Table A-3. Pneumatic Conductivity Test, Depressurization Well 2-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc) Vacuum Points			Water Level Measurements			Comments
		Monitoring Wells (if applicable)			Monitoring Wells (if applicable)			
		MW - __	MW - __	MW - __	DW-2S Screen (10-17)	VMWC-5B Screened (15.2-19.2)	MW - __	
					DTW	DTW	DTW	
		(ft bmp)	(ft bmp)	(ft bmp)	(ft bmp)	(ft bmp)	(ft bmp)	
Baseline[5]	2:15 PM				Dry	Dry		Wells Dry yesterday also, DTW on 5D yesterday was 49.24 ft bls.
Steady State[11]	2:26 PM					NM		Stack reading 68% RH and 71F 3:08 PM Carbon Effluent 64% RH 81.6F
1 hr	3:41 PM					NM		EFF PID Readings 17, 18, 25, 35, 39, 28; EFF PID Readings 6, 1.9, 0.1, 0.7, 0.1, 0.2, 0.0 EFF PID Readings 19, 32, 79, 119, 131, 153--
2 hr	4:35 AM					NM		
3 hr	5:35 AM					NM		5:48 PM Carbon Eff RH 22.8% and 96.2 F
4 hr [3]	6:25 PM					NM		
5 hr / 75% Changed at 7:00 PM	7:30 PM					NM		7 PM changed flow to 75% of Original
6 hr / 50% Changed at 7:40PM	8:11 PM					NM		7:40 PM changed flow to 50% of Original

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Table A-3. Pneumatic Conductivity Test, Depressurization Well 2-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Notes & Abbreviations:

1. Radial Distances for VMWCs 5-8 are measured from DW-2S.
2. + indicates increasing, - indicates decreasing
3. Air sample was collected in 6-liter suma canister and submitted to Columbia Analytical Labs, Rochester, New York for TO-15 analysis; 24 Hr. TAT requested. Pre-carbon sample was collected at test hour 4.
4. Water was not generated during this event therefore, water sample was not collected or submitted for analysis.
5. Initial measurement after start-up for wellhead vacuum.
6. PID readings taken with 2 separate Minirae 2000 units and no correlation was observed. Unit # 3881 INF 7.8 Eff 83-85 Calibration gas check 116-118 ppm. Unit # 8708 INF 0.0ppm; EFF 7.1ppm; calibration gas check 91ppm. One PID unit was recalibrated, sample bags were left in field vehicle with the PID to normalize to stable temperature. Screened samples 30 mins later- results not stable (see note 7). Samples collected again and results varied largely, moisture determined to be one of the problems and meters not holding calibration, new minirae meters (11.7) ordered from another vendor.
7. Measurement varied from 0-153 moisture problem from effluent of carbon RH >60%
8. Wellhead temperature 46.2-46.4F with thermal anemometer; RH approx. 87% at 1 time during sampling. When probe from anemometer removed at end of day there was moisture beading on the probe.
9. Velocity measured at 4"D well pipe with thermal anemometer (see note 8), skid mounted Rotron flow meter malfunctioned.
10. Test started at 2:24 PM readings stabilized 2 mins later.

DTW	depth to water
DW	Depressurization Well
fpm	feet per minute
ft. bls	feet below land surface
ft. bmp	feet below measuring point
in Hg	inches of mercury
iwc	inches of water column
PID	photoionization detector
ppm	parts per million
SCFM	standard cubic feet per minute
TOC	top of casing
VCS	vapor control system
VMWC	vacuum monitoring well cluster

Table A-4. Pneumatic Conductivity Test, Depressurization Well 2-Deep Field Monitoring Parameters,
Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	DW-2D Wellhead Vacuum	VCS Air Flow	DW-2D Wellhead Temperature	Wellhead Effluent PID	Knockout Tank Vacuum	Post Knockout Vacuum	Blower Influent Vacuum	Blower Influent Temperature	Blower Effluent Pressure	Blower Effluent Temperature	Carbon Influent Pressure Approximate	Carbon Effluent PID
		VI-1 (iwc)	Hand Held/FM-1 (fpm)/(scfm)	(F)	ASP-1 (ppm)	VI-2 (iwc)	(iwc)	VI-3 (iwc)	TI-1 (F)	PI-1 (iwc)	TI-2 (F)	(iwc)	ASP-2 (ppm)
Baseline[5]	10:10 AM	-8.090		38.1									
Steady State [1,2]	10:55 AM	-11.13	2390/314	NM	NM	-12	-28	-40	52	30	138	18	NM
1 hr	12:18 PM	-11.06	2390/NM	NM	NM	-12	-30	-41	52	30	134	18	NM
2 hr	1:23 PM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
3 hr	1:57 PM	-11.12	2527/NM	56.3	NM	-12	-28	-41	50	30	132	18	NM
4 hr [3]	~3:00 PM	-11.08	2437/NM	55.4	0.0	-12	-29	-40	46	30	130	18	16.4
5 hr / 75% Changed at 4:12 PM	4:55 PM	-7.846	1754/285	54.8	NM	-7	-19	-24	44	38	NM	18-30	NM
6 hr / 50% Changed at 5:24 PM	~5:50 PM	-7.191	1564/265	55.7	NM	-6	-16	-22	42	40	110	20-32	NM

Initials:	PAR	Date: 03/21/07	(+/-)[2]
Barometric Pressure (inHg)		30.79 & 33% RH	(-) @ 9:22 am
Ambient Temperature		41.4 F	25.4% RH @ 11:58 am
Ambient Conditions		Cold, Sunny, Slight Breeze	

% Dilution Valve opened at start of test	None
Total Volume of water collected from knockout tank	1 Quart

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Table A-4. Pneumatic Conductivity Test, Depressurization Well 2-Deep Field Monitoring Parameters,
Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc)					
		Vacuum Points					
		VMWC-5	VMWC-5	VMWC-5	VMWC-6	VMWC-6	VMWC-6
		Radial Distance[1] 13 ft	Radial Distance[1] 13 ft	Radial Distance[1] 13 ft	Radial Distance[1] 28 ft	Radial Distance[1] 28 ft	Radial Distance[1] 28 ft
		Depth A	Depth B	Depth D	Depth A	Depth B	Depth D
		(7-8 ft bls)	(15.2-19.2 ft bls)	(40-50 ft bls)	(8-9 ft bls)	(15-16 ft bls)	(39-40 ft bls)
Baseline[5]	8:50 AM	+0.0681	+0.0263	0.0061	-0.0188	-0.002	+0.0501
Steady State [12]	10:55 AM	-0.0065	0.0041	-3.498	-0.0079	-0.0074	-2.864
1 hr	12:18 PM	-0.0151 [9]	-0.0257	-3.477	-0.0095	-0.0105	-2.855
2 hr	1:23 PM	NM	NM	NM	NM	NM	NM
3 hr	1:57 PM	-0.0155	-0.0115 [6]	-3.406	-0.0147	+0.0023	-2.755
4 hr [3]	~3:20 PM	-0.0199	-0.0145	-3.392	-0.0105	+0.0015	-2.788
5 hr / 75% Changed at 4:12 PM	4:55 PM	-0.0162	-0.0008	-2.469	+0.0012	-0.0027	-2.009
6 hr / 50% Changed at 5:24 PM	~5:50 PM	-0.0084	-0.0112	-2.347	-0.0204	-0.0124	-1.928

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Table A-4. Pneumatic Conductivity Test, Depressurization Well 2-Deep Field Monitoring Parameters,
Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc)					
		Vacuum Points					
		VMWC-7	VMWC-7	VMWC-7	VMWC-8	VMWC-8	VMWC-8
		Radial Distance[1] 53 ft	Radial Distance[1] 53 ft	Radial Distance[1] 53 ft	Radial Distance[1] ~35 ft	Radial Distance[1] ~35 ft	Radial Distance[1] ~35 ft
		Depth A	Depth B	Depth D	Depth A	Depth B	Depth D
		(7-8 ft bls)	(14-15 ft bls)	(36-37 ft bls)	(7-8 ft bls)	(13-14 ft bls)	(35-36 ft bls)
Baseline[5]	9:26 AM	-0.0124	+0.0002 [6]	-0.0319	+0.0089	+0.0117	+0.0071
Steady State [12]	10:55 AM	-0.0164	-0.0187	-2.193	-0.0273	-0.0148	-2.613
1 hr	12:18 PM	-0.006	-0.0006 [7]	-2.163	-0.020	-0.0181	-2.600
2 hr	1:23 PM	NM	NM	NM	NM	NM	NM
3 hr	1:57 PM	-0.0013	-0.0019	-2.063	-0.0116	-0.0119	-2.475
4 hr [3]	~3:35 PM	-0.0120	-0.0184	-2.08	-0.0004	-0.0019	-2.556
5 hr / 75% Changed at 4:12 PM	4:55 PM	-0.0039	-0.0238	-1.498	-0.0099	-0.0101	-1.845
6 hr / 50% Changed at 5:24 PM	~5:50 PM	-0.0016	-0.012	-1.432	-0.0143	-0.0072	-1.783

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Table A-4. Pneumatic Conductivity Test, Depressurization Well 2-Deep Field Monitoring Parameters,
Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc) Vacuum Points			Water Level Measurements			Comments
		Monitoring Wells (if applicable)			Monitoring Wells (if applicable)			
		MW -__	MW - __	MW - ___	DW-2D Screen (27-47)	VMWC5-D Screen (40-50)	MW -___	
					DTW	DTW	DTW	
		(ft bmp)	(ft bmp)	(ft bmp)	(ft bls)	(ft bls)	(ft bls)	
Baseline	8:50 AM				Dry	NM		9:15 am calls from GWTT to troubleshoot skid system FM - run system start close influent valve Note: FM SCFM actually increased. 10:02 AM reading at DW-2D +0.0239 prior to start-up.
Steady State [12]	12:11 PM				Dry	49.9		
1 hr	12:18 PM					NM		
2 hr	1:23 PM					NM		Unable to take readings phone calls to office discussion of readings/vendor calls regarding FM. Jen Gasho 610-692-5650.
3 hr	1:57 PM					NM		Moisture Build-up on well head anemometer
4 hr [3]	~3:56 PM					NM		Vacuum Gauge for air sample was borrowed from IRM work - location SGP 11A 7.5-8 ft @ 1450.
5 hr / 75% Changed at 4:12 PM	4:55 PM					Dry		Carbon influent pressure indicator needle bouncing vigorously during reading.
6 hr / 50% Changed at 5:24 PM	~5:50 PM					NM		Carbon influent pressure indicator needle bouncing vigorously during reading. Barb on Effluent of well left open from 5 Hr reading until before VMWC-8 (last) readings.

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Table A-4. Pneumatic Conductivity Test, Depressurization Well 2-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Notes & Abbreviations:

1. Radial Distances for VMWCs 5-8 are measured from DW-2D.
2. + indicates increasing, - indicates decreasing
3. Air sample was collected in 6-liter suma canister and submitted to Columbia Analytical Labs, Rochester, New York for TO-15 analysis; 24 Hr. TAT requested. Pre-carbon sample was collected at test hour 4.
4. One water sample was collected from the moisture separator at the end of the test and was submitted (on 3/26) to Columbia Analytical Labs, Rochester, New York for VOC Analysis (ASP 2000) TO-15 analysis; 2 week TAT requested.
5. Initial measurement after start-up for wellhead vacuum.
6. Barb found loose on 5B during this reading
7. Readings varied +0.0010, -0.0153, +0.0034, -0.0081, 0.0146
8. Reading varying from - to +.
9. Readings varied -0.0152, -0.0174, -0.0147, -0.0203, -0.0230
10. Vacuum Gauge for air sample was borrowed from IRM work - location SGP 11A 7.5-8 ft @ 1450.
11. Carbon effluent end of day (5:38 PM) 91.8F and 21.0% RH.
12. Test started at 10:10 AM readings stabilized approximately 42 mins later.

DTW	depth to water
DW	Depressurization Well
fpm	feet per minute
ft. bls	feet below land surface
ft. bmp	feet below measuring point
in Hg	inches of mercury
iwc	inches of water column
PID	photoionization detector
ppm	parts per million
SCFM	standard cubic feet per minute
TOC	top of casing
VCS	vapor control system
VMWC	vacuum monitoring well cluster

Table A-5. Pneumatic Conductivity Test, Depressurization Well 3-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	DW-3S Wellhead Vacuum	DW-3S Wellhead Temperature	Wellhead Effluent PID	VCS Air Flow (10)	Post Knockout Vacuum	Blower Influent Vacuum	Blower Influent Temperature	Blower Effluent Pressure	Blower Effluent Temperature	Carbon Influent Pressure	Carbon Effluent Temperature	Carbon Effluent PID
		VI-1 (iwc)	Hand Held (F)	ASP-1 (ppm)	Manifold (scfm)	(iwc)	VI-3 (iwc)	TI-1 (F)	PI-1 (iwc)	TI-2 (F)	(iwc)	(F)	ASP-2 (ppm)
Baseline[5]	12:15 PM	-0.0109	72.5										
Steady State[11]	2:20 PM	-2.003	64.4	NM[6]	105	--	-61	NM	10	130	10	70	NM[5]
30 min	3:05 PM	-1.989	64.1	0.0	104	--	-60	70	10	146	10	90	3.1
1 hr	3:42 PM	-1.982	64.3	NM	104	--	-60	NM	10	NM	10	100	NM
2 hr	4:20 PM	-1.962	64.1	7.2	104	--	-60	70	10	148	10	100	0.7
3 hr[3]	5:35 PM	-2.012	63.9	9.2	104	--	-60	70	10	142	10	96	0.0
4 hr	6:54 PM	-2.065	63.7	11.1	104	--	-60.5	NM	10	140	10	90	4.2
5 hr / 75% Changed at 7:30 PM	8:00 PM	-1.490	63.5	NM[7]	77	--	-40	60	18	~ 120[8]	18	~ 88	3.0
6 hr / 50% Changed at 8:24PM	9:00 PM	-1.405	63.5	NM[7]	73	--	-36	55	20	NM[8]	20	80	NM

Initials:	PAR	Date: 6/13/07	(+/-)[2]
Barometric Pressure (inHg)			
Ambient Temperature (F)		71.6°F	RH = 90.5% @ 12:50 PM
Ambient Conditions		Overcast, cloudy; rain in AM	

% Dilution Valve opened at start of test	None
Total Volume of water collected from knockout tank[4]	0 Gallons

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Table A-5. Pneumatic Conductivity Test, Depressurization Well 3-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc)											
		Vacuum Points											
		VMWC-9			VMWC-10			VMWC-11			VMWC-12		
		Radial Distance[1]			Radial Distance[1]			Radial Distance[1]			Radial Distance[1]		
		(30.2 ft)	(34 ft)	N/A	N/A	(55.3 ft)	(58 ft)	N/A	(80.8 ft)	(83.9 ft)	N/A	N/A	(107.3 ft)
		Depth A	Depth B	Depth D	Depth A	Depth B	Depth D	Depth A	Depth B	Depth D	Depth A	Depth B	Depth D
		(6.3-7.3 ft bls)	(19.3-20.3 ft bls)	N/A	N/A	(18.8-19.8 ft bls)	(39-40 ft bls)	N/A	(19.2-20.2 ft bls)	(39.3-40.3 ft bls)	N/A	N/A	(39.2-40.2 ft bls)
Baseline[5]	12:15 PM	-0.0018	0.0062			0.0032	0.0089		0.0047	NM			NM
Steady State[11]	2:20 PM	-0.3706	-0.3651			-0.2893	-0.2136		-0.1704	-0.1464			-0.0933
30 min	3:05 PM	-0.3499	-0.3688			-0.2330	-0.2021		-0.1470	-0.1269			-0.1062
1 hr	3:50 PM	-0.3581	-0.3660			-0.2506	-0.2209		-0.1725	-0.1614			-0.1076
2 hr	4:23 PM	-0.3491	-0.3424			-0.2374	-0.2158		-0.1726	-0.1599			-0.1162
3 hr[3]	5:35 PM	-0.3839	-0.3754			-0.2606	-0.2315		-0.1936	-0.1705			-0.1091
4 hr	7:04 PM	-0.3652	-0.3644			-0.2586	-0.2217		-0.1944	-0.1787			-0.1111
5 hr / 75% Changed at 7:30 PM	8:00 PM	-0.2664	-0.2649			-0.1951	-0.1745		-0.1818	-0.1389			-0.1268
6 hr / 50% Changed at 8:24PM	9:00 PM	-0.2873	-0.2862			-0.1893	-0.1891		-0.1588	-0.1567			-0.1002

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Table A-5. Pneumatic Conductivity Test, Depressurization Well 3-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings	Water Level Measurements	Comments
		Monitoring Well	Monitoring Well	
		B24MW-3[6]	B24MW-3	
		Radial Distance[1] 182.4 ft	Radial Distance[1] 182.4 ft	
		Screened (55-70 ft bls)	Screened (55-70 ft bls)	
		(iwc)	DTW (ft bmp)	
Baseline[5]	12:15 PM	NM	53.36	Depth to water 53.92 ' below land surface.
Steady State[11]	2:20 PM	NM	NM	
30 min	3:05 PM	NM	NM	w/o Filter: 7.8
1 hr	3:50 PM	NM	NM	
2 hr	4:23 PM	NM	NM	Finished this round measurements 4:52pm.
3 hr[3]	5:35 PM	NM	NM	DW-3S air sample at 6:15pm.
4 hr	7:04 PM	0.0000[9]	NM	
5 hr / 75% Changed at 7:30 PM	8:00 PM	0.0000[9]	NM	Influent PID reading to dilution valve 1.3 ppm; Top of casing for well B24MW-3 cracked, seal may not be good.
6 hr / 50% Changed at 8:24PM	9:00 PM	NM	NM	

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Table A-5. Pneumatic Conductivity Test, Depressurization Well 3-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Notes & Abbreviations:

1. Radial Distances for VMWCs 9-11 and B24MW-3 are measured from DW-3S and taken from survey done by Nelson & Pope on July 25, 2007.
2. + indicates increasing, - indicates decreasing
3. Air sample was collected in 6-liter suma canister and submitted to Columbia Analytical Labs, Rochester, New York for TO-15 analysis; 24 Hr. TAT requested. Pre-carbon sample was collected at 6:15pm.
4. Water was not generated during this event therefore, water sample was not collected or submitted for analysis.
5. Initial measurement after start-up for wellhead vacuum.
6. Generator not working so vacuum pump could not be started. No PID measurements for steady state.
7. Vacuum pump not available, no further influent PID measurements taken.
8. Could not read gauge clearly due to moisture accumulation on glass.
9. Induced vacuum at well B24MW-3 not applicable to test - entire well screen submerged.
10. VCS Flow readings taken from manifold have been reduced by 9 SCFM due to technical error in field.
11. Test started at 2:15 PM readings stabilized 5 minutes later.

DTW	depth to water
DW	Depressurization Well
fpm	feet per minute
ft. bls	feet below land surface
ft. bmp	feet below measuring point
in Hg	inches of mercury
iwc	inches of water column
PID	photoionization detector
ppm	parts per million
SCFM	standard cubic feet per minute
TOC	top of casing
VCS	vapor control system
VMWC	vacuum monitoring well cluster

Table A-6. Pneumatic Conductivity Test, Depressurization Well 3-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	DW-3D Wellhead Vacuum	DW-3D Wellhead Temperature	Wellhead Effluent PID	VCS Air Flow (8)	Post Knockout Tank Vacuum	Blower Influent Vacuum	Blower Influent Temperature	Blower Effluent Pressure	Blower Effluent Temperature	Carbon Influent Pressure	Carbon Effluent Pressure	Carbon Effluent Temperature	Carbon Effluent PID
		VI-1 (iwc)	Hand Held (F)	ASP-1 (ppm)	Manifold (scfm)	(iwc)	VI-3 (iwc)	TI-1 (F)	PI-1 (iwc)	TI-2 (F)	PI-1 (iwc)	(iwc)	(F)	ASP-2 (ppm)
Baseline[5]	11:48 AM	-0.0063	71.5											
Steady State	11:56 AM	-2.562	65.2	5.8	105		-62	60	10	142	10	5	90	0.0
30 min	12:30 PM	-2.619	63.5	6.8	103		-61	68	10	142	10	5	90	0.0
1 hr[5]	1:00 PM	-2.436	63.5	7.0	104	--	-61	68	10	144	10	5	94	0.0
2 hr	2:00 PM	-2.613	63.4	NM	104	--	-61	70	10	146	10	5	96	0.0
3 hr	3:00 PM	-2.569	63.4	17.4	102	--	-61	70	10	146	10	5	96	0.3
4 hr[3]	4:40 PM	-2.635	63.4	14.3	102	--	-61	73	10	~146	10	5	98	0.0
5 hr / 75% Changed at 5:30 pm[7]	6:00 PM	-1.897	63.5	14.4	75	--	-39	NM	18	130	16	8	98	0.0
6 hr / 50% Changed at 6:17 pm	6:47 PM	-1.753	63.5	14.6	71	--	-34	NM	19	128	19	NM	NM	NM

Initials:	PAR	Date: 6/14/07	(+/-)[2]
Barometric Pressure (inHg)			
Ambient Temperature (F) -- 11:59 AM		68°F	RH = 59.7%
Ambient Conditions			Overcast, Breezy, Dark

% Dilution Valve opened at start of test	None
Total Volume of water collected from knockout tank[4]	0 Gallons

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Table A-6. Pneumatic Conductivity Test, Depressurization Well 3-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc)											
		Vacuum Points											
		VMWC-9			VMWC-10			VMWC-11			VMWC-12		
		Radial Distance[1]			Radial Distance[1]			Radial Distance[1]			Radial Distance[1]		
		25.2	29	N/A	N/A	50.3	53	N/A	75.8	79	N/A	N/A	102.3
		Depth A	Depth B	Depth D	Depth A	Depth B	Depth D	Depth A	Depth B	Depth D	Depth A	Depth B	Depth D
		(6.3-7.3 ft bls)	(19.3-20.3 ft bls)	N/A	N/A	(18.8-19.8 ft bls)	(39-40 ft bls)	N/A	(19.2-20.2 ft bls)	(39.3-40.3 ft bls)	N/A	N/A	(39.2-40.2 ft bls)
Baseline[5]	Early AM	-0.0193	0.0013			0.0215	0.0206		-0.004	0.0013			-0.0092
Steady State	--	-0.2903	-0.3230			-0.2414	-0.2306		-0.1799	-0.1813			-0.1245
30 min	--	-0.2728	-0.3094			-0.2308	-0.2298		-0.1651	-0.1082			-0.1084
1 hr[6]	1:20 PM	-0.2611	-0.2888			-0.2103	-0.1876		-0.1471	-0.1498			-0.1309
2 hr	2:25 PM	-0.2769	-0.3155			-0.2333	-0.2315		-0.1605	-0.1560			-0.1151
3 hr	--	-0.2755	-0.3134			-0.2322	-0.2265		-0.1696	-0.1634			-0.1198
4 hr[3]	--	-0.3085	-0.3418			-0.2541	-0.2545		-0.1765	-0.1669			-0.1140
5 hr / 75% Changed at 5:30 pm[7]	--	-0.2064	-0.2333			-0.1770	-0.1390		-0.1238	-0.1117			-0.0855
6 hr / 50% Changed at 6:17 pm	--	-0.2102	-0.2384			-0.1924	-0.1982		-0.1414	-0.1193			-0.0940

Notes on last page

Table A-6. Pneumatic Conductivity Test, Depressurization Well 3-Deep Field Monitoring Parameters,
Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings		Water Level Measurements		Comments
		Monitoring Well	Depressurization Well	Monitoring Wells	Depressurization Well	
		B24MW-3 [10]	DW-3S	B24MW-3	DW-3D	
		Radial Distance 177.6 ft	Radial Distance 5 ft	Radial Distance 177.6 ft	Radial Distance 0 ft	
		Screened (55-70 bls)	Screened (10-30)	Screened (55-70 bls)	Screened (26-46)	
		(iwc)	(iwc)	DTW (ft bmp)	DTW (ft bmp)	
Baseline[9]	Early AM	0.0001[10]	NM	53.52	Dry	
Steady State	--	0.0001[10]	NM	53.50	NM	
30 min	1:00 PM	0.0002[10]	NM	53.51	Dry	
1 hr [6]	1:40 PM	0.0001[10]	-0.4588	53.51	NM	
2 hr	--	0. 0000[10]	-0.4792	53.51	NM	
3 hr	--	-0.0001[10]	-0.4630	NM	Dry	
4 hr [3]	4:30 PM	NM	-0.5016	NM	NM	
5 hr / 75% Changed at 5:30 pm [7]	--	NM	-0.3538	NM	NM	
6 hr / 50% Changed at 6:17 pm	--	NM	-0.3452	NM	NM	

Notes on last page

Table A-6. Pneumatic Conductivity Test, Depressurization Well 3-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Notes & Abbreviations:

1. Radial Distances for VMWCs 9-12 and B24MW-3 are measured from DW-3D and taken from survey done by Nelson & Pope on July 25, 2007.
2. + indicates increasing, - indicates decreasing
3. Air sample was collected in 6-liter suma canister and submitted to Columbia Analytical Labs, Rochester, New York for TO-15 analysis; 24 Hr. TAT requested. Pre-carbon sample was collected at 5:20pm.
4. Water was not generated during this event therefore, water sample was not collected or submitted for analysis.
5. Initial measurement after start-up for wellhead vacuum.
6. Vacuum measurements taken with water level indicator access port open.
7. Post-carbon air sample was taken at 6:15pm, collected in 6-liter suma canister and submitted to Columbia Analytical Labs, Rochester, New York for TO-15 analysis; 24 Hr. TAT requested.
8. VCS Flow readings taken from manifold have been reduced by 9 SCFM due to technical error in field.
9. Vacuum readings for all but well head were taken early am prior to start of test.
10. Induced vacuum at well B24MW-3 not applicable to test - entire well screen submerged. TOC was damaged and almost level with cement seal so fitting PVC cap over casing may not provide adequate seal in the future.

DTW	depth to water
DW	Depressurization Well
fpm	feet per minute
ft. bls	feet below land surface
ft. bmp	feet below measuring point
in Hg	inches of mercury
iwc	inches of water column
PID	photoionization detector
ppm	parts per million
SCFM	standard cubic feet per minute
TOC	top of casing
VCS	vapor control system
VMWC	vacuum monitoring well cluster

Table A-7. Pneumatic Conductivity Calculation Summary Table, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds Bethpage, New York.

Pneumatic Conductivity [1,2]			
Depressurization Well		Depressurization Well	
DW-1S [3]		DW-2S [4]	
Between VMWC-1C and VMWC-2C	1.35×10^{4}	Between VMWC-5B and VMWC-6B	3.15×10^{5}
Between VMWC-1C and VMWC-3C	8.00×10^{5}	Between VMWC-5B and VMWC-7B	3.36×10^{5}
Between VMWC-2C and VMWC-3C	5.43×10^{5}	Between VMWC-6B and VMWC-7B	3.70×10^{5}
Average:	8.98×10^{5}	Average:	3.41×10^{5}
DW-1S [3]		DW-2S [4]	
Between VMWC-1C and VMWC-4C	7.95×10^{5}	Between VMWC-5B and VMWC-8B	3.66×10^{5}
Between VMWC-2C and VMWC-4C	3.75×10^{5}	Between VMWC-6B and VMWC-8B	6.58×10^{5}
Between VMWC-4C and VMWC-3C	8.16×10^{5}	Between VMWC-8B and VMWC-7B	2.62×10^{5}
Average:	6.62×10^{5}	Average:	4.29×10^{5}
DW-1D [3]		DW-2D [4]	
Between VMWC-1D and VMWC-2D	1.38×10^{5}	Between VMWC-5D and VMWC-6D	1.68×10^{5}
Between VMWC-1D and VMWC-3D	1.52×10^{5}	Between VMWC-5D and VMWC-7D	1.42×10^{5}
Between VMWC-2D and VMWC-3D	1.70×10^{5}	Between VMWC-6D and VMWC-7D	1.19×10^{5}
Average:	1.53×10^{5}	Average:	1.43×10^{5}
DW-1D [3]		DW-2D [4]	
Between VMWC-1D and VMWC-4D	1.12×10^{5}	Between VMWC-5D and VMWC-8D	1.57×10^{5}
Between VMWC-2D and VMWC-4D	6.82×10^{6}	Between VMWC-6D and VMWC-8D	1.27×10^{5}
Between VMWC-4D and VMWC-3D	5.00×10^{5}	Between VMWC-8D and VMWC-7D	1.15×10^{5}
Average:	2.27×10^{5}	Average:	1.33×10^{5}
DW-3S [3]		DW-3D [3]	
Between VMWC-9B and VMWC-10B	2.95×10^{5}	Between VMWC-10D and VMWC-11D	3.98×10^{5}
Between VMWC-9B and VMWC-11B	3.26×10^{5}	Between VMWC-10D and VMWC-12D	3.87×10^{5}
Between VMWC-10B and VMWC-11B	3.78×10^{5}	Between VMWC-11D and VMWC-12D	3.73×10^{5}
Average:	3.33×10^{5}	Average:	3.86×10^{5}

Notes & Abbreviations:

1. Pneumatic conductivity values shown based on data collected during tests conducted the week of March 19 and June 11, 2007. Data interpreted using "Soil Vapor Extraction System Design Calculation Method" by ARCADIS.
2. Units of values shown are in seconds.
3. Pneumatic conductivity calculated using air flow measurements collected with a variable area flow meter.
4. Pneumatic conductivity calculated using air flow measurements collected with a hand-held anemometer.

DW depressurization well
VMWC vapor monitoring well cluster

Table A-7. Pneumatic Conductivity Calculation Summary Table, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Evaluation of Pneumatic Conductivity Test Data Depressurization Well 1S with Manifold (Variable Area Flowmeters),

Factor of Safety on Flow =	1	Based on pilot test data.
Acceleration due to Gravity	980	cm/sec^2

Parameter	Value	Units	Basis
		Input Parameters	
Air Flow	-94	scfm	Flow is Negative for Vacuum; Air flow reading from VA meters during 100% flow with manifold in line.
Distance From Vacuum Well to Inner Point	10.00	feet	Inner Point = VMWC-1C
Distance From Vacuum Well to Outer Point	25.00	feet	Outer Point = VMWC-2C
Vadose Zone Thickness	15.00	feet	Screened Interval
Vacuum at Inner Poiot(1C)	0.29420	in. H2O	Vacuum reading at 7 hrs.
Vacuum at Outer Point(2C)	0.24000	in. H2O	Vacuum reading at 7 hrs.
		Output Parameters	
Air Flow	-96.94	ft^3/min	Assumes temp 52F blower inlet temp; P=P
Air Mass Flow (Q)	-57.15	grams/sec	Assumes air density = 1.25 g/L
Distance From Vacuum Well to Inner Point	304.80	cm	
Distance From Vacuum Well to Outer Point	762.00	cm	
Vadose Zone Thickness	457.20	cm	
Vacuum at Inner Point	732.26	grams/cm-sec^2	
Vacuum at Outer Point	597.36	grams/cm-sec^2	
Pressure Drop Over Interval	134.90	grams/cm-sec^2	
Pneumatic Conductivity (Kair)	**1.35E-04**	sec	
	1.32E-01	cm/s	Kair * g
Effective Air Permeability (kair)	**1.88E-05**	cm^2	
Intrinsic Permeability (kiot)	**2.58E-05**	cm^2	Assumes fraction of soil volume occupied by water is equal to 10% of the porosity
Hydraulic Conductivity (Kwater)	**1.81E+00**	cm/s	

$$Q(b, ER) = \frac{ER \cdot \pi \cdot (b^2 - a^2) \cdot h \cdot \eta \cdot \rho_{air}}{1440 \cdot 60}$$

$ER = Pore_Volume_Exchange_Rate_(g/\sec)$

$b = Radial_Dis\tan ce_to_Outter_Monitoring_Po\text{int}_(cm)$

$a = Radia_Dis\tan ce_to_Inner_Monitoring_Po\text{int}_(cm)$

$h = Vadose_Zon\bar{e}Thickness$

$b = Dis\tan ce_From_Vacuum_to_Outter_Monitoring_Po\text{int}\ (ft)$

$$k_{air} = \frac{K_{air} \cdot \mu_{air}}{\rho_{air} \cdot g}$$

$\mu_{air} = Vis\cos ity_Air_10^oC$

$\rho_{air} = Density_Air_10^oC$

$g = Acceleration_due_to_gravity$

$$k_{int} = \frac{k_{air}}{\left(n - S_w/n\right)^3}$$

$n = Porosity$

$S_w = Fraction_of_soil_volume_occupied_by_water$

$$K_{water} = \frac{k_{int} \cdot \rho_{water} \cdot g}{\mu_{water}}$$

$\rho_{water} = Density_Water_10^oC$

$g = Acceleration_due_to_gravity$

$\mu_{water} = Vis\cos ity_Water_10^oC$

Table A-8. Summary of Vapor Analytical Results, Pneumatic Conductivity Tests, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

CONSTITUENT (ug/m^3)	Site ID: Sample ID: Sample Date:	DW-2S PCT ASP-1 3/20/2007	DW-2D DW-2D INF 3/21/2007	DW-1S DW1S 3/22/2007	DW-1D DWID 3/23/2007
Volatile Organic Compounds	**CAS Number**				
1,1,1-Trichloroethane	71-55-6	**1.4**	**59**	54	**88**
1,1,2,2-Tetrachloroethane	79-34-5	< 0.15	< 1.3	< 4.1	< 4.2
1,1,2-Trichloroethane	79-00-5	< 0.6	< 5.3	< 16	< 17
1,1-Dichloroethane	75-34-3	< 0.45	< 3.9	< 12	< 12
1,1-Dichloroethylene	75-35-4	**1.5**	< 3.9	< 12	**18**
1,2-Dichloroethane	107-06-2	< 0.45	< 3.9	< 12	< 12
1,2-Dichloropropane	78-87-5	< 0.51	< 4.5	< 14	< 14
1,3-Butadiene	106-99-0	< 0.49	< 4.3	< 13	< 14
2-Butanone	78-93-3	**35 D**	**49**	**47**	**42**
4-Methyl-2-Pentanone	108-10-1	< 0.9	< 8	< 24	< 25
Acetone	67-64-1	**8.4**	< 11	< 32	< 33
Benzene	71-43-2	< 0.35	< 3.1	< 9.5	< 9.8
Bromodichloromethane	75-27-4	< 0.15	< 1.3	< 4	< 4.1
Bromomethane	74-83-9	< 0.43	< 3.8	< 12	< 12
Carbon Disulfide	75-15-0	< 0.34	< 3	< 9.2	< 9.5
Carbon Tetrachloride	56-23-5	< 0.14	< 1.2	**31**	**40**
Trichlorofluoromethane (CFC-11)	75-69-4	**1.1**	32	< 17	< 17
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	**0.46**	**4.8**	**17**	**45**
Chlorobenzene	108-90-7	< 0.51	< 4.5	< 14	< 14
Chlorodibromomethane	124-48-1	< 0.19	< 1.7	< 5.1	< 5.2
Chloroethane	75-00-3	< 0.58	< 5.1	< 16	< 16
Chloroform	67-66-3	**0.68**	< 4.8	< 14	22
Chloromethane	74-87-3	< 0.45	< 4	< 12	< 13
cis-1,2-Dichloroethene	156-59-2	**630 D**	**83**	**130**	36
cis-1,3-Dichloropropene	10061-01-5	< 1	< 8.9	< 27	< 28
Dichloromethane	75-09-2	< 0.38	< 3.4	< 10	< 11
Ethylbenzene	100-41-4	< 0.95	< 8.5	< 26	< 27
m,p-Xylenes	NA	**2.3**	< 17	**68**	< 53
Methyl n-Butyl Ketone	591-78-6	< 0.45	< 4	< 12	< 13
Methyl tert-Butyl Ether	1634-04-4	< 0.79	< 7	< 21	< 22
Methylbenzene	108-88-3	**1.5**	< 3.7	**59**	< 12
o-Xylene	95-47-6	**1.1**	< 8.5	**28**	< 27
Styrene	100-42-5	< 0.94	< 8.3	< 25	< 26
Tetrachloroethene	127-18-4	**9.5**	**25**	**44**	**83**
trans-1,2-Dichloroethene	156-60-5	< 0.44	< 3.9	< 12	< 12
trans-1,3-Dichloropropene	10061-02-6	< 0.5	< 4.4	< 13	< 14
Tribromomethane	75-25-2	< 1.1	< 10	< 31	< 32
Trichloroethylene	79-01-6	**140 D**	**390**	**840**	**1,600 D**
Vinyl Chloride	75-01-4	**3.1**	< 5	**28**	**33**
Total VOCs [2]		**836.0**	**642.8**	**1,346**	**2,007**

Notes & Abbreviations:

1. Analytical results for system carbon effluent, for March 2007 are not consistent with system influents and are attributable to regenerated carbon supplied by vendor.
2. "Total VOCs" represents the sum of individual concentrations of constituents listed in this table.

Bold	detected compound
<	less than MDL
ASP	air sample port
C EFF	effluent from vapor extraction pilot system carbon
CAS	Chemical Abstracts Service Registry Number
D	concentrations identified from analysis of the sample at a secondary dilution
DW	depressurization well
INF	influent to vapor extraction pilot system
J	estimated value
PCT	pneumatic conductivity test
ug/m^3	microgram per meter cubed
VOCs	volatile organic compounds

Table A-8. Summary of Vapor Analytical Results, Pneumatic Conductivity Tests, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

CONSTITUENT (ug/m³)	Site ID: / Sample ID: / Sample Date:	Carbon Effluent Day 4 [1] DWID-C EFF 3/23/2007	DW-3S DW-3S-20070613 6/13/2007	DW-3D DW-3D-20070614 6/14/2007	Carbon Effluent CARBON EFF-20070614 6/14/2007
Volatile Organic Compounds	**CAS Number**				
1,1,1-Trichloroethane	71-55-6	< 800	**660**	**720**	< 17
1,1,2,2-Tetrachloroethane	79-34-5	< 200	< 3.7	< 4.4	< 4.2
1,1,2-Trichloroethane	79-00-5	< 800	< 15	< 18	< 17
1,1-Dichloroethane	75-34-3	< 590	**170**	**220**	< 12
1,1-Dichloroethylene	75-35-4	< 580	< 11	< 13	< 12
1,2-Dichloroethane	107-06-2	< 590	< 11	< 13	< 12
1,2-Dichloropropane	78-87-5	< 680	< 13	< 15	< 14
1,3-Butadiene	106-99-0	< 650	< 12	< 14	< 14
2-Butanone	78-93-3	< 860	**49**	< 19	< 18
4-Methyl-2-Pentanone	108-10-1	< 1200	< 22	< 26	< 25
Acetone	67-64-1	**11,000 J**	**130 J**	**53**	< 33
Benzene	71-43-2	< 470	< 8.6	< 10	< 9.8
Bromodichloromethane	75-27-4	< 200	< 3.6	< 4.3	< 4.1
Bromomethane	74-83-9	< 570	< 11	< 13	< 12
Carbon Disulfide	75-15-0	< 460	< 8.4	< 10	< 9.5
Carbon Tetrachloride	56-23-5	< 180	< 3.4	< 4.1	< 3.8
Trichlorofluoromethane (CFC-11)	75-69-4	< 820	**21**	**21**	< 17
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	< 220	**21**	**27**	< 4.7
Chlorobenzene	108-90-7	< 670	< 12	< 15	< 14
Chlorodibromomethane	124-48-1	< 250	< 4.6	< 5.5	< 5.2
Chloroethane	75-00-3	< 770	< 14	< 17	< 16
Chloroform	67-66-3	< 710	**71**	**75**	< 15
Chloromethane	74-87-3	< 600	< 11	< 13	< 13
cis-1,2-Dichloroethene	156-59-2	< 580	**8,800 D**	**17,000 D**	< 12
cis-1,3-Dichloropropane	10061-01-5	< 1300	< 25	< 29	< 28
Dichloromethane	75-09-2	< 510	< 9.4	< 11	< 11
Ethylbenzene	100-41-4	< 1300	< 23	< 28	< 27
m,p-Xylenes	NA	< 2500	< 47	< 56	< 53
Methyl n-Butyl Ketone	591-78-6	< 600	< 11	< 13	< 13
Methyl tert-Butyl Ether	1634-04-4	**85,000 D**	< 20	< 23	< 22
Methylbenzene	108-88-3	< 550	**270**	**40**	< 12
o-Xylene	95-47-6	< 1300	< 23	< 28	< 27
Styrene	100-42-5	< 1200	< 23	< 28	< 26
Tetrachloroethene	127-18-4	< 200	**570**	**800**	< 4.1
trans-1,2-Dichloroethene	156-60-5	< 580	**330**	**430**	< 12
trans-1,3-Dichloropropene	10061-02-6	< 660	< 12	< 15	< 14
Tribromomethane	75-25-2	< 1500	< 28	< 33	< 32
Trichloroethylene	79-01-6	< 160	**39,000 D**	**65,000 D**	< 3.3
Vinyl Chloride	75-01-4	< 750	< 14	< 17	< 16
Total VOCs [2]		**96,000**	**50,092**	**84,386**	**0**

Notes & Abbreviations:

1. Analytical results for system carbon effluent, for March 2007 are not consistent with system influents and are attributable to regenerated carbon supplied by vendor.
2. "Total VOCs" represents the sum of individual concentrations of constituents listed in this table.

Bold	detected compound
<	less than MDL
ASP	air sample port
C EFF	effluent from vapor extraction pilot system carbon
CAS	Chemical Abstracts Service Registry Number
D	concentrations identified from analysis of the sample at a secondary dilution
DW	depressurization well
INF	influent to vapor extraction pilot system
J	estimated value
PCT	pneumatic conductivity test
ug/m³	microgram per meter cubed
VOCs	volatile organic compounds

Table A-9. Summary of Analytical Results for Collected Condensate[1], Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

CONSTITUENT (ug/m^3)	Site ID: Sample ID: Sample Date:	DW2D-Condensate DW2D-KO-20070321 3/21/2007
Volatile Organic Compounds	**CAS Number**	
1,1,1-Trichloroethane	71-55-6	< 5
1,1,2,2-Tetrachloroethane	79-34-5	< 5
1,1,2-Trichloroethane	79-00-5	< 5
1,1-Dichloroethane	75-34-3	< 5
1,1-Dichloroethlene	75-35-4	< 5
1,2-Dichloroethane	107-06-2	< 5
1,2-Dichloropropane	78-87-5	< 5
2-Butanone	78-93-3	< 50
4-Methyl-2-Pentanone	108-10-1	< 50
Acetone	67-64-1	< 50
Benzene	71-43-2	< 0.7
Bromodichloromethane	75-27-4	< 5
Bromomethane	74-83-9	< 5
Carbon Disulfide	75-15-0	< 50
Carbon Tetrachloride	56-23-5	< 5
Freon 12	75-71-8	< 5
Freon 22	75-45-6	< 5
Freon 113	76-13-1	< 5
Chlorobenzene	108-90-7	< 5
Chlorodibromomethane	124-48-1	< 5
Chloroethane	75-00-3	< 5
Chloroform	67-66-3	< 7
Chloromethane	74-87-3	< 5
cis-1,2-Dichloroethene	156-59-2	< 5
cis-1,3-Dichloropropene	10061-01-5	< 5
Dichloromethane	75-09-2	< 5
Ethylbenzene	100-41-4	< 5
m,p-Xylenes	NA	< 5
Methyl n-Butyl Ketone	591-78-6	< 50
Methylbenzene	108-88-3	< 5
o-Xylene	95-47-6	< 5
Styrene	100-42-5	< 5
Tetrachloroethene	127-18-4	< 5
trans-1,2-Dichloroethene	156-60-5	< 5
trans-1,3-dichloropropene	10061-02-6	< 5
Tribromomethane	75-25-2	< 5
Trichloroethlene	79-01-6	< 5
Vinyl Chloride	75-01-4	< 2

Note & Abbreviations:

1. Only one well of six produced condensate during pneumatic conductivity testing therefore, one water sample was collected.

< less than MDL
CAS chemical abstracts service registry number
DW depressurization well
KO knockout tank
ug/m^3 micrograms per cubic meter
NA not applicable

ARCADIS

Appendix B

Design Calculations

Table B-1. Data Evaluation for Extraction Well DW-1S, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Assumptions -

Well Screen Length (feet) -	15
Well Diameter (feet) -	0.33
Formation Porosity (v/v) -	0.25
Percent Moisture (%) -	10%

Distance-Drawdown Relationships -

Distance (Feet)	Observed/Calculated Vacuum (Drawdown - IWC) @ Air Flow (SCFM)					
	250 SCFM	210 SCFM	200 SCFM	150 SCFM	94 SCFM	82 SCFM
10	-0.81	-0.68	-0.65	-0.49	**-0.29**	-0.27
25	-0.56	-0.47	-0.45	-0.34	**-0.24**	-0.18
35	-0.47	-0.40	-0.38	-0.28	**-0.17**	-0.16
55	-0.35	-0.29	-0.28	-0.21	**-0.12**	-0.12
70	-0.29	-0.24	-0.23	-0.17	-0.11	-0.09
85	-0.23	-0.20	-0.19	-0.14	-0.09	-0.08
100	-0.19	-0.16	-0.15	-0.11	-0.07	-0.06
115	-0.15	-0.13	-0.12	-0.09	-0.06	-0.05
130	-0.12	-0.10	-0.10	-0.07	-0.04	-0.04
145	-0.09	-0.08	-0.07	-0.05	-0.03	-0.03
160	-0.06	-0.05	-0.05	-0.04	-0.02	-0.02
175	-0.04	-0.03	-0.03	-0.02	-0.01	-0.01
190	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01
205	0.00	0.00	0.00	0.00	0.00	0.00

Data Analysis -

Parameter	Value @ Air Flow (SCFM)					
	250	210	200	150	94	82
R^2	NA	NA	NA	NA	0.938092222	NA
Slope	0.620337699	0.521083667	0.496270159	0.372202619	0.233246975	0.203470765
y-intercept	-1.430648793	-1.201744986	-1.144519035	-0.858389276	-0.537923946	-0.469252804
Maximum ROI (Feet)	202	202	202	202	202	202
Observed Well Efficiency (%)	NA	NA	NA	NA	22%	NA
Design Parameters -						
Desired Minimum Vacuum (IWC)	0.1	0.1	0.1	0.1	0.1	0.1
ROI @ Minimum Vacuum (feet)	140	130	127	109	75	65
Pore Volume Exchange (per day)	1.74	1.68	1.68	1.71	2.24	2.61
Pore Volume Exchange (per week)	12.19	11.79	11.74	11.99	15.71	18.29
Required Wellhead Vacuum (IWC)	-6.553	-5.505	-5.243	-3.932	-2.464	-2.149

Notes/Formulas -

1. Values in BOLD represent field data. Values in regular font represent calculated values based on distance-drawdown relationship.
2. Field data used is from Depth C for each location during Hr 7 VCS Test on 3/22/07.
3. Maximum ROI (feet) based on minimum ROI during VCS Test.
4. Boxed solid line values represent selected design assumptions for wells DW-1S, DW-4S, DW-5S & DW-6S.

Table B-1. Data Evaluation for Extraction Well DW-1S, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

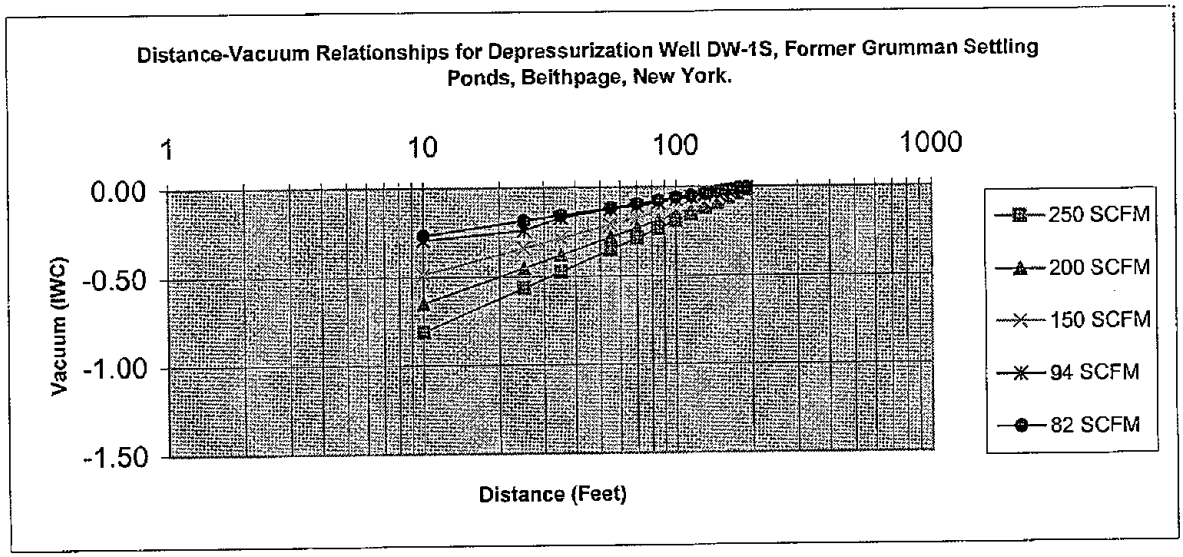

Table B-2. Data Evaluation for Extraction Well DW-2S, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Assumptions -

Well Screen Length (feet) -	7
Well Diameter (feet) -	0.33
Formation Porosity (v/v) -	0.25
Percent Moisture (%) -	10%

Distance-Drawdown Relationships -

Distance (Feet)	Observed/Calculated Vacuum (Drawdown - IWC) @ Air Flow (SCFM)						
	250 SCFM	200 SCFM	146 SCFM	105 SCFM	98 SCFM	66 SCFM	45 SCFM
10	-3.24	-2.60	**-1.94**	**-1.39**	**-1.28**	-0.86	-0.58
25	-1.83	-1.46	**-1.03**	**-0.73**	**-0.67**	-0.48	-0.33
35	-1.31	-1.05	**-0.87**	**-0.63**	**-0.56**	-0.35	-0.24
50	-0.76	-0.61	**-0.44**	**-0.36**	**-0.29**	-0.20	-0.14
53	-0.67	-0.54	-0.41	-0.32	-0.26	-0.18	-0.12
56	-0.59	-0.47	-0.36	-0.29	-0.23	-0.15	-0.11
59	-0.51	-0.40	-0.32	-0.26	-0.20	-0.13	-0.09
61	-0.45	-0.36	-0.29	-0.23	-0.18	-0.12	-0.08
64	-0.38	-0.30	-0.24	-0.20	-0.15	-0.10	-0.07
67	-0.31	-0.25	-0.20	-0.18	-0.12	-0.08	-0.06
70	-0.24	-0.19	-0.16	-0.15	-0.10	-0.06	-0.04
73	-0.18	-0.14	-0.12	-0.12	-0.07	-0.05	-0.03
76	-0.12	-0.09	-0.09	-0.10	-0.05	-0.03	-0.02
79	-0.06	-0.04	-0.05	-0.07	-0.02	-0.01	-0.01
81	-0.02	-0.01	-0.03	-0.06	-0.01	0.00	0.00
82	0.00	0.00	-0.02	-0.05	0.00	0.00	0.00
84	0.04	0.03	0.00	-0.03	0.02	0.01	0.01
87	0.09	0.07	0.04	-0.01	0.04	0.02	0.02
88	0.11	0.09	0.05	0.00	0.04	0.03	0.02
90	0.15	0.12	0.07	0.01	0.06	0.04	0.03

Data Analysis -

Parameter	Value @ Air Flow (SCFM)						
	250	200	146	105	98	66	45
R^2	NA	NA	0.990491182	0.989758068	0.990417317	NA	NA
Slope	3.551931862	2.84154549	2.086797	1.447112903	1.39235729	0.937710012	0.63934774
y-intercept	-6.79608222	-5.436865776	-4.012268706	-2.818408033	-2.66406423	-1.794165706	-1.2232948
Maximum ROI (Feet)	82	82	84	89	82	82	82
Observed Well Efficiency (%)	NA	NA	45%	46%	48%	NA	NA
Design Parameters -							
Desired Minimum Vacuum (IWC)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
ROI @ Minimum Vacuum (feet)	77	76	75	76	69	64	57
Pore Volume Exchange (per day)	12.34	10.20	7.56	5.35	5.92	4.68	4.01
Pore Volume Exchange (per week)	86.41	71.41	52.95	37.43	41.42	32.75	28.08
Required Wellhead Vacuum (IWC)	-14.555	-11.644	**-8.867**	**-6.071**	**-5.504**	-3.843	-2.620

Notes/Formulas -

1. Values in BOLD represent field data. Values in regular font represent calculated values based on distance-drawdown relationship.
2. Field data used is from Depth B for each location during Hrs 4, 5 & 6 of VCS Test on 3/20/07.
3. Maximum ROI (feet) based on minimum ROI during VCS Test.
4. Boxed solid line values represent selected design assumptions for Well DW-2S, DW-8S, DW-9S, DW-10S, DW-11S.

Table B-2. Data Evaluation for Extraction Well DW-2S, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

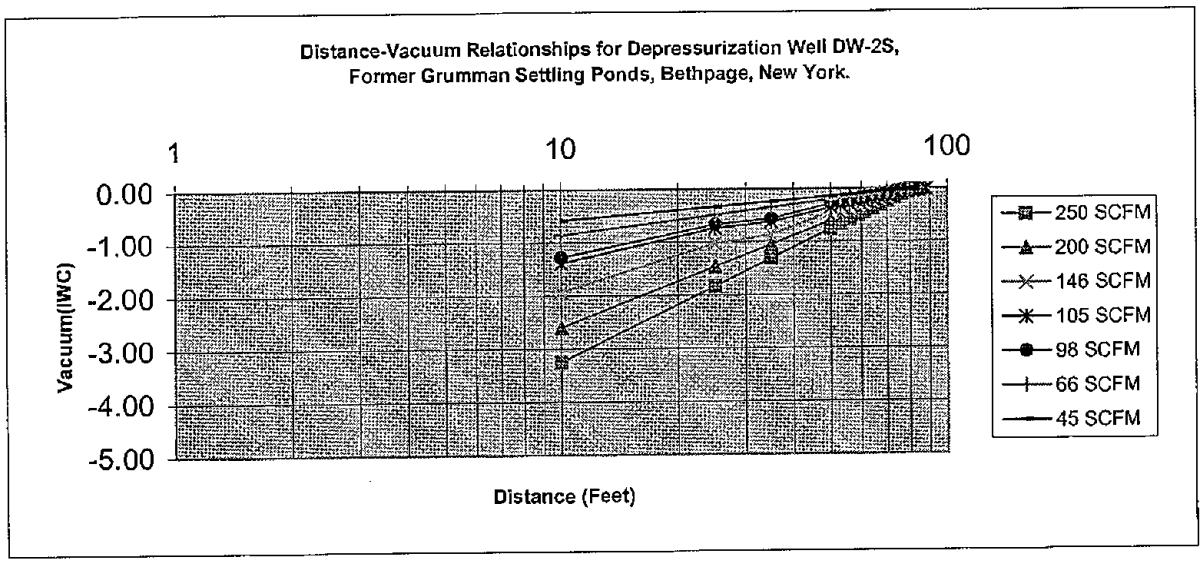

Table B-3. Data Evaluation for Extraction Well DW-3S, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Assumptions -

Well Screen Length (feet) -	20
Well Diameter (feet) -	0.33
Formation Porosity (v/v) -	0.25
Percent Moisture (%) -	10%

Distance-Drawdown Relationships -

Distance (Feet)	Observed/Calculated Vacuum (Drawdown - IWC) @ Air Flow (SCFM)					
	104 SCFM	100 SCFM	**77 SCFM**	**73 SCFM** [4]	79 SCFM	45 SCFM
34	**-0.36**	-0.35	**-0.26**	**-0.29**	-0.27	-0.16
55.3	**-0.26**	-0.26	**-0.20**	**-0.19**	-0.20	-0.11
80.8	**-0.19**	-0.18	**-0.18**	**-0.16**	-0.14	-0.08
100	-0.15	-0.14	-0.15	-0.12	-0.11	-0.06
120	-0.11	-0.11	-0.13	-0.09	-0.09	-0.05
140	-0.08	-0.08	-0.12	-0.07	-0.06	-0.04
160	-0.06	-0.05	-0.11	-0.05	-0.04	-0.02
180	-0.03	-0.03	-0.09	-0.03	-0.02	-0.01
200	-0.01	-0.01	-0.08	-0.01	-0.01	-0.01
220	0.01	0.01	-0.07	0.00	0.01	0.00
240	0.02	0.02	-0.07	0.01	0.02	0.01
260	0.04	0.04	-0.06	0.03	0.03	0.02
280	0.05	0.05	-0.05	0.04	0.04	0.02
300	0.07	0.07	-0.04	0.05	0.05	0.03
320	0.08	0.08	-0.04	0.06	0.06	0.04
340	0.09	0.09	-0.03	0.07	0.07	0.04
360	0.10	0.10	-0.03	0.07	0.08	0.05
380	0.11	0.11	-0.02	0.08	0.09	0.05
400	0.13	0.12	-0.02	0.09	0.10	0.05

Data Analysis -

Parameter	Value @ Air Flow (SCFM)					
	104	100	**77**	73	79	45
R^2	0.995251005	NA	0.911150571	0.951988395	NA	NA
Slope	0.454453651	0.436974664	0.226098981	0.344421501	0.345209985	0.196638599
y-intercept	-1.057401347	-1.016732064	-0.604452655	-0.806319919	-0.803218331	-0.457529429
Maximum ROI (Feet)	212	212	471	219	212	212
Observed Well Efficiency (%)	51%	NA	41%	57%	NA	NA
Design Parameters -						
Desired Minimum Vacuum (IWC)	0.1	0.1	0.1	0.1	0.1	0.1
ROI @ Minimum Vacuum (feet)	128	125	170	112	109	66
Pore Volume Exchange (per day)	0.65	0.65	0.27	0.59	0.68	1.06
Pore Volume Exchange (per week)	4.54	4.54	1.89	4.12	4.75	7.41
Required Wellhead Vacuum (IWC)	**-2.065**	-2.045	**-1.490**	**-1.405**	-1.615	-0.827

Notes/Formulas -

1. Values in BOLD represent field data. Values in regular font represent calculated values based on distance-drawdown relationship.
2. Field data used is from Depth B for each location during Hrs 4, 5 & 8 of VCS Test on 6/13/07.
3. Maximum ROI (feet) based on minimum ROI during VCS Test.
4. Based on data evaluation provided above, ARCADIS considers data from hour 5 (73 SCFM) to be outliers. Data is not used in further calculations.
5. Boxed solid line values represent selected design assumptions for Well DW-3S.
6. Boxed dashed line values represent selected design assumptions for Well DW-7S.

Table B-3. Data Evaluation for Extraction Well DW-3S, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

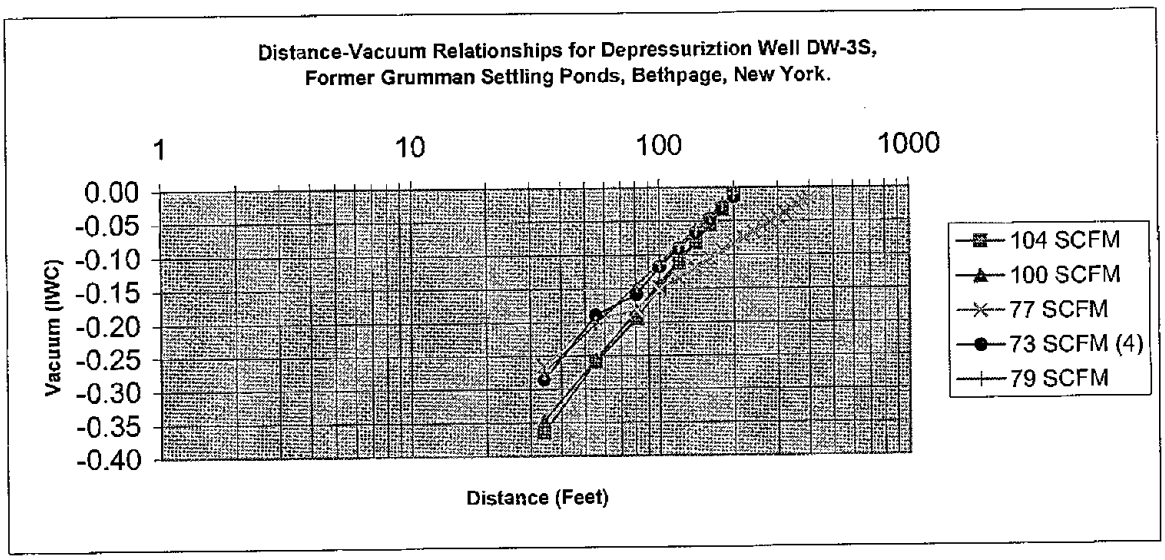

Table B-4. Data Evaluation for Extraction Well DW-1D, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Assumptions -

Well Screen Length (feet) -	5
Well Diameter (feet) -	0.33
Formation Porosity (v/v) -	0.25
Percent Moisture (%) -	10%

Distance-Drawdown Relationships -

Distance (Feet)	Observed/Calculated Vacuum (Drawdown - IWC) @ Air Flow (SCFM)						
	150 SCFM	125 SCFM	80 SCFM	75 SCFM	54 SCFM	49 SCFM	9 SCFM
13	-6.31	-5.26	**-3.23**	-3.16	-2.327	**-2.104**	-0.38
28	-4.12	-3.43	**-2.096**	-2.06	-1.522	**-1.37**	-0.25
35	-3.48	-2.90	**-1.428**	-1.74	-1.031	**-0.97**	-0.21
58	-2.03	-1.69	**-1.222**	-1.02	-0.86	**-0.80**	-0.12
60	-1.94	-1.61	-0.98	-0.97	-0.70	-0.66	-0.12
65	-1.71	-1.42	-0.87	-0.85	-0.61	-0.59	-0.10
70	-1.49	-1.25	-0.77	-0.75	-0.54	-0.52	-0.09
75	-1.30	-1.08	-0.67	-0.65	-0.47	-0.46	-0.08
80	-1.11	-0.93	-0.58	-0.56	-0.40	-0.40	-0.07
85	-0.94	-0.78	-0.49	-0.47	-0.34	-0.34	-0.06
90	-0.78	-0.65	-0.41	-0.39	-0.28	-0.29	-0.05
95	-0.62	-0.52	-0.33	-0.31	-0.22	-0.24	-0.04
100	-0.47	-0.40	-0.26	-0.24	-0.17	-0.19	-0.03
105	-0.33	-0.28	-0.19	-0.17	-0.12	-0.15	-0.02
110	-0.20	-0.17	-0.13	-0.10	-0.07	-0.11	-0.01
115	-0.07	-0.06	-0.07	-0.04	-0.03	-0.07	0.00
118	0.00	0.00	-0.03	0.00	0.00	-0.04	0.00
120	0.05	0.04	-0.01	0.02	0.02	-0.03	0.00
123	0.12	0.10	0.03	0.06	0.04	-0.01	0.01

Data Analysis -

Parameter	Value @ Air Flow (SCFM)						
	150	125	80	75	54	49	9
R^2	NA	NA	0.940732079	NA	0.946706321	0.954016295	NA
Slope	6.587099	5.489248847	3.249772292	3.293549308	2.371355502	2.095750227	0.395225917
y-intercept	-13.64863249	-11.37386041	-6.762151323	-6.824316244	-4.913507696	-4.386003595	-0.818917949
Maximum ROI (Feet)	118	118	120	118	118	124	118
Observed Well Efficiency (%)	NA	NA	20%	NA	20%	21%	NA
Design Parameters -							
Desired Minimum Vacuum (IWC)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
ROI @ Minimum Vacuum (feet)	114	113	112	110	107	111	66
Pore Volume Exchange (per day)	4.70	3.98	2.59	2.52	1.92	1.62	0.84
Pore Volume Exchange (per week)	32.93	27.83	18.12	17.66	13.42	11.35	5.91
Required Wellhead Vacuum (IWC)	-66.958	-55.799	**-33.570**	-33.479	**-24.010**	**-21.350**	-4.018

Notes/Formulas -

1. Values in BOLD represent field data. Values in regular font represent calculated values based on distance-drawdown relationship.
2. Field data used is from Depth D for each location during Hrs 4, 5 & 6 (all with Manifold) of VCS Test on 3/20/07.
3. Maximum ROI (feet) based on minimum ROI during VCS Test.
4. Boxed solid line values represent selected design assumptions for wells DW-1D, DW-4D, DW-5D & DW-6D.

Table B-4. Data Evaluation for Extraction Well DW-1D, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

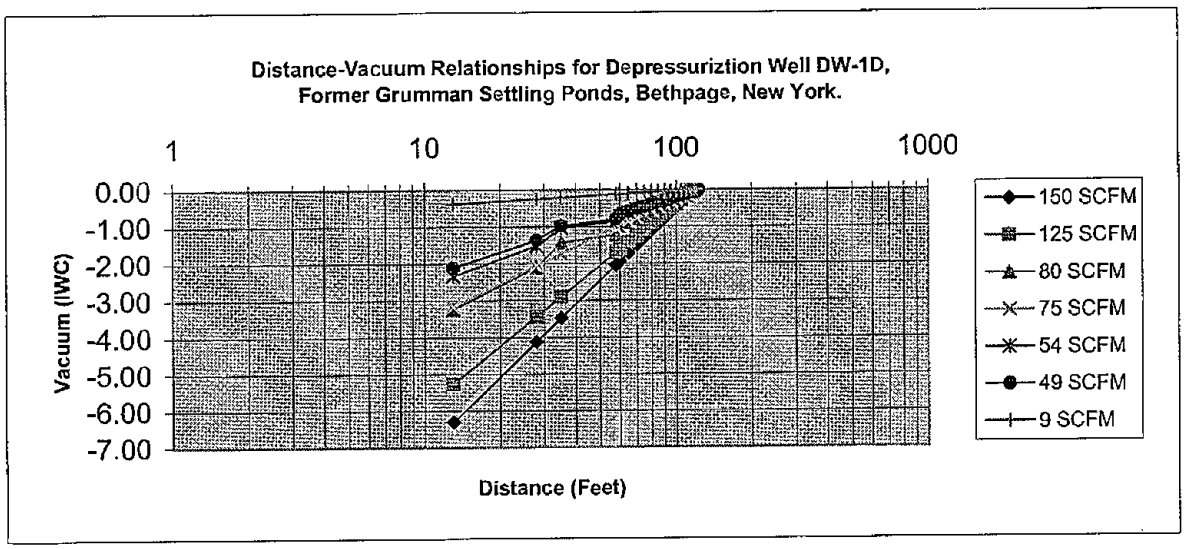

Table B-5. Data Evaluation for Extraction Well DW-2D, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Assumptions -

Well Screen Length (feet) -	20
Well Diameter (feet) -	0.33
Formation Porosity (v/v) -	0.25
Percent Moisture (%) -	10%

Distance-Drawdown Relationships -

Distance (Feet)	Observed/Calculated Vacuum (Drawdown - IWC) @ Air Flow (SCFM)					
	219 SCFM	**158 SCFM**	**141 SCFM**	100 SCFM	75 SCFM	50 SCFM
13	**-3.39**	**-2.47**	**-2.35**	-1.58	-1.18	-0.79
28	**-2.79**	**-2.01**	**-1.93**	-1.25	-0.94	-0.62
35	**-2.56**	**-1.85**	**-1.78**	-1.15	-0.86	-0.58
53	**-2.08**	**-1.50**	**-1.43**	-0.97	-0.73	-0.49
100	-1.56	-1.11	-1.08	-0.70	-0.53	-0.35
150	-1.19	-0.83	-0.82	-0.53	-0.39	-0.26
200	-0.92	-0.64	-0.63	-0.40	-0.30	-0.20
250	-0.72	-0.48	-0.49	-0.31	-0.23	-0.15
300	-0.55	-0.36	-0.38	-0.23	-0.17	-0.11
350	-0.41	-0.25	-0.28	-0.16	-0.12	-0.08
400	-0.28	-0.16	-0.19	-0.10	-0.08	-0.05
450	-0.18	-0.08	-0.12	-0.05	-0.04	-0.03
500	-0.08	-0.01	-0.05	-0.01	-0.01	0.00
550	0.01	0.05	0.01	0.03	0.02	0.02

Data Analysis -

Parameter	Value @ Air Flow (SCFM)					
	219	**158**	141	100	75	50
R^2	0.98826527	0.990816361	0.985319298	NA	NA	NA
Slope	2.114664833	1.565801386	1.467744435	0.991013535	0.743260152	0.495506768
y-intercept	-5.786830742	-4.238438381	-4.011533974	-2.682555938	-2.011916953	-1.341277969
Maximum ROI (Feet)	545	509	541	509	509	509
Observed Well Efficiency (%)	52%	54%	56%	NA	NA	NA
Design Parameters -						
Desired Minimum Vacuum (IWC)	0.1	0.1	0.1	0.1	0.1	0.1
ROI @ Minimum Vacuum (feet)	489	440	462	404	374	320
Pore Volume Exchange (per day)	0.09	0.08	0.07	0.06	0.05	0.05
Pore Volume Exchange (per week)	0.65	0.58	0.47	0.44	0.38	0.35
Required Wellhead Vacuum (IWC)	**-11.08**	**-7.846**	**-7.191**	-4.967	-3.725	-2.483

Notes/Formulas -

1. Values in BOLD represent field data. Values in regular font represent calculated values based on distance-drawdown relationship.
2. Field data used is from Depth D for each location during Hrs 3, 5 & 6 of VCS Test on 3/21/07.
3. Maximum ROI (feet) based on minimum ROI during VCS Test.
4. Boxed solid line values represent selected design assumptions for well DW-2D.

Table B-5. Data Evaluation for Extraction Well DW-2D, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

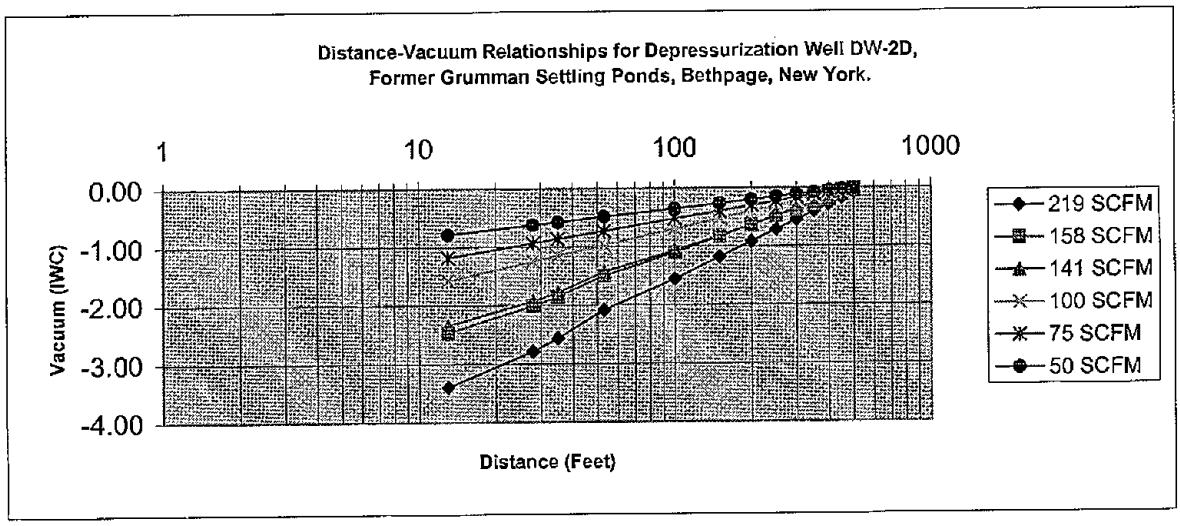

Table B-6. Data Evaluation for Extraction Well DW-3D, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Assumptions -

Well Screen Length (feet) -	20
Well Diameter (feet) -	0.33
Formation Porosity (v/v) -	0.25
Percent Moisture (%) -	10%

Distance-Drawdown Relationships -

Distance (Feet)	Observed/Calculated Vacuum (Drawdown - IWC) @ Air Flow (SCFM)					
	150 SCFM	**102 SCFM**	**75 SCFM[4]**	**71 SCFM**	70 SCFM	49 SCFM
53	-0.37	**-0.25**	**-0.14**	**-0.20**	-0.17	-0.12
79	-0.25	**-0.17**	**-0.11**	**-0.12**	-0.12	-0.08
102.3	-0.17	**-0.11**	**-0.09**	**-0.09**	-0.08	-0.05
112	-0.14	-0.09	-0.08	-0.07	-0.06	-0.05
127	-0.10	-0.07	-0.07	-0.05	-0.05	-0.03
142	-0.06	-0.04	-0.06	-0.03	-0.03	-0.02
157	-0.03	-0.02	-0.05	-0.02	-0.01	-0.01
172	0.00	0.00	-0.05	0.00	0.00	0.00
187	0.02	0.02	-0.04	0.01	0.01	0.01
202	0.05	0.03	-0.03	0.02	0.02	0.02
217	0.07	0.05	-0.03	0.03	0.03	0.02
237	0.10	0.07	-0.02	0.05	0.05	0.03
252	0.12	0.08	-0.02	0.06	0.05	0.04
267	0.14	0.09	-0.01	0.07	0.06	0.04
282	0.15	0.10	-0.01	0.08	0.07	0.05
297	0.17	0.12	0.00	0.08	0.08	0.06
312	0.18	0.13	0.00	0.09	0.09	0.06

Data Analysis -

Parameter	Value @ Air Flow (SCFM)					
	150	**102**	**75**	**71**	70	49
R^2	NA	0.999648944	0.987723229	0.972764294	NA	NA
Slope	0.72513025	0.493088568	0.184780469	0.372546181	0.338394115	0.236875881
y-intercept	-1.62370865	-1.104121881	-0.458947562	-0.836532536	-0.757730703	-0.530411492
Maximum ROI (Feet)	173	173	305	176	173	173
Observed Well Efficiency (%)	NA	42%	24%	48%	NA	NA
Design Parameters -						
Desired Minimum Vacuum (IWC)	0.1	0.1	0.1	0.1	0.1	0.1
ROI @ Minimum Vacuum (feet)	126	109	88	95	88	66
Pore Volume Exchange (per day)	0.96	0.88	1.00	0.80	0.92	1.16
Pore Volume Exchange (per week)	6.71	6.15	6.97	5.63	6.47	8.11
Required Wellhead Vacuum (IWC)	-4.280	-2.635	-1.897	-1.753	-1.997	-1.398

Notes/Formulas -

1. Values in BOLD represent field data. Values in regular font represent calculated values based on distance-drawdown relationship.
2. Field data used is from Depth D for each location during Hrs 4, 5 & 6 of VCS Test on 6/14/07.
3. Maximum ROI (feet) based on minimum ROI during VCS Test.
4. Based on data evaluation provided above, ARCADIS considers data from hour 5 (75 SCFM) to be outliers. Data is not used in further calculations.
5. Boxed solid line values represent selected design assumptions for Well DW-3D.
6. Boxed dashed line values represent selected design assumptions for Well DW-7D.

Table B-6. Data Evaluation for Extraction Well DW-3D, Pneumatic Conductivity Test, Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

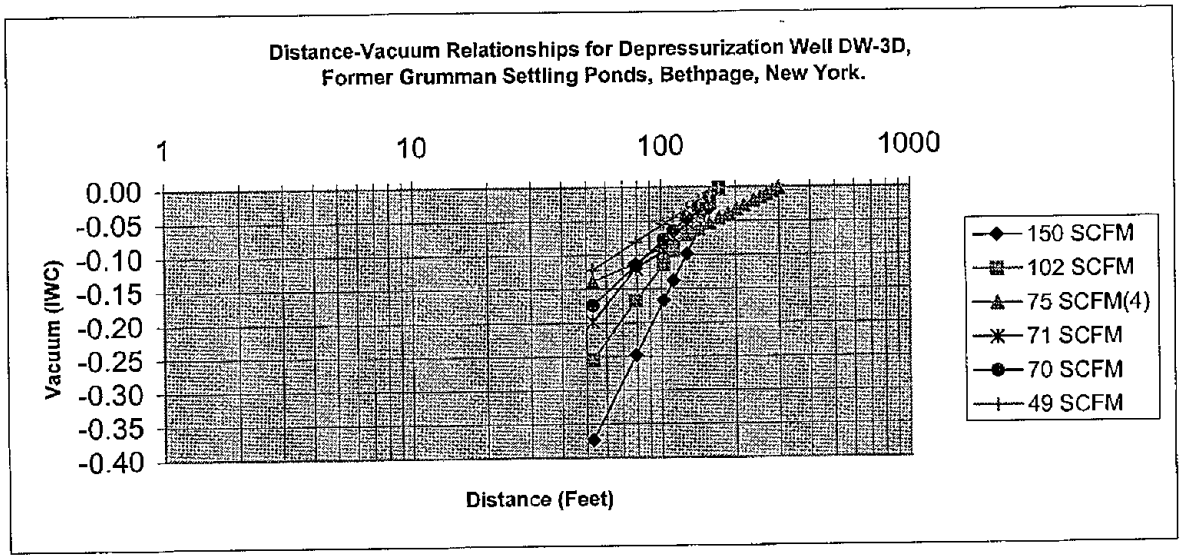

Table B-7. Individual Depressurization Pipe Sizing Preliminary Calculations, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Pressure Loss formula:

$$\Delta P = \left(\frac{0.0625 L v^2}{25{,}000 d}\right) \cdot C$$

L = length of pipe in feet
v = velocity of air through pipe in feet per second
d = inside diameter of pipe in inches
C = Conversion (0.361 psi)
ΔP = pressure loss in iwc

Well ID	Design Flow Rate (scfm)	Nominal Diameter (inches)	Effective Inside Diameter (inches)	Pipe Length (feet)	Velocity (ft/min)	Velocity (ft/s)	Pressure Loss (iwc)
DW-7D	49.0	4	3.938	417	579	10	0.684
DW-7S	45.0	4	3.938	410.5	532	9	0.568
DW-3D	102.0	4	3.938	565	1206	20	4.014
DW-3S	79.0	4	3.938	560	934	16	2.386
DW-5D	75.0	4	3.938	769.3	887	15	2.955
DW-5S	150.0	6	5.798	775.5	818	14	1.722
DW-6S	150.0	6	5.798	967.5	818	14	2.148
DW-6D	75.0	4	3.938	968	887	15	3.718
DW-1S	150.0	6	5.798	1150	818	14	2.554
DW-1D	75.0	4	3.938	1154	887	15	4.432
DW-4S	150.0	6	5.798	1346.5	818	14	2.990
DW-4D	75.0	4	3.938	1351	887	15	5.189
DW-8S	66.0	4	3.938	1487.5	780	13	4.424
DW-9S	66.0	4	3.938	1603	780	13	4.768
DW-2D	100.0	6	5.798	1714	545	9	1.692
DW-2S	66.0	4	3.938	1718	780	13	5.110
DW-10S	66.0	4	3.938	1834	780	13	5.455
DW-11S	66.0	4	3.938	1936.5	780	13	5.760

Notes & Abbreviations:

1. This calculation sheet is for pipe sizing only.
2. Pipe size for individual wells based on maximum pressure loss of 10 iwc.
3. Assumes piping is 17 high density poly ethylene.

ft/s feet per second
ft/min feet per minute
iwc inches of water column
psi pounds per square inch
scfm standard cubic feet per minute

Table B-8. Summary Table Schedule of Depressurization Wells, Northrop Grumman Operable Unit 3
Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Shallow Wells

Western Access Road	*Radius (feet)*	*Flow (scfm)*	Screen *(ft bls)*	Well Head Req. Vac *(iwc)*
DW-7S	66	45	10-30	-0.8
DW-3S	109	79	10-30	-1.6

Southern Access Road	*Radius (feet)*	*Flow (scfm)*	Screen *(ft bls)*	Well Head Req. Vac *(iwc)*
DW-5S	109	150	15-30	-3.932
DW-6S	109	150	15-30	-3.932
DW-1S	109	150	15-30	-3.932
DW-4S	109	150	15-30	-3.932
DW-8S	64	66	10-17	-3.843
DW-9S	64	66	10-17	-3.843
DW-2S	64	66	10-17	-3.843
DW-10S	64	66	10-17	-3.843
DW-11S	64	66	10-17	-3.843

Total for 11 Shallow wells **1,054 scfm**
Safety factor **30%**
1,370 scfm

Deep Wells

Western Access Road	*Radius (feet)*	*Flow (scfm)*	Screen *(ft bls)*	Well Head Req. Vac *(iwc)*
DW-7D	66	49	30-40	-1.4
DW-3D	109	102	30-50	-2.6

Southern Access Road	*Radius (feet)*	*Flow (scfm)*	Screen *(ft bls)*	Well Head Req. Vac *(iwc)*
DW-5D	110	75	42-47	-33.479
DW-6D	110	75	42-47	-33.479
DW-1D	110	75	42-47	-33.479
DW-4D	110	75	42-47	-33.479
DW-2D	404	100	27-47	-4.967

Total for 7 Deep wells **551 scfm**
Safety factor **30%**
716 scfm

Abbreviations:

ft bls feet below land surface
iwc inches water column
scfm standard cubic feet per minute

Table B-9. Depressurization System Headloss Calculations for Blower BL-200, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Pressure Loss formula for Straight Pipe and Duct:

$$\Delta P = \left(\frac{0.0625Lv^2}{25{,}000 \cdot d} \right) \cdot C$$

L = length of pipe in feet
v = velocity of air through pipe in feet per second
d = inside diameter of pipe in inches
C = Conversion: (0.361 psi)
ΔP = pressure loss in iwc

Location Description	Design Flow Rate (scfm)	Inside Diameter (inches)	Pipe Length (feet)	Fitting/Valve Equivalent Length (feet)	Minor Loss Coefficient (ξ)	Fitting/Valve Quantity	Velocity (ft/min)	Velocity (ft/s)	Pressure Loss (iwc)
Well Head [1]	75	--	--	--	--	--	--	--	33.479
From Well Header to Treatment Shed									
4" SDR. 17 HDPE [2]	75	3.9	1351.0	--	--	--	887	15	5.189
Elbow (90)	75	3.9	--	16.7	--	4	887	15	0.257
Building Interior to Blower [3]									
4" SCH. 80 PVC	100	3.8	5.75	--	--	--	1250	21	0.045
Erdco Flowmeter	100	--	--	--	--	--	--	--	2.320
Ball Valve[4]	100	3.8	--	--	0.050	1	--	--	0.026
4"×6" Expansion	100	3.8	--	2.31	--	1	1250	21	0.018
Elbow (90)	100	5.8	--	16.7	--	1	553	9	0.017
Tee (Run)	175	5.8	--	12.3	--	1	967	16	0.038
Tee (Run)	250	5.8	--	12.3	--	1	1382	23	0.078
Tee (Run)	325	5.8	--	12.3	--	1	1796	30	0.133
Tee (Branch)	716	5.8	--	32.7	--	1	3957	66	1.710
6" SCH. 80 PVC	716	5.8	15.75	--	--	--	3957	66	0.824
Butterfly Valve	716	6.0	--	7.5	--	2	3647	61	0.639
Elbow (90)	716	5.8	--	16.7	--	3	3957	66	2.620
Knockout Tank	716	--	--	--	--	1	--	--	7.000
Air Filter	716	--	--	--	--	1	--	--	4.791
6"×4" Reducer	716	4.0	--	2.31	--	1	8205	137	0.748
From Blower to Heat Exchager									
4"×6" Expansion	716	4.0	--	2.31	--	1	8205	137	0.748
6" SCH. 40 C.S.	716	6.0	6.4	--	--	--	3647	61	0.273
Elbow(90)	716	6.0	--	16.7	--	1	3647	61	0.712
Tee (branch)	716	6.0	--	32.7	--	1	3647	61	1.394
6"×10" Expansion	2087	6.0	--	9.44	--	1	10629	177	3.420
10" A. Duct	2087	10.0	20.8	--	--	--	3826	64	0.586
Butterfly Valve	2087	10.0		7.5	--	1	3826	64	0.211
Elbow(90)	2087	10.0	--	26.0	--	3	3826	64	2.197
10"×12" Expansion	2087	10.0	--	5.77	--	1	3826	64	0.163

Continued on following page.

Table B-9. Depressurization System Headloss Calculations for Blower BL-200, Northrop Grumman Operable Unit 3
Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Location Description	Design Flow Rate (scfm)	Inside Diameter (inches)	Pipe Length (feet)	Fitting/Valve Equivalent Length (feet)	Minor Loss Coefficient (ξ)	Fitting/Valve Quantity	Velocity (ft/min)	Velocity (ft/s)	Pressure Loss (iwc)
From Heat Excheger to Carbon Unit									
12"×10" Reducer	2087	10.0	--	5.77	--	1	3826	64	0.163
Heat Exchenger	2087	--	--	--	--	--	--	--	5.536
Elbow(90)	2087	10.0	--	26.0	--	3	3826	64	2.197
10" A. Duct	2087	10.0	28.0	--	--	--	3826	64	0.789
10"×12" Expansion	2087	10.0	--	5.77	--	1	3826	64	0.163
Carbon Unit and Stack									
Carbon Unit	2087	--	--	--	--	2	--	--	3.600
25"×10" Contraction	2087	10.0	--	12.24	--	1	3826	64	0.345
Elbow (90)	2087	10.0	--	26.0	--	2	3826	64	1.465
10"×16" Expansion	2087	10.0	--	9.53		1	3826.4	63.8	0.268
16"A. Duct	2087	16.0	35.0	--	--	--	1495	25	0.094
Total Losses Vacuum (iwc)									59.932
Total Losses Pressure (iwc)									24.923

Notes, Calculations & Abbreviations:

1. Design vacuum from DW-4D used as worst-case value.
2. Design belowgrade pipe loss from DW-4D used as worst-case value.
3. Design flowrate from DW-2D (100 SCFM) used as worst-case value because it is furthest from blower.
4. Head losses for ball valve are calculated using:

$$\Delta h = \frac{\xi v^2}{2g}$$

Δh Headloss in iwc
ξ: Minorloss coefficient
v: Velocity of air through pipe (ft/s)
g: Acceleration of gravity

5. Head loss for reducer/ expansion is calculated using:

$\log(L_{equiv}) = -0.56424 + 0.120936\,F + 0.99912 \log(D_{small})$, where:
F: Value dependent on the attached diameters and fitting type
Lequiv: Equivalent length of smaller pipe, feet
D_{small}: Nominal diameter of smaller pipe, inches
log( ): Base 10 logarithm

6. Head losses for flowmeter, knockout tank, filter, and carbon obtained directly from individual manufacturers.
7. Equivalent lengths for other fittings obtained from mulitple hydraulic/pnuematic pressure loss resources.

ft/s feet per second
ft/min feet per minute
iwc inches of water column
psi pounds per square inch
scfm standard cubic feet per minute

Table B-10. Depressurization System Headloss Calculations for Blower BL-300 and 400, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Pressure Loss formula for Straight Pipe and Duct:

$$\Delta P = \left(\frac{0.0625Lv^2}{25{,}000 \cdot d} \right) / C$$

L = length of pipe in feet
v = velocity of air through pipe in feet per second
d = inside diameter of pipe in inches
C = Conversion: (0.361 psi)
ΔP = pressure loss in iwc

Location Description	Design Flow Rate (scfm)	Inside Diameter (inches)	Pipe Length (feet)	Fitting/Valve Equivalent Length (feet)	Minor Loss Coefficient (ξ)	Fitting/Valve Quantity	Velocity (ft/min)	Velocity (ft/s)	Pressure Loss (iwc)
Well Head [1]	--	--	--	--	--	--	--	--	3.932
From Well Head to Treatment Shed									
4" SDR. 17 HDPE [2]	66	3.9	1936.5	--	--	--	780.3	13.0	5.760
Elbow (90)	66	3.9	--	16.7	--	4	795.6	13.3	0.209
Building Interior to Blower [3]									
4" SCH. 80 PVC	66	3.8	5.8	--	--	--	824.9	13.7	0.020
Erdco Flowmeter	66	--	--	--	--	--	--	--	2.100
Ball Valve [4]	66	3.8	--	--	0.050	1	--	--	0.011
4"×6" Expansion	66	3.8	--	2.31	--	1	825	14	0.008
Elbow (90)	66	5.8	--	16.7	--	1	359.7	6.0	0.007
Tee (Run)	132	5.8	--	12.3	--	1	719.4	12.0	0.021
Tee (Run)	198	5.8	--	12.3	--	1	1079.2	18.0	0.048
Tee (Run)	264	5.8	--	12.3	--	1	1438.9	24.0	0.084
Tee (Run)	330	5.8	--	12.3	--	1	1798.6	30.0	0.132
Tee (Run)	480	5.8	--	12.3	--	1	2616.1	43.6	0.279
Tee (Run)	630	5.8	--	12.3	--	1	3433.7	57.2	0.481
Tee (Run)	780	5.8	--	12.3	--	1	4251.2	70.9	0.737
Tee (Run)	930	5.8	--	12.3	--	1	5068.7	84.5	1.048
Tee (Run)	1009	5.8	--	12.3	--	1	5499.3	91.7	1.234
Tee (Run)	1054	5.8	--	12.3	--	1	5744.6	95.7	1.346
Elbow (90)	1370	5.8	--	16.7	--	1	7466.9	124.4	3.088
6" SCH. 80 PVC	1370	5.8	4	--	--	--	7571	126	0.766
Butterfly Valve	1370	6.0	--	7.5	--	1	6977.4	116.3	1.171
Tee (Branch)	685	5.8	--	32.7	--	1	3785.5	63.1	1.565
6" SCH. 80 PVC	685	5.8	11	--	--	--	3785	63	0.526
Butterfly Valve	685	6.0	--	7.5	--	2	3488.7	58.1	0.585
Elbow (90)	685	5.8	--	16.7	--	3	3733.4	62.2	2.316
Knockout Tank	685	--	--	--	--	1	--	--	7.000
Air Filter	685	--	--	--	--	--	--	--	3.891
6"×4" Reducer	685	4.0	--	2.31	--	1	7850	131	0.685

Continued on following page.

Table B-10. Depressurization System Headloss Calculations for Blower BL-300 and 400, Northrop Grumman Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Location Description	Design Flow Rate (scfm)	Inside Diameter (inches)	Pipe Length (feet)	Fitting/Valve Equivalent Length (feet)	Minor Loss Coefficient (ξ)	Fitting/Valve Quantity	Velocity (ft/min)	Velocity (ft/s)	Pressure Loss (iiwc)
From Blower to Heat Exchanger									
4"×6" Expansion	685	4.0	--	2.31	--	1	7850	131	0.685
6" SCH. 40 C.S.	685	6.0	11.0	--	--	--	3488.7	58.1	0.429
Tee (Run)	1370	6.0	--	12.3	--	1	6977	116	1.920
6" SCH. 40 C.S.	1370	6.0	5.0	--	--	--	6977.4	116.3	0.780
Tee (Run)	2087	6.0	--	12.3	--	1	10629	177	4.455
6" SCH. 40 C.S.	2087	6.0	3.0	--	--	--	10629.0	177.2	1.087
6"×10" Expansion	2087	6.0	--	9.44	--	1	10629	177	3.420
10" A.Duct	2087	10.0	20.8	--	--	--	3826.4	63.8	0.586
Butterfly Valve	2087	10.0		7.5	--	1	3826	63.8	0.211
Elbow (90)	2087	10.0	--	26.0	--	3	3826.4	63.8	2.197
10"×12" Expansion	2087	10.0	--	5.77	--	1	3826	64	0.163
From Heat Exchanger to Carbon Unit									
12"×10" Reducer	2087	10.0	--	5.77	--	1	3826	64	0.163
Heat Exchanger	--	--	--	--	--	--	--	--	5.536
Elbow (90)	2087	10.0	--	26.0	--	3	3826.4	63.8	2.197
10" A. Duct	2087	10.0	28.0	--	--	--	3826.4	63.8	0.789
10"×12" Expansion	2087	10.0	--	5.77	--	1	3826	64	0.163
Carbon Unit and Stacks									
Carbon Unit	2087	--	--	--	--	2	--	--	3.600
25"×10" Contraction	2087	10.0	--	12.24	--	1	3826	64	0.345
Elbow(90)	2087	10.0	--	26.0	--	2	3826.4	63.8	1.465
10"×16" Expansion	2087	10.0	--	9.53		1	3826.4	63.8	0.268
16" A. Duct	2087	16.0	35.0	--	--	--	1494.7	24.9	0.094
Total Losses Vacuum (iwc)									39.050
Total Losses Pressure (iwc)									30.552

Notes, Calculations & Abbreviations:

1. Design vacuum from DW-4S used as worst-case value.
2. Design below grade pipe loss from DW-11S used as worst-case value.
3. Design flowrate from DW-11S (66 SCFM) used as worst-case value because it is furthest from blower.
4. Head losses for ball valve are calculated using:

$$\Delta h = \frac{\xi v^2}{2g}$$, where:

- Δh Headloss in iwc
- ξ: Minor loss coefficient
- v: Velocity of air through pipe (ft/s)
- g: Acceleration of gravity

5. Head loss for reducer/ expansion is calculated using:

$$\log(L_{equiv}) = -0.56424 + 0.120936\,F + 0.99912 \log(D_{small})$$, where:

- F: Value dependent on the attached diameters and fitting type
- L_{equiv}: Equivalent length of smaller pipe, feet
- D_{small}: Nominal diameter of smaller pipe, inches
- log( ): Base 10 logarithm

ft/s	feet per second
ft/min	feet per minute
iwc	inches of water column
psi	pounds per square inch
scfm	standard cubic feet per minute

Table B-11. Basis of Vapor Design Concentrations, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

		Individual Depressurization Well Design Concentrations																	
	Depressurization Well ID:	DW-7S(1,7)	DW-7D(1,8)	DW-3S(9)	DW-3D(10)	DW-5S(1,7)	DW-5D(1,8)	DW-6S	DW-6D	DW-1S(3)	DW-1D(4)	DW-4S	DW-4D	DW-8S(1)	DW-9S(2)	DW-2S(5)	DW-2D(6)	DW-10S(1)	DW-11S(1)
	Screened:	(10-30)	(30-50)	(10-30)	(30-50)	(15-30)	(42-47)	(15-30)	(42-47)	(15-30)	(42-47)	(15-30)	(42-47)	(10-17)	(10-17)	(10-17)	(27-47)	(10-17)	(10-17)
	Well Design Flow (scfm):	45	49	79	102	150	75	150	75	150	75	150	75	66	66	66	100	66	66
	Well Design Flow (m3/min)	1.3	1.4	2.2	2.9	4.2	2.1	4.2	2.1	4.2	2.1	4.2	2.1	1.9	1.9	1.9	2.8	1.9	1.9
	Design Basis:	SGP-13	SGP-13	DW-03S	DW-03D	SGP-14	SGP-14	SVP-4	SVP-4	DW-1S	DW-1D	SVP-3	SVP-3	SVP-3	DW-2S	DW-2S	DW-2D	SVP-1	SVP-1
CONSTITUENT	Sample ID:	19.5 - 20	41 - 41.5	DW-3S-20070613	DW-3D-20070614	19.5 - 20	47.5 - 48	SVP-4(15')	SVP-4(40')	DW1S	DWID INF	SVP-3(15')	SVP-3(40')	SVP-3(15')	PCT ASP-1	PCT ASP-1	DW-2D INF	SVP-1(15')	SVP-1(15')
(ug/m3)	Sample Date:	5/29/2007	5/31/2007	6/13/2007	6/14/2007	6/1/2007	6/1/2007	10/26/2004	10/26/2004	3/22/2007	3/23/2007	10/26/2004	10/26/2004	10/26/2004	3/20/2007	3/20/2007	3/21/2007	10/27/2004	10/27/2004
	Depth:	19.5-20	41-41.5	19.5-20	44.5-45	19.5-20	44.5-48	15	40	15-30	42-47	15	40	15	10-17	10-17	27-47	15	15
	Units:	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)
Volatile Organic Compounds	**CAS Number**																		
1,1,1-Trichloroethane	71-55-6	< 8.1	< 17	660	720	78	39	71	<110	54	88	150	310	150	1.4	1.4	59	9.8	9.8
1,1-Dichloroethane	75-34-3	< 13	< 27	170	220	1.5	1.5	19	<85	< 12	< 12	29	160	29	< 0.45	< 0.45	< 3.9	<2	<2
1,1-Dichloroethylene	75-35-4	< 12	< 25	< 11	< 13	1.4	< 0.028	<9.9	<83	< 12	18	<12	<40	<12	1.5	1.5	< 3.9	<2	<2
1,2-Dichloroethene	540-59-0	--	--	--	--	--	--	<9.9	<83	*<24*	*<39*	34	150	34	*<2*	*<2*	*<2*	<2	<2
1,3-Butadiene	106-99-0	< 52	< 110	< 12	< 14	17	160	31	400	< 13	< 14	17	110	17	< 0.49	< 0.49	< 4.3	29	29
2,2,4-Trimethylpentane	540-84-1	--	--	--	--	--	--	<12	<98	NA	NA	<14	<47	<14	*2.6*	*2.6*	*<2.3*	<2.3	<2.3
2-Butanone (Methyl ethyl ketone)	78-93-3	< 13	< 27	49	< 19	11	200	18	270	47	42	35	56	35	35	35	49	15	15
2-Hexanone (Methyl n-Butyl Ketone)	591-78-6	< 9.8	< 21	< 11	< 13	3.5	24	<10	<86	< 12	< 13	<12	<41	<12	< 0.45	< 0.45	< 4	<2	<2
4-Methyl-2-Pentanone	108-10-1	< 6.9	< 15	< 22	< 26	1	9.6	<10	<86	< 24	< 25	<12	<41	<12	< 0.9	< 0.9	< 8	<2	<2
Acetone	67-64-1	< 52	< 110	130 J	53	51	790 J	140	2100	< 32	< 33	330	570	330	8.4	8.4	< 11	240	240
Benzene	71-43-2	< 10	< 22	< 8.6	< 10	6.2	59	45	640	< 9.5	< 9.8	22	83	22	< 0.35	< 0.35	< 3.1	27	27
Benzene, 1,2,4-trimethyl	95-63-6	--	--	--	--	--	--	<12	<100	NA	NA	<15	<49	<15	*6.4*	*6.4*	*6.9*	4.9	4.9
Bromomethane (Methyl bromide)	74-83-9	< 33	< 70	< 11	< 13	< 0.08	1.6	<9.7	<82	< 12	< 12	<12	<39	<12	< 0.43	< 0.43	< 3.8	<1.9	<1.9
Carbon disulfide	75-15-0	< 14	< 29	< 8.4	< 10	3	14	17	<65	< 9.2	< 9.5	78	65	78	< 0.34	< 0.34	< 3	18	18
Carbon tetrachloride	56-23-5	< 17	< 37	< 3.4	< 4.1	0.92	0.93	<16	<130	31	40	<19	<63	<19	< 0.14	< 0.14	< 1.2	<3.1	<3.1
Chlorobenzene	108-90-7	< 14	< 31	< 12	< 15	< 0.035	< 0.035	<12	100	< 14	< 14	<14	<46	<14	< 0.51	< 0.51	< 4.5	<2.3	<2.3
Chloroform	67-66-3	< 12	< 25	71	75	6.2	3.8	<12	<100	< 14	22	<15	<49	<15	0.68	0.68	< 4.8	<2.4	<2.4
cis-1,2-Dichloroethylene	156-59-2	33,000	70,000	8,800 D	17,000 D	< 0.021	< 0.021	<9.9	<83	130	36	23	120	23	630	630	83	<2	<2
Cyclohexane	110-82-7	--	--	--	--	--	--	72	260	NA	NA	76	220	76	*79*	*79*	*130*	<1.7	<1.7
Dichlorodifluoromethane (CFC-12)	75-71-8	< 14	< 29	*<3.2*	*2.3*	2.4	2.2	<12	<100	*<74*	*<120*	<15	<49	<15	*<2.5*	*<2.5*	*<2.5*	<2.5	<2.5
Ethylbenzene	100-41-4	< 13	< 27	< 23	< 28	4.4	15	12	<91	< 26	< 27	<13	<43	<13	< 0.95	< 0.95	< 8.5	7.8	7.8
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	< 21	< 45	21	27	3.8	2.5	<19	<160	17	45	<23	<77	<23	0.46	0.46	4.8	<3.8	<3.8
m&p-Xylenes	NA	< 26	< 56	< 47	< 56	20	46	30	140	68	< 53	26	52	26	2.3	2.3	< 17	23	23
Methyl tert-butyl ether	1634-04-4	*< 20*	*< 23*	< 20	< 23	*< 20*	*< 23*	<9	<76	< 21	< 22	<11	<36	<11	< 0.79	< 0.79	< 7	2.9	2.9
n-Heptane	142-82-5	--	--	--	--	--	--	82	290	NA	NA	45	110	45	*53*	*53*	*130*	40	40
n-Hexane	110-54-3	--	--	--	--	--	--	74	340	NA	NA	19	74	19	*31*	*31*	*120*	23	23
o-Xylene	95-47-6	< 15	< 32	< 23	< 28	6.4	17	11	<91	28	< 27	<13	<43	<13	1.1	1.1	< 8.5	7.4	7.4
p-Dichlorobenzene	106-46-7	--	--	--	--	--	--	<15	<130	NA	NA	<18	<60	<18	*11*	*11*	--	9	9
p-Ethyltoluene	622-96-8	--	--	--	--	--	--	<12	<100	NA	NA	<15	<49	<15	*<2.5*	*<2.5*	--	5.9	5.9
Styrene	100-42-5	< 9.8	< 21	< 23	< 28	1.2	4.9	<11	<89	< 25	< 26	<13	<43	<13	< 0.94	< 0.94	< 8.3	<2.1	<2.1
tert-Butyl alcohol	75-65-0	--	--	--	--	--	--	<76	<640	NA	NA	<91	<300	<91	*<15*	*<15*	*39*	18	18
Tetrachloroethylene	127-18-4	1,200	2,200	570	800	25	5.3	56	<140	44	83	81	160	81	9.5	9.5	25	55	55
Toluene (Methylbenzene)	108-88-3	< 12	< 26	270	40	21	92	64	570	59	< 12	45	110	45	1.5	1.5	< 3.7	41	41
trans-1,2-Dichloroethene	156-60-5	530	720 J	330	430	< 0.03	< 0.029	<9.9	<83	< 12	< 12	13	40	13	< 0.44	< 0.44	< 3.9	<2	<2
trans-1,3-Dichloropropene	10061-02-6	< 13	< 27	< 12	< 15	< 0.031	< 0.031	<11	<95	< 13	< 14	<14	<45	<14	< 0.5	< 0.5	< 4.4	<2.3	<2.3
Trichloroethylene	79-01-6	52,000	77,000	39,000 D	65,000 D	410	100	640	<110	840	1600	860	2500	860	140	140	390	24	24
Trichlorofluoromethane (CFC-11)	75-69-4	*21*	*21*	21	21	*21*	*21*	<14	<120	NA	NA	<17	<56	<17	*<2.8*	*<2.8*	*<2.8*	<2.8	<2.8
Vinyl chloride	75-01-4	< 17	< 36	< 14	< 17	< 0.041	< 0.04	<6.4	<54	28	33	<7.7	<26	<7.7	3.1	3.1	< 5	<1.3	<1.3
Xylene (total)	1330-20-7	--	--	--	--	--	--	42	150	*<26*	*<43*	27	52	27	--	--	--	31	31
Total VOCs:		86,751	149,941	50,092	84,388	696	1,609	1424	5260	1346	2007	1910	4942	1910	1018	1018	1037	632	632

Notes:

1. Data based on nearby SGP.
2. Data based on nearby PCT location.
3. Underlined and italic values for location DW-1S are from SGP-05 interval 34-34.5 ft for sampling conducted on 5/5/06.
4. Underlined and italic values for location DW-1D are from SGP-05 interval 49-49.5 ft for sampling conducted on 5/5/06.
5. Underlined and italic values for location DW-2S are from SGP-2 interval 15 ft for sampling conducted on 10/26/04.
6. Underlined and italic values for location DW-2D are from SGP-2 interval 40 ft for sampling conducted on 10/27/04.
7. Underlined and italic are from Well 3S pilot test results 6/13/07.
8. Underlined and italic are from Well 3D pilot test results 6/14/07.
9. Underlined and italic values for location DW-3S are from SGP-11 interval 19.5-20 ft for sampling conducted on 3/23/07.
10. Underlined and italic values for location DW-3D are from SGP-11D interval 44.5-45 ft for sampling conducted on 3/22/07.

Abbreviations:

--	not analyzed
<26	underlined and italic values were not analyzed for in subject sample, value taken from adjacent locations per footnotes.
Bold	detected compound.
CAS	chemical abstracts service registry number
ND	not detected
ug/m3	micrograms per meter cubed

Table B-12. Summary of Vapor Design Concentrations and Mass Loading Rates, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

CONSTITUENT (ug/m^3)		Shallow Well System Design Concentration	Deep Well System Design Concentration	Total Influent Design Concentration	Shallow Well System Design Concentration	Deep Well System Design Concentration	Total Influent Design Concentration	Shallow Well System Design Mass Loading	Deep Well System Design Mass Loading	Total Influent Design Mass Loading
	Units:	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ppbv)	(ppbv)	(ppbv)	(lbs/yr)	(lbs/yr)	(lbs/yr)
Volatile Organic Compounds	**CAS Number**									
1,1,1-Trichloroethane	71-55-6	110.5	203.5	142.4	19.63	36.15	25.30	3.82	3.68	7.50
1,1-Dichloroethane	75-34-3	21.6	62.7	35.7	5.17	15.01	8.55	0.75	1.13	1.88
1,1-Dichloroethylene	75-35-4	0.4	2.5	1.1	0.09	0.60	0.27	0.01	0.04	0.06
1,2-Dichloroethene	540-59-0	7.0	20.4	11.6	1.70	4.99	2.63	0.24	0.37	0.61
1,3-Butadiene	106-99-0	13.9	91.2	40.5	6.11	39.96	17.73	0.48	0.66	1.15
2,2,4-Trimethylpentane	540-84-1	0.3	0.0	0.2	0.07	0.00	0.04	0.01	0.00	0.01
2-Butanone (Methyl ethyl ketone)	78-93-3	27.9	86.2	47.9	9.18	28.33	15.75	0.97	0.89	1.86
2-Hexanone (Methyl n-Butyl Ketone)	591-78-6	0.5	3.3	1.4	0.12	0.77	0.34	0.02	0.06	0.08
4-Methyl-2-Pentanone	108-10-1	0.1	1.3	0.5	0.03	0.31	0.13	0.00	0.02	0.03
Acetone	67-64-1	135.7	480.8	254.1	55.35	196.15	103.69	4.69	3.52	8.21
Benzene	71-43-2	15.2	106.4	46.5	4.61	32.30	14.11	0.52	0.35	0.87
Benzene, 1,2,4-trimethyl	95-63-6	1.4	1.3	1.4	0.28	0.25	0.27	0.05	0.02	0.07
Bromomethane (Methyl bromide)	74-83-9	0.0	0.2	0.1	0.00	0.05	0.02	0.00	0.00	0.00
Carbon disulfide	75-15-0	21.1	10.8	17.5	6.57	3.35	5.46	0.73	0.19	0.92
Carbon tetrachloride	56-23-5	4.5	5.6	4.9	0.70	0.86	0.75	0.16	0.10	0.26
Chlorobenzene	108-90-7	0.0	13.6	4.7	0.00	2.86	0.98	0.00	0.00	0.00
Chloroform	67-66-3	6.3	17.4	10.1	1.25	3.45	2.01	0.22	0.31	0.53
cis-1,2-Dichloroethylene	156-59-2	2170.6	9408.3	4655.3	530.62	2299.93	1138.03	75.05	170.05	245.10
Cyclohexane	110-82-7	35.7	86.9	54.0	10.06	25.04	15.20	1.23	0.97	2.20
Dichlorodifluoromethane (CFC-12)	75-71-8	0.3	0.7	0.5	0.07	0.14	0.09	0.01	0.01	0.02
Ethylbenzene	100-41-4	3.3	2.0	2.9	0.74	0.46	0.64	0.11	0.04	0.15
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	4.6	12.3	7.2	0.58	1.56	0.92	0.16	0.22	0.38
m&p-Xylenes	NA	25.3	32.4	27.7	5.76	7.38	6.31	0.87	0.24	1.12
Methyl tert-butyl ether	1634-04-4	0.4	0.0	0.2	0.10	0.00	0.06	0.01	0.00	0.01
n-Heptane	142-82-5	32.5	78.0	48.2	7.70	18.46	11.39	1.13	0.70	1.82
n-Hexane	110-54-3	21.2	78.1	40.7	5.83	21.49	11.20	0.73	0.58	1.31
o-Xylene	95-47-6	7.5	2.3	5.7	1.71	0.53	1.31	0.26	0.04	0.30
p-Dichlorobenzene	106-46-7	2.5	0.0	1.6	0.40	0.00	0.27	0.09	0.00	0.09
p-Ethyltoluene	622-96-8	0.7	0.0	0.5	0.15	0.00	0.10	0.03	0.00	0.03
Styrene	100-42-5	0.2	0.7	0.3	0.04	0.15	0.08	0.01	0.01	0.02
tert-Butyl alcohol	75-65-0	2.3	7.1	3.9	0.72	2.26	1.25	0.08	0.13	0.21
Tetrachloroethylene	127-18-4	136.4	382.1	220.8	19.49	54.58	31.54	4.72	6.91	11.62
Toluene (Methylbenzene)	108-88-3	55.3	112.5	74.9	14.22	28.93	19.27	1.91	0.63	2.54
trans-1,2-Dichloroethene	156-60-5	50.0	149.1	84.0	12.23	36.44	20.54	1.73	2.69	4.42
Trichloroethylene	79-01-6	5609.0	19522.7	10385.6	1011.75	3521.48	1873.35	193.93	352.87	546.80
Trichlorofluoromethane (CFC-11)	75-69-4	5.5	8.6	6.5	0.94	1.49	1.13	0.19	0.16	0.34
Vinyl chloride	75-01-4	4.4	4.5	4.4	1.66	1.70	1.67	0.15	0.08	0.23
Xylene (total)	1330-20-7	15.4	27.5	19.5	3.50	6.26	4.45	0.53	0.13	0.66
Total VOCs:		**8,550**	**31,025**	**16,285**	**1,739**	**6,394**	**3,337**	**295**	**548**	**843**

Notes, Abbreviations and Calculation on next page

Table B-12. Summary of Vapor Design Concentrations and Mass Loading Rates, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Notes, Abbreviations and Calculation:

1. Values for ND and NA results set to zero for design calculations.
2. Constituents shown are for analytes that were detected in one or more soil gas samples used for design purposes.

--	not analyzed
Bold	detected compound.
CAS	chemical abstracts service registry number
lbs/yr	pounds per year
ND	not detected
ppbv	parts per billion by volume
ppmv	parts per million by volume
ug/m^3	micrograms per meter cubed

$$\text{ppmv} = \frac{\text{mass removed}(\mu g)}{\text{air flow}(m^3)} \times \frac{0.0237}{\text{molecular weight}}$$

Table B-13. Preliminary NYSDEC DAR-1 Annual Guidance Concentration Air Modeling Analysis, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Discharge Temperature	T	560	°R
Ambient Temperature	T_a	525	°R
Exit Flow	Q	2086	scfm
Stack Height	h_s	30	ft
Building Height	h_b	8	ft
Ratio of Heights	h_s/h_b	3.75	
Plume rise credit? $h_s/h_b > 1.5$?	(If no, $h_e=h_s$)	(If Yes, $h_e = h_s + 1.1\ (F_m)^{1/3}$)	
Momentum Flux	$F_m = T_a/T * V^2 * R^2$	n/a	ft^4/s^2
Effective Stack Height	h_e	30.0	ft
Reduction Factor? $2.5 > h_s/h_b > 1.5$?	RF	No, do not reduce impact	
Actual Annual Impact	C_a	$RF*6*Q_a/h_e^{2.25}$	
Mass Flow	Q_a	S lbs emitted for last 12 months	

Notes, Assumptions & Abbreviations:

1. The stack discharge temperature is 100°F based on anticipated conditions.
2. The ambient temperature is estimated at 65°F for design purposes.
3. AGC refers to the Annual Guideline Concentration as determined using the hand calculations in the DAR-1 AGC/SGC Tables dated December 22, 2003.

CAS chemical abstracts service registry number
fps feet per second
scfm standard cubic feet per minute
ug/m^3 micrograms per cubic meter
lb/yr pounds per year
ppb parts per billion
°R = °F + 460

Table B-13. Preliminary NYSDEC DAR-1 Annual Guidance Concentration Air Modeling Analysis, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Compounds	CAS Number	Molecular Weight	Maximum Limit on C_a (AGC^3) ug/m^3	Maximum Allowable Annual Mass Flow Q_a lb/yr	Design Mass Flow per Year lb/yr	Percent of Maximum Allowable Annual Mass Flow %
1,1,1-Trichloroethane	71-55-6	133.4	1,000	351,052.10	7.50	0.00
1,1-Dichloroethane	75-34-3	99	0.63	221.16	1.88	0.85
1,1-Dichloroethylene	75-35-4	97	70	24,573.65	0.06	0.00
1,2-Dichloroethene	540-59-0	97	1,900	666,998.99	0.61	0.00
1,3-Butadiene	106-99-0	54.09	0.028	9.83	1.15	11.66
2,2,4-Trimethylpentane	540-84-1	114.22	3,300	1,158,471.92	0.01	0.00
2-Butanone (Methyl ethyl ketone)	78-93-3	72.11	5,000	1,755,260.49	1.86	0.00
2-Hexanone (Methyl n-Butyl Ketone)	591-78-6	100.2	48	16,850.50	0.08	0.00
4-Methyl-2-Pentanone	108-10-1	100.2	3,000	1,053,156.29	0.03	0.00
Acetone	67-64-1	58.09	28,000	9,829,458.74	8.21	0.00
Benzene	71-43-2	78.1	0.13	45.64	0.87	1.92
Benzene, 1,2,4-trimethyl	95-63-6	120.2	290	101,805.11	0.07	0.00
Bromomethane (Melthyl bromide)	74-83-9	94.95	5	1,755.26	0.00	0.00
Carbon disulfide	75-15-0	76.1	700	245,736.47	0.92	0.00
Carbon tetrachloride	56-23-5	153.8	0.067	23.52	0.26	1.10
Chlorobenzene	108-90-7	112.6	110	38,615.73	0.00	0.00
Chloroform	67-66-3	119.4	0.043	15.10	0.53	3.52
cis-1,2-Dichloroethylene	156-59-2	96.95	1,900	666,998.99	245.10	0.04
Cyclohexane	110-82-7	84.16	6,000	2,106,312.59	2.20	0.00
Dichlorodifluoromethane (CFC-12)	75-71-8	120.92	12,000	4,212,625.17	0.02	0.00
Ethylbenzene	100-41-4	106.2	1,000	351,052.10	0.15	0.00
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	187.4	180,000	63,189,377.62	0.38	0.00
m&p-Xylenes	NA	104.1	100	35,105.21	1.12	0.00
Methyl tert-butyl ether	1634-04-4	88.15	3,000	1,053,156.29	0.01	0.00
n-Heptane	142-82-5	100.21	3,900	1,369,103.18	1.82	0.00
n-Hexane	110-54-3	86.18	200	70,210.42	1.31	0.00
o-Xylene	95-47-6	104.1	100	35,105.21	0.30	0.00
p-Dichlorobenzene	106-46-7	147	0.09	31.59	0.09	0.27
p-Ethyltoluene	622-96-8	120.19	NA	NA	0.03	--
Styrene	100-42-5	104.15	1,000	351,052.10	0.02	0.00
tert-Butyl alcohol	75-65-0	74.12	720	252,757.51	0.21	0.00
Tetrachloroethylene	127-18-4	165.9	1	351.05	11.62	3.31
Toluene (Methylbenzene)	108-88-3	92.14	400	140,420.84	2.54	0.00
trans-1,2-Dichloroethene	156-60-5	96.95	1,900	666,998.99	4.42	0.00
Trichloroethylene	79-01-6	131.39	0.50	175.53	546.80	311.52
Trichlorofluoromethane (CFC-11)	75-69-4	137.38	NA	NA	0.34	--
Vinyl chloride	75-01-4	62.5	0.11	38.62	0.23	0.60
Xylene (total)	1330-20-7	104.1	100	35,105.21	0.66	0.00

Notes, Assumptions & Abbreviations:

1. The stack discharge temperature is 100°F based on anticipated conditions.
2. The ambient temperature is estimated at 65°F for design purposes.
3. AGC refers to the Annual Guideline Concentration as determined using the hand calculations in the DAR-1 AGC/SGC Tables dated December 22, 2003.

CAS chemical abstracts service registry number
fps feet per second
scfm standard cubic feet per minute
ug/m^3 micrograms per cubic meter
lb/yr pounds per year
ppb parts per billion
°R = °F + 460

ARCADIS

Appendix C

Preliminary Sampling and Analysis Plan

ARCADIS

To Be Provided Under Separate Cover

ARCADIS

Appendix D

NYSDEC Minor Facility Air Registration Form and Town of Oyster Bay Discharge Authorization Letter

New York State Department of Environmental Conservation
Air Facility Registration

DEC ID
- -

Owner/Firm				Taxpayer ID
				1 3 6 4 0 0 4 3 4
Name	Northrop Grumman Systems Corporation			
Street Address	Mail Stop Z18-025, 600 Grumman Road West			
City / Town / Village	Bethpage	State or Province NY	Country USA	Zip 11714-3583

Owner/Firm Contact		
Name	Larry Leskovjan	Phone No. 516-575-2333

Facility		
Name	Northrop Grumman Systems Corporation	
Location Address	Mail Stop Z18-025, 600 Grumman Road West, Bethpage, NY	
■ City / □ Town / □ Village	New York	Zip 11714-3583

Facility Information

Total Number of Emission Points: 1 (stack) | ☐ Cap by Rule

Description

Northrop Grumman Systems Corporation (NG) is implementing the Operable Unit 3 (OU3) Soil Gas Interim Remedial Measure (SG IRM) pursuant to the Order On Consent (Consent Order or CO) Index # W1-0018-04-01 that was executed by the New York State Department of Environmental Conservation (NYSDEC) and NG, effective July 4, 2005 (NYSDEC 2005). The present day Bethpage Community Park property (Park), which the NYSDEC has termed the "Former Grumman Settling Ponds Area" and designated as OU3, as well as the adjacent Plant 24 Access Road Property are collectively referred to herein as the Site. NG has elected to implement an Interim Remedial Measures (IRMs) soil gas mitigation system to address non-Freon 12 and non-Freon 22 related soil gas that may be emanating from the Park. The SG IRM will use a subsurface depressurization system (SDS) to prevent VOCs in the on-site soil gas from migrating off-site along the site southern and western property boundary (i.e. on the Plant 24 Access Road Property). SDS will consist of vertical extraction wells connected to regenerative type vacuum blowers to induce and maintain a vacuum in the subsurface. The collected soil gas will be vented through a 30-foot high stack located in the vicinity of the treatment buildings. Soil gas treatment will be provided during initial system operation through a single 10,000-lb carbon adsorption bed.

A summary of the anticipated design mass loading rate of individual VOCs along with a preliminary NYSDEC DAR-1 air model evaluation is provided in Appendix B, Table B-13, of the 95% Design Report.

Standard Industrial Classification Codes					
NAICS 336411					

HAP CAS Numbers					
See Table B-13					

Applicable Federal and New York State Requirements (Part Nos.)					
201-3.3 (29)					

Certification	
I certify that this facility will be operated in conformance with all provisions of existing regulations.	
Responsible Official	Title Deputy Commissioner
Signature	Date ____/____/____

7/29/96

NORTHROP GRUMMAN

Northrop Grumman Corporation
Integrated Systems

Eastern Region
600 Grumman Road West
Bethpage, New York 11714-5000

ESH&M-07L-049
September 6, 2007

Mr. Maurice J. Osman
Chief Chemist
Cedar Creek WPCP
3340 Merrick Road
Wantagh, New York 11793

Subject: Request for Discharge of IRM Condensate Water to Nassau County POTW, Northrop Grumman Systems Corporation, Bethpage, New York

Dear Mr. Osman:

Northrop Grumman Systems Corporation (Northrop Grumman) has prepared this letter to provide information to the Nassau County Department of Public Works (DPW) in regard to our plan to discharge water associated with the operation of a soil gas interim remedial measure (IRM) located at Former Grumman Settling Ponds in Bethpage, New York. We request that water associated with this activity be permitted to be discharged to the POTW. This letter provides DPW with details regarding the origin of the condensate water, an estimate of the anticipated quantity, and expected contaminant concentrations of the water that we propose to discharge to the POTW.

Northrop Grumman entered into Order On Consent (Consent Order or CO) Index # W1-0018-04-01 with the New York State Department of Environmental Conservation (NYSDEC) effective July 4, 2005. The present day Bethpage Community Park property (Park), which the NYSDEC has termed the "Former Grumman Settling Ponds Area" and has designated Operable Unit 3 (OU3) has been owned and operated by the Town of Oyster Bay since 1962. The CO allows the implementation of IRMs for OU3. In response to NYSDEC's December 22, 2006 letter to Northrop Grumman, Northrop Grumman has elected to implement a soil gas mitigation system as an IRM.

The soil gas IRM will consist of regenerative type extraction blowers connected to vertical vapor extraction wells. The purpose of the extraction blowers and wells will be to generate negative pressure within the subsurface soils; thereby preventing the offsite migration of volatile organic compounds (VOCs) from onsite soil gas. To protect the blowers from moisture damage, air-moisture separators will be installed immediately prior to the regenerative blowers. The moisture collected in the separators is essentially condensed water. It is anticipated that the concentration of total VOCs in the condensate will be less than 100 parts per billion (ppb) based on the analytical results of a recent pilot test conducted at the Site. It is anticipated that the condensate will be generated at a rate of less than 300 gallons per month based on the same pilot test. Water would most likely be transferred to the POTW as a monthly discharge (e.g., approximately 300-gallons of condensate will be transferred once per month via the existing sanitary sewer intake located on NG property).

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We expect that the soil gas IRM will begin operation in late October 2007. The duration of operation will depend on several factors and is currently unknown. However, it is anticipated that the soil gas IRM will operate for several years. We request that DPW issue written authorization for us to proceed with disposal of water to the Nassau County POTW, as described above. Should the system generate more condensate than currently anticipated, we will contact you promptly for a revision to the approval requested herein. If you have any questions or comments regarding the content of this letter, please contact David Stern of ARCADIS at (631) 391-5284.

Sincerely,

John Cofman
Lead Engineer

cc: David Stern, ARCADIS of New York