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April 20, 2005
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U.S. Nuclear Regulatory Commission
ATTN: Mrs. Deborah A. DeMarco
Division of High-Level Waste Repository Safety
Office of Nuclear Material Safety and Safeguards
Mail Stop 8A–23
Washington, DC 20555

Subject: Programmatic Review of Presentation for Devils Hole Workshop, May 18–20, 2005

Dear Mrs. DeMarco:

Enclosed are presentation slides that we propose to show at the May 18–20, 2005, Devil's Hole Workshop to be held at Death Valley National Park Headquarters, Furnace Creek Ranch, Death Valley, California. This presentation will summarize recent saturated zone flow modeling to evaluate whether future spring discharges south of Yucca Mountain could potentially capture flow paths from beneath Yucca Mountain. We request a programmatic review by NRC for approval to make this presentation.

Please advise me of the results of your programmatic review. Your cooperation in this matter is appreciated.

Sincerely,

Gordon Wittmeyer

Gordon Wittmeyer, Ph.D.
Assistant Director, Earth Sciences

/ph
Enclosures: Presentation
NRC Form 390A

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Saturated Zone Flow Modeling to Evaluate the Effects of Initiating Spring Flows South of Yucca Mountain, Nevada, Following a Potential Future Water-Table Rise

Presented by:

Jim Winterle

Center for Nuclear Waste Regulatory Analyses (*CNWRA*)

Contributions by

Hans Arlt

U.S. NRC

Devil's Hole Workshop

May 18-20, 2005

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Notes

- The activities presented here were performed on behalf of the U.S. Nuclear Regulatory Commission (NRC) Office of Nuclear Material Safety and Safeguards, Division of High Level Waste Repository Safety. This presentation is an independent product of the *CNWRA* and does not necessarily reflect the view or regulatory position of the NRC.
- Models scenarios and results presented here are exploratory in nature and intended only as a tool to better understand the saturated zone flow system near Yucca Mountain. As such, the modeling approach, scenarios, and results presented here should not be construed as being preferred by either *CNWRA* or NRC.

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Outline

- Description of hydrogeologic framework
- Description of flow model and model calibration
- Approach for simulation of potential water table rise
- Approach for including potential spring flows into the flow model
- Effects of potential spring flows on groundwater flow paths, modeled source area for potential spring flow water

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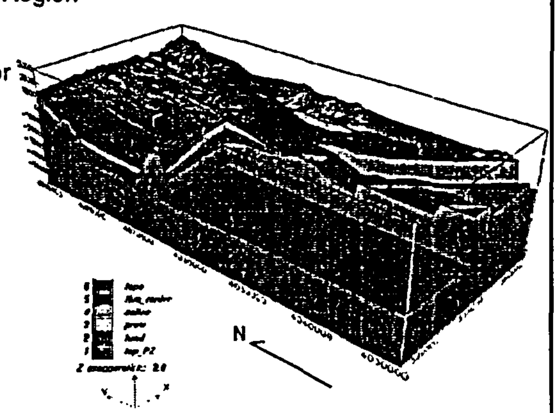
Hydrogeologic Framework

- Hydrogeologic Framework Model (HFM) based on Sims et al. (1999) 3-D Earth Vision model of Amargosa Region
- GFM 3.1 (CRWMS M&O, 1999) was starting point for HFM interior region; layers were grouped into hydrostratigraphic types and model region was extended based on independent interpretation of borehole and geophysics data
- Hydrologic properties for flow model were assigned based on correspondence to layers and structural features in HFM



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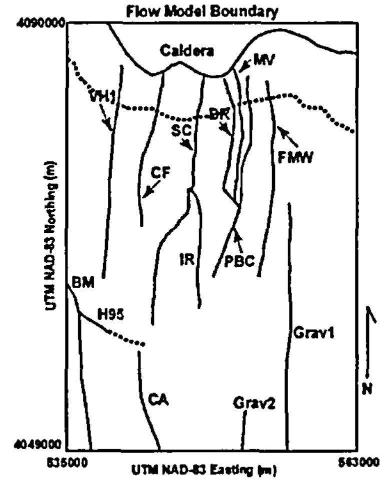
Structural Features Included in the Model Domain

- Changes from Sims et al. (1999) HFM were made during flow model grid construction and model calibration:
  - — Caldera Zone extended southward (upper red dashed line at right) to match large hydraulic gradient north of Yucca Mountain
  - — Bow Ridge (BR), Midway Valley (MV) and Paintbrush Canyon (PBC) faults were combined into a single, wide fault zone because 300-m grid size is too coarse to include them as separate features
  - — Area between PBC and Fortymile Wash (FMW) faults also made into a single, wide fault zone to improve calibration
  - — Highway-95 fault zone extended eastward (lower red dashed line at right) to match steep hydraulic gradient in this area



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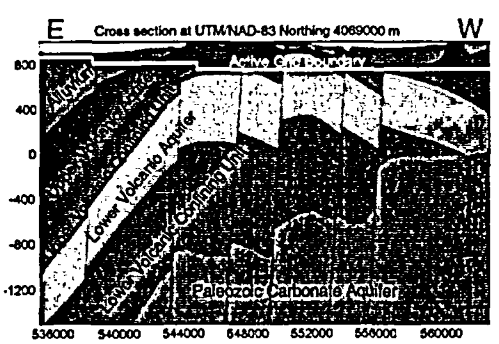
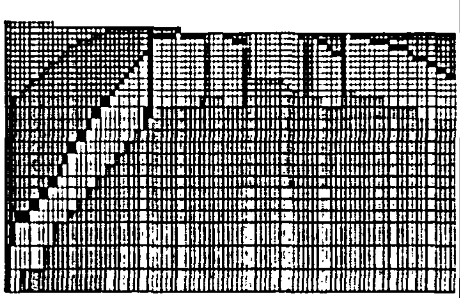
Flow Model Grid

- Comparison of hydrogeologic framework model to material types assigned to model grid



Sims et al. (1999) Framework Model
vertical scale = meters above sea level (masl)
horizontal scale = UTM NAD-83 Easting (m)
[note: 1 m = 3.281 ft]



Corresponding Section of 30-Layer Model Grid (Winterle, 2003)

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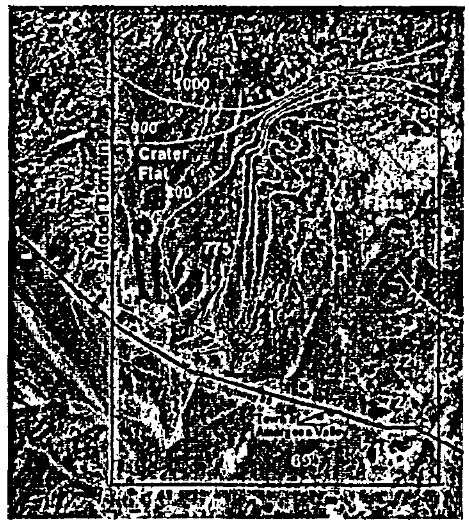
Model Description

- Model Domain shown at right:
  - 28.5 km x 41.4 km [17.7 x 25.7 mi]
  - vertical extent is from -1500 masl to 1200 masl
- MODFLOW-2000 groundwater flow modeling code used
- 300m x 300m horizontal grid; 30 layers ranging from 50-m thick at top ten layers to 200-m thick at bottom two layers
- Interpretation of water table used to estimate constant head values for model sides; constant with depth
- 10 mm/yr recharge in northern high-elevation area; 5 mm/yr recharge in Yucca Mountain area
- 151 hydraulic head and water level measurements used for calibration points



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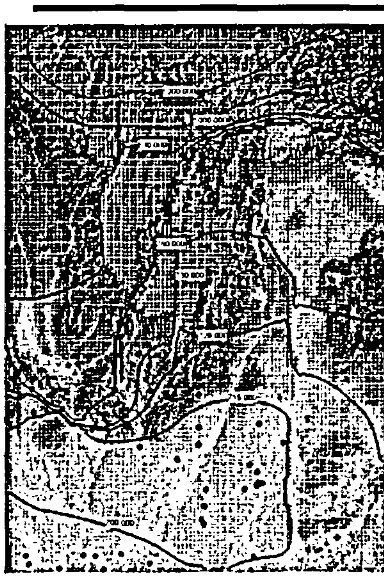
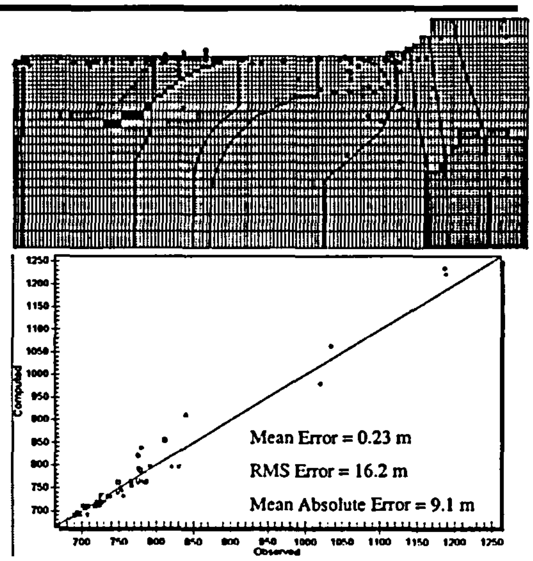
Model Calibrated to Present-Day Observations





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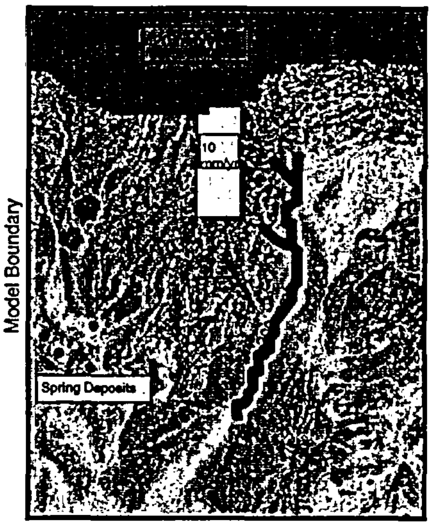
Simulation of Water Table Rise

- Recharge in northern and Yucca Mtn. areas was doubled and recharge of 200 mm/yr was added to 40-Mile Wash channel
- All constant-head side boundary values were raised by a constant percentage
- 5-percent raise in boundary heads resulted in computed water table reaching land surface elevation in area where spring deposits are observed just north of Hwy-95

Model Boundary



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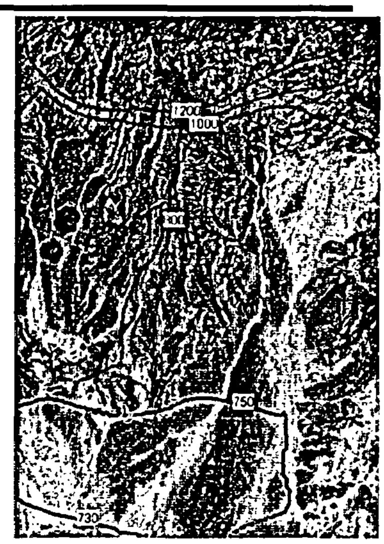
Simulation of Water Table Rise

- Water table rise resulted in simulated water table intersecting model cells designated as "above land surface" (ALS)
- These ALS locations are shown in green at right
- However, the ALS condition was assigned to model cells where the cell center is above the land surface... thus, as much as half of these cells may still be below land surface
- Thus, not all "ALS" cells were selected as potential spring discharge locations



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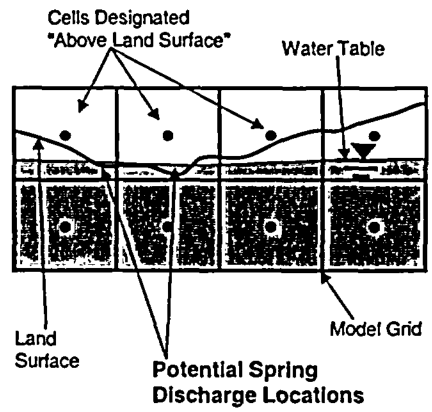
Selecting Potential Spring Discharge Locations

- Figure on right illustrates process used for identifying which cells should be assigned as potential spring discharge locations
- Cells adjacent to southern model boundary were not selected as discharge locations because they are a direct result of assigned boundary heads
- Cells where computed water level was less than 5 meters above the bottom of the cell were not selected except where they correspond to topographic lows



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Potential Spring Discharge Locations

- A total of 23 model cells were selected as potential spring discharge locations
- These locations were included in the MODFLOW "Drain Package"
- Key parameters in Drain Package are drain elevation and drain conductance
- Drain cells are activated as sinks whenever water table elevation is above drain elevation; flow rate proportional to elevation difference and drain conductance
- Model was run using various assumptions about drain elevation and conductance to evaluate effects of spring discharge on flow paths
- Maximum total discharge modeled was 10,800 m^3/day (3200 ac-ft/yr)

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Effects of Simulated Spring Discharge on Flow Paths from Yucca Mountain Area

Flow paths without simulated spring discharge

Flow paths with 10,800 m³/d simulated spring discharge

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Conclusions

- Simulation of a potential water table rise by assuming a uniform five percent increase in model boundary heads resulted in the simulated water table intersecting the land surface elevation in areas where paleospring deposits suggest spring flows have occurred in the past
- Simulation of spring flows as high as 10,800 m³/day in the area of these spring deposits, using the MODFLOW Drain Package, had a nearly negligible effect on the simulated particle tracks of flow paths from the northern Yucca Mountain area
- Reverse particle tracking from the simulated drain locations in the vicinity of the paleospring deposits indicates the groundwater flow system beneath Crater Flat would be the likely source of spring flows in this area

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References

Sims, D.W., J.A. Stamatakos, D.A. Ferrill, H.L. McKague, D.A. Farrell, and A. Armstrong. "Three-Dimensional Structural Model of the Amargosa Desert, Version 1.0: Report to Accompany Model Transfer to the Nuclear Regulatory Commission." San Antonio, Texas: CNWRA. 1999.

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