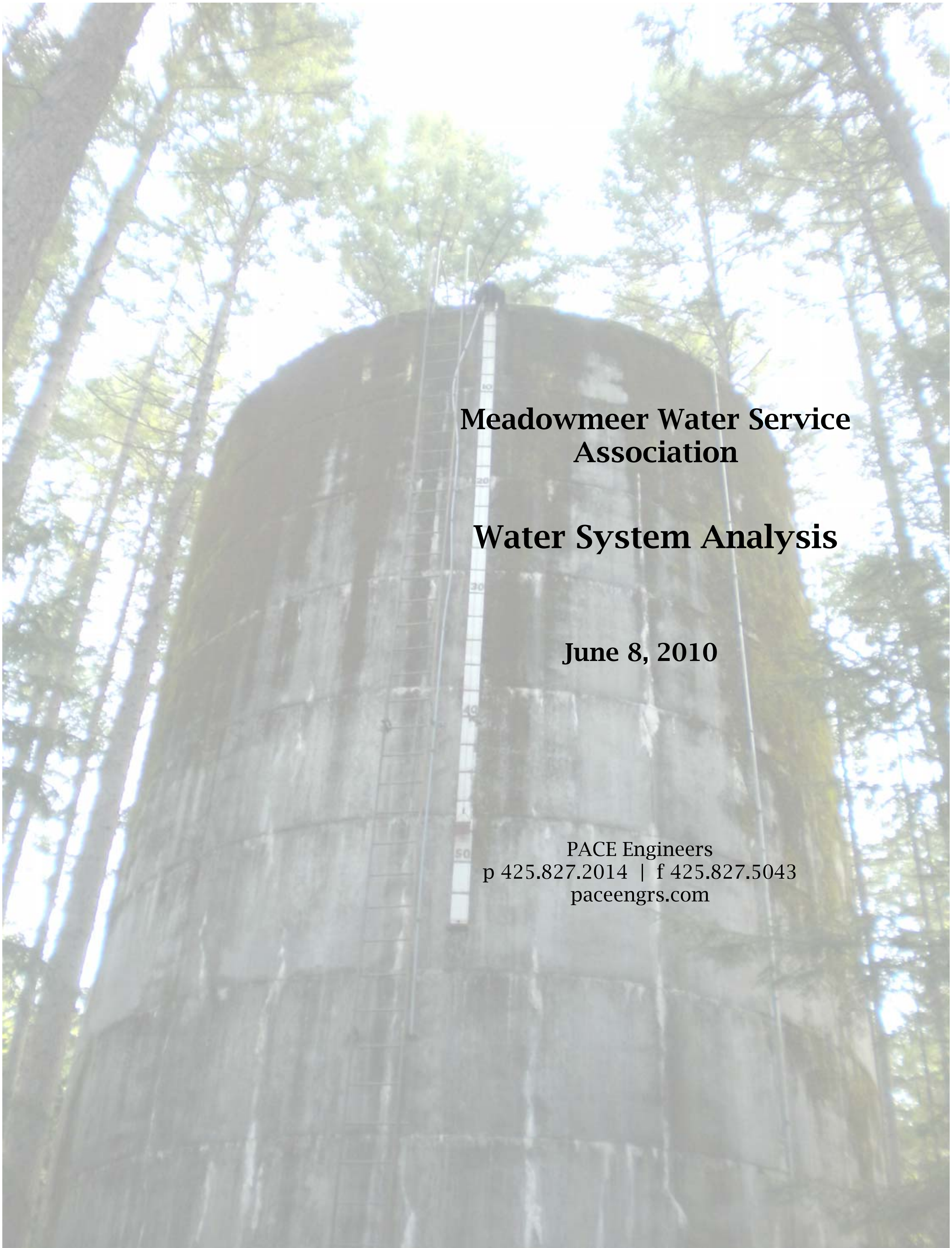

Meadowmeer Water Service Association

Water System Analysis

June 8, 2010

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MEADOWMEER WATER SERVICE ASSOCATION
WATER SYSTEM ANALYSIS

1. INTRODUCTION

This report summarizes the analyses performed on the Meadowmeer Water Service Association (MWSA) water system under existing and future conditions and presents the recommendations arrived at as a result of those analyses. The water system has been analyzed in accordance with the requirements of the State Department of Health (DOH) and typical minimum design criteria utilized by PACE for similar water systems. Note that no hydraulic modeling analyses have been performed as part of this study effort. Therefore, the capability of the system to maintain adequate pressures during specific flow events (fire flow, peak hour, etc.) has been assumed from previous studies and modeling. The last MWSA comprehensive plan update indicated that the addition of a second transmission loop to the east would be sufficient to address fire flow issues in the eastern portion of the system. That second loop was constructed several years ago and we therefore assume that adequate fire flow is available throughout the system.

PACE Engineers, Inc. was authorized by the MWSA Board of Directors to complete this study and provide them with additional information necessary to make informed decisions regarding operation and maintenance of the system and ensure that funding resources are adequate to meet capital improvement requirements. This study is not intended to be an update of the existing Comprehensive Water System Plan, the last update of which occurred in 2006. Rather it is an independent analysis of the existing system facilities only and does not duplicate much of the work put into the 2006 document. Readers should therefore refer to the current Plan for background information on the system and additional information regarding issues such as wellhead protection, system modeling, well reports, aquifer levels, etc.

2. PLANNING ASSUMPTIONS

Meadowmeer Water has an established service area boundary and has no plans to expand its designated retail water service area outside of its current delineation. With the exception of the Tennis and Health Club and the Golf Course club house, no other business connections currently exist within the service area, nor are any expected in the foreseeable future. Current zoning limits any further development of commercial or industrial use, and the overall make-up remains within zoning that allows either one dwelling unit per 2 acres or one dwelling unit per 0.4 acres. For the purposes of water system facility planning, historical water consumption records are analyzed and then projected based on the number of equivalent residential units (ERUs) in the system. The Tennis and Health Club service connection has been estimated to consume approximately ten times the amount of the average household and is therefore assessed as 10 ERU's. Likewise, the golf course clubhouse has been determined to be equivalent to 4 ERU's. These are the only two service connections that represent more than one ERU in the system.

In 2005, the City of Bainbridge Island completed an analysis of potential housing capacity based upon land use for growth management purposes. The results of the *Final Report: Mayor's 2025 Growth Advisory Committee* show that the area served by Meadowmeer has potential for a modest increase in development. Setting aside properties that have been designated as "farms" to conserve open space, MWSA can expect up to 40 new units on currently (2009) vacant parcels, and up to 24 new residences on lots that could be sub-divided and/or redeveloped to the maximum density allowed under current (2009) established zoning. While the rate of growth in the area remains uncertain, the Puget Sound Regional Council has estimated an annual growth rate of 1.3% for residences in the area. At this rate, the MWSA area would reach its maximum allowable (build-out) development by 2025. However, local knowledge of the properties owned in the service area indicates a slower growth rate is more likely to occur, and as such, it is assumed full build-out will not occur until the year 2030. Table 1 below describes the anticipated growth in units used in this analysis.

TABLE 1: EQUIVALENT RESIDENTIAL UNITS (ERUs) PROJECTIONS
MEADOWMEER WATER SERVICE ASSOCIATION

Year	Single Family Residential Connections	Residential ERUs	Business Connections	Business ERUs	Total ERUs
2010	291	295	2	14	305
2020	323	327	2	14	337
2030	355	359	2	14	369

Notes: ERU's are based on an average use of 248 gallons/day and provide a means for capacity analyses and sizing of facilities.

3. HISTORIC WATER CONSUMPTION

MWSA has experienced a significant drop in average household water consumption since it installed meters on all source and service connections, which were completed in 2000. All customers are now metered and an increasing block rate structure, established in 2001, has encouraged conservation for most customers resulting in a downward trend in average and peak day demand in the service area. Table 2 indicates the average and peak day consumption based on well pumping records.

TABLE 2: HISTORIC CONSUMPTION
MEADOWMEER WATER SERVICE ASSOCIATION

Year	ERUs	Average Daily Production (gal)	Average Day Demand per ERU (gal)	Peak Day Production[1]	Peak Day Demand per ERU (gal)	PDD to ADD Factor
2006	289	81,044	280	196,897	681	2.43
2007	304	70,923	233	197,622	650	2.79
2008	303	73,084	241	204,773	676	2.80
2009	305	71,839	236	186,527	612	2.60
Average, 2006-2009	**300**	**74,222**	**248**	**196,455**	**655**	**2.65**

Notes: 1 - Based on an average of the five highest days of production for each year

4. PROJECTED WATER DEMANDS

Meadowmeer Water expects to see similar production levels to that shown for the past four years (see Table 2). With a potential growth in ERUs from the present 305 (2009) to 369 (2030), the increase in water consumption from new customers will have an impact on various facilities in the system. Table 3 shows the anticipated total average and peak day production required to meet MWSA's future customers, based on recent trends in use.

TABLE 3: PROJECTED DEMANDS
MEADOWMEER WATER SERVICE ASSOCIATION

Year	ERUs	Projected ADD (gal)	Projected ADD per ERU (gal)	Projected PDD (gal)	Projected PDD per ERU (gal)	PDD to ADD Factor
2010	305	75,640	248	199,775	655	2.65
2020	337	83,576	248	220,735	655	2.65
2030	369	91,512	248	241,695	655	2.65

Notes: ADD = Average Day Demand based on annual use/365 days.
PDD = Peak Day Demand and is based on ADD times the peaking factor to accommodate high water use typically occurring on hot summer days.

The analysis performed on the source, storage, and pumping facilities owned and operated by MWSA are based on the assumed consumption figures provided in Table 3. Impacts on various facilities are discussed in the following paragraphs.

5. SOURCE OF SUPPLY

The supply requirements for the MWSA are based on the guidelines established by the Washington State Department of Health's "Water System Design Manual" (2009 Edition). Based on these guidelines, a water supply should be able to deliver the maximum day demand (MDD) of the system while concurrently replenishing the depleted fire suppression storage within 72 hours.

5.1. Existing Source Facilities

There are currently three groundwater wells utilized as source facilities for MWSA. These include wells SO1, SO2 and SO5, which have rated pumping capacities of 50, 162 and 150 gpm respectively. Well SO1 has good quality water but has experienced a declining yield over the last several years. It is therefore used only during non-peak seasons. Well SO2 also has good quality water and is the main production well for MWSA and runs year-round. Well SO5 is a high production well but has iron and manganese. While the iron levels are above the allowed Maximum Concentration Levels (MCL's), manganese is below the MCL. Therefore, the water from wells SO2 and SO5 is currently blended to bring the iron concentration level down to acceptable levels.

The water from all three wells is also slightly acidic, which has in the past caused copper to leach out of some home plumbing fixtures resulting in copper levels slightly above the MCL. To correct this problem, water from the wells is sprayed into an aeration tank to raise the pH. This process has been successful in controlling the copper corrosion problem and the system has been below the MCL for copper since aeration implementation in 2003. For additional information on the history of water treatment analyses and efforts, refer to the 2006 Comprehensive Plan.

5.2. Source Analysis and Recommendations

The Washington State Department of Health (DOH) Water Design Manual requires that "[All] public water system[s] must have sufficient source capacity to meet the demands of its customers as stipulated in WAC 246-290-222(4). The source(s), in accordance with WAC 246-290-130(1), must provide drinking water of the highest quality feasible. It is further required that the source(s) be sufficient to provide reliable service in accordance with the provisions of WAC 246-290-420."

Table 4 lists all active sources in the MWSA system, and the associated supply requirements for the years 2010, 2020 and 2030. Comparing available source rates to Fire Suppression Storage (FSS) requirements and projected peak day demands (PDD) provides an overview of the ability of current sources of supply to meet or exceed future demands. Table 4 shows that the capacity of the MWSA source facilities is sufficient to provide adequate service through build-out of the area.

TABLE 4: SOURCE ANALYSIS
MEADOWMEER WATER SERVICE ASSOCIATION

Year	ERUs	MDD (gpm)	FSS[1] (gpm)	Required Source (gpm)	Existing Source (gpm)	Surplus (Deficit) (gpm)
2010	305	53	11	64	362	298
2020	337	58	11	69	362	293
2030	369	64	11	75	362	287

Notes: 1 – Fire Suppression Storage (FSS) replenishing rate. The rate at which a source must replenish the FSS volume within 72 hours. FSS is based on the anticipated fire flow requirements of 750 gpm for a duration of 1 hour.

5.3 Source Reliability

Although there are three primary wells serving the system, they are all in the same location which makes them all vulnerable to a power outage. There are currently no provisions for providing backup power. There is also potential vulnerability to a contamination of the source aquifer, which would be much more long term than a power outage.

For the power outage issue, it is recommended that provisions be added for connection of a portable generator to run critical equipment. This would include a generator receptacle, pigtail (cord and plug) and manual transfer switch. Many systems add on-site backup power generation but those facilities increase O&M costs because they have to be regularly exercised, the fuel source has to be kept fresh and they can be a target for vandalism. They also represent a significant capital investment for something that may rarely be used. The upside of on-site generation is that it is always there when needed versus having to find an available generator under conditions where many other critical facilities in the immediate area may also be without power. It is recommended that MWSA enter into an agreement with a local rental agency such that they get priority consideration for a generator under emergency conditions. The agreement should be for a generator that is large enough at a minimum to run one of the higher production wells (preferably Well SO2) and one of the booster pumps.

To provide a backup source for the potential aquifer/source contamination issue, it is recommended that an intertie with an adjacent system be pursued. The system's supply must be adequate to accommodate the addition of the MWSA peak day demand at least on a temporary basis. There were a couple potential intertie locations mentioned in the current Comprehensive Plan. These included an intertie with the Kitsap County Public Utility District No. 1 in Penny Place extended to Lovegren Road. This intertie would include construction of approximately 750 lineal feet of 6" main and would require acquisition of several easements.

The second intertie location identified was with the Sunset Hills Water System, a system to which MWSA was formerly connected. The location would be approximately at the intersection of Penny Place and Bayhill Road. Although this intertie would require only a short spool of pipe, the piping on each side of the connection is only 3" in diameter and the Sunset Hills System is very small, serving only approximately 80 people. It would therefore not have the capacity to provide a significant amount of water to MWSA.

A third intertie alternative would be with the Kitsap County PUD #1. The location would be at the intersection of Miller Road NE and NE Koura Road. Although there is an existing MWSA main in this vicinity of Koura Road, it is only 1½" in size and would have to be replaced with a larger main. The intertie improvements would therefore involve construction of approximately 900 lineal feet of 4" main in Koura Road. It is not known at this time whether the hydraulic grades of the systems are compatible or whether one system would have to pump to the other. For estimating purposes, it is assumed that a pump would be required on the MWSA side to provide adequate pressure. Under emergency conditions, this connection would be expected to provide the maximum daily demand of 655 gallons per ERU. Per Table 4, that equates to a flow rate of 75 gpm at buildout.

5.4 Source Protection

The groundwater aquifer from which MWSA withdraws its water supply is replenished naturally by surface water recharge. As described in WAC 246-290-105, small Group A public water systems such as MWSA have to submit and maintain a Wellhead Protection Plan (WHPP) as part of their Small Water System Management Program. Aside from adhering to State law, it is imperative that MWSA create and adopt a Wellhead Protection Plan in order to minimize potential public health risks to its water supply and its customers. The WHPP must include, at a minimum, the following components when submitting to DOH:

1. A completed susceptibility assessment or equivalent information.
2. A Wellhead Protection Area (WHPA) delineation for each well, wellfield, or spring with the six month, one, five and ten-year time of travel boundaries marked. If time of travel cannot be reasonably defined, delineation can be performed using recognized methods in the Washington State DOH guidance on wellhead

protection document or in the *EPA Guidance for Delineation of Wellhead Protection Areas.*

The WHPP may include management measures such as posting signs to notify the public of the delineated WHPA, encouraging the golf course to use fertilizers and pesticides that present a low risk to contaminating the aquifer, and inventorying potential contaminant sources such as underground fuel storage tanks within the WHPA. As far as we know, MWSA has not had any water quality issues that may have resulted from improper application of pesticides or fertilizers, but maintaining a working relationship or partnership with the owner of the golf course to ensure its practices are consistent with healthy wellhead management practices is recommended. Currently, MWSA has the advantage of its primary water utility operator also serving as the head grounds keeper at the golf course. Should this arrangement ever change, MWSA will want to ensure critical information such as changes in pesticide and fertilizer use is communicated with the MWSA water system manager.

Collecting and maintaining an inventory of the historic uses of land within the service area will assist MWSA in completing its susceptibility assessment and WHPP. In addition to the golf course, the area has residential septic systems and a history of minor livestock operations and strawberry farming activities. These and any other potential contaminants will need to be included in the inventory of potential ground water contamination sources.

6. WATER STORAGE

The storage requirements are based on the following components: effective storage, equalizing storage, standby storage, and fire suppression storage. In addition to these primary storage components is operational storage, which is used to prevent excessive cycling of supply pump motors. Each of the individual storage components are described below.

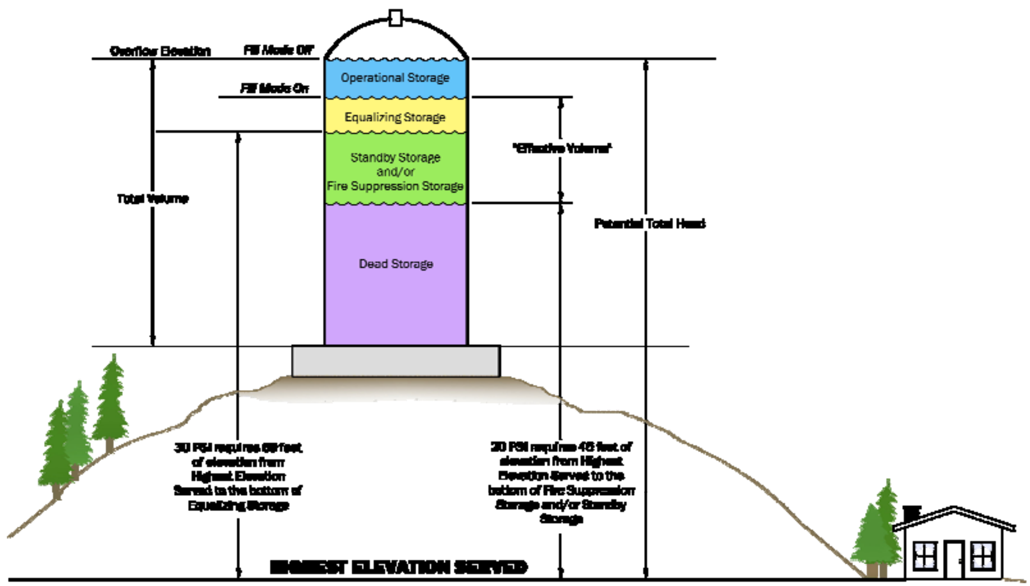
6.1. Effective Storage

The total volume of a reservoir or storage tank, as measured between the overflow elevation and the outlet elevation, may not necessarily equal the effective volume available to the water system. Effective volume is equal to the total volume less any dead storage built into the reservoir. Dead storage is defined as the volume of water stored and not available to all customers at the minimum design pressure in accordance with WAC 246-090-230 (5) and (6). The dead storage volume is excluded from the volumes provided to meet the operational, equalizing, and fire suppression storage requirements.

6.2. Operational Storage

As defined previously, the operational storage is the volume of water available to supply the system under normal operating conditions while the source is "off". This volume varies according to the sensitivity of the water level sensors controlling the source pumps and the configuration of the tanks designed to provide the required volume while preventing excessive cycling of the pump motor(s). We note that normal operation of the reservoir calls for pumps to shut off at the 49.5-foot level in the 52-foot tank (as indicated in information provided to us by MWSA staff). For this analysis, we have assumed that normal operation is bumped up by two feet such that the level ranges between 49.5 and 51.5 feet. This gains nearly 8,000 gallons in usable storage.

WATER STORAGE RESERVOIR SCHEMATIC



6.3. Equalizing Storage

The most common method for determining equalization storage is to utilize the formula shown below, from DOH's "Water System Design Manual":

> ES = (PHD-QS) * 150 Minutes (but in no case less than zero)
> *Where:*
> ES = Equalization Storage, gallons
> PHD = Peak Hourly Demand, gpm
> QS = Sum of all installed and active source of supply capacities, except emergency source of supply, gpm.

This method was used in determining the equalization storage requirements for the MWSA. To increase reliability in the system, one of the pumps in the well house was considered to be off-line.

6.4. Standby Storage

For multiple source systems, the DOH minimum required standby storage volume is 200 gallons per connection which should be located above the elevation necessary to provide service at 20 psi to all connections. Water systems with single sources are required to have a standby storage volume of twice the average day demand per the equation below.

ADD x N x 2 = Total Standby Storage Required
Where:
ADD = Average Day Demand for the MWSA (248 gal/ERU/day)
ERU's = The number of ERU's served by the Storage facility
2 = 2 days of water supply

For reasons of increased reliability, some systems with multiple sources choose to provide the two days of average day demand required of single source systems.

6.5. Fire Suppression Storage

Fire suppression storage calculations are based on fire flow requirements for buildings and improvements typically found in various types of assigned land use and zoning. For the Meadowmeer system, the fire flow requirements are 750 gpm for a period of one hour, resulting in 45,000 gallons of storage to be readily available for fire fighting.

6.6. Existing Storage Facilities

The MWSA currently has a single concrete standpipe located on Mandus Olson Road that is approximately 26 feet in diameter by 52 feet tall, with a total storage capacity of 206,492 gallons. The reservoir was constructed in 1980 and is in fairly good condition. There is also a 35,000 gallon steel tank on the well site that is used as an aeration tank for pH adjustment of the water to eliminate corrosion issues with copper piping. The smaller aeration tank could theoretically be included as standby storage in the case of the loss of the well source, but currently can not be used in the case of a power outage. It therefore is not included in the total storage volume calculations.

6.7. Storage Analysis and Recommendations

Analysis of storage volume is often times based on the sum of three storage components: equalizing (ES), standby (SB), and fire suppression storage (FSS). However, DOH requirements allow for "nesting" of fire suppression and standby storage. This is the situation where the smaller of the two storage components is allowed to be excluded from the total storage calculation. The MWSA was in fact granted DOH approval in 1999 for a certain number of ERU's based on nesting, or consolidation of Standby and Fire Suppression storage. For water quality reasons, this is often the preferred approach to storage for smaller systems. Therefore, based on past history in the MWSA system and on typical recommendations for small systems, the storage analysis has been performed based on the assumption of nesting.

Water storage must also be located at an elevation above which all services can be provided a minimum of 30 psi at the meter under normal operations and 20 psi under emergency conditions. In the case of the several services south of the reservoir, along Mandus Olson Road, they lie at an elevation such that 30 psi cannot be provided by gravity even when the reservoir is full. Therefore, for storage analysis purposes, it is assumed that a pump station will be provided to serve these properties as discussed further in Section 8. It is also assumed that the next highest property served by gravity is at elevation 280 feet. This number has been identified in previous studies. In that case, the lower 13 feet of the reservoir, or nearly 52,000 gallons, is considered to be unusable or dead storage under normal operating conditions. However, under emergency conditions, a portion of the standby storage could be considered to occupy that lower 13 feet and still provide 20 psi to all services. Therefore, for overall storage requirement calculations, dead storage is considered to be zero.

Table 5 summarizes the storage requirements and potential deficiencies based on an analysis of present (2010), near-term future (2020), and long-term future (2030) scenarios. Two versions of Table 5 have been presented herein. One provides the storage analysis based on the minimum required Standby Storage volume of 200 gallons per ERU and the other provides analysis based on the more conservative value of two times the ADD per ERU. Although the MWSA can be considered to be a multiple source system, and as such could justify the use of the lower value for Standby Storage, an argument could also be made that due to their proximity to each other, all of the sources (wells) are vulnerable to outage at the same time. For this reason, it is PACE's recommendation that the larger value be used at this time for the MWSA system.

Addition of a standby power source at the well site would allow the system to operate more as a multiple source system, which could justify the use of a smaller Standby Storage volume. The MWSA Board should discuss the issue to determine their level of comfort regarding the amount of emergency storage to provide and consider factors such as the number, frequency and duration of power outages, the reliability of well pumps and controls and the ability of customers to curtail water use in the event of a serious emergency.

As depicted in the Table 5, the MWSA system has adequate storage volume through build-out of the system when utilizing the lower value for Standby Storage. However, if the higher value is used, calculations indicate that the system is currently deficient by approximately 18,000 gallons, which will increase to about 58,000 gallons at build-out.

Should the Board elect to provide the larger Standby Storage volume, it is recommended that a second standpipe of approximately 60,000 gallons total volume be constructed. This would be a 14-foot diameter by 52-foot tall tank (closest standard form size). It is important to note that increasing the storage volume may result in water quality issues during certain portions of the year due to decreased turnover in the reservoirs.

6.7.1 Storage Reliability

Below is an analysis of both the concrete reservoir and the steel aeration tank to address concerns of MWSA staff regarding reliability/longevity of the facilities.

Concrete Reservoir

During PACE's site visit, there were a couple of questions regarding the dependability of the existing concrete reservoir. While newer concrete reservoirs utilize approximately double the amount of reinforcing steel as older ones to comply with ever-changing seismic requirements, we know of no local concrete reservoirs that have failed during the seismic events of the recent past. We contacted the foremost provider of concrete reservoirs in the area who indicated they would have absolutely no concern about the structural integrity of a tank that was constructed 30 years ago. Based on this, we believe the existing reservoir still has many years of useful life.

One potential issue that has arisen on some of the older concrete tanks is due to the failure to apply a sealant between the top of the wall and the roof slab at the time of construction. In those cases, water could potentially run off of the roof and seep through the cold joint into the tank. This is easily remedied by cleaning around the joint and applying an external sealant. If there is concern, maintenance personnel may want to investigate the joint on the MWSA tank and have a sealant applied if necessary. The cost of this has been estimated at about $1,000.

The concrete reservoir looked fairly weathered and was covered in places with mildew, moss and graffiti. However, this should not have any effect on the functionality and longevity of the reservoir. The reservoir can be pressure washed to rid it of these items if there is an aesthetic issue but it is fairly well hidden by trees and this would be an item of personal preference.

For maintenance purposes, the reservoir should be drained, cleaned and inspected approximately every 5 years. This will help identify any internal issues that need to be addressed. We were told that the last inspection revealed that the internal ladder was in fairly poor condition. MWSA may wish at some time in the future to replace the ladder and overflow pipe supports with a non-corrosive material such as stainless steel or fiberglass reinforced plastic (FRP).

Steel Aeration Tank

There was also concern expressed about the integrity of the steel aeration tank because of its age. It is partially buried in the ground and appears to have a coal tar coating on the exterior surfaces. The interior of this tank was apparently sandblasted and epoxy coated several years ago when the aeration process began. At that time no obvious structural issues were discovered or noted. There is also no visible indication of any leaking in the immediate area around the tank. Although an investigation of the interior was not performed, we were told that the aeration nozzles are impinging on the tank surface and causing wear and damage to the epoxy coating.

Although not the most visually appealing facility, the above grade portions of the exterior of the tank looked to be in good enough condition. For the buried portions, it may be desirable to perform some spot investigations by exposing several areas below grade and checking the condition of the coating and of the steel walls themselves. Although this may not uncover specific problem areas, if they exist, it will give an indication of the general condition of the tank walls. Care should be taken to restore any coating that is removed or damaged during the testing and investigations.

For the spray system and wear on the interior coating, there may be fairly simple solutions to address the issue. From visual inspection, it looks as though the rigid pipe headers that the nozzles are connected to could be easily extended further into the tank such that the force of the spray on the tank walls would be reduced. Any damaged paint areas should be assessed and touched up at the time piping modifications are made.

TABLE 5: STORAGE FACILITY ANALYSIS
(200 GALLONS PER ERU FOR STANDBY)
MEADOWMEER WATER SERVICE ASSOCIATION

Year	Existing Storage (gallons)				Effective Storage Required (gallons)				A – B
	Total Capacity	Operating Storage (OS)	Dead Storage (DS)	Net Available (A)	Equalizing Storage (ES)	Standby Storage (SB)	Fire Suppress. Storage (FSS)	Total Required (B)	Storage Surplus (gal.)
2010	196,582	7,943	0	196,582	18,686	61,000	45,000	124,686	71,895
2020	196,582	7,943	0	196,582	22,616	67,400	45,000	135,016	61,565
2030	196,582	7,943	0	196,582	26,546	73,800	45,000	145,346	51,235

Notes: Standby Storage assumes a minimum of 200 gallons per ERU will be available.
Dead Storage assumes highest service is 280 feet. SB and FSS are nested.

TABLE 5: STORAGE FACILITY ANALYSIS
(2 DAYS OF ADD PER ERU FOR STANDBY)
MEADOWMEER WATER SERVICE ASSOCIATION

Year	Existing Storage (gallons)				Effective Storage Required (gallons)				A – B
	Total Capacity	Operating Storage (OS)	Dead Storage (DS)	Net Available (A)	Equalizing Storage (ES)	Standby Storage (SB)	Fire Suppress. Storage (FSS)	Total Required (B)	Storage Surplus (gal.)
2010	196,582	7,943	0	196,582	18,686	151,046	45,000	214,732	-18,150
2020	196,582	7,943	0	196,582	22,616	166,893	45,000	234,510	-37,928
2030	196,582	7,943	0	196,582	26,546	182,741	45,000	254,287	-57,705

Notes: Standby Storage assumes a minimum of 2 days of average day use (248 gallons) per ERU will be available.
Dead Storage assumes highest service is 280 feet. SB and FSS are nested.

7. PUMPING FACILITIES

7.1. Existing Pumping Facilities

There are currently two booster pumps on the MWSA well site. These are used to pump water from the aeration tank to the system and storage reservoir. Each pump is capable of pumping 150 gpm into the system. However, a section of the discharge main directly downstream of the pumps is 4 inches in size which creates a bottleneck and high head losses when both pumps are running. The result is that instead of doubling the flow rate with both pumps running (300 gpm), the maximum that can be achieved is approximately 200 to 250 gpm.

7.2. Pumping Analysis and Recommendations

Since all water used by the system must be pumped, the pump station analysis falls under the same criteria as the source analysis. Along with the recommendation that the source be able to replenish the fire suppression storage within 72 hours while delivering the maximum day demand, it is also recommended for reliability purposes that the maximum day demand be met with 18 hours of continuous pumping and that the average day demand be deliverable with the largest source pump off-line, or in this case with one of the two pumps out of service.

Since the buildout source requirement is around 75 gpm, the existing pumping system is easily capable of providing the appropriate level of service with one pump out of service. However, to provide a level of comfort that all peak demands can be met, the MWSA may wish to replace the short section of 4" pipe immediately downstream of the pumps to allow a higher flow rate when both pumps are running.

8. SYSTEM PRESSURES

There is currently only one pressure zone within the MWSA service area. With the reservoir nearly full, pressures in the system range from a low of about 19 psi for those services off of Mandus Olson Road south of the reservoir, to about 125 psi along Just A Meer Lane at the NE corner of the system.

Although preferences vary, public water systems typically like to maintain system pressures in the 40 to 80 psi range. High pressures are of concern due to the fact that, at high pressures, many distribution pipes (especially older pipes) may be subject to greater stresses than they are designed to withstand on a consistent basis. Higher pressures also result in greater losses of water through leaks. Low pressures on the other hand are obviously of concern in that they do not meet the service criteria established by DOH, which is that a minimum pressure of 30 psi must be provided at the service meter under peak hour demand (PHD) conditions. Low system pressures also increase the chances of backflow of non-potable water into the system from unprotected connections.

8.1. Pressure Analysis and Recommendations

As stated above, the low pressures provided to the services along Mandus Olson Road south of the reservoir do not meet DOH service pressure requirements. Although these services have individual pressure booster pumps, it is the water system's responsibility to provide 30 psi at the meter. To correct this deficiency, a small constant pressure pump system could be installed to serve the area south of the reservoir. An example of such a system is shown in the attached exhibit. The size of the pump system should be capable of providing the peak hour demand for the number of ERU's that could potentially be served in that specific area. The water mains serving these residences are not large enough to support fire flow volumes. Therefore, a fire pump is not warranted until such times as the mains are upsized.

For the high pressure area in Just-A-Meer, the issue can be resolved by the installation of a main line PRV at the east end of Meadowmeer Circle NE. Although the customers in this development have individual PRV's on their services, this does not relieve the pressure on the public line that serves them. Therefore, a system PRV is preferred. The new PRV should be set to reduce the pressure approximately 50 psi such that the maximum pressure delivered to the development is about 75 psi. This would take much of the strain off of the existing main line.

9. TRANSMISSION AND DISTRIBUTION SYSTEM

The purpose of the transmission and distribution systems is to convey water to customers within the system at adequate service pressures while providing fire protection and maintaining water quality. The distribution system should have sufficient hydraulic capacity to meet the peak hour demand at residual pressures that do not fall below 30 psi. Adequate hydraulic capacity must also be available to deliver fire flows during maximum day demand while maintaining a residual pressure of at least 20 psi throughout the entire system. Again, we are relying on the hydraulic modeling performed as part of the last Comprehensive Plan update, which indicated that the system was capable of meeting the above criteria. In the absence of new modeling information, only general observations about the distribution/piping system are made herein.

In order to provide an appropriate level of redundancy in the system and to minimize water quality issues, looping of mains is recommended wherever feasible. The elimination of dead-end mains helps to provide greater circulation of water through the system and helps to alleviate the problems associated with stagnant water such as poor taste and unpleasant odors.

In a general review of the existing system map it is very clear that looping of system mains has been made a priority by MWSA managers and operators in the past. Although some mains are undersized, the level of looping is impressive for a system of this size.

There is some asbestos cement (AC) water main in the system, including the primary east-west transmission main in Koura Road. While many water system jurisdictions have AC main replacement programs in place, where they replace a certain number of lineal feet or a certain dollar value of AC mains per year, it is not necessarily just because of the fact that it is AC pipe. Often times it is largely due to the fact that their AC mains have a history of cracks, breaks and leaks which take up the bulk of their O&M efforts. The fragility of AC mains is often due to soil types and the aggressive nature of source water. However, under the right conditions, some AC mains can exhibit the structural integrity of new pipe even 50 years after installation. Although it may be desirable to replace the existing AC main at some point in the future, until it starts to exhibit problems it may be preferable to dedicate available funds to replacing undersized pipes.

The undersized pipes recommended for replacement are indicated on the attached water system map. The replacements include fairly long segments of pipe. Each section could be phased over several years to allow adequate funds to be accumulated from rates. The upsizing of the mains provides stronger hydraulic characteristics and the capacity for fire protection. Therefore, replacement priority should be given to those sections where fire flow would provide a benefit to the highest number of existing homes. In other words, constructing larger mains and fire hydrants along an existing street provides a much greater benefit than replacing a main along a back lot line where hydrants cannot be accessed. Other considerations for determining replacement priority include history of breaks/repairs and whether the existing main is in a sensitive area where a failure of substandard pipe could cause significant damage. New development could also help with replacement costs if the provision of fire flow is a requirement of the development.

Note that we have recommended the replacement of one stretch of 6” pipe with 8” pipe. This is due to the fact that it is a dead-end 6” run with fire hydrants on it, which does not meet DOH criteria. If it is planned to loop this pipe at some point in the future, then DOH requirements would be met and the 6” pipe could remain, thereby saving approximately $100,000 in replacement costs.

The Just-A-Meer development is served by a long, dead-end, 1½” PVC pipe that is adequate for domestic service for the approximately 5 connections but incapable of providing fire flow. Provision of fire service would require the installation of a 6” looped main or an 8” dead-end main, per DOH requirements. Looping of a 6” main seems to be impractical for this location and installation of a long 8” main would bear a significant cost and also could create water quality problems for the few customers served by the main. A new main would also be very difficult to install due to its location and the steepness/accessibility of the terrain. If at some future date it is desired to replace the existing 1½” PVC main, options for doing so would include installation of an HDPE main by Horizontal Directional Drilling (HDD) or potentially by pipe bursting the old main. However, under the assumption that the number of services connections is not going to increase, and unless there are extensive problems with the existing main, especially after the pressure is reduced via the PRV mentioned earlier, it is not recommended at this time that the main be replaced due to the cost versus the number of residents served.

The level of funds committed to water main replacement on a yearly basis, in conjunction with other system improvements, is typically set by other jurisdictions at the value of the yearly depreciation of water system assets. This should provide a guideline to MWSA in their budgeting for system replacement costs.

10. CAPITAL IMPROVEMENT PROGRAM

10.1 Project Recommendations

The projects recommended in Table 6 are the result and summary of the analyses and recommendations made herein. Each project, or project area, is shown on the Water System Plan Map attached to this report. Note that the improvement recommendations identified herein are only those resulting from this study. Other capital improvements identified in previous studies are not repeated here. Also, projects that are considered to be operation or maintenance related, such as tank investigations, painting, etc., are not included in the Capital Project list.

10.2 Cost Estimates

The cost estimates outlined herein are planning level estimates and are based on industry standards, engineering experience and documented costs of similar recent construction work. Estimated recommended improvement costs include: construction costs, tax, overhead costs for project engineering and administrative services and a contingency factor. The projects outlined have been identified in conceptual terms and it is important to note that further analysis and actual design of the improvements could significantly impact the cost of the project from the given estimate. Prior to the initiation of the projects outlined in the CIP, specific design criteria should be reviewed and the cost estimates should be updated to reflect current conditions.

10.3 Project Scheduling

The projects recommended in this study are general in nature and are not directly tied to growth projections developed for the MWSA system. Therefore, the schedule is somewhat flexible and the projects do not necessarily have to be constructed by any specific year. However, the projects in the CIP are listed by their relative order of importance. It will be up to the MWSA Board to determine what level of funding will be made available on a yearly basis, and maintain a fee and rate structure that is adequate to support that funding, in order for a schedule and timeline of improvements to be developed. It is recommended that the CIP be reviewed annually to confirm the actual construction program for the year.

TABLE 6: WATER SYSTEM CAPITAL IMPROVEMENT PLAN
MEADOWMEER WATER SERVICE ASSOCIATION

ID# On Map	Project Title and Description	Estimated Total Cost[1]
N/A	Wellhead Protection Plan (WHPP)	$7,500
1	Backup Power at Well Site (includes manual transfer switch, generator receptacle, wiring, etc.)	$15,000
2	Just-A-Meer PRV Installation (2" PRV at top of hill)	$3,000
3	Constant Pressure Pump System for Services on Mandus Olson Road	$15,000
4	Miscellaneous Undersized Water Main Replacements (includes 2,500 LF 6" and 650 LF 8" main)[2]	$410,000
5	60,000 Gallon Concrete Reservoir (14' dia. By 52' tall)	$220,000
6	Emergency Intertie w/Kitsap County PUD #1 (includes approx. 900 LF 4" main, 75 gpm pump station & meter vault)	$130,000
7	Replace 4" Main Downstream of Booster Pumps	$5,000
	Total Capital Improvements	**$805,500**

1. Costs are in 2010 Dollars
2. Main replacement costs based on $125 per LF for 6" and $150/LF for 8" main (overall project costs)

Example Small Pump Station