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RESPONSE TO OHIO EPA COMMENTS ON THE U.S. DEPARTMENT OF ENERGY'S SOUTH PLUME REMOVAL ACTION GROUNDWATER MODELING REPORT, APRIL 1992

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General Comments

Comment 1: The conclusions reached in the above-mentioned report seem to place too much credibility on the ability of the model to accurately predict the effects of well placement variation on the chemical migration. The current model lacks the required level of calibration to accurately differentiate between the alternate well schemes. For example, on page 5-1, line 8, the model is not accurate enough to reliably state that the currently proposed well field will deflect the inorganics plume by less than 20 feet. The position of the plumes is simply not that well known.

Response: DOE agrees that predictive results obtained from the FEMP local flow/transport model are limited. This limitation is due, in part, to the need for further calibration work. The FEMP transport model is not satisfactorily calibrated south of Willey Road. Until additional site specific data is obtained for the model domain pertaining to the SP, until the model mesh is further refined, until the northern PRRS plume boundaries are better delineated, and until additional calibration work has been conducted, predictions made using the FEMP local uranium transport model will remain questionable.

The SP recovery well field locations are not based on the FEMP local uranium transport model. Instead they are based on the FEMP local flow model, field based uranium contour plots, and particle tracking. Because of these inherent uncertainties, the recovery system has been designed in a conservative manner with excess pumping capacity, excess force main capacity, and additional stubs for future well connections. A periodic evaluation program will determine if the system is achieving its objectives and changes will be made based on the results of this evaluation (see DMEPP for further explanation).

Groundwater modeling was performed for the South Plume (SP) Removal Action (simulated flow vectors, linear velocities, and uranium concentration values) in an area where well control was sparse and where time predictions were queried. Recovery wells are being designed in a line normal to the axis of the plume. These recovery wells are best viewed as barrier wells with a significant capability of arresting uranium buildup at the proposed recovery location. They are based on the FEMP local flow model. Particle tracking (STLINE) was imposed on the local flow regime as estimated by SWIFT III governing flow equations under steady state conditions. Particle tracking results have been compared and integrated with field characterization data south of Willey Rd.

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The extent of the uranium plume in the South Plume Area is best determined using field-based uranium contour plots. South of Willey Rd, well control (for modeling purposes) is believed to be satisfactory along the eastern frontage of Paddys Run Rd. Predicted water levels near Paddys Run appear to be adequately calibrated. In the case of transport though, only three wells have been calibrated for uranium in wells south of Willey Road. Risk assessment time plots generated from FEMP local flow/transport modeling, over time intervals of 5, 10, 20, ... years at best postulate a southeasterly component and a moderate uranium concentration gradient on the western edge of the SP.

Because of the limited well calibrations for extrapolating uranium transport and the conservative approach to stress advective transport of uranium, particle tracking (STLINE) was emphasized in the SP well recovery field design. Particles seeded in the uppermost model layer suggest that the proposed configuration of SP recovery wells will have the least impact on the PRRS plumes. The cell size of the mesh south of Willey Rd. preclude accurately predicting particle deflections of the order of 20 ft. The particle tracking is initially constrained by the output flow vector and velocity from a SWIFT III cell. That output is generated from 125 ft cells. This mesh cell size of the SP improved the numerical stability in solving the governing flow equations but is too coarse to be employed in other routines to predict particle deflections of 20 ft.

Action: The modeling report will be revised to stress the use of the FEMP regional flow and FEMP local flow/solute model as an optimization tool rather than an accurate predictor of deflections in the PRRS plumes. Text will also be revised to emphasize the accuracy of the model predictions being made using the various groundwater model codes.

Additional site specific data will be obtained from the South Plume area during a planned pump test and the installation of additional monitoring wells under Parts 2 and 3 of the South Plume Removal Action. Work is proceeding (Part 5 of the South Plume Removal Action) to further delineate plume boundaries in the South Plume Area. Further calibration work is also planned (see response to OEPA comment #5).

Comment 2: The discussion on model sensitivity on page 4-7, lines 25-35 clearly indicates that the model is overly constrained in its ability to represent the groundwater flow system. The model does not include the local hydraulic variability on the scale of tens and hundreds of

feet, thus is not the referenced sensitivity analysis (i.e, variation of hydraulic conductivity and recharge) are not provided in the report.

Response: Flow parameters imported from the FEMP regional flow model to the FEMP local flow model might be off-scale in some areas of the model domain if localized hydraulic variability in those areas is high. Site specific hydraulic data to support modeled input parameters is sparse south of Willey Rd. However the calibrations of water levels on the western side of FEMP toward the SP area are less than 1 ft utilizing, for example, a hydraulic conductivity (K_h) of 450 ft/day in model layer 1 of the FEMP flow model. A limited number of wells though were utilized in the calibration of the SWIFT III FEMP regional flow model with April 1986 data. However flow predictions made using SWIFT III continue to match at 95% confidence intervals the water levels measured in wells along Paddys Run. The pronounced flow gradient patterns along Paddys Run are also repeated. Elsewhere in the SP area, well control is too sparse to confirm whether the FEMP local flow model is predicting flow patterns adequately.

Sensitivity analyses are necessary to assess how (1) changing hydraulic parameters, particularly in model layer 1 of the Great Miami Aquifer affect model performance; and (2) localized hydraulic parameters influence model performance.

Sensitivity analyses were conducted on the regional FEMP flow model. Sensitivity of horizontal hydraulic conductivity, for example, was performed on two interim calibrated runs prior to completion of the final 1986 regional FEMP flow model calibration. Because the runs were only on model layer 4 and 5, and associated with the FEMP regional flow model, it is uncertain how variable conductivities and recharge impact the FEMP local flow model performance in the SP area. Model performance by the FEMP regional flow system apparently is not sensitive to horizontal hydraulic conductivity, for example, because of the influence of the seepage of the Great Miami River. This is not unexpected but the river's influence may be limited in the area of the SP. ASI/IT (1990) does show that Darcian velocities increase 13 % up to a distance of about 7250 ft from the SOWC collector field but those velocity vectors are not situated in the SP area. Still local differences in hydraulic parameters may influence the SP predictions.

The range of horizontal/isotropic hydraulic conductivities that were bracketed by the sensitivity runs are attached; additional horizontal/isotropic hydraulic conductivities are provided that are

in ASI/IT (1990) and other reports.

Presently there is a task underway to validate the groundwater model in the vicinity of the south plume. This task is part of the design confirmation program as described in the South Plume Groundwater Recovery System, Design, Monitoring, and Evaluation Plan (Rev. 0, July 15, 1992). This task consists of a pump test, monitoring the groundwater elevation effects over the first quarter of the operation of the recovery well system, and validating the SWIFT site model using these data. Data collected from this validation process will be factored into model re-calibration work as deemed appropriate.

Sensitivity analyses will be performed for the upper model layers within the FEMP local flow/transport models. Spatially weighted statistical measures will also be performed to quantify the degree of uncertainty surrounding the wells south of Willey Rd.

Action: The report will be revised to emphasize the limitations of the modeling near the SP.

Comment 3: The Groundwater Report (ASI/IT, 1990) shows the predicted present plume (Figure 21-27) and the 70-year prediction (Figure 21-32), whereas this report shows the present plume (Figure 13). There is now way to easily inspect the simulated effects of the currently proposed well field. To illustrate the simulated effects of the proposed recovery well withdrawals, the report should display the predicted plumes at 5 or more years with and without the proposed well fields.

Response: DOE concurs with Ohio EPA comments.

Action: The report will be revised with figures and appropriate text describing the SP uranium transport with and without the planned recovery well field south of Willey Rd. Each figure will show output of the predicted uranium concentrations at 5, 10, 20, and 70 year intervals.

Comment 4: The predicted hydraulic head map (Figure 15) should include greater detail (i.e., a contour interval of 0.1 ft. on a separate smaller-scale figure) in the region near the well field. This will allow a better interpretation of the simulated capture zone.

Response: The accuracy of the hydraulic heads or water table elevations for model layer 1 are constrained by the FEMP regional flow model.

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Calibrated flow vector fields in the FEMP local flow model in the SP area may have error bars greater than 1 ft. This is actually uncertain because the sensitivity runs were limited to the lower layers of the model and do not have a bearing on model layer 1.

During pumping of the SP recovery well field the water table conditions will change and the drawdowns in the new potentiometric surface probably can be modeled with greater accuracy.

Action: DOE concurs with OEPA comment. The modeling report will be revised to include a predicted drawdown map with a smaller contour interval to obtain better definition of the drawdown in the vicinity of the recovery wells. The scale of the predicted potentiometric map will be enlarged to depict finer contour intervals.

Comment 5: There appears to be too much credibility placed on the predicted well performance in Figures 16 to 18. The simulated plume is a gross generalization near Paddy's Run. In the Groundwater Report, the two uranium measurements in layer 1 have residuals of -35.54 and 161.88 (Figure 21-11) and in layer 2 a residual of -116.19 ug/ is reported (Figure 21-12). Predicted concentration reductions in this area of the model are suspect as evidenced by the fact that deviations between measured and simulated uranium concentrations are on the order of the simulated well field concentration changes.

Response: The FEMP transport model is not satisfactorily calibrated south of Willey Rd. Three wells were utilized in model layer 1 and one was outside the 95% confidence limit. They are not triangulated across the predicted extension of the SP across Willey Rd.

The SP recovery well field locations were not based on the FEMP local uranium transport model. They were based on the FEMP local flow model. Particle tracking (STLINE) was imposed on the local flow regime as estimated by SWIFT III governing flow equations under steady state conditions. Model results were compared and integrated with field characterization data south of Willey Rd. DOE agrees that the model needs to be recalibrated but because of the SP recovery well field locations are not based on the FEMP local uranium transport model, the recalibration will not be addressed in the SP report.

Action: The SWIFT III FEMP local transport model will be re-calibrated using available and representative wells south of Willey Rd. and utilizing the original hydraulic parameters. This may improve the residuals and/or point out differences with the field-based uranium contour maps. Further, preparations will be made to perform a spatially

statistical analysis of the uranium concentrations of the SP. This will assist determining better the spatial variance of uranium. It has not been determined yet if a separate report for this activity will be issued or if the work will be appended to an existing or planned document.

Comment 6: The predicted heads in layer 1 of the local transport model (Figure 6) are clearly impacted by the assumed recharge distribution (groundwater report, Fig 20-15) and are not the same as those appearing in the groundwater report (Figure 20-19) in the area east of the village of Fernald and just west of the bedrock "island." The importance of this is that the spatial allocation of the recharge in this area significantly determined the convergence of the plume as it crosses Route 128. Furthermore, the degree of flow convergence directly determines the predicted easterly deflection of the particles from Paddy's Road Run Site. The sensitivity and importance of the recharge variations should be addressed and not simply dismissed on page 4-7.

Response: The predicted water table elevations of the GMA shown in Figure 6 are identical to those in Figure 20-19 of the Groundwater Report (ASI/IT, 1990). The isopleths in the area east of Fernald and west of the bedrock "island" are an artifact of the contouring package. The contouring program extrapolated points outside the model's aquifer cells and caused the contours to bend. The splining function in the contouring packages tend to "pull" contours toward the margin. This is evidenced by the flow arrows shown in the same figure, which do not flow out from the bedrock but flow near parallel with the model bedrock boundary. These same contours were deleted from Figure 6 of the Removal Action report due to their anomalous nature but were not edited out of the draft Groundwater Report (ASI/IT, 1990).

Action: No action required, as noted in response.

Comment 7: Results of the 72-hour aquifer test conducted in the vicinity of alternate water supply well AW-1 suggest that the hydraulic conductivity of the Great Miami Aquifer in the south plume area may be much greater than that used in the model. If this is the case, much higher pumping rates will be required for plume capture. DOE reports that the proposed recovery well locations will be optimum in any event (page 4-7, lines 25-26). However, if the pumping rates need to be doubled or tripled to achieve the desired plume capture, will the Part 3 IAWWT system have adequate capacity? DOE should conduct a bounding type analysis of its 72-hour pump test to

estimate a range of hydraulic conductivity consistent with the test data; and then report its results. What are the consequences for the removal action if the hydraulic conductivity in the south plume area is significantly higher than estimated by DOE? What contingency options are available to deal with the consequences?

Response: Results of the 72-hour pump test, designed to confirm water supply for Albright & Wilson Co., did not quantify hydraulic conductivities for the Great Miami Aquifer. The test was not conducted long enough to stress the aquifer. A pump test conducted to the north at Production Well-2 (within the modeled domain) by the USGS in 1962, resulted in a horizontal hydraulic conductivity (K_h) calculation of 267 ft/d. It is possible that the K_h is actual larger due to the partial penetration of the test well used during the 1962 test. A higher value (450 ft/day) has been employed in the FEMP flow model for the upper model layer. This value was also utilized in the SP recovery design as it represents the high end value for the calibrated upper model layer where the pump inlets are planned.

Each of the five recovery well screens/casings are designed for 800 gpm. The pumps are designed to be operated at a nominal 400 gpm each, but will be capable of operating at an upper range of 650 gpm if necessary. At 400 gpm, the capture zone analyses suggest that a hydraulic barrier be achieved. The IAWWT is designed for a SP pumping rate of 2000 gpm at 140 ppb uranium. A margin of safety is available in the event that flow and/or the concentration of uranium is greater than anticipated. Operating parameters for the IAWWT may need to be revised to increase thruput in the event that the margin of error is too great. Continuous evaluation of all factors (i.e., actual rate & concentration from the south plume, waste pit runoff control project, existing waste-streams) affecting the makeup of the 1700#/yr will be conducted, when the systems are operational, to see if further adjustments are required.

Action: The DMEPP has defined a program of periodic monitoring and system evaluations to determine if the recovery system is meeting the removal action objectives. Based on these results, system modifications will be implemented as necessary.

Specific Comments

Comment 8: Pg.#1-1, Line #36. Mercury is not a contaminate associated with the Paddy's Run Road Site (PRRS) and should be removed from this line.

Response: DOE concurs with OEPA comments.

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Action: Mercury will be deleted as per the comment.

Comment 9: Pg.#1-4. The last sentence in this paragraph appears to be misstated. Part 3 was expanded to ensure that no more than 1,700 lbs. of uranium would be discharged annually to the Great Miami River.

Response: DOE concurs with OEPA comments.

Action: The line will be corrected to read "...no more than 1700 pounds per year..." as per the comment.

Comment 10: Pg.#1-4. "will not" should be changed to reflect probability associated with modeling efforts. While this may appear trivial, Ohio EPA wants to stress the limits of numeric modeling to DOE. A model is at best a tool which can help a hydrogeologist make decisions which are based upon a sound knowledge of the hydrogeology of a site. A model can never be a substitute for good data.

Response: DOE concurs with OEPA comments.

Action: The line will be changed to read "Groundwater flow and solute transport modeling has been performed to determine a location where pumping of the recovery well field is predicted to not significantly affect the PRRS plume and to not draw PRRS contaminants into the recovery wells."

Comment 11: Pg.#1-4, Line#20. It is unclear to Ohio EPA if this is based upon actual data or a model prediction. This should be clarified by DOE.

Response: The line will be changed to stress that the data cited is based both on actual field observations and on model predictions.

Action: Line #20 will be revised as per the response.

Comment 12: Pg.#2-9, Line#1. DOE should give specific references; do not simply reference "scientific literature".

Response: DOE concurs with OEPA.

Action: The references of Anderson (1984; 1989) and Borg (1976) will be added to this line and included in the references.

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Comment 13: Pg.#2-9, Line#7. If geochemical investigation showed "that uranium is in complexes which have neutral or negative charges; such charges imply low retardation," then why does DOE use a retardation factor of 12 in the ground water model? This should be explained in detail by DOE and should be supported with the appropriate field data.

Response: Site specific differential uranium leaching analyses for aquifer solids taken from split-spoon cores in the SP were collected to assist in the determination of retardation factors. South of Willey Rd., there were 3 samples collected from 2000-series wells and 1 sample collected from 3000-series wells. In combination with analytical results from groundwater in these wells, the arithmetic mean of uranium partitioning from solid to water was calculated as 2.38 l/kg (+/- 1.42 l/kg). The corresponding retardation factor is 25.75 (+/- 2 sigma = 10.98 - 40.52) employing a porosity of 0.25 and a bulk density of 2.60 g/cc.

This leaching technique recovers iron (FE) and manganese (MN) from any coatings on grains during the analyses. As a result, the uranium represents both recent uranium presumably from product releases at FEMP plus background uranium adsorbed onto solids in the GMA.

Aqueous speciation modeling of the groundwater in the GMA near the SP suggest a predominance of uranium carbonate complexes $UO_2(CO_3)_3^{-4}$, $UO_2(CO_3)_2^{-2}$, $UO_2(CO_3)^0$ and/or $UO_2(H_2PO_4)_2$. The predominance of negative-charged and neutral-charged uranium speciation in the sampled groundwater would suggest lower potential for uranium retardation. These complexes would tend to be repelled by negatively-charged clays in the GMA.

However, the presence of some Fe-compounds on aquifer solids in limited split-spoon cores would suggest that uranium may be retarded from entering into solution. The influence of Fe and Mn leaching influenced the selection of retardation factors of 9-12 into the FEMP local transport model. Equally significant, was the observation that lower retardation factors would have resulted in uranium predictions beyond the presently observed distribution of uranium south of Willey Rd.

Retardation is variable and competes with other geochemical processes that are difficult to model locally without site specific data south of Willey Rd. The governing equations of transport are dependent greatly on dispersivities which were estimated from the literature.

Action: The report will be revised to reflect the uncertainties associated with the model transport equations and emphasize the limited

laboratory analyses of aquifer solids and groundwater south of Willey Rd.

Comment 14: Pg.#2-9, Lines#17-31. A groundwater plume may not have a true mean concentration. If the concentration changes in time it may be, and probably is, related to temporal changes in geochemistry. Therefore, it is technically incorrect to average concentrations over a two year period of time for the sake of calibration.

Response: Time-averaged data were employed in the calibration of uranium at each well. It does not represent a mean of replicates at one time-slice at the well. With few wells available for calibration south of Willey Rd, in particular, multiple sampling rounds was the only viable substitute.

Aqueous speciation modeling suggests that the predominant uranium complexation will be carbonate or phosphate. It is unlikely that radical changes in speciation of uranium complexes will occur during the time-averaging period. Absolute concentrations will vary though as desorbtion occurs between the aquifer solids and the water column.

Selected time-series sampling and statistical autocorrelations will be employed to more fully measure absolute uranium concentration fluctuations. In the past, general inspection of uranium concentration vs. time plots for most wells did not exhibit great fluctuations. A 95% confidence limit on the time averages was employed in the calibrations. Outliers were not treated because the steady state modeling adjusts uranium predictive values to a normal distribution. The FEMP local transport model was not run under a transient mode. Dynamically changing uranium concentrations in the SP are difficult to predict under the present model design.

Action: The report will be revised to emphasize the uncertainties associated with time-averaging and the limitations of the FEMP local transport modeling.

Comment 15: Page#3-1, Lines#24-29: It is unclear to Ohio EPA as to how DOE determined that the error in the model indicates that source loading was greater in the past. Ohio EPA believes that this error could also represent incorrect values for attenuation and hydraulic conductivity.

Response: FEMP local transport model predictions of uranium are calibrated on a few wells south of Willey Rd. The residuals are poor and it is unclear if the input parameters are accurately reflecting the

transport processes beneath parts of FEMP. The gross geometric patterns of the SP component at FEMP match the observed gross patterns. Site specific parameters, such as retardation of uranium, dispersivity, and hydraulic conductivity, may significantly influence local perturbations of the SP.

The residuals are probably a combination of SWIFT III model performance, lack of site specific model input parameters, and uncertain loading patterns of uranium at FEMP.

Observed geochemical parameters including uranium distribution suggest at least two loading source regions for anomalous contamination on the western FEMP area (i.e., Waste Pit area and the SSOD area). The existing SP has either separated from its loading term under the waste pits and/or is sourced from historical releases in the SSOD area. There is an observed gap between the SP and the waste pit area. Present uranium data in the waste pit area suggest continued fingering between the 2000 and 3000-series depths. Transport from the 1000-series to the 2000 series depths appears to have been slowed. Presumably past loadings at the 2000 series have since been transported to the present SP configuration. Or that with the aid of Paddys Run losing reaches has allowed contamination to enter the water table of GMA near the confluence of the SSOD.

Action: The report will be revised to emphasize the uncertainty of the FEMP local transport model to simulate changes in the distribution of uranium.

Comment 16: Pg.#3-1, Lines#38-3-2. This section describes modeling of the alternate water supply area. DOE does not have any site specific hydrogeologic data for this area. Such data is necessary for model calibration.

Response: A water-supply type pump test was performed in AWS-1. The water table drawdown was measured on a datalogger for up to 72 hours in observation piezometers. The drawdown was minimal and time-drawdown plots could not resolve hydraulic parameters such as conductivity.

Nevertheless, particle tracking superimposed on the FEMP local flow model suggested no influence of the AWS-1 pumping (500 gpm) on the present observed configuration of the SP uranium.

Action: The report will be revised to clarify the applicability of the water-supply well testing and the FEMP regional and local flow modeling.

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Comment 17: Pg.#3-2, Lines#27-34. The Ohio EPA recommends that DOE develop contingencies which will allow for the installation of additional capture wells if it is determined that they are necessary to meet the goals of the interception system. Site specific data for this area will not be obtained until after the first recovery well is installed. As a result, DOE has used a ground water model which is not capable of accurately determining contaminant concentrations to provide information on the location of interception wells. This was deemed by GeoTrans to be an unacceptable use of the ground water model. This practice is inverse of the accepted use of ground water models. Ground water models are intended to provide a hydrogeologist with tools to take existing site specific hydrogeologic data and extrapolate out the effects of time and influence. Once the conceptual model is created, the standard scenario for modeling is:

1. Estimate hydrogeologic values based upon published data for the general area.

2. Obtain site specific data.

3. Input site specific data into the ground water model.

4. Calibrate the model based upon observed data and existing site specific data.

5. Verify the model over time.

Because DOE did not input site specific data and use regional area data, the effectiveness of the model is greatly reduced. When such a model yields contaminate concentrations twice those which are observed, the only logical conclusion is that the confidence in the ground water model to represent real conditions is further minimized.

Response: The design of this well field provides pipe stubs and flow capability for the installation of additional capture wells if it is determined that they are needed to meet the goals of the interception system. It has been suggested that alternative/additional recovery wells be orientated longitudinal to the axis of the plume. Capture zone analyses were performed on transverse well recovery fields at New Haven Rd. and at incremental distances toward Willey Rd. The combination of adequately calibrated regional flow modeling, particle tracking on the FEMP local flow model, observed SP uranium concentrations, and the general position of the PRRS plumes is sufficient to plan the first transverse recovery well field.

This first well field should act as a barrier and arrest the axial portion of the plume. Site specific data acquired during the pump testing will be used to better determine model parameters and thus improve predictive capabilities of the FEMP local flow model. In parallel, additional geochemical analyses are needed to better constrain the modeled geochemical input parameters to the FEMP local transport model.

It is arguable whether the transport modeling will ever accurately reflect the contamination transport processes. It may ultimately be necessary to rely more heavily on particle tracking.

The FEMP local flow model will be refined with a finer mesh and will benefit from the results of the SP pumping. Particle tracking will be seeded at more numerous increments throughout the thickness of the GMA.

The existing FEMP regional flow model has performed reasonably well. The residual water levels are about 1 foot and the simulated gradients are similar to those observed. It is recognized that the input data and scaling of the FEMP local flow model from the FEMP regional flow model will probably need to be modified after the SP pump test is completed. Residuals will be continuously improved as more wells become available.

Action: Additional modeling will be conducted using results of the SP pump test coupled with a finer model mesh.

Comment 18: Section#4.0. In order to allow the reader to better visualize the affects of various pumping scenarios on the PRRS plums, a current state or no action (baseline) scenario map should be provided within the work plan.

Response: A no-action alternative utilizing particle-tracking and 5-year predicted uranium concentration maps with text will be amended to the report.

Action: As noted in the comment.

Comment 19: Page 4-1, Section 4.X. The Ohio EPA comments on the modeling effort apply to this section as well as the ones previous. However, the actual final locations of the interception wells appear to be acceptable based upon the limited data which exists. These locations could change if the assumptions prove to be incorrect. As a safeguard, Ohio EPA recommends the use of a ground water monitoring

program specific to the interception system to determine the effects of the system upon the FEMP plume and the PRRS plume. Because the advanced waste water treatment system is not designed to treat contaminates found in the PRRS plume, the condition closely resembles a wellhead protection issue. It is important to closely monitor the PRRS plum to guarantee early warning of its impact on the interception system.

Response: The present Part 5 hydropunching program and Part 2 piezometer and monitoring well installation program are specifically designed to verify the vertical depth of the proposed five well recovery system. Provisions for future flexibility in system reconfiguration are being provided in the well field design. The Design, Monitoring, and Evaluation Program Plan (DMEPP), recently issued for U.S. EPA and Ohio EPA review, defines detailed programs to periodically monitor and evaluate the operation of the recovery well system so that South Plume Removal Action objectives are continually met. The DMEPP also includes provisions to modify the system based on the evaluation findings.

Action: None beyond those currently planned and discussed in the response.

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Attachment

Great Miami Aquifer Horizontal Hydraulic Conductivities:

ft/d	Reference	Source
330	Dove (1961)	pump test
328-534	Smith (1962)	pump test
120	Klaer (1968)	pump test
318-368	Kazmann (1950)	pump test
326-371	Shaefer and Walton(1956)	flow-net analysis
312-323	Klaer and Kazmann (1943)	pump test
267	Speiker and Norris(1962)	pump test
334-403	Lewis (1968)	pump test
774	Smith (1960)	pump test
270-446	Speiker (1968)	estimated
100-280	Papadopoulos (1984)	pump test
20(?)-520	ASI/IT (1990)	estimated
270-370	Dames and Moore (1985)	estimated
334-403	CH_2M-Hill (1987)	pump test
318-397	Geotrans (1985)	estimated
133-419	Fang (1992)	estimated