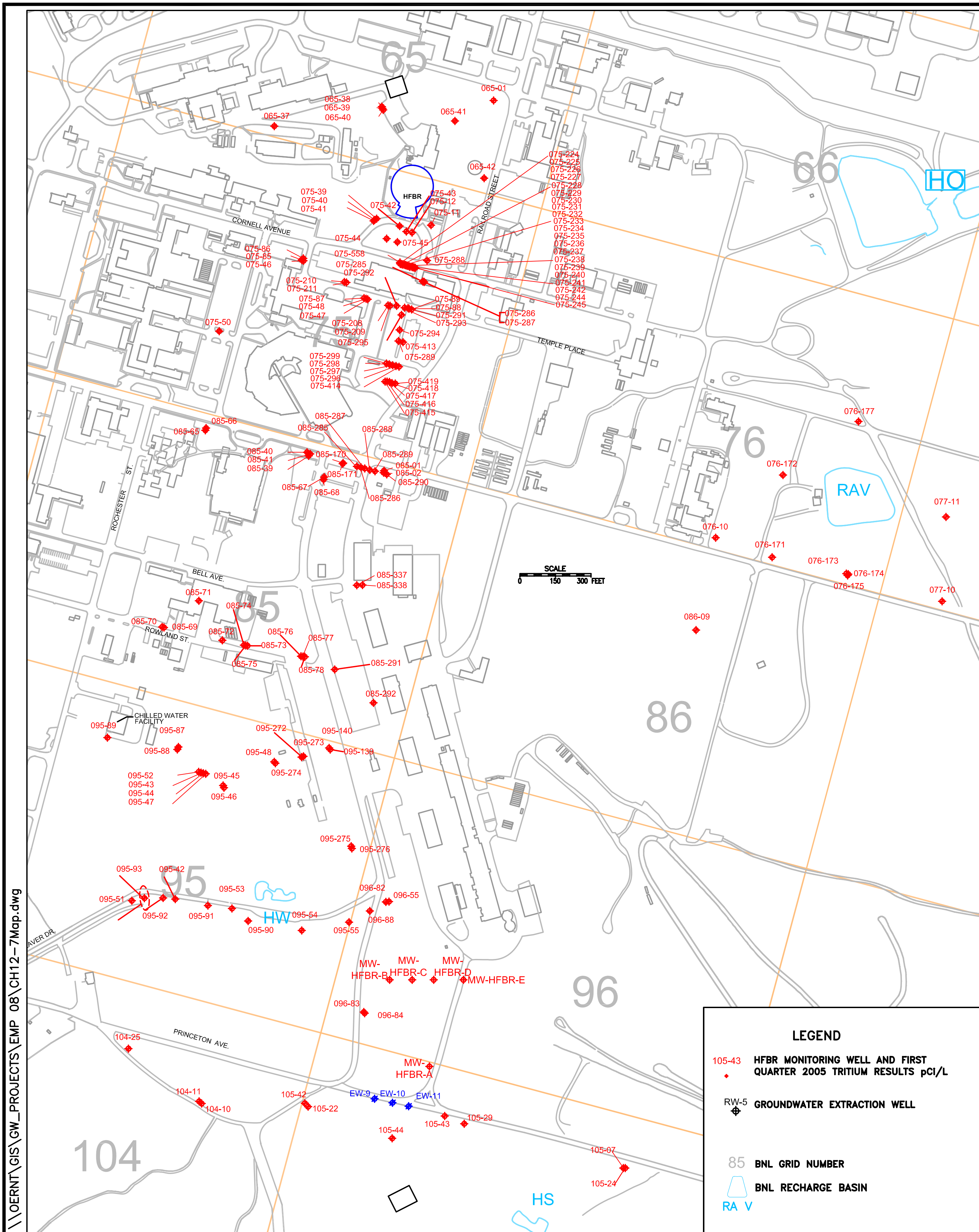

BROOKHAVEN NATIONAL LABORATORY EWMS DIVISION	TITLE: OU III HFBR AOC 29 TRITIUM MONITORING WELL LOCATIONS 2008 EMP	DWN: JEB	VT: HZ.: –	DATE: 12/13/07	PROJECT NO.: 07926
		CHKD: --	APPD: –	REV.: –	NOTES: –
		FIGURE NO.: 12.7.1			

OU III BGRR/WCF STRONTIUM-90

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 5, October 11, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

SUMMARY OF CHANGES/PROPOSED CHANGES

The following are the changes for the BGRR/WCF treatment system and groundwater monitoring program:

- Installed new monitoring wells to replace those previously abandoned.
- Installed an additional perimeter monitoring well downgradient of the leading edge of the WCF plume. The new well is located southwest of the HFBR building and downgradient of (and slightly deeper than) well 075-189.
- Installed an additional monitoring well (sentinel well) downgradient of the PFS plume. The new well is located adjacent to the 75-46 well cluster.
- Change the treatment system monitoring frequency from weekly to two times per month.
- Remove gross beta from the analyte list for the treatment system sampling, since this sampling is no longer needed. It was previously used as a means to confirm any rapid breakthrough of the resin. However, based on over 2 years worth of operations data, breakthrough is a slow and gradual process. Thus, the two-week turnaround on Sr-90 analyses is now adequate for continued verification.
- Change the monitoring well sampling frequency from startup (semi-annual and quarterly) to the O&M phase (semi-annual and annually).

DESCRIPTION AND TECHNICAL BASIS

The OU III Brookhaven Graphite Research Reactor/Waste Concentration Facility project monitors the extent of a Sr-90 plume in groundwater. Some of the wells included in the OU III BGRR/WCF network are also monitored for tritium as part of the OU III AOC 29 (HFBR) program. The overlapping wells are sampled concurrently for both programs to avoid duplication of effort. As this summary only addresses the OU III BGRR/WCF project, evaluation of the sampling frequency and analytical parameters for the OU III HFBR Tritium project will be conducted separately.

The OU III BGRR/WCF project only monitors the existing Sr-90 groundwater plumes and was not designed to monitor the contaminant sources. Other monitoring programs have been implemented to address the demolition of the BGRR and issues resulting from the Engineering Evaluation/Cost Analysis process. The current monitoring well network for the OU III BGRR/WCF project consists of 86 wells; locations are shown on Figure 12.8.1. The wells are sampled annually to semi-annually for analysis of Sr-90. The monitoring schedule is provided in Table 12.1.1.

During CY2004???, Sr-90 was detected at an activity exceeding the New York State groundwater standard in 17 wells. The analytical results show several distinct areas of elevated Sr-90: one emanating from the WCF and extending approximately 1,300 feet south, another beginning south of the BGRR and extending south approximately 1,200 feet. The third area of elevated Sr-90 concentrations begins at the PFS area and extends south for a distance of approximately 600 feet Variability in groundwater flow directions due to changes in pumping and recharge patterns in the plume vicinity over time have resulted in lateral spreading of the contamination.

In addition, evaluation of various scenarios for potable water supply at the BNL site has shown that if eastern supply wells 10, 11, and 12 are used as the primary source of potable water for an extended period of time, the capture zone for these supply wells may extend to near the BGRR. This could result in the Sr-90 contamination being drawn into the supply wells. The BNL Water and Sanitary Planning committee is charged with monitoring supply well usage across the site to minimize any impacts from changing groundwater flow on contaminant plumes.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

In the Upper Glacial aquifer beneath the central portion of the BNL site, there is an area of groundwater contaminated by Sr-90. In response, groundwater characterization and remediation is in progress. Data are needed to continue to track the vertical and horizontal extent of the contamination.

Step 2: Identify the Decisions

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Has the plume been controlled?
- Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?
- Have the cleanup goals been met? Can the groundwater treatment system be shut down?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow

- Sr-90 analytical results in groundwater
- Locations of existing wells relative to flow patterns
- Regulatory drivers (OU III ROD)
- Action levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data
- Status of potential downgradient receptors
- Estimated retardation rate for Sr-90

Step 4: Define the Study Boundaries

The horizontal extent of the study area is defined by the area of the Upper Glacial aquifer downgradient of the BGRR/WCF with detectable activities of Sr-90. Due to the slow travel time for Sr-90 in groundwater, the timeframe for decisions is 180 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from all wells will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

This decision applies to the plume perimeter and bypass detection wells. **If** the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as a significant increase in Sr-90 concentration in plume perimeter or bypass detection.

If the trend in each plume perimeter and bypass detection well has a negative or zero slope based on the four most recent consecutive samples and this trend is consistent with professional judgment, **then** continue to operate the system. **If** not, **then** consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?

This decision applies to the plume core and bypass detection wells. **If** the system is performing as planned, **then** actual Sr-90 concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation of the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis, and expert judgment), **then** continue to operate. **If** not, **then** consider operational adjustments and/or engineering evaluation. Note: When the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Have the cleanup goals been met? Can the groundwater treatment system be shut down?

All of the following decision subunits must be satisfied in order to shut down an extraction well.

4a. Have asymptotic Sr-90 concentrations been reached in core wells?

This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in Sr-90 concentrations in the plume core wells. The Kendall-Mann statistical test is a nonparametric trend analysis (Gilbert, 1987) used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.

To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in Sr-90 concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. **If** so, **then** operation of the system will continue.

4b. Is the Sr-90 concentration in core wells less than 175 pCi/L by 2015?

This decision also applies to the plume core wells. It is anticipated that approximately 7 to 10 years of active groundwater treatment will reduce the Sr-90 concentrations in the plume core to less than *175 pCi/L*.

If this occurs, **then** it is reasonable to expect (based on model projections) that MNA of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs by 2070. **If** the Sr-90 concentration remains above 175 pCi/L, **then** consider operational adjustments and/or engineering evaluation..

4c. How many individual plume core wells are above 175 pCi/L Sr-90 ?

If the Sr-90 concentration in each plume core well has been reduced to less than 175 pCi/L in less than 7 to 10 years of active remediation, **then** proceed with pulsed operation of the system. **If** not and treatment has occurred for less than 7 to 10 years, **then** continue treatment. **If** not and treatment has occurred for at least 7 to 10 years, **then** perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2070.

4d. Have the groundwater cleanup goals been met? Specifically, have MCLs been achieved in the Upper Glacial aquifer (expected by 2070)?

If the concentration of Sr-90 in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 8 pCi/L, **then** petition for system shutdown and continue with MNA until MCLs are met. **If** not, **then** consider the need for continued remediation. Note: This assumes that system operation is already considered "optimal."

Step 6: Specify Acceptable Error Tolerances

Table 12.8-1 summarizes the decision and possible decision errors for this project.

Table 12.8.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Is the extent of the Sr-90 plume still defined by the existing monitoring well network?	See Step 3 for inputs.	(1) Data indicate the plume is not defined by existing wells when it is. (2) Data indicate the plume is defined by existing wells when it is not.	(1) Wasted resources evaluating, possibly constructing and sampling additional wells. (2) Potential bypass of contaminants and potential risk to downgradient receptors.
Can Sr-90 contamination impact existing or planned groundwater remediation systems?	See Step 3 for inputs.	(1) Data indicate the plume will impact systems when it will not. (2) Data indicate the plume will not impact systems when it will.	(1) Wasted resources conducting technical evaluations and possible system modifications. (2) Potential for inadequate treatment or system failure due to contamination beyond design limits.
Is the Sr-90 plume migrating toward BNL supply wells 10, 11 and 12?	See Step 3 for inputs.	(1) Data indicate the plume is migrating toward supply wells when it is not. (2) Data indicate the plume is not migrating toward supply wells when it is.	(1) Wasted resources conducting technical evaluations, loss of use of supply wells 10, 11 and 12. (2) Potential risk to receptors through ingestion of impacted water.
Is the plume controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Locations of Wells

The current sampling program, consisting of 86 monitoring wells, is downgradient of several source areas in the vicinity of the BGRR and WCF.

Parameters and Frequency

Samples are collected semi-annually for analysis of Sr-90. Due to the slow travel time for Sr-90, this frequency is sufficient and no modifications are proposed at this time. Well-specific sampling frequency and parameter information is provided in Table 12.1.1.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Based on the changes to the sampling schedule and the new sampling and analytical contract prices, the sampling program costs will decrease $21,546 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2007	$ 103,668
FY2008	$82,122 Need
Difference	$-21,546

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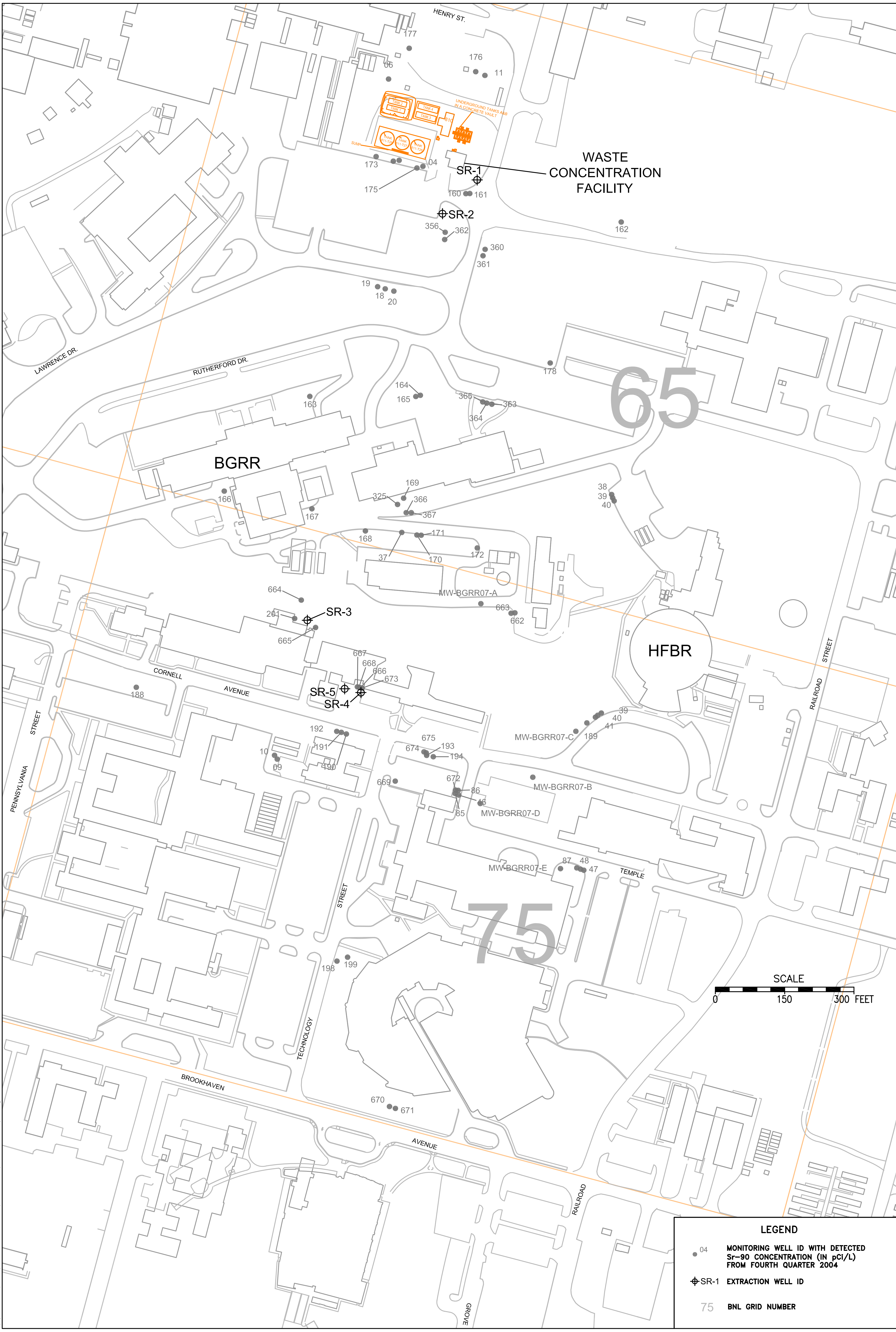

LEGEND

- 04 MONITORING WELL ID WITH DETECTED Sr-90 CONCENTRATION (IN pCi/L) FROM FOURTH QUARTER 2004
- SR-1 EXTRACTION WELL ID
- 75 BNL GRID NUMBER

BROOKHAVEN NATIONAL LABORATORY

EWMS DIVISION

TITLE:

OU III BGRR/WCF
MONITORING WELL LOCATIONS
2008 EMP

DWN:	VT:HZ.:	DATE:	PROJECT NO.:
JEB	–	12/13/07	07926
CHKD: --	APPD: --	REV.: –	NOTES: –
FIGURE NO.: 12.8.1			

OU III CARBON TETRACHLORIDE

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, October 11, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

SUMMARY OF CHANGES/PROPOSED CHANGES

The following are the changes for the Carbon Tetrachloride treatment system and groundwater monitoring program:

- Change the monitoring well sampling frequency from shutdown phase (quarterly) to standby (semi-annually).
- Move monitoring well 095-92 to the Middle Road Pump and Treat System well network.

DESCRIPTION AND TECHNICAL BASIS

A 1,000-gallon underground storage tank (UST) used to store carbon tetrachloride at the former Chemistry Department complex during the 1950s was removed in April 1998. At that time, carbon tetrachloride within the UST was inadvertently released. Plume characterization was conducted during the summer and fall of 1998. A groundwater remediation system, consisting of two shallow extraction wells and carbon treatment, was constructed and began operation during the fall of 1999. Shallow groundwater flow in this area is toward the southeast.

Groundwater characterization data collected since the fall of 2000 indicated that the distribution of the carbon tetrachloride contamination is complex, with a shallow component and a deeper component. The plume distribution is complicated by the following:

- Significant influences on groundwater flow patterns near Weaver Drive by stormwater recharge at the Weaver Drive basin
- A more complicated source then the spill which occurred during the April 1998 tank removal, and/or
- Stratigraphic variability that is not yet fully identified by borings nor incorporated in the groundwater models

An additional extraction well was constructed in 2001 to capture high concentrations of the shallow carbon tetrachloride plume and remove the majority of the mass of contamination, thereby minimizing plume growth and providing source remediation. A remediation plan for the deeper contamination will be developed when this portion of the plume has been characterized.

The monitoring well network for the OU III Carbon Tetrachloride project currently consists of 34 wells, some of which were located using the BNL Regional Groundwater Flow Model. Well locations are shown on Figure 12.9.1.

Currently, the wells are sampled semi-annually for analysis of VOCs. The monitoring schedule is detailed in Table 12.1.1. The carbon tetrachloride concentrations in the plume core area have declined significantly in response to the removal action. Carbon tetrachloride was not detected in any of the bypass wells in the vicinity of Weaver Drive during 2006, which indicates the plume is being controlled

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A carbon tetrachloride plume that could represent a potential risk to human health has been defined downgradient of a former carbon tetrachloride UST in the central portion of the BNL site. In response, remediation of the plume was implemented in the fall of 1999, and additional remediation measures will soon be implemented, with the goal of minimizing plume growth and completing the cleanup of the groundwater in the Upper Glacial aquifer within 30 years. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Have the source control goals been met?
- Has the plume been controlled?
- Is the system operating as planned?
- Have asymptotic conditions been demonstrated?
- Is an engineering evaluation needed to modify the Middle Road treatment system to ensure capture and remediation of the carbon tetrachloride plume?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the carbon tetrachloride contamination. The identified subunits and the decisions supported by each are:

- Plume core wells (Decisions 1, 2, 4, and 5)
- Sentinel (bypass detection) wells (Decisions 1, 3, and 4)
- Sentinel (Middle Road Tracking) wells (Decisions 1 and 6)

The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Carbon tetrachloride analytical results in groundwater

- Locations of existing wells relative to flow patterns (Figure 12.9.1)
- Evaluation of capture zone for extraction wells
- Action levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Rowland Street and well 085-160 to the north
- Middle Road to the south
- Rochester Street (wells 085-160, 085-162, and 095-185) to the west
- Grove Street to the east
- the saturated thickness of the Upper Glacial aquifer

Step 5: Develop the Decision Rules

Separate decisions will be made in the three subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire study system. The timeframe for decisions for each subunit varies, as described below. The wells to be included in each subunit, based on the recommended (revised) sampling program, are presented in Step 7.

- *Plume Core Wells:* Because the treatment system is located in the contaminant source area, contamination already downgradient of the treatment area will not be captured by the existing system. In addition, plume core wells will be used to provide data for measuring the performance of the source control measure. Decisions for the plume core wells will be made using a 90-day timeframe. This timeframe will be sufficient to monitor the effectiveness of the shallow remediation system, to determine whether the plume is being captured, and to support a petition for system shutdown. The sampling frequency proposed for all wells, including the secondary plume core wells in Step 7, will continue to be monitored quarterly for calendar year 2006.
- *Plume Perimeter:* Because the wells in this subunit define the plume horizontally, which is used to determine whether the plume is being captured, the timeframe for decisions here is 90 days. The wells are screened outside the known extent of the plume at the depth of contamination in the plume core. Although the plume is not expected to shift laterally due to changing flow conditions, the decision timeframe for this area will be 90 days during the 2-year system start-up phase.
- *Sentinel (Bypass Detection) Wells:* Because data from the wells included in this subunit will be used to monitor the effectiveness of the shallow remediation system, to determine whether the plume is being captured, and to support a petition for system shutdown, the timeframe for decisions here is 90 days.
- *Sentinel (Middle Road Tracking) Wells:* These wells will be used to evaluate whether the contamination already downgradient of the groundwater remediation system will be captured by the Middle Road extraction wells. The decision timeframe for these wells is 90 days.

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all three subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Have the source control goals been met?

Analytical results from plume core wells will be utilized for this decision. It has been determined that, in order to meet the OU III cleanup goals in the required timeframe (30 years), groundwater extraction should be continued until plume core wells show carbon tetrachloride concentrations below 50 µg/L. At that time, the source control measure could be terminated.

If the mean carbon tetrachloride concentration in groundwater in each plume core well, computed from measurements over the previous 2 years is less than 50 µg/L, and the computed mean is consistent with professional judgment, **then** the source control goals for this remedial action have been achieved. If not, consider the need for continued remediation.

Decision 3

Has the plume been controlled?

This decision applies to the sentinel wells. **If** the source control goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in carbon tetrachloride concentration in sentinel wells to above 50 µg/L (if currently less than 50 µg/L) or a significant increase in carbon tetrachloride concentration (if currently above 50 µg/L).

If the carbon tetrachloride concentration in each sentinel and perimeter well is less than 50 µg/L, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 4

Is the system operating as planned?

This decision applies to the plume core and sentinel wells. If the system is performing as planned, actual carbon tetrachloride concentrations in plume core and sentinel wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis, and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation. Note: When the majority and/or "key" wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 5

Is an engineering evaluation needed to modify the Middle Road treatment system to ensure capture and remediation of the carbon tetrachloride plume?

This decision applies to the Sentinel (Middle Road tracking) wells. There are four wells (104-11, 105-23, 105-42, and 104-36) to be included in the Sentinel (Middle Road tracking) wells subunit. Well locations are shown on Figure 12.1-1. Three of the wells (104-11, 105-23, and 105-42) are located to confirm that any of the shallow carbon tetrachloride plume that is not recovered by the upgraded existing remediation system will be captured by the Middle Road remediation system. The fourth well, 104-36, is located as an outpost well. Carbon tetrachloride detected in well 104-36 may not be captured by the Middle Road remediation system, and, if carbon tetrachloride is detected in this well at a concentration above 50 μg/L, then the Middle Road remediation system may need to be modified to ensure capture of the shallow carbon tetrachloride plume.

If the carbon tetrachloride concentration in any Middle Road tracking well exceeds 50 μg/L, **then** consider an engineering evaluation to determine whether modifications to the Middle Road treatment system are warranted.

Step 6: Specify Acceptable Error Tolerances

Table 12.9.1 (page 12.9-6) summarizes the decision and possible decision errors for this project.

Step 7: Optimize the Design

Number and Locations of Wells

The current sampling program consisting of 34 monitoring wells is sufficient to monitor the remediation systems effectiveness. Therefore, no modifications to the well network are required.

Parameters and Frequency

Because the contaminant of concern for this project is carbon tetrachloride and samples are currently analyzed for VOCs only, no modifications are proposed to analytical parameters. Sufficient data will be required in anticipation of a petition for system shutdown in CY2004. The sampling frequency for all wells should therefore be quarterly for CY2004. The proposed sampling program for the OU III Carbon Tetrachloride Source Control project includes 34 wells. A summary of the proposed changes to the sampling program is shown in Table 12.9.2. Well subunits are detailed in Table 12.1.2 (page 12.9-7).

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Based on the new sampling and analytical contract prices, the sampling program costs will decrease $5,070 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2007	$17,574
FY2008	$12,504
Difference	$-5,070

Table 12.9.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Have source control goals been met?	See Step 3 for inputs.	(1) Determine source control goals have been met when they are not. (2) Fail to determine source control goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Is an engineering evaluation needed to modify the Middle Road treatment system to ensure capture and remediation of the carbon tetrachloride plume?	See Step 3 for inputs.	(1) Determine an evaluation is needed when it is not. (2) Determine an evaluation is not needed when it is.	(1) Wasted resources, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.

Table 12.9.2 Proposed Modifications to the Carbon Tetrachloride Source Control Monitoring Wells

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
085-07	Quarterly	Semi-annually	VOCs
085-13	Quarterly	Semi-annually	VOCs
085-16	Quarterly	Semi-annually	VOCs
085-160	Quarterly	Semi-annually	VOCs
085-161	Quarterly	Semi-annually	VOCs
085-162	Quarterly	Semi-annually	VOCs
085-163	Quarterly	Semi-annually	VOCs
085-17	Quarterly	Semi-annually	VOCs
085-236	Quarterly	Semi-annually	VOCs
085-237	Quarterly	Semi-annually	VOCs
085-238	Quarterly	Semi-annually	VOCs
085-98	Quarterly	Semi-annually	VOCs
095-183	Quarterly	Semi-annually	VOCs
095-185	Quarterly	Semi-annually	VOCs
095-186	Quarterly	Annually	VOCs
095-277	Quarterly	Semi-annually	VOCs
095-279	Quarterly	Semi-annually	VOCs
095-280	Quarterly	Semi-annually	VOCs
095-42	Quarterly	Semi-annually	VOCs
095-43	Quarterly	Semi-annually	VOCs
095-45	Quarterly	Semi-annually	VOCs
095-47	Quarterly	Semi-annually	VOCs
095-53	Quarterly	Semi-annually	VOCs
095-88	Quarterly	Semi-annually	VOCs
095-89	Quarterly	Semi-annually	VOCs
095-90	Quarterly	Semi-annually	VOCs
095-92	Quarterly	Move to Middle Road	VOCs
104-11	Quarterly	Semi-annually	VOCs
104-36	Quarterly	Semi-annually	VOCs
105-23	Quarterly	Semi-annually	VOCs
105-42	Quarterly	Semi-annually	VOCs
095-301	Quarterly	Semi-annually	VOCs
095-300	Quarterly	Semi-annually	VOCs
095-296	Quarterly	Semi-annually	VOCs

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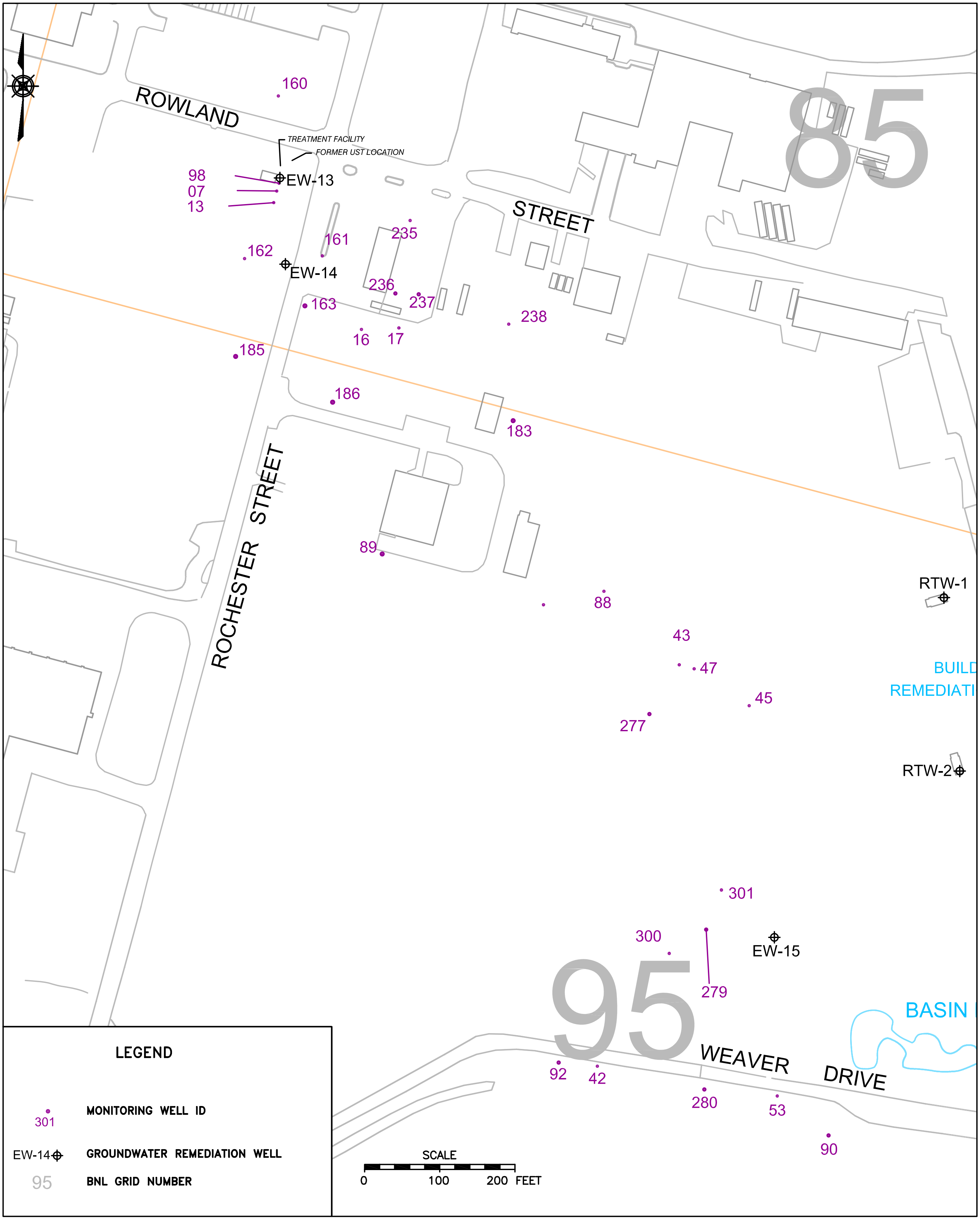

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BROOKHAVEN NATIONAL LABORATORY

EWMS DIVISION

TITLE:

OU III CARBON TETRACHLORIDE MONITORING WELL LOCATIONS

2008 EMP

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
JEB	–	12/13/07	07926
CHKD:	APPD:	REV.:	NOTES:
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FIGURE NO.: 12.9.1

OU III CENTRAL POST-ROD

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, October 19, 2007

IMPLEMENTATION DATE January 1, 2008

Point of Contact William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

SUMMARY OF PROPOSED CHANGES

There are no proposed changes for CY2008

DESCRIPTION AND TECHNICAL BASIS

The OU III Remedial Investigation identified several low-level (less than 100 μg/L) source areas and nonpoint contaminant sources within the developed central areas of the BNL site. These sources include spills within the AGS Complex and at the storage area for site maintenance equipment (Building 208) and other sources. Because these sources are not significant enough to warrant a dedicated monitoring program, they are monitored under the OU III Central project. In addition, this project includes sentinel wells for the SCWA William Floyd Parkway well field, and wells 109-03 and 109-04 near the BNL site boundary.

The monitoring well network for the OU III Central project consists of 20 wells that provide groundwater quality data in the vicinity of the source areas and at downgradient locations. Well locations are shown on Figure 12.10.1. The wells are sampled quarterly for analysis of VOCs and annually for analysis of gross alpha/beta, gamma spectroscopy, tritium, and Sr-90, as shown in Tables 12.1.1 and 12.1.2.

The contaminants of concern associated with the sources monitored by the OU III Central wells are VOCs. During CY2006, most of the wells contained VOCs at concentrations less than the New York State groundwater standards, with the exception of well 083-01. No radionuclides were detected at an activity above New York State groundwater standards in any of the OU III Central wells. Groundwater flow in the central portion of the BNL site is locally variable, due to BNL pumping and recharge sources in the area. In general, groundwater flow is toward the south or southeast.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater beneath the BNL site has been impacted by low levels of VOCs from historic operations at several isolated areas. Because active remediation of these commingled plumes is not being conducted, data are needed to verify that the contaminants are naturally degrading according to the attenuation model.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Are there potential impacts to the SCWA William Floyd Parkway well field from on-site contamination?
- Are performance objectives met?
- If not, are observed conditions consistent with the attenuation model?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- VOC analytical results in groundwater
- Locations of existing wells relative to flow patterns (Figure 12.10.1)
- Regulatory drivers (OU III ROD)
- Action levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL EMP
- variability of data.

Step 4: Define the Study Boundaries

The project decision unit limits are defined by:

- Cornell Avenue (well 064-03) on the north
- Middle Road (wells 113-06 and 113-07) and Ashton Lane (wells 109-03 and 109-04) on the south
- HO Basin and RA V Basin on the east
- William Floyd Parkway on the west
- Upper Glacial and shallow Magothy aquifers.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Are there potential impacts to the SCWA William Floyd Parkway well field from on-site contamination?

For this project, particular attention will be paid to results from wells 109-03 and 109-04, which are located near the BNL site boundary and serve as sentinel wells for the SCWA William Floyd Parkway wellfield. Results from future sampling events will be evaluated in context with historic data to determine whether contamination from the BNL Site can potentially impact the wellfield.

If sample results from sentinel wells 109-03 and 109-04 indicate the potential for impacts to the SCWA William Floyd Parkway wellfield from on-site contamination and these results are confirmed by resampling, **then** the Groundwater Contingency Plan will be implemented and notification will be made to SCWA, the Suffolk County Department of Health Services, and NYSDEC, as necessary.

Decision 3

Are performance objectives met?

According to the Record of Decision for OU III, concentrations of individual VOCs will be reduced to below MCLs within 30 years. Portions of the plumes may attenuate to below MCLs before active remediation is instituted.

If, for all wells, the mean concentration of each VOC in groundwater, computed from the previous four consecutive sampling events, is less than the compound-specific MCL, and the computed mean is consistent with professional judgment, **then** petition for closure of the remedial action. Otherwise, continue attenuation monitoring.

Decision 4

If not, are observed conditions consistent with the attenuation model?

If performance objectives have not been met, **then** it must be determined whether VOC concentrations in groundwater are being reduced according to the attenuation model.

If the detected VOC concentrations are consistent with the attenuation model, groundwater model results and professional judgment, **then** continue attenuation monitoring. If not, consider refining the conceptual model and/or implementing supplements to bolster the attenuation process.

Step 6: Specify Acceptable Error Tolerances

Table 12.10.1 summarizes the decision and possible decision errors for this project.

Table 12.10.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Are performance objectives met?	See Step 3 for inputs.	(1) Data indicate that MCLs have not been met when they have. (2) Data indicate that MCLs have been met when they have not.	(1) Wasted resources conducting continued unnecessary monitoring. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.
If not, are observed conditions consistent with attenuation model?	See Step 3 for inputs.	(1) Data indicate that conditions are not consistent with model when they are. (2) Data indicate that conditions are consistent with model when they are not.	(1) Wasted resources conducting attenuation model refinements and introducing supplements. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.

Step 7: Optimize the Design

Number and Locations of Wells

The current sampling program consisting of 20 monitoring wells is sufficient to monitor the OU III Central area. Therefore, no modifications to the well network are required.

Parameters and Frequency

The wells are sampled annually for VOCs with the exception of 109-03 and 109-04, which are sampled quarterly. Select wells are analyzed annually for radionuclides, as shown in Table 12.10.2.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Based on the new sampling contract prices, the sampling program costs will increase by $130 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2007	$8,884
FY2008	$9,014
Difference	$130

Table 12.10.2 Modifications to the OU III Central Sampling Program

Well	Current Sampling Frequency	Sampling Frequency Changes	Affected Parameters
064-03	Annually	No Change	None
065-02	Annually	No Change	None
065-05	Annually	No Change	None
066-08	Annually	No Change	None
066-09	Annually	No Change	None
075-01	Annually	No Change	None
075-02	Annually	No Change	None
076-28	Annually	No Change	None
076-314	Annually	No Change	None
076-317	Annually	No Change	None
076-373	Annually	No Change	None
083-01	Annually	No Change	None
083-02	Annually	No Change	None
084-04	Annually	No Change	None
084-05	Annually	No Change	None
096-07	Annually	No Change	None
105-05	Annually	No Change	None
105-06	Annually	No Change	None
109-03	Quarterly	No Change	None
109-04	Quarterly	No Change	None

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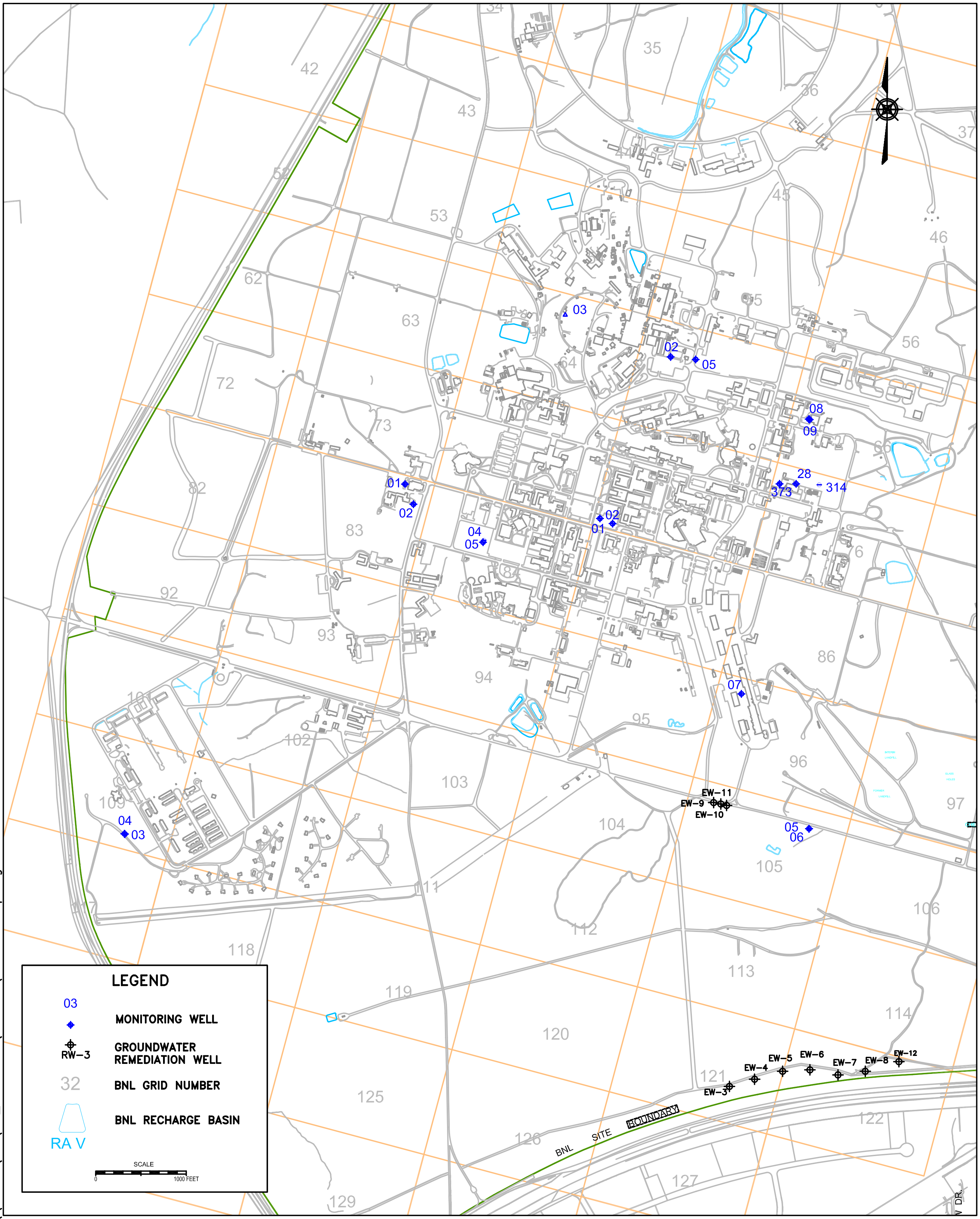

BROOKHAVEN NATIONAL LABORATORY

EWMSD

TITLE:

OU III CENTRAL
POST-ROD
MONITORING WELL LOCATIONS
2008 EMP

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
JEB	–	12/13/07	07176
CHKD:	APPD:	REV.:	NOTES:
JEB	--	1	–

FIGURE NO.: 12.10.1

OU III BUILDING 96 AREA

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, October 11, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Robert Howe (631) 344-5588

SUMMARY OF CHANGES

The following are changes to the OU III Building 96 groundwater remediation system and monitoring program issued in the 2006 Annual Groundwater Status Report:

- As an interim action to maintain hydraulic containment of the source area, modify recirculation well RTW-1 to work as a pumping well and discharge to the nearby surface drainage culvert. This will involve running a discharge line to the culvert approximately 300 feet away, and will require a SPDES equivalency permit. Effluent sampling frequency will be performed, as per the SPDES equivalency permit.
- Since VOC concentrations did not show a consistent decline in the source area wells, alternative methods for remediating the contamination in the silt zone upgradient of extraction well RTW-1 will be evaluated. This evaluation will include excavation of the source area, adding an additional extraction well in the source area, and evaluating other remedial technologies. The evaluation will be prepared in early 2008.

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DESCRIPTION AND TECHNICAL BASIS

Solvents were historically used at a former vehicle maintenance and drum storage area located immediately west of the Supply and Materiel area. While no spills were documented in this area, soil and groundwater samples collected during the OU III Remedial Investigation contained high concentrations of PCE and TCA, especially in shallow groundwater. These results indicate that spillage has historically occurred in this area and a narrow plume (approximately 200 feet wide) has been defined migrating south from the area of Building 96.

The identified groundwater contamination was addressed by construction of a treatment system consisting of four, recirculation wells (RTW-1, -2, -3, and -4). Well RTW-1 is in the area where the highest concentrations of VOCs were detected. The remaining three wells (RTW-2, -3, and -4) are further south (downgradient) in an east–west line to intercept the plume migrating south of RTW-1. Well locations are shown on Figure 12.11.1. Impacted groundwater is extracted through the well's lower screen, treated via air stripping, and recharged through the well's upper screen. Operation of the system began during calendar year 2001. On July 13, 2004, wells RTW-2, -3, and -4 were placed in standby mode due to reduced VOC concentrations in the plume. The system continued to operate utilizing well RTW-1 only. Influent samples from wells RTW-2, -3, and -4 continued to be collected quarterly. Due to the high concentrations remaining upgradient of extraction well RTW-1, an engineering evaluation of additional treatment technologies was performed as part of the recommendation to place the three downgradient wells in standby. The proposed remedy resulting from the screening process was chemical oxidation by *in situ* permanganate injection. As of June 2005, all recovery wells were placed in standby mode. However, due to increasing VOC concentrations in a well immediately upgradient, recovery well RTW-1 was turned back on in October 2005. As noted above, RTW-1 was placed in standby mode in June 2006. Due to increasing VOC concentrations, well RTW-2 was restarted in October 2007.

The remediation wells were located to intercept the area of greatest contaminant concentrations. Groundwater flow maps indicate that existing contamination currently downgradient of the Building 96 remediation system will be intercepted by OU III Middle Road treatment system extraction wells, which are approximately 1,500 feet downgradient of the Building 96 area. As a result, the Building 96 contamination is not expected to migrate off site.

The monitoring well network for the OU III Building 96 program consists of 33 wells, all of which are screened in the shallow Upper Glacial aquifer. Two of the wells (085-97 and -293) are upgradient of the former Building 96 source area. The remaining wells except 095-171 are within the plume core and serve to define the lateral extent of the contamination approximately 300 feet downgradient of the former source area. Well 095-171 was constructed to monitor the plume perimeter downgradient of the source area. Well locations are shown on Figure 12.11.1. The monitoring wells are currently sampled quarterly for analysis of VOCs to monitor the plume configuration and the effectiveness of the remediation system. A monitoring schedule is provided in Table 12.1.1.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The remediation system for the Building 96 VOC plume consists of four recovery wells. Currently only well RW-2 is operating. The remaining wells are in stand-by mode. Data are needed to verify that this system is reducing the identified contamination according to plan. In 2007 it was determined that the three applications of the oxidizer potassium permanganate performed in 2005 and 2006 were ineffective in addressing the continuing source of VOC contamination in the silt zone. In early 2008, alternative methods for remediating the contamination in the silt zone upgradient of extraction well RTW-1 will be evaluated. The Building 96 remediation system is a source control action and is part of a comprehensive cleanup program to restore the Upper Glacial aquifer to MCLs within 30 years.

Step 2: Identify the Decisions

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?

- Have the source control goals been met?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume core wells (Decisions 1, and 2)
- Pplume perimeter wells (Decision 1)
- Bypass detection wells (Decision 1)

The decision units for each of the wells in the current monitoring network are shown in Table 12.11.1. The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Locations of existing wells relative to flow patterns (Figure 12.11.1)
- Evaluation of capture zone for extraction wells
- Action levels
- Variability of data.

Step 4: Define the Study Boundaries

The decision unit limits for this project are the area being remediated in the vicinity of Building 96 as defined by a perimeter extending approximately 100 feet beyond the groundwater remediation wells. The vertical study limits are from the water table surface to approximately 70 feet below ground surface, which is the zone containing total VOCs at concentrations above 50 µg/L. The Building 96 plume becomes commingled with other plumes immediately downgradient of the system.

The potential risk to downgradient receptors from the Building 96 VOC plume was determined to be low based on the following factors:

- Public water hookups have been provided off site.
- This contamination is not within the capture zone of BNL supply wells.
- Travel time is approximately 20 years to the BNL site boundary.
- Once the source is addressed, contamination that is not captured by the Building 96 treatment system will be intercepted by the Middle Road treatment systems before reaching the BNL site boundary.

The rate of source removal from the aquifer was expected to be relatively quick, as the treatment system was originally projected to operate for less than 3 years. The rate of groundwater migration is relatively slow (less than 1 foot per day). However, there is a continuing source of VOC contamination. Data are required on a frequent basis to enable operational adjustments designed to achieve the goals of reducing the VOC concentration in the silt zone to less than 380 µg/L.

Step 5: Develop the Decision Rules

Decision 1

Was the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all three subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Have the source control objectives been met?

The OU III Record of Decision requires that this VOC plume source area be remediated to prevent or reduce downgradient impacts. As this is a source control activity, setting specific cleanup goal concentrations is not necessary to ensure that the system is operated in an efficient manner. Rather, the removal of a significant portion of the contaminant mass is the appropriate decision metric for determination of shut-down criteria. A series of indices have been developed to aid in this decision. The first decision rule index is the cumulative mass removal of contamination. The second is the identification of a “rebound” in concentrations after treatment, and the third is an interpretation/evaluation of whether the remaining contamination is a significant risk to achieving the cleanup goals specified in the ROD.

If data from plume core wells show that more than 50 percent of the VOC mass or at least 58 pounds of VOCs have been removed from the aquifer beneath the former scrap yard and there are no indications of a continuing source, **then** consider termination of fulltime system operation and beginning of pulsed operation of the system. If not, then further actions will be evaluated.

If pulsing of the remediation system does not result in significant rebound in contaminant concentrations, and model predictions indicate that any remaining contamination will not prevent achievement of cleanup objectives, **then** consider termination of system operation. If not, then continue operation of the system.

Step 6: Specify Acceptable Error Tolerances

Table 12.11.1 summarizes the decision and possible decision errors for this project.

There are no potential receptors immediately downgradient of the Building 96 area, and groundwater travel time to the site boundary is approximately 20 years. In addition, groundwater remediation was implemented in this area during calendar year 2001 and other remediation systems (OU III Middle Road) are in place downgradient of the Building 96 area.

Due to these factors, it is very unlikely that decision error will result in adverse consequences to human health. The consequences of decision error relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust and BNL credibility, and potentially wasted resources.

Step 7: Optimize the Design

Number and Locations of Wells

The current sampling program of 33 monitoring wells is sufficient to monitor the remediation systems effectiveness. Therefore, no modifications to the well network are required at this time.

Parameters and Frequency

The monitoring wells are sampled quarterly for VOCs. Influent and effluent sampling is conducted monthly when the system is in operation. A summary of the revised sampling program for this project is provided in Table 12.11.2.

Table 12.11.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Was the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Have the source control objectives been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.

Annual Cost Impact Due to Proposed Change

Since four of the five treatment system recovery wells are not operational, the sampling program costs will decrease $1,040 per year.

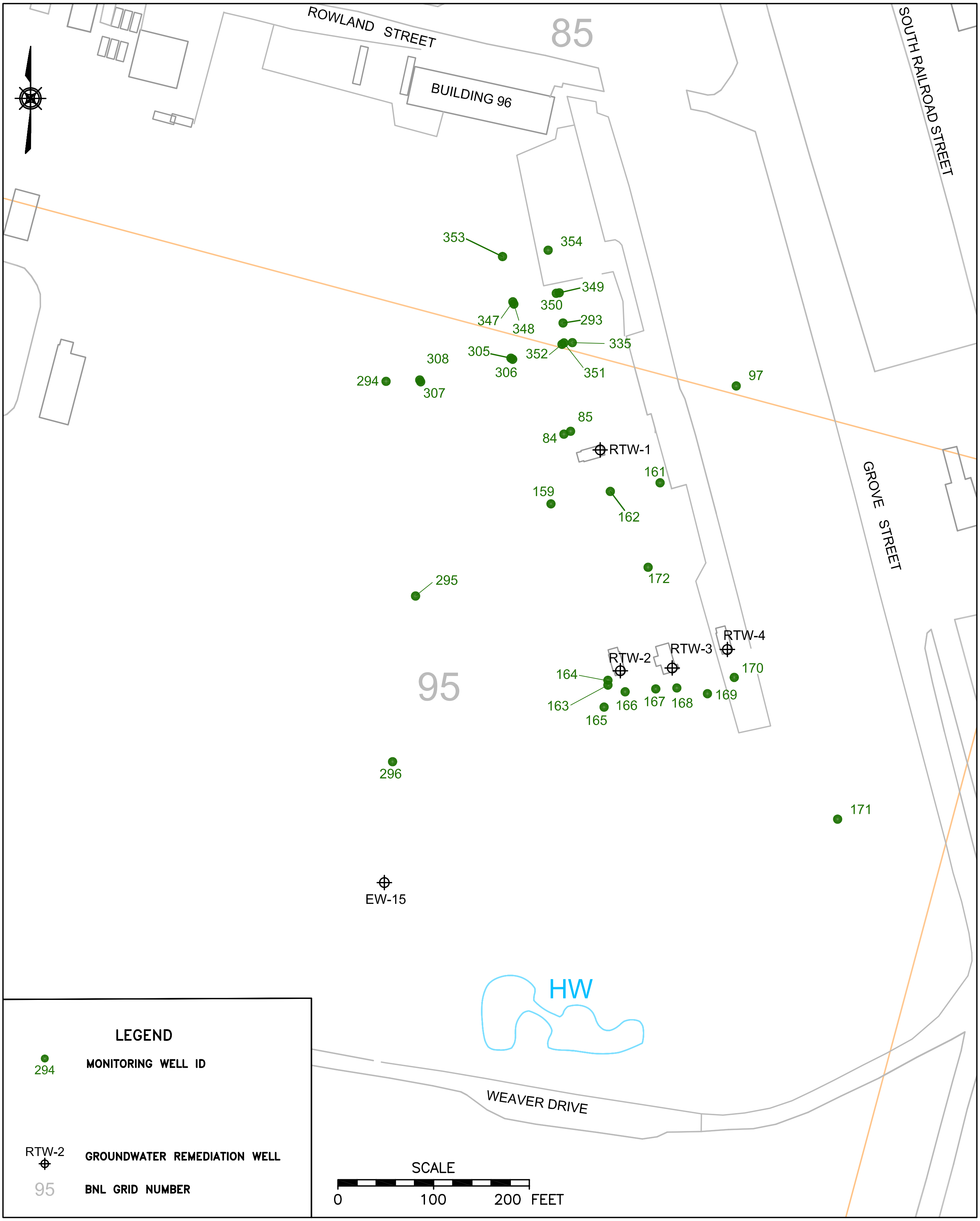
Total Cost for Monitoring Program

FY2007	$27,548
FY2008	$26,508
Difference	$-1,040

Table 12.11.2 Modifications to the Building 96 Treatment System Monitoring Wells

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
085-97	Quarterly	No Change	None
085-293	Quarterly	No Change	None
095-84	Quarterly	No Change	None
095-85	Quarterly	No Change	None
095-159	Quarterly	No Change	None
095-161	Quarterly	No Change	None
095-162	Quarterly	No Change	None
095-163	Quarterly	No Change	None
095-164	Quarterly	No Change	None
095-165	Quarterly	No Change	None

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
095-166	Quarterly	No Change	None
095-167	Quarterly	No Change	None
095-168	Quarterly	No Change	None
095-169	Quarterly	No Change	None
095-170	Quarterly	No Change	None
095-171	Quarterly	No Change	None
095-172	Quarterly	No Change	None
085-335	Quarterly	No Change	None
085-294	Quarterly	No Change	None
085-295	Quarterly	No Change	None
085-295	Quarterly	No Change	None
095-305	Quarterly	No Change	None
095-306	Quarterly	No Change	None
095-307	Quarterly	No Change	None
095-308	Quarterly	No Change	None
085-347	Quarterly	No Change	None
085-348	Quarterly	No Change	None
085-349	Quarterly	No Change	None
085-350	Quarterly	No Change	None
085-351	Quarterly	No Change	None
085-352	Quarterly	No Change	None
085-353	Quarterly	No Change	None
085-354	Quarterly	No Change	None



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BROOKHAVEN NATIONAL LABORATORY EWMS DIVISION	TITLE: OU III BUILDING 96 AREA 2008 EMP	DWN: AJZ	VT: HZ.: –	DATE: 12/13/07	PROJECT NO.: 7926
		CHKD: JEB	APPD: WRD	REV.: –	NOTES: –
		FIGURE NO.:		12.11.1	

OU III South Boundary Pump and Treat System

DQO Start Date January 1, 2003

Revision Number/Date Rev. 4, October 19, 2007

Implementation Date January 1, 2007

Point of Contact William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

Summary of Changes

The following are changes for the OU III South Boundary groundwater remediation system and monitoring program:

- Extraction wells EW-6 and -7, which were placed in standby mode in October 2007 due to low VOC concentrations in these wells, will continue to be in a standby mode. Therefore, four of the seven extraction wells will be in a standby mode during 2008. The wells will be restarted if extraction or monitoring well data indicate TVOC concentrations exceed the 50 µg/L capture goal.

Description and Technical Basis

The OU III South Boundary pump and treat system was designed to capture contamination consisting of VOCs in the Upper Glacial aquifer. These systems, working together, are designed to remediate the OU III VOC plume. Some VOC contamination currently existing in the upper portion of the Magothy aquifer will be addressed by the new LIPA and Industrial Park East off-site systems.

The OU III South Boundary groundwater extraction and treatment system includes seven extraction wells. Extracted groundwater is treated via air stripping and recharged upgradient of the plume. The system has been in operation since 1977. Shallow groundwater flow in this area is toward the south.

The monitoring network for the OU III South Boundary system includes 38 wells. Well locations are shown in Figure 12.12.1.

Currently, the wells are sampled semi-annually or annually for analysis of VOCs and annually for tritium, gamma spectroscopy, and Sr-90, as shown in Tables 12.1.1 and 12.1.2. During calendar year 2006, 11 of the 38 wells contained concentrations of individual VOCs greater than New York State groundwater standards. No radionuclides were detected at an activity above New York State groundwater standards in any well during CY2007.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health has been defined on the BNL site. In response, capture and remediation of the plume was implemented in the fall of 1997. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decisions

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Have the cleanup goals been met?
- If not, has the plume been controlled?
- Is the system operating as planned?
- Have asymptotic conditions been demonstrated?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume core wells (Decisions 1, 2, 4, and 5)
- Perimeter wells, used to define the extent of the plume (Decisions 1 and 3)
- Bypass detection wells (Decisions 1, 3, and 4)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Locations of existing wells relative to flow patterns
- Evaluation of capture zone for extraction wells
- Action levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data.

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Middle Road to the north

- Long Island Expressway to the south
- well 122-33 to the east
- wells 121-06, 121-07, and 121-08 to the west
- Upper Glacial and Upper Magothy aquifers.

Separate decisions will be made in the three subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire study system. The temporal boundaries of the study area vary, based on the decision.

- *Plume Core:* Because the rate of water quality improvement in this area is relatively slow and historic results indicate that the plume is being controlled by the treatment system, the time-frame for decisions for this subunit is 180 days.
- *Perimeter:* Because the wells included in this subunit define the plume horizontally and vertically (which is used to determine whether the plume is being captured), and since historic results indicate that the plume is being controlled by the treatment system, the timeframe for decisions for this subunit is 180 days.
- *Bypass Detection Area:* Because the wells in this area indicate whether the plume capture performance objective is being met, the decision timeframe for this subunit is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Was the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all three subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

This decision applies to the perimeter and bypass detection wells. **If** the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume fringe or bypass detection wells to above 50 µg/L (if currently less than 50 µg/L) or a significant increase in total VOC concentration (if currently above 50 µg/L).

If the trend in each plume fringe and bypass detection well has a negative slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 µg/L, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?

This decision applies to the plume core and bypass detection wells. **If** the system is performing as planned, **then** actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis, and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation. Note: When the majority and/or "key" wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Can the groundwater treatment system be shut down?

All of the following decision subunits must be satisfied in order to shut down an extraction well:

4a. Have asymptotic TVOC concentrations been reached in core wells?

This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in TVOC concentrations in the plume core wells. The Kendall-Mann statistical test is a non-parametric trend analysis (Gilbert, 1987) used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.

To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

4b. Is the mean TVOC concentration in core wells less than 50 µg/L?

This decision also applies to the plume core wells. It is anticipated that approximately 7 to 10 years of active groundwater treatment will reduce the mean TVOC concentrations in the plume core to less than 50 µg/L.

If this occurs, **then** it is reasonable to expect (based on model projections) that MNA of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs within 30 years. **If** the TVOC concentration remains above 50 µg/L, **then** consider operational adjustments and/or engineering evaluation.

4c. During pulsed operation of the system, is there significant concentration rebound in the core wells?

This decision applies to the plume core wells:

If, for each plume core well, the slope of mean concentrations for all contaminants of concern are not different from zero for 3 years, and if subject matter experts on BNL hydrogeology and hydrochemistry concur with the results of the statistical analysis, **then** petition for system shutdown. If not, then continue system operation. Note: this assumes that system operation is already considered "optimal."

Decision 5

Have the cleanup goals been met? Specifically, have MCLs been achieved (expected by 2030)?

Analytical results from plume core wells will be utilized for this decision. It has been determined that, in order to meet cleanup goals in the required timeframe (30 years), groundwater extraction should be continued until plume core wells show total VOC concentrations below 50 µg/L. At that time, the project could be reclassified as Monitored Natural Attenuation.

If the mean concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous 2 years, is less than the established cleanup goal for that parameter and the computed mean is consistent with professional judgment, **then** the cleanup goals for this remedial action have been achieved. If not, consider the need for continued remediation.

Step 6: Specify Acceptable Error Tolerances

Table 12.12.1 summarizes the decision and possible decision errors for this project.

Table 12.12.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Have cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Locations of Wells

The current sampling program consists of 38 monitoring wells located along the south boundary of the site.

Parameters and Frequency

Plume wells will be monitored on a semi-annual frequency for VOCs. Select wells are analyzed either annually or quarterly for VOCs. These frequencies are based on historic data and proximity to the recovery wells. Monitoring schedule details are provided in Tables 12.1.1 and 12.1.2. Changes to the monitoring schedule details are provided in Table 12.12.2.

Annual Cost Impact Due to Proposed Change

The costs for monitoring the OU III South Boundary Treatment system are incorporated into the Middle Road Treatment System costs and are not discussed here. Based on the changes to the sampling l contract prices, the sampling program costs will increase by $410 per year.

Total Cost for Monitoring Program

FY2007	$16,448
FY2008	$16,858
Difference	$410

Table 12.12.2 Proposed Modifications to the South Boundary Monitoring Wells

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
000-280	Annually	No Change	None
121-06	Annually	No Change	None
121-09	Annually	No Change	None
121-12	Annually	No Change	None
121-18	Annually	No Change	None
121-21	Annually	No Change	None
122-10	Annually	No Change	None
122-15	Annually	No Change	None
122-18	Annually	No Change	None
114-06	Semi-annually	No Change	None
114-07	Semi-annually	No Change	None
121-10	Quarterly	No Change	None
121-11	Semi-annually	No Change	None
121-13	Semi-annually	No Change	None
121-14	Semi-annually	No Change	None
121-20	Semi-annually	No Change	None
121-23	Semi-annually	No Change	None

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
121-43	Semi-annually	No Change	None
122-04	Semi-annually	No Change	None
122-05	Semi-annually	No Change	None
122-16	Semi-annually	No Change	None
122-17	Semi-annually	No Change	None
122-19	Semi-annually	No Change	None
122-20	Semi-annually	No Change	None
122-21	Semi-annually	No Change	None
122-22	Semi-annually	No Change	None
122-31	Semi-annually	No Change	None
122-32	Semi-annually	No Change	None
122-33	Semi-annually	No Change	None
122-34	Quarterly	No Change	None
122-35	Quarterly	No Change	None
121-07	Semi-annually	No Change	None
121-08	Semi-annually	No Change	None
121-19	Semi-annually	No Change	None
121-22	Semi-annually	No Change	None
122-02	Semi-annually	No Change	None
122-09	Semi-annually	No Change	None
OU3SBMW-01-2006	New	Quarterly	VOCs

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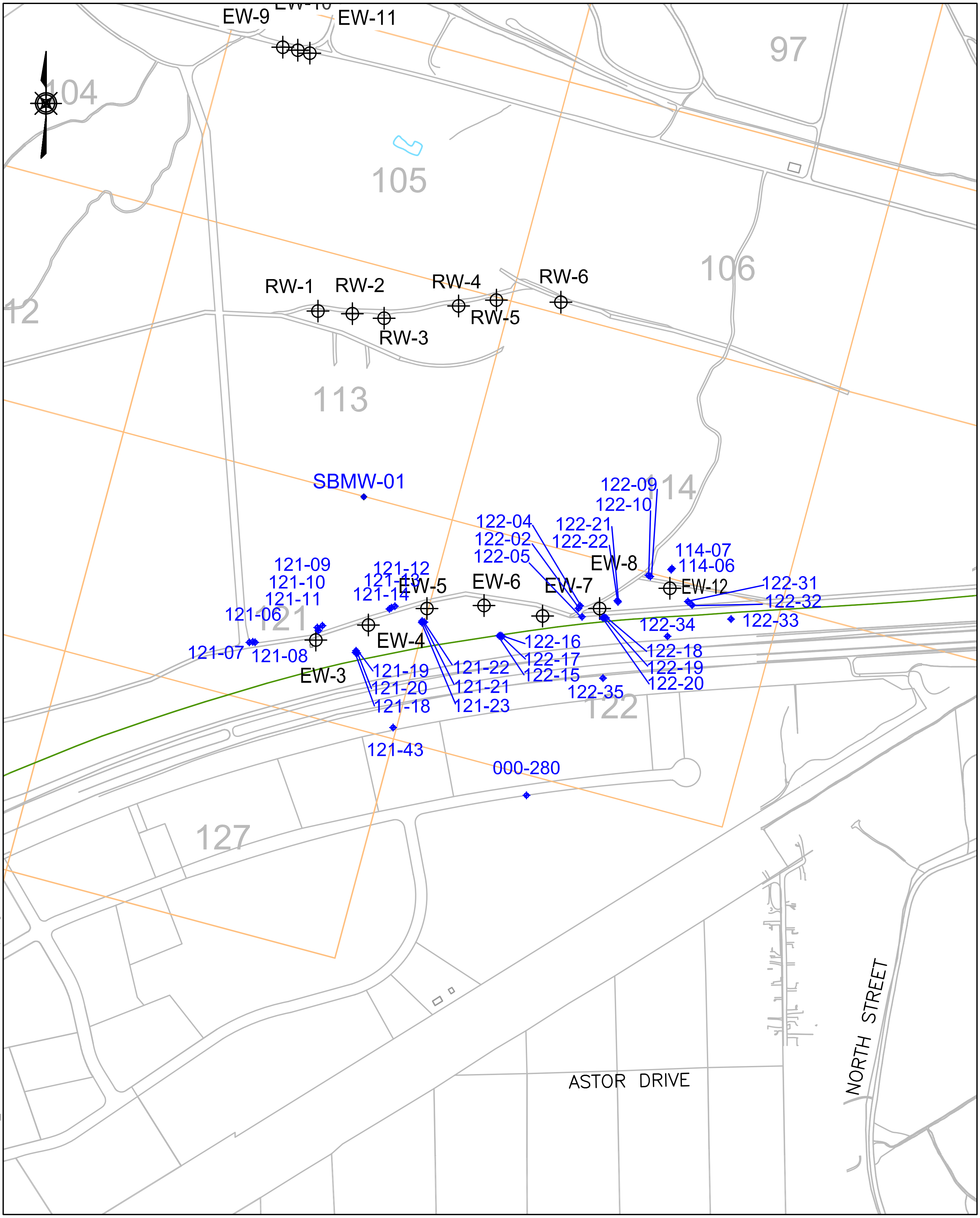

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BROOKHAVEN NATIONAL LABORATORY

EWMSD

TITLE:

OU III SOUTH BOUNDARY PUMP AND TREAT SYSTEM MONITORING WELL LOCATIONS

2008 EMP

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
JEB	–	12/14/07	07176
CHKD:	APPD:	REV.:	NOTES:
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FIGURE NO.: 12.12.1

OU III South Boundary Radionuclide

DQO Start Date January 1, 2003

Revision Number/Date Rev. 3, October 19, 2007

Implementation Date January 1, 2008

Point of Contact William Dorsch (631) 344-5186

Summary of proposed Changes

There are no proposed changes for CY2008.

Description and Technical Basis

As part of Data Quality Objective analysis for the OU III South Boundary and Western South Boundary pump and treat systems, it was recommended that analysis for radionuclides be eliminated from these programs. However, in order to confirm that groundwater impacted by radionuclides is not flowing off site, periodic analysis for radionuclides at the BNL southern property boundary may be warranted.

Drivers for Monitoring Being Conducted under This Change

___ Compliance
___ Support Compliance
_x_ Surveillance
___ Restoration

Data Quality Objective Analysis

Step 1: State the Problem

Data are needed to evaluate whether groundwater impacted by radionuclides is migrating off site.

Step 2: Identify the Decision

The decision for the project is:

Is groundwater impacted by radionuclides migrating off site (that is, is the Groundwater Contingency Plan triggered)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow

- Analytical results for radionuclides in groundwater
- Locations of existing wells relative to flow patterns
- Analytical methods and detection limits as described in the BNL EMP
- Action levels
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Middle Road to the north
- the BNL site boundary to the south
- wells 121-31 and 121-32 to the east
- William Floyd Parkway to the west
- Upper Glacial and upper Magothy aquifers.

Step 5: Develop the Decision Rules

Decision 1

Is groundwater impacted by radionuclides migrating off-site (that is, is the Groundwater Contingency Plan triggered)?

The sample results will be evaluated in context with historical data. As part of that evaluation, circumstances that would require implementation of the Groundwater Contingency Plan would be determined for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, including detection of previously undetected contaminants and detection of contaminants in wells where those contaminants have not previously been detected.

If radionuclides are detected in any well at unusually high concentrations (relative to the historical baseline) and the results are confirmed by resampling, **then** implement actions as prescribed in the BNL Groundwater Contingency Plan.

Step 6: Specify Acceptable Error Tolerances

Table 12.13.1 summarizes the decision and possible decision errors for this project.

Table 12.13.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is groundwater impacted by radionuclides migrating off site?	See Step 3 for inputs.	(1) Data indicate that groundwater impacted by radionuclides is flowing off site when that is not true. (2) Data indicate that there is not groundwater impacted by radionuclides flowing off site when there is.	(1) Investigation and/or remediation of groundwater contamination may be undertaken by BNL when it is not warranted. (2) Delays in addressing contamination, possible actions by regulatory agencies.

Step 7: Optimize the Design

Number and Locations of Wells

The current sampling program consists of 56 monitoring wells located along the south boundary of the site.The wells to be sampled are summarized in Table 12.13.2. Well locations are shown on Figure 12.13.1.

Parameters and Frequency

No changes are recommended for the OU III South Boundary Radionuclide Monitoring Program. The wells will continue to be sampled on an annual basis for radionuclides. Since results from historic samples indicate that there is currently little potential for groundwater impacted by radionuclides to flow off site along the western BNL site boundary, sampling for radionuclides should be conducted annually. Such sampling should be conducted in conjunction with the current monitoring programs for the OU III South Boundary and Western South Boundary projects to eliminate additional costs for sample collection. The monitoring schedule is provided in Table 12.1.1.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There were no modifications to this program for 2008; therefore, the sampling and analysis costs will remain the same.

TOTAL COST FOR MONITORING PROGRAM

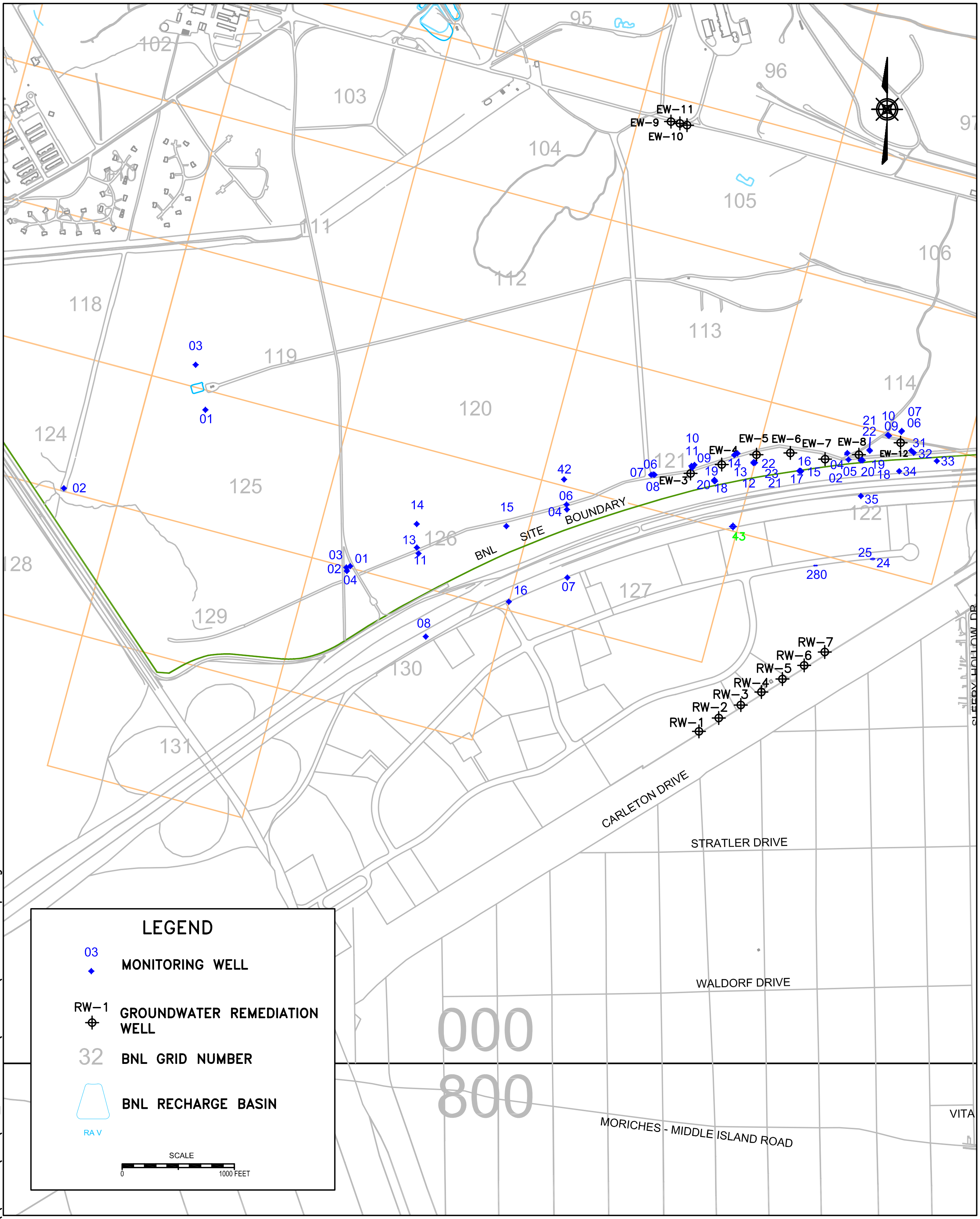
FY2007	$12,200
FY2008	$12,200
Difference	$0

See Appendix B for the monitoring program for this DQO.

Table 12.13.2 Proposed Modifications to the South Boundary Radionuclide Monitoring Wells

Well	Current Sampling Frequency	Proposed Frequency Changes	Affected Parameters
000-280	Annually	No Change	None
114-06	Annually	No Change	None
114-07	Annually	No Change	None
121-06	Annually	No Change	None
121-10	Annually	No Change	None
121-11	Annually	No Change	None
121-12	Annually	No Change	None
121-13	Annually	No Change	None
121-18	Annually	No Change	None
121-21	Annually	No Change	None
122-10	Annually	No Change	None
122-15	Annually	No Change	None
122-18	Annually	No Change	None
119-03	Annually	No Change	None
121-07	Annually	No Change	None

Well	Current Sampling Frequency	Proposed Frequency Changes	Affected Parameters
121-08	Annually	No Change	None
121-09	Annually	No Change	None
121-14	Annually	No Change	None
121-19	Annually	No Change	None
121-20	Annually	No Change	None
121-22	Annually	No Change	None
121-23	Annually	No Change	None
121-42	Annually	No Change	None
121-43	Annually	No Change	None
122-02	Annually	No Change	None
122-04	Annually	No Change	None
122-05	Annually	No Change	None
122-09	Annually	No Change	None
122-16	Annually	No Change	None
122-17	Annually	No Change	None
122-19	Annually	No Change	None
122-20	Annually	No Change	None
122-21	Annually	No Change	None
122-22	Annually	No Change	None
122-31	Annually	No Change	None
122-32	Annually	No Change	None
122-33	Annually	No Change	None
122-34	Annually	No Change	None
122-35	Annually	No Change	None
124-02	Annually	No Change	None
125-01	Annually	No Change	None
126-01	Annually	No Change	None
126-11	Annually	No Change	None
126-13	Annually	No Change	None
126-14	Annually	No Change	None
126-15	Annually	No Change	None
127-04	Annually	No Change	None
127-06	Annually	No Change	None
127-07	Annually	No Change	None
130-02	Annually	No Change	None
130-03	Annually	No Change	None
130-04	Annually	No Change	None
126-16	Annually	No Change	None
130-08	Annually	No Change	None



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BROOKHAVEN NATIONAL LABORATORY EWMSD	TITLE: OU III SOUTH BOUNDARY RADIONUCLIDE MONITORING MONITORING WELL LOCATIONS 2008 EMP	DWN: JEB	VT: HZ.: –	DATE: 12/14/07
		CHKD: --	APPD: --	REV.: 1
		PROJECT NO.: 7926	NOTES: –	FIGURE NO.: 12.13.1

OU III MIDDLE ROAD PUMP AND TREAT SYSTEM

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, October 19, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

SUMMARY OF CHANGES

The following are changes to the OU III Middle Road Pump and Treat System and monitoring program issued in the 2006 Annual Groundwater Status Report:

- Install one additional temporary well 150 feet west of MRVP-104 to characterize the high-concentration portion of the plume in this area. Install two monitoring wells, one near MRVP-103 to monitor the high concentrations and one on the western edge of the plume to use as a perimeter monitoring well.

DESCRIPTION AND TECHNICAL BASIS

The OU III Middle Road pump and treat system was designed to capture contamination consisting of VOCs in the Upper Glacial aquifer upgradient of the BNL south property boundary. It includes six extraction wells. Extracted groundwater is treated via air stripping and recharged upgradient of the plume. The system has been in operation since the fall of 2001. Shallow groundwater flow in this area is toward the south.

As described in the Operation and Maintenance Manual for the OU III Middle Road project, the monitoring network includes 24 wells. Two of the wells in the OU III Middle Road project are also sampled as part of the OU III HFBR project, and one other well is sampled as part of the Chemical/Animal Holes project. Well locations are shown on Figure 12.14.1.

A routine operation and maintenance monitoring frequency was implemented in August 2003. Plume core and perimeter wells will be monitored on a semi-annual frequency. Bypass wells will continue to be sampled at a quarterly frequency. Samples will be analyzed for VOCs.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health has been defined on the BNL site. In response, capture and remediation of the plume was implemented in the fall of 2001. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Have the cleanup goals been met?
- If not, has the plume been controlled?
- Is the system operating as planned?
- Have asymptotic conditions been demonstrated?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume core wells (Decisions 1, 2, 4, and 5)
- Perimeter wells, used to define the extent of the plume (Decisions 1 and 3)
- Bypass detection wells (Decisions 1, 3, and 4)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Locations of existing wells relative to flow patterns
- Evaluation of capture zone for extraction wells
- Action levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Princeton Avenue to the north
- Approximately 500 feet south of Middle Road (wells 113-16, -17, -18, -19, and -20)
- well 122-33 to the east
- well 113-08 to the west
- Upper Glacial and upper Magothy aquifers

Separate decisions will be made in the three subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire study system. As described below, the temporal boundaries of the study area are currently the same for each decision subunit. However, as more data are collected, the timeframe for decisions in a subunit may be modified. Therefore, the subunits have been described separately.

- *Plume Core:* Plume core wells will be used to provide data for measuring the performance of the system. Because the system is in its third year of operation and is in the O&M phase, data are needed on a less frequent basis. Therefore, the timeframe for decisions for this subunit is 180 days.
- *Perimeter:* The wells included in this subunit define the plume horizontally and vertically, which is used to determine whether the plume is being captured. . Because the system is in its third year of operation and is the O&M phase, data are needed on a less frequent basis. Therefore, the timeframe for decisions for this subunit is 180 days.
- *Bypass Detection Area:* Because the wells in this area indicate whether the plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all three subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

This decision applies to the perimeter and bypass detection wells. If the cleanup goals have not been met, then it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in perimeter or bypass detection wells to above 50 µg/L (if currently less than 50 µg/L) or a significant increase in total VOC concentration (if currently above 50 µg/L).

If the trend in each perimeter and bypass detection well has a negative slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 µg/L, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for this treatment system?

This decision applies to the plume core and bypass detection wells. If the system is performing as planned, then actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation. Note: When the majority and/or "key" wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Can the groundwater treatment system be shut down?

If evaluation of analytical results for any contaminant of concern in any upgradient or plume core well sample, in conjunction with historic analytical results and trends indicates that the treatment system have met the shutdown criteria of achieving the cleanup goal within 30 years, then a petition for shutdown will be issued to the regulatory agencies.

4a. Have asymptotic VOC concentrations been reached in core wells?

This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in TVOC concentrations in the plume core wells. The Kendall-Mann statistical test is a non-parametric trend analysis (Gilbert, 1987) used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.

To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

4b. Is the mean TVOC concentration in core wells less than 50 µg/L (expected by 2025)?

This decision also applies to the plume core wells. It is anticipated that approximately 7 to 10 years of active groundwater treatment will reduce the mean TVOC concentrations in the plume core to less than 50 µg/L.

If this occurs, **then** it is reasonable to expect (based on model projections) that MNA of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs within 30 years. **If** the TVOC concentration remains above 50 µg/L, **then** consider operational adjustments and/or engineering evaluation.

4c. How many individual plume core wells are above 50 µg/L?

If the total VOC concentration in each plume core well has been reduced to less than 50 µg/L in less than 7 to 10 years of active remediation, **then** proceed with pulsed operation of the system (see Decision subunit 4c). **If** not and treatment has occurred for less than 7 to 10 years, **then** continue treatment. If not and treatment has occurred for at least 7 to 10 years, then perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2030.

4d. During pulsed operation, is there significant concentration rebound in core wells?

This decision is to determine whether there is significant concentration rebound after system pulsing. **If** yes, and system has operated for less than 7 to 10 years, **then** continue operation. **If** yes and system has operated for more than 7 to 10 years, **then** an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted (see Decision subunit 4d to help with this decision). **If** no significant rebound is observed within a 1-year time period, **then** petition for system shutdown and continue with MNA.

Decision 5

Have the cleanup goals been met? Have MCLs been achieved (expected by 2030)?

Analytical results from plume core wells will be utilized for this decision. It has been determined that, in order to meet cleanup goals in the required timeframe (30 years), groundwater extraction should be continued until plume core wells show total VOC concentrations below 50 µg/L. At that time, the project could be reclassified as Monitored Natural Attenuation.

If the mean concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous two years, is less than the established cleanup goal for that parameter and the computed mean is consistent with professional judgment, **then** the cleanup goals for this remedial action have been achieved. If not, consider the need for continued remediation.

Step 6: Specify Acceptable Error Tolerances

Table 12.14.1 summarizes the decision and possible decision errors for this project.

Table 12.14.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Have cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Locations of Wells

The existing monitoring well network, consisting of 24 wells.

Parameters and Frequency

A baseline of over 5 years of groundwater data has been obtained from many of the OU III Middle Road Program wells. A routine operation and maintenance monitoring frequency has been implemented in the August 2003. Plume core and perimeter wells will be monitored on a semiannual frequency. Bypass wells will continue to be sampled at a quarterly frequency.

A summary of the proposed sampling program is shown in Table 12.14.2.

Annual Cost Impact Due to Proposed Change

Due to the construction, the costs for monitoring the OU III South Boundary Treatment system are incorporated into the Middle Road Treatment System costs. Based on the changes to the sampling program and the new sampling contract prices, the sampling program costs will increase by $310 per year.

Total Cost for Monitoring Program

FY2007	$30,168
FY2008	$30,478
Difference	$310

See Appendix B for the monitoring program for this DQO.

Table 12.14.2 Proposed Modifications to the Middle Road Project Monitoring Wells

Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
105-52	Quarterly	No Change	None
105-53	Quarterly	No Change	None
105-54	Quarterly	No Change	None
113-16	Quarterly	No Change	None
113-17	Quarterly	No Change	None
113-18	Quarterly	No Change	None
113-19	Quarterly	No Change	None
113-20	Quarterly	No Change	None
113-21	Quarterly	No Change	None
113-22	Quarterly	No Change	None
114-12	Quarterly	No Change	None
105-23	Quarterly	No Change	None
105-25	Quarterly	No Change	None
105-44	Quarterly	No Change	None
113-06	Quarterly	No Change	None
113-07	Quarterly	No Change	None
113-08	Quarterly	No Change	None
113-09	Quarterly	No Change	None
113-11	Quarterly	No Change	None
106-55	Quarterly	No Change	None
106-56	Quarterly	No Change	None
106-58	Quarterly	No Change	None
106-62	Quarterly	No Change	None
OU3SBMW-01-2006	New	Quarterly	VOCs

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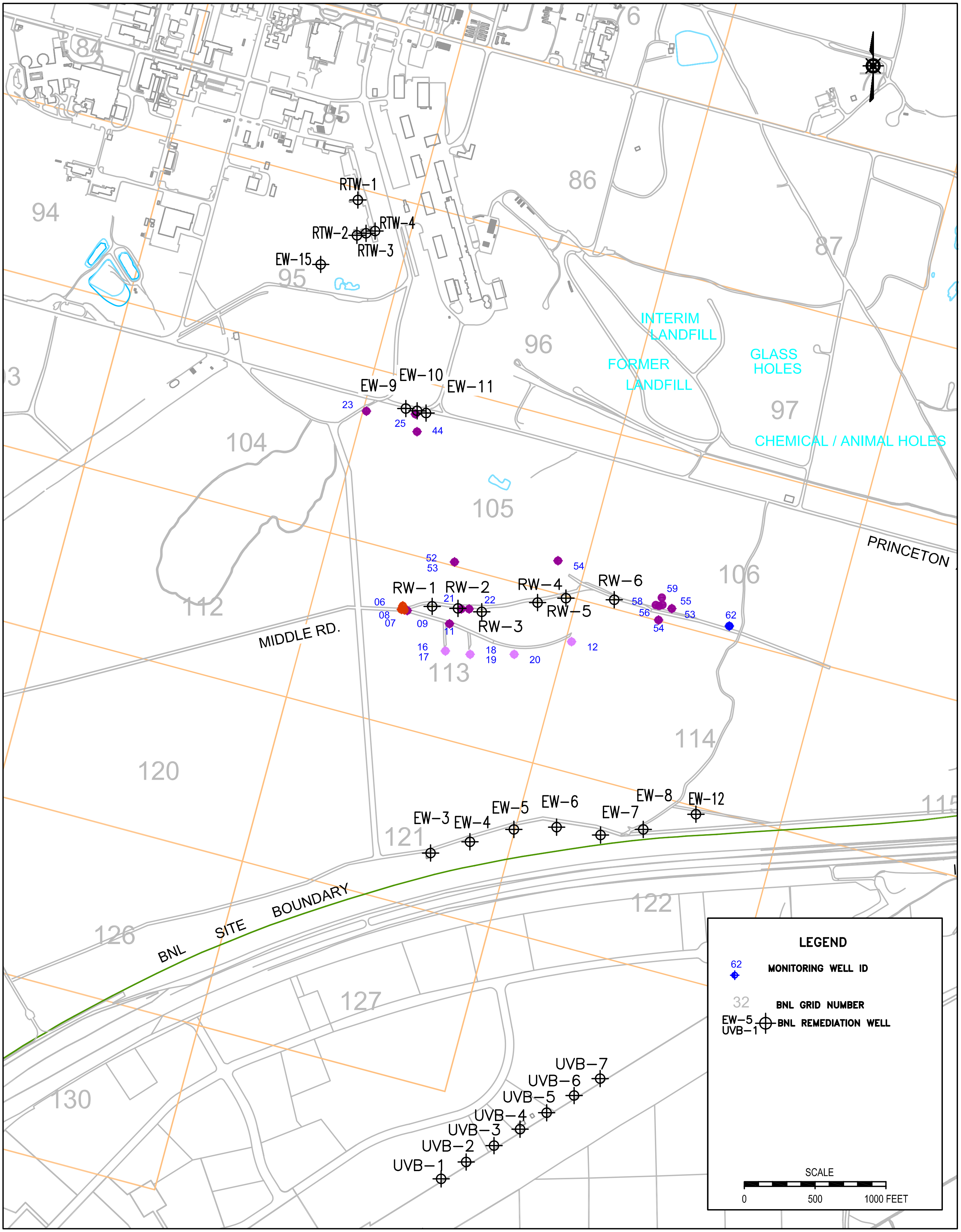

BROOKHAVEN NATIONAL LABORATORY

EWMSD

TITLE:

OU III MIDDLE ROAD PUMP AND TREAT SYSTEM MONITORING WELL LOCATIONS

2008 EMP

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
JEB	–	12/14/07	07176
CHKD:	APPD:	REV.:	NOTES:
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FIGURE NO.: 12.14.1

OU III Western South Boundary Pump and Treat System

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, October 23, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

Summary of Changes

There are no changes to the OU III Western South Boundary Treatment System and monitoring program for CY2008.

Description and Technical Basis

The OU III Western South Boundary Pump and Treat System was designed to capture the higher concentrations of VOCs in the Upper Glacial aquifer along the western portion of the BNL south property boundary. This system captures and remediates a portion of the OU III VOC plume to reduce future off-site migration of the contamination and potential discharge of the VOC plume to the Carmans River.

The OU III Western South Boundary groundwater extraction and treatment system has been operational since May 2002. The system includes two extraction wells along the BNL south property boundary. Extracted groundwater is treated via air stripping and recharged at the western end of Middle Road upgradient and cross-gradient of the plume. Groundwater flow in this area is toward the south.

The monitoring network for the OU III Western South Boundary program includes 17 wells. Well locations are shown on Figure 12.15.1. Groundwater samples are collected and analyzed for VOCs on a semi-annual or quarterly basis, as shown in Tables 12.1.1 and 12.1.2.

Drivers for Monitoring Being Conducted under This Change

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health or the environment (off-site sensitive receptor, the Carmans River) has been defined on the BNL site. In response, capture and remediation of the higher concentrations of VOCs is being implemented along the western site boundary. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Is the system operating as planned?
- Have asymptotic conditions been demonstrated?

Step 3: Identify Inputs to the Decision

The project was divided into four decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume core wells (Decisions 1, 2, and 3)
- Perimeter wells, used to define the extent of the plume (Decision 1)
- Bypass detection wells (Decisions 1 and 2)
- Perimeter (recharge basin) wells (Decisions 1 and 2)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Locations of existing wells relative to flow patterns
- Evaluation of capture zone for extraction wells
- Action levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Middle Road to the north
- Long Island Expressway eastbound service road and wells 127-07, 126-16, and 130-08 to the south
- unpaved north-south access road and wells 121-06, 121-07, and 121-08 to the east
- western south boundary recharge basin and wells 119-03, 125-01, and 125-02 to the west
- Upper Glacial and upper Magothy aquifers

Separate decisions will be made for the four subunits described in Step 3. As described below, the temporal boundaries of the study area are currently the same for each decision subunit. However, as more data are collected, the timeframe for decisions in a subunit may be modified. Therefore, the subunits have been described separately.

- *Plume Core:* Plume core wells will be used to provide data for measuring the performance of the system. Because the system is in its third year of operation and is the O&M phase, data are needed on a less frequent basis. Therefore, the timeframe for decisions for this subunit is 180 days.
- *Perimeter:* The wells included in this subunit will also be used to provide data for measuring the performance of the system. Because the system is in its third year of operation and is the O&M phase, data are needed on a less frequent basis. Therefore, the timeframe for decisions for this subunit is 180 days.
- *Bypass Detection Area:* The wells in this area will provide data for measuring the system performance and will also indicate water quality that will eventually discharge to the Carmans River. Therefore, the decision timeframe for this area is 90 days.
- *Perimeter (Recharge Basin):* Because the wells around the recharge basin provide information regarding system performance by evaluating the quality of treated water being discharged into the recharge basin, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Was the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all four subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

This decision applies to the perimeter and bypass detection wells. **If** the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume fringe or bypass detection wells to above 20 µg/L (if currently less than 20 µg/L) or a significant increase in total VOC concentration (if currently above 20 µg/L).

If the trend in each plume fringe and bypass detection well has a negative slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 20 µg/L, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned?_*Specifically, is the aquifer being restored at the planned rate?*

This decision applies to the plume core, bypass detection and recharge basin wells. If the system is performing as planned, then actual total VOC concentrations in plume core, bypass detection, and recharge basin wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need to evaluate this discrepancy.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation. Note: When the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Can the groundwater treatment system be shut down?

All of the following decision subunits must be satisfied in order to shut down an extraction well.

4a. Have asymptotic TVOC concentrations been reached in core wells? Have asymptotic conditions been demonstrated?

This decision applies to the plume core area wells. When no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

If, for each plume core well, the slope of mean concentrations for all contaminants of concern are not different from zero for three years, and if subject matter experts on BNL hydrogeology and hydrochemistry concur with the results of the statistical analysis, **then** petition for system shutdown. If not, then continue system operation.

4b. Is the mean TVOC concentration in core wells less than 20 µg/L?

This decision also applies to the plume core wells. It is anticipated that approximately seven to ten years of active groundwater treatment will reduce the mean TVOC concentrations in the plume core to less than 20 µg/L

If this occurs, **then** it is reasonable to expect (based on model projections) that MNA of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs within 30 years. **If** the TVOC concentration remains above 20 µg/L, **then** consider operational adjustments and/or engineering evaluation.

4c. <u>How many individual plume core wells are above 20 µg/L TVOCs?</u>

If the total VOC concentration in each plume core well has been reduced to less than 20 µg/L in less than 7 to 10 years of active remediation, then proceed with pulsed operation of the system (see Decision subunit 4c). If not and treatment has occurred for less than 7 to 10 years, then continue treatment. If not and treatment has occurred for at least 7 to 10 years, then perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2030.

4d. During pulsed operation, is there significant concentration rebound in core wells?

This decision is to determine whether there is significant concentration rebound after system pulsing. If yes, and system has operated for less than 7 to 10 years, then continue operation. If yes and system has operated for more than 7 to 10 years, then an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted. If no significant rebound is observed within a 1-year time period, then petition for system shutdown and continue with MNA.

Decision 5

Have the groundwater cleanup goals been met? Specifically, have MCLs been achieved by 2030?

If the mean concentration of TVOCs in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 50 µg/L, and if the mean TVOC concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous two years, is less than 20 µg/L, and pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations, **then** petition for system shutdown and continue with MNA until MCLs are met. **If** not, **then** consider the need for continued remediation. Note: This assumes that system operation is already considered "optimal."

Step 6: Specify Acceptable Error Tolerances

Table 12.15.1 summarizes the decision and possible decision errors for this project.

Table 12.15.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Is the system performing as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Locations of Wells

The number and locations of wells for this program are considered adequate.

Parameters and Frequency

Groundwater monitoring will continue in O&M phase mode. Plume core and perimeter wells will be monitored on a semiannual frequency. Bypass wells will continue to be sampled at a quarterly frequency (see Tables 12.1.1 and 12.1.2).

Annual Cost Impact Due to Proposed Change

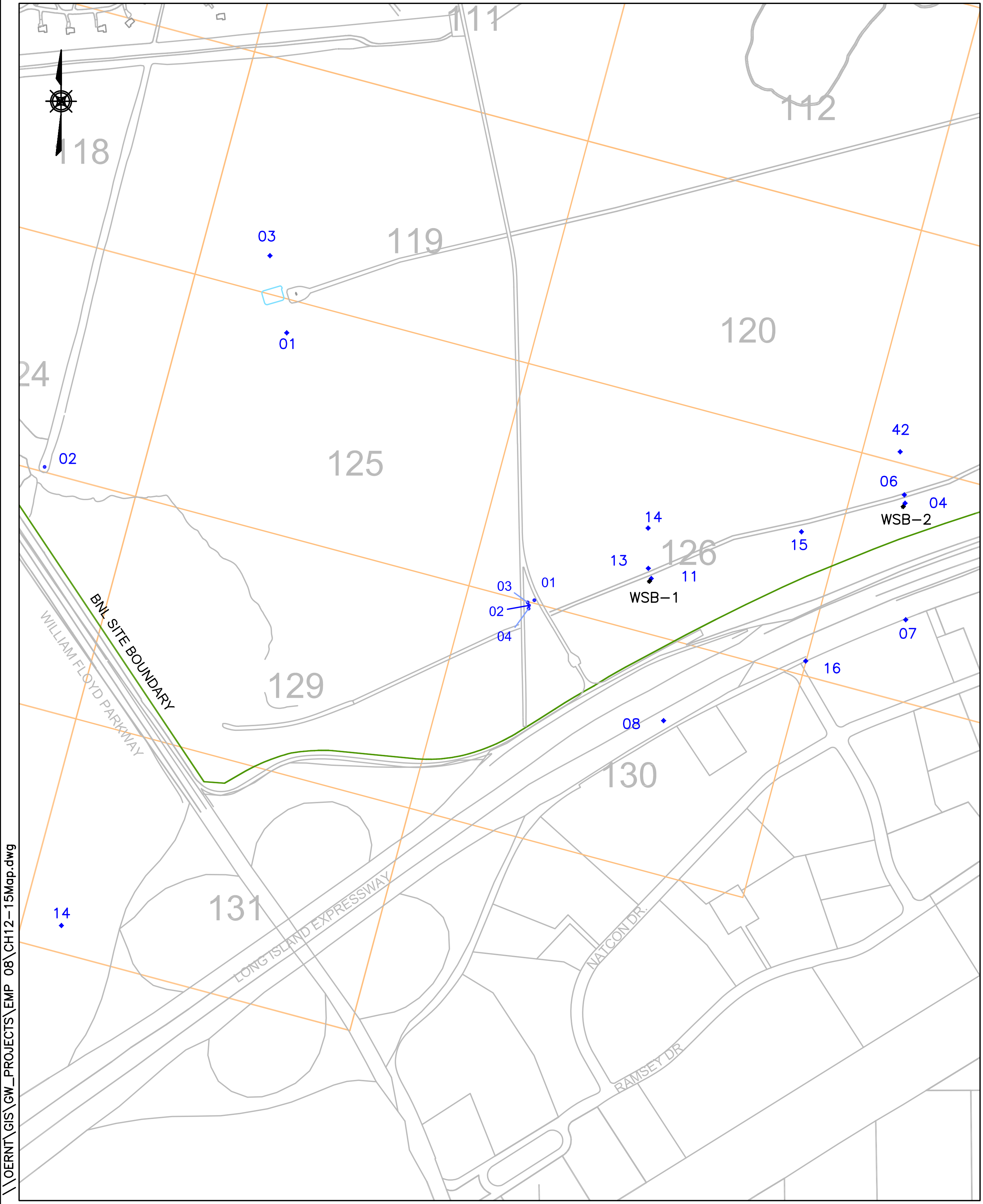
Based on the new sampling contract prices, the sampling program costs will increased by $210 per year.

Total Cost for Monitoring Program

FY2007	$13,788
FY2008	$13,998
Difference	$210

Table 12.15.2 Proposed Modifications to the Western South Boundary Monitoring Wells

Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
124-02	Semi-annual	No Change	None
126-01	Semi-annual	No Change	None
130-02	Semi-annual	No Change	None
130-03	Semi-annual	No Change	None
130-04	Semi-annual	No Change	None
119-03	Semi-annual	No Change	None
126-11	Semi-annual	No Change	None
126-15	Semi-annual	No Change	None
121-42	Semi-annual	No Change	None
127-04	Semi-annual	No Change	None
126-13	Semi-annual	No Change	None
126-14	Semi-annual	No Change	None
125-01	Semi-annual	No Change	None
127-06	Semi-annual	No Change	None
127-07	Quarterly	No Changes	None
126-16	Quarterly	No Changes	None
130-08	Quarterly	No Changes	None



BROOKHAVEN NATIONAL LABORATORY

EWMSD

TITLE:

OU III WESTERN SOUTH BOUNDARY PUMP AND TREAT SYSTEM MONITORING WELL LOCATIONS

2008 EMP

DWN: JEB	VT: HZ.: –	DATE: 12/14/07	PROJECT NO.: 07176
CHKD: --	APPD: --	REV.: 1	NOTES: –

FIGURE NO.: 12.15.1

OU III Off Site Post-ROD

DQO Start Date January 1, 2003

Revision Number/Date Rev. 4, October 23, 2007

Implementation Date January 1, 2008

Point of Contact William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

Summary of Changes

The following change for the Off-Site Groundwater Monitoring program was issued in the 2006 Annual Groundwater Status Report:

- Change the frequency of monitoring from semi-annual to annual.

Description and Technical Basis

The sources for the plumes monitored by the OU III Off-Site program are located within the developed central areas of the BNL Site. Due to the proximity of the plume source areas and variability in groundwater flow direction in the vicinity of the source areas, the plumes are commingled south of the BNL site boundary. Groundwater flow south of the BNL site boundary is toward the south.

The monitoring well network for the OU III Off-Site project consists of 12 wells that provide groundwater quality data south of the western portion of the BNL site boundary. The screen zone and aquifer screened by each of the wells currently sampled are summarized in Table 12.16.1. Well locations are shown in Figure 12.16.1. Wells are sampled semi-annually for analysis of VOCs, as shown in Tables 12.1.1 and 12.1.2.

The contaminants of concern associated with the sources monitored by the OU III Off-Site wells are VOCs. During CY2006, VOCs were not detected at concentrations above New York State groundwater standards.

Drivers for Monitoring Being Conducted under This Change

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

Table 12.16.1 Current OU III Off-Site Wells

Well	Screen Zone *	Aquifer Screened
000-97	284-304	Magothy
000-98	190-210	Deep Upper Glacial
000-99	83-93	Shallow Upper Glacial
000-107	195-215	Deep Upper Glacial
800-21	202-222	Magothy
800-22	105-125	Deep Upper Glacial
800-23	35-45	Shallow Upper Glacial
800-40	166-186	Deep Upper Glacial
800-41	203-223	Magothy
800-51	70-80	Shallow Upper Glacial
800-52	140-160	Deep Upper Glacial
800-53	190-210	Mid Upper Glacial

* Feet below ground surface

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater south of the BNL site boundary has been impacted by VOCs at concentrations exceeding New York State groundwater standards. Because active remediation of these commingled plumes is currently being planned or designed, data are needed to verify that the contaminants are naturally degrading in the interim and to determine the nature and extent of the VOC plumes for system design.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Have performance objectives been met?
- If not, are observed conditions consistent with the attenuation model?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- VOC analytical results in groundwater
- Locations of existing wells relative to flow patterns
- Action levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

The project decision unit limits are defined by:

- Carleton Drive on the north
- wells 800-21, 800-22, and 800-23, and Flower Hill Drive on the south
- Boxwood Drive (well 000-107) on the east

- Carmans River (wells 800-21, -22, and -23) and Westend Avenue (wells 800-51,-52, and -53) on the west
- Upper Glacial and upper Magothy aquifers

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Are performance objectives met?

According to the Record of Decision for OU III, concentrations of individual VOCs will be reduced to below MCLs within 30 years. Portions of the plume may attenuate to below MCLs before active remediation is instituted.

If, for all wells, the mean concentration of each VOC in groundwater, computed from the previous four consecutive sampling events, is less than the compound-specific MCL, and the computed mean is consistent with professional judgment, **then** petition for closure of the remedial action. Otherwise, continue attenuation monitoring.

Decision 3

If not, are observed conditions consistent with the attenuation model?

If performance objectives have not been met, **then** it must be determined whether VOC concentrations in groundwater are being reduced according to the attenuation model.

If the detected VOC concentrations are consistent with the attenuation model, groundwater model results, and professional judgment, **then** continue attenuation monitoring. If not, consider refining the conceptual model and/or implementing supplements to bolster the attenuation process.

Step 6: Specify Acceptable Error Tolerances

Table 12.16.2 summarizes the decision and possible decision errors for this project.

Table 12.16.2 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Are performance objectives met?	See Step 3 for inputs.	(1) Data indicate that MCLs have not been met when they have. (2) Data indicate that MCLs have been met when they have not.	(1) Wasted resources conducting continued unnecessary monitoring. (2) Potential bypass of contaminants, project delays, potential risk to down-gradient receptors.
If not, are observed conditions consistent with attenuation model?	See Step 3 for inputs.	(1) Data indicate that conditions are not consistent with model when they are. (2) Data indicate that conditions are consistent with model when they are not.	(1) Wasted resources conducting attenuation model refinements and introducing supplements. (2) Potential bypass of contaminants, project delays, potential risk to down-gradient receptors.

Step 7: Optimize the Design

Number and Locations of Wells

The number and locations of wells for this program are considered adequate.

Parameters and Frequency

The monitoring wells in the OU III Off-Site program were sampled for VOCs semi-annually. Since there were no detections of VOCs above standards, the sampling frequency was reduced to annually. A summary of the modifications to the OU III Off-Site sampling programs is provided in Table 12.16.3.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Based on the new sampling schedule, the sampling program costs will decrease $2,508 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2007	$5,136
FY2008	$2,628
Difference	$2,508

See Appendix B for the monitoring program for this DQO.

Table 12.16.3 Modifications to the OU III Off-Site Monitoring Wells

Well	Current Sampling Frequency	Proposed Sampling Frequency	Proposed Analytical Parameters
000-97	Semi-annually	Annual	VOCs
000-98	Semi-annually	Annual	VOCs
000-99	Semi-annually	Annual	VOCs
000-101	Semi-annually	Annual	VOCs
000-102	Semi-annually	Annual	VOCs
000-104	Semi-annually	Annual	VOCs
000-105	Semi-annually	Annual	VOCs
000-107	Semi-annually	Annual	VOCs
000-131	Semi-annually	Annual	VOCs
800-21	Semi-annually	Annual	VOCs
800-22	Semi-annually	Annual	VOCs
800-23	Semi-annually	Annual	VOCs
800-40	Semi-annually	Annual	VOCs
800-41	Semi-annually	Annual	VOCs
800-43	Semi-annually	Annual	VOCs
800-44	Semi-annually	Annual	VOCs
800-50	Semi-annually	Annual	VOCs
800-51	Semi-annually	Annual	VOCs
800-52	Semi-annually	Annual	VOCs
800-53	Semi-annually	Annual	VOCs

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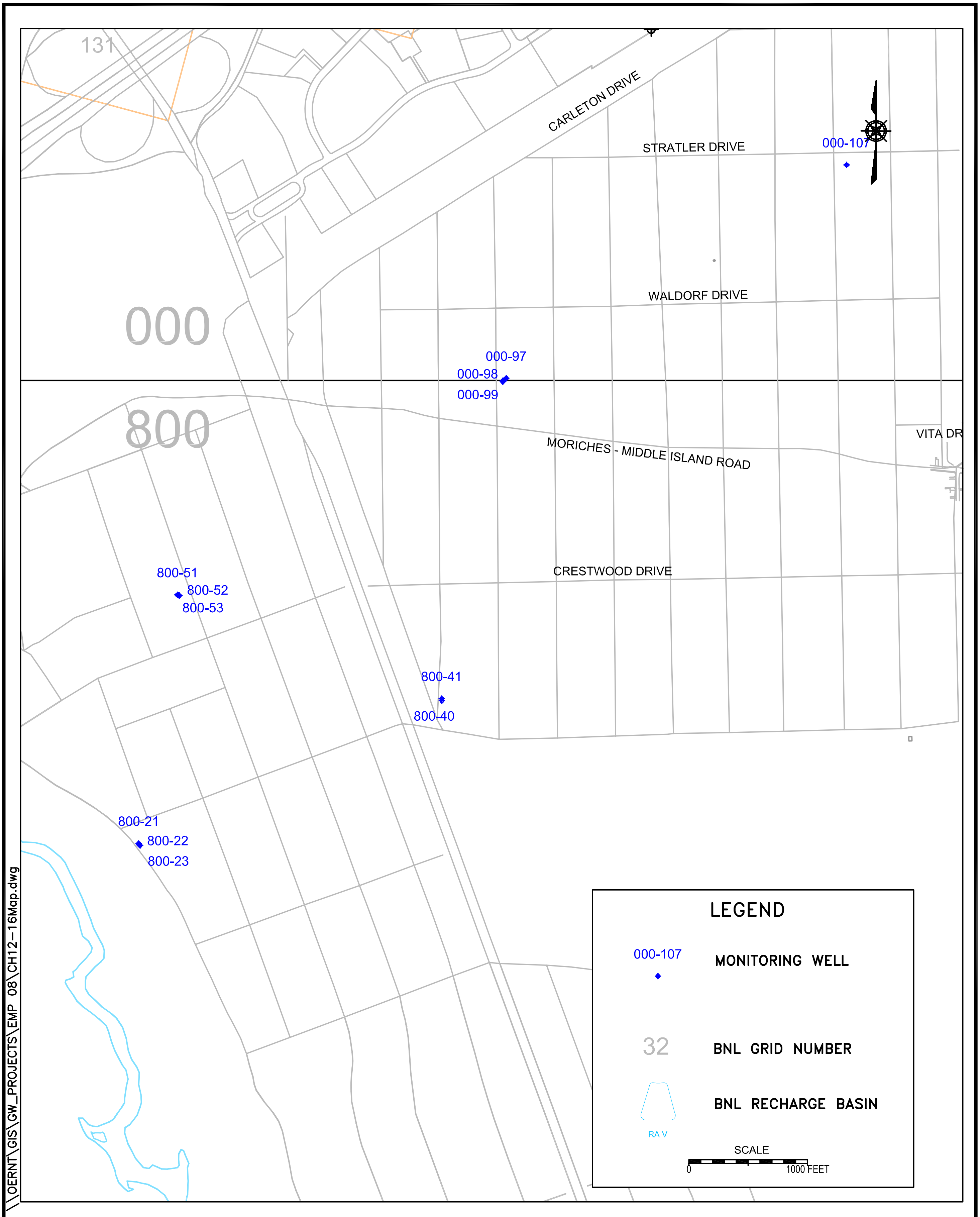

BROOKHAVEN NATIONAL LABORATORY

EWMSD

TITLE:

OU III OFFSITE
POST-ROD
MONITORING WELL LOCATIONS
2008 EMP

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
JEB	–	12/14/07	7926
CHKD:	APPD:	REV.:	NOTES:
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FIGURE NO.: 12.16.1

OU III INDUSTRIAL PARK

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, October 23, 2006

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

SUMMARY OF PROPOSED CHANGES

The following changes to the OU III Industrial Park treatment system and monitoring program were issued in the 2006 Annual Groundwater Status Report:

- The system will continue operations at 60 gpm per well except for wells UVB-1 and UVB-4, which is to remain in a standby mode. Monthly sampling will continue, and if TVOC concentrations greater than 50 µg/L are observed, wells UVB-1 and -4 will be restarted.

DESCRIPTION AND TECHNICAL BASIS

The sources for the VOC plumes addressed by the OU III Industrial Park program are located within the developed central areas of the BNL Site. Due to the proximity of the plume source areas and variability in groundwater flow direction in the vicinity of the source areas, the plumes are commingled south of the BNL site boundary. Groundwater flow south of the BNL site boundary is toward the south, with a slight south-southwesterly component in the southwestern portion of the project area.

A portion of the commingled VOC plume migrated beyond the BNL site boundary prior to construction and operation of the OU III South Boundary groundwater extraction and treatment system. In response, the seven in-well air stripping treatment wells that comprise the OU III Industrial Park System were constructed within the Parr Industrial Park, located south of the west-central portion of the BNL southern site boundary. This system was constructed to provide hydraulic control to prevent further downgradient migration of the VOC plume and to remediate the portion of the plume with a concentration of total VOCs above 50 µg/L in the deep Upper Glacial aquifer. The system has been operated since December 1999.

The monitoring well network for the OU III Industrial Park project consists of 40 wells, plus the seven recirculation wells. These wells monitor the VOC plume in the vicinity of the Parr Industrial Park as well as the effectiveness of the seven in-well groundwater treatment systems. Additional characterization of groundwater contamination within the shallow Magothy aquifer is planned. If warranted, remediation systems will be designed and constructed to address Magothy contamination at a future date. The contaminants of concern associated with the OU III Industrial Park are VOCs.

Well locations are shown on Figure 12.17.1. The plume core and plume perimeter wells are currently sampled semi-annually and the bypass detection wells are sampled quarterly for analysis of VOCs with the exception of shallow wells 000-254, 000-257, 000-260, 000-263, 000-266, and 000-269, which are sampled annually for VOC analysis. The monitoring schedule is provided in Table 12.1.2.

During calendar year 2006, 11 of the 40 wells contained concentrations of individual chlorinated VOCs greater than New York State groundwater standards, including tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, 1,1-dichloroethene, methylene chloride, carbon tetrachloride, chloroform, 1,1,2,2-tetrachloroethane and 1,1,1-trichloroethane.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health or the environment has been defined south of the BNL site. In response, remediation of the plume has been conducted since September 1999. Data are needed to verify that the remediation is occurring according to plan.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Have the cleanup goals been met?
- If not, has the plume been controlled?
- Is the system operating as planned?
- Have asymptotic conditions been demonstrated?

Step 3: Identify Inputs to the Decision

The project was divided into four decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume core wells (Decisions 1, 2, 4, and 5)
- Plume perimeter wells, used to define the extent of the plume (Decisions 1 and 3)
- Bypass detection wells (Decisions 1, 3, and 4)
- Magothy (Decision 1 and planning for future Magothy restoration)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater

- Location of existing wells relative to flow patterns (Figure 12.17.1)
- Evaluation of capture zone for extraction wells
- Action levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data
-

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Long Island Expressway to the north
- Carleton Drive to the south
- Boxwood Drive (well 000-272) to the east
- Lockwood Drive (well 000-245) to the west
- the Upper Glacial aquifer

Separate decisions will be made in the four subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire system. The temporal boundaries of the study area vary, based on the decision.

- *Plume Core*: Because the system is in its fourth year of operation and is in the operation and maintenance (O&M) phase, data are needed on a less frequent basis. Therefore, the timeframe for decisions for this subunit is 180 days.
- *Plume Perimeter*: Because the wells in this subunit define the plume horizontally and vertically, which is used to determine whether the plume is being captured, the timeframe for decisions here is 180 days. Shallow wells located above the plume core have been monitored since 1999 and remain clean. These monitoring wells are for verifying that the shallow zone remains clean. This has been demonstrated with 3 years of data. The probability of the shallow zone becoming contaminated is low because the treated effluent is monitored before return to the aquifer and operational adjustments are made as required to ensure adequate treatment. Therefore, the shallow zone decision time frame is not less than 365 days.
- *Bypass Detection Area*: Because the wells in this area indicate whether the plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Was the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

This decision applies to the plume fringe and bypass detection wells. **If** the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume fringe or bypass detection wells to above 50 µg/L (if currently less than 50 µg/L) or a significant increase in total VOC concentration (if currently above 50 µg/L).

If the trend in each plume perimeter and bypass detection well has a negative or zero slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 µg/L, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for this treatment system?

This decision applies to the plume core and bypass detection wells. **If** the system is performing as planned, **then** actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. **If** not, **then** consider operational adjustments and/or engineering evaluation. Note: When the majority and/or "key" wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Can the groundwater treatment system be shut down?

All of the following decision subunits must be satisfied in order to shut down an extraction well.

4a. Have asymptotic TVOC concentrations been reached in core wells?

> This decision applies to the plume core area wells. When no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.
>
> **If**, for each plume core well, the slope of mean concentrations for all contaminants of concern are not different from zero for three years, and if subject matter experts on BNL hydrogeology and hydrochemistry concur with the results of the statistical analysis, **then** petition for system shutdown. If not, then continue system operation.

4b. Is the mean TVOC concentration in core wells less than 50 ug/L (expected by 2025)?

This decision also applies to the plume core wells. It is anticipated that approximately seven to ten years of active groundwater treatment will reduce the mean TVOC concentrations in the plume core to less than 50 µg/L.

If this occurs, **then** it is reasonable to expect (based on model projections) that MNA of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs within 30 years. **If** the TVOC concentration remains above 50 µg/L, **then** consider operational adjustments and/or engineering evaluation.

4c. How many individual plume core wells are above 50 ug/L TVOC ?

If the total VOC concentration in each plume core well has been reduced to less than 50 µg/L in less than 7 to 10 years of active remediation, **then** proceed with pulsed operation of the system (see Decision subunit 4c). **If** not and treatment has occurred for less than 7 to 10 years, **then** continue treatment. **If** not and treatment has occurred for at least 7 to 10 years, **then** perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2025.

4d. During pulsed operation, is there significant concentration rebound in the core wells?

This decision is to determine whether there is significant concentration rebound after system pulsing. **If** yes, and system has operated for less than 7 to 10 years, **then** continue operation. **If** yes and system has operated for more than 7 to 10 years, **then** an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted. If no significant rebound is observed within a 1-year time period, then petition for system shut-down and continue with MNA.

Decision 5

Have the groundwater cleanup goals been met? Specifically, have MCLs been achieved (expected by 2030)?

If the mean concentration of TVOCs in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 50 µg/L, and if the mean TVOC concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous two years, is less than 50 µg/L, and pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations, **then** petition for system shutdown and continue with MNA until MCLs are met. If not, then consider the need for continued remediation. Note: This assumes that system operation is already considered "optimal."

Step 6: Specify Acceptable Error Tolerances

Table 12.17.1 summarizes the decision and possible decision errors for this project.

Table 12.17.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based On Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Have cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ imple-menting operational adjustments.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than neces-sary, wasted resources.
Is the system per-forming as planned?	See Step 3 for inputs.	(1) Determine system is performing as planned when it is not. (2) Determine system is not performing as planned when it is.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ imple-menting operational adjustments.
Have asymptotic conditions been demonstrated?	See Step 3 for inputs.	(1) Determine asymptotic conditions reached when they are not. (2) Determine asymptotic conditions not reached when they are.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Locations of Wells

The number and locations of wells for this program are considered adequate.

Parameters and Frequency

The plume core and plume perimeter wells are currently sampled semi-annually and the bypass detection wells are sampled quarterly for analysis of VOCs with the exception of shallow wells 000-254, 000-257, 000-260, 000-263, 000-266, and 000-269, which are sampled annually for VOC analysis. A summary of the revised sampling program for this project is provided in Table 12.17.2.

ANNUAL COST IMPACT DUE TO CHANGE

Based on the new sampling contract prices, the sampling program costs will increase by $250 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2007	$40,244
FY2008	$40,724
Difference	$250

See Appendix B for the monitoring program for this DQO.

Table 12.17.2 Proposed Modifications to the Industrial Park Project Monitoring Wells

Well	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
000-112	Semi-annually	No Change	None
000-114	Semi-annually	No Change	None
000-245	Semi-annually	No Change	None
000-246	Semi-annually	No Change	None
000-247	Semi-annually	No Change	None
000-248	Semi-annually	No Change	None
000-249	Quarterly	No Change	None
000-250	Quarterly	No Change	None
000-251	Semi-annually	No Change	None
000-252	Semi-annually	No Change	None
000-253	Semi-annually	No Change	None
000-254	Annually	No Change	None
000-255	Semi-annually	No Change	None
000-256	Semi-annually	No Change	None
000-257	Annually	No Change	None
000-258	Semi-annually	No Change	None
000-259	Semi-annually	No Change	None
000-260	Annually	No Change	None
000-261	Semi-annually	No Change	None
000-262	Semi-annually	No Change	None
000-263	Annually	No Change	None
000-264	Semi-annually	No Change	None
000-265	Semi-annually	No Change	None
000-266	Annually	No Change	None
000-267	Semi-annually	No Change	None
000-268	Semi-annually	No Change	None
000-269	Annually	No Change	None
000-270	Semi-annually	No Change	None
000-271	Semi-annually	No Change	None
000-272	Semi-annually	No Change	None
000-273	Quarterly	No Change	None
000-274	Quarterly	No Change	None
000-275	Quarterly	No Change	None
000-276	Quarterly	No Change	None
000-277	Quarterly	No Change	None
000-278	Quarterly	No Change	None
000-279	Semi-annually	No Change	None
000-280	Quarterly	No Change	None
000-431	Quarterly	No Change	None
000-432	Quarterly	No Change	None

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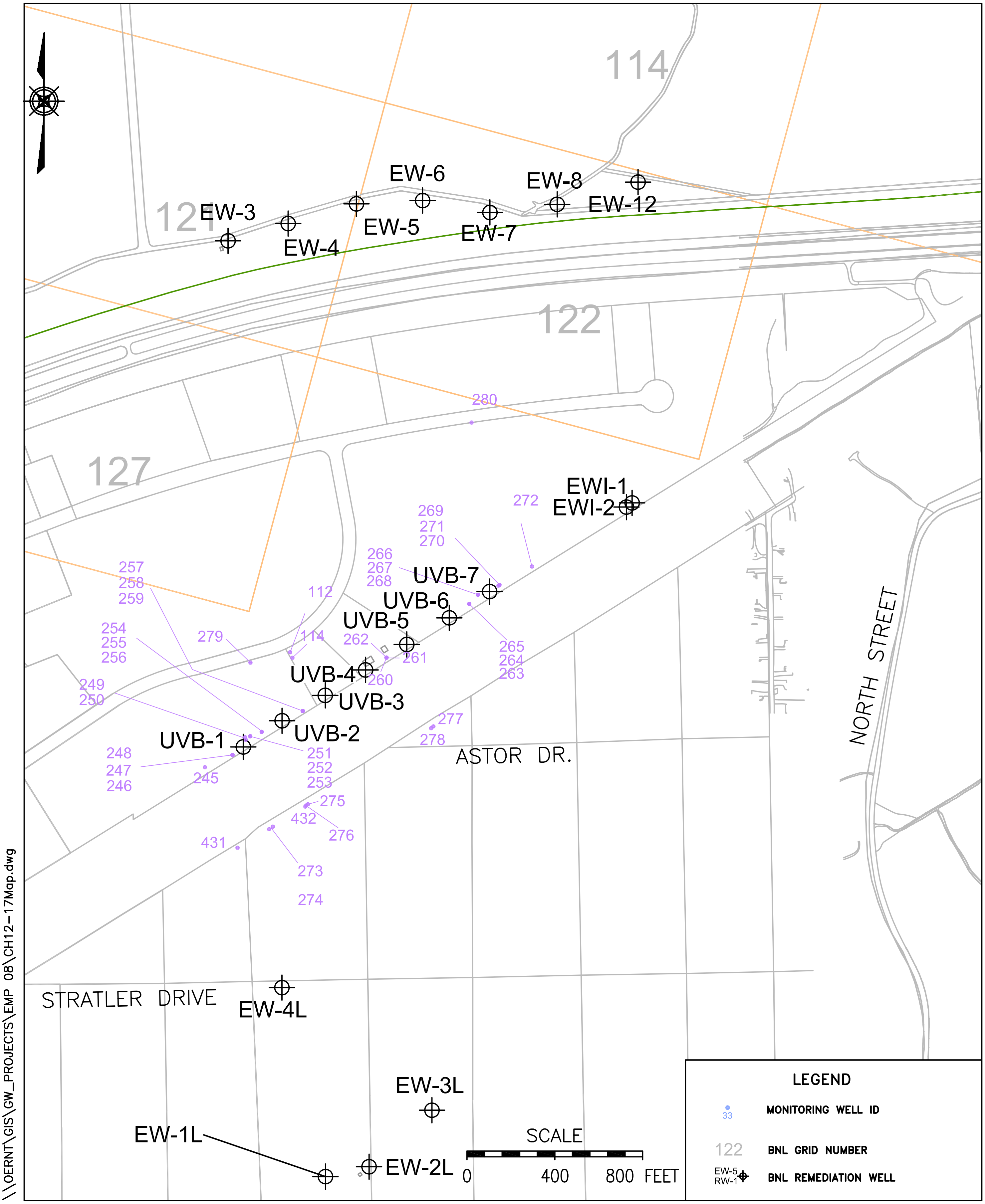


BROOKHAVEN NATIONAL LABORATORY

EWMSD

TITLE:

OU III INDUSTRIAL PARK
MONITORING WELL LOCATIONS

2008 EMP

DWN: JEB	VT: HZ.: –	DATE: 12/14/07	PROJECT NO.: 07926
CHKD: --	APPD: --	REV.: 1	NOTES: –
FIGURE NO.: 12.17.1			

OU IV AOC 5

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 5, December 7, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

SUMMARY OF PROPOSED CHANGES

No changes to the OU IV Former AS/SVE Post-Closure groundwater monitoring program are warranted at this time.

DESCRIPTION AND TECHNICAL BASIS

The OU IV AOC 5 project monitors a 1977 spill of fuel oil and mineral spirits that occurred at the BNL CSF, as well as other minor historic spills that occurred in the vicinity of the CSF. An air sparge/soil vapor extraction system had been operated from November 1997 until July 2003 to address these contaminant sources. Groundwater sample results show that the system has been effective at reducing contaminant levels. A request to shut down the remediation system was submitted to the regulators in December 2000, and approved. However, groundwater sample results from the October 2000 sampling event showed exceedances of New York State groundwater standards for VOCs in two wells (076-04 and 076-06). In response, a portion of the remediation system was restarted and additional remediation using Oxygen Release Compound® (ORC) was implemented in early CY2001.

This project has completed the active treatment phase, and has shifted to the post closure monitoring phase. Cleanup goals for this project are NYSDEC Class GA Groundwater Standards for each contaminant, unless asymptotic conditions are reached at some higher level. A portion of the plume migrated past the treatment area before remediation was implemented. These contaminants will be addressed by downgradient remediation systems that are currently in operation and by natural attenuation.

The groundwater flow direction is generally to the south, although it may vary due to effects from several recharge basins in the area. The monitoring well network for the OU IV AOC 5 project consists of three wells. Well locations are shown on Figure 12.18.1. Wells 076-04 and 076-06 are sampled quarterly for analysis of VOCs and SVOCs and well 076-185 is sampled semi-annually for analysis of VOCs, as shown in Tables 12.1.1 and 12.1.2.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance

x Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health has been defined in the central portion of the BNL Site. In response, remediation of the plume has been conducted since November 1997. Data are needed to verify that cleanup objectives have been met.

Step 2: Identify the Decision

The decisions for the project are:

1. Is the BNL Groundwater Contingency Plan triggered?
2. Have the cleanup goals been met?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs and SVOCs in groundwater
- Locations of existing wells relative to flow patterns
- OU IV Operation and Maintenance Manual
- June 2002 Petition for closure for the OU IV AS/SVE Remediation System
- Action levels
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

- Cornell Avenue (well 076-02) to the north
- Brookhaven Avenue to the south
- Seventh Street (wells 076-23 and 076-18) to the west
- North Sixth Street and well 076-06 to the east
- the shallow and mid-depth portions of the Upper Glacial aquifer

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Step 6: Specify Acceptable Error Tolerances

Table 12.18.1 summarizes the decision and possible decision errors for this project.

Table 12.18.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays (2) Lost time in addressing problem, loss of stakeholder confidence.
Have cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.
Are additional enhancements necessary or is further operation of the AS/SVE system required?	See Step 3 for inputs.	(1) Determine enhancements or system restart is not required when it is. (2) Determine enhancements or system restart is required when it is not.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments or system restart.

Step 7: Optimize the Design

Number and Locations of Wells

The number and locations of wells for this program are considered adequate.

Parameters and Frequency

No changes to the monitoring program are warranted at this time.

Table 12.18.2 Proposed Modifications to the AOC 5 AS/SVE Project Monitoring Wells

Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
076-04	Semi-annually	No Change	None
076-06	Semi-annually	No Change	None
076-185	Semi-annually	No Change	None

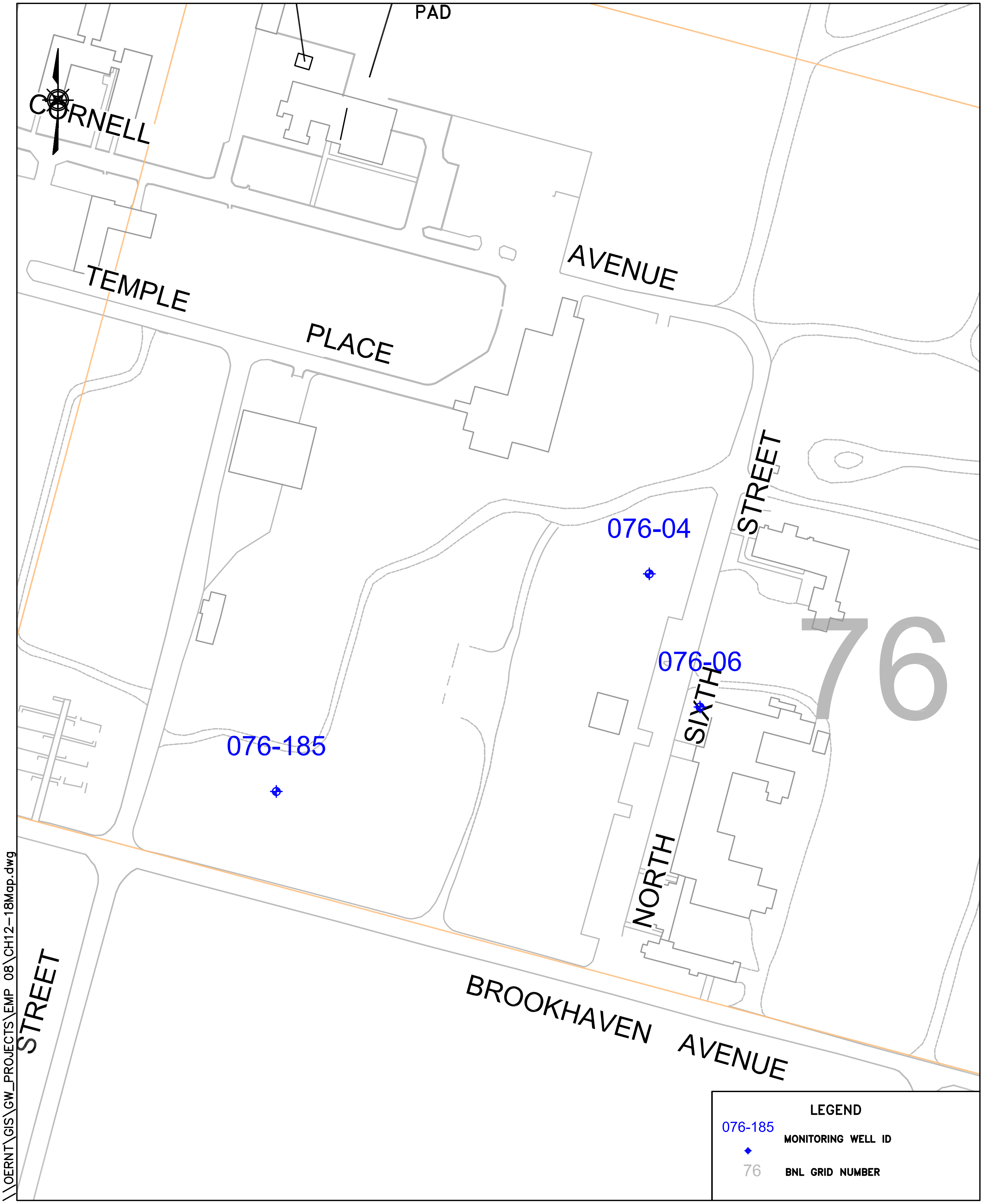
Annual Cost Impact Due to Proposed Change

The sampling program costs have not changed..

Total Cost for Monitoring Program

FY2007	$2,800
FY2008	$2,800
Difference	$0

See Appendix B for the monitoring program for this DQO.



BROOKHAVEN NATIONAL LABORATORY
EWMS DIVISION

TITLE:
OU IV AOC 5
MONITORING WELL LOCATIONS
2008 EMP

DWN: JEB	VT:HZ.: –	DATE: 12/14/07	PROJECT NO.: 07926
CHKD: JEB	APPD: --	REV.: –	NOTES: –
FIGURE NO.:		12.18.1	

OU IV AOC 6 – Building 650 Sump Outfall Area

DQO Start Date January 1, 2003

Revision Number/Date Rev. 3, December 7, 2007

Implementation Date January 1, 2008

Point of Contact William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

Summary of Changes

The following changes were made for the Building 650 Strontium-90 Groundwater Monitoring Program:

- Reduce the sampling frequency for monitoring wells 076-07, -09, -10, -22, -181, -182, -184, and -265 to annual.
- Since the primary contaminant for this plume is Sr-90, delete further monitoring of gross alpha/beta, gamma spectroscopy, and tritium.

Description and Technical Basis

The OU IV AOC 6 project monitors a Sr-90 plume emanating from contaminated soil within an area known as the Building 650 Sump Outfall Area. This area is a natural depression at the terminus of a discharge pipe from Building 650. The pipe conveyed discharges from decontamination of radioactively contaminated clothing and equipment that was conducted on an outdoor pad at Building 650 beginning in 1959. Impacted soil within the sump outfall area was excavated during CY2002. Groundwater flow in this area is toward the south–southwest.

The monitoring well network for the OU IV AOC 6 project consists of 29 wells. The wells are located to monitor groundwater downgradient of the decontamination pad and Building 650 Sump Outfall Area. Some wells were constructed south of the leading edge of the plume to act as sentinel wells. Well locations are shown on Figure 12.19.1. In accordance with the ROD for OU IV, the wells are sampled semi-annually for analysis of Sr-90, gross alpha/beta, gamma spectroscopy, and tritium. A schedule is provided in Table 12.1.1.

During CY2006, two wells contained Sr-90 at an activity above New York State groundwater standards. No other radionuclides were detected at activities above New York State groundwater standards in any of the OU IV AOC 6 wells. In general, Sr-90 activity trends are stable for the wells within the plume, and in wells downgradient of the plume.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater in the vicinity of Building 650 and the Building 650 Sump Outfall Area, and downgradient of these areas, has been impacted by Sr-90 at activities exceeding New York State groundwater standards. Data are needed to define the extent of the Sr-90 plume.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Are performance objectives met?
- If not, are observed conditions consistent with the attenuation model?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include

- Direction and velocity of groundwater flow
- Radionuclide analytical results in groundwater
- Locations of existing wells relative to flow patterns
- Action levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

The project decision unit limits are defined by:

- HO Basin (well 066-190) on the north
- Brookhaven Avenue on the south
- Railroad Street (wells 076-373 and 076-317) on the west
- HO Basin and RA V Basin on the east
- shallow and mid-depth Upper Glacial aquifer

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Are performance objectives met?

The performance objectives for this project are Sr-90 activities below New York State groundwater standards.

If, for all wells, the mean Sr-90 activity in groundwater, computed from the previous four consecutive sampling events, is less than the New York State groundwater standard and the computed mean is consistent with professional judgment, **then** petition for cessation of monitoring; otherwise, continue monitoring.

Decision 3

If not, are observed conditions consistent with the attenuation model?

If performance objectives have not been met, **then** it must be determined whether Sr-90 activities in groundwater are consistent with the attenuation model (e.g., results are on track to attenuate to less than MCLs within 30 years).

If the detected Sr-90 activities are consistent with the attenuation model, groundwater model results and professional judgment, **then** continue monitoring. If not, consider refining the conceptual model and/or conducting an evaluation to determine whether outside factors (such as additional contaminant sources) are affecting the results. As part of this decision, the following subrules apply:

- **If** the gross alpha activity exceeds 5 pCi/L and the results are not explained by the gamma spectroscopy results, **then** isotopic alpha analyses will be performed to determine which radionuclides are present.
- **If** the gross beta activity results exceed 16 pCi/L and the results are not explained by the Sr-90 or gamma spectroscopy results, **then** isotopic analyses will be performed to determine which radionuclides are present.
- **If** the gamma spectroscopy results show positive results for radionuclides which have specific isotopic analyses, **then** the original groundwater sample will be analyzed for the specific radionuclide to confirm the activity.

Step 6: Specify Acceptable Error Tolerances

Table 12.19.1 summarizes the decision and possible decision errors for this project.

Table 12.19.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Are performance objectives met?	See Step 3 for inputs.	(1) Data indicate that performance objectives have not been met when they have. (2) Data indicate that performance objectives have been met when they have not.	(1) Wasted resources conducting continued unnecessary monitoring. (2) Potential bypass of contaminants, project delays, potential risk to down-gradient receptors.
If not, are observed conditions consistent with attenuation model?	See Step 3 for inputs.	(1) Data indicate that conditions are not consistent with model when they are. (2) Data indicate that conditions are consistent with model when they are not.	(1) Wasted resources conducting attenuation model refinements and introducing supplements. (2) Potential bypass of contaminants, project delays, potential risk to down-gradient receptors.

Step 7: Optimize the Design

Number and Locations of Wells

The number and locations of wells for this program are considered adequate.

Parameters and Frequency

The majority of the wells are sampled semi-annually for analysis of Sr-90, gross alpha/beta, gamma spectroscopy, and tritium. Based on a recommendation in the 2006 Annual Groundwater Status Report, wells 076-07, 076-09, 076-10, 076-22, 076-181, 076-182, 076-184, and 076-265 were reduced in frequency to annual sampling. In addition tritium, gamma spectroscopy, and gross alpha/beta analyses were dropped from the program.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications described in Step 7 will result in a decrease in sampling and analysis costs of $7,489 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2007	$18,080
FY2008	$10,591
Difference	$-7,489

See Appendix B for the monitoring program for this DQO.

Table 1219.2 Proposed Modifications to the AOC 6 Project Monitoring Wells

Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
076-05	Semi-annually	No Change	Delete gross alpha/beta, gamma spectroscopy, and tritium.
076-07	Semi-annually	Annually	Delete gross alpha/beta
076-09	Semi-annually	Annually	Delete gross alpha/beta
076-181	Semi-annually	Annually	Delete gross alpha/beta
076-182	Semi-annually	Annually	Delete gross alpha/beta
076-183	Semi-annually	No Change	Delete gross alpha/beta
076-184	Semi-annually	Annually	Delete gross alpha/beta
076-22	Semi-annually	Annually	Delete gross alpha/beta
076-24	Semi-annually	No Change	Delete gross alpha/beta
066-17	Semi-annually	No Change	Delete gross alpha/beta
066-189	Semi-annually	No Change	Delete gross alpha/beta
066-190	Semi-annually	No Change	Delete gross alpha/beta
076-13	Semi-annually	No Change	Delete gross alpha/beta
076-167	Semi-annually	No Change	Delete gross alpha/beta
076-168	Semi-annually	No Change	Delete gross alpha/beta
076-169	Semi-annually	No Change	Delete gross alpha/beta
076-20	Semi-annually	No Change	Delete gross alpha/beta
076-25	Semi-annually	No Change	Delete gross alpha/beta
076-26	Semi-annually	No Change	Delete gross alpha/beta
076-262	Semi-annually	No Change	Delete gross alpha/beta
076-263	Semi-annually	No Change	Delete gross alpha/beta
076-264	Semi-annually	No Change	Delete gross alpha/beta
076-265	Semi-annually	Annually	Delete gross alpha/beta
076-27	Semi-annually	No Change	Delete gross alpha/beta
076-28	Semi-annually	No Change	Delete gross alpha/beta
076-314	Semi-annually	No Change	Delete gross alpha/beta
076-317	Semi-annually	No Change	Delete gross alpha/beta
076-373	Semi-annually	No Change	Delete gross alpha/beta
076-10	Semi-annually	Annually	Delete gross alpha/beta

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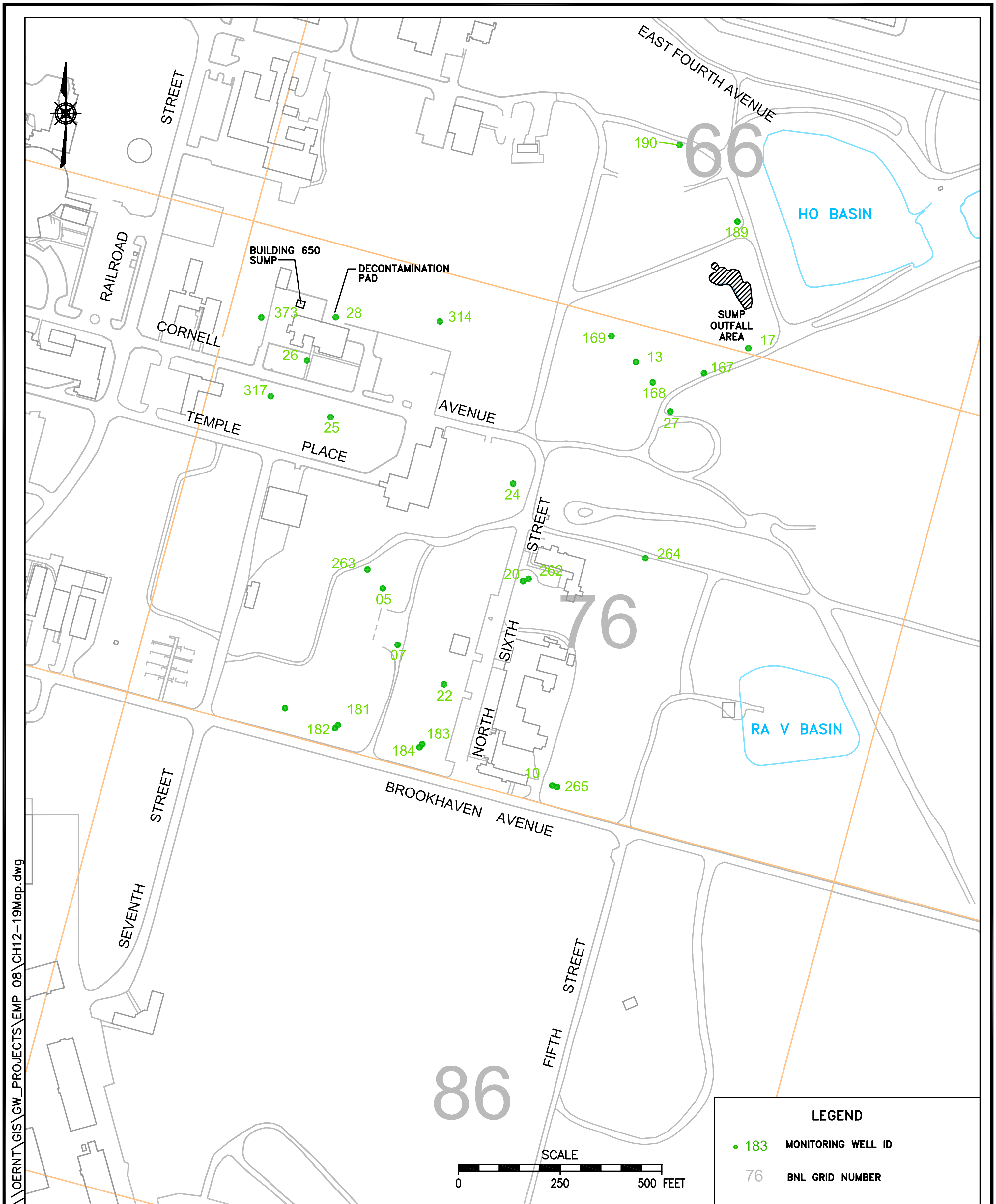

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TITLE:

OU IV AOC 6
MONITORING WELL LOCATIONS
2008 EMP

DWN: JEB	VT: HZ.: –	DATE: 12/14/07	PROJECT NO.: 07926
CHKD: JEB	APPD: ––	REV.: –	NOTES: –
FIGURE NO.:	12.19.1		

OU V SEWAGE TREATMENT PLANT TVOC PLUME DISTRIBUTION

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, December 7, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-7046

SUMMARY OF CHANGES

The following changes were made for the OU V plume groundwater monitoring program:

- The monitoring program sampling frequency will change from semi-annual to annual.

DESCRIPTION AND TECHNICAL BASIS

Historically, the BNL STP received discharges of contaminants from routine operations at the facility. Releases of contaminants, in particular, VOCs, metals, and radionuclides, to groundwater occurred via the STP sand filter beds and discharges to the Peconic River. In addition, trace levels of pesticides have occasionally been detected in some wells. Public water was provided by BNL in 1997 to off-site residences downgradient of the plume. The OU V project monitors the identified groundwater contamination in the area of the STP, eastern site boundary, and off site. Groundwater flow in the vicinity of the STP is toward the southeast and toward the south-southeast in the vicinity of the southeastern BNL site boundary.

The monitoring well network for the OU V project consists of 34 wells designed to monitor the attenuation of the contaminants, including sentinel wells constructed downgradient of the off-site VOC plume. The BNL Regional Groundwater Model was utilized for placement of the sentinel wells. Well locations are shown on Figure 1. The wells are sampled semiannually for analysis of VOCs and tritium (Table 12.1.1 and 12.1.2).

There were no significant changes to the VOC plume in 2006, as compared to 2005. During 2006, the highest TVOC concentration was 13 µg/L in well 000-122, located just north of the Long Island Expressway. In general, VOC concentrations in on-site plume core wells decreased slightly, while the TVOC concentrations in off-site plume core well 000-122 displayed a slight increase. The only individual VOCs detected at levels exceeding NYS AWQS were TCE, and 1,2-dichloropropane.

Eight OU V monitoring wells were sampled and analyzed for perchlorate during the 2006 sampling rounds. This sampling was performed in response to a SCDHS request in June 2004. The request was prompted by the detection of perchlorate in SCDHS monitoring well EGA, located off site and east of BNL. The perchlorate was detected in the deep section of the Upper Glacial aquifer. The compound was detected in wells 049-06, 061-05, and 000-123, all of which monitor the deep portion of the Upper Glacial aquifer. Well 049-06 is near the eastern firebreak road, well 061-05 is at the eastern site boundary and well 000-123 is located immediately north of the LIE.

The maximum perchlorate concentration, from well 000-123, was 15 µg/L, again, below the NYSDOH action level. Concentrations in wells 049-06 and 061-05 have been slowly declining over the past several years. The detection in well 000-123 during the March 2006 sampling round is the first for this well; perchlorate was not detected in the September 2006 sampling event for this well.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

_x_ Compliance
___ Support Compliance
___ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Groundwater downgradient of the BNL STP and off site has been impacted by contaminants at concentrations exceeding New York State groundwater standards. Data are needed to confirm that these contaminants are attenuating according to plan and that performance objectives are achieved.

Step 2: Identify the Decision

The decisions for the project are:

- Is the BNL Groundwater Contingency Plan triggered?
- Are performance objectives met?
- Is the extent of the plume still defined by the existing monitoring well network?

Step 3: Identify Inputs to the Decision

The project was divided into three decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume core wells (Decisions 1 and 2)
- Sentinel wells, used to define the extent of the plume (Decisions 1 and 3)
- Background wells (Decision 1)

The wells included in each subunit are shown in Table 12-1.2. The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs, pesticides, PCBs, metals, water quality parameters, and tritium in groundwater
- Locations of existing wells relative to flow patterns
- Action levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

The project decision unit limits are defined by:

- the BNL STP to the north and west
- Country Club Drive on the south
- Chichester Avenue/Wading River Road on the east
- Upper Glacial and Upper Magothy aquifers

Separate decisions will be made for the three subunits described in Step 3. As described below, the temporal boundaries of the study area are currently the same for each decision subunit. The temporal boundaries will remain the same until the project's first 5-year review. At that time, the timeframe for decisions in a subunit may be modified. Therefore, the subunits have been described separately.

- *Plume Core:* Plume core wells will be used to provide data for measuring the attenuation of the contaminants and evaluating whether performance objectives (cleanup goals) have been met. The timeframe for decisions for this subunit is 180 days.
- *Sentinel:* The wells included in this subunit will be used to provide data to evaluate whether the existing well network can be used to define the plume, thereby ensuring potential downgradient receptors are protected. The timeframe for decisions here is 180 days.
- *Background:* The wells in this area will provide data for evaluating contamination from upgradient sources that may be entering the project area. The decision timeframe for this area is 180 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

For each future sampling event, sample results from all wells will be evaluated in context with historic data. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Are performance objectives met?

The performance objectives for this project are to attain drinking water standards in groundwater in the Upper Glacial aquifer within 30 years. Sample results from plume core wells will be evaluated to determine whether these objectives have been met.

If, for all plume core wells, the mean concentration for each individual VOC in groundwater, computed from the previous four consecutive sampling events, is less than the New York State groundwater standard for that compound and the computed mean is consistent with professional judgment, **then** petition for cessation of monitoring; otherwise, continue monitoring.

Decision 3

Is the extent of the plume still defined by the existing monitoring well network?

In order to ensure that potential downgradient receptors are protected, the plume must be able to be defined by the existing monitoring well network. Sample results from sentinel wells will be compared to New York State groundwater standards to evaluate the extent of the plume.

If evaluation of VOC results in conjunction with historic analytical results and trends, groundwater model predictions, and site conceptual model and professional judgment, indicates that the plume can still be defined by the existing monitoring well network, **then** continue monitoring. If not, consider recategorizing some wells into a different decision subunits and conducting an evaluation of whether additional sentinel wells are required.

Step 6: Specify Acceptable Error Tolerances

Table 12.20.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the BNL Groundwater Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Are performance objectives met?	See Step 3 for inputs.	(1) Data indicate that performance objectives have not been met when they have. (2) Data indicate that performance objectives have been met when they have not.	(1) Wasted resources conducting continued unnecessary monitoring. (2) Potential bypass of contaminants, project delays, potential risk to downgradient receptors.
Is the extent of the plume still defined by the existing monitoring well network?	See Step 3 for inputs.	(1) Data indicate the plume is not defined by existing wells when it is. (2) Data indicate the plume is defined by existing wells when it is not.	(1) Wasted resources evaluating, possibly constructing and sampling additional wells. (2) Potential bypass of contaminants and potential risk to downgradient receptors.

Step 7: Optimize the Design

Number and Locations of Wells

The number and locations of wells for this program are considered adequate.

Parameters and Frequency

The contaminants of concern for the OU V STP are VOCs, tritium, and perchlorate. The sampling frequency will change from semi-annual to annual sampling. A summary of the proposed sampling program is provided in Table 12.20.2.

Annual Cost Impact Due to Proposed Change

The sampling program modifications described in Step 7 will result in a decrease in sampling and analysis costs of $6,864 per year.

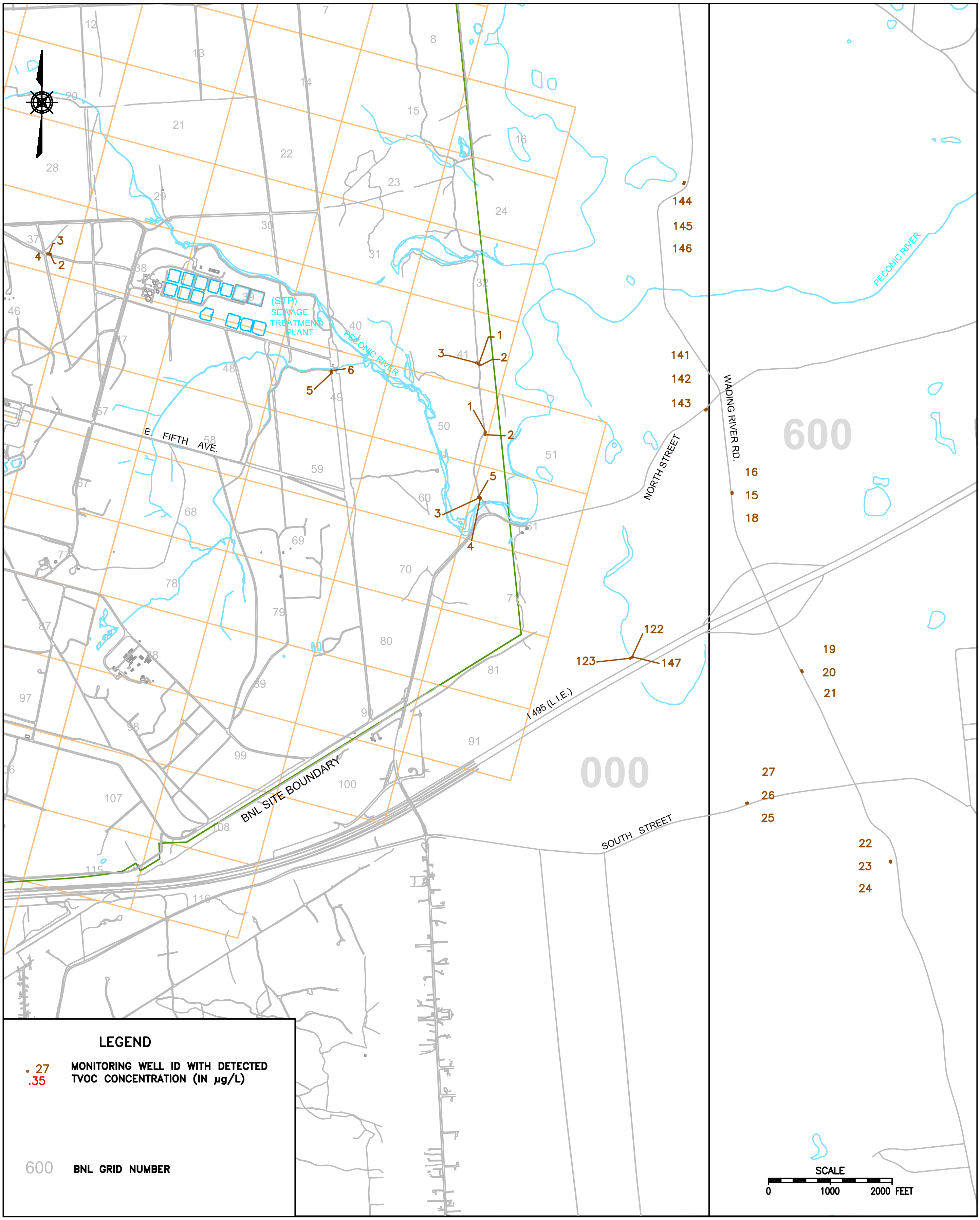
Total Cost for Monitoring Program

FY2007	$14,425
FY2008	$7,561
Difference	$-6,864

See Appendix B for the monitoring program for this DQO.

Table 12.20.2 Proposed Modification to the OU V Monitoring Wells

Well ID	Current Sampling Frequency	Sampling Frequency Changes	Affected Parameters
000-122	Semi-annually	Annual	All
000-123	Semi-annually	Annual	All
000-141	Semi-annually	Annual	All
000-142	Semi-annually	Annual	All
000-143	Semi-annually	Annual	All
000-144	Semi-annually	Annual	All
000-145	Semi-annually	Annual	All
000-146	Semi-annually	Annual	All
000-147	Semi-annually	Annual	All
037-02	Semi-annually	Annual	All
037-03	Semi-annually	Annual	All
037-04	Semi-annually	Annual	All
041-01	Semi-annually	Annual	All
041-02	Semi-annually	Annual	All
041-03	Semi-annually	Annual	All
049-05	Semi-annually	Annual	All
049-06	Semi-annually	Annual	All
050-01	Semi-annually	Annual	All
050-02	Semi-annually	Annual	All
061-03	Semi-annually	Annual	All
061-04	Semi-annually	Annual	All
061-05	Semi-annually	Annual	All
600-15	Semi-annually	Annual	All
600-16	Semi-annually	Annual	All
600-18	Semi-annually	Annual	All
600-19	Semi-annually	Annual	All
600-20	Semi-annually	Annual	All
600-21	Semi-annually	Annual	All
600-22	Semi-annually	Annual	All
600-23	Semi-annually	Annual	All
600-24	Semi-annually	Annual	All
600-25	Semi-annually	Annual	All
600-26	Semi-annually	Annual	All
600-27	Semi-annually	Annual	All



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BROOKHAVEN NATIONAL LABORATORY

EWMS DIVISION

TITLE:

OU V SEWAGE TREATMENT PLANT TVOC PLUME DISTRIBUTION

2008 EMP

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
JEB	–	12/14/07	07926
CHKD:	APPD:	REV.:	NOTES:
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FIGURE NO.:	12.20.1		

OU VI ETHYLENE DIBROMIDE

DQO START DATE	January 1, 2003
REVISION NUMBER/DATE	Rev. 4, December 7, 2007
IMPLEMENTATION DATE	January 1, 2008
POINT OF CONTACT	William Dorsch (631) 344-5186 Vincent Racaniello (631) 344-5436

SUMMARY OF PROPOSED CHANGES

The following change was made for the OU VI EDB Pump and Treat System and groundwater monitoring program:

- Since there were no detections above the DWS for EDB in well 000-498 for 2006, change the sampling frequency for this well from quarterly (system start-up phase) to semi-annually (O&M phase). This will allow for consistency with the remainder of the wells in this monitoring program.

DESCRIPTION AND TECHNICAL BASIS

The monitoring well network for the OU VI EDB Project consists of 33 wells. Three wells (058-02, 089-13, and 089-14) are located on site upgradient of the current EDB plume in the former source area. Five wells (000-180, 000-285, 800-24, 800-25, and 800-54) serve as sentinel wells in the area downgradient and east of the plume. Wells 800-24, 800-25, and 800-54 are being dropped from the program, as they are no longer deemed to be providing value. This is due both to the establishment of hydraulic control of the plume at EW-1E and EW-2E and the fact that these three wells are not positioned, either horizontally or vertically with respect to the plume, to intercept EDB should it reach these locations. The remaining 26 wells define the off-site EDB plume in the horizontal and vertical dimensions. Well locations are shown on Figure 12.21.1. The wells are sampled quarterly for analysis of VOCs and EDB, and annually for analysis of tritium. Table 12.1.1 shows the monitoring schedule for CY2008. Until the middle of CY2001, samples were also analyzed for bromide ion, total organic carbon (TOC), carbon dioxide, ethane, and ethane to evaluate natural degradation of the EDB. However, because active remediation of the plume was implemented during CY2004, analysis for these degradation indicator parameters was discontinued in mid-2001.

The contaminant of concern associated with the OU VI plume is EDB. During CY2006, EDB concentrations exceeding the New York State groundwater standard were not detected in any on-site well, indicating that the plume has migrated completely off site. There were no exceedances of New York State groundwater standards for VOCs other than EDB in any of the wells during CY2006.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

There is an existing plume of groundwater contaminated by EDB that has migrated south of the BNL Site boundary. In response, a groundwater remediation system is currently being designed. Data are needed to confirm the vertical and horizontal extent of the EDB plume so that the design of the remediation system can be optimized

Step 2: Identify the Decision

Is the design of the planned remediation system adequate to intercept and treat the existing contamination to prevent impacts to potential downgradient receptors?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- EDB analytical results in groundwater
- Locations of existing wells relative to flow patterns (Figure 12.21.1)
- Regulatory drivers (OU I ROD)
- action levels (New York State groundwater standards and/or baseline groundwater concentrations)
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data
- Status of potential downgradient receptors

Step 4: Define the Study Boundaries

The horizontal extent of the study area is the existing EDB plume and surrounding wells at, and south of, the southern BNL site boundary. These limits are defined by well 100-12 to the north, wells 800-24, 800-25, and 800-54 to the south, wells 000-285 and 000-180 to the east, and wells 099-06, 000-117, and 800-54 to the west. The vertical extent of the study area is the saturated thickness of the Upper Glacial aquifer.

Because the contaminant plume has already passed the southern BNL site boundary, tracking the plume configuration over time is of critical importance. In addition, the remediation system design will depend on the plume configuration. The timeframe to consider analytical results is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all three subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

If not, has the plume been controlled?

This decision applies to the perimeter and bypass detection wells. If the cleanup goals have not been met, it must be verified that the plume is not growing. Plume growth is defined as an increase in EDB concentration in perimeter or bypass detection wells to above 0.05 µg/L (if currently less than 0.05 µg/L) or a significant increase in total VOC concentration (if currently above 50 µg/L).

If the trend in each perimeter and bypass detection well has a negative slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the EDB concentration is less than 0.05 µg/L, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate?

This decision applies to the plume core and bypass detection wells. When the system is performing as planned, actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis, and expert judgment), **then** continue to operate. **If** not, **then** consider operational adjustments and/or engineering evaluation. Note: When the majority and/or "key" wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

4. *Can the groundwater treatment system be shut down?*

If evaluation of analytical results for any contaminant of concern in any upgradient or plume core well sample, in conjunction with historic analytical results and trends indicates that the treatment system have met the shutdown criteria of achieving the cleanup goal within 30 years, **then** a petition for shutdown will be issued to the regulatory agencies.

4a. Have asymptotic EDB concentrations been reached in core wells?

This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. **If** no significant reductions in contaminant concentrations have been observed, **then** a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in TVOC concentrations in the plume core wells. The Kendall-Mann statistical test is a nonparametric trend analysis (Gilbert, 1987) used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.

To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

4b. Are there individual plume core wells above 0.05 µg/L EDB ?

This decision also applies to the plume core wells. It is anticipated that approximately 7 to 10 years of active groundwater treatment will reduce the mean TVOC concentrations in the plume core to less than 50 µg/L.

If this occurs, **then** it is reasonable to expect (based on model projections) that MNA of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs within 30 years. **If** the TVOC concentration remains above 50 µg/L, **then** consider operational adjustments and/or engineering evaluation.

4c. During pulsed operation, is there significant concentration rebound in core wells?

If yes, and system has operated for less than 7 to 10 years, **then** continue operation. **If** yes and system has operated for more than 7 to 10 years, **then** an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted (see Decision subunit 4d to help with this decision). **If** no significant rebound is observed within a 1-year time period, **then** petition for system shutdown and continue with MNA.

4d. Have the groundwater cleanup goals been met? Have MCLs been achieved by 2030?

If the mean concentration of EDB in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 0.05 µg/L, and if the mean EDBC concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous two years, is less than 0.05 µg/L, and pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations, **then** petition for system shutdown and continue with MNA until MCLs are met. **If** not, **then** consider the need for continued remediation.

Step 6: Specify Acceptable Error Tolerances

Table 12.21.1 summarizes the decision and possible decision errors for this project.

Table 12.21.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is the Contingency Plan activated?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been trig-gered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Is the system operating as planned?	See Step 3 for inputs.	(1) Determine system operating as planned when it is not. (2) Determine system isn't operating as planned when it is.	(1) Premature petition for system shutoff, potential to have to restart system. (2) Continue remediation that is no longer effective.
Can the groundwater treatment system be shut down?	See Step 3 for inputs.	(1) Determine system can be shut down when operation should continue. (2) Determine to continue operating system when shut down is warranted.	(1) Plume growth continues, ultimate project delays. (2) Wasted resources , project delays.

Step 7: Optimize the Design

Number and Locations of Wells

The monitoring well network for the OU VI EDB Project consists of 30 wells. The locations of the wells are shown in Figure 12.21-1.

Parameters and Frequency

Since there were no detections above the DWS for EDB in well 000-498 for 2006, change the sampling frequency for this well from quarterly (system start-up phase) to semi-annually (O&M phase). This will allow for consistency with the remainder of the wells in this monitoring program.

A summary of sampling parameters and frequency is provided in Table 12.21.2.

Annual Cost Impact Due to Proposed Change

The sampling program modifications described in Step 7 will result in a decrease in sampling and analysis costs of $414 per year.

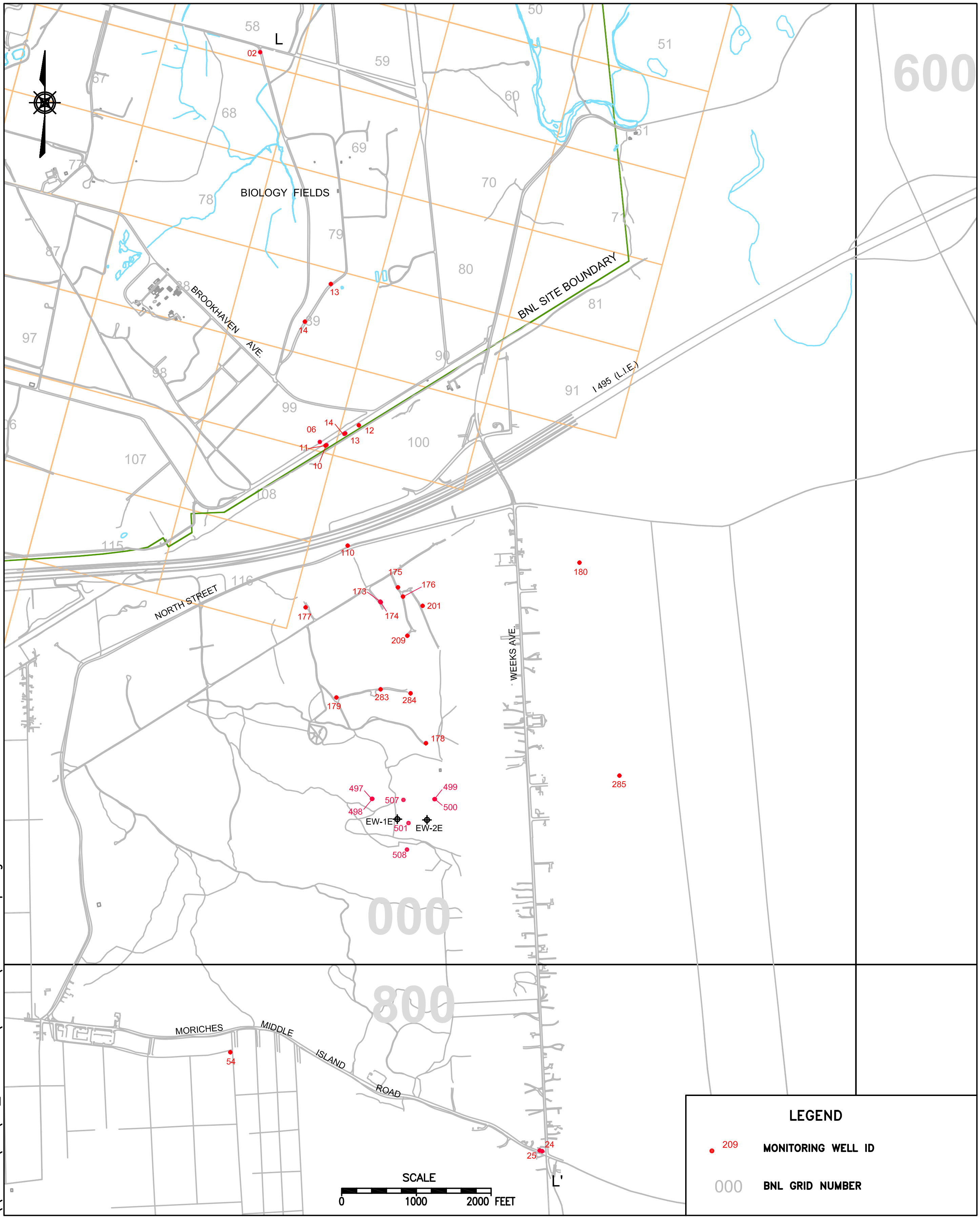
Total Cost for Monitoring Program

FY2007	$16,417
FY2008	$16,073
Difference	$-414

See Appendix B for the monitoring program for this DQO.

Table 12.21.2 Proposed Modifications to the Ethylene Dibromide Pre-Design Monitoring Wells

Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
000-110	Semi-Annually	No Change	None
000-173	Semi-Annually	No Change	None
000-174	Semi-Annually	No Change	None
000-175	Semi-Annually	No Change	None
000-176	Semi-Annually	No Change	None
000-177	Semi-Annually	No Change	None
000-178	Quarterly	No Change	None
000-179	Semi-Annually	No Change	None
000-180	Semi-Annually	No Change	None
000-181	Semi-Annually	No Change	None
000-201	Semi-Annually	No Change	None
000-209	Semi-Annually	No Change	None
058-02	Quarterly	No Change	None
089-13	Quarterly	No Change	None
089-14	Quarterly	No Change	None
099-06	Semi-Annually	No Change	None
099-10	Semi-Annually	No Change	None
099-11	Semi-Annually	No Change	None
100-12	Semi-Annually	No Change	None
100-13	Semi-Annually	No Change	None
100-14	Semi-Annually	No Change	None
800-24	Semi-Annually	No Change	None
800-25	Semi-Annually	No Change	None
800-54	Semi-Annually	No Change	None
000-283	Semi-Annually	No Change	None
000-284	Semi-Annually	No Change	None
000-285	Semi-Annually	No Change	None
000-497	Semi-Annually	No Change	None
000-498	Quarterly	Semi-Annually	EDB
000-499	Semi-Annually	No Change	None
000-500	Semi-Annually	No Change	None
000-501	Semi-Annually	No Change	None
000-507	Semi-Annually	No Change	None
000-508	Quarterly	No Change	None



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BROOKHAVEN NATIONAL LABORATORY EWMS DIVISION	TITLE: OU VI EDB MONITORING WELL LOCATIONS 2008 EMP	DWN: JEB	VT: HZ.: —	DATE: 12/14/07	PROJECT NO.: 07926
		CHKD: JEB	APPD: --	REV.: -	NOTES: -
		FIGURE NO.:	12.21.1		

SITE BACKGROUND

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, December 7, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-7046

SUMMARY OF PROPOSED CHANGES

There are no proposed changes for CY2008.

DESCRIPTION AND TECHNICAL BASIS

Background water quality at BNL has been monitored since 1996. The current program includes 10 wells located in the northwestern portion of the BNL property (017-01, 017-03, 017-04, 018-01, 018-02, 018-04, 018-05, 034-02, 034-03, and 063-09) and three wells off site to the north (000-118, 000-119, and 000-120). Well locations are shown on Figure 12.22.1

Samples are collected semi-annually and analyzed for the contaminants of concern identified for groundwater characterization work conducted for the various remedial investigations and removal actions at BNL, including VOCs, metals, and leachate parameters. Analytical results are reviewed to determine whether contaminants from off-site, upgradient sources are being transported onto the BNL facility. Historically, low levels of VOCs (less than New York State groundwater standards) have been detected in the deeper portion of the Upper Glacial aquifer and in the Magothy aquifer. During CY2000, aluminum, iron, manganese, and sodium were detected at concentrations exceeding New York State groundwater standards in some Site Background wells.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
_x_ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

During CY2000, groundwater flow in the northwestern portion of the BNL facility within the shallow and deep portions of the Upper Glacial aquifer was toward the east to south-southeast and groundwater flow within the Magothy aquifer was toward the east-southeast. This is consistent with historic groundwater flow patterns at the BNL facility. Site Background wells are positioned to detect contamination migrating onto the BNL site.

Problem Statement: Data are needed to evaluate whether off-site, upgradient sources of groundwater contamination are impacting the BNL facility and to establish baseline/background levels of naturally occurring constituents, including metals and radionuclides, that are not impacted by BNL activities.

Step 2: Identify the Decision

Is groundwater quality at BNL being impacted by off-site, upgradient source(s) of contamination (e.g., is the Groundwater Contingency Plan triggered)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Locations of existing wells relative to flow patterns (Figure 12.22.1)
- Analytical methods and detection limits as described in the BNL EMP
- Variability of data

Step 4: Define the Study Boundaries

The study boundaries for the Site Background program are the northwestern (upgradient) portion of the BNL facility and nearby off-site areas within the Upper Glacial and shallow Magothy aquifers.

Step 5: Develop the Decision Rules

Decision 1

The sample results will be evaluated in context with historical data. As part of that evaluation, circumstances that would require implementation of the Groundwater Contingency Plan would be determined for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, including detection of previously undetected contaminants and detection of contaminants in wells where those contaminants have not previously been detected.

If contaminants are detected in any well at unusually high concentrations (relative to the historical baseline) and the results are confirmed by resampling, **then** implement actions as prescribed in the BNL Groundwater Contingency Plan.

Step 6: Specify Acceptable Error Tolerances

Table 12.22.1 summarizes the decision and possible decision errors for this project.

Table 12.22.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Is groundwater quality at BNL being impacted by off-site, upgradient source(s) of contamination?	See Step 3 for inputs.	(1) Data indicate the existence of an upgradient source when one does not exist (data indicate detected contamination is from an off-site source when it is not). (2) Data indicate that there is not an upgradient source when one does exist (data indicate detected contamination is from an on-site source when it is not).	(1) On-site contaminant source(s) will not be investigated and/or remediated and may continue to degrade groundwater quality. (2) Investigation and/or remediation of groundwater contamination may be undertaken by BNL when it is not warranted.

Because the wells included in the Site Background Program are located in the upgradient portion of the BNL facility, travel time for contamination detected in these wells to the nearest potential receptor (on-site potable supply wells) is on the order of 10 years. It is therefore unlikely that decision error will result in adverse consequences to human health. The consequences of decision error relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust and BNL credibility, and wasted resources.

Step 7: Optimize the Design

Number and Locations of Wells

The number and locations of wells for this program are considered adequate.

Parameters and Frequency

The analytical parameters and sampling frequency currently conducted for this project are considered adequate. Therefore, no modifications are recommended at this time. A summary of the proposed modifications to the Site Background sampling program is provided in Table 12.22.2.

Annual Cost Impact Due to Proposed Change

Due to increases in sampling costs, the sampling and analysis costs will increase by $50 per year.

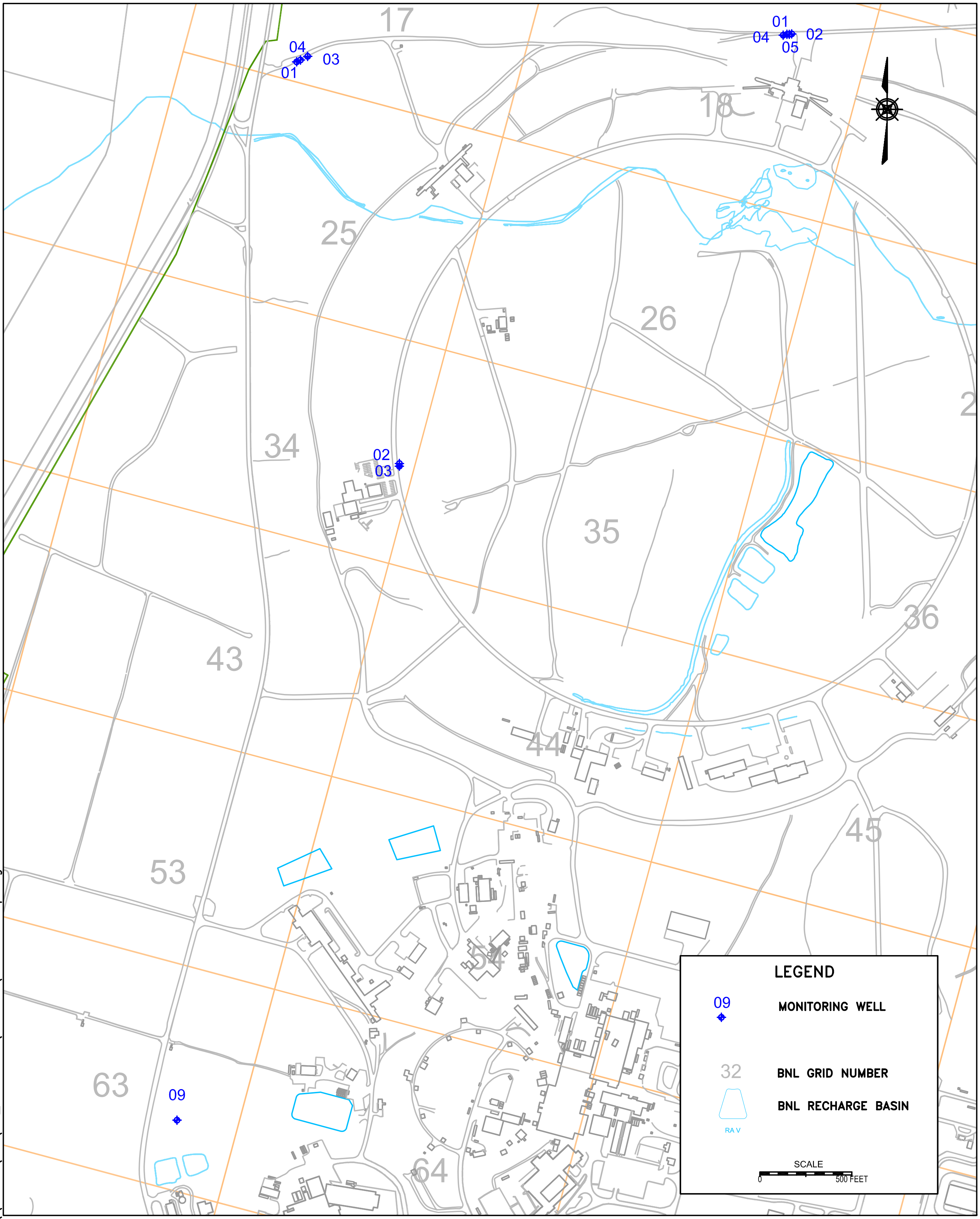
Total Cost for Monitoring Program

FY2007	$1,940
FY2008	$1,990
Difference	$50

See Appendix B for the monitoring program for this DQO.

Table 12.22.2 Proposed Modifications to the Site Background Monitoring Wells

Well ID	Current Sampling Frequency	Proposed Sampling Frequency Changes	Affected Parameters
017-01	Annually	No Change	None
017-03	Annually	No Change	None
017-04	Annually	No Change	None
018-01	Annually	No Change	None
018-02	Annually	No Change	None
018-04	Annually	No Change	None
018-05	Annually	No Change	None
034-02	Annually	No Change	None
034-03	Annually	No Change	None
063-09	Annually	No Change	None



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BROOKHAVEN NATIONAL LABORATORY

EWMSD

TITLE:

SITE BACKGROUND
MONITORING WELL LOCATIONS
2008 EMP

DWN: JEB	VT: HZ.: –	DATE: 12/14/07	PROJECT NO.: 7926
CHKD: --	APPD: --	REV.: 1	NOTES: –

FIGURE NO.: 12.22.1

GROUNDWATER ELEVATION MONITORING

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, December 7, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186

SUMMARY OF PROPOSED CHANGES

There are no proposed changes for CY2007.

DESCRIPTION AND TECHNICAL BASIS

The purpose of the groundwater elevation monitoring program is to characterize the groundwater flow direction and rate across the BNL site and off site in multiple aquifers of interest to the groundwater protection and cleanup programs. The aquifers or sub-aquifers are:

- *Shallow Upper Glacial aquifer*: This portion of the aquifer is first to be impacted by any BNL releases and is currently contaminated in portions of the site. Groundwater flow direction and rate vary, depending on the discharge area (Peconic River, Carmans River, or Moriches Bay), as well as BNL water supply well and groundwater remediation well pumping and recharge basin operations.
- *Deep Upper Glacial aquifer*: This portion of the aquifer is utilized by BNL's water supply wells and is also contaminated in certain areas on and off site. The deep Upper Glacial aquifer is also the target of numerous groundwater remediation systems. Groundwater flow direction and rate vary, depending on the discharge area (Peconic River, Carmans River, or Moriches Bay), as well as BNL water supply well and groundwater remediation well pumping and, to a lesser extent, recharge basin operations.
- *Upper Magothy aquifer*: This aquifer is contaminated in isolated off-site areas and is currently the focus of a comprehensive characterization study. This aquifer is also utilized by the SCWA for off-site community water supply purposes (BNL's plumes are currently not an immediate threat to these wells). This aquifer tends to have different flow patterns and rates (i.e., more east-southeast and slower) than the Upper Glacial aquifer.

Synoptic groundwater elevation measurements are currently collected from approximately 780 wells on a semiannual basis. Measured wells are screened at various depths within the Upper Glacial aquifer and the upper portion of the Magothy aquifer. Most of the wells included in the groundwater elevation monitoring program are located on site, although off-site wells constructed by BNL and by the United States Geological Survey are also measured. In addition, because wells in some areas are more closely spaced than necessary for the groundwater elevation monitoring program, only a representative number of wells are monitored and not all existing wells are included in the program.

The resulting groundwater elevation data are used to develop groundwater elevation contour maps. The information contained on these maps is utilized to evaluate horizontal groundwater flow directions and rates throughout the BNL site, as well as to determine vertical gradients within and between the Upper Glacial and Magothy aquifers. These data are used to confirm that monitoring and extraction wells are located properly, to confirm that existing remediation systems are effective at capturing the targeted contamination, and that monitoring of operational and engineered controls for groundwater protection is capable of rapidly detecting an unexpected release of contamination.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
_x_ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

To monitor groundwater quality and the effectiveness of groundwater protection and cleanup activities, comprehensive groundwater flow information is required. Groundwater level information is required to generate groundwater flow information. Data are needed to evaluate groundwater flow directions and rates, and horizontal and vertical gradients in multiple aquifer segments across the BNL site and off site.

Step 2: Identify the Decision

This project generates comprehensive and regional data inputs for decisions to be made in various groundwater remediation and groundwater protection projects. These decisions are not discussed here. The decisions related to this project are:

- Are the groundwater flow direction and rate data developed for this project of sufficient level of detail and confidence to support other projects?
- Is the groundwater flow system approaching a steady state condition that could justify changes in monitoring?

Step 3: Identify Inputs to the Decision

The groundwater flow inputs generated by this project that are necessary for decisions in other projects include:

- Quarterly depth to water measurements in selected wells, measured to the nearest 0.01 foot
- Measuring point elevations for measured wells, measured to the nearest 0.01 foot
- Locations of measured wells

Step 4: Define the Study Boundaries

Because wells located throughout the BNL site and off site are included in this program, the study boundaries are the groundwater watershed areas for the Upper Glacial and upper Magothy aquifers in the vicinity of the BNL site.

Step 5: Develop the Decision Rules

Decision 1

Are the groundwater flow direction and rate data developed for this project of sufficient level of detail and confidence to support other projects?

These decision rules should be applied for each of the three aquifer segment or layers of interest. The data generated for each measurement round will be reviewed by experts on BNL hydrogeology with respect to historic data and pumping and recharge rates for supply wells and existing remediation systems.

If data generated for each measurement round for each of the three aquifer segments of interest are considered adequate as input for decisions to be made for other projects, **then** utilize the data for project-specific decisions. Otherwise, consider modifying the suite of wells that are measured to address the identified data gap(s).

Decision 2

Is the groundwater flow system approaching a steady state condition that could justify changes in elevation monitoring?

If, for any of the three aquifer segments of interest, significant change in groundwater flow direction or gradient is observed during any four consecutive measuring periods, **then** continue with the existing monitoring program for that aquifer segment.

If significant change in groundwater flow direction or gradient is not observed in one or more of the three aquifer segments of interest during any four consecutive measuring periods, **then** apply expert judgment to consider reducing monitoring frequency or the number of measured wells for that aquifer segment(s).

Step 6: Specify Acceptable Error Tolerances

Table 12.23.1 summarizes the decision and possible decision errors for this project.

Table 12.23.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Are the groundwater flow direction and rate data developed for this project of sufficient level of detail and confidence to support other projects?	See Step 3 for inputs.	(1) Data indicate data are sufficient when they are not. (2) Data indicate data are not sufficient when they are.	(1) Potential for decision or monitoring errors in other projects due to inadequate data. (2) Wasted resources considering/ implementing operational or monitoring adjustments in other projects.
Is the groundwater flow system approaching a steady state condition that could justify changes in elevation monitoring?	See Step 3 for inputs.	(1)Data indicate that the groundwater system is approaching a steady state condition when it is not. (2) Data indicate that the groundwater system is not approaching a steady state condition when it is.	(1) Potential for variations in groundwater flow direction to be missed due to decreased monitoring frequency, loss of stakeholder trust. (2) Wasted resources conducting unnecessary water level monitoring.

Step 7: Optimize the Design

Number and Locations of Wells

Groundwater data have been reviewed and are considered to be sufficient to support the decisions to be made in other projects. The number and locations of wells currently measured are considered adequate. Therefore, no modifications to the program are recommended.

Frequency

The collection frequency currently conducted for this project is considered adequate. Therefore, no modifications are recommended at this time.

Annual Cost Impact Due to Proposed Change

There is no change to the annual cost for this program..

Total Cost for Monitoring Program

FY2007 $15,300
FY2008 $15,300
Difference $0

See Appendix B for the monitoring program for this DQO.

Table 12.24.2 ES Sampling Information for CY2008

Well ID	Area	Sub Area	Decision Subunit	EPA 524.2 VOCs	EPA 625 Semi-VOCs	EPA 608 Pest/PCBs	Sulfate/Chloride/Nitrate	Metals	EPA 900 Gross Alpha/Beta	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Floating Product	Frequency (events/year)
054-61	BLIP		Upgradient								X			2
064-46	BLIP		Upgradient								X			2
064-47	BLIP		Downgradient							X(b)	X			4
064-48	BLIP		Downgradient							X(b)	X			4
064-49	BLIP		Downgradient								X			2
064-50	BLIP		Downgradient								X			2
064-67	BLIP		Downgradient							X(b)	X			4
054-08	AGS	NSRL	Downgradient								X			1
054-191	AGS	NSRL	Downgradient								X			1
064-51	AGS	Booster Beam Stop	Downgradient								X			1
065-52	AGS	Booster Beam Stop	Downgradient								X			1
064-03	AGS	Bldg. 914	Downgradient								X			1
064-53	AGS	Bldg. 914	Downgradient								X			1
064-54	AGS	Bldg. 914	Downgradient								X			1
054-62	AGS	Bkgd. J-10 Beam Stop	Upgradient								X			1
054-63	AGS	J-10 Beam Stop	Downgradient								X			1
054-64	AGS	J-10 Beam Stop	Downgradient								X			1
054-66	AGS	g-2 Beam Stop	Downgradient								X			1
054-67	AGS	g-2 Beam Stop	Downgradient								X			1
054-68	AGS	g-2 Beam Stop	Downgradient								X			1
054-125	AGS	g-2 Beam Stop	Downgradient								X			1
054-127	AGS	Fm. U-Line Target	Upgradient								X			1
054-128	AGS	Fm. U-Line Target	Downgradient								X			1
054-129	AGS	Fm. U-Line Target	Downgradient								X			1
054-130	AGS	Fm. U-Line Target	Downgradient								X			1
054-168	AGS	Fm. U-Line Stop	Downgradient								X			1
054-169	AGS	Fm. U-Line Stop	Downgradient								X			1
054-69	AGS	Bldg 912/U-Line Stop	Upgradient								X			1
055-14	AGS	Bldg 912/U-Line Stop	Upgradient								X			1
065-120	AGS	Bldg 912	Downgradient								X			1
065-125	AGS	Bldg 912	Downgradient								X			1
065-126	AGS	Bldg 912	Downgradient								X			1
065-195	AGS	Bldg 912	Downgradient								X			1
055-31	AGS	Bldg 912	Downgradient								X			1
055-15	AGS	Bldg 912	Downgradient								X			1

Table 12.24.2 ES Sampling Information for CY2008

Well ID	Area	Sub Area	Decision Subunit	EPA 524.2 VOCs	EPA 625 Semi-VOCs	EPA 608 Pest/PCBs	Sulfate/Chloride/Nitrate	Metals	EPA 900 Gross Alpha/Beta	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Floating Product	Frequency (events/year)
055-16	AGS	Bldg 912	Downgradient								X			1
065-192	AGS	Bldg 912	Downgradient								X			1
055-29	AGS	Bldg 912	Downgradient								X			1
055-30	AGS	Bldg 912	Downgradient								X			1
055-32	AGS	Bldg 912	Downgradient								X			1
064-55	AGS	E-20 Catcher	Downgradient								X			1
064-56	AGS	E-20 Catcher	Downgradient								X			1
064-80	AGS	E-20 Catcher	Downgradient								X			1
054-65	AGS/g-2	Bkgd.g-2 Stop/Plume	Upgradient								X			2
054-07	AGS/g-2	g-2 Tritium Plume	Downgradient							X(b)	X			4
054-124	AGS/g-2	g-2 Tritium Plume	Downgradient							X(b)	X			4
054-184	AGS/g-2	g-2 Tritium Plume	Downgradient							X(b)	X			4
054-185	AGS/g-2	g-2 Tritium Plume	Downgradient							X(b)	X			4
064-95	AGS/g-2	g-2 Tritium Plume	Downgradient							X(b)	X			4
054-126	AGS/g-2	g-2 Tritium Plume	Downgradient							X(b)	X			4
065-122	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-121	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-193	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-123	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-124	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-194	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-321	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-322	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-323	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-324	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-02	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
065-173	AGS/g-2	g-2 Tritium Plume	Downgradient								X			2
025-01	RHIC	B/Y Beam Stop Area	Upgradient								X			2
025-03	RHIC	B/Y Beam Stop Area	Downgradient								X			2
025-04	RHIC	B/Y Beam Stop Area	Downgradient								X			2
025-05	RHIC	B/Y Beam Stop Area	Downgradient								X			2
025-06	RHIC	B/Y Beam Stop Area	Downgradient								X			2
025-07	RHIC	B/Y Beam Stop Area	Downgradient								X			2
025-08	RHIC	B/Y Beam Stop Area	Downgradient								X			2
034-05	RHIC	B/Y Collimator Area	Downgradient								X			2

Table 12.24.2 ES Sampling Information for CY2008

Well ID	Area	Sub Area	Decision Subunit	EPA 524.2 VOCs	EPA 625 Semi-VOCs	EPA 608 Pest/PCBs	Sulfate/Chloride/Nitrate	Metals	EPA 900 Gross Alpha/Beta	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Floating Product	Frequency (events/year)
034-06	RHIC	B/Y Collimator Area	Downgradient								X			2
043-01	RHIC	B/Y Collimator Area	Downgradient								X			2
043-02	RHIC	B/Y Collimator Area	Downgradient								X			2
044-13	RHIC	B/Y Collimator Area	Downgradient								X			2
044-14	RHIC	B/Y Collimator Area	Downgradient								X			2
044-29	RHIC	W-Line Stop	Downgradient								X			2
046-01	SG Range		Upgradient											0
046-02	SG Range		Downgradient											0
046-03	SG Range		Downgradient											0
039-91	LF Range		Downgradient											0
039-92	LF Range		Downgradient											0
084-12	BMRR		Downgradient											1(e)
084-13	BMRR		Downgradient											1(e)
084-27	BMRR		Downgradient											1(e)
084-28	BMRR		Upgradient											1(e)
102-05	Motor Pool	Gasoline USTs	Downgradient	X									X	2
102-06	Motor Pool	Gasoline USTs	Downgradient	X									X	2
102-08	Motor Pool	Bldg 326	Upgradient											(a)
102-10	Motor Pool	Bldg 326/USTs	Downgradient	X									X	2
102-11	Motor Pool	Bldg 326	Downgradient	X										1
102-12	Motor Pool	Bldg 326	Downgradient	X										1
102-13	Motor Pool	Bldg 326	Downgradient	X										1
085-16	Gas Station	Pump Island	Downgradient	X										2(f)
085-17	Gas Station	Pump Island	Downgradient	X									X	2(f)
085-235	Gas Station	Gasoline USTs	Downgradient	X									X	2
085-236	Gas Station	Gasoline USTs	Downgradient	X									X	2(f)
085-237	Gas Station	Gasoline USTs	Downgradient	X									X	2(f)
055-03	WMF	Bkgd.	Upgradient	X			X(b)	X(b)	X	X	X			2
055-10	WMF	Bkgd.	Upgradient	X			X(b)	X(b)	X	X	X			2
056-21	WMF	RCRA Bldg.	Downgradient	X			X(b)	X(b)	X	X	X			(g)
056-22	WMF	Rad. Bldg.	Downgradient	X			X(b)	X(b)	X	X	X			(g)
056-23	WMF	Rad. Bldg.	Downgradient	X			X(b)	X(b)	X	X	X			(g)
066-07	WMF	Bkgd	Upgradient	X			X(b)	X(b)	X	X	X			(g)
066-83	WMF	Mixed Waste Bldg.	Downgradient	X			X(b)	X(b)	X	X	X			(g)
066-84	WMF	Bkgd.	Upgradient	X			X(b)	X(b)	X	X	X			(g)

Table 12.24.2 ES Sampling Information for CY2008

Well ID	Area	Sub Area	Decision Subunit	EPA 524.2 VOCs	EPA 625 Semi-VOCs	EPA 608 Pest/PCBs	Sulfate/Chloride/Nitrate	Metals	EPA 900 Gross Alpha/Beta	EPA 901 Gamma Spec	EPA 906 Tritium	EPA 905 Sr-90	Floating Product	Frequency (events/year)
WMF-1-2007	WMF	RCRA Bldg.	Downgradient	X			X(b)	X(b)	X	X	X			2
WMF-2-2007	WMF	RCRA Bldg.	Downgradient	X			X(b)	X(b)	X	X	X			2
WMF-3-2007	WMF	Rad. Bldg.	Downgradient	X			X(b)	X(b)	X	X	X			2
WMF-4-2007	WMF	Rad. Bldg.	Downgradient	X			X(b)	X(b)	X	X	X			2
WMF-5-2007	WMF	Mixed Waste Bldg.	Downgradient	X			X(b)	X(b)	X	X	X			2
084-36	BIO	Greenhouses	Downgradient											0
084-37	BIO	Greenhouses	Downgradient											0
076-16	MPF		Downgradient	X	X								X(d)	2
076-17	MPF		Downgradient	X	X								X(d)	2
076-18	MPF		Downgradient	X	X								X(d)	2
076-19	MPF		Downgradient	X	X								X(d)	2
076-25	MPF		Upgradient	X	X								X(d)	2
076-378	MPF		Downgradient	X	X								X(d)	2
076-379	MPF		Downgradient	X	X								X(d)	2
076-380	MPF		Downgradient	X	X								X(d)	2
038-02	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		1
038-03	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		1
039-07	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		1
039-08	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		1
039-86	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		1
039-87	STP	Filter Beds	Downgradient	X			X	X	X	X	X	X(c)		1
039-88	STP	Holding Ponds	Downgradient	X					X	X	X			1
039-89	STP	Holding Ponds	Downgradient	X					X	X	X			1
039-90	STP	Holding Ponds	Downgradient	X					X	X	X			1
065-325	801	Basement Flood Area	Downgradient						X	X	X	X		2

(a) Sampling of this well is optional.
(b) Samples collected annually.
(c) Sr-90 samples to be collected only if elevated gross beta values are observed.
(d) Floating product determination measurements to be collected monthly.

GROUNDWATER MONITORING AT THE AGS

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, January 2, 2008

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

For 2008, routine groundwater monitoring well sampling frequency at the AGS Booster and NASA Space Radiation Laboratory (NSRL) facilities will be reduced from semi-annually to annually. Monitoring requirements for the g-2 Source Area and Tritium Plume are now defined in DQO Statement 12-41.

DESCRIPTION AND TECHNICAL BASIS

Since 1999, BNL has installed approximately 50 permanent monitoring wells and numerous temporary wells to evaluate the potential impact of activated soil shielding located near the AGS's beam stop and target areas. Early groundwater monitoring results indicated that groundwater quality had been impacted by tritium originating from operations at the former g-2 experiment, former U-Line beam stop, and the former E-20 catcher. In these areas, rainwater was able to infiltrate activated soil shielding and leach tritium into the groundwater. Tritium concentrations were found to exceed the 20,000 pCi/L MCL in these three locations. BNL installed impermeable caps over the activated soil shielding areas to prevent additional leaching of the radioactivity from the shielding. Following these corrective actions, tritium concentrations in the former U-Line beam stop and the former E-20 catcher areas dropped to well below the 20,000 pCi/L standard. However, tritium is still routinely detected at concentrations greater than 20,000 pCi/L in wells downgradient of the g-2 source area (see DQO Statement 12-41). Monitoring at other potential soil activation areas such as the J-10 beam stop, Booster beam stop, NSRL, Building 914 transfer tunnel, and Building 912 continue to demonstrate that groundwater has not been significantly impacted by these operations, and that existing engineered controls are working.

DRIVERS FOR MONITORING BEING CONDUCTED

_X_ Compliance
___ Support Compliance
_X_ Surveillance
___ Restoration/IAG

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Secondary particles are created near beam loss points, beam targets, and beam stops. These particles have the potential to escape into the soils surrounding the accelerator tunnels or into the soils underlying target and beam stop areas in the experimental halls. Although considerable effort is taken to design appropriate shielding and other engineering controls into these systems, many secondary particles will still interact with soils surrounding the tunnels and underlying floors. The types of radionuclides created from this interaction include tritium, beryllium-7, carbon-11, nitrogen-13, oxygen-15, and sodium-22. Once present in the soils, some of these radionuclides can be leached downward into groundwater by means of rainwater percolation. Only radionuclides with long half-lives, namely tritium ($t_{1/2}$ = 12.3 years) and sodium-22 ($t_{1/2}$ = 2.6 years), are detected in the groundwater below the AGS. BNL has been taking steps to either reduce the amount of radioactivity produced in soils (by means of additional shielding or modifying operating procedures) or by the construction of impermeable caps to prevent the leaching of these materials to groundwater. Another potential source of groundwater contamination is the inadvertent release of activated water from the AGS's primary cooling water systems. To reduce this threat, the piping systems have been modified to reduce the volume of water that can be exposed to beam line losses, and piping containing high levels of tritiated water is located inside facility structures where they can be visibly inspected.

The collection of groundwater samples from wells downgradient of the soil activation areas is required, to demonstrate that the operational and engineered controls are effective in protecting groundwater quality. These controls include:

- Limiting the amount of soil activation by use of internal shielding material and beam focusing
- Primary cooling water management
- Installation and maintenance of impermeable caps (geomembrane, gunite, etc.)
- Storm water management

Although groundwater quality in the AGS area has been impacted by the historical releases of VOCs (primarily 1,1,1-trichloroethane), this monitoring program is focused on the evaluation of potential impacts that may result from activation of soil shielding. However, this program does support the Long Term Response Actions Program's continual evaluation of historical VOC contamination in this area of the site by periodically providing samples for VOC analysis.

Step 2: Identify the Decision

Are the operational and engineered controls employed at the AGS complex effective at preventing the release of tritium and sodium-22 to groundwater at concentrations that exceed drinking water standards at the point of assessment (i.e., the closest wells downgradient of each identified soil activation area)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the AGS
- Modeled estimates on the amount of soil activation at each beam stop and target area

- Direction and velocity of groundwater flow
- Tritium and sodium-22 concentrations in groundwater
- Locations of background and downgradient wells relative to each identified soil activation area
- Regulatory requirements (DOE Order 450.1)
- Action levels:
  – Action levels are defined by the Groundwater Protection Contingency Plan
- Analytical methods and detection limits:
  – Tritium: EPA Method 906
  – Gamma spectroscopy (0ptional analysis): EPA Method 901

Starting in 2004, routine analyses of groundwater samples for sodium-22 were discontinued. Since that time, the focus has been placed on tritium analyses because tritium is more mobile than sodium-22 and has a longer half-life (12.6 years compared to 2.3 for sodium-22). Therefore, the presence of tritium in groundwater is a better early indicator of a failure in an engineered storm-water control.

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the AGS complex, and the nearest practicable monitoring points (i.e., "points of assessment") near each of the identified soil activation areas. The period for which decisions are made is 365 days. These timeframes are based on the following:

- The time required for tritium and sodium-22 to migrate through the vadose zone and reach the groundwater table (by means of rainwater leachate) is likely to be between 30 to 60 days.

- Once the radionuclides have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, typically 100 feet from the source) is likely to be between 130 to 275 days.

- Decision periods of 365 days are acceptable for areas where monitoring has demonstrated that current engineered and operational controls are effective (e.g., J-10 Beam Stop, Booster Beam Stop, Building 914 Transfer Tunnel, Former U-Line Target, former E-20 Catcher, and portions of Building 912).

Step 5: Develop the Decision Rules

Are the engineered and operational controls effective at preventing or reducing the leaching of radionuclides from activated soils to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells.

Decision Rule for a Category 4 Response

If for any monitoring well:

- Tritium or sodium-22 concentrations exceed the applicable MCLs (and this result is confirmed by re-sampling), indicating a new release resulting from a failure in an engineered control or release from a previously unidentified source; or tritium or sodium-22 concentrations indicate an unexpected release rate from an existing groundwater contaminant source, or previously unknown source;
- Tritium or sodium-22 concentrations increase by greater than 10 times the established baseline concentration (and the result is confirmed by re-sampling) for an existing plume;

Then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well, the tritium or sodium-22 concentrations are greater than 50 percent but less than 100 percent of the applicable MCL (and this result is confirmed by re-sampling), indicating a new release resulting in a failure in an engineered control or release from a previously unidentified source; or if tritium or sodium-22 concentrations increase by greater than five times but less than 10 times the established baseline concentration for an existing plume;

Then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.25.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching of tritium and sodium-22 from activated soil shielding to the groundwater.	See Step 3 for inputs	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to several hundred feet long could exist and not be detected.* (2) Need to re-sample well and resulting additional unplanned costs. Potential erosion of stakeholder confidence.

*Assumes results from one sample period were inaccurate.

There are no potential receptors (i.e., potable water supply wells) immediately downgradient of the AGS complex, and groundwater travel time to the nearest potential receptor (Potable Well 10) is greater than 2 years. Because of exiting groundwater contamination in the AGS complex (primarily the g-2 tritium plume), operations of potable Well 10 have been significantly reduced since 2000. The restrictions placed on the operations of Well 10 reduce the likelihood that a plume from the AGS area will be captured by this well, and reduced pumping also helps to stabilize groundwater flow directions in the AGS area. Due to these factors, and additional Land Use and Institutional Controls developed for the AGS area, it is unlikely that a decision error will result in adverse consequences to human health. Consequences associated with (short-term) decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial action under CERCLA or another regulatory program.

Step 7: Optimize the Design

Number and Locations of Wells

The wells located around the AGS are biased toward detecting contamination originating from activated soils associated with current and former beam stop and target areas (Figure 12.25.1). The wells are located as close as possible to these potential source areas to allow for early detection of contaminant releases. The current approved monitoring network allows for the timely evaluation of potential impacts, and is considered adequate for meeting the acceptable risk levels of stakeholders.

Parameters and Frequency

Groundwater quality in the AGS complex is routinely evaluated using as many as 34 monitoring wells. Five or more years of analytical data are available to assess potential impacts from activated soil shielding areas and the effectiveness of engineered stormwater controls. Tritium and sodium-22 have been detected in groundwater downgradient of several activated soil shielding areas. Whereas tritium has been found to exceed MCLs in these areas, sodium-22 is usually detected at very low concentrations. Because tritium is easily leached from activated soils, is highly mobile in groundwater and has a longer half-life (12.3 years as opposed to 2.6 for sodium-22), the primary focus of the monitoring program is for the detection of tritium.

- During 1999 and 2000, elevated levels of tritium and sodium-22 were detected downgradient of two inactive accelerator beam stop areas. Tritium and sodium-22 concentrations up to 40,400 pCi/L and 704 pCi/L, respectively, were detected in wells downgradient of the former E-20 Catcher, and tritium was detected up to 70,000 pCi/L in wells downgradient of the former U-Line Beam Stop. As a result of these findings, impermeable caps were constructed over these areas to prevent rainwater infiltration of the activated soils. Soon after the caps were installed, there were noticeable reductions in contaminant concentrations, and all tritium and sodium-22 concentrations are currently well below drinking water standards. As a result, starting in 2006 the sampling frequency for these wells was reduced from semi-annual to annual. Samples are analyzed for tritium.

- Monitoring results have demonstrated that engineered and operational controls have been effective in protecting groundwater quality at the J-10 beam stop, Booster beam stop, Building 914 transfer tunnel, former U-Line target, NSRL, and Building 912 areas. Tritium concentrations in these areas have ranged from non-detectable to generally less than 1,000 pCi/L, whereas sodium-22 concentrations have ranged from non-detectable to less than 25 pCi/L. Based upon proven effectiveness of the engineered stormwater controls at the NSRL and Booster facilities the groundwater sampling frequency in these areas will be reduced from semi-annually to annually starting in 2008. The groundwater samples will be analyzed for tritium.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Changing the sampling frequency for the NSRL and Booster area wells will result in a cost reduction of approximately $2,000.

TOTAL COST FOR MONITORING PROGRAM

Sampling and analysis of existing permanent wells will cost approximately $18,000.

Table 12.25.2 Comparison of CY2007 and CY2008 Monitoring Program – Permanent Wells

Well	Monitoring Sub-Area	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
054-08	NSRL beam stop	Semi-annual	Annual	None
054-191	NSRL beam stop	Semi-annual	Annual	None
064-51	Booster beam stop	Semi-annual	Annual	None
065-52	Booster beam stop	Semi-annual	Annual	None
064-03	Bldg 914	Annual	Annual	None
064-53	Bldg 914	Annual	Annual	None
064-54	Bldg 914	Annual	Annual	None
054-62	Bkgd. J-10 beam stop	Annual	Annual	None
054-63	J-10 beam stop	Annual	Annual	None
054-64	J-10 beam stop	Annual	Annual	None
054-66	g-2 beam stop	Annual	Annual	None
054-67	g-2 beam stop	Annual	Annual	None
054-68	g-2 beam stop	Annual	Annual	None
054-125	g-2 beam stop	Annual	Annual	None
054-127	U-line target	Annual	Annual	None
054-128	U-line target	Annual	Annual	None
054-129	U-line target	Annual	Annual	None
054-130	U-line target	Annual	Annual	None
054-168	U-line stop	Annual	Annual	None
054-169	U-line stop	Annual	Annual	None
054-69	Bldg 912/U-line stop	Annual	Annual	None
055-14	Bldg 912/U-line stop	Annual	Annual	None
065-120	Bldg 912	Annual	Annual	None
055-15	Bldg 912	Annual	Annual	None
055-16	Bldg 912	Annual	Annual	None
065-192	Bldg 912	Annual	Annual	None
055-29	Bldg 912	Annual	Annual	None
055-30	Bldg 912	Annual	Annual	None
055-32	Bldg 912	Annual	Annual	None
064-55	E-20 Catcher	Annual	Annual	None
064-56	E-20 Catcher	Annual	Annual	None
064-80	E-20 Catcher	Annual	Annual	None

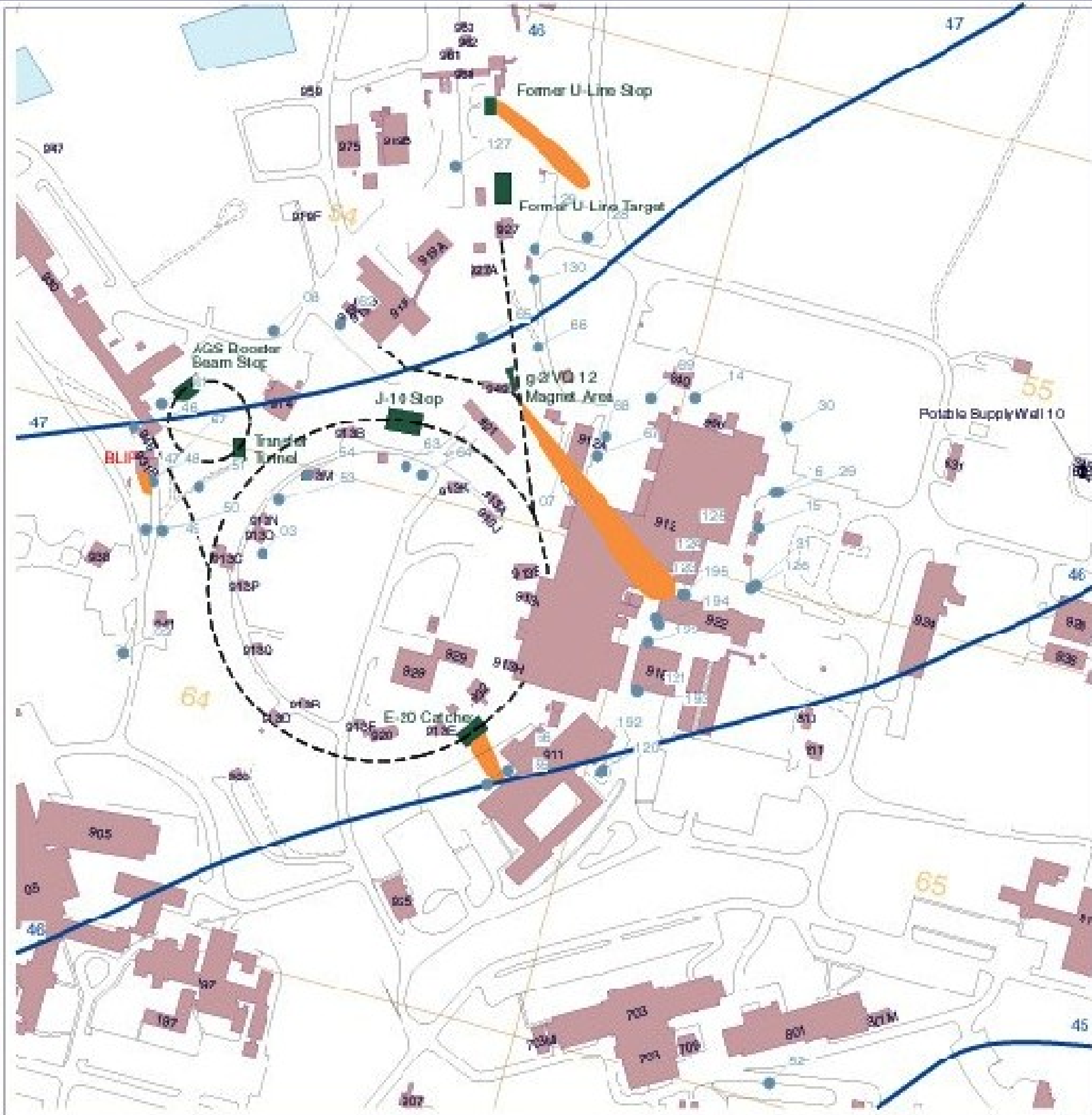

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Figure 1

Environmental Surveillance Monitoring Well Locations AGS and BLIP Facility Area

LEGEND

- Monitoring well
- Potable Supply Well
- Buildings, Facilities
- Recharge Basins
- AGS Facilities
- AGS Ring
- June 2000 Groundwater Table (ft AMSL)
- Tritium Concentration > Drinking Water Standards

SCALE

JLH - 12/27/00

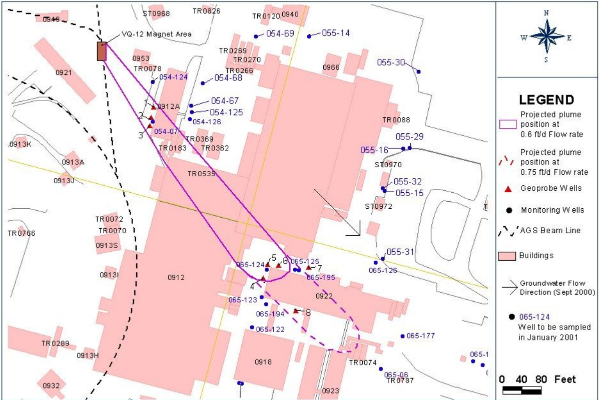

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Figure 4

g-2 Tritium Plume
Proposed Geoprobe Locations

JLH - 1/17/01
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GROUNDWATER MONITORING AT THE BLIP

DQO START DATE	January 1, 2003
REVISION NUMBER/DATE	Rev. 3, December 3, 2007
IMPLEMENTATION DATE	January 1, 2008
POINT OF CONTACT	Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

There are no proposed changes for CY2008. Implementation of the monitoring requirements defined in the g-2/BLIP/UST Record of Decision (ROD) (April 2007) will not result in any changes to the previously established routine monitoring program. Although there were no contingency actions defined in the ROD, the BLIP source area monitoring results will continue to be evaluated using the BNL Groundwater Protection Contingency Plan Subject Area.

DESCRIPTION AND TECHNICAL BASIS

The 1998 discovery of tritium and sodium-22 in groundwater downgradient of the Brookhaven Linac Isotope Producer indicated that rainwater was leaching these radionuclides from activated soil shielding located near the BLIP target vessel. To prevent continued rainwater infiltration, BNL has made improvements to several engineered controls, included the reconnection of the building's rain gutters, sealing paved areas, the construction of an impermeable cap, and the injection of a grouting material to reduce the permeability of the activated soils. BNL installed seven monitoring wells to evaluate the effectiveness of these engineered controls.

Following the initial 1998 improvements to stormwater controls, tritium concentrations decreased to less than 20,000 pCi/L and remained below this level until the summer of 2000. A short-term increase in tritium concentrations was detected in the monitoring wells following the May–June 2000 injection of a viscous liquid barrier (VLB) grout into the activated soils. Tritium concentrations increased from nearly non-detectable levels prior to the grout injection to 56,500 pCi/L in October 2000. An investigation determined that the grout had displaced a small volume of tritiated soil pore water. Some of this displaced water entered the aquifer below the BLIP building. Tritium concentrations decreased to <20,000 pCi/L by the end of December 2000, and remained at these levels through 2001 and 2002. Since 2002, tritium concentrations in groundwater have periodically exceeded the 20,000 pCi/L standard. In 2003, tritium concentrations reached a maximum of 42,900 pCi/L in October. Sodium-22 concentrations increased to a maximum of 185 pCi/L, but well below the 400 pCi/L standard. Although tritium concentrations remained less than the 20,000 pCi/L for most of 2004 and early 2005, in July 2005 tritium levels spiked to 46,500 pCi/L. Tritium concentrations dropped to less than 20,000 pCi/L by August 2005. In July 2006, tritium concentrations increased to 46,500 pCi/L, and then declined to less than 20,000 pCi/L for the remainder of the year. Tritium levels remained below the 20,000 pCi/L standard during all of 2007.

The groundwater monitoring data suggest that the periodic spikes in tritium concentrations are related to the flushing of residual tritium located close to the water table. A comparison of tritium concentrations to changes in water table position suggests that the 2003 increase in tritium concentrations appeared to correlate to a 6.5-foot increase in water table elevation that occurred between November 2002 and July 2003. As the water table rose, older tritium that was leached from the activated soils prior to capping in 1987 and from the grout injection project may have been flushed from the vadose zone soils close to the water table. From April 2004 through January 2005, the position of the water table generally declined. The spike in tritium concentrations observed in July 2005 followed a steady rise in the water table position that resulted from springtime rains. A similar pattern was observed during 2006. Tritium concentrations in downgradient wells were less than 20,000 pCi/L during all of 2007. It is expected that the amount of tritium remaining in the vadose zone close to the water table will decline over time due to this flushing mechanism and by natural radioactive decay. The g-2/BLIP/UST Record of Decision requires continued groundwater monitoring to verify the effectiveness of the operational and engineered controls. Monitoring of wells immediately downgradient of BLIP will remain on a quarterly schedule for at least one more year (see Tables 12.24.1 and 12.24.2).

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

_X_ Compliance
___ Support Compliance
_X_ Surveillance
_X_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Secondary particles created at the BLIP target vessel have activated some of the soils that surround portions of the vessel. The types of radionuclides created from this interaction include tritium, beryllium-7, carbon-11, nitrogen-13, oxygen-15, and sodium-22. Some of these radionuclides can be leached downward into groundwater by means of rainwater percolation. Only radionuclides with long half-lives such as tritium ($t_{1/2}$ = 12.3 years) and sodium-22 ($t_{1/2}$ = 2.6 years) are detected in the groundwater below the BLIP. As noted previously, BNL has been taking steps to prevent the leaching of these materials to groundwater by improving rainwater management. During 1998, rainwater management initiatives included the reconnection of the building's rain gutters, sealing paved areas, and constructing an impermeable gunite cap. In conjunction with the Environmental Restoration program, in 2000 colloidal silica grout was injected into the activated soil area to reduce the permeability of the soils. In late 2004, the impermeable cap was extended over the Linac-to-BLIP spur. Another potential source of groundwater contamination could be the inadvertent release of activated water from the BLIP's primary cooling water system. However, these water systems are located inside the BLIP building, and can be visually inspected.

As defined in the g-2/BLIP/UST Record of Decision, the continued collection of groundwater samples from wells downgradient of the BLIP is required to demonstrate that the operational and engineered controls are effective in protecting groundwater quality. These controls include:

- Limiting the amount of soil activation by beam focusing
- Primary cooling water management
- Reduced the permeability of the activated soils using colloidal silica grout

- Installation and maintenance of impermeable caps (gunite and asphalt)
- Conveying storm water away from the building foundation

Step 2: Identify the Decision

Are the operational and engineered controls employed at BLIP effective at preventing additional releases of tritium and sodium-22 to groundwater at concentrations that exceed drinking water standards at the point of assessment (i.e., the closest downgradient wells)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at BLIP
- Modeled estimates on the amount of soil activation near the target vessel.
- Direction and velocity of groundwater flow
- Tritium and sodium-22 concentrations in groundwater.
- Locations of background and downgradient wells relative to the soil activation area
- Regulatory requirements (DOE Order 450.1, Interagency Agreement AOC 16K)
- Action levels (as described in the Groundwater Protection Contingency Plan)
  - The g-2/BLIP/UST Record of Decision did not define any additional action levels.
- Analytical methods and detection limits:
  - Tritium: EPA Method 906
  - Gamma spectroscopy (optional analysis): EPA Method 901

Starting in 2004, the requirement for routine sodium-22 analyses was dropped from the monitoring program. Focus is now placed on tritium analyses because tritium is more mobile than sodium-22 and has a longer half-life (12.6 years compared to 2.3 for sodium-22). Therefore the presence of high levels of tritium in groundwater would be a better early indicator of a failure in an engineered stormwater control.

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area immediately downgradient of BLIP. The period for which decisions are made is 90 days. This time frame is based upon the following:

- The time required for tritium and sodium-22 to migrate through the vadose zone and reach the groundwater table (by means of rainwater leachate) is likely to be on the order of 30 to 60 days.
- Once the radionuclides have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessments, which are located approximately 50 feet from the source) is on the order of 90 days.
- Based upon the continued periodic detection of tritium at concentrations exceeding the 20,000 pCi/L standard, a decision period of 90 days is still required to evaluate the effectiveness of the engineered controls. Therefore, the three wells located immediately downgradient of BLIP will be sampled on a quarterly basis. The remaining upgradient and downgradient wells will continue to be sampled semi-annually.

Step 5: Develop the Decision Rules

Are the engineered and operational controls effective at preventing or reducing the leaching of radionuclides from activated soils to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously "clean" wells.

Decision Rule for a Category 4 Response

If for any monitoring well, tritium concentrations increase by greater than 10 times the previous year's baseline concentration for the existing plume (and this result is confirmed by re-sampling) or tritium or other radionuclide concentrations indicate a release from a previously unknown source (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well, tritium concentrations increase by greater than five times but less than 10 times the previous year's baseline concentration for the existing plume (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.26.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching of tritium and sodium-22 from activated soil shielding to the groundwater.	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 100 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

*Assumes results from one sample period were inaccurate.

There are no potential receptors (i.e., potable water supply wells) immediately downgradient of the BLIP, and groundwater travel time to the nearest potential downgradient receptor (Potable Well 4) is greater than 5 years. Due to these factors, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require additional remedial actions.

Step 7: Optimize the Design

Number and Locations of Wells

The wells near the BLIP are biased toward detecting contamination originating from activated soils adjacent to the target vessel and to evaluate potential contamination that could originate from upgradient sources such as the LINAC-to-BLIP beam line (Figure 12.26.1). The downgradient wells are located as close as possible to the BLIP building to enable early detection of contaminant releases. The current monitoring well network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years and the potential source is relatively small, no refinements are recommended.

Parameters and Frequency

Groundwater quality at BLIP is routinely evaluated using seven monitoring wells. Because tritium is easily leached from activated soils, is highly mobile in groundwater, and has a longer half-life (12.3 years compared to 2.6 for sodium-22), the primary focus of the monitoring program is the detection of tritium. Due to retardation of sodium-22 migration in the aquifer, tritium would be the first radionuclide detected in the monitoring well network, if the established engineered controls were to fail. Sampling frequency for sodium-22 could increase if there were a significant increase in tritium concentrations.

The groundwater monitoring data suggest that the periodic spikes in tritium concentrations appears to relate to the flushing of residual tritium located close to the water table. It is expected that the amount of tritium remaining in the vadose zone close to the water table will decline over time due to this flushing mechanism and by natural radioactive decay. Groundwater samples will continue to be collected quarterly from downgradient wells 064-47, 064-48, and 064-67. The remaining BLIP wells will continue to be sampled semi-annually. If the tritium concentrations remain within the observed range, the sampling frequency for the downgradient wells may be reduced to semi-annually at a later date. Samples will continue to be analyzed primarily for tritium.

Table 12.26.2. Comparison of CY2007 and CY2008 Monitoring Programs

Well	CY2006 Sampling Frequency	CY2007 Sampling Frequency	Affected Parameters
054-61	Semi-annually	Semi-annually	None
064-46	Semi-annually	Semi-annually	None
064-47	Quarterly	Quarterly	None
064-48	Quarterly	Quarterly	None
064-49	Semi-annually	Semi-annually	None
064-50	Semi-annually	Semi-annually	None
064-67	Quarterly	Quarterly	None

TOTAL COST FOR MONITORING PROGRAM

The groundwater monitoring cost for CY2008 is estimated to be $11,300.

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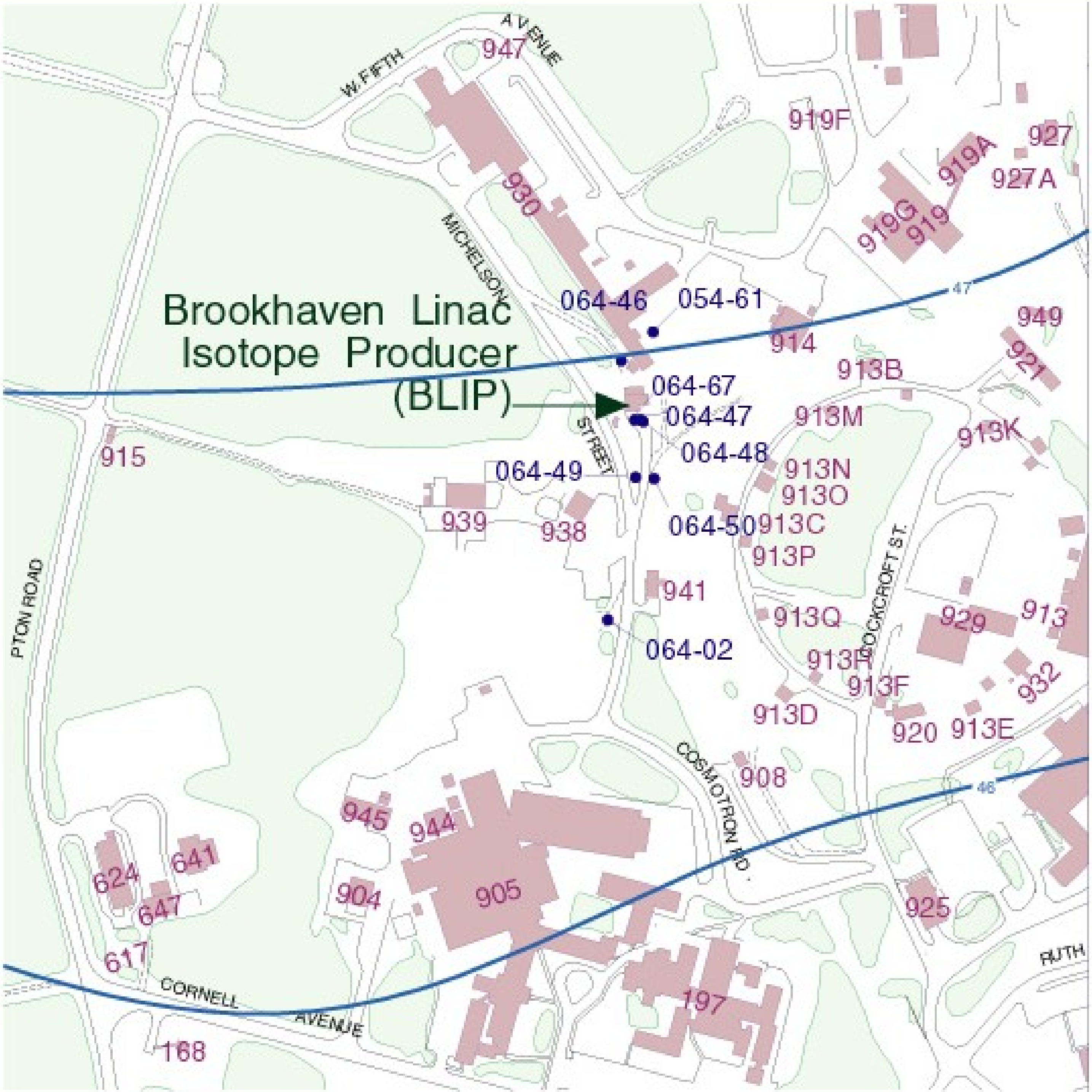

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Figure 1

Environmental Surveillance Monitoring Well Locations BLIP Facility Area

LEGEND

- Monitoring Well
- Wooded Areas
- Buildings, Facilities
- June 2000 Groundwater Elevation (ft AMSL)

SCALE

Meters: 0 10 20 30 40 50 60 70

Feet: 0 100 200

JLH - 03/21/01
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GROUNDWATER MONITORING AT THE RELATIVISTIC HEAVY ION COLLIDER

DQO START DATE	January 1, 2003
REVISION NUMBER/DATE	Rev. 3, December 3, 2007
IMPLEMENTATION DATE	January 1, 2008
POINT OF CONTACT	Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

There are no proposed changes for CY2008.

DESCRIPTION AND TECHNICAL BASIS

During 1999 and 2000, BNL installed 13 monitoring wells to evaluate the effectiveness of the engineered (caps) and operational controls designed to protect groundwater quality near activated soil shielding at the RHIC beam stops and collimator areas. Monitoring conducted to date indicates that the controls are effectively protecting the activated soils. For 2008, RHIC monitoring wells will continue to be monitored semi-annually (see Tables 12.24.1 and 12.24.2).

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
_x_ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Secondary particles are created near the RHIC beam stops and collimators. These particles have the potential to escape into the soils surrounding the accelerator tunnel. Although considerable effort is taken to design appropriate shielding and other engineering controls into these systems, many secondary particles will still interact with soils surrounding the tunnels and underlying floors. The types of radionuclides created from this interaction include tritium, beryllium-7, carbon-11, nitrogen-13, oxygen-15, and sodium-22. Some of these radionuclides can be leached downward into groundwater by means of rainwater percolation. These leaching processes are usually quite slow and, therefore, only radionuclides with long half-lives such as tritium ($t_{1/2}$ = 12.3 years) and sodium-22 ($t_{1/2}$ = 2.6 years) are likely to be detected in the groundwater below the RHIC. BNL has been taking steps to reduce the amount of radioactivity produced in soils (by means of additional shielding or modifying operating procedures) and/or to prevent the leaching of these materials to groundwater by the construction of impermeable caps. In October 2005, water infiltrated several sections of the RHIC beam line following abnormally high levels of rainfall, including one of the beam stop areas. This flooding called into question the effectiveness of the beam stop cap during periods of abnormally high rainfall and subsequent rise in the local water table. An evaluation of the local geology determined that the flooded sections of the beam line tunnel were constructed over low-permeability deposits, which become saturated following significant rainfall events. However, tritium has not been detected in groundwater to date, which suggests that the flooding has not resulted in the release of tritium from the activated soil shielding.

The collection of groundwater samples from wells located downgradient of the soil activation areas is required to demonstrate that the operational and engineered controls are effective in protecting groundwater quality. These controls include:

- Limiting the amount of soil activation by use of internal shielding material and beam focusing
- Installation and maintenance of impermeable geomembrane caps over each potential soil activation area (e.g., three beam stops and two collimators)
- Storm water management

Step 2: Identify the Decision

Are the operational and engineered controls employed at RHIC effective at preventing the release of tritium and sodium-22 to groundwater at concentrations that exceed drinking water standards at the point of assessment (i.e., the closest downgradient wells near each of the identified soil activation areas)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the RHIC
- Modeled estimates on the amount of soil activation at each beam stop and collimator.
- Direction and velocity of groundwater flow
- Tritium and sodium-22 concentrations in groundwater.
- Locations of background and downgradient wells relative to each identified soil activation area
- Regulatory requirements (DOE Order 450.1)
- Action levels (as described in the Groundwater Protection Contingency Plan)
- Analytical methods and detection limits:
  - Tritium: EPA Method 906
  - Gamma spectroscopy (optional analysis): EPA Method 901

Starting in 2004, the requirement for routine sodium-22 analyses was dropped from the monitoring program. Focus is now placed on tritium analyses because tritium is more mobile than sodium-22 and has a longer half-life (12.6 years compared to 2.6 years for sodium-22). Therefore, tritium's presence in groundwater would be a better early indicator of a failure in an engineered stormwater control.

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the beam stop and collimator areas within RHIC facility, and the nearest practicable monitoring points (i.e., "points of assessment") near each of the identified potential soil activation areas. The period for which decisions are made is 180 days. These timeframes are based on the following:

- The time required for tritium and sodium-22 to migrate through the vadose zone and reach the groundwater table (by means of rainwater leachate) is likely to be between 30 to 60 days.
- Once the radionuclides have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, typically 100 to 200 feet from the source) is approximately 130 to 260 days.
- Decision periods of 180 days are acceptable for areas where monitoring has demonstrated that current engineered and operational controls are effective.

Step 5: Develop the Decision Rules

Are the engineered and operational controls effective at preventing or reducing the leaching of radionuclides from activated soils to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously "clean" wells.

Decision Rule for a Category 4 Response

If for any monitoring well, the tritium concentrations exceed the applicable drinking water standard (and this result is confirmed by re-sampling), this indicates a significant failure of existing operational or engineered controls; **then** implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well, the tritium concentrations are greater than 50 percent but less than 100 percent of the applicable drinking water standard (and this result is confirmed by re-sampling), this indicates a potential failure of existing operational or engineered controls; **then** implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 3 response. (Note: Initiation of preliminary investigations or other actions may occur if concentrations are less than 50 percent of the drinking water standards.)

Step 6: Specify Acceptable Error Tolerances

Table 12.27.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching of tritium and sodium-22 from activated soil shielding to the groundwater?	See Step 3 for inputs.	Data indicate controls are effective when they are not. Data indicate controls are not effective when they are, due to sampling or analytical error, or wells not properly located.	A discrete slug of contamination potentially up to 100 feet long and 20 feet wide could exist and not be detected.* Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

*Assumes results from one sample period were inaccurate.

There are no potential receptors (i.e., potable water supply wells) located immediately downgradient of the RHIC beam stop and collimator areas, and groundwater travel time to the nearest potential downgradient receptor (Potable Well 10) is greater than 5 years. Due to these factors, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial action under CERCLA or other regulations.

Step 7: Optimize the Design

Number and Locations of Wells

The wells located at the RHIC are biased toward detecting contamination originating from activated soils associated with the facility's beam stops and collimators (Figure 12.27.1). The wells are located as close as possible to these potential source areas to enable early detection of contaminant releases. The current approved monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. No additional wells are recommended for this program.

Parameters and Frequency

Groundwater quality in the RHIC beam stop and collimator areas is routinely evaluated using up to 14 monitoring wells. These wells have been monitored at least semi-annually since their installation in 1999 and 2000. Because tritium is easily leached from activated soils, is highly mobile in groundwater, and has a longer half-life (12.3 years as opposed to 2.6 for sodium-22), the primary focus of the monitoring program is the detection of tritium. Due to retardation of sodium-22 migration in the aquifer, tritium would be the first radionuclide detected in the monitoring well network should the established engineered controls fail. Following the October 2005 flooding of the southern beam stop section of the RHIC beam line, BNL increased the monitoring frequency for select downgradient wells; however no tritium has observed in the groundwater samples collected to date. For CY 2008, groundwater samples will be collected on a semi-annual (180 day) basis, or more frequently as required. Samples will be analyzed only for tritium. Should tritium be detected in any of the wells, samples could also be collected to test for the presence of sodium-22.

Annual Cost Impact Due to Proposed Change

No changes are recommended.

Total Cost for Monitoring Program

$12,100

Table 12.27.2 Comparison of CY2007 and CY 2008 Sampling Programs

Well ID	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
025-03	Semi-annual	Semi-annual	None
025-04	Semi-annual	Semi-annual	None
025-05	Semi-annual	Semi-annual	None
025-06	Semi-annual	Semi-annual	None
025-07	Semi-annual	Semi-annual	None
025-08	Semi-annual	Semi-annual	None
034-05	Semi-annual	Semi-annual	None
034-06	Semi-annual	Semi-annual	None
043-01	Semi-annual	Semi-annual	None
043-02	Semi-annual	Semi-annual	None
044-13	Semi-annual	Semi-annual	None
044-14	Semi-annual	Semi-annual	None
044-29	Semi-annual	Semi-annual	None

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BROOKHAVEN NATIONAL LABORATORY

Environmental Services Division

Figure 1

Environmental Surveillance Monitoring Well And Surface Water Sampling Locations RHIC Facility Area

LEGEND

- Surface Water Collection Points
- Monitoring well
- Buildings, Facilities
- Recharge Basins
- Site Boundary
- June 2000 Groundwater Elevation (ft AMSL)

SCALE

Meters: 0 100 200

Feet: 0 100 200 300 400 500 600

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/home1/higbie/maytempoa/emplan_rhic_f1.aml
GraphicalFacilities/emplan_rhic_01_f1.ai

GROUNDWATER MONITORING AT THE WASTE MANAGEMENT FACILITY

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, December 3, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

Five new downgradient groundwater monitoring wells were installed in 2007. As described below, the wells will be integrated into the Waste Management Facility monitoring program starting in 2008.

DESCRIPTION AND TECHNICAL BASIS

The Waste Management Facility is designed to safely handle, repackage, and temporarily store BNL-derived wastes prior to shipment to an off-site disposal or treatment facility. The WMF has been designed as a state-of-the-art facility, with administrative and engineered controls that meet all applicable federal, state, and local environmental protection requirements. Moreover, institutional controls such as spill prevention plans, operations management plans, maintenance, and personnel training ensure that the facility is operated in a manner that is protective of the environment and human health.

The WMF is a complex consists of four buildings: the Operations Building (Building 860), Reclamation Building (Building 865), RCRA Waste Building (Building 855), and the Mixed Waste Building (Building 870). In addition to administrative controls (procedures, contingency plans, etc.), engineering controls have been designed for these buildings and the outlying paved areas to ensure that any spills and leaks will be contained and detected prior to a release to the environment. Outdoor storage of hazardous or mixed waste only occurs within secondary containment. Sealed floors and isolated drainage areas mitigate potential accidental releases of liquid wastes in the Reclamation Building, the RCRA Building, and the Mixed Waste Building. All storage area floors are pitched inward to ensure that any spills remain inside the building. For added protection, sealed concrete floors in liquid waste handling and storage areas are underlain by 20-mil. high-density polyethylene (HDPE) tertiary containment membranes with monitoring access pipes that can be used to determine whether there has been any leakage through the concrete from the storage cells. Spills in paved areas would be mitigated by concrete curbs and isolated drainage. (Note: The drain at the east roadway exit from the yard adjacent to the Reclamation Building and the drain northeast of the Reclamation Building do not have isolation valves, but they do lead to the stormwater system that discharges to the Recharge Basin HO—SPDES Outfall 003. This outfall is routinely monitored under the SPDES permit.) There are no RCRA-regulated above- or belowground tanks in the WMF. However, all above- and belowground storage tanks that are used to store non-RCRA-regulated waste were designed, installed, and maintained in conformance with Article 12 of the Suffolk County Sanitary Code. The underground storage tanks located at the Waste Reclamation building have never been used, and there are no plans for their future use. These tanks have been officially taken out of service and will be abandoned.

The WMF is located within 2 years of groundwater travel to BNL Potable Supply Wells 11 and 12, which are south of East Fifth Avenue and just north of the WMF site. Because of the proximity of the WMF to Potable Wells 11 and 12, it is imperative that the engineering and administrative controls discussed above are effective in ensuring that waste handling operations at the WMF do not degrade the quality of the soils and groundwater in this area. The Groundwater Monitoring Plan for the WMF supplements the WMF engineered and administrative controls by providing additional means of detecting potential contaminant releases from the WMF. The groundwater monitoring requirements are defined in the facility's RCRA Part B Permit. To account for changes in the predominant groundwater flow pathway since the groundwater monitoring program was established in 1997, five new downgradient monitoring wells were installed in late 2007. The new wells will be integrated into the WMF monitoring program starting in 2008.

From 1997 through the fall of 2003, the eight WMF monitoring wells were sampled quarterly for a wide variety of organic, inorganic, and radiological constituents. Monitoring results indicate that WMF operations have not impacted groundwater quality. Based on the low probability of an undetected release of either chemical or radiological contaminants from the WMF, the quarterly monitoring frequency was reduced to semi-annual in 2004. The adequacy of the semi-annual groundwater monitoring program is based, in part, on the assumption that a low-volume contaminant release would slowly leach into the aquifer and not result in a rapid concentration increase between sample collection periods. Secondly, because the supply wells pump large volumes of water over a large area, considerable mixing of contaminated and uncontaminated water would result in the dilution of any contaminant(s).

In accordance with the BNL Groundwater Protection Contingency Plan, the monitoring program would be reevaluated immediately if a significant contaminant release to the environment were to occur in the WMF area, or if the monitoring wells within the WMF were to indicate that contaminants have been released from the facility due to a previously undetected spill or leak.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

_x_ Compliance
___ Support Compliance
___ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The collection of groundwater samples from wells located at the WMF is required to demonstrate that controls are effective in protecting groundwater quality by means of spill prevention and early detection. These controls include:

Outdoor storage of hazardous or mixed waste only occurs within secondary containment. Potential accidental releases of liquid wastes in the Reclamation Building, the RCRA Building, and the Mixed Waste Building are mitigated by sealed floors and isolated drainage areas. All storage area floors are pitched inward to ensure that any spills would remain inside the building. For added protection, sealed concrete floors in liquid waste handling and storage areas are underlain by high density polyethylene (HDPE) tertiary containment membranes with monitoring access pipes can be used to determine whether there has been any leakage through the concrete from the storage cells. Spills in paved areas would be mitigated by concrete curbs and isolated drainage. All liquid waste storage tanks were designed, installed and maintained in conformance with Article 12 of the Suffolk County Sanitary Code.

Step 2: Identify the Decision

Are the operations of the WMF impacting groundwater quality? If so, do concentrations exceed drinking water standards at the point of assessment (i.e., the closest downgradient wells)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the WMF
- Direction and velocity of groundwater flow
- Contaminant concentrations in groundwater
- Locations of background and downgradient wells relative to known or potential source areas
- Regulatory requirements (DOE Order 450.1; NYSDEC RCRA Part B Permit)
- Action levels – detection volatile organic compounds or radionuclides at concentrations exceeding levels outlined in the Groundwater Contingency Plan
- Analytical methods and detection limits:
  - VOCs (EPA Method 524.2/624)
  - Tritium (EPA Method 906)
  - Gamma spectroscopy (EPA Method 901)
  - Gross alpha/beta (EPA Method 900)
  - Anions (chlorates, sulphates, and nitrates)
  - Metals (EPA Method 200 Series)

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area immediately downgradient of the WMF. A decision period of 180 days is sufficient to provide a secondary means of verifying that the operational and engineered controls in place at the WMF are effective. This timeframe is based on the following considerations:

As described above, the WMF has a number of engineered and operational controls that are designed to prevent release of contaminants to the environment. A more frequent monitoring program can be implemented if a leak is found or suspected.
The time required for small volumes of contaminants to migrate through the vadose zone and reach the groundwater table is likely to be 90 days or more. It is important to note that most waste materials that are stored at the WMF are not readily mobile in soils. (See waste profile descriptions in the RCRA Part B Permit, pages 99 through 113.) Once contaminants have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, typically within 50 to 100 feet of a storage building) is on the order of 130 days.

Step 5: Develop the Decision Rules

Are the operational and engineered controls effective at preventing the release of contaminants to groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency

Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously "clean" wells.

Decision Rule for a Category 4 Response

If for any monitoring well: the contaminant concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling); the contaminant has not been detected in an upgradient well and suggests a release from a WMF activity; the contaminant concentrations are significant enough to immediately threaten the quality of water pumped from nearby drinking water supply wells 11 and 12; or contaminant concentrations indicate the presence of a previously unidentified source (including potential upgradient sources); **and** this result is confirmed by re-sampling, **then** implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well, the contaminant concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling), and the contaminant has not been detected in an upgradient well and is not associated with a known upgradient source, **then** implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.28.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the release of contaminants to soils and groundwater?	See Step 3 for inputs.	Data indicate controls are effective when they are not. Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	A discrete slug of contamination potentially up to 200 feet long could exist and not be detected.* Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and all operational and engineered controls (i.e., inventory resolution, leak detection, secondary containment) were to fail.

BNL potable water supply wells 11 and 12 are located immediately adjacent to the WMF. Although it is possible that a decision error could result in adverse consequences to human health, the WMF is designed and operated in a manner that eliminates or limits any potential contaminant release to the environment. In addition to the groundwater monitoring program, the supply wells are also routinely monitored for the contaminants of concern in accordance with SDWA requirements. Because these supply wells draw water from a large area (i.e., zone of contribution), it is likely that low-level contamination would undergo considerable dilution before entering the water distribution system. Under current preferred potable water system operating conditions, these wells supply less than 25 percent of the water demand for the site. Consequences associated with decision errors for this program relate primarily to impacts to BNL's water supply and possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require the short-term or long-term shut down of the supply wells, and possible remedial actions under applicable NYS regulations.

Step 7: Optimize the Design

Number and Locations of Wells

The wells are located as close as possible to potential WMF source areas to allow for early detection of contaminant releases (Figure 12.28.1). When the WMF monitoring program began in 1997, the predominant groundwater flow pathway in the WMF area was to the north. This northerly flow pattern was the result of a significant groundwater mound below recharge basin HO located to the south of the WMF and significant pumpage from water supply wells 11 and 12 located to the north of the WMF. To accommodate this northerly flow pathway, four (downgradient) wells were positioned between waste storage facilities and the potable supply wells, with the four remaining wells positioned to detect potential contamination from upgradient sources (e.g., Building 830, Basin HO and the AGS research complex). However, since 1997, there has been a significant reduction in cooling water discharges to basin HO and restrictions have been placed on prolonged pumpage of water from supply wells 11 and 12. This has resulted in a return to a more natural southeasterly flow pathway in the WMF area. In late 2007, five new downgradient monitoring wells were installed to account for this change in groundwater flow direction. The current sampling protocol, as described in the RCRA Part B Permit, calls for the running of supply wells 11 and 12 for a two-week period prior to sampling the WMF wells in order to establish a south to north groundwater flow direction. However, starting in 2008, the natural southeasterly groundwater flow pathway will be maintained for at least one month prior to sampling the new downgradient monitoring wells. The older downgradient wells will be kept in reserve, and will only be sampled if supply wells 11 and 12 have been in continuous operation for two or more weeks prior to the sampling period.

Because the monitoring well network is designed to act as a secondary means of verifying proper facility operation, the current approved monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders.

Parameters and Frequency

Groundwater quality at the WMF area is evaluated using as many as eight monitoring wells during a sample period. Monitoring data collected since 1997 indicates WMF operations have not impacted ground-water quality.

As described in the NYSDEC-approved groundwater monitoring plan for the WMF, the monitoring wells are sampled semi-annually. Samples are analyzed semi-annually for VOCs and radioactivity, and annually for anions and metals.

Table 12.28.2. Comparison of CY2007 and CY 2008 Sampling Programs

Well	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
055-03 (Upgradient Well)	Semi-annual	Semi-annual	None
055-10 (Upgradient Well)	Semi-annual	Semi-annual	None
056-21 (Downgradient Well)	Semi-annual	Placed In Reserve (a)	--
056-22 (Downgradient Well)	Semi-annual	Placed In Reserve (a)	--
056-23 (Downgradient Well)	Semi-annual	Placed In Reserve (a)	--

066-07 (Upgradient Well)	Semi-annual	Placed In Reserve (a)	--
066-83 (Downgradient Well)	Semi-annual	Placed In Reserve (a)	--
066-84 (Downgradient Well)	Semi-annual	Placed In Reserve (a)	--
WMF-01-2007 (Downgradient Well)	Not Installed	Semi-annual (b)	None
WMF-02-2007 (Downgradient Well)	Not Installed	Semi-annual (b)	None
WMF-03-2007 (Downgradient Well)	Not Installed	Semi-annual (b)	None
WMF-04-2007 (Downgradient Well)	Not Installed	Semi-annual (b)	None
WMF-05-2007 (Downgradient Well)	Not Installed	Semi-annual (b)	None

(a) These wells will be sampled only if supply wells 11 and 12 have been in continuous operation for two weeks or more prior to the scheduled sampling date. The pumping induced groundwater flow pattern in the WMF area would be to the north.

(b) These are the preferred downgradient monitoring wells for the WMF. These wells will be sampled only if supply wells 11 and 12 have not been in continuous operation for one month or more prior to the scheduled sampling date. The normal groundwater flow pattern in the WMF area would be to the southeast.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Although five new downgradient wells will be integrated into the monitoring program in CY2008, six of the older wells will be placed into reserve status. Although this will result in the sampling of one less well, there will be a cost increase of approximately $1,100 due to increased sampling and analysis costs.

TOTAL COST FOR MONITORING PROGRAM

The FY 2008 cost for the WMF groundwater surveillance program is estimated to be $16,400.

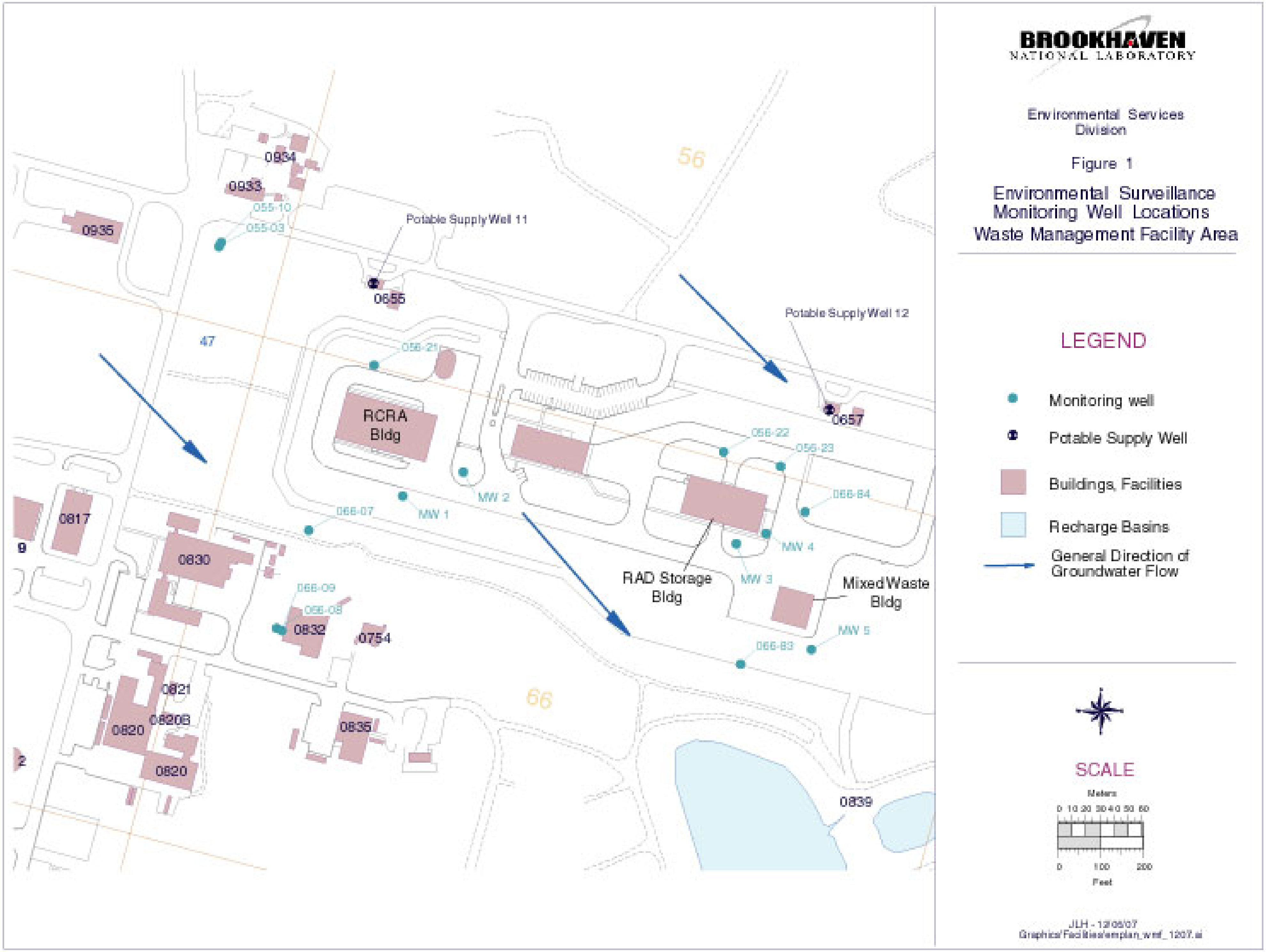

Figure 1
Environmental Surveillance Monitoring Well Locations Waste Management Facility Area

GROUNDWATER MONITORING AT THE BNL MEDICAL RESEARCH REACTOR

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, December 3, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

Because tritium levels in the groundwater have been consistently below the 20,000 pCi/L drinking water standard since the start of the monitoring program in 1997, and all cooling water systems within the Brookhaven Medical Research Reactor (BMRR) have been drained, the sampling frequency has been changed from annually to once every 2 years. No sampling was conducted during 2007; sampling will resume in 2008.

DESCRIPTION AND TECHNICAL BASIS

Tritium has routinely been detected in groundwater downgradient of the BMRR since monitoring started in 1997, but at concentrations below the drinking water standard of 20,000 pCi/L. Tritium concentrations have declined from a maximum of 17,100 pCi/L in 1999 to <5,000 pCi/L since mid 2000. No other potential BMRR related radionuclides have been detected in groundwater to date. Some residual tritium remains in the vadose zone below the facility, and it is expected that some amount will migrate into groundwater by natural processes (i.e., water table fluctuation) over many years. Operational and engineered controls were implemented in 1997; since that time, all nuclear fuel has been removed from the BMRR and all primary cooling water lines have been drained. Monitoring well sampling frequency and methods of analysis is summarized in Tables 12.24.1 and 12.24.2.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
_x_ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Following the discovery of tritium in groundwater downgradient of the HFBR in 1997, BNL installed groundwater monitoring wells at the BMRR to evaluate any potential impacts to groundwater quality. Tritium was detected at concentrations up to 11,800 pCi/L in several of the new monitoring wells directly downgradient of the BMRR facility. The drinking water standard for tritium is 20,000 pCi/L. A 1997 review of systems and operations within the BMRR facility identified two potential sources for the tritium detected in groundwater: (1) spills that occurred during the transfer of radioactive liquids to a former aboveground storage tank, and (2) a floor drain system and associated sump that had received primary cooling water on several occasions. Primary coolant contained tritium at a concentration up to 465 pCi/L. Although small volume releases occurred while transferring liquids to an outdoor storage tank on several occasions, the most likely source for the tritium detected in groundwater is primary cooling water discharges to the floor drain system and an associated, unlined 150-gallon SU-2 sump in the basement of the BMRR. Reactor operations records indicated 16 spills or discharges totaling nearly 800 gallons of primary water to the floor drains or directly to the SU-2 sump. The last such discharge occurred in January 1987. Although most of the primary water that was discharged was properly disposed, qualitative leak-rate testing conducted in 1997 indicated that the sump and/or floor drain piping system was not entirely leak tight, and some amount of radioactive water may have leaked to the underlying soils. Furthermore, until 1997, secondary (nonradioactive) coolant water was routinely discharged to the SU-2 sump and floor drain system. Leakage of secondary water could have provided sufficient water volume to drive the tritium through the unsaturated zone and into the groundwater beneath the reactor building.

To prevent potential future releases of radioactive materials to the soils and groundwater below the BMRR, the floor drain system was abandoned in 1997. BNL also sealed the SU-2 sump and a plastic container was installed in the sump pit. A liquid sensor installed in the sump is used to detect the presence of any liquids outside the plastic container. In addition, the BMRR facility has been designated for decommissioning and demolition. Issues related to the decommissioning and demolition has not been addressed in this DQO. All nuclear fuel has been removed from the facility, and the activated primary water was drained in 2005.

The groundwater monitoring well network includes upgradient well 084-28 and downgradient wells 084-12, 084-13, and 084-27. Samples collected from these wells have been analyzed for tritium, gross alpha, gross beta, and gamma spectroscopy. Occasionally, tests have also been performed for Sr-90 when elevated gross beta levels were detected. The predominant direction of groundwater flow in the area is to the south-southeast.

Following the removal of the fuel and primary cooling water, continued groundwater surveillance is required to evaluate potential small-scale releases of residual tritium from the vadose zone beneath the reactor facility. Based on an average groundwater flow velocity of 0.75 feet per day, the travel time from the point where contaminants may enter the soils below the reactor building, migrate through the vadose zone, and travel to the monitoring wells is likely to be greater than 100 days. Monitoring conducted during 2003 and the first half of 2004 indicates that tritium concentrations have dropped to <1,400 pCi/L. No other reactor-related radionuclides have been detected in groundwater downgradient of the BMRR.

Step 2: Identify the Decision

Are the controls effective at eliminating further discharges to soils and groundwater below the BMRR (i.e., are performance objectives met)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Maintenance of reactor structure and future D&D activities
- Direction and velocity of groundwater flow

- Tritium, gross alpha, gross beta, and Sr-90 concentrations in groundwater with time, from historical sampling
- Current location of background (1) and downgradient monitoring (3) wells
- Regulatory driver (DOE Order 450.1)
- Action levels (MCLs, as described in the Groundwater Protection Contingency Plan)
- Analytical methods and detection limits:
  - Tritium: EPA Method 906
  - Gross alpha/beta: EPA Method 908 (optional analysis)
  - Gamma spectroscopy: EPA Method 901 (optional analysis)
  - Sr-90: EPA Method 905 (optional analysis)

Step 4: Define the Study Boundaries

The decision for this project applies to the area in the immediate vicinity of the BMRR facility. The period for which the individual decisions will be made is 730 days, based on the following factors:

- Tritium concentrations in groundwater have remained <1,400 pCi/L since 2002.
- Currently, there are no pathways for new releases of tritiated water. (Note: The primary cooling water system was drained in 2005.)
- No other reactor-related radionuclides have been detected in groundwater.
- There are no nearby drinking water supply wells.

Step 5: Develop the Decision Rules

Are the controls effective at eliminating further discharges to soils and groundwater below the BMRR?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, the detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response

If for any monitoring well, radionuclide concentrations in a sample exceed the applicable water quality standards (and this result is confirmed by re-sampling) **or** radionuclide concentrations indicate a new release from a previously unknown source (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well, radionuclide concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.29.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching of radionuclides to the groundwater?	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to ~400 feet long and 30 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Protection Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and operational and engineered controls (i.e., leak detection or secondary containment) were to fail. Note, however, that the primary cooling water system was completely drained in 2005.

There are no potential receptors immediately downgradient of the BMRR, and groundwater travel time to the nearest current potential downgradient receptor is greater than 10 years. Furthermore, most homes south of BNL have been connected to public water. Contaminant concentrations have historically not exceeded drinking water standards and are not expected to exceed them in the future because the BMRR operations ended in 2000. The nuclear fuel has been removed and activated primary cooling water was removed during 2005. Therefore, it is very unlikely that decision error will result in adverse consequences to human health. The consequences of decision error relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions.

Step 7: Optimize the Design

Number and Locations of Wells

Three of the BMRR wells are biased toward surveillance of groundwater quality immediately downgradient of the facility. One well is immediately upgradient of the BMRR. The monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders (Figure 12.29.1). Because the groundwater flow direction has been relatively constant in this area in recent years and the potential source is relatively small in area, no refinements are recommended.

Parameters and Frequency

- The four BMRR surveillance wells were monitored semi-annually from 1997 through 2004, with samples tested for tritium, gross alpha, gross beta, and gamma spectroscopy, and occasionally for Sr-90. Because tritium concentrations have not been observed at concentrations above the drinking water standard and because of the declining concentration trend, the frequency of monitoring was reduced to annually starting in 2005, and biannually starting in 2007.
- A significant amount of groundwater data has been collected since 1997. Tritium concentrations have never exceeded the drinking water standard of 20,000 pCi/L, and have remained <5,000 pCi/L since mid 2000. Because tritium concentrations for the past several years have been less than one quarter of the drinking water standard and the primary cooling water system has been drained, under current conditions the collection of groundwater samples every two years should provide adequate groundwater surveillance data for the BMRR.
- Since the beginning of the monitoring program in 1997, no other reactor-related radionuclides have been observed in the groundwater downgradient of the BMRR.

- Future evaluation of the sampling program for optimization purposes will need to consider that the facility is scheduled for full decommissioning and demolition.

Table 12.29.2. Comparison of CY 2007 and CY 2008 Monitoring Programs

Well	CY2007 Sampling Frequency	CY2007 Sampling Frequency	Affected Parameters
084-12	None	Annual	H-3
084-13	None	Annual	H-3
084-27	None	Annual	H-3
084-28	None	Annual	H-3

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

Because no sampling was conducted during 2007, there will be a $1,900 increase in spending for 2008.

TOTAL COST FOR MONITORING PROGRAM

Because this is a biannual sampling program, there will be an increase of approximately $1,900 for CY2008.

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Environmental Services Division

Figure 1

Environmental Surveillance Monitoring Well Locations Medical Research Reactor Area

LEGEND

Monitoring well

Buildings, Facilities

June 2000 Groundwater Elevation (ft AMSL)

Direction of Groundwater Flow

SCALE

Meters

0 10 20 30

0 100

Feet

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GROUNDWATER MONITORING AT THE SEWAGE TREATMENT PLANT

DQO START DATE	January 1, 2003
REVISION NUMBER/DATE	Rev. 3, December 3, 2007
IMPLEMENTATION DATE	January 1, 2008
POINT OF CONTACT	Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

There are no recommended changes for CY 2008.

DESCRIPTION AND TECHNICAL BASIS

BNL has established an environmental monitoring program at the STP to evaluate potential impacts to environmental quality and to demonstrate compliance with DOE requirements and applicable federal, state, and local laws, regulations, and permits. The primary monitoring program is conducted in accordance with BNL's SPDES permit. Because approximately 15 percent of the water sent to the STP filter beds is recharged directly to groundwater, BNL uses groundwater monitoring to provide a secondary means of evaluating potential impacts of STP operations. The monitoring well sampling frequency and methods of analysis are summarized in Tables 12.24.1 and 12.24.2.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
_x_ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The STP processes sanitary sewage for BNL facilities. The STP processes an average of 0.72 million gallons per day (MGD) during non-summer months and approximately 1.25 MGD during the summer months. Treatment of the sanitary waste stream includes: primary treatment to remove settleable solids and floatable materials, aerobic oxidation for secondary removal of the biological matter and nitrification of ammonia, secondary clarification, sand filtration for final effluent polishing, and ultraviolet disinfection for bacterial control prior to discharge into the Peconic River. Oxygen levels are regulated during the treatment process; nitrogen can be biologically removed using nitrate-bound oxygen for respiration. The discharge is regulated under a NYSDEC SPDES permit, NY-0005835.

Wastewater from the STP clarifier is released to the sand filter beds, where the water percolates through 3 feet of sand before being recovered by an underlying clay tile drain system that transports the water to the discharge point at the Peconic River (SPDES Outfall 001). Approximately 15 percent of the water released to the filter beds is either lost to evaporation or to direct groundwater recharge. At the present time, six sand filter beds are used in rotation.

Two emergency holding ponds east of the sand filter bed are used for the emergency storage of sanitary waste in the event of an upset condition or if the influent contains contaminants in concentrations exceeding BNL administrative limits and/or SPDES permit effluent release criteria. The holding ponds are equipped with fabric reinforced (hypalon) plastic liners that are heat-welded along all seams. The first lined holding pond was constructed in 1978, and has a capacity of approximately 4 million gallons. A second 4-million gallon lined pond was constructed in 1989. The combined capacity of nearly 8 million gallons enables BNL to divert all sanitary system effluent for approximately 12 days. As part of the Phase III Sewage Treatment Plant Upgrades project in 2001, the original single liners were replaced with double liners and an integrated leak detection system.

Collecting groundwater samples from wells near the filter beds and downgradient of the emergency holding ponds is required, to demonstrate that current operational and engineered controls are effective in protecting groundwater quality. These controls include the following:

- BNL has developed a comprehensive pollution prevention program, which includes worker education on proper use and disposal of hazardous materials. These programs are integrated into the BNL Standards Based Management System.
- In accordance with the SPDES permit, BNL carefully monitors both the influent and effluent from the STP. SPDES monitoring is the primary means of ensuring that the engineered and operational controls are working.

Step 2: Identify the Decision

Are the operations of the STP impacting groundwater quality? If so, do concentrations exceed drinking water standards at the point of assessment (i.e., the closest downgradient well)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the STP
- Direction and velocity of groundwater flow
- VOC, radionuclide, metals and anion concentrations in groundwater
- Locations of background and downgradient wells relative to known or potential source areas
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Contingency Plan)
- Analytical methods and detection limits
  - VOCs (EPA Method 524.2)
  - Radionuclides analyses: tritium, gross alpha/beta, gamma, (Sr-90 is optional)
  - Metals (EPA Method 200 Series)
- Nature of use of emergency holding ponds

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the STP facility. Because the SPDES monitoring program is the primary means of evaluating potential environmental impacts from STP operations, a decision period of 365 days for the filter bed area groundwater monitoring is sufficient to provide a secondary means of verifying that the operational and engineered controls are effective. Similarly, a decision period of one year for the emergency holding ponds area is sufficient to provide a secondary means of verifying that the operational and engineered controls are effective. This timeframe is based on the following:

- Influent and effluent of the STP is carefully monitored, as required by the SPDES permit. A more frequent monitoring program can be implemented if a significant contaminant release to the sanitary system is discovered or suspected.
- Groundwater monitoring conducted for the past 5 years has demonstrated that STP operations are not significantly affecting groundwater quality in the area. All VOC, radionuclide, and anion concentrations have been below applicable water quality standards. Some metals, such as sodium, are occasionally detected at concentrations slightly above standards.
- Once contaminants have migrated to groundwater, the travel time from the STP filter bed area or emergency holding ponds to the site boundary is estimated to be greater than 10 years. Although there is a potential for contaminated groundwater originating from the northern filter bed areas to enter the Peconic River via groundwater discharge, the time of travel is likely to be more than 180 days.
- There are no drinking water supply wells near the STP.
- The double liners and integrated leak detection system installed in the emergency holding ponds significantly reduce the risk of leaks of contaminated water that may be diverted to the ponds.

Step 5: Develop the Decision Rules

Are the operational and engineered controls effective at preventing the introduction of contaminants to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response

If for any monitoring well, the contaminant concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling) or contaminant concentrations indicate a new release, an unexpected release rate, or previously unknown source (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well contaminant concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.30.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the discharge of contaminants to the groundwater?	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 300 feet long could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and one or more operational and engineered controls (i.e., SPDES monitoring, leak detection, secondary containment) were to fail.

There are no potable water supply wells immediately downgradient of the STP area, although during certain hydraulic conditions (i.e., seasonal water table rises), local groundwater can discharge into the nearby Peconic River. Groundwater travel time from the STP area to the BNL eastern boundary is greater than 10 years, and most homes east of BNL have been connected to public water. Therefore, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under applicable NYS regulations.

Step 7: Optimize the Design

Number and Locations of Wells

The wells are as close as possible to the potential source areas to enable early detection of contaminant releases (Figure 12.30.1). Six wells are near the STP filter beds and three wells are near the emergency holding ponds. The current monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years, no refinements are recommended.

Parameters and Frequency

Multiple sets of analytical data are available to assess potential impacts from recent operations. As noted above, groundwater monitoring conducted for the past 5 years has demonstrated that STP operations are not significantly affecting groundwater quality in the area. All VOC, radionuclide and anion concentrations have been below applicable drinking water or ambient water quality standards. Some metals, such as sodium, are occasionally detected at concentrations slightly above standards.

Table 12.30.2 Comparison of CY2007 and CY2008 Sampling Programs

Well	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
038-02	Annual	Annual	None
038-03	Annual	Annual	None
039-07	Annual	Annual	None
039-08	Annual	Annual	None

Well	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
039-86	Annual	Annual	None
039-87	Annual	Annual	None
039-88	Annual	Annual	None
039-89	Annual	Annual	None
039-90	Annual	Annual	None

Annual Cost Impact Due to Proposed Change

No changes are recommended for CY 2008.

Total Cost for Monitoring Program

Total cost for the CY 2008 groundwater surveillance program at the STP is estimated to be $10,700.

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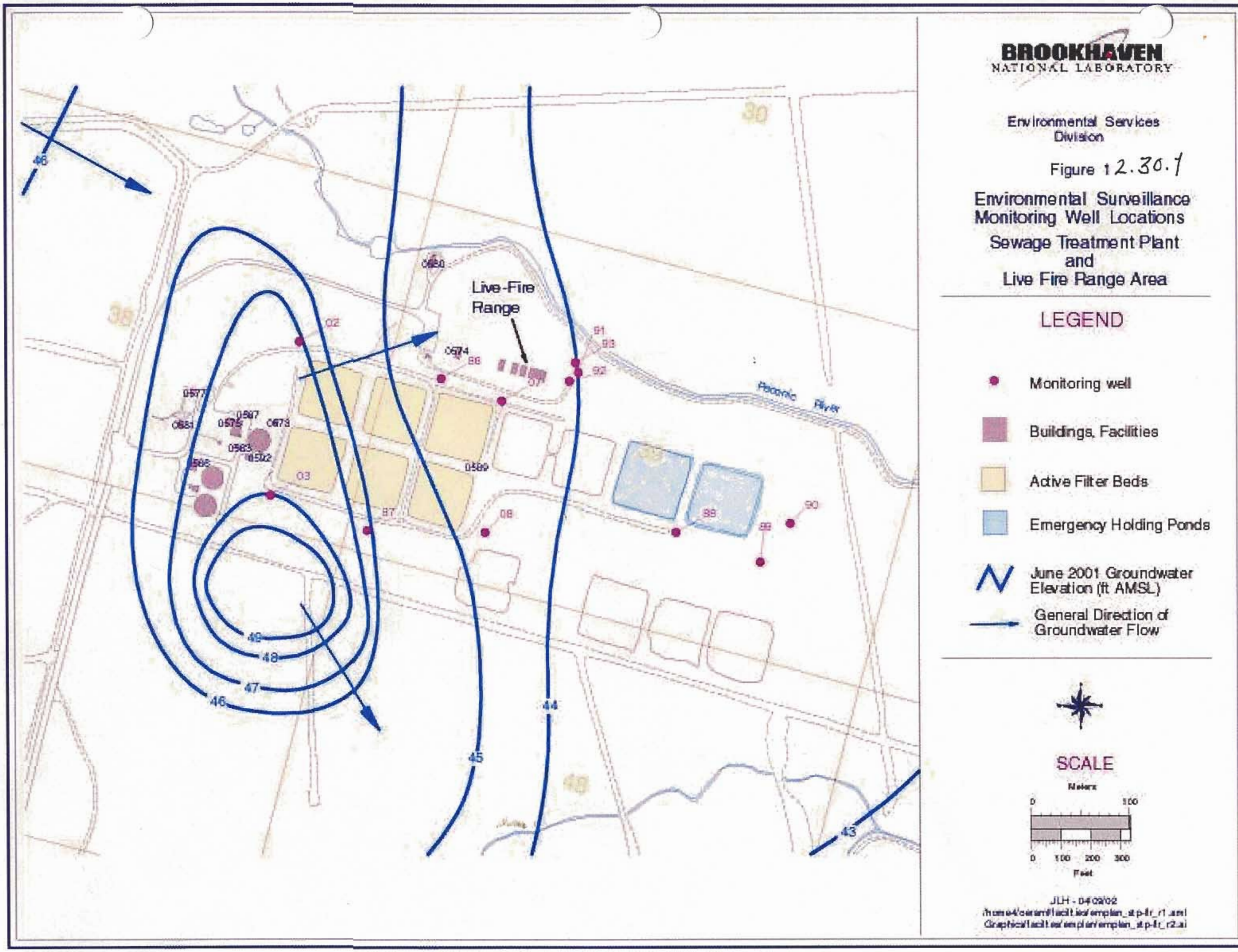

Live-Fire Range
Peconic River
30
38
48
46
45
44
43
47
48
49
02
03
07
08
86
87
88
89
90
91
92
93
0674
0680
0577
0581
0576
0587
0673
0583
0592
0589
0586
BROOKHAVEN NATIONAL LABORATORY
Environmental Services Division
Figure 12.30.1
Environmental Surveillance Monitoring Well Locations
Sewage Treatment Plant and Live Fire Range Area
LEGEND
Monitoring well
Buildings, Facilities
Active Filter Beds
Emergency Holding Ponds
June 2001 Groundwater Elevation (ft AMSL)
General Direction of Groundwater Flow
SCALE
Meters
0
100
Feet
0
100
200
300
JLH - 04/09/02

GROUNDWATER MONITORING AT THE SHOTGUN AND LIVE-FIRE RANGES

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 3, December 3, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

Routine sampling of the Shotgun and Live-Fire Range monitoring wells was discontinued at the end of 2002. There are no plans to sample these wells in CY2008.

DESCRIPTION AND TECHNICAL BASIS

In 2000, BNL installed monitoring wells 039-91 and 039-92 at the Shotgun Range and the Live-Fire Range (LFR) to evaluate the potential impact to groundwater from the long-term use of lead shot and bullets. Based on data collected from 2000 through 2002, groundwater quality in these two areas has not been impacted by lead, and anion concentrations are consistent with ambient conditions. Routine monitoring of these wells was suspended at the end of 2002. The LFR wells were also sampled once for perchlorate in response to a 2004 request by the SCDHS to evaluate perchlorate levels in groundwater at BNL. Perchlorate was not detected in these samples.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
_x_ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

There is a potential that the use of lead bullets at the LFR and lead shot at the Shotgun Range could cause soil contamination and potentially impact groundwater quality. The Shotgun Range was permanently closed in December 2004, but it is estimated that as many as 30,000 shotgun rounds per year were used in the past. Until 2000, when BNL placed an administrative ban on the use of lead shot, as much as 2,100 pounds of lead could have been deposited on the surface of the range annually. Although the downrange berm at the LFR is annually screened for spent bullets, some number of bullets may be missed. Lead can also be imparted directly onto soils as the bullets impact with sand grains. Although it is thought to be of minor concern, lead could leach into the soils as it is exposed to rain water, which is typically slightly acidic.

Analytical data from groundwater samples collected from the Shotgun and Live-Fire Range area monitoring wells was used to determine whether the operational and engineered controls were effective in protecting groundwater quality. These controls include:

- Live-Fire Range: reducing the potential for lead contamination of soils and exposure of spent lead bullets by periodically screening the soils to remove the bullets and by using copper and Teflon-coated bullets.
- Shotgun Range: requiring the use of steel shot (requirement implemented in 2000). The Shotgun Range was permanently closed in December 2004. In 2006, BNL removed approximately 500 cubic yards of the more highly contaminated soils. The Laboratory is currently evaluating whether the remaining contaminated soil needs to be removed.

Step 2 Identify the Decision

Are the current and past operations of the Live-Fire and Shot Gun Ranges impacting groundwater quality? If so, do concentrations exceed water quality standards at the point of assessment (i.e., the closest downgradient well)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the ranges
- Direction and velocity of groundwater flow
- Metals concentrations in groundwater (including naturally occurring metals concentrations)
- Locations of background and downgradient wells relative to each range
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Contingency Plan)
- Analytical methods and detection limits (as described in the EMP)
  - Metals (EPA Method 200 Series)

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the Live-Fire and Shotgun Range areas. The period for which decisions are made is 730 days. This timeframe is based on the following:

- The time required for lead to migrate through the vadose zone and reach the groundwater table (potentially in dissolved form by means of rainwater leachate) is likely expected to be greater than 365 days.
- Once the lead has migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, typically 50 feet from the source) is 75 or more days.
- Current data indicate that groundwater quality has not been affected by lead contamination at either range.

Step 5: Develop the Decision Rules

Are the operational controls effective at preventing or reducing the leaching of lead from spent bullets, shot, or contaminated soils to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and the detection of contaminants in previously "clean" wells.

Decision Rule for a Category 4 Response

If for any monitoring well, the lead concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well, the lead concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.31.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching lead to the groundwater?	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 200 feet long and 20 to 100 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and that lead will be in a state that will allow it to readily migrate in the aquifer system (i.e., lead migration is not retarded).

There are no potential receptors (i.e., potable water supply wells) immediately downgradient of LFR. However, there is a potential that contaminants entering the groundwater near the LFR could enter the Peconic River during high water table conditions. At the Shotgun Range, groundwater travel time to the nearest potential downgradient receptor (Potable Wells 11 and 12) is greater than 5 years. Due to these factors, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require additional remedial actions.

Step 7: Optimize the Design

Number and Locations of Wells

The wells downgradient of the Live-Fire and Shotgun Ranges are biased toward detecting contamination originating from areas of the ranges where lead accumulates (Figure 12.31.1). The wells are as close as possible to these potential source areas to enable early detection of contaminant releases. The current monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. No additional monitoring wells are recommended.

Parameters and Frequency

Groundwater quality at the Live-Fire and Shotgun Range areas has been evaluated using monitoring wells that were installed in early 2000. The wells were routinely sampled from 2000 through 2002. No detectable levels of lead were found in any of the groundwater samples. Because these ranges have been in operation for many years, the results indicate that lead from bullets and shotgun pellets is not being leached at appreciable levels, and is not impacting groundwater quality. Groundwater samples may be collected in the future to verify that the use of these ranges has not impacted groundwater quality.

Table 12.31.2. Comparison of CY2007 and CY2008 Sampling Programs – Shotgun Range

Well ID	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
046-01	None	None	None
046-02	None	None	None
046-03	None	None	None

Table 12.31.3. Comparison of CY2007 and CY2008 Sampling Programs – Live-Fire Range

Well	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
039-91	None	None	None
039-92	None	None	None

TOTAL COST FOR MONITORING PROGRAM

No samples will be collected during CY2008.

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Figure 1

Environmental Surveillance Monitoring Well Locations BNL Shotgun Range Area

LEGEND

- Monitoring well
- Potable Supply Well
- Buildings, Facilities
- June 2000 Groundwater Elevation (ft AMSL)
- General Direction of Groundwater Flow

SCALE

Meters: 0 – 100

Feet: 0, 100, 200, 300

JLH - 04/02/01
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Graphics/Facilities/emplan_sgr_r1.ai

GROUNDWATER MONITORING AT THE BNL MOTOR POOL FACILITY

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 3, December 3, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

No changes are recommended for CY 2008.

DESCRIPTION AND TECHNICAL BASIS

In 1996, BNL installed two monitoring wells downgradient of the gasoline underground storage tanks (USTs). Data from these wells indicate that current fuel storage and dispensing operations are not impacting groundwater quality. In 1999, BNL installed six additional monitoring wells to evaluate the potential impact to groundwater quality from two oil spills. Although the monitoring results indicated that the two oil spills had not impacted groundwater quality, the degreasing agent 1,1,1-trichloroethane and several gasoline by-products were observed. Based upon solvent handling and spill controls that have been in effect for the past 15 years, these contaminants likely originate from historical small-scale spills resulting from vehicle maintenance activities. SVOCs have not been detected in any samples, and sampling for these compounds was discontinued in CY2005. Monitoring well sampling frequency and methods of analysis is summarized in Tables 12.24.1 and 12.24.2.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
_x_ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Potential environmental concerns at the Motor Pool include the historical and current use of USTs for the storage of gasoline and waste oil, hydraulic fluids used for lift stations, and the use of solvents for parts cleaning. In August 1989, the USTs, pump islands, and associated piping were upgraded to comply with Suffolk County Article 12 requirements for secondary containment, leak detection devices, and overfill alarms. Following the removal of the old USTs, there were no obvious signs of soil contamination. The present tank inventory includes two 8,000 gallon USTs used for the storage of unleaded gasoline, one 260 gallon UST for waste oil, and one 3,000 gallon UST for No. 2 fuel oil. The facility also has five vehicle lift stations. In 2002, the petroleum-based hydraulic fluid for the lifts was replaced with a vegetable-based product.

In December 1996, BNL removed an underground propane tank near the Site Maintenance Facility (Building 326). During this removal, the surrounding soils had a distinct petroleum staining and smell. These soils were contaminated from a previously unknown historical oil spill. The site was excavated to the extent that the footings of the building were almost undermined. Although approximately 60 cubic yards of contaminated soil were removed, there was clear evidence that contaminated soils remained. In February 1998, it was discovered that hydraulic fluid was leaking from one of the lift stations in Building 423. The lift was excavated and approximately 50 cubic yards of contaminated soils were removed.

In response to a NYSDEC request, BNL installed six new monitoring wells in the Motor Pool (Building 423/326) area to evaluate the potential impacts of the two oil spills. As part of the Stipulation Agreement with NYSDEC, BNL measured for floating product on a monthly basis, and collected quarterly samples for VOCs and SVOCs. One well (102-08) was installed upgradient of the Motor Pool area to provide background water quality data, and one well (102-09) was installed directly downgradient of the Building 423 vehicle lift station. Four wells were installed downgradient of the Building 326 fuel oil spill site.

The collection of groundwater samples from wells downgradient of the Motor Pool area is required, to demonstrate that the remedial actions (i.e., removal of contaminated soils) and current operational and engineered controls are effective in protecting groundwater quality. These controls include:

- All USTs, pump islands, and associated piping comply with Suffolk County Article 12 requirements for secondary containment, leak detection devices, and overfill alarms.
- BNL maintains an inventory/accounting of gasoline stored in USTs at the Motor Pool.
- BNL maintains an inventory of all chemical degreasers in use at the Motor Pool.
- All spent degreasing agents are properly stored and disposed of.

Step 2: Identify the Decision

The decision for this monitoring program is:

Are the operations of the Motor Pool impacting groundwater quality? If so, do concentrations exceed water quality standards at the point of assessment (i.e., the closest downgradient well(s)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the Motor Pool
- Direction and velocity of groundwater flow
- VOC and SVOC concentrations in groundwater
- Floating product determination measurements
- Locations of background and downgradient wells relative to known or potential source areas
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Contingency Plan)
- Analytical methods and detection limits
  - VOCs (EPA Method 524.2)
  - SVOCs (EPA Method 625): Samples no longer routinely analyzed for SVOCs

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the Motor Pool/Site Maintenance Buildings. The period for which decisions are made is 180 days. This timeframe is based on the following:

- The USTs, pump islands, and associated piping were upgraded to comply with Suffolk County Article 12 requirements for secondary containment, leak detection devices, and overfill alarms. A more frequent monitoring program can be implemented if a leak is found or suspected. Vegetable-based products replaced petroleum-based hydraulic fluids in the vehicle lift stations.
- The time required for small-scale petroleum hydrocarbons and solvent spills to migrate through the vadose zone and reach the groundwater table is likely to be 30 or more days. It is important to note that some petroleum hydrocarbons are not readily mobile in soils.
- Once contaminants have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, approximately 20 feet from the USTs or historical spill areas) is on the order of 30 days.
- Decision periods of 180 days is sufficient to provide a secondary means of verifying that the current operational and engineered controls in place at the Motor Pool are effective, and evaluate the potential continued impact from historical solvent, oil, and gasoline spills.

Step 5: Develop the Decision Rules

Are the operational and engineered controls effective at preventing the introduction of petroleum hydrocarbons and solvents to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, the detection of previously undetected contaminants, and the detection of contaminants in previously "clean" wells.

Decision Rule for a Category 4 Response

If for any monitoring well:

- The VOC concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling), or
- VOC concentrations indicate a new release, an unexpected release rate, or previously unknown source (and this result is confirmed by re-sampling), or
- Floating product is detected,

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well, the VOC concentrations are greater than 50 percent but less than 100 percent of the applicable drinking water standards (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.32.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching lead to the groundwater?	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 480 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and all operational and engineered controls (i.e., inventory resolution, leak detection, secondary containment) were to fail.

There are no potential receptors (i.e., potable water supply wells) immediately downgradient of Motor Pool area. Travel time from the Motor Pool area to the BNL southern boundary is greater than 15 years, and most homes south of BNL have been connected to public water. Therefore, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under NYS regulations.

Step 7: Optimize the Design

Number and Locations of Wells

The wells at the Motor Pool are biased toward detecting contamination that could originate from the UST area and petroleum contaminated soils associated with the spills discussed above (Figure 12.32.1). The wells are as close as possible to these potential source areas, to enable early detection of any contaminant releases. The current monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years and the potential source is relatively small, no refinements are recommended.

Parameters and Frequency

Groundwater quality at the Motor Pool/Site Maintenance Facility area has been evaluated using monitoring wells that were installed in 1999. Multiple sets of analytical data are available to assess potential impacts from current operations and historical spills.

- The solvent 1,1,1-trichloroethane is routinely detected at concentrations up to 50 μg/L. (The NYS Ambient Water Quality Standard for TCA is 5 μg/L.) It is important to note that TCA has not been used as a parts degreaser at the Motor Pool for many years, and its presence in groundwater is related to historical spillage.

- Contaminants associated with the historical oil spill and recent hydraulic oil spill have not been detected in groundwater samples. Based on these results, NYSDEC removed the two oil spill areas from its active spill list, and ended the sampling requirements outlined in the Stipulation Agreement.
- The gasoline additive MTBE is occasionally detected in samples collected from wells down-gradient of Building 423/326 at concentrations above NYS Ambient Water Quality Standard for MTBE is 10 μg/L. The occurrence of MTBE in groundwater is likely due to possible historical (pre-1989) gasoline leakage from the older USTs or possibly historical or ongoing small-scale surface spills during vehicle re-fueling operations.

Groundwater samples will be collected on a semi-annual basis from wells downgradient of the gasoline USTs and annually from wells downgradient of Buildings 423/326 to verify that current operations at the Motor Pool are not affecting groundwater quality. The groundwater samples will be analyzed for VOCs. Floating product determination measurements in wells downgradient of the USTs will also be conducted semi-annually.

Table 12.32.2 Comparison of CY2007 and CY2008 Sampling Programs

Well ID	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
102-05	Semi-annual	Semi-annual	None
102-06	Semi-annual	Semi-annual	None
102-10	Semi-annual	Semi-annual	None
102-08	Annual	Annual	None
102-11	Annual	Annual	None
102-12	Annual	Annual	None
102-13	Annual	Annual	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There are no recommended changes for CY 2008.

TOTAL COST FOR MONITORING PROGRAM

The CY 2008 cost for the groundwater surveillance program at the Motor Pool is estimated to be $5,800.

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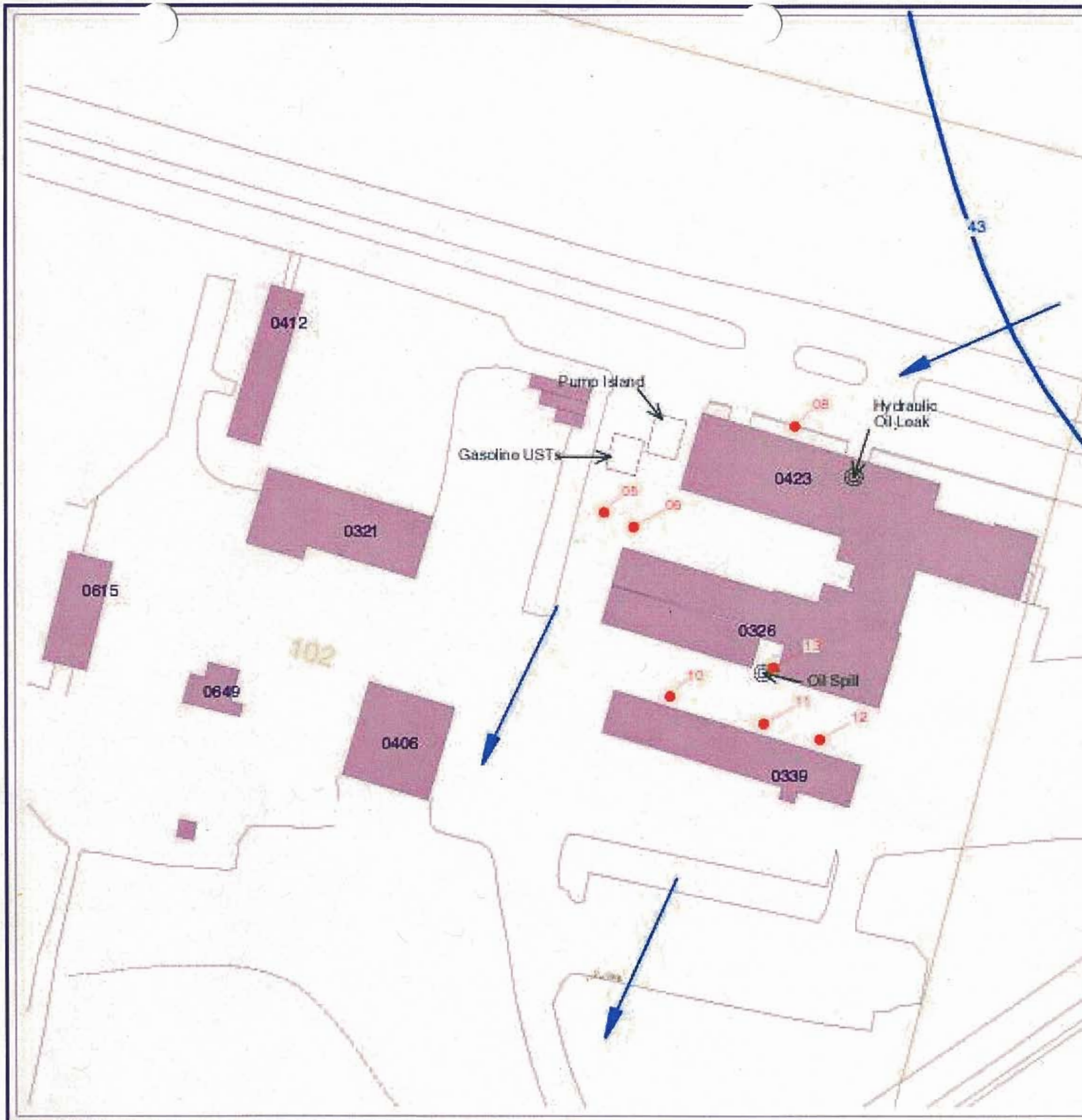

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Environmental Services Division

Figure 12.32.1

Environmental Surveillance Monitoring Well Locations Motor Pool Area

LEGEND

- Monitoring well
- Buildings, Facilities
- June 2001 Groundwater Elevation (ft AMSL)
- General Direction of Groundwater Flow

SCALE

Meters: 0 10 20

Feet: 0 10 20 30 40 50 60

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GROUNDWATER MONITORING AT THE UPTON SERVICE STATION

DQO START DATE	January 1, 2003
REVISION NUMBER/DATE	Rev. 3, December 3, 2007
IMPLEMENTATION DATE	January 1, 2008
POINT OF CONTACT	Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

There are no proposed changes for CY2008.

DESCRIPTION AND TECHNICAL BASIS

In 1996, BNL installed two monitoring wells downgradient of the Upton Service Station. In 1999, BNL installed three additional monitoring wells to improve the monitoring of the UST area. Data from these wells indicate that while the USTs are not impacting groundwater quality, small-scale historical spillage of petroleum hydrocarbons and degreasing solvents have impacted groundwater quality in the service station area. SVOCs have not been detected in groundwater, and routine analysis for these compounds was suspended in 2005. Monitoring well sampling frequency and analytical methods are summarized in Tables 12.24.1 and 12.24.2.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
_x_ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Potential environmental concerns at the Upton Service Station include the historical and current use of USTs for the storage of gasoline and waste oil, hydraulic fluids used for lift stations, and the use of solvents for parts cleaning. In 1989, the USTs, pump islands, and associated piping were upgraded to conform to Suffolk County Article 12 requirements for secondary containment, leak detection devices and overfill alarms. Following the removal of the old USTs, there were no obvious signs of soil contamination. The present tank inventory includes three 8,000-gallon USTs for storing unleaded gasoline, and one 500-gallon UST for waste oil. The facility also has five vehicle lift stations. In 2002, the petroleum-based hydraulic fluids in the vehicle lift stations were replaced with a vegetable oil product.

The collection of groundwater samples from wells downgradient of the service station is used to demonstrate that current operational and engineered controls are effective in protecting groundwater quality. These controls include:

- All USTs, pump islands, and associated piping conform with Suffolk County Article 12 requirements for secondary containment, leak detection devices, and overfill alarms.
- BNL maintains an inventory/accounting of gasoline stored in USTs at the service station.
- BNL maintains an inventory of all chemical degreasers in use at the service station.
- All spent degreasing agents are properly stored and disposed of.

Step 2: Identify the Decision

The decision for this monitoring program is:

Are the operations of the Upton Service Station impacting groundwater quality? If so, do concentrations exceed drinking water standards at the point of assessment (i.e., the closest downgradient wells)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the service station
- Direction and velocity of groundwater flow
- VOC concentrations in groundwater
- Floating product determination measurements in wells downgradient of the USTs
- Locations of background and downgradient wells relative to known or potential source areas
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Contingency Plan)
- Analytical methods and detection limits (as described in the EMP)
  - VOCs (EPA Method 524.2)
  - SVOCs (EPA Method 625): (Samples no longer routinely analyzed for SVOCs)
- Fuel inventory and waste management records

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the service station facility. The timeframe of 180 days is based on the following:

- The USTs, pump islands, and associated piping were upgraded to comply with Suffolk County Article 12 requirements for secondary containment, leak detection devices, and overfill alarms. A more frequent monitoring program can be implemented if a leak is found or suspected.
- The time required for small-scale petroleum hydrocarbons and solvent spills to migrate through the vadose zone and reach the groundwater table is likely to be 30 or more days. Note that some petroleum hydrocarbons are not readily mobile in soils.
- Once contaminants have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, approximately 20 feet from the USTs) is on the order of 30 days.

- A decision period of 180 days is sufficient to provide a secondary means of verifying that the operational and engineered controls in place at the service station are effective, and to evaluate the potential continued impact from historical solvent and oil spills.

Step 5: Develop the Decision Rule

Are the operational and engineered controls effective at preventing the introduction of petroleum hydrocarbons and solvents to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, the detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response

If for any monitoring well:

- The VOC concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling), or
- VOC concentrations indicate a new release, an unexpected release rate, or previously unknown source (and this result is confirmed by re-sampling), or
- Floating petroleum is found at the water table,

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well:

- The VOC concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling), or
- VOC concentrations indicate a new release, an unexpected release rate, or previously unknown source (and this result is confirmed by re-sampling),

then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.33.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling release of contaminants to the groundwater.	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 480 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and all operational and engineered controls (i.e., inventory resolution, leak detection, secondary containment) were to fail.

There are no potential receptors (i.e., potable water supply wells) immediately downgradient of service station area, and many of the VOCs (e.g., BTEX compounds) associated with gasoline degrade in the aquifer within a relatively short distance (within 500 feet) from the station. Furthermore, the travel time from the service station area to the BNL southern boundary is greater than 15 years, and most homes south of BNL have been connected to public water. Therefore, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under applicable NYS regulations.

Step 7: Optimize the Design

Number and Locations of Wells

The wells are located as close as possible to these potential source areas to enable early detection of contaminant releases (Figure 12.33.1). The current monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years and the potential source is relatively small, no refinements are recommended.

Parameters and Frequency

Groundwater quality at the service station area has been evaluated using seven monitoring wells; two were installed in 1997, and five in 1999. Multiple sets of analytical data are available to assess potential impacts from current operations and historical spills.

- Since 2000, petroleum hydrocarbon compounds, such as xylenes and ethylbenzene, and the solvent tetrachloroethylene have been detected in several monitoring wells directly downgradient of the service station at concentrations above the NYS AWQS. Evaluations of service station operations have indicated that the underground storage tanks and associated distribution lines are not leaking and that all waste oils and used solvents were being properly stored and recycled. Therefore, the petroleum hydrocarbon–related compounds and tetrachloroethylene detected in groundwater are likely to have originated from small-scale releases from historical vehicle maintenance and fuel dispensing operations. SVOCs have not been detected in any samples collected to date.

- From 2000–2002, high levels of carbon tetrachloride (>1,000 µg/L) were detected in a number of groundwater monitoring wells upgradient and downgradient of the service station. This contamination was related to the inadvertent release of carbon tetrachloride during an April 1998 removal of an underground storage tank that was located approximately 200 feet northwest (upgradient) of the station. Most of the carbon tetrachloride has been remediated, and the residual contamination is being monitored as part of BNL's Long Term Response Actions (LTRA) program.
- Since 1997, the gasoline additive MTBE has been detected at concentrations slightly above the NYS AWQS of 10 µg/L in several of the downgradient wells. The occurrence of MTBE in groundwater is likely due to historical or ongoing small-scale surface spills during vehicle re-fueling operations. Starting in early 2003, the use of MTBE was discontinued in gasoline sold in New York State.

Groundwater samples are collected on a semi-annual basis to verify that continued operations at the service station are not affecting groundwater quality. Samples from seven service station monitoring wells are analyzed for VOCs. (Note: Four of the five wells are currently sampled quarterly for VOCs under the LTRA Carbon Tetrachloride monitoring program.) Floating product determination measurements in wells downgradient of the USTs will also be conducted semiannually.

Table 12.33.2. Comparison of CY2007 and CY2008 Sampling Programs

Well	CY2007 Sampling Frequency (a)	CY2008 Sampling Frequency (a)	Affected Parameters
085-16	Semi-annual	Semi-annual	None
085-17	Semi-annual	Semi-annual	None
085-235	Semi-annual	Semi-annual	None
085-236	Semi-annual	Semi-annual	None
085-237	Semi-annual	Semi-annual	None

Note (a): Four of five of the service station's monitoring wells are currently sampled quarterly for VOCs under the LTRA Carbon Tetrachloride monitoring project. To avoid duplication of effort, these LTRA monitoring data are used to assess groundwater quality at the service station.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There are no proposed changes for CY 2008.

TOTAL COST FOR MONITORING PROGRAM

CY2008 sampling and analysis costs are estimated to be $6,300. Some of these sampling and analysis costs will paid by the LTRA Carbon Tetrachloride Project.

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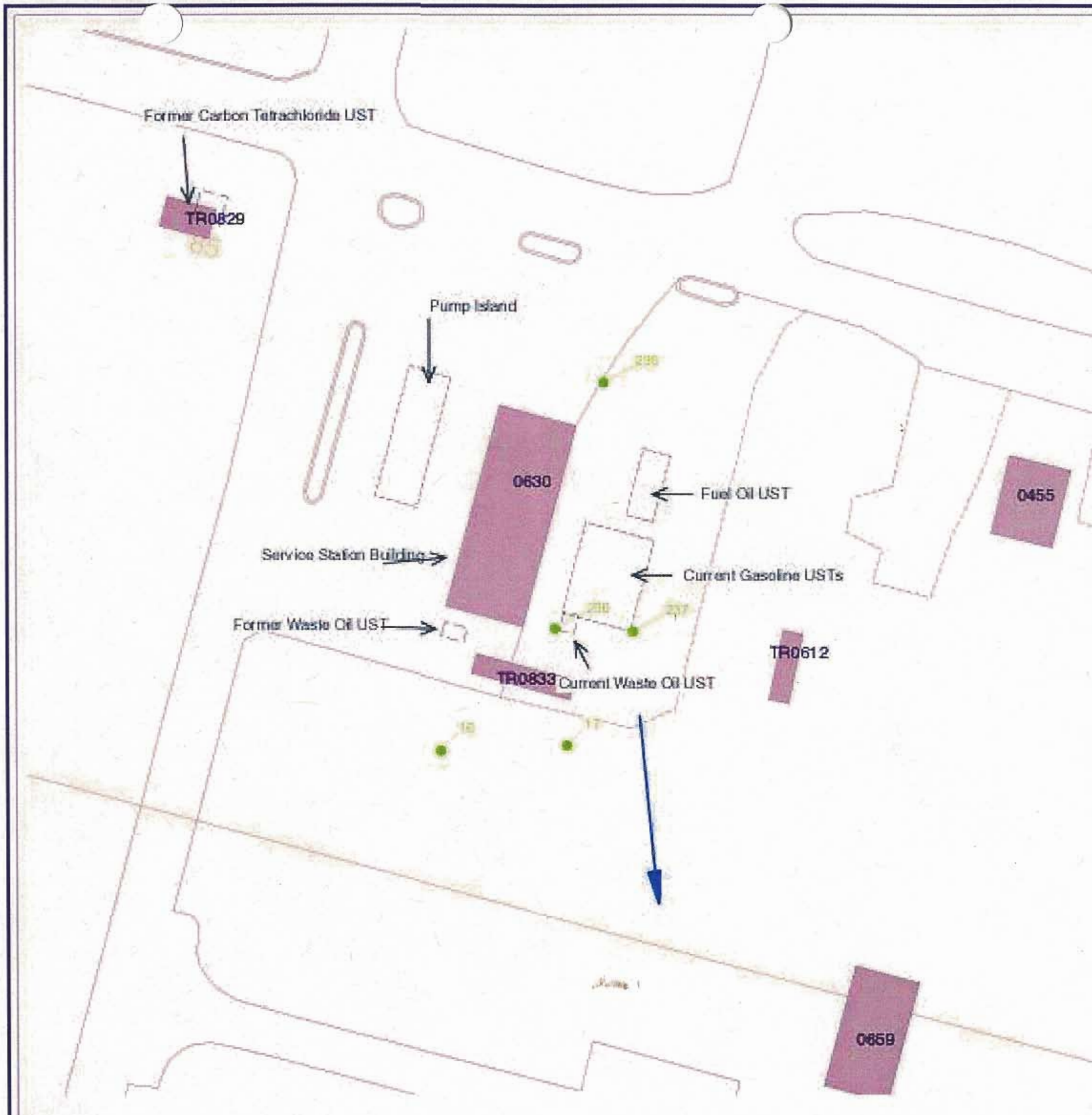

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Figure 12.33.1

Environmental Surveillance Monitoring Well Locations Service Station Area

LEGEND

- Monitoring well
- Buildings, Facilities
- June 2001 Groundwater Elevation (ft AMSL)
- General Direction of Groundwater Flow

SCALE

Meters: 0 – 10

Feet: 0 10 20 30 40

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GROUNDWATER MONITORING AT THE MAJOR PETROLEUM FACILITY

DQO START DATE	January 1, 2003
REVISION NUMBER/DATE	Rev. 3, December 3, 2007
IMPLEMENTATION DATE	January 1, 2008
POINT OF CONTACT	Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

There are no proposed changes for CY2008

DESCRIPTION AND TECHNICAL BASIS

In accordance with the New York State operating license for the Major Petroleum Facility, BNL routinely monitors groundwater quality downgradient of the MPF's bulk oil storage tanks. The monitoring program was initiated in the 1980s with five wells. Three additional wells were installed in 1999. In accordance with the updated license, the wells are monitored semi-annually for VOCs and SVOCs, and monthly for floating petroleum products. To date, no fuel-related compounds or floating products have been detected.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

_x_ Compliance
___ Support Compliance
___ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The MPF is the holding area for fuels used at the Central Steam Facility (CSF). Fuel oil for the CSF is held in a network of seven aboveground storage tanks, two of which are currently inactive. All fuel storage tanks are in bermed containment areas that have a capacity to hold >110 percent volume of the largest tank within each bermed area. The bermed areas have bentonite clay liners consisting of either Environmat (consisting of bentonite clay sandwiched between geotextile materials) or bentonite clay mixed into the native soils to form an impervious soil/clay layer. Nevertheless, there is a potential that small-scale leakage from the base of the tanks may go undetected.

The collection of groundwater samples from wells downgradient of the bulk storage area is required to demonstrate that current operational and engineered controls are effective in protecting groundwater quality. These controls include:

- The fuel storage tanks are connected to the CSF by aboveground pipelines that have secondary containment and leak detection devices.

- All fuel storage tanks are located in bermed containment areas that have a capacity to hold >110 percent of the volume of the largest tank within each bermed area.
- The bermed areas have bentonite clay liners consisting of either Environmat (consisting of bentonite clay sandwiched between geotextile materials) or bentonite clay mixed into the native soils to form an impervious soil/clay layer.
- All fuel unloading operations were consolidated in one centralized building that has secondary containment features.
- BNL maintains an accurate inventory/accounting of fuel oil stored at the MPF.

Step 2: Identify the Decision

The decision for this monitoring program is:

Are the operations of the MPF impacting groundwater quality? If so, do concentrations exceed water quality standards at the point of assessment (i.e., the closest downgradient well(s)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the MPF
- Direction and velocity of groundwater flow
- SVOC concentrations in groundwater
- Floating product determination measurements
- Locations of background and downgradient wells relative to known or potential source areas
- Regulatory requirements (NYSDEC permit)
- Action levels – detection of floating petroleum on the water table, or detection of SVOCs at concentrations exceeding levels outlined in the Groundwater Contingency Plan
- Analytical methods and detection limits (as described in the Environmental Monitoring Plan)
- VOCs (EPA 624 including MTBE)
- SVOCs (EPA Method 625)
- Fuel inventory records

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediately downgradient of the MFP. A decision period of 180 days is sufficient to provide a secondary means of verifying that the operational and engineered controls in place at the MPF are effective. This timeframe is based on the following:

- As described above, the MPF has a number of engineered and operational controls that are designed to prevent leakage of fuel oil to the environment. A more frequent monitoring program can be implemented if a leak is found or suspected.
- The time required for small-scale petroleum hydrocarbons to migrate through the vadose zone and reach the groundwater table is likely to be 90 or more days. Note that some petroleum hydrocarbons are not readily mobile in soils.
- Once contaminants have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, approximately 100 feet from the tanks) is on the order of 130 days.
- The MPF is outside the 5-year capture zone for the BNL supply wells.

Step 5: Develop the Decision Rules

Are the operational and engineered controls effective at preventing the introduction of petroleum hydrocarbons to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, the detection of previously undetected contaminants, and the detection of contaminants in previously “clean” wells.

Decision Rule for a Category 4 Response

If for any monitoring well:

- SVOC concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling) and the contaminants are related to MPF operations, or
- VOC or SVOC concentrations exceed applicable water quality standards and indicate a release from a source not associated with known historical releases or current MPF operations (and this result is confirmed by re-sampling), or
- Floating petroleum is found at the water table,

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well:

- VOC or SVOC concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling), or
- VOC or SVOC concentrations exceed applicable water quality standards (and this result is confirmed by re-sampling) and the suspected source is associated with a known historical spill, results may call for new/modified corrective actions,

then implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.34.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the release of contaminants to the groundwater?	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 200 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and all operational and engineered controls (i.e., inventory resolution, leak detection, secondary containment) were to fail.

There are no potential receptors (i.e., potable water supply wells) immediately downgradient of the MPF area. Travel time from the MPF area to the BNL southern boundary is greater than 15 years, and most homes south of BNL have been connected to public water. Therefore, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under applicable NYS regulations.

Step 7: Optimize the Design

Number and Locations of Wells

The wells are as close as possible to potential MPF source areas to enable early detection of contaminant releases (Figure 12.34.1). The current approved monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years, and the potential source is relatively small, no refinements are recommended.

Parameters and Frequency

Groundwater quality at the MPF area is evaluated using eight monitoring wells; five were installed in the 1980s, and three were installed in 2000. Multiple rounds of analytical data are available to assess potential impacts from past and current operations. No impacts from MPF operations have been observed to date. Low levels of 1,2-dichlorethene and tetrachloroethylene are occasionally detected in one MPF well at concentrations exceeding the NYS AWQS of 5 µg/L. This contamination is thought to have originated from historical spills near the CSF.

In accordance with the NYSDEC operating permit, groundwater samples will continue to be collected on a semi-annual basis for VOCs (including MTBE) and SVOCs, and the wells will be checked monthly for the presence of floating petroleum.

Table 12.34.2. Comparison of FY2007 and CY2008 Sampling Programs

Well	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
076-16	Semi-annual	Semi-annual	None
076-17	Semi-annual	Semi-annual	None
076-18	Semi-annual	Semi-annual	None
076-19	Semi-annual	Semi-annual	None
076-25	Semi-annual	Semi-annual	None
076-378	Semi-annual	Semi-annual	None
076-379	Semi-annual	Semi-annual	None
076-380	Semi-annual	Semi-annual	None

Annual Cost Impact Due to Proposed Change

There are no proposed or required changes to the monitoring program for CY 2008.

TOTAL COST FOR MONITORING PROGRAM

Total CY2008 sampling and analysis cost is estimated to be $15,600.

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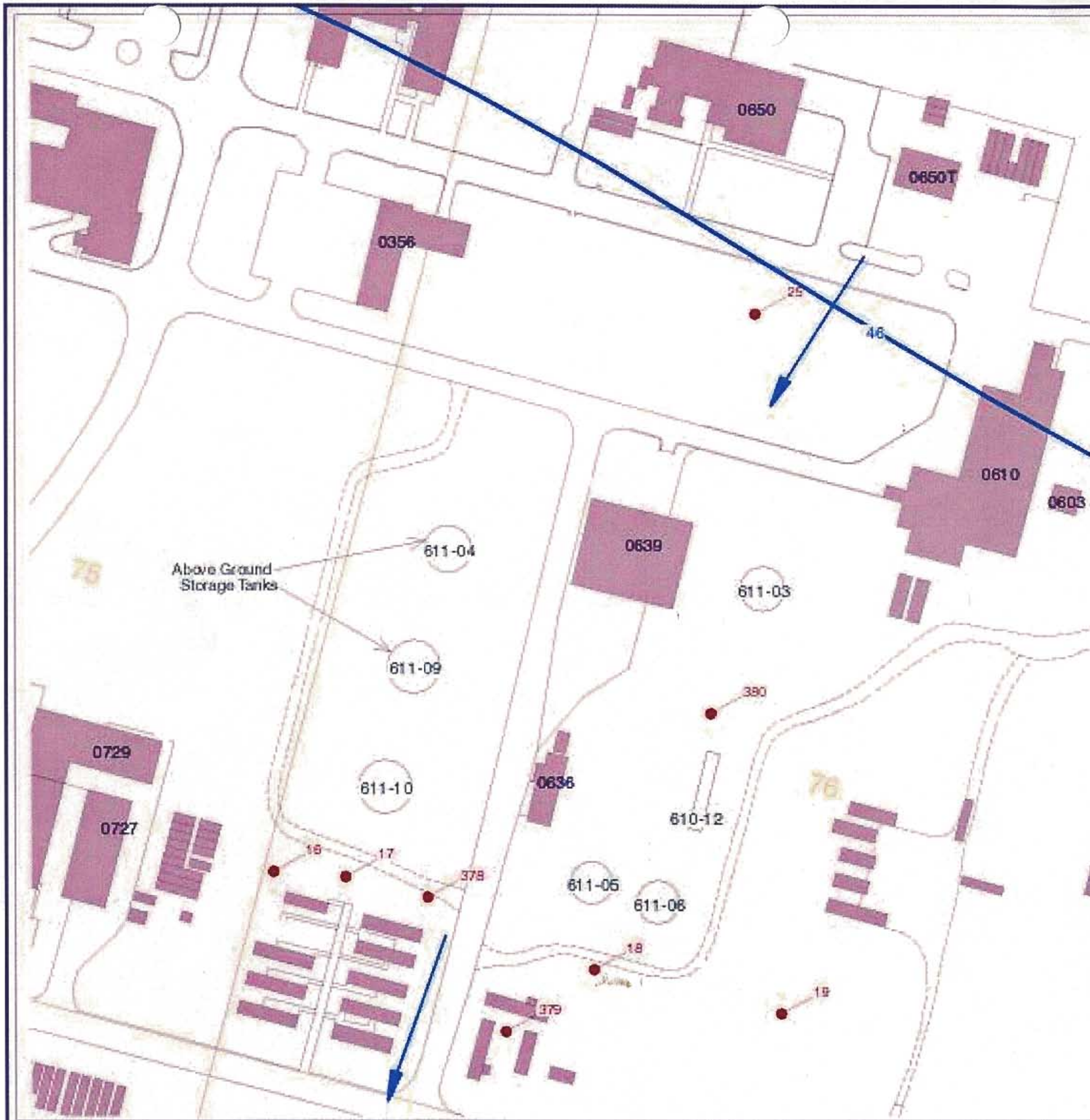
Figure 12.34.1

Environmental Surveillance Monitoring Well Locations Major Petroleum Facility Area



LEGEND

- Monitoring well
- Buildings, Facilities
- June 2001 Groundwater Elevation (ft AMSL)
- General Direction of Groundwater Flow June 2001

SCALE

Meters: 0 10 20 30

Feet: 0 100

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GROUNDWATER MONITORING AT THE BIOLOGY DEPARTMENT GREENHOUSE AREA

DQO START DATE	January 1, 2003
REVISION NUMBER/DATE	Rev. 3, December 3, 2007
IMPLEMENTATION DATE	January 1, 2008
POINT OF CONTACT	Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

Monitoring in the greenhouse area was suspended at the end of 2002. There are no plans to sample the greenhouse area wells in CY2008.

DESCRIPTION AND TECHNICAL BASIS

During 1999, BNL installed two monitoring wells downgradient of the Biology Department's greenhouse area (Wells 084-36 and 084-37) to evaluate the potential impact to groundwater by the use of pesticides, fertilizers and herbicides. Based on data collected during 2000-2002, groundwater quality in the greenhouse area has not been impacted by greenhouse operations. Routine monitoring has been suspended, and the wells are currently used to collect water level data that are used to assess groundwater flow directions.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
_x_ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

The Biology Department facility (Building 463) includes 11 greenhouses where various types of plants are grown for biological research. Eight of the greenhouses have dirt floors and three currently have concrete floors. Pesticides, such as Endosulphan II, and fertilizers have been routinely used in the greenhouses. Records indicate that copper sulfate was also applied to the dirt floors on an annual basis up to 15 years ago. The pesticide Endosulphan II has been detected in soil samples collected from a dry well in Greenhouse 10. It is likely that other pesticides have been used over the operational history of the facility.

The collection of groundwater samples from wells downgradient of the greenhouse area is required, to demonstrate that the operational and engineered controls are effective in protecting groundwater quality. These controls include:

- BNL maintains an inventory of all chemicals in storage and maintains records of all chemical applications. All applicator personnel are trained and certified by the New York Department of Environmental Conservation for the safe handing and application of these chemicals.

- The greenhouses are fully enclosed, and there are no direct pathways for rainwater to interact with potentially contaminated greenhouse soils. However, use of internal irrigation systems may cause some of the contaminants of concern to migrate into the soils below the greenhouses. The dry well in Greenhouse 10 was sealed.

Step 2: Identify the Decision

Are the operations of the Biology Department's greenhouses impacting groundwater quality? If so, do concentrations exceed water quality standards at the point of assessment (i.e., the closest downgradient well)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at the greenhouses
- Direction and velocity of groundwater flow
- Pesticide and metals concentrations in groundwater (including data on naturally occurring metals concentrations)
- Locations of background and downgradient wells relative to each range
- Regulatory requirements (DOE Order 5400.1)
- Action levels (as described in the Groundwater Contingency Plan)
- Analytical methods and detection limits:
  - Pesticides/PCBs (EPA Method 608)
  - Metals (EPA Method 200 Series)
  - Anions (EPA Method 300)

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area in the immediate vicinity of the Biology Department's greenhouses. The period for which decisions are made is 730 days. This timeframe is based on the following:

- The time required for most pesticides and heavy metals to migrate through the vadose zone and reach the groundwater table is expected to be greater than 365 days. Note that many pesticides and metals are not readily mobile in soils under normal conditions.
- Once pesticides or heavy metals have migrated to groundwater, the typical travel time to the nearest downgradient well (i.e., point of assessment, approximately 100 feet from the greenhouses) is on the order of 130 or more days.
- Current data do not indicate that operations of the greenhouses are affecting groundwater quality.

Step 5: Develop the Decision Rules

Are the operational and engineered controls effective at preventing the introduction of pesticides or heavy metals to the groundwater?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. Examples of such circumstances are unusually high contaminant concentrations, the detection of previously undetected contaminants, and the detection of contaminants in previously "clean" wells.

Decision Rule for a Category 4 Response

If for any monitoring well:

- The pesticide or metals concentrations exceed the applicable water quality standards (and this result is confirmed by re-sampling), or
- Pesticide or metals concentrations indicate a new release from a previously unknown source (and this result is confirmed by re-sampling),

then implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well, the pesticide or metals concentrations are greater than 50 percent but less than 100 percent of the applicable water quality standards (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.35.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching lead to the groundwater?	See Step 3 for inputs.	(1) Data indicate controls are effective when they are not. (2) Data indicate controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A discrete slug of contamination potentially up to 200 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

* Assumes results from one sample period were inaccurate and that the contaminants of concern are readily mobile in the aquifer system.

There are no potential receptors (i.e., potable water supply wells) immediately downgradient of Biology Department greenhouse area. Travel time from the greenhouse area to the BNL southern boundary is greater than 20 years. Therefore, it is very unlikely that a decision error will result in adverse consequences to human health. Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in degradation of groundwater quality to such an extent as to require remedial actions under NYS regulations.

Step 7: Optimize the Design

Number and Locations of Wells

The wells downgradient of the Biology Department greenhouse area are biased toward detecting contamination originating from greenhouse operations (Figure 12.35.1). The wells are located as close as possible to these potential source areas to allow for early detection of contaminant releases. The current monitoring network is considered adequate for meeting the acceptable risk levels of stakeholders. Because the groundwater flow direction has been relatively constant in this area in recent years and the potential source area is relatively small, no refinements are recommended.

Parameters and Frequency

Groundwater quality at the Biology Department's greenhouse area was evaluated using monitoring wells that were installed in early 2000. Samples were collected from 2000 through 2002.

Detectable levels of pesticides were not found in any of the groundwater samples collected during 2000–2002. Nitrate levels were less than one-third the NYS Ambient Water Quality Standard of 10 mg/L, and no metals (including copper) associated with greenhouse operations have been detected. Because the greenhouses have been in operation for many years, the results indicate that the use of pesticides, herbicides and fertilizers at this facility has not affected groundwater quality. Groundwater samples may be collected in the future to verify that greenhouse operations continue to have no impact on groundwater quality.

Table 12.35.2 Comparison of CY 2007 and CY 2008 Sampling Programs

Well	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
084-36	None	None	None
084-37	None	None	None

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There are no proposed changes in the monitoring program for 2008.

TOTAL COST FOR MONITORING PROGRAM

No monitoring will be conducted during 2008.

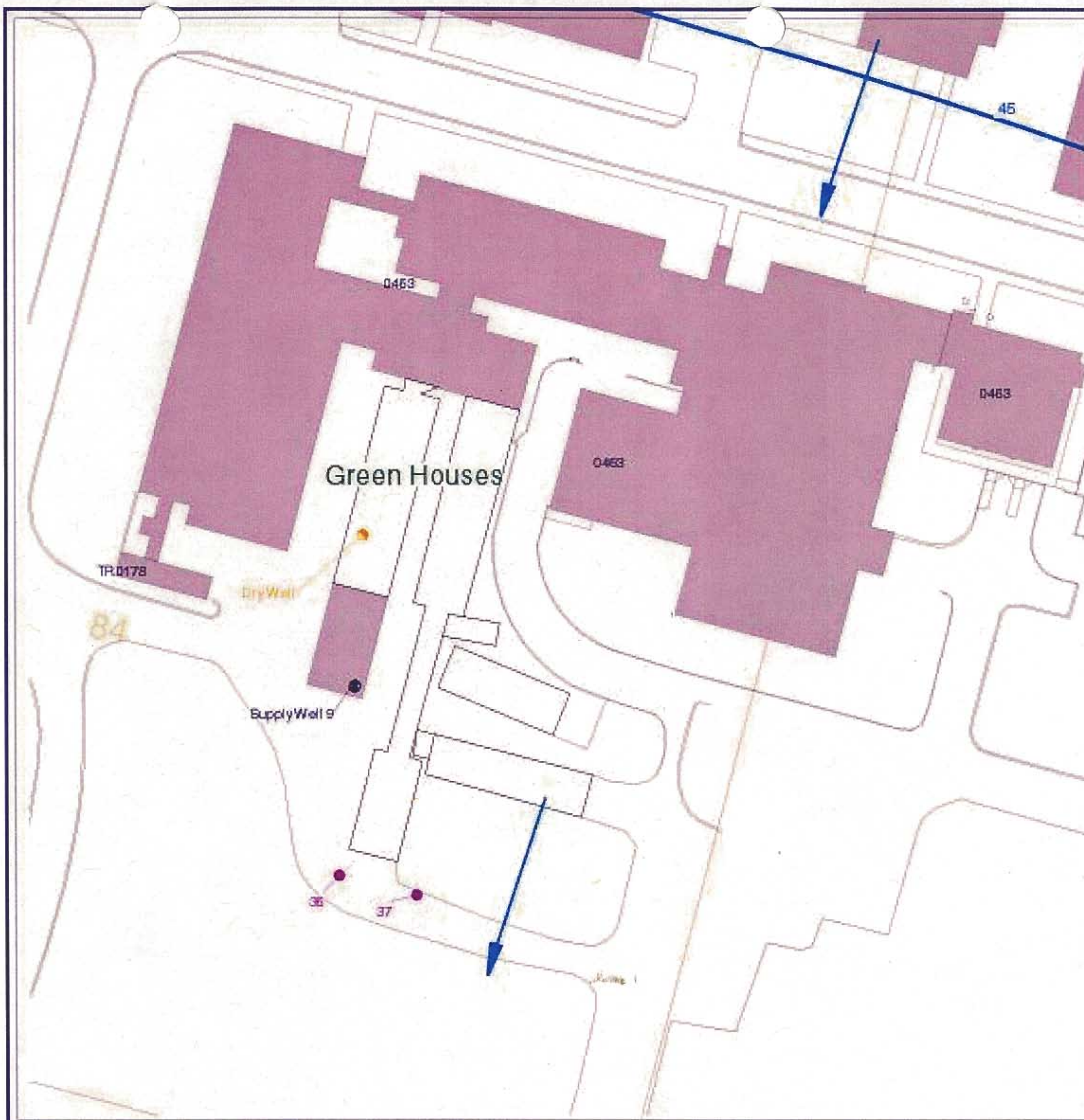

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Figure 12.35.1

Environmental Surveillance Monitoring Well Locations Biology Department Greenhouse Area

LEGEND

- Monitoring well
- Supply Well
- Dry Well
- Buildings, Facilities
- June 2001 Groundwater Elevation (ft AMSL)
- General Direction of Groundwater Flow

SCALE

Meters: 0 10 20

Feet: 0 10 20 30 40 50 60

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GROUNDWATER MONITORING AT BUILDING 801

DQO START DATE	January 1, 2003
REVISION NUMBER/DATE	Rev. 3, December 3, 2007
IMPLEMENTATION DATE	January 1, 2008
POINT OF CONTACT	Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

There are no proposed changes for CY2008.

DESCRIPTION AND TECHNICAL BASIS

In early December 2001, approximately 8,000 gallons of stormwater seeped into the basement of Building 801. Analysis of the floodwater indicated that the water contained Cs-137, Sr-90, and tritium at levels that exceeded drinking water standards. Cs-137 was detected up to 784 pCi/L, Sr-90 up to 594 pCi/L, and tritium up to 25,000 pCi/L. It is believed that the floodwater became contaminated when it came in contact with the basement floor, which contains significant residual contamination from historical spills. When the floodwater was pumped from the basement on March 8, 2002, approximately 4,950 gallons of contaminated water were removed. Taking into account possible losses due to evaporation, it was estimated that between 1,350 and 2,750 gallons of contaminated floodwater might have escaped into the soils below Building 801. To evaluate the potential effect that this lost water might have on groundwater quality, BNL conducted monthly monitoring of three existing downgradient monitoring wells and installed a new water table well (well 065-325) closer to the building.

Sr-90 concentrations in samples collected during 2002 and 2003 from shallow groundwater wells downgradient of Building 801 are consistent with pre-December 2001 values. Additionally, Cs-137 has not been detected in any of the groundwater samples. Tritium was not detected in the shallowest well, 065-325. Based on typical migration rates through soils for Sr-90 and Cs-137, it is estimated that it could take approximately 3 to 8 years for Sr-90, and approximately 100 years for Cs-137 from the December 2001 Building 801 floodwater release to migrate to the closest downgradient well (065-325). Furthermore, detecting any new groundwater impacts from this release will be difficult to identify, as the local groundwater is already contaminated with radioactivity from legacy releases. Because of the slow migration rates for Sr-90 and Cs-137, the monitoring frequency for well 065-325 is semi-annual. This monitoring coincides with the planned semi-annual sampling of wells 065-37, 065-169, and 065-170 by the Long Term Response Actions (LTRA) Program.

In accordance with the BNL Groundwater Protection Contingency Plan, the monitoring program would be reevaluated immediately if a significant increase in contaminant concentrations were detected.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
_x_ Surveillance
___ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

In December 2001, up to 2,700 gallons of contaminated stormwater may have seeped into the soils below the basement of Building 801. Analysis of the floodwater indicated that the water contained Cs-137, Sr-90, and tritium at levels that exceeded drinking water standards. Cs-137 was detected up to 784 pCi/L, Sr-90 up to 594 pCi/L, and tritium up to 25,000 pCi/L. The monitoring program is designed to evaluate the potential effects that this lost water might have on groundwater quality.

Step 2: Identify the Decision

The decision for this monitoring program is:

Prior to December 2001, the groundwater near Building 801 contained Sr-90 at concentrations exceeding the 8 pCi/L standard. Will the contaminated water that leaked from the basement of Building 801 in December 2001 result in a significant increase in Sr-90 concentrations over baseline levels?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Current and planned operations at Building 801
- Direction and velocity of groundwater flow
- Contaminant concentrations in groundwater
- Action levels – detection of radionuclides at concentrations exceeding levels outlined in the Groundwater Protection Contingency Plan
- Analytical methods and detection limits:
  - Tritium (EPA Method 906)
  - Gamma spectroscopy (EPA Method 901)
  - Gross alpha/beta (EPA Method 900)
  - Sr-90 (EPA Method 905)

Step 4: Define the Study Boundaries

The decision for this monitoring program applies to the area immediately downgradient of Building 801. A decision period of 180 days is sufficient to assess whether the December 2001 leak will impact groundwater quality. This timeframe is based on the following considerations:

- Based on simple infiltration calculations, it is possible that water from a leak of this magnitude would take several weeks to a month to reach the groundwater. However, because Cs-137 and Sr-90 are metallic elements that strongly bind to soils, their migration rates through the nearly 50 feet of vadose zone (i.e., the unsaturated soils below the building's basement floor) and aquifer soils would be significantly retarded. It is estimated that it could take approximately 3 to 8 years for Sr-90, and approximately 100 years for Cs-137 from the December 2001 Building 801 floodwater release to migrate to the closest downgradient well (065-325). Furthermore, the building structure and surrounding paved areas are expected to reduce or eliminate the amount of rainwater that could infiltrate the contaminated soils below the building and carry contamination to the groundwater.

Step 5: Develop the Decision Rules

Will the contaminated water released from the basement of Building 801 impact groundwater quality?

Because the groundwater in the Building 801 area has already been affected by Sr-90 from historical operations, the sample results will be evaluated in context with baseline concentrations. As part of the evaluation, circumstances that would require the implementation of the Groundwater Protection Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. An example of such circumstances would be significantly higher Sr-90 concentrations relative to the baseline conditions.

Decision Rule for a Category 4 Response

If for any monitoring well the contaminant concentrations exceed 10 times the existing baseline concentrations (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 4 response.

Decision Rule for a Category 3 Response

If for any monitoring well the contaminant concentrations are between 5 to 10 times baseline concentrations (and this result is confirmed by re-sampling), **then** implement actions as prescribed in the BNL Groundwater Protection Contingency Plan for a Category 3 response.

Step 6: Specify Acceptable Error Tolerances

Table 12.36.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based on Data	Potential Consequences
Anticipated slow migration rates for Sr-90 and Cs-137 in soils. Also, the building structure and surrounding paved areas should be effective at reducing rainwater infiltration into contaminated soils.	See Step 3 for inputs.	(1) Rainwater infiltration occurs, and/or contaminant migration rates in soils are much greater than anticipated. (2) A sampling or analytical error results in an indication that migration rates for Sr-90 and Cs-137 are faster than anticipated.	(1) A discrete slug of contamination could enter the groundwater at a higher concentration and/or at a rate faster than anticipated. (2) Need to re-sample well (as per Groundwater Contingency Plan). Potential erosion of stakeholder confidence.

Consequences associated with decision errors for this program relate primarily to possible enforcement actions for environmental degradation, erosion of stakeholder trust, and loss of BNL credibility. Ultimately, a decision error could result in the degradation of groundwater quality to such an extent as to require remedial actions under applicable NYS regulations.

Step 7: Optimize the Design

Number and Locations of Wells

Well 065-325 is approximately 10 feet south of Building 801, immediately downgradient of the 2001 basement flood area. Well 065-325 is screened across the water table. Three other wells are downgradient of the release area in Building 801, although less optimally positioned than 065-325 for assessing the December 2001 release. These wells are monitored under the Environmental Restoration program and the analytical data are reviewed for the Building 801 monitoring assessment. Well 065-169 is approximately 10 feet south of Building 801 and screened slightly below the water table, and wells 065-37 and 065-170 are approximately 80 feet downgradient of the building and are screened approximately 10 feet below the water table. The combined monitoring network is considered adequate for assessing potential impacts to groundwater and meeting the acceptable risk levels of stakeholders.

Parameters and Frequency

Well 065-325 is monitored semi-annually and samples are analyzed for Sr-90, gamma (including Cs-137), tritium, and gross alpha/beta. Nearby wells 065-169, 065-37, and 065-170 are monitored by the LTRA program for the same parameters and at the same frequency. Sampling of the wells is coordinated to ensure that the samples are collected during the same general time period.

Table 12.36.2. Comparison of CY2007 and CY 2008 Sampling Programs

Well ID	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
065-169 (a)	Semi-annual	Semi-annual	None
065-325	Semi-annual	Semi-annual	None
065-37 (a)	Semi-annual	Semi-annual	None
065-170 (a)	Semi-annual	Semi-annual	None

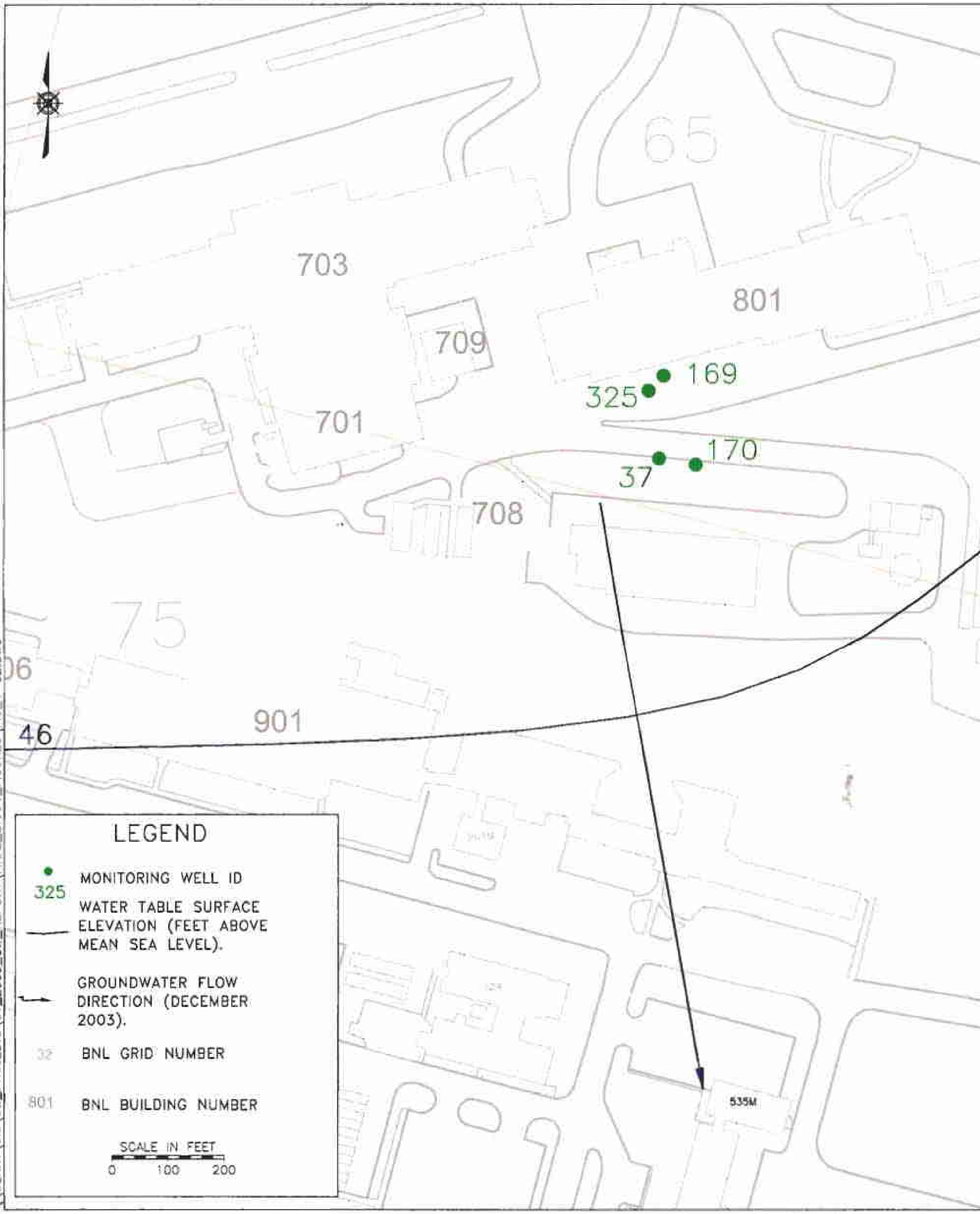
(a) Well is sampled under the LTRA program.

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

There are no recommended changes to the monitoring program for CY 2008.

TOTAL COST FOR MONITORING PROGRAM

The groundwater sampling and analysis program for well 065-325 is approximately $2,400/year



BROOKHAVEN NATIONAL LABORATORY GROUNDWATER PROTECTION PROGRAM	ENVIRONMENTAL SURVEILLANCE MONITORING WELL LOCATIONS AT BUILDING 801 2003 BNL GROUNDWATER STATUS REPORT	DWN: KCK	VT:HZ.: –	DATE: 06/01/04	PROJECT NO.: 07176
		CHKD: WRD	APPD: DEP	REV.: –	NOTES: –
		FIGURE NO.: 12.36.1			

OU III AIRPORT

DQO START DATE	January 1, 2003
REVISION NUMBER/DATE	Rev. 4, October 23, 2007
IMPLEMENTATION DATE	January 1, 2008
POINT OF CONTACT	William Dorsch (631) 344-5186 Vincent Racaniello (631) 344-5436

SUMMARY OF CHANGES

The following are changes for the Airport Groundwater Treatment System and groundwater monitoring program issued in the 2006 Annual Groundwater Status Report that have been implemented:

- As per the recent groundwater investigation, an additional extraction well (RW-6A) was added west of Airport well RTW-1A. Five new monitoring wells were installed.
- The extraction well sampling was changed to quarterly, except for the well RTW-1A, which will be maintained at the monthly schedule.
- System sampling and analysis has been reduced from weekly to two times per month.

DESCRIPTION AND TECHNICAL BASIS

The OU III Airport remediation system consists of six groundwater recirculation wells along the northern boundary of the Brookhaven Airport. The recirculation wells are designed to remediate VOC contamination residing in the deep portion of the Upper Glacial aquifer. The contamination in this area had migrated off site prior to the startup of the OU I (RA V) South Boundary treatment system in December 1996 and consists primarily of 1,1,1-TCA, PCE, and carbon tetrachloride. The contamination consists of commingled plumes from several sources, including the chemical/animal holes, former landfill, and OU IV area. The plume is migrating in a southerly direction with groundwater flow.

This system is designed to achieve the OU III ROD objectives of preventing or minimizing plume growth and meeting MCLs in the Upper Glacial aquifer in 30 years or less. The system will address the highest VOC concentration portion of the plume (above 50 μg/L).
The monitoring well network for the OU III Airport project consists of 23 wells, all of which are located from Crestwood Drive to the northern portion of the Brookhaven Airport between Lockwood Drive and Girald Drive. Well locations are shown on Figure 12.37.1. The wells will be sampled quarterly and analyzed for VOCs. The monitoring schedule is provided in Tables 12.1.1 and 12.1.2.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance

____
____ Surveillance
_x__ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health or the environment has been defined south of the BNL site. In response, a groundwater remediation system has been constructed to treat this plume. Data are needed to verify that the remediation is occurring according to plan. Based on groundwater modeling, the extraction wells are scheduled to operate for up to 15 years.

Step 2: Identify the Decision

- Is the BNL Groundwater Contingency Plan triggered?
- If not, has the plume been controlled?
- Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?
- Can the groundwater treatment system be shut down?

Step 3: Identify Inputs to the Decision

The project was divided into a total of five decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume core wells (Decisions 1, 2, and 4)
- Plume perimeter wells, used to define the extent of the plume (Decisions 1 and 2)
- Bypass detection wells (Decisions 1, 2, and 4)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Location of existing wells relative to flow patterns (Figure 12.37.1)
- Evaluation of capture zone for extraction wells
- Action Levels
- Analytical methods and detection limits as described in the BNL Quality Assurance Program Plan (QAPP)
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Crestwood Drive to the north
- east of Lockwood Drive
- west of Girald Drive
- northern portion of Brookhaven Airport

- the Upper Glacial aquifer

Separate decisions will be made in the four subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire system. The temporal boundaries of the study area vary, based on the decision.

- *Plume Core:* Due to the need for frequent data collection during the system startup period, the timeframe for decisions for this subunit is 90 days.
- *Plume Perimeter:* Because the wells in this subunit define the plume horizontally, which is used to determine whether the plume is being captured, the timeframe for decisions here is 90 days. The wells are screened outside the known extent of the plume at the depth of contamination in the plume core. Although the plume is not expected to shift laterally due to changing flow conditions, the decision timeframe for this area will be 90 days during the 2-year system startup phase.
- *Bypass Detection Area:* Because the wells in this area indicate whether the plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously "clean" wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

This decision applies to the plume perimeter and bypass detection wells.

If the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume perimeter or bypass detection wells to above 50 μg/L (if currently less than 50 μg/L) or a significant increase in total VOC concentration (if currently above 50 μg/L).

If the trend in each plume perimeter and bypass detection well has a negative or zero slope, based on the four most recent consecutive samples, and this trend is consistent with professional judgment and the total VOC concentration is less than 50 μg/L, **then** continue to operate the system. If not, then consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?

This decision applies to the plume core and bypass detection wells. **If** the system is performing as planned, **then** actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation to determine the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis, and expert judgment), **then** continue to operate. If not, then consider operational adjustments and/or engineering evaluation. Note: When the majority and/or "key" wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Can the groundwater treatment system be shut down?

All of the following decision subunits must be satisfied in order to shut an extraction well down.

4a. Have asymptotic TVOC concentrations been reached in core wells?

This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in TVOC concentrations in the plume core wells. The Kendall-Mann statistical test is a nonparametric trend analysis (Gilbert, 1987) used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.

To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

4b. Is the TVOC concentration in core wells less than 50 µg/L(expected by 2025)?

This decision also applies to the plume core wells. It is anticipated that approximately 7 to 15? years of active groundwater treatment will reduce the mean TVOC concentrations in the plume core to less than 50 µg/L. If this occurs, it is reasonable to expect (based on model projections) that Monitored Natural Attenuation (MNA) of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs within 30 years. **If** the TVOC concentration remains above 50 µg/L, **then** consider operational adjustments and/or engineering evaluation.

4c. During pulsed operation, is there significant concentration rebound in the core wells?

If yes, and system has operated for less than 7 to 15 years, **then** continue operation. **If** yes, and system has operated for more than 7 to 15 years, **then** an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted (see Decision subunit 4e. to help with this decision). **If** no significant rebound is observed within a 1-year time period, **then** petition for system shutdown and continue with MNA.

Decision 5

Have the groundwater cleanup goals been met? Specifically, have MCLs been achieved (expected by 2030)?

If the mean concentration of TVOCs in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 50 μg/L, and if the mean TVOC concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous 2 years, is less than 50 μg/l, and pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations, **then** petition for system shutdown and continue with MNA until MCLs are met. **If** not, **then** consider the need for continued remediation.

Step 6: Specify Acceptable Error Tolerances

Table 12.37.1 summarizes the decision and possible decision errors for this project.

Table 12.37.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based On Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Has the plume been controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Can the groundwater treatment system be shut down?	See Step 3 for inputs.	(1) Determine system can be shut down when operation should continue. (2) Determine to continue operating system when shut down is warranted.	(1) Plume growth continues–ultimate project delays. (2) Wasted resources, project delays.
Is the system operating as planned?	See Step 3 for inputs.	(1) Determine system operating as planned when it is not. (2) Determine system isn't operating as planned when it is.	(1) Premature petition for system shutoff, potential to have to restart system. (2) Continue remediation that is no longer effective.
Have the groundwater cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.

Step 7: Optimize the Design

Number and Locations of Wells

The monitoring well network for the OU III Airport project consists of 23 wells, all of which are located between Crestwood Drive and the northern portion of Brookhaven Airport. Five new monitoring wells were drilled and one replacement monitoring well was installed for well 800-108 (or is it 800-107?) that was abandoned due to Dowling College construction work in the second half of 2007. They have been added to the quarterly sampling schedule..

Parameters and Frequency

The wells will be sampled quarterly and analyzed for VOCs.

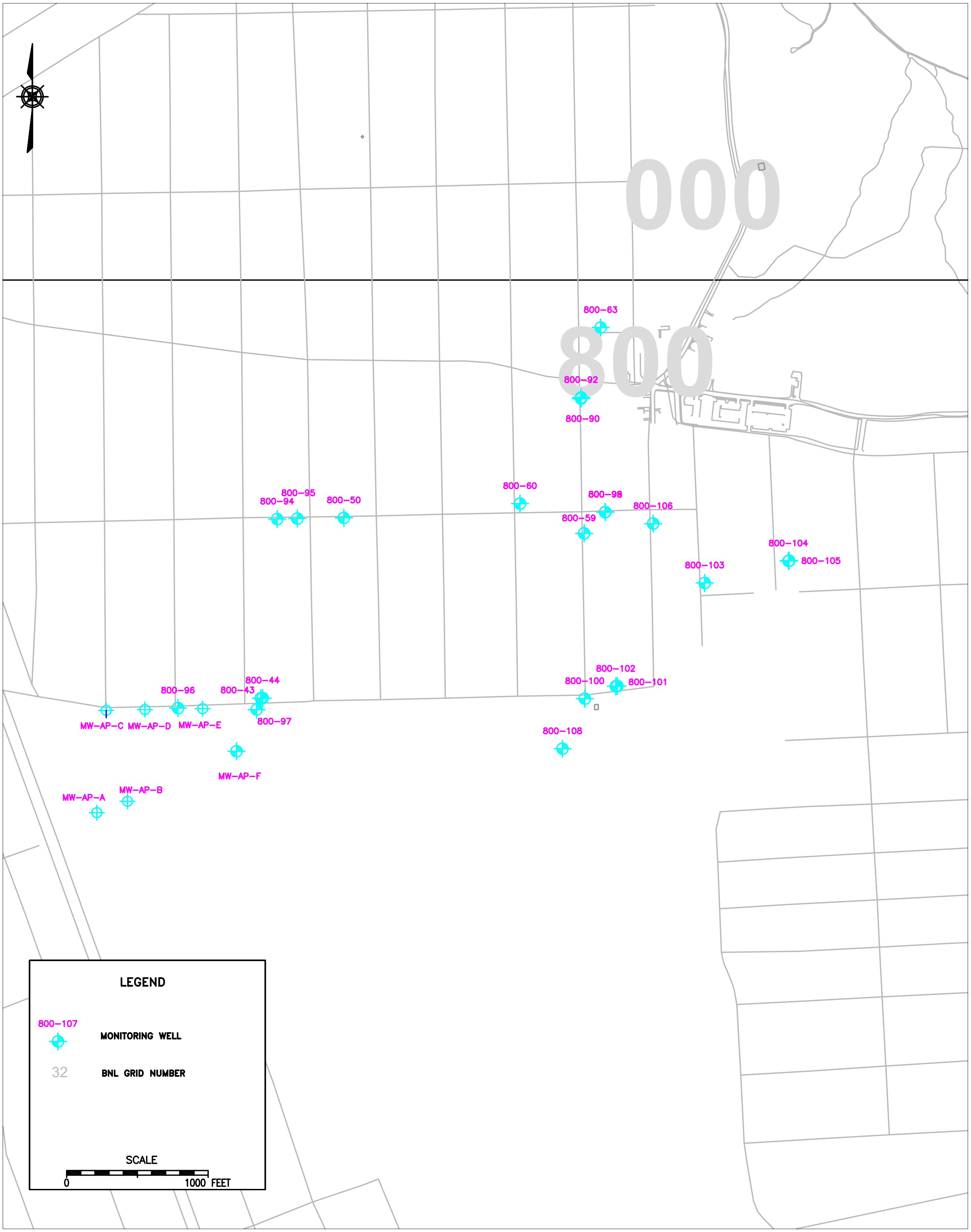
Annual Cost Impact Due to Proposed Change

The sampling program modifications will result in an increase in the sampling and analysis costs of $3,840 per year.

Total Cost for Monitoring Program

FY2006	$32,988
FY2007	$36,828
Difference	$3,840

See Appendix B for the monitoring program for this DQO.



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BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL SERVICES DIVISION

TITLE:

OU III AIRPORT
MONITORING WELL LOCATIONS
2008 EMP

DWN: JEB	VT: HZ.: –	DATE: 12/14/07	PROJECT NO.: 07926
CHKD:	APPD: RH	REV.: –	NOTES: –

FIGURE NO.: 12.37.1

OU III LONG ISLAND POWER AUTHORITY (LIPA)

DQO START DATE January 1, 2003

REVISION NUMBER/DATE Rev. 4, December 7, 2007

IMPLEMENTATION DATE January 1, 2008

POINT OF CONTACT William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

SUMMARY OF CHANGES

The following are changes for the LIPA/Airport Groundwater Treatment System and groundwater monitoring program:

- Change the groundwater monitoring frequency from the startup phase to O&M phase (core and perimeter wells sampled semi-annually, and sentinel wells sampled quarterly).
- The extraction well sampling will change to quarterly.
- Shut down and place in standby mode LIPA wells EW-1L and -3L.

DESCRIPTION AND TECHNICAL BASIS

The OU III LIPA remediation system consists of three groundwater extraction wells (south of the BNL boundary and Long Island Expressway [LIE] along the LIPA right of way between Rowlinson Drive and Starlight Drive) that address VOC contamination in the Upper Glacial aquifer, and an extraction well located along Starlight Drive in the vicinity of Rowlinson Drive in North Shirley that treats VOCs in the Magothy aquifer. One of the extraction wells is designed to remediate carbon tetrachloride contamination entering the upper portion of the Magothy aquifer. During system design, a determination was made to combine the Airport and LIPA projects into a single groundwater treatment system. The water from the three LIPA and the one Magothy pumping well will be piped approximately 6,000 feet to a combined groundwater treatment system at Brookhaven Avenue. These areas of contamination had already migrated south of the site boundary prior to the startup of the OU III South Boundary Pump and Treat System in 1997.

This Upper Glacial aquifer system is designed to achieve the OU III ROD objectives of minimizing plume growth and meeting MCLs in the Upper Glacial aquifer in 30 years or less. The southernmost portions of this plume will be eventually addressed by the Brookhaven Airport remediation system as it continues travel south with the regional groundwater flow. The Magothy extraction well will capture and treat the highest TVOC concentrations (>7,000 µg/L) identified in the uppermost portion of the Magothy aquifer.

The Upper Glacial monitoring well network for the OU III LIPA project consists of 16 wells, plus the three Upper Glacial aquifer extraction wells. The Magothy monitoring well network consists of 10 wells in addition to the Magothy aquifer extraction well. These wells monitor the Upper Glacial VOC plume south of the LIE to Waldorf Drive in the North Shirley residential area, and Upper Magothy VOC plume from the Industrial Park area south to Waldorf Drive, as well as the effectiveness of the groundwater treatment systems. The contaminants of concern associated with the OU III LIPA Upper Glacial and Magothy aquifer contamination project include 1,1,1-TCE, 1,1-DCE, carbon tetrachloride, trichloreylene, and tetrachloeoethylene. Well locations are shown on Figure 12.38.1.. The monitoring schedule is provided in Table 12.1.1.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

VOC plumes that could represent a potential risk to human health or the environment have been defined south of the BNL site. In response, a groundwater remediation system has been con-tructed to treat these plumes in both the Upper Glacial and Magothy aquifers. Data are needed to verify that the remediation is occurring according to plan. Based on groundwater modeling, both the Upper Glacial and Magothy extraction wells are scheduled to operate for up to 10 years.

Step 2: Identify the Decision

- Is the BNL Groundwater Contingency Plan triggered?
- If not, has the plume been controlled?
- Is the system operating as planned? Specifically, is the aquifer being restored as the planned rate for a particular treatment system?
- Can the groundwater treatment system be shut down?

Step 3: Identify Inputs to the Decision

The project was divided into a total of eight decision subunits (four each for the Upper Glacial and Magothy systems) to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are as follows:

Upper Glacial System:

- plume core wells (Decisions 1, 2, 4, and 5)
- plume perimeter wells, used to define the extent of the plume (Decisions 1 and 3)
- bypass detection wells (Decisions 1, 3, and 4)

Magothy System:

- plume core wells (Decisions 1, 2, 4, and 5)
- plume perimeter wells, used to define the extent of the plume (Decisions 1 and 3)
- bypass detection wells (Decisions 1, 3, and 4)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- direction and velocity of groundwater flow
- analytical results for VOCs in groundwater
- location of existing wells relative to flow patterns (Figure 12.38.1)
- evaluation of capture zone for extraction wells
- action levels
- analytical methods and detection limits described in the BNL Quality Assurance Program Plan
- variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Long Island Expressway to the north
- Waldorf Drive to the south
- Starlight Drive to the east
- Rowlinson Drive to the west
- the Upper Glacial aquifer (Upper Glacial System)
- the Upper Magothy aquifer (Magothy System).

Separate decisions will be made in the eight subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire system (Upper Glacial or Magothy). The temporal boundaries of the study area vary, based on the decision.

- *Plume Core:* Plume Core: Due to the need for frequent data collection during the system startup period, the timeframe for decisions for this subunit is 90 days.
- *Plume Perimeter:* Because the wells in this subunit define the plume horizontally, which is used to determine whether the plume is being captured, the timeframe for decisions here is 90 days. The wells are screened outside the known extent of the plume at the depth of contamination in the plume core. Although the plume is not expected to shift laterally due to changing flow conditions, the decision timeframe for this area will be 90 days during the 2-year system startup phase.
- *Bypass Detection Area:* Because the wells in this area indicate whether the plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan will be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

This decision applies to the plume perimeter and bypass detection wells.

If the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume fringe or bypass detection wells to above 50 µg/L (if currently less than 50 µg/L) or a significant increase in total VOC concentration (if currently above 50 µg/L).

If the trend in each plume perimeter and bypass detection well has a negative or zero slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 µg/L, **then** continue to operate the system. **If** not, **then** consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?

This decision applies to the plume core and bypass detection wells. **If** the system is performing as planned, **then** actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. **If** not, **then** consider operational adjustments and/or engineering evaluation. Note: When the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Can the groundwater treatment system be shut down?

All of the following decision subunits must be satisfied in order to shut an extraction well down.

4a. Have asymptotic TVOC concentrations been reached in core wells?

> This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in TVOC concentrations in the plume core wells. The Kendall-Mann statistical test is a non-parametric trend analysis (Gilbert, 1987) used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.

To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. **If** so, **then** operation of the system will continue.

4b. *Are there individual plume core wells above 50 µg/L TVOC ?*

If the total VOC concentration in each plume core well has been reduced to less than 50 µg/L in less than 7 to 10 years of active remediation, **then** proceed with pulsed operation of the system (see Decision subunit 4d.). **If** not and treatment has occurred for less than 7 to 10 years, **then** continue treatment. **If** not and treatment has occurred for at least 7 to 10 years, **then** perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2030.

4c. During pulsed operation, is there significant concentration rebound in the core wells?

If yes and system has operated for less than 7 to 10 years, **then** continue operation. **If** yes and system has operated for more than 7 to 10 years, **then** an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted (see Decision subunit 4e. to help with this decision). **If** no significant rebound is observed within a 1-year time period, **then** petition for system shutdown and continue with MNA.

Decision 5

Have the groundwater cleanup goals been met? Specifically, have MCLs been achieved (expected by 2030)?

If the mean concentration of TVOCs in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 50 µg/L, and if the mean TVOC concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous 2 years, is less than 50 µg/L, and pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations, **then** petition for system shutdown and continue with MNA until MCLs are met. If not, then consider the need for continued remediation.

Step 6: Specify Acceptable Error Tolerances

Table 12.38.1 summarizes the decision and possible decision errors for this project.

Table 12.38.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based On Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Can the groundwater treatment system be shut down?	See Step 3 for inputs.	(1) Determine system can be shut down when operation should continue. (2) Determine to continue operating system when shut down is warranted.	(1) Plume growth continues, ultimate project delays. (2) Wasted resources, project delays.
Is the system operating as planned?	See Step 3 for inputs.	(1) Determine system operating as planned when it is not. (2) Determine system isn't operating as planned when it is.	(1) Premature petition for system shutoff, potential to have to restart system. (2) Continue remediation that is no longer effective.
Have the groundwater cleanup goals been met?	See Step 3 for inputs.	(1) Determine cleanup goals have been met then they are not. (2) Fail to determine cleanup goals are met when they are.	(1) Delay in making operational adjustments, avoidable growth of plume. (2) Wasted resources considering/ implementing operational adjustments.

Step 7: Optimize the Design

Number and Locations of Wells

The Upper Glacial monitoring well network for the OU III LIPA project consists of 16 wells, plus the three Upper Glacial aquifer extraction wells. The Magothy monitoring well network consists of 10 wells in addition to the Magothy aquifer extraction well.

Parameters and Frequency

The groundwater monitoring frequency will change from the startup phase to O&M phase (core and perimeter wells sampled semi-annually, and sentinel wells sampled quarterly).

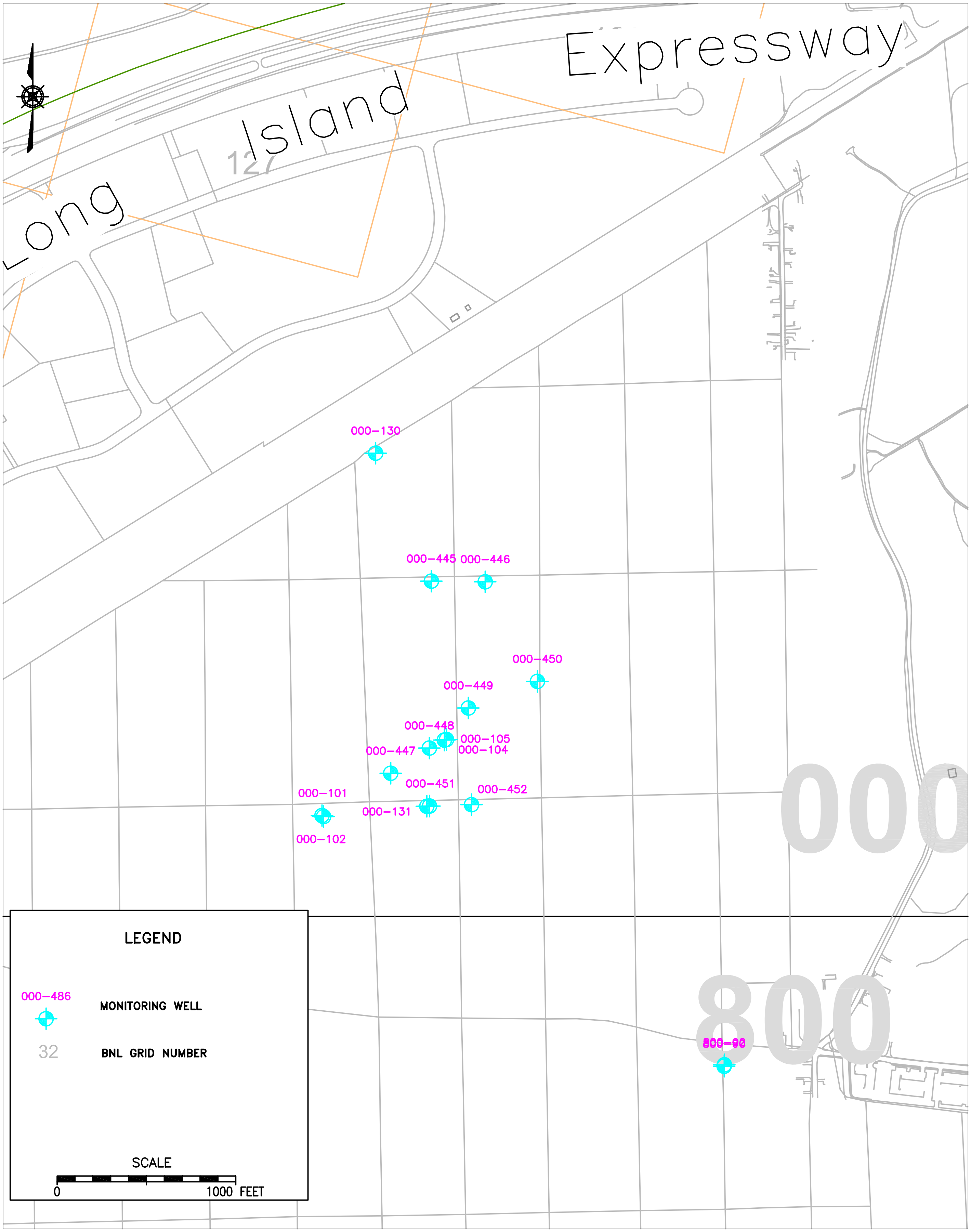
ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications will result in a decrease in collection costs of $4,394 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2007 $27,496
FY2008 $23,102
Difference $-4,394

See Appendix B for the monitoring program for this DQO.



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BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL SERVICES DIVISION

TITLE:

OU III LIPA
MONITORING WELL LOCATIONS
2008 EMP

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
JEB	–	12/14/07	07926
CHKD:	APPD: RH	REV.: –	NOTES: –

FIGURE NO.: 12.38.1

OU III Industrial Park East

DQO Start Date January 1, 2003

Revision Number/Date Rev. 4, December 7, 2007

Implementation Date January 1, 2008

Point of Contact William Dorsch (631) 344-5186
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Summary of Changes

The following are changes for the Industrial Park East Pump and Treat System and groundwater monitoring program:

- Pulse pump the extraction wells one month on and one month off at 115 gpm for EWI-1 and 75 gpm for EWI-2. The extraction wells will be restarted if data indicate that capture goal of 50 µg/L TVOC is exceeded. If no rebound is seen (i.e., TVOC concentrations exceeding 50 µg/L) in extraction or monitoring wells after one year of pulse pumping, then petition for shutdown of this system.
- Change the monitoring well network sampling frequency from the O&M phase (semiannual sampling) to the shutdown phase (quarterly sampling)

Description and Technical Basis

The OU III Industrial Park East remediation system consists of two groundwater extraction wells and a diffusion well located south of the BNL boundary and Long Island Expressway (LIE) and immediately east of the OU III Industrial Park Treatment System. One of the extraction wells is designed to remediate VOC contamination entering the upper portion of the Magothy aquifer. A second well is designed to treat VOC contamination in the Upper Glacial aquifer. This contamination originates in the central, developed areas of the BNL site and migrates southward in the direction of groundwater flow. The area of contamination had already migrated south of the site boundary prior to the startup of the OU III South Boundary Pump and Treat System in 1997.

This system is designed to achieve the OU III ROD objectives of minimizing plume growth and meeting Maximum Contaminant Levels (MCLs) in the Upper Glacial aquifer in 30 years or less. The system will address the highest VOC concentration portion of the plume (above 50 µg/L). The southernmost portions of this plume will eventually be addressed by the Brookhaven Airport remediation system, as it continues to travel south with the regional groundwater flow.

The Upper Glacial monitoring well network for the OU III Industrial Park East project consists of five wells, plus the one Upper Glacial aquifer extraction well. The Magothy monitoring well network consists of seven wells in addition to the Magothy aquifer extraction well. Five of the 12 wells in this monitoring network were newly installed in 2003. These wells monitor the VOC plume south of the LIE to Astor drive in the North Shirley residential area, as well as the effectiveness of the groundwater treatment systems. The monitoring schedule is provided in Table 12.1.1.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health or the environment has been defined south of the BNL site. In response, a groundwater remediation system has been constructed to treat this plume. Data are needed to verify that the remediation is occurring according to plan. Based on groundwater modeling, both the Upper Glacial and Magothy extraction wells are scheduled to operate for up to 5 years.

Step 2: Identify the Decision

- Is the BNL Groundwater Contingency Plan triggered?
- If not, has the plume been controlled?
- Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?
- Can the groundwater treatment system be shut down?

Step 3: Identify Inputs to the Decision

The project was divided into a total of eight decision subunits (four each for the Upper Glacial and Magothy systems) to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are as follows:

Upper Glacial System:

- plume core wells (Decisions 1, 2, and 4)
- plume perimeter wells, used to define the extent of the plume (Decisions 1 and 2)
- bypass detection wells (Decisions 1, 2, and 4)

Magothy System:

- plume core wells (Decisions 1, 2, and 4)
- plume perimeter wells, used to define the extent of the plume (Decisions 1 and 2)
- bypass fetection wells (Decisions 1, 2, and 4)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- direction and velocity of groundwater flow
- analytical results for VOCs in groundwater
- location of existing wells relative to flow patterns (Figure 12.39.1)
- evaluation of capture zone for extraction wells

- action levels
- analytical methods and detection limits as described in the BNL Quality Assurance Program Plan (QAPP)
- variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Long Island Expressway to the north
- Astor Drive to the south
- Birch Hollow Drive (well MW-B) to the east
- Boxwood Drive (well MW-D) to the west
- the Upper Glacial aquifer (Upper Glacial System)
- the Upper Magothy aquifer (Magothy System).

Separate decisions will be made in the eight subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire system (Upper Glacial or Magothy). The temporal boundaries of the study area vary, based on the decision.

- *Plume Core:* Due to the need for frequent data collection during the system startup period, the timeframe for decisions for this subunit is 90 days.
- *Plume Perimeter:* Because the wells in this subunit define the plume horizontally, which is used to determine whether the plume is being captured, the timeframe for decisions here is 90 days. The wells are screened outside the known extent of the plume at the depth of contamination in the plume core. Although the plume is not expected to shift laterally due to changing flow conditions, the decision timeframe for this area will be 90 days during the 2-year system startup phase.
- *Bypass Detection Area:* Because the wells in this area indicate whether the plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

This decision applies to the plume perimeter and bypass detection wells (Upper Glacial and Magothy systems). **If** the cleanup goals have not been met, **then** it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume fringe or bypass detection wells to above 50 µg/L (if currently less than 50 µg/L) or a significant increase in total VOC concentration (if currently above 50 µg/L).

If the trend in each plume perimeter and bypass detection well has a negative or zero slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 µg/L, **then** continue to operate the system. **If** not, **then** consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?

This decision applies to the plume core and bypass detection wells (Upper Glacial and Magothy systems). When the system is performing as planned, actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need to evaluate for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis, and expert judgment), **then** continue to operate. **If** not, then consider operational adjustments and/or engineering evaluation. Note: When the majority and/or “key” wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Can the groundwater treatment system be shut down?

All of the following decision subunits must be satisfied in order to shut an extraction well down (Upper Glacial and Magothy systems).

4a. Have asymptotic TVOC concentrations been reached in core wells?

> This decision applies to the plume core wells (for both the Upper Glacial and Magothy systems). It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in TVOC concentrations in the plume core wells. The Kendall-Mann statistical test is a nonparametric trend analysis (Gilbert, 1987) used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.
>
> To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. **If** so, **then** operation of the system will continue.

4b. Is the mean TVOC concentration in core wells less than 50 µg/L (expected by 2009)?

This decision also applies to the plume core wells (for both the Upper Glacial and Magothy systems). It is anticipated that approximately 3 to 5 years of active groundwater treatment will reduce the mean TVOC concentrations in the plume core to less than 50 µg/L. If this occurs, it is reasonable to expect (based on model projections) that Monitored Natural Attenuation (MNA) of the remaining contamination in the plume core will be reduced further to meet the cleanup goals of restoring the Upper Glacial aquifer to MCLs within 30 years. **If** the TVOC concentration remains above 50 µg/L, **then** consider operational adjustments and/or engineering evaluation.

4c. How many individual plume core wellsare above 50 µg/L TVOC ?

If the total VOC concentration in each plume core well has been reduced to less than 50 µg/L in less than 3 to 5 years of active remediation, **then** proceed with pulsed operation of the system (see Decision subunit 4d). **If** not and treatment has occurred for less than 3 to 5 years, **then** continue treatment. **If** not and treatment has occurred for at least 3 to 5 years, **then** perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2030.

4d. During pulsed operation, is there significant concentration rebound in the core wells?

This decision is to determine whether there is significant concentration rebound after system pulsing. **If** yes, and system has operated for less than 3 to 5 years, **then** continue operation. **If** yes and system has operated for more than 3 to 5 years, **then** an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted (see Decision subunit 4e. to help with this decision). **If** no significant rebound is observed within a 1-year time period, **then** petition for system shutdown and continue with MNA.

Decision 5

Have the groundwater cleanup goals been met? Specifically, have MCLs been achieved in the Upper Glacial aquifer (expected by 2030) and the Magothy aquifer (expected by 2070)?

If the mean concentration of TVOCs in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 50 µg/L, and If the mean TVOC concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous 2 years, is less than 50 µg/L, and pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations, **then** petition for system shutdown and continue with MNA until MCLs are met. **If** not, **then** consider the need for continued remediation.

Step 6: Specify Acceptable Error Tolerances

Table 12.39.1 summarizes the decision and possible decision errors for this project.

Table 12.39.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based On Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Can the groundwater treatment system be shut down?	See Step 3 for inputs.	(1) Determine system can be shut down when operation should continue. (2) Determine to continue operating system when shut down is warranted.	(1) Plume growth continues; ultimate project delays. (2) Wasted resources, project delays.
Is the system operating as planned?	See Step 3 for inputs.	(1) Determine system operating as planned when it is not. (2) Determine system isn't operating as planned when it is.	(1) Premature petition for system shutoff, potential to have to restart system. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Locations of Wells

The monitoring well network for the OU III Industrial Park East project consists of 12 wells.

Parameters and Frequency

The wells will be monitored for VOCs. The monitoring well network sampling frequency will change from the O&M phase (semiannual sampling) to the shutdown phase (quarterly sampling).

ANNUAL COST IMPACT DUE TO PROPOSED CHANGE

The sampling program modifications will result in an increase in collection costs of $3,380 per year.

TOTAL COST FOR MONITORING PROGRAM

FY2007	$20,272
FY2008	$23,652
Difference	$3,380

BROOKHAVEN NATIONAL LABORATORY ENVIRONMENTAL SERVICES DIVISION	TITLE: OU III INDUSTRIAL PARK EAST MONITORING WELL LOCATIONS 2008 EMP	DWN: JEB	VT: HZ.: –	DATE: 12/14/07	PROJECT NO.: 07926
		CHKD:	APPD: RH	REV.: –	NOTES: –
		FIGURE NO.: 12.39.1			

OU III North Street East

DQO Start Date January 1, 2003

Revision Number/Date Rev. 4, December 7, 2007

Implementation Date January 1, 2008

Point of Contact William Dorsch (631) 344-5186
Vincent Racaniello (631) 344-5436

Summary of Changes

The following are changes for the OU III North Street East groundwater remediation system and monitoring program:

- Since the system has been operating for over 2 years, change the sampling frequency for the monitoring wells from start-up to the O&M phase (core and perimeter wells sampled semi-annually, and sentinel wells sampled quarterly). However, plume core wells 000-481, -482, -483, and -484 should be maintained at the quarterly sampling frequency since they are immediately upgradient of extraction well NSE-2.

Description and Technical Basis

The OU III North Street East remediation system consists of two groundwater extraction wells and four diffusion wells (to be shared with the OU III North Street system) located east of North Street, south of the Long Island Expressway (LIE), and north of Moriches-Middle Island Road, in East Yaphank. The extraction wells are designed to remediate VOC contamination residing in the middle portion of the Upper Glacial aquifer. The contamination in this area had migrated off-site prior to the start-up of the OU I (RA V) South Boundary treatment system in December 1996 and consists primarily of 1,1,1-TCA, 1,1-DCE, and TCE. The contamination consists of commingled plumes from several sources, including the Current Landfill and the former HWMF. The plume is migrating in a southerly direction with groundwater flow.

This system is designed to achieve the OU III ROD objectives of minimizing plume growth and meeting Maximum Contaminant Levels (MCLs) in the Upper Glacial Aquifer in 30 years or less. The system will address the highest VOC concentration portion of the plume (above 50 µg/L).

The monitoring well network for the OU III North Street East project consists of 15 wells, all of which are located off site and south of the LIE. Well locations are shown on Figure 12.40.1. The wells will be sampled quarterly and analyzed for VOCs. The monitoring schedule is provided in Table 12.1.1.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

___ Compliance
___ Support Compliance
___ Surveillance
_x_ Restoration

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

A VOC plume that could represent a potential risk to human health or the environment has been defined south of the BNL site. In response, a groundwater remediation system has been constructed to treat this plume. Data are needed to verify that the remediation is occurring according to plan. Based on groundwater modeling, the extraction wells are scheduled to operate for up to 10 years.

Step 2: Identify the Decision

- Is the BNL Groundwater Contingency Plan triggered?
- If not, has the plume been controlled?
- Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for this particular treatment system?
- Can the groundwater treatment system be shut down?

Step 3: Identify Inputs to the Decision

The project was divided into a total of five decision subunits to reflect the categories of wells for which decisions will be made with respect to the VOC contamination. The identified subunits and the decisions supported by each are:

- Plume core wells (Decisions 1, 2, and 4)
- Plume perimeter wells, used to define the extent of the plume (Decisions 1 and 2)
- Bypass detection wells (Decisions 1, 2, and 4)

The wells included in each subunit are shown in Table 12.1.2. The inputs necessary for the decisions include:

- Direction and velocity of groundwater flow
- Analytical results for VOCs in groundwater
- Location of existing wells relative to flow patterns (Figure 12.40.1)
- Evaluation of capture zone for extraction wells
- Action levels
- Analytical methods and detection limits as described in the BNL Quality Assurance Program Plan (QAPP)
- Variability of data

Step 4: Define the Study Boundaries

As currently defined, the spatial boundaries of the study area are defined by:

- Long Island Expressway to the north
- east of North Street
- north of Moriches–Middle Island Road
- the Upper Glacial aquifer

Separate decisions will be made in the five subunits described in Step 3. However, some of the decisions, such as system performance, are based on the entire system. The temporal boundaries of the study area vary, based on the decision.

- *Plume Core:* Due to the need for frequent data collection during the system start-up period, the timeframe for decisions for this subunit is 90 days.
- *Plume Perimeter:* Because the wells in this subunit define the plume horizontally, which is used to determine whether the plume is being captured, the timeframe for decisions here is 90 days. The wells are screened outside the known extent of the plume at the depth of contamination in the plume core. Although the plume is not expected to shift laterally due to changing flow conditions, the decision timeframe for this area will be 90 days during the 2-year system service station phase.
- *Bypass Detection Area:* Because the wells in this area indicate whether the plume capture performance objective is being met, the decision timeframe for this area is 90 days.

Step 5: Develop the Decision Rules

Decision 1

Is the BNL Groundwater Contingency Plan triggered?

Analytical results from wells in all subunits will be utilized for this decision. Future sample results will be evaluated in context with historic data for each sampling event. As part of that evaluation, circumstances that would require implementation of the BNL Groundwater Contingency Plan would be ascertained for each sampled well. Examples of such circumstances are unusually high contaminant concentrations, detection of previously undetected contaminants, and detection of contaminants in previously “clean” wells.

If conditions indicate that the Groundwater Contingency Plan needs to be implemented, **then** the Contingency Plan will be implemented.

Decision 2

Has the plume been controlled?

This decision applies to the plume perimeter and bypass detection wells. If the cleanup goals have not been met, then it must be verified that the plume is not growing. Plume growth is defined as an increase in total VOC concentration in plume fringe or bypass detection wells to above 50 μg/L (if currently less than 50 μg/L) or a significant increase in total VOC concentration (if currently above 50 μg/L).

If the trend in each plume perimeter and bypass detection well has a negative or zero slope, based on the four most recent consecutive samples, this trend is consistent with professional judgment, and the total VOC concentration is less than 50 μg/L, **then** continue to operate the system. **If** not, **then** consider an engineering evaluation or operational adjustments to optimize system operation.

Decision 3

Is the system operating as planned? Specifically, is the aquifer being restored at the planned rate for a particular treatment system?

This decision applies to the plume core and bypass detection wells. When the system is performing as planned, actual total VOC concentrations in plume core and bypass detection wells will compare well to predicted values, based on model runs. A significant difference between actual and predicted concentrations indicates the need for an evaluation for the reason for the difference.

If the system is performing as planned (based on groundwater model predictions, trend analysis and expert judgment), **then** continue to operate. **If** not, **then** consider operational adjustments and/or an engineering evaluation. Note: When the majority and/or "key" wells, as defined by a subject matter expert, are performing as planned, the system as a whole is considered to be properly operating.

Decision 4

Can the groundwater treatment system be shut down?

All of the following decision subunits must be satisfied in order to shut an extraction well down.

4a. Have asymptotic TVOC concentrations been reached in core wells?

This decision applies to the plume core wells. It is likely that asymptotic conditions will be reached before cleanup goals have been met. Therefore, when no significant reductions in contaminant concentrations have been observed, a petition to shut down the system may be appropriate. Asymptotic conditions are demonstrated by analyzing the average trends in TVOC concentrations in the plume core wells. The Kendall-Mann statistical test is a non-parametric trend analysis (Gilbert, 1987) used to aid in determining the slope in groundwater quality data. It is particularly useful when the residuals from a regression analysis are not normally distributed, or for an unknown distribution.

To demonstrate asymptotic conditions, there must be a prolonged period with no appreciable decrease in total VOC concentrations, followed by an evaluation of whether adjustments to system operational parameters (such as pumping rates or pulsed pumping) will cause contaminant recovery rates to increase. If so, then operation of the system will continue.

4b. Are there individual plume core wells above 50 µg/L TVOC ?

If the total VOC concentration in each plume core well has been reduced to less than 50 µg/L in less than 7 to 10 years of active remediation, **then** proceed with pulsed operation of the system (see Decision subunit 4c). **If** not and treatment has occurred for less than 7 to 10 years, **then** continue treatment. **If** not and treatment has occurred for at least 7 to 10 years, **then** perform an engineering evaluation to predict the fate of the remaining contamination and determine whether MCLs will be met by 2030.

4c. During pulsed operation, is there significant concentration rebound in the core wells?

This decision is to determine whether there is significant concentration rebound after system pulsing. **If** yes, and system has operated for less than 7 to 10 years, **then** continue operation.

If yes and system has operated for more than 7 to 10 years, **then** an engineering evaluation should be performed to evaluate whether continued operation of the system is warranted (see Decision subunit 4d. to help with this decision). **If** no significant rebound is observed within a 1-year time period, **then** petition for system shutdown and continue with MNA.

4d. Have the groundwater cleanup goals been met? Have MCLs been achieved by 2030?

If the mean concentration of TVOCs in groundwater, calculated from analytical results from all plume core wells for the most recent sampling event, is less than 50 μg/L, and if the mean TVOC concentration of each contaminant of concern in groundwater in each plume core well, computed from measurements over the previous 2 years, is less than 50 μg/L, and pulsing of the remediation system has not resulted in significant rebound of contaminant concentrations, **then** petition for system shutdown and continue with MNA until MCLs are met. If not, then consider the need for continued remediation.

Step 6: Specify Acceptable Error Tolerances

Table 12.40.1 summarizes the decision and possible decision errors for this project.

Table 12.40.1 Decisions, Potential Decision Errors, and Potential Consequences

Decision	Inputs	Potential Errors Based On Data	Potential Consequences
Is the Contingency Plan triggered?	See Step 3 for inputs.	(1) Trigger Contingency Plan unnecessarily. (2) Fail to trigger Contingency Plan when it should have been triggered.	(1) Unnecessary administrative process, project delays. (2) Lost time in addressing problem, loss of stakeholder confidence.
Is plume growth controlled?	See Step 3 for inputs.	(1) Determine plume is controlled when it is not. (2) Determine plume is not controlled when it is.	(1) Premature petition for system shutoff, project delays. (2) Continue remediation longer than necessary, wasted resources.
Can the groundwater treatment system be shut down?	See Step 3 for inputs.	(1) Determine system can be shut down when operation should continue. (2) Determine to continue operating system when shut down is warranted.	(1) Plume growth continues; ultimate project delays. (2) Wasted resources, project delays.
Is the system operating as planned?	See Step 3 for inputs.	(1) Determine system operating as planned when it is not. (2) Determine system isn't operating as planned when it is.	(1) Premature petition for system shutoff, potential to have to restart system. (2) Continue remediation that is no longer effective.

Step 7: Optimize the Design

Number and Locations of Wells

The monitoring well network for the OU III North Street East project consists of 15 wells, all of which are located off-site south of the LIE.

Parameters and Frequency

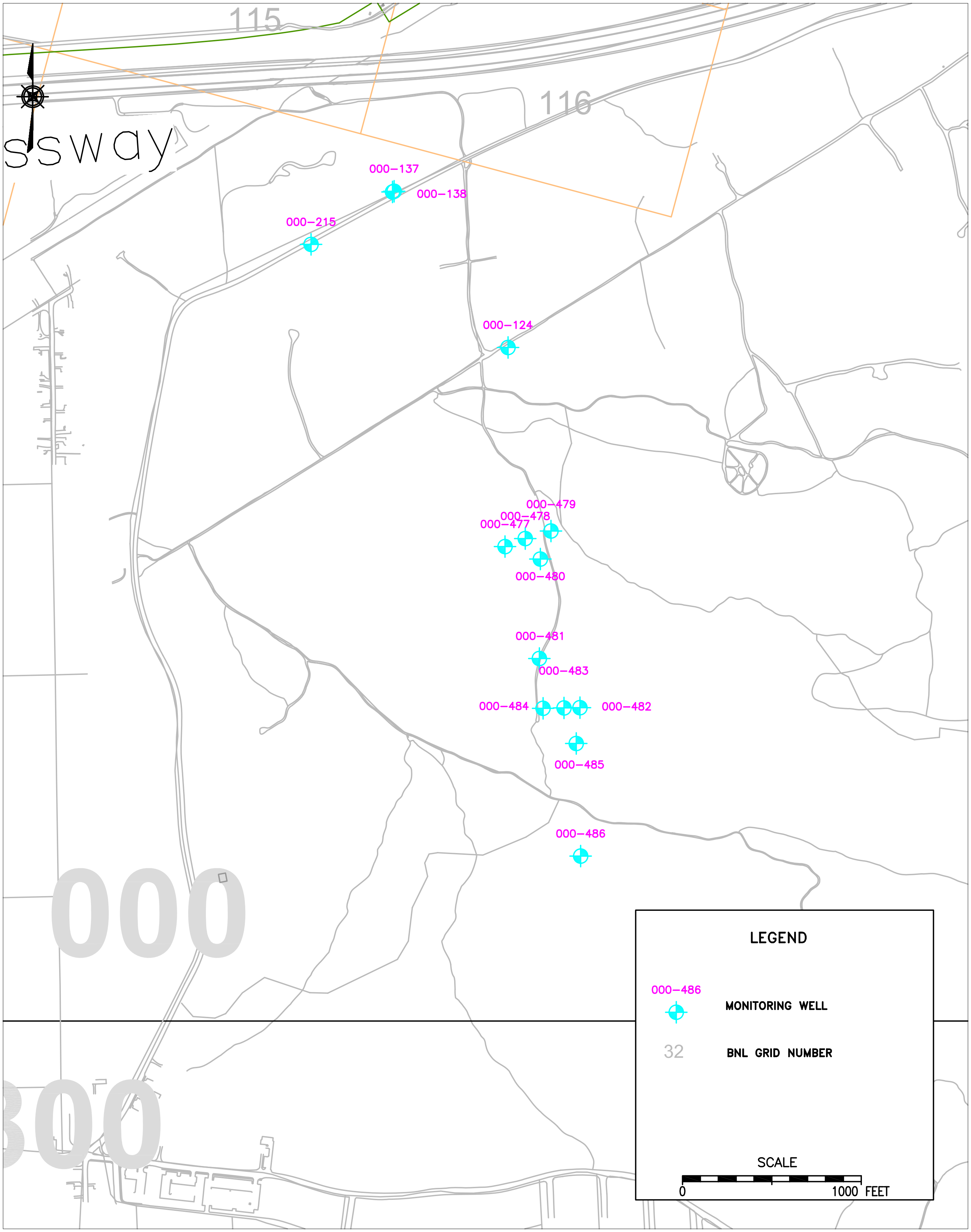
Since the system has been operating for over two years, change the sampling frequency for the monitoring wells from start-up to the O&M phase (core and perimeter wells sampled semi-annually, and sentinel wells sampled quarterly). However, plume core wells 000-481, -482, -483, and -484 should be maintained at the quarterly sampling frequency since they are immediately upgradient of extraction well NSE-2..

Annual Cost Impact Due to Proposed Change

The sampling program modifications will result in a decrease in collection costs of $4,394 per year.

Total Cost for Monitoring Program

FY2007	$28,864
FY2008	$24,470
Difference	$-4,394



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BROOKHAVEN NATIONAL LABORATORY ENVIRONMENTAL SERVICES DIVISION	TITLE: OU III North Street East MONITORING WELL LOCATIONS 2008 EMP	DWN: JEB	VT: HZ.: –	DATE: 12/14/07	PROJECT NO.: 07926
		CHKD:	APPD: RH	REV.: –	NOTES: –
		FIGURE NO.: 12.40.1			

GROUNDWATER MONITORING FOR THE G-2 TRITIUM SOURCE AREA AND PLUME

DQO START DATE	January 2, 2008
REVISION NUMBER/DATE	Rev. 0, January 2, 2008
IMPLEMENTATION DATE	January 2, 2008
POINT OF CONTACT	Douglas Paquette (631) 344-7046

SUMMARY OF PROPOSED CHANGES

Implementation of the monitoring requirements defined in the g-2/BLIP/UST Record of Decision (April 2007) will not result in any changes to the previously established routine monitoring program for the g-2 source area (previously defined in the AGS DQO statement). However, additional temporary wells will need to be installed to monitor the downgradient segments of the g-2 tritium plume. The ROD has also established contingency action triggers if tritium is detected above 1,000,000 pCi/L in any segment of the g-2 tritium plume, or if the plume does not attenuate to below the 20,000 pCi/L MCL before reaching Brookhaven Avenue.

DESCRIPTION AND TECHNICAL BASIS

In November 1999, tritium was detected in the groundwater near the g-2 experiment at concentrations above the 20,000 pCi/L MCL. Sodium-22 was also detected in the groundwater, but at concentrations well below the 400 pCi/L MCL. An investigation into the source of the contamination revealed that the tritium and sodium-22 originated from activated soil shielding located adjacent to the g-2 target building where approximately five percent of the beam was inadvertently striking the beam-line's VQ12 magnet. Rainwater was able to infiltrate the activated soils and carry the tritium and sodium-22 into the groundwater. To prevent additional rainwater infiltration into the activated soil shielding, a concrete cap was constructed over the soil shielding in December 1999. Other corrective actions included refocusing the beam and improved beam loss monitoring to reduce additional soil activation, stormwater management improvements, and additional groundwater monitoring. The g-2 experiment concluded its operations in 2001, and the facility is being maintained for potential future use.

Following the concurrence from the NYSDEC, a Record of Decision (ROD) was signed by the U.S. DOE and U.S. EPA in early 2007. This ROD requires continued routine inspection and maintenance of the impermeable cap, groundwater monitoring of the source area to verify the continued effectiveness of the storm water controls, and monitoring the tritium plume until it attenuates to less than the 20,000 pCi/L MCL. Monitoring of the source area will continue for as long as the activated soils remain a threat to groundwater quality. Contingency actions have been developed if tritium levels greater than 1,000,000 pCi/L are detected within the plume, or if the tritium plume does not attenuate to below the 20,000 pCi/L MCL before reaching Brookhaven Avenue.

DRIVERS FOR MONITORING BEING CONDUCTED UNDER THIS CHANGE

____ Compliance
____ Support Compliance
____ Surveillance
_X_ Restoration/IAG

DATA QUALITY OBJECTIVE ANALYSIS

Step 1: State the Problem

Although the cap and other stormwater controls appear to be effectively protecting the activated soils, long-term monitoring is required to verify the continued effectiveness of these controls. Monitoring data indicate that natural fluctuations in the position of the water table periodically flush small amounts of residual tritium that was leached close to the water table before the controls were put in place. The amount of residual tritium near the water table will be reduced by this flushing mechanism and by natural radioactive decay, and since 2004 tritium concentration in surveillance wells located immediately downgradient of the source area have remained <100,000 pCi/L. Tritium concentrations were <50,000 pCi/L during the second half of 2007.

Monitoring of the downgradient segments of the g-2 tritium plume is also required to verify that the plume attenuates (via natural radioactive decay and dispersion) to <20,000 pCi/L before it reaches Brookhaven Avenue as predicted by groundwater modeling.

Step 2: Identify the Decision

Are the engineered controls employed at the g-2 source area effective at preventing additional leaching of tritium from the activated soil shielding? Furthermore, are the tritium concentrations within the g-2 tritium plume declining at the rate and within the geographical area predicted by groundwater modeling (see g-2 EE/CA)?

Step 3: Identify Inputs to the Decision

The inputs necessary for the decision include:

- Direction and velocity of groundwater flow
- Tritium concentrations in groundwater
- Locations of background and downgradient wells
- Regulatory requirements (g-2/BLIP/UST Record of Decision)
- Action levels:
  - As defined in the g-2/BLIP/UST Record of Decision, DOE will determine whether additional remedial actions are required if future tritium levels exceed 1,000,000 pCi/L in groundwater immediately downgradient of the g-2 source area or within the downgradient sections of the g-2 tritium plume
  - As defined in the g-2/BLIP/UST Record of Decision, DOE will determine whether additional remedial actions are required if future tritium levels within the plume exceed 20,000 pCi/L south of Brookhaven Avenue
- Analytical methods and detection limits:
  - Tritium: EPA Method 906
  - Gamma spectroscopy (Optional analysis): EPA Method 901

Note: Starting in 2004, routine analyses for sodium-22 was discontinued. Since that time, the focus has been placed on tritium analyses because tritium is more mobile than sodium-22 and has a longer half-life (12.6 years compared to 2.3 for sodium-22). Therefore, the presence of tritium in groundwater is a better early indicator of a failure in an engineered stormwater control.

Step 4: Define the Study Boundaries

The decision for the g-2 source area monitoring program applies to the nearest monitoring wells, which are located between 275 to 300 feet downgradient of the source, near Building 912A. The period for which decisions are made is 90 days. This timeframe is based on the following:

- The time required for tritium to migrate through the vadose zone and reach the groundwater table (by means of rainwater leachate) is likely to be between 30 to 60 days.

- Once tritium has migrated into the groundwater, the tritium migrates at the same rate as groundwater (approximately 0.75 feet/day). The travel time between the source area and the nearest downgradient wells (near Building 912A) is expected to be approximately 365 days.

- Decision periods of 90 days are acceptable for the g-2 source area where historical monitoring has demonstrated that groundwater quality has already been significantly impacted. A decision period of 90 days is required to continually evaluate the effectiveness of engineered or operational controls implemented in this area.

The decision for the g-2 tritium plume monitoring program applies to the permanent and temporary monitoring wells used to track the downgradient segments of the plume. The periods for which decisions are made ranges between 180 and 365 days. This timeframe is based on the following:

- Once tritium has migrated into the groundwater, the tritium migrates at the same rate as groundwater - approximately 0.75 feet/day or 275 feet/year.
- Decision periods of 180 to 365 days are acceptable because the g-2 tritium plume is located entirely within the central area of the BNL site, the plume cannot be drawn into any potable water supply wells, and the plume is not expected to impact operations of any existing groundwater treatment systems.

Step 5: Develop the Decision Rules

Are the engineered and operational controls effective at preventing or reducing the leaching of radionuclides from activated soils to the groundwater? Is the plume attenuating at the rate and within the geographic area predicted by groundwater modeling?

The sample results will be evaluated in context with historical data. As part of the evaluation, circumstances that would require the implementation of the Groundwater Contingency Plan (either response Category 4 or Category 3 of the plan) would be ascertained for each sampled well or set of wells. As defined in the g-2/BLIP/UST Record of Decision – DOE will determine whether additional remedial actions are required for the g-2 source area or plume control should future tritium levels exceed 1,000,000 pCi/L within any section of the g-2 plume, or if the tritium plume migrates beyond Brookhaven Avenue at concentrations that exceed 20,000 pCi/L.

Decision Rule for a Category 4 Response

A Category 4 response would be required if either of the two ROD contingency trigger levels are met. **If** for any monitoring well:

- Tritium levels exceed 1,000,000 pCi/L (and this result is confirmed by re-sampling) within any segment of the g-2 tritium plume.
- Tritium levels in the plume exceed 20,000 pCi/L south of Brookhaven Avenue.

Decision Rule for a Category 3 Response

A Category 3 response could be implemented if monitoring data indicate a significant increase over recent baseline tritium concentrations or if the plume is not attenuating as predicted by groundwater modeling. Consideration for a Category 3 response should be given **if** for any monitoring well:

- The tritium concentrations are greater than 50 percent but less than 100 percent of the 1,000,000 pCi/L ROD Trigger Level (and this result is confirmed by re-sampling);
- Tritium levels in wells installed south of Cornell Avenue indicate that the g-2 plume is likely to migrate beyond Brookhaven Avenue at concentrations above 20,000 pCi/L

Step 6: Specify Acceptable Error Tolerances

Table 12.41.1 Decisions, Potential Errors, and Potential Consequences

Decision	Inputs	Potential Error Based on Data	Potential Consequences
Are controls effective at eliminating or controlling the leaching of tritium from the g-2/VQ12 activated soil shielding to the groundwater.	See Step 3 for inputs	(1) Data indicate that source controls are effective when they are not. (2) Data indicate source controls are not effective when they are because of sampling or analytical error, or wells not properly located.	(1) A slug of contamination potentially up to 100 feet long and 20 feet wide could exist and not be detected.* (2) Need to re-sample well and resulting additional unplanned costs. Potential erosion of stakeholder confidence.

*Assumes results from one sample period were inaccurate.

Under current conditions, there are no potential receptors (i.e., potable water supply wells) near the g-2 source area or downgradient segments of the tritium plume. Although the g-2 source area is within a two-year capture zone of BNL potable supply well 10, restrictions have been placed on the operation of potable Well 10 since early 2000 to prevent the possible capture of the g-2 plume by this well, and also help to stabilize groundwater flow directions in the AGS area. Due to these factors, and existing Land Use and Institutional Controls, it is unlikely that a decision error will result in adverse consequences to human health. Consequences associated with (short-term) decision errors for this program relate primarily to possible enforcement actions for continued environmental degradation, erosion of stakeholder trust, and loss of BNL credibility.

Step 7: Optimize the Design

Number and Locations of Wells

The g-2 source area is monitored using six wells located near Building 912A (Figure 12.41.1). These surveillance wells are located as close as possible to the source area to allow for early detection of new contaminant releases (approximately one year's travel time). The downgradient segments of the g-2 tritium plume are monitored using a combination of 13 permanent wells (near Building 912 and the AGS Parking Lot), and temporary Geoprobe wells. As of late 2007, the tritium plume has been tracked to the northern section of the HFBR facility. During 2008, additional temporary wells will be installed in the HFBR area to track the leading edge of the plume.

Parameters and Frequency

During 2008, the g-2 source area and plume will be monitored as follows:

- Wells immediately downgradient of the source area will continue to be sampled quarterly. Samples will be analyzed for tritium on a quarterly basis, and annually for sodium-22.
- Because the high-concentration segments of the g-2 plume have passed Building 912 and the AGS Parking Lot area, in early 2007 the sampling of the permanent wells near Building 912 and the parking lot was reduced from quarterly to semi-annual. This sampling frequency will continue for 2008. Samples will be analyzed for tritium.
- Monitoring of the segments of the g-2 plume downgradient of the AGS parking lot area will be conducted using temporary wells. Samples will be analyzed for tritium. Monitoring plans for the installation of the temporary wells will be reviewed with the regulatory agencies. As defined in the g-2/BLIP/UST Record of Decision, the downgradient segments of the g-2 plume will be monitored until the tritium levels drop below the 20,000 pCi/L MCL.

Annual Cost Impact Due to Proposed Change

To fulfill the monitoring requirements defined in the g-2/BLIP/UST ROD, new temporary wells will be installed to track the downgradient segments of the g-2 tritium plume. Installation, sampling, and analysis costs for the temporary wells will be approximately $30,000.

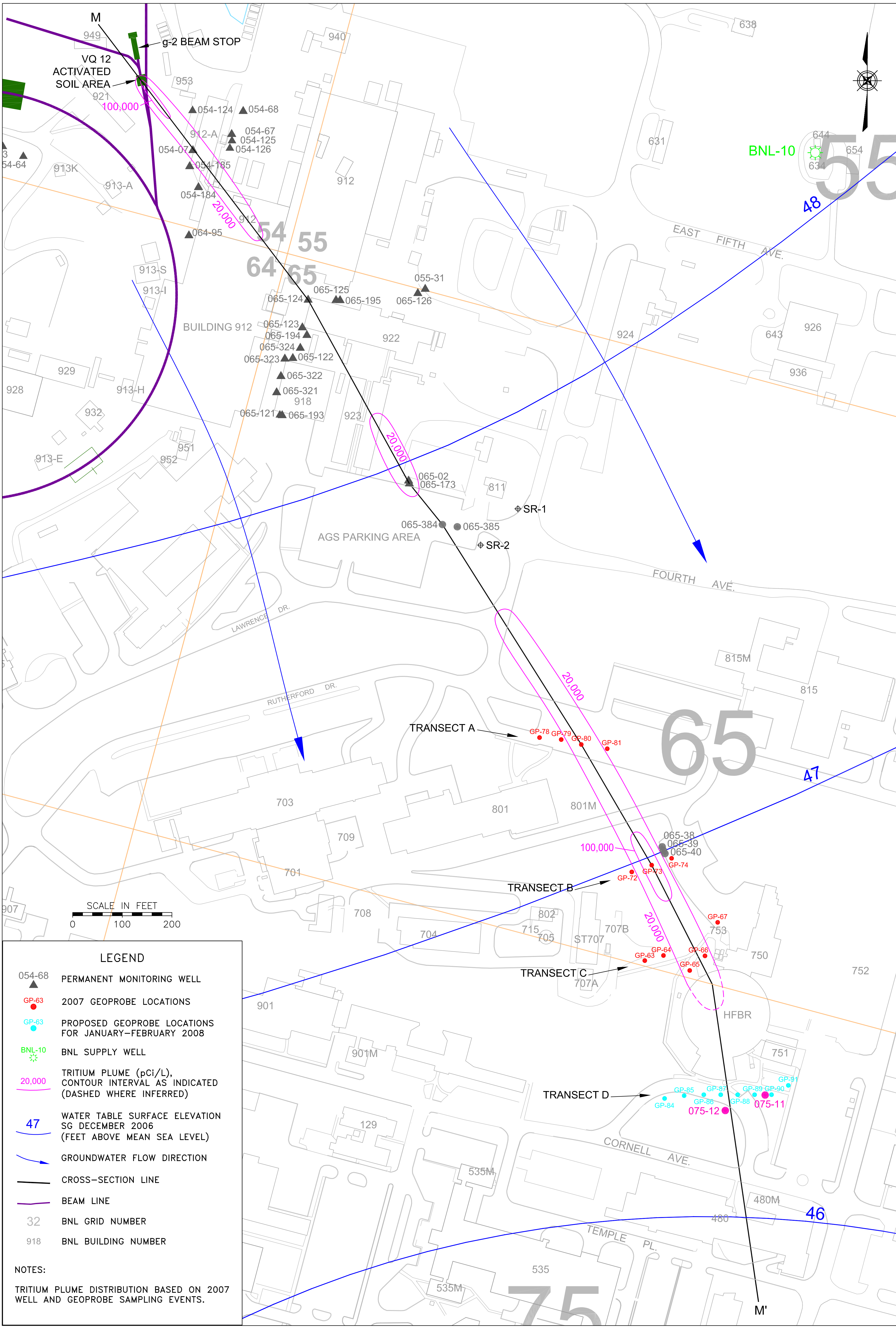
Total Cost for Monitoring Program

Total installation, sampling and analysis costs for the permanent and temporary wells will be approximately $70,000.

Table 12.41.2 Comparison of CY2007 and CY2008 Monitoring Program – Permanent Wells

Well	Monitoring Sub-Area	CY2007 Sampling Frequency	CY2008 Sampling Frequency	Affected Parameters
054-65	Bkgd. g-2	Semi-annual	Semi-annual	None
054-07	g-2/VQ12 source	Quarterly	Quarterly	None
054-124	g-2/VQ12 source	Quarterly	Quarterly	None
054-184	g-2/VQ12 source	Quarterly	Quarterly	None
054-185	g-2/VQ12 source	Quarterly	Quarterly	None
064-95*	g-2/VQ12 source	Quarterly	Quarterly	None
054-126	g-2/VQ12 source	Quarterly	Quarterly	None
065-122	g-2 tritium plume	Semi-annual	Semi-annual	None
065-123	g-2 tritium plume	Semi-annual	Semi-annual	None
065-124	g-2 tritium plume	Semi-annual	Semi-annual	None
065-125	g-2 tritium plume	Semi-annual	Semi-annual	None
065-126	g-2 tritium plume	Semi-annual	Semi-annual	None
065-194	g-2 tritium plume	Semi-annual	Semi-annual	None
065-195	g-2 tritium plume	Semi-annual	Semi-annual	None
055-31	g-2 tritium plume	Semi-annual	Semi-annual	None
065-321	g-2 tritium plume	Semi-annual	Semi-annual	None
065-322	g-2 tritium plume	Semi-annual	Semi-annual	None
065-323	g-2 tritium plume	Semi-annual	Semi-annual	None
065-324	g-2 tritium plume	Semi-annual	Semi-annual	None
065-02	g-2 tritium plume	Semi-annual	Semi-annual	None
065-173	g-2 tritium plume	Semi-annual	Semi-annual	None

* Access to well 064-95 is periodically restricted because it is within a posted radiation area when AGS/RHIC is in operation.



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BROOKHAVEN NATIONAL LABORATORY

EWMS DIVISION

TITLE:

AOC 16T g–2
TRITIUM PLUME
2007

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
YS	–	12/27/07	–
CHKD:	APPD:	REV.:	NOTES:
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FIGURE NO.: –