

Oil & Natural Gas Technology

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Quarterly Report

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Water-related Issues Affecting Conventional Oil and Gas Recovery and Potential Oil-Shale Development in the Uinta Basin, Utah



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EXECUTIVE SUMMARY

In October of 2008, the Utah Geological Survey (UGS) began work on the National Energy Technology Laboratory (NETL) funded project *Water-related Issues Affecting Conventional Oil and Gas Recovery and Potential Oil-Shale Development in the Uinta Basin, Utah*. The first couple months were mostly dedicated to project management activities that included revising the Project Management Plan, writing a 2-page Project Summary, writing the Technology Status Assessment, setting up our one subcontract, and participating in the project kickoff meeting held at the Morgantown campus of NETL. In the latter part of the first quarter, research efforts commenced with data collection and the initiation of important collaborations.

After setting up a subcontract with Paul Anderson, Consulting Geologist, work began on digitizing information used to map the 1987-version of the base of the moderately saline aquifer in the Uinta Basin, Utah. In addition to compiling this database, several contacts were made with Uinta Basin oil and gas operators, as well as federal and state agencies, to determine their willingness to help and donate relevant water quality data. Early communications are promising, and we expect to receive the data needed to accurately remap the base of the moderately saline aquifer.

This project will also look in detail at the Birds Nest aquifer in the upper Green River Formation and how saline water disposal into this interval might impact potential oil-shale development. First we need to determine the vertical relationship, or interburden, between the Birds Nest and the rich oil-shale horizons. Work in the first quarter focused on picking tops of important oil-shale zones (i.e., Mahogany zone) for roughly 300 wells throughout the basin. The next step will involve picking the top and bottom of the Birds Nest aquifer and generating several isopach and interburden maps.

Anadarko Petroleum Corporation has already provided the UGS with Birds Nest water quality information from about 100 wells in central Uintah County. Combined with water quality data from an additional 15 wells referenced in the literature, we are beginning to generate a clearer picture of the spatial salinity changes within this zone. Future efforts will focus on gathering more data to better understand the aquifer's areal extent.

The groundwater research group at the UGS has submitted to NETL a Quality Assurance Project Plan (QAPP) that outlines the water sampling strategy that will be undertaken to develop a baseline water quality and quantity database for Utah land classified by the U.S. Bureau of Land Management as having oil-shale development potential. This plan lists 50 potential sample sites, explains the sample methodology, and describes the types of analyses that will be performed. NETL has approved the plan and sampling is scheduled to begin in the spring of 2009.

In addition to starting the proposed research, the UGS has initiated several technology transfer activities to inform interested parties of the project's intended goals and objectives. The project was announced at several venues including the quarterly Uinta Basin Oil and Gas Collaborative Group meeting, the 28th Oil Shale Symposium, and a Society of Petroleum Engineers Conference on oil shale. We have also created a Web site that displays project details, recent project publications, and contact information. Furthermore, we submitted an abstract to the American Association of Petroleum Geologists (AAPG) annual meeting to be held in Denver in June of 2009. This conference will be attended by hundreds of researchers and oil and gas operators and will be an excellent venue to announce our project and display preliminary results.

PROGRESS, RESULTS, AND DISCUSSION

Task 1.0: Project Management Plan

During the month of October, the Principal Investigator (PI) revised and resubmitted the Project Management Plan (PMP), incorporating comments from the DOE Project Officer. This plan outlines the research to be performed during the entire three-year project. In addition, the PI wrote and submitted a short two-page Project Summary and the Technology Status Assessment.

Task 2.0: Moderately Saline Aquifer Study

The first job related to Task 2 involved setting up a subcontract with Paul Anderson, Consulting Geologist. Unexpected delays with the State Purchasing Office pushed the contract finalization to mid-December. Shortly after the contract was signed, work began on digitizing the old moderately saline aquifer map from Utah Department of Natural Resources Technical Publication 92. The first task was to digitize the locations of all the wells used in the 1987 study (the original list of wells is lost). The wells only appear as dots on the old paper map with no API numbers or other well identifiers. After obtaining a scanned version of the map and georeferencing it in ArcGIS, a complete list of well locations was digitized, along with the depth to the moderately saline aquifer. We cross-referenced these sites with known oil and gas well locations and were able to identify roughly 70% of the 400 wells used in the old study.

Other work related to Task 2 included compiling a database of water disposal wells within the Uinta Basin, including well logs and permitting files, that latter of which contain water quality information. Furthermore, we have created an ArcGIS program template with all pertinent GIS shape files such as general geology, oil and gas fields, oil and gas wells, and relevant geographic information.

To help facilitate data collection, we have contacted several Uinta Basin oil and gas operators requesting water quality analyses, digitized well logs, and formation top information. To date, three major companies, Anadarko, Questar, and Newfield, have agreed to support our efforts and supply data. We anticipate several more companies will follow suit.

Task 3.0: Geologic Examination of the Birds Nest Aquifer

Anadarko Petroleum Corporation has provided the UGS a database of over 100 wells from the Natural Buttes gas field with water quality information on the Birds Nest aquifer. Along with data from an additional 15 wells, we are beginning to develop a picture of the geographic salinity changes present within this zone (figure 1). We have also collected geophysical logs from these wells which will be used to determine aquifer thickness. Future work will focus on collecting additional data to increase our spatial view.

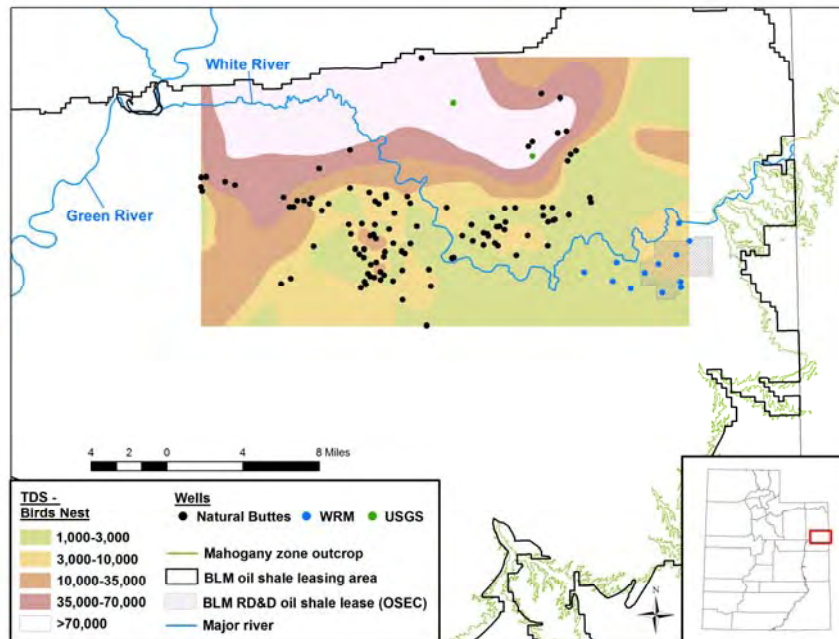


Figure 1. Preliminary salinity map within the Birds Nest aquifer, Uintah County, Utah.

In order to determine how the Birds Nest aquifer might affect oil-shale development, we need to determine the vertical distance (interburden) between the richest oil-shale zones and the aquifer. Work in the first quarter focused on picking tops of various oil-shale horizons (in descending order: Big Three [picked as the top of economic oil shale], A-Groove, Mahogany zone [the richest zone], B-Groove, R-6, L-5, R-5, L-4, and R-4). These zones were picked for roughly 300 wells throughout the basin and isopach maps were generated displaying their thickness and areal extent. Future work will focus on picking the base of the Birds Nest aquifer and mapping the above-mentioned interburden.

In preparation for cross-section generation, we have imported several relevant geophysical logs into the software package Petra. These cross sections will show the subsurface relationship between the Birds Nest aquifer and the surrounding rock layers. Related to this effort will be the mapping of the Birds Nest outcrop expression. We have started compiling Horsebench Sandstone GIS outcrop layers; the mapped Horsebench Sandstone is stratigraphically very close to (maybe somewhat above) the unmapped Birds Nest aquifer. These files will help determine locations for future field analyses and locations for measured stratigraphic sections.

Finally, we have begun compiling a bibliography of all work published on the Birds Nest aquifer and surrounding rock layers. Currently we have found only about 25 references; not much has been published about this zone.

Task 4.0: Baseline Water Quality and Quantity GIS Database

The majority of the first quarter was spent creating the Quality Assurance Project Plan (QAPP) which outlines the water sampling strategy. This plan identifies 50 potential sample sites for water quality sampling from wells, creeks, and springs, including the criteria for choosing sample locations (figure 2). The report also details the types of analyses that will be performed and outlines sample collection methodologies.

Task 5.0: Integration of Analysis of Produced Water from Simulated In-situ Oil Shale Extraction Technologies

This task is scheduled for Budget Period 3.

Task 6.0: Technology Transfer

A project Web site was created as a subpage of the main UGS Web site (http://geology.utah.gov/emp/UBwater_study). The site gives an overview of the project, a list of downloadable project publications, and contact information. In addition to the Web site, the project was announced/discussed at several relevant conferences and meetings including the Society of Petroleum Engineers (SPE) Oil Shale Conference, the 28th Oil Shale Symposium, and the quarterly Uinta Basin Oil and Gas Collaborative Group meeting. In December, the PI traveled to NETL offices in Morgantown, WV, and presented an overview of the project to NETL staff and other grant recipients. An abstract announcing the project objectives was also submitted to the American Association of Petroleum Geologist (AAPG) annual meeting to be held in Denver in June of 2009.

CONCLUSION

Most of the work performed in the project's first quarter was geared toward project management activities; project details were finalized, subcontracts were signed, and partner collaborations were initiated. We also began our initial data collection activities, which will be the basis for all future research. Technology transfer activities mainly included announcing the project to interested parties at various conferences and meetings, as well as setting up a Web site with project details, updates, and contacts.

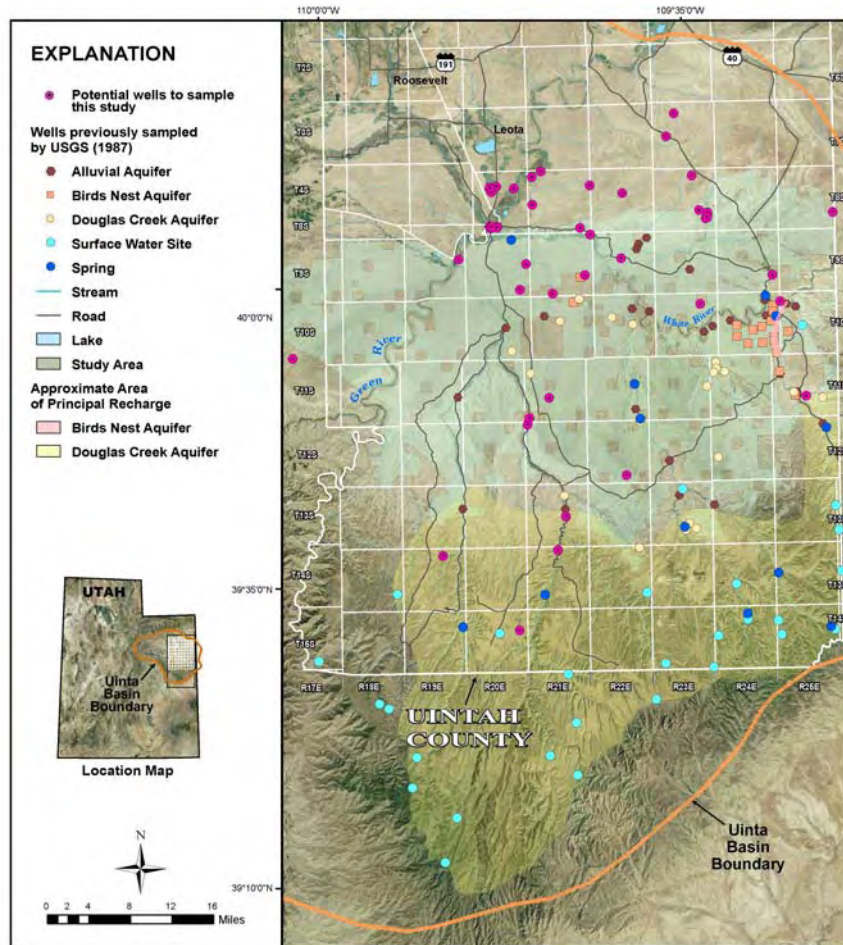


Figure 2. Proposed sites for ground-water quality sampling in the Uinta Basin, Utah.

COST STATUS

Table 1. Project costing profile for Budget Period 1.

	Oct 2008		Nov 2008		Dec 2008	
	Plan	Actual	Plan	Actual	Plan	Actual
UGS-personnel	\$4,868	\$7,011	\$13,720	\$10,775	\$11,297	\$14,989
Travel Expenses ¹		\$20		\$11	\$1,136	\$799
Water Chemistry						
Miscellaneous ²		\$475				
SUBTOTALS	\$4,868	\$7,506	\$13,720	\$10,786	\$12,433	\$15,788
UGS OVERHEAD (32.40%)	\$1,577	\$2,432	\$4,445	\$3,495	\$4,028	\$5,115
SUBCONTRACTS						
P. Anderson					\$8,132	\$160
GRAND TOTALS	\$6,445	\$9,938	\$18,165	\$14,281	\$24,593	\$21,063

¹October travel – Uinta Basin Oil and Gas Collaborative Group meeting in Vernal, UT; November travel – SEP oil shale conference in Salt Lake City, UT; December travel – Kickoff meeting in Morgantown, WV

²October – Exhibit booth rental for AAPG annual meeting 2009

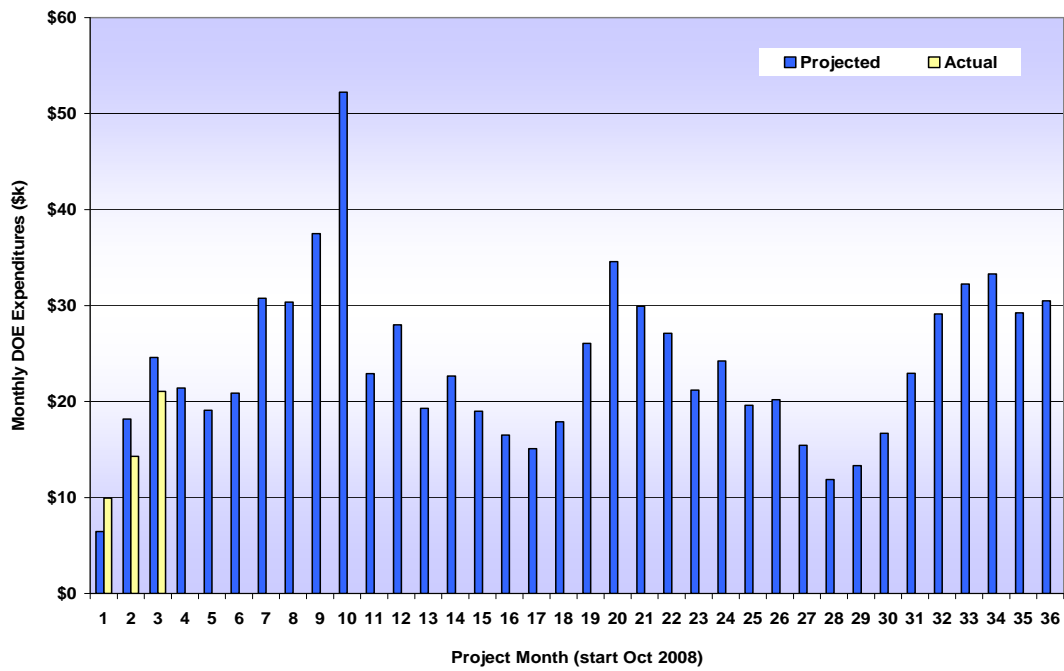


Figure 3. Project costing profile.

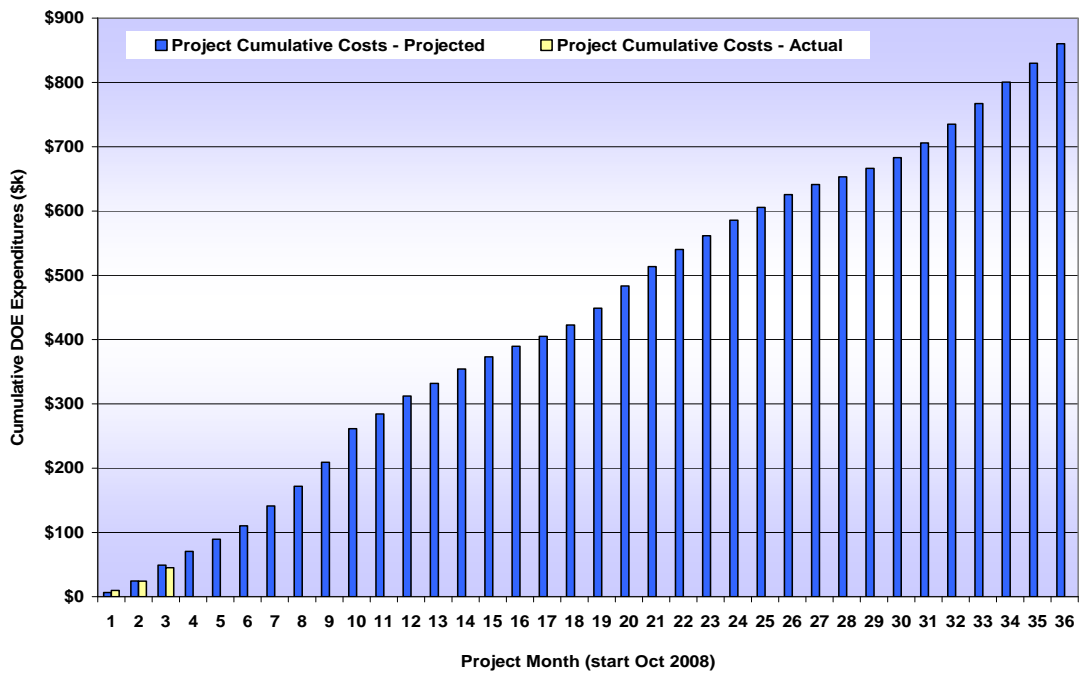


Figure 4. Project cumulative costs.

MILESTONE STATUS

Table 2. Milestone log for Budget Period 1.

	Title	Description	Related task or subtask	Completion Date	Update/comments
Milestone 1.1	Water chemistry data collection (part 1)	Collect at least half of the required 1 well per township	Subtask 2.1	9/30/2009	Data collection is in progress; have contacted several companies about getting data; started collecting and organizing historical data
Milestone 1.2	Evaluation of the Birds Nest in core and outcrop	Examine the Birds Nest in core and find at least five outcrop exposures to describe	Subtask 3.2, 3.3	6/30/2009	Yet to be completed, scheduled for Winter/Spring 2009
Milestone 1.3	Completion of the Quality Assurance Project Plan	Locate 50 sites suitable for water chemistry analyses	Subtask 4.2	12/15/2008	Completed

ACCOMPLISHMENTS

- Completion of the Quality Assurance Project Plan (QAPP)
 - The QAPP identifies 50 potential sampling sites for water quality sampling from wells, creeks, and springs within the Uinta Basin study area. This plan also includes a section describing methods, techniques, and criteria for choosing sample locations and descriptions of the chemical tests to be performed.
 - This report will soon be available on the UGS Web site (February 2009)
- Paul Anderson's subcontract
 - Anderson's subcontract was finalized and signed in mid-December 2008. This contract specifies the research Anderson will perform as part of this project.

PROBLEMS OR DELAYS

The subcontract for Paul Anderson took longer to arrange than expected. We anticipated the subcontract being in place by the end of November, but it was not signed until mid-December due to unexpected delays with the State of Utah purchasing office. This will not affect the first-year budget since Anderson still plans to work his contracted 1000 hours.

PRODUCTS

- Revised Project Management Plan
- Project Web site
 - A project Web site was set up outlining the project objectives
 - Provides access to published reports and project updates
 - http://geology.utah.gov/emp/UBwater_study
- Project Summary
 - 2-page project summary outlining project goals and objectives
 - The summary is available on the UGS and NETL project Web sites

- Technology Status Assessment
 - Summary report describing the current state of information and technology relevant to the project objectives
 - The assessment is available on the UGS project Web site
- Quality Assurance Project Plan (QAPP)
 - The QAPP identifies 50 potential sampling sites for water quality sampling from wells, creeks, and springs within the Uinta Basin study area. This plan also includes a section describing methodology, techniques, and criteria for choosing sample locations and descriptions of the chemical tests to be performed.
 - This report will soon be available on the UGS Web site (February 2009)
- Abstract – AAPG 2009 annual meeting – Denver, CO, June 7-10, 2009
 - An abstract was submitted to the AAPG 2009 annual meeting detailing the project objectives, with particular emphasis on the Birds Nest aquifer and its relationship to oil and gas development. We are waiting to hear if it was accepted.
 - Abstract is available on the UGS project Web site
- Uinta Basin Oil and Gas Collaborative Group meeting - Vernal, UT – October 9, 2008
 - This is a group of state and federal officials and Uinta Basin oil and gas operators that meets quarterly to discuss latest activities in the basin.
 - Members of the research team attended the meeting and networked about the project
- 28th Oil Shale Symposium - Golden, CO – October 13-15, 2008
 - The PI presented work related to Utah's oil-shale deposits and highlighted this project's upcoming research
- SPE Oil Shale Conference - Salt Lake City, UT – November 13, 2008
 - The PI presented work related to Utah's oil-shale deposits and highlighted this project's upcoming research
- NETL kickoff meeting, Morgantown, WV – December 9, 2008
 - The PI delivered a project overview presentation at the kickoff meeting at the NETL Morgantown campus
 - The presentation is available on the UGS project Web site

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