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From:
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Date:
August 14, 2009

ARCADIS Project No.:
NY001493.1109.00001

Subject:
Results of Groundwater Modeling Simulations and Environmental Visualization System Estimates conducted in support of the OU-3 Site Area Focused Feasibility Study, Northrop Grumman Systems Corporation, Bethpage, New York.

Summary

Results of modeling performed indicates that to capture all groundwater with total volatile organic compound (TVOC) concentrations greater than 5 micrograms per liter (µg/L) migrating beneath the Access Road would require supplementing the existing groundwater interim remedial measure (GW IRM) with four additional/deeper wells and pumping nearly double the GW IRM design flow rate.

Over the 30-year evaluation period, the Enhanced IRM (8 well system) removes approximately 10 percent more mass than the GW IRM (4 well system), but requires a system-wide groundwater extraction rate increase of approximately 86 percent.

Introduction

This memo summarizes the results of groundwater modeling simulations conducted in support of the OU-3 Site Area Focused Feasibility Study (FFS) for the Northrop Grumman Systems Corporation, Bethpage, New York. This memo describes the scenarios simulated, the applied modeling methodology, and simulation results.

Groundwater modeling was conducted using the IRM-design model, which was previously configured for flow and transport evaluation of the 4-well interim remedial system. The distribution of contaminant mass used for the modeling simulations was consistent with the TVOC mapped data as presented in the OU-3 Site Area Remedial Investigation Report (ARCADIS, 2008).

mass removed for the GW IRM. The GW IRM was predicted to extract 227,452 pounds of TVOCs from groundwater, while the Enhanced IRM was predicted to extract 251,061 pounds of TVOCs, an increase of only 10.4%. Likewise, at the conclusion of the 30-year simulation, the model-predicted TVOC concentrations in each of the Enhance IRM wells (RW-5 through RW-8) were less than 1 ppb.

In addition to the modeling scenarios described above, EVS (Environmental Visualization System) was used to estimate the mass and volume of impacted groundwater beneath the Site Area. **Table 4** summarizes the estimated TVOC volume and mass for groundwater with TVOC concentrations of more than 10, 100, 1,000, 10,000, 50,000 and 90,000 • g/L. The table includes the volume and mass of the aquifer in the impacted area, as well as the volume and mass of impacted aquifer water and the average TVOC concentration in the portion of the plume for the specified TVOC range.

Reference

ARCADIS, 2008. Figure 4. Suspected Groundwater Source Areas, Northrop Grumman Systems Corporation, Former Grumman Settling Ponds, Bethpage, New York, Operable Unit 3. September 11, 2008.

Table 1. Remedial Well Screen Zones and Pumping Rates, OU-3 Site Area Focused Feasibility Study, Northrop Grumman Systems Corporation, Bethpage, New York.

Well ID	Well Screen Elevation		Pumping Rate
	Top (ft msl)	Bottom (ft msl)	(gpm)
RW-1	20	-2	30
RW-2	41	22	75
RW-3	41	22	75
RW-4	18	-5	30
RW-5	-120	-140	75
RW-6	-200	-220	38
RW-7	-10	-25	30
RW-8	-200	-220	38

ft msl feet relative to mean sea level.
gpm gallons per minute.

Table 2. Model-predicted Mass Removed[1] by remedial Scenario OU-3 Site Area FFS, Northrop Grumman Systems Corporation, Bethpage, New York.

Well ID	Scenario 1	Scenario 2
RW-1	39	29
RW-2	216,840	237,090
RW-3	10,506	10,993
RW-4	67	68
RW-5	NA	853
RW-6	NA	181
RW-7	NA	1,534
RW-8	NA	313
Total Mass Removed [1,2]	**227,452**	**251,061**

NA - well not active in this scenario.
Scenario No.1 IRM (containment of all TVOCs>5 µg/L in the upper 20 ft of aquifer and containment of all TVOC>50 µg/L below the upper 20 ft of aquifer).
Scenario No.2 IRM + 4 additional wells (containment of all TVOCs>5 µg/L).
(1) Mass removed is expressed in pounds.
(2) Total model-predicted mass removed by remedial system after 30 years of operation.

TVOC: total volatile organic compounds.
µg/L: micrograms per Liter.
OU3: Operable Unit 3.

Table 3. Model-predicted TVOC Concentrations[(1)] in Extracted Water after 30 years of Remedial System Operation, OU-3 Site Area FFS, Northrop Grumman Systems Corporation, Bethpage, New York.

Well ID	Scenario 1	Scenario 2
RW-1	0.06	0.03
RW-2	716	795
RW-3	26	28
RW-4	0.00	0.00
RW-5	NA	0.76
RW-6	NA	0.04
RW-7	NA	0.86
RW-8	NA	0.69

NA - well not active in this scenario.
Scenario No.1 IRM (containment of all TVOCs>5 µg/L in the upper 20 ft of aquifer and containment of all TVOC>50 µg/L below the upper 20 ft of aquifer).
Scenario No.2 IRM + 4 additional wells (containment of all TVOCs>5 µg/L).
(1) Model-predicted TVOC concentations are given in micrograms per Liter.

TVOC: total volatile organic compounds.
µg/L: micrograms per Liter.
OU3: Operable Unit 3.

Table 4. EVS-based estimate of TVOC plume mass and volume above referenced iso-concentrations, OU-3 Site Area Focused Feasibility Study, Northrop Grumman Systems Corporation, Bethpage, New York.

Iso-concentration Range	Soil Vol	Soil Mass	TVOC Vol	TVOC Mass	Water Vol	Water Mass	Average TVOC Conc
• g/liter (ppb)	gallons	Pounds	gallons	Pounds	gallons	Pounds	• g/liter (ppb)
>10	365,671,300	6,598,995,000	17	145	73,134,260	610,311,700	237
>100	104,775,300	1,890,801,000	16	131	20,955,060	174,871,800	748
>1,000	12,040,940	216,752,500	10	83	2,402,189	20,046,470	4,161
>10,000	1,045,216	18,862,230	4	35	209,043	1,744,484	19,835
>50,000	14,952	269,827	0.18	1.51	2,990	24,955	60,393
>90,000	0	1	0.00	0.00	0	0	90,124

This estimate is based on the modeled groundwater concentration (i.e., mass dissolved in groundwater) and does not account for any continuing source of groundwater contamination that may be present, such as that simulated in the groundwater model as a continuing source term.
EVS: Environmental Visualization System.
TVOC: total volatile organic compounds.
µg: micrograms.
ppb: parts per billion.

Figure 1. Model-predicted TVOC concentrations for Remedial Scenario 1, OU-3 Site Area Focused Feasibility Study, Northrop Grumman Sytems Corporation, Bethpage, New York.

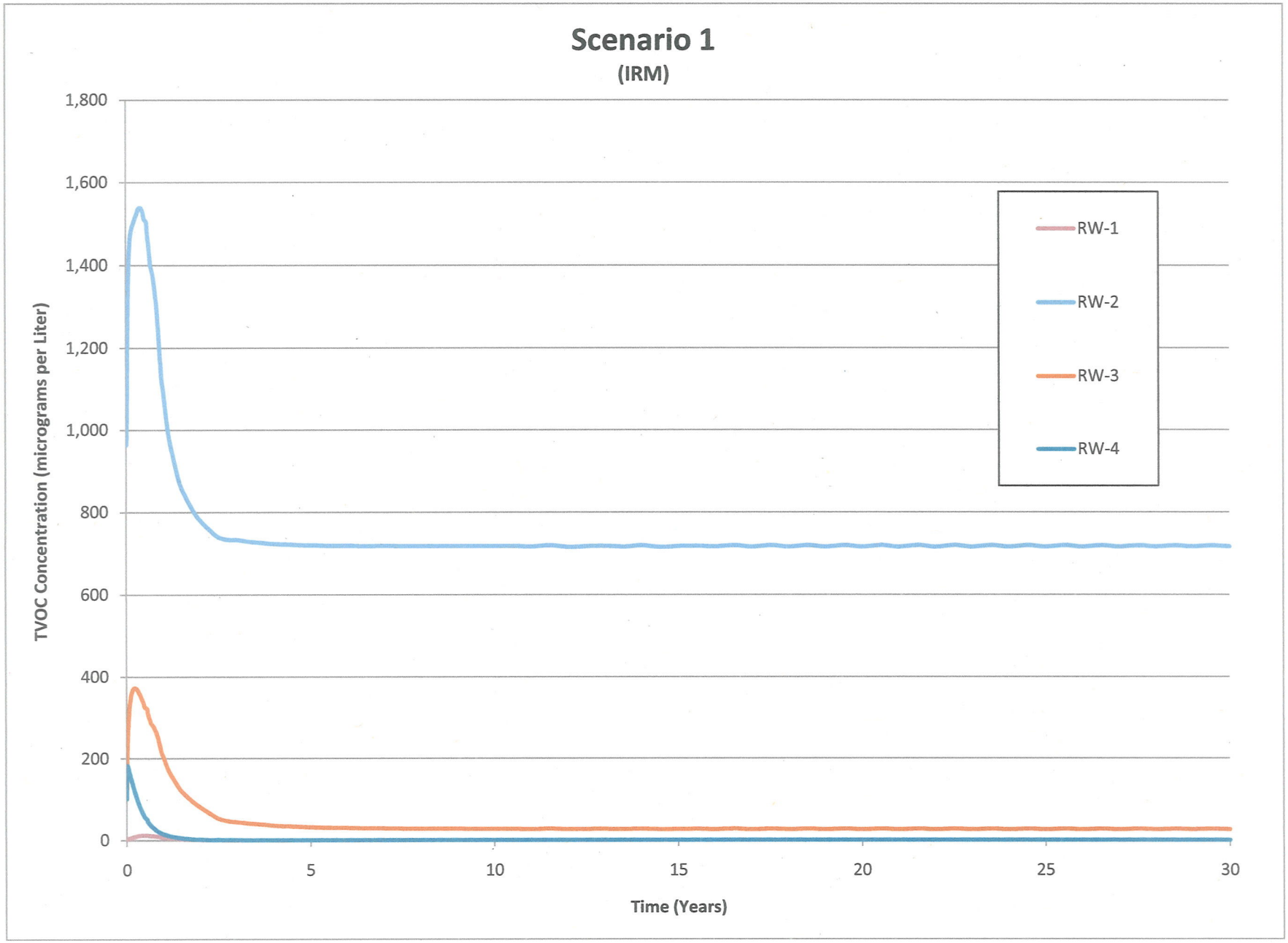

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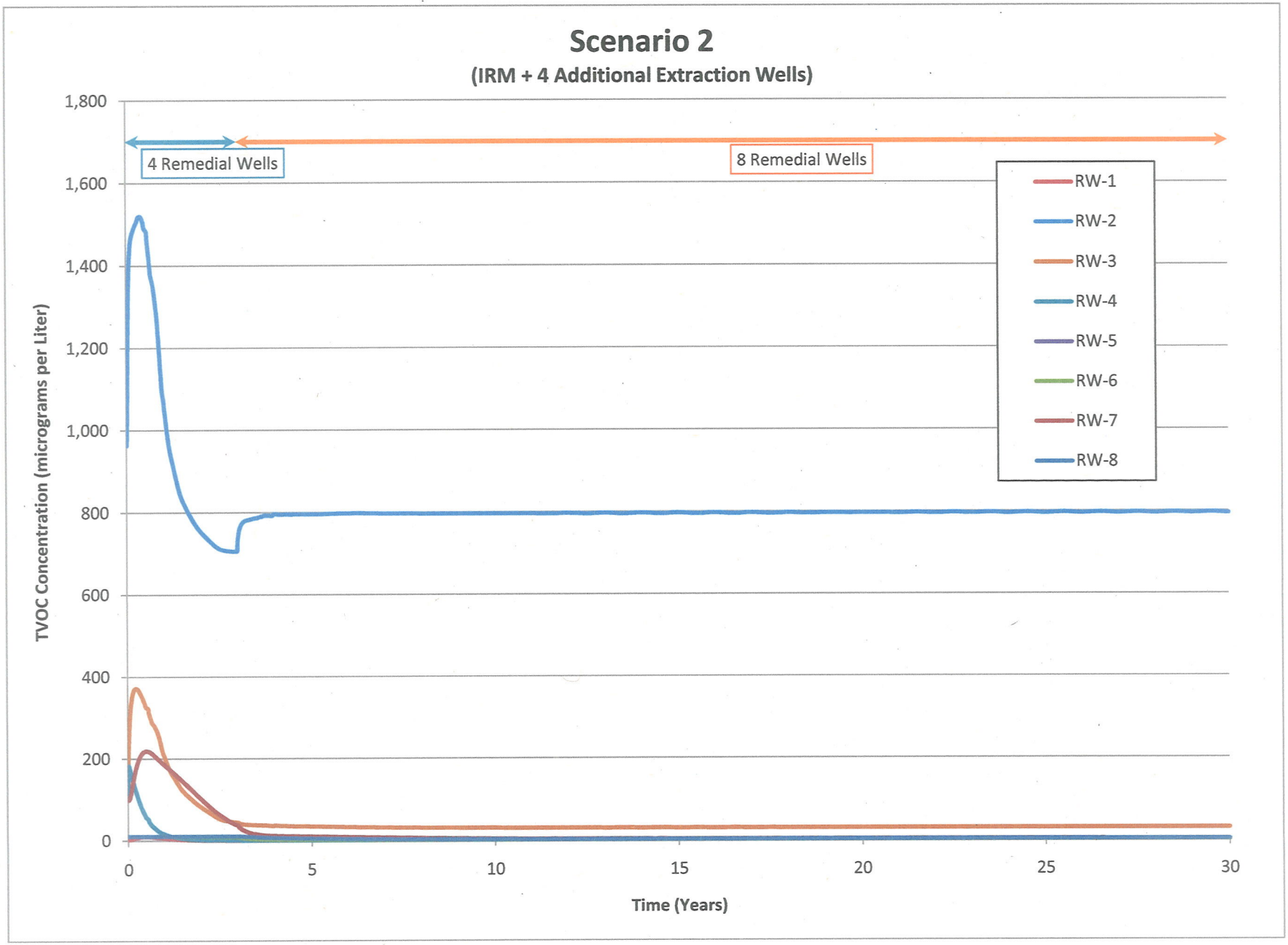
Figure 2. Model-predicted TVOC concentrations for Remedial Scenario 2, OU-3 Site Area Focused Feasibility Study, Northrop Grumman Systems Corporation, Bethpage, New York.



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