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United States Department of the Interior

U.S. GEOLOGICAL SURVEY
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INFORMATION ONLY

May 15, 1997

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SUBJECT: Yucca Mountain Project Branch - U.S. Geological Survey (YMPB-USGS) Progress Report, April, 1997

Attached is the USGS progress report in the required format for the month of April, 1997.

If you have any questions or need further information, please call Raye Ritchey Arnold at (303)236-0516, ext. 282.

Sincerely,

Raye R. Arnold
for Robert W. Craig
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U. S. GEOLOGICAL SURVEY
EXECUTIVE SUMMARY
April 1997

WBS 1.2.3.1 Coordination and Planning

U. S. Geological Survey - Yucca Mountain Project Branch is currently processing 186 scientific papers prepared by USGS authors. Of these, 100 are related to geologic studies and 86 to hydrologic studies. In addition 48 abstracts are being processed, as well as 17 reports by LBL personnel.

WBS 1.2.3.2 Geology

Geologic Framework

Evaluation of key lithostratigraphic contacts in boreholes in support of 3-D modeling continued. Because many of the boreholes being used for stratigraphic control were hammer drilled and only have drill cuttings rather than cores, geophysical logs are being closely examined as a means to better identify unit contacts. Boreholes SD-12 and UZ#16 have been chosen for initial evaluation because many of the principal rock types and units were penetrated in these wells, and both have cores and suites of geophysical logs that can be used for comparison of lithologic characteristics and rock properties with geophysical log responses.

A preliminary version of the 1:24,000-scale geologic mapping of Yucca Mountain, incorporating newly mapped portions of the area extending south from the south margin of the Claim Canyon caldera to Busted Butte and from Fortymile Wash west to Windy Wash, was prepared and distributed to personnel involved in 3-D modeling, seismic hazards assessment, and Site Description (PISA) report preparation. The map incorporates the new standard stratigraphic nomenclature that has been developed for Yucca Mountain. Additional field investigations and the construction of structure cross sections are continuing.

Project staff completed a review of geophysical data in the potential repository area to determine the applicability of geophysical signatures for characterizing block-bounding faults as well as intrablock faults. General conclusions are that block-bounding faults such as the Bow Ridge fault have distinct signatures, especially for potential-field data. For the intrablock Ghost Dance fault, on the other hand, only ground-magnetic and ultra-high-resolution seismic reflection data were found to be useful, and for faults smaller than the Ghost Dance no standard geophysical techniques proved to be reliable indicators of subsurface relationships.

A completed milestone report (SPG32M3) contains all available qualified fracture data for each of the lithostratigraphic units developed for the LBL site area UZ hydrologic flow model. These data and accompanying structural interpretations directly support the site-scale, three-dimensional, unsaturated-zone flow models.

Comparisons of ESF and surface fracture data yield similar results in terms of strike and dip, the

number and orientation of fracture sets, fracture trace lengths, and spacing (both true and apparent) for rocks equivalent to each model unit. Fracture data d\from drill holes are not strictly comparable, because of severe bias imposed by directional sampling, the lack of a minimum trace-length cutoff, and assumptions built into corrections for unrecovered core. Nevertheless, borehole fracture data are consistent with the trends of surface and ESF data in terms of fracture intensity (as spacing or frequency) for each of the model units, and in a more general way for distribution of dips. Fracture frequency and orientations reported for older, non-Q drill holes are in close agreement with those reported here for the Q'd boreholes. By far the most important controls on fracture attributes for rocks that are equivalent to individual model units are primary, lithologic controls. Degree of welding, lithophysae development, vapor-phase alteration and pumice content are all primary controls that affect fracture spacing, type, number of sets, continuity of individual fractures and probably connectivity of the entire network. Structural controls on fracture distribution are secondary to primary lithologic controls. Nowhere in the ESF do fractures 1-m or longer display large increases in abundance in the immediate vicinity of fault zones. Individual faults in the ESF have very narrow zones of influence (1-7 meters wide) in which fractures less than 1-m long increase in abundance in proximity to the fault. The width of these zones of influence correlates to fault displacement and lithology, but not to depth, within the ESF. The narrow envelope of deformed rock surrounding faults in the ESF contrasts markedly with broad zones of fracturing and brecciation associated with the Ghost Dance fault at the surface. Sets of cooling and tectonic joints vary in their relative importance in particular stratigraphic intervals, but where identified, they have consistent orientations throughout the northern and central portions of Yucca Mountain. There do not appear to be significant areal changes in fracture orientations that can be linked to the structural blocks defined in the LBL UZ model. In contrast to the general consistency of joint orientations when averaged over the entire mountain, the expressions of particular fracture sets within a model area, or within a particular lithostratigraphic horizon, are quite variable.

Geologic mapping in the ESF was accomplished as follows: (1) full-periphery geologic mapping was completed to station 77+86; (2) detailed line survey at the heading was completed to station 77+88; (3) stereophotography was completed to station 77+97; (4) full-periphery geologic mapping was completed in Alcove #6 to station 1+28; and (5) detailed line survey in Alcove #6 was completed to station 1+37.

Project personnel continued preparation of sections on site stratigraphy, site structure, and fracture characteristics for inclusion in the Site Description (PISA) report.

Seismotectonic Studies

Preliminary results of ground motion assessments were discussed at the Ground Motion Feedback Workshop April 16-18, at which time preliminary calculations of different attenuation models for various faulting scenarios were presented. It was agreed among the ground motion experts that further adjustments to the models and individual assessments were needed, and a meeting to discuss revisions and refinements of the calculations and assessments (weighting of models) was scheduled for early May.

At the Seismic Source Feedback Workshop that was held April 14-16, preliminary results of both the characterization of seismic sources and the methodologies for assessing fault displacements were presented by each of the six expert teams involved. In order to provide an opportunity for the panels to become more familiar with all of the methodologies being considered, it was decided that a final feedback workshop on fault displacement be delayed until early June.

The Seismic Design Team met on April 23-24 to review the preliminary results of the Seismic Source, Fault Displacement, and Ground Motion expert teams. It was understood that the results of the Fault Displacement expert team would not give the Seismic Design team actual displacement values for features within the potential repository block, but would give them the methods by which such values at any given place can be calculated. The Seismic Design team agreed to conduct a study of deterministic earthquakes for Type I faults within five kilometers of the potential repository and present the results for discussion at the next seismic design meeting in mid-August. An outline and schedule for writing the Seismic Design Basis report were developed, and responsibilities for the preparation of each chapter were assigned.

Project personnel continued to prepare sections for the Site Description report (PISA) on subjects covering regional geologic setting (structure and stratigraphy), seismicity and seismic hazards, surficial geology and erosion, and tectonic models.

WBS 1.2.3.3 HYDROLOGY

Regional Hydrology

Analysis and interpretation of regional precipitation data continued in support of regional flow modeling and the draft regional saturated-zone synthesis report. A draft of the report was completed and revised after PI review. A final draft was prepared for technical review and submitted to the Hydrologic Modeling Team chief for review.

Streamflow and precipitation data collected through March have been compiled and stored in project files for computation of daily discharge at streamgage sites along Fortymile Wash. During April, routine maintenance was performed on the three recording streamflow gages. Runoff was neither observed nor reported during the period for the three gages. Preliminary tables of streamflow and precipitation data collected through March were updated for the data base, along with supporting information.

In unscheduled efforts, staff addressed QA issues associated with data collected during testing of borehole SD-7 and discussed possible configuration and testing of borehole WT-24. Staff attended parts of a workshop on geographic information systems for use in the USGS. Staff also met with M&O staff to discuss status of the regional flow model and potential future work with the model.

Unsaturated-Zone Hydrology

Monitoring of the unsaturated-zone (UZ) borehole instrumentation network continued. Borehole data from NRG-7a, UZ#4, UZ#5, UZ-7a, and SD-12 were transferred to Denver, converted to engineering units, and archived to optical disk on a routine basis throughout the month. Daily EKES files were checked for any shelter activity. Sensor readings were checked daily as well for unusual occurrences, and any statistical outliers were flagged. Three pressure transducers and one thermistor were calibrated for the ESF air-permeability (air-K) testing program. One Keithley 866 thermometer was calibrated for the ESF borehole monitoring program. Current versions of DOS on all the functioning calibration computers were upgraded to DOS 5.50 to insure that obsolete versions were compatible with existing backup software. Non-functional

and non-repairable computer equipment in the calibration laboratory is being weeded out for excess.

Borehole monitoring data were reduced and analyzed in continuing efforts. Relations between Paintbrush nonwelded hydrogeologic unit (PTn) thickness and efficiency of pneumatic pressure signal attenuation were researched, with indication that the relation should be linear for the PTn depths and thicknesses under consideration; differences in attenuating efficiency can be attributed to differences in saturation and dual-porosity effects.

Several trips were made to field sites for correction of generator, UPS, and chiller problems: 12 site visits were made for routine generator maintenance; four site visits were made to correct UPS and generator problems; and five site visits were made to UZ#4 and 5 and UZ-7a because of EKES problems. Problems at UZ#4 and 5 have been corrected. Twelve site visits were made to correct data-acquisition problems: five trips were made to correct unexplained faults with the data-collection system at UZ#4 and 5 and UZ-7a; three trips were made to look for cause of noisy data at UZ-7a (no cause could be found, and the problem seems to have resolved itself); and four trips were made to correct communication hang-ups at SD-12.

NTS communication support ceased on April 23. The individual providing communication support to the borehole monitoring project was debriefed regarding common problems with the UPSs, EKES, and radio modems, and his ideas about the causes of these problems, their diagnosis, and correction. There no longer is an experienced technician available to the project to service the EKES, UPS, and radio modems.

Investigation of UZ matrix hydrologic properties continued with studies on existing core samples from the ESF. The high-pressure permeameter is finally operational, though still in the process of being interfaced to a computer so data can be collected automatically. Samples have been run that did not provide any flow using the low-pressure permeameter. For example, a sample of lower-lithophysal Tiva Canyon Tuff (Tpcpll) from borehole SD-7, that previously had no flow, had a measured saturated hydraulic conductivity of 4.3×10^{-13} m/s with the new permeameter, whereas with the low-pressure equipment, the previous lower limit of measurement was 5×10^{-12} m/s. The determination of conductivity on all samples with conductivities previously too low for measurements will enhance the matrix-properties data set, providing a critical piece of information for numerical modeling for evaluation of flux through the repository horizon. Seventy currently available samples from the main drift will be run in the next few weeks and may provide an understanding of the variation in matrix permeability through this horizon and whether or not there are preferential matrix flow pathways that will influence the percentage of fracture flow incorporated into the models. A modification of technical procedure HP-266 has been completed and is being submitted for QA approval.

An additional suite of 70 samples was collected from the main drift and incorporated into the 40-m spacing so that now there are 140 samples spaced 20 m apart. These samples have been processed to determine porosity, bulk density and particle density. Samples from Alcove 7, the southern Ghost Dance fault alcove, have been processed for water content, porosity, bulk density and particle density. In addition to these measurements, an effort is being made to refine the measurement of water potential, in particular for the accurate determination of water-potential gradients to assess preferential flow pathways through the PTn and in the repository horizon niches. A filter-paper method is being developed to obtain these measurements. Filter paper is put in contact with a preserved rock sample, allowed to equilibrate, and the water content of the filter paper is determined. Using a moisture-retention curve for the filter paper, water potential can be calculated. This method has not previously been used on rocks, and there are a number of details to be evaluated to ensure that the methodology is viable for rocks, especially welded rocks with small volumetric water contents. This method was tried on the Alcove 7 samples with some success, but with several problems introduced that are now being investigated. Samples from the boreholes being drilled in the first ESF niche in the Main Drift are being preserved with filter paper on site, which should provide an improvement to the Alcove 7 measurements.

In support of E&I Design Basis modeling, a presentation was prepared and presented on spatial distribution of infiltration. The influence of infiltration on design issues was discussed with the conclusion that estimates of flux in the ESF were needed to support or refute the direct transfer of infiltration into repository flux. Ideas on how this might be done, in addition to those programs already in place, were requested.

Air-permeability and hydrochemical testing in the ESF continued with the initiation of geothermal logging in borehole SAD-GTB#1 in the southern Ghost Dance fault alcove on April 8. The log showed a 0.5-degree (Celsius) temperature decrease at the western trace of the Ghost Dance fault and no temperature change at the main trace. A memo documenting the completion of the milestone was sent to the M&O in completion of Level 3 milestone **SP3505M3 [Initiate South GDF testing geothermal borehole]**. In work on data from ESF testing started in FY96, the PI conducted numerical modeling of the northern Ghost Dance fault (NGDF) fault zone and surrounding middle-nonlithophysal Topopah Spring Tuff (Tptpmn). The model pressures and flow results are within 15% of the field results from air-injection testing in borehole NAD-GTB#1a. The model results indicate that the model configuration is correct. Based on the numerical model results, the configuration of the NGDF Alcove three-dimensional boreholes has been determined. The first two boreholes will be separated by 5 m. This spacing will insure successful cross-hole tracer tests.

Tritium concentrations from borehole NAD-GTB#1a range from 0 to 13 tritium units (TU), indicating that post-bomb water has moved through the fault to the repository level. The compositions of ^{14}C samples range from 58 to 75% modern, indicating ages that are older than anticipated.

Preparation for air-K and hydrochemistry testing continued in the Ghost Dance fault alcoves. The main trace of the southern GDF was located at a depth of 63 m from the collar of borehole SAD-GTB#1. The borehole was completed at a depth of 78 m. A single packer was installed in SAD-GTB#1 above the western trace, to limit air flow, and excavation of the SAD an additional 15 m has begun. Preparation of field equipment for drilling-gas evacuation, gas sampling, and pneumatic monitoring of the western trace has been completed. Construction of the NGDF Alcove continued. As of April 30, 20 m remained to be excavated. Construction and calibration of the equipment for thermal and pressure testing in the alcove is completed.

Air pressure, temperature and humidity are targets of ongoing monitoring in the ESF. Collection of temperature and relative humidity data continued at five sites. Wind speed data are currently being collected at two sites. Installation of four additional wind speed monitors (plus relative humidity and temperature monitors) is underway. Barometric pressure, temperature, and relative humidity are being collected at two locations. Data collection from heat-dissipation probes and time-domain reflectometry (TDR) probes in Alcove 3 continued. Data collected between February 1, 1997, and July 1997 are being assembled for a data package. Sets of tensiometers and heat-dissipation probes continue to monitor the dry-out of the tunnel wall. A 5- x 5-ft sheet of plastic was installed over each of the monitoring sites to determine if that section of the tunnel wall would "wet up". The plastic will restrict water evaporation to the tunnel and should cause the instruments to show any increase in the rock water potential. This work is being done to support future ESF monitoring activities.

Investigation of the percolation flux across the repository horizon continued with *in situ* field estimation of percolation flux rate. Time-domain reflectometry (TDR) systems and heat-dissipation probes (HDP), installed in Alcove #3, were covered with plastic in an attempt to rewet the rock and calculate a sorption water-retention curve and to determine current field water potential and water content. Plans were developed for implementing an instrumentation scheme for the potential East-West drift to estimate the spatial variability of percolation flux. Rock samples, collected from the main drift at 20-m spacings, were analyzed in the laboratory to determine bulk properties and hydraulic conductivity. Determination of these properties will help in the analysis of data from the Main Drift and the East-West drift.

Investigations of South Ramp hydrology continued during the period. Installation of plastic sheets in the South Ramp of the ESF has been completed with the daylighting of the TBM (on April 25). The plastic was installed at key features and lithologic contacts in the south ramp to protect the rock from water spray during mapping and from dry-out after mapping. A total of 45 sites in the ESF have been covered with plastic at locations between Stations 66+41 and 75+10. These sites will be evaluated as possible locations for boreholes for collecting core and installing instrumentation. Data were collected from the sets of tensiometers and heat-dissipation probes installed at ESF Station 66+99 and 67+33, and graphical analysis of the data has begun. At each location, tensiometers and heat-dissipation probes are installed at 15-cm, 30-cm, 45-cm, and 60-cm distances into the tunnel wall. The areas around these instruments were covered with plastic to monitor the recovery of the rocks from the drying effects due to tunnel ventilation and to interpret anomalies in the collected data. Core from the two prototype boreholes (ESF-SR-MOISTSTD#1 and ESF-SR-MOISTSTD#2) were processed for physical-property measurements. Evaluation of the filter-paper technique to determine the *in situ* water potential of cores was started using the core from these boreholes. A prototype packer was installed in ESF-SR-MOISTSTD#1. The packer was instrumented with a heat-dissipation probe and a tensiometer. Differences between the water potential measured with the tensiometer and the water potential measured with the heat-dissipation probe are being evaluated. Development of a packer with a heat-dissipation probe, a tensiometer, and a psychrometer was started. A TDR probe that possibly can log water content profiles through a borehole was ordered and will be evaluated when it arrives.

Studies to evaluate lateral diversion in the PTn unit have been initiated with focus on planning and preparations. Due to priorities set with the daylighting of the tunnel boring machine and drilling of boreholes for alcoves and niches, the drilling of the boreholes in the North Ramp has been scheduled to start July 7. This will set back the schedule to process core samples from these boreholes and to install monitoring instruments. In the meantime, instruments are still being evaluated, and tensiometers, heat-dissipation probes, and thermocouple psychrometers are being compared in a single location to evaluate the methodology. Not all of these instruments have previously been used in boreholes. Additional methodologies are being evaluated, such as time-domain reflectometry, for possible use in the boreholes. The methodology being evaluated to refine water-potential measurements will be used with the core samples from these boreholes and will provide very useful information for numerical modeling.

In the ESF drift-scale flux and niche study, drilling support was initiated for pneumatic-testing Niche #1. A new method of determining water potential was tested at the HRF. Filter papers with known water-characteristic curves were wrapped around welded and nonwelded cores. When the filter papers reach potential equilibrium with the rock samples, the filter paper is removed, weighed and dried to determine its water content and therefore its water potential. Rock core collected during drilling will be wrapped with small filter papers and sealed in cans. The filter paper will be processed when the rock samples are opened for laboratory analysis.

Unsaturated-zone hydrochemical studies continued during the period, with a variety of active efforts. Eight pore-water samples from ESF alcoves were analyzed for tritium concentration, and the data were reduced. A laboratory memo containing the analytical results was prepared. Six samples for core from the Drift Scale Test Area were processed for pore-water extraction for Sr and U isotopic analyses and for Na/K ratio determinations. The samples, when examined upon unpacking, were discovered to have dried out, which precludes vacuum distillation for tritium and stable isotope analyses. Subsequent preparation involved crushing, pulverizing and sizing. The size fraction between 8 and 60 mesh was selected as being suitable for leaching with deionized water to extract pore-water salts. Data from pore waters collected by compression and distillation methods during March were recorded in the data base. Seven UZ pore-water samples (from SD-7 and SD-9 cores) and one known standard were sent to Huffman Laboratories for anion and cation analyses. Four ^{14}C samples from cores of Topopah Spring Tuff were sent to Beta Analytic, Inc. for carbon-isotope analysis. The CO_2 samples were extracted from SD-12 and SD-7 cores using acidification of

precipitated calcite and the vacuum-distillation method to expel dissolved CO_2 from pore water. In work to obtain analyses of CO_2 for $^{13}C/^{12}C$ and ^{14}C determinations, nineteen molecular-sieve cylinders were heat evacuated (to remove the residual CO_2 gas and H_2O vapor) and leak-tested. The evacuated cylinders were pressurized with nitrogen gas and shipped to the NTS for field collection of gas samples. Gaseous CO_2 and whole-gas samples were pumped and collected from the Calico Hills Formation of borehole UZ-14. The samples were transported back to Denver for sample processing and analyses of carbon-isotope concentrations. Staff began construction of a second dissolved-CO_2 distillation system.

Efforts continued on development of the conceptual model of the UZ hydrogeologic system. Work continued on the report "A conceptual model of unsaturated zone flow and transport, Yucca Mountain, Nevada" by Kwicklis, Bodvarsson and Flint. This report summarizes the findings of many other studies on surface and subsurface hydrology, gaseous and aqueous chemistry, and geology in an attempt to create a consistent conceptual model of water and gas flow within the unsaturated zone, and the report also makes original interpretations based on these data. During April, publications dealing with ^{36}Cl, the geology of the Calico Hills and the Prow Pass Tuff, and past climate were reviewed and summarized in the report. Temperature data were analyzed and, in some cases, modeled numerically to produce estimates of percolation flux at particular boreholes. Analyses of the major-ion chemistry at several UZ boreholes were made and incorporated into the report.

Work also continued on the site-scale UZ flow model. One of the goals of the site UZ flow model is to define the dominant flow paths leading from the repository horizon to the water table. Flow paths predicted by the model should be consistent with what is known about permeability distribution at depth, the distribution of perched water, and available chemical and isotopic data. The chemical and isotopic data potentially can provide some of the strongest constraints on the flow system with regard to flow paths and flow rates. Reactions which may have led to the evolution of the UZ water chemistry, however, previously had remained largely undetermined, and there have been concerns that the isotope data, particularly ^{14}C data, have in some cases been contaminated during borehole construction. The ^{14}C data from the Calico Hills hydrogeologic unit in borehole UZ-14 produce apparent ^{14}C ages as young as 500 years underlying perched water with corrected ages of approximately 5,000 years. One possible explanation of this apparent age inversion is lateral flow along permeable beds lying between the perched water and the Calico Hills unit. Another possibility is that the Calico Hills samples have been contaminated with ^{14}C in the air used during drilling of the borehole. To help discriminate between the two possibilities, a chemical reaction model was developed that attempted to explain the water chemistry in the Calico Hills as the result of drainage and mixing of perched water in the fractures and adjacent pore water in the rock matrix, and chemical reactions along a vertical flow path leading from the perched water in the Topopah Spring Tuff to sampling points in the Calico Hills unit. If the Calico Hills pore water chemistry can be explained as a result of vertical drainage and mixing of these two waters and reactions with the host rock, the ^{14}C data for the Calico Hills would be even more suspect because the ^{14}C data would remain the only data set that could be explained only by lateral flow. Mixing and reaction models developed with NETPATH software did apparently succeed in modeling the chemical evolution of the water through a vertical-flow mechanism, and so on this basis, contamination of the Calico Hills ^{14}C samples appears more likely. Recently analyzed ^{14}C data for the Calico Hills hydrogeologic unit in the SD-9 and SD-12 boreholes collected from beneath perched-water zones, however, also produce extremely young ages but did not exhibit other characteristics that initially raised concerns about contamination at UZ-14. The current conclusion is that lateral flow through the vitric tuffs overlying the zeolitic Calico Hills from the direction of Solitario Canyon may be a reasonable means of explaining the age inversions in the lower unsaturated zone.

USGS staff also continued to support the expert elicitation for both the UZ flow model and the Performance Assessment consideration of percolation flux. One of the means of estimating percolation flux in the unsaturated zone at Yucca Mountain is to compare the difference in the conductive heat flux at two elevations along a borehole. In the absence of changes in heat flux due to evaporation or extremely rapid gas

convection, a decrease in heat flux with increasing elevation can be most readily explained as a result of the warming of percolating water as it moves from cooler, shallow zones to warmer, deeper ones. Because of its comparatively large thickness and relatively uniform saturation, the Topopah Spring Tuff is a logical unit in which to make estimates of heat flux within a given borehole. The elevation of the second point at which heat flux is to be estimated varies from borehole to borehole but may include any of the underlying units, including those in the saturated zone where evidence for significant convection is absent. To help characterize the uncertainty in these calculations, uncertainty in heat flux in the Topopah Spring Tuff was characterized through the regression statistics of straight-line fits of the Topopah Spring temperature data from approximately 30 boreholes, along with statistical analysis of the thermal conductivity data for the Topopah Spring Tuff contained in Sass and others (1988). Summary tables and graphical plots of this information were provided to the members of the UZ Expert Team. The USGS also provided in-house expertise that helped focus discussions during the elicitations and answered questions raised by the experts regarding site data and interpretations.

Saturated-Zone Hydrology

Work continued on hydraulic testing and tracer studies of the saturated zone (SZ) at the C-hole complex. Tracer concentrations of Pyridone and 2,6 difluorobenzoic acid as a function of time, from the tracer tests initiated on 1/9/97 and 1/10/97 respectively, will be submitted as one data package. The pressure and water-level data collected at the C-holes and nearby wells UE-25 ONC-1, USW H-4, UE-25 WT#14, UE-25 WT#3, and UE-25 p#1 will be processed for submittal as another data package. During April 1997, discussions were held regarding the QA program of the University of Nevada at Las Vegas (UNLV), which is producing the chemical concentration data. Work continued on preparation of a USGS report presenting the results from all hydraulic and tracer tests conducted at the C-hole complex, starting in May 1995, in the Bullfrog and Tram intervals.

The multiple-well convergent tracer test with UE-25 c#3 as the pumping well and in which Pyridone was injected into UE-25 c#1 on January 9, 1997, and 2,6 Difluorobenzoic (2,6 DFBA) acid was injected into UE-25 c#2 on January 10 continued during April. The 2,6 DFBA breakthrough curve is in its final, or "tail" stage of development. After replacing the sample size for injection into the HPLC/(fluorescence detector) instrument for quantifying Pyridone concentration, UNLV has determined that Pyridone had been present in the water samples from UE-25 c#3 since approximately March 6. The Pyridone breakthrough curve is showing a steady rise in concentration which, on April 30, was at 130 parts per trillion (ppt). The 1.66" injection tubing was removed from UE-25 c#2 and samples of water were air-lifted from the 2 7/8" tubing, which is in hydraulic connection with the lower Bullfrog aquifer. These samples were analyzed for Pyridone and indicated a pattern of decreasing concentration with time from an initial value of 2 ppb. This may indicate that, although UE-25 c#3 is the well being pumped, some of the Pyridone has traveled from UE-25 c#1 to UE-25 c#2 along fracture zones connecting the latter two wells.

Potentiometric-level monitoring continued to provide data during the period. For the month of April, 34 manual measurements were completed and four zones in four wells were monitored hourly with transducer measurements, including UE-25 WT#3, UE-25 WT#14, UE-25 p#1 and USW H-4 (upper interval). Water-level measurements were made at numerous sites, including UE-25 WT#6, UE-25 WT#13, UE-25 WT#15 and UE-25 WT#16 on April 2; USW WT-1, USW WT-2, UE-25 WT#4, UE-25 b#1 (upper interval), J-11, J-12, and J-13 on April 7; USW H-1 (tubes 1, 2, 3, and 4) on April 8; USW H-3, upper and lower intervals on April 9; USW H-3, lower interval, and USW H-5, upper and lower intervals, on April 10; USW H-3 (upper and lower intervals) and USW G-2 on April 14; USW VH-1, USW WT-7, USW WT-10, USW WT-11, USW H-6, upper and lower intervals, on April 15; USW H-4 (lower interval) on April 16; USW H-3, upper and lower intervals, on April 17; and USW H-3 (upper and lower intervals) on April 24. The 1996 hourly water-level data were reviewed, and corrections were made following the review. The final data package to be submitted to the Records Center will be prepared at a later date. Water-level work sheets for

all manual water-level measurements made through April have been completed.

The report *Analysis of water-level data in the Yucca Mountain area, Nevada, 1985-95*, by R.P. Graves, Patrick Tucci, and G.M. O'Brien (Director's approval as WRIR 96-4526 on September 30, 1996), was printed and received by USGS-Yucca Mountain Project Branch during April. The report will be distributed following preparation of errata sheets for errors found in the printed copy.

Activity continued in development of the site-scale saturated-zone flow model and the SZ synthesis report, with efforts presently focused on obtaining and inputting data for model calibration; work on "final" model input/output will occur once the model essentially is calibrated. Sensitivity and uncertainty analyses for the site flow model continued, with results to accompany the flow model when submitted to DOE and PA staff. A draft of a report documenting results of aquifer testing at well USW G-2, a critical site in looking at alternative conceptual models of flow at the large hydraulic gradient, received supervisor's review, and the report was revised and submitted for colleague review. Work continued on preparation of potentiometric-surface maps that will be used for model calibration and for the synthesis report. A fourth interpretation of the potentiometric data, which assumes that all potentiometric levels north of Yucca Mountain represent perched-water conditions, was constructed and incorporated into a framework model and gridded for input to FEHMN. This alternative conceptual model, therefore, assumes that the large hydraulic gradient is not a feature of the volcanic aquifers beneath Yucca Mountain. Staff continued working on analysis of water-level fluctuations to estimate hydraulic properties of saturated-zone rock units. Concurrent with these efforts, the site geohydrologic framework model was updated, and summary documentation of the update was prepared. The model and documents were submitted for technical review, completing this activity and Level 4 milestone **SPH24FM4 [Memo to TPO: Updated Geohydro Frmwrk Sub for Rev]** on April 30. Further refinements may be necessary once the site flow model is calibrated, however, to insure consistency with the calibrated model. Staff participated in the Abstraction/Testing Workshop for Saturated Zone Flow and Transport, April 1 through 3. Staff prepared a draft proposal for the workshop that will provide PA with a regional flow model with reduced uncertainty in model results. Discussions were held concerning transfer of the site flow model to PA after April 30.

Substantial progress toward a calibrated site flow model was achieved. This progress began with the completion of a model mesh consisting of 5,485 nodes and 29,760 tetrahedral elements. The top of the mesh corresponds to a representation of the potentiometric surface which includes the large hydraulic gradient north of Yucca Mountain. Imbedded in the mesh are 94 observation points corresponding to midpoints of the water columns of observation wells. A parameter-estimation simulation, using 13 adjustable parameters, was run. The value of the initial objective function (sum of weighted squared residuals) was reduced from 241 to 63 MPa^2, in spite of high correlation among several of the parameters. An inspection of the distribution of residuals suggested the need for additional permeability zones in the vicinity of Solitario Canyon and the large hydraulic gradient (immediately south of wells USW G-2 and WT-6). Two new adjustable parameters for permeability in these two areas were introduced into the model. A parameter-estimation simulation was run to optimize these two permeability zone values, reducing the objective function to 13 MPa^2. Current residuals indicate that, in at least some cases, additional recharge should be specified to elevate heads in the northern part of the model. Additional evaluation of various boundary conditions (specified pressure and specified flux) were undertaken. Although progress toward model calibration has been significant, the model is not yet fully calibrated. Work will continue for another few weeks to achieve more acceptable calibration.

In work on water-table Eh and pH measurements, USGS staff met with Arend Meijer (LANL) to discuss objectives, sampling protocol, and overall coordination attendant with the Risk Mitigation work on Water Table Eh-pH studies. Staff met with LANL and LBNL staff and others on April 17 to discuss the construction of an integrated hydrochemical and isotopic data base for ground water in the Yucca Mountain

area. Although substantial data exist and numerous data bases have been prepared in the past, there is still no single data base that integrates isotopic (oxygen, hydrogen, carbon, strontium, and uranium) data with major and minor dissolved-element chemistry, nor are the existing data bases in a form easily used by Project scientists to obtain spatial displays of chemical and isotopic parameters. Although there was no agreement on the details of constructing such a data base, there was general agreement for its need especially to help answer key questions about the SZ within and downgradient from the repository block. Various software packages for displaying the numerical data are currently being evaluated by USGS personnel, including AutoCad Map, ArcView, MapInfo and others.

In unscheduled work, staff contributed to Chapter 2.5 "Hydrogeologic Systems" of the PISA report. Staff also prepared wiring harnesses for the Paroscientific transducers which will be used for future testing at wells WT-24 and SD-6. Staff reviewed and revised a report documenting aquifer test analyses at wells WT-10, WT #12, and SD-7, in preparation for publication.

WBS 1.2.3.6 CLIMATOLOGY and PALEOHYDROLOGY

Investigations of lakes, playas, and marshes for details of climatic history continued during the period. Staff spent most of the month entering high-resolution sample counts into spreadsheets for Owens Lake core OL 92/2. Counting for this core is finished. Graphic and numeric analysis of spreadsheet data is in progress. The collection of the diatom and ostracode data that is now completed, when submitted to the CRF, will complete milestone SPC331M4.

Other climatological data gathering and analysis continued. Evaluation of ostracode morphological change through long Quaternary lake records continued, in order to document within-species range changes that may enhance the paleoclimatic resolving power of the ostracode record. Ostracodes were picked from prepared sediment residues, and diatom samples from Owens Lake cores and from modern diatom analogs of hydroclimatic conditions in Owens Valley and elsewhere in the western U.S. also were prepared.

Work on the paleoclimate synthesis report continued in support of milestone SPC332M4. Staff completed initial work on a manuscript that describes the common ostracode taxa from the wetland sediments in the Yucca Mountain area. Once completed, this report will provide the key documentation of paleontological data used in interpretations of past climate and past discharge, fulfilling a component of the synthesis milestone. Also in support of this milestone is a manuscript that treats the climatic and hydrological states that existed in the Las Vegas and Indian Springs Valleys during the Pleistocene. The ostracode and diatom data from the Owens Lake cores have been divided into discrete topics related to regional climate, and staff members have initiated manuscript preparation in support of the synthesis milestone. Staff also began work on a manuscript summarizing results of stable isotope studies on subsurface materials, another component of the climate synthesis report.

A paper titled *A diatom record of climate and hydrology for the past 200 ky from Owens Lake, California*, by J. Platt Bradbury, was recently published in Quaternary Sciences Reviews (v. 16, p. 203-219). This paper is a partial fulfillment of milestone SPC332M4.

Evaluation of paleo ground-water discharge continued during the period. Staff examined specimens of carbonate- and silica-rich materials from sample collections obtained last December. Samples were prioritized for the next phase of dating and isotopic analysis focusing on depositional sequences collected in the Stateline area of the Amargosa Desert. Experiments have been designed to evaluate the age distributions within the sections and whether or not isotopic data indicate a variation between the contributions from the Fortymile Wash and Amargosa Valley ground-water systems.

In other isotopic work on past ground-water discharge, staff created a uranium concentration standard from NIST uranium-oxide powder and used the solution to provide additional calibration information on the tracer-isotope solution used for uranium-series disequilibrium analyses. Additional uranium-thorium data were collected from samples of alluvial deposits associated with Fortymile Wash in the Yucca Mountain vicinity. New data support previous results indicating that the high terrace aggraded over multiple cycles associated with changing climate, and that the surface of the present-day high terrace was established between 100 and 50 ka with the first buried soil established around 170 ka or slightly before. The history of surface runoff in the Fortymile Wash system is closely linked with ground-water discharge in the toe of the tributary in the Stateline area of the Amargosa Desert.

Studies of fracture-fill materials in the ESF and estimation of past water flux proceeded during the period with collection of samples from secondary mineralization in the ESF between stations 75+78 and 64+96. A total of 26 samples of cavity- and vein-coating materials were collected for geochronological and isotopic studies relevant to issues of paleo flux determination. Samples from that part of the ESF will provide critical tests of models of UZ percolation based on isotopic compositions of secondary minerals. Subsamples were taken for preparation of thin sections for fluid-inclusion studies.

USGS staff met with LANL colleagues for exchange of technical information on subsurface minerals and their geochemical compositions. Stable isotope compositions obtained from calcite samples that have been analyzed for rare-earth element contents could provide important insight on timing and subsurface conditions controlling secondary mineralization in the past. Future sampling possibilities were also outlined.

Samples of secondary opal and calcite were prepared for radium analysis by activity counting under a cooperative agreement with AECL (Canadian radioactive waste isolation program) Whiteshell Laboratories. Samples were sent for analysis. Radium studies have the potential to determine if the latest mineralization on outermost surfaces is younger than 5000 to 10,000 years.

In unscheduled work, staff participated in two different DOE audits of calibration issues and sample/data tracking issues. Climate-studies staff responded to a request from the State of Colorado to detail usage of laboratory safety, hygiene and disposal issues. Staff reviewed a paper for the Journal of Hydrology on techniques for sampling and determination of stable isotopes of dissolved inorganic carbon in ground waters. Staff prepared and made an oral presentation summarizing isotopic and geochronological work on subsurface secondary minerals to the U.S. Geological Survey National Research Program Branch.

WBS 1.2.3.9 SPECIAL STUDIES

Progress continued on development of contributions to the PISA report. PISA chapter 2.3 (Geological Systems) Principal Investigator and five others from the USGS attended a meeting with DOE and the M&O on April 22 for USGS presentations on site stratigraphy and seismicity at regional and site scales. M&O personnel gave presentations on natural-resources and geophysical results; USGS provided input to these sections of the PISA. Drafts for each USGS section of the PISA are largely complete, and the first draft of the seismic section is in process. A unified reference section has been created and edited to DOE format. The DOE staff has suggested several additions to the PISA Content Guide for chapter 2.4 (Hydrology) sections. Most, but not all, of the suggested additions have been previously incorporated in the detailed outline and are therefore appropriate for inclusion in the Content Guide. Responses to other suggestions have been forwarded to the M&O PISA coordinator. Authors continued preparation of draft sections of the hydrology chapter. Planning efforts for PISA chapter 2.4 (Climate/Meteorologic Site Description) continued with arrangement of an author meeting set for May 21 in Denver, where each author will discuss the proposed content of specific sections. The meeting will also serve to ensure that proposed chapter contents are adequate for both the Climate chapter and the other chapters to which it is linked. Organization and

interpretation of data suited to both publication (milestone SPC332M4) and preparation of PISA climate subchapters on past and future climate have been initiated.

Efforts continued on the latest site-characterization progress report. Eleven questions and comments on USGS input to chapter 3 of SCPR #16 were received from M&O staff during the first week of April. All questions and comments were expeditiously resolved. One fairly significant issue was raised regarding content of Appendix A and involved the lack of seismic-reflection surveys of the Furnace Creek Fault at the eastern edge of Death Valley. After communication with the DOE lead for tectonics, the issue was resolved by providing documentation of the decision not to run regional seismic surveys over the Furnace Creek Fault. A critical part of the documentation was the report of the 1991 Seismic Methods Peer Review Panel, which now is cited as a reference in Appendix A.

The M&O/USGS Internal Review Draft of SCPR #16 was received and reviewed by the USGS technical lead. Although officially assigned as a reviewer for the Executive Summary only, the USGS technical lead offered review comments for other sections of SCPR #16 as well. A total of 70 comments were offered as follows: Executive Summary--8, Chapter 2 (Programmatic)--1, Chapter 3 (Site)--34, Chapter 4 (Repository)--1, and Appendix A--26. The technical lead participated by teleconference in the SCPR #16 M&O/USGS Interactive Review meetings for Site Programs and attended the review meeting for the Executive Summary and Appendices.

WBS 1.2.8.4.7 WATER-RESOURCES MONITORING

Staff completed modification of technical procedures for water-resources monitoring (necessitated by sample collection, processing, and laboratory analyses added for the third quarter of FY 1997) and submitted the procedure for USGS-YMPB approval on April 21. Monitoring staff processed an equipment blank for the M&O's Radiological/Environmental Field Programs according to prescribed protocols on April 30. Planned data-collection activities for May 6 through 16 were scheduled with well owners, and preparations continued for sample collection.

In preparations for the 2nd-quarter water-resources monitoring report, periodic measurements and information on pressure-sensor calibrations were obtained from site-characterization personnel. Ground-water levels were measured at 29 sites, and discharge was measured at one flowing well. Data collected during March were checked and filed. Site-characterization data on ground-water levels were compiled for seven sites. Data on ground-water levels and discharges collected and compiled for monitoring sites during January through March, 1997, were reviewed. Staff prepared and delivered the 2nd-quarter monitoring report to DOE on April 29, in completion of Level 3 milestone SSH13DM3 [Letter Report: monitoring report 2nd Quarter FY97]. Staff continued processing and checking pressure-sensor data collected at wells JF-3 and AD-6. Data from USFWS (Fish and Wildlife Service) periodic water-level and discharge measurements at monitoring sites in Ash Meadows were checked and tabulated.

USGS staff met with USGS-NV District and USGS-ESIP data-management personnel on April 3 and April 17 to discuss inconsistencies in the NWIS database (following merge of the USGS-NV District and USGS-ESIP databases). Potential modifications to future data-collection activities in the immediate vicinity of Yucca Mountain (to continue satisfying requirements of the water-appropriations permit) were discussed with USGS-ESIP personnel on April 11 and April 17. Staff attended training courses on ground-water modeling (April 7 to 17) and use of statistical software (April 21 to 23).

USGS Level 3 Milestone Report

October 1, 1996 - April 30, 1997

Sorted by Baseline Date

Deliverable	Due Date	Expected Date	Completed Date	Comments
LETTER REPORT **Milestone Number:** SSH13BM3	11/1/96	10/30/96	10/30/96	
LETTER REPORT **Milestone Number:** SSH13CM3	1/31/97	1/30/97	1/30/97	
Ltr Rpt: Geo S.R. Sta 55+00 to STA 63+47 **Milestone Number:** SPG42BM3	2/28/97	2/27/97	2/27/97	
Rpt Geo North/South Main Drft Sta 28+00 to55+00 **Milestone Number:** SPG42AM3	2/28/97	2/28/97	2/28/97	
Main Drift Hydrogeology Report **Milestone Number:** SPH223M3	3/14/97	3/14/97	3/14/97	
Initiate South GDF Testing Geothermal Borehole **Milestone Number:** SP3505M3	4/18/97	4/10/97	4/10/97	
Complete Fracture Evaluation Report **Milestone Number:** SPG32M3	4/30/97	4/29/97	4/29/97	
LETTER REPORT **Milestone Number:** SSH13DM3	5/1/97	4/29/97	4/29/97	

USGS Level 4 Milestone Report

October 1, 1996 - April 30, 1997

Sorted by Baseline Date

Deliverable	Due Date	Expected Date	Completed Date	Comments
Memo to TPO: SS Hazards Methodologies Wrkshop **Milestone Number:** SPG28FM4	10/25/96	10/24/96	10/24/96	
Memo to TPO: Jan-Jun96 Perio Wtr Lvl Data to RPC **Milestone Number:** SPH21CM4	10/31/96	10/30/96	10/30/96	
Memo to TPO: SS Hazards Method. Wrkshop Summary **Milestone Number:** SPG28GM4	11/15/96	11/14/96	11/14/96	
Memo toTPO: Seis. Src. Mdls & Proponents Wrkshop **Milestone Number:** SPG28HM4	11/27/96	11/26/96	11/26/96	
Memo to TPO: Comp Frac Data Coll:Cal. Hills,Prow **Milestone Number:** SPG34M4	11/27/96	11/27/96	11/27/96	
Memo to TPO: Comp Re-Eval Priority Strat Contact **Milestone Number:** SPG21M4	12/13/96	12/13/96	12/13/96	
Memo to TPO: Detailed Content Outline **Milestone Number:** SPH391M4	12/13/96	12/13/96	12/13/96	
Memo to TPO: SS Modls & Propnents Wrkshop Summry **Milestone Number:** SPG28IM4	12/19/96	12/19/96	12/19/96	
Report: Mod Flow In UZ Frac Ntwk TS W-U in ESF **Milestone Number:** SPH21AM4	12/31/96	12/19/96	12/19/96	
Memo to TPO: Monitoring Data Apr-Sep 1996 to RPC **Milestone Number:** SPH22GM4	12/31/96	12/23/96	12/23/96	
Memo to TPO: GM Models and Interpret. Workshop **Milestone Number:** SPG28AM4	1/17/97	1/13/97	1/13/97	
Memo to TPO: Seismic Source Interp. Wrkshop **Milestone Number:** SPG28JM4	1/17/97	1/13/97	1/13/97	

Deliverable	Due Date	Expected Date	Completed Date	Comments
Memo to TPO: Clim Scenarios Recvd & Sim Started **Milestone Number:** SPH23AM4	1/30/97	1/13/97	1/13/97	
Memo to TPO: SS Interpretations Wrkshop Summary **Milestone Number:** SPG28KM4	2/4/97	2/3/97	2/3/97	
Memo to TPO: GM Modls & Interpret Wrkshp Summry **Milestone Number:** SPG28BM4	2/6/97	2/5/97	2/5/97	
Memo to TPO: Sub Bh Video Frac Db to GENISES **Milestone Number:** SPG21IM4	2/28/97	2/27/97	2/27/97	
Memo to TPO: Jul-Dec96 Perio Wtr Lvl Data to RPC **Milestone Number:** SPH21BM4	2/28/97	2/7/97	2/7/97	
Memo to TPO: Annotated Outline Site SZ Synth Rpt **Milestone Number:** SPH23VM4	2/28/97	2/11/97	2/11/97	
Memo to TPO: Summary of Meetings with PA Mdlrs **Milestone Number:** SPH25CM4	2/28/97	2/13/97	2/13/97	
Memo to TPO: Rslts New Age & Iso Determinations **Milestone Number:** SPC23FM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: 1995 Water-Level Data **Milestone Number:** SPH21FM4	3/14/97	2/13/97	2/13/97	
Memo to TPO: Meteorlogical Data FY96 to RPC/TDB **Milestone Number:** SPH21IM4	3/14/97	3/14/97	3/14/97	
Publish Sel Streamflow & Precip Data for FY96 **Milestone Number:** SPH22CM4	3/14/97	6/30/97		
Memo to TPO: Subm FY96 Data to RPC/TDB **Milestone Number:** SPH22DM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Trans Funct Precip/Infil of Num Mdl **Milestone Number:** SPH22FM4	3/14/97	3/11/97	3/11/97	
Memo to TPO: Synth UZ Mont Data fm MD of ESF **Milestone Number:** SPH22IM4	3/14/97	3/14/97	3/14/97	

Deliverable	Due Date	Expected Date	Completed Date	Comments
Memo to TPO: Reslt of Matrix-Hydro-Prop Determin **Milestone Number:** SPH22KM4	3/14/97	3/11/97	3/11/97	
Memo to TPO: Matrix-Hydro-Prop Compl Pkg to RPC **Milestone Number:** SPH22LM4	3/14/97	3/11/97	3/11/97	
Memo to TPO: Monitoring Data Thru Jan 97 to RPC **Milestone Number:** SPH22NM4	3/14/97	3/7/97	3/7/97	
Memo to TPO: Rslts Analyses/Interpret thru Jan97 **Milestone Number:** SPH22QM4	3/14/97	3/11/97	3/11/97	
Memo to TPO: Data Collected thru Jan 97 to RPC **Milestone Number:** SPH22RM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Rslts Chem Analysis Thru Jan 1997 **Milestone Number:** SPH22WM4	3/14/97	3/10/97	3/10/97	
Memo to TPO: Pkg of Chem Anal thru Jan 97 to RPC **Milestone Number:** SPH22XM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Final Hydrogeo Framewrk Data to RPC **Milestone Number:** SPH23DM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Test Data for July-Dec 1996 to RPC **Milestone Number:** SPH23MM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Results of Tests Comp Jul-Dec 96 **Milestone Number:** SPH23NM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Tech Anal/Interp Air-Perm & Hydroch **Milestone Number:** SPH35EM4	3/14/97	3/13/97	3/13/97	
Memo to TPO: Subm Air-Perm/Hydrochem Tstg to RPC **Milestone Number:** SPH35FM4	3/14/97	3/14/97	3/14/97	
Memo to TPO:Elicit of Experts Interpret Complete **Milestone Number:** SPG28LM4	3/20/97	3/20/97	3/20/97	
Memo to TPO: Comp QA Eval pre-1992 Bh Geo Logs **Milestone Number:** SPG212M4	3/28/97	3/26/97	3/26/97	

Deliverable	Due Date	Expected Date	Completed Date	Comments
Memo to TPO: Draft Site Area Geol. Map to PISA **Milestone Number:** SPG222M4	4/18/97	4/17/97	4/17/97	
Memo to TPO: Ground Motion Feedback Workshop **Milestone Number:** SPG28CM4	4/21/97	4/21/97	4/21/97	
Memo to TPO: Seismic Source Feedback Workshop **Milestone Number:** SPG28MM4	4/25/97	4/21/97	4/21/97	
Memo to TPO: Updated Geohydro Frmwrk Sub for Rev **Milestone Number:** SPH24FM4	4/30/97	4/29/97	4/29/97	

Ver. 7.3.0

Participant USGS
Prepared - 05/05/97:16:35:45

Yucca Mtn. Site Char. Project-Planning & Control System
PACS Participant Work Station (PPWS)
WBS Status Sheet (WBS02)

01-Apr-97 to 30-Apr-97
Page - 1
Inc. Dollars in Thousands

WBS No. - 1.2

WBS Title - Yucca Mountain Project

Parent WBS No. - 1.0

Parent WBS Title - Mined Geologic Disposal System

Element ID - 12

Statement of Work:

See the current WBS Dictionary

Cost/Schedule Performance

		Current Period					FY1997 Cumulative to Date					FY1997 at Completion		
Id	Description	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	CV	BAC	EAC	VAC
1.2.3	Site Investigations	970	970	1018	0	-48	6632	6822	6573	190	249	11402	12589	-1187
1.2.5	Regulatory	44	44	35	0	9	268	268	223	0	45	504	491	13
1.2.8	Environment, Safety, and H	52	52	44	0	8	356	356	340	0	16	612	644	-32
1.2.9	Project Management	54	54	58	0	-4	366	366	326	0	40	664	622	42
1.2.12	Information Management	7	7	4	0	3	46	46	28	0	18	80	72	8
1.2.15	Support Services	142	142	132	0	10	1001	1001	945	0	56	1722	1707	15
Total		1269	1269	1291	0	-22	8669	8859	8435	190	424	14984	16125	-1141

Resource Distributions by Element of Cost

Fiscal Year 1997

Budgeted Cost of Work Scheduled

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	19540	19599	16166	20824	21329	20182	22106	22047	22573	22479	21615	20362	248822
LABOR	885	899	632	866	876	906	909	904	921	919	891	856	10464
SUBS	139	143	87	148	145	145	140	150	153	149	148	136	1683
TRAVEL	25	43	34	45	43	47	35	37	38	36	35	31	449
PM&E	7	6	7	5	9	6	7	6	9	7	5	4	78
OTHER	197	201	179	206	285	184	178	182	176	179	170	173	2310
Total BCWS	1253	1292	939	1270	1358	1288	1269	1279	1297	1290	1249	1200	14984

Actual Cost of Work Performed

LBRHRS	19283	18578	18523	18723	17133	18725	19233	0	0	0	0	0	130198
LABOR	771	712	732	829	727	782	787	0	0	0	0	0	5340
SUBS	127	139	117	185	134	179	226	0	0	0	0	0	1107
TRAVEL	11	24	61	53	42	46	44	0	0	0	0	0	281
PM&E	43	16	88	85	89	110	60	0	0	0	0	0	491
OTHER	119	129	145	158	252	239	174	0	0	0	0	0	1216
Total ACWP	1071	1020	1143	1310	1244	1356	1291	0	0	0	0	0	8435

WBS No. - 1.2 -Yucca Mountain Project

Resource Distributions by Element of Cost

Fiscal Year 1997
Estimate to Complete

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	0	0	0	0	0	0	0	23657	24443	24246	23064	21821	117231
LABOR	0	0	0	0	0	0	0	992	1018	1003	973	921	4907
SUBS	0	0	0	0	0	0	0	191	205	209	194	177	976
TRAVEL	0	0	0	0	0	0	0	54	57	57	62	52	282
PM&E	0	0	0	0	0	0	0	51	9	7	7	1	75
OTHER	0	0	0	0	0	0	0	296	259	228	299	368	1450
Total ETC	0	0	0	0	0	0	0	1584	1548	1504	1535	1519	7690

Resource Distributions

Fiscal Year 1997	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
BCWS	1253	1292	939	1270	1358	1288	1269	1279	1297	1290	1249	1200	14984
BCWP	1195	1245	1131	1353	1328	1338	1269	0	0	0	0	0	8859
ACWP	1071	1020	1143	1310	1244	1356	1291	0	0	0	0	0	8435
ETC	0	0	0	0	0	0	0	1584	1548	1504	1535	1519	7690

Fiscal Year Distribution

	Prior	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	Future	At Complete
BCWS	15914	14984	9432	980	0	0	0	0	0	0	0	0	41310
BCWP	15609	8859	0	0	0	0	0	0	0	0	0	0	
ACWP	15908	8435	0	0	0	0	0	0	0	0	0	0	
ETC	0	7690	9432	980	0	0	0	0	0	0	0	0	42445

YMP PLANNING AND CONTROL SYSTEM (PACS)

Participant U.S. Geological Survey

Date Prepared 05/06/97 11:54

MONTHLY COST/FTE REPORT

Fiscal Month/Year APRIL 1997

	CURRENT MONTH END						FISCAL YEAR		
WBS ELEMENT	ACTUAL COSTS	PARTICIPANT HOURS	SUBCON HOURS	PURCHASE COMMITMENTS	SUBCON COMMITMENTS	ACCRUED COSTS	APPROVED BUDGET	APPROVED FUNDS	CUMMULATIVE COSTS
1.2.3	1010	16102	3784	0	680	95	11402	0	6547
1.2.5	36	352	704	0	128	0	504	0	221
1.2.8	44	546	0	0	0	0	612	0	340
1.2.9	59	912	195	0	50	5	664	0	328
1.2.12	4	176	0	0	0	6	80	0	28
1.2.15	131	1145	352	0	44	35	1722	0	932
TOTALS	1284	19233	5035	0	902	141	14984	0	8396

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR 10/1/96 - 04/30/97

		OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
0G311FA1	Scientific Programs Management & Integra	15.7	16.6	12.0	21.8	62.3	32.4	35.6	0.0	0.0	0.0	0.0	0.0	196.4
1.2.3.1.1		15.7	16.6	12.0	21.8	62.3	32.4	35.6	0.0	0.0	0.0	0.0	0.0	196.4
0G312FA1	Nevada Operations/Earth Science Investig	55.0	57.4	62.9	66.3	98.9	87.7	57.2	0.0	0.0	0.0	0.0	0.0	485.4
1.2.3.1.2		55.0	57.4	62.9	66.3	98.9	87.7	57.2	0.0	0.0	0.0	0.0	0.0	485.4
*1.2.3.1		70.7	74.0	74.9	88.1	161.2	120.1	92.8	0.0	0.0	0.0	0.0	0.0	681.8
0G32211FB1	Review & Revision of Lithostratigraphy B	14.1	13.4	50.3	23.9	8.6	14.0	2.4	0.0	0.0	0.0	0.0	0.0	126.7
1.2.3.2.2.1.1		14.1	13.4	50.3	23.9	8.6	14.0	2.4	0.0	0.0	0.0	0.0	0.0	126.7
0G32212FB2	Complete Site Area Geologic Map	36.9	24.9	34.2	12.0	21.2	50.7	18.6	0.0	0.0	0.0	0.0	0.0	19[illegible]
0G32212FB3	Fracture Studies	6.3	16.8	14.9	12.2	9.9	9.7	10.8	0.0	0.0	0.0	0.0	0.0	[illegible]
0G32212FB4	Geologic Mapping of the Exploratory Stud	119.7	139.2	106.3	155.8	135.2	146.7	148.2	0.0	0.0	0.0	0.0	0.0	951.1
1.2.3.2.2.1.2		162.9	180.9	155.4	180.0	166.3	207.1	177.6	0.0	0.0	0.0	0.0	0.0	1230.2
0G3252FB1	Evalute Tectonic Scenarios for PA	10.6	4.1	-4.1	2.3	0.0	2.5	0.6	0.0	0.0	0.0	0.0	0.0	16.0
1.2.3.2.5.2		10.6	4.1	-4.1	2.3	0.0	2.5	0.6	0.0	0.0	0.0	0.0	0.0	16.0
0G32836FB1	Conduct Probabilistic Seismic Hazards An	88.3	62.1	54.3	46.4	36.5	3.0	53.5	0.0	0.0	0.0	0.0	0.0	344.1
1.2.3.2.8.3.6		88.3	62.1	54.3	46.4	36.5	3.0	53.5	0.0	0.0	0.0	0.0	0.0	344.1
*1.2.3.2		275.9	260.5	255.9	252.6	211.4	226.6	234.1	0.0	0.0	0.0	0.0	0.0	1717.0
0G33111FB4	Collection of Site Meteor. Data for Hydr	7.8	8.8	12.2	17.5	14.3	29.6	0.4	0.0	0.0	0.0	0.0	0.0	90.6
1.2.3.3.1.1.1		7.8	8.8	12.2	17.5	14.3	29.6	0.4	0.0	0.0	0.0	0.0	0.0	90.6
0G33112FB1	Collection of Site Streamflow Data	5.6	5.1	5.3	7.4	5.7	7.1	0.0	0.0	0.0	0.0	0.0	0.0	36.2
0G33112FB2	Collection of Site Streamflow Data	0.0	0.0	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0	6.8
1.2.3.3.1.1.2		5.6	5.1	5.3	7.4	5.7	7.1	6.8	0.0	0.0	0.0	0.0	0.0	43.0
0G33114FB3	Regional Saturated Zone Synthesis Report	7.6	7.6	0.0	12.5	29.1	11.6	55.4	0.0	0.0	0.0	0.0	0.0	123.8
1.2.3.3.1.1.4		7.6	7.6	0.0	12.5	29.1	11.6	55.4	0.0	0.0	0.0	0.0	0.0	123.8
0G33121FB1	Infiltration Processes	21.5	16.0	19.0	18.3	30.7	41.4	6.1	0.0	0.0	0.0	0.0	0.0	153.0
1.2.3.3.1.2.1		21.5	16.0	19.0	18.3	30.7	41.4	6.1	0.0	0.0	0.0	0.0	0.0	1[illegible]
0G33123FB4	Integrated Analysis & Interpretation	14.5	5.4	14.5	20.9	38.8	10.6	-14.8	0.0	0.0	0.0	0.0	0.0	89.9
0G33123FB5	Matrix Properties of Hydrologic Units	14.1	12.0	16.2	17.8	1.8	3.7	4.9	0.0	0.0	0.0	0.0	0.0	70.5
0G33123FBA	Unsaturated Zone Borehole Instrumentatio	31.9	36.3	32.6	32.3	34.2	-10.8	1.5	0.0	0.0	0.0	0.0	0.0	158.0
0G33123FBB	Unsaturated Zone Borehole Instrumentatio	0.0	0.0	0.0	0.0	0.0	11.0	24.4	0.0	0.0	0.0	0.0	0.0	35.4
0G33123FBC	Integrated Analysis & Interpretation	0.0	0.0	0.0	0.0	0.0	9.3	32.9	0.0	0.0	0.0	0.0	0.0	42.2
0G33123FBD	Matrix Properties of Hydrologic Units	0.0	0.0	0.0	0.0	0.0	0.0	16.5	0.0	0.0	0.0	0.0	0.0	16.5
1.2.3.3.1.2.3		60.5	53.7	63.3	71.0	74.8	23.8	65.4	0.0	0.0	0.0	0.0	0.0	412.5
0G33124E96	Air-K and Hydrochemisty Test - North Ram	5.5	3.1	6.4	6.1	1.4	5.8	0.1	0.0	0.0	0.0	0.0	0.0	28.4
0G33124FA1	Support E&I Design Basis Modeling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0G33124FB7	Air Permeability & Hydrochem Testing ESF	46.1	40.6	40.9	68.9	62.7	21.6	-5.9	0.0	0.0	0.0	0.0	0.0	274.9
0G33124FB8	Percolation Flux across Repository Horiz	0.0	0.0	0.0	0.0	0.0	3.9	1.8	0.0	0.0	0.0	0.0	0.0	5.7
0G33124FBA	Moisture Monitorning in the ESF	2.4	2.4	1.5	18.3	8.3	2.6	2.2	0.0	0.0	0.0	0.0	0.0	37.7

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OG33124FBB	Air-Permeability & Hydrochem Testing ESF	0.0	0.0	0.0	0.0	0.0	14.5	56.6	0.0	0.0	0.0	0.0	0.0	71.1
OG33124FBD	Moisture Monitoring in the ESF	0.0	0.0	0.0	0.0	0.0	4.9	18.8	0.0	0.0	0.0	0.0	0.0	23.7
OG33124FBF	South Ramp Hydrology	0.0	0.0	0.0	0.0	0.0	44.3	18.1	0.0	0.0	0.0	0.0	0.0	62.4
OG33124FBG	PTn Lateral Diversion (Phase I)	0.0	0.0	0.0	0.0	0.0	2.0	8.5	0.0	0.0	0.0	0.0	0.0	10.5
OG33124FBH	ESF Drift Scale Flux and Niche Study	0.0	0.0	0.0	0.0	0.0	2.0	10.8	0.0	0.0	0.0	0.0	0.0	12.8
1.2.3.3.1.2.4		54.0	46.1	48.8	93.3	72.4	101.6	111.0	0.0	0.0	0.0	0.0	0.0	527.2
OG33127B96	UZ Hydrochemistry	0.0	0.0	0.0	20.0	0.0	0.4	3.1	0.0	0.0	0.0	0.0	0.0	23.5
OG33127FBA	UZ Hydrochemistry	23.0	27.1	22.0	1.2	18.0	14.5	-14.3	0.0	0.0	0.0	0.0	0.0	[illegible]
OG33127FBB	UZ Hydrochemistry	0.0	0.0	0.0	0.0	0.0	12.8	29.7	0.0	0.0	0.0	0.0	0.0	42.[illegible]
1.2.3.3.1.2.7		23.0	27.1	22.0	21.2	18.0	27.7	18.5	0.0	0.0	0.0	0.0	0.0	157.5
OG33128FBD	Fluid Flow in Unsaturated Zone Fractured	7.6	5.3	2.9	6.0	4.8	2.0	-0.4	0.0	0.0	0.0	0.0	0.0	28.2
1.2.3.3.1.2.8		7.6	5.3	2.9	6.0	4.8	2.0	-0.4	0.0	0.0	0.0	0.0	0.0	28.2
OG33129FBG	Site Unsaturated Zone Flow Model	7.8	6.4	8.3	25.5	-13.3	10.9	-0.8	0.0	0.0	0.0	0.0	0.0	44.8
OG33129FBK	Support UZ Model Expert Elicitation	0.0	21.2	6.8	8.6	7.4	3.5	3.2	0.0	0.0	0.0	0.0	0.0	50.7
1.2.3.3.1.2.9		7.8	27.6	15.1	34.1	-5.9	14.4	2.4	0.0	0.0	0.0	0.0	0.0	95.5
OG33131FBA	C-Well Complex Hydraulic & Conservative	46.5	42.2	46.6	74.2	58.5	31.3	4.0	0.0	0.0	0.0	0.0	0.0	303.3
OG33131FBB	C-Well Complex Hydraulic & Tracer Test	0.0	0.0	0.0	0.0	0.0	22.2	49.4	0.0	0.0	0.0	0.0	0.0	71.6
OG33131FBC	Water-Level Monitoring	20.7	17.8	20.5	18.2	14.3	6.2	0.8	0.0	0.0	0.0	0.0	0.0	98.5
OG33131FBD	Water-Level Monitoring	0.0	0.0	0.0	0.0	0.0	6.0	12.0	0.0	0.0	0.0	0.0	0.0	18.0
OG33131FBF	WT Eh and Ph Measurements	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	2.3
1.2.3.3.1.3.1		67.2	60.0	67.1	92.4	72.8	65.7	68.5	0.0	0.0	0.0	0.0	0.0	493.7
OG33133FB3	Site Saturated Zone Flow Model	16.5	25.9	21.8	27.0	22.2	10.3	39.3	0.0	0.0	0.0	0.0	0.0	163.0
OG33133FB4	Site Saturated Zone Synthesis Report	1.3	0.0	2.5	0.3	11.0	6.2	10.4	0.0	0.0	0.0	0.0	0.0	31.7
OG33133FB5	Conduct VA SZ Flow Model Sensitivity An	4.0	2.0	2.6	8.5	8.9	12.9	22.0	0.0	0.0	0.0	0.0	0.0	60.0
OG33133FB6	Confirm SZ Hydrologic Flow Models	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
1.2.3.3.1.3.3		21.8	27.9	26.9	35.8	42.1	29.4	71.7	0.0	0.0	0.0	0.0	0.0	255.6
*1.2.3.3		284.4	285.2	282.6	409.5	358.8	354.3	405.8	0.0	0.0	0.0	0.0	0.0	2380.6
OG3521FA1	Tracer Gas Support	5.7	5.1	6.0	6.8	5.4	9.5	6.4	0.0	0.0	0.0	0.0	0.0	44.9
1.2.3.5.2.1		5.7	5.1	6.0	6.8	5.4	9.5	6.4	0.0	0.0	0.0	0.0	0.0	44.9
*1.2.3.5		5.7	5.1	6.0	6.8	5.4	9.5	6.4	0.0	0.0	0.0	0.0	0.0	44.9
OG36212FB1	Confirmatory Aquatic Investigations	0.0	2.1	6.9	7.9	3.0	4.1	7.2	0.0	0.0	0.0	0.0	0.0	31.2
1.2.3.6.2.1.2		0.0	2.1	6.9	7.9	3.0	4.1	7.2	0.0	0.0	0.0	0.0	0.0	31.2
OG36215FB2	Paleoclimate/Paleoenvironmental Synthesi	40.1	38.6	31.7	62.4	37.8	19.5	9.6	0.0	0.0	0.0	0.0	0.0	239.7
1.2.3.6.2.1.5		40.1	38.6	31.7	62.4	37.8	19.5	9.6	0.0	0.0	0.0	0.0	0.0	239.7
OG36221FB1	Evaluation of Paleo Ground-Water Dischar	17.4	15.4	27.9	28.8	13.0	9.9	-34.8	0.0	0.0	0.0	0.0	0.0	77.6
OG36221FB2	Geo. Fract. Fill Mater, ESF & Est Past W	57.0	39.2	87.6	70.6	85.8	107.1	10.0	0.0	0.0	0.0	0.0	0.0	457.3
OG36221FB3	Syn.Dist.&Anal Geochron. Age Dets Potent	0.0	0.0	0.0	0.0	0.0	24.4	66.4	0.0	0.0	0.0	0.0	0.0	90.8

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1.2.3.6.2.2.1		74.4	54.6	115.5	99.4	98.8	141.4	41.6	0.0	0.0	0.0	0.0	0.0	625.7
*1.2.3.6		114.5	95.3	154.1	169.7	139.6	165.0	58.4	0.0	0.0	0.0	0.0	0.0	896.6
OG395FB1		0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	5.7
1.2.3.9.5		0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	5.7
OG39BFA1D	Support Systems Engineering Reports & St	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OG39BFA1F	Data & Del Mgt., QA Compl, Oversite Sup,	14.6	13.0	13.3	10.9	15.1	26.8	22.2	0.0	0.0	0.0	0.0	0.0	115.9
OG39BFB1	Support Development of PISA Ch 2.3 (Geol	30.1	29.7	43.9	50.1	55.5	50.1	69.2	0.0	0.0	0.0	0.0	0.0	328.6
OG39BFB1C	Provide Support to LA Plan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
OG39BFB1E	Provide Input to SC Progress Report 16	9.9	11.0	10.9	5.6	13.1	9.1	9.5	0.0	0.0	0.0	0.0	0.0	6[illegible]
OG39BFB2	Develop PISA Chapter 2.4 (Hydrology)	11.6	12.5	33.0	31.0	43.5	54.0	54.8	0.0	0.0	0.0	0.0	0.0	240.4
OG39BFB2E	Provide Input to SC Progress Report 17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OG39BFB4	Dev Climate/Meteorologic Sys Desc (PISA	0.0	0.0	0.0	0.0	0.0	16.1	51.3	0.0	0.0	0.0	0.0	0.0	67.4
1.2.3.9.11		66.2	66.2	101.1	97.6	127.2	156.1	207.0	0.0	0.0	0.0	0.0	0.0	821.4
*1.2.3.9		66.2	66.2	101.1	97.6	127.2	156.1	212.7	0.0	0.0	0.0	0.0	0.0	827.1
**1.2.3		817.4	786.3	874.6	1024.3	1003.6	1031.6	1010.2	0.0	0.0	0.0	0.0	0.0	6548.0
OG535FA1	Provide FY97 Technical Data Base Input	21.3	18.0	18.0	40.7	25.5	29.9	30.5	0.0	0.0	0.0	0.0	0.0	183.9
1.2.5.3.5		21.3	18.0	18.0	40.7	25.5	29.9	30.5	0.0	0.0	0.0	0.0	0.0	183.9
*1.2.5.3		21.3	18.0	18.0	40.7	25.5	29.9	30.5	0.0	0.0	0.0	0.0	0.0	183.9
OG541FA2	Viability Assessment Scenarios Developme	0.0	0.0	0.0	3.5	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	3.4
1.2.5.4.1		0.0	0.0	0.0	3.5	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	3.4
OG544FA1	UZ Flow Model Abstractions for VA	0.0	0.0	5.5	1.3	5.2	8.3	0.0	0.0	0.0	0.0	0.0	0.0	20.3
OG544FA2	SZ Flow Model Abstractions for VA	0.0	0.0	7.1	-0.4	-0.4	1.6	5.2	0.0	0.0	0.0	0.0	0.0	13.1
1.2.5.4.4		0.0	0.0	12.6	0.9	4.8	9.9	5.2	0.0	0.0	0.0	0.0	0.0	33.4
*1.2.5.4		0.0	0.0	12.6	4.4	4.8	9.9	5.1	0.0	0.0	0.0	0.0	0.0	36.8
**1.2.5		21.3	18.0	30.6	45.1	30.3	39.8	35.6	0.0	0.0	0.0	0.0	0.0	2[illegible]
OG825FA1	Federal Occupation Safety & Health	8.8	7.1	9.0	8.9	7.3	7.4	7.0	0.0	0.0	0.0	0.0	0.0	55.5
1.2.8.2.5		8.8	7.1	9.0	8.9	7.3	7.4	7.0	0.0	0.0	0.0	0.0	0.0	55.5
*1.2.8.2		8.8	7.1	9.0	8.9	7.3	7.4	7.0	0.0	0.0	0.0	0.0	0.0	55.5
OG845FA1	Radiation Protection	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1.2.8.4.5		0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
OG847FA1	Water Resources Envir Impact Stmt Suppor	0.0	0.0	0.0	0.0	2.4	2.8	0.0	0.0	0.0	0.0	0.0	0.0	5.2
OG847FA2	Rad Water Quality Sample Collection	0.0	0.0	0.0	0.0	0.0	49.3	3.8	0.0	0.0	0.0	0.0	0.0	53.1
OG847FB1	Water Resources	30.4	29.6	30.3	48.3	17.0	37.6	32.8	0.0	0.0	0.0	0.0	0.0	226.0
1.2.8.4.7		30.4	29.6	30.3	48.3	19.4	89.7	36.6	0.0	0.0	0.0	0.0	0.0	284.3
*1.2.8.4		30.4	29.6	30.4	48.3	19.4	89.7	36.6	0.0	0.0	0.0	0.0	0.0	284.4
**1.2.8		39.2	36.7	39.4	57.2	26.7	97.1	43.6	0.0	0.0	0.0	0.0	0.0	339.9
OG912FA1	Participant Technical Project Office	25.0	23.2	27.3	25.9	29.0	22.2	24.1	0.0	0.0	0.0	0.0	0.0	176.7

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1.2.9.1.2		25.0	23.2	27.3	25.9	29.0	22.2	24.1	0.0	0.0	0.0	0.0	0.0	176.7
*1.2.9.1		25.0	23.2	27.3	25.9	29.0	22.2	24.1	0.0	0.0	0.0	0.0	0.0	176.7
OG922FA1	Participant Project Control - USGS	21.4	18.6	18.1	20.5	17.5	19.9	34.8	0.0	0.0	0.0	0.0	0.0	150.8
1.2.9.2.2		21.4	18.6	18.1	20.5	17.5	19.9	34.8	0.0	0.0	0.0	0.0	0.0	150.8
*1.2.9.2		21.4	18.6	18.1	20.5	17.5	19.9	34.8	0.0	0.0	0.0	0.0	0.0	150.8
**1.2.9		46.4	41.8	45.4	46.4	46.5	42.1	58.9	0.0	0.0	0.0	0.0	0.0	327.5
OGC522FA1	Satellite Records Operations	3.8	3.5	4.7	4.2	4.2	3.9	4.0	0.0	0.0	0.0	0.0	0.0	28.3
1.2.12.5.2.2		3.8	3.5	4.7	4.2	4.2	3.9	4.0	0.0	0.0	0.0	0.0	0.0	28.3
*1.2.12.5		3.8	3.5	4.7	4.2	4.2	3.9	4.0	0.0	0.0	0.0	0.0	0.0	28.3
**1.2.12		3.8	3.5	4.7	4.2	4.2	3.9	4.0	0.0	0.0	0.0	0.0	0.0	28.3
OGF23FA1	Support/Personnel Services	32.4	28.7	35.4	25.6	22.5	27.7	25.9	0.0	0.0	0.0	0.0	0.0	198.2
OGF23FA2	Facilities Management - Space	61.7	61.7	61.7	61.7	61.7	61.7	64.0	0.0	0.0	0.0	0.0	0.0	434.2
OGF23FA3	Facilities Management - Computers/Phones	16.7	16.7	16.7	16.7	16.7	16.7	16.7	0.0	0.0	0.0	0.0	0.0	116.9
OGF23FA4	Facilities Management - Other	12.5	12.5	12.5	12.5	12.5	12.5	12.5	0.0	0.0	0.0	0.0	0.0	87.5
OGF23FA5	Procurement/Property Management - USGS	10.2	11.0	8.0	7.3	11.5	9.9	8.5	0.0	0.0	0.0	0.0	0.0	66.4
1.2.15.2.3		133.5	130.6	134.3	123.8	124.9	128.5	127.6	0.0	0.0	0.0	0.0	0.0	903.2
*1.2.15.2		133.5	130.6	134.3	123.8	124.9	128.5	127.6	0.0	0.0	0.0	0.0	0.0	903.2
OGF3FA1	USGS Training Support	4.5	4.2	3.7	4.8	4.2	4.2	3.8	0.0	0.0	0.0	0.0	0.0	29.4
1.2.15.3		4.5	4.2	3.7	4.8	4.2	4.2	3.8	0.0	0.0	0.0	0.0	0.0	29.4
*1.2.15.3		4.5	4.2	3.7	4.8	4.2	4.2	3.8	0.0	0.0	0.0	0.0	0.0	29.4
**1.2.15		138.0	134.8	138.0	128.6	129.1	132.7	131.4	0.0	0.0	0.0	0.0	0.0	932.6
1.2 OPERATING		1066.1	1021.1	1132.7	1305.8	1240.4	1347.2	1283.7	0.0	0.0	0.0	0.0	0.0	8397.0
CAPITAL EQUIPMENT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL		1066.1	1021.1	1132.7	1305.8	1240.4	1347.2	1283.7	0.0	0.0	0.0	0.0	0.0	839[illegible]
FTEs														
FEDERAL		112.7	108.9	108.0	109.3	99.7	109.6	112.6	0.0	0.0	0.0	0.0	0.0	
CONTRACT		17.0	17.8	19.2	26.5	22.1	25.9	29.0	0.0	0.0	0.0	0.0	0.0	
TOTAL		129.7	126.7	127.2	135.8	121.8	135.5	141.6	0.0	0.0	0.0	0.0	0.0	

* Fourth level WBS roll-up
** Third level WBS roll-up