CLARK, LINCOLN, AND WHITE PINE COUNTIES GROUNDWATER DEVELOPMENT PROJECT EIS

WATER RESOURCES TECHNICAL REVIEW
MEETING 1 – BASELINE DATA
June 23-24, 2005

GEOLOGY AND GEOPHYSICS

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Presentation Overview

- Background
- Objectives
- Data Types
- Geologic Mapping Data
- Borehole Data
- Geophysical Data
- Data arrangement on CD / DVD

General geologic setting of eastern Nevada

- Eastern Nevada is within the "carbonate terrain"
  - Paleozoic carbonate bedrock is common
- Tertiary volcanic rocks and volcanic centers are also common
- Rocks are tectonically (structurally) disrupted by large extensional and compressional features (faults and folds)
- Alluvial basins are present between mountain ranges
- Other features are significant locally

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Presentation Objectives

- Description of geological data to be transmitted and background information related to assembling the maps and data for the purpose of creating a digital (GIS) geologic basemap
  - Geologic maps
    - Published paper and digital GIS versions used for the assembly
  - Borehole / well data
- Description of geophysical data

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Data Types

- Geologic Mapping Data
- Borehole / Well Data
  - Lithologic data
- Geophysical Data
  - Gravity, seismic, etc.

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Geologic Mapping Data…

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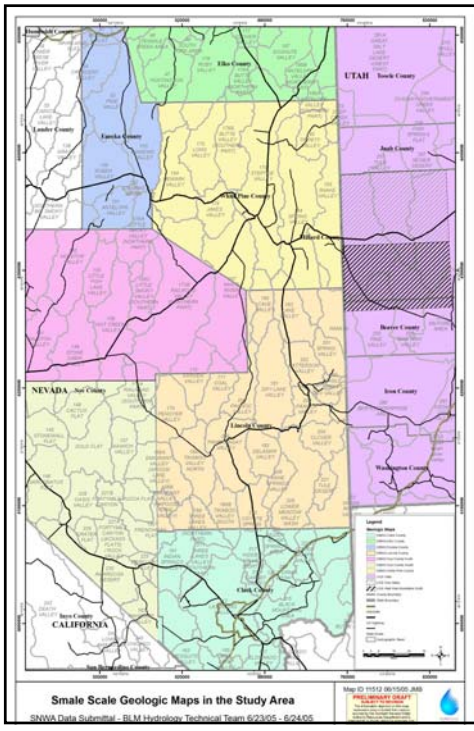
Geologic Mapping Data Sources

- Published Reports and GIS maps (Nevada and Utah)
  - Nevada Bureau of Mines and Geology (NBMG)
  - Utah Geological Survey (UGS)
  - U.S. Geological Survey (USGS)
- Current Cooperative Geologic Map Studies



Regional Geologic Maps and Reports

1:1,000,000 to 1:100,000

- Clark, Lincoln, White Pine, Nye (north and south), Eureka, and Elko County Geologic Reports (1965 to 1987)
  - Converted to GIS in 1997 by NBMG
- Utah State Geologic Map
  - Converted to GIS in 2000 by UGS
- Wah Wah Mtns and Tule Valley, Utah (2002)
- Geology of Nevada Report (1980)
- Geologic History of Utah Report (1988)

Regional Digital Geologic Data Compilation

- Existing GIS coverages / shapefiles that describe area of interest
  - The Nevada county map series of NBMG was converted to GIS form, but not revised, in 1997
    - County reports of interest are; Clark, Lincoln, Nye (north and south), White Pine, Eureka, Elko Counties
    - All original reports reports of interest published between 1965 and 1987, at 1:250,000 scale
  - The Utah state geologic map is also available digitally, it was converted to GIS form, and possibly revised, in 2000
    - Original and digital publications available from Utah Geological Survey (UGS)
    - Original report was published in 1980, at 1:500,000 scale

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Non digital data sources (Maps and Reports)

- Wah Wah Mtns and Tule Valley, Utah
  - Two maps at 1:100,000 scale but same authors and publication year (Hintze and Davis, 2002)
  - Found useful in clarifying understanding Confusion Range (Utah) of Snake Valley
- Geology of Nevada Report (1980)
  - Summary of the geology of Nevada
- Geologic History of Utah Report (1988)
  - Summary of the geology of Utah

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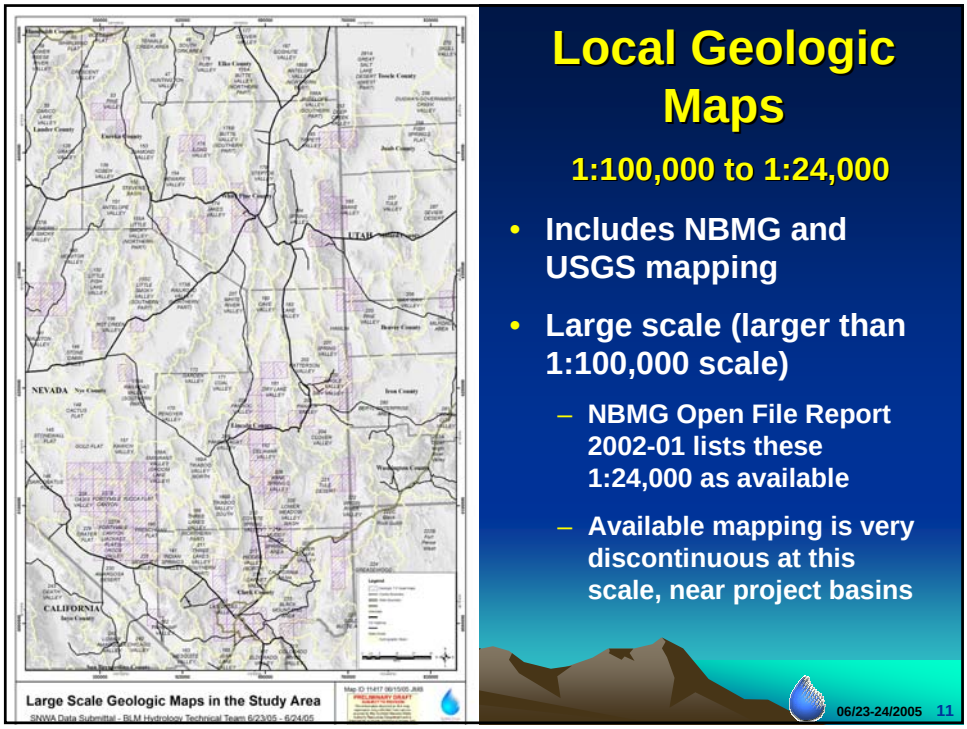

Local Geologic Maps

1:100,000 to 1:24,000

- Includes NBMG and USGS mapping
- Large scale (larger than 1:100,000 scale)
  - NBMG Open File Report 2002-01 lists these 1:24,000 as available
  - Available mapping is very discontinuous at this scale, near project basins

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Geologic Map Data Considerations

- Digital data
- Non Digital Data
- Geologic maps are usually designed to be viewed at a specific size (scale)
  - Regional
    - Describes large area, features are generalized
    - Also called “small scale”
  - Local
    - Describes small area in detail
    - Also called “large scale”

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Current Cooperative Geologic Studies (USGS, NBMG, NPS, and SNWA)

- Geologic and Geophysical maps of the Las Vegas 30' x 60' Las Vegas Valley Quadrangle, Clark and Nye Counties, Nevada and Inyo County, California, USGS Scientific Investigations Map (SMI) 2814 (Page and others, 2005)
  - 1:100,000 scale map of Las Vegas and Pahrump Valleys and Spring Mountains
  - Recently Published (June 2005)
  - Available in GIS format at website (http://pubs.usgs.gov/sim/2005/2814/)
- Southern White River flow system and adjacent areas (in press)
  - 1:250,000 scale map of Lincoln and northern Clark County, Nevada and adjacent areas
  - To be published by NBMG (with funding provided by NPS and SNWA)

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Borehole Data…

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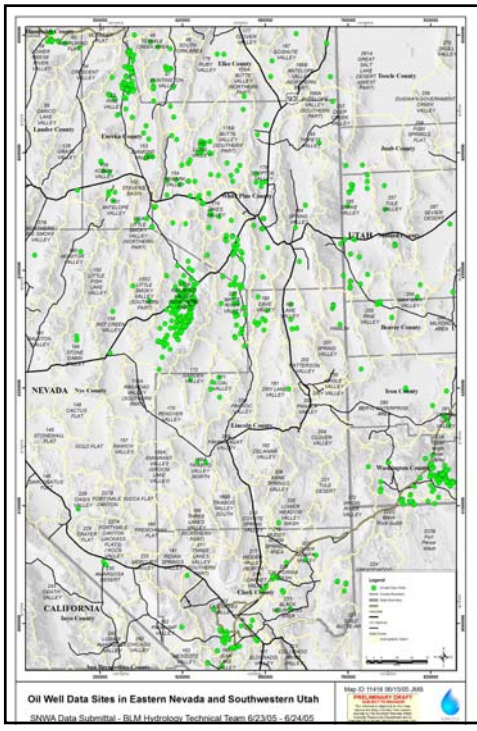
Borehole / Well Data Sources

- Borehole or well data (Nevada and Utah)
  - Nevada Oil and Gas Wells (NBMG)
  - Utah Oil and Gas Wells (Utah Oil and Gas Information Center)
  - Water Well data discussed in "Hydrology – Groundwater presentation"



Oil and Gas Wells in Nevada and Utah

- Nevada – Nevada Bureau of Mines and Geology
  - Published paper report (Garside and others, 1988)
  - Database (Hess and others, 2004)
  - Website (http://www.nbmg.unr.edu/lists/oil/oil.htm)
- Utah – Utah Oil and Gas Information Center
  - Website (http://ogm.utah.gov/oilgas/default.HTM)

Oil and Gas Wells Data Considerations

- Significant thickness (> 1,000 feet) of geologic material (rocks and alluvium) is usually drilled
- Drill target is usually a specific location and stratigraphic (depth) interval
  - Results in well clusters
  - Inconsistency of detail (volcanic rock interval not distingued from alluvial interval, basin fill not described), is common
  - Plots of the different kinds of logs are commonly scanned
    - Individual details would need to be hand typed

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GEOPHYSICAL DATA…

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Historical Geophysical Investigations
MX Siting Investigations
Gravity Surveys

- Completed in support of USAF MX-missile siting program
- 12 reports included in submittal for the following valleys
  - Delamar, Dry Lake (Bristol and Muleshoe), Cave, and Spring
  - White River, Coal, Garden, Pahroc, Hamlin, and Hot Creek

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Ongoing Geophysical Data Sources

- USGS Geophysical Unit of Menlo Park (USGS - GUMP) is assembling historic data and collecting new data as part of cooperative agreement with SNWA
- Borehole geophysics data to be collected (in the field) as part of SNWA monitoring well drilling program

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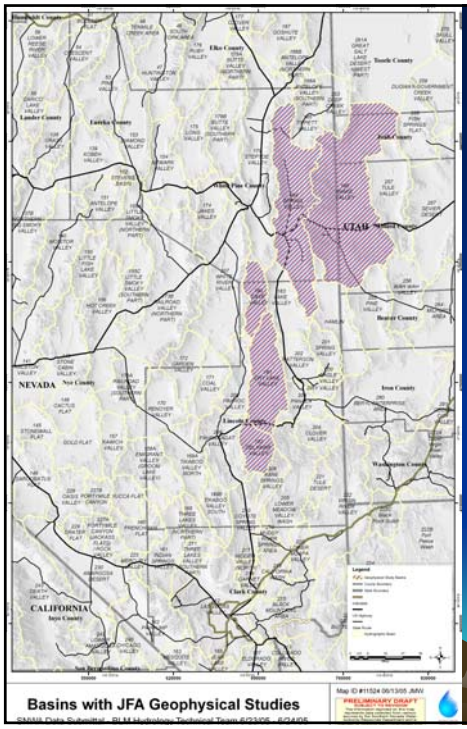

JFA – Geophysical Studies
(USGS GUMP / SNWA)

USGS Geophysical Unit Menlo Park completing gravity Studies in
- Delamar
- Dry
- Cave
- Spring
- Snake

Compilation and qualification of existing gravity-station data

Collection of additional gravity data

Data analysis and interpretation (depth-to-basement / valley fill thickness)

Audiomagnetotelluric (AMT) Studies In Spring Valley

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Preliminary Findings
Cave, Dry Lake, Delamar Valleys
(USGS GUMP)

- **Cave Valley**
  - Depth-to-basement (maximum) ~ 4.5 km (15,000 ft)
  - Deepest portion in the south
- **Dry Lake Valley**
  - Depth-to-basement (maximum) ~ 5.5 km (18,000 ft)
  - Deepest portion in the south
- **Delamar Valley**
  - Depth-to-basement (maximum) ~ 4.5 km (15,000 ft)
  - Bowl-shaped base and deepest in the south

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Preliminary Findings
Cave, Dry Lake, Delamar Valleys
(USGS GUMP)

- Data compilation and field efforts completed
- Final report expected by end of fiscal year

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Spring and Snake Valleys

- Field sessions completed this fiscal year
- Spring Valley
  - Refined gravity studies and;
  - Audiomagnetotelluric (AMT) studies in selected areas
- Snake Valley
  - Refined gravity studies

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Geophysical Data Considerations

- Numerous types of data are collected, by specialists, using specialized equipment, and analyzed using advanced mathematical models and techniques
- Must be calibrated with "hard" data (outcrops, drill cuttings)
- May be the most important data for selecting optimal well locations and can enable the delineation of large scale buried features
- Regional and Borehole (well) Geophysical Information
  - (Regional) Current USGS / GUMP and SNWA cooperative project is intended to refine the subsurface interpretations
  - (Borehole) Geophysical data collected in new SNWA monitoring wells to maximize amount of useful data collected from a single drill hole (well)

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Interaction between Geological and Geophysical Data

- Surface geology (maps and cross-sections)
  - Projection of features (structures and rock types) to depth
- Boreholes (wells)
  - Provide data that can be used as calibration points for geophysics and interpreted geology. Both drilled material and the difficulty in drilling provide potential information
- Geophysics
  - (Regional) Very useful in determining the general shape of features in the subsurface (especially for large areas) best used in combination with site specific data (wells and surface mapping)
  - (Borehole) Instrumental detection of very small changes in material type or geometry, many, not apparent to the eye in drill cuttings or downhole videos. Some features (color changes, for example) not detectable

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Uses of geological and geophysical in hydrogeological investigations

- Assist in identifying well locations
- Development of geologic framework
  - Assist in characterization of regional 3D ground-water flow paths
  - Assist in determination of potential effects of regional geologic structure on the flow system
  - Assist in definition of boundaries of the subregional and local flow systems
  - Can form the basis of conceptual flow models

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Data Submittal…

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Data to be transmitted

- GIS (vector) coverages / shapefiles of selected geological maps
- PDF (raster) versions of selected geological maps
- GIS shapefiles of Nevada and Utah oil and gas wells
  - Underlying data sets from NBMG and Utah Oil and Gas Information Center
- PDF maps showing location of data
  - Geologic maps
  - Oil and Gas well logs
- MX Missile Siting Investigation Gravity Studies

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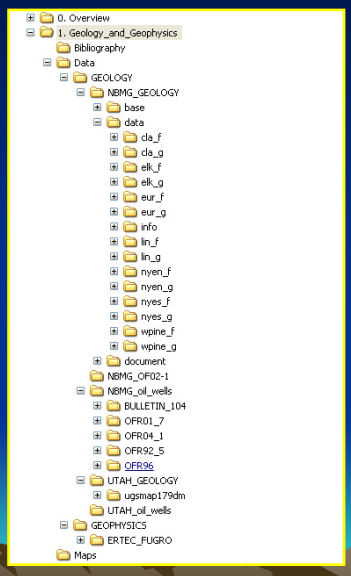
Data Structure Geology and Geophysics



- Data directories organized by source
  - Geology
    - NBMG
    - UGS
  - Geophysics
    - ERTEC / FUGRO
- GIS “coverages” are directories
- GIS “shapefiles” are a group of 2 - 7 Files
- Access Databases are a single file
- Spreadsheets and PDF’s are single “stand alone” files

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Thank You