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Hydrologic Linkage Between Alluvial, Intermediate, & Regional Groundwater on the Pajarito Plateau, North Central New Mexico

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INTRODUCTION

Groundwater occurs in three distinct zones in the Pajarito Plateau of northern New Mexico.

(1) Shallow **alluvial** groundwater in the canyon bottom sediments is recharged by short reaches of perennial flow maintained by natural spring input or anthropogenic discharges and by seasonal flow associated with storm runoff and snowmelt.

(2) Perched **intermediate** groundwater occurs in subsurface bedrock above layers of low permeability or due to capillary barriers (Robinson et al., 2005). The intermediate groundwater is highly variable in vertical (1 ft - 400 ft thick) and lateral extent (up to 3.7 mile wide) and is an important monitoring zone for subsurface contamination.

(3) Deep **regional** groundwater is the source for drinking water for the town of Los Alamos and is found at depths of over 1200 ft on the western side of the plateau to approximately 600 ft on the eastern edge of the plateau (Broxton and Vaniman, 2005).

There are inferred connections between the alluvial and the intermediate because contaminants (e.g. high explosives, nitrate, perchlorate, and tritium) are present in both alluvial and intermediate groundwater.

A plateau wide monitoring network of alluvial, intermediate, and regional groundwater levels has been continuously in place for almost two years.

By thoroughly analyzing the water level data, **our goal is to identify physical responses of recharge events and linkages between the three groundwater zones.**

ALLUVIAL GROUNDWATER

•Snowmelt runoff and storm runoff recharge the alluvial groundwater.

•Once the system has wetted up, surface and subsurface flow is more frequent in response to precipitation.

•As the alluvial groundwater levels decrease, the water goes into storage, drains laterally, vertically, or is lost to evapotranspiration.

PERCHED INTERMEDIATE GROUNDWATER

• Most perched intermediate wells do not show water level changes in response to runoff events.

•Isolated wells show apparent response to snowmelt runoff, particularly wells completed in the Cerros del Rio basalt on the eastern edge of the plateau.

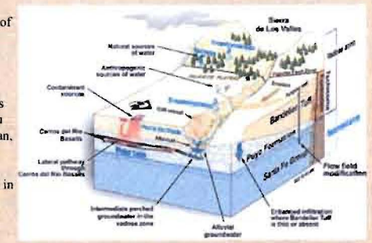
➢Intermediate well R-9i in Los Alamos Canyon responded to 2005 snowmelt runoff, and possibly responded to large storm runoff during summer of 2006.

➢Water levels in intermediate well R-12 also show response to 2005 spring snowmelt runoff. Intermediate well R-12 is located in lower Sandia Canyon just south of Los Alamos Canyon. The similar response to snowmelt runoff suggests the perched zones beneath the two canyons are hydraulically connected.

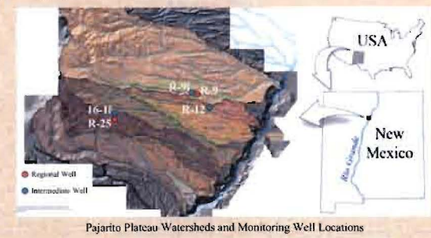
REGIONAL GROUNDWATER

•The available water level data show no apparent hydrogeologic response (measurable with transducers) between intermediate zones of saturation and the regional aquifer. However, the presence of anthropogenic tracers (contaminants) detected at select locations in the regional aquifer indicate linkage between the deep regional and overlying intermediate and alluvial groundwater zones.

•Water levels in some regional wells show seasonal transient response associated with municipal pumping of the regional aquifer. Other regional wells closer to the mountain front (e.g. CdV-R-15-3 and CdV-R-37-2) show seasonal variation in water levels but apparently are not associated with supply well pumping. Response is not fully understood at this time.



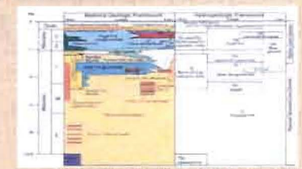
Conceptual Hydrogeologic Model of the Pajarito Plateau (LANL, 2005)



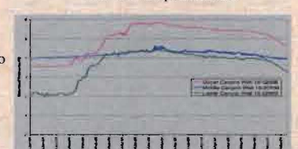
Pajarito Plateau Watersheds and Monitoring Well Locations

2005-2006 Precipitation Record

Surface Flow Monitoring Station Pajarito Watershed Summer 2006

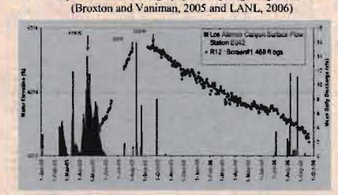


Pajarito Plateau Stratigraphy and Hydrogeologic Units (Broxton and Vaniman, 2005 and LANL, 2006)

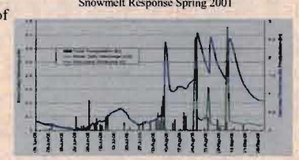


Cañon de Valle Alluvial Groundwater Snowmelt Response Spring 2001

Snowmelt Runoff Cañon de Valle Watershed Spring 2001

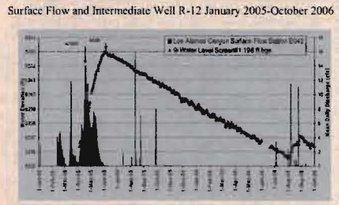


Surface Flow and Intermediate Well R-12 January 2005-October 2006

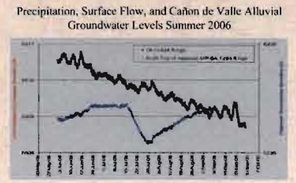


Precipitation, Surface Flow, and Cañon de Valle Alluvial Groundwater Levels Summer 2006

Storm Runoff after Rainstorm Los Alamos Watershed Summer 2006

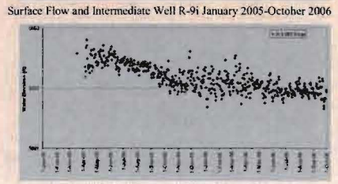


Surface Flow and Intermediate Well R-9i January 2005-October 2006



Intermediate and Regional Groundwater Elevations, Cañon de Valle Summer 2006

Flow after Summer Rainstorm Mortandad Watershed Summer 2006



Regional Well R-9 January 2005-October 2006

CONCLUSIONS

•Recharge to the alluvial groundwater is common from snowmelt or rainstorms. Measurable differences in the intermediate groundwater are not commonly observed but exist at a couple of well locations on the Plateau. At most locations the recharge signal is muted and not discernable. The two intermediate wells which showed water level changes are completed in the Cerros del Rio fractured basalt, which likely has limited storage capacity and small changes in water volume correspond to large changes in water elevation.

•Following periods of extended alluvial saturation such as after snowmelt runoff or storm runoff after large summer rainstorms, there may be a sustained elevated head and/or extended zones of saturation which could possibly drive water deeper to the intermediate perched zone. At most intermediate well locations and at all regional well locations on the Plateau this recharge cannot be measured with pressure transducers.

•During past Laboratory operations, permitted outfalls from process buildings, absorption beds, cooling towers, etc. discharged millions of gallons of treated and/or contaminated water a year. This sustained discharge may have provided the necessary head to drive the contaminants and water deeper to the intermediate zone. Current conditions of natural discharge events i.e. snowmelt runoff and storm runoff, are highly variable from one year to the next. Ideal conditions for recharging the perched intermediate aquifer may be more infrequent now than in the past when there were more frequent and higher volume discharges.

ACKNOWLEDGEMENTS

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