Madison Water Utility	PROJECT SCOPING DOCUMENT	Project Manager:	Alan L Larson, P.E. 608.266.4653 allarson@cityofmadison.com
		Project Information:	Well 8 Iron and Manganese Mitigation
		Draft:	March 4, 2009
Department: Madison Water Utility	Section: Engineering	Revised:	
		Approved:	

Project Scoping Document

Well #8
Iron and Manganese Mitigation

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1. Project Description

A description of the project, including a map showing existing facilities, approximate location of proposed facilities, documented contaminated sites, the extent of the Eau Claire shale (if applicable) and the location of floodplain areas.

Overview

Well 8 is located at the east end of the Isthmus in the vicinity of Olbrich Park and Gardens. Well 8 was drilled in 1945 and has provided water to the City of Madison for over 60 years. The facility consists of a 774-foot deep 16-inch diameter borehole below 280 feet of 18-inch diameter grouted steel casing. A copy of the well log is attached as Figure 1. The average production of the well is approximately 1,800 gallons per minute. Between 1999 and 2007 the well operated an average of 270 days per year. Due to water quality concerns, operation was limited to 122 days in 2008. It is expected that annual production will be reduced to approximately 4 months until the water quality issues are addressed. The average production from the well between 1999 and 2007 was 230 million gallons. In 2008, the production was approximately 114 million gallons or less than an average of 1.0 million gallons per day. The well serves an estimated population of 8,000 primarily during the summer months. Attached Figures 2 and 3 depict the historic pumpage between 1999 and October 2008. Figure 4 indicates the estimated service area for the well in 2006 & 2007. Valves have been closed at the Yahara River to improve hydraulic conditions on the east side and this will impact the westerly extents of the Well 8 service area in the future.

Water quality at Well 8 is a concern due to the levels of iron and manganese found in the well. The inorganic chemical analysis for 2008 is presented in Table 1. Iron and manganese above the secondary standard of 0.3 mg/l and 50 ug/l respectively will cause color and odor complaints and nuisance conditions such as stained laundry and plumbing fixtures. Frequent colored water complaints attributed to Well 8 are typical when the well is in operation. Historic iron and manganese levels in Well 8 are presented in Figure 5. The colored water complaints by month have been plotted on Figure 2.

Over 80 years ago, the Madison distribution system was developed using the distributed supply concept and is dependent upon each and every one of its supply points during the high demand months of the year. The advantage of a distributed supply system is that piping can remain small and thus less costly but this limits the hydraulic capacity of the system to move water long distances. Well 8 is a key supply point within Pressure District 6 which is more commonly known as the Main Pressure Zone. The Main Pressure Zone is outlined on Figure 6 by the dark blue border. Due to the limitations of the water distribution system, providing adequate pressure and supply, keeping reservoirs full, and providing fire flow capacity to the East Isthmus area in the high demand summer months is reliant upon the operation of Well 8.

Service Area Characteristics

Well 8 serves an estimated population of 8,000 people located in the older neighborhoods of the East Isthmus of the City of Madison. Small densely developed residential lots characterize the service area. Historically the area contains areas that were used as landfills, industrial areas, and commercial developments. Zoning and land use are depicted in Figures 7 and 8.

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Well 8 is located on the westerly edge of Olbrich Park near Olbrich Beach on the shore of Lake Monona. The neighborhood surrounding the well is residential and is Zoned R2, single family. The property the well itself sits on is zoned conservancy in association with Olbrich Park and Gardens. The neighborhood is fully described in the March 2000 Schenk-Atwood-Starkweather-Worthington Park Neighborhood Plan. To quote the plan, *"The neighborhood envisions diverse, community-oriented places, activities and people. ... This will be a neighborhood where vibrant residential areas, community activities, and business corridors continually build upon each other's strengths. ... In short, neighbors want to improve on the many great qualities in their neighborhood and keep an eye to its long-term sustainability."*

The piping system throughout the service area is generally 80 to 100 years old, is small diameter cast iron pipe and is typically unlined. The unlined pipe in conjunction with the iron and manganese in the Well 8 water result in water quality concerns throughout the service area. It is anticipated that replacing the aging unlined piping system with lined pipe will reduce or even eliminate the contribution of the unlined pipes to the water quality problem. This process will take years to complete and pipe replacement will not improve source water quality, which is the major contributor to the colored water episodes. Operation of the system requires frequent flushing of mains and there are occasional main breaks. Pressures and fire flow capacity throughout the area are generally adequate.

2. Purpose

The purpose and necessity of the project, with supporting data including recent and anticipated water consumption data and hydraulic model summarizations.

The purpose of this project is to improve water quality at Well 8 and in neighborhoods served by the well currently and in the future. Improved water quality will help to optimize use of Well 8 while reducing episodes of colored water in the service area. It is expected that Well 8 would become a year-round well if iron and manganese levels are mitigated. Using Well 8 year-round would reduce the reliance on Wells 7, 11, and 15 and will balance the supply and groundwater withdrawal on the near east side. See Figure 6 for location of existing facilities.

3. Projected Impact

The projected affect of the project on quality and reliability of service, and hydrologic impacts.

It is expected that improved water quality at Well 8 will have the following results:

- Reduced colored water episodes
- Reduce flushing requirements and therefore improved water conservation
- Increased use of the facility, more than likely year-round use
- More balanced groundwater withdrawal
- Reduced pumping stress on Wells 7, 11, and 15
- Improved system hydraulics

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4. Alternatives

A description of alternative projects or programs considered (This does not include specific site comparisons during early phases of the project).

Alternatives for mitigating the iron and manganese at Well 8 and improving overall water quality and use of the facility include but are not necessarily limited to:

1. **Maintaining status quo.**
   - **a. Discussion:** Given the frequent colored water complaints, the negative perception of the water quality coming from Well 8, and the reduced capacity of a critical system supply point, this "do nothing" alternative does not meet minimum Water Utility goals and objectives. The Utility has the obligation to provide consistently high quality drinking water to all portions of its service area. The Utility intends to continue its pipe replacement program. Replacing unlined pipes with lined pipes will improve distribution water quality but it will not address source water quality and colored water problems are likely to continue. Doing nothing and not addressing the iron and manganese issues at Well 8 would continue to expose the residents and businesses of the East Isthmus area to an unacceptable risk of repeated episodes of colored water. This situation would require the Utility to reduce the use of Well 8 minimizing a critical point of supply and putting additional long term strains on other east side main zone wells.
   - **b. Estimated Cost:** Capital Cost $0; Operational cost $27,500 per zone flush including the use of 6 million gallons. Use of the well for 8 to 12 hours per day for the 4 to 6 month summer growing season would result in two flushings per year. Flushing requirements would continue to be high throughout the service area.
   - **c. Recommendation**: Considering that this alternative does not address the long-term goals and objectives of the Utility and continues to stress other system wells no further consideration will be given to this alternative.
2. **Abandon Well 8 and Drill Another Well either at the existing site or on the East Isthmus.**
   - **a. Discussion:** A new well constructed to current standards and cased through the upper aquifer may offer higher water quality. Redrilling on the existing site would be evaluated with the DNR in addition to looking for an alternative site on the East Isthmus. Drilling a new well at the existing site may not provide any improvement in water quality. The deeper casing and improved construction methods would protect the well from surface contamination in the long term and may improve production capacity. Based on the experience of looking for a replacement well for Well 3 on the East Isthmus, finding a second site that is not hydraulically remote from the existing Well 8 location will be difficult if not impossible. Moving the well to the east will result in the need for significant improvements to the distribution

system driving capital costs up. The risks associated with drilling a new well are the unknowns associated with property selection and availability and water quality. This alternative does not guarantee better water quality; in fact, water quality may be the same or worse at a new well. The time required to investigate a new well is expected to be 2 to 5 years.

b. **Estimated Cost:** Estimated costs for drilling a well and constructing a reservoir and pump station are currently estimated to be about $3,000,000. If the well were located on the existing site, some savings could be realized by using the existing reservoir and portions of the existing pump station. Some improvements would be necessary to bring the facility up to current standards.

c. **Recommendation:** While drilling a replacement well is a viable alternative, based on the experience of searching for a replacement well for Well 3, it will be difficult to complete given the developed nature and historical use of the area. The regulatory requirements and economical feasibility of this alternative will be the critical components in analyzing the viability of drilling a replacement well.

3. Move Surplus Water From other System Wells to the Well 8 Area

a. **Discussion:** A detailed analysis of the east portion of the Main Pressure Zone completed for Well 3 did not indicate that surplus water supply capacity exists on the east side under current or future system demand projections. During the high demand summer months, when the system can be stressed with facilities off line, the east side of the main pressure zone has challenges meeting demands and keeping system reservoirs full. When the system is further stressed by imposing fire flow conditions, the level of service drops to unacceptable levels.

The Madison water distribution system was constructed over the decades as a distributed supply system. Supply points, wells, were located throughout the system to provide service on a neighborhood basis rather than a system wide basis. This style of system has the advantage of keeping piping small and economical. Its disadvantage is the limited hydraulic capacity to move water around the system if too many of these supply points are out of commission. Eliminating Well 8 and drawing water from other Main Pressure Zone wells would require a comprehensive system evaluation and potentially significant costly piping improvements.

b. **Estimated Cost:** Capital Cost is unknown due to required system improvements. The annual operating cost would be the resulting increased pumping required.

c. **Recommendation:** Based on previous analysis of the supply capacity of the Pressure Zone 6 East, sufficient excess water supply capacity does not exist. Eliminating Well 8 and relying on other wells would reduce the reliability of the water system. This alternative will not be considered further.

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4. Construct an Iron and Manganese Filtration Plant

a. Discussion: Constructing a filtration facility to remove the iron and manganese from the Well 8 water is a proactive means of addressing the existing source water quality issue. Maintaining the Well 8 facility maximizes the use of an existing facility, it minimizes the impact to system hydraulics and it will maintain a critical supply point within the eastern portion of the Main Pressure Zone. The condition of the facility was assessed during the 2005 Infrastructure Management Plan and noted the following conclusion *"Well Facility and Reservoir in good shape."*. There were no immediate concerns noted with the facility and with some minor upgrades the facility could provide excellent service to the Utility for many decades to come. The only issue noted in the assessment was the iron and manganese water quality problem being addressed by this project. It is noted that operating a filtration facility at Unit Well 8 will increase the complexity of the facility and therefore increase overall operating costs. A significant advantage of constructing a filter at Well 8 would be the ability to use the well year-round and reduce the stress on other Main Pressure Zone wells.

b. Estimated Cost: Capital Cost: $3.75 million, includes improvements to the existing pump station. Estimated annual operating cost of an iron and manganese filtration plant operating at approximately 75% of full capacity is estimated to be $50,000.

c. Recommendation: This alternative provides a proven way to reduce the levels of iron and manganese in the source water to well below the EPA secondary standard. It will maximize the use of an existing facility and has very little risk associated with it. This alternative was recommended to the Water Utility Board in a report in the January 2008.

5. Disinfect the Well to Control Problem Bacteria

a. Discussion: It has been proposed by a UW-Madison PhD student, Andrew Jacque, that a significant portion of the elevated levels of iron and manganese found within Madison's wells is the result of iron and manganese bacteria. The hypothesis is that thoroughly disinfecting the well will remove the bacteria and thereby reduce a significant portion of the nuisance iron and manganese from the water pumped from Well 8. This is an unproven hypothesis that could be evaluated and validated. The potential for success is unknown and issues such as background iron and manganese levels due to water chemistry, length of effectiveness of well disinfection, costs, and other variables would need to be evaluated to determine feasibility of this alternative.

b. **Estimated Cost:** Total costs of this alternative are unknown. Costs of the initial study could be from $5,000 to $50,000 depending on the testing required and method of well treatment selected. Additional study may be required and these costs are unknown. Frequency of well disinfection is also unknown and may be dependent on well borehole configuration or other factors unknown at this time.

c. **Recommendation:** This is an unproven hypothesis that has the potential of saving the Utility the capital cost of either drilling another well or constructing a filtration facility at Well 8. The risk associated with this alternative is the many unknowns, the time required to evaluate the hypothesis, costs of well treatment or mitigation, and its unknown long-term effectiveness as a treatment method. Due to the significant capital cost benefits, the hypothesis will be evaluated further.

6. Provide Regional Treatment

a. **Discussion:** The cost of well treatment is a significant capital investment and there could be some economic advantages to regionalizing and centralizing treatment. Similar water quality challenges facing the Utility at Unit Well 7, 24, and 17, all main zone wells, may benefit from a regional treatment facility. Untreated raw water would be pumped from the wells to a centrally located treatment facility. This alternative would require the construction of raw water transmission mains and improvement to the well pumps to meet revised hydraulic requirements. Construction of miles of raw water transmission mains would be a significant capital cost that would impact the economics of this alternative. The treatment plant would benefit due to the economy of scale, doubling or tripling its size will not result in a proportional increase in capital and operating costs. Moving the water to a centralized location for treatment would modify system hydraulics and may result in the requirement for significant distribution system improvements to get the water from the treatment facility to where it is needed. A significant advantage of this alternative would be the improved water quality at Wells 7, 24, and possibly 17.

b. **Estimated Cost:** Assuming that a regionalized iron and manganese treatment facility would treat 3 wells it would have a capacity of approximately 9 million gallons per day. Capital costs would be $5 to $7 million depending on site constraints and treatment process selected. Treatment facility operating costs would exceed $100,000 per year. Transmission mains could cost $4 to 6 million depending upon routes selected. Additional annual raw water pumping costs would be $20,000 to $30,000. The cost of other required system hydraulic improvements is unknown.

c. **Recommendation:** This alternative has merit and should be considered further. To fully evaluate the economics of this alternative will require significant system hydraulic analysis to develop all capital and operations cost impacts.

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7. Blend the Well 8 Water with Other High Quality Water to Reduce Water Quality Impacts from Well 8

a. **Discussion**: By pumping Well 8 water to a well with better water quality, the water could be blended in the reservoir to lessen the impact of the iron and manganese levels at Well 8. Mixing Well 8 and Well 11 would be one proposal for this alternative. With the construction of a raw water transmission main, water would be pumped from Well 8 to Well 11 and mixed in the Well 11 reservoir effectively diluting the Well 8 water. Mixing the wells in the proportion of 33% Well 8 and 67% Well 11 (2:1) would bring the iron levels down to approximately 0.2 mg/l and the manganese levels down to 20 ug/l. These iron and manganese levels, while below the EPA secondary standard, make the economic investment for this alternative questionable. The disadvantage of this alternative would be that the Well 11 service area would experience a decrease in water quality that may not be acceptable to Well 11 customers. This alternative would result in additional flushing of the service area of Well 11 increasing operational costs. To mitigate this impact, the blending option could only be used in the summer. This limited operation would impact the economic feasibility of this option. Another distinct disadvantage to this option is that the need to reduce production to 50% at Well 8 reduces the usable capacity of Well 8 to only 1.3 million gallons per day.

b. **Estimated Cost:** Capital cost: $1.75 to $2 million for the transmission main, upgrading the well pump at Well 8, upgrading the booster pump system at Well 11, and installing a mixing system in the Well 11 reservoir. Estimated annual operating cost of pumping the water from Well 8 to Well 11 is estimated to be $12,000. Due to the fact that the water from two wells would now enter the distribution system at a single point, some unknown system improvements may be required to maintain the level of service within the system.

c. **Recommendation:** Given the limited water quality benefit and the reduced production capacity of Well 8, this alternative is not considered to be feasible and will not be considered further.

5. Photographic Examples	*Photographic examples of similar facilities with discussion of possible variations.*

Photographs of Unit Well 8 and similar well and filtration facilities are attached. These photos illustrate the varied architecture that would be used to “fit into” any neighborhood. Madison Water Utility is committed to working with the neighborhood and the approving authorities to construct facilities that complement the neighborhood in terms of scale, architectural context, and site layout.

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6. Capital Cost Estimate

The cost of the project by major plant accounts.

A filter to remove the iron and manganese was recommended in a report to the Water Utility Board in January 2008. The cost of adding a filter to Unit Well 8 is estimated in the Utility 2009 and 2010 Capital Budget which includes:

Pilot study, design, and contract administration services (2009):	$350,000
Construction/Training/Startup Cost (2010):	$3,400,000

The cost estimates for this project will be revised accordingly based on the selected alternative.

7. Financing

The proposed method of financing the project.

The capital projects budget is funded through the issuance of revenue bonds.

8. Operational Costs

The estimated annual operating costs of the project, by major expense accounts, to include possible fiscal effects of water treatment if anticipated.

Annual operating costs are estimated to be: $50,000 per year based on year-round operation of the filter and an estimated annual production of 500 million gallons of water.

This estimate will be updated and revised based on the alternative selected for this project.

9. Replacement Costs

A description of and the original cost of any property being replaced, by major plant accounts.

To implement one of the alternatives noted above is a significant alteration to an existing facility. No property will be replaced with the construction of this project.

10. Designation of Affected Parties, Notification List

The designation of public utilities, alders, and other persons materially affected by the project and a list of those, which have been notified.

The stakeholder list includes the Aldermanic Representatives from City of Madison Aldermanic Districts 6 and 15, Madison Parks, various neighborhood organizations on the East Isthmus, Olbrich Botanical Society, residents and businesses within the historic service area of Well 8 as depicted on Figure 9, and the community at-large. Other interested groups or associations identified by the Alders, the Water Board, or staff may be added to the stakeholders list.

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11. RFP for Property Valuation Analysis	*A draft request for proposals (RFP) for the acquisition of services to determine the impact on values of adjoining properties.*

Madison Water Utility will work closely with the project stakeholders such that this project will not negatively impact any of the surrounding neighborhoods. If the project CAP deems it necessary to acquire services to determine the negative impact on values of properties adjoining the project, a request for proposals (RFP) will be prepared for acquiring such services.

12. Site Selection Criteria	*A description of the draft site selection criteria to be used in locating, evaluating, and ranking potential sites for the proposed facility. Site selection criteria categories will include regulatory requirements, groundwater quality and quantity, aesthetic impact, compatibility with existing neighborhood context, historic land use, existence of natural buffers, and environmental equity/justice considerations.*

Site selection criteria to be used for this project will include, but not be limited to the following categories: regulatory requirements, Madison Water Utility standards and level of service requirements, groundwater quality, groundwater quantity, contamination potential, long term aesthetic impacts, compatibility and suitability with existing neighborhood context, historic land use, existence of natural buffers, and environmental equity/justice considerations.

13. Project Timeline	*The estimated project timeline, with identifies major project phases and decision points requiring an approved resolution from the Water Utility Board. Project phases requiring a resolution shall, at a minimum, include the establishment of the proposed project, the facility site selection, and the site plan selection.*

The estimated project timeline includes the following:

- Friday December 5, 2008 – Draft documents circulated for review and comment
- February 27, 2009 – Meet with Alder Rummel
- Friday March 6, 2009 – Transmit final documents to District 6 and 15 Alders, post information on Utility Web Page & mail notification to stakeholders and residents
- March 24, 2009 – Water Board refers the Scoping Document to May 2009 meeting
- Week of April 13th, 2009 – Hold first public meeting
- Week of April 27th, 2009 – Convene Citizen's Advisory Committee if interest exists
- Incorporate any comments into the scoping document
- Solicit written comments until May 20th, 2009
- May 26th, 2009 – Public Hearing before the Water Board; Water Board considers the comments and the Scoping Document and acts on whether or not to establish the project.
- If project is established, proceed with project alternative evaluation phase
- Alternative selection by October 1, 2009
- Site analysis, evaluation, and testing by January 31st, 2010
- Preliminary Design by May 1st, 2010
- Architectural review and final design completed by August 2010

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- Permitting and Bidding December 2010
- Construction in Spring/Summer/Fall 2011
- Fully operational January 2012

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14. Appendix

Documents referenced in the Scoping Document.

List of Attachments

Well 8 Well Log	Figure 1
Well 8 Historic Average Pumpage	Figure 2
Well 8 Pumping and Complaint History	Figure 3
Well 8 Service Area	Figure 4
Well 8 Iron and Manganese Concentrations	Figure 5
Existing Madison Water Utility Facility Map	Figure 6
Existing and Proposed Zoning	Figure 7
Land Use	Figure 8
Public Notification Area	Figure 9
2008 Inorganic Analyses	Table 1
Photos of Unit Well 8	
Photos of Existing Unit Wells	