U.S. DEPARTMENT OF **ENERGY** | **Energy Efficiency & Renewable Energy**

Pyramid Lake

Astor Pass

Comprehensive Evaluation of the Geothermal Resource Potential within the Pyramid Lake Paiute Reservation

PI: John Jackson (PLPT)
Presenter: Greg Pohll (DRI)

Pyramid Lake Paiute Tribe
Desert Research Institute
University of Nevada, Reno
Optim Software and Data Solutions
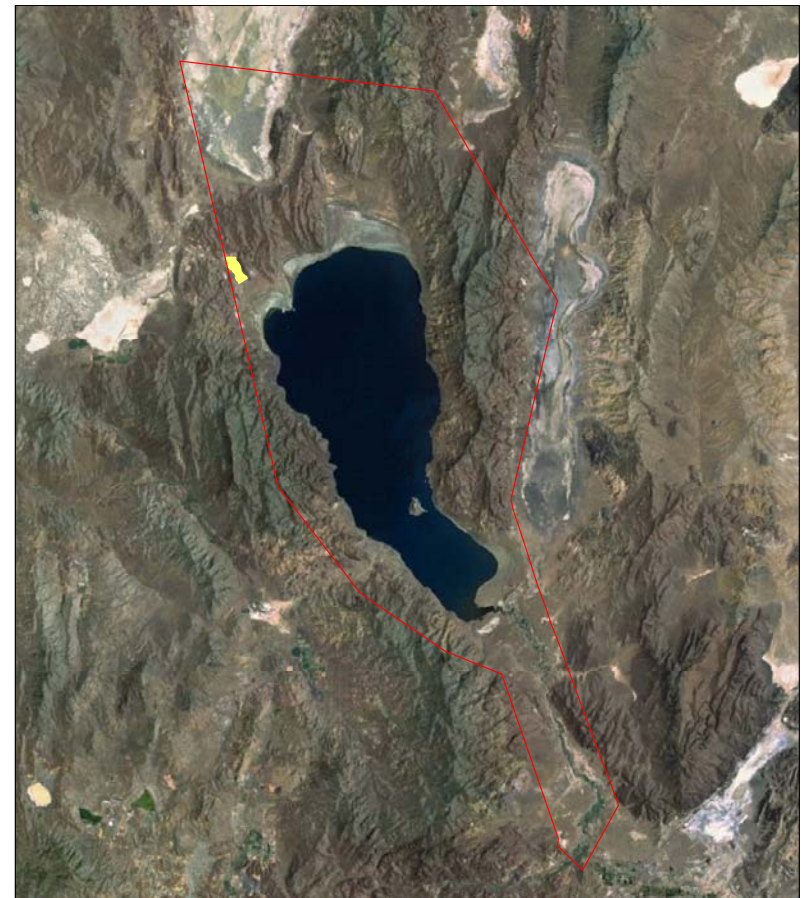Ehni Enterprises

Validation of Innovative Exploration Technologies

May 19, 2010

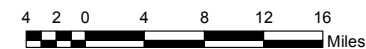- ## Timeline
  - Project start date: February 1, 2010
  - End Date: January 31, 2013
- ## Budget
  - Total project funding: ~4.85 million
  - DOE share: ~4.85 million
  - FY10 funding: ~500,000

Legend

▭ PLPT Reservation Boundary

▮ Astor Pass Area

4 2 0   4   8   12   16
Miles

NV

- **Barriers**
  - Insufficient information to validate resource potential
  - The proposed work will integrate state-of-the-art exploration technologies with geologic framework and reservoir modeling to determine the efficacy of future geothermal production at the Astor Pass Site within the Pyramid Lake Paiute Reservation

- **Partners**
  - Multidisciplinary research team including Pyramid Lake Paiute Tribe, Desert Research Institute, University of Nevada, Reno, Optim Software and Data Solutions, Ehni Enterprises

Relevance/Impact of Research

- The overarching objective of this project is to characterize the geothermal reservoir using novel technologies and integrating this information into a 3D geologic and reservoir model numerical model to determine the efficacy of future geothermal production

- Provide additional geothermal data for the National Geothermal Database

- Validate state-of-the-art reservoir simulation techniques to reduce model uncertainty and project risk

Scientific/Technical Approach

- ## Phase I – Resource evaluation
  - Shallow temperature survey
  - Seismic data collection and analysis
  - Fracture stress analysis
- ## Phase II – Drilling
  - Two wells ~ 3,800 ft
  - Borehole geophysics
- ## Phase III – Well testing and analysis
  - Well testing (60 days)
  - Geochemical sampling
  - Three-dimensional geologic framework model
  - Three-dimensional reservoir model

Accomplishments

- Shallow temperature survey

- Seismic analysis
  - The P-wave arrival time data will be inverted for subsurface velocity within the geothermal field using innovative and proprietary SeisOpt® simulated-annealing algorithm
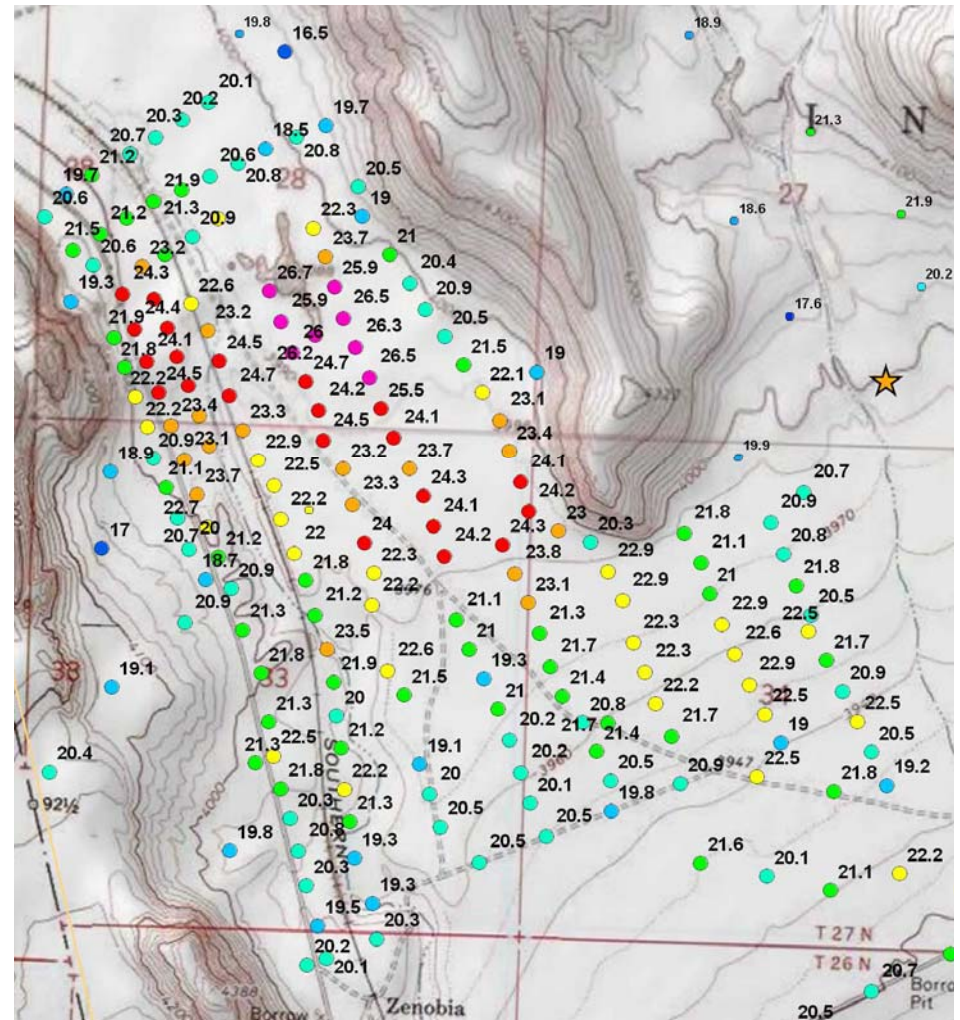
- Accurate parameterization of reservoir parameters as determined from well testing

- Updated conceptual model with detailed temperature and pressure measurements at depth

- Three dimensional reservoir model to optimize well placement and determine long-term research potential

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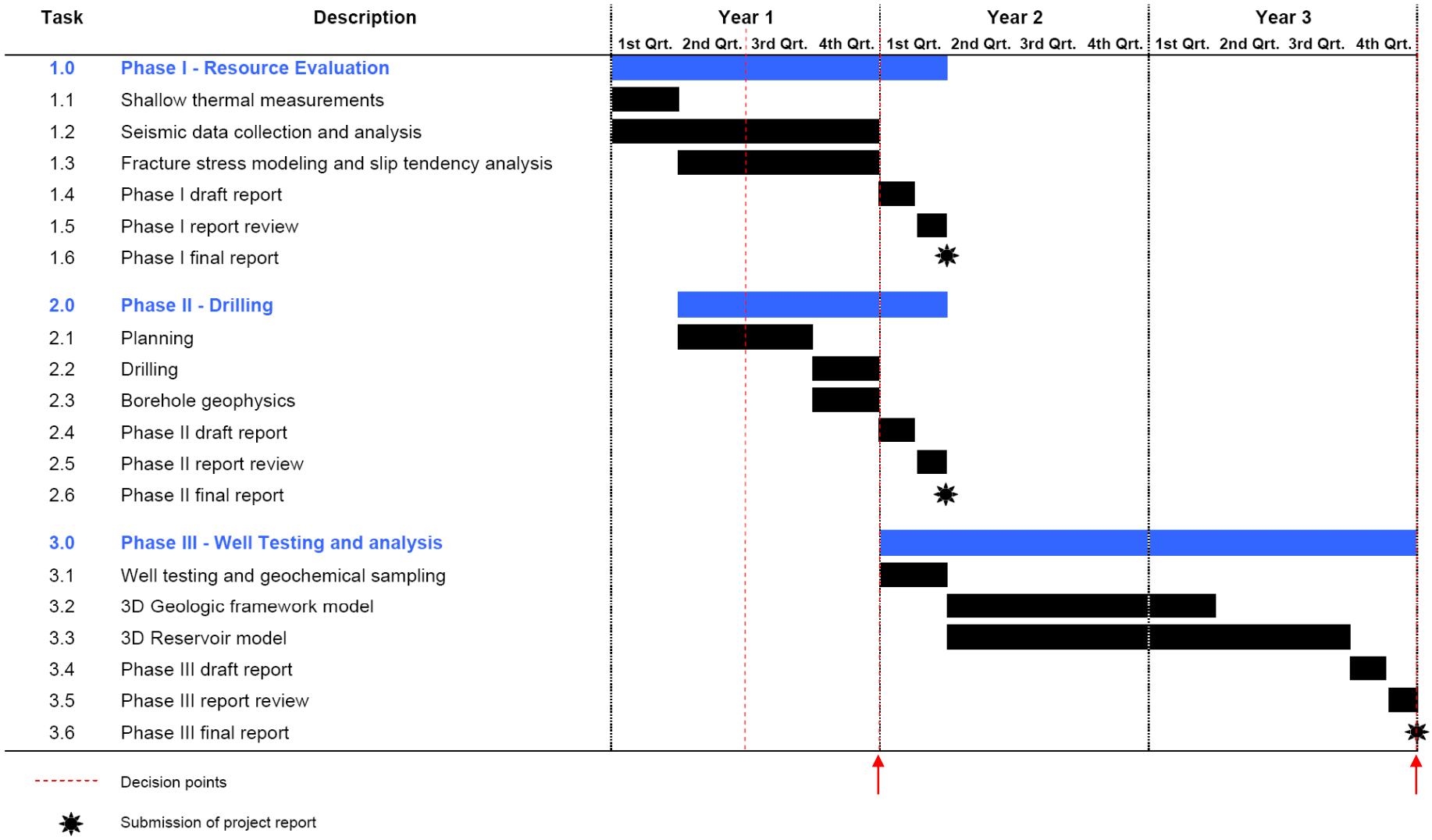| Task	Description	Year 1				Year 2				Year 3			
		1st Qrt.	2nd Qrt.	3rd Qrt.	4th Qrt.	1st Qrt.	2nd Qrt.	3rd Qrt.	4th Qrt.	1st Qrt.	2nd Qrt.	3rd Qrt.	4th Qrt.
1.0	**Phase I - Resource Evaluation**												
1.1	Shallow thermal measurements												
1.2	Seismic data collection and analysis												
1.3	Fracture stress modeling and slip tendency analysis												
1.4	Phase I draft report												
1.5	Phase I report review												
1.6	Phase I final report												
2.0	**Phase II - Drilling**												
2.1	Planning												
2.2	Drilling												
2.3	Borehole geophysics												
2.4	Phase II draft report												
2.5	Phase II report review												
2.6	Phase II final report												
3.0	**Phase III - Well Testing and analysis**												
3.1	Well testing and geochemical sampling												
3.2	3D Geologic framework model												
3.3	3D Reservoir model												
3.4	Phase III draft report												
3.5	Phase III report review												
3.6	Phase III final report												

-------- Decision points

★ Submission of project report

Project Management/Coordination

Total Budget

| | Year 1 | | | Year 2 | | | Year 3 | | | |
	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3	Total
PYRAMID LAKE PAIUTE TRIBE	24,861	102,821	-	-	-	102,634	-	-	98,924	329,240
DESERT RESEARCH INSTITUTE	24,561	278,947	-	-	-	474,188	-	-	371,729	1,149,425
UNIVERSITY OF NEVADA, RENO	437,421	-	-	5,121	-	242,080	-	-	218,997	903,619
DRILLING	-	2,336,250	-	-	-	-	-	-	-	2,336,250
BOREHOLE GEOPHYSICS	-	30,000	-	-	-	-	-	-	-	30,000
EHNI ENTERPRISES	5,000	20,000	-	-	-	36,000	-	-	36,000	97,000
TOTAL	491,843	2,768,019	-	5,121	-	854,902	-	-	725,650	**4,845,534**

Annual Totals:	**3,259,861**	**860,023**	**725,650**

Project Management/Coordination
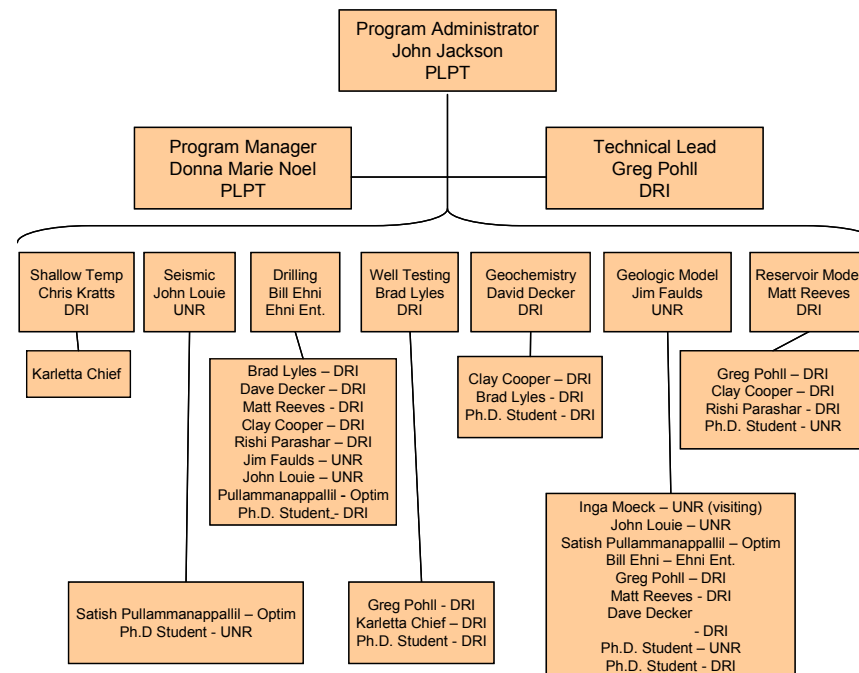
- Additional funds from BIA are being used to support the following:
  - Additional geophysical exploration
  - Drilling support

Future Directions

- FY10
  - Complete shallow temperature analysis
  - Seismic data collection and analysis
  - Finalize drilling plan
  - Fracture stress modeling
  - Go/no go decision following seismic analysis

- FY11
  - Drill two wells
  - Plan and conduct well testing
  - Borehole geophysics
  - Preliminary temperature analysis
  - Go/no go decision following drilling

- Evaluate the potential of Emerson Pass site if Astor Pass temperatures not at acceptable levels

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- The proposed work will integrate state-of-the-art exploration technologies with geologic framework and reservoir modeling to determine the efficacy of future geothermal production at the Astor Pass Site within the Pyramid Lake Paiute Reservation

- The information gained during this study will allow the Pyramid Lake Paiute Tribe to make informed decisions regarding construction of a geothermal power plant

- Additional benefits include the transfer of new technologies and geothermal data to the geothermal industry