

Alternative Power Source To Draw Underground Water

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Team 01

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Overview

Problem Statement Recapitulation

Current Operating Costs (CEMEX)

Wind Power

Solar Power

Solitary Diesel Generator

Proposal (CEMEX)

Revised Project Direction (Babbitt Ranches)

Constraints

Possible Solutions

Next Steps

Proposed Semester Schedule

Problem Statement Recapitulation

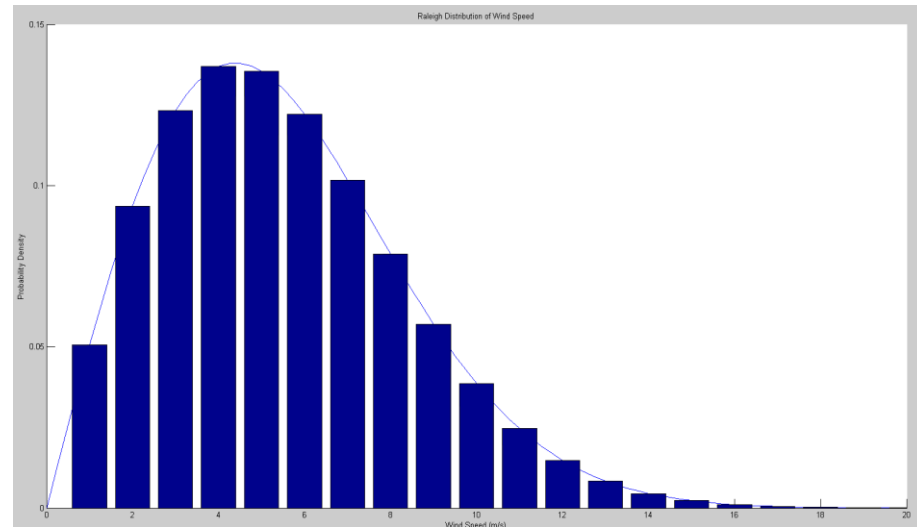
- The Client requests a solution that will draw water from 520 meters while maintaining the current flow rate of $0.3 \text{ m}^3/\text{min}$ and reducing the overall cost.

Current Diesel Generator Costs (CEMEX)

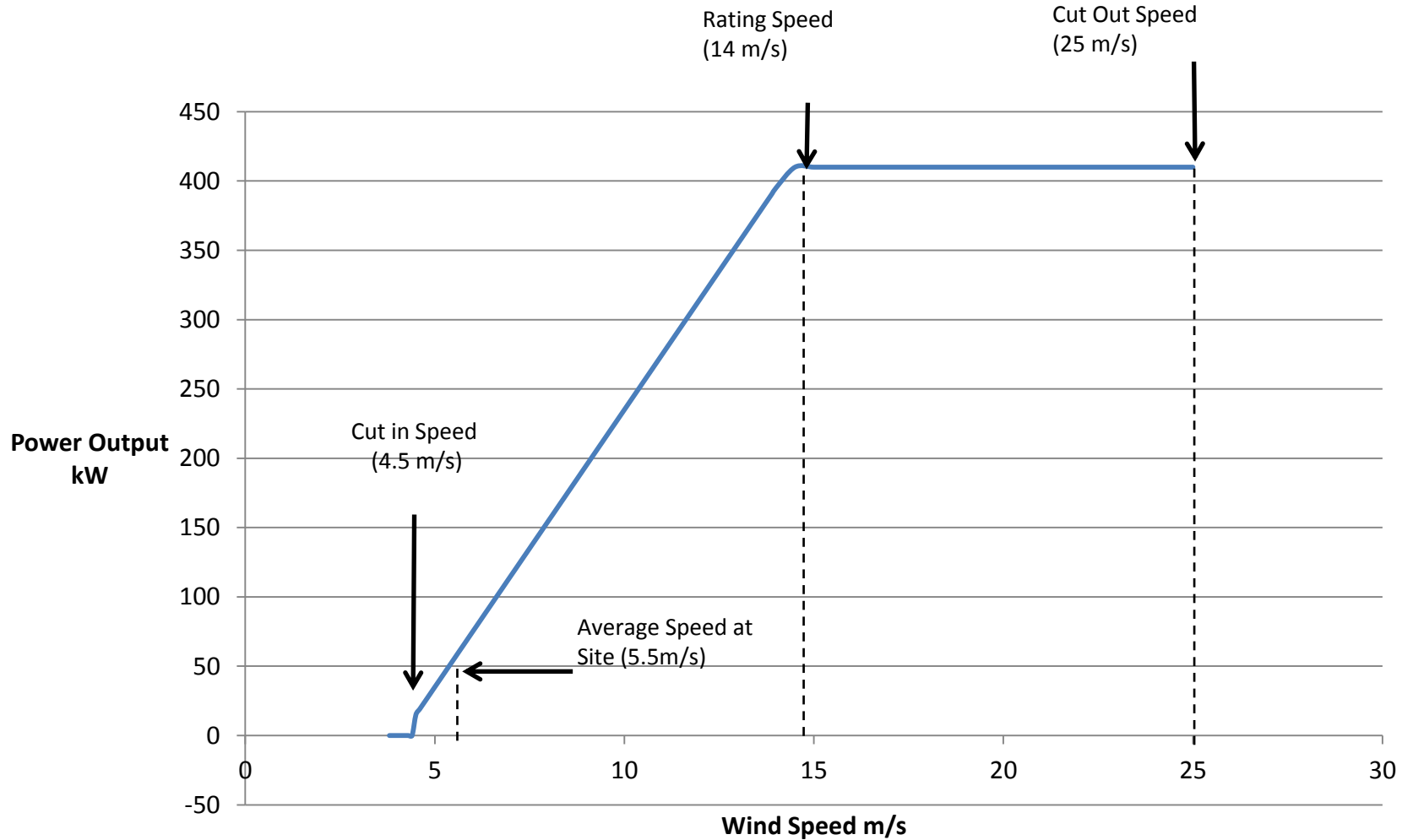
- Cost of fuel - \$3.50 per gallon
- Fuel Consumption - 27 gallons per day
- Operation - Running 6 days per week
- Yearly cost - \$29,000 per year

Wind Power

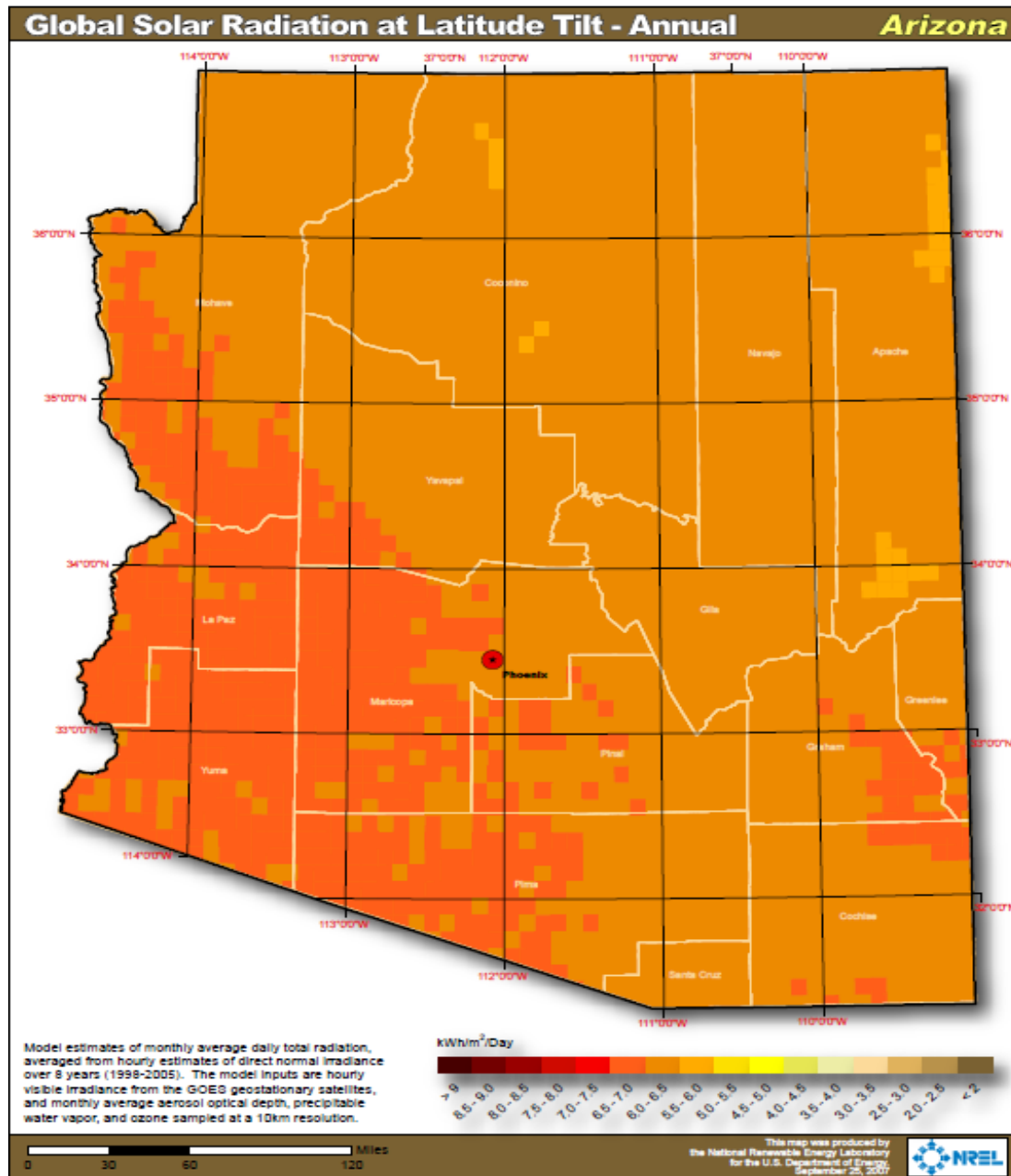
- Average wind speed - 5.5 m/s
- Minimum cut in speed - 4.5 m/s
- Rayleigh distribution
 - Expected usable average 7 m/s wind speed
 - 60% availability factor



Idealized Power Curve -30m Rotor Diameter



Solar Resource



Solar Power in Concert with Batteries

- 6 days of autonomous function
 - Recommended for systems with no backup
- 11 year maximum life
- 18 year payoff to offset diesel costs
 - Using diesel generator at maximum
- Battery array is not feasible

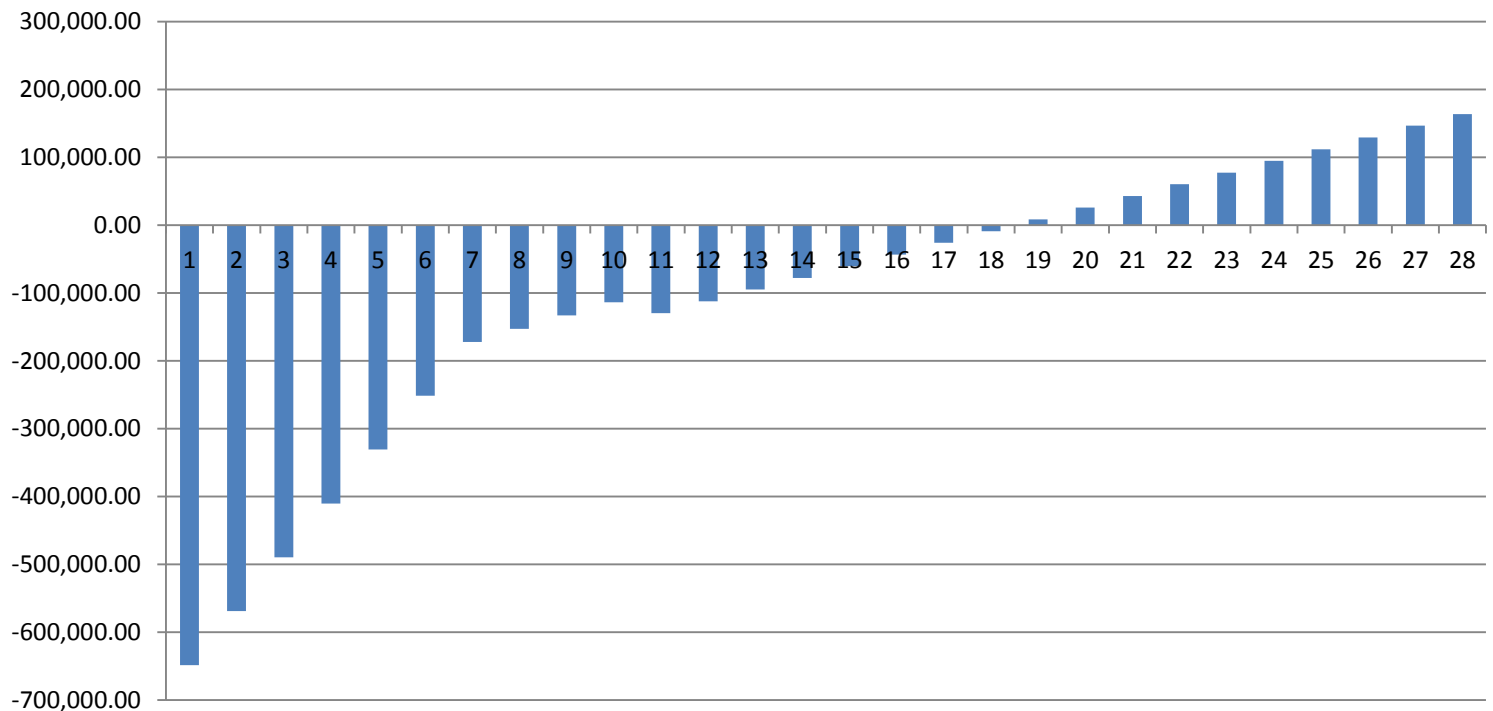
Solar Power with Diesel Generator

- Average cost per watt (DC) installed - \$10.00

Year Of Operation	At Installation	1	2	3	4	5
Gross Installation Cost	-\$1,000,620.00					
Federal Tax Credit	\$300,186.00					
Annual System Maintenance		-\$10,006.20	-\$10,006.20	-\$10,006.20	-\$10,006.20	-\$10,006.20
AZ Solar Energy Production Tax Credit	\$2,103.70	\$2,103.70	\$2,103.70	\$2,103.70	\$2,103.70	\$2,103.70
State Credits Corporate Rate	\$50,000.00					
APS Utility Rebate	\$60,037.20					
Inverter Cost	-\$60,000.00					
Tax Savings from MACRS Depreciation (5yr)		\$60,037.20	\$60,037.20	\$60,037.20	\$60,037.20	\$60,037.20
Diesel Fuel Savings /year		\$30,660.00	\$30,660.00	\$30,660.00	\$30,660.00	\$30,660.00
Generator Fuel Cost		-\$3,406.67	-\$3,406.67	-\$3,406.67	-\$3,406.67	-\$3,406.67
Generator Purchase	-\$35,000.00					
Generator Tier 4 Maintenance Program	-\$5,000.00					
Annual Cash Flow	-\$648,293.10	\$44,388.04	\$79,388.04	\$79,388.04	\$79,388.04	\$79,388.04
Cumulative Cash Flow	-\$648,293.10	-\$603,905.06	-\$524,517.02	-\$445,128.99	-\$365,740.95	-\$286,352.91

Solar Power with Diesel Generator

Cumulative Cash Flow



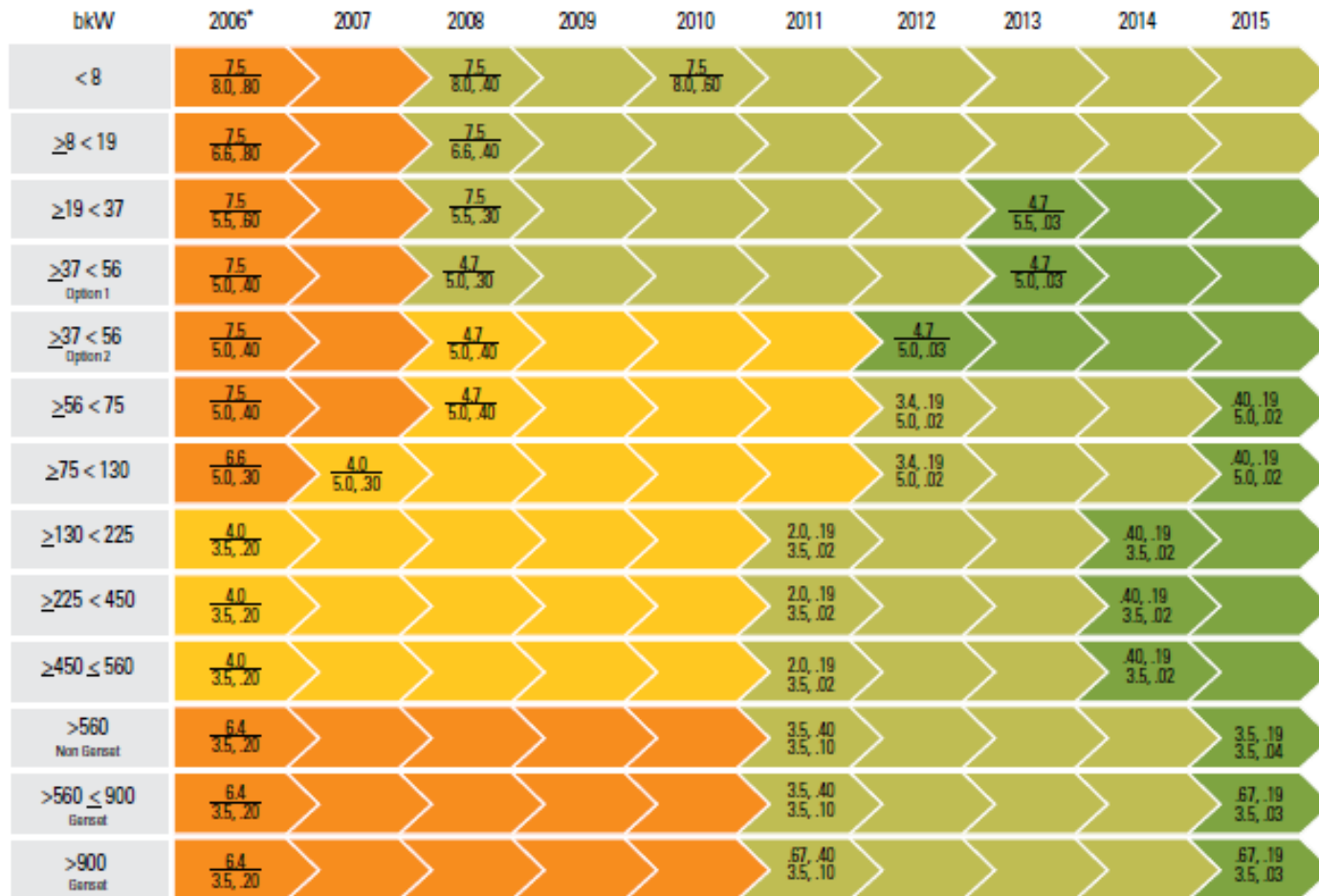
Solitary Diesel Generator

Design Constraints:

- Must Meet Needs
- Must Conform to New Emissions Standards
 - Required by 2015

Tier 4 Emissions Standards

EPA Nonroad Diesel Emissions Limits and Timing



NO_x, HC
CO, PM or NO_x+HC
CO, PM g/kW-hr

● Tier 2 ● Tier 3 ● Tier 4 Interim ● Tier 4 Final

*EPA Nonroad Regulations commenced with Tier 1 in January 1996

Generator: Cummins QSB 3.3



- 60 kW
- Conforms to Tier 4
- MSRP \approx \$35,000
- T-Tip \approx \$5,000

Source: <http://cumminsengines.com>

Proposal (CEMEX)

- Solar Panels with Diesel Generator
 - \$1,000,000
 - Payoff time of 19 years
- Diesel Generator
 - Cummins QSB 3.3
 - \$40,000 with maintenance program

Revised Project Direction

- Will be working with Babbitt Ranches
- Cedar Ranch well
- Main head waters for many locations
- In conjunction with Slate Mtn. well
- Different location, different use
- Lower flow rate

Revised Problem Statement

- The Client requests an alternative energy solution that will draw water from the Cedar Ranch well. The system must meet water demands while reducing the average annual cost of operation over a five to seven year span.

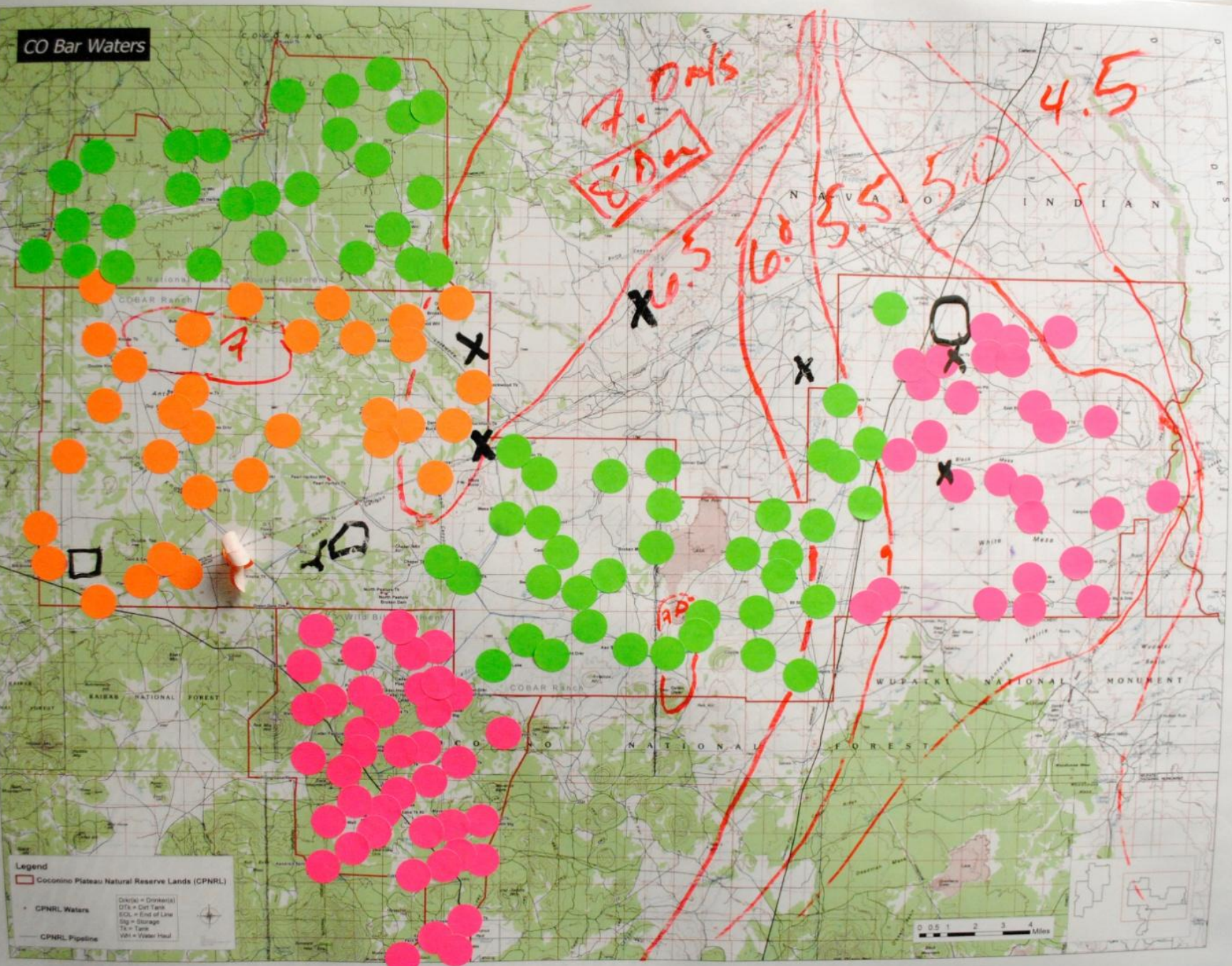
Constraints

- Well depths from 800-1200 feet
- Flow rate varies 2-12 gallons per minute
- Alternative energy must be 80%-100% of total energy used

Possible Solutions

- Wind
- Solar
- Wind and Solar in concert
- Increase the flow rate and store water

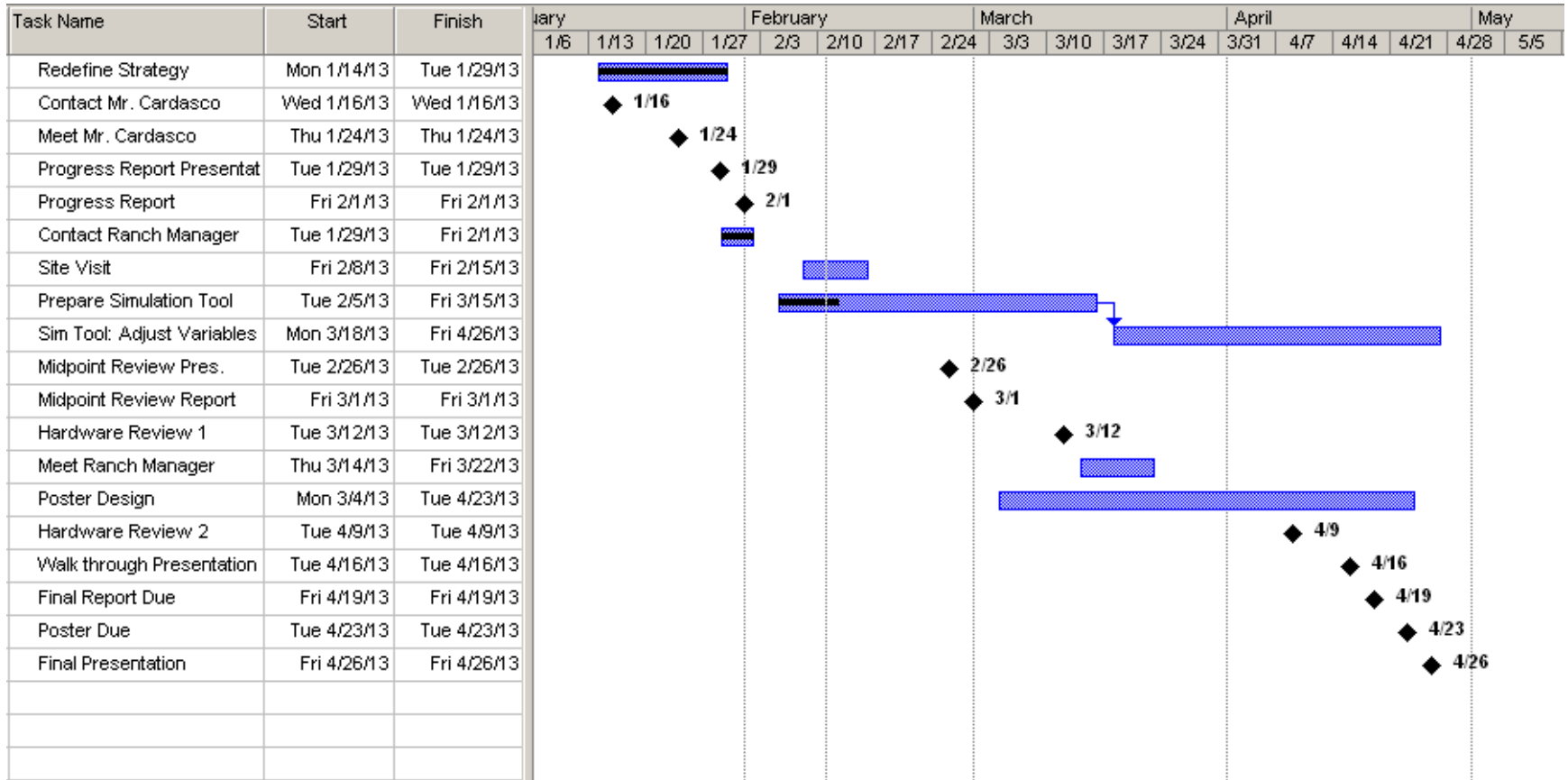
CO Bar Waters



Next steps

- Site visit
- Meet with pump specialist
- Generate real time simulations using location specific solar and wind data

Gantt Chart



Reference

Bill Cardasco – Babbitt Ranches

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www.wind-estimate.org

solarenergy.advanced-energy.com

www.wind-sun.com

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[*www.generac.com/en082011*](http://www.generac.com/en082011)

Questions?