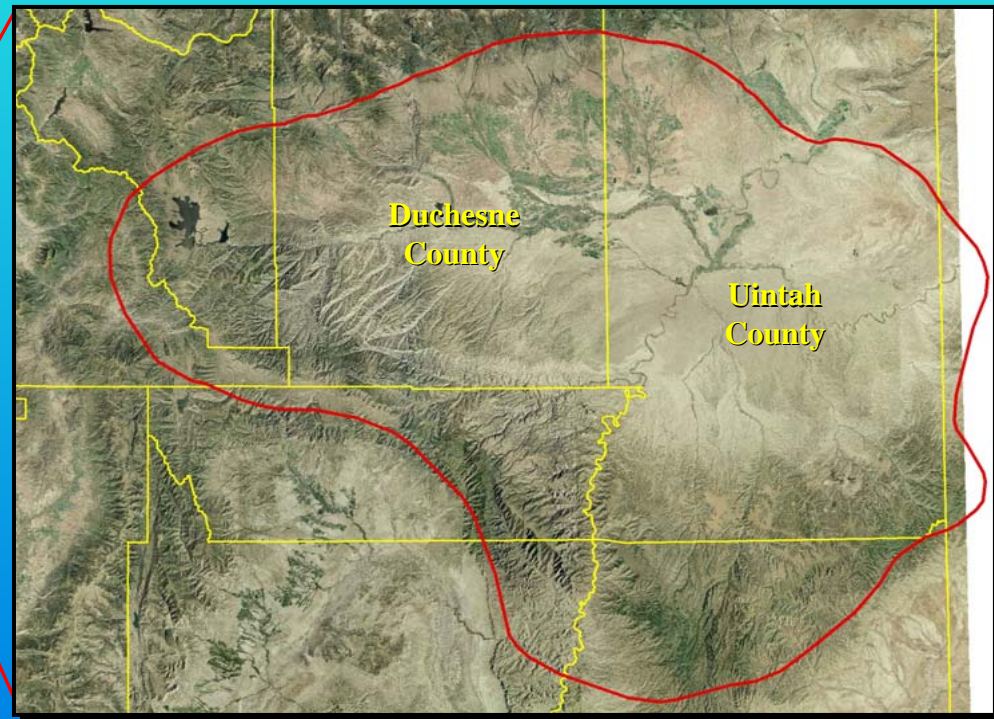


# Water-related issues affecting conventional oil and gas recovery and potential oil shale development in the Uinta Basin, Utah



**Michael D. Vanden Berg**

Utah Geological Survey

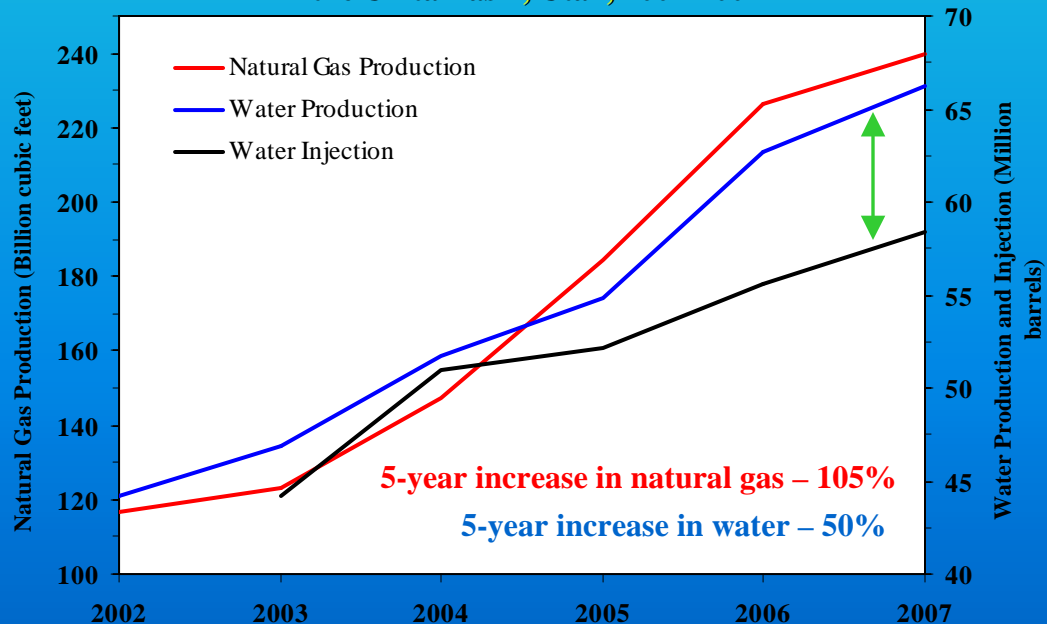
December 9, 2008

Project website: [geology.utah.gov/emp/UBwater\\_study](http://geology.utah.gov/emp/UBwater_study)

# Overall Goals

- 1) Address saline water disposal problems that hinder oil and natural gas development in the Uinta Basin, Utah
- 2) Assess how saline water disposal from conventional petroleum development might create technical and economic hurdles for a prospective oil shale industry
- 3) Collect baseline surface and ground water information for lands with oil shale development potential

Natural gas production, water production, and water injection  
in the Uinta Basin, Utah, 2002-2007



\*\*Data from Utah Division of Oil, Gas and Mining and EPA Region 8\*\*



# Tasks to be Performed

Task 1: Project Management

Task 2: Moderately Saline Aquifer Study

Task 3: Geologic Examination of the Bird's-nest Aquifer

Task 4: Baseline Water Quality and Quantity GIS Database

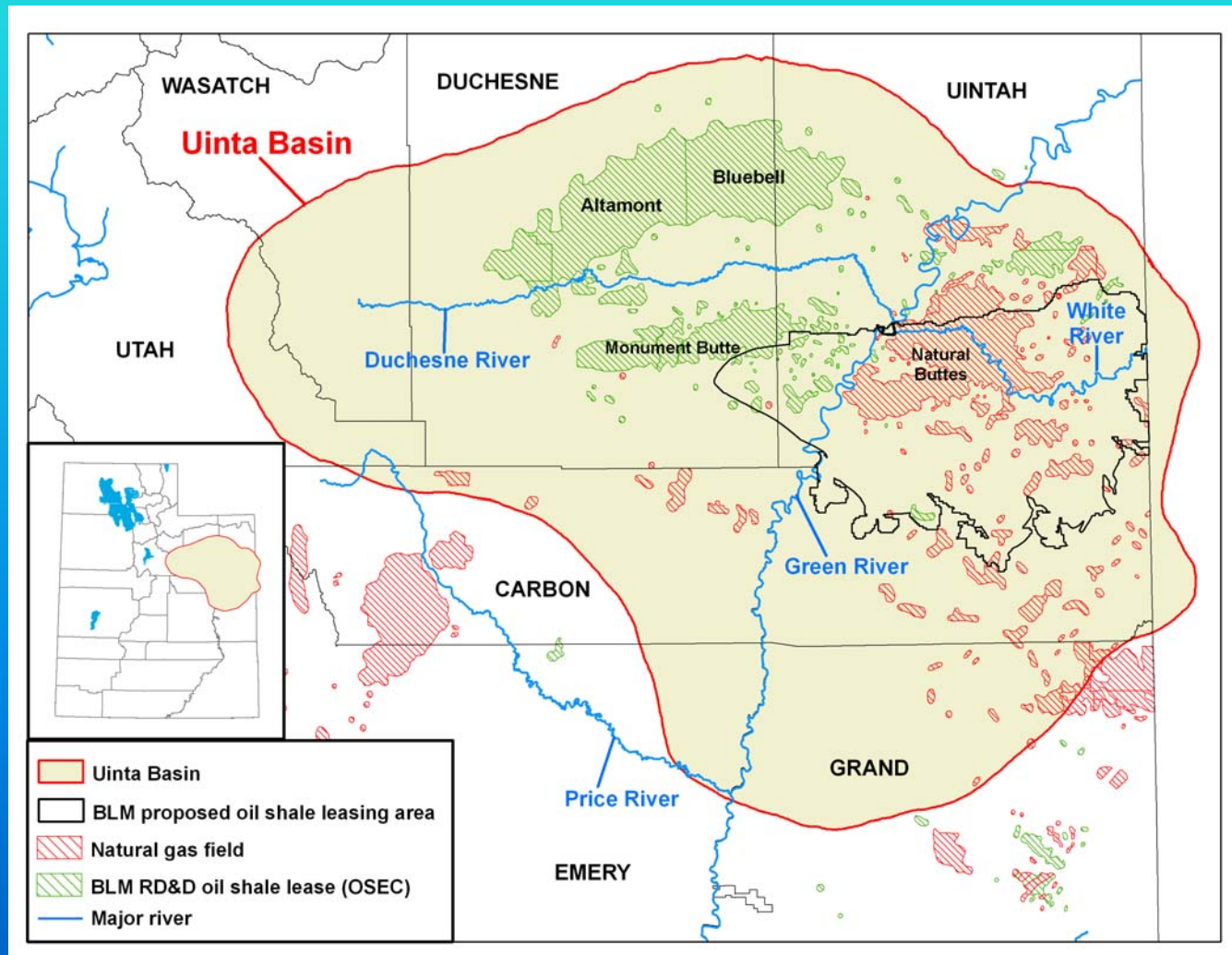
Task 5: Integration of Analysis of Produced Water from Simulated In-situ Oil Shale Extraction Technologies (collaboration with the University of Utah)

Task 6: Technology Transfer



## Task 2: Moderately Saline Aquifer Study

**Problem:** A lack of saline water disposal options is the number one limiting factor with regard to increases in oil and gas production in the Uinta Basin, Utah



## Task 2: Moderately Saline Aquifer Study

**Problem:** A lack of saline water disposal options is the number one limiting factor with regard to increases in oil and gas production in the Uinta Basin, Utah

- Current disposal wells are at capacity
- Evaporation ponds are not the answer
- New disposal well permits are being delayed

**Solution:** Determine new zones suitable for saline water disposal

- Saline water needs to be disposed of into a saline aquifer
- Protect freshwater resources

**Proposed Research:** Re-map the base of the moderately saline aquifer in the Uinta Basin, Utah

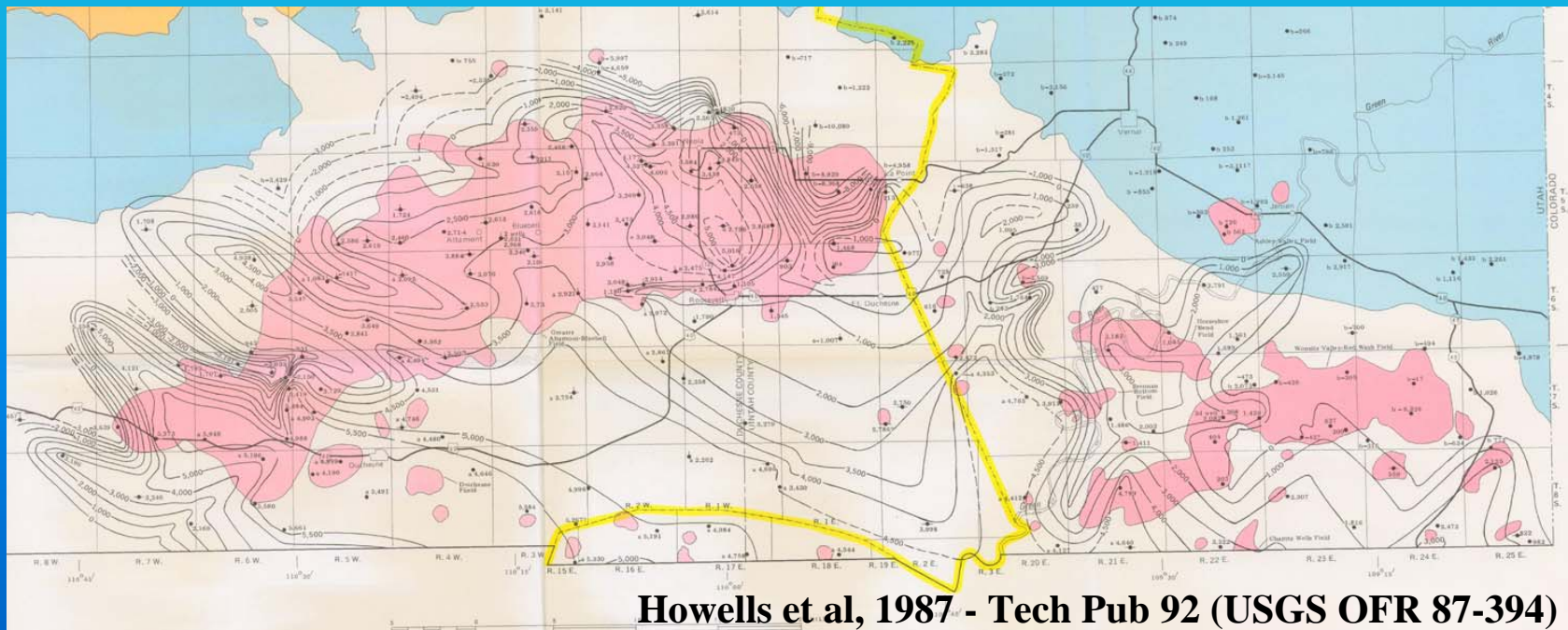




## Task 2: Moderately Saline Aquifer Study

### Why new mapping?

- Substantial new data available: Water quality data from oil and gas companies (7 of the major petroleum companies in the basin have agreed to work with UGS)
- 20+ years of saline water disposal has changed aquifer salinity
- Old method of using geophysical logs was unreliable in many cases, UGS will re-evaluate methods for calculating water quality from logs



## Task 2: Moderately Saline Aquifer Study

### Deliverables:

- Database of well and water quality information – including digitized well logs
- New map of the base of the moderately saline aquifer
- Geologic cross sections showing the saline water transition with identified seals and disposal zones
- Comparative study to evaluate the changes in the aquifer transition over the last 20 years

### Schedule:

- Year 1 and 2 – data collection, log digitization, digitization of old map
- Year 3 – data synthesis, map making, cross sections, comparative study



## Task 3: Geologic Examination of the Bird's-nest Aquifer

**Problem:** The Bird's-nest aquifer is poorly understood and needs further study to determine potential impacts of saline water disposal

- Relationship to fresh water resources
- Potential affects on future oil shale development

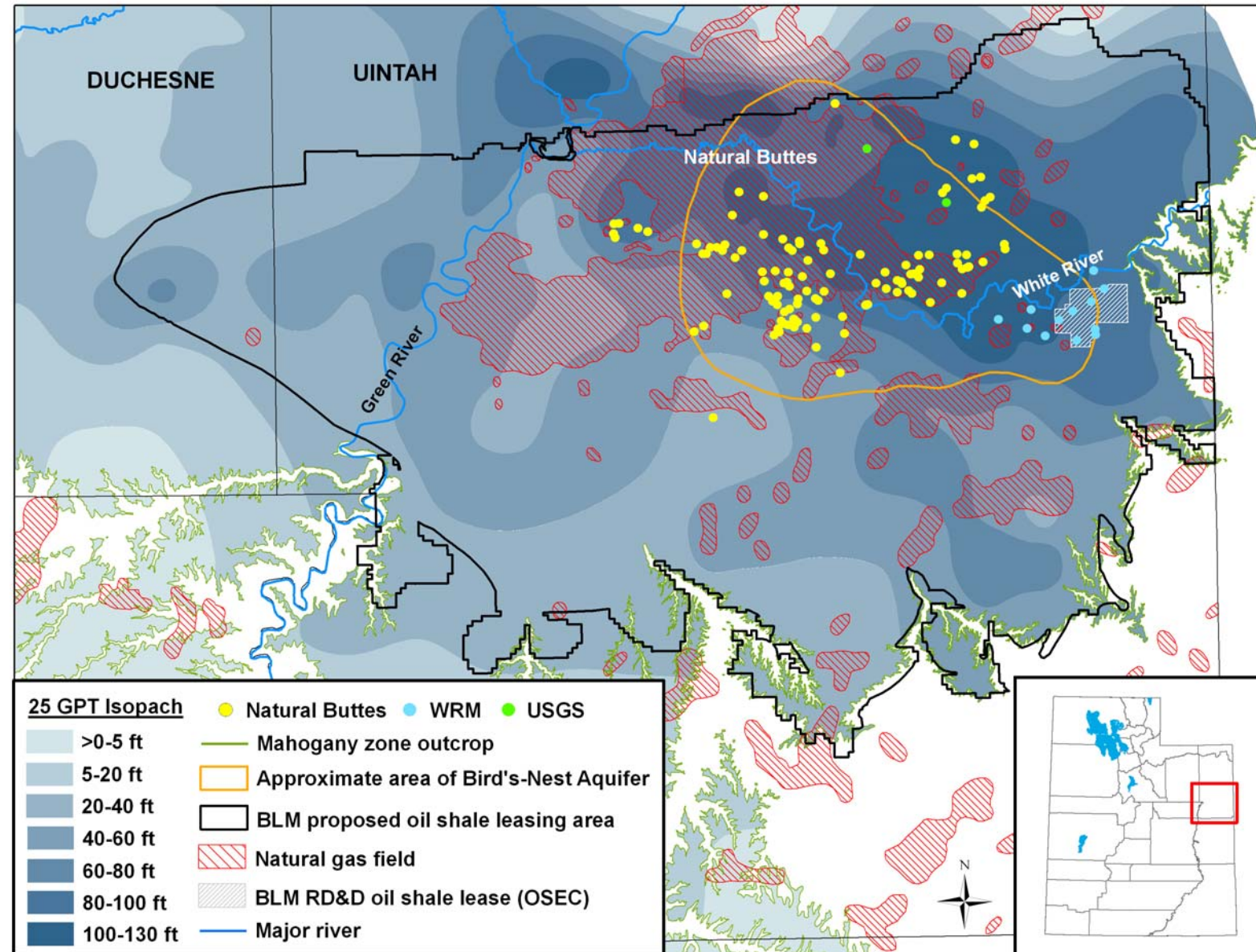
### Proposed Research:

- Literature review – data collection
- Evaluate Bird's-nest in core and outcrop
- GIS database and maps showing:
  - Outcrop
  - Thickness
  - Water quality
  - Interburden between Bird's-nest and rich oil shale zones



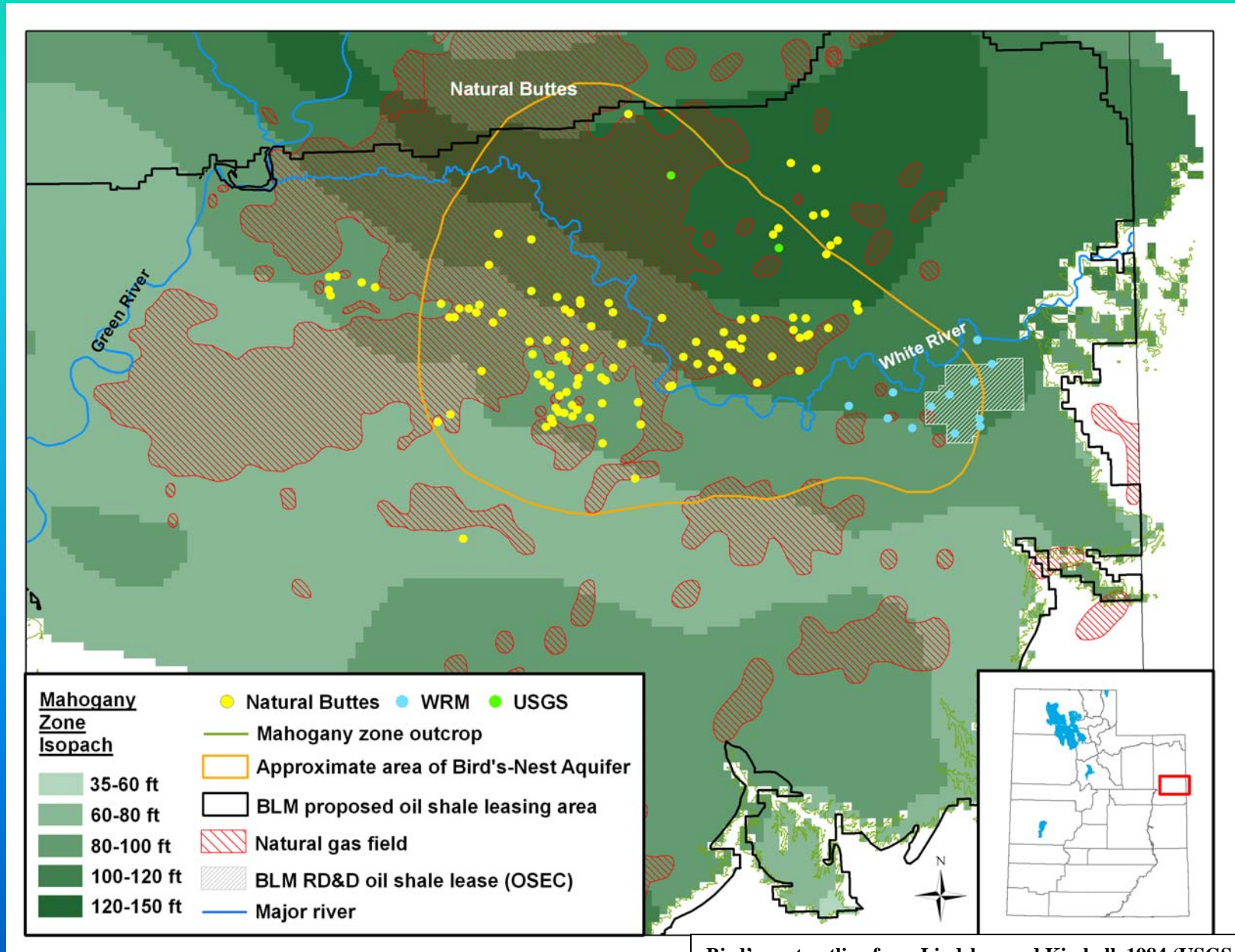


## Task 3: Geologic Examination of the Bird's-nest Aquifer



Bird's-nest outline from Lindskov and Kimball, 1984 (USGS PP-1307)

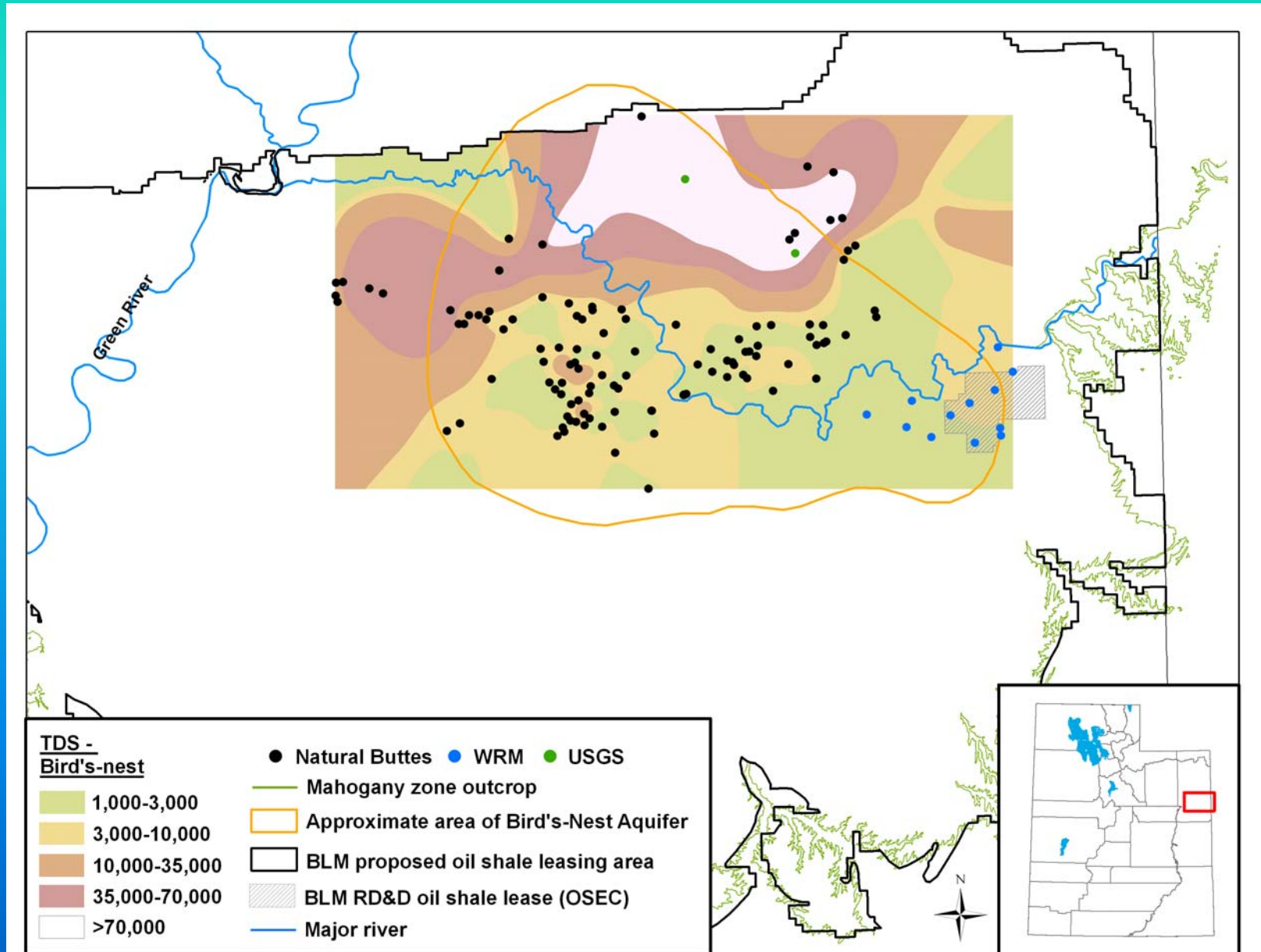
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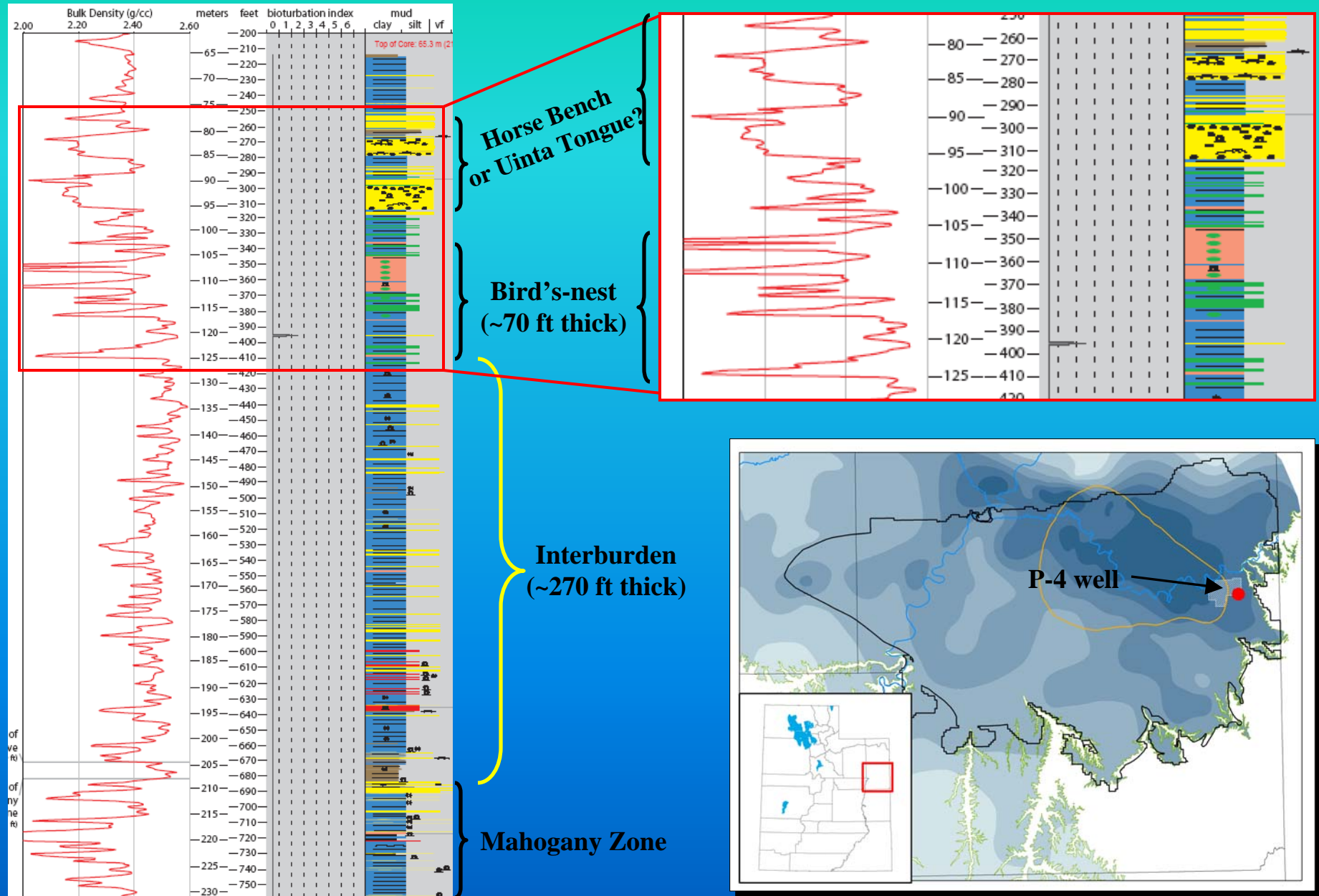


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## Task 3: Geologic Examination of the Bird's-nest Aquifer





### Task 3: Geologic Examination of the Bird's-nest Aquifer





### **Task 3: Geologic Examination of the Bird's-nest Aquifer**



**Bird's-nest outcrop at Evacuation Creek**



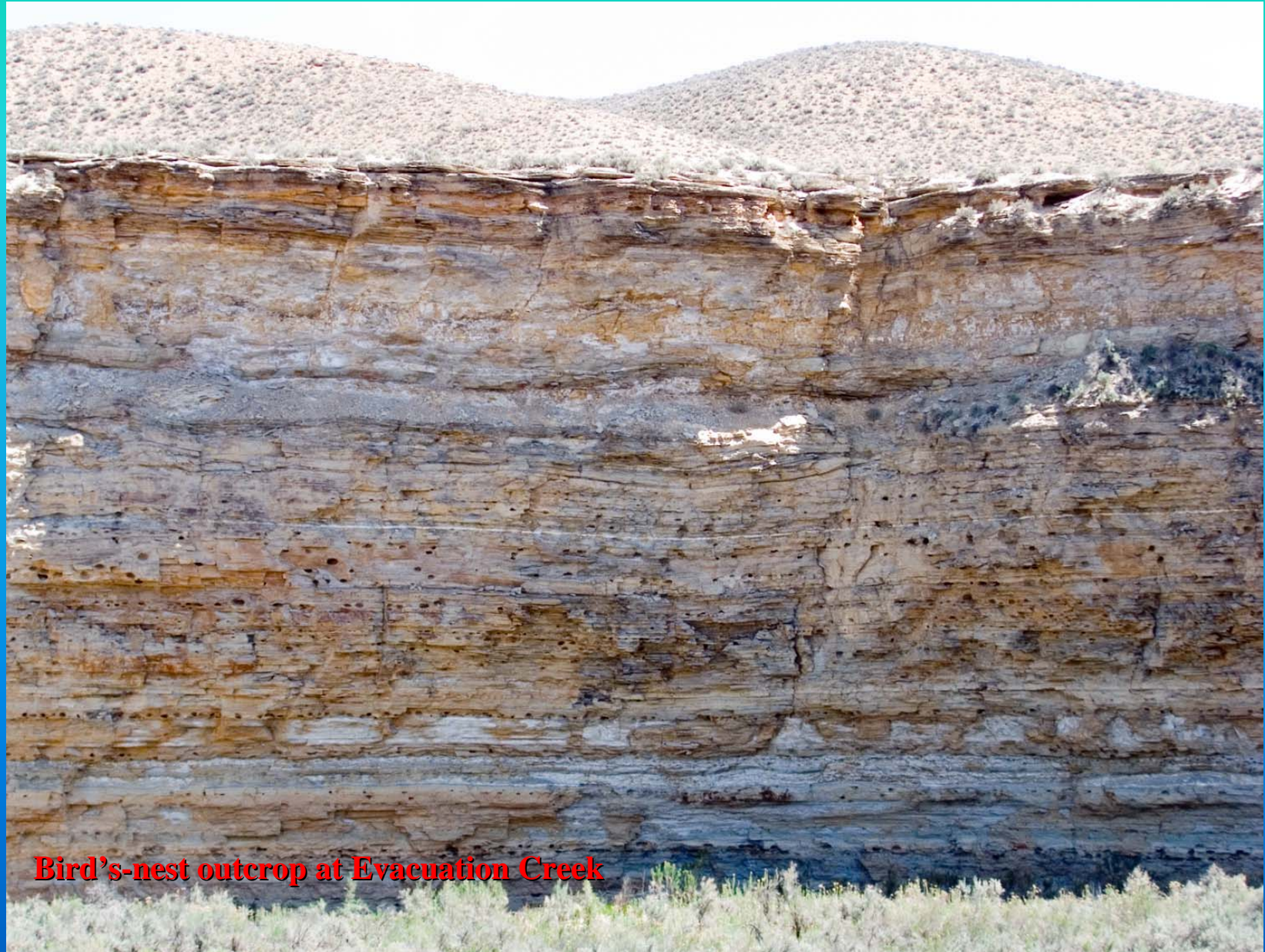
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**Bird's-nest outcrop at Evacuacion Creek**



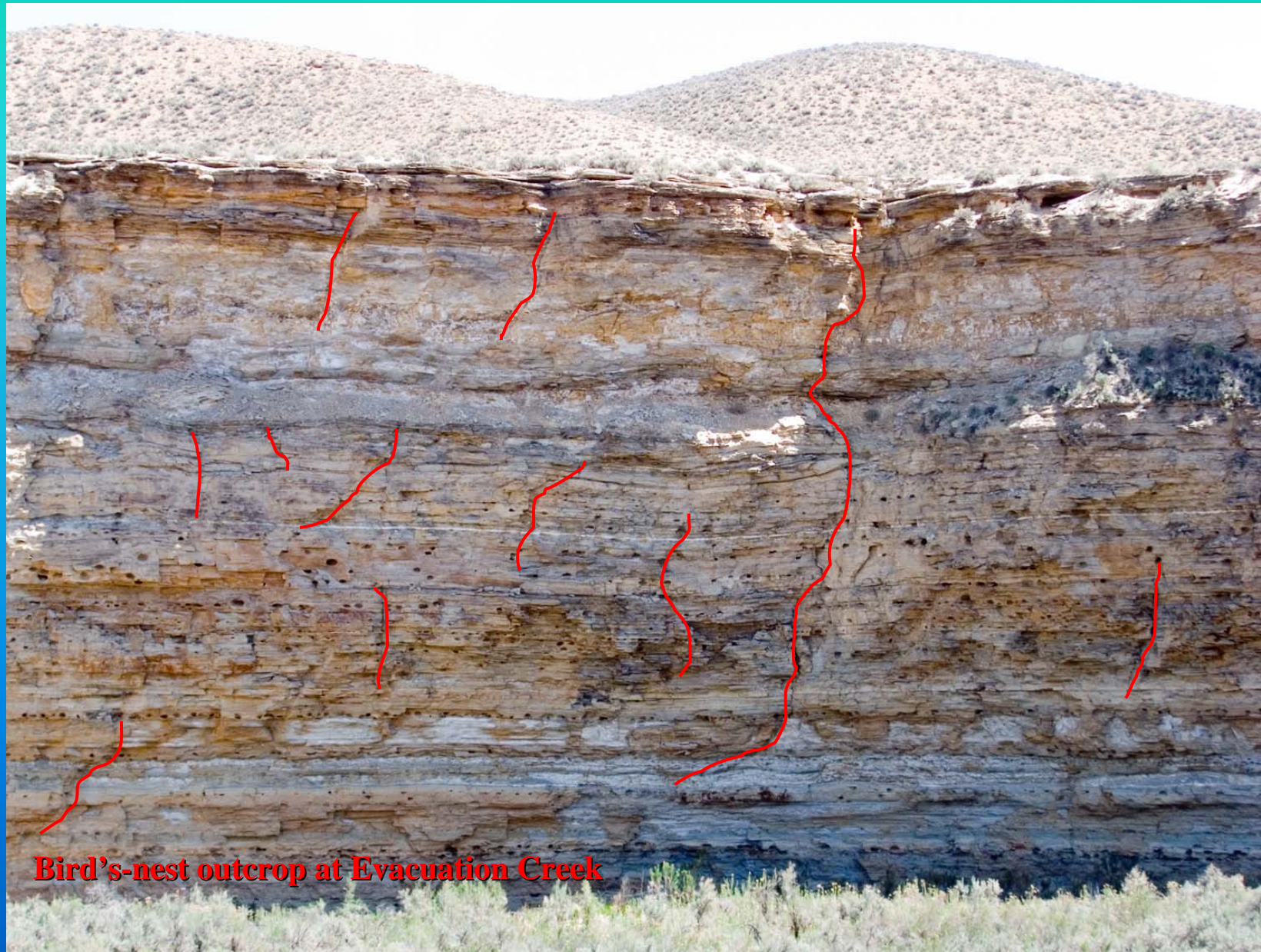
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**Bird's-nest outcrop at Evacuation Creek**



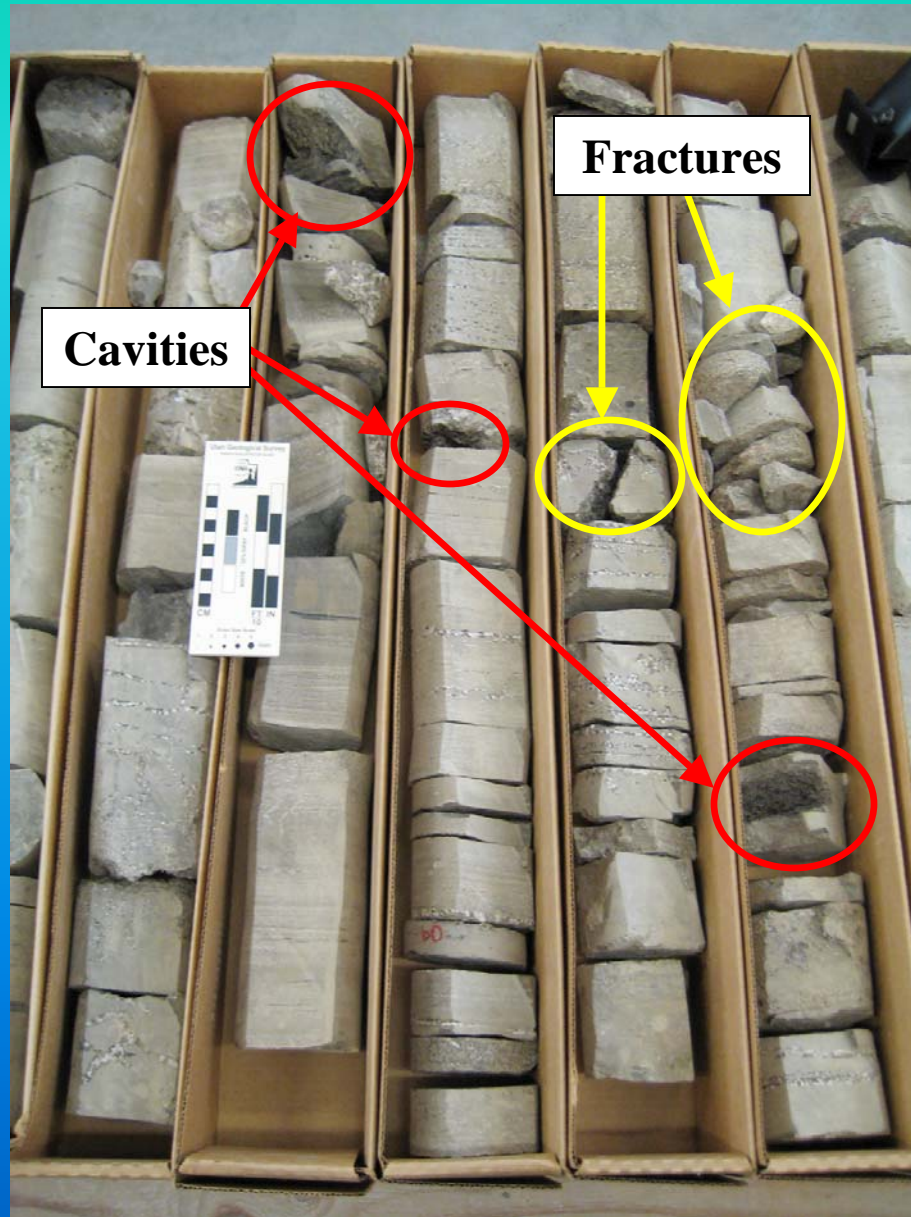
### Task 3: Geologic Examination of the Bird's-nest Aquifer



**Bird's-nest outcrop at Evacuation Creek**



### Task 3: Geologic Examination of the Bird's-nest Aquifer





## Task 3: Geologic Examination of the Bird's-nest Aquifer

### Deliverables:

- Database of well and water quality information
- Geologic maps – isopach, overburden, interburden, etc.
- Measured sections

### Schedule:

- Year 1 – gather historical information, collect and analyze well logs, analyze core, start fieldwork
- Year 2 – fieldwork, collect well data
- Year 3 – fieldwork, create maps



## Task 4: Baseline Water Quality and Quantity GIS Database

**Problem:** There is a regulatory need for baseline water quality and quantity data for Utah lands proposed by the BLM as having oil shale development potential

**Solution:** Historic data needs to be gathered and combined with new data into a user friendly format that will facilitate overall data analysis and manipulation by researchers, modelers, developers, and regulators

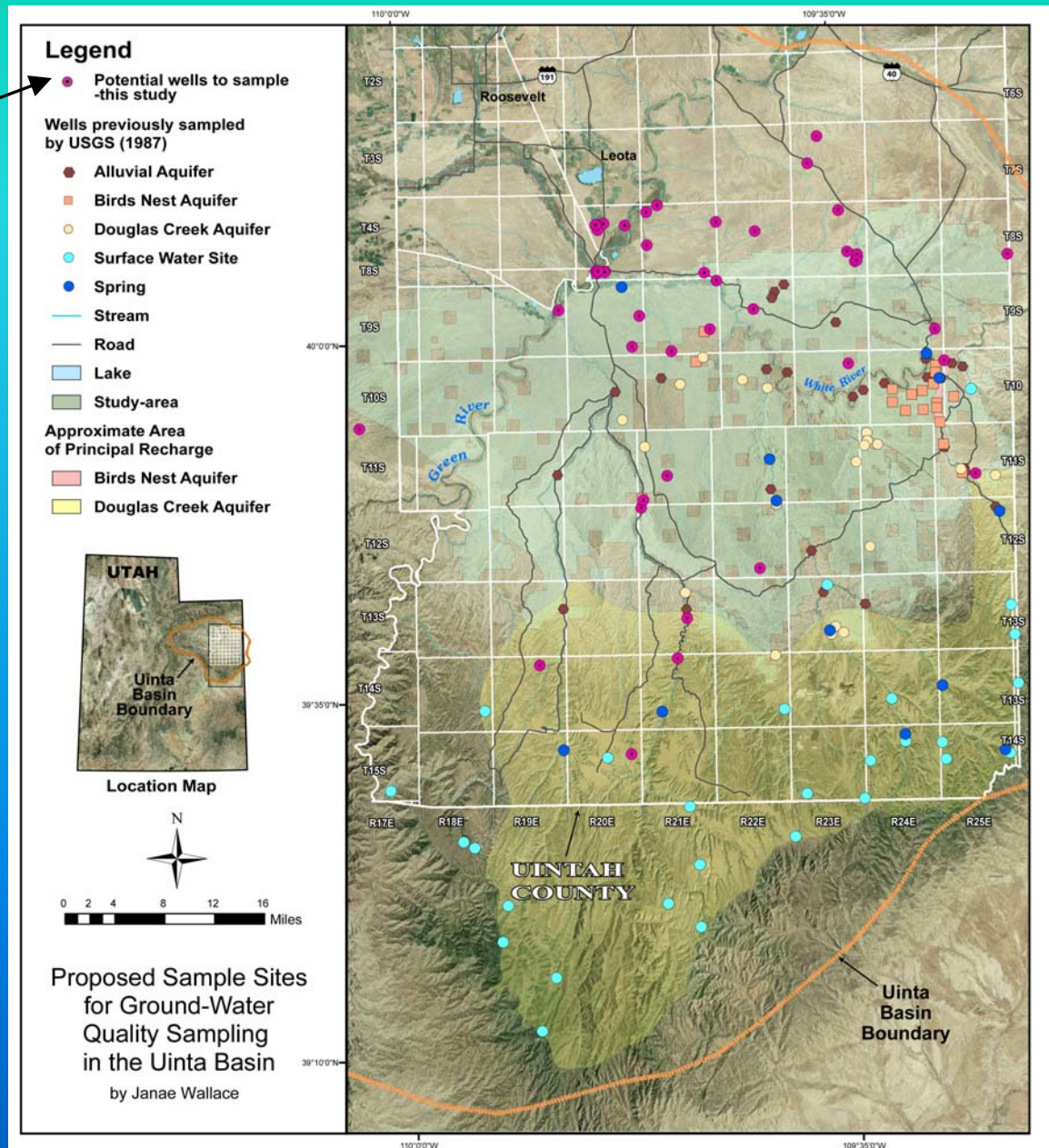
### Proposed Research and Deliverables:

- Collect all historical data
- Sample water from 50 sites throughout the area (sample each of the three years)
- Perform a suite of water quality analyses including general chemistry (TDS), nutrients, dissolved oxygen, dissolved metals, volatile organic compounds, and total organic carbon
- Create comprehensive database with historic and new data
- Create chemistry compilation maps, etc.



## Task 4: Baseline Water Quality and Quantity GIS Database

- Proposed UGS water sampling sites
- Sites with historic water data



## **Task 5: Integration of Analysis of Produced Water from Simulated In-situ Oil Shale Extraction Technologies**

### **Proposed Research – To be Performed by the University of Utah:**

- In-situ extraction laboratory experiments
- Analyze produced water
- Investigate the transfer of the determined fluids from the productive zone to adjacent aquifers using computer simulations

### **UGS – Integration Report:**

- Based on the successful experiments performed by U of U, UGS will write an integration report synthesizing research from both institutions



## Task 6: Technology Transfer

### Website:

- [geology.utah.gov/emp/UBwater\\_study](http://geology.utah.gov/emp/UBwater_study)
- Updates, reports, publications, contacts, etc.

### Annual Debriefing Meeting:

- Each fall in Vernal, Utah
- Oil and gas companies, government agencies, academia, general public

### Professional Conferences:

- AAPG, Oil Shale Symposium, etc.

