

APPENDIX O

COMPARATIVE COST ESTIMATE OF PRACTICAL REGIONAL WATER SUPPLY

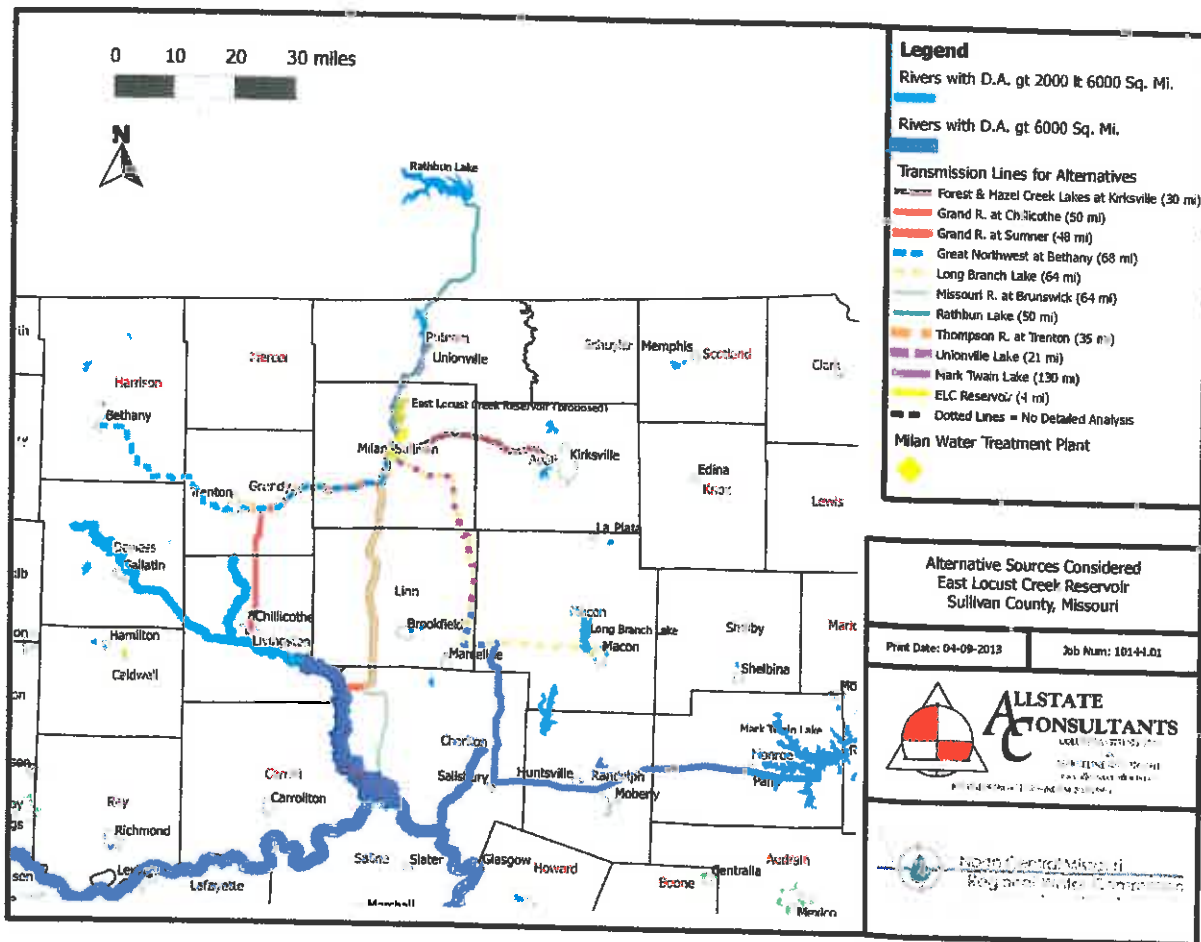
Comparative Cost Estimates of Practical Regional Water Sources

April 10, 2013

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Cost estimates were developed for three shallow alluvial or river intake alternatives (Grand River at Sumner and Chillicothe and Missouri River at Brunswick), two major lake alternatives (Rathbun and Mark Twain), 1 small lake alternative (Kirkville) plus the East Locust Creek Reservoir were given a detailed analysis focusing on transmission costs. Six of these options hold promise for providing the full design 7 MGD average daily demand, the exception being Kirkville which may be able to provide the first phase demand, but no more. Another three alternatives were considered and summarily rejected because they either can't supply enough water or because it was clear that they wouldn't be competitive with the other alternatives.

Figure 1. Alternatives Considered



The Statewide 60 meter Digital Elevation Model (DEM) was used to develop ground profiles from which preliminary design of pump stations was developed.

Figure 2. Alternatives Considered with Existing Ground Elevations from 60 m DEM.

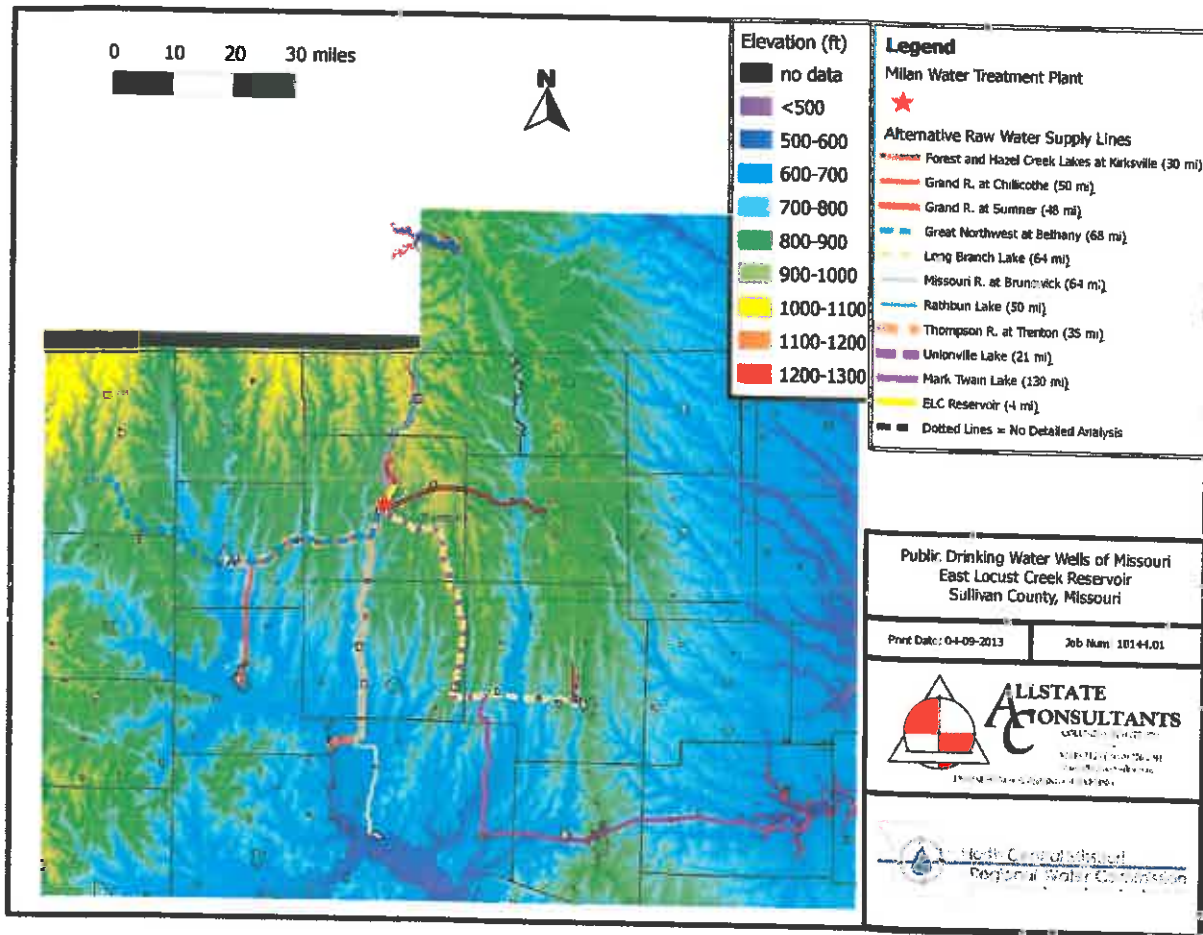
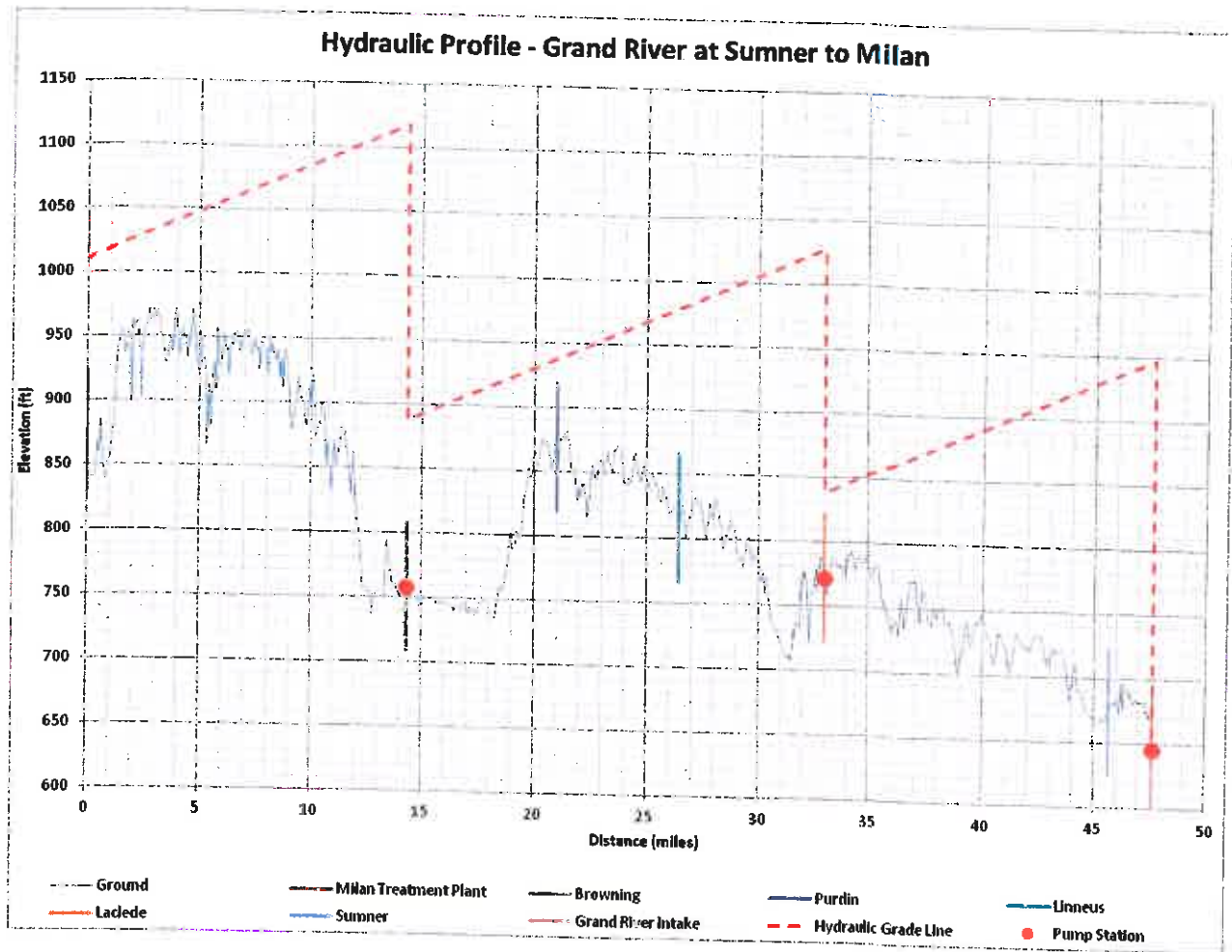


Figure 3. Typical Distribution Line Hydraulic Profile and Pump Station Layout



The following assumptions were made regarding costs.

Constants Used in Alternatives Analysis		
Item	Unit	Value
Mobilization %	LS	2%
Raw water intake or well (ea)	EA	\$750,000
Pump Stations		
Pump -Estimated Pump Power Less than 650 Hp	EA	\$25,000
Pump -Estimated Pump Power Less than 800 Hp	EA	\$30,000
Pump -Estimated Pump Power Less than 1000 Hp	EA	\$40,000
Pump -Estimated Pump Power Less than 1200 Hp	EA	\$50,000
Pump -Estimated Pump Power Greater than 1200 Hp	EA	\$60,000

Constants Used in Alternatives Analysis			
Item	Unit	Value	
Pump Sta Piping	LS	\$100,000	
Controls/Motor Starters	EA	\$50,000	
Telemetry	LS	\$50,000	
Building/Site/Fencing/Access	LS	\$150,000	
Generator/Transfer Switch	LS	\$150,000	
Miles of access road needed per well, and pump sta.	Mi.	0.25	
Access Road Easement Cost \$/mi	Mi.	\$26,400	
Access Road Linear Grading \$/mi	Mi.	\$10,560	
Access Road Aggregate cost per mile	Mi.	\$38,720	
Access Road Total per mile	Mi.	\$75,680	
Electrical Power Connection	EA	\$25,000	
Transmission Lines			
16" Raw Water Main	L.F.	\$40	
24" Multiplier		2.50	
30" Multiplier		3.50	
24" Raw Water Main	L.F.	\$100	
30" Raw Water Main	L.F.	\$140	
Percent of pipe that needs encasement		2%	
Encasement for 16" pipe	L.F.	\$350	
Length of Bore Needed for Stream Crossings	L.F.	200	
number of stream crossings per mile		0.5	
Length of Bore Needed for Road Crossings	L.F.	50	
number of road crossings per mile		1	
16" Boring Unders Streams or Roads	L.F.	\$200	
16" Valves	EA	\$3,500	
Number of miles per valve		5	
Miscellaneous			
Holding Tank	EA	\$500,000	
Yds of road repair per mi of pipe	Sq. Yd.	50	
Road Repairs	Sq. Yd.	\$75	
contingency		10%	
Engineering Services			
Basic Design as a percent of estimated construction cost		6.00%	
Construction Inspection as a percent of estimated construction cost		4.00%	
Construction Engineering/Staking as a percent of estimated construction cost		1.00%	
Geotechnical as a percent of estimated construction cost		0.40%	
Topographic Survey as a percent of estimated construction cost		0.50%	
Legal Descriptions/Title Work/Easements as a percent of estimated construction cost		1.50%	

Constants Used in Alternatives Analysis		
Item	Unit	Value
Other Professional Services & Miscellaneous		
Legal and Attorney Fees as a percent of estimated construction cost		2.00%
Bond Council as a percent of estimated construction cost		0.20%
Appraisals as a percent of estimated construction cost		0.40%
Easement Costs per foot of pipe (\$/ft)	L.F.	\$5
Land to be Acquired for Each Pump Sta, Well Location, etc.	AC	2
Land Acquisition \$/acre of estimated space needed for facilities		\$2,400

The assumptions for determining the Operation and Maintenance Costs were:

O&M Estimate Constants	
Operation and Administration	Assumed same on all alternatives
System Maintenance and Materials	
Routine Maintenance / Repairs \$/ft of constructed pipe	\$0.10
Pump Maintenance \$/pump	\$3,500.00
Parts and Surplus (\$/pieces of equip (pumps, wells, valves)	\$100.00
Miscellaneous as a percent of other routine maintenance estimates	10%
Replacement Fund	
Percent of parts replaced per year	10%
Electrical Components - Percent of value replaced per year	3%
Pipe \$/ft of pipe	\$0.10
Miscellaneous as a percent of other replacement fund items	10%
Other	
Vehicle and Heavy Machinery Expense, annual cost per mile of pipe (assuming 2 round trips per day, \$0.3 per mile)	\$450.00
Gas, Oil, Fuel annual cost per mile of dist (assuming 2 round trips per day, 10 MPG, \$4 per gallon to cover gas, oil, etc)	\$500.00
Facility Electricity, Cost per KWH	\$0.08
Insurance as a percentage of the construction cost estimate	0.10%

The assumptions for the Present Worth Analysis were:

Assumptions for Present Worth Analysis	
Analysis Period (Years)	50
Interest Rate for Loan (%)	4%
Base Cost for purchase and/or treatment of Water (\$/MGD)	\$1,000.00
Inflation %	3%
Interest Rate for Present Worth Analysis	5%
Pumping Costs were determined for each year by an equation that was fit to each distribution line based on current electricity costs and future demand.	
The pumping cost curves represent an assumption that the pump stations are operated at peak demand for 25% of the water and at average daily demand for the remaining 75% of the water supplied.	

The above assumptions were applied to the 7 alternatives to develop projected cost estimates and present worth estimates. Because it would be unfair to expect that the NCMRWC would be expected to pay for a reservoir that is sized for the entire region, an alternative was evaluated in which the Reservoir Costs were not included. Also, because there is a good chance that a pump station from East Locust Creek Reservoir could be avoided, an additional alternative representing the cost for East Locust Creek Reservoir without a pump station was evaluated. The following tables summarize the results.

Below the table are the profile displays and the pumping cost curves for each alternative.

NCMRWC Water Supply Alternatives - Initial Cost Estimate Summary									
	Sumner to Milan	Chillicothe to Milan	Rathbun to Milan	Brunswick to Milan	Mark Twain Lake to Milan	Kirksville to Milan	East Locust Creek Reservoir Pumped to Milan (excluding reservoir cost)	East Locust Creek Reservoir Gravity fed to Milan (including reservoir cost)	East Locust Creek Reservoir Pumped to Milan (including Reservoir Cost)
Number of Pump Stations	3	3	2	4	7	2	1	0	1
Length of Line (mi)	47.7	49.7	50.5	64.3	129.8	29.6	4.15	4.15	4.15
Mobilization	\$1,012,153	\$1,052,269	\$1,051,451	\$1,353,568	\$2,686,960	\$638,841	\$121,995	\$1,266,703	\$1,281,581
Intake/Wells	\$750,000	\$750,000	\$750,000	\$750,000	\$750,000	\$750,000	\$750,000	\$750,000	\$750,000
Pump Stations	\$2,654,200	\$2,693,120	\$1,858,120	\$3,464,880	\$5,973,680	\$1,702,440	\$793,920	\$50,000	\$793,920
Transmission Line	\$46,438,812	\$48,385,932	\$49,164,780	\$62,599,908	\$126,368,088	\$28,817,376	\$4,040,274	\$4,040,274	\$4,040,274
Valves	\$85,750	\$98,000	\$110,250	\$122,500	\$269,500	\$61,250	\$0	\$0	\$0
Holding Tanks	\$500,000	\$500,000	\$500,000	\$500,000	\$500,000	\$500,000	\$500,000	\$58,479,309	\$58,479,309
Road Repairs	\$178,875	\$186,375	\$189,375	\$241,125	\$486,750	\$111,000	\$15,563	\$15,563	\$15,563
Contingency	\$5,161,979	\$5,366,570	\$5,362,398	\$6,903,198	\$13,703,498	\$3,258,091	\$622,175	\$6,460,185	\$6,536,065
Total Construction	\$56,800,000	\$59,000,000	\$59,000,000	\$75,900,000	\$150,700,000	\$35,800,000	\$6,800,000	\$71,100,000	\$71,900,000
Total Engineering	\$7,600,000	\$7,900,000	\$7,900,000	\$10,200,000	\$20,200,000	\$4,800,000	\$900,000	\$9,500,000	\$9,600,000
Total Other Professional Services and Misc.	\$2,800,000	\$2,900,000	\$2,900,000	\$3,700,000	\$7,400,000	\$1,700,000	\$300,000	\$2,000,000	\$2,000,000
Total	\$67,100,000	\$69,800,000	\$69,800,000	\$89,800,000	\$178,300,000	\$42,400,000	\$8,100,000	\$82,500,000	\$83,500,000

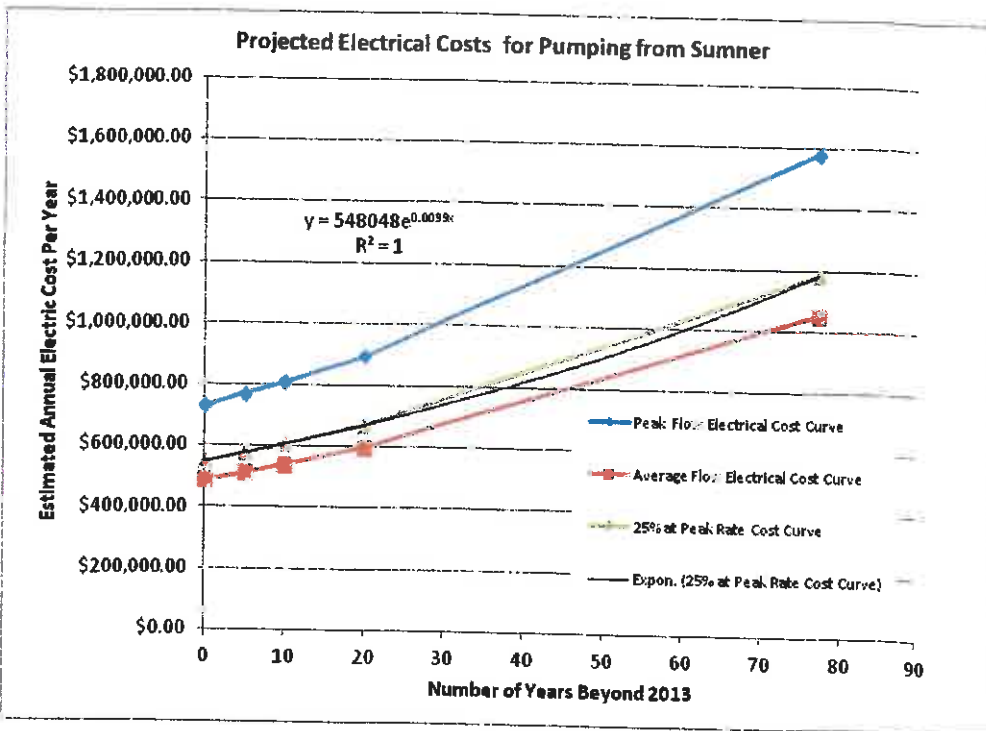
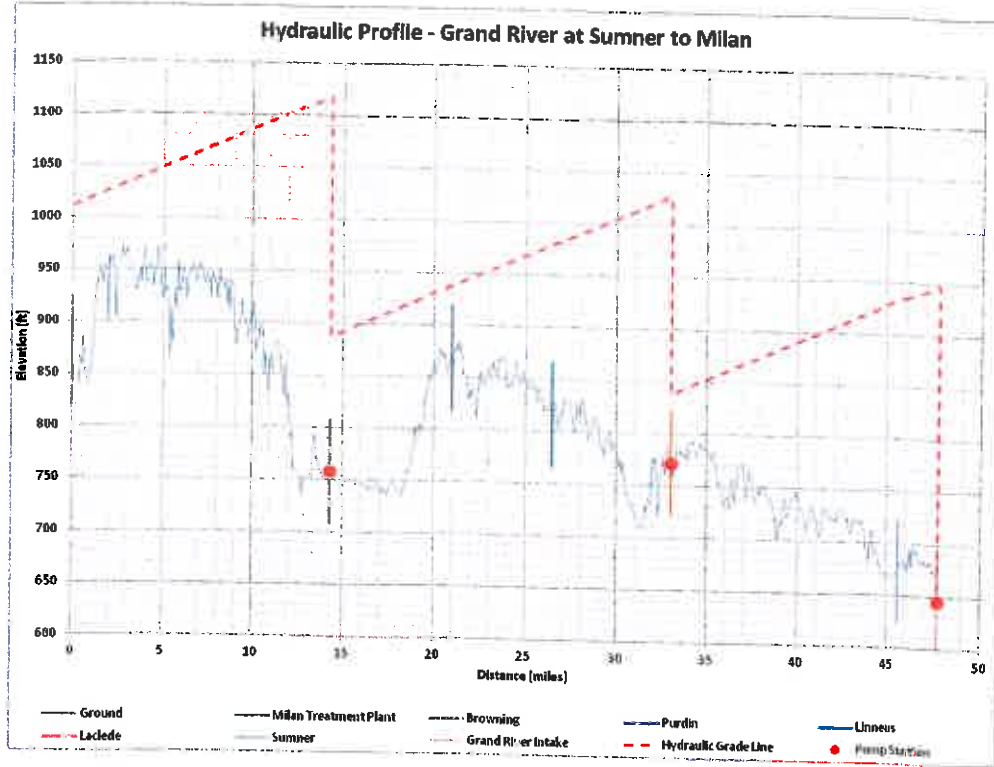
* Kirksville only has enough excess capacity to meet NCMRWC's phase 1 demands. An additional source would be needed to supply 7MGD.

NCMRWC Water Supply Alternatives - Present Worth Summary

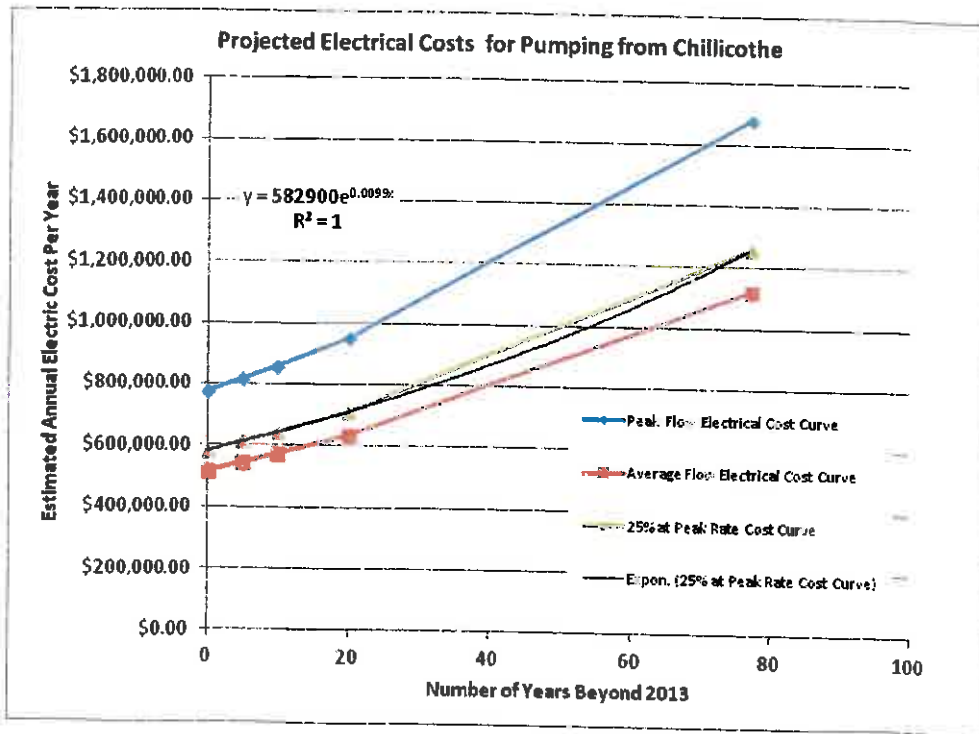
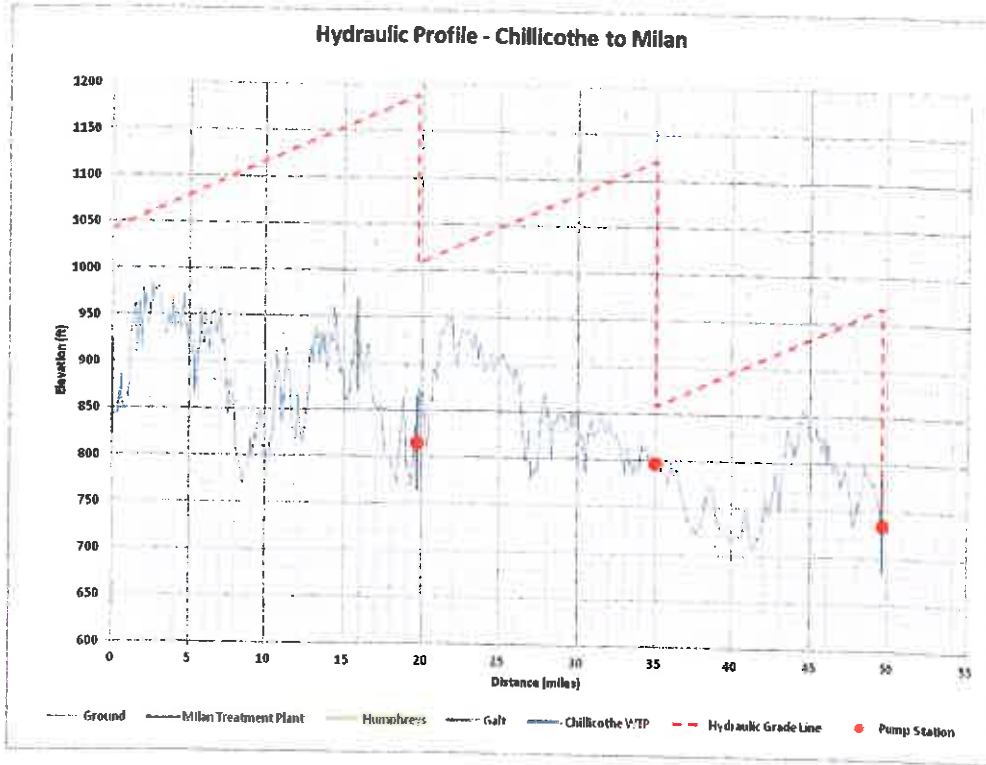
	Sumner to Milan	Chillcothe to Milan	Rathbun to Milan	Brunswick to Milan	Mark Twain Lake to Milan	Kirksville to Milan*	East Locust Creek Reservoir Pumped to Milan (excluding reservoir cost)	East Locust Creek Reservoir Gravity fed to Milan (including reservoir cost)	East Locust Creek Reservoir Pumped to Milan (including Reservoir Cost)
Length (mi)	47.7	49.7	50.5	64.3	129.8	29.6	4.15	4.15	4.15
Number of Pump Stations	3	3	2	4	7	2	1	0	1
Construction Cost	\$56,781,769	\$59,032,265	\$58,986,373	\$75,935,179	\$150,738,476	\$35,838,998	\$6,843,927	\$71,062,033	\$71,896,711
Engineering Cost	\$7,608,757	\$7,910,324	\$7,904,174	\$10,175,314	\$20,198,956	\$4,802,426	\$917,086	\$9,522,312	\$9,634,159
Legal Cost	\$2,750,006	\$2,861,319	\$2,876,446	\$3,691,035	\$7,379,520	\$1,722,854	\$292,302	\$1,961,973	\$1,983,674
Total Capital Cost	\$67,140,532	\$69,803,908	\$69,766,993	\$89,801,528	\$178,316,952	\$42,364,278	\$8,053,315	\$82,546,319	\$83,514,545
Initial Annual O&M (Less Pump Power)	\$426,000	\$436,000	\$408,000	\$508,000	\$817,000	\$322,000	\$201,000	\$248,000	\$266,000
Initial Annual Pumping Power Cost	\$548,048	\$582,900	\$392,510	\$548,267	\$917,596	\$230,020	\$60,695	\$0	\$60,695
Initial Total O&M	\$974,048	\$1,018,900	\$800,510	\$1,056,267	\$1,734,596	\$552,020	\$261,695	\$248,000	\$326,695
NPV 50 years of pumping power	\$14,149,118	\$15,048,903	\$10,133,547	\$15,051,015	\$24,658,184	\$5,938,495	\$1,566,981	\$0	\$1,566,981
Net Present Value of Project (50 years)	\$251,365,070	\$261,403,756	\$147,199,859	\$326,424,769	\$359,644,826	\$93,965,181	\$27,802,300	\$140,187,020	\$145,246,004

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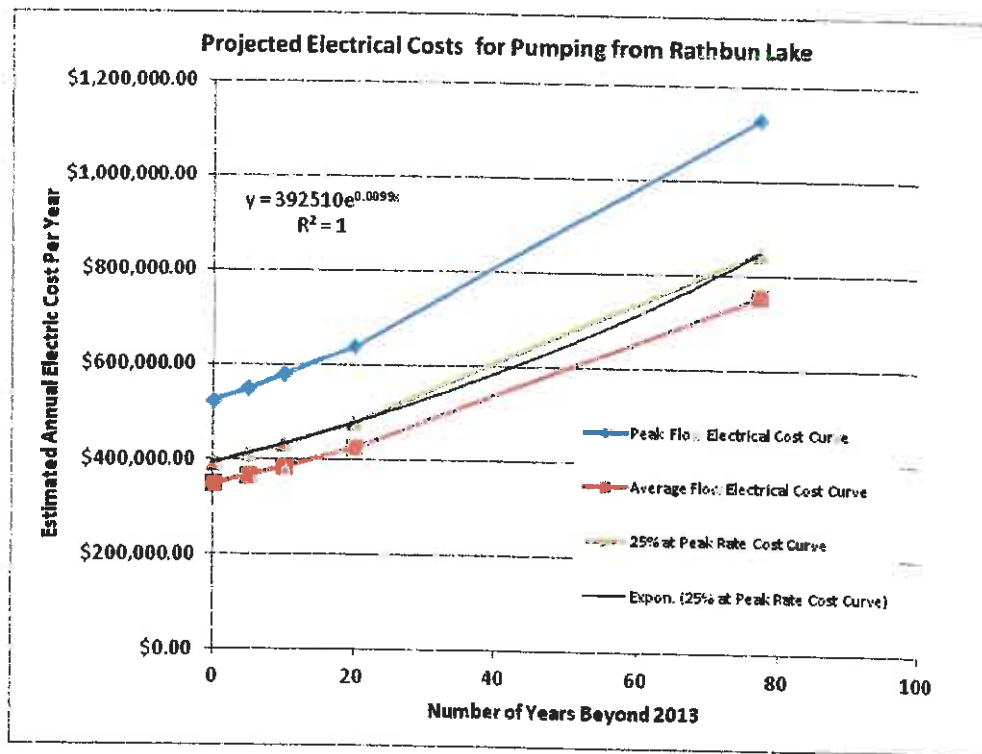
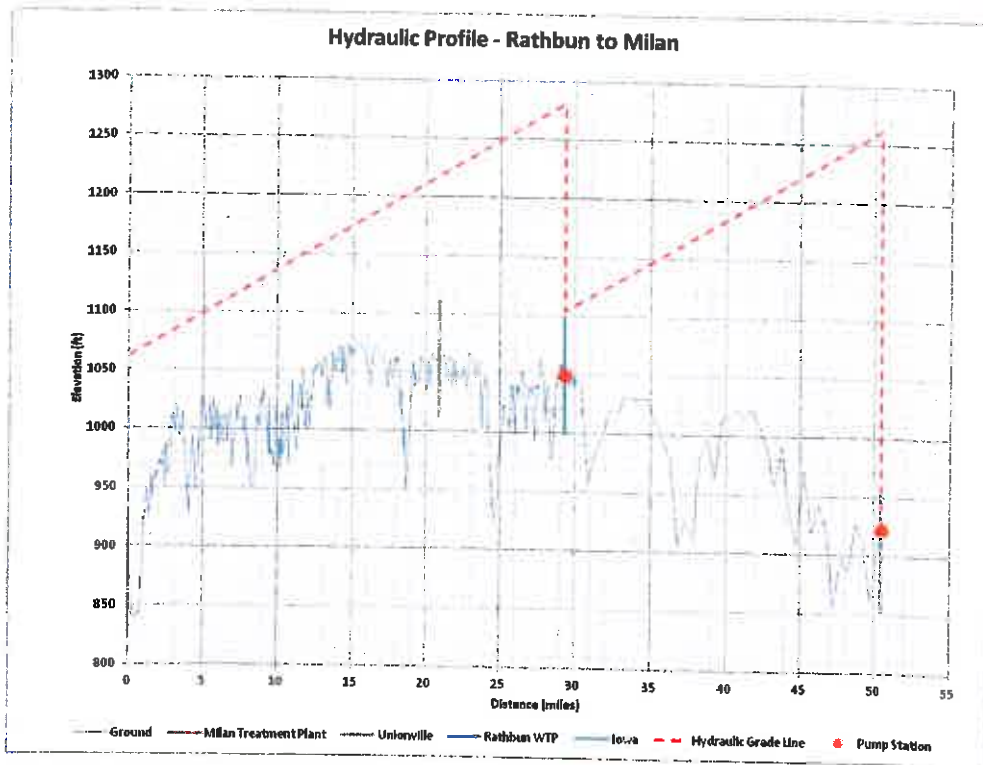
Sumner



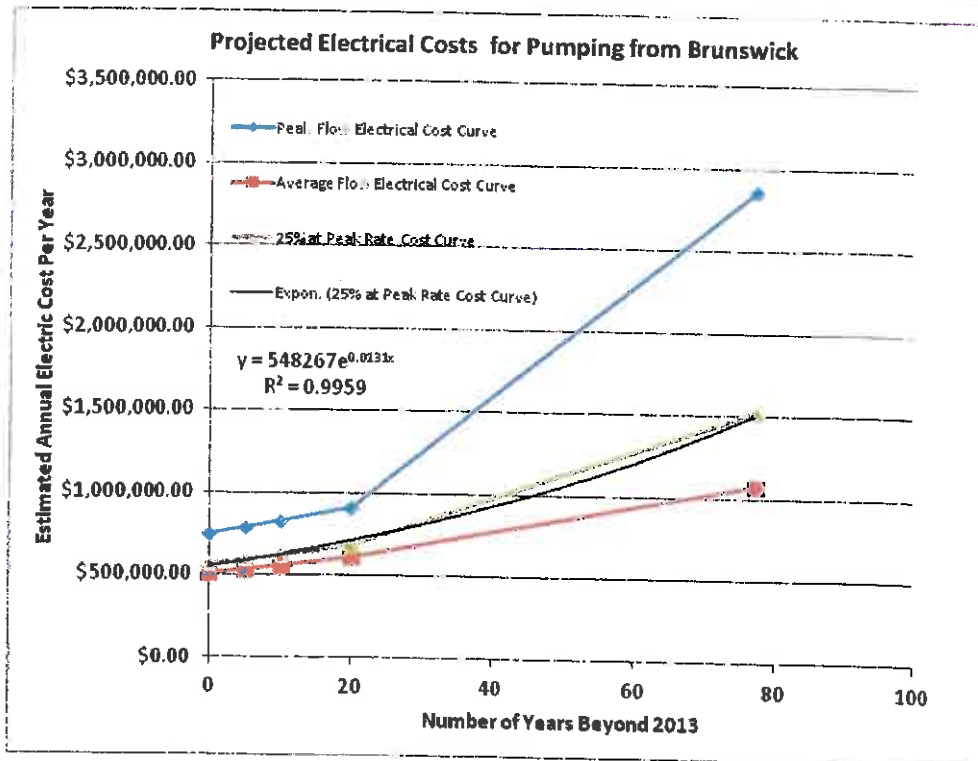
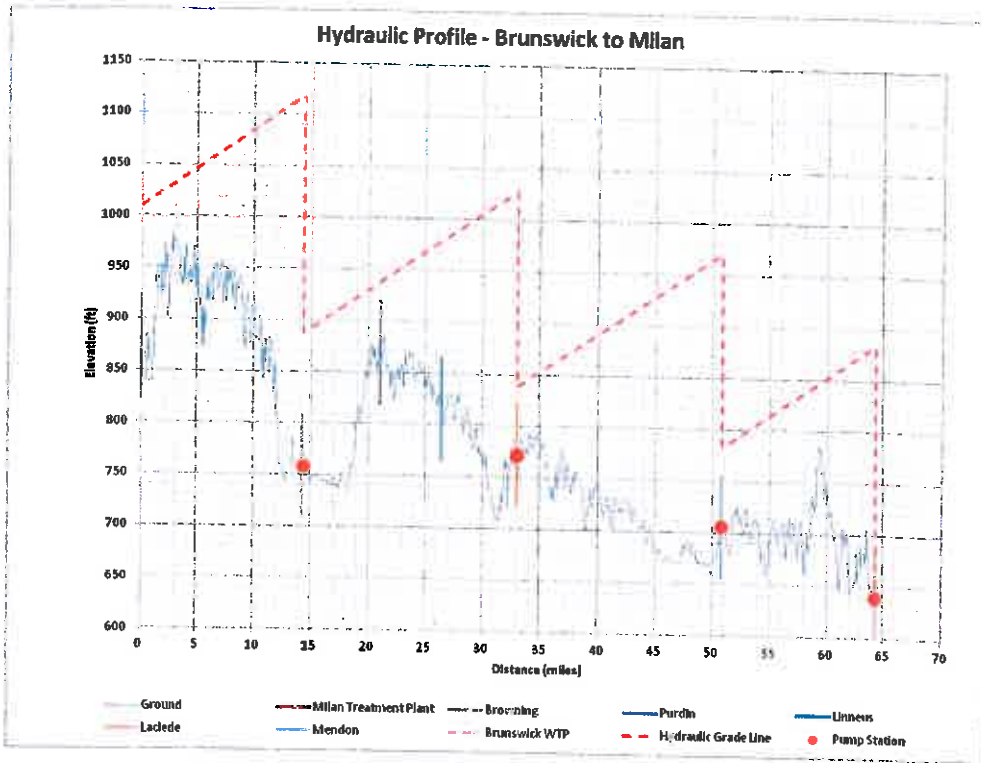
Chillicothe



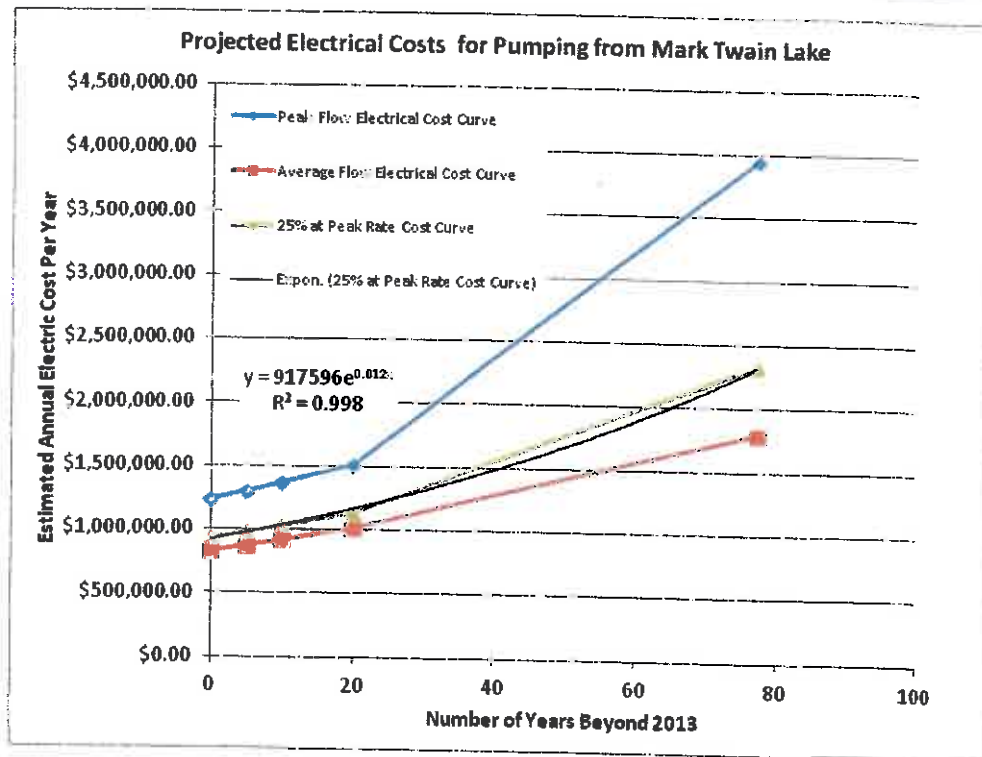
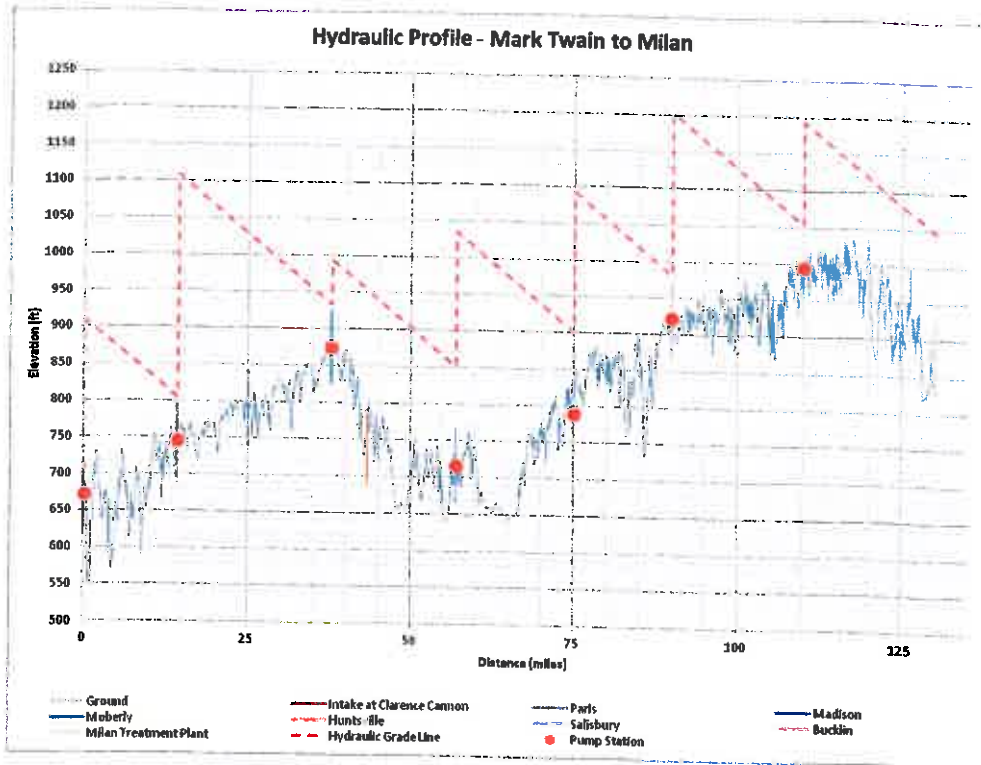
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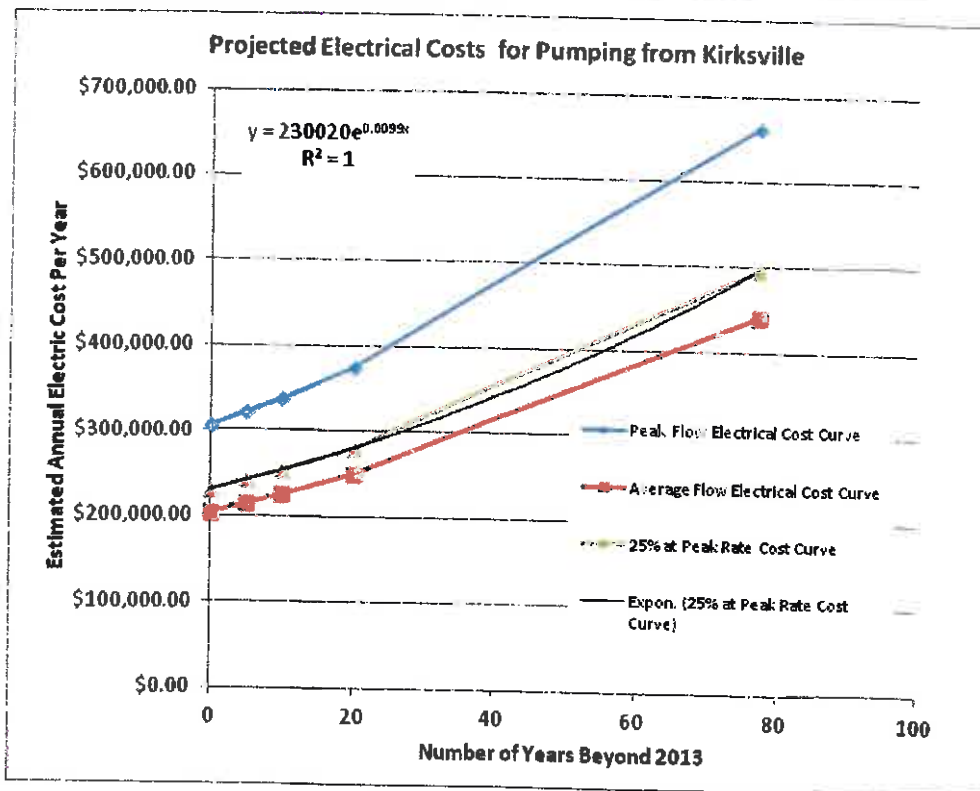
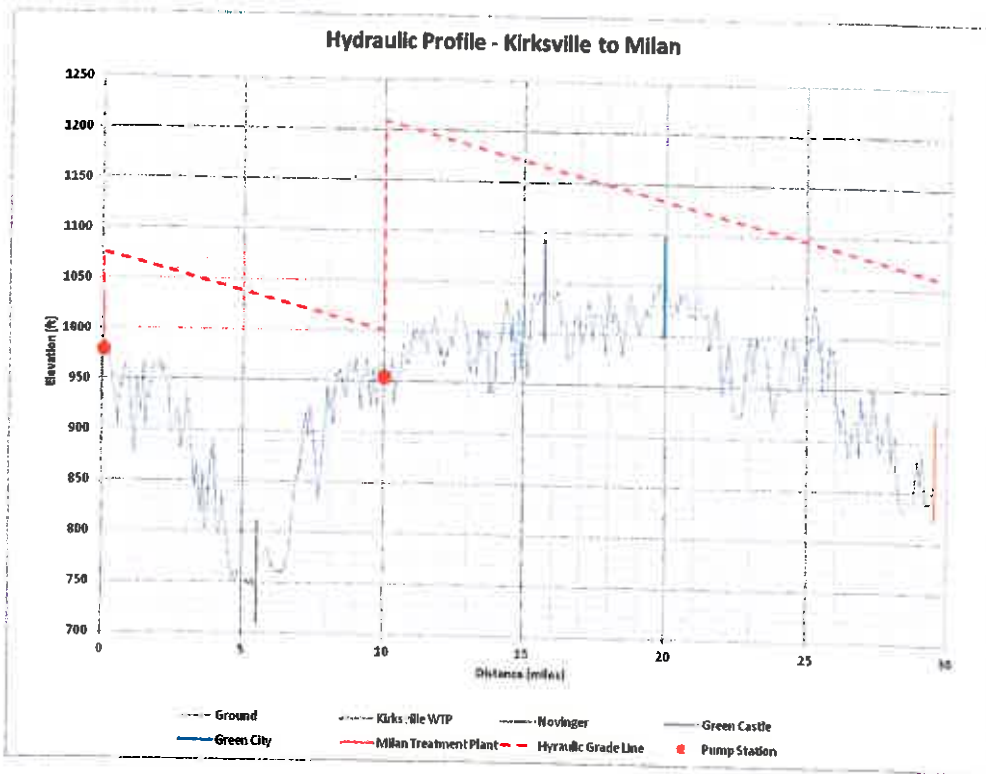
Brunswick



Mark Twain Lake



Kirksville



East Locust Creek Reservoir

