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GREAT BASIN PALEOENVIRONMENTAL STUDIES PROJECT
TECHNICAL PROGRESS REPORT
THIRD QUARTER
December 1993 – February 1994

Cooperative Agreement No. DE–FC08–93–NV11417

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Submitted to:
U.S. Department of Energy
Yucca Mountain Site Characterization
Project Office
Las Vegas, Nevada

PROJECT AIM

Examination of the paleolithic and geomorphic records to determine the local and regional impact of past climates will advance assessment of Yucca Mountain's suitability as a high–level nuclear waste repository. The project includes the integration of botanical, faunal, and geomorphic components to accomplish this goal.

PALEOBOTANICAL STUDIES IN THE GREAT BASIN

Dr. Peter E. Wigand, Principal Investigator

Project Goals:

Paleobotanical studies will reconstruct the response of vegetation to climate change at the community and the organismal levels by integrating data obtained from nearly continuous sediment records of pollen, plant macrofossils, and stable isotopes from fossil woodrat middens.

These data will be used to 1) identify periods of wetter climate at Yucca Mountain and the adjacent region during the last 20,000 to 50,000 years, 2) estimate differing magnitude and duration of rainfall, and 3) determine the amount and actual period of availability of excess water. The modern distribution, characteristics, and ecophysiology of analogous plant communities and/or indicator species in combination with data derived from ostracode and diatom analyses conducted by the USGS will provide reasonable indications in past climate. Past extremes in infiltration rates can then be reconstructed to serve as estimates for the next 10,000 years at Yucca Mountain.

Progress on Tasks:

Palynological:

Task 1 Extend the present 4,000 year vegetation history record from Lower Pahranagat Lake, southern Nevada. This will provide baseline data to generate transfer functions for the interpretation of less complete Pleistocene paleoclimatic proxy records. Lower Pahranagat Lake is located at the eastern terminus of a network of sites that stradle the Nevada Test Site and Yucca Mountain. As such, it will establish the regionality of any climate patterns that are revealed.

Progress: The present 4,000 year vegetation history record from Lower Pahranagat Lake, southern Nevada, has been sampled intensively for pollen and radiocarbon dates. This will provide higher resolution and precision of the present record to further resolve rates of climate change and vegetation response. In addition, ostracode samples have been submitted to Dr. R. Forester of the USGS to compare the terrestrial and the lacustrine records. We are also comparing these data with the currently available tree–ring records from the White Mountains and central Nevada to derive potential transfer functions between modern climate, tree–ring records, and long–term pollen records.

Paleobotanical Continued

Task 2 Assemble a modern plant community pollen database.

Progress: Assembly of a modern plant community pollen database is being conducted at this time. We have been setting out passive pollen traps this winter along elevational transects and near established weather stations so that modern weather data can be tied directly to the pollen record. The transect will eventually stretch into the northern Rockies.

Task 3 Incorporate available palynological data from the Intermountain West into a database. This task includes; 1) review of the data from some localities previously examined by us in order to accomplish the goals of the project, 2) the submission of radiocarbon dates and tephra analyses for the resolution of chronologies, and 3) analyses of pollen samples taken at closer intervals to resolve the rates of climate change, their magnitude, and the response of the vegetation community.

Progress: Assembly of available palynological data from the Intermountain West into a database is proceeding. In addition, we are putting the database into a format conforming with the guidelines followed by the National Geophysical Data Center.

Task 4 Coring selected southern Nevada localities for paleoenvironmental records.

Progress: The requisite state–wide and local permits from the BLM and Fish and Wildlife Service have been obtained to core selected southern Nevada localities for paleoenvironmental records. Three localities, including Pahrump Playa, Stewart Playa, and Peter's Playa, were cored last summer. Although we have cored in the Eagle Lake area of northeastern California and intend to use some of that data in our final analyses (for tracking the location of the polar front during the last 30,000 year), we are delaying any further coring in the south until the spring due to wet playa conditions.

Paleonidological:

Task 5 Assemble available woodrat midden data from the Intermountain West into a database.

Progress: Assembly of available woodrat midden data from the Intermountain West into a database is proceeding. We are in correspondence with other investigators in an attempt to fill in gaps in the data where necessary.

Paleobotanical Continued

Task 6 Process samples already collected that are pertinent to the goals of the project.

Progress: Samples previously collected from the Pahranagat Range of southern Nevada have been processed, some 30 plus radiocarbon dates have been run, and the plant materials are being sorted and identified. Stable isotopic samples will be run in the near future. Insect remains from 21 packrat midden samples have already been sent and analyzed by Dr. S. Elias, a subcontractor.

Task 7 Collection of modern vegetation and climate data pertinent to interpretation of woodrat midden data in an analogue/nonanalogue manner.

Progress: Collection of modern vegetation and climate data pertinent to interpretation of woodrat midden data for use in analogue/nonanalogue comparisons is preceding. These localities correspond, in as much as is possible, with the pollen collection localities mentioned above.

Task 8 Select, collect, and process new midden localities that are pertinent to the goals of the project.

Progress: New localities in southern and central Nevada have been selected, collected and are being processed, radiocarbon dated, and analyzed. These localities are adjacent to localities that are being or have been cored for pollen and ostracode records. Localities include middens collected in the Massachusetts Mountain area between Frenchman and Yucca flats and the Last Chance Range between Pahrump and Stewart playas.

Problems Encountered:

This task is currently over-budget. Due to the hantavirus epidemic, the collection of middens has been delayed. Collection is now progressing slowly due of the safety precautions that must be taken. We have received approval from Birdie Hamilton-Ray, Contracting Officer, to rebudget the analyses costs from subcontracting funds to operating funds.

PALEOFAUNAS STUDIES IN THE GREAT BASIN
Dr. Stephanie Livingston, Principal Investigator

Project Goals:

The goal of this study is to construct a history of Great Basin vertebrates, particularly mammals, that will provide empirical evidence of past environmental and climatic conditions within the Great Basin as it is recorded by the animals. Taxonomic composition of archaeological and paleontological faunas from various areas within the Great Basin and morphological change within individual mammalian taxa at specific localities are being investigated to monitor faunal response to changing environmental conditions. Data are being obtained from published records, modern museum specimens, and raptor pellets to provide a modern control to which the paleofaunal data can be compared. This study will provide an independent set of surrogate data for use in building a model of past conditions and assessing the effects of past climate change on various aspects of the environment.

Progress on Tasks:

Task 1 Data collection from existing paleo– and modern–vertebrate collections.

Progress: Data collection continues from the Floating Island Cave assemblage, and has been initiated from the Homestead Cave assemblage. A database of published Great Basin paleofaunas is being compiled in a GIS–compatible format.

Task 2 Field recovery of modern, archaeological, and/or paleontological vertebrate materials.

Progress: Samples from the DeLong core have been submitted for paleo–magnetic, ostracode, and radiocarbon analysis. Analysis of the two small assemblages from rockshelters north of Pahrump are completed. Plans for field reconnaissance in Eureka Valley are underway. The trip is tentatively scheduled for June.

Task 3 Dating and other special analyses.

Progress: Analysis of the core taken at the DeLong locality for chronological control is being conducted at University of California, Bakersfield under subcontract with Dr. Robert Negrini. Ostracodes from the core are being analyzed by Dr. Rick Foresters, USGS, Denver.

Problems Encountered:

No specific problems have been encountered.

GEOMORPHOLOGY STUDIES IN THE GREAT BASIN
Dr. Nicholas Lancaster, Principal Investigator

Project Goals:

The objective of the geomorphology component of the paleoenvironmental program is to document the responses of surficial processes and landforms to the climatic changes documented by studies of packrat middens, pollen, and faunal distributions. This major objective will be achieved by a variety of projects designed to reveal the linkage between climate change and physical response. The project will focus on: 1) stratigraphic relationships between lake deposits and aeolian or fluvial sediments and landforms; 2) cut and fill sequences in floodplain and river–channel deposits; 3) identification of periods of dune mobility and stability; 4) documentation of episodes of alluvial fan and terrace development and erosion; and 5) correlation of (3) and (4) to climatically driven lake–level fluctuation as revealed by shoreline features such as strandlines and beach ridges. Numerical and relative dating of geomorphic events will be accomplished by a range of techniques including C^{14}, tephrochronology, dendrochronology, luminescence, and soil chronology.

Progress on Tasks:

Activities in this quarter have focussed on analysis of samples collected during the field season last year. Samples from natural exposures and cores collected from two areas in northern and central Nevada (Black Rock Desert, Long Valley) were examined for the presence or absence of ostracodes and other dateable materials. A preliminary analysis of sediment size, depositional features, and sedimentary structures was undertaken at the same time. Ostracode samples were sent to the USGS Denver for analysis and preparation for AMS ^{14}C dating. Samples from alluvial deposits in Illipah Wash and lacustrine deposits in the Buena Vista Valley were also prepared for ^{14}C dating.

In addition, planning for the coming summer field program has begun with selection of locations thought to provide the maximum information on climate/geomorphic process interactions during the late Pleistocene and Holocene. This has involved field reconnaissance of suitable areas and examination of previously published literature.

Good progress has been made on luminescence dating of aeolian and lake shoreline deposits in the Mojave Desert. Infra–red stimulated luminescence (IRSL) techniques have been applied to aeolian sands associated with playa shorelines (East Cronese Basin) and dune ridges (West Cronese Basin). The Cronese Basins, located north of the Mojave River Wash in the eastern Mojave Desert, are fed by flow in the ephemeral Mojave River as a response to increased rainfall in the San Bernadino Mountains. Results from the West Cronese Basin show that dune ridges range in age from 155 ± 90 years to 1850 ± 200 years with the majority of dune stabilization occurring around 200 years ago. A sample taken from a one meter high yardang at the north side of the West Cronese Basin near the spillway, gave an age of 250 ± 75 showing that there has been significant erosion and transport of sand from the West Cronese Basin since that time. We plan to take cores from these basins over the summer to study the relations between flood events in the Mojave River drainage and aeolian activity. Further work on dating of shoreline deposits is in progress.

Geomorphology Continued

A manuscript documenting this work has been submitted for publication to the Journal Geomorphology.

Problems Encountered:

No specific problems have been encountered.

TRANSPORTATION
Dr. Richard French, Principal Investigator

Project Goal:

The goal of this project is to compare the results from three models (FESWMS–2DH, DAMBRK, and FLO–2D) that have been suggested as appropriate for evaluating flood flows on alluvial fans with the results obtained from the traditional one–dimensional, stochastic model used in previous research performed by DRI for the Yucca Mountain Project. In a previous research project, three alluvial fans with rail transportation alignments crossing them were identified; hydrologic data were collected; flood hazard/drainage analyses were performed using the one–dimensional stochastic model; and the results of the flood hazard/drainage analyses compared with the documented historic performance of the drainage system. Therefore, the basis for this comparison of model results will be these three alluvial fans.

Progress on Tasks:

Task 1 The primary focus of the project during the third quarter has been to initiate work with the FLO–2D computer model. Dr. O'Brien, a subcontractor from FLO Engineering, has begun to digitize the topographic maps of the alluvial fans selected for this study. Grid systems will be generated from these maps for use in the FLO–2D model. In a meeting with Dr. O'Brien on March 23, 1994, it was decided that O'Brien would initially apply FLO–2D to one alluvial fan using a large–scale grid system. The results of this application will be studied and refinements made to the procedure and grid system before application is made to the other alluvial fans. Topographic maps and grid system information have been supplied to O'Brien and supporting documents are being sent as needed.

Task 2 Contacts have continued regarding difficulties with the FESWMS computer code. A sensitivity analysis of channel slope is currently being performed. FESWMS was developed to model flows in natural, perennial river systems with slopes typically less than 0.001 ft/ft. The alluvial fans to be modeled have slope values ranging up to 0.300 ft/ft. Several contacts have suggested that FESWMS may be sensitive to slopes steeper than those of natural river systems.

Task 3 Initial applications using DAMBRK are being made. Refinement of these models is continuing.

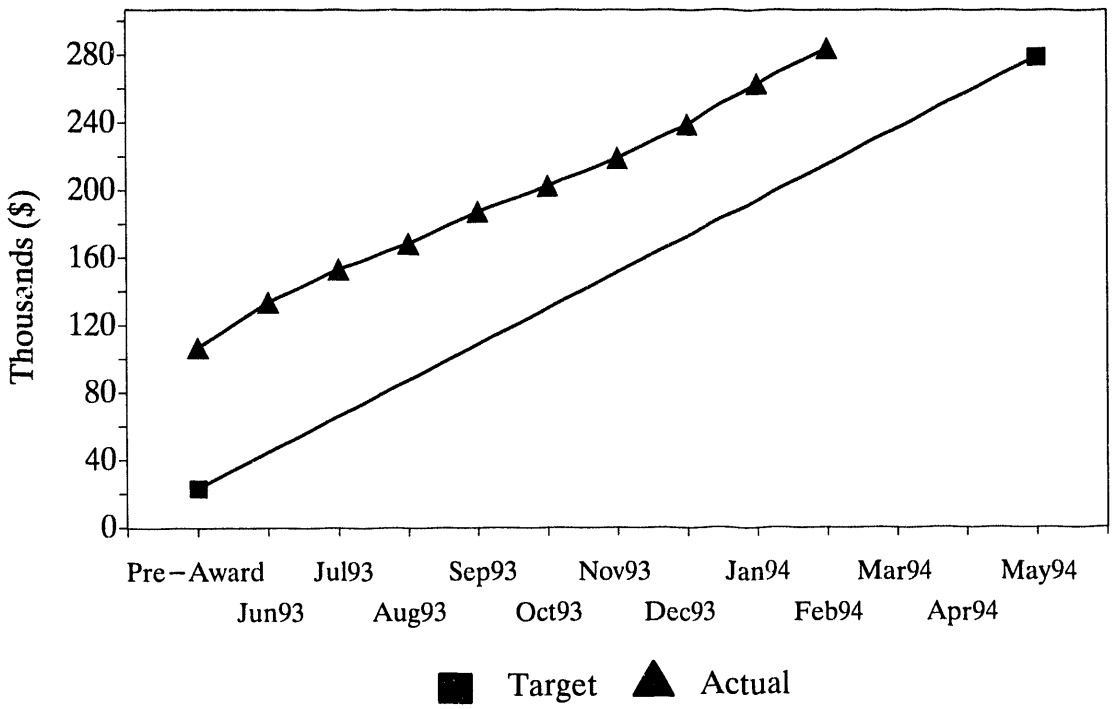
Task 4 The dialogue with Alberta Environment personnel has continued regarding the previous peer reviewed publication ("Preferred Directions of Flow on Alluvial Fans", Journal of Hydraulic Engineering, Vol. 118, No. 7, pp. 1002–1013). The result of this dialogue is a new, jointly authored manuscript for peer–reviewed publication titled "Preferred Direction of Flow on Alluvial Fans: Additional Data." It is anticipated that this manuscript will be submitted to the Journal of Hydraulic Engineering for publication before the end of the fourth quarter.

Problems Encountered:

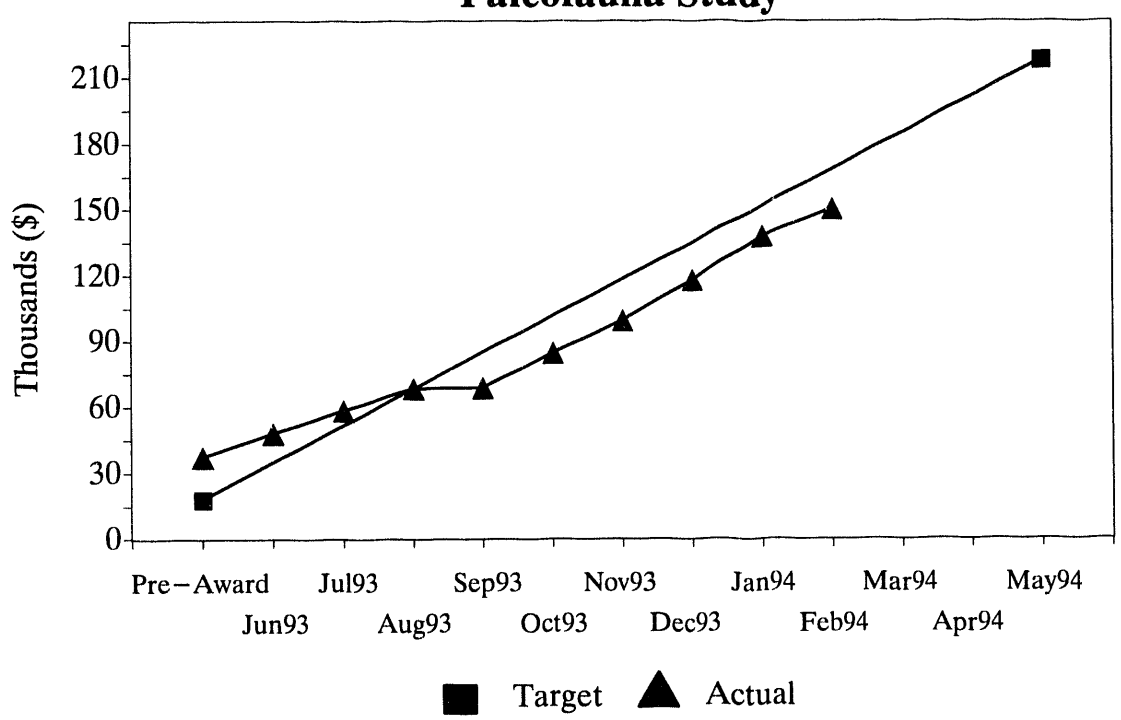
Sufficient funding is not currently available to meet the milestones and deliverables contained in the proposal.

GREAT BASIN PALEOENVIRONMENTAL STUDIES PROJECT
BUDGET SUMMARY

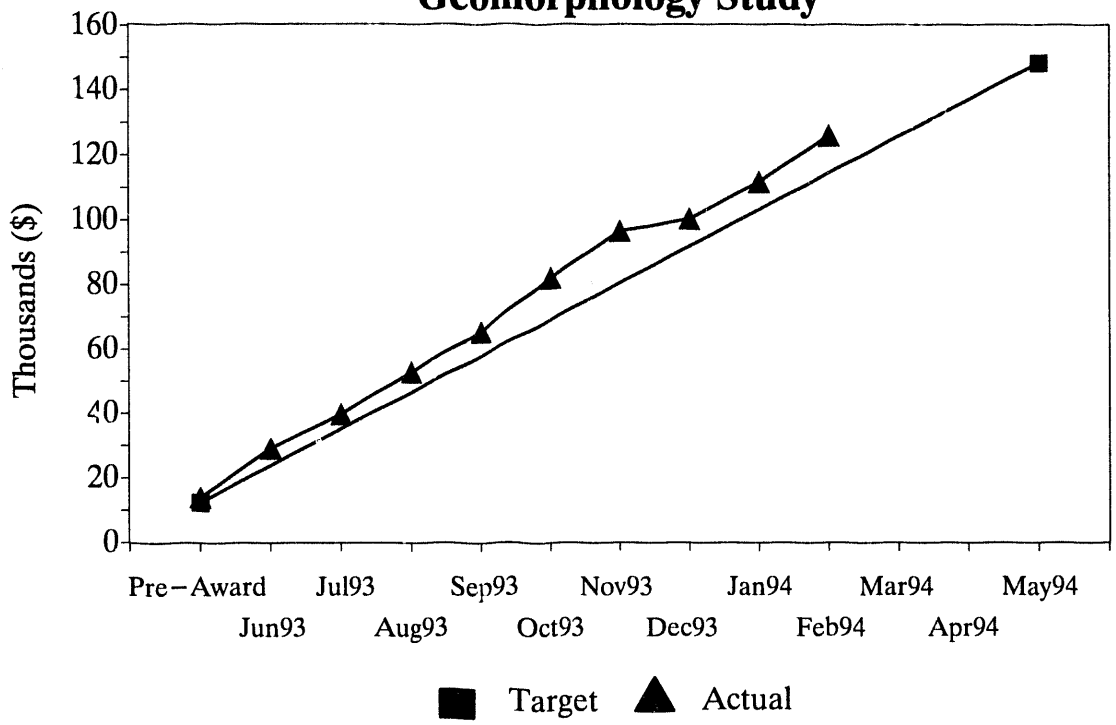
Paleobotanical Study



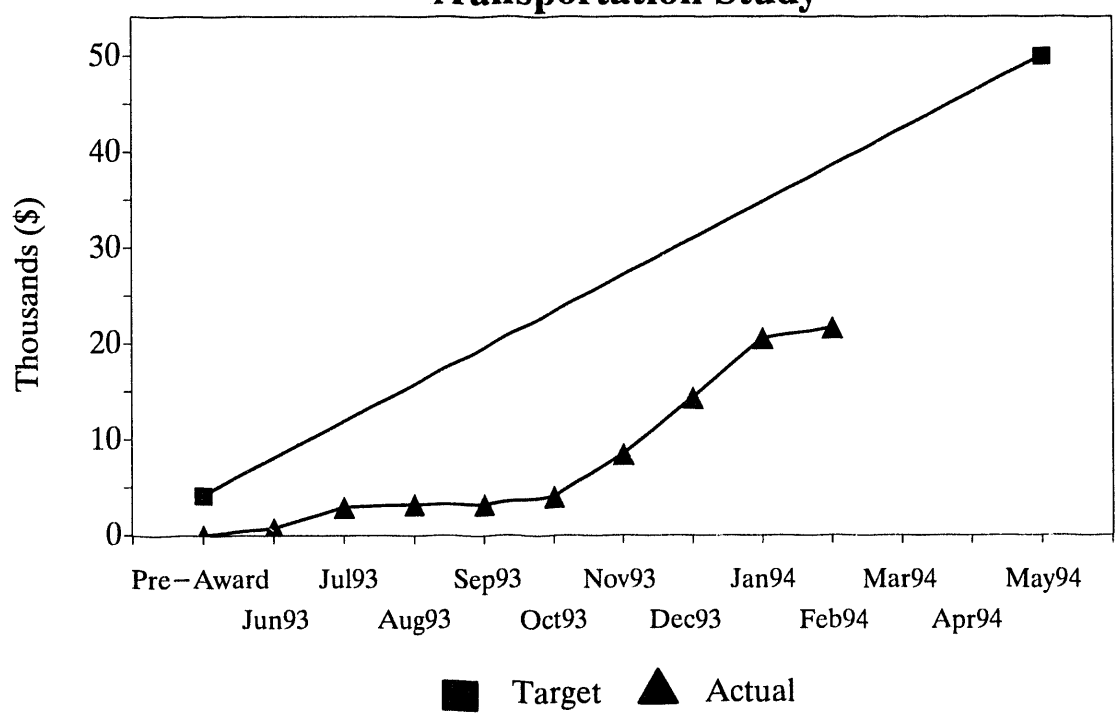
Paleofauna Study



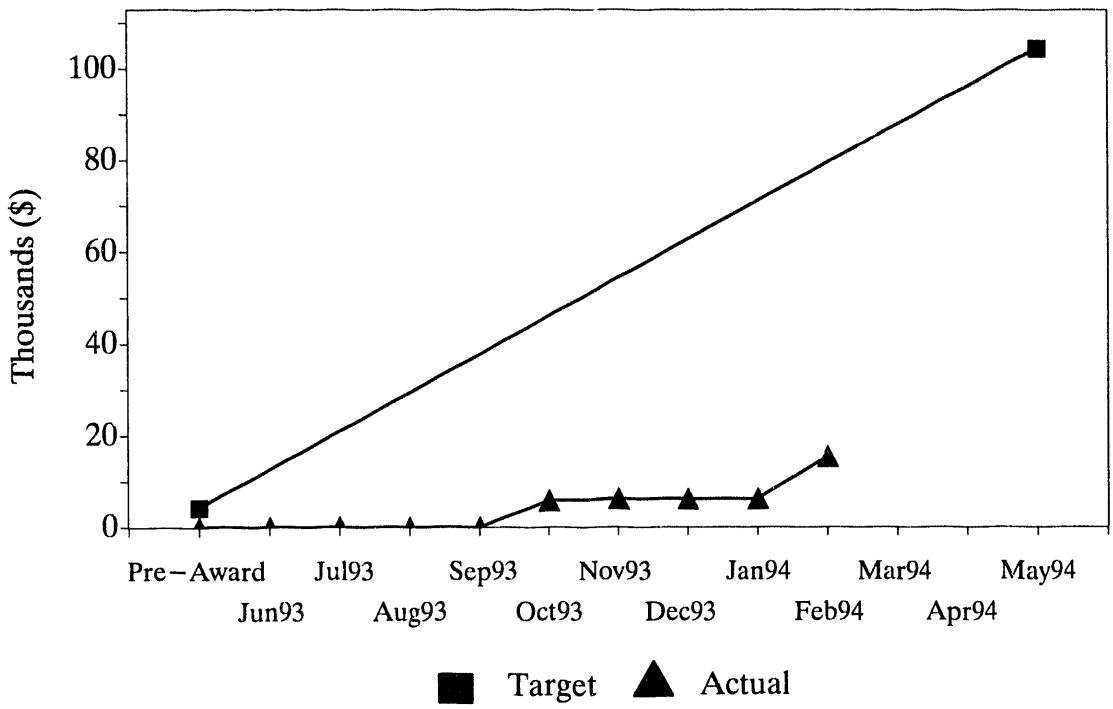
Geomorphology Study



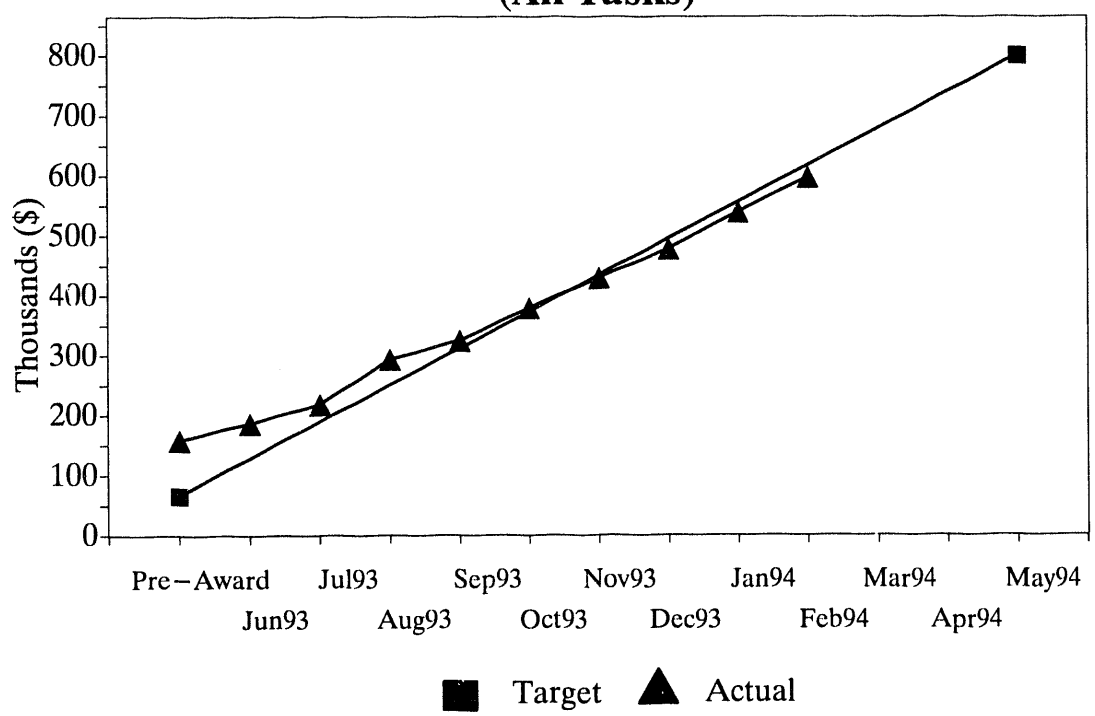
Transportation Study



Subcontracts



Summary (All Tasks)



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DATE
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