Madison Metropolitan Sewerage District

Annual Chloride Progress Report

(June 2011)

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Chloride Reduction Background

The District's Wisconsin Pollutant Discharge Elimination System (WPDES) Permit specifies effluent limitations, monitoring and reporting requirements, and other terms/conditions that the District is required to meet. The permit contains a variance to the water quality based effluent limit for chloride, granted in accordance with Chapter NR 106.83(2) of the Wisconsin Administrative Code. As conditions of the variance, the District is required to meet effluent limitations for chloride, implement specific chloride source reduction measures, and submit annual progress reports to DNR.

Per Section 6.2 of the District's WPDES Permit, the District is providing the first report of its chloride source reduction program. Subsequent reports will be submitted to the Department by June 30th of each year. This report:

- Presents baseline information on effluent chloride concentration and mass
- Summarizes activities taken to date to address each of the six (6) chloride source reduction measures identified in the District's WPDES permit
- Identifies anticipated future activities in support of the chloride source reduction focus areas, and the relative priority assigned to each of these activities.

Detailed information related to each of the bulleted items above is provided in the following sections. Although this first report of the chloride reduction program lays out a roadmap for future source reduction activities, program adjustments are likely as new information becomes available. Maintaining flexibility will help ensure that District efforts are properly and efficiently focused.

Baseline Effluent Chloride Information

All wastewater generated in the District's 180 square mile service area is treated at the Nine Springs Wastewater Treatment Plant (NSWTP). Approximately 92% of the treated effluent is returned to the environment via discharge to the Badfish Creek outfall (001), with 8% returned to the environment via discharge to the Badger Mill Creek outfall (005). Both streams are effluent dominated. The 2010 average daily volume of effluent returned to the streams identified above was 40.7 million gallons per day (MGD) and 3.57 MGD, respectively.

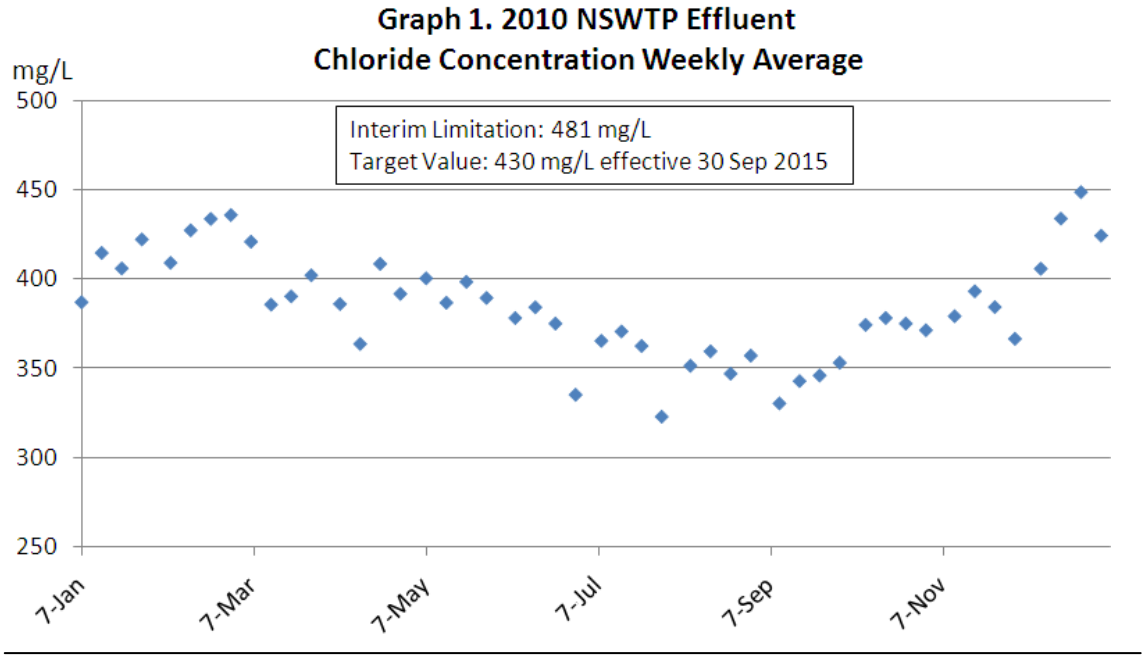
The District's permit contains an interim concentration limitation and a target concentration value for chloride. The interim limitation is 481 mg/l, expressed as a weekly average. The target value is 430 mg/l, expressed as a weekly average. The interim limitation is in effect until September 30th, 2015, at which time the target value becomes effective. The permit also contains chloride mass limitations, expressed as weekly averages. The mass limitations for Badfish Creek (BFC) and Badger Mill Creek (BMC) are 200,000 lbs/day and 14,000/day respectively. The mass limitations are calculated values based on effluent flow and concentration.

A single sampling point at NSWTP is used to characterize effluent quality for discharges to both Badfish Creek and Badger Mill Creek. A 24-hour flow composited sample is collected on a daily basis. The flow split to the Badfish Creek and Badger Mill Creek outfalls occurs after the sample collection point.

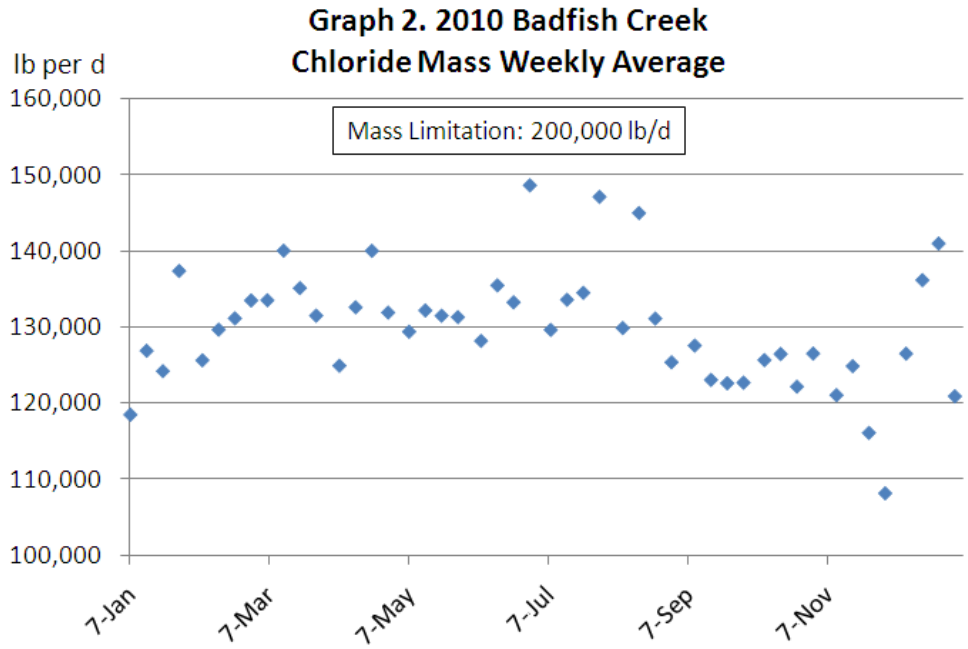
Effluent chloride concentration and mass data for 2010 is summarized in Table 1. Both the Badfish Creek and the Badger Mill Creek outfalls were in full compliance with chloride limitations contained in the Districts WPDES permit. The annual mass of chloride discharged from NSWTP was approximately 51.6 million pounds.

Table 1. 2010 Chloride Summary Information			
	NSWTP Conc. (mg/L)	BFC Mass (lb/d)	BMC Mass (lb/d)
Avg Week	385	129,834	11,444
Max Week	449 (15-21 Dec)	148,588 (22-28 Jun)	13,463 (15-21 Dec)
Interim Weekly Avg Limitations (value not to exceed)			
	481	200,000	14,000

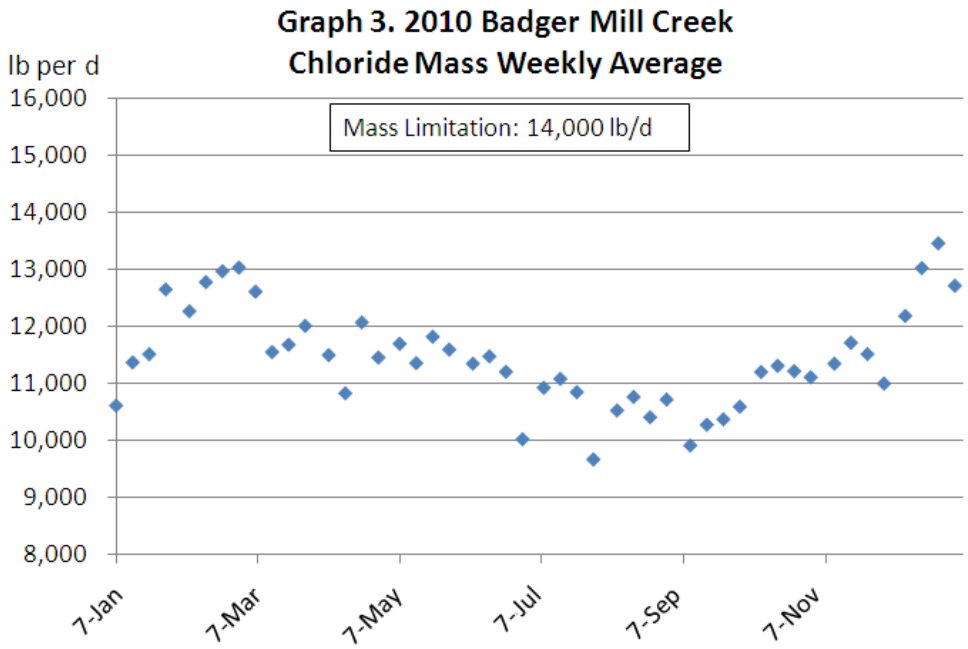
Graphs 1 through 3 provide additional summary information for chloride. Graph 1 shows the weekly average effluent concentration. Graphs 2 and 3 show the weekly average mass of chloride discharged to the Badfish Creek and Badger Mill Creek outfalls, respectively. More detailed information and discussion related to loading data is provided in Appendix A. Review of Graph 1 data shows that higher effluent chloride concentrations typically occur in the winter months, suggesting a linkage to road salt entering the sewerage collection system. The road salt effect is evaluated further in Appendix A.



Graph 2 indicates that the weeks with the lowest mass of chloride occur around the winter holidays. This is likely caused by decreased loadings from significant industrial sources due to plants shutting down during holiday periods.



Graph 3 demonstrates a nearly identical pattern to the concentration data of Graph 1. This is to be expected as the rate of pumping to BMC was consistent throughout 2010.



Permit Required Chloride Source Reduction Measures

The District's WPDES Permit identifies the following six chloride source reduction measures that the District is required to implement over the course of the five-year permit term:

1. Identify sources of chloride to the sewer system
2. Require significant industrial and commercial to evaluate their chloride discharges and make recommendations for significantly reducing them, with the results of that evaluation being the basis for potential restrictions of chloride discharges
3. Educate homeowners on the impact of chloride from residential softeners, discuss options available for increasing softener efficiency, and request voluntary reductions
4. Recommend residential softener tune-ups on a voluntary basis
5. Request voluntary support from local water softening businesses in the efforts described in subds. 2 and 3
6. Educate licensed installers and self-installers of softeners on providing optional hard water for outside faucets for residences

There is significant overlap between several of these six source reduction measures. For the purpose of discussion, these measures have been broadly grouped into focus areas as follows:

- Source Identification Focus Area
- Education and Outreach Focus Area

District actions taken to date and anticipated future actions for these focus areas are discussed below.

Source Identification Focus Area

Source identification efforts to date have focused on four core activities:

- wastewater monitoring
- industrial inspections
- survey methods
- road salt inflow evaluation

Wastewater Monitoring

The District has analyzed chloride concentrations in wastewater samples collected as part the District's user-charge billing program on three occasions. The first sampling effort was conducted in 2003. More recently, sampling efforts were conducted during the first and second quarters of 2011. The billing samples are not inclusive of all wastewater sewerage basins in the District, and therefore, care must be taken when interpreting the data. The primary benefit of these sampling efforts is that they provide insight on loads and potential sources. The billing sampling regions are as small as 40-home

neighborhoods and as large as entire communities. High priority will be given to performing additional targeted sampling of sewerage basins throughout the permit term.

The 2011 neighborhood sampling data has shown that households contribute, on average, 0.9 pounds of chloride per day (1.5 lb/d salt equivalent). The study allows the District to estimate the mass of chloride contributed by 122,000 households in the District as 110,000 lb/d, or about 75% of daily loadings. This mass estimation for households appears to be too high when considering other industrial and institutional chloride sources. The estimation requires additional study of the household types and prevalence of household softeners.

The concentration of chloride in household wastewater has been observed in the 450-550 mg/L range during several District wastewater studies. The bulk of the mass of chloride from households is presumed to be from regeneration of softeners. It is apparent that leading households through a transition process of replacement of old, wasteful, softeners with modern, efficient, softeners will be a long-term activity for the District. Sampling data will continue to be generated to support and confirm the process.

Additionally, some industrial chloride loadings have been characterized by the billing samples. The industrial sampling data indicates that one meat packing plant contributes nearly 15% of the daily NSWTP chloride loading. Cooperative measures will be employed in this permit term to achieve chloride reductions where industries are shown to discharge significant mass of chloride from processes other than softening. High priority is given to targeted sampling of industrial wastewater to support and confirm the industrial chloride reduction process.

Industrial Pretreatment / Source Control Inspection Program

Chloride is an additional (new) focus of inspections of industrial facilities and institutions. Inspections performed in 2010 showed that facilities will commit resources to modernize softening systems without prompting by District programs. Innovative technologies routinely employed to reduce chloride discharges have been observed at several industrial/institutional facilities and are reported more fully in Appendix B. These innovations, including brine reclamation and electrostatic removal of calcium in cooling tower reservoirs. These innovative approaches will be featured on the District chloride reduction web pages and discussed with other industrial/institutional facilities as part of the District's education and outreach focus area. Discussion of chloride issues during inspections is high priority work.

Regional sampling studies of industrial parks may also be needed to support this source evaluation effort. Sampling activities will initially be given a moderate priority. To more fully evaluate sources, the District anticipates conducting sector-targeted surveys as noted below. Survey work may lead to expanding District presence at industrial/institutional facilities, most of which are not required to have a permit under current pretreatment program procedures.

Performing door-to-door site visits in mixed-use business/industrial parks will be considered where small industries do not fit the profile a known chloride usage sectors. Site visits in industrial/business parks may more quickly and thoroughly ascertain salt and other chloride-containing chemical usage data than could be gathered through phone or mail survey methods. This activity will initially be given a low priority as the mass of chloride discharged by mixed-use regions is expected to be low when compared to known sectors where chloride usage is likely much higher.

Sector -Targeted Survey Methods

Surveys were developed in 2010 and tested for effectiveness in assessing chloride usage data from industries and institutions in similar sectors. Surveys questions were sector specific. Response rates were good and the manageable number of surveys sent to one sector allowed focused follow-up by the District.

Preliminary data from these surveys indicates that water softening is prevalent at most industrial/institutional facilities, and salt consumption/usage is readily reportable. For example, industrial laundry survey data indicates an average daily salt usage of 600 lbs at each of four laundries. The survey indicated that chlorine (bleach) and muriatic acid usage at these laundries (both chemicals are additional sources of chloride) is a minor source in comparison to salt usage.

An inventory of sector sources and their chloride usage data can readily be generated over the permit term by survey techniques. Significant softening loads are expected to be found. It is expected that significant chloride reduction potential, in the short-term, will be identified in large softening systems at industrial and institutional facilities (i.e. “low hanging fruit”).

The District anticipates that a thorough inventory of significant industrial/institutional sources of chloride will help focus future source reduction efforts. An accurate accounting of industrial/institutional softening loadings and prevalence must be considered with estimations of residential/commercial softening loadings to best target the source reduction resources in the softening sector. Inventory efforts are considered a high priority but are resource intensive. A goal is to substantially complete this effort over the course of the District’s current permit term.

Road Salt Monitoring

Appendix A provides a detailed discussion of NSWTP chloride loadings and two apparent road salt contributory periods (i.e. winter and summer) are noted. A preliminary evaluation of the data suggests that, annually, road salt contributes possibly 3% of the chloride load in wastewater. However, episodic contribution of road salt to sewerage via inflow to the collection system during snow melt periods is likely causative of the peak weekly concentration and peak weekly mass events of 2010, as evidenced by data shown in Graphs 1 and 3. Inflow of salt-laden water during snow melt periods carries the greatest potential for violation of concentration limits. This fact makes the identification and tightening-up of significant road salt inflow points a high priority of the District.

Weekly spikes in chloride mass were measured in the 2010 wet-weather events of summer at about 110% of typical weekly loadings. This may indicate that legacy road salt in ditches, swales, and roadbeds is washed into the sewerage system as inflow during times of significant wet-weather.

The District will further evaluate the road salt issue and identify possible approaches moving forward. Evaluating roadside and parking lot runoff during melting events by qualitative or quantitative sampling methods will be challenging and labor intensive. While important, this effort is assigned a medium priority level relative to other chloride initiatives that the District anticipates undertaking, as there is a reasonable buffer between expected wintertime effluent chloride concentrations and the interim limit specified in the District's WPDES permit.

As noted in the Education and Outreach section below, the education of road salting operators should be used as a tool to identify trouble spots where salt-laden runoff pools near wastewater collection system structures. With regard to source identification of inflow, the District and its municipal wastewater customers are undertaking measures to control I/I as noted in Appendix D. These high priority efforts should result in a reduction of road salt chloride loadings to the sewerage system over time.

Education and Outreach Focus Area

The District has engaged in multiple education and outreach efforts related to chloride and expects to continue to do so throughout the course of the permit term. Education and outreach efforts are expected to focus on five core activities:

- households outreach
- significant water softening sources education
- plumbing installers education
- road salting professionals education
- significant industrial sources (other than from softening) education

Households Outreach

Available data indicates household water softening is the major source of chlorides. Thus, education and outreach activities targeted at homeowners are essential. All household outreach efforts noted below will be high priority work for the reduction program.

Possibly the most important component of a successful residential source reduction program will be the cooperation and support that has been pledged by local water conditioning companies. The District has met with local providers of water softening equipment and representatives of the national Water Quality Association. The meetings resulted in commitments to issue a best practices agreement in the near future. The best practices lay out commitments and focus areas for water conditioning companies that sign on to the agreement. The draft best practices are included in Appendix C.

Consumer-targeted outreach information, being prepared cooperatively by the District and water conditioning companies, will be provided to homeowners by water conditioning sales staff and service technicians. The informational flyer will reinforce the importance of highly efficient water softening to households and the environment. A draft copy of the flyer is included in Appendix C.

In 2003, the District conducted a long-term chloride study in the McFarland area. The study region is predominately comprised of residential users. An outreach brochure was sent to households in newspapers and newsletters. The brochure provided information on the environmental effects of chloride and it provided information regarding tune-up and optimization of household softeners. No change in regional chloride levels was observed following distribution of the outreach material. The brochure is attached in Appendix C.

The District maintains a "salt page" on its website focused on providing timely education and outreach information related to chloride to households and other sectors. New information will continue to added on an as needed basis. The website text of the District's salt page is provided in Appendix C.

Use of public service announcements (PSA's) related to chloride may prove helpful in homeowner outreach. The District prepared a PSA regarding softening that was broadcast on local radio stations this past spring. The text for this PSA is provided in Appendix C. The District anticipates expanding its use of PSA's in the future.

Consideration will be given to using the highly efficient softening flyer to educate do-it-yourself installers of softeners. This could be done by working with hardware stores, plumbing supply retailers, and "big-box" home improvement stores to include the flyer in the softener aisle displays. A flyer could also perform the task of educating self-installers on the need to plumb hard water to outdoor spigots. The flyer could educate the public on the environmental issues related to salt in wastewater and the need to install efficient softening equipment.

Significant Water Softening Sources Education

Where survey and inspection identify significant sources of water softening discharges, the District will respond with education and outreach efforts designed to support the source facility in evaluating efficiencies in softening. This work can provide significant short-term chloride reduction and is of high importance. The survey and follow-up process should point each significant source towards a voluntary self-evaluation process. The water conditioning providers will be expected to supplement the District education efforts by providing technical expertise and support to the customer.

Plumbing Installers Education

Plumbing students from the Madison College apprenticeship program typically tour the NSWTP during the course of their studies. The tours present an opportunity to provide information and education material identifying steps that plumbers can suggest and/or use to reduce chloride contributions. An example would be separating outdoor spigots from the soft water plumbing system in homes and businesses. Plumbing contractors could be

given the same information. This educational material has not been prepared and is a low priority of the District chloride reduction program at this time.

Road Salting Professionals Education

Earlier discussion on source identification indicated the important of working with private and municipal road salting agencies. Much has already been done to address road salt usage in the District's service area by other agencies. The City of Madison has had a road salt reduction plan in place since 1977. Dane County Highway Department has cut its salt usage by one-third through the use of brine applications to roadways.

In 2005, the Madison Commission on the Environment formed the Road Salt Reduction Subcommittee. Subcommittee members include: the health department, USGS, City of Madison Engineering, WI DOT, and Edgewood College Toxicology Lab. A presentation, "Solving the Road Salt Problem – A Reasonable First Step (April 2010)", available on-line, provides considerable information on the road salting situation in Dane County.

The District anticipates working with municipal road salting agencies to inform them of the wastewater issues related to road salt. The District may need to seek the assistance of road salting professionals in identifying trouble spots where salt-laden runoff pools on or near wastewater collection system structures. The trouble spots would be prime target areas for focusing sewer inflow mitigation projects.

Private contractors of plowing and salting services may need to be approached as well. As noted in the web-presentation listed above, "private applicators use almost the same amount of salt on parking lots as the City [of Madison] uses on city streets". Private salting contractors will need to be educated on the wastewater issues regarding road salt, and they might be asked to provide data on trouble spots where salt-laden runoff pools near private or public wastewater collection system structures. Another potentially significant "class" of salting operations to target with education is the on-site provider of snow clearing services at large commercial and institutional facilities such as hospitals, campuses, and large corporations.

When considering the relatively high potential for permit violations of chloride concentration limits during the winter season, the education of road salting professionals will be a high priority for the chloride reduction program in the short-term. Well educated salting professionals could be the eyes on the ground to point out trouble spots where salt-laden runoff pools near wastewater collection system structures.

Significant Industrial Sources Education

Where an industrial facility discharges significant mass of chloride from processes other than softening, the District reduction program must meet with and educate the user. Each significant chloride discharger will be asked to self-evaluate chloride discharges to set baseline discharge levels and to identify reduction measures and goals. Two sectors of industrial user have been identified for focused source control at this early stage: food processors and chemical synthesis facilities. This must be high priority work for the reduction program in the short term.

Summary

The District was fully compliant with its WPDES permit chloride concentration and mass limitations during 2010. A major sampling effort was conducted to characterize chloride sources, and data from this effort is still being analyzed. Additional targeted sampling is anticipated. Survey, education and outreach activities have been initiated, and more work in these areas is anticipated. Collectively, these efforts should contribute towards a reduction in the concentration and mass of chloride in the District's effluent. It will take time to implement these activities and for the impact to be reflected in improved effluent quality. It should be noted that water conservation and infiltration control efforts within the District's service area could mask the impact of these chloride reduction efforts, particularly as it relates to effluent chloride concentrations.

The following chloride reduction projects and tasks will be addressed by the District over the course of the permit term. Progress made in these areas will be discussed in subsequent annual reports.

High Priority Tasks and Projects

- Source identification via sampling of regional or targeted sewerage basins
- Source identification via targeted industrial sampling
- Source identification through pretreatment program inspections of industrial and institutional facilities in the permit and mercury programs
- Source identification via sector-targeted surveys
- Source identification via the education of road salting professionals (i.e. find trouble spots)
- Outreach to households via web pages and public service announcements, and education of households via contacts regarding water softener sales/service
- Education of significant water softening sources
- Education of public and private sewer system owners regarding the importance of I/I control in regard to source control of road salt chloride
- Education of significant industrial non-softening sources

Medium Priority Tasks and Projects

- Source identification via sampling of industrial parks
- Source identification via sampling of storm water runoff
- In conjunction with survey work, encourage industrial users and commercial facilities to evaluate their chloride discharges; priority will be higher later in the reduction program

Low Priority Tasks and Projects

- Source identification via an expanded inspection program of non-permitted facilities in mixed-use business/industrial parks
- Education of plumbing installers regarding hard water piping to outdoor spigots

Chloride Source Reduction Outlook

Chloride source reduction will require both short term and long term outlook.

Long Term Outlook

- Improving the softening efficiency in tens of thousands of households, accounting for 50-75% of chloride loadings, is a long term effort. Outreach and education to households is unlikely to demonstrate measurable short-term impacts.
- Addressing road salt contributions to sewerage in wintertime trouble spots can shave off the peaks of the wintertime chloride concentration data. Reducing this loading is long-term work potentially involving the District and all communities targeting possibly hundreds of sewerage structures located at trouble spots.
- The loading impact of road salt on the sewerage system appears to be considerable during wintertime and during significant wet-weather events. The potential for violation of mass limitations appears to be small during significant wet-weather, and there is no potential for violation of concentration limits. The control of inflow will remain a routine long term effort for all sewerage agencies' collection system programs.

Short Term Outlook

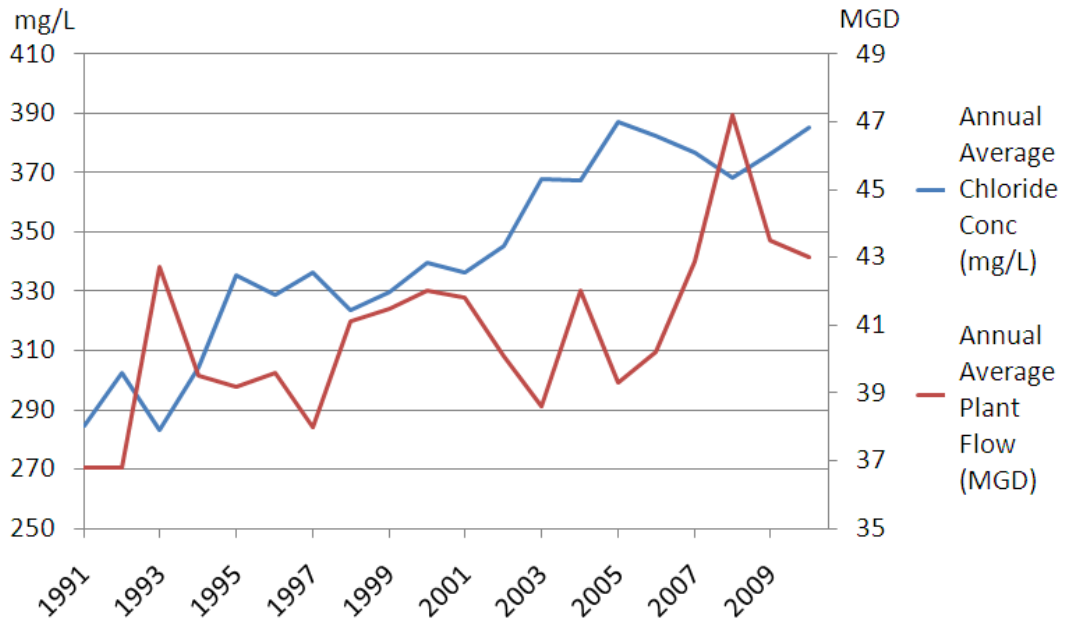
- Addressing non-softening industrial loadings is vital to the success of the reduction program. The District must engage with known significant sources to determine baseline levels and to set voluntary reduction goals. Non-softening industrial chloride usage is affected by economics and chemical handling concerns. These considerations can drive industries towards potentially significant reductions over the short-term.
- Possibly the greatest potential for short term reductions hinges on softening innovations and alternatives to softening that are available to large industrial and institutional sources. Survey and inspection has already demonstrated a heightened awareness to cut salt usage by the operators of large softening systems. Efficiencies in salt usage have been demonstrated, and the short term outlook for additional reductions is good.

In closing, the District looks forward to the continued progress in identifying sources and reducing the loading of chloride to wastewater. The successes and challenges will be provided in June 2012 in the second report of the chloride reduction program.

Appendix A: Additional Chloride Data

Annual Average Data:
Annual average NSWTP flow and chloride concentration data from 1991 through 2010 is presented in Graph 4. The graph demonstrates that, typically, a year with considerable wet-weather has higher than normal plant flows and chloride concentrations that are lower than the years preceding and following the "wet" year. For the Madison area, "wet" years include 1993, 2000, 2004, and 2008.

Graph 4: NSWTP Annual Average Data



Seasonal Effluent Chloride Data:
Seasonal effluent (i.e. quarterly) data is presented in Table 2. Seasonally, the mass of chloride is relatively constant; average mass for each quarter is within 3% of the annual average. 2010 wintertime loadings, as evaluated by first quarter data, did not "spike". The springtime (second quarter) data showed the greatest increase above the annual average. The apparent chloride loadings effect produced by second and third quarter wet-weather events is discussed in Appendix D.

Table 2. 2010 NSWTP Seasonal Average Chloride Data				
	Flow (daily avg, MGD)	Chloride Average Conc. (mg/L)	Chloride Average Mass (lb/d)	Mass difference from CY Avg, as %
2010 CY Avg	44.2	385	141,300	--
First Quarter	41.6	411	142,600	+0.9
Second Quarter	45.4	383	144,300	+2.1
Third Quarter	48.4	352	141,400	same
Fourth Quarter	41.5	396	136,800	-3.2

Evaluation of 2010 Peak Weeks:

Chloride Concentration: The highest concentration of chloride in effluent was in winter. Two factors drive this effect. The lowest volumes of pollutant-diluting I/I occur in winter and road salt is applied in winter. The peak week for chloride concentration occurred in December 2010; a week following a snowstorm where rainfall reduced the depth of snow a few inches.

Chloride Mass - Badfish Creek Outfall: Surprisingly, nearly identical peak weeks for mass were observed during the significant wet-weather events of June and July. The concentration of chloride in effluent was at the lowest levels of the year (due to significant levels of I/I), yet the mass of chloride reached annual highs. This is likely due significant inflow of precipitation carrying legacy road salt into the sewerage system.

Chloride Mass - Badger Mill Creek Outfall: For this outfall, effluent flow rates are restricted to 3.6 MGD and were consistently maintained at that level in 2010. With constant flows to the outfall, the peak week for the outfall is expected to occur when the weekly average effluent chloride concentration is highest, as it was during the winter thaw of December 15th through 21st.

Evaluation of 2010 Peak Daily Data

Table 3 shows the expected; peak daily concentrations occur in wintertime. Table 3 indicates that peak daily mass loadings may be expected in all seasons.

Table 3. 2010 NSWTP Peak Daily Data			
Chloride Conc. "Top Ten" (mg/L)		Chloride Mass "Top Ten" (lb)	
14-Dec-10	499	23-Jun-10	188,054
15-Dec-10	492	24-Jan-10	178,132
19-Feb-10	481	22-Jul-10	178,025
18-Dec-10	472	13-May-10	174,307
19-Dec-10	471	14-Dec-10	172,288
16-Dec-10	469	31-Dec-10	171,481
12-Feb-10	468	15-Dec-10	171,154
31-Dec-10	468	10-Mar-10	169,626
25-Feb-10	466	13-Aug-10	169,016
24-Feb-10	462	15-Jul-10	167,907

Appendix B: Industrial Innovations Supporting Chloride Reduction

2010 Industrial/Institutional Success Stories:

Meriter Hospital: In 2010, the H-O-H Water Technology Co. installed the Green Machine, an electrolysis system that has allowed the hospital to eliminate softening to support the chilled water system. The chillers now run on "hard water" that has had the calcium dropped out of solution via electrolysis. The Green Machine accomplishes salt-free softening, in this application, by recycling a reservoir side-stream and providing multiple passes through electrically charged canisters. Other softening systems supporting other processes were also upgraded with new resins and control heads.

St. Mary's Hospital: In 2009, a sweet-brine reclamation system was installed in softeners used to support chilled water cooling towers. Brine reclamation should cut salt consumption by 20% at St. Mary's Hospital.

Becton Dickinson Diagnostic Systems: In 2011, a new softener system replaced an old inefficient system. Sweet brine reclamation should provide the facility with a 30% reduction in salt usage.

The District web page has a role in hosting the industrial/institutional salt-saving success stories. With the permission of each successful industrial/institutional user, and its vendor, the District plans to include photographs, innovation summaries, and salt reduction data on the District Salt Page.

Industrial Softening Outlook:

Industrial inspections are demonstrating that efficiencies in softening systems are routinely evaluated and upgraded. A "green" corporate culture can be a driving factor leading operations departments to consider softening and chemical usage evaluations. Salt and water are both commodities that are receiving increased scrutiny by large consumers, even considering the relatively low cost of each. Costs are indeed rising for each commodity and industry is responding by installing water conserving processes and efficient softening controls. Efficient softening and water conservation are mutually beneficial as water conservation typically cuts the demand for softened water and efficient softeners typically operate with less water used in regeneration of the media. .

Appendix C: Education & Outreach Materials

The following education and outreach products are used or are in development:

- Water Softening Best Practices (2011)
- Softening Tune-up Public Service Announcement (2011)
- Consumer Softening Flyer (2011)
- Softening, Salt, and the Environment Brochure (2003)
- Salt Page of the MMSD website (2010)
- Sector-targeted Survey (2010)

A copy of each product is attached below.

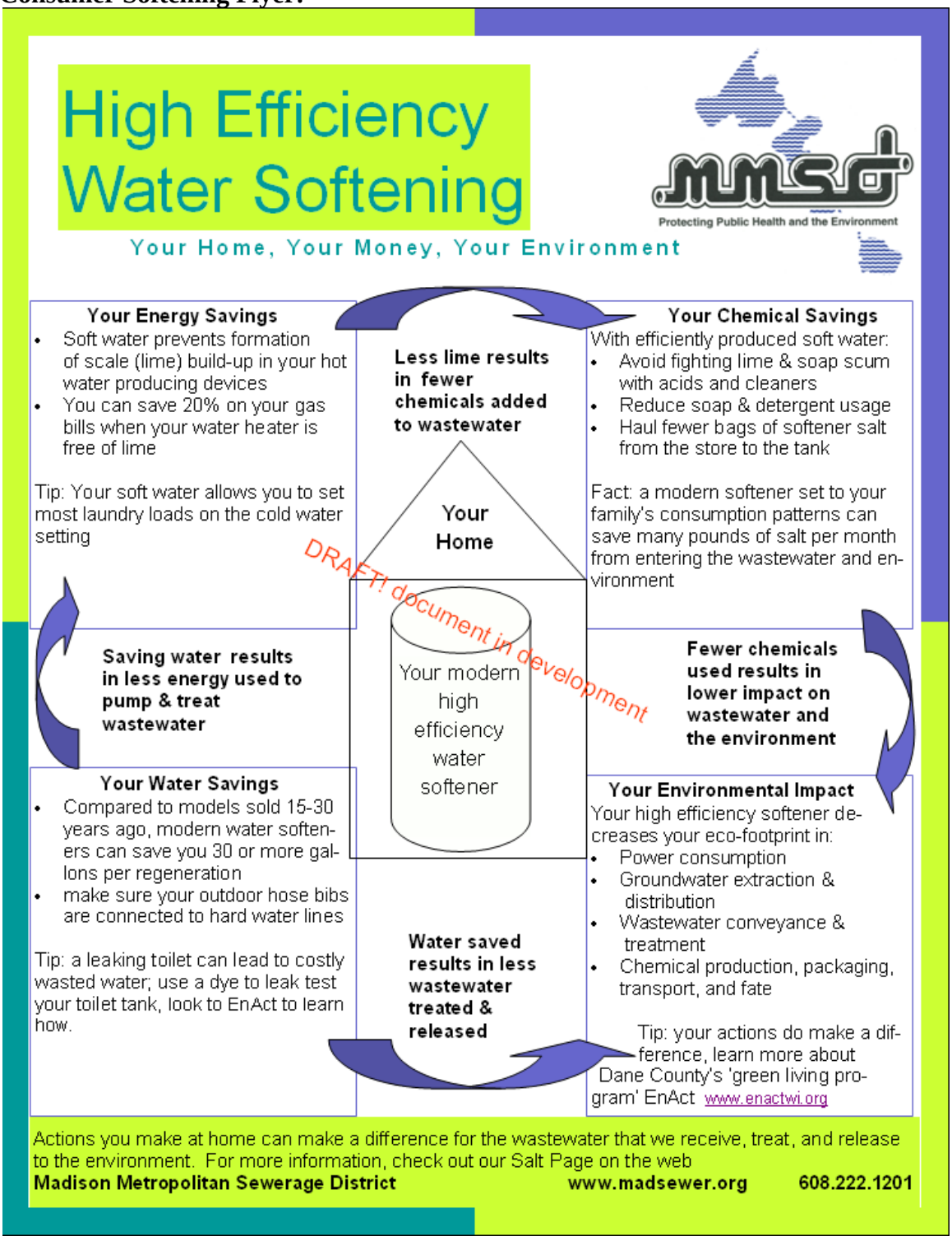
Water Softening Best Practices:
The best practices listed below will be presented in a letter of agreement from the District to each of the participating water conditioning companies. The Best Practices are:

1. Existing softening units will be evaluated during service calls and adjusted to more efficiently use salt. The consumer will receive educational material regarding the benefits of upgrading to a more efficient softening system.
2. Residential and commercial applications will be set to the same softening criteria
3. Typical sizing criteria will include: 50 gallons of water consumed per person per day; the average family size of four persons will be the minimum
4. Minimum softening efficiency for new softening equipment will be 3,350 grains per pound of salt
5. Regeneration frequency shall be no less than three days
6. Time-clock softener controls will not be offered as an option

Public Service Announcement:
The text of the 30-second public service announcement is provided below:

> Tired of lugging heavy bags of salt to your softener tank? Madison Metropolitan Sewerage District wants to save your back and some cash, while preserving water quality! Each day, enough salt to fill twenty snow plows passes through our treatment plant. Salt can be harmful to plants and animals living in our waterways. Go easy on the softener salt, and help us lighten the load! Call a water conditioning pro for a softener tune-up. Visit the salt-page at mad-sewer-dot-org.

Consumer Softening Flyer:



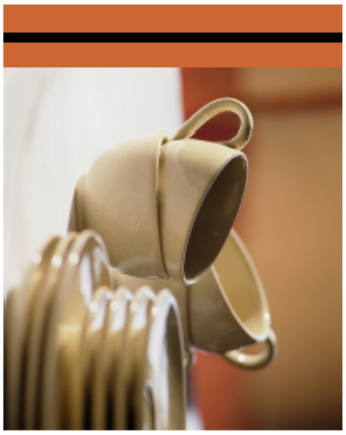
Softening, Salt, and the Environment Brochure:
The interior panels of the brochure developed in 2003 to support the McFarland residential study are displayed below. The entire brochure is viewable on the District website.

What's the Message?

The Madison Metropolitan Sewerage District is asking for your help in reducing the amount of chloride released to the environment.

Chloride ions do not break down in the wastewater treatment process, but rather pass through the treatment plant to the environment. High concentrations of chloride can be harmful to the plants and animals that live in streams and rivers.

You can help by controlling the amount of salt (sodium chloride) used in your water softener. In this way, the advantages of softened water, such as the need for less soap and detergent for cleaning, and less energy for heating, can be achieved while minimizing the negative effects of salt in the environment.



What Can You Do?

Each time your softener regenerates, its resin tank is flushed with a salt solution that is discharged to the sewer system. Several options are available to reduce the amount of salt used to regenerate your softener.

1. If your softener regenerates on a timer, consider switching to a high efficiency softener that regenerates with a meter. Metered water softeners track the amount of water you use and regenerate only when needed.

2. Increase the time between regeneration cycles. If your softener uses a timer, increase the settings gradually, a day at a time, until you notice hardness effects, such as less sudsing, for two cycles. Then set the timer back one day. If your softener uses a meter, increase the settings 100 gallons at a time until you notice hardness effects after two weeks, then set the meter 100 gallons lower.

3. Consult with an expert. Have your softener tuned up by a qualified water softener representative.

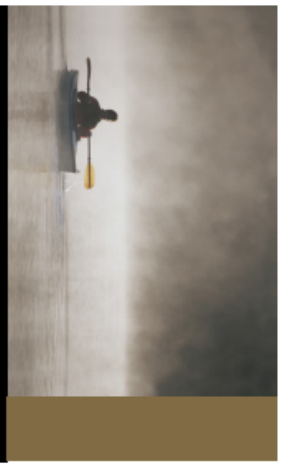
What Are The Benefits?

1. Reducing salt use helps the environment. High chloride concentrations can be harmful to aquatic plants and animals. Minimizing the amount of chloride released to the environment allows our streams and rivers to remain healthy, and their beauty and recreational benefits can continue to be enjoyed by everyone.

2. You save money. An efficiently running water softener uses less salt and less water, plain and simple. You can realize savings of 30% to 50% or more without noticing a difference in your water quality.

Thanks for Your Help!

Our goal is to reduce the amount of chloride entering the environment by reducing the rate of salt used by water softeners. Your efforts, although perhaps seemingly small, will aid in collectively reducing the release of chloride to our local streams and rivers. Call us with your questions at 222-1201 or visit us on the web at madsewer.org.



Make a Difference!

Salt Page of the MMSD Website:

The Salt Page

FREQUENTLY ASKED QUESTIONS ABOUT CHLORIDE

Who do I call? Madison Metropolitan Sewerage District water quality experts can help you with your questions on chloride in the environment and how to make sure your water softener is running efficiently. Call MMSD at 222-1201; for environmental questions use extension 201, and for water softener information use extension 362.

Chloride **What is it?** Chloride is one of two components of sodium chloride, also known as table salt or rock salt. When salt dissolves in water, it separates into sodium (Na^+) ions and chloride (Cl^-) ions.

Where does chloride come from? Small amounts of chloride come from soaps, detergents, and other cleaning products. Some also comes from industrial and commercial processes. A significant amount of chloride comes from self regenerating water softeners.

Our Environment **Why should I care about chloride?** Our freshwater streams and lakes contain low levels of naturally occurring salts, including chloride. These salts are essential to the aquatic organisms that live there. However, high concentrations of chloride are harmful to aquatic plants and animals.

How does it get in the environment? From the water softener, chloride is flushed into the sewer where it goes to the wastewater treatment plant. Treatment plants are designed to remove solid particles, like grit and sand; and to biologically degrade organic waste, such as food and human waste. Once chloride is dissolved in water, it cannot be removed by settling, or biologically degraded by standard treatment processes. Chloride that comes to the Nine Springs Treatment Plant passes through the plant to Badfish Creek or Badger Mill Creek and eventually the Sugar River. About one hundred tons of salt pass through the plant to the environment each day. This is equal to the amount of road salt loaded into 20 5-ton salt trucks. This brings up another significant source of chloride, ***Road Salt***.

Can treatment plants be modified to remove chloride? The technology to remove chloride is available, but it is very costly. It would involve microfiltration and reverse osmosis, which are the same treatment processes used to produce pure water used in laboratories. One community determined that it would cost about twenty cents to add a pound of chloride at the water softener, and $5.00 to remove it at the treatment plant. Households can use up to 100 lbs of salt a month in their water softeners.

Is potassium chloride a better choice than sodium chloride for my water softener? No. Although it consists of potassium instead of sodium, it still contains chloride. There is no advantage to using potassium chloride as your softener salt here in the Madison area. In some of the drier parts of western U.S., crops are regularly irrigated with treated wastewater. Certain crops are sensitive to sodium, and in those areas, they are promoting the use of potassium chloride over sodium chloride.

Hard Water **What makes hard water hard?** Rainwater that falls is “soft”. It does not contain any minerals. As it percolates through the soil, water dissolves minerals which can include calcium and magnesium. Water with substantial amounts of calcium and magnesium is referred to as “hard water”.

How do you measure hardness? Hardness is measured in terms of grains per gallon (g/gal) or milligrams per liter (mg/L). If you were to evaporate one gallon of water that had a hardness of 5 g/gal, the residue would be the equal to one 5-grain aspirin tablet. Laboratories often record hardness as mg/L or parts per million (ppm). One g/gal of hardness is equal to 17.1 mg/L of hardness. In the example above, 5 g/gal equals 85.5 mg/L hardness. Water that is 10 g/gal or more is considered very hard.

What is the problem with hard water? The minerals in hard water can be deposited as scale on pipes and in hot water heaters. They also chemically interact with soaps and detergents and make them less efficient. For example, it takes 50% to 75% less detergent to clean laundry in soft water than in hard water.

Why is my water hard? Most drinking water in Dane County comes from groundwater held in a sandstone-dolomite aquifer far below the surface. The wells that supply water for the Madison Water Utility range from 744 feet deep to 1175 feet deep. Dolomite is composed of calcium magnesium carbonate and is the source of the minerals that make our water hard. The hardness of water from the Madison Water Utility is typically 20 to 22 g/gal. Groundwater in northern Wisconsin is 4 to 7 g/gal and is considered moderately hard. The following map shows water hardness across the United States.

Water Softeners **How is Water Softened?** Home water softeners have two tanks; a mineral tank that contains a resin in the form of small beads, and a brine tank which holds the sodium chloride (salt) solution. As water flows through the mineral tank, the hard minerals, magnesium (Mg^{++}) and calcium (Ca^{++}) ions, replace sodium (Na^{+}) ions on the resin. This process is called ion exchange. The water that flows out is considered “soft” because sodium ions do not build up on pipes as lime or interfere with detergents and soaps.

What is the Regeneration Cycle? Eventually, the resin reaches its limit as to how much calcium and magnesium it can hold. At this point, the resin is flushed with a strong brine solution from the brine tank. Because of its high salt concentration, the brine washes off the calcium and magnesium and replaces them with sodium. The minerals and brine wash go down the drain and into the sewer system. New salt must be added regularly to the brine tank to replace the salt that is used to regenerate the resin. The regeneration cycle can be initiated by a timer or by demand. A timer regulated softener regenerates the resin after a fixed amount of time regardless of how much water is used. A demand initiated regeneration (DIR) softener either tracks the amount of water used or utilizes a hardness sensor to indicate the resin is near capacity and needs to be regenerated. A DIR softener is the more efficient softener in terms of salt and water usage.

Road Salt **How much salt comes from road de-icing?** Road salt used to de-ice streets and highways is also a significant source of chloride to the environment. Most road salt is applied as pellets or as a sand/salt mixture. The "City of Madison Road Salt Report, 2004-2005" provides some information on the quantity of salt used in Dane county. From the winter of 2000/2001 to the winter of 2004/2005, the City of Madison applied an average of 10,000 tons of salt annually. During the 2004/2005 winter, over 66,000 tons of salt were also purchased by other local municipal and county agencies. In addition to salt used by government agencies, substantial amounts of salt are applied to private commercial and residential roads, parking lots, driveways, and sidewalks each year for which data is unavailable.

What Can I Do?

 Check to see how your softener is calibrated. Some softeners are preset for the highest hardness setting at the factory. This setting may be as high as 30 grains. Reset the hardness to 22 grains.

 Soften everything except the kitchen cold and the outside faucets. Generally people prefer the taste of hard over soft water, so the kitchen cold can be left unsoftened.

 Check the timer. When was it last adjusted? Many of us move into a house or purchase a water softener and never check it again. Children move out or other factors come into play that affects the amount of water we use. If your softener is regulated by a timer, you may be able to increase the interval between regeneration cycles without affecting the water quality. Increase the time by one day and see if there is any affect on dish washing and laundry during the next month. If hard water is coming through near the end of the cycle, it will take more soap to produce the desired amount of sudsing. When you have determined the time period when hardness is breaking through, set the timer back one day.

 If you are looking for a new water softener, consider getting a softener that regenerates based on a meter or a sensor. It is more expensive than a timer regulated softener, but it will pay for itself in 3-4 years because you will use considerably less salt and less water. The added benefit is that you will know you are helping to protect our environment right here in Dane County.

Sector-Targeted Survey as Educational Material:

The primary focus of the surveys developed in 2010 is to obtain salt and other chloride containing chemical usage data. The surveys, in conjunction with follow-up calls, can be used to educate the recipient of the issues related to chloride discharge to the sewerage system. The survey text is provided below.

Subject: Chloride Survey

According to the US Bureau of Mines, there are over 14,000 industrial uses of salt (sodium chloride). Today, the Madison Metropolitan Sewerage District is asking your assistance in completing a business survey regarding a few known sources of the chloride ion in industrial wastewater. Please complete this short survey regarding your facility and return it to MMSD at your earliest convenience.

A. Incoming Materials: Does your facility bring in (import/use) any of the following:

1. More than 100 pounds per month of water conditioning (softening) salt No / Yes
   If yes, approximately _____ pounds per month are used in softening
2. Salt, for uses other than water softening and exceeding 100 pounds per month
   No / Yes If yes, approximately _____ pounds per month are used
3. More than 10 gal per month of bleach, ferric chloride, or muriatic (hydrochloric) acid
   No / Yes
   If Yes, approximately _____ gal of bleach per month
   _____ gal of ferric chloride per month
   _____ gal of muriatic (hydrochloric) acid per month

If you answered "No" to questions A(1-3), then proceed to section C.

B. Outgoing Products and Wastes:

1. Are any of the materials noted with "yes" responses (above) consumed in product or lost as solid waste? No / Yes
   If No, can we assume that the majority of your incoming materials surveyed above are sent to the sanitary sewer in the wastewater? Yes / No
2. Can you provide estimated or measured wastewater volume data for a typical production week? Yes / No If Yes, approximately _____ gal per week
3. Do you have any site-specific sampling/analytical data for the chloride ion in wastewater that you can provide to us? Yes / No

C. Customer Information:

Please complete the customer information section below and return this survey in the envelope provided.

Company Name:
Site Address:
Primary Business Activities:
Person Completing this survey:

Thank you for taking the time to complete our survey. I will be pleased to discuss our wastewater treatment programs with you. The District's Programs and Initiatives can be reviewed on our website: www.madsewer.org.

Appendix D: Infiltration & Inflow Data

Wet-weather Chloride Evaluation:
Two very similar wet-weather events occurred in 2010 and are summarized in Table 4. Comparisons of percent change were made to the mass and volume totals from the week previous to each wet-weather event.

Table 4. Weekly summary data from two wet-weather events

Weekly Summary	Week of 22-28 June 2010	Week of 22-28 July 2010
Rainfall	3.6 inches	4.9 inches
Volume of rainfall District-wide	10,000 MG	13,800 MG
Effluent volume increase	74 MG / 25%	74 MG/ 24%
Effluent chloride loading increase	98,000 lb / 10%	80,000 lb / 7.8%
Effluent chloride concentration decrease	11%	11%

The review of 2010 wet-weather events demonstrates the enormous volume of precipitation produced by significant wet-weather events. The evaluation appears to show that legacy road salt, possibly residing under the pavement and in swales and ditches, is readily flushed into the storm water system during significant wet-weather periods. Inflow of storm water into the sewerage system during these periods resulted in measurable short-term increases in chloride loadings and decreases in chloride concentration. In 2010, the NSWTP flows returned to normal ranges within days of the conclusion of the wet-weather events and chloride levels also returned to normal levels as quickly.

Ongoing Infiltration and Inflow Evaluation:
The District routinely monitors the rate of I/I in the collection system through flow records at its seventeen regional pumping stations. The District televises 10% of its collection system each year to assess pipe condition and identify any pipe defects. A significant fraction of I/I conveyed to the treatment plant originates in local sewers. The District has been proactive in identifying those communities with higher than average rates of I/I based on evaluation of flow data. In June of 2009, the District contacted seventeen of its municipal customers to request that funding for I/I studies be included in their annual budgets.

A 1998 technical memo produced by Strand Associates for the District indicated the relative low level of inflow in the District collection system. Where “R” is a measure of the fraction of rainfall entering the system as inflow, the memo indicated the maximum “R” value for the District system, as studied, was 0.9%. The City of Madison sewerage system rated as well as the District system. Nationally, EPA data indicates typical “R” values have been observed between 1% and 3% with a maximum of 5%.