City of Antigo, Wisconsin

Water System Improvements
Preliminary Engineering Report

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Summary of Test Boring, Test Pumping, and Groundwater Sampling

General Procedure:

1. Select locations based on desktop study, surface geophysical surveys and consultation with city.
2. Drill temporary test borings to bedrock.
3. Collect and evaluate soil samples as drilling proceeds.
4. Set temporary well screen at optimum depth.
5. Perform short term stepped-rate pumping test.
6. Determine aquifer production potential.
7. Collect water samples for laboratory analyses.

What are the results?

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Test Drilling, Sampling and Pumping Results

Phase 1 – Test borings by treatment plant and Well 17, east of treatment plant, deeper than existing wells. (Why these locations?)

1. Treatment plant boring – production potential insufficient.
2. Boring by Well 17 – production potential okay, water quality okay.
3. Discontinuous protective clay layer above deeper production zone. Bacteriological contaminants will be drawn into deeper aquifer from above.
4. Area 1 rejected.

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Test Drilling, Sampling and Pumping Results

Phase 2 – Two test borings near Wells 15/18 (north field) constructed deeper than these existing wells.

1. Deeper wells desired due to presence of nitrates (farm fields) impacting shallow wells.
2. Water quality okay, but production potential was insufficient at desired depths.
3. Area 2 rejected.

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Test Drilling, Sampling and Pumping Results

Phase 3 – Test borings at Cedar Plantation, NCTC (two) and east of Charlotte Street, north of North Avenue.

1. Charlotte Street/North Avenue – insufficient production potential.
2. South location on NCTC – insufficient production potential.
3. North location on NCTC and Cedar Plantation are recommended for production well development because:
    a. Raw water quality is good.
    b. Production potential is good from formations at suitable depth.
    c. Needed land can be acquired.
    d. Compatible land uses exist up-gradient from these locations.

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Project Planning Area

- Current and near future service area
- Limited to City's corporate limits & immediately adjacent areas
- 2000 Census City population – 8,560
- 2000 Census households – 3,630
- City area - approximately 4,000 acres

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Existing Facilities

- 7 active wells – 2 north field & 5 south field
- 2.0 mgd iron removal & softening plant
- 500,000 gal finished water reservoir
- 150,000 gal treatment site elevated tank
- 200,000 gal industrial park elevated tank
- 63 miles of 4” to 16” water main

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Need for the Project

- South Well Field
  - Bacterial contamination
  - Surface water influence
- North Well Field
  - Nitrate contamination
  - Likely from fertilizer
- WDNR Consent Order
  - Executed April 28, 2003
  - 34 month compliance schedule

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Alternatives Considered

- No Action
  - Not applicable – Legal issues with WDNR Consent Order
- Optimize Current Facilities
  - WDNR guidelines require contaminated well replacement
  - Current facility not capable of removals
- Interconnection with Other Systems
  - Not applicable - None available
- Small Cluster or Individual Facilities
  - Not applicable – Dense municipal area with historic infrastructure investment in place
- Continued Use of Existing Wells with Treatment (filtration)
  - Rebuild or replacement of existing facility
  - Not consistent with WDNR policy
- Development of New Environmentally Safe Well Field
  - Transmission costs offset by long term operational costs over filtration
  - Includes continued use of high service pumping & reservoir

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Present Worth

	Existing Wells with Treatment	New Wells with Softening	New Wells without Softening
Capital Costs	$3,684,000	$4,214,000	$2,963,000
O&M (production only)	$550,000	$500,000	$300,000
Present Worth	$16,744,030	$14,464,514	$8,978,396

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Alternative Selection

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
Existing Wells w/ Filtration	- Addresses problem	- High capital cost
	- Makes use of exist. Wells	- High O&M costs
		- Less reliable
		- WDNR may not permit
New well field w/ softening	- Addresses problem	- Dedicated trans. Main
	- Makes use of exist. Plant	- Moderate O&M cost
	-Aesthetics	- Moderate capital cost
	- More reliable than #1	
New well field w/o softening	- Addresses problem	-Aesthetics
	- Most reliable	- Doesn't use exist. plant
	- Least capital cost	
	- Least O&M cost	
	- Most likely permittable	

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Alt. #1 – Existing South Well Field with Treatment

- Use existing wells with enhanced treatment
- Two approaches
  - Modify existing WTP
  - Microfiltration add-on
- Modify existing WTP
  - Meet surface water standards
  - Add clarifier, filter re-build, chemical feed
  - Add UV disinfection
  - Some risk – WDNR hesitant
  - Pilot testing required
  - $2,680,000 capital

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Alt. #1 – Existing South Well Field with Treatment

- Microfiltration add-on
  - Existing WTP as pretreatment
  - High quality / low risk
  - $3,903,000 capital
  - $50,000 to $100,000 / year added O&M
  - New membrane filtration building

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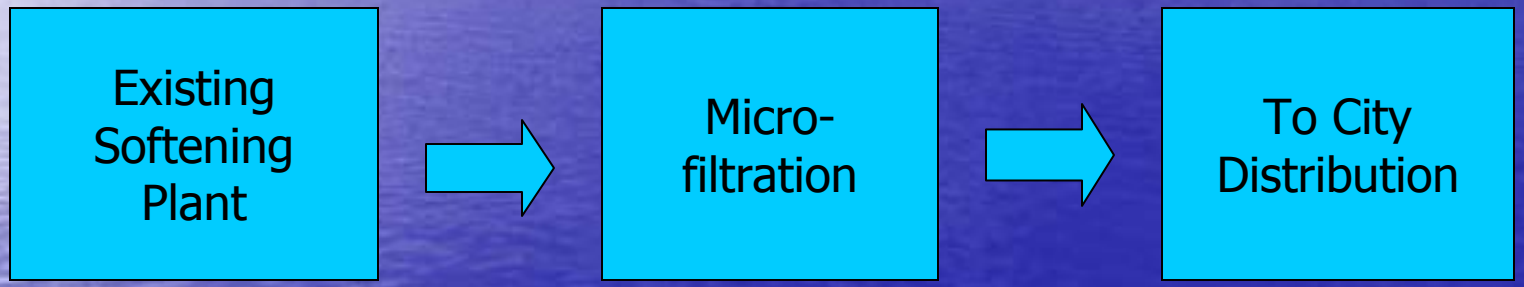
Microfiltration Concept



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Alt. #2A – New Wells & Softening

- New Well Field – Existing Softening Plant
- Reduced level WTP Improvement
- New Transmission Main to WTP
- $1,251,000
- Somewhat less O&M than Alt. #1

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Alt. #2B – New Wells w/ No Softening

- Large Reduction in Up-front Costs
- Large Reduction in Annual O&M
- Harder Water – Very Low Iron
- Ex. WTP used for Storage & Pumping

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What is the drinking water quality of some other Wisconsin communities?

City	Population Served	Average Hardness	Average Iron
Beloit	41,223	370	0.14
Brookfield	21.020	340	0.38
New Berlin	19,354	360	0.60
Oconomowoc	12,868	330	0.24
Waukesha	66,186	370	0.30
Antigo	8,390		
a. Existing unsoftened		190	1.5
b. Existing softened		90	Less than 0.001
c. Wells 15 & 18 unsoftened		190	Less than 0.001
d. Proposed south wells unsoftened		200	0.05
Unsoftened Lake Michigan water		135	Less than 0.001

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Water softening can be effectively performed by individual customers. Softening cost for a typical single family home in Antigo:

Item	Estimated Annual Cost
Softener depreciation	$75
Salt for regeneration	20
Regeneration water and wastewater	12
Total	$107

Based on an initial softener cost of $870, softener life of 12 years, water hardness of 200, salt cost of $6.50 per 80 pound bag, 1,700 gallons of regeneration water used per year, and a water and wastewater rate of $6.80 per thousand gallons.

Use of home softening is a personal choice, not a requirement!

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Alternative Rating Matrix

Item	Ex Wells w/ Filtration	New Wells w/ Softening	New Wells w/o Softening
Probability of Success	1	2	3
Implementation	1	3	2
Permitting	1	3	2
Short Term Environmental	1	2	3
Long Term Environmental	1	2	3
Capital Costs	2	1	3
O&M Costs	1	2	3
System Reliability	1	2	3
System Life	1	2	3
Total (higher is better)	10	19	25

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Alternatives – Design Demands

- Average Day
  - Existing – 1.2 mgd
  - 2025 – 1.3 mgd
- Maximum Day
  - Existing – 1.8 mgd
  - 2025 – 2.0 mgd
- Peak Rate
  - Existing – 3.6 mgd
  - 2025 – 3.9 mgd

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Wastewater Collection

- 2002 Sanitary Sewer System Study by Vierbicher & Associates
- Part of Option III-C
- East & South sides interceptor and pump station
- Anticipated project costs - $1.3 million

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Proposed Project

- Well Field Development $445,000
- Transmission $1,515,000
- Distribution $697,000
- Miscellaneous (telemetry - $112,000 & high svc pumping - $194,000) $306,000

- Subtotal $2,963,000

- Softening / Iron Removal (plant - $400,000 & trans - $851,000) $1,251,000

- Sanitary Sewers (interceptor - $1,035,000 & US45 - $284,000) $1,319,000

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FINANCING (assuming USDA loan)

	New Wells without Softening	With Softening at Ex Plant	Wastewater Collection
Capital Cost	$2,963,000	$4,214,000	$1,319,000
Annual Debt 5%-40yr	$172,684	$245,592	$76,871
Debt Reserve	$17,268	$24,559	$7,687
Equipment Repl. Reserve	$28,000	$59,000	$8,000
O&M Change	-$60,000	$0	$0
Total Annual Cost	$157,952	$329,151	$92,558
Approx. System EDU	6,700	6,700	6,700
Annual Increase per EDU	$24	$49	$14

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Conclusions & Recommendations

Recommended alternative

- Develop new well field(s) on south side of City

- Implement needed transmission and distribution system improvements

- Install telemetry & needed improvements to existing high service pumping facilities

- Install sanitary sewer improvements in Forest & Mary areas as part of same project

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