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December 18, 2007

Jane R. Summerson
M. Lee Bishop
Environmental Impact Statement Office
U.S. Department of Energy
Office of Civilian Radioactive Waste Management
1551 Hillshire Drive
Las Vegas, NV 89134

Re: Inyo County's comments on draft Repository Supplemental Environmental Impact Statement and draft Nevada Rail Corridor/Alignment Environmental Impact Statement

Dear Ms. Summerson and Mr. Bishop,

The County of Inyo, State of California, is an Affected Unit of Local Government under the Nuclear Waste Policy Act of 1987, as amended. Inyo County has prepared its response to the U.S. Department of Energy's (DOE) draft Repository Supplemental Environmental Impact Statement and draft Nevada Rail Corridor/Alignment Environmental Impact Statement.

The County has identified several issues regarding both documents that should be addressed by the DOE in the course of developing both Final Environmental Impact Statements (EIS). A supplement to the comment letter has also been attached and offers technical details of Inyo County's groundwater studies program, its main findings, and specific recommendations for the Final Repository Environmental Impact Statement.

Failure to Define the Affected Environment Correctly - Inadequate analysis in the draft Repository Supplemental Environmental Impact Statement relating to groundwater impacts to the Lower Carbonate Aquifer

The draft Repository Supplemental EIS (draft SEIS) gives an adequate description of individual groundwater basins, recharge sources, water uses, and major subterranean geologic characteristics. The SEIS also gives a brief summary of Inyo County's groundwater studies program, mentioning that a primary focus of the County "has been the investigation of the source of water that discharges from the various springs on the east side of Death Valley and whether there is a hydraulic connection between those springs and the groundwater moving beneath Yucca Mountain." The County has amassed a body of strong scientific evidence through geochemical analysis that the Lower Carbonate Aquifer (LCA), which underlies the repository, has several discharge points on the western side of the Funeral Mountains in the Furnace Creek area of Death Valley National Park (Park). The County also recognizes, as does the draft SEIS, that groundwater discharged in the Park is mixed with other groundwater sources from the Ash Meadows area and the Amargosa Desert.

The draft SEIS makes mention of an independent study, conducted by the University of Nevada, Las Vegas, that substantiates this theory of carbonate flow discharging in to the Park. The brief section describing Inyo County's program also concludes that flow from volcanic aquifers does not discharge into the Park. While this statement is correct, it misinterprets the purpose of Inyo's program, which is to study whether the LCA, and not volcanic aquifers, discharge in to the Park. The DOE assumes that because the volcanic aquifers do not discharge in to the Park, that no impacts to the Park are anticipated. This is an erroneous statement, as Inyo County believes that the Park will be potentially affected by contaminated discharge from the LCA, and **not** the volcanic aquifers. It should also be noted that the DOE concedes that Inyo County, but not the Park, will be impacted from contaminants in the volcanic aquifers. Radionuclides in the volcanic aquifers will surface at Franklin Lake Playa and Alkali Flat, near Death Valley Junction, California. However, the DOE predicts this will happen after any applicable compliance period.

From Inyo County's perspective, the most glaring omission in the draft SEIS is that it contains no meaningful assessment of potential impacts to the LCA. The draft SEIS makes no predictions, based on water infiltration and waste package corrosion rates, or groundwater migration times, of the severity or timeframe for impacts to the LCA, or its discharges points in the Park. Accordingly, the draft SEIS contain no impact assessment for plant life, wildlife, wildlife habitat or drinking water supplies in the Park that could potentially be impacted by migrating radiouclides from the repository.

The 2002 Final Environmental Impact Statement for a Geologic Repository at Yucca Mountain, Nevada (2002 FEIS) frequently references ongoing studies relating to groundwater impacts, but the draft SEIS contains little new information on studies conducted by the DOE, the State of Nevada, or Nye and Inyo Counties. DOE concedes that Death Valley proper is the regional hydrological sink for surface and groundwater, yet Inyo County is scarcely mentioned in terms of groundwater impacts from the repository. The Yucca Mountain regional hydrographic map on page 3-33 (Figure 3.9) in the "Affected Environment" section conveniently omits California in terms of hydrographic areas, even though maps on pages 3-28 (figure 3-7) and 3-30 (Figure 3-8) clearly show Inyo County and Death Valley as part of Death Valley regional groundwater flow system, receiving flow from both the volcanic aquifers and the LCA.

Failure to Define the Affected Environment Correctly - Inadequate analysis in the draft Repository Supplemental Environmental Impact Statement relating to groundwater pumping in the region, its effects on repository compliance and groundwater migration from the repository

Currently, an upper gradient exists in the LCA, which causes LCA water to move upward in to the volcanic aquifers because of a steep down gradient found in the vicinity of Yucca Mountain. The DOE argues that the upper gradient will prevent migration of radionuclides from the repository to the LCA. While Inyo's scientific data supports this conclusion, the upper gradient is ephemeral and very fragile. The County believes that the upper gradient could be degraded by regional groundwater pumping, both from the LCA and volcanic aquifers. The DOE maintains that the future effects of groundwater pumping are highly speculative, and need not be considered in any NEPA analysis. Therefore, there is no analysis from groundwater pumping in the region, and no regulatory measures to maintain the upper gradient. Inyo County strongly disagrees with this assertion. At the very least, the County believes that the DOE should consider present pumping rates and its impact on the upper gradient and radionuclide migration. Any NEPA analysis of repository performance and radionuclide migration that does not take into account the effects of groundwater pumping is incomplete and completely inadequate.

Clean up or remediation plan for radionuclides surfacing at Alkali Flat/Franklin Lake Playa

The 2002 FEIS states that water from beneath Yucca Mountain surfaces at Alkali Flat and Franklin Lake Playa, and the 69,000 people could be exposed to contaminated groundwater. The County recognizes that NEPA does not require mitigation measures. However, the County believes it is the DOE's responsibility to implement a mitigation/remediation plan, and an evacuation plan should the repository suffer a catastrophic failure.

Inadequate analysis relating to socio-economic impacts to Inyo County

The DOE considers Inyo County outside the "region of influence" for socio-economic impacts analysis under NEPA. Inyo County strenuously disagrees with this assertion, as the repository is approximately 15 miles from the Inyo County line and the boundary for Death Valley National Park. The Park has approximately 700,000 visitors a year, many of whom are foreign tourists. The County relies heavily on tourism revenues from the Park, as well as other regional attractions, such as the China Date Ranch, the Amargosa River, bird watching, and local mineral baths. The County is concerned about reduced tourism revenues, as well as decreases in real and business properties, from repository operations and the transportation of nuclear materials through the County. Therefore, Inyo County should be considered within the "region of influence" for socio-economic impacts analysis because of it proximity to the site. Without meaningful analysis in the 2002 Final EIS, and now the draft SEIS, the DOE's impact assessment of socio-economic impacts in Inyo County is incomplete and entirely inadequate because it fails to define the region of influence for the impacts created by the proposed action or due to reasonably foreseeable alternatives.

Inadequate analysis relating to reasonable alternatives to the Caliente Rail Corridor

The draft Rail EIS states that if the Caliente Rail Corridor is not completed, that the future course is "uncertain" with regards to transportation of nuclear materials to Yucca Mountain. Inyo County believes that if the Caliente Rail Corridor fails, truck transport will become the preferred method of transportation to the repository. Yet the draft Rail Corridor/Alignment EIS contains no analysis for a mostly truck shipping scenario, which should be considered a reasonable alternative, given the massive uncertainty surrounding the Caliente Rail Corridor. This will be the largest rail construction project in 80 years, and will cost $2.5-$3 billion dollars to complete the rail line. The Caliente Rail Corridor also faces several engineering challenges, as the route traverses seven north-south mountain ranges with steep grades, and numerous areas prone to flash flooding. The Caliente Rail Route will also impact grazing allotments by local ranchers, and require approximately 175 new groundwater wells to be drilled along the route to support construction. Given the uncertainty with cost, engineering challenges, and land-use conflicts, the prospects of the Caliente Rail Corridor being completed is highly questionable. Therefore, the DOE should be required to analyze a "mostly truck" shipping campaign as a reasonable alternative to the Caliente Rail Corridor.

Inadequate analysis of impacts relating to the movement of construction equipment and personnel on Highway 127 for the Caliente Rail Corridor

Finally, the draft Rail EIS gives no impact assessment of construction equipment and personnel traveling on Inyo County highways for construction of the portion of the Caliente Rail Corridor which parallels Nevada Highway 95, south from Tonopah, Nevada to the repository site. The County believes it is highly likely that the DOE will move construction equipment along California Highways 127 and 178 because of their close proximity to the Caliente Rail Corridor. This has the potential to increase the volume of traffic on these County highways and impact air quality, yet the draft Rail Alignment/Construction EIS makes no such prediction or assessment of potential impacts. The DOE should analyze the impacts of increased traffic volumes to Inyo County on Highways 127 and 178 in the Final Rail EIS.

Transportation, Aging, and Disposal Canister

The Transportation, Aging, and Disposal (TAD) canister is a multi-purpose canister designed to simplify the transport process and reduce exposure to highly radioactive spent fuel rods. The TAD utilizes one packaging system for spent fuel when it leaves the reactor site.

Use of the TAD canister system will significantly increase workers' radiological exposure and the risks associated with handling bare spent fuel assemblies, and loading and welding canisters at reactor sites. There also are uncertainties regarding acceptance of the TAD canisters at the repository and the potential return of rejected TADS to originating sites. The Final SEIS should thoroughly assess the risks and impacts to workers, surrounding communities, the environment, and populations in transit (highways, rail) at reactor sites from using the TAD system. In addition, the Final EIS should analyze how the TAD system will interface with the dry cask storage system at reactor sites as well as analyze its costs and financial arrangements for paying for the TAD system at reactor sites. All four California commercial reactor sites (Diablo Canyon, San Onofre, Rancho Seco, and Humboldt Bay) may have specific problems with the proposed TAD system. All commercial reactors in California are either planning to transfer or have transferred all or a portion of their spent fuel into dry cask storage. Finally, because TADs will be packaged by the individual utilities offsite and then shipped to Yucca Mountain, inspection of the TAD by the DOE before emplacement is critical to the repository's performance.

The Final EIS also should assess how the TAD system would work at decommissioned reactors where the spent fuel handling equipment and facilities have been removed and no longer remain onsite. All of the spent fuel at Rancho Seco, which is in the final stages of decommissioning, has been transferred into dry storage using multi-purpose canisters. The Final SEIS should evaluate how the TAD system would work at decommissioned reactors, where spent fuel handling equipment and facilities have been dismantled and removed from the site. The Final SEIS should identify who is responsible for building facilities to house spent handling operations and how would the costs, liability, and impacts associated with transferring spent fuel into TADs at reactor sites would be handled. About 10% of all spent fuel rods have broken due to gamma ray exposure during fission. These broken rods are not compatible with the TAD. Consequently, the Final EIS should identify and analyze how these broken rods will be shipped to the repository. Inyo County also remains concerned that the TAD will not be certified by the U.S. Nuclear Regulatory Commission before submission of the DOE's License Application. Given the massive uncertainty surrounding the TAD, the Final SEIS must evaluate alternatives if the TAD system does not prove to be suitable, due to its cost and/or risk.

Potential truck transportation of nuclear materials on California Highways 127 and 178

Inyo County remains very concerned about the potential for nuclear materials to be shipped to Yucca Mountain on California State Highways 127 and/or 178 given the uncertainties surrounding the Caliente Rail Corridor. While these alternative truck routes have not yet been designated, the Draft SEIS estimates that approximately 755 rail casks would be transported through California (8% of total shipments) and 857 truck casks (32% of total) if the Caliente Rail Corridor is constructed and used. It should be noted that the State of Nevada has estimated a potential for larger numbers of rail cask shipments to Yucca Mountain through California for both the Caliente Rail Corridor (as many as 4,400 casks or 45% of the total shipments). Under the terms of the standard contracts between the DOE and the utilities, 47% of the waste shipments in the first five years of the program will originate at sites without rail access. There will be a huge incentive for DOE to begin it's shipping campaign with truck shipments.

California Highways 127 and 178 began originally as wagon routes across the desert, and do not take into account the engineering demands that a prolonged truck shipping campaign of nuclear material will place on the roadways. These highways are inadequate for a truck shipping campaigns for many reasons:

1.Two-lane highway from San Bernardino County line to Nye County line
2. Limited passing lanes
3. Limited areas of highway shoulder
4. Few turnoffs
5. Flooding from the Amargosa River during spring run off or during other flood events

The first responder to any release of nuclear material in Southeast Inyo County is the Southern Inyo Fire Protection District (SIFPD). The SIFPD has a volunteer staff of approximately 10, with one full time paid employee who acts as Chief. Response times vary based on the location of an incident. In the past, the

SIFPD has received limited training to respond to a nuclear release through the DOE's Training Emergency Preparedness Program (TEPP). It is anticipated that the SIFPD would need numerous full-time, paid employees, in addition to its current volunteer staff, if a shipping campaign to Yucca Mountain is initiated. In addition, the SIFPD would need specialized equipment and detection devices, along with a rigorous training plan to adequately deal with a release of radionuclides in Southeast Inyo County.

The nearest major hospital facilities are in Las Vegas or Barstow, depending on the site of the incident. It is unclear whether these facilities are properly equipped or trained to handle persons who have been exposed to radioactive materials. Travel times to these facilities range from one and a half to three hours away from potential truck shipping routes in Inyo County. Currently, there is no regional communication network that could alert residents and visitors to a radioactive release.

The DOE maintains that these routes are currently not under consideration as truck transport routes. However, due to lingering uncertainties regarding the TAD canister, the Caliente Rail Corridor, and Clark County's steadfast opposition to nuclear shipments through Las Vegas, truck transport appears to be the most probable method of transporting nuclear materials to Yucca Mountain. This belief is further strengthened by the fact that the DOE currently uses State Highway 127 and 178 for low-level waste transport to and from the Nevada Test Site.

The County believes that Section 180 (c) of the Nuclear Waste Policy Act, which provides grants to affected states and tribes for response training, is ineffective both in funding and scope, to adequately train emergency responders to deal with a nuclear release. Modeling indicates that the State of California will only receive approximately $200,000 to distribute to the hundreds of local jurisdictions and first responder agencies.

Other Transportation Issues

The Draft SEIS does not consider "worst-case" accidents in its NEPA analysis because such combinations of factors were considered "not reasonably foreseeable." Yet, the Draft SEIS acknowledges that clean-up costs after a very severe transportation incident involving a repository shipment resulting in the release of radioactive material could range from $300,000 to $10 billion. The Final SEIS should evaluate the impacts from a credible worst-case transportation accident or terrorist attack, as well as other accidents scenarios caused by human error.

A National Academy of Sciences (NAS) study recommended that detailed surveys of transportation routes for spent fuel be done to identify potential hazards that could lead to or exacerbate extreme accidents involving very long duration, fully engulfing fires and that steps should be taken to avoid or mitigate such hazards. The Final SEIS should identify the shipping corridors and include route-specific analyses that identify potential hazards along shipment routes. The risk analyses should include the potential consequences of a severe accident or terrorist attack involving extreme, long duration fire conditions that exceed package performance requirements. The Final SEIS should also consider the impact of human error as well as the potential for unique local conditions to exacerbate the

consequences of accidents or terrorist attacks. Certain segments of possible routes in California could provide conditions in which an accident or terrorist attack could exceed the spent fuel packaging performance requirements. Two major highway accidents that occurred this year on California highways (one in the Bay Area and one in Santa Clarita tunnel fire) are being investigated to determine whether these accidents may have resulted in conditions, in particular fire temperatures and fire durations, which approached or exceeded packaging performance requirements. Similarly nearly half of the 16 historical severe accident scenarios that were examined in the NAS 2006 study on spent fuel transport safety occurred in California. The Final SEIS should examine credible accident scenarios that could exceed packaging performance standards.

In the draft Rail EIS, the DOE proposes to ship newer spent nuclear fuel first, contrary to the recommendation made by the NAS that the oldest spent fuel be shipped first to the repository. This recommendation was proposed because fuel that has aged fifty or more years contains significantly less amounts of Cesium-90 and Stonchium-137. These radioactive isotopes present the most substantial risk to workers who package the spent fuel for transport, and those involved in the actual transport of spent fuel. Inyo County recommends that the Final Rail EIS incorporate the NAS's recommendation of the oldest fuel being shipped first to Yucca Mountain.

No final U.S. Environmental Protection Agency compliance standard

The final U.S. Environmental Protection Agency (EPA) rule regarding acceptable radiation dose rates at the compliance point, located near Nevada Test Site Gate 5-10, has not yet been finalized. It should be noted that this is the only compliance point for the entire repository. The compliance point also appears to have been selected because it is at the far southern boundary of the Nevada Test Site, rather than for any unique radionuclide detection capabilities. Without any final standard, it is impossible for Inyo County to assess and verify the DOE's claims of compliant repository operations. Therefore, the final Repository EIS should incorporate the EPA's final rule regarding acceptable radiation releases from the repository.

Emergency preparedness in Southeast Inyo County

The first responder to any release of nuclear material in Southeast Inyo County is the Southern Inyo Fire Protection District (SIFPD). The SIFPD has a volunteer staff of approximately 10, with one full time paid employee who acts as Chief. Response times vary based on the location of an incident. In the past, the SIFPD has received limited training to respond to a nuclear release through the DOE's Training Emergency Preparedness Program (TEPP). It is anticipated that the SIFPD would need numerous full-time, paid employees, in addition to its current volunteer staff, if a shipping campaign to Yucca Mountain is initiated. In addition, the SIFPD would need specialized equipment and detection devices, along with a rigorous training plan to adequately deal with a release of radionuclides in Southeast Inyo County. The Final Rail EIS should incorporate the DOE's contingency plans for any type of radioactive release in Inyo County.

Impacts to the Timbisha Shoshone Tribe

The U.S. Department of the Interior has recognized the Timbisha Shoshone Tribe as an "affected Indian tribe" under the Nuclear Waste Policy Act. Neither the draft SEIS nor the draft Rail EIS recognize the proximity of the tribe to the site and the likely impacts that will be felt throughout each phase of the Yucca Mountain Project by the Timbisha Shoshone. The final EIS's should asses and analyze impacts to the tribe's drinking water supply, impacts from truck transport of nuclear materials through tribal lands, socio-economic impacts, impacts to cultural resources, and environmental justice issues.

NEPA Procedural Concerns

The spirit and intent of NEPA is to maximize public input regarding the environmental impacts of actions undertaken by federal agencies. NEPA public meetings allow impacted citizens and other members of the public the opportunity to formally comment on any potential impacts on federal projects. The DOE has scheduled only one public meeting for all three NEPA draft EIS's in the State of California. California will be highly impacted from the Yucca Mountain Project, specifically from the transportation of nuclear materials in the state. It is estimated that 7.5 million people in California live within one mile of federal interstates that will be used for shipment. One meeting is wholly inadequate, given the anticipated impacts to the state, for citizens to participate effectively in the NEPA process. Additionally, the single meeting location, in Lone Pine, California, is in an area that will experience little to no impact from the Yucca Mountain Project. Finally, Inyo County would recommend that question and answer periods during any public hearing be placed on the administrative record.

Thank you for the opportunity to comment on the draft Repository SEIS and the draft Rail EIS. Inyo County believes that its comments will allow the DOE to make the most informed decision regarding impacts to Inyo County, the severity of such impacts, and appropriate mitigation measures.

Please contact Matt Gaffney, Project Coordinator, Yucca Mountain Repository Assessment Office, at (760)-873-7423 if you have any questions.

Sincerely,

Supervisor Jim Bilyeu, Chairperson
Inyo County Board of Supervisors

Supplement to Inyo County's comments on groundwater impacts

This supplemental section discusses in detailed scope Inyo County's groundwater studies program, and specific oversights found in the draft Repository Supplemental Impact Statement (draft SEIS). It is incorporated by reference in the main text of the County's comment letter. The County's general conclusions regarding the adequacy of the draft SEIS are:

1. The draft SEIS does not fully reference or utilize DOE sponsored Inyo County hydrogeology research on the Lower Carbonate Aquifer (LCA).

2. The draft SEIS does not fully or accurately characterize the LCA.

3. The draft SEIS does not adequately discuss the upward gradient in the LCA as a barrier to radionuclide transport, or possible impacts on repository performance with a possible loss in the upward gradient due to regional groundwater usage.

1. The draft SEIS does not fully reference or utilize DOE sponsored Inyo County hydrogeology research on the LCA

The 2002 FEIS and SEIS references and utilizes data from the Nye County Early Warning Drilling Program. Inyo County geologic and hydrologic studies are referenced in a single paragraph in Section 3.1.4.2.1 (Regional Groundwater), with minor notations in various texts. A brief summary of Inyo County's research is provided with references.

With funding from the U.S. Department of Energy (DOE), Inyo County has been conducting geological and hydrological studies since 1997. Specifically, the County is concerned with potential transport, by ground water, of radionuclides into Inyo County, including Death Valley, and the evaluation of a connection between the LCA and the biosphere. Key research conducted includes:

- Geological mapping.
- Construction of a LCA monitoring well on eastside of Southern Funeral Mountain Range.
- Geophysical surveys of portions of the Amargosa Valley and Death Valley areas.
- Geochemical sampling and testing of springs and wells in Death Valley National Park.
- Numerical groundwater modeling of the LCA in the Amargosa Valley and Southern Funeral Mountain Range.

All of these materials are, and have been, available to the DOE. The DOE should analyze and incorporate all of Inyo County's findings regarding groundwater impacts in its Final

SEIS. All of the materials supporting Inyo County's findings regarding groundwater impacts can be found below.

References

Bredehoeft, et. al., 2005, The Lower Carbonate Aquifer as a Barrier to Radionuclide Transport, Waste Management Conference 05, WM 5482.

Bredehoeft, et. al., 2007, Radionuclide Transport from Yucca Mountain and Inter-basin Fow in Death Valley, Waste Management Conference 07, WM 7120.

Bredehoeft, et. al., 2007, Radionuclide Transport from Yucca Mountain and Inter-basin Flow in Death Valley: Testimony to U.S. Nuclear Waste Technical Review Board, May 15.

Inyo County, September 2005, Death Valley Lower Carbonate Aquifer Monitoring Program-Wells Down Gradient of the Proposed Yucca Mountain Nuclear Waste Repository: U.S. Department of Energy Cooperative Agreement DE-FC08-02RW12162 Final Project Report.

Inyo County, August 2007, Death Valley Lower Carbonate Aquifer Monitoring Program-Wells Down Gradient of the Proposed Yucca Mountain Nuclear Waste Repository: U.S. Department of Energy Cooperative Agreement DE-FC28-06RW12368 Year One Project Report.

King, et. al., 2003, Inyo County, California, Regional Ground Water Monitoring Program, Testimony to U.S. Nuclear Waste Technical Review Board, October.

King, et. al., 1999, Death Valley Springs Geochemical Investigation, Yucca Mountain Nuclear Repository, Inyo County Oversight-1998, www.hydrodynamics-group.com, March.

2. The draft SEIS does not fully or accurately characterize the LCA

The draft SEIS provides only a limited characterization of the LCA. The draft SEIS characterization of the LCA should be expanded because of the importance of the LCA as a barrier to radionuclide transport at Yucca Mountain. A discussion of the LCA should also accurately represent the current data on the LCA.

Bredehoeft, et. al., Waste Management 2007 Conference paper and Bredehoeft's testimony in May 2007 to the Nuclear Waste Technical Review Board provides a characterization of the aerial distribution and hydraulic properties of the LCA at and down gradient of Yucca Mountain. The paper also describes Inyo's understanding of the LCA and which has been provided to the DOE's for its consideration. The following is a concise summary of the properties and characteristics of the LCA.

DEATH VALLEY REGIONAL GROUNDWATER MODEL

Concern about the potential transport of contaminants from both the Nevada Test Site and from Yucca Mountain led to groundwater flow models being developed for both sites. Initially two separate models were developed—one for the Test Site by IT/GeoTrans and a second for Yucca Mountain by the United States Geological Survey (USGS). Initially this was a duplicative effort. It was decided to merge the two efforts into a single model under the leadership of the USGS.

A groundwater flow model of the area poses unique problems. The area is broken up into mountain ranges and intervening valleys. In addition the area was at the continental margin during much of its geologic history; the facies of many of the stratigraphic units change in the area of the model. While there are outcrops of the rocks in the mountain ranges, there are few drill holes in the valleys that penetrate the LCA. Creating the model was a challenging problem.

The final USGS model design is unusual. The model consists of 16 layers that are created based loosely upon elevation—they are more or less horizontal slices of rock. Superimposed on the layers is the usual horizontal finite difference grid—cells are 1500 meters by 1500 meters in the east-west and north south-direction. Using this grid system the rocks that underlie the region can be assigned into the grid cells within the model (5).

This modeling system has both strengths and weaknesses. Its strength is that it readily accommodates the rapid horizontal changes in lithology that occur within the region—all the differing rocks are readily accommodated. The scheme has the disadvantage that it is hard to follow a given aquifer through the model. For example, one has to search for all the cells in each layer that contain Paleozoic carbonate. One then has to aggregate the information from the layers to obtain a picture of the total carbonate rock at any location. If several layers at any given location contain Paleozoic carbonate the head representing the aquifer at that location has to be interpreted from the head in each of the model layers

Geology in the Model

There are few drill holes in the area of the Death Valley flow system model that reach the Paleozoic carbonate aquifer beneath the valleys. Outcrops of the various stratigraphic units, including Paleozoic carbonate rocks occur in the mountain ranges. However, in order to fully populate the model it is necessary to interpret the geology, especially the geology beneath the valleys. Geologists constructed a series of cross-sections through the area of the model that depicted their interpretation of the geology.

Geologic mapping in the mountain ranges where the rocks are exposed is a more or less straightforward procedure. However, interpreting the geology beneath the valleys is a much more subjective endeavor, even when it is guided by regional geophysics. There is the further problem that the data must be interpolated from the cross-sections to the model grid; errors in input can occur in this procedure.

In summary, the USGS Death Valley Regional Flow System Model has the advantage that the laterally discontinuous nature of rocks in the region are accommodated. The model has the disadvantage that it is difficult to extract information of interest. It is Inyo's intent to extract from the USGS as much information as possible that pertains to the LCA.

The Palezoic Carbonate Aquifer

Of particular concern to Inyo County is the Paleozoic carbonate aquifer, or LCA. Inyo County has extracted from the USGS Death Valley Regional Flow Model the data pertaining to the Paleozoic carbonate aquifer. Figure 1 is a distribution map for the carbonate taken from the USGS Regional model area (see next page).

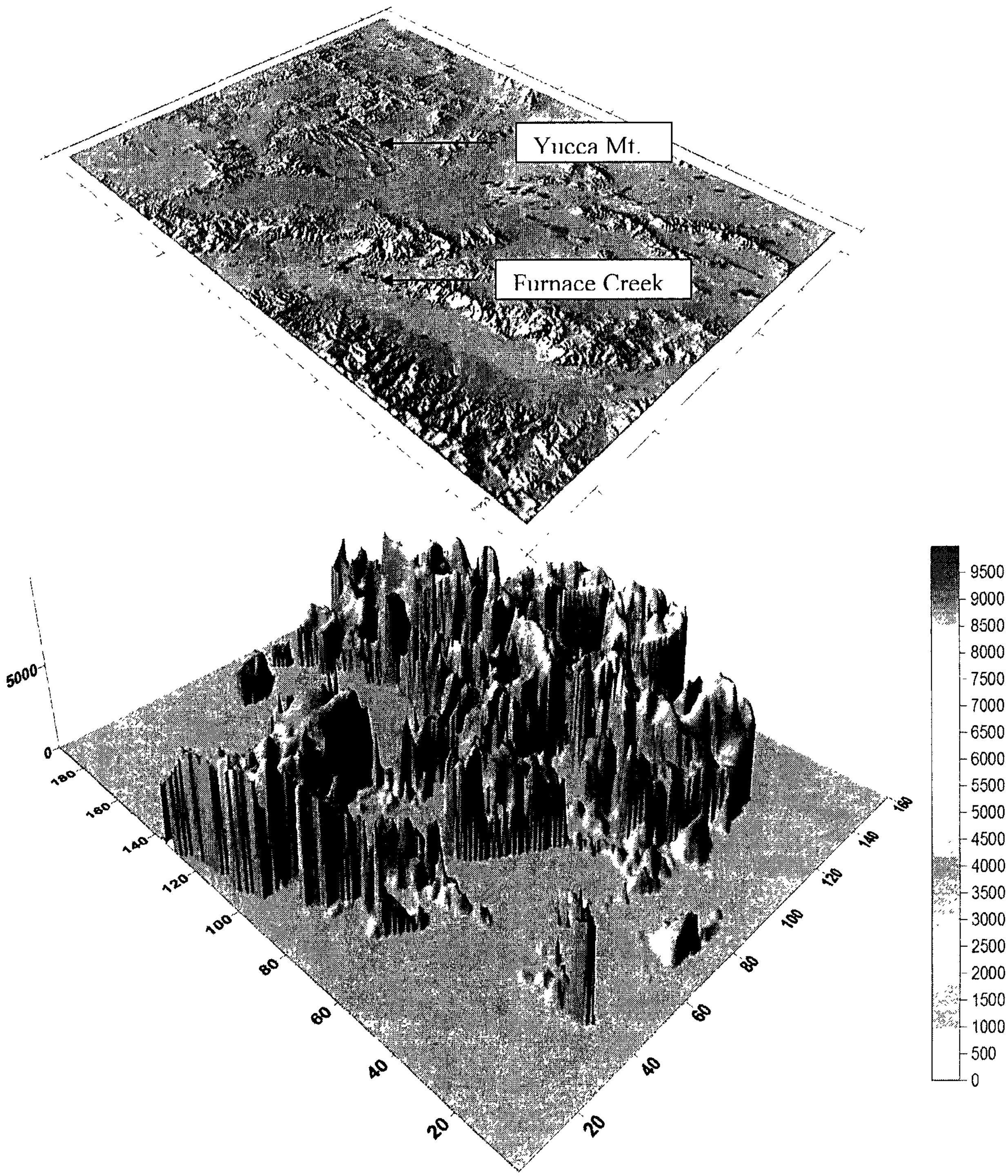

Figure 1. Distribution of Carbonate Rocks in the Death Valley Regional Flow System Model.

As Figure 1 illustrates, the carbonate rocks are discontinuous across the region. In places they are very thick, reaching more than 5000 meters in thickness. A large mass of carbonate rock underlies Yucca Mountain and the Amargosa Valley that extends through the Southern Funeral Mountains.

The potentiometric surface for the area indicates an area of low gradients over the Amargosa Valley that is bound by an area of high gradients through the Southern Funeral Mountain Range to the southwest to a spring discharge area in Death Valley. the area of low gradients discharge occurs at Ash Meadows, and to a lesser amount in Pahrump Valley, Shoshone and Tecopa.

Amargosa Valley Sub-Region

Inyo County's focus is on Yucca Mountain, the Amargosa Valley, and the Southern Funeral Mountains. It is through this area that the Paleozoic carbonate aquifer provides a potential pathway for contaminants to be transported from Yucca Mountain to the biosphere.

We extracted from the USGS regional model the thickness of the Paleozoic carbonate rock in the sub region. Figure 2 is an isolith map for the Paleozoic carbonate rock within the sub-region. Not all of the sub-region contains carbonate. Beneath the Amargosa Valley the Paleozoic carbonate rocks are greater than 5000 meters thick. In this area, even extensional basin and range faults with large vertical throws would juxtapose carbonate rocks against carbonate rocks across the faults. With such large thickness of carbonate rock one can understand why the aquifer integrates the subsurface flow at depth.

Each researcher working on the hydrogeology of the Paleozoic carbonate aquifer has a somewhat different conceptual image of what forms the interconnected pore space of the Paleozoic carbonate aquifer. The brittle carbonate rocks are broken up by the tectonics of the basin and range. Joints and faults in the rock have been enlarged by subsequent dissolution of the rock. Caverns are known to occur—Devils Hole is a good example. The question arises: can one drill anywhere in the carbonate rock terrain and obtain a reasonable productive water well—a well producing several hundred gallons a minute or more? Experienced Nevada ground-water hydrologists believe this is possible, provided that one drills a "sufficient" thickness of carbonate rock.

Recently the Southern Nevada Water Authority (SNWA) proposed to pump groundwater from valleys to the south and east of Ely, Nevada and pipe it to Las Vegas. Estimates vary for their proposed withdrawal; but they talk in terms of 190 million cubic meters annually (150,000 acre-feet). One of their early requests to the Nevada State Engineer is for a water right to pump 110 million cubic meters (90,000 acre-feet) annually from Spring Valley. SNWA's contractor, Durbin & Associates, assembled hydraulic conductivity values for the entire Paleozoic carbonate region as input for a model of Spring Valley. Figure 3 illustrrates a cumulative distribution of transmissivity taken from the SNWA data.

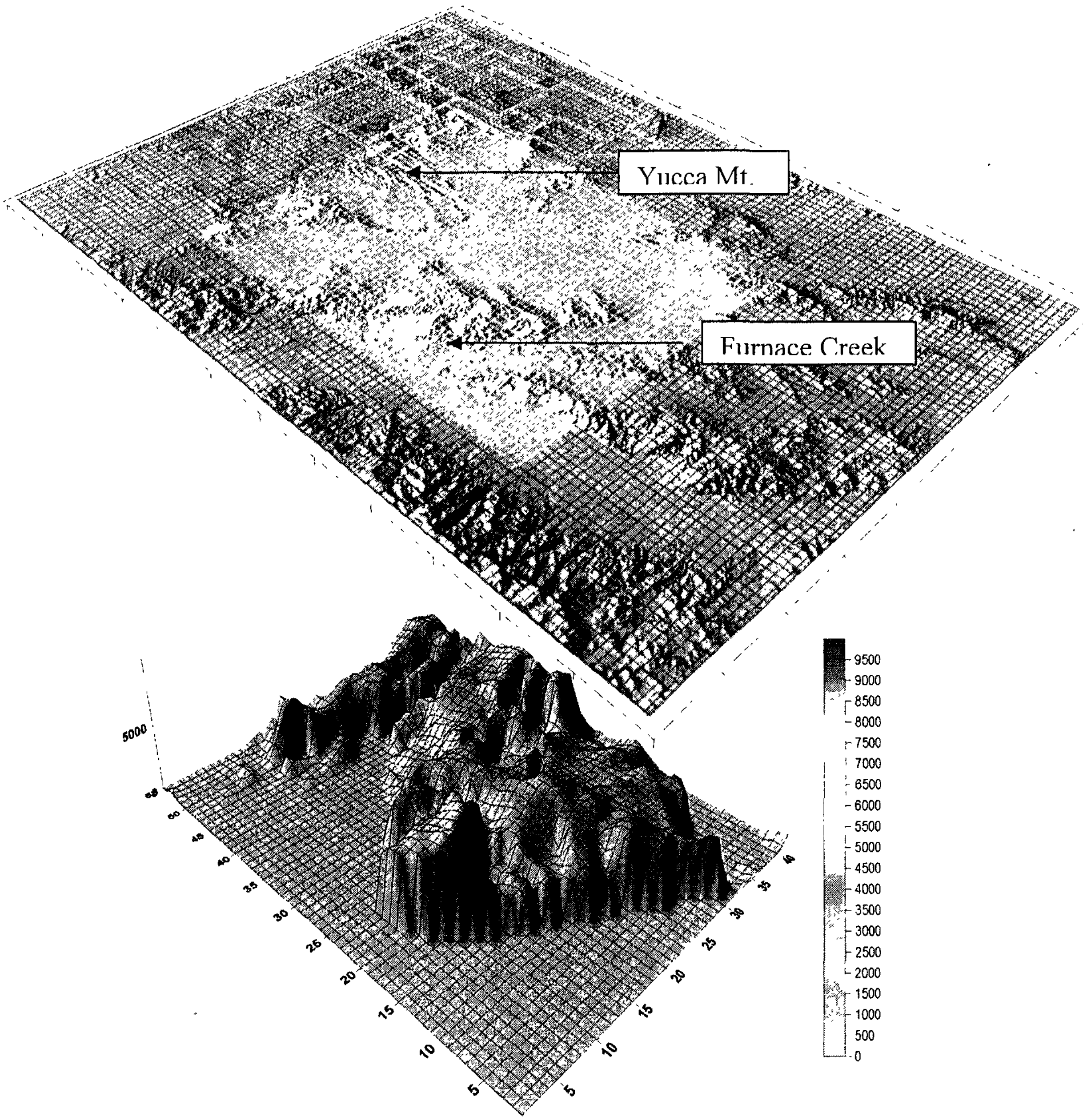

Figure 2. Thickness of the Paleozoic Carbonate Rocks in the Sub-Region.

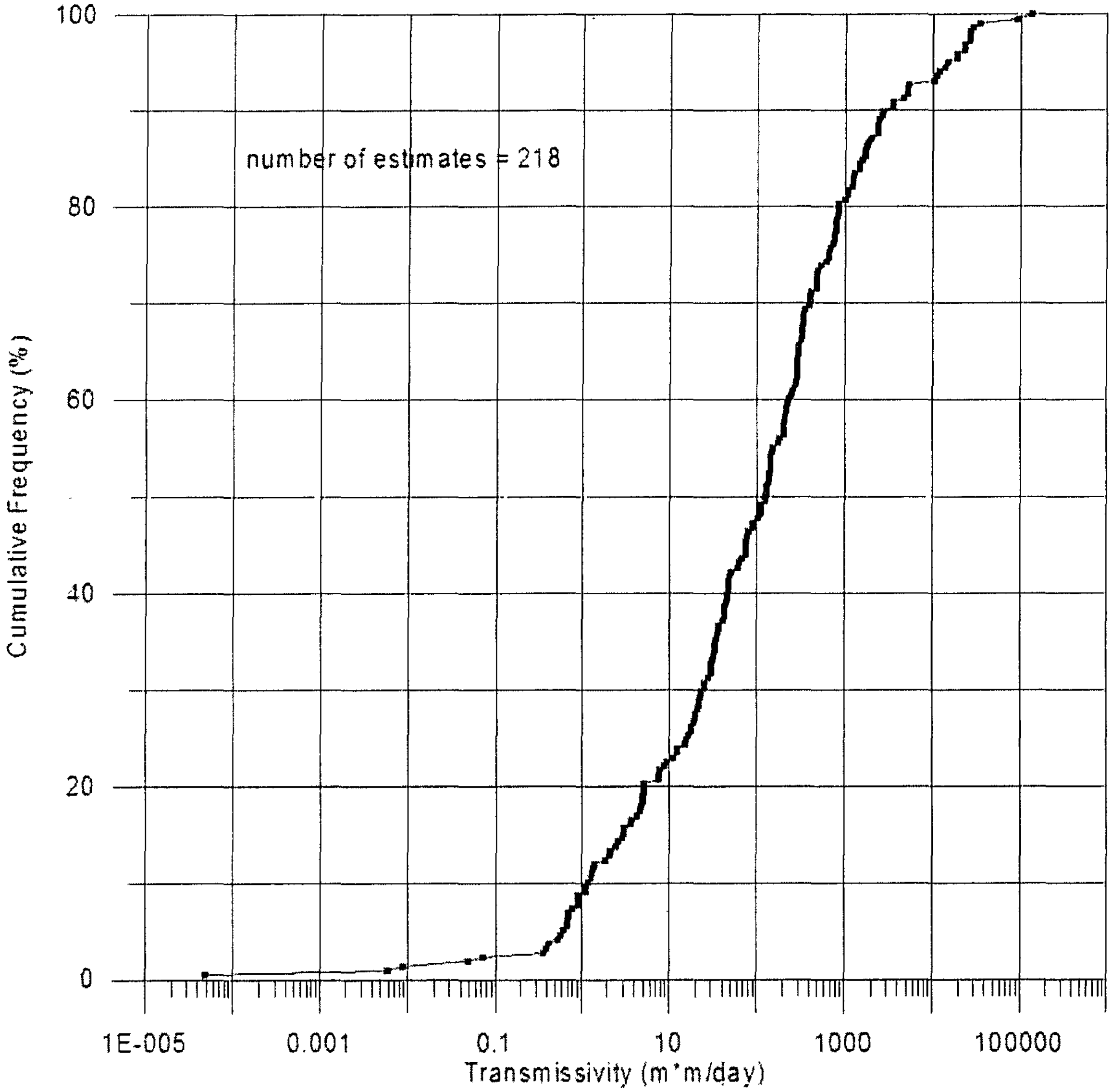

Figure 3. Cumulative Distribution of Transmissivity from SNWA Data (SNWA, 2006).

The data suggest that there is approximately an 85% chance of obtaining a well that yields 0.4 cubic meters per minute with 30 meters of drawdown (100 gpm with 100 feet of drawdown). It also indicates that there is approximately a 10% chance that a well with 30 meters of drawdown will yield approximately 8 cubic meters per minute (2000 gallons per minute with 100 feet of drawdown).

One can calculate a hydraulic conductivity from the Transmissivity data. The usual assumption is that the screened interval, or the open-hole section of the portion of the well tested should be divided into the transmissivity to obtain a local estimate of the hydraulic conductivity. If one compares the cumulative ratio of the cumulative distributions you see that the hydraulic conductivity generally represents approximately 30 meters of tested well section. This suggests that there is about an 85% chance that if one drills a sufficiently thick section of Paleozoic carbonate rock one will find a 30 meter, or smaller zone that is sufficiently permeable to yield a good well (defined as more than 100 gallons per minute with 100 feet of drawdown).

In other words, the simple conceptual model of the hydraulic conductivity in the aquifer shows the aquifer contains at least a permeable zone, maybe 10 meters, or several tens of meters thick, more or less everywhere where the Carbonate rocks are more than several hundred meters thick. The permeability is enhanced where it is associated with recent faulting within the carbonate units. Barriers to flow seem to occur where the carbonate is juxtaposed against less permeable rock. Caves are known in the carbonate rock; for example, Devils Hole is a known cave.

There is some suggestion in the carbonate data that the hydraulic conductivity decreases with depth; however, the data is very scattered. Some workers explain that this scatter is due to burial; on the other hand, the temperature rises with depth making the water less viscous, increasing the hydraulic conductivity. Researchers seem to assume a depth of burial beneath which the hydraulic conductivity does not decrease further. This seems questionable, given the noisy nature of the data, that correcting the hydraulic conductivity for depth adds much to the precision of the analysis.

The conceptual model may not be all that important when one's concern is only the movement of water. However, when you begin to transport chemical constituents the nature of the conduit for flow becomes all-important—more on the permeability/porosity conceptual model below.

A Simple Flow Model

One simple way to investigate the system is to assume that the principal pathway for flow is mostly through the Paleozoic carbonate aquifer. With this thought in mind one can construct a model for flow through only the carbonate rock; this is a simplistic, first-order approximation for the system; but it provides insight. The USGS in their RASA study used a two-layer idealized model—this model is even simpler.

In the Ash Meadows/Amargosa area the largest amount of recharge comes from the Spring Mountains. The big discharge areas are in Ash Meadows, Pahrump Valley, in the area of Shoshone and Tecopa, and in Death Valley. Approximately 75% of the recharge comes from the Spring Mountains.

Inyo County created a one-layer model of the Paleozoic carbonate aquifer. As suggested above, this is a kind of zero-order model that provides insight into how contaminants might move through the carbonate aquifer. In this model the aquifer is decoupled from the overlying Tertiary deposits. Where the Paleozoic carbonate aquifer has been penetrated in the area, a good low-permeability confining layer overlies the aquifer. We know that this isolates the aquifer, not totally, but certainly to a great degree. So the simple model is only useful in that it provides an estimate of how contaminants might move. Figure 4 is a computed steady-state potentiometric surface generated from the one layer model. Flow is continuous in the aquifer from the area of Yucca Mountain to the discharge area in Death Valley.

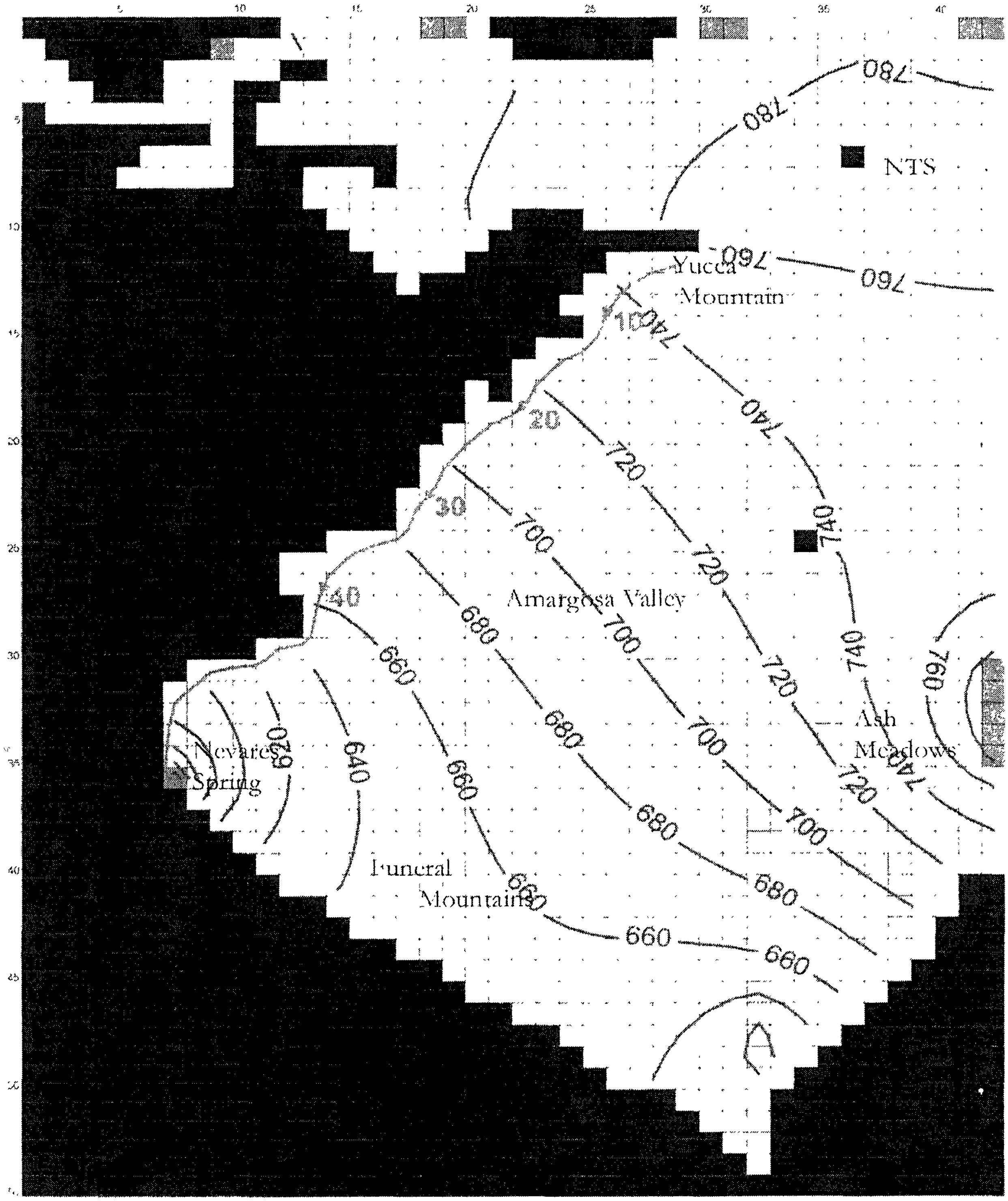

Figure 4. Map of Steady State Hydraulic Head from the one Layer Carbonate Aquifer Model.

The yellow areas are spring discharge areas. The red line is a particle track for a particle introduced in the vicinity of Yucca Mountain that exits in Death Valley—the red numbers are estimates in years of the time of travel for the particle.

Potential for Contaminant Travel Through the Carbonate Aquifer

One common way to estimate the time of travel of a chemical constituent is to assume that the constituent moves with the velocity of the water. In groundwater flow, Darcy's Law defines the groundwater velocity as:

$v = K/\varepsilon\ (\partial h/\partial l)$

Where v is the groundwater velocity, K is the hydraulic conductivity, ε is the porosity, and $(\partial h/\partial l)$ is the gradient in hydraulic head. The question becomes what is the appropriate porosity to apply to the calculation? This again raises the issue of how one conceives the connected pore space in the aquifer. There are several investigations that shed some information on this issue.

Winograd and Pearson investigated the isotopic content of major springs in the Ash meadows complex. They focused particularly on carbon 14 that varied greatly between individual springs. They concluded that the carbon 14 content of the springs was best explained by what they termed "mega scale channeling" within the aquifer.

One hole in the vicinity of Yucca Mountain, UE 25p1, penetrated approximately 500 m of the Paleozoic carbonate aquifer. Galloway and Rojstaczer (10) studied earth tide signals in the carbonate aquifer. They concluded that the aquifer was well confined, and that the storage coefficient derived from their analysis indicated porosity less than 1%. Craig and Robison (11) estimated from a pumping test that the transmissivity of the carbonate aquifer penetrated by the hole was 59 m^2/day this is approximately mid-range in the transmissivity distribution (see Figure 3).

The evidence suggests that the porosity one assigns to the carbonate aquifer to estimate the velocity of groundwater flow should be less than 1%. This is consistent with a fractured zone in the thick carbonate sediments that is highly permeable.

The particle path line, shown on Figure 4, is calculated using a permeable zone 100 meters thick, with a porosity of 0.1%. With this calculation it takes less than 50 years for the particle to travel though the aquifer from vicinity of Yucca Mountain to Death Valley. If the porosity were 1% the travel time would be 500 years.

What Protects the Carbonate Aquifer at Yucca Mountain

Borehole UE 25p1 had a hydraulic head in the Paleozoic carbonate aquifer that was 15 m higher than the hydraulic head in the overlying Tertiary volcanic rocks. This higher head has the potential to move groundwater upward from the carbonate into the overlying volcanic sequence of rocks. As long as the head relationship remains as presently observed the carbonate is protected from contamination moving downward from the repository to the carbonate aquifer.

Summary and Conclusions

The Paleozoic carbonate aquifer, or LCA in the Death Valley flow system has been the site of intensive investigation since the 1950s. Conventional wisdom, that has become doctrine, has the carbonate aquifer integrating the ground water flow in the area. The investigations have intensified as the Federal Government has embarked on building a nuclear repository at Yucca Mountain. One of the more ambitious of the projects has been the construction of the USGS Death Valley Regional Ground Water Flow Model.

Any model of contaminant transport through the carbonate aquifer depends heavily upon how one pictures the connected pore space in the carbonate rocks. Inyo's conceptual model is of a thick carbonate sequence that contains a zone ten to several tens of meters thick where the rocks are fractured and provide a permeable pathway for flow. The information suggests that everywhere there is a reasonable thickness of carbonate rock one can obtain a reasonably good water well, provided he/she drills a sufficient thickness of the rock. One can enhance his/her chances of getting a really good well by going to places where recent tectonics movements in the region have further disturbed the carbonate rocks.

Finally with this model in mind transport through the carbonate aquifer from a location near the site of the repository at Yucca Mountain to the biosphere in Death Valley will be relatively rapid. Our calculation with a permeable zone 100 m thick and porosity of 0.1% indicates a transit time of less than 50 years; if the porosity is of the order of 1% the time is of the order of 500 years.

3. The draft SEIS does not adequately discuss the upward gradient in the LCA as a barrier to radionuclide transport or possible impacts on repository performance with a possible loss in the upward gradient due to regional groundwater pumping

The importance of the upward gradient in the LCA as a barrier to radionuclide transport at Yucca Mountain, and the potential impact of down gradient pumping on repository Total System Performance Assessment (TSPA), is not discussed in the draft SEIS. It is also evident from discussions with DOE-Office of Civilian Radioactive Waste Management (OCRWM) that the hydraulic relationship between the LCA and the Tertiary aquifers is misunderstood. The upward gradient in the LCA represents an important natural barrier to radionuclide transport from Yucca Mountain. It is believed that downward migration of radionuclides through the Tertiary Saturated Zone aquifers will be stopped by the higher hydraulic head or pressure from the LCA. Thus, understanding the hydraulic relationship between the Tertiary and LCA is critical TSPA analysis.

The upward gradient in the LCA has been established from water level measurement in LCA monitoring wells UE25p1, Nye County well 2DB, National Park Service Ash Meadow wells GF-2A and 2B, and Inyo County well BLM #1. This data indicated the LCA has an upward gradient at Yucca Mountain and over most of the Amargosa Valley. Geochemical data from the Nye County Early Warning Drilling Program Wells show a carbonate signature that indicates a hydraulic connection between the Tertiary and LCA.

Numerical groundwater modeling has been performed for the region at and down gradient of the Yucca Mountain repository by the United States Geological Survey (Belcher, 2004), by the State of Nevada Engineer's Office (Water Rights Ruling 5750), and by The Hydrodynamics Group, LLC (WM 2007). These numerical groundwater models demonstrate the hydraulic connection between the Tertiary and LCA systems. The models show that the potentiometric surface in the Tertiary aquifer system is supported by the upward gradient in the LCA.

Hydraulic head is one of the more ephemeral of hydrologic conditions. Head is subject to change by development of groundwater for water supply in the Amargosa Valley south of the repository site. The population of southern Nevada is growing rapidly. Local groundwater is looked to for a large portion of the water supply. Both the valley fill deposits and the Paleozoic Carbonate Aquifer are targets for development. Groundwater pumping, lowering the hydraulic head, could eliminate the upward hydraulic head gradient that serves as the barrier to contaminate movement into the LCA at Yucca Mountain.

Current pumping rates from water wells in the Amargosa Valley and Yucca Mountain areas were modeled into the future for a 1,000-year period. Both the Nevada State Engineer's and Hydrodynamics models show an approximate 10-meter drop in the saturated zone water level below Yucca Mountain after 1,000 years of pumping at current rates (Bredehoeft, et. al., 2007).

A reduction in water level in the Tertiary aquifer will cause a loss of head, or hydraulic gradient, in the LCA. As water is withdrawn from the Tertiary aquifer at a rate that exceeds recharge, the hydraulic system will approach a new equilibrium. The upward gradient in the LCA will go to support the lowered head in the Tertiary auqifer. The net result, over time, will be a lowering and possible loss of the fragile upward gradient in the LCA.

Therefore, ground water development could destroy the upward head gradient in the LCA that currently serves as a barrier to downward contaminant movement at Yucca Mountain. Should contaminants reach the LCA, they will be transported quickly to the springs in Death Valley. The TSPA and Pre-Closure Safety Analysis should take into account potential groundwater impacts to Inyo County.

Conclusion

The ultimate conclusion from Inyo's groundwater studies is that the LCA is a good pathway for contamination to the biosphere. Every effort should be made to keep contaminants out of the LCA that may include protection of the upward hydraulic gradient in the Paleozoic carbonate aquifer. The draft SEIS needs to address the importance of the upward gradient in the LCA as a barrier to radionuclide transport from Yucca Mountain, and the potential impacts and mitigation of those impacts on total system performance.

Specific comments/recommendations on the draft SEIS

Inyo County respectfully provides the following comments on specific sections of the SEIS.

Section 3.1.3 Geology, pg 3-16
DOE provides a detailed discussion of Nye Counties geological studies related to Yucca Mountain. Inyo County recommends that DOE add a third paragraph describing the County's geological studies related to Yucca Mountain.

Section 3.1.3.1.1 Site Stratigraphy and Lithology, pg 3-17
DOE should identify the source for the Paleozoic Era carbonate rocks at the Ue25P1 well. It should also include the stratigraphy and lithology from Nye County well 2DB, NPS wells GF-2A and 2B, and Inyo well BLM #1.

Section 3.1.3.1.2 Selection of Repository Host Rock, pg 3-18
The DOE should add a fifth reason for selection of the Yucca Mountain repository site. Specifically, 5) the upward gradient of the LCA as a barrier to radionuclide transport.

Figure 3-5, pg 3-20
The white geological unit below Yucca Mountain should be identified on the figure and in the legend.

Section 3.1.4.2.1 Regional Groundwater, pg 3-27
The first paragraph of this section does not reference Inyo County geological studies and well drilling data. The Final EIS should specifically reference Inyo's work in describing the Carbonate aquifers in the Death Valley region.

Section 3.1.4.2.1 Regional Groundwater, pg 3-29
Inyo County disagrees with the statements in the first paragraph at the top of page 3-29: "Although carbonate aquifers are regionally extensive, they are not necessarily extensively interconnected and often occur in compartments (DIRS Nye County Nuclear Waste Repository Project Office-NWRPO 2001, p.F53) that might or might not have a hydraulic connection to the carbonate rock in an adjacent compartment." First, the Nye County research does not accurately represent the regional data collected on the LCA by Inyo County and the NPS. Second, the USGS Death Valley Regional Groundwater model, publications by Winograd, USGS, and Inyo County's models of the LCA aquifer system indicate that the LCA is highly connected and provides a bases for inter-basin flow between the Amargosa Valley and Death Valley through the Southern Funeral Mountain range.

The second paragraph on page 3-29 should include a discussion on the observed regional upward gradient in the LCA with its contribution to the regional groundwater table.

Section 3.1.4.2.1 Regional Groundwater, Basins, pg 3-31
Paragraph three does not reference Inyo County in relation to groundwater conditions and movement in the Death Valley region. Belcher, 2004 and Bredehoeft, et. al., 2005 and 2007 groundwater models characterize groundwater flow through the Amargosa Valley basin. An explanation of this research should be included.

Section 3.1.4.2.1 Regional Groundwater, Basins, pg 3-32
Paragraph one provides a reasonable explanation of Inyo County's studies with emphasizes on geochemical data. The County recommends the DOE include the results of Inyo's geological mapping, geophysical surveys, LCA monitoring wells, and numerical groundwater modeling for completeness.

The County disagrees with the last sentence of the first paragraph that states "However, water that moves south from the volcanic aquifers (such as Yucca Mountain area) is not a primary source for those discharges. Chemical modeling and groundwater models suggest some portion of waters from the Yucca Mountain area contribute to the flows to Death Valley.'

A paragraph should be added after the first paragraph to discuss the LCA flow system.

Section 3.1.4.2.1 Regional Groundwater, Uses, pg 3-32 & 33 and Table 3-4, pg 3-34
The discussion of water uses in the Amargosa Valley does not discuss the potential impacts of groundwater withdrawals from the Amargosa Farms area on the regional water table that includes Yucca Mountain. Some discussion on the findings of the Nevada States Engineer's Water Rights Ruling 5750 should be included.

DOE should ensure the perennial yields stated for the Amargosa Desert reflect the Nevada States Engineer's Water Rights Ruling 5750.

Section 3.1.4.2.2 Groundwater at Yucca Mountain, Saturated Zone, pg 3-39
Inyo County agrees with the majority of the discussion presented in the second paragraph. However, the last sentence should be changed to state:

This is significant in the assessment of the postclosure performance of the proposed repository (see Chapter 5 of this draft SEIS) because it constrains the pathway by which *radionulcides* could move after repository closure ***providing the upward gradient in the LCA is preserved over time.***

Section 3.1.4.2.2 Groundwater at Yucca Mountain, Saturated Zone, Water Sources and Movement, pg 3-42
The first paragraph of Water Sources and Movement need to be qualified. The groundwater pumping referred to appears to be limited to only pumping at the Yucca Mountain repository site, which has relatively low and stable volumes of water for some time. However, the critical issue is the impact of the large scale regional pumping on the stability of water levels at Yucca Mountain. As discussed earlier, projections of current

pumping in the Amargosa Valley for 1,000 years could results in a 3-meter drop in the water table below Yucca Mountain. This situation should be addressed the Final SEIS.

Section 3.1.4.2.2 Groundwater at Yucca Mountain, Saturated Zone, Inflow to Volcanic Aquifers at Yucca Mountain, pg 3-45

Inyo County disagrees with the last sentence of this section that states "The amount of inflow from the carbonate aquifer, if it exists, is unknown." The thermal modeling of the upward gradient in Ue25p1 and the regional groundwater modeling of the LCA in the Yucca Mountain region shows that inflow from the LCA into the Tertiary aquifers exists. This section should be corrected to reflect the current data from the LCA studies.

SEIS Section 8 Cumulative Impacts

Section 8 of the SEIS makes no mention of the potential impacts from a potential loss of the upward gradient in the LCA on the TSPA of the Yucca Mountain. Limiting the discussion of what impacts the repository will have on the environment versus impacts the environment may have on repository performance is not responsive to the goals of the NEPA process. The DOE should include a discussion on the significance of the upward gradient of the LCA on repository performance.

SEIS Section Best Management Practices

Section 9 of the draft SEIS provides a detailed discussion on the issues that may impact Nye County concerning the proposed Yucca Mountain repository. Yucca Mountain has the potential for radionuclide transport into Inyo County through the major springs in Death Valley National Park via the LCA or at Franklin Lake Playa via the volcanic Tertiary aquifers. The DOE should provide the same level of effort to discuss potential impacts to Inyo County due to the potential of radionuclide contamination of groundwater.