Title
Water Conveyance System

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Water Conveyance System

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PROJECT DESCRIPTION

San Diego currently imports about 90% of its total water consumption. To improve water reliability in an environment influenced by climate change the region is embarking on a program to diversify its water portfolio. This strategy includes the proposed $2b Indirect Potable Reuse (IPR) project called Pure Water.

The Anteater Hydro-Tech Project is for the $150m Water Conveyance System for Pure Water. The conveyance system is being optimized considering Triple Bottom Line principles: Economic, Environmental, Social.

DESIGN APPROACH

- Triple Bottom Line Optimization: Economic, Environmental, Social
- Conveyance system route elevation change minimized
- Design guiding criteria: M11 Steel Pipe Design & Installation
- Pump station integration in order to eliminate tunneling needs and to fulfill flow demands.
- Minimized altering existing terrain wherever possible
- Cost analysis (Present Worth) conducted on pipeline, pump station, and energy costs in a low discount rate and variable energy escalation environment

ASSUMPTIONS AND DESIGN CRITERIA

FLOW

- Uniform Flow
- Tri Annual Flow Magnitude Changes: 10, 15, 20 MGD every 4 months
- Additional 53 MGD flow introduced 10 years after project completion 6 miles to outlet
- 30 year planning period

PIPELINE

- Uniform Diameter
- Uniform Diameter of 66" for common pipe
- 50' surge pressure
- Free water surface at each pump station
- Hazen–Williams C factor: 120
- 250 Working Pressure–City's Preference
- Minimum wall thickness for low pressures adopted for pipeline handling stability

COST ANALYSIS

- ENRALA10051.3–Cost Index
- Discount Rate: 4%,5%,6%
- Energy Cost $0.15 / kWhr
- Wire to water efficiency range 69%, 75% and 69% for 10, 15, and 20 MGD, respectively
- Construction Cost Contingency 30%

PIPELINE ALIGNMENT

North City Water Reclamation Plant to San Vicente Reservoir – 26 miles

- Recommended Alternative: Optimizing Energy and Capital Costs, avoids energy loss at Fortuna Mountain at low flows, achieves reasonably low pressures below San Diego City's Requirement of 250 psi.

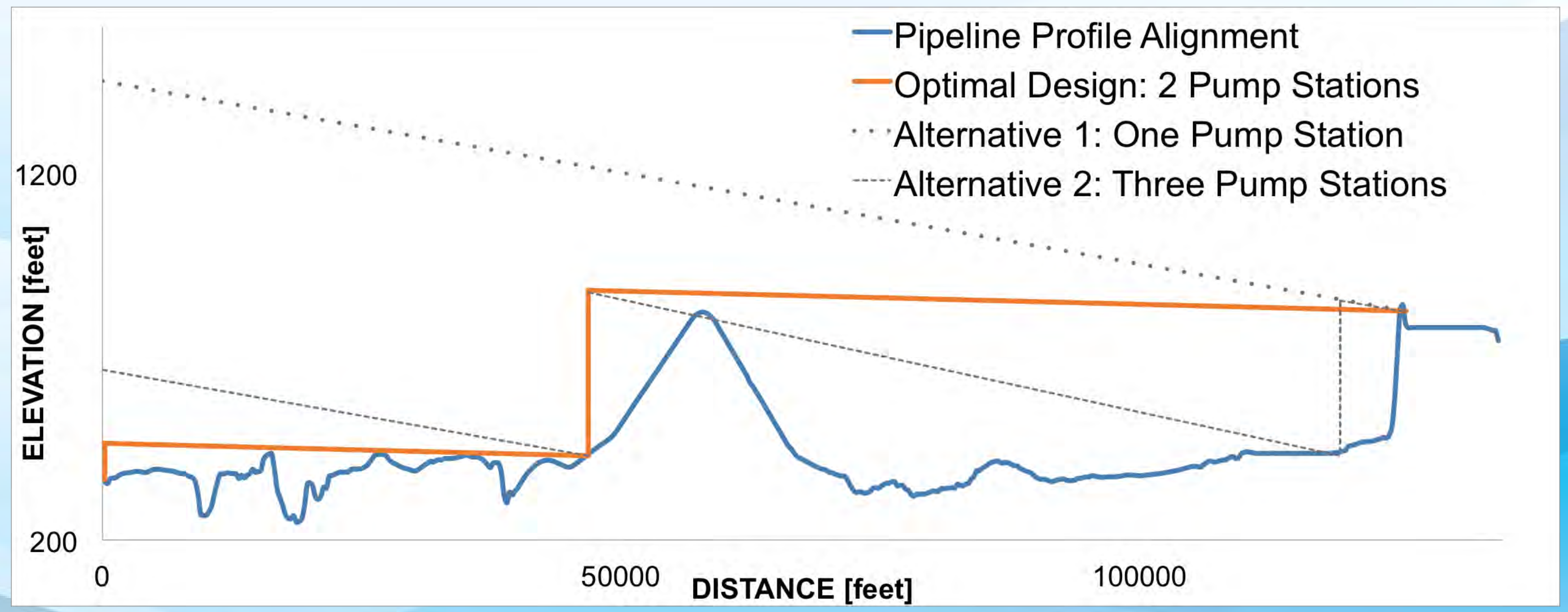
SENSITIVITY ANALYSIS OF PRESENT WORTH

Pipe Size	Capital Cost in $Million	Annual Power $Million
24"	$106.26	$4.71
30"	$110.64	$2.96
32"	$115.51	$2.42
33"	$117.19	$2.30
36"	$120.64	$2.12
39"	$127.96	$1.93
42"	$134.87	$1.81

Present Worth in $ Million					
Discount Rate	Pipe Size	Energy Escalation Rate			
		2%	3%	4%	5%
2.5	24"	$237.32	$258.71	$284.58	$315.96
	30"	$193.01	$206.46	$222.72	$242.45
	33"	$182.87	$193.86	$207.16	$223.29
	34"	$181.32	$191.79	$204.45	$219.80
	36"	$179.58	$189.20	$200.83	$214.94
	39"	$181.61	$190.37	$200.96	$213.81
	42"	$185.20`	$193.41	$203.35	$215.40
3	24"	$228.12	$247.51	$270.90	$299.21
	30"	$187.23	$199.42	$214.12	$231.92
	33"	$178.14	$188.11	$200.13	$214.68
	34"	$176.82	$186.31	$197.75	$211.60
	36"	$175.44	$184.16	$194.68	$207.41
	39"	$177.85	$185.79	$195.36	$206.95
	42"	$181.67	$189.11	$198.10	$208.97
3.5	24"	$219.94	$237.41	$258.60	$284.17
	30"	$182.09	$193.07	$206.39	$222.46
	33"	$173.94	$182.92	$193.81	$206.95
	34"	$172.82	$181.36	$191.73	$204.25
	36"	$171.76	$179.62	$189.15	$200.65
	39"	$172.94	$179.85	$188.23	$198.35
	42"	$178.53	$185.23	$193.37	$203.19

Powering water infrastructure in California amounts to a concerning 20% of all electricity produced in the state.

HYDRAULIC GRADE LINE PROFILE



- Alternatives are at hypothetical loss of 5'/1000'
- Alternative 1: One Pump Station alternative eliminated because of excessive head
- Alternative 2: Three Pump Station alternative eliminated because of free water surface with associated energy loss at Fortuna Mountain
- Two Pump Station alternative adopted

OPTIMIZING TRIPLE BOTTOM LINE

ECONOMIC

- Using multiple energy escalation and discount rate combinations for sensitivity analysis
- Using the sensitivity analysis we can determine the optimal present worth value

ENVIRONMENTAL

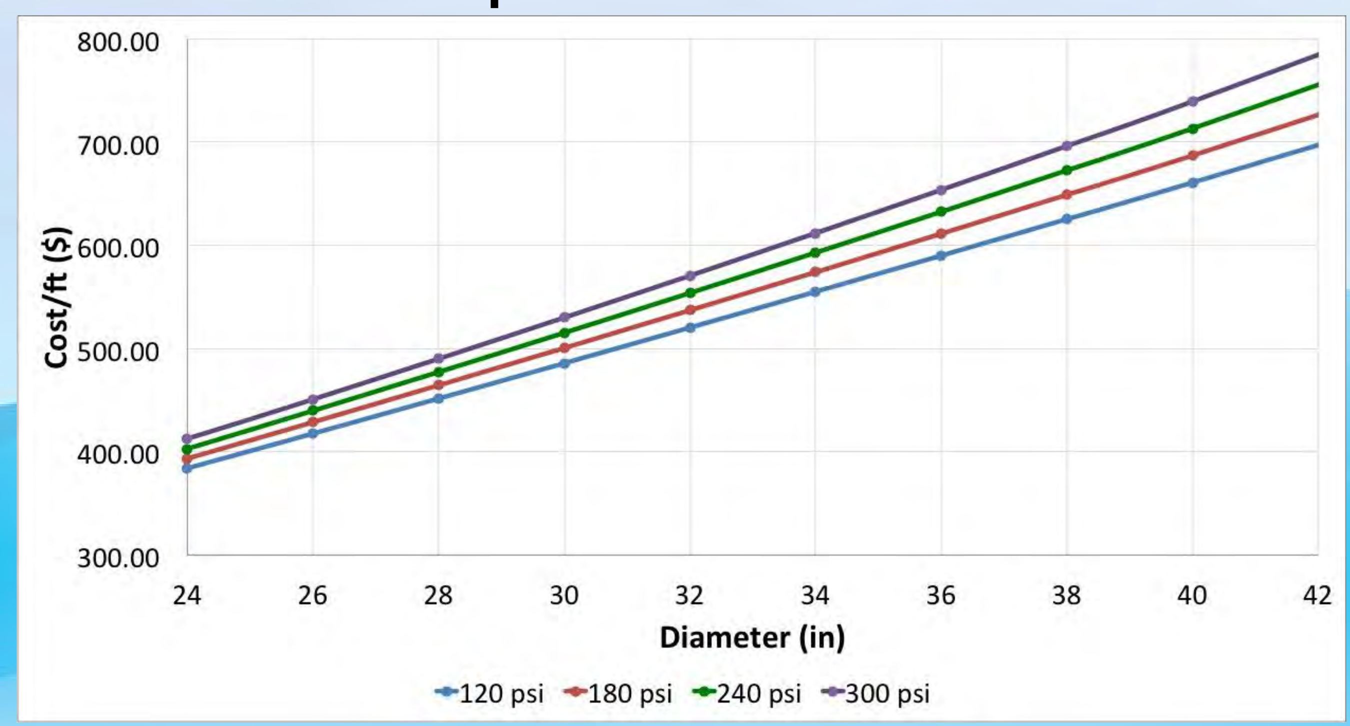
- Flat areas chosen to build pump stations in order to minimize altering mountainside
- Route alignment parallel to existing roads in order to minimize altering undeveloped areas
- Construction methods that minimize dust emission implemented
- Energy usage optimized

SOCIAL

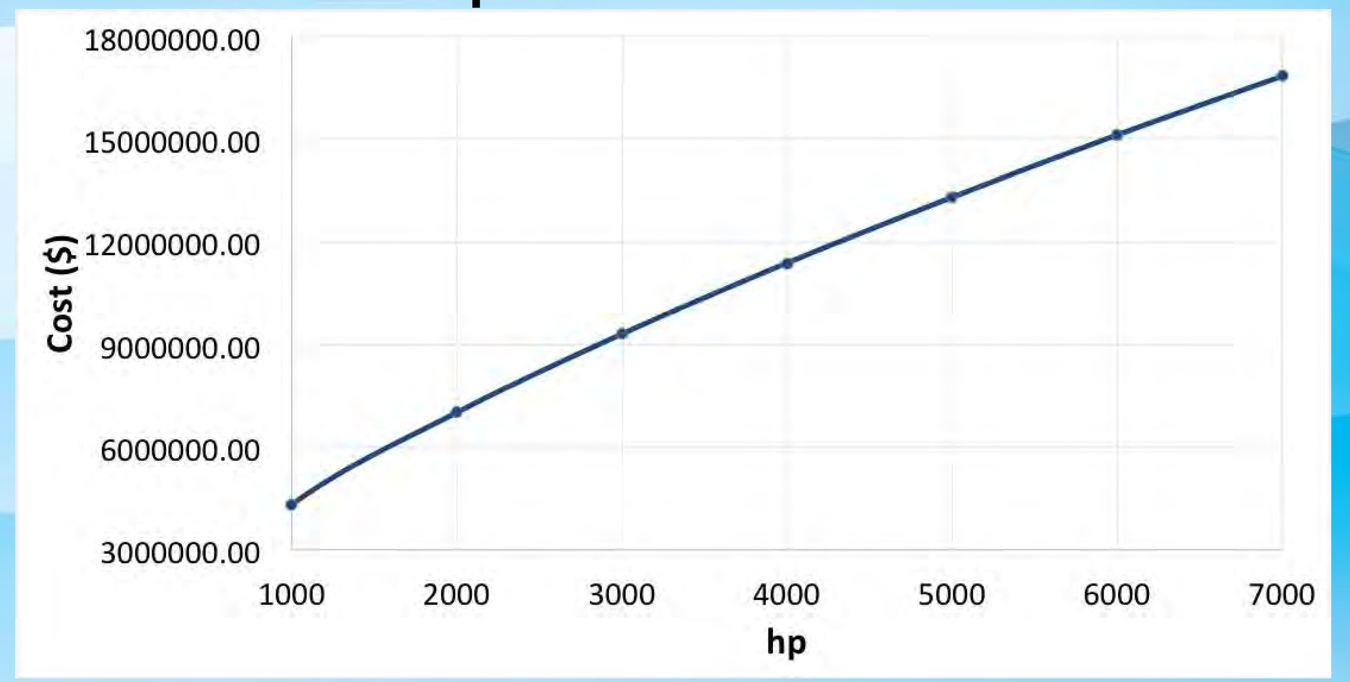
- Provide safe, reliable water
- Minimizing community Impact
  - Alignment designed to stay out of site whenever possible
  - Construction time only during normal working hours
  - Safe construction methods implemented to minimize risk to public

STEEL & PUMP STATION COST

Pipe Cost Per Foot



Pump Station Cost Curve



- As the pipe diameter increases, the cost/ft increases. With increasing pressure, the curve shifts upwards, meaning that the cost/ft also increases.
- The pump station cost curve was using 3000 (hp) pump station as a base. As the (hp) increases, the cost also increases.

NEXT PHASE

- AutoCAD drawings of horizontal & vertical alignments for pipeline design
- Open channel dimensions and cost
- Optimal pipeline diameter using energy escalation and discount rate model
- Specific type of pump selection and location of pump stations