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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankowsky *John Jankowsky*
Date: 6/22/94
Subject: Model Selection for OU7 Groundwater Modeling

Wayne:

Stoller is modeling the groundwater in the immediate vicinity of OU7, the Present Landfill, as part of its decision document for the OU7 Leachate IM/IRA.

At the present time, we are using analytical solutions to examine various scenarios for the capture of contaminants. These analytical solutions include the Theis solution and the Hantush-Jacob solution. We are at the early stages of formulating the problem for input into MODFLOW.

We selected MODFLOW combined with MT3D as our numerical modeling software for the following reasons:

- A critical part of the OU7 modeling effort is modeling two layers: surficial materials and weathered bedrock; MODFLOW and MT3D have three dimensional modeling capabilities, while other models that were considered, such as MOC, do not.
- MODFLOW and MT3D are well documented, widely used, and well validated.
- The sitewide groundwater modeling effort at Rocky Flats is using MODFLOW. Use of MODFLOW at OU7 will enhance the possibility of integration of the modeling efforts.

Per your suggestion, we will also be examining the possibility of using PATH3D as an alternative to MT3D

If I can be of any further assistance, please call me at 546-4412.

ADMIN RECCRD

BZ-A-000472

1/45

The S.M. Stoller Corporation
Informal Memorandum

To: Wayne Belcher, EG&G
From: John Jankovsky *John Jankovsky*
Date: 6/24/94
Subject: Progress Report for OU7 Groundwater Modeling

Wayne:

As stated in my memo to you regarding the selection of MODFLOW, we are currently using analytical solutions to examine various scenarios for the capture of contaminants. These analytical solutions include the Theis solution, the Hantush-Jacob solution, and flownet analysis. We are at the early stages of formulating the problem for input into MODFLOW.

I would estimate the modeling effort to be 5% complete.

If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G

**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 6/30/94
Subject: Progress Report for OU7 Groundwater Modeling

Wayne

I am sending this report on Thursday because I am on vacation Friday, July 1

My work on the modeling was postponed this week because of the change in emphasis for the first Decision Document to the seep at SW097

My only actions on the modeling were reviewing a literature package on PATH3D and talking on the phone with Gehrity and Miller with some questions about MODELCAD We are taking the necessary steps to purchase both of these packages.

I estimate the modeling effort to be 5% complete (no change from last week).

If I can be of any further assistance, please call me at 546-4412.

cc. B. Caruso, Stoller
 L. Peterson-Wright, EG&G

Post-It™ Fax Note 7871		Date	# of Pages 1
To	L. Peterson-Wright		From J. Jankousky
Co./Dept.			Co.
Phone #	966 8704	Phone #	546 4412
Fax #	5	Fax #	

**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 7/8/94
Subject: Progress Report for OU7 Groundwater Modeling

Wayne:

Once again, work on the modeling was postponed because of the change in emphasis for the first Decision Document to the seep at SW097.

I hope to have the MODELCAD software by the end of next week and should start on grid definition soon afterward.

I estimate the modeling effort to be 5% complete (no change from last week)

If I can be of any further assistance, please call me at 546-4412.

cc. B Caruso, Stoller

L. Peterson-Wright, EG&G

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To	L. Peterson-Wright	
From	J. Jankousky	
Co.		
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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 7/15/94
Subject: Progress Report for OU7 Groundwater Modeling

Wayne

Once again, I worked on options analysis for the Leachate IM/IRA and not on modeling.
 The MODELCAD software has not arrived as of 1 p.m., but should arrive either today or Monday
 I estimate the modeling effort to be 5% complete (no change from last week)
 If I can be of any further assistance, please call me at 546-4412.

cc: B Caruso, Stoller
 L Peterson-Wright, EG&G

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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 7/22/94
Subject: Progress Report for OU7 Groundwater Modeling

Wayne

I received the MODELCAD software on Tuesday of this week. I have installed the software and familiarized myself with it. I had our GIS person generate some .DXF files and some XYZ files for input into the model. I began the construction of the model grid in MODELCAD

Next week, I will call you regarding weathered bedrock topography outside of the map area I currently have. I may also want to discuss boundary conditions and any other issues that come up.

I estimate the modeling effort to be 10% complete.

If I can be of any further assistance, please call me at 546-4412

cc B. Caruso, Stoller
 L. Peterson-Wright, EG&G
 M. Vaag, Stoller

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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 7/29/94
Subject: Progress Report for OU7 Groundwater Modeling

Wayne.

I completed the construction of the model grid in MODELCAD this week. I am running MODFLOW and refining the grid and boundary conditions

I spoke with Mark Tufius after I talked to you. He had not received the bedrock topography information as of 1 pm, but was expecting it today. He says that the information may require some manipulation by him to put it in a usable form for me. I will incorporate the information as it becomes available to me.

Next week I will continue to calibrate the model. Our meeting on Wednesday at 9:30 should help ensure that the model is progressing in the proper manner.

I estimate the modeling effort to be 20% complete.

If I can be of any further assistance, please call me at 546-4412

cc. B. Caruso, Stoller
 L. Peterson-Wright, EG&G
 M. Vaag, Stoller

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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankovsky
Date: 8/4/94
Subject: Progress Report for OU7 Groundwater Modeling

Wayne:

I am on vacation tomorrow, August 5, and will return on August 15.

This week I worked on calibration of the model. More work remains to be done. Our Wednesday meeting was helpful.

Mark Tulias has received the bedrock topography, thickness of alluvium, and thickness of the UHSU information. He passed it along to me in the form of XYZ files. I will need to do some manipulation to incorporate the information into my grid. Per our discussion, I will use the OU 7 Work Plan contours where they are available, and the new information outside of the OU 7 contour area. I plan to work on this starting on August 15.

I estimate the modeling effort to be 25% complete.

If I can be of any further assistance, please call me at 546-4412

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

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To	Wayne Belcher	From	John Jankovsky
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Post-It™ brand fax transmittal memo 7671		# of pages ▶	1
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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 8/19/94
Subject: Progress Report for OU7 Groundwater Modeling

Wayne

This week I incorporated the new XYZ files for top and bottom of weathered bedrock that I received last week from Mark Tullius. I used the OU 7 Work Plan contours where they were available.

I worked extensively on varying the solver parameters to make the solution more stable and reduce the size of the areas that dry out in the model. I ran both steady state and transient runs.

I met with Barry Roberts at Interlocken on Friday afternoon. Our discussion was helpful to me

Next week I will work on inputting a stream below the landfill dam per your (and Barry's) suggestion. I will also work on refining an input head file and comparing model results to actual heads.

I estimate the modeling effort to be 30% complete.

If I can be of any further assistance, please call me at 546-4412

cc: B Caruso, Stoller
 L. Peterson-Wright, EG&G
 M. Vaag, Stoller

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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankowsky
Date: 8/26/94
Subject: Progress Report for OU7 Groundwater Modeling

This week I completed the following actions on the OU7 modeling.

- Built SURFER head files to use as starting heads for layer 1 and 2
- Added GHB below landfill dam to simulate a stream. I would like to discuss with you the use of the GHB as opposed to the stream boundary for this case.
- Experimented with different GHB conductances as well as no-flow boundaries in certain locations.
- Added drain and low K cells to simulate the groundwater intercept around the landfill. I would like to talk with you about the conductance values you are using for the drain in your solution.
- Added low K cells at landfill dam.
- Began using the MODELCAD CALSTATS package to compute residuals from actual well elevation data.
- Checked the top of weathered bedrock location from all well borehole logs against my model grid bottom of layer 1 elevation. Made several adjustments based on borehole logs.
- Added secondary stream to the northeast of the landfill dam as a GHB

Next week I will continue to calibrate the flow I estimate the modeling effort to be 35% complete

If I can be of any further assistance, please call me at 546-4412

cc B Caruso, Stoller
 L Peterson-Wright, EG&G
 M Vaag, Stoller

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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 9/2/94
Subject: Progress Report for OU7 Groundwater Modeling

This week I completed the following actions on the OU7 modeling.

- Continued using the MODELCAD CALSTATS package to compute residuals from actual well elevation data.
- Varied the GHB conductances and heads in calibrating the model.
- Varied hydraulic conductivities in individual cells to calibrate the model heads
- Placed constant head boundary in Layer 2 for the pond and GHB in Layer 2 for the stream channel below the dam. The first is probably justified, since the pond is in contact with weathered bedrock. The second may not be justified - I will run iterations both with and without this GHB to determine the need for it.
- Installed Path3D software; worked some with example problems.

At this time, the flow model for the top layer is in pretty good shape. Layer 2 consistently mirrors Layer 1, indicating that adjustments to vertical Ks are in order.

Next week I will continue to calibrate the flow in both layers. By the end of next week, I hope to add a drain to simulate the proposed seep IM/IRA. The next step will be to estimate flows to the drain using the model and use Path3D to show particle capture. I estimate the modeling effort to be 40% complete.

If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
 L. Peterson-Wright, EG&G
 M. Vaag, Stoller

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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 9/9/94
Subject: Progress Report for OU7 Groundwater Modeling

This week I completed the following actions on the OU7 modeling.

- Made some more minor adjustments to calibrate the flow model
- Removed the GHB in Layer 2 for the stream channel below the dam
- Began work with Path3D using the existing flow model

I have not yet added a drain to simulate the proposed seep IM/IRA. I will do that next week. I will also continue working with Path3D. I estimate the modeling effort to be 45% complete.

If I can be of any further assistance, please call me at 546-4412

cc B Caruso, Stoller
 L. Peterson-Wright, EG&G
 M. Vaag, Stoller

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To Wayne Belcher	From John Jankousky	
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AUG-31-94 WED 13:28
TERRAMATRIX INC.

AQCTD
ID:3038799048

FAX NO. 303 868 8575 P. 02
HUG 24 '94 10:52 AM 8.04

FAX M. Yang and M. Eisenbeis
August 24, 1994
Page 2

Cover Soil Barrier Layer

1. Identify borrow source
2. Index tests (moisture content, sieve, hydrometer, specific gravity, and Atterberg limits)
3. Proctor compaction
4. Permeability
5. Triaxial strength
6. Interface direct shear
7. Drying and shrinkage potential

We discussed that a lot of this data may be available from the design studies for the new landfill. Is there any new information on the status of this? Even if testing data is available, we may have to do some additional work that will reflect the loading conditions for a cover.

Please call if you have any questions.

Gravel + Compaction

AUG 24 '94 11:34

3038799048

PAGE. 002

**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 9/23/94
Subject: Progress Report for OU7 Groundwater Modeling

I worked on the OU7 modeling approximately one-quarter time this week.

I followed up on some of the things we talked about in our meeting last week. These include.

- Ran the model with vertical hydraulic conductivities set to 1/100 of horizontal conductivities instead of 1/10
- Ran the model with all layer 2 hydraulic conductivities increased one order of magnitude in an attempt to lower heads.
- Ran the model with leakance specified instead of allowing MODELCAD to calculate the leakance.

None of these solutions showed any improvement over my previous solution. In fact, each of them was slightly worse than the previous solution.

In order to better understand the model, I spent some time sorting and studying the cell-by-cell flow terms. Based on the cell-by-cell terms, I changed some of the boundary condition heads.

Some of the comments on our PAM questioned the expected flow values that were presented. I spent some time reviewing an analytical solution I did a few weeks ago as well as attempting to confirm this estimate by summing certain of the cell-by-cell flow terms. I will try to have an informal report on this estimate by Wednesday, September 28. I will drop off a copy for you so you can review it if you like.

Next week, in addition to completing a flow estimate report, I will continue the analysis of the cell-by-cell terms and try to improve the flow calibration.

I estimate the modeling effort to be 47%. If I can be of any further assistance, please call me at 546-4412.

cc: B Caruso, Stoller
 L. Peterson-Wright, EG&G

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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankowsky
Date: 10/7/94
Subject: Progress Report for OU7 Groundwater Modeling

This week I worked on the following items regarding the OU7 groundwater modeling.

- I stopped work on the flow report for the seep collection flows because the scope of work for the PAM has changed. We are no longer going to collect subsurface flow at the seep. My results were showing approximately 2 gpm flow to the pond at high flow; approximately 0.5 gpm of this flow was captured by a simulated drain located at the leachate seep.
- Did some final calibration of the flow model to reduce the head at well 4087 below the landfill dam
- Used Path3d to simulate the movement of particles in layer 1 and layer 2. Using the current model, particle movement in layer 2 is very slow. This is to be expected, the geometric mean of the hydraulic conductivities is $4E-7$ cm/sec. However, using this K value results in heads that are too high in many locations (where layer 2 is actually partially unsaturated). I will try some higher K values and reevaluate the heads and particle tracking.
- Next week I hope to begin simulation of the final remedy, including a new slurry wall and some type of groundwater collection (drains or wells).

I estimate the modeling effort to be 55%. If I can be of any further assistance, please call me at 546-4412

cc B Caruso, Stoller
 L Peterson-Wright, EG&G
 M. Vaag, Stoller

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Groundwater

**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 10/14/94
Subject: Progress Report for OU7 Groundwater Modeling

Thus week I worked on the following items regarding the OU7 groundwater modeling:

- Completed one run with higher K values in layer 2. Output was not significantly changed. Constructed well hydrographs for certain bedrock wells. Some bedrock wells fluctuate from complete saturation to partial saturation repeatedly. These fluctuating water levels indicate to me that some water is moving through the weathered bedrock at rates greater than those expected for a homogenous aquifer with $K = 10^{-7}$ cm/sec.
- I began simulation of one possible final remedy, including a new slurry wall and groundwater collection. I may need to refine the grid at the slurry wall and at the collection points. I will try to talk to you about this in the near future.
- I would like to discuss the usefulness of PATH3D output versus MT3D output with you and with other members of the project team. I spoke to Myra Vaag, our project manager, who stated that the modeling is in support of the IM/IRA only, not in support of the subsequent risk assessment. However, concentration values below the dam in particular may be valuable in choosing collection methods and collection locations.
- I prepared a presentation for the modeling meeting at Woodward-Clyde on Thursday. I attended the meeting.

I estimate the modeling effort to be 58%. If I can be of any further assistance, please call me at 546-4412

cc B. Caruso, Stoller
 L. Peterson-Wright, EG&G
 M. Vaag, Stoller

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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 11/11/94
Subject: Progress Report for OU7 Groundwater Modeling

This week I completed the following on the OU7 groundwater modeling:

- Completed flow and particle tracking runs on two of the proposed remediation scenarios. I am having some difficulties with the PATH3D program that I am working on clearing up.
- Wrote text for the alternatives assessment regarding the required depth of the slurry wall. It is my opinion at this time that the OU7 slurry wall needs to key into the weathered bedrock but does not need to fully penetrate the weathered bedrock.

Next week I hope to solve my difficulties with the PATH3D program and continue work on the analysis of scenarios. I am thinking about how to best organize my output and analysis for inclusion in the text and in an appendix of the decision document. I estimate the modeling effort to be 70% complete. If I can be of any further assistance, please call me at 546-4412.

cc. B. Caruso, Stoller
 L. Peterson-Wright, EG&G
 M. Vaag, Stoller

Post-It™ brand fax transmittal memo 7871		# of pages	221
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Post-It™ brand fax transmittal memo 7871		# of pages	221
To	Wayne Belcher		
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Phone #	546 4412		
Fax #	966 8663		

**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankowsky
Date: 12/2/94
Subject: Progress Report for OU7 Groundwater Modeling

This week I completed the following on the OU7 groundwater modeling:

- Presented to EG&G, DOE, and Stoller the results of flow and particle tracking runs on the eight initially proposed remediation scenarios at our Wednesday meeting. DOE representatives expressed a desire to know how the contaminant concentrations will decline over time.
- Talked to Barry Roberts to compare hydraulic conductivity values used in his model and in my model. The values match quite closely.
- Reexamined the base case scenario and attempted to recalibrate to allow more water into the model. I ran this model but have not post-processed the results yet.

Next week I will postprocess the results of my attempted recalibration and see if that recalibration is worth pursuing. I will also begin looking at the requirements of the MT3D package for concentration modeling. I estimate the modeling effort to be 74% complete. If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

Post-It™ brand fax transmittal memo 7671		# of pages	22
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The S.M. Stoller Corporation
Informal Memorandum

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 12/9/94
Subject: Progress Report for OU7 Groundwater Modeling

This week I completed the following on the OU7 groundwater modeling:

- Postprocessed the MODFLOW run that I recalibrated to allow more water into the model. Calibration is still good for the base case heads.
- Used the high flow model to simulate remediation scenario 2 (cap to dam, leave dam in, capture groundwater above and below dam). The amount of water captured under scenario using this high flow model increased from 0.8 gpm to approximately 1.0 gpm, an increase of 25%. I view this as an indicator that my existing scenario analysis are pretty good with respect to flow volumes.
- Began work on building MT3D files. Interrupted this work to spend some time examining the available analytical data. Examined data for volatile organics, semivolatile organics, metals, and radionuclides and attempted to correlate the concentration data to the flow regime. I am still working on this effort.

Next week I continue to work with the concentration data. One thing I will be looking at is the feasibility of using a simple qualitative model to examine the expected dilution and attenuation of contaminants as they travel from the landfill down No Name Gulch. I estimate the modeling effort to be 76% complete. If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

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**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankovsky
Date: 12/16/94
Subject: Progress Report for OU7 Groundwater Modeling

This week I completed the following on the OU7 groundwater modeling:

- Performed multiple groundwater containment and collection simulations based on four capping options presented last week by Pat Corser of TerraMatrix.
- As part the data evaluation task, I continued to analyze the analytical data. It is my opinion at this time that a concentration model such as MT3D would be very hard to calibrate. The main value I see from a concentration model for OU 7 is to model the plume below the dam to support an argument that groundwater collection below the dam is not needed. If this argument is not going to be made, I think that concentration modeling would have limited use.
- Examined the possibility of using simple qualitative model to examine the expected dilution and attenuation of contaminants as they travel from the landfill down No Name Gulch. This is possible, although estimating dilution would be difficult with the amount of data available.

I estimate the modeling effort to be 80% complete. If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

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Groundwater

The S.M. Stoller Corporation
Informal Memorandum

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 1/6/95
Subject: Progress Report for OU7 Groundwater Modeling

This week I completed the following on the OU7 groundwater modeling.

- Reran one remediation scenario with an extended slurry wall on the south side of the landfill to estimate the benefit of the longer slurry wall in terms of reduced flows to drains. The longer slurry wall caused a very small reduction in flow to the capture drain.
- Performed a calculation to estimate dilution and reduction of contaminate concentrations as the remediation progresses. I estimate that one complete water change should occur within the landfill in 10 - 20 years. This water change should result in a reduction of concentrations due to reduction of the amount of contaminants released from the sources over time. A second factor in reducing concentrations is the lowering of the water table in the main portion of the landfill by approximately 5 feet. This should dewater some of the waste and reduce the loading to groundwater. Unfortunately, with the current data, it is impossible to estimate the extent that these concentrations will be reduced.

I estimate the modeling effort to be 81% complete. If I can be of any further assistance, please call me at 546-4412

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

Post-It™ brand fax transmittal memo 7871		# of pages > 21	
To: L. Peterson-Wright	From: J. Jankousky		
Co.	Co.		
Dept.	Phone # 546 4412		
Fax # 966 8704	Fax #		

Post-It™ brand fax transmittal memo 7871		# of pages > 21	
To: Wayne Belcher	From: John Jankousky		
Co.	Co.		
Dept.	Phone # 546 4412		
Fax # 966 8663	Fax #		

**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankowsky
Date: 1/20/95
Subject: Progress Report for OU7 Groundwater Modeling

This week I completed the following on the OU7 groundwater modeling:

- Reran several remediation scenarios with a 1E-7 cm/sec slurry wall (instead of 1E-6) This reduction in conductivity was effective in reducing flows through the wall.
- Recalibrated basic model with slightly higher recharge and slightly increased hydraulic conductivities. Began running scenarios with new calibration. I will look at collection with no cap and no slurry wall, with a cap and no slurry wall, with a cap and 1E-7 slurry wall, and with a cap and 1E-12 slurry wall (slurry wall with HDPE liner). These runs will be an attempt to quantify the benefit from each component of the remedy.

I estimate the modeling effort to be 83% complete. If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

Post-It™ brand fax transmittal memo 7571 # of pages > 21

To	L. Peterson-Wright	From	J. Jankowsky
Co.		Co.	
Dept.		Phone #	546 4412
Fax #	966 8704	Fax #	

Post-It™ brand fax transmittal memo 7571 # of pages > 21

To	Wayne Belcher	From	John Jankowsky
Co.		Co.	
Dept.		Phone #	546 4412
Fax #	966 8663	Fax #	

The S.M. Stoller Corporation
Informal Memorandum

To: Wayne Belcher, EG&G
From: John Jankowsky
Date: 2/3/95
Subject: Progress Report for OU7 Groundwater Modeling

This week I completed the following on the OU7 groundwater modeling:

- Examined the question of whether groundwater will surface because of water building up above the slurry wall. Based on modeling runs and historical well data, I concluded that under normal conditions, groundwater will not surface, but that it will probably surface under high flow conditions.
- Ran a series of scenarios with drain cells west of the new slurry wall to estimate required pumping rates to prevent surfacing of groundwater. The flow of 0.25 gpm was required to reduce the heads near the western edge of the slurry wall by four feet.
- After examining MODFLOW and PATH3D results, I came to the conclusion that some water was travelling through the capture drains I had placed below the dam area. I reran the four currently favored scenarios after adding a low K cell directly downgradient from each drain cell. This configuration should more accurately simulate a drain with an impermeable barrier placed downgradient. I also increased the number of drain cells from five to seven. Flows increased significantly in each scenario. This difference in captured flows and captured particles indicates that a drain with an impermeable liner is superior to capture wells or a drain without a liner for our site.

I estimate the modeling effort to be 87% complete. If I can be of any further assistance, please call me at 546-4412.

cc. B Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

Post-It™ brand fax transmittal memo 7671		# of pages > 22
To Wayne Belcher	From John Jankowsky	
Co.	Co.	
Dept.	Phone # 546 4412	
Fax # 966 8663	Fax #	

Post-It™ brand fax transmittal memo 7671		# of pages > 22
To L. Peterson-Wright	From J. Jankowsky	
Co.	Co.	
Dept.	Phone # 546 4412	
Fax # 966 8704	Fax #	

**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 2/10/95
Subject: Progress Report for OU7 Groundwater Modeling

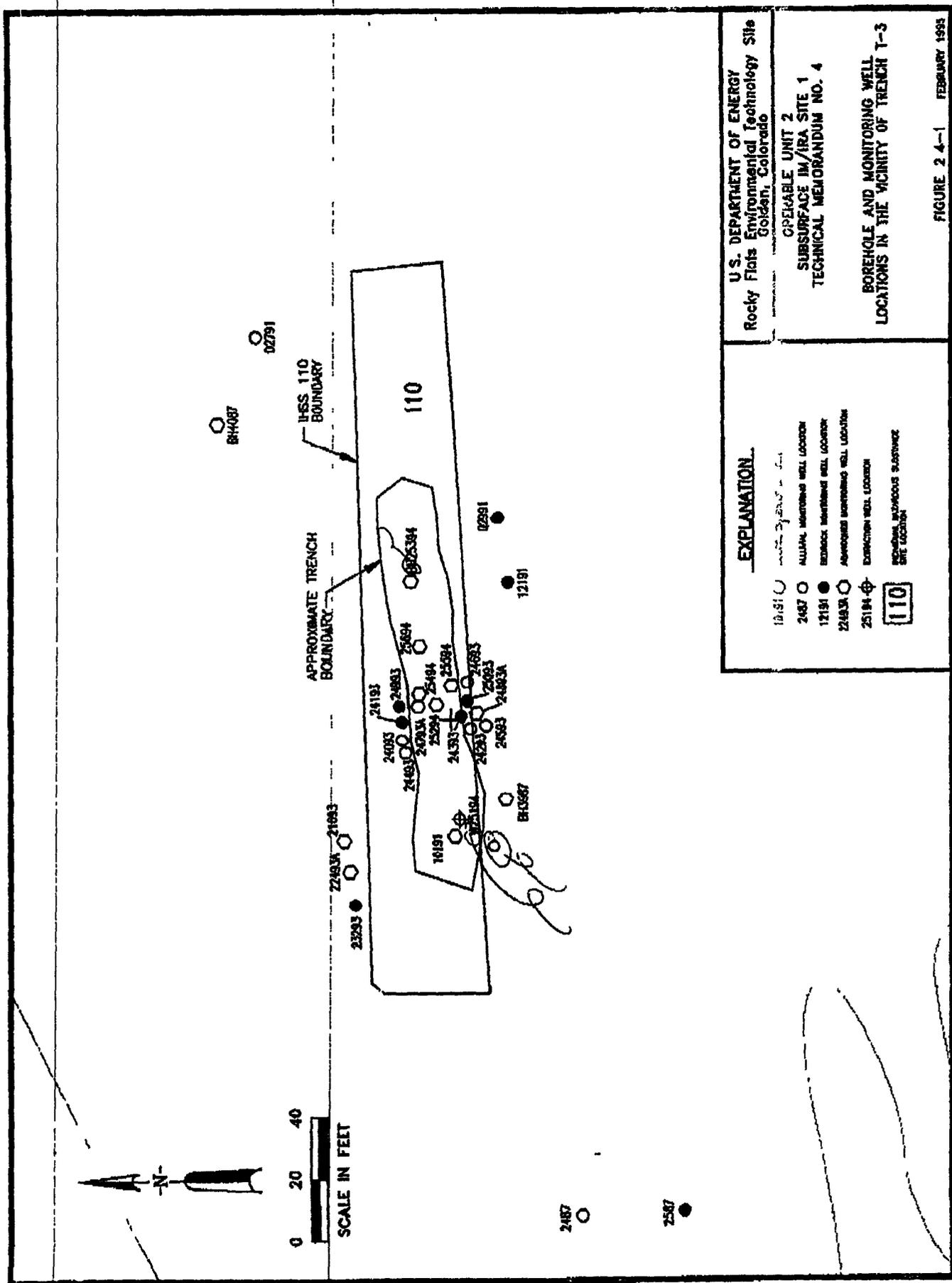
No work was done on the OU7 groundwater modeling this week.

I estimate the modeling effort to be 87% complete. If I can be of any further assistance, please call me at 546-4412.

cc: B Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

Post-It™ brand fax transmittal memo 7671		# of pages > 2
To Wayne Belcher	From John Jankousky	
Co.	Co.	
Dept.	Phone # 546 4412	
Fax # 966 8663	Fax #	

Post-It™ brand fax transmittal memo 7671		# of pages > 2
To L. Peterson-Wright	From J. Jankousky	
Co.	Co.	
Dept.	Phone # 546 4412	
Fax # 966 8704	Fax #	



U.S. DEPARTMENT OF ENERGY
 Rocky Flats Environmental Technology Site
 Golden, Colorado

OPERABLE UNIT 2
 SUBSURFACE IM/IRA SITE 1
 TECHNICAL MEMORANDUM NO. 4

BOREHOLE AND MONITORING WELL
 LOCATIONS IN THE VICINITY OF TRENCH T-3

EXPLANATION

○	ALLIUM MONITORING WELL LOCATION
●	REDWOOD MONITORING WELL LOCATION
⊗	ADVANCED MONITORING WELL LOCATION
⊕	EXTRACTION WELL LOCATION
⊖	EXHAUSTION MONITORING WELL LOCATION
□	IHS 110

FIGURE 2 4-1 FEBRUARY 1993
 SGT0014 T-48

The S.M. Stoller Corporation
Informal Memorandum

To: Wayne Belcher, EG&G
From: John Jankousky
Date: 3/10/95
Subject: Progress Report for OU7 Groundwater Modeling

No work was performed on the modeling this week.

I estimate the modeling effort to be 88% complete. If I can be of any further assistance, please call me at 546-4412

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

Post-It™ brand fax transmittal memo 7571		# of pages	21
To	Wayne Belcher	From	John Jankousky
Co.		Co.	
Dept.		Phone #	546 4412
Fax #	966 8663	Fax #	

Post-It™ brand fax transmittal memo 7571		# of pages	21
To	L. Peterson-Wright	From	J. Jankousky
Co.		Co.	
Dept.	8623	Phone #	546 4412
Fax #	966 8704	Fax #	

**The S.M. Stoller Corporation
Facsimile**

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankovsky
Phone: 546-4412 **Fax No.:** 443-1408

Date: 3/17/95

Subject: Progress Report for OU7 Groundwater Modeling

No work was performed on the modeling this week.

I estimate the modeling effort to be 88% complete. If I can be of any further assistance, please call me at 546-4412

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

**The S.M. Stoller Corporation
Facsimile**

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankowsky
Phone: 546-4412 **Fax No.:** 443-1408

Date: 3/31/95

Subject: Progress Report for OU7 Groundwater Modeling

This week the following was performed on the modeling:

- Ran a no-action scenario and used cell-by-cell flow terms and recharge terms to estimate the contributions of recharge (infiltration), horizontal inflow, and vertical inflow to the total flow of water into the landfill mass. The results were.
 - ⇒ Recharge as a percentage of (Inflow + Recharge) = 40.6%
 - ⇒ Horizontal Inflow as a percentage of (Inflow + Recharge) = 58.5%
 - ⇒ Vertical Inflow as a percentage of (Inflow + Recharge) = 0.9%
 - ⇒ Summary of Flows (percent) = 100%

I estimate the modeling effort to be 89% complete. If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

**The S.M. Stoller Corporation
Facsimile**

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankousky
Phone: 546-4412 **Fax No.:** 443-1408

Date: 4/7/95

Subject: Progress Report for OU7 Groundwater Modeling

No work was performed on the modeling this week.

cc: B. Caruso, Stoller
L Peterson-Wright, EG&G
M. Vaag, Stoller

**The S.M. Stoller Corporation
Facsimile**

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankovsky
Phone: 546-4412 **Fax No.:** 443-1408

Date: 4/14/95

Subject: Progress Report for OU7 Groundwater Modeling

This week the following was performed on the modeling:

- Wrote a section for the OU 7 Closure Strategy discussing the water balance modeling performed two weeks ago.

I estimate the modeling effort to be 89% complete. If I can be of any further assistance, please call me at 546-4412.

cc. B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

**The S.M. Stoller Corporation
Facsimile**

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankousky
Phone: 546-4412 **Fax No.:** 443-1408

Date: 5/1/95

Subject: Progress Report for OU7 Groundwater Modeling

This week the following was performed on the modeling:

- Performed water balances for a north slurry wall without cap and a north slurry wall with a cap. The results of these water balances were compared to an earlier water balance for the no-action alternative.

I estimate the modeling effort to be 90% complete. If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

*Laurie:
2 page water balance
follows.
John*

Water Balance Summaries for Three OU 7 Scenarios

The groundwater flow system at OU 7 was modeled using MODFLOW. Three scenarios were modeled and the cell-by-cell flow terms were summarized for the boundaries of the landfill mass. This summary is presented in Table 1. For each scenario, outflow equals inflow. The model shows that approximately three-fourths of the outflow is in the vicinity of the seep. The remaining one-fourth flows into the pond as groundwater. The scenarios and the resultant flows are as follows:

1. **No Action Scenario** This scenario assumes the groundwater flow system remains unchanged. Total flow into the landfill is 1.9 gpm. Recharge or infiltration contributes approximately 0.8 gpm of that amount. Groundwater inflow contributes approximately 1.1 gpm. Outflow equals inflow.
2. **North Slurry Wall Scenario.** This scenario assumes the groundwater flow is altered by the addition of a 10^{-7} cm/sec slurry wall on the north side of the landfill. No cap is assumed. Total flow into the landfill is 1.3 gpm. Recharge or infiltration contributes approximately 0.8 gpm of that amount. Groundwater inflow contributes approximately 0.5 gpm. Outflow equals inflow.
3. **North Slurry Wall and Cap Scenario.** This scenario assumes the groundwater flow is altered by the addition of a 10^{-7} cm/sec slurry wall on the north side of the landfill. A single barrier layer cap is assumed. Total flow into the landfill is 0.4 gpm. Recharge or infiltration contributes approximately 0.01 gpm of that amount. Groundwater inflow contributes approximately 0.4 gpm. Outflow equals inflow.

Table 1: Water Balance Summaries for Three OU 7 Scenarios

Scenario	No Action	North Slurry Wall	North Slurry Wall and Cap
	Subtotals for Horizontal Inflow (gpm)	Subtotals for Horizontal Inflow (gpm)	Subtotals for Horizontal Inflow (gpm)
Component of Inflow and Recharge	Flow Rate (gpm)	Flow Rate (gpm)	Flow Rate (gpm)
Recharge	0.77	0.77	0.01
Horizontal Inflow (Individual segments directly below)	1.12	0.48	0.35
Inflow through or under North Slurry Wall	0.375	0.140	0.070
Inflow through or under North Groundwater Intercept	0.801	0.232	0.100
Inflow through or under West Groundwater Intercept	0.068	0.034	0.035
Inflow through or under South Groundwater Intercept	-0.002	0.002	0.073
Inflow through or under South Slurry Wall	0.075	0.074	0.071
Vertical Inflow	0.02	0.02	0.02
Summary of Flows	1.9	1.3	0.4

33

**The S.M. Stoller Corporation
Facsimile**

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankowsky
Phone: 546-4412 **Fax No.:** 443-1408

Date: 5/5/95

Subject: Progress Report for OU7 Groundwater Modeling

No work was performed on the modeling this week.

I estimate the modeling effort to be 90% complete. If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

**The S.M. Stoller Corporation
Facsimile**

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankousky
Phone: 546-4412 **Fax No.:** 443-1408

Date: 5/12/95

Subject: Progress Report for OU7 Groundwater Modeling

This week the following work was performed on the modeling:

- Began work with the MT3D concentration model. The initial work this week has been experimenting with the model settings to improve the stability of the model for use with the OU 7 model grid. The goal of the concentration modeling is to evaluate future concentrations of various contaminants under various scenarios. The modeling will support alternative selection and locating the point of compliance.

I estimate the modeling effort to be 91% complete. If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

**The S.M. Stoller Corporation
Facsimile**

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankousky
Phone: 546-4412 **Fax No.:** 443-1408

Date: 5/22/95

Subject: Progress Report for OU7 Groundwater Modeling

This week the following work was performed on the modeling:

- Continued work with the MT3D concentration model. Made trials with the different solvers both with and without dispersions term activated. None of the solvers are currently stable with the dispersion term active. At this point, we are putting a hold on the MT3D modeling because of budget concerns. If the work continues, will probably use the Modified Method of Characteristics (MMOC) solver without a dispersion term. The MMOC solver allows some numerical dispersion.
- Dan Reeder began work using an analytical model to estimate travel times of various contaminants to compliance well 53194

I estimate the modeling effort to be 92% complete. If I can be of any further assistance, please call me at 546-4412.

cc. B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

The S.M. Stoller Corporation
Facsimile

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankowsky
Phone: 546-4412 **Fax No.:** 443-1408

Number of Pages: 1

Date: 5/30/95

Subject: Progress Report for OU7 Groundwater Modeling

No work was performed on the modeling last week.

I estimate the modeling effort to be 92% complete. If I can be of any further assistance, please call me at 546-4412.

cc: B. Caruso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

**The S.M. Stoller Corporation
Facsimile**

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankousky
Phone: 546-4412 **Fax No.:** 443-1408

Number of Pages: 1

Date: 6/5/95

Subject: Progress Report for OU7 Groundwater Modeling

No work was performed on the modeling last week.

I estimate the modeling effort to be 92% complete. If I can be of any further assistance, please call me at 546-4412

cc: B Caruso, Stoller
L Peterson-Wright, EG&G
M. Vaag, Stoller

**The S.M. Stoller Corporation
Facsimile**

To: Wayne Belcher, EG&G
Laurie Peterson-Wright, EG&G
Fax No.: 966-8663

From: John Jankousky
Phone: 546-4412 **Fax No.:** 443-1408

Number of Pages: 1

Date: 6/12/95

Subject: Progress Report for OU7 Groundwater Modeling

No work was performed on the modeling last week.

I estimate the modeling effort to be 92% complete. If I can be of any further assistance, please call me at 546-4412

Unless you have an objection, I would like to make this the last weekly report. The only tasks remaining are completing the write-up for the Decision Document. EG&G will receive a draft in mid-July I may also need to complete a few more model runs to answer specific questions (e.g., when will the landfill start to dry up under the current cap and slurry wall scenario)

cc B. Canuso, Stoller
L. Peterson-Wright, EG&G
M. Vaag, Stoller

Memorandum

To L Peterson-Wright
From W Belcher
Date June 23, 1994
Subject OU7 Modeling

Attached is an informal memo regarding Stoller's selection of groundwater modeling software for the OU7 leachate IM/IRA. It is my understanding that this software will be used to simulate various remediation strategies for the Present Landfill. I have initiated a program with Mr. John Jankousky (Stoller's modeler) to provide me with weekly status reports on the modeling progress. These reports will consist of a list of activities for the week and a percentage indicator of progress toward finishing. This percentage will be based on budgeted hours.

You will see by the attached memo that Stoller has selected S. S. Papadopoulos's MT3D to perform their transport modeling. I would strongly recommend that they consider using Papadopoulos's PATH3D. It is probably not necessary to perform a full-blown contaminant transport model. A particle tracking modeling (like PATH3D) will give an indication of the effectiveness of various remediation strategies, without the input requirements (source size, concentrations, biodegradation, dispersivities, etc.) of contaminant transport simulation.

If you have any questions, please contact me at X6931.

Thanks

CC: E. Mast, C. Bicher

**The S.M. Stoller Corporation
Informal Memorandum**

To: Wayne Belcher, EG&G
From: John Jankowsky *John Jankowsky*
Date: 6/22/94
Subject: Model Selection for OU7 Groundwater Modeling

Wayne:

Stoller is modeling the groundwater in the immediate vicinity of OU7, the Present Landfill, as part of its decision document for the OU7 Leachate IM/IRA.

At the present time, we are using analytical solutions to examine various scenarios for the capture of contaminants. These analytical solutions include the Theis solution and the Hantush-Jacob solution. We are at the early stages of formulating the problem for input into MODFLOW

We selected MODFLOW combined with MT3D as our numerical modeling software for the following reasons:

- A critical part of the OU7 modeling effort is modeling two layers: surficial materials and weathered bedrock; MODFLOW and MT3D have three dimensional modeling capabilities, while other models that were considered, such as MOC, do not.
- MODFLOW and MT3D are well documented, widely used, and well validated.
- The sitewide groundwater modeling effort at Rocky Flats is using MODFLOW. Use of MODFLOW at OU7 will enhance the possibility of integration of the modeling efforts.

Per your suggestion, we will also be examining the possibility of using PATH3D as an alternative to MT3D.

If I can be of any further assistance, please call me at 546-4412.

Post-It [®] Fax Note	7671	Date	6/22/94
To	WAYNE BELCHER	From	JOHN JANKOWSKY
Co./Dept.		Co	
Phone #		Phone #	546 4412
Fax #	966 8663	Fax #	443 1408

Memorandum

To L Peterson-Wright
From W Belcher
Date June 28, 1994
Subject Use of a particle tracking code for OU7 modeling

It is my understanding that numerical modeling is being used to evaluate various closure scenarios for the Present Landfill (OU7). In order to evaluate the flow field resulting from various closure scenarios, Stoller has proposed using a solute transport model (MT3D). I would strongly recommend that a particle tracking code (such as PATH3D) be used instead for the following reasons:

- 1 The modeling exercise is evaluating the effectiveness of various scenarios at capturing leachate from the landfill. As such it is not necessary to simulate concentrations of various contaminants or quantify dispersion or chemical reactions.
- 2 Solute transport requires input of chemical and physical parameters that are not easily measurable.
- 3 The use of particle tracking codes involves much less uncertainty than solute transport codes.
- 4 The use of particle tracking codes allows workers to estimate solute travel paths and discharge points without the effort of using a solute transport code.
- 5 Because of the relative ease of use and less input requirements, particle tracking codes can save time and money.

PATH3D (S S Papadopoulos and Assoc) is an acceptable particle tracking code because it is fully integratable to MODFLOW, can simulate in three dimensions, and can simulate transient conditions. It is also fully documented and well-verified. It will also produce the desired type of output¹.

I would strongly recommend that PATH3D (or another suitable particle tracking code) be used for the evaluation of the closure scenarios for OU7. It would produce acceptable results and analyses and save time, effort, and money in the process.

CC E Mast, C Bicher

¹MT3D produces concentrations at the model nodes and PATH3D produces XYZ coordinates and seepage velocity components at different times, XYZ coordinates of all particles at selected times, and initial and final positions of particles captured by various sinks in the simulation. These output files can be used in a commercial graphics package to produce pathlines, illustrating the capture or non-capture of the particles by the various scenarios.

**OU1 Closures
OU2 Closures
OU567 Closures
Groundwater Modeling
Highlight for W R. Belcher
for Week ending 16 July 1994**

Significant Accomplishments/Achievements

NONE

Significant Problems/Issues/Concerns/Barriers

It has been brought to my attention that EG&G is purchasing the software that Stoller will use in the OU7 modeling. Care should be taken that EG&G obtain this software (since it is DOE property) once the modeling effort by Stoller is completed.

This week's completed Activities

Work is proceeding on the site geologic characterization maps for C Dodge. The latest changes in the weathered bedrock unit thickness, base of weathered bedrock, and the upper hydrostratigraphic thickness maps involve changes made by Ms Dodge in a few eastern data points that significantly alter the interpretations at the eastern site boundary. It is anticipated that these maps will be completed by COB July 16, 1994.

A water level map for the 881 Hillside was completed for R Cirillo of ER/EOM. This figure, along with a tabulation of the data used in its preparation will be included in the Operable Unit #1 (OU-1) Quarterly Operation Report for the second quarter 1994 (April-June 1994). Two copies of the map and one copy of the tabulated data will be transmitted to Mr Cirillo by the end of next week (July 23, 1994). The internal milestone for this task is July 25, 1994. This work represents a prior commitment to ER/EOM made by the now-defunct Geosciences group. It is anticipated that I will continue to meet these milestones for this year.

A follow-up on last week's meeting with Woodward-Clyde Federal Services regarding the OU2 three-dimensional SVE modeling. WCFS is currently working on constructing data files for EG&G that will contain geologic and VOC contaminant data. The contaminant data for TCE, CCl₄, Chloroform, and PCE is scheduled to be delivered to EG&G by July 16, 1994. The geologic data, consisting of XYZ coordinates corresponding to the top and bottom surfaces of the Rocky Flats Alluvium and the sandstone body in OU2. These data files will serve to update the existing geologic model of OU2, with attention being applied to the area around IHSS 110. This work is scheduled to be completed by the end of August 1994.

Meetings

A meeting discussing the OU1 modeling being performed by Dames and Moore was held on July 11, 1994. This meeting was attended by P Sinton (D&M), W Belcher (EG&G), E Pottorf (CDH), and G Kleeman (EPA). The current status of the modeling effort for the 881 Hillside was discussed. At present, the model is having some difficulty due to unstable behavior. Mr Sinton presented some concerns that the calibration of the model could be delayed due to these problems. Mr Sinton does not feel that this is a problem as yet, but it could be if D&M does not obtain a well-behaved model this week. Mr Sinton, however, does feel that preliminary calibration can be completed by the end of this week. CDH and EPA representatives were happy that this series of meetings are being held. They feel that they are left completely in the dark until they receive the final draft reports for the RI's. They also emphasized that their attendance does not constitute agency buy-off, but is rather an information exchange.

A meeting discussing the status of modeling at RFP was held on July 12, 1994 and was attended by representatives from EG&G, DOE, EPA, and CDH (and various agency and DOE contractors) Representatives from EG&G presented the modeling efforts at RFP covering air, surface water, and groundwater/contaminant transport for the OUs and sitewide activities The purpose of the meeting was to show that EG&G is attempting to be consistent in its application across OUs, depending on site conditions

General

NONE

Modeling Subcontractor Updates
Wayne R. Belcher
Environmental Restoration Division
January 3 - 6 1995

OU1

No modeling activity

OU2

M. Schreiber of WCFS completed the update of the modeling files to reflect the more recent geologic interpretation of OU2. Dr. Zhang returned on Jan. 9 and will be checking these files for consistency (to ensure that, for example, that the top of bedrock and the bottom of the subcropping alluvium are the same value). Mr. Schreiber also completed seep location files and zonation files for recharge and hydraulic conductivity. Work is also being currently performed on bedrock and alluvial water levels (for input as initial conditions). This work involves the extrapolation of contoured data into areas of the model domain where there is little or no measured data. Currently, the modeling is 2-3 days behind schedule. However, it should be noted that this apparent delay is for the calibration part of the modeling, which WCFS has not been approved to proceed with at this time. Further approval delays may cause delay of the project.

W. Belcher has spoken with B. Roberts about filling in for him when he is in Pakistan during the end of March-early April. Dr. Roberts has assured him that this will be fine and Mr. Belcher will meet with Dr. Roberts prior to leaving for Pakistan to fill him in on the status of the project.

OU5

As of January 6, ASI modelers have completed the following tasks: Preliminary Setup, Establishment of Calibration Targets and Criteria, Grid and Data Input, and Groundwater Flow Model Calibration. Significant progress (greater than 50% completed) has been made on the following tasks: Particle Tracking Modeling, Flow Model Summary, Source Loading and K_d Estimation, and Establishment of Target concentrations and Calibration Criteria for the Transport Modeling. Much work was done during the week of December 23, addressing comments raised by CDH during the meeting held earlier in the month between CDH, EPA, DOE, and EG&G modelers. The concerns mainly centered on the boundary heads, water budget, and recharge for portions of the model. ASI is currently developing the source location and loading for the solute transport model. A summary report of the flow modeling has been prepared and will be folded into the draft modeling report upon completion of this modeling effort.

OU6

No Activity

OU7

As of January 6, 1995, the groundwater modeling at OU7 is approximately 81% completed. Stoller modelers reran one scenario to examine the effectiveness of a longer slurry wall at the south side of the landfill. This new run caused a relatively small reduction in groundwater flow to the capture drain. Stoller modelers also estimated the dilution and reduction of contamination that will occur during the remediation process. It is estimated that the removal of one pore volume of groundwater from within the landfill will take approximately 10-20 years. It was also noted by the Stoller modelers that source concentrations should be reduced because the water table within the landfill will be lowered by approximately 5 feet during remedial activities. De-watering of the landfill material should reduce the loading to the groundwater.

45/45