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MODEL IMPROVEMENT REPORTS

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LETTER
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Department of Energy
Fernald Environmental Management Project
P.O. Box 398705
Cincinnati, Ohio 45239-8705

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Mr. James A. Saric, Remedial Project Manager
U. S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Blvd.
Chicago, IL 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
40 South Main Street
Dayton, Ohio 45402-2086

Dear Mr. Saric and Mr. Schneider:

MODEL IMPROVEMENT REPORTS

Enclosed are the following reports and response to comments:

- Glacial Overburden/Upper Great Miami Aquifer System (GO/UGMAS) Development Report
- Sandia Waste Isolation Flow and Transport (SWIFT) Great Miami Aquifer Model, Summary of Improvement Report (Draft Final)
- Response to the United States Environmental Protection Agency (USEPA) comments on the Surface Water Flow and Infiltration Model Summary Report

The SWIFT Great Miami Aquifer Model, Summary of Improvement Report is provided as Draft Final and will be finalized upon receipt and resolution of EPA comments. The model improvement reports lay the foundation for the Operable Unit 5 (OU5) Remedial Investigation (RI) groundwater fate and transport modeling. The Department of Energy, Fernald Field Office (DOE-FN) offers these documents for EPA review as a culmination of the model improvement technical integration exchange process, and to facilitate resolution of potential issues regarding the modeling efforts prior to the June 24, 1994 submittal of the OU5 RI.

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Recycled and Recyclable

The Fernald Environmental Management Project (FEMP) has committed to providing these documents to the USEPA and Ohio EPA prior to the Technical Information Exchange (TIE) meeting scheduled for April 26. For your convenience, a one page synopsis of each modeling effort has been enclosed with each document.

If you or your staff have any questions, please contact Kathi Nickel at (513) 648-3166.

Sincerely,

FN:Nickel

Jack R. Craig
Fernald Remedial Action
Project Director

Enclosures: As Stated

cc w/enc:

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SYNOPSIS OF GLACIAL OVERBURDEN/UPPER GREAT MIAMI AQUIFER SYSTEM MODEL PHASE I DEVELOPMENT REPORT

Background

A modeling effort was conducted to assess and improve the modeling of groundwater flow and contaminant transport through the Glacial Overburden and Upper Great Miami Aquifer System (GO/UGMAS). A one dimensional analytical code for solute transport in homogenous, semi-infinite media (ODAST) was being used to model fate and transport in the GO/UGMAS. There was a concern that ODAST was not effectively simulating actual conditions due to the presence of multiple sources of contamination and the possibility of contaminants migrating laterally through coarser grained sediment pathways.

3-D GO/USMAS Model Description

* three dimensional SWIFT III finite difference code

* assumptions
  (1) the glacial overburden is saturated
  (2) the upper unsaturated sands and gravels of the Great Miami Aquifer are assumed to be saturated with only vertical transport
  (3) the upper layer of the model is highly permeable

* cross verification
  Multiphase Subsurface Transport Simulator Code (MSTS) used to assess whether assumption of saturated conditions resulted in a conservative result.

Conclusions

* modeling under saturated conditions produces higher (conservative) estimates of lateral flux than modeling under unsaturated conditions

* a saturated 3-D model can be used to reasonably assess plume migration through the GO/UGMAS; however,

* lateral migration of uranium is insignificant in relation to vertical plume migration; therefore,

* a one-dimensional vertical transport code (e.g., ODAST) can be used for Contaminant of Potential Concern (CPC) screening, and PRG development in the glacial overburden.

* Simple analytical models (e.g. ECTran) will be used to supplement ODAST to screen and evaluate the impact due to migration of contaminants (other than uranium) in the perched water zone of the GO/UGMAS.

SYNOPSIS OF SWIFT GREAT MIAMI AQUIFER MODEL SUMMARY OF IMPROVEMENTS REPORT

Objective

The objective of the model improvement program is to create a reasonable and defensible groundwater model that is acceptable to the US and Ohio EPAs for designated applications at the FEMP. The improved model will be used for: 1) performing CERCLA/RCRA Unit 5 (CRU5) RI fate and transport modeling; 2) supporting Feasibility Studies for the FEMP CRUs; 3) supporting relevant preliminary design efforts; 4) conducting performance modeling during detailed design; and 5) supporting clean-up operations.

Model Improvements

* grid expansion to the east and north
* addition of a model layer
* geostatistical analysis to understand and correlate spacial distribution of data sets
* transient flow, steady state flow, and solute transport calibration
* uncertainty and sensitivity analysis
* capture zone analysis of area pumping wells
* improved quality assurance program
* a post-audit program.

This document incorporates the previously submitted interim deliverables and summarizes the completed short-term model improvements tasks by presenting the approach and the results of each tasks.

Updated Data Utilized by Improved Model

* monitoring data from the 1990 to 1993 period
* monitoring data from new wells installed since original calibration
* Results of additional aquifer analysis to define K_d
* geostatistical analysis of data sets
* results from the South Plume Pumping Test
* data from construction and operation of the South Plume Recovery System
* output from additional models (glacial overburden, Paddys Run) to better define hydraulic and solute loading terms.

Summary and Conclusions

Quantitative comparisons between modeling results from the original and the improved GMA model were conducted to determine the possible impact of the model improvements on the previous applications using the original model (i.e., Operable Unit 1, 2, and 4 RIs). In general, the improved model is more conservative than the original model. However, the noted differences do not affect conclusions reached in all the previous applications of the original model.

SYNOPSIS OF THE SURFACE WATER FLOW AND INFILTRATION MODEL SUMMARY REPORT

Objective:

The objective of the Surface Water Flow and Infiltration Model (SWF&IM) Summary Report is to provide information concerning the hydrology and hydraulics of the Paddys Run drainage basin needed to conduct modeling of contaminant transport in the surface water at the FEMP site. The hydrologic/hydraulic results are combined with the surface water contaminant transport calculations conducted for each operable unit to yield the following information:

1) predictive surface water concentrations
2) predictive sediment concentrations
3) predicted annual contaminant loadings to the Great Miami Aquifer (GMA) from surface water infiltration

The contaminant loadings provide input to the groundwater solute transport model. The SWF&IM report does not present the source concentrations or the modeling results that are to be used in the OU5 RI baseline risk assessment. The modeling results will be presented in the OU5 RI report.

Model Description

The SWF&IM consists of several models used together to simulate the movement of surface water:

1) HEC-1 modeling code (USACE, 1990) - simulates rainfall and runoff
2) VS2DT (Healy, 1990)
   - two dimensional code that calculates infiltration from surface water to the GMA
   - simulates variably saturated flow conditions. Stream water depths, based on the runoff hydrographs from HEC-1 combined with the rating curves developed using Mannings equation (Henderson 1966), provide input into the VS2DT program to simulate the fluctuation of flow depths in the streams during a storm event.
   - output from the VS2DT provides the infiltration volume and pattern to the GMA along the length of Paddys Run and the SSOD.
3) Modified Universal Soil Loss Equation (MUSLE) - estimates the amount of sediment in surface water from a single storm event.
4) Universal Soil Loss Equation (USLE) - estimates the amount of sediment in surface runoff over a period of one year.

Contaminant transport calculations conducted for each source area predict the amount of contaminant adsorbed to the sediment and the amount dissolved in the surface water runoff using partitioning equations presented in the Superfund Exposure Assessment Manual

(EPA, 1988). Mixing of flow from areas with different concentration of contaminants is estimated using a mass balance approach. Based on the results of the single storm event and the annual precipitation, annual mass loadings to the GMA are estimated.

Sensitivity Analysis

In order to assess the model's uncertainty and its performance, sensitivity analyses on key parameters and model performance evaluations, respectively, were conducted on the surface water model. Surface water contaminant transport calculations are being completed for the OU5 RI using the hydrologic/hydraulic modeling results and the contaminant transport approach presented in the SWF&IM Report. Preliminary model performance evaluations indicate that the model is performing satisfactorily (i.e., the model is conservative) in comparisons of modeled and measured surface water concentrations, sediment concentrations, and the loadings to the GMA.